## MS6MT Robot

# Maintenance Manual



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# Maintenance Manual

## MS6MT Robot

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QKM Technology (Dongguan) Co., Ltd.

## Preface

Thank you for purchasing the robot produced by QKM! This manual describes the instructions to maintain the robot. Refer to the contents of this manual for maintenance. Please keep this manual properly for future reference

## General

This manual provides detailed information on the routine maintenance and safety inspection of MS6MT Robot, as well as the maintenance of related parts and components, so that users can better use MS6MT Robot. This manual can serve as a reference for system integrators to design user workstation systems by using our MS6MT Robot, and can also be used to guide system installation, debugging and maintenance.

## Target reader

This manual applies to:

Electrical Engineer Mechanical Engineer Maintenance Engineer Technical Support Engineer

## Signs & meanings

The signs in this document clearly indicate any dangers, warnings, attentions and notes that may occur while users perform the operations described in this manual; be sure to pay attention to the following signs when they appear in this document.

The signs in this manual are described in the table below:

Signs	Description
DANGER	It indicates that a dangerous situation would occur and cause serious personal injuries or deaths if it is not avoided.
WARNING	It indicates that a potentially dangerous situation would occur and cause personal injury or robot damage if it is not avoided.
	It indicates that an unpredictable situation would occur and cause robot damage, performance degradation, data loss, etc. if it is not avoided.
	It gives the description on key information and operation tips.

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## **Revision history**

The version history contains the accumulated information on each update of the document, and the latest version of the document includes the updates in all previous versions of the document.

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## Chapter 1 Safety Precautions

Before starting maintenance on the robot, please read all the following precautions:

## 1.1 Safety Responsibility Notice

• The maintenance of the robot system must be performed by safety-trained personnel.



Safety-trained personnel are those who have received safety training (on knowledge, operation, teaching, etc. of industrial robots, knowledge related to inspection and other operations, and related laws and regulations) prescribed by local laws and regulations for workers engaged in services related to industrial robots.

• Do not use the robot illegally. QKM will not be liable for any losses due to illegal use by users.

Common situations involving illegal use:

- beyond specified operating range
- unsafe use of electricity
- non-use of additional protective devices
- beyond specified environmental requirements
- overload
  - excessive moment of inertia
- Do not modify the robot without permission. QKM assumes no responsibility for any personal injury or machine damage caused by unauthorized changes to the robot.
- QKM is committed to providing safe and reliable information, but does not assume responsibility for it. Even if all operations are performed in accordance with the safety instructions, there is no guarantee that the robot will not cause any personal or property damage.

## 1.2 Safety Precautions

## 1.2.1 Precautions for general safety

- The robot may be damaged in the case of incomplete safety functions and protective devices. Do not use the robot when safety functions are disabled or protective devices are removed.
- Make sure that there are no other persons within the work area of the robot before operating the robot system.
- Do not disassemble the parts that are not described in this manual or perform maintenance in a different way from that described. Improper disassembly or maintenance will disable the normal operation of the robot system and may cause serious safety problems.
- Be sure to make replacement after turning off the power of the robot and unplugging the power plug. If the replacement is performed while the power is on, electric shock or equipment failure may be caused.
- Connect the cables properly. Do not place heavy objects on the cables, or forcibly pull or clamp the cables. Failure to do so may result in cable damage, disconnection or poor contact, abnormal system operation or electric shock to personnel.
- Do not plug or unplug the cables on the interface panel of the base while the robot is powered on.

## 1.2.2 Precautions before operation

## Setting up safe area

Understand the safe area before using the robot. Users need to pay full attention to the safe area during use to avoid accidents caused by neglecting it.

- Work area
- The work area refers to the range of working area of the robot determined by its motion trajectories and guaranteed by protective devices.
- Protective area
- The protective area must be larger than the work area, outside which protective devices need to be placed for warning and safe use.
- Common isolated protective device: safety fence; common safety reminders: warning sign and slogan.
- > Hazardous area

- The dangerous area includes any position where the robot body and the robot arms may stay in their motion trajectories, which can be protected by isolated protective devices to avoid personal injury or property damage.
- When the robot stops running, the robot arms will stop in the dangerous area.

#### Setting emergency stop device

The robot needs to be equipped with an emergency stop device before running. In case of an abnormality in the robot, press the emergency stop button to ensure the safety of personnel and avoid damage to the robot.

The emergency stop device needs to be properly set in a position in the industrial robot convenient for operation. Immediately press the device in the event of a dangerous or emergency situation.

After pressing the device, the robot will stop in the current state and enter the servo-off state.

#### 1.2.3 Precautions during operation

Before putting the robot into operation for the first time, be sure to inspect it to ensure that the equipment and its devices are complete with perfect functions for safe operation and fault identification.

Precautions when putting into operation for the first time or putting into operation again:

- Ensure that all protective devices are properly installed and perfectly functioning, and that signs are set up to direct relevant operations.
- The robot has been correctly placed and secured in accordance with the manual.
- Make sure that the electrical wires and cables have been properly connected and the robot is grounded.
- When teaching the robot, check whether its work area is reasonable and remove other objects from the work area.
- Do not plug or unplug the power or communication wires and cables during normal operation of the robot.

## 1.2.4 Precautions when a fault occurs

When the robot fails, be sure to operate it in accordance with normal steps to prevent personnel injury and robot damage caused by incorrect operation.

Steps for operation when a fault occurs:

- Turn off the control system of the robot to prevent any unexpected restart without permission.
- Set up an obvious sign at the site where the fault occurs to indicate the fault.
- Record the fault.
- Resolve the fault and perform a function check.

