HIWIN®
Motion Control and System Technology

Articulated Robot RA610

User Manual

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HIWIN®
Motion Control and System Technology

INDUSTRIE 4.0 Best Partner

Multi Axis Robot

Pick-and-place / Assembly /
Array and packaging / Semiconductor /
Electro-Optical industry /
Automotive industry / Food industry

- Articulated Robot
- Delta Robot
- SCARA Robot
- Wafer Robot
- Electric Gripper
- Integrated Electric Gripper
- Rotary Joint

Single Axis Robot

Precision / Semiconductor /
Medical / FPD

- KK, SK
- KS, KA
- KU, KE, KC

Direct Drive Rotary Table

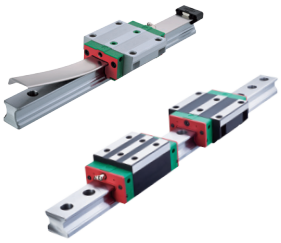
Aerospace / Medical / Automotive industry /
Machine tools / Machinery industry

- RAB Series
- RAS Series
- RCV Series
- RCH Series

Ballscrew

Precision Ground / Rolled

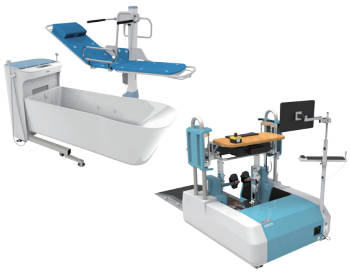
- Super S series
- Super T series
- Mini Roller
- Ecological & Economical lubrication Module E2
- Rotating Nut (R1)
- Energy-Saving & Thermal-Controlling (C1)
- Heavy Load Series (RD)
- Ball Spline



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

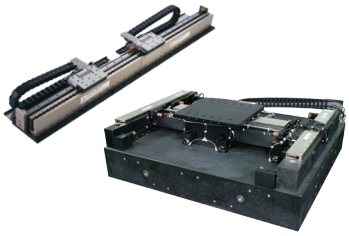
Semiconductor / Packaging machine
/SMT / Food industry / LCD

- 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

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
   - ■ 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	❖ 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.

WARNING	❖ The personnel operating 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	❖ 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.

3.3 Maintenance

⚠ DANGER	❖ 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.

3.4 End Effector

⚠ DANGER	❖ 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.

⚠ WARNING	❖ The end effector may be equipped with its own control unit. Be sure the control unit does not interfere with robot operation.

3.5Pneumatic, Hydraulic System

⚠ DANGER	❖ When using the pneumatic or hydraulic system, the gripped workpiece may fall due to insufficient pressure or gravity.

3.6Emergency Stop

⚠ DANGER	❖ 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.

4. 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.

Content

1. Transportation and Installation

1.1 Transportation

Lifting tackle or forklift truck can be used to transport the robot. The transportation procedure is as follows:

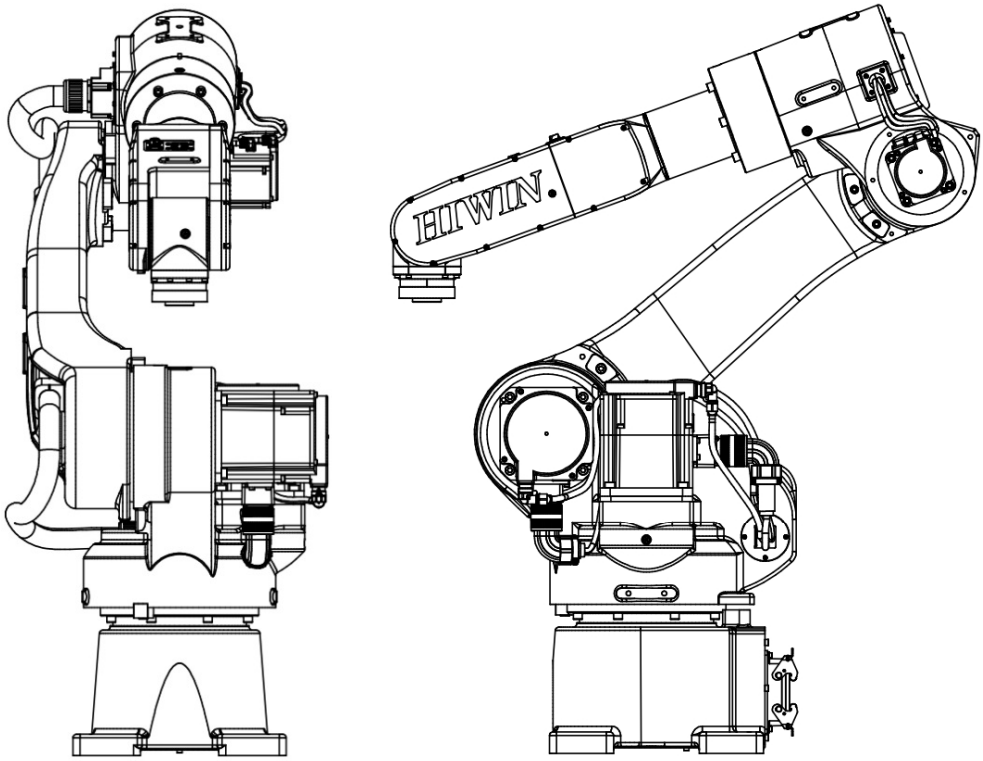
STEP 1. Move the robot into its transport position and the angle of each joint is shown in the table of Figure 1-1.

STEP 2. Secure the frames for transportation to the robot as shown in Figure 1-2(a)~(d). When carrying the robot with forklift truck, the frame should be mounted on the robot with four M8x1.25Px 20L screws. When carrying the robot with lifting tackle, as shown in Figure 1-3(a)~(d), four groups of M8x1.25Px15L eye bolt, M8 nuts and M8 washers should be mounted on the frame additionally.

STEP 3. Move the robot to the desired position by lifting tackle or forklift truck.

STEP 4. Remove the frame.

STEP 5. When carrying the robot with lifting tackle, two M12x1.75Px22L eye bolt, should be mounted on the robot, shown in Figure 1-4(a)~(e).



Transport position				
	RA610-1355-GA	RA610-1476-GA	RA610-1672-GA	RA610-1869-GA
J1	0°	0°	0°	0°
J2	45°	55°	45°	35°
J3	-75°	-75°	-80°	-80°
J4	0°	0°	0°	0°
J5	-60°	-70°	-55°	-45°
J6	0°	0°	0°	0°

Figure 1-1 Transport position

⚠ WARNING	❖ 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 transportation frame, please maintain it properly for re-transportation. ❖ Before operation, remove the transportation frame to avoid danger.

