



Articulated Robot -RA620

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



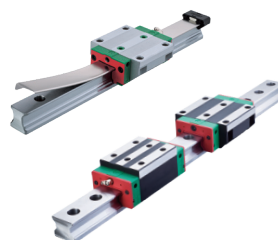
Direct Drive Rotary Table

- Aerospace / Medical / Automotive industry /
Machine tools / Machinery industry
- RAB Series
 - RAS Series
 - RCV Series
 - RCH Series



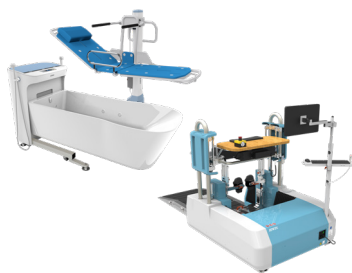
Ballscrew

- 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



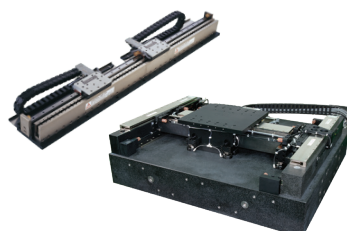
AC Servo Motor & Drive

- 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 technical staff or the dealer who you purchased with.

 WARNING	<ul style="list-style-type: none">❖ Improper modification or disassemble the robot might reduce the robot function, stability or lifespan.❖ 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 technical staff for special modification coming from production line set up.❖ For the safety reason, any modification for HIWIN product is strictly prohibited.
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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.
 - ⊙ In compliance with the safety information on industrial robot described in this manual can't guarantee that *HIWIN* robot will not occur any safety problems.
 - ⊙ This machine is defined as a partly completed machinery, the associated hazards must be handled by system integrator in accordance with ISO 102018-1/-2.
 - ⊙ A safety-related part of control system (SRP/CS) should conform to the requirement of performance level d and category 3 according to ISO 13849-1.
 - ⊙ The installation for emergency functions shall be defined by the system integrator in accordance with ISO 10218-1/2.
- Safety Operation Principle
 - ⊙ Before connecting the power supply for HIWIN industrial robot startup assembly procedure, check whether the specification of factory output voltage matches the specification of input voltage of the product. If it does not match, ensure to use the corresponding transformer (HIWIN optional transformer is recommended).
 - ⊙ Emergency Stop button (on Teach Pendant or from external emergency stop switch) must be pressed before turning off the power, and then switch off the power switch.
 - ⊙ While connecting to the external I/O or the signal, please operate in the condition that the power switch is turned off to prevent from a shortcut caused by mistaken touch in the process, and resulting in damage.

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:
 - Turns robot controller ON/OFF
 - Starts robot program from operator's panel
 - Reset system alarm
 - Teaches robot
 - Maintenance engineer:
 - Turns robot controller ON/OFF
 - Starts robot program from operator's panel
 - Reset system alarm
 - Teaches robot
 - Does maintenance, adjustment, replacement
- ☉ Programmer and the maintenance engineer must be trained for proper robot operation.

3. Precautions


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 workwear for working environment, safety shoes and helmets. ❖ When encountering danger or other emergency or abnormal situation, please press the emergency stop button immediately. After danger is eliminated, move the robot away with low speed in manual mode. ❖ 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 allowable load moment at wrist. Exceeding these values could lead to the driver alarm or malfunction of the robot. ❖ Do not climb on manipulator. ❖ Do not store the machine in the environment with corrosion and flammable gas or close to the flammable object. ❖ Do not operate the machine in the environment with moisture, water or grease. ❖ Do not operate the machine at the place where vibration or the strong impact occurs. ❖ Do not immerse the electric wires into grease or water.
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	<ul style="list-style-type: none"> ❖ Do not connect or operate the machine with wet hands. ❖ Do not operate the machine in potentially explosive environment. ❖ Please ensure the controller is grounded. ❖ Keep hands away from the inner part of the controller while it is connecting to the power or during operating. ❖ Do not touch the heat sink, regenerative resistance, the power supply or the computer inside the controller while it is operating due to its high temperature. ❖ Be sure power is disconnected prior to repair and maintenance, and ensure to operate under the condition of no electrical shock risk. ❖ Do not disassembly the controller without permission. If there's any issues, please contact our engineers.
 WARNING	<ul style="list-style-type: none"> ❖ 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 spare parts to repair 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 or unexpected damage. ❖ Do not stand on the controller or put heavy objects on it. ❖ Do not block the vent or put foreign objects into the controller. ❖ Please ensure the controller is fixed on the base.

	<ul style="list-style-type: none"> ❖ Do not pull the connector violently or twist the electric wires excessively. ❖ Do not frequently switch ON/OFF the power switch and the control button. ❖ Please ensure that the robot, the emergency stop switch and the controller are functioning properly before performing any work. ❖ Do not shutdown the power switch during the operation. ❖ Do not open, modify, disassemble and maintain the machine without permission. ❖ The power must be disconnected when the machine does not operate in a long time. ❖ Do not turn off the power of the controller when modifying the program or parameter. Otherwise, the data stored in the controller will be damaged. ❖ After the brake of a servo motor is released, the robot will be moved due to gravity and it may injured the operator. ❖ The industrial robots can be applied for the different industrial environments. ❖ When the operating procedures are interrupted, the special attention should be paid during the troubleshooting.
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3.2 Operation

 DANGER	<ul style="list-style-type: none"> ❖ Teaching, jogging or programming should be done outside of the safety fence. If it is inevitable to enter the safety fence, press the emergency stop button before entrance. Operation should be restricted at low speed and beware of surrounding safety. ❖ All operations shall be executed by trained staff.
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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 switch 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 object going into the robot.
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3.4 End Effector


The end effector can be classified as two types:

- A. Gripper: Used to load and unload, such as pneumatic gripper, electric gripper and vacuum sucker.
- B. Tool: Used to process, such as welding, cutting and surface treatment.



 DANGER	<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 fall during operation which may cause personal injury or hazard.
 WARNING	<ul style="list-style-type: none"> ❖ The end effector may be equipped with its own control unit. During installation, pay attention to installed location. Ensure that the control unit does not interfere with robot operation. ❖ The gripper-type end effector should prevent the workpiece from dropping or damaging when the robot experiences a power error or other errors. If potential dangers or abnormal situations exist when using end effector, the associated hazards must be handled by the system integrator in accordance with the related standards.

3.5 Pneumatic, Hydraulic System

 DANGER	<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 or hydraulic system must be equipped with the relief valve, so that it can be applied in an emergency.
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 WARNING	<ul style="list-style-type: none"> ❖ More attention should be paid to the pressure remained in the pneumatic systems after the power is disconnected. ❖ The internal pressure must be released before the pneumatic systems are maintained. ❖ More attention should be paid to the pressure in the pneumatic system as it is several times more than the atmosphere pressure.
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3.6 Emergency Stop Switch

 DANGER	<ul style="list-style-type: none"> ❖ The robot or other control component should have at least one device for immediate halt, 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 reduce the lifespan of the robot.
 WARNING	<ul style="list-style-type: none"> ❖ The drive power and the control system will be disconnected to stop all actions during the emergency stop. ❖ If you want to restart the procedures, you should reset the emergency stop switch. ❖ Emergency stop established an immediate stop: Immediately stop the robot system, and disconnect the driver power. ❖ The emergency stop switch is used for emergency stop only. ❖ The <i>HIWIN</i> robot is equipped with two emergency stop switches, where one is installed on the teach pendant and the other is directly connected to the controller via a cable. If additional emergency

	<p>stop switches are required, other connecting method can be applied for the same purpose.</p> <ul style="list-style-type: none"> ❖ Based on the relevant industrial safety regulations, the emergency stop switch is directly connected to the controller of the robot via the physical wires. ❖ If the version of the braking is not applied to the whole axis, once the emergency stop is executed and the heavy objects are loaded on the robot end, the axis without brake will move due to gravity. This attention must be paid for safety issue.
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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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Edition	Date	Model	Remark
C08UE001-1711	2017.11.14	RA620	First edition
C08UE001-1801	2018.01.30	RA620	Modify manipulator operation range expression
C08UE001-1803	2018.03.15	RA620	Add J6 calibration method, origin angle
C08UE001-1808	2018.08.22	RA620	Modify content figure, standard and optional table, model name expression

1. Transport and Installation

1.1 Transport

The transportation of the robot can use lifting tackle or forklift truck. The transportation procedure is as follows:

- Step1. The angle of each joint is shown in the table of Figure 1-2 and 1-3.
- Step2. Attach the suspension frame to the robot, as shown in Figure 1-1. When carrying the robot with lifting tackle, four M8×1.25P eye bolt, M8 nuts and M8 washers should be mounted on the suspension frame.
- Step3. Move the robot to the desired position by lifting tackle or forklift truck.
- Step4. Remove the suspension frame.

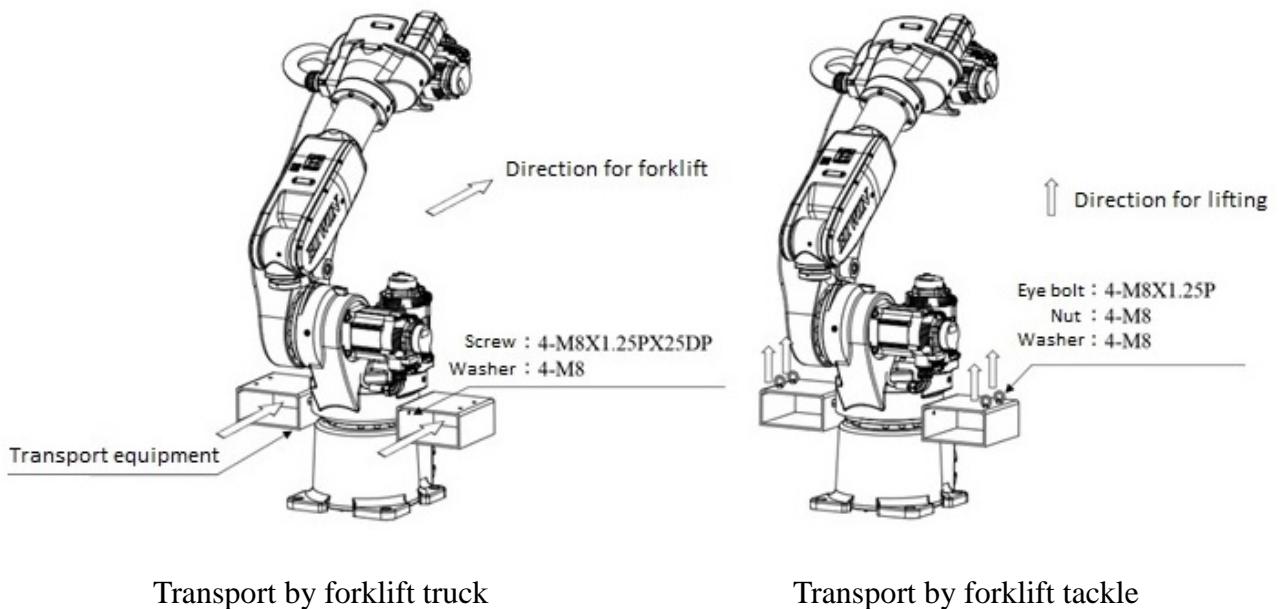
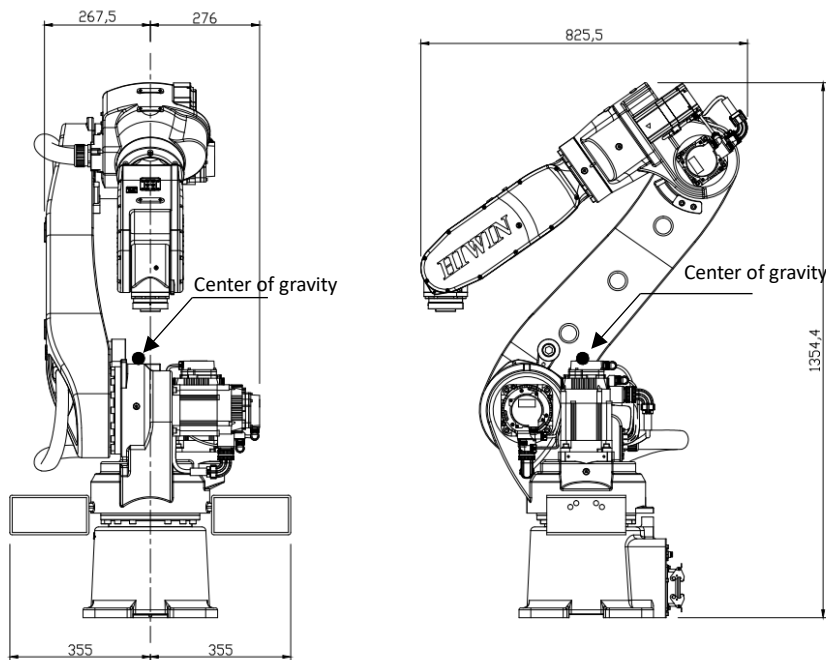


