



P800R V5 User Manual

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Geek+

Original instructions

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Contents

1 Preface.....	1
1.1 About this manual.....	1
1.1.1 Scope of application of this document.....	1
1.1.2 User Notice.....	1
1.1.3 Direction description.....	1
1.1.4 Symbol description.....	1
1.1.5 Technical data.....	1
1.2 Use regulations.....	2
1.2.1 Conforming uses.....	2
1.2.2 Non-conforming uses.....	2
1.3 Maintenance tips.....	3
1.4 More information.....	3
2 Safety.....	4
2.1 Introduction.....	4
2.2 Warning Signs in the Document.....	4
2.3 Safety signs on robots.....	4
2.4 Residual risk.....	5
2.5 Personal protective equipment.....	6
2.6 Safety notices.....	6
2.6.1 Requirements for operator.....	7
2.6.2 Reminders for maintenance personnel.....	7
2.6.3 Risk of accessing Internet.....	8
2.6.4 Electrical safety and conforming use.....	8
2.6.5 Risks of collision between personnel and robot.....	8
2.6.6 Risks of robot on slopes.....	8
2.6.7 Risk of eye injury due to strong light.....	8
2.6.8 Compliance with technical limits.....	9
2.6.9 Battery precautions.....	9
2.6.10 Welding operation.....	10
2.6.11 Risks of modification.....	10
2.6.12 Firefighting apparatus.....	10
2.6.13 Route layout risk.....	10
3 Safety features.....	11
3.1 Principle of robot obstacle detection and overview of obstacle detection area.....	11
4 Robot system description.....	12
4.1 Robot overview.....	12

4.1.1 Robot model description.....	12
4.1.2 External overview.....	14
4.1.3 Inside overview.....	16
4.1.4 Information on the nameplate and equipment.....	17
4.1.4.1 Robot nameplate.....	17
4.1.4.2 Robot serial number.....	18
4.1.4.3 Battery information.....	19
4.2 Charging station overview.....	20
4.2.1 Horizontal charging station.....	20
4.2.2 Vertical charging station.....	21
4.3 Overview of robot working area.....	22
4.3.1 Overview of ground area.....	22
4.3.2 Wireless AP overview.....	23
4.3.3 Workstation overview.....	23
4.3.3.1 Overview.....	23
4.3.3.2 Overview.....	24
4.3.4 Shelf overview.....	25
4.3.5 Overview.....	25
4.4 Working Principle of the Robot System.....	26
4.5 BMS.....	26
5 Technical parameters.....	28
5.1 Robot.....	28
5.1.1 Overall dimensions.....	28
5.1.2 Overall weight.....	28
5.1.3 Center of gravity parameters.....	29
5.1.4 Obstacle detection parameters.....	29
5.1.4.1 Parameters of infrared obstacle detector.....	29
5.1.4.2 Parameters of lidar obstacle detector.....	30
5.1.5 Lifting parameters.....	31
5.1.6 Driving parameters.....	31
5.1.7 Battery parameters.....	31
5.1.8 Encoder battery parameters.....	32
5.2 Charging station.....	32
5.3 Working conditions.....	32
5.3.1 Technical parameters of working environment.....	32
5.3.1.1 P800R (normal temperature).....	32
5.3.1.2 P800R (wide temperature)	33
5.3.2 Working ground parameter.....	34
5.3.3 Working network parameters.....	35
5.4 Shelf parameters.....	35
5.5 QR code label parameters.....	35

5.6 Optional equipment.....	38
5.6.1 Wide temperature battery *	38
5.6.2 Lidar *	38
6 Transport and store.....	39
6.1 Transportation.....	39
6.2 Robot transportation.....	40
6.3 Storage of robots.....	41
7 Operations.....	42
7.1 Managing robots in RMS	42
7.2 Operation on robot.....	42
7.2.1 Front control panel.....	42
7.2.2 Rear control panel.....	43
7.2.3 Information indicated by light strips.....	44
7.3 Operation of the charging station.....	45
7.4 Operations when personnel entering robot working area.....	45
7.4.1 Personnel enter robot working area.....	45
7.4.2 Stop robot system.....	45
7.4.3 Move the robot to the maintenance area.....	46
8 Maintenance.....	49
8.1 Safety notices.....	49
8.2 Maintenance list and interval.....	49
8.2.1 Maintenance schedule.....	49
8.2.2 Daily maintenance before power-on.....	51
8.2.3 Daily maintenance after power-on.....	51
8.2.4 Weekly maintenance.....	51
8.2.5 First run for a month.....	52
8.2.6 Every 3 months maintenance.....	52
8.3 Working Environment.....	53
8.3.1 Check the floor.....	53
8.3.2 Check the QR code.....	54
8.3.3 Check the appearance of shelves and placement of goods.....	56
8.4 Mechanical system.....	56
8.4.1 Robot housing.....	56
8.4.1.1 Check the robot housing.....	56
8.4.1.2 Remove and install the robot housing.....	57
8.4.2 Lift tray.....	58
8.4.2.1 Check the lift tray.....	58
8.5 Electrical system of robot.....	58
8.5.1 Clean the upper camera.....	58

8.5.2 Clean the obstacle detector.....	59
8.5.3 Check the light strip.....	60
8.5.4 Check the bumper strips.....	60
8.5.5 Check the emergency stop button on the robot.....	61
8.5.6 Check the charging socket of the robot.....	62
8.5.7 Disconnect and connect battery plug.....	63
8.6 Check the safety label on the robot.....	64
8.7 Battery storage notices.....	64
8.8 Encoder battery storage notice.....	64
8.9 List of common materials.....	65
9 Common faults and troubleshooting.....	66
9.1 Fault and troubleshooting of light strip indication.....	66
9.2 Restart the robot right above the QR code.....	71
9.2.1 Suitable for robots without brake.....	71
9.2.2 Suitable for robots with brake.....	72
9.3 Method for recoverable fault.....	73
9.4 Troubleshoot unrecoverable faults.....	74
10 Decommissioning and disposal.....	75
11 Technical terms and abbreviations.....	76
11.1 Technical terms.....	76
11.2 Abbreviations.....	76
12 Certification and testing.....	77
12.1 Certification.....	77
13 Back cover.....	78

1 Preface

1.1 About this manual

1.1.1 Scope of application of this document

Series	Model	Submodel	Robot serial number	
			From	To
P	P800R	All	12xxxxx	—

1.1.2 User Notice

Please make sure to read this manual carefully before using the products of Beijing Geekplus Technology Co., Ltd. (referred to as Geekplus) in order to understand and operate the products correctly.

This manual describes the usage, safety-related matters, and maintenance of the specified product. Incorrect or improper use may result in device damage or personal injury. If you have any questions about this manual, please feel free to contact sales service personnel or agents of Geekplus.

This manual is intended for the following audience:

- Operation personnel
- Maintenance personnel
- On-site technical support personnel

1.1.3 Direction description

The "front", "back", "left", and "right" directions described in the manual refer to this product forward direction.

1.1.4 Symbol description

Signal	Description
[A]	Additional information
*	Optional equipment
< >	Keys in software

1.1.5 Technical data

All products described in this manual, including their hardware, software, firmware, and more, are provided on the "as-is" basis to the maximum extent permitted by law.

The specifications, dimensions, weights, etc. have tolerances and are not binding on the manufacturer.

The manufacturer reserves the right to make changes during the development of the technology and upgrade the product continuously.

1.2 Use regulations

1.2.1 Conforming uses

This product is an automation device that is developed for the processing of logistics goods based on the widely recognized logistics practices in the industry. The robot consists of related mechanical parts, electrical parts, control programs, and more. They operate in a specified manner in a specified space.

This product can only be used in a fence-enclosed area where no human is allowed in the robot area during system running.

This product must be operated, serviced and maintained by personnel who have received Geek+ professional training and are familiar with the characteristics of the product and relevant safety rules.

A conforming use also includes compliance with the instructions in this manual and the operating, maintenance, and repair conditions specified by the manufacturer. The laws vary with countries. Users must strictly abide by and implement laws and regulations, electrical safety and other regulations of respective countries and regions.

1.2.2 Non-conforming uses

Uses beyond the specified purpose are non-conforming uses, which are misuses. The manufacturer shall not be liable for any loss caused therefrom. All losses caused by non-conforming uses shall be borne by the user.



Serious personal injury or death!

Using this product to carry people may cause serious personal injury or even death.

This product is designed for logistics activities and cannot be used to carry people.

The followings are also non-conforming uses:

- Modify this production without authorization.
- Use and maintain the product by untrained personnel.
- Perform operations and maintenance that are not in compliance with the manual.
- Use spare parts that do not meet Geekplus requirements.
- Exceeds the workload specified for this product.
- Handling non-specified shelves.

1.3 Maintenance tips

Follow the instructions in this manual to carry out the specified maintenance to reduce failures and the related maintenance/shutdown cost, thus ensuring optimal utilization rate and safety.

1.4 More information

If you need more information, please visit the website: www.geekplus.com.

2 Safety

2.1 Introduction

This chapter is an important safety chapter. Please read carefully and observe relevant safety regulations.

This chapter describes the safety principles and specifications that should be followed when operating robots or robotic systems. You must read this document carefully, understand and strictly observe the contents with warning signs. The robot system is complex and dangerous. You need to fully understand the risks of operation, strictly abide by and implement the specifications and requirements in this document.

2.2 Warning Signs in the Document

For contents related to safety or critical information in the document, use the following signs. When the contents of the following signs appear in the document, please read it carefully and observe the provisions.

Symbol	Description
 DANGER	It indicates a direct dangerous situation which leads to death or serious injury if not avoided.
 WARNING	It indicates a direct dangerous situation which leads to death or serious injury if not avoided.
 CAUTION	It indicates a possible dangerous situation which leads to medium or slight injury and property loss if not avoided.
 NOTICE	It indicates a possible dangerous situation which leads to property loss if not avoided.
 Note:	Highlight some facts users need to pay attention to.

2.3 Safety signs on robots

This section describes the safety signs used on robot labels (stickers). Safety signs are used in combination on the label to describe each specific warning. The descriptions in this section are general, and the labels may contain additional information such as values.

The robot is attached with the following safety and information labels, which contain important information about the product. This information is very useful for all personnel using the robot system (such as installation, maintenance or operation personnel).

Safety labels should always remain legible and intact.

Symbol	Position	Description
	Above the charging socket at the rear of the robot.	Watch out for electricity!
	Below the lidar at the front of the robot.	Laser radiation, please do not look directly into the beam!
	Upper part of robot	<ul style="list-style-type: none"> ■ No Stepping On Surface. ■ Crush Hazard. ■ Entanglement hazard. ■ Caution the rotating parts.

2.4 Residual risk

- There is still the possibility of manual handling of packages containing robots, which may lead to waist injury during the handling process.
- There is still the possibility that the untrained personnel carry out handling operations, which may cause the goods to fall during transportation and cause injury to operators or nearby personnel.
- There is still the possibility that the operator does not wear PPE to carry out the handling operation, which may cause the operator's hands or feet to be squeezed and injured.
- When an operator ignores the notes of manual and not use tooling, and manually handles the robot, the operator may injure his back during the handling process, or injure his hands or feet by crushing them when lowering the robot to the ground.
- There is still a risk of hand pinching under the lifting device of the robot.
- There is still a risk of hand pinching if the robot does not move without a housing during maintenances.

2.5 Personal protective equipment

Table 1 Personal protective equipment instructions

Symbol	Name	Description
	Safety helmet	Protect the head from injury.
	Protective gloves	Protect hands from being crushed or struck by objects.
	High-visibility safety vest	Make operation personnel highly visible.
	Safety footwear	Protect feet from being crushed or struck by objects.

 **Note:**

Refer to local regulatory requirements and project requirements for the selection of personal protective equipment.

2.6 Safety notices

Only trained and authorized personnel can enter the robot work area and maintenance area.

Only trained personnel can install, operate, troubleshoot and maintain this product. Trained personnel refer to those who have completed safety training in accordance with national regulations, basic mechanical and electrical technical knowledge and Geek+ professional training conducted by manufacturers, distributors and local agents.

Authorized personnel must wear appropriate personal protective equipment (PPE), including high-visibility clothing, protective gloves and safety footwear, and comply with relevant work procedures.

To avoid safety incidents, users should always:

- Put safety first.
- Observe all general safety regulations and accident prevention regulations.

2.6.1 Requirements for operator

WARNING

Risk of personal injury!

If the operator approaches or extends his hand into the lift connecting rod assembly while the robot is lifting, it may cause serious personal injury.

When the robot is powered on, the operator should ensure that no one approaches or extends his hand into the lift connecting rod assembly before starting the robot.

For the sake of safety, operator with the product must meet the following requirements:

- Have the physical condition to operate this product without fatigue.
- Haven't drunk any alcohol or taken psychotropic drugs.
- Have received professional training on Geek+ robot system.
- Understand the working principle of this product and avoid danger in operation.
- Understand the user manual and be able to use the information to complete the required work.

Do the following when operating this product:

- Considering the movement trend of this product.
- Consider in advance to avoid the movement trajectory of this product, and make sure that the line is not interfered.
- It is necessary to know the position and status of all switches, sensors and control signals used to control the movement of this product.
- Know the positions of the emergency stop buttons on this product controller and peripheral control devices and prepare for an emergency.

2.6.2 Reminders for maintenance personnel

WARNING

Risk of personal injury!

If the operator approaches or extends his hand into the lift connecting rod assembly while the robot is lifting, it may cause serious personal injury.

When the robot is powered on, the operator should ensure that no one approaches or extends his hand into the lift connecting rod assembly before starting the robot.

Before maintaining the equipment, understand the maintenance process, ensure that the maintenance site is clean and dry, and prepare necessary tools.

2.6.3 Risk of accessing Internet

If you connect the robot system to the Internet, you shall bear the risks, including but not limited to the exposure of robots to network attacks, hacker attacks, virus infection, and more. Geekplus shall not be responsible for device malfunction, information leakage and other problems caused thereby.

2.6.4 Electrical safety and conforming use

You must strictly observe and implement the electrical safety regulations of the country and region in which you are located, and observe the relevant regulations involved in this manual. Violation may result in serious personal injury or property damage.

2.6.5 Risks of collision between personnel and robot



DANGER

Serious personal injury or death!

Entering the robot work area carries a risk of collision with the robot, which may result in serious personal injury or death.

The robot work area shall be strictly distinguished from the personnel work area. If personnel want to enter the robot work area, they must strictly abide by the relevant requirements of this document.

2.6.6 Risks of robot on slopes

Operate, maintain, and transport the robot on a conforming level ground. If the robot operates on a sloped ground, it may overturn or slide, causing potential personal injury or robot damage.

2.6.7 Risk of eye injury due to strong light



Ergonomic hazard!

There are light-emitting parts on the robot, mainly light strips, camera fill lights, lidars, etc. Eye irritation by strong light may cause eye injury.

During the operation and maintenance of the robot, please try to avoid looking directly at the relevant strong light!

2.6.8 Compliance with technical limits

⚠ CAUTION

Personal injury or device damage!

Failure to adhere to the technical limits of this product may result in damage to the robot, leading to accidents and causing personnel injury.

Comply with the technical limits specified for this product and use it safely within the specified range.

For the sake of safety, observe the following technical limits:

- Product maximum load.
- Minimum and maximum temperature requirements for the product.
- Floor requirements of the product
- Product requirements for power supply voltage, frequency, wire diameter, and protective devices.
- Product requirements for altitude and humidity.

2.6.9 Battery precautions

⚠ DANGER

Serious personal injury or death!

Incorrect inspection of batteries may cause the batteries to explode, causing serious personal injury or fire.

Check the battery with a suitable voltmeter.

Charge the robot battery as specified.

Keep the battery away from high temperature, open fire, and humid environment.

ⓘ Note:

1. For the site storing the spare parts and spare batteries, regular maintenance is required. Only after you are trained by Geek+ engineers and have purchased Geek+ maintenance tooling can you perform relevant operations.
2. For users who do not store spare batteries, please contact the service personnel of Geek+ or Geek+ agent for battery maintenance.

2.6.10 Welding operation

⚠ CAUTION

personal injury!

Welding may damage the electronic components of the product, and harmful vapors may be generated when the paint is heated by the welding torch and inhaled, which may cause loss or danger to you.

If welding is required, contact the professional service personnel of Geek+ or Geek+ agents for operation.

2.6.11 Risks of modification

⚠ WARNING

Unpredictable risks!

Modifying or altering the original design of this product without permission may invalidate the existing risk analysis of the robot, resulting in unforeseen risks and causing personal injury or equipment damage.

Modification of this product without authorization is strictly prohibited.

2.6.12 Firefighting apparatus

Keep a dry powder extinguisher in the area near the robot and in the maintenance area in accordance with local regulations. The operating and maintenance personnel must keep in mind the storage location and use method of the dry powder extinguisher. Once the robot is on fire, put the fire off using a dry powder extinguisher.

2.6.13 Route layout risk

⚠ WARNING

Personal injury or property damage!