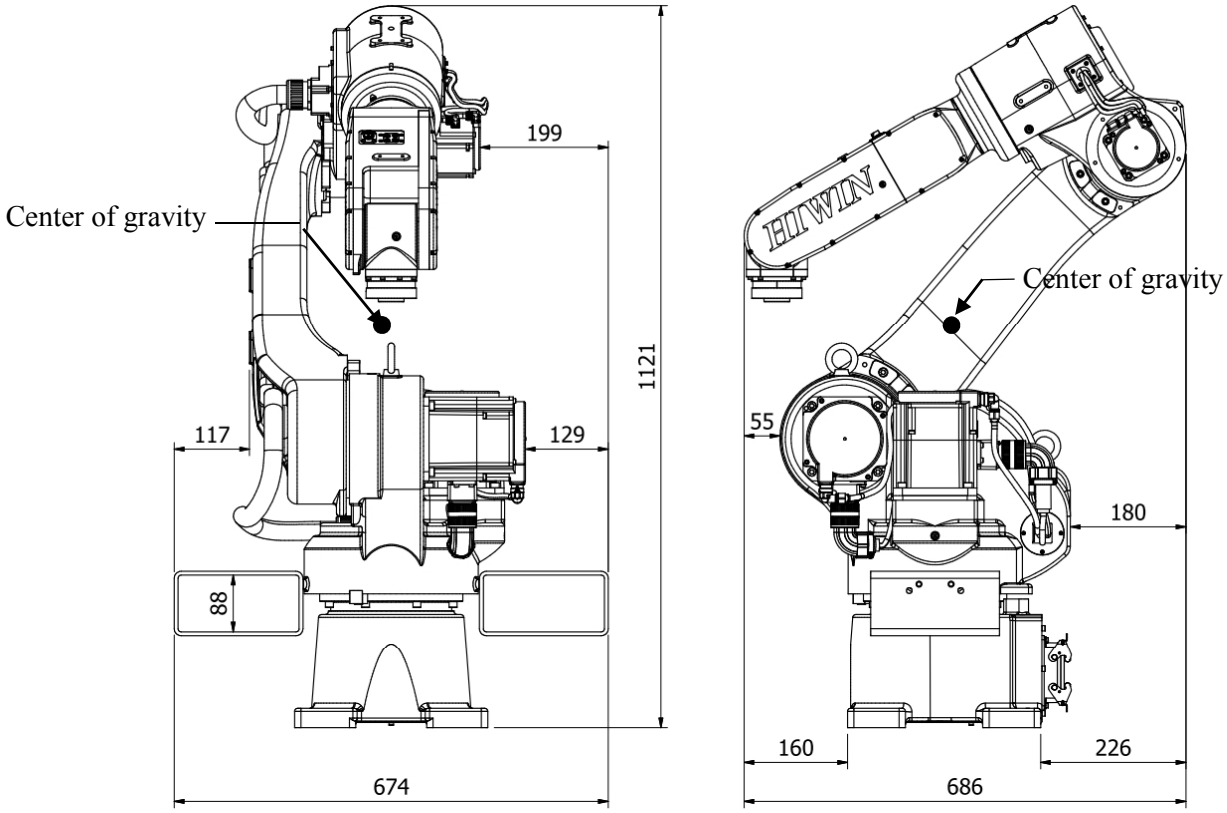


Figure 1-2(a) RA610-1355-GA Transport dimensions

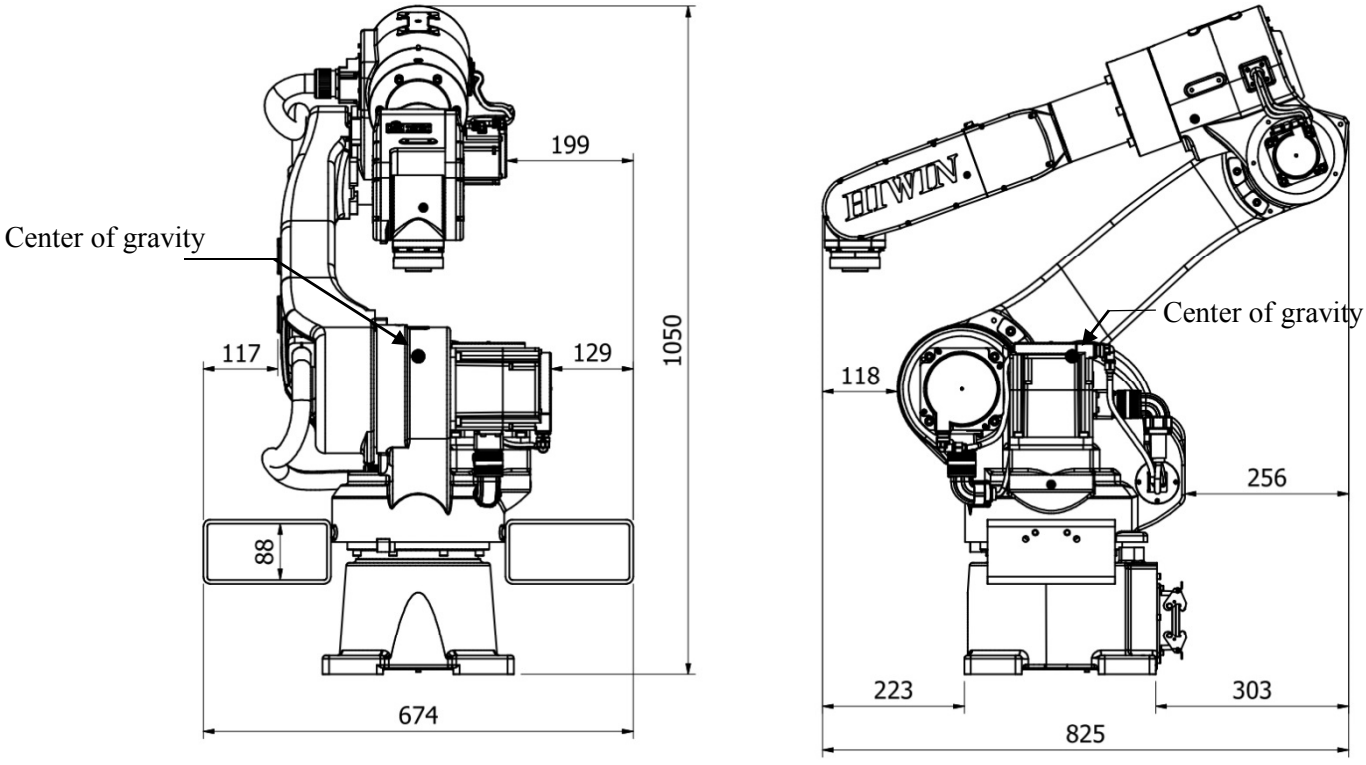


Figure 1-2(b) RA610-1476-GA Transport dimensions

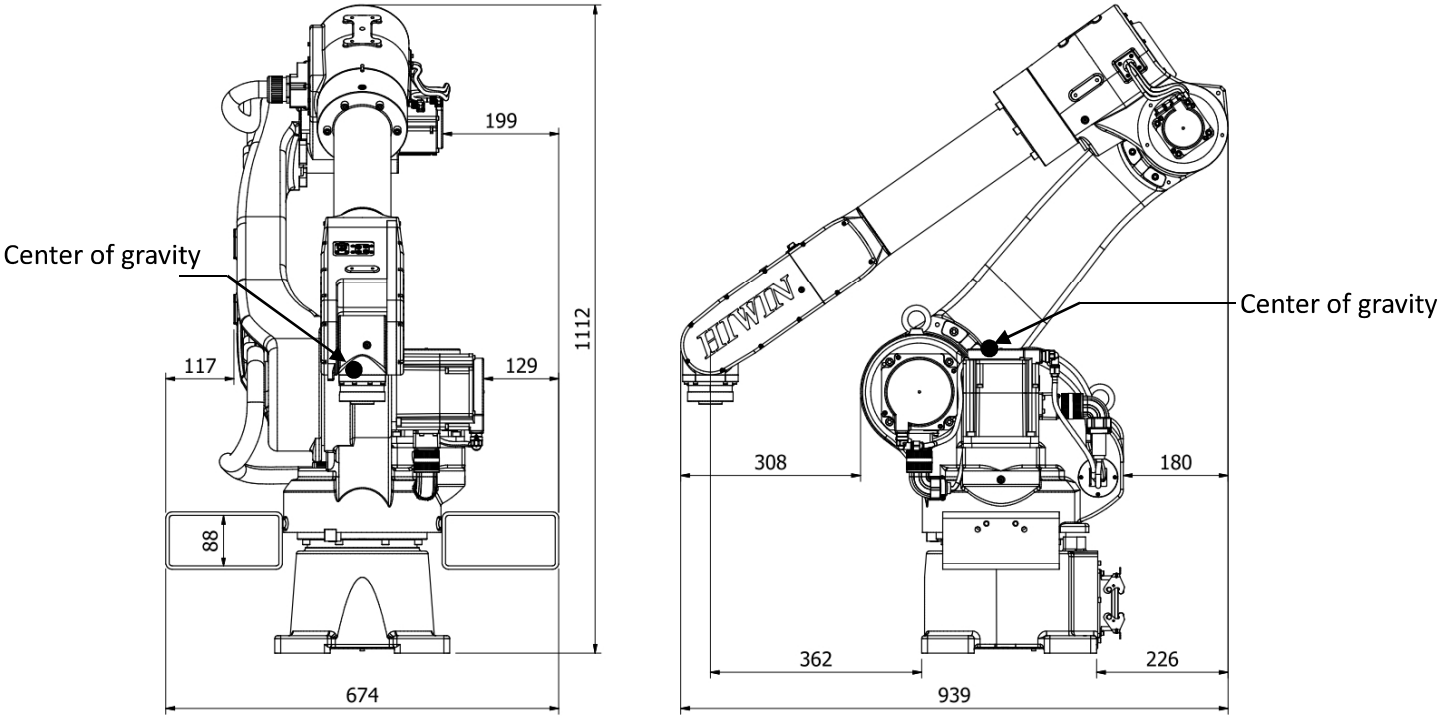


Figure 1-2(c) RA610-1672-GA Transport dimensions

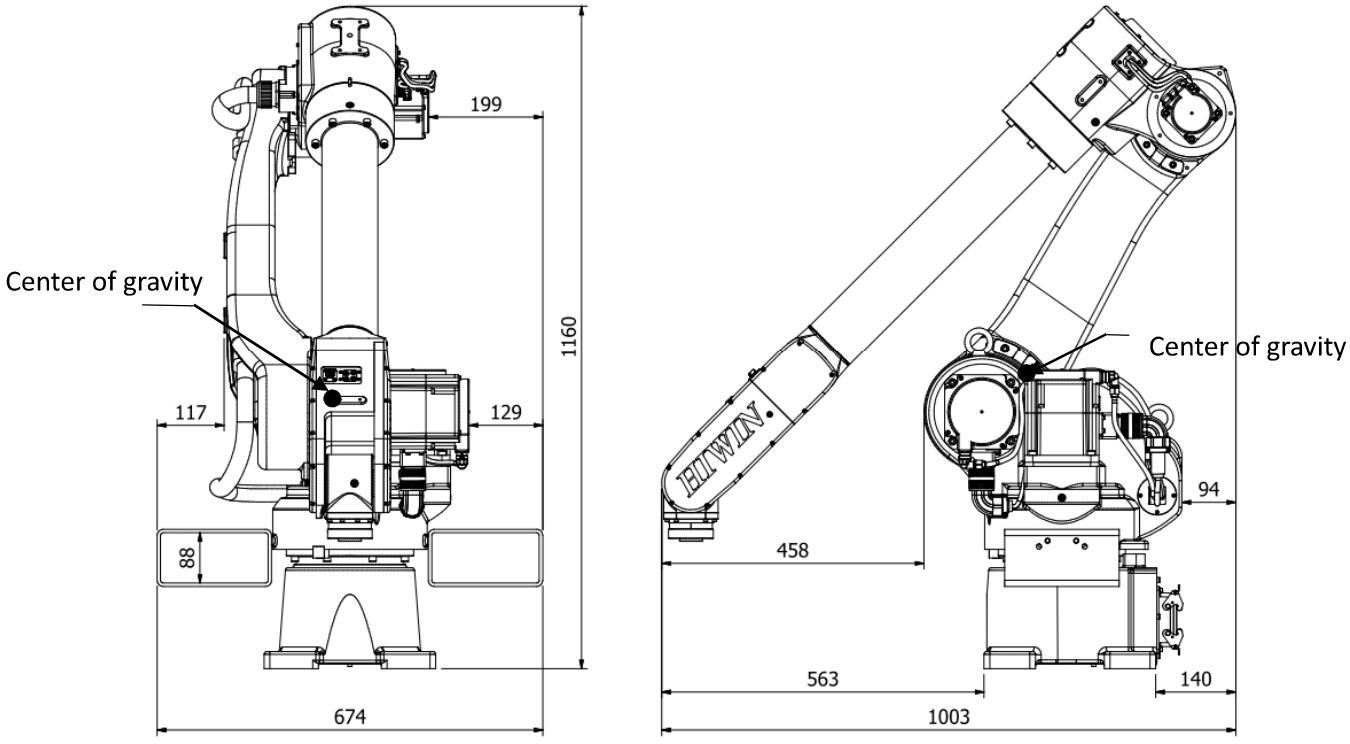
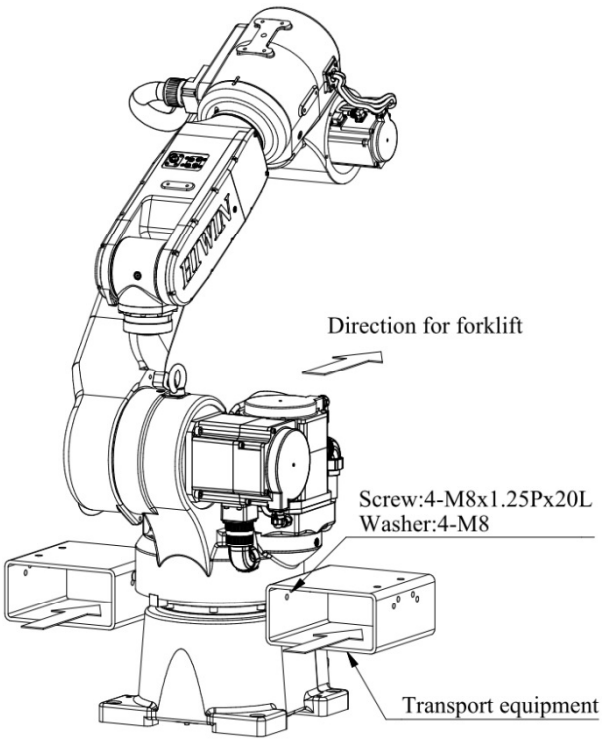
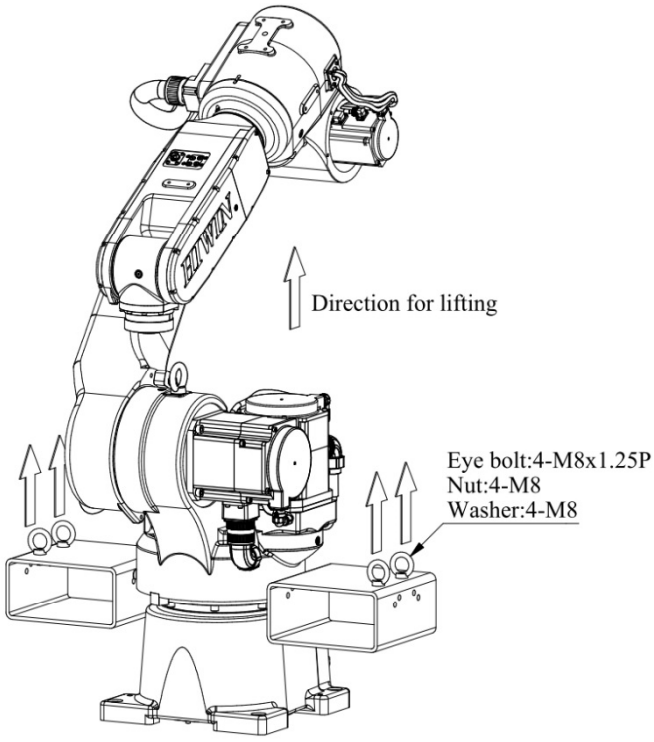


