



LT Robotic Tool Changer User Manual



Payload 10kg

Product : LTC-0010E



Preface

Thank you for purchase our LT Robot Tool Changer.

This Brochure describes the basic information of LTC-0010E, About electrical, Pneumatic and other parts please refer to other user manual.

If you have any questions please contact LT Company.

Note: This brochure introduced the function, application and safety precautions of tool changer, before install and operate the manual should be read and understood carefully, otherwise the product may be damaged or unsafe.

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Glossary

Steel ball snap ring	The steel ring on the tool side,it fits to the locking steel ball during locking.
Cam	Circular cam attached to the piston that forces the locking balls outward during the locking process.
Electrical Module	a wide variety of utility modules that pass electrical power or electrical signals through Master plate to Tool plate and then to the end-effector.
End-Effector	A tool installed on a robot to perform a certain function.
adapter flange	Optional components for the installation between the transition of robot tool changer to the robot or tools.
Locking ball	Hardened steel ball for locking mechanism with air pressure lost protection function.The locking cam extrudes the steel ball and clamps it with the steel ball snap ring on the tool side,Realize the master plate locking tool plate.
Locking mechanism	It is used to pull the master plate locking tool plate, which can ensure reliable locking even in case of air loss until the mechanism is unlocked normally. The locking mechanism includes locking steel ball, cam, ball bearing cover, ball race, etc.
Lock Port	Pneumatic port on the Master plate to which air is supplied to Lock the Master plate to the Tool plate.
Master plate	The half of the Tool Changer that is mounted to a robot. The Master plate contains the locking mechanism.
Moment	The applied force multiplied by the distance it is from a point
No touch	Design feature of Tool Changer products that allows coupling the Master plate and Tool plate without physical contact prior to locking.
Piston	Piston located in the Master plate that actuates the locking mechanism
Air module	pass air power through the Master plate to the Tool plate and to the end effector.



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Sensor plate	seals the pneumatic chamber and provides mounting points for the Lock/Unlock switches.
Tool Plate	The half of the Tool Changer to which various tools or end-effector are mounted.
Tool stand	Stand that holds Tools not being used by the robot. This is usually supplied by the customer and is specific to the application.
Unlock port	The master plate unlocks the port of the air supply circuit to drive the master plate to be separated from the tool plate.
Arc Prevention	makes it possible to couple/uncouple without switching off electrical module power. Arcing can damage and shorten the life of the electrical power contacts. Arc Prevention extends the life of all electrical power contacts by eliminating arcing caused by inductive loads and high inrush current during coupling/uncoupling.
Coupling	Lock
Discrete	Refers specifically to modules that pass discrete signals and/or power from Master to Tool. The number of discrete pass-through signals is limited by either the number of pins on the connector or the number of pins at the pin block interface between Master and Tool. Some Discrete modules also provide the user the ability to control the Tool Changer by providing “Latch” and “Unlatch” signals to an integrated valve that locks and unlocks the Tool Changer. The Tool Changer Locked, Unlocked, Ready-to-Lock, and TSI switch signals can also be provided to the user, these discrete modules are referred to as Discrete Control/Signal Module.
Ethernet Switch	An Ethernet network component connecting multiple communication partners with each other
Fieldbus	A generic term referring to any one of a number of industrial computer networking standards. Examples include: CAN, Modbus, and PROFINET.
Gigabit Ethernet	The interface that can realize 1000mdps transmission rate by CAT6 standard



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Latch	Command that is issued to lock (couple) the Master and Tool Plates.
Lock	The physical action of the coupling the Master and Tool Plates together.
Locked	A proximity sensor output signal indicating that the coupling mechanism is in the Locked position.
Lock Sensor	A proximity sensor that detects the position of the pneumatically-actuated piston when it is in the locked or missed tool position.
Teach Tool	A device convenient for teaching when teaching by robot.
Tool ID	An individual or set of push button switches on the control/signal Tool module that provides a unique identification number for each tool when using multiple tools. The tool-ID also provides the tool not present indication.
Tool Present	A hard-connect input (sourced from the Tool) indicating the Master and Tool are electrically connected to each other.
Trip Dog	A physical device used to trip a mechanical switch, use in the Tool Stand Interlock circuit.
Uncoupling	See unlock
Unlatch	The input signal supplied to the ATI Master module to uncouple the Tool Changer.
Unlock	The physical action of the uncoupling the Master and Tool Plates.
Unlocked	A proximity sensor output signal indicating that the coupling mechanism is in the Unlocked position.
Unlock sensor	A proximity sensor that detects the position of the pneumatically-actuated piston when it is in the unlocked position.

1. Safety

This section describes the general safety guidelines to be followed for this product , The mentioned warning instructions and safety precautions are applicable to this product. Refer to other application manuals for more specific warning instructions.

1.1 Notices:

The following notice is for the products covered by this manual. Users should pay attention to all notifications from robot manufacturers and robot parts manufacturers.



Danger: Inform information or instructions that failure to comply will result in death or serious injury. The Notice provides information on the nature of the dangerous situation, the consequences of not avoiding the danger and the methods to avoid it.



Warning: Notice of information or instructions that may result in death or serious injury if not observed. The notification provides information on the nature of the hazardous situation, the consequences of not avoiding the hazard and the methods to avoid it.



Note: Inform information or instructions that failure to comply may result in moderate injury or equipment damage. The notification provides information on the nature of the hazardous situation, the consequences of not avoiding the hazard and the methods to avoid it.

Notice: Notice of specific information or instructions for maintaining, operating, installing or setting up the product. Failure to follow these information or instructions may cause equipment damage. The notice emphasizes, but is not limited to, specific grease types, best operating practices, and maintenance techniques.

1.2 General safety rules

Before purchase and installation, the customer shall verify that the selected tool changer has met the maximum allowable moment and allowable torque expected during operation. Please refer to the product specifications in each models of this manual. Special attention Dynamic load caused by acceleration and deceleration of robot. In the case of high acceleration or deceleration, these forces may be many times the static force.

It is the customer's responsibility to ensure that during locking and locking , there has no foreign matter between master plate and tool plate, otherwise will result in serious injury.



Danger: the gap between the master plate and the tool plate is a pinch point. All personnel shall be prevented from placing any part of their body or clothing in the gap, especially during the operation of the locking mechanism.

Customer responsible for learn the functions of robot tool changer , And implement appropriate fasteners and software to safely operate the tool changer. It shall be controlled to avoid endangering personnel or equipment during locking or unlocking.

