Product Manual

Mechanical Manual for GBT-S3A Series Robots

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V1.2

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Safety instructions

It is necessary to read and understand the contents described in this chapter before using robots.

In this Manual, the robot system refers to an integrated system integrating the industrial robot and its controller, teach pendant, cables, software and other accessories. So, it is required to fully consider the safety precautions of the user and the system.

Nobody is allowed to modify the industrial robot without authorization from Shanghai Agilebot Robotics Co., Ltd. Shanghai Agilebot Robotics Co., Ltd. shall assume no responsibility for any damage to the industrial robot or its components due to the use of any other components (software, tools, etc.) not provided by Agilebot.

Shanghai Agilebot Robotics Co., Ltd. Assumes no responsibility for any consequences caused by misuse of the industrial robot. The misuse includes:

➢ Use the robot beyond the specified parameter range
➢ Use it as a carrier for humans or animals
➢ Use it as a climbing tool
➢ Use it in explosive environments
➢ Use it without safety protection

Besides safety precautions in this chapter, this Manual contains other safety instructions, which must be followed as well.

Definition of user

The operators are defined as follows:

- ➢ Operator
  - Perform power-on/off operation on the robot.
  - Start the robot program from the panel board.
- ➢ Debugging Engineer
  - Operate the robot.
  - Perform teaching and programming debugging of the robot within the safety fence.
- ➢ Maintenance Engineer
  - Operate the robot.
  - Perform teaching of the robot within the safety fence.
  - Carry out maintenance (repair, adjustment, replacement) operations on the robot.

The “Operator” is not allowed to enter the safety fence.

The "Debugging Engineer" and "Maintenance Engineer" can carry out operations within the safety fence.

The operations within the safety fence include handling, setting, teaching, adjustment, maintenance, etc.

To carry out the operations within the safety fence, it is necessary to receive professional training on the robot.
When operating, programming and maintaining the robot, the operator, programmer and maintenance engineer must give a safety warning and wear at least the following protective articles.

- ➢ Work clothes suitable for operations
- ➢ Safety shoes
- ➢ Safety helmets

Definition of safety records

This Manual includes safety warnings to ensure personal safety of the users and avoid any damage to the machine tool and describes them with "Danger" and "Warning" in the main text based on their importance in safety.
In addition, relevant supplementary explanations are described as "Caution".
Before use, the user must thoroughly read the precautions described in "Danger", "Warning" and "Caution".

Identification	Definition
	It indicates dangerous situations possibly resulting in serious injury or death to the user during incorrect operation.
	It indicates dangerous situations possibly resulting in mild or moderate personal injury or property damage during incorrect operation.
	It provides supplementary explanations outside the scope of danger or warning.

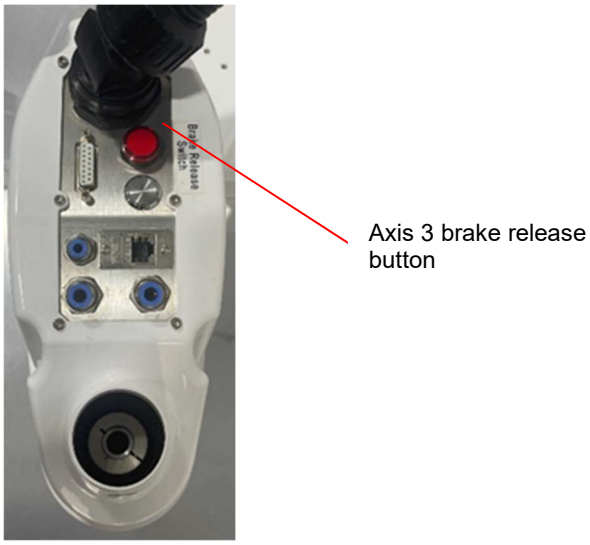
Please read this Manual carefully and keep it secure for easy reference at any time.

Steps for robot axis operation in emergency and abnormal situations

In emergency and abnormal situations where a person is trapped or surrounded by the robot, it is required to immediately cut off the power supply to the robot controller, directly move the robot arm and change its posture to help the operator get out of danger. When the robot controller is powered on, press the Axis 3 brake release button as shown in the figure to release the brake. If the Axis 3 brake cannot be released while the robot controller is powered on, open the outer cover and loosen the mounting bolts of the Axis 3 unit to release the belt from the belt drive.

Warning

If the belt is directly disengaged, the Axis 3 may fall, possibly causing injury. Please take appropriate measures before releasing belt engagement, e.g. supporting the Axis 3 with a block.



Caution

Please contact our technician to know about the recovery of belt tensioning.

Safety warning label

Both the robot and the controller bear several safety and information labels, which contain important information related to the product. This information is very useful for all persons operating the robot system, e.g. during mounting, maintenance or operation.
The safety labels are only graphical and applicable to all languages.

Caution

It is required to observe the safety and health signs on the product label. In addition, it is also necessary to comply with the supplementary safety information provided by the system builder or integrator.

Sign	Description
	An electric shock may occur if the internally energized parts of the controller are touched when powered on.
	Operation against the instructions may result in an accident of injury and/or product damage. This is a warning message applicable to certain functional requirements.
	Grounding sign of controller
	

Sign	Description
	Keep your hand away from moving parts, otherwise your hand or fingers may get stuck between the axis and the cover. The robots equipped with telescopic covers do not pose the risk of pinching hands or fingers. Therefore, they do not have this label.
	Never enter the work area while the robot is moving. Otherwise, the robot may collide with the operator. This is very dangerous and may cause serious safety issues.
	Beware of burns due to high temperature.
	Handling and hoisting
	Beware of collision in the work area.

1 Handling and mounting

1.1 Handling

During transportation and handling, ensure that the robot is fixed securely and kept at the transportation posture. Before the robot is lifted and transported, it is required to confirm that the screws and locating pins fixing the robot have been removed. The robot can be handled for a short distance by two adults or transported for a long distance by a forklift. The weights of GBT-S3A series robots (excluding cables) are shown in the table below:

Robot model	Weight
GBT-S3A-400	12kg

Table 1.1

Properly choose the pickup points when manually handling the robot. Unsuitable pickup points may easily result in finger pinching or other injuries as well as damage to the robot.

When a forklift is used, the robot must be securely fixed on the forklift and must not shake or move relative to the forklift during transportation.

The transport posture of GBT-S3A robot is shown in Fig. 1.1:

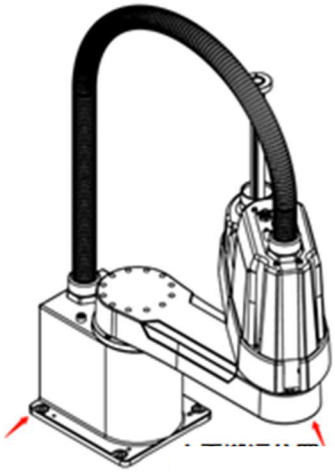


Fig. 1.1 Transport Posture of GBT-S3A Robot

Axis No.	**1**	**2**	**3**	**4**
Angle/stroke	0°	150°	0mm	0°

Table 1.2 Axis Data at Transport Posture of GBT-S3A Robot

1.2 Mounting

Parts required for mounting the robot:

S/N	Name	Number (PCS)
1	Hexagon socket screw M8*20 (GB/T 70.1-2008**[NOTE 1]**)	4
2	Spring washer M8	4
3	Flat washer M8 (GB/T 97.1-2002**[NOTE 2]**)	4
4	Cylindrical pin φ6	2

[NOTE]
1. GB/T 70.1-2008 Correspondence standard: ISO 4762:1997 Hexagon socket head cap screws
2. GB/T 97.1-2002 Correspondence standard: ISO 7089:2000 lain washers – Normal series - product grade A

The mounting dimensions are shown in Fig. 1.2:

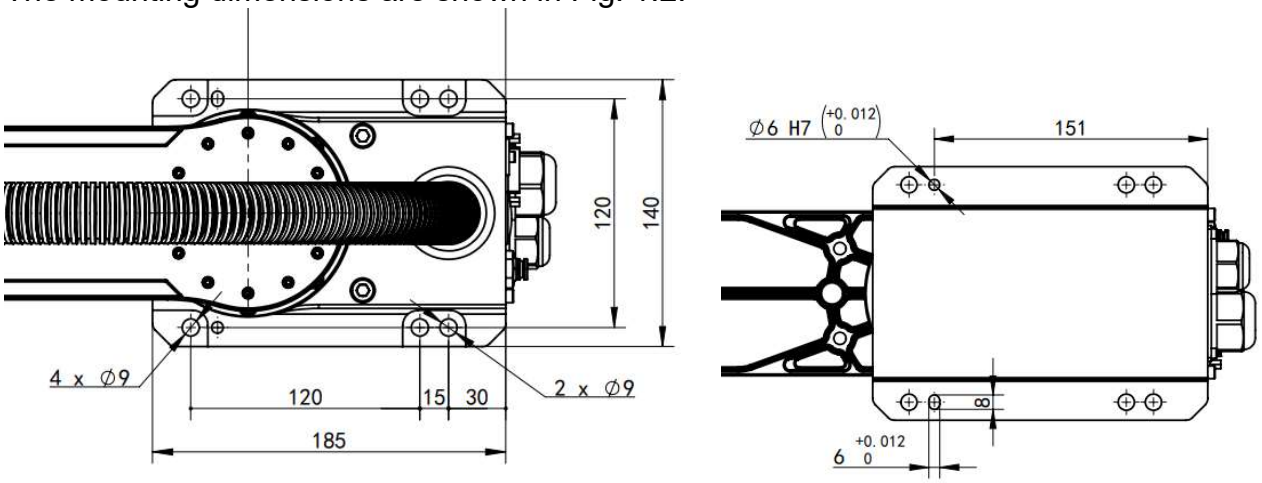


Fig. 1.2 Mounting Dimensions of GBT-S3A Robot

Caution

The dimensional units for all measurements of the drawings in this section are in millimeters (mm).

Mounting requirements:

Mounting base required	Maximum surface roughness	0.5mm
	Maximum tilt angle	0.5°
	Minimum resonance frequency	30Hz
Storage conditions	Minimum environmental temperature	-20℃
	Maximum environmental temperature	50℃
	Maximum humidity	90% RH (non-condensation)
Operating conditions	Minimum temperature	5℃
	Maximum temperature	40℃
	Maximum humidity	80% RH (non-condensation)
Environmental conditions	Indoors; avoid direct sunlight, dust, salt, metal powder or other pollutants; stay away from water, flammable or other highly corrosive liquids and gases; avoid shock and vibration.	