Figure 1-2(d) RA610-1869-GA Transport dimensions

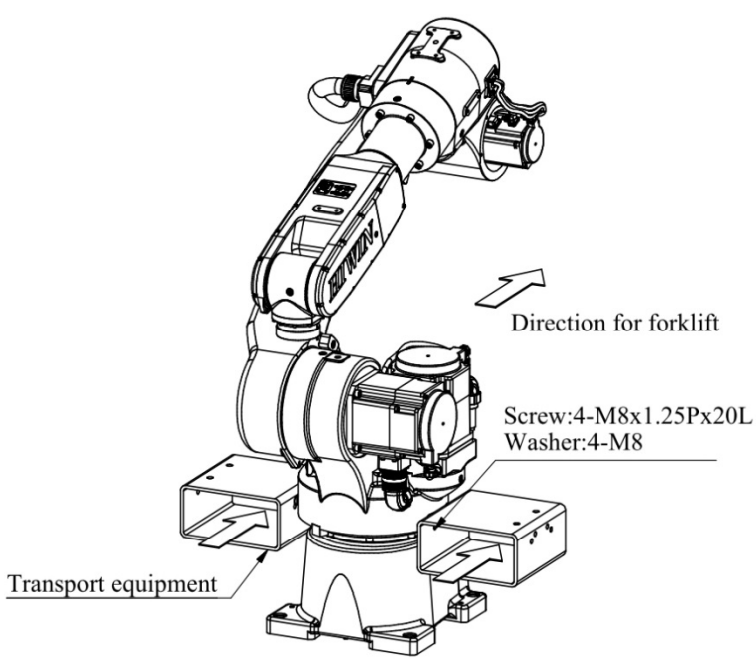


Transport by forklift truck

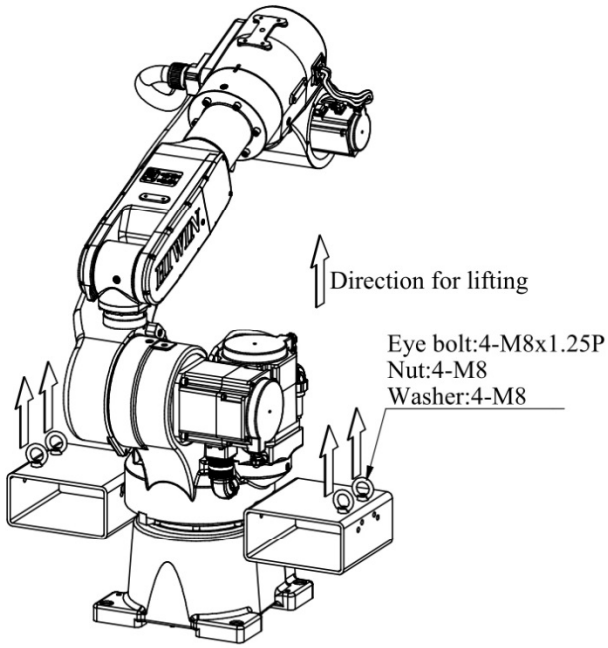


Transport by bridge crane tackle

Figure 1-3(a) RA610-1355-GA Transportation

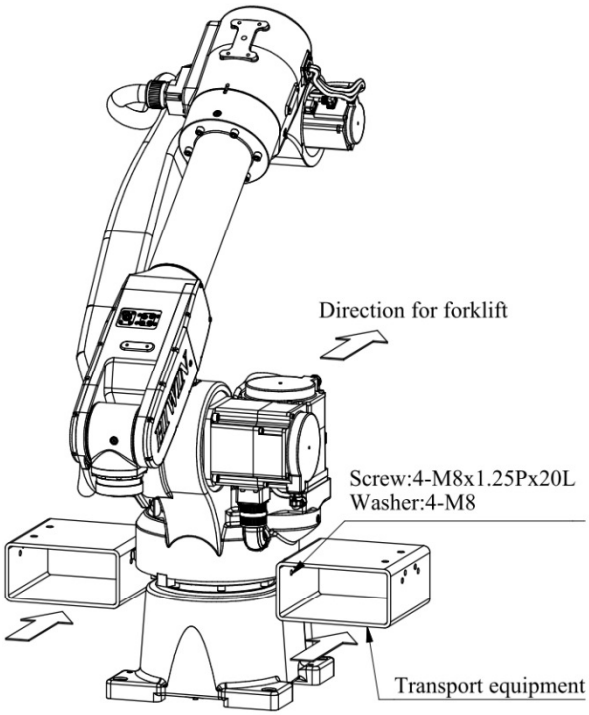


Transport by forklift truck

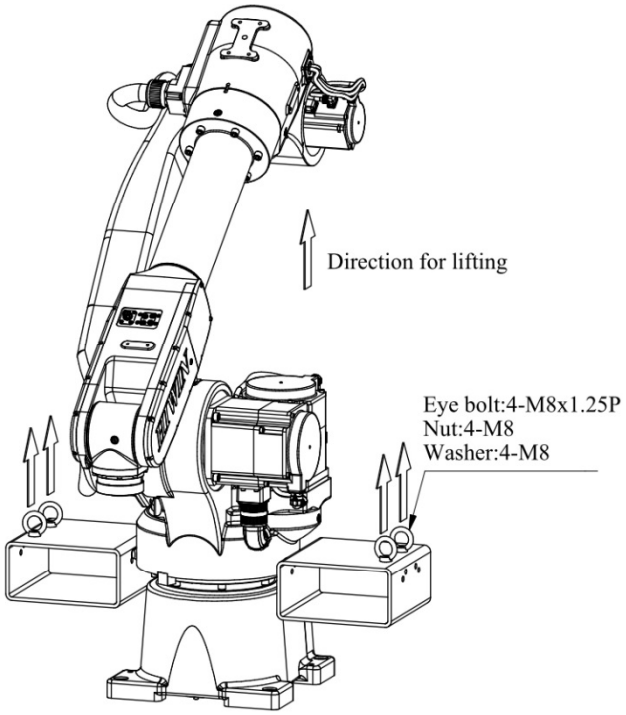


Transport by bridge crane tackle

Figure 1-3(b) RA610-1476-GA Transportation

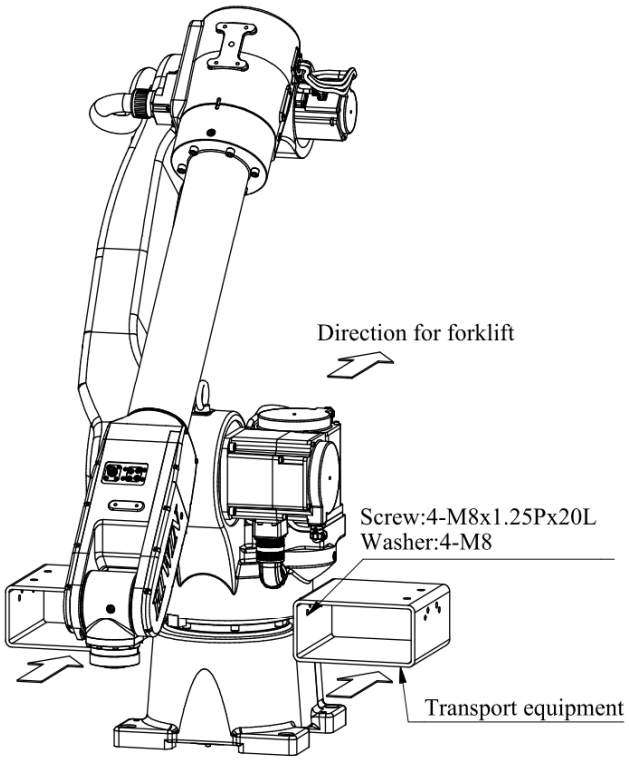


Transport by forklift truck

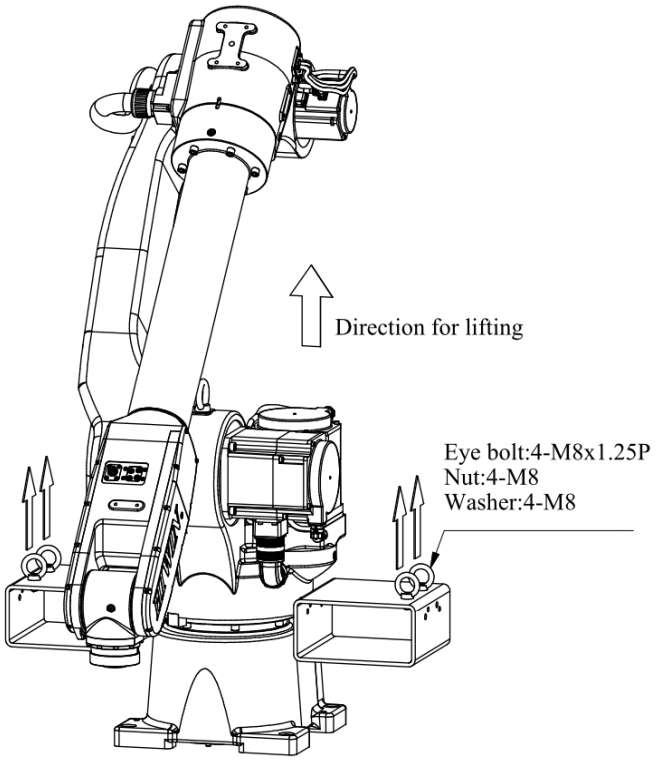


Transport by bridge crane tackle

Figure 1-3(c) RA610-1672-GA Transportation



Transport by forklift truck



Transport by bridge crane tackle

Figure 1-3(d) RA610-1869-GA Transportation

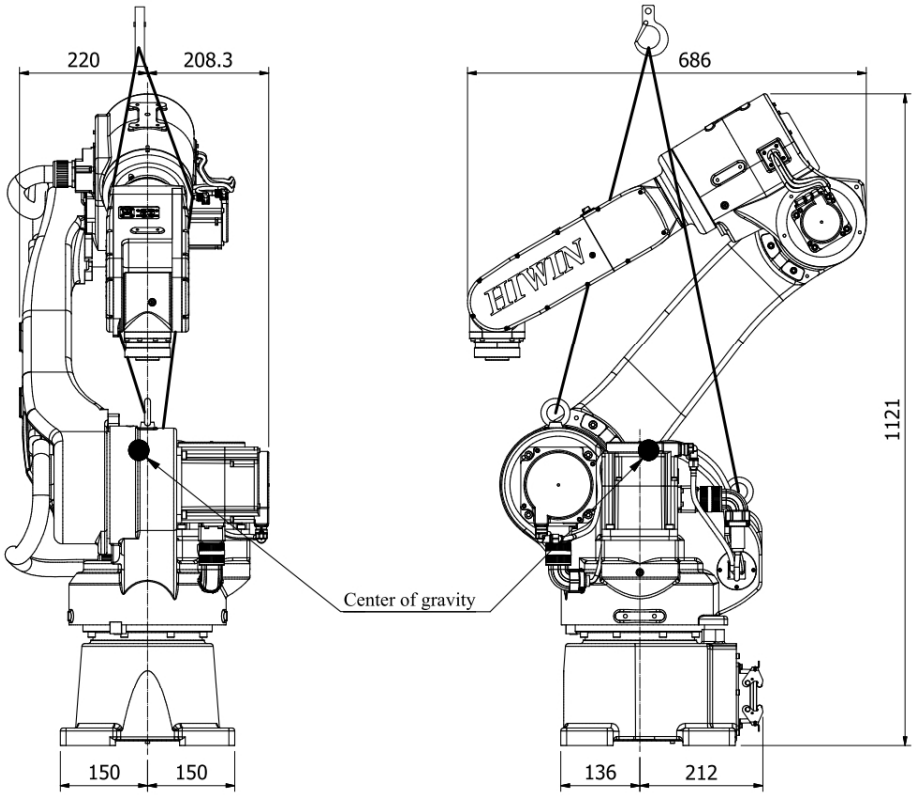


Figure 1-4(a) RA610-1355-GA Transportation

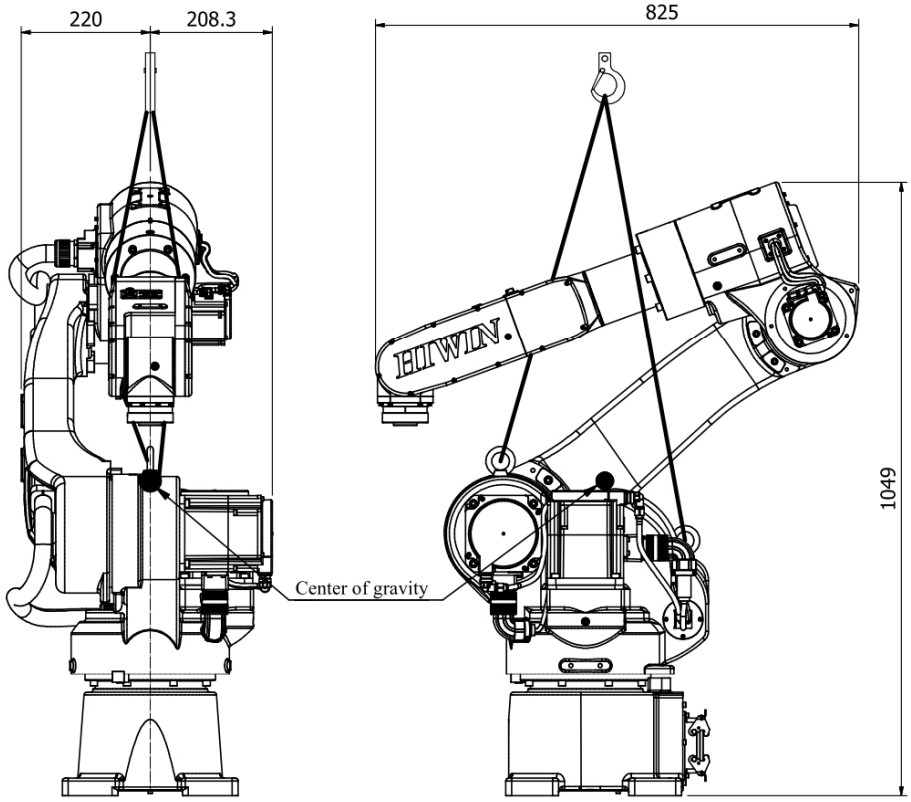


Figure 1-4(b) RA610-1476-GA Transportation

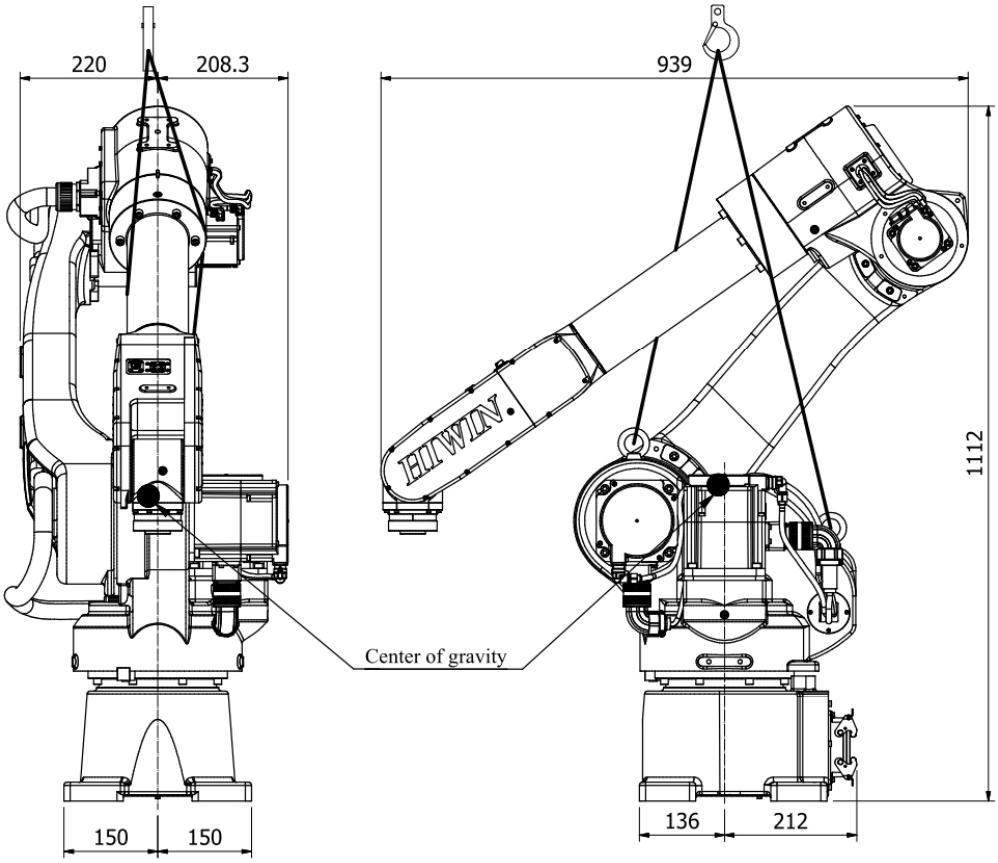


Figure 1-4(c) RA610-1672-GA Transportation

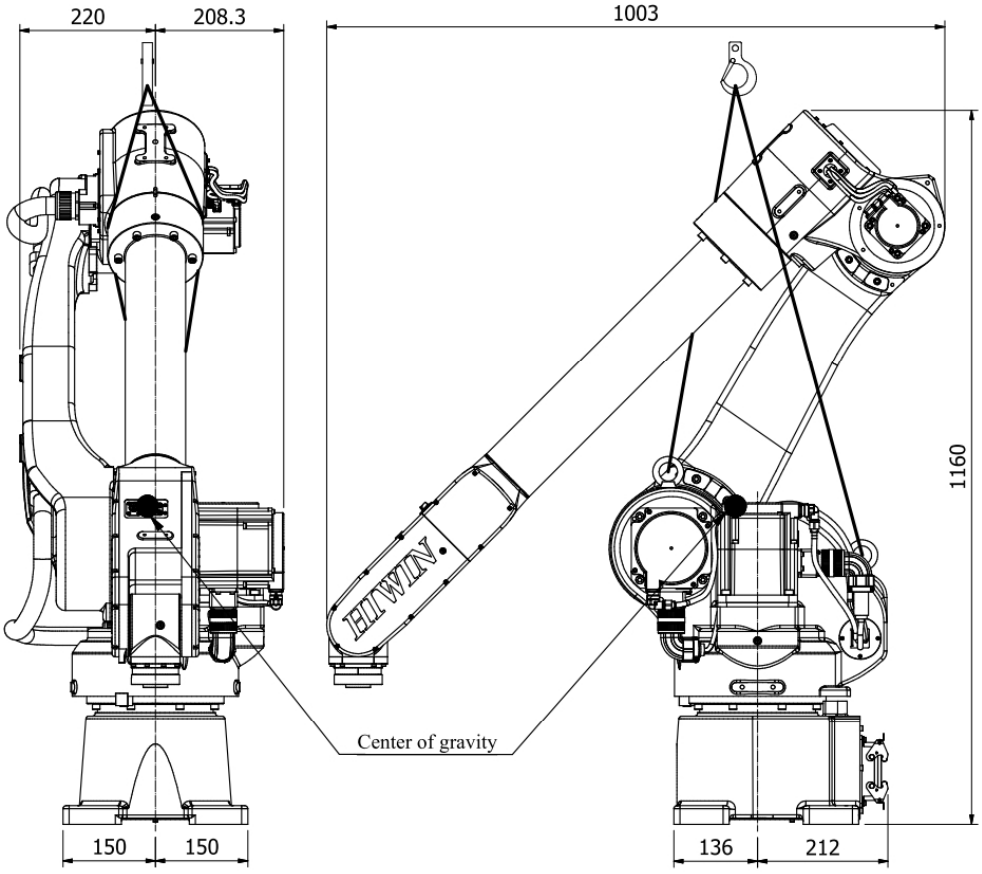


Figure 1-4(d) RA610-1869-GA Transportation

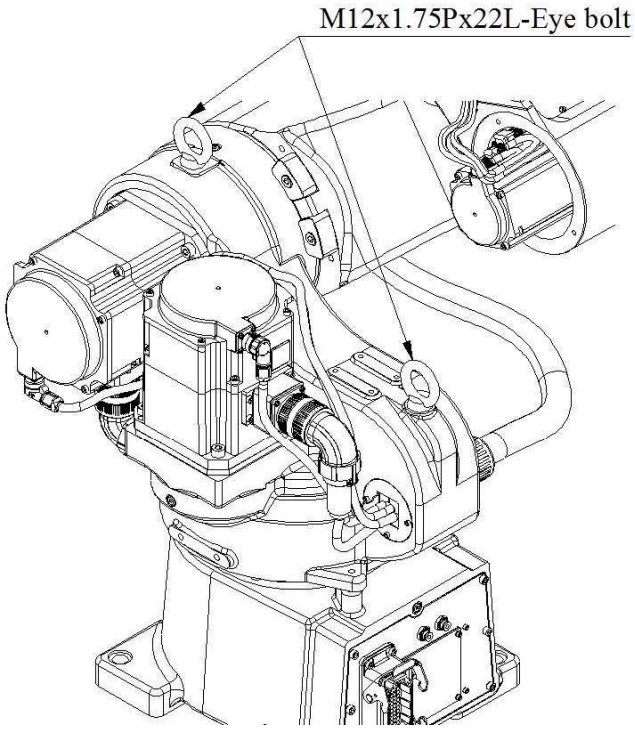


Figure 1-4(e) Eye bolt securement

1.2 Installation

Figure 1-5 shows the installation dimensions of the robot. According to the dimensions, fix the robot with installation bolt (M14x30L；Tensile Strength>1200N/mm2) on the installation surface. Figure 1-6 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.

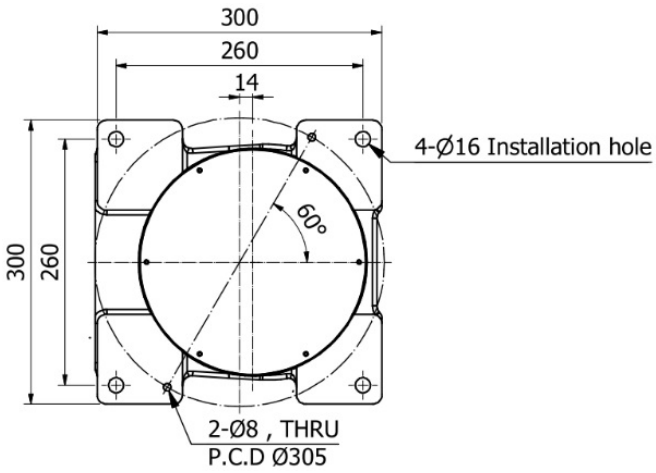


Figure 1-5 Base dimension

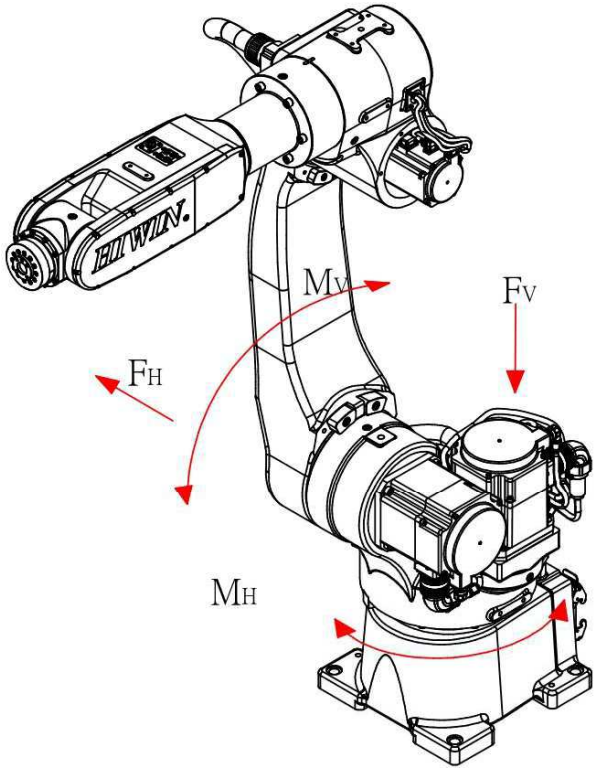


Figure 1-6 Forces and moments acting on the installation surface

Table1-1 Value of forces and moments acting on the installation surface (All type)

	Vertical moment M_V (Nm)	Vertical force F_V (N)	Horizontal moment M_H (Nm)	Horizontal force F_H (N)
Stop	661	1422	0	0
Acceleration /Deceleration	2201	2308	1021	937
Power cuts Stop	12129	6903	6985	5433

⚠ 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 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 J1, as shown in Figure 1-9. The pin assignment of the power supply and signal connector is shown in Table 1-2.

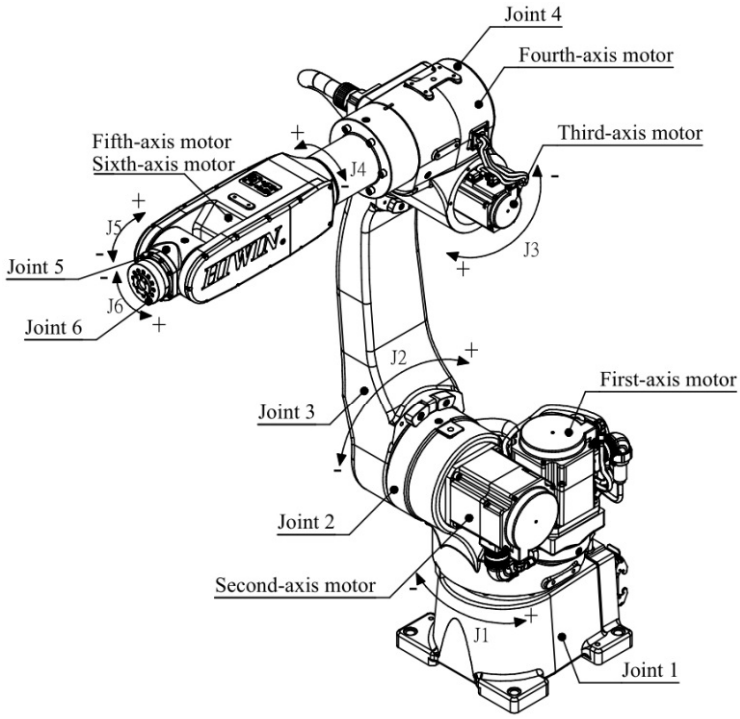


Figure 1-7 Structure drawing of the robot

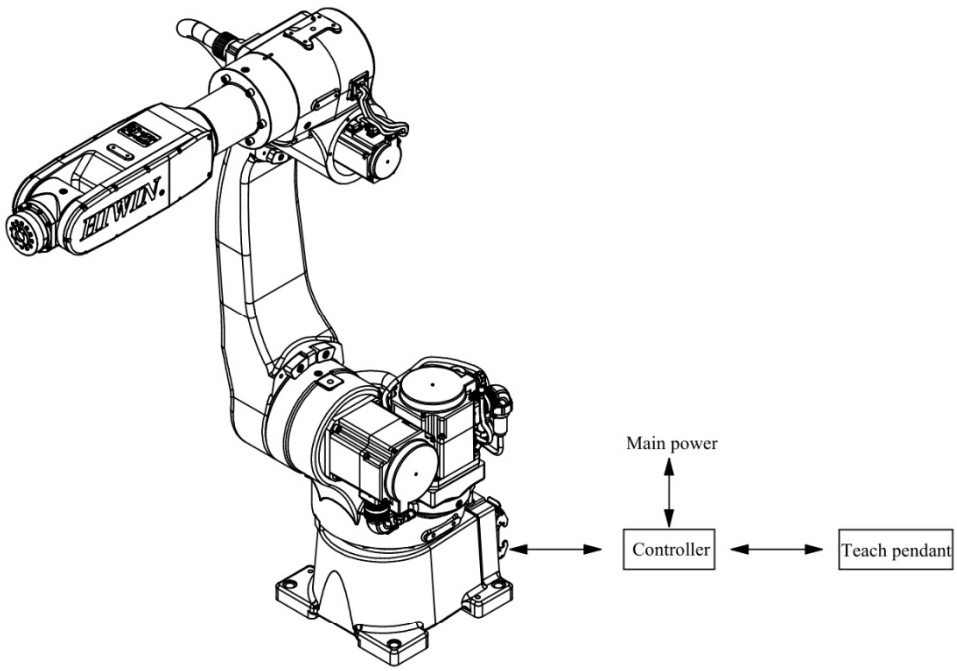


Figure 1-8 Illustration of robot and controller installation

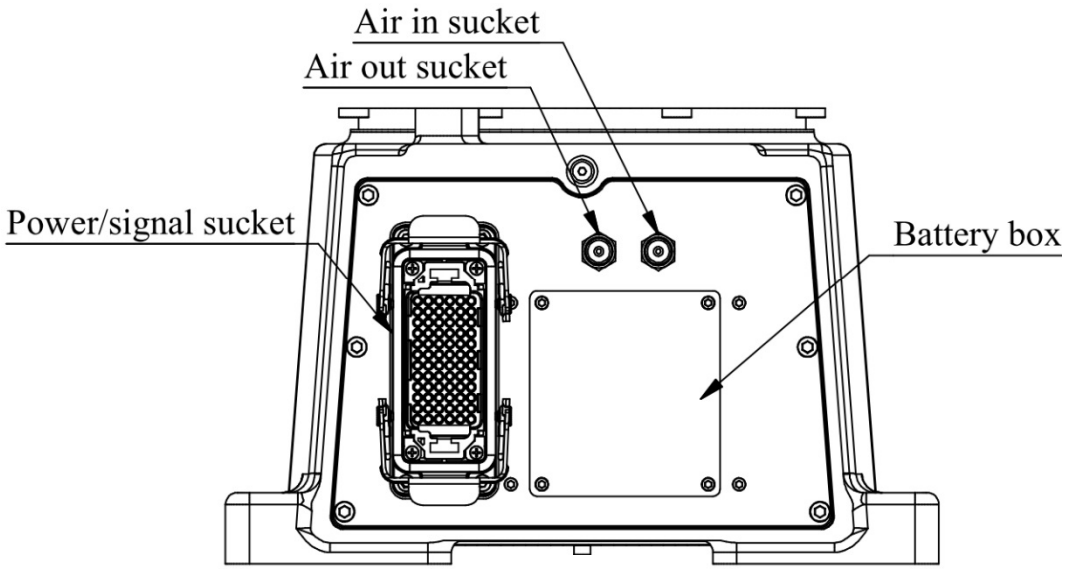


Figure 1-9 Interface at the rear of J1

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 mm^2) is used to connect the robot and the grounding area by the screws (M5x0.8Px12L) and the washers as shown in Figure 1-10.

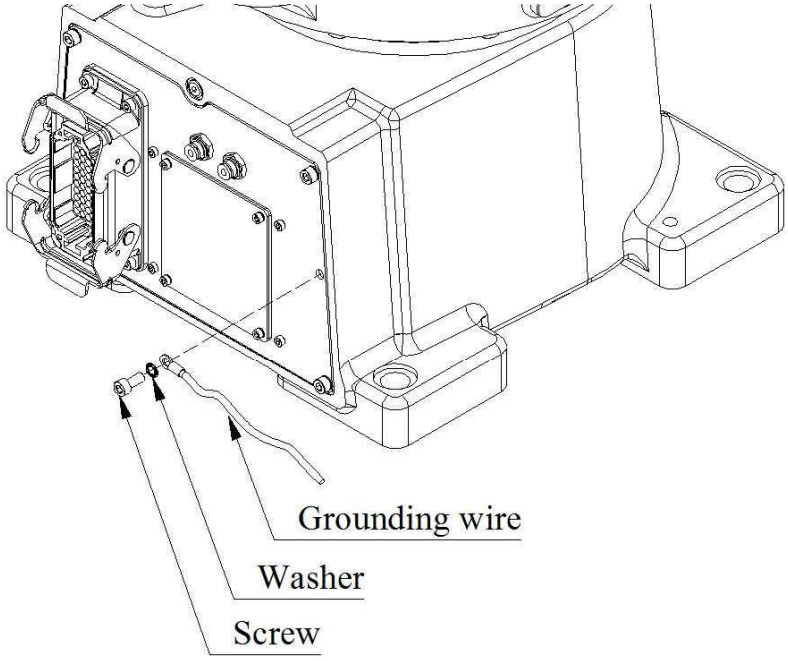


Figure 1-10 Connecting the grounding wire

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 ℃[Note 1] 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	• Keep away from flammable or corrosive solvents and gases. • Keep away from explosives. • Keep away from radiate environment.

