Quicktron 快仓

快人一步　智领仓储

M100 CE VERSION WAREHOUSING ROBOT OPERATING INSTRUCTION

* All pictures herein are for reference only, which shall be subject to the actual objects in the actual environment

* Please read carefully before using

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THE LEADER IN INTELLIGENT WAREHOUSING ROBOT

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Document History

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1. Notes before Use

1.1 Requirements for the floor of the site

Before the robot enters the site, the operation area for the robot shall be inspected, evaluated and modified or reconstructed as necessary by Quicktron or the warehouse operator as technically required for the floor of Quicktron robot. If the modification or reconstruction is completed by the warehouse operators themselves, after the construction completes, the site shall be tested and accepted after inspection from Quicktron. The basic requirements for the floor are as follows:

a) The absolute value of the maximum height difference measured within two consecutive 1m intervals shall be less than 3 mm;

b) The road gradient (H/L) is defined that the maximum allowable value of the road gradient where the robot drive at the rated speed of within the length range of 100mm or more must be less than 0.05 (including 0.05). For the robot that needs to be accurately positioned, the parking point must be less than 0.01 (including 0.01);

c) The maximum allowable value of step height of pavement shall be less than 5 mm (including 5 mm);

d) The maximum allowable of pavement crack width shall be less than 8 mm (including 8 mm);

e) The average floor load of M100 robot shall reach 2.1 T/m^2;

f) The hardness of the floor shall be above c30 (tested by a rebound hammer, with the value greater than 30 MPa or 30 KN/m2);

g) Emery floor or cement hardened floor shall be wear-resistant, static-free and dust-free when rubbed;

h) In case of epoxy floor, anti-static treatment is required;

i) The floor for operation must be free of dust, water, ice, etc. to prevent the machine from skidding during emergency stop or braking;

j) The dust level on the floor should be less than grade 300,000;

k) Waxing on the floor is prohibited; As for friction, the static friction coefficient between the floor and polyurethane wheels shall be no less than 0.55;

l) On the floor, there should be no obvious potholes or concave-convex parts, or residual steel nails, expansion screws or other items.

1.2 On-site environment set-up

Before the robot enters the site, Quicktron or warehouse operator should set up a wireless network environment in the robot operating area in accordance with the requirements of Quicktron. If the network is built by the warehouse operators themselves, after the construction completes, the

network shall undergo the testing and acceptance inspection by Quicktron.

The wireless network environment for the robot shall meet the following requirements:

a) Requirements for the weakest signal at the edge of the covered network environment: -65 dBm;

b) Minimum signal-to-noise ratio: 25 dBm;

c) AP Network overlap: 10%-20%;

d) Channel overlap: No more than -82dbm;

e) Single terminal bandwidth no less than 2Mbps;

f) Number of terminals associated with a single AP no less than 30;

g) End-to-end delay from robot to server no more than 100ms;

h) Typical/Maximum roaming time: For wireless client-end robots, it is necessary to set or negotiate about a wireless roaming threshold for supporting signals in corresponding frequency bands.

1.3 List of auxiliary parts/components

Number	Name	Quantity	DESCRIPTION
1	Operating instructions	1	
2	Qualified Certificate	1	
3	Charging pile	optional	To be based on the requirements of the customer

2. General Safety Instructions

2.1 Safety sign instructions

	Tips for safe use of electricity: Pay attention to electrical safety when using.
	Warning sign: All operations, which involve such a sign and are related to the safety of the product and the personal safety of the user, must be carried out in strict accordance with the requirements thereof, which otherwise will cause damage to the product or endanger the personal safety of the user.
	Prohibition sign: All acts indicated with such a sign must be prohibited; otherwise it will damage the product or endanger the personal safety of the user.

2.2 Safety precautions

	● There is high voltage in this product, so non-professional personnel shall not remove the shell thereof to avoid electric shock; ● The grounding end of the power socket connected with this product shall be reliably grounded, and all socket, wires and other components shall be qualified products certified according to relevant national regulations; ● Power circuit connecting to this product shall be equipped with overload protection devices such as fuses with appropriate specifications; ● No pinching, bending or twisting the AC power cord excessively to avoid breaking or short-circuiting the internal cores; ● Turn off the power when not in use; ● No short-circuiting, recharging, or incorrectly connecting the positive and negative electrodes;

	● No exposure to an environment beyond the specified range, and do not burn the battery; ● No squeezing, puncturing or disassembling the battery, which contains safety and protection equipment, which, if damaged, may cause the battery to heat, explode or burn; ● No wetting the battery; ● Only the original charger is applicable and the battery manufacturer's instructions shall always be respected. ● Please turn off the power supply during maintenance; ● Not to place any heavy objects on the AC power cord.
	● Use robots only indoor, not outdoor; ● No using robots on ships; ● No small objects appearing on the floor within the area where the robots move, because the robot is unable to detect obstacles below the size of 100 mm, which may run over such small objects; ● Components should avoid heating, and the working environment for the robot shall not exceed 45℃; ● No exposing the robot to extremely wet or extremely dry environment and the environmental requirements should be met; ● This product should be used in a place far away from heat sources and direct sunlight to prevent accelerated aging of plastic and rubber parts/components, which will affect their service life; ● No one shall be allowed to enter the restricted area while this product is working; ● Equipment shall not be splashed by water. If water enters the product accidentally, ventilating and drying is required before use; ● This product needs regular maintenance and cleaning in accordance with the provisions in this instruction to avoid affecting the service life of the product; ● If the using environment such as floors and walls no longer meet the environmental requirements of this product, please stop using this product and correct the problems in time; ● In case of any abnormality found during operation, please firstly cut off the power supply and then contact the after-sales service personnel;

	● Do not gaze at radar sensors for a long time; ● Avoid the existence of a slope and a step or seam not meeting the requirement of the floor along the route; ● This product may only operate on dry and flat floor surface which meets the Quicktron requirements; ● No overloading the robot; The rack/carrier loaded by the robot shall not exceed 1000 kg; ● No exceeding the load capacity of this product when using, otherwise the machine will get damaged; ● When it is necessary to repair or replace parts/components of the robot, Quicktron approved parts must be used; ● The warning sign must be clear and should be repaired in time if there is any damage; ● Any change to the machine shall be in line of the CE standard; ● The dimension of items must be in line with unit regulations； For the shape, size, quality and specifications of the items, please check 5.5 Load Instructions for details.
	● No untrained personnel shall be allowed to operate and use this product; ● Professional personnel not designated by the company shall be forbidden to disassemble the product; ● No placing naked flame sources near this product; ● No using this product near inflammable and explosive gases and liquids; ● No using organic solvents or corrosive liquids to wipe the exterior, plastic parts and rubber parts of this product; ● Liquid leakage shall be avoided during transportation; ● No hand be inserted into the position with hole or gap between the two sides when the lifting mechanism of the robot is operating; ● No inserting the hand into the top view identification interval position when the lifting mechanism of the robot is operating; ● No inserting the hand into the gap between the shell and the robot shell; ● No inserting the hand into the gap between the front and rear chassis;

	● No touching the robot during operation. ● No operating the robot irresponsibly to prevent personal injury or damage to the machine; ● No using robots to transport personnel to prevent personal injury or damage to the machine; ● No inserting any foreign matter into the product through the vent or the shell opening. If any foreign matter enters the product accidentally, please stop using it and contact the after-sales personnel of the company.

2.3 Safety circuit instructions

When personnel or other moving objects enter the safety area of the robot, if there is no response due to planned response time, errors, etc., the safety circuit will force the robot to stop emergently, causing the robot to stop immediately. The emergency stop can be reset and the operation can continue only when the personnel or objects are outside the safe area again. M100 is designed with redundant power safety circuit with complete SICK safety components. If there is an internal error in the safety circuit, the robot will immediately be stopped, and all components will become free of voltage due to mechanical disconnection. Only when redundant safety circuits are provided can the emergency stop be reset and operation continues. The emergency stop, side-contact, safety encoder and safety radar involved in the robot are integrated by a safety PLC module to ensure that power supply can be reliably cut off when any safety issue occurs, so as to ensure safety.