Failure to lay out the path as required can result in personal injury or property damage!

When laying out the path on site, all the following requirements need to be met :

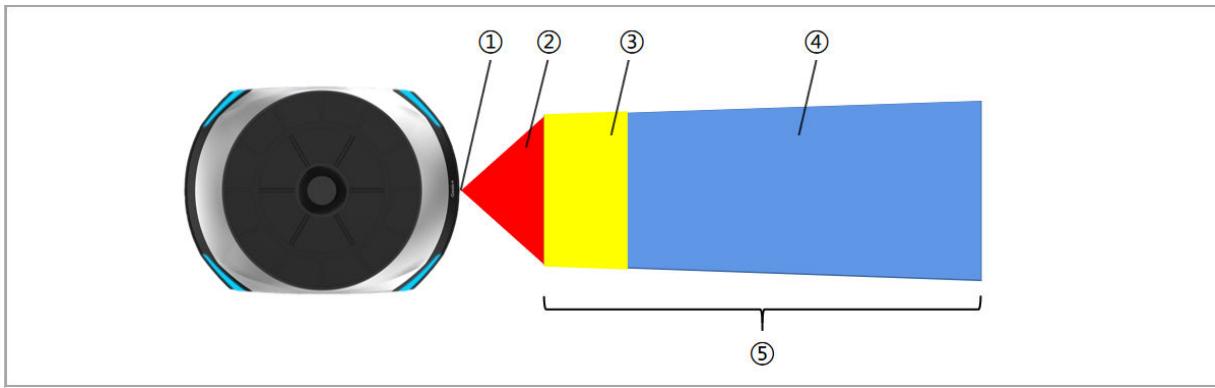
The proper floor area markings are needed to insure safe operation, including restricted area markings are needed to indicate no one should be in the area.

Robot shall not be routed through doorways that are also used by personnel unless the doorway is large enough to allow a person to pass through without entering the travel boundary.

The routing of the robot need to avoid being too close to edge or a ramp or platform, and to keep clear of fire doors, firefighting equipment, access to stairways and exits, and all emergency shutdown switches in the facility.

3 Safety features

3.1 Principle of robot obstacle detection and overview of obstacle detection area



Number	Name	Description
1	Obstacle detector	Detect obstacles in front
2	Robot stopping area	The minimum distance of the robot from the obstacle when the robot stops due to an obstacle in front of it
3	Buffer area	When the obstacle is in the buffer area, the robot decelerates at a constant speed until it stops. After the obstacle is removed outside the buffer area, the robot continues the task
4	Far area	When the obstacle is in the far area, the robot slows down but does not stop. After slowing down to set speed, the robot runs at a constant speed
5	Decelerating area	It contains the buffer area and far area.

Obstacle detection principle

The robot detects obstacles by using the obstacle detector of the robot. When the robot works, the obstacle avoidance sensor will send out a laser signal, which will be reflected back and received by the obstacle avoidance sensor when it meets an obstacle. By analyzing the reflected signal, the robot can determine the position and distance of the obstacle, and then control the robot movement to achieve obstacle avoidance.

When the ground is uneven, the robot might tilt up or down, and the obstacle detector can detect the ground or the bottom of the shelf, triggering the obstacle detection function. If this phenomenon occurs frequently, you need to check and repair the floor.

4 Robot system description

4.1 Robot overview

4.1.1 Robot model description

Please obtain the relevant parameters in the following table according to the actual model of the robot used.

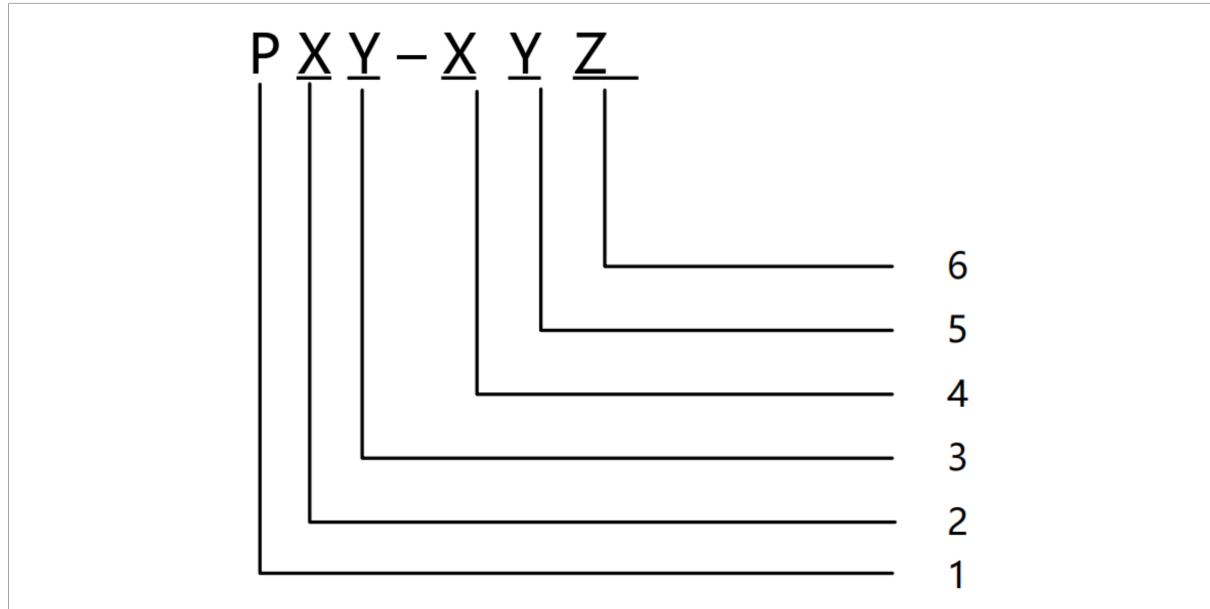


Figure 1 P series robot naming diagram

Table 2 P series robot naming rules

SN	Configuration name	Configuration code	Description
1	Pick (Picking)	P	-
2	Max load capacity (Max load capacity)	-	The value represent the actual load capacity of the product Unit: kg
3	Hardware feature (Hardware feature)	A	Adaptive lift height, scissor lift (Adaptive lift height, scissor lift)
		S	Fixed lift height, screw lift (Fixed lift height, screw lift)
		R	Fixed lift height, connecting rod lift (Fixed lift height, connecting rod lift)

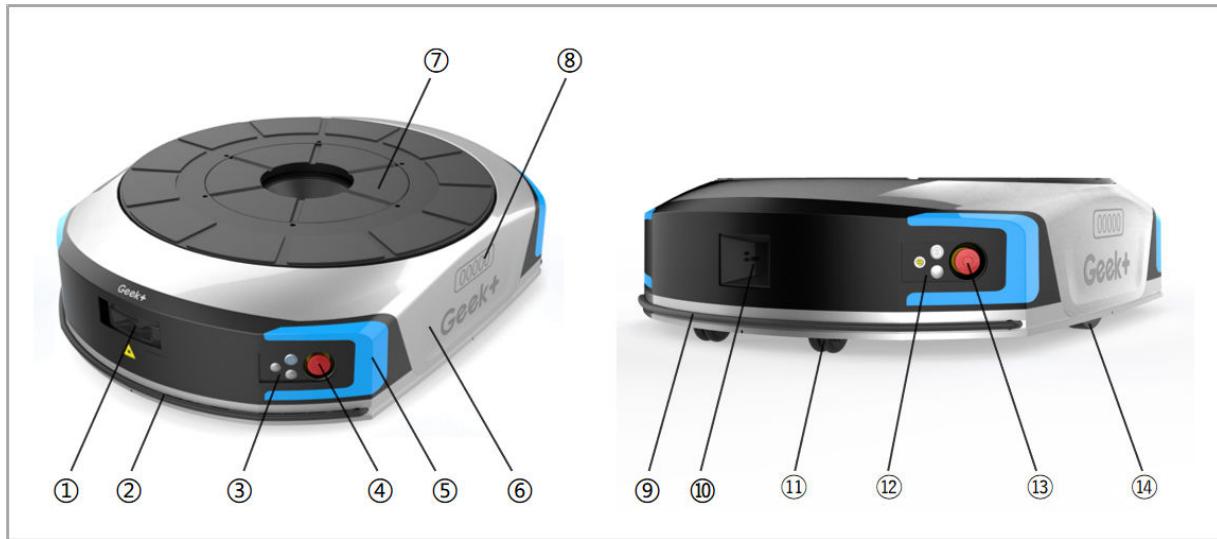
Table 2 P series robot naming rules

SN	Configuration name	Configuration code	Description
4	Safety sensor (Safety sensor)	L	Laser scanner obstacle detection (Laser scanner obstacle detection)
		I	Infrared scanner obstacle detection (Infrared scanner obstacle detection)
		S	Safety laser scanner and safety circuit (Safety laser scanner and safety circuit)
		A	360° Laser scanner (360° Laser scanner)
		E	Lidar detection, enhanced perception for operator, shelf and low obstacle (Lidar detection, enhanced perception for operator, shelf and low obstacle)
5	Environment (Environment)	N	Normal temperature (Normal temperature)
		L	Low temperature (Low temperature)
		W	Wide temperature (Wide temperature)
6	Certification level Certification Level	D	Domestic version (Domestic version)
		E	Export version (CE, ETL&UL3100 applied on Robot) (Export version (CE, ETL&UL3100 applied on Robot))
		U	America version (ETL&UL3100 applied on Robot) (America version (ETL&UL3100 applied on Robot))
		S	System Functional Safety Version (CE, ETL&UL3100 applied on both System&Robot)

Table 2 P series robot naming rules

SN	Configuration name	Configuration code	Description
			(System Functional Safety Version (CE, ETL&UL3100 applied on both System&Robot))

4.1.2 External overview

**Figure 2 Schematic overview of robot**

Number	Name	Description
1	Obstacle detector	<p>Check whether an obstacle exists in front of the robot.</p> <ul style="list-style-type: none"> ■ In case of foreign matter, the robot stops moving forward. It automatically continues the task after removing the foreign matter.
2	Front bumper strip	<p>When the emergency stop is triggered, the robot enters the fault status. It brakes at the maximum deceleration, and the red light is always on.</p> <ul style="list-style-type: none"> ■ The robot will not continue the task after removing the obstacle, and must exit the fault mode. ■ Restart the robot to exit from the fault mode (restart the robot right above the QR code if you want it to resume running).
3	Front control panel	Manually control the robot
4	Front emergency stop button	Stop the robot in case of emergency

Number	Name	Description
5	Light strip	1 piece at each of the four corners, which indicates different robot status by different colors and flashing modes.
6	Robot housing	Robot housing
7	Lift tray	Raises / lowers the shelf and keeps it stable.
8	SN	The serial number on the housing is used to identify the robot.
9	Rear bumper strip	<ul style="list-style-type: none"> ■ When moving backward in the non-task state, the robot will stop if this bumper strip is triggered, and the red light is always on. After the obstacle is removed, the robot will automatically resume running. ■ When moving backward in the task state, the robot will enter the fault mode if this bumper strip is triggered. The fault phenomenon and exit method are the same as those for the front safety bumper strip.
10	Charging socket	Charging the robot
11	Universal wheel	Keeping the robot balanced
12	Rear control panel	Manually control the robot
13	Rear emergency stop button	Same as the front emergency stop button.
14	Driving wheel	Driving and steering

4.1.3 Inside overview

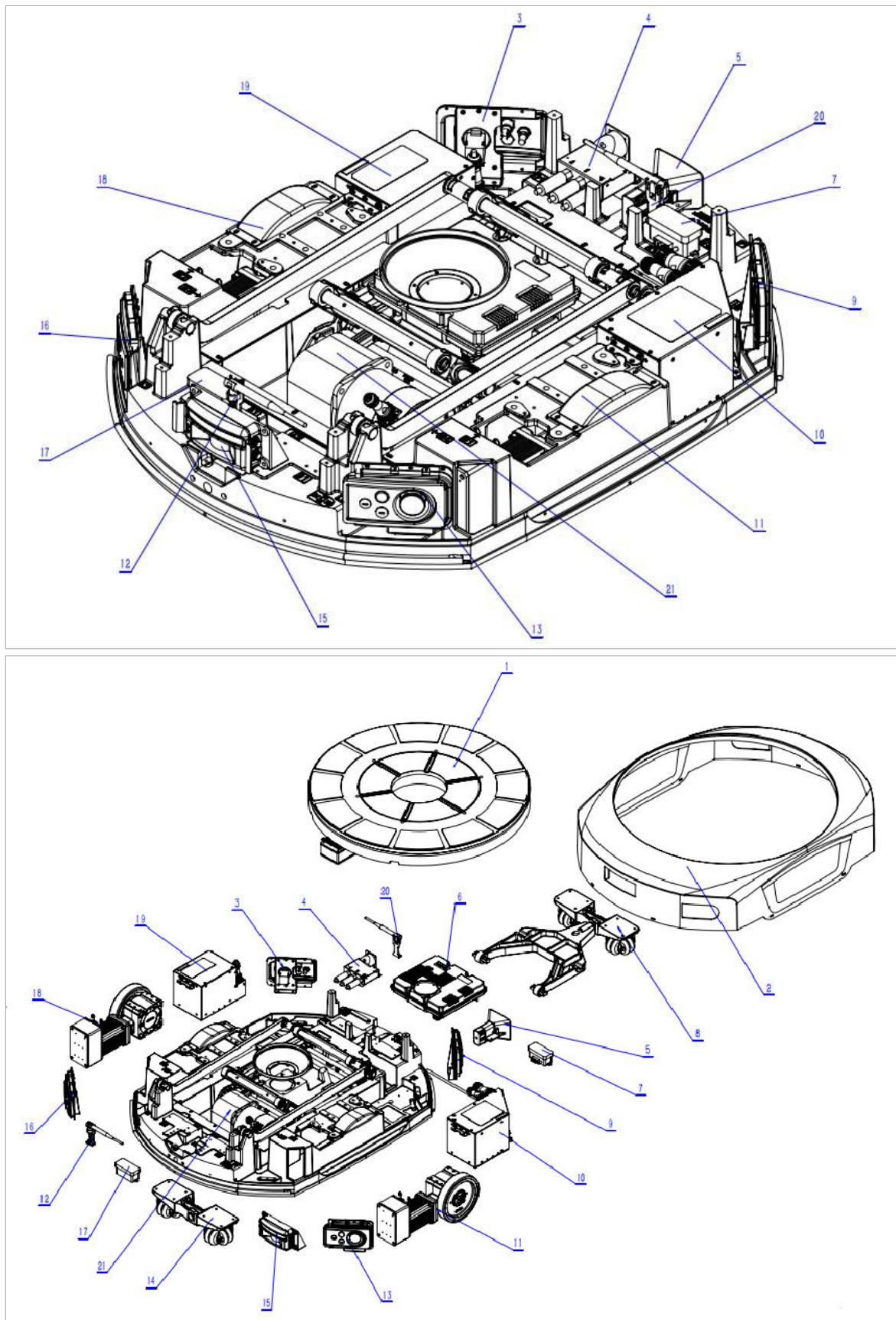


Figure 3 Schematic overview of robot

Number	Name	Number	Name
1	Pallet	12	Antenna 1
2	Robot housing	13	Light kit (front left)
3	Light kit (rear right)	14	Driven wheel 2
4	Sound-light warning module	15	Infrared obstacle detector
5	Socket kit	16	Light kit (front right, rear left)
6	Main control	17	Pressure wave switch 2
7	Pressure wave switch 1	18	Dirve wheel kit-right
8	Driven wheel 1	19	Battery 2
9	Light kit (front right, rear left)	20	Antenna 2
10	Battery 1	21	Lifting mechanism
11	Dirve wheel kit-left		

4.1.4 Information on the nameplate and equipment

4.1.4.1 Robot nameplate



Figure 4 Nameplate schematic

Number	Name	Number	Name
1	Product name	7	Manufacturer
2	Model	8	Manufacturer address
3	Dead weight	9	Rated capacity of battery

Number	Name	Number	Name
4	Rated voltage	10	Dimension
5	SN	11	Maximum load
6	Manufacturing date	12	Charging current

4.1.4.2 Robot serial number

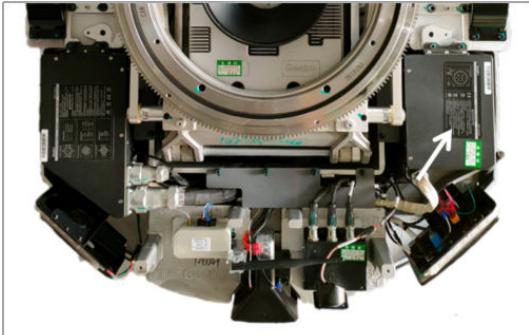


Machine serial number on the frame.



Machine serial number on the housing (excluding the robot model number).