[Note 1]: When the robot is stopped for a long period of time at the temperature near 0℃, 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 and 1-5.

Table 1-4 Standard equipment list

Item	HIWIN Part Number	Remark
Calibration tool set (PIN)	4C200ZV1	Refer to section 4.1
Calibration tool set (key)	4C200ZW1	Refer to section 4.1
Transportation frame set	4C200WS3	Refer to section 1.1
End effector I/O connector	4CA30008	Refer to section 3.4
Quick coupling (pneumatic)	4CA30001	Refer to section 3.3

Table 1-5 Optional equipment list

Item	HIWIN Part Number	Remark
Lithium battery	462600LN	Refer to section 5.2.1
J5, J6 Timing belt	453100YZ	Refer to section 5.2.2
J1-J3 grease	47110042	Refer to section 5.2.3
J4-J6 grease	47110035	Refer to section 5.2.3
Quick coupling (pneumatic)	4CA30001	Refer to section 3.3
M12 Eye bolt	4540063T	Refer to section 1.1
M8 Eye bolt	4540084B	Refer to section 1.1

2. Basic Specifications

2.1 Description of Serial Number

The robot has a serial number on the rear of J1, and the explanation of serial number is shown in Figure 2-1.

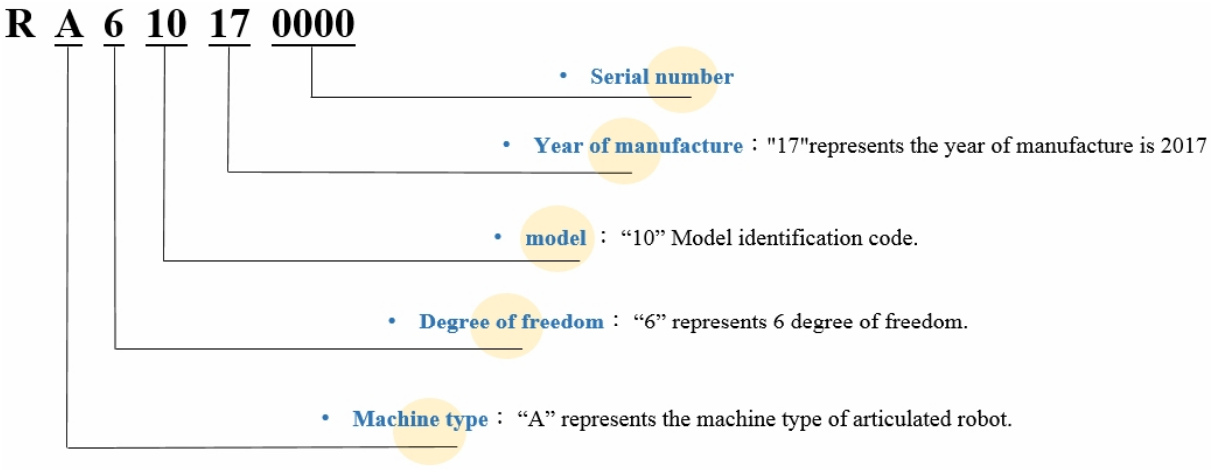


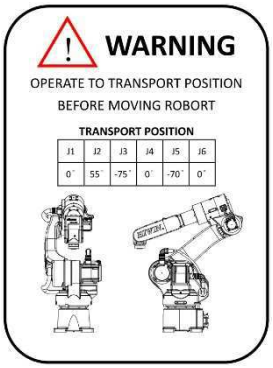
Figure 2-1 Description of serial number

2.2 Labels

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

Table 2-1 Labels description

Labels	Name	Description
	Collision	Keep safety distance from robot system, and prevent colliding to operator during operation.
	Grounding	Make sure grounding is completed, or it will cause electric shock.
	Electric shock	Pay more attention that the robot may have a risk of electric shock.

	Transport	Be aware of transport position when transporting robot, please refer to section 1-1 for detailed information.
	Specification	Robot specification and serial number
	Air in	The connection port of air tube for air input.
	Air out	The connection port of air tube for air output.
	Grease in	The hole for grease in.
	Grease out	The hole for grease out.

2.3 Robot Specifications

The robot specifications are as shown in Table 2-2

Table 2-2 Robot specifications

Item		Specification			
Model No.		RA610-1355-GA	RA610-1476-GA	RA610-1672-GA	RA610-1869-GA
Degrees of Freedom		6			
Installation		Floor、slope (wall mounting, ceiling mounting) [Note 1]			
Load Capacity[Note 2]		12kg	10kg	10kg	7kg
Maximum Motion Radius		1355 mm	1476mm	1672 mm	1869 mm
Cycle Time		1s[Note 3]			
Repeatability		±0.05 mm		±0.06mm	
Working Range	J1	+170˚~ -170˚			
	J2	+95˚~ -150˚			
	J3	+185˚~ -85˚			
	J4	+190˚~ -190˚			
	J5	+135˚~ -135˚			
	J6	+360˚~ -360˚			
Maximum speed	J1	192°/ s (3.35rad/ s)			
	J2	206°/ s (3.59rad/ s)			
	J3	219°/ s (3.82rad/ s)			
	J4	450°/ s (7.85rad/ s)			
	J5	450°/ s (7.85rad/ s)			
	J6	720°/ s (12.56rad/ s)			
Allowable load moment at wrist	J4	16.9 N-m			
	J5	16.9 N-m			
	J6	10.98 N-m			
Allowable load inertia at wrist	J4	1.07 kg- m^2			
	J5	1.07 kg- m^2			
	J6	0.49 kg- m^2			
Weight		143 kg	147 kg	150 kg	152kg
Power		3Φ220V			
Protection rating		IP65[Note 4]			
Noise level		Less than 75 dB [Note 5]			

[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 RA610-1476-GA is loaded at 10kg to forward and backward move in the vertical height 25mm and the horizontal distance 300mm, as shown in Figure 2-2.

Figure 2-2 Cycle time trajectory

[Note 4]：The wrist protection rating is IP65. The robot protection rating is IP54.

[Note 5]：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 2-3[(a)~(d)].

