



# SCARA Robot - RS403

User Manual





## Semiconductor Subsystem

- Semiconductor/LED/Panel
- EFEM (Equipment Front End Module)
  - Wafer Robot
  - Load Port
  - Wafer Aligner



## Multi-Axis Robot

- Pick-and-Place / Assembly / Array and Packaging / Semiconductor / Electro-Optical Industry / Automotive Industry / Food Industry
- Articulated Robot
  - SCARA Robot
  - Electric Gripper
  - Integrated Electric Gripper



## Single-Axis Robot

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



## Torque Motor Rotary Table

- Medical / Automotive Industry / Machine Tools / Machinery Industry
- RAB Series
  - RAS Series
  - RCV Series
  - RCH Series



## Ball screw

- 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
  - Support Unit



## DATORKER® Strain Wave Gear

- Robot / Automation Equipment / Semiconductor Equipment / Machine Tools
- DSC Type
  - DSH Type
  - DGC Type
  - DGH Type
  - DLC Type



## AC Servo Motor & Drive

- Semiconductor / Packaging Machine / SMT / Food Industry / LCD
- Drives--D1, D2T/D2T-LM, E1
  - Motors--FR, E1



## Medical Equipment

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



## Linear Motor Stage

- 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
  - Single-Axis Linear Motor Stage



## Torque Motor & Direct Drive Motor

- Machine Tools
- Torque Motor--TM-2/IM-2, TMRW Series
- Inspection / Testing Equipment / Robot
- Direct Drive Motor--DMS, DMY, DMN, DMT Series

Company: HIWIN Technologies Corp.

Address: No.7, Jingke Road, Taichung Precision Machinery Park,  
Taichung 40852, Taiwan

Date: November 2017

Version: 2.0

Tel: +886-4-23594510

Fax: +886-4-23594420

E-mail: [business@hiwin.tw](mailto:business@hiwin.tw)

Website: <http://www.hiwin.tw>

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**Revision History**

Version	Date	Remark
Ver1.0	2017/08	First issuance
Ver1.1	2017/11	Added the Ball Screw /Spline lubrication
Ver1.2	2018/04	Added End-extending load

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# Foreword

Thank you for purchasing the Selective Compliance Assembly Robot Arm or Selective Compliance Articulated Robot Arm (SCARA). This manual will provide the method for installing and maintaining the machine, and protect a user life from improper operation. A user should carefully read the description prior to the operation. If the regulations are not followed to cause the machine damage or injury, a user must take the related responsibilities. After you read this manual, please keep it well so that can be read any time.

# About Manual

This manual describes the SCARA Robot developed by HIWIN, whose structure includes the body, the control panel, the Teaching Pendant (optional), the connection cable and the software. A user who purchases the robot can operate and maintain the robot via this manual.

This manual is suitable for the SCARA Robot only, which can be operated under the ambient environment, but is not suitable for the related equipment and the operating environment not mentioned in this manual, such as vacuum condition and equipment involved in personal life.

# Warranty

The SCARA Robot is strictly tested and examined, and delivered to a customer after its performance meets our requirements.

## Warranty Period:

The product provides one-year warranty period from the day since it is delivered. For the detailed terms and clauses of maintenance and repair, please contact the agent.

## Warranty Content:

- Guarantee the equipment delivered to customer.
- In the warranty period, we provide free maintenance for failure during the normal operation. The failure after the warranty period is expired will be charged.

## Disclaimer:

Even in the warranty period above-mentioned, the service will be charged when the following items are met.

- Failure and damage caused by incorrect operation different from the manual.
- Reconstruct or remove the robot by yourself.
- Failure and damage caused by improper adjustment/maintenance.
- Failure and damage caused by act of God/fire/other factor.
- If you operate the robot in the conditions or specifications beyond the manual, we will not guarantee the basic performances.
- We should not take any responsibility for human body (death or serious injury)/damage incident/failure caused by not following “WARNINNG” and “CAUTION” in this manual.

We can't completely forecast all conditions for danger and failure. Such ability to forecast shows the limit. Therefore, “WARNINNG”, “CAUTION” and other items in this manual belong to the forecasting scopes.



# Notice Symbol

The symbols and warnings on the robot represent the danger in different extents to remind a user of the safety concern during the operation, described as follows.



## **DANGER**

※DANGER symbol: represents an urgent danger. If it can't be stopped and avoided in time, the death or serious injury could take place.



## **WARNING**

※WARNING symbol: represents a potential danger condition. If it can't be solved in time, the injury or death could take place.



## **CAUTION**

※CAUTION symbol: represents a potential danger. If it can't be solved, the injury or the intermediate incident will take place.



※NOTE symbol: represents a special purpose or a remark on the product, including the mark qualified by the QC engineer.

## Contact

For the maintenance/examination/adjustment on the SCARA Robot, please contact customer service.

### **Please prepare the following information when you contact us:**

- System name/series number
- Software name/version
- Issue on the system

## Customer Service

Customer hotline: +866-4-23594510

E-mail: [business@hiwin.tw](mailto:business@hiwin.tw)

## **About Safety**

# 1 About Safety

This chapter mainly describes the operation regulations about the SCARA Robot, which not only provide the detailed operation information for a user and explain the meaning for each alert symbol one by one, but also inform a user of the risk and the emergency response during the operation.

## 1-1 Operation



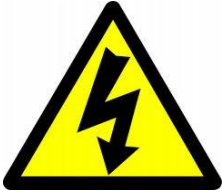


For the sake of human body, the following regulations must be obeyed:

- The robot can be operated or maintained by the trained and qualified operators.
- Please carefully read the description in this manual, so that can efficiently and safely operate the robot.
- The operators must be familiar with the position, the function and operation for safety switches.
- Please ensure there are no obstacles stacked around the robot prior to the operation.
- Don't open or remove the shelter on the robot.
- Please ensure the circuit systems have been indeed grounded prior to the operation.
- Before you replace any circuit, all power must be disconnected to avoid electric shock.
- Please immediately disconnect the main switch during the power failure or disconnection.
- Don't stain, scratch or move the warning label and product nameplate.

## 1-2 Safety Symbol

Each type of warning label is stuck on the robot and the control panel to remind a user of operational safety. If the labels are stained or fallen, they must be indeed cleaned or replaced.

Table 1-1 Safety Symbol

Sticking position	Label pattern	Remark
A		The pinch label is stuck on the SCARA Robot. There are many articulated joints on the robot. Please pay attention to your safety during the operation and avoid pinch by accident.
B		There is a hit label on the SCARA Robot. Don't enter the operating area to avoid damage or injury when the robot is operated.
C		There is a high voltage label on the SCARA Robot. Permissible voltage and the maximum current for the robot are 1P 200~240VAC and 10A. A user needs to note the circuit has been indeed grounded or there is any damage. When the robot is removed or any pipe is replaced, please disconnect the power and unplug the power connector to avoid electric shock.
D		Robot record. When the robot fails, you can provide the information for the supplier.
E		If you have any problems on the robot, please carefully read the Maintenance Manual, Software Manual or contact our customer service. If the property loss and life safety are caused by the personal factors, a user must take responsibility.

RS403-400-150-N

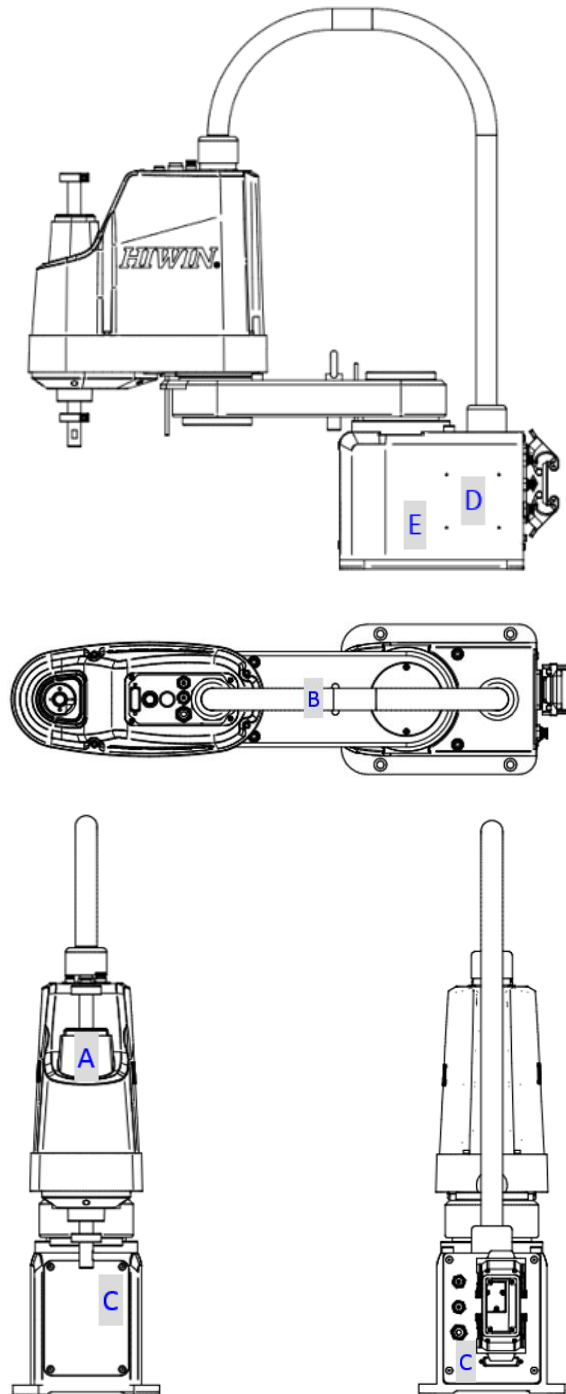



Figure 1-1 Illustration for Safety Symbol

 <p><b>CAUTION</b></p>	<p>➤ Don't remove the safety symbol. If it is lost, please contact us or the agent.</p>
---	---

## 1-3 Operation Notice

### 1-3-1 Run Alert Area



#### **WARNING**

The robot is a machine operating at high speed, whose maximum revolution radius depends on the fixture size installed on the end. Before you operate the robot, please ensure there is no any obstacle within the motion range, and indeed perform the calibration to avoid collision and damage. When the robot is operated, the operator should pay attention to the motion range for damage.

### 1-3-2 Temperature Error



#### **CAUTION**

When the robot is operated, the heat source comes from the electronic parts in the control panel. There are the cooling fans on two side of the panel. The operator should note the cooling fans normally run to prevent shutdown from overheating.

### 1-3-3 Flammability Alert



#### **WARNING**

If you wipe the robot with volatile detergent or volatile chemicals are used in the process, please ensure the temperature and the fan condition at any time to avoid a fire.

### 1-3-4 Humidity Error



#### **CAUTION**

Electronic components in the robot and the control panel are made of metal materials, which are more sensitive to the relative humidity of the operating environment. Higher humidity will accelerate to oxidize the contacts of metal part and electronic component, and loosen the assembly structure and cause poor contact; lower humidity will easily generate static electricity and damage electronic components. It is recommended the relative humidity in the ambient environment should be less than 50%.

