

MG400 Hardware User Guide (DT-MG400-4R075-01)

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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 MG400 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
2021/02/06	The first releases
2021/04/06	Add description of hand-teaching button and diameter of the air interface
2021/07/26	Add input and output circuit examples in different application scenarios
2021/08/23	Updated end-effector size, and add reserved mounting hole
2022/03/03	Updated the sequence of 3. Electrical Specifications , and modified the motion range of J4 joint

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

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1. Security Precautions

This topic describes the security precautions that should be noticed when using this product. Please read this document carefully before using the robot for the first time. This product needs to be carried out in an environment meeting design specification. You cannot remold the product without authorization, otherwise, it could lead to product failure, and even personal injury, electric shock, fire, etc. People who use this product for system design and manufacture must be trained by our company, relevant institution, or must have the same professional skills. The installation personnel, operators, teaching personnel, programmers and system developers of the robot must read this document carefully and use the robot strictly according to the regulations of this document strictly.

1.1 Security Warning Sign

The following safety warning signs may appear in this manual, and their meanings are as follows.

Sign	Description
 DANGER	Indicates a high degree of potential danger, which, if unavoidable, will result in death or serious injury
 ELECTRICITY	Dangerous power consumption will soon be caused. If it cannot be avoided, it will cause personal injury or serious injury to the equipment.
 HOT	May cause dangerous hot surfaces, if touched, may cause personal injury
 WARNING	Indicates that there is a moderate or low potential hazard. If it cannot be avoided, it may cause minor injuries to the equipment and damage to the equipment.
 ATTENTION	Indicates a potential risk, and ignoring these texts may result in damage to the robotic arm, loss of data, or unpredictable results
 NOTICE	A situation that, if unavoidable, can cause personal injury or equipment damage For items marked with such symbols, depending on the specific situation, there is sometimes the possibility of significant consequences

1.2 General Security

The following security rules should be followed when using the robot for industrial design and manufacture.



- Robot is electrical equipment. Non-professional technicians cannot modify the circuit, otherwise, it can injure the device or the person.
- You should 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.
- Please use the robot in the specified environment scope. If not, exceeding the specifications or load conditions will shorten the service life of the robot, even damage it.
- Please 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 that the performance of the main circuit components inside the robot is degraded. If turning on or off the power continually is required, please keep frequency less than once a minute.

NOTICE

- The personnel responsible for installation, operation and maintenance of equipment must first undergo rigorous training, understand various safety precautions, and master the 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 Shenzhen Yuejiang Technology Co., Ltd 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 robotic 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.
- Shenzhen Yuejiang Technology Co., Ltd. assumes no responsibility for robot damage or personal injury caused by failure to follow product instructions or other improper operations.
- Shenzhen Yuejiang Technology Co., Ltd. is not responsible for the damage caused during the transportation and handling of equipment.
- Please make sure that the robot is in the packing posture before packaging, and the brakes on each axis are normal.

- When the robot is transported, the packaging needs to be fixed to ensure that the robot is stable.
- After removing the outer packaging, please make sure that the robot maintains the original packing posture and the brakes on each axis are normal.
- During the commissioning process, it is necessary to confirm 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.
- When an abnormality occurs in the mechanical arm, it is necessary to ensure that the machine is stopped and then checked.
- 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 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 light industry or family environment, please take protective measures.
- It is prohibited to operate the robot in strong radiation environment, for example,

RF source without shielding, otherwise, it could lead to robot abnormally.

 **WARNING**

- In order to protect the equipment and personal safety, when turning off the power, please press the ship type switch, then unplug the AC power cable.
- 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 and maintaining the robot, the personnel responsible for the installation, operation and maintenance must be trained to understand the various security precautions and to master the correct methods of operation and maintenance.
- Be careful during the robot carrying or installing. Please follow the instructions on the packing box to put down the robot gently and place it correctly in 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 robot and tools are installed correctly.
- Please ensure that the robot has enough space to move freely.
- If the robot is damaged, please do not continue to use it.
- Any impact will release a lot of kinetic energy, having a much more significant effect than that under high speed and high load.

1.3 Personal Security

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

 **WARNING**

- To reduce the risk of personal injury, please comply with local 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 in 10 minutes after the power is shut off, to avoid an electric shock since there is residual capacitance inside the robot.

- Even if the power switch of the robot is already in the **OFF** status, touching the terminal blocks or removing the interval circuit components is not allowed, to avoid an electric shock since there is residual capacitance inside the robot.
- When working with robots, please do not wear loose clothing or jewelry. When operating the robot, make sure that the long hair bundle is 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, please do not approach the robot.
- Please ensure that the robot establishes safety measures near the operation area, such as guardrails, to protect the operator and surrounding people.

2. Overview

The collaborative robot work system is composed of the collaborative robot body, robot control software, and robot operation software. DOBOT MG400 supports direct connection with computer, which is really simple and easy to use. With the self-developed dynamic algorithm, one-handed teach-in and sensor less collision detection are realized to ensure the safety of human and machine working together. DOBOT MG400 has a repeat positioning accuracy of $\pm 0.05\text{mm}$, a max load of 500g. It is a product with the advantages of both industrial robots and collaborative robots.



Figure 2.1 DOBOT MG400

2.1 Technical Specifications

Table 2.1 MG400 technical parameters

Product	DOBOT MG400
Model	DT-MG400-4R075-01
Weight	8kg
Max load	500g
Reach	440mm
Power adapter	100V~240V AC, 50/60Hz, Max. 240W
Rated voltage	DC48V
Installation	Table installation, indoor
Rated power	150W
Repeatability	$\pm 0.05\text{mm}$
Base size	190mm * 190mm

Operation software	DobotStudio2020、SCStudio	
Motion range	J1	$\pm 160^{\circ}$
	J2	$-25^{\circ} \sim 85^{\circ}$
	J3	$-25^{\circ} \sim 105^{\circ}$
	J4	$-360^{\circ} \sim 360^{\circ}$
Joint maximum speed	J1	300 %s
	J2	300 %s
	J3	300 %s
	J4	300 %s
End-effector I/O interface	DI	2
	DO	2
Base interface	DI	16
	DO	16
	ABZ incremental encoder (differential)	1
	Ethernet	2
	USB 2.0	2
Communication mode	TCP/IP, Modbus, TCP	
Temperature range	Storage temperature: $-25^{\circ}\text{C} \sim 55^{\circ}\text{C}$ Working temperature: $0^{\circ}\text{C} \sim 40^{\circ}\text{C}$	
Operating altitude range	≤ 1000 m	
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	

2.2 Robot Dimension

Figure 2.2 shows the dimension of MG400 robot.

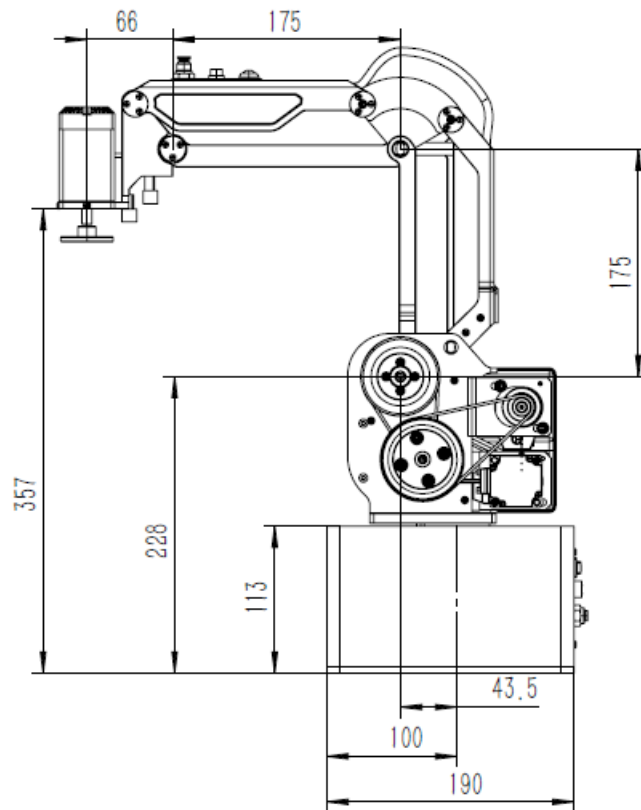


Figure 2.2 MG400 robot dimension

2.3 Robot Workspace

Figure 2.3 shows the workspace of MG400 robot.

