



M1 Pro Hardware User Guide



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Shenzhen Yuejiang Technology CO.,Ltd.|China

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Before using our product, please thoroughly read and understand the contents of this document and related technical documents that are published online, to ensure that the robot is used on the premise of fully understanding the robot and related knowledge. Please use this document with technical guidance from professionals. Even if follow this document or any other related instructions, damages or losses will be happening in the using process. Dobot shall not be considered as a guarantee regarding all security information contained in this document.

The user has the responsibility to make sure of following the relevant practical laws and regulations of the country, in order that there is no significant danger in the use of the robot.

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Preface

Purpose

This Document describes the functions, technical specifications, installation guide of Dobot M1 Pro robot, making it easy for users to fully understand and use it.

Intended Audience

This document is intended for:

- Customer
- Sales Engineer
- Installation and Commissioning Engineer
- Technical Support Engineer

Change History

Date	Change Description
2021/04/23	The first releases.
2021/07/08	Add the general security.
2022/03/29	Add release brake button description.
2023/02/02	Overall content optimization

Symbol Conventions

The symbols that may be found in this document are defined as follows.

Symbol	Description
 DANGER	Indicates a hazard with a high level of risk which, if not avoided, could result in death or serious injury
 WARNING	Indicates a hazard with a medium level or low level of risk which, if not avoided, could result in minor or moderate injury, robot damage
 NOTICE	Indicates a potentially hazardous situation which, if not avoided, can result in equipment damage, data loss, or unanticipated result
 NOTE	Provides additional information to emphasize or supplement important points in the main text

Contents

1. Safety	1
1.1 Liability	1
1.1.1 Validity and responsibility	1
1.1.2 Limitation of liability	1
1.1.3 Intended use	1
1.2 Safety warning signs	2
1.3 General safety	2
1.4 Personal safety	6
1.5 Emergency	6
1.5.1 Emergency stop switch	6
1.5.2 Emergency recovery	6
1.5.3 Forced joint movement	7
2. Transportation	8
3. Product Introduction	9
3.1 Overview	9
3.2 Indicator light	10
3.3 Drag button	10
3.4 Operation terminal	10
4. Product Features	11
4.1 Arm orientation	11
4.2 Coordinate system	11
4.2.1 Joint coordinate system	12
4.2.2 User coordinate system	12
4.2.3 Tool coordinate system	13
4.3 Home posture	14
4.4 Stop time and angle	14
5. Mechanical Specifications	15
5.1 Robot dimension	15
5.2 Base and end-effector dimension	15
5.3 Robot workspace	16
5.4 Robot load curve	16
6. Electrical Specifications	17
6.1 Interface of base	17
6.1.1 Interface overview	17
6.1.2 Base I/O interface	18
6.2 End-effector I/O Interface Description	19
7. Installation	21
7.1 Installation environment	21
7.2 Unpacking	21
7.3 Robot installation	21
7.4 Wiring	21
8. Maintenance and Repair	23

8.1 Safety Instructions	23
8.2 Body Maintenance	23
Appendix A Technical Specifications.....	25
Appendix B Digital Circuit Description.....	27

1. Safety

1.1 Liability

1.1.1 Validity and responsibility

The information in this document does not cover designing, installing and operating a complete robot system, nor does it cover all peripheral equipment that can affect the safety of the complete system. The complete system must be designed and installed in accordance with the safety requirements set forth in the standards and regulations of the country where the robot is installed.

The integrators of Dobot are responsible for ensuring that the applicable safety laws and regulations in the country concerned are observed and that any significant hazards in the complete robot application are eliminated. This includes, but is not limited to:

- Performing a risk assessment for the complete robot system.
- Adding safety machines and mechanisms based on the risk assessment.
- Setting up the appropriate safety settings in the software.
- Ensuring that the user will not modify any safety measures.
- Validating that the total robot system is designed and installed correctly.
- Specifying instructions for use.
- Marking relevant signs and contact information of the integrators on the robot.
- Archiving relevant technical files.

1.1.2 Limitation of liability

Any safety information provided in this document should not be construed as a warranty, by Dobot. The robot may cause injury or damage even if all safety instructions are observed.

1.1.3 Intended use

Dobot M1 Pro robots are collaborative robots only for general industrial use, such as processing or delivering components or other products through end tools.

Dobot M1 Pro robots are equipped with special safety mechanisms including collision detection. These mechanisms are purposely designed for human-robot collaborative operation, but only intended for non-hazardous applications after risk assessment, where tools, commodities, environments and other machines have been demonstrated to be incapable of significant risk through application-specific risk assessments.

Any use or application deviating from intended use is deemed to be impermissible misuse, including, but is not limited to:

- Use in potentially explosive environments.
- Use in life critical applications.

- Use before performing a risk assessment.
- Use over-stated specifications.

1.2 Safety warning signs

The following safety warning signs may appear in this document, and their meanings are described as follows. The same safety warning signs are also used in the products.

Sign	Description
 DANGER	Indicates a high degree of potential danger, which, if not avoided, will result in death or serious injury.
 ELECTRICITY	May cause dangerous power consumption soon, which, if not avoided, will cause personal injury or serious damage to the equipment.
 	May cause dangerous hot surfaces, which, if touched, may cause personal injury.
 WARNING	Indicates a moderate or low potential hazard, which, if not avoided, may cause minor personal injury and damage to the equipment.
 ATTENTION	Indicates a potential risk, which, if ignored, may result in damage to the robot arm, loss of data or unpredictable results
 NOTICE	A situation that, if not avoided, can cause personal injury or damage to the equipment. For items marked with such signs, depending on the specific situation, there is sometimes a possibility of significant consequences

1.3 General safety

Follow the safety instructions below when starting and using the robot for the first time.

DANGER

- The robot system is electrical equipment. Non-professional technicians should not modify the circuit, otherwise, it may cause damage to devices or personal injury.
- Comply with the local laws and regulations when operating the robot. The security precautions in this document are only supplemental to the local laws and regulations.
- Use the robot in the specified environment scope. Exceeding the specifications or load conditions will shorten the service life of the robot, even damage it.
- Ensure that the robot is operated under the security conditions and there is no

harmful object around the robot.

- Turning on or off the power continually may result in degraded performance of the main circuit components inside the controller. If turning on or off the power continually is required, please keep the frequency less than once per minute.

•
 HOT

- The robot and the controller will generate heat during operation. Please do not operate or touch the robot when the robot is working or has just stopped working.
- Turn off the power and wait an hour for the robot to cool down.
- Do not put your fingers to where the control cabinet gets hot.

