



Articulated Robot RA605

User Manual

Original Instruction





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



Direct Drive 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 (C1)
 - 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



Medical Equipment

- Hospital / Rehabilitation centers / Nursing homes
- Robotic Gait Training System
 - Hygiene System
 - Robotic Endoscope Holder



Bearing

- Machine tools / Robot
- Crossed Roller Bearings
 - Ball Screw Bearings
 - Linear Bearing
 - Support Unit



AC Servo Motor & Drive

- Semiconductor / Packaging machine / SMT / Food industry / LCD
- Drives-D1, D1-N, D2T
 - Motors-50W-2000W



Driven Tool Holders

- All kinds of turret
- VDI Systems
 - Radial Series, Axial Series, MT
 - BMT Systems
 - DS, NM, GW, FO, MT, OM, MS



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)

- Inspection / Testing equipment / Machine tools / Robot
- Rotary Tables-TMS,TMY,TMN
 - TMRW Series
 - TMRI 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:

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

The following conditions are not covered by the warranty:

- Product serial number or date of manufacture (month and year) cannot be verified.
- Using non-genuine HIWIN products.
- Adding or removing any components into/out the product without authorized.
- Any modification of the wiring and the cable of the product.
- 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.
- 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 technician or the dealer who you purchased with.

**WARNING**

- ❖ Improper modification or disassemble the robot might reduce the robot function, stability or life.
- ❖ 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.
- ❖ Please contact the technician for special modification coming from production line set up.
- ❖ For the safety reason, any modification for HIWIN product is strictly prohibited.

Safety Precautions

1. Safety Information

- Safety Responsibility and Effect
 - ⊙ This chapter explains how to use the robot safely. Be sure to read this chapter carefully before using the robot.
 - ⊙ 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.

2. Description Related to Safety

I. Safety Symbols

- ⦿ Carefully read the instructions in the user manual prior to robot use. The following shows the safety symbols used in this user manual.

Symbol	Description
 DANGER	Failure to follow instructions with this symbol may result in serious hazard or personal injury. Please be sure to comply with these instructions.
 WARNING	Failure to follow instructions with this symbol may result in personal injury or product damage. Please be sure to comply with these instructions.
 CAUTION	Failure to follow instructions with this symbol may result in poor product performance. Please be sure to comply with these instructions.

II. Working Person

- ⦿ The personnel can be classified as follows
 - Operator:
 - Turns robot controller ON/OFF
 - Starts robot program from operator's panel
 - Reset system alarm
 - Programmer or teaching operator:
 - Operates the robot
 - Teaches robot inside the safety fence
 - Maintenance engineer:
 - Operates the robot
 - Teaches robot inside the safety fence
 - Does maintenance, adjustment, replacement
- ⦿ Programmer and the maintenance engineer must be trained for proper robot operation.

3. Warning

3.1 Common Safety Issues

 DANGER	<ul style="list-style-type: none"> ❖ All operating procedures should be assessed by professional and in compliance with related industrial safety regulations. ❖ When operating robot, operator needs to wear safety equipment, such as smock for working environment, safety shoes and helmets. ❖ When encountering danger or other emergency or abnormal situation, please press the emergency stop button immediately and move the arm away with low speed in manual mode. ❖ 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. ❖ A safety zone should be established around the robot with an appropriate safety device to stop the unauthorized personnel from access. ❖ While installing or removing mechanical components, be aware of a falling piece which may cause injury to operator. ❖ Ensure the weight of workpiece does not exceed the rated load or the tolerable torque. Exceeding these values could lead to the driver alarm or malfunction of the robot. ❖ Do not climb on robot. ❖ The installation for emergency functions shall be defined by the system integrator in accordance with ISO 10218-1/-2.
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**WARNING**

- ❖ The personnel installing robot should be trained and licensed.
- ❖ To ensure personal safety, robot installation must comply with this manual and related industrial safety regulations.
- ❖ 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.
- ❖ Using non-HIWIN repair components may cause robot damage or malfunction.
- ❖ Beware of the heat generated by the controller and servo motor.
- ❖ Do not overbend the cable to avoid poor circuit contact.

3.2 Operation

 DANGER	<ul style="list-style-type: none">❖ Programming should be done outside of the safety fence. If it is inevitable to enter the safety fence, be prepared to press the emergency stop button whenever necessary. Operation should be restricted at low speed and beware of surrounding safety.
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3.3 Maintenance

 DANGER	<ul style="list-style-type: none">❖ Please contact us if the procedure not specified by HIWIN is needed.❖ Please contact us if the replacement of the component not specified by HIWIN is needed.❖ Be sure to carry out regular maintenance, otherwise it will affect the service life of the robot or other unexpected danger.❖ Prior to repair and maintenance, please turn off power supply.❖ 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.❖ When replacing the components, avoid foreign material going into the robot.
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3.4 End Effector

 <p>DANGER</p>	<ul style="list-style-type: none"> ❖ 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. ❖ 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. ❖ The end effector should be mounted firmly on the robot to avoid workpiece release during operation which may cause personal injury or hazard.
 <p>WARNING</p>	<ul style="list-style-type: none"> ❖ The end effector may be equipped with its own control unit. Be sure the control unit does not interfere with robot operation.

3.5 Pneumatic, Hydraulic System

 <p>DANGER</p>	<ul style="list-style-type: none"> ❖ When using the pneumatic or hydraulic system, the gripped workpiece may fall due to insufficient pressure or gravity. ❖ The pneumatic system must be equipped with the relief valve, so that can be applied in an emergency.
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3.6 Emergency Stop

 <p>DANGER</p>	<ul style="list-style-type: none"> ❖ The robot or other control component should have at least one device for immediate halt of n function, such as an emergency stop switch. ❖ The emergency stop button must be installed in an easily accessible location for quick stop. ❖ 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. ❖ Avoid using emergency stop to replace a normal stop procedure. This could lead to unnecessary loss to robot.
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4. Intended use

HIWIN robots are industrial robots and intended for pick-and-place, handling, assembling, deburring, grinding and polishing. Use is only permitted under the specified environment, for more detailed information please see section 2.5 environmental conditions.

Use is not permitted under the following conditions:

- Use in potentially explosive environments
- Use without performing risk assessments
- Transportation of people and animals
- Operation outside the allowed operating parameters

5. Disposal

The disposal of HIWIN robot shall be in accordance with the local environmental regulations.

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Version	Date	Product	Note
1.0.0	2018.03.20	RA605-710-GB	First edition

1. Transportation and Installation

1.1 Transportation

Sling can be used to transport the robot. The transportation procedure is as follows:

- Step1. Move the robot into its transport posture and the angle of each joint is shown in the table of Figure 1-1.
- Step2. Secure the suspension plate to the robot with four M8×1.25P×12L screws as shown in Figure 1-2. Make the sling go through the suspension plate to keep the center of gravity under the hanging point shown as Figure 1-3. Please ensure the robot is in stable condition to avoid overturning.
- Step3. Move the robot to the desired position by using sling.
- Step4. Remove the suspension plate.

[Note] The transport suspension plate (4C201E41) is an optional part. Please refer to appendix for the dimensions.

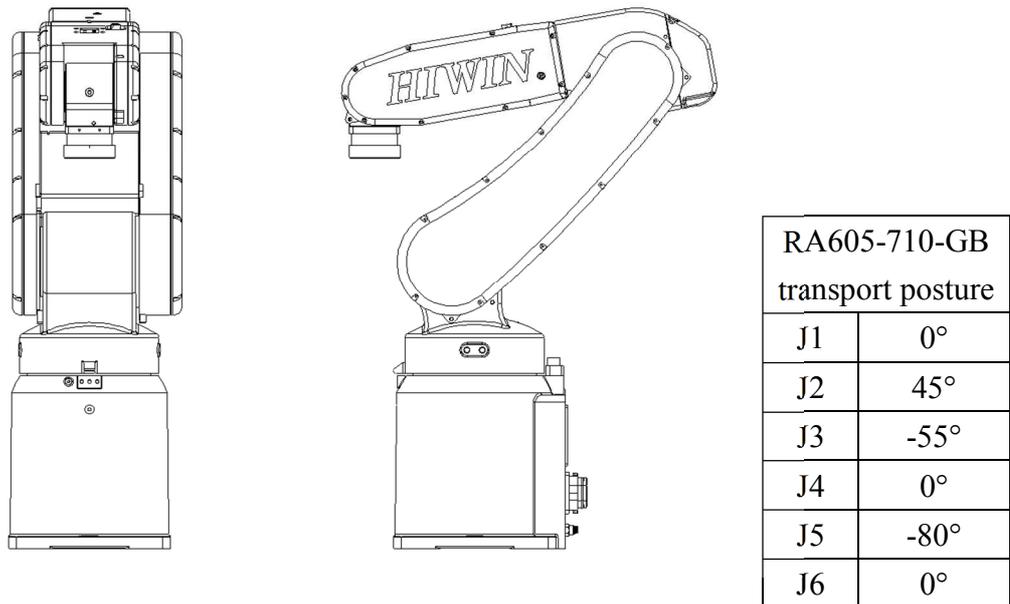


Figure 1-1 Transport posture

 <p>WARNING</p>	<ul style="list-style-type: none"> ❖ Before carrying the robot, be sure to remove the end effector which changes the center of gravity. ❖ Please keep stable, slow down and avoid excessive vibration or shock during transportation. ❖ While placing the robot be sure to avoid the robot and the installation surface collision. ❖ After removing the suspension plate, please maintain it properly for re-transportation. ❖ Before operation, remove the suspension plate to avoid danger.
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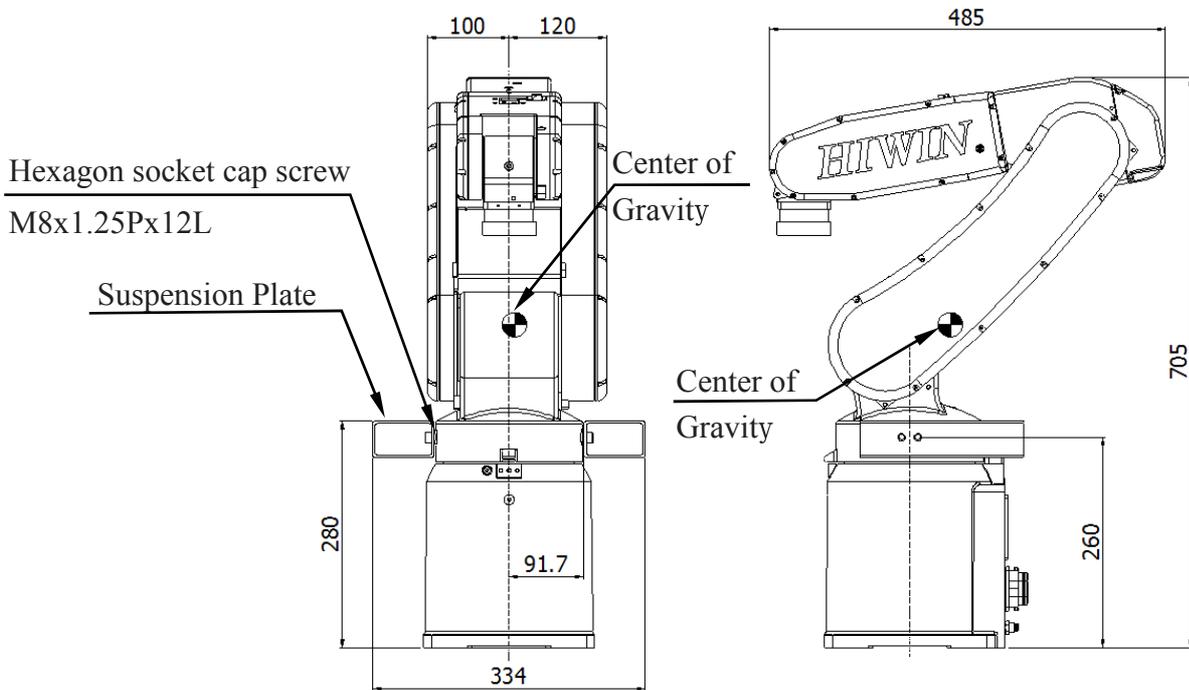


Figure 1-2 RA605-710-GB Transport dimensions

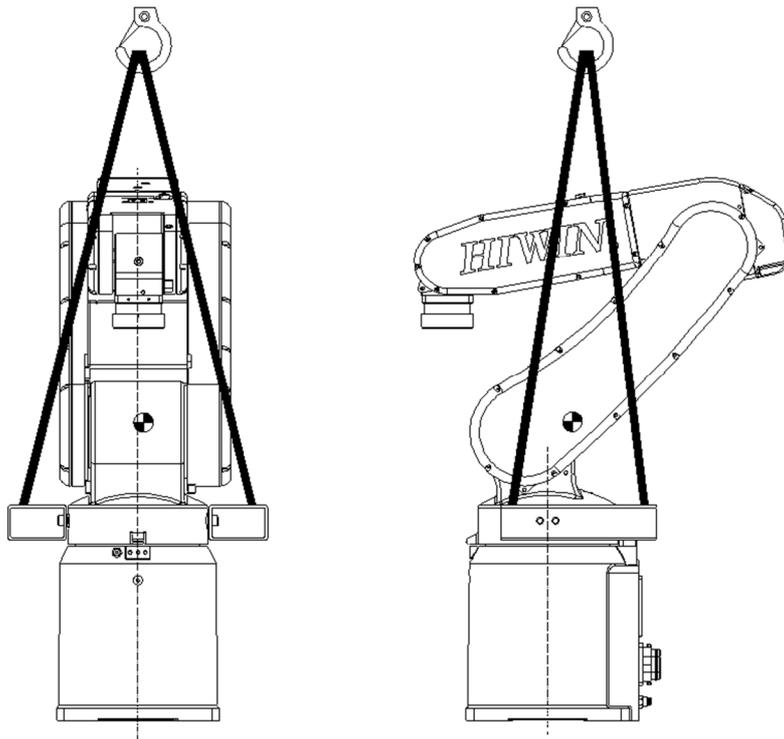


Figure 1-3 Crane lifting transportation

RA605-710-GB Transport method

1.2 Installation

Figure 1-4 shows the installation dimensions of the robot. According to the dimensions, fix the robot on the installation surface with M10 screws, spring washer and flat washer shown as Figure 1-5. Figure 1-6 and table 1-1 show the forces and moments acting on the installation surface during operation. The strength of surface must be considered when installing the robot. It is recommended to use screws bigger than M10X20L.

