AUBO Robotics USA

AUBO IS Series Control Box (CB)
User Manual

Version 1.2

Content

1 Safety

1.1 Overview

This chapter describes the safety principles and practices to be followed when operating a robot or robotic system. Integrators and users must read this manual carefully, and the contents with warning signs need to be understood and strictly followed. Since the robot system is complex and dangerous, users need to understand the risks of operation fully and strictly abide by and implement the specifications and requirements in this manual. Users and system integrators must maintain a high level of safety awareness and comply with the industrial robot safety standard ISO 10218.

1.2 Safety Warning Symbols

The table below defines the captions specifying the danger levels used throughout this manual. These warnings, which are relevant to safety, must be observed.

Table 1 Warning Symbols Description

Symbol	Description
	This indicates an imminently hazardous electrical situation that, if not avoided, could result in injury or major damage to the equipment.
	This indicates a hazardous electrical condition may result which, if not avoided, may result in personal injury or serious damage to the equipment.
	This indicates a potential situation which, if not avoided, could result in injury or major damage to the equipment. Marked with this symbol, depending on the circumstances, sometimes may have significant consequences.
	This indicates a situation which, if not avoided, could result in injury or major damage to the equipment. Marked with this symbol, depending on the circumstances, sometimes may have significant consequences.

1.3 Safety Precautions

The following basic information needs to be understood and followed when using the robot or robot system for the first time. Also, other safety-related information will be introduced in other parts of this manual. However, it may not cover everything. In practical applications, it is necessary to analyze specific issues.

1. Make sure to install the robot and all electrical equipment according to the manual requirements and specifications.
2. Make sure to conduct a preliminary test and have inspections for the robot and its protection systems before using the robot or putting it into production for the first time.
3. Make sure to check the system and equipment for completion, operational safety, and any damage that can be detected before starting the system and equipment for the first time. The test needs to confirm whether it accords with valid safety production rules and regulations in the country or region. All safety functions must be tested.
4. .Make sure that all safety parameters and user programs are correct, and all safety functions are working normally. A qualified robotics operator is needed to check each safety function. Only by passing the thorough, careful safety test and reaching the safe level, can we power on the robot.
5. Installation and commissioning need to be performed by professionals in accordance with the installation standards.
6. When the robot is installed, a comprehensive risk assessment is necessary, and the test results need to be recorded in a report.
7. Set and modify the safety parameters by a qualified person. Use password or isolation measures to prevent unauthorized people from setting and modifying safety parameters. After a safety parameter is modified, the related safety functions need to be analyzed.
8. When the robot is in an accident or abnormal operation, the emergency stop switch needs to be pressed down to stop the movement.
9. The control cabinet generates heat during operation. Do not operate or touch the machine while it is running or immediately after it stops. Disconnect the power and wait for an hour for the machine to cool down.
10. Never put your fingers into the hot parts of the control box.

	1. Make sure that the robot's joints and tools are installed properly and safely. 2. Don’t use the robot if the robot is damaged. 3. Do not connect any safety equipment to normal I/O. Use safety-related interfaces only. 4. Make sure to use the correct installation settings (e.g., the robot's mounting angle, TCP weight, TCP offset, security configuration). Save and load the installation file along with the program. 5. The different mechanical linking may increase the risk or lead to new dangers. Make sure to perform a comprehensive risk assessment for the entire installation. Always choose the highest-level performance when different safety and emergency shutdown performance levels are needed. Make sure to read and understand all the devices’ manuals used for installation. 6. Do not modify the robot. Changes to robots may cause unpredictable danger to the integrator. The robots authorize restructuring needs in accordance with the latest version of all relevant service manuals. If the robot is changed or altered in any way, AUBO Robotics USA disclaims all liability. 7. Users need to check the insulation and protection measures before transportation. 8. Transporting robots must follow the transport requirements. Handing carefully and avoiding the bumps.
	1. When the robot is combined with or working with machines capable of damaging the robot, then it is highly recommended to test all the functions of the robot and the robot program separately. It is recommended to test the robot program using temporary waypoints outside the workspace of other machines. 2. AUBO cannot be held responsible for any damage caused to the robot or to other equipment due to programming errors or malfunctioning of the robot. 3. Don't expose the robot to a permanent magnetic field. Very strong magnetic fields can damage the robot.

1.4 Responsibility and Standard

Having AUBO-CB-iS by itself is often incomplete and thus it can be combined with other equipment to form a complete machine. The information in this manual does not cover how to design, install, and operate a complete robot, nor does it cover all peripheral equipment that can influence the safety of the complete system. The safety of installing a complete robot is determined by how it is integrated. Risk assessment is one of the most crucial tasks an integrator must complete, and integrators can refer to the following standards to carry out the risk assessment process.

○ ISO 12100:2010 Safety of machinery - General principles for design - Risk assessment and risk reduction.

○ ISO 10218-2:2011 Robots and robotic devices - Safety requirements - Part 2: Industrial robot systems and integration.

○ RIA TR R15.306-2014 Technical Report for Industrial Robots and Robot Systems - Safety Requirements, Task-based Risk Assessment Methodology.

○ ANSI B11.0-2010 Safety of Machinery; General Requirements & Risk Assessment.

AUBO robot integrators need to fulfill but are not limited to the following responsibilities:

○ Comprehensive risk assessment of a complete robot system.

○ Make sure the whole system design and installation is correct.

○ Provide training to users and personnel.

○ Create operational specifications for a complete system, and specify instructions for the process.

○ Establish appropriate safety measures.

○ Use appropriate methods to eliminate or minimize all hazards to an acceptable level in the final installation.

○ Convey the residual risk to the users.

○ Mark the logo and contact information of the integrators on the robot.

○ Archive technical file.

Guidance on how to find and read applicable standards and laws is provided on: https://aubo-usa.com/

All safety information contained in this manual is not considered as a guarantee for AUBO. Even if all the safety instructions are observed, the personnel injury or equipment damage caused by the operator is still likely to occur.

AUBO is committed to continuously improving the reliability and performance of the product. Therefore, we reserve the right to upgrade products without notice. AUBO seeks to ensure the accuracy and reliability of the contents in this manual but is not responsible for any errors or omissions.

1.5 Intended Use

The AUBO-CB-iS control cabinet is exclusively designed for general industrial equipment applications. Operation is strictly permitted only under the specified environmental conditions detailed in the Appendix.

This safety-critical system must not be utilized in non-conforming scenarios, including but not limited to:

- Explosive Atmospheres
- Mobile platforms for personnel/animal transport
- Medical Life-Support Devices
- Public transportation/power grid systems
- Vehicular/marine installations
- Climbing/hoisting mechanisms

1.6 Emergency Situations

1.6.1 Emergency Stop Device

Pressing the Emergency Stop button immediately stops all the robot's motion. Emergency Stop shall not be used as a risk reduction measure but as a secondary protective device. If multiple emergency stop buttons are connected, it should be recorded in the risk assessment of the robot application. Emergency stop buttons should comply with IEC 60947-5-5.

The external emergency stop interface can be found on the control box (see Chapter 8.5.5 External Emergency Stop Input), the integrator or users could use that interface according to the actual situation.

	If the equipment or tools that connect to the robot flange may cause potential danger, it must be integrated into the emergency stop circuit in the system. It may result in death, serious injury, or substantial property damage if failure to observe this warning notice.

1.6.2 Recovering from Emergency Condition

All the button-type emergency stop devices have a "lock" function. This "lock" must be opened to end the emergency stop state.

Rotating the emergency stop button can open the "lock".

	Recovery from an emergency stop state is a simple but very important step. This step can only operate after making sure that the robot system is completely excluded from danger.

2 Transportation and Precautions

When hoisting the robot, the moving parts should be located properly to avoid unexpected movement which can cause damage during hoisting and transportation. When packaging and transporting, it should follow packaging standards and be marked with the required signs outside the package.

The control cabinet should be lifted using the handle. When the machine is being hoisted, appropriate measures should be taken to secure the moving parts, preventing any unexpected movement during hoisting and transportation that could cause harm.

Save the original packaging after transportation. Store the packaging material in a dry place for future repackaging and moving the control box.

1. Make sure not to overload the operator’s back or other body parts when the equipment is lifted.
2. All regional and national guidelines should be followed. AUBO is not responsible for any damage caused during the transportation of equipment.
3. Make sure to follow the instructions when installing a robot.

3 Maintenance, Repair and Disposal

3.1 Maintenance and Repair

Maintenance and repair work must strictly follow all safety instructions in this manual.

Maintenance must be performed by authorized partners or AUBO. All parts returned to AUBO will be returned according to the service manual.

Make sure to reach the safety level of maintenance and repair, follow all regional and national guidelines, and test whether all safety functions work normally.

The purpose of maintenance and repair is to make sure that the system runs normally or help it return to normal condition when system error occurs, including fault diagnosis and actual maintenance.

