HIWIN®

Robot System Software

-HRSS 3.2

User Manual

Original Instruction

www.hiwin.tw

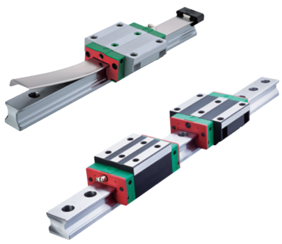
HIWIN® INDUSTRIE 4.0 Best Partner

Multi-Axis Robot
Pick-and-Place / Assembly /
Array and Packaging / Semiconductor /
Electro-Optical Industry /
Automotive Industry / Food Industry
- Articulated Robot
- Delta Robot
- SCARA Robot
- Wafer Robot
- Electric Gripper
- Integrated Electric Gripper
- Rotary Joint

Single-Axis Robot
Precision / Semiconductor /
Medical / FPD
- KK, SK
- KS, KA
- KU, KE, KC

Torque Motor Rotary Table
Aerospace / Medical / Automotive Industry /
Machine Tools / Machinery Industry
- RAB Series
- RAS Series
- RCV Series
- RCH Series

Ballscrew
Precision Ground / Rolled
- Super S Series
- Super T Series
- Mini Roller
- Ecological & Economical Lubrication Module E2
- Rotating Nut (R1)
- Energy-Saving & Thermal-Controlling (Cool Type)
- Heavy Load Series (RD)
- Ball Spline

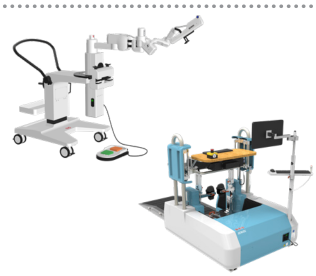


Linear Guideway
Automation / Semiconductor / Medical
- Ball Type--HG, EG, WE, MG, CG
- Quiet Type--QH, QE, QW, QR
- Other--RG, E2, PG, SE, RC

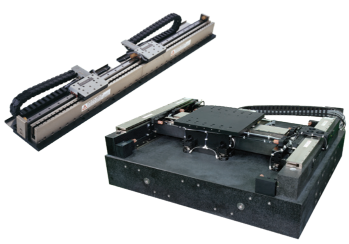
Bearing
Machine Tools / Robot
- Crossed Roller Bearing
- Ballscrew Bearing
- Linear Bearing
- Support Unit

DATORKER® Robot Reducer
Robot / Automation Equipment /
Semiconductor Equipment / Machine Tools
- WUT-PO Type
- WUI-CO Type
- WTI-PH Type
- WTI-AH Type

AC Servo Motor & Drive
Semiconductor / Packaging Machine
/ SMT / Food Industry / LCD
- Drives--D1, D1-N, D2T/D2T-LM
- Motors--50W~2000W



Medical Equipment
Hospital / Rehabilitation Centers /
Nursing Homes
- Robotic Gait Training System
- Robotic Endoscope Holder



Linear Motor
Automated Transport /
AOI Application / Precision /
Semiconductor
- Iron-core Linear Motor
- Coreless Linear Motor
- Linear Turbo Motor LMT
- Planar Servo Motor
- Air Bearing Platform
- X-Y Stage
- Gantry Systems

Torque Motor & Direct Drive Motor
Machine Tools
- Torque Motor--TMRW Series

Inspection / Testing Equipment / Robot
- Direct Drive Motor--DMS, DMY, DMN Series

Warranty Terms and Conditions

The period of warranty shall commence at the received date of HIWIN product (hereafter called "product") and shall cover a period of 12 months. The warranty does not cover any of the damage and failure resulting from:

1. The damage caused by using with the production line or the peripheral equipment not constructed by HIWIN.
2. Operating method, environment and storage specifications not specifically recommended in the product manual.
3. The damage caused by changing installation place, changing working environment, or improper transfer after being installed by the professional installer.
4. Product or peripheral equipment damaged due to collision or accident caused by improper operation or installation by the unauthorized staff.
5. Installing non-genuine HIWIN products.

The following conditions are not covered by the warranty:

1. Product serial number or date of manufacture (month and year) cannot be verified.
2. Using non-genuine HIWIN products.
3. Adding or removing any components into/out the product without authorized.
4. Any modification of the wiring and the cable of the product.
5. Any modification of the appearance of the product; removal of the components inside the product. e.g., remove the outer cover, product drilling or cutting.
6. Damage caused by any natural disaster. i.e., fire, earthquake, tsunami, lightning, windstorms and floods, tornado, typhoon, hurricane etc.

HIWIN does not provide any warranty or compensation to all the damage caused by above-mentioned circumstances unless the user can prove that the product is defective.

For more information towards warranty terms and conditions, please contact the technical stuff or the dealer who you purchased with.

WARNING

1. Improper modification or disassemble the robot might reduce the robot function, stability or lifespan.
2. The end-effector or the cable for devices should be installed and designed by a professional staff to avoid damaging the robot and robot malfunction.
3. Please contact the technical stuff for special modification coming from production line set up.
4. For the safety reason, any modification for HIWIN product is strictly prohibited.

Safety Precautions

1. Safety Information

- Safety Responsibility and Effect
  1. This chapter explains how to use the robot safely. Be sure to read this chapter carefully before using the robot.
  2. The user of the HIWIN industrial robot has responsibility to design and install the safety device meeting the industrial safety regulations in order to ensure personal safety.
  3. In compliance with the safety information on industrial robot described in this manual can't guarantee that *HIWIN* robot will not occur any safety problems.
  4. This machine is defined as a partly completed machinery, the associated hazards must be handled by system integrator in accordance with ISO 102018-1/ ISO 102018-2.
  5. A safety-related part of control system (SRP/CS) should conform to the requirement of performance level d and category 3 according to ISO 13849-1.
  6. The installation for emergency functions shall be defined by the system integrator in accordance with ISO 10218-1/ ISO 10218-2.

- Safety Operation Principle
  1. Before connecting the power supply for HIWIN industrial robot startup assembly procedure, check whether the specification of factory output voltage matches the specification of input voltage of the product. If it does not match, ensure to use the corresponding transformer (HIWIN optional transformer is recommended).
  2. Emergency Stop button (on Teach Pendant or from external emergency stop switch) must be pressed before turning off the power, and then switch off the power switch.
  3. While connecting to the external I/O or the signal, please operate in the condition that the power switch is turned off to prevent from a shortcut caused by mistaken touch in the process, and resulting in damage.

Safety Precautions

i. General

All personnel involved in the use or setup of the industrial robot arm must read the safety related literature for the robot arm and instruction manual in detail and operate it in accordance with the specifications.

Safety Symbol

DANGER

Users must strictly abide by the content description, otherwise it will cause serious casualties.

WARNING

Users must strictly abide by the content instructions, otherwise it may cause minor injuries or equipment damage.

CAUTION

User must strictly abide by the content description, otherwise it may cause poor product performance.

Use Limit

Robotic arm is prohibited for use in the following environments and uses

- Personnel carrying purposes
- Explosive environment
- Environment without safety precautions
- Outdoor environment
- Environment affected by oil, water, dust, etc.

ii. Relevant Personnel

Electrical or mechanical work on industrial robot arms is only permitted by professionals.

⚠ WARNING

All personnel working on industrial robotic arms must read and understand the manual containing the safety section of the system of the robotic arm.

System Integrator

Refers to the person who integrates the industrial robot arm into a set of equipment according to safety regulations and puts it into operation.

The system integrator is responsible for the following tasks:

- Install industrial robot arm.
- Industrial machinery arm related equipment connection work.
- Risk assessment of the overall system.
- Use safe guard devices.
- Confirm that the components used by the safe guard devices are in compliance with regulations.
- Placement, replacement, setup, operation, maintenance and repair work is only permitted for specially trained personnel in accordance with the operating instructions for the components of the industrial robot arm.

User

Users must be professionally trained, have the knowledge and experience in this area, and be familiar with the prescribed standards, and thus be able to make a correct judgment of the work to be performed and identify potential hazards.
Users can be defined into three categories based on operational permissions:

1. Operator

- System startup and shutdown
- Power on and off
- Alarm system status recovery

2. Engineer

- Operating personnel usage authority
- Programming and changing
- Arm teaching operation

3. Expert

- Engineer usage authority
- Mechanical arm maintenance work

System Operation

Those who do not use functional safety kits must implement safety-fence guidance.
The system operation of personnel is divided into the following three levels

1. Operator
2. Engineer
3. Expert

Its control permissions are shown in the following table.

No.	Function	Operator	Engineer	Expert
	Function Table			
1	File	X	X	O
2	Configuration>User group	O	O	O
3	Display>Input/Output	X	O	O
4	Display>Variable	X	O	O
5	Display>Mileage	O	O	O
6	Display>Utilization	O	O	O
7	Display>Motor Torque	O	O	O
8	Diagnosis>Logbook	O	O	O
9	Start-up>Calibrate	X	X	O
10	Start-up>Master	X	X	O
11	Start-up>Robot data	X	O	O
12	Start-up>Network Config	X	X	O
13	Start-up>RS-232	X	X	O
14	Start-up>System Setting	X	X	O
15	Track>Setting	X	O	O
16	Track>Vision Setting	X	O	O
17	Track>Vision Object	X	O	O
18	Track>Calibration	X	O	O
19	Track>Monitor	O	O	O
20	Help>About	O	O	O
21	Help>Operating Time	O	O	O
22	Help>Update	X	X	O
23	Help>TP Calibration	O	O	O
24	Help>Manual	O	O	O

	Interface			
25	Message box	O	O	O
26	Velocity configuration	X	O	O
27	Tool/base coordinate	X	X	O
28	Teach Pendant configuration	X	O	O
29	Change JOG coordinate system	X	O	O
30	JOG	X	O	O
31	On-screen keyboard	O	O	O
32	Remove teach pendant	X	O	O
33	Step execution	X	X	O
34	Program execution	O	O	O
35	Program selection	O	O	O
36	Modify program	X	X	O
37	Tool/base calibration	X	O	O
38	IO operation	X	O	O
39	Functional IO modification	X	X	O

WARNING

Electrical or mechanical work is only allowed to be carried out by professionals.

Operator Safety Precautions

The manner and scale of the work and the possible hazards must be explained to the relevant personnel before work, and relevant training courses must be carried out on a regular basis. In the event of an accident or technical correction, a training course must be re-run.

System Set Up Safety Precautions

The system set up only allows specially trained personnel to perform and work in accordance with the installation, setup, operation and other relevant documents provided by the original manufacturer.

Maintenance Personnel's Precautions

Maintenance should only be carried out by specially trained personnel in accordance with the instructions and operating instructions.

iii. Robotic Arm Working Range Definition

- Working area

The working area of the robot is defined as the area of motion under motion constraints, and the working area must be limited to the minimum required.

- Collaboration area

The area in which the operator and the robot arm may work together in the protection zone. The collaboration area includes the working area and the stopping distance of the robotic arm and the additional axis (optional). The area can be protected by an isolation devices.

Note: Stop distance = reaction distance (time to get the message) + braking distance (time to receive the message)

- Protective area

A protected area is an area of the working area that is protected by a safe guard device. The area must include working areas and collaboration areas, and the safety areas ensure safety in the working area.

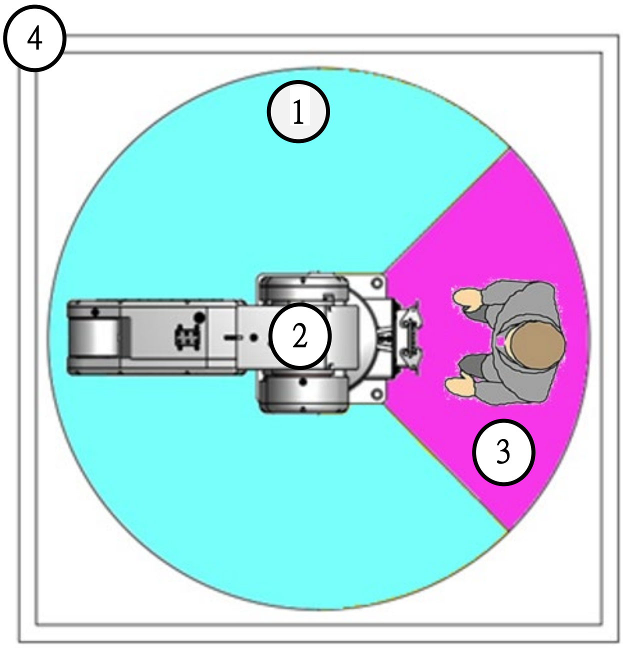


Illustration of axis A1

1. Workspace
2. Robot
3. Collaborative distance
4. Protective area

iv. Description of Safety Functions

Industrial robotic arms must have the following safety features:

- Selection of operating mode of the robot arm
- Safe guard devices
- Emergency stop device
- Teach pendant enable switch

The safety function of the robot arm system is to prevent loss of personnel or property. If the function is not complete or in failure state, the industrial robot arm must be prohibited from operating.

Operation Mode Selection

Operating mode application and speed description

Mode	Application	Velocity
T1	Used for run test, programming and instruction	Programmed velocity, maximum 250 mm/s
T2	Used for run test	Programmed initial velocity, less than 250 mm/s
AUT	Used for robot without the higher-level controllers	No speed limit Unable to perform manual control
AUT EXT	Used for the robot with the higher-level controllers (For example, PLC)	No speed limit Unable to perform manual control

Manual Operation Mode (T1,T2 Mode)

The manual operation mode is used for program design, program operation check or teaching, etc. When performing manual operation, pay attention to the followings:

- All actions must be operated within the protection area.
- Do not damage or potentially damage the relevant equipment due to operates the robotic arm.
- Operation must be carried out outside the protected area as much as possible.

Both manual and automatic modes of operation in the protected area are not permitted unless the arm is equipped with a certified speed monitoring accessory from the manufacture.

Automatic Mode

The automatic mode startup should include the following conditions:

- The safe guard devices have been set up and confirmed that their functions are working properly.
- All suspended security should restore its full functionality.
- Confirm that there are no people in the protected area.
- Relevant workflow rules are complied.

To enter the protection area in this mode, the emergency stop function must be activated before entering.

Safe Guard Devices Description

The safe guard device must use the components approved by the safety regulations and set and plan according to the relevant regulations.
The robotic arm system must be automatically activated to receive the safety signal.
In the event of a connection failure during automatic mode operation, an emergency stop must be triggered. When reconnecting after disconnection, the device cannot be automatically started directly and must be started manually. Manual slow running (T1) and manual fast running (T2) modes allow the guard not activate. A method must be provided to confirm that no personnel are in the protected area when the automatic mode is activated.
Users must strictly abide by the content description, otherwise it will cause serious casualties.
Temporary fences can be used during system installation and can be set according to ISO 10218-2 regulations

Stop Functions

<u>Stop Category Description</u>
Stop Category 0: The drive immediately cuts off the power after triggered.
Stop Category 1: The drive cuts off the power after the robot stops moving.
Stop Category 2: The drive maintains the power supply after the robot stops moving.

Stop Mode of Operation Mode

Trigger	T1,T2	AUT, AUT EXT
Release the Start Button	STOP 2	-
Press the Stop Button	STOP 2 (stop 2)	
Disconnect the drive device	STOP 1 (stop 1)	
No "run allowance" at input	STOP 2 (stop 2)	
Disconnect the control system (power disconnection)	STOP 0 (stop 0)	
Internal failure in the control system not related to the safety	STOP 0 or STOP 1 (depend on the failure reason)	
Operating mode changed	STOP 2	
Open the safety door (safety device)	-	SAFETY STOP 1
Release Enabling Switch	STOP 2	-
Press Enabling Switch or failure	STOP 2	-
Trigger emergency stop	SAFETY STOP 1	

Emergency Stop Description

Emergency stop related precautions

- Confirm that the function is functioning normally every six months.
- System integrators should provide emergency stop devices to ensure that the machine is operational or that a hazardous situation exists.
- At least one external emergency stop device is installed. Make sure that additional emergency stop devices are available for use without or losing the teach pendant.
- Provide interface to connect external emergency stop devices.
- The emergency stop function can be triggered when the safety control system connected to the robot arm is cut off.
- The risk assessment should assess whether the emergency stop is not triggered when the robotic arm control system is turned off and provides a response.
- If a tool or other device connected to the robot is dangerous, it must be connected to the emergency stop circuit on the equipment side.

Teach Pendant Enabling Switch

The teach pendant is equipped with two three-stage enabling switches:

Three-stage enable switch position

- When the switch is in the first stage, it will trigger the stop state of Stop Category 2
- When the switch is in the second stage, the industrial robot arm motion command can be executed in the teach mode.
- When the switch is in the third stage (fully pressed), it is the alarm position, which will trigger the stop state of Stop Category 2

Do not use any methods or tools to affect the function of the enable switch, otherwise it may cause serious danger and property damage.

v. Warnings and Precautions

General considerations

DANGER

1. All operating procedures should be assessed by professional and in compliance with related industrial safety regulations.
2. When operating robot, operator needs to wear safety equipment, such as workwear for working environment, safety shoes and helmets.
3. When encountering danger or other emergency or abnormal situation, please press the emergency stop button immediately. After danger is eliminated, move the robot away with low speed in manual mode.
4. When considering safety of the robot, the robot and the system must be considered at the same time. Be sure to install safety fence or other safety equipment and the operator must stand outside the safety fence while operating the robot.
5. A safety zone should be established around the robot with an appropriate safety device to stop the unauthorized personnel from access.
6. While installing or removing mechanical components, be aware of a falling piece which may cause injury to operator.
7. Ensure the weight of workpiece does not exceed the rated load or allowable load moment at wrist. Exceeding these values could lead to the driver alarm or malfunction of the robot.
8. Do not climb on manipulator.
9. Do not store the machine in the environment with corrosion and flammable gas or close to the flammable object.
10. Do not operate the machine in the environment with moisture, water or grease.
11. Do not operate the machine at the place where vibration or the strong impact occurs.
12. Do not immerse the electric wires into grease or water.
13. Do not connect or operate the machine with wet hands.
14. Do not operate the machine in potentially explosive environment.
15. Please ensure the controller is grounded.
16. Keep hands away from the inner part of the controller while it is connecting to the power or during operating.
17. Do not touch the heat sink, regenerative resistance, the power supply or the computer inside the controller while it is operating due to its high temperature.

18. Be sure power is disconnected prior to repair and maintenance, and ensure to operate under the condition of no electrical shock risk.
19. Do not disassembly the controller without permission. If there’s any issues, please contact our engineers.

⚠ WARNING

1. The personnel installing robot should be trained and licensed.
2. To ensure personal safety, robot installation must comply with this manual and related industrial safety regulations.
3. The control cabinet should not be placed near high voltage or machines that generate electromagnetic fields to prevent interference that could cause the robot to deviation or malfunction.
4. Using non-HIWIN spare parts to repair may cause robot damage or malfunction.
5. Beware of the heat generated by the controller and servo motor.
6. Do not overbend the cable to avoid poor circuit contact or unexpected damage.
7. Do not stand on the controller or put heavy objects on it.
8. Do not block the vent or put foreign objects into the controller.
9. Please ensure the controller is fixed on the base.
10. Do not pull the connector violently or twist the electric wires excessively.
11. Do not frequently switch ON/OFF the power switch and the control button.
12. Please ensure that the robot, the emergency stop switch and the controller are functioning properly before performing any work.
13. Do not shutdown the power switch during the operation.
14. Do not open, modify, disassemble and maintain the machine without permission.
15. The power must be disconnected when the machine does not operate in a long time.
16. Do not turn off the power of the controller when modifying the program or parameter. Otherwise, the data stored in the controller will be damaged.
17. When changing the program or parameters inside the robot controller, do not turn off the power of the controller. Otherwise, the internal data of the controller will be damaged.
18. After the brake of a servo motor is released, the robot will be moved due to gravity and it may injured the operator.
19. The industrial robots can be applied for the different industrial environments.
20. When the operating procedures are interrupted, the special attention should be paid during the troubleshooting.

Precautions during operations

⚠ DANGER

1. Teaching, jogging or programming should be done outside of the safety fence. If it is inevitable to enter the safety fence, press the emergency stop button before entrance. Operation should be restricted at low speed and beware of surrounding safety.
2. All operations shall be executed by trained staff.
3. All operations are required to perform in the safe area.

Maintenance Precautions

⚠ DANGER

1. Please contact us if the procedure not specified by HIWIN is needed.
2. Please contact us if the replacement of the component not specified by HIWIN is needed.
3. Be sure to carry out regular maintenance, otherwise it will affect the service life of the robot or other unexpected danger.
4. Prior to repair and maintenance, please switch off power supply.
5. Maintenance and repair should be performed by a qualified operator with a complete understanding of the entire system to avoid risk of robot damage and personal injury.
6. When replacing the components, avoid foreign object going into the robot.

Precautions for using End Effector

End effectors can be basically divided into the following two categories:

A. Gripper: Mainly for pick and place operations, such as pneumatic, electric gripper, vacuum suction cup, etc.

B. Tools: Mainly for processing operations, such as welding, cutting, surface treatment, etc.

⚠ DANGER

1. More attention must be paid to the design of the end effector to prevent power loss or any other errors that could lead to workpiece falling or damage.
2. The tool-type end effector is usually equipped with high voltage, high temperature and active rotary shaft. Special attention should be paid to the operating safety.
3. The end effector should be mounted firmly on the robot to avoid workpiece fall during operation which may cause personal injury or hazard.

WARNING

1. The end effector may be equipped with its own control unit. During installation, pay attention to installed location. Ensure that the control unit does not interfere with robot operation.
2. The gripper-type end effector should prevent the workpiece from dropping or damaging when the robot experiences a power error or other errors. If potential dangers or abnormal situations exist when using end effector, the associated hazards must be handled by the system integrator in accordance with the related standards.

Precautions for using Hydraulic and Pneumatic

DANGER

1. When using the pneumatic or hydraulic system, the gripped workpiece may fall due to insufficient pressure or gravity.
2. The pneumatic or hydraulic system must be equipped with the relief valve, so that it can be applied in an emergency.

WARNING

1. More attention should be paid to the pressure remained in the pneumatic systems after the power is disconnected.
2. The internal pressure must be released before the pneumatic systems are maintained.
3. More attention should be paid to the pressure in the pneumatic system as it is several times more than the atmosphere pressure.

Emergency Stop Switch Precautions

DANGER

1. The robot or other control component should have at least one device for immediate halt, such as an emergency stop switch.
2. The emergency stop button must be installed in an easily accessible location for quick stop.
3. While executing an emergency stop, power to the servo motor will be cut, and all movements will be stopped. And the control system will be shut down. Emergency stop should be reset if the restoration of operating procedure is wanted.
4. Avoid using emergency stop to replace a normal stop procedure. This could reduce the lifespan of the robot.

WARNING

1. When an emergency stop is performed, the power of the drive is cut off, all operations are stopped, and the control system of the robot arm is turned off.
2. To resume execution, reset the emergency stop switch.
3. Emergency stop is immediate stop: Immediately stop the movement of the robot arm and cut off the power of the drive.
4. The emergency stop switch is for emergency stop only.
5. HIWIN's industrial robot arm has two emergency stop switches, one of which is located on the teach pendant and the other is automatically connected to the controller via a dedicated cable. If there is a need for other emergency stop switches, the other means of connection can be used to achieve the purpose of emergency stop.
6. Based on the relevant industrial safety regulations, the emergency stop switch needs to be directly connected to the control box of the robot arm through a physical connection line.
7. Additional installed safety equipment must comply with PLD level.

Content

Version Update

Edition	Date	Applicable Software	Applicable Range	Remark
1.0.0	2017.07.10	HRSS V3.2.0	RA605、RA610、RA620、RD4D5、RD401、RD403	Preliminary Issue
1.1.0	2017.09.11	HRSS V3.2.2	RA605、RA610、RA620、RD4D5、RD401、RD403	Add 4.6、4.17、5.9、8.15.2、9.3.3、9.3.4、11.1 Content Modified 5.8、8.2.2.4、9、10.5.5、10.8 Content
1.2.0	2017.12.15	HRSS V3.2.5	RA605、RA610、RA620、RD4D5、RD401、RD403、RT605	1.Add 5.5.2.1、9.1.10 2.Modified 3.5.1、3.5.2、3.5.8、3.5.10、3.5.11、3.5.12、3.6.1、4.6、4.11.3、4.16、9.1.4、9.3.2、9.3.4
1.3.0	2018.01.08	HRSS V3.2.6	RA605、RA610、RA620、RD4D5、RD401、RD403、RT605	1.Add 4.13.7、4.16、6.6.3、9.1.11 2.Modified 4.9、4.15、4.17、5.3.1、5.3.2、5.5.2、9.1.2、9.1.5、9.2.2、10.7.1、10.7.2、10.10.2
1.4.0	2018.02.13	HRSS V3.2.7	RA605、RA610、RA620、RD4D5、RD401、RD403、RT605	1.Add 5.10、8.16.10、8.16.11、8.20、10.5.10、10.5.11、10.5.12 2.Modified 4.15、4.17、5.3.1、5.7.2、8.16.6、8.19.1.5、8.19.1.7、9.1.2、9.1.4、10.15

1.5.0	2018.04.17	HRSS V3.2.8	RA605、RA610、RA620、RD4D5、RD401、RD403、RT605	1.Add 4.12.13、4.17、4.18、8.16.1 2.Modified 9.4 、10.3.1
1.6.0	2018.09.28	HRSS V3.2.12	RA605、RA610、RA620、RD4D5、RD401、RD403、RT605	1.Add 4.11.9、4.20、4.23、8.15.3、8.16.2 、8.17.12 2.Modified 9.3.2 、9.3.4
1.7.0	2018.12.11	HRSS V3.2.14	RA605、RA610、RA620、RD4D5、RD401、RD403、RT605	1.Add 8.17.13, 10.5.13, 10.5.14 2.Modified 4.15, 8.20, 9.4, 10.15, 11.1
1.8.0	2019.05.22	HRSS V3.2.15	RA605、RA610、RA620、RD4D5、RD401、RD403、RT605	1.Add 4.13.3, 4.13.4, 8.16.2, 8.16.3 2.Modified 3.2, 4.7, 4.12.13, 4.13.1, 4.13.2, 8.10.1, 9.1.1, 9.1.2, 9.4.2, 9.4.3
1.8.1	2020.01.06	HRSS V3.2.15		1.Modified 6.6.6, 6.13.3, 7.1.1, 7.1.5, 8.6.6
1.8.2	2020.05.27	HRSS V3.2.15		1.Modified 2.13.9, 6.13.3

1. Product Description

1.1. Software Overview

The following software will be applied:

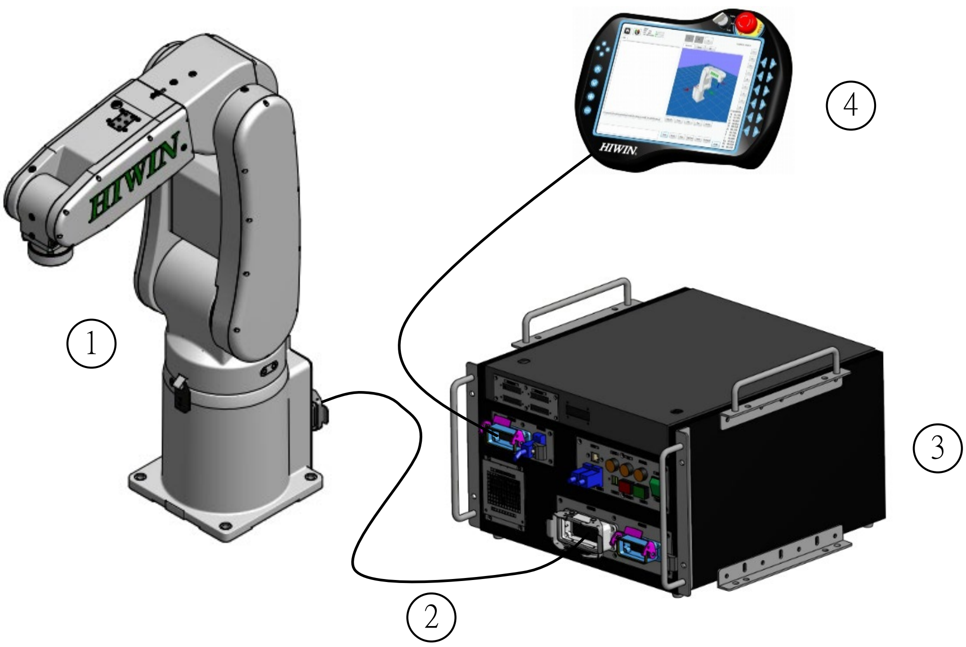
◆ HIWIN Robot System Software

◆ Windows 7 Embedded

1.2. Robot Overview

The robot is comprised of the following parts:

1. Robot (Six-axis robot or Four-axis robot)
2. Cable
3. Control System
4. Teach Pendant (HRSS software)



Robot illustration

1.3. Hiwin Robot System Software (HRSS) Overview

Description

The HIWIN Robot System Software (HRSS) controls all basic functions for the robot.

- Path planning
- I/O management
- Data and file management…
- HRSS

The interface is called HIWIN ROBOT SYSTEM SOFTWARE (HRSS).
Features:

- User management
- Program editor
- Robot language
- Inline forms for programming
- Message display
- Configuration windows
- etc.

Offline version recommended environment

- Window 7
- Resolution 1360x768 above
- Console ->all console project ->Display: Small (100%)

⚠ CAUTION

The operating interface may differ from the standard model depending on the user's settings.

2. Operation

2.1. Teach Pendant

2.1.1. Front view

<u>Function</u>

The Teach Pendant is a portable programming device for the robot, which can provide both programming operation and display. It is equipped with a touch screen: the HRSS can operate by finger or stylus without an external mouse and external keyboard.

⚠ CAUTION

In this reference, the Teach Pendant is referred as "TP"

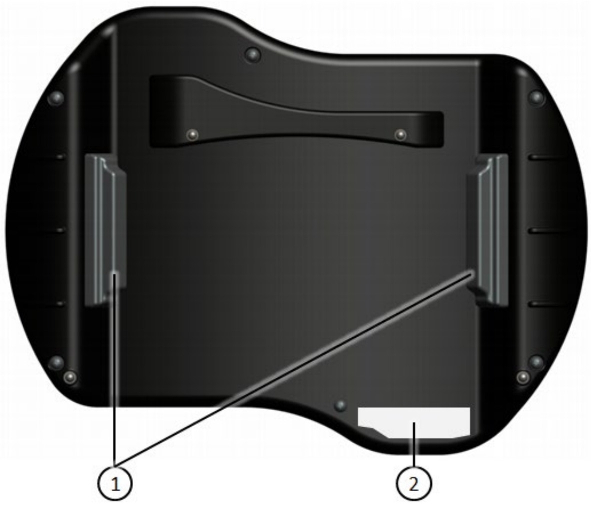
<u>Overview</u>

Front view of HIWIN's teach pendant

No.	Description
1	Used to change operation mode and turn on/off the monitor. Only after the key is inserted, the switch can be turned.
2	Emergency Stop Button, used to stop the robot in emergency. It will lock when the Emergency Stop Button is pressed.
3	Run Button, used for JOG.
4	Velocity adjustment
5	Space Operation Button

2.1.2. Rear View

Overview



Rear View of HIWIN's Teach Pendant

1. Enabling Switch
2. Model Plate

Description

Component	Description
Enabling Switch	The Enabling Switch has three positions: ● Not pressed ● Center position ● Pressed In T1 or T2, the Enabling Switch must be kept in the center position to start the robot. In the Auto Run and External Auto Run modes, the Enabling Switch will not activate.
Model Plate	Model Plate

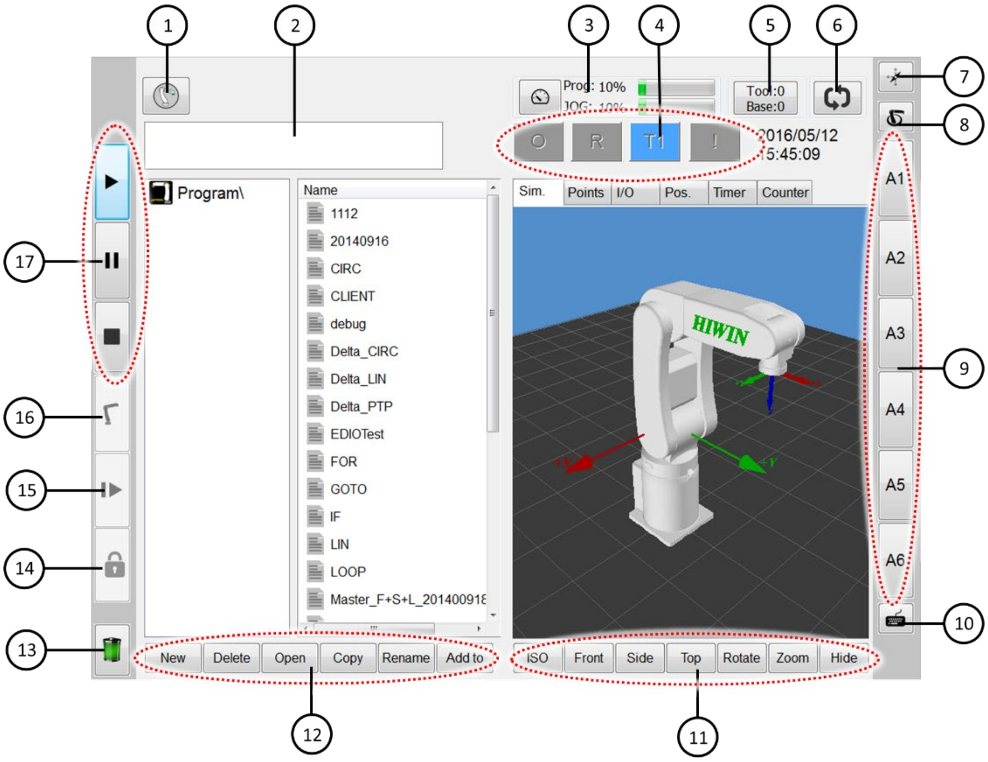
⚠ WARNING

It is prohibited to remove or insert Teach Pendant when the controller is under powered condition, this is to prevent damaging Teach Pendant. If Teach Pendant is removed under powered condition, the emergency stop will be activated immediately. Only reinsert the Teach Pendant can deactivate the emergency stop.

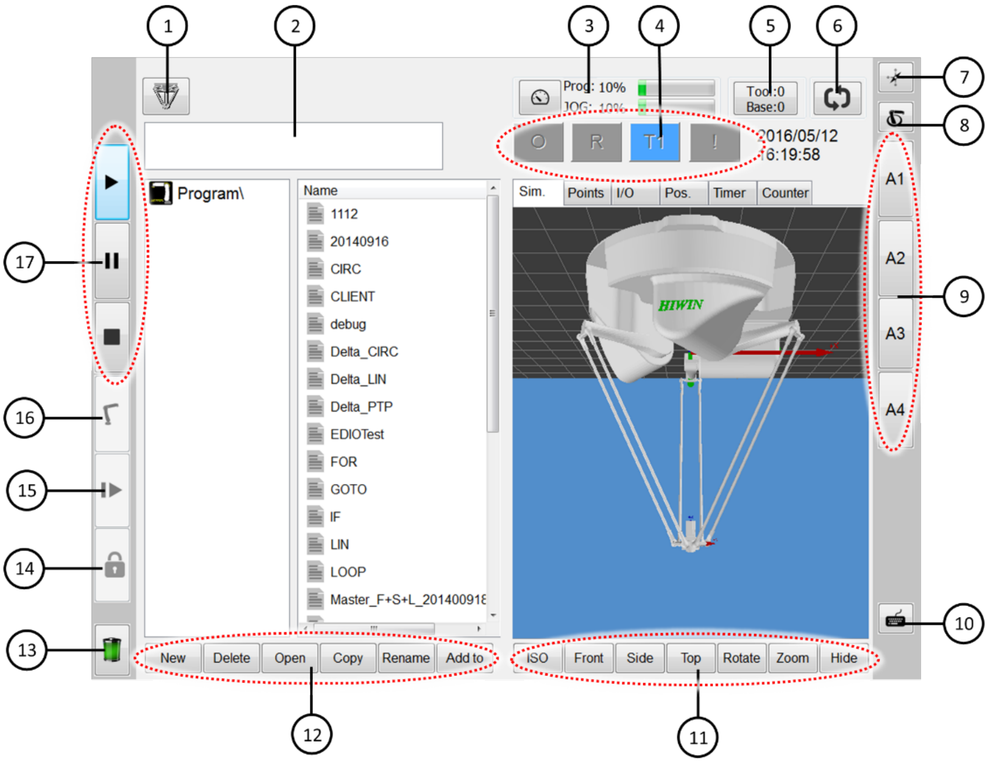
WARNING

If the Teach Pendant is removed, the robot cannot be stopped from the Emergency Stop Button on the Teach Pendant. An external Emergency Stop Device is required to connect to the control system.
The providers should take responsibility to remove the Teach Pendant from the robot and keep it safe. It should be stored out of operator's view and away from contact. The purpose is to avoid confusion of valid and invalid emergency stop devices.
Failure to take these measurements could lead to serious injury, death or equipment damage

2.2. HRSS Interface



6-axis robot HRSS interface



Delta robot HRSS interface

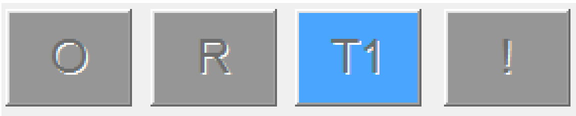
No.	Name	Description
1	Main Menu	Display the Main Menu
2	Error Information Window	Displays the error information according to the default configuration.
3	Program Ratio and Jogging Ratio	Displays by the program to change the ratio.
4	Status Bar	
5	Tool and Base	Displays the selected tool and base number. Click to change the tool or base number.
6	Step motion	Step motion and continue motion
7	Teach Pendant Configuration	Touch the display to select the relative position where the Teach Pendant faces the robot.
8	Coordinate system Button	Displays the current coordinate system. Touch to display all coordinate systems and select another one.
9	Run Button	If axis-specific jogging is selected, the axis number (A1, A2 etc) will be displayed here. If Cartesian jogging is selected, the direction of the coordinate (6-axis) system (X, Y, Z, A, B, C) will be displayed; If coordinate (4-axis) system is selected (X, Y, Z, A4) will be displayed.
10	Keyboard Button	Click to display the keyboard.
11	Simulation View Angle Button	Shift to simulate the view angle
12	Status button	The Status button will dynamically be changed according to the window currently activated by the HRSS. Button edit is on the right, use this to transfer different command from Teach Pendant.
13	Battery Figure	Display the status of absolute encoder's battery.
14	Lock Button	When the program is executed, button will lock or unlock it.
15	Next step	motion Button
16	Home Button	Hold this button to return the robot to the home position

17	Run Control Button	Three buttons are used for run, pause and stop the program.

2.2.1. Status Bar

The status bar displays the configuration status of the robot.

Overview



HRSS status bar

2.2.2. Status Display "Interpreter"

Figure	Color	Description
	Orange	Interpreter running.
	Gray	Interpreter failure or stop.

Program execution status display for submit encoder of the robot.

2.2.3. Keyboard

The Teach Pendant is equipped with a touch screen. The HRSS can be operated by finger or stylus.
The keyboard on the HRSS can be used to enter alphabets and numbers.

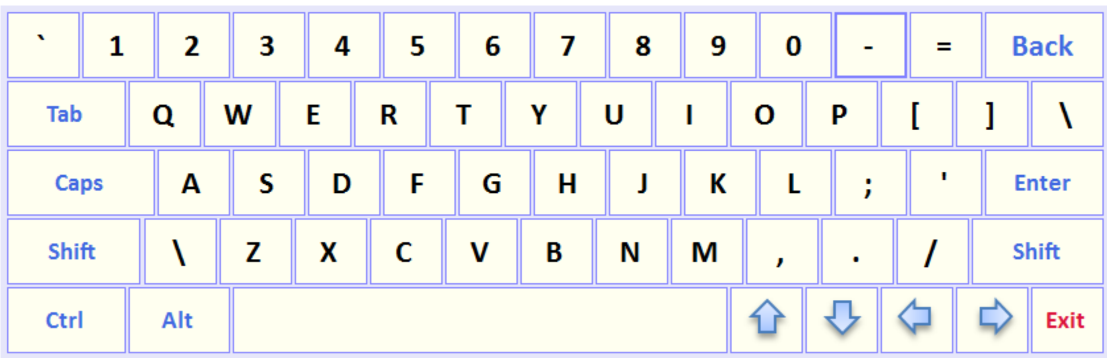


Illustration of HRSS keyboard

2.3. Connect to Control System, and Start HRSS

Operation steps

The main switch on the control system is shifted to ON.
The operating system and the HRSS will automatically start.

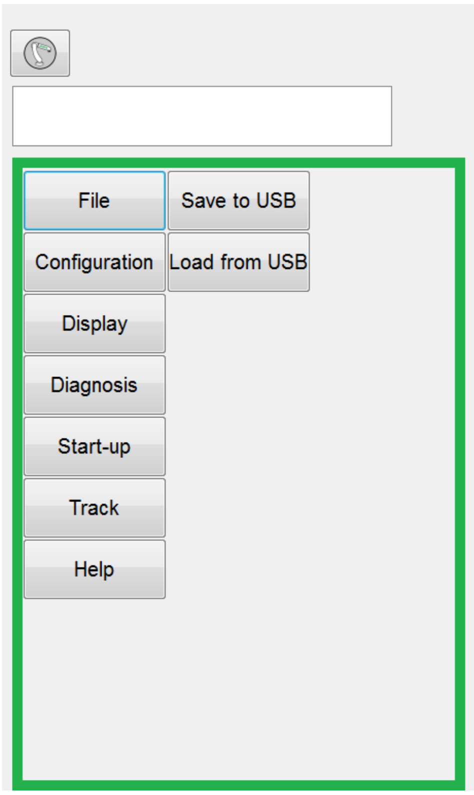
2.4. Open Main Menu

Operation steps

Click the Main Menu on the Teach Pendant, and then open it.

Description

1. Property for Main Menu window
   The Main Menu is displayed in the left window.
   Click an item to display the next-level function table (e.g. File).
   Display table or opened interface by pressing the menu button on the upper left.
   You can select these function items again without closing the next-level table.



Example: opened next function table

2.5. Language Settings

Description

The interface enable three different languages to be selected for the settings: English, Traditional Chinese and Simplified Chinese.

When setting is completed, most of the interface will change to the language selected by the user immediately. The rest will be changed after the Teach Pendant is restarted.

Language Setting Interface

Operation steps

Main menu>Configuration>Language

1. Select language
2. Restart Teach Pendant to complete full language change

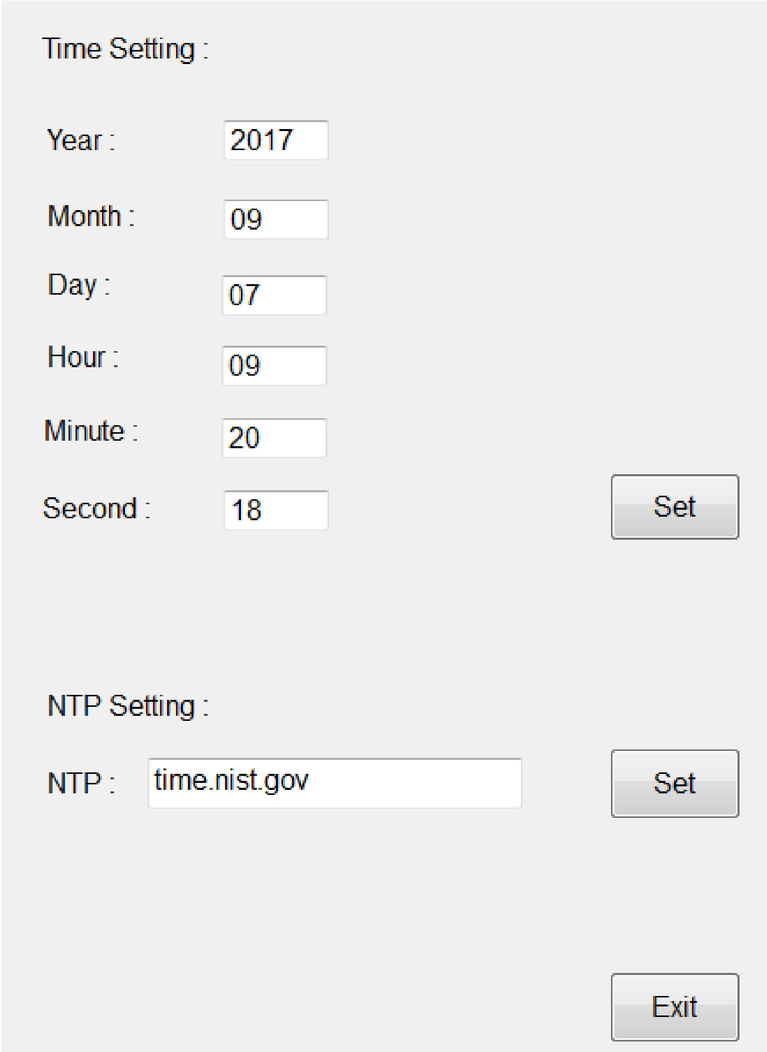
2.6. Time and NTP Settings

Description

User could use the Time setting in HRSS to increase the Network Time Protocol (NTP) server function. When using time and NTP settings mention above, user will be notified with warning signal under continuous operation. Data will be recorded in LOGBOOK for further references to know when the time has been edited. Only under the Expert Mode has the permission to use time and NTP settings.

Operation steps

1. Time Settings
    1. Main menu>Configuration>User group>Expert
    2. Main menu>Configuration>Time setting
    3. Enter required time under time setting
    4. Press SET button
2. NTP Settings
    1. Main menu>Configuration>User group>Expert
    2. Main menu>Configuration>Time setting
    3. Enter required NTP under NTP setting
    4. Press SET button



Time and NTP Settings Interface

2.7. Change User Group

Operation steps

1. Select [Configuration]>[User group] on the Main Menu to display the current user group.
2. To switch to the default user group, press [Change]. To switch to other user groups, press [Login] … select the user group.
3. If needed, enter password and login.

Description

In the HRSS, the functions can be selected according to the user group. The following user group exist:

1. Operator
Operator group
This is the default user group.

2. Engineer
Engineer group
This user group is protected by a password. The default password is “HIWIN”. Modification unavailable.

3. Expert
Expert group
This user group is protected by a password. The default password is “HIWIN”. Modification unavailable.

No.	Function	Operator	Engineer	Expert
	Function Table			
1	File	X	X	O
2	Configuration>User group	O	O	O
3	Display>Input/Output	X	O	O
4	Display>Variable	X	O	O
5	Display>Mileage	O	O	O
6	Display>Utilization	O	O	O
7	Display>Motor Torque	O	O	O
8	Diagnosis>Logbook	O	O	O
9	Start-up>Calibrate	X	X	O
10	Start-up>Master	X	X	O
11	Start-up>Robot data	X	O	O
12	Start-up>Network Config	X	X	O
13	Start-up>RS-232	X	X	O

14	Start-up>System Setting	X	X	O
15	Track>Setting	X	O	O
No.	Function	Operator	Engineer	Expert
16	Track>Vision Setting	X	O	O
17	Track>Vision Object	X	O	O
18	Track>Calibration	X	O	O
19	Track>Monitor	O	O	O
20	Help>About	O	O	O
21	Help>Operating Time	O	O	O
22	Help>Update	X	X	O
23	Help>TP Calibration	O	O	O
24	Help>Manual	O	O	O
	Interface	O	O	O
25	Message box	O	O	O
26	Velocity configuration	X	O	O
27	Tool/base coordinate	X	X	O
28	Teach Pendant configuration	X	O	O
29	Change JOG coordinate system	X	O	O
30	JOG	X	O	O
31	On-screen keyboard	O	O	O
32	Remove teach pendant	X	O	O
33	Step execution	X	X	O
34	Program Execution	O	O	O
35	Program selection	O	O	O
36	Modify program	X	X	O
37	Tool/base calibration	X	O	O
38	IO operation	X	O	O
39	Functional IO modification	X	X	O

2.8. Change Run

⚠ CAUTION

Don't modify the run during programming period. If it is changed, the robot will stop.

Prerequisite

The controller doesn't processing any program.
Insert the key for the mode selector switch.

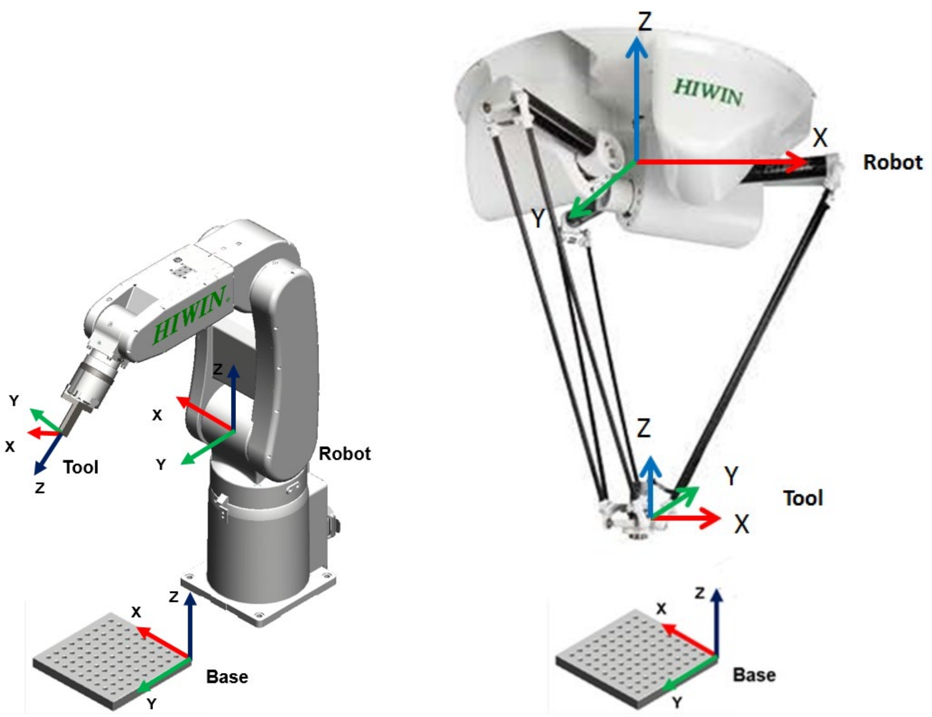
Operation steps

1. Turn the mode selector switch on the Teach Pendant, and display the mode selection.
2. Select the run.
3. The selected mode will be displayed in the status bar of the Teach Pendant.

Mode	Application	Velocity
T1	Used for test operation, programming and teaching	Program verification: Programmed velocity, maximum 250 mm/s Jog Mode: Jog velocity, maximum 250 mm/s
T2	Used for run test	Program verification: Programmed velocity Jog Mode: Unable to run
AUT	Used for robot without the higher-level controller	Programming mode: Programmed velocity Jog mode: Unable to run
EXT	Used for the robot with the higher-level controllers (For example, PLC)	Programming mode: Programmed velocity Jog mode: Unable to run

2.9. Coordinate System

Overview



Coordinate System Overview

Description

1. ROBOT

   The ROBOT used the Cartesian coordinate system. If it is a 6 axes robot, it will be fixed at the location of the 1st –axis center point and the 2nd –axis center point of the robot. If it is a 4 axes robot, it will be fixed at the robotic foot. This is used as the origin coordinate system of the base coordinate system.

   In the default configuration, the coordinate system of ROBOT is consistent with the BASE coordinate system.

2. BASE

   The BASE Coordinate System is Cartesian system used to describe the position of the workpiece. It is based on the ROBOT Coordinate System.

By default, the Base Coordinate System is consistent with the ROBOT system. A user can move it to the workpiece.

3. TOOL

The TOOL Coordinate System is a Cartesian system, located at the tool center point.

By default, the home of the Tool Coordinate System is located at the flange center point (called the Flange Coordinate System). The Tool Coordinate System is offset to the tool center point by the user.

Rotation of the six axes robot coordinate system

Corner	Rotation around axis
A	Rotate around X axis
B	Rotate around Y axis
C	Rotate around Z axis

Rotation of delta robot coordinate system

Corner	Rotation around axis
A4	Rotate around Z axis

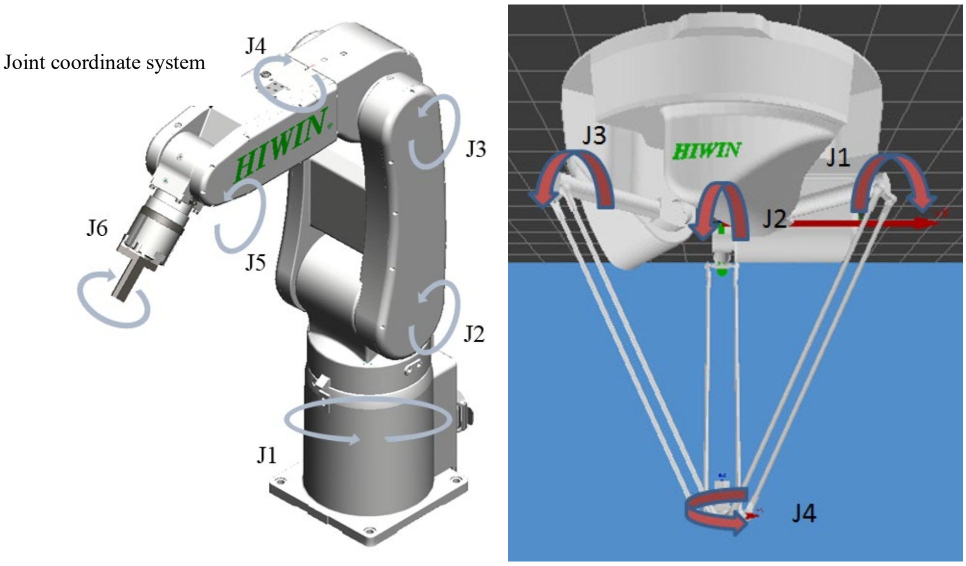
2.10. JOG

Description

There are two types of jogging:

Cartesian jogging, TCP (Tool Center Point) is jogged in the positive or negative direction along an axis of the coordinate system.

Axis-specific jogging, each axis can independently be moved in a positive or negative direction.



Axis-specific jogging

2.11. Manual Move

Description

When Administrator rights are Engineer or Expert, under the manual mode of T1, it is possible to configure all the parameters in the manual move options window.

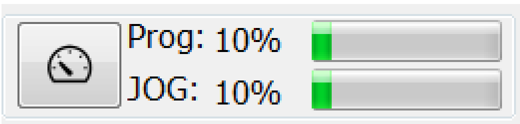
2.11.1. Jog Velocity Change

Description

Manually drag the bar to change the jog velocity or see 4.11.4 by using the +/- button at the left side of the Teach Pendant to set the ratio.

Operation steps

1. Open the speed options window (shown as the chart button).
2. Change the JOG speed.
3. It is also possible to use the left button of teach pendant to change the JOG speed.



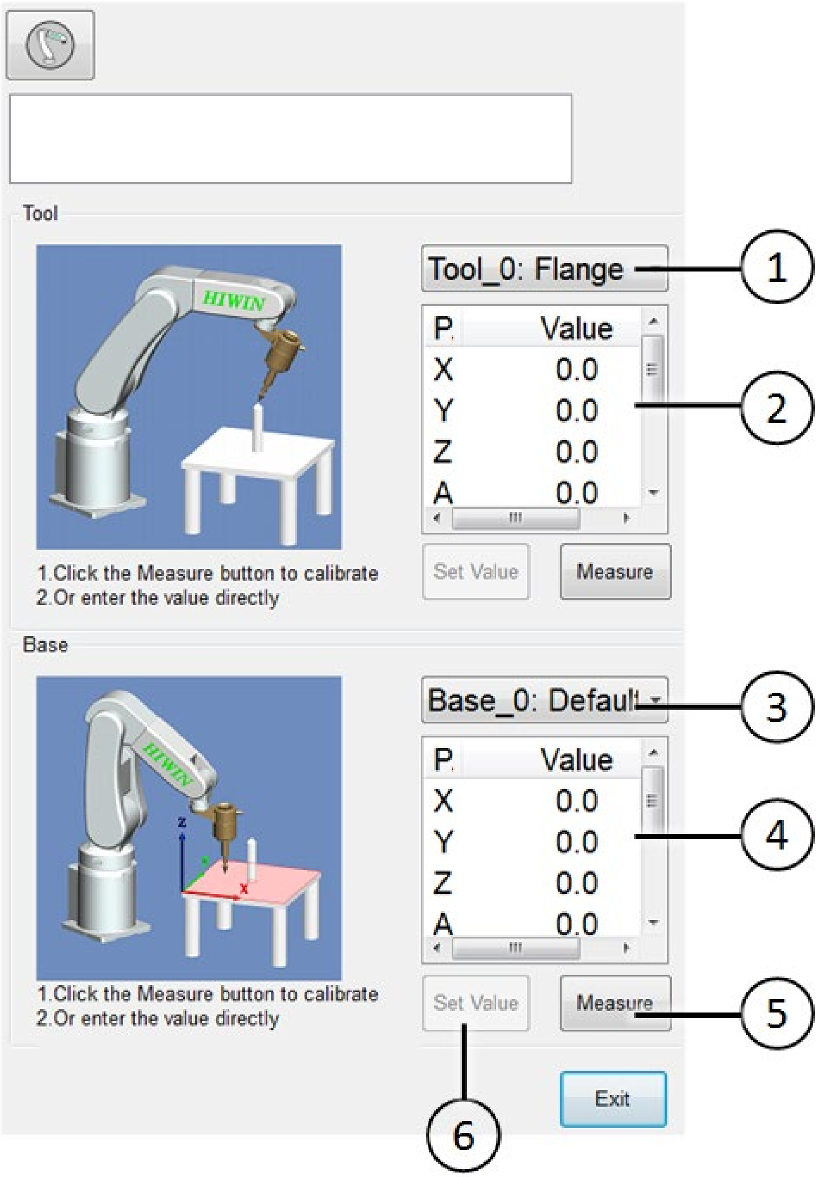
Configuration related to speed of jog

2.11.2. BASE/TOOL Coordinate

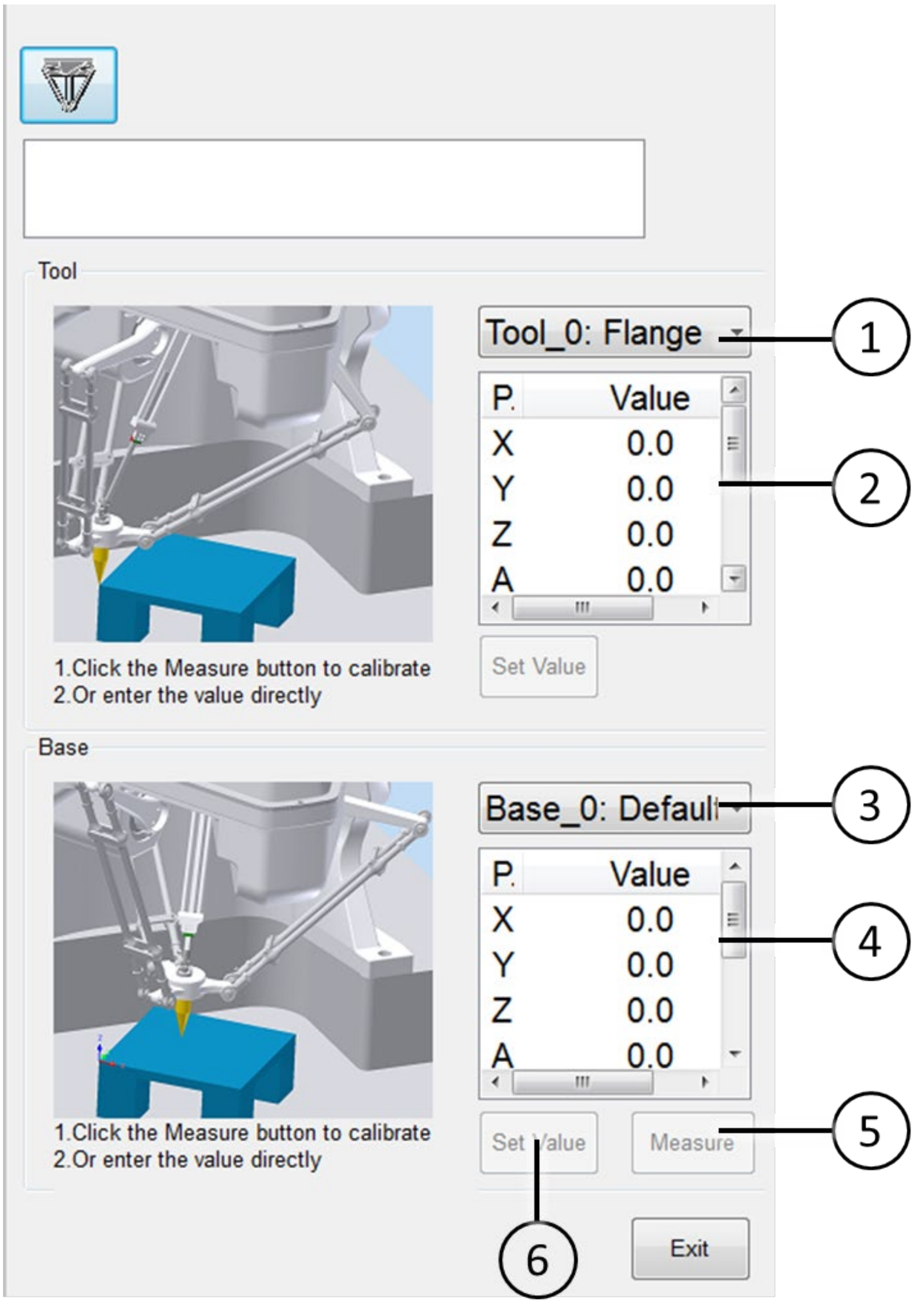
Description

View and modify the base or tool coordinate

16 tool and 32 base coordinate systems can be saved in the control system at most. When you apply the Cartesian jogging, you must select a tool (Tool Coordinate System) and a base (Base Coordinate System).



6-axis robot base/tool window



Delta robot base/tool window

No.	Description
1	Tool coordinate currently selected
2	Parameters relate to selected tool coordinate
3	Base coordinate currently selected
4	Parameters relate to selected base coordinate
5	Recalibrate
6	Directly enter a value on the selected item to calibrate

Operation steps

Open the TOOL/BASE window.

You can directly choose the tool/base coordinate system by click on ① and ③ in figure respectively.

2.11.3. Teach Pendant Position Configuration

Robot installation method

Floor Mode

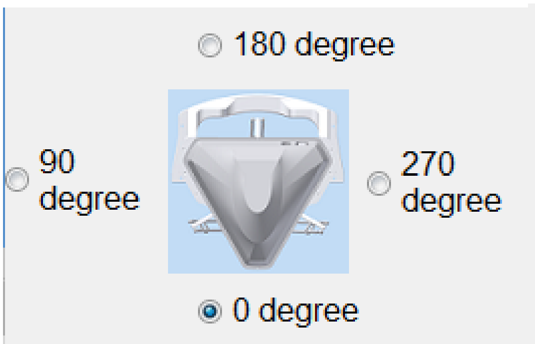
Operation Steps

1. Start-up -> Robot data -> Mount Position
2. Select Floor mode

Description

Define the user's position relative to the robot before you use space button.

Window of 6-axis robot teach pendant configuration



Window of delta robot teach pendant configuration

Robot Installation method

Ceiling Mode

Operation Steps

1. Start-up -> Robot data -> Mount Position
2. Select Ceiling mode

Description

Define the user's position relative to the robot before you use space button.

Window of 6-axis robot teach pendant configuration

2.11.4. Jogging velocity Ratio

Description

The jogging velocity ratio is the robot velocity during jogging. It is presented by percentage, based on the maximum velocity when the robot is jogging. That value is 250mm/s.

Operation steps

1. Click the jogging ratio button.
2. Set the desired jogging ratio. Set with the +/- button or the adjustor.
3. Touch the area outside the jogging ratio window. The window closes and the ratio is applied,

Other method

Use the +/- button at the left side of the Teach Pendant to set the ratio.

2.11.5. Axis-specific jogging with the jog keys

Prerequisite

T1 mode

Operation steps

1. Select the "JOINT" as the coordinate system for the jog key.
2. Set jogging velocity ratio.
3. Hold the enabling Switch.

4. Axis A1 to A6(or A1 to A4) beside the jog keys.
5. Press the +/- button, so that the axis move towards the positive or negative direction.

2.11.6. Cartesian jogging with the jog keys

Prerequisite

T1 mode

The tool and base coordinate systems have been selected.

Operation steps

1. Select the "XYZ" as the coordinate system for the jog keys.
2. Set manual ratio.
3. Hold the enabling Switch.
4. Axis X, Y, Z and RX, RY, RZ(or axis X, Y, Z and A) will display beside the jog keys.
    1. X, Y, Z: Used for linear motion along the axis of the selected coordinate system.
    2. RX, RY, RZ: Used for rotation motion along the axis of the selected coordinate system.
    3. A: Used for rotation motion along Z axis.
5. Press the +/- button, so that the axis move towards the positive or negative direction.

⚠ CAUTION

The position where the TCP is located can be displayed in the following method: select Main Menu>Display > Actual Position.

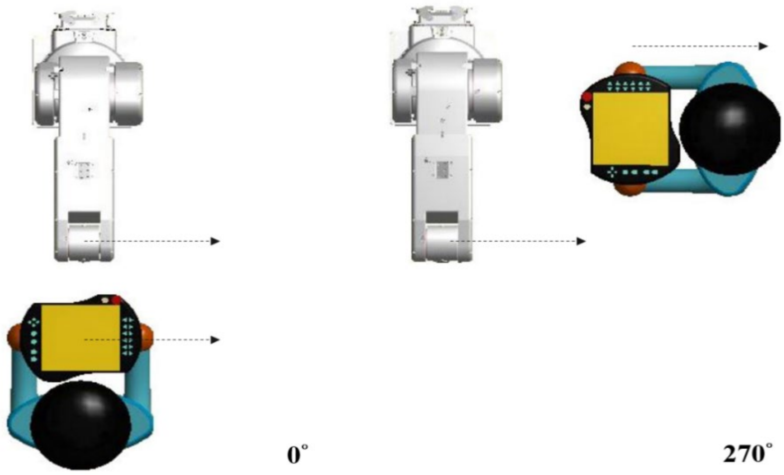
2.11.7. Teach Pendant Alignment

Description

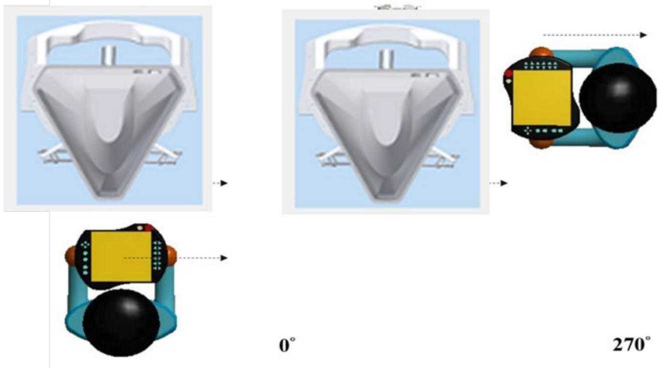
Adjust according to the user location, so that the direction of TCP movement adapts the rotation of the Teach Pendant.

The user location is selected in a unit of angle. The reference point for that angle is on the base.

Default: 0°. This corresponds to a user standing on the opposite side of the robot.



Teach Pendant configured at 0° and 270°(Six axes robot)



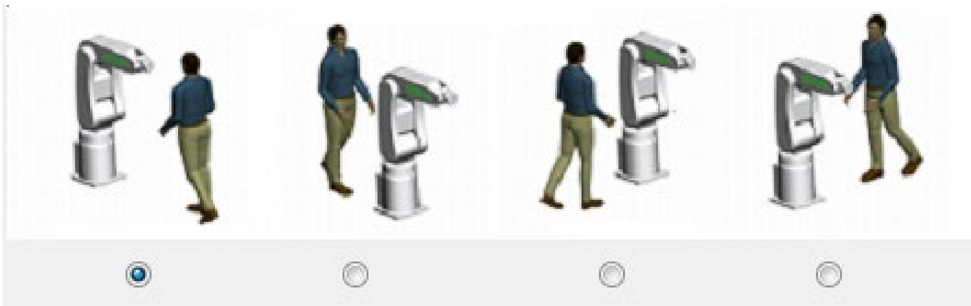
Teach Pendant configured at 0° and 270°(Delta robot)

Prerequisite

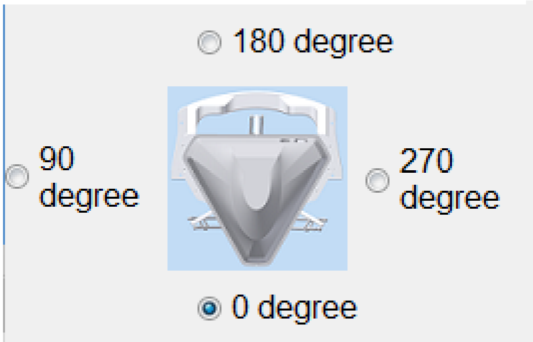
T1 mode

Operation steps

1. Open the window of Teach Pendant Configuration.



Window of six axes robot teach pendant configuration



Window of delta robot teach pendant configuration

2. Set the position where the Teach Pendant is located with regards to the robot.
3. Close the window of the Teach Pendant configuration.