Those designing or manufacturing the robot system with this product must read this Manual to understand basic precautions before work. Otherwise, it is very dangerous and may result in serious injury or significant damage.
Please use the robot system under the environmental conditions recorded in the Manual. This product is designed and manufactured firstly for the purpose of typical indoor environments.
Operation in an environment unsatisfying the environmental conditions may not only shorten the service life, but also cause serious safety issues
Please use the robot system within the specified specifications. Operation beyond the specifications may not only shorten the service life, but also cause serious safety issues.
When mountingthe robot system, you must wear at least the following protective devices.
-Work clothes suitable for operations
-Safety helmets
-Protective shoes
Be sure to install an emergency stop device so that the operator can immediately stop the system. Otherwise, it is very dangerous and may cause serious injury or significant damage to the robot system. Ensure that the emergency stop switch of the teach pendant connected to the TP port can operate properly when safety doors and other emergency stop or safety input signals are connected to the emergency stop circuit connector.
Mountthe robot in a position with sufficient space and ensure that the surrounding area of the end fixture or the workpiece does not collide with walls or safety guards when the robot moves the workpiece and is extending. A collision (if any) may cause serious personal injury or significant equipment damage.
Fix the robot securely before power-on or operation. Otherwise, it is very dangerous - the robot may fall, resulting in serious injury or significant damage to the robotic arm system.
Before mountingand operation, please ensure that all components of the robot are in place and free from external defects. Missing or defective components may lead to improper operation of the robot. It is very dangerous and may cause serious injury or significant damage.
Never use the robot near the devices generating powerful electromagnetic forces. Otherwise, it may cause malfunction or defect of the robot.
Never use the robot in places subject to electromagnetic interference, electrostatic discharge or radio frequency interference risk. Otherwise, it may cause malfunction of the robot.
Never use the robot in places exposed to flammable gases, dust, gasoline or solvents that may explode or catch fire. Otherwise, it may cause serious accidents or fires involving injury (including death).
Never place your hands or fingers near the moving parts of the robot. Otherwise, it may cause hand pinching and other injuries.
Never mount the robot controller upside down or tilted.

Warning

For the power cable, make sure touse a power plug or disconnector. Never connect it directly to the power supply in the factory.
Never open the controller or robot cover except during maintenance. It is very dangerous when the controller cover is opened. Even if the main power is turned off, the internal high-voltage charging unit may cause electric shock as well.
Before connecting or disconnecting the cable, ensure that the power supply of the robot system is cut off. It is very dangerous to connect or disconnect the cable in the power-on state. It may lead to electric shock or controller failure.
Ensure that the plug should be plugged into the factory socket by a qualified operator.
The device must always be properly grounded to avoid electric shock.
Be sure to use a leakage circuit breaker for the power supply of the controller. Otherwise, it may cause electric shock or system malfunction.
Make sure to disconnect the power plug when opening the front cover of the controller. It is very dangerous to touch the power terminal inside the controller during power-on. It may cause electric shock or serious safety issues.
When mountingthe robot, please ground it through the controller cable. Make sure to install the controller and connect its cable. Improper grounding may lead to fire or electric shock hazards. Prevent the connector from being impacted or loaded during cabling. Never forcefully pull the cable during connection.
Please make sure to turn off the power of the controller and related equipment and pull up the warning sign (e.g. no power-on) before wiring. It is very dangerous for wiring in the power-on state. It may lead to electric shock or robot system malfunction.
When the brake release unit or external short-circuit connector is used: When connecting/replacing the brake release unit or external short-circuit connector, please turn off the power of the controller and the brake release unit.
Installation/removal of the connector in the power-on state may cause electric shock.
Do not touch the terminal. Otherwise, it may cause electric shock, product damage or malfunction.

Caution

The corresponding robot S/N is indicated on the controller label. Connect the controller and the robot correctly. In case of a mistake in the connection relationship, not only the robot system may not function properly, but also it may cause safety issues.
According to the rigidity of the mounting platform, vibration (resonance) may occur during operation. In case of vibration, increase the rigidity of the platform or change the speed or acceleration and deceleration settings.
Please confirm that the pins are not bent before the connector is connected. If the pins are bent during connection, it may damage the connector or cause the robot system to malfunction.

2 Connection to controller

2.1 Connection to controller

The connecting cables between the robot and the controller include power cables and signal cables. Please connect each cable to the connector on the back of the mounting base. Don't forget to ground the controller.

Warning

Before connecting the power of the controller, please connect the robot and the controllerwith a ground wire. Electric shock may occur if the ground wire is not connected.

Warning

The connection of cables must be performed after disconnecting the power.

Do not wind the excess part (over 10m) of the robot cable into a loop. Otherwise, it may cause a significant increase in cable temperature during certain robot actions, resulting in adverse effects on cable sleeve.

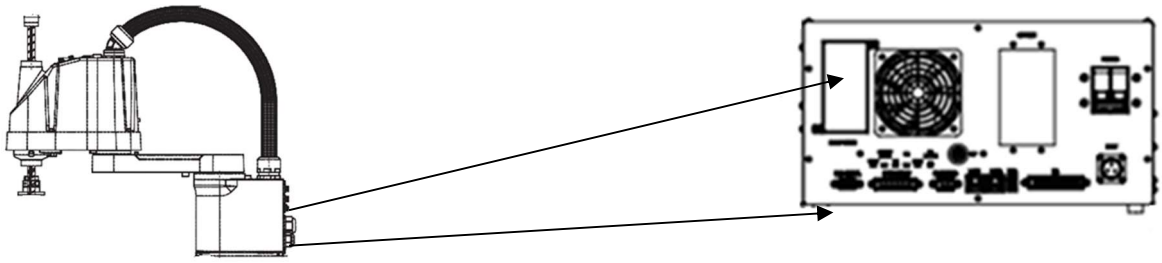


Fig. 2.1 Diagram for Connection between GBT-SA Robot and Controller

3 Basic specification

3.1 Composition of robot

The GBT-S3A series robot is composed of a base, a large arm, a small arm, a screw and a pipeline package. Totally, 4 servo motors can drive the movement of 4 joints to achieve different forms of motion. The following figure shows various motion joints and forward motion direction of the robot.

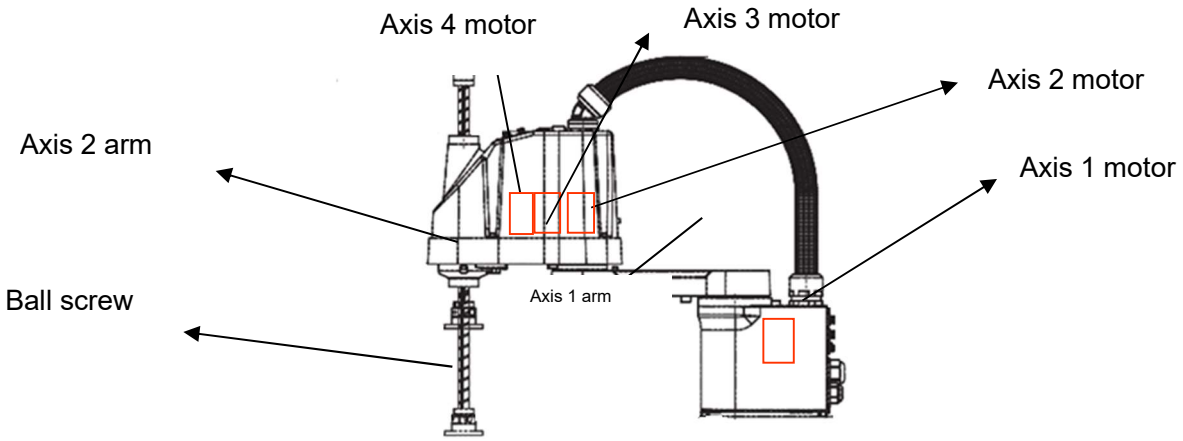


Fig. 3.1 Diagram for Motor Locations of GBT-S3A Robot

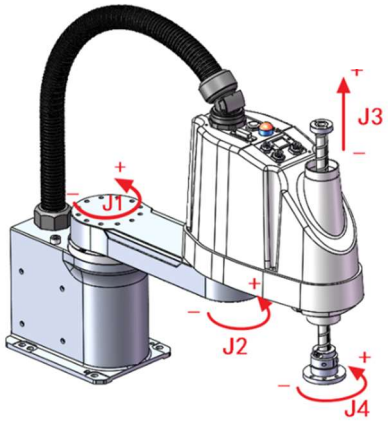


Fig. 3.2 Various Motion Joints and Forward Motion Direction of GBT-S3A

Caution

Do not move Axis 1 and 2while the ball screw splines are under stress. Otherwise, it may cause damage.

Model	GBT-S3A-400	
Axes		4
Maximum reach		400 mm
Payload	**Rated**	1kg
	Maximum	3kg
Axis 4 Moment of Inertia	**Rated**	0.005 kgm^2
	Maximum	0.05 kgm^2
Axis 3 Down Force		100 N
Mounting method		Countertop-mounted
Axis Motion Range	Axis 1	±132°
	Axis 2	±141°
	Axis 3	150 mm
	Axis 4	±360°
Axis Maximum Speed	Axis 1+2	6000mm/s
	Axis 3	1100 mm/s
	Axis 4	2350°/s
Position Repeatability*1	Axis 1+2	0.01 mm
	Axis 3	0.01 mm
	Axis 4	0.01°
Standard cycle time *2		0.41s

Table 3.1 Performance Parameter Table of GBT-S3A

1.Even when the robot is used within the specification range, certain action programs may shorten the lifespan of the reducer or cause overheating alarms.
2.Sometimes, it is impossible to reach maximum speed of each axisat a short action distance.
3. Please use the robot system and the controller under the environmental conditions recorded in the Manual. This product is designed and manufactured firstly for the purpose of typical indoor environments. Operation in an environment unsatisfying the environmental conditions may not only shorten the service life, but also cause serious safety issues.
4. Please consult our company for use in the environments with high/low temperature, vibration, dust, high concentration of cutting oil, etc.

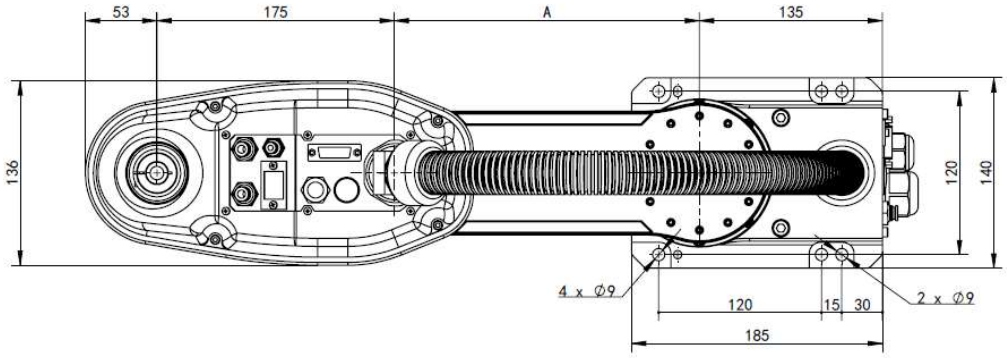
3.2 Diagram for overall dimensions and action range