	1. Remove the main input cable from the bottom of the control box to ensure that it is completely powered off. Take necessary precautions to prevent other people from recharging the system during the repair period. After the power is turned off, the system must be re-examined to ensure that it is powered off. 2. Please check the ground connection before turning the system back on. 3. Observe ESD (Electro-Static discharge) regulations when parts of the manipulator or control box are disassembled. 4. Avoid disassembling the power supplies inside the control box. High voltages can be present inside these power supplies for several hours after the control box has been switched off. 5. Prevent water and dust from entering the manipulator or control box. 6. Replace the defective components with new components with the same article number or equivalent components approved by AUBO. **7.** Reactivate any deactivated safety measures immediately after the work is complete. 8. . Record all maintenance operations and save them in technical documentation. 9. There is no self-serviceable part in the control box. If maintaining or repairing service is required, please contact your dealer or AUBO.

3.2 Disposal

AUBO robots must be disposed of in accordance with the applicable national laws, regulations, and standards.

3.3 Product Warranty

AUBO robots have a finite warranty period of 18 months.

In the case of new devices and their components exhibiting defects resulting from manufacturing and/or material faults within 18 months of entry into service, AUBO should provide the necessary reserve components to replace or repair the related components.

AUBO has the ownership of the devices or components which have been replaced or returned to AUBO.

If the product is not under warranty, AUBO reserves the right to charge the replacement or repair fee to the customer.

If there are any defects that appear in the device outside the warranty period, it is not responsible for any damage or loss caused by the equipment, such as loss of production or damage to other production equipment.

3.4 Disclaimer

This Warranty will be invalid if the equipment defect is caused by improper handling or failure to follow the relevant information described in the user manual.

Failures caused by the following conditions are not covered by this warranty:

1. Products purchased from non-AUBO-approved channels.

2. Does not meet the requirements of industrial standards or does not follow the user manual to install, connect wires, and connect to other control devices.

3. Using products beyond the specifications or standards of the manual.

4. Using products beyond the appointed purposes.

5. Storage methods and working environments are beyond the appointed range (e.g., pollution, salt injury, and moisture condensation).

6. Where the product is used in a grinding (polishing) environment or any other special environment without appropriate protective measures.

7. Products' damage caused by improper transportation.

8. Failures, damage, or indirect damage caused by accidents or human factors.

9. Not installing the original assembled components and accessories.

10. The damage caused by the third party which is not AUBO or the designated integrator while reconstructing, adjusting, or repairing the original components.

11. Any natural disasters including fires, earthquakes, tsunamis, lightning, high winds, and flooding.

12. Any malfunction does not relate to AUBO's responsibility apart from the circumstances mentioned above.

Warranty will not be provided in the following circumstances:

1. Unable to identify the product's serial number.

2. Unable to identify the production date or the warranty start date.

3. Changing the software or the internal data.

4. The malfunction cannot reappear or be identified by AUBO.

5. Using the products as radioactive equipment, biological test equipment or any other dangerous environment ascertained by AUBO.

6. Appearance parts, consumable parts.

Regarding the product warranty, AUBO only provides the warranty for the flaws and defects in the products and components that are sold to dealers.

AUBO is not responsible for the relevant warranty responsibility to any other express or implied warranty or responsibility, including but not limited to the implied warranty to the merchantability or the specific use. In addition, AUBO is not responsible for any indirect damage and consequences caused by the relevant products.

3.5 Consumable part list

NO.	Consumable parts
1	Nameplate
2	Control box socket cap
3	Control box top cover
4	Control box rubber feet
5	Control box fan dust cover

4 Control Box

4.1 Introduction

AUBO-CB-iS is the control center of the AUBO robot, which contains a control board, a safety control board, a switching power supply, and a safety protection device. The control cabinet can optionally be powered by 110V/220V AC, and its internal switching power supply converts the 110V/220V AC to 12V, 24V, and 48V DC to power the loads and robots in the control box. Therefore, the connection between the robot and the teach pendant or the control box must be checked securely before use.

The control box is designed with hardware protection and software protection to ensure security to the greatest degree when people use it. Using multiple circuit breakers inside the control box plays a reliable role in short-circuit and overload protection on the hardware. With the emergency stop button in both the control box and the teach pendant, users can cut off the robot's power in the shortest time to protect personnel and equipment.

Figure 5-1 AUBO-iS control box appearance

	1. There are dangerous voltages of 110V/220V AC and 48V DC inside the cabinet. Non-professionals are not allowed to open the cabinet while it is powered on. 2. Do not touch the screws and other metal devices fastened to the control box directly with your hands, and do not remove the wiring while the power is on.
	The software in the robot system only supports the upgrade and use of default software. It is prohibited to install other software such as the ROS system. If there is a need for software installation, it is recommended that users install it on other platforms.

4.2 Control Box Panel Introduction

4.2.1 Front Panel

The front panel structure of the control box is shown below.

Figure 5-2 Control box front panel

Table 2 Function description of the front panel indicators and buttons

No.	Name	Function
1	EMERGENCY STOP - Button	Emergency stop button - When pressed, the robot will enter the emergency stop state. To recover the system to a normal state, the user should rotate the button in the direction shown in the picture above.
2	MODE MANUAL/LINKAGE - Button	System Manual mode or Linkage mode selection button - When pressed, the system will enter linkage mode.
3	TEACH PENDANT ENABLE/DISABLE - Button	The teach pendant enable/disable button – It is used in the scenario where a teach pendant is not necessary in operation, such as linkage mode. Normally, this button pops up, in which case the teach pendant must be connected in order to function properly (the teach pendant emergency stop is available). If the user needs to unplug the teach pendant, they can press this button. At that time, the emergency stop button of the teach pendant is disabled. Then the user can unplug the teach pendant cable and use the interface signal to control the robot.
4	MANIPULATOR ON - Indicator	MANIPULATOR ON - Indicator
5	EMERGENCY STOP - Indicator	When lights are on, it means the system is at emergency stop status.
6	STANDBY - Indicator	When lights are on, the interface board in the control box has been initialized

7	POWER - Indicator	When the light is on, external power is on.

4.2.2 Rear Panel

The structure of the control box rear panel is shown below:

Figure 5-3 Rear panel of the control box

Table 3 Function description of the rear panel sockets and switches

No.	Name	Function
1	POWER	Power switch – “I” means on, “O” means off.
2	TEACH PENDANT - Socket	Teach pendant socket – Connects the teach pendant cable.
3	ROBOT - Socket	Robot socket – Connects the manipulator cable.
4	POWER - Socket	Power socket – Connects the power cable.
5	I/O outlet	Control box internal I/O outlet

4.3 Cable Connection

1. **Robotic arm cable connection:** First, the control box interface on the red dust cap from the socket, and then the robot cable plug into the control box ROBOT interface. (Pay attention to the direction of insertion, it will be automatically locked after inserted in place)

2. **TP cable connection:** Insert the TP cable plug into the TEACH PENDANT interface of the control box and lock the screws on both sides.

3. **The power cord connection:** first remove the red dust cap on the control box interface from the socket, and then insert the plug of the robot cable into the control box POWER interface. (Pay attention to the direction of insertion, inserted into place will automatically lock)

Figure 5-4 Cable connection of the control box

4.4 Power on

1. Place the control box in a suitable location.
2. Connect the control box with the cables as described in the section above.
3. Check that all the cables of the control box are well connected. (Teach pendant, IO terminals, and robot cables).
4. Insert the three-pin plug of the power cord into the AC power socket, then press the power switch on the rear panel of the control cabinet from O (OFF) to I (ON). The power indicator light will illuminate.

4.5 Power off

To power off the control cabinet: Press the power switch on the rear panel to the "O" (OFF) position. This will de-energize the system and extinguish the power indicator light.

	Shutting down the system by unplugging the power cord directly from the outlet may result in damage to the machine's file system, which may cause the machine to malfunction.

5 Electrical Interface

5.1 Electrical Warnings and Cautions

When designing robot applications and installing control boxes, be sure to follow the following warnings and precautions. Also, follow these warnings and cautions when performing maintenance work.

	**1.** Never connect safety signals to a PLC that does not fulfill the requirements of a correct safety level. Failure to follow this warning could result in serious injury or death due to the failure of the safety stop function. **2.** The control box must be powered off when the electrical interface is wired. **3.** All safety signals have dual-loop safety channels (redundant design). Keeping the two channels independent ensures that no safety function is lost in the event of a single failure.
	**1.** Make sure that all non-waterproof equipment remains dry. If water comes inside the product, turn off all the power switches and then contact your supplier. **2.** Use original cables supplied with the robot only. Do not use the robot for applications where the cables will be bent. Contact your supplier if longer or flexible cables are needed. **3.** All mentioned GND connections are only for powering and transmitting signals. For Protective Earth (PE) use the screw connections marked with the earth symbols inside the control box. The grounding conductor shall have at least the current rating of the highest current in the system. **4.** Be careful when installing the interface cables to the robot's I/O.
	**1.** Interference signals higher than the level specified in the IEC standard will cause abnormal behavior of the robot. Extremely high signal levels or excessive exposure can damage the robot permanently. EMC problems usually occur in welding processes and are normally prompted by an error message in the log. AUBO is not responsible for the loss caused by the EMC problem. **2.** I/O cables going from the control box to other machinery and factory equipment may not be longer than 30 m unless extended tests are performed.