⚠ CAUTION

When switching to the external auto run, the Space Operation Button will be automatically positioned as 0°.

2.11.8. Move with Space Operation Key

<u>Description</u>

Operate the arm to forwardly, backwardly, left, right, up and down according to the angle and direction set in 2.11.7.

<u>Prerequisite</u>

T1 mode

Ensure the Teach Pendant is positioned

<u>Operation steps</u>

1. Set the manual ratio
2. Hold the Enable Switch.
3. Press the Space Operation button, so that the arm can move to the relative direction.

⚠ CAUTION

When the space operation is used for manual movement, the moving direction depends on the position of Teach Pendant, not relevant to Base coordinate.

2.12. Display

2.12.1. Display Actual Position

Operation steps

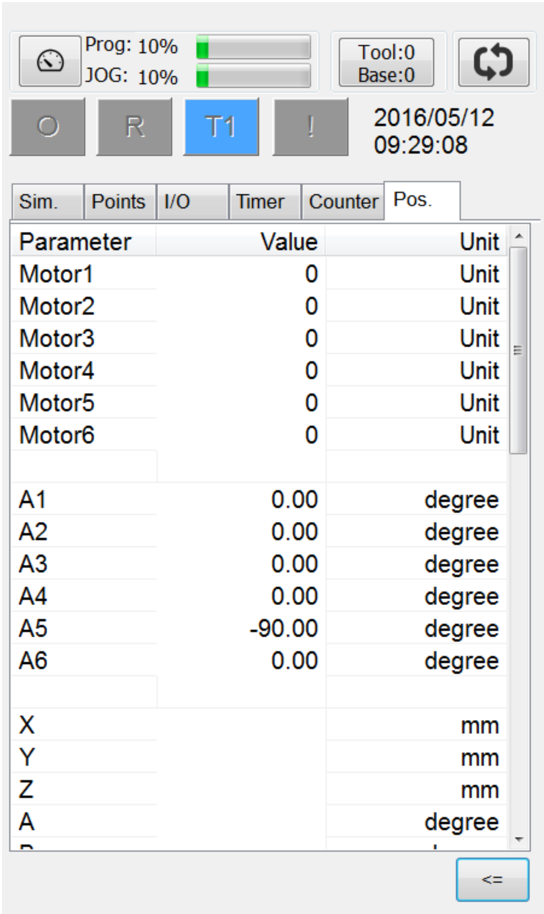
Click the operating page of [Pos.].

Description

Display the motor position, the axis angle and the Cartesian coordinate of the current base.

If the 6-axis robot is operated, 6-axis information will be displayed.

If the 4-axis robot is operated, 4-axis information will be displayed.



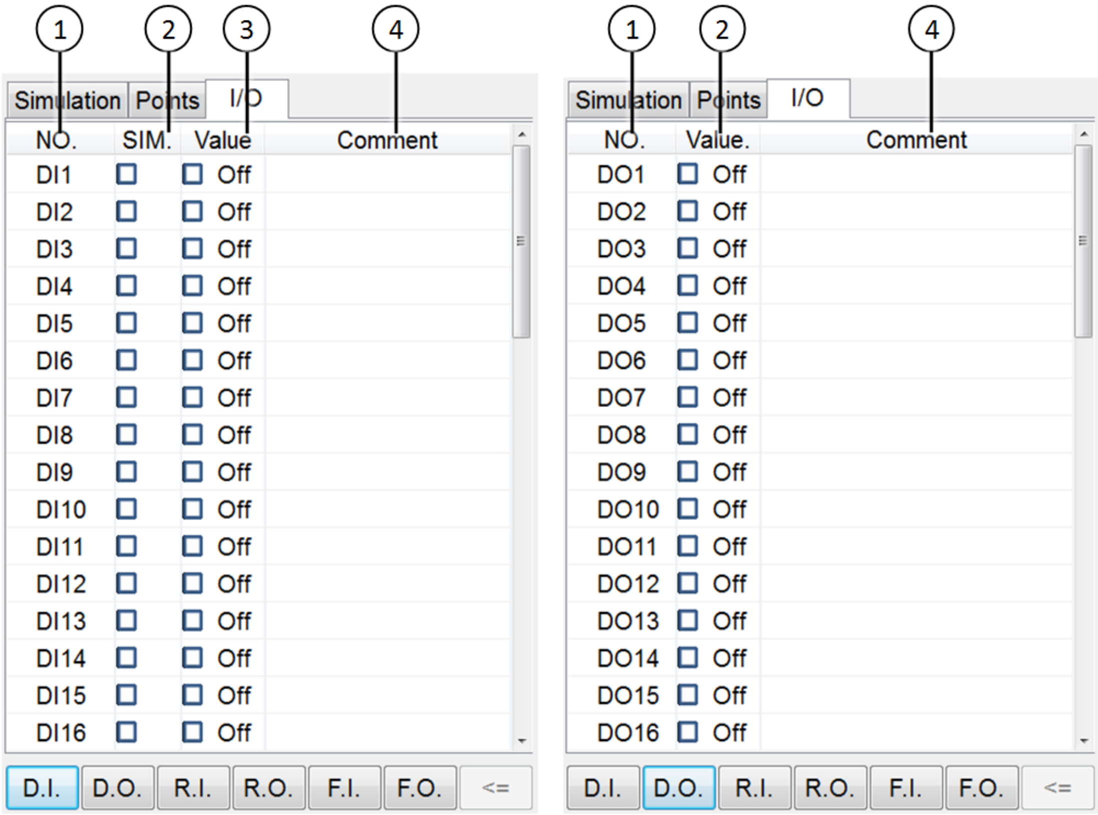
Window of actual position

2.12.2. Display Digital Input/Output

Operation steps

1. Click the operating page of [I/O].
2. Click [D.I.] or [D.O.].

Description



Digital input/output interface

No.	Description
1	Input/Output No.
2	Simulation, opened as red
3	The input/output simulated signal (can be used when the simulation is selected) ON is displayed in red and showed On. OFF is displayed in white and showed Off.
4	Input/output name (double-click to modify)

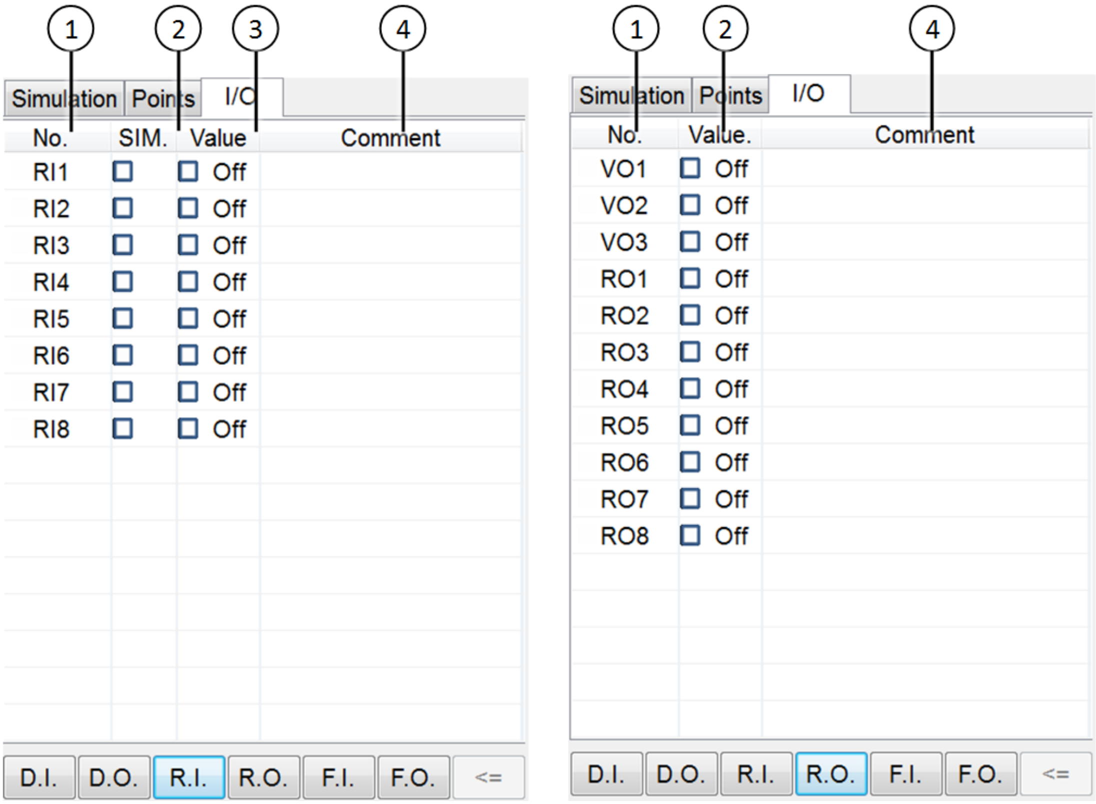
※When equipped with one I/O card (standard), 16 DIO can be used in HRSS, if there is two I/O card (optional), HRSS can use 48 DIO.

2.12.3. Display Remote Input/Output

Operation steps

1. Click the operating page of [I/O].
2. Click [R.I.] or [R.O.].

Description



Robot input/output interface

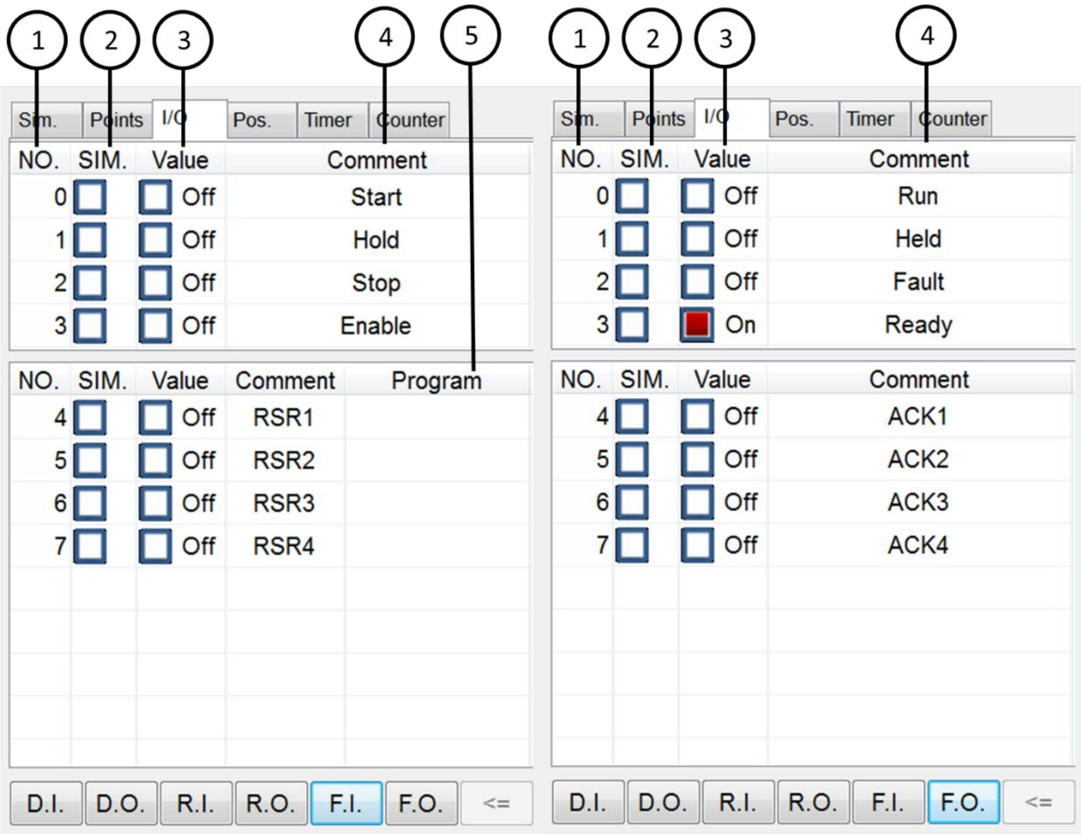
No.	Description
1	Input/Output No.
2	Simulation, opened as red.
3	The input/output simulated signal (can be used when the simulation is selected) ON is displayed in red and showed On. OFF is displayed in white and showed Off.
4	Input/output name (double-click to modify)

2.12.4. Display External Functional Input/Output

Operation steps

1. Click the operating page of [I/O].
2. Click [F.I.] or [F.O.].

Description



External Auto Run input/output interface

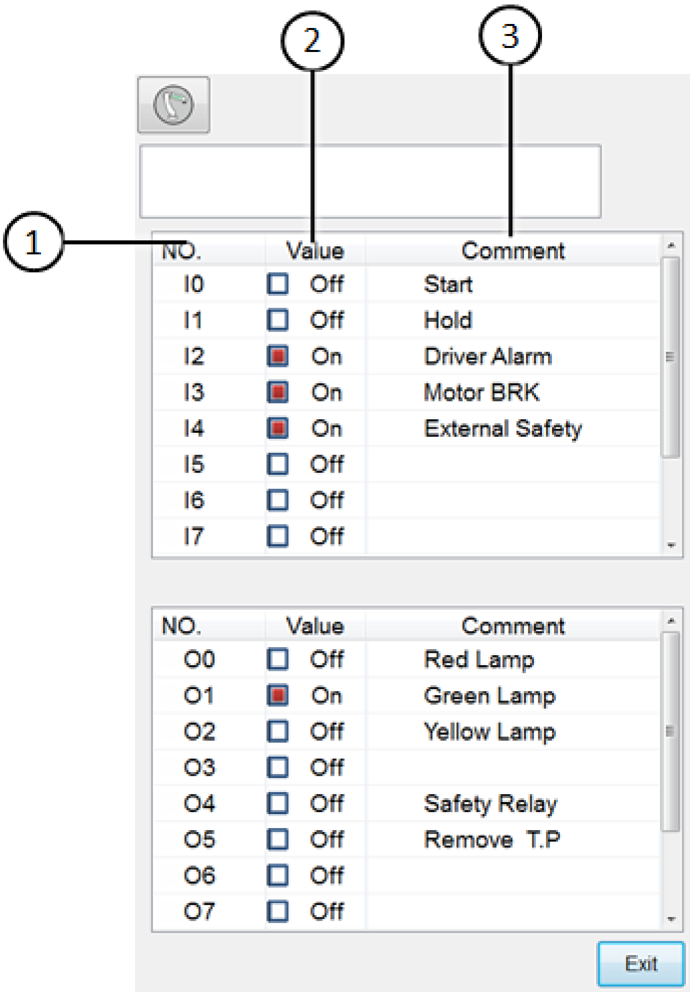
No.	Description
1	Input/Output No.
2	Simulation, opened as red
3	The input/output simulated signal (can be used when the simulation is selected) ON is displayed in red and showed On. OFF is displayed in white and showed Off.
4	Input/output name
5	Program name Click and hold two seconds to remove the program

2.12.5. Display System Status Input/Output

Operation steps

Main Menu>Display > System I/O

Description



System input/output interface

No.	Description
1	Input/Output No.
2	The opened input/output signal displays in red and shows On. OFF is displayed in white and showed Off.
3	Input/output name

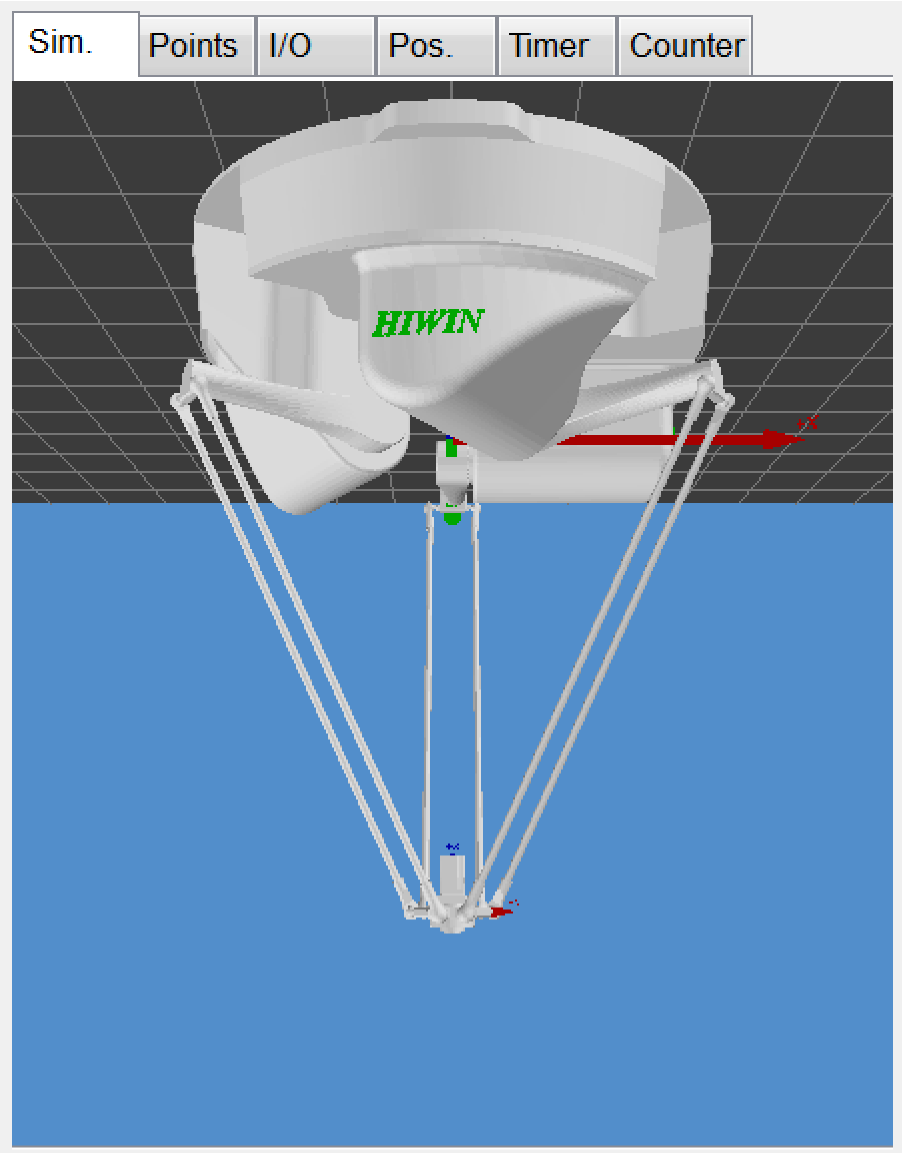
2.12.6. Display Robot Simulation Screen

Operation steps

Click the [Sim.] on the screen.

Description

Displays the posture when the robot runs or simulates the program.



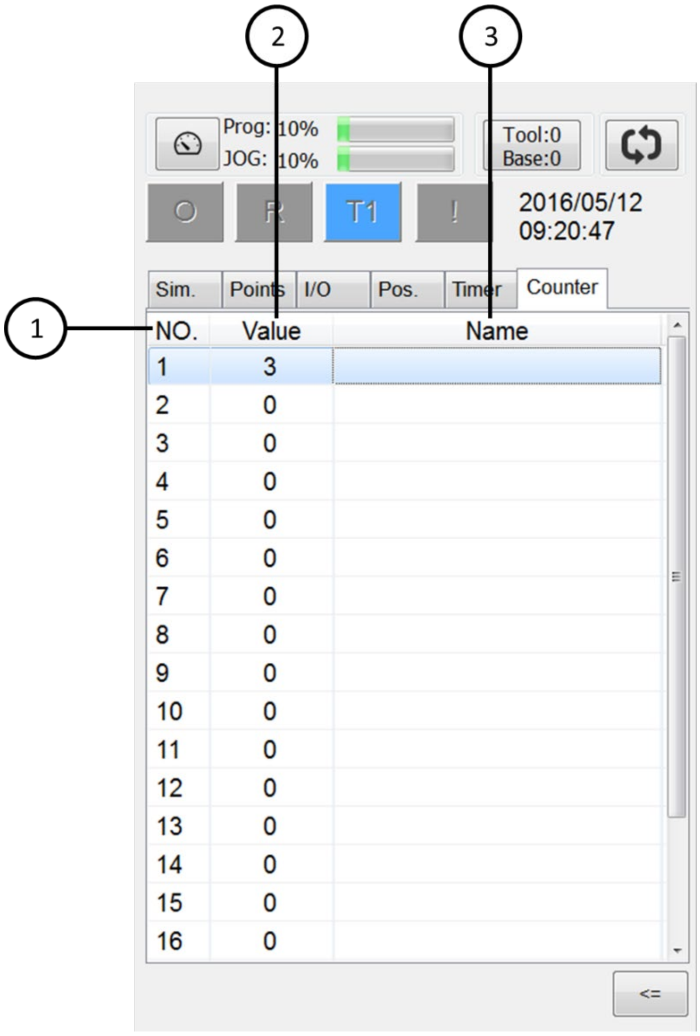
Robot simulation screen

2.12.7. Display Counter Variable

<u>Operation steps</u>

Click the operating page of [Counter].

<u>Description</u>



Counter interface

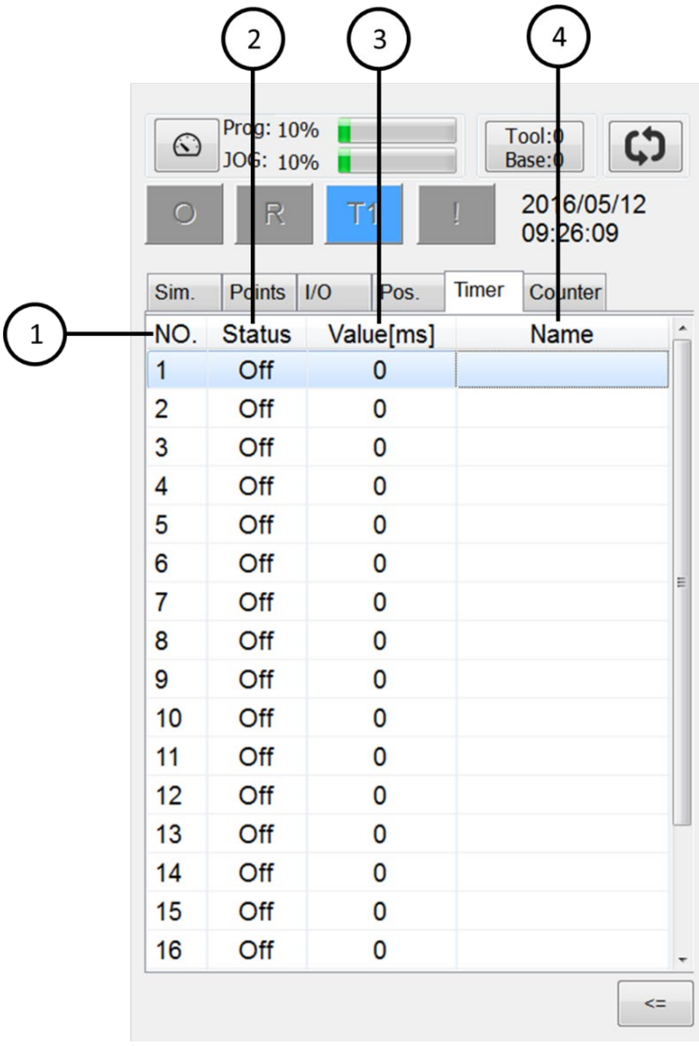
No.	Description
1	Counter No.
2	Counter value
3	Counter name (double-click to change the name)

2.12.8. Display Timer Variable

Operation steps

Click the operating page of [Timer].

Description



Timer interface

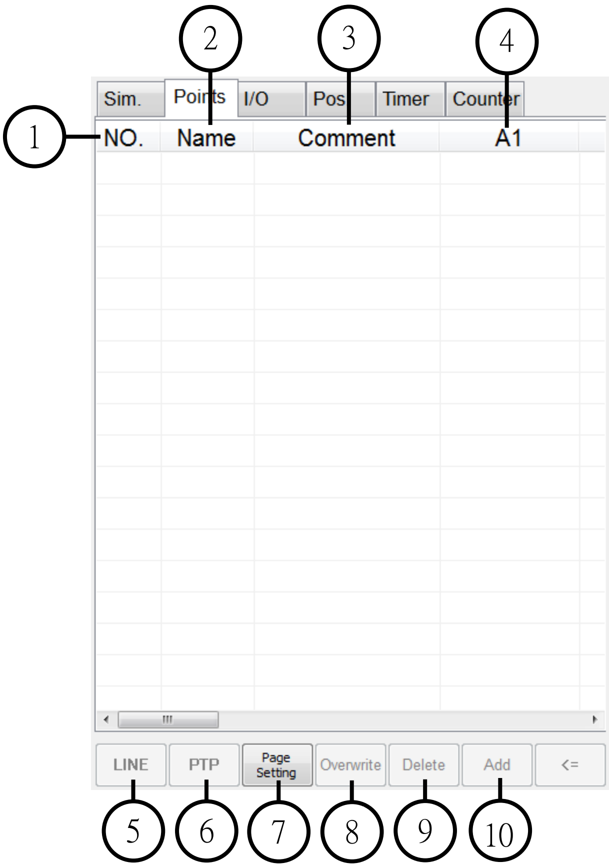
No.	Description
1	Timer No.
2	Timer status On Off
3	Timer value
4	Timer name (double-click to change the name)

2.12.9. Display Point List

Operating Steps

Click the operating page of [Points].

Description

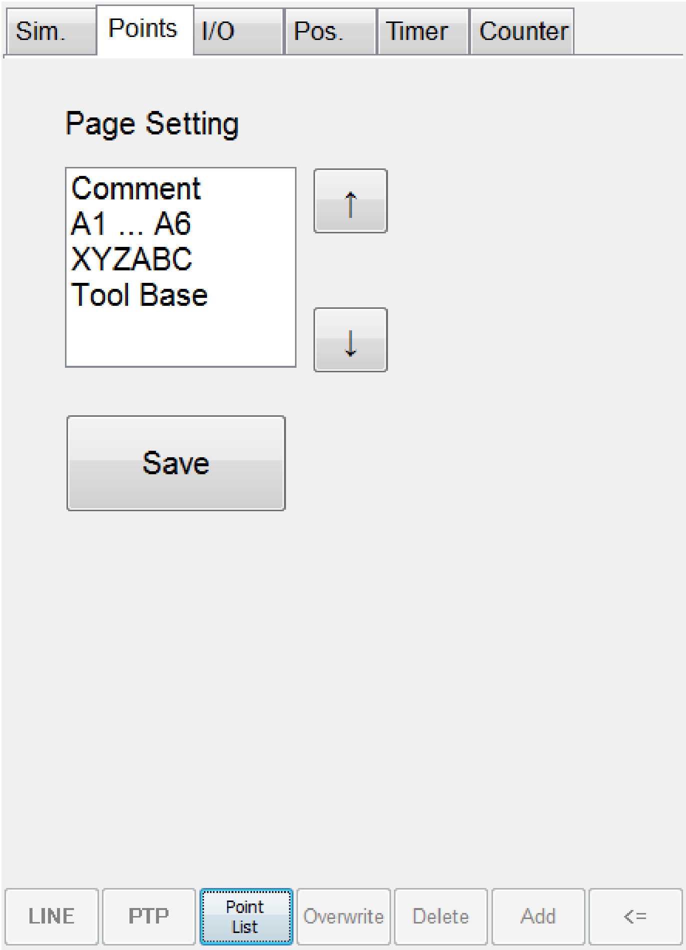


Points interface

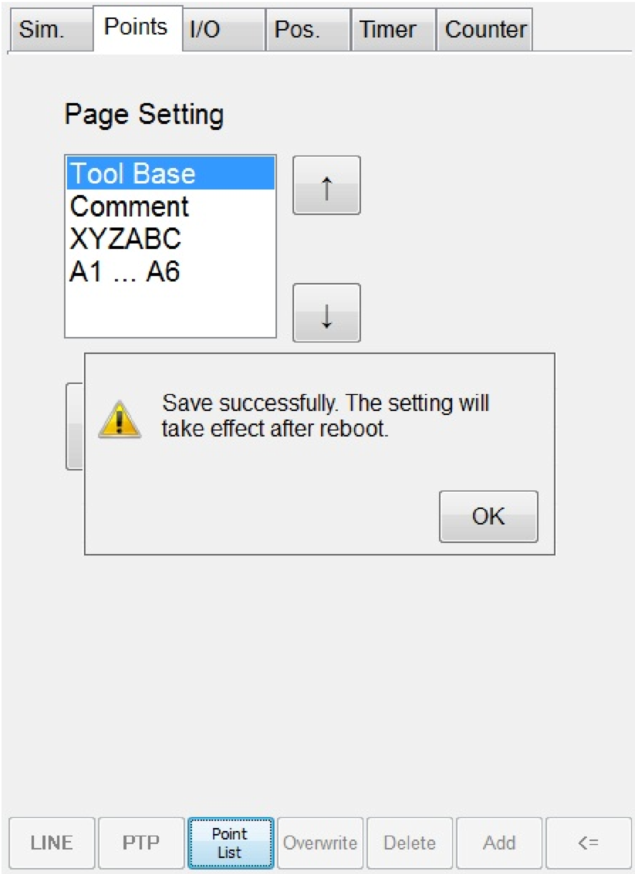
Item No.	Description
1	Numbering for points
2	Name for points
3	Functional comment for points (free to edit by oneself)
4	Information for points, includes angle of each axis (A1~A6), Cartesian coordinates (X, Y, Z, A, B, C), plus numbering of Tool and Base used.
5	Select a point and move to that point with LINE mode.
6	Select a point and move to that point with PTP mode.
7	Function to adjust the arrangement of data
8	Select a point and replicate the information for that point.
9	Select a point and delete that point.
10	Newly add a point with the current information.

Description of Adjusting Arrangement of Data

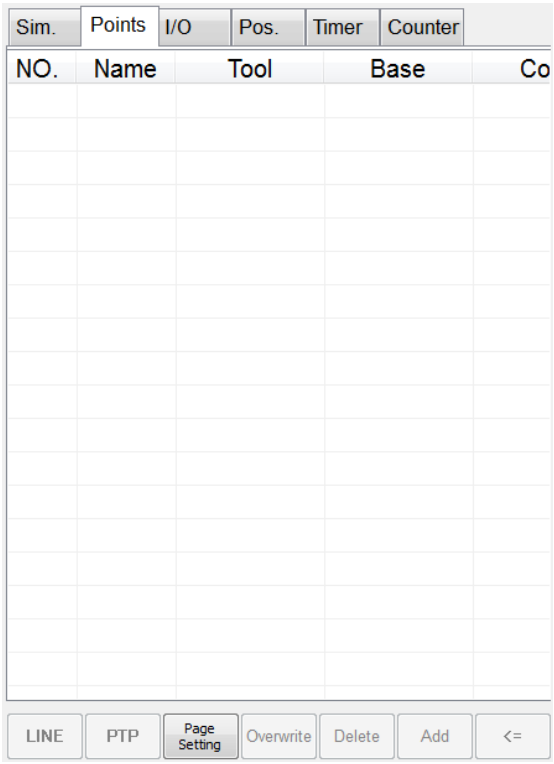
When [Page Setting] is clicked, figure below will appear, user can self-adjust the order of arrangement. Once the adjustment is completed, click [Save] button to store the setting. A notification will appear to remind user that the setting will take effect after reboot (figure below). After reboot, point list will appear with the format set by the user (figure below).



Adjusting arrangement of data interface



[Save] clicked, notification message appeared



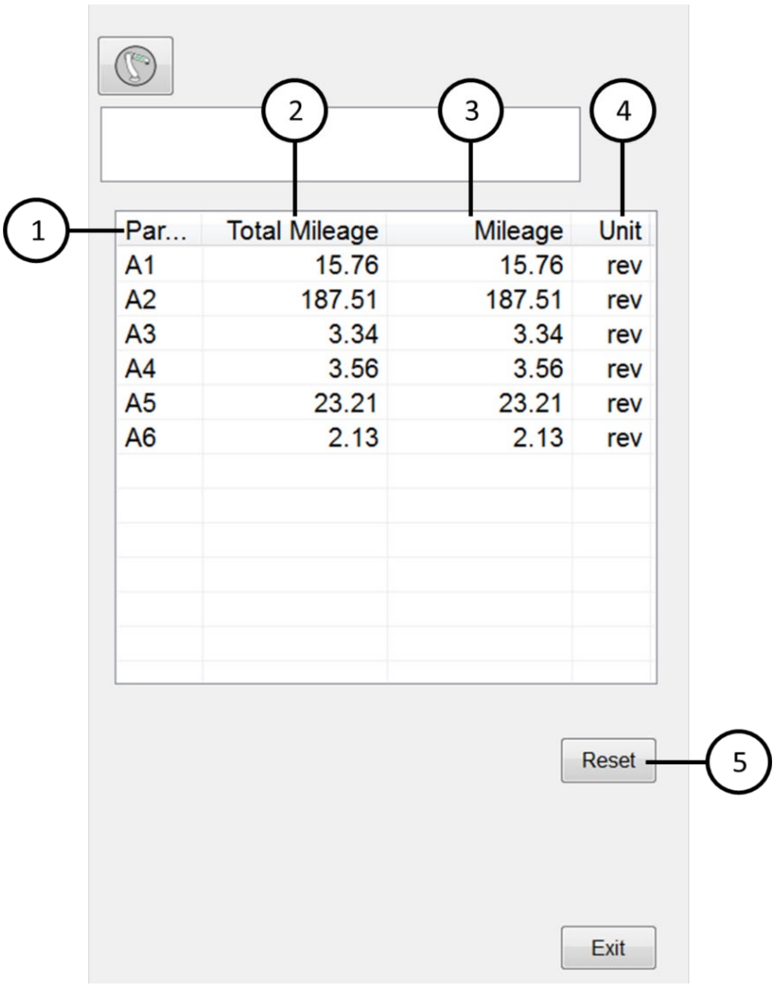
After reboot, appeared according to user's setting

2.12.10. Display Mileage

Operating Steps

Main Menu>Display > Mileage

Description



Mileage Interface

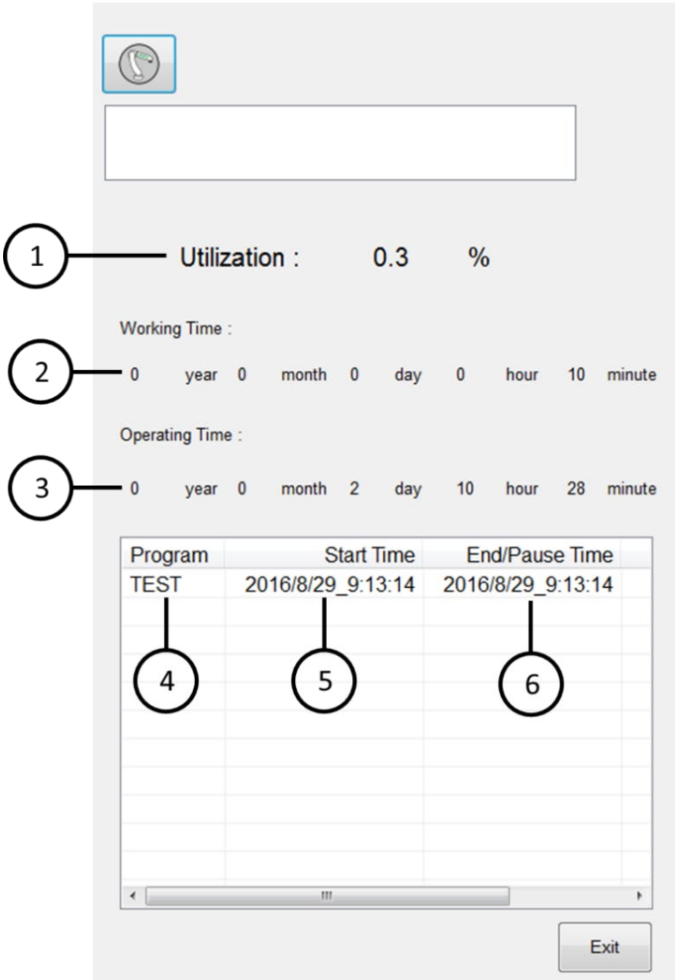
Item No.	Description
1	Numbering of motor axis
2	Total accumulated mileage
3	Current mileage (can be zeroed)
4	Unit of mileage (number of turns)
5	Zeroed reset「Current Mileage」

2.12.11. Display Utilization Rate

Operating Steps

Main Menu>Display > Utilization

Description



Utilization Interface

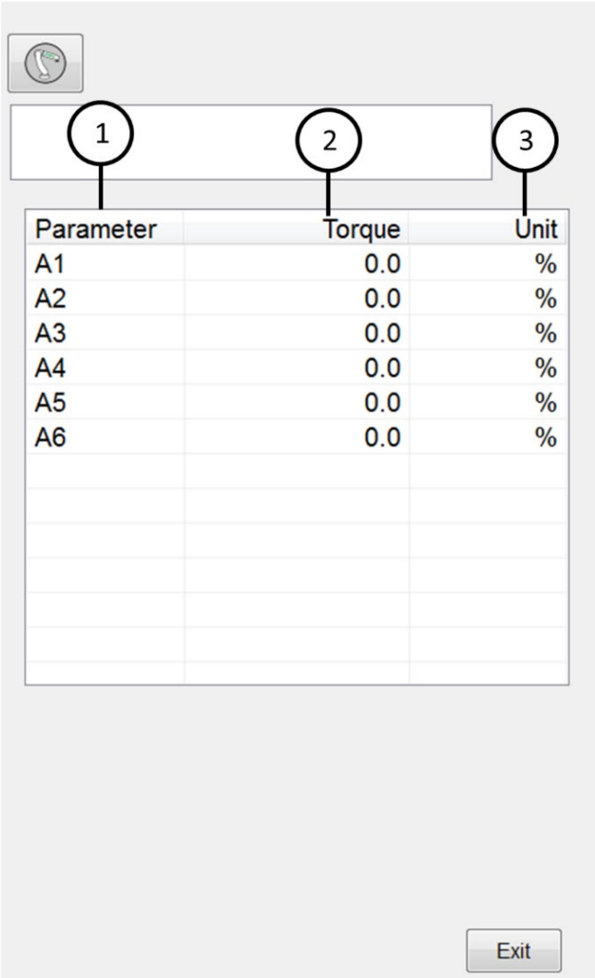
Item No.	Description
1	Utilization rate
2	Total time of executing program
3	Total time of turning on power
4	Name of executing program
5	Start time of executing program
6	End/pause time of executing program

2.12.12. Display Load Percentage

Operating Steps

Main Menu>Display > Motor Torque

Description



Motor Torque Interface

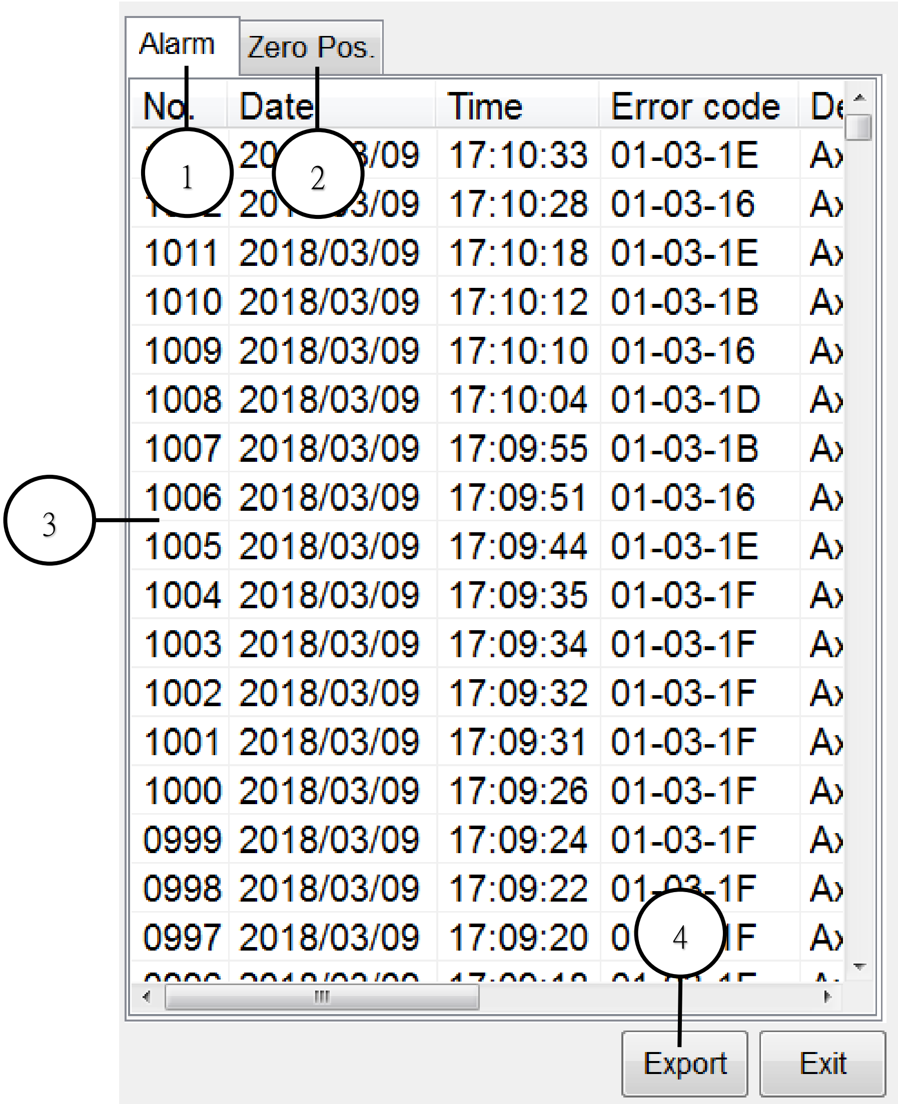
Item No.	Description
1	Numbering of motor axis
2	Load percentage of motor
3	Unit (percentage)

2.12.13. Display Alarm and Zero Position History Message

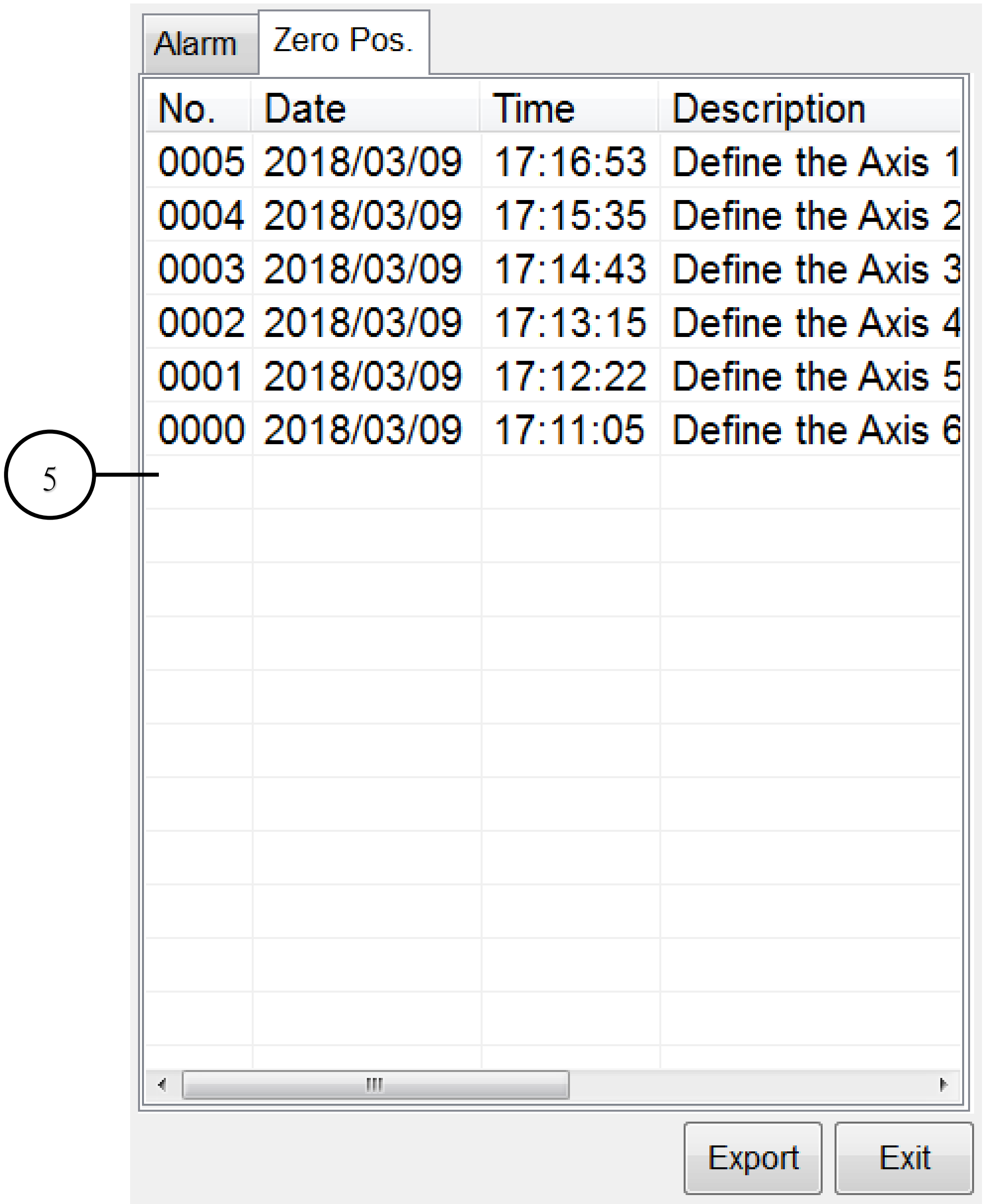
<u>Operating Steps</u>

Main Menu>Diagnosis > Logbook

<u>Description</u>



Alarm Message Interface



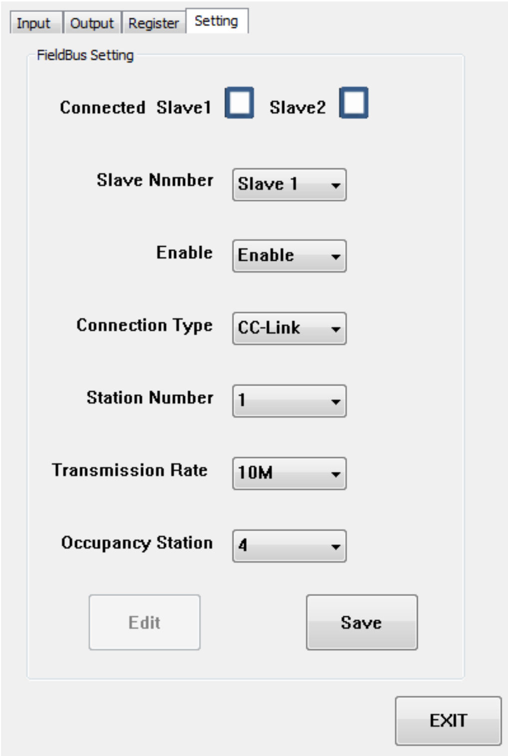
Zero Position Message Interface

Item No.	Description
1	Alarm history message page
2	Zero position history message page
3	Alarm history message
4	Export historical information file
5	Zero position history message

2.13. Field Bus Setting (Optional)

2.13.1. Set CC-Link Connection Parameters

A. Open HRSS，Click Main Menu → Display → FieldBus → Setting (Opened parameters setting interface)



CC-Link connection parameters setting

B. Click「Edit」you can the content of each setting option

C. Slave Number，device name「cifX0」please choose Slave1，device name「cifX1」please choose Slave2.

D. Enable，select「Enable」means next time reboot will immediately open connection, select「Disable」will be opposite. Unused position please select「Disable」.

E. Connection Type，can choose the type of connection，please choose「CC-Link」.

F. Station Number，this device can be selected as the station number of the entire CC-Link network，select between 1~64。

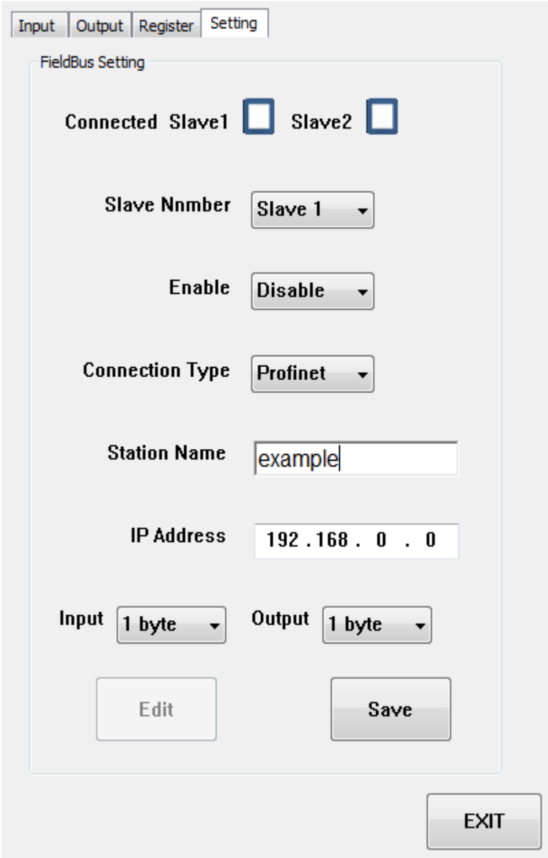
G. Transmission Rate，choose the transfer rate of connection for this device.

H. Occupancy Station，number of stations (1~4) can be choose from this device.

I. Once setting is complete, click「Save」to store the setting，next reboot would use current setting for connection.

2.13.2. Set Profinet Connection Parameters

A. Open HRSS，Click Main Menu → Display → FieldBus → Setting (Open parameters setting interface)



Profinet connection parameters setting

B. Click「Edit」you can the content of each setting option

C. Slave Number，device name「cifX0」please choose Slave1，device name「cifX1」please choose Slave2.

D. Enable，select「Enable」means next time reboot will immediately open connection, select「Disable」will be opposite. Unused position please select「Disable」.

E. Connection Type，can choose the type of connection，please choose「Profinet」.

F. Station Name，set same name as Master drive。

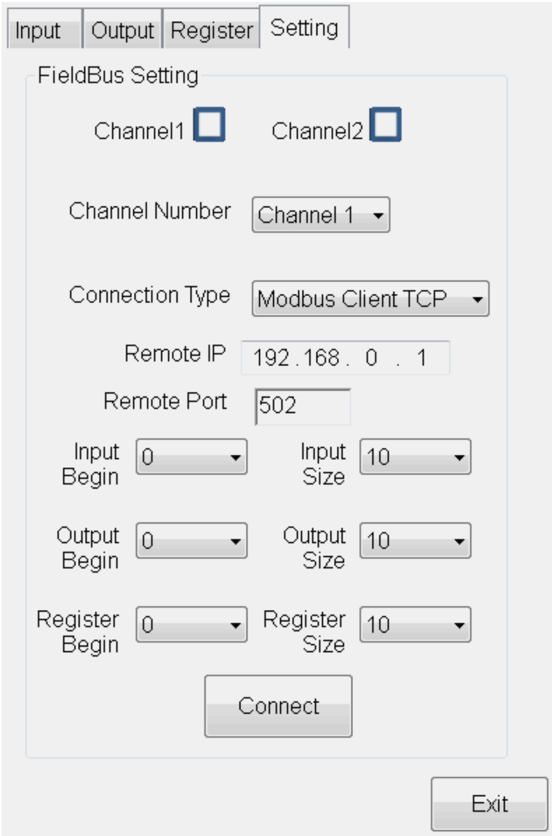
G. IP Address，set corresponding to Master drive

H. Input、Output，setting of IO quantity should correspond to the setting of Master drive. IO supports up to 16 Byte each.

I. Once setting is complete, click「Save」to store the setting，next reboot would use current setting for connection.

2.13.3. Set ModbusTCP Client Connection Parameters

A. Open HRSS, Click Main Menu → Display → FieldBus → Setting (Open parameters setting interface)



ModbusTCP Client connection parameters setting

B. Channel Number, choose Channel1 or Channel2 for current communication device.

C. Connection Type, can choose the type of connection, please choose「Modbus Client TCP」.

D. Remote IP, set corresponding to Server.

E. Remote Port, set corresponding to Server.

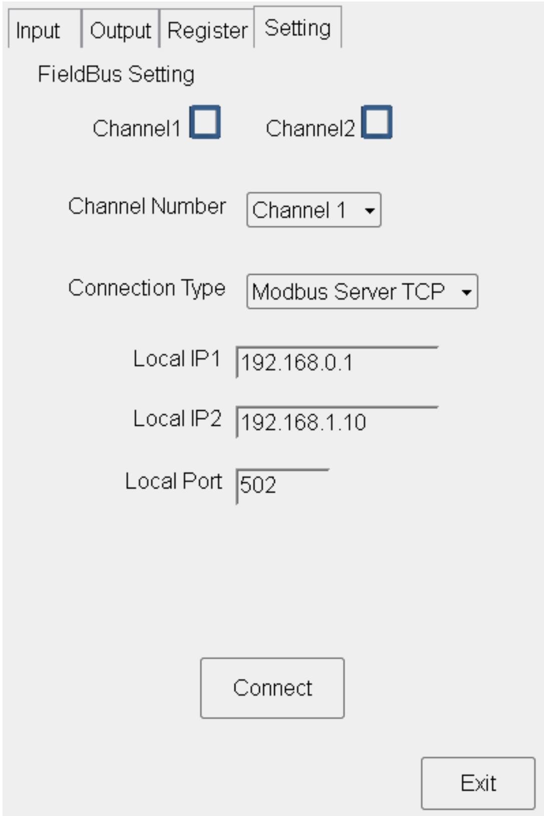
F. Input Begin、Output Begin、Register Begin, Set the remote device Input (address: 0 ~ 255), Output (address: 0 ~ 255) and Register (address: 0 ~ 999) start address.

G. Input Size, Output Size and Register Size, set the number of IO read by the remote device.

H. Once setting is complete, click「Connect」to connecting, next reboot would use current setting for connection.

2.13.4. Set ModbusTCP Server Connection Parameters

A. Open HRSS, Click Main Menu → Display → FieldBus → Setting (Open parameters setting interface)



ModbusTCP Server connection parameters setting

B. Channel Number, choose Channel1 or Channel2 for current communication device.

C. Connection Type, can choose the type of connection, please choose「Modbus Server TCP」.

D. Local IP1, Local IP2, external devices connected to the local IP.

E. Local Port, set the external device to connect to the local port.

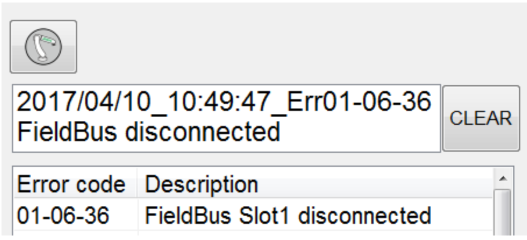
F. Once setting is complete, click「Connect」to connecting, next reboot would use current setting for connection.

2.13.5. Confirmation of Connection Status

A. Start-up connection success or fail: in the Setting page, signal will be shown，if connection is successful，the box will appear red，if connection is failed or setting is not switched on, the box will appear white.

Situation where Slave1 、Slave2 appear red

B. If the setting is switched on and disconnection occur due to wrong parameters setting, connection abnormal or etc. A warning signal will appear.



FieldBus disconnection error

2.13.6. Use FieldBus Input (SI[n])

A. According to the Slave Number used and Occupancy, the number of Input Number that can be controlled can be different.

a. When using Slave1, SI[1]~SI[128] can be used.

i. When Occupancy is 1, SI[1]~SI[32] can be used.

ii. When Occupancy is 2, SI[1]~SI[64] and so on.

b. When using Slave2, SI[129]~SI[256].

i. When Occupancy is 1, SI[129]~SI[160].

ii. When Occupancy is 2, SI[129]~SI[192] and so on.

B. SI[1]~SI[8] are reserved and have similar function as FI[1]~FI[8].

C. Interface can be used directly for selection

a. Main menu→ Display → FieldBus → Input

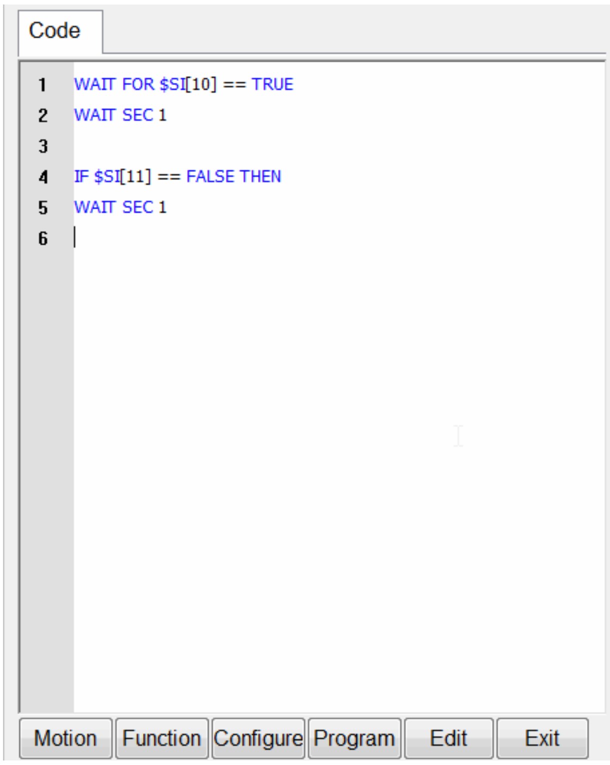
b. When logging into EXPERT user group, click SIM. (Simulation function) and test the SI function.

c. Comment for SI[1]~SI[8] is unmodifiable, the rest will be stored.

D. Can be controlled by command.

a. The command $SI[n] can be used to read Input status

b. Other instruction can be used such as IF 、WAIT FOR



Code modify SI[n]

2.13.7. Use FieldBus Output (SO[n])

A. According to the Slave Number used and Occupancy, the number of Output Number that can be controlled can be different.

a. When using Slave1, SO[1]~SO[128] can be used.

i. When Occupancy is 1, SO[1]~SO[32] can be used.

ii. When Occupancy is 2, SO[1]~SO[64] and so on.

b. When using Slave2, SO[129]~SO[256].

i. When Occupancy is 1, SO[129]~SO[160].

ii. When Occupancy is 2, SO[129]~SO[192] and so on.

B. SO[1]~SO[8] are reserved and have similar function as FO[1]~FO[8].

C. Interface can be used directly for selection

a. Main menu→ Display → FieldBus → Output

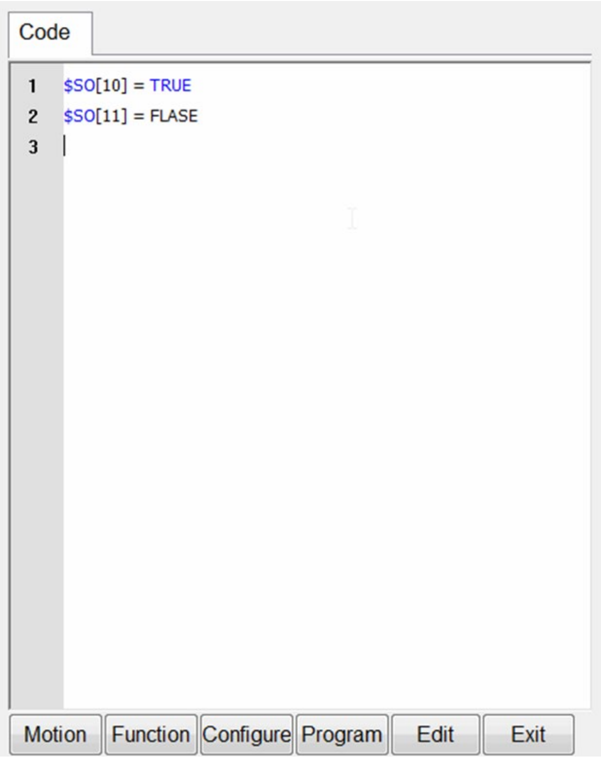
b. When logging into EXPERT user group, click Value directly to change the Output status and test SO function.

c. SO[1]~SO[8] not allow to set Value status directly。

d. Comment for SO[1]~SO[8] is unmodifiable, the rest will be stored.

D. Can be controlled by comment

a. Command $SO[n] can be used to set Output status.



Code modify SO[n]

2.13.8. Use FieldBus Register (SRR 、SRW)

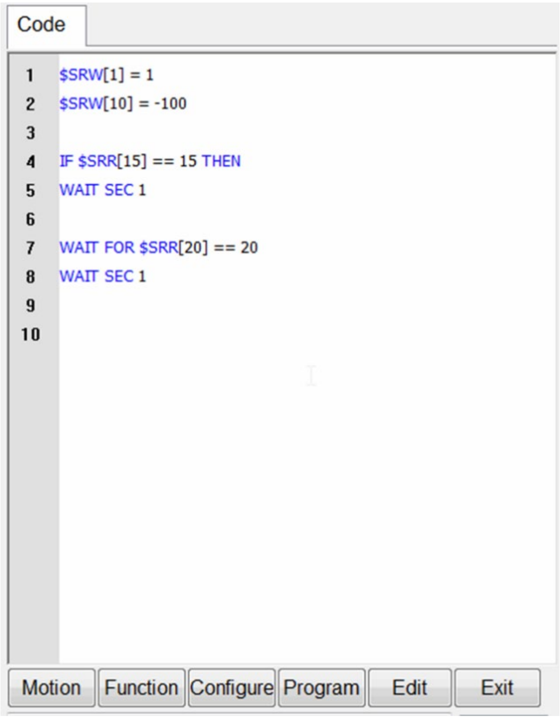
A. SRR (Register for Read) and SRW (Register for Write)。

B. When using Slave1, SRR[1]~SRR[16]、 SRW[1]~SRW[16]
   a. When Occupancy is 1, SRR[1]~SRR[4]、SRW[1]~SRW[4]
   b. When Occupancy is 2, SRR[1]~SRR[8]、SRW[1]~SRW[8] so on.

C. When using Slave2, SRR[17]~SRR[32] 、 SRW[17]~SRW[32]
   a. When Occupancy is 1, SRR[17]~SRR[20]、SRW[17]~SRW[20]
   b. When Occupancy is 2, SRR[17]~SRR[24]、SRW[17]~SRW[24] so on.

D. Values can be written or read directly through interface.
   a. Main menu → Display → FieldBus → Register。
   b. SRR column can be read but not modify.
   c. SRW column can modify when clicked.
   d. Range of value input 32767~-32767.
   e. Comment after modified will be saved.

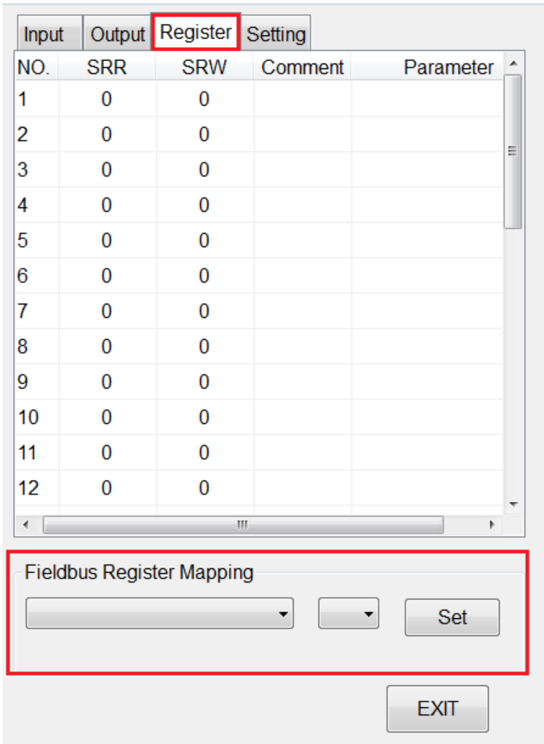
E. Can be controlled by command
   a. Command $SRW[n] used to set SRW status.
   b. Command $SRR[n] used to set SRR status.



Code modify SRW[n]、SRR[n]

2.13.9. Use FieldBus Register Mapping

A. Open HRSS，click Main Menu → Display → Fieldbus → Register (open Fieldbus Register Mapping setting interface)



Fieldbus Register Mapping setting interface

B. Select system parameters that user required

Parameters name

A1_ACTUAL: Actual angle of 1st axis

A2_ACTUAL: Actual angle of 2nd axis

A3_ACTUAL: Actual angle of 3rd axis

A4_ACTUAL: Actual angle of 4th axis

A5_ACTUAL: Actual angle of 5th axis

A6_ACTUAL: Actual angle of 6th axis

X_ACTUAL: Actual X coordinate of TCP

Y_ACTUAL: Actual Y coordinate of TCP

Z_ACTUAL: Actual Z coordinate of TCP

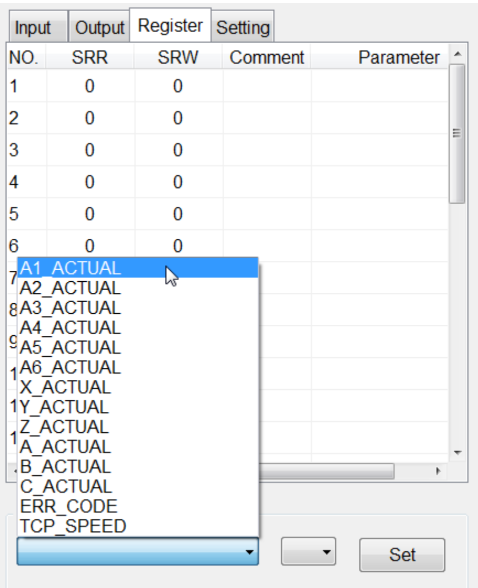
A_ACTUAL: Actual A coordinate of TCP

B_ACTUAL: Actual B coordinate of TCP

C_ACTUAL: Actual C coordinate of TCP

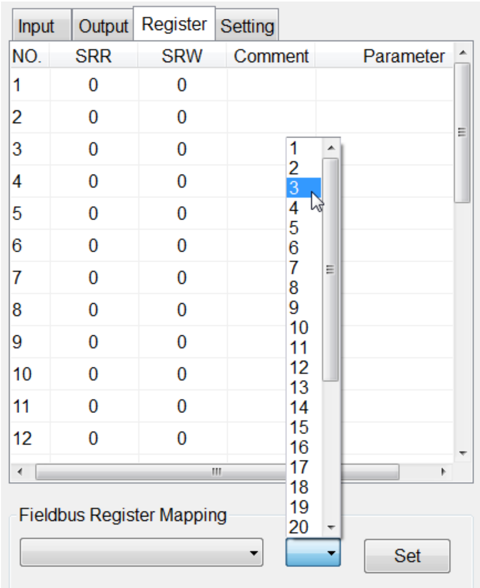
ERR_CODE: Error code

TCP_SPEED: Actual speed of TCP



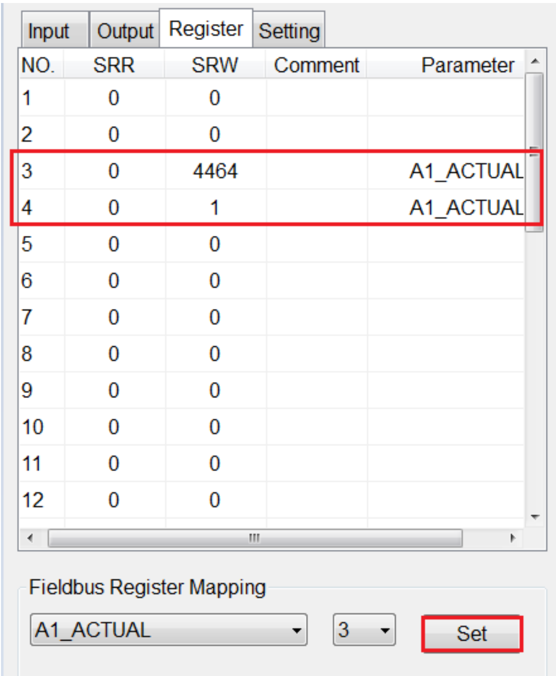
Selection of System Parameters interface

C. Select the Register Number that user wanted to store the parameter into



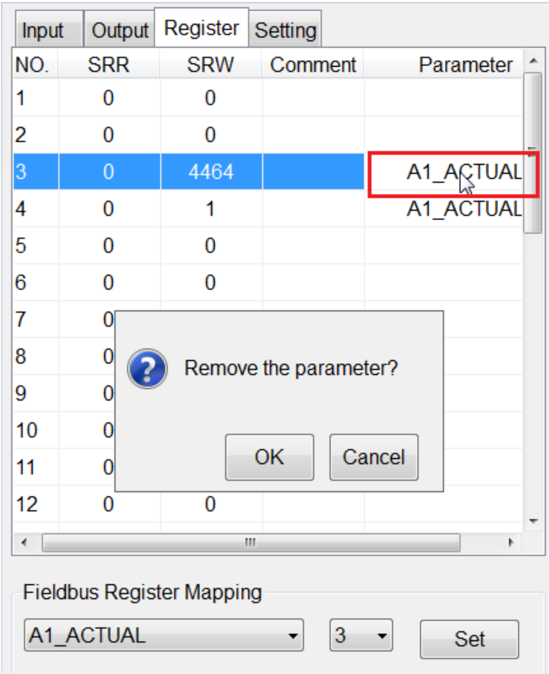
Register Number storage for parameter interface

D. Click set to save the setting.



Set button to store setting interface

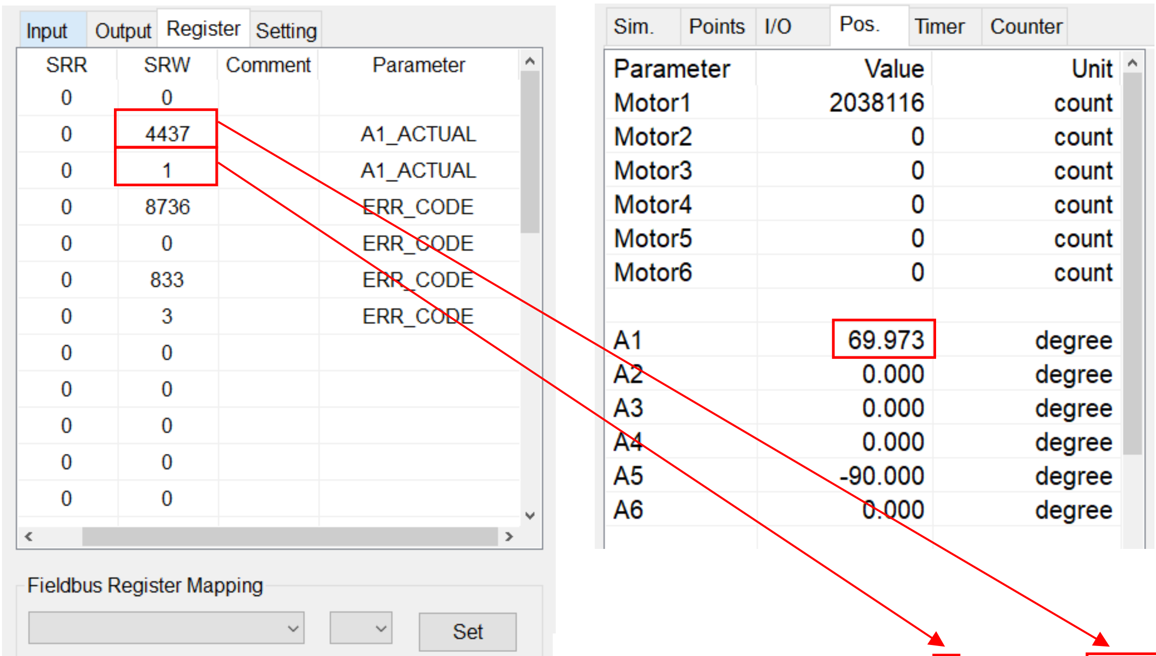
E. Click parameter column to remove the stored parameter from Register.