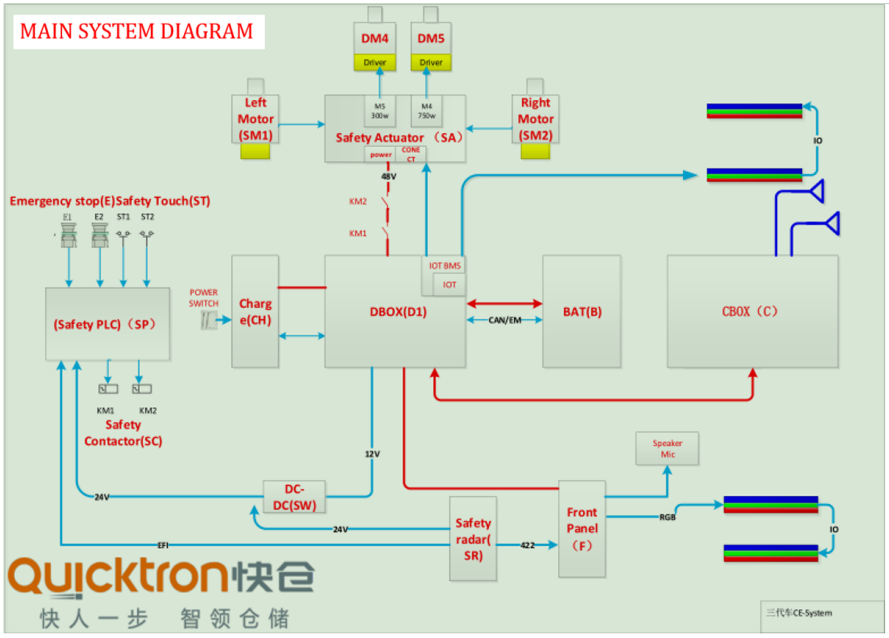

Figure 1. System framework diagram

3. Precautions for Use

3.1 Handling precautions

Only trained personnel can install the robot system. Trained personnel refer to those who have participated in and passed the robot system training and maintenance training conducted by manufacturer, distributors and local agencies, or those who are familiar with relevant manuals and have the same level of knowledge and skills as those who have completed the training.

 Caution	The packaging weight of the robot is relatively large, so the specified labor protection appliances should be worn when handling, and reasonable handling methods should be used to avoid personal injury or robot damage; The robot needs to use a slope* from the package to the ground, and the operation needs to pay attention to safety, refer to the following figure。

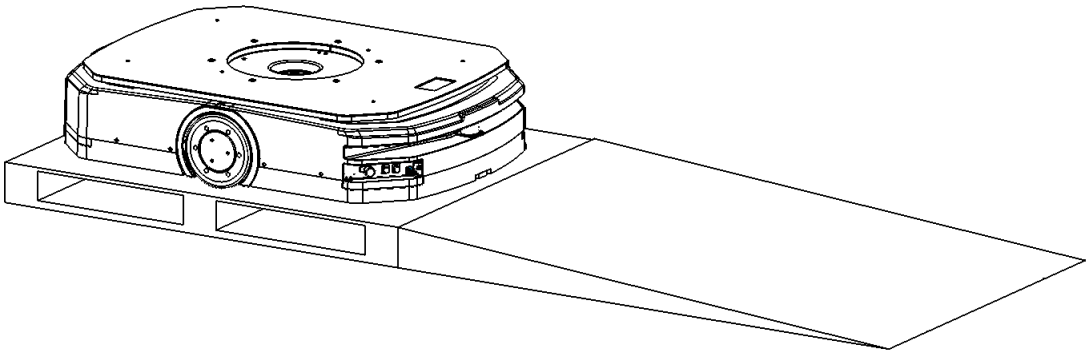

Figure 2. Robot handling schematic

Note: the inclined plank is not standard configuration, and it is necessary to confirm whether the list contains it.

3.2 Packing and transportation instructions

The robot shall be packed in wooden box under appropriate specifications. With the packing requirements as follows:

a) Use wooden box or foam paper to wrap the robot to avoid damage to robot during transportation.

b) The robot shall be fixed on the chassis of the wooden box to ensure that the robot does not shift on the plane during transportation; Due to the heavy weight of the robot, it is recommended to use gantry cranes and other lifting equipment to assist in the packaging of the robot so as to avoid danger to human body caused by manual handling;

c） After the robot is placed in the wooden box, the robot inside the wooden box needs to be fixed to ensure that the robot does not move;

d） Wooden cases with robots inside shall be transported by specialized devices. During the transportation of wooden cases, the handling requirements for robots shall be strictly followed to prevent the wooden cases from getting wet. Overlapping stacking of more than two wooden boxes shall be prohibited, and the wooden cases shall be kept flat.

3.3 Storage instructions

Robots out of service for a long time should be stored according to the following conditions:

a） Indoor storage, away from dust and flammable, explosive or corrosive gases and liquids;

b） Temperature: -10~50℃;

c） Humidity: No more than 80%, without moisture condensation;

d） The battery shall be charged to ≥ M100% rated capacity and recharged regularly. During storage at room temperature, the battery shall be fully charged and discharged at least once every 6 months, otherwise the battery may be damaged.

3.4 Requirements for service environment

When the robot is in operation, the site needs to meet the following requirements:

a） Use them indoor to avoid dust, water, lampblack or other pollutants, away from flammable, explosive or corrosive gases and liquids;

b） Temperature: -10~45℃;

c） Humidity: 10-90%, without moisture condensation;

d） Altitude: Less than 2,000 meters above sea level.

3.5 Requirements for QR codes

The following items should be noted in the use of QR codes on site:

a） No trampling on QR codes;

b） No touching the QR code surface directly with a mop;

c） No scratching QR codes with foreign objects;

d） No staining QR codes with glue, paint, oil, ink, etc.;

e） No cleaning QR codes with hard/rigid materials such as steel wool, dish brushes and scrubbing brushes;

f） No cleaning QR codes directly with water or detergent.

4. Product Introduction

4.1 About M100 handling robot

M100 warehousing robot is an autonomous mobility robot, it belongs to latent robot series products. It is mainly composed of chassis system, driving system, lifting system, control system, communication system, navigation system, safety protection system and human-computer interaction system. It can realize the functions of autonomous transportation, autonomous navigation, automatic obstacle avoidance and autonomous charging. This product combines the robot scheduling system (RCS) and intelligent warehouse execution system (WES) to meet the requirements of warehousing, outbound, replenishment, tally and other needs. The robot is mainly used for:

- E-commerce, logistics, medicine, clothing and other warehousing goods to person picking.
- Production line docking and material handling in manufacturing industry.
- Expansion platform, support customization as equipment docking, etc.