### 1-3-5 High Voltage



#### **DANGER**

1P 200~240VAC is supplied to the robot. Once electric leakage or touch by accident takes place, it will cause serious injury or death. When you install the robot, you need to check each connector is indeed connected, and ensure all circuits are not excessively bent, even broken or damaged.

## 1-4 Emergency Stop

If you feel the robot failed during the operation, please immediately press the EMERGENCY STOP button. When you press the EMERGENCY STOP button, the arm will stop in the shortest distance by the controller and the motor brake.

Don't press the EMERGENCY STOP button when the arm normally operates. If you press EMERGENCY STOP button during the operation, it could hit the peripherals and internal hardware to cause damage.



The EMERGENCY STOP button is pressed in the urgent condition, not for pause/run. If you want to stop the robot in the normal operation and the working path, please operate it according to the software manual.

## 1-4-1 Robot Operation in Emergency Stop

When you press the EMERGENCY STOP button, please move the robot according to the following methods. When you perform the operations above-mentioned, please ensure the EMERGENCY STOP button on the robot is pressed and indicated in flash.

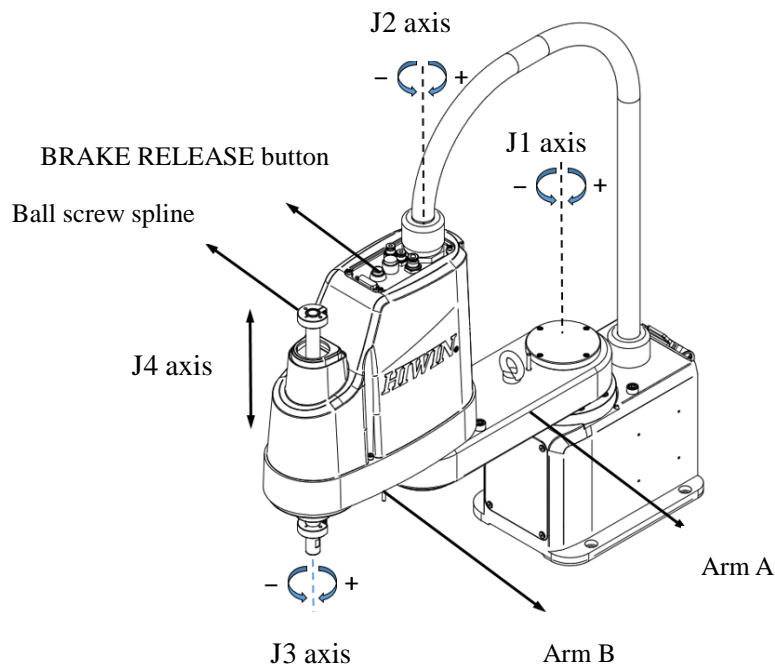



Figure 1-2 Illustration for Robot Axes

J1 axis: Move Arm A after you press the BRAKE RELEASE button.

J2 axis: Move Arm B after you press the BRAKE RELEASE button.

J3 axis: Rotate ball screw spline after you press the BRAKE RELEASE button.

J4 axis: Pull ball screw spline after you press the BRAKE RELEASE button.

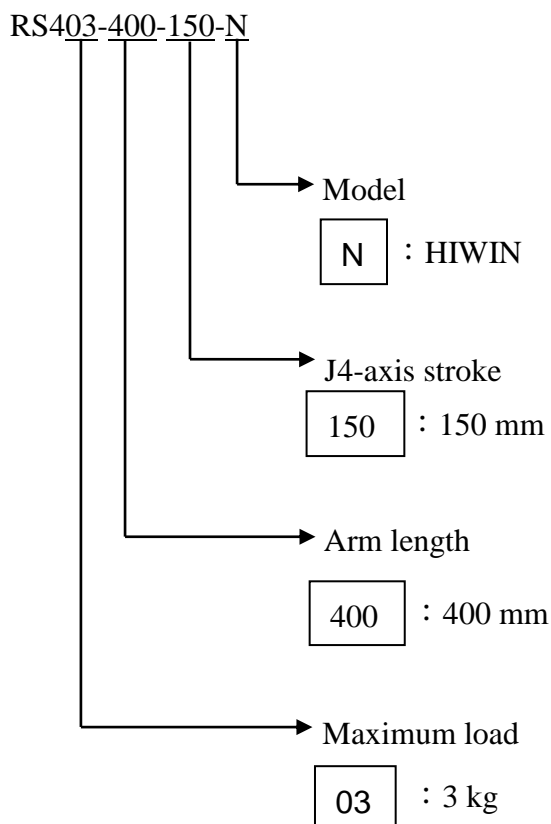
 <p><b>DANGER</b></p>	<ul style="list-style-type: none"> <li>➤ Don't apply excessive force to move the robot or quickly rotate the parts after you press the EMERGENCY STOP button. This condition could damage the robot.</li> <li>➤ Press the BRAKE RELEASE button after you press the EMERGENCY STOP button to simultaneously release the brake for four axes. Note that the object loaded on the end could drop and cause injury or death owing to its weight.</li> </ul>
--	---

## 2 Specifications

### 2-1 Features

The SCARA Robot, suitable for the ambient environment, can be applied for delivering and assembling the components, such as electronic parts. The maximum permissible inertia can reach 0.05 kg-m<sup>2</sup>.

### 2-2 Model Name



<b>NOTE</b>	<p>➤ The robot is operated in the standard environment. The accessories with additional coating are installed on the robot to prevent dust accumulation, which can be used for food industry.</p>
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## 2-3 Part Name and Dimensions