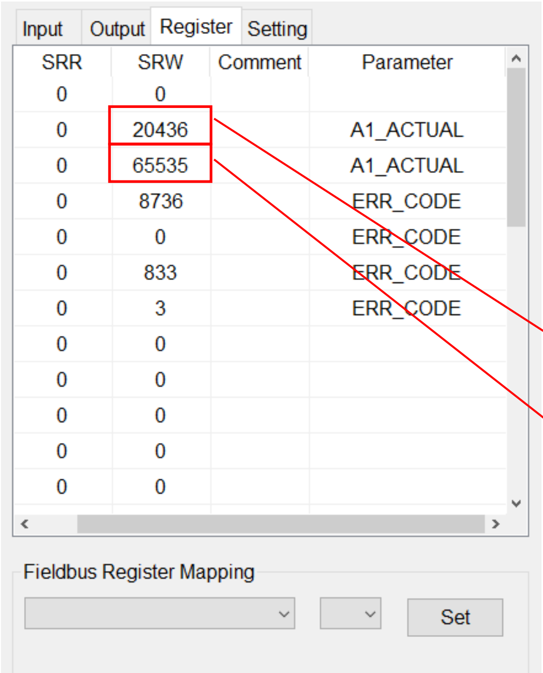
Remove parameter from Register

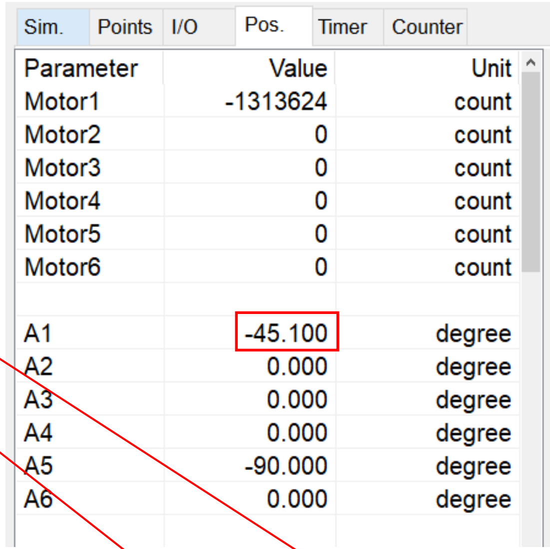
F. How to transfer parameter:

A1_ACTUAL:



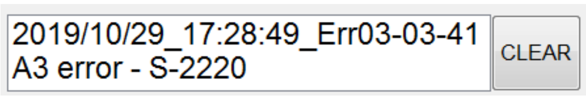
A1(69.679)*1000 = 69679 = $\boxed{1}$ x65536 + $\boxed{4437}$





(65536 × 65536 - A1 × 1000) = $\boxed{65535}$ × 65536 + $\boxed{20436}$

ERR_CODE:

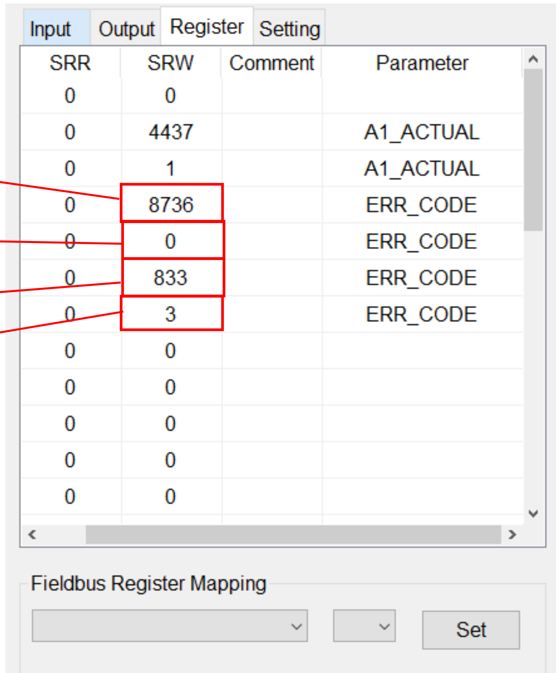


Driver Error Code 2220(hex) = 8736(dec)

Default 0

Error Code 0341(hex) = 833(dec)

Device = 03(hex) = 3(dec)

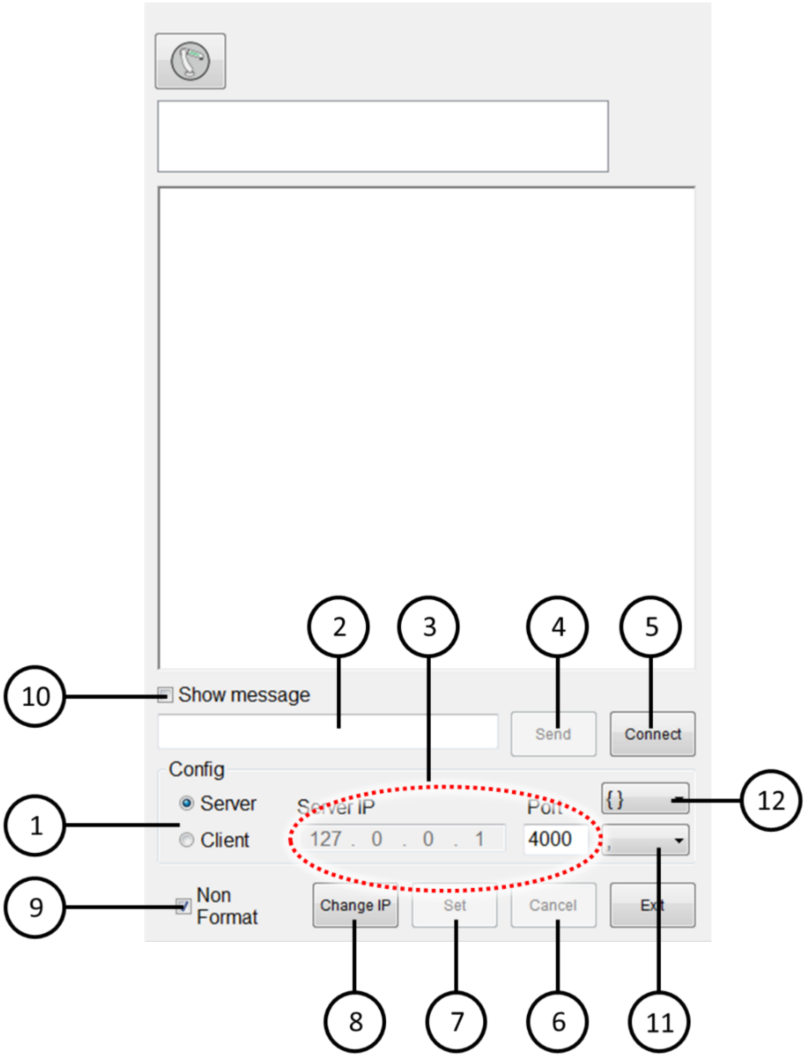


2.14. Communication

2.14.1. TCP/IP Communication

Description

Send and transfer the data by network communication.
You can select RC as Client or Server to connect.
The parameter type is the floating decimal.
The communication format has two parentheses (The type of parenthesis can be selected.), including the value form such "{xxx}" For example, if "{123,456}" is sent, two sets of value "123" and "456" will be received, which there are up to 50 sets of parameter.



TCP/IP interface

No.	Description
1	Server/Client configuration
2	Message sending field
3	IP and Port configuration
4	Send message
5	Connect/Disconnect button
6	Cancel
7	Set
8	Change IP
9	Cancel format
10	Display Content of Sending Message and Receiving Message
11	Division symbol
12	Parenthesis type

Operation steps

Main Menu>Start-up >Network Config

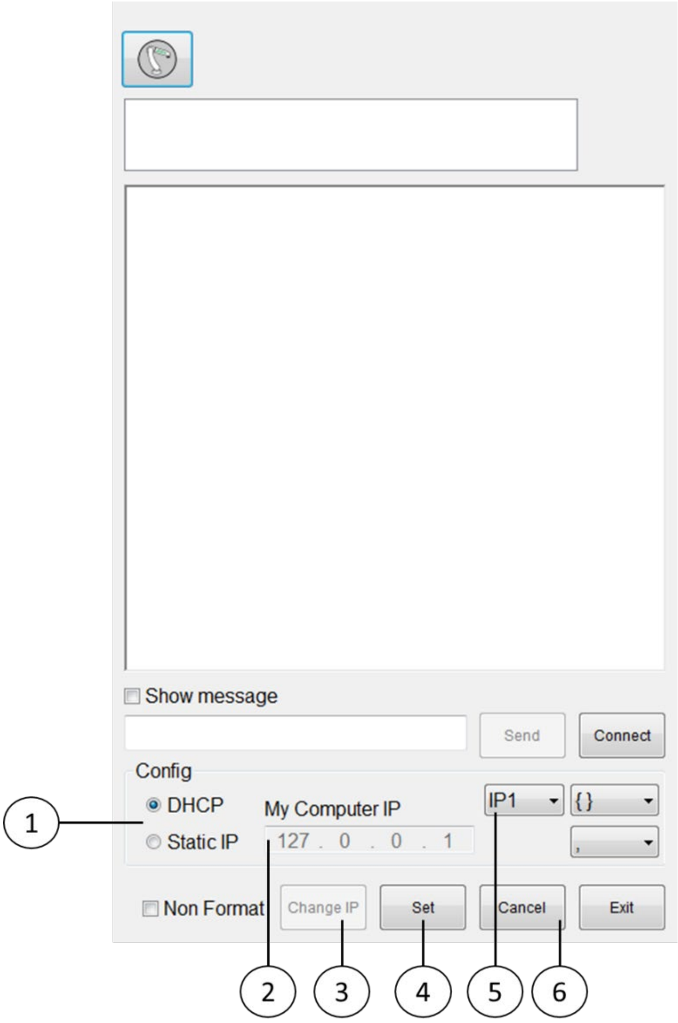
3. Client
1. Enter the Server's IP and Port
2. Press [Connect].
3. Display "Connection is successful!" to represent the connection success.

4. Server
1. Enter the port you want to connect.
2. Press [Connect].
3. Display "Server is opened!" to represent opened.

2.14.2. Setting connection for IP address

Description

Set IP address for robot controller.
Robot controller consist of two internet port, they are：Port 1 and Port 2.
User can choose to change IP address for either Port 1 or Port 2, using DHCP mode (automatic obtain IP address) or Static mode (specify specific IP address).



Change IP interface

No.	Description
1	DHCP / Static IP mode selection
2	Static IP, specific IP address
3	Enter Change IP interface
4	Confirm setting
5	Select to change Port 1/ Port2 IP address
6	Cancel setting

Operation Steps

Main menu >Start-up >Network Config>Change IP

1. DHCP
2. Click [DHCP] option.
3. Press [Set] button.
4. Wait for the bar to finish loading, setting is completed.

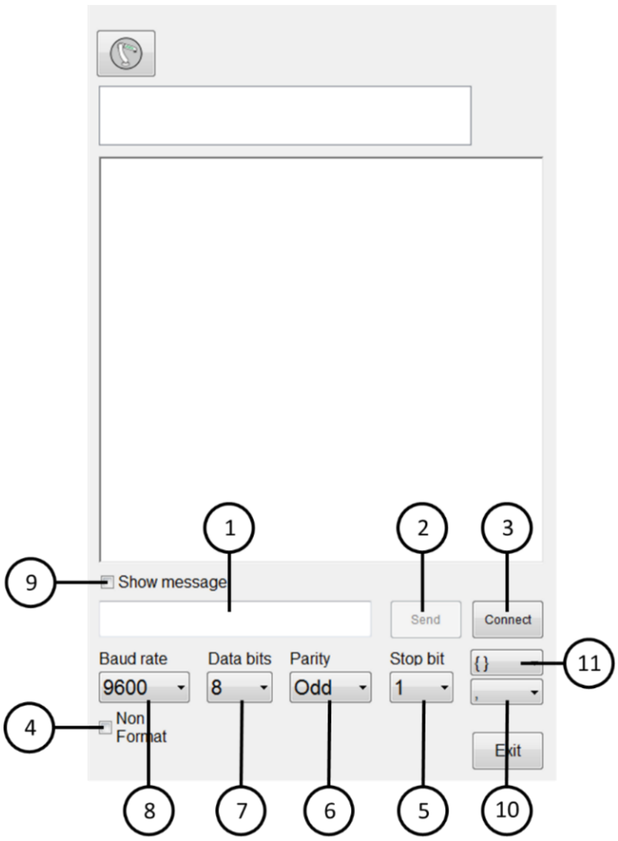
5. Static IP
6. Click [Static IP] option.
7. In [My Computer IP] column enter required IP address.
8. Press [Set] botton.
9. Wait for the bar to finish loading, setting is completed.

If setting failed message appeared, please check the internet connection to see if it is connected properly or there is a problem in IP setting.

2.14.3. RS232 Communication

Description

Send and transfer the data by serial communication.
The parameter type is the floating decimal.
The communication format has two parentheses (The type of parenthesis can be selected.), including the value form such "{xxx}" For example, if "{123,456}" is sent, two sets of value "123" and "456" will be received, which there are up to 50 sets of parameter.



RS232 interface

No.	Description
1	Message sending field
2	Send message
3	Connect/Disconnect button
4	Cancel format
5	RS232 Stop bit
6	RS232 Parity
7	RS232 Data bit
8	RS232 Baud rate
9	Display Content of Transmitting Message & Receiving Message
10	Division symbol
11	Parenthesis type

<u>Operation steps</u>

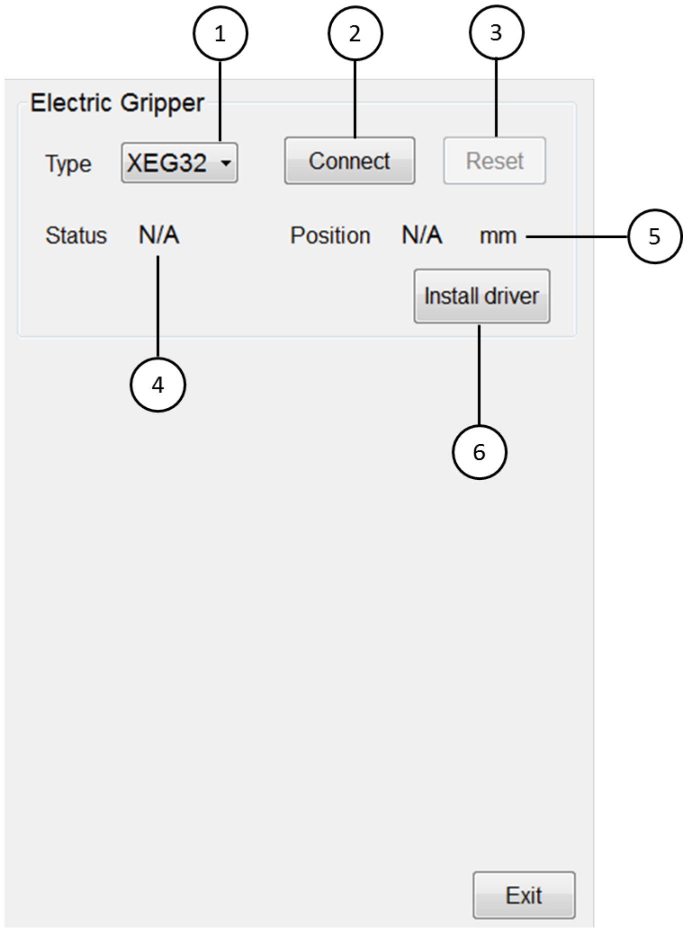
Main Menu>Start-up>RS-232

1. Enter RS232 parameters.
2. Press [Connect].
3. Display “Connection is successful!” to represent the connection success.

2.15. Electric Gripper Setting

Description

User can use HRSS to set the series of electric gripper XEG and IEG's connection and reset it to allow user to manually move the gripper and use HRL relevant command to control under T1 mode.



Electric Gripper operation interface

No.	Description
1	Set the model of Gripper
2	Connect/Disconnect with the Gripper
3	Rest Gripper
4	Display current Gripper status
5	Display current Gripper position
6	Install Gripper driver

<u>Operation Steps</u>

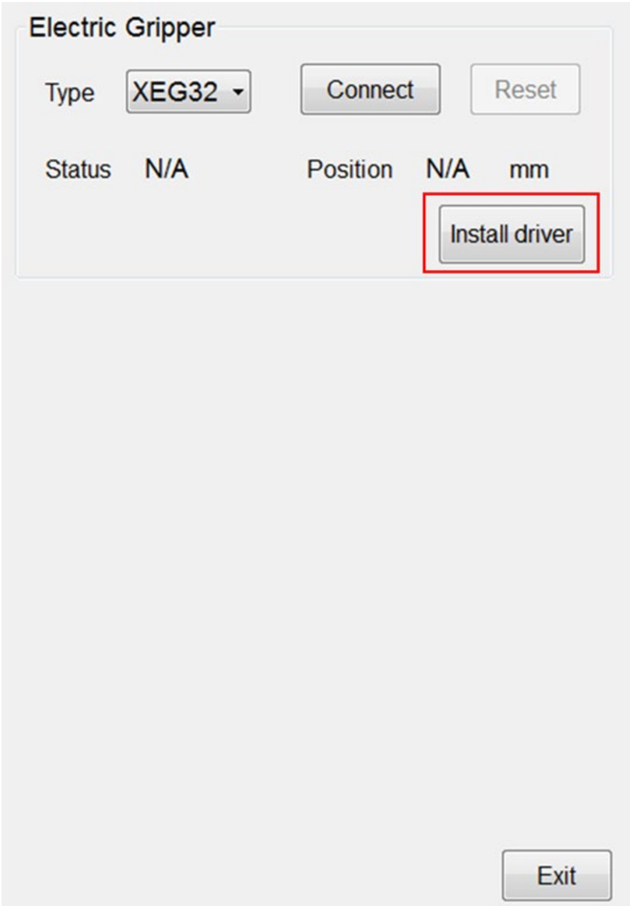
Main menu>Start-up>Electric Gripper

1. If driver not installed, driver needed to be installed first, installation steps are as follows:

A. HRSS software version has to be updated to 3.2.5 and above.

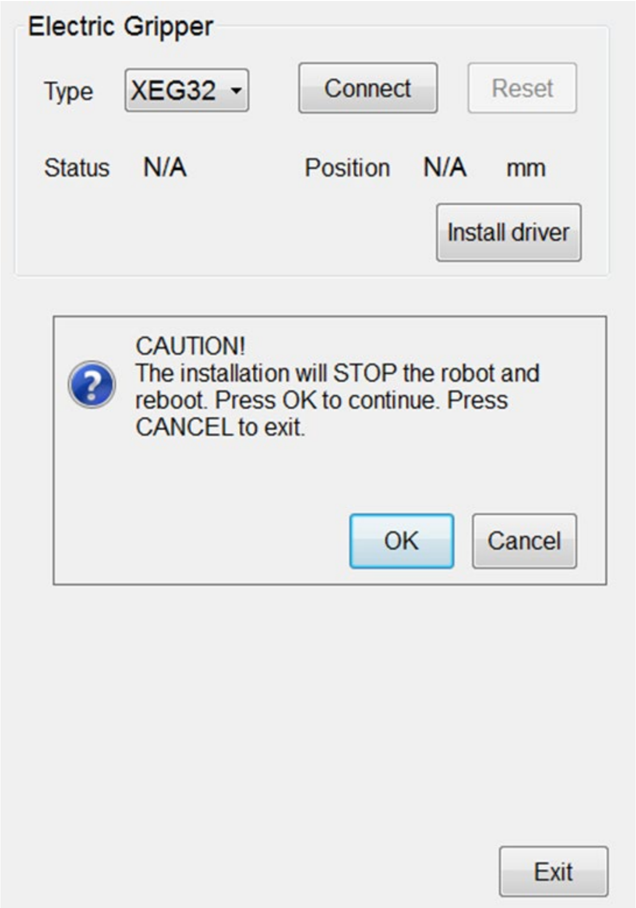
B. Download the Electric Gripper Driver.exe from official website and save the file in USB under HIWIN folder. Then insert the USB into controller.

C. In the main screen of HRSS, select Start-up->Electric Gripper, once Electric Gripper interface is opened, click the install driver button.



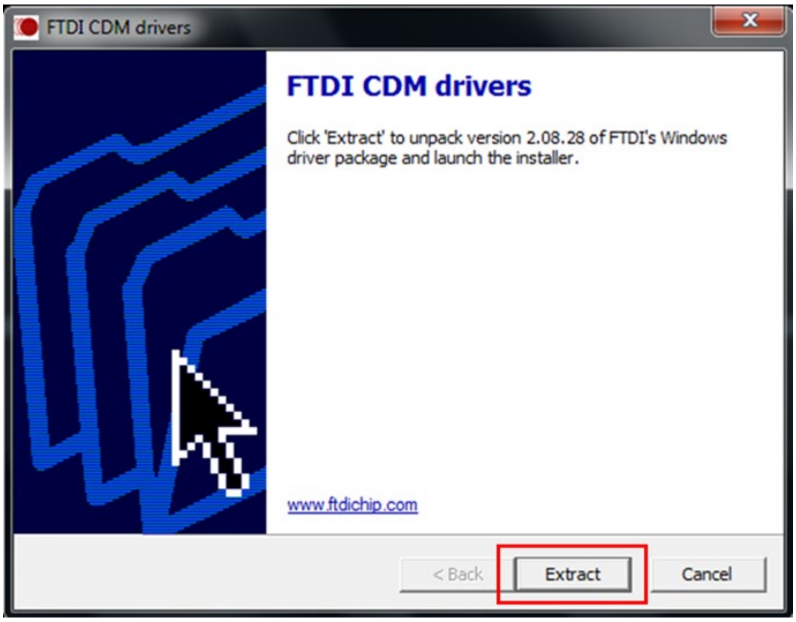
Electric Gripper operation interface

D. If HRSS detected the driver installation file from the USB, a warning signal will appear to inform user that installation will stop the robot and reboot. Press OK to start driver installation; Press CANCEL to exit.



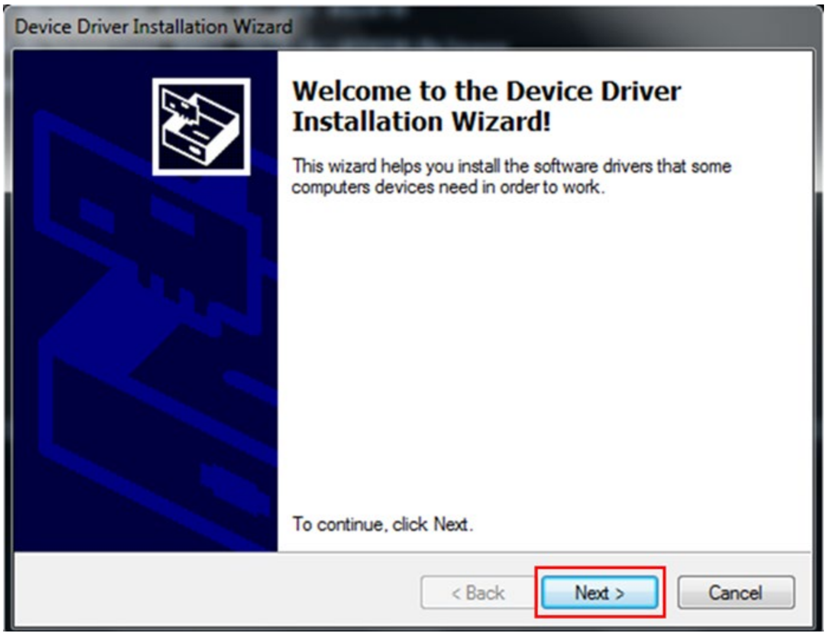
Install Electric Gripper warning

E. Press OK to end HRSS and start rebooting. Once reboot completed, the driver installation will appear, click Extract.



Electric Gripper driver installation step 1

F. Click Next to continue



Electric Gripper driver installation step 2

G. Click Finish, the system will operate according to different anti-write system. If FBWF anti-write system is set, the system will start rebooting and open HRSS. If EWF anti-system is set, the system will open HRSS once the driver installation is completed.

Electric Gripper driver installation step 3

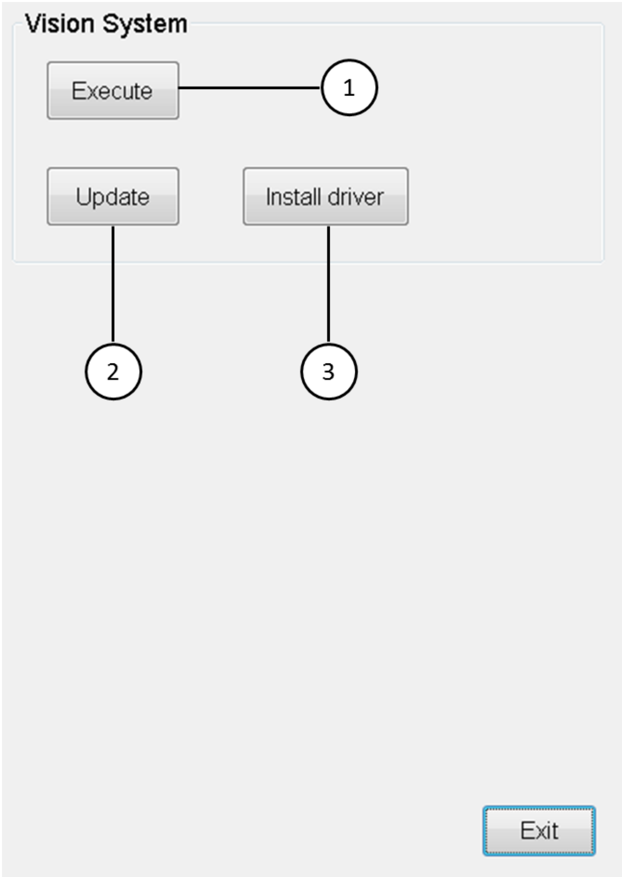
Installation completed, enter HRSS

2. Select type of Gripper to connect
3. Click Connect button to start connection
4. Click Reset button to reset Gripper position, the gripper is operated in T1 mode with enabling switch pressed, please beware that the status of the gripper turned from Busy to Idle indicated that the reset is completed.
5. The gripper detection function is preset to be on. This function will notify that the gripper is not gripped to any object. If user does not need the detection, the function can be unchecked.

2.16. Vision System

- Description

  User can operate vision system in HRSS, update and install driver is available, for more information, please visit HIWIN official website and download further documents.



Vision system operation interface

No.	Description
1	Execute vision system
2	Update vision system
3	Install vision system driver

- Operation steps

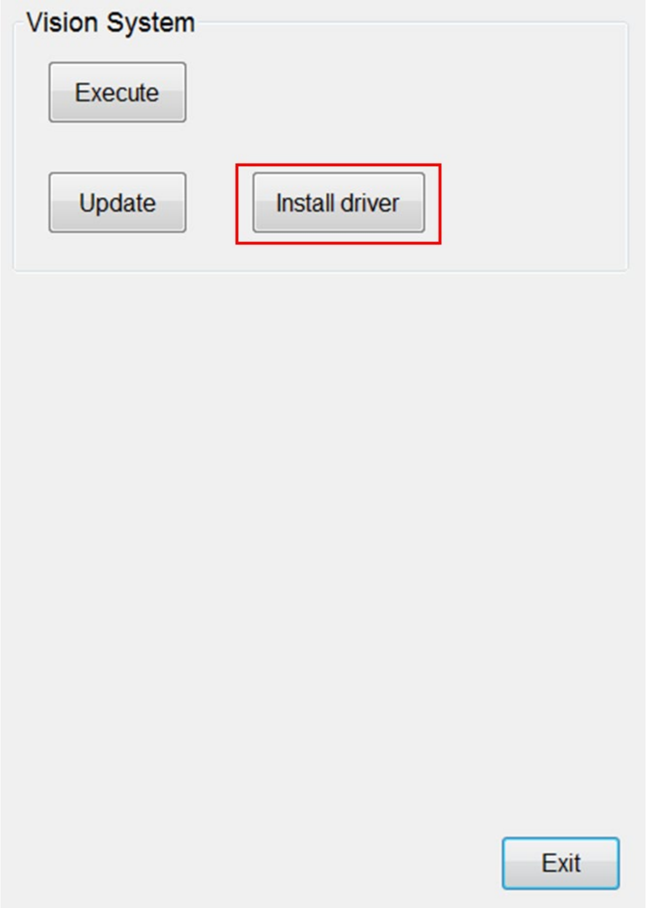
  Main menu>Configuration>Vision System

  1. If driver not installed, driver needed to be installed first, installation steps are as follows:

A. HRSS software version has to be updated to 3.2.6 and above.

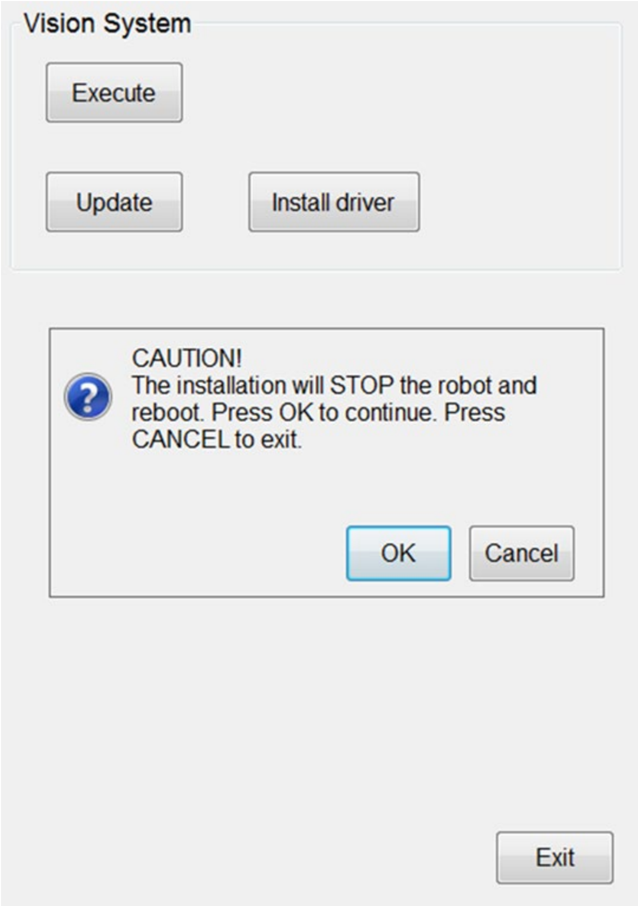
B. Download the Vision System Driver.exe from official website and save the file in USB under HIWIN folder. Then insert the USB into controller.

C. In the main screen of HRSS, select Configuration->Vision System, once Vision System interface is opened, click the install driver button.



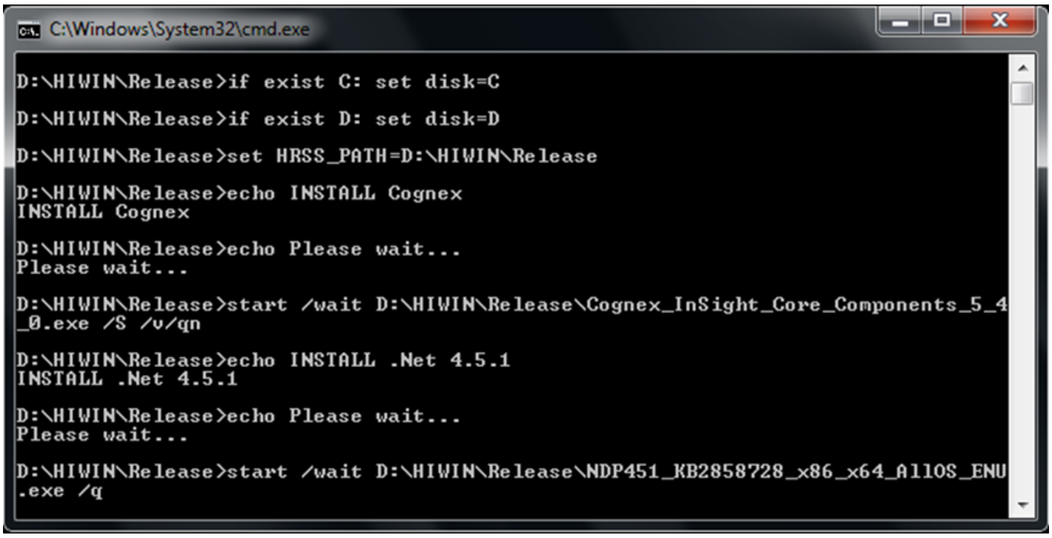
Vision System operation interface

D. If HRSS detected the driver installation file from the USB, a warning signal will appear to inform user that installation will stop the robot and reboot. Press OK to start driver installation; Press CANCEL to exit.



Install Vision System warning

E. Press OK to end HRSS and start rebooting. Once reboot completed, the driver installation will start execute, please wait patiently for installation to complete.



Vision System driver installation

F. When installation is completed, the system will operate according to different anti-write system. If FBWF anti-write system is set, the system will start rebooting and open HRSS. If EWF anti-system is set, the system will open HRSS once the driver installation is completed.

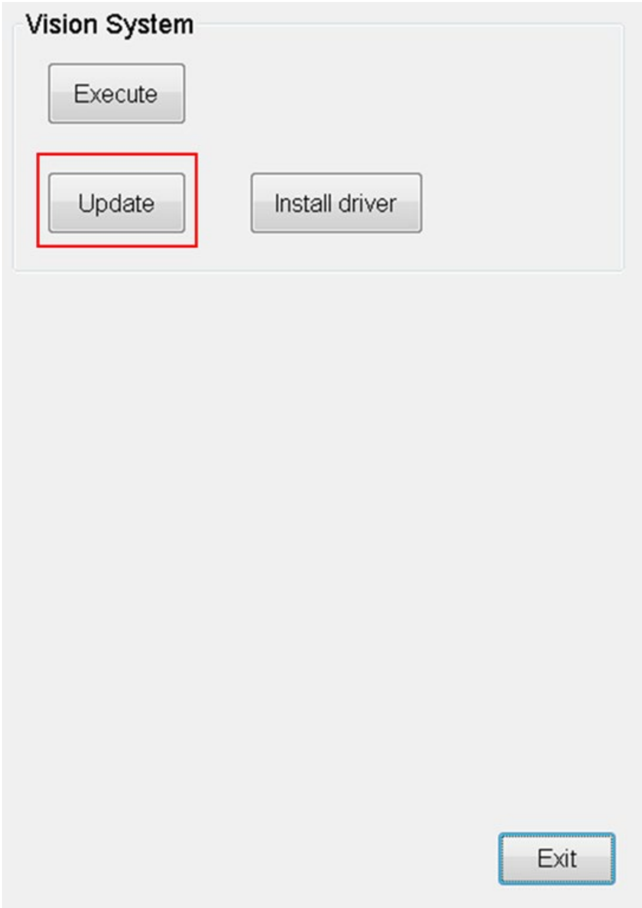
Installation completed, enter HRSS

2. If vision system update is required, steps are as follows:

A. HRSS software version has to be updated to 3.2.6 and above.

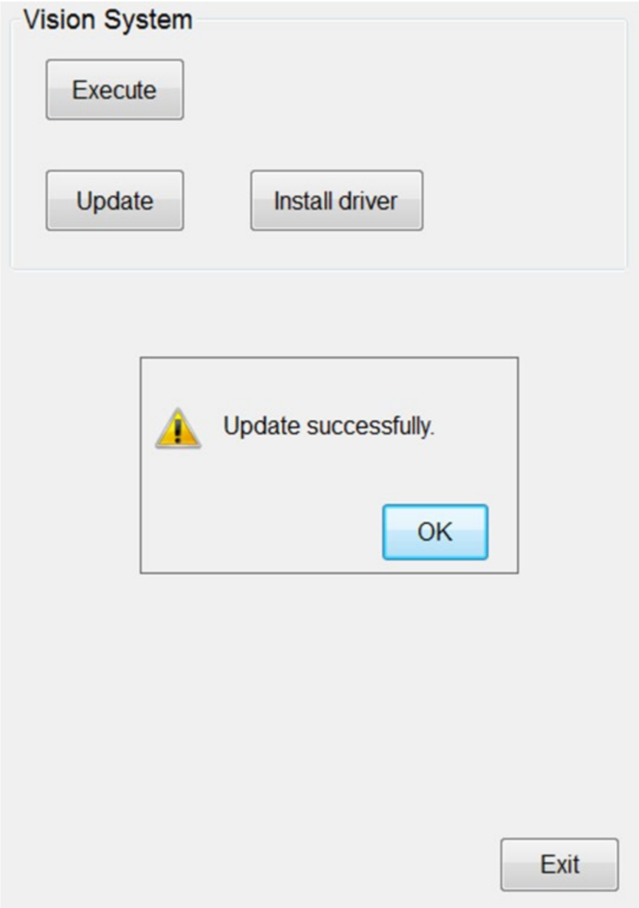
B. Download the InSightControl.exe from official website and save the file in USB under HIWIN folder. Then insert the USB into controller.

C. In the main screen of HRSS, select Configuration->Vision System, once Vision System interface is opened, click the update button.



Vision System operation interface

i. If HRSS detected update file in the USB, update will start operate and a “update successfully” message will appear.



Update Vision System

3. Execute Vision System.

2.17. Module I/O Function

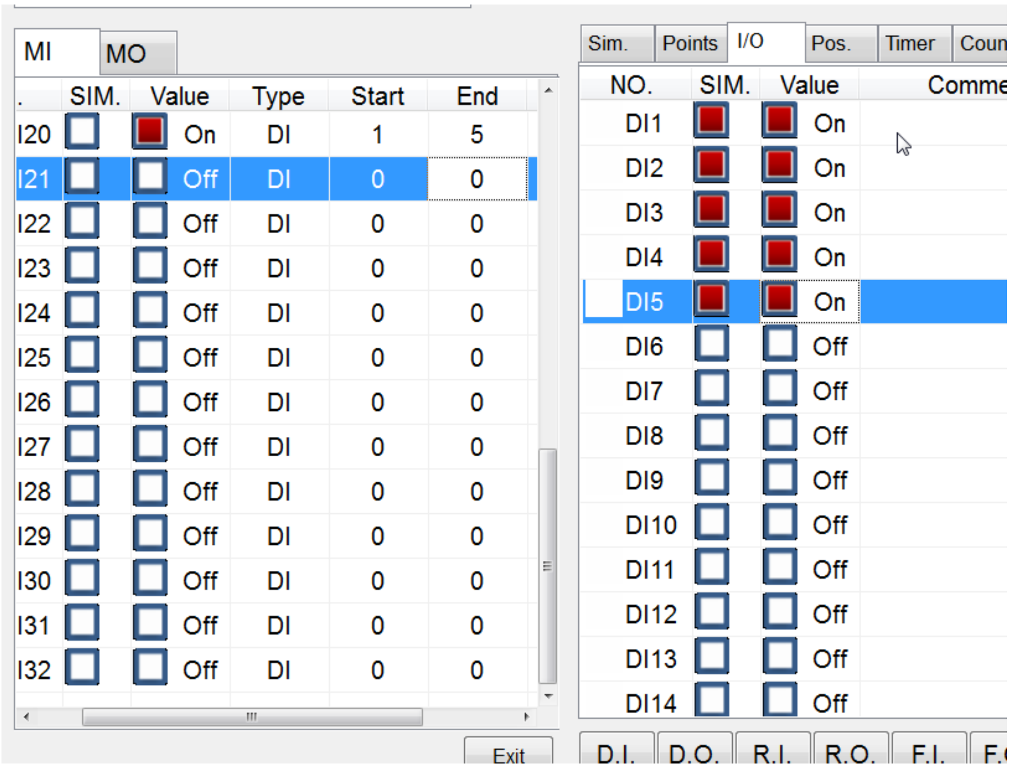
- Description

  User can set module I/O functions in HRSS, allowing user to monitor several I/Os simultaneously.

- Operation steps

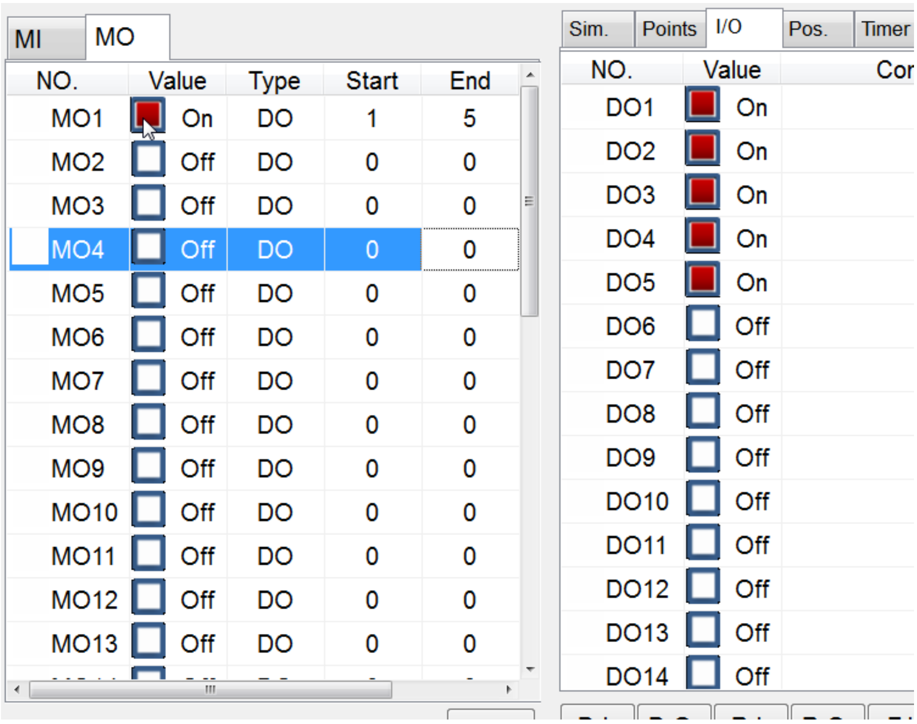
  Main Menu>Display>Variable>Module I/O

  1. Module Input setting is shown in the figure below:
     Start is the starting Input number, and End is the ending Input number.
     When Input is set to On in the module, the Module Input is displayed as On.



Module Input

2. The module Output setting interface is shown below:
   Start is the starting Output number, End is the ending Output number. When the module Output is On after setting, all Outputs in the module are displayed as On.



Module Output

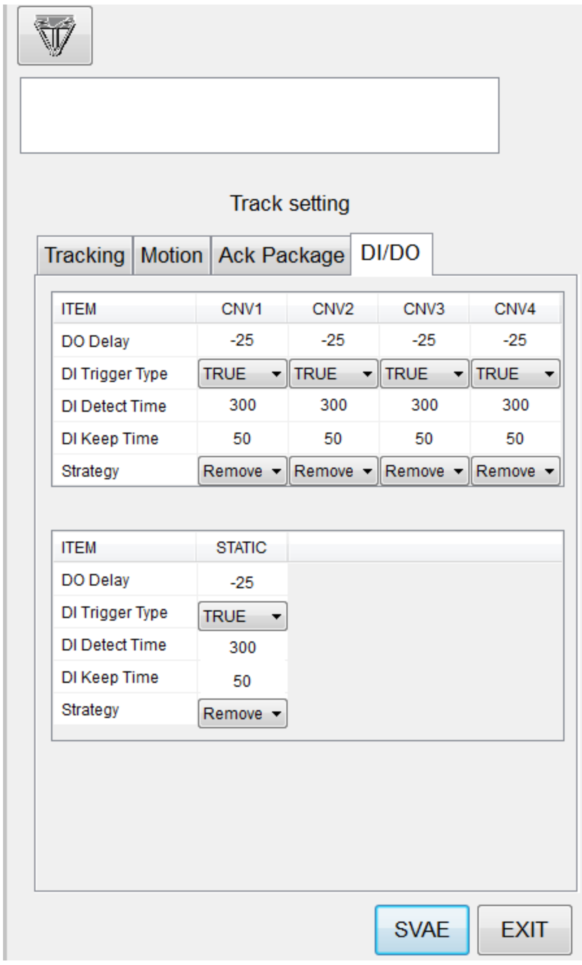
2.18. Pick/Place DI Detection Function

- Description

  DI detection function can be used to prevent object from falling off during picking and placing when operating conveyor belt pick and place.

- Operation Steps

  Main Menu>Track>Setting
- The interface is as follows and four parameters can be set: DI Trigger Type、DI Detect Time、DI Keep Time、Strategy
  1. DI Trigger Type: The state when manipulator picks an object.
  2. DI Detect Time: After DO signal is sent, the time of DI detection is maintained.
  3. DI Keep Time: Detecting the duration of DI, when over the duration, determine the detect DI.
  4. Strategy: During pick, response strategy DI is detected



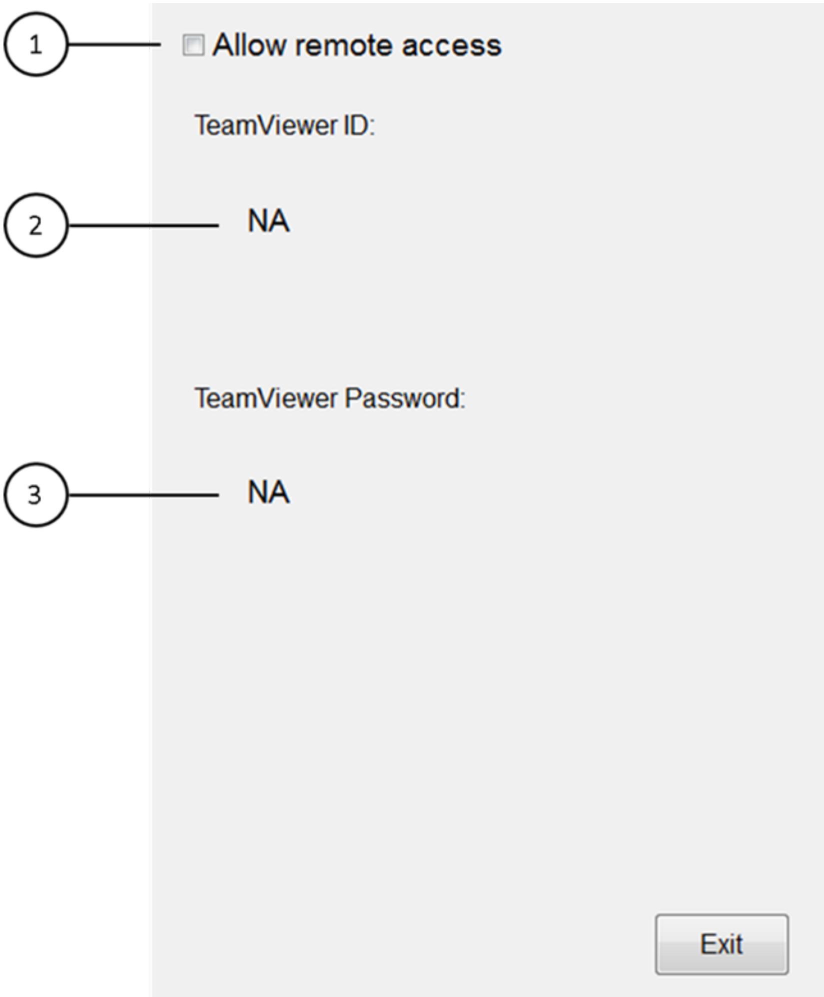
Module Output

2.19. Remote Monitoring Function

- <u>Description</u>

  HRSS uses TeamViewer software to achieve remote monitoring requirements, allowing customer service to conduct operation teaching, error diagnosis and remote control, etc. User can open TeamViewer in HRSS interface and obtain TeamViewer ID and password. The function needs following requirements:

  1. The robot controller needs to be able to connect to network.
  2. The TeamViewer software has been installed automatically on the robot controller for HRSS software version 3.2.8 or higher. If the version is updated in 3.2.7 or before, manually installation is required.



Remote monitor setting interface

No.	Description
1	Allow remote monitoring of robot controller
2	Display TeamViewer ID
3	Display TeamViewer password

- <u>Operation Step</u>

  Main Menu> Start-up>System Setting>Remote Access

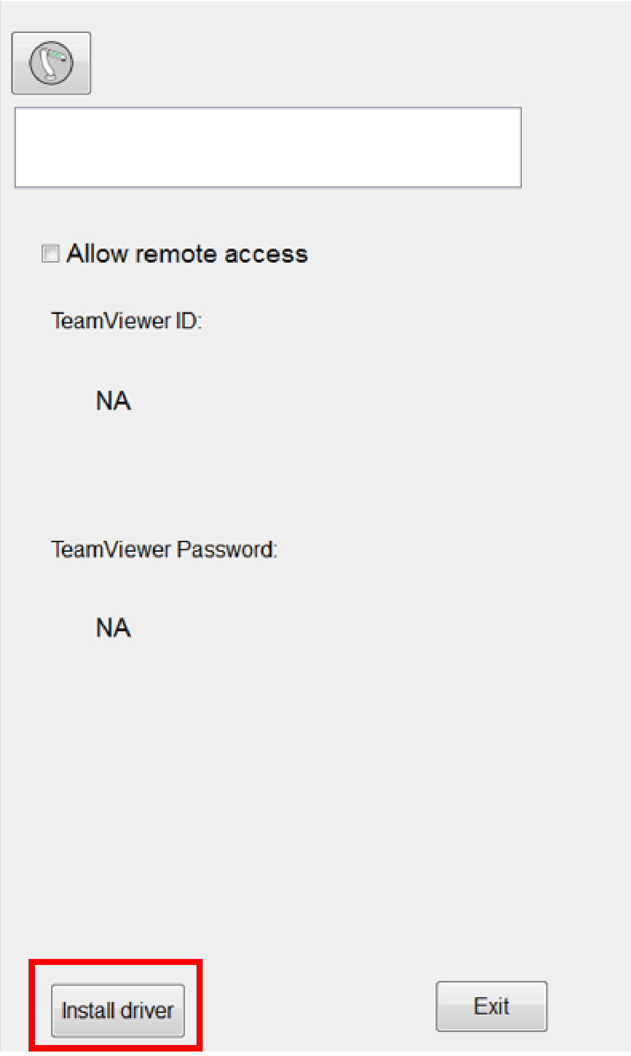
  1. Ensure robot controller is connected to network
  2. Ensure TeamViewer is installed on the robot controller, HRSS version 3.2.8 and above is already installed automatically, if user has version 3.2.7 or earlier, please install the software manually, the manual installation steps is as follows:

  A. The HRSS software version need to be updated to 3.2.8 or higher.

B. Please go to the official website to download the Remote Desktop Driver.exe file, place the file in the HIWIN folder in the USB device, and insert the USB device into the controller.

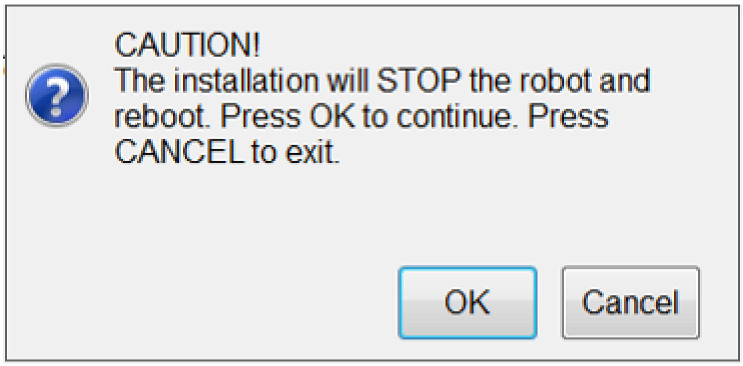
C. Select Start-up>System Setting>Next>Remote Access in the HRSS main menu to open the remote monitoring function interface.

D. Click the Install Drive button.



Remote monitoring operation interface

E. If HRSS detects the driver installation file in USB, it will pop up a warning window to remind the user to stop the robot. When the driver is installed and reboot several times, pressing OK will start the driver installation automatically, pressing Cancel will cancel the installation.

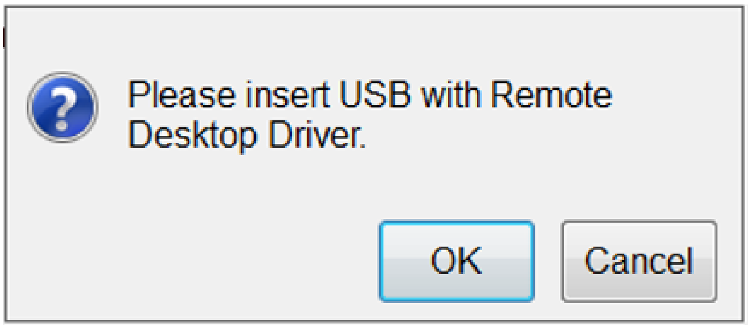


Installation remote monitor warning

F. After pressing OK, HRSS will automatically shut down and reboot, and automatically start the driver installation. After the program is installed, it will automatically restart again, and open HRSS to complete the installation process.

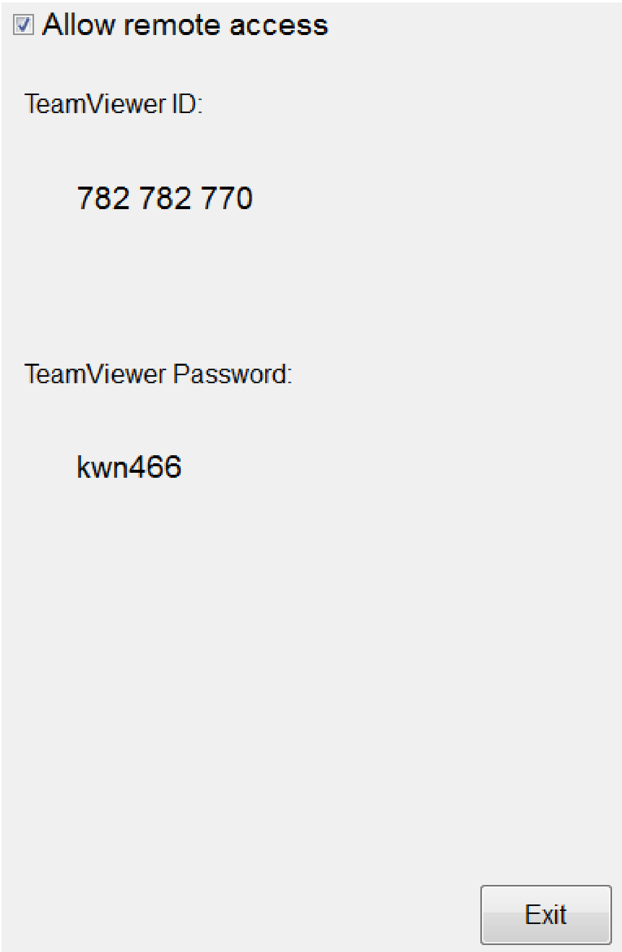
Installation complete automatically enter HRSS

G. If the driver installation file is not placed in the USB device, or the folder path name is incorrect, it will cause failure in installation and the warning window will pop up.



Pick file failure warning

H. Tick allow remote access, after TeamViewer successfully opened and the ID and password will be displayed on HRSS shown in figure below. If TeamViewer install incorrectly, the open error will appear, show in figure below.

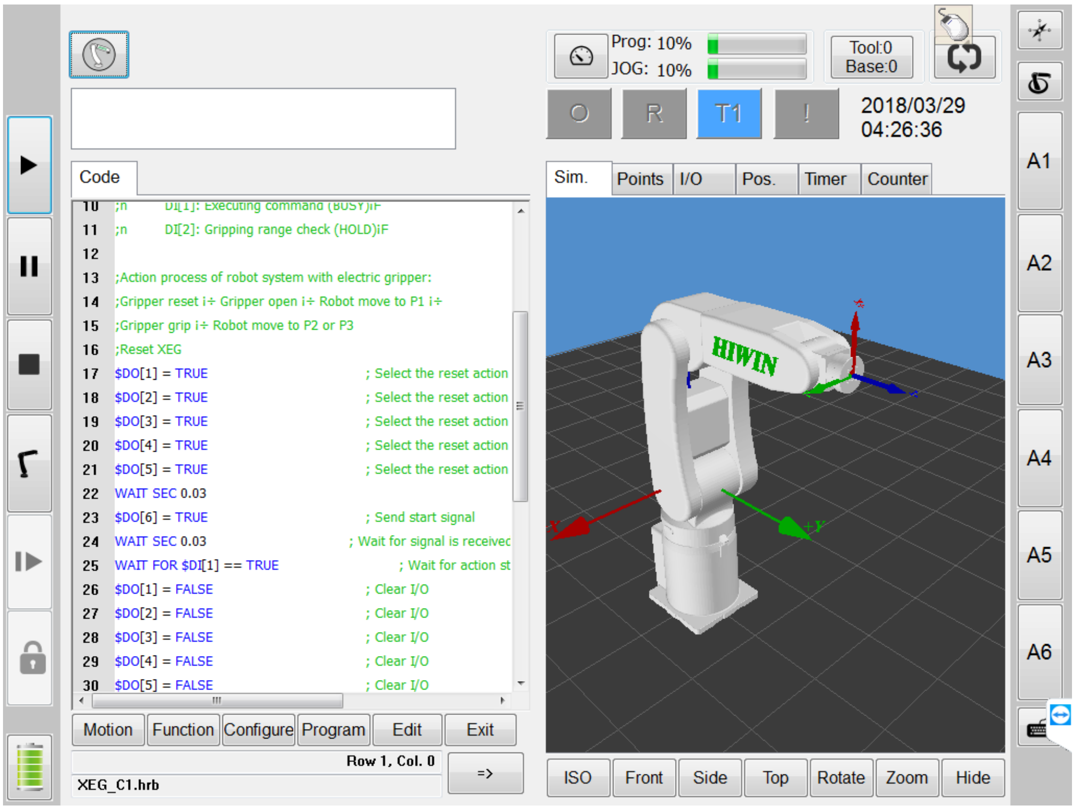


Successfully open TeamViewer

TeamViewer open error warning

I. Inform the sales about the remote ID of the ID and password displayed on the interface of the robot.

J. After the customer service has successfully connected, the robot controller screen can be obtained and the manipulator can remotely operated.

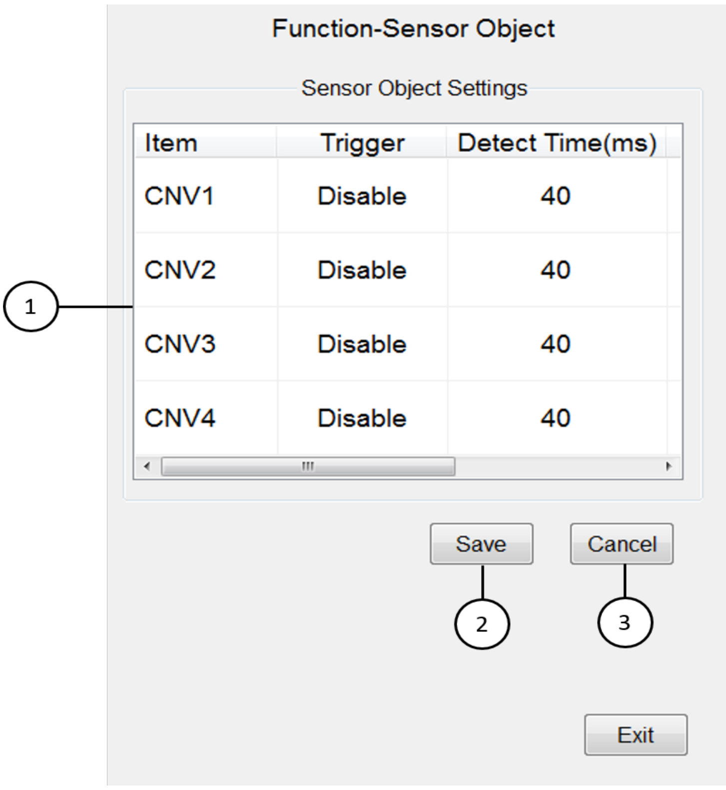


Connection successful, obtained robot control screen

2.20. Conveyor Belt Tracking Sensor Trigger Object Identification Function

- <u>Description</u>

  In the belt tracking, if the trigger source is selected to use the sensor trigger (Sensor Latch), the corresponding input detection signal when the object is triggered can be set in the specified conveyor belt in the HRSS. If the input detection signal reaches the set time (Keep Time) in the Detec Time set after the object is triggered, the object is identified as the desired type, and generally can be applied to the good product detection, and used the command CNV_OBJECT to perform different program processing.



Sensor trigger object identification function

No.	Description
1	Set the object recognition trigger signal, detection time, duration of the specified conveyor belt.
2	Save setting
3	Cancel setting

- Operation steps

Main Menu>Track>Sensor Object

1. Conveyor belt related setting calibration is completed, and sensor trigger is selected.
2. Set the selection of the conveyor object identification input trigger source.

3. Set the input signal detection time for the selected conveyor object identification.
4. Set the input signal duration for the selected conveyor object identification.
5. The program uses the value of CNV_OBJECT after the CNV_PICK instruction for subsequent programming planning

2.21. Software Update

- Description

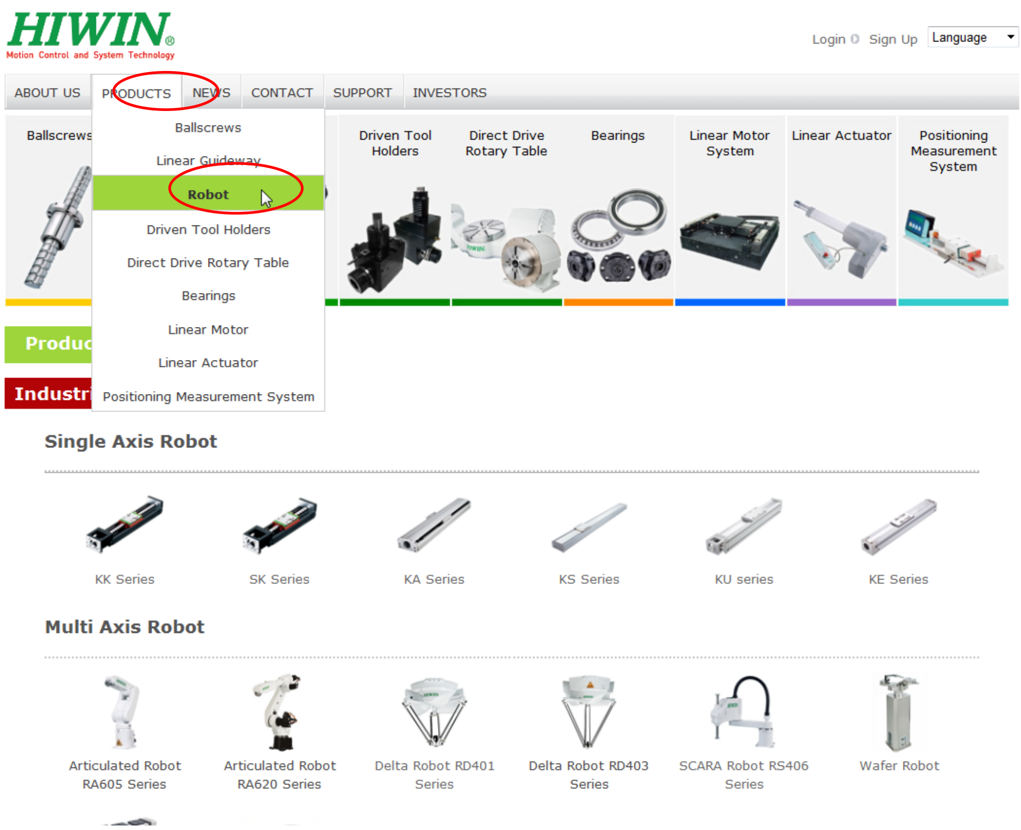
User can download HRSS program updates from the official HIWIN website, and operate update in HRSS interface.

- Operation steps

1. Connect to the official website of HIWIN (www.hiwin.tw).

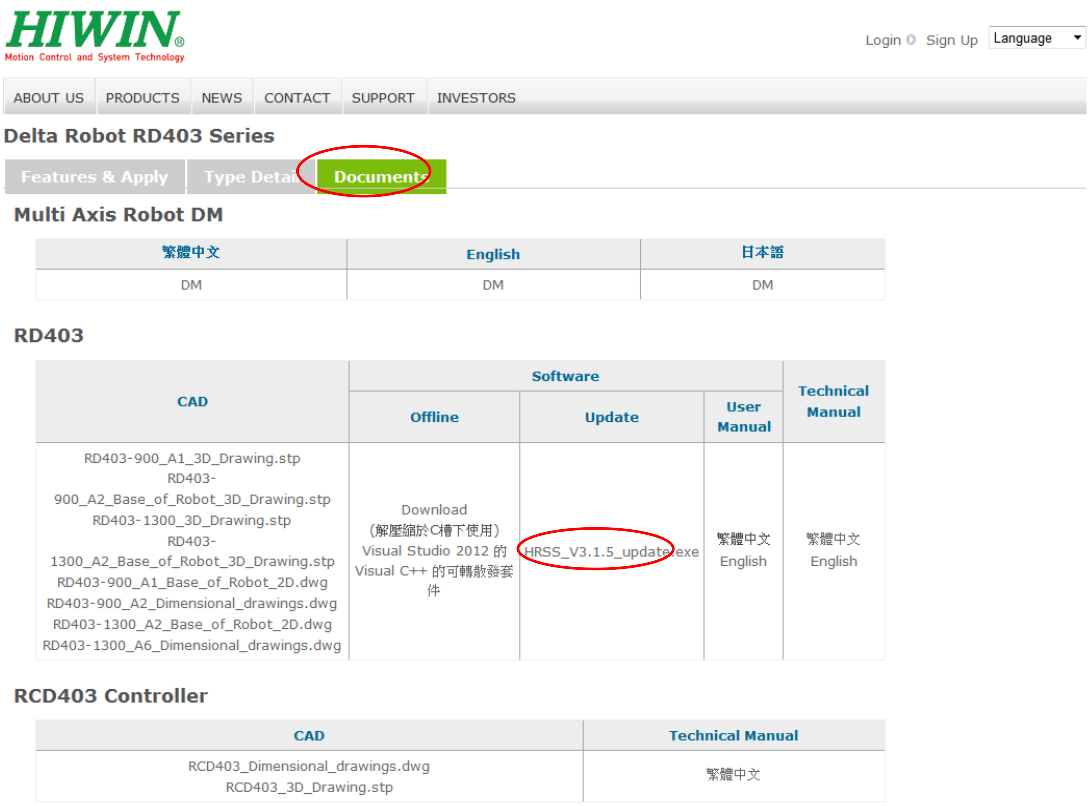
On the web page select: PRODUCTS>Robot

.