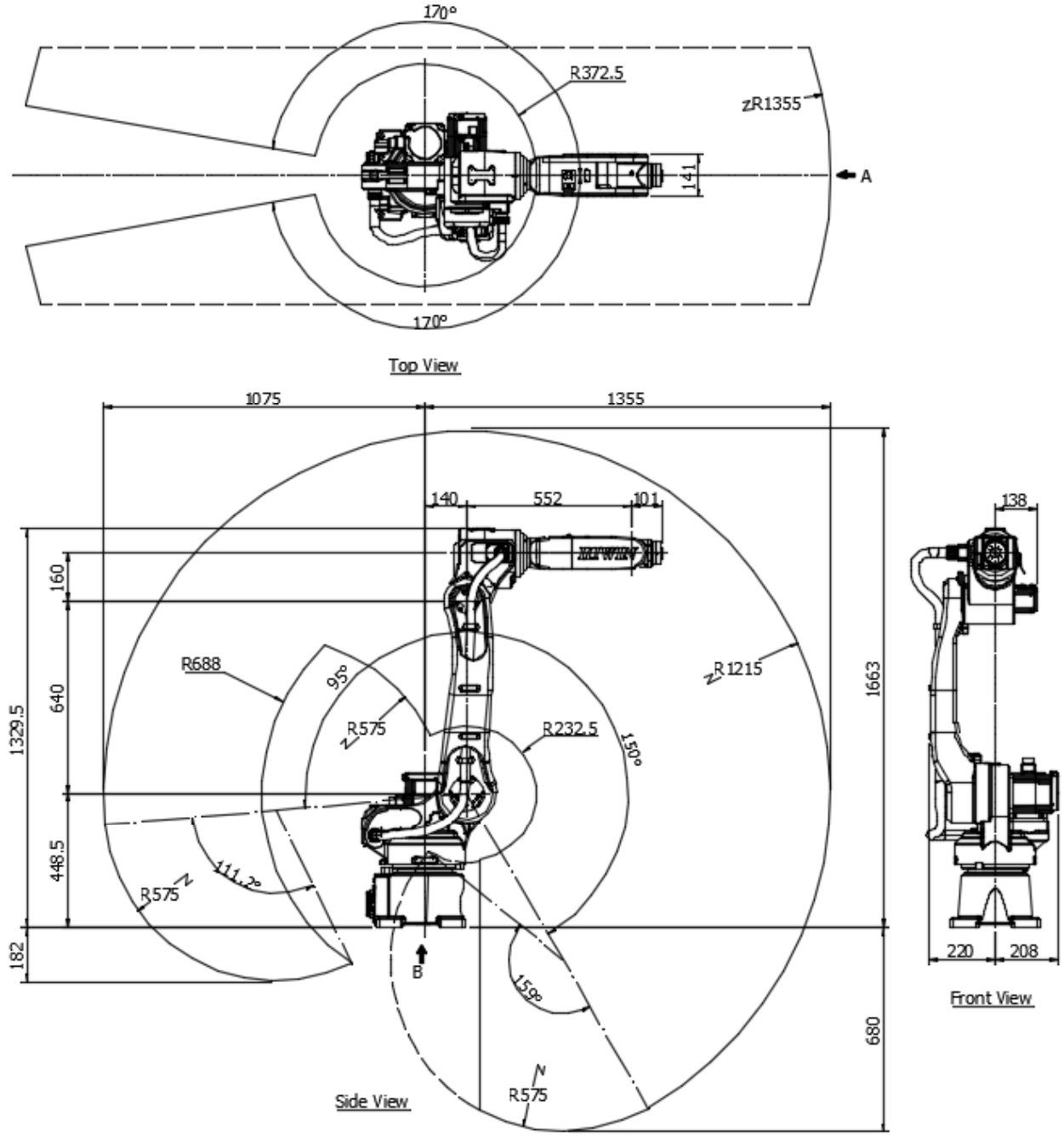


Figure 2-3(a) RA610-1355-GA Outer dimension and motion range

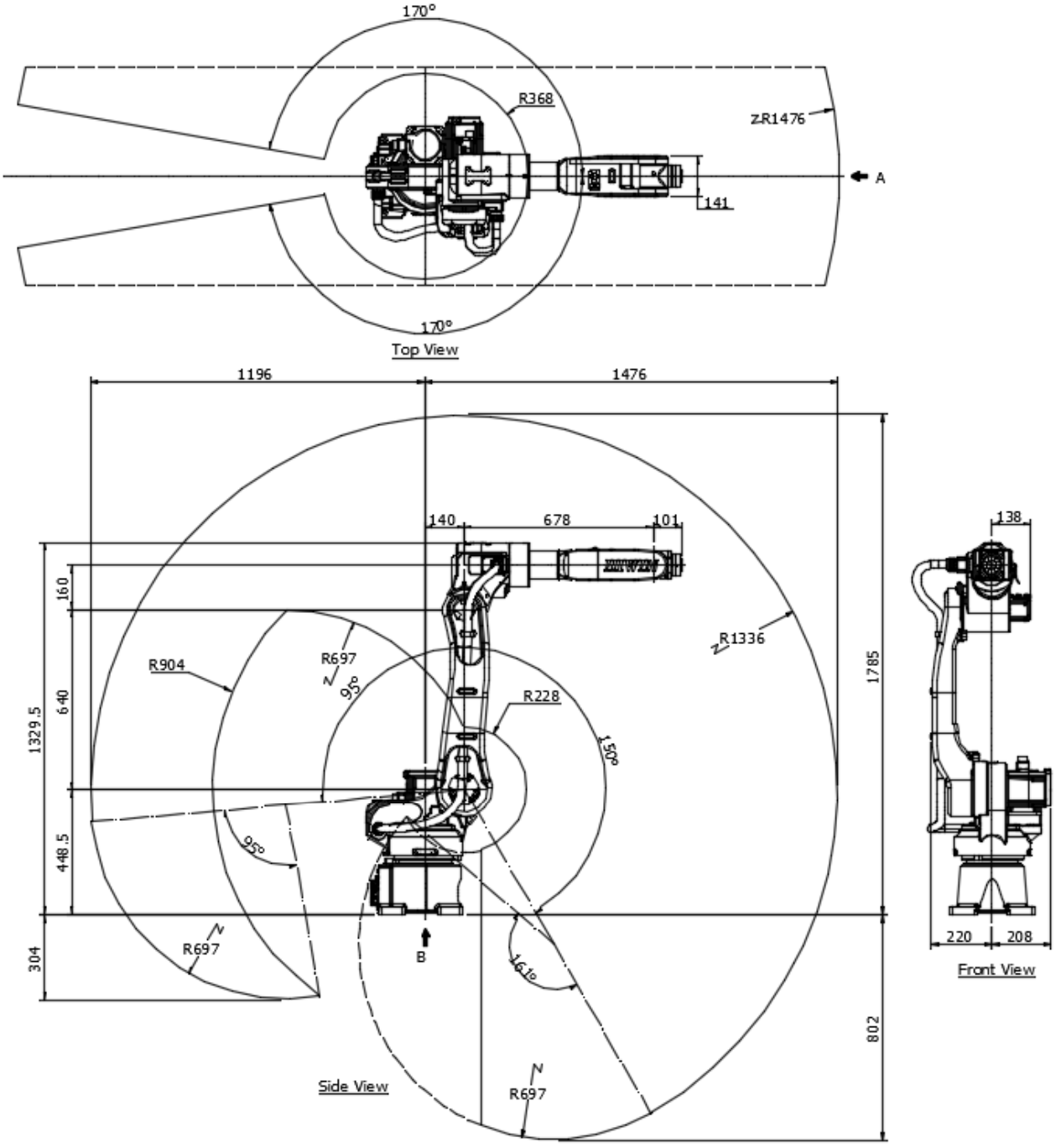


Figure 2-3(b) RA610-1476-GA Outer dimension and motion range

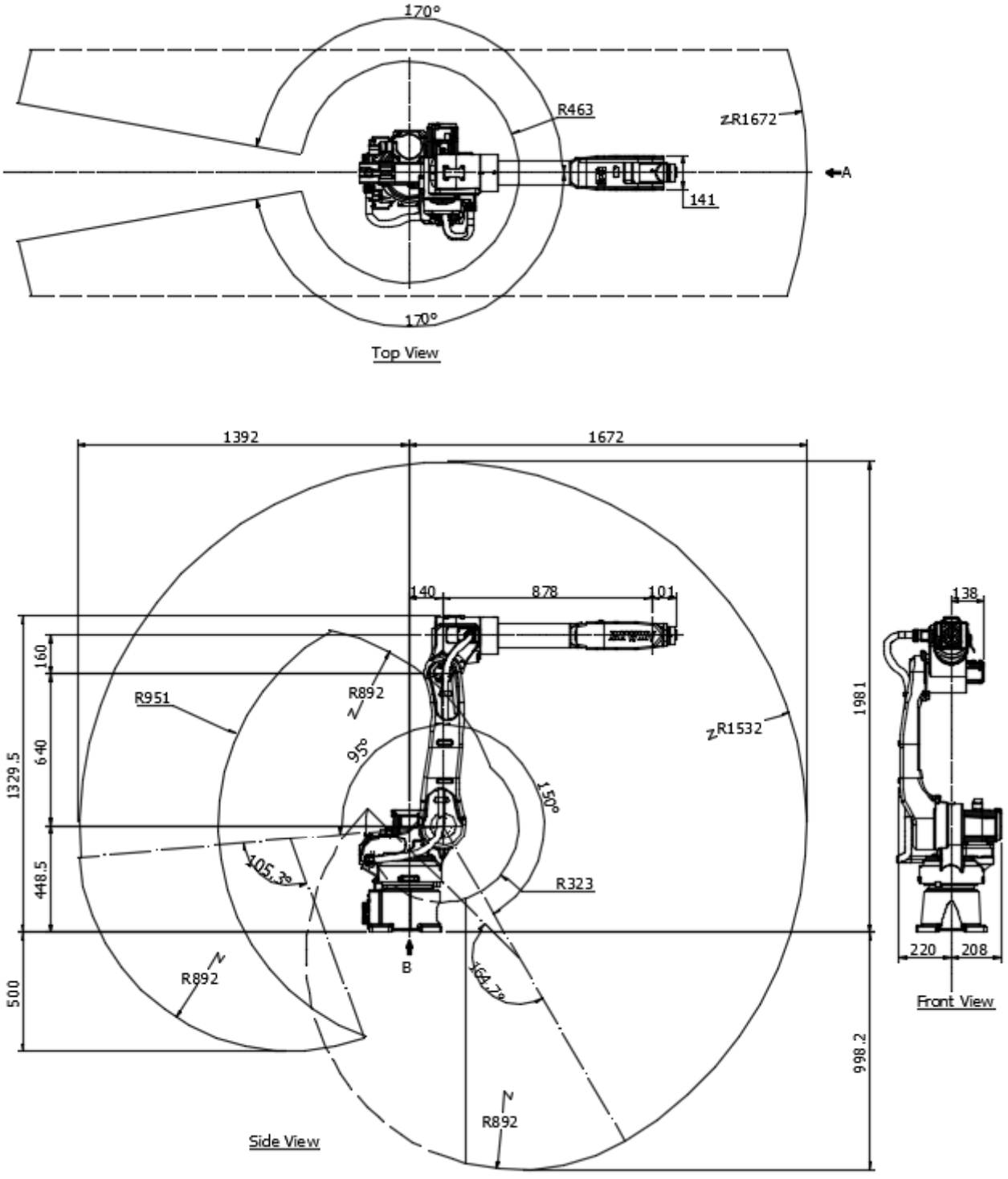


Figure 2-3(c) RA610-1672-GA Outer dimension and motion range

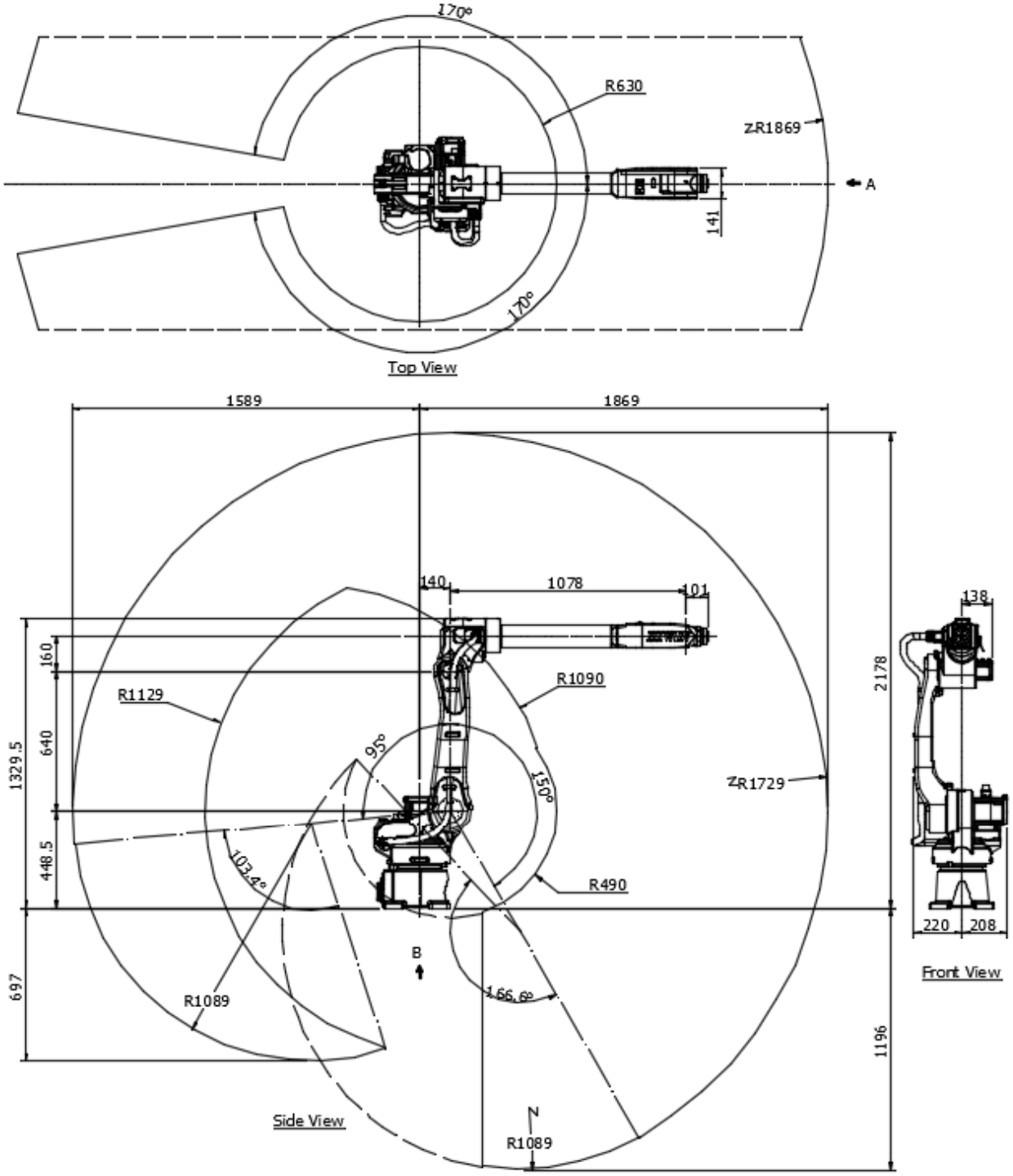


Figure 2-3(d) RA610-1869-GA Outer dimension and motion range

2.5 Wrist Load 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 2-4(a)~(d) shows allowable center of gravity of the load.

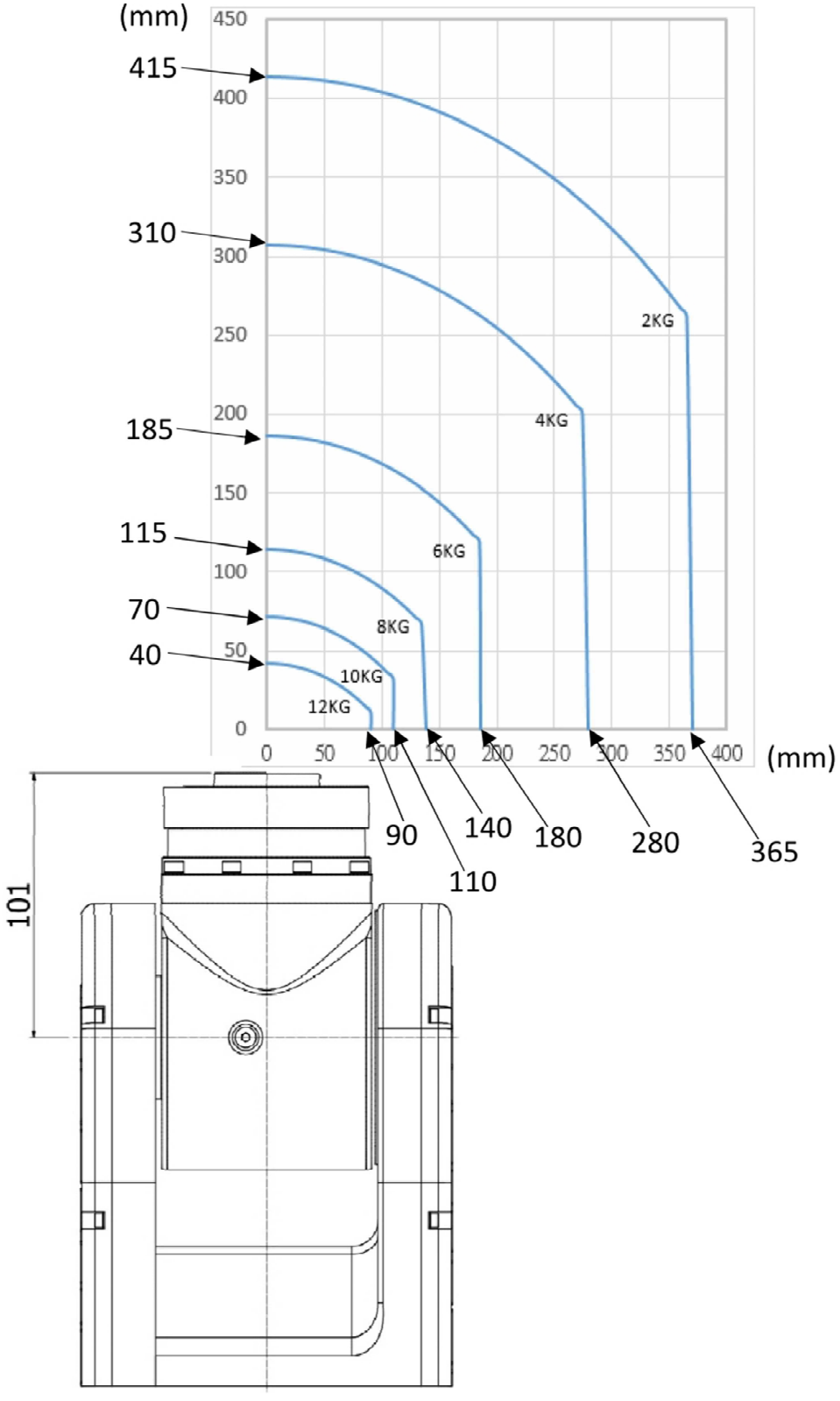


Figure 2-4(a) RA610-1355-GA Wrist moment diagram

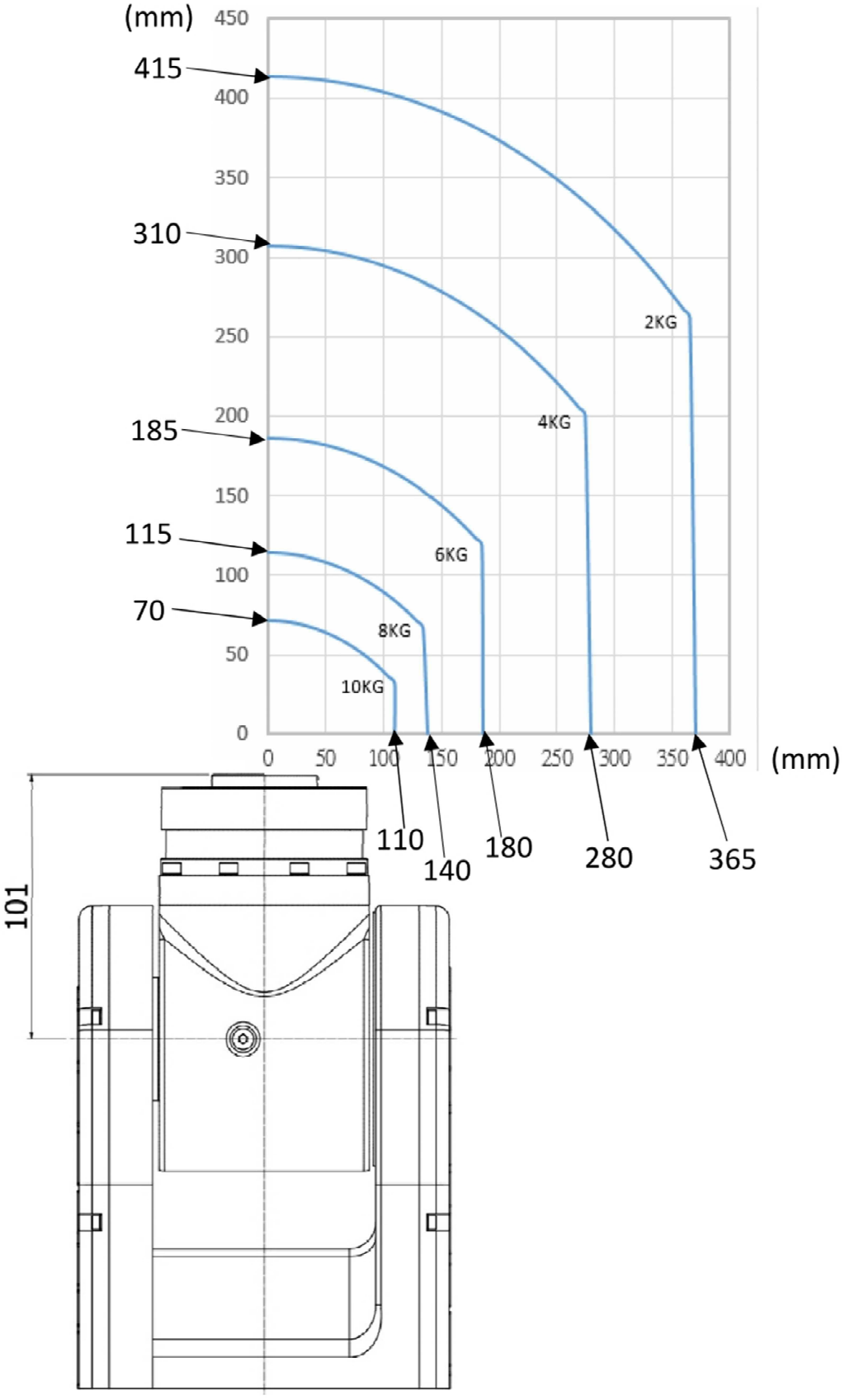


Figure 2-4(b) RA610-1476-GA Wrist moment diagram

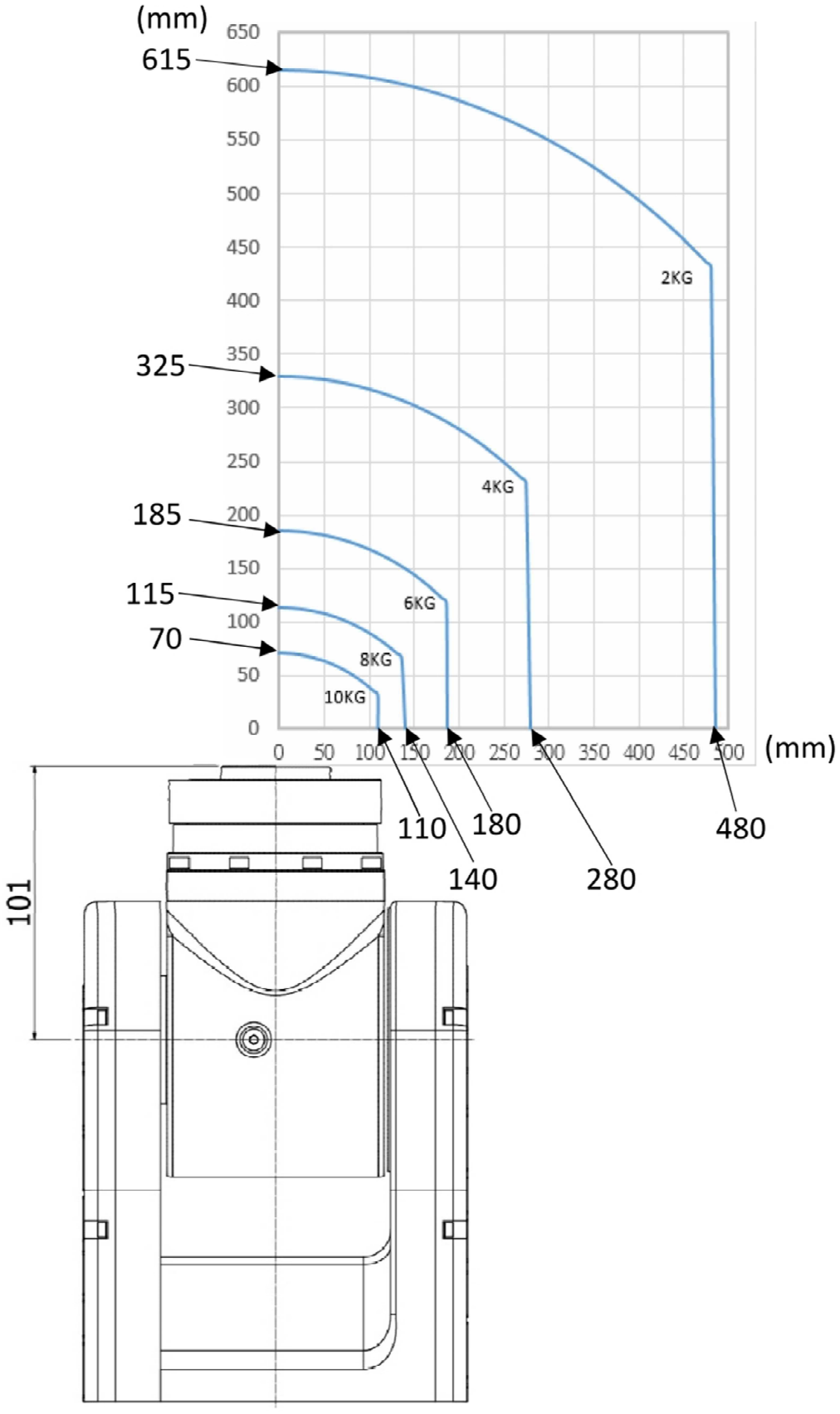


Figure 2-4(c) RA610-1672-GA Wrist moment diagram

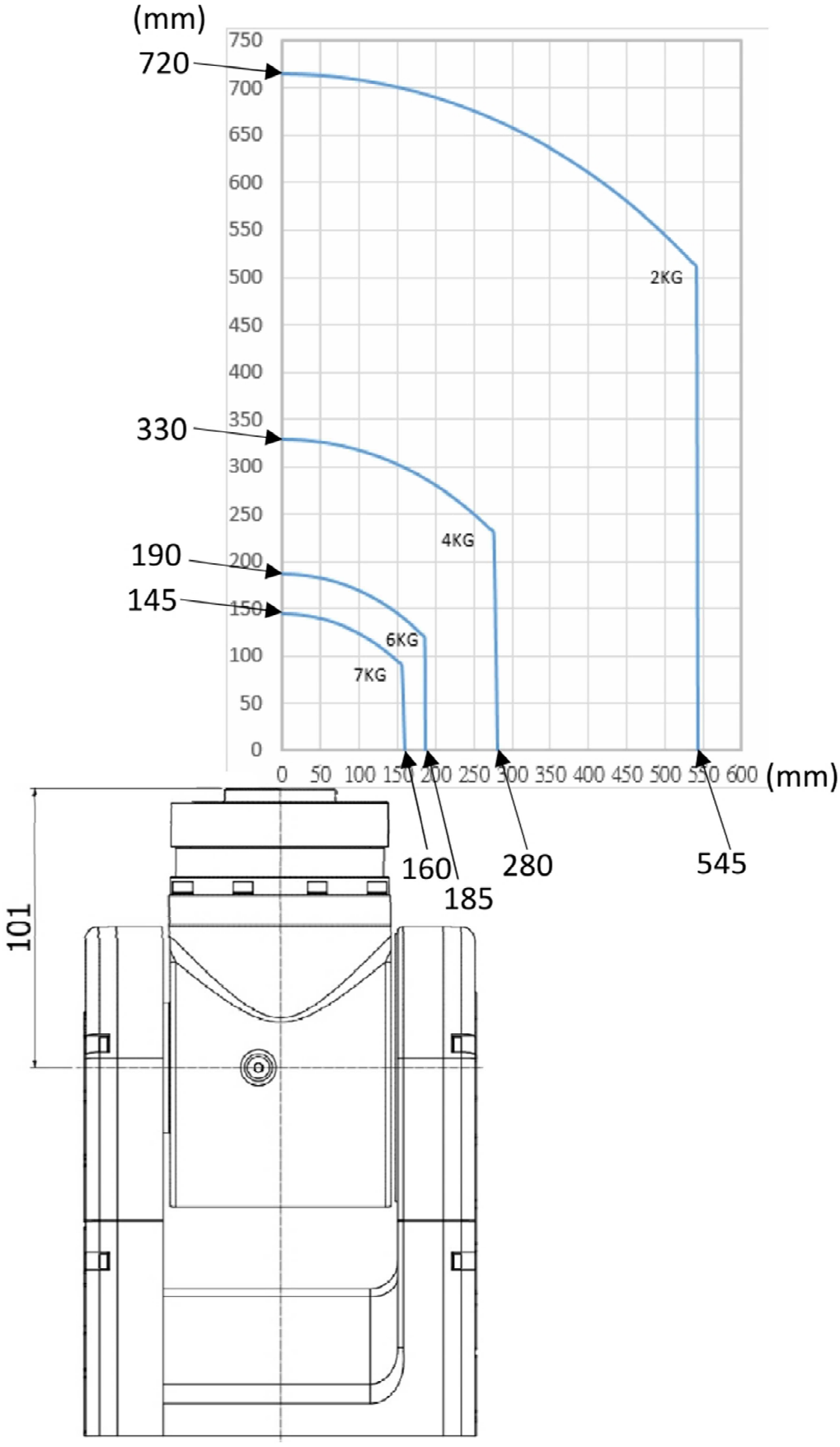


Figure 2-4(d) RA610-1869-GA Wrist moment diagram

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.