 NOTICE

- The personnel responsible for installation, operation and maintenance of equipment must first receive strict training, understand various safety precautions, and master correct operation and maintenance methods before they can operate and maintain equipment.
- Personnel without professional training shall not disassemble and repair the equipment without authorization. If the device fails, please contact Dobot technical support engineer in time.
- Be sure to carry out daily inspections and regular maintenance, and replace faulty components in time to ensure the safe operation of the equipment.
- If the equipment is scrapped, please comply with relevant laws to properly handle industrial waste and protect the environment.
- In order to prevent personnel from accidentally entering the working space of the robot arm, be sure to set up safety fence to prevent personnel from entering the hazardous area.
- Before operating the robot, make sure that no one is inside the safety fence. When operating the robot, be sure to operate outside the safety fence.
- Do not expose the robot to permanent magnetic fields all the time. Strong magnetic fields can cause damage to the robot.
- Dobot assumes no responsibility for robot damage or personal injury caused by failure to follow product instructions or other improper operations.
- Use appropriate and reliable lifting equipment during handling operations such as lifting rings and bridge crane. According to the relevant regulations of various countries, it must be carried out by personnel with operating qualification certificates or personnel authorized by the company.
- Make sure that there are no obstacles within 2 meters of the robot during transportation. Relevant personnel should stay away from the suspended robot.

- Dobot is not responsible for any damage caused during the transportation and handling of equipment.
- Make sure that the robot is in the packing posture before packaging, and the brakes on each axis are normal.
- Make sure that there are no obstacles around the packing area, so that the staff can leave in a timely manner in case of an emergency.
- When the robot is transported, the packaging needs to be fixed to ensure that the robot is stable.
- After removing the outer packaging, make sure that the robot maintains the original packing posture and the brakes of each axis are normal.
- During the commissioning process, make sure that no relevant personnel and equipment (include computer used for debugging) stay in the dangerous area of the machine.
- If necessary, wear corresponding safety protective equipment, such as safety helmets, safety shoes (with non-slip soles), face shields, protective glasses and gloves. Inappropriate clothing may cause personal injury.
- In order to prevent personnel from entering the working space of the robot arm by mistake, please set up safety barriers to prevent personnel from entering the hazardous area.
- Do not enter the working space of the manipulator at will during operating the robot, otherwise cause injury to the robot or yourself.
- The personnel responsible for installation, operation, and maintenance of the equipment must first undergo strict training, understand various safety precautions, and master the correct operation and maintenance methods before operating and maintaining the equipment.
- When an abnormality occurs in the mechanical arm, it is necessary to ensure that the machine is stopped and then checked.
- After the commissioning of the operator is completed, the test needs to be performed in the Manual mode first, and then it is automatically run after it is confirmed to be correct.
- If the controller needs to be restarted due to power failure, when restarting, the robot must be manually returned to the initial position of the automatic operation program before restarting the automatic operation.
- Before maintenance and wiring work, the power supply must be cut off, and the sign **No power supply** must be put on. Otherwise, electric shock and personal injury may result.
- Please observe the ESD regulations when disassembling the robot or controller.

- Avoid dismantling the power supply system in the controller. After the controller is turned off, its power supply system may still have high voltage for several hours.
- Please contact our technical support staff for the disassembly and repair of the robot.
- Maintenance and repair work must be carried out by designated personnel, otherwise electric shock and personal injury may result.
- If the brake is manually released, the robot may move because of the action of gravity. So, when manually releasing the brake, please ensure that the robot body and the tools or workpieces installed on the robot are effectively supported.
- In order to prevent electric shock, when replacing parts, please turn off the circuit breaker in advance and cut off the main power before proceeding.
- Turn off the main power supply for 5 minutes before replacing parts.
- The replacement operation must be performed by the specified operator.
- The robot is designed and tested according to the group I class A engineering medical robot standard. In order to reduce the radio interference in in light industry or family environment, please take protective measures.
- It is prohibited to operate the robot in strong radiation environment (such as RF source without shielding), otherwise, it could interference robot work.

 **WARNING**

- Before the operation, please wear protective clothing, such as antistatic uniform, protective gloves, and protective shoes.
- It is prohibited to modify or remove the nameplates, instructions, icons and marks on the robot and the related equipment.
- Before operating the equipment, please find and be familiar with the operation method of the emergency stop function to ensure that the robot arm can be stopped urgently in the case of sudden stress. The emergency stop function is Stop Category 1.
- Be careful when carrying or installing the robot. Please follow the instructions on the packing box to put down the robot gently and place it correctly in the direction of the arrow.
- Please use the matched cables when connecting a robot to internal or external equipment for personal security and equipment protection.
- Please ensure that the robot and tools are installed correctly.
- Please ensure that the robot has enough space to move freely.
- If the robot is damaged, do not continue to use it.

- Any impact will release a lot of kinetic energy, which is much higher than that under high speed and high load.

1.4 Personal safety

When operating the robot system, please strictly follow the general precautions listed below to ensure the personal safety of the operator.



- Please comply with local laws or regulations with regard to the maximum weight one person is permitted to carry.
- Do not touch the terminal blocks or disassemble the equipment with the power ON. Otherwise, it may result in an electric shock.
- Please confirm that the equipment is well grounded, otherwise it will endanger personal safety.
- Do not touch the terminal blocks or remove the interval circuit components within 10 minutes after the power is shut off, so as to avoid an electric shock since there is residual capacitance inside the controller.
- Even if the power switch of the controller is already in the OFF status, touching the terminal blocks or removing the interval circuit components is not allowed, so as to avoid an electric shock since there is residual capacitance inside the controller.
- When working with robots, do not wear loose clothing or jewelry. When operating the robot, make sure that you have bundle your hair behind your head.
- If the robot appears to have stopped during the operation of the equipment, it may be because the robot is waiting for the start signal and is in the state of being about to move. In this case, the robot should also be considered to be in motion. Do not approach the robot.

1.5 Emergency

1.5.1 Emergency stop switch

After you press the emergency stop switch in emergencies, the robot will immediately stop all motions and be locked.

Emergency equipment is not a safety guard according to IEC 60204-1 and ISO 13850. They are supplemental protective measures and are not intended to prevent injury.

1.5.2 Emergency recovery

The emergency stop switch will be locked after you press it. To unlock the switch, you need to rotate the switch according to the mark on the switch.

 WARNING

- Please operate the robot to recover from the emergency only after the danger of the robot system is completely removed.