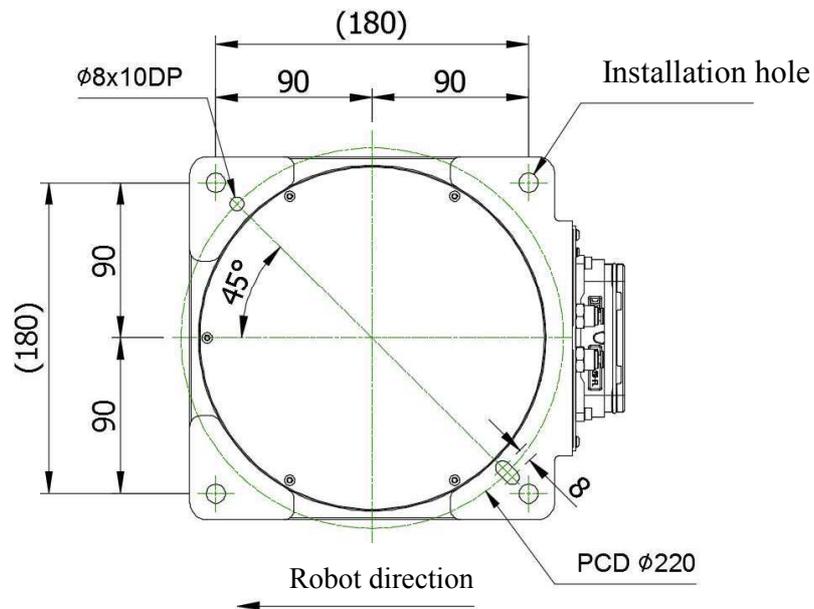


Figure 1-4 Base dimensions

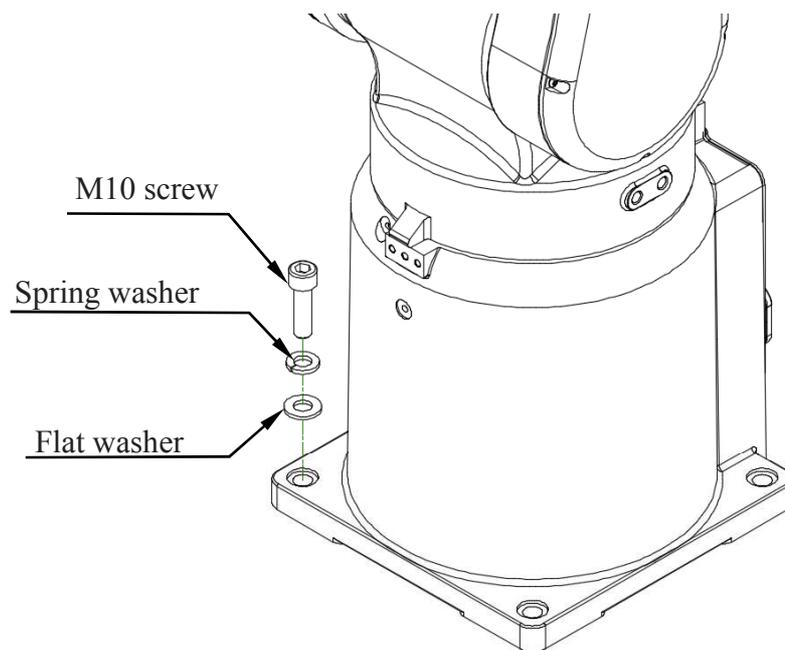


Figure 1-5 installation diagram

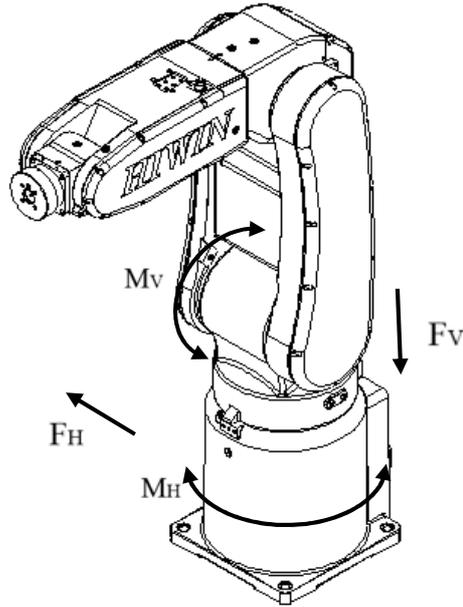


Figure 1-6 Forces and moments acting on the installation surface

Table 1-1 RA605-710-GB Value of forces and moments acting on the installation surface

	Vertical moment M_v (Nm)	Vertical force F_v (N)	Horizontal moment M_H (Nm)	Horizontal force F_H (N)
Stop	144	441	0	0
Acceleration /Deceleration	382	1009	149	456
Power cut stop	462	1199	248	760



WARNING

- ❖ Ensure the installation surface is smooth plane which is recommended to be 6.3a or less for the roughness. If the installation surface is rough, the robot could produce the position shift during the operation.
- ❖ Ensure the position of the installation surface for the robot will not shift owing to the movement.
- ❖ Ensure the strength of the installation surface for the robot will not be damaged owing to the movement.

1.3 Connection with the Controller

Figure 1-7 shows the structure drawing of the robot. ; Figure 1-8 shows the connection between robot, controller, teach pendant and power source. Figure 1-9 and Figure 1-10 show the interface of J1 and the pin assignment of CN2 connector.

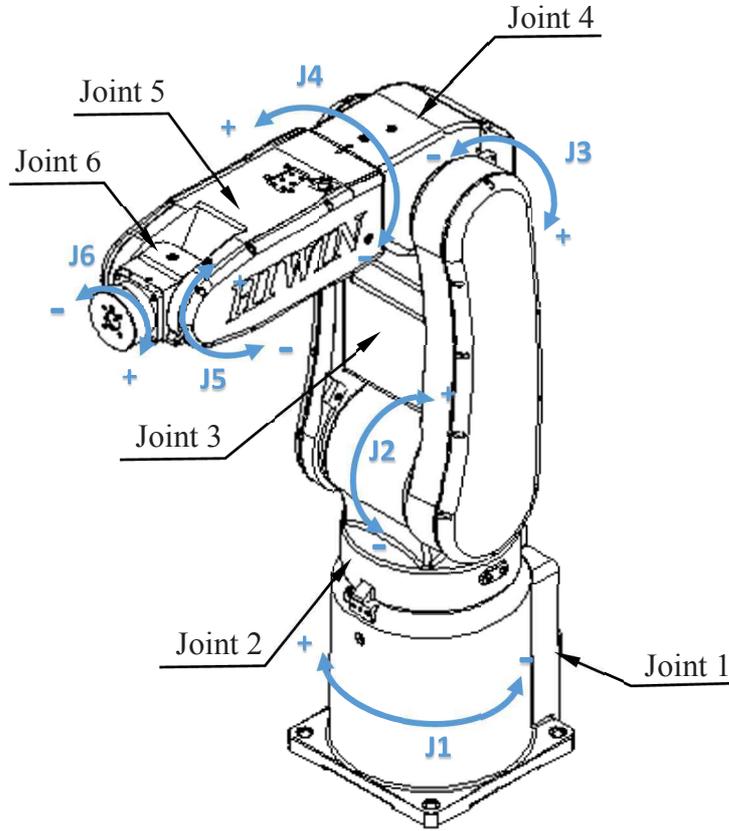


Figure 1-7 Drawing of robot structure

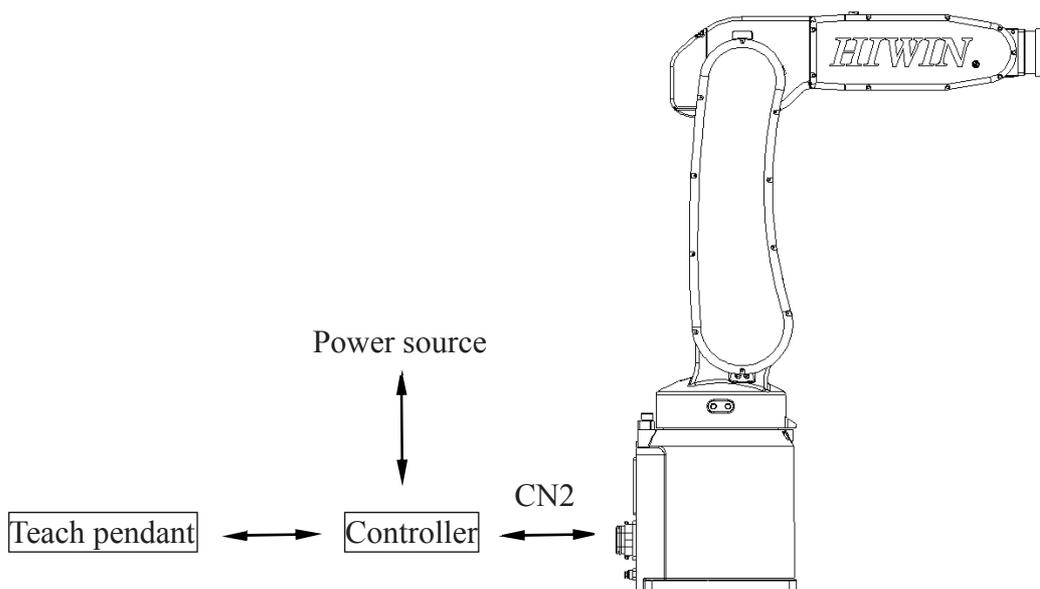


Figure 1-8 Robot and controller connection

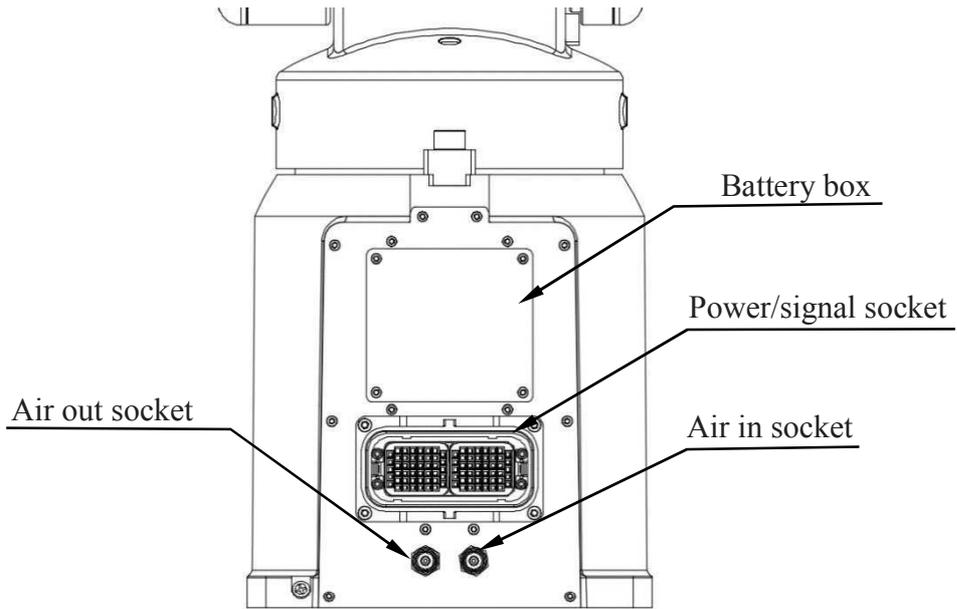
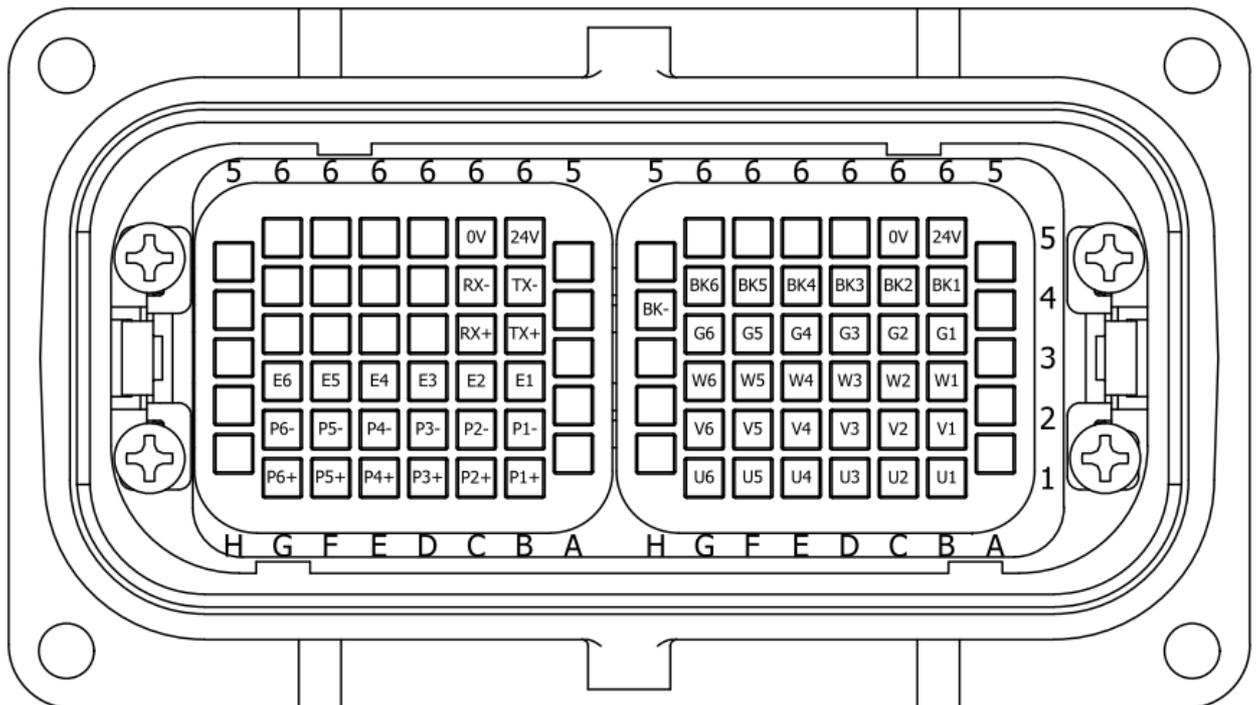


Figure 1-9 Interface at the rear of J1



	WARNING	<ul style="list-style-type: none"> ❖ When connecting the cable, be sure to turn off power supply first.
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Figure 1-10 Pin assignment of CN2 connector

1.4 Grounding

Figure 1-11 shows the grounding connection of the robot with the screw (M5×0.8P×8L).

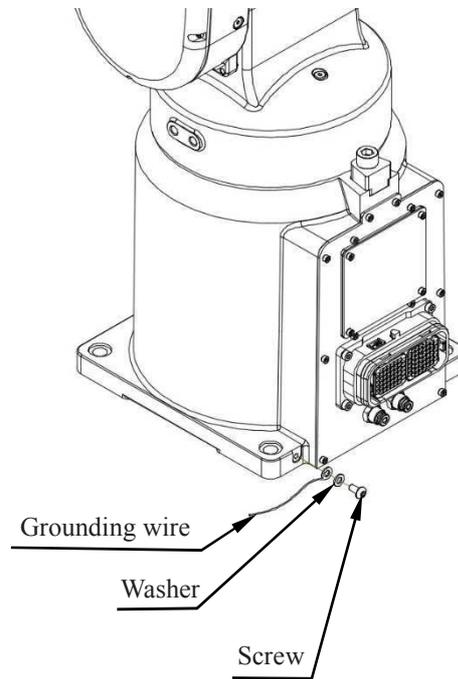


Figure 1-11 Grounding method

1.5 Operating Ambient Conditions

The robot operating ambient conditions is shown in Table 1-2.