#### 1.2.5 Precautions during maintenance

- Make sure there is no danger before entering the safety fence.
- Make sure that the robot or peripheral equipment is in a safe state before performing any maintenance.
- Maintenance personnel must wear work clothes, safety helmet, etc. when performing maintenance on the robot.
- To replace any parts, please contact QKM; avoid damage to the robot or personal injury caused by unexpected situations from operations of users upon subjective judgment.
- After replacing related parts, prevent foreign matter from adhering to or entering the robot.
- The parts (screws, etc.) removed shall be correctly installed in their original positions. In case of redundant or insufficient parts, please confirm again and install them correctly.
- When restarting the robot after maintenance, ensure that there are no people in the work area of the robot.
- If the maintenance needs to be performed while the power is on, one group of two workers is required. When one worker maintains the robot, the other worker shall be able to quickly press the emergency stop switch when the robot runs abnormally so as to prevent personal injury or equipment damage.
- After changing the composition of the robot, be sure to check whether it meets the necessary safety requirements and test all safety functions.

Testing of safety functions:

- External emergency stop device (input and output terminals)
- Confirmation device (in test mode)
- Personnel protective equipment
- All other safety-related input and output terminals used

- When starting a changed program, test it by reducing the system speed and then gradually increasing the speed.
- After repairing and maintaining the robot, test the robot to ensure that the robot and its functions are complete.

#### 1.2.6 Precautions for safe shutdown

Precautions when the robot stops running:

- Decrease the speed of the robot before enabling the robot to be off servo. Turn off the power after the robot is off servo.
- Recover materials and supplies related to the equipment and ensure that the equipment restores to the safe state for restart.
- Set up protective devices to indicate the current state of the equipment and prevent others from incorrectly operating it.
- The robot restarts at a recommended interval of about 300s. Do not restart it immediately after turning off the power to avoid damage to the robot.
- Before the robot starts again, check whether the emergency stop button is released to avoid the situation that the robot can not energize the servo.

#### 1.3 Waste disposal

The discontinuation, storage and waste disposal of the robot and related parts must be handled in accordance with relevant laws, regulations and standards to protect the environment.

## Chapter 2 Routine Maintenance and Exception Handling

Routine maintenance is a kind of preventive maintenance, which means that maintenance personnel periodically carry out inspection and maintenance during normal operation of equipment to ensure that the equipment is intact, tidy, clean, lubricated and safe meeting production requirements, and hidden faults can be timely found and removed.

Personnel responsible for maintaining the equipment shall determine the maintenance cycle according to the contents of this manual and the actual local conditions. They shall also perform routine inspection and maintenance of the equipment, find faults and resolve them in a timely manner.

## 2.1 Maintenance cycle

#### 2.1.1 Regular check

To keep the robot in good working condition, prevent failures and ensure safety, perform maintenance and checks on the following items. The cycle for routine inspection is based on the normal working conditions. For the normal working environment, please refer to the parameters of operating environment in "MS6MT Robot User Manual". The actual maintenance cycle depends on the operating frequency of the robot.

Maintenance	Maintenance	Maintenance Interval				Maintenance Method		
Part Item (Content)	Routine	1 month	3 months	6 Months	Cleaning	Adjustment	Replacement	
Main								
exposed	Measure torque							
fastening	with torque							
screws and	wrench to check			$\checkmark$			$\checkmark$	
the like on	whether they are							
the robot	loose.							
body								

➤ Inspection before power-on

Wires and cables	Check whether the connectors of wires and cables on the interface panel of the robot body are loose, and whether the wires and cables are twisted or tangled.	V				V	
Encoder battery	Check whether the battery voltage is lower than 3.15V			V			V
Robot surface	Check whether there is dust on it	$\checkmark$			V		
Work space	Check whether there are sundries in the work space	$\checkmark$			V		



Clean the robot with routine disinfectant and cleaning liquid. Do not use acidic cleaning liquid to perform routine maintenance on the robot.

Maintenance		Maintenance Interval				Maintenance Method		
Part	Item (Content)	Routine	1 month	3 months	6 Months	Cleaning	Adjustment	Replacement
E-stop switch	Press the emergency stop button to check whether emergency stop is enabled		$\checkmark$				$\checkmark$	$\checkmark$
Robot motion	Check whether there is any vibration or abnormal noise when running each axis of the robot at low speed	V					V	V

#### > Inspection after power-on

- The maintenance time of the robot mainly depends on the operating environment and frequency of the robot. The following recommended maintenance items are set under normal working conditions.
- If the above exceptions cannot be resolved by troubleshooting of mechanical failures, please contact QKM.

## 2.2 Handling of common exceptions

CAUTION

Exceptions may occur during the operation of MS6MT Robot. The common exceptions are analyzed and handled as follows:

	5	I I I I I I I I I I I I I I I I I I I		
Common exception	Possible Cause	Troubleshooting:		
Robot is in emergency stop state.	Failure in robot emergency stop line.	• Ensure that the emergency stop switch is not pressed.		

Table 2-1 Handling of common exceptions

		<ul> <li>Check whether the emergency stop switch is damaged.</li> <li>Replace the emergency stop switch.</li> </ul>
	Failure in PC network settings.	Change the IP of the PC connected to the robot to be in the same network segment as the robot's IP, and then connect it.
Unable to connect robot.	Multiple problems in PC network card.	Disable all other network cards in the PC except the network card connected to the robot.
	Ethernet interface or network cable is damaged.	<ul><li>Replace the Ethernet interface.</li><li>Replace with another network cable.</li></ul>



For the handling of more exceptions, please refer to "Error Code Manual".