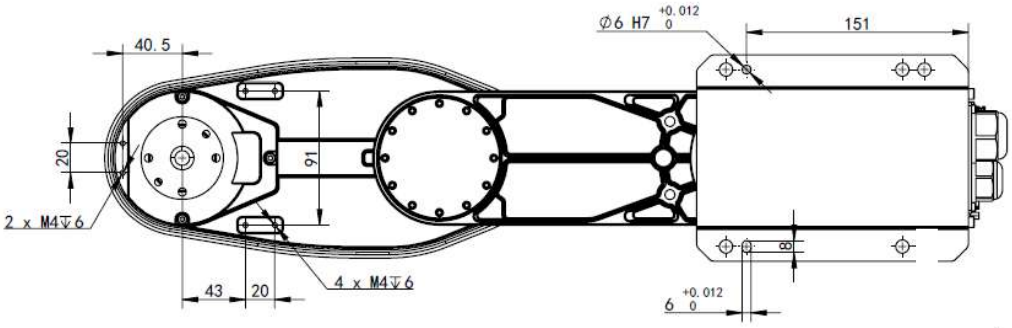
Caution

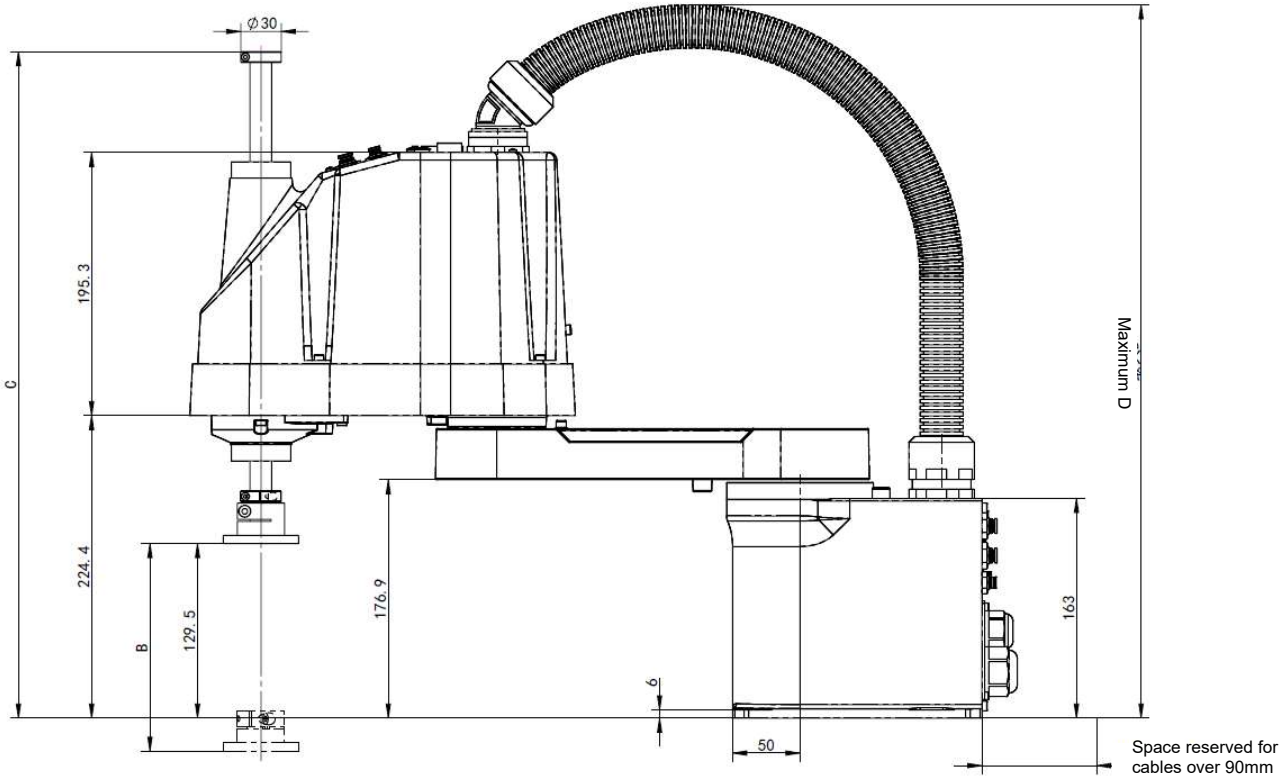
The workspace shown in this figure is the maximum space that can be theoretically reached. It may vary depending on the mounting method during actual operation. In practical application, please consider the impact of mounting method on the workspace.

Caution

The dimensional units for all measurements of the drawings in this section are in millimeters (mm).

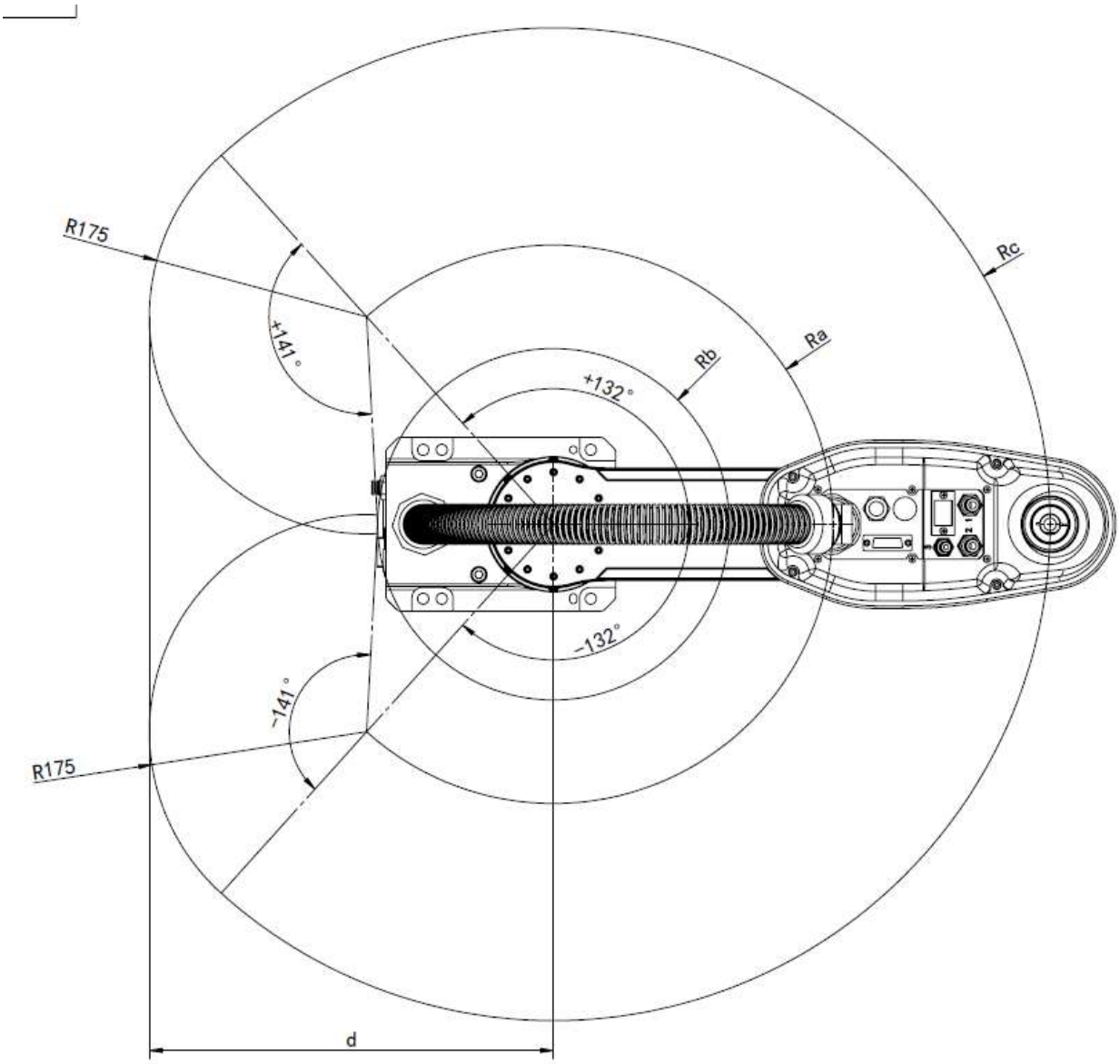






Model	A	B	C	D
GBT-S3A-400	225	150	494.5	540

Fig. 3.3 Overall Dimensions of GBT-S3A Series



Model	a	b	c	d
GBT-S3A-400	225	141.6	400	326

Fig. 3.4 Operating Reach of GBT-S3A Series

3.3 Origin position and range of motion (ROM)

An origin position and an ROM are provided on each control axis. It is called overtravel (OT) if the control axis reaches the limit of its ROM. Each axis undergoes overtravel detection at both ends of ROM. As long as the origin position is not lost due to abnormalities in the servo system and system errors, the robot's action may not exceed the ROM. In addition, to further ensure safety, ROM limits are also provided by the mechanical brake.

Fig. 3.5 shows the position of the hard limit. Do not modify the hard limit, etc. Otherwise, the robot may not stop normally. The hard limit is behind the first axis motor for Axis 1, behind the second axis motor for Axis 2 and above and below the screw for Axis 3, but Axis 4 has no hard limit.

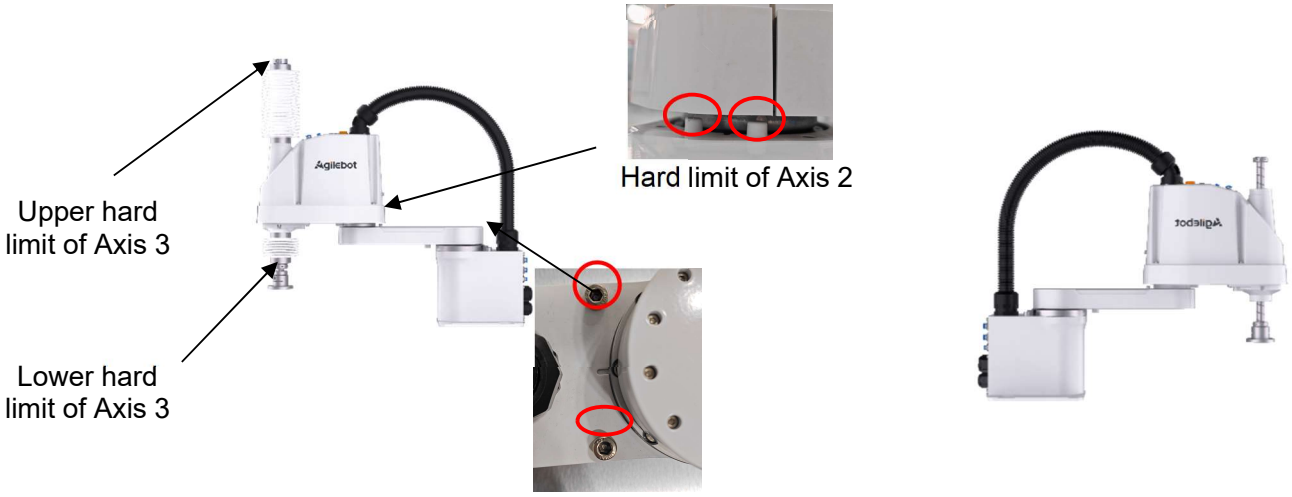


Fig. 3.5 Diagram for Hard Lim on the left and standard version on the right, with the same hard limits)

3.4 Wrist payload conditions

Before use, it is necessary to set the correct payload data for the robot. It is important to carefully confirm the mass and inertia of the payload before operation. Overload may lead to excessive operation of the motor, the reducer and relevant structures. It may also affect their service life, seriously damage the robot and even cause injury.