Table 1-2 Ambient conditions

Ambient conditions	
Ambient temperature	0~45 °C [Note 1]
Ambient relative humidity	75% R.H. or less No condensation permissible
Altitude	Up to 1000 m above mean sea level [Note 2]
Vibration	0.5G or less
Environment	Do not use under corrosive environment Do not use under flammable environment Do not use under explosive environment Do not use under radiative environment

[Note 1] : When the robot is stopped for a long period of time at the temperature near 0°C, the robot operation may have greater resistance in the beginning and then an overload alarm may be raised. It is recommended to warm up the robot at low speed for a few minutes.

[Note 2] : The performance level will be de-rated around 10% at an altitude over 1000m.

1.6 Standard and Optional Equipment List

Standard and optional equipment list is shown in Table 1-3.

Table 1-3 Standard and optional equipment list

Item	HIWIN Part No.	Standard	Optional	Remark
Teach pendant	AH301401		○	
Calibration tool set	4C201EK1	●	○	Refer to section 4.1
End effector I/O connector	4CA30008	●	○	Refer to section 3.3
Connector set	4C201701	●	○	
I/O cover	46170099	●	○	
Suspension plate set	4C201E41		○	Refer to section 1.1
Robot base(GB)	4C300F42		○	
J2 belt	45310141		○	Refer to section 5.2.2
J3 belt	453100QN		○	Refer to section 5.2.2
J5、J6 belt	453100MY		○	Refer to section 5.2.2
J1~J4 grease(16KG)	47110035		○	Refer to section 5.2.3
J5~J6 grease(16KG)	47110037		○	Refer to section 5.2.3
Encoder battery	462600LN		○	Refer to section 5.2.1
CN3 Emergency stop set (5M)	4C7013F2		○	
External input/output wiring set	4C201DY1		○	
External input/output expansion module	4C201DZ2		○	
Cotton filter	4657003Y		○	
Battery	462C0097		○	

2. Basic Specifications

2.1 Description of Serial Number

There is a serial number on the specification label of each robot. The explanation of serial number and model name are shown in Figure 2-1、Figure 2-2.

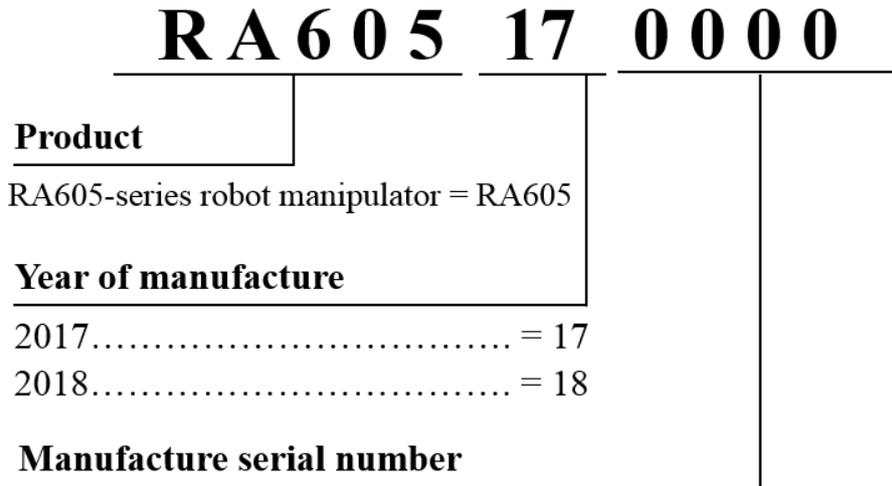


Figure 2-1 Description of serial number

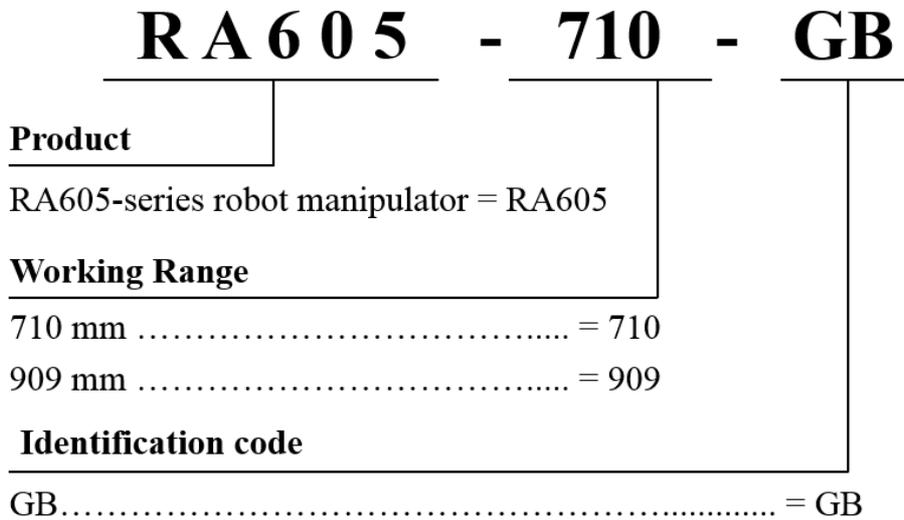
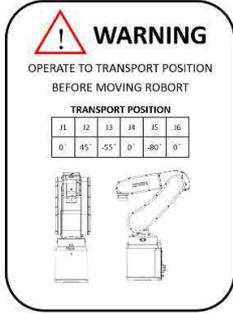


Figure 2-2 Description of model name

2.2 Labels

The labels on the robot are shown in Table 2-1.

Table 2-1 Labels description

Labels	Name	Description
	<u>Collision</u>	Keep safety distance from robot system, and prevent colliding to operator during operation.
	<u>Grounding</u>	Make sure grounding is completed, or it will cause electric shock.
	<u>Electric shock</u>	Pay more attention that the robot may have a risk of electric shock.
	<u>Transport posture</u>	Be aware of transport posture when transporting robot, please refer to section 1.1 for detailed information.
	<u>Specification</u>	Robot specification and serial number.
	<u>Air in</u>	The connection port of air tube for air input.
	<u>Air out</u>	The connection port of air tube for air output.
	<u>Grease in</u>	The hole for grease in.
	<u>Grease out</u>	The hole for grease out.

2.3 Robot Specifications

The robot specifications are shown in Table 2-2

Table 2-2 Robot specification

Item		Specification
Model name		RA605-710-GB
Degrees of freedom		6
Installation		Floor 、 slope (wall mounting, ceiling mounting) [Note 1]
Load capacity		5kg [Note 2]
Maximum reach radius		710 mm
Cycle time		0.5 s [Note 3]
Repeatability		±0.02 mm
Motion range	J1	±165°
	J2	+85°~ -125°
	J3	+185°~ -55°
	J4	±190°
	J5	±115°
	J6	±360°
Maximum speed	J1	360°/ s
	J2	288°/ s
	J3	420°/ s
	J4	444°/ s
	J5	450°/ s
	J6	720°/ s
Allowable load moment at wrist	J4	8.40 N-m
	J5	8.40 N-m
	J6	5.56 N-m
Allowable load inertia at wrist	J4	0.36 kg- m ²
	J5	0.36 kg- m ²
	J6	0.13 kg- m ²
Weight		40 kg (Manipulator only)
Tool wiring		6 input / 4 output
Tool pneumatic pipes		Two channels of tracheal connection (apply with M5 thread ψ4 tracheal caliber connector)
Protection rating		IP 65
Noise level		Less than 75 dB [Note 4]

[Note 1]: Compared to mounting on the ground, the performance of the robot may be different when mounting on the wall or ceiling. Please contact HIWIN if there's any demand for this application.

[Note 2]: For details about load capacity, please refer to section 2.5.

[Note 3]: The cycle time is the time that the robot moves forward and backward in the vertical height 25mm and the horizontal distance 300mm with 1 kg load, as shown in Figure 2-3.



Figure 2-3 Cycle time trajectory

[Note 4]: The noise level is measured at maximum speed and maximum load according to ISO11201.

2.4 Outer Dimensions and Motion Range

The motion range is shown in Figure 2-4.

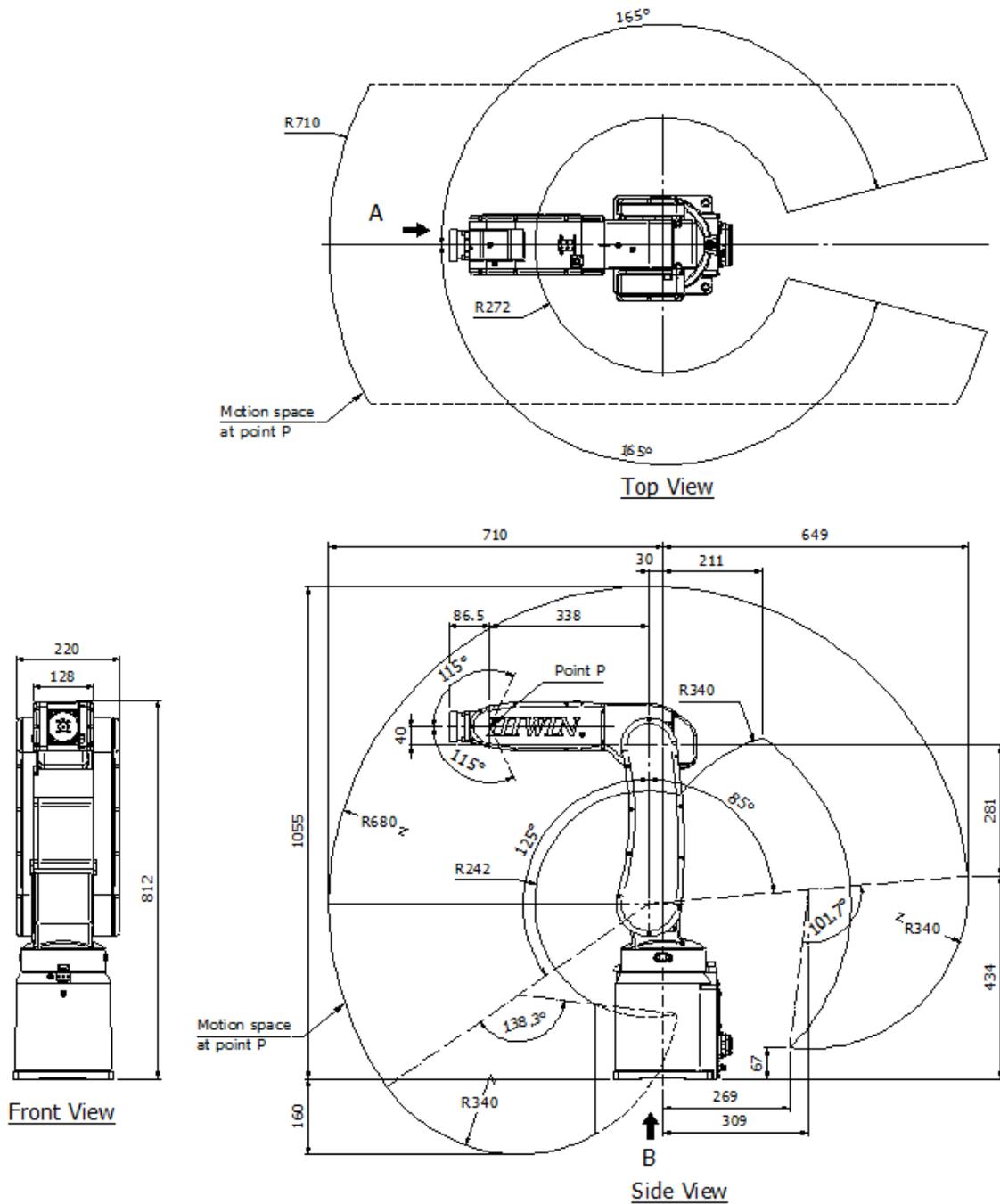


Figure 2-4 RA605-710-GB Motion range

2.5 Mechanical Stopper

Mechanical stoppers are installed at J1-axis to J3-axis to limit the motion range to a minimum value. Please refer to Table 2-3 and Figure 2-5 to Figure 2-9.

Table 2-3 Description of mechanical stoppers

Illustration	Axis applied	Motion range limited
	J1	-170°~+170°
	J2	-126°
	J2	86°
	J3	-56°
	J3	186°