4.1.4.3 Battery information

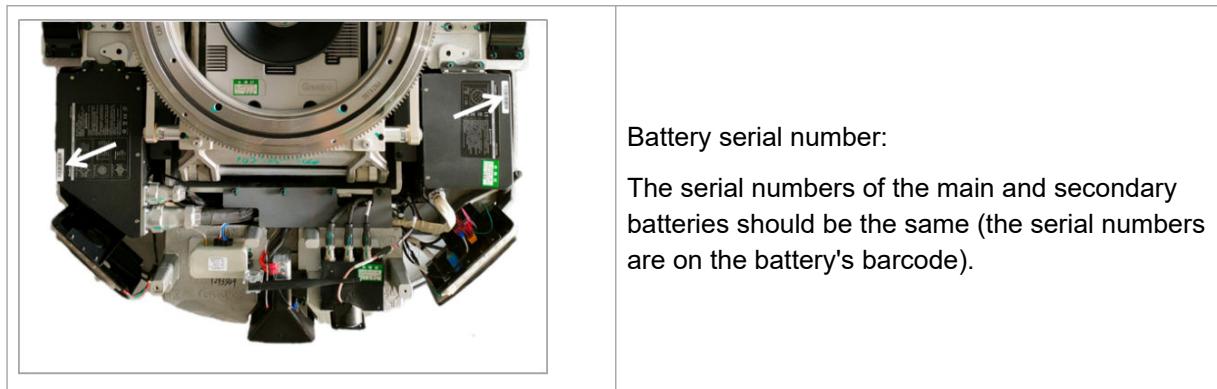


Information on the main battery:

Battery pin description, model number, technical parameters and operating instructions.

Information on the secondary battery:

Battery pin description, model number, technical parameters and operating instructions.



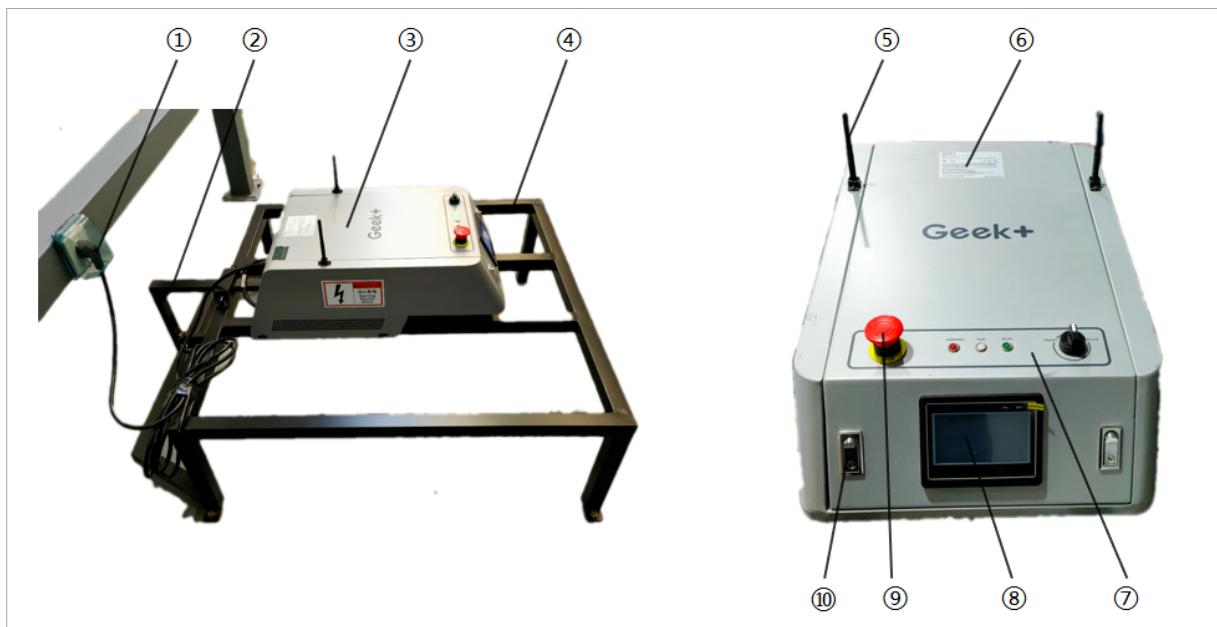
Battery serial number:

The serial numbers of the main and secondary batteries should be the same (the serial numbers are on the battery's barcode).

4.2 Charging station overview

This section provides an overview of the charging station. For more technical parameters and instructions, please refer to the relevant "Charging Station User Manual".

4.2.1 Horizontal charging station



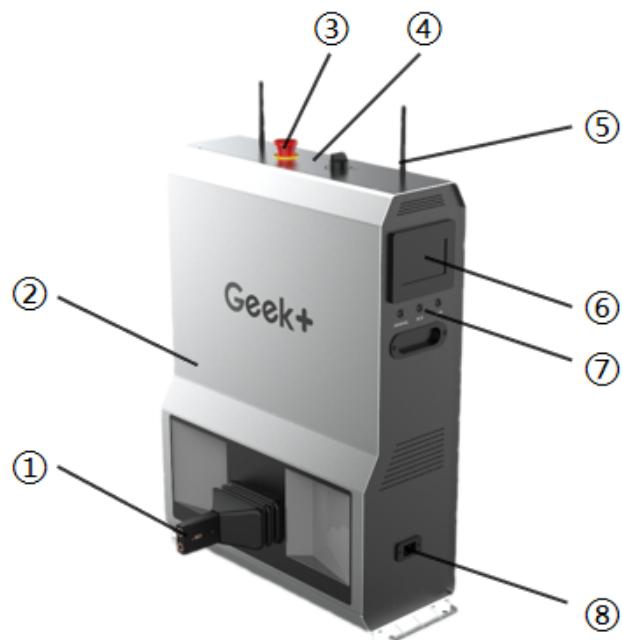
Number	Name	Description
1	Power cable	Powers the charging station.
2	Charging connector	Docks with the robot charging socket to charge the robot.
3	Charging station cabinet	For voltage transformation, overcurrent protection, and display.
4	Base	Supports and secures the charging station ■ Two sizes of bases are available

Number	Name	Description
5	Antenna	2 antennas, used to receive/send messages to servers.
6	Nameplate	Charging station nameplate
7	Control panel	Displays the status of the charging station via the indicators. You can operate the charging station through the control panel.
8	Display screen	Touch screen, used to display information about the charging station and charging status or set the charging station
9	Emergency power off switch	Stop charging station in case of emergency.
10	Switch of the charging station lid	2 in total, one on the left and one on the right ■ Unlock the cover with a key. Press the upper part of the switch to open the lid.

i Note:

The E4850A charging station is also known as the horizontal charging station.

4.2.2 Vertical charging station



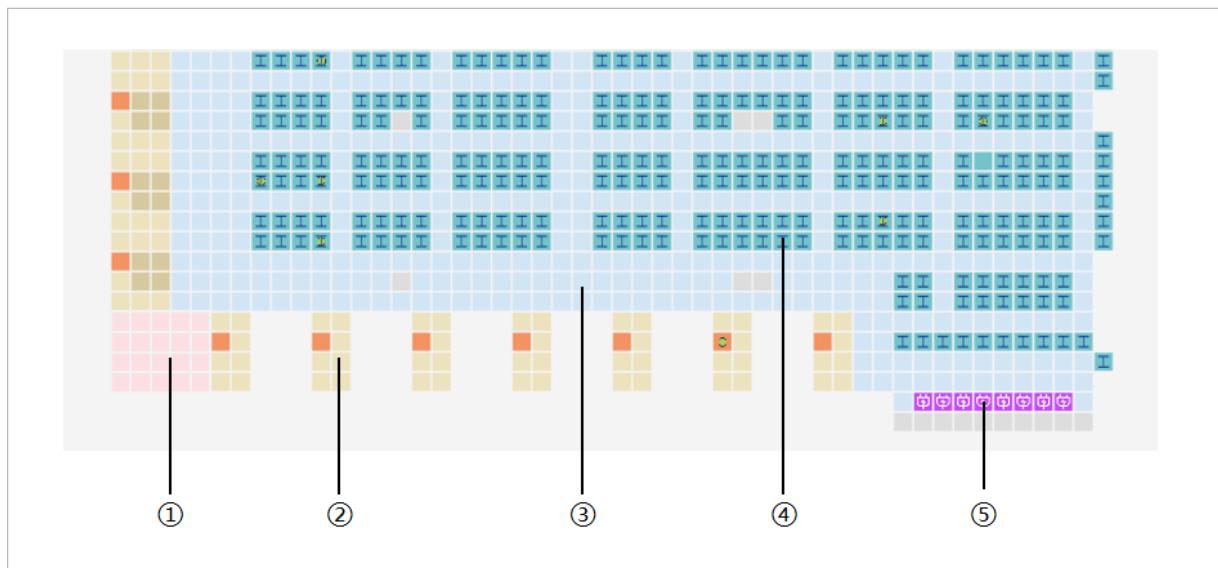
Number	Name	Description
1	Charging connector	Docks with the robot charging socket to charge the robot.
2	Charging station cabinet	For voltage transformation, overcurrent protection, and display.
3	Emergency power off switch	Stop charging station in case of emergency.
4	Control panel	Operating charging station
5	Antenna	2 antennas, used to receive/send messages to servers.
6	Display screen	Touch screen, used to display information about the charging station and charging status or set the charging station
7	Indicator	Indicate the charging station status
8	Power receptacle	Powers the charging station.

Note:

The E4850B/E4825B charging station is also known as vertical charging station.

4.3 Overview of robot working area

4.3.1 Overview of ground area



Number	Name	Description
1	Repair area	For repairing the robots

Number	Name	Description
2	Picking area	For picking operations
3	Aisle area	For robot travelling
4	Shelf area	For storing shelves
5	Charging area	For charging the robots

4.3.2 Wireless AP overview

Geekplus robots communicate with servers through Wi-Fi. Use a wireless Access Point (AP) to extend the Wi-Fi network to the entire working area.

4.3.3 Workstation overview

This section is an introduction to P-series workstations. For detailed technical parameters and instructions, please refer to the "User Manual of P Series Workstation".

4.3.3.1 Overview



Figure 5 Component location of the workstation

Position	Name	Position	Name	Position	Name
1	Door frame	2	Indicators and buttons	3	fixed scanner
4	Climbing ladder	5	Anti-fatigue platform	6	Tricolor lamp
7	Work computer	8	Handheld scanner	9	Rebin wall

Position	Name	Position	Name	Position	Name
10	Electronic tag				

4.3.3.2 Overview

The standard workstation consists of the following:

- Robot queuing area
 - Robot queuing position
 - Turning position
 - Stop position
- Workstations
- Worker operation area

The worker operation area is the place where the worker picks goods, puts them to the rebin wall (putaway). The robot doesn't enter this area.

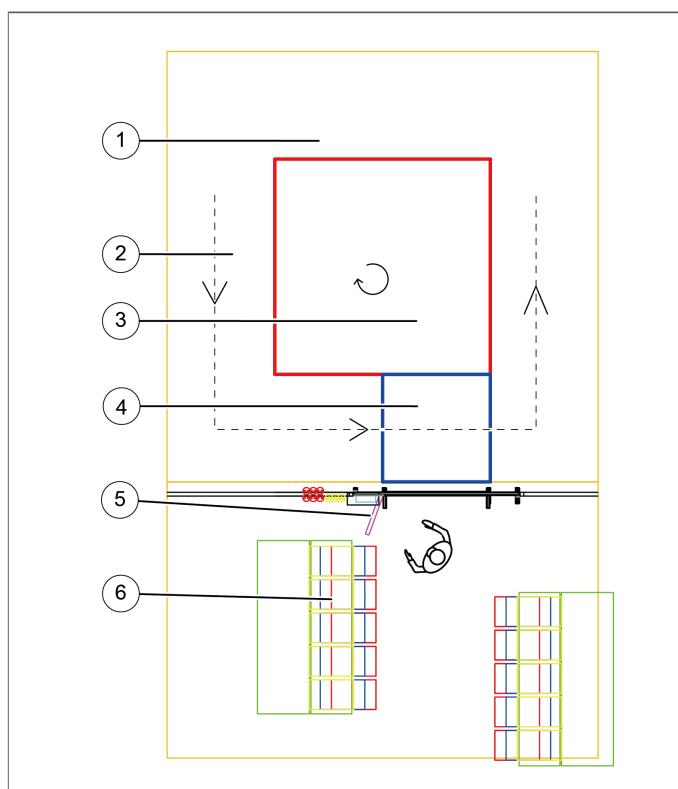


Figure 6 Standard workstation layout

Position	Name	Position	Name
1	Robot inbound channel	2	Robot queuing position
3	Robot turning position	4	Robot stop position

Position	Name	Position	Name
5	Workstation	6	Rebin wall

4.3.4 Shelf overview

4.3.5 Overview

QR code labels are attached to the floor, shelves, and charging stations of the robot work area to provide the robot with position and angle information.

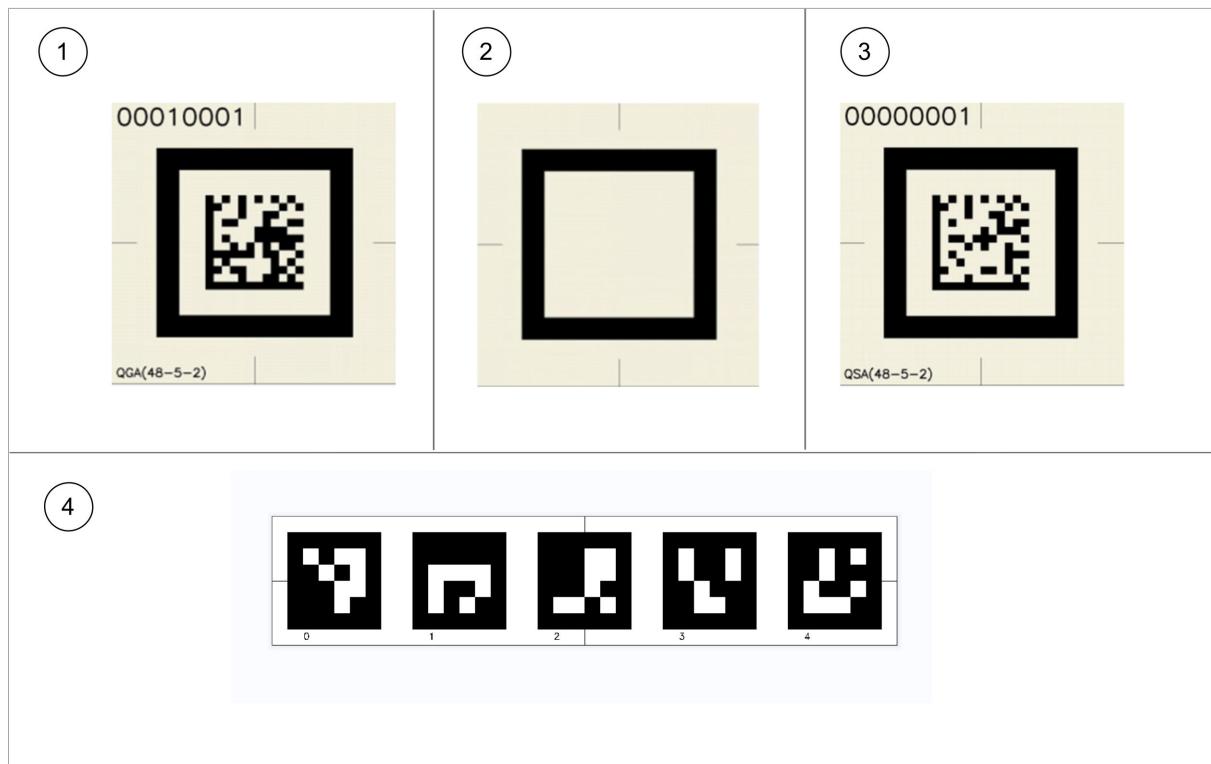


Figure 7 Example of QR code labels

Table 3 Example of QR code labels

Number	Description
1	Floor QR code label
2	Floor complementary code label
3	Shelf QR code label ¹
4	Bar QR code label for shelf beam ²

(1) Shelf QR code label can be also used for charging stations.

(2) Only the shelves docked to PopPick workstation have shelf QR code labels.

Note:

- In the environment below - 10 °C, the viscosity of the QR code sticker decreases, and it is easy to fall off the floor. Please replace the QR code with the low temperature adhesive backing.
- In the environment above - 10 °C, use conventional QR code.

4.4 Working Principle of the Robot System

Robot Management System (RMS) stores all the QR codes in the robot working area. The RMS has the function of planning the routes of robots, checking the status and information of the robots, and dispatching the robots, etc. The QR codes on the ground form the driving area map, providing robots with information about position and angle. In addition, the RMS records the real time information of type, quantity, location and so on of all goods on all shelves in the robot working area.

After the picker gives the picking order at the workstation, the RMS automatically generates the route and task for the robot according to the position of the shelf where the goods are located and the position of the target workstation, and sends them to the robot through Wi-Fi network. The route may include forward, backward, steering, etc. The task may include lifting the shelf, rotating the shelf and other actions.