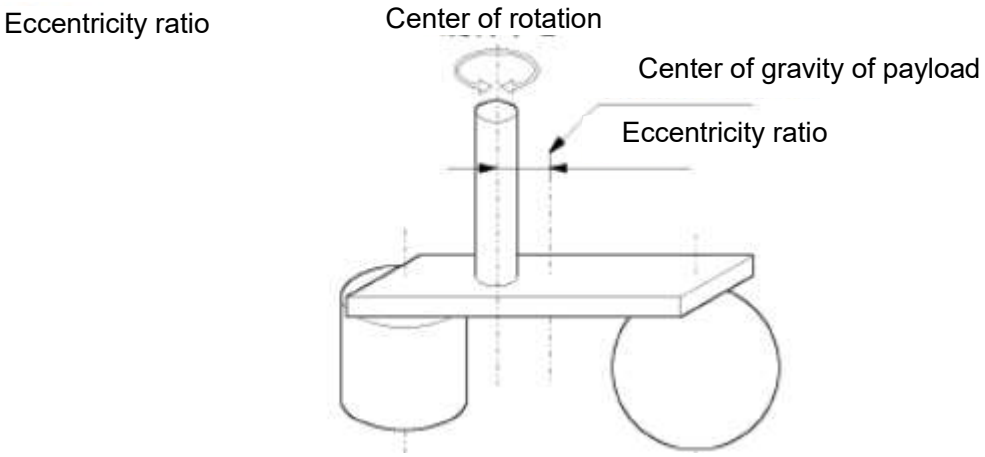


Fig. 3.6 Diagram for Payload Eccentricity

Product model	GBT-S3A-400
Maximum payload (kg)	3
Maximum payload inertia of Axis 4 (kg*m2)	0.05
Maximum XY payload offset (mm)	100
Rated XY payload offset (mm)	0

Table 3.1 Description of Payload and Other Relevant Parameters for the Robot

4 Mount the device onto the robot

4.1 Mount the end-effector to the front end of the wrist

The following figure shows the mounting surface of the end-effector at the front end of the wrist. Select the lengths of the bolts and positioning pins after sufficiently considering the depths of the screw hole and pin hole. In addition, please tighten the bolts for fixing the end-effector as per the tightening torque.

> ⚠ Caution
>
> When mounting the device onto the mounting surface of the end-effector, do not engage more than the length of the recess.

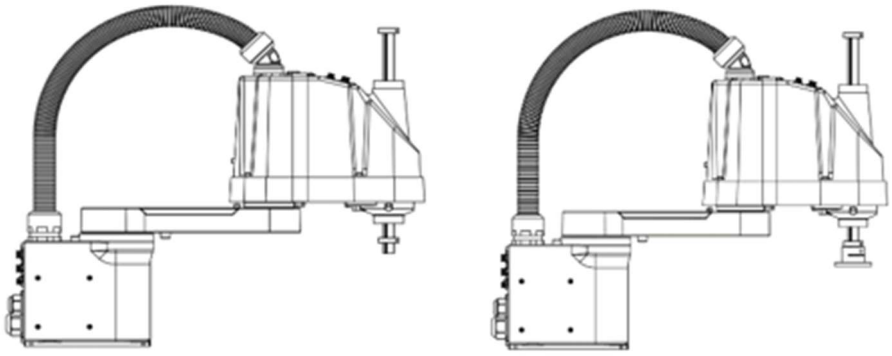


Fig. 4.1 Diagram for Mounting of End-effector

Parts required for mounting of end-effector

S/N	Name	Number (ea.)
1	Hexagon socket screw M5 (GB/T 70.1-2008[NOTE 1])	4
2	Spring washer M5	4
3	Flat washer M5 (GB/T 97.1-2002[NOTE 2])	4
4	Cylindrical pin φ5	2

[NOTE]

1. GB/T 70.1-2008 Correspondence standard: ISO 4762:1997 Hexagon socket head cap screws
2. GB/T 97.1-2002 Correspondence standard: ISO 7089:2000 Plain washers – Normal series - product grade A

4.2 Mounting surface

> **Caution**
>
> 1. Never increase machining holes or screw holes on the robot body, for it may cause adverse effects on the safety and functionality of the robot.
> 2. Please note that the use of screw holes other than those shown in the following figure is not warranted. In addition, do not fix other bolted mechanism to the robot.
> 3. When mounting the device onto the robot, it is warned to avoid interference with the cables inside the mechanism. The interference (if any) may cause cable break within the mechanism, which will lead to unexpected malfunctions.

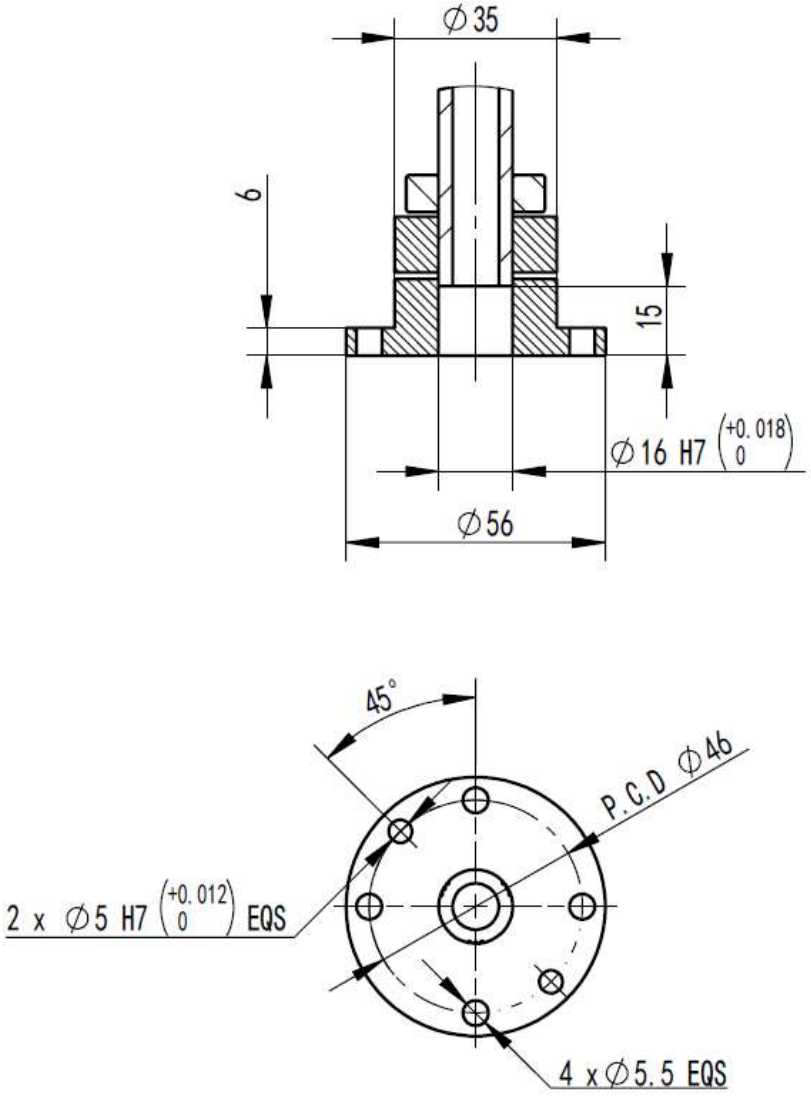


Fig. 4.2 End Flange Interface Dimensions of GBT-S3A Robot

4.3 About payload setting

Caution

Before operation, it is important to correctly set the payload for the robot. Do not operate under payloads inconsistent with the set payload or under overload conditions. The weight of the payloads, including cables connecting surrounding devices, cannot exceed the transportable weight of the robot. Otherwise, it may shorten the lifespan of the reducer.

Specific setting methods are as follows:
Click on the upper left corner of the screen to enter the menu screen, as shown in Fig. 4.3. Click on the System button as shown in Fig. 4.4. After all System functions pop out, click on Basic Setting as shown in Fig. 4.5. Then click on Payload Setting as shown in Fig. 4.6 to enter the Payload Setting screen. Create a new Payload, input and edit the parameters based on actual circumstances, and save it as shown in Fig. 4.7. The parameters must be activated first before they can be successfully saved.