5.2 Side panels of control box

Opening the side panel of the control box, the following electrical connections are provided inside for the user's use.

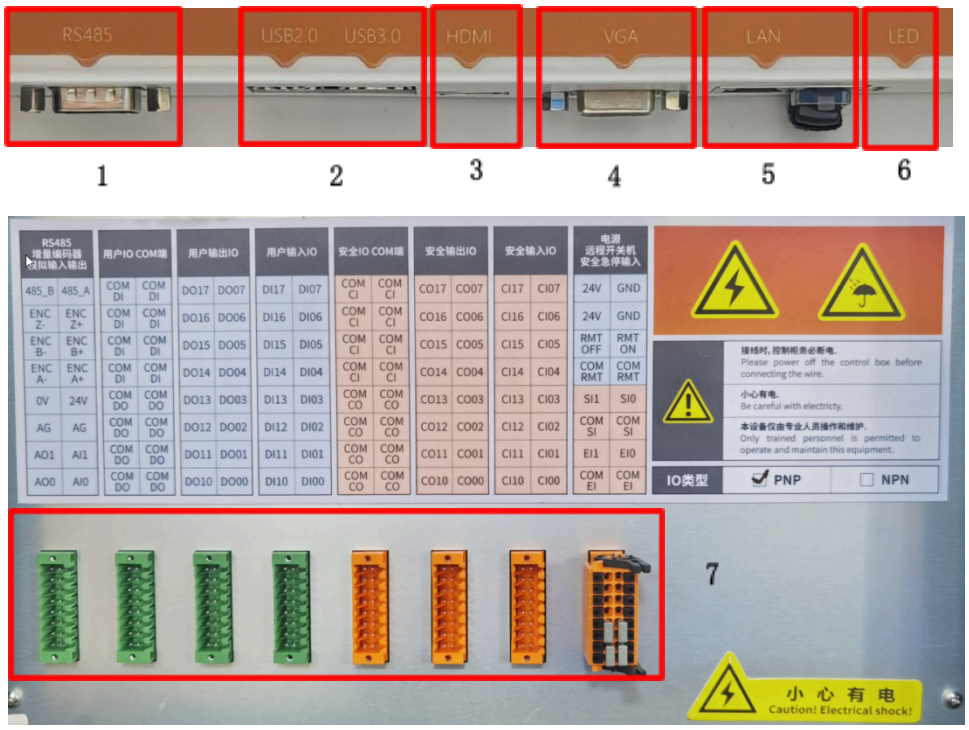


Figure 6-1 Control Box Internal Interfaces

Table 4 Functional description of the internal interfaces of the control box

No.	Name	Function
1	RS485	Connections can be made to Modbus RTU such as 485 interfaces, which can be used to increase the number and type of IO interfaces in the control cabinet or to add analog interfaces
2	USB2.0、USB3.0	Connection of devices for software upgrades, and file import/exports.
3	HDMI	Can be connected to the HDMI interface of the monitor.
4	VGA	Can be connected to the VGA interface of the monitor.
5	LAN	Can be used for remote access and control.
6	LED Signal	Status indicator of the control box I/C.
7	IOs	External User and Safety IOs

5.3 I/O Power Supply

5.3.1 NPN/PNP Model

The upgraded control cabinet I/O system supports dual logic-level configurations: NPN (sinking) and PNP (sourcing) modes. The current hardware implementation utilizes fixed preconfigured settings via internal jumpers, with no software-configurable interface available. The active signal logic (high/low enable) is factory-preset and physically validated through jumper block selection as illustrated below:

Figure 6-2 I/O Factory Preset Logic-Level Configuration Diagram

5.3.2 Internal Power Supply

The control box panel IO selects the internal power supply method by default, as shown below:

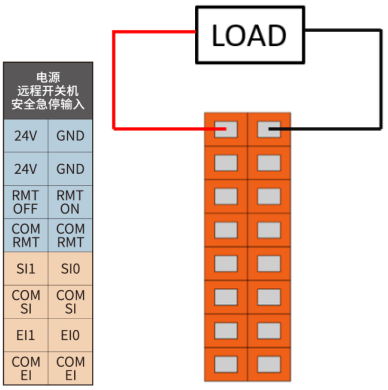


Figure 6-3 Schematic diagram of internal power supply

5.3.3 External Power Supply

If the user needs to use an external power supply, please use the following wiring method:

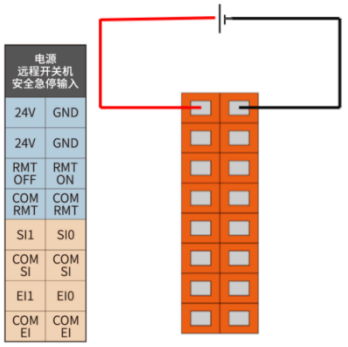


Figure 6-4 Schematic diagram of external power supply

5.4 Control box safety I/O

5.4.1 Introduction

The safety I/Os are designed as dual-channel (redundancy design) to ensure the safety function shall not be lost in any case of a single failure. The safety devices and equipment must be implemented in accordance with the safety instructions and a comprehensive risk assessment needs to be conducted before use. The safety I/Os are located on the orange terminal block.

5.4.2 Safety Tips

1. Never connect safety signals to safety PLC which is not in the correct safety level.
2. Be sure to separate the safety I/O signals from normal I/O signals.
3. Ensure to check the safety function before using the robot, and the safety function must be tested regularly.

5.4.3 Safety I/O Function Definition

Table 5 Safety I/O function definition

Input/Output	I/O Name		Function Definition
Input	EI1	EI0	External Emergency Stop
	SI1	SI0	Safeguard Stop
	CI12	CI02	Reduced Mode
	CI13	CI03	Safeguard Stop Reset
	CI14	CI04	Three-Position Enabling Device
	CI15	CI05	Operational Mode
	CI16	CI06	Force Control Enable
	CI17	CI07	Robot System Stop
Output	CO10	CO00	Robot Emergency Stop (Normally Open)
	CO11	CO01	Robot Moving
	CO12	CO02	Robot Not Stopped
	CO13	CO03	Robot in Reduced Mode
	CO14	CO04	Robot in non-reduced Mode
	CO15	CO05	System Error
	CO16	CO06	Robot Emergency Stop (Normally Closed)
	CO17	CO07	Robot System Running

There are two safety-related electrical inputs:

- External Emergency Stop Input: only used to stop the system completely in case of emergency
- Safeguard Stop Input: used for other safety protection equipment

Functional differences are as below:

Table 6 Difference between external emergency and safeguard stops

	EMERGENCY STOP	SAFEGUARD STOP
ROBOT STOP MOVING	Yes	Yes
PROGRAM STATUS	Stopped	Pause
ROBOT POWER STATUS	Off	On
RESET	Manual	Manual/Auto
USAGE FREQUENCY	Infrequent	Depend on project
REINITIALIZATION	Brake Release Only	No
STOP CATEGORY	1	2

Table 7 Safety-related electrical input performance

Safety Input Function	Extreme Case		
	Detection time	Power off time	Reaction time
External Emergency Stop	100ms	1200ms	1300ms
Safeguard stop input	100ms	——	1200ms
Reduced Mode Input	100ms	——	1200ms
Safeguard Stop Reset	100ms	——	1200ms
3 Position Enable Device	100ms	——	1200ms
Operational Mode	100ms	——	1200ms
Teach Pendant Emergency Stop	100ms	1200ms	1300ms
System Stop Input	100ms	——	1200ms

Table 8 Safety-related electrical output performance

Safety Output	Extreme Case Responding Time	Safety Output	Extreme Case Responding Time
Robot Emergency Stop	1000ms	REDUCED MODE	1000ms
Robot Moving	1000ms	NON-REDUCED MODE	1000ms
Robot Not Stopping	1000ms	SYSTEM ERROR	1000ms

5.4.4 COM Ports

In the new iS Series Control Box, IO's support both NPN or PNP control. Leading into COM ports, which are discussed in this section

COM port types

- **Input COM Port**

For ease of user understanding, input COM ports have 5 different types: COM RMT, COM SI, COM EI, COM CI, and COM DI.

- **Output COM Port**

Output COM ports have two types: COM CO and COM DO.