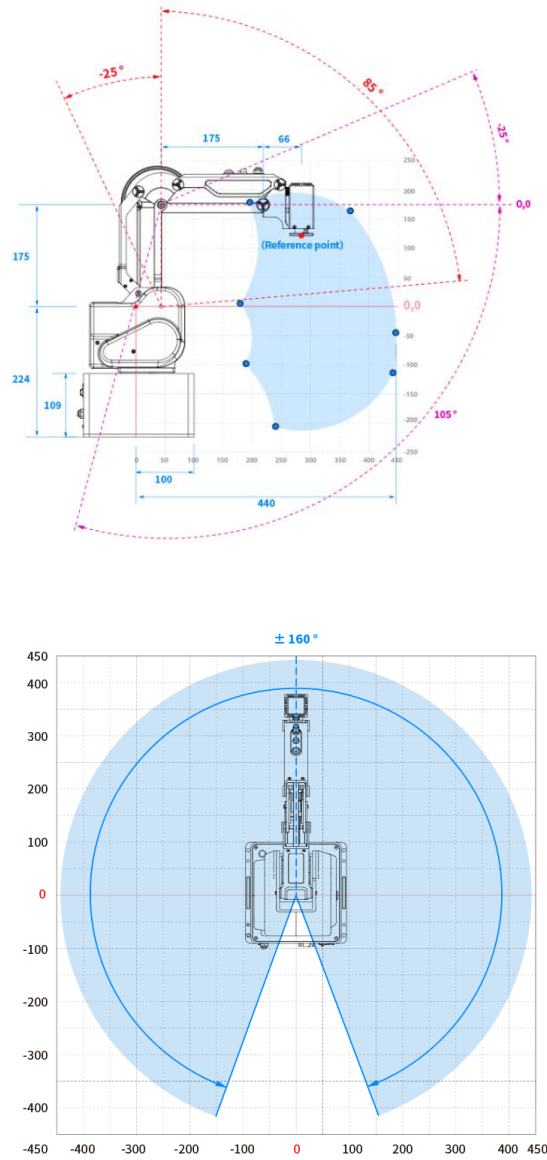


Figure 2.3 MG400 robot workspace

 NOTICE

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

2.4 End-effector Size

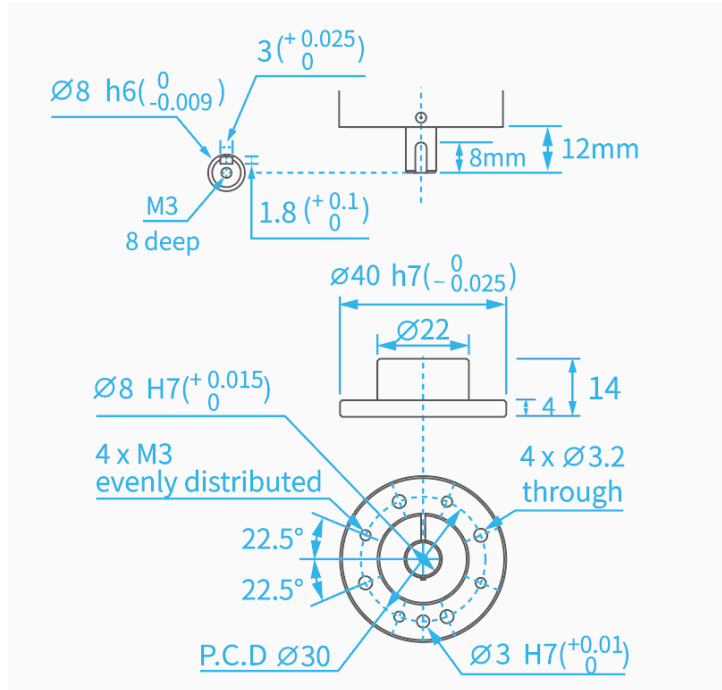


Figure 2.4 End-effector Size

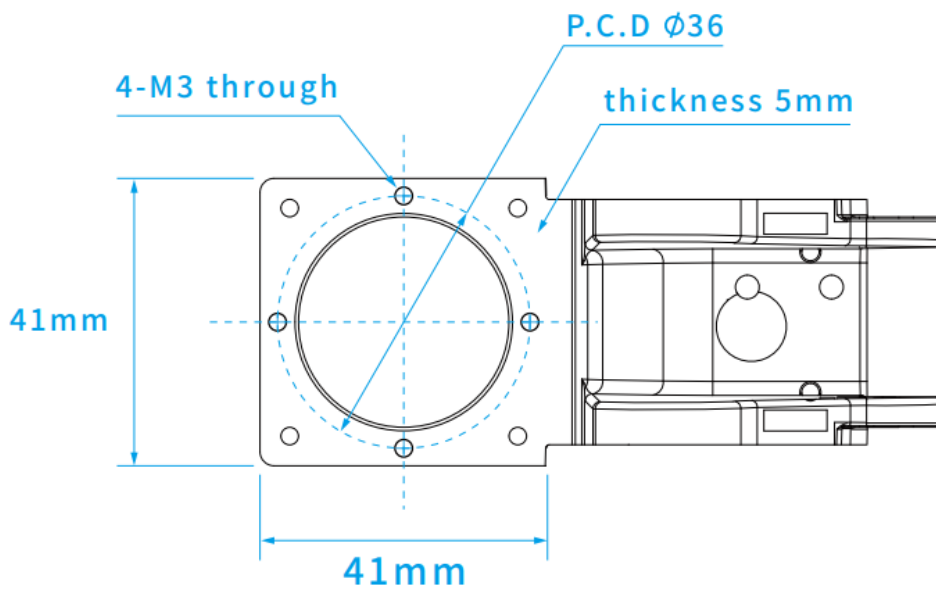


Figure 2.5 Reserved mounting hole

2.5 End-effector Load Description

When the rated load is 500g, the maximum eccentricity of the center of mass shall not exceed 40mm.

2.6 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 2.2 Stop time and angle

Axis	Max. stop angle (°)	Max. stop time (ms)
J1	63.391	427
J2	16.13	114
J3	17.951	123
J4	22.027	131

2.7 Home Description

After some parts (motors, reduction gear units) of the robot have been replaced or the robot has been hit, the origin of the robot will be changed. You need to reset the origin. For details, please see *DobotSCStudio User Guide (MG400 Robot)*.

2.8 Factory point

When the robot leaves the factory, moving robot to the factory point can reduce the robot space, easy to pack and transport. Figure 2.6 shows the factory point. The robot has 4 joints, respectively J1, J2, J3 and J4, please see 2.9.2.1 Joint Coordinate System for explanation of joints. The joint angles corresponding to the factory point are: J1= 0 °, J2= 0 °, J3= 60 °, and J4= 0 °. Adjust joint Angles by jog or programming. For details, please see *DobotSCStudio User Guide (MG400 Robot)*.