Figure 1-1 Transportation

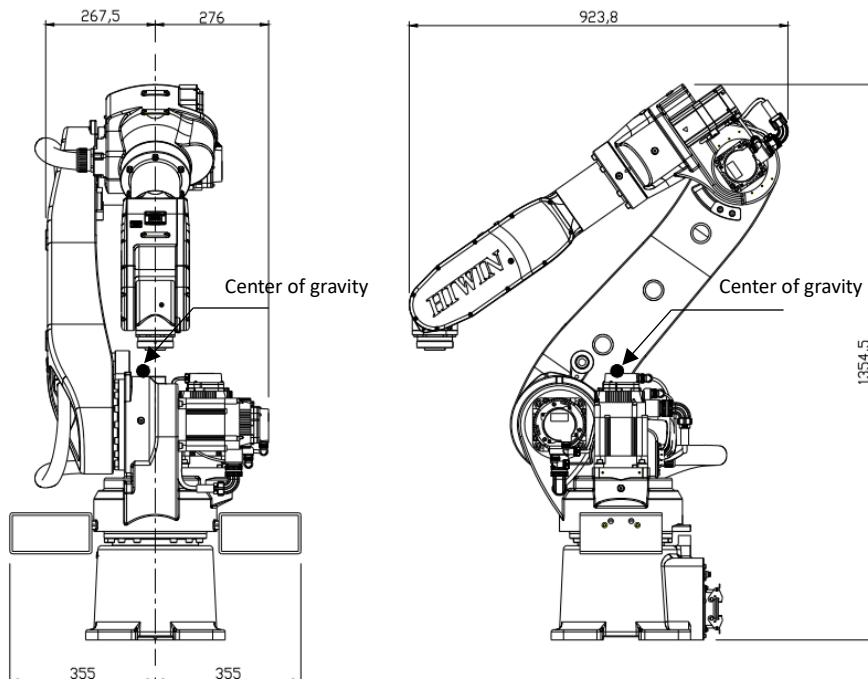
<div data-bbox="220 1727 288 1789" data-label="Image"> </div> <div data-bbox="304 1727 571 1789" data-label="Section-Header"> <h3>WARNING</h3> </div>	<ul style="list-style-type: none"> ❖ Before carrying the robot, be sure to remove the end effector. That will cause center of gravity changes. ❖ Please always stay in stable condition and avoid excessive vibration or shock during transportation. ❖ Placing the robot be sure to avoid the robot and the installation surface collision. ❖ After removing the suspension frame, please maintain it properly for re-transportation. ❖ Before operation, remove the suspension frame to avoid damage to the robot.
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Weight of the robot: 226 kg

Transport position	
J1	0°
J2	35°
J3	-70°
J4	0°
J5	-55°
J6	0°

Figure 1-2 Transport position(RA620-1621)



Weight of robot: 230 kg

Transport position	
J1	0°
J2	35°
J3	-70°
J4	0°
J5	-55°
J6	0°

Figure 1-3Transport position(RA620-1739)

1.2 Installation

Figure 1-4 shows the installation dimensions of the robot. According to the dimensions, fix the robot with installation bolt (M16 Grade 12.9) on the installation surface. Figure 1-5 and Table 1-1 show the forces and moments acting on the installation surface. The installation surface must have sufficient strength to withstand the dynamic movement of the robot when operating at maximum speed.

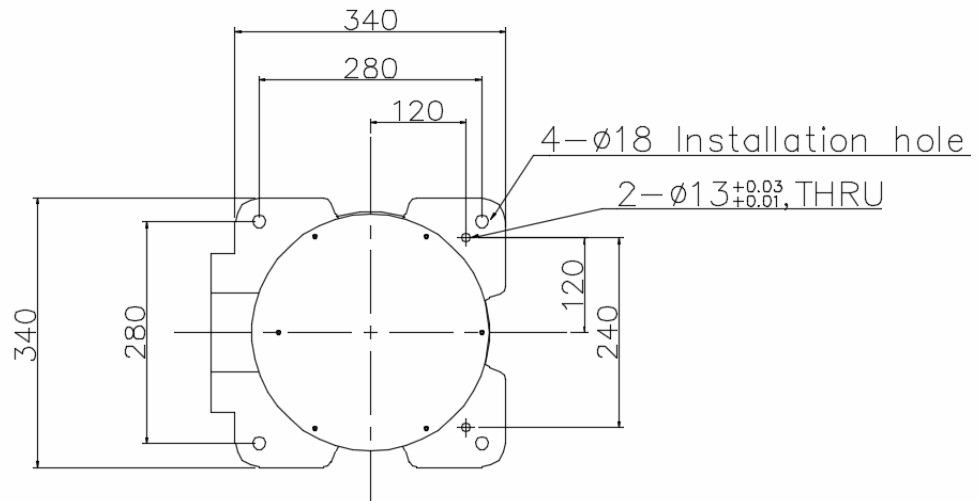


Figure1-4 Installation dimension

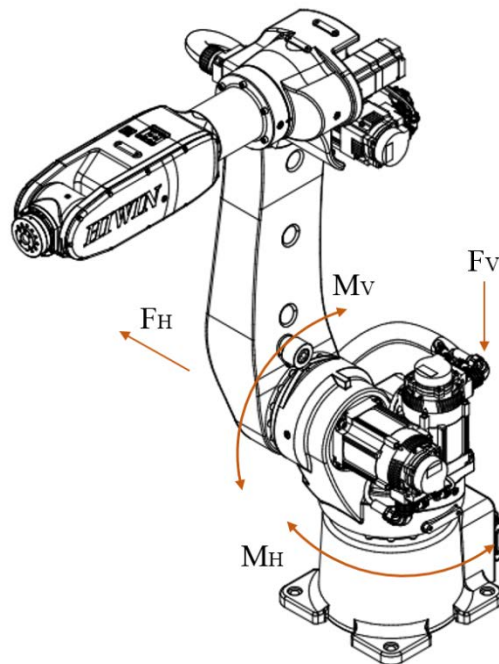



Figure 1-5 Forces and moments acting on the installation surface

Table 1-1 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	1550	2352	0	0
Acceleration /Deceleration	5114	5718	2735	4148

 WARNING	<ul style="list-style-type: none"> ❖ Ensure the installation surface has been leveled. It is recommended the roughness on this surface be 6.3a or less. 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 damage owing to the movement.
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1.3 Connection with the Controller

Figure 1-6 shows the structure drawing of the robot. Figure 1-7 shows overview of the robot system. A robot system comprises the robot, the controller, CN2 connecting cable, and the teach pendant. The connection for the motor and air in/out are located at the rear of the J1 base, as shown in Figure 1-8. The pin assignment of the connection for the motor is shown in Table 1-2.

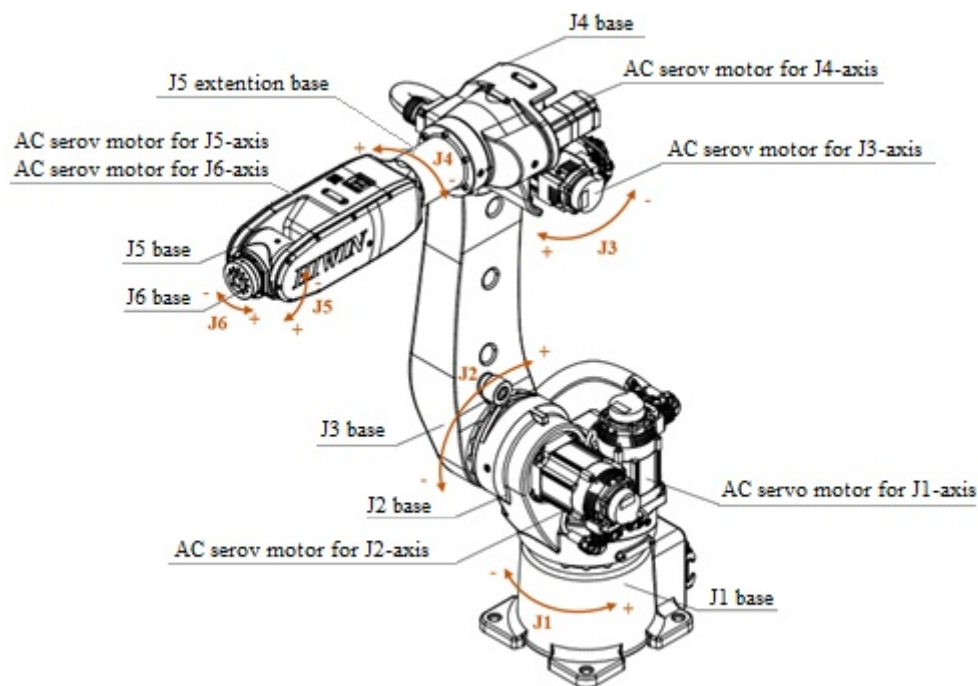


Figure 1-6 structure drawing of the robot

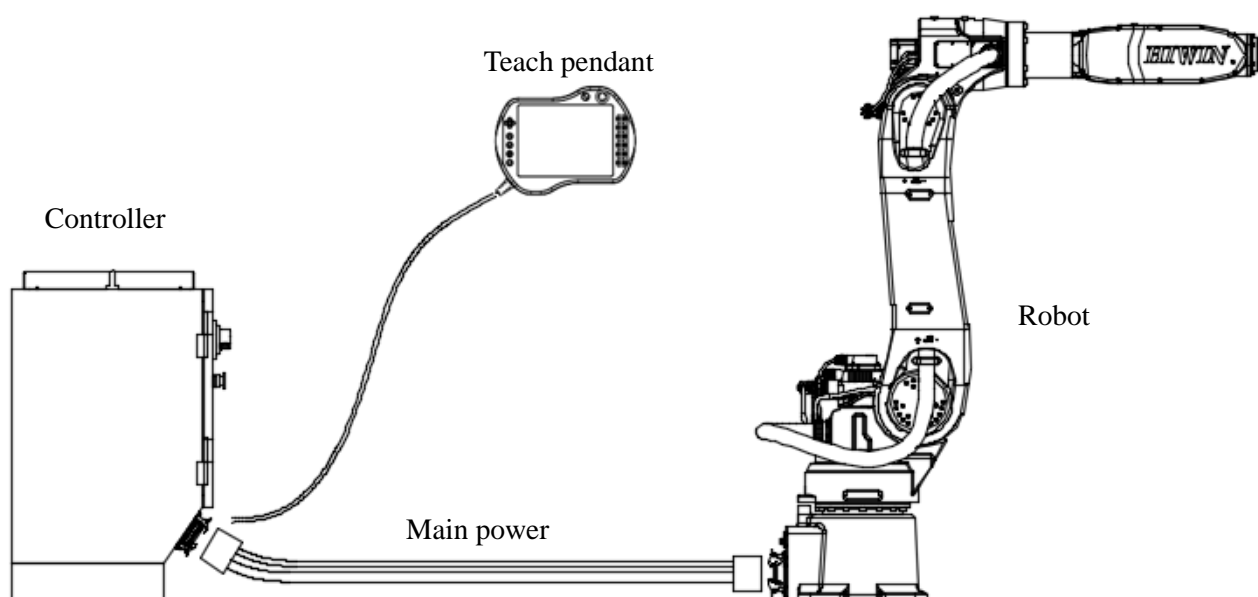


Figure 1-7 Illustration of robot and controller installation

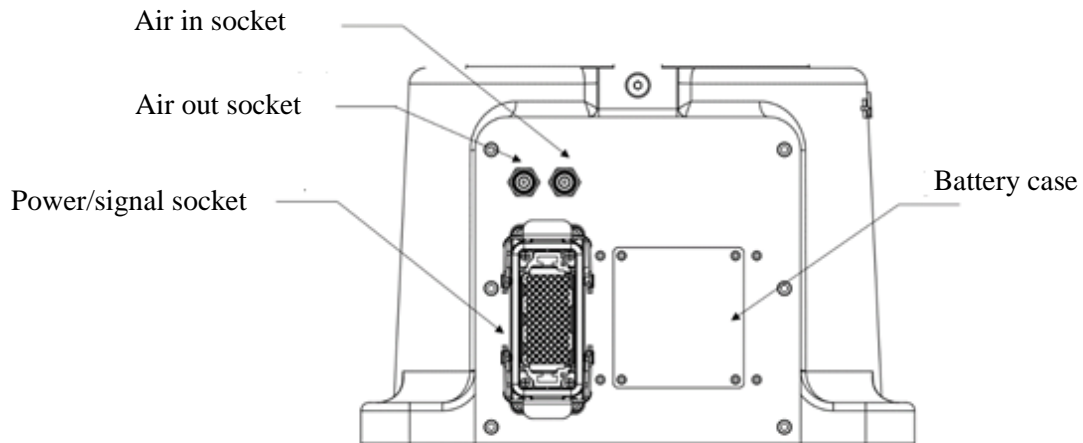


Figure 1-8 Interface at the rear of J1 base

Table 1-2 Pin assignment of the CN2

72	60	48	36	24	12
TX+	5V6-	5V6+	E6	P6-	P6+
71	59	47	35	23	11
TX-	5V5-	5V5+	E5	P5-	P5+
70	58	46	34	22	10
RX+	5V4-	5V4+	E4	P4-	P4+
69	57	45	33	21	9
RX-	5V3-	5V3+	E3	P3-	P3+
68	56	44	32	20	8
	5V2-	5V2+	E2	P2-	P2+
67	55	43	31	19	7
	5V1-	5V1+	E1	P1-	P1+
66	54	42	30	18	6
BK+	BK6-	G6	W6	V6	U6
65	53	41	29	17	5
0V	BK5-	G5	W5	V5	U5
64	52	40	28	16	4
24V	BK4-	G4	W4	V4	U4
63	51	39	27	15	3
	BK3-	G3	W3	V3	U3
62	50	38	26	14	2
	BK2-	G2	W2	V2	U2
61	49	37	25	13	1
	BK1-	G1	W1	V1	U1



WARNING

❖ When connecting the cable, be sure to turn off power supply first.