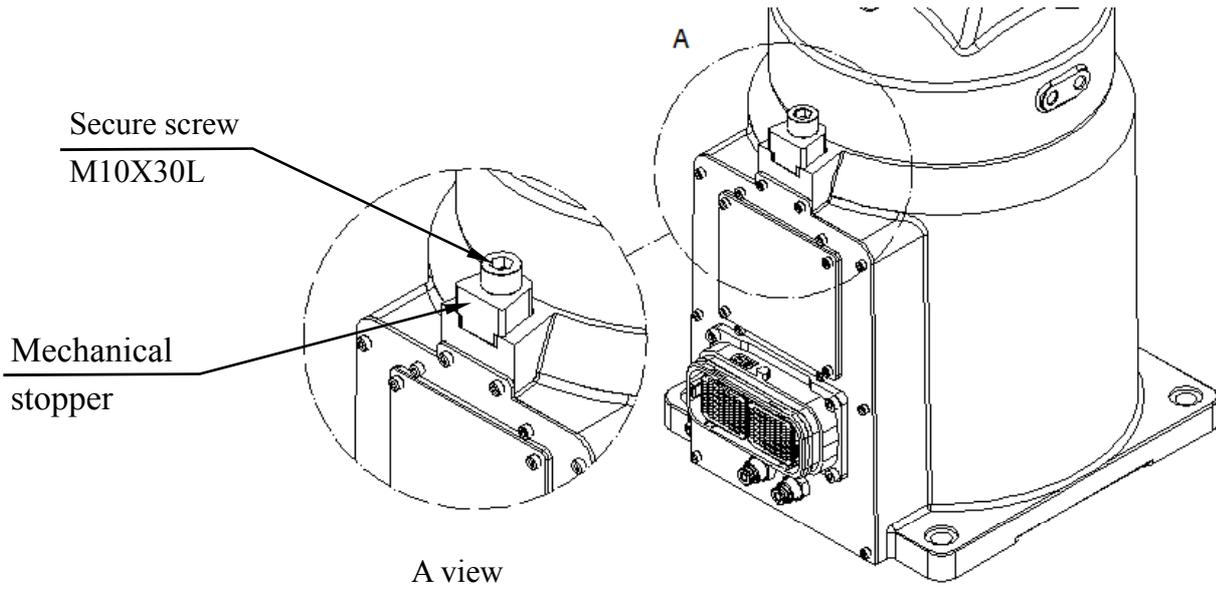


Figure 2-5 J1-axis positive/negative limit

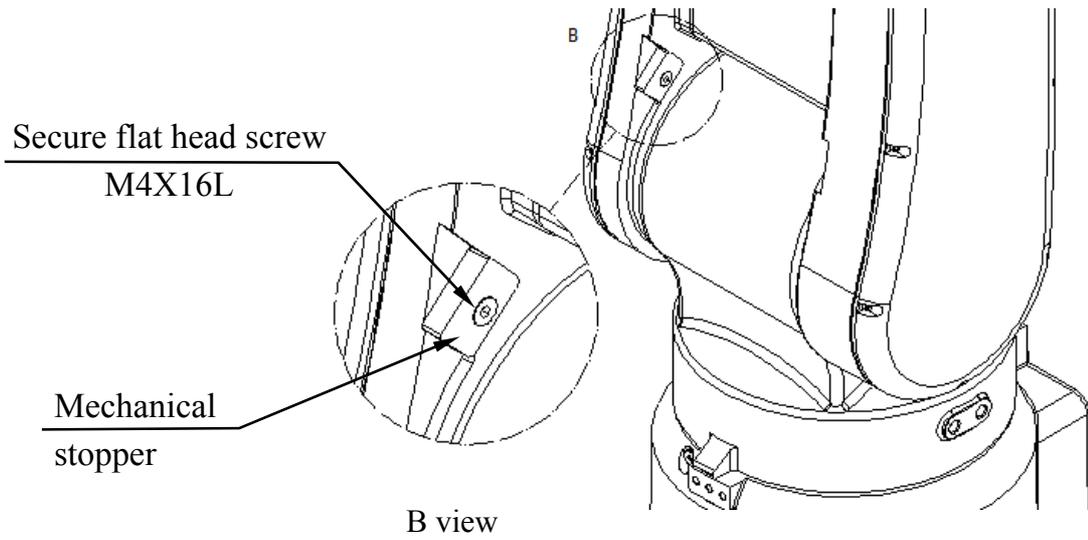


Figure 2-6 J2-axis negative limit

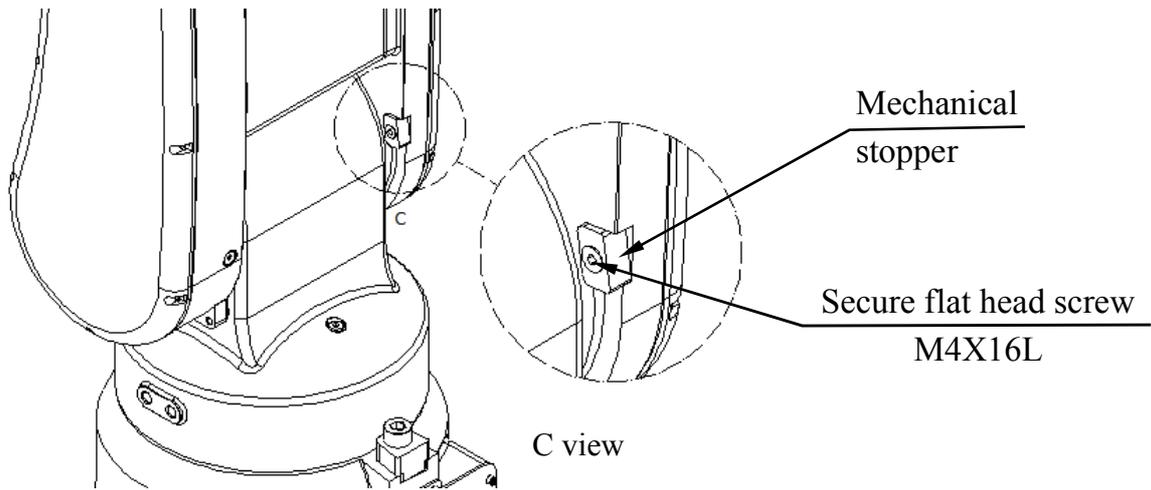


Figure 2-7 J2-axis positive limit

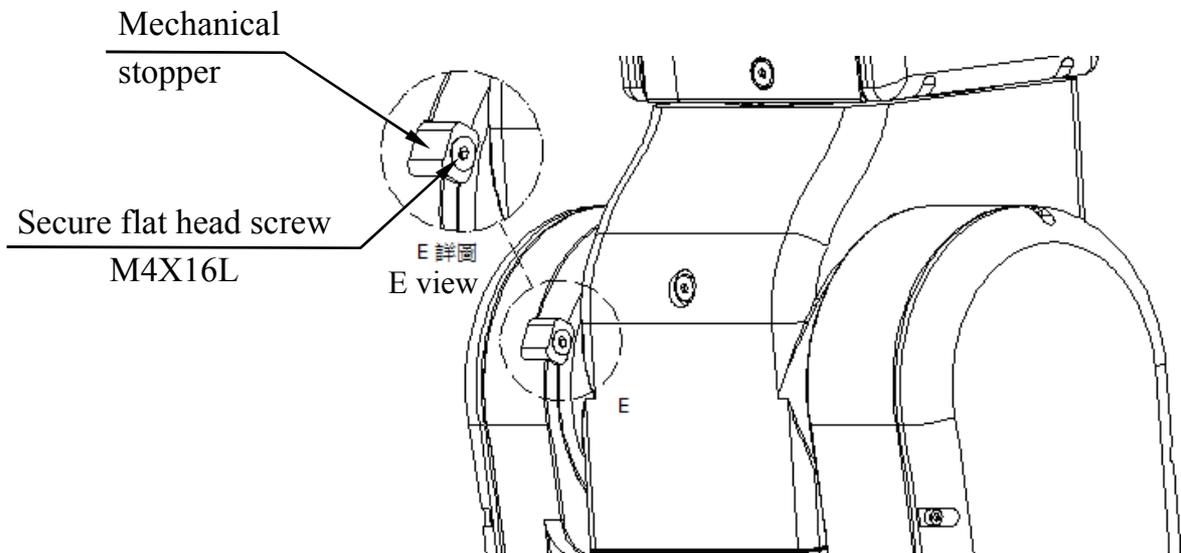


Figure 2-8 J3-axis negative limit

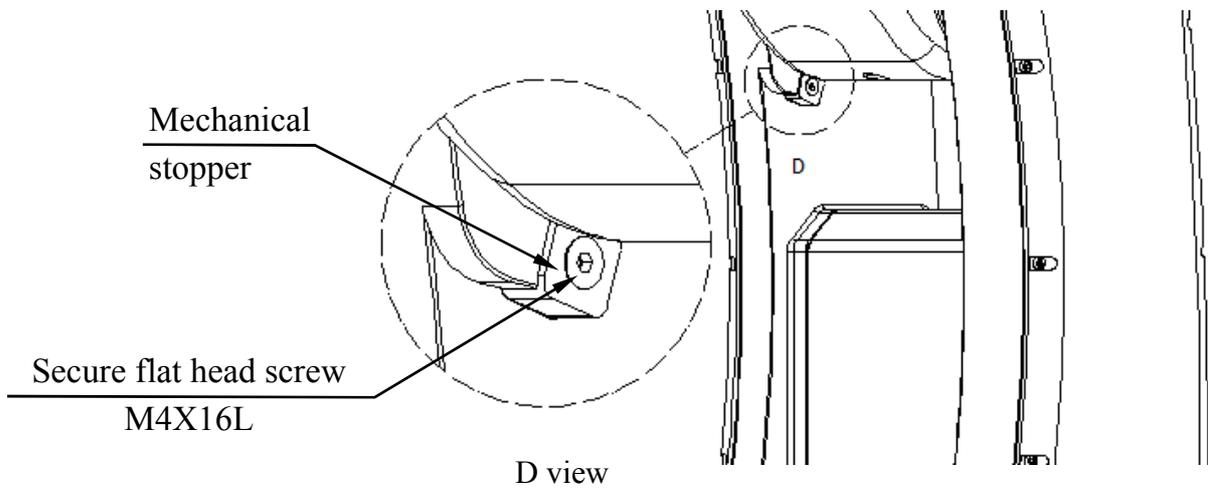


Figure 2-9 J3-axis positive limit

2.6 Wrist Moment Conditions

The load capacity of the robot is not only limited by the weight of the load, but also limited by the center of gravity of the load. Figure 2-10 shows allowable center of gravity of the load when the robot is loaded 1~5kg.

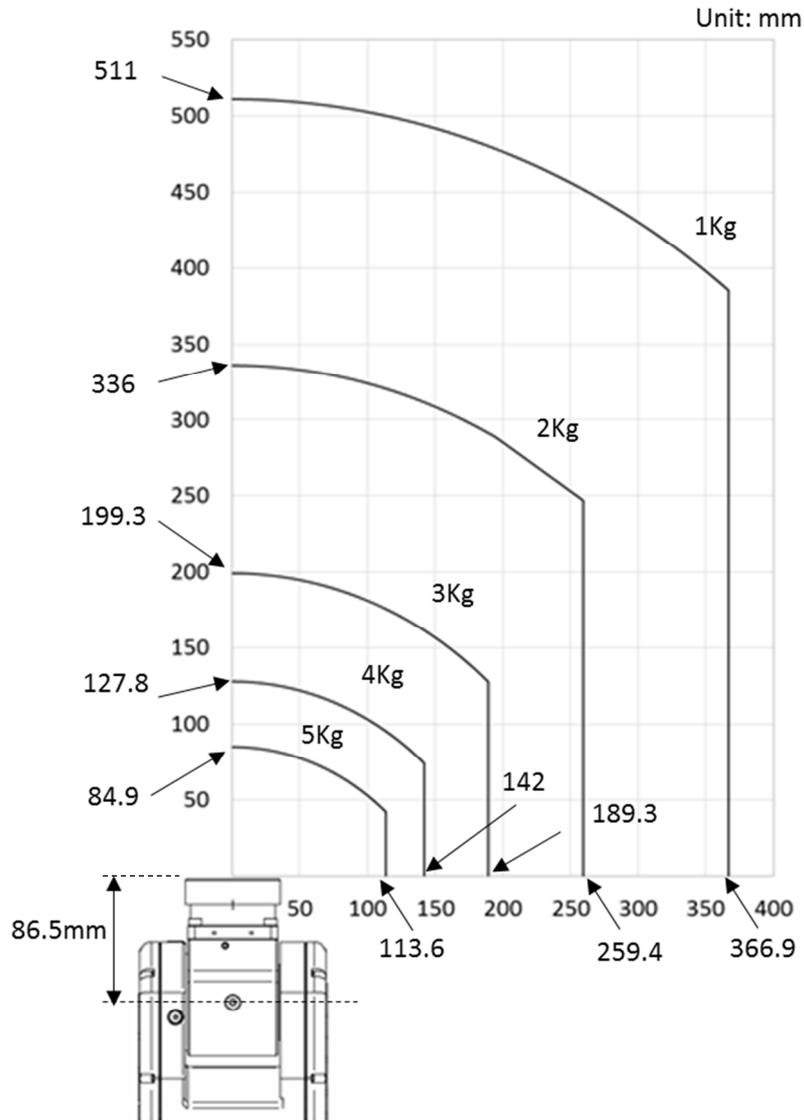


Figure 2-10 Wrist moment diagram

3. Equipment Mounting Surface and Interface

3.1 Mounting Surface for End Effector

The mounting surface for end effector on the wrist end is shown in Figure 3-1.

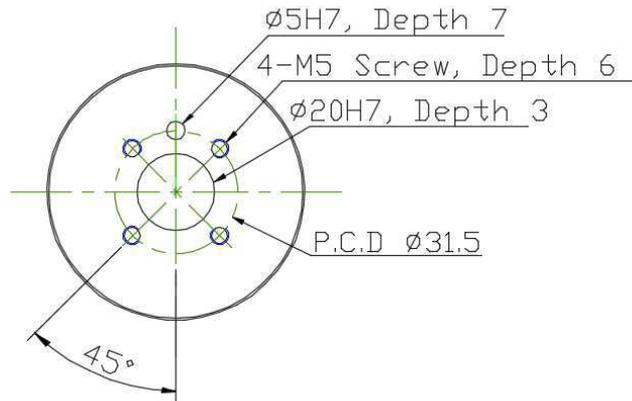


Figure 3-1 Mounting surface for end effector

3.2 Pneumatic Interface

Pneumatic holes (AIR IN & AIR OUT) are installed on the rear of J1 as shown in Figure 3-2, and the outer diameter of the air tube in the robot is $\phi 4\text{mm}$. The robot has three 5/2-way solenoid valves for end effector on J5 and the secure holes for the nozzle are M5×0.8P. The schematic diagram of pneumatic circuit is shown in Figure 3-3.