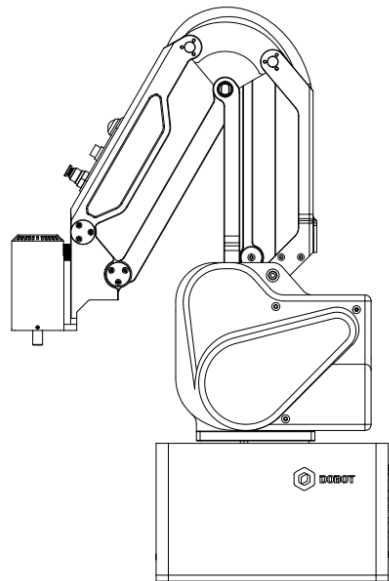


Figure 2.6 Factory point

2.9 Product Features

2.9.1 Motion Function

The motion trajectory consists of a series of interpolated motions since the interpolated motion is the basic motion type. According to the different trajectories, motion functions are classified as joint interpolated motion, linearly interpolated motion, circular interpolated motion and continuous path. The joint interpolated motion is in the joint space. And the other interpolated motions are in the Cartesian space.

2.9.1.1 Joint Interpolated Motion

Joint interpolated motion includes **Go**, **MoveJ** modes.

- **Go/MoveJ**: From point A to point B, each joint will run from an initial angle to its target angle, regardless of the trajectory, as shown in Figure 2.7.



Figure 2.7 Go/MoveJ modes

2.9.1.2 Linearly Interpolated Motion

The joints will perform a straight line trajectory from point A to point B, as shown in Figure 2.8.



Figure 2.8 Move mode

- **Jump**: The trajectory looks like a door. From point A to point B, the robot will move in the **Move** mode
 1. Move up to the lifting height (**StartHeight** is a relative height).
 2. Move up to the maximum lifting height (**zLimit**).
 3. Move horizontally to a point that is above point **B**.
 4. Move down to a point where the height is point **B** plus the dropping height (**EndHeight** is a relative height).

5. Move down to Point **B**.

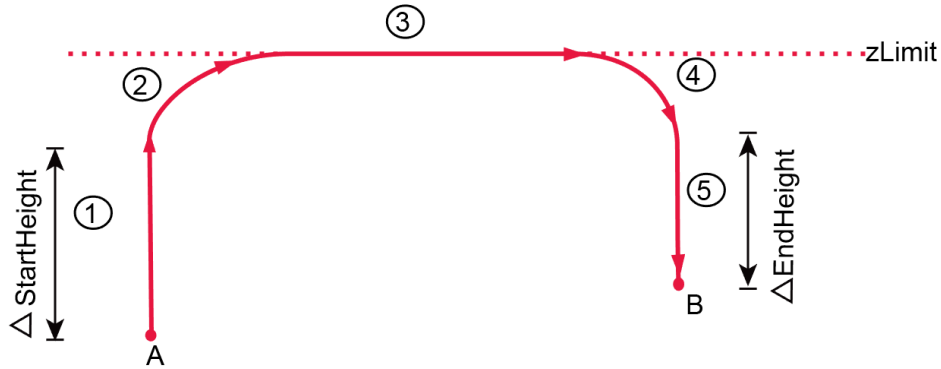


Figure 2.9 Jump mode

NOTICE

- Point **A** and point **B** cannot be higher than **zLimit**. Otherwise, an alarm will be triggered.
- If point **A** plus **StartHeight** or point **B** plus **EndHeight** is higher than **zLimit**, the robot moves up from point **A** to **zLimit** or moves down from **zLimit** to point **B** directly, the trajectory looks like a door without transition, as shown in Figure 2.10.

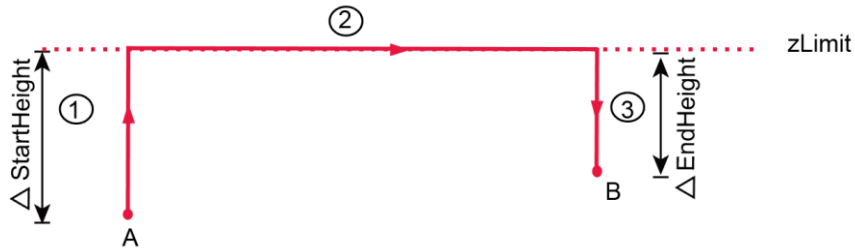


Figure 2.10 Jump mode (1)

- If the heights of point **A** and point **B** are the same with **zLimit**, the trajectory is shown in Figure 2.11.



Figure 2.11 Jump mode (2)

2.9.1.3 ARC (Circular Interpolated Motion)

The trajectory is an arc, which is determined by three points (the current point, any point and the end point on the arc), as shown in Figure 2.12.

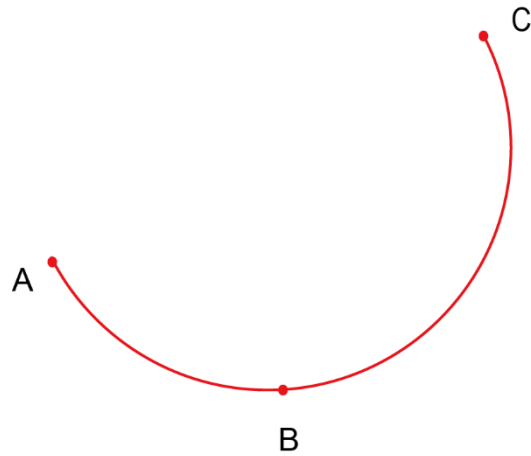


Figure 2.12 Arc trajectory

2.9.1.4 Circle (Circular Interpolated Motion)

The trajectory is a circle, which is determined by three points (the current point, any point and the end point on the arc) as well, as shown in Figure 2.13.

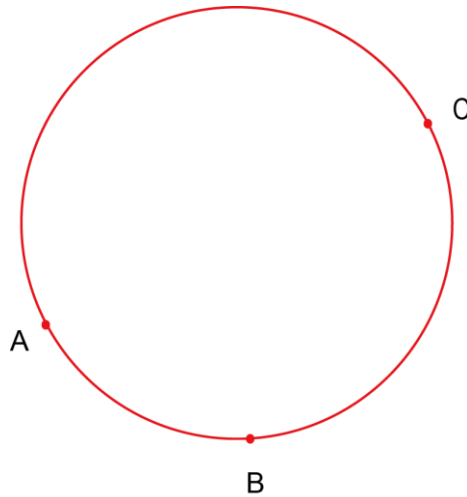


Figure 2.13 Circle trajectory

2.9.2 Coordinate System

2.9.2.1 Joint Coordinate System

The Joint coordinate system is determined by the motion joints.

Figure 2.14 shows the Joint coordinate system of a MG400 robot. All the joints are rotating.

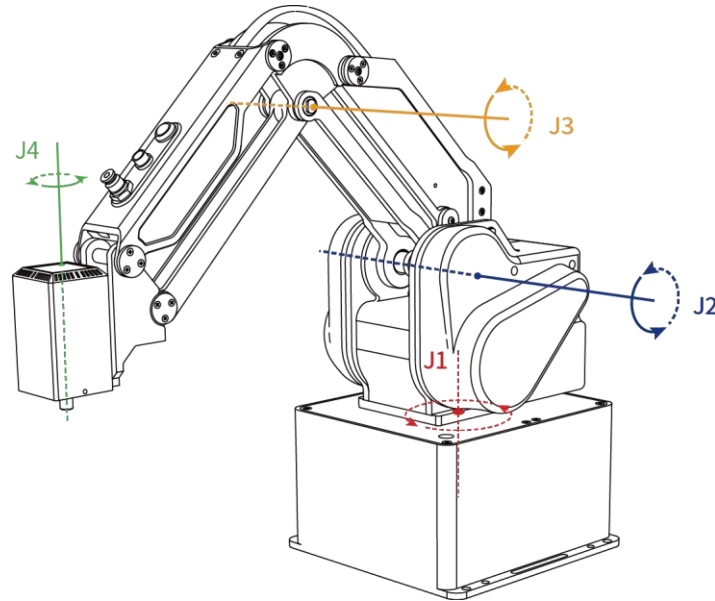


Figure 2.14 Joint coordinate of a MG400 robot

2.9.2.2 Base Coordinate System

The Base coordinate system is determined by the base. Figure 2.15 shows the Base coordinate system of MG400 robot.