After the robot received the route and task, it starts running to find the buffer tray along the specified route. After the robot reaches the specified position, the lifting mechanism picks up the tote and drives to the corresponding workstation according to the specified route.

When robot running paths intersect, RMS specifies the robot passing sequence in advance to avoid robot collision and ensure the maximum robot running efficiency.

After the picker completes the corresponding picking work at the workstation, the robot automatically leaves and sends the tote back to the shelf area or transports the tote to the next workstation.

When the battery level of the robot is lower than the lower limit of the battery level, RMS sends the charging command and the corresponding path to the robot according to the usage of the charging station. The robot automatically runs to the charging station according to the specified path to charge through the charging socket. When the battery level reaches the requirement, the RMS commands the robot to leave the charging station and resume the task or stand by at a designated location.

For details, please refer to the "RMS User Manual".

4.5 BMS

BMS (Battery Management System) 管理电池的充电，放电；保证机器人运行效率最大化；可以有效的保护电池。

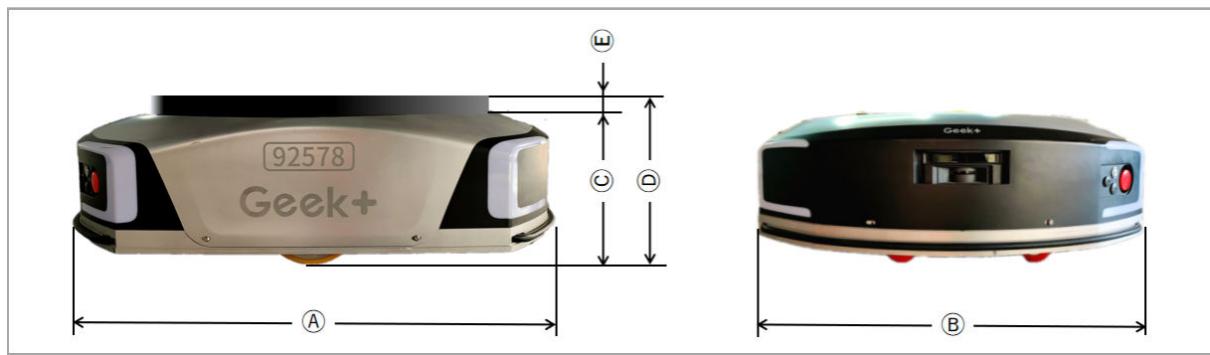
BMS 具备软件监控和硬件监控两级保护，含有以下功能（包含但不限于）：

1. 电池 **PACK** 的放电过流保护：对瞬时输出电流和短时输出电流，进行 2 级保护策略；当输出放电电流大于指定保护电流时，分别监控瞬时输出电流和短时输出电流 200ms 和 5s，**BMS** 触发禁止电池进行放电，防止电池输出过载。
2. 电池 **PACK** 的充电过流保护：对充电桩向机器人释放的充电电流进行监控；当输入充电电流大于指定保护电流时，监控 3s，**BMS** 触发禁止电池进行充电，防止充电电流超过阈值。
3. 电芯过充保护：对单体电芯电压进行监控，当单体电芯电压高于指定充电保护电压时，**BMS** 切断充电输入，防止电芯能量过高。
4. 电芯过放保护：对单体电芯电压进行监控，当单体电芯电压低于指定放电保护电压时，**BMS** 切断放电输出，防止电芯能量过低，无法开机。
5. 短路保护：对电池输出端是否发生短路进行监控和保护，当电池输出端正负极短路，**BMS** 切断放电电路。
6. 电芯温度保护：对单体电芯的温度进行监控，防止电池过热。
 - a. 当电芯温度低于 -20C 时，**BMS** 禁止电池进行放电。
 - b. 当电芯温度高于 65C 时，**BMS** 禁止电池进行放电。
 - c. 当电芯温度低于 -10C 时，**BMS** 禁止电池进行充电。
 - d. 当电芯温度高于 55C 时，**BMS** 禁止电池进行充电。
7. 电池组压差保护：对电池 **PACK** 内部的多个电芯单体电压进行监控，对内部电芯的一致性进行监控。
8. 电池 **PACK** 的监控：温度监控、输出电流监控、输入电流监控、电压监控；电池 **PACK** 内部温度超出设定保护温度阈值时，**BMS** 自动切断充电输入或放电输出。
9. 电池 **PACK** 整体电压高于或低于设定的保护电压时，**BMS** 切断充电输入或放电输出。
10. **BMS** 监控电芯内部温度，对该温度下充电电流进行阈值控制。延长电池寿命，杜绝析锂，确保电芯绝对安全。

5 Technical parameters

5.1 Robot

5.1.1 Overall dimensions



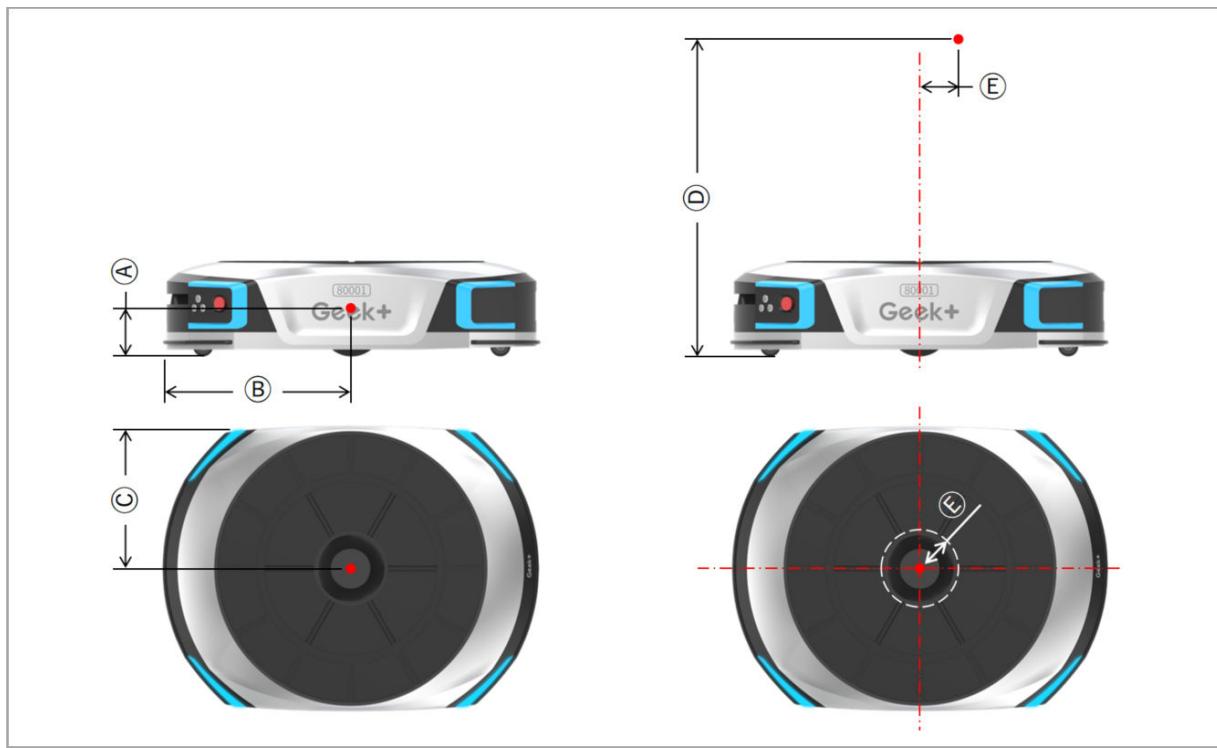
Item	Name	Value (mm)
A	Length	1095
B	Width	830
C	Height (The lifting mechanism is located at the lower limit)	275
D	Height (The lifting mechanism is located at the upper limit)	335
E	Maximum lift height	60

5.1.2 Overall weight

Table 4 Overall weight parameters description

Item	Weight (kg)
Overall weight	162

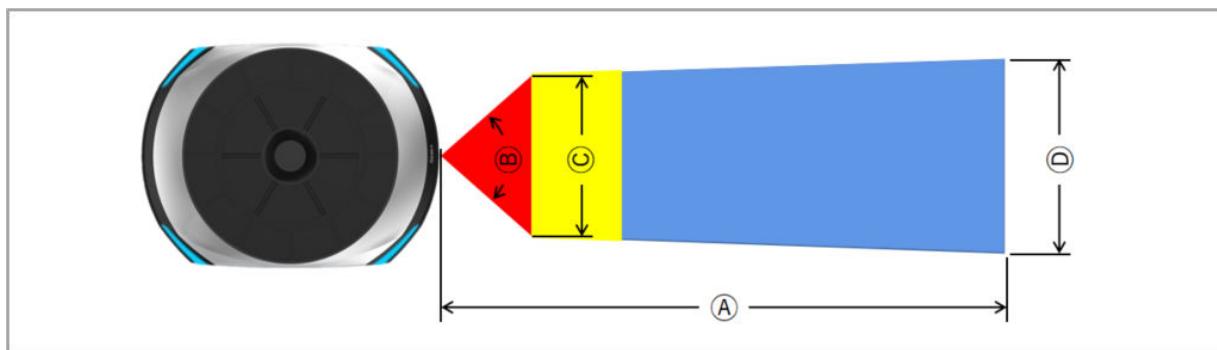
5.1.3 Center of gravity parameters



Item	No.	Value (mm)
No load	A	138
	B	545
	C	415
Loaded	D	< 1200
	E	< 200

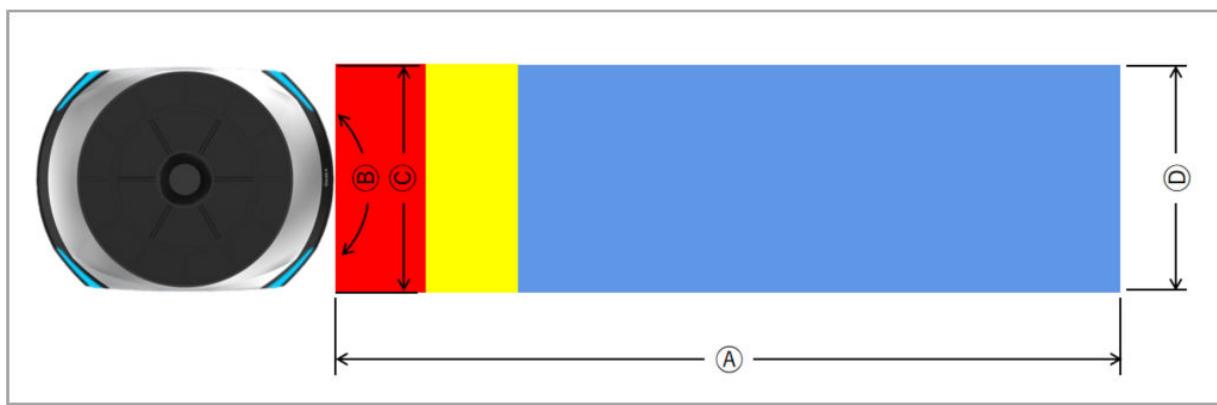
5.1.4 Obstacle detection parameters

5.1.4.1 Parameters of infrared obstacle detector



Item	Name	Value
A	Total obstacle detecting length	2000 mm
B	Obstacle detecting angle	72°
C	Near-end width of the decelerating area No load	500 mm
	Loaded	
D	Far-end width of the decelerating area No load	560 mm
	Loaded	

5.1.4.2 Parameters of lidar obstacle detector



Item	Name	Value
A	Total obstacle detecting length	3000 mm
B	Obstacle detecting angle	180°
C	Near-end width of the decelerating area No load	Equal to robot width
	Loaded	Equal to shelf width
D	Far-end width of the decelerating area No load	Equal to robot width
	Loaded	Equal to shelf width
-	laser scanning plane height	163 mm

Note:

Below -10°C, only the infrared version robot can be used, and must only be used in unmanned scenarios.

5.1.5 Lifting parameters

Table 5 Lifting parameters description

Parameter	Value	
	Ambient and wide temperature* versions	Low temperature version
Maximum load	1000 kg	800 kg
Lifting height	60 mm	60 mm
Minimum lifting time	4 s	4 s

5.1.6 Driving parameters

Table 6 Driving parameters description

Parameter	Value	
	Ambient and wide temperature* versions	Low temperature version
Maximum no load driving speed	2.0 m/s	1.5 m/s
Maximum full-load driving speed	1.5 m/s	1.0 m/s
Stop accuracy	≤± 10 mm, ± 1° (geometric center of vehicle body)	≤± 10 mm, ± 1° (geometric center of vehicle body)
Driving mode	Dual-wheel differential driving	Dual-wheel differential driving
Turning mode	Spin turn or set radius turn	Spin turn or set radius turn

5.1.7 Battery parameters

Table 7 Battery parameters description

Parameter	Value		
	Ambient version	Wide temperature* version	Low temperature version
Battery model	GKB5140	JZJ5130	E5CS03A0
Rated voltage	51.8 V	51.1 V	46 V
Rated capacity	40.3 Ah	30 Ah	20 Ah
Maximum charging voltage	58 V	58V	≤50 V
Maximum charging current	30 A	30 A	20 A

Table 7 Battery parameters description

Parameter	Value		
	Ambient version	Wide temperature* version	Low temperature version
Quantity of batteries	2	2	2
工作温度范围	-10°C ~ 50°C	-10°C ~ 45°C	-30 °C ~ -5 °C

5.1.8 Encoder battery parameters

Table 8 Encoder battery parameters descriptions

Parameter	Value
Battery model	ER18505
Rated voltage	3.6 V
Rated capacity	4 Ah
Weight	28 g

5.2 Charging station

For the parameters of the charging station, please refer to the "Charging station user manual".

5.3 Working conditions

5.3.1 Technical parameters of working environment

5.3.1.1 P800R (normal temperature)

Table 9 P800R (normal temperature) working environment parameters description

Parameter	Value
Installation method	Indoor installation <ul style="list-style-type: none"> ■ Avoid dust, water, fumes or other pollutants. ■ Keep the workstation away from flammable, explosive, or corrosive gases and liquids.
Use environment	Normal temperature area
Operating temperature (standard battery)	-10 ~ 45°C (Refer to charging environment requirements)

Table 9 P800R (normal temperature) working environment parameters description

Parameter	Value
Charging environment	The type selection shall meet the requirements of charging environment $\geq 5^{\circ}\text{C}$. $\leq 0^{\circ}\text{C}$ can not be charged, the robot needs to run to heat up before charging. The charging station interactive charging mode needs to be turned on, and the single charging time ≤ 5 minutes.
Humidity	$\geq 5^{\circ}\text{C}$: 10% ~ 95%, no condensation. $< 5^{\circ}\text{C}$: 10%-40%, non-condensing
Altitude	≤ 2000 m

 **Note:**

P800R (normal temperature) will trigger low temperature protection when the working environment temperature is lower than 0°C , and the battery cannot be charged. In this case, you need to select a wide temperature battery or use a P800R (low temperature) robot.

5.3.1.2 P800R (wide temperature)

Table 10 P800R (wide temperature) * working environment parameters description

Parameter	Value
Installation method	Indoor installation <ul style="list-style-type: none"> ■ Avoid dust, water, fumes or other pollutants. ■ Keep the workstation away from flammable, explosive, or corrosive gases and liquids. ■ Regular maintenance of robots and warehouse floors to avoid frost buildup.
Use environment	Refrigerated area
Ambient temperature (low temperature battery)	$-10^{\circ}\text{C} \sim 50^{\circ}\text{C}$
Charging environment	$\leq -10^{\circ}\text{C}$ can not be charged, the robot needs to run to heat up before charging. $\geq 40^{\circ}\text{C}$, single charge time ≤ 5 minutes. The charging station interaction mode needs to be started.
Humidity	$\geq 5^{\circ}\text{C}$: 10% ~ 95%, no condensation.

Table 10 P800R (wide temperature) * working environment parameters description

Parameter	Value
	< 5°C: 10%-40%, non-condensing
Altitude	≤ 2000 m

i Note:

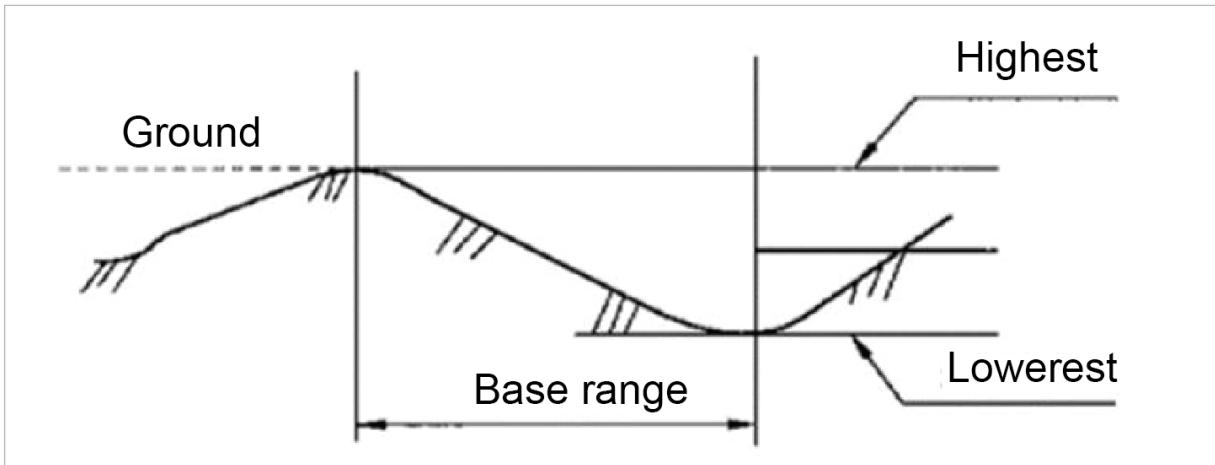
The use of P800R (wide temperature) * in the refrigerated area is only suitable for unmanned scenarios.