Table 9 COM ports functionality description

COM		Function	Count	Usage Explanation
Input COM	COM RMT	Remote Power on input COM	2	Used with Remote Power on input
	COM SI	Safeguard stop input COM	2	Used with Safeguard stop input
	COM EI	External E-Stop input COM	2	Used with External E-Stop input
	COM CI	Safety IO input COM	8	Used with Safety inputs
	COM DI	Digital IO input COM	8	Used with Digital inputs
Output COM	COM CO	Safety IO output COM	8	Used with Safety outputs
	COM DO	Digital IO output COM	8	Used with Digital outputs

The safety I/O COM terminals and user I/O COM terminals are shown in the figure below:
The safety I/O COM terminal provides 8 inputs and 8 outputs each, freely configurable
The user I/O COM terminal also provides 8 inputs and 8 outputs each, freely configurable

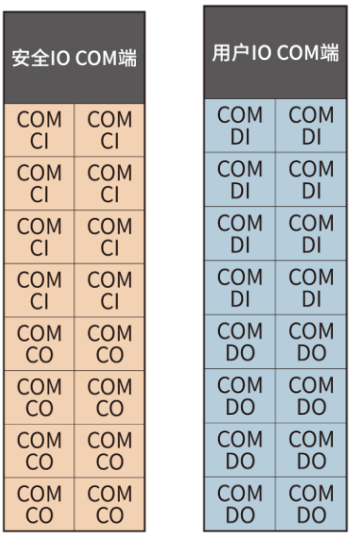


Figure 6-5 Safety IO and User IO COM terminal

1. All I/O logic levels (active-high/low) are pre-configured at the factory. Verify the NPN/PNP jumper settings inside the control cabinet.
2. Regardless of logic level configuration, inputs and outputs maintain consistency with factory settings (both follow the same logic).
3. The common COM terminal wiring applies uniformly to all I/O points, whether using NPN or PNP configurations.

5.4.5 Default Safety Configuration

The robot is shipped with a default configuration as below. In this case, the robot can be operated without any additional safety equipment.

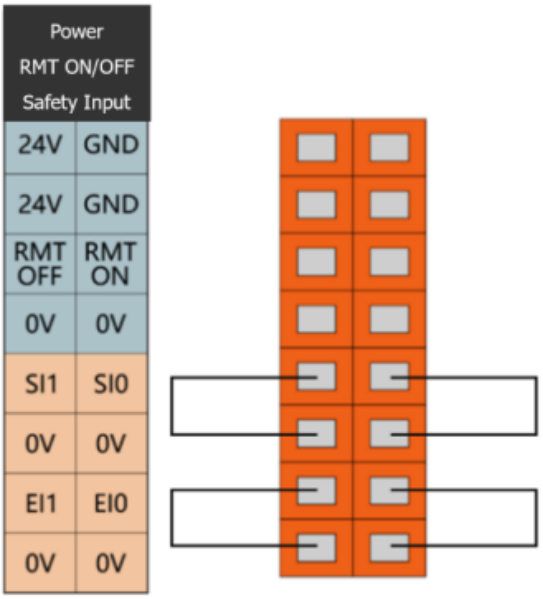


Figure 6-4 Default safety configuration

5.4.6 External Emergency Stop Input

When one or more external emergency stop devices are required for robot application, users can connect those devices as below.

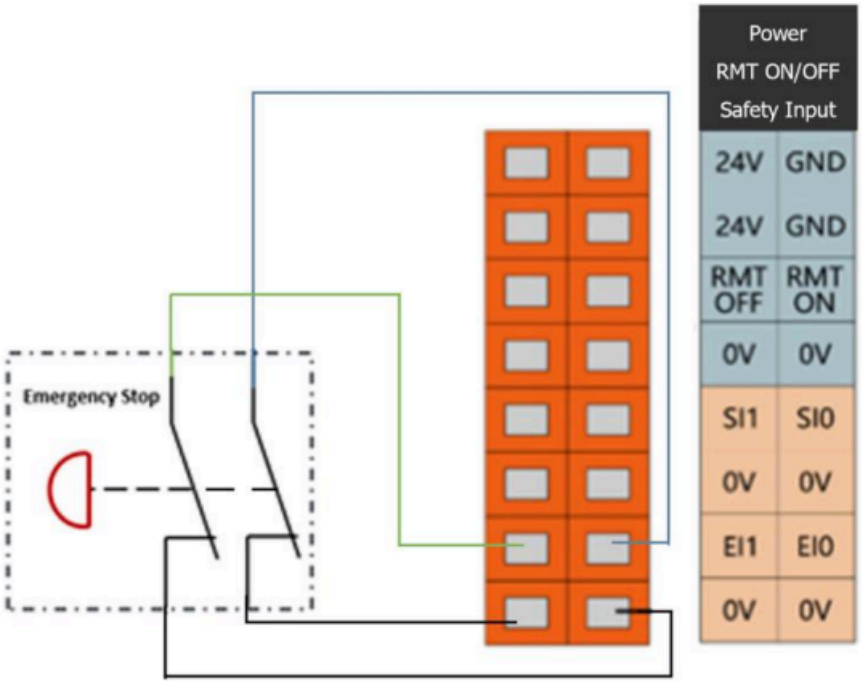


Figure 6-5 External emergency stop input

5.4.7 Safeguard Stop Input

Users can connect external safety devices (such as safety light curtains, safety laser scanners, etc.) through this interface, and then control the robot to enter the safeguard stop state.

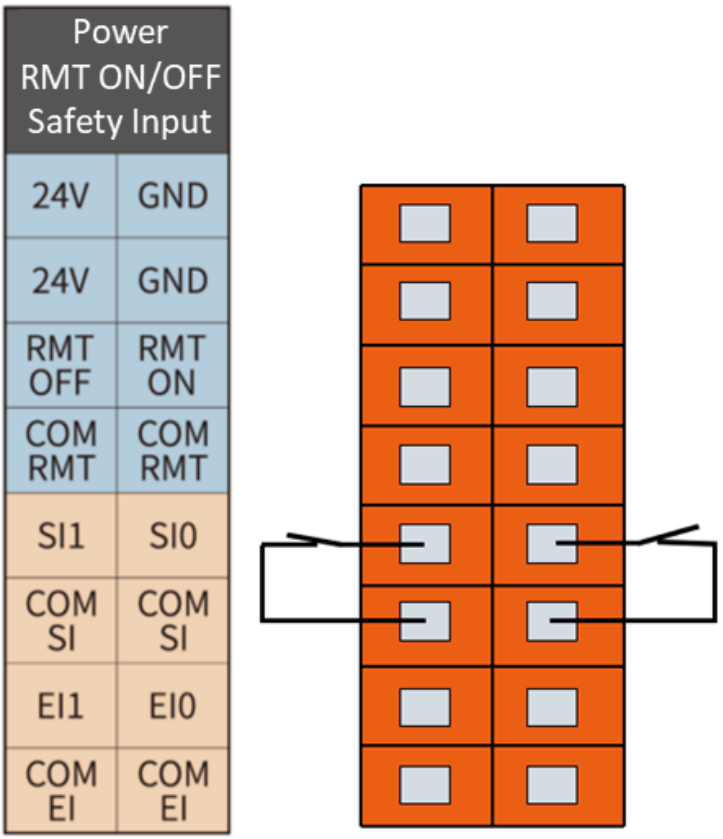


Figure 6-6 Diagram of protection stop input connection

After the operator entered the safety zone, the robot stopped moving and maintained a category 2 stop. After the operator leaves the safety zone, the robot starts automatically from the waypoint where it stopped. During this process, there is no need to use protective reset input.

注意!	1. In this mode, the system response time is 1200ms. If the user calls this stop too frequently, the system may report errors. 2. In this configuration, users should select the protective reset as auto reset via AUBOPE “Settings” tag.

5.4.8 Reduce Mode Input

The user can use this port to control the robot entering the reduced mode. In this mode, the motion parameters (joint speed, TCP speed) of the robot are limited to a user-defined reduced mode range.

The user can refer to the following example, using a safety mat to connect to the reduced mode input interface. See below:

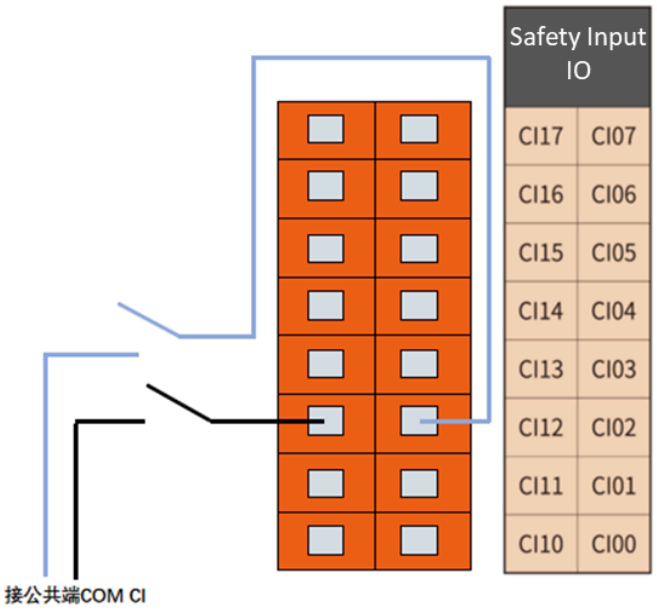


Figure 6-7 Reduced mode input

When the operator enters the safety zone, the robot enters the reduced mode, and the motion parameters (joint speed, TCP speed) of the robot are limited to the user-defined reduced mode range. After the operator leaves the safety zone, the robot exits the reduced mode and enters the normal mode.