4.2 Description of external parts/components

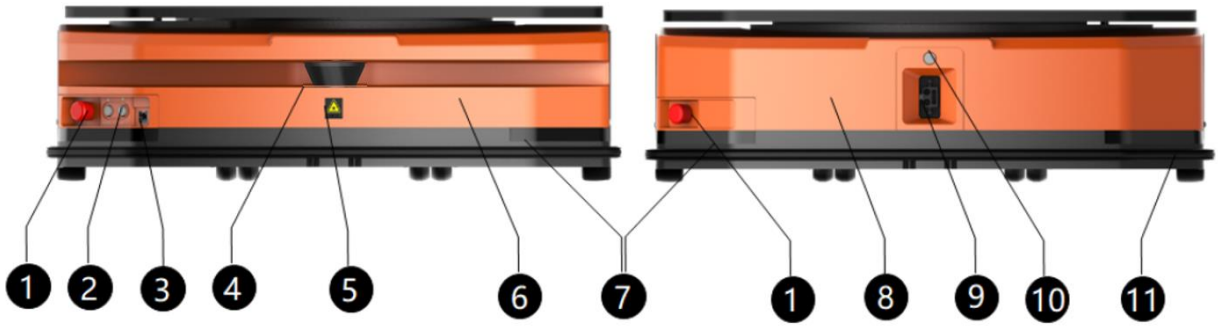

Figure 3. Front and rear view of robot

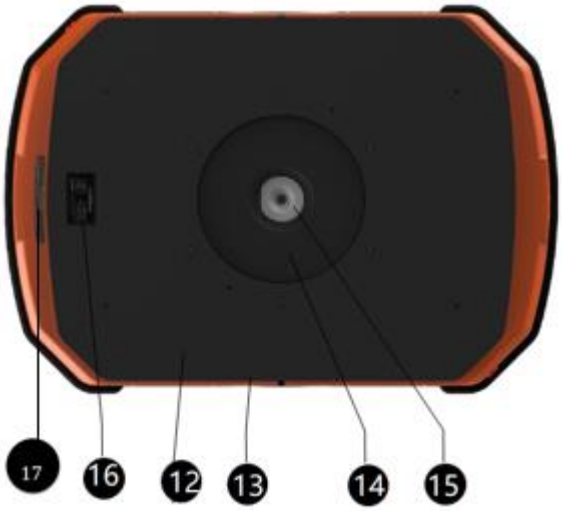

Figure 4. Top view of robot

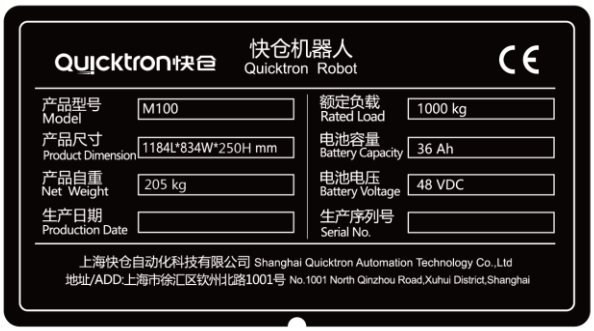

Figure 5. Information on nameplate of robot

No.	Name	DESCRIPTION
1	Front and Rear emergency stop button	Emergency stop function for stopping the robot by pressing
2	Up/down function key	Pallet up/down key, refer to 6.3 for the definition of multi-function buttons
3	Debug port	Used for debug and program update
4	Safety LIDAR	Actively detect dynamic and static obstacles in front of the path, and make corresponding safety strategies
5	Laser safety sign	Beware of laser signs, remind the operator not to look directly at the eyes for a long time
6	Front shell	Made of flame retardant ABS material used to protect internal devices/components
7	Lamp board	Used for display of status information, with blue, white, yellow and other status indicating different information
8	Rear shell	Made of flame retardant ABS material used to protect internal devices/components
9	Charging port	Used for manual/automatic charging
10	Power switch	ON/OFF key
11	Safety edge	Used to avoid contact collision to prevent close-range failure, which brakes in case of contact.
12	Rubber mat	Buffer load, increase friction between shelf and robot body
13	Pallet	Contact with racks to provide load-bearing and buffering, with rotary support to provide follow-up function
14	Top view protection plate	Used to protect main control panel devices
15	Top view identification module	Mainly used for identifying the QR code information of the load rack or the carrier
16	Nameplate	Used to display the basic information of a robot; See Fig. 7 for details
17	Safety sign	Used to indicate safety information and remind operators to pay attention to safety

5. Description of Basic Functions and Parameters of Products

5.1 List of functions

Basics	Function name	Function description
Basic function	Control mode	Automatic mode, manual mode and off-line automatic mode are used to execute movement instructions, and manual mode is provided with inching control function
	Navigation mode	Based on inertial navigation + visual QR code navigation, a system of QR code plus Quicktron customized code
	Driving mode	Dual-wheel differential drive
	Communication mode	WIFI
	Braking mode	Compatible with manual braking and electric braking
Motion control	Operation	The robot can move to any position according to the trajectory planning and positioning navigation of the motion control system, and is capable to rotate to any angle as well as support going forward, going backward, turning, self-rotating and arc turning, etc.
	Stop	The robot can normally stop according to the position designated by the scheduling system, and can also initiate the soft stop when it encounters conventional faults, with the hard stop to be initiated in case of the CAN communication fault of the driving device, the fault stop to be initiated in case of the hardware fault of the driving device, obstacle avoidance stop to be initiated in case of the obstacle detected, and braking stop to be initiated in case of the emergency stop operation
	Reset	The robot, when stops, will perform self-inspection and self-repair, reset, and initiate the task to operate; and it also will reset and initiate the task to operate when manual intervention is used to clear errors or restart
	Patrol inspection along the route	The robot will automatically check the states of the QR code on the floor and the racks during operation, and timely feedback the abnormal conditions to the RCS

		scheduling system and give an alarm
Lifting control	Lifting function	Capable to lift and lower to the designated position within the schedule time, with detection of the lifting limit and lifting position
	Movement interlock function	Prevent the robot from moving during loading, unloading or equipment docking operations.
	Overload protection and locking	The robot can set the maximum load value according to the load capacity of the motor. Under normal circumstances, if the load exceeds the maximum value, the robot will give an alarm and lock
Follow-up control	Follow-up function	Capable to rotate a rack relative to the robot, detect and reset the rotation angle of the pallet, and move the rack to any position and posture;
Navigation positioning	Autonomous positioning	After the equipment is positioned on the QR code, it will be capable to report the current position and direction, and other information to the system platform in real-time
	Floor QR code identification	Identify the QR code of floor.
	Good QR code identification	Identify the QR code of rack.
	Rectification of running deviation	Capable to make real-time correction and run along the specified route
	Rectification of loss codes	The robot allows for certain QR code defacement and loss
	Upward-view rectification	In the movement of robot, the upward-view camera calculates the rack code once every other period of time and continuously monitors the rack posture. If the rack deviation is found to be too great, the robot will stop at the nearest code to put down the rack -> make confirmation before lifting -> lifting to realize the rectification of the rack.
Power supply	Autonomous charging	With this function, the robot will be capable to automatically detect the battery level. When the power

function		level is lower than the preset threshold value, the robot will be capable to automatically give a charging application signal, and can automatically run to the charging pile to complete charging as scheduled by the platform. The online charging system support Non-fully-charged /Non-fully-discharged mode.
	Manual charging	Capable to charge a robot with a manual charging port.
	Low battery self-protection	With this function, when the battery level is lower than the pre-designed value, the robot stops, prompts for charging and gives an alarm, which requires manual operation to start up once again
	Battery event statistics	Capable to make statistics on abnormal battery conditions, charging/discharging times, external control power-off times, etc.
	Battery management system	Capable to monitor the information in real time, such as battery pack's single cell voltage, charging/discharging current, sampling point temperature and the like, in order to adjust charging strategies and charging equalization; capable to assess and calculate the state of charge, life and health of the battery, in order to automatically output the battery maintenance strategy; in case of abnormal state (such as single cell over-voltage, under-voltage, over-temperature and over-current), the management system will immediately stop charging/discharging and upload the alarm information.
Safety protection	RCS scheduling	With this function, under the scheduling of the main control system, it is possible to ensure smooth operation and avoid collision accidents
	Radar detection	As a laser sensing obstacle avoidance detection method, this function is respectively used for long-distance detection and short-distance detection, feedback of obstacle distance, and implementation of deceleration and stop strategies to ensure that no collision with other facilities occurs during equipment operation

	Safety edge	When colliding an obstacle in low-speed and in short-distance, which makes stop action.
	Emergency stop button	An emergency stop button is arranged at an eye-catching position to facilitate emergency operation; after the emergency stop button is pressed, the system will immediately stop in the working state and remain in the stopped state, and it can only restart after the abnormality is manually confirmed and eliminated, which aims to ensure the safety of operation
	Automatic locking and reporting of failure points	If a robot fails, it will report the location of the failure and lock the surrounding area, which aims to prevent other robots from approaching the dangerous area
Human-computer interaction	ON/OFF key	With functions that operate the switch and execute key
	LED indicator	The state information of the robot can be displayed by indicating lamps in different colors
	Voice reminder	Different sound reminders are defined according to different working conditions
	Operating platform	With this operating platform, the robot can be operated in single-unit mode or remote control mode
Control and treatment of abnormal conditions	Abnormal state alarm	In an abnormal state, the robot automatically reports warning information to RCS, with different audible and visual alarm modes for itself according to different error information
	Operation condition monitoring	Various sensors in the robot will feedback the data to DSP in real time during its movement, and it is capable to monitor the absolute coordinates through the upper computer software, robot body posture angle, pallet height, obstacle distance, movement state, robot speed, battery level and other data
	Power-on self-test	The robot will detect the running status of each module before starting up the operation, and display different indicator states according to the detection status. Some abnormalities can be cleared through self-recovery. If the error cannot be cleared, the robot will report the error

		information and give an alarm.
	Fault diagnosis	With this function, it is capable to record in detail the running event log and state log of the robot, and save the log data to a disk, which can offer help to professionals during repair or maintenance; it is capable to automatically alarm and record equipment faults, and can also prompt corresponding troubleshooting methods through the system to support remote fault diagnosis
Maintenance operation	Remote data download	With this function, it is capable to remotely connect the robot to download local data like log
	Remote upgrade	With this function, it is capable to upgrade the lower computer and components remotely through the network for the robot
	Remote reboot	With this operation, it is capable to reboot the robot remotely through the network and initialize the robot, including issuing parameters, map deviation, posture initialization and other operations
	One-click homing	With this function, it is capable to transfer the robots to a designated area for parking through background operation