## Chapter 3 Robot Debugging and Components Maintenance



The axis joints of MS6MT Robot are assembled in a modular manner. If the internal components of the module are damaged, the whole module needs to be replaced.

## 3.1 Rough calibration

The loss of zero of MS6MT Robot is actually the loss of zero of the encoder. If the zero is lost, perform calibration to recover the zero. The zero of the robot can be roughly recovered through rough calibration.

- If the zero of MS6MT Robot is lost, ensure that the robot remains in its original position and each axis rotates at an angle of less than 360°, then perform a rough calibration of the robot zero to prevent internal cables from damage due to excessive winding.
  - Confirmation of rotation angle of each axis:

Open the waterproof cover at the rear end of each axis, observe the winding degree of cables, and turn the mechanical arm to restore the cables to normal.

Loss of zero:

CAUTION

When the motion trajectories of the robot deviate from the actual planned paths or the six-axis robot is in a straight state and the calibrated grooves of each axis are aligned separately, the joint coordinate value is not the value of the origin. The above situation means that the zero is lost.

Possible causes:

(1) Low battery voltage of the encoder.

② Failure in the connection between the encoder and the module.

③ Failure in the module and encoder assembly.

(4) Robot collision.

- (5) Electromagnetic interference.
- 6 Problem in Config file configuration.

Preparation for operation: Laptop, network cable, calibration block.

Software: ARM software

The operation steps are as follows:

- **Step 1** Connect the robot to the power supply, then connect the laptop for power-on later.
- **Step 2** Move each axis of the robot and use the calibration block to adjust the posture of the robot to restore its zero according to the sequence in (Figure 3-1).



Figure 3-1 Use of calibration block

- Enter the ARM interface, connect the robot to the ARM, and move the mechanical arm.
- After aligning the grooves, use the calibration block to perform auxiliary positioning to enable them to be completely inserted.



- Use the calibration block provided in the accessory box for rough calibration. Do not replace it with other tools.
- Refer to "MS6MT Robot User Manual" for ARM operations.
- **Step 3** Execute the Robot.Encoder instruction in the ARM to obtain the value of the current encoder, as shown in Figure 3-2.

宏语言开发界面		
🖕 🔁 🙁 🖸 😋 🖬	II 🔳 🖞 🕆 🖓 🗯 単次 🔹 📮 🗍 10 2 🐵 🜑 IP 192.168.10.120 💿	
宏语言手册 2.3.0 •	指令输入	Start1
Convey     Com     Dir     Dir     File     Interrupt     Latch     Location     LocationJ     Print     Profile     AxisNum	1 RobotEnconder 1.1: 2 RobotEnconder 1.2: 3 RobotEnconder 1.3: 4 RobotEnconder 1.4: 5 RobotEnconder 1.5; 6 RobotEnconder 1.6;	login 0 Power On 手动 自动 清除借误 Home Logout
Frame	<sup>絵山</sup>	笛卡尔
Here		添加
描述 10個人還性及方法 新开始後		

Figure 3-2 Obtain the encoder values

- **Step 4** After the execution is completed, the encoder values of each axis will be displayed in the output window, and each value will be recorded.
- **Step 5** Open <My Computer>, enter FTP://192.168.10.120 in the input box, click <media>  $\rightarrow$  <flash> and find the robot1.xml file in the folder, as shown in the figure.

and the second second			- • ×
🔾 🗢 📕 🕨 Internet	▶ 192.168.10.120 ) media ▶ flash ▶	▼ <b>4</b> 9 搜	素 flash 👂
组织 ▼			u≖ <b>•</b>
<ul> <li>★ 收藏夹</li> <li>▲ 下载</li> <li>■ 桌面</li> <li>3 最近访问的位置</li> </ul>	InterpreterConfig 文件夹 eni.xml	sysconf 文件夹 esi.xml	
<ul> <li>□ 库</li> <li>□ 视频</li> <li>□ 图片</li> <li>□ 文档</li> <li>□ 介档</li> <li>□ 介档</li> </ul>	robot1.xml	syscfg.xml	
<ul> <li>※ 计算机</li> <li>▲ 本地磁盘 (C:)</li> <li>→ 本地磁盘 (D:)</li> <li>→ 本地磁盘 (E:)</li> <li>→ 本地磁盘 (Q:)</li> <li>☆ share (\\qkmfs(</li> </ul>			
6 个对象			

Figure 3-3 Enter the configuration folder of the robot



192.168.10.120 is the factory default IP address of the MS6MT Robot controller. If the robot has been modified, the actual IP address of the robot shall prevail.

Step 6 Drag the robot1.xml file to the desktop. Open the file and find the encoder id. Record the obtained encoder values in the configuration file (Note: The coordinates of the origin of Axes J1, J2 and J4 are special, and 131072 needs to be added after the encoder values), as shown in Figure 3-4.