注意!	1. In this mode, the system response time is 1200ms. If the user calls this stop too frequently, the system may report errors. 2. When using this type of configuration, the user needs to configure the reduced mode motion parameters through the AUBOPE “Settings” tag.

5.4.9 Safeguard stop Reset Input

When configuring the safeguard stop with a reset device, users can use this interface to connect external reset devices (reset buttons, etc.).

Referring to the following example, connect the safety light curtain to the safeguard stop input terminal and use the safety reset button to connect to the safeguard stop reset input terminal. See the picture below:

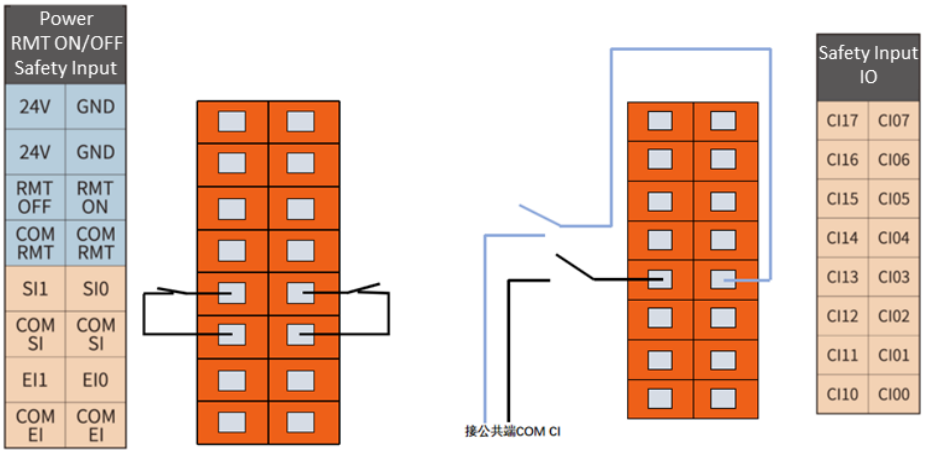


Figure 6-8 Safeguard Stop Reset Input Connection

After the operator entered the safety zone, the robot stopped moving and maintained a category 2 stop. When the operator leaves the safety zone, the system needs to be reset from the outside of the safety zone by pressing the reset button. Then the robot will continue to run from the stop point. During this process, a protective reset input is required.

注意!	When using this type of configuration, the user needs to configure the protective reset as a manual reset through the AUBOPE.

5.4.10 Three-Position Enabling Device Input

Users can use this port to connect external safety devices (such as a three-position enabling switch, etc.), to verify the project.

The user can refer to the following example, using the three-position enabling switch to connect the enabling device input interface. See below.

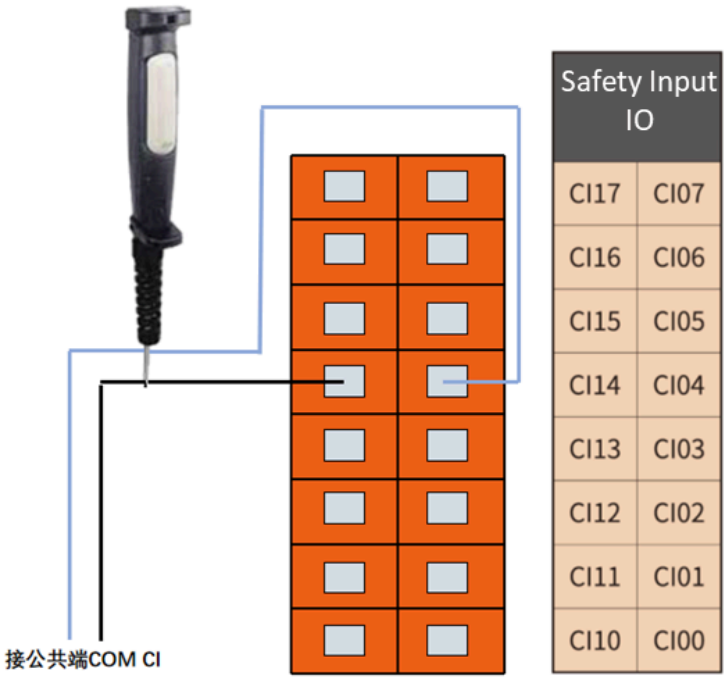


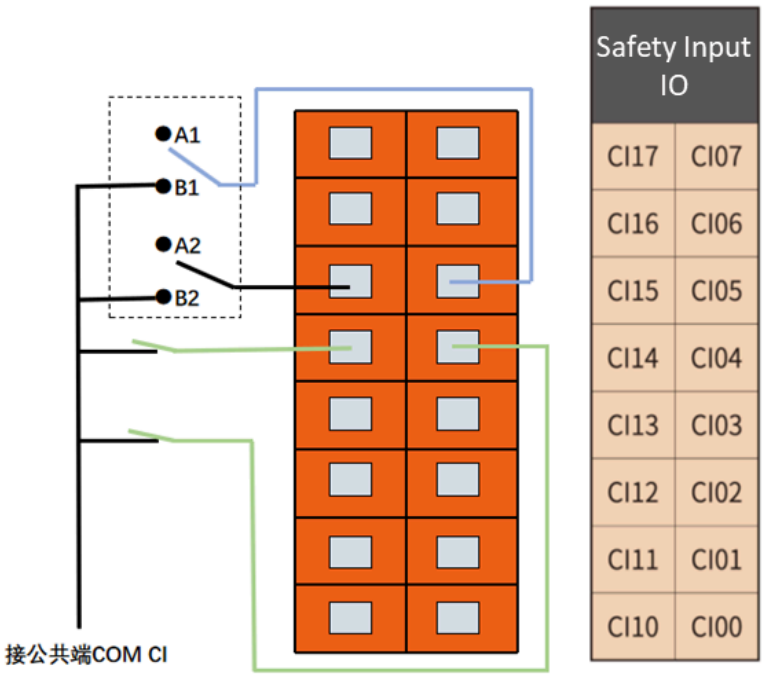
Figure 6-9 Enabling device input

In verification mode, the robot moves only when the three-position enable switch is in the enable position (intermediate position); when the user releases or presses the three-position enable switch, making the three-position switch enter a non-enabled position, the robot will pause its movement.

注意!	When using this configuration, the user must ensure the robot is in “Verification” mode. The user can set the robot to this mode through the AUBOPE “Settings” tag, or the user can also use the operation mode input ports to set the robot to verification mode

5.4.11 Operational Mode Input

Users can use this interface to connect an external safety device (mode selector switch, etc.) and select the robot's working mode. The user can refer to the following example, using the safety selector switch to connect to the operation mode input interface. See below.



6-10 operation mode input

When the user switches the switch to A position, the robot enters normal mode, and the user can operate the robot normally.

When the user switches the selector switch to B position, the robot enters verification mode. In this mode, only when the enabling device input is valid, can the robot execute the target project and operations. When the enabling device input is invalid, the robot will pause its movement immediately.

5.4.12 Drag-and-drop teaching mode

Users could use this interface to receive external drag-teach input signals, then the robot will enter drag-teach mode. Users can refer to the following example to perform the drag-teach demonstration without using the force control button of the teach pendant.

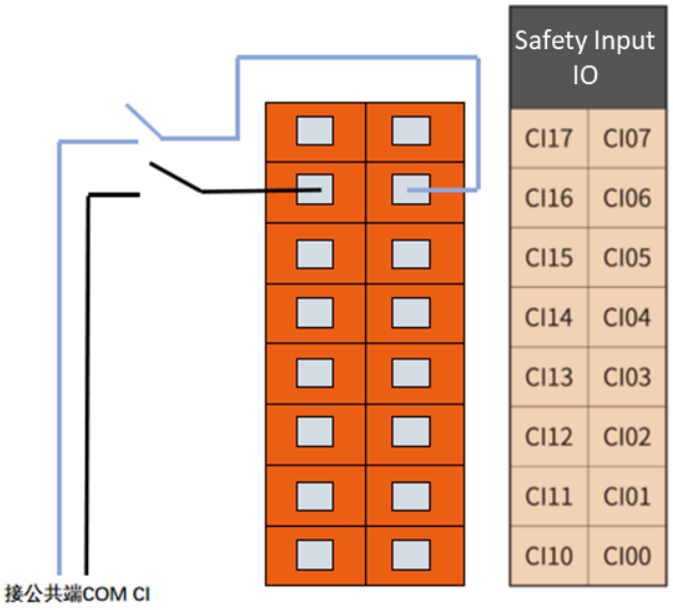


Figure 6-11 Drag-teach mode input

5.4.13 System Stop Input

This interface allows the user to receive an external stop signal input to control the robot into a category 1 stop state. This input can be used in a multi-machine collaboration state to share an emergency stop with other machines by setting up a common emergency stop line. The operator can control the entire line of machines to go in Emergency Stop from the Emergency Stop button of one machine.

Users can refer to the following example, two machines can switch the emergency stop state according to the connection, the system emergency stop output in this line is connected to the system stop input interface. Please refer to the diagram below.