5.2 List of performance parameters

Category	Technical parameter	Descriptions
Physical parameters	Size	1184 (L) * 834 (W) *250 (H) mm
	Weight	205 kg
load capacity	Rated load	1000 kg
	Applicable rack	Standard 1200*1200*2400 mm(Subject to actual agreement)
	Lifting height	60 mm
Speed	Rated running speed	1.5 m/s at no-load; 1.2m/ at full load
	Rotational angular speed	180 °/ s² at no-load, 110 °/s²at full load
	Running acceleration	1.5 m/s² at no-load, 0.6 m/s²at full load

	Lifting time	3 s
Navigation positioning	Navigation mode	QR code positioning + inertial navigation
	QR code type	Quicktron self-made QR code shall be applicable
	Code reading accuracy	±10 mm
	Stop accuracy	±5 mm
Battery	Battery capacity	Ternary lithium battery 36 Ah
	Time for full charging	1.5 hours
	Duration of endurance	7.5 hours after fully charged
	Battery life	Fully charged and fully discharged for 500 times
Operating requirement	Floor requirement	Quicktron standard floor requirements will be acceptable
	Environmental requirement	The temperature of -10 ~ 45 ℃ and humidity of 10% – 90% will be acceptable
	Noise	< 75 dB

5.3 Description of human-computer interaction LED indicator

Subject to the actual agreement:

State	**Lamp color**	**Sound**
Stationary	Blue, normally ON	N/A
Moving	White, normally ON	Light music
Reporting errors	Yellow, normally ON	Voice broadcast
Emergency stop	Yellow, normally ON	Voice broadcast
At code	Left front and right rear lamp flashing	N/A
Driving motor turned off	Right front and left rear lamp flashing	N/A
Left turn/Rotation	Left front and right rear lamp white marquee	Voice broadcast
Right turn	Right front and left rear lamp white marquee	Voice broadcast

Obstacle avoidance	Two lamp beads outside the front lamp showing purple	Voice broadcast
Reversing	Two rear lights flashing white	Voice broadcast
Charging	Breathing lamp	Voice broadcast

5.4 Radar detection range and description

5.4.1 Radar detection range description

The radar obstacle avoidance range is mainly divided into two areas: emergency stop area (red) and deceleration area (yellow). The specific data of single machine are as follows:

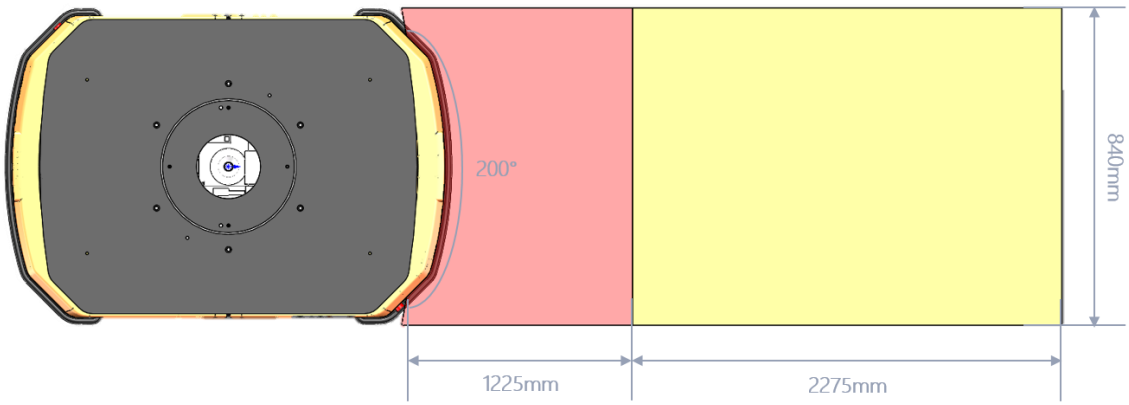

Figure 6. Radar detection range

5.4.2 Deceleration mode

If an obstacle is found within the range of 1.2 - 3.5 m away from the robot, the robot will slow down; if an obstacle is found within the range of 1.2m from the robot, the robot will stop immediately.

5.4.3 Recovery mode

If the obstacle disappears in a short time (5-10s), the robot will give an audible and visual prompt for 2s and then move again; if the obstacle does not disappear for a long time (more than 10s), the robot will report an error and stop.

5.5 Load description

To ensure the safety of the load, it is suggested that the items shall be distributed as evenly as possible and should be distributed in a way that heavier item is placed at a position lower than the position where the lighter one is placed (Refer to the weight distribution method please see the Appendix). The recommended way for placing the items is as shown in Fig. 8, Diagram for Layout of Robot's Load, and the placed items need to be fixed, and there is no displacement between them. The load weight shall not exceed 1000kg（Including the weight of racks）.

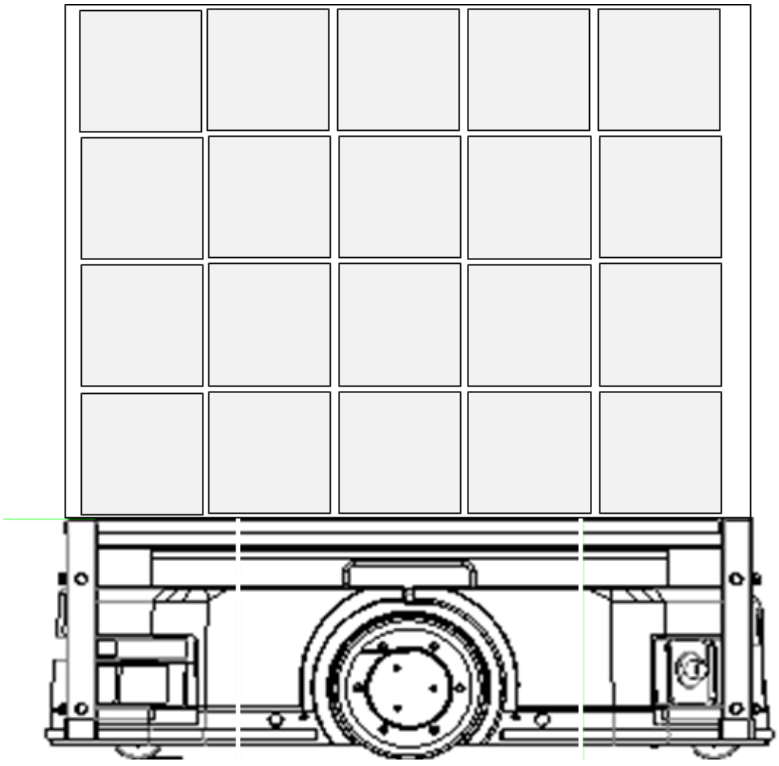

Figure 7. Schematic diagram for robot loading.

6. Instruction for Quick Operating

6.1 Power switch

Mode	State
Power-off	The button is in the middle of the robot and the lamp of power key is off
Power-on	The button is in the middle of the robot and the lamp of power key is on

6.2 Emergency stop switch:

Mode	State
Press down the emergency button	The motor of driving device is powered off
Pull up the emergency button	The motor of driving device is powered on again

6.3 Motor button + Lifting button:

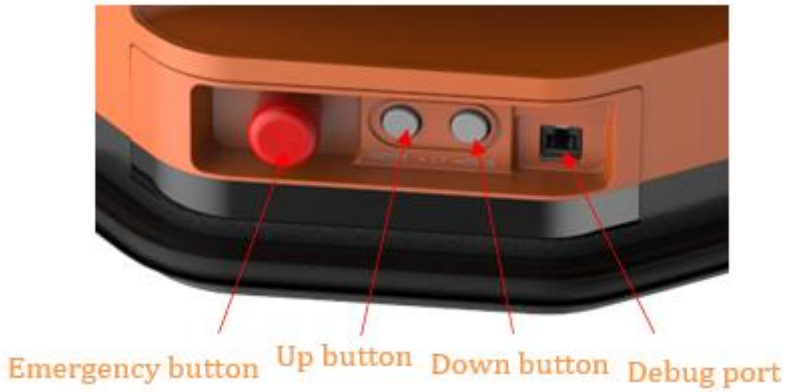

Figure 8. Schematic diagram for button interaction.