5.3.2 Working ground parameter

Table 11 Working ground parameters description

Parameter	Value
Ground bearing	> 1.5 t/m ²
Allowable ground pressure	> 1.5 MPa
Ground hardness	> 30 KN/m ²
Ground flatness [A]	≤ 8 mm/m ²
Ditch width on road	≤ 10 mm
Step height	≤ 5 mm
Coefficient of friction	≥ 0.5
Other requirements	<ul style="list-style-type: none"> ■ Hard ground ■ Keep the ground clean, avoid dust, particles, no oil, liquid, water stains. ■ Use the anti-electrostatic materials on the ground of the robot working area ■ No waxing on the floor ■ No obvious light reflection on the floor

[A]: Ground flatness refers to the height difference X between the highest point and the lowest point of the ground within the reference range of 1 square meter (m²).



5.3.3 Working network parameters

Table 12 Description of working network parameters

Parameter	Value
Network type	Wi-Fi
Network standard	IEEE 802.11 b/g/n
Power supply of AP	POE
Installation height of AP	According to design requirements
Network cable requirements	CAT 6, with a length not more than 80 m.

5.4 Shelf parameters

Table 13 Shelf parameters description

Parameter	Value
Minimum shelf dimension	1020 mm x 1020 mm
Standard shelf dimension	1020 mm x 1020 mm
Maximum shelf dimension	1250 mm x 1250 mm
Shelf bottom height	300 mm ± 3 mm
Maximum shelf height	≤ 2800 mm

5.5 QR code label parameters

The QR code label must be made of PVC frosted surface, ordinary paper, or non-reflective surface material.

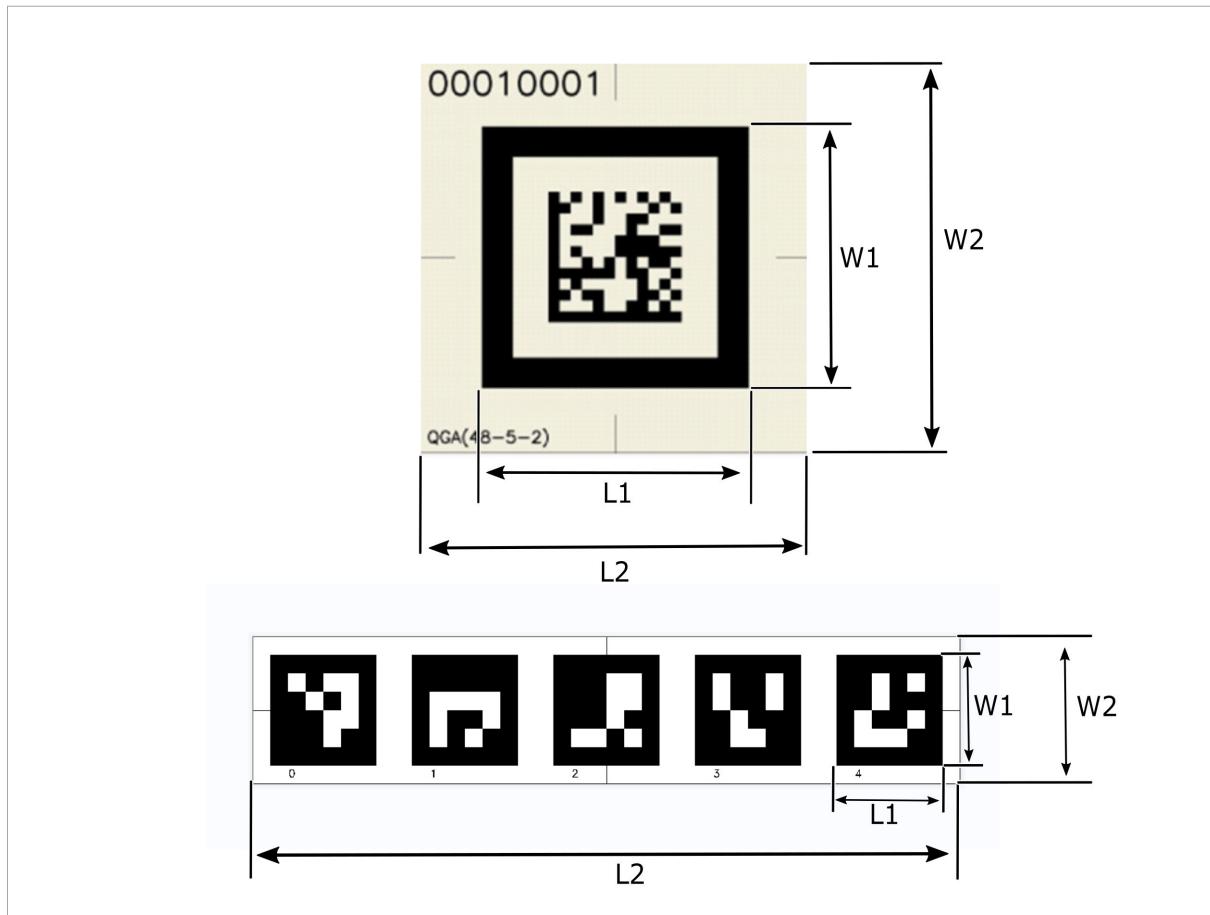


Figure 8 Dimensions of QR code labels

Name	Dimensions of QR code (L1×W1)	Dimensions of QR code label (L2×W2)
Floor QR code label	48 × 48 mm	72 × 72 mm
Floor complementary code label	48 × 48 mm	72 × 72 mm
Shelf QR code label	48 × 48 mm	72 × 72 mm
Bar QR code label for shelf beam	15 × 15 mm	100 × 20 mm

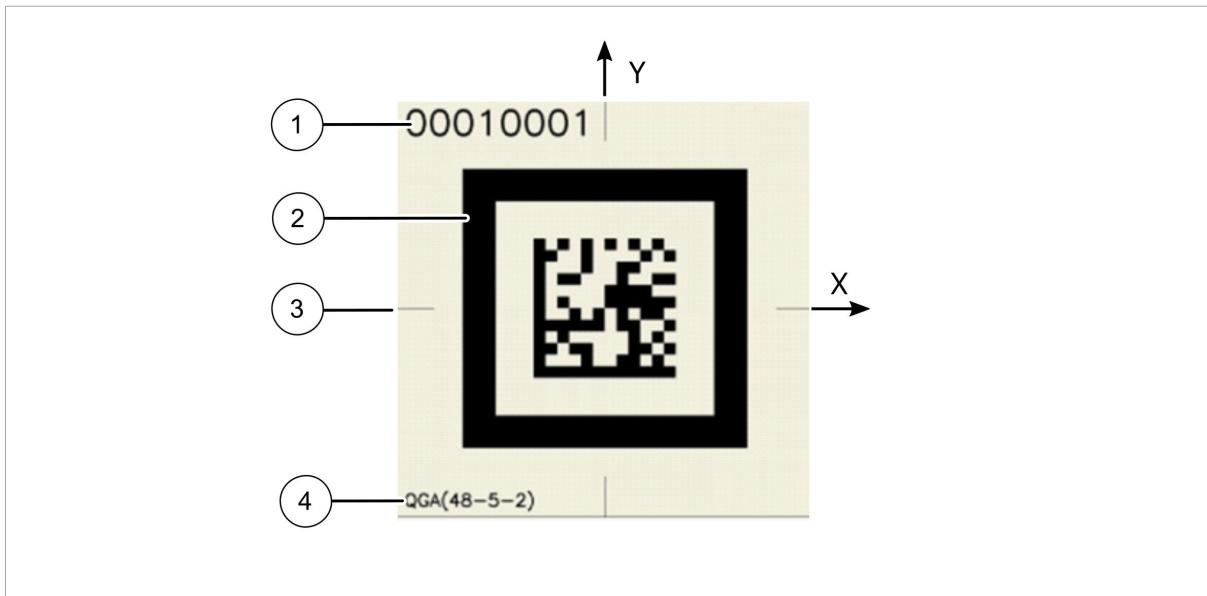


Table 14 Information on floor, shelf QR code labels

Number	Name	Description
1	Serial number of QR code labels	The numerical direction represent that positive direction of the y-axis of QR code.
2	QR code	Provides the robot with position information
3	Auxiliary central line	The short lines are at the center of each side of the label, which can assist in the alignment
4	Parameters of QR code	QGA: used for the floor QSA: used for the shelf or the charging station 48: The size of the black box of the QR code is 48×48 mm 5: The width of the black box of the QR code is 5 mm 2: The size of particles in the QR code is 2×2 mm

i Note:

- Adjacent ground QR codes are 300 mm apart from center to center.
- Make sure that the color of the ground area, within 200 mm x 200 mm of the QR code's center, is the same as the color of the QR code on the ground, avoiding black lines and color differences.

5.6 Optional equipment

5.6.1 Wide temperature battery *

P800R (normal temperature) will trigger low temperature protection when the working environment temperature is lower than 0°C, and the battery cannot be charged. In this case, you need to select a wide temperature battery or use a P800R (low temperature) robot.

5.6.2 Lidar *



Lidar has better ability to identify obstacles, and you can choose lidar as a robot obstacle detection sensor.

Note:

1. Below -10°C, only the infrared version can be used, and must only be used in unmanned scenarios.
2. The laser version is turned on in a working environment below -10°C, and the obstacle detection sensor fails to work; even if it is dispatched by RMS to an environment greater than -10°C, it cannot resume work.

6 Transport and store

6.1 Transportation

⚠ CAUTION

Ergonomic hazards!

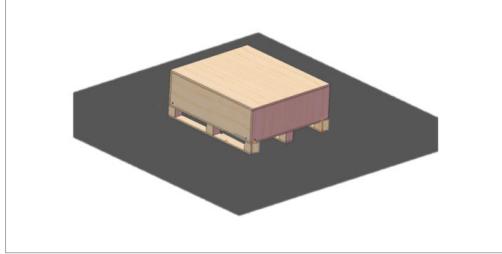
People who handle the packing boxes manually will hurt their waist. In some cases, the operator may be seriously injured by the packing boxes containing the robot.

Labels are marked on the packing box that it can only be lifted by forklifts and no manual lifting is permitted; The robot packing box is clearly marked with reserved forklift holes.

ℹ Note:

During transportation, the robot should always be placed on a horizontal plane to avoid damage to the robot due to the overturning of the packing box.

Steps



1. Use a forklift to transport the packing box with robots to the unpacking site.
2. A forklift should be used for handling through the pallet at the bottom of the packing box.

ℹ Note:

The forklift and packing box shown in the figure are only examples. The actual appearance shall be subject to the actual product used.

6.2 Robot transportation

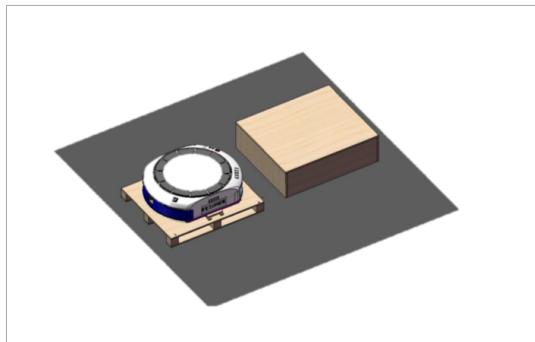
WARNING

Mechanical hazards!

If the operator handles the robot manually, it may hurt the waist, and when lowering the robot on the floor, it is easy to cause squeezing injury to fingers or feet. In some cases, the operator may be injured by robots or even seriously injured.

Please use maintenance tooling to push the robot directly from the packing box to the floor.

Steps



1. Remove the fixing bolt on the cover.



2. Remove the cover.
3. **For robots without brakes**
 - a. Put the slope in front of the robot.
 - b. Use the tooling to slowly push the robot down the slope to horizontal ground..
4. **For robot with brake**
 - a. Turn on the robot.
 - b. Put the slope in front of the robot.
 - c. Press the break release key to release the brake.
 - d. Lift the rear of the robot slightly and slowly push the robot (4) down the slope device (3) to the horizontal ground.
 - e. Switch off the key for break release and turn off the robot when do not need to move the robot.

6.3 Storage of robots

When the robot is not used for a long time, store it according to the following conditions:

- Keep it indoor and away from dust, flammable, explosive or corrosive gases and liquids.
- Temperature: -10°C to 40°C.
- Humidity: ≤ 80%, non-condensing
- Fully charge the battery for storage after each use, which helps extend the battery life.
- Fully charge the battery every 90 days to prevent damage to the battery.
- Fully charge and discharge the battery at least every 6 months for ambient temperature storage. Otherwise, the battery may be damaged.

7 Operations

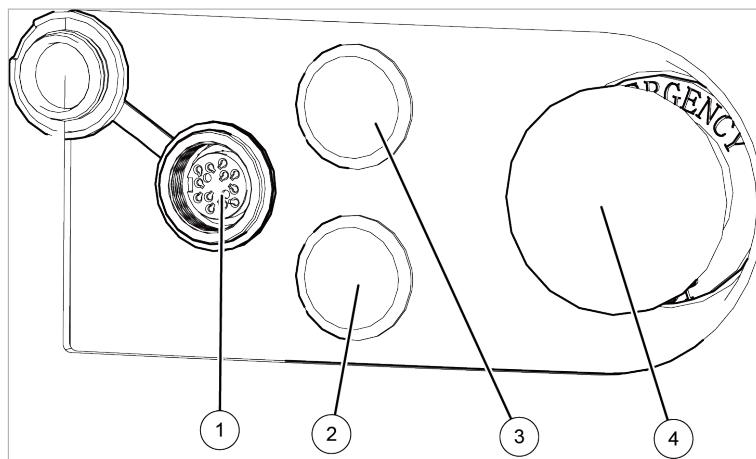
7.1 Managing robots in RMS

Through the Operation Monitoring module in the RMS system, you can manage robots and view robot information.

For specific operation methods, please refer to the "RMS System User Guide" and other relevant manuals.

7.2 Operation on robot

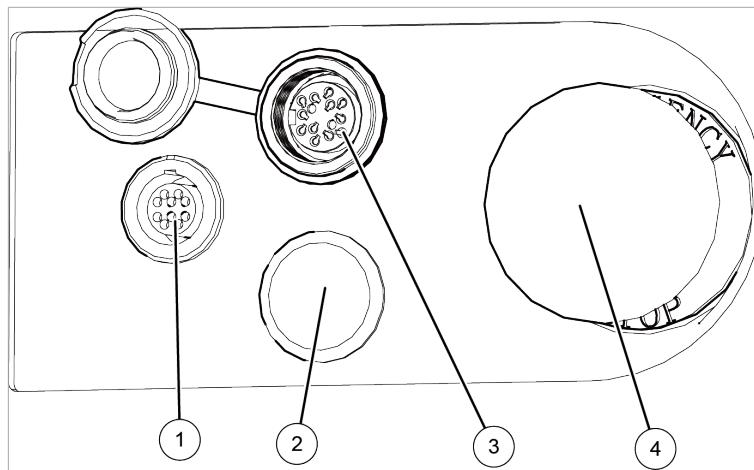
7.2.1 Front control panel



No.	Name	Function	Method of use
1	Handheld console port	Connect the hand console or manual mode maintenance plug	Connecting the hand console enables the robot to enter manual mode. Once the enable button is pressed, the robot can be controlled using the rocker. To push the robot, connect the manual mode maintenance plug and press the release brake. For details, refer to "Handheld Console User Manual".
2	Brake release button *	Releases the brake	<p>Enable: Press to engage the button. Disable: Press to release the button.</p> <p>Note:</p> <ul style="list-style-type: none"> ■ Suitable for robots with brake. ■ Releasing the brake is in maintenance mode. Maintenance mode can be exited by shutting down or restarting.

No.	Name	Function	Method of use
3	On/Off button	Turn on/off the robot	<p>Turn on: Press it to engage the button. Turn off: Press it to raise the button.</p> <p>!CAUTION</p> <p>Personal injury or robot damage! The robot will automatically rotate for one circle when it is turned on, which may injure people. Press the turn-on button and stay more than 1.5 m away from the robot.</p>
4	Front emergency stop button	Stop the robot in case of emergency	<p>Enable: Press to engage the button. Disable: Rotate in the direction of the arrow until the button is raised.</p> <ul style="list-style-type: none"> ■ When the emergency stop is triggered, the robot enters the fault state and brakes at the maximum deceleration speed, while the red light stays on. ■ After the emergency stop is disabled, the robot will not continue the task. It must be restarted to exit the fault state.

