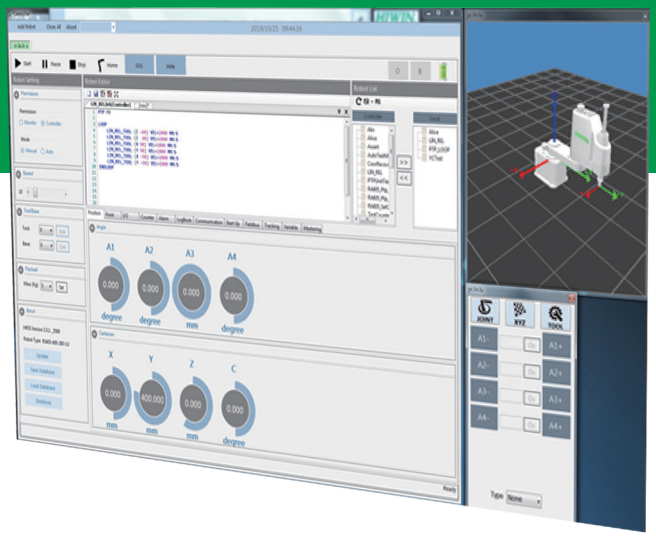
HIWIN®

Remote Robot Controller Software

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

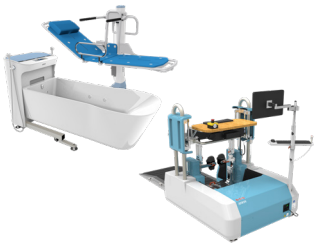
Robot / Automation Equipment /
Semiconductor Equipment / Machine Tools

- WUT-PO Type
- WUI-CO Type
- WTI-PH Type
- WTI-AH Type

AC Servo Motor & Drive

Semiconductor / Packaging Machine
/ SMT / Food Industry / LCD

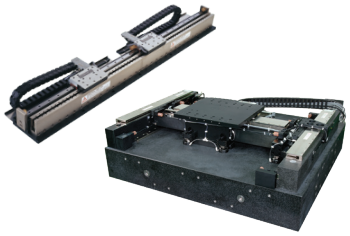
- Drives--D1, D1-N, D2T/D2T-LM
- Motors--50W~2000W



Medical Equipment

Hospital / Rehabilitation Centers /
Nursing Homes

- Robotic Gait Training System
- Hygiene 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.

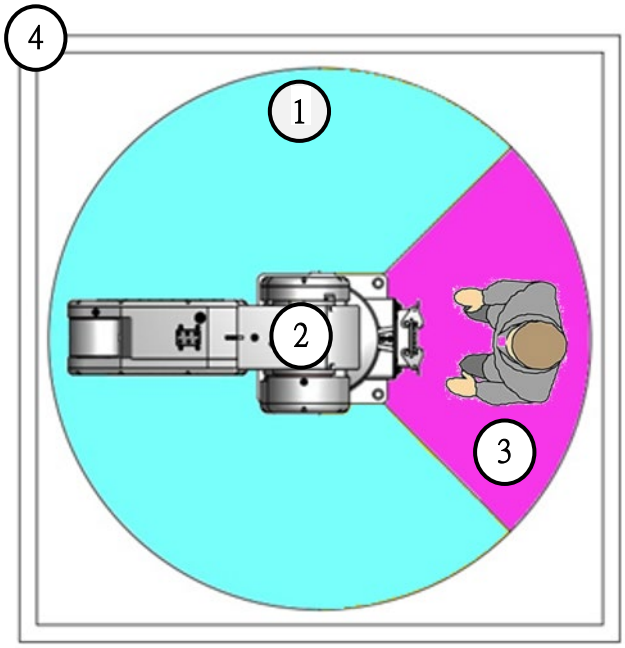


Illustration of axis A1

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 Mode (T1,T2 Mode)

The manual 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

Stop Category Description

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 ting 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

1. Introduction 28
1.1. Remote Control Robot Software (Caterpillar) Overview 28
1.2. Connect to controller 28
1.3. Recommended Environment 29
2. Operation 30
2.1. Front View 30
2.1.1. Connection Level 31
2.2. Connection 31
2.3. Status Bar 32
2.4. Change Operation Mode 34
2.5. Coordinate System 35
2.6. JOG 38
2.6.1. Manual Move 38
2.6.2. Base/Tool Coordinate 39
2.6.3. Jogging velocity Ratio 40
2.7. Display 40
2.7.1. Display Actual Position 40
2.7.2. Display Digital Input/Output 40
2.7.3. Display External Functional Input/Output 42
2.7.4. Display Point 44
2.7.5. Display Counter 45
2.7.6. Display Timer 46
2.7.7. Display Alarm and Zero Position History Message 47
2.7.8. Robot Simulation 48
Simulation Figure 48
2.8. Communication 49

2.8.1. TCP/IP 49
2.8.2. Set up Robot Controller IP 51
2.8.3. RS232 Communication 53
2.9. FieldBus Setting 54
2.9.1. Setup CC-Link connection parameters 54
2.9.2. Setup Profinet connection parameters 55
2.9.3. Setup ModbusTCP Server connection parameters 56
2.9.4. Setup ModbusTCP Client connection parameters 57
2.9.5. Field Bus Input(SI[n]) 58
2.9.6. Field Bus Output(SO[n]) 59
2.9.7. Field Bus Register Mapping(SRR、SRW) 61
2.10. Time Setting of Controller 63
2.11. Language Setting 64
2.12. Payload Setting 64
2.13. Self-defined Digital Input/Output Function 65
2.13.1. Clear Error 65
2.13.2. External Alarm 65
2.13.3. External Shutdown Input 66
2.13.4. Motor Warning 66
2.13.5. System Start Up 66
2.13.6. Manual/Auto Mode Output 67
2.14. Module I/O Function 67
2.15. Position Register setting 69
2.16. Conveyor Calibration 70
2.16.1. Conveyor Image Calibration 70
2.16.2. Conveyor Arm Calibration 71

2.16.3. Conveyor Image Parameters 73
2.16.4. Conveyor Object Parameters 74
2.17. Update Caterpillar and HRSS 81
3. Initial Settings 84
3.1. Check Parameters 84
3.2. Calibration Flow 86
3.3. Adjust Origin Position of Hardware Mechanism 87
3.3.1. Mastering Method (6-axis robot) 88
3.3.2. Mastering Method（4 Axes Robot） 91
3.4. Calibration（6 axes Robot） 95
3.4.1. Base calibration 95
3.4.1.1. 3-point Method 96
3.4.1.2. Enter Value 98
3.4.2. Tool calibration 99
3.4.2.1. 4-point Method 100
3.4.2.2. Enter Value 102
3.5. Calibrate Coordinates（4-axis robot） 103
3.5.1. Calibrate Base Coordinates 103
3.5.2. Calibration of Tool Coordinates 107
3.6. Home and Position Check Configuration 111
3.6.1. Home Configuration 111
3.6.2. Position Check 112
4. Program Management 113
4.1. Program List 113
4.2. Add and Delete File 114
4.3. Add and Delete Folder 114

4.4. HRSS Program Structure 115
4.5. Start Program 116
4.5.1. Pre-reading 116
4.5.2. Set Program Ratio 116
4.5.3. Driver Status 117
4.5.4. Status Display “Interpreter” 117
4.5.5. Start a Program 118
4.6. Edit Program 119
4.6.1. Comment Program Bar 119
4.6.2. Indent Program Bar 119
4.6.3. Cancel Indent Program Bar 120
4.7. Rules for naming files 120
5. Motion Program Design 121
5.1. Motion Overview 121
5.2. Point-to-point (PTP) Motion 121
5.3. LIN Motion 122
5.4. CIRC Motion 123
5.5. Blend 123
5.6. Singular Point 125
6. Error Message 127
6.1. Robot System Software(01-XX-XX) 127
6.1.1. System Error Message(01-01-XX) 127
6.1.2. Program Error(01-02-XX) 131
6.1.3. Motion Error(01-03-XX) 131
6.1.4. Operation Error(01-04-XX) 135
6.1.5. IO & Communication(01-05-XX) 139

6.1.6. Operator Error (01-06-XX) 141
6.1.7. External Axis Error (01-07-XX) 143
6.1.8. Conveyor Tracking Error(01-08-XX) 146
6.1.9. User-Defined Error (01-09-XX) 147
6.1.10. Authorization Error(01-0B-XX) 148
6.1.11. Windows Information 149
6.2. HIWIN Robot Controller(02-XX-XX) 150
6.2.1. Safety Input(02-01-XX) 150
6.2.2. Hardware Error(02-02-XX) 150
6.3. Axis Amplifier(03-XX-XX) 151
6.3.1. Function Name and Number Description 151
6.3.2. Driver Alert Number 151
6.3.3. DAC - Y Driver Alarm Code(Y-XXX) 162
6.3.4. DAC - S Driver Alarm Code(S-XXXX) 174
6.4. Electric gripper(04-XX-XX) 179
6.4.1. Hardware Error (04-01-XX) 179
6.4.2. Operation Error (04-02-XX, 04-01-8X) 181
6.4.3. Electric Gripper Controller Alarm Signal Error (04-01-3X) 184
6.4.4. Electric Gripper Command Communication Timeout (04-01-4X) 185
7. Program Examples 186
7.1. Register 186
7.1.1. COUNTER Register 186
7.1.2. TIMER Register 186
7.2. Variable Type 187
7.2.1. REAL 187
7.2.2. INT 187

7.2.3. BOOL 187
7.2.4. CHAR 188
7.2.5. E6POS Point 188
7.2.6. E6AXIS Point 188
7.2.7. E6POINTPoint 189
7.3. Operator 189
7.3.1. Arithmetic Operator 189
7.3.2. Logic Operator 190
7.3.3. Relation Operator 190
7.4. Input/Output 191
7.4.1. Digital Input 191
7.4.2. Digital Output 191
7.4.3. Robot Input 191
7.4.4. Robot Output 191
7.4.5. Valve Output 191
7.5. Motion Function 192
7.5.1. PTP 192
7.5.2. PTP_REL 193
7.5.3. LIN 194
7.5.4. LIN_REL 195
7.5.5. LIN_REL_TOOL 196
7.5.6. CIRC 196
7.5.7. CIRC_REL 198
7.5.8. SPLINE 198
7.5.9. Array Accumulation 199
7.5.10. CT_A6 199

7.5.11. BRAKE 200
7.5.12. EXT_TCP 200
7.6. Control Function 202
7.6.1. IF 202
7.6.2. FOR 205
7.6.3. LOOP 206
7.6.4. WHILE 207
7.6.5. REPEAT 209
7.6.6. GOTO 210
7.6.7. SWITCH 212
7.6.8. WAIT 216
7.6.9. QUIT 216
7.7. Motion Parameter 217
7.7.1. CONT 217
7.7.2. FINE 220
7.7.3. VEL 220
7.7.4. ACC 220
7.8. Definition of Structure 221
7.9. Function & Subprogram 222
7.9.1. Definition & Using Method of Function 222
7.9.2. Definition & Using Method of Subprogram 224
7.10. External Function & Subprogram 226
7.10.1. Definition & Using Method of External Function(EXTFCT) 226
7.10.2. Definition &Using Method of External Subprogram(EXT) 227
7.11. RS232 Configuration 229
7.12. NET Configuration 230

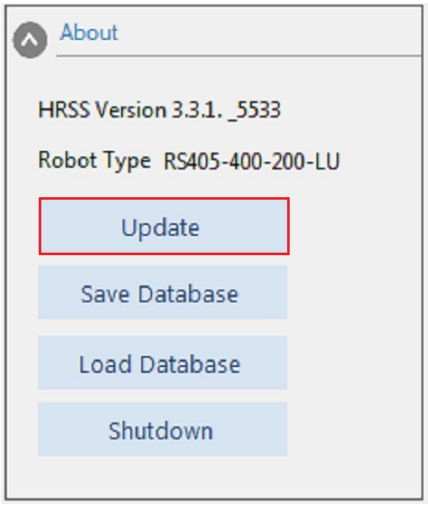
7.13. Conveyor Configuration 231
7.13.1. Pick Program(1) 231
7.13.2. Pick Program(2) 232
7.13.3. Pick Program(3) 233
7.14. DO switching on the path(SYN OUT) 235
7.14.1. Program Example 1 of SYN 235
7.14.2. Program Example 2 of SYN 236
7.14.3. Program Example 3 of SYN 237
7.14.4. Example 4 of SYN Program 238
7.14.5. Example 5 of SYN Program 239
7.15. Electric Gripper 240
8. Appendix 244
8.1. Software commands 244

Version Update

Edition	Date	Applicable Software	Applicable Range	Remark
1.0.0	2019.04.15	HRSS 3.2.15	RS405-500-200	Preliminary Issue
1.0.0b.4615	2019.07.01	HRSS 3.3.0.4615	RS405	SDK 2.1.8
1.0.1.5474	2019.10.01	HRSS 3.3.1.5472	RS405	SDK 2.1.9

⚠ WARNING

1. The software update package contains the robot system software HRSS and the remote control softeware Caterpillar. The two versions have the corresponding relationship as above, and must be updated at the same time.
2. Please update HRSS first, then use new version Caterpillar to connect to robot.
3. Update button is as follows:



Software Update Steps are as follows:

1. Download HRSS update package (.exe)
2. Download Caterpillar update package (A folder) 。
3. Execute Caterpillar of old version, press update button and select HRSS update package file to update HRSS.
4. Execute Caterpillar of **new version** and connect to the robot instead of old version.

1. Introduction

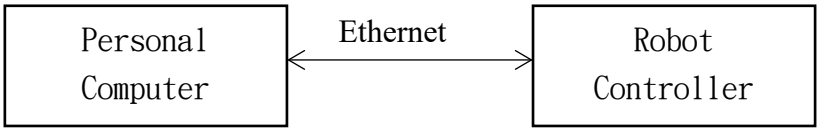
1.1. Remote Control Robot Software (Caterpillar) Overview

- Can be run under Microsoft Windows 7 and Windows 10
- Communicate with robot controller through Ethernet
- Allow personal computer to connect to single or multiple robot controllers. Maximum number of connections is four.
- HIWIN Robot language editor
- Robot program files management
- I/O management
- TCP/IP and RS232 management
- Logbook

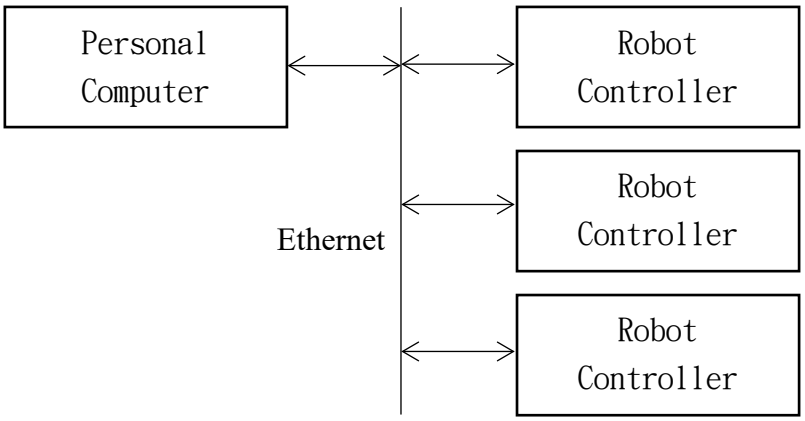
1.2. Connect to controller

The following system block diagram displays how remote control robot software connect to single or multiple robot controllers.

System 1：Connect a robot controller to personal computer through Ethernet



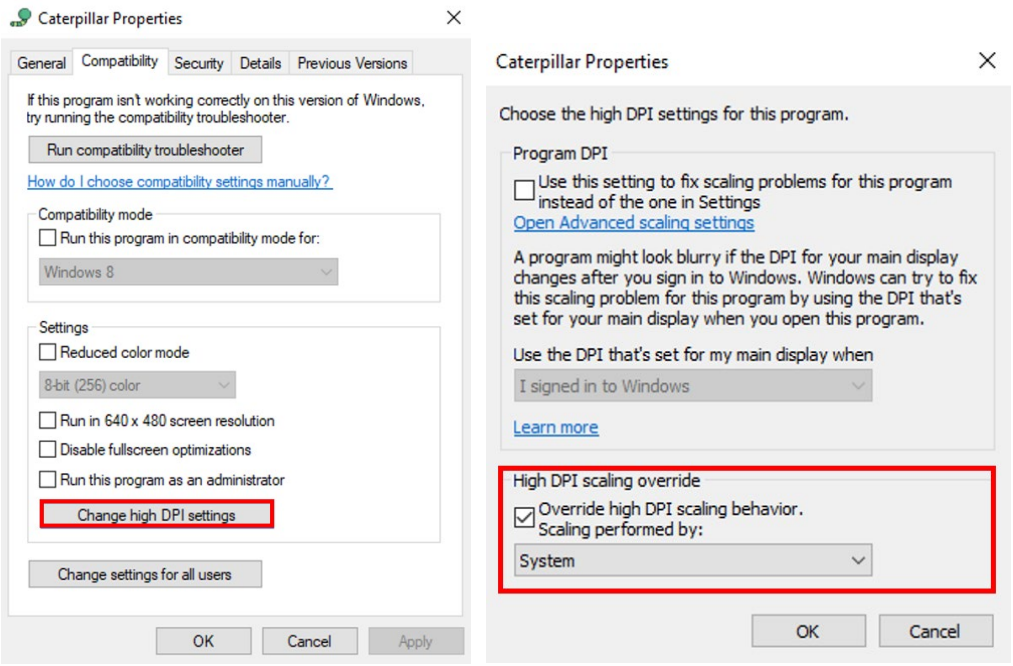
System 2：Connect multiple controllers to personal computer through Ethernet



System Block Diagram

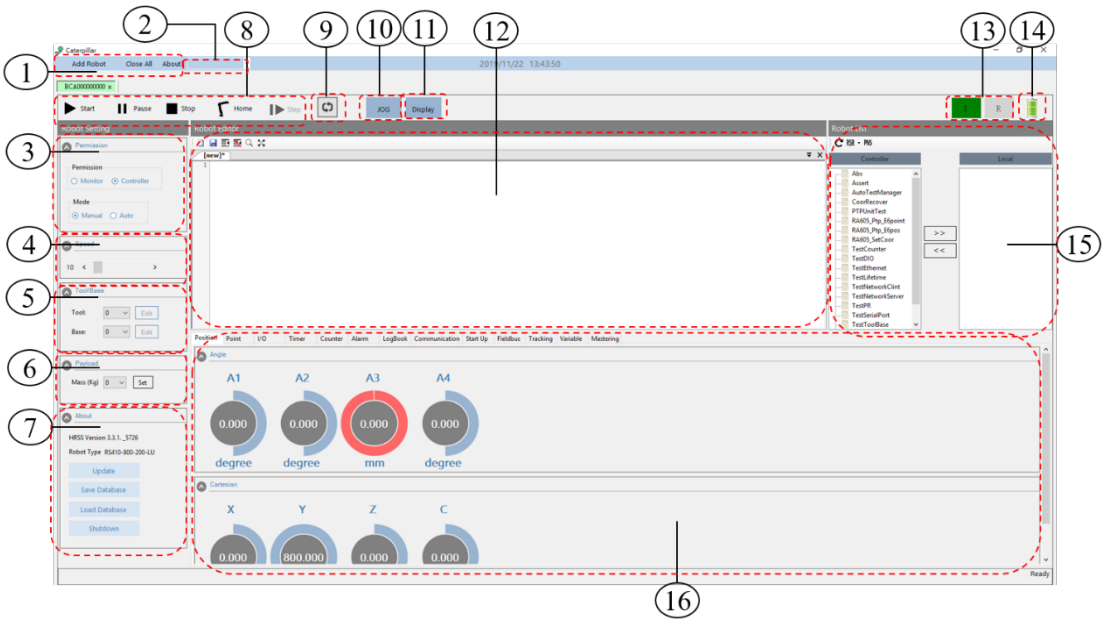
1.3. Recommended Environment

- Robot controller does not support TCP/IPv6. TCP/IPv4 is allowed.
- .NetFrameWork 4.6.1。
- Visual studio 2017 redistributable
- Resolution 1024x768 above
- Support robot type: RS405-500-200-LU、RS405-500-400-LU、RS405-400-200-LU、RS405-400-400-LU、RS410-600-200-LU、RS410-700-400-LU、RS410-800-400-LU
- At least one external emergency stop button is installed
- Adjust display settings for Windows scaling issues with high-DPI devices. Right-click the application (Caterpillar.exe), select “Properties”, select “Compatibility” tab, and then select the “Change high DPI settings”. Check the “override high DPI scaling behavior” box and choose “System” from the drop-down menu. Finally, click ”OK”.



2. Operation

2.1. Front View



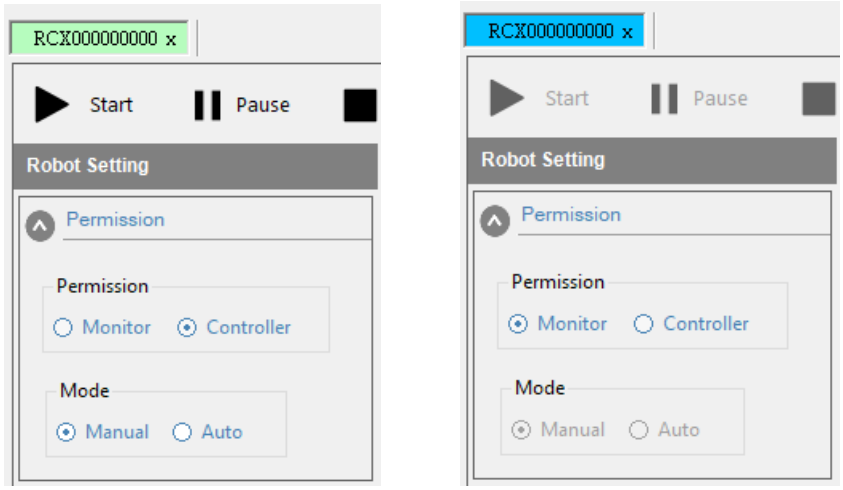
Front view of Caterpillar

No.	Function	Description
1	Main menu	Add robot and close all robot connections.
2	Language Bar	Change language to English, Traditional Chinese and Simplified Chinese.
3	Mode	Connection level and operation mode setting.
4	Program Ratio and Jogging Ratio	Display by the program to change the ratio.
5	Tool and Base	Display the selected tool and base number. Click to change the tool and base number.
6	Payload	RS405 and RS410 is supported to set acceleration time (ms).
7	About	Display the version of HRSS and robot type. Update HRSS software. Save and load database.

8	Run Control Buttons	The buttons are used for run, pause and stop the program. Hold home button to return the robot to the home position. Click motion button to next step.
9	Step Motion	Step motion and continue motion.
10	Jog	Jog the robot.
11	3D Simulation	Display 3D simulation of robot.
12	Program Editor	Edit program files.
13	Status Bar	Display driver and interpreter status
14	Battery Figure	Display the status of absolute encoder's battery.
15	Program List	Program files on robot controller and local computer
16	Function Page	Switch the setting function

2.1.1. Connection Level

- There are two connection levels: Controller and Monitor.
- Single connection with controller level is allowed on a robot.
- The default connection level is Monitor.

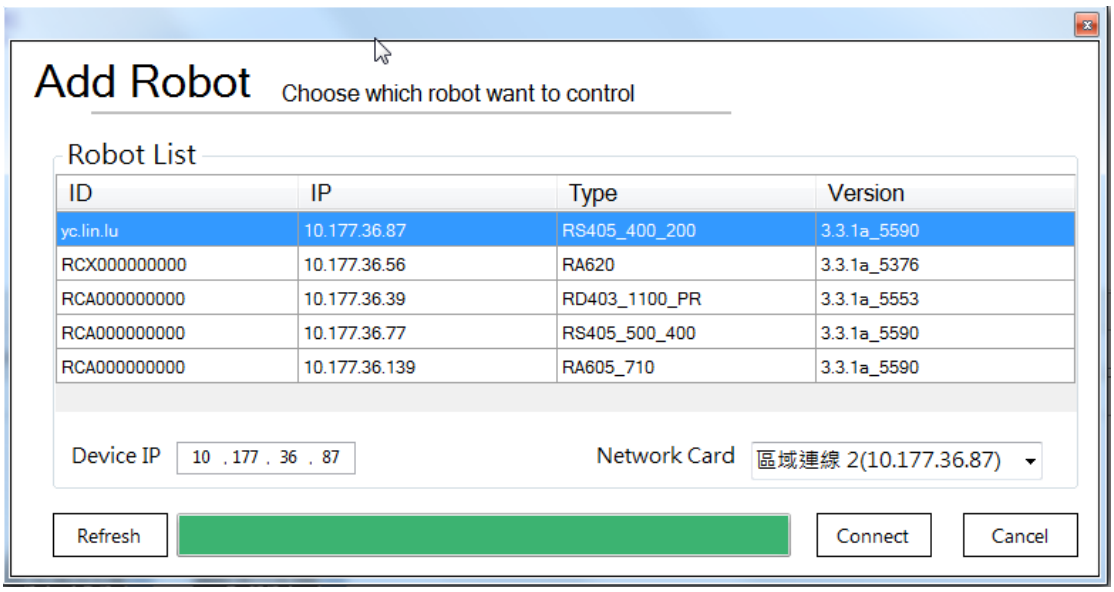


Mode Interface

2.2. Connection

Operation Steps

1. Wait for controller startup finish and power switch is on.
2. Press "Add Robot" and choose a network card to detect robots.
3. Press "Connect".



Connection Interface

Description

1. The default IP is 192.168.0.3 on RC4 robot controller.
2. If failed to detect robot, please check the internet connection to see if it is connected properly.

2.3. Status Bar

Status Bar

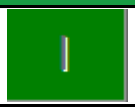
Figure	Color	Description
	Green	Driver ready
	Gray	Driver not ready

Figure	Color	Description
	Orange	Interpreter running
	Gray	Interpreter failure or stop

2.4. Change Operation Mode

⚠ WARNING

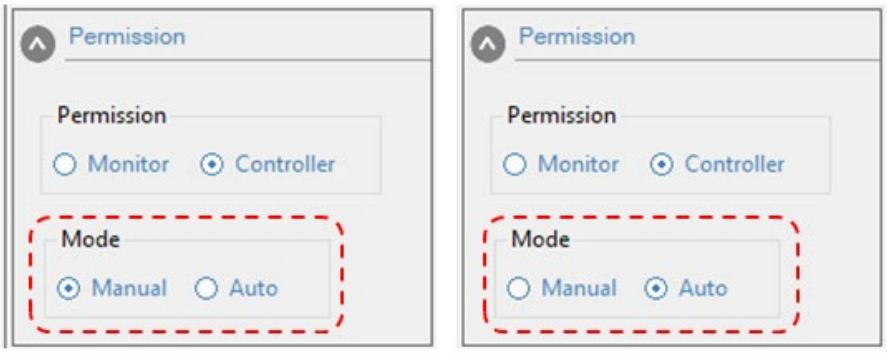
Don’t modify the operation mode during programming period. If it is changed, the robot will stop.

Prerequisite

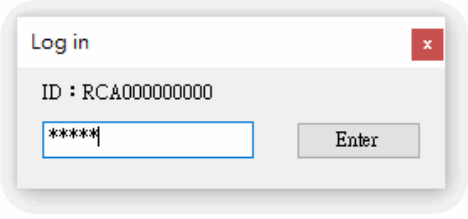
1. The controller doesn’t processing any program.

Operation steps

1. Select operation mode
2. If switch operation mode is needed, enter password and login. Default password (”HIWIN”) is not allowed to modify.
3. Select Program to run. Choose running velocity if Manual is selected. There are Testing Speed and Normal Speed.