🧾 C:\Use	rs\jxli\Desktop\雷神Thor更新版本\20191018\1.0.6\参数文件\robot1.xml - Notepad++		
文件(F)	编辑(E) 搜索(S) 视图(V) 格式(M) 语言(L) 设置(T) 宏(O) 运行(R) 插件(P) 窗口(W) ?	2	
	] B G G Al & B B I D C I A & G G G B 5 1 🗐 🖉 🛛		
😑 robot	. xnl 🖾		
136	<pre><customitem attribute="double" id="P-0-0513.0.61"> -135.3</customitem></pre>		dh[5].d unit:mm
137			
138			
139	<customitem attribute="double" id="P-0-0513.0.64"> 0</customitem>		dh[0].alpha unit:deg
140	<customitem attribute="double" id="P-0-0513.0.65"> 90</customitem>		dh[1].alpha unit:deg
141	<customitem attribute="double" id="P-0-0513.0.66"> 0</customitem>		dh[2].alpha unit:deg
142	<customitem attribute="double" id="P-0-0513.0.67"> 0</customitem>		dh[3].alpha unit:deg
143	<customitem attribute="double" id="P-0-0513.0.68"> 90</customitem>		dh[4].alpha unit:deg
144	<customitem attribute="double" id="P-0-0513.0.69"> -90</customitem>		dh[5].alpha unit:deg
145			
146	<customitem 1d="P-0-0513.0.72" attribute="double"> 0</customitem>		<pre><!-- dn[0].theta unit:deg--></pre>
147	<customitem attribute="double" id="P-U-USI3.U.73"> -90</customitem>		<pre><!-- an[1].theta unit:deg--> </pre>
148	<customitem attribute="double" id="P-U-U513.U.74"> U</customitem>		<pre><!-- an[2].theta unit:deg--></pre>
149	<pre><customitem attribute="double" id="P-0-0313.0.75"> -90 </customitem></pre>		<pre><!-- dn[3].theta unit:deg--> <!-- db[4] sheep unit:deg ---></pre>
150	<pre><customitem attribute="double" id="P-U-USI3.U.76"> U </customitem></pre>		<pre><!-- dn[4].theta unit:deg--> </pre>
151	<pre><customitem attribute="double" id="P-0-0513.0.77"> 0</customitem></pre>		<: dn[5].theta unit:deg>
153	<pre>customItem id= "P-0-0513.0.168" attribute="double"&gt; 142591</pre>	1	joint 0 motor encoder zero
154	<pre><customitem attribute="double" id="P-0-0513.0.169"> 105591</customitem></pre>	1	<pre><!-- joint 1 motor encoder zero--></pre>
155	<pre><customitem attribute="double" id="P-0-0513.0.170"> 353122</customitem></pre>	<pre>2 </pre>	joint 2 motor encoder zero
156	<pre><customitem attribute="double" id="P-0-0513.0.171"> 84900</customitem></pre>		joint 3 motor encoder zero
157	<pre><customitem attribute="double" id="P-0-0513.0.172"> 483372</customitem></pre>	<pre>2 </pre>	joint 4 motor encoder zero
158	<pre><customitem attribute="double" id="P-0-0513.0.173"> 98359</customitem></pre>		joint 5 motor encoder zero
159			
160	<customitem attribute="double" id="P-0-0514.0.1"> 6</customitem>		robot mode define
161	<customitem attribute="double" id="P-0-0514.0.2"> 6</customitem>		robot mode tmp define, use for change mode
162			ROBOT MODULE IDLE MODE = 0, robot in idle mode
163			<pre><!-- ROBOT MODULE HARD ESTOP MODE = 1,hard estop mode--></pre>
164			<pre><!-- ROBOT MODULE SOFT ESTOP MODE = 2,soft estop mode--></pre>
165			< ROBOT MODULE CHANGE LOCAT MODE = 3, change location>
166			ROBOT MODULE HOME MODE = 4, home mode
167			<pre><!-- ROBOT_MODULE_LOCALBUFFER_MODE = 5,local buffer mode--></pre>
168			ROBOT_MODULE_MACRO_PROGRAM_MODE = 6,macro program parse n</td
169			ROBOT_MODULE_USER_PROGRAM_MODE = 7,user program parse mod</td
170			ROBOT_MODULE_JOG_MODE = 8, jog mode
171			ROBOT_MODULE_SCRIPT_MODE = 9,script mode
172	<pre>constomTtem id= "P-0-0515 0 1" attribute="double"&gt; 100</pre>		<pre><!-- ranid ston used dec mercent %--></pre>

Figure 3-4 Replacement of encoder values

The id values of the six mechanical arm encoders of MS6MT Robot are as follows:

ΝΟΤΕ

id="P-0-0513.0.168" id="P-0-0513.0.169" id="P-0-0513.0.170" id="P-0-0513.0.171" id="P-0-0513.0.172" id="P-0-0513.0.173"

Step 7 At the end of recording, drag the robot1.xml file back to the original folder, power off the robot and restart it to complete the rough calibration of the robot.

## 3.2 Removal and maintenance of cables

## 3.2.1 Removal and maintenance of end interface cables

Extend the cables from the end pass-through interfaces of MS6MT Robot to Axis J3, and connect to the cables from the base interface panel through the connector.

The distribution of end pass-through cables of the robot is shown in Figure 3-5.



Figure 3-5 Distribution of end pass-through cables

When removing the axis (Axis J6) modules from the upper part:

- **Step 1** Remove the waterproof covers from the rear ends of Axes J3 ~ J6 at the upper part.
- **Step 2** Disconnect the pass-through signal connector from the power connector at the end of Axis J3.
- Step 3 Use diagonal pliers to cut the cable ties fixing the cables on the modules of Axes J3 ~ J6. The cable fixing block is shown in Figure 3-6.



Figure 3-6 Cable fixed sheet metal

Distribute the signal cable and power cable of the top/end pass-through interface along the inside of the robot body, and pull out the cables.

- Carefully distribute the cables and pull them out slowly. Do not pull the cables so hard to avoid damage to them.
- When a robot module fails, determine the position of the module. Pull out the cables from Axis J3 to the rear end of the determined axis module. Remove the waterproof covers from the rear ends of axes till the corresponding axis. (For example, to remove the Axis J5 module, you need to remove the waterproof end covers of Axes J3 ~ J5 and cut off the cable ties fixed on each module, and pull out the end passthrough signal and power cables disconnected from Axis J3 to the rear end of Axis J5).