RS403-400-150-N

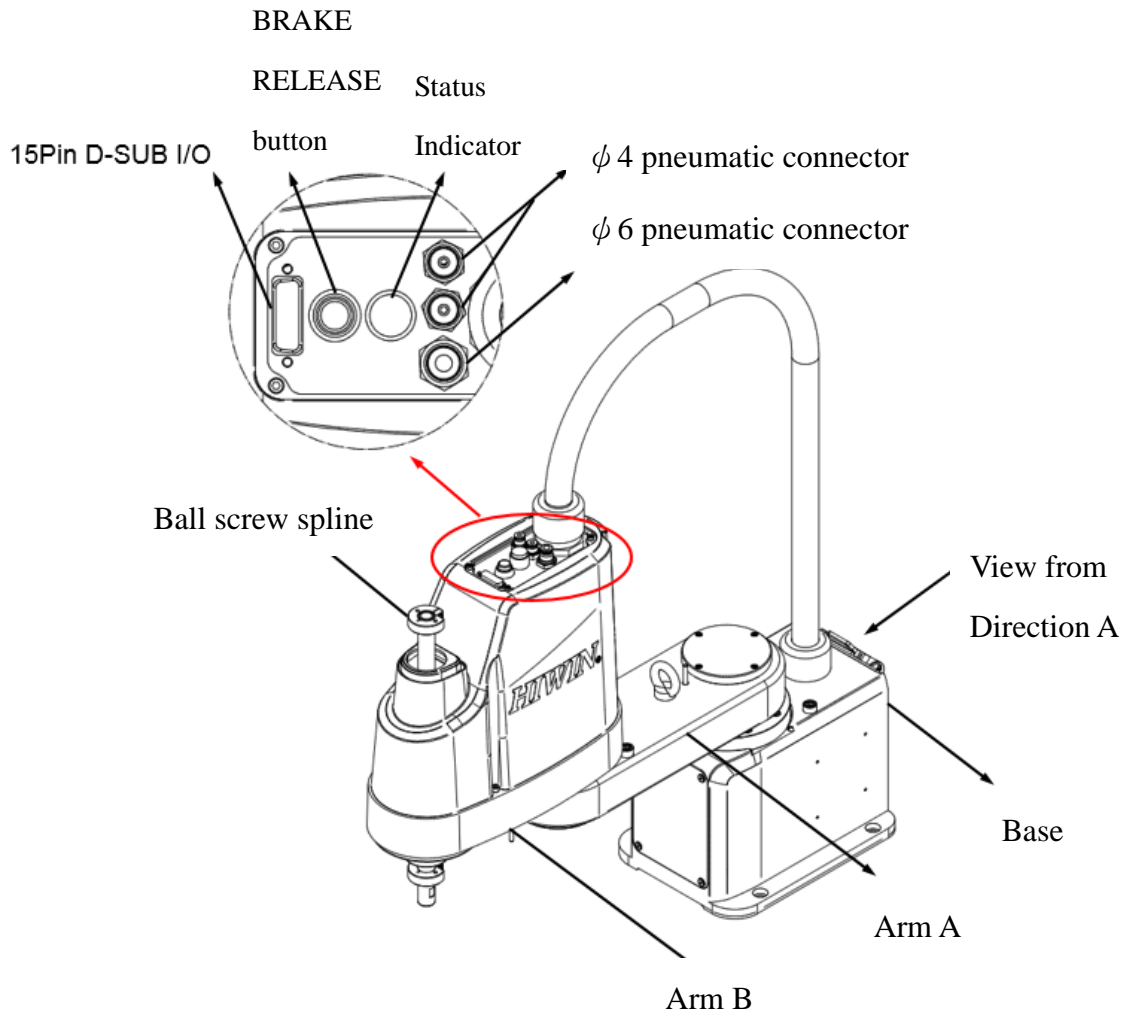


Figure 2-1 Part Names on Robot

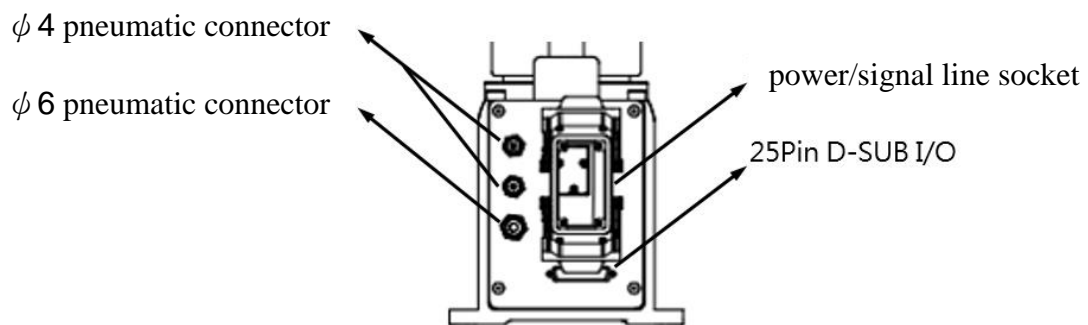


Figure 2-2 Illustration from the Direction A of Figure 2-1

RS403-400-150-N

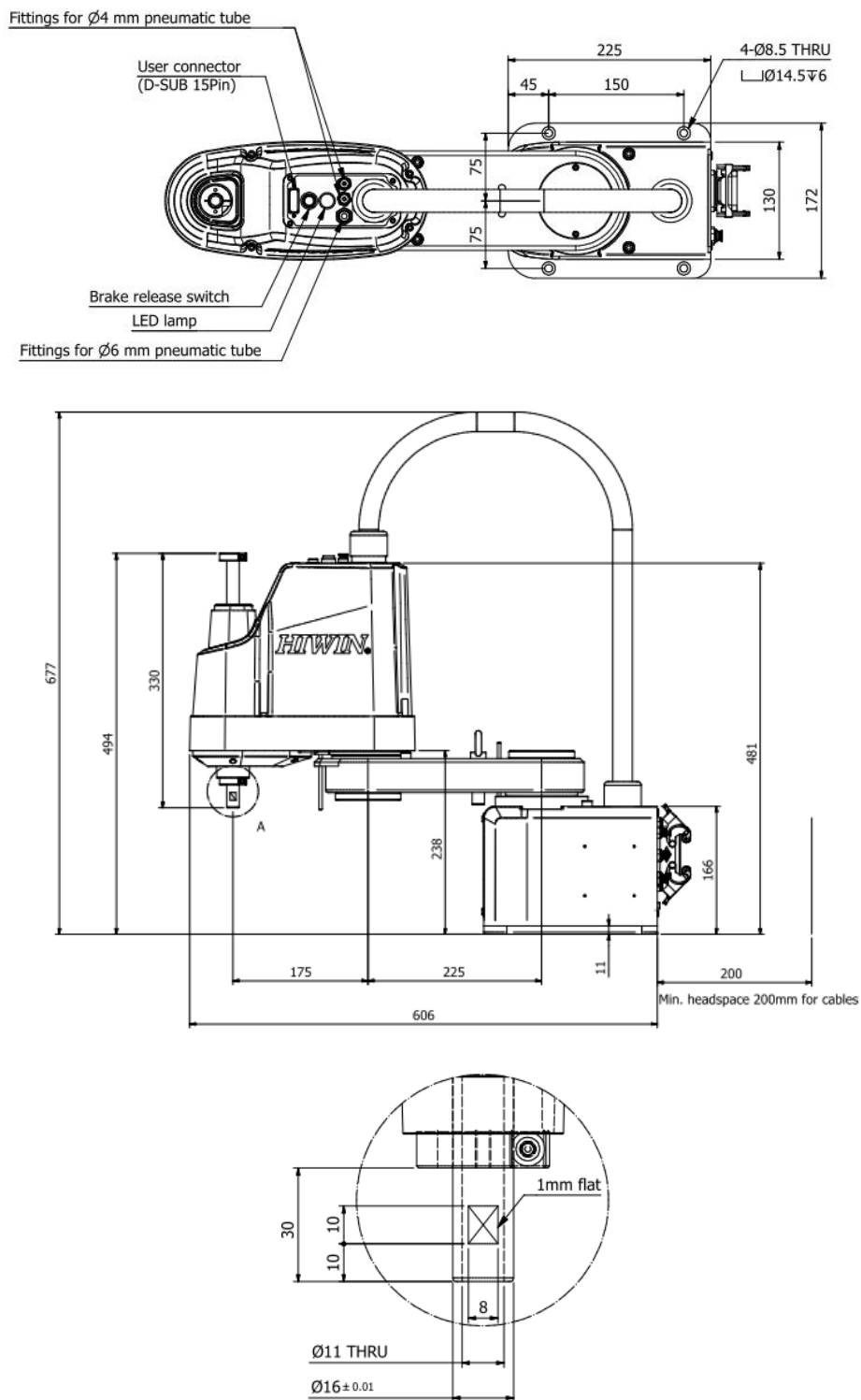


Figure 2-3 Part Dimensions for Robot

<b>NOTE</b>	➤ This dimension diagram is used for the reference, based on the approved ones or the actual ones.
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RS403-400-150-N

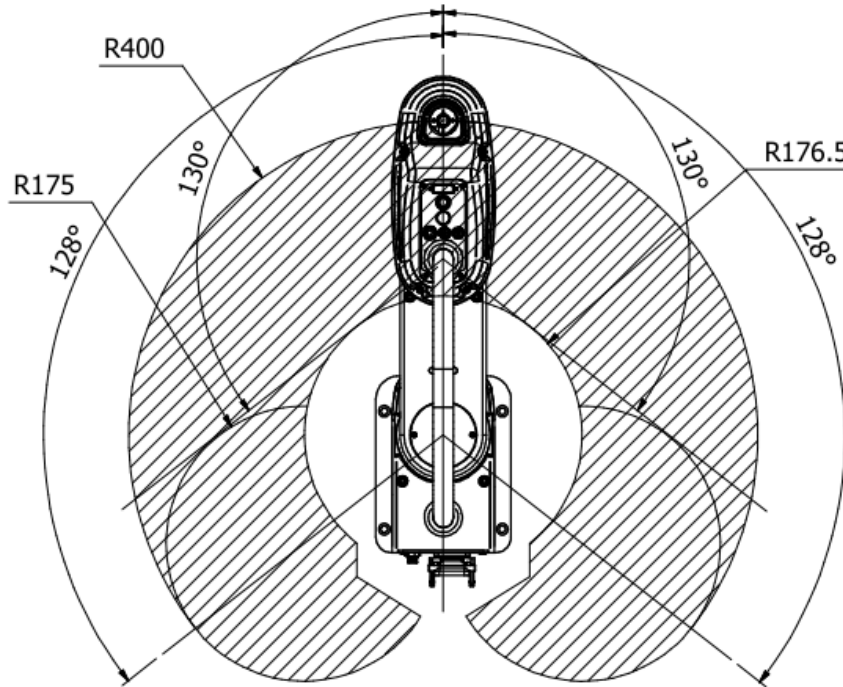


Figure 2-4 Motion Range for Robot



**DANGER**

- All motion ranges in this diagram is used for the reference. The dimensions are based on the approved diagrams or the delivered machines.
- The working range in this diagram doesn't include the end effector.

## 2-4 Specification Table

This manual takes RS403-400-150-N for example, and describes the performance and the specification of the robot, as shown in the following table.

Table 2-1 Specification Table for RS403-400-150-N

Specification Table				
Model Number	RS403-400-150-N			
Degree of Freedom	4			
Payload	Rated	kg	1	
	Maximum		3	
Maximum arm length (Arm A, and Arm B)		mm	400	
Maximum motion range	J1	deg	±128	
	J2	deg	±130	
	J3	deg	±360	
	J4	mm	150	
Cycle time		sec	0.42	
Repeatability		J1+J2	mm	±0.01
		J3	deg	±0.01
		J4	mm	±0.01
Maximum axial speed		J1	deg/sec	600
		J2		600
		J3		2000
		J4	mm/sec	890
Permissible rotation inertia		Rated	kg-m <sup>2</sup>	0.005
		Maximum		0.05
Arm I/O		3 Output Point 3 Input Point		
Pneumatic connector quantity/dimension		∅ 4 x 2		
		∅ 6 x 1		
Arm weight (not including the control panel)		kg	17	
Input power		V/A	AC 220V 1P 50 / 60 Hz	
Maximum pneumatic input	Input pressure	kg / cm <sup>2</sup>	7	
	Vacuum pressure		1	

### 3 Operating Environment

Before you operate the robot, you must ensure the operating environment can meet the related requirements to maintain the stability and lifetime.

Table 3-1 Operating Environment

Environmental condition	Operating environment	Storage environment
Temperature	5°C ~40°C	5°C ~40°C
Relative humidity	Less than 50%	Less than 50%
Assembly platform	Table	None
Power system	1P 200~240VAC	None
Notice	<ul style="list-style-type: none"> <li>➤ Install indoors to keep away from direct sunlight.</li> <li>➤ Keep away from dust, mist, salt, metal powder or other pollutants.</li> <li>➤ Keep away from flammable or corrosive solution and gas.</li> <li>➤ Keep away from the environment with water and high moisture.</li> <li>➤ Keep away from impact or vibration.</li> <li>➤ Keep away from a source of electromagnetic interference.</li> </ul>	
<div style="border: 2px solid black; background-color: yellow; padding: 5px; display: inline-block; font-weight: bold; margin-bottom: 10px;">NOTE</div>	<ul style="list-style-type: none"> <li>➤ The robot is not suitable in the coating environment. If it is operated at the place where doesn't meet the conditions above-mentioned, please contact us or the agent.</li> <li>➤ The robot is operated only under the ambient environment.</li> <li>➤ The surface of the robot for the special condition must be resistant to grease. If it could be stained with special grease, please contact us or the agent to confirm in advance.</li> <li>➤ If the robot is operated in the environment with larger temperature and humidity change, water condensation could take place inside. When it is used to move food, please contact us or the agent to ensure it will not pollute food.</li> <li>➤ The robot can't be operated in the acid or corrosive environment. In addition, the body could be corroded in the salty environment.</li> </ul>	

### 3-1 Install Robot

When you install the robot, please lock with M8 bolts. The bolt specifications need to meet ISO898-1:10.9 or 12.9. The base is installed on the lock surface. It is recommended the thickness be 20mm or more, and be made of the steel material to reduce the operating vibration. It is suggested the surface roughness be 25μm or less than 25μm. The other assemblies are installed with appropriate tools in accordance with the operating manual to avoid injury or damage by the improper operation.

When you install the robot, the working range must be taken into account. If the end effector is installed, the maximum motion range will vary (depending on the position and overhang of the end effector). Therefore, the safety area or the safety fence will be changed, and the operators should not enter the area to avoid injury or death when the robot operates.

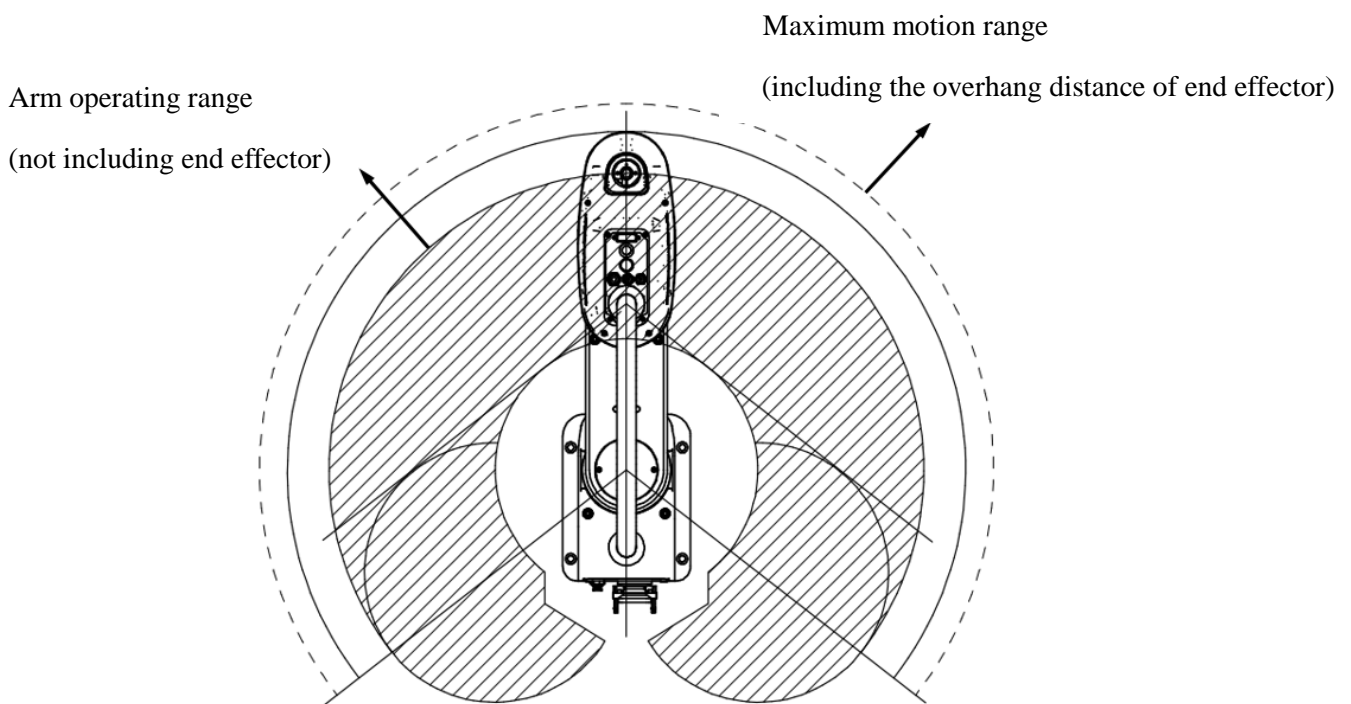




Figure 3-1 Working Range for Robot


	<ul style="list-style-type: none"> <li>➤ When you install the robot, please consider the motion range (including the distance of end effector), and set up the warning or safety fence.</li> <li>➤ The operators should not enter the area to avoid injury or death when the robot operates.</li> </ul>
---	---