1.5.3 Forced joint movement

In the unlikely event of an emergency, you may need to move the robot joint/s when the robot power is either impossible or unwanted. In this case, you must push or pull the robot arm hard to move the joint.

 WARNING

- Moving the locked joints forcefully may cause joint damage. Please operate only in emergencies.

2. Transportation

You need to transport the robot in its packaging posture (As shown below), and use the original packaging for transportation. The robotic arm has 4 joints, namely J1, J2, J3, and J4. The joint angles/position corresponding to the packaging posture are: $J1=0^\circ$, $J2=0^\circ$, $J3=0\text{mm}$, $J4=0^\circ$. The adjustment of the joint angle/position can be realized by jogging or programming. For specific operations, please refer to the user guide of the control software.

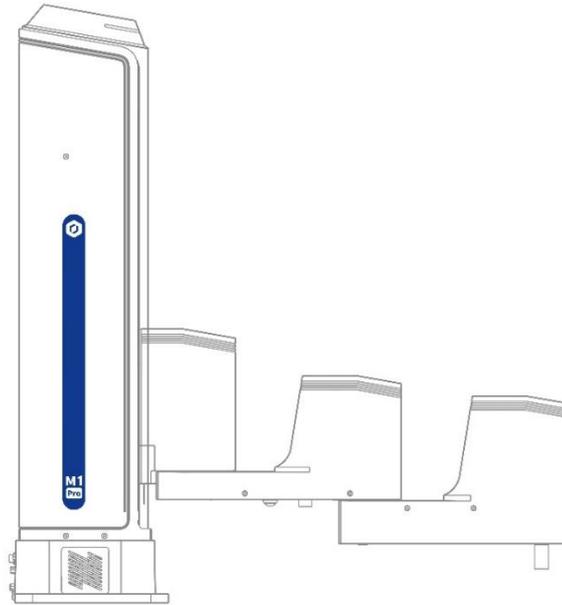


Figure 2.1 Packaging posture

During transportation, ensure that the robot arm is stable and fixed by corresponding measures.

During transportation and long-term storage, ensure that the ambient temperature ranges from -20°C to $+55^\circ\text{C}$, and the ambient humidity is no more than 95% without condensation.

When moving the robot from its packaging to the installation space, hold the robot arm in place until all mounting bolts are securely tightened at the base of the robot.

After transportation, store the original package in a dry place for repacking and transporting it in the future.

WARNING

- Ensure that the operator is not unduly stressed on their back or other body parts when lifting the equipment, and use appropriate lifting equipment if necessary.
- Dobot shall not be held responsible for any damage caused by transportation of the equipment.
- Be sure to follow all installation instructions when installing the robot.

3. Product Introduction

3.1 Overview

Dobot Master 2nd generation robotic arm (Dobot M1 Pro for short) focuses on the light industrial market with great potential, and supports teaching, playback, script control, blockly, vision identity and other functions, which is flexibly used in intelligent sorting, circuit board soldering and other automatic production lines, so that it can become the sword to solve practical problems for light industrial users, and can also become the platform to carry the imagination of the maker. Dobot M1 Pro has the following characteristics.

- The integrated design of the driver and controller without external controller simplifies the process of the initial installation and deployment.
- Built-in calibrated servo, harmonic reducer, combined with kinematic algorithm, can make M1 pro bring out the best of strength and speed.
- The rated load is 1.5kg, and the repeatability is $\pm 0.02\text{mm}$.
- Various I/O and communication interfaces can meet the use of users in different scenarios.

The Dobot M1 Pro controller is installed in the base, and the motion part includes 3 rotation joints (J1, J2, J4), a vertical movement joint (J3) and two connecting rods of the rear arm and the forearm, as shown in the figure below.



Figure 3.1 M1 Pro appearance

3.2 Indicator light

There is a strip indicator light on the top of the M1 Pro to indicate the status of the robotic arm, and its meanings are as follows:

- White flashing: The system is starting up.
- Blue solid: The system is started, but the robotic arm is not enabled.
- Blue flashing: Hand-guiding state
- Green solid: Robotic arm is enabled (no project is running)
- Green flashing: Automatic running state (running project)
- Red solid: General alarm status
- Red flashing: Pose limit alarm status

3.3 Drag button

When the power is disconnected, the braking function of M1 Pro can avoid accidental drop of the rear arm and forearm in J3 axis due to gravity action, resulting in equipment damage or personal injury.

There is a drag button at the bottom of the rear arm. Press the drag button when the power is on, and the arms can be dragged to move.

This drag button is an automatic reset switch and is effective only when pressed.



WARNING

In the process of moving by pressing the drag button, it is necessary to support the rear arm and forearm of M1 Pro with your hand, otherwise the rear arm and forearm may fall off.

3.4 Operation terminal

M1 Pro support control through PC and App, as shown in the table below. If you need to use WiFi for control, you need to plug the WiFi module into the base.

Table 3.1 Operation terminal parameters

Terminal type	PC	Tablet (Android)	iPad
Operation system	Windows7/10/11	Android 10 and above	iOS 10 and above
Control software	DobotStudio Pro	Dobot CRStudio	Dobot CRStudio
Minimum configuration	CPU: Intel Core i3 Memory: 4GB Storage space: 256GB	CPU: 4-core Running memory: 2G Storage space: 32G	Storage space: 32G
Communication mode	LAN/WiFi	WiFi	WiFi

4. Product Features

4.1 Arm orientation

With two types of the arm orientation (lefty hand orientation and righty hand orientation), M1 Pro can move to nearly any position and orientation within a given work envelope. You need to specify the arm orientation when M1 Pro is moving. If you fail to do so, M1 Pro may move following an unexpected path, resulting in interference with peripheral equipment. The arm orientations are shown in Figure 4.1 and Figure 4.2.

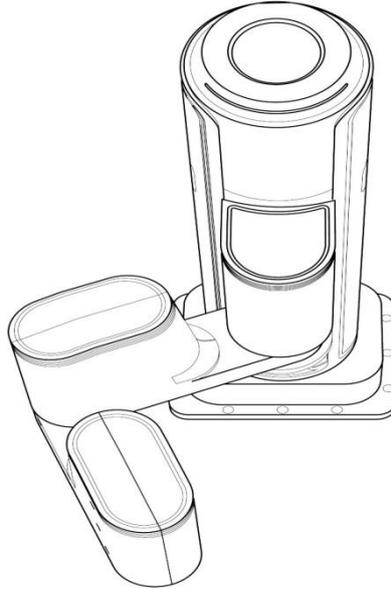


Figure 4.1 Righty hand orientation

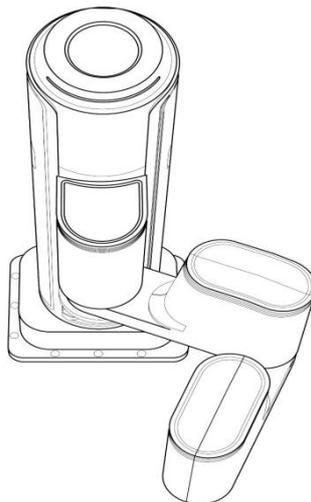


Figure 4.2 Lefty hand orientation

4.2 Coordinate system

4.2.1 Joint coordinate system

The Joint coordinate system is determined by the motion joints.