1.4 Grounding

A grounding cable (AWG#11, 4.2 mm²) is used to connect the robot and the grounding area by the screw (M5x0.8Px12L) and the washer as shown in Figure 1-9.

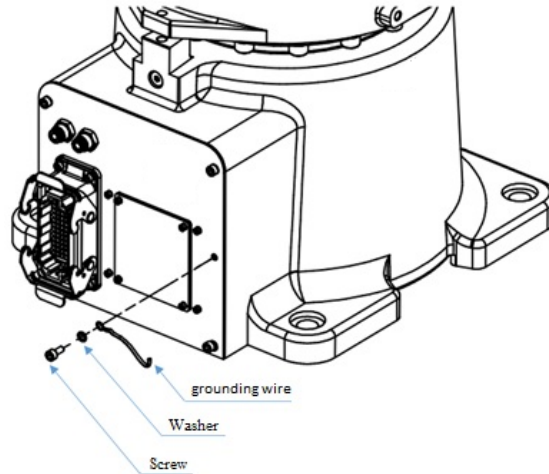


Figure 1-9. Connecting the grounding cable

1.5 Operating Ambient Conditions

The robot operating ambient conditions is shown in Table 1-3.

Table 1-3. Ambient conditions

Ambient conditions	
Ambient temperature (Operation)	0~45°C [* Note1] No condensation permissible
Ambient relative humidity	75% R.H or less
Altitude	Up to 1000 m above mean sea level
Vibration	0.5G or less
Environment	<ul style="list-style-type: none"> Keep away from flammable or corrosive solvents and gases. Keep away from direct sunlight. Keep away from sources of electric noise.

[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 initial and then an overload alarm may be raised. It is recommended to warm up the robot at low speed for a few minutes.

1.6 Standard and Optional Equipment List

Standard and optional equipment list is shown in Table 1-4.

Table 1-4 Standard equipment list

Item	HIWIN Part No.	Standard	Optional	Remark
RA620 Calibration tool set	4C201K01	●	○	Refer to section 4.1
Suspension frame set	4C200WS3	●	○	Refer to section 1.1
End effector I/O connector	4CA30008	●	○	Refer to section 3.4
Lithium battery	462600LN		○	Refer to section 5.2.1
Timing belt 505-5GT-9	453100SR		○	Refer to section 5.2.2 (RA620-1739)
Timing belt 540-5GT-9	4531012N		○	Refer to section 5.2.2 (RA620-1621)
End effector straight connector with 1.5m cable	4C7015J1		○	
End effector right angle connector with 1.5m cable	4C7015K1		○	
J1~J4 Lubrication grease	47110042		○	Refer to section 5.2.3
J5~J6 Lubrication grease	47110035		○	Refer to section 5.2.3

2. Basic Specifications

2.1 Description of Model Name




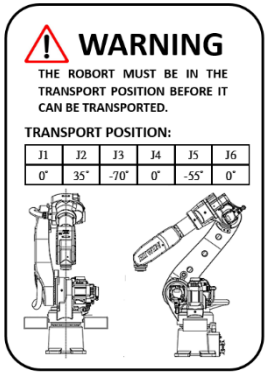
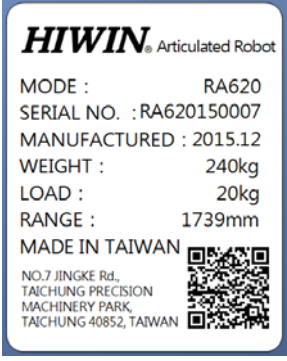




There is a model name on the specification label of RA620. The explanation of model name is shown below.

Model		
Model example		
RA620 – 1621		
		Maximum Reach Radius
	1621	1621 mm
	1739	1739 mm
RA620	Series	
	RA620 Series articulated robot controller	

2.2 Labels

The labels on the robot arm is 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</u>	Be aware of transport position 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 out.
	<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 as shown in Table 2-2

Table 2-2 The robot specifications

Item		Specification	
Model No.		RA620-1739	RA620-1621
Degrees of Freedom		6	
Installation		Floor (wall mounting, ceiling mounting) [*1]	
Load capacity		20kg [*2]	30kg[*2]
Maximum reach radius		1739 mm	1621mm
Cycle time		0.9 s [*3]	
Position Repeatability		±0.06 mm	
Motion range	J1	±180°	
	J2	+100° ~-135°	
	J3	+190° ~-80°	
	J4	±200°	
	J5	±130°	
	J6	±360°	
Maximum speed	J1	231° / s	
	J2	210° / s	
	J3	205° / s	
	J4	360° / s	
	J5	420°/ s	210°/ s
	J6	720°/ s	360°/ s
Allowable load moment at wrist	J4	34.2 N-m	65.5 N-m
	J5	34.2 N-m	65.5 N-m
	J6	22.3 N-m	34 N-m
Allowable load inertia at wrist	J4	1.35 kg- m ²	4.71 kg- m ²
	J5	1.35 kg- m ²	4.71 kg- m ²
	J6	0.6 kg- m ²	1.49 kg- m ²
Weight		230 kg	226 kg
Protection rating		Wrist(J5~J6) :IP65, Arm(J1~J4): IP54	
Acoustic noise level		Less than 75 dB [*4]	

[Note 1] : The robot arm motion range shall be defined when used by mounting on the wall.

So that the end effector does not interfere with the rear side of robot arm when mounting on the wall.

[Note 2] : When installing the end effector, please refer to section 2.5.

[Note 3] : The cycle time is the time that the robot is loaded at 20kg to forward and backward move in the vertical height 25mm and the horizontal distance 30mm, as shown in Figure 2-1.

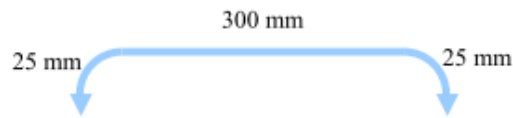


Figure 2-1 Moving path for cycle time

[Note 4] : This is measured at maximum speed and maximum load according to ISO11201:2010.

2.4 Outer Dimensions and Motion Range

The outer dimensions and motion range are shown in Figure 2-2 and 2-3.

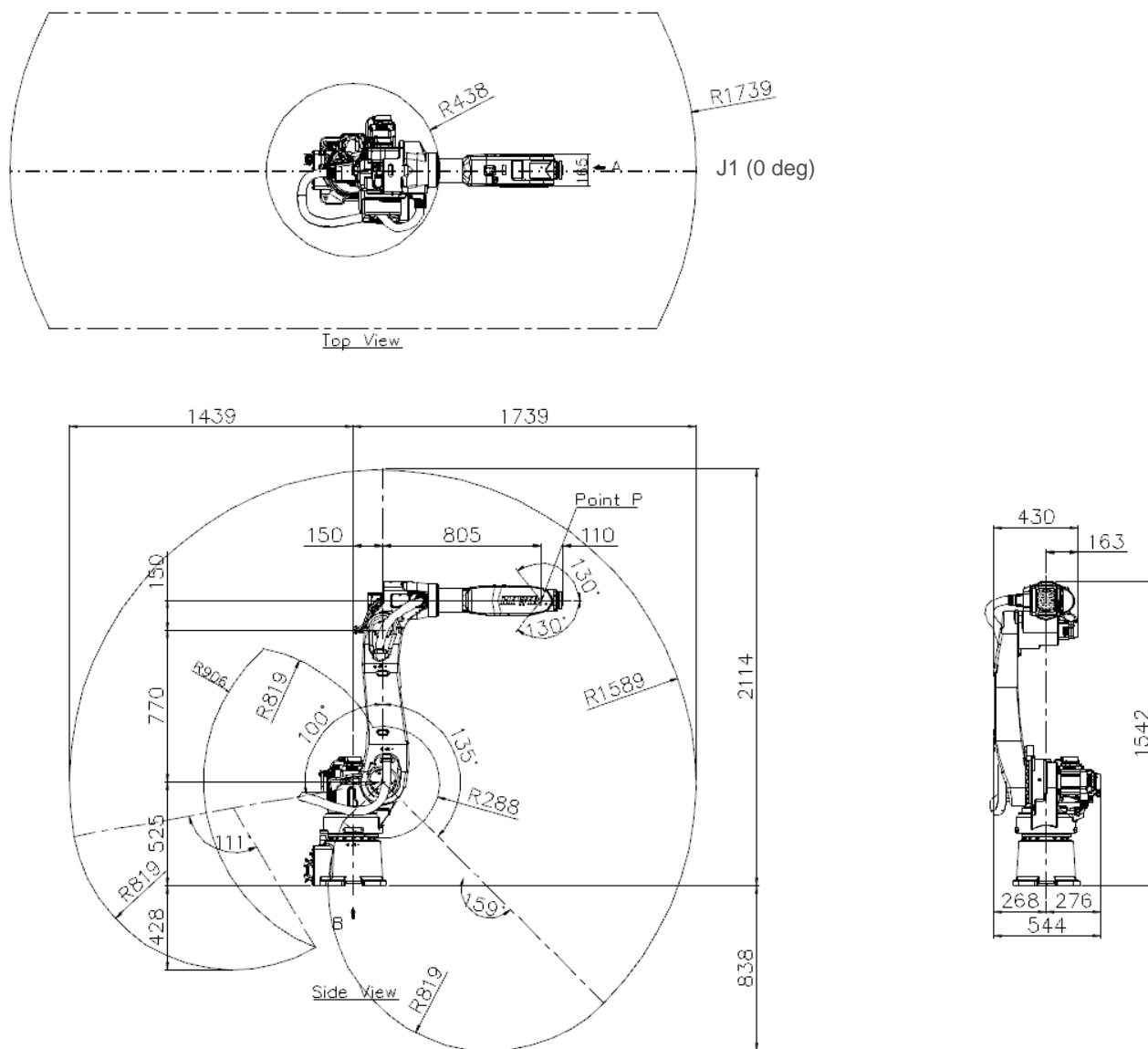


Figure 2-2. Outer dimension and motion range (RA620-1739)