Robot Model

2. Find the model number of robot from the Industrial Robot area below, and then click to enter.



HIWIN® Motion Control and System Technology

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Delta Robot RD403 Series

Features & Apply | Type Detail | Documents

Multi Axis Robot DM

繁體中文	English	日本語
DM	DM	DM

RD403

CAD	Software			Technical Manual
	Offline	Update	User Manual	
RD403-900_A1_3D_Drawing.stp RD403-900_A2_Base_of_Robot_3D_Drawing.stp RD403-1300_3D_Drawing.stp RD403-1300_A2_Base_of_Robot_3D_Drawing.stp RD403-900_A1_Base_of_Robot_2D.dwg RD403-900_A2_Dimensional_drawings.dwg RD403-1300_A2_Base_of_Robot_2D.dwg RD403-1300_A6_Dimensional_drawings.dwg	Download (解壓縮於C槽下使用) Visual Studio 2012 的 Visual C++ 的可轉散發套件	HRSS_V3.1.5_update.exe	繁體中文 English	繁體中文 English

RCD403 Controller

CAD	Technical Manual
RCD403_Dimensional_drawings.dwg RCD403_3D_Drawing.stp	繁體中文

Download documents

3. Select「Documents」from the above list.
4. Click the updated version of Download from below, and download to USB, the path is placed under the HIWIN folder of root, insert into the USB port of controller.
5. Select Main Menu>Help>Update.
6. A window will appear warning that the Robot will stop when updating software. After pressing OK, software will start to update; to cancel update, press CANCEL.
7. HRSS will reboot and complete update.

⚠ CAUTION

Before updating the software, please check current software version, for example: HRSS 3.2.1.2673, please download version with same two number at the front, e.g. HRSS 3.2.2.2775 or HRSS 3.2.4.2925. Do not download version that has two different number at the front, e.g. HRSS 3.3.x.x to avoid incompatible.

2.22. Export Manual

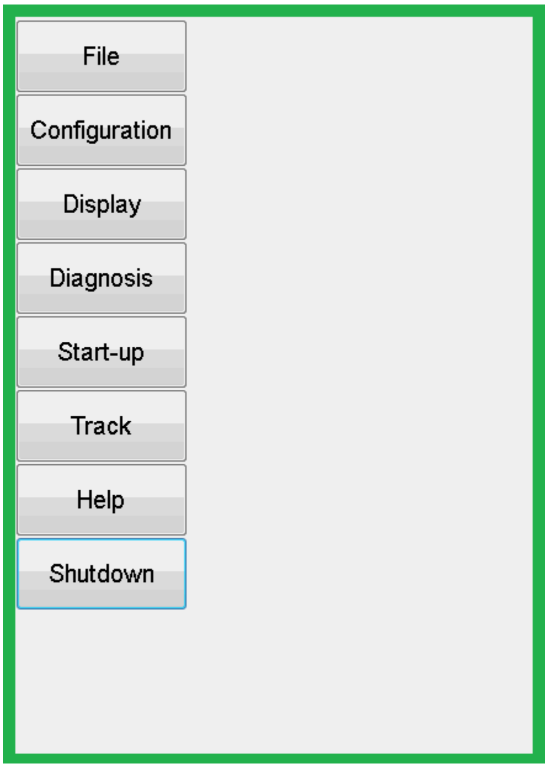
- Description
  User can export the manual from controller to the USB memory stick.
- Operation Steps
  1. Insert USB to the controller
  2. Select Main menu>Help>Manual
  3. Display save successfully
  4. Manual save in the path USB:\HIWIN\Manual\Folder

2.23. Software Shutdown

- Description
  User can perform software shutdown from HRSS

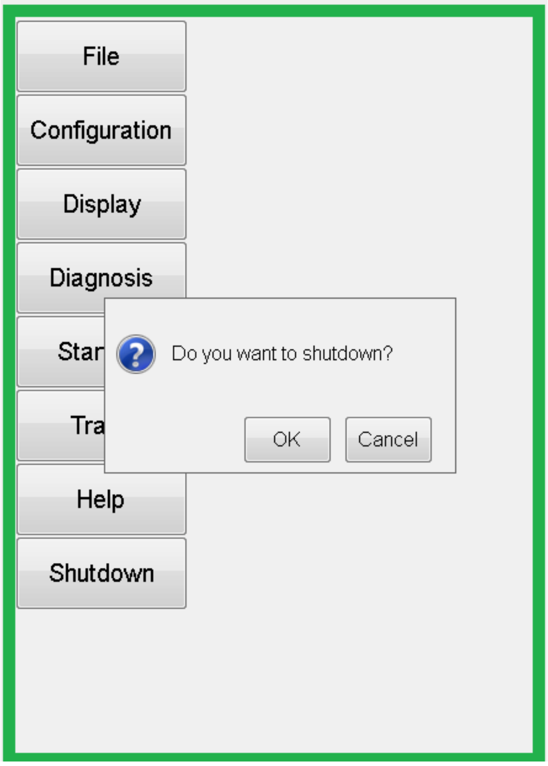
- Operation Steps

1. Open main menu



2. Main Menu>Shutdown

3. Ask if you want to shutdown



4. Press OK to start shutdown

3. Initial Settings

3.1. Check Parameters

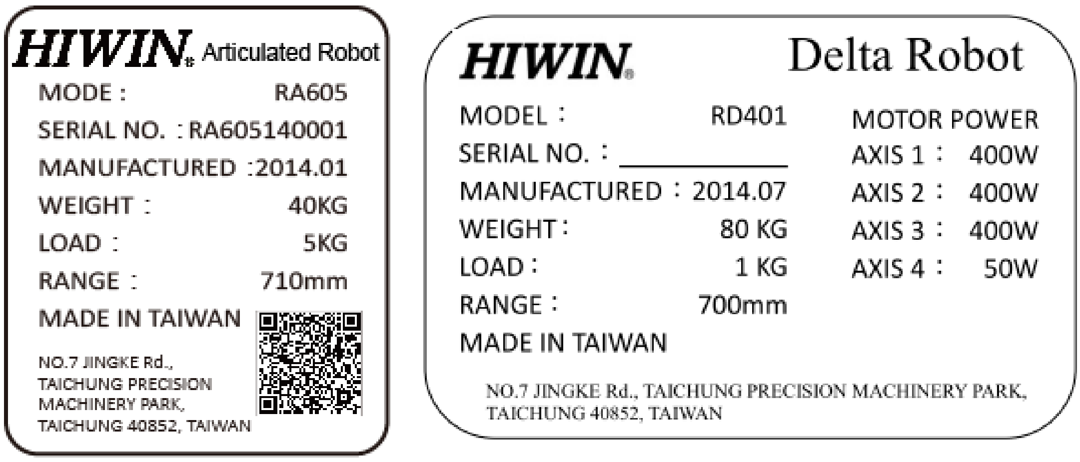
- <u>Description</u>

  The correct robot program data must be loaded. During parameter check, the loaded robot data must match with the data of the model plate.

  If loading the new data is required, the status of the robot data must fully match with the HRSS. This is to ensure that when the data is applied, it can be submitted with the HRSS.

⚠ DANGER

If the wrong data is loaded, the robot should not be operated! Failure to take these measurements could lead to serious injury, death or equipment damage



Model Plate(Left:RA605, Right:RD401)

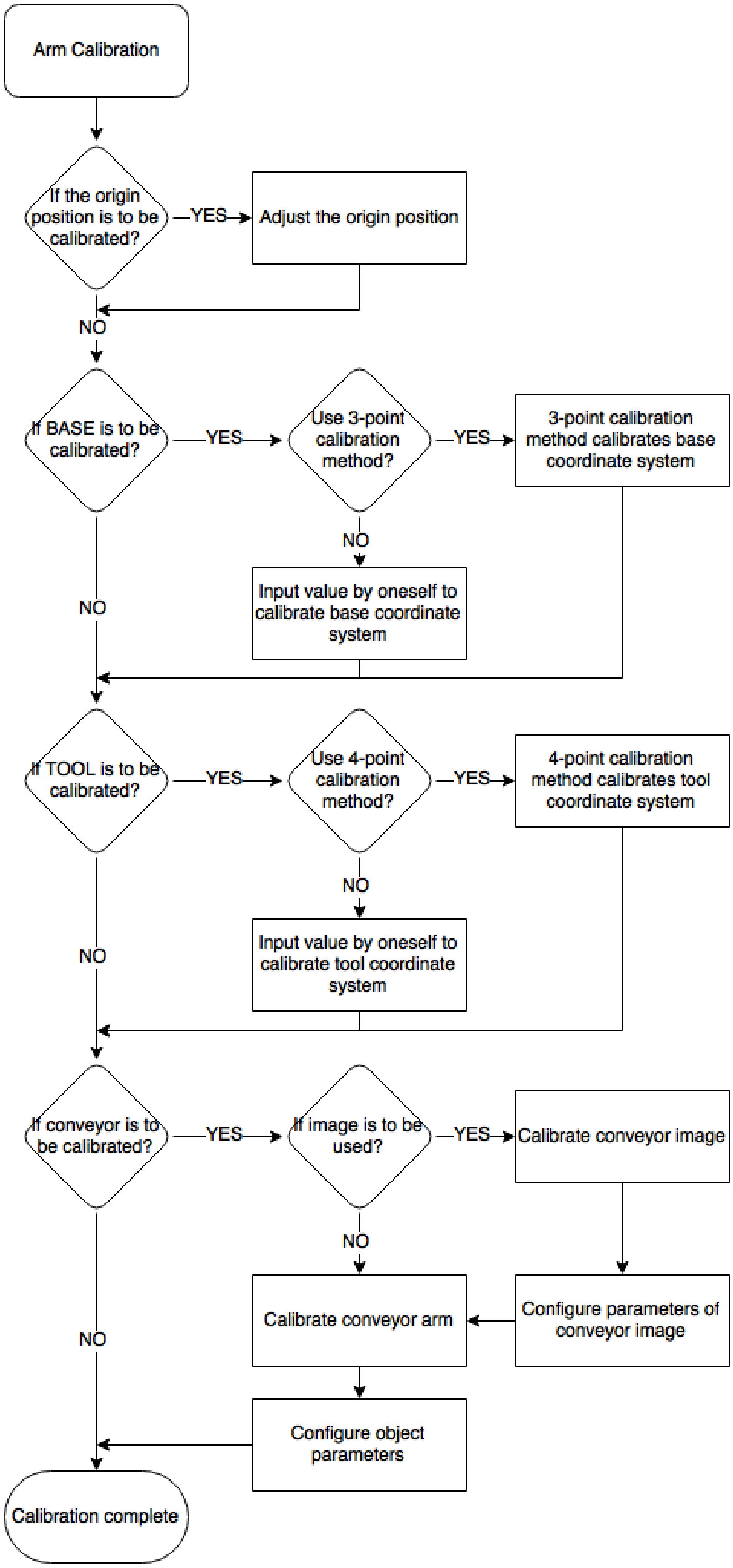
- <u>Operation steps</u>

  Main Menu>Help>about

3.2. Calibration Flow

Fig. 5.2 is the calibration flowchart of robotic arm. According to the user's requirements, they are: Adjusting the origin position (5.3) → Calibrate the base coordinate system (5.4.1,5.5.1) → Calibrate the tool coordinate system (5.4.2,5.5.2) → Calibration of conveyor image (5.6.1) → Calibration of conveyor arm (5.6.2) → Configure the parameters of conveyor image (5.7.1) → Configure the parameters of conveyor object (5.7.2).

The above mentioned calibration steps will be introduced in the subsequent sections.

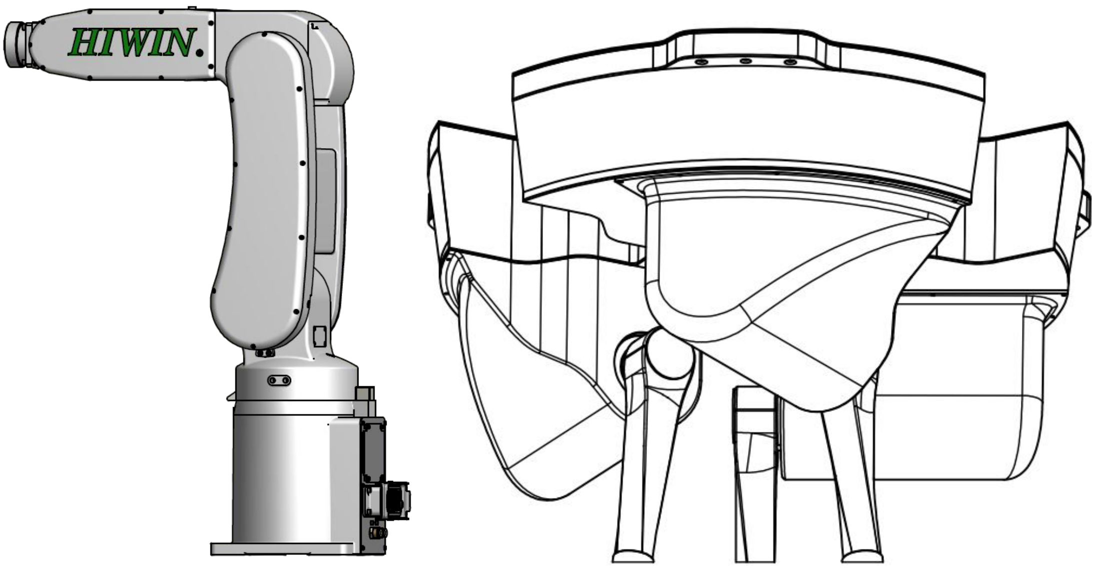


Calibration Flowchart of Robot

3.3. Adjust Origin Position of Hardware Mechanism

- <u>Overview</u>

  Each robot must be mastered. The robot can make Cartesian motion only after being mastered and moved to the programmed position. The mechanical position of the robot will be made consistent with the encoder during mastering. The robot must be placed on a defined mechanical position, which is the mastered position. The encoder value of each axis will be saved.



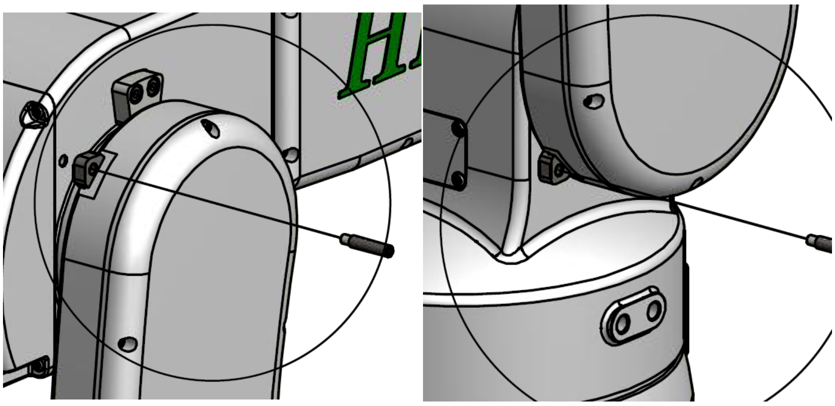
Adjust the approximate position of origin

Situation	Remark
Before commissioning	- - -
The value of motor position is lost after maintenance such as replacement of a motor	- - -
If the robot moves without robot controller instruction (for example, with a device release)	- - -
After replacement of gear unit	The old mastering data has to be deleted before carrying out a new mastering procedure. Remove mastering data by manually cancelling the axis mastering.
After a collision	
If the absolute position is missing after replacing the battery.	

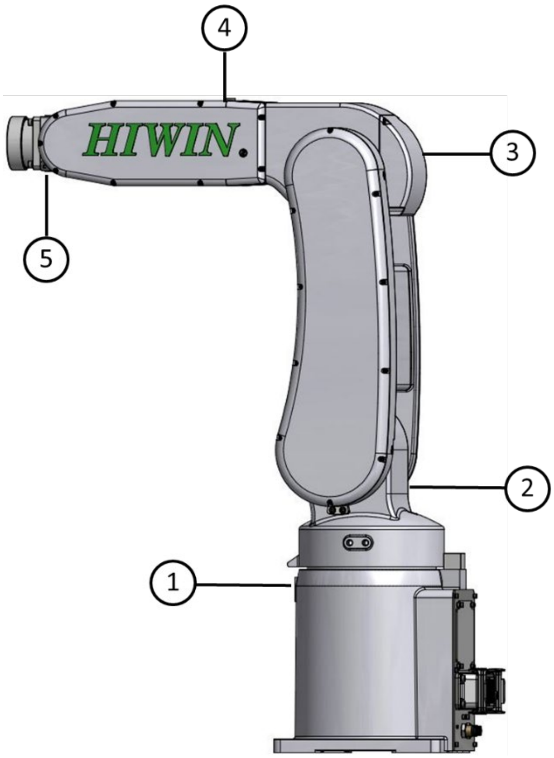
3.3.1. Mastering Method (6-axis robot)

- <u>Description</u>

  Move each axis, so that it can overlap with the mastering mark.



Move an axis to the mastering position



Mastering marks on the robot

⚠ CAUTION

Based on the model number, the position of the mastering marks could be slightly different from the illustration. For origin calibration method and image, please refer to the manual of each model.

- <u>Prerequisite</u>

  The “jog key” has been activated.
  T1 mode

- <u>Operation steps</u>
  1. Select the axis as the coordinate system for the jog keys.（Please refere to Section 2.11.5）
  2. Hold the Enabling Switch. The axis A1 to A6 will be dsiplayed beside the jog keys.
  3. Press the + or – button, so that the axis moves to the positive or negative direction.
  4. Start to jog from the axis A1, so that it can overlap with the mastering mark.
  5. After mastering, click Main Menu>Start-up>Master>Zero Position.
  6. Click Axis 1 in the list twice, a pop-up message of "Clear axis 1 position?"will appear.
  7. Press OK to complete the setting of zero position for 1st - axis.
  8. And so on for 2nd - axis to 6th - axis.
  9. After completing the clearing, press Home button to confirm if the angle is correct, if the position shown on the screen is different from the actual position, please clear the position again.

⚠ CAUTION
When the simulated robot posture is located beyond the limit to cause motion disabled, please execute [Zero Position] first.

1. Master first-axis
   A mastering pin is used to attach the plate on the zero axis. The first-axis velocity is reduced to the minimum velocity until the first axis is close to the plate. First-axis mastering is completed, as shown below.

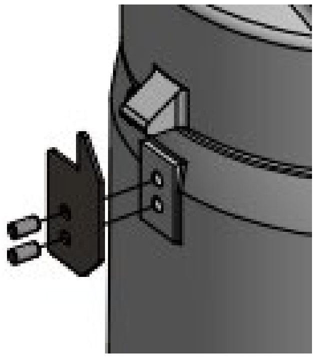


Illustration of first-axis mastering

2. Master second-axis
   The second-axis velocity is reduced to the minimum velocity until the second-axis mastering hole matches with the first-axis hole and a mastering rod can be placed into position. The second-axis mastering is completed, as shown in below.

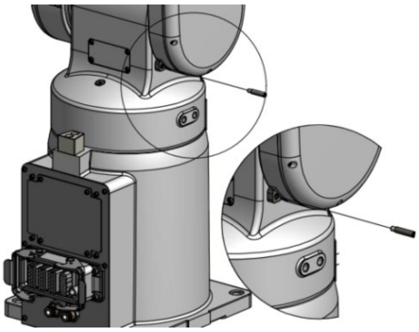


Illustration of second-axis mastering

3. Mastering third-axis
The third-axis velocity is reduced to the minimum velocity until the third-axis mastering hole matches with the third-axis hole and a mastering rod can be placed into position. The third-axis mastering is completed, as shown in below.

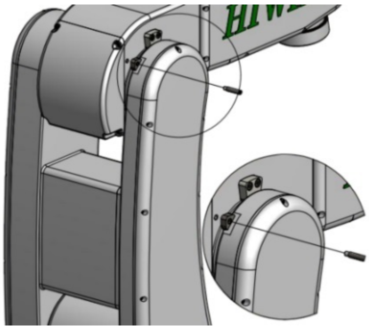

。

Illustration of third-axis mastering

4. Master fourth-axis
The fourth-axis velocity is reduced to the minimum velocity until the fourth-axis mastering notch matches with the third-axis notch and a mastering key can be placed into position. The fourth-axis mastering is completed. A screw can be used to remove the mastering key from the notch after calibration, as shown in below.

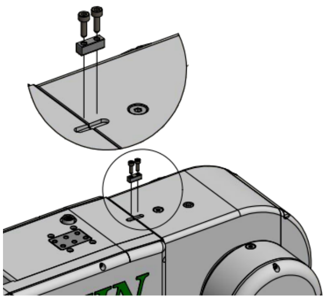


Illustration of fourth-axis mastering

5. Set fifth-axis home
   The fifth-axis velocity is reduced to the minimum velocity until the fifth-axis mastering hole matches with the fourth-axis hole and a mastering rod can be placed into position. The fifth-axis mastering is completed, as shown in below.

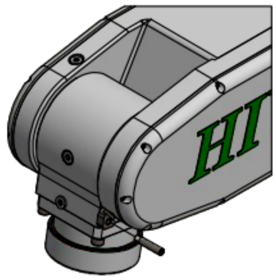
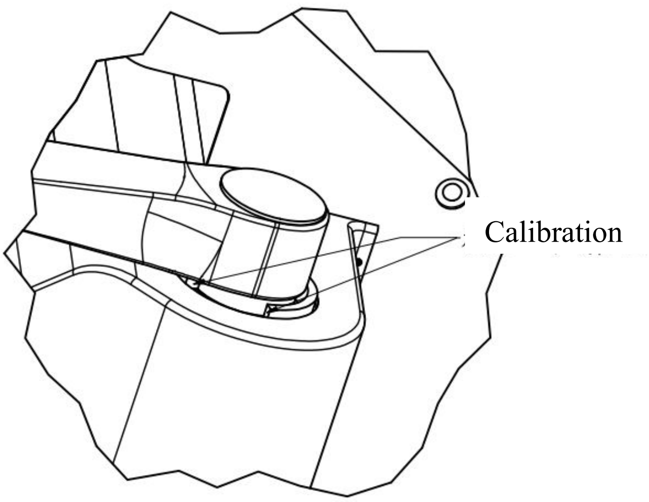


Illustration of fifth-axis mastering

3.3.2. Mastering Method (Delta Robot)

- Description

  Move each axis, so that it can overlap with the mastering mark.



Calibration surface

⚠ CAUTION

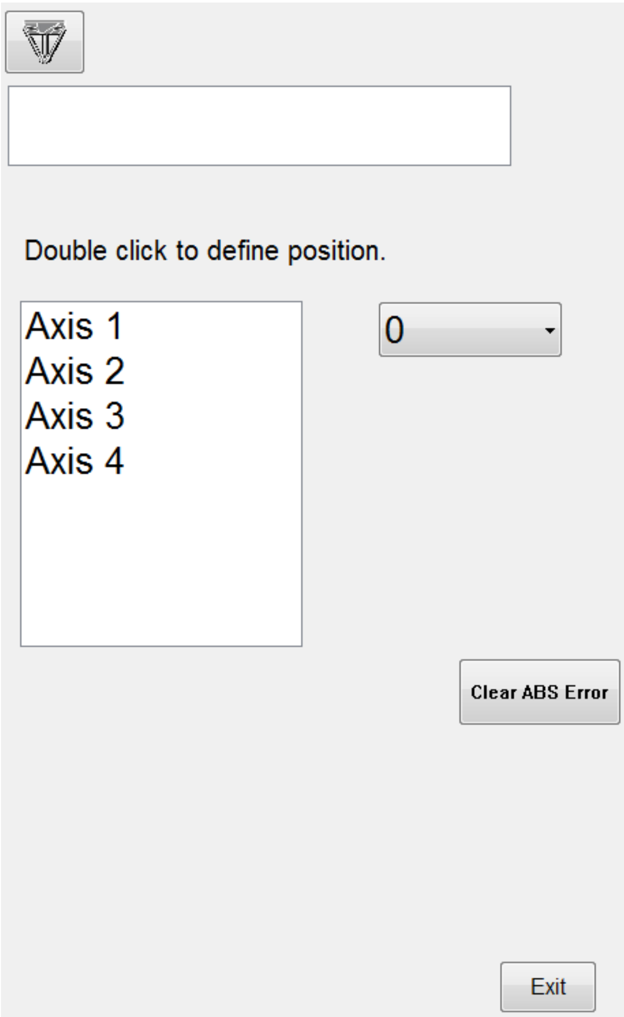
Depending on model number, the position of the calibration surface may be slightly different from the illustration. For origin calibration method and image, please refer to the manual of each model.

- Prerequisite

  Expert group

- Operation steps

  1. Manually release the robot brake.
  2. Move the arm (Axis-1) to the top (lowest) side.
  3. Use the hardware brake.
  4. Select HightLimit or LowLimit, and click Axis 1 twice.
  5. Appear "Clear axis 1 position?"
  6. Press the OK button to clear the position.
  7. Follow the previous procedures for second and third axis.
  8. Once cleared, press the Home button to ensure the angle is correct. If the position on the figure is different from the actual position, clear the position again.



Zero Position interface

⚠ CAUTION

When the simulated robot posture is located beyond the motion limit to cause motion disabled, execute [Zero Position].

3.3.3. Reset Encoder Error

- Description

  When the encoder occurs an error, it can be reset. If the error can not be cleared after reset, please check if there is any problem for the circuit, battery and driver. If the error still exists, please contact HIWIN. After reset, the encoder must be cleared.

- Prerequisite

  Expert group

- Operation steps

  1. Main Menu >Start-up>Master>Zero Position.
  2. Select Axis 1.
  3. Press Clear ABS Error.
  4. After cleared, press the Home button to ensure the angle is correct. If the position on the figure is different from the actual position, please clear the encoder again.

3.4. Calibration (Six-axis Robot)

3.4.1. Base calibration

- Description

  During base calibration, the user assigns a Cartesian coordinate system (BASE coordinate system) to a work surface or the work piece. The BASE coordinate system has its origin at a user-defined point.

⚠ CAUTION

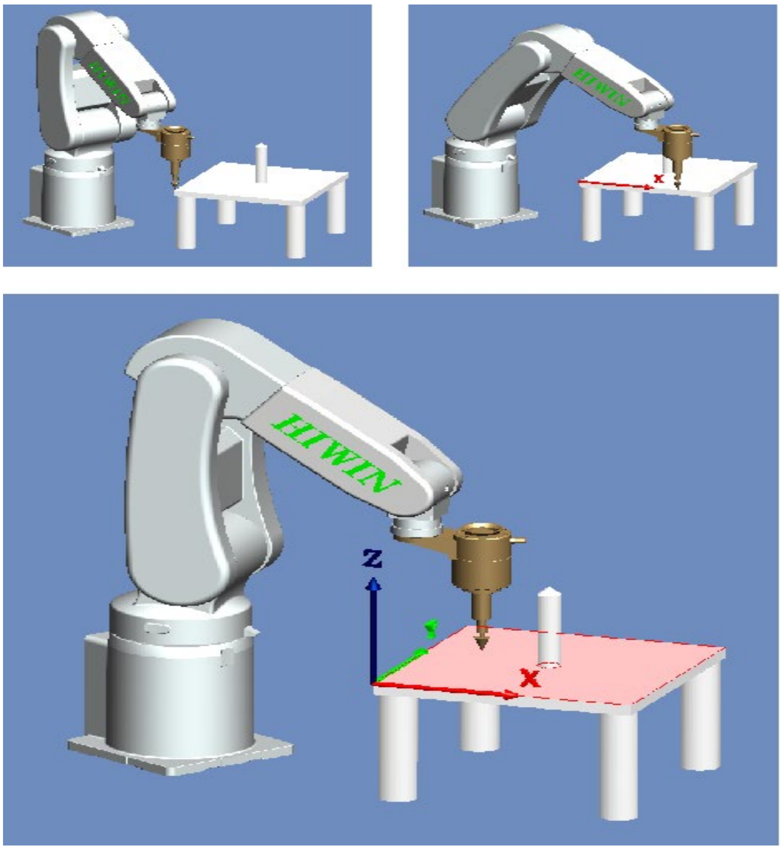
If a workpiece has been installed on the mounting flange, the calibration described here will not apply.

Advantages of base calibration:

1. TCP can be jogged along the work plane or the edge of workpiece.
2. Points can be taught relative to base. If the base has to move, for example, because the work plane is moved, these points will be moved as well, but no need to be taught again.

32 base coordinates can be saved at most. Variable: BASE [0…31].

3.4.1.1. 3-point Method



3-point Method

- Prerequisite

  Install a calibrated tool on the mounting flange.

  T1 mode

- Operation steps

  1. In the main menu select Start-up > Calibrate > Base.
  2. In the pull-down menu, given a number and a name for base coordinate system. Confirm with OK button.
  3. Select a number for the base to be calibrated, and then press [Measure].
  4. Give a name for the base to be calibrated.
  5. Move TCP to the origin of new base coordinate. Click [Measure], and then confirm by pressing the OK button.
  6. Move TCP to a point on positive X axis of new base coordinate. Click [Measure], and then confirm by pressing the OK button.

7. Move TCP to a point with positive Y on the XY plane. Click [Measure], and then confirm by pressing the OK button.
8. Press the OK button after completed. The data will be saved.

3.4.1.2. Enter Value

- Description

  Known the following values, for example, obtain from CAD:
  1. Distance between the base origin and global origin
  2. Rotation for base coordinate relative to global coordinate

  T1 mode
- Prerequisite

  Known X, Y, Z, A, B and C relative to the global coordinate system

  T1 mode
- Operation steps
  1. In the main menu select Start-up > Calibrate > Base
  2. Select a number for the base to be measured.
  3. Select the coordinate you want to enter, and then press [Set Value].
  4. Give a name for the base to be measured.
  5. Enter the value.
  6. Press the OK button after completed. The data will be saved.

3.4.2. Tool calibration

- Description

  When the tool is calibrated, the user will give a set of Cartesian Coordinates (Tool Coordinate System) to the tool mounted on the flange. The tool coordinate system has its origin at a user-defined point. This point is called as TCP (Tool Center Point). Usually, TCP is located at the working point of the tool.

⚠ CAUTION

The calibration method described here must not be used for a fixed tool.

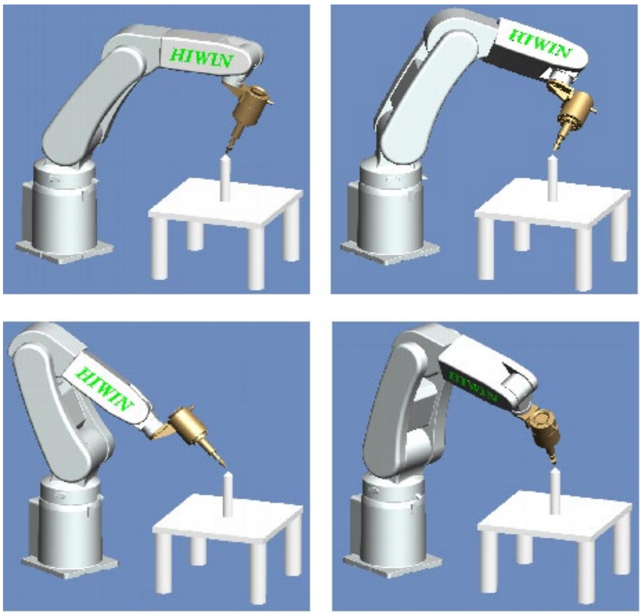
3.4.2.1. 4-Point Method

- <u>Description</u>

  The TCP of the tool to be calibrated is moved to a reference point from 4 different directions. The reference point can be freely selected. The robot control system calculates the TCP from the different flange positions.

⚠ CAUTION

The 4 flange positions at the reference point must be sufficiently apart from one another.



4-point method

- <u>Prerequisite</u>

  1.Install the tool to be calibrated on the mounting flange.

  2.T1 mode

  3. Select a fixed reference point position, it is recommended that this reference point is a shape that is easy to recognize, for example: cuspidal point.

- <u>Operation steps</u>

  1. In the main menu select Start-up > Calibrate > Tool
  2. Select a tool number from the pull-down menu for the tool to be measured, and then press [Measure].
  3. Give a name for the tool to be calibrated.
  4. Use TCP to move to the configured reference point. Click [Measure]， if the position of reference point is to be confirmed, please use OK button for confirmation, otherwise, use No or Cancel to cancel the operation.
  5. Use TCP to replace another posture position of arm, move to the reference point. Click [Measure]， if the position of reference point is to be confirmed,

please use OK button for confirmation, otherwise, use No or Cancel to cancel the operation.

6. Repeat Step 5 twice.
7. Press confirmation button after completion. The data displays the reference point of new base coordinate system and is saved, the changed coordinate system can also be observed from the 3D simulation window.

3.4.2.2. Enter Value

- Description

  Tool data can be manually entered.

  Possible data source:

  1. In the CAD diagram file, acquire the size information of tool.
  2. Tool size from the measurement of actual object.
  3. Instruction manual of tool manufacturer.

- Prerequisite

  Known X, Y, Z, A, B, C distance dimension as relative to the flange coordinate system.

  T1 mode

- Operation steps

  1. In the main menu select Start-up > Calibrate > Tool
  2. Select a number for the tool to be measured in the pull-down menu.
  3. Select the coordinate axis you want to enter, and then press [Set Value].
  4. If it is the first time entering the value, then a name shall be given to the tool to be measured.
  5. Enter a value.
  6. Press confirmation button after completion. The data displays the reference point of new base coordinate system and is saved. The changed coordinate system can also be observed from the 3D simulation window.

3.5. Calibrate Coordinates (Delta Robot)

When Delta is used to set the coordinate, the base coordinate can be set the same with the vision and conveyor coordinates. It can be convenient to set the calibration of the position in future. There are two methods to set the base coordinate, the first one is the Three-point Method and the second one is to use the coordinates from CAD to enter the values of X, Y, Z, A, B and C coordinates.

3.5.1. Calibrate Base Coordinates

- Description

During base calibration, the user assigns a Cartesian coordinate system (BASE coordinate system) to a work surface or the work piece. The BASE coordinate system has its origin at a user-defined point.

⚠ CAUTION

If a workpiece has been installed on the mounting flange, the calibration described here will not apply.

Advantages of base calibration:

1. TCP can be jogged along the work plane or edge of workpiece.
2. Points can be taught relative to base. If the base must be moved, for example, because the work plane is moved, the points will be moved as well, and no need to be taught again.

32 base coordinates can be saved at most. Variable: BASE[0…31].

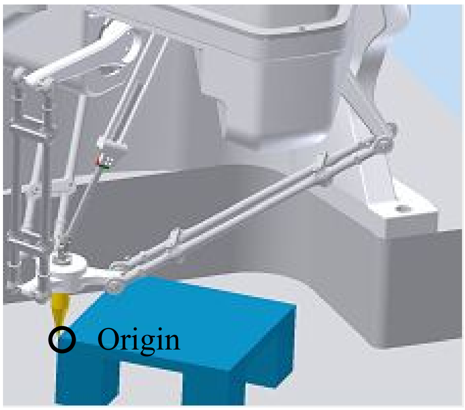
3.5.1.1. Three-point Method

- Prerequisite

Install a calibrated tool on the mounting flange.
T1 mode

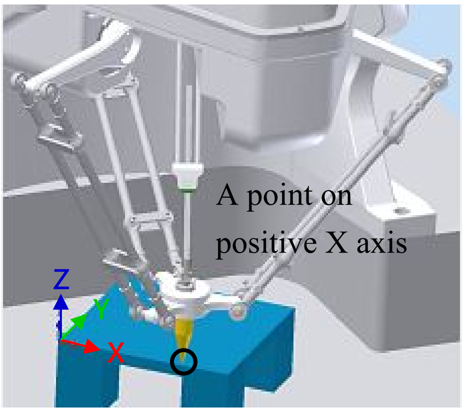
- Operation steps

1. In the main menu select Start-up > Calibrate > Base
2. A number and a name is given to the Base Coordinate System, and then press the CONTINUE button to confirm.
3. Select a number for the base to be calibrated, and then press [Measure].
4. Give a name for the base to be calibrated.
5. Move TCP to the origin of new base coordinate. Click [Measure], and confirm by pressing the OK button.



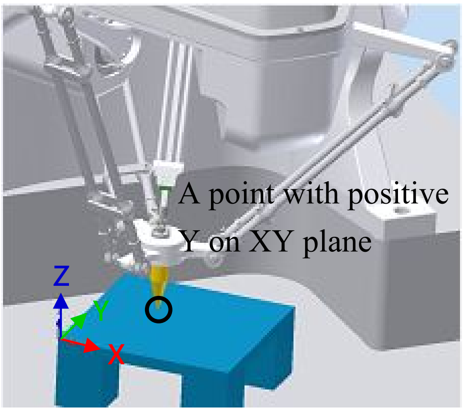
Set the origin of base coordinate system

6. Move TCP to a point on positive X axis of new base coordinate. Click [Measure], and confirm by pressing the OK button.



Set a point on positive X axis

7. Move TCP to a point with positive Y on the XY plane. Click [Measure], and confirm by pressing the OK button.



Set a point with positive Y on XY plane

8. Press the OK button after completed. The data will be saved.

3.5.1.2. Enter Value

- Description

  Values are known, from CAD, for example:

  1. Distance between the base origin and global origin
  2. Rotation for base coordinate relative to global coordinate

  T1 mode

- Prerequisite

  X, Y, Z, A, B and C relative to the flange coordinate system is known

  T1 mode

- Operation steps

1. In the main menu Select Start-up > Calibrate > Base
2. Select a number for the base to be measured.
3. Select the coordinate you want to enter, and then press [Set Value].
4. Give a name for the base to be measured.
5. Enter the value.
6. Press the OK button after completed. The data will be saved.

3.5.2. Calibrate Tool Coordinates

- Description

  When the tool is calibrated, the tool coordinate system has its origin at a user-defined point. This point is called as TCP (Tool Center Point). Usually, TCP is located at the working point of the tool.

⚠ CAUTION

The calibration method described here must not be used to a fixed tool.

Advantage of tool calibration:

1. The tool can rotate along the TCP. The position of TCP will not change.
2. Program running: The track along TCP keeps the programed velocity.

16 tool coordinates can be saved at most. Variable: TOOL [0…15]).

The following data will be saved:

X, Y, Z:

The origin of tool coordinate, relative to flange coordinate

A, B, C:

The rotation of tool coordinate, relative to flange coordinate

X: X coordinate

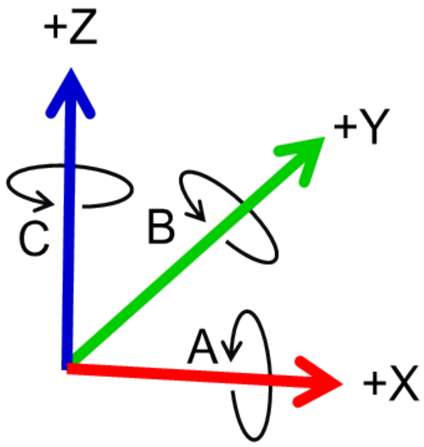
Y: Y coordinate

Z: Z coordinate

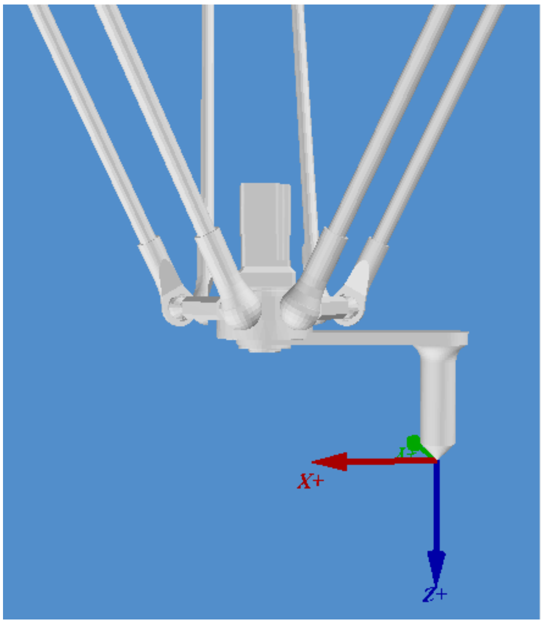
A: Rotate along X coordinate

B: Rotate along Y coordinate

C: Rotate along Z coordinate



Flange coordinates



TCP calibration principle

3.5.2.1. 3-point Method

- Description

  The TCP of the tool to be calibrated is moved to a reference point from 3 different directions. The reference point can be freely selected. The robot control system calculates the TCP from the different flange positions. Achieve the tool coordinates (X, Y, Z, C value, where value of C [J4 rotational angle] is the C value of the first calibrated value).

  ⚠ CAUTION

  The 3 flange positions at the reference point must be sufficiently apart from one another.

- Prerequisite

  1.Install the tool to be calibrated on the mounting flange.

  2.T1 mode

  3.Select a fixed reference point position, it is recommended that this reference point is a shape that is easy to recognize, for example: cuspidal point.

- Operation steps

  1. In the main menu select Start-up > Calibrate > Tool
  2. Select a tool number from the pull-down menu for the tool to be measured, and then press [Measure].
  3. Give a name for the tool to be calibrated.
  4. Use TCP to move to the configured reference point.
  5. Click [Measure] to confirm the first calibration point，if the position of reference point is to be confirmed, please use OK button for confirmation, otherwise, use No or Cancel to cancel the operation.
  6. Use TCP to replace another posture position of arm, move to the reference point. Click [Measure] to confirm second point，if the position of reference point is to be confirmed, please use OK button for confirmation, otherwise, use No or Cancel to cancel the operation.
  7. Repeat Step 6 to confirm third point.
  8. Press confirmation button after completion. The data displays the reference point of new tool coordinate system and is saved, the changed coordinate system can also be observed from the 3D simulation window.

3.5.2.2. Enter Value

- <u>Description</u>

  The tool data can be manually entered.

  Possible data source:

  1. CAD
  2. External measurement tool
  3. Description from tool manufacture

- <u>Prerequisite</u>

  Known X, Y, Z, A, B and C relative to flange coordinate

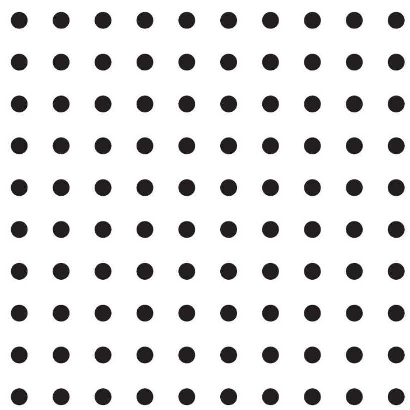
  T1 mode

- <u>Operation steps</u>

  1. In main menu select Start-up > Calibrate > Tool
  2. Select a value for the tool to be measured.
  3. Select the coordinate axis you want to enter, and then press [Set Value].
  4. Give a name for the tool to be measured.
  5. Enter a value.
  6. Press the OK button after completed. The data will be saved.

3.6. Conveyor Calibration

3.6.1. Conveyor Image Calibration



Calibration plate

- The Image System needs to decide the origin of image coordinate, the ratio of pixel length and the reading of conveyor encoder via the calibration plate (Figure above).
- Please ensure that there is a reading on the conveyor encoder before performing the calibration.
- Figure below is an illustration of picking. From the direction of the conveyor, the upstream is before the robot, and the downstream is after the robot.

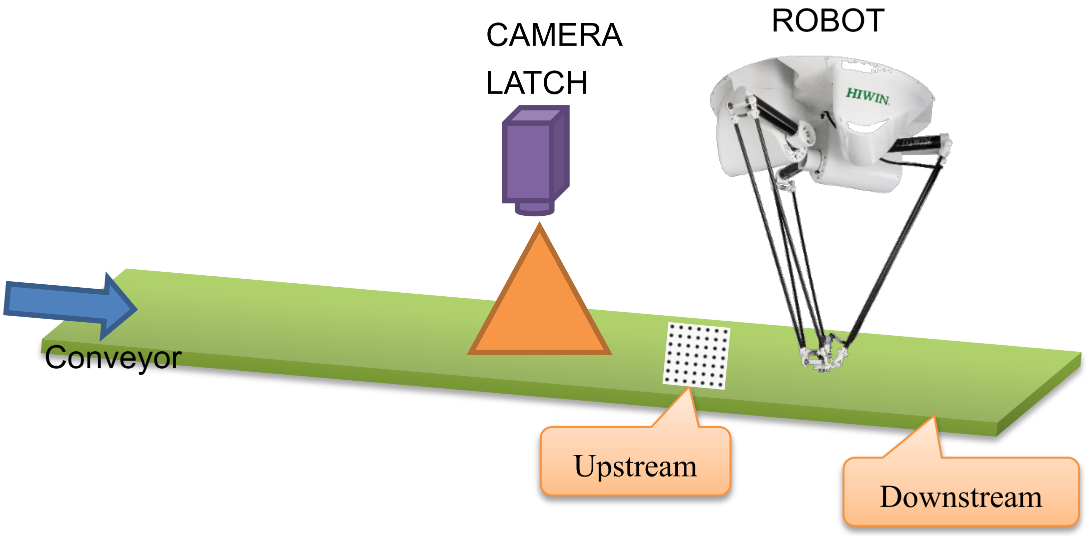
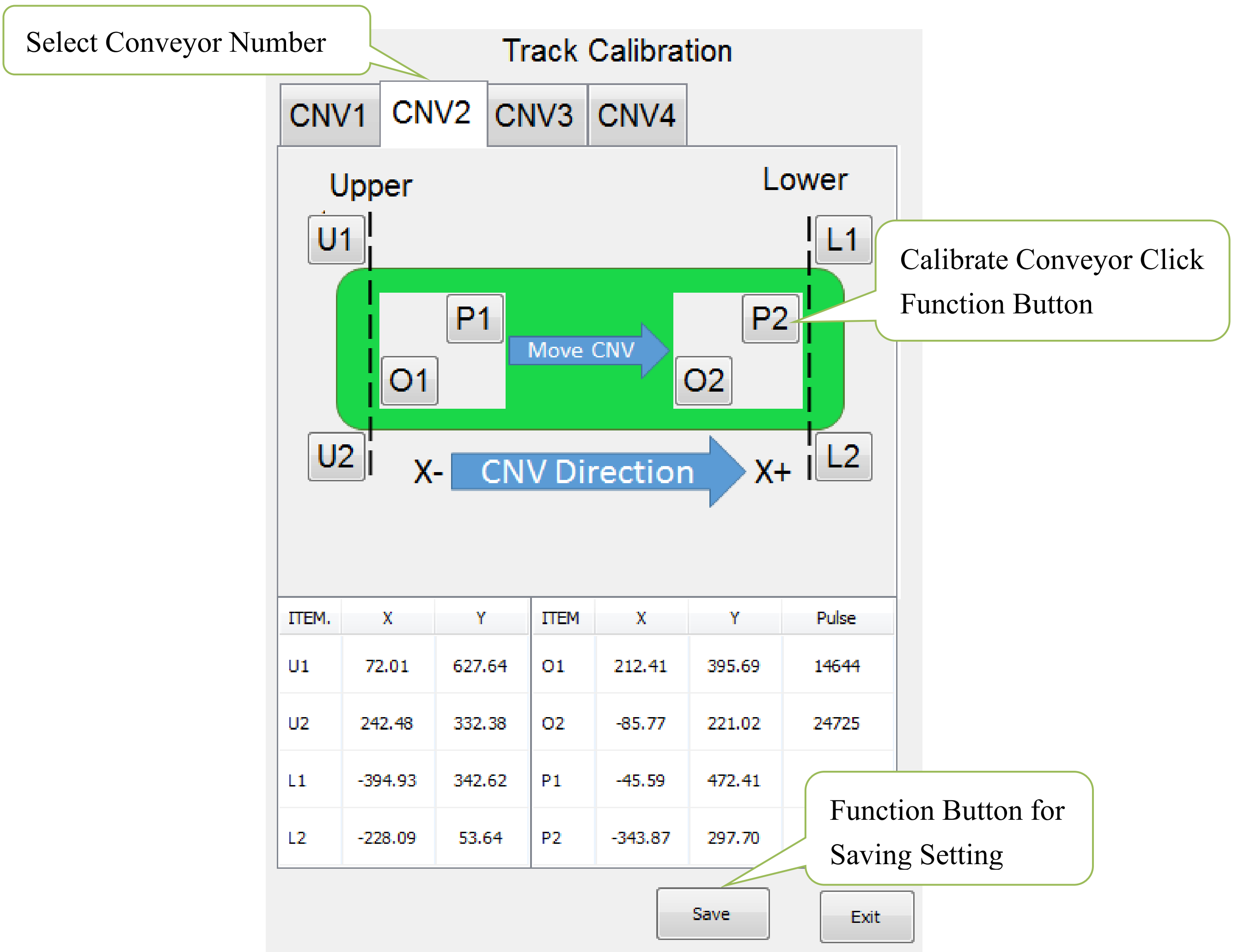


Illustration of Delta and CCD with conveyor

3.6.2. Conveyor Arm Calibration

1. After the images are calibrated, the upstream and downstream of the arm is moved by the conveyor without moving the calibration plate so that the arm can relate with the image coordinate and conveyor via the calibration plate.
2. Install the calibration rod on the arm end when performing the calibration.
3. Click the Main Menu>Track>Calibration.
4. Select the number of the conveyor.
5. When calibration plate is located at the upstream of the arm, and the center of the calibration rod is aligned with the origin of the calibration plate (the same with the vision origin) and press O1, and then aligned with the calibration point of the calibration point and press P1 (If it is in the mode of Sensor Latch, P1 can be omitted.).
6. The calibration plate is moved to the downstream of the arm, the center of the calibration rod is aligned with the origin of the calibration plate (the same with the vision origin) and press O2, and then aligned with the calibration point of the calibration plate and press P2 (The value of the encoder needs to be positive.) (If it is in the mode of Sensor Latch, P2 can be omitted.).
7. The arm is moved to the left and right limit of upstream, pressing U1 and U2 (U1 and U2 cannot be the same point.) respectively; the arm is moved to the left and right limit of downstream, pressing L1 and L2 (L1 and L2 cannot be the same point.) respectively, as shown in below.
8. If the counting direction of CNT is found as counted downward when the conveyor moves during the calibration process, open the function of REV column and make that conveyor counted backward, and then change to count upward.
9. Press “CLEAR” to zero CNT of all conveyors and recount.



Arm calibration screen

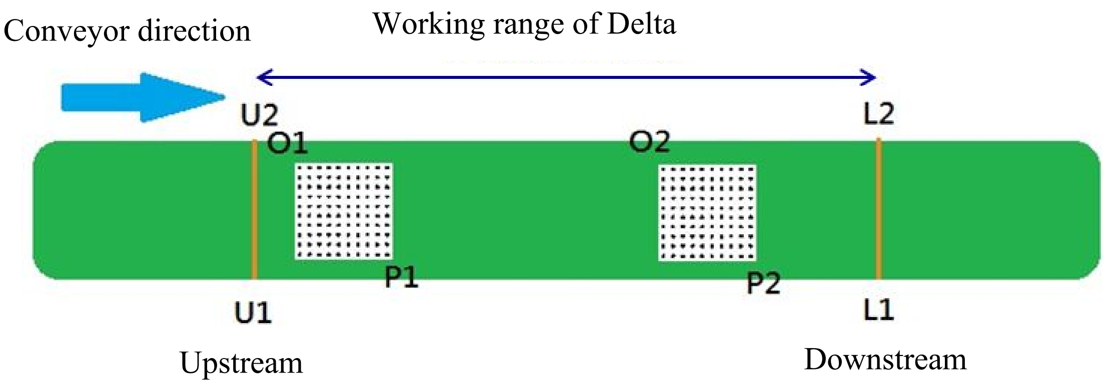
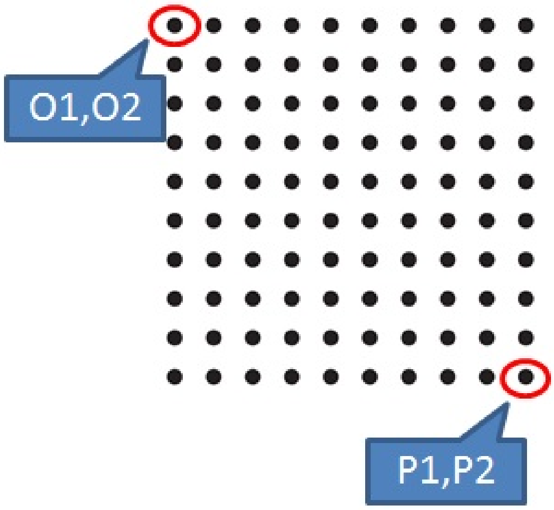


Illustration to calibrate arm position



Set O and P screen

3.7. Conveyor Parameters

3.7.1. Image Parameters

- Main Menu>Track>Vision
- Conveyor number: The information set in the Image Parameter screen (Figure below) will be recorded according to the number of the conveyor. When setting the parameters, select the number first. After setting completed, press the Save button.
- Calibration information: Before using the conveyor track, the calibration point is set to correspond to the coordinate position (mm) in the image system, which is the distance from the origin of the calibration plate to calibration point, as well as the counting value of the encoder when the image is calibrated.
- Connection: IP for the system and the connection port.

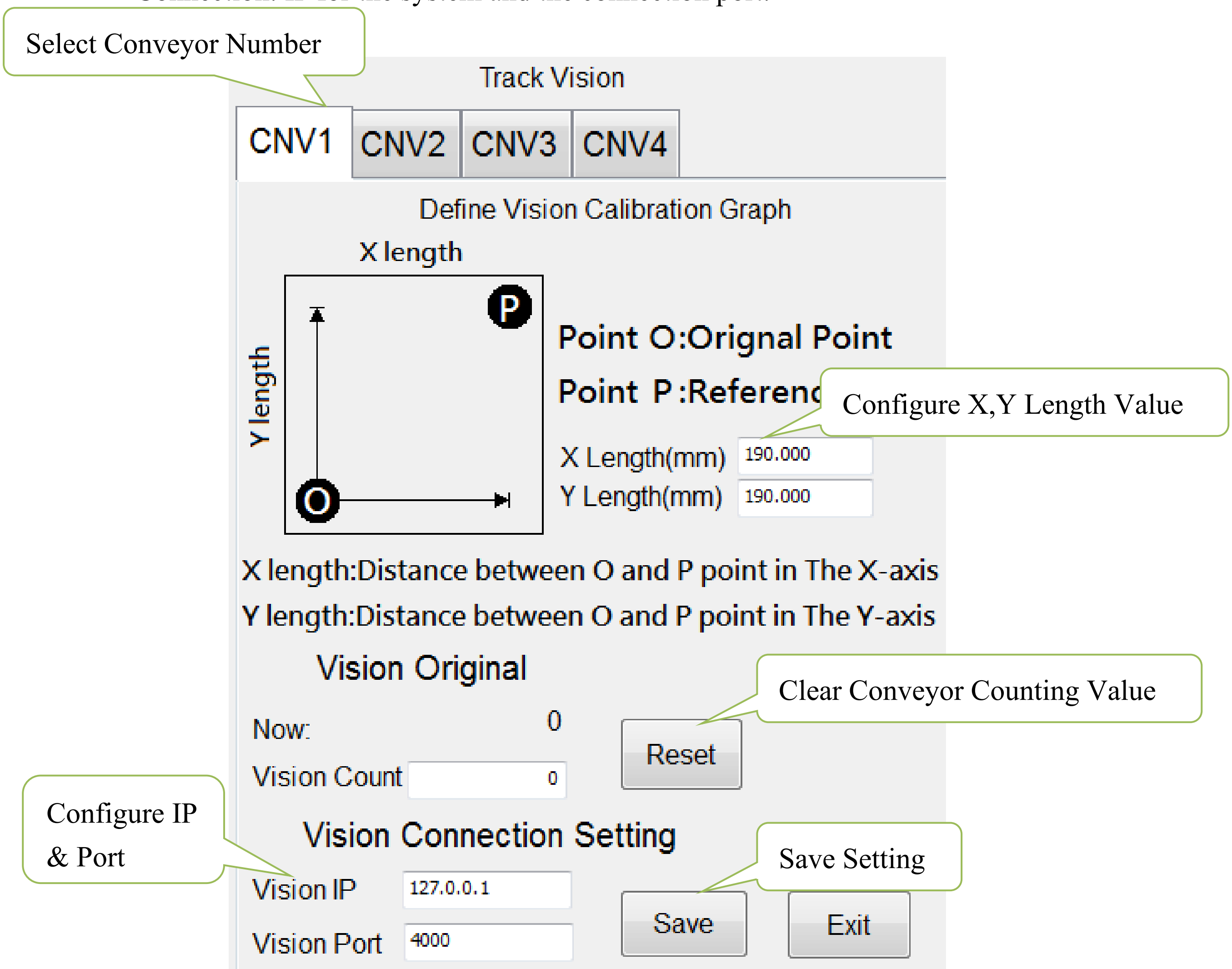
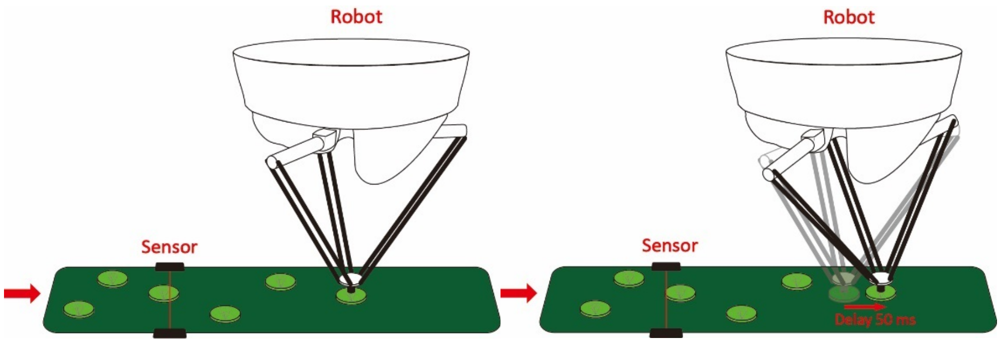


Image parameter configuration interface

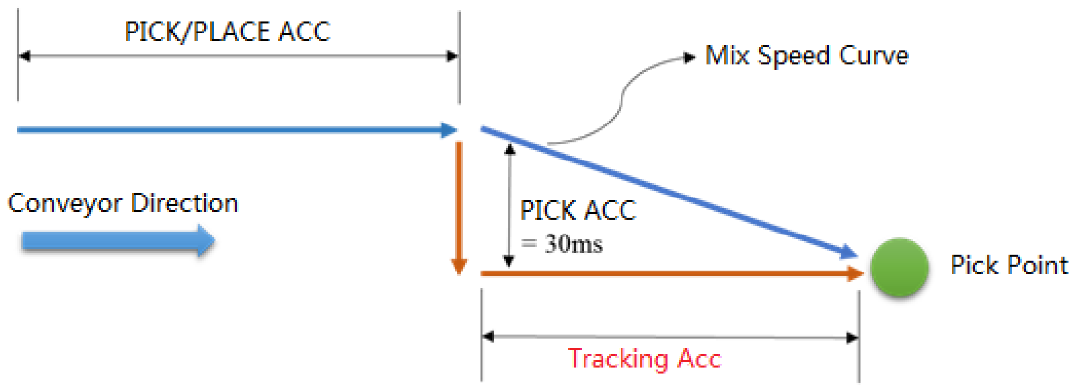
3.7.2. Object Parameters

- Main Menu>Track>Setting.
- CNV STATUS：Configure if this conveyor is to be used.
- DIRECTION：Configure the encoder counting direction of this conveyor.
- Trigger Type：Configure the retrieving type of conveyor object, 1 for using image triggering, 2 for using SENSOR triggering.
- Trigger times: Conveyor tracking state variables, conveyor is set to be used when sensor is triggered. When the sensor is triggered, the arm will receive a signal to perform pick or place. The variable can be set to trigger the sensor several times before adding another work task. Setting range is 1~100, default value as 1.
- Place Batch: The place variable is used when multiple objects are placed in the same workspace. When the senor on conveyor is triggered, the robot will obtain a position where the objects can be placed. The maximum number of place times which the robot will be at that position can be set by this variable. Input range 1~100, default value is 1.
- Tracking Delay：Set how long does take to follow the object and return to action when object is tracked, unit is ms, range 0~1500, default value 0.



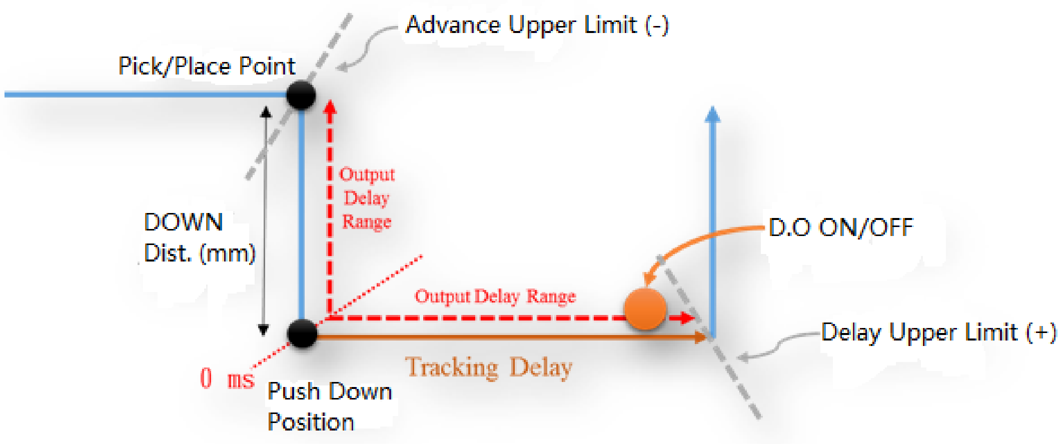
Object tracking delay time

- Tracking Acc：Synchronize acceleration/deceleration time in conjunction with conveyor, unit is ms, range 4~1000, default value is 150.



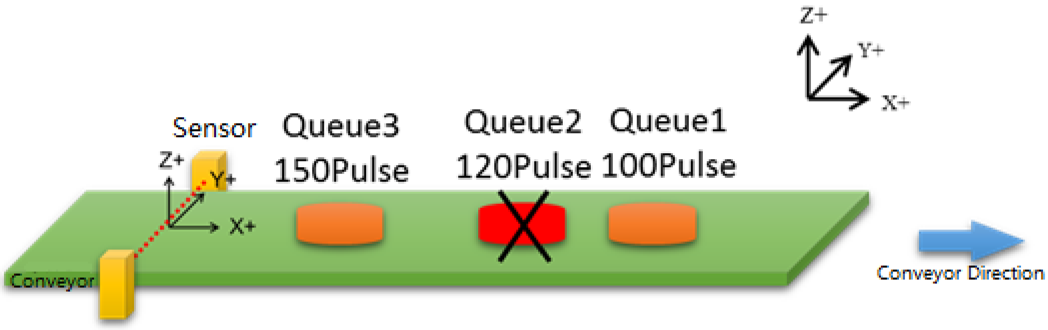
Object tracking acc. time

- Output Delay：Configure the D.O. time required to open when the arm is tracked in place, use the positive/negative value to advance or delay. Range -1500~1500, default value is -25.



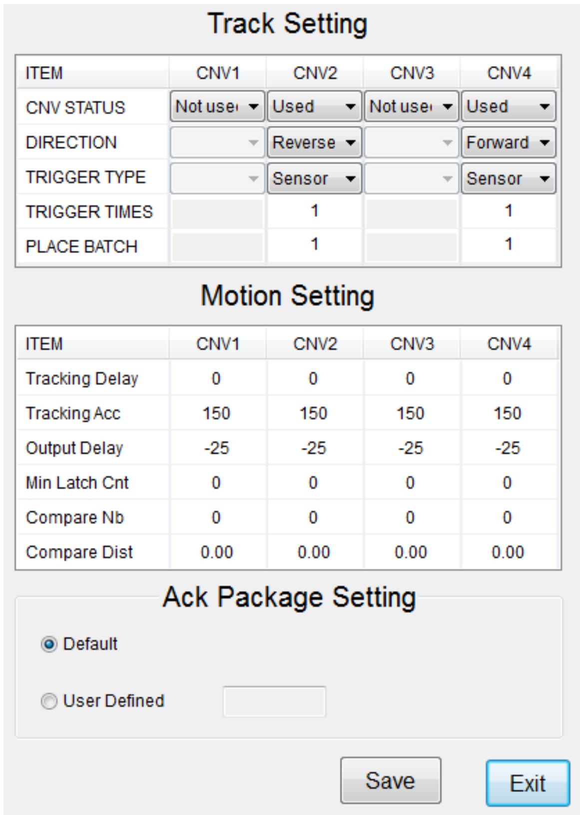
Output delay time

- Min Latch Cnt：Sensor triggers the filtering. Configure the minimum interval of Latch. For example: if the difference between the previous object of Latch and the current object of Latch is less than the setting of Count, the current object of Latch will be ignored, default value is 0. Figure below shows 3 object on the conveyor, when Min Latch Cnt is set as 25, Queue 2 will be ignored.



Description of Min Latch Cnt

- Compare Nb：Vision triggers the filtering function, it is able to configure the size of filtering Buffer, this size affects when the vision acquires the information of new object, it is required to compare the distance with the n number of determined Latch objects, and then determine if it is the Latch object. Range x0~20, default value is 0.
- Compare Dist：Vision triggers the filtering function, undertake the functional description of above point, this parameter is the length of compared distance, and default value is 0.00.
- Ack Package Setting：Customize image return signal content, Default return "{Conveyor number}".



Object parameters setting interface

3.8. Home and Position Check Configuration

3.8.1. Home Configuration

- Description

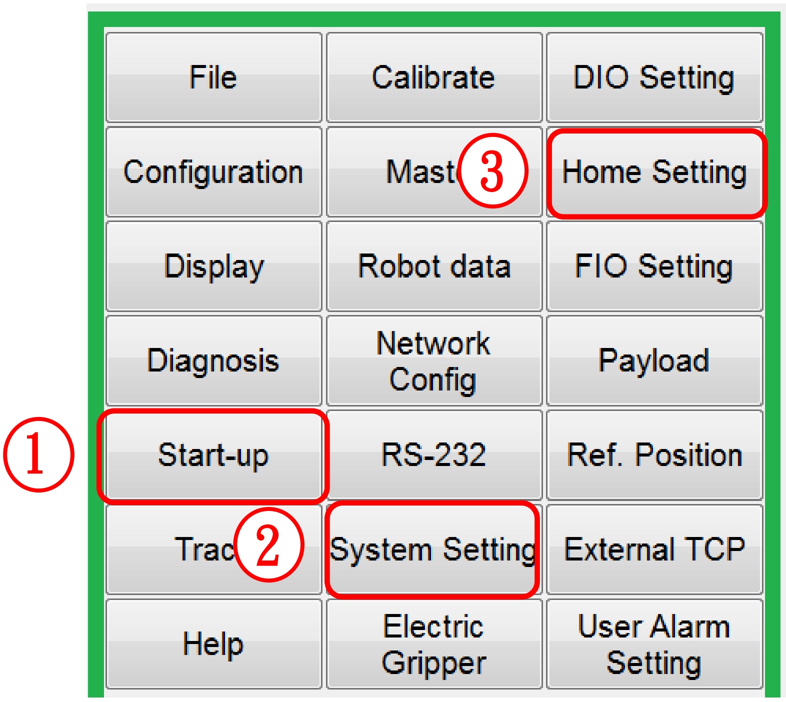
  Self-setting or recover the origin (Home) position.

- Prerequisite

  T1 mode

- Operation steps

1. Select Start-up>System Setting>Home Setting. (Figure below)
2. Use Jog to move to the user-defined origin position.
3. Press the Setting Home Point button after moving. (Figure below)
4. The ”Do you want to set new home point?” window appears.
5. Press the OK button to complete.
6. If you want to recover the initial setting, press the Default button.
7. The ”Do you want to recover default value?” window appears.
8. Press the OK button to complete.



Home Setting

3.8.2. Configuration of Position Check Alarm

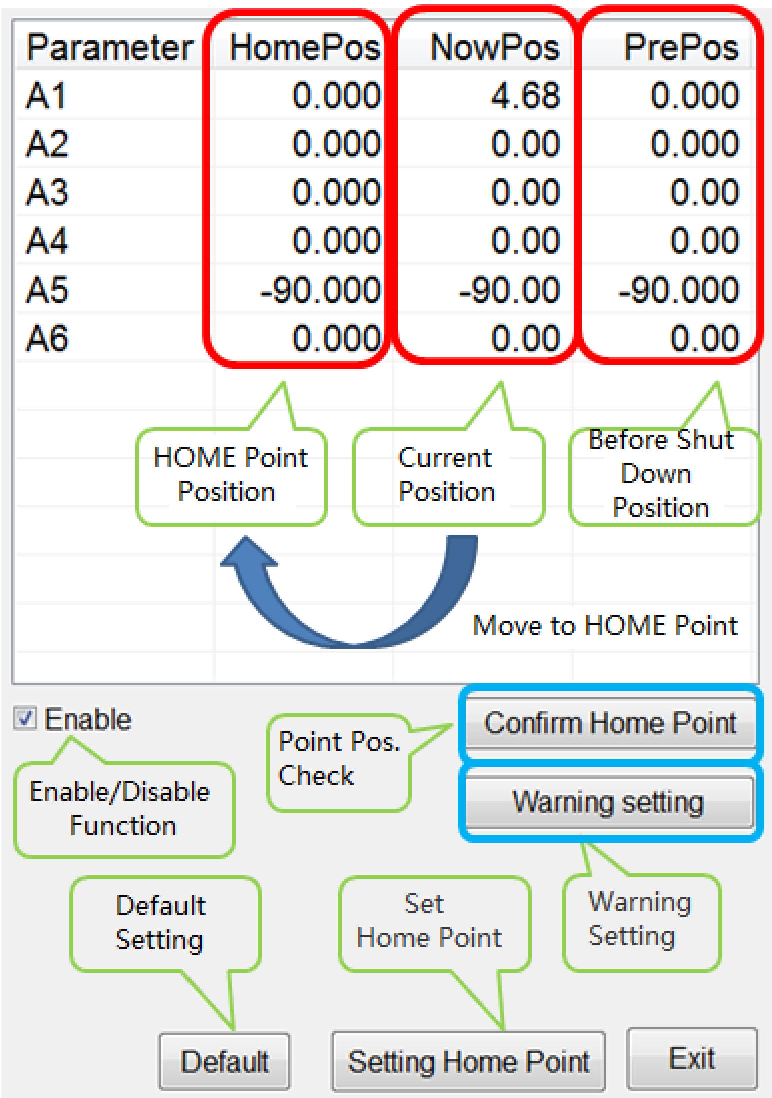
- Description

  The parameters for position check alarm appears.