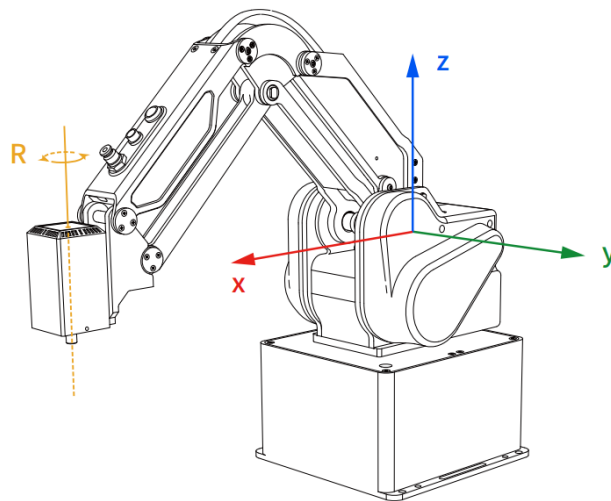


Figure 2.15 Base coordinate system of MG400 robot

2.9.2.3 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. The 10 types of tool coordinate systems can be defined. Tool 0 coordinate system is the predefined Tool coordinate system which is located at the robot flange without end effector and cannot be changed. And the others can be customized by users. Figure 2.16 shows the

default Tool coordinate system of a MG400 robot.

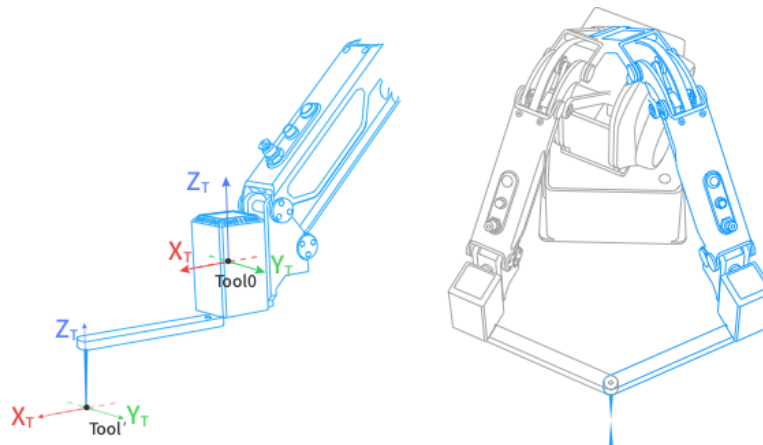


Figure 2.16 The default Tool coordinate system of MG400 robot

2.9.2.4 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.

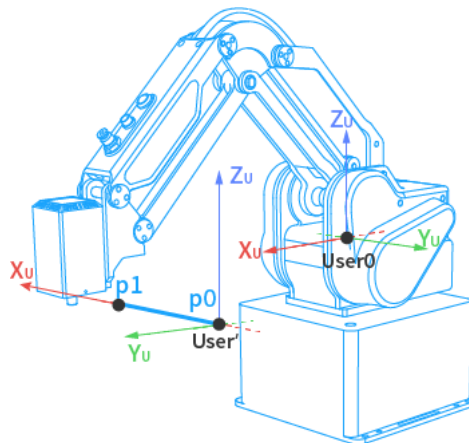


Figure 2.17 The default User coordinate system of MG400 robot

2.9.3 Collision Detection

Collision detection is mainly used for reducing the impact on the robot, to avoid damage to the robot or external equipment. If the collision detection is activated, the robot arm will stop running automatically when the robot arm hits an obstacle.

3. Electrical Specifications

3.1 Interface Description

3.1.1 Base Interface Board

Figure 3.1 shows the interface board of the Base. Table 3.1 lists the description.

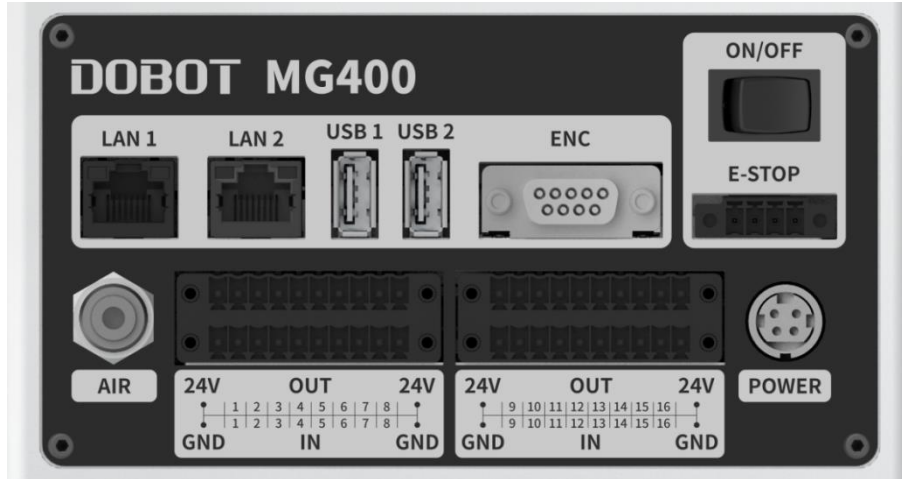


Figure 3.1 Interface board of the base

Table 3.1 Interface description

screen printing	Description
LAN1	LAN interface The default IP address is 192.168.1.6, which cannot be modified. It can be used for software debugging on the upper computer
LAN2	LAN 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
ENC	Encoder interface For connecting to the conveyor belt for dynamic tracking
ON/OFF	Power switch For controlling the robot power on and off
E-Stop	Emergency stop interface
Power	Power interface

screen printing	Description
	For connecting to DC 48V power supply
I/O	I/O interface
AIR	Air interface, the corresponding trachea diameter was 4mm

The ENC interface of the MG400 is shown in Figure 3.2, Table 3.2 lists the description of ENC interface.

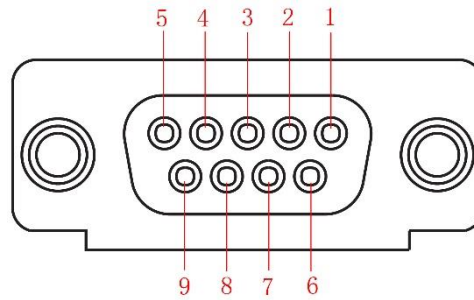


Figure 3.2 ENC interface

Table 3.2 ENC 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

3.1.2 Forearm Interface Description

The forearm interface of the MG400 includes a hand-teach button, an end I/O Interface, and an air interface, as shown in Figure 3.3. The diameter of the trachea corresponding to the air interface is 4mm.

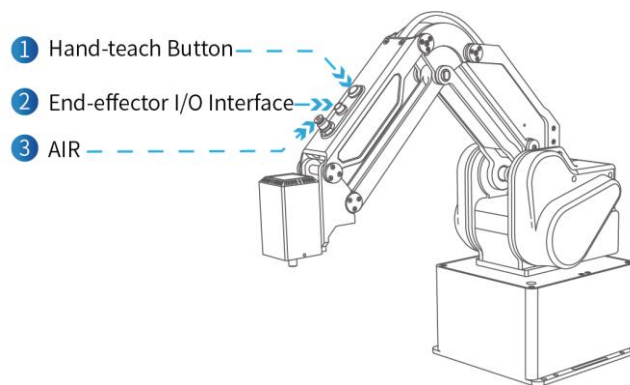


Figure 3.3 Forearm interface

Press the hand-teaching button on the forearm and drag the forearm to a point and then press the button again. In addition, when the power supply is normal, this button can also release the brake to rescue the trapped personnel in an emergency.