All pneumatic fittings and piping must be able to withstand repeated movements of the application without failure. The wiring of electrical and pneumatic pipelines must minimize the possibility of sprains, kinks, cracks, etc. Failure of key electrical or pneumatic pipelines to work properly may cause injury to personnel and equipment.

Disconnect all power, pneumatic and fluid circuits during maintenance.



Warning: before operation, remove all temporary protective materials (cover, plug, tape, etc.) from the locking surface of the tool changer and module. Otherwise, the tool changer, module and arm end tools will be damaged and personal injury may be caused.

1.3 Safety notes:



Warning: do not maintain or repair the tool changer or module , Unless the tool is safely supported or placed on the tool stand , All energized circuits (such as electrical, air, water, etc.) have been closed, the high-voltage connection has been cleaned, and the power supply has been discharged from the circuit in accordance with the customer's safe operation procedures and policies. Personal injury or equipment damage may result if not placed in the tool holder and the circuit is energized. Place the tool on the tool holder, close and discharge all energized circuits, release all pressurized connections, and confirm that all circuits are powered off before maintaining or repairing the tool changer or module.



Warning: during operation, the area between the master plate and the tool plate must be kept clean. If the area is not kept clean, the tool changer, module or arm end tool will be damaged and personal injury may be caused.



Warning: the tool changer is only used for the intended application and the application approved by the manufacturer. Using the tool changer in unexpected use will cause damage to the tool changer, module or arm end tool, and may cause personal injury.

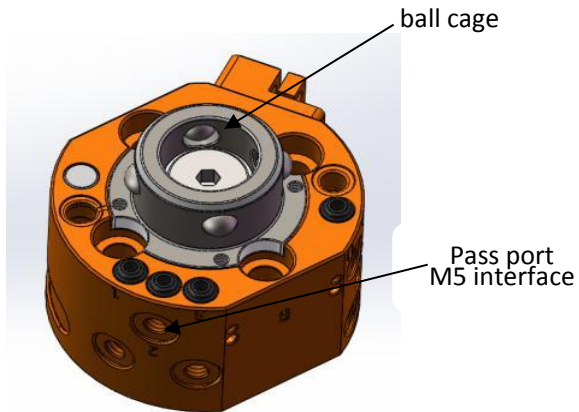
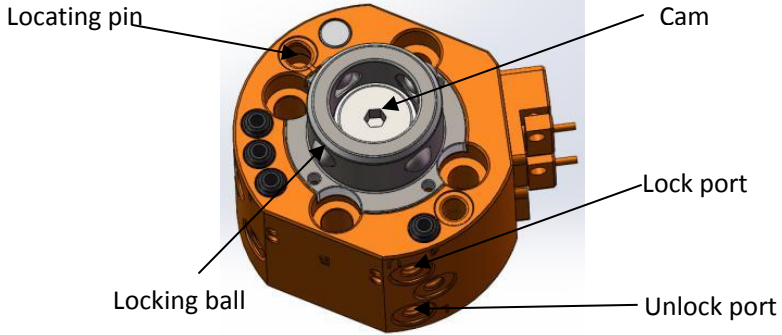


2. Product overview

The LT robot tool changer enhances the universality of the robot by using a variety of tools (such as fixtures, vacuum suction cups, pneumatic and electric motors, welding guns, etc.). The tool changer includes a master plate installed on the robot arm and a tool plate installed on the customer's tool. When the robot picks up the tool, the pneumatically driven locking mechanism connects the two plates. The fault self-locking mechanism of the patent adopts multi conical cam with ball locking technology , Ensure during operation , If the air pressure less than 60psi (4.1 bar) , too changer will not release. The robot can select the required tools through programming ,Master plate connect to tool plate. Electricity, fluid and other energy are transferred to the end tools through optional modules attached to the master and tool plate.

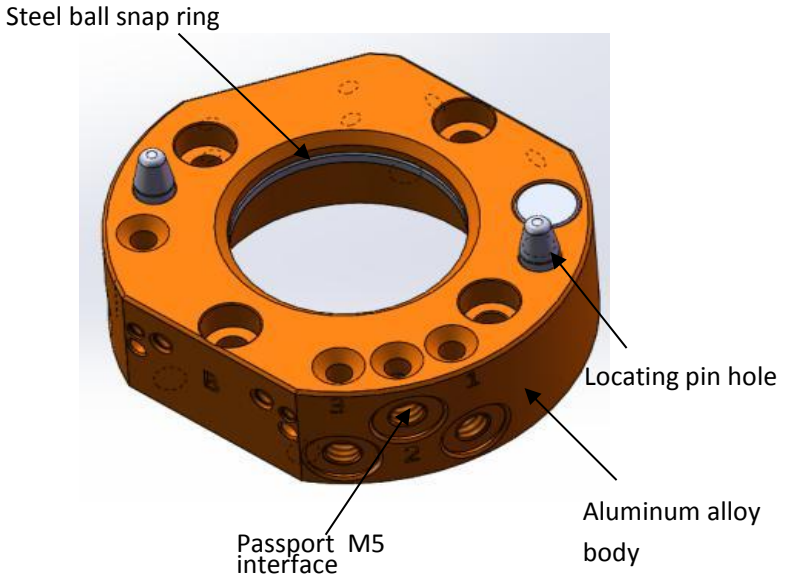
2.1 Master components

The master plate components includes an anodized aluminum body , Hardened stainless steel locking mechanism and hardened steel locating pin.The locking mechanism includes a cam , One ball cage and chrome steel ball bearing. The master plate has two flat sides , used for install optional modules,can install relevant modules according the projects application, Through“L”and“U” the pneumatic ports provides locking and unlocking air for the locking mechanism , A vent is provided for the end effector through the digital pneumatic port on the master plate. The locating pin is matched with the bushing to ensure that the positioning can be repeated during the combination process. Grease shall be used for cams, Ball cages and balls to improve performance and maximize the service life of the master plate components.



2.2 Tool plate components

The tool plate components consists of an anodized aluminum body and a hardened stainless steel ball snap ring. Tool plate provides two flat interface for install modules. Tool plate has air pass port , to supply end effector.



2.3 Optional modules

This model has 2 module mounting interface , can install electrical module , more modules please find from website:

<https://www.ltautotools.com/products/ltc-0010e-tool-changer.html>

3. Installation

The end effector is usually connected to the tool plate through the tool adapter flange. We can provide standard and customized tool adapter flanges as required. All fasteners used to install the tool changer on the robot and tools shall be tightened to the torque value as indicated. In addition, removable (blue) Loctite 242 anaerobic adhesive shall be used for fasteners. The pneumatic pipeline and cable are fixed and tied together, and must be able to move freely during operation.