- Prerequisite

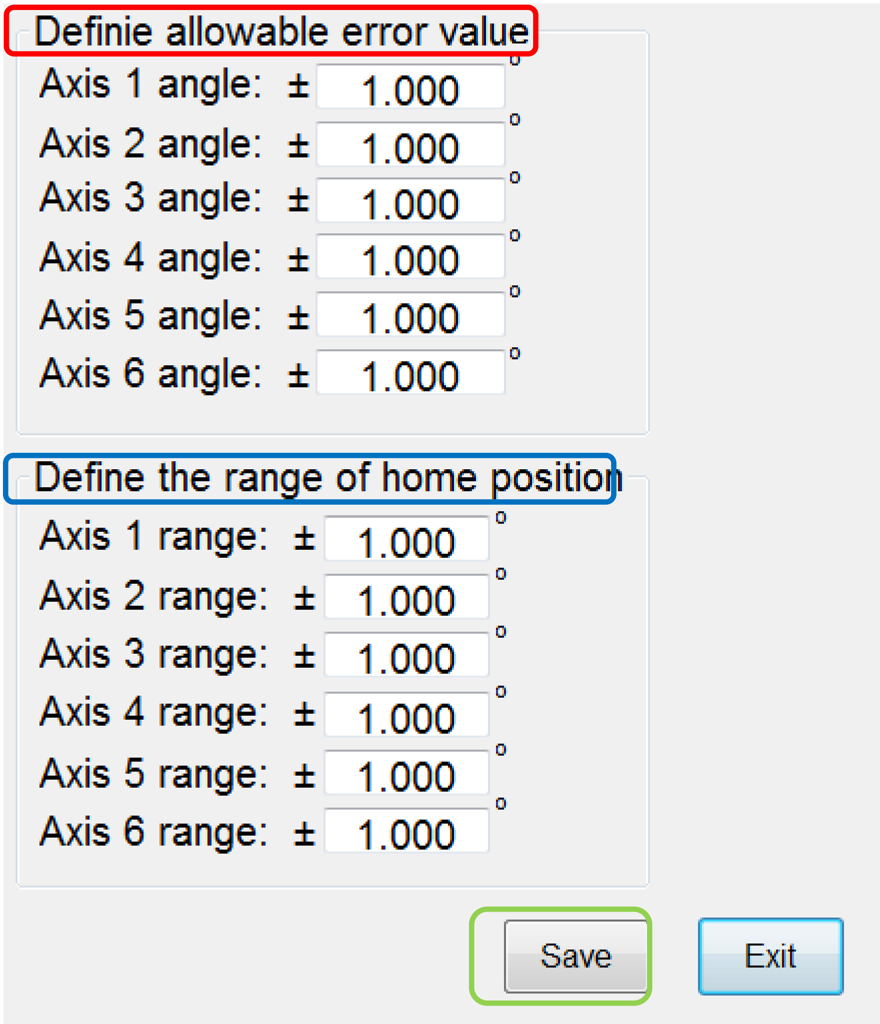
  T1 mode

- Operation steps
  1. Select Start-up>System Setting>Home Setting. (Figure below)
  2. Click Warning Setting button (Figure below).



Home Setting interface

3. In the Define allowable error value field, the tolerant error range of the first axis to the sixth axis can be set. If the angle difference before shutdown and after booting is greater than this setting value, the alarm will appear “Start pos declination error.” Code 01-04-30.
4. In the Define the range of home position field, you can set the range of angles that can remove the alarm. When the position check alarm appears, you need to manually move back to the origin. If the final position is located in this range, you can use Confirm Home Point to remove the alarm.
5. Press the Save button to save the set value.



Warning setting interface

3.8.3. Position Check

- Description

  The alarm can be removed because of the difference before and after booting "Start pos declination error"

- Operation steps

  1. Select Start-up>System Setting>Home Setting. (Figure below)
  2. The NowPos field shows the current axle angle, and the HomePos field shows the setting Home. (Figure below)
  3. Using hand to move the robot manually, so that the angle of NowPos moves closer to HomePos.
  4. When it is close to Home, even though there is an angle within 1º difference, Press Confirm Home Point to finish the position check, and remove the alarm.

3.9. Infinite Rotation Function (Optional)

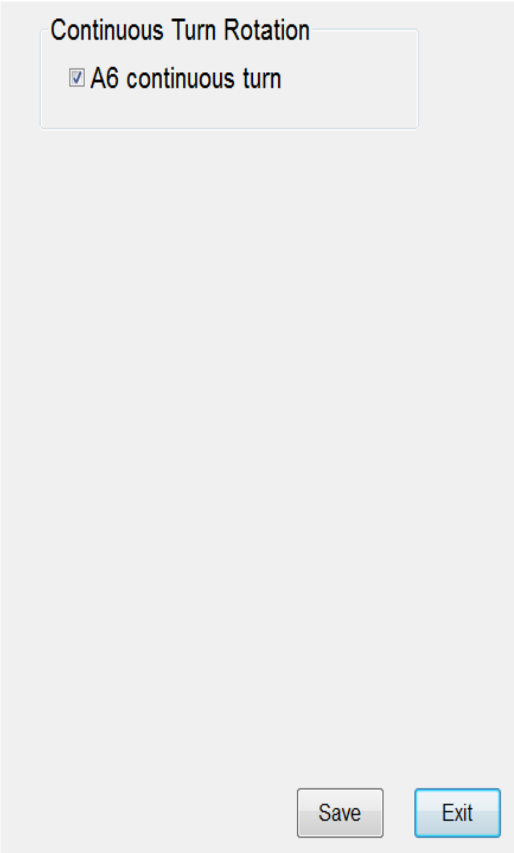
3.9.1. Axis 6 Infinite Rotation Function

- Description

  The infinite rotation function of sixth axis of the manipulator can be set, so that there is no limit when the sixth axis is running.
- Prerequisite

  Keypro device is connected to the controller

  Expert user group
- Operation Steps
  1. Main Menu> Start-up>System Setting>(Next)>Continuous Turn
  2. Select A6 continuous turn.
  3. Click **Save** button, "Saved Successfully!" window will pop up when setting is saved.
  4. The user can manually move the sixth axis of the manipulator without limit.
  5. The user can use the CT_A6 command to perform the infinite rotation of the sixth axis of the manipulator.

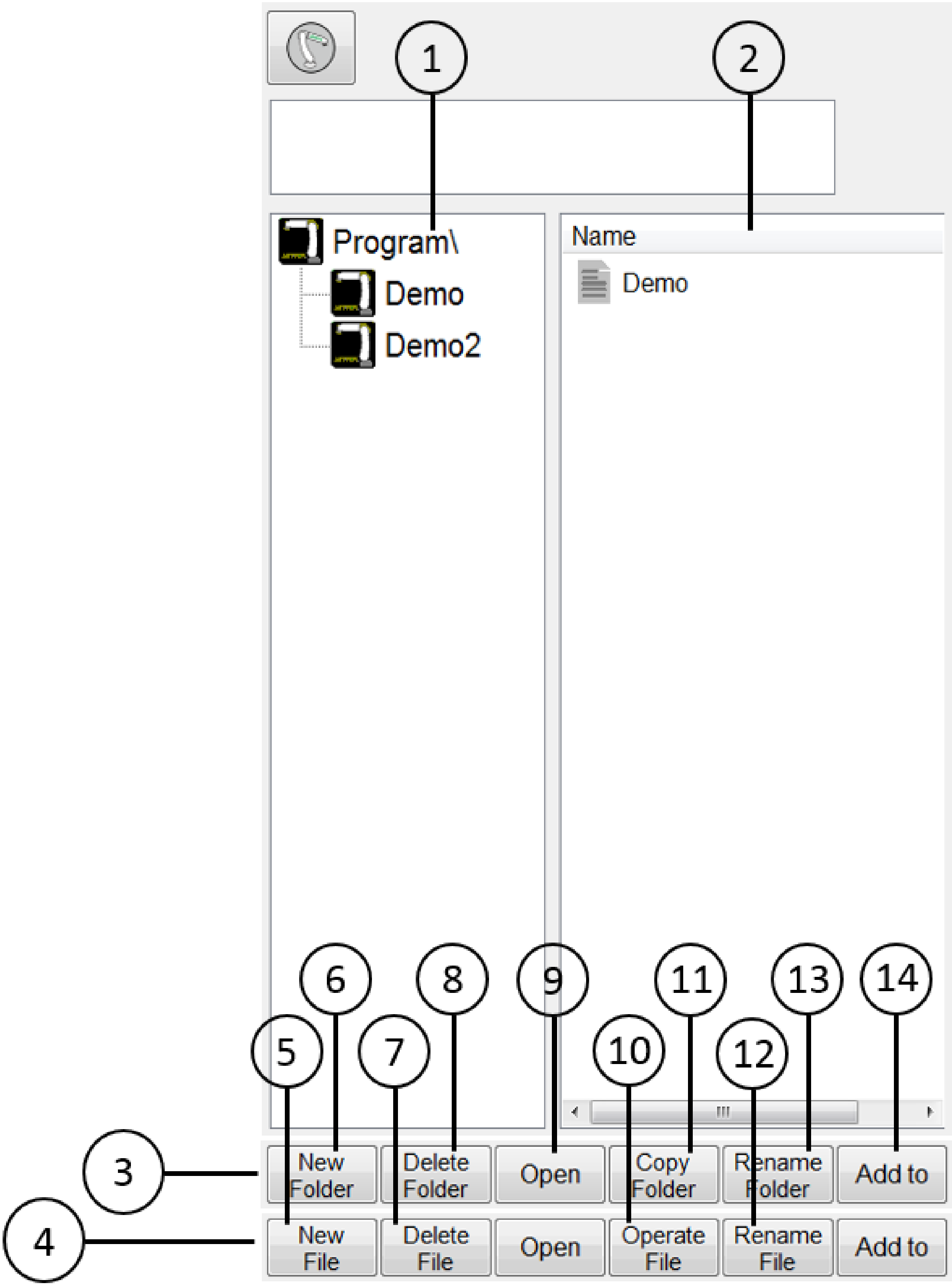


Sixth axis infinite rotation function interface

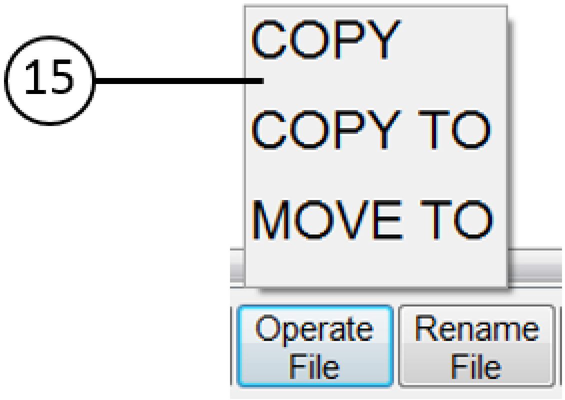
4. Program Management

4.1. Document Navigator

- Overview



Navigator



Program file operation interface

- Description

  A user can manage the program in the navigator.

No.	Description
1	Content structure When double click the folder, refresh the document list.
2	Document list Display the program in the content structure
3	Click on No. 1 to display the folder operation
4	Click on No. 2 to display the program file operation
5	Add new program
6	Add new file
7	Delete program file
8	Delete folder
9	Open program
10	Operate program file
11	Copy folder
12	Rename program
13	Rename folder
14	Add the program to Functional I/O
15	Click on No. 10 to open this operation. Program file can be “COPY”, “COPY TO” and “MOVE TO”.

4.2. Add Program

- Prerequisite

  T1 mode, T2, AUT and EXT

  T2, AUT and EXT cannot edit the program.

- Overview

  One program file can be added.

- Operation Steps

1. Click on New File
2. Enter the name of the new file, make sure it meets the file name specification.
3. Press Ok to complete adding new program.

4.3. Copy Program

- Prerequisite

  T1 mode, T2, AUT and EXT

  T2, AUT and EXT cannot edit the program.

- Overview

  One program file can be copied.

- Operation Steps

1. Click the program file from the program list.
2. Select the COPY from the operate file or COPY TO folder
3. If selected COPY, the current program in the folder will be copied.
4. If selected COPY TO, user can choose which folder to copy.
5. The name of the copied file is called “xxx_copy.hrb”, if the name is existed, the rename window will appear. Please type in the name that has not been used and make sure the file of the name meets the file name specification.

4.4. Open Program

- Prerequisite
  T1 mode, T2, AUT and EXT
  T2, AUT and EXT can not edit the program.

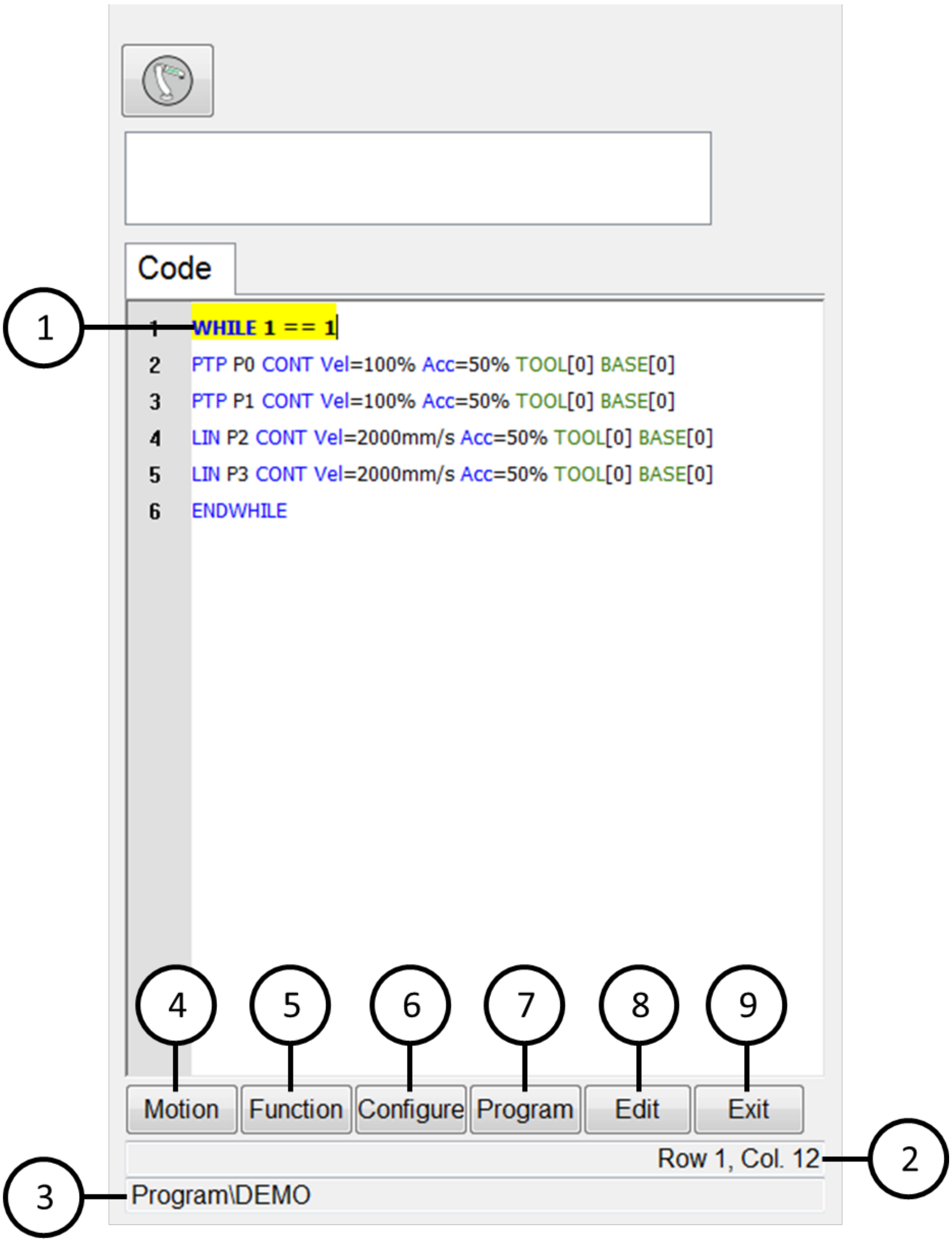
- Overview
  Select or open a program. An editor and a program will be displayed, but not the navigator.

- The program has been opened:
  1. The program can start.
  2. Only experts can edit the program.

- Operation steps
  1. Select the program in the navigator and press the Open button. That program will be displayed on the editor.
  2. Edit the program.
  3. Close the program.

⚠ WARNING
When bring external computer-edited program file is loaded into the controller, the file cannot be opened if the file name does not meet the format of the file name.

- Description



Program interface

No.	Description
1	Cursor & highlighted line The line is highlighted when a cursor is moved on it.
2	Cursor position
3	Program path and filename
4	Basic motion command

5	Determination and loop command
6	Control command (Timer, Counter and Output)
7	Operation control (copy, cut, paste, delete, comment, cancel annotation, indentation, cancel indentation, recovery, cancel recovery)
8	Edit the program content which has already been established.
9	Exit

4.5. HRSS STRUCTURE

```
...
8 LIN P1 CONT Vel= 200 mm/s Acc=50% Tool[3] Base[4]
...
14 PTP P1 CONT Vel= 100 % Acc=50% Tool[3] Base[4]
...
```

Line	Description
8	LIN motion
14	PTP motion

If the first motion command is not a default home position or that position has changed, one of the following commands must be used:

Complete PTP command

Complete LIN command

"Complete" represents all contents which must enter the target points.

⚠ WARNING

If you change the home position, all programs will be affected and may cause the injury and property loss.

4.5.1. Home Position

The home position is located in the effective range of the whole program. It is generally used for the start and end. It is clearly defined, but it does not take critical effect.

By default, the home position is located in the control system, and provided with the following values:

Six axis robot:

Axis	A1	A2	A3	A4	A5	A6
Angle	0°	0°	0°	0°	-90°	0°

Delta robot:

Axis	A1	A2	A3	A4
Angle	0°	0°	0°	0°

Other home positions are possible under following conditions:

1. Good starting position for program execution
2. Good standstill position. For example, the stationary robot must not be an-obstacle.

⚠ WARNING

If the home position is changed, all programs will be affected which could lead to serious injury, death or equipment damage.

4.6. Start Program

4.6.1. Select Program Running

- Operation steps
  1. Click "Single Step", and execute the Select button.
  2. Select Program Running.

4.6.2. Program Running

Program Running	Description
Continuous	The program continuously runs to the end.
Single step	The program will pause after each line. The unseen lines and empty lines are included. The Start button must be pressed again for each line.

4.6.3. Pre-reading

- Description

  Pre-reading means that the controller will pre-read the program to calculate the motion of the smooth track for example:

  LIN P1 CONT
  LIN P2 CONT
  IF $DI[1] == TRUE THEN
  LIN P3 CONT
  ENDIF

  During the execution of the program, if IF $DI[1] == TRUE the condition is true, the controller will pre-read LIN P3 command. If you want to reach P2 before condition is judged, please add WAIT SEC command on the next line of LIN P2. With the command, the program will then judge the condition of $DI[1] after P2 is reached to decide whether execute LIN P3

4.6.4. Set Program Ratio

- Description

  The program ratio is used to set the robot velocity. It is represented with a percentage, based on the programmed velocity.

CAUTION

In T1, the maximum velocity is 250mm/s, nothing to do with the set value.

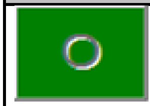
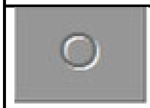
- Operation steps
  1. Open the velocity window.
  2. Set the program ratio. The +/- button or scroll can be used to set.
  3. Select the area outside the window. Close the window or apply the ratio.

- Another method

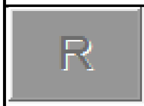
  The +/- button on the left side of Teach Pendant can be used to set the ratio.

4.6.5. Driver status

The driver status will be dispalyed in the status bar.

Figure	Color	Description
	Green	Driver ready
	Gray	Driver not ready

4.6.6. Decoder Status Display

Figure	Color	Description
	Orange	Decoder is under running.
	Gray	Decoder is not running.

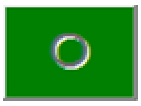
4.6.7. Start a Program (Manual)

- Prerequisite

  Program selected

  T1 mode or T2 mode

- Operation steps
  1. Select Program Running.
  2. Press the Enabling Switch until it displays the status bar “Driver ready”:



3. Press the Start button.
4. The program starts to execute.
5. To stop a program with manual start, press the Stop button or release the Enabling Switch.

4.6.8. Start a Program (Auto)

- <u>Prerequisite</u>

  Program selected
  AUT

- <u>Operation steps</u>

1. Select program running.
2. Press the Start button.
3. The program starts to run.
4. To stop a program in automatic mode, press the Stop button.

4.6.9. Start External Auto Run

- <u>Prerequisite</u>

  Program selected
  EXT

- <u>Operation steps</u>

1. Select “EXT”.
2. The program starts to activate from the higher-level control system (PLC). In order to stop the program in EXT Auto Run, press the Stop button.

4.7. Edit Program

- <u>Overview</u>

  A running program can’t be edited.
  The program can’t be edited in T2, AUT and EXT AUT.

CAUTION

If a selected program is edited in the expert group, a cursor must be moved to another line from the edited line after edited. This will ensure the contents are saved when the program is closed.

4.7.1. Copy Program Bar

- Premise

  Program is selected or already opened

  Expert user group

  Operation mode T1
- Operating Steps
  1. Select the program bar to be copied.

     (No need to highlight the program bar, only the cursor is needed.)
  2. Select menu Program > Copy

4.7.2. Paste Program Bar

- Premise

  Program is selected or already opened

  Expert user group

  Operation mode T1
- Operating Steps
  1. Select the location where the program bar is to be pasted.
  2. Select menu Program > Paste

4.7.3. Cut Program Bar

- Premise

  Program is selected or already opened

  Expert user group

  Operation mode T1
- Operating Steps
  1. Select the program bar to be cut.

  (No need to highlight the program bar, only the cursor is needed.)

  2. Select menu Program > Cut

4.7.4. Delete Program Line

- Prerequisite

  Program is selected or already opened

  Expert user group

  T1 mode

- Operation steps
    1. Select the program lines to be deleted. It is not necessary to highlight the program line. If a cursor is in the program line, it is ok. (No need to highlight that program bar, only need the cursor in that program bar.)
    2. Select menu Program>Delete.

⚠ CAUTION

The program lines deleted cannot be recovered again!

4.7.5. Comment Program Bar

- Premise

  Program is selected or already opened

  Expert user group

  Operation mode T1
- Operating Steps
    1. Select the program bar to be commented.

  (No need to highlight the program bar, only the cursor is needed.)

    2. Select Menu Program > Comment

4.7.6. Cancel Comment Program Bar

- Premise

  Program is selected or already opened

  Expert user group

  Operation mode T1
- Operating Steps
    1. Select the program bar required to cancel comment.

  (No need to highlight the program bar, only the cursor is needed.)

    2. Select Menu Program > Uncomment

4.7.7. Indent Program Bar

- Premise

  Program is selected or already opened

  Expert user group

  Operation mode T1
- Operating Steps

  Select Menu Program > Indent

4.7.8. Cancel Indent Program Bar

- Premise

  Program is selected or already opened

  Expert user group

  Operation mode T1

- Operating Steps

  1. Select the program bar required to cancel indent.

  (No need to highlight the program bar, only the cursor is needed.)

  2. Select Menu Program > Unindent

4.7.9. Recovery Program Bar

- Premise

  Program is selected or already opened

  Expert user group

  Operation mode T1

- Operating Steps

  Select Menu Program > Undo

4.7.10. Cancel Recovery Program Bar

- Premise

  Program is selected or already opened

  Expert user group

  Operation mode T1

- Operating Steps

  Select Menu Program > Redo

4.8. Backup and Recovery Data

4.8.1. Backup Data

- Description

  This function will create a HIWIN/Backup on the USB memory stick with the year and date as the name of the folder for the program.

- Prerequisite

  Connect a USB memory stick to the control system.

- Operation steps

  1. Main Menu>File>Save to USB.
  2. Wait for the completion window, and close it.
  3. Remove the USB memory stick when the LED indicator turns off.

4.8.2. Recovery Data

- Description

⚠ WARNING

Only load saved file data with the same model and same software version in the robot program. If other files are loaded, the following results could appear:

1. Errored information
2. The robot controller will not run
3. Injury or property damage could occur

- Prerequisite

  Connect USB memory stick with files to the controller.

- Operation steps

  1. Main Menu>File>Load from USB, and then select the program you need.
  2. Click Yes to answer the safety inquiry. The saved files will be recovered on the control system.
  3. Remove the USB memory stick when the LED indicator turns off.
  4. Reboot the control system.

4.9. Rules for naming files

- Overview

  Rules for naming files, the program file has to satisfy this rule to ensure adding or copying of the file successfully.

- Content

  1. Only Arabic numerals (0-9), English letters (a-z, A-Z) and underscore (_) can be used for naming.
  2. Special symbols「~!@#$%^&*()-+={}[]<>,.?/\|」 are not allowed.
  3. The first character cannot be a number.
  4. Not more than 100 words.

⚠ WARNING

If the name of the program file does not correspond to the rules, follow situation may occur when operating other function :

1. Unable to open the file
2. Unable to copy the file
3. Unable to be added to external startup functions list
4. Unable to use external subroutine functions

5. Motion Program Design

5.1. Motion Overview

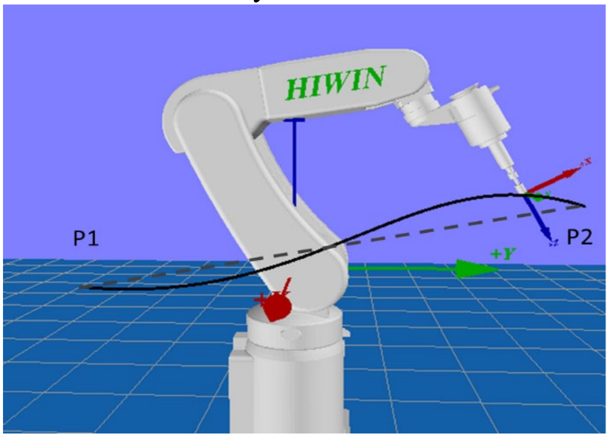
Program designed by the following motion:

Point-to-point motion (PTP)
Linear motion (LIN)
Circular motion (CIRC)

LIN and CIRC Motion is also called as "CP motion" (CP = Continuous Path).
A start point must begin at the end point of the previous motion.

5.2. Point-to-point (PTP) Motion

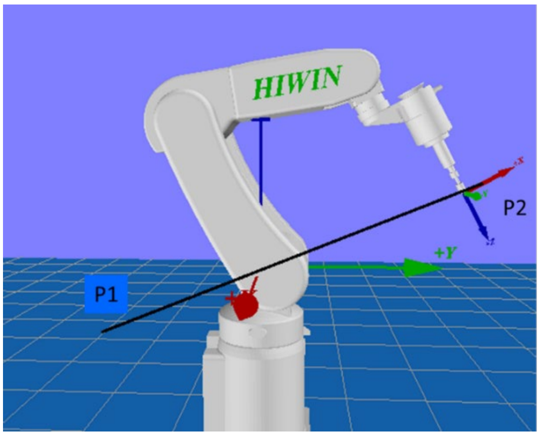
The robot guides TCP to the target point along the fastest path. Generally the fastest path is not the shortest one. This means that it is not a straight line. Because the axis performs rotational motion, the curved path is faster than the straight one.
The motion cannot be accurately known in advance.



PTP motion

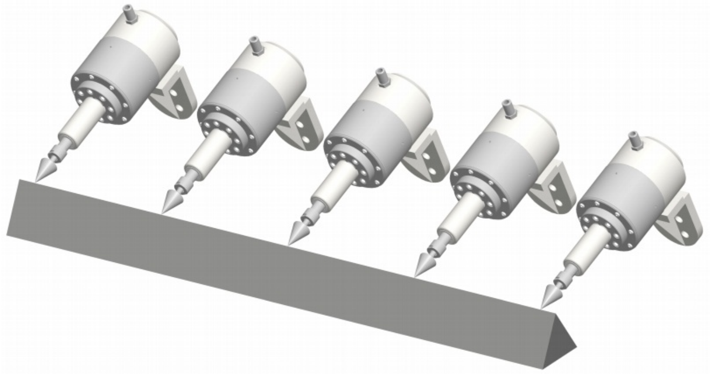
5.3. LIN Motion

The velocity defined by the robot along a straight line moves TCP to the target point.

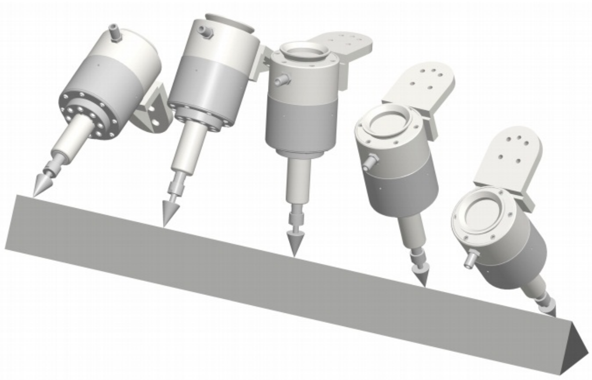


LIN motion

TCP at the start point of motion could be in an orientation different from the target point. The orientation of TCP will gradually change during the motion. When the TCP is at the start point of motion and in the same orientation as the target point, the orientation of TCP will remain the same in the motion.



Start point in same orientation of target point



Start point in different orientation of target point

5.4. CIRC Motion

The velocity defined by the robot along the circular path moves the TCP to the target point. A circular track is defined by the start point, auxiliary point and target point.
For the CIRC motion, the orientation guide is the same orientation as with LIN motion.
In the CIRC motion, the control system only considers the orientation of the target point. The orientation of auxiliary point is usually ignored.

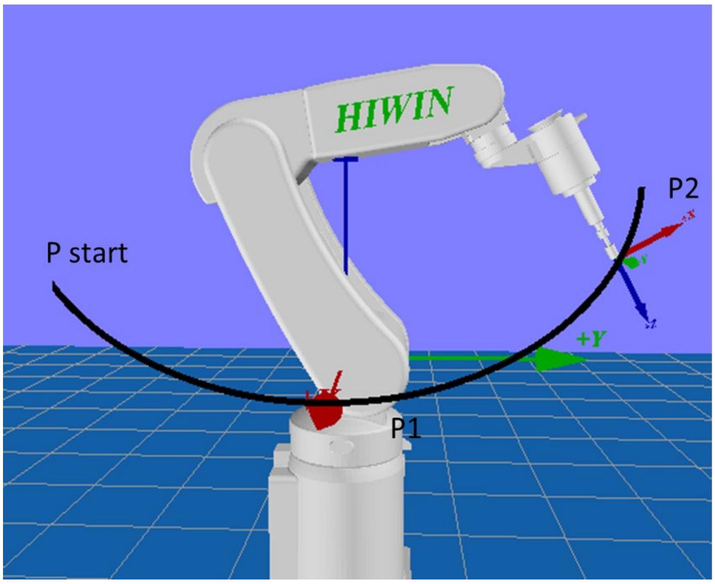


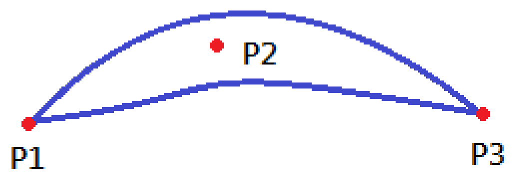
Figure 7.5 CIRC motion

5.5. Blend

Blend: Not accurately moved to the point programmed. The over blending is another option that can be selected during the motion program.

- PTP motion

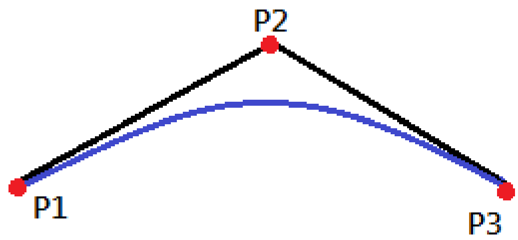
  The TCP will leave a track where it can accurately reach the target point, and adopt the faster one. When over blending takes place in a PTP motion, the track change cannot be foreseen. The point through which side on the track cannot be forecasted.



PTP motion and P2 blended

- LIN motion

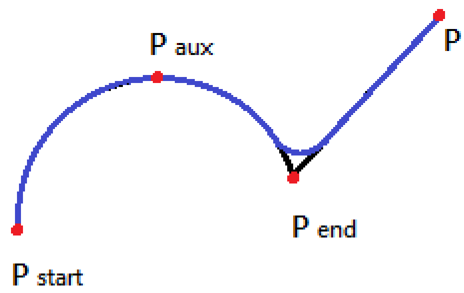
  TCP will leave a track where it should accurately move to the target point, and run on a shorter track. The region where the track path runs is not an arc.



LIN motion and P2 blended

- CIRC motion

  TCP will leave a track where it should accurately move to the target point, and run on a shorter track. The auxiliary point can reach accurately. The region where the track path runs is not an arc.



CIRC motion and Pend blended

5.6. Singular Point

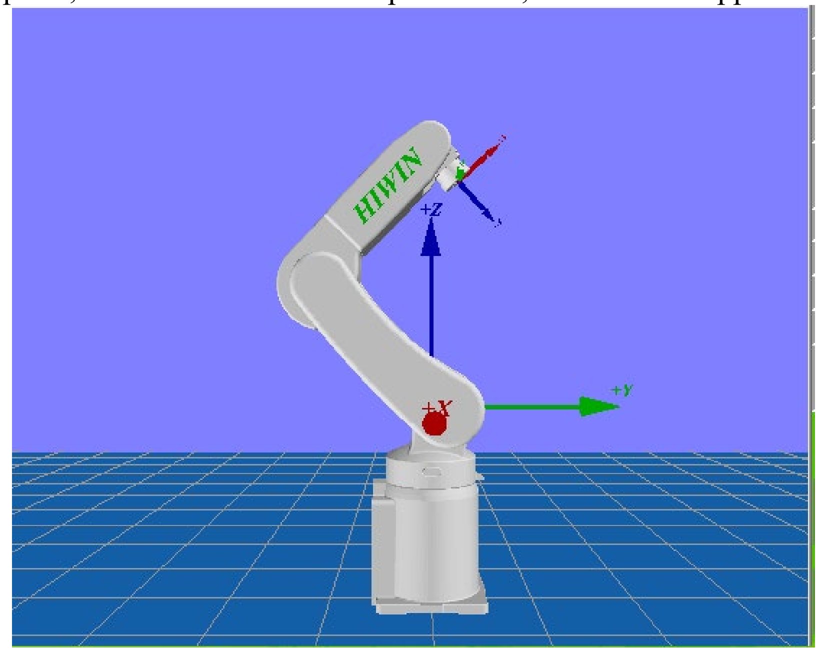
The HIWIN's robot with six degrees of freedom has three kinds of singular point.

1. Overhead singular point
2. Singular point at extended position
3. Singular point at wrist axis

It is considered as a singular point position only when one value can't be obtained by the inverse conversion (converted from Cartesian coordinate to articulated coordinate). In this situation, it is a position of singular point when the minimum Cartesian variation could cause a large change of axis angle.

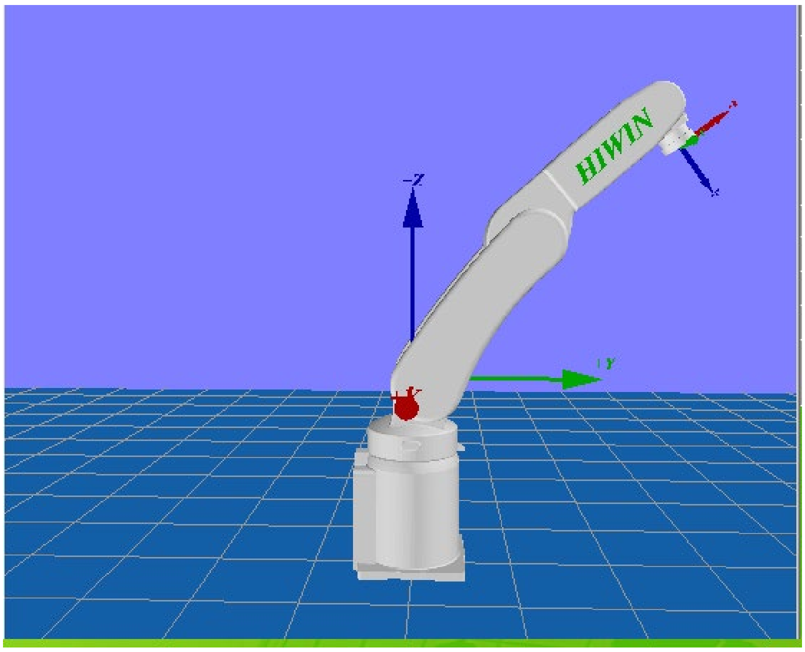
- Overhead

For the overhead singular point, the wrist point (the middle point of axis A5) is vertical to the axis A1.
The position of the axis A1 cannot be confirmed by the inverse conversion, and it can be any value.
At this point, if the inverse motion is performed, an error will appear.



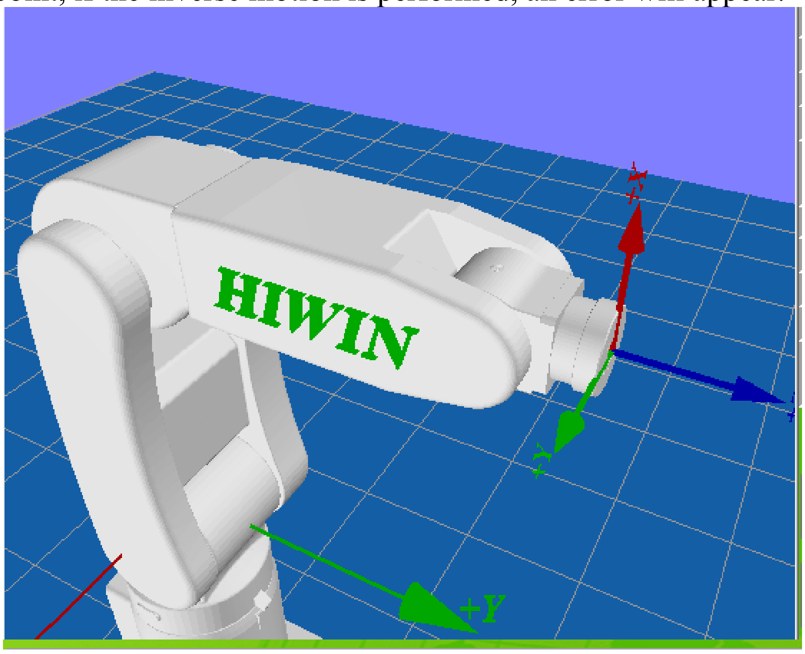
- Extended position

For the singular point at the extended position, the wrist point (the middle point of axis A5) is located in the extension of axis A2 and A3.
The robot is located at the edge of the workspace.
Although only one axis angle can be obtained by the inverse conversion, the small Cartesian variation will cause the large velocity of the axis A2 and A3.
At this point, if the inverse motion is performed, an error will appear.



- Wrist axis

  For the singular point of the wrist axis, the axis A4 is parallel with A6, and the axis A5 is within the range ±0.1° .
  The positions of two axes can't be confirmed by the inverse conversion. Although the axis A4 and A6 can have many positions but the sum of the axis angle is the same.
  At this point, if the inverse motion is performed, an error will appear.



6. Programming with inline forms

Frequently used commands are provided in the HRSS inline forms. These commands can simplify program design.

⚠ CAUTION

Commands can be program without inline forms. The HRL (HIWIN robot language) is used to program.

6.1. Name in Inline Form

The program can enter the data name. For example, the name of the motion data set.

The name must satisfy the following limits:

1. No more than 30 characters.
2. Special characters other than $ are not allowed.
3. The first character can not be a number.

This limit does not exist for the output name.

6.2. Programming for PTP, LIN, CIRC, SPINE Motion

6.2.1. Programming for PTP Motion

⚠ CAUTION

When motion is programmed, ensure the power supply will not wind or be damaged when the program is run.

6.2.1.1. PTP

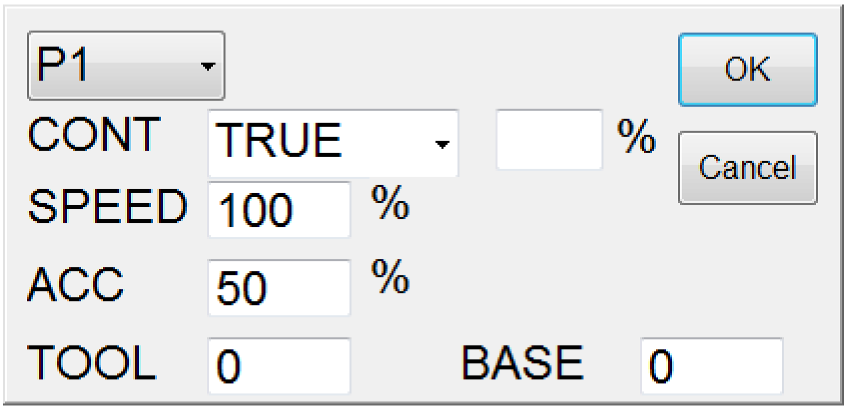
- <u>Prerequisite</u>

  Program selected

  T1 mode

- <u>Operation steps</u>
  1. The TCP move should be configured as the target position.
  2. Put the cursor behind, and insert on the line of the motion command.
  3. Select Motion>PTP。
  4. Change the relevant parameters.
  5. Press the OK button.

- <u>Overview</u>



PTP interface

6.2.1.2. PTP (programmed by keyboard)

- <u>Prerequisite</u>

  Program selected

  T1 mode

  Keyboard connected

- <u>Operation steps</u>

  1. Put the cursor behind, and insert on the line of the motion command.
  2. Input the command by keyboard.

     Example:

     E6POS POINT = {X 0,Y 300,Z 200}

     PTP POINT CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]

     Example:

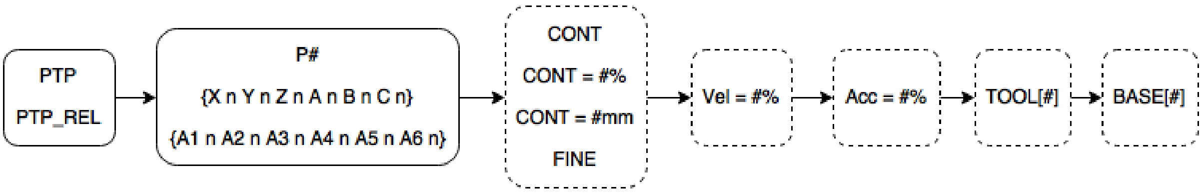
     PTP {X 100} CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]

     Example:

     PTP {A1 45} CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]

     (See the Appendix example at P342. For the description of CONT, please see the Appendix at P338.)

- <u>Command flowchart</u>



PTP&PTP_REL flowchart

6.2.1.3. PTP_REL (programmed by keyboard)

- Prerequsite

  Program selected

  T1 mode

  Keyboard connected

- Operation steps

  1. Put the cursor behind, and insert on the line of the motion command.
  2. Input the command by keyboard.

     Example:

     PTP_REL {X 100} CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]

     Example:

     PTP_REL {A1 45} CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]

     (See the Appendix example at P344. For the description of CONT, please see the Appendix at P368.)

- Command flowchart

  Refer to PTP

6.2.2. Programming for LIN Motion

⚠ CAUTION

When the motion is programming, it is sure the power supply will not wind or damage when programming to run.

6.2.2.1. LIN

- Prerequisite

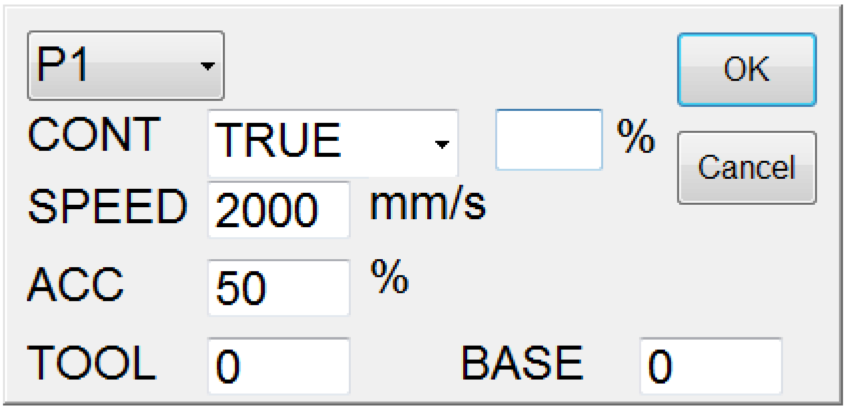
  Program selected

  T1 mode

- Operation steps

  1. The TCP move should be configured as the target position.
  2. Put the cursor behind, and insert on the line of the motion command.
  3. Select Motion>LIN.
  4. Change the relevant parameters.
  5. Press the OK button.

- <u>Overview</u>



LIN interface

6.2.2.2. LIN (programmed by keyboard)

- <u>Prerequisite</u>

  Program selected

  T1 mode

  Keyboard connected

- <u>Operation steps</u>

1. Put the cursor behind, and insert on the line of the motion command.
2. Input the command by keyboard.

   Example:

   E6POS POINT = {X 0,Y 300,Z 200}

   LIN POINT CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]

   Example:

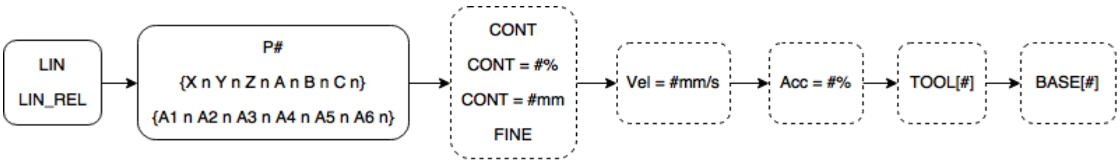
   LIN {X 100} CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]

   Example:

   LIN {A1 45} CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]

   (See the Appendix example at P344. For the description of CONT, please see the Appendix at P368.)

- <u>Command flowchart</u>



LIN&LIN_REL flowchart

6.2.2.3. LIN_REL (programmed by keyboard)

- Prerequisite
  Program selected
  T1 mode
  Keyboard connected

- Operation steps
  1. Put the cursor behind, and insert on the line of the motion command.
  2. Input the command by keyboard.
     Example:
     LIN_REL {X 100} CONT=100% Vel=2000mm/s Acc=50% TOOL[0] BASE[0]
     Example:
     LIN_REL {A1 45} CONT=100% Vel=2000mm/s Acc=50% TOOL[0] BASE[0]
     (See the Appendix example at P345. For the description of CONT, please see the Appendix at P368.)

- Command flowchart
  Refer to LIN

6.2.2.4. LIN_REL_TOOL (programmed by keyboard)

- Prerequisite
  Program selected
  T1 mode
  Keyboard connected

- Operation steps
  1. Put the cursor behind, and insert on the line of the motion command.
  2. Input the command by keyboard.
  3. One axis can be rotated at a time
     Example:
     LIN_REL_TOOL {X 100} CONT=100% Vel=2000mm/s Acc=50% TOOL[0] BASE[0]

Example:

LIN_REL_TOOL {A 45} CONT=100% Vel=2000mm/s Acc=50% TOOL[0] BASE[0]

(See the Appendix example at P346. For the description of CONT, please see the Appendix at P368.)

6.2.3. Programming for CIRC Motion

⚠ CAUTION

When the motion is programming, it is sure the power supply will not wind or damage when programming to run.

6.2.3.1. CIRC

- Prerequisite

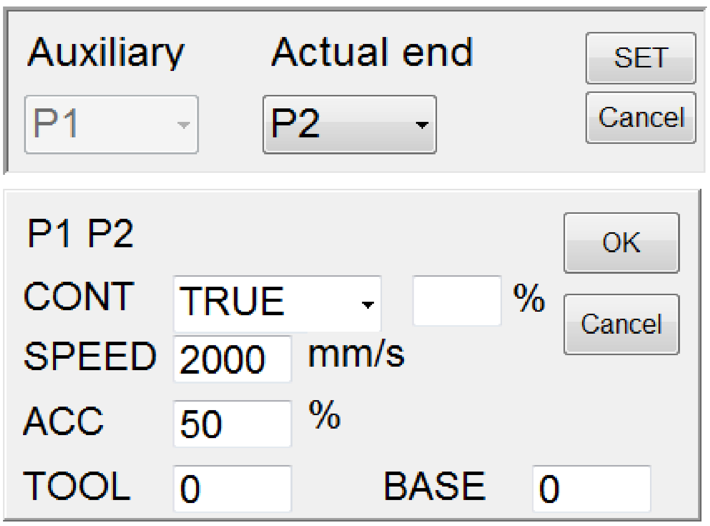
  Program selected

  T1 mode

- Operation steps

  1. The TCP move should be configured as the arc position.
  2. Put the cursor behind, and insert on the line of the motion command.
  3. Select Motion>CIRC.
  4. Click [SET].
  5. The TCP move should be configured as the target position.
  6. Click [SET].
  7. Click [FINSH].
  8. Enter the Paramer interface to change the relevant parameters.
  9. Press the OK button.

- Overview



CIRC interface

6.2.3.2. CIRC (programmed by keyboard)

- Prerequisite

  Program selected

  T1 mode

  Keyboard connected

- Operation steps

  1. Put the cursor behind, and insert on the line of the motion command.
  2. Input the command by keyboard.

     Example:

     E6POS POINT1 = {X 0,Y 300,Z 200}

     E6POS POINT2= {X 20,Y 320,Z 220}

     CIRC POINT1 POINT2 CONT=100% Vel=2000mm/s Acc=50% TOOL[0] BASE[0]

     Example:

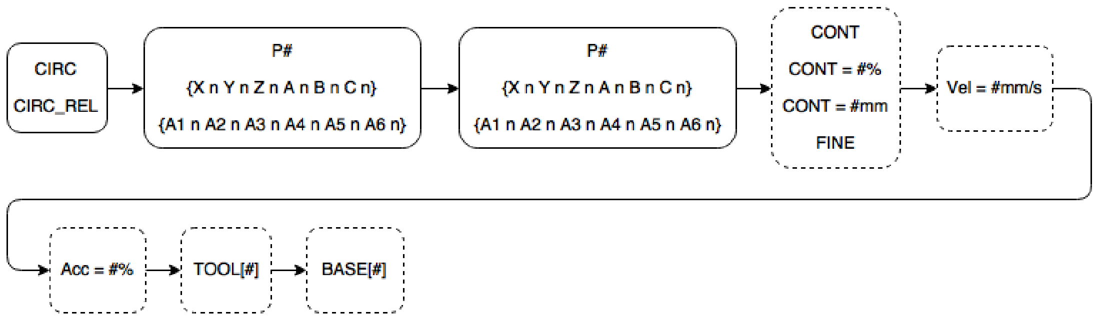
     CIRC {X 0, Y 450} {X -150, Y 300} CONT=100% Vel=2000mm/s Acc=50% TOOL[0] BASE[0]

     Example:

     CIRC {A1 5.0, A2 5.0, A3 5.0, A4 5.0} {A1 10.0, A2 10.0, A3 10.0, A4 10.0,} CONT=100% Vel=2000mm/s Acc=50% TOOL[0] BASE[0]

     (See the Appendix example at P347. For the description of CONT, please see the Appendix at P368.)

- Command flowchart



CIRC&CIRC_REL flowchart

6.2.3.3. CIRC_REL (programmed by keyboard)

- Prerequisite

  Program selected

  T1 mode

  Keyboard connected

- Operation steps

  1. Put the cursor behind, and insert on the line of the motion command.
  2. Input the command by keyboard.

     Example:

     CIRC_REL {X -150, Y 150} {X -150, Y -150} CONT=100% Vel=2000mm/s Acc=50% TOOL[0] BASE[0]

     Example:

     CIRC_REL {A1 5.0, A2 5.0, A3 5.0, A4 5.0} {A1 10.0, A2 10.0, A3 10.0, A4 10.0,} CONT=100% Vel=2000mm/s Acc=50% TOOL[0] BASE[0]

     (See the Appendix example at P349. For the description of CONT, please see the Appendix at P368.)

- Command flowchart

  Refer to CIRC

6.2.4. Perform Programming for SPLINE Motion

⚠ CAUTION

When perform the motion programming, please assure that the power supply system will not be wound or damaged while running the written progrm.

6.2.4.1. SPLINE (Keyboard Writing)

- Premise

  Program selected

  T1 mode

  Keyboard connected

- Operating Steps

  1. Put the cursor behind, and insert on the line of the motion command.
  2. Input the command by keyboard.

  Example:

```
E6POINT P1 ={ X 95 , Y 0 , Z -500 }
E6POINT P2 ={ X 94.63849632 , Y 3.922008424 , Z -500 }
E6POINT P3 ={ X 93.55673654 , Y 7.814167995 , Z -500 }
…..
SPLINE
SPL P1
SPL P2
SPL P3
…..
ENDSPLINE
```

6.3. Variable Configuration

6.3.1. REAL

- Prerequisite

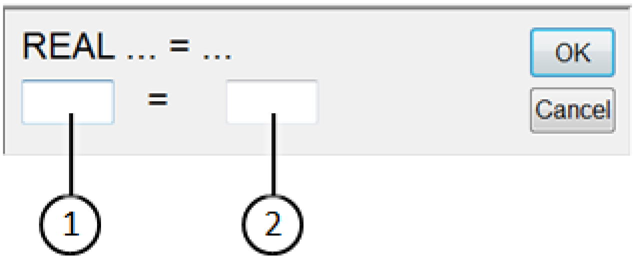
  Program selected

  T1 mode

- Operation steps

  1. Put a cursor behind, and insert on the line of the logic command.
  2. Select Configure>Variable>REAL.
  3. Set the parameters in the interface.
  4. Save the command by pressing OK.

- Overview



REAL interface

No.	Description
1	Variable name
2	Initial value

6.3.2. INT (programmed by keyboard)

- Prerequisite

  Program selected

  T1 mode

  Keyboard connected

- Operation steps

  1. Put the cursor behind, and insert on the line of the motion command.
  2. Input the command by keyboard.

     Example:

INT Two = 2
(See the Appendix example at P338.)

6.3.3. BOOL (programmed by keyboard)

- Prerequisite
  Program selected
  T1 mode
  Keyboard connected

- Operation steps
  1. Put the cursor behind, and insert on the line of the motion command.
  2. Input the command by keyboard
     Example:
     BOOL K = TRUE
     (See the Appendix example at P338.)

6.3.4. CHAR (programmed by keyboard)

- Prerequisite
  Program selected
  T1 mode
  Keyboard connected

- Operation steps
  1. Put the cursor behind, and insert on the line of the motion command.
  2. Input the command by keyboard.
     Example:
     CHAR COLOR = 'R'
     (See the Appendix example at P339.)

6.3.5. E6POS Coordinate Points (programmed by keyboard)

- Prerequisite
  Program selected
  T1 mode
  Keyboard connected

- Operation steps
  1. Put the cursor behind, and insert on the line of the motion command.
  2. Input the command by keyboard.
     Example:
     E6POS POINT = {X 0,Y 300,Z 200}
     PTP POINT CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
     (See the Appendix example at P339. For the description of CONT, please see the Appendix at P368.)

6.3.6. E6AXIS Axis Points (programmed by keyboard)

- Prerequisite
  Program selected
  T1 mode
  Keyboard connected

- Operation steps
  1. Put the cursor behind, and insert on the line of the motion command.
  2. Input the command by keyboard.
     Example:
     E6AXIS POINT = {A1 90}
     PTP POINT CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
     (See the Appendix example at P339. For the description of CONT, please see the Appendix at P368.)

6.3.7. E6POINT Coordinate Points (programmed by keyboard)

- Prerequisite
  Program selected
  T1 mode
  Keyboard connected

- Operation steps
  1. Put the cursor behind, and insert on the line of the motion command.
  2. Input the command by keyboard.
     Example:
     E6POINT HOME = {X 0,Y 200,Z -1000,A 90}
     PTP HOME CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
     (See the Appednix example at P339. For the description of CONT, plese see the Appendix at P368.)

Tip: E6POINT does not have the definition of axis point, hence not able to directly set the value of A1~A6.

6.3.8. FRAME Coordinate Points (programmed by keyboard)

- Description
  Write this instruction in the program, and it will declare a variable including the information of X, Y, Z, A, B , C.

- Format
  FRAME POINT_A
  POINT_A.X = 0
  POINT_A.Y = 1
  POINT_A.A = 2
  POINT_A.C = 3

- Format Description
  The variable type is the floating-point number, if there is no input, it will set to the default 0.

6.4. Register Configuration

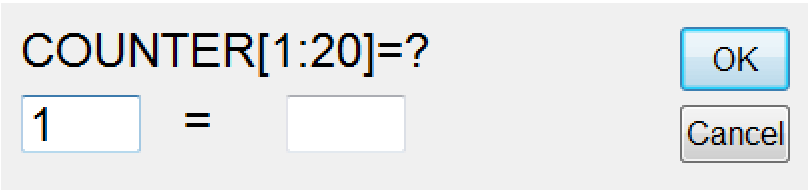
6.4.1. Using COUNTER Register

- Prerequisite

  Program selected

  T1 mode

- Operation steps
  1. Put the cursor behind, and insert on the line of the variable command.
  2. Select Configure>Variable>Counter.
  3. Set the parameters in the interface.
  4. Save the command by pressing OK.
- Overview



COUNTER interface

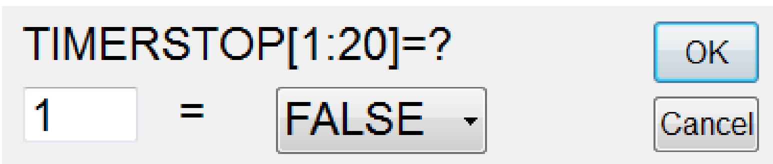
6.4.2. Enable TIMER Register

- Premise

  Program selected

  T1 mode

- Operating Steps
  1. Put the cursor behind, and insert on the line of the variable command.
  2. Select Configure > Variable > Stop Timer
  3. Set the parameters in the interface.
  4. Add "$T_STOP[n]=FALSE" to the previous line to start timing.
  5. Add "$ T_STOP [n]=TRUE" to the next line to end timing.
  6. Save the command by pressing OK.
- Overview



TIMER Setting Interface

6.4.3. Using Timer Register

- Prerequisite

  Program selected

  T1 mode

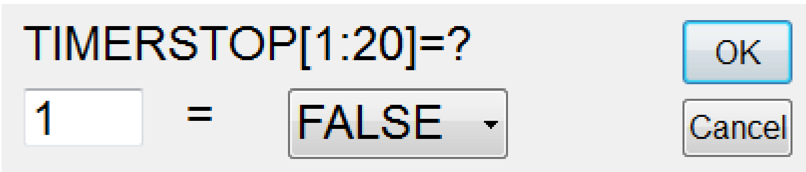
- Operation steps

7. Put the cursor behind, and insert on the line of the variable command.
8. Select Configure>Variable>Timer.
9. Set the parameters in the interface.
10. Add “$T_STOP[n]=FALSE” on the previous line to start timing.
11. Add “$ T_STOP [n]=TURE” on the next line to end timing.
12. Save the command by pressing OK.

⚠ CAUTION

TIMER is based on 1 ms as an unit, where the accuracy is 55 ms.

- Overview



TIMER interface

6.5. Programming for Logic Command

6.5.1. Input/Output

- Digital Input/Output

  The control system can manage up to 24 digital inputs and 24 digital outputs.

  The configuration can set depending on the user requirements.

Input/output can be managed by the following variables:

	Input	Output
Number	$DI[1] … $DI[24]	$DO[1] … $DO[24]
Number	--	$VO[1] … $VO[3]
Number	$RI[1] … $RI[8]	$RO[1] … $RO[8]

6.5.2. OUT

- Prerequisite

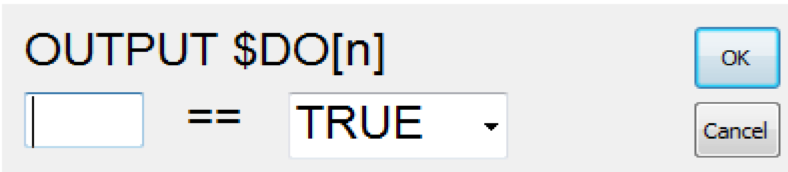
  Program selected

  T1 mode

- Operation steps

  1. Put the cursor behind, and insert on the line of the logic command.
  2. Select Configure> Output>Digital, or other IO output interface.
  3. Set the parameters in the interface.
  4. Save the command by pressing OK.

- Overview



OUTPUT interface

6.5.3. WAIT

- Prerequisite

  Program selected

  T1 mode

- Operation steps
  1. Put the cursor behind, and insert on the line of the logic command.
  2. Select Function> WAIT FOR.
  3. Set the parameters in the interface.
  4. Save the command by pressing OK.

- Overview

WAIT FOR SEC interface

6.5.4. WAIT FOR…

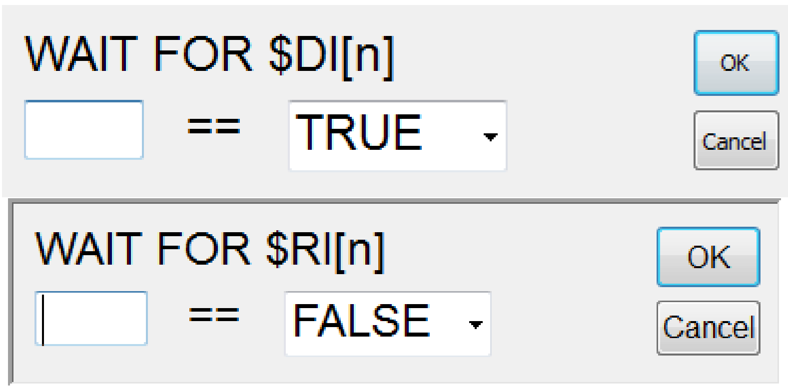
- Prerequisite

  Program selected

  T1 mode

- Operation steps
  1. Put the cursor behind, and insert on the line of the logic command.
  2. Select Function> INPUT.
  3. Set the parameters in the interface.
  4. Save the command by pressing OK.

- Overview



WAIT FOR interface

6.5.5. QUIT (programmed by keyboard)

- Prerequisite

  Program selected

  T1 mode

  Keyboard connected

- Operation steps

  1. Put the cursor behind, and insert on the line of the motion command.
  2. Input the command by keyboard.

     Example:

     QUIT

6.6. Programming for LOOP Command

6.6.1. IF

- Prerequisite

  Program selected

  T1 mode

- Operation steps

  1. Put the cursor behind, and insert on the line of the logic command.
  2. Select Function> IF ENDIF> Determination.
  3. Set the parameters in the interface.
  4. Save the command by pressing OK.

- Overview

IF interface

6.6.2. FOR (programmed by keyboard)

- Prerequisite

  Program selected

T1 mode
Keyboard connected

- Operation steps
  1. Put the cursor behind, and insert on the line of the motion command.
  2. Input the command by keyboard.
     Example:
     FOR *start* TO *last* STEP *increment*
     ………………
     ENDFOR
     (see the Appendix example at P356)

6.6.3. LOOP (programmed by keyboard)

- Prerequisite
  Program selected
  T1 mode
  Keyboard connected

- Operation steps
  1. Put a cursor behind, and insert on a line of the motion command.
  2. Input the command by keyboard.
     Example:
     LOOP
     ………………
     ENDLOOP
     (see the Appendix example at P357)

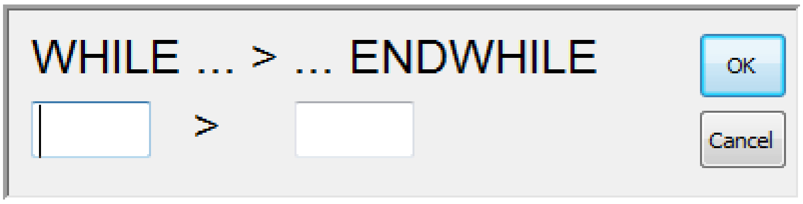
6.6.4. WHILE

- Prerequisite
  Program selected
  T1 mode

- Operation steps
  1. Put a cursor behind, and insert on a line of the logic command.
  2. Select Function> WHILE ENDWHILE> Determination.

3. Set the parameters in the interface.
4. Save the command by pressing OK.

- Overview



WHILE interface

6.6.5. REPEAT (programmed by keyboard)

- Prerequisite

  Program selected

  T1 mode

  Keyboard connected

- Operation steps

1. Put a cursor behind, and insert on a line of the motion command.
2. Input the command by keyboard.

   Example:

   REPEAT

   ………………

   UNTIL *condition*

   (See the Appendix example at P360)

6.6.6. GOTO (programmed by keyboard)

- Prerequisite

  Program selected

  T1 mode

  Keyboard connected

- Operation steps

1. Put a cursor behind, and insert on a line of the motion command.
2. Input the command by keyboard.

   Example:

IF *condition* THEN
GOTO *LABEL 1*
ENDIF
IF *condition* THEN
GOTO *LABEL 2*
ENDIF
IF *condition* THEN
GOTO *LABEL 3*
ENDIF
LABEL 1:
………………
LABEL 2:
………………
LABEL 3:
………………
(See the Appendix example at P361)

⚠ CAUTION

The label specified by the GOTO grammar must be in the current function, cross functions cannot be applied.

6.6.7. SWITCH (programmed by keyboard)

- Prerequisite

  Program selected
  T1 mode
  Keyboard connected

- Operation steps

1. Put a cursor behind, and insert on a line of the motion command.
2. Input the command by keyboard

   Example:
   SWITCH *number*
   ………………
   CASE *number1*
   ………………
   CASE *number2*
   ………………

ENDSWITCH
(See the Appendix example at P363)

6.7. Simulate Environment Instruction

6.7.1. ADDTOOL Newly Add Tool (programmed by keyboard)

- Premise
  Program selected
  T1 mode
  Stl file putted in the stl folder
- Operating Steps
  1. Put a cursor behind, and insert on a line of the instruction command
  2. Input the command by keyboard.

  Example:
  ADDTOOL File Name (no need to enter the extension)
  Take ee.stl as an example
  ADDTOOL ee
  Attention: stl file will be in binary format, and the coordinate system of file will be consistent with the end coordinate system of the flange surface. Currently the file named with underscore (_) or started with Upper/Lower case are all acceptable.

6.7.2. SHOW_TOOL Show Tool (programmed by keyboard)

- Premise
  Program selected
  T1 mode
  Stl file putted in the stl folder
- Operating Steps
  1. Put a cursor behind, and insert on a line of the instruction command
  2. Input the command by keyboard.

  Example:
  SHOW_TOOL File Name (no need to enter the extension) TRUE/FALSE
  Take ee.stl as an example

Show ee.stl: SHOW_TOOL ee TRUE
Hide ee.stl: SHOW_TOOL ee FALSE
Attention: stl file will be in binary format, and the coordinate system of file will be consistent with the end coordinate system of the flange surface. Currently the file named with underscore (_) or started with Upper/Lower case are all acceptable.

6.7.3. ADDOBJ Newly Add Workpiece (programmed by keyboard)

- Premise
  Program selected
  T1 mode
  Stl file putted in the stl folder

- Operating Steps
  1. Put a cursor behind, and insert on a line of the instruction command
  2. Input the command by keyboard.
  Exampe:
  ADDOBJ File Nmae (no need to enter the extension) P: X, Y, Z, A, B, C C: R, G, B
  P: Displacement (mm) & rotation (degree) as relative to the robot origin
  C: Color, RGB Value
  Take table.stl as an example
  ADDTOOL table P: 500 C:200
  ADDTOOL table P: 500, 200 C: 200,50
  Attention: stl file must be in binary format, and the coordinate system of file must be consistent with the end coordinate system of flange surface. Currently the file named with underscore (_) or started with Upper/Lower case are all acceptable.

6.7.4. SHOW_OBJ Show Workpiece (programmed by keyboard)

- Premise

Program selected

T1 mode

Stl file putted in the stl folder

- Operating Steps

1. Put a cursor behind, and insert on a line of the instruction command
2. Input the command by keyboard.

Example:

SHOW_OBJ File Name (no need to enter the extension) TRUE/FALSE

Take table.stl as an example

Show table.stl: SHOW_OBJ table TRUE

Hide table.stl: SHOW_OBJ table FALSE

Attention: stl file will be in binary format, and the coordinate system of file will be consistent with the end coordinate system of the flange surface. Currently the file named with underscore (_) or started with Upper/Lower case are all acceptable.