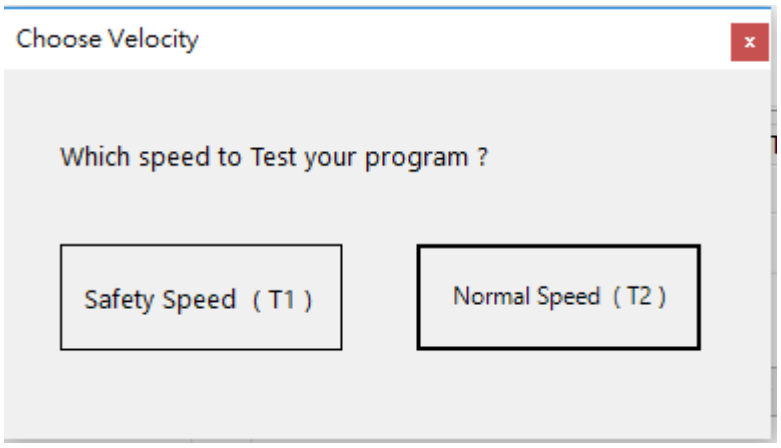


Operation Mode Interface



Login Window

Mode	Application	Running velocity	Jog velocity
Manual	Use for test operation, programming and teaching	Safety Speed: maximum 250 mm/s Normal Speed: maximum 2000 mm/s	Maximum 250 mm/s
Auto	Used for the robot with the higher-level controllers (For example, PLC)	maximum 2000 mm/s	Unavailable



Choose Running Velocity Window

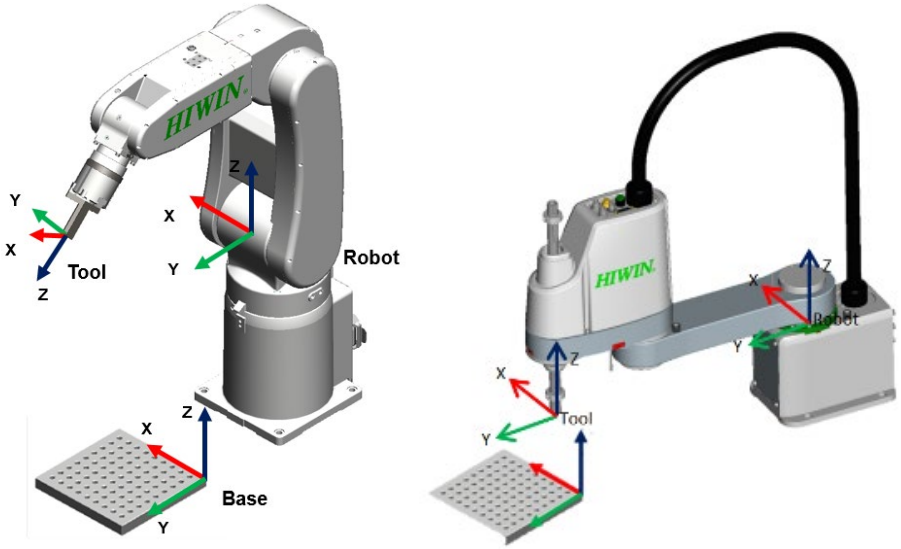
2.5. Coordinate System

Define following Cartesian coordinate system in robot controller system:

ROBOT

BASE

TOOL



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 axis robot coordinate system

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

Rotation of scara robot coordinate system

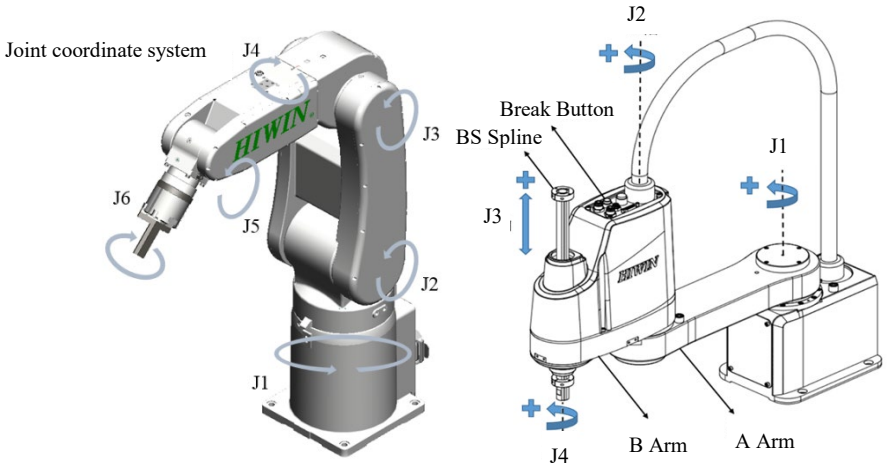
Corner	Rotation around axis
A4	Rotate around Z axis

2.6. 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

2.6.1. Manual Move

Prerequisite:

1. Connection level need to be Controller.
2. Mode need to be Manual.

Description:

When connection level is controller and mode is manual, you could jog on TP (Teach Pendant) window.

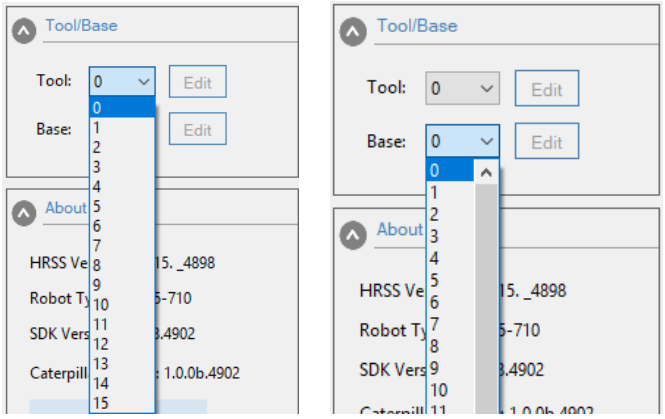
TP window

2.6.2. Base/Tool Coordinate

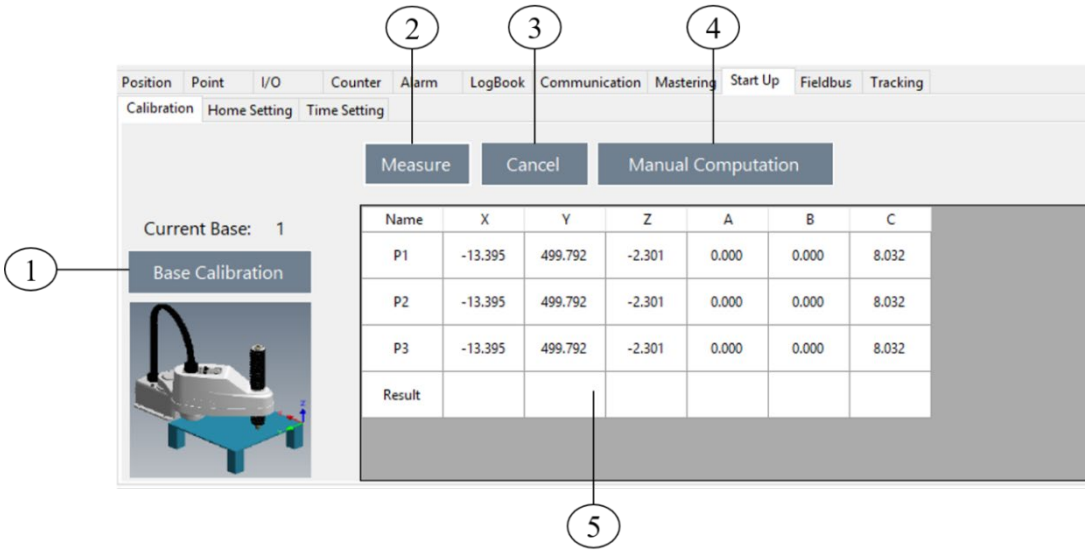
Description:

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).



Base/Tool interface



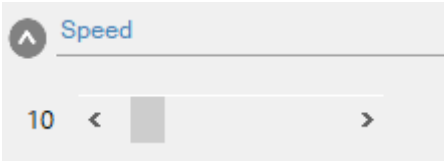
SCARA Robot Base/Tool calibration interface

No.	Description
1	Base/Tool coordinate currently selected.
2	The current position is selected as the calibration point.
3	The current calibration canceled.
4	Enter calculations manually.
5	The information of calibration point.

2.6.3. Jogging velocity Ratio

Description:

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



Velocity Ratio Interface

2.7. Display

2.7.1. Display Actual Position

Operation steps:

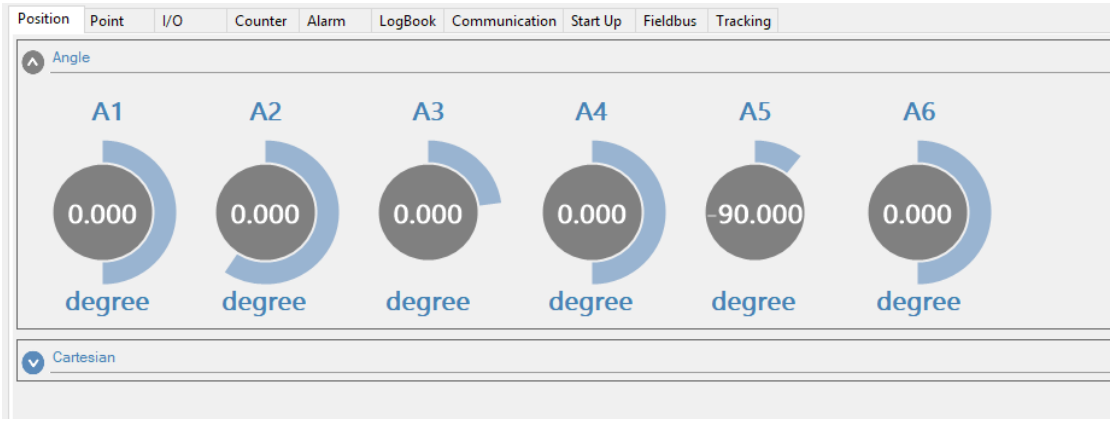
1. Click the operating page of [Position]。

Description:

Display the motor position, the axis and the Cartesian coordinate of 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.



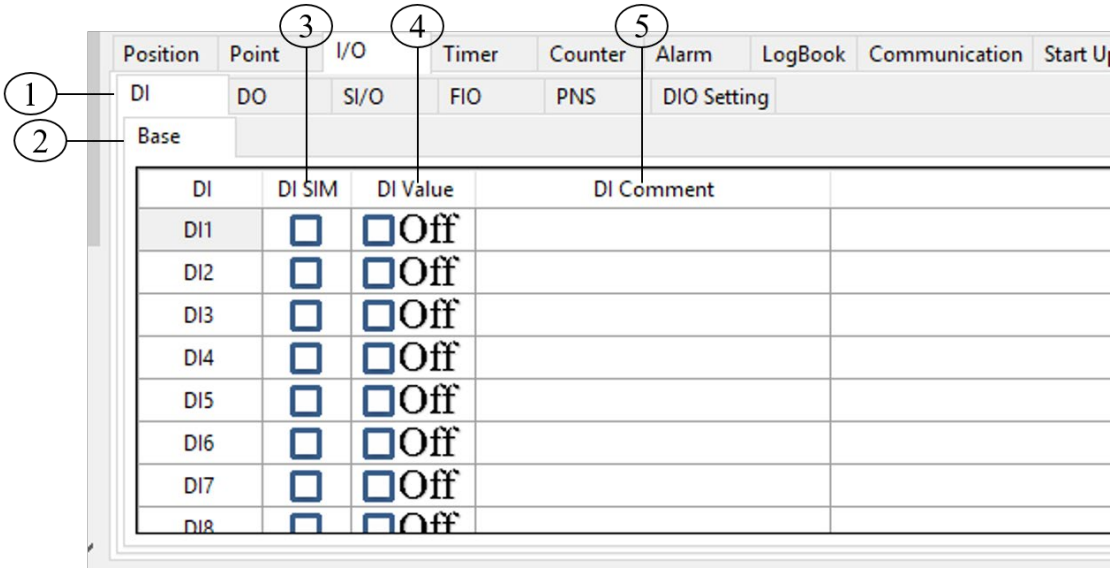
Actual Position Interface

2.7.2. Display Digital Input/Output

Operation steps:

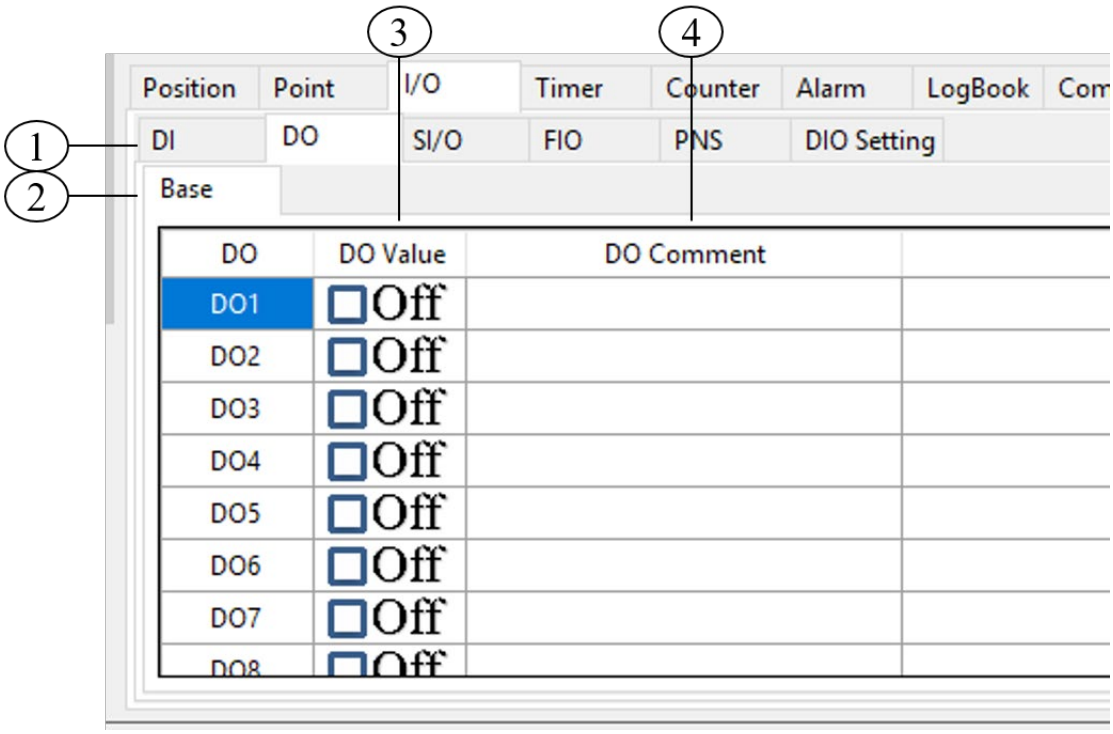
1. Click the operating page of [I/O].
2. Click the [I/O] page of [DI/O].

Description:



Digital Input Interface

No.	Description
1	Switch I/O page.
2	Switch Basic DI and external DI page.
3	Simulation. opened as red.
4	Digital Input value. (It can be used when the simulation is selected.) ON is displayed red and showed On. OFF is displayed white and showed Off.
5	Digital Input Comment. (Double click to modify.)



Digital Output Interface

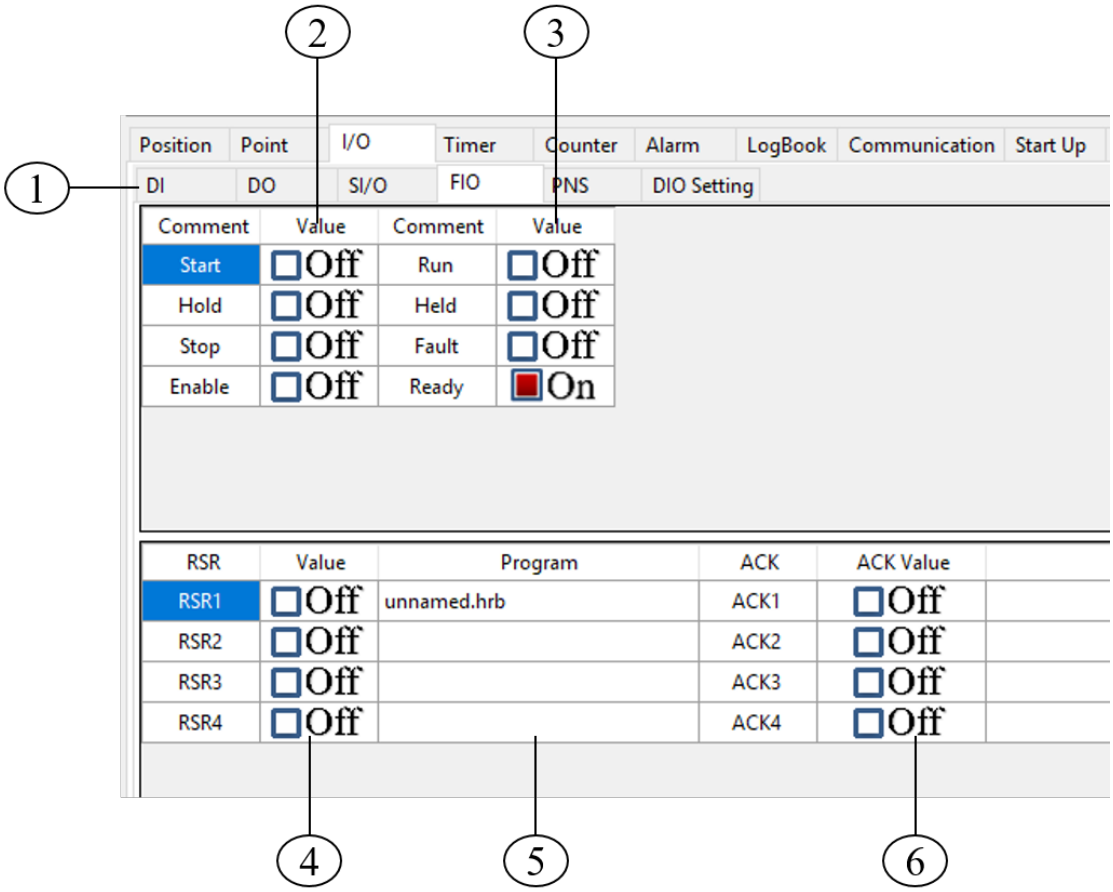
No.	Description
1	Switch I/O page。
2	Switch Basic DO and external DO page.
3	Digital Output value. (It can be used when the simulation is selected.) ON is displayed red and showed On. OFF is displayed white and showed Off.
4	Digital Output Comment. (Double click to modify.)

2.7.3. Display External Functional Input/Output

Operation steps:

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

Description:



External Functional Input/Output Interface

No.	Description
1	Switch I/O page.
2	Functional Input value.
3	Functional Output value.
4	RSR value.
5	RSR program name.
6	ACK1~ACK4 display corresponding signal.

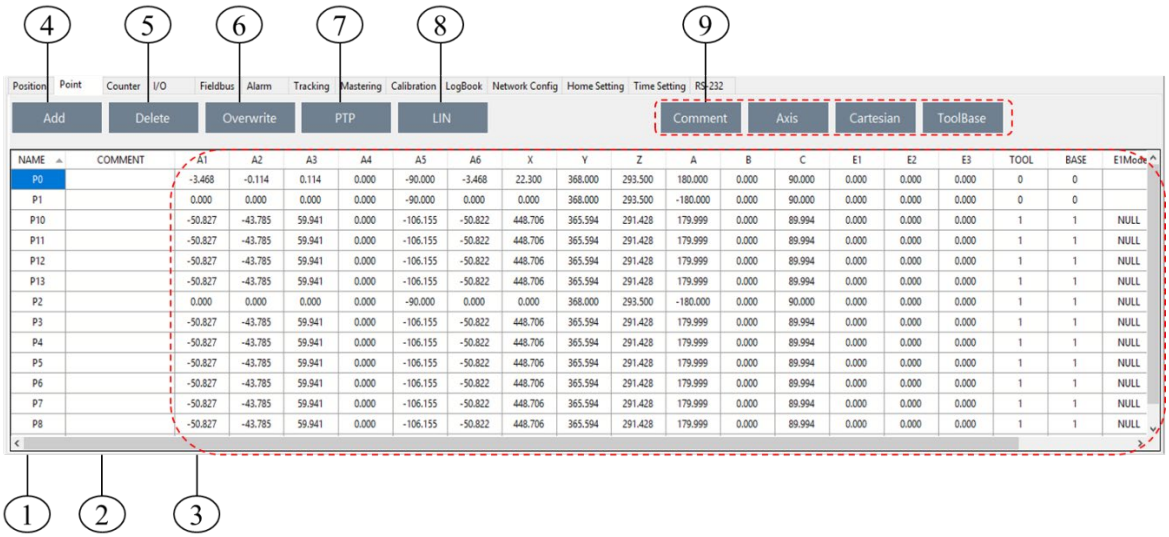
※ON is displayed in red and showed On. OFF is displayed in white and showed Off.

2.7.4. Display Point

Operation steps:

- Click the operating page of [Point].

Description:



NAME	COMMENT	A1	A2	A3	A4	A5	A6	X	Y	Z	A	B	C	E1	E2	E3	TOOL	BASE	EIMode
P0		-3.468	-0.114	0.114	0.000	-90.000	-3.468	22.300	368.000	293.500	180.000	0.000	90.000	0.000	0.000	0.000	0	0	
P1		0.000	0.000	0.000	0.000	-90.000	0.000	0.000	368.000	293.500	-180.000	0.000	90.000	0.000	0.000	0.000	0	0	
P10		-50.827	-43.785	59.941	0.000	-106.155	-50.822	448.706	365.594	291.428	179.999	0.000	89.994	0.000	0.000	0.000	1	1	NULL
P11		-50.827	-43.785	59.941	0.000	-106.155	-50.822	448.706	365.594	291.428	179.999	0.000	89.994	0.000	0.000	0.000	1	1	NULL
P12		-50.827	-43.785	59.941	0.000	-106.155	-50.822	448.706	365.594	291.428	179.999	0.000	89.994	0.000	0.000	0.000	1	1	NULL
P13		-50.827	-43.785	59.941	0.000	-106.155	-50.822	448.706	365.594	291.428	179.999	0.000	89.994	0.000	0.000	0.000	1	1	NULL
P2		0.000	0.000	0.000	0.000	-90.000	0.000	0.000	368.000	293.500	-180.000	0.000	90.000	0.000	0.000	0.000	1	1	NULL
P3		-50.827	-43.785	59.941	0.000	-106.155	-50.822	448.706	365.594	291.428	179.999	0.000	89.994	0.000	0.000	0.000	1	1	NULL
P4		-50.827	-43.785	59.941	0.000	-106.155	-50.822	448.706	365.594	291.428	179.999	0.000	89.994	0.000	0.000	0.000	1	1	NULL
P5		-50.827	-43.785	59.941	0.000	-106.155	-50.822	448.706	365.594	291.428	179.999	0.000	89.994	0.000	0.000	0.000	1	1	NULL
P6		-50.827	-43.785	59.941	0.000	-106.155	-50.822	448.706	365.594	291.428	179.999	0.000	89.994	0.000	0.000	0.000	1	1	NULL
P7		-50.827	-43.785	59.941	0.000	-106.155	-50.822	448.706	365.594	291.428	179.999	0.000	89.994	0.000	0.000	0.000	1	1	NULL
P8		-50.827	-43.785	59.941	0.000	-106.155	-50.822	448.706	365.594	291.428	179.999	0.000	89.994	0.000	0.000	0.000	1	1	NULL

Point Interface

No.	Description
1	Point name.
2	Point comment. (It can be modified.)
3	Information for points, includes angle of each axis (A1~A6), Cartesian coordinates (X,Y,Z,A,B,C), and number of Tool/Base used.
4	Add a new point with the current information.
5	Delete a selected point.
6	Overwrite a selected point.
7	Move to selected point by PTP.
8	Move to selected point by LINE.
9	Adjust the data arrangement.

Description of adjusting arrangement of data:

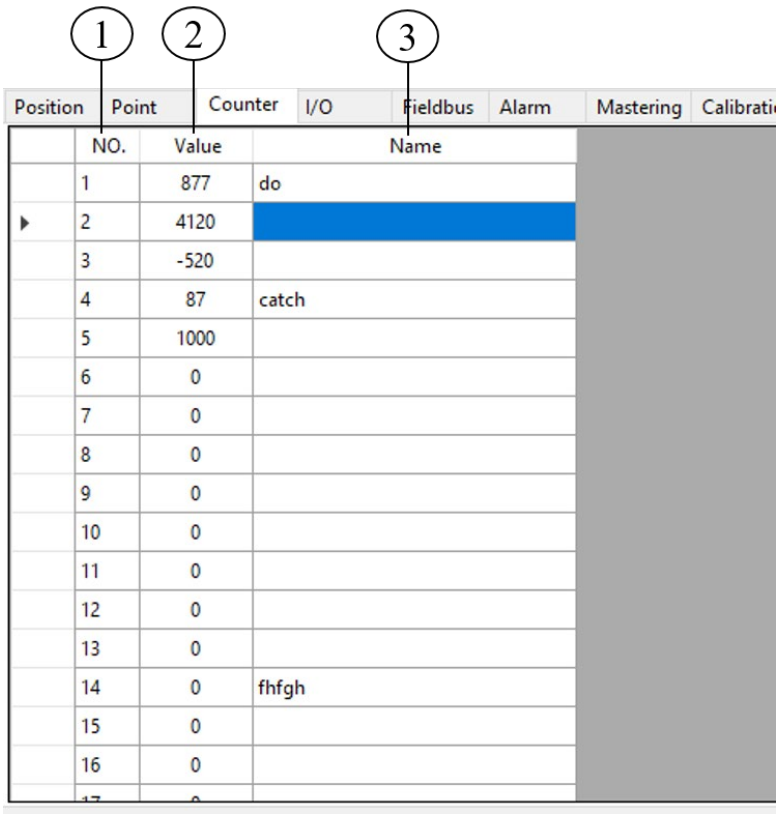
Press the button will hide the corresponding point information, and then display it in the order of clicking.

2.7.5. Display Counter

Operation steps:

- Click the operating page of [Counter].

Description:



Counter Interface

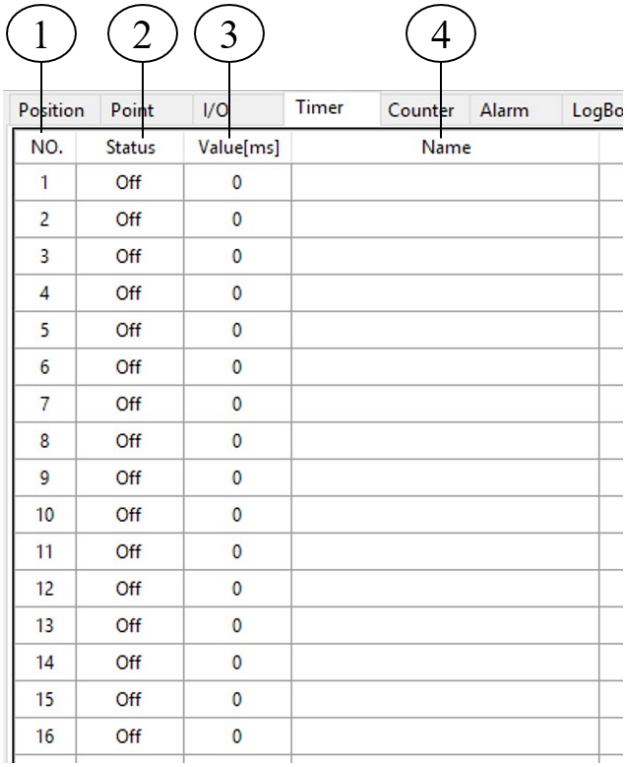
No.	Description
1	Counter No.
2	Counter value.(Double click to modify.)
3	Counter name.(Double click to modify.)

2.7.6. Display Timer

Operating steps

- Click the function tab [Timer].

Description



Timer Interface

No.	Description
1	Timer number
2	Timer state
3	Timer value (Double click to modify.)
4	Timer name (Double click to modify.)

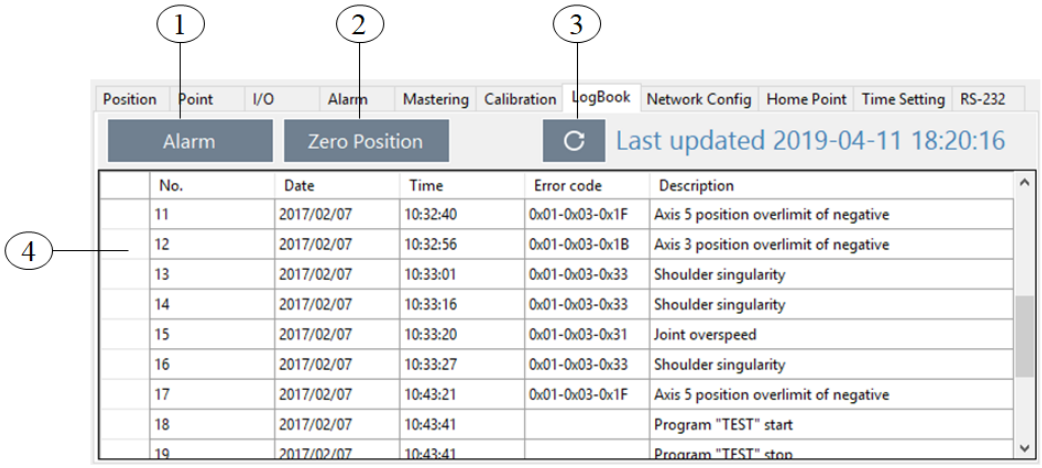
2.7.7. Display Alarm and Zero Position History Message

Operating steps

- Click the function tab [LogBook]。

Description

Record alarm occurrences and events.



LogBook Interface

No.	Description
1	Alarm history message page
2	Zero position history message page
3	Refresh list information.
4	List.

2.7.8. Robot Simulation

Operating steps

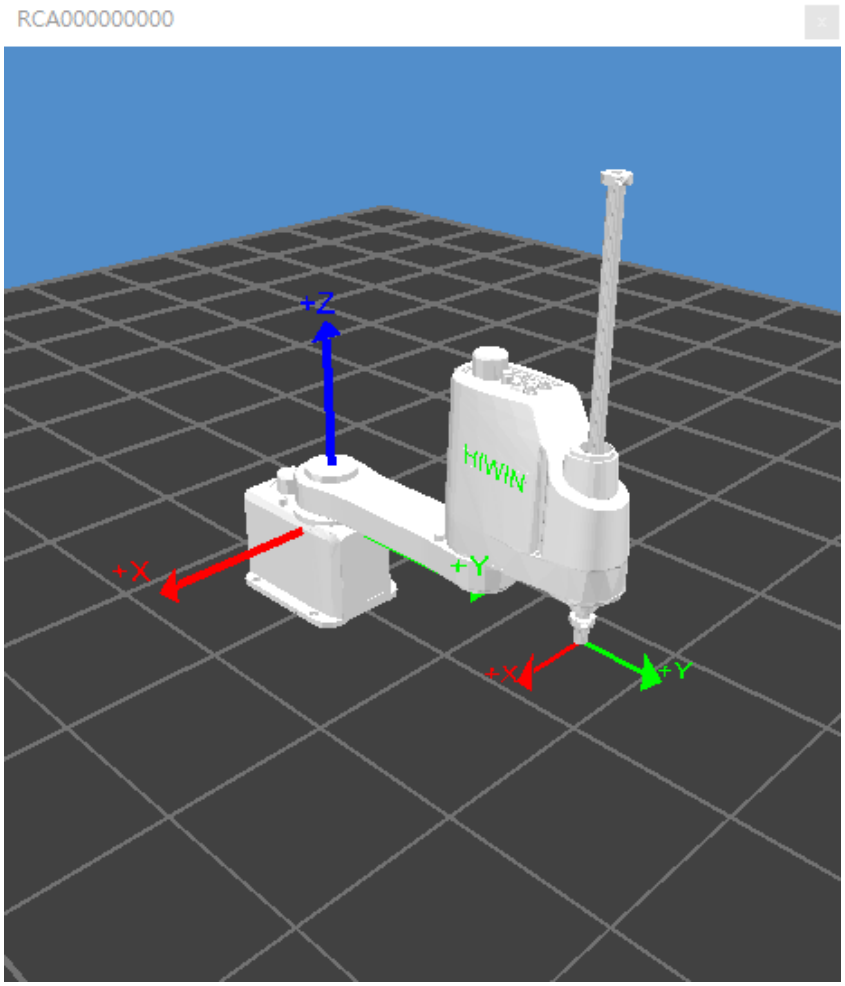
- Click the function tab [Display].