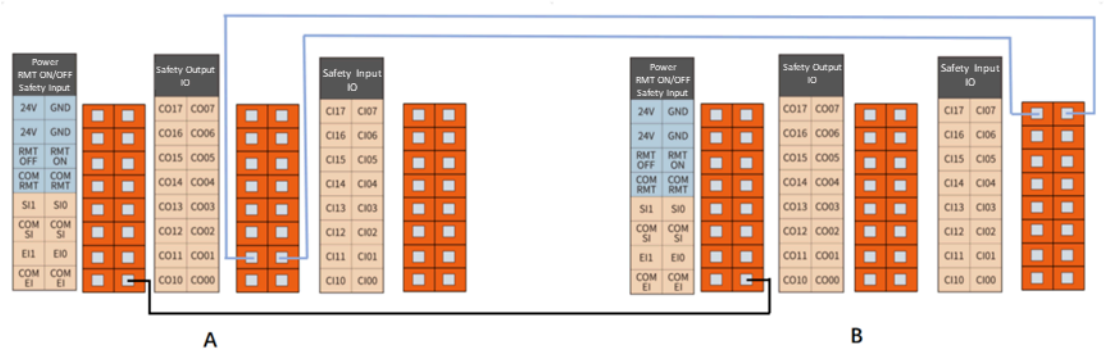


Figure 6-12 System Stop Input Connections (from A to B)

Figure 6-13 System Stop Input Connections (from B to A)

As shown in Figure 6-12, when Machine A enters the emergency stop state, Machine B also enters the emergency stop state immediately; but when Machine B enters the emergency stop state, Machine A is not affected.

As shown in Figure 6-13, the opposite is true, i.e., when Machine B enters the Emergency Stop state, Machine A also enters the Emergency Stop state immediately; but when Machine A enters the Emergency Stop state, Machine B is not affected.

In other words, the emergency stop state sharing mechanism is unidirectional and can only go from A→B→..... or from .....→B→A.

5.4.14 System Emergency Stop Output (NO)

This port outputs a signal when the robot enters the emergency stop state.

The user can refer to the following example to set up an external alarm light to the system emergency stops output port. See below.

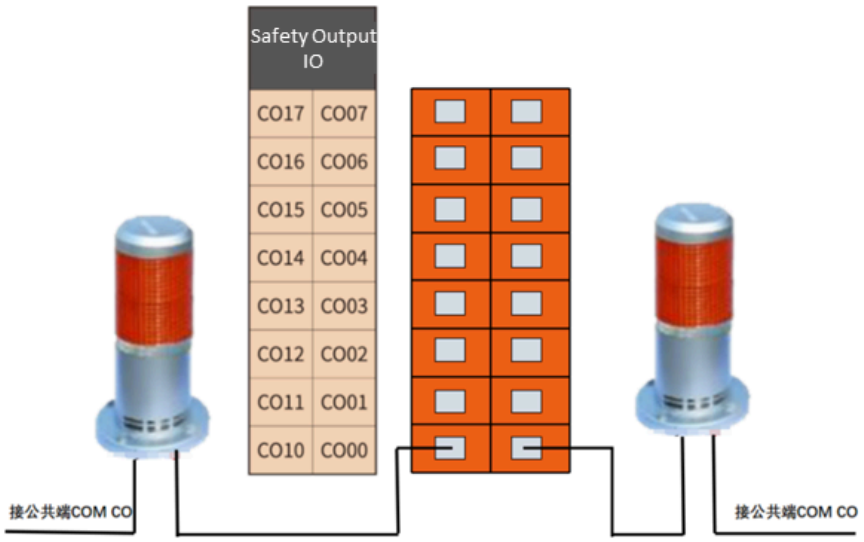


Figure 6-14 System emergency stop output

In this configuration, when the robot enters the emergency stop state, the system emergency stop signal is output externally and the external alarm lamp lights up.

注意!	This function is widely used, in any case, a complete risk assessment is required for users.

5.4.15 Robot Moving Output

This port outputs a signal when the robot moves normally

The user can refer to the following example to connect an external indicator to the robot moving output port. See below.

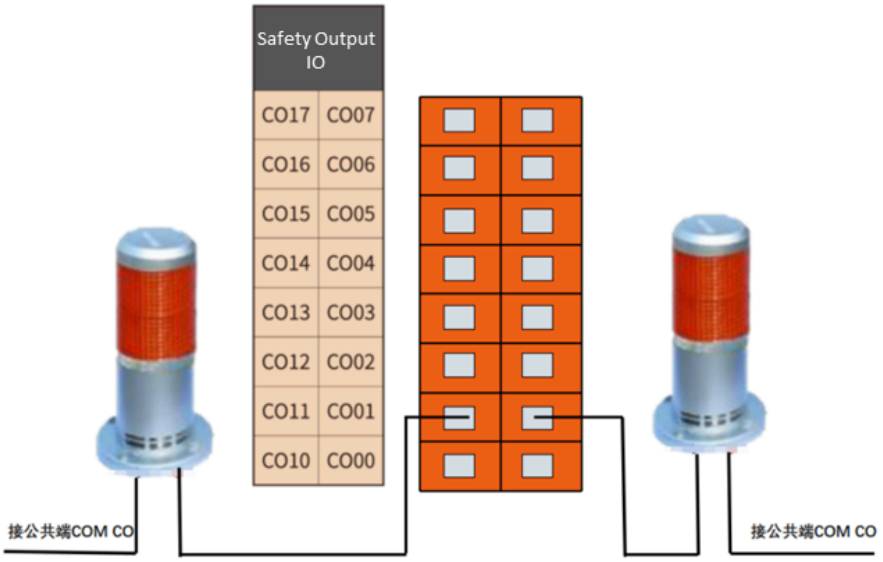


Figure 6-15 Robot move status output

注意!	This function is widely used, in any case, a complete risk assessment is required for users.

5.4.16 Robot Not Stopping Output

This port outputs a signal after the robot receives a stop signal, decelerates its movement, and has not yet completely stopped.

The user can refer to the following example to connect an external indicator to this robot without stopping the output port. See below:

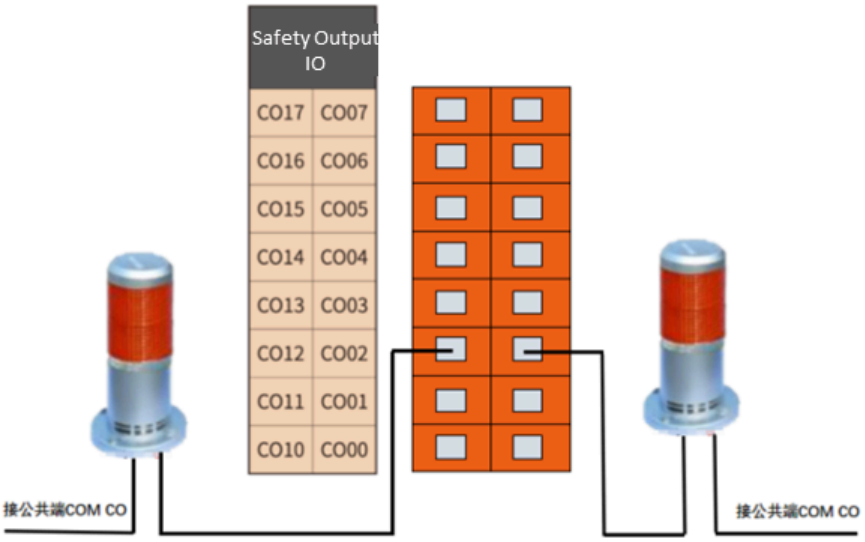


Figure 6-16 Robot unstopped output

Under this configuration, after the robot receives the stop signal and decelerates its movement, and has not yet completely stopped, the external robot not stopping status indicator light will turn on.

注意!	This function is widely used, in any case, a complete risk assessment is required for users.

5.4.17 Reduced Mode Output

The user can use this interface to output the reduced mode signal when the arm enters the reduced mode.

Users can refer to the following example to connect an external indicator to the scaling mode output interface. Please refer to the following figure.

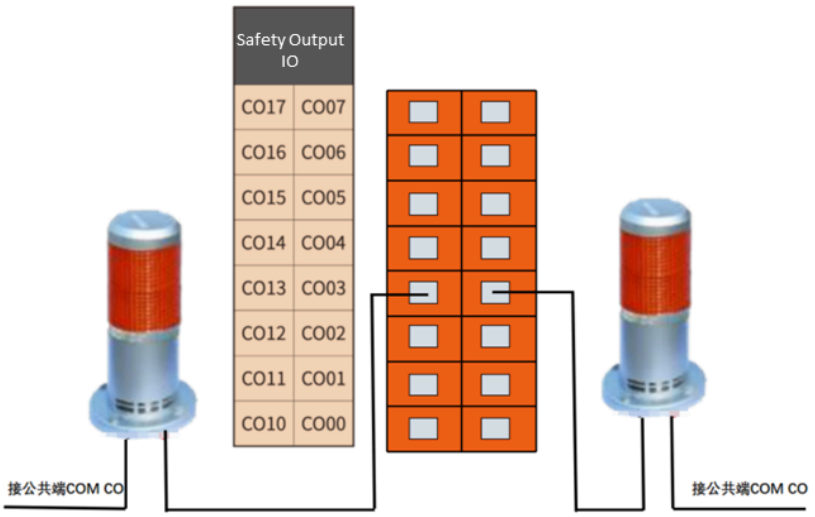


Figure 6-17 Reduce mode output

Under this configuration, when the robot enters the reduced mode, the reduced mode signal is output, and the external reduced mode indicator lights up.