Warning: before maintaining or repairing the tool changer, be sure to place the tool



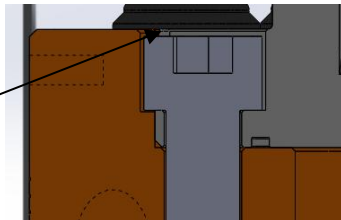
on the tool support or stop, turn off all electrical, air, water, etc., and the power supply has been discharged from the circuit according to the customer's specific safety operation procedures and policies. And confirm that the air pressure and liquid pressure have been released.



Warning: pneumatic fittings and pipelines must be able to withstand repeated movements of the application without failure. The wiring of electrical and pneumatic lines must minimize the possibility of over stress, pull-out or kink. Failure to do so may result in critical electrical or pneumatic pipeline failure and may result in personal injury or equipment damage.

Warning: do not use a washer under the head of the mounting screw, and do not let the mounting screw protrude above the mating surface of the master plate and the tool plate. If the mounting screw protrudes above the mating surface, a gap will be formed between the master plate and the tool plate, resulting in the failure of the locking mechanism to fully engage, which may cause equipment damage or personal injury. The mounting screws must be flush or below the mating surface of the master plate and tool plate.

The screw must be lower than the mating surface of the master plate and tool plate.



Note: in the design of adapter flange and tool flange plate, the positioning criteria of master plate and adapter flange and the positioning criteria of tool plate



and tool flange shall be followed. Otherwise, the connection may be loose;



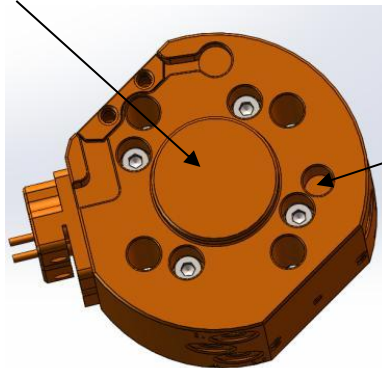
Note: after the connecting screw uses the thread fastening glue, if it is removed and reused, the thread fastening glue shall be applied again. Otherwise, the screw may become loose. Always use new thread locking compound when reusing fasteners.

3.1 Master Plate

Master plate usually install on Sixth axis flange of the robot , Master plate match with the size of ISO9409-40-4-M6 , if the robot Sixth axis fit the size ISO9409-40-4-M6 can connect directly do not use adapter flange,

Otherwise need custom the adapter flange to connect the robot Sixth axis with master plate ; The master plate own with a locating pin hole and a locating boss.

Locating boss



locating pin hole



If the customer chooses to design the adapter flange, please consider the following points:

1.The adapter flange shall include bolt holes for installation, as well as a locating pin and a boss for accurate positioning on the robot and the master plate. The pin and boss function prevents unnecessary rotation. For the installation function of the robot, please refer to the robot manual.

2.The thickness of the adapter flange must be sufficient to provide the necessary thread engagement for the mounting bolts.

3.The pin shall not protrude from the surface of the adapter flange beyond the depth of the pin hole on the master plate.

4.If bosses are used on the master plate, grooves of appropriate depth and diameter must be machined on the adapter flange to correspond to the bosses on the master plate.

5.Too long mounting bolts will form a gap between the adapter flange and the master plate, thus damaging the equipment.

6.The adapter flange must be firmly installed on the master plate.

7.The design of adapter flange must consider the clearance required for module accessories.

3.2 Installation of master plate

Tool required : 5 mm Allen wrench, torque wrench.

Other required : Cleaning cloth , Loctite242 Thread anaerobic adhesive.

1.Keep tools in a safe place.

2.Release master plate and tool plate.

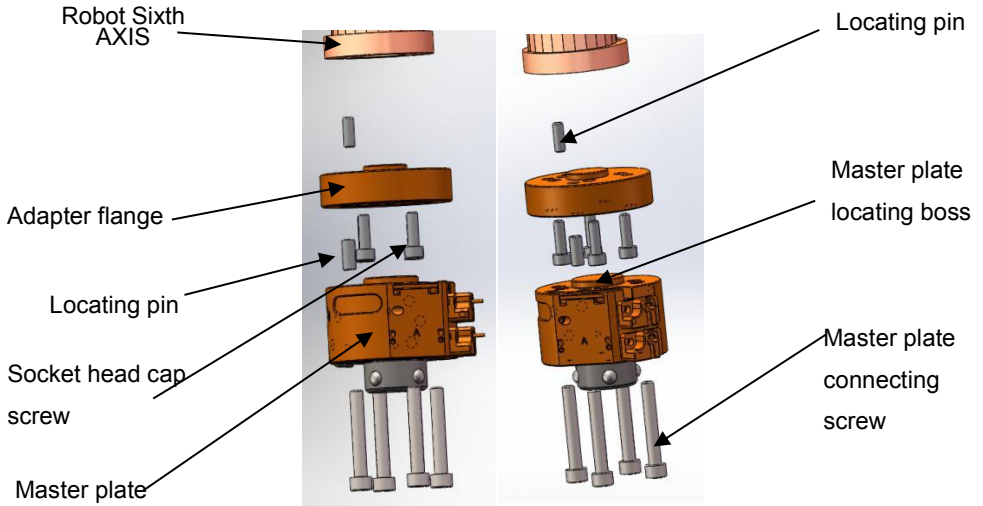
3.Close and completely disconnect all energy connections; For example: electrical, air, etc.

4.clean install interface.

5.Using the alignment function, place the adapter flange on the robot arm and fasten it with screws.

6.Connect all "lock / unlock" and "through" air utilities to the master plate.

Use adapter flange connect to robot sixth axis



3.3 Tool plate

Tool plate connect to relevant tools. The adapter flange can adapt the tool plate to the corresponding tool. (Locating pin hole) Accurately position and fix the tool plate to the corresponding tool through the bolt hole.



Note: do not use more than two alignment functions when fixing the tool plate to the adapter flange. Using more than two alignment functions may damage the device. Use two locating pins to align the tool plate with the adapter flange.

Note: do not use too long locating pins. Using an excessively long locating pin will create a gap between the adapter flange and the tool plate and damage the equipment. When using pins, the length of the pins shall not exceed the allowable range of the tool plate.