Description

Display the robot simulation figure.

1. Shift : Press the middle wheel of mouse to move.
2. Zoom In/Out: Scroll the middle wheel of mouse.
3. Rotation: Press ‘shift’ and scroll the middle wheel of mouse.

Simulation Figure Display Button



Simulation Figure

2.8. Communication

2.8.1. TCP/IP

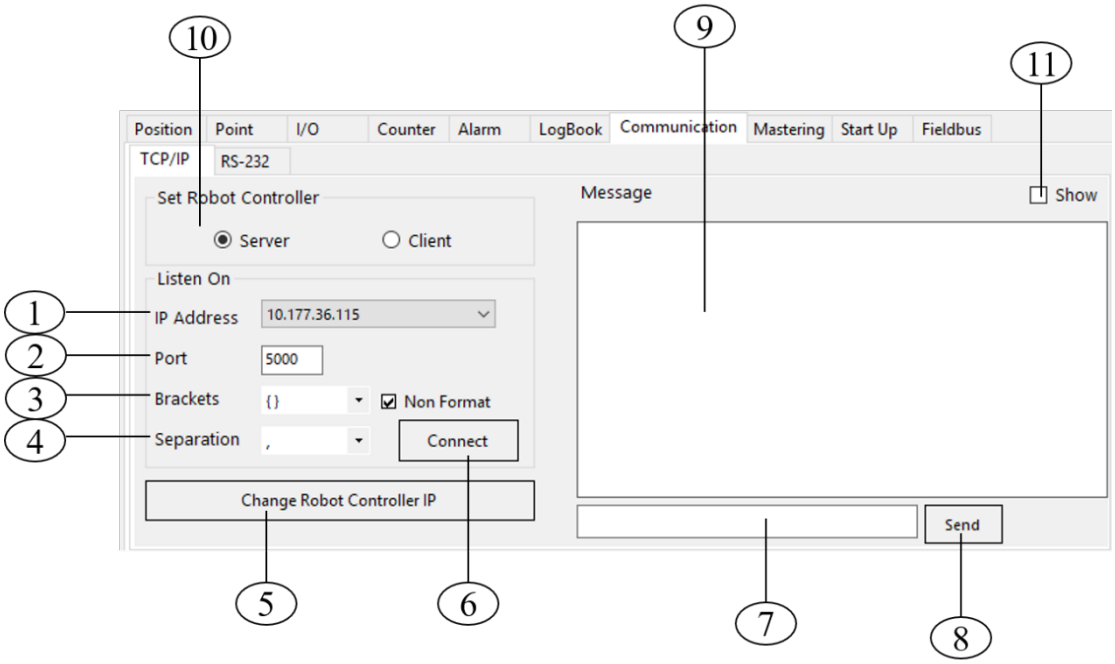
Description

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	Target IP to communicate with.
2	Port configuration of TCP/IP connection.
3	Braces / Square brackets / Parenthesis selection.
4	Separation selection.
5	Change the robot controller IP.
6	Connect or Disconnect button.

7	Message sending field
8	Send message
9	Message box to indicate the content which has been transmitted or received.
10	Server/Client configuration of the local robot controller.
11	Display Content of Sending Message and Receiving Message

Operating steps

1. Click the function tab [Communication]
2. Click the sub tab [TCP/IP] in the [Communication] tab.

■ Local RC is Client

1. Input the Server's IP and Port.
2. Click [Connect] button.
3. "Connection is successful!" means the connection succeeds.

■ Local RC is Server

1. Input the TCP/IP Port to be connected.
2. Click [Connect] button.
3. "Server is opened!" means the port succeeds in listening.

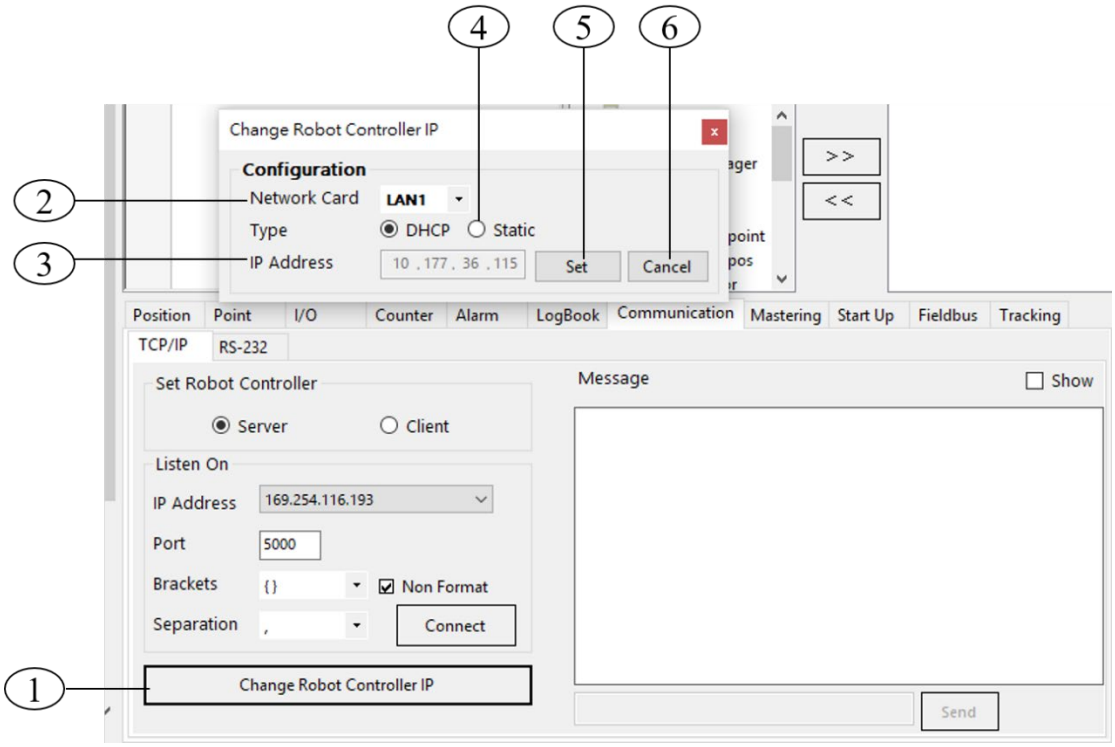
2.8.2. Set up Robot Controller IP

Description

Configure the IP address in robot controller.

Users can configure the IP address in each Network Card.

It can be configured as DHCP (automatic obtain IP address) or Static (specify specific IP address)。



Change IP interface

No.	Description
1	The button to Change Robot Controller IP.
2	Select to change network card
3	Static IP address, specific IP address
4	DHCP / Static IP mode selection
5	Confirm setting
6	Cancel setting

Operating steps

- Click the [TCP/IP] sub-tab in the [Communication] tab.
- Click Change Robot Controller IP button.
- Select the Network card.
- DHCP

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

- Static IP

1. Select [Static] item.
2. In the [IP Address] column, assign the IP address for robot controller.
3. Click the [Set] button.
4. 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.

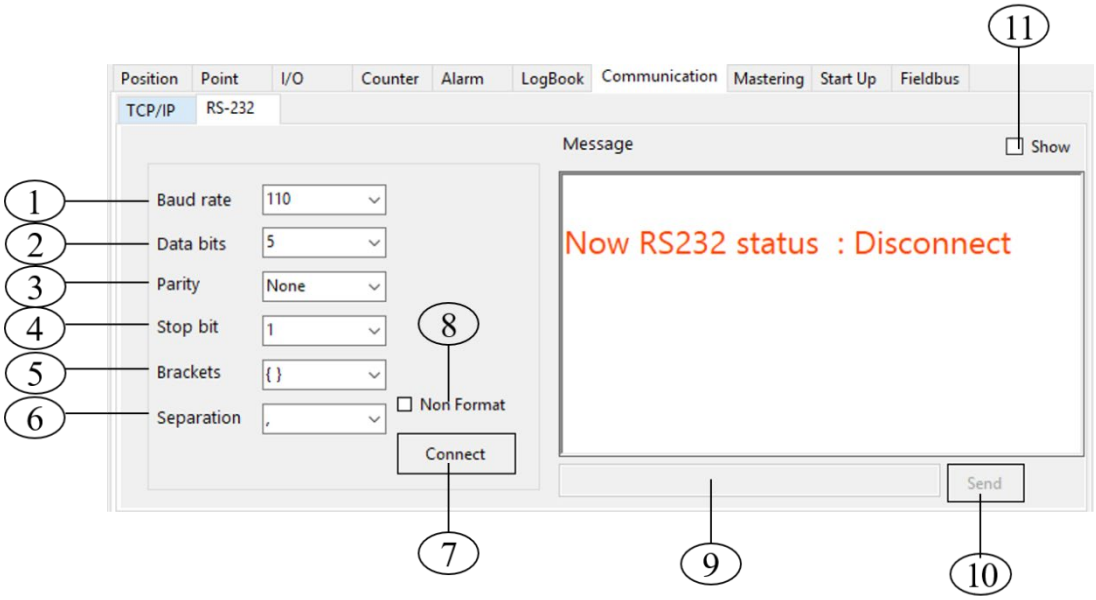
2.8.3. RS232 Communication

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	RS232 Baud rate
2	RS232 Data bit
3	RS232 Parity
4	RS232 Stop bit
5	Braces / Square brackets / Parenthsis selection
6	Separation selection
7	Connect / Disconnect button.
8	Cancel format
9	Messages to be send
10	Send message
11	Display Content of Transmitting Message & Receiving Message

Operating steps

Click the [RS-232] sub tab in the [Communication] tab.

1. Input RS232 paramters.
2. Click [Connect] button.
3. Display “Connection is successful!” to represent the connection success.

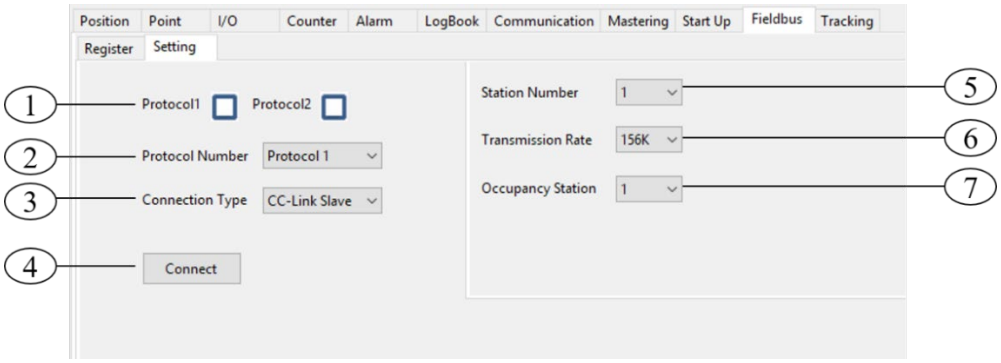
2.9. FieldBus Setting

2.9.1. Setup CC-Link connection parameters

Operating steps

1. Click the [FieldBus] sub tab.
2. Click the [Setting] sub tab.

Description



CC-Link connection parameters setting

No.	Description
1	Display Protocol connection status. If connection is successful, it will show red block. If failed or disable, it will show white block.
2	Protocol selection. It can be Protocol1 or Protocol2.
3	Connection type, please select [CC-Link Slave].
4	Connect or Disconnect.
5	Station number in this CC-Link network. The range is 1~64。
6	Transmission Rate for data transfer.
7	Occupancy station number for this equipment. The range is 1~4.

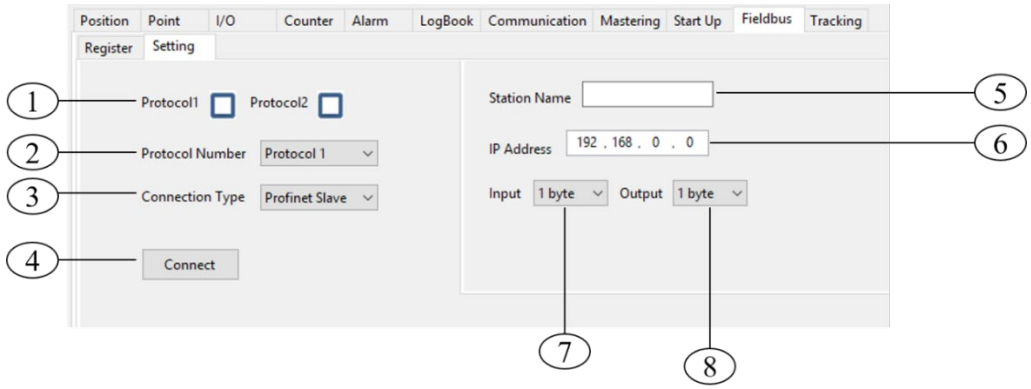
After finishing above, Click [Connect] buttont to proceed this connection and click [Save] button to save this configuration. Next time to start this system, it will use this configration to make connection.

2.9.2. Setup Profinet connection parameters

Operating steps

1. Click the [FieldBus] sub tab.
2. Click the [Setting] sub tab.

Description



Profinet connection parameters setting

No.	Description
1	Display Protocol connection status. If connection is successful, it will show red block. If failed or disable, it will show white block.
2	Protocol selection. It can be Protocol1 or Protocol2.
3	Connection type, please select [Profinet Slave].
4	Reconnect or Disconnect.
5	Station name. Require to set up the same name with the Master's.
6	IP address corresponding to the Master's.
7	Input bytes number corresponding to the Master's. The IO maximum number support 16 Bytes.
8	Output bytes number corresponding to the Master's. The IO maximum number support 16 Bytes.

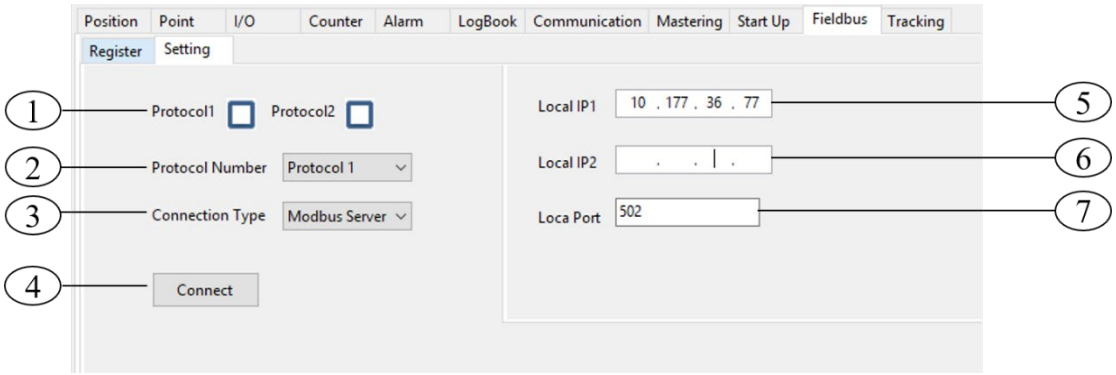
After finishing above, Click [Connect] buttont to proceed this connection and click [Save] button to save this configuration. Next time to start this system, it will use this configuration to make connection.

2.9.3. Setup ModbusTCP Server connection parameters

Operating steps

1. Click [Fieldbus] → [Setting].

Description



ModbusTCP Server connection parameters setting

No.	Description
1	Confirmation of protocol connection status. If connection is successful, the box will appear red, if connection is failed or setting is not switched on, the box will appear white.
2	Protocol Number, can select the protocol of connection. When select protocol 1, SI/O[1]~[128] can be used. When select protocol 2, SI/O[129]~[256] can be used.
3	Connection Type, please select「Modbus Server」.
4	Click to connect or disconnect.
5	Local IP1, setting of the local IP1address.
6	Local IP2, setting of the local IP2address.
7	Local Port, setting of the local communication port.

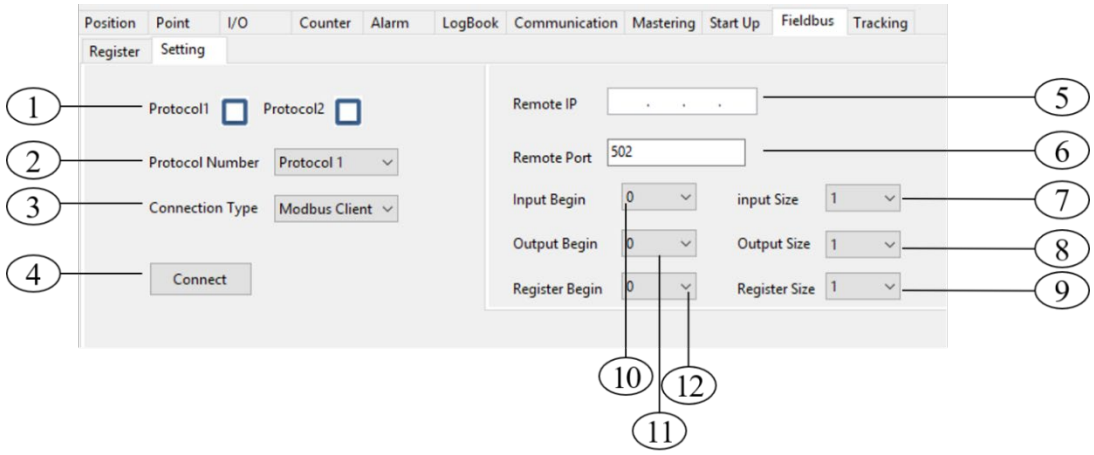
The Modbus function codes(1,2,3,15,16) are available.
Once setting is complete, click [Connect] to connect and store the setting, next reboot would use current setting for connection.

2.9.4. Setup ModbusTCP Client connection parameters

Operating steps

1. Click [Fieldbus] → [Setting].

Description



ModbusTCP Client connection parameters setting

No.	Description
1	Confirmation of protocol connection status. If connection is successful, the box will appear red, if connection is failed or setting is not switched on, the box will appear white.
2	Protocol Number, can select the protocol of connection. When select protocol 1, SI/O[1]~[128] can be used. When select protocol 2, SI/O[129]~[256] can be used.
3	Connection Type, please select「Modbus Client」.
4	Click to connect or disconnect.
5	Remote IP, set corresponding to remote device.
6	Remote Port, set corresponding to remote device.
7	Input Size, setting of IO quantity should correspond to the setting of remote device.
8	Output Size, setting of IO quantity should correspond to the setting of remote device.
9	Register Size, setting of register quantity should correspond to the setting of remote device.
10	Input Begin, setting of input start offset should correspond to the setting of remote device.

11	Output Begin, setting of output start offset should correspond to the setting of remote device.
12	Register Begin, setting of register start offset should correspond to the setting of remote device.

Once setting is complete, click [Connect] to connect and store the setting, next reboot would use current setting for connection.

2.9.5. Field Bus Input(SI[n])

Operating steps

1. Click [I/O] → [SI/O].

Description

A. When using Protocol1, SI[1]~SI[128] can be used.
   a. When Occupancy is 1, SI[1]~SI[32] can be used.
   b. When Occupancy is 2, SI[1]~SI[64] and so on.
B. When using Protocol 2, SI[129]~SI[256] can be used.
   a. When Occupancy is 1, SI[129]~SI[160] can be used.
   b. When Occupancy is 2, SI[129]~SI[192] and so on.
C. SI[1]~SI[8] are reserved and have similar function as FI[1]~FI[8].
D. Interface can be used directly for selection.
   a. SI[1]~SI[8] cannot be set directly.
   b. Comment for SI[1]~SI[8] is unmodifiable, the reset will be stored.
E. 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.

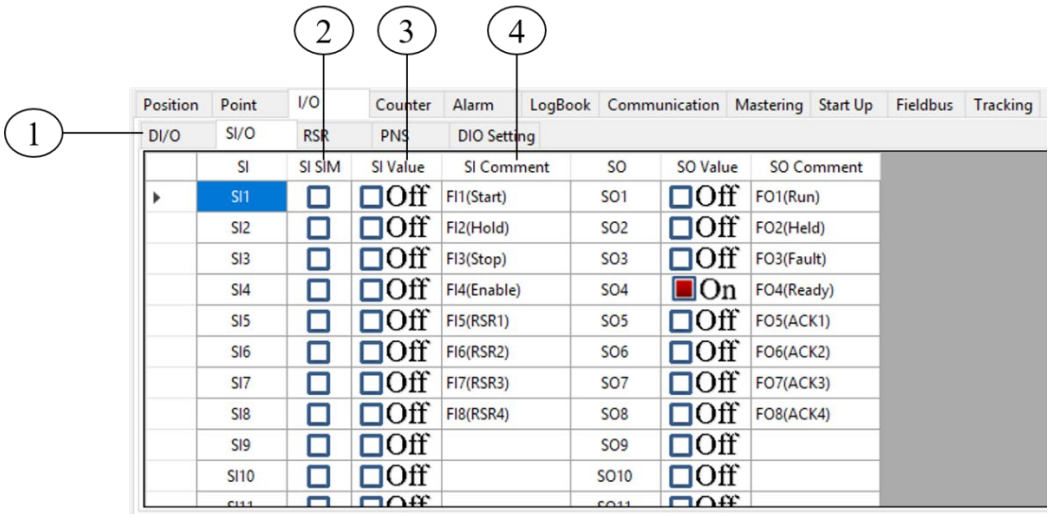
2.9.6. Field Bus Output(SO[n])

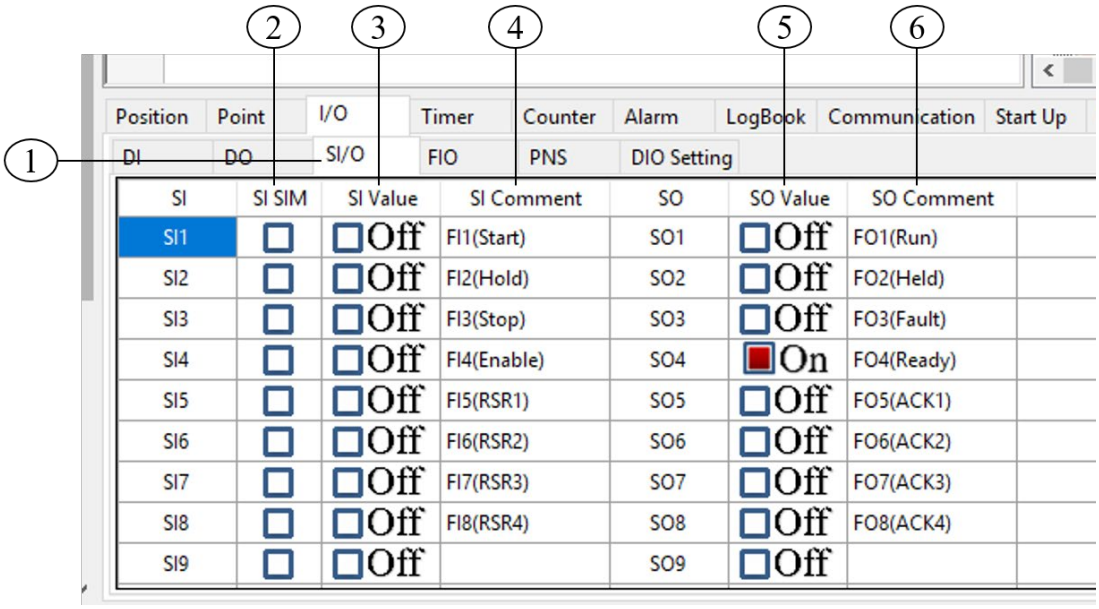
Operating steps

1. Click [I/O] → [SI/O].

Description

A. When using Protocol1, SO[1]~SO[128] can be used.
   a. When Occupancy is 1, SO[1]~SO[32] can be used.
   b. When Occupancy is 2, SO[1]~SO[64] and so on.
B. When using Protocol2, SO[129]~SO[256] can be used.
   a. When Occupancy is 1, SO[129]~SO[160] can be used.
   b. When Occupancy is 2, SO[129]~SO[192] and so on.
C. SO[1]~SO[8] are reserved and have similar function as FO[1]~FO[8].
D. Interface can be used directly for selection.
   a. SO[1]~SO[8] cannot be set directly.
   b. Comment for SO[1]~SO[8] is unmodifiable, the reset will be stored.
E. Can be controlled by command.
   a. Then command $SO[n] can be used to write Output status.





FieldBus I/O interface

No.	Description
1	SI/O tab page.
2	SI SIM, If simulation is enabled, the box will appear red, otherwise it will appear white.
3	SI Value.(It only can be set when enable simulation.) If input signal is ON, the box will appear red, if input signal is OFF, the box will appear white.
4	SI Comment.(Double click to modify.)
5	SO Value. If output signal is ON, the box will appear red, if output signal is OFF, the box will appear white.
6	SO Comment.(Double click to modify.)

2.9.7. Field Bus Register Mapping(SRR、SRW)

Operating steps

1. Click [FieldBus] → [Register]

Description

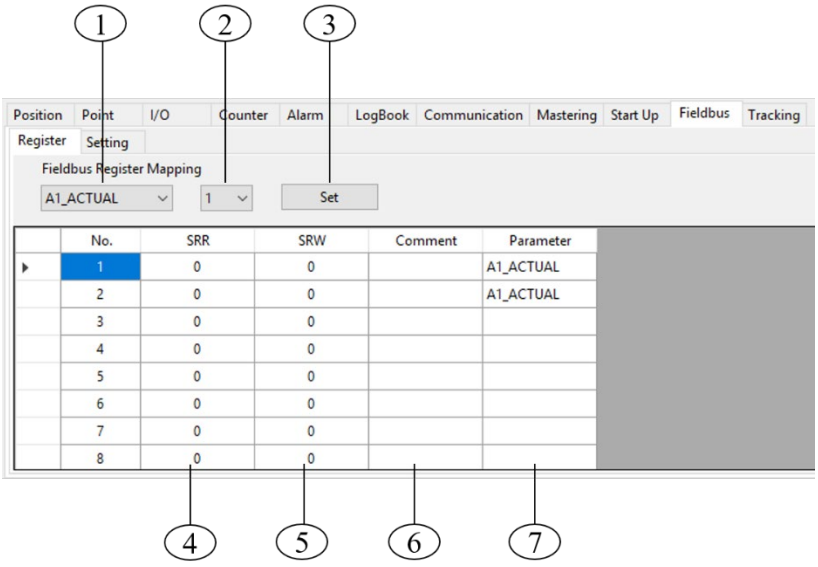
A. SRR (Register for Read) and SRW (Register for Write).

B. When using Protocol1, SRR[1]~SRR[16]、SRW[1]~SRW[16] can be used.
   a. When Occupancy is 1, SRR[1]~SRR[4]、SRW[1]~SRW[4] can be used.
   b. When Occupancy is 2, SRR[1]~SRR[8]、SRW[1]~SRW[8] and so on.

C. When using Protocol2, SRR[17]~SRR[32]、SRW[17]~SRW[32] can be used.
   a. When Occupancy is 1, SRR[17]~SRR[20]、SRW[17]~SRW[20] can be used.
   b. When Occupancy is 2, SRR[17]~SRR[24]、SRW[17]~SRW[24] and so on.

D. Value can be written or read directly through interface.
   a. SRR column can be read but not modify.
   b. SRW column can modify when clicked.
   c. Range of input value is -32767~-32767.
   d. Comment after modified will be saved.

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



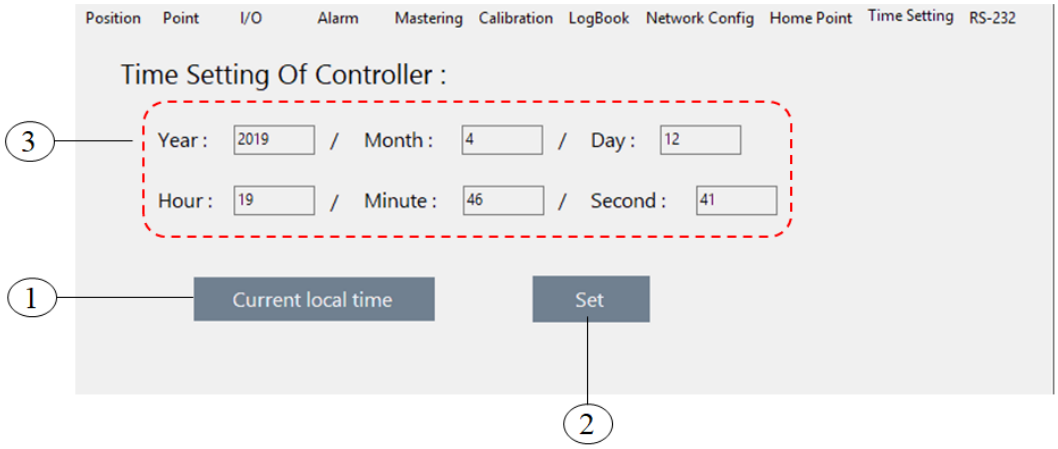
FieldBus Register interface

No.	Description
1	Select system parameters that user required. Parameter 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
2	Register number storage for parameter interface.
3	Click [Set] to save the setting.
4	The value of SRR for the specific register.
5	The value of SRW for the specific register.
6	The comment of the specific register.
7	System parameter name for the specific register. Click parameter column to remove the stored parameter from register.

2.10. Time Setting of Controller

Description

User can use the Time Setting to modify the controller time, in order to sync computer time.



Time Setting of Controller

No.	Description
1	Click to get current local computer time.
2	Click to save time setting into the controller.
3	Required time setting.

Operating steps

■ Sync local computer time

1. Click [Start Up] → [Time Setting].
2. Click [Current local time] to get current local computer time.
3. Click [Set] to save time setting into the controller.