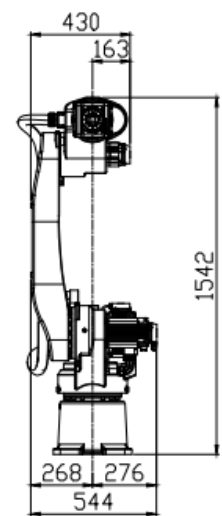
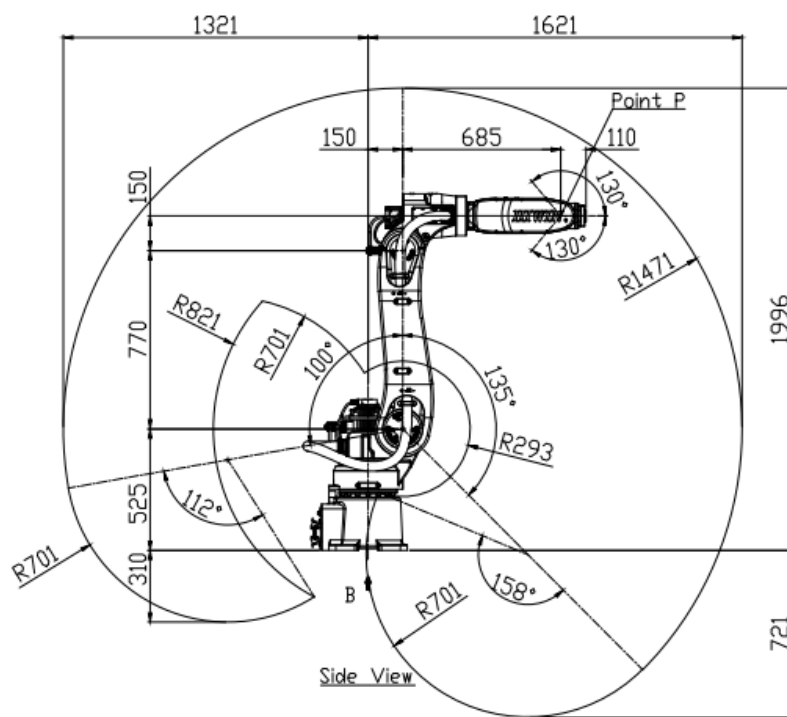
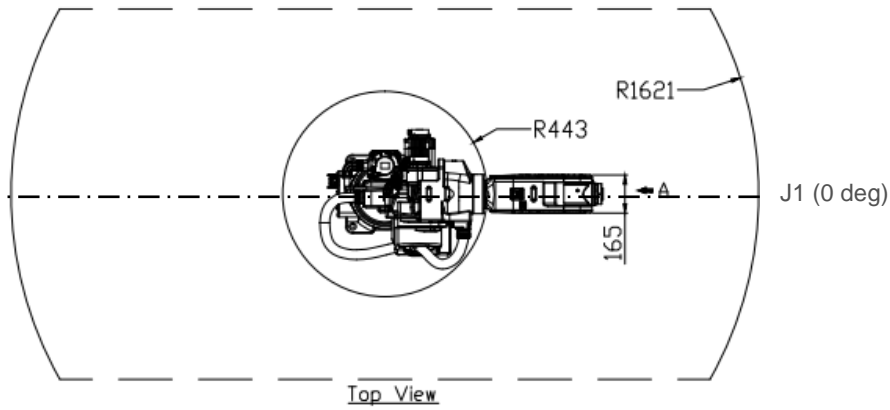


Figure 2-3. Outer dimension and motion range (RA620-1621)

2.5 Wrist Load conditions

The rated load of the robot end is not only limited by the weight but also limited by the position of the center of gravity of the load, where Figure 2-4 and 2-5 show the allowed position of the center of gravity.

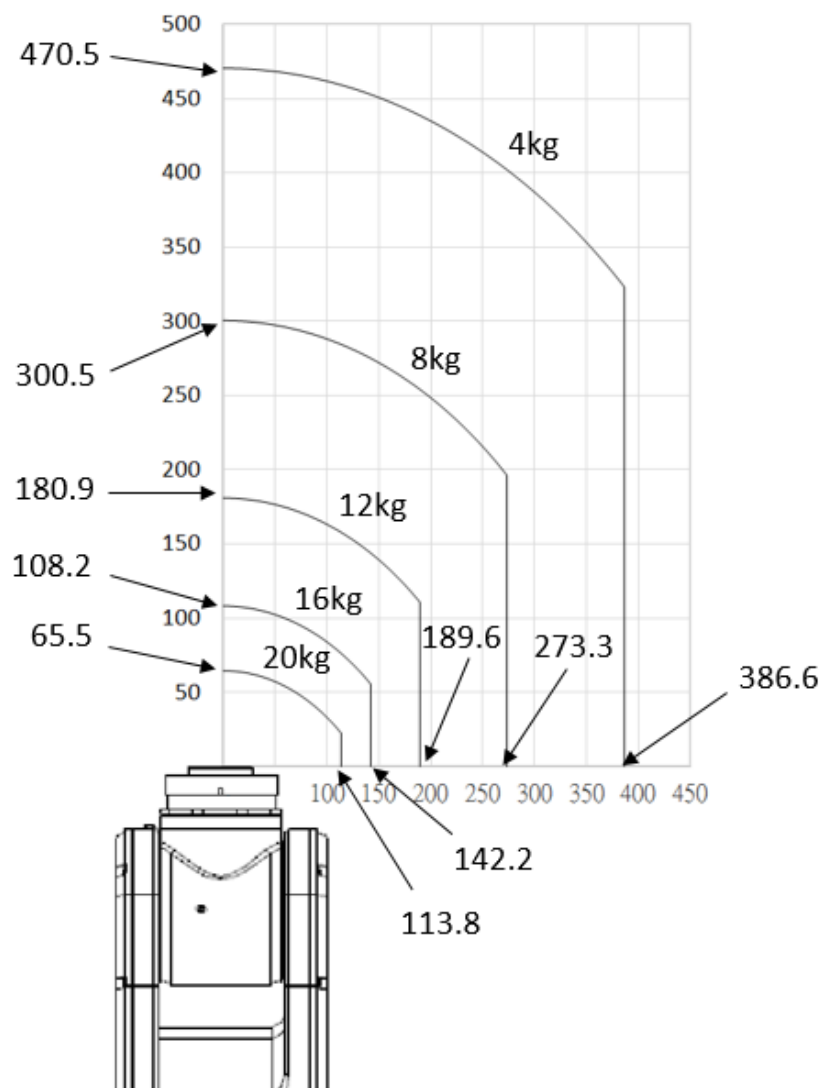


Figure 2-4. Wrist load diagram (RA620-1739)

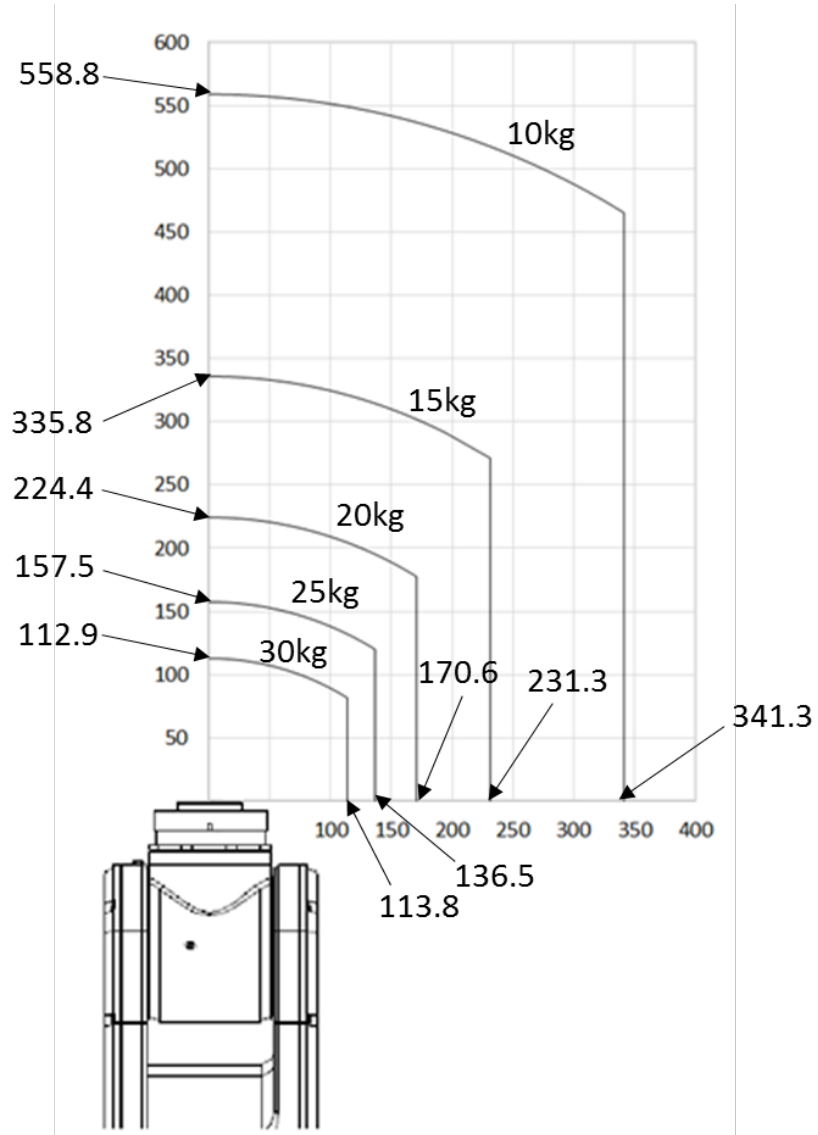


Figure 2-5. Wrist load diagram (RA620-1621)

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.

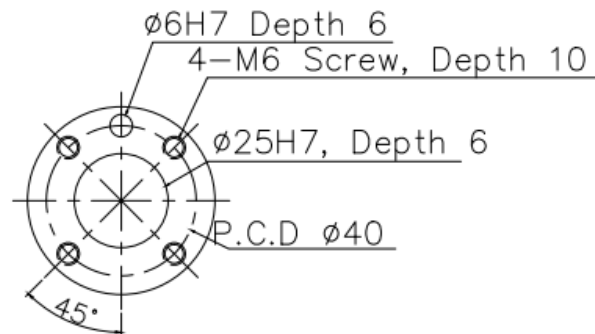


Figure 3-1. Mounting surface for end effector (RA620-1739 and RA620-1621)

3.2 Mounting Surface on the robot arm

Mounting surfaces for the peripheral equipment are shown in Figure 3-2~3-4.

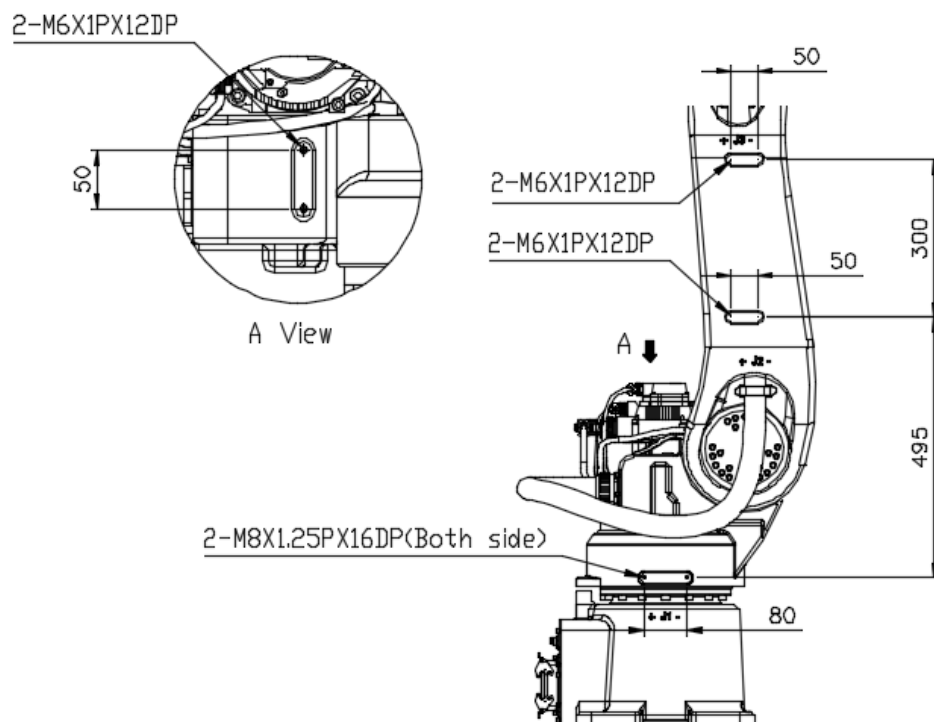


Figure 3-2. Mounting surfaces on the robot arm (RA620-1739 and RA620-1621)

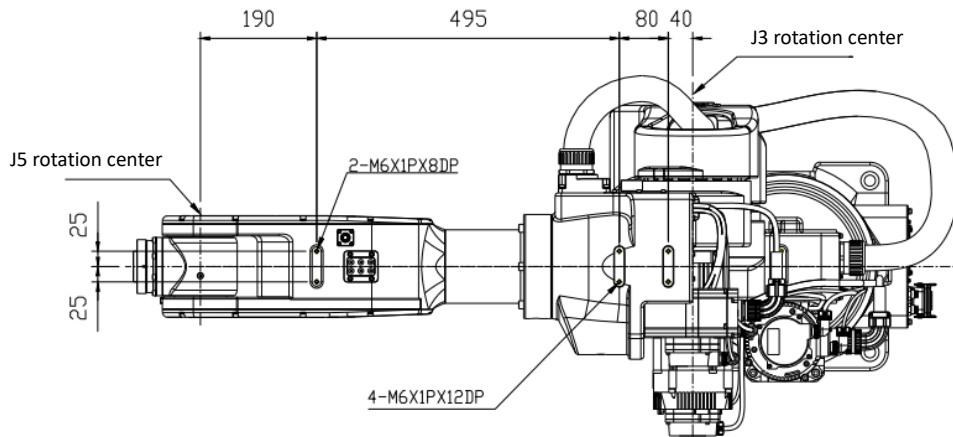


Figure 3-3. Mounting surfaces on the robot arm (RA620-1739)