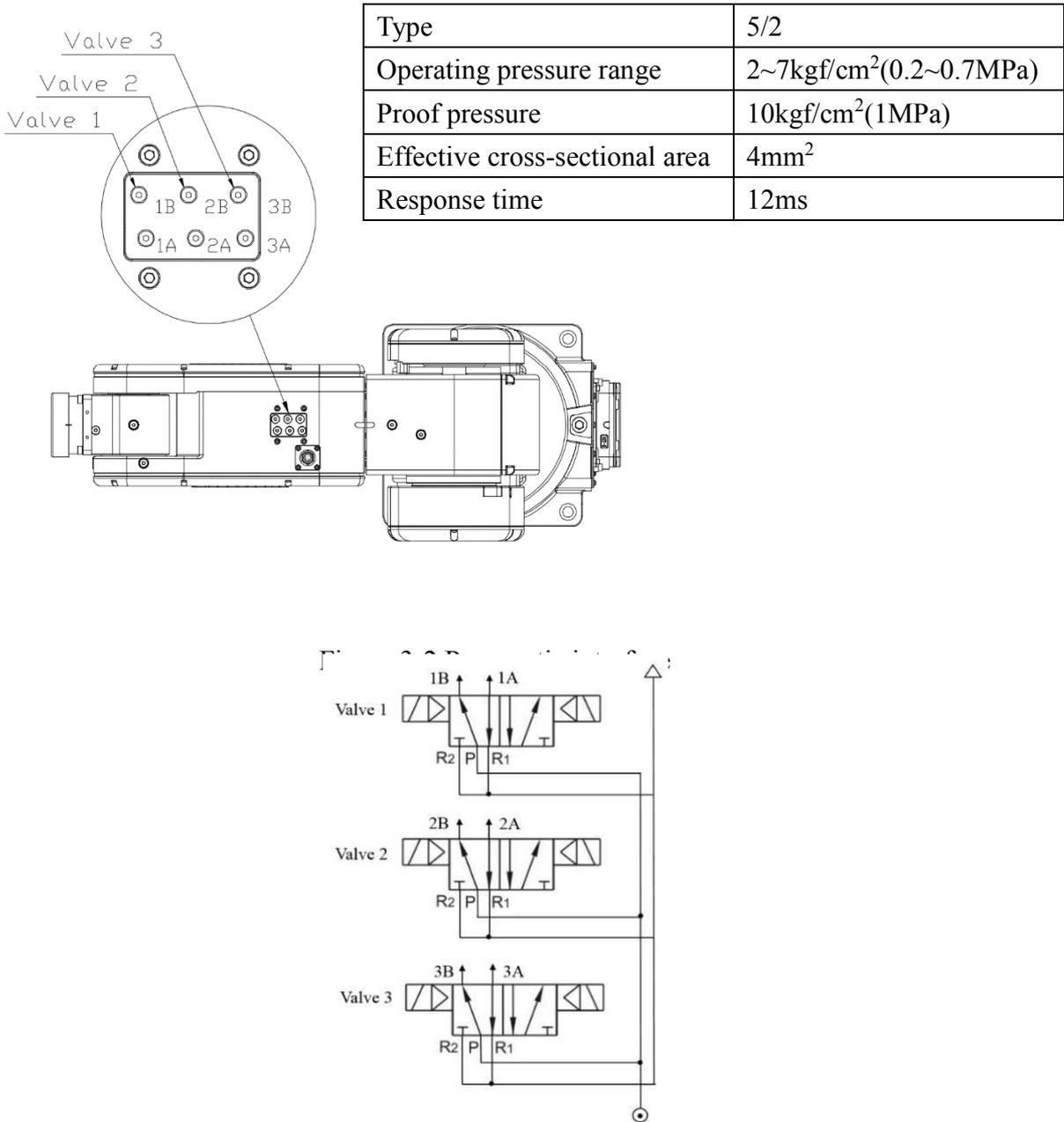


Figure 3-3 Pneumatic circuit diagram

3.3 I/O Interface

I/O interface for end effector on J5 and the pin assignment of I/O connector are shown in Figure 3-4. Figure 3-5 to Figure 3-8 show the wiring diagram of I/O interface.

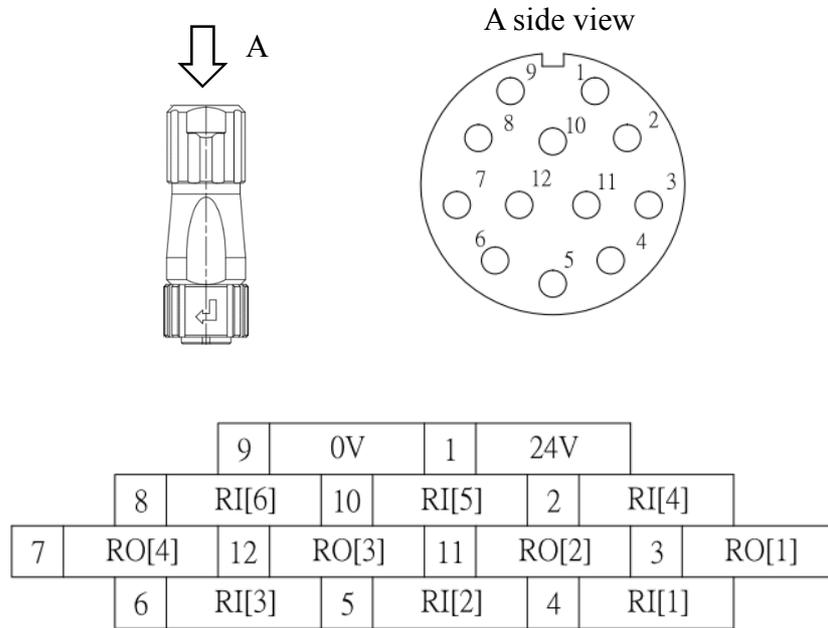


Figure 3-4 Pin assignment of the I/O connector (Power output: 24V/1A)

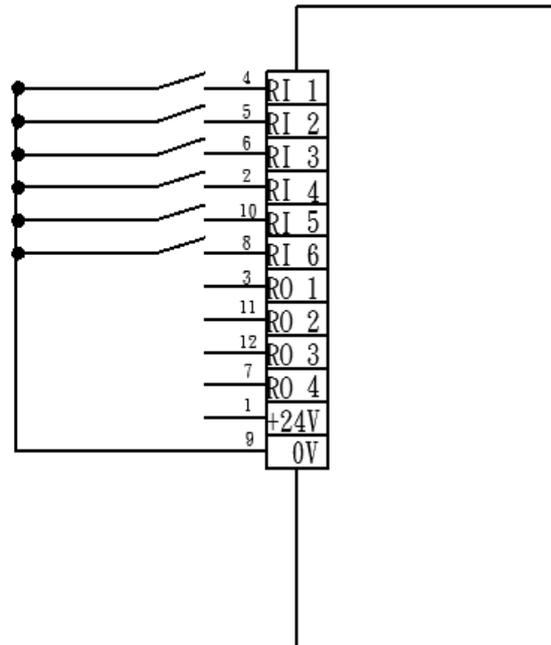


Figure 3-5 Wiring diagram of input (Standard: Sinking type)

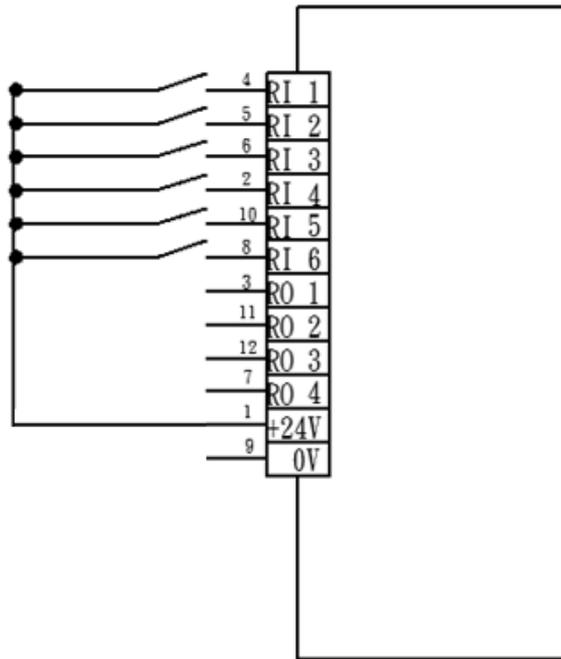


Figure 3-6 Wiring diagram of input (Optional: Sourcing type)

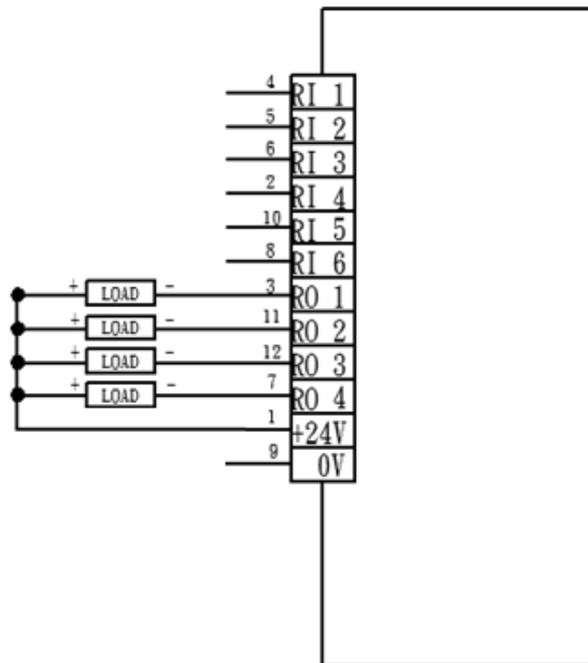


Figure 3-7 Wiring diagram of output (Standard: Sinking type)

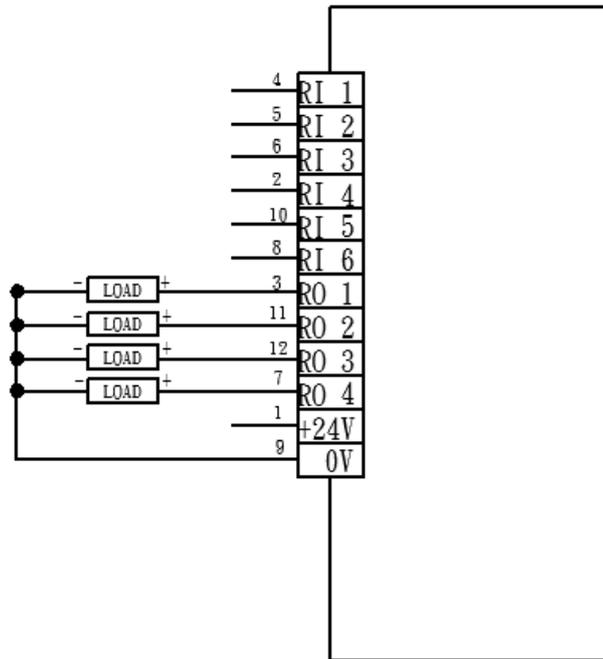


Figure 3-8 Wiring diagram of output (Optional: Sourcing type)

 CAUTION	<ul style="list-style-type: none"> ❖ Pin 1 and pin 9 are used for signal, not for power input of end effector. ❖ The maximum output current at each pin is 100mA.
--	---

4. Zero-Position

4.1 Zero Position Setting

The calibration tools for setting Zero-position are shown in Figure 4-1. The robot is adjusted to the minimum speed during the calibration, and aligns the pinhole with the calibration tool to set up the Zero-position. The procedure of resetting Zero-position with the calibration tools is shown in Figure 4-2 to Figure 4-7 below.

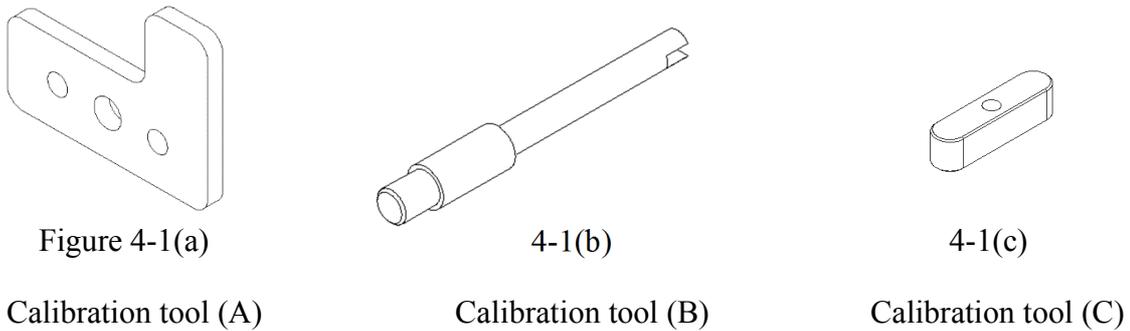


Figure 4-1 The calibration tool set

- J1-axis Zero-position setting

- Step1. Secure the calibration tool (A) on J1-axis by using positioning pin and screws.
- Step2. Operate J1 at low speed to align the positioning surface of J2 with the calibration tool (A).
- Step3. Finish calibration and remove the calibration tool (A).
- Step4. Clear encoder by HRSS. (Refer to page 33)
- Step5. Zero-position setting of J1-axis is completed.

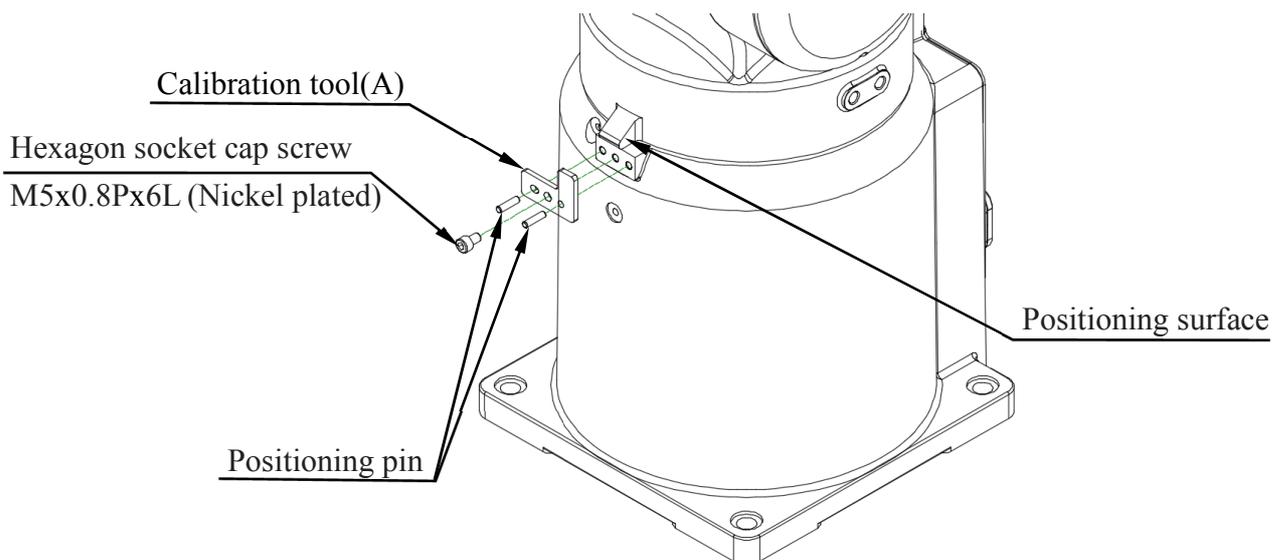


Figure 4-2 Illustration of J1-axis Zero-position setting

● J2-axis Zero-position setting

- Step1. Operate J2 at low speed to align the pinhole of J3 with the pinhole of J2.
- Step2. Insert the calibration tool (B) to the pinhole to calibrate Zero-position.
- Step3. Finish calibration and remove the calibration tool.
- Step4. Clear encoder by HRSS. (Refer to page 33)
- Step5. Zero-position setting of J2-axis is completed.