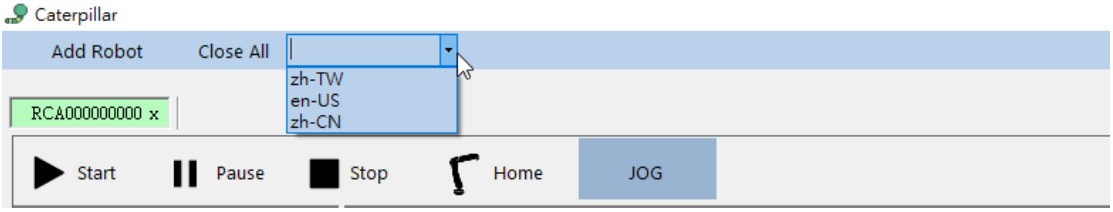
■ Modify time setting manually

1. Click [Start Up] → [Time Setting].
2. Enter required time setting manually.
3. Click [Set] to save time setting into the controller.

2.11. Language Setting

Description

The interface enable three different languages to be selected for the setting: Traditional Chinese(zh-TW), English(en-US) and Simplified Chinese(zh-CN). When setting is completed, the interface will change to the selected language immediately.



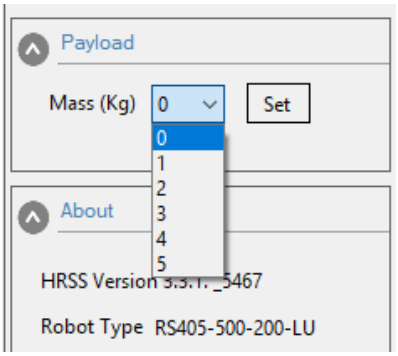
Language Setting

Item	Description
zh-TW	Traditional Chinese.
en-US	English.
zh-CN	Simplified Chinese.

2.12. Payload Setting

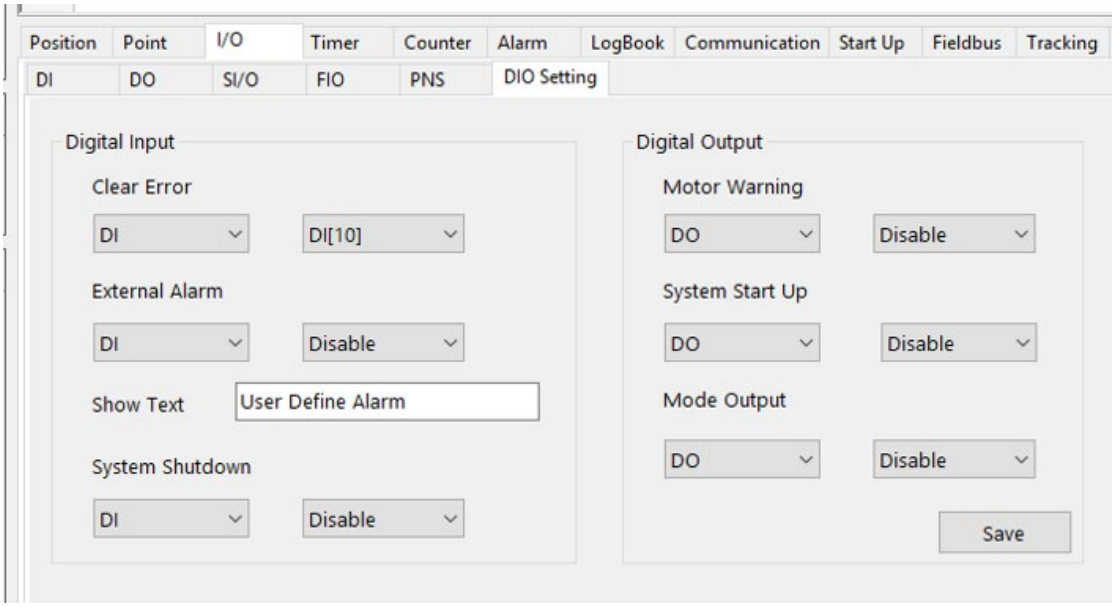
Description

The input parameter indicates the configured payload, the unit is Kg.



Payload setting interface

2.13. Self-defined Digital Input/Output Function



2.13.1. Clear Error

Description

User can select the specific D.I. to trigger the error clear function.

Operating steps

1. Select the specific D.I. from the Clear Error option, it will enabled to use as the functional signal of clearing error through the configured D.I.
2. If Disable is selected, it indicates that this function is disabled.
3. Press [Save] to save the setting.

2.13.2. External Alarm

Description

User can select the specific D.I. to trigger the external alarm function.

Operating steps

1. 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.
2. If Disable is selected, it indicates that this function is disabled.
3. Set the word to be appeared in Show Text when the alarm is triggered.
4. Press [Save] to save the setting.

2.13.3. External Shutdown Input

Description

User can select the specific D.I. to trigger the external shutdown function.

Operating steps

1. 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.
2. If Disable is selected, it indicates that this function is disabled.
3. Press [Save] to save the setting.

2.13.4. Motor Warning

Description

User can select the specific D.O. to trigger the motor warning function.

Operating Steps

1. 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.
2. If Disable is selected, it indicates that this function is disabled.
3. Press [Save] to save the setting.

2.13.5. System Start Up

Description

User can select the specific D.O. to trigger the system start up function.

Operating steps

1. 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.
2. If Disable is selected, it indicates that this function is disabled.
3. Press [Save] to save the setting.

2.13.6. Manual/Auto Mode Output

Description

User can select the specific D.O. to trigger the mode output function.

Operating steps

1. Select the specific D.O. from the Mode Output option, it will enable to use as the functional signal of mode output through the configured D.O. If T1/T2 mode is selected, the specific D.O. is OFF. If AUT/EXT mode is selected, the specific D.O. is ON.
2. If Disable is selected, it indicates that this function is disabled.
3. Press [Save] to save the setting.

2.14. Module I/O Function

Description

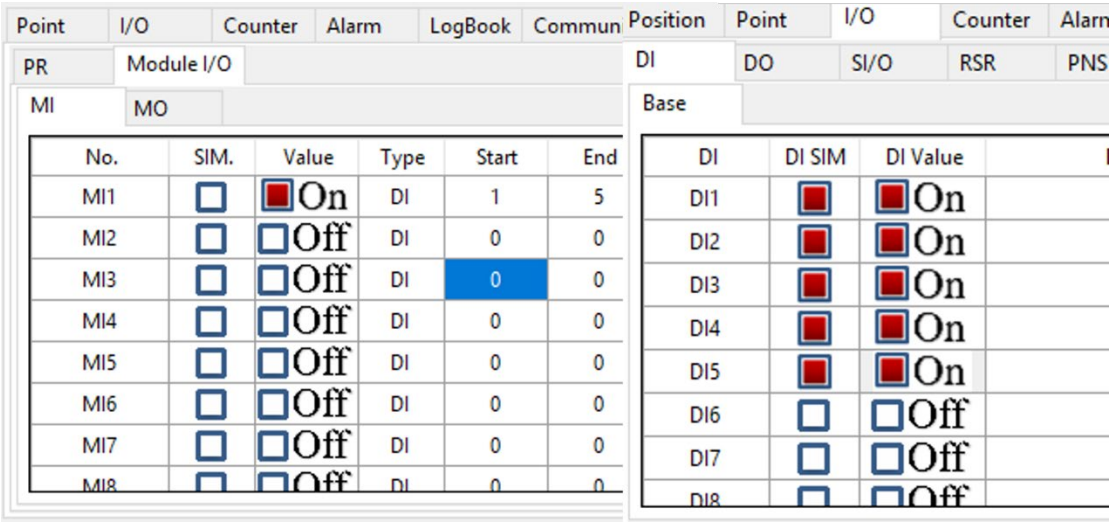
User can use module I/O to map and control to multiple inputs (DIs) or outputs(DOs).

Operating steps

[Module I/O] tab under [Variable] tab.

1. Module Input setting:

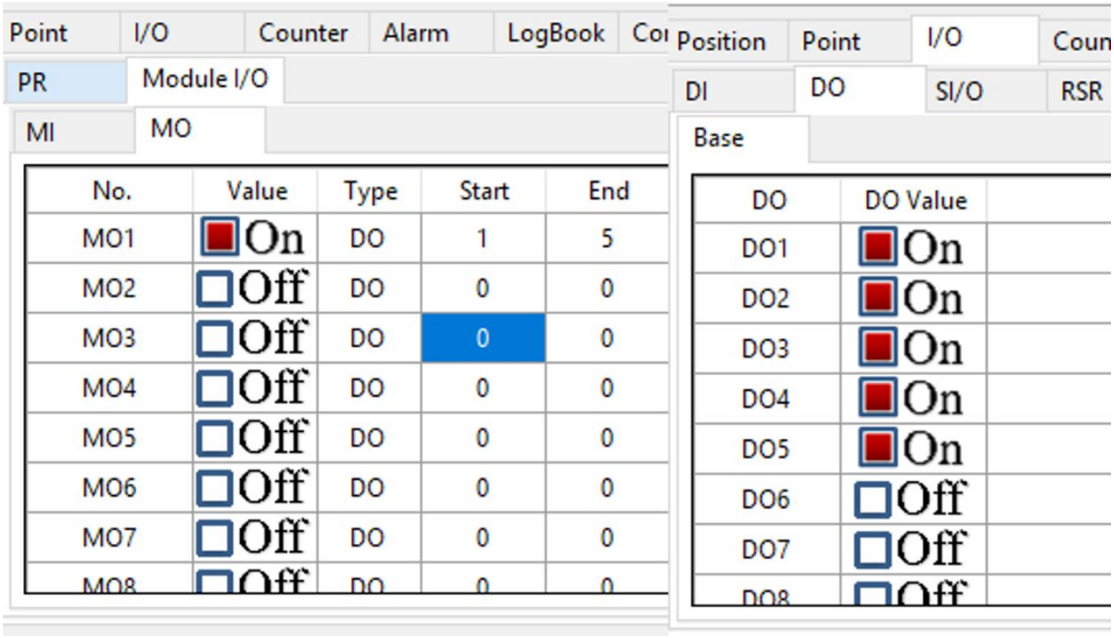
"Start" is beginning Input number and "End" is the ended Input number. After setting, while the specific Module Input is ON, the mapped Inputs (DIs) will be ON as well.



Module Input

2. Module Output setting:

“Start” is beginning Output number and “End” is the ended Output number. After setting, while the specific Module Output is ON, the mapped Outputs (DOs) will be ON as well.



Module Output

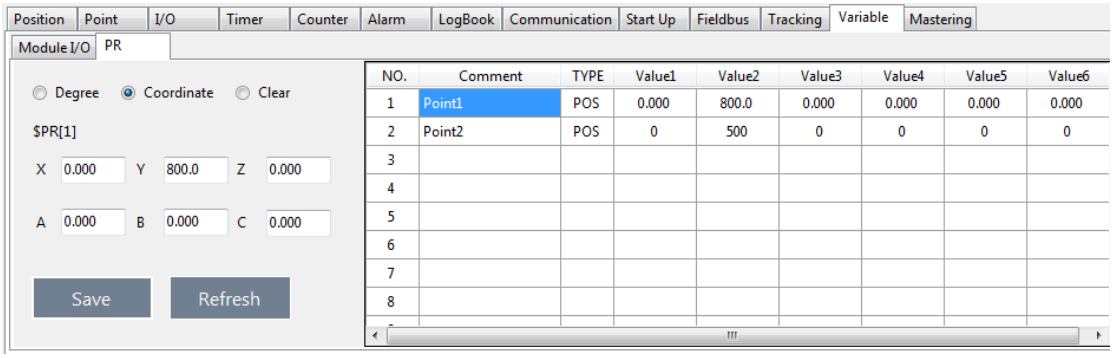
2.15. Position Register setting

Description

User can set Position Registers.

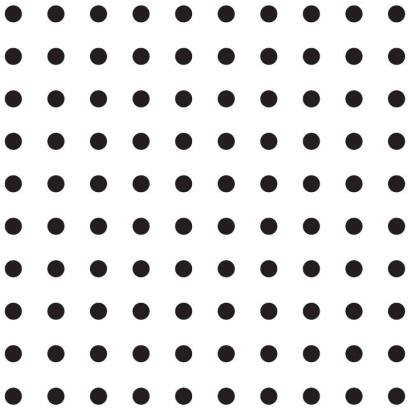
Operating steps

1. Click [PR] tab under [Variable] tab.
2. Select one row of table of registers.
3. Select one of “Degree” option, “Coordinate” and “Clear”.
4. If “Degree” option is selected, fill angles of A1 to A6 to define position.
5. If “Coordinate” option is selected, fill current Cartesian coordinate to define position.
6. If “Clear” is selected, the data of this row will be cleared.
7. After inputs, click “Save” to save the changes to the table.



2.16. Conveyor Calibration

2.16.1. Conveyor Image Calibration



Calibration plate

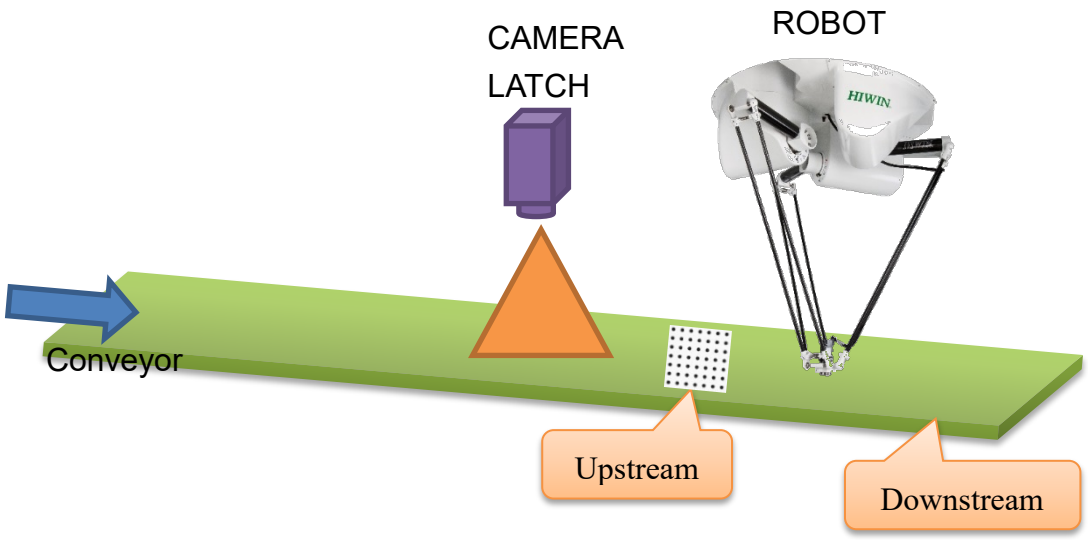


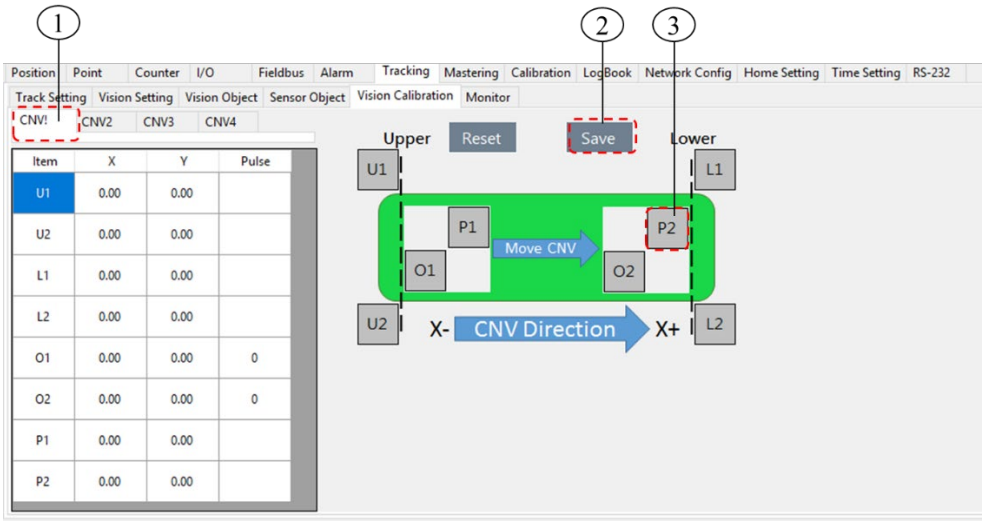
Illustration of Delta and CCD with conveyor

Description

1. 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 (As above figure).
2. Please ensure that there is a reading on the conveyor encoder before performing the calibration.
3. 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

2.16.2. Conveyor Arm Calibration

Description



Arm calibration interface

No.	Description
1	Select conveyor number
2	Save setting
3	Calibrate conveyor click function button

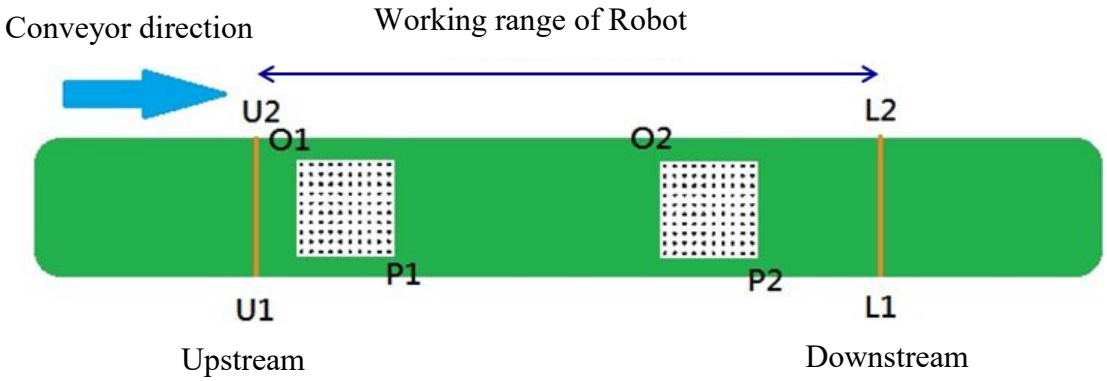
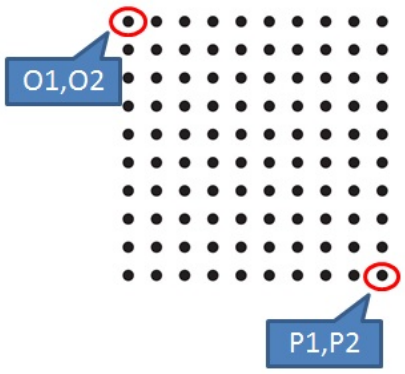


Illustration to calibrate arm position



Set O and P screen

Operating steps

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 [Tracking] tab.
4. Click the [Vision Calibration] tab under the [Tracking] tab.
5. Select the number of the conveyor.
6. 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.).
7. 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.).
8. 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 above.
9. 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.

10. Press “CLEAR” to zero CNT of all conveyors and recount.

2.16.3. Conveyor Image Parameters

Description

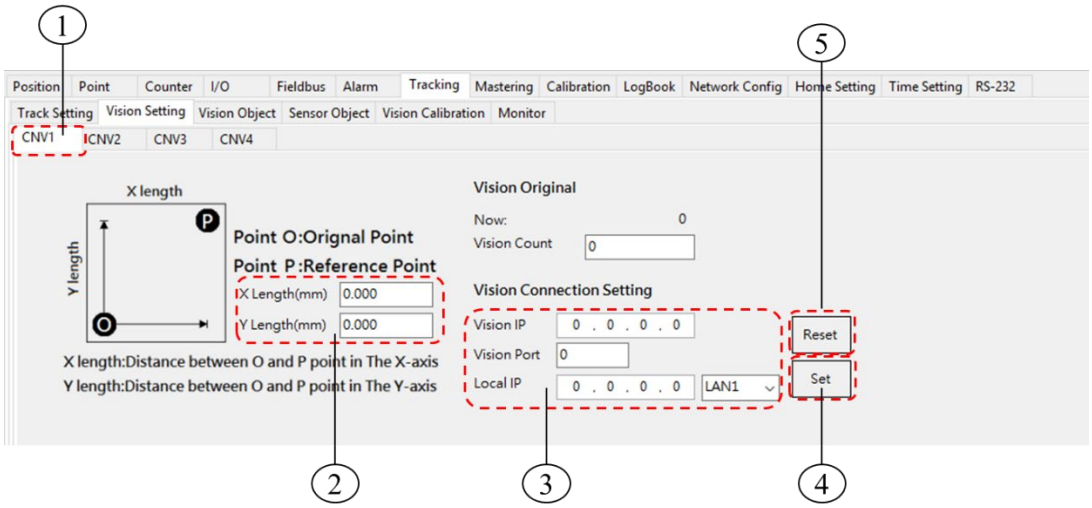


Image parameter configuration interface

No.	Description
1	Select conveyor number
2	Configure X,Y length value
3	Configure IP & Port
4	Save setting
5	Clear conveyor counting value

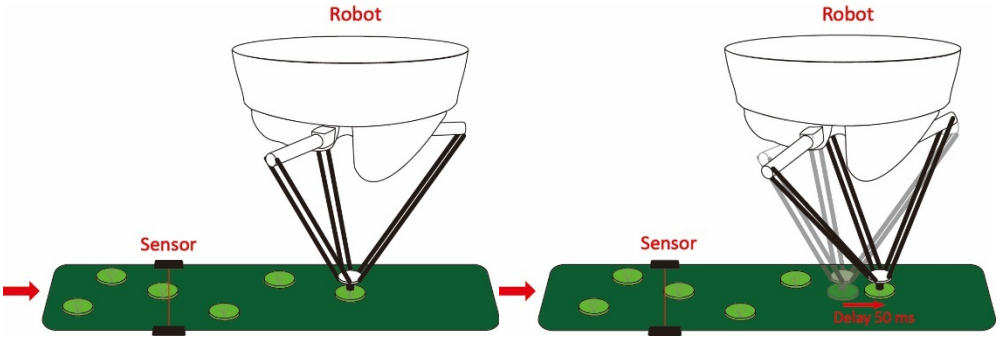
Operating steps

1. Click [Tracking] tab.
2. Click [Vision Setting] tab under [Tracking] tab.
3. Conveyor number: The information set in the Image Parameter screen (As above figure) will be recorded according to the number of the conveyor. When setting the parameters, select the number first. After setting completed, press the [Set] button.
4. 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.
5. Connection: IP for the system and the connection port.

2.16.4. Conveyor Object Parameters

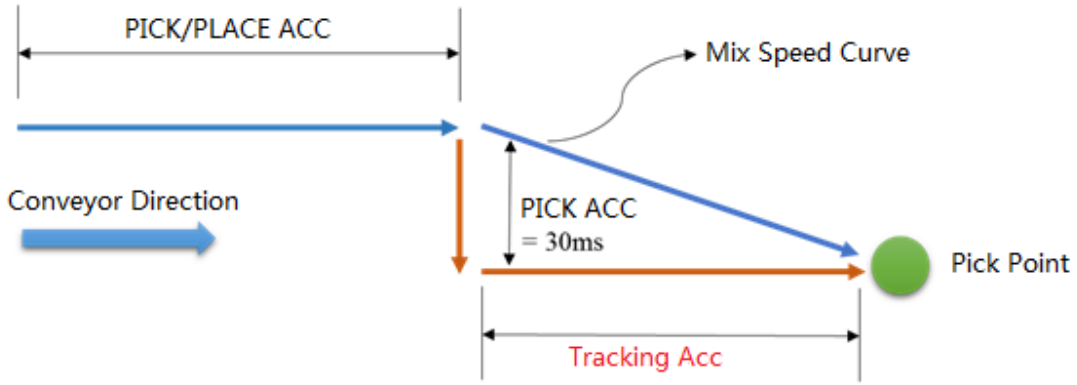
Description

- 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.



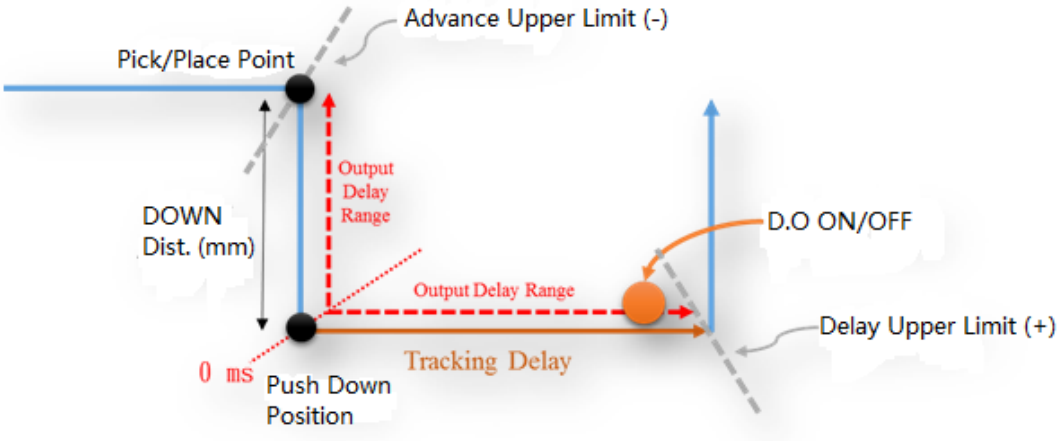
Object tracking delay time

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



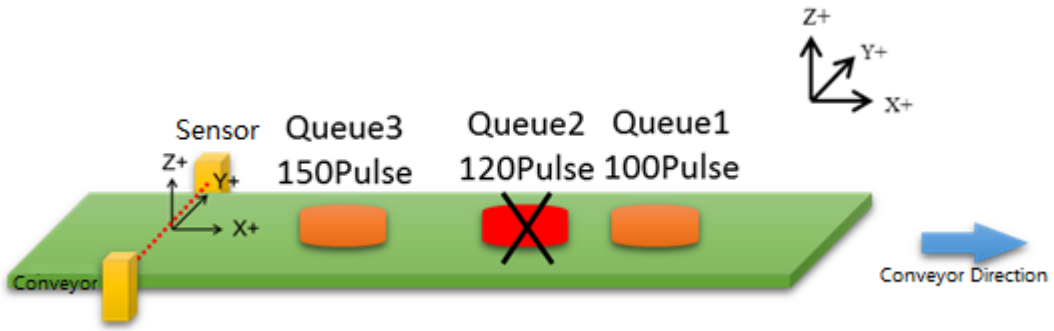
Object tracking acc. time

- 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 mm.
- Ack Package Setting：Customize image return signal content, Default return "{Conveyor number}".

Below are samples of Compare Nb and Compare Dis:

- Step 1: Ready Queue1 is the first data and there is no prior data for comparison. So Ready Queue1 is kept as Queue1。

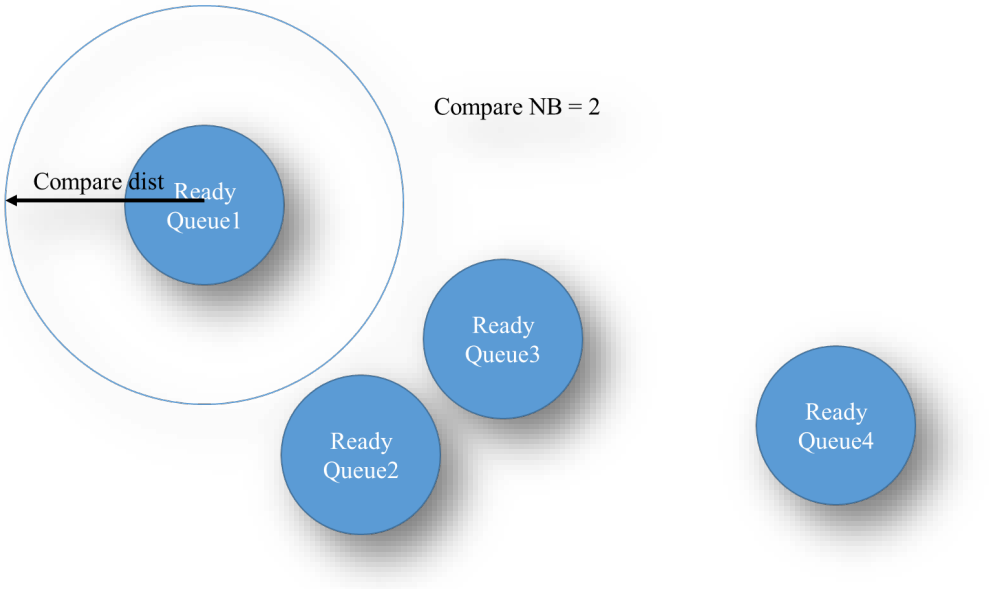


Figure of Step 1 of Compare Nb and Compare Dist.

- Step 2: Ready Queue2 will compare with Queue1 distance. And the distance is longer than setting value of "Compare Dist", so Ready Queue2 is kept as Queue2.

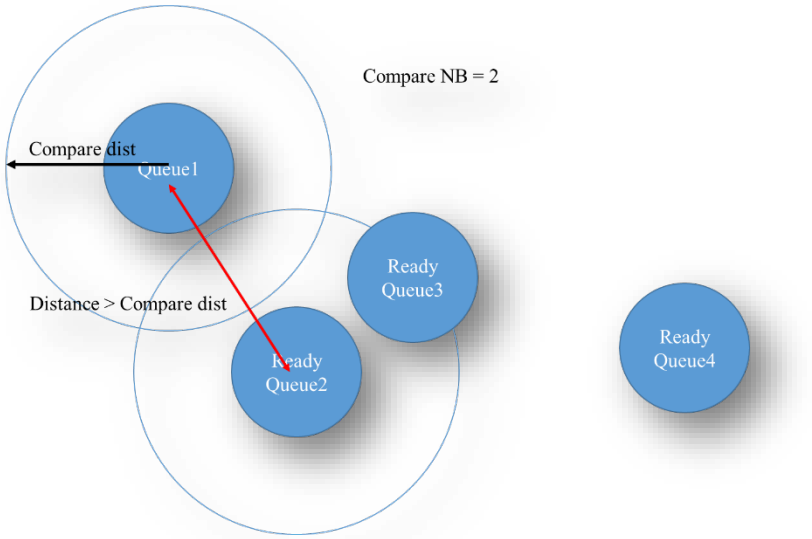


Figure of Sample 2 of Compare Nb and Compare Dist.