Operation	Effect
Single-click the up button on the front panel	The blue lamp flashes three times, and then the motor is enabled
Double-click the up button on the front panel	The pallet is lifted
Keep pressing the up button on the front panel	The blue lamp flashes slowly, then the error is cleared and the robot goes online
Single-click the down button on the front panel	The blue lamp flashes three times, and then the motor is shut down
Double-click the down button on the front panel	The pallet is lowered
Keep pressing the down button on the front panel	The single-unit mode is initiated

6.4 Failure recovery

a) Click the down button on the front panel of M100 robot once, and then, 3s later, the blue lamp on M100 robot will flash several times, indicating that the motor is turned off.

b) Push the M100 robot onto the code (adjust the head of the robot to be in place), and the lamps on the left front and right rear of the robot flash;

c) Keep pressing the up button on the front panel of the M100 robot for 5s until the blue lamp on the robot flashes, then release the key, and the M100 robot will automatically clear the error and go online.

7. Service and Maintenance

In order to ensure the efficiency of this product and extend its service life, please contact the after-sales service personnel of our company to maintain the product regularly in accordance with the requirements. At the end of the maintenance, please ensure that the maintenance personnel fills the maintenance record manually for this product. At the end of the maintenance, please start the machine together with the maintenance personnel to verify whether the functions of this product are normal.

7.1 Precautions for maintenance

a) When the robot fails, the maintenance personnel need to enter the operating site for maintenance, and the personnel need to keep in communication with the off-site personnel. In addition, when maintenance personnel enter the site, the system will be suspended and alarm, the system can only be returned to normal and stop alarming after the maintenance personnel complete their operation and leave the area.

b) When it is necessary to repair or replace parts/components of the robot, Quicktron-approved parts/components must be used.

c) Refer to sections 1.1 and 3.4 for the floor requirements and ambient temperature requirements of the maintenance area.

7.2 Routine service and maintenance of robots (Users/Weekly)

a) Keep the overall surface of robot clean and free of dirt, and the upward-view camera lens should be free of obvious dust and foreign matters (The dust and particles cleared shall be prohibited from scattering into the equipment. There are precision electronic components under the camera lens which can easily be damaged by the scattered dust and particles);

b) The lamps of the robot (top and bottom supplement lamps, front and rear housing lamps) should display normally;

c) The emergency stop button, lifting button and motor enabling button shall function normally;

d) The laser radar for obstacle avoidance should operate normally.

e) The robot shall operate without abnormal noise (wheels, lifting mechanism, etc.);

f) The robot shell should be free of defects;

g) Check whether the left and right driving wheels are stuck by the wheel frame and whether the wheel frame screws are locked.

a) Check whether the charging pin and CAN communication pin of the charging port are

skewed and whether the charging sensor contracts in. keep the charging port clean, no foreign matters and dust.

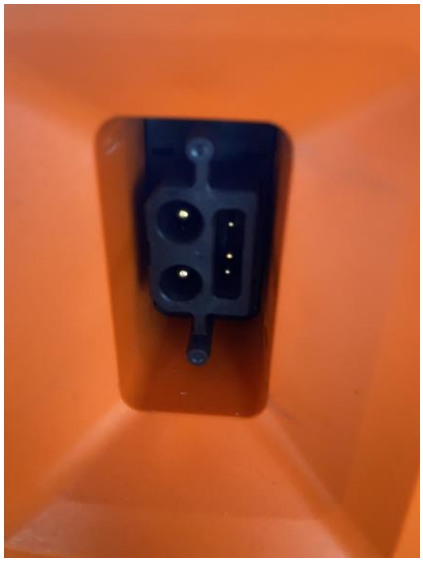

Figure 9. Charging port

7.3 Service and maintenance of robots (Every year)

7.3.1 Inspection of overall running state of robot

a) The robot should be able to move forward free of abnormal noise and travel smoothly without getting stuck, running deviation, skidding and code loss.

b) In the process of guidance and positioning of the robot, only rotate for 1 time instead of multiple times.

c) When the robot is charged, only a single advance and retreat can make it successfully charged rather than repeated advance and retreat to get charged. ;

d) The lifting process of the robot should be smooth, without getting stuck, improper lifting or lifting deviation.

e) The radar function of the robot should be tested to check whether it can follow the robot normally and whether there is a false alarm.

7.3.2 Inspection of overall appearance of the robot

a) The overall surface of robot shall be clean and free from dirt or damage, and the upward-view camera lens shall be free from obvious dust and foreign matters.

b) The lamps of the robot should display normally (top and bottom supplement lamps, front and rear housing lamps);

c) The emergency stop button, lifting button and motor enabling button shall function

normally;

d） Check the limited block of pallet on the robot for looseness.

7.3.3 Inspection of the driving wheels of the robot

a） When the motor is enabled, push forward the robot and shake it left and right, and the left and right driving wheels of the robot should not rotate.

b） Driving wheels shall be flexible in driving operation, without abnormal noise and getting stuck.

c） Remove the entanglement at the bearing of the robot and add the specified lubricating oil.

7.3.4 Inspection of the driven wheels of the robot

a） When pressing the robot body forward and backward, the driven wheel can bounce back normally, and the reverse driven wheel can touch the floor. The wheel body of the front and rear driven wheel should be able to rotate normally and the wheel shaft should not be loosened;

b） Check whether the front and rear driven wheel can rotate flexibly and the wearing of the wheel. Meanwhile, record the travel distance of the robot. Check to see if the degree of wearing and travel distance have reached the level of replacement.

7.3.5 Inspection of the overall fasteners of the robot

a） Check whether the fasteners of robot have been fastened and whether the wiring of LIDAR, control boards, industrial control computers, sensors and drivers for looseness. The installation should be reliable, and the components should not loosen.

b） Cleaning dust for robot: Remove dust from the inside of the robot.

7.3.6 Electrical inspection

a） Check whether the output voltage 48V and 12V of battery is normal;

b） Check the battery voltage;

c） Check whether the communication cable of the driver has been fixed normally;

d） Check whether the power supply wires of C-box control board, D-box control board, radar, driver and other modules have been fixed normally, whether the voltage is within the standard range, and whether the wires are damaged, etc.

e） Check to see if the lumen value of the upper and lower supplement-light plates is within the standard.

8. Warranty Description

The free warranty period for the overall machine of this product shall be 1 year, with the following circumstances not covered by the free warranty:

a) Damage caused by improper transportation, installation, operation and management of users;

b) Damage caused by unauthorized dis-assembly of the product by user;

c) Damage caused by abnormal voltage, fire and other external reasons;

d) Damage caused by failure to comply with the requirements of the instructions, indicative signs on the main body of the product, and other matters needing attention;

Consumables shall not be covered by this warranty, with a list of details as shown in the table below (For reference only, please refer to the technical agreement or contract).

No.	Components/Parts	Quantity	Unit	Service life
1	Lifting rubber pad	1	Set	1 year
2	Driven wheel	4	Set	1 year or 10000 km
3	Driving wheel	2	Set	1 year or 10000 km
4	Ternary lithium battery	1	Pcs	1 year (Fully charged and fully discharged for 500 times)

9. Simple Troubleshooting

Sometimes it is not necessarily a fault in case of the following circumstances. Please check the product for confirmation according to the following list before it is commissioned for repair. If it is indeed a failure, please contact our after-sales service personnel, and do not repair without authorization. Before checking, make sure that the product is powered off.

When the robot fails, the corresponding protection mechanism will be triggered, and the corresponding error code will be displayed in the Build UI interface bar, with the "instruction terminated due to error" on the information board to be displayed in red. The Build UI interface bar is shown in Figure 11 below: Interface of operation by robot:

Figure 10. Interface of operation by robot.