## 3-2 Disassemble Package and Transport

The robot must be installed by the authorized engineer, and complied with the national regulations. After you remove the package and take out the robot with a protective bag, please transport it to the installation position by appropriate facilities. The robot must be properly fixed during the transportation. The operator must note the personal safety to prevent pinch or hurt from strong vibration or object.

 <p><b>WARNING</b></p>	<ul style="list-style-type: none"> <li>➤ The authorized staff can operate crane or forklift only. When those without authorization perform the operations above-mentioned, the surrounding operators could be injured or the robot could be damaged.</li> </ul>
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 <p><b>CAUTION</b></p>	<ul style="list-style-type: none"> <li>➤ Transport the robot with a cart.</li> <li>➤ The robot must be delivered by two operators or more when transported with bare hands. The base, Arm A or Arm B are held with two hands. Don't pull black flexible conduit or any connector.</li> <li>➤ When you adjust the position to install the robot, please hold it with two hands so that it drops to pinch the operator.</li> <li>➤ The robot must be indeed fixed on the transportation facility to avoid collision, falling and damage when transported in long distance.</li> </ul>
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## 4 Install End Effector

### 4-1 Installation Notice

When you install the end effector, please obey the following items.

1. Don't remove or change any mechanical stopper on the robot by yourself.
2. When you install the end effector on ball screw spline, please install it at 30mm on the lower end of ball screw spline and fix with the threaded structure over M4.
3. When you install the end effector, please note weight, static torque and rotation inertia are in the motion range. For the method to calculate static torque and rotation inertia, please refer to 4-2 Overview for Calculating Static Torque and Rotation Inertia.

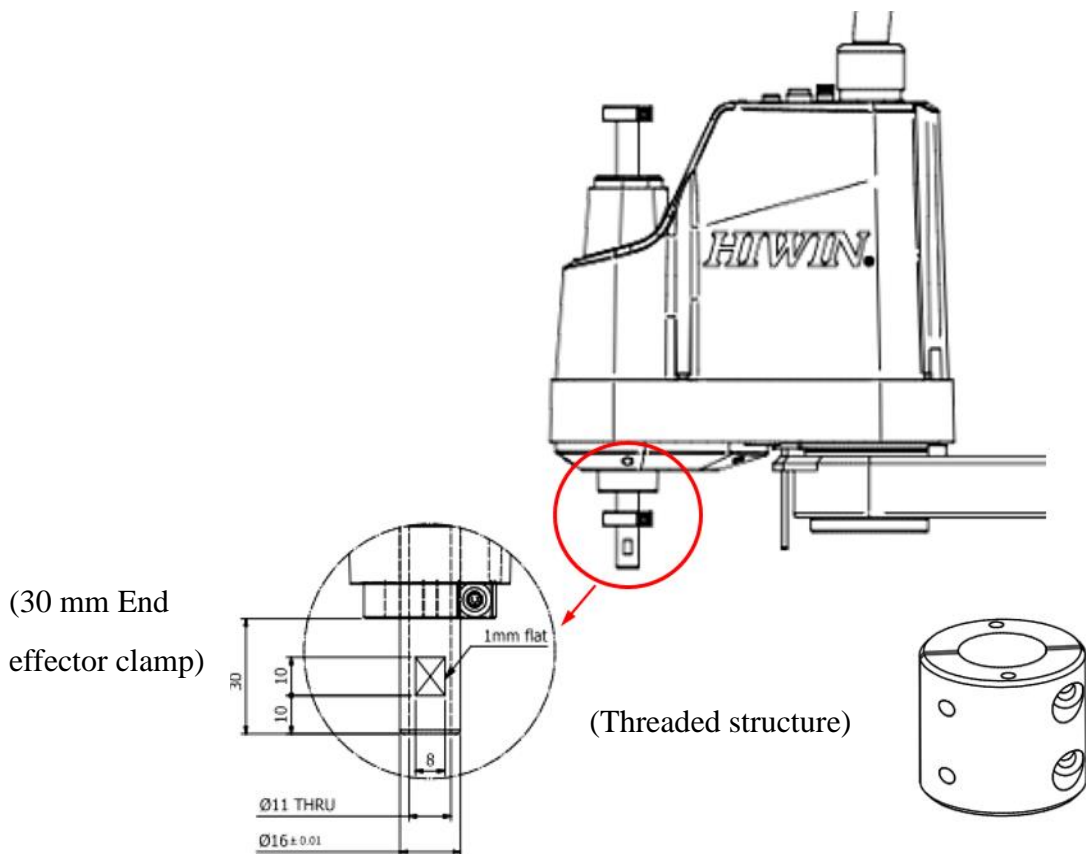


Figure 4-1 Recommended Installation Illustration for Ball End Effector

**NOTE**

- If there are some doubts on weight, static torque and rotation inertia, please contact us or the agent.

## 4-2 Overview for Calculating Static Torque and Rotation Inertia

### 4-2-1 Calculate Static Torque

The permissible static torque for this robot is 90N.m, determined by  $M$  (torque) =  $F$  (force)  $\times$   $L$  (end fixture/effector overhang plus total arm length), and must be less than 90N.m. Please obey the operating condition. If the torque exceeds this value, the performance and lifetime will be reduced.

Formula to calculate static torque:

$$M \text{ (torque)} = F \text{ (force)} \times L \text{ (overhang plus total arm length)}$$

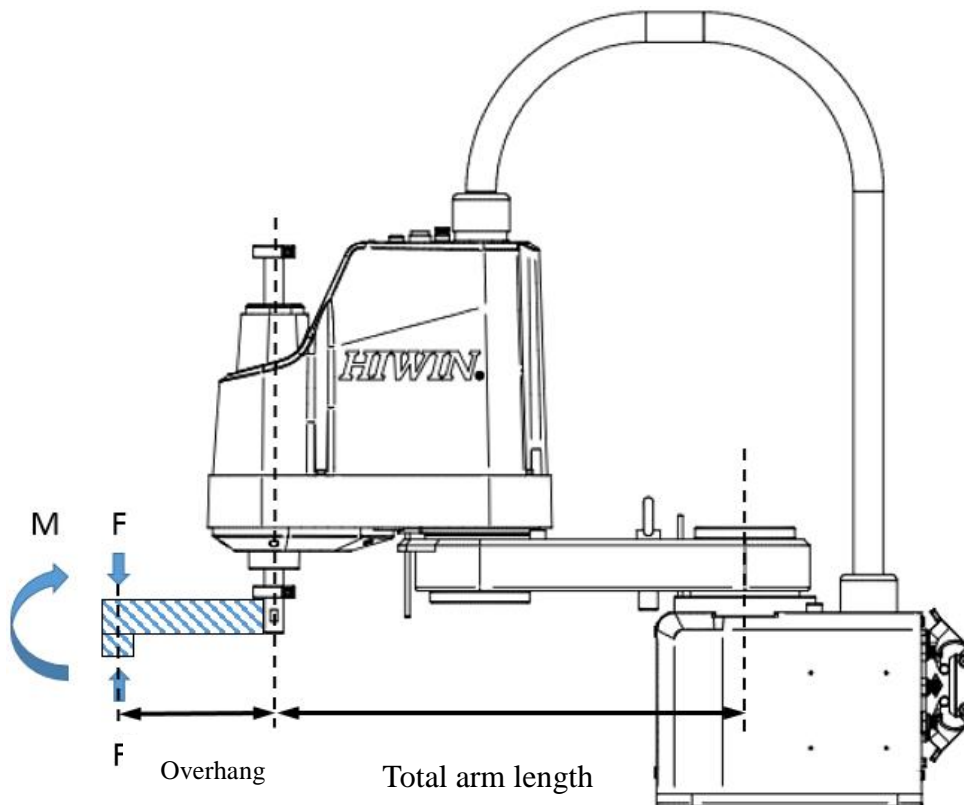
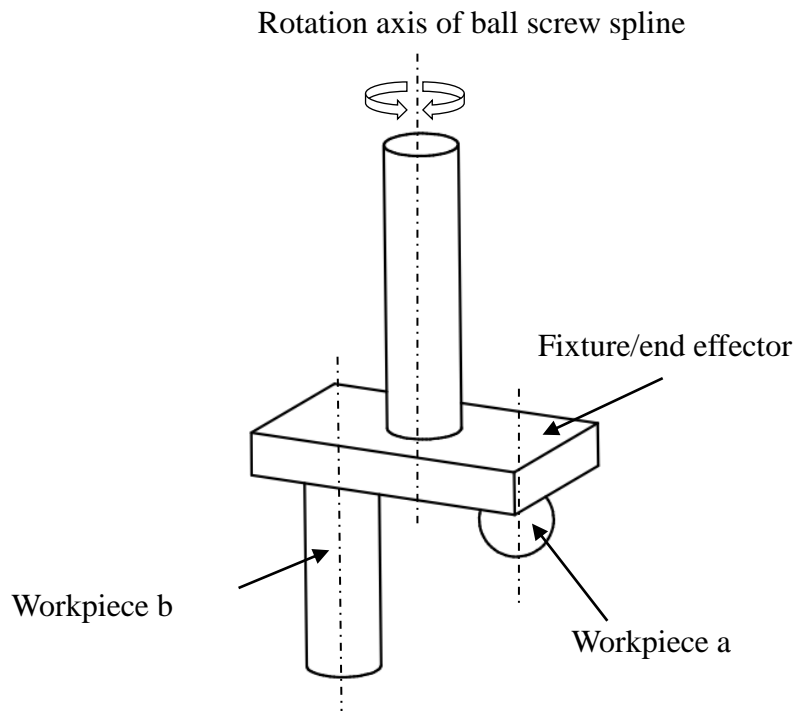


Figure 4-2 Illustration for Calculating Static Torque of Robot End

<b>NOTE</b>	<ul style="list-style-type: none"> <li>➤ Please calculate if permissible static torque is greater than 90N.m prior to the operation.</li> <li>➤ If the torque is greater than this value, the performance and lifetime will be reduced.</li> </ul>
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## Calculate Rotation Inertia

Rotation inertia is quantity used to indicate a force is against the rotation of an object. When a fixture/an end effector are installed on the end of ball screw spline, rotation inertia for the loaded device must be taken into account.