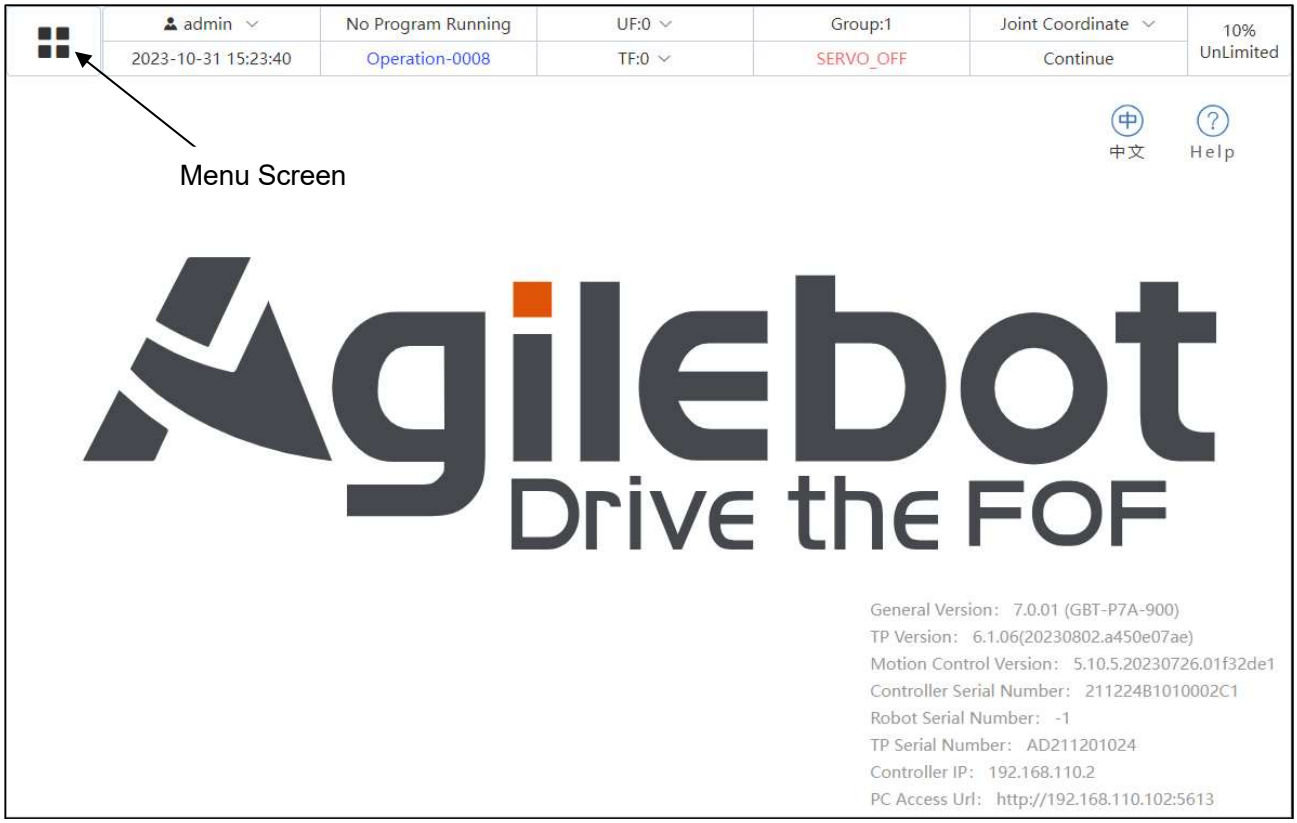


Fig. 4.3

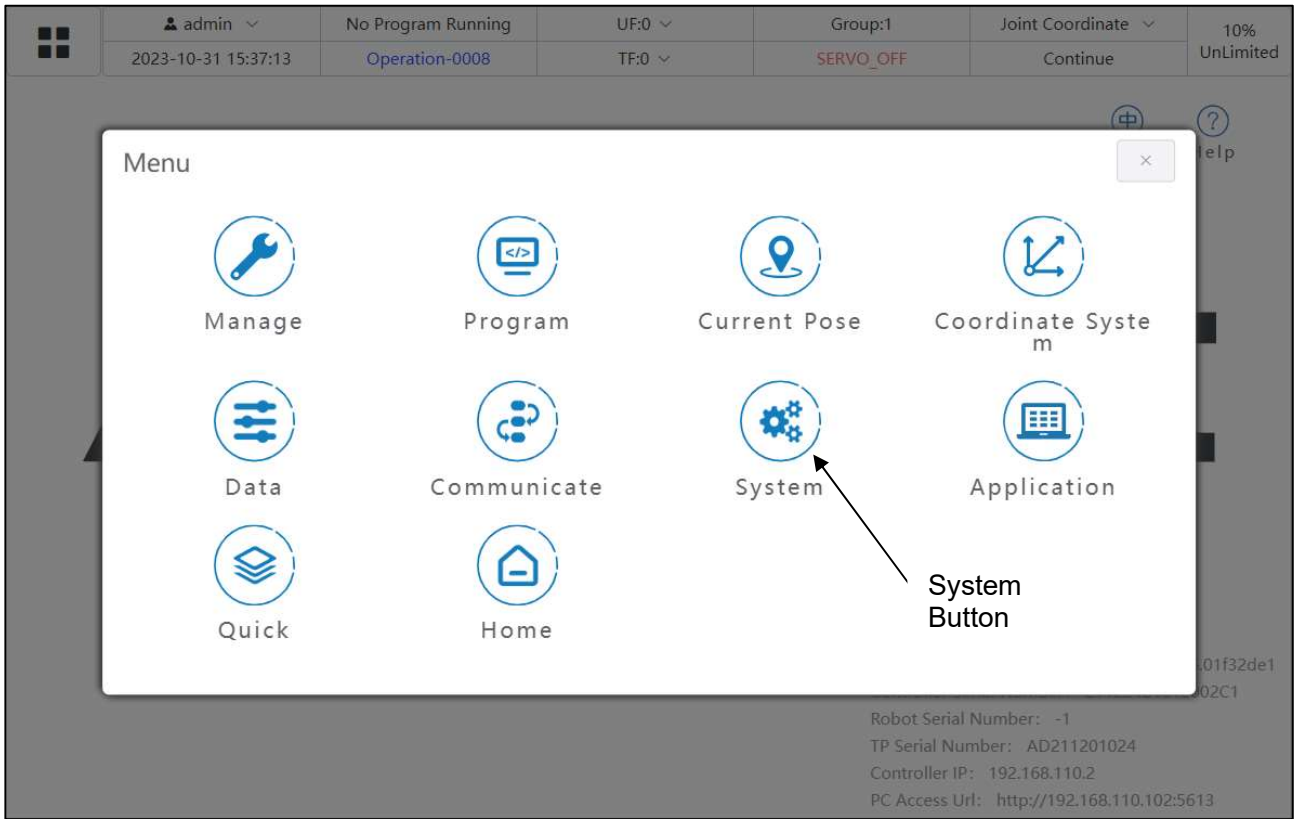

admin
No Program Running
UF:0
Group:1
Joint Coordinate
10%
UnLimited
2023-10-31 15:37:13
Operation-0008
TF:0
SERVO_OFF
Continue
Menu
Manage
Program
Current Pose
Coordinate System
Data
Communicate
System
Application
Quick
Home
System
Button
Robot Serial Number: -1
TP Serial Number: AD211201024
Controller IP: 192.168.110.2
PC Access Url: http://192.168.110.102:5613

Fig. 4.4

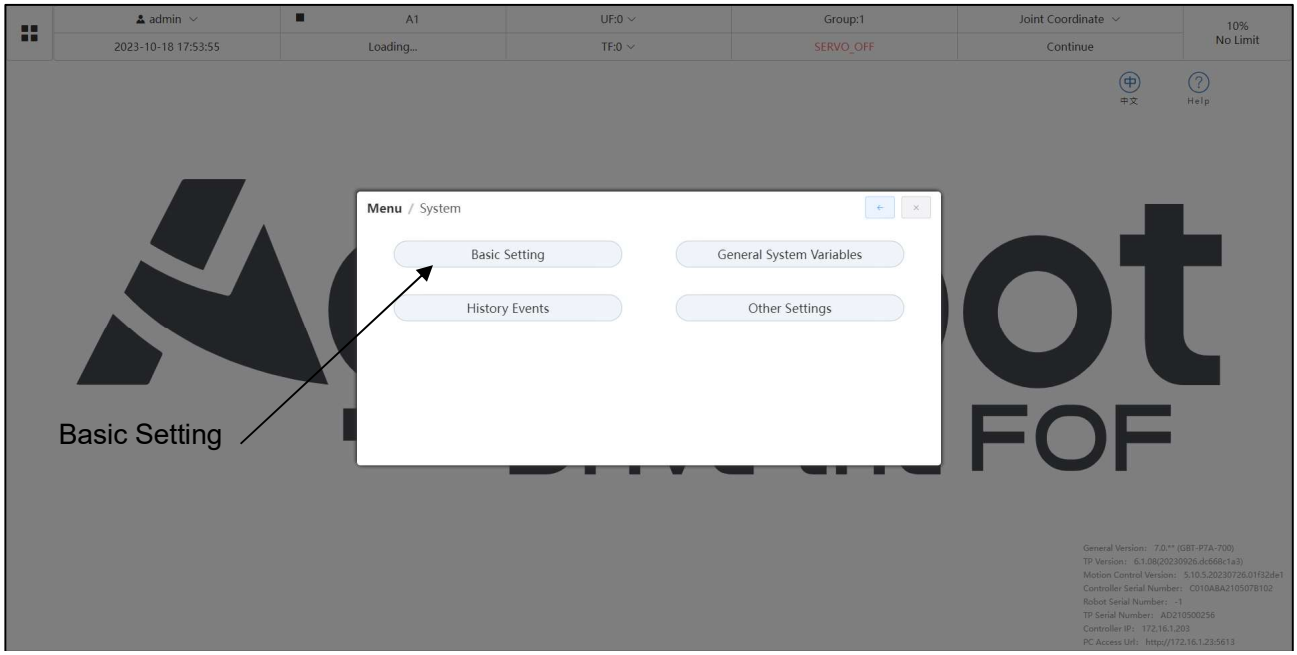

admin
A1
UF:0
Group:1
Joint Coordinate
10%
No Limit
2023-10-18 17:53:55
Loading...
TF:0
SERVO_OFF
Continue
Menu / System
Basic Setting
General System Variables
History Events
Other Settings
Basic Setting