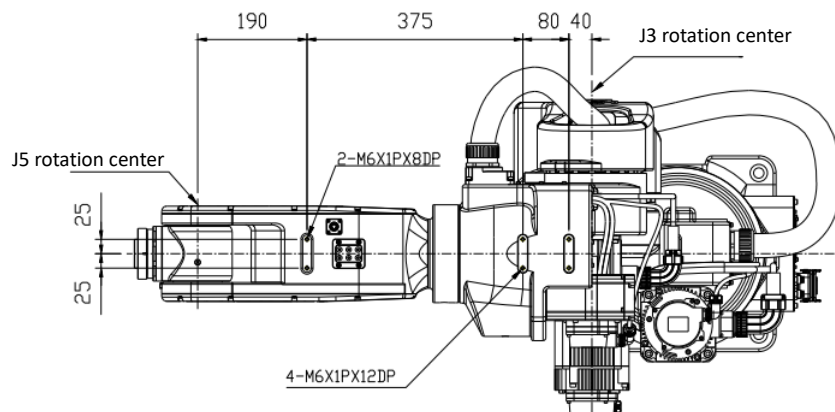


Figure 3-4. Mounting surfaces on the robot arm (RA620-1621)

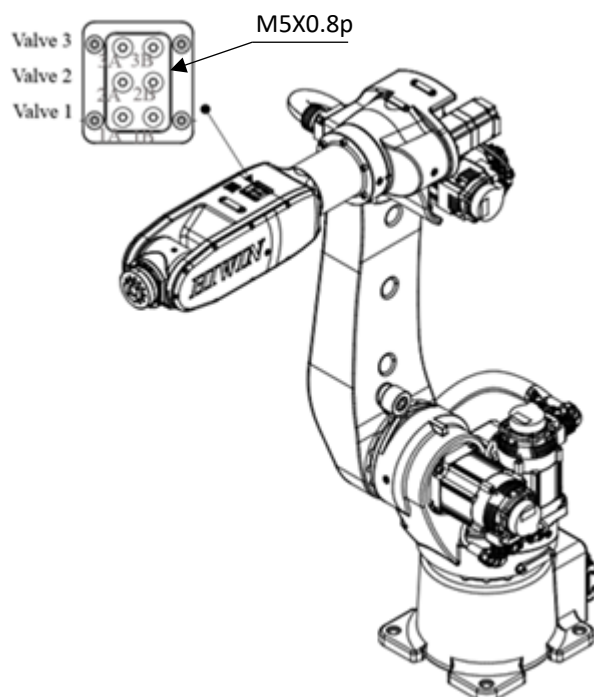


WARNING

- ❖ When other equipment is installed on the robot, be aware of the interface between robot and motor cable.

3.3 Interface for Air supply

Air supply holes (AIR IN & AIR OUT) are prepared on the rear of the J1 base and the J5 base as shown in Figure 3-5, and the outer diameter of the air tube in the robot is $\phi 6\text{mm}$. The robot has three 5/2-way solenoid valves for end effector in the J5 base, and the schematic diagram for the valves is shown in Figure 3-6 °



No. of port	5
No. of position	2
Operating pressure range	0.15~0.7 MPa
Proof pressure	1 MPa
Effective orifice	11 mm ²
Response time	19 ms

Figure 3-5 The interface for air supply

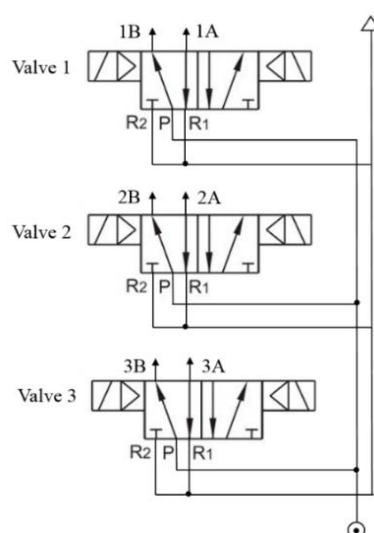


Figure 3-6. Pneumatic diagram

3.4 R-I/O Interface

R-I/O interface for end effector is on the J5 base as shown in Figure 3-7, and the pin assignment of R-I/O connector for user is shown in Figure 3-8. Figure 3-9 ~ 3-12 shows the wiring diagram of R-I/O interface. Figure 3-13 show the two-wire proximity switches connecting method for customers.

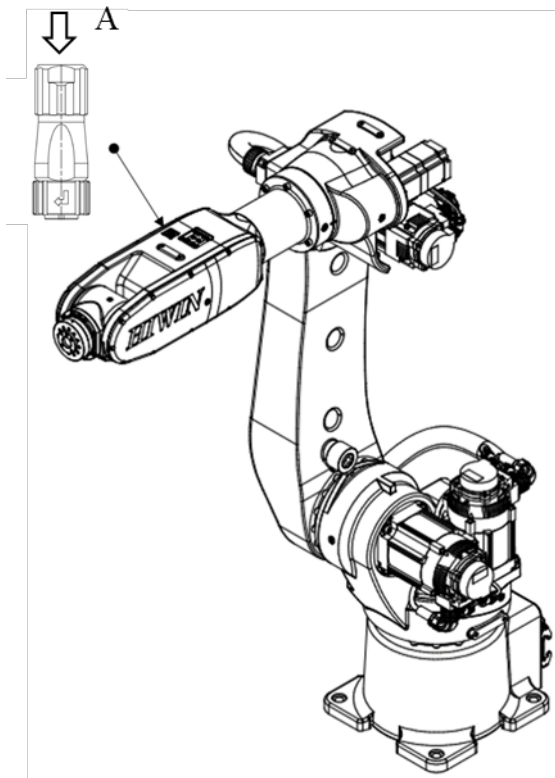


Figure 3-7. R-I/O interface for end effector

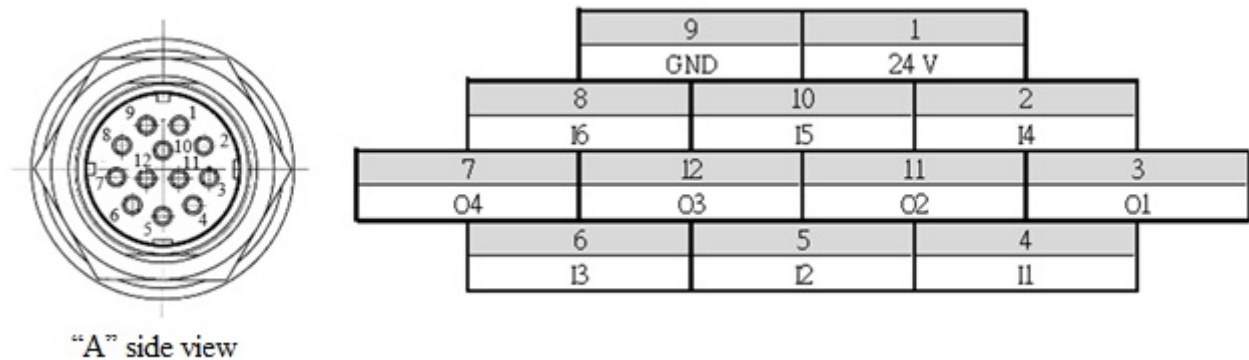


Figure 3-8 Pin definition of the R-I/O plug

(Power output: 24V/1A)

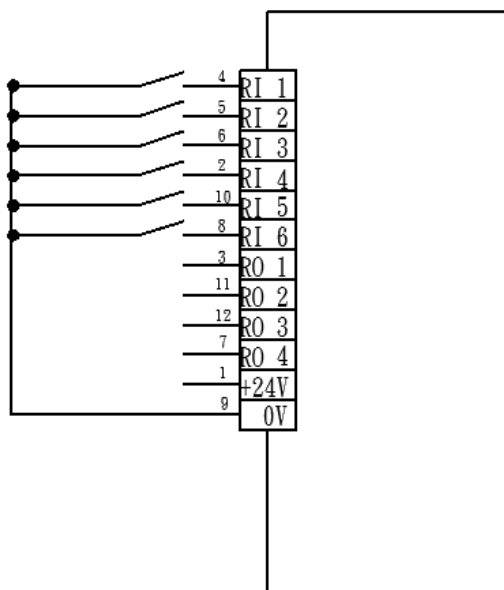


Figure 3-9. Wiring diagram of input (Standard: Sinking type)

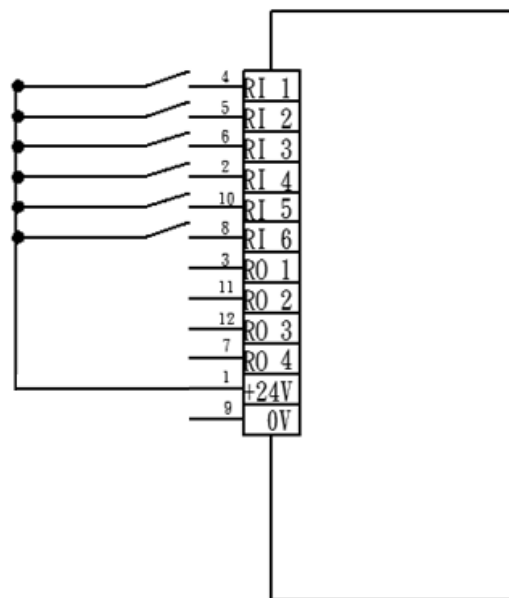


Figure 3-10. Wiring diagram of input (Optional: Sourcing type)

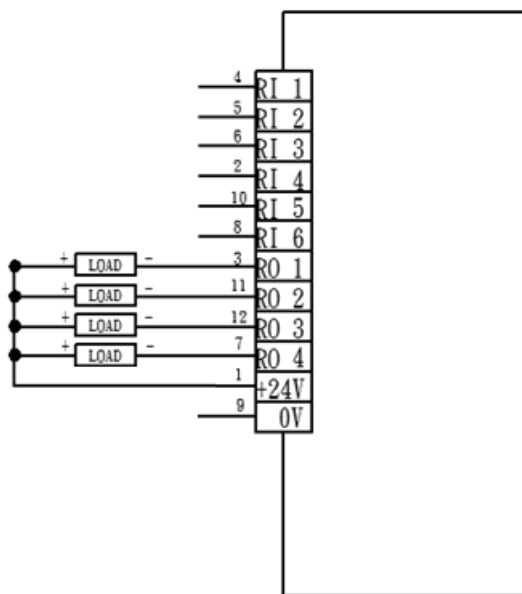


Figure 3-11. Wiring diagram of input (Standard: Sinking type)

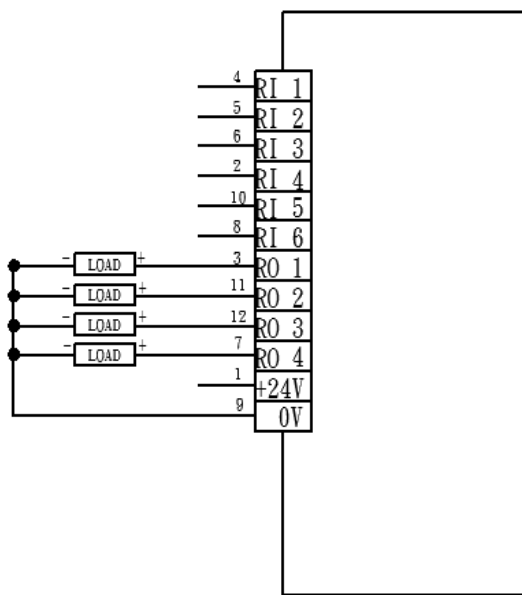
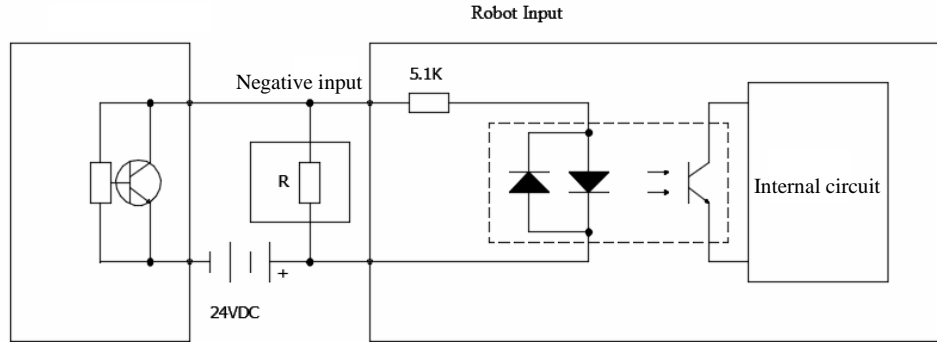


Figure 3-12. Wiring diagram of output (Optional: Sourcing type)

Two-wire proximity switch



Two-wire proximity switch

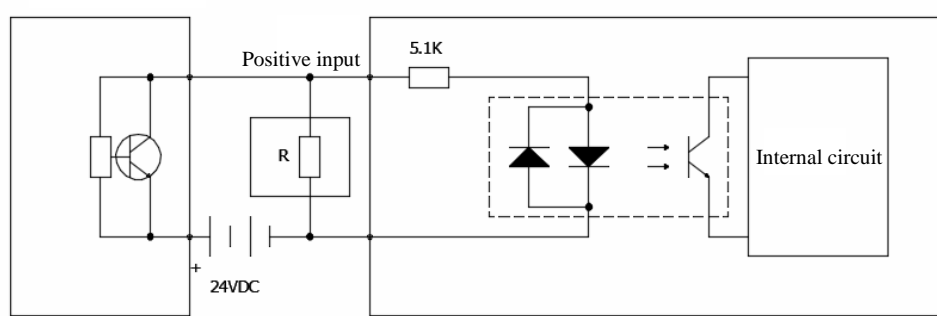


Figure 3-13 Two-wire proximity switch wiring diagram



CAUTION

- ❖ Pin 1 and 9 are used for signal, not for input power of end effector.
- ❖ The maximum current at each pin is 100mA.
- ❖ Two-wire proximity switch may cause Robot Input error action occur due to residual voltage. Therefore, if you want to use two-wire proximity switch, you should connect it according to Figure 3-13 and select the matching R value.