- Step 3: Ready Queue3 will compare with Queue1、Queue2 by distance. And one comparison is shorter than setting value of "Compare Dist", so Ready Queue3 is removed.

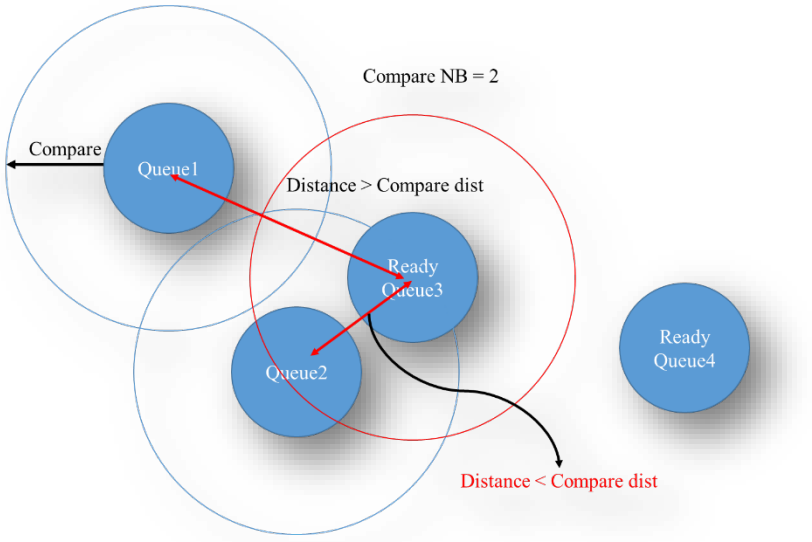


Figure of Step 3 of Compare Nb and Compare Dist.

- Step 4: Ready Queue4 will compare with Queue1、Queue2by distance. And both are longer than setting value of "Compare Dist", so Ready Queue4 is kept as Queue3.

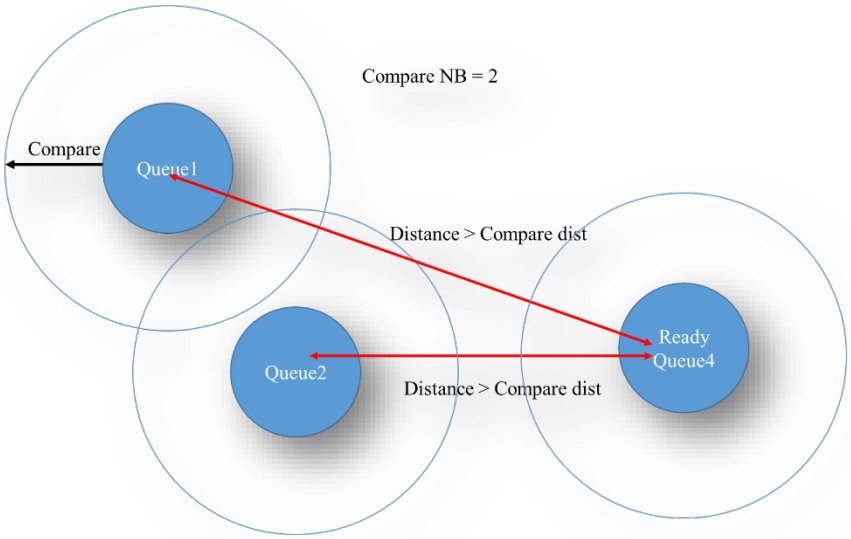


Figure of Step 4 of Compare Nb and Compare Dist.

- Step 5: Finally, the sequences of receiving are Queue1, Queue2 and Queue3

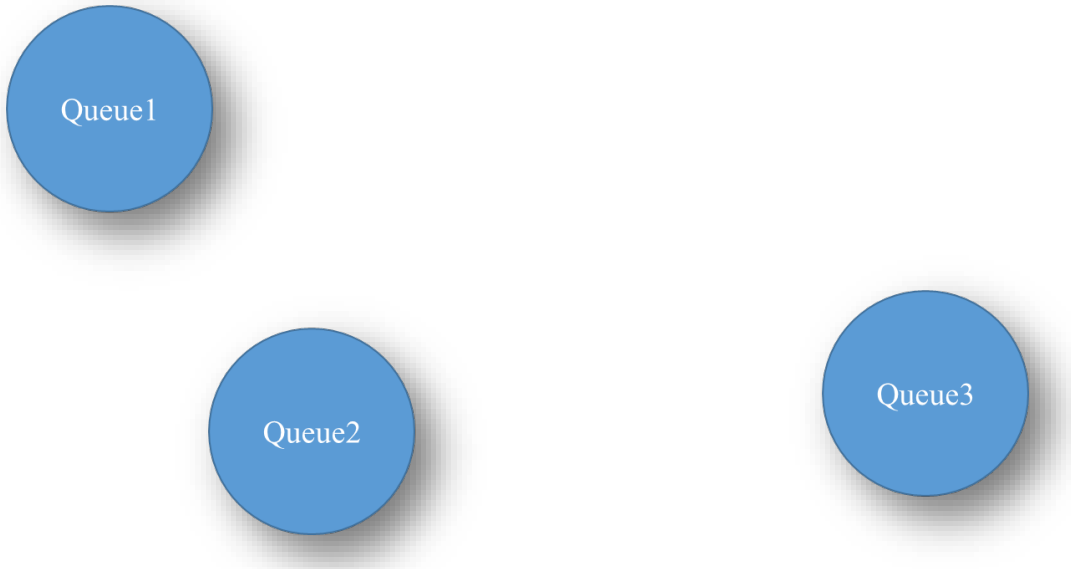
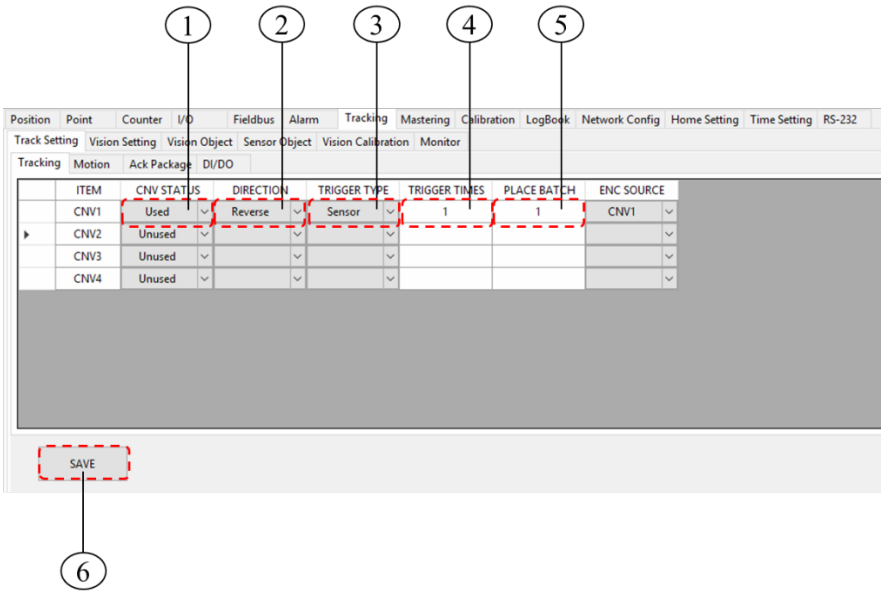
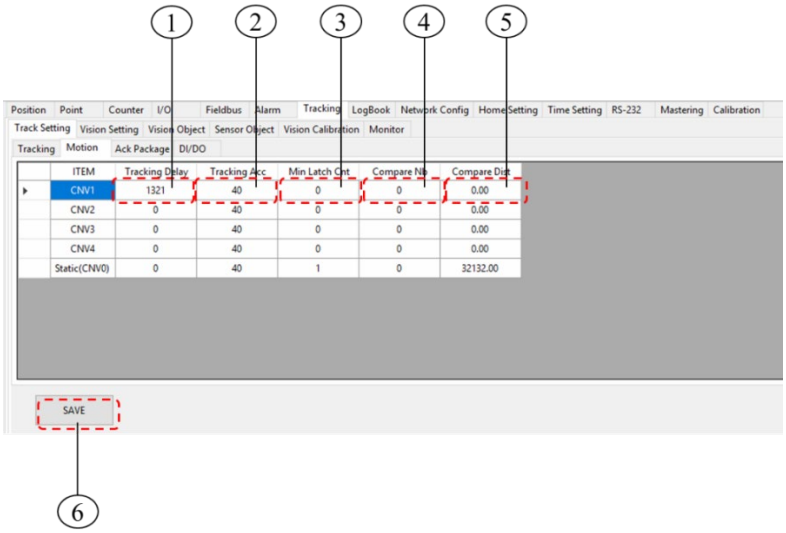


Figure of Step 5 of Compare Nb and Compare Dist.



Conveyor tracking parameters setting interface

No.	Description
1	CNV STATUS：Configure if this conveyor is to be used.
2	DIRECTION：Configure the encoder counting direction of this conveyor.
3	Trigger Type：Configure the retrieving type of conveyor object, 1 for using image triggering, 2 for using SENSOR triggering.
4	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.
5	Place Batch: The place variable is used when multiple objects are placed in the same workspace. When the sensor 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.
6	Save



Conveyor motion parameters setting interface

No.	Description
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.
2	Tracking Acc：Synchronize acceleration/deceleration time in conjunction with conveyor, unit is ms, range 4~1000, default value is 150.
3	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 above shows 3 object on the conveyor, when Min Latch Cnt is set as 25, Queue 2 will be ignored.
4	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 is 0~20, default value is 0
5	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 mm.
6	Save

Conveyor Ack package parameters setting interface

No.	Description
1	Default is for returning of "{Conveyor Number}"
2	User defined returning content of Camera
3	Save

Operating steps

1. Click [Tracking] page.
2. Click [Track Setting] subpage.

2.17. Update Caterpillar and HRSS

Description

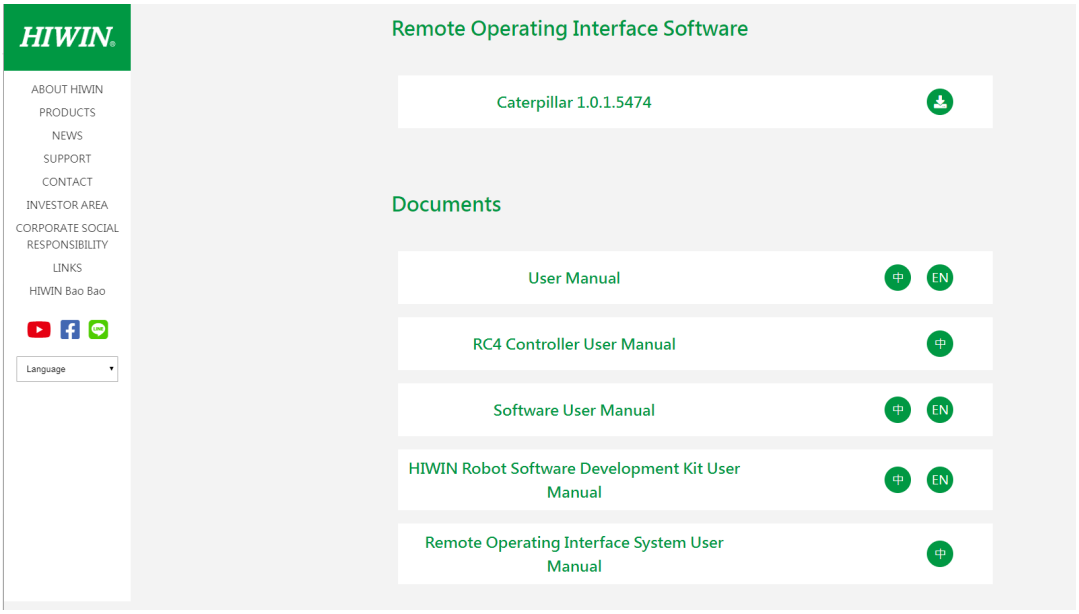
Users can download the HRSS and Caterpillar software update files at the same time from the official HIWIN website, and operate update in Caterpillar interface.

Operation steps

- Connect to the official website of HIWIN (www.hiwin.tw)
- On the web page select: Support>Muti axis Robot>Scara.

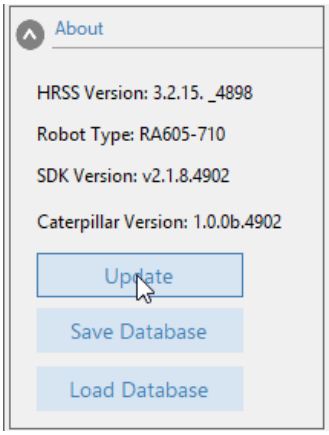
HIWIN official website

- Choose robot type
- Download Caterpillar



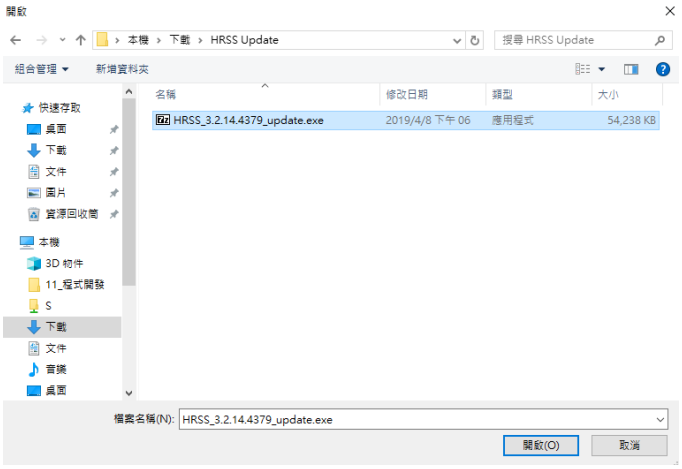
Download file

- Click update button on the Caterpillar

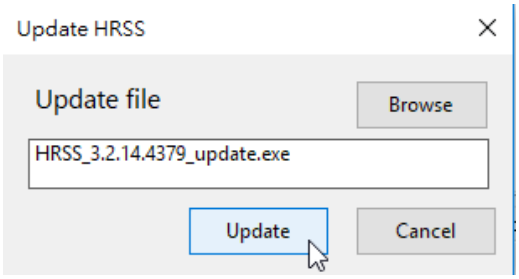


Update HRSS

■ Choose the update file to update.



Choose HRSS update file



Update file interface

⚠ CAUTION

1. The software update package contains HRSS and Caterpillar. The two versions are dependent and must be downloaded at the same time and updated together.
2. Update the HRSS before you can use the new Caterpillar.
3. 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.
4. Download the Caterpillar update package with the HRSS update file.
5. Open the old version of Caterpillar, update the controller software after connecting the robot. Press Update button in the lower left corner, and select the HRSS update package .exe file to do update procedure. (it will be disconnected after the update)
6. Copy the .hrb files from the old Caterpillar directory to the new one.
7. Open the new Caterpillar and connect the robot (Do not use the old version of Caterpillar to connect the robot after updating the controller software.)

3. Initial Settings

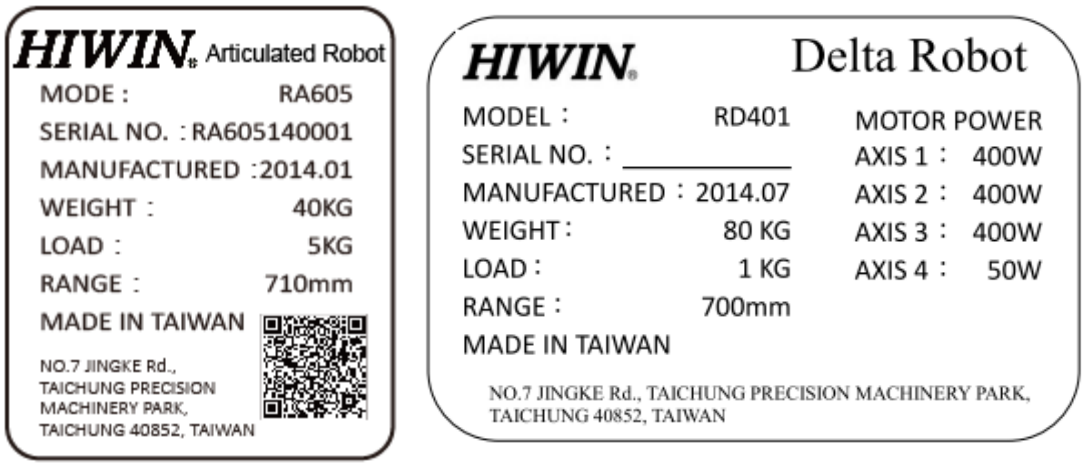
3.1. Check Parameters

Description

1. The correct robot program data must be loaded. During parameter check, the loaded robot data must match with the data of the model plate.
2. 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.
3. When connecting the robot system software HRSS, be sure to use the delivered Caterpillar for connection to avoid incompatible versions and cause injury to the robot system.
4. When updating the software, be sure to download HRSS on the official website and Caterpillar at the same time to update.
5. As described in Section 2.17, first update the new version of HRSS with the old version of Caterpillar. After the update is successful, you must copy your program to the new Caterpillar folder. Only new HRSS can be connected with the new Caterpillar.

⚠ DANGER

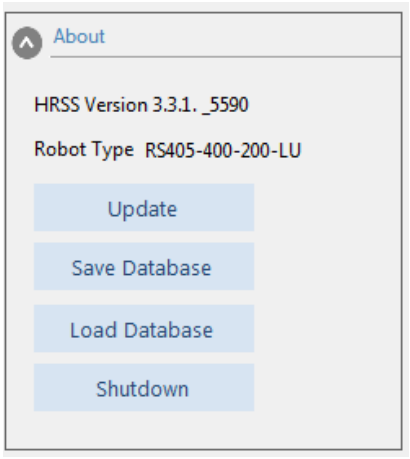
If the wrong data is loaded, the robot should not be operated! Failure to take these measurements could lead to serious injury, death or equipment damage



Model Plate(Left:RA605, Right:RD401)

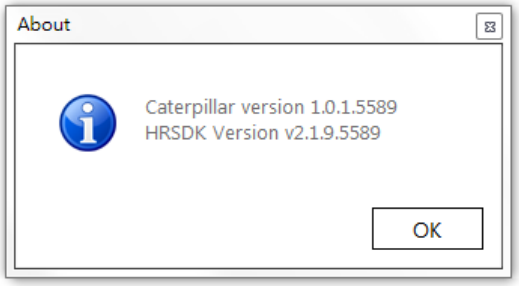
Operation steps

View the [About] page on the left side of the remote interface software.



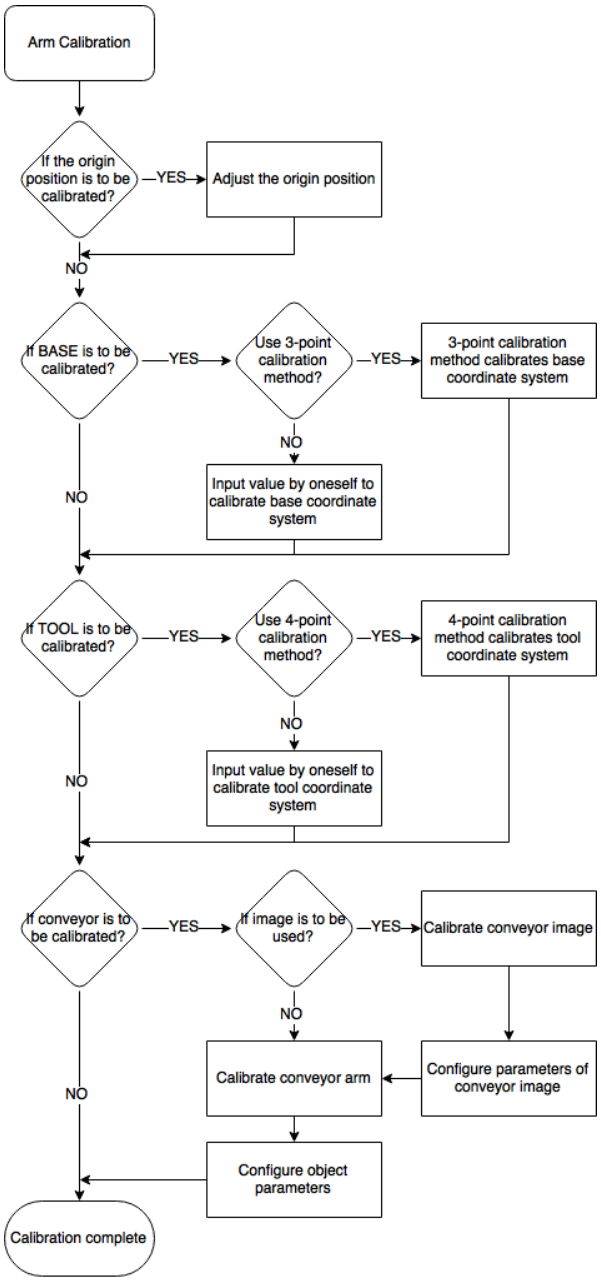
About interface

View the [About] page above the remote interface software.



3.2. Calibration Flow

Figure below is the calibration flowchart of robot. According to the user's requirements, they are: Adjusting the origin position (3.3) → Calibrate the base coordinate system (3.4.1,3.5.1) → Calibrate the tool coordinate system (3.4.2,3.5.2) → Calibration of conveyor image (2.16.1) → Calibration of conveyor and robot (2.16.2) → Configure the parameters of conveyor image (2.16.3) → Configure the parameters of conveyor object (2.16.4).
The above mentioned calibration steps will be introduced in the subsequent sections.

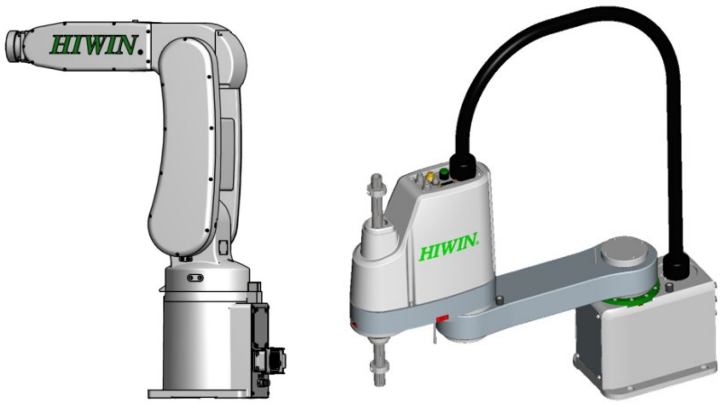


Calibration flowchart of robot

3.3. Adjust Origin Position of Hardware Mechanism

Overview

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.



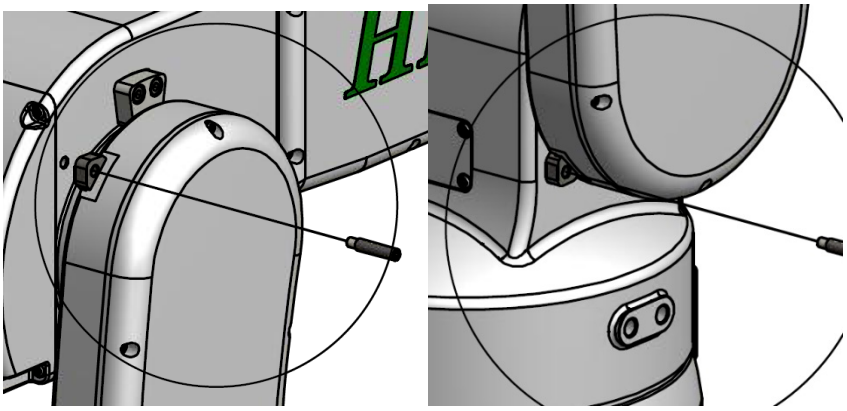
Adjust the approximate position of origin

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 lost after carrying out a new mastering procedure.
After a collision	
If the absolute position is missing after replacing the battery.	

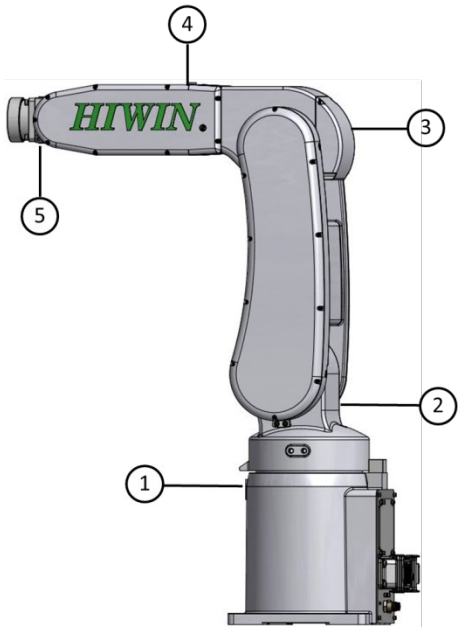
3.3.1. Mastering Method (6-axis robot)

Description

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

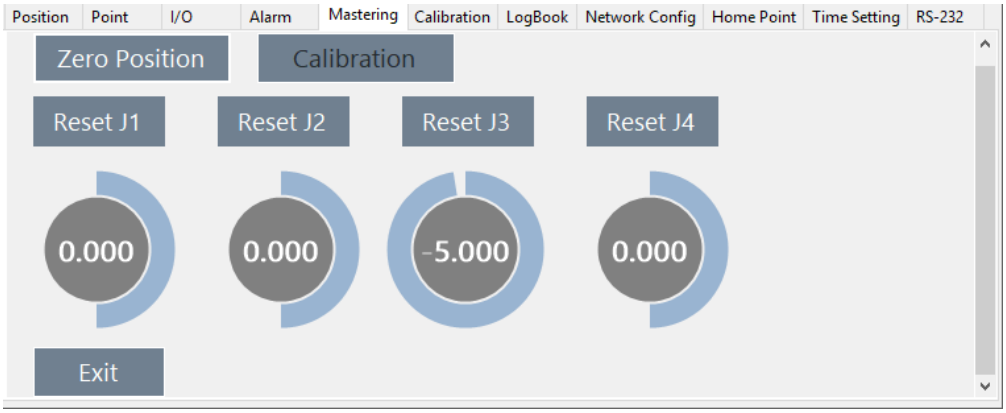
Based on the model number, the position of the mastering marks could be slightly different from the illustration. For origin calibration method and image, please refer to the manual of each model.

Prerequisite

1. Select Manual mode.
2. Open JOG window.

Operation steps

1. Select the axis as the coordinate system for the jog keys.
2. Press the + or – button, so that the axis moves to the positive or negative direction.
3. Start to jog from the axis A1, so that it can overlap with the mastering mark.
4. Click [Mastering] > [Zero Position] ◦
5. Click [Reset J1], a pop-up message will appear ◦
6. Press Yes to complete the setting of zero position for 1st - axis.
7. And so on for 2nd - axis to 6th - axis.
8. 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.



Zero position interface

⚠ CAUTION

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

- 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.

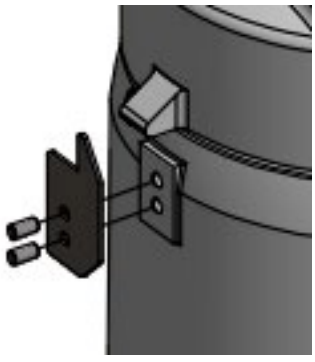


Illustration of first-axis mastering

- 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.

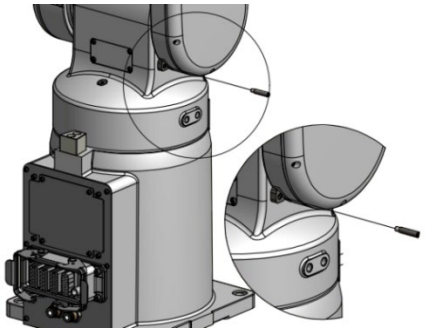


Illustration of second-axis mastering

- 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.

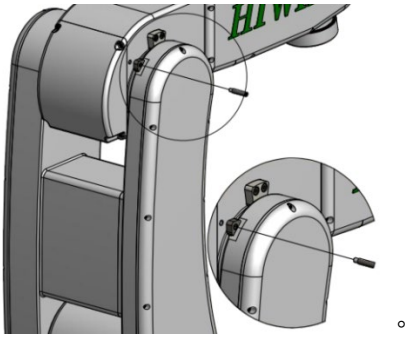


Illustration of third-axis mastering

- 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.

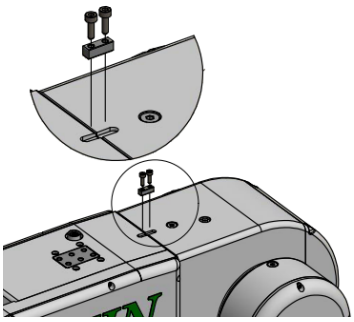


Illustration of fourth-axis mastering

- 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.