Fig. 4.5

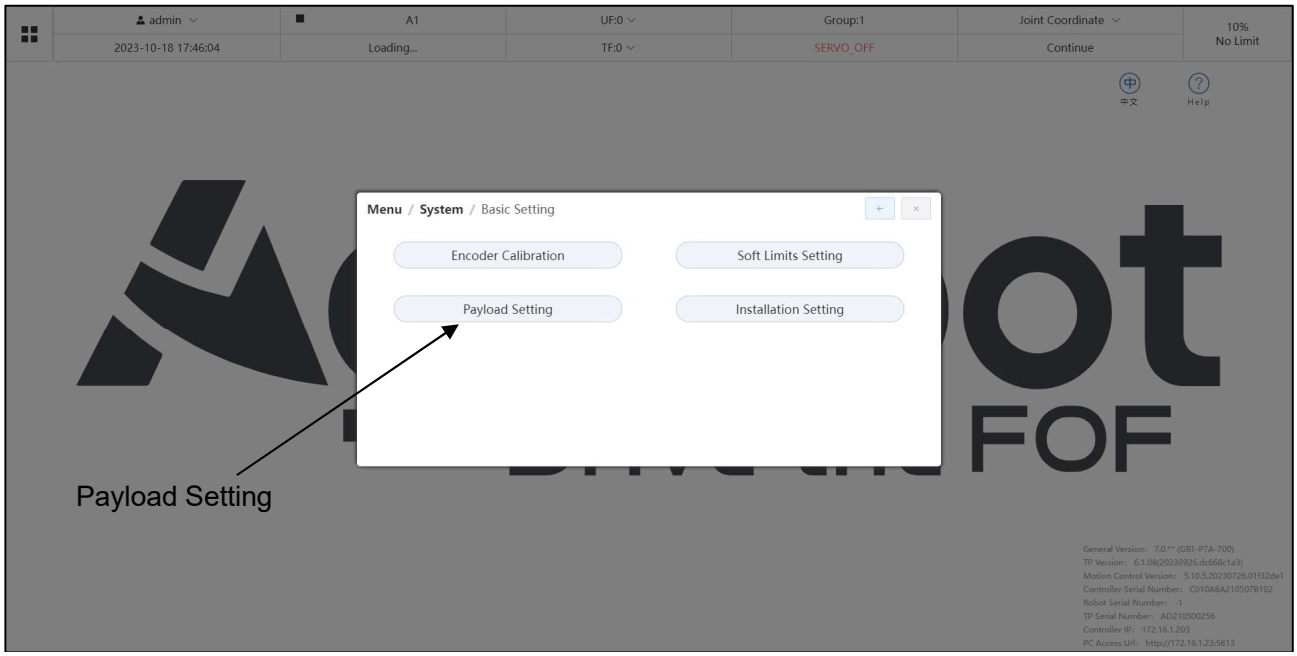


Fig. 4.6

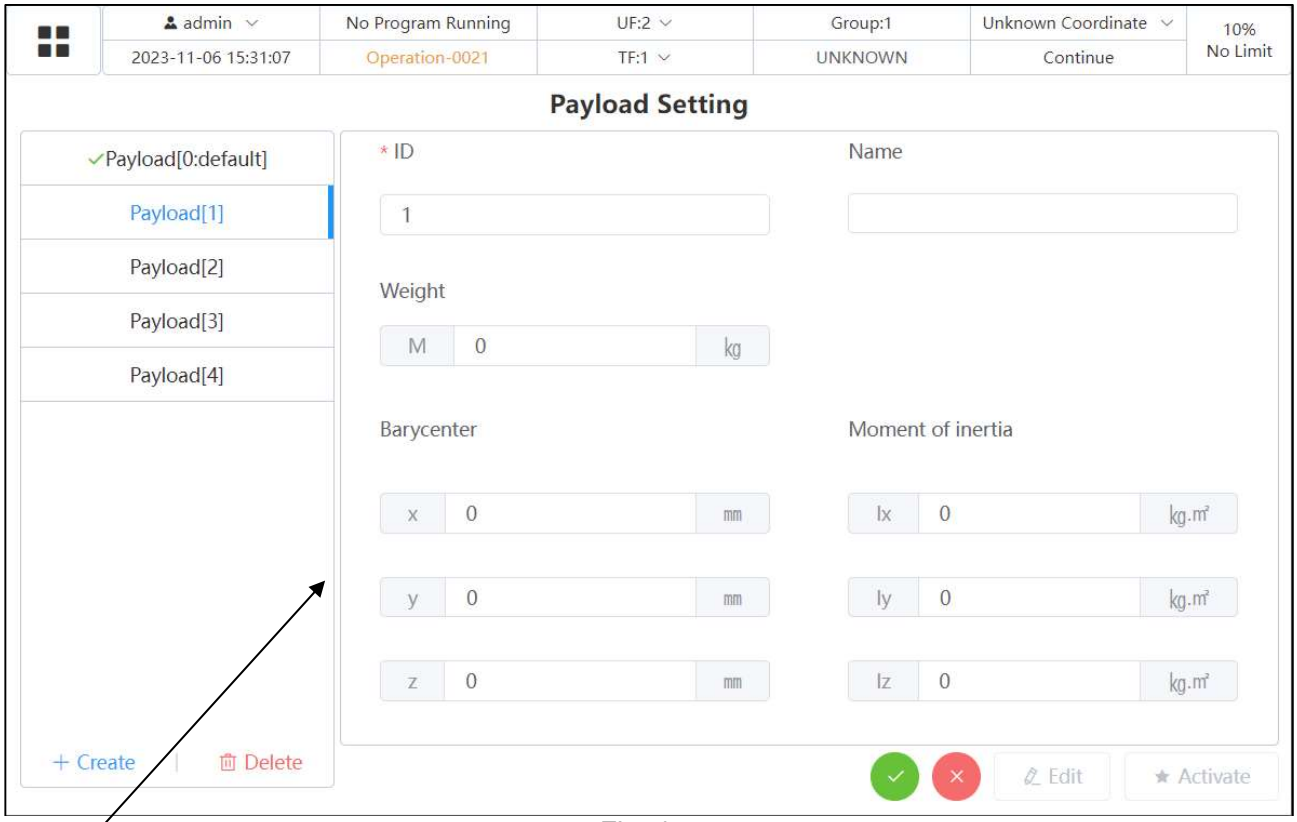


Fig. 4.7

Payload Setting Screen

5 Cabling and piping to end-effector

Warning

- Cables with necessary user interfaces should be used inside the robot mechanism.
- Do not add cables or hoses inside the robot mechanism.
- When installing cables outside the robot mechanism, take care not to obstruct the motion of the robot.
- Do not obstruct the movement of the exposed part of the cable. Take care not to interfere with other parts of the robot.
- Please cut off any excess part of the end-effector cable and insulate it, e.g. wrapping insulation tape.
- If it is impossible to prevent the end-effector or workpiece from being electrified, please try to route the end-effector cable as far away as possible from the end-effector or workpiece. Carry out insulation treatment between the cable and the end-effector or workpiece when the cable has to be routed near the end-effector or workpiece.
- Seal cable connectors and ends effectively to prevent water from entering the robot mechanism.
- Perform daily inspection to confirm if the connector gets loose or the outer protective layer of the end-effector (manipulator) cable is damaged.
- Cable damage due to non-compliance with the above precautions may cause wrong actions of the end-effector and alarm/stop or incorrect actions of the robot. In addition, there is a risk of electric shock if exposed to damaged power cables.

5.1 Air pipe and electrical interfaces

The following figure indicates the positions of air pipe and electrical interfaces on the robot.

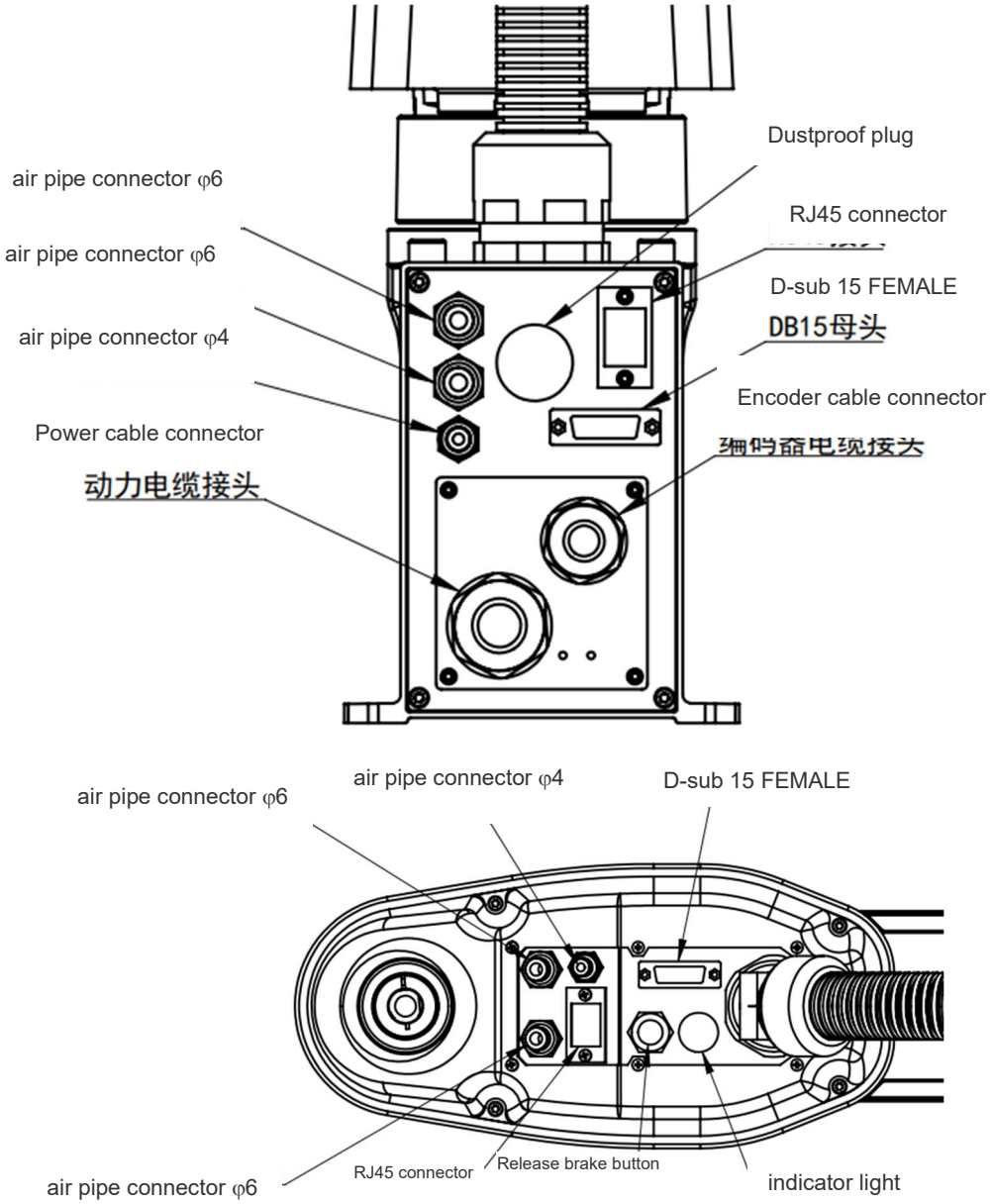


Fig. 5.2 Air Pipe and Electrical Interfaces on the Arm

6 Maintenance and repair

It is possible to maintain the performance of the robot in a stable state through maintenance and repair.

The cumulative operating time of the GBT robot is assumed to be 3000h in a year. If the annual operating time is longer than 3000h, it is necessary to shorten the maintenance cycle according to the operating time. For example, the maintenance and repair cycle is shortened by half when the cumulative operating time is 6000h in a year.

6.1 Maintenance and repair contents

Daily maintenance

Before daily maintenance, please read this chapter carefully to fully understand safe maintenance methods.

Only those who have passed robot system training of our company and the distributors are allowed to maintain the robot system.

Warning

- Never remove any components unless otherwise specified in the Maintenance Manual. Please strictly follow the maintenance steps specified. Incorrect disassembly or maintenance (if any) may lead to not only malfunction of the robot system but also serious safety issues.
- Untrained persons must not approach the robot powered on. Also, do not enter the action area. Even if the robot seems to have stopped, it is still very dangerous for the robot may move again and possibly cause serious safety issues. To prevent hazards caused by unexpected motion of the robot or improper operation of the operator, please develop and follow a Safe Operation Guideline.
- Please confirm the robot's action outside the safety fence after replacement of any part. Otherwise, the robot may perform unexpected actions and possibly cause serious safety issues.
- Before normal operation, please confirm that the emergency stop switch and safety fence switch operate normally. If the robot system is operated in a state where the switches cannot operate normally, it is very dangerous that the switches cannot perform their safety function in case of an emergency, which may possibly lead to serious injury or significant damage to the robot system.
- If it is necessary to touch the external terminals of the controller or connector during maintenance, please turn off the controller and cut off its power to avoid electric shock. Be sure to cut off the power supply before cleaning or tightening the terminal screws. If all relevant power supplies are not cut off, it may cause electric shock, product damage or malfunction. Turn off the power of the robot system by pulling out the power plug.
- Before replacement, set up a signboard that indicates “Replacement in Progress”, turn off the power supply of the robot system and relevant devices and pull out the power plug. Operations in the power-on state may lead to electric shock or robot system malfunction. Do not connect or disconnect the motor connector in the power-on state. Otherwise, it is very dangerous for the robot may malfunction. In addition, operations in the power-on state may lead to electric shock.
- Please use a cable with high-voltage protection and make sure to connect the cable to the controller. Please warn not to forcefully bend the cable to avoid additional payload to it. (Additionally, do not place any heavy object on the cable or forcefully bend or pull the cable.) Otherwise, it may cause cable damage, breakage or poor contact. These are very dangerous and may lead to electric shock or robot system malfunction.

Caution

- Please use alcohol, liquid gasket and adhesive carefully according to respective instructions and the following descriptions. Improper use of alcohol, liquid gasket or adhesive may lead to fire or safety issues.
  - It is prohibited to keep alcohol, liquid gasket or adhesive near fire sources.
  - Perform indoor ventilation when using alcohol, liquid gasket or adhesive.
  - Please wear protective devices, such as masks, goggles and oil-resistant gloves.
  - Thoroughly clean with water and soap the alcohol, liquid gasket or adhesive flashed on the skin.
  - If alcohol, liquid gasket or adhesive is splashed into the eyes or mouth, thoroughly rinse the eyes or mouth with water and seek medical attention immediately.
- Please wear protective devices during grease filling, such as masks, goggles and oil-resistant gloves. Once lubricating grease enters eyes or mouth or is stained on the skin, please perform the following treatment.
  - When entering the eyes:

    Please thoroughly clean the eyes with clean water and seek medical attention.
  - When swallowing:

    Do not forcefully induce vomiting and seek medical attention immediately.
  - When entering the mouth:

    Please rinse the mouth thoroughly with water.
  - When adhering to the skin:

    Please rinse thoroughly with water and soap.
- The robot may generate heat due to motor heating or similar reasons. Do not touch the robot before it cools down. In addition, ensure that the robot has cooled down and is not hot when touched. Then, perform teaching or maintenance.
- When performing robot maintenance, ensure a space of approximately 50cm around the robot.