## 3.2.2 Removal and maintenance of base interface cables

Extend the cables from the power and signal interfaces of the MS6MT Robot base to Axis J3, and connect to the end pass-through signal cable and power cable through the connector.

Refer to Figure 3-5 for the distribution of cables from the power and signal interfaces of the robot base.

When removing the axis (Axis J1) modules from the lower part:

**Step 1** Remove the waterproof covers from the rear ends of Axes J1~J3 at the lower part.

- **Step 2** Disconnect the pass-through signal connector from the power connector at the end of Axis J3.
- **Step 3** Use scissors to cut off the cable ties fixing cables on the modules of Axes J1  $\sim$  J3. Refer to Figure 3-6 for the cable fixed sheet metal.

Distribute the base power and signal cables along the inside of the robot body, and pull out the cables.

• Carefully distribute the cables and pull them out slowly. Do not pull the cables so hard to avoid damage to them.



• When a robot module fails, determine the position of the module. Pull out the cables from Axis J3 to the rear end of the determined axis module. Remove the waterproof covers from the rear ends of axes till the corresponding axis. (For example, to remove the Axis J2 module, you need to remove

the waterproof end covers of Axes J2 ~ J3 and cut off the cable ties fixed on each module, and pull out the pass-through signal and power cables disconnected from Axis J3 to the rear end of Axis J2).



3.2.3 Removal and maintenance of module interface cables

The MS6MT Robot module comprises communication interfaces, power supply interfaces, and an encoder battery interface. The distribution of the interfaces on the module is shown in Figure 3-7.



Figure 3-7 Distribution of interfaces on the module

Step 1 Remove the waterproof cover from the rear end of the corresponding module.

Step 2 Use scissors to cut off the cable ties at the rear end of the module.

Step 3 Disconnect the communication cable and power cable from the interface panel at the rear end of the module. The cabling diagram of the module is shown in Figure 3-8.



#### Figure 3-8 Module cabling diagram

- For 48V power input of Axes J1~J3, connect the power cable from the base power interface to the power input interface of the module. The power output interfaces of Axes J1 and J2 are not equipped with connectors, so pay attention to it during removal and installation.
  - The Axis J6 module is a terminal module, and the power output and signal output interfaces are not equipped with connectors, so pay attention to it during removal and installation.

## 3.2.4 Removal and maintenance of ground wires

To ensure that the robot is internally well grounded, connect the axes  $J2 \sim J4$  with ground wires. If the modules of Axes  $J2 \sim J4$  and other components are removed, the ground wires of the corresponding axes need to be removed. The connection of ground wires of Axes  $J2 \sim J4$  is shown in Figure 3-9.



Figure 3-9 Ground terminal fastening screws

The ground wires are fixed to the screws at the interface of the module, as shown in Figure 3-10.



Ground terminal fastening screw

Figure 3-10 Ground wire connection diagram of Axes J2 ~ J4

Removal:

Step 1 Use Allen wrench to loosen the ground terminal fastening screws.

**Step 2** Disconnect the ground terminal from the module.

## 3.3 Replacement and maintenance of modules

The MS6MT Robot body is assembled in a modular manner. If some components of the



CAUTION

modules are damaged, the overall modules need to be removed and replaced.

- Remove and replace the robot modules only after the robot is powered off.
  - At the time of removal and installation, set up a safety fence and warning signs around the robot to prevent other workers from incorrectly operating it.

#### 3.3.1 Replacement of Axis J6 module

If a problem is detected in the Axis J6 module, remove and replace the Axis J6 module following the steps below:

Tools: Allen wrench (one set), anti-static gloves, scissors, cable ties.

- **Step 1** Remove the end pass-through cables with reference to Section 3.2.1.
- **Step 2** Remove the power and signal cables from the Axis J6 module interface with reference to Section 3.2.3.
- **Step 3** Use Allen wrench to remove the six fastening screws from the end flange and remove the end flange, as shown in Figure 3-11.



Figure 3-11 Remove the fastening screws from end flange

When removing the end flange, do not pull the cables so hard to avoid damage to the end pass-through cables.

CAUTION

**Step 4** Use Allen wrench to remove the fastening screws from the flange of the Axis J6 module and remove the Axis J6 flange, as shown in Figure 3-12.



Figure 3-12 Remove the screws from the Axis J6 module

- **Step 5** Gently push and remove the old module from the end flange. Remove the wear ring, module rubber plug and cable holder from the module.
- Step 6 Install the wear ring, module rubber plug and cable holder on the new module, as shown in Figure 3-13. Apply a layer of Black Power Sealant on the outer ring of the module (the area between the screw holes), then install the module on the shell, and tighten the screws (apply a layer of thread glue when installing the screws) with a screw torque of 2.4N⋅m, as shown in the figure.



Figure 3-13 Axis J6 module installation diagram

- **Step 7** Re-thread the signal and power cables at the end pass-through interface to Axis J3 and connect the interface.
- Step 8 Connect the communication and power cables on the Axis J6 module one after another, fix the cables of Axes J3 ~ J6 with cable ties, and then re-install the waterproof cover at the rear end.
- Step 9 Fill the four countersunk head screws in the inner ring of the module with Black Power Sealant. Apply a layer of Black Power Sealant on the inner ring of the flange (the area between screw holes), and then restore the flange end,

and tighten the screws (apply a layer of thread glue when installing the screws) with a screw torque of 2.4 N·m.



Figure 3-14 Axis J6 flange inner ring

## 3.3.2 Replacement of Axis J5 module

If a problem is detected in the Axis J5 module, remove and replace the Axis J5 module following the steps below:

Tools: Allen wrench (one set), anti-static gloves, special tool for removing pins, scissors, cable ties.