If the customer choose to design and build a tool adapter flange, consider the following:



The adapter flange shall include bolt holes for installation and two locating pins for accurate positioning on customer tools and tool plates. The pin prevents unnecessary rotation.

the pin shall not protrude from the surface of the transition flange beyond the depth of the pin hole on the tool disc.

The thickness of the transition flange must be sufficient to provide the necessary thread engagement for the mounting bolts. Fasteners shall meet the recommended minimum joint length without exceeding the maximum available thread depth. Using too long bolts may damage the tool disc.

The adapter flange design must consider the clearance required for module accessories and accessories.

The center of the adapter flange must have a threaded hole to manually return the locking mechanism to the unlocked position under adverse conditions, such as accidental power failure or air pressure drop. The minimum center threaded hole is M10.

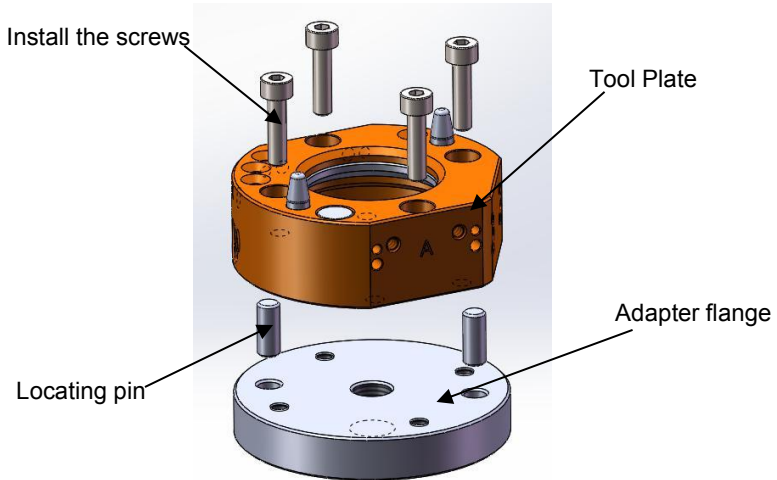
3.4 Tool Plate installation

Tools Requirements : 3 mm Allen wrench, torque wrench.

Required items: cleaning cloth, LOCTITE 242 thread anaerobic adhesive.

- 1、 Clean the mounting surface ;
- 2、 Install the tooling adapter flange on the customer's tooling, align it with the pin shaft, and fasten it with bolts (coated with LOCTITE 242 glue);
- 3、 Align with the pin shaft and install the tool plate on the adapter flange with M3 screws (Gluing LOCTITE242) ;
- 4、 Install the tools on the adapter flange.

3.5 Tool Plate installation

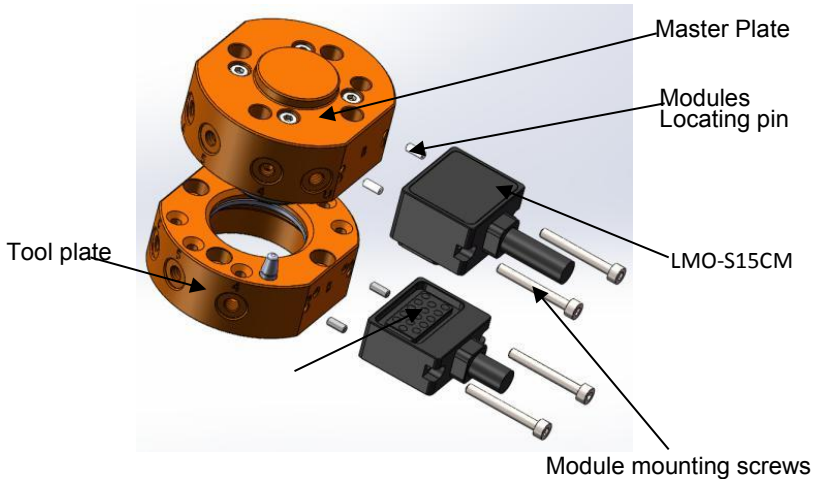


3.6 Remove Tool Plate

- 1、 Tools requirements : 3mm Allen wrench ;
- 2、 Keep tools in a safe place ;
- 3、 Release master plate and tool plate ;
- 4、 Close and completely disconnect all energy connections; For example: electrical, air, etc. ;
- 5、 Remove the fasteners that fix the tool plate to the tool adapter flange or customer tool; ;
- 6、 Remove the tool plate ;

3.7 Optional modules installation

Optional modules are usually installed on the tool changer by the LT company before shipment. The following steps described the field installation or removal as required. The tool changer can select many different types of modules. Some modules will require an adapter plate to be installed on the tool changer. (Take LMO-S15C for example)



Tools Requirement : 2mm Allen wrench ;

Required items: cleaning cloth, LOCTITE 242 thread anaerobic adhesive.

- 1.Keep tools in a safe place ;
- 2.Release master plate and tool plate ;
- 3.Close and completely disconnect all energy connections; For example:
electrical, air, etc. ;
- 4.Clean the mounting surface ;
- 5.Align the optional module with the mounting surface of the master plate or
tool plate ;
- 6.If fasteners with pre applied adhesive are not used, apply LOCTITE 242
thread sealant to the mounting fasteners ; use 2mm Allen wrench and use 4
pieces M2.5 Install the screw fixing module;
- 7.Before operation, please remove all protective covers, plugs, tapes, etc.
from the module;
- 8.Safely and normal operation;

3.8 The method of remove modules

Tools Requirement : 2mm Allen wrench ;

1.Keep tools in a safe place ;

2.Release master plate and tool plate ;

3.Close and completely disconnect all energy connections; For example:
electrical, air, etc. ;

4.Use 3mm Allen wrench to remove 4pieces M2.5 Socket head cap screw.

5.Remove modules from master plate and tool plate.

3.9 Air requirement

The normal operation of the locking mechanism requires a continuous supply of clean, dry and unlubricated air under the following conditions:

- The pressure range is 60 to 100 psi (4.1-6.9Pa) , suggested 80 psi.
- Minimum filtering : 40micron.

To lock or unlock the tool changer, a constant supply of compressed air is required.

If there is a loss of air pressure in the locked state, the cam profile will prevent the master plate and tool plate from unlocking, and the tool changer will enter the fault self-locking state.



Note: do not use the tool changer under the condition of fault self-locking. The locking mechanism may be damaged. Before resuming normal operation, re-establish the air pressure and ensure that the tool changer is in the safe locking position.