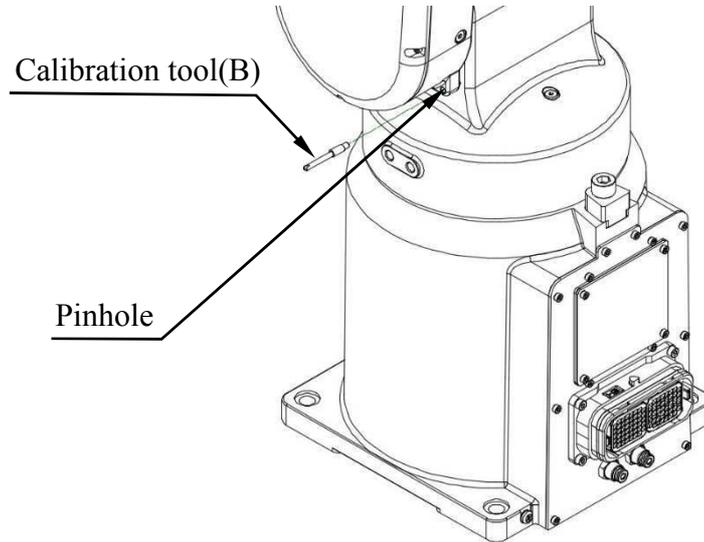


Figure 4-3 Illustration of J2-axis Zero-position setting

● J3-axis Zero-position setting

- Step1. Operate J3 at low speed to align the pinhole of J4 with the pinhole of J3.
- Step2. Insert the calibration tool (B) to the pinhole to calibrate Zero-position.
- Step3. Finish calibration and remove the calibration tool.
- Step4. Clear encoder by HRSS. (Refer to page 33)
- Step5. Zero-position setting of J3-axis is completed.

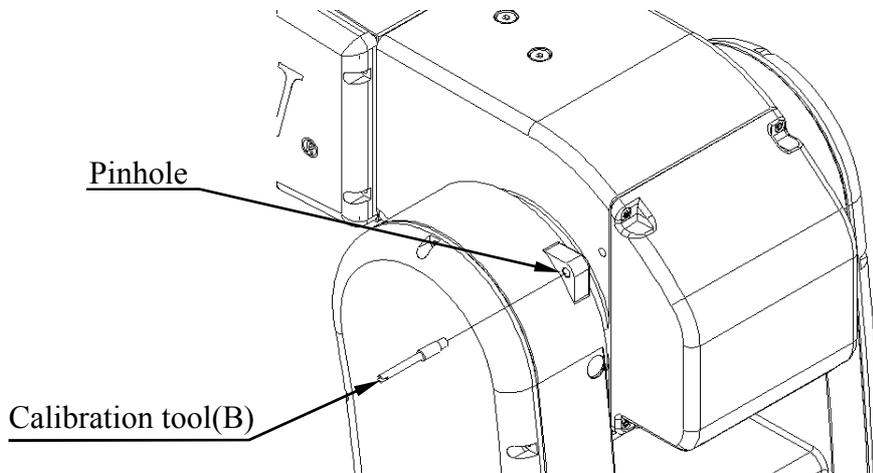


Figure 4-4 Illustration of J3-axis Zero-position setting

● J4-axis Zero-position setting

- Step1. Operate J4 at low speed to align the keyway of J5 with the keyway of J4.
- Step2. Insert the calibration tool (C) to the keyway to calibrate Zero-position.
- Step3. Finish the calibration and remove the calibration tool.
- Step4. Clear encoder by HRSS. (Refer to page 33)
- Step5. Zero-position setting of J4-axis is completed.

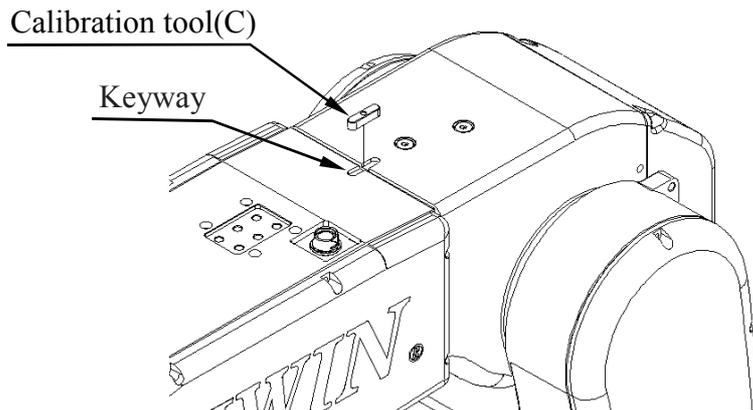


Figure 4-5 Illustration of J4-axis Zero-position setting

● J5-axis Zero-position setting

- Step1. Operate J5 at low speed to align the pinhole of J6 with the pinhole of J5.
- Step2. Insert the calibration tool (B) to the keyway to calibrate Zero-position.
- Step3. Finish the calibration and remove the calibration tool.
- Step4. Clear encoder by HRSS. (Refer to page 33)
- Step5. Zero-position setting of J5-axis is completed.

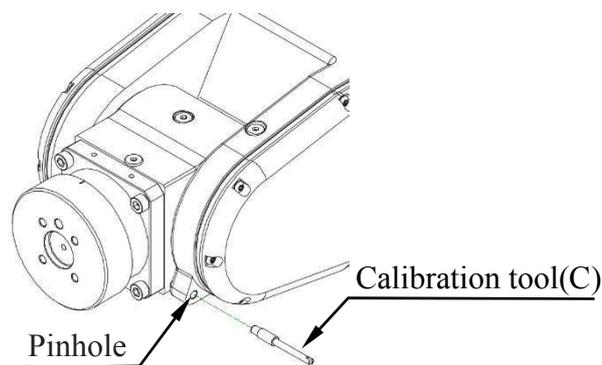


Figure 4-6 Illustration of J5-axis Zero-position setting

● J6-axis Zero-position setting

- Step1. Operate J6 at low speed to align the calibration mark of end effector with the mark of J6.
- Step2. Clear encoder by HRSS. (Refer to page 33)
- Step3. Zero-position setting of J5-axis is completed.

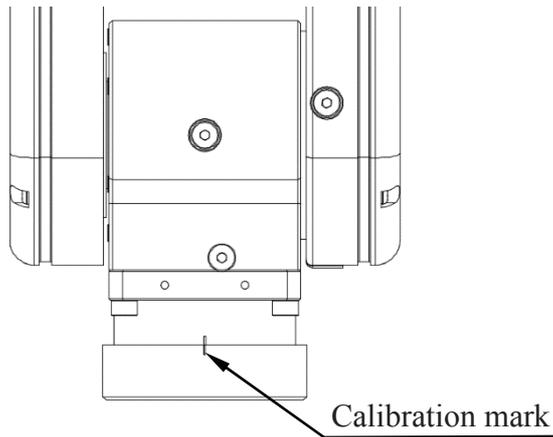


Figure 4-7 Illustration of J6 -axis Zero-position setting

⊙ Clear encoder by HRSS

- Step1. Select the “JOINT” as the coordinate system.
- Step2. Move the robot to the Zero-position. (Refer to section 4.1)
- Step3. Click Main Menu>>Start-up>>Master>>Clear Encoder.
(As shown in Figure 4-8)
- Step4. Double click the axis to clear encoder. (As shown in Figure 4-8)

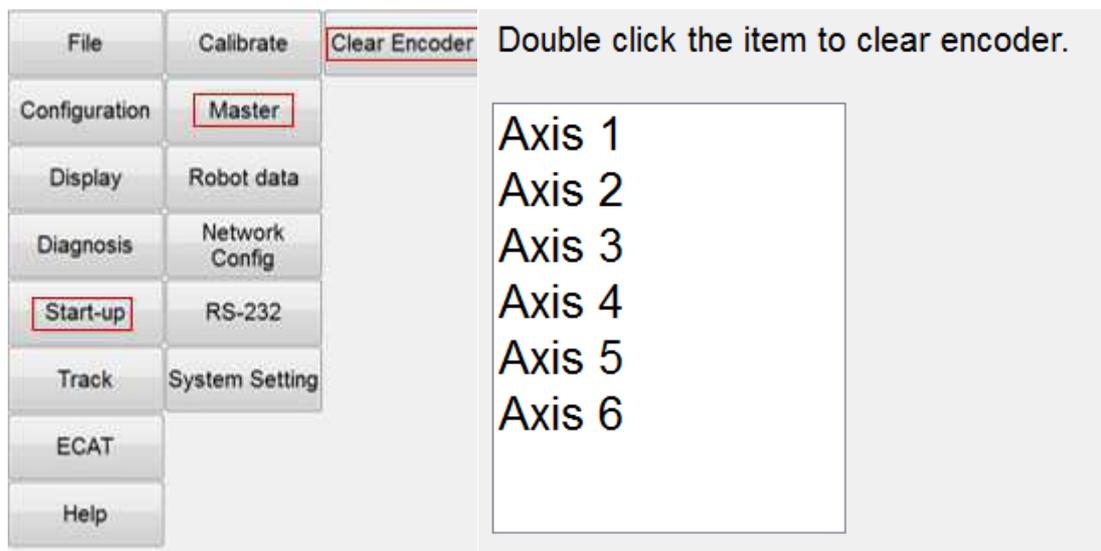


Figure 4-8 Clear encoder by HRSS

5. Maintenance and Inspection

This chapter presents the maintenance and periodical inspection procedures to maintain the robot for a reasonable service life. It includes the cover removal and installation, inspection and replacement of the timing belt, lubrication position, the procedures for replacing the battery, and other notes.

[Note 1] The operating time of the robot is defined as 3840 hours per year. When using the robot beyond this operating time, correct the maintenance frequencies shown in this chapter by calculation in proportion to the difference between the actual operating time and 3840 hours per year.

5.1 Periodic Inspection Items

The daily inspection items before the robot operation are shown in Table 5-1.

Table 5-1 Daily Inspection Items

	Inspection item	Remedy
Before turning power ON		
1	Are any of the robot installation screws, cover installation screws and end effector installation screws loose?	Securely tighten the screws.
2	Are all the cables securely connected? Such as the power and signal cable, grounding cable, the cable for teach pendant and the cable connected the robot and other equipment.	Securely connect.
3	Is the pneumatic system normal? Are there any air leak, drain clogging or hose damage? Is the air source normal?	Drain the drainage system and replace the leaking component.
After turning power ON		
1	Check whether the robot moves smoothly without vibration and noise.	<ol style="list-style-type: none"> 1. The robot installation screws might not be securely tightened to the installation surface. Securely tighten the screws. 2. If the roughness of the installation surface is uneven, modify the installation surface to the reasonable surface roughness. 3. The base might not be sufficiently rigid. Please replace the base to make it more rigid. 4. There might be foreign material between the robot and the installation surface. Please remove it.

		<ol style="list-style-type: none"> 5. Some operating positions might exceed the mechanism limit. Please reduce the load, speed or acceleration. 6. The timing belt might loosen or not be in correct position. Please replace or adjust the timing belt. (Refer to section 5.2.2) 7. If the grease of the reducer has not been changed for a long period. Please change the grease. (Refer to section 5.2.3) 8. If the bearing or the reducer has been damaged by the rolling surface or the gear tooth surface. Please contact HIWIN directly.
2	The repeatability is not within the tolerance.	<ol style="list-style-type: none"> 1. The Zero-position of the robot might be rewritten. Please set the Zero-position. (Refer to section 4.1) ° 2. The Zero-position data will be lost if the backup batteries is dead. Please replace the backup batteries (Refer to section 5.2.1) and set the Zero-position. (Refer to section 4.1) ° 3. The Robot J1 base retaining bolt might loosen. Please apply LOCTITE and tighten it to the appropriate torque.

The project and time of periodic inspection refer to Table 5-2.

Table 5-2 Periodic inspection items

	Inspection item	Remedy
Inspection item A (1 month / 320 hours)		
1	Check if there are any cracks and flows on the robot.	Clean and check each part of the robot.
Inspection item B (3 months / 960 hours)		
1	Check the ventilation system of the controller.	If it is dusty, turn off the power and clean the ventilation system of the controller
Inspection item C (6 months / 1920 hours)		
1	Check whether the timing belt is normal.	Adjust the tension of the timing belt. If the friction at the timing belt is severe, replace it. Refer to section 5.2.2.
Inspection item D (1year / 3840 hours)		

1	Replace the backup battery in the robot.	Replace the backup battery. Refer to section 5.2.1
Inspection item E (3years/11520hours)		
1	Change the lubrication grease of the reducer.	Change the grease. Refer to section 5.2.3.

 CAUTION	<p>❖ It is normal that the belt produces debris during operation, but if it happens right after cleaning the belt, it is recommended to replace the belt.</p>
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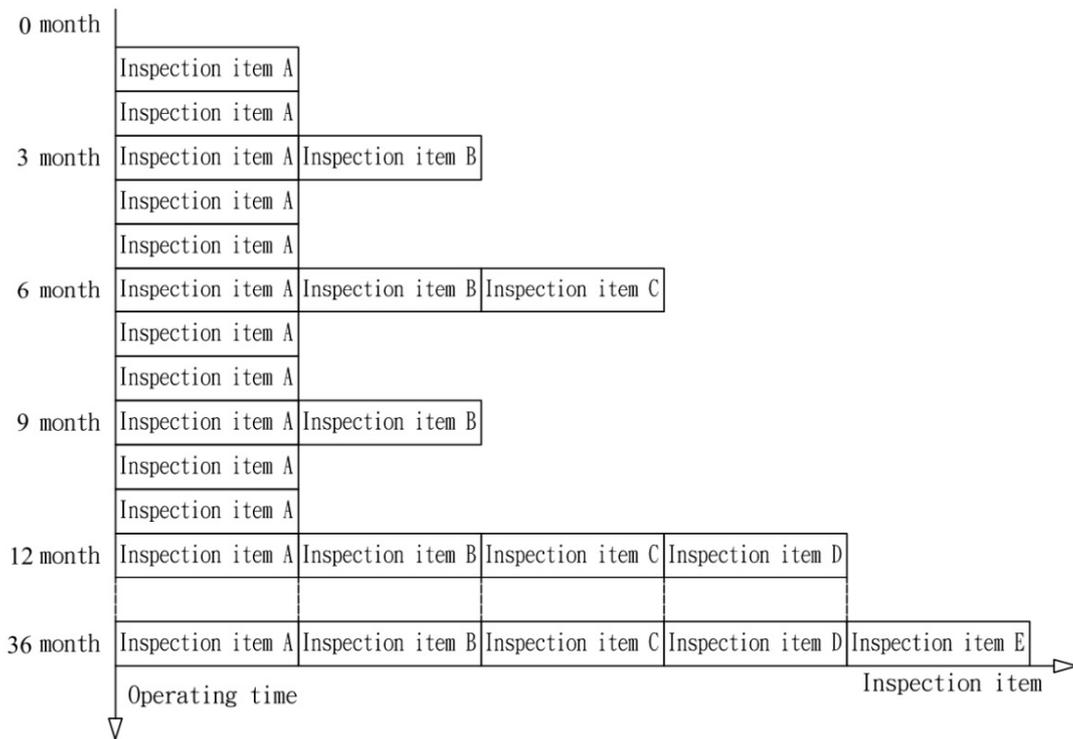


Table 5-3 Inspection schedule

5.2 Repair

5.2.1 Backup Batteries Replacement

The absolute encoder of the motor is used to record the position of the robot. When the controller power is turned off, the position data of each -axis is preserved by the backup batteries. The batteries are installed when the robot is delivered from the factory. If the batteries are in use, the annual change of batteries is needed. The service life of the batteries depends on the operating conditions of the robot. In order to avoid the loss of position data, the batteries need to be changed by the user periodically. The procedure for replacing the batteries of the robot is shown in Figure 5-1 and described as below.