Figure 4.3 shows the Joint coordinate system of a M1 Pro robot. M1 Pro contains four joints.

- J1, J2, and J4 are the rotating joints, which are located and oriented in the horizontal plane. And their axes are parallel to each other. The positive direction of these joints is counter-clockwise.
- J3 is the moving joint, which is used for the movement of the end effector in the perpendicular plane. The positive direction of J3 is vertical upward.

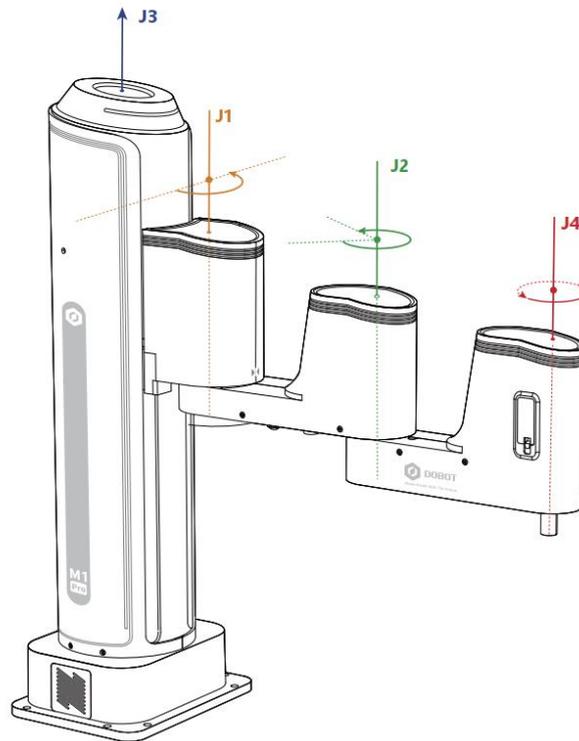


Figure 4.3 Joint coordinate of a M1 Pro robot

4.2.2 User coordinate system

The User coordinate system is a movable coordinate system which is used for representing equipment like fixtures, workbenches. The origin and the orientations of axes can be defined based on site requirements, to measure point data within the workspace and arrange tasks conveniently. The default user coordinate system is a coordinate system is located at the base of the robot, as shown in the figure below.

- The origin is the axes center of the motor of Rear Arm where Rear Arm is dropped to the bottom of the Z-axis screw.
- The direction of X-axis is perpendicular to the base forward.
- The direction of Y-axis is perpendicular to the base leftward.
- The direction of Z-axis is vertical upward, which is based on the right-hand rule.

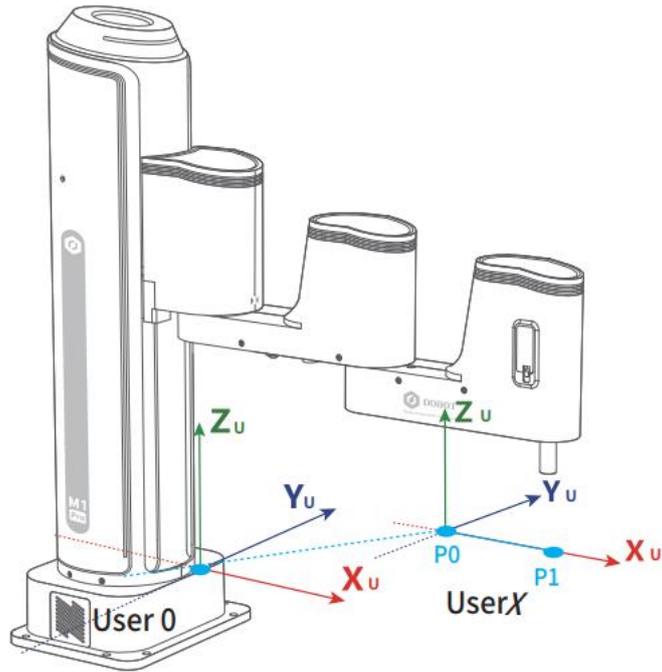


Figure 4.4 The default User coordinate system of M1 PRO robot

4.2.3 Tool coordinate system

Tool coordinate system is the coordinate system that defines the distance and rotation angle of the offset, of which the origin and orientations vary with the position and attitude of the workpiece located at the robot flange.

Figure 4.5 shows the default Tool coordinate system of a M1 Pro robot.

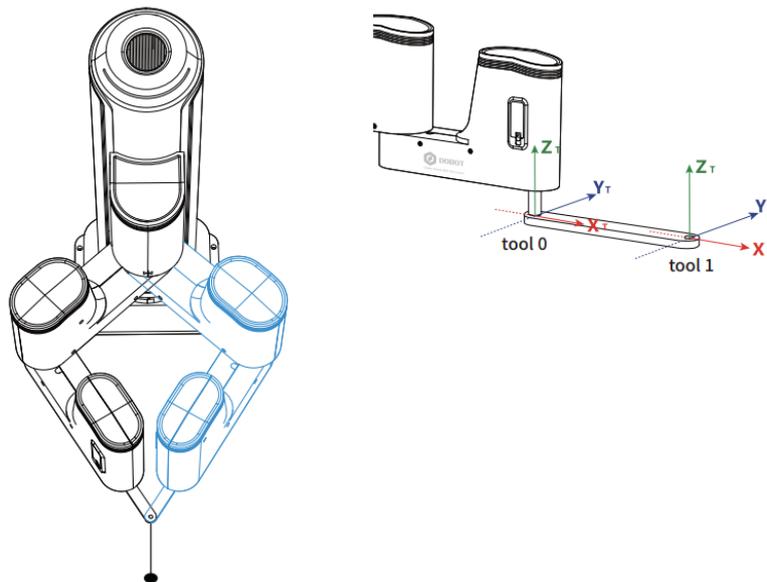


Figure 4.5 The default Tool coordinate system of M1 Pro robot

4.3 Home posture

The posture when all the joint angles/position of the robot are 0 degrees/mm is called the home posture, as shown in the figure below.