NOTE

In the process of teaching by pressing the hand-teaching button, it is necessary to support the forearm of MG400 with your hand, otherwise the forearm may lift slowly or fall off.

3.2 I/O Interface Description

3.2.1 Base I/O Interface

A robot controller contains I/O interfaces, for connecting to external equipment, such as air pump, PLC, etc. These I/O interfaces provide 16 digital inputs, 16 digital outputs, as shown in Figure 3.4.

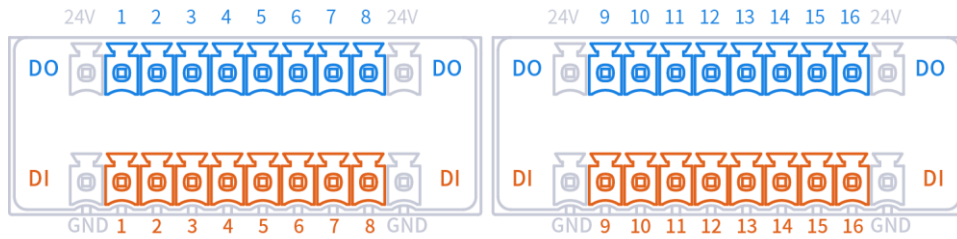


Figure 3.4 I/O interface

NOTE

- The output current of every I/O can't exceed 500mA.
- The total current can't exceed 2A.

3.2.2 End I/O Interface

The cable used for the end pins is the designated cable, the model is SF810/P6.

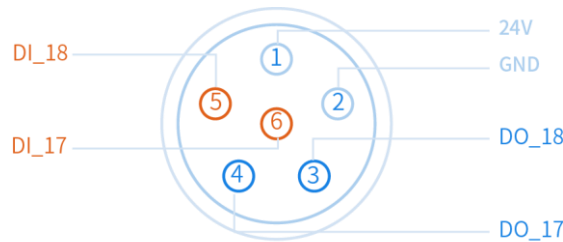


Figure 3.5 end I/O interface

3.3 Digital Circuit Description

3.3.1 Digital Input

Figure 3.6 shows the simple digital input circuit and Table 3.3 lists the technical specifications.

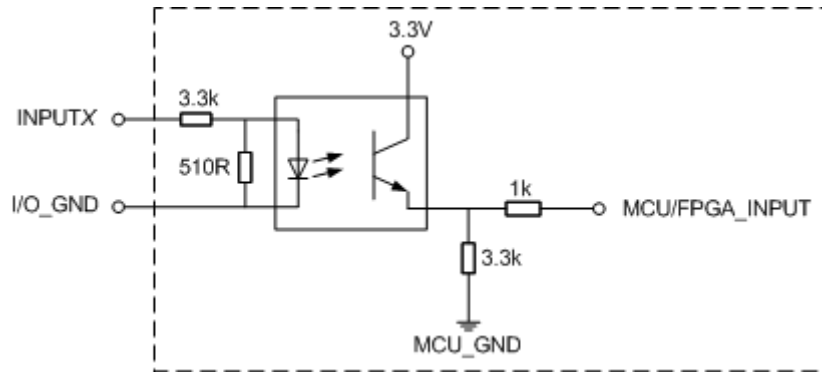


Figure 3.6 Simple digital input circuit

Table 3.3 Technical specifications

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

Figure 3.7 is the circuit diagram of DI external mechanical contact switch (such as relay contact, button, switch, etc.).

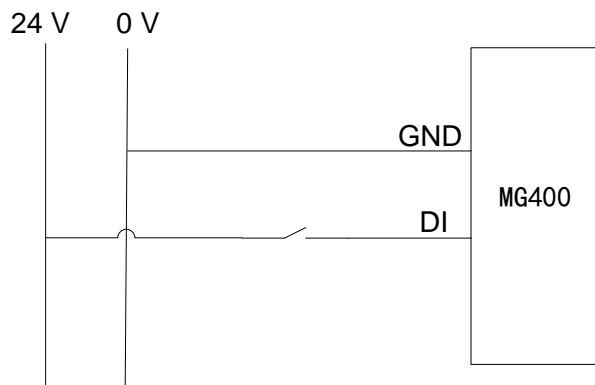


Figure 3.7 DI external mechanical contact switch

Figure 3.8 shows the schematic diagram of DI external PNP three-wire switch.

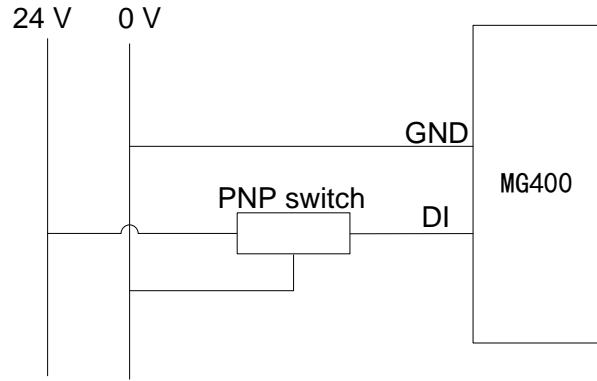


Figure 3.8 DI external PNP three-wire switch

3.3.2 Digital Output

Figure 3.9 shows the simple digital output circuit and Table 3.4 lists the technical specifications.

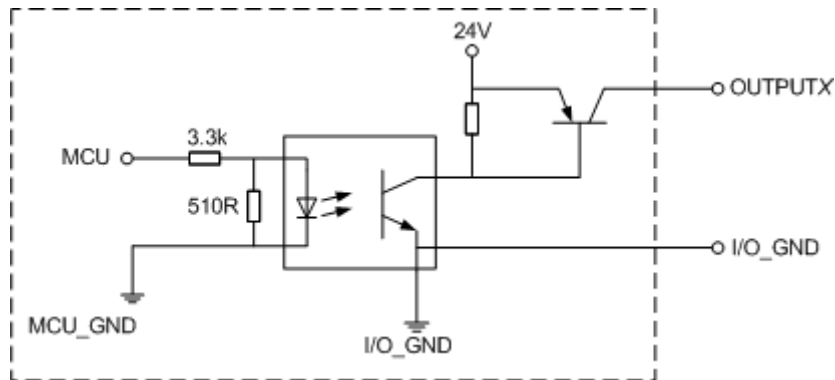


Figure 3.9 Simple digital output circuit

Table 3.4 Technical specifications

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

Figure 3.10 is the circuit diagram of DO external load without external power supply. At this time, the load driving current is less than or equal to 500mA. Where, 0V is the grounding terminal corresponding to the external power supply.

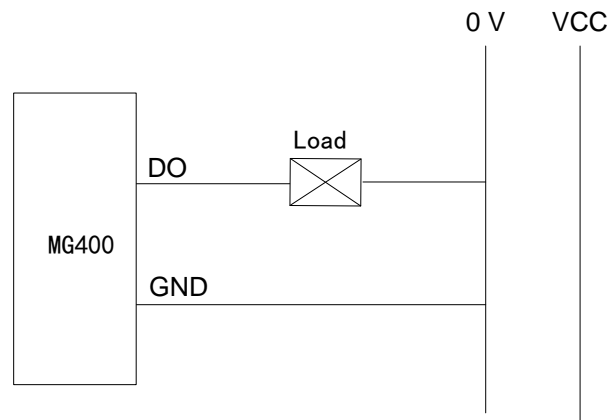


Figure 3.10 DO external load without external power supply

When the load connected through the DO interface requires a large driving capability (that is, the load driving current is greater than 500mA), the default driving capability of the MG400 cannot meet the requirements. In this case, an external driving circuit needs to be connected to increase the driving capability.