When operating robot, the cable of end effector might be tangled together with the robot. Fixing a cable-tie-fix-seat on the J5 base by using the screw (M6×1P), and secure the cable of end effector R-I/O connector as Figure 3-14.

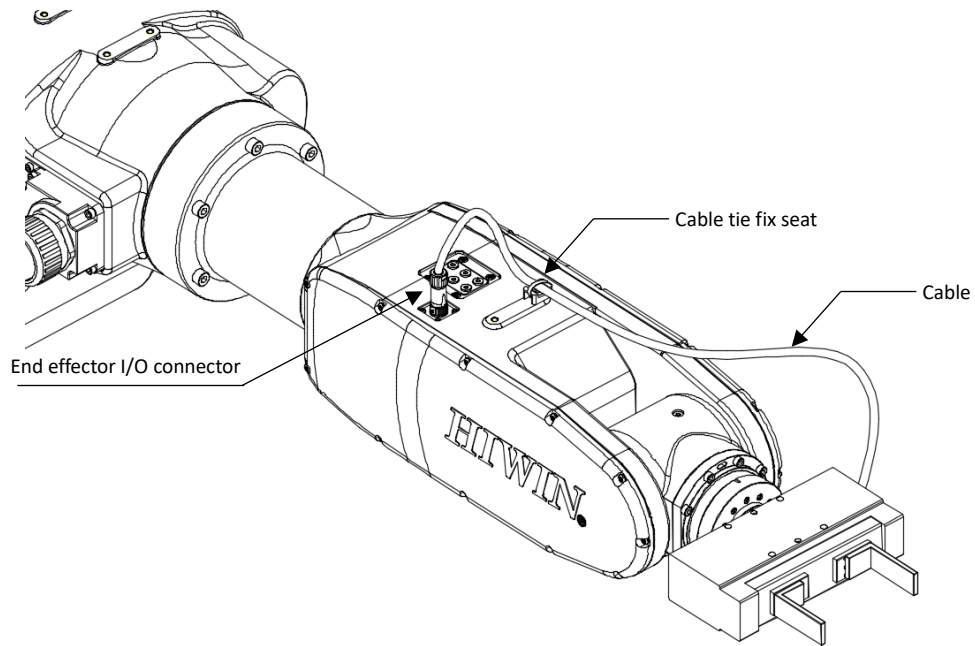


Figure 3-14. Fixing method for the cable of the end effector R-I/O connector

4. Calibration

4.1 Resetting Zero Position

The calibration tools for resetting zero position are shown in Figure 4-1. When reset zero position, operate the robot at low speed and move the robot to align the calibration tool with the pinhole. The robot is adjusted to the minimum speed during the calibration, and aligns the pinhole with the calibration tool to set up the original position. The procedure of resetting zero position with the calibration tools is shown in Figure 4-1 below.

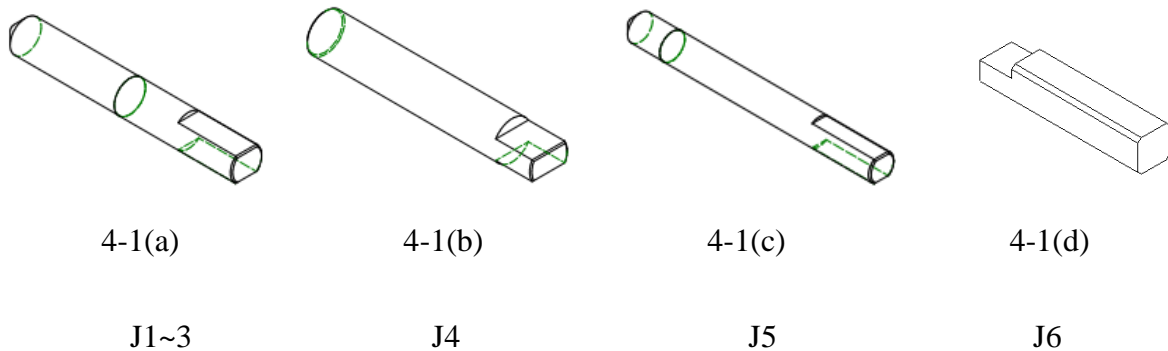


Figure 4-1. The calibration tool set

● J1-axis zero position setting

- Step1: Operate J1 at low speed to align the pinhole of J2 base with the pinhole of J1 base.
- Step2: Insert the calibration tool for J1~3 to the pinhole to calibrate zero position.
- Step3: Complete the calibration and remove the calibration tool.
- Step4: Clear encoder by HRSS. (Refer to page 42)
- Step5: Resetting zero position 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 base with the pinhole of J1 base.

Step2: Insert the calibration tool for J1~3 to the pinhole to calibrate zero position.

Step3: Complete the calibration and remove the calibration tool.

Step4: Clear encoder by HRSS. (Refer to page 42)

Step5: Resetting zero position of J2-axis is completed.

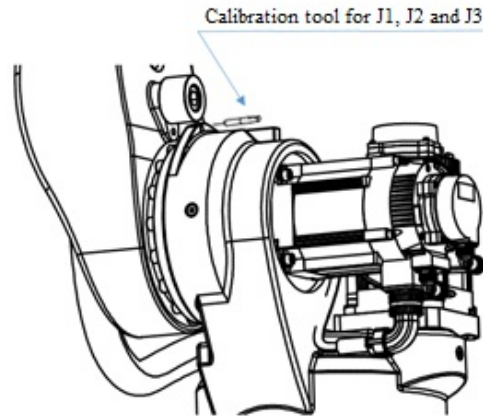


Figure 4-3 Illustration of J2-axis zero position setting

- J3-axis zero position setting

Step1: Operate J3 at low speed to align the pinhole of J4 base with the pinhole of J3 base.

Step2: Insert the calibration tool for J1~3 to the pinhole to calibrate zero position.

Step3: Complete the calibration and remove the calibration tool.

Step4: Clear encoder by HRSS. (Refer to page 42)

Step5: Resetting zero position of J3-axis is completed.

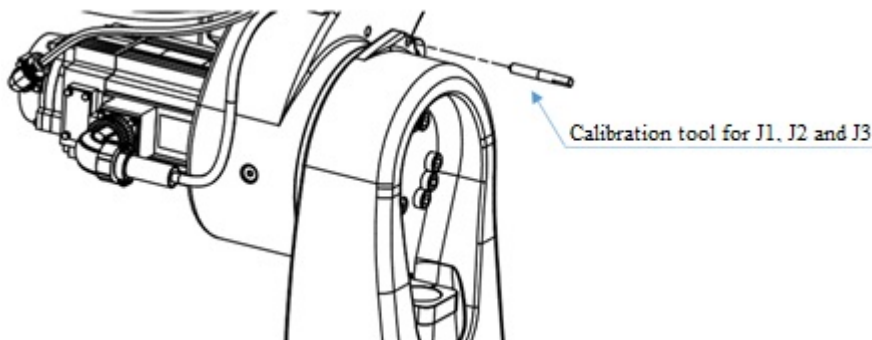


Figure 4-4 Illustration of J3-axis zero position setting

- J4-axis zero position setting

Step1: Operate J4 at low speed to align the keyway of J5 base with the keyway of J4 base.

Step2: Insert the calibration tool for J4 to the keyway to calibrate zero position.

Step3: Complete the calibration and remove the calibration tool.

Step4: Clear encoder by HRSS. (Refer to page 42)

Step5: Resetting zero position of J4-axis is completed.

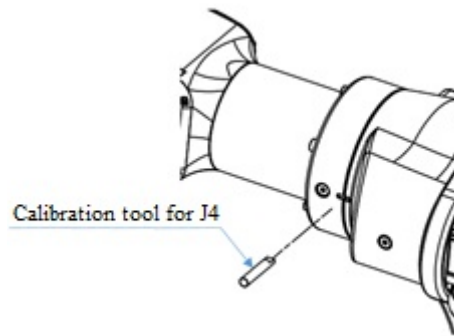


Figure 4-5 Illustration of J4-axis zero position setting

- J5 -axis zero position setting

Step1: Operate J5 at low speed to align the pinhole of J6 base with the pinhole of J5 base.

Step2: Insert the calibration tool for J5 to the pinhole to calibrate zero position.

Step3: Complete the calibration and remove the calibration tool.

Step4: Clear encoder by HRSS. (Refer to page 42)

Step5: Resetting zero position of J5 -axis is completed.

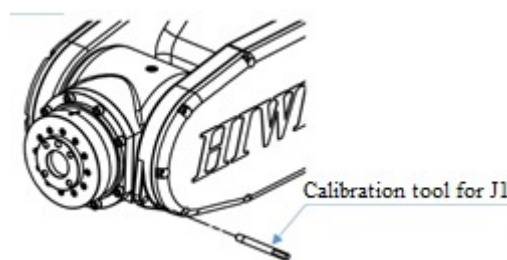


Figure 4-6 Illustration of J5-axis zero position setting

● J6-axis zero position setting

Step1: Operate J6 at low speed to align the keyway of EE with the keyway of J6 base.

Step2: Insert the calibration tool for J6 to the keyway to calibrate zero position.

(Old design reference to Figure 4-7(b), align the calibration mark with the keyway.)

Step3: Complete the calibration and remove the calibration tool.

Step4: Clear encoder by HRSS. (Refer to page 42)

Step5: Resetting zero position of J6-axis is completed.