6.7.5. MOVEFLOOR Position of Moving Floor (programmed by keyboard)

- Premise

Program selected

T1 mode

- Operation Steps

1. Put a cursor behind, and insert on a line of the instruction command
2. Input the command by keyboard.

Example:

MOVEFLOOR 100 (moving distance)

6.7.6. AXISON Display Coordinate System

- <u>Premise</u>

  Program selected

  T1 mode
- <u>Operating Steps</u>
  1. Put a cursor behind, and insert on a line of the instruction command
  2. Input the command by keyboard.

  Example:

  AXISON

6.7.7. AXISOFF Hidden Coordinate System

- <u>Premise</u>

  Program selected

  T1 mode

- <u>Operating Steps</u>
  1. Put a cursor behind, and insert on a line of the instruction command
  2. Input the command by keyboard

  Example:

  AXISOFF

6.8. Definition of Structure (programmed by keyboard)

- <u>Prerequisite</u>

  Program selected

  T1 mode

  Keyboard connected

- <u>Operation steps</u>
  1. Put a cursor behind, and insert on a line of motion command
  2. Input the command by keyboard.

     Example:

     STRUC *LABEL* INT *PARAMETER1*, REAL *PARAMETER2*

     DECL *LABEL* PART1 ,PART2, ……. , …….

PART1 = { *PARAMETER1* 10, *PARAMETER2* 500 }
PART2 = { *PARAMETER1* 20, *PARAMETER2* 100 }
………………
………………
(See the Appendix example at P372)

6.9. Subprogram (programmed by keyboard)

- Prerequisite
  Program selected
  T1 mode
  Keyboard connected

- Operation steps
  1. Put a cursor behind, and insert on a line of motion command
  2. Input the command by keyboard.
     Example:
     ………………
     LABEL
     DEFFCT VOID *LABEL*
     ………………
     ENDFCT
     (See the example in the Appendix at P373)

6.10. Communication Configuration

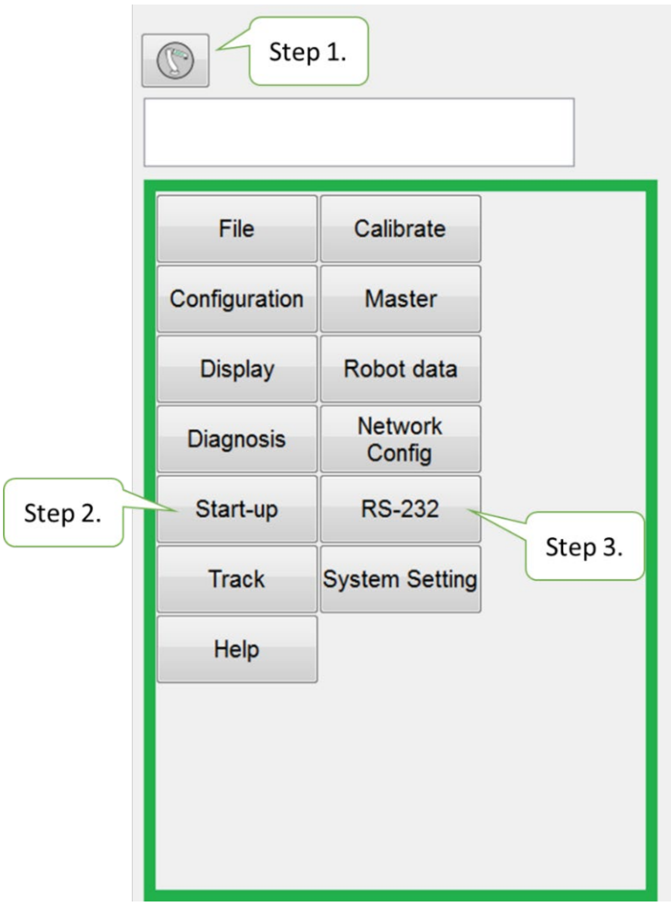
6.10.1. Using RS232 to Connect with External Equipment

- Confirm the transfer setting

  Step 1. Click Main Icon

  Step 2. Click Start-up

  Step 3. Click RS-232



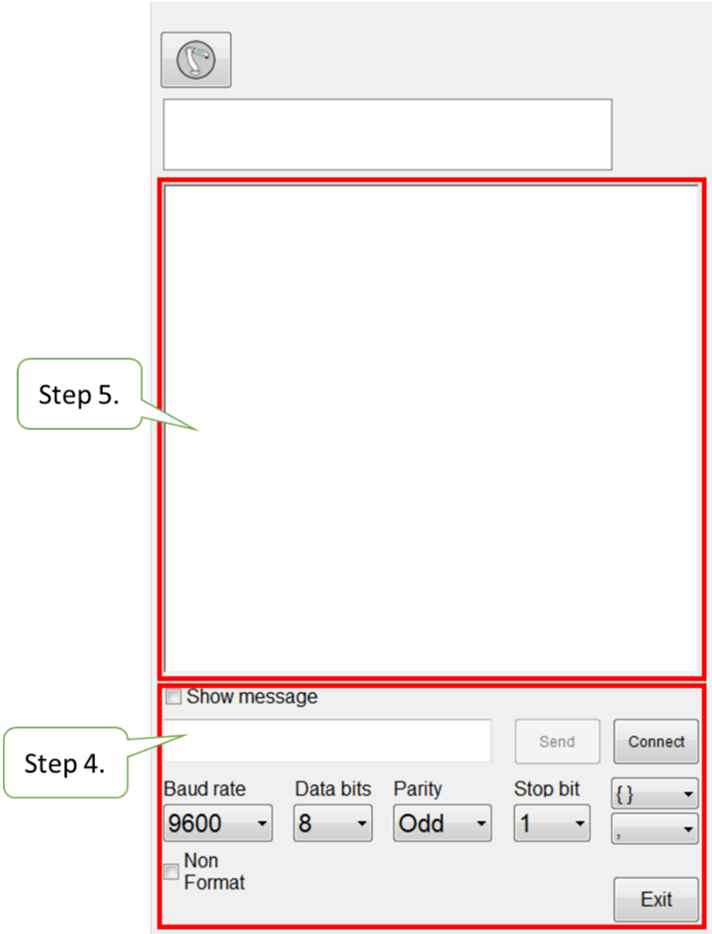
RS232 Process Setting Interface (I)

Step 4. Configure the communication and packet formats

(The defaulted start and end symbol is ”{”AND”}”, and use comma ”,” as the delimiter.)

Step 5. The communication data will be displayed in the middle of dialog box.

NOTE: It is possible to perform a manual test on this page to check if the connection and transfer value are successful.



RS232 Process Setting Interface (II)

- Description of Relevant Instructions

  Prerequisite:

  Program selected

  T1 mode

Code	Comment
COPEN(SER,*NAME*)	Open communication SER indicates the opened communication is RS232 Save the opened state to *NAME*
CREAD(*NAME*,*val*) CREAD(*NAME*,*val1*,*val2*)	Read and save the data to *val*, When read mulitple data, it may use multiple variables *val1*, *val2*.., however, please beaware that each
Code	Comment

CREAD(*NAME*,*val*) CREAD(*NAME*,*val1*,*val2*)	CREAD instruction will read one set of packet, therefore, when the variable does not match the number of transfer value, it will take 0 as the value or be negligible.
CREAD(*NAME*,*val*) CREAD(*NAME*,*val1*,*val2*)	e.q.1 Camera： send {100,200,45} Robot： CREAD(*NAME*,*val1*,*val2*,*val3*) val1 = 100 ; val2 = 200 ; val3 = 45 e.q.2 Camera： send {100,200} Robot： CREAD(*NAME*,*val1*,*val2*,*val3*) val1 = 100 ; val2 = 200 ;val3 = 0 e.q.3 Camera： send {100,200,45,50} Robot： CREAD(*NAME*,*val1*,*val2*,*val3*) val1 = 100 ; val2 = 200 ; val3 = 45
CCLEAR(*NAME*)	Clear the data in the temporary storage When the packet number is greater than the instruction number of CREAD, the old data will be read, therefore, CCLEAR will be added before or after the reading instruction.
CWRITE(*NAME*,*val*) CWRITE(*NAME*,*val1*,*val2*)	Transfer the data in *val* Multiple data *val1*, *val2*…can be sent at one time However, please be aware that val can only be real type and unable to send text, plus each CWRITE instruction is a set of packet. e.q.1 Robot：

	CWRITE(*NAME*,100,200,45) Camera： read {100,200,45}
Code	**Comment**
CWRITE(*NAME*,*val*) CWRITE(*NAME*,*val1*,*val2*)	e.q.2 Robot： CWRITE(*NAME*,100) CWRITE(*NAME*,200,45) Camera： read {100}{200,45}

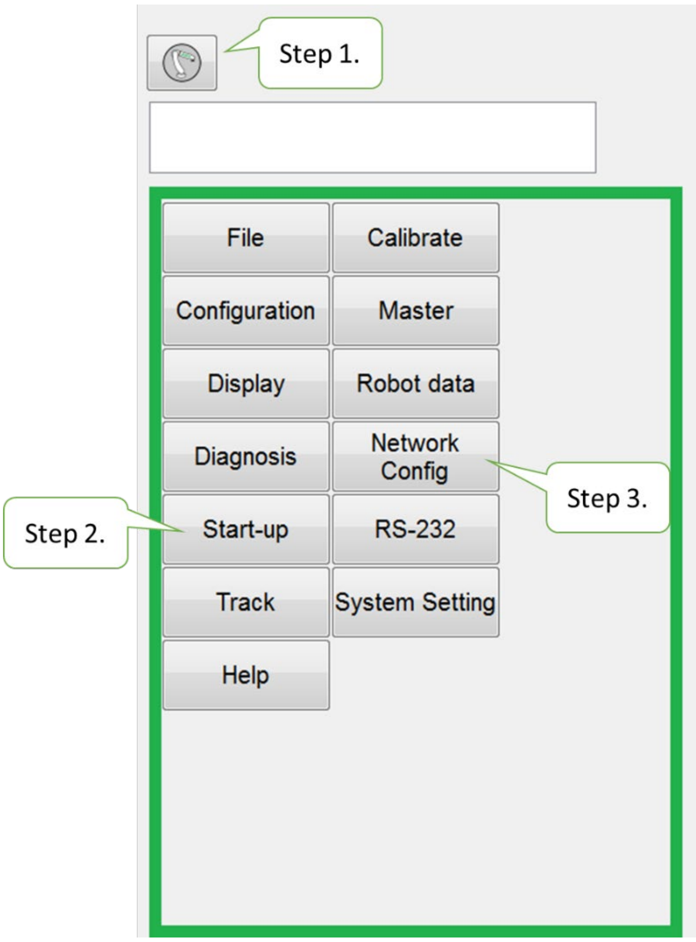
6.10.2. Use Ethernet to Connect with External Equipment

- Confirm the transfer setting

  Step 1. Click Main Icon

  Step 2. Click Start-up

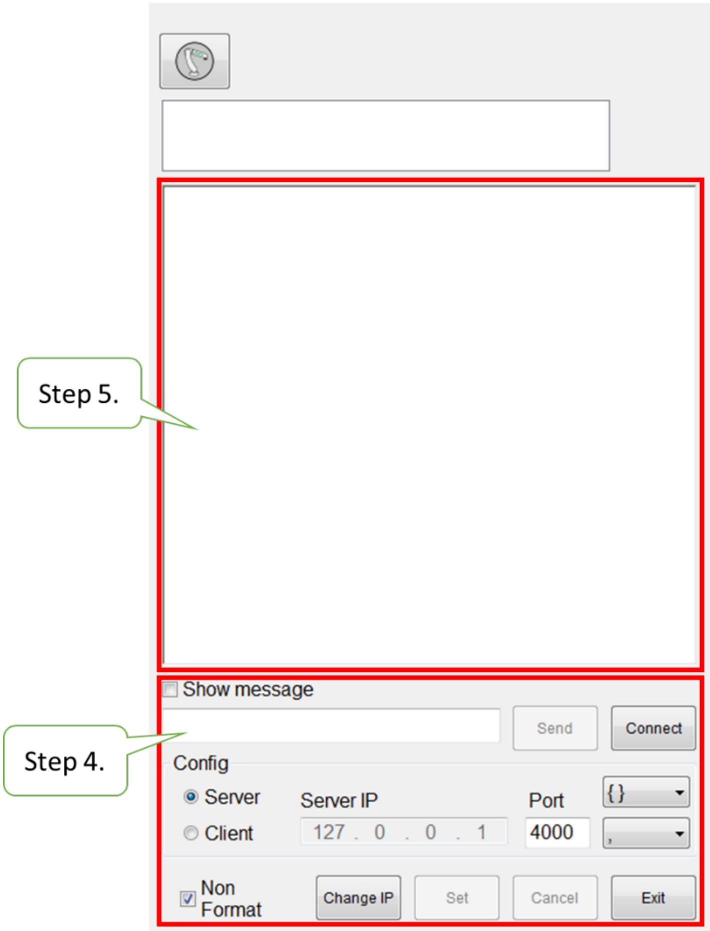
  Step 3. Click Network Config



Ethernet TCP/IP Process Setting Interface (I)

Step 4. Configure the Server/Client communication method and packet format (The defaulted start and end symbol is ”{”AND”}”, and use comma ”,” as the delimiter.)

Step 5. The communication data will be displayed in the middle of dialog box. NOTE：It is possible to perform a manual test on this page to check if the connection and transfer value are successful.



Ethernet TCP/IP Process Setting Interface (II)

- Description of Relevant Instructions

<u>Prerequisite:</u>

Program selected

T1 mode

Code	Comment
COPEN(ETH,*NAME*)	Open communicatio ETH indicates the opened communication is Ethernet TCP/IP

	Save the opened state to *NAME*
CREAD(*NAME*,*val*) CREAD(*NAME*,*val1*,*val2*)	Read and save the data to *val*, When read mulitple data, it may use multiple variables *val1*, *val2*.., however, please beaware that each CREAD instruction will read one set of packet, therefore, when the variable does not meet the number of transfer value, it will take 0 as the value or be negligible.
Code	Comment
CREAD(*NAME*,*val*) CREAD(*NAME*,*val1*,*val2*)	e.q.1 Camera： send {100,200,45} Robot： CREAD(*NAME*,*val1*,*val2*,*val3*) val1 = 100 ; val2 = 200 ; val3 = 45 e.q.2 Camera： send {100,200} Robot： CREAD(*NAME*,*val1*,*val2*,*val3*) val1 = 100 ; val2 = 200 ; val3 = 0 e.q.3 Camera： sned {100,200,45,50} Robot： CREAD(*NAME*,*val1*,*val2*,*val3*) val1 = 100 ; val2 = 200 ; val3 = 45
CCLEAR(*NAME*)	Clear the data in temporary storage When the packet number is greater than the instruction number of CREAD, the old data will

	be read, therefore, CCLEAR will be added before or after the reading instruction.
CWRITE(*NAME*,*val*) CWRITE(*NAME*,*val1*,*val2*)	Transfer the data in *val* Multiple data *val1*, *val2*…can be sent at one time However, please be aware that val can only be real type and unable to send text, plus each CWRITE instruction is a set of packet.
Code	Comment
CWRITE(*NAME*,*val*) CWRITE(*NAME*,*val1*,*val2*)	e.q.1 Robot： CWRITE(*NAME*,100,200,45) Camera： read{100,200,45} e.q.2 Robot： CWRITE(*NAME*,100) CWRITE(*NAME*,200,45) Camera： read {100}{45}

6.11. Conveyor Command

6.11.1. CNV_START

- Description:
  Start conveyor procedures, and connect with the system. The command for other conveyor can be executed after this command, used for the start of the conveyor program.

- Format:
  CNV_START CNV=1
  …
  CNV_END CNV=1

- Format description:
  CNV is the parameter for the conveyor number, which can be input from 1 to 4.

6.11.2. CNV_END

- Description:
  End the conveyor and the connection with the system, used for the end of the conveyor program.

- Format:
  CNV_START CNV=1
  …
  CNV_END CNV=1

- Format description:
  CNV is the parameter for the conveyor number, which can be input from 1 to 4.

6.11.3. CNV_PICK_QUANTITY

- Description:
  The variables for the conveyor are used to set the maximum quantity of the object that the robot can pick every time. When the quantity reaches this value, the following pick commands will not be executed.

This variable will simultaneously affect CNV_FULL and CNV_EMPTY (see P226).

- Format:
  CNV_PICK_QUANTITY = 1

- Format description:
  The variable type is positive integer. The default is 1, which can be input from 1 to 8.

6.11.4. CNV_TRIGGER_TIMES[NUM]

- Description:
  This is a variable for the conveyor, used when the conveyor is set as a sensor trigger. When the conveyor sensor is triggered, the robot will receive a task to pick or place. This variable can be set to increase the speed of a task after the sensor is triggered several times, require to specify a conveyor number, # as the conveyor number.

- Format:
  CNV_TRIGGER_TIMES[NUM] = 1

- Format description:
  This variable type is positive integer from 1 to 100. If no quantity is assigned, the default is 1. NUM is the number of the conveyor. Input can be from 1 to 4, and represented by CNV1 to CNV4.

6.11.5. CNV_PICK

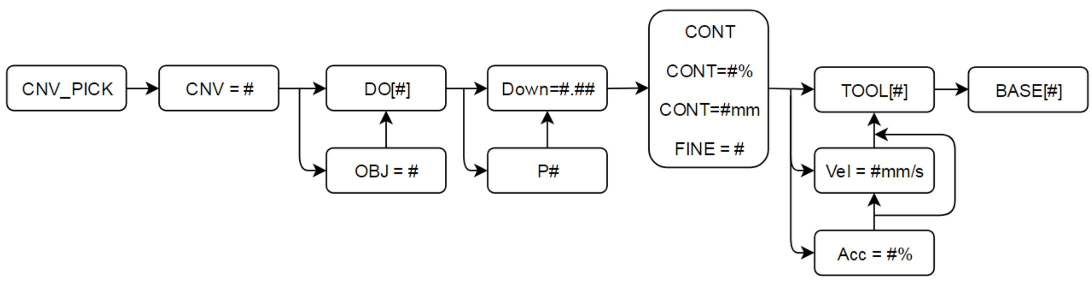
- Description:
  Pick the object. Automatically waits for messages from the system when the command is given that it can pick the object. After a successful pick, the robot will return to the height that the pick started from. If the pick fails, the robot will return to the starting position.

- Format:

CNV_PICK CNV=1 OBJ=1 $DO[1] P1 Down=5.000mm CONT=50% Vel=2000mm/s Acc=50% TOOL[0] BASE[0]

- Format description:
  - CNV is the parameter for the conveyor number. When it is necessary to track the object, the CNV number will be set. If the number is obmitted, it will not track. The input range 1 to 4.
  - OBJ is the object parameter, used to assign a number to the object. When it is omitted, no number is assigned to the object. All objects will be picked. The input range input is 1 to 8.
  - $DO[] is the parameter for the number O, which represents the Digital Output position to pick the object. The input range input is 1 to 48.
  - P is the position parameter. The number for this position is the coordinate when the object triggers the sensor signal; if the image trigger is employed, it can be omitted.
  - Down is the height that pressed downwardly to pick the object. During picking, the robot will stop a distance over the object and move downwardly. This parameter is used to assign this distance. The input range is a positive integer.
  - FINE and CONT are the paramaters for the discontinuous and continuous motion. The percentage behind the paramter is the smooth extent. For the description of CONT, please see the Appendix at P368.
  - Vel is the velocity parameter. The default is 2000mm/s.
  - Acc is the acceleration. The default is 100%.
  - TOOL is the parameter for the tool coordinates, which can be used to set the position of different end tools, input is from 0 to 15.
  - BASE is the parameters for base coordinate, which can be used to set the base number that the conveyor is calibrated, input is from 0 to 31.

- Command flowchart:



PICK flowchart

- Flowchart description:
  - # is the number.
  - CNV, OBJ, P, Vel and Acc can be omitted to input.
  - Please select either CONT, CONT = #%, CONT = #mm or FINE.

6.11.6. CNV_PLACE

- Description:

  The objects can be picked and placed or selected according to the object number or O (chosen object); the object will return the safety height after successfully placed. When the place fails, the conveyor will return to the starting position.

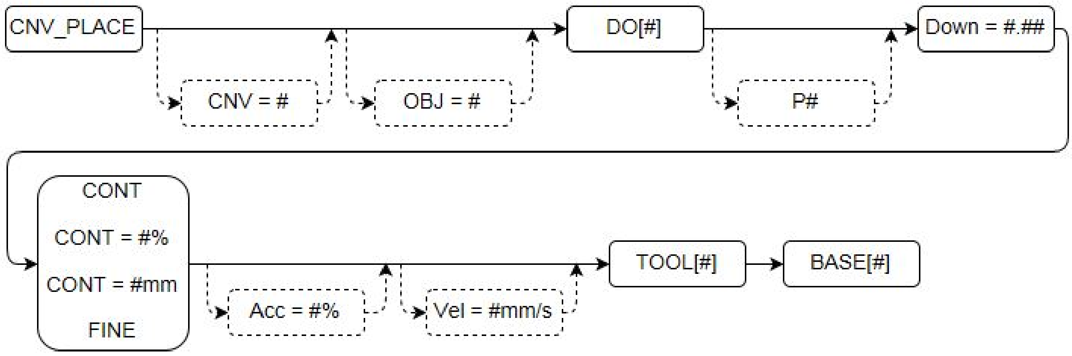
- Format:

  CNV_PLACE CNV=1 OBJ=1 $DO[1] P1 Down=5.000mm CONT=100% Vel=2000mm/s Acc=50% TOOL[0] BASE[0]

- Format description:
  - CNV is the parameter for the conveyor number. When it is necessary to track the object, the CNV number will be entered. If the number is omitted, it will not track. The input range is from 1 to 4.
  - OBJ is the object parameter, which can be used to assign the picked object number. If it is omitted, the object number is not assigned. All objects are placed. The input range is 1 to 8.
  - $DO[] is the parameter for the number O, which represents the position to place the object in this time. If it is omitted, it will represent to place according to the object number.
  - P is the position parameter, which represents the position to place the object.
  - Down is the height that pressed downwardly to pick the object. During picking, the robot will stop a distance over the object and move downwardly. This parameter is used to assign this distance, which should be positive integer or 0.
  - FINE and CONT are the paramaters for the discontinuous and continuous motion. The percentage behind the paramter is the smooth extent. For the description of CONT, please see the Appendix at P368.
  - Vel is the velocity parameter. The defaut is 2000mm/s.
  - Acc is the acceleration parameter. The default is 100%.

- TOOL is the parameter for tool coordinate.
- BASE is the parameter for the base coordinate.

- Command flowchart:



PLACE flowchart

- Flowchart description
  - # is the number.
  - CNV, OBJ, P, Vel and Acc can be omitted to input.
  - Please select either CONT, CONT = #%, CONT = #mm or FINE.

6.11.7. CNV_OBJECT

- Description:

  The variable for picking represents the latest object number picked. After the object is placed, the number will be automatically reset, which can be used to determine the current object and perform the specific action.
  (ATTENTION: CNV_OBJECT can be used only after CNV_PICK)

- Format:

```
CNV_PICK CNV=1 $DO[1] P1 Down=5.000mm CONT=50% Vel=2000mm/s
Acc=50% TOOL[0] BASE[0]
IF CNV_OBJECT == 1 THEN
CNV_PLACE CNV=1 $DO[1] P3 Down=5.000mm CONT=100%
Vel=2000mm/s Acc=50% TOOL[0] BASE[0]
ENDIF
CNV_PLACE CNV=1 $DO[1] P2 Down=5.000mm CONT=100%
Vel=2000mm/s Acc=50% TOOL[0] BASE[0]
```

- Format description:

  The variable type is integer, which can be used for WHILE or IF.

6.11.8. CNV_FULL

- Description:

  The Boolean variable for picking (For the description of Boolean, please see the Appendix at P338) represents when the quantity of objects that have been picked by the robot reaches the upper limit. When the picking quantity has reached the value set by CNV_PICK_QUANTITY, this variable is TRUE; if the quantity doesn't reach the setting value, it will be FALSE.

- Format:

```
CNV_PICK_QUANTITY = 2
WHILE CNV_FULL == FALSE
…
ENDWHILE
```

- Format description:

  The variable type is Boolean, which can be used for WHILE or IF.

6.11.9. CNV_EMPTY

- Description:

  The Boolean variable for picking (For the description of Boolean, please see the Appendix at P307) represents the quantity of the objects that have been picked by the robot. When no object is picked, this variable is TRUE; if one or more object is picked, this variable is FALSE.

- Format:

```
WHILE CNV_EMPTY == FALSE
…
ENDWHILE
```

- Format description:

  The variable type is Boolean, and can be used for WHILE or IF.

6.11.10. CNV_SET_DELAY_TIME[NUM]

- Description:

  This parameter is used to set the delay time for the conveyor. By setting this variable, the robot can continue to move with the object in the specific time and leave after reaching the position to pick or place.

  As shown in below, the robot will move with the object in 50ms and leave after picking or placing.

- Format:

  CNV_SET_DELAY_TIME[NUM] = 50

- Format description:

  NUM is the number of the conveyor. Input can be from 1 to 4, and represented by CNV1 to CNV4.

  The variable type is positive integer. The default is 0, which can be input from 0 to 1500 with a unit of ms.

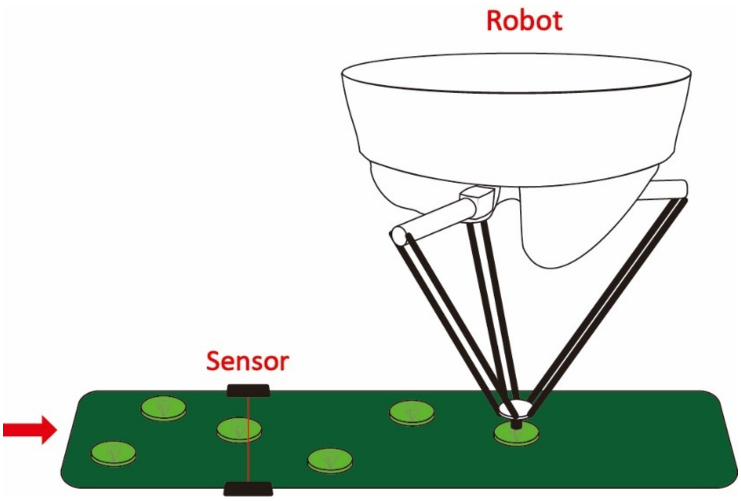


Illustration of Delta positioning

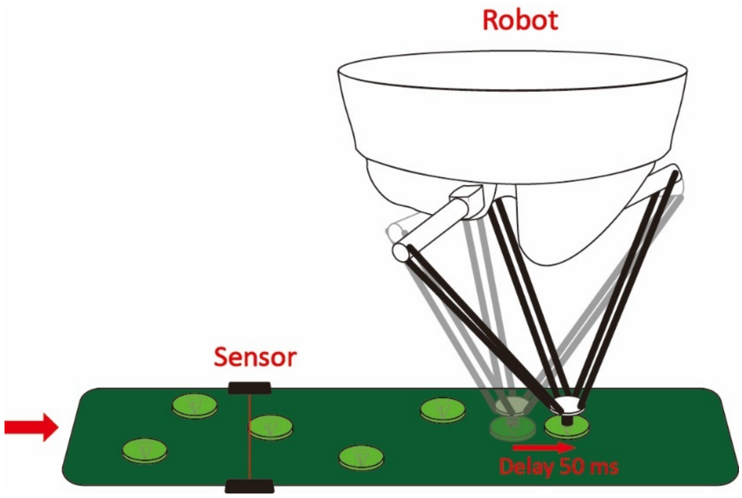


Illustration of Delta delay 50 ms

6.11.11. CNV_QUEUE_SIZE[NUM]

- Description:

  This is the pick variable. This variable shows the sensor has been triggered on the conveyor, but there is a quantity of object not picked.

  As shown in below, the sensor for the Conveyor 2 has triggered three objects, but the robot has not picked them. Therefore, this variable is 3.

- Format:

  IF CNV_QUEUE_SIZE[NUM] > 0 THEN

  …

  ENDIF

- Format description:

  NUM is the number of the conveyor. Input can be from 1 to 4, and represented by CNV1 to CNV4.

  The variable type is a positive integer, and can be used for WHILE or IF.

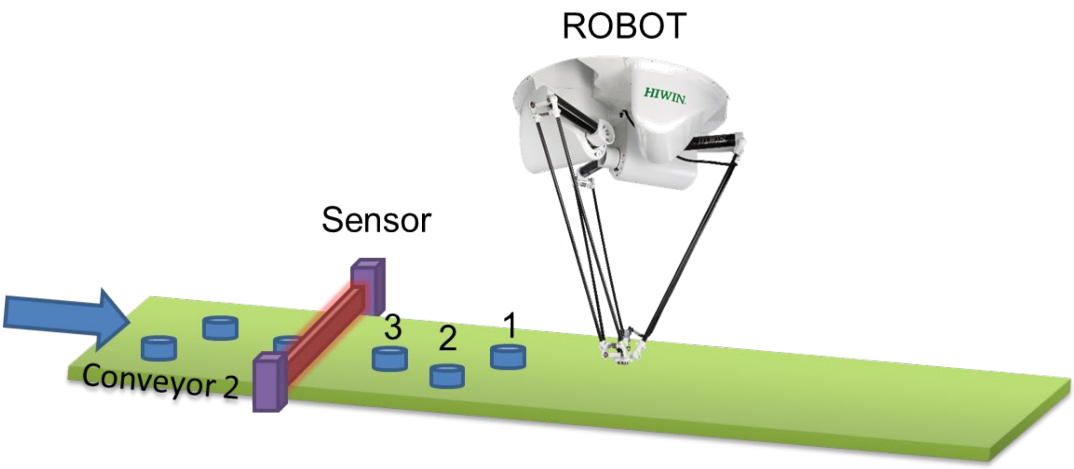


Illustration of CNV_QUEUE_SIZE

6.11.12. CNV_OBJ_CNT_DIST[NUM]

- Description:

  This is the conveyor variable. When the variable CNV_QUEUE_SIZE[NUM] is greater than or equal to 2 (Two or more objects on the conveyor have been triggered.) can be used immediately.

  This variable can display the difference between the position of the first object and the second object triggered by the sensor from the difference in Encoder value. It is usually used to determine if the triggered objects are continuous.

- Format:

```
IF CNV_QUEUE_SIZE[NUM] > 1 THEN
   IF CNV_OBJ_CNT_DIST[NUM] < 2600 THEN
   …
   ELSE
   …
   ENDIF
ENDIF
```

- Format Description:

  NUM is the number of the conveyor. Input can be from 1 to 4, and represented by CNV1 to CNV4.

  The variable type is positive integer, and can be used for WHILE or IF.

6.11.13. CNV_PLACE_BATCH[NUM]

- Description:
  The place variable is used when many objects are placed in the same work space.
  When the senor that releases an object is triggered, the robot will obtain a position where the object can be placed. The maximum number of times that the robot can place an object in this position can be set by this variable.

- Format:
  CNV_PLACE_BATCH[NUM] = 1

- Format Description:
  The variable type is a positive integer. If no quantity is assigned, the default is 1. The input range is 1 to 100 and represented by CNV1 to CNV4.

6.11.14. CNV_RESET_ENC

- Description:
  Conveyor Tracking Instruction. The user can use this instruction to clear the counting value of the external encoder when writing program.
  The effect of using this instruction is same as the effect of pressing "CLEAR" on the conveyor calibration interface. (Please refer to the description of P155).

- Format:
  CNV_RESET_ENC

- Format Description:
  No need to enter parameter.

6.11.15. CNV_QUEUE_REMOVE[NUM]

- Description:
  Flying pick/flying place state variable. The user is able to remove the temporary value placed at the forefront of the waiting queue by using this instruction during the process of writing the program.

- Format:
  CNV_QUEUE_REMOVE[NUM]

- Format Description:
  NUM is the number of the conveyor. Input can be from 1 to 4, and represented by CNV1 to CNV4.

6.11.16. CNV_PICK_ACC[NUM]

- Description:
  Flying pick state variable. The user is able to configure the acceleration time of tracking push-down by using this instruction when writing program.

- Format:
  CNV_PICK_ACC[NUM]

- Format Description:
  NUM is the number of the conveyor. Input can be from 1 to 4, and represented by CNV1 to CNV4. The default value is 30, range from 10 to 100.

6.11.17. CNV_OFFSET_X[NUM]

- Description:
  Flying pick/flying place state variable. The user is able to configure the offset value of X by using this instruction when writing program.

- Format:
  CNV_OFFSET_X[NUM] = 10

- Format Description:
  NUM is the number of the conveyor. Input can be from 1 to 4, the offset value of X is configured as 10mm.

6.11.18. CNV_OFFSET_Y[NUM]

- Description:
  Flying pick/flying place state variable. The user is able to configure the offset value of Y by using this instruction when writing program.

- Format:
  CNV_OFFSET_Y[NUM] = 10

- Format Description:
  NUM is the number of the conveyor. Input can be from 1 to 4, the offset value of Y is configured as 10mm.

6.11.19. CNV_OFFSET_Z[NUM]

- Description:
  Flying pick/flying place state variable. The user is able to configure the offset value of Z by using this instruction during the process of writing program.

- Format:
  CNV_OFFSET_Z[NUM] = 10

- Format Description:
  NUM is the number of the conveyor. Input can be from 1 to 4, the offset value of Z is configured as 10mm.

6.11.20. CNV_SPEED[NUM]

- Description:
  Conveyor state variable, user is able to read the current speed of conveyor.

- Format:
  INT ISpeed
  ISpeed = CNV_SPEED[NUM]

- Format Description:
  NUM is the number of the conveyor. Input can be from 1 to 4, and represented by CNV1 to CNV4.

6.12. DO switching on the path (SYN)

- Prerequisite
  Program selected
  T1 mode
  Keyboard connected

- Description
  TCP can be output in motion. The command for START, END and PATH can be used.
  The delay time of START and END is ±1000 ms.
  The range of PATH is ±2000 mm.
  Attention: Due to the limit of software memory, it limits the count of SYN, the maximum count is eight (8) counts, if the SYN instruction is entered over 8 counts before the motion instruction, Error Code 3010 will be pop-out: SYNC_CMD_QUEUE_FULL_ERROR.
  (See the Appendix example at P385)

- Operation steps
  1. Put a cursor behind, and insert on a line of the motion command.
  2. Input the command by keyboard.

  (See the Appendix example at P385)

6.13. Setting of External Procedure Input/Output

6.13.1. Mode Setting of External Procedure

- Operating Steps:
  1. Select Start-up>System Setting>FIO Setting。
  2. After pressing Edit in the Mode column, it is possible to select the mode of FIO from the pull-down menu, the first mode is RSR, PNS is the second mode.
  3. Press Save to save the setting.

6.13.2. External Procedure Function of RSR Mode

- Prerequisite

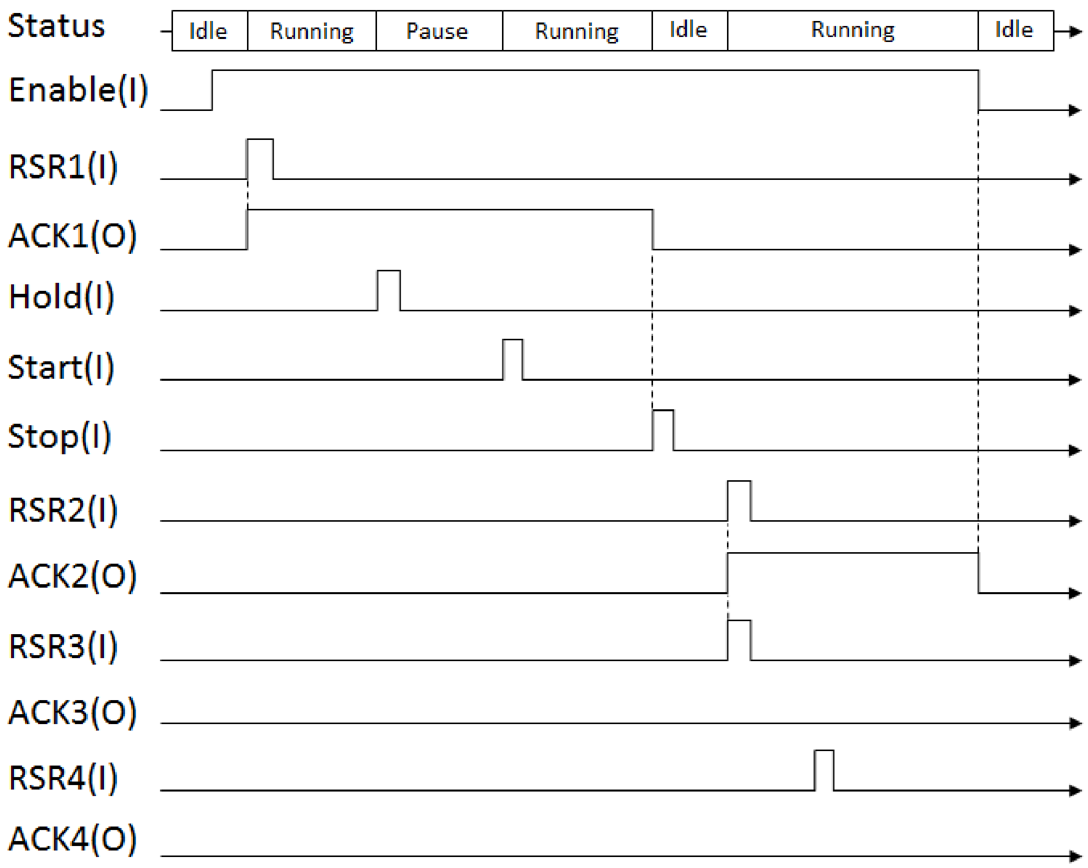
  EXT mode

  Program edit is complete.

  Select RSR mode.

- Operating Steps
  1. Click the completed program in the program directory, press "Add to" and then add the program to the list of RSR Program.
  2. In the paging of I/O, click F.I. and F.O., it is possible to observe the execution of the program triggered by exterior source.
  3. When Enable of F.I. is "On", and if RSR1~RSR4 are "On", it is possible to enable the corresponding RSR Program, and execute that program.
  4. ACK1~ACK4 of F.O. will be able to output the signal corresponded to F.I.
  5. Double click on the column of RSR Program, it will be able to delete the program from the list.

- Period Chart
  1. When two RSR signal is detected simultaneously, execute the one with the lowest number, from the period chart, RSR2 and RSR3 appeared simultaneously, RSR2 will be executed while RSR3 will be ignored.
  2. During execution of RSR, when other RSR signal is detected, they will be ignored, from period chart, RSR4 is detected when RSR2 is being executed, and thus it is ignored.



RSR Period Chart

6.13.3. External Procedure Function of PNS Mode

- Prerequisite

  EXT mode

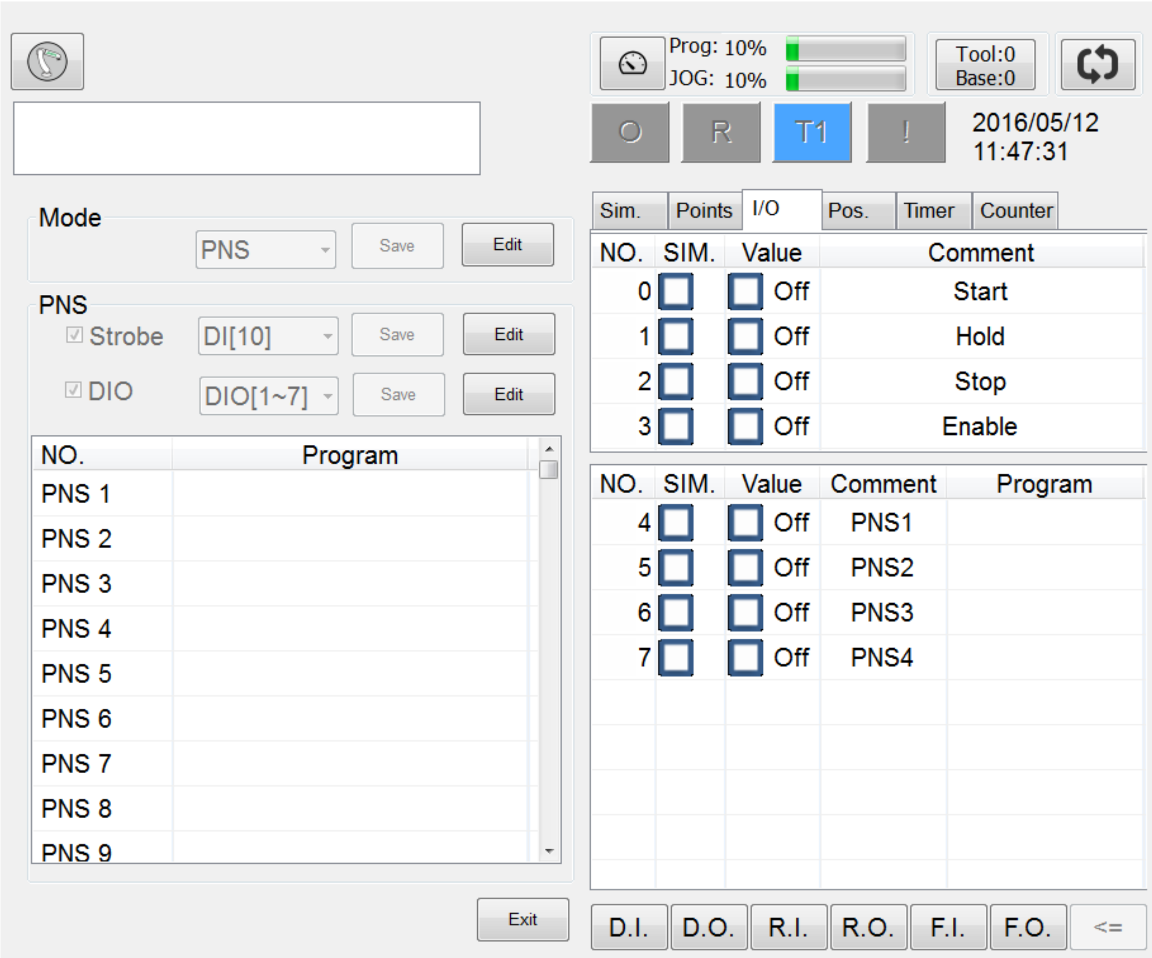
  Program edit is complete.

  Select PNS mode.

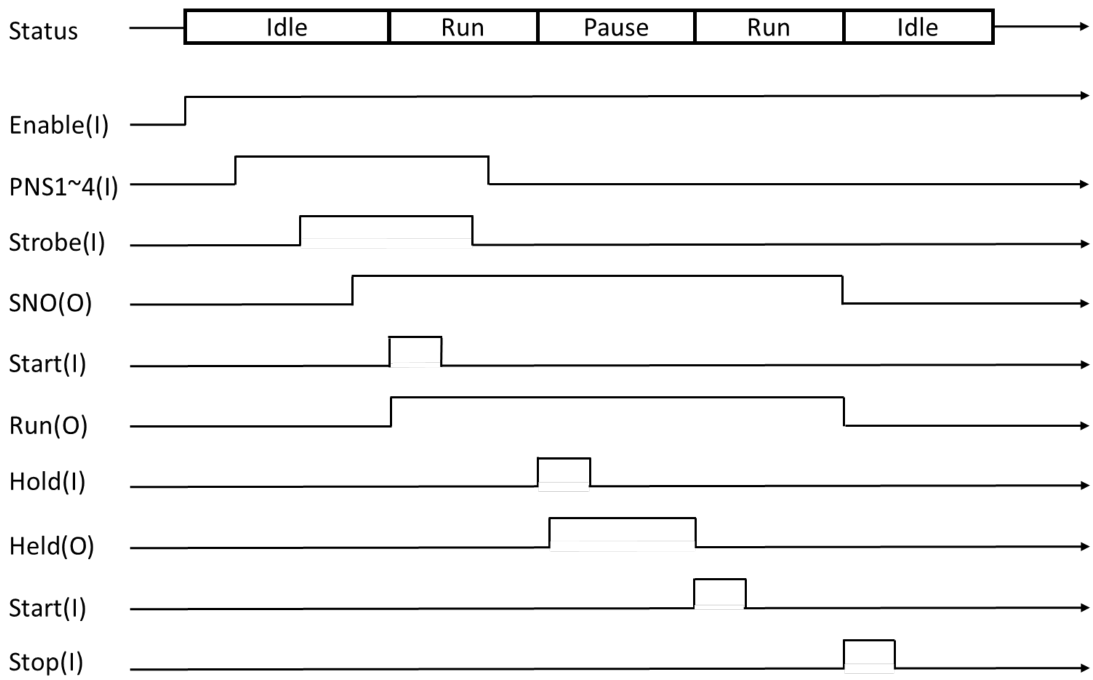
- Operating Steps

  1. Select the completed program in the program directory, press “Add to” and then add the program to the list of PNS Programs.
  2. Select Start-up>System Setting>FIO Setting.
  3. Confirm the ”Mode” option is the selection of PNS mode, if not, please press ”Edit” to proceed the change, and then press ”Save” for saving.
  4. Check “Strobe” already set.
  5. In the paging of I/O, tap F.I. and F.O., it is possible to observe execution of the program triggered by exterior source.
  6. When Enable of F.I. is “On”, it will then be possible to execute the relevant function of the external procedure.

7. Trigger F.I.[4~7] to choose program needed execute.
8. Set DI which is "Strobe" as On to open program selected.
9. Check program number through SNO in F.O.
10. When Start of F.I. is "On", according to current state of I.O., it will automatically enable the program that has already been added to Program column and execute enabled program automatically.
11. When Hold of F.I. is "On", the program under execution will be temporarily stopped, if the program must be enabled again, the state of Start must be set to "On".
12. When Stop of F.I. is "On", the program under execution will be stopped.
13. If "DIO" option is checked, it is possible to select D.I. as the expansion of triggering program, the highest support is up to DI [1~7] which is able to trigger 2047 types of program.
14. Double click under the column of "NO.", to view the I.O. state that requires to trigger this program.
15. Double click on the column of Program to delete the program from the list.



FIO Setting interface



6.14. Positioning Check of Arm Position

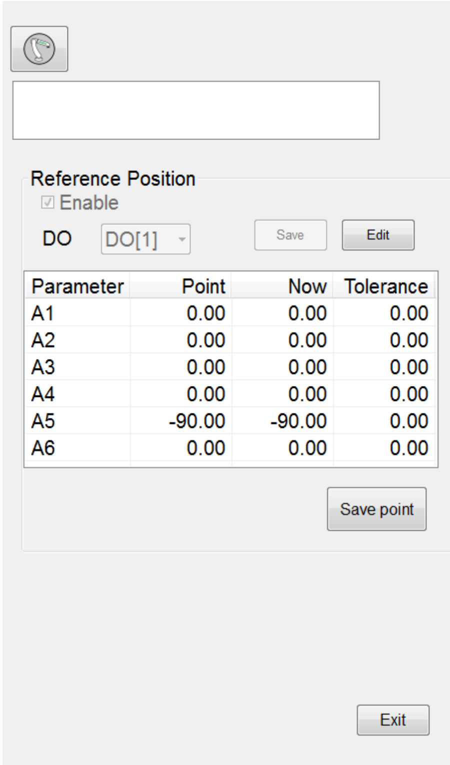
- Description

  User is able to define their own point position (Point column) and tolerance range (Tolerance column) of one arm, if the current angle position (Now column) of arm enters into the tolerance range of point position previously configured and when the arm is moved manually or moved by the program, it will change the specified output DO to the state of “ON”.

  This function can be used to check if the position of arm has been returned to the position as predetermined by the user before enabling the program or after ending the program.

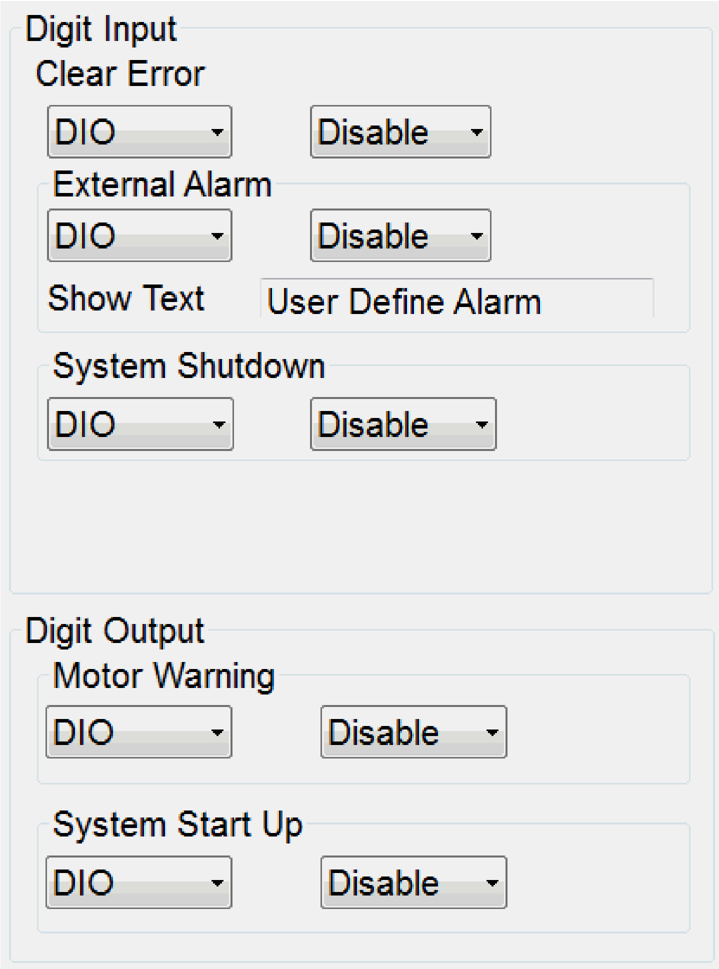
- Operating Steps

  1. Select Start-up>System Setting>Ref. Position
  2. Click “Edit”, check Enable and configure DO, and then press “Save” for saving the setting.
  3. Move the arm to the position to be configured as the check point.
  4. Press “Save point” button, save the Point column with the new value.
  5. Click twice on the table, it enables the tolerance range of each axis (Tolerance) to be edited.



Reference Position interface

6.15. Self-defined Digital Input Control Function



DIO setting interface

6.15.1. Clear Error

- Prerequisite
  Expert user group.

- Operating Steps
  1. Select Start-up>System Setting>DIO Setting.
  2. Select the specific D.I. from the Clear Error option, it will enable to use as the functional signal of clearing error through the configured D.I.
  3. If Disable is selected, it indicates that this function is disabled.
  4. Press Save to save the setting.

6.15.2. External Alarm

- Prerequisite
  Expert user group.

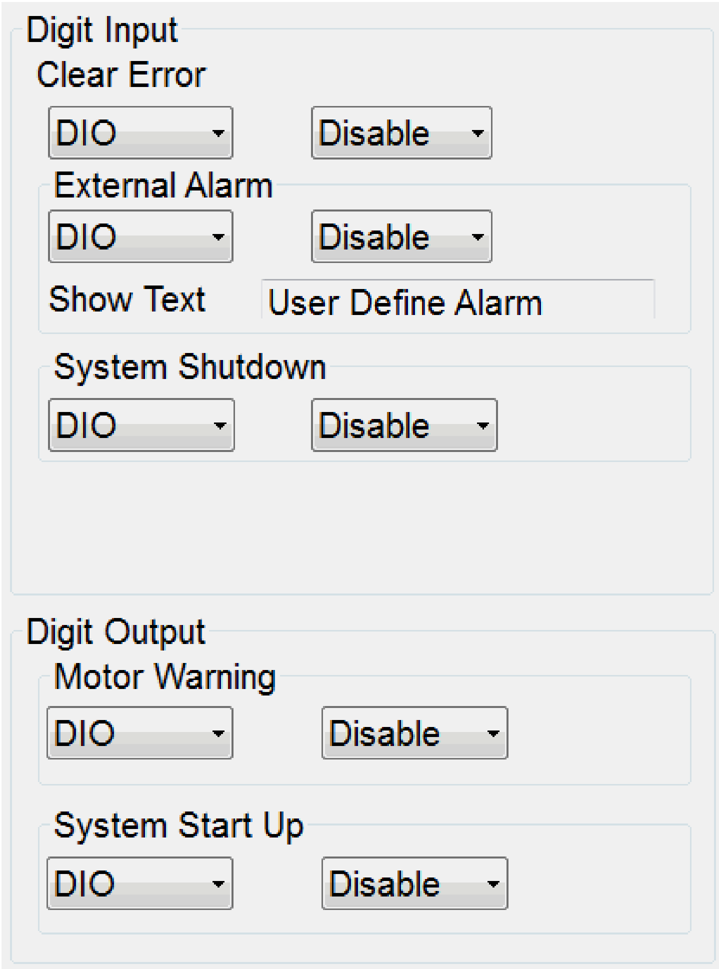
- Operating Steps
  1. Select Start-up>System Setting>DIO Setting
  2. Select the specific D.I. from the External Alarm option, it will enable to use as the functional signal of external alarm through the configured D.I.
  3. If Disable is selected, it indicates that this function is disabled.
  4. Set the word to be appeared in Show Text when the alarm is triggered.
  5. Press Save to save the setting.

6.15.3. External Shutdown Input

- Prerequisite
  Expert user group

- Operation Steps
  1. Select Start-up>System Setting>DIO Setting.
  2. Select the specific D.I. from the System Shutdown option, it will enable to use as the functional signal of system shutdown through the configured D.I.
  3. If Disable is selected, it indicates that this function is disabled.
  4. Press Save to save the setting.

6.16. Self-defined Digital Output Control Function



DIO setting interface

6.16.1. Motor Warning

- <u>Prerequisite</u>

  Expert user group.

- <u>Operating Steps</u>

  1. Select Start-up>System Setting>DIO Setting.
  2. Select the specific D.O. from the Motor Warning option, it will enable to use as the functional signal of motor warning through the configured D.O.
  3. If Disable is selected, it indicates that this function is disabled.

6.16.2. System Start Up

- Prerequisite
  Expert user group.

- Operating Steps
  1. Select Start-up>System Setting>DIO Setting.
  2. Select the specific D.O. from the System Start Up option, it will enable to use as the functional signal of starting up through the configured D.O.
  3. If Disable is selected, it indicates that this function is disabled.

6.17. Setting of Motion Parameters (programmed by keyboard)

- <u>Prerequisite</u>
  Program selected
  T1 mode
  Keyboard connected

6.17.1. SET_OVERRIDE_SPEED

- <u>Description</u>
  Use this instruction in the program to change the program override during movement.
  The input parmaters indicate maximum running speed percentage.

- <u>Format</u>
  SET_OVERRIDE_SPEED 100

- <u>Format Description</u>
  The variable type is a positive integer, the allowable range is from 1 to 100 and can not be 0.

6.17.2. SET_ SPEED

- <u>Description</u>
  Use this instruction in the program to configure the moving speed of tangent track and circular orbit during movement.
  The input paramaters indicate the configured speed, unit is mm/s. Range between 1 to 6000.

- <u>Format</u>
  SET_ SPEED 2000

- <u>Format Description</u>
  The variable type is a positive integer that can not be 0, different model has a different default.

WARNING

1. Using SET_SPEED instruction gives the robot a higher speed of operation. However, when the value is set too high, it may exceed the robot load and cause false alarm.
2. Please adjust the parameters according to the actual requirement of use to avoid equipment damage caused by the excessive operating speed.

6.17.3. SET_ ACC

- Description

  Use this instruction in the program to configure the 100% acceleration time of motion.

  This is the time used to accelerate to the required motion speed, the unit is ms, range between 20 to 400.

  If this setting is not used, different model has a different default.

- Format

  SET_ ACC 250

- Format Description

  The variable type is the positive integer which cannot be 0.

WARNING

1. Using SET_ACC instruction gives the robot a higher speed of operation. However, when the value is set too low, it may exceed the robot load and cause false alarm.
2. Please adjust the parameters according to the actual requirement of use to avoid equipment damage caused by the excessive operating speed.

6.17.4. SET_ ROTATION_SPEED

- Description

  Use this instruction in the program to configure the speed of rotation of the gesture during the motion.

  The input paramaters indicate the configured speed, the unit is deg/sec.

- Format

  SET_ ROTATION_SPEED 100

- Format Description

  The variable type is the positive integer which cannot be 0.

WARNING

1. Using SET_ACC instruction gives the robot a higher speed of operation. However, when the value is set too low, it may exceed the robot load and cause false alarm.
2. Please adjust the parameters according to the actual requirement of use to avoid equipment damage caused by the excessive operating speed.

6.17.5. SET_TOOL

- Description

  Use this instruction in the program to allow the arm to select the specified number of TOOL setting, or change the setting of current parameters of TOOL.

- Format

```
FRAME T_ONE
T_ONE.X = 100
SET_TOOL 1
SET_TOOL T_ONE
```

- Format Description

  SET_TOOL supports the input of a positive integer and 2 types of parameter for FRAME.

  The allow the range of positive integer from 0 to 15, if the positive integer is entered, it will set the arm to select specified number of Tool setting, the Tool number on the upper right corner will also be changed.

  If FRAME is entered, it will change the currently selected Tool setting parameter to the value of FRAME. (Please refer to P199 for the using example of FRAME.)

6.17.6. SET_BASE

- Description

  Use this instruction in the program to allow the arm to select the specified number of BASE setting, or change the setting of current parameters of BASE.

- Format

```
FRAME B_ONE
B_ONE.Y = 100
SET_BASE 1
SET_BASE B_ONE
```

- Format Description

  SET_BASE supports the input of a positive integer and 2 types of parameter for FRAME.
  The allow the range of positive integer from 0 to 31, if a positive integer is entered, it will set the arm to select speified number of Base setting, the Base number on the upper right corner will also be changed.
  If FRAME is entered, it will change the currently selected Base setting parameter to the value of FRAME. (Please refer to P199 for the using example of FRAME.)

6.17.7. TRUE_PATH

- Description

  Configure this parameter to select in the program if the accurate moving mode is enabled.
  If the accurate moving mode is enabled, it will enhance the absolute accuracy during arm movement, however, if excessive moving speed is configured under the accurate moving mode, it may cause the arm to produce abnormal sound.

- Format

  TRUE_PATH = TRUE

- Format Description

  The variable type is Boolean, if this variable is not configured, the default is FALSE.

6.17.8. GETPOINT

- Description
  Acquire the coordinate value and angle value of current position.
- Format
  E6POINT E6TEST
  E6TEST = GETPOINT
- Format Description
  E6TEST acquires the coordinate value and angle value of current position.

6.17.9. GET_MOTION_STATUS

- Description
  Acquire the current motion status.

- Format
  INT Istatus
  Istatus = GET_MOTION_STATUS

- Format Description
  Istatus acquires the value of current motion status.
  0 is the idle status, 1 is the running status, 2 is the hold status.

6.17.10. BRAKE

- Description
  Stop and clear the motion command which contained motion queue command.

- Format
  LIN P1
  LINP2
  …
  BRAKE

- Format Description
  When executed to BRAKE, the motion will stop.

6.17.11. EXT_TCP (Optional)

- Description

  This command is required when the robot takes a workpiece to perform a LIN or CIRC motion on an external tool point, such as a polishing job.

- Format

```
EXT_TCP_START
LIN P1
LINP2
…
EXT_TCP_END
```

- Format Description

  The motion command between EXT_TCP_START and EXT_TCP_END will move as external tool point.

6.17.12. CHECK_LIN

- Description

  The manipulator may move to the singular point in addition to the PTP command during the movement. At this time, the manipulator will trigger the alarm to stop the manipulator. This command can be checked whether the singular point occurs between two points in advance, and perform different motion design to avoid moving to singular point and stop in the midway, this increase the efficiency of use.

- Format

```
IF CHECK_LIN(P1,P2) == FALSE THEN
LIN P1
LIN P2
ENDIF
```

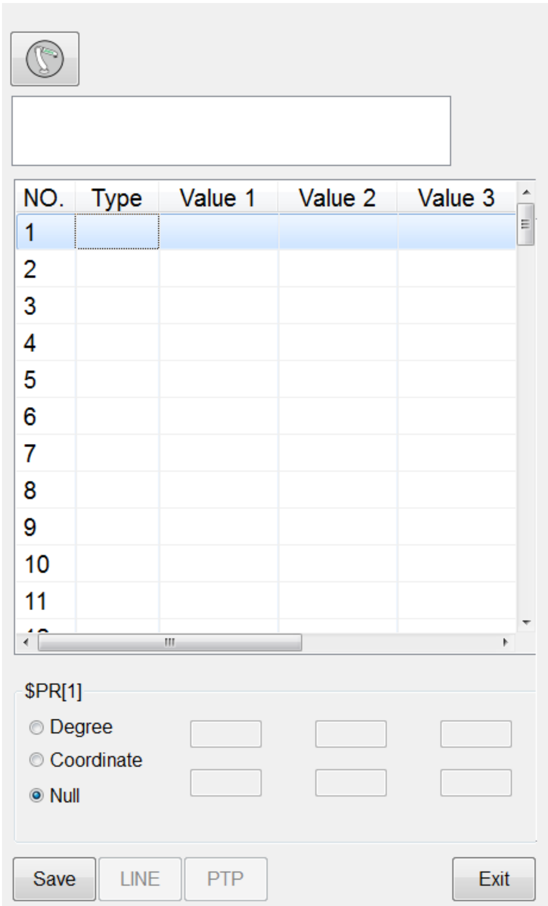
- Format Description

  Using CHECK_LIN command to determine that P1 and P2 will not be singular, then execute the movement of LIN P1 and LIN P2.

6.18. Location Register

6.18.1. Using Interface to Enter Location Register

- Operating Steps
  1. Select Display > PR.
  2. Click any column in the list.
  3. User may select Degree, Coordinate or Null from the options below.
  4. If Degree is selected, the default value is filled in A1 to A6 angle, user can edit this value directly.
  5. If Coordinate is selected, the default value is filled in the Cartesian coordinate, user can edit this value directly.
  6. If Null is selected, all content will be cleared.
  7. Press Save to save the setting.



Location Register setting interface

6.18.2. Using Instruction to Enter Location Register

- Operating Steps
  1. Put a cursor behind, and insert on a line of the instruction command
  2. Input the command by keyboard

Example 1:

$PR[1] = {A1 1 , A2 2 , A3 3 , A4 4 ,A5 5 , A6 6}
$PR[2] = {X 7 ,Y 8 , Z 9 , A 10 ,B 11 , C 12}
$PR[3] = {A1 1 , A2 2 , A3 3 , A4 4 ,A5 5 , A6 6, X 7 ,Y 8 , Z 9 , A 0,B 0, C 0}

Example 2:

E6POS A = {X 10 ,Y 10 ,Z 10 ,A 10 ,B 10 ,C 10}
E6AXIS B = {A1 20 , A2 20 , A3 20 , A4 50 ,A5 10 , A6 20}
E6POINT C = { X 5 ,Y 15 ,Z 25 ,A 35 ,B 45 ,C 55}
$PR[1] = A
$PR[2] = B
$PR[3] = C

Example 3:

$PR [1] = GETPOINT

6.18.3. Use Location Register for Motion

- Operating Steps
  1. Put a cursor behind, and insert on a line of the instruction command
  2. Input the command by keyboard

Example:

LIN $PR [1]
LIN_REL $PR [1]
PTP $PR [1]
PTP_REL $PR [1]
CIRC $PR [1] $PR [2]
CIRC_REL $PR [1] $PR [2]

Attention: TYPE of two PR used by CIRC and CIRC_REL must be the same (same DEG or same POS).

6.19. User Self-defined Alarm

6.19.1. Content of Defined Alarm

- Description
  User is able to define 10 sets of alarm text content, issued by program instruction.

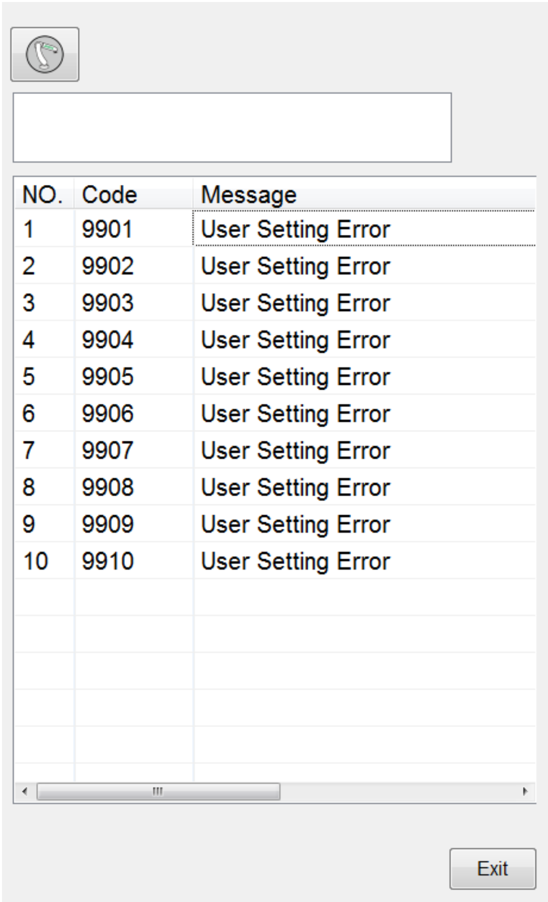
- Operating Steps
  1. Select Main menu > Start-up > System Setting > User Alarm Setting
  2. Click twice on the column of Message, and then edit the alarm text content of that column.

6.19.2. Issue Self-defined Alarm (programmed by keyboard)

- Description
  If the user requires an alarm based on the self-determined condition during the execution of program, it is possible to use this instruction function to issue an alarm while the program is running.
  When using this instruction to issue the alarm, it has the function as temporary motion stop, the "Start" button will be used to continue executing the operation.

- Format
  USER_ALARM [n]

- Format Description
  The variable type is a positive integer, from 1 to 10 and cannot be 0.



User Alarm Setting interface

6.20. Electric Gripper Command

6.20.1. Command Description

In HRSS, there are 8 command in total related to XEG series electric gripper for user to program, each command will be executed or completed first in order to continue the next execution.

6.20.1.1. EG_OPEN (str Type)

- Description
  Connect XEG series electric gripper. Before executing any command to operate the electric gripper, this command must be executed to open the connection with the electric gripper.

- Format
  EG_OPEN(Type)

- Format Description
  Type will be representing the model of the XEG series electric gripper, the code for each model will be represented below:

Code	Electric Gripper Model
X16	XEG-16
X32	XEG-32
X64	XEG-64

6.20.1.2. EG_CLOSE

- Description
  Close the connection for current XEG electric gripper. Can be used to close the current electric gripper and switch on connection for other model of XEG electric gripper.

- Format
  EG_CLOSE

- Format Description

  No other parameters

6.20.1.3. EG_RESET

- Description

  Execute reset for XEG series electric gripper. After the connection with electric gripper is completed, the reset has to be performed to ensure that each control parameters are read and write.

- Format

  EG_RESET

- Format Description

  No other parameters

6.20.1.4. EG_GET_STATUS

- Description

  Obtain the status of XEG series electric gripper, each status code are as followed:

Code	Status of Electric Gripper	
0	Idle	Ready
1	In action	Busy
2	Grip	Hold
-1	Abnormal position	Alarm 1
-2	Over trip	Alarm 2
-3	Unusual origin return	Alarm 3

  Used to determine whether the electric gripper is currently grip on to an object or in an action as one of the basis of object recognition.

- Format

  IF EG_GET_STATUS == 2 THEN

  …

  ENDIF

- Format Description
  Using IF condition to determine the status of XEG series electric gripper in order to execute different operation.

6.20.1.5. EG_RUN_MOVE(double MovPos, int MovSpeed)

- Description
  Execute the movement of XEG series electric gripper. According to the speed set by the user to control the electric gripper to move to the specified position (absolute coordinates).

- Format
  EG_RUN_MOVE(MovPos, MovSpeed)

- Format Description
  - **MovPost** Moving electric gripper to the specified position, minimum unit 0.01mm.
  - **MovSpeed** Movement speed of the electric gripper, minimum unit 1mm/s.
  Setting range for each electric gripper as followed:

Model of Electric Gripper	MovPos	MovSpeed
XEG-16	0~16 (mm)	0~60 (mm/s)
XEG-32	0~32 (mm)	0~80 (mm/s)
XEG-64	0~64 (mm)	0~100 (mm/s)

6.20.1.6. EG_RUN_GRIP(str Dir, int Str, str GriSpeed, str GriForce)

- Description

Execute the gripping movement of XEG series electric gripper. According to the direction, displacement, speed and force of gripping set by the user to control the electric gripper for operating gripping action (relative coordinates).

- Format
  EG_RUN_GRIP(Dir, Str, GriSpeed ,GriForce)

- Format Description

  - **Dir** Electric gripper moving direction, C represent moving inwards, O represent moving outwards.
  - **Str** Displacement of the grip, minimum unit as 1mm;
  (XEG-16 range(0~16mm)、XEG-32 range(0~32mm)、XEG-64range(0~64mm))
  - **GriSpeed** Speed of the grip, L represent Low, M represent Medium, H represent High
  - **GriForce** Force of the grip, L represent Low, M represent Medium, H represent High

6.20.1.7. EG_RUN_EXPERT(str Dir, double MovStr, int MovSpeed, double GriStr, int GriSpeed, int GriForce)

- Description

  Execute gripping movement of XEG series electric gripper in expert mode. According to the direction, displacement, speed and force of gripping set by the user to control the electric gripper for operating fast movement and slow grip (relative coordinates).