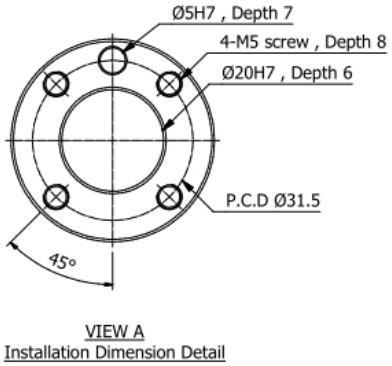


Figure 3-1 Mounting surface for end effector

3.2 Mounting Surface on the Robot

Mounting surfaces for the peripheral equipment are shown in Figure 3-2(a)~(e).

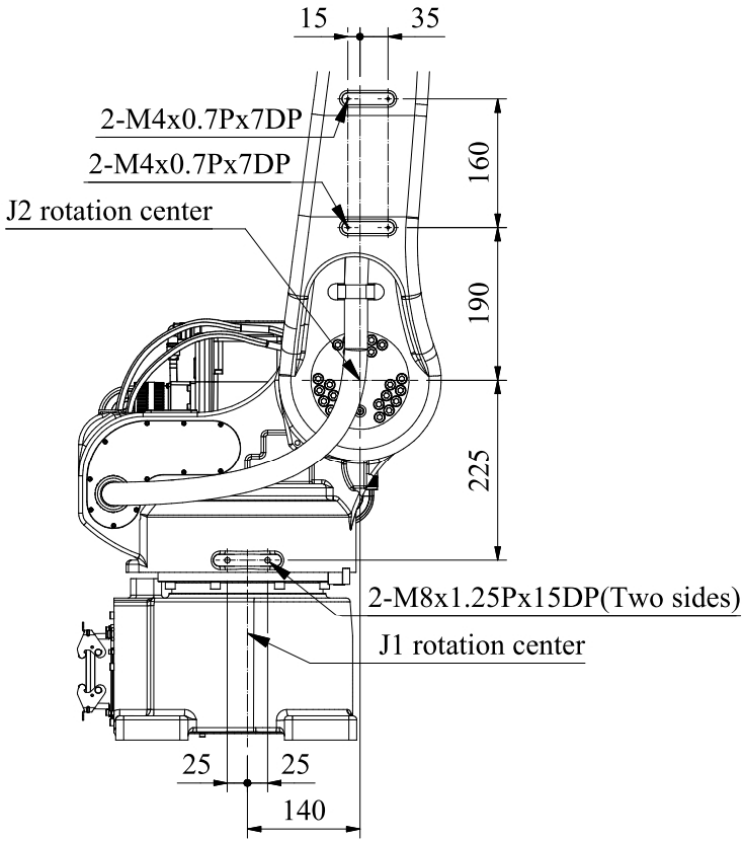


Figure 3-2(a) Mounting surfaces on the robot

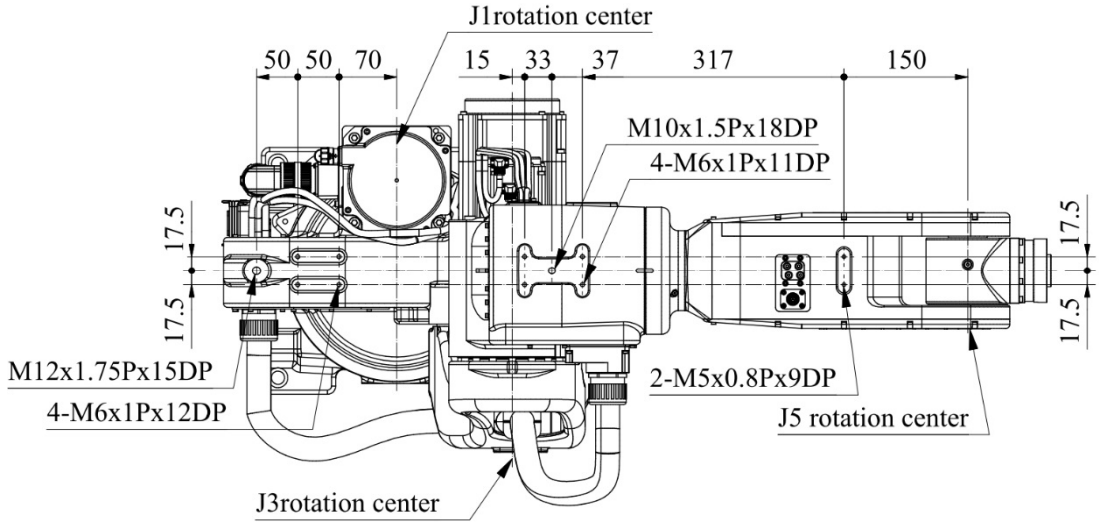


Figure 3-2(b) RA610-1355-GA Mounting surfaces on the robot

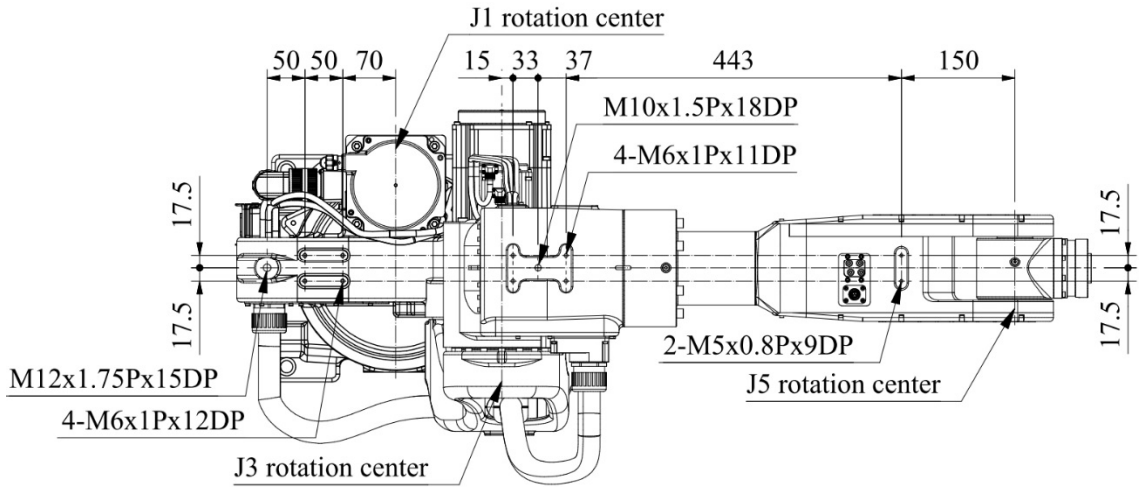


Figure 3-2(c) RA610-1476-GA Mounting surfaces on the robot

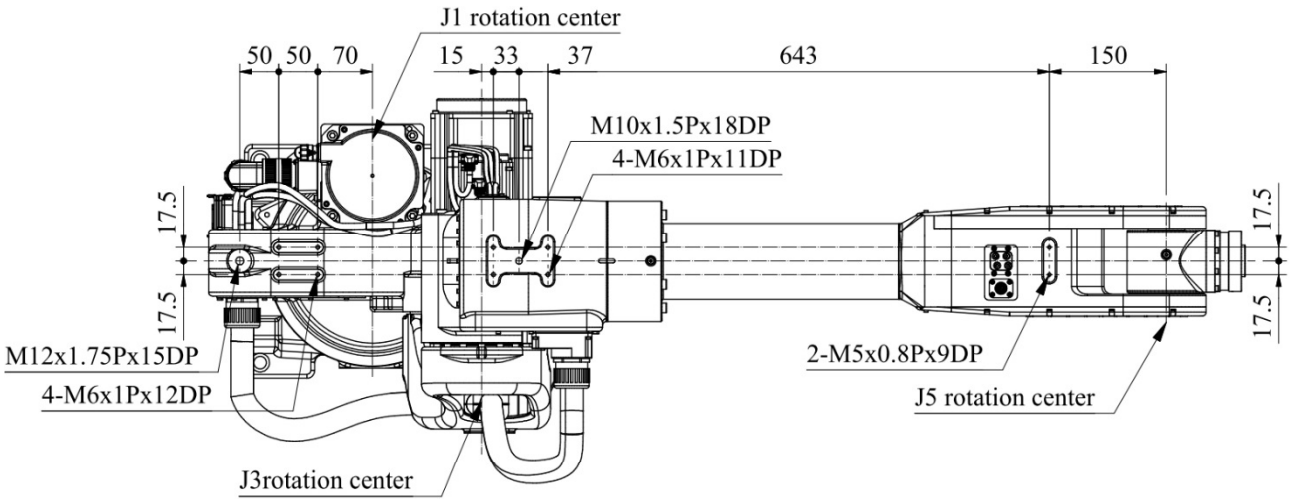


Figure 3-2(d) RA610-1672-GA Mounting surfaces on the robot

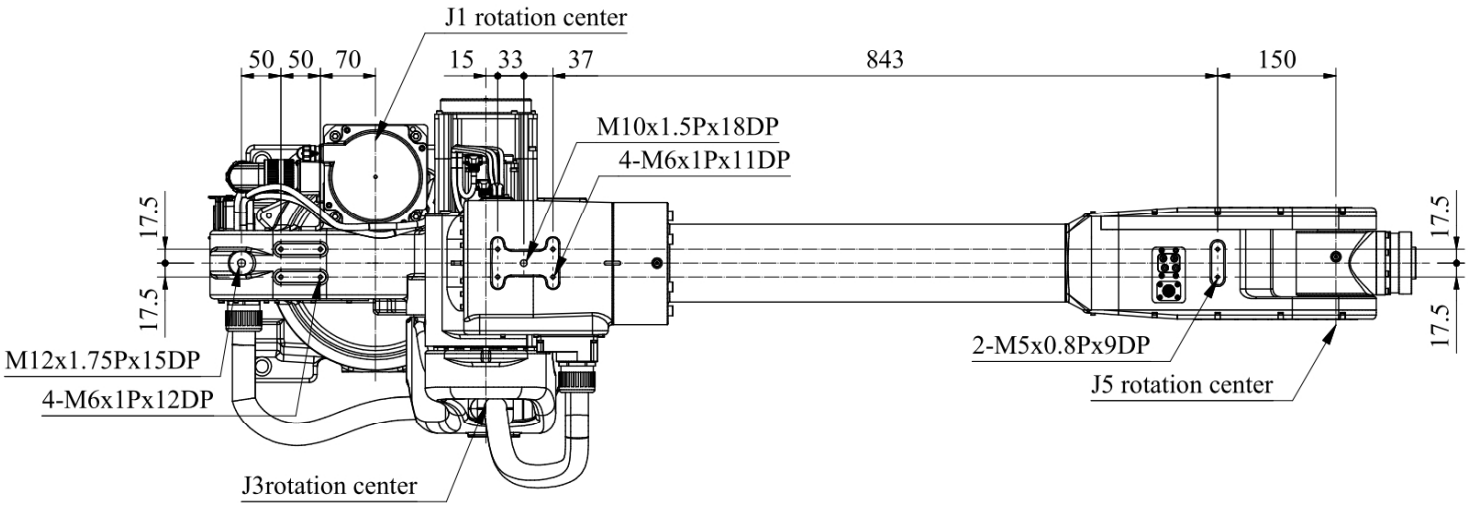


Figure 3-2(e) RA610-1869-GA Mounting surfaces on the robot

⚠ WARNING	❖ When other equipment is installed on the robot, be aware of the interference between robot and motor cable.

3.3 Interface of Air Supply

Air supply holes (AIR IN & AIR OUT) are installed on the rear of J1 as shown in Figure 3-3, and the outer diameter of the air tube in the robot is ϕ4mm. The robot has two 5/2-way solenoid valves for end effector on J5, and the schematic diagram of pressure circuit is shown in Figure 3-4.

Type	MVSY-100M-4E2
Operating pressure range	2~7kgf/cm^2(0.2~0.7MPa)
Proof pressure	10kgf/cm^2(1MPa)
Effective cross-sectional area	4mm^2
Response time	12ms

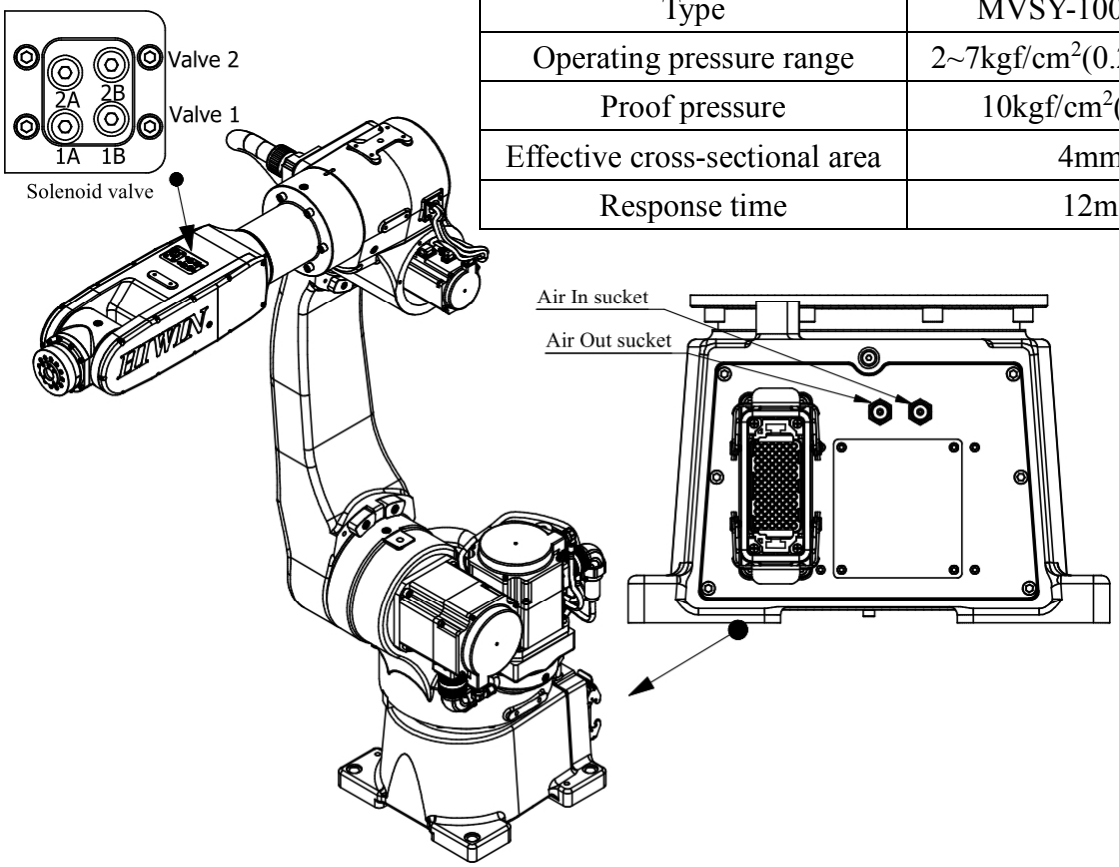


Figure 3-3 The interface for air supply

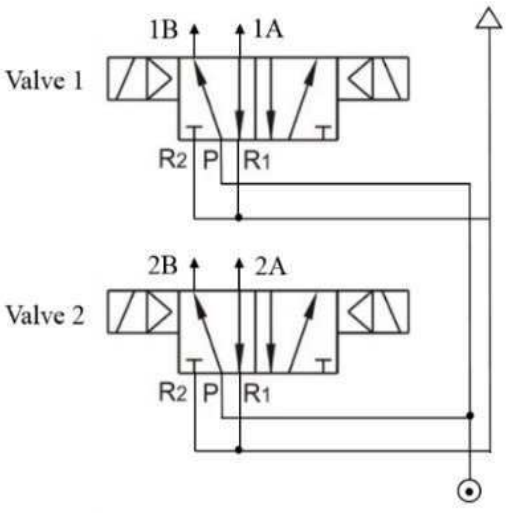


Figure 3-4 Pneumatic diagram

3.4 I/O Interface

I/O interface for end effector is on J5 as shown in Figure 3-5, and the pin assignment of I/O connector is shown in Figure 3-6. Figure 3-7 to Figure 3-10 shows the wiring diagram of I/O interface.