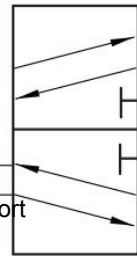
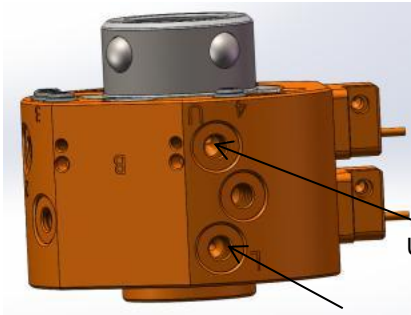
3.8.1Solenoid valve requirements and connections

The customer provides 2-position 4-way valve or 2-position 5-way valve to drive the locking mechanism in the master plate. When air is supplied to the locked or unlocked port on the master plate, the opposite port must be vented to the atmosphere(That is, when air is supplied to the locking port, the unlocking port must be unlocked to the atmosphere) Failure to vent trapped air or vacuum at the inactive port may inhibit the operation of the locking mechanism and prevent locking or unlocking.



Note: when connected to the three-way valve, the locking mechanism will not work properly because this type of valve cannot discharge residual air or vacuum from the tool changer. This may cause product damage, incidental tools or personal injury. Connect the lock and unlock air supply to the 2-position 4-way valve or the 2-position 5-way valve.

2 position 5 way valve



supply of clean, dry and unlubricated air (60 to 100psi)

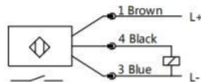
The exhaust port leads to the atmosphere

3.10 Electrical connection

The master plate of robot tool changer integrates Unlock/lock and tool tool plate in position detection sensors.

Sensor connector wiring mode:

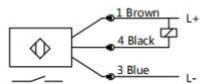
PNP



锁定、解锁检测开关 接线方式

产品特征	
输出类型	PNP
输出功能	常开
输出持续电流	200mA
工作电压	10...30 DC
工作环境	-25...75°C

NPN



锁定、解锁检测开关 接线方式

产品特征	
输出类型	NPN
输出功能	常开
输出持续电流	200mA
工作电压	10...30 DC
工作环境	-25...75°C


3.11 Sensor signal status table

Signal status table of Lock/unlock and tool plate in position sensor:

Tool changer status	Unlock sensor	Lock sensor	Tool plate in position sensor
Locking status with tool plate	No signal	With signal	With signal
Unlock status not Separated tool plate	With signal	No signal	With signal
Unlock status Separated tool plate	With signal	No signal	No signal

4. Operation

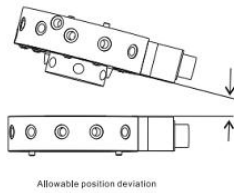
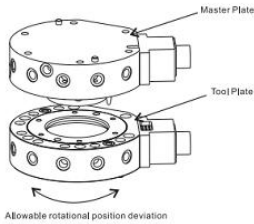
The main locking mechanism is pneumatically driven and is locked and unlocked with the bearing seat ring on the tool quick change device. The master plate provides locking/unlocking pressure to the locking mechanism through L/U air ports.



Note: Safe and reliable operations of tool changes depend on a continuous supply of compressed air at pressures of 60-100 psi (4.1-6.9 Bar). If the air supply pressure drops below 60 psi (4.1 Bar), the robot should stop moving at once.

Note: All tool changers are initially lubricated with Mobil XHP222 special grease. The end user must add additional lubricant to the locking mechanism and locating pins before using.

The robot should be programmed to minimize deviations in the locking and unlocking process. In addition, the tool stand should be durable under the weight of the unlocked tools and not allow for deflection which would align the tool quick-change mechanism beyond the allowable offset. The recommended maximum allowable offset before locking is shown below. In some cases, a larger offset than the one shown below can be adjusted by the master plate and the tool plate, but will increase abrasion.



Allowable horizontal position deviation	±1mm
Allowable rotational position deviation	±1deg
Allowable position deviation	±1deg

4.1 Locking sequence



Note: The locking mechanism must be in the unlocking position when attempting to connect the tool quick-change device. Failure to comply with this condition may damage tool changer or robot.

1. Please place the master plate right above the tool plate and supply compressed air to the unlock port.

2. Move the master plate toward to the tool plate so that the positioning pin enters the positioning hole on the tool plate, program the robot so that the master plate and the tool plate are aligned axially and parallel to each other (as close as possible). This will minimize movement and abrasion of the tool changers during locking process.



Note: Clearance locking technology allows the device to maintain some distance between the master plate and the tool plate. Do not touch the mating surface of the tool before connecting the masterplate. Contact may damage the unit or robot.

3. When the combination surface between the master plate and the tool plate is within the specified gap, the pressure is released from the unlock port and air is supplied to the locked port. The tool plate is pulled towards the master plate and locked. During operation, air pressure must be maintained on the locking ports to ensure a rigid connection.

4. A sufficient delay must be set between the solenoid valve action and the robot movement so that the locking process can be completed before the robot is moved.



Note: If air pressure is lost during operation, the fail-safe design prevents the tool plate from being dropped. Do not use quick tool change device in self-locking condition. Before resuming normal operation, refill the air pressure and ensure that the quick tool change device is in a

safe locking position.

4.2 Fault self locking operation

When the air pressure on master plate disappears unexpectedly, self-locking function works. After air pressure disappear, master plate and tool plate might has slight separate, it will cause lock sensors indicate unlocked. fault protection function using multiple CAM to capture bearing of ball and prevent accidental release tool plate, in this case position repeatability can't keep, and don't operate tool changers anymore. If the air source is lost, stop moving at once until the air pressure is restored.

After the air pressure is re-established on the master plate, the locking mechanism will energize and firmly lock the master plate and tool plate together. In some cases, when the load on the tool quick-change unit is significantly off-center, it may be necessary to place the load under the tool quick-change unit or return the tool to the tool storage location to ensure a safe locking state. If a locking sensor is equipped, ensure that the locking sensor indicates that the tool quick-change device is in the locking position before resuming normal operation.



Warning: Do not use quick tool change device in fault - locking condition, otherwise the locking mechanism may be damaged. Before resuming normal operation, re-establish the pressure and ensure that the tool quick-change device is in a safe locking position.

4.3 Unlocking sequence

1.Place the tool plate in the tool support so that there is almost no force between the tool plate and the tool support.

2.Release air from the locked port and then inject compressed air into the unlocked port. (if equipped, the unlock sensor will indicates that the robot tool changer is in the unlocked position.)



Note: Compressed air will cause the locking device to loosen and the weight of the tool plate and attached tools will facilitate its removal. If the tool is released only in a vertical position, the weight of the tool

helps unlock.