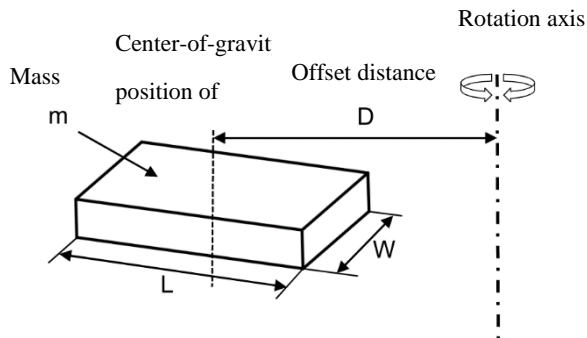


Total rotation inertia at the end of ball screw	=	Rotation inertia of fixture/end effector	+	Rotation inertia of Workpiece a	+	Rotation inertia of Workpiece b
--	---	---	---	------------------------------------	---	------------------------------------

<div style="background-color: yellow; border: 2px solid black; padding: 5px; display: inline-block;"><b>NOTE</b></div>	<ul style="list-style-type: none"> <li>➤ Please calculate if total rotation inertia at the end of ball screw spline is within rated/maximum permissible inertia.</li> <li>➤ If rotation inertia is greater than the value, the performance and lifetime will be reduced.</li> </ul>
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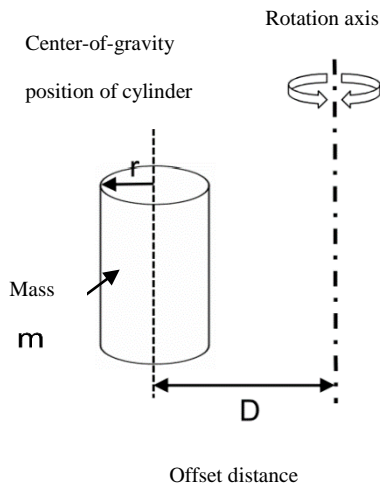
The methods to calculate rotation inertia of an object are as shown in (a), (b) and (c). Please refer to the methods to calculate rotation inertia for the basic shape, and determine rotation inertia of the object.

(a) Rotation inertia of rectangle



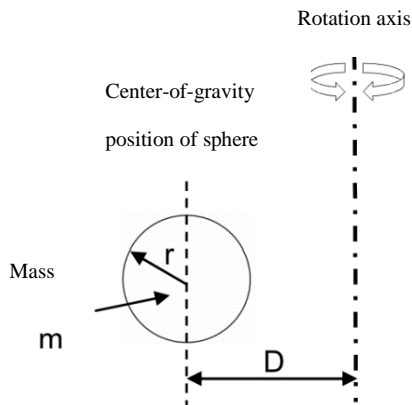
$$m \frac{W^2 + L^2}{12} + m \times D^2$$

(b) Rotation inertia of cylinder



$$m \frac{r^2}{2} + m \times D^2$$

(c) Rotation inertia of sphere



$$m \frac{2}{5} r^2 + m \times D^2$$

## End-extending load

The calculation of the end-extending load will vary depending on the shape of the load. It is recommended that the actual calculation of the inertia be done.

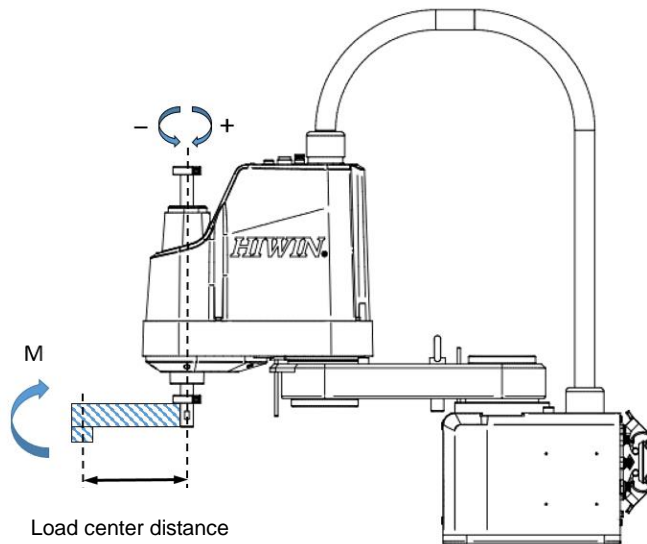


Figure 4-3 、 RS403-400-150-N arm end extension load diagram

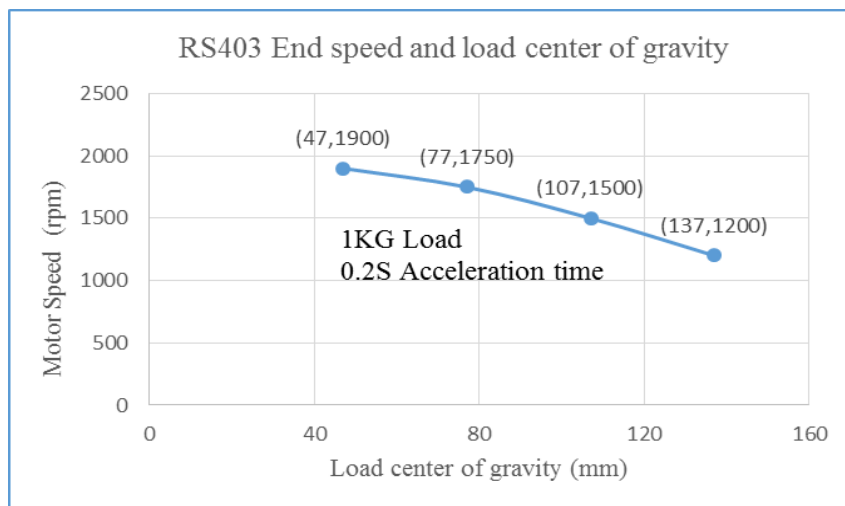


Figure 4-4 、 Load center of gravity and motor speed for 1KG load, spline length 330mm

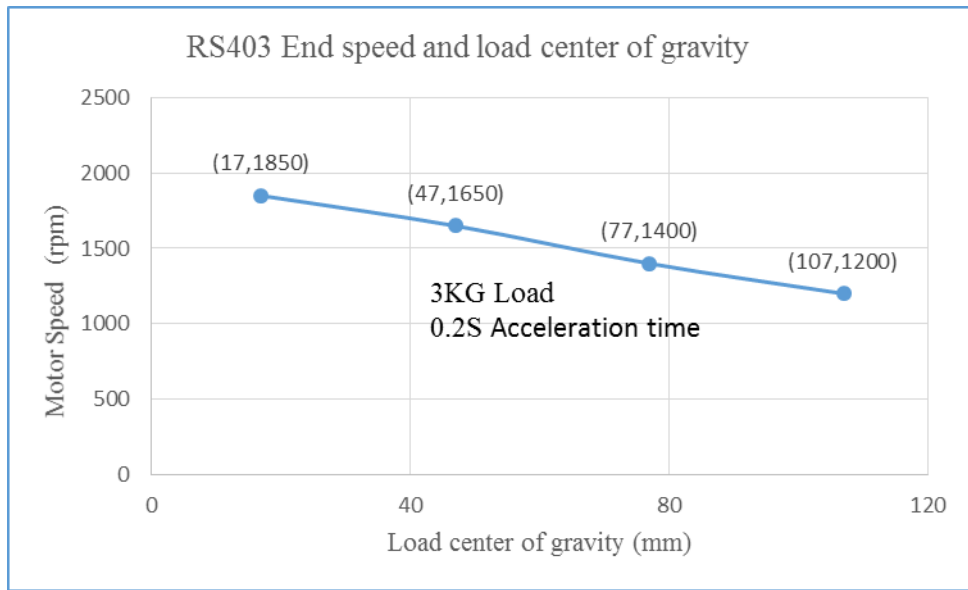


Figure 4-5 、 Load center of gravity and motor speed for 3KG load, spline length 330mm

# Maintenance





## 5 Robot Maintenance

In order to ensure the robot can efficiently operate and protect the operator safety, please periodically maintain the robot according to the following sections. Don't disassemble the motor, decelerator and ball screw spline for the maintenance by yourself to influence the accuracy of the robot. If there is any failure, please contact the agent.

### 5-1 Cover

The cover is locked on the upper side of Arm B, which includes J2, J3 and J4 motors and three drive belts. You can remove the cover to check there are foreign objects in Arm B, ball screw spline is damage and the belts are worn.

 <p><b>DANGER</b></p>	<ul style="list-style-type: none"> <li>➤ Please disconnect the power on the control panel and unplug the power prior to the maintenance. Don't make any maintenance when the robot operates, so that can avoid electric shock or improper operation.</li> </ul>
 <p><b>CAUTION</b></p>	<ul style="list-style-type: none"> <li>➤ In the period of maintenance, the robot should not contact any objects to prevent electronic components from short circuit or damage ball screw spline. Otherwise, the robot could damage when the power is distributed.</li> </ul>

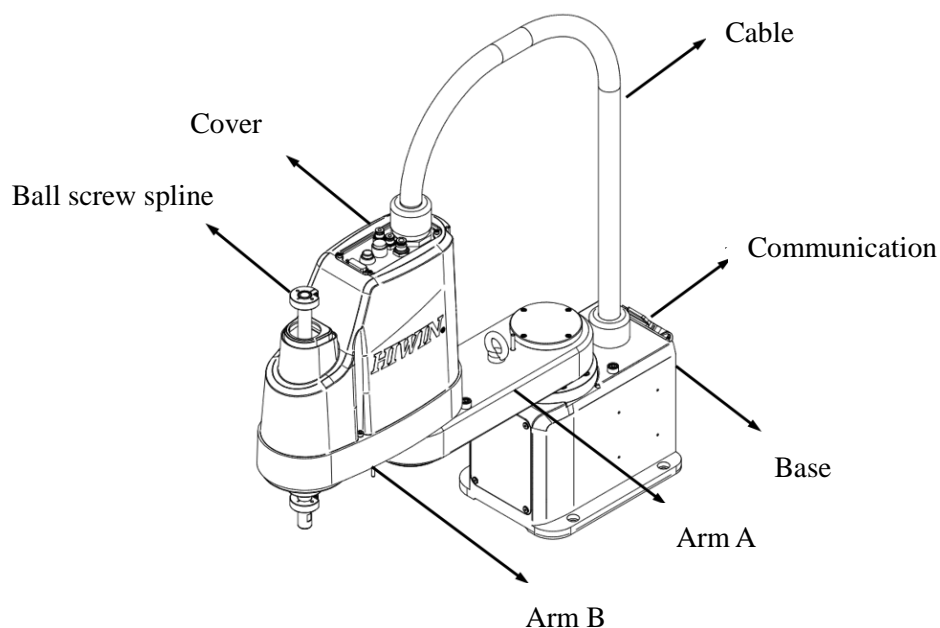



Figure 5-1 Illustration of Part Name for Robot

## 5-1-1 Disassemble Cover

 <b>CAUTION</b>	<ul style="list-style-type: none"> <li>➤ Don't force to disassemble the cover. Otherwise, it could cause poor cable contact or damage as well as electric shock or robot failure.</li> <li>➤ Don't remove the cable sleeve when you disassemble the cover, and avoid excessively pulling it so that the circuit drops or breaks to cause the robot failure.</li> <li>➤ Don't continuously apply force and heavily press/push to the cover protrusion. Otherwise, it could break or damage.</li> </ul>
---	---

Step 01. Turn off the power on the control panel.