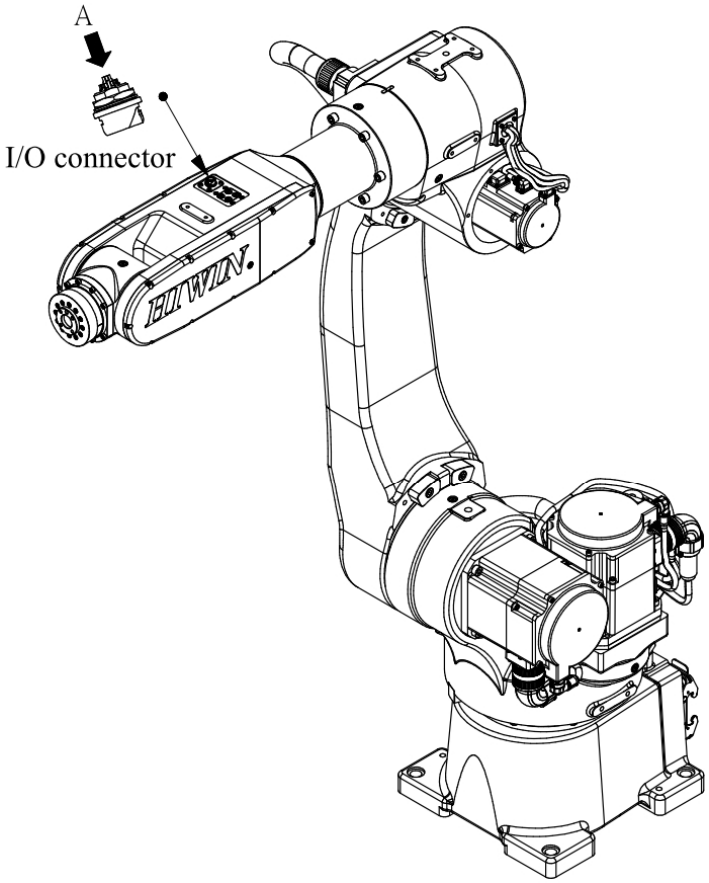
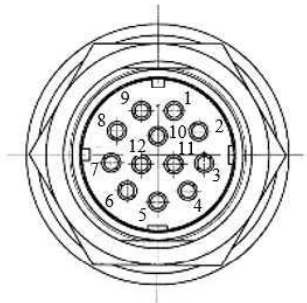


Figure 3-5 I/O interface for end effector



"A" side view
(Soldering side)

9			1
GND			24 V
	8	10	2
	I6	I5	I4
7	I2	I1	3
O4	O3	O2	O1
	6	5	4
	I3	I2	I1

Figure 3-6 Pin assignment of the I/O plug

(Power output: 24V/1A)

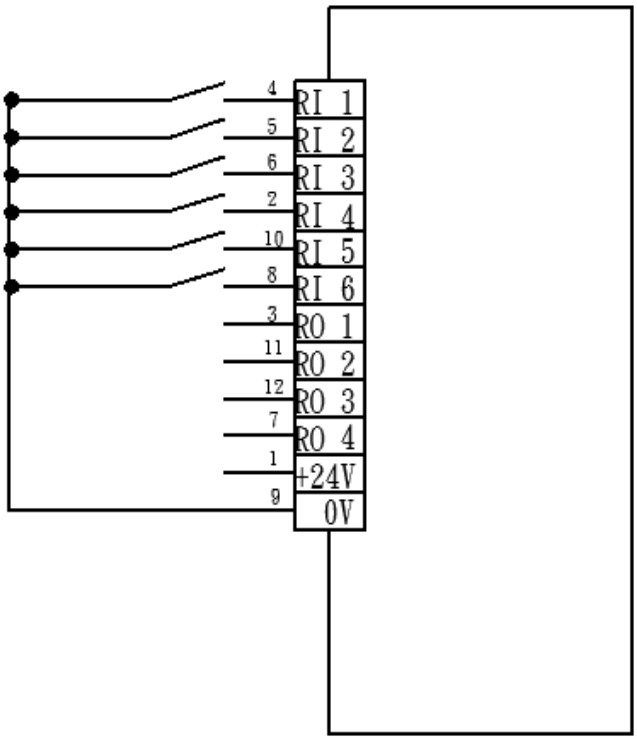


Figure 3-7 Wiring diagram of input (Standard: Sinking type)

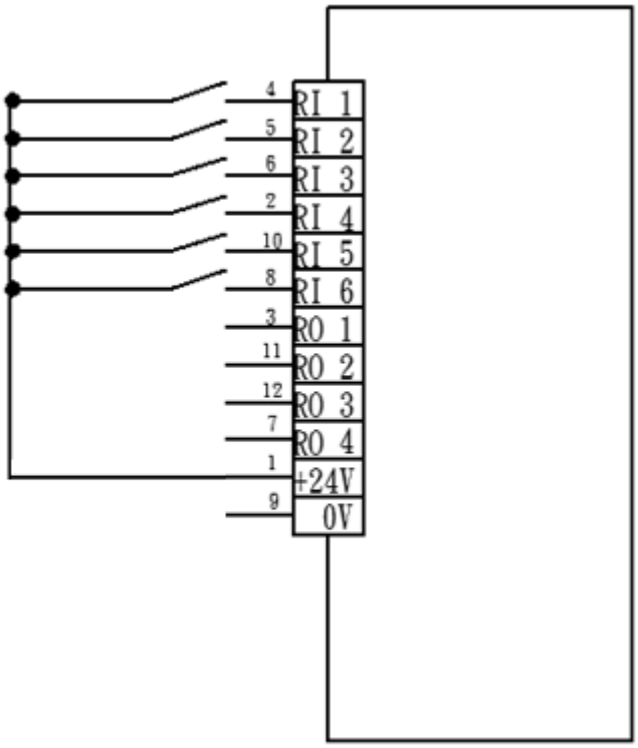


Figure 3-8 Wiring diagram of input (Optional: Sourcing type)

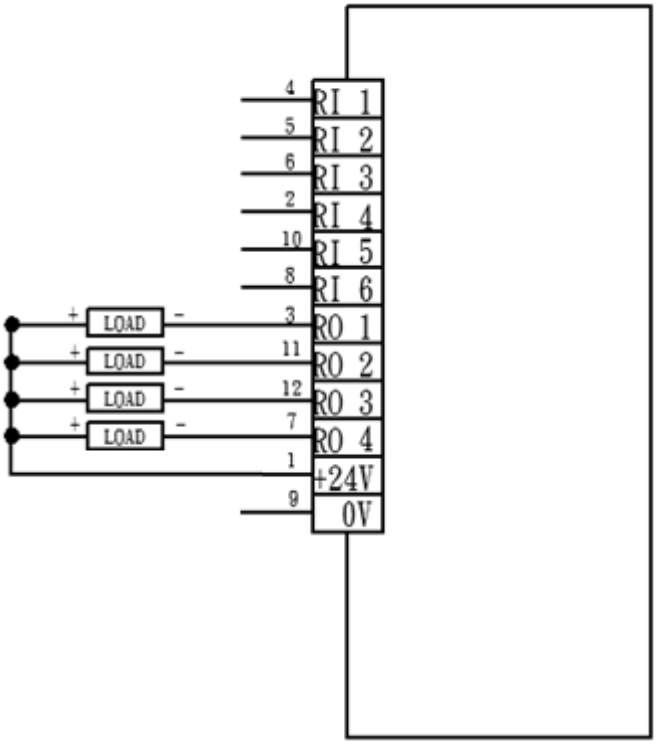


Figure 3-9 Wiring diagram of output (Standard: Sinking type)

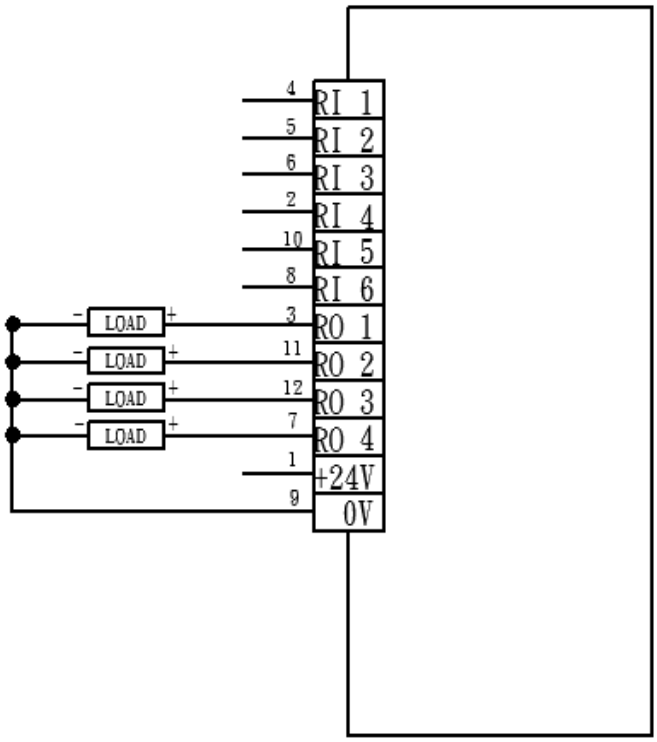


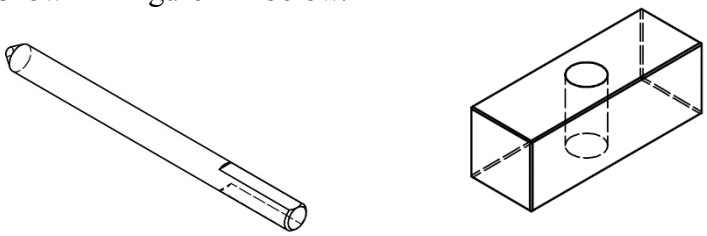
Figure 3-10 Wiring diagram of output (Optional: Sourcing type)

⚠ CAUTION	❖ 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 4-1 below.



The calibration tool for (A) The calibration tool for (B)

Figure 4-1 The calibration tool set

- J1-axis Zero-position position setting

  Step1 Operate J1 at low speed to align the pinhole of J2 with the pinhole of J1.
  Step2 Insert the calibration tool(A) to the pinhole to calibrate Zero-position.
  Step3 Finish calibration and remove the calibration tool.
  Step4 Clear encoder by HRSS. (Refer to page 46)
  Step5 Zero-position setting of J1 axis is completed.

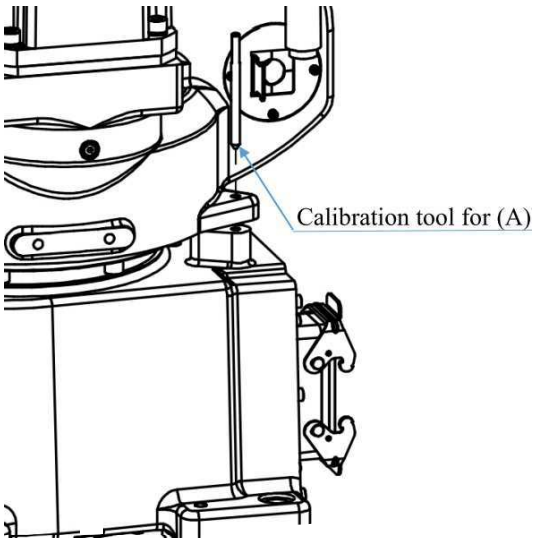


Figure 4-2 Illustration of J1-axis Zero-position setting

- 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(A) to the pinhole to calibrate Zero-position.

  Step3 Finish calibration and remove the calibration tool.

  Step4 Clear encoder by HRSS. (Refer to page 46)

  Step5 Zero-position setting of J2-axis is completed.

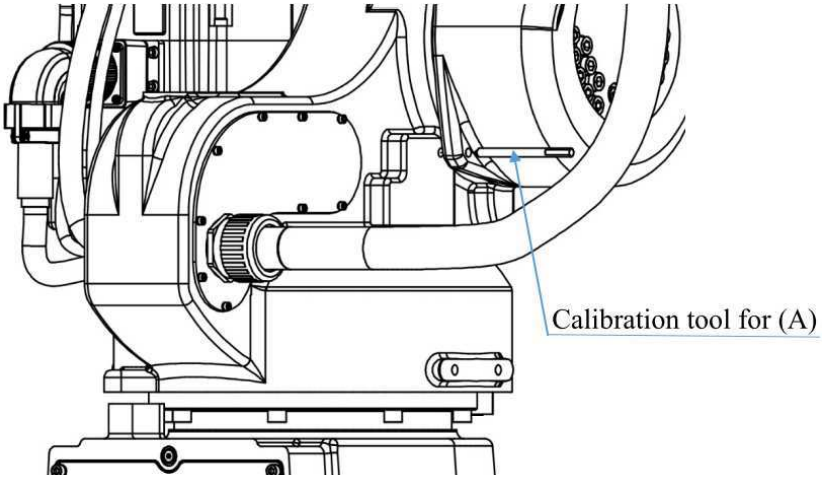


Figure 4-3 Illustration of J2-axis Zero-position setting

- 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(A) to the pinhole to calibrate Zero-position.

  Step3 Finish calibration and remove the calibration tool.

  Step4 Clear encoder by HRSS. (Refer to page 46)

  Step5 Zero-position setting of J3-axis is completed.

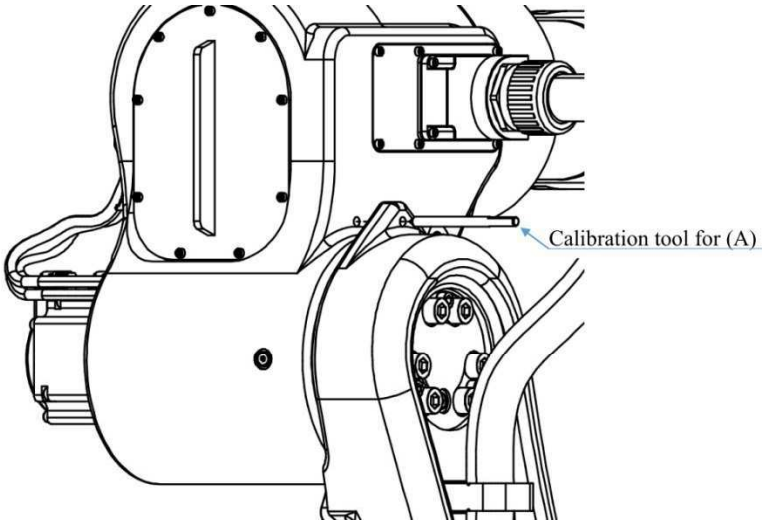


Figure 4-4 Illustration of J3-axis Zero-position setting

- 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(B) to the pinhole to calibrate Zero-position.

  Step3 Finish the calibration and remove the calibration tool.

  Step4 Clear encoder by HRSS. (Refer to page 46)

  Step5 Zero-position setting of J4-axis is completed.

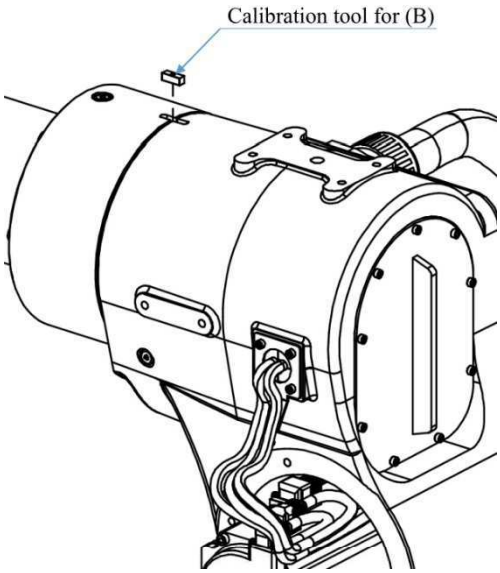


Figure 4-5 Illustration of J4-axis Zero-position setting

- 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(A) to the pinhole to calibrate Zero-position.

  Step3 Finish the calibration and remove the calibration tool.

  Step4 Clear encoder by HRSS. (Refer to page 46)

  Step5 Zero-position setting of J5-axis is completed.

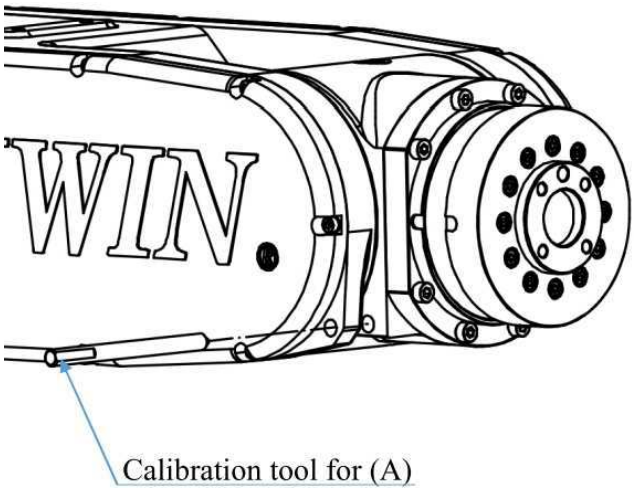


Figure 4-6 Illustration of J5-axis Zero-position setting

- J6 -axis Zero-position setting

  Step1 Operate J6 at low speed to align the calibration mark with the keyway.

  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 46)

  Step5 Zero-position setting of J6-axis is completed.

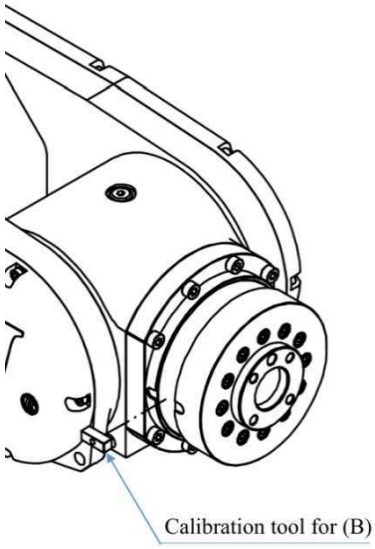


Figure 4-7 Illustration of J6 -axis Zero-position setting

⊙ 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)

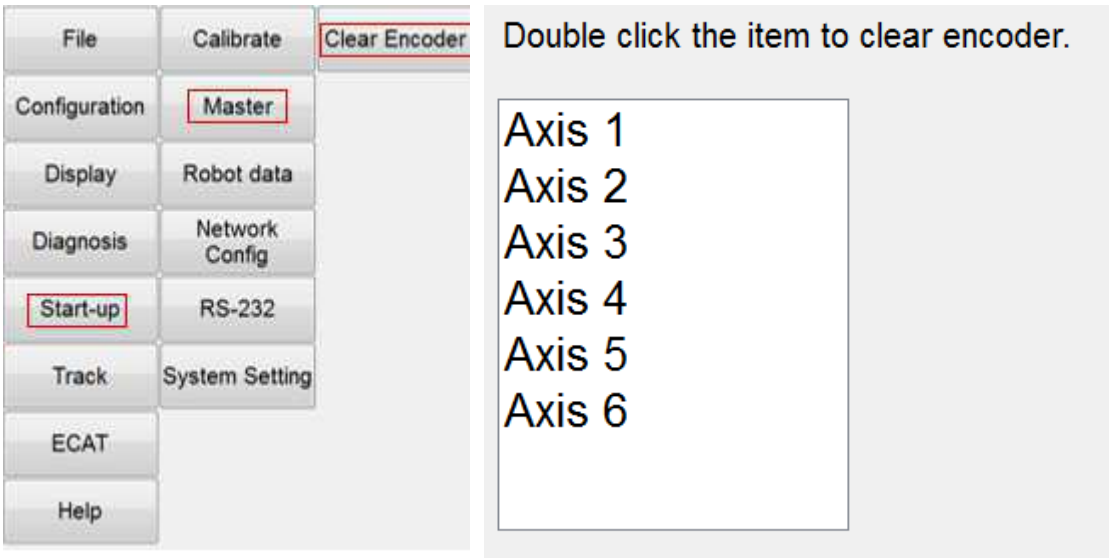


Figure 4-8 Clear encoder by HRSS

5. Maintenance and Check

This chapter 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.	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.