7.2.2 Rear control panel



No.	Name	Function	Method of use
1	Debugging port	Connect with the debugging cable	Plug the debugging cable into the debugging port

No.	Name	Function	Method of use
2	Brake release button *	Releases the brake	<p>Enable: Press to engage the button. Disable: Press to release the button.</p> <p>Note:</p> <ul style="list-style-type: none"> ■ Suitable for robots with brake. ■ Releasing the brake is in maintenance mode. Maintenance mode can be exited by shutting down or restarting.
3	Handheld console port	Connect the hand console or manual mode maintenance plug	Connecting the hand console enables the robot to enter manual mode. Once the enable button is pressed, the robot can be controlled using the rocker. To push the robot, connect the manual mode maintenance plug and press the release brake. Please refer to the "Hand Console User Manual" for details.
4	Rear emergency stop button	Stop the robot in case of emergency	Same as the front emergency stop button

7.2.3 Information indicated by light strips



The combination of different colors and flashing modes of the light strips (A) indicates different status of robots. Understanding these information will help you operate the robot. Please get to know about the following information regarding the light strip:

- Always on: The light strip is steady on, without flashing.
- Flashing: on for 0.5s and off for 0.5s, with the frequency of 1 Hz
- Slow flashing: On for 1s and Off for 1s, with the frequency of 0.5Hz.
- Extremely slow flashing: The light turns on for 1s, turns off for 4s, that is, the frequency is 0.2Hz.
- Short flashing: On for 0.2s and Off for 4s.

For more information on the definition of the light strip, refer to [Fault and troubleshooting of light strip indication \(Page 66\)](#).

7.3 Operation of the charging station

It adopts a touch screen. You can touch the screen to perform operations. Please refer to the E4850A-E4850B-4825B Charging Station User Manual for the parameters of the charging station.

7.4 Operations when personnel entering robot working area

7.4.1 Personnel enter robot working area



Risk of personal injury!

Entering the robot area during robot system operation is an extremely dangerous behavior and may lead to serious personal injury or death.

Access to the robot work area is allowed only if the robot system is completely stopped!

If personnel need to enter the robot working area:

1. [Stop robot system \(Page 45\)](#)。
2. Wait until all robots have stopped running.
3. Lock the screen of the computer to prevent system login by other people.
4. Wear necessary safety equipment.

Note:

Always pay attention to safety.

7.4.2 Stop robot system

Stop the robot system in the following situations:

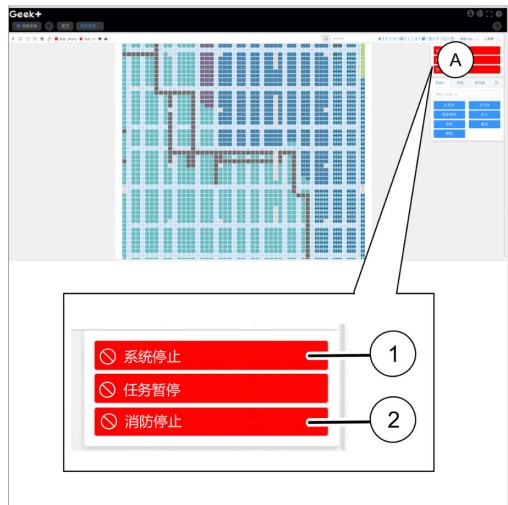
- Personnel need to enter the robot working area
- Fire accident
- Other

Scenario 1: With safety solutions.

Complete the operation according to the instructions in the Safety Solution User Manual.

Scenario 2: With no safety solutions.

Perform the following steps:



1. Click (1) <System stop> on <Operation monitoring>/<Map operation> interface (A) of WMS.

Note:

Click (2) <Fire emergency stop> in the case of fire.

2. Wait for the robot system to stop completely.
3. Lock the screen of the computer to prevent system login by other people.

Note:

If the system stop function fails, please contact the service personnel of Geek+ or Geek+ agent immediately.

7.4.3 Move the robot to the maintenance area

If the robot has a fault, it should be moved to the special maintenance area using manual dragging tooling, and the robot should be removed from the system before maintenance. Never maintain robots in the robot working area!

WARNING

Risk of personal injury!

The robot may collide with maintenance personnel, resulting in serious personal injury or property damage.

During maintenance, the robot must be removed from the system to prevent the system from starting the robot, resulting in serious consequences.

Scenario 1: With safety solutions.

Please complete the operation according to the instructions in the "Standard Safety Solution User Manual".

Scenario 2: With no safety solutions.

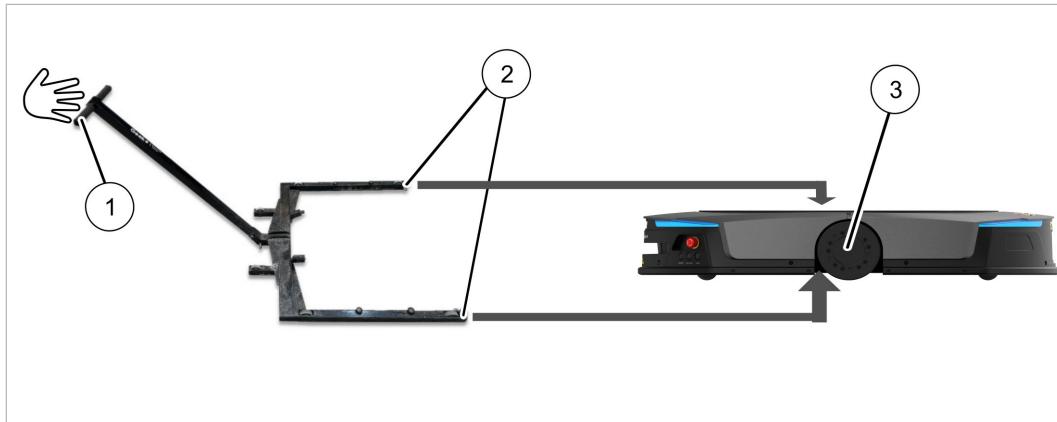
Please perform the following steps:

1. Dispatch the robot to the vicinity of the maintenance area in RMS.
2. Stop the robot system.
3. Turn the robot off (for robots without brake).
4. Press the brake release button to release the brake (for robots with brake).
5. Use manual drag tooling to move the robot to the maintenance area.

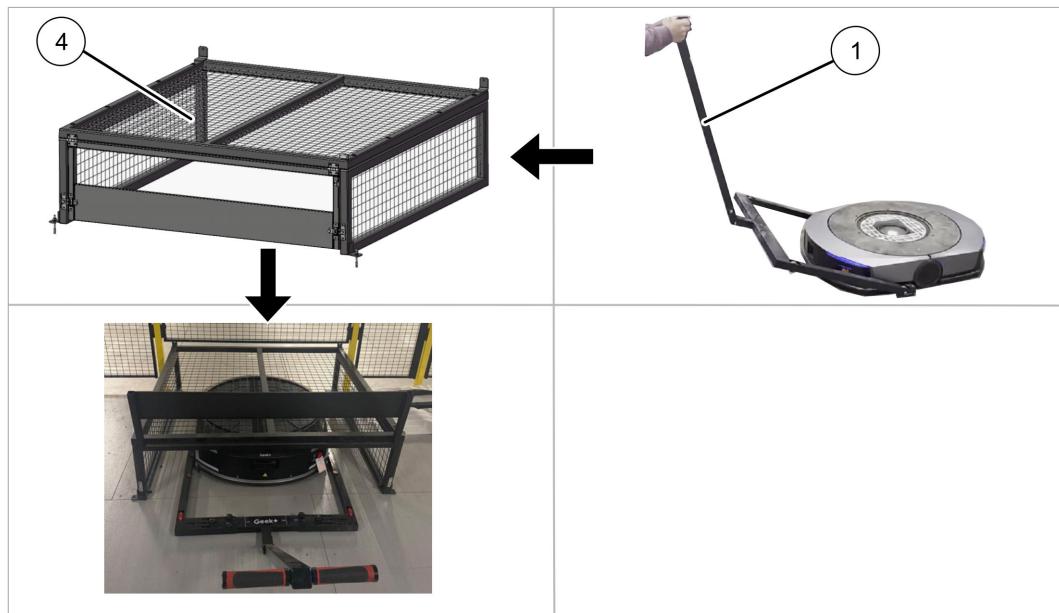
Note:

The robot appearance shown in the flowing figures are only examples. The actual appearance shall be subject to the actual product used.

- a. Hold the handle (1) of the dragging tooling with both hands and push it towards the robot.



- b. Insert the two jaws (2) of the dragging tooling into the front or rear side of the robot drive wheel (3).
- c. Pull the handle (1) of the dragging tooling to move the robot to the maintenance area (4).



- d. Remove the two jaws (2) of the dragging tooling from the front or rear side of the robot drive wheel (3) at the same time.
6. Remove the robot from the RMS.

8 Maintenance

8.1 Safety notices

Regular maintenance and service of the product can keep the performance of the product in a stable state. If maintenance is not executed on time, the function and service life of the product will be affected, causing unexpected accidents.



警告

Mechanical hazards!

During the operation of the robot, such as running or lifting, the gaps in the robot may cause injury to fingers or hands.

The gaps on the robot are designed to be less than 5 mm, so fingers can't easily get in; the emergency stop switch can be used to stop all movements of the robot in any emergency situation.

Always put safety first when maintaining the device:

- Observe the regulations for "Reminders for maintenance personnel".
- Disconnect the main power supply of the device, except for the maintenance work that needs to be carried out with power on. Lock the power supply if needed, to prevent others from accessing the power.
- Some maintenance work requires access to the robot work area. If personnel need to enter the robot work area, please strictly abide by the requirements for "personnel entre the working areas".
- Access to the robot work area is allowed only if the robot system is completely stopped.
- If you encounter unprovided handling methods and other unmentioned matters, contact the service personnel of Geek+ or Geek+ agent. Geek+ shall not be liable for any loss caused by unauthorized operation.

8.2 Maintenance list and interval

8.2.1 Maintenance schedule

Note:

The daily (daily, weekly, first monthly and every 3 months) maintenance of the product can be completed by the user according to the guidance provided in this manual. For the maintenance every 6 months and every year, please contact the Geek+ service team.

Table 15 Maintenance period

Item	Recommended maintenance frequency	
	Every 6 months	Annual
Robot	Robot appearance	Check/Clean
	Robot lifting mechanism	Check/Clean
	Dust plate	Check/Clean
	Obstacle detector	Check/Clean
	Upper camera	Check/Clean
	LED light strip	Check
	Robot control panel	Check
	Bumper strip	Check Replace
	Chassis bottom	Check/Clean
	Universal wheel assembly	Check/Clean Replace
	Driving wheel assembly	Check/Clean
	Lower camera	Check/Clean
	Robot interior	Check/Clean
	Robot charging socket	Check
	Battery	Check
Charging station	Charging station appearance	Check/Clean
	Charging station charging plug	Check
	Operation panel of the charging station	Check
QR code label	Floor QR code label	Check
	Shelf QR code label	Check
	QR code label of the charging station	Check
Shelf	Shelf	Check
	Goods placement	Check

Table 15 Maintenance period

Item		Recommended maintenance frequency	
		Every 6 months	Annual
Other	System emergency stop button	Check	
	System stop controller *	Check	
	Floor	Check	

8.2.2 Daily maintenance before power-on

Table 16 Daily maintenance items before power-on

No.	Item
1	All robots are normal, without red indicator which indicates exceptions.
2	All robots under <Route mode> are idle (IDLE/GO_REST) or in charging (GO_CHARGING).
3	All robots have more than 50% of power.
4	The robot system is running.

8.2.3 Daily maintenance after power-on

Table 17 Daily maintenance items after power-on

No.	Item
1	All robots are normal, without red indicator which indicates exceptions.
2	All robots under <Route mode> are idle (IDLE/GO_REST) or in charging (GO_CHARGING).
3	All robots have more than 50% of power.
4	The robot system is running.

8.2.4 Weekly maintenance

Table 18 Maintenance items every 1 week

No.	Item
1	Perform the required maintenance works listed in Daily maintenance after power-on (Page 51) .

Table 18 Maintenance items every 1 week

No.	Item
2	<i>Check the floor (Page 53)</i>
3	<i>Check the QR code (Page 54)</i>
4	<i>Check the appearance of shelves and placement of goods (Page 56)</i>

8.2.5 First run for a month

After one month of the first operation, maintenance of the items requested in the table is required. There is no every monthly maintenance for subsequent periodic maintenance, only the following items are required at the same time as the periodic maintenance every three months.

Table 19 Maintenance items for first month

No.	Item
1	Perform the required maintenance works listed in <i>Daily maintenance after power-on (Page 51)</i> .
2	Carry out the maintenance work listed in <i>Weekly maintenance (Page 51)</i> .
3	<i>Check the robot housing (Page 56)</i>
4	<i>Check the lift tray (Page 58)</i>
5	<i>Clean the upper camera (Page 58)</i>
6	<i>Clean the obstacle detector (Page 59)</i>
7	<i>Check the light strip (Page 60)</i>
8	<i>Check the charging socket of the robot (Page 62)</i>

8.2.6 Every 3 months maintenance

Table 20 Maintenance items every 3 months

No.	Item
1	Carry out the maintenance work listed in <i>After daily operation (Page 51)</i> .
2	Carry out the maintenance work listed in <i>Weekly maintenance (Page 51)</i> .
3	Perform the required maintenance works listed in <i>First run for a month (Page 52)</i> .
4	<i>Check the bumper strips (Page 60)</i>
5	<i>Check the emergency stop button on the robot (Page 61)</i>

Table 20 Maintenance items every 3 months

No.	Item
5	<i>Disconnect and connect battery plug (Page 63)</i>

8.3 Working Environment

8.3.1 Check the floor

WARNING

Personal injury or property damage

In the process of transporting goods, the robot may stop due to environmental reasons or the weight of the goods exceeds the rated load of the robot. At this time, the high temperature of the motor may cause a fire. People around may get seriously burnt.

Please check and clean the floor periodically.

CAUTION

Personal injury or property damage

While approaching to the picking workstation, it may cause the robot movement state to be abnormal due to the floor itself, which may further lead to an unstable status of the robot or an impact with the fence or other robots. The goods may fall from the shelf in such condition and may impact with people at the picking workstation.

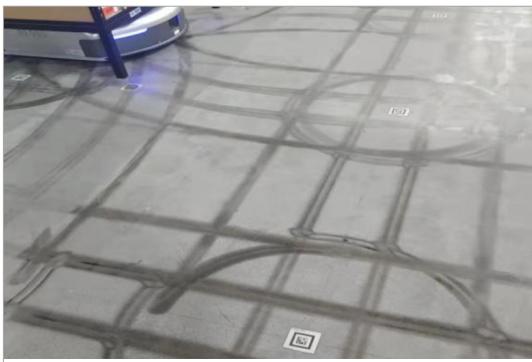
Please check and clean the floor periodically.

Tools and equipment

No.	Name
1	Long-handled commercial office cotton yarn mop

Steps

1. *Stop the robot system (Page 45) .*
2. *Personnel entering robot working area (Page 45) .*



3. Visually inspect the floor. The floor should be flat and free of foreign matters, dirt or damage.
4. If there are foreign matters or dirt on the floor, clean them with a long-handled commercial office cotton yarn mop.
Please pay attention when cleaning:
 - Avoid wet mops leaving black stains on the floor QR code.

i Note:

Perform a complete floor QR code cleaning. The site needs to be cleaned repeatedly with a mop to avoid leaving black stains on the floor QR code.

- Avoid moving the floor QR code location with too much force.
5. If the floor is damaged, , contact Geek+ or Geek+ agent.

i Note:

Ground QR codes under shelves usually do not need to be cleaned, areas where robots frequently lose codes can be counted on the RDC to identify the specific locations.

8.3.2 Check the QR code

The QR codes provide navigation, position, angle and other information for the robot. If the QR codes are dirty, damaged, wrong or missing, it will affect the normal running of the robot.

Checking the QR code regularly is conducive to reducing the risk of failure and improving the operational efficiency.

Tools and equipment

No.	Name
1	Clean towel without water dripping

Steps



1. *Stop the robot system (Page 45) .*
2. *Personnel entering robot working area (Page 45) .*
3. Visually inspect the floor QR code label. The QR code label should be clean and free of stains, edges should be free of warping, angles should be normal and free of offset, and the black part of the QR code label should be clear and free without damage and whitening.
4. If a QR code is dirty, wipe and clean the QR code with a clean towel without dripping water. In the figure, (A) is a clean QR code label, and (B) is a dirty QR code label.
If the QR code label is tilted or skewed, it needs to be re-pasted.
If a QR code is damaged or whitened, please contact the Geek+ service personnel to get a new QR code and replace it.