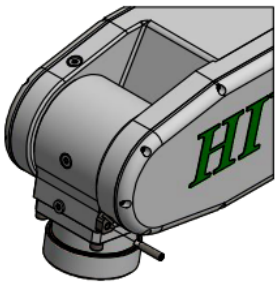
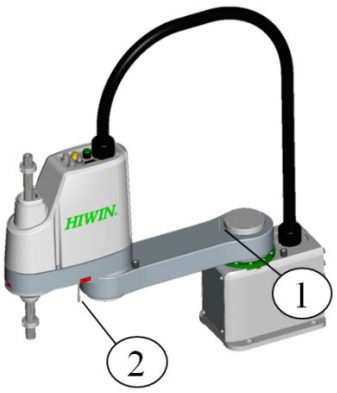


Illustration of fifth-axis mastering

3.3.2. Mastering Method（4 Axes Robot）

Description

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



Mastering mark of robot

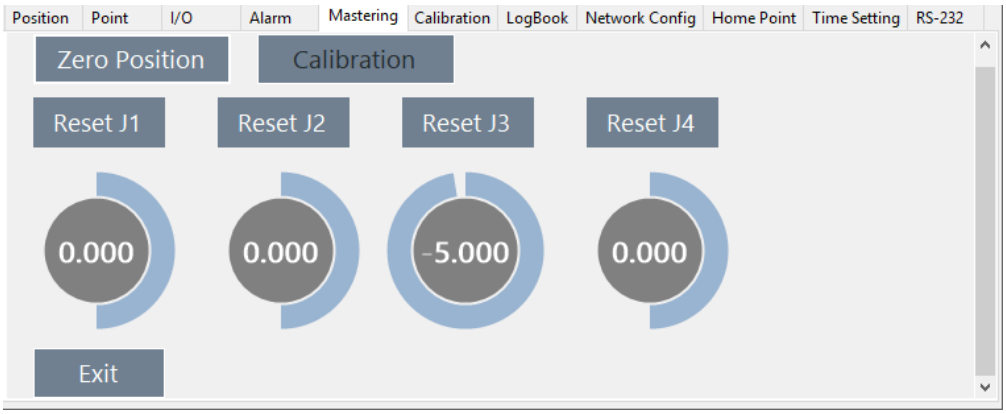
⚠ CAUTION

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

Prerequisites

1. Manual mode.
2. Open function page [Mastering] > [Zero Position]。

Operation steps



Zero position interface

⚠ CAUTION

If the simulated robot position outside the limit and cannot move, please execute Reset first

■ Setting origin of axis 1

Step1. Press the emergency stop button and push the A arm with your hand until the A arm matches the calibration hole in the base.

Step2. Use the calibration tool to insert the calibration hole from top to bottom.

Step3. Click [Reset J1] to set the origin position.

Step4. After the position is determined, remove the calibration tool.

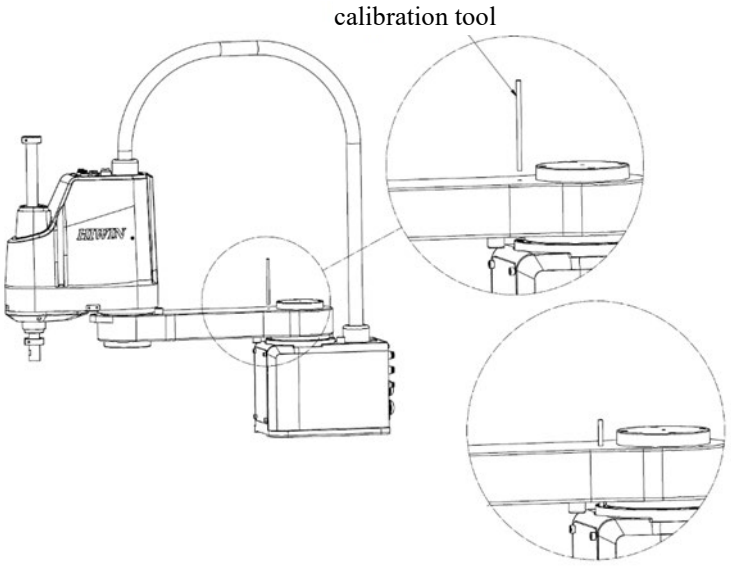


Illustration of first-axis mastering

■ Setting origin of axis 2

Step1. Press the emergency stop button and push the B arm with your hand until the B arm matches the calibration hole of the A arm.

Step2. Use the calibration tool to insert the calibration hole from top to bottom.

Step3. Click [Reset J2] to set the origin position.

Step4. After the position is determined, remove the calibration tool.

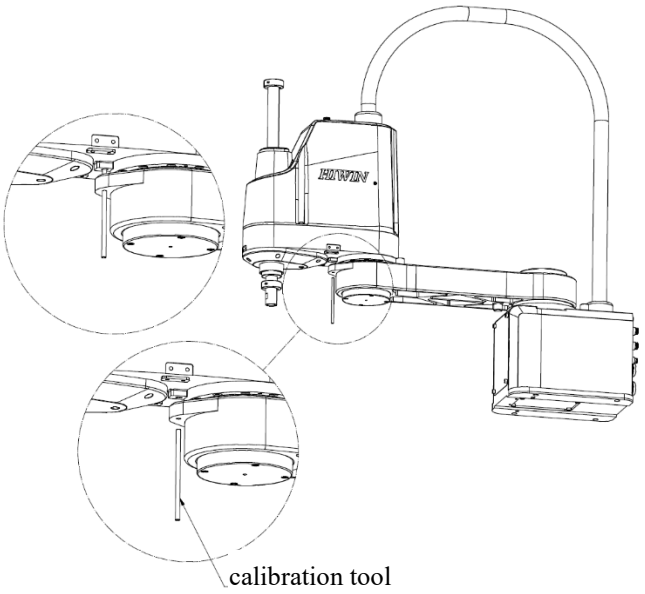


Illustration of second-axis mastering

■ Setting origin of axis 3 and axis 4

Step1. Confirm that the distance between the stop ring and the spline is 30mm, as shown below.

Step2. After pressing the emergency stop button, hold the brake release button and push the spline by hand until the stop ring contacts the body of the robot arm.

Step3. Turn the spline by hand until the upper surface of the spline is facing directly in front of the B arm, and release the brake release button.

Step4. Make sure that the stop ring is in contact with the body of the robot arm, and the upper surface of the spline is facing directly in front of the B arm.

Step5. Through the software, select the axis 3, set the origin position, and the position will be recorded as + 10.9mm.

Step6. Through the software, select the axis 4 and set the origin position.

Step7. Press the brake release button again and push the spline down about 50mm.

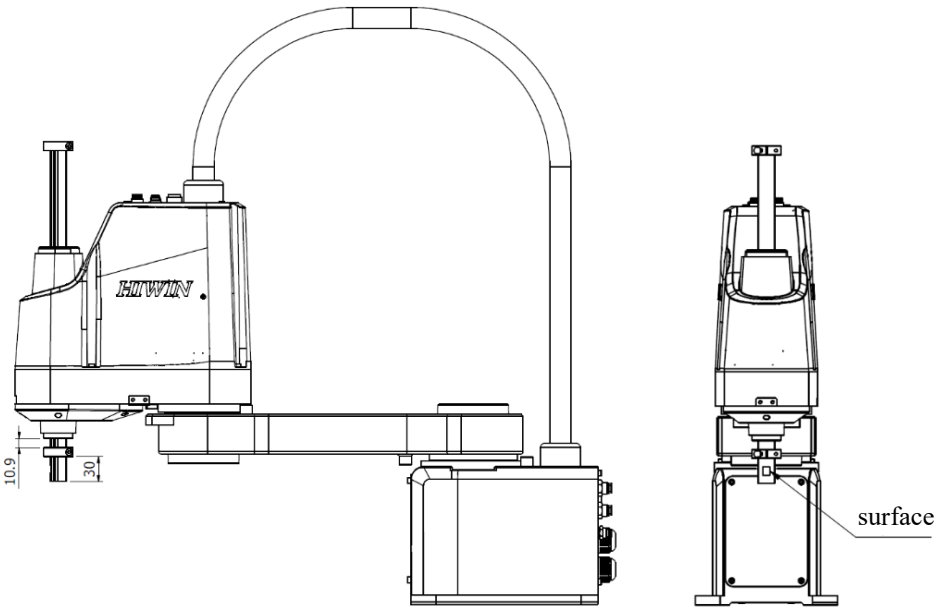


Illustration of third-axis and fourth-axis mastering

3.4. Calibration（6 axes 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.

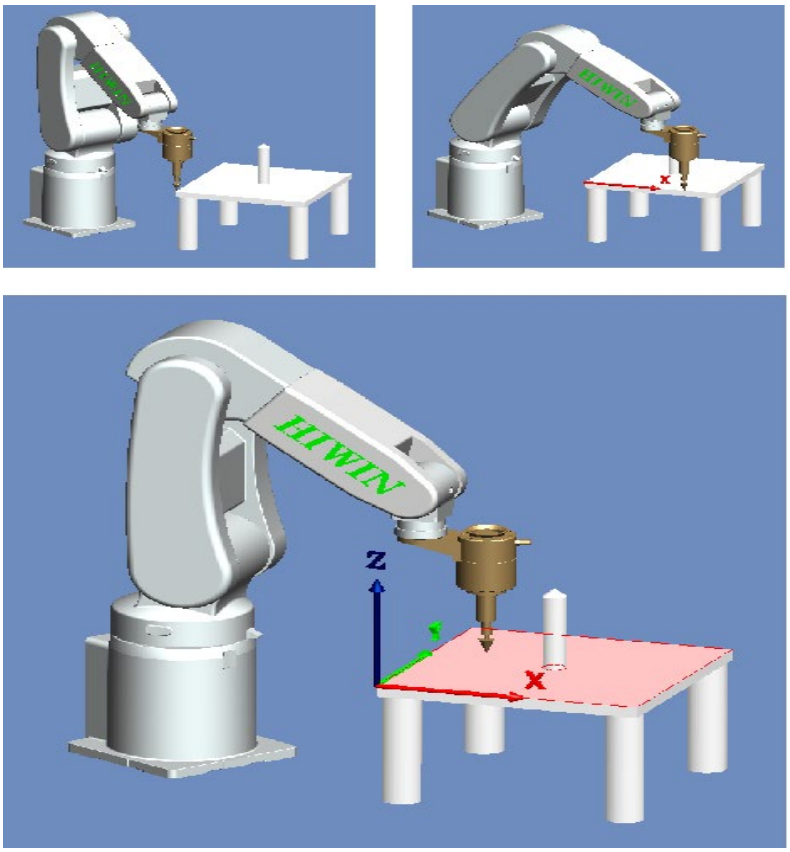
Advantages of base calibration:

- TCP can be jogged along the work plane or edge of workpiece.
- 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].

※BASE [0] is Default and cannot be changed.

3.4.1.1. 3-point Method



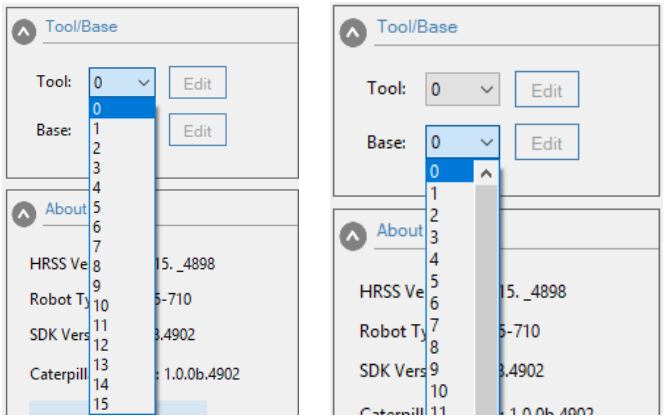
3-point Method

Prerequisite

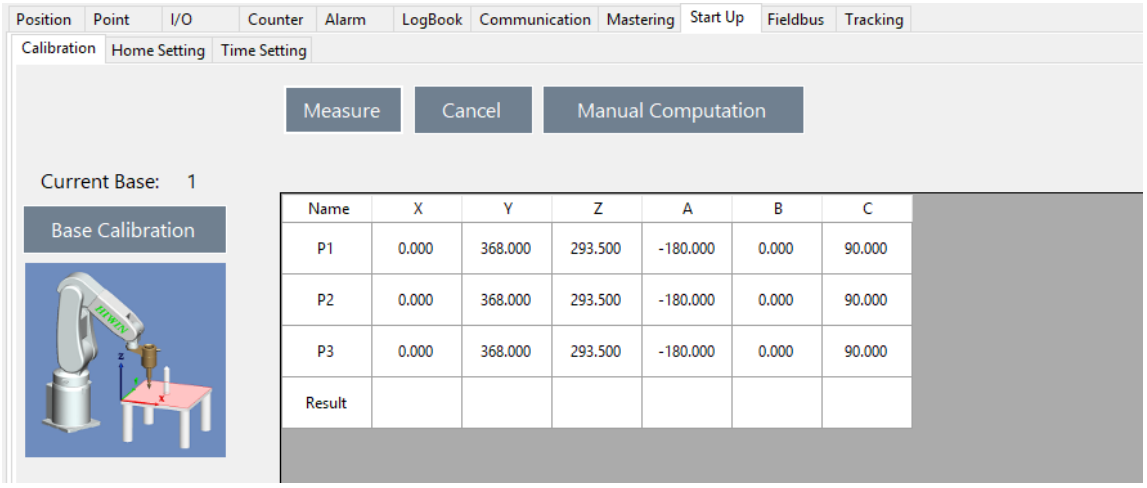
1. Manual mode.
2. Install a calibrated tool on the mounting flange.

Operation steps

1. Select the base number of [Tools / Base] on the left side of the remote operation interface.
2. Select the sub-tab [Calibration] of the function tab [Start Up].
3. Click Base Calibration。
4. Move TCP to the origin of new base coordinate. Click [Measure].
5. Move TCP to a point on positive X axis of new base coordinate. Click [Measure].
6. Move TCP to a point with positive Y on the XY plane. Click [Measure].
7. After completed. The data will be saved.



Base/Tool selection interface



RA605 robot base calibration interface

3.4.1.2. Enter Value

Description

Known the following values, for example, obtain from CAD:

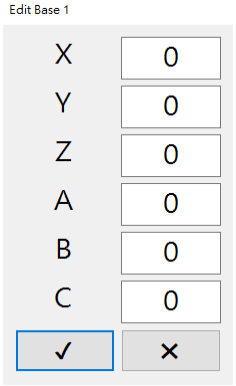
- Distance between the base origin and global origin
- Rotation for base coordinate relative to global coordinate

Prerequisite

1. Manual mode.
2. X, Y, Z, A, B and C relative to the flange coordinate system is known.

Operation steps

1. Select the base number of the remote operation interface vertical [Tool / Base].
2. Click [Edit].
3. Enter the values in the table.
4. Click [✓] button after completed. The data will be saved.



Enter value interface

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 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]).

※TOOL [0] is Default and cannot be changed.

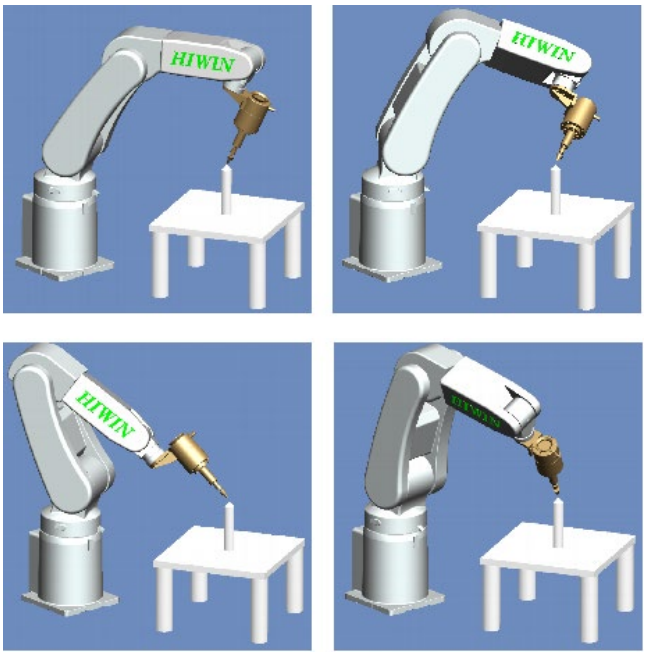
3.4.2.1. 4-point Method

Description

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

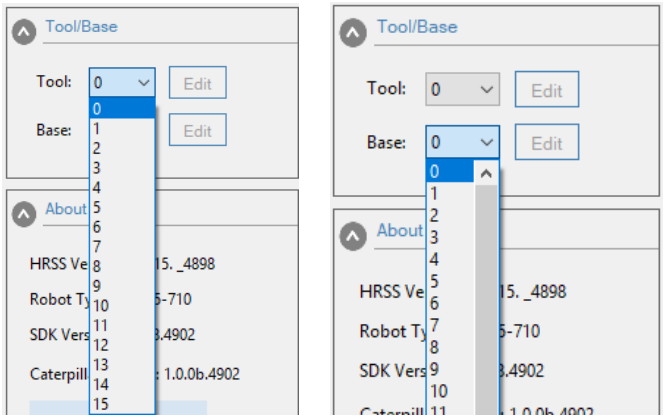
Prerequisite

1. Manual mode.
2. Install the tool to be calibrated on the mounting flange.
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.

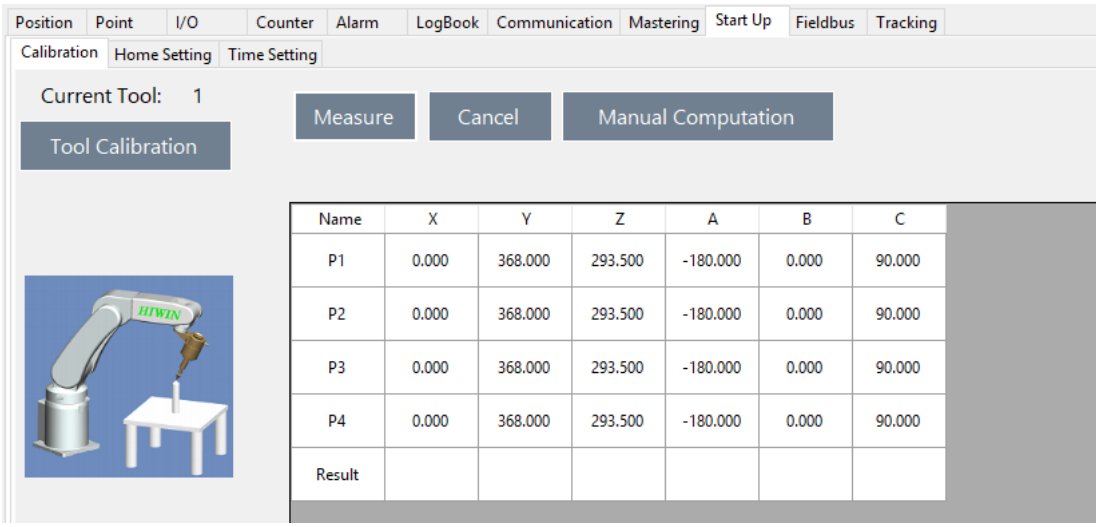
Operation steps

1. Select the tool number of [Tool / Base] on the left side of the remote operation interface.
2. Select the sub-tab [Calibration] of the function tab [Start Up].
3. Click [Tool Calibration].

4. Use TCP to move to the configured reference point. To confirm the reference point, click [Measure].
5. Use TCP to change the position of the other arm and move to the reference point. If you confirm the reference point position, click [Measure].
6. Repeat step 5 twice.
7. After completion, the data shows the new TOOL coordinate system reference position and is saved.



Tool / Basel selection interface



RA605 robot tool calibration interface

3.4.2.2. Enter Value

Description

Tool data can be manually entered.

Possible data sources：

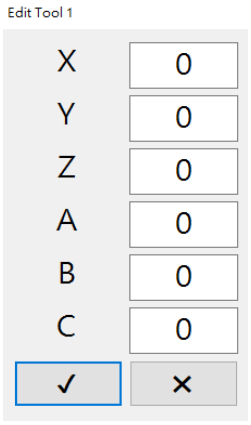
- In the CAD diagram file, acquire the size information of tool.
- Tool size from the measurement of actual object.
- Instruction manual of tool manufacturer.

Prerequisite

1. Manual mode.
2. Known X, Y, Z, A, B, C distance and orientation data relative to the flange coordinate system.

Operation Steps

1. Select the tool number of [Tool / Base] on the left side of the remote operation interface.
2. Click [Edit].
3. Enter the values in the table.
4. Click [✓] button after completed. The data will be saved.



Numerical input interface

3.5. Calibrate Coordinates（4-axis robot）

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.

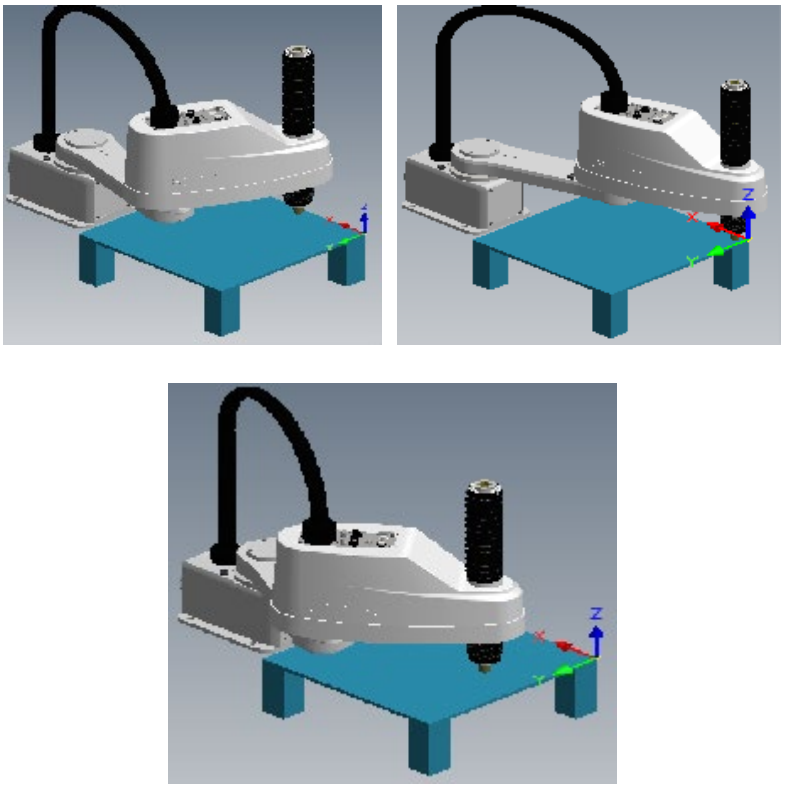
Advantages of base calibration：

- TCP can be jogged along the work plane or edge of workpiece.
- 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].

※BASE [0] is default and cannot be changed.

3.5.1.1. 3-point Method



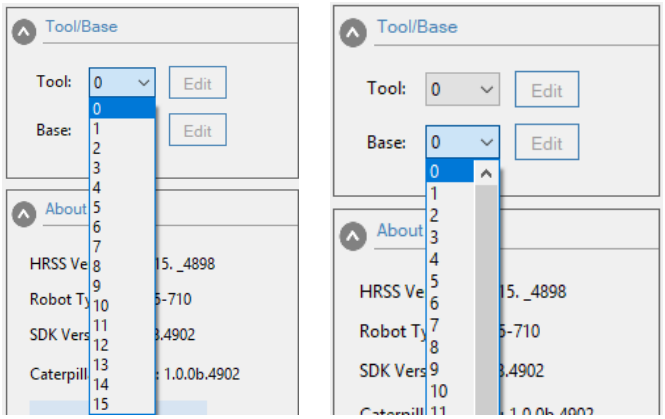
3-point method

Prerequisite

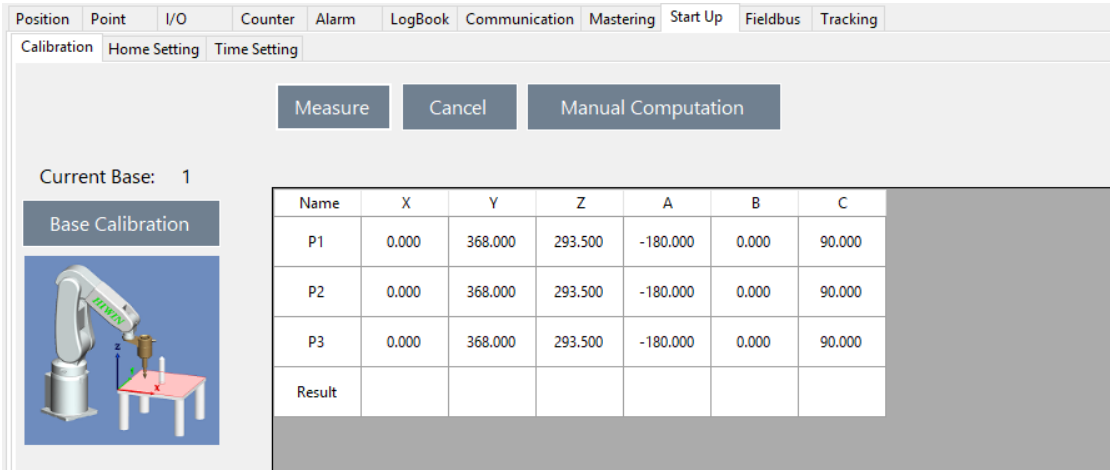
1. Manual mode.
2. Install a calibrated tool on the mounting flange.

Operation steps

1. Select the base number of [Tools / Base] on the left side of the remote operation interface.
2. Select the sub-tab [Calibration] of the function tab [Start Up].
3. Click Base Calibration.
4. Use TCP to move to the origin of the new base frame. Click [Measure].
5. Move TCP to a point on the positive X axis of the new base frame. Click [Measure].
6. Move TCP to a point on the XY plane with a positive Y value. Click [Measure].
7. After completion. The data will be saved.



Base / tool selection interface



SCARA robot base calibration interface

3.5.1.2. Enter Value

Description

Values are known, from CAD, for example：

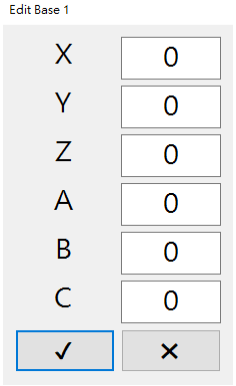
- Distance between the base origin and global origin
- Rotation for base coordinate relative to global coordinate

Prerequisite

1. Manual mode
2. X, Y, Z, A, B and C relative to the flange coordinate system is known

Operation steps

1. Select the base number of [Tools / Base] on the left side of the remote operation interface.
2. Click [Edit].
3. Enter the values in the table.
4. Click [✓] button after completed. The data will be saved.



Numerical input interface

3.5.2. Calibration of Tool Coordinates

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.

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].

※TOOL [0] is default and cannot be changed. 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

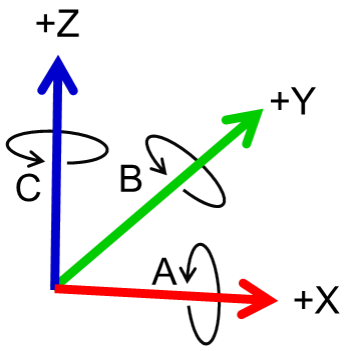
Y：Y coordinate

Z：Z coordinate

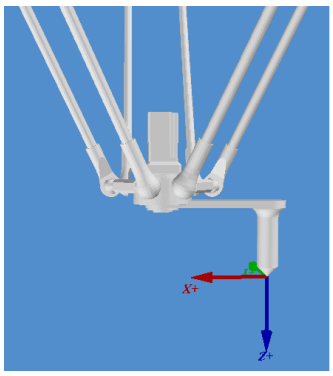
A：Rotate along X coordinate

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

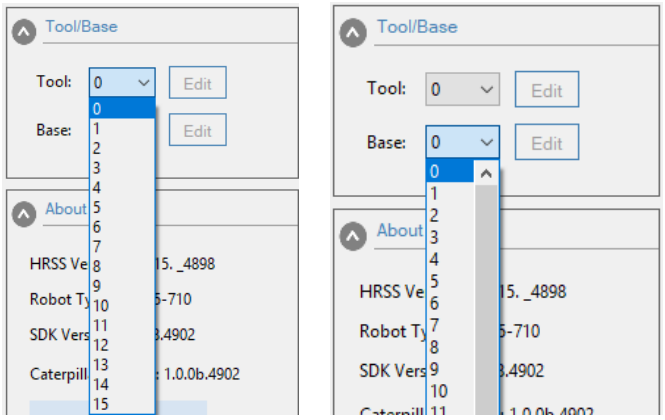
The 3 flange positions at the reference point must be sufficiently apart from one another.

Prerequisite

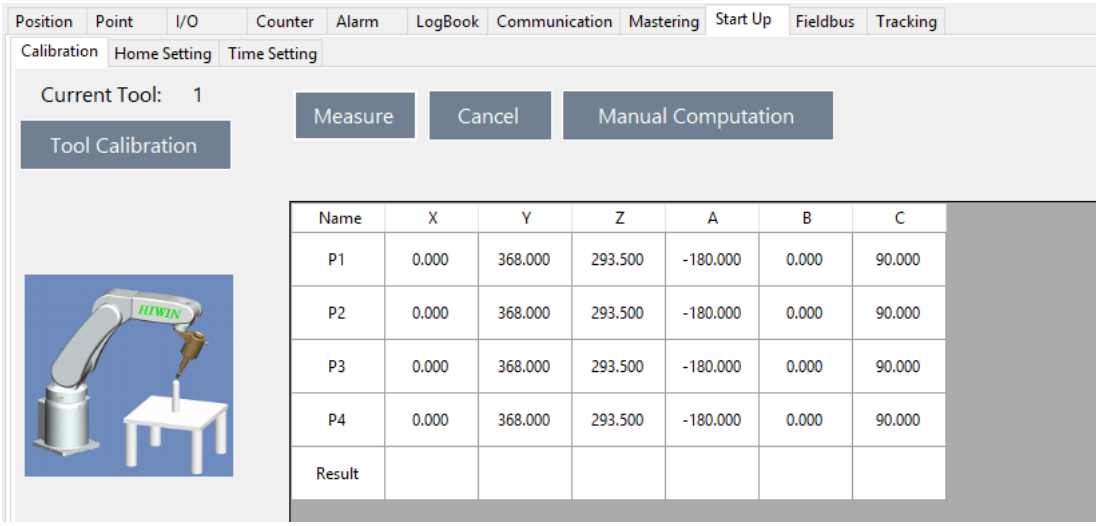
1. Manual mode
2. Install the tool to be calibrated on the mounting flange.
3. Select a fixed reference point position, it is recommended that this reference point is a shape that is easy to recognize, for example: cuspidal point.

Operation steps

1. Select the tool number of [Tool / Base] on the left side of the remote operation interface.
2. Select the sub-tab [Calibration] of the function tab [Start Up].
3. Click [Tool Calibration].
4. Use TCP to move to the configured reference point. Click [Measure] to confirm the first calibration point.
5. 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.
6. Repeat Step 5 to confirm third point.
7. After completion, the data will show the new TOOL coordinate system reference position and be saved.