The list of common fault types and troubleshooting methods is as follows:

No.	Failure phenomenon	Causes	Methods
1	The robot stops during operation and the yellow light on	In order to ensure safety, the robot will automatically stop running when it encounters two consecutive ground QR codes that cannot be	Press down the emergency stop button, and pull it up after pushing the robot onto the QR code, then the robot will be able to automatically clear the error and go online. And observe whether QR code is damaged after robot passes by, and if QR code can't be recognized by robot because of there is dirt on

		recognized.	it. If so, please clean by using rag.
2	Abnormal obstacle avoidance and tracking of robot	There is something wrong with the radar or the parameters are not configured correctly.	First check if parameter 126 is 1. If so, the radar is off. If it is 2, the radar is on to check if the radar data changes correctly with the obstacle range. If the radar data does not change, replace the radar.
3	When the robot is turned on, it is found with lamps of multiple colors and getting stuck. Indicator light jammed	After the robot is turned on, the indicator lamps will perform self-test from the right side of the front of the robot.	If the state of the indicator lamp remains unchanged for a long time, check to see if the emergency stop button has been pressed down, and if so, just pull it up. If the emergency stop button is not pressed down, it may be due to low battery level and needs to be pushed to get recharged. If the Indicator light lamps get stuck at the same time, and the emergency stop button is not pressed down, remotely check the industrial control computer to see if there are any abnormal parameters of the lower computer.
4	Congestion caused by route occupied	Robot gets deadlocked	If the deadlock lasts for a long time, turn off one of the robot motors and drag it to other places to go online again, and the deadlock can be released.
5	Congestion caused by route occupied The robot is turned off due to low battery level	The robot which is out of the map has not been removed from the system.	Check the number of the robot parked in front of it, select the blocked robot and drag the fault robot away from the site through the central control system after pushing the robot to the charging pile to get charged
6	Congestion caused by	The failed robot was pushed away	Locate the failed robot and bring it back online successfully, then find the robot

	route occupied Unable to make the failed robot go offline through the central control system	before it successfully goes online	through the central control system and let it leave the site
7	Error reporting on robot lifting	Rack tilted or rack QR code tilted	Open 642UI and select the upward-view camera to see if the rack code is tilted. If yes, adjust the rack or reattach the rack code.
8	Error reporting on M100 robot in lowering rack	Confirm failure of the upward-view camera after lifting	Open 642UI, select the upward-view camera to check the rack code angle for deviation, if the deviation from the specified angle is more than 2.8 degrees, it will report an error, click "lower rack", and follow the procedure of confirmation before lifting – lifting – confirmation after lifting to recover.
9	M100 robot skidding with load	Skidding	Check whether the floor where skidding occurs is bulged, and check whether the left and right driving wheels of M100 robot get stuck, and check whether the limit block screws for fixing the wheel frame have got loosened. Quick recovery process: First press the lower one of the two buttons next to the emergency stop, close the click, push it to the code, and keep pressing the upper one, then the error is cleared and the robot recovers to go online. (Never press down the emergency stop button of the M100 robot)

10	M100 robot no-load error reporting	Lost code or skidding	The recovery process is the same as above
11	The robot reports an error, and the upper computer interface gets stuck and fails to operate.	Caused by an unknown abnormal process	Turn off the networking build and turn it on once again. If it is still not restored, turn on the single-unit build to restore the robot to the state before the error is reported, and then turn on the networking build to go online.

10.Contact Information

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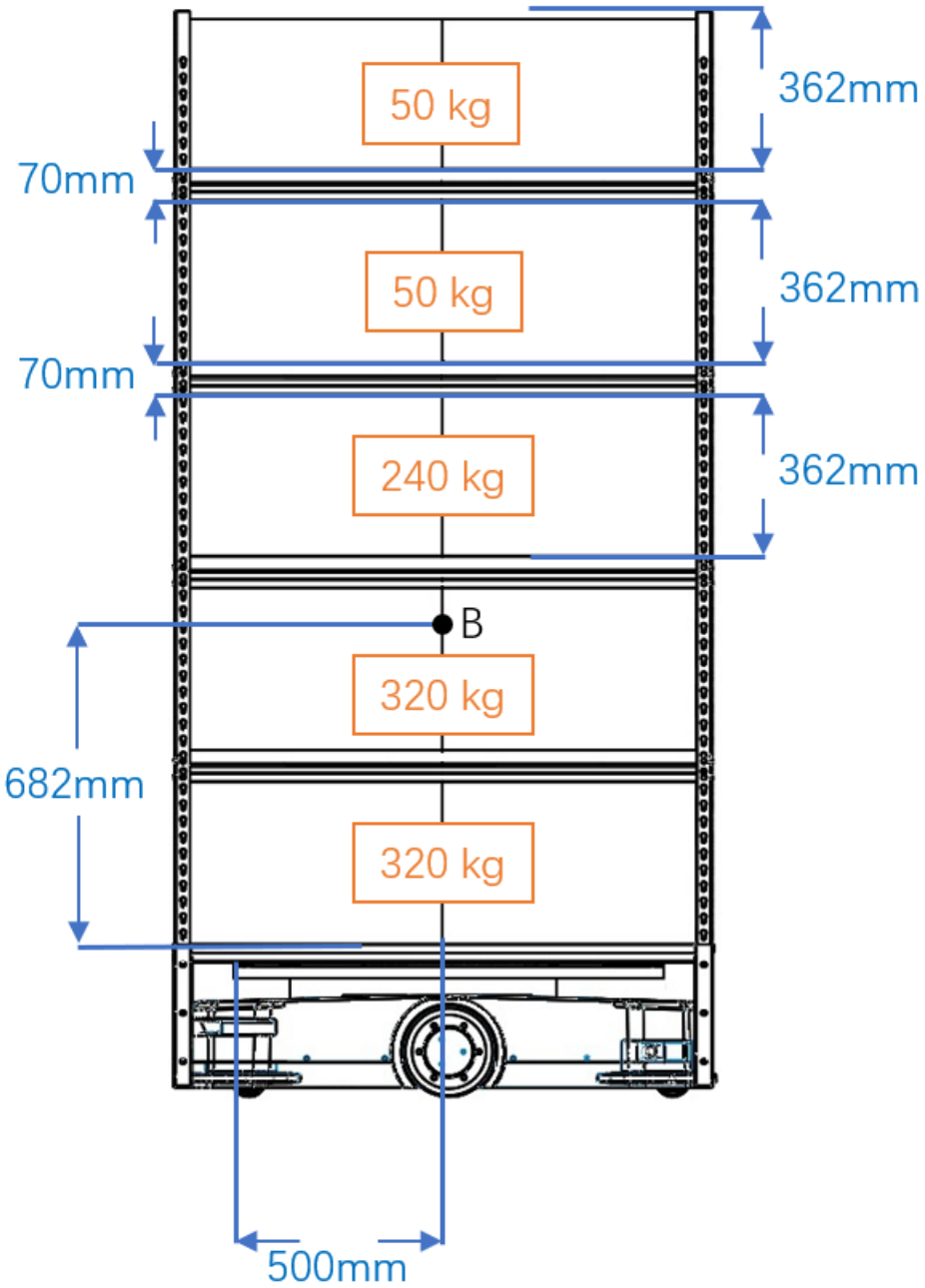
Website: http://www.flashhold.com/
Tel: 021-66182002

Appendix: Stability Calculation

Base on the simulation and calculation by the SolidWorks software. The height of the center of gravity of the shelf (contains goods) should be controlled lower than the point B. Here is an 1.1 times rated weight distribution method(Only for stability calculation): The shelf weights 120kg, the first layer (goods) weighs 320kg, the second layer weighs 320kg, the third layer weighs 240kg, the fourth layer weighs 50kg, and the fifth layer weighs 50kg.