注意!	This function is widely used, in any case, a complete risk assessment is required for users.

5.4.18 Non-Reduced Mode Output

Users can use this interface to output a non-curtailment mode signal when the arm enters the non-reduced mode.

Users can refer to the following example to connect an external indicator to the non-reduced mode output interface. Please refer to the following figure.

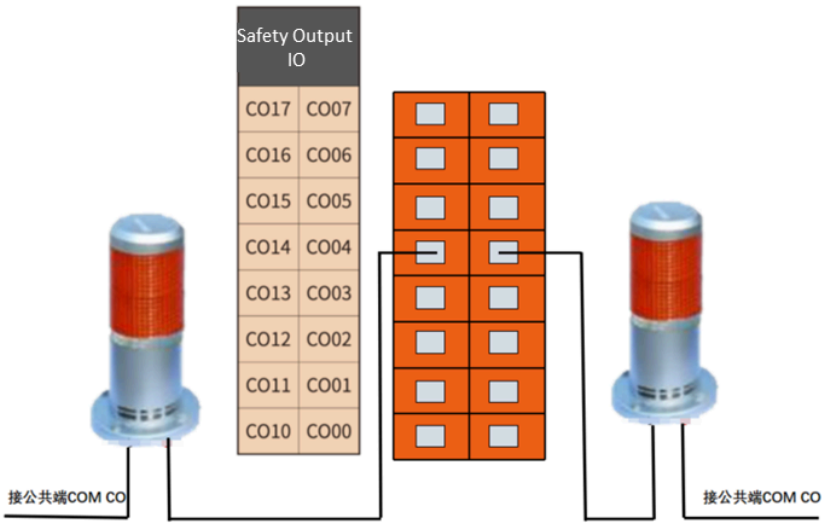


Figure 6-18 Non-reduced mode output

Under this configuration, when the robot is in non-reduced mode, the external non-reduced mode indicator light will turn on.

注意!	This function is widely used, in any case, a complete risk assessment is required for users.

5.4.19 System Error Output

This interface allows the user to output a system error signal when the robot has a system error.

Users can refer to the following example to connect an external indicator to the system error output interface. Please refer to the following figure.

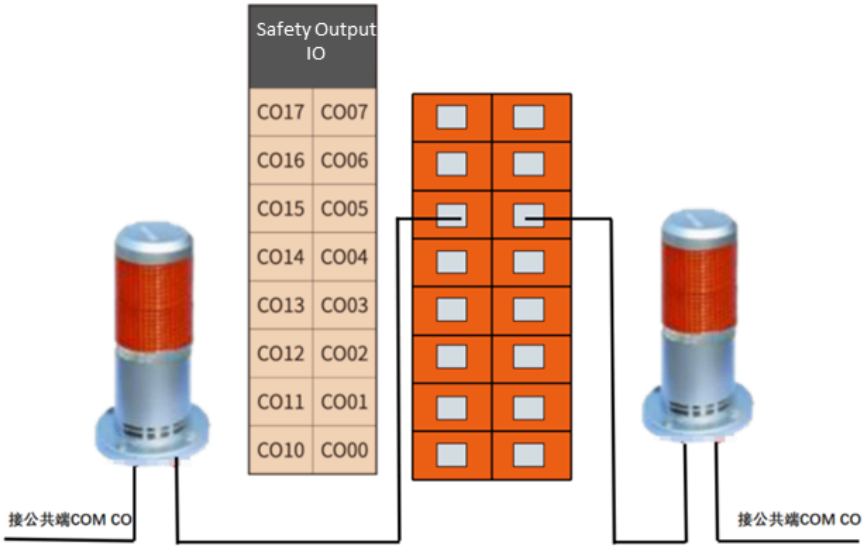


Figure 6-19 System Error Output

Under this configuration, when the robot system error alarms, the external system error indicator light will be on.

注意!	This function is widely used, in any case, a complete risk assessment is required for users.

5.4.20 Robot Emergency Stop (NC)

This interface maintains active signal output when the robot is under normal operation (non-E-stop state), exhibiting a complementary logic state to the system's emergency stop output (normally open). Users may utilize this signal interface to initiate simultaneous stop commands for multiple robotic arms.

For multi-arm emergency stop coordination, connect the robotic arms to external emergency stop output (normally closed) interfaces using a daisy-chain configuration as illustrated in the following diagram.

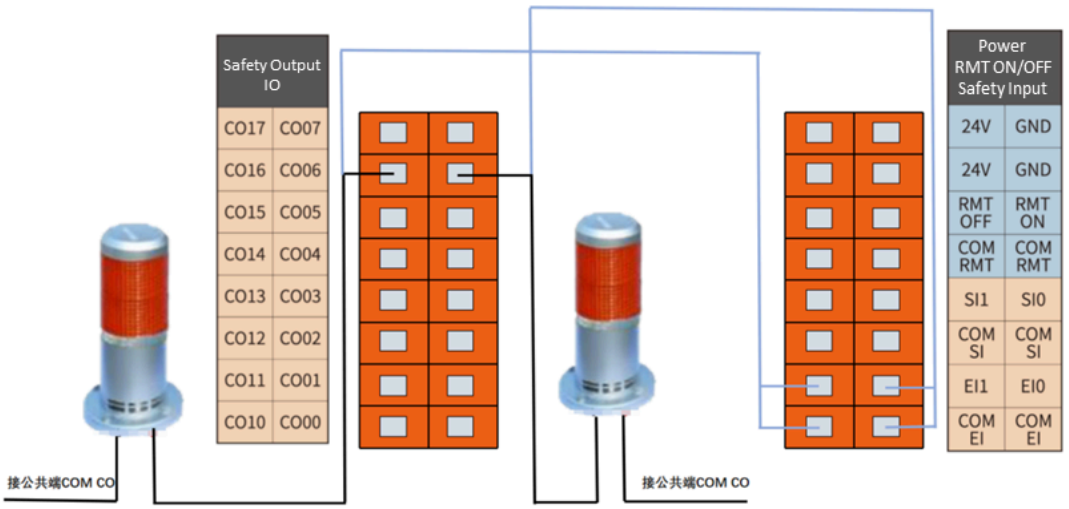


Figure 6-20 Multiple robots sharing emergency stop

5.4.21 AUBO Server Running Indication Output

Users can use this interface to output an AUBO server running signal.

Users can refer to the following example to connect an external indicator to this interface. Please refer to the following picture.

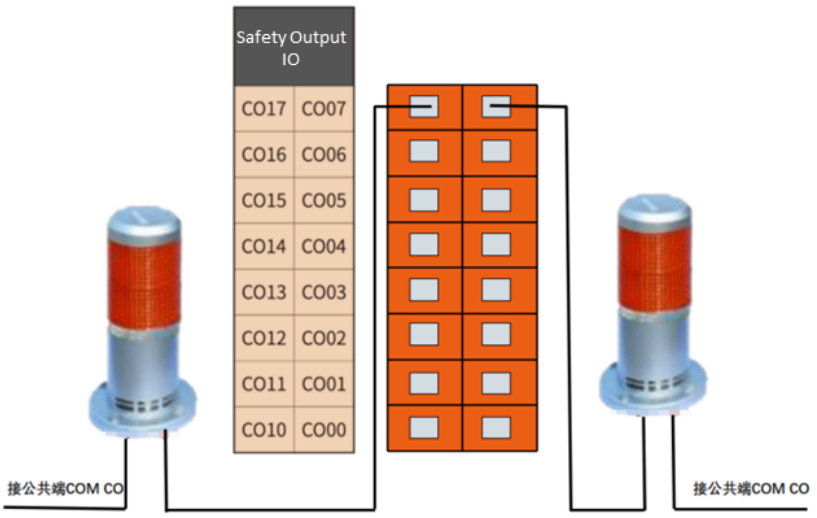


Figure 6-21 Server on signal output

5.5 Internal I/O

Internal I/Os are internal function ports that provide I/O state displays of the internal interface board of the control box. These I/Os are not open to the user. The user can monitor the internal I/O state through the teach pendant. The internal I/O states of the control box are described in the following table:

Table 10 Internal IO names and functions

Input	Function
CI00	Enable Status - Linkage mode/Disable Status - Manual mode
CI01	Enable Status - Host/Disable Status - Slave
CI02	Power Contactor of Control Box
CI03	Control Box Emergency Stop
CI10	Servo Powered On
CI11	Servo Powered Off
CI12	Power Contactor of Control Box
CI13	Control Box Emergency Stop
Output	**Function**
CO00	Stand By
CO01	Emergency Stop
CO02	Enable Status - Linkage mode/Disable Status - Manual mode
CO03	AUBOPE Running
CO10	Reserved
CO11	Emergency Stop
CO12	Reserved
CO13	Reserved

5.6 General I/O

The AUBO interface board has 8 digital input interfaces, 8 digital output interfaces, 2 pairs of analog differential input interfaces, and 2 pairs of analog voltage output interfaces whose electrical errors are about ± 1%.