- Step1. Press the emergency stop button to prohibit the movement of the robot motion.
- Step2. Ensure the robot and controller are connected with the cables. Keep the power ON.
- Step3. Please remove the battery cover. the screws for battery cover are hexagon socket screws (M3×0.5P×6L) and the four batteries are 3.6V.
- Step4. Replace the battery one by one. If all batteries are removed in the same time, the position data will be lost. If so, please reset the robot to the Zero-position. All batteries should be changed at one time. Please prevent the old batteries are included.
- Step5. After replacing the battery, ensure to install the battery cover to prevent the robot being damaged by dust and grease.

 CAUTION	❖ All batteries should be changed at one time. If the old batteries are included, the service life of the batteries may be reduced.
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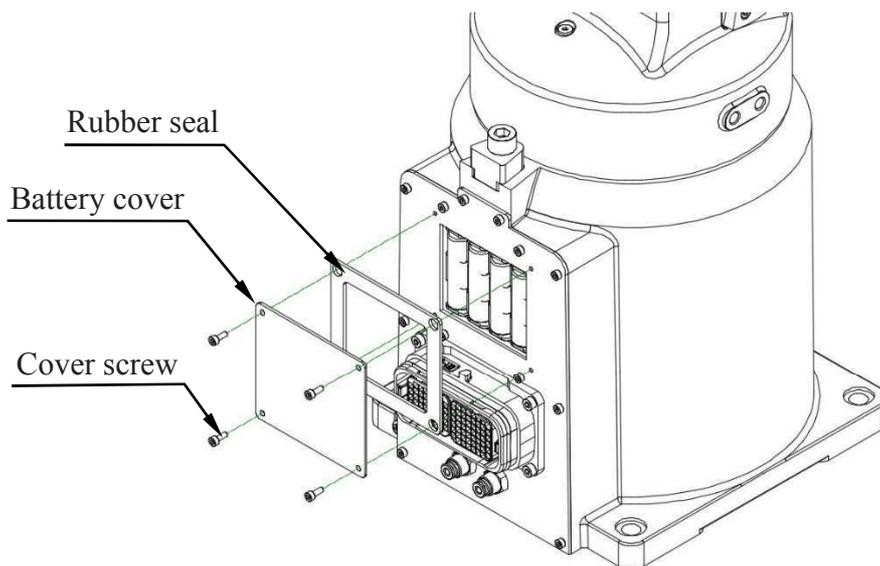


Figure 5-1 The backup batteries replacement

5.2.2 Timing Belt Replacement

The timing belt is used in the robot for the driver system of the J5 and J6 -axis. Although the belt tension has been adjusted before the robot delivery, the timing belt will wear depending on the working conditions. The belt tension might be lower than the standard after operating for a long time. The timing belt should be periodically checked, maintained and replaced.

⊙ Timing Belt replacement period

Check the timing belt about every 6 months. The timing belt must be replaced if the belt teeth is found cracked, worn to approximately half of the tooth width, or broken.

 CAUTION	<p>❖ When replacing the belt, the robot system origin may deviate. In this case, the position data must be rechecked if the origin is offset. Please refer to section 4.1 for Zero-point setting.</p>
--	---

⊙ Belt Tension

It is very important to keep proper belt tension. The belt tooth jumping will happen if the belt tension is too loose. If the belt tension is too tight, it will cause damage to the motor or bearing. Measuring methods of the belt by using fingers or tools are shown in Figure 5-2. The sonic tension meter is used to measure the belt tension. The specifications and standard tension of belt are shown in Table 5-4.

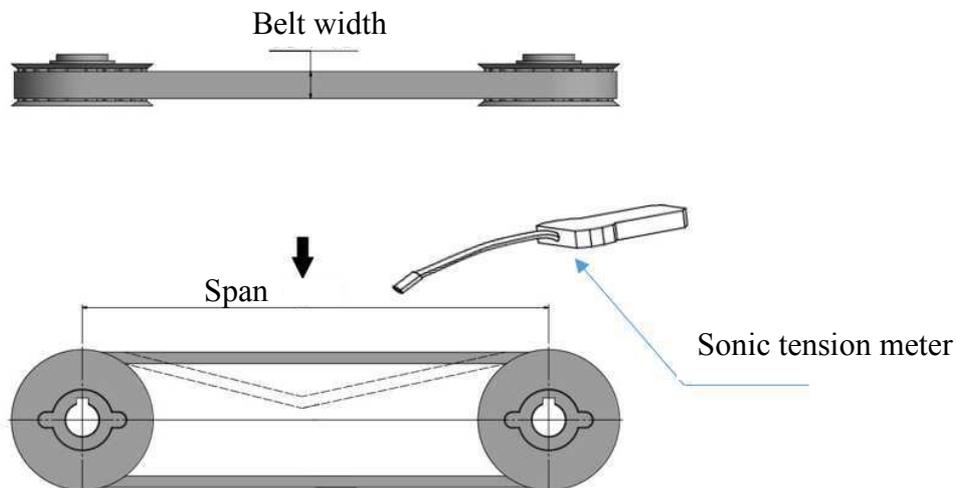


Figure 5-2Belt tension measurement

 CAUTION	<p>❖ It is normal that the belt produces debris during operation, but if it happens right after cleaning the belt, it is recommended to replace the belt.</p>
--	---

Table 5-4 The belt specifications

Axis	Belt type	Width(mm)	Span(mm)	Tension(N)
2	365-5GT-9	9	117.5	55
	375-5GT-9		116.9	
3	440-5GT-9	9	154.9	55
	635-5GT-9		254.9	
5	285-3GT-6	6	100.3	29
6	285-3GT-6	6	100.3	29

 CAUTION	❖ If the belt of J1 and J4 need to be replaced, please contact HIWIN.
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⊙ Cover removal

Before replacing the belt, remove the cover of J3 and J5 as shown in Figure 5-3.

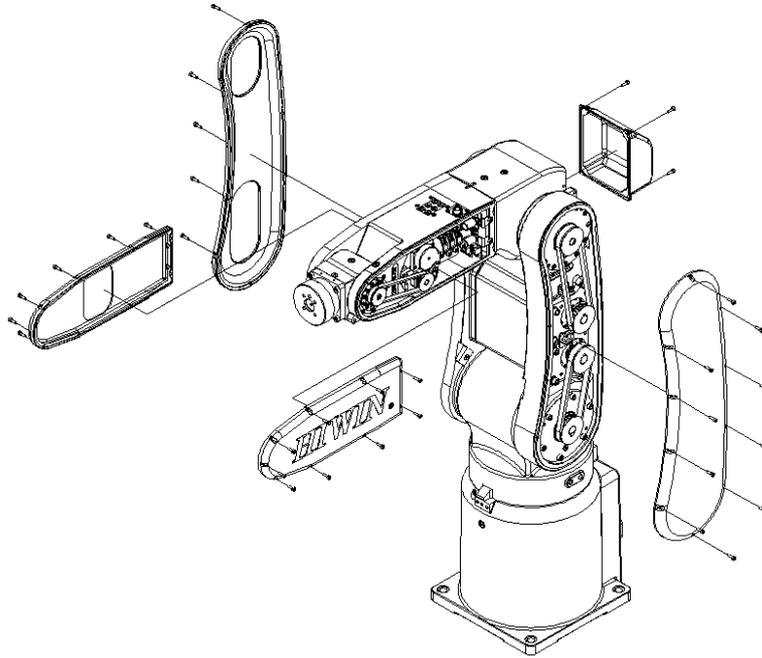


Figure 5-3 Cover removal diagram

⊙ Inspection, maintenance and replacement of timing belt in J2-axis.

Figure 5-4 shows the structure of J2-axis.

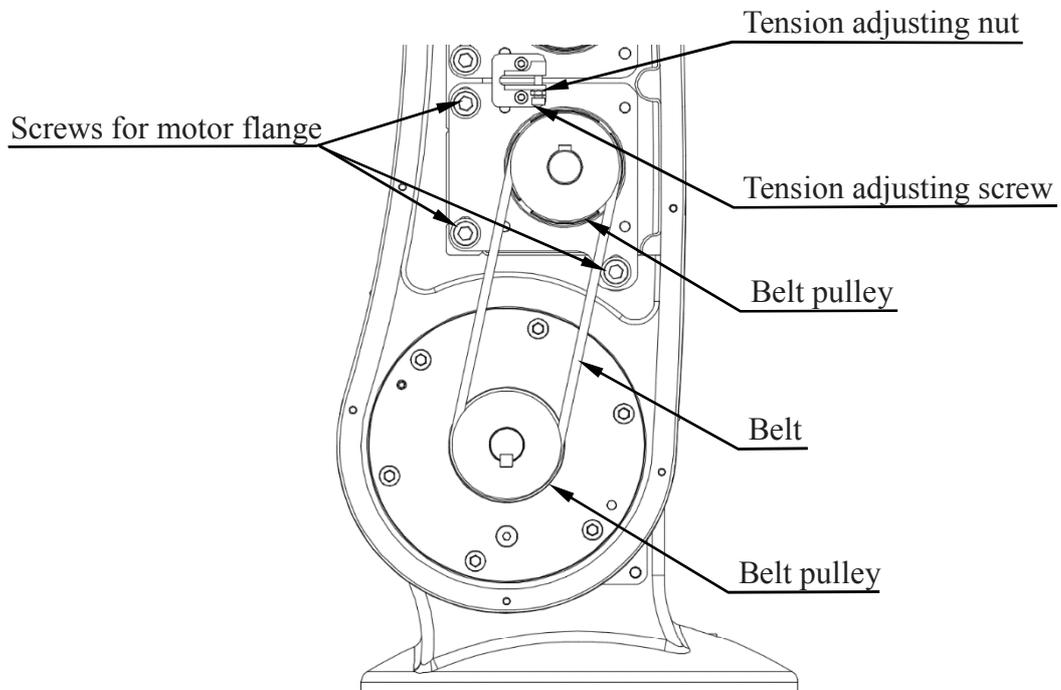


Figure 5-4 J2-axis structure diagram

- Inspect J2-axis timing belt
 - Step1. Ensure the power of controller is switched off.
 - Step2. Remove the cover of J3.
 - Step3. Check whether the timing belt is normal.
 - Step4. If the timing belt is abnormal, refer to the following paragraph to replace the timing belt.
 - Step5. If the belt tension is lower than the standard, refer to the following paragraph to adjust the belt tension.
- Adjust J2-axis timing belt
 - Step1. Loose the two fixing screws on motor flange, so that the motor can be move.
No need to remove the screws.
 - Step2. Refer to Table 5-4, loosen or tighten the adjusting screw to adjust the tension of the belt.
 - Step3. Tighten the two fixing screws on motor flange.
- Replace J2-axis timing belt
 - Step1. Remove the two fixing screws on motor plate.
 - Step2. Loose the adjusting screw to replace the timing belt.
 - Step3. After replacing the belt, refer to the paragraph “Adjust J2-axis timing belt” above to adjust the tension of the belt.

⊙ Inspection, maintenance and replacement of timing belt in J3-axis.

Figure 5-5 shows the structure of J3-axis.

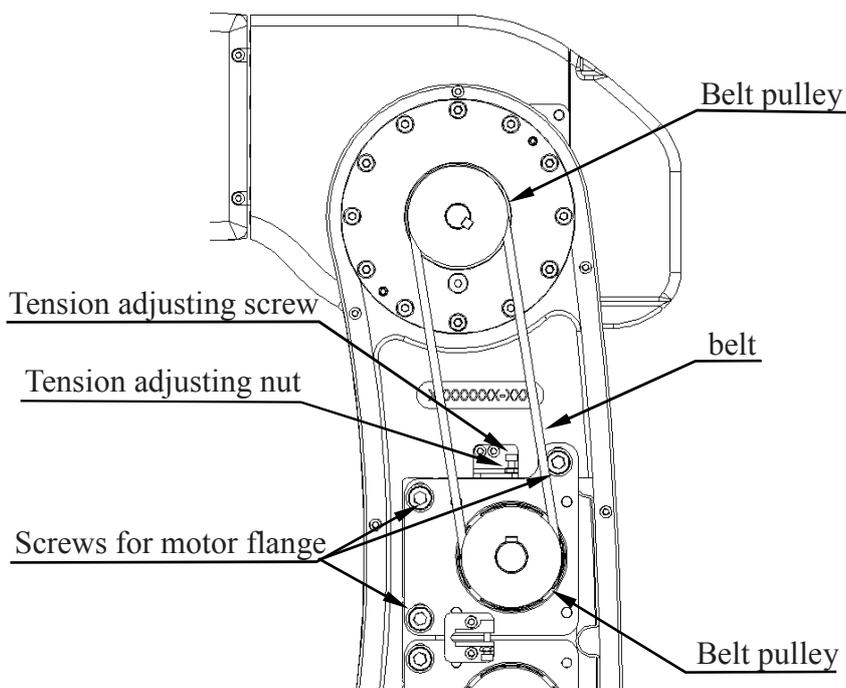


Figure 5-5 J3-axis structure diagram

- Inspect J3-axis timing belt
 - Step1. Ensure the power of controller is switched off.
 - Step2. Remove the cover of J3.
 - Step3. Check whether the timing belt is normal.
 - Step4. If the timing belt is abnormal, refer to the following paragraph to replace the timing belt.
 - Step5. If the belt tension is lower than the standard, refer to the following paragraph to adjust the belt tension.
- Adjust J3-axis timing belt
 - Step1. Loose the two fixing screws on motor flange, so that the motor can be move.
No need to remove the screws.
 - Step2. Refer to Table 5-4, loosen or tighten the adjusting screw to adjust the tension of the belt.
 - Step3. Tighten the two fixing screws on motor flange.
- Replace J3-axis timing belt
 - Step1. Remove the two fixing screws on motor plate.
 - Step2. Loose the adjusting screw to replace the timing belt.
 - Step3. After replacing the belt, refer to the paragraph “Adjust J3-axis timing belt” above to adjust the tension of the belt.

⊙ Inspection, maintenance and replacement of timing belt in J5-axis.

Figure 5-6 shows the structure of J5-axis.