Figure 3.11 is the circuit diagram of DO external load with external power supply, where VCC is the external voltage and 0V is the grounding terminal corresponding to the power supply.

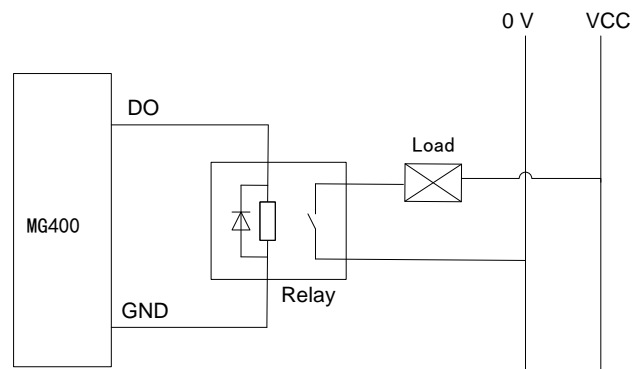


Figure 3.11 DO external load with external power supply

4. Installation

4.1 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.
- When the robot is installed, corresponding measures should be taken for positioning. You must use four hexagon socket bolts M5 (GB/T 3098.1-2010) and tighten the base of the robot with $9 \text{ N} \cdot \text{m}$ torque.
- When the robot is installed, the robot must be fixed on a sufficiently strong base. The base must be able to withstand the reaction force of the robot during acceleration and deceleration and the static weight of the robot and the workpiece.

4.2 Installation Location

The stability of a robot depends on the installation. You can design the platform according to the size of the hole of the base and the real environment for mounting a robot. And the installation height of the robot should be above 0.6 meters. The platform must not only bear the robot but also bear the dynamic force by the maximum acceleration. Note the following before mounting the robot.

- Design the platform according to the robot's workspace, and ensure that the robot moves without interference.
- Keep the platform level which is used to mount a robot.

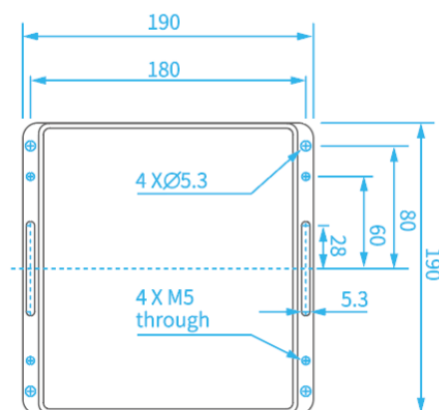


Figure 4.1 Robot base size

5. 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. For details, please see 2.8 Factory point.

5.1 Safety Instructions

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

- Replace faulty components using 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 persons 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.

5.2 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 are shown below.

Table 5.1 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 air pipe	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 air pipe is locally bent, twisted, damaged, etc
	√		Joint bolts	Check the torque based on the specified tightening torque table (Push aside the rubber to check)
√			Tool mounting bolts	Check the torque based on the specified tightening torque table
√			Motor	Abnormal heating or sound confirmation
√			Brake	Check whether the robot arm or end-effector will fall when the servo is powered off
	√		Synchronous belt	Check whether the synchronous belt is worn out, elongated, broken, etc

Table 5.2 lists the bolted tightening torque table.

Table 5.2 Bolted tightening torque table

Bolt size	Hexagon socket head cap screw	Hexagon socket countersunk flat head screw	Cross recessed countersunk flat head screw	Hexagon screw (rubber part)
2.5	-	0.8	0.6	-
3 mm	2.2 Nm	-	-	1.2 Nm
4 mm	4 Nm	-	-	-
5 mm	7.5 Nm	-	-	-

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 Servo Alarm Description

ID	Level	Description	Solution
25376	0	Abnormalities in internal servo parameters	System error, please contact technical support engineer
21120	0	Programmable logic configuration faults	System error, please contact technical support engineer
29953	5	FPGA software version too low	Please contact technical support engineer
29954	5	Programmable logic interrupt fault	If connecting the power for many times, the alarm is still reported, please replace the drive
25377	5	Internal program exceptions	System error, please contact technical support engineer
21808	0	Parameter storage failure	Reset the parameter and power on again, or please contact technical support engineer
28962	0	Product matching faults	1. Check whether the motor parameter matches the motor model in nameplate; 2. Check whether the motor and driver match, otherwise, select the right motor and driver
21574	0	Invalid servo ON command fault	System error, please contact technical support engineer
28964	0	Absolute position mode product matching fault	System error, please contact technical support engineer
25378	0	Repeated assignment of DI functions	1. Check whether the same function is assigned to different DI's 2. Confirm whether the corresponding MCU supports the assigned functionality
25379	0	DO function allocation overrun	Check whether the motor and circuit are working properly, or contact technical support engineer
29488	0	Data in the motor encoder ROM is incorrectly checked or parameters are not stored	System error, please contact technical support engineer
8752	0	Hardware overcurrent	System error, please contact technical support engineer
8977	0	DQ axis current overflow fault	System error, please contact technical support engineer

ID	Level	Description	Solution
65288	0	FPGA system sampling operation timeout	System error, please contact technical support engineer
9024	0	Output shorted to ground	Please contact technical support engineer
13184	0	UVW phase sequence error	System error, please contact technical support engineer
33922	0	Flying Cars	Please contact technical support engineer
12816	0	Electrical over-voltage in the main circuit	System error, please contact technical support engineer
12832	0	Main circuit voltage undervoltage	System error, please contact technical support engineer
12592	0	Main circuit electrical shortage	Check the cable connection of power, otherwise, replace the driver
12576	0	Control of electrical undervoltage	System error, please contact technical support engineer
33920	0	Overspeed	System error, please contact technical support engineer
65296	0	Pulse output overspeed	System error, please contact technical support engineer
65282	0	Failure to identify angles	System error, please contact technical support engineer
9040	0	Drive overload	Replace the driver
29056	0	Motor overload	System error, please contact technical support engineer
28961	0	Overheating protection for blocked motors	Check whether the hardware is working properly, or contact technical support engineer
17168	0	Radiator overheating	Drop the environment temperature, or contact technical support engineer
29571	0	Encoder battery failure	Connect battery, or contact technical support engineer
29490	0	Encoder multi-turn count error	Replace the motor
29491	0	Encoder multi-turn count overflow	System error, please contact technical support engineer
29492	0	Encoder interference	System error, please contact technical

ID	Level	Description	Solution
			support engineer
29493	0	External encoder scale failure	System error, please contact technical support engineer
29494	0	Encoder data abnormalities	System error, please contact technical support engineer
29495	0	Encoder return checksum exception	System error, please contact technical support engineer
29496	0	Loss of encoder Z signal	System error, please contact technical support engineer
34321	0	Excessive position deviation	Check whether the motor is working properly, or contact technical support engineer
34322	0	Position command too large	System error, please contact technical support engineer
34323	0	Excessive deviation from fully closed-loop position	System error, please contact technical support engineer
25380	0	Electronic gear setting overrun	System error, please contact technical support engineer
25381	0	Wrong parameter setting for fully closed loop function	System error, please contact technical support engineer
25382	0	Software position upper and lower limits set incorrectly	System error, please contact technical support engineer
25383	0	Wrong home position offset setting	System error, please contact technical support engineer
30083	0	Loss of synchronization	System error, please contact technical support engineer
30081	0	Unburned XML configuration file	Burn the XML configuration file
65298	0	Network initialization failure	System error, please contact technical support engineer
30082	0	Sync cycle configuration error	System error, please contact technical support engineer
30084	0	Excessive synchronisation period error	System error, please contact technical support engineer
25384	0	Fault in crossover pulse output setting	System error, please contact technical support engineer