		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.	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.

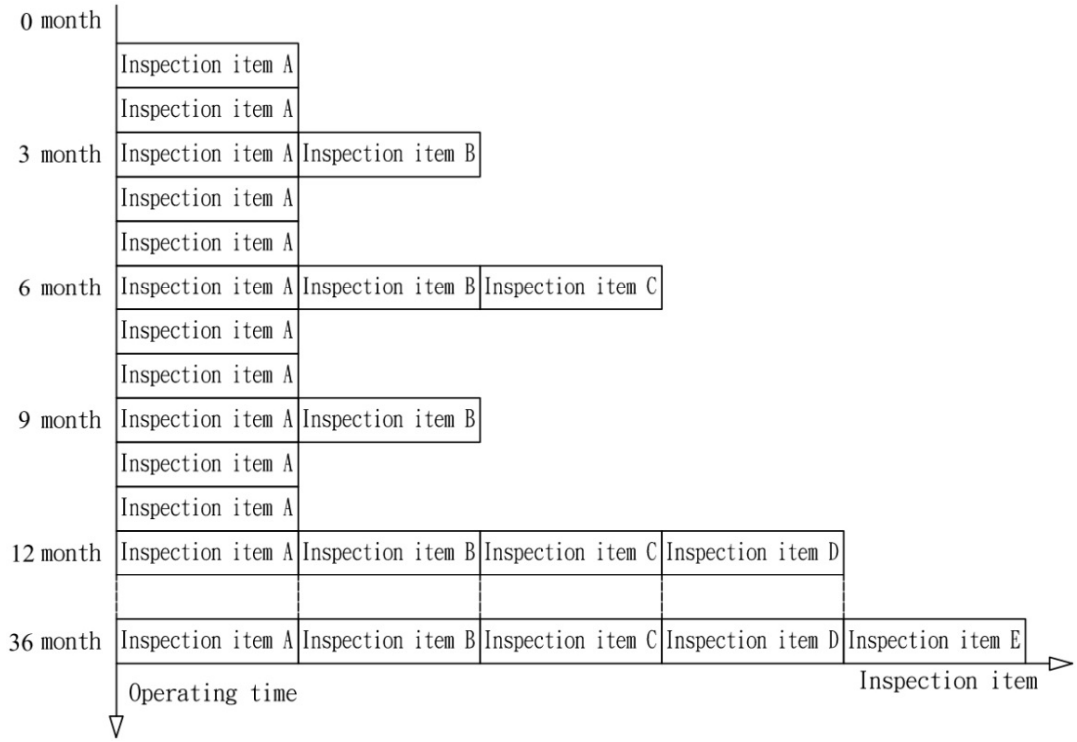
Table 5-2 Periodic inspection items

	Inspection item	Remedy
Inspection item A (1 month / 320 hours)		
1	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 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	❖ 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.

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 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 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 on the rear of J1. 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. If so, please resetting the robot to the Zero-position.

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

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

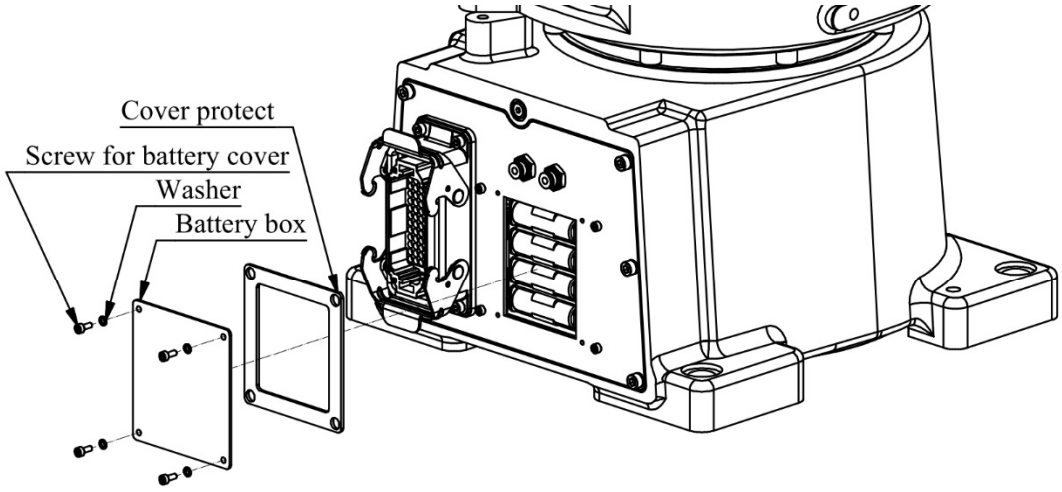


Figure 5-1 The backup batteries replacement

5.2.2 Timing Belt Replacement (Please contact HIWIN)

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	❖ When replacing the belt, the robot system origin may deviate. In this case, the position data must be rechecked if the origin is offset.

⊙ 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.

⚠ 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.

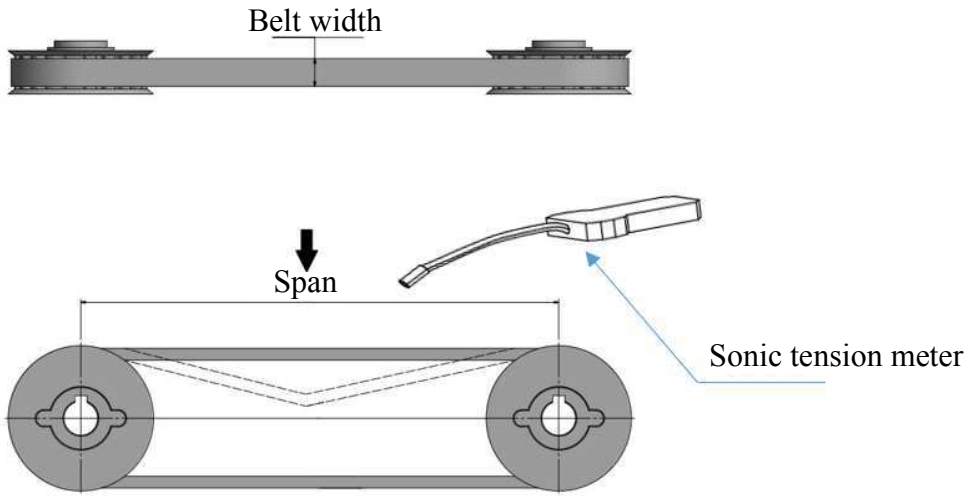


Figure 5-2 Measure belt tension

Table 5-4 The belt specifications

Axis	Belt type	Width (mm)	Span (mm)	Tension (N)
5	396-3GT-6	6	152.5	29±5
6	396-3GT-6	6	152.5	29±5

⊙ Removing the cover

Before replacing the belt, remove the cover of J5 and J6. The M3x0.5Px15L screws are used, as shown in Figure 5-3.

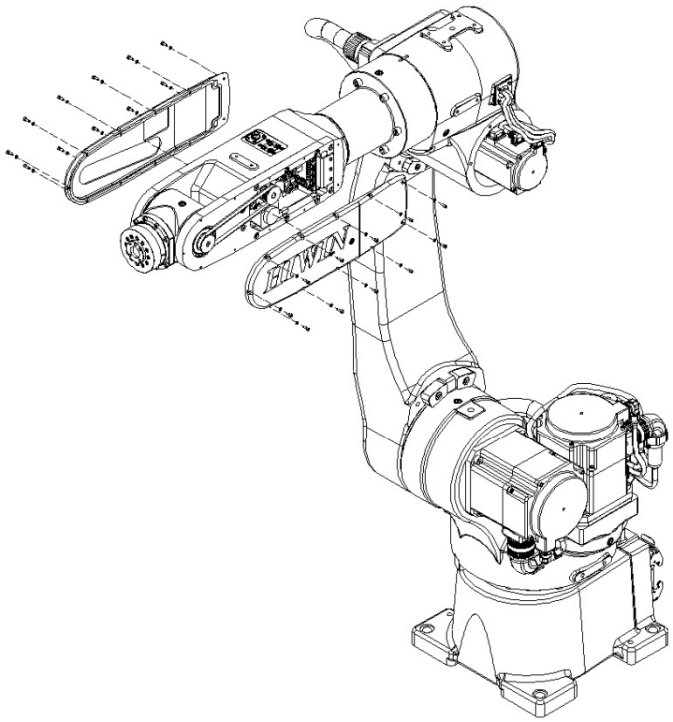


Figure 5-3 Removing the cover

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

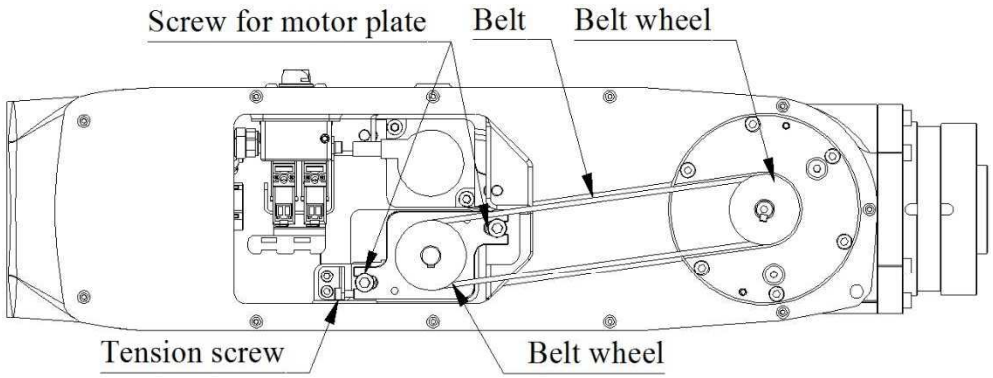


Figure 5-4 J5 -axis structure diagram

- 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 plate, so that the motor can be moved.

  Step2 Refer to Table 5-4, loose or tighten the adjusting screw to adjust the tension of the belt.

  Step3 Tighten the two fixing screws on motor plate. (Screws Pounds 4.7N*m)

- 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 J6 -axis timing belt

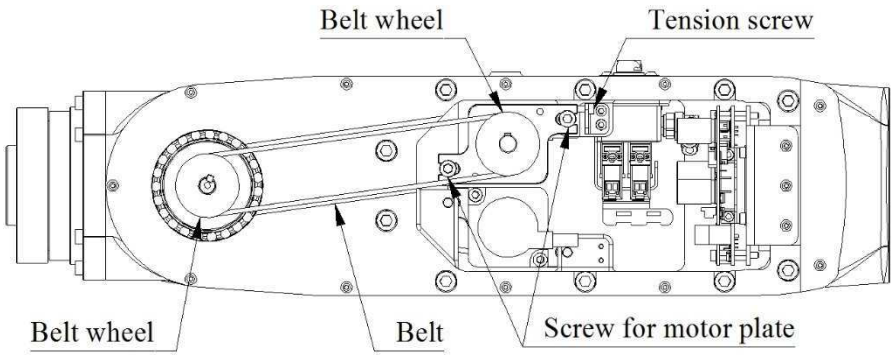


Figure 5-5 J6 -axis structure diagram

- Inspect J6 -axis timing belt

  Step1 Ensure the power of controller is switched off.

  Step2 Remove the cover of J6.

  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 plate, so that the motor can be moved.

  Step2 Refer to Table 5-4, loose or tighten the adjusting screw to adjust the tension of the Belt..

  Step3 Tighten the two fixing screws on motor plate. (Screws Pounds 4.7N*m)

- 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 (Please contact HIWIN)

⊙ The grease inlets and the air vents are shown in Figure 5-6.

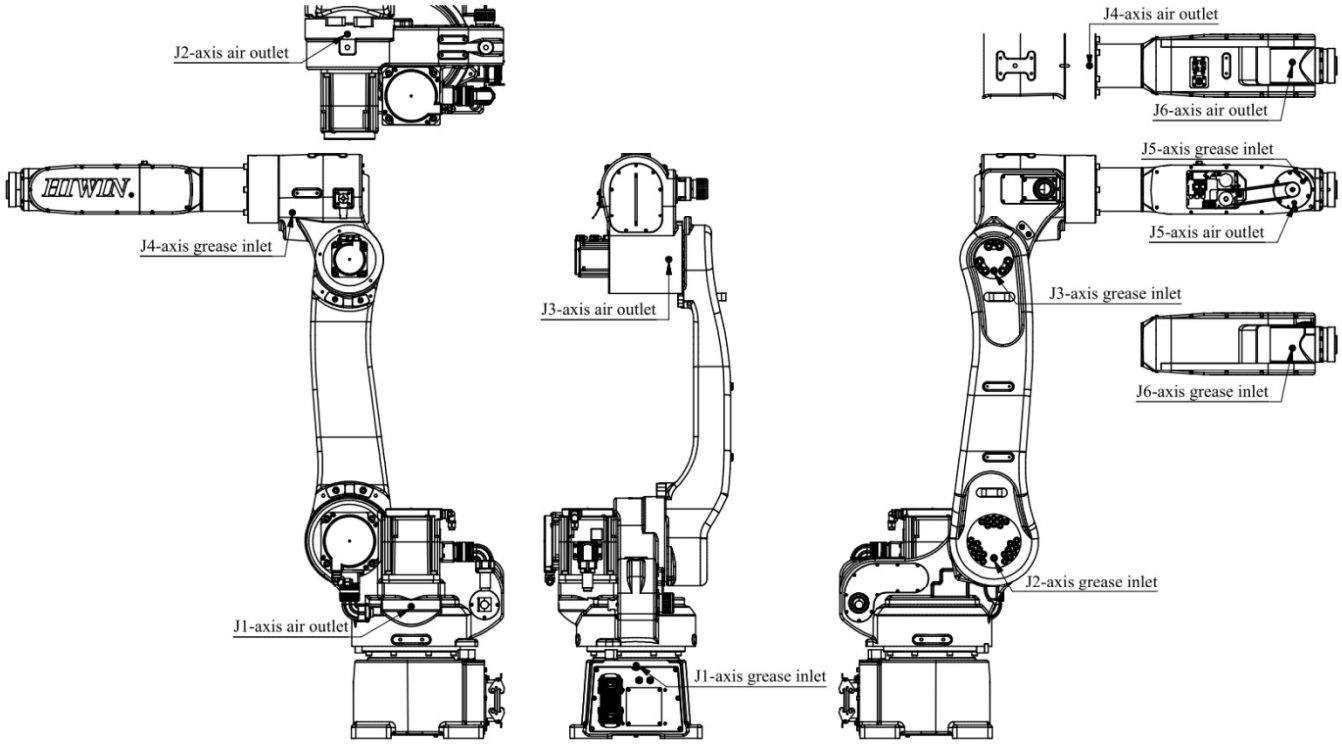


Figure 5-6 Lubrication and air inlet/outlet positions

⊙ Grease specification

Table 5-5 Grease specification

Part name	Grease nipple	Lubrication grease	Quantity	Lubrication interval
J1 reduction gear	M6	VIGOGREASE REO	700 ml	3Year/ 11520Hr
J2 reduction gear	M6	VIGOGREASE REO	468 ml	
J3 reduction gear	M6	VIGOGREASE REO	241 ml	
J4 reduction gear	M6	SK-1A	131 ml	
J5 reduction gear	M6	SK-1A	18 ml	
J6 reduction gear	M6	SK-1A	149 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 replacement.

⊙ Procedure of grease replenishment

Step1 The grease inlets and the air vents of the robot are shown in Figure 5-7.

Step2 Remove the screw of the grease inlet, and install the grease nipple.

Step3 Remove the screw of the air vent.

Step4 Replenish the grease from the grease inlet by the grease gun.

Step5 Grease Replenishment is completed as the grease coming out from the air vent is yellow.

Step6 Install the screw of the air vent.

Step7 Remove the grease nipple, and install the screw of the grease inlet.

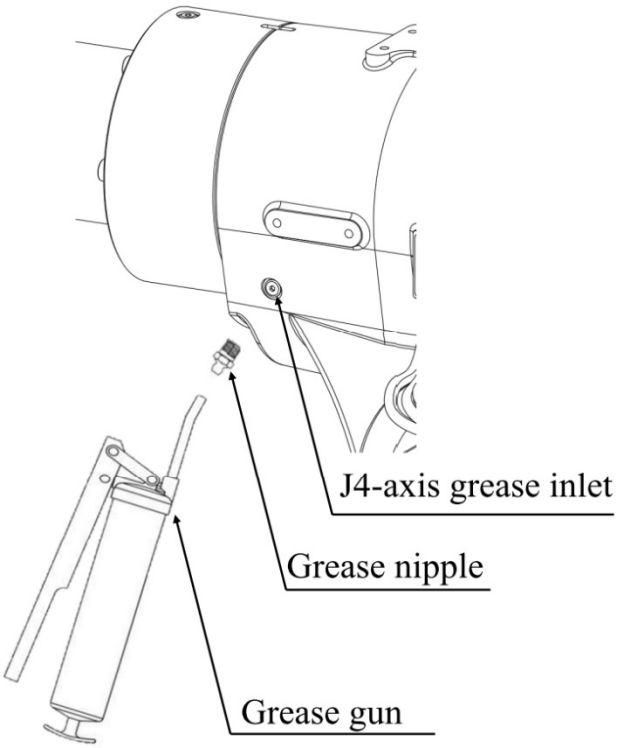


Figure 5-7 Grease replenishment

Articulated Robot-RA610 User Manual

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