Regular maintenance

Carry out maintenance and repair for the items below according to the shorter term of the specified period or cumulative operating time. (Please refer to Appendix A for detailed documents)

Maintenance cycle	Maintenance · repair items	Maintenance and repair methods
3 months	Clean the body	Wipe away dirt and clear away accumulated splashes, dust, chips, etc.
3 months	Tighten bolts	Tighten all exposed bolts on the robot.
3 months	Secureness of end tools	Apply certain forces to the end tool in front, back, left, right, up and down directions and confirm that it doesn't shake.
1 year	Robot cables	Confirm if they are worn
1 year	Warning sign	Confirm if it is broken or lost
1 year	Hard limit and buffer block	Confirm if they are loose, damaged or broken
1 year	Synchronous belt and pulley	Wearing of 3 belts and pulleys and reasonable tensioning of synchronous belts
3 months	Spline screw	This replacement cycle should be shortened if the operating conditions are quite harsh.
3 months	Dust cover	Visually inspect the dust cover for damage.

6.2 Key points

Maintenance of hard limit

If the hard limit is deformed or damaged, please contact us for repair and replacement.

Fig. 6.1 Hard Limits of GBT-S3A Series（Same as S6A）

6.3 Repair

Battery replacement

(1-year regular maintenance period for specified built-in battery)
The position data of the robot axes is saved through a backup battery. The built-in battery (if used) should be replaced regularly every year. In addition, the battery should be replaced as well when the voltage-drop alarm is displayed

> ⚠ Warning
>
> Do not set the power supply to OFF state. Replace the battery when the power supply is in the ON state. Otherwise, it may result in the loss of current position information. Then, it is required to perform zero calibration.
> 1.Please press the emergency stop button to prevent danger.
> 2.Remove the battery cover. Gently tap the battery chamber cover horizontally with a plastic hammer when it cannot be removed.
> 3.Do not mistake positive and negative electrodes of the battery.

The following is the method for replacing the battery:
Remove the back cover of the robot base, first unplug the connecting wire at the battery input interface on the PCB board and then remove the battery from the holder. Connect the connecting cable of the replaced battery to the battery input interface on the PCB board, then mount the battery onto the battery holder and secure it with a strap.

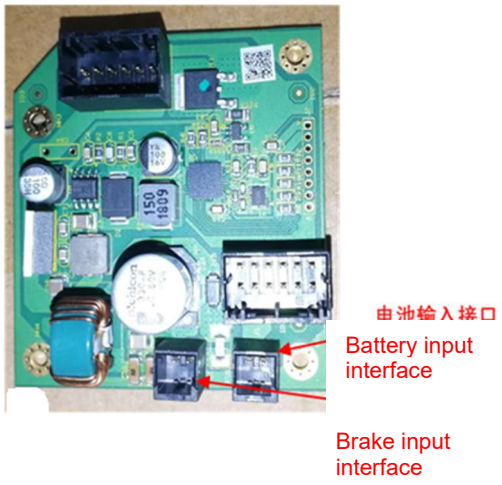


Fig. 6.2 Management Board of Encoder

Fig. 6.3 Fixing of Internal Battery

About grease for reducer

The reducer is maintenance-free for life and should not be re-greased.

Re-greasing of ball screw splines

Re-greasing of ball screw splines (3-month (750h) regular maintenance)

Move Axis 3 to the lower limit and apply a small amount of grease evenly to the exposed surface of the lead screw. Then move it to the upper limit and repeat the greasing step. The application position is shown in the diagram of application area.

Fig. 6.4 Diagram for Greasing Area on Screw Splines

7 Zero calibration method

7.1 Summary

Zero calibration is an operation associating the angle of each robot joint with the pulse count.
The zero calibration operation is to obtain the pulse count corresponding to the zero position.
The “zero calibration” is completed before ex-factory. It is unnecessary to perform zero calibration in daily operations. However, zero calibration should be performed in the following situations.
Please contact us for performing high-precision calibration in the following situations: the motor, pulse encoder or reducer is replaced, or the battery used for pulse count backup is depleted.

The data of the robot and the pulse encoder, including zero calibration data, are saved through their respective backup batteries. The battery depletion may cause data loss. The batteries in the controller and mechanism should be replaced regularly. When the battery voltage drops, the system will give an alarm to notify the user - please replace the battery timely.

Zero calibration method

- General calibration method
- Direct writing method of zero encoding data

7.2 General calibration method

Select one or several axes and record their current readings as new zero data in the parameter file of the robot's Flash. The recording objects include main axis and additional axes of the robot (if any). It is possible to calibrate a single axis. (For example, if a user moves a robot to coincide the zero scale of a certain axis and then uses this function to achieve zero calibration of the robot.)

It is required to perform zero calibration when the loss of zero calibration data for a specific axis is caused by the voltage drop of the battery for the rear pulse counter or the replacement of the pulse encoder. Select the general calibration method and check multiple axes or a single axis for calibration. Check “complete” and click the “calibration” button to complete the calibration.

Note:That the following functional interfaces of the SCARA series are the same.

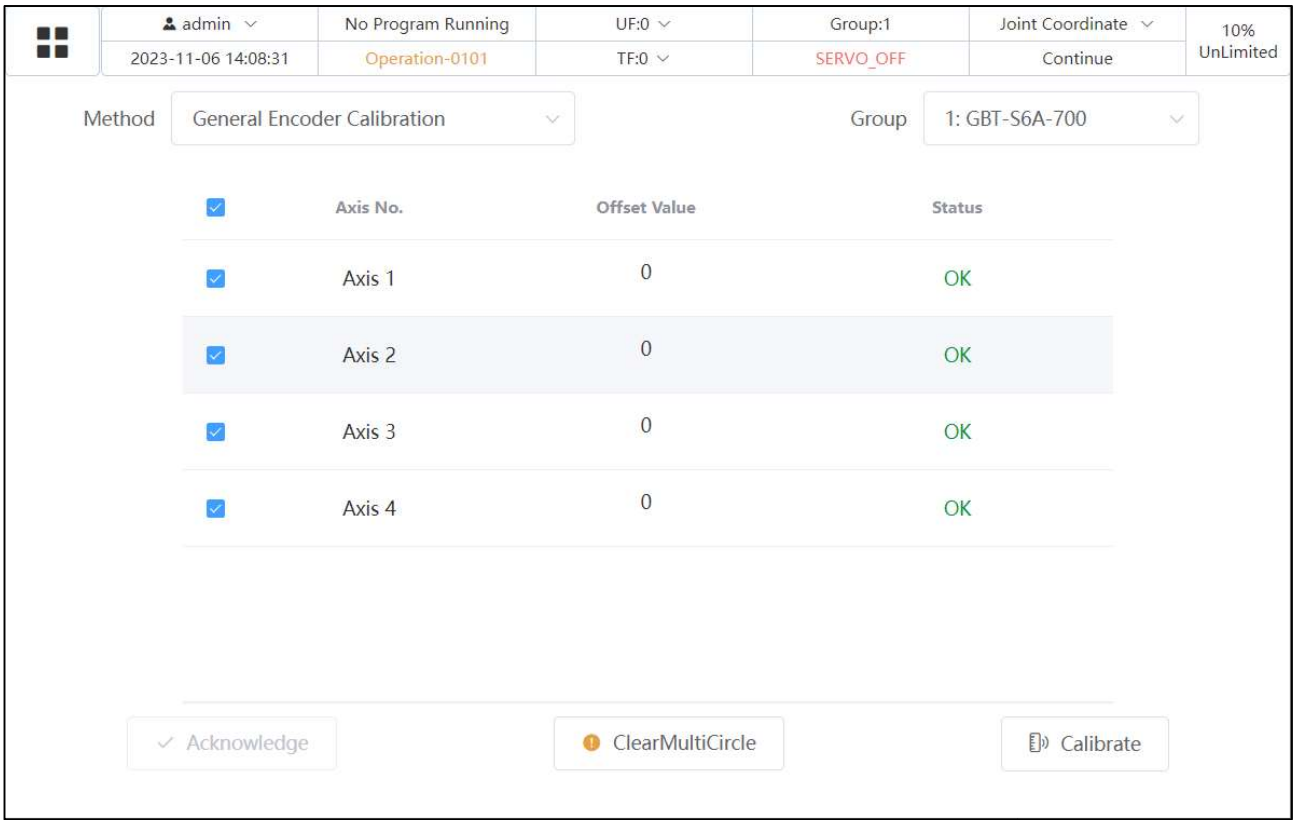


Fig. 7.1 Interface of General Calibration Method

7.3 Zero encoded data direct write

As for the direct writing of zero calibration data, the zero calibration data can be directly entered into the system variables. This operation is used in the situations where zero calibration data is lost while pulse data is still maintained.

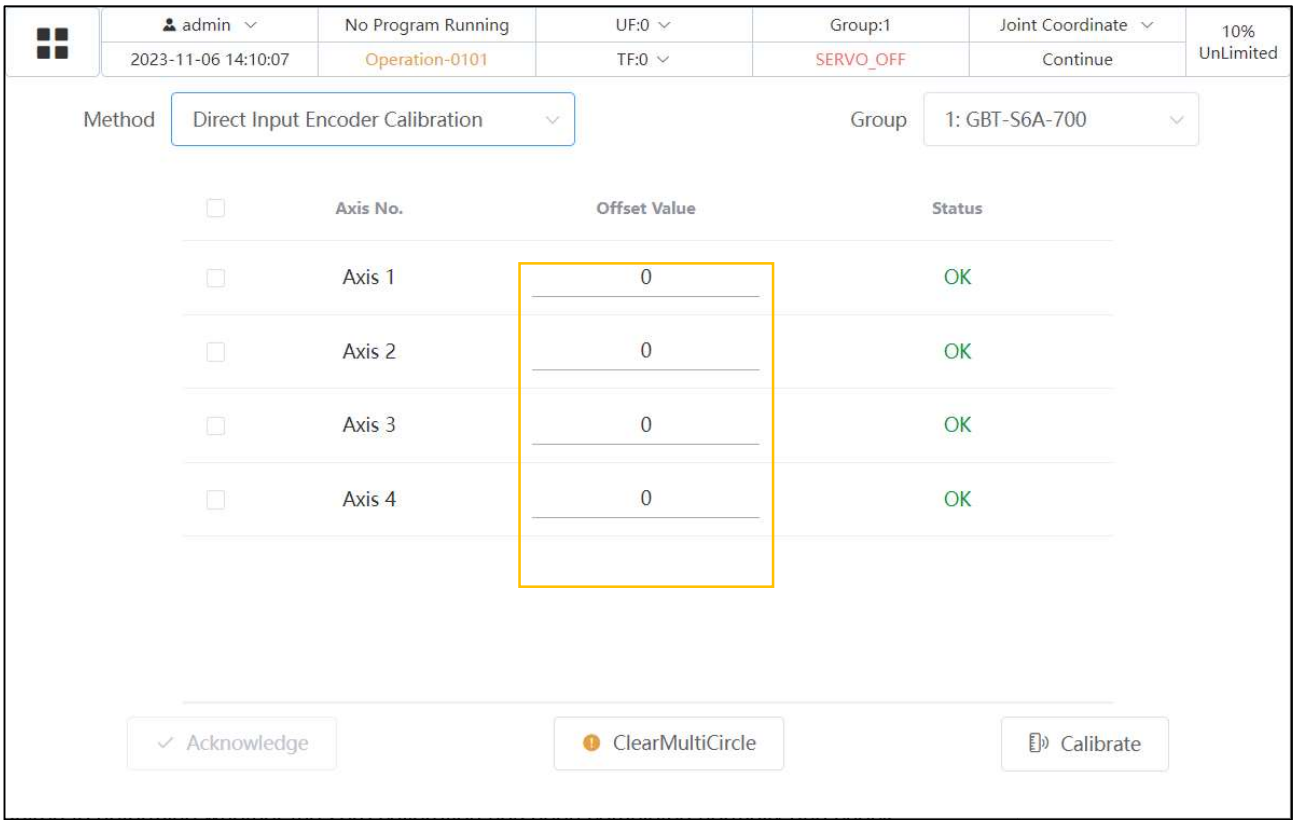


Fig. 7.2 Interface of Direct Writing Method

7.4 Confirmation of zero calibration results

Confirm whether the zero calibration is carried out normally:
Usually, it is required to determine whether the zero calibration has been completed normally and check whether the current position display is consistent with the actual position of the robot by the following method.