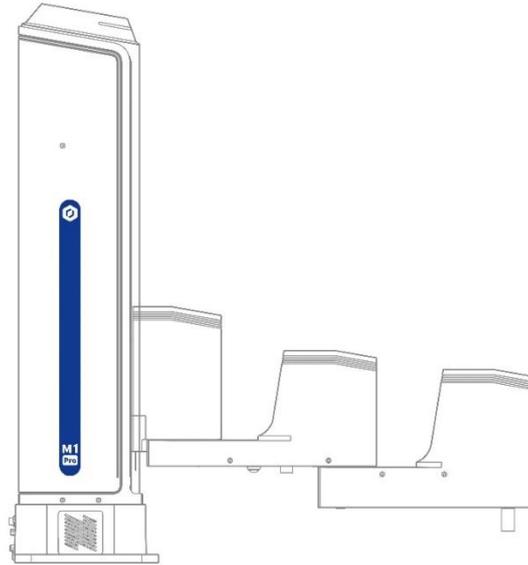


Figure 4.6 Home posture of M1 Pro robot

If the home point of the robotic arm changes due to the replacement of transmission parts or collision, you can use the calibration block and control software in the delivery accessories to calibrate. For details, refer to the corresponding control software user manual.

4.4 Stop time and angle

The Max. stop time and angle of axis J1, J2, J3 and J4 at the max speed, load and arm stretch are shown below.

Table 4.1 Stop time and angle

Axis	Max. stop angle (°)	Max. stop time (ms)
J1	9.6	103
J2	9.4	102
J4	36.5	100
Axis	Max. stop distance (mm)	Max. stop time (ms)
J3	43	104

5. Mechanical Specifications

All dimensions in this chapter are in millimeters (mm).

5.1 Robot dimension

Figure 5.1 shows the dimension of M1 Pro robot.

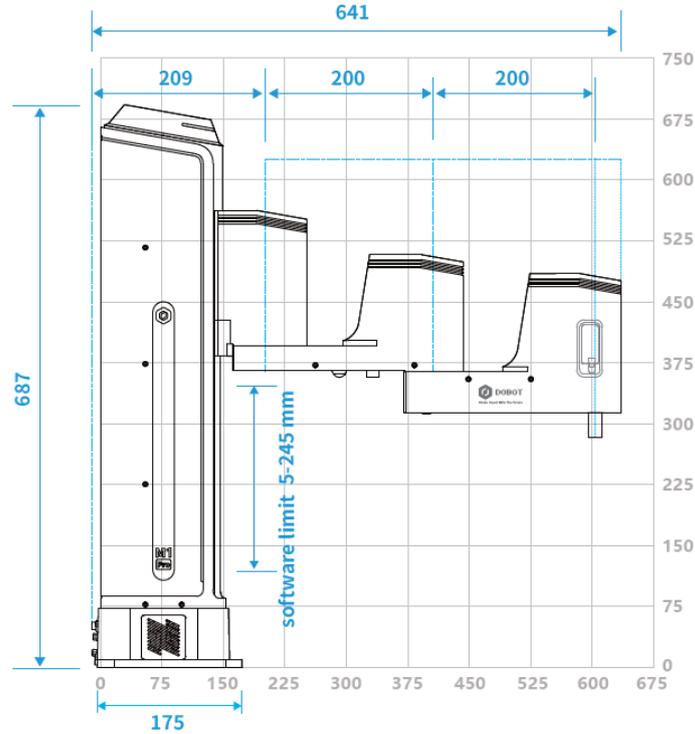


Figure 5.1 M1 Pro dimension

5.2 Base and end-effector dimension

You can install the matching gripper, suction cup on the end of the M1 Pro for transporting and intelligent sorting. Figure 5.2 shows the dimension of end-effector.

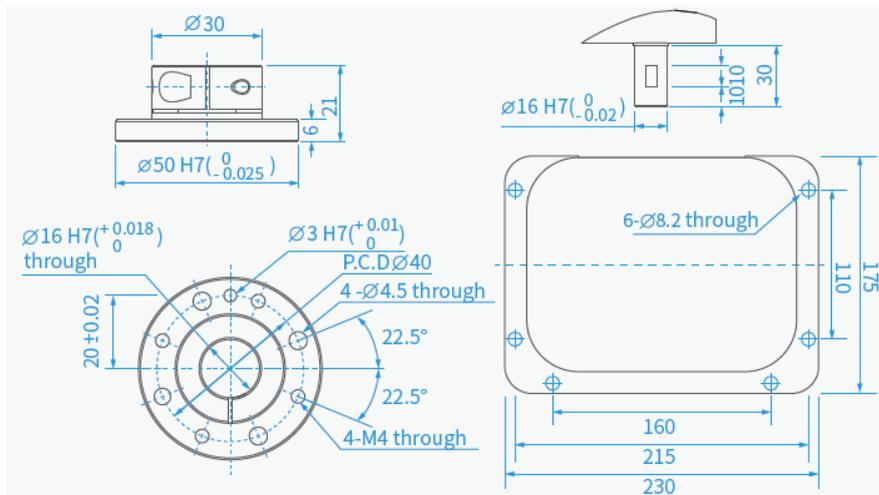


Figure 5.2 Base and End-effector dimension

5.3 Robot workspace

Figure 5.3 shows the workspace of M1 Pro robot.



When operating the robot, be sure to operate inside the workspace.