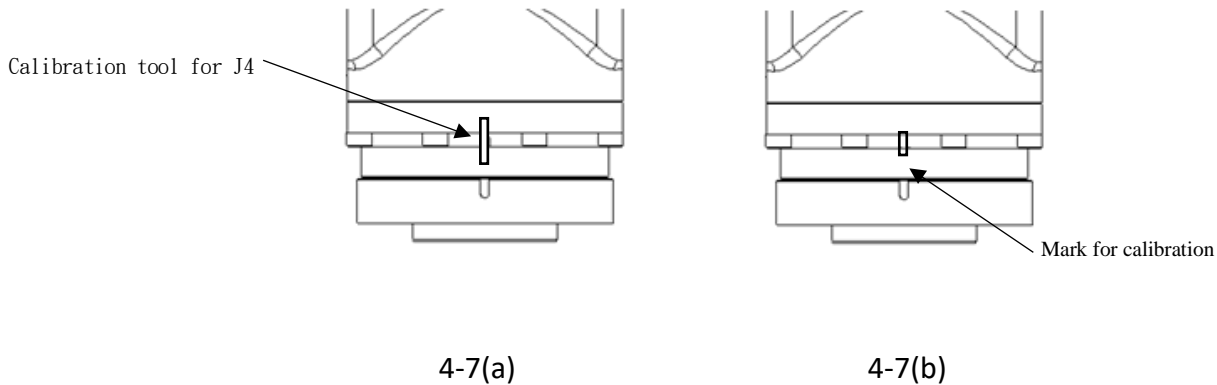


Figure 4-7 Illustration of J6 -axis zero position setting

⊙ 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)

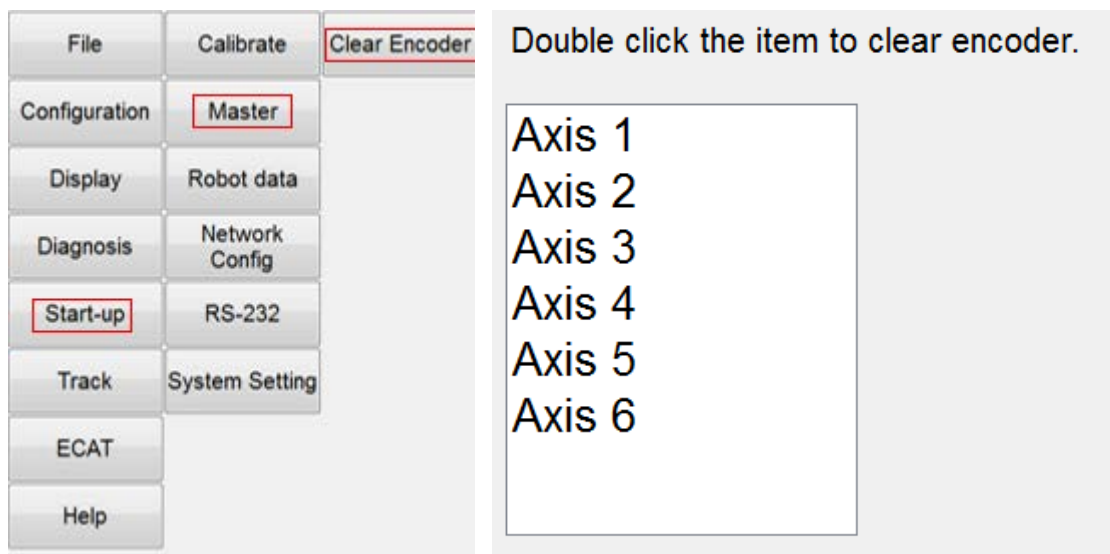


Figure 4-8 Clear encoder by HRSS

5. Maintenance and Check

This chapter will introduce 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	Remedies
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 any of cables securely connected? Such as the power and signal cable, grounding cable, the cable for teach pendant and the cable between the robot and other equipment.	Securely connect.
3	Is the pneumatic system normal? Are there any air leaks, drain clogging or hose damage? Is there air source normal?	Drain the drainage and replace the leaks part.
After turning power ON		
1	Check whether the robot moves smoothly without vibration or noise.	<ol style="list-style-type: none"> 1. The robot installation screws might not be securely fastened 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 reinforce the base to make it more rigid. 4. There might have foreign material between the robot and the installation surface. Please

		<p>remove it.</p> <ol style="list-style-type: none"> 5. Some operating positions might be too demanding for the robot mechanism, please adjust the load, speed or acceralation. Please reduce load or acceleration. 6. The timing belt might loosen or not in correct location. 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 damage on 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 reset the zero position. (Refer to section 4.1) 2. If the repeatability is unstable, repair the robot by referring to the descriptions of unusual vibration and noise above.

Table 5-2 Periodic inspection items

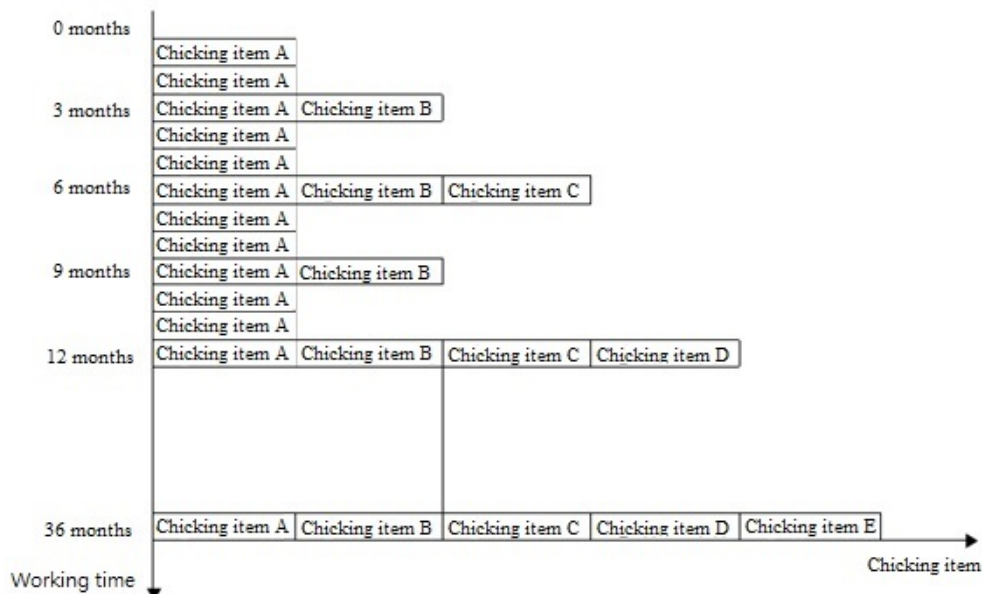
	Inspection item	Remedies
Inspection item A (1 month / 320 hours)		
1	Clean and check each part of the robot.	Check if there are any cracks and flows on the robot.
Inspection item B (3 months / 960 hours)		
1	Check the ventilation portion of the controller.	If it is dusty, turn off the power and clean the ventilation portion of the controller
Inspection item C (6 months / 1920 hours)		
1	Check whether the timing belt is abnormal.	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 (1 year / 3840 hours)		
1	Replace the backup battery in the robot.	Replace the backup battery. Refer to section 5.2.1
Inspection item E (3 years/11520hours)		
1	Change the lubrication grease of the reducer.	Change the grease. Refer to section 5.2.3.



CAUTION

- ❖ In the initial operation, it is normal that the timing belt has some friction. If the rubber appear soon after cleaning it, please wipe them again and replace the belt.

Table 5-3 Inspection schedule



5.2 Maintenance

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 turn off, the position data of each -axis is preserved by the backup batteries. The batteries are installed when the robot is shipped 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. The procedures are described as below.


Step1. Ensure the robot and controller are connected with the cables.

Step2. Keep the power on. Press the emergency stop button to prohibit the movement of the robot motion.

Step3. The battery box is located in the rear of the J1 base. Please remove the battery cover.

Step4. Replace the battery one by one. If all batteries are removed in the same time, the position data will be lost. Therefore, please resetting the robot to the zero position.

Step5. After replacing the battery, ensure to install the battery cover.

 CAUTION	<p>❖ All batteries should be changed simultaneously. If the old batteries are included, the service life of the batteries may be reduced.</p>
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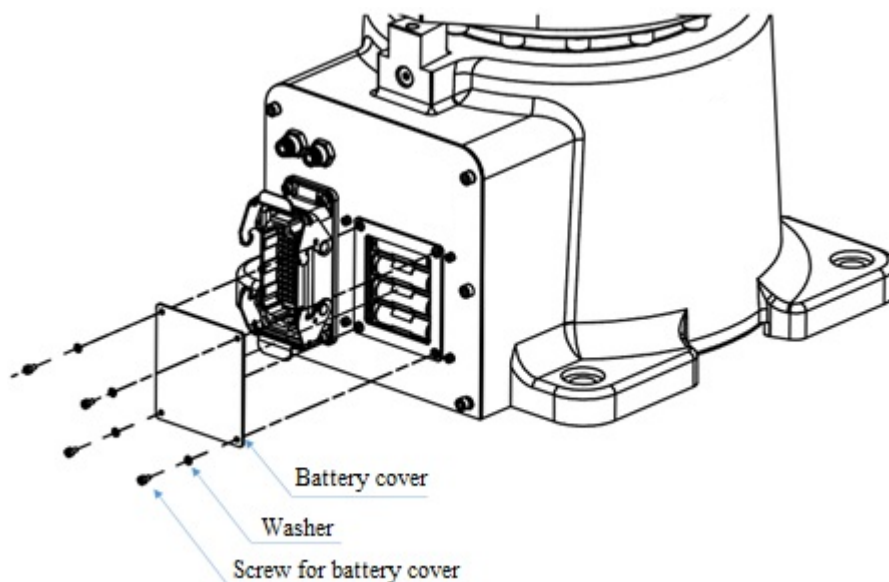



Figure 5-1. The backup batteries replacement

5.2.2 Timing Belt Replacement

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


⊙ Timing Belt replacement period

Check the timing belt for about 6 months. The timing belt must be replaced if the belt teeth is found cracks, wear to approximately half of the tooth width, or break.

 CAUTION	❖ 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.
--	--

⊙ Timing Belt replacement period

It is very important to have 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 for 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.

 CAUTION	❖ 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.
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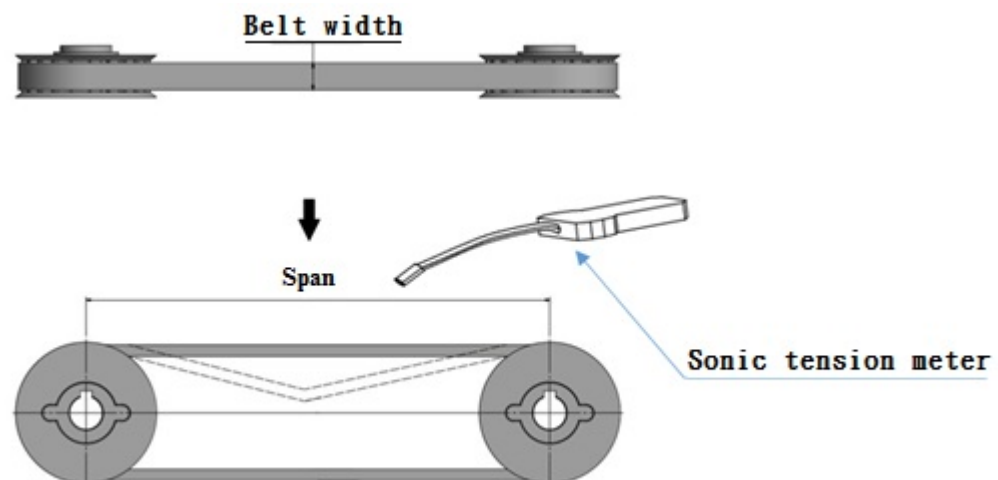


Figure 5-2 Measure belt tension

Model	Axis	Belt type	Width(mm)	Span(mm)	Tension(N)
RA620-1739	J5	505-5GT-9	9	188.6	55±10
	J6	505-5GT-9	9	188.6	55±10
RA620-1621	J5	540-5GT-9	9	188.6	55±10
	J6	540-5GT-9	9	188.6	55±10

Table 5-4 The belt specifications

⊙ Removing the cover

Before replacing the belt, remove the cover of the J5 base. The M4×0.7P×15L screws are used, as shown in Figure 5-3.

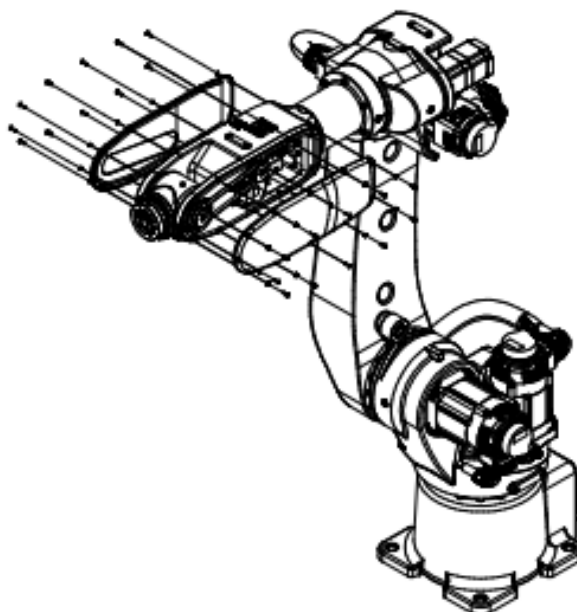


Figure 5-3 Removing the cover

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

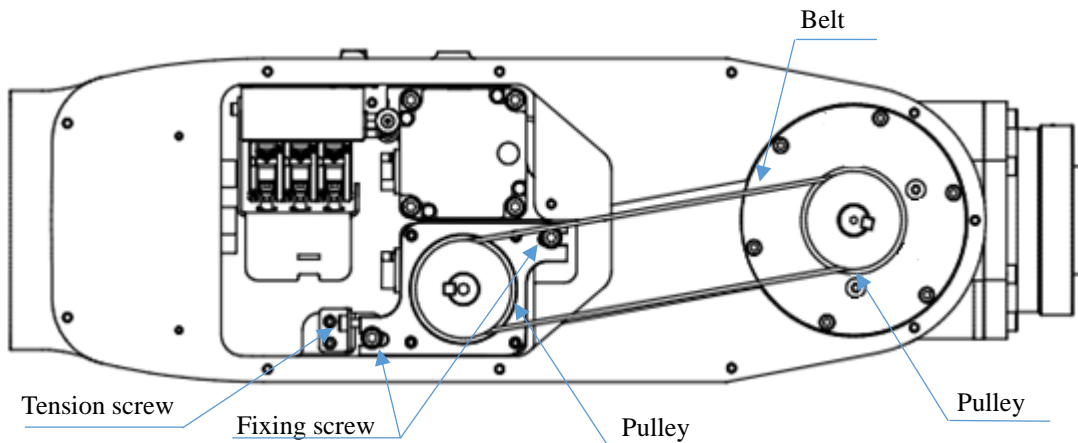


Figure 5-4 J5 -axis structure diagram (RA620-1739)