- Make specific points in the program reappear again and confirm their consistency with the positions taught.
- Move the robot to a position where all axes are at 0° and visually confirm whether the zero marks shown in the following figure are consistent.

Check the synchronous positions before starting any programming of the robot system. It is allowed to move the robot to the specified zero position by the manual operation window on TP.

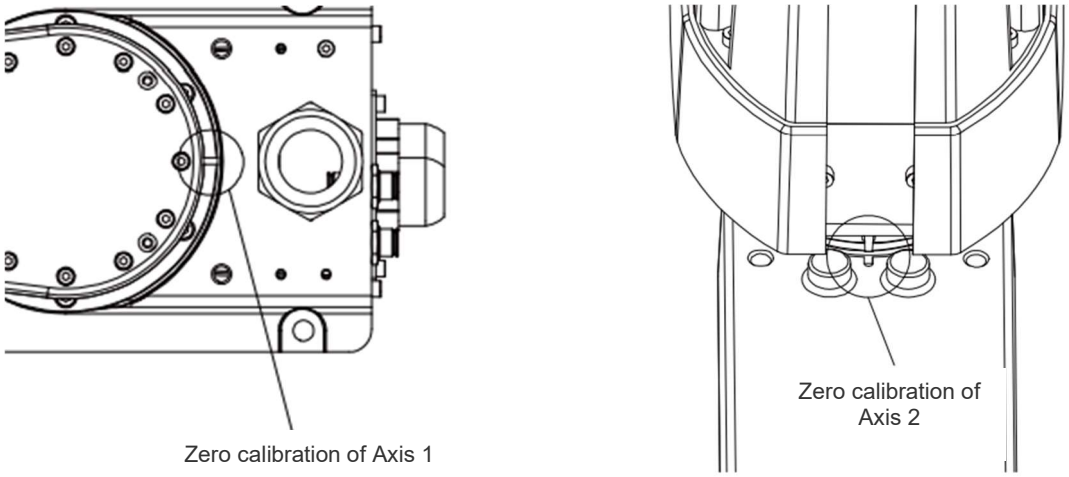


Fig. 7.3 Zero Positions of Axis 1 and 2

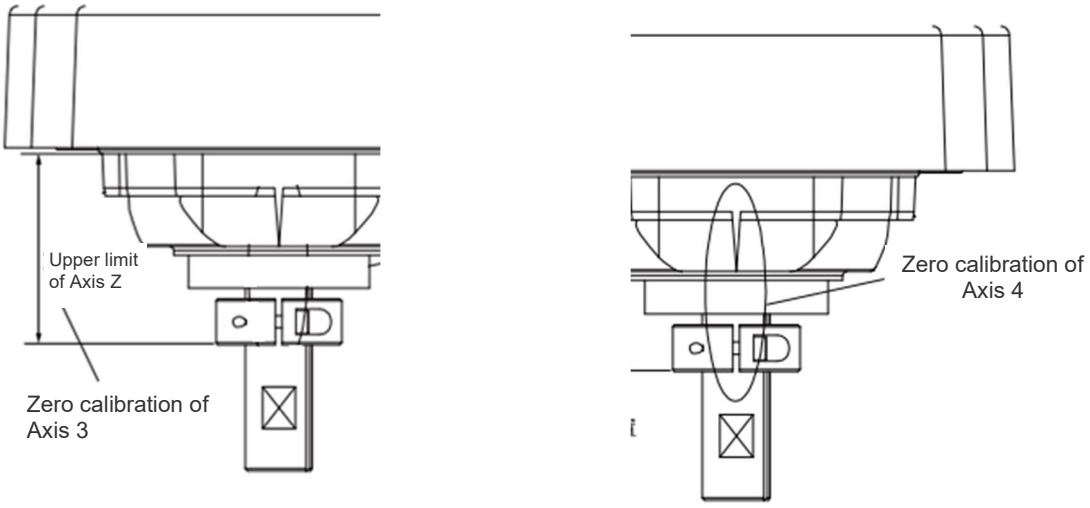


Fig. 7.4 Zero Positions of Axis 3 and 4

8 Resolution of common faults

A fault in the mechanism is sometimes caused by multiple different causes together. So, it is often difficult to thoroughly investigate them. In addition, incorrect measures (if taken) may actually lead to further deterioration of the fault. Therefore, it is important to analyze the fault in detail and clarify its true cause.

The solutions for common faults in the mechanism are shown in the following. Please contact us if you cannot find the reason and don't know how to take countermeasures.

Phenomenon	Description	Cause analysis	Solution
Vibration	The base is not firmly fixed to the ground.	The connection between the base and the ground gets loose due to frequent vibration during robot operation.	Reinforce the connection between the robot and the ground again.
	The robot vibrates significantly beyond a certain speed.	The routing program used by the robot poses a heavy payload on the robot hardware.	Adjust the programmed route of the robot.
	The robot vibrates significantly at a specific position.	The payload on the robot is probably too heavy.	Reduce the payload on the robot.
	The robot vibrates after collision or long overload.	Collision or overload causes damage to the joint structure or reducer.	Replace the reducer or repair the structure in the area causing vibration.
	The vibration of the robot may be related to other running machines around.	The operations of the robot and the machine around may resonate.	Change the distance between the robot and other machine.

	When turning off the robot, manually move the robot and find that it is shaking.	Overload or impact causes the screws on robot joints to get loose.	Check if the screws at each joint are loose (motor screws, reducer screws and connecting screws). If loose, tighten them according to regulations.
Abnormal noise	The robot generates an abnormal noise when exceeding a certain speed.	The routing program used by the robot poses a heavy payload on the robot hardware.	Adjust the programmed route of the robot.
	The robot generates an abnormal noise at a specific position.	The payload on the robot is probably too heavy.	Reduce the payload on the robot.
	The robot generates an abnormal noise after collision or long overload.	Collision or overload causes damage to the joint structure or reducer.	Replace the reducer or repair the structure in the area causing vibration.
Motor overheating	The temperature rises in the operating environment of the robot or its heat dissipation is influenced for the servo motor is covered by some object.	The motor temperature rises due to an increase in environmental temperature or poor heat dissipation of the motor.	Reduce environmental temperature, enhance heat dissipation and remove coverings on the motor.
	The control program or payload of the robot has been changed.	The program or payload exceeds the acceptable range of the robot.	Adjust the program and reduce the payload.
	The parameters imported into the controller have changed, causing motor overheating.	The imported parameters don't match the model of the robot	Re-import correct parameters
Jiggling	When cutting off the power supply of the robot, press it with a hand to find some robot mechanisms jiggling. There is a gap on the connecting surface of the parts.	Probably, overload or collision causes connecting bolts of robot components to get loose.	For each axis, confirm whether the bolts in the following positions are loose. If loose, use anti-loosening adhesive and tighten them with appropriate torque. ·Fixing bolts on motor ·Fixing bolts on reducer ·Fixing bolts on base ·Fixing bolts on arm ·Fixing bolts on cover ·Fixing bolts on end-effector

Grease leaking	Grease leaks from the mechanism.	[Poor sealing] It may be caused by cracked casting, damaged O-ring seal, broken oil seal, loose sealing bolts, etc. The cracked casting may be caused by excessive external force on the mechanism due to collision or other reasons. The broken oil seal may be caused by scratches on the lip of the oil seal due to the invasion of dust or other foreign objects. When the sealing bolt is loose, lubricating oil may leak out along the screw. Too much grease may be applied to the spline of the ball screw.	
Position offset	The robot moves in a position deviating from the teach position. Repetitive positioning accuracy is greater than the allowed value.	[Mechanical fault] Unstable accuracy of repetitive positioning may be caused by abnormal driving systems, loose bolts or other faults on the mechanical part. If the repetitive positioning accuracy is stable after certain offset, it may be due to the mechanical deformation caused by excessive payload in case of collision. It may be caused by an abnormal pulse encoder.	
	The position is only offsetting for specific peripheral devices.	[Position offset of peripheral device] It may be because external forces acting on peripheral devices cause offsetting of relative positions.	
	Position offset occurs after the variable is changed.	[Variable] It may be because the robot's origin is lost due to rewriting of zero calibration data.	

Appendice

A Regular Maintenance Sheet

Robot Maintenance Schedule

Category	Inspection items	Interval	Contents
Inspection	Clean the body	3 months	Wipe away dirt and clear away accumulated splashes, dust, chips, etc.
Inspection	Bolt	3 months	Tighten all exposed bolts on the robot.
Inspection	Gap	3 months	Apply certain forces to the end tool in front, back, left, right, up and down directions and confirm that it doesn't shake.
Inspection	Dust cover	3 months	Confirm if it is worn
Inspection	Robot cables	1 year	Confirm if they are worn
Inspection	Warning sign	1 year	Confirm if it is broken or lost
Inspection	Hard limit and buffer block	1 year	Confirm if they are loose, damaged or broken
Inspection	Synchronous belt and pulley on Axis 3/4	3 months	Wearing of belts and pulleys and reasonable tensioning of synchronous belts
Replacement	Grease for spline screw[1]	3 months/80km	This replacement cycle should be shortened if the operating conditions are quite harsh
Replacement	Encoder battery	1 year	

1.Grease： THK AFB-LF

B. List of Bolt Strengths and Tightening Torques

Please use the following strengths for bolts:
Bolts below M22 (inclusive): tensile strength higher than 1200 N/mm²
Bolts above M24 (inclusive): tensile strength higher than 1000 N/mm²
Hexagonal head bolts, stainless steel bolts, special shaped bolts (flat head bolts, countersunk bolts, etc.): tensile strength higher than 400 N/mm²
If it is required to tighten screws after reassembly, please use hexagonal socket screws (GB/T70.1-2008[NOTE]) - Grade 12.9. The torques of different screws are shown in the table below:

[NOTE]

1. GB/T 70.1-2008 Correspondence standard: ISO 4762:1997 Hexagon socket head cap screws

List of Recommended Screw Tightening Torques (Nm)

Specification	Base material of steel parts	Base material of aluminum parts
M3	2±0.18	1.57±0.18
M4	4.5±0.33	3.63±0.33
M5	9.01±0.49	7.35±0.49
M6	15.6±0.78	12.4±0.78
M8	37.2±1.86	30.4±1.86
M10	73.5±3.43	59.8±3.43
M12	128.4±6.37	104±6.37

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