Base / tool selection interface



SCARA robot tool calibration interface

3.5.2.2. Enter Value

Description

The tool data can be manually entered.

Possible data source：

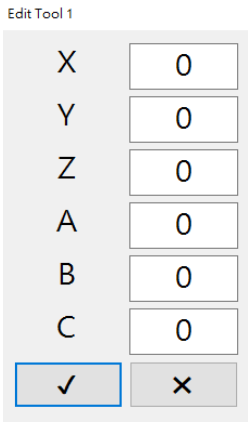
- In the CAD diagram file, acquire the size information of tool.
- Tool size from the measurement of actual object.
- Instruction manual of tool manufacturer.

Prerequisite

1. Manual mode
2. Known X, Y, Z, A, B and C relative to flange coordinate

Operating steps

1. Select the tool number of [Tools / Base] on the left side of the remote operation interface.
2. Click [Edit].
3. Enter the values in the table.
4. Click [✓] button after completed. The data will be saved.



Numerical input interface

3.6. Home and Position Check Configuration

3.6.1. Home Configuration

Description

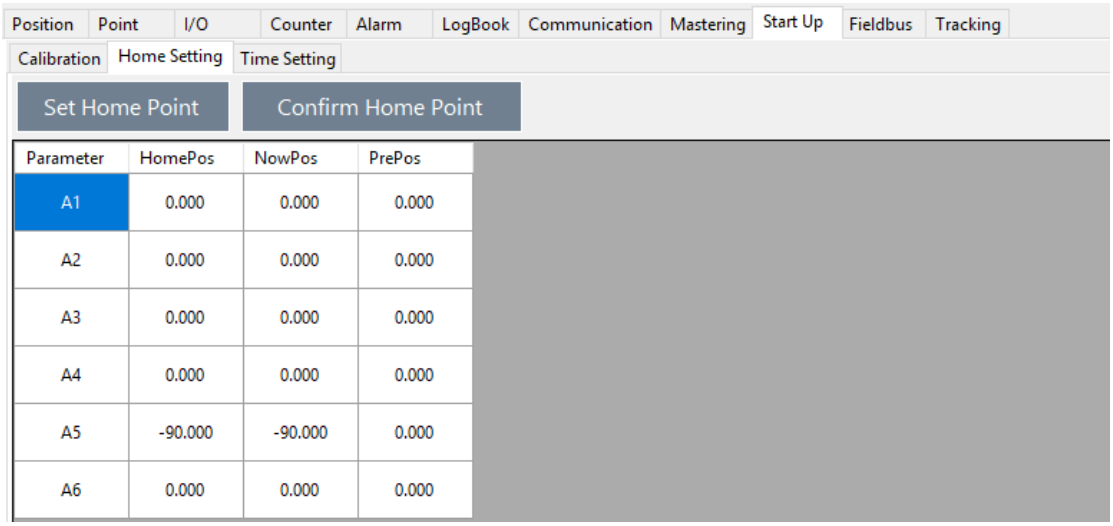
Self-setting or recover the origin (Home) position.

Prerequisite

1. Manual mode.
2. Open the adjustment operation interface.

Operation steps

1. Click the sub-tab [Home Setting] of the function tab [Start Up].
2. Move to the self-defined origin position.
3. After moving, click the [Setting Home Point] button to complete the setting.



Home Setting interface

3.6.2. Position Check

Description

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

Prerequisite

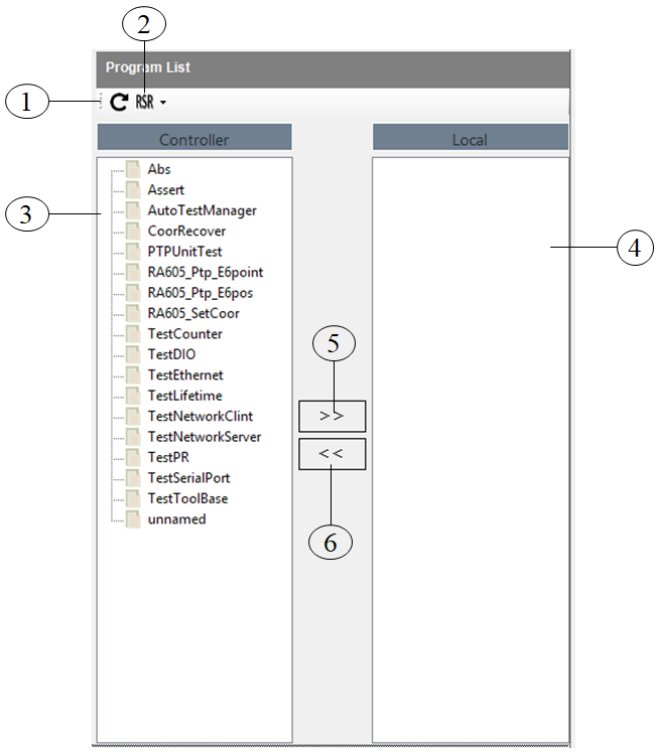
1. Manual mode
2. Open the adjustment operation interface.

Operation steps

1. Select Start-up>Home Setting.
2. The NowPos field shows the current axle angle, and the HomePos field shows the setting Home.
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.

4. Program Management

4.1. Program List



List

Description

A user can manage the program in the list.

No.	Description
1	Refresh the program list.
2	Add the program to Functional I/O.
3	Controller program list.
4	Local program list.
5	Upload to Local.
6	Download to controller.

4.2. Add and Delete File

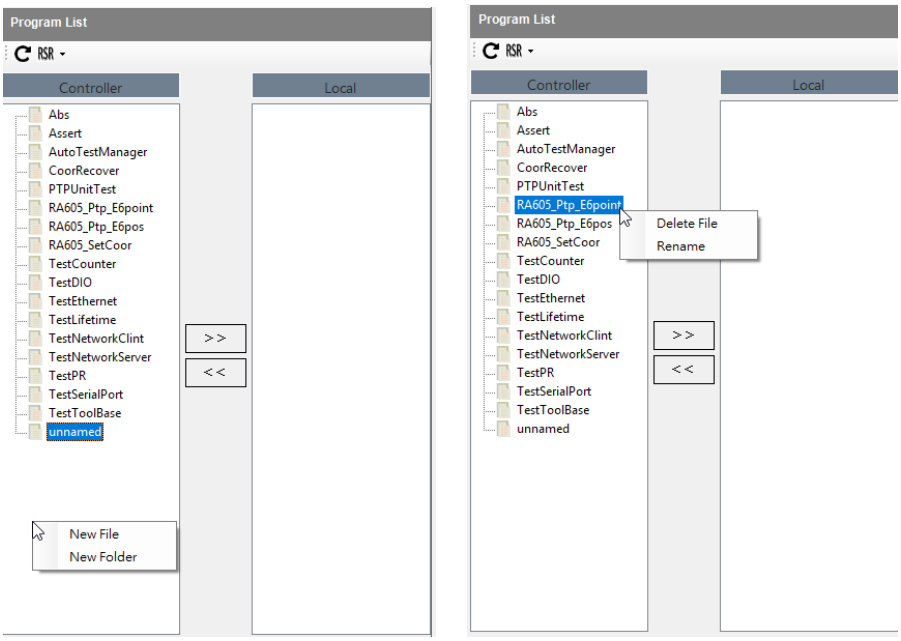
- Add file steps
  1. Right click on empty space of the program list to add file.(New File)
  2. Enter the name of the new file, make sure it meets the file name specification. Please see section 4.7.

- Delete file steps
  1. Select file and right click to delete file. (Delete File)

4.3. Add and Delete Folder

- Add folder steps
  1. Right click on empty space of the program list to add folder.(New Folder)
  2. Enter the name of the new folder, make sure it meets the folder name specification. Please see section 4.7.

- Delete folder steps
  1. Select folder and right click to delete folder. (Delete File)



Program list interface

⚠ WARNING

When download the local program file to the controller, if the file name does not meet the file name specification, the file will not be opened.

4.4. HRSS Program Structure

```
...
8 LIN P1 CONT=100% Vel= 200 mm/s Acc=50% Tool[3] Base[4]
...
14 PTP P1 CONT=100% 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 motion command must enter all parameter contents about 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. Start Program

4.5.1. 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

4.5.2. 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 manual mode, the maximum velocity is 250mm/s, nothing to do with the set value.

Operation steps

1. Adjust in program execution velocity window.
2. Set the program ratio.

4.5.3. Driver Status

The driver status will be dispalyed in the status bar.

Figure	Color	Description
	Green	Driver ready
	Gray	Driver not ready

4.5.4. Status Display “Interpreter”

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

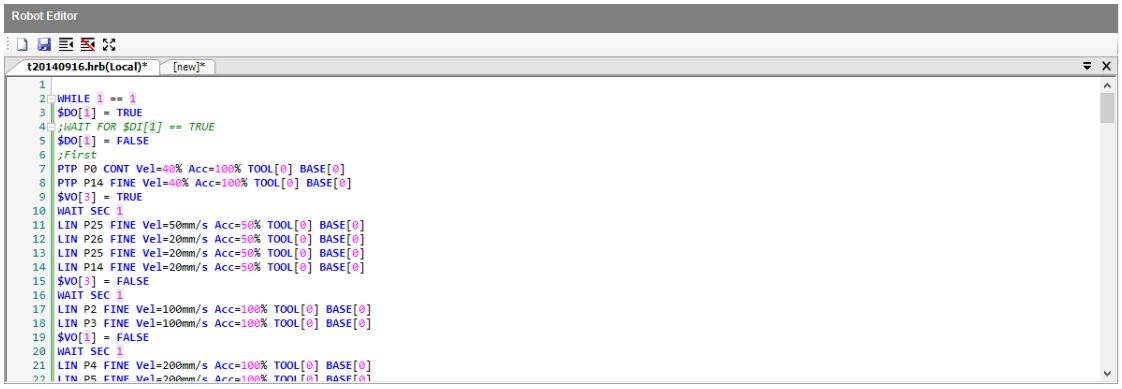
4.5.5. Start a Program

Prerequisite

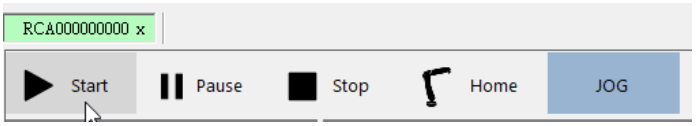
Program selected.

Operation steps

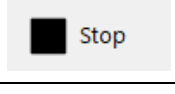
1. Select program opening.
2. Press the Start button.
3. The program starts to execute.
4. To stop a program, press the Stop button.



Program editor interface

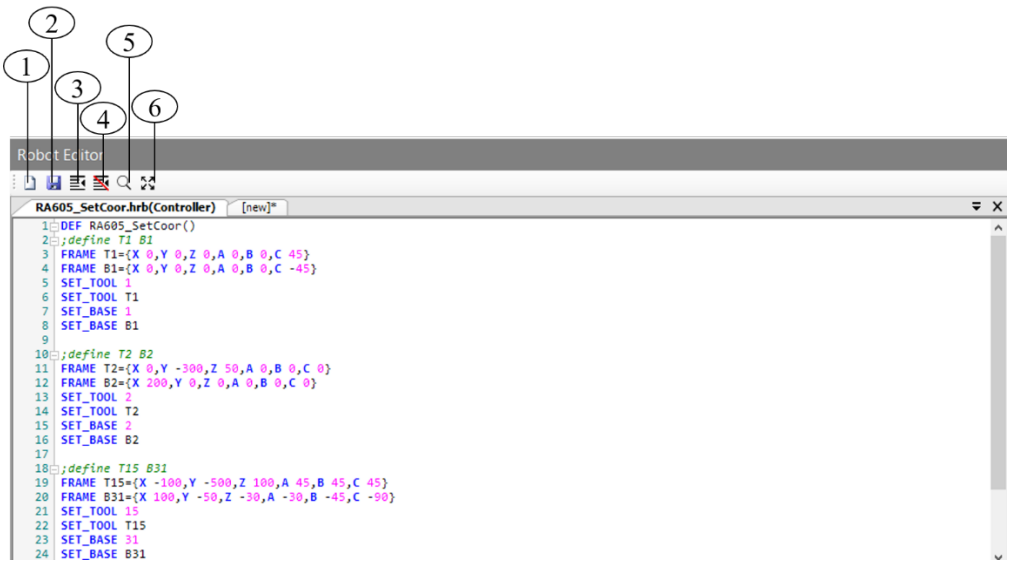


Program running control button

Figure	Hot Key
	Press F5 start program.
	Press F6 pause program.
	Press F7 stop program.

4.6. Edit Program

Overview



Program editor interface

No.	Description
1	Create new file.
2	Save file. (Hot key: Ctrl+S)
3	Increase indentation.
4	Decrease indentation.
5	Search a word in the editor.(Hot Key: Ctrl+F)
6	Zoom in.

⚠ CAUTION

A running program can’t be edited.

4.6.1. Comment Program Bar

Operating steps

1. Add semicolon(” ; ”) to the program bar that is selected to be commented. ◦

4.6.2. Indent Program Bar

Operating Steps

1. Select[Indent] ◦

4.6.3. Cancel Indent Program Bar

Operating Steps

1. Select[Unindent]。

4.7. Rules for naming files

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)

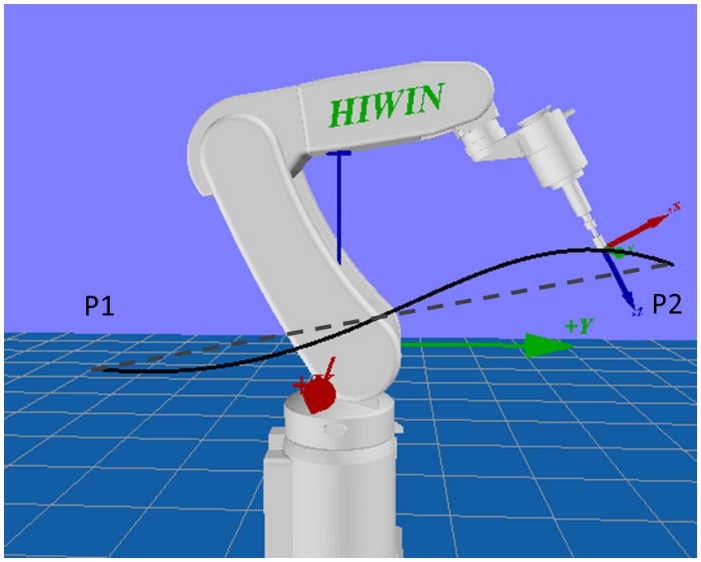
LIN and CIRC Motion is also called as “CP motion” (CP = Continuous Path).

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.

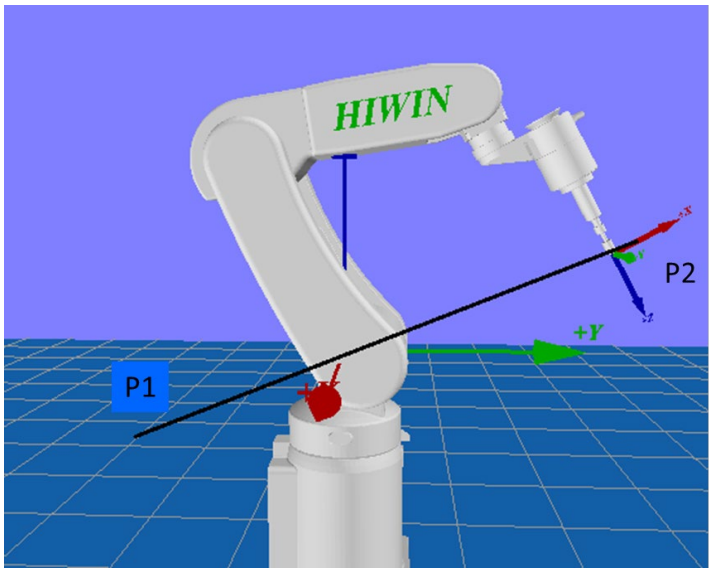
The motion cannot be accurately known in advance.



PTP motion

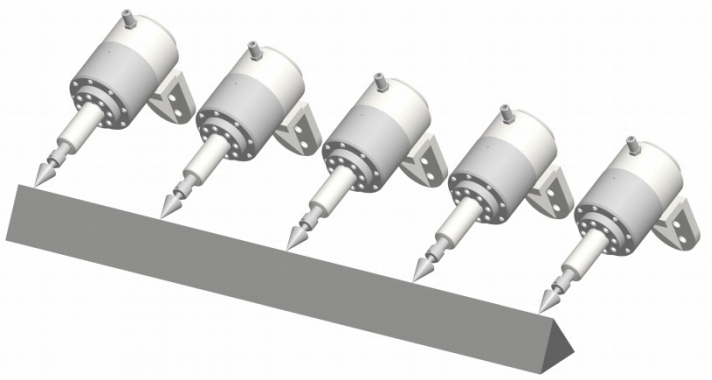
5.3. LIN Motion

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

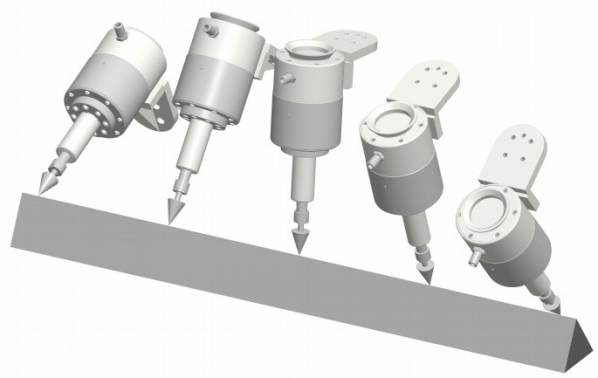


LIN motion

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.



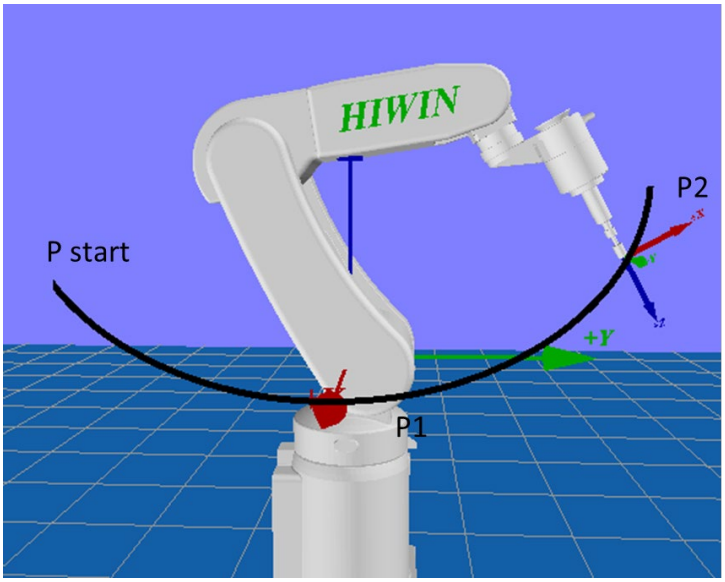
Start point in same orientation of target point



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.



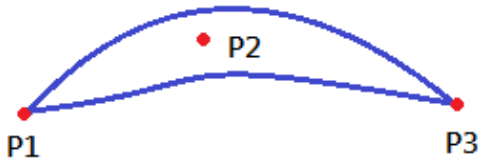
CIRC motion

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

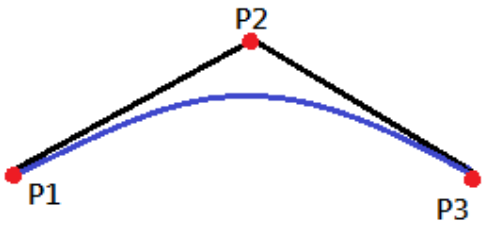
The TCP will leave a track where it can accurately reach the target point, and adopt the faster one. When over blending takes place in a PTP motion, the track change cannot be foreseen. The point through which side on the track cannot be forecasted.



PTP motion and P2 blended

- LIN motion

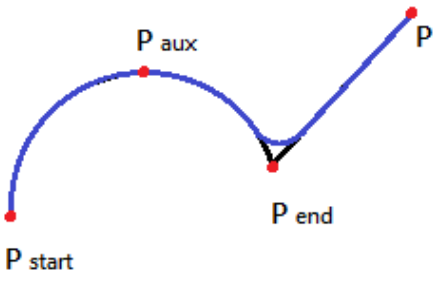
  TCP will leave a track where it should accurately move to the target point, and run on a shorter track. The region where the track path runs is not an arc.



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

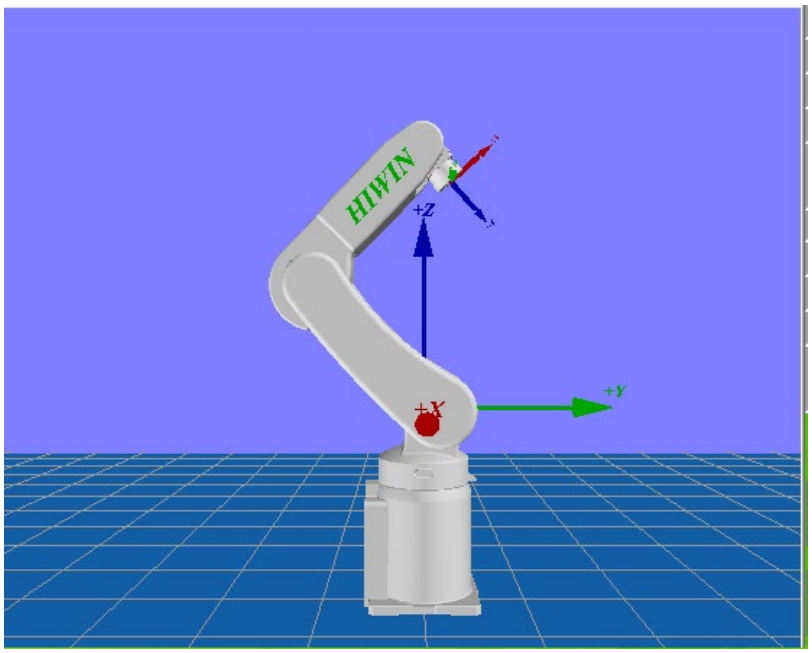
The HIWIN's robot with six degrees of freedom has three kinds of singular point.

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.

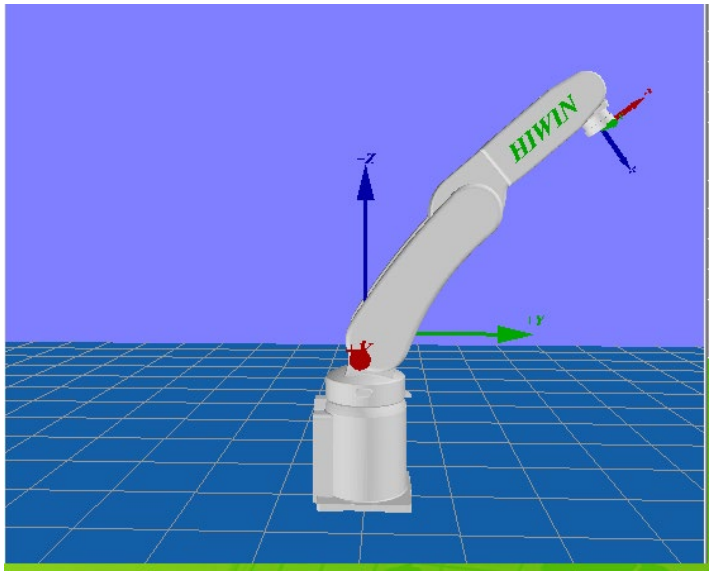
- Overhead

  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.



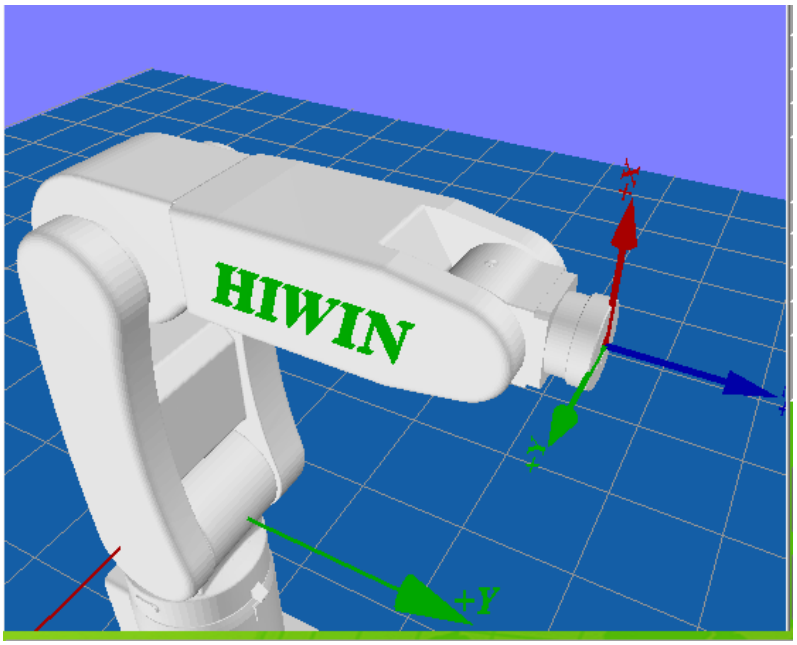
- Extended position

  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. Error Message

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

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

6.1.1. 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			
01-01-23	EtherCAT line crossing alarm			
01-01-24	EtherCAT none slave alarm			
01-01-25	EtherCAT can't check slave			
01-01-26	EtherCAT slave none response			

Error code	Error	Message	Reason	Solution
01-01-27	EtherCAT cycle alarm	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.
01-01-28	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			
01-01-31	EtherCAT busbar scan error			
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			

Error code	Error	Message	Reason	Solution
01-01-36	EtherCAT slave counter error of initialization command	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.
01-01-37	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			
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			
01-01-58	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	User needs to reboot

			full to 512 MB	
01-01-60	FBWF file failed to open	FBWF file failed to open	File damage	Confirm that the file is damaged

6.1.2. 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 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.

6.1.3. 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		

Error code	Error	Message	Reason	Solution
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	Motion to Axis 3 reach negative limit	Axis 3 move positive

		negative rotation limit		
01-03-1C	Axis 4 position overlimit of positive	Axis 4 exceeded positive rotation limit	Motion to Axis 4 reach positive limit Motion to	Axis 4 move negative
01-03-1D	Axis 4 position overlimit of negative	Axis 4 exceeded negative rotation limit	Axis 4 reach negative limit Motion to Axis 5 reach	Axis 4 move positive

Error code	Error	Message	Reason	Solution
01-03-1E	Axis 5 position overlimit of positive	Axis 5 exceeded positive rotation limit	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
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	

Error code	Error	Message	Reason	Solution
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

6.1.4. 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	Driver connection is abnormality	Check driver connection.
01-04-17	Write data to driver 2 is abnormality	Axis 2 driver parameter write back failed		

Error code	Error	Message	Reason	Solution
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		

01-04-1C	Clear driver 1 encoder is abnormality	Clear Axis 1 driver encoder failed	1.Driver connect is abnormality. 2. The command is forbidden	1.Check driver connected. 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		

Error code	Error	Message	Reason	Solution
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 3.6.2
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			
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	

Error code	Error	Message	Reason	Solution
01-04-53	Interpolation buffer overflow	Interpolation command buffer overflow	Interpolation command too much, causing 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.
01-04-60	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, will not shutdown	Inform user NTP is 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.

6.1.5. 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	1.Change TP. 2.Check connect port.

			port is abnormal.	
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 automatically disconnect from client
Error code	Error	Message	Reason	Solution
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	Network client	Check sever whether interact with client

		disconnect time out	disconnect time out	disconnect message

6.1.6. 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.
Error code	Error	Message	Reason	Solution
01-06-17	Setting conveyor tracking acceleration error	Parameter setting error	Parameter out of the range	Check the parameter

01-06-18	Setting conveyor pick acceleration error			setting is correct.
01-06-19	Enable smooth motion error			
01-06-1A	Disable smooth motion error			
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			
Error code	Error	Message	Reason	Solution
01-06-30	DI can't be setting	Parameter cannot be set	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
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		

6.1.7. 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	
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

Error code	Error	Message	Reason	Solution

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

6.1.8. 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.

6.1.9. 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

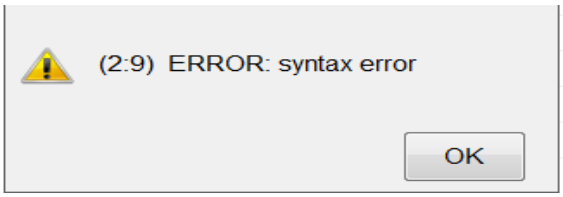
Error code	Error	Message	Reason	Solution
01-09-16	User-defined error 7	User-defined error 7	User-defined error.	User-defined error 7
01-09-17	User-defined error 8	User-defined error 8		User-defined error 8
01-09-18	User-defined error 9	User-defined error 9		User-defined error 9
01-09-19	User-defined error 10	User-defined error 10		User-defined error 10

6.1.10. 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		

6.1.11. 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.

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

6.2.1. 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.

6.2.2. 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.

6.3. Axis Amplifier(03-XX-XX)

6.3.1. 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.

6.3.2. 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.
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 released. 3. Power	1. Change the motion plan, or reduce load. 2. Check that the wiring and the driver voltage are correct.

			supply wiring is incorrect	

Error code	Error	Message	Reason	Solution
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.
03-0m(En)-52	Anti-surge resistor overheat	Anti-Surge resistor overheated.	1. Power switch frequency is too high. 2. Ambient temperature is too high.	1. Reduce the power switch frequency. 2-1. Check the cooling fan is running. 2-2. Change the amplifier installation conditions.

Error code	Error	Message	Reason	Solution
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.

Error code	Error	Message	Reason	Solution
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.
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	1. Wrong connection. 2. Connector off.	1. Check the encoder cable.

		disconnected.	3. Poor connection	2. Check the power supply voltage on the motor side.

Error code	Error	Message	Reason	Solution
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.
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.

Error code	Error	Message	Reason	Solution
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		
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.

Error code	Error	Message	Reason	Solution
03-0m(En)-C1	speed overlimit	The speed of the motor exceeds 120% of the maximum speed.	Overshoot too big.	1. Adjust the servo parameters. 2. Slow command acceleration and 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.
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.
Error code	Error	Message	Reason	Solution
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.	
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.	The temperature around the amplifier is	Reduce the ambient temperature.

		Robot will not stop.	greater than the preset temperature range.	
03-0m(En)-FB	regenerated overload warning	* Regenerative overload warning. Robot will not stop	Regenerated resistance overload.	Relax the conditions of use.

Error code	Error	Message	Reason	Solution
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.
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.

Error code	Error	Message	Reason	Solution
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.

6.3.3. 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.

Error code	Error	Message	Reason	Solution
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	Combinatio n 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.
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.

Error code	Error	Message	Reason	Solution
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.

Error code	Error	Message	Reason	Solution
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.

Error code	Error	Message	Reason	Solution
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.
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.

Error code	Error	Message	Reason	Solution
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.

Error code	Error	Message	Reason	Solution
Y-7AB	Built-in fan stopped.	The internal fan of the SERVOPACK stopsped.	There is a foreign object entering, or the servo unit is abnormal.	1. Remove foreign objects. 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.

Error code	Error	Message	Reason	Solution
Y-B11	The speed command A/D conversion data is abnormal.	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-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.

Error code	Error	Message	Reason	Solution
Y-C91	The encoder communication position data acceleration 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-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.

Error code	Error	Message	Reason	Solution
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 unit is abnormal.	1. Please turn off the power and restart. 2. Please contact the 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.

6.3.4. 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.

Error code	Error	Message	Reason	Solution
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 power supply.	Replace the drive or Confirm external circuit.

Error code	Error	Message	Reason	Solution
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.

Error code	Error	Message	Reason	Solution
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	Communicati on error.	Communication error.	Abnormal communicati on.	Check if the communication format is correct.
S-7520	Link lost.	Communication disconnect.	Communicati on 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.

Error code	Error	Message	Reason	Solution
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.

6.4. Electric gripper(04-XX-XX)

6.4.1. 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.

Error code	Error	Message	Reason	Solution
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.

6.4.2. 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.	

Error code	Error	Message	Reason	Solution
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.	

Error code	Error	Message	Reason	Solution
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.

6.4.3. 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.

6.4.4. 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		

7. Program Examples

7.1. Register

7.1.1. 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.

7.1.2. 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).

7.2. Variable Type

7.2.1. 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.

7.2.2. 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.

7.2.3. 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.

7.2.4. 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.

7.2.5. 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.

7.2.6. 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.

7.2.7. 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.

7.3. Operator

7.3.1. 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.

7.3.2. 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

7.3.3. 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

7.4. Input/Output

7.4.1. Digital Input

Program:
$DI[1] = TRUE
Parameter explanation:
The Digital Channel 1 inputs TRUE.

7.4.2. Digital Output

Program:
$DO[1] = TRUE
Parameter explanation:
The Digital Channel 1 outputs TRUE.

7.4.3. Robot Input

Program:
$RI[1] = TRUE
Parameter explanation:
The Channel 1 of Robot signal inputs TRUE.

7.4.4. Robot Output

Program:
$RO[1] = TRUE
Parameter explanation:
The Channel 1 of Robot signal outputs TRUE.

7.4.5. Valve Output

Program:
$VO [1] = TRUE
Parameter explanation:
The Channel 1 of Solenoid Valve outputs TRUE.

7.5. 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}.

7.5.1. 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.

7.5.2. 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.

7.5.3. 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.

7.5.4. 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]

7.5.5. 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.

7.5.6. 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).

7.5.7. 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).

7.5.8. 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.

7.5.9. 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.

7.5.10. 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.

7.5.11. BRAKE

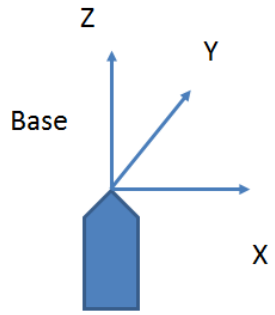
Program:

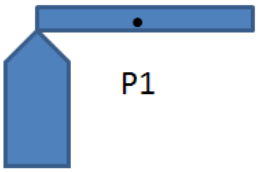
```
LIN P0 FINE=1 Vel=3000mm/s Acc=100% TOOL[0] BASE[0]
LIN_REL {Z -200}
LOOP
  IF $DI[1] == TRUE THEN
    BRAKE
    EXIT
  ENDIF
ENDLOOP
LIN P1 FINE=1 Vel=3000mm/s Acc=100% TOOL[0] BASE[0]
```

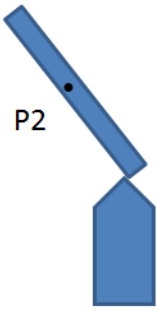
Description:
The robot moves to P0, it moves 200mm down along Z axis. The sensor of DI[1] is triggered on the way, the robot stop the motion and moves linearly from the stop point to P1.

7.5.12. EXT_TCP

Front work:
At the external tool point, teach a Base coordinate system, and the origin of the Base coordinate system is at the tool processing point.
Teaching starting point is at point P1 and ending point at P2







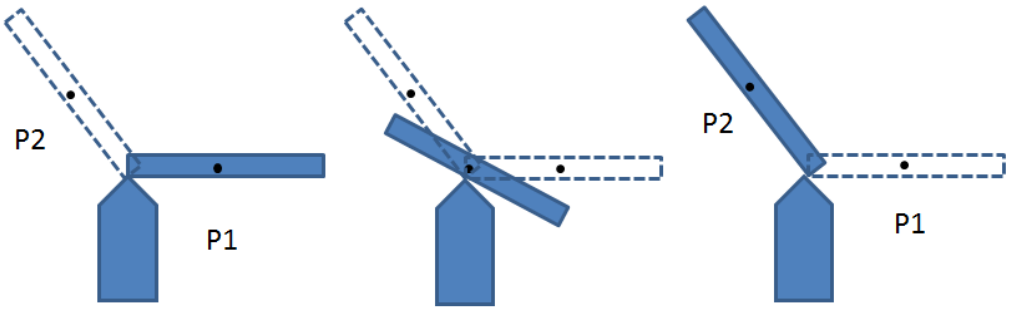
Teach Base Starting Point Ending Point

Program:

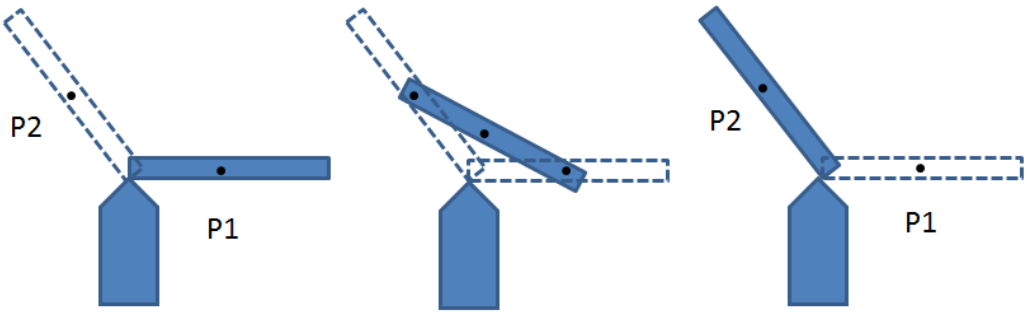
```
EXT_TCP_START
LIN P1 FINE=1 Vel=1000mm/s Acc=100% TOOL[0] BASE[1]
LIN P2 FINE=1 Vel=1000mm/s Acc=100% TOOL[0] BASE[1]
EXT_TCP_END
```

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

7.6. Control Function

7.6.1. 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.

7.6.2. 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.

7.6.3. 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.

7.6.4. 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.

7.6.5. 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.

7.6.6. 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.

7.6.7. 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.

7.6.8. 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.

7.6.9. 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).

7.7. Motion Parameter

7.7.1. 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.

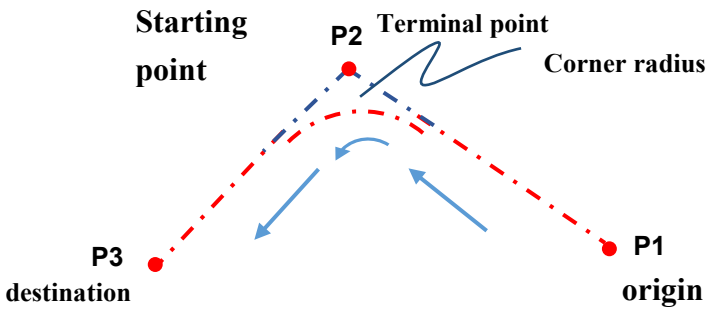
- CONT

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

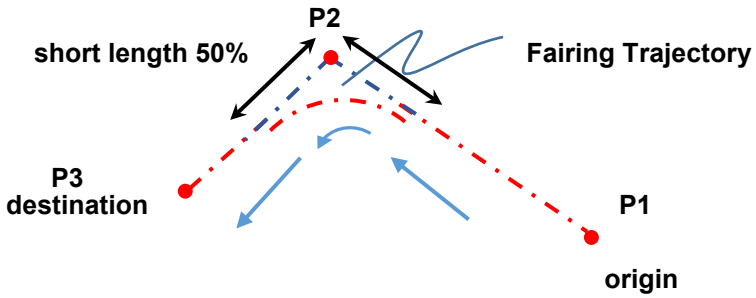
As Figure 10.2 show:

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%

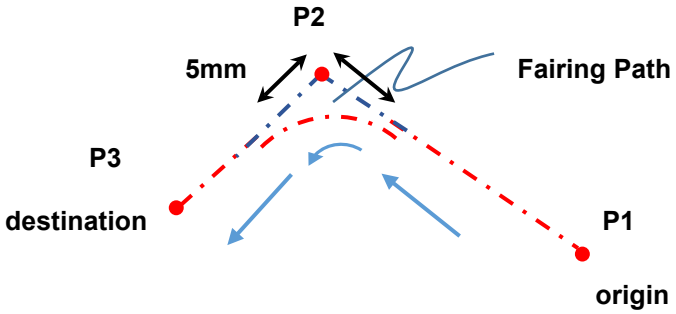
- CONT = #mm

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.

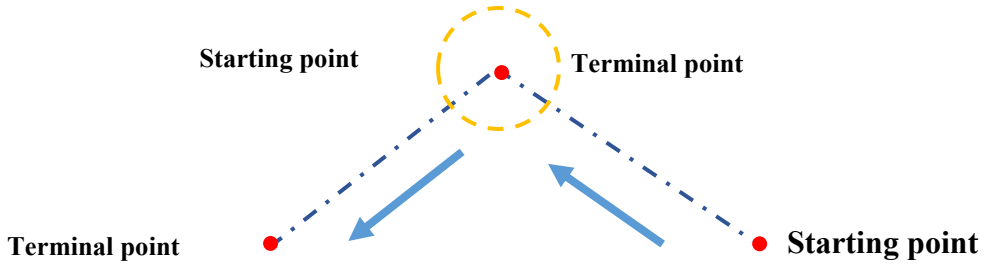
Example：