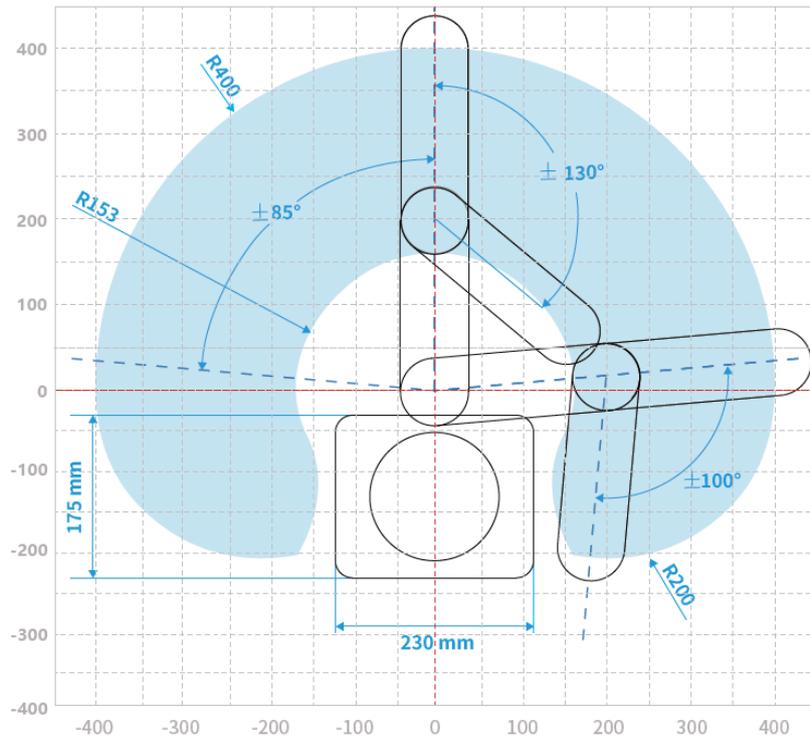


Figure 5.3 M1 Pro robot workspace

5.4 Robot load curve

The load offset that the robot can bear is within 100mm from the J4 axis, that is, the center of mass of the load needs to be within the range of the cylinder 100mm from the center of the end flange; The maximum load that the robot can bear is 1.5kg, which decreases with the increase of the load offset, as shown in the figure below (when the load offset is 100mm, the maximum load of the robot is 0.5kg).

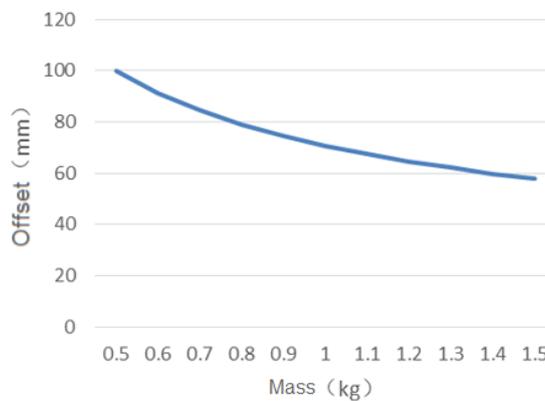


Figure 5.4 M1 Pro load curve

6. Electrical Specifications

6.1 Interface of base

6.1.1 Interface overview

Figure 6.1 shows the interface panel of the base. Table 6.1 lists the description.

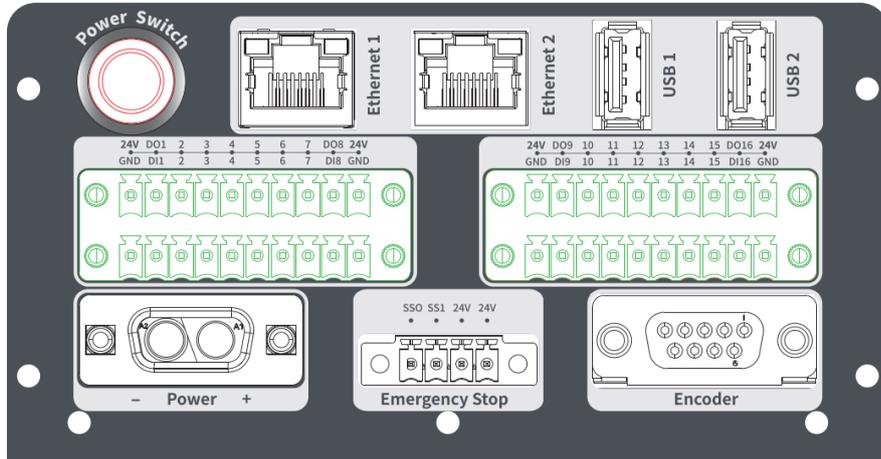


Figure 6.1 Interface panel of the base

Table 6.1 Interface description

Screen printing	Description
Ethernet1	Ethernet interface The default IP address is 192.168.1.6, which cannot be modified. It can be used for debugging on the upper computer
Ethernet2	Ethernet interface For connecting to external equipment. The default IP address is 192.168.2.6, which can be modified.
USB1	USB interface For connecting WiFi module, updating firmware, etc
USB2	USB interface For connecting WiFi module, updating firmware, etc
Encoder	Encoder interface (differential ABZ incremental encoder) For connecting to the conveyor belt for dynamic tracking
Power Switch	For controlling the robot power on and off
Emergency Stop	Emergency stop interface
Power	For connecting to DC 48V power supply
I/O	I/O interface

The Encoder interface of the M1 Pro is shown in Figure 6.2, Table 6.2 lists the description of Encoder interface.

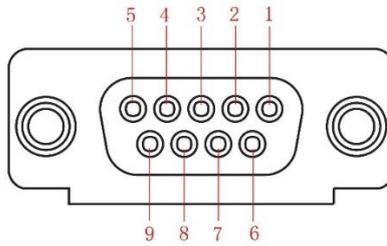


Figure 6.2 Encoder interface

Table 6.2 Encoder Interface description

No.	1	2	3	4	5	6	7	8	9
Description	ABZ_A+	ABZ_A-	ABZ_B+	ABZ_B-	ABZ_Z+	ABZ_Z-	5V	0V	unused

6.1.2 Base I/O interface

A robot controller contains I/O interfaces, for connecting to external equipment, such as PLC, etc. These I/O interfaces provide 16 digital inputs, 16 digital outputs, as shown in Figure 6.3.



Figure 6.3 I/O interface

NOTE

- Digital output is powered by internal 24V power supply.
- The output current of every DO can't exceed 500mA.
- The total current can't exceed 2A.

DI wiring

The wiring of DI connected to a simple switch is shown below.

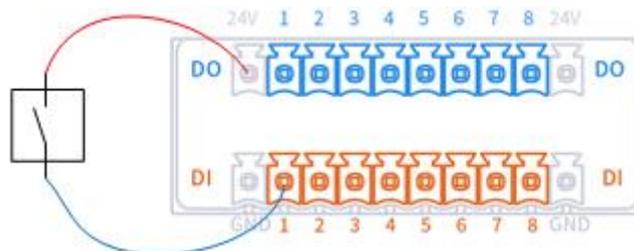


Figure 6.4 DI connected to a simple switch

The wiring of DI connected to external DO is shown below, which takes PNP-type DO without power supply as an example. If DO has its own power supply, you do not need to connect V+ cable.