- **Step 1** Remove the end pass-through cables with reference to Section 3.2.1.
- **Step 2** Remove the power and signal cables from the Axis J5 module interface with reference to Section 3.2.3.
- Step 3 Use a small flathead screwdriver or similar tool to gently remove the black flexible flat ring from the junction of Axes J5 and J6 and pull it back from its original position on the joint shell. Then slide the black ring back, as shown in Figure 3-15. 10 screws are visible, with 5 screws on each side of the joint. Use a special open-end wrench to loosen the screws by at least two and a half turns for each. Then pull the two parts apart and gently rotate by 10° counterclockwise until they are mechanically stopped (with keyhole type holes). After that, the Axis J5 can be completely separated from the Axis J6.



Figure 3-15 Remove the screws from the Axis J5 shell

Step 4 Remove the Axis J6 and slowly pull out the cables from the middle of the Axis

J5 module.

When removing the Axis J6, do not pull the cables so hard to avoid damage to the end pass-through cables.

**Step 5** Use Allen wrench to remove the fastening screws from the Axis J5 flange and remove the flange, as shown in Figure 3-16.



Figure 3-16 Remove the Axis J5 flange

**Step 6** Use Allen wrench to remove the fastening screws from the Axis J5 module, as shown in Figure 3-17.



Figure 3-17 Remove the screws from the Axis J5 module



When removing the fastening screws from the Axis J5 module, hold the Axis J5 module with hand to prevent the module from falling at the end of the removal.

- **Step 7** Gently push and remove the old module from the fixed end. Remove the wear ring, module rubber plug and cable holder from the module.
- Step 8 Install the wear ring, module rubber plug and cable holder on the new module. Apply a layer of Black Power Sealant on the outer ring of the module (the area between the screw holes), then install the module on the shell, and tighten the screws (apply a layer of thread glue when installing the screws) with a screw

torque of 2.4 N·m, as shown in Figure 3-18.



Figure 3-18 Axis J5 module installation diagram

- **Step 9** Re-thread the signal and power cables at the end pass-through interface to Axis J3 and connect the interface.
- Step 10 Connect the communication and power cables on the Axis J5 module one after another, fix the cables of Axes J3 ~ J5 with cable ties, and then re-install the waterproof cover at the rear end.
- Step 11 Fill the four countersunk head screws in the inner ring of the module with Black Power Sealant. Apply a layer of Black Power Sealant on the inner ring of the flange (the area between screw holes), and then restore the flange end, and tighten the screws (apply a layer of thread glue when installing the screws) with a screw torque of 2.4 N·m.



Figure 3-19 Axis J5 flange inner ring

Step 12 Restore the Axis J6 and tighten the screws on the shell.

## 3.3.3 Replacement of Axis J4 module

If a problem is detected in the Axis J4 module, remove and replace the Axis J4 module

following the steps below:

Tools: Allen wrench (one set), anti-static gloves, special tool for removing pins, scissors, cable ties.

- Step 1 Remove the end pass-through cables with reference to Section 3.2.1.
- **Step 2** Remove the power and signal cables from the Axis J4 module interface with reference to Section 3.2.3.
- Step 3 Use a small flathead screwdriver or similar tool to gently remove the black flexible flat ring from the junction of Axes J4 and J5 and pull it back from its original position on the joint shell. Then slide the black ring back, as shown in Figure 3-20. 10 screws are visible, with 5 screws on each side of the joint. Use a special open-end wrench to loosen the screws by at least two and a half turns for each. Then pull the two parts apart and gently rotate by 10° counterclockwise until they are mechanically stopped (with keyhole type holes). After that, the Axis J4 can be completely separated from the Axis J5.



Figure 3-20 Remove the screws from the Axes J4 and J5 shell

After removing the mounting screws and pins from Axis J4, hold the Axis J5/J6 with hand to prevent the module from falling.

- **Step 4** Remove the Axis J5/J6 and slowly pull out the cables from the middle of the Axis J4 module.
- **Step 5** Use Allen wrench to remove the fastening screws from the Axis J4 flange and remove the flange, as shown in Figure 3-21.



Figure 3-21 Remove the Axis J4 flange

**Step 6** Use Allen wrench to remove the fastening screws of the Axis J4 module, as shown in Figure 3-22.



Figure 3-22 Remove the screws from the Axis J4 module

- **Step 7** Gently push and remove the old module from the fixed end. Remove the wear ring, module rubber plug and cable holder from the module.
- Step 8 Install the wear ring, module rubber plug and cable holder on the new module, as shown in Figure 3-23. Apply a layer of Black Power Sealant on the outer ring of the module (the area between the screw holes), then install the module on the shell, and tighten the screws (apply a layer of thread glue when installing the screws) with a screw torque of 2.4 N·m.



Figure 3-23 Axis J4 module installation diagram

- **Step 9** Re-thread the signal and power cables at the end pass-through interface to Axis J3 and connect the interface.
- Step 10 Connect the communication and power cables on the Axis J4 module one after another, fix the cables of Axes J3 ~ J4 with cable ties, and then re-install the waterproof cover at the rear end.
- Step 11 Fill the four countersunk head screws in the inner ring of the module with Black Power Sealant. Apply a layer of Black Power Sealant on the inner ring of the flange (the area between screw holes), and then restore the flange end, and tighten the screws (apply a layer of thread glue when installing the screws) with a screw torque of 2.4 N·m.



Figure 3-24 Axis J4 flange inner ring

**Step 12** Restore the Axis J5/J6 completely, and tighten the fastening screws of the shell with a screw torque of 2.4 N·m.