3. A sufficient delay must be set between solenoid valve propulsion and robot movement to complete the unlocking process and fully release the tool tray before moving the robot.

4. Move the master plate axially away from the tool plate.

5. In the application of exchange of tools, we suggest use tool status sensor in the tool holder, To verify that the tool exists and whether the tool is still in place when the robot leaves after the unlocking process.

4.4 Precautions for tool placement

Note: The design of the tool support is critical to the operation of the tool quick-change device. Improper design of tool supports can lead to stuck and excessive wear of tool quick-change components.

A tool tray with customer tools can be stored in a tool holder.

When the customer provides the tool support, it must provide a fixed, repeatable, horizontal, stable position to facilitate the lifting of the tool. The tool support must support the weight of the tool tray, tool transition flanges, optional modules, cables, hoses, and customer tools. The offset cannot exceed the specified offset.

Ideally, the tool should be suspended vertically from the tool holder so that gravity helps separate the tool board from the motherboard during unlocking. A tool support can be designed to hold the tool in a horizontal position, but the necessary compliance must be provided during locking and unlocking. In general, "horizontal position" tool supports cause more wear and tear to the locking mechanism and positioning characteristics of the tool supports.

The tool can be placed on the tool holder in a variety of ways. A common method is to use tapered locator pins and bushings. Robot programming and position repeatability are critical to tool picking and dropping.

It is recommended to use sensors to detect the presence of tools in the tool holder. Sensors can be used prior to locking to ensure that tools are properly placed in the bracket. Sensors can also be used when the robot disconnects and starts to move away. If the tool gets stuck on a stand or cannot be released from the robot, the sensor provides a safety measure.

The position close to the sensor should be as vertical as possible to prevent metal shavings, weld splashes or other debris from landing on the sensor and producing false readings.

A chip guard on the tool stand can cover tools and modules to protect them from dirty conditions such as grinding or welding. Alternatively, position the tool in an area free from weld splashes, liquids, adhesives, or other debris so that a debris shield is not required.

5.Maintenance



Warning: All energy connections (e.g. electrical, air, water, etc.) are turned off unless the tool is safely supported or placed in the tool holder; Otherwise, do not maintain or repair the tool or module. Release pressure and turn off power according to customer specific safety specifications and policies. If no tools are placed and the circuit is powered on, personal injury or device damage may occur. Before performing maintenance or repair on the tool quick-change unit or module, place the tool in the tool holder, close and discharge all energized circuits, clear all pressurized connections, and verify that all circuits are powered off.

Note: the cleanliness of the working environment seriously affects the trouble-free operation of the tool quick-change device. The dirtier the environment, the greater the need for debris protection. You may need to protect the entire end gripper tool, master disk, tool disk, and all modules.

Protective measures include:



- *Tools should be placed away from the chip generator.*
- *Tool holder mounting cover.*
- *Shields, deflectors, air curtains and similar devices mounted on end gripper tools and tool brackets.*

5.1Regular Maintenance

The following table provides a visual inspection and regular maintenance plan. For detailed periodic maintenance steps for all utility modules, see the Modules section.

5.1Maintain the checklist regularly		
Application program	Tool change frequency	Survey schedule
Normal application	>1 min	per week
	<1 min	per month
Welding/servo/deburring, casting operation (dirty environment)	all	per week
Check list		
<p style="text-align: center;">Install fasteners/adaptor flanges</p> <ol style="list-style-type: none"> 1、 Inspect if fasteners has proper torque,interference and abrasion, tighten and correction as required. 2、 Check ball/locating pin/hole/bearing seat ring for abrasion and lubrication. The lubricant can be contaminated with debris over time, therefore it is recommended to thoroughly clean existing oils and replace new oils as needed regularly. 3、 Check if excessive abrasion exit in the pin/bushing, if yes then it may be a sign of poor robot position during pick/drop process, adjust robot position as needed. 4、 Check if tool support with abrasion and alignment problems. 5、 Check the abrasion situation of ball bearing/housing ring, if abrasion is severe, it indicates overload. 6、 Sensors and cables 7、 Check if the sensor cable connector is tight, If the connector is loose,pls tighten 		

it.

- 8、 Check if the sensor cable is damaged,cuttetd or abrasion, pls change it when necessary.
- 9、 Check hose connections for tightness and leaks as required. If it leaks or becomes loose, secure or replace the hose connection.
- 10、 Check hoses for interference, abrasion, cuts and leaks. Replace as needed.
- 11、 Check seal rings for abrasion, cuts and leaks.
- 12、 Inspect electrical contacts/pins for damage, debris and stuck/charred pins.
Remove or replace as required.

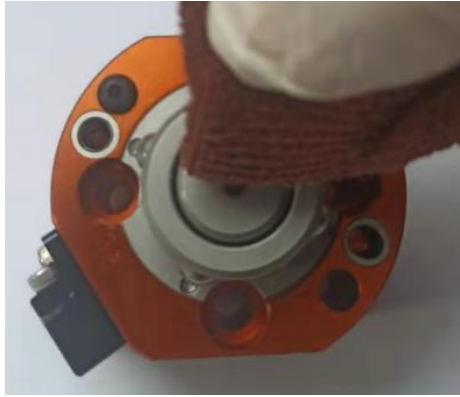
5.2Cleaning and lubrication of locking mechanism and locating pin

Needed goods: Cleaning cloth, Mobil XHP222 extra grade grease

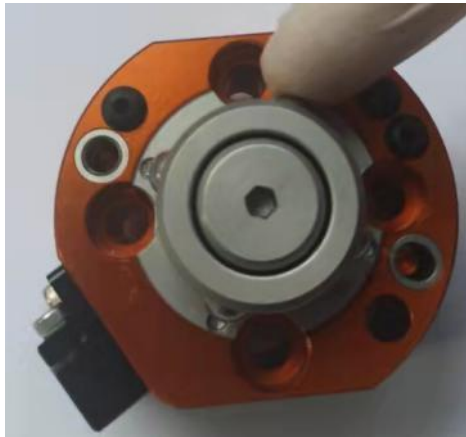
- 1.Pls put tools in safety place.
- 2.Unlock master plate and tool plate.
- 3.Cut off all power supply (such as electric, Pneumatic etc).
- 4.Use a clean cloth remove any lubricants and debris from ball bearings, ball bearing housings, cams and locating pins thoroughly.



- 5.Use a clean cleaning cloth to remove all lubricants and debris from the ball bearing housing and the inner surface of the CAM.



6. Check each ball bearing to ensure it is free to move in the bearing seat ring. Clean up the oil stains on the steel balls and ensure that the steel balls can rotate freely in the rehole.