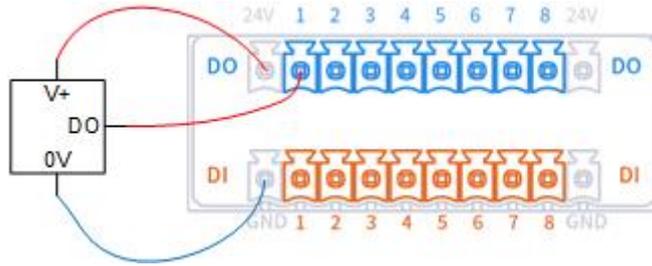


Figure 6.5 DI connected to external DO

DO wiring

The wiring of DO connected to external load (without external power supply) is shown below.

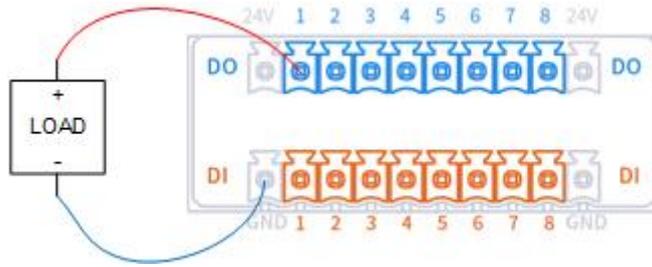


Figure 6.6 DO connected to external load (without external power supply)

When the load connected to the DO interface requires a large driving capacity, that is, when the load driving current is greater than 500mA, the default driving capacity of the MG400 cannot meet the requirements. At this time, the external driving circuit is required to increase the driving capacity, as shown in the figure below.

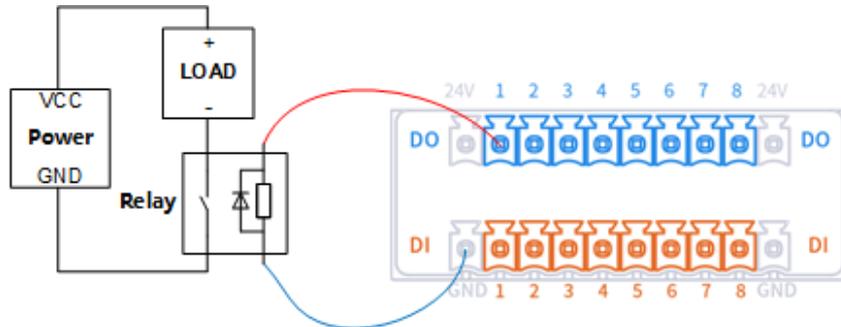


Figure 6.7 DO connected to external load (with external power supply)

6.2 End-effector I/O Interface Description

The end-effector I/O interfaces of the M1 Pro include a RS485 interface, 4 digital inputs and 4

digital outputs, as shown in Figure 6.8, Table 6.3 lists the description of End-effector I/O interface.

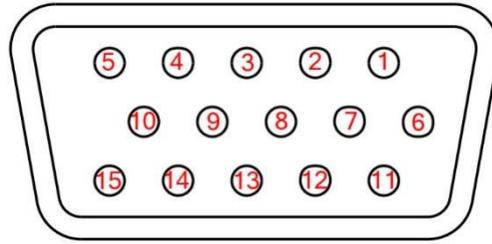


Figure 6.8 End-effector I/O interface

Table 6.3 End-effector I/O interface description

No.	1	2	3	4	5	6	7	8
Description	24V	DO17	DO18	DO19	DO20	unused	unused	unused
No.	9	10	11	12	13	14	15	
Description	RS485 A	RS485 B	DI17	DI18	DI19	DI20	0V	

7. Installation

7.1 Installation environment

To maintain the controller and robot performance and to ensure the safety, please place them in an environment with the following conditions.

- Install indoors with good ventilation.
- Keep away from excessive and shock.
- Keep away from direct sunlight.
- Keep away from dust, oily smoke, salinity, metal powder, corrosive gases, and other contaminants.
- Keep away from flammable.
- Keep away from cutting and grinding fluids
- Keep away from sources of electromagnetic interference.
- High altitude environment may affect the performance of the robot. For details, please consult the Dobot technical support.

7.2 Unpacking

When unpacking, please check the attached shipping list to ensure that all contents are included. If there is anything missing, please contact your supplier.

7.3 Robot installation

After taking out the robot from the package, use 6 M6 hexagon socket bolts to tighten and fix the robot base with a torque of 17 N·m. The installation of the robot directly affects the stability of the robot operation. When fixing the robot, users can design or select the installation platform according to the hole size of the robot base and the real environment, and the installation height of the robot needs to be more than 0.6 meters. The installation platform of the robot should not only bear the weight of the robot, but also bear the dynamic force of the maximum acceleration movement. When fixing the robot on the platform, pay attention to:

- Design or select the installation platform according to the workspace of the robot to ensure that the movement track of the robot is not disturbed during operation.
- The plane used to support the robot on the installation platform shall be kept horizontal.

7.4 Wiring

1. Connect the emergency stop switch wire with the wiring terminal.
2. Connect the power cord. The other end of the power cord is connected to the external power supply through the power adapter.
3. Use the network cable to connect the LAN1 interface of the base and the computer for debugging. If you have purchased a WiFi module, you can also plug the WiFi module into the USB interface of the base without connecting the network cable.
4. Press the power switch. After the robot is started, you can use the control software (DobotStudio Pro or Dobot CRStudio) to control the robot. See the user manual of the

corresponding software for details.

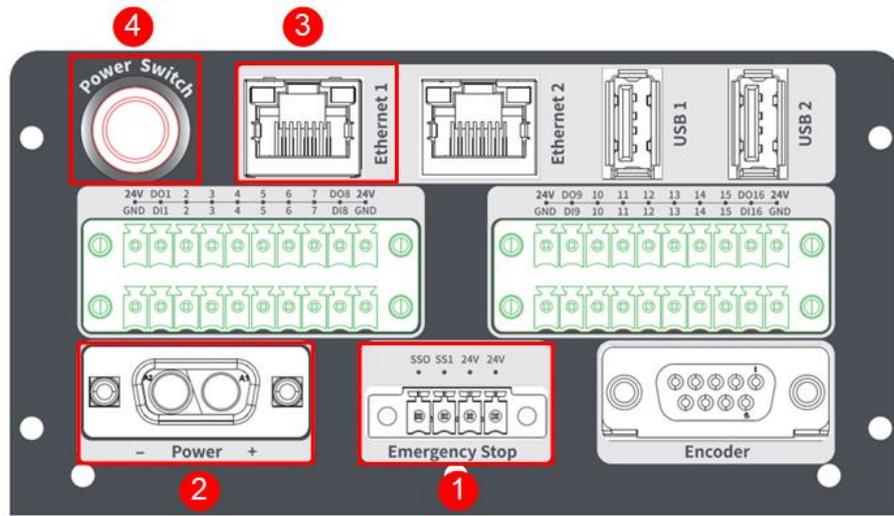


Figure 7.1 M1 Pro wiring

8. Maintenance and Repair

Maintenance and repairing must be performed in compliance with all safety instructions in this manual.