- Format

  EG_RUN_EXPERT(Dir, MovStr ,MovSpeed,GriStr,GriSpeed,GriForce)

- Format Description

  - **Dir** Electric gripper moving direction, C represent moving inwards, O represent moving outwards.
  - **MovStr** Movement displacement, minimum unit 0.01mm.
  - **MovSpeed** Movement speed, minimum unit 1mm/s.
  - **GriStr** Displacement of the grip, minimum unit 1mm/s
  - **GriSpeed** Speed of the grip, minimum unit 1mm/s
  - **GriForceForce** of the grip, minimum unit 5%

Setting range for each electric gripper as followed:

Model of Electric Gripper	MovStr	MovSpeed	GriStr	GriSpeed	GriForce
XEG-16	0~16 (mm)	0~60 (mm/s)	0~16 (mm)	0~20 (mm/s)	50~100%
XEG-32	0~32 (mm)	0~80 (mm/s)	0~32 (mm)	0~20 (mm/s)	40~100%
XEG-64	0~64 (mm)	0~100 (mm/s)	0~64 (mm)	0~20 (mm/s)	40~100%

6.20.1.8. EG_GET_POS

- Description

  Obtain the position of XEG series electric gripper, minimum unit 0.01mm. Used to confirm whether the electric gripper has moved to the specified position or within a range, as one of the basis of object recognition.

- Format

```
IF EG_GET_POS > 5.00 AND EG_GET_POS < 7.00 THEN
…
ENDIF
```

- Format Description

  Using IF condition to determine the position of XEG series electric gripper in order to execute different operation.

6.21. Infinite Rotation Command (Optional)

6.21.1. CT_A6

- Description

  Execute the infinite rotation of the sixth axis of the robot, this command must be used with Keypro.

- Format

  CT_A6 velocity_ratio

- Format Description

  velocity_ratio is the ratio of infinite rotation speed, the input range is -100 to 100, the sign indicates the direction of rotation, and the input 0 stops the infinite rotation.

7. Error Message

The error message with * symbol, on behalf of this error does not stop robot.

7.1. Robot System Software(01-XX-XX)

7.1.1. System Error Message(01-01-XX)

Error code	Error	Message	Reason	Solution
01-01-10	System initialization failure	System initialization failure	Software damaged or lost	1.Check the drive EtherCAT connection status. 2.Please turn off the power and then restart. 3.Please contact the engineer from manufacturer.
01-01-11	Motion library load failure	Motion library load failure	Motion library damaged or lost	
01-01-12	Motion library initialization failure	Motion library initialization failure		
01-01-13	Motion library memory initialization failure			
01-01-14	Motion library start failure	Motion library start failure		
01-01-20	EtherCAT library loading failure	EtherCAT library loading failure	Software damaged	
01-01-21	EtherCAT disconnection	EtherCAT anomalies	EtherCAT connection anomalies	
01-01-22	EtherCAT initialization failure			

Error code	Error	Message	Reason	Solution
01-01-23	EtherCAT line crossing alarm	EtherCAT anomalies	EtherCAT connection anomalies	1.Check the drive EtherCAT connection status.
01-01-24	EtherCAT none slave alarm			
01-01-25	EtherCAT can't check slave			

01-01-26	EtherCAT slave none response	EtherCAT anomalies	EtherCAT connection anomalies	2.Please turn off the power and then restart. 3.Please contact the engineer from manufacturer.
01-01-27	EtherCAT cycle alarm			
01-01-28	EtherCAT cycle jitter			
01-01-29	EtherCAT cycle counter error			
01-01-2A	EtherCAT cycle watchdog error			
01-01-2B	EtherCAT INIT switching error			
01-01-2C	EtherCAT PREOP switching error			
01-01-2D	EtherCAT SAFEOP switching error			
01-01-2E	EtherCAT OP switching error			
01-01-2F	EtherCAT master none response			
01-01-30	EtherCAT master initialization error			
Error code	Error	Message	Reason	Solution
01-01-31	EtherCAT busbar scan error	EtherCAT anomalies	EtherCAT connection anomalies	1.Check the drive EtherCAT connection status. 2.Please turn off the power and then restart. 3.Please contact the engineer from manufacturer.
01-01-32	EtherCAT frame response error			
01-01-33	EtherCAT frame lost			
01-01-34	EtherCAT master counter error of initialization command			
01-01-35	EtherCAT master response error of			

	initialization command	EtherCAT anomalies	EtherCAT connection anomalies	
01-01-36	EtherCAT slave counter error of initialization command			
01-01-37	EtherCAT slave response error of initialization command			
01-01-38	EtherCAT mailbox time out			
01-01-39	EtherCAT mailbox SDO cancel			
01-01-3A	EtherCAT mailbox COE counter receive error			
01-01-3B	EtherCAT mailbox COE counter send error			
01-01-3C	EtherCAT mailbox receive invalid data			
01-01-3D	EtherCAT master alarm			

Error code	Error	Message	Reason	Solution
01-01-40	Axis 1 parameter setting fail	System anomalies	Software damaged or lost	If reinstall software is required, please contact engineer from the original equipment manufacturer.
01-01-41	Axis 2 parameter setting fail			
01-01-42	Axis 3 parameter setting fail			
01-01-43	Axis 4 parameter setting fail			
01-01-44	Axis 5 parameter setting fail			

01-01-45	Axis 6 parameter setting fail	System anomalies	Software damaged or lost	If reinstall software is required, please contact engineer from the original equipment manufacturer.
01-01-50	Conveyor 1 encoder initial fail			
01-01-51	Conveyor 2 encoder initial fail			
01-01-52	Conveyor 3 encoder initial fail			
01-01-53	Conveyor 4 encoder initial fail			
01-01-54	External parameter initial fail			
01-01-55	HRSS Loading fail			
01-01-57	HRSS last shutdown error	HRSS last shutdown abnormality	1. The HRSS is not turned off properly, and the HRSS is not turned off when the program is stopped. 2. Directly cut off the main power instead of turning off the controller.	1. Please confirm whether the data is stored correctly, and avoid turning off the HRSS in the same way (the HRSS is not turned off when the program is stopped, or the main power is turned off instead of turning off the controller power). 2. If the program has stopped and the main power is not cut off directly, please contact the engineer to check and repair the controller.

01-01-58	FBWF memory consumption 128MB	FBWF memory consumption 128MB	FBWF anti-write memory is full to 128 MB	User needs to reboot
01-01-59	FBWF memory consumption 512MB	FBWF memory consumption 512MB	FBWF anti-write memory is full to 512 MB	User needs to reboot
01-01-60	FBWF file failed to open	FBWF file failed to open	File damage	Confirm that the file is damaged

7.1.2. Program Error(01-02-XX)

Error code	Error	Message	Reason	Solution
01-02-10	Program code incorrectness	Program code format incorrect	Syntax error.	Check robot language. Ref 9.1.11
01-02-11	Try to repair the corrupted file. Please confirm the program content is correct before execute.	Program file open failure.	Files are damaged or lost.	Use backup file or create new file.
01-02-12	Program copy error	Program file copy error	Program file copy error	Please export the history record and send it back to original factory for analysis.

7.1.3. Motion Error(01-03-XX)

Error code	Error	Message	Reason	Solution
01-03-10	Axis 1 following error too big	Axis 1 position over deviation	Motion speed too fast or actual position exceeded deviation	1. Reduce speed。 2. Reduce load. 3. Reduce acceleration.
01-03-11	Axis 2 following error too big	Axis 2 position over deviation		
01-03-12	Axis 3 following error too big	Axis 3 position over deviation		
01-03-13	Axis 4 following error too big	Axis 4 position over deviation		
01-03-14	Axis 5 following error too big	Axis 5 position over deviation		
01-03-15	Axis 6 following error too big	Axis 6 position over deviation		
01-03-16	Axis 1 position overlimit of positive	Axis 1 exceeded positive rotation limit	Motion to Axis 1 reach positive limit	Axis 1 move negative
01-03-17	Axis 1 position overlimit of negative	Axis 1 exceeded negative rotation limit	Motion to Axis 1 reach negative limit	Axis 1 move positive
01-03-18	Axis 2 position overlimit of positive	Axis 2 exceeded positive rotation limit	Motion to Axis 2 reach positive limit	Axis 2 move negative
01-03-19	Axis 2 position overlimit of negative	Axis 2 exceeded negative rotation limit	Motion to Axis 2 reach negative limit	Axis 2 move positive

01-03-1A	Axis 3 position overlimit of positive	Axis 3 exceeded positive rotation limit	Motion to Axis 3 reach positive limit	Axis 3 move negative
01-03-1B	Axis 3 position overlimit of negative	Axis 3 exceeded negative rotation limit	Motion to Axis 3 reach negative limit	Axis 3 move positive
01-03-1C	Axis 4 position overlimit of positive	Axis 4 exceeded positive rotation limit	Motion to Axis 4 reach positive limit	Axis 4 move negative
01-03-1D	Axis 4 position overlimit of negative	Axis 4 exceeded negative rotation limit	Motion to Axis 4 reach negative limit	Axis 4 move positive
01-03-1E	Axis 5 position overlimit of positive	Axis 5 exceeded positive rotation limit	Motion to Axis 5 reach positive limit	Axis 5 move negative
01-03-1F	Axis 5 position overlimit of negative	Axis 5 exceeded negative rotation limit	Motion to Axis 5 reach negative limit	Axis 5 move positive
01-03-20	Axis 6 position overlimit of positive	Axis 6 exceeded positive rotation limit	Motion to Axis 6 reach positive limit	Axis 6 move negative
01-03-21	Axis 6 position overlimit of negative	Axis 6 exceeded negative rotation limit	Motion to Axis 6 reach negative limit	Axis 6 move positive

Error code	Error	Message	Reason	Solution
01-03-30	XY coordinate overlimit of software	XY coordinates reached the limit	Motion to XY coordinate limit	Clear error and move in opposite limit direction
01-03-31	Joint overspeed	Shaft over speed	Reverse solution to determine a shaft speed too fast.	Clear error and use PTP motion
01-03-32	Wrist singularity	Near wrist singular point	Near wrist singular point	Try to avoid the singular point of motion
01-03-33	Shoulder singularity	Near shoulder singular point	Near shoulder singular point	
01-03-34	Elbow singularity	Near elbow singular point	Near elbow singular point	
01-03-40	Circle command 3 reference points on the same line	Circle command on the same line	Command setting error.	Check CIRC description.
01-03-41	Circle comm can't found center point	Unable to calculate center of circle in two point space		
01-03-42	Circle comm can't calculate transpose matrix	Circle command parameter error, unable to calculate transpose matrix		
01-03-50	Synchronize output queue overflow	Synchronize output command buffer overflow	Synchronize output command too much, causing	1. Please check if the connecting line is correctly connected, and turn off the

			buffer overflow	power and then re-start. 2. Please contact engineer from the original equipment manufacturer.
01-03-51	Synchronize output overlimit	Synchronize output control command overlimit	Synchronize activate output command too much	
01-03-52	Found motion command when compliance teaching	During compliance tuning, send motion command	Motion command cannot be performed during compliance tuning.	Clear error and stop sending motion command

7.1.4. Operation Error(01-04-XX)

Error code	Error	Message	Reason	Solution
01-04-10	Read driver 1 encoder is abnormality	Axis 1 absolute encoder position error	Read axis encoder under moving status	Please confirm whether the brake shaft is falling.
01-04-11	Read driver 2 encoder is abnormality	Axis 2 absolute encoder position error		
01-04-12	Read driver 3 encoder is abnormality	Axis 3 absolute encoder position error		
01-04-13	Read driver 4 encoder is abnormality	Axis 4 absolute encoder position error		

01-04-14	Read driver 5 encoder is abnormality	Axis 5 absolute encoder position error		
01-04-15	Read driver 6 encoder is abnormality	Axis 6 absolute encoder position error		
01-04-16	Write data to driver 1 is abnormality	Axis 1 driver parameter write back failed		
01-04-17	Write data to driver 2 is abnormality	Axis 2 driver parameter write back failed		
01-04-18	Write data to driver 3 is abnormality	Axis 3 driver parameter write back failed	Driver connection is abnormality	Check driver connection.
01-04-19	Write data to driver 4 is abnormality	Axis 4 driver parameter write back failed		
01-04-1A	Write data to driver 5 is abnormality	Axis 5 driver parameter write back failed		
01-04-1B	Write data to driver 6 is abnormality	Axis 6 driver parameter write back failed	Driver connection is abnormality	Check driver connection.

Error code	Error	Message	Reason	Solution
01-04-1C	Clear driver 1 encoder is abnormality	Clear Axis 1 driver	1.Driver connect is abnormality.	1.Check driver connected.

		encoder failed	2. The command is forbidden	2.Check driver status.
01-04-1D	Clear driver 2 encoder is abnormality	Clear Axis 2 driver encoder failed		
01-04-1E	Clear driver 3 encoder is abnormality	Clear Axis 3 driver encoder failed		
01-04-1F	Clear driver 4 encoder is abnormality	Clear Axis 4 driver encoder failed		
01-04-20	Clear driver 5 encoder is abnormality	Clear Axis 5 driver encoder failed		
01-04-21	Clear driver 6 encoder is abnormality	Clear Axis 6 driver encoder failed		
01-04-30	Start position declination is abnormality	Robot position declination	. The robot's position is different from when it was last powered off.	Please move to the origin and confirm that the angle is correct. Refer 5.8
01-04-31	A1 declination is abnormality			
01-04-32	A2 declination is abnormality			
01-04-33	A3 declination is abnormality			
01-04-34	A4 declination is abnormality			
01-04-35	A5 declination is abnormality			
01-04-36	A6 declination is abnormality			

Error code	Error	Message	Reason	Solution
01-04-40	RSR(&NUM) no file	RSR file not set	RSR execution file not set	Confirm that the execution file is set.
01-04-41	PNS(&NUM) no file	PNS file not set	PNS execution file not set	
01-04-50	ISR delay stack overflow	ISR delay buffer overflow	ISR delay buffer overflow	1.Please turn off the power and then re-start. 2.If it is still unable to resolve, please contact engineer from the original equipment manufacturer.
01-04-51	Motion command queue overflow	Motion command buffer overflow	Motion command too much, causing buffer overflow	
01-04-52	Jog queue overflow	Jog command buffer overflow	Jog command too much, causing buffer overflow	
01-04-53	Interpolation buffer overflow	Interpolation command buffer overflow	Interpolation command too much, causing buffer overflow	
01-04-60	Modify Time Setting	* Time is modified, will not shutdown.	Time Setting is modified, will not shutdown	Inform user time setting is modified, will not shutdown
01-04-61	Modify NTP Setting	*NTP is modified, will not shutdown.	NTP Setting is modified,	Inform user NTP is

			will not shutdown	modified, will not shutdown
01-04-70	Infinite rotation is not turned on.	Infinite rotation is not turned on.	User operates infinite rotation in infinite rotation function interface, and executes the CT_A6 command.	After the user turns on the infinite rotation function in the interface, the user executes the CT_A6 command.

7.1.5. IO & Communication(01-05-XX)

Error code	Error	Message	Reason	Solution
01-05-10	Teach Pendant connection error	TP connection error	1.TP destroy. 2.TP connection port is abnormal.	1.Change TP. 2.Check connect port.
01-05-20	ROBOT IO connection error	Robot IO connection error	Interference	Confirm RIO wire.
01-05-21	ROBOT IO disconnection	Robot IO disconnection	1.Robot IO destroy 2.Robot IO port is abnormal.	1. Change Robot IO. 2. Confirm RIO port.
01-05-30	Network disconnection	Network disconnection	Network is abnormal.	Check network connection.
01-05-31	Network connect failure	Network connect failure	Network server is abnormal.	1.Check network connection server.

				2.Check network domain. 3.Check connection IP and PORT setting
01-05-32	Server opened failure	Server opened failure	Server opened failure	Check connection IP and PORT setting
01-05-33	Server closed the connection	Sever connection closed	Sever automatically closed connection	Prevent sever automaticall y disconnect from client
01-05-34	Network port setting error	Network port setting error	Network port setting error	Check port setting.
01-05-35	Network client disconnect time out	Network client disconnect time out	Network client disconnect time out	Check sever whether interact with client disconnect message
01-05-36	Fieldbus connection failed	Fieldbus slot 1 open failed	The fieldbus PCI card is not installed correctly.	Confirm whether the fieldbus PCI card is installed correctly.
01-05-37		Fieldbus slot 2 open failed		
01-05-38		Fieldbus slot 1 communication error	1. The fieldbus line is not	1. Check whether the connection

01-05-39		Fieldbus slot 2 communication error	connected properly. 2. The connection parameter setting does not correspond to the PLC. 3. The PLC is not operating normally.	line is normal. 2. Check whether the connection parameters are set correctly. 3. Check whether the PLC device operates normally.
01-05-40		Fieldbus slot 1 connection timeout	The fieldbus related files were not imported correctly.	Confirm that the fieldbus related files are imported correctly.
01-05-41		Fieldbus slot 2 connection timeout		

7.1.6. Operator Error (01-06-XX)

Error code	Error	Message	Reason	Solution
01-06-10	Motion delay command abnormality	Parameter cannot be set	Parameter is not within the range to be set	Check parameter.
01-06-11	Acceleration setting command abnormality	Parameter cannot be set		
01-06-12	PTP motion command abnormality	PTP motion failed	1.Command format error. 2.Unable to give motion command instruction	1. Confirm the command format. 2. Confirm the motion function status。
01-06-13	Circle motion command abnormality	CIRC motion failed		
01-06-14	Line motion command abnormality	LIN motion failed		
01-06-15	Feedspeed setting command abnormality	Parameter cannot be set	Parameter cannot be set.	Check parameter.
01-06-16	Path abnormality	Moving path abnormality	The moving path is out of working range.	Re-design the position of point and the action instruction, or check if the setting of Tool and Base has any error.
01-06-17	Setting conveyor tracking acceleration error	Parameter setting error	Parameter out of the range	Check the parameter setting is correct.
01-06-18	Setting conveyor pick acceleration error			

01-06-19	Enable smooth motion error			
01-06-1A	Disable smooth motion error			
Error code	Error	Message	Reason	Solution
01-06-20	Counter index abnormality	Parameter cannot be set	Index not within setting range	Confirm Index No.
01-06-21	Timer index abnormality			
01-06-22	Counter stop number abnormality			
01-06-23	DI index abnormality			
01-06-24	DO index abnormality			
01-06-25	RI index abnormality			
01-06-26	RO index abnormality			
01-06-27	VI index abnormality			
01-06-28	VO index abnormality			
01-06-29	SI index abnormality			
01-06-2A	SO index abnormality			
01-06-2B	SR index abnormality			
01-06-30	DI can't be setting		DI setting unavailable	DI not set
01-06-31	RI can't be setting		RI setting unavailable	RI not set
01-06-32	SI can't be setting		SI setting unavailable	SI not set

Error code	Error	Message	Reason	Solution
01-06-33	SO can't be setting	Parameter cannot be set	Specific SO setting not available	Specific SO not set
01-06-34	SRR can't be setting		SRR setting not available	SRR not set
01-06-35	SRW value abnormality	SRW value is abnormal.	Parameter error.	Check setting command.
01-06-36	Fieldbus Slot1 abnormality	Fieldbus Slot1 abnormality	1. Parameter setting error. 2. Driver is not installed. 3. Fieldbus connection abnormal.	1. Set the correct parameters. 2. Confirm that the driver installation is completed. 3Check the hardware wiring.
01-06-37	Fieldbus Slot2 abnormality	Fieldbus Slot2 abnormality		

7.1.7. External Axis Error (01-07-XX)

Error code	Error	Message	Reason	Solution
01-07-10	E1 axis following error overlimit	E1 axis position over deviation	E1 axis motion command and actual position exceeded deviation	1. Reduce the speed 2. Reduce the load weight 3.Reduce acceleration in percentage
01-07-11	E2 axis following error overlimit	E2 axis position over deviation	E2 axis motion command and actual position exceeded deviation	

01-07-12	E3 axis following error overlimit	E3 axis position over deviation	E3 axis motion command and actual position exceeded deviation	

Error code	Error	Message	Reason	Solution
01-07-13	E1 axis position overlimit of positive	E1 axis exceeded positive rotation limit	Over the positive limit.	E1 axis move towards negative
01-07-14	E1 axis position overlimit of negative	E1 axis exceeded negative rotation limit	Over the negative limit.	E1 axis move towards positive
01-07-15	E2 axis position overlimit of positive	E2 axis exceeded positive rotation limit	Over the positive limit.	E2 axis move towards negative
01-07-16	E2 axis position overlimit of negative	E2 axis exceeded negative rotation limit	Over the negative limit.	E2 axis move towards positive
01-07-17	E3 axis position overlimit of positive	E3 axis exceeded positive rotation limit	Over the positive limit.	E3 axis move towards negative
01-07-18	E3 axis position overlimit of negative	E3 axis exceeded negative rotation limit	Over the negative limit.	E3 axis move towards positive
01-07-19	E1 axis clear encoder error	E1 axis driver clear encoder failed	1. Connection with axis is abnormal.	1.Check Axis is connected. 2.Check Axis status.

01-07-1A	E2 axis clear encoder error	E2 axis driver clear encoder failed	2. Axis prohibits this command.	
01-07-1B	E3 axis clear encoder error	E3 axis driver clear encoder failed		

7.1.8. Conveyor Tracking Error(01-08-XX)

Error code	Error	Message	Reason	Solution
01-08-10	Camera connection failure	Connection with the vision system is failed.	1.IP setting error. 2.PORT setting error.	1.Check IP setting. 2.Check Port setting.
01-08-11	Camera connection abnormality		Vision system no response.	Confirm the connection with the vision system.
01-08-12	Camera disconnect fail			
01-08-13	Pick command error	Execution instruction is failed.	Point setting error.	If the tracking function of conveyor is triggered by Sensor, the position of point is required to enter into the instruction. Please confirm if the information of point position is entered into the instruction.
01-08-14	Place command error			

01-08-15	Conveyor encoder clear error	Encoder clear failed.	Encoder clear failed.	Check the conveyor wiring is correct
01-08-16	Setting latch source error	Setting latch source error	Setting latch failed	
01-08-17	Start conveyor command error	Start conveyor failed	Conveyor setting failed	Check conveyor setting is correct.

Error code	Error	Message	Reason	Solution
01-08-18	Read encoder count error	Read encoder error	Encoder fault	Check encoder and wiring.
01-08-19	Clear place data error	Data clearing failed	Place clearing failed	Contact an engineer from the original equipment manufacturer.
01-08-1A	CNV_OBJECT can't be setting	Unavailable to set parameters	Unavailable to set parameters	Check Robot Language.
01-08-1B	CNV_FULL can't be setting	Unavailable to set parameters		
01-08-1C	CNV_EMPTY can't be setting	Unavailable to set parameters		
01-08-1E	Encoder latch value inconsistent	Encoder latch value inconsistent	Trigger sensor or encoder error.	Check the trigger sensor and the encoder is normal.

7.1.9. User-Defined Error (01-09-XX)

Error code	Error	Message	Reason	Solution
01-09-10	User-defined error 1	User-defined error 1	User-defined error.	User-defined error 1

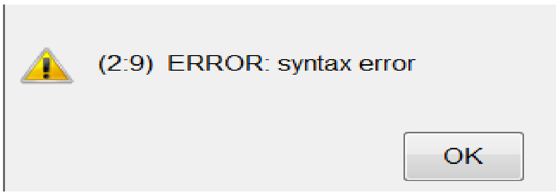
01-09-11	User-defined error 2	User-defined error 2		User-defined error 2
01-09-12	User-defined error 3	User-defined error 3		User-defined error 3
01-09-13	User-defined error 4	User-defined error 4		User-defined error 4
01-09-14	User-defined error 5	User-defined error 5		User-defined error 5
01-09-15	User-defined error 6	User-defined error 6		User-defined error 6
01-09-16	User-defined error 7	User-defined error 7		User-defined error 7
01-09-17	User-defined error 8	User-defined error 8		User-defined error 8
01-09-18	User-defined error 9	User-defined error 9		User-defined error 9
01-09-19	User-defined error 10	User-defined error 10		User-defined error 10

7.1.10. Authorization Error(01-0B-XX)

Error code	Error	Message	Reason	Solution
01-0B-10	You have no license of HRSDK	You have no license of HRSDK	1. SDK is not enabled. 2. Function is not authorized.	1.With the original purchase authorization. 2. Check whether the authorized device is connected normally.
01-0B-11	You have no license of Fieldbus	You have no license of Fieldbus		
01-0B-12	You have no license of External Axis	You have no license of External Axis		
01-0B-13	You have no license of External TCP	You have no license of External TCP	1. SDK is not enabled. 2. Function is not authorized.	
01-0B-14	You have no license of Continuous Turn	You have no license of Continuous Turn		

7.1.11. Windows Information

When the program is executed, if the program syntax is wrong, the following window will appear



The above figure as an example, the message is divided into two main parts:

1. Error location: (2: 9), on behalf of 9th words on line 2 is wrong.
2. Error message: syntax error.

Error code	Error	Message	Reason	Solution
01-02-10	syntax error	Syntax error	Command spelling error. Wrong space.	Check spelling and spaces.
01-02-10	ID not exist	Variable not exist	Variable not declared.	Declare variable before use.
01-02-10	Unknown character	Character cannot be recognized	Use special symbols.	Change variable name.
01-02-10	… is not declared	Variable not declared	Variable not declared.	Declare variable before use.
01-02-10	Invalid value	Invalid value	Value out of range	Modify value according to instruction
01-02-10	Index of … is out of range	Index is out of range	Array index out of range	Modify array index
01-02-10	Type should be …	Type error	Type error.	Change to the correct type.
01-02-10	Fail in handling STRUC member expression	Structure member variable expression error	Struct member not declared.	Check the declaration of structure variables.

7.2. HIWIN Robot Controller(02-XX-XX)

7.2.1. Safety Input(02-01-XX)

Error code	Error	Message	Reason	Solution
02-01-10	Emergency input	Emergency stop signal disconnect	Emergency stop trigger.	Release the emergency stop and clear the error.
02-01-11	Enable switch down	Enable switch down	Enable switch is pressed to the third paragraph.	Release enable switch.

7.2.2. Hardware Error(02-02-XX)

Error code	Error	Message	Reason	Solution
02-02-11	No motor brake signal	Do not receive motor brake signal	1. Hardware abnormalities. 2. The emergency stop status is excluded within 500 milliseconds.	1. Contact with the engineer from the original equipment manufacturer. 2. Press emergency stop again, over 500 millisecond.

7.3. Axis Amplifier(03-XX-XX)

7.3.1. Function Name and Number Description

Function	No.	Description
Axis number(m)	0m	m: axis umber. ex 03-01-21：axis 1 alarm, 03-02-21：axis 2 alarm, and so on.
Ext axis number (n)	En	n: external axis number ex：03-E1-21-> external axis 1 alarm, 03-E2-21->external axis 2 alarm, and so on.

7.3.2. Driver Alert Number

Error code	Error	Message	Reason	Solution
03-0m(En)-21	overcurrent	Current exceeds the specified value	1. Driver is abnormal. 2. Motor U, V, W is short circuit. 3. Motor is broken.	1. Check the servomotor main circuit cable connection. 2. Replace the driver. 3. Replace the motor.
03-0m(En)-25	STO	Safety input protection.	Safety input signal.	Check the safety input signal status.

Error code	Error	Message	Reason	Solution
03-0m(En)-41	overload	Torque is too large.	1.The effective torque exceeds the rated torque. 2. The motor's hold brake is not	1. Change the motion plan, or reduce load. 2. Check that the wiring and the driver voltage are correct.

			released. 3. Power supply wiring is incorrect	
03-0m(En)-43	regenerative resistor overload	Regenerative load rate is too large.	1. Insufficient external regeneration resistor capacity. 2. Amplifier failed.	1. Replace the external regeneration resistor capacity 2. Replace amplifier
03-0m(En)-45	overspeed	Exceeded average rotational speed	The servomotor speed is above the maximum rotational speed	Change operating conditions.
03-0m(En)-51	amplifier thermal abnormality	The amplifier temperature is too high.	1. Regenerative power is too large. 2. The surrounding air temperature is too high. 3. Built-in Fan in amplifier Stopped.	1. Change the amplifier installation conditions. 2. Check whether the cooling fan is running.

Error code	Error	Message	Reason	Solution
03-0m(En)-52	Anti-surge resistor overheat	Anti-Surge resistor overheated.	1. Power switch	1. Reduce the power switch frequency.

			frequency is too high. 2. Ambient temperature is too high.	2-1. Check the cooling fan is running. 2-2. Change the amplifier installation conditions.
03-0m(En)-53	dynamic brake resistor overheat	Dynamic brake resistor overheated.	Dynamic brake action frequency is too high.	Used within the allowable operating frequency range
03-0m(En)-58	Drive temperature overheat	Drive temperature overheat	1. Drive environment is overheated. 2. Motor overload. 3. Motor speed too fast.	1. Confirm drive cooling mode is normal. 2. Confirm electrical control box is in a ventilated condition 3. Reduce the load weight. 4. Reduce arm speed.
03-0m(En)-61	overvoltage	Main circuit DC voltage is excessively high.	1. The power supply exceeded the allowable range. 2. The moment of inertia ratio exceeded the allowable value.	1. Measure the power supply voltage 2. Confirm that the moment of inertia ratio is within the allowable range.

03-0m(En)-62	undervoltage	Main circuit DC voltage is excessively low.	1. Input supply voltage is below the allowable range. 2. The power supply is unstable, or was influenced by a lightning surge.	Set AC power supply voltage within the specified range.

Error code	Error	Message	Reason	Solution
03-0m(En)-71	control power source voltage shortage	The voltage of the control power is too low.	1. Input supply voltage is below the allowable range. 2. The power supply is unstable, or was influenced by a lightning surge.	1. Set AC power supply voltage within the specified range. 2.
03-0m(En)-72	control circuit voltage shortage	The control circuit voltage is insufficient	1. Contact fault of connector or incorrect wiring for encoder cable. 2.The amplifier internal circuit is bad.	1. Re-insert the connector and confirm that the encoder is correctly wired. 2.Replace amplifier.
03-0m(En)-81	encoder disconnect	Encoder signal is disconnecte d.	1. Wrong connection. 2. Connector off.	1. Check the encoder cable. 2. Check the power supply

			3. Poor connection	voltage on the motor side.
03-0m(En)-84	encoder communication abnormality	Encoder Communications Error	1. Malfunction caused by noise interference. 2. Contact fault of connector or incorrect wiring for encoder cable.	1. Correct the wiring around the encoder by separating the encoder cable from the servomotor main circuit cable or by checking the grounding and other wiring. 2. Check the encoder cable.

Error code	Error	Message	Reason	Solution
03-0m(En)-85	encoder initial error(5V abnormality)	Encoder initial error	1. Wrong connection. 2. Connector off. 3. Poor connection.	1. Check the encoder cable. 2. Check the power supply voltage on the motor side.
03-0m(En)-87	encoder CS abnormality	Encoder CS signal disconnect.	1. Wrong connection. 2. Connector off. 3. Poor connection.	1. Check the encoder cable. 2. Check the power supply voltage on the motor side.
03-0m(En)-A1	encoder multi-turn data error (battery abnormality)	Encoder Backup Error	1. The encoder cable disconnected, and connected again. 2. The battery voltage is low.	1. Check the encoder connector battery or the connect or contact status.

				2. Measure the battery voltage.
03-0m(En)-A3	encoder overspeed	Servomotor speed is too high.	Motor acceleration exceeds allowable acceleration range.	Modify motion condition, increase acceleration/deceleration time
03-0m(En)-A5	encoder single turn error	Detected encoder single turn error	1. Excessive noise to the encoder cable. 2. The amplifier internal circuit is bad.	1. Check noise in the cable between the SERVOPACK and the host controller. 2. Re-insert the connector and confirm that the encoder is correctly wired.
03-0m(En)-A6	encoder multi-turn error	Detected encoder single turn error		

Error code	Error	Message	Reason	Solution
03-0m(En)-A9	encoder overheat	The amplifier temperature is too high.	1. The surrounding air temperature is too high. 2. Motor is overheated.	Change motor installation method.
03-0m(En)-AB	encoder error	An encoder error was detected.	1. Excessive noise to the encoder cable. 2. The amplifier internal circuit is bad.	1. Check noise in the cable between 2. If the restart cannot be solved, please replace the motor.
03-0m(En)-C1	speed overlimit	The speed of the motor exceeds 120% of the	Overshoot too big.	1. Adjust the servo parameters. 2. Slow command acceleration and

		maximum speed.		deceleration mode.
03-0m(En)-D1	position error too big	Position deviation exceeded the set value	1. Load inertia is too large. 2. The brake is not released. 3. The position command frequency is too high.	1. Change the load conditions, or replace a larger capacity motor. 2. Check the encoder cable. 3. Change the controller's position command.

Error code	Error	Message	Reason	Solution
03-0m(En)-E1	EEPROM abnormality	EEPROM abnormality	The driver internal circuit is bad.	Replace the driver.
03-0m(En)-E2	EEPROM check is abnormality	EEPROM check is abnormality	The CPU cannot read the correct data from the driver's built-in EEPROM.	Replace the driver.
03-0m(En)-EF	Motor not matching	The amplifier does not match the motor.	Use the wrong driver or motor.	Replace the correct driver or motor.
03-0m(En)-F3	amplifier error	amplifier error	amplifier error	According to the driver brand, compare the driver Error code.
03-0m(En)-F4	software thermal reach limit	Motor reaches temperature limit.	Motor temperature is too high.	Reduce speed or reduce load.

03-0m(En)-F5	motor disconnect	Motor cannot connect.	Motor disconnect.	Check the motor cable.
03-0m(En)-F6	amplifier phase initial error	amplifier phase initial error	Phase initialization failed.	1. Replace motor or driver. 2. Check the cable.
03-0m(En)-F7	Hall sensor error	Hall sensor error.	Hall sensor error.	
03-0m(En)-F8	Hall phase error	Hall phase error.	Hall phase check error.	

Error code	Error	Message	Reason	Solution
03-0m(En)-F9	overload warning	* Overload warning. Robot will not stop	The effective torque exceeds the set torque.	Relax the conditions of use.
03-0m(En)-FA	amplifier overheating warning	*Amplifier overheated warning. Robot will not stop.	The temperature around the amplifier is greater than the preset temperature range.	Reduce the ambient temperature.
03-0m(En)-FB	regenerated overload warning	* Regenerative overload warning. Robot will not stop	Regenerated resistance overload.	Relax the conditions of use.
03-0m(En)-FC	detecting power failure	* Detecting power failure. Robot will not stop.	Detected control power input voltage is insufficient.	1. Check if the input power supply has momentary or low voltage status. 2. Maybe the internal circuit of the amplifier is abnormal. If this alarm occurs for a long time, replace an amplifier.

Error code	Error	Message	Reason	Solution
03-0m(En)-FD	main circuit is abnormal	* Main voltage is abnormal. Robot will not stop.	Main power voltage exceeds DC 105V.	1. Check input mains voltage is within specifications. (Three-phase：AC200～230V+10，－15%　，50/60Hz±3Hz) 2. The inertia of the load may be too large, reducing the load inertia. 3. For regenerative resistors, the wiring may not be correct or the impedance does not match the cause of the problem. Check that the impedance of the wiring or external resistor meets the specifications in this manual.
03-0m(En)-FE	battery insufficient	* The battery voltage is low.	Measure the battery voltage.	Replace the battery.
03-0m(En)-FF	battery empty	The battery voltage is empty.	Battery is empty	User should replace with a new battery immediately.

7.3.3. DAC - Y Driver Alarm Code(Y-XXX)

Error code	Error	Message	Reason	Solution
Y-020	Parameters and check abnormal.	Servo unit is abnormal	Data of internal parameter of SERVOPACK is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.
Y-021	Parameters format abnormal.	Servo unit is abnormal	Data format of internal parameter of SERVOPACK is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.
Y-022	System and calibration abnormal.	Servo unit is abnormal	Data of internal parameter of SERVOPACK is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.
Y-030	Main loop detected abnormal.	Servo unit is abnormal	Servo unit is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.
Y-040	Parameters setting abnormal.	Servo unit is abnormal.	Data of internal parameter of SERVOPACK is abnormal.	1. Please turn off the power and restart. 2. Please contact the

				engineer from manufacturer.
Y-041	Division pulse output setting abnormal.	Parameter setting abnormal.	Parameter setting is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.
Y-042	Parameters combination abnormal.	Parameter setting abnormal.	Parameter setting is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.
Y-044	Semi/closed loop/ Full close loop parameters.	Parameter setting abnormal.	Parameter setting is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.
Y-050	Combination error.	Servo unit is abnormal.	Servo unit is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.
Y-051	Product is not supported.	Servo unit is abnormal.	Servo unit is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.

Y-0B0	Servo ON command is invalid.	Servo unit is abnormal.	Servo unit is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.

Error code	Error	Message	Reason	Solution
Y-100	Overcurrent detection	Servo unit is abnormal.	Servo unit is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.
Y-300	Abnormal regeneration	Servo unit is abnormal.	Servo unit is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.
Y-320	Regenerative overload	Regeneration overload alarm.	Regenerative resistor capacity is insufficient or it is in a continuous regeneration state.	1. Please turn off the power and restart. 2. Review the operating conditions. 3. Please contact the engineer from manufacturer..
Y-330	Main circuit power wiring error.	Servo unit is abnormal.	Servo unit is abnormal.	1. Please turn off the power and restart.

				2. Please contact the engineer from manufacturer.
Y-400	Overvoltage	Servo unit is abnormal.	Servo unit is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.
Y-410	Insufficient voltage	Servo unit is abnormal.	Servo unit is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.
Y-450	Main circuit capacitor overvoltage.	Servo unit is abnormal.	Servo unit is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.
Y-510	Overspeed	Motor speed is above maximum speed.	Command input value is too high or the servo unit is abnormal.	1. Adjust the operating conditions. 2. Please turn off the power and restart. 3. Please contact the engineer from manufacturer.

Y-511	Division pulse output overspeed.	Servo unit is abnormal.	Servo unit is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.
Y-520	Vibration alarm	Abnormal vibration of motor speed is detected.	Command input value is too high or the servo unit is abnormal.	1. Adjust the operating conditions. 2. Please turn off the power and restart. 3. Please contact the engineer from manufacturer.

Error code	Error	Message	Reason	Solution
Y-521	Advanced auto-tune alert.	The vibration was detected in the adjustment-free function.	When the adjustment function is executed, the motor vibrates greatly.	1. Adjust the operating conditions. 2. Please turn off the power and restart. 3. Please contact the engineer from manufacturer.
Y-710 (moment) Y-720 (continuous)	Overload	Exceeded the maximum payload.	The motor runs beyond the overload protection feature.	1. Adjust the operating conditions. 2. Please turn off the power and restart. 3. Please contact the

				engineer from manufacturer.
Y-730 Y-731	DB overload.	The power consumption of the detected DB is too large.	The motor is driven by an external force or the servo unit is abnormal.	1. Do not drive the motor by external force. 2. Please turn off the power and restart. 3. Please contact the engineer from manufacturer.
Y-740	The surge current limit resistor is overloaded.	Main circuit is energized too high.	Servo unit is abnormal.	1. Adjust the operating conditions. 2. Please turn off the power and restart. 3. Please contact the engineer from manufacturer.
Y-7A0	Heat sink is overheated.	The heat sink temperature exceeds 100 °C.	The ambient temperature is too high or the servo unit is abnormal.	1. Adjust the operating conditions. 2. Please turn off the power and restart. 3. Please contact the engineer from manufacturer.
Y-7AB	Built-in fan stopped.	The internal fan of the SERVOPACK stopsped.	There is a foreign object entering, or	1. Remove foreign objects.

			the servo unit is abnormal.	2. Please turn off the power and restart. 3. Please contact the engineer from manufacturer.
Y-810	Encoder backup alert.	The encoder data is abnormal.	The power is turned on for the first time, or the servo unit is abnormal.	1. Make the settings of the encoder. 2. Please turn off the power and restart. 3. Please contact the engineer from manufacturer.
Y-820	Encoder and number alarm.	Encoder and number verification errors.	Servo unit is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.
Y-830	Encoder battery alarm.	The battery voltage of the absolute encoder is lower than the specified value.	The battery voltage is insufficient or the servo unit is abnormal.	1. Replace the battery. 2. Please turn off the power and restart. 3. Please contact the engineer from manufacturer.

Error code	Error	Message	Reason	Solution
Y-840	Encoder data alert.	The encoder is malfunctioning.	The servo unit is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.
Y-850	Encoder overspeed.	When the control power is turned on, the encoder overspeed is detected.	The servo unit is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.
Y-860	The encoder is overheated.	The encoder exceeds the upper temperature limit.	The ambient temperature is too high or the servo unit is abnormal.	1. Adjust the ambient temperature to below 40 °C. 2. Please turn off the power and restart. 3. Please contact the engineer from manufacturer.
Y-B10	The speed command A/D is abnormal.	When the servo is turned ON, the speed command input is incorrectly operated.	The servo unit is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.
Y-B11	The speed command A/D conversion	The speed command input is incorrectly operated.	The servo unit is abnormal.	1. Please turn off the power and restart.

	data is abnormal.			2. Please contact the engineer from manufacturer.
Y-B20	The torque command A/D is abnormal.	When the servo is turned ON, the torque command input is incorrectly operated.	The servo unit is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.
Y-B31	Current detection error 1	U phase current detection loop is abnormal.	The servo unit is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.
Y-B32	Current detection error 2	V phase current detection loop is abnormal.	The servo unit is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.
Y-B33	Current detection error 3	The current detection loop is abnormal.	The servo unit is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.

Error code	Error	Message	Reason	Solution
Y-BF0 Y-BF1 Y-BF2 Y-BF3 Y-BF4	System alarm 0~4	The servo unit is abnormal.	The servo unit is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.
Y-C10	Detected out of control.	When the servo is turned ON, the detected motor is out of control.	The motor wiring is incorrect or the servo unit is abnormal.	1. Confirm that there is no problem with the motor wiring. 2. Please turn off the power and restart. 3. Please contact the engineer from manufacturer.
Y-C80	The clearing of encoder is abnormal.	The upper limit of the number of revolutions setting is abnormally.	The servo unit is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.
Y-C90	The encoder communication is abnormal.	The encoder is malfunctioning.	The servo unit is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.
Y-C91	The encoder communication position data	The encoder is malfunctioning.	The servo unit is abnormal.	1. Please turn off the power and restart.

	acceleration is abnormal.			2. Please contact the engineer from manufacturer.
Y-C92	The encoder communication timer is abnormal.	The encoder is malfunctioning.	The servo unit is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.
Y-CA0	The encoder parameters are abnormal.	The encoder is malfunctioning.	The servo unit is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.
Y-CB0	Encoder calibration returned abnormal.	The encoder is malfunctioning.	The servo unit is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.
Y-CC0	The upper limit of the number of revolutions is inconsistent.	The encoder is malfunctioning.	The servo unit is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.
Y-D00	The position deviation is too large.	In the state of servo ON, the position deviation exceeds the upper limit.	The position command is too fast, or the servo	1. Please turn off the power and restart. 2. Please contact the

			unit is abnormal.	engineer from manufacturer.
Y-D01	The position deviation is too large when the servo is turned ON.	When the servo is OFF and the position deviation is too large, the servo is directly turned ON.	The servo unit is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.
Y-D02	The positional deviation caused by the speed limit at servo ON is too large.	In the accumulated position deviation state, the servo is ON, and the position command is input in this state, and the position deviation excessive alarm value is exceeded.	The servo unit is abnormal.	1. Please turn off the power and restart. 2. Please contact the engineer from manufacturer.
Y-F10	The power cable is out of phase.	When the main circuit power is ON, the low voltage state of one of the R, S, and T phases lasts for more than 1 second.	The three-phase power supply wiring is defective, or the servo unit is abnormal.	1. Confirm that there is no problem with the power wiring. 2. Please turn off the power and restart. 3. Please contact the engineer from manufacturer.

7.3.4. DAC - S Driver Alarm Code(S-XXXX)

Error code	Error	Message	Reason	Solution
S-3110	Power supply overvoltage	Power supply overvoltage	Main circuit AC voltage is out of range.	Check if the power supply voltage is within the specified range or install an external regenerative resistor.
S-3130	Main power phase error	Main power phase error	One of the phase is disconnected from three-phase main power supply.	Check wiring or replace the drive.
S-3211	Overvoltage	Overvoltage	Mains DC overvoltage.	Replace the drive. Reduce the power supply voltage to the specified range. Reduce the load rate.
S-3212	Regenerative resistor overload.	Regenerative resistor overload.	Regenerative resistance load is too large.	Confirm that the operating conditions are correct.
S-3220	Main circuit low voltage.	Main circuit low voltage.	Main circuit DC low voltage.	Check if the power supply voltage is within the

				specified range. Replace the drive.
S-4110	Drive temperature error.	Drive temperature is abnormal.	Ambient temperature is too high or the drive is damaged.	Confirm that the drive ambient temperature does not exceed 55℃. Replace the drive.
S-4210	Anti-surge resistor overheating.	Anti-surge resistor overheating.	Drive failure or ambient temperature is too high.	Replace the drive. Confirm that the ambient temperature does not exceed 55℃.
S-5113	Control power supply low voltage 2.	Control power supply low voltage 2.	Undervoltage ±5V control switching power supply.	Replace the drive or Confirm external circuit..
S-5114	Control power supply low voltage.	Control power supply low voltage.	Control power supply voltage is too low.	Replace the drive Check if the power supply voltage is within the specified range.
S-5115	Control power supply low voltage 1.	Control power supply low voltage 1.	Undervoltage ±12V control switching	Replace the drive or

			power supply.	Confirm external circuit.
S-5210	Abnormal current detection.	Abnormal current.	Drive damage or motor damage.	Replace the motor or drive.
S-5220	System error.	System error.	Setting mismatch.	Replace the drive.
S-5400	Main power supply equipment error.	Abnormal power supply.	Abnormal power supply, over-current or overheating of the servo module.	Confirm wiring, replace servo motor or drive. Confirm that the environment does not exceed 55℃.
S-5510	Memory error.	Memory error.	CPU access error of CPU built-in memory.	Replace the drive.
S-5530	EEPROM error	EEPROM error	Drive built-in EEPROM abnormal.	Replace the drive.
S-6010	Initialization thread timeout.	Initialization thread timeout.	The initialization thread was not completed within the initialization time.	Replace the drive. Confirm that the drive is properly grounded.

S-6310	EEPROM calibration code error.	EEPROM calibration code error.	CPU access error of CPU built-in EEPROM.	Replace the drive.
S-6320	System parameter error.	System parameter error.	System parameter abnormal.	Replace the drive.
S-7120	Motor temperature error.	Abnormal motor temperature.	Motor damage, high ambient temperature, short circuit.	Replace the servo motor. Confirm that the ambient temperature does not exceed 55℃. Confirmation cable.
S-7122	Speed feedback error.	Speed feedback error.	Motor power cable disconnection.	Confirm wiring. Replace the drive or motor.
S-7300	Encoder initialization failed.	Encoder initialization failed.	Cable break.	Confirm wiring. Check if the encoder power supply is higher than 4.75V Replace the motor or drive.
S-7305	Encoder connector 1 is broken.	Encoder connector 1 is broken.	Power supply cable disconnection.	Confirm wiring. Check if the encoder power supply is

				higher than 4.75V or replace the motor
S-7510	Communication error.	Communication error.	Abnormal communication.	Check if the communication format is correct.
S-7520	Link lost.	Communication disconnect.	Communication cable is damaged or not connected.	Confirm that the communication cable is connected or normal.
S-8311	Overload	Overload	Motor load is too large.	Reduce load or slow down.
S-8312	STO safe torque off abnormal.	STO safe torque off abnormal.	STO input is abnormal.	Confirm stop.
S-8400	Average continuous speed overspeed.	Average continuous speed overspeed.	Motor speed overspeed.	Reduce operating speed.
S-8500	Position command error.	Position command error.	Position command is out of setting range.	Reduce the amount of input movement command.
S-8611	Position deviation is too large.	Position deviation is too large.	Position deviation exceeds the set value.	Confirm wiring. Confirm the power supply voltage. Replace the drive or motor.

S-8700	Task thread error.	Task thread error.	CPU interrupt error.	Replace the drive.

7.4. Electric gripper(04-XX-XX)

7.4.1. Hardware Error (04-01-XX)

Error code	Error	Message	Reason	Solution
04-01-11	Electric gripper data return error.	Electric gripper data return error.	Electric gripper connection failed, and no data was returned.	Check that the 24V power supply is properly connected. Check that the USB cable is properly connected, Check that the serial port is set correctly. Refer to the manual to install the gripper driver.
04-01-12	Number of gripper serial port exceeds the upper limit.	Number of gripper serial port exceeds the upper limit.	Exceeded the connection port name limit.	Modify the connection port setting is less than or equal to COM99.
04-01-13	Gripper hardware is not connected.	Gripper hardware is not connected.	Connection port is disconnected.	Re-plug the USB cable and reconnect it.
04-01-14	Gripper serial port are closed.	Gripper serial port are closed.	Gripper serial port is not turned on.	Close this serial port and reconnect.
04-01-15	Gripper serial port not available.	Gripper serial port not available.	Unable to achieve serial port.	Re-plug the USB cable

				and reconnect it. Replace the USB cable.
04-01-16	Gripper reconnection failed.	Gripper reconnection failed.	Connection port is interrupt and an attempt to reconnect failed.	Re-plug the USB cable and reconnect it. Replace the USB cable.
04-01-17	Gripper serial port is repeatedly connected.	Gripper serial port is repeatedly connected.	When a duplicate connection port is detected, the connection is automatically disconnected.	Check if the gripper is repeatedly connected.

7.4.2. Operation Error (04-02-XX, 04-01-8X)

Error code	Error	Message	Reason	Solution
04-01-20	Gripper model setting error.	Gripper model setting error.	Gripper type setting is incorrect.	Check that the gripper type setting is correct.
04-01-21	Repeat gripper command.	Repeat gripper command.	Repeat the instructions in succession.	Wait for the gripper Busy to end, and then issue a new order.
04-01-23	Gripper position setting error.	Gripper position setting error.	Gripper position setting is greater than the total stroke.	Check that the gripper movement position input is correct.

04-01-24			Gripper position setting is less than zero	
04-01-25	Gripper speed setting error.	Gripper speed setting error.	Gripper moving speed setting is greater than the preset range.	Check if the gripper moving speed input is correct.
04-01-26			Gripper moving speed setting is less than the preset range.	
04-01-27	Gripper position direction setting error.	Gripper position direction setting error.	Gripper movement direction setting is incorrect.	Check that the gripper movement direction input is correct.
04-01-28	The gripping displacement setting is incorrect.	The gripping displacement setting is incorrect.	Gripping displacement setting is greater than the range of motion.	Check that the gripping displacement input is correct.
04-01-29			Gripping displacement setting is smaller than the range of motion.	
04-01-2A	Gripping speed setting is incorrect.	Gripping speed setting is incorrect.	Gripping speed is greater than the preset range.	Check that the gripping speed input is correct.

04-01-2B			Gripping speed is smaller than the preset range.	
04-01-2C	Gripping force setting is incorrect.	Gripping force setting is incorrect.	Gripping force is greater than the preset range.	Check that gripping force input is correct.
04-01-2D			Gripping force is smaller than the preset range.	
04-01-2E	Gripping failed.	Gripper failed to grip.	After the user turns on the grip detection function, the gripping action is performed and the electric gripper detects the unwound object.	This alarm is used to detect if the jaws are clamped to the object. If you do not need to send this detection alarm, you can cancel this function in the setting interface.
04-01-2F	Gripper is set incorrectly with respect to the total stroke.	Gripper is set incorrectly with respect to the total stroke.	Gripper exceeds the movable range with respect to the total stroke.	Check if the gripper moving distance and the total gripping displacement are correct.
04-01-80			Gripper is less than the movable range relative to the total stroke	

04-01-81	Gripper speed setting error.	Gripper speed setting error.	Gripper moving speed is less than the gripping speed.	Check that the gripper moving speed input is correct.

7.4.3. Electric Gripper Controller Alarm Signal Error (04-01-3X)

Error code	Error	Message	Reason	Solution
04-01-30	Gripper reset error	Gripper reset error	Some workpiece have not been removed during the route. Finger design interferes with the stroke	Check that there are no foreign objects in the itinerary. Modify the finger design.
04-01-31	Gripper position error	Gripper position error	Obstacles in the movement of the gripper.	Check and eliminate obstacles in the route.
04-01-32	Gripper overtravel	Gripper overtravel	Gripper displacement setting is greater than the range of motion.	Check that the gripper displacement input is correct.

7.4.4. Electric Gripper Command Communication Timeout (04-01-4X)

Error code	Error	Message	Reason	Solution
04-01-41	Gripper connection timeout	Gripper connection timeout	Electric gripper command communication failed and data returned timeout.	Check that the 24V power supply is properly connected. Check that the USB cable is properly connected, Check that the serial port is set correctly. Refer to the manual to install the jaw driver. Replace the controller unit.
04-01-42	Gripper firmware communication timeout	Gripper firmware communication timeout		
04-01-43	Gripper stop action timeout	Gripper stop action timeout		
04-01-44	Gripper reset timeout	Gripper reset timeout		
04-01-45	Gripper movement timeout	Gripper movement timeout.		
04-01-46	Gripping timeout	Gripping timeout		
04-01-47	Gripper expert mode action timeout	Gripper expert mode action timeout		
04-01-48	Gripper state reading timeout	Gripper state reading timeout		

8. Program Examples

8.1. Register

8.1.1. COUNTER Register

Program:

```
$C[1] = 10
```

Description:

The constant 10 is saved into COUNTER 1. After the program is closed, the number of the variable definition still registered.

Hint:

There are 20 COUNTERs from 1 to 20. The saved number is integer. The storage capacity is 32bit, which is -2147483648 ~ 2147483647.

8.1.2. TIMER Register

Program:

```
$T[1] = 0
WAIT SEC 0
$T_STOP[1] = FALSE
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
WAIT SEC 0
$T_STOP[1] = TRUE
```

Description:

Calculate the period when the robot moves from the original position to P0. After the program is closed, the number of the variable definition still registered.

Parameter explanation:

Start counting when $T_STOP[n]=FALSE. And stop when $T_STOP[n]=TRUE.

Hint:

There are 20 TIMERs, from 1 to 20. $T[n] represents the TIMER n. Before starting and ending $T_Stop, "WAIT SEC 0" command which can stop pre-read is necessary. Every TIMER is 32bit, the display range is from -2147483648 ~ 2147483647(ms).

8.2. Variable Type

8.2.1. REAL

Program:

REAL One
One = 1

Description:

The format is similar to the data type of the decimal data. This variable will disappear after the program is closed.

Hint: The storage capacity is 32bit about 10^{-37}~10^{38}, effective to 6 digits after the decimal point.

8.2.2. INT

Program:

INT Two = 2

Description:

Which is a format of the integer-type data, and will disappear after the program is closed.

Hint: The storage capacity is 32bit, which are -2147483648 ~ 2147483647.

8.2.3. BOOL

Program:

BOOL K = TRUE

Description:

Which means “Boolean”, is a logically variable. Will disappear after the program is closed.

Hint: Used to declare the variable represents TRUE or FALSE.

8.2.4. CHAR

Program:

```
CHAR COLOR = 'R'
```

Description:

Which represents the character variable. Will disappear after the program is closed.

Hint: Used to declare the variable represents the specific characters.

8.2.5. E6POS Point

Program:

```
E6POS POINT = {X 0,Y 300,Z 200}
PTP POINT CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
```

Description:

Define POINT in Cartesian coordinate, and move the robot to POINT.

Hint:

If the parameter is not set, its value will not changed(A, B, C in this case). This point doesn't define E6AXIS(A1~A6) values.

8.2.6. E6AXIS Point

Program:

```
E6AXIS POINT = {A1 90}
PTP POINT CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
```

Description:

Define POINT in the joint coordinate, and move the robot to POINT.

Hint:

Parameter A2、A3、A4 are not set, and will remain the original value. This point doesn't define E6POS(X, Y, Z, A, B, C) value.

8.2.7. E6POINTPoint

Program:

```
E6POINT HOME = {Y 200,Z -1000,A 90}
PTP HOME CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
```

or you change the definition of HOME like this:

```
E6POINT HOME = {A1 90}
```

Description:

The first definition of HOME is in Cartesian coordinate, and then move the robot to HOME. The second definition is in Joint coordinate.

Hint:

If there is parameter not defined, it will remain the current value.

8.3. Operator

8.3.1. Arithmetic Operator

Program:

```
INT a, b, e
REAL c, d, f
a= 3
b= 5
c= 0.6
d= 12.2
e= 10
f= 10.0
a= a*b        ; a= 3*5= 15
b= b+d        ; b= 5+12.2= 17.2  →  round it: b= 17
c= c*d        ; c= 0.6*12.2= 7.32
d= b+d        ; d= 17+12.2= 29.2
e= e/2        ; e= 5
e= 10/4       ; e= 2(remove the decimal)
e= f/4        ; e= 2(remove the decimal)
f= f/4        ; f= 2.5
```

Hint: If the format is INT and there are decimals after operation, decimals will be removed. After INT and REAL are operated by "+", "-", or "*", the result format will be REAL.

8.3.2. Logic Operator

Logic Operator		A AND B	A OR B
A=TRUE	B=TRUE	TRUE	TRUE
A=TRUE	B=FALSE	FALSE	TRUE
A=FALSE	B=TRUE	FALSE	TRUE
A=FALSE	B=FALSE	FALSE	FALSE

8.3.3. Relation Operator

Relation Operator	A > B	A >= B	A < B	A <= B	A == B	A != B
A = 2,B = 1	TRUE	TRUE	FALSE	FALSE	FALSE	TRUE
A = 1,B = 1	FALSE	TRUE	FALSE	TRUE	TRUE	FALSE
A = 1,B = 2	FALSE	FALSE	TRUE	TRUE	FALSE	TRUE

8.4. Input/Output

8.4.1. Digital Input

Program:

$DI[1] = TRUE

Parameter explanation:

The Digital Channel 1 inputs TRUE.

8.4.2. Digital Output

Program:

$DO[1] = TRUE

Parameter explanation:

The Digital Channel 1 outputs TRUE.

8.4.3. Robot Input

Program:

$RI[1] = TRUE

Parameter explanation:

The Channel 1 of Robot signal inputs TRUE.

8.4.4. Robot Output

Program:

$RO[1] = TRUE

Parameter explanation:

The Channel 1 of Robot signal outputs TRUE.

8.4.5. Valve Output

Program:

$VO [1] = TRUE

Parameter explanation:

The Channel 1 of Solenoid Valve outputs TRUE.

8.5. Motion Function

The way to define the point can be:
1. Establish the point with the software frame.
2. Establish the point of E6POS or E6AXIS.
3. Define the point parameter directly. The coordinates not defined will remain the same, for example, PTP {X 200}.
4. Define the joint angle directly, and the parameter not defined will be the current value, like PTP {A1 90, A3 60}.

8.5.1. PTP

Point Definition 1

Program:

```
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
```

Description:

Only require the position of the starting point and the terminal point. There is no limit for the middle process. TCP will be guided with the fastest trace of the robot to the target point. P0 is additionally established for TCP except for the Home status. TCP will move point-to-point from Home to P0.

Parameter explanation:

PTP	; name of point-to-point command, the shortest trace for the robot
P0	; any point except for Home
CONT	; smooth extent
Vel	; moving velocity relative to maximum velocity
Acc	; moving acceleration relative to maximum acceleration

Point Definition 2

Program:

```
E6POS POINT = {X 0,Y 300,Z 200}
PTP POINT CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
```

Description:

Move to POINT.

Hint: The same way to establish points with E6AXIS.

Point Definition 3

Program:

PTP {X 100} CONT=100% Vel=2000mm/s Acc=50% TOOL[0] BASE[0]

Description:

The TCP moves to this coordinate (refer to the base coordinate). The parameters not defined will remain the same.

Point Definition 4

Program:

PTP {A1 45} CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]

Description:

The A1 axis of TCP moves to +45° (refer to the base coordinate). For the axis not defined, the angle will not change.

8.5.2. PTP_REL

Point Definition 1

Program:

PTP_REL {X 100 } CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]

Description:

The TCP moves to this coordinate (refer to the base coordinate). The coordinates not defined will remain the same.

Point Definition 2

Program:

PTP_REL {A1 45} CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]

Description:

The A1 axis of TCP moves at +45° relative to the original A1 axis (refer to the base coordinate). For the axis not defined, the angle will not change.

8.5.3. LIN

Point Definition 1

Program:

```
LIN P0 CONT=100% Vel=2000mm/s Acc=50% TOOL[0] BASE[0]
```

Description:

P0 is additionally established for TCP except for the Home status. TCP will move point-to-point from Home via P0 to P1. The robot will guide TCP to the target point along the linear trace with the defined velocity.

Parameter explanation:

LIN	; name of point-to-point command, linear trace connecting two points
P0	; any point except for Home
CONT	; smooth extent
Vel	; velocity moving on linear trace
Acc	; acceleration moving on linear trace

Point Definition 2

Program:

```
E6POS POINT = {X 0,Y 368,Z 293}
LIN POINT CONT=100% Vel=2000mm/s Acc=50% TOOL[0] BASE[0]
```

Description: move to POINT

Hint: Same method to establish points with E6AXIS

Point Definition 3

Program:

```
LIN {X 100} CONT=100% Vel=2000mm/s Acc=50% TOOL[0] BASE[0]
```

Description:
The TCP moves to this coordinate (refer to the base coordinate). The coordinates not defined will remain the same.

Point Definition 4
Program:
LIN {A1 45} CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]

Description:
The A1 axis of TCP moves at +45° relative to the original A1 axis (refer to the base coordinate). For the axis not defined, the angle will not change.

8.5.4. LIN_REL

Point Definition 1
Program:
LIN_REL {X 100 } CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]

Description:
The coordinates of TCP moves in relative to this coordinate (refer to the base coordinate). For the direction not defined, the coordinates will not change.

Point Definition 2
Program:
LIN_REL {A1 45} CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]

Description:
The A1 axis of TCP moves at +45° relative to the original A1 axis (refer to the base coordinate). For the axis not defined, the angle will not change.
Program:
LIN_REL {X 100 } CONT=100% Vel=2000mm/s Acc=50% TOOL[0] BASE[0]

8.5.5. LIN_REL_TOOL

Point Definition 1

Program:

LIN_REL_TOOL {X 100 } CONT=100% Vel=2000mm/s Acc=50% TOOL[0] BASE[0]

Description:

The TCP of the robot will move along the axis of the command("X" in this case) by increasing the value("100" in this case).

Point Definition 2

Program:

LIN_REL_TOOL {A 45} CONT=100% Vel=2000mm/s Acc=50% TOOL[0] BASE[0]

Description:

In this case, the TCP will rotate +45° along the X axis of the TCP coordinate. And the command "B"("C") means to rotate along "Y"("Z") axis.

8.5.6. CIRC

Point Definition 1

Program:

CIRC P0 P1 CONT=100% Vel=2000mm/s Acc=50% TOOL[0] BASE[0]

Description:

P0 and P1 are additionally established for TCP except for the Home status. TCP will move with circular trace from Home via P0 to P1. The robot will guide TCP to the target point along the circular trace with the defined velocity.

Parameter explanation:

CIRC ; name of point-to-point command, the starting point arrives the target point via the auxiliary point along the circular trace

P0 ; any point except for Home as auxiliary point

P1 ; any point except for Home as target point

CONT ; smooth extent
Vel ; velocity moving on circular trace
Acc ; acceleration moving on circular trace

Hint:
P0 and P1 should be established first.

Point Definition 2
Program:
E6POS POINT1 = {X 0,Y 300,Z 200}
E6POS POINT2= {X 20,Y 320,Z 220}
CIRC POINT1 POINT2 CONT=100% Vel=2000mm/s Acc=50% TOOL[0] BASE[0]

Description: Move to POINT2 via POINT1.

Hint: The points are established the same method as E6AXIS.

Point Definition 3
Program:
CIRC {X 0, Y 450} {X -150, Y 300} CONT=100% Vel=2000mm/s Acc=50% TOOL[0] BASE[0]
Description:
TCP based on the starting point as the original coordinate moves to the auxiliary point and then arrives the destination point (refer to the base coordinates).

Point Definition 4
Program:
CIRC {A1 5.0, A2 5.0, A3 5.0, A4 5.0} {A1 10.0, A2 10.0, A3 10.0, A4 10.0} CONT=100% Vel=2000mm/s Acc=50% TOOL[0] BASE[0]

Description:
TCP based on the starting point as the original coordinate moves to the auxiliary point and then arrives at the destination point (refer to the base coordinates).

8.5.7. CIRC_REL

Point Definition 1

Program:

CIRC_REL {X -150, Y 150} {X -150, Y -150} CONT=100% Vel=2000mm/s Acc=50% TOOL[0] BASE[0]

Description:

TCP based on the starting point as the original coordinate moves to the auxiliary point and then arrives the destination point (refer to the base coordinates).

Point Definition 2

Program:

CIRC_REL {A1 5.0, A2 5.0, A3 5.0, A4 5.0} {A1 10.0, A2 10.0, A3 10.0, A4 10.0} CONT=100% Vel=2000mm/s Acc=50% TOOL[0] BASE[0]

Description:

TCP based on the starting point as the original coordinate moves to the auxiliary point and then arrives at the destination point (refer to the base coordinates).

8.5.8. SPLINE

Point Definition 1

Program:

E6POINT P1 ={ X 95 , Y 0 , Z -500 }
E6POINT P2 ={ X 94.63849632 , Y 3.922008424 , Z -500 }
…..
E6POINT P54 ={ X -8.279795561 , Y -44.82876141 , Z -500 }
E6POINT P55 ={ X 0 , Y -45 , Z -500 }
E6POINT P56 ={ X 8.279795561 , Y -44.82876141 , Z -500 }
…..
E6POINT P73 ={ X 95 , Y 0 , Z -500 }
SPLINE
SPL P1
SPL P2
…..

```
SPL P54
SPL P55
SPL P56
…..
SPL P73
ENDSPLINE
```

Description:

Start from P1 point and move to P73 point with B-Spline curvilinear motion.

8.5.9. Array Accumulation

Program:

```
PTP P0 CONT=100% Vel=100% Acc=100% TOOL[0] BASE[1]
P0.A1 = P0.A1 + 10
PTP P0
P0.A1 = P0.A1 + 10
PTP P0
```

Description:

The A1 coordinate of P0 accumulates 10 degrees every time, and the other coordinates will not change.

8.5.10. CT_A6

Program:

```
LIN P0 FINE=1 Vel=100mm/s Acc=100% TOOL[0] BASE[0]
CT_A6 100
WHILE $C[1] <2
$C[1] = $C[1]+1
LIN P1 FINE=1 Vel=100mm/s Acc=100% TOOL[0] BASE[0]
LIN P2 FINE=1 Vel=100mm/s Acc=100% TOOL[0] BASE[0]
ENDWHILE
$C[1] = 0
CT_A6 -50
WHILE $C[2] <2
$C[2] = $C[2]+1
LIN P1 FINE=1 Vel=100mm/s Acc=100% TOOL[0] BASE[0]
```

```
LIN P2 FINE=1 Vel=100mm/s Acc=100% TOOL[0] BASE[0]
ENDWHILE
$C[2] = 0
CT_A6 0
WAIT SEC 1
LIN P0 FINE=1 Vel=100mm/s Acc=100% TOOL[0] BASE[0]
```

Description:

The sixth axis of the robot first reciprocates between P1 and P2 at a speed of 100% in the positive direction, and then reciprocates between P1 and P2 at a speed of 50% in the negative direction, and then ends infinite rotation and returns to the P0 point.

8.5.11. BRAKE

Program:

```
LIN P0 FINE=1 Vel=3000mm/s Acc=100% TOOL[0] BASE[0]
LIN_REL {Z -200}
LOOP
  IF $DI[1] == TRUE THEN
    BRAKE
    EXIT
  ENDIF
ENDLOOP
LIN P1 FINE=1 Vel=3000mm/s Acc=100% TOOL[0] BASE[0]
```

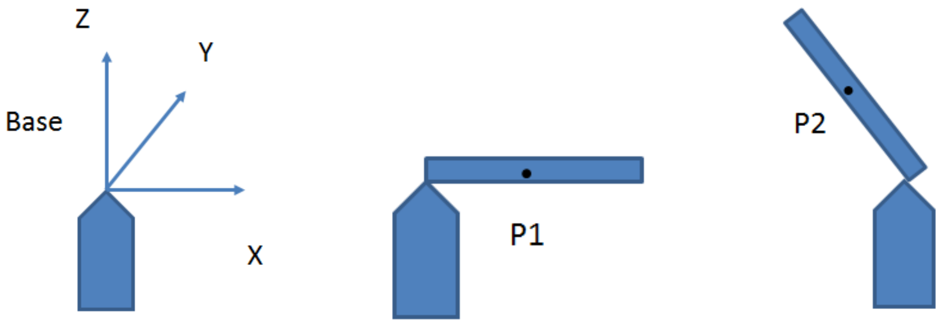
Description:

The robot moves to P0, it moves 200mm down along Z axis. The sensor of DI[1] is triggered on the way, the robot stop the motion and moves linearly from the stop point to P1.