7. Apply a thick layer of grease to the ball bearings, bearing seat rings and locating pins



8. Thoroughly remove lubricant and debris from bearing seat rings and bushings on tool tray with a clean cleaning cloth.

Note: Lubrication is not required on the tool plate assembly.

9. Start for normal operation.



5.3 Inspection and cleaning of electrical modules

For details, please refer to 《LTC Electrical Module Instruction Manual》.

6. Troubleshooting and service procedures

The following section provides fault diagnosis information and troubleshooting service flow for the quick change tooling device.



Warning: All energy connections (e.g. electrical, air, etc.) are turned off unless the tool is safely supported or placed in the tool holder; Otherwise, do not maintain or repair the tool changer or module. Release pressure and turn off power according to customer specific safety specifications and policies. If no tools are placed and the circuit is powered on, personal injury or device damage may occur. Before performing maintenance or repair on the tool quick-change unit or module, place the tool in the tool holder, close and discharge all energized circuits, clear all pressurized connections, and verify that all circuits are powered off.

6.1 Fault handling

6.1.1 Provide troubleshooting tables to help diagnose problems that may cause the tool quick-change device not work properly.

Sheet 6.1 troubleshooting

Troubles	cause	solutions
Tool changer can't be locked or can't be unlocked(or locking sensor can't indicate locking state)	pneumatic supply is abnormal	pneumatic supply pressure keeps 0.4MPa~0.7MPa
	there are debris between master plate and tool palte	Clean debris between master plate and tool palte,make sure fasteners are securely installed and do not protrate from the mating surface.
	no air pressure is supplied to lock or unlock ports.	Equip proper air pressure and magnetic valve.
	Air pressure exist in Locking or unlocking port under power off state.	release air pressure correctly.
	Pneumatic port connector is loose or damaged.	Check if hose connect is tight and without leak, if yes then pls fasten hose connect,and Inspect hoses for



		interference, abrasion, cuts and leaks. Replace as needed.
	Steel ball or cam can't move freely in bearing set ring.	Cleaning and lubricate regularly to make sure smooth operation.
	The master plate and tool plate are not in the specified contact area when trying to lock them.	Check if tools put in tool support correctly. Reteach robot to make master plate closer to tool plate before locking purpose.
Tool changer with air leakage	Not in place or missing seals, aging, damage;	Check if connector has been properly installed. Check if interface exist gap; Check siliga gel seal ring for aging,damage or missing; Check interface with blockages.
Electric modules signal is poor(signal pins with foreign matters or signal interference)	Signal pins can't send message out	check with multimeters or other tools and repair.
	electric modules with damage	check and repair
	signal cable with excessive bend or flat	check and repair
	Signal connector is loose	check and repair
	Master plate and tool plate don't connect perfectly	check and repair
	Signal pins with black color or can't pop up or with foreign matters.	change signal pins
Plate can't lock tightly to start work	Pneumatic supply pressure is innormal	keep pneumatic pressure within 0.4-0.7MPa
	electric magnetic valve don't work	check and repair
	master plate and tool plate	check and repair



	don't contact properly	
	air trachea with excessive twist and bend	check and repair
	O-shape ring in master plate with damage	check and repair

Emergency investigation and treatment

6.1.2 Quick tool changers treatment by external interference and impact

If the robot or the tool mounted on the robot is disturbed or impacted (impinged) during working, the tool changers must be checked as listed in the table below. During interference and impact, the superposition of arm lever will lead to a very large force to tool changers, even if the following items are normal, the life of the tool changers may be affected. It is recommended to carry out regular inspection according to the maintenance provisions.

No.	Inspection items	Inspection method	inspection position	treatment measure
1	cracks	check and confirm	main body appearance	replace main body
2	plate deformation	check and confirm	main body appearance	replace main body
3	bolt looseness	check and confirm	bolts position	tight or replace
4	steel ball action and all signal state	check and confirm	Manual handle solenoid valve open and close operation and signal on/off inspection	replace main body
5	gap between connect interface	check and confirm	steel ball set ring of tool plate with large dent	replace main body
6	rotation direction with	check and	position pins with	replace



	loose or gap	confirm	broken or loose	damage parts or main body
7	signal pins,electric plug and surrounding cables with damage	check and confirm	check tool changer and other electric modules	replace damage parts or main body

6.2Air port maintainence process

The following services provide instructions for checking, adjustments, tests or replacing of components.

6.2.1 Rubber bushing inspection and replacement

Rubber bushing seals the air port from the master plate to the tool plate. If the bushing is cut or damaged, it needs to be replaced.

- 1.Put tools in safe place.
- 2.Unlock master plate and tool plate.
- 3.Cut off all power supply (such as electric, Pneumatic, liquid etc).
- 4.Grasp the damaged rubber bushing with fingers and pull the bushing out of the main body.
- 5.Put new rubber bushing into water for smooth installation.
- 6.Insert the bevel (chamfered) of the rubber bush into the hole so that the taper of the bush faces outward.
- 7.Secure bushings to holes by hand, tapping the bushings with a plastic or rubber soft face hammer when necessary.
- 8.Safely restore normal operation.



6.2.2 Electric modules sealing inspection and replacement

The sealing gasket protects the electrical connection between the master plate module and the tool plate module. Replace the gasket if it is worn or damaged. Refer to LTC electrical module instruction for detailed operations.