## 3.3.4 Replacement of Axis J3 module

If a problem is detected in the Axis J3 module, remove and replace the Axis J3 module following the steps below:

Tools: Allen wrench (one set), anti-static gloves, scissors, cable ties.

**Step 1** Remove the fastening screws from the waterproof covers at the front and rear ends of Axis J3, as shown in Figure 3-25.



Figure 3-25 Unscrew the waterproof end cover

- **Step 2** Disconnect the communication cable, power cable and encoder battery cable from the rear interface panel of the Axis J3 module.
- **Step 3** Disconnect the pass-through signal cable and power cable from the other end.
- **Step 4** Use Allen wrench to remove the screws from the Axis J3 shell, as shown in Figure 3-26.



After removing the fastening screws from Axis J3, hold the Axis J4/J5/J6 with hand to prevent the module from falling.



Figure 3-26 Remove the screws from the Axis J3 shell

Step 5 Use Allen wrench to remove the fastening screws from the Axis J3 module, gently push and remove the old module from the fixed end, as shown in Figure 3-27.



Figure 3-27 Remove the screws from the Axis J3 module

Step 6 As shown in Figure 3-28, apply a layer of Black Power Sealant on the outer ring of the new module (the area between the screw holes), then install the module on the Axis J3 shell, and tighten the screws (apply a layer of thread glue when installing the screws) with a screw torque of 4.6 N·m.



Figure 3-28 Axis J3 module installation diagram

Step 7 Apply a layer of Black Power Sealant on the inner ring of the module (the area between screw holes). Fill the four countersunk head screws in the inner ring of the module with Black Power Sealant, then restore the Axis J4/J5/J6 completely, and tighten the screws of the shell with a screw torque of 4.6 N·m.



Figure 3-29 Axis J3 module

**Step 8** Connect the communication and power cables one after another. Reconnect the end pass-through signal and power cables, and restore the waterproof covers at both ends.

## 3.3.5 Replacement of Axis J2 module

If a problem is detected in the Axis J2 module, remove and replace the Axis J2 module by following the steps below:

Tools: Allen wrench (one set), anti-static gloves, special tool for removing pins, scissors, cable ties.

**Step 13** Remove the end pass-through power and signal cables from the base with reference to Section 3.2.2.

Step 14 Refer to Section 3.2.3 to unscrew the waterproof cover at the rear end of Axis

J2 clockwise, and disconnect the communication cable, power cable and encoder battery cable from the interface panel of the module.

**Step 15** Use a small flathead screwdriver or similar tool to gently remove the black flexible flat ring from the junction of Axes J1 and J2 and pull it back from its original position on the joint shell. As shown in Figure 3-30.



Figure 3-30 Remove the screws from the Axes J1~J2 shell

Step 1 Slide the black ring back. 10 screws are visible, with 5 screws on each side of the joint. Use an open-end wrench to loosen the screws by at least two and a half turns for each. Then pull the two parts apart and gently rotate by 10° counterclockwise until they are mechanically stopped (with keyhole type holes). After that, the Axis J1 can be completely separated from the Axis J2.



When removing the screws, hold the mechanical arm with hand to prevent it from falling. Place the mechanical arm on the cushion before removing the Axis J2 module.

- Step 2 Slowly pull out the cables from the middle of the Axis J2 module.
- **Step 3** Use Allen wrench to remove the fastening screws from the Axis J2 flange and remove the flange, as shown in Figure 3-31.



Figure 3-31 Remove the Axis J2 flange

**Step 4** As shown in Figure 3-32, connect the black long screws to the four hexagonal isolation columns. After removing the hexagonal isolation columns, use Allen wrench to remove the fastening screws from the Axis J2 module.



Figure 3-32 Remove the fastening screws from the Axis J2 module

- Step 5 Gently push and remove the old module from the fixed end.
- Step 6 As shown in Figure 3-33, apply a layer of Black Power Sealant on the outer ring of the new module (the area between the screw holes), then install the module on the Axis J2 shell, and tighten the screws (apply a layer of thread glue when installing the screws) with a screw torque of 4.6 N·m.



Figure 3-33 Axis J2 module installation diagram

- **Step 7** Re-thread the base end pass-through signal and power cables to Axis J3 and connect the interface.
- Step 8 Connect the communication and power cables on the Axis J2 module one after another, fix the cables of Axes J2 ~ J3 with cable ties, and then re-install the waterproof cover at the rear end.
- Step 9 Fill the four countersunk head screws in the inner ring of the module with Black Power Sealant. Apply a layer of Black Power Sealant on the inner ring of the flange (the area between the screw holes), and then restore the flange end, and tighten the screws (apply a layer of thread glue when installing the screws) with a screw torque of 4.6 N·m.



Figure 3-34 Axis J2 flange inner ring

**Step 10** Restore the Axis J1, and tighten the fastening screws of the shell with a screw torque of 2.4 N⋅m.

#### 3.3.6 Replacement of Axis J1 module

If a problem is detected in the Axis J1 module, remove and replace the Axis J1 module following the steps below:

Tools: Allen wrench (one set), anti-static gloves, scissors, cable ties.

- Step 1 Refer to Section 3.2.2 to remove the waterproof end covers from both sides of the Axis J3, and disconnect the base end pass-through signal cable and power cable.
- **Step 2** Refer to Section 3.2.3 to unscrew the waterproof cover from the rear end of Axis J1 clockwise, and disconnect the communication cable, power cable and encoder battery cable from the interface panel of the Axis J1 module.
- **Step 3** Place the robot on the cushion, and use Allen wrench to remove the screws from the base plate, as shown in Figure 3-35.