8.3.3 Check the appearance of shelves and placement of goods

WARNING

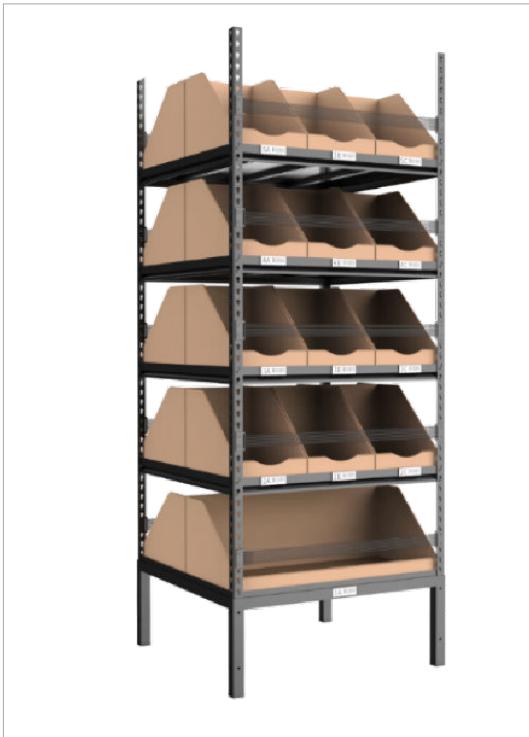
Personal injury or property damage

Deformation of the shelf and abnormal placement of goods can cause the goods to fall or the shelf to overturn, which will affect the normal running of robots and cause property loss or personal injury.

Please check the shelves periodically.

Steps

1. *Stop the robot system (Page 45) .*
2. *Personnel entering robot working area (Page 45) .*
3. Visual inspection of all shelf appearances and goods placement.
 - If the shelves are damaged or deformed, replace them.
 - If the goods protrude from the edge of the tote, place the goods back in the tote.



8.4 Mechanical system

8.4.1 Robot housing

8.4.1.1 Check the robot housing

Tools and equipment

No.	Name
1	Wet wipes or semi-dry towel

Steps



1. **Move the robot to the repair area (Page 46)**.
 2. Turn off the robot.
 3. Visually inspect the robot housing (1) for dust, and use wet wipes or semi-dry towel to wipe and clean the robot housing (1).
 4. Check whether the robot housing (1) has scratches, dents, cracks, deformation, or other damage. Check whether the robot housing (1) is fully snapped into the chassis and no cables are pressed. If the robot housing (1) is seriously damaged, it needs to be replaced, see **Remove and install the robot housing (Page 57)**.

8.4.1.2 Remove and install the robot housing

Steps



1. **Move the robot to the repair area (Page 46)**
 2. Turn off the robot.
 3. **Removal**
 - a. Remove the housing fixing bolts M5×12 (1), 8 in total.
 - b. Press the emergency stop switch of the robot to have space for removing the housing.
 - c. Gently move the housing upward to remove it.
 4. **Installation**

The installation process is the reverse of the removal process.

8.4.2 Lift tray

8.4.2.1 Check the lift tray

Tools and equipment

No.	Name
1	Rubber hammer

Steps



1. *Move the robot to the repair area (Page 46)*.
2. Turn off the robot.
3. Check whether the rubber pad (3) of the tray is loose or missing.
 - If it is loose, use a rubber hammer to tap it into the groove.
 - If it is missing, reinstall it.
4. Shake the tray (1) by hand and check whether it is loose. If it is loose, tighten the set bolt (2) of the tray.

8.5 Electrical system of robot

8.5.1 Clean the upper camera

⚠ WARNING

Personal injury or property damage

In the process of maintaining the robot chassis components, it is sometimes necessary to turn the robot over or lift the robot. The robot may fall to the floor if it is overturned or hoisted improperly. People nearby may be injured by robots or even seriously injured.

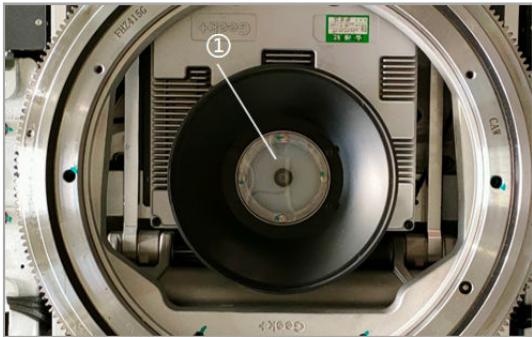
Please use the special maintenance tooling to repair the parts of the robot chassis.

Tools and equipment

No.	Name
1	Lens paper or alcohol pad

No.	Name
2	Maintenance tooling

Steps



1. *Move the robot to the repair area (Page 46)*.
2. Turn off the robot.
3. **Clean the upper camera**
 - a. Visually inspect whether the upper camera (1) is covered with dust or foreign matter, remove the foreign matter, and wipe the camera with lens paper or alcohol pad.
4. **Clean the lower camera**
 - a. Use the maintenance tooling to turn the robot over. For specific operation methods, please refer to the Robot Maintenance Tooling User Manual.
 - b. The cleaning method of the lower camera is the same as that of the upper camera (1).

8.5.2 Clean the obstacle detector

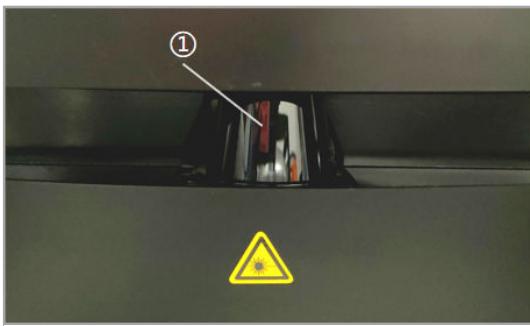
Tools and equipment

No.	Name
1	Lens paper or alcohol pad

Steps



1. *Move the robot to the repair area (Page 46)*.
2. Turn off the robot.
3. **Suitable for infrared obstacle detector**
Visually inspect the obstacle detection sensors (1) and (2) for dirt or other particles and clean the sensors (1) and (2) with a wipe of lens paper or alcohol pad.



4. Suitable for lidar obstacle detector

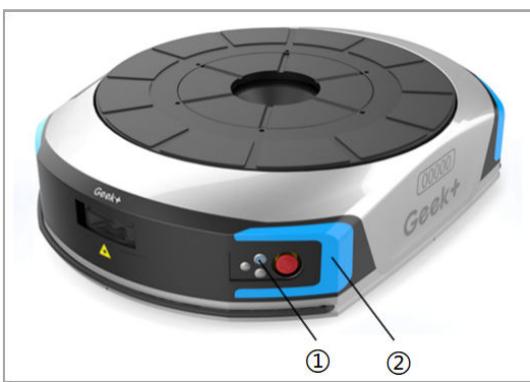
Visually inspect the obstacle detection sensors (1) for dirt or other particles and clean the sensors (1) with a wipe of lens paper or alcohol pad.

NOTICE

Suitable for lidar obstacle detector. The obstacle detector is highly sensitive. Check the wiping result carefully to make sure the sensor is clean. Otherwise, the operation of the robot can be affected.

8.5.3 Check the light strip

Steps



1. [Move the robot to the repair area \(Page 46\)](#) .
2. Turn off the robot.
3. Press the on/off button (1) to turn the robot on.
4. When the robot is turned on, all four light strips (2) should be on, with uniform light, no shadow and consistent color.

i Note:

If the light strip is abnormal, please contact the professional service personnel of Geek+ or Geek+ agents.

8.5.4 Check the bumper strips

The bumper strip is a hollow pipe with both ends closed. The electric pressure switch is activated by the change of air pressure in the pipe, which affects the movement of the robot, thus avoiding collision.

The rupture of bumper strip means that the air pressure cannot be established due to air leakage, so that the bumper strip fails. Therefore, the robot loses the anti-collision function.

Steps



1. [Move the robot to the repair area \(Page 46\)](#).
2. Turn off the robot.
3. Remove the robot housing. Please see [Remove and install the robot housing \(Page 57\)](#).
4. Check the bumper strip (1) for visible damage, bending or warping.
5. Turn on the robot.
6. Press the rear bumper strip by hand. If the red indicator of the robot is always on, and returns to normal state after the strip is released, it means that the function of the rear bumper strip is normal.
7. Press the front bumper strip by hand. If the red indicator of the robot is always on, the bumper strip works normally.
 - After the front bumper strip is triggered, the robot enters the fault mode. The robot needs to be restarted to resume to the normal state.
8. Restart the robot to exit the fault mode.

Note:

If the bumper strip is damaged, contact the service personnel of Geek+ or Geek+ agent immediately for resolution.

8.5.5 Check the emergency stop button on the robot

Steps

1. [Move the robot to the repair area \(Page 46\)](#).
2. Turn on the robot.



3. Press the front emergency stop switch (1) of the robot.
4. Check whether the red indicator of the robot is always on. If so, the front emergency stop button is functioning properly.
5. Release the front emergency stop button (1) of the robot.
6. Restart the robot right above the QR code.
7. Follow the same procedure to check the rear emergency stop button (2) of the robot.

Note:

If the emergency stop button is damaged or the function is abnormal, please contact the service personnel of Geek+ or Geek+ agent for repair.

8.5.6 Check the charging socket of the robot

⚠ CAUTION

Personal injury

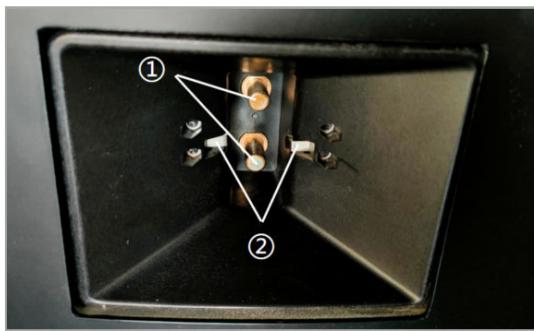
While touching the charging socket of the robot, people may get electrical shock.

Please turn off the robot and disconnect the battery connector before maintenance.

⚠ CAUTION

It is forbidden to use conductors or metal products to directly connect the charging pin (1) and the charging signal pin (2), otherwise there will be a risk of short circuit.

Steps



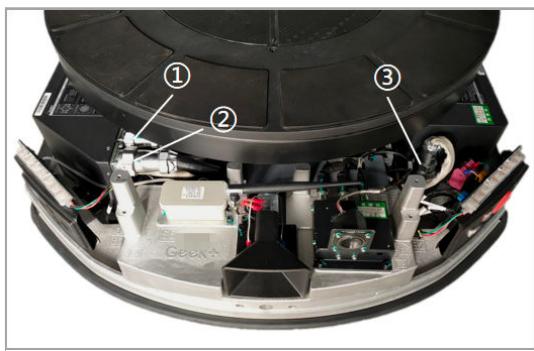
1. [Move the robot to the repair area \(Page 46\)](#) .
2. Turn off the robot.
3. Check whether the charging pin (1) has visible bending, 2 in total.
4. Visually check whether the socket clips (2) are normal.

Note:

If the charging pin (1) is bent or the socket tab (2) is damaged, please contact the service personnel of Geek+ or Geek+ agent immediately for replacement.

8.5.7 Disconnect and connect battery plug

Steps



1. [Move the robot to the repair area \(Page 46\)](#) .
2. Turn off the robot.
3. Remove the robot housing. For details, see [Remove the robot housing \(Page 57\)](#) .
4. **Disconnect with battery plug**
 - a. Screw out plugs (1) ~ (3) counterclockwise.
 - b. Remove the battery plugs (1) ~ (3) from the battery.
5. **Connect with battery plug**
 - a. Insert the plugs (1) ~ (3) into corresponding sockets of the battery.
 - b. Screw the plugs (1) ~ (3) in clockwise until the plugs are in place.

8.6 Check the safety label on the robot

- Check them for any dirty. If yes, clean them immediately.
- Check them for any damage or loss. If yes, replace them immediately. You can contact the service department or agent of Geek+ for safety labels.
- When you repair or replace a component with a safety label, make sure that the new component contains the correct safety label.

8.7 Battery storage notices

Observe the following requirements when using batteries:

- Fully charge the battery and store it after each use, which can help extending the battery life.
- Do not use or store the battery in an environment with the temperature lower than -10 °C or higher than 45 °C. Fully charge the battery every 90 days to prevent the battery from being damaged. Otherwise, the battery can be damaged, and the warranty does not cover such damages.
- Do not use battery packs of other models or brands. There might be safety risks.
- The battery is a lithium battery with high voltage.
- Do not touch the battery pins or disassemble/puncture the shell. Keep metal objects away from the battery pins to avoid short circuit. Otherwise, it might cause battery damage or casualties.
- Use the original charger only, otherwise there is a risk of damage or fire.
- Dispose of the used batteries properly. Otherwise, it may cause severe environmental pollution. Follow local regulations when discarding the battery pack. Do not discard the battery pack at will to protect the environment.
- The robot and battery are transported as a whole. Unauthorized personnel are not allowed to remove the battery. If you need to remove the battery, please contact the professional service personnel of Geek+ or Geek+ agents.

8.8 Encoder battery storage notice

Observe the following requirements when storing encoder battery batteries:

- The battery should be used and stored in a place away from static electricity.
- The battery should be stored in an environment with temperature not exceeding 30 °C and relative humidity of 45%~75%.
- The battery should be stored away from heat sources, corrosive gas environment and direct sunlight to ensure that the storage area is clean, cool, dry and ventilated.
- The stacking height of battery packing box is not more than 1.5 m, and the wooden box is not more than 3 m.
- When the battery is not in use, it shall be stored in its original packing. The battery after removing the packing cannot be stacked at will.
- Before installing the encoder battery, confirm that the voltage of the encoder battery is greater than 3.6 V through a multimeter.

For robots of the same batch in the site, the period of applying for encoder battery spare parts is shown in the table below.

Table 21 Encoder battery spare parts period

Spare parts period	Description
36 months	Please contact the professional service personnel of Geek+ or Geek+ agents.
Any single robot reports a low battery alarm.	The encoder can still be used normally within 1 month after the low battery alarm. Encoder battery replacement shall be completed within 1 month.
The lift tray is not at the lowest point when any single robot starts up.	Please contact the professional service personnel of Geek+ or Geek+ agents.

8.9 List of common materials

Table 22 List of common materials

Material No.	Tool name	Model	Description	Quantity ^[A]	Unit
—	Lens paper	—	For cleaning upper and lower cameras/sensors	10	Pieces
—	Medium strength thread compound	Loctite-242	—	2	ml

(A) The amount of material required to maintain a single robot.

9 Common faults and troubleshooting

9.1 Fault and troubleshooting of light strip indication

⚠ WARNING

Risk of personal injury!

During start-up, if the top plate of the lifting connecting rod assembly is not at the lowest point, it will trigger automatic lowering. If the operator approaches or extends his hand into the lift connecting rod assembly at this time, it may cause serious personal injury.

Before start-up, please ensure that there are no human limbs in the lifting connecting rod. Avoid triggering squeezing and shearing risks.

NOTICE

During maintenance, special attention should be paid to:

- Remove the load on the robot.
- Before maintenance and disassembly, the robot should be in the shutdown state and pressed the emergency stop button.