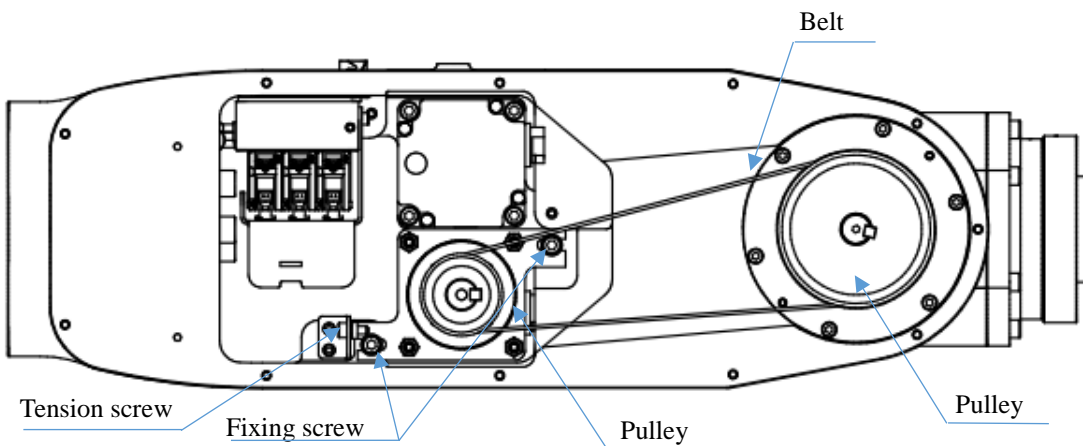


Figure 5-5 J5 -axis structure diagram (RA620-1621)

- Inspect J5 -axis timing belt
 - Step1. Ensure the power of controller be switched off.
 - Step2. Remove the cover of the J5 base.
 - 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 the following paragraph to adjust the belt tension.
- Adjust J5 -axis timing belt
 - Step1. Loose the two motor plate fixing screws, so that the motor can be moved.
 - Step2. Refer to Table 5-4, turn the adjusting screw to adjust the tension of the belt.
 - Step3. Tighten the two motor plate fixing screws(4.6 N-m).

- Replacing J5 -axis timing belt
 - Step1. Remove the two motor plate fixing screws.
 - Step2. Loose the adjusting screw to replace the timing belt.
 - Step3. After replacing the belt, refer to the paragraph “Adjusting J5 -axis timing belt” above to adjust the tension of the belt.
- ⊙ Inspection, maintenance and replacement of J6 -axis timing belt

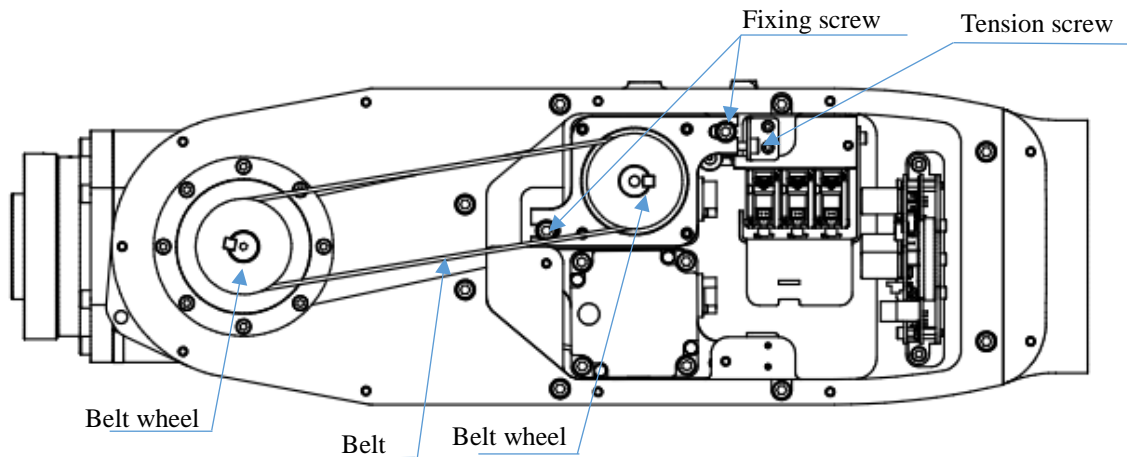


Figure 5-6 J6 -axis structure diagram

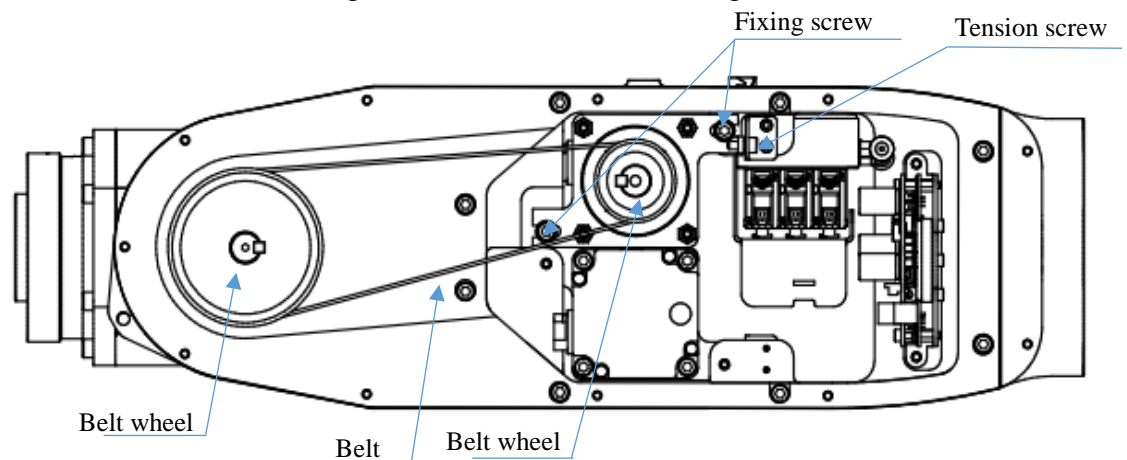


Figure 5-7 J6 -axis structure diagram

- Inspect J6 -axis timing belt
 - Step1. Confirm that the controller power is OFF. Ensure the power of controller be switched off.
 - Step2. Remove the cover of the J6 base.
 - 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 the following paragraph to adjust the belt tension.

- Adjusting J6 -axis timing belt
 - Step1. Loose the two motor plate fixing screws, so that the motor can be moved.
 - Step2. Refer to Table 5-4, turn the adjusting screw to adjust the tension of the belt.
 - Step3. Tighten the two motor plate fixing screws. (4.6 N-m)

- Replacing J6 -axis timing belt
 - Step1. Remove the two motor plate fixing screws.
 - Step2. Loose the adjusting screw to replace the timing belt.
 - Step3. After replacing the belt, refer to the paragraph “Adjusting J6 -axis timing belt” above to adjust the tension of the belt.

5.2.3 Grease Replenishment

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

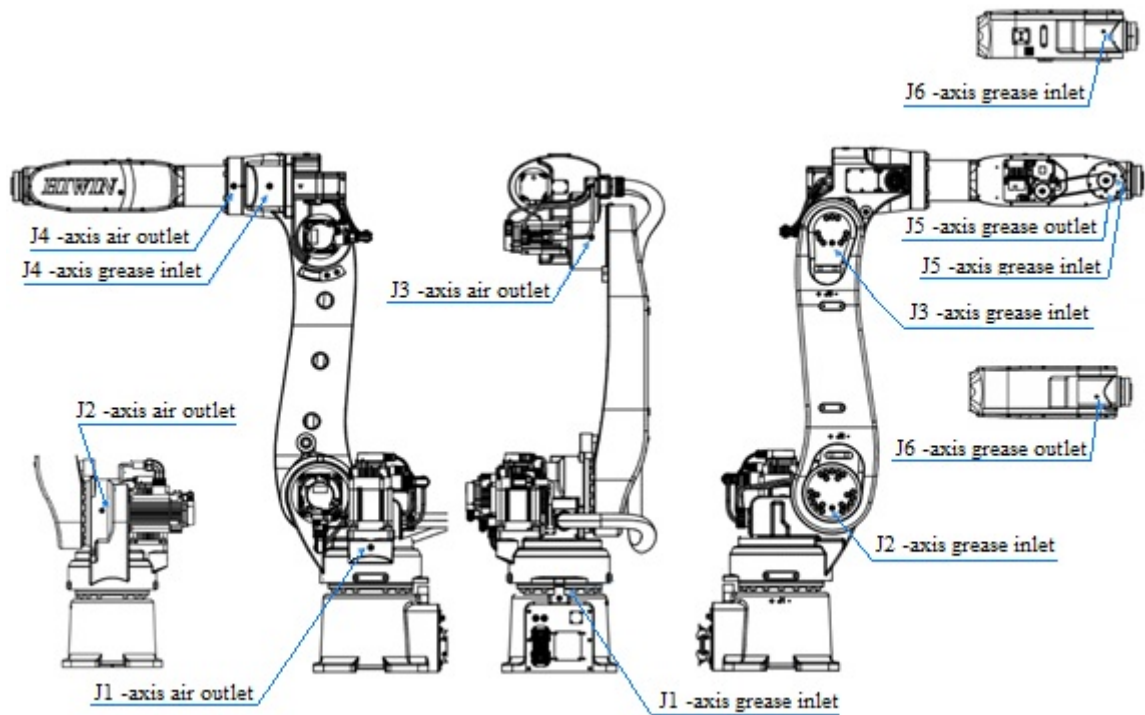


Figure 5-8 Lubrication and grease inlet/outlet positions

- ☉ Grease specification

☉ Table 5-5 Grease specification

Part name	Grease nipple	Lubrication grease	Quantity	Lubrication interval
J1 reduction gear	M8	VIGOGREASE REO	1405 ml	11520Hr
J2 reduction gear	M8	VIGOGREASE REO	745 ml	
J3 reduction gear	M8	VIGOGREASE REO	350 ml	
J4 reduction gear	M8	VIGOGREASE REO	265 ml	
J5 reduction gear	M5	SK-1A	18 ml	
J6 reduction gear	M5	SK-1A	33 ml	

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

[Note2] : The J5 cover needs to be removed for J5 grease replacing.

⊙ Procedure of grease replenishment

- Step1. The grease inlets and the outlet 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 grease outlet.
- Step4. Replenish the grease from the grease inlet by the grease gun.
- Step5. Refer to Table 5-5 for the amount of grease.
- Step6. Install the screw of the grease outlet.
- Step7. Remove the grease nipple, and install the screw of the grease inlet.

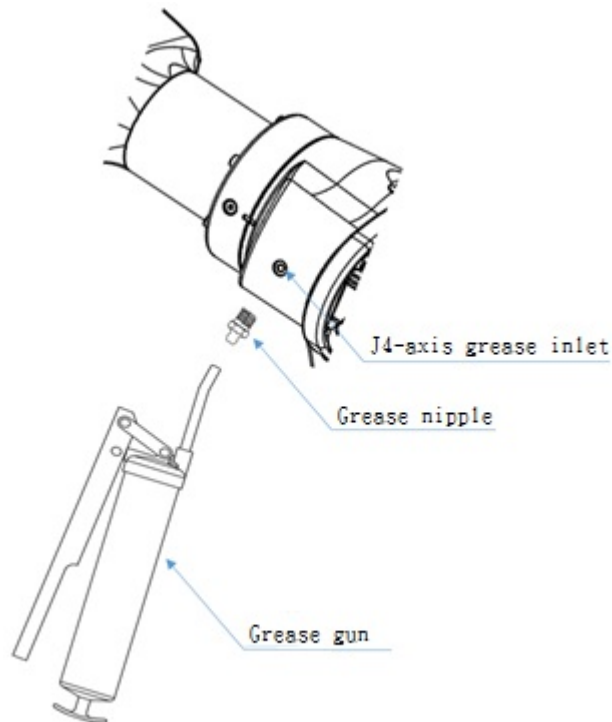


Figure 5-9 Grease replenishment

Articulated Robot - RA620 (Original Instruction) User Manual

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