Step 02. Remove the external M4 and M3 screws.

Step 03. Disassemble the robot cover from down to up.

Step 04. Keep the screws well to avoid missing or damage.

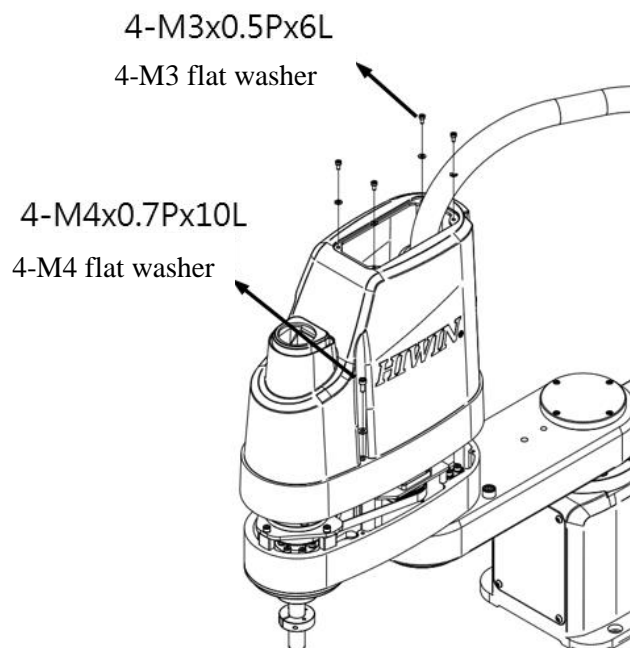



Figure 5-2 Illustration of Disassembling Cover for Robot

## 5-1-2 Install Cover

 <p><b>CAUTION</b></p>	<ul style="list-style-type: none"><li>➤ Note that the internal circuits are excessively bent when you install the cover. Otherwise, it could cause poor cable contact or damage.</li><li>➤ Note that ball screw spline is interfered with the cover when you install the cover, and the screws are fastened to complete the installation.</li><li>➤</li></ul>
---	---

Step 01. Turn off the power on the control panel.

Step 02. Install the robot cover from up to down.

Step 03. Ensure the cover doesn't interfere with any parts and pipes.

Step 04. Fasten the external M4 and M3 screws.

## 5-2 J3 & J4 Axes

J3 & J4 axes employ 100W servo motors. With the link of the belt wheel and the belt, the rotational and linear motions of ball screw spline are controlled. A user can remove the cover to check there is any failure inside the Arm B.



**WARNING**

- Please press the Emergency Stop button before the maintenance. Don't make any maintenance when the robot runs, so that the operators could be hit or the incorrect run could take place.



**CAUTION**

- Don't remove J3 & J4 motors without the authorization to influence the running accuracy of the robot.

## 5-2-1 Check J3 & J4 Belts

There are three drive belts, 2 for J3 axis and one for J4 axis, installed in the robot, which are used to link the servo motor and ball screw spline. A user must periodically check the belts are worn, and confirm the belt tension meets the requirements to ensure the robot can efficiently run.

Table 5-1 J3 and J4 Belts

	Name		Quantity	Remark
Part	J3 Belt (ball end)	Width: 15mm	1	150-S2M-300
	J3 Belt (motor end)	Width: 10mm	1	100-S2M-172
	J4 Belt	Width: 10mm	1	100-S3M-396
Tool	Allen wrench		1	M4 screw (recommended torque: 55kgf-cm)
	Tension meter		1	Belt tension J3 (motor end): 30~40N, J3 (ball end): 45~55N, J4: 45~55N
Parameter	J3 Belt (ball end)	M=1.3 g/m, W=15mm, S= 86 mm (Note 1)		
	J3 Belt (motor end)	M=1.3 g/m, W=10mm, S= 44 mm (Note 1)		
	J4 Belt	M=1.9 g/m, W=10mm, S=124 mm (Note 1)		

Note: M (unit mass), W (belt width), and S (line length)

Step 01. Turn off the power on the control panel.

Step 02. Disassemble the robot cover (Please see 5-1-1 Disassemble Cover.).

Step 03. Press the Emergency Stop button after the power is supplied.

Step 04. Slightly release the screws for J3 and J4 plates.

Step 05. Adjust the motor plate.

Step 06. Use the tension meter to measure the belt tension

J3 (motor end): 30N~40N, J3 (ball end): 45N~55N, J4: 45N~55N.

Step 07. Hold the Release Brake button, and push ball screw spline upwardly and backwardly to ensure the tension in each section meets the requirement.

Step 08. Check the motors of J3 and J4 axes as well as screws for middle wheel.

Step 09. Turn off the power on the control panel.

Step 10. Install the robot cover.

RS403-400-150-N Belt Tension Adjustment

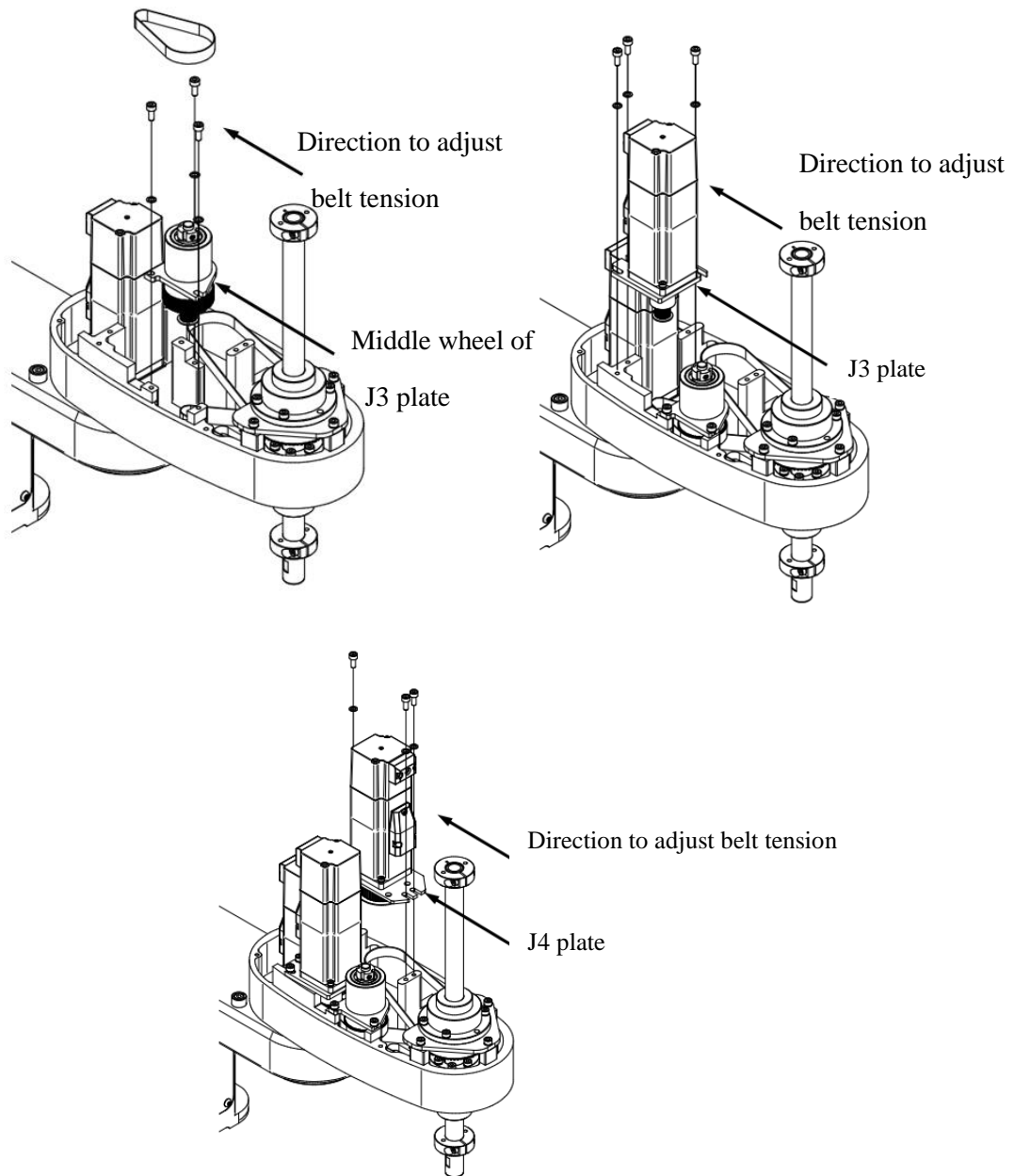


Figure 5-3 Illustrations for Adjusting Belt Tension

## 5-3 Grease Lubrication

There are many movable joints and parts on the SCARA Robot. The decelerator and ball screw spline must be periodically serviced and maintained. Because ball screw spline is exposed in the open environment for long time to easily accumulate dust or insufficiently lubricate, a user must pay more attention so that the robot can efficiently operate.

### 5-3-1 Lubrication of Ball Screw Spline

Ball screw spline is used for the rotation (J3-axis) and linear (J4-axis) motion of the robot, supported by two sets of nut respectively. The bearing in the nut needs to be periodically greased with HIWIN (G04), and the external grooves of ball screw spline must be kept clean. It is recommended ball screw spline be cleaned and maintained every three months to keep smoothly running.



 <b>WARNING</b>	<ul style="list-style-type: none"> <li>➤ Please press the Emergency Stop button and disconnect the power prior to the maintenance. Don't make any maintenance when the robot operates, so that can avoid electric shock or improper operation.</li> </ul>
 <b>CAUTION</b>	<ul style="list-style-type: none"> <li>➤ Don't remove ball screw spline without the authorization to influence the running accuracy of the robot.</li> </ul>

Table 5-2 Lubrication of Ball Screw Spline

Lubrication part	Item	Check	Operation
Roller spline bearing	Lubrication	Check once per three month when the running distance reaches 200km.	Fill new lubricant into the nut nozzle (M3), and remove old grease.Recommended fill: 2c.c.
Flat spline bearing			Fill new lubricant into the nut nozzle (M3), and remove old grease.Recommended fill: 2c.c.
Ball screw spline			Uniformly apply grease on the screw surface in the grooves.