Table 23 Faults indicated by light strips and troubleshooting

CE light strip status	Non-CE light strip status	Cause	Troubleshooting
White indicator is always on	White indicator is always on	1. Remote upgrade 2. Parametric solidification	Wait for the mission to complete, no need to deal with it
White indicator is always on	Cyan indicator is always on	Calibrating gyro zero bias	Wait for the mission to complete, no need to deal with it
White indicator is always on	Cyan light slow flashing (on for 1000ms off for 1000ms)	Charging task status	No handling required
White indicator is always on	Blue indicator is always on	On mission	No handling required
White light slow flashing (on for 1000ms off for 1000ms)	Blue light slow flashing (on for 1000ms off for 1000ms)	Mission complete, idle mode	No handling required

Table 23 Faults indicated by light strips and troubleshooting

CE light strip status	Non-CE light strip status	Cause	Troubleshooting
White light short flashing (on for 200ms off for 4000ms)	Blue light short flashing (on for 200ms off for 4000ms)	Low power mode	No handling required
Purple light flashing (on for 500ms and off for 500ms)	Purple light flashing (on for 500ms and off for 500ms)	1. Master control does not receive heartbeat frame for more than 90 seconds 2. RMS and host TCP connection disconnected 3. Security WIFI master station disconnected from slave station	Single robot purple light flashing: push the robot directly above the QR code near the Wi-Fi node and restart the robot. Multiple robots purple light flashing at the same time: the overall network environment is abnormal, please check the warehouse network.
Red indicator is always on	Red indicator is always on	1. Robot bumper strip trigger 2. Emergency stop button pressed 3. Brake release button pressed 4. Lift button pressed	Front/rear bumper strip Trigger: Remove the obstacle, then restart the robot directly above the QR code. Emergency stop trigger: eliminate emergency, and then restart the robot directly above the QR code. Brake release button pressed: press the brake release button causes it to pop up. Lift button pressed: Restart the robot directly above the QR code.
Red light slow flashing (on for 1000ms off for 1000ms)	Red light slow flashing (on for 1000ms off for 1000ms)	1. Battery power below 30% 2. Charging without current 3. Absolute encoder battery power is low	Battery capacity is lower than 30% / No current when charging: 1. Dispatch the robot to be charged in WMS or manually charge the robot

Table 23 Faults indicated by light strips and troubleshooting

CE light strip status	Non-CE light strip status	Cause	Troubleshooting
			<p>after remove it from WMS.</p> <p>2. Check the charging station. If the charging station is abnormal, please contact the service personnel of Geek+.</p> <p>Absolute encoder battery power is low: Replace the parts, please contact the service personnel of Geek+.</p>
Red light short flashing (on for 200ms off for 4000ms)	Red light short flashing (on for 200ms off for 4000ms)	System emergency stop	No handling required
Red light flashing (on for 500ms and off for 500ms)	Red light flashing (on for 500ms and off for 500ms)	<p>1. The master control has not received the obstacle avoidance data sent by the industrial control.</p> <p>2. Drive Lost</p> <p>3. Manual mode</p>	<p>1. Restart the robot directly above the QR code</p> <p>2. If not be recovered, please contact service personnel of Geek+ .</p>
Cyan indicator is always on	Green indicator is always on	<p>1. Shelf code not found in the process of picking up and returning the shelves.</p> <p>2. Shelf code not found after rotating the body during the load movement.</p> <p>3. The angle or position of the shelf deviates too much during the load movement.</p> <p>4. Backpack charging station, charging and charging exit not found shelf code.</p>	<p>Check whether the QR code of the shelf/charging station is lost, stained or offset. Check whether there are foreign objects on the upward camera of the robot. Clean the camera if needed.</p>

Table 23 Faults indicated by light strips and troubleshooting

CE light strip status	Non-CE light strip status	Cause	Troubleshooting
		5. Big deviation of path end position and angle even after calibration	
Cyan light slow flashing (on for 1000ms off for 1000ms)	Green light slow flashing (on for 1000ms off for 1000ms)	1. In non-standard map mode, the robot did not complete map information interaction with RMS after startup. 2. wrong starting position of path segment	Restart the robot right above the QR code.
Cray light flashing (on for 500ms and off for 500ms)	Green light flashing (on for 500ms and off for 500ms)	1. Lost code and stop moving 2. Charging and ground code not found after charging 3. No QR code is recognized at the end of the path after the calibration of the end point is started	Number of continuously lost QR code ≥2: 1. Check whether the four consecutive QR code behind the robot are dirty or have angle deviation. Clean or replace dirty QR codes. Re-paste or replace the deviated QR codes. 2. Check whether the floor of 4 consecutive cell behind the robot is damaged or pitted in, and repair it if necessary. 3. Check whether there are objects on the shelves near the 4 consecutive cells behind the robot rubs against the robot. If so, remove the objects. Leaving or entering the charging station without recognizing the ground QR code: check if the ground QR code of the charging station is working properly and repair it if necessary.

Table 23 Faults indicated by light strips and troubleshooting

CE light strip status	Non-CE light strip status	Cause	Troubleshooting
			No QR code is recognized at the end of the path after the endpoint calibration is started: Check if the ground QR code is normal and repair it if necessary.
Yellow indicator is always on	Yellow indicator is always on	1. The obstacle detector detects an obstacle 2. Safety controller requests a stop 3. Triggering UWB deceleration or stopping 4. Exit obstacle avoidance, or wait two seconds before stopping	The obstacle detector detects an obstacle: Remove the obstacle. The safety controller requests a stop: 1. Check that the robot emergency stop switch has not been triggered 2. Eliminate the emergency 3. Restart the robot directly above the QR code Triggering UWB deceleration or stopping: the person leaves the warning area. Exit obstacle avoidance, or wait two seconds before stopping: no processing required
Yellow light slow flashing (on for 1000ms off for 1000ms)	Yellow light slow flashing (on for 1000ms off for 1000ms)	1. weighing overload 2. partial load overrun 3. Enable of hand manipulator/APP after entering manual mode	Weighing overload: reduce the weight. Partial load overrun: relocate the goods and adjust the gravity center of the shelf near the geometric center of the shelf. Robot in manual mode: exit manual mode after operation.

Table 23 Faults indicated by light strips and troubleshooting

CE light strip status	Non-CE light strip status	Cause	Troubleshooting
Yellow light flashing (on for 500ms and off for 500ms)	Yellow light flashing (on for 500ms and off for 500ms)	1. Drive error 2. Angle overrun in moving	Restart the robot above the QR code and observe whether it recovers; contact service person of Geek+ if necessary.

9.2 Restart the robot right above the QR code

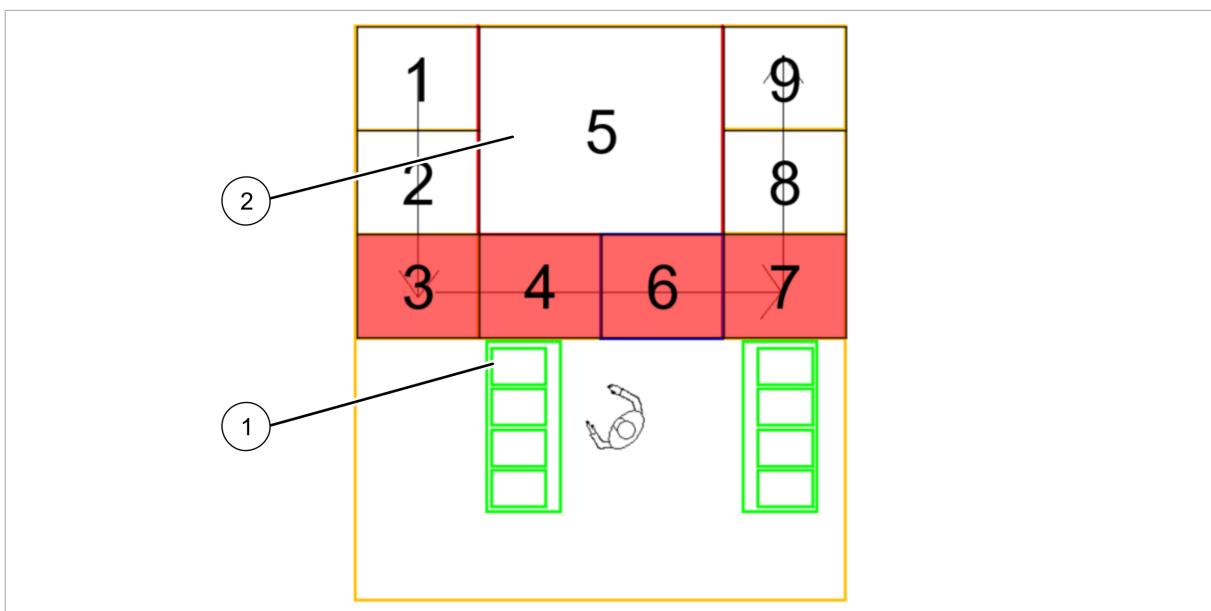
When the robot needs to be added to the WMS after recovery, restart or repair, it is necessary to restart the robot right above the QR code.

NOTICE

Before the robot is turned on/off, it is necessary to remove the tote on the lift tray to ensure that there are no goods on the lift tray.

9.2.1 Suitable for robots without brake.

1. *Stop the robot system. (Page 45)*
2. Turn off the robot.
3. Use the drag tooling to move the robot directly above the QR code in the aisle area.
 - When the robot is on the shelf turning position, move the robot to be right above the QR code in the aisle area.



Number	Name
1	Workstation
2	Shelf turning position

4. Turn on the robot.

WARNING

Risk of personal injury!

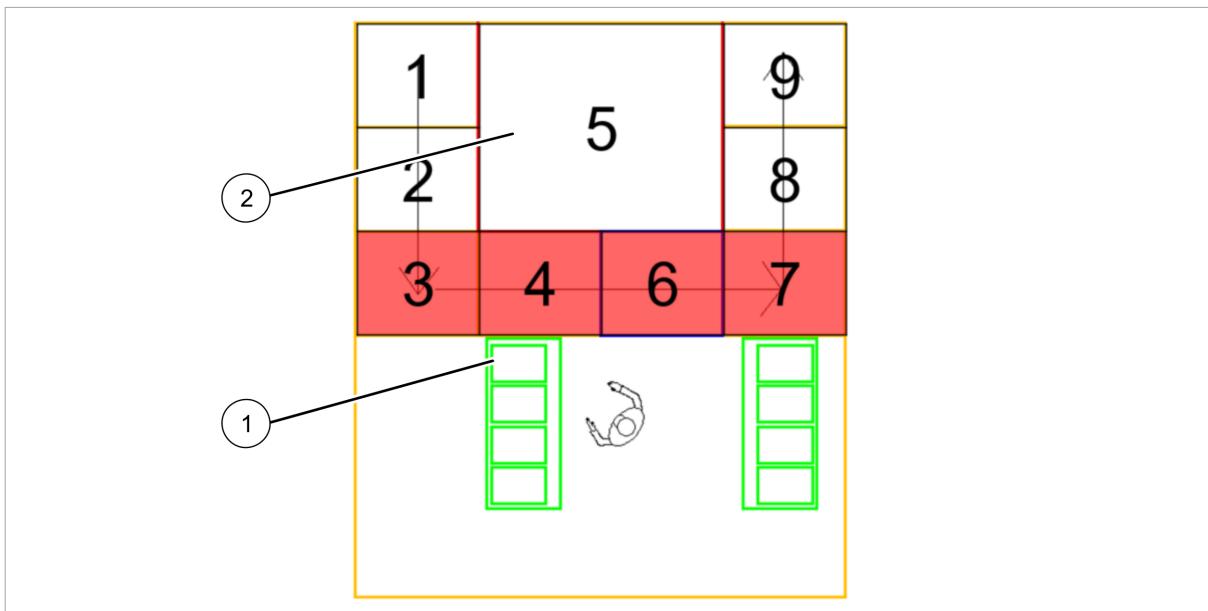
During start-up, if the top plate of the lifting connecting rod assembly is not at the lowest point, it will trigger automatic lowering. If the operator approaches or extends his hand into the lift connecting rod assembly at this time, it may cause serious personal injury.

Before start-up, please ensure that there are no human limbs in the lifting connecting rod. Avoid triggering squeezing and shearing risks.

5. After turning on, if the green indicator (Non-CE version) / Cyan indicator (CE version) of the robot is always on, it means that the QR code is not recognized. Slightly move the robot until it can recognize the QR code.
6. The robot will automatically lock the wheels after recognizing the floor QR code; If the operator cannot push it, it means that the robot has completed the QR code recognition, and the operator can stand up.
7. After the robot starts, leave the robot work area according to the site safety regulations.

9.2.2 Suitable for robots with brake.

1. [Stop the robot system. \(Page 45\)](#)
2. In the turn-on state, press the brake release button to turn off the robot.
3. Use the drag tooling to move the robot directly above the QR code in the aisle area.
 - When the robot is on the shelf turning position, move the robot to be right above the QR code in the aisle area.



Number	Name
1	Workstation
2	Shelf turning position

4. Turn on the robot.
5. After turning on, if the green indicator (Non-CE version) / Cyan indicator (CE version) of the robot is always on, it means that the QR code is not recognized. Slightly move the robot until it can recognize the QR code.
6. The robot will automatically lock the wheels after recognizing the floor QR code; If the operator cannot push it, it means that the robot has completed the QR code recognition, and the operator can stand up.
7. After the robot starts, leave the robot work area according to the site safety regulations.

9.3 Method for recoverable fault

Scenario 1: For robots with power

Recoverable troubleshooting steps:

1. *Personnel enter robot working area (Page 45)*
2. Restart the robot according to *Restart the robot right above the QR code (Page 71)*; If it cannot be recovered, please use the drag tooling to manually drag the robot out of the work area (for robots without brakes).
3. According to the instructions in the "Standard Safety Solution User Manual", the system shall be restored after the personnel leave the operation area.

Scenario 2: For robots without power

The fault of the robot without power is unrecoverable, and the troubleshooting steps are as follows:

1. Restore according to [Troubleshoot unrecoverable faults \(Page 74\)](#) .

9.4 Troubleshoot unrecoverable faults

Unrecoverable faults refer to damaged components which need to be repaired and replaced. Most of these faults refer to the inability to perform RMS scheduling tasks after startup, which does not mean that the robot cannot start normally.

For steps 5-6 of the operation steps, please refer to the "RMS System User Guide" and other relevant manuals.

1. [Stop the robot system. \(Page 45\)](#)
2. Place the shelf carried by the malfunctioning robot right above the QR code in the aisle area.

Methods to lower the shelf:

- a. Turn on or turn off the robot; During initialization, the robot automatically lowers the shelves.
- b. Operate the raising and lowering buttons; Manually triggered robot will automatically lower the shelf.

i Note:

Before lowering the shelf, if the robot is not above the QR code, it is necessary to release the motor through the release brake button; Manually push the shelf and the robot to the top of the QR code, and align the shelf with the naked eye. Then trigger the shelf lowering action.

3. Update the shelf to the actual position.
4. Please use the drag tooling to manually move the faulty robot to the maintenance area. See [Move the robot to the maintenance area \(Page 46\)](#) .
5. Remove the robot from the RMS.
6. Recover the system, and the system automatically schedules the new robot to perform the task.

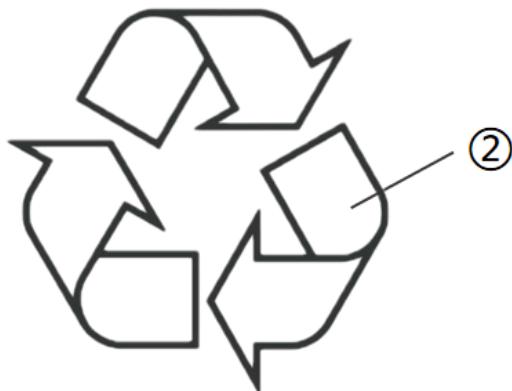
10 Decommissioning and disposal

When the equipment or its components have reached the end of life and need to be scrapped, they must be properly disposed of. In this process, the regulations issued by the local authorities in charge must be observed. If you have any questions, contact the service department of Geek+ or Geek+ agent.

- Products with symbol (1) shall not be mixed into household waste at its end of life, but shall be disposed of according to the local regulations.



- Materials with symbol (2) are recyclable. Recycle them according to local regulations.



- Recycle the recyclable packaging materials. Do not throw them into household waste.
- Recycle the recyclable plastics. Do not throw them into domestic garbage.
- Used batteries contain harmful substances, which can seriously pollute the environment. They must be recycled by the dealer, properly disposed of or delivered to a collection point. Do not throw used batteries into the garbage.
- Please pay attention to the relevant local laws and regulations and comply with these regulations.

11 Technical terms and abbreviations

11.1 Technical terms

Table 24 Technical terms

Technical terms	Description
PopPick	Geek+ new-generation goods-to-person picking solution, named after Pop out Pick easy. Totes are stored on movable racks, and the P series latent robots transport the movable racks to the automatic tote picking workstation - PopPick workstation. The hit totes are automatically removed and sent to the operator for easy picking. At the same time, it is compatible with large and entire-pallet storage and picking, and one solution can meet the storage and picking needs of all categories of large, medium and small items.

11.2 Abbreviations

Table 25 Abbreviations

Abbreviations	English name	Chinese description
A		
AP	Access Point	无线接入点
AMR	Autonomous Mobile Robot	自主移动机器人
G		
GPS	Geek+ Picking System	极智嘉拣选系统
I		
ID	Identity Document	识别号
R		
RF	Radio Frequency	无线射频
RS	RoboShuttle	货箱到人产品名
RMS	Robot Management System	机器人管理系统
U		
UI	User Interface	用户界面
W		
Wi-Fi	Wireless Fidelity	无线通信技术
WMS	Warehouse Management System	仓储管理系统
5G	5th Generation Mobile Communication Technology	第五代移动通信技术

12 Certification and testing

12.1 Certification

We, Nanjing Geekplus Robotics Co., Ltd.

Address: 2nd floor, Block B4, Hongfeng Science and Technology Park, Nanjing Economic and Technological Development Zone

declare under our sole responsibility that the product:

product name: Geek Robot

trade name: Geekplus

type: P800R, P500R, M1000R-S-B

to which this declaration relates is in conformity with the essential requirements and other relevant requirements of the Machinery Directive (2006/42/EC), Radio Equipment Directive(2014/53/EU), EMC Directive(2014/30/EU), RoHS Directive(2011/65/EU).The product is in conformity with the following standards and/or other normative documents:

EN ISO 12100, EN 60204-1, EN ISO 13849-1, EN 1175-1, EN 1525 / EN ISO 3691-4

EN 61000-6-2, EN 61000-6-4, EN 301489-1, EN 301489-17

EN 62311, EN 300328, EN 301893



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