Figure 3-35 Remove the screws from the base plate

- **Step 4** Use straight screwdriver to gently open the base, remove the base plate and set it aside for later use.
- **Step 5** Use Allen wrench to remove the fastening screws from the base and remove the base, as shown in Figure 3-36.



Figure 3-36 Remove the fastening screws from the base

- Step 6 Slowly pull out the cables from the middle of the base bottom axis module.
- Step 7 As shown in Figure 3-37, connect the black long screws to the four hexagonal isolation columns. After removing the hexagonal isolation columns, use Allen wrench to remove the fastening screws from the Axis J1 module.



Figure 3-37 Remove the fastening screws from the Axis J1 module

- Step 8 Gently push and remove the old module from the fixed end.
- Step 9 Apply a layer of Black Power Sealant on the outer ring of the new module (the area between the screw holes), then install the module on the Axis J1 shell, and tighten the screws (apply a layer of thread glue when installing the screws) with a screw torque of 4.6 N·m.



Figure 3-38 Axis J1 module installation diagram

- **Step 10** Re-thread the base end pass-through signal and power cables to Axis J3 and connect the interface.
- Step 11 Connect the communication and power cables on the Axis J1 module one after another, fix the cables of Axes J1 ~ J3 with cable ties, and then re-install the waterproof cover at the rear end.

Step 12 Fill the four countersunk head screws in the inner ring of the module with Black Power Sealant. Apply a layer of Black Power Sealant on the inner ring of the base flange (the area between the screw holes), and then restore the base, and tighten the screws (apply a layer of thread glue when installing the screws) with a screw torque of 4.6 N·m.



Figure 3-39 Base flange inner ring

**Step 13** Fix the base plate with a screw torque of  $0.8N \cdot m$ .

## 3.4 Replacement and maintenance of encoder battery

Fix the encoder battery on the sheet metal at the rear end of each axis module, and the position of the fixed sheet metal of Axis J1 is shown in the figure.

When replacing the encoder battery, do not turn the mechanical arm at an angle of more than 180° when the power is turned on.



The replacement of encoder battery of Axis J2/J3/J4/J5/J6 is the same as that of Axis J1. If you need to replace it, replace it according to the steps of replacing the Axis J1 encoder battery.



Figure 3-40 Fixed sheet metal

When the encoder battery has a low voltage or fails, replace it in time by following the steps below:

Tools: Scissors, anti-static gloves, cable ties, encoder battery

- **Step 1** Remove the waterproof cover from the rear end of Axis J1, and fix the cables and encoder battery on the sheet metal.
- Step 2 Use scissors to cut the cable ties fixing the encoder battery.
- **Step 3** Find the axis encoder battery to be replaced, and connect the new encoder battery to the corresponding backup interface.
- Step 4 Disconnect the old encoder interface and remove the old encoder battery.
- **Step 5** Fix the new encoder battery on the sheet metal of the encoder battery with cable tie.
- Step 6 Restore the waterproof end cover.
- 3.5 Replacement and maintenance of controller



- At the time of removal and installation, set up a safety fence and warning signs around the robot to prevent other workers from incorrectly operating it.
- Remove and replace the robot components only after the robot is powered off.
- The controller is provided separately, and users can fix it with M3 screws according to the structural characteristics of the

equipment.

• After replacing the controller, copy the configuration file of the old controller into the new controller to avoid parameter loss.

In case of any problems in the controller, replace it in time by following the steps below:

Tools: Allen wrench (one set), straight screwdriver (2\*75), anti-static gloves

- **Step 1** Disconnect all cables from the interface panel of the controller.
- **Step 2** Use Allen wrench to remove the fastening screws.
- **Step 3** Fix the new controller in situ, and connect the disconnected cable interfaces one after another.
- 3.6 Replacement and maintenance of 48V relay module
  - At the time of removal and installation, set up a safety fence and warning signs around the robot to prevent other workers from incorrectly operating it.
  - Remove and replace the robot components only after the robot is powered off.



• The 48V relay module is provided separately, and users can fix it with M3 screws according to the structural characteristics of the equipment.

In case of any problems in the 48V relay module, replace it in time by following the steps below:

Tools: Allen wrench (one set), a straight screwdriver (2\*75), a cross screwdriver (PH2), anti-static gloves

- Step 1 Disconnect all cables from the interface panel of the 48V relay module.
- Step 2 Use Allen wrench to remove the fastening screws.
- **Step 3** Install the new 48V relay module in situ, and connect the disconnected cable interfaces one after another.

## 3.7 Replacement and maintenance of discharge resistor

	NOTE
=	NOTE

• At the time of removal and installation, set up a safety fence and warning signs around the robot to prevent other workers from incorrectly operating it.

- Remove and replace the robot components only after the robot is powered off.
- The discharge resistor is provided separately, and users can fix it with M4 screws according to the structural characteristics of the equipment.

In case of any problems in the discharge resistor, replace it in time by following the steps below:

Tools: Allen wrench (one set), straight screwdriver (2\*75), anti-static gloves

- **Step 4** Disconnect all cables from the discharge resistor.
- Step 5 Use Allen wrench to remove the fastening screws.
- **Step 6** Install the new discharge resistor in situ, and connect the disconnected cable interfaces.

## Chapter 4 Technical service

## 4.1 Consulting and services

QKM Technology Co., Ltd. is committed to providing you with technical information on machine motion and operation to help you remove faults and reply to your inquiry in detail. If your robot or equipment fails during use, you can contact our service department and provide information below as much as possible:

- Model and serial number of robot or equipment
- Model and serial number of control system
- Control system version number
- Attached software function package (optional)
- Existing applications
- Other auxiliary products and devices attached (View, PLC, etc.)
- Description of the problem, duration and frequency of the fault, etc.

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