The purpose of maintenance and repairing is to ensure that the system is kept operational, or to return the system to an operational state in the event of a fault. Repairing includes troubleshooting in addition to the actual repair itself.

Repairing must be performed by an authorized system integrator or Dobot staff.

Robots or parts returned to Dobot should be as the following instructions.

- Remove all parts that do not belong to Dobot.
- Before returning to Dobot, please make a backup copy of the files. Dobot will not be responsible for the loss of programs, data or files stored in robot.
- The robot should move to the package point before returning to Dobot.

8.1 Safety Instructions

The following safety procedures and warnings must be observed during the operation of the robot or controller:

- Replace faulty components with new components with the same article number or equivalent components approved by Dobot.
- Reactivate any deactivated safety measures immediately after the repairing is completed.
- Record all repairs and save them in the technical document with the robot system.
- Remove the main input cables from the back of the robot to ensure that it is completely unpowered. Take necessary precautions to prevent other people from powering on the system during the repair period.
- Observe ESD regulations during the disassembly of the parts of the robot.
- Prevent water and dust from entering the robot.

8.2 Body Maintenance

In order for the robot to maintain high performance for a long time, a maintenance check must be carried out. The person in charge of overhaul must prepare an overhaul plan and carry out an inspection. The overhaul items is shown below.

Table 8.1 Overhaul item

Cycle			Overhaul Item	Overhaul essential
Daily	3 month	6 month		
√			Robot clean	Wipe off dirt, dust, cutting residue on the body with water or 10% alcohol

√			Cable, cable protective cover and bolts	Observe the moving part of the cable, check whether the cable is damaged, whether there is local bending or distortion; Check whether the cable protective cover is damaged; Check whether the screws are loose.
√			Motor	Abnormal heating or sound confirmation
√			Brake	Check whether the robot arm or end-effector will fall when the servo is powered off

Table 8.2 lists the bolted tightening torque table.

Table 8.2 Bolted tightening torque table

Bolt size	Hexagon sock-et head cap scre	Hexagon socket countersunk flat cap head screw	Hexagon screw (rubber part)
2.5 mm	0.7 N•m		-
3 mm	2 N•m	-	1.2 N•m
4 mm	4 N•m	2 N•m	-
5 mm	9 N•m	-	-

The tightening torques will vary depending on the type of base metal or bolt. When not specified, please contact Dobot technical engineer.

In addition, overhauls are required every 10,000 hours of operation time or every 3 years. If you are not clear about the maintenance processes, please contact Dobot technical engineer.

Appendix A Technical Specifications

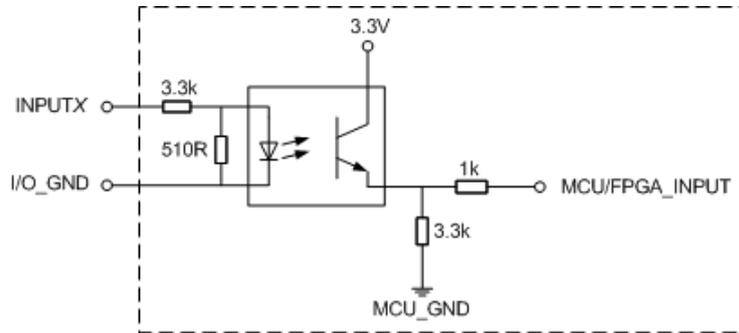
Table 8.3 M1 Pro technical parameters

Product	DOBOT M1 Pro	
Model	DT-M1-P4R15-01I	
Weight	15.7kg	
Max load	1.5kg	
Reach	400mm	
Power supply	100~240 VAC, 50/60Hz	
Rated voltage	DC48V	
Installation	Table installation, indoor	
Rated power	192W	
Repeatability	±0.02mm	
Base size	230mm*175mm	
Operation software	DobotSCStudio, DobotStudio2020	
Motion range	J1	±85°
	J2	±135°
	J3	5mm~245mm
	J4	±360°
Joint maximum speed	J1	180°/s
	J2	180°/s
	J3	1000mm/s
	J4	1000°/s
End-effector interface	DI	4
	DO	4
	RS485 (Modbus_RTU)	1
Base interface	DI	16
	DO	16
	ABZ incremental encoder (differential)	1

	Ethernet	2
	USB 2.0	2
Temperature range	Storage temperature: -25°C~55°C Working temperature: 0°C~40°C	
Safety Standard	EN ISO 10218-1:2011 Steel wire and wire products. General. Test methods EN 60204-1:2018 Safety of machinery. Electrical equipment of machines. General requirements EN ISO 12100:2010 Safety of machinery. General principles for design. Risk assessment and risk reduction	
EMC Standard	EN 61000-6-2:2019 Electromagnetic compatibility (EMC). Generic standards. Immunity standard for industrial environments EN 61000-6-4:2019 Electromagnetic compatibility (EMC). Generic standards. Emission standard for industrial environments	

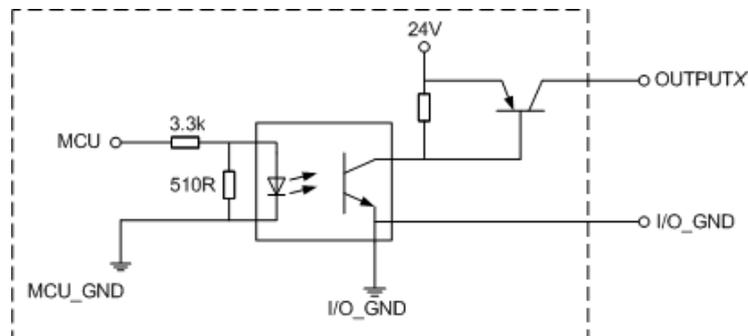
Appendix B Digital Circuit Description

Digital Input



Item	Specification
Input channel	16 channels
Connection method	Crimping terminal
Input type	PNP
Input voltage (DC)	24V±10%
Isolation method	Optical coupling isolation

Digital Output



Item	Specification
Output channel	16 channels
Connection method	Crimping terminal
Output type	PNP
Power supply (DC)	24V±10%
Load current of single channel	500mA
Output current	2A
Isolation method	Magnetic isolation