Illustration for RS403-400-150-N Lubrication of Ball Screw Spline

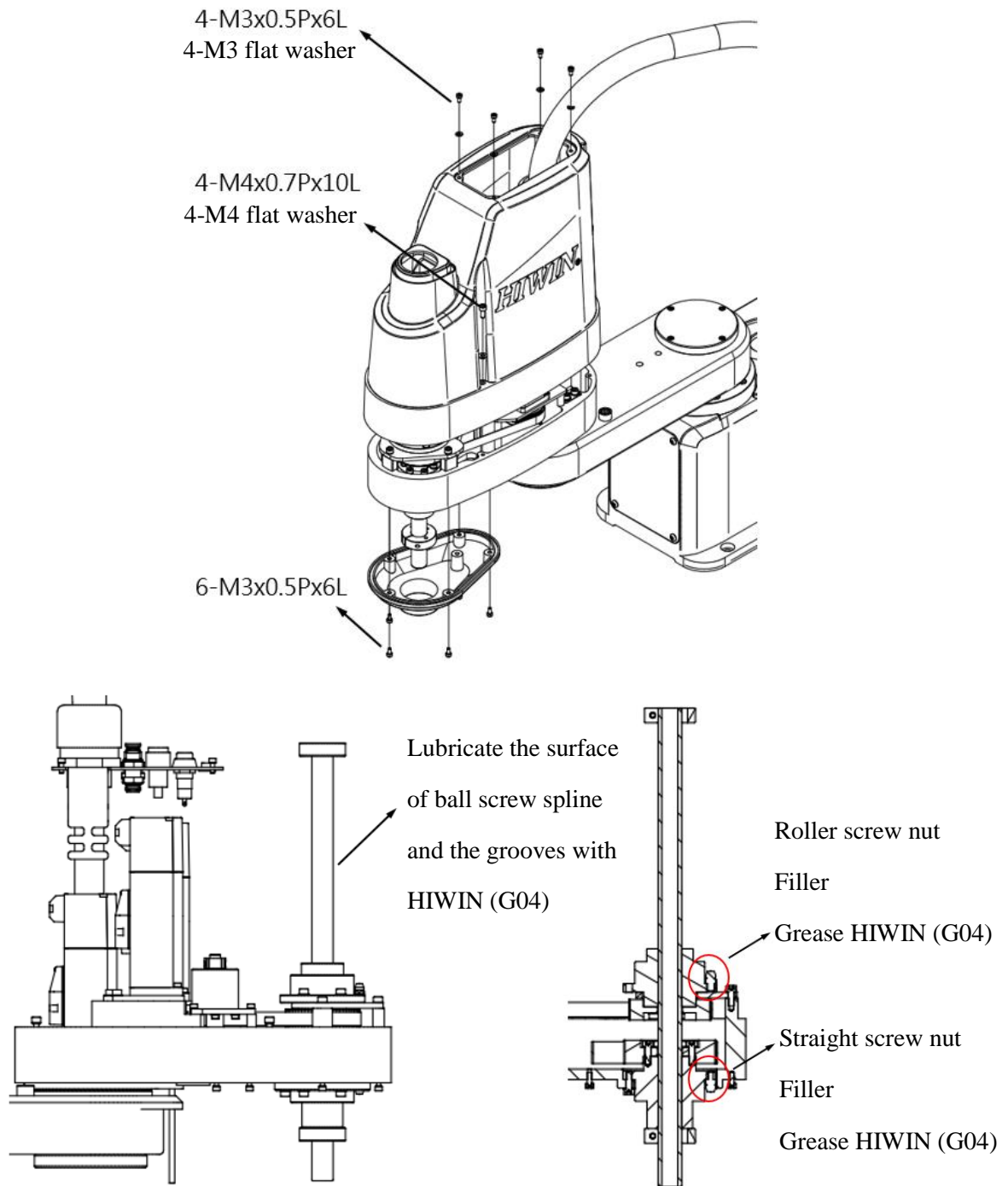


Figure 5-4 Illustration for Lubricating Ball Screw Spline



Table 5-3 Lubrication of Ball Screw Spline

Lubrication part	Item	Check	Operation
Roller spline bearing	Lubrication	Check once per three month when the running distance reaches 200km.	Fill new lubricant into the nut opening (Ø 1.5), and remove old grease.Recommended fill: 2c.c.
Flat spline bearing			Fill new lubricant into the nut opening (Ø 1.5), and remove old grease.Recommended fill: 2c.c.
Ball screw spline			Uniformly apply grease on the screw surface in the grooves.

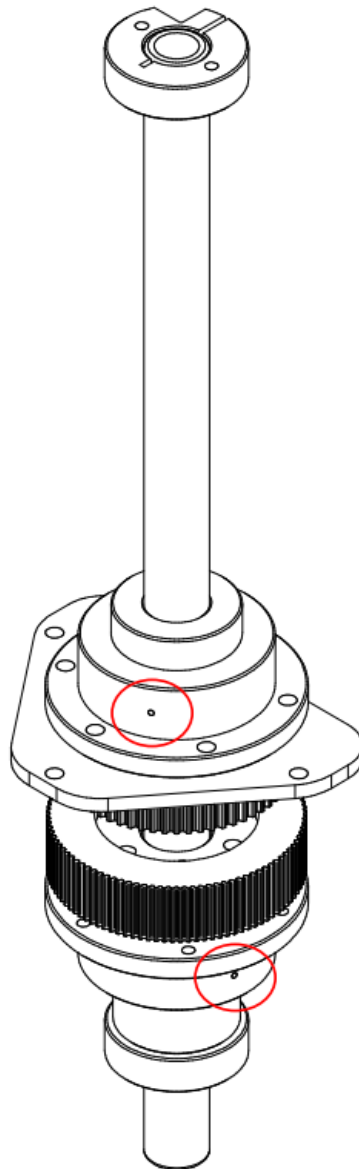



Figure 5-5 Illustration for Lubricating Ball Screw Spline

### 5-3-2 Decelerator Lubrication

The base, the Arm A and the Arm B of the robot are linked by the decelerator to provide the rotation motion for J1 and J2 axes. Because the lubricant is fully covered in the decelerator, the insufficient lubrication will not take place. However, the tear and wear of the mechanical structure could make noise from the decelerator, even poor position accuracy, please contact the agent as soon as possible.

 <b>CAUTION</b>	<ul style="list-style-type: none"> <li>➤ The decelerator should be disassembled by he trained or authorized engineers only to avoid the accuracy and lifetime of the robot.</li> <li>➤ The lubricant should be replaced by the trained or authorized engineers only to avoid the accuracy and lifetime of the robot.</li> </ul>
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Maintenance Item	Period	Operation
Replacement of decelerator lubricant	Running up to 6000 hours or per 18 months	Described as Table 5-3
Check on back clearance of decelerator	Per 2.5 years	New parts should be replaced if the clearance is greater than the permissible value.

Table 5-4 Decelerator Lubrication

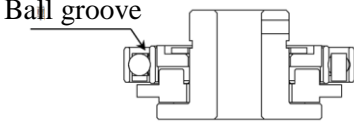
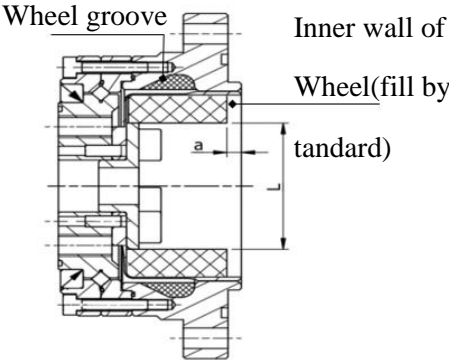
Area to apply grease	Operation	Reference Diagram
Flexible bearing grooves	Fill the roller space with grease.	
Decelerator body	<ol style="list-style-type: none"> <li>1. Remove old grease in the wall of the flexible wheel, and fill in new one.</li> <li>2. Fill new grease in the groove of the rigid wheel (fill via the gear gap).</li> <li>3. For grease filling, please refer to Table 5-4.</li> </ol>	

Table 5-5 Grease Fill

Specification	Unit	J1	J2
Grease capacity			
Inner wall of flexible wheel	g	21~27	21~27
Groove of rigid wheel	g	6	6
A (reference dimension)	mm	3	3
L (reference dimension)	mm	38~41	38~41

Description to disassemble RS403-400-150-N decelerator

Steps to disassemble the decelerator

Step 01. Turn off the power on the control panel.

Step 02. Remove the screws on the Arm A.

Step 03. Remove the M6 screws and washer for Arm A.

Step 04. Remove the M5 screws and washer for the decelerator and the motor plate.

Step 05. Disassemble the decelerator upwardly in the vertical direction.

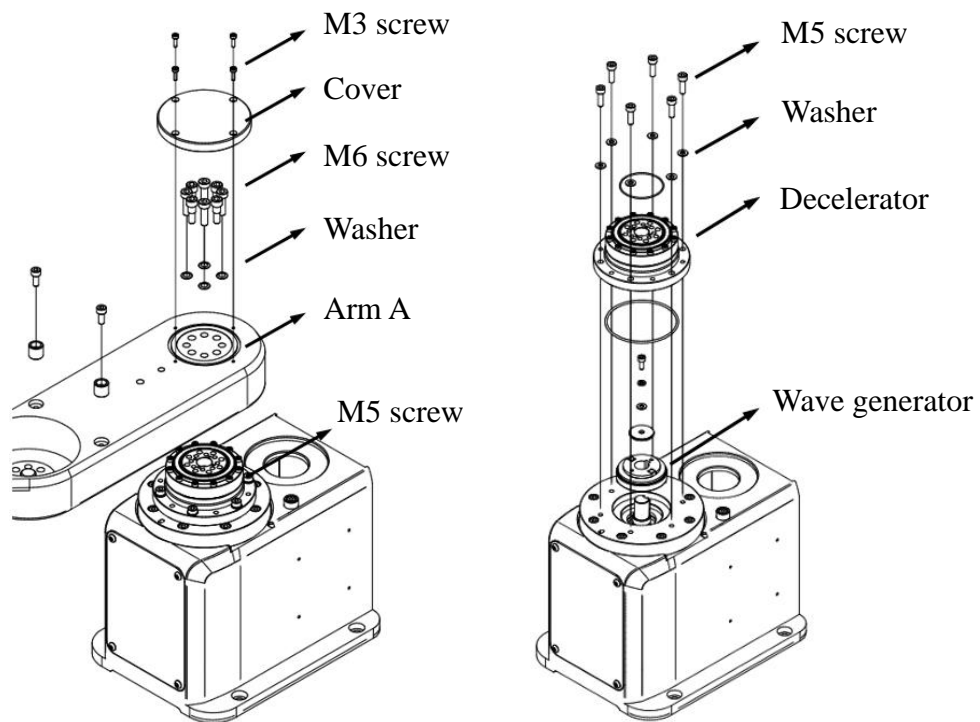


Figure 5-6 Illustrations of Disassembling Decelerator for Robot J1

<b>NOTE</b>	<ul style="list-style-type: none"> <li>➤ Please keep each origin part and component when you disassemble the decelerator. Don't assemble the decelerator with non-origin parts.</li> <li>➤ The decelerator should be disassembled and installed by the trained or authorized engineer.</li> </ul>
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Disassemble the decelerator for Arm B

Step 01. Turn off the power on the control panel.