ID	Level	Description	Solution
65521	0	Zero return timeout fault	System error, please contact technical support engineer
29570	0	Encoder battery warning	Replace battery
21570	0	DI emergency brake	System error, please contact technical support engineer
12851	0	Motor overload warning	System error, please contact technical support engineer
12817	0	Brake resistor overload alarm	System error, please contact technical support engineer
25385	0	External braking resistor too small	System error, please contact technical support engineer
13105	0	Motor power cable disconnection	System error, please contact technical support engineer
25386	0	Change of parameters requires re-powering to take effect	Clear the alarm and power on again
30208	0	Frequent parameter storage	Check whether the upper computer is working normal, or contact technical support engineer
21571	0	Forward overtravel warning	System error, please contact technical support engineer
21572	0	Reverse overtravel warning	System error, please contact technical support engineer
29569	0	Internal failure of the encoder	System error, please contact technical support engineer
12597	0	Input phase failure warning	System error, please contact technical support engineer
65432	0	Zero return mode setting error	System error, please contact technical support engineer
65344	0	Parameter recognition failure	System error, please contact technical support engineer
21121	0	internal error	System error, please contact technical support engineer
29956	0	FPGA configuration error	System error, please contact technical

ID	Level	Description	Solution
			support engineer
51020	0	Driver board identification error	System error, please contact technical support engineer
29568	0	Encoder connection error	Check the cable connection of encoder, or contact technical support engineer
8992	0	Software overcurrent	System error, please contact technical support engineer
9088	0	Current zero point too large	System error, please contact technical support engineer
30080	0	EtherCAT communication failure	System error, please contact technical support engineer
33921	0	Excessive speed tracking error	System error, please contact technical support engineer
21120	0	STO Warning	System error, please contact technical support engineer
21569	0	Upper and lower board connection failure	System error, please contact technical support engineer
8980	0	Busbar overcurrent	System error, please contact technical support engineer
17169	0	Damaged or uninstalled temperature measuring resistors	System error, please contact technical support engineer
29572	0	Encoder Eeprom reading CRC fault	System error, please contact technical support engineer
12928	0	Servo and motor power matching faults	System error, please contact technical support engineer

Appendix B Controller Alarm Description

ID	Level	Description	Solution
17	5	Inverse kinematics error with no solution	Reselect movement points
18	5	Inverse kinematics error with result out of working area	Reselect movement points
19	5	Duplicated data in JUMP or ARC or Circles instruction	Reselect movement points
20	5	Wrong input parameters for arc	Enter the correct parameters
21	5	The Start and the End is negative or the zLimit is below the start and end points	Enter the correct parameters
22	5	Wrong arm orientation switch	Reselect movement points
23	5	Plan point during linear motion out of working area	Reselect movement points
24	5	Plan point during circular arc motion out of working area	Reselect movement points
25	5	Wrong mode for motion instruction	Internal software error, restart or contact manufacturer
26	5	Wrong input parameters for speed	Input correct parameter
27	5	Wrong trajectory motion plan of continuous path	Input correct parameter
28	0	Wrong input parameters for circle	Input correct parameter
29	5	Plan point during circular circle motion out of working circle	Reselect movement points
30	5	Inching target position inaccessible	Reverse inch out of limit
32	5	Inverse kinematics singularity during moving	Reselect movement points
33	5	Inverse kinematics with no solution during moving	Reselect movement points
34	5	Inverse kinematcis with result out of working area	Reselect movement points
48	5	Joint1 overspeed	Reset the speed or re-select the movement point away from the singularity
49	5	Joint2 overspeed	Reset the speed or re-select the movement point away from the singularity

ID	Level	Description	Solution
50	5	Joint3 overspeed	Reset the speed or re-select the movement point away from the singularity
51	5	Joint4 overspeed	Reset the speed or re-select the movement point away from the singularity
52	0	Joint1 position out of range	Internal error, restart or contact manufacturer
53	0	Joint2 position lag error	Internal error, restart or contact manufacturer
54	0	Joint3 position lag error	Internal error, restart or contact manufacturer
55	0	Joint4 position lag error	Internal error, restart or contact manufacturer
64	5	Joint1 exceeds positive limit	Reverse jog out of limit
65	5	Joint1 exceeds negative limit	Reverse jog out of limit
66	5	Joint2 exceeds positive limit	Reverse jog out of limit
67	5	Joint2 exceeds negative limit	Reverse jog out of limit
68	5	Joint3 exceeds positive limit	Reverse jog out of limit
69	5	Joint3 exceeds negative limit	Reverse jog out of limit
70	5	Joint4 exceeds positive limit	Reverse jog out of limit
71	5	Joint4 exceeds negative limit	Reverse jog out of limit
72	5	Parallelogram positive limit	Reverse jog out of limit
73	5	Parallelogram negative limit	Reverse jog out of limit
74	5	Joint6 exceeds positive limit	Reverse jog out of limit
75	5	Joint6 exceeds negative limit	Reverse jog out of limit
80	0	Joint1 lose step	Internal error, restart or contact manufacturer
81	0	Joint2 lose step	Internal error, restart or contact manufacturer
82	0	Joint3 lose step	Internal error, restart or contact manufacturer
83	0	Joint4 lose step	Internal error, restart or contact manufacturer
84	0	Algorithm timeout	Internal error, restart or contact manufacturer
85	0	Emergency button pressed	Release the emergency stop button
96	0	Joint1 drive alarm	Check if the communication of joint 1 is normal and then clear the error
97	0	Joint1 Servo power off	Re-enable joint 1
98	0	Joint2 drive alarm	Check if the communication of joint 2 is normal and then clear the error

ID	Level	Description	Solution
99	0	Joint2 Servo power off	Re-enable joint 2
100	0	Joint3 drive alarm	Re-enable joint 3
101	0	Joint3 Servo power off	Re-enable joint 3
102	0	Joint4 drive alarm	Re-enable joint 4
103	0	Joint4 drive power off	Re-enable joint 4
104	0	Robot homing failed	Home again
105	0	Robot Servo on failed	Check whether the hardware is normal and re-enable
106	0	Abnormal conveyor data	Please contact technical support engineer
107	0	Abnormal conveyor synchronization	Please contact technical support engineer
108	0	Conveyor conveyor encoder 1 is disconnected	Please contact technical support engineer
109	0	Conveyor conveyor encoder 2 is disconnected	Please contact technical support engineer
110	0	Encoder position error	Internal error, restart or contact manufacturer
112	0	Collision Detection	Keep away from the work area and continue to run
161	0	Error switching drag and drop mode	Internal error, restart or contact manufacturer
4096	5	Failed to open mechanical file	Check if the file location is correct and restart
8192	5	Failed to open project file	Check if the file location is correct and restart
8193	5	Failed to open program file	Check if the file location is correct and restart
8194	5	Failed to open global variable file	Check if the file location is correct and restart
8195	5	Failed to open teaching point file	Check if the file location is correct and restart
8196	5	Failed to start debugger process	Rerun debugger process
12288	5	Emergency stop detected	Power on again
12289	5	External emergency stop detected	Power on again
12290	0	The servo power board temperature is too high	Turn off the machine and let it cool for a period of time
33024	5	No input parameters for CP instruction	Enter the correct parameters
33025	5	Input parameters of CP instruction out of range	Enter the correct parameters