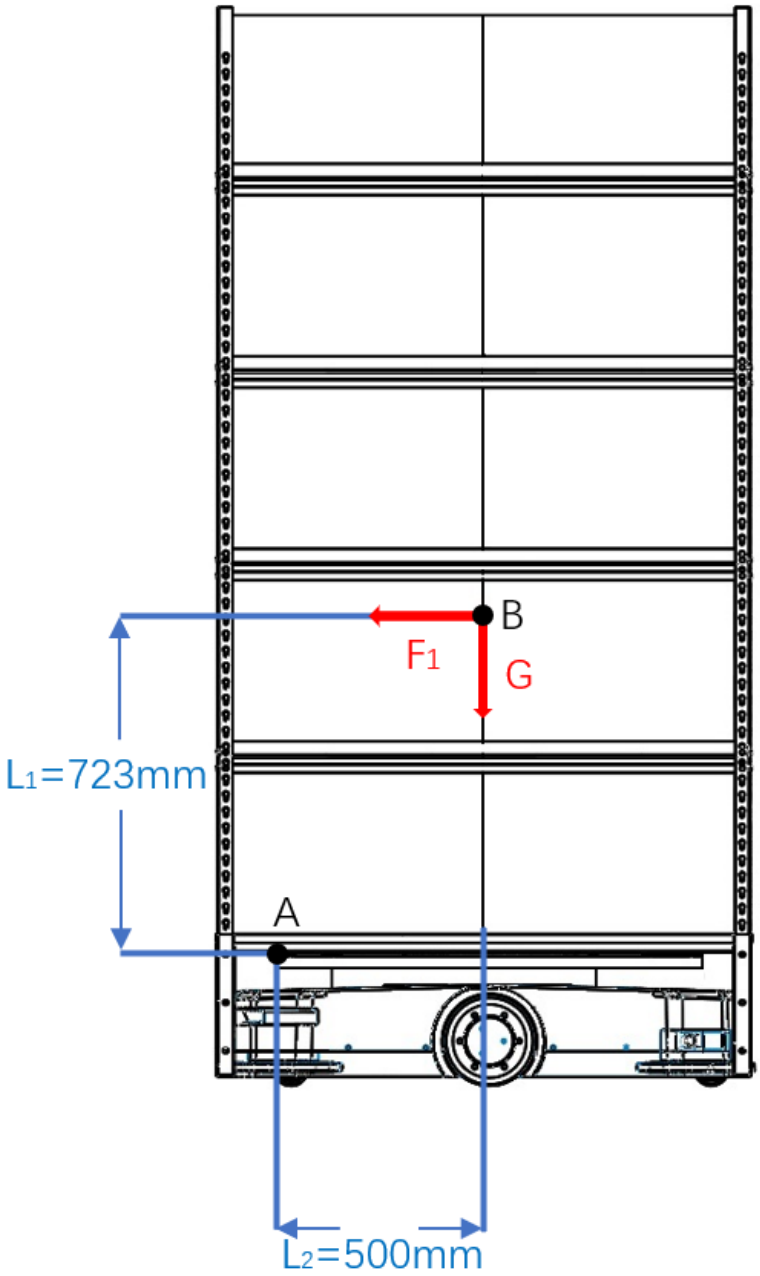


Case 1: The stability of the shelf during the emergency braking

Base on the simulation and calculation by the SolidWorks software, the allowable highest center of gravity is Point B. The outermost contact point between shelf and AGV tray is Point A.

Mass of the shelf: $m_1 = 120kg$. Mass of the goods: $m_2 = 980kg$.

Drag acceleration during emergency braking: $a = 1.5m/s^2$



Thus, the torque created by the shelf's weight to point A is:

$$M_{A1} = G \times L_2 = (m_1 + m_2) \times g \times L_2 = (120 + 980) \times 9.8 \times 500 = 539000Nmm = 5390Nm$$

The torque created by the inertia force to the point A is:

$$M_{A2} = F_1 \times L_1 = (m_1 + m_2) \times a \times L_1 = (120 + 980) \times 1.5 \times 723 = 119295Nmm$$
$$= 1192.95Nm$$

So $M_{A1} > M_{A2}$, Safety factor: $n = \frac{M_{A1}}{M_{A2}} = 4.52$

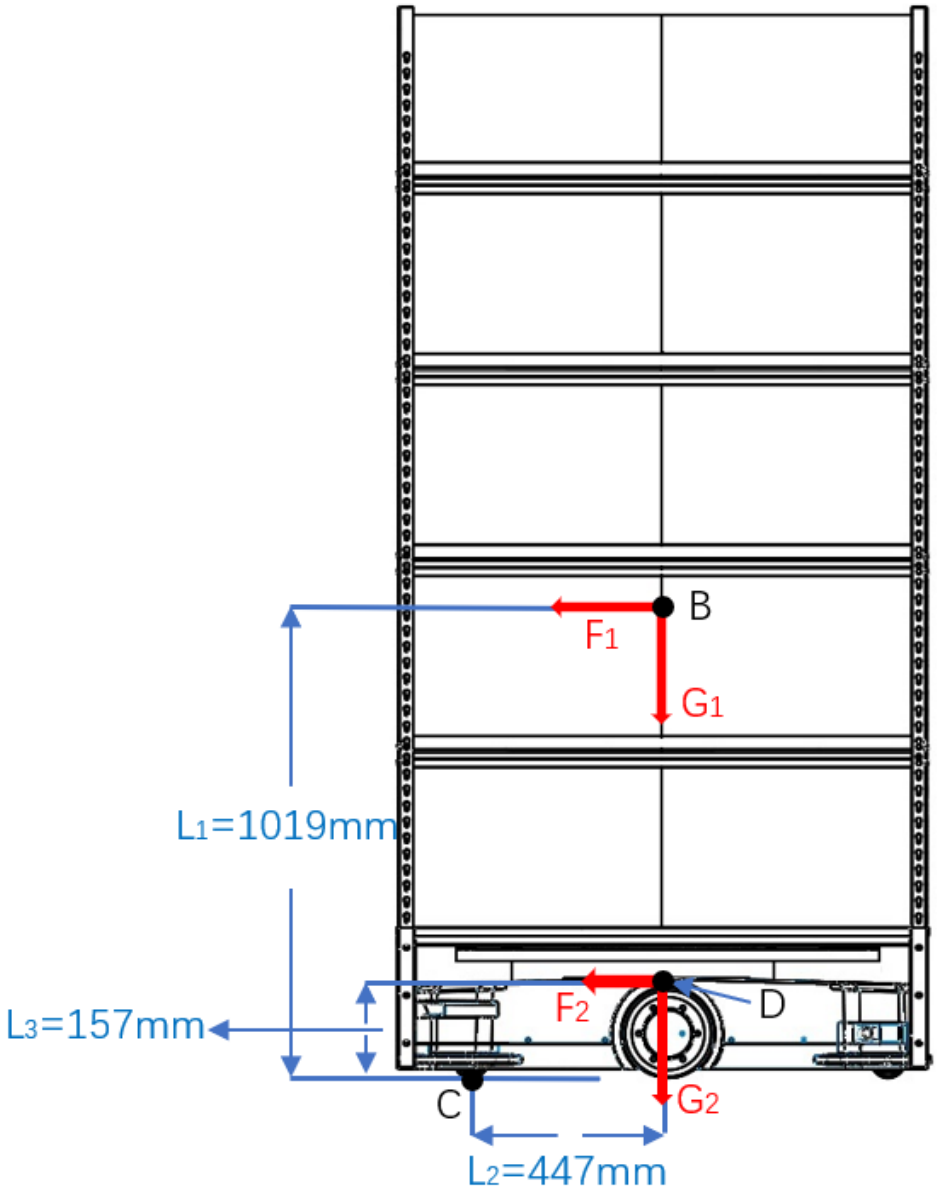
Thus, the safety factor is high enough, and there is no risk of dumping.

Case 2: The stability of AGV during the emergency braking

Base on the simulation and calculation by the SolidWorks software, the allowable highest center of gravity is point B. The support point of AGV's caster is point C and the center of gravity of AGV is point D.

Mass of the shelf：$m_1 = 120kg$ Mass of the goods：$m_2 = 980kg$The mass of the AGV: $m_3 = 205kg$

Drag acceleration during emergency braking：$a = 1.5m/s^2$



Thus, the torque created by all weights is:

$$M_{C1} = (m_1 + m_2 + m_3) \times g \times L_2 = (120 + 980 + 205) \times 9.8 \times 447$$

$$= 5716683Nmm = 5716.68Nm$$

The torque created by the inertia force to the point C is:

$$M_{C2} = F_1 \times L_1 + F_2 \times L_3 = (m_1 + m_2) \times a \times L_1 + m_3 \times a \times L_3$$

$$= (120 + 980) \times 1.5 \times 1019 + 205 \times 1.5 \times 157 = 1729627Nmm$$