Step 02. Remove the screw cover on the Arm A.

Step 03. Remove M6 screws on the bottom of Arm A.

Step 04. Remove the Arm B.

Step 05. Remove the M5 screws and washer for the decelerator and the Arm B.

Step 06. Disassemble the decelerator upwardly in the vertical direction.

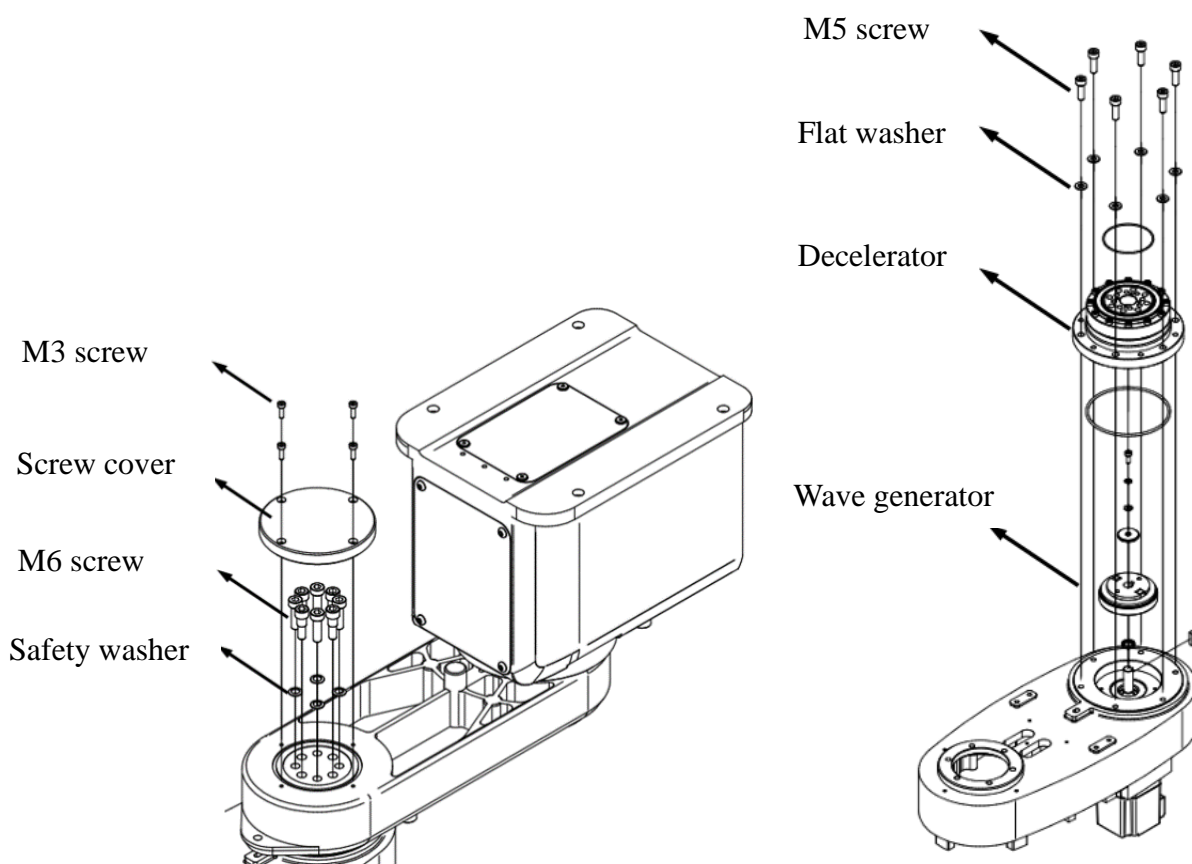


Figure 5-7 Illustrations of Dissembling Decelerator for Robot J2


<div style="background-color: yellow; border: 2px solid black; padding: 5px; display: inline-block;"><b>NOTE</b></div>	<ul style="list-style-type: none"> <li>➤ Please keep each origin part and component when you disassemble the decelerator. Don't assemble the decelerator with non-origin parts.</li> <li>➤ The decelerator should be disassembled and installed by the trained or authorized engineer.</li> </ul>
--	---


## 5-4 Wiring Panel

There are the communication cables, pneumatic pipes and driver batteries in the wiring panel. A user can replace the batteries by removing the cover, so that can maintain the memory of the robot coordinate.

### 5-4-1 Replace Battery

The batteries, located on the internal side of the wiring panel, are used to record the value of the driver at each axis after power failure takes place. A user must periodically replace them to ensure the robot coordinates can be memorized.

 <p><b>CAUTION</b></p>	<ul style="list-style-type: none"> <li>➤ Please press the emergency button and disconnect the power prior to the maintenance. Don't make any maintenance when the robot operates, so that can avoid hit or improper operation.</li> </ul>
---	---

 <p><b>NOTE</b></p>	<ul style="list-style-type: none"> <li>➤ If the batteries are replaced when the power on the control panel is not supplied, the coordinates at each axis can't be recorded. The robot home must be recalibrated.</li> <li>➤ The industrial lithium batteries are used for memory. Don't replace them with commercial alkaline or rechargeable one.</li> </ul>
--	---

Step 01. Remove the wiring panel.

Step 02. Turn on the power on the control panel, and press the Emergency Stop button.

Step 03. Take out 4 batteries in order.

Step 04. Install new batteries in order (primary lithium battery 3.6V/2.4AH for TADIRAN No. 3).

Step 05. Turn off the power on the control panel.

Step 06. Install Wiring Panel (please see).

Step 07. Turn on the power on the control power to test the coordinates at each axis.

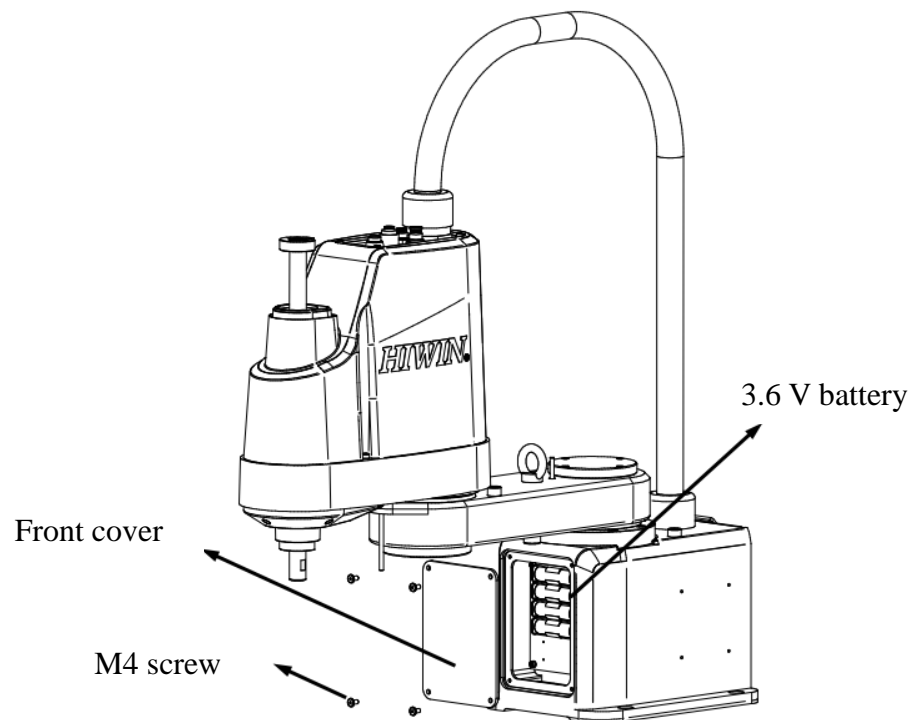


Figure 5-8 Illustration for replace batteries

## 5-5 Maintenance Period

Contents related to service and maintenance

Check Item	Part Name	Daily	Monthly	Quarterly	Twice a year	Yearly
Check the screws/bolts are loose.	Base bolts	√	√	√	√	√
	Robot bolts					√
	Bots for ball screw spline					√
Check the communication cables/power cable connectors are loose.	Communication cable	√	√	√	√	√
	Power cable connectors for control panel		√	√	√	√
Check the appearance is dirty or damaged, and clean and wipe it.	Robot appearance	√	√	√	√	√
	Appearance of communication cable	√	√	√	√	√
	Appearance of control panel	√	√	√	√	√
Check the communication cables/power cables/pneumatic pipes are excessively bent or broken	Communication cables	√	√	√	√	√
	Power cables on control panel	√	√	√	√	√
	Pneumatic cables				√	√
Check belt tension	J3 and J4 axes (See:5-2-1)				√	√
Grease Lubrication	ball screw spline (See:5-3-1)			√	√	√
Grease Lubrication	Decelerator (See:5-3-2) *1					
Replace Battery	Driver battery (See:5-4-1)					√

\*1: For the maintenance time in each item, please follow 5-3-2.

## **6 Troubleshooting**

### **6-1 Offset**

Upon the position is offset when the robot operates, please immediately stop all operations and execute the home command, so that the robot can read the relative position at each station. If the condition for the serious position offset can't be modified by resetting the home, please contact customer service for calibration.

### **6-2 Overheat**

The robot is equipped with a mechanism of temperature protection. The incorrect working temperature will influence the operations. A user must maintain the appropriate environment temperature. As soon as the temperature rise in the system takes place owing to the fan failure, the robot will stop the operation. Please contact customer to replace the fan.

The motor drivers at each axis are equipped with a protection mechanism. The high temperature or acceleration/deceleration will stop the operation of the robot. You must recover the system setting by restarting it. A user can keep the robot normally operating by changing the system setting.

- Lower acceleration and velocity when the robot runs.
- Reduce the time when the robot continuously runs.

### **6-3 Noise from Machine**

The robot comprises several slide and rotation parts and components. It is recommended a user periodically lubricate each part and component, so that the robot can smoothly operate. As soon as noise is generated when the robot operates, please contact customer service for check and maintenance.



## 6-4 Jog Vibration

When you evaluate to operate the robot, please carefully read the specifications. The efficiency of the robot depends on the fixtures or objects loaded on ball screw spline. If the loads exceed the requirements, a user can maintain the normal operation of the robot by changing the system setting or seek the assistance from customer service.

- Reduce acceleration and velocity when the robot operates.
- Modify the fixture dimension and weight.

# Opinion Response

Issue	Actual condition
Use Advice:	
E-mail: <a href="mailto:business@hiwin.tw">business@hiwin.tw</a> Customer hotline: +866-4-23594510	

## SCARA Robot - RS403 User Manual

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HIWIN CHINA  
SUZHOU, CHINA  
[www.hiwin.cn](http://www.hiwin.cn)  
[info@hiwin.cn](mailto:info@hiwin.cn)

Mega-Fabs Motion System, Ltd.  
HAIFA, ISRAEL  
[www.mega-fabs.com](http://www.mega-fabs.com)  
[info@mega-fabs.com](mailto:info@mega-fabs.com)

## 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](http://www.hiwin.tw)  
[business@hiwin.tw](mailto:business@hiwin.tw)