```
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.

7.7.2. 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.

7.7.3. 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.

7.7.4. ACC

Acc=50%

Define the acceleration. The expression is the percentage of maximum acceleration.

7.8. 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.

7.9. Function & Subprogram

7.9.1. 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.

7.9.2. 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.

7.10. External Function & Subprogram

7.10.1. 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.

7.10.2. 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.

7.11. 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

7.12. 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:

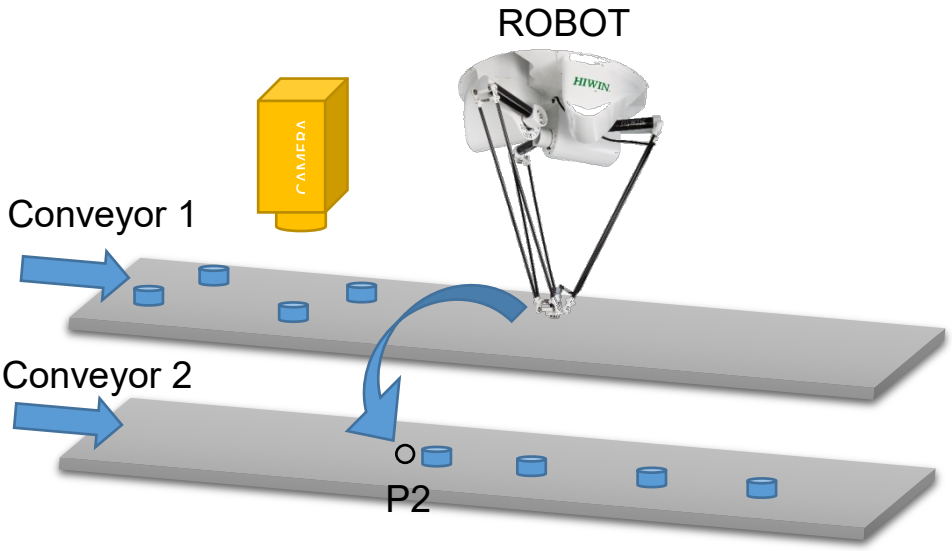
Program writing and reading the number via network

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

7.13. Conveyor Configuration

7.13.1. Pick Program(1)



Pick Example 1

Program description:

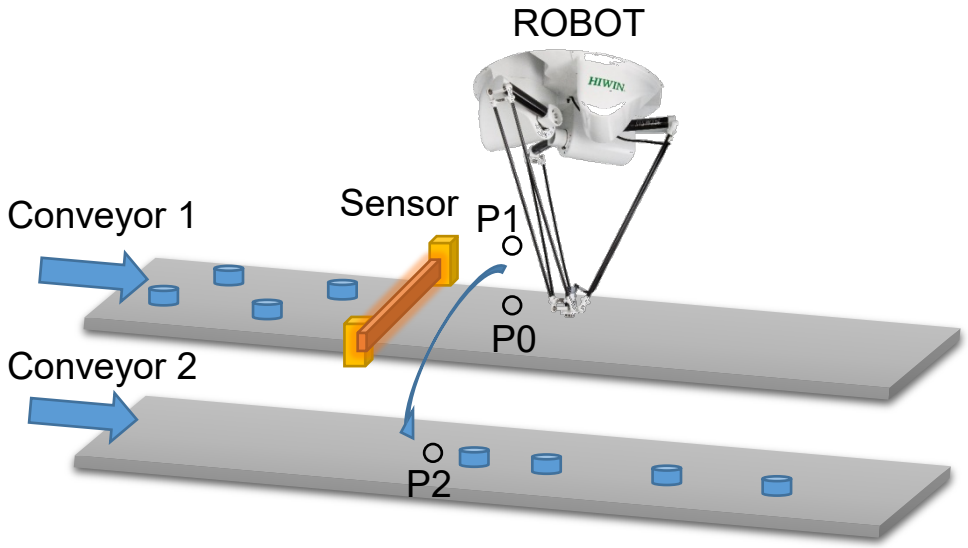
This is a visual example.

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
```

7.13.2. Pick Program(2)



Pick Example 2

Program description:

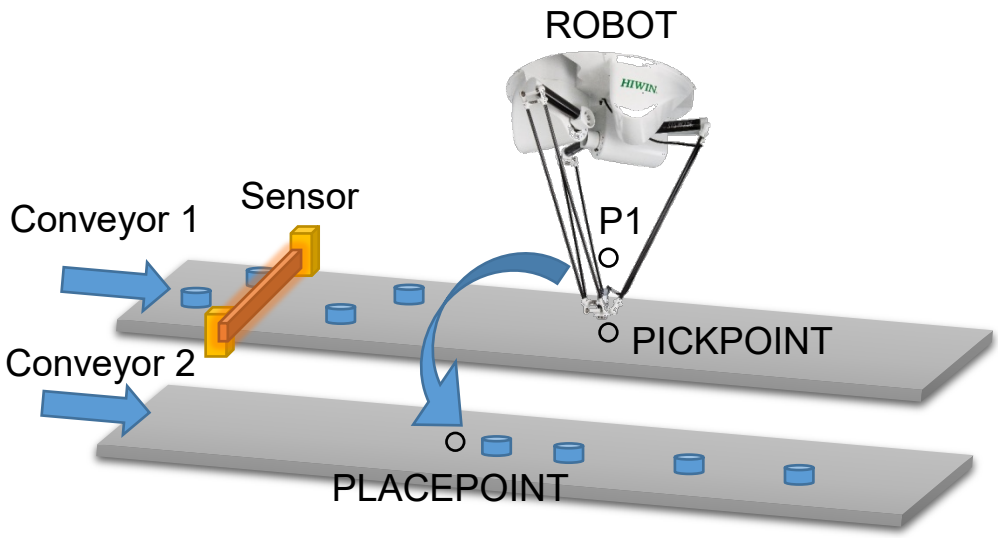
When the position to trigger a sensor is within the picking range, P can be directly set as the pick and place position.

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
```

7.13.3. 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
```

7.14. DO switching on the path(SYN OUT)

7.14.1. 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.

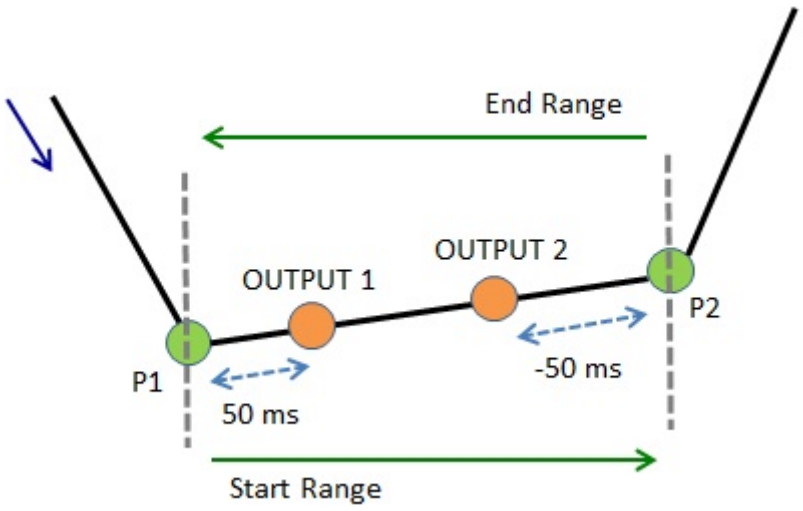


Illustration of Example 1

7.14.2. 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.

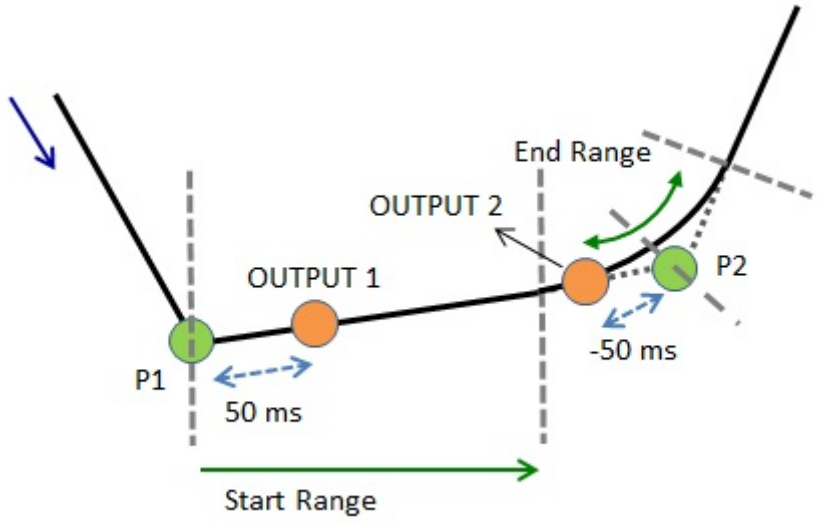


Illustration of Example 2

7.14.3. 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.

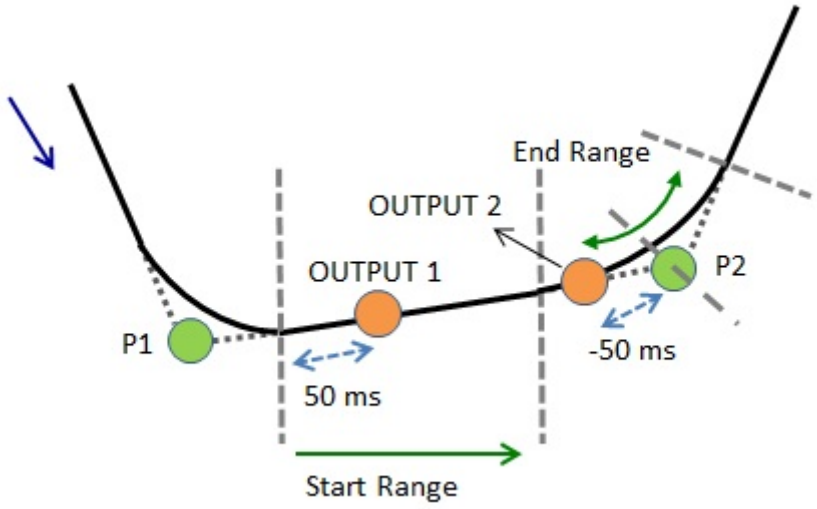


Illustration of Example 3

7.14.4. 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.

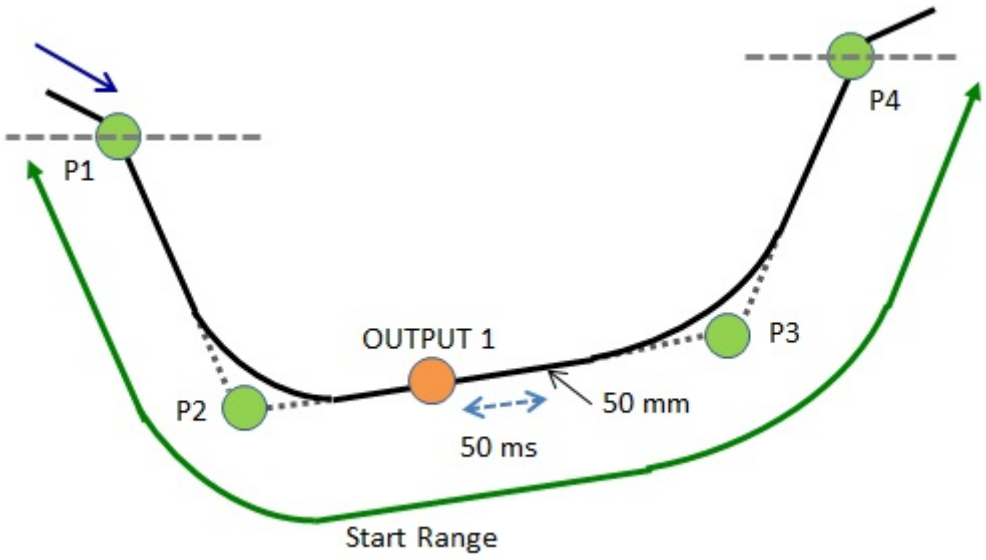


Illustration of Example 4

7.14.5. 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.

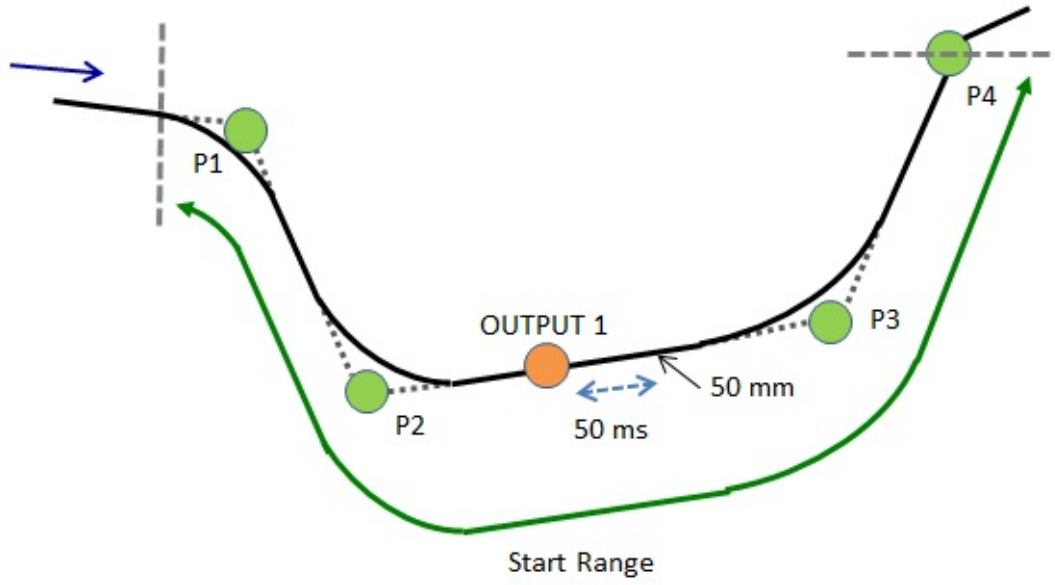


Illustration of Example 5

7.15. 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
```

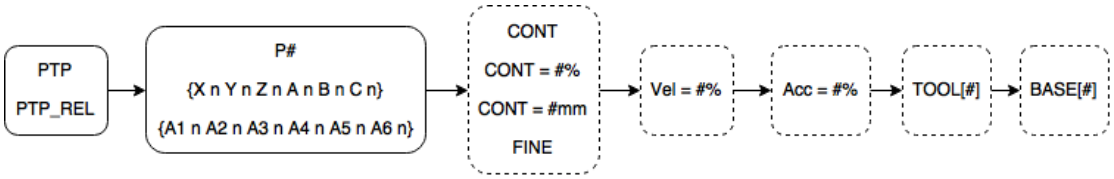
8. Appendix

8.1. Software commands

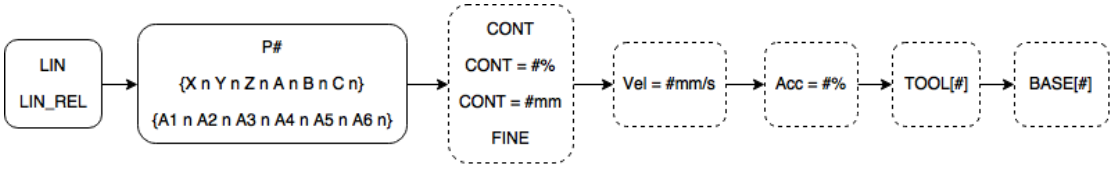
Motion commands:

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

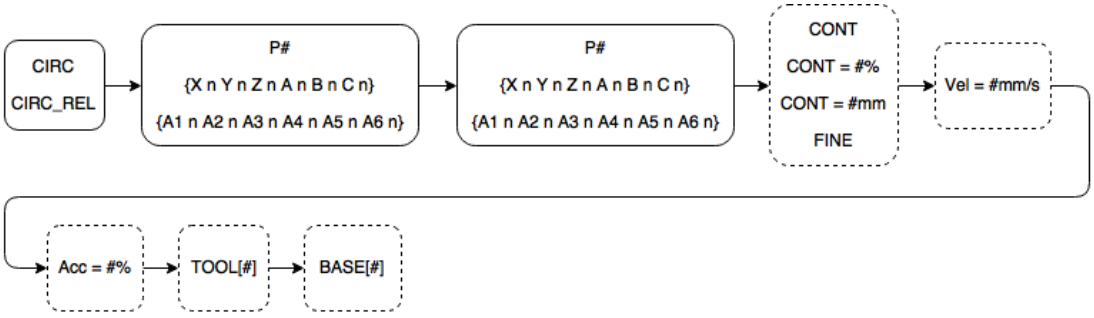
PTP&PTP_REL flowchart:



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_SPEED	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_STATUS	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

Remote Robot Controller Software (Original Instruction)
User Manual

Publication Date：January 2020

1. HIWIN is a registered trademark of HIWIN Technologies Corp. For your protection, avoid buying counterfeit products from unknown sources.
2. Actual products may differ from specifications and photos provided in this catalog. These differences may be the result of various factors including product improvements.
3. HIWIN will not sell or export products or processes restricted under the "Foreign Trade Act" or related regulations. Export of restricted products should be approved by proper authorities in accordance with relevant laws and shall not be used to manufacture or develop nuclear, biochemical, missiles or other weapons.
4. HIWIN website for patented product directory: http://www.hiwin.tw/Products/Products_patents.aspx

HIWIN®

Subsidiaries / Research Center

HIWIN GmbH
OFFENBURG, GERMANY
www.hiwin.de
www.hiwin.eu
info@hiwin.de

HIWIN Schweiz GmbH
JONA, SWITZERLAND
www.hiwin.ch
info@hiwin.ch

HIWIN KOREA
SUWON · CHANGWON, KOREA
www.hiwin.kr
info@hiwin.kr

HIWIN JAPAN
KOBE · TOKYO · NAGOYA · NAGANO · TOHOKU · SHIZUOKA · HOKURIKU · HIROSHIMA · FUKUOKA · KUMAMOTO, JAPAN
www.hiwin.co.jp
info@hiwin.co.jp

HIWIN s.r.o.
BRNO, CZECH REPUBLIC
www.hiwin.cz
info@hiwin.cz

HIWIN CHINA
SUZHOU, CHINA
www.hiwin.cn
info@hiwin.cn

HIWIN USA
CHICAGO, U.S.A.
www.hiwin.com
info@hiwin.com

HIWIN SINGAPORE
SINGAPORE
www.hiwin.sg
info@hiwin.sg

Mega-Fabs Motion Systems, Ltd.
HAIFA, ISRAEL
www.mega-fabs.com
info@mega-fabs.com

HIWIN Srl
BRUGHERIO, ITALY
www.hiwin.it
info@hiwin.it

HIWIN TECHNOLOGIES CORP.
No. 7, Jingke Road,
Taichung Precision Machinery Park,
Taichung 40852, Taiwan
Tel: +886-4-23594510
Fax: +886-4-23594420
www.hiwin.tw
business@hiwin.tw

©2020 FORM 2020-01 (PRINTED IN TAIWAN)