$$= 1729.63Nm$$

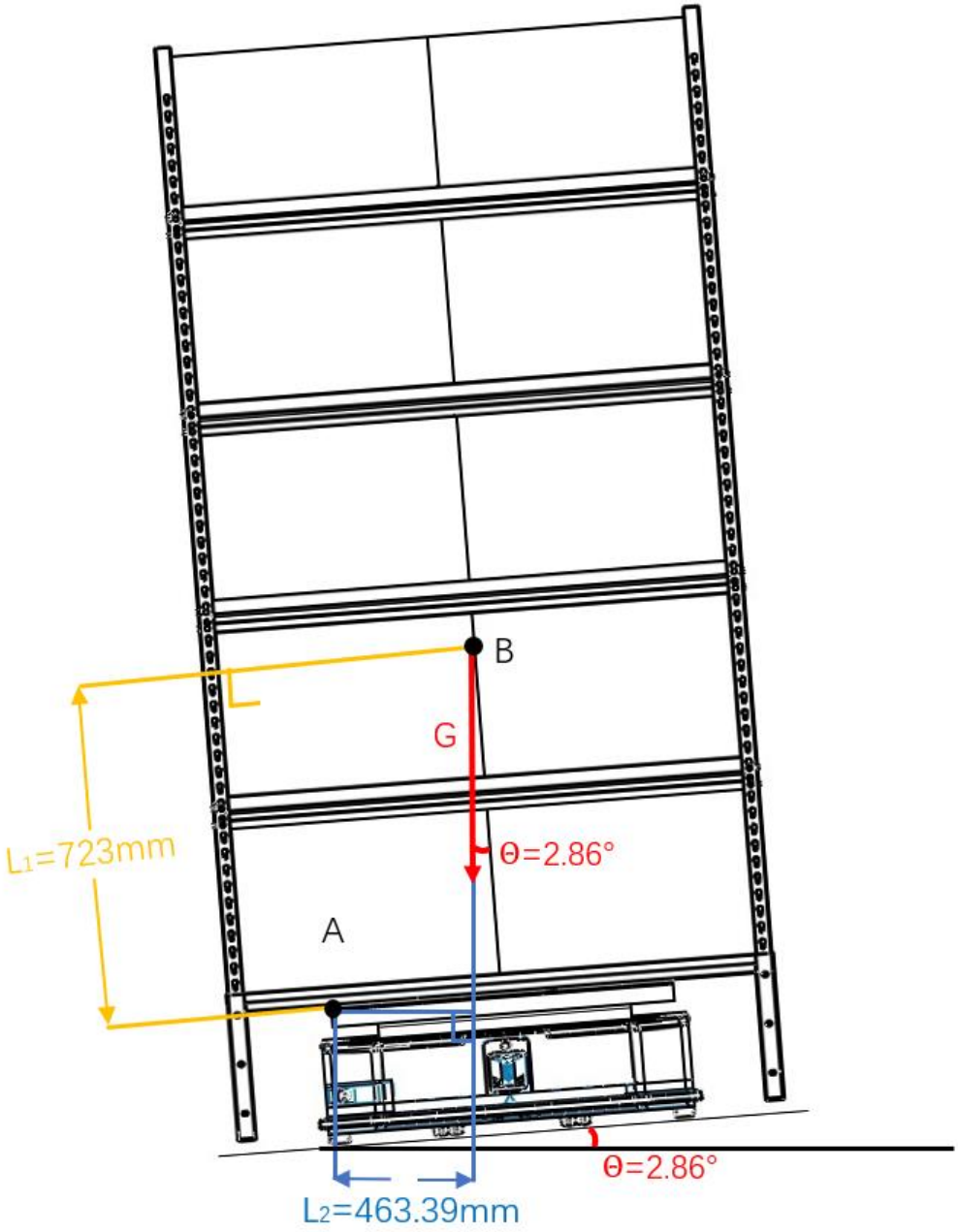
$\therefore$ $M_{C1} > M_{C2}$, Safety factor $n = \frac{M_{C1}}{M_{C2}} = 3.31$

Thus, the safety factor is high enough, and there is no risk of dumping.

Case 3：The lateral stability of the shelf on the slope

Base on the simulation and calculation by the SolidWorks software, the allowable highest center of gravity is point B. The outermost contact point between shelf and AGV tray is Point A.

Mass of the shelf：$m_1 = 120kg$. Mass of the goods：$m_2 = 980kg$. The angle of the slope：$\theta = 2.86°$.



Thus, the torque created by the shelf's weight to point A is:

$$M_{A1} = (m_1 + m_2) \times g \times L_2 = (120 + 980) \times 9.8 \times 463.39 = 4995344Nmm = 4995.34Nm$$

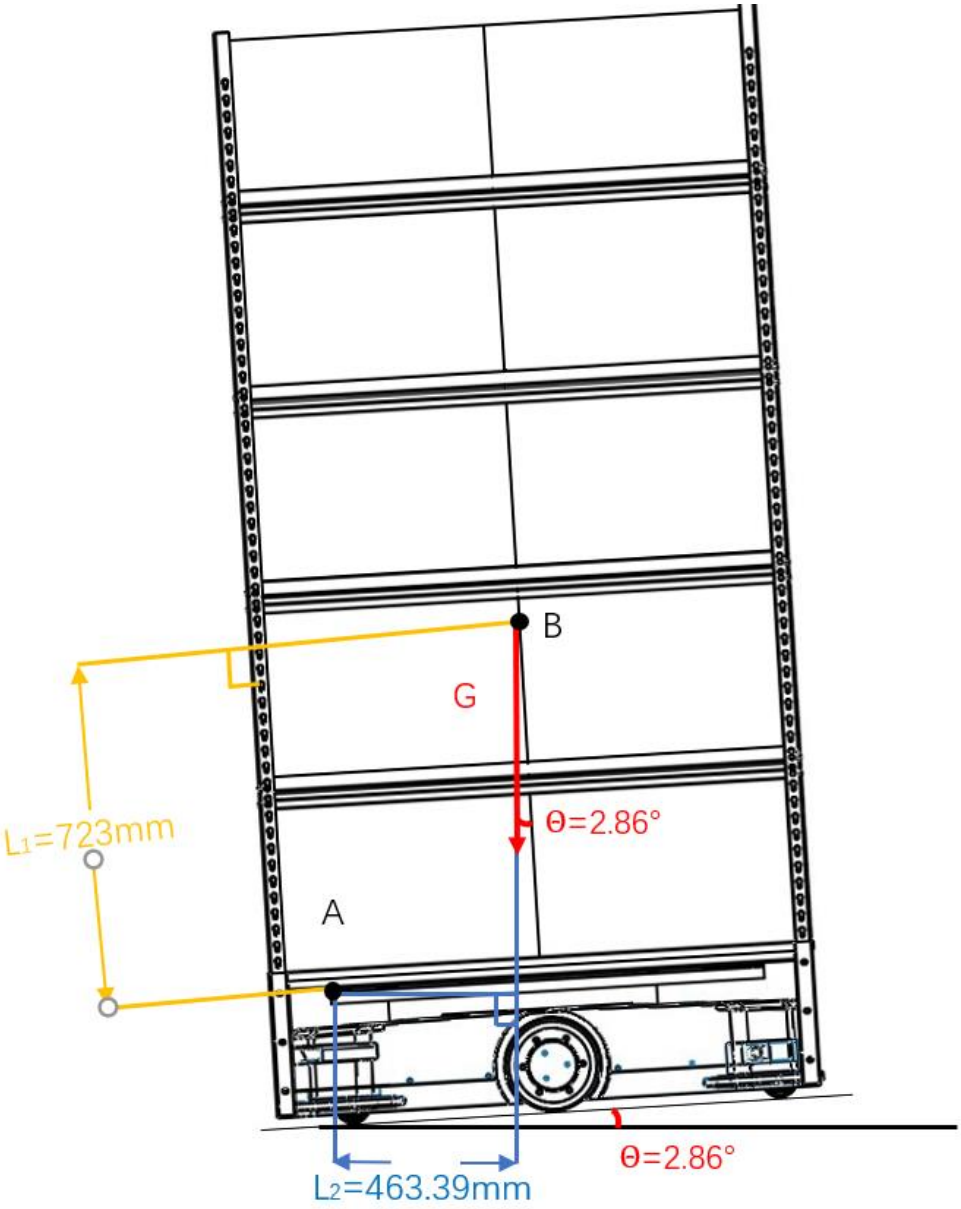
Thus the extension line of the gravity G is inside of point A, and there is no risk of dumping.

Case 4：The longitudinal stability of the shelf on the slope

Base on the simulation and calculation by the SolidWorks software, the allowable highest center of gravity is point B. The outermost contact point between shelf and AGV tray is Point A.

Mass of the shelf：$m_1 = 120kg$. Mass of the goods：$m_2 = 980kg$. The angle of the slope：$\theta = 2.86°$.

Drag acceleration during emergency braking：$a = 1.5m/s^2$



Thus, the torque created by the shelf's weight to point A is:

$$M_{A1} = (m_1 + m_2) \times g \times L_2 = (120 + 980) \times 9.8 \times 463.39 = 4995344Nmm = 4995.34Nm$$

The torque created by the inertia force to the point A is:

$$M_{A2} = F \times L_1 = (m_1 + m_2) \times a \times L_1 = (120 + 980) \times 1.5 \times 723 = 119295Nmm$$
$$= 1192.95Nm$$

So $M_{A1} > M_{A2}$, Safety factor $n = \frac{M_{A1}}{M_{A2}} = 4.19$.

Thus, the safety factor is high enough, and there is no risk of dumping.