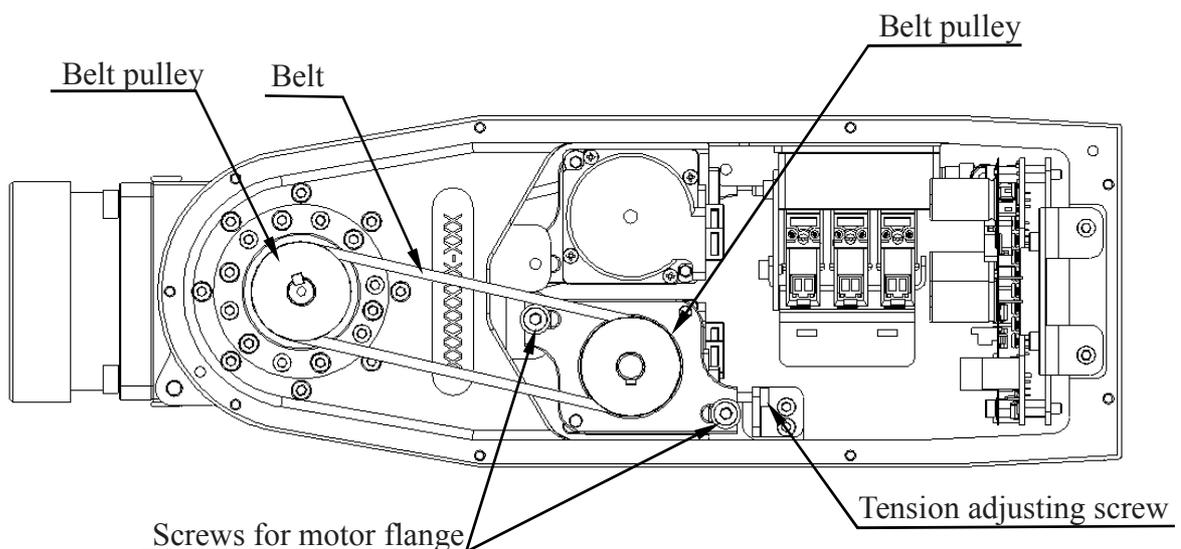


Figure 5-6 J5-axis structure diagram

- Inspect J5-axis timing belt
 - Step1. Ensure the power of controller is switched off.
 - Step2. Remove the cover of J5.
 - Step3. Check whether the timing belt is normal.
 - Step4. If the timing belt is abnormal, refer to the following paragraph to replace the timing belt.
 - Step5. If the belt tension is lower than the standard, refer to the following paragraph to adjust the belt tension.
- Adjust J5-axis timing belt
 - Step1. Loose the two fixing screws on motor flange, so that the motor can be move.
No need to remove the screws.
 - Step2. Refer to Table 5-4, loosen or tighten the adjusting screw to adjust the tension of the belt.
 - Step3. Tighten the two fixing screws on motor flange.
- Replace J5-axis timing belt
 - Step1. Remove the two fixing screws on motor plate.
 - Step2. Loose the adjusting screw to replace the timing belt.
 - Step3. After replacing the belt, refer to the paragraph “Adjust J5-axis timing belt” above to adjust the tension of the belt.

⊙ Inspection, maintenance and replacement of timing belt in J6-axis.

Figure 5-7 shows the structure of J6-axis.

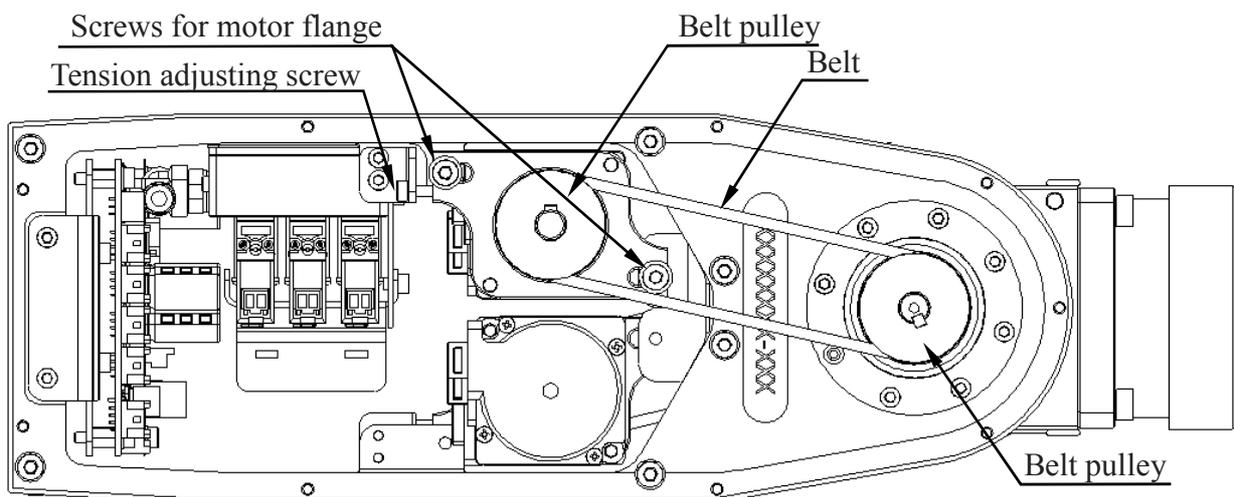


Figure 5-7 J6-axis structure diagram

- Inspect J6-axis timing belt
 - Step1. Ensure the power of controller is switched off.
 - Step2. Remove the cover of J5.
 - Step3. Check whether the timing belt is normal.
 - Step4. If the timing belt is abnormal, refer to the following paragraph to replace the timing belt.
 - Step5. If the belt tension is lower than the standard, refer to the following paragraph to adjust the belt tension.
- Adjust J6-axis timing belt
 - Step1. Loose the two fixing screws on motor flange, so that the motor can be move.
No need to remove the screws.
 - Step2. Refer to Table 5-4, loosen or tighten the adjusting screw to adjust the tension of the belt.
 - Step3. Tighten the two fixing screws on motor flange.
- Replace J6-axis timing belt
 - Step1. Remove the two fixing screws on motor plate.
 - Step2. Loose the adjusting screw to replace the timing belt.
 - Step3. After replacing the belt, refer to the paragraph “Adjust J6-axis timing belt” above to adjust the tension of the belt.

5.2.3 Grease Replenishment

☉ The grease inlets and the air vents are shown in Figure 5-8.

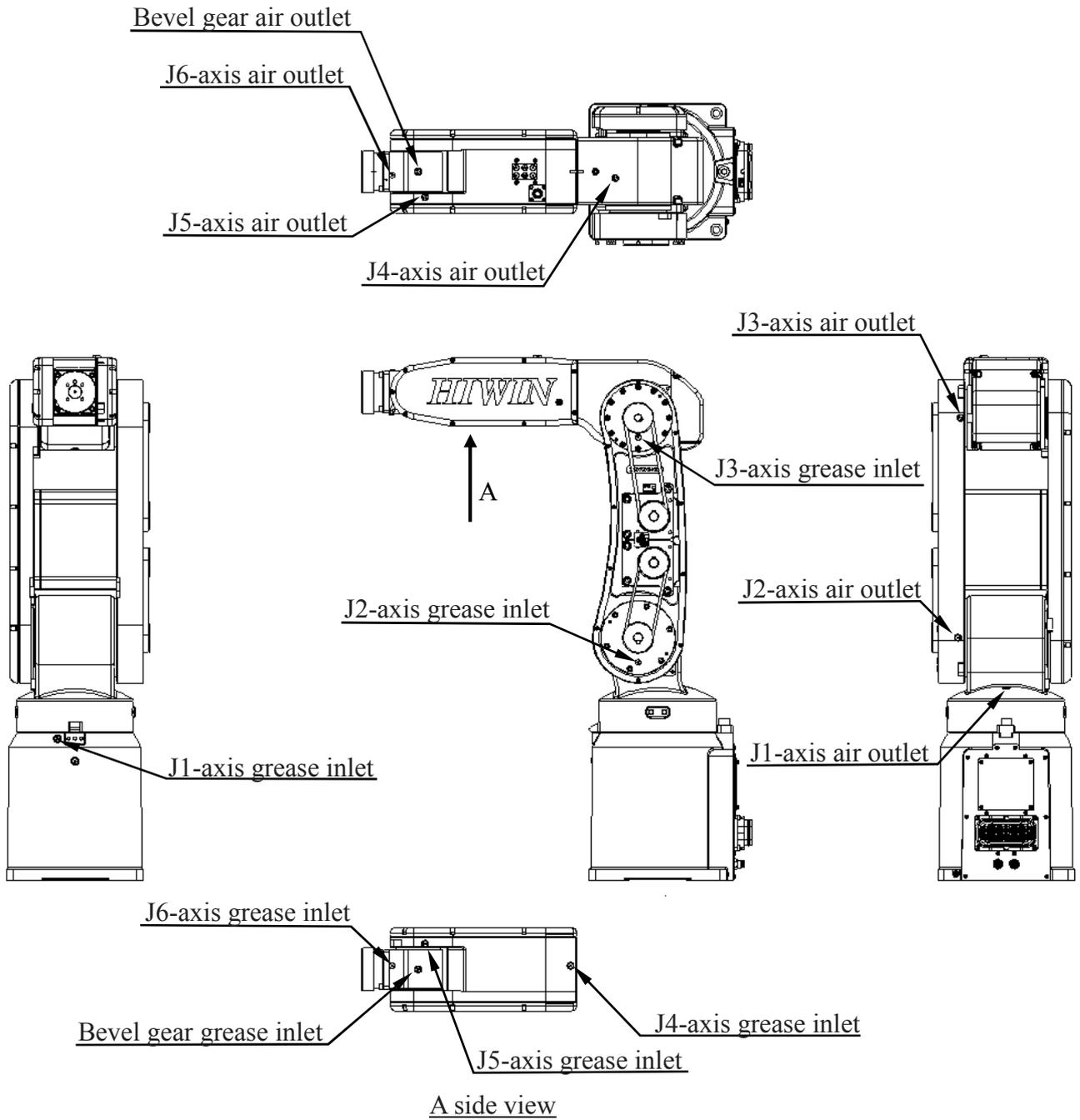


Figure 5-8 Lubrication and air inlet/outlet positions

⊙ Grease specification

Table 5-5 shows the specification of grease.

Table 5-5 Grease specification

Part	Grease nipple	Lubrication grease	Quantity	Lubrication interval
J1 reduction gear	M6	SK-1A	93.3 ml	3Year /11520Hr
J2 reduction gear	M5	SK-1A	66.6 ml	
J3 reduction gear	M5	SK-1A	33.3 ml	
J4 reduction gear	M5	SK-1A	20 ml	
J5 reduction gear	M5	SK-2	6.1 ml	
J6 reduction gear	M5	SK-2	6.1 ml	
Bevel gear	M5	SK-2	11.2 ml	

[Note1] : If the robot is not used for 2 years, replace the grease of each axis.

[Note2] : The J3 cover needs to be removed for J2 grease replacement.

⊙ Procedure of grease replenishment

- Step1. The grease inlets and the air outlets of the robot are shown in Figure 5-9.
- Step2. Remove the screw of the grease inlet, and install the grease nipple.
- Step3. Remove the screw of the air outlet.
- Step4. Replenish the grease from the grease inlet by the grease gun.
- Step5. Refer to Table 5-4 for the amount of grease.
- Step6. Install the screw of the air outlet.
- Step7. Remove the grease nipple, and install the screw of the grease inlet.

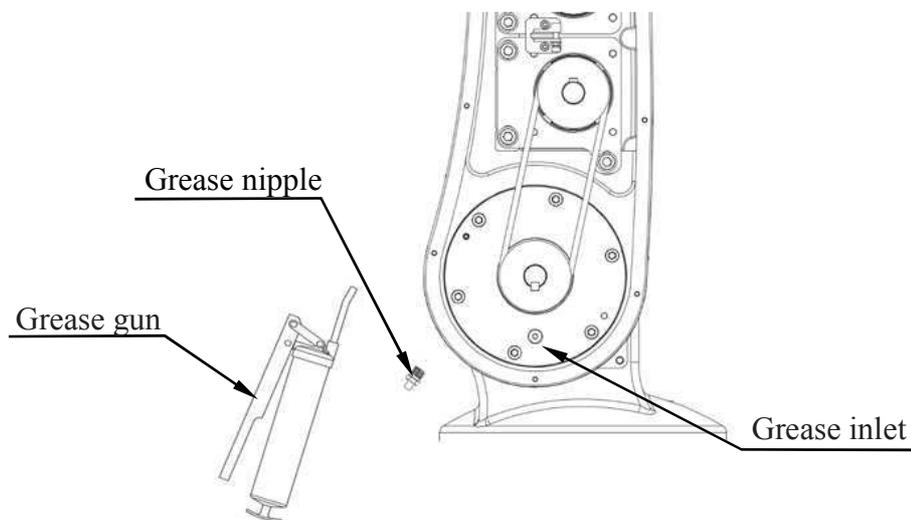
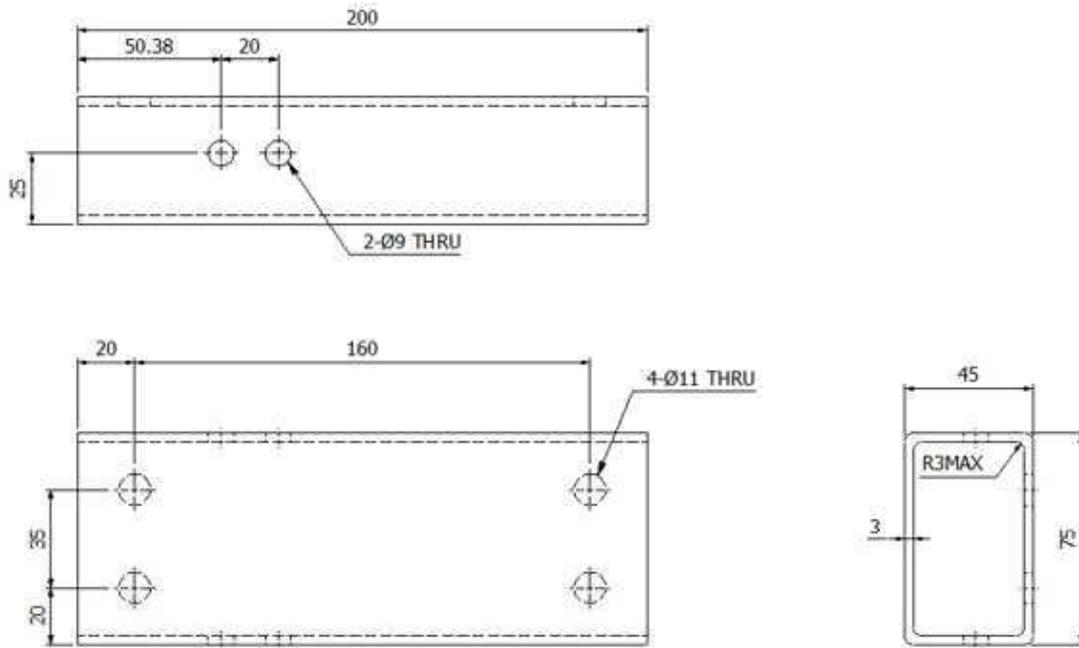


Figure 5-9 Grease replenishment

6. Appendix

Suspension plate (refer to section 1.2)



Articulated Robot-RA605 (Original Instruction) User Manual

Publication Date : April 2018, first edition

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