ID	Level	Description	Solution
33280	5	No input parameters for Arch instruction	Please enter parameters
33281	5	Index parameter of Arch instruction out of range	Enter the correct parameters
33282	5	Index parameter of Arch instruction not configured yet	Please set index parameters
33536	5	No input parameters for LimZ instruction	Please enter parameters
33537	5	Input parameters of LimZ instruction out of range	Enter the correct parameters
33792	5	No input parameters for Speed instruction	Please enter parameters
33793	5	Ratio parameter of Speed instruction out of range [1, 100]	Enter the correct parameters
34048	5	No input parameters for Accel instruction	Please enter parameters
34049	5	Ratio parameter of Accel instruction out of range [1, 100]	Enter the correct parameters
34304	5	No input parameters for Jerk instruction	Please enter parameters
34305	5	Ratio parameter of Jerk instruction out of range [1, 100]	Enter the correct parameters
34560	5	No input parameters for SpeedS instruction	Please enter parameters
34561	5	Ratio parameter of SpeedS instruction out of range [1, 100]	Enter the correct parameters
34816	5	No input parameters for SpeedR instruction	Please enter parameters
34817	5	Ratio parameter of SpeedR instruction out of range [1, 100]	Enter the correct parameters
35072	5	No input parameters for AccelS instruction	Please enter parameters
35073	5	Ratio parameter of AccelS instruction out of range [1, 100]	Please enter parameters
35328	5	No input parameters for AccelR instruction	Enter the correct parameters
35329	5	Ratio parameter of AccelR instruction out of range [1, 100]	Enter the correct parameters
35584	5	No input parameters for JerkS instruction	Please enter parameters
35585	5	Ratio parameter of JerkS instruction out of range [1, 100]	Enter the correct parameters

ID	Level	Description	Solution
35840	5	No input parameters for JerkR instruction	Please enter parameters
35841	5	Ratio parameter of JerkR instruction out of range [1, 100]	Enter the correct parameters
36096	5	No input parameters for Go instruction	Please enter parameters
36097	5	No motion point parameter for Go instruction	Please enter parameters
36098	5	Incorrect motion point for Go instruction	Enter the correct parameters
36099	5	Incorrect control parameter for Go instruction	Enter the correct parameters
36352	5	No input parameters for Move instruction	Please enter parameters
36353	5	No motion point parameter for Move instruction	Please enter parameters
36354	5	Incorrect motion point for Move instruction	Enter the correct parameters
36355	5	Incorrect control parameter for Move instruction	Enter the correct parameters
36608	5	No input parameters for Arch3 instruction	Please enter parameters
36609	5	No motion point parameter for Arch3 instruction	Please enter parameters
36610	5	Incorrect motion point for Arch3 instruction	Enter the correct parameters
36611	5	Incorrect control parameter for Arch3 instruction	Enter the correct parameters
36864	5	No input parameters for Jump instruction	Please enter parameters
36865	5	No motion point parameter for Jump instruction	Please enter parameters
36866	5	Incorrect motion point for Jump instruction	Enter the correct parameters
36867	5	Incorrect control parameter for Jump instruction	Enter the correct parameters
40960	5	No input parameters for Circle3 instruction	Please enter parameters
40961	5	No motion point parameter for Circle3 instruction	Please enter parameters

ID	Level	Description	Solution
40962	5	Incorrect motion point for Circle3 instruction	Enter the correct parameters
40963	5	Incorrect control parameter for Circle3 instruction	Enter the correct parameters
45056	5	Circle3 Option Error	Enter the correct parameters
45057	5	Jump Option Error	Enter the correct parameters
45058	5	Arch Option Error	Enter the correct parameters
45059	5	Arch3 Option Error	Enter the correct parameters
45060	5	Jerk Option Error	Enter the correct parameters
45061	5	JerkR Option Error	Enter the correct parameters
45062	5	JerkS Option Error	Enter the correct parameters
45063	5	Accel Option Error	Enter the correct parameters
45064	5	AccelR Option Error	Enter the correct parameters
45065	5	AccelS Option Error	Enter the correct parameters
45066	5	SpeedFactor Option Error	Enter the correct parameters
45067	5	Speed Option Error	Enter the correct parameters
45068	5	SpeedR Option Error	Enter the correct parameters
45069	5	Limz Option Error	Enter the correct parameters
45070	5	CP Option Error	Enter the correct parameters
45071	5	DO Option Error	Enter the correct parameters
45072	5	Go Option Error	Enter the correct parameters
45073	5	Move Option Error	Enter the correct parameters
45074	5	MoveJ Option Error	Enter the correct parameters
45075	5	Ecp Option Error	Enter the correct parameters
45076	5	EcpSet Option Error	Enter the correct parameters
45077	5	SetExitMode Option Error	Enter the correct parameters
32768	5	No input parameters for speedFactor instruction	Enter the correct parameters
32769	5	Input parameters of speedFactor instruction out of range	Enter the correct parameters
32770	5	DO input parameters Error	Enter the correct parameters

ID	Level	Description	Solution
32771	5	DI input parameters Error	Enter the correct parameters
36100	5	No input parameters for movej instruction	Enter the correct parameters
36101	5	No motion point parameter for movej instruction	Enter the correct parameters
36102	5	No motion point parameter for movej instruction	Enter the correct parameters
36103	5	Incorrect motion point for RP instruction	Enter the correct parameters
36104	5	Incorrect offset for RP instruction	Enter the correct parameters
36105	5	Incorrect motion point for RJ instruction	Enter the correct parameters
36106	5	Incorrect offset for RJ instruction	Enter the correct parameters
36107	5	No input parameters for GoR instruction	Enter the correct parameters
36108	5	Incorrect motion point for GoR instruction	Enter the correct parameters
36109	5	No input parameters for MoveJR instruction	Enter the correct parameters
36110	5	Incorrect motion point for MoveJR instruction	Enter the correct parameters
45079	5	loadSwitch Option Error	Enter the correct parameters
45080	5	loadSet Options Error	Enter the correct parameters
45081	5	CPPParamErrorOption	Enter the correct parameters
45082	5	TOOLParamErrorOption	Enter the correct parameters
45083	5	USERParamErrorOption	Enter the correct parameters
45084	5	SPEEDParamErrorOption	Enter the correct parameters
45085	5	SPEEDSPParamErrorOption	Enter the correct parameters
45086	5	ACCELParamErrorOption	Enter the correct parameters
45087	5	ACCELSParamErrorOption	Enter the correct parameters
45088	5	ARCHParamErrorOption	Enter the correct parameters
45089	5	STARTParamErrorOption	Enter the correct parameters
45090	5	ZLIMITParamErrorOption	Enter the correct parameters
45091	5	ENDParamErrorOption	Enter the correct parameters
45092	5	SYNCaramErrorOption	Enter the correct parameters

ID	Level	Description	Solution
45093	5	ARMParmErrorOption	Enter the correct parameters
45312	5	loadSwitch Option Error	Enter the correct parameters
45313	5	loadSet Options Error	Enter the correct parameters
49152	5	Enable remote control when enabled	Enter the correct parameters
36111	5	No input parameters for GoIO instruction	Enter the correct parameters
36112	5	Incorrect motion point for GoIO instruction	Enter the correct parameters
36113	5	Incorrect parameters for GoIO instruction	Enter the correct parameters
36114	5	No input parameters for MoveIO instruction	Enter the correct parameters
36115	5	Incorrect motion point for MoveIO instruction	Enter the correct parameters
36116	5	Incorrect parameters for MoveIO instruction	Enter the correct parameters
36117	5	No input parameters for MoveJIO instruction	Enter the correct parameters
36118	5	Incorrect motion point for MoveJIO instruction	Enter the correct parameters
36119	5	No input parameters for MoveJIO instruction	Enter the correct parameters