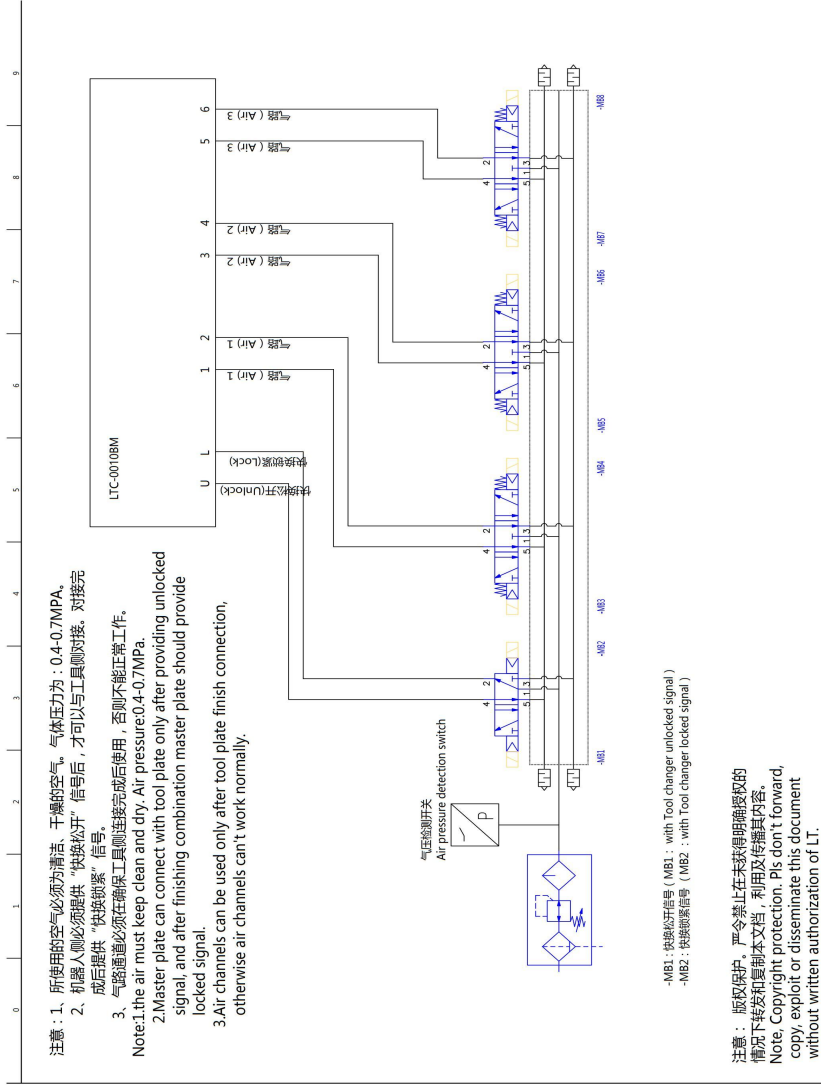
**7.Parameter table**

Model	Master plate	LTC-0010EM
	Tool plate	LTC-0010ET
Load	Payload capacity	10kg
	(when pressure 0.49Mpa) Allowable moment	1193N
	(static)Allowable moment	26.5N·m
	(static)Allowable torque	35.7N·m
Size and precision	Housing diameter	φ60mm
	Combined profile	55mm
	Position repeatability	±0.02mm
Air pressure for working		0.4~0.7Mpa
Locking mechanism		Locking steel ball
Texture of material	Main body material	Aluminum alloy
	Locking mechanism	Alloy steel
Environmental Science	Temperature	0-60℃
	Humidity	95%
Weight	Master side	0.33kg
	Tool side	0.09kg
Air connector	Pneumatic port	4 x M5
	Max pressure	0.8Mpa



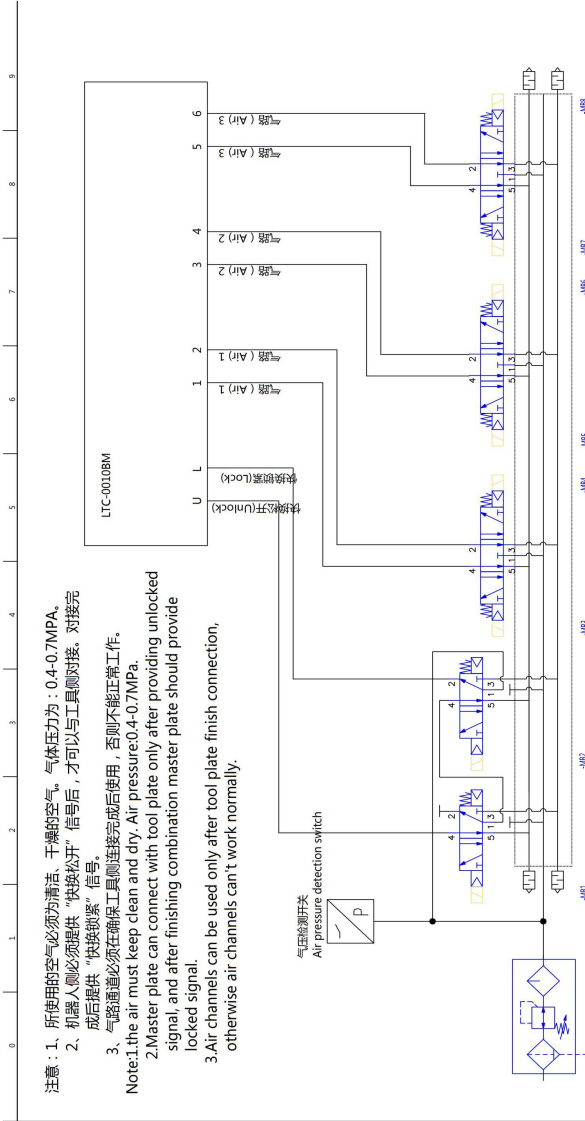
9.Recommended Solenoid valve to control tool changers

9.1Single solenoid valve control



图号(Revise)	图号(DWG)	图名(Name)	图章(Revise)	项目名称(Project name)	郑州凌航机器人有限公司 Zhengzhou Linghang Robot Co.,Ltd 郑州市二七区航海东路聚创国际科技园11幢 No.11 Zhengzhou Technology Innovation Park, Mahai Industrial District, Zhengzhou Henan,China. 450009 86-0371-86259680 www.zplp.com / www.linghangrobot.com
				项目编号(No.) LTC-0010BM 图号(Change No.) LTC-2006L 版本号(Approve)	领航 郑州凌航机器人有限公司 Zhengzhou Linghang Robot Co.,Ltd
				设计(Design) 审核(Review) 批准(Approve)	图号(DWG) 图名(Name) 图章(Revise)

9.2 Double solenoid valve control (safer control way)



注意：1. 所使用的空气必须为清洁、干燥的空气，气体压力为：0.4-0.7MPa。
 2. 机器人必须提供“快换松开”信号后，才可以与工具侧对接。对接完成后提供“快换锁紧”信号。
 3. 气路通道必须在确保工具侧连接完成后使用，否则不能正常工作。
 Note: 1. the air must keep clean and dry. Air pressure: 0.4-0.7MPa.

2. Master plate can connect with tool plate only after providing unlocked signal, and after finishing combination master plate should provide locked signal.
 3. Air channels can be used only after tool plate finish connection, otherwise air channels can't work normally.

-MB1和-MB2：两个都有信号快换松开(Both MB1 and MB2 with Tool changer unlocked signals)
 -MB1和-MB2：两个都没有信号快换锁紧(Both MB1 and MB2 without Tool changer locked signals)

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