8.5.12. EXT_TCP

Front work:

1. At the external tool point, teach a Base coordinate system, and the origin of the Base coordinate system is at the tool processing point.
2. Teaching starting point is at point P1 and ending point at P2



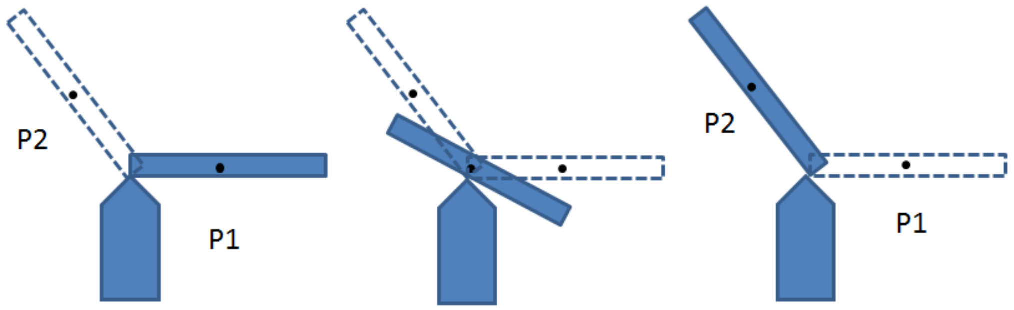
Teach Base Starting Point Ending Point

Program:

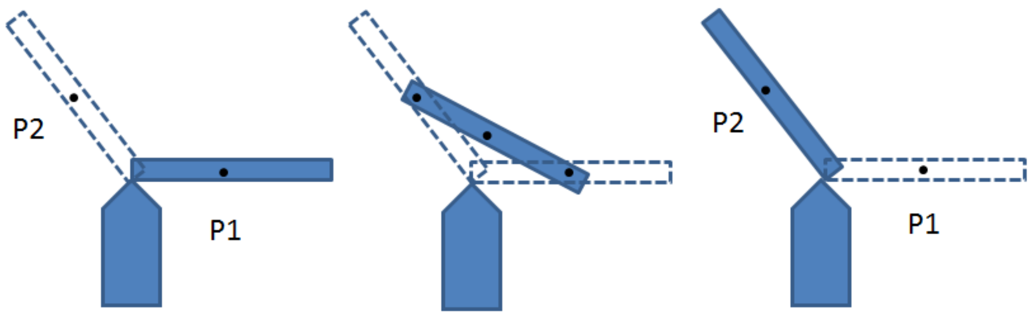
```
EXT_TCP_START
LIN P1 FINE=1 Vel=1000mm/s Acc=100% TOOL[0] BASE[1]
LIN P2 FINE=1 Vel=1000mm/s Acc=100% TOOL[0] BASE[1]
EXT_TCP_END
```

Description:

After the robot moves to P1, it is processed (polished) along the straight line of the workpiece and moved to P2. During the process, the workpiece remains in contact with the tool. If EXT_TCP is not used, the workpiece and tool will only be in contact at the start and end points



Using EXT_TCP



Not using EXT_TCP

8.6. Control Function

8.6.1. IF

- **Format 1 of IF**

IF *condition* THEN

………………

ENDIF

Program:

```
INT n = 1
IF n > 0 THEN
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
ENDIF
```

Description:

Because the *condition* is true, TCP will move to P0.

Parameter description:

Condition; condition

Because the condition is true, the statement in IF will be executed.

- **Format 2 of IF**

IF *condition* THEN

………………

ELSE

………………

ENDIF

Program:

```
INT n = 0
IF n > 0 THEN
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
ELSE
PTP P1 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
ENDIF
```

Description:

Because the condition is false, TCP will execute ELSE and move to P0.

- **Application for determining IF condition**

```
IF ((TRUE) AND (TRUE)) THEN
………………
ENDIF
```

Program:

```
INT n, m
n = 1
m = 2
IF ((n == 1) AND (m ==2)) THEN
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
ENDIF
```

Description:

Because the condition is true, TCP will move to P0.

```
IF ((TRUE) OR (FALSE)) THEN
………………
ENDIF
```

Program:

```
INT n,m
n =1
m =3
IF   ((n == 1) OR (m == 2)) THEN
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
ENDIF
```

Description:

Because the condition is true, TCP will move to P0.

IF *condition* THEN
………………
ENDIF
Program:

```
IF $DI[1] == TRUE THEN
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
ENDIF
```

Description:
If DI[1] is true, the condition will be true. TCP will move to P0.

8.6.2. FOR

- **FOR TO STEP ENDFOR**

FOR *start* TO *last* STEP *increment*

………………

ENDFOR

Program:

```
INT n
FOR n = 0 TO 2 STEP 1
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
PTP P1 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
ENDFOR
```

Description:

TCP moves to and fro between P0 and P1 three times.

Parameter explanation:

start ; start

last ; condition

increment ; increment

After FOR is executed from the start to the condition, FOR will end.

If the STEP increment is omitted, the increment default is 1.

- **FOR application**

Program:

```
INT n
FOR n = 0 TO 20 STEP 10
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
PTP P1 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
ENDFOR
```

Description:

TCP moves to and fro between P0 and P1 three times.

Program:

```
INT n
FOR n = 2 TO 0 STEP 1
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
PTP P1 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
ENDFOR
```

Description:

TCP moves to and fro between P0 and P1 three times.

Program:

```
INT n
FOR n = -1 TO 3 STEP 2
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
PTP P1 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
ENDFOR
```

Description:

TCP moves to and fro between P0 and P1 three times.

8.6.3. LOOP

- **LOOP ENDLOOP**

```
LOOP
………………
ENDLOOP
```

Program:

```
LOOP
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
PTP P1 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
ENDLOOP
```

Description:

TCP repeatedly moves to and fro between P0 and P1.

Parameter explanation:
LOOP is an infinite loop.

- **LOOP EXIT ENDLOOP**

LOOP
………………
EXIT
………………

ENDLOOP

Program:

```
INT n =0
LOOP
IF n == 1 THEN
EXIT
ELSE
n = n + 1
ENDIF
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
ENDLOOP
```

Description:
TCP will move to P0.
Parameter explanation:
LOOP execute to EXIT and end LOOP.

8.6.4. WHILE

- **WHILE ENDLOOP**

WHILE *condition*
………………
ENDWHILE

Program:

```
INT n = 2
WHILE n > 0
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
PTP P1 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
n = n - 1
ENDWHILE
```

Description:
TCP moves to and fro between P0 and P1 twice.

Parameter explanation:
condition ; condition
When the condition of WHILE is true, repeatedly execute the statement in WHILE until the condition is false and ends.

- **Application for determining WHILE condition**

```
WHILE ((TRUE) AND (TRUE))
………………
ENDWHILE
```

Program:

```
INT n,m
n = 1
m = 2
WHILE ((n == 1) AND (m == 2))
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
PTP P1 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
n = n + 1
ENDWHILE
```

Description:
TCP moves to and fro between P0 and P1 once.

```
WHILE ((TRUE) OR (FALSE))
………………
ENDWHILE
```

Program:

```
INT n,m
n = 1
m = 2
WHILE ((n == 1) OR (m == 3))
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
ENDWHILE
```

Description:
TCP moves to and fro between P0 and P1 once.

8.6.5. REPEAT

- **REPEAT UNTIL**

REPEAT
………………
UNTIL *condition*

Program:

```
INT n =0
REPEAT
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
PTP P1 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
n = n + 1
UNTIL n > 2
```

Description:
TCP will move to P0 and P1 as well as repeatedly execute twice.
Parameter explanation:
Condition ; condition
Repeatedly execute the statement in REPEAT until the condition is true, and end REPEAT.

- **Application for determining REPEAT condition**

REPEAT
………………
UNTIL((FALSE) OR (TRUE))

Program:

```
INT n =0
INT k =1
REPEAT
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
PTP P1 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
n = n + 1
UNTIL (k ==2) OR (n > 2)
```

Description:

TCP will move to P0 and P1 as well as repeatedly execute twice.

```
REPEAT
………………
UNTIL((TRUE) AND (TRUE))
```

Program:

```
INT n =0
INT k =1
REPEAT
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
PTP P1 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
n = n + 1
UNTIL(k ==1) AND (n > 2)
```

Description:

TCP will move to P0 and P1 as well as repeatedly execute twice.

8.6.6. GOTO

IF *condition* THEN

GOTO *LABEL1*

ENDIF

IF *condition* THEN

GOTO *LABEL 2*
ENDIF
IF *condition* THEN
GOTO *LABEL 3*
ENDIF

LABEL 1:
………………
LABEL 2:
………………
LABEL 3:
………………

Program:

```
INT n =0
LOOP
IF n == 0 THEN
GOTO STEP0
ENDIF
IF n == 1 THEN
GOTO STEP1
ENDIF
IF n == 2 THEN
GOTO STEP2
ENDIF

PRO:
n = n + 1
ENDLOOP

STEP0:
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
GOTO PRO
STEP1:
PTP P1 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
GOTO PRO
STEP2:
```

Description:
TCP moves from P0 to P1, and then ends LOOP.

Parameter explanation:
LABEL ; label
The label of GOTO corresponds to the following statement of the label. If the label doesn't have the statement, it will end program. The specified label must be in the current function, cross function cannot be applied.

8.6.7. SWITCH

- **SWITCH without default**

SWITCH *number*
………………
CASE *number1*
………………
CASE *number2*
………………

ENDSWITCH

Program:

```
INT n =0
LOOP
SWITCH n
CASE 0
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
CASE 1
PTP P1 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
CASE 2
EXIT
ENDSWITCH
n = n + 1
ENDLOOP
```

Description:
TCP moves from P0 to P1, and then executes EXIT to end LOOP.

Parameter explanation:

number ; argument

The argument of SWITCH corresponds to the statement of CASE.

When the argument of SWITCH doesn't correspond to CASE, it will directly correspond to ENDSWITCH.

- **SWITCH with default**

SWITCH *number*

………………

CASE *number1*

………………

CASE *number2*

………………

DEFAULT

EXIT

ENDSWITCH

Program:

```
INT n =0
LOOP
SWITCH n
CASE 0
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
CASE 1
PTP P1 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
DEFAULT
EXIT
ENDSWITCH
n = n + 1
ENDLOOP
```

Description:

TCP moves from P0 to P1, and then executes EXIT to end LOOP.

Parameter explanation:

The argument of SWITCH corresponds to CASE. If there is no correspondence, the statement of DEFAULT will be executed.

When the argument of SWITCH doesn't correspond to CASE, the statement with DEFAULT will jump to the statement of DEFAULT.

- **SWITCH Extension 1**

SWITCH *number*

………………

CASE *number1, number3, number5*

………………

CASE *number2, number4*

………………

DEFAULT

EXIT

ENDSWITCH

Program:

```
INT n =0
LOOP
SWITCH n
CASE 0,2,4
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
CASE 1,3
PTP P1 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
CASE 5
EXIT
ENDSWITCH
n = n + 1
ENDLOOP
```

Description:

TCP moves to and fro between P0 and P1, moves to P0, and then executes EXIT to end LOOP.

- **SWITCH Extension 2**

SWITCH *character*

………………

CASE *character1*

………………

CASE *character2*

………………

DEFAULT

EXIT

ENDSWITCH

Program:

```
CHAR COLOR = 'R'
LOOP
SWITCH COLOR
CASE 'R'
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
CASE 'G'
PTP P1 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
DEFAULT
EXIT
ENDSWITCH
IF COLOR =='G' THEN
COLOR ='Y'
ENDIF
IF COLOR =='R' THEN
COLOR ='G'
ENDIF
ENDLOOP
```

Description:

TCP moves from P0 to P1, and then executes EXIT to end LOOP.

8.6.8. WAIT

- **WAIT SEC**

Program:

```
WAIT SEC 3
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
```

Description:

After the program waits for three second, TCP will move to P0.

- **WAIT INPUT**

Program:

```
WAIT FOR $DI[1] == TRUE
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
```

Description:

When the program waits the Digital INPUT Channel 1 is TRUE, TCP will move to P0.

Program:

```
WAIT FOR $RI[1] == TRUE
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
```

Description:

When the program waits the INPUT Channel 1 for the robot is TRUE, TCP will move to P0.

8.6.9. QUIT

QUIT:

```
LOOP
IF $DI[1] == TRUE THEN
QUIT
ENDIF
ENDLOOP
```

Description:

The program will be closed when executing “QUIT” command(when DI[1] == TRUE in this case).

8.7. Motion Parameter

8.7.1. CONT

Continue Trajectory

If the “CONT” command is called, the robot controller will consider the next motion point, and will move in a smoother path. The path smooth level will depend on the motion velocity and acceleration.

There are three kinds of CONT command: CONT, CONT = #%, CONT = #mm. Last two kinds represent the fixed path, like CONT = 50% or CONT = 30mm.

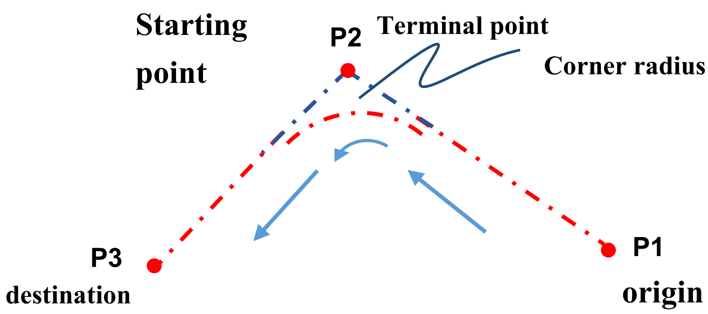
- CONT

LIN P1 CONT

LIN P2 CONT

LIN P3 CONT

When execute the commands open, there will be the smooth path in “LIN P2 CONT”, but there won’t move to P1 and P3(because they are the origin and destination).



CONT motion

- CONT = #%

LIN P1 CONT

LIN P2 CONT = 50%

LIN P3 CONT

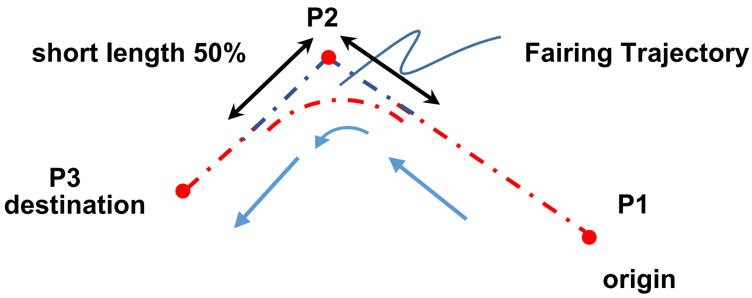
As Figure 10.2 show:

The distance between P2, P3 is shorter than the one between P1, P2, which is called the short length.

When execute the open program, the trajectory will start fairing when 50% short length away before P2.

⚠ CAUTION

Because the "CONT= # %" command will create a fixed path, so the velocity of the robot may change.



CONT = 50%

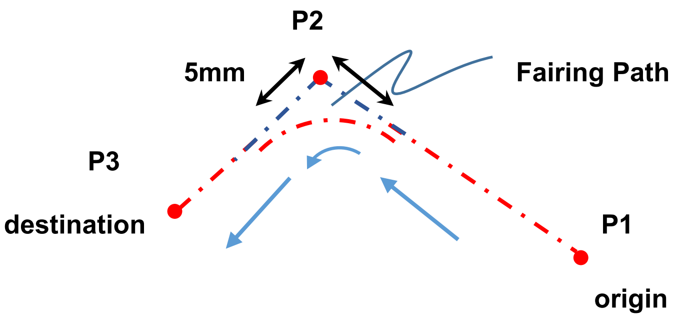
- CONT = #mm

LIN P1 CONT

LIN P2 CONT = 5mm

LIN P3 CONT

The path will start fairing when 5mm away before P2.



CONT = 5mm

⚠ CAUTION

Because the "CONT= # mm" command will create a fixed path, so the velocity of the robot may change.

⚠ CAUTION

When using "CONT= # mm" command, it does not mean that the value specified by the user will be exactly the same. However, the system will attempt at the distance specified by the user.

If there is “DO” command before the “CONT”, then the path won’t be smoothed.

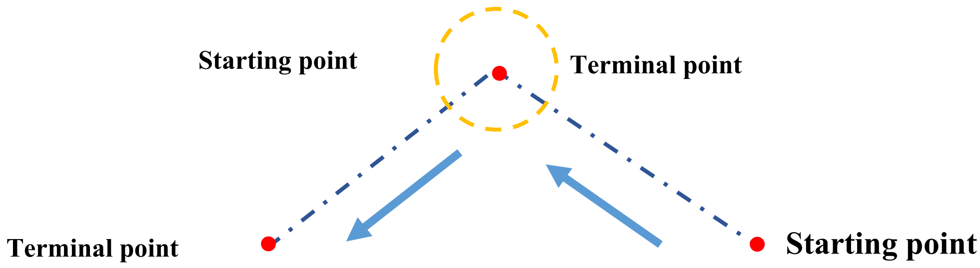
Example：

LIN P1 CONT
LIN P2 CONT
$DO[1] = TRUE
LIN P3 CONT

Originally, the path moving to P2 should be faired, but in this case, the path won’t be smoothed.

8.7.2. FINE

Discontinuous Motion



FINE motion

"FINE" command make TCP arrive the point without fairing the path.
FINE has four kinds:

- FINE, pre-read the next command, not check the actual position.
- FINE = 0, pre-read the next command, not check the actual position.
- FINE = 1, not pre-read the next command, not check the actual position.
- FINE = 2, not pre-read the next command, check the actual position.

8.7.3. VEL

Vel=100%

Define the velocity. If the PTP motion is used, the expression is the percentage that the maximum velocity can move. If this parameter is not entered, the default is 20%.

Vel=2000mm/s

Define the velocity. If the LINE and CIRC motions are used, the expression is mm/s. If this parameter is not entered, the default is 250mm/s.

8.7.4. ACC

Acc=50%

Define the acceleration. The expression is the percentage of maximum acceleration.

8.8. Definition of Structure

STRUC *LABEL* INT *PARAMETER1*, REAL *PARAMETER2*
DECL *LABEL* PART1 ,PART2, ……. , …….
PART1 = { *PARAMETER1* 10, *PARAMETER2* 500 }
PART2 = { *PARAMETER1* 20, *PARAMETER2* 100 }
………………
………………

Program:

```
STRUC CASTING_TYPE INT MASS, REAL VOLUME
DECL CASTING_TYPE PART1 ,PART2
PART1 = {MASS 10, VOLUME 500 }
PART2 = {MASS 20, VOLUME 100 }
```

Description:
For the different objects in the specific type, the different parameters can be assigned in the same variable.

Parameter explanation:

STRUC *LABEL*	; define the type name
INT *PARAMETER1*	; define the format of object parameter
REAL *PARAMETER2*	; define the format of object parameter
PART1	; define the object
PART2	; define the object

Hint:
PART1. *PARAMETER1* = K, which can obtain the parameter.

8.9. Function & Subprogram

8.9.1. Definition & Using Method of Function

Function is a program code which allows the user to execute the specific task or specific motion. User may write the frequently repeated program code in the function, and may also decide to write the program code with any length in the function. Usually, one function only performs one task.
The declaration of function tells the compiler with respect to the function name, post back value and parameters.

Definition of Function:
DEFFCT return_type function_name (parameter list)

statement body of the function
RETURN…

ENDFCT

The declaration of function includes the function header and function body. The description of each part is shown as follows:
return_type: Data type returns from function.
function_name: Function name.
parameter list: Function parameters. User may deliver the parameters into the function. The data type of parameter will refer to the data type and support point type declared in the function field. If the parameter is input, then use "parameter: IN" for indication, use as the input parameter, it will not affect the incoming variable even it is modified in the function. If it is used as the output variable and modified in the function, then use "parameter: OUT". As the output variable, if it is modified in the function, the originally incoming variable will also be changed accordingly. One function may have no function parameters, and up to five (5) parameters as the maximum.
statement body: Function body. If the function has parameter, then the user needs to declare the type of parameter in order to undertake.

Example of program 1:

```
INT iFUN
iFUN = FCT_1(2,3)
DEFFCT INT FCT_1(num1:IN,num2:IN)
        INT num1
INT num2
RETURN num1+num2
ENDFCT
```

Description:
Declare one function named as FCT_1, income two (2) INT parameters i.e. num1 and num2 respectively, and then post back after adding these two parameters.

Example of program 2:

```
E6POINT RE_E6,OUT_E6
INT iX
OUT_E6 = P1
RE_E6 = FCT_2(P0,OUT_E6)

DEFFCT E6POINT FCT_2(A:IN,B:OUT)
E6POINT A
E6POINT B
A.X = B.X
B.X = 100
PTP A
RETURN A
ENDFCT

iX = OUT_E6.X
```

Description:
Declare one function named as FCT_2, income one parameter of E6POINT and one output parameter B of E6POINT, the function assigns the X value of B to X of A first, and then configures X of B to 100, and then executes the point to point moving to A, and finally post back A, and B is taken as output returning to the calling procedure.

8.9.2. Definition & Using Method of Subprogram

The difference between the defined subprogram and function are: the subprogram has no post back value and the declaration is different.

Definition of subprogram:
DEF subprogram_name (parameter list)

statement body of the subprogram

END

The declaration of function includes the subprogram header and subprogram body. Description of each part is shown as follows:
subprogram_name: Subprogram name.
parameter list: Subprogram parameter and up to five (5) parameters as the maximum.
statement body: Subprogram body.

Example of program 1:

```
INT iNUM
iNUM = 4
$C[4] = 0
PROG_1(3,iNUM)
$C[4] = iNUM

DEF PROG_1(num1:IN,num2:OUT)
INT num1
INT num2
num2= num1+num2
END
```

Description:
Declare one subprogram named as PROG_1, income one parameter num1 of INT and one output parameter num2 of INT, and then add these two parameters, and assign to num2 as the output.

Example of program 2:

```
E6POINT E6_OUT_A,E6_OUT_B
E6_OUT_A = P0
E6_OUT_B = P1
PROG_2(E6_OUT_A,E6_OUT_B)

DEF PROG_2(A:OUT,B:OUT)
E6POINT A
E6POINT B
A.X = B.X
B.X = 100
PTP A
END
```

Description:

Declare one subprogram named as PROG_2, income two (2) output parameters of E6POINT i.e. A and B respectively, the subprogram assigns X of B to X of A first, and then configures X of B to 100, and then executes the pint to point moving A, takes the modified A and B as the output returning to the calling procedure.

8.10. External Function & Subprogram

8.10.1. Definition & Using Method of External Function(EXTFCT)

Declare the external function which indicates that the user writes this function into a separate independent file, and the name of this independent file shall be the same as the function name, and call this function outside this independent file. The external function locates on the first line of program code and must begin with the keyword of DEFFCT, one file can only define one external function. If it desires to call the external function, it will have to declare the external function at the calling program. The declaration of external function must use the keyword of EXTFCT. After declaration, it will be the same as the calling of general function.

Definition of declaration for external function:
EXTFCT return_type function_name (parameter list)

Description of each part of external function is shown as follows:
return_type: Type of post back value, structure of supporting point position.
function_name: Function name.
parameter list: Function parameters. Please be aware that the declaration of function parameter name (located in the procedure desired to call) must be consistent with the definition (located at the procedure being called) and up to five (5) parameters as the maximum, support the type of point position.

Example of program:

The program content of file named as FCT_1:

```
DEFFCT INT FCT_1 ( num1:IN,num2:IN)
INT num1
INT num2
RETURN num1+num2
ENDFCT
```

Content of external program:

```
EXTFCT INT FCT_1(num1:IN,num2:IN)
INT iNum
```

```
iNum = 10
iNum = FCT_1(6,8)
```

Description:
In the program with the file name of FCT_1, declare one function named as FCT_1, income two (2) parameters of INT i.e. num1 and num2 respectively, and then add these two parameters, and post back to the calling procedure, in addition, in another external file program, use EXTFCT to declare the external function of FCT_1, and then perform the calling by using the function mode directly, please be aware that the calling of external function can be up to eight (8) layers as the deepest, the compiler will report error if exceeded.

8.10.2. Definition &Using Method of External Subprogram(EXT)

Declare the external subprogram which indicates that the user writes this subprogram into a separate independent file, and the name of this independent file shall be the same as the subprogram name, and call this program outside this independent file. The external subprogram locates on the first line of program code and must begin with the keyword of DEF, one file can only define one external function. If it desires to call the external subprogram, it will have to declare the external subprogram at the calling program. The declaration of external subprogram must use the keyword of EXT. After declaration, it will be the same as the calling of general subprogram.

Definition of declaration for external subprogram:
EXT subprogram_name (parameter list)

Description of each part of external subprogram is shown as follows:
subprogram_name: Subprogram name.
parameter list: Subprogram parameters. The declaration of subprogram parameter name (located in the procedure desired to call) must be consistent with the definition (located at the procedure being called) and up to five (5) parameters as the maximum, support the type of point position.

Example of program:

The program content of file named as PROG_1:

```
DEF PROG_1 ( num1:IN,num2:OUT )
INT num1
INT num2
num2 = num1+num2
END
```

Content of external program:

```
EXT PROG_1( num1:IN,num2:OUT )
INT iNum

iNum = 7
PROG_1(4,iNum)
```

Description:

In the program with the file name of PROG_1, declare one function named as PROG_1, income one (1) parameter num1 of INT and one output parameter num2 of INT, and then add these two parameters, and assign to num2 as the output returning to the calling procedure, in addition, in another external file program, use EXT to declare the external function of PROG_1, and then perform the calling by using the subprogram mode directly, please be aware that the calling of external subprogram can be up to eight (8) layers as the deepest, the compiler will report error if exceeded.

8.11. RS232 Configuration

Program:

```
INT HANDLE
INT NUM
REAL SERDATA
COPEN ( SER , HANDLE)
LOOP
IF HANDLE > -1 THEN
CINQUIRE(HANDLE,NUM)
If NUM>0 THEN
CREAD (HANDLE, SERDATA)
ENDIF
CCLEAR (HANDLE)
SERDATA = SERDATA + 1
CWRITE (HANDLE, SERDATA)
ENDIF
WAIT SEC 0.3
ENDLOOP
```

Description:

Program writing and reading the number via RS232.

Parameter explanation:

SER	; RS232
HANDEL	; target folder
CWRITE (HANDLE, SERDATA)	; write the number of SERDATA into HANDLE
CREAD (HANDLE, SERDATA)	; give the number of HANDLE to SERDATA
CCLEAR (HANDLE)	; clear the number of HANDLE
CINQUIRE(HANDLE,NUM)	; read the received quantity

8.12. NET Configuration

Program:

```
INT HANDLE
INT NUM
REAL ETHDATR
COPEN ( ETH , HANDLE)
LOOP
IF HANDLE > -1 THEN
CINQUIRE(HANDLE,NUM)
If NUM>0 THEN
CREAD (HANDLE, ETHDATR)
ENDIF
CCLEAR (HANDLE)
ETHDATR = ETHDATR + 1
CWRITE (HANDLE, ETHDATR)
ENDIF
WAIT SEC 0.3
ENDLOOP
```

Description:

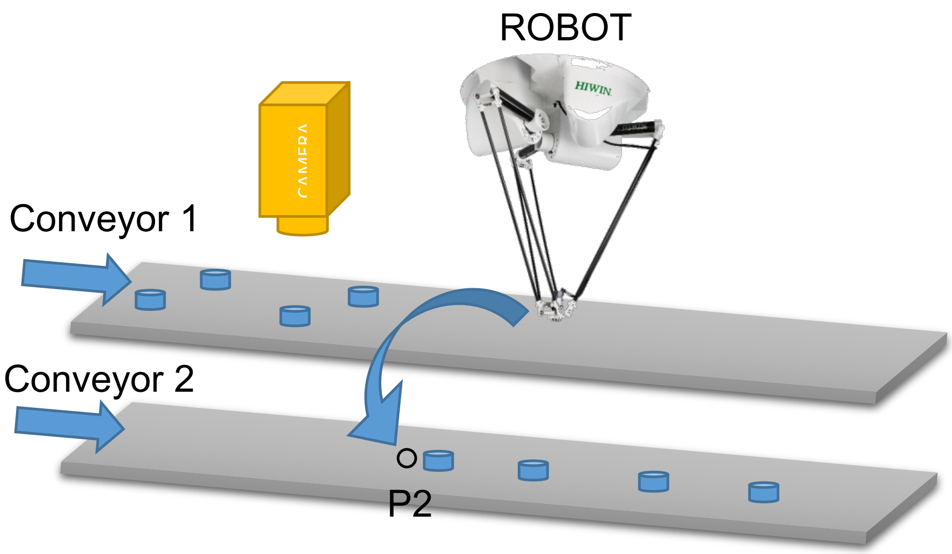
Program writing and reading the number via network

Parameter explanation:

ETH	; Internet
HANDLE	; target folder
CWRITE (HANDLE, ETHDATR)	; write the number of ETHDATR into HANDLE
CREAD (HANDLE, ETHDATR)	; give the number of HANDLE to ETHDATR
CCLEAR (HANDLE)	; clear the number of HANDLE
CINQUIRE(HANDLE,NUM)	; read the received quantity

8.13. Conveyor Configuration

8.13.1. Pick Program(1)



Pick Example 1

Program description:

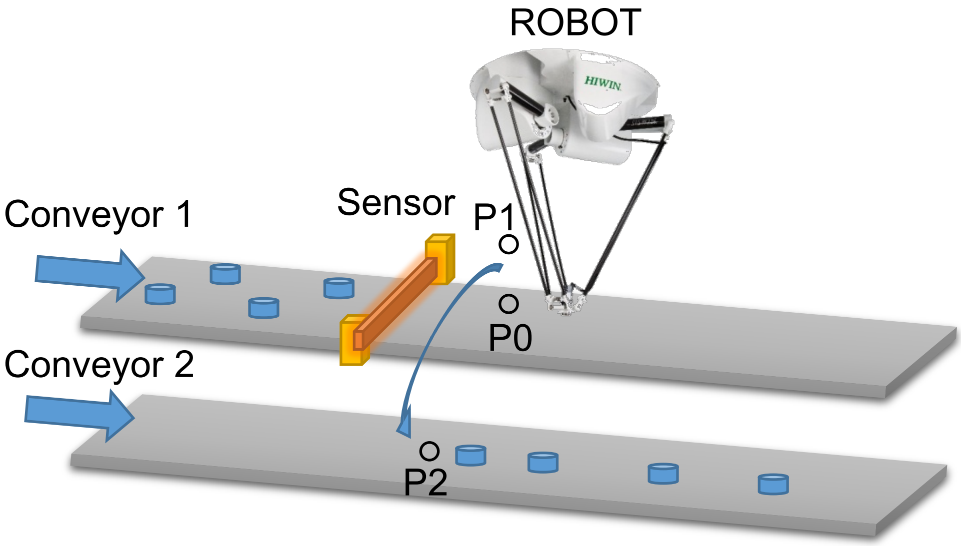
This is a visual example.

The robot picks the object from the Conveyor 1 to place on the Conveyor 2. The position is visually picked, and place P2 on the Conveyor 2.

Program:

```
CNV_START CNV=1                    ; start pick&place
CNV_PICK_QUANTITY = 2              ; set the maximum quantity to pick object
WHILE CNV_FULL == FALSE            ; go to loop when the quantity on the robot
doesn't reach the upper limit..
CNV_PICK CNV=1 OBJ=1 $DO[1] Down=5.000mm FINE Vel=2000mm/s
Acc=50% TOOL[0] BASE[0]            ; execute pick
ENDWHILE
WHILE CNV_EMPTY == FALSE           ; go to loop when the quantity on the robot is
not empty.
CNV_PLACE $DO[1] P2 FINE Vel=2000mm/s Acc=50% TOOL[0] BASE[0]
                                   ; execute place
ENDWHILE
CNV_END CNV=1                      ; end pick&place
```

8.13.2. Pick Program(2)



Pick Example 2

Program description:

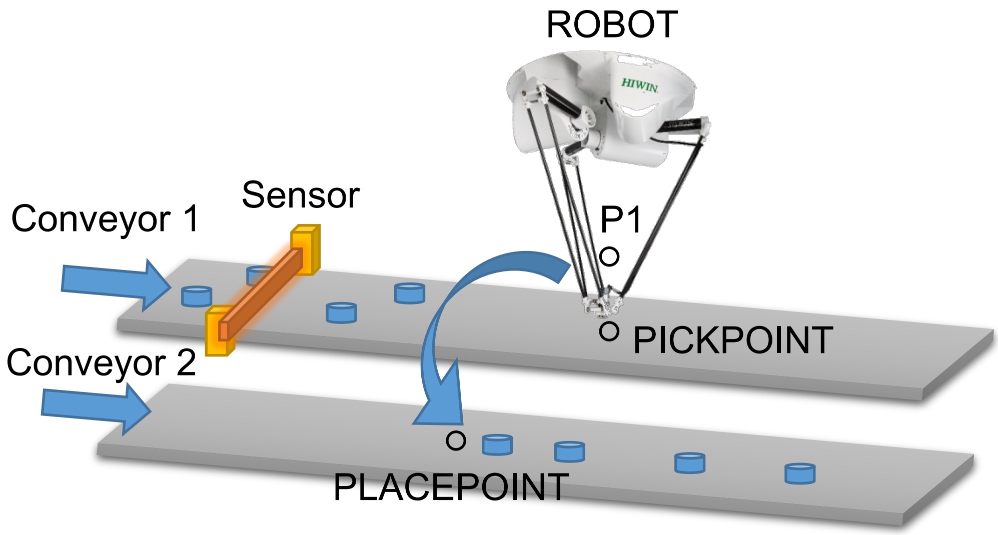
When the position to trigger a sensor is within the picking range, P can be directly set as the pick and place position.

The robot picks and places the object from the Conveyor 1 to the Conveyor 2. When the object is triggered by the sensor, the robot will move to P0 and pick, and then move to P1 and finally place P2.

Program:

```
CNV_START CNV=1                      ; start pick&place
CNV_PICK_QUANTITY = 2                ; set the maximum quantity to pick object
WHILE CNV_FULL == FALSE              ; go to loop when the quantity on the robot
doesn’t reach the upper limit.
CNV_PICK CNV=1 $DO[1] P0 Down=5.000mm FINE Vel=2000mm/s Acc=50%
TOOL[0] BASE[0]                      ; execute pick
ENDWHILE
PTP P1 CONT Vel=100% Acc=50% TOOL[0] BASE[0]          ; move to P1
WHILE CNV_EMPTY == FALSE             ; go to loop when the quantity on the robot is
 not empty.
CNV_PLACE CNV=2 $DO[1] P2 FINE Vel=2000mm/s Acc=50% TOOL[0]
BASE[0]
                                     ; execute place
ENDWHILE
CNV_END CNV=1                        ; end pick&place
```

8.13.3. Pick Program(3)



Pick Example 3

Program description:

When the position to trigger a sensor is beyond the picking range, the command E6POINT can be used to set the pick and place position.

(Before using the command E6POINT, please ensure the ToolBase coordinates have been parallel with those for the conveyor. So, you just need to adjust X coordinate or Y coordinate following P is adjusted).

The robot picks from the Conveyor 1 to the Conveyor 2, waits for the object to move to PICKPOINT, and then place to PLACEPOINT after moving to P1.

This example will release two objects after they are simultaneously picked.

Program:

```
CNV_START CNV=1                    ; start pick&place
CNV_PICK_QUANTITY = 2              ; set the maximum quantity to pick
object
E6POINT PICKPOINT = P0             ; set the pick point of E6POINT
PICKPOINT.X = PICKPOINT.X - 200
; If our ToolBase coordinate is parallel with the conveyor coordinate, X for
PICKPOINT will be needed.
; the coordinate position minus 200, no change for Y coordinate
E6POINT PLACEPOINT = P2            ; set place point for E6POINT
PLACEPOINT.X = PLACEPOINT.X – 50
; If our ToolBase coordinate is parallel with the conveyor coordinate, X for
```

PLACEPOINT will need to minus 50 and there is no change for Y coordinate.

```
WHILE CNV_FULL == FALSE                     ; go to loop when the quantity on the
conveyor doesn't reach the upper limit
CNV_PICK CNV=1 $DO[1] PICKPOINT Down=0.000mm FINE Vel=2000mm/s
Acc=50% TOOL[0] BASE[0]                     ; pick the first object
CNV_PICK CNV=1 $DO[2] PICKPOINT Down=0.000mm FINE Vel=2000mm/s
Acc=50% TOOL[0] BASE[0]                     ; pick the second object
ENDWHILE
PTP P1 CONT Vel=100% Acc=50% TOOL[0] BASE[0]
                                            ; move to P1
WHILE CNV_EMPTY == FALSE                    ; go to loop when the quantity on the
conveyor is not empty
CNV_PLACE CNV=2 $DO[1] PLACEPOINT FINE Vel=2000mm/s Acc=50%
TOOL[0] BASE[0]                                      ; execute pick
ENDWHILE
CNV_END CNV=1                               ; end pick&place
```

8.14. DO switching on the path(SYN OUT)

8.14.1. Program Example 1 of SYN

Program:
LIN P1 FINE Vel=100% Acc=50% TOOL[0] BASE[0]
SYN $DO[1] = TRUE START DELAY = 50 ms
SYN $DO[2] = TRUE END DELAY = -50 ms
LIN P2 FINE Vel=100% Acc=50% TOOL[0] BASE[0]

Description:
As shown in below, the command for SYN is given when moving from P1 to P2. P1 and P2 are not in the smooth circumstance. The range of START is from the position of the accurate position for P1 to P2. The range for END is from P2 to P1; the command for START Delay in SYN is given to 50ms, which executes the command for DO[1]=True after the time elapses 50ms. The command for END Delay in SYN is given to -50ms, which backwards 50ms from P2 to execute DO[2]=True.

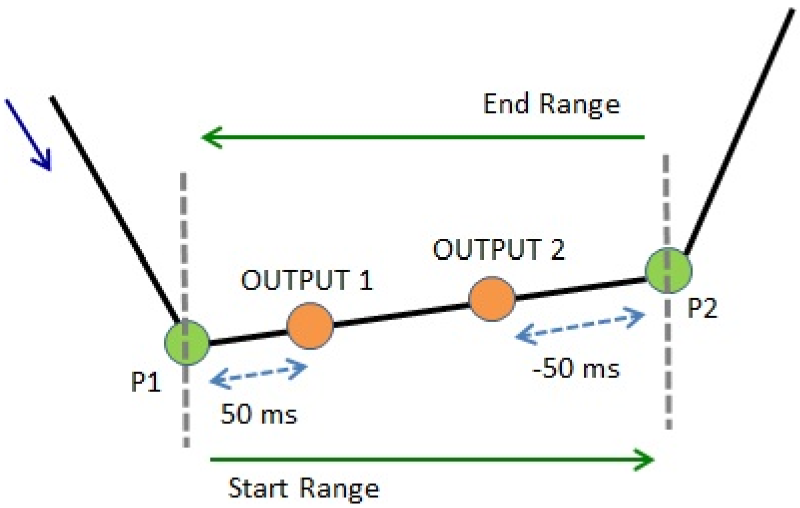


Illustration of Example 1

8.14.2. Program Example 2 of SYN

Program:

LIN P1 FINE Vel=100% Acc=50% TOOL[0] BASE[0]
SYN $DO[1] = TRUE START DELAY = 50 ms
SYN $DO[2] = TRUE END DELAY = -50 ms
LIN P2 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]

Description:

As shown in below, the command for SYN is given when moving from P1 to P2. P2 is in the smooth circumstance. The range of START is from the position of the smooth termination for P1 to the smooth start for P2. The range for END is from the position of the smooth start for P2 to the smooth termination for P2; the command for START Delay in SYN is given to 50ms, which executes the command for DO[1]=True after the time elapses 50ms from the position of the smooth termination for P1. The command for END Delay in SYN is given to -50ms, which executes the command for DO[2]=True after the time elapses 50ms forward from the central point of the Bezier curve in the smooth range of P2. For the description of CONT, please see the Appendix at Chap.8.7.1.

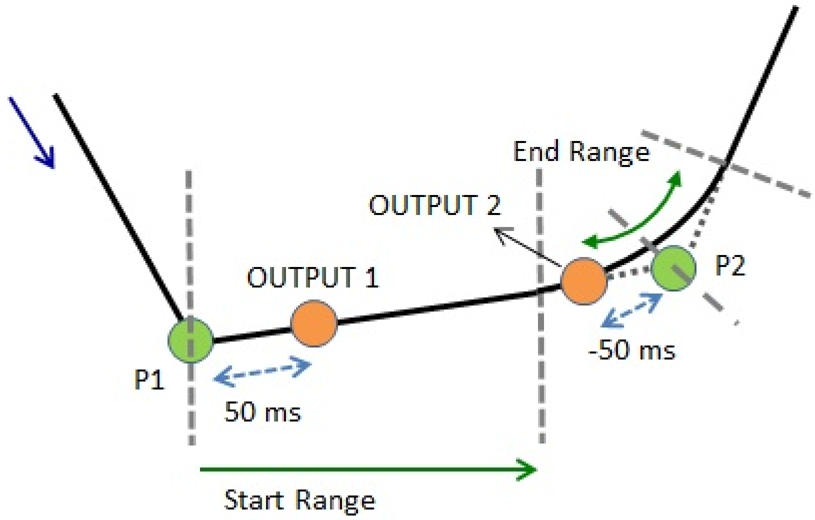


Illustration of Example 2

8.14.3. Program Example 3 of SYN

Program:

LIN P1 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
SYN $DO[1] = TRUE START DELAY = 50 ms
SYN $DO[2] = TRUE END DELAY = -50 ms
LIN P2 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]

Description:

As shown in below, the command for SYN is given when moving from P1 to P2. P1 and P2 are in the smooth circumstance. The range of START is from the position of the smooth termination for P1 to the smooth start for P2. The range for END is from the position of the smooth start for P2 to the smooth termination for P2; the command for START Delay in SYN is given to 50ms, which executes the command for DO[1]=True after the time elapses 50ms from the position of the smooth termination for P1. The command for END Delay in SYN is given to -50ms, which executes the command for DO[2]=True after the time elapses 50ms forward from the central point of the Bezier curve in the smooth range of P2. For the description of CONT, please see the Appendix at Chap.8.7.1.

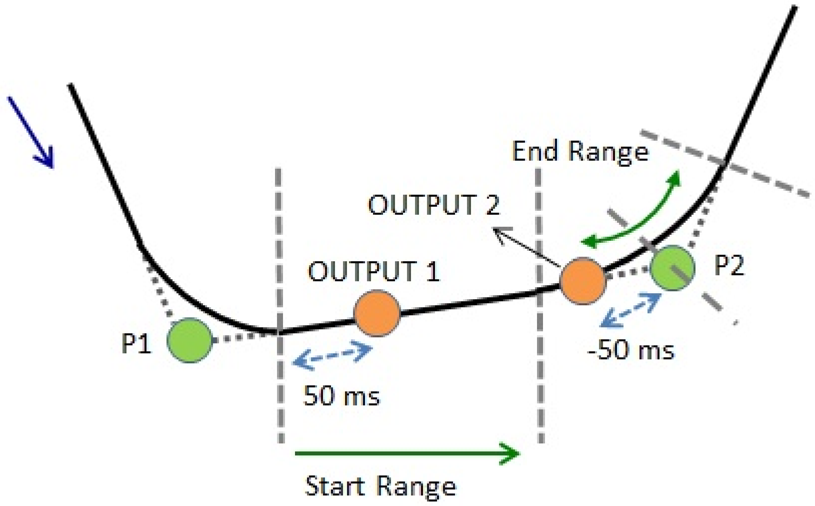


Illustration of Example 3

8.14.4. Example 4 of SYN Program

Program:

LIN P1 FINE Vel=100% Acc=50% TOOL[0] BASE[0]
SYN $DO[1] = FALSE START PATH = 50 mm DELAY = -50 ms
LIN P2 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
LIN P3 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
LIN P4 FINE Vel=100% Acc=50% TOOL[0] BASE[0]

Description:

As shown in below, the command for SYN is given when moving from P1 to P2. The path is used, as well as P2 and P3 are in the smooth circumstance. The range of START is from the position of the smooth start for P1 to P4; PATH=50mm and DELAY = -50ms are in SYN, counting 50mm from the start of P1, moving to 50ms and executing DO[1] = False; if P3 is the accurate position, the range of START is from the smooth start of P1 to P3. For the description of CONT, please see the Appendix at Chap.8.7.1.

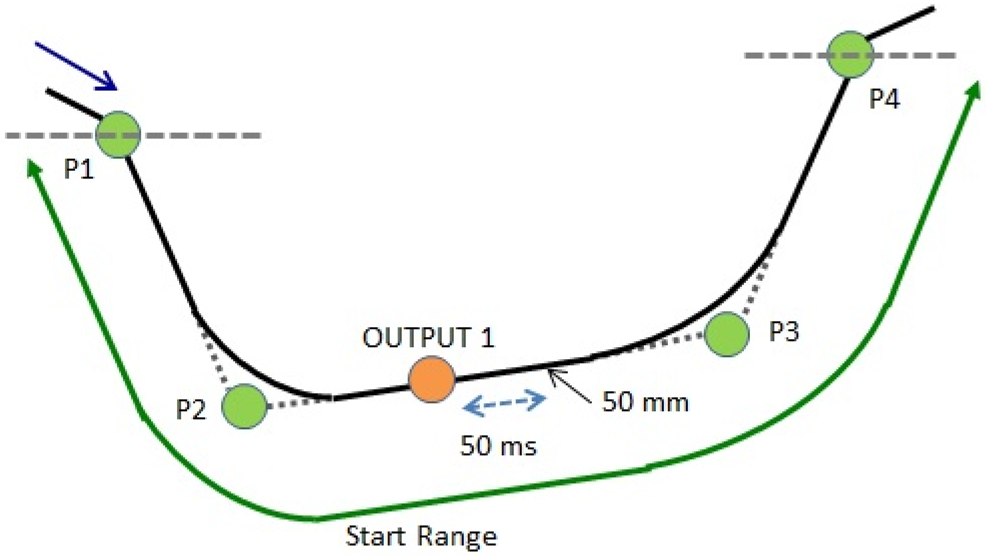


Illustration of Example 4

8.14.5. Example 5 of SYN Program

Program:

LIN P1 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
SYN $DO[1] = FALSE START PATH = 50 mm DELAY = -50 ms
LIN P2 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
LIN P3 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
LIN P4 FINE Vel=100% Acc=50% TOOL[0] BASE[0]

Description:

As shown in below, the command for SYN is given when moving from P1 to P2. The path is used, as well as P1, P2 and P3 are in the smooth circumstance. The range of START is from the position of the smooth start for P1 to P4; PATH=50mm and DELAY = -50ms are in SYN, counting 50mm from the smooth start of P1, moving to 50ms and executing DO[1] = False; if P3 is the accurate position, the range of START is from the smooth start of P1 to P3. For the description of CONT, please see the Appendix at Chap.8.7.1.

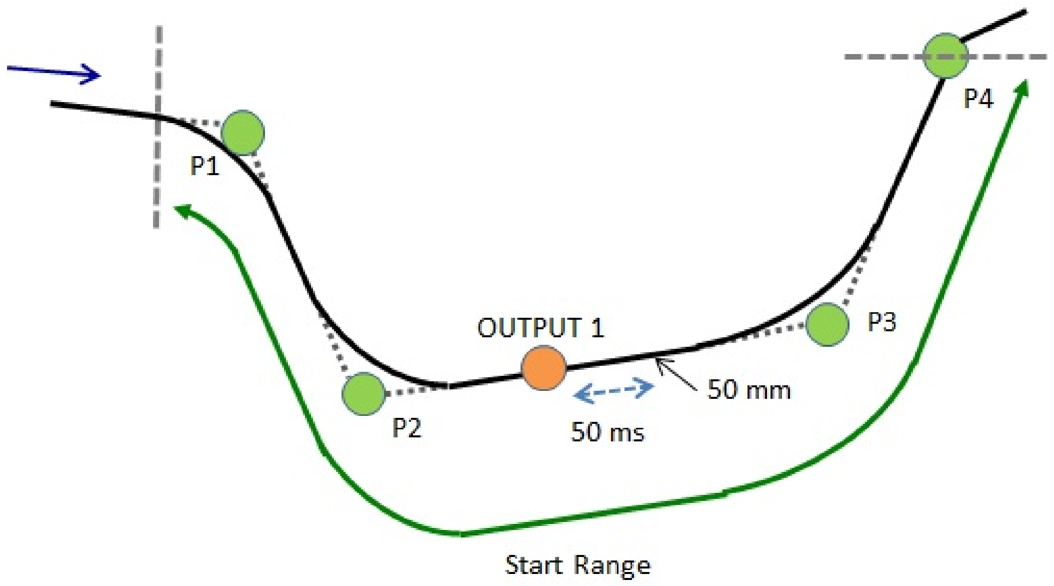


Illustration of Example 5

8.15. Electric Gripper

There is a sample program below. First of all, set the parameter “Wait Idle” to “ON”. This sample will be using all commands of XEG (a kind of electric gripper), including “pick”, “place”, and changing to expert mode to recognize different items by picking status. Users can refer to this sample to develop their own programs.

```
;Initialize: move the robot to the original position, connect to the XEG, and reset the
XEG.
PTP P1 FINE Vel=100% Acc=100% TOOL[0] BASE[0]
;try to connect to the XEG
EG_OPEN(X32)
;reset the XEG
EG_RESET
$C[1]=0

;The major part of the program: recognize two different objects by pick and place.
WHILE $C[1] <= 100
$C[1] = $C[1]+1
;move XEG to a specific position
IF EG_GET_STATUS <0 THEN
;TO DO the handling commands if XEG gets errors
ENDIF
EG_RUN_MOVE(26.5,80)
PTP P6 FINE Vel=100% Acc=100% TOOL[0] BASE[0]
PTP P3 FINE Vel=100% Acc=100% TOOL[0] BASE[0]
;execute the picking command
IF EG_GET_STATUS <0 THEN
;TO DO the handling commands if XEG gets errors
ENDIF
EG_RUN_GRIP(C,25,H,M)
;recognize the objects by the position and status of XEG
IF SelectObject(EG_GET_POS, EG_GET_STATUS) ==2 THEN
PTP P6 FINE Vel=100% Acc=100% TOOL[0] BASE[0]
PTP P2 FINE Vel=100% Acc=100% TOOL[0] BASE[0]
ENDIF
;move XEG to a known position
```

```
IF EG_GET_STATUS <0 THEN
;TO DO the handling commands if XEG gets errors
ENDIF
EG_RUN_MOVE(26.5,80)
PTP P7 FINE Vel=100% Acc=100% TOOL[0] BASE[0]
PTP P8 FINE Vel=100% Acc=100% TOOL[0] BASE[0]
PTP P9 FINE Vel=100% Acc=100% TOOL[0] BASE[0]
PTP P4 FINE Vel=100% Acc=100% TOOL[0] BASE[0]
;change to expert mode to move XEG to pick
IF EG_GET_STATUS <0 THEN
;TO DO the handling commands if XEG gets errors
ENDIF
EG_RUN_EXPERT(C,3.5,60,20.5,20,50)
IF SelectObject(EG_GET_POS, EG_GET_STATUS) ==1 THEN
PTP P9 FINE Vel=100% Acc=100% TOOL[0] BASE[0]
PTP P11 FINE Vel=100% Acc=100% TOOL[0] BASE[0]
PTP P5 FINE Vel=100% Acc=100% TOOL[0] BASE[0]
ENDIF
; move XEG to a known position
IF EG_GET_STATUS <0 THEN
;TO DO the handling commands if XEG gets errors
ENDIF
EG_RUN_MOVE(26.5,80)
PTP P10 FINE Vel=100% Acc=100% TOOL[0] BASE[0]
PTP P5 FINE Vel=100% Acc=100% TOOL[0] BASE[0]
;pick
IF EG_GET_STATUS <0 THEN
;TO DO the handling commands if XEG gets errors
ENDIF
EG_RUN_GRIP(C,25,H,M)
; recognize the objects by the position and status of XEG
IF SelectObject(EG_GET_POS, EG_GET_STATUS) ==1 THEN
PTP P10 FINE Vel=100% Acc=100% TOOL[0] BASE[0]
PTP P8 FINE Vel=100% Acc=100% TOOL[0] BASE[0]
PTP P4 FINE Vel=100% Acc=100% TOOL[0] BASE[0]
ENDIF
; move XEG to a known position
```

```
IF EG_GET_STATUS <0 THEN
;TO DO the handling commands if XEG gets errors
ENDIF
EG_RUN_MOVE(26.5,80)
PTP P8 FINE Vel=100% Acc=100% TOOL[0] BASE[0]
PTP P7 FINE Vel=100% Acc=100% TOOL[0] BASE[0]
PTP P2 FINE Vel=100% Acc=100% TOOL[0] BASE[0]
; change to expert mode to move XEG to pick
IF EG_GET_STATUS <0 THEN
;TO DO the handling commands if XEG gets errors
ENDIF
EG_RUN_EXPERT(C,3.5,60,20.5,20,50)
; recognize the objects by the position and status of XEG
IF SelectObject(EG_GET_POS, EG_GET_STATUS) ==2 THEN
PTP P7 FINE Vel=100% Acc=100% TOOL[0] BASE[0]
PTP P6 FINE Vel=100% Acc=100% TOOL[0] BASE[0]
PTP P3 FINE Vel=100% Acc=100% TOOL[0] BASE[0]
ENDIF
; move XEG to a known position
IF EG_GET_STATUS <0 THEN
;TO DO the handling commands if XEG gets errors
ENDIF
EG_RUN_MOVE(26.5,80)
PTP P6 FINE Vel=100% Acc=100% TOOL[0] BASE[0]
PTP P1 FINE Vel=100% Acc=100% TOOL[0] BASE[0]
ENDWHILE
;disconnect from XEG
EG_CLOSE

;Subprogram: the function to recognize different objects
DEFFCT INT SelectObject(POSITION:IN,STATUS:IN)
REAL POSITION
INT STATUS
IF POSITION>=18.5 AND POSITION<=20.5 AND STATUS==2 THEN
RETURN 1
ELSE
IF POSITION>=3 AND POSITION<=4 AND STATUS==2 THEN
```

```
RETURN 2
ELSE
RETURN 0
ENDIF
ENDIF
ENDFCT
```

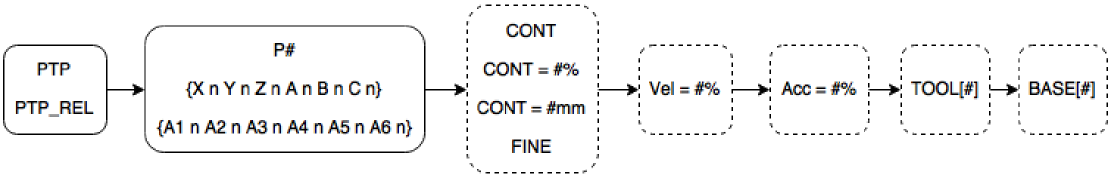
9. Appendix

9.1. Software commands

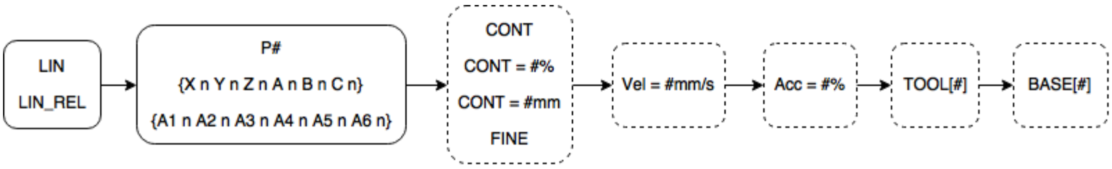
Motion commands:

Commands	Description
PTP	Point to point motion
PTP_REL	Point to point relative motion
LIN	Linear motion
LIN_REL	Linear relative motion
CIRC	Circular motion
CIRC_REL	Circular relative motion
SPLINE…SPL…ENDSPLINE	B-Spline curvilinear motion

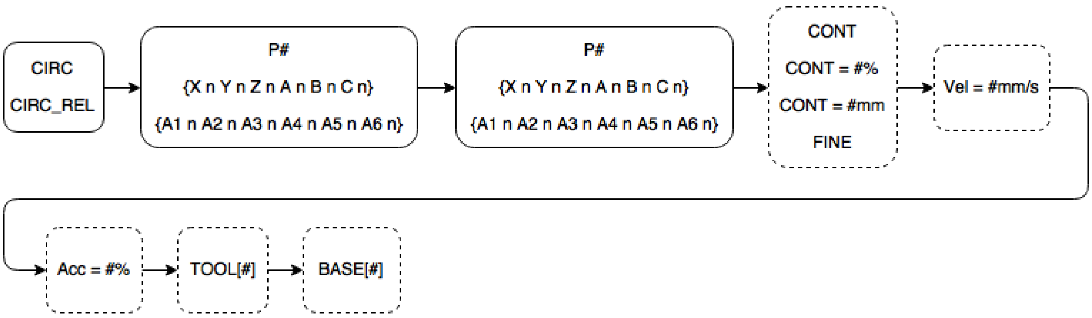
PTP&PTP_REL flowchart:



LIN&LIN_REL flowchart:



CIRC&CIRC_REL flowchart:



SPLINE Instructions：

SPLINE

SPL　P1

…..

SPL　P73

ENDSPLINE

RS232 or EtherNet Commands:

Commands	Description
COPEN	Open RS232 or EtherNet
CCLOSE	Close RS232 or EtherNet
CCLEAR	Delete RS232 or EtherNet data
CREAD	Read received data from RS232 or EtherNet
CWRITE	Write RS232 or EtherNet data
CINQUIRE	Inquire RS232 or EtherNet package numbers

Example:

```
INT HANDLE
INT NUM
REAL SERDATA
COPEN ( SER , HANDLE)
LOOP
    IF HANDLE > -1 THEN
        CINQUIRE(HANDLE,NUM)
        If NUM>0 THEN
            CREAD (HANDLE, SERDATA)
        ENDIF
        CCLEAR (HANDLE)
        SERDATA = SERDATA + 1
        CWRITE (HANDLE, SERDATA)
    ENDIF
    WAIT SEC 0.3
ENDLOOP
CCLOSE (HANDLE)
```

Conveyor tracking commands:

Commands	Description
CNV_START	Startup the tracking procedure of conveyor, and connect with the dispatching system/vision
CNV_END	End the tracking of conveyor and connection of dispatching system/vision
CNV_PICK	Flying-pick to pick object
CNV_PLACE	Flying-place to place object
CNV_SET_DELAY_TIME[#]	Configure the ending time of tracking delay for the flying-pick/flying-place
CNV_QUEUE_REMOVE[#]	Remove the forefront queue of flying-pick/flying-place temporary storage
CNV_PICK_ACC[#]	Configure the acceleration time of tracking push-down
CNV_EMPTY	If the pick quantity is zero
CNV_FULL	If the pick quantity is up to the upper limit
CNV_OBJECT	The numbering of latest object picked currently
CNV_PICK_QUANTITY	The maximum quantity able to pick
CNV_QUEUE_SIZE[#]	The quantity of already sensed but not pick yet
CNV_TRIGGER_TIMES	Configure the triggering times of sensor for adding one working task
CNV_OFFSET_X	X Offset value of flying-pick/flying-place
CNV_OFFSET_Y	Y Offset value of flying-pick/flying-place
CNV_OFFSET_Z	Z Offset value of flying-pick/flying-place
CNV_PLACE_BATCH	Configure the maximum times for flying-place
CNV_OBJ_CNT_DIST[#]	Position difference between the first object and second object
CNV_RESET_ENC	Clear the count value of external encoder
CNV_SPEED[#]	Read the speed of specified conveyor

Example: Use vision to collaborate with flying-pick

```
CNV_START CNV=1                ;start pick & place
CNV_SET_DELAY_TIME[1] = 50     ; delay 50ms, and leave flying-pick/flying-place
CNV_PICK_ACC[1] = 50           ; push-down acceleration of flying-pick is 50ms
CNV_PICK_QUANTITY = 2          ; set the maximum quantity to pick object
```

```
WHILE CNV_FULL == FALSE          ; go to loop when the quantity on the robot
doesn't reach the upper limit
CNV_PICK CNV=1 OBJ=1 $DO[1] Down=5.000mm FINE Vel=2000mm/s
Acc=50% TOOL[0] BASE[0]       ; execute pick
ENDWHILE
IF CNV_OBJECT == 1 THEN          ; if the object numbering is 1
CNV_OFFSET_X = 10             ; configure X Offset value of flying-pick/flying-
place as 10
CNV_OFFSET_Y = 10             ; configure Y Offset value of flying-pick/flying-
place as 10
CNV_OFFSET_Z = 10             ; configure Z Offset value of flying-pick/flying-
place as 10
ENDIF
WHILE CNV_EMPTY == FALSE         ; go to loop when the quantity on the
conveyor is not empty
CNV_PLACE $DO[1] P2 FINE Vel=2000mm/s Acc=50% TOOL[0] BASE[0]
                              ; execute place
ENDWHILE
CNV_END CNV=1                    ; end pick & place
```

Example：Use sensor to collaborate with flying-pick

```
INT ISpeed
ISpeed = CNV_SPEED[1]            ; read the speed of conveyor 1
CNV_START CNV=1                  ; start pick & place
CNV_RESET_ENC                    ; clear the count value of external encoder
CNV_TRIGGER_TIMES = 1            ; sensor is triggered once, add working task
once
CNV_PLACE_BATCH = 1              ; allowable number of time for flying-place in
one working task is one time
CNV_PICK_QUANTITY = 2            ; set the maximum quantity to pick object
WHILE CNV_FULL == FALSE          ; go to loop when the quantity on the robot
doesn't reach the upper limit
CNV_PICK CNV=1 $DO[1] P0 Down=5.000mm FINE Vel=2000mm/s Acc=50%
TOOL[0] BASE[0] ; execute pick
ENDWHILE
IF CNV_OBJECT == 1 THEN          ; if the object numbering is 1
CNV_QUEUE_REMOVE[1]           ; remove the first queue
ENDIF
```

```
PTP P1 CONT Vel=100% Acc=50% TOOL[0] BASE[0]     ;move to P1
IF CNV_QUEUE_SIZE[1] > 1 THEN   ; determine if the queue content is more than
1
IF CNV_OBJ_CNT_DIST[1] > 2600 THEN; determine if the difference value is
more than 2600 ea counts
WHILE CNV_EMPTY == FALSE        ; go to loop when the quantity on the
conveyor is not empty
CNV_PLACE CNV=2 $DO[1] P2 FINE Vel=2000mm/s Acc=50% TOOL[0]
BASE[0]         ;execute place
ENDWHILE
ENDIF
ENDIF
CNV_END CNV=1                           ;end pick & place
```

Register commands:

Commands	Description
$C[#]	Counter register
$DI[#]	Digital input point register
$DO[#]	Digital output point register
$PR[#]	Robot input point register
$RI[#]	Robot output point register
$RO[#]	Timer register
$T[#]	Start timer register
$T_STOP[#]	Valve output register
$VO[#]	Counter register

Example:

```
$C[1] = 0
$DO[1] = TRUE
WAIT FOR $DI[1] == TRUE
$RO[1] = TRUE
WAIT FOR $RI[1] == TRUE
$VO[1] = TRUE
$T_STOP[1] = TRUE
$T[1] = 0
```

PR Example 1:

$PR[1] = {A1 1 , A2 2 , A3 3 , A4 4 ,A5 5 , A6 6}

$PR[2] = {X 7 ,Y 8 , Z 9 , A 10 ,B 11 , C 12}

$PR[3] = {A1 1 , A2 2 , A3 3 , A4 4 ,A5 5 , A6 6, X 7 ,Y 8 , Z 9 , A 0,B 0, C 0}

PR Example 2:

E6POS A = {X 10 ,Y 10 ,Z 10 ,A 10 ,B 10 ,C 10}

E6AXIS B = {A1 20 , A2 20 , A3 20 , A4 50 ,A5 10 , A6 20}

E6POINT C = {A1 20 , A2 20 , A3 20 , A4 50 ,A5 10 , A6 20 ,X 10 ,Y 10 ,Z 10 ,A 10 ,B 10 ,C 10}

$PR[1] = A

$PR[2] = B

$PR[3] = C

PR Example 3:

$PR[1] = GETPOINT

Variable types:

Commands	Description
BOOL	Boolean variable type
CHAR	Character variable type
E6AXIS	Angular variable value type
E6POINT	Coordinates or angular variable type
E6POS	Coordinates variable type
FRAME	BASE or TOOL coordinate system
INT	Integer variable type
REAL	Real point variable type

Example:

```
BOOL K = TRUE
CHAR COLOR = 'R'
INT I = 0
REAL R = 0
```

FRAME：

```
FRAME POINT = {A1 90}
```

E6POS/E6AXIS：

```
E6POS POINT = {X 0,Y 300,Z 200}
E6AXIS POINT = {A1 90}
PTP POINT CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
```

E6POINT：

```
E6POINT HOME = {Y 200,Z -1000,A 90}
```

or

```
E6POINT HOME = {A1 90}
PTP HOME CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
```

Math Calculation:

Commands	Description
ACOS	Arc cosine(X)
ASIN	Arc sine(X)
ATAN	Arc tangent(X)
ATAN2	Arc tangent(X, Y)
COS	Cosine(X)
SIN	Sine(X)
TAN	Tangent(X)

Example:

```
REAL TESTA
TESTA=ACOS(0)
TESTA=ASIN(0)
TESTA=ATAN(0)
TESTA=ATAN2(0,1)
TESTA=COS(0)
TESTA=SIN(0)
TESTA=TAN(0)
```

Control function

Commands	Description
FOR…ENDFOR	For loop
GOTO	Go to label position
IF…ENDIF	IF statement
LOOP…ENDLOOP	LOOP
REPEAT…UNTIL	Repeat loop
SWITCH…ENDSWITCH	Switch statement
WHILE…ENDWHILE	While loop

Example:

FOR…ENDFOR：

```
INT n
FOR n = 0 TO 2 STEP 1
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
PTP P1 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
ENDFOR
```

GOTO：

```
FOUND:
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
GOTO FOUND
```

IF…ENDIF：

```
INT n = 1
IF n > 0 THEN
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
ENDIF
```

LOOP…ENDLOOP：

```
LOOP
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
PTP P1 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
ENDLOOP
```

REPEAT…UNTIL：

```
INT n =0
REPEAT
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
PTP P1 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
n = n + 1
UNTIL n > 2
```

SWITCH…ENDSWITCH：

```
INT n =0
LOOP
SWITCH n
CASE 0
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
CASE 1
PTP P1 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
CASE 2
EXIT
ENDSWITCH
n = n + 1
ENDLOOP
```

WHILE…ENDWHILE：

```
INT n = 2
WHILE n > 0
PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
PTP P1 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0]
n = n - 1
ENDWHILE
```

Gripper commands：

Commands	Description	Example
EG_OPEN	Connect with XEG series electric gripper	EG_OPEN(Type)
EG_CLOSE	Disconnect current XEG series electric gripper connection	EG_CLOSE
EG_RESET	Reset XEG series electric gripper	EG_RESET

EG_GET_STATUS	Get XEG series electric gripper status	IF EG_GET_STATUS == 2 THEN
		…
		ENDIF

EG_RUN_MOVE	Move XEG series electric gripper	EG_RUN_MOVE(10,20)
EG_RUN_GRIP	Grip action of XEG series electric gripper	EG_RUN_GRIP(C,5,L,M)
EG_RUN_EXPERT	Grip action and movement of XEG series electric gripper	EG_RUN_EXPERT(C,10,20,5,10,100)

EG_GET_POS	Get XEG series electric gripper position	IF EG_GET_POS > 5.00 THEN
		…
		ENDIF

Other commands

Commands	Description	Example
ADDTOOL	Add tool	ADDTOOL ee
ADDOBJECT	Add object	ADDTOOL table P:500,200 C:200,50
SET_TOOL	Set tool coordinate system	FRAME T_ONE T_ONE.X = 100 SET_TOOL 1 SET_TOOL T_ONE
SET_BASE	Set base coordinate system	FRAME B_ONE B_ONE.Y = 100 SET_BASE 1 SET_BASE B_ONE

SET_OVERRIDE_SPEE D	Set override speed ratio	SET_OVERRIDE_SPEED 100
SET_SPEED	Set line speed	SET_ SPEED 2000
SET_ACC	Set acceleration	SET_ ACC 250
TRUE_PATH	Open or close trajectory accuracy control	TRUE_PATH = TRUE
USER_ALARM	Configure user alarm	USER_ALARM[1]
SYN	Synchronous switch O pint in motion path	LIN P1 FINE Vel=100% Acc=50% TOOL[0] BASE[0] SYN $DO[1] = TRUE START DELAY = 50 ms SYN $DO[2] = TRUE END DELAY = -50 ms LIN P2 FINE Vel=100% Acc=50% TOOL[0] BASE[0]
MOVEFLOOR	Move floor position	MOVEFLOOR 100
DEFFCT…ENDFCT	Define subprogram	PTP P0 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0] MY() DEFFCT INT MY() PTP P1 CONT=100% Vel=100% Acc=50% TOOL[0] BASE[0] RETURN 100 ENDFCT
GETPOINT	Get coordinates or angular value	E6POINT E6TEST E6TEST = GETPOINT
AXISON	Axis coordinates on	AXISON
AXISOFF	Axis coordinates off	AXISOFF
GET_MOTION_STATU S	Get motion status	INT Istatus Istatus = GET_MOTION_STATUS
WAIT SEC	Wait second	WAIT SEC 10
WAIT FOR $DI[#]	Wait digital input	WAIT FOR $DI[1] == TRUE
STRUC	Define structure	STRUC CASTING_TYPE INT MASS, REAL VOLUME

Robot System Software-HRSS 3.2 (Original Instruction) User Manual

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