When connecting external devices, all external devices should be connected to the ground with the control box.

5.6.1 General Purpose Digital I/O Interface

The control cabinet contains 16 general digital inputs (subsequently referred to as "DI terminals"), which support two operational modes - NPN and PNP configurations. These are hardware pre-configured at the factory with identical wiring topology: Each DI terminal must connect to the COM DI terminal. The DI circuit accepts signals from devices including tactile switches, sensors, PLCs, or motion status outputs from other AUBO robots.

Correspondingly, 16 general digital outputs ("DO terminals" hereafter) are provided, also supporting NPN/PNP modes through hardware configuration. The wiring methodology remains uniform: DO terminals interface directly with loads or communication modules (PLCs/other robots), with return paths connected to COM DO. All digital I/O operations are controllable via the teach pendant interface. Refer to the wiring examples in subsequent sections for implementation details.

Table 11 General-purpose digital I/O interface list

Input	DI00	DI01	DI02	DI03	DI04	DI05	DI06	DI07
	DI10	DI11	DI12	DI13	DI14	DI15	DI16	DI17
Output	DO00	DO01	DO02	DO03	DO04	DO05	DO06	DO07
	DO10	DO11	DO12	DO13	DO14	DO15	DO16	DO17

Table 12 General-purpose digital I/O interface electrical parameter specification

DI/DO	Parameter	Specification
DI	Input signal form	Sinking Input No-voltage contact input NPN open collector transistor
	Input method	Input signal current
	Electrical specifications	5mA/DC24V
DO	Output form	Transistor (compatible with NPN sinking and PNP sourcing configurations)
	Electrical specifications	300mA/DC24V

Table 13 General-purpose digital Input port electrical parameter specification

Parameter Term	Minimum Value	Maximum Value
Single DI input voltage	0 V	24 V

Example: DI terminal connection button switch

As shown in the figure below, the DI terminal can be connected to COM DI through a normally open button. When the button is pressed, the DI terminal and COM DI are turned on to trigger an

action. When the button is not pressed, the DI terminal is disconnected from COM DI, and no action is triggered. This is the simplest wiring example.

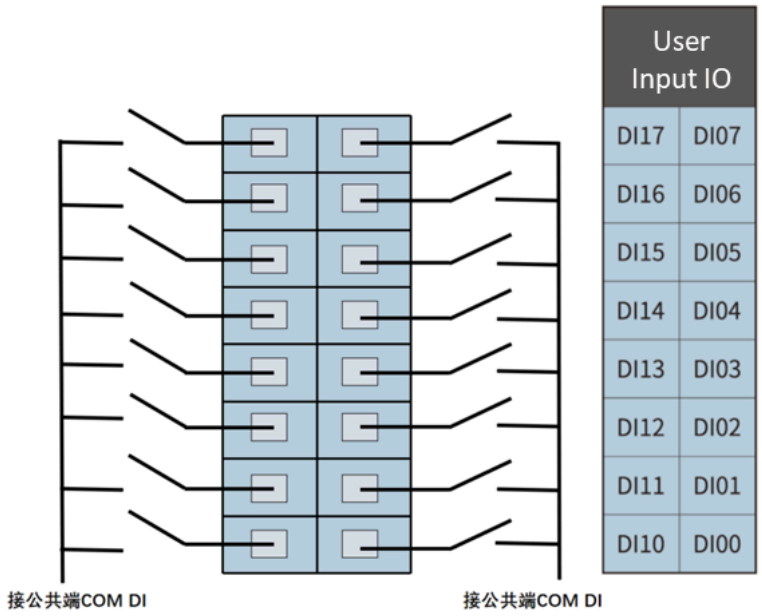


Figure 6-23 DI terminal connection button switch

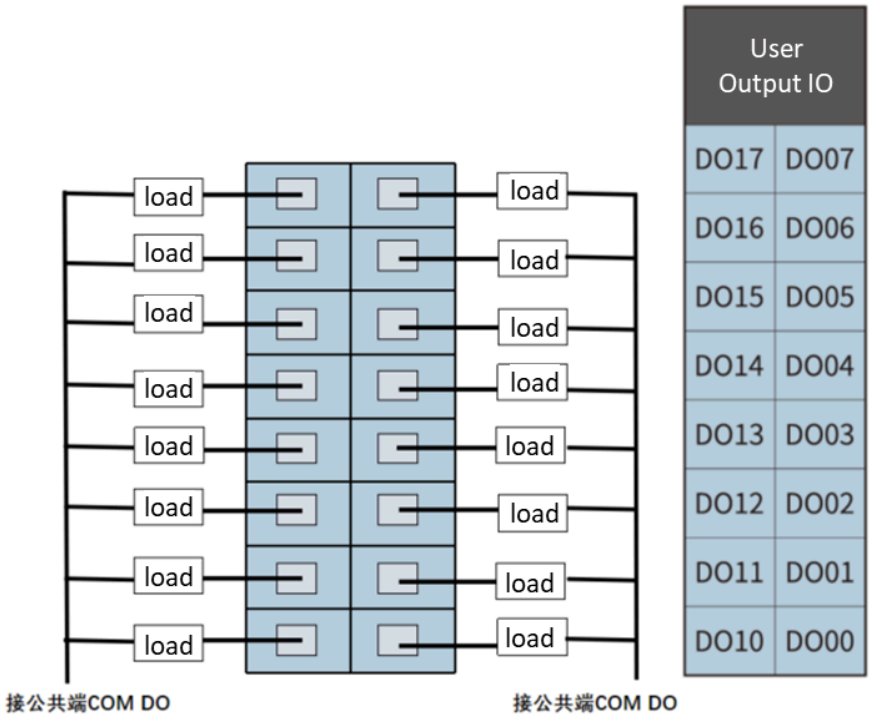


Figure 6-25 DO Terminal Load Interfacing Schematic Diagram

5.6.2 Analog I/O Interface

The analog I/O interface is located on the interface board on the upper panel of the control box. There are 2 analog voltage input interfaces, indicated by AI. There are 2 analog voltage outputs, which are represented by AO. As shown below:

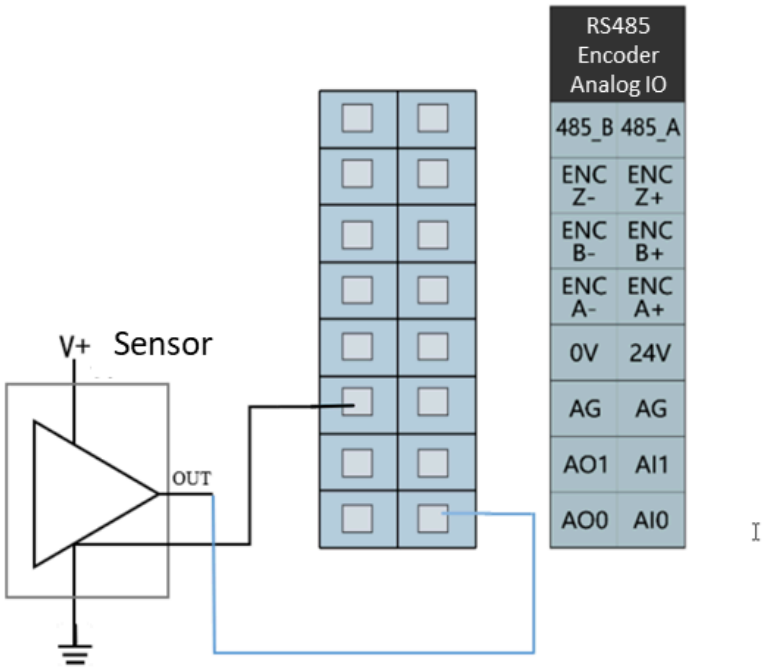


Figure 6-26 Analog I/O interface diagram

Table 14 General purpose analog I/O list

Input	AI0	Analog voltage input
	AI1	Analog voltage input
Output	AO0	Analog voltage output
	AO1	Analog voltage output

Table 15 General purpose analog I/O interface electrical parameter specification

Type	Voltage
Input	0~+10V
Output	0~+10V
Precision	±1%

Table 16 AI terminal electrical parameters

Parameter term	Minimum value	Maximum value	Units
Input Voltage	0	+10	V
Input Resistance	100K		Ω
AI Sampling Resolution	12		bit
AI Sampling Accuracy	10		bit

Table 17 AO terminal electrical parameters

Parameter term	Minimum value	Maximum	Units
Single AO Terminal Output Voltage	0	+10	V

Example:

1. Analog voltage input wiring method

For the analog voltage input, please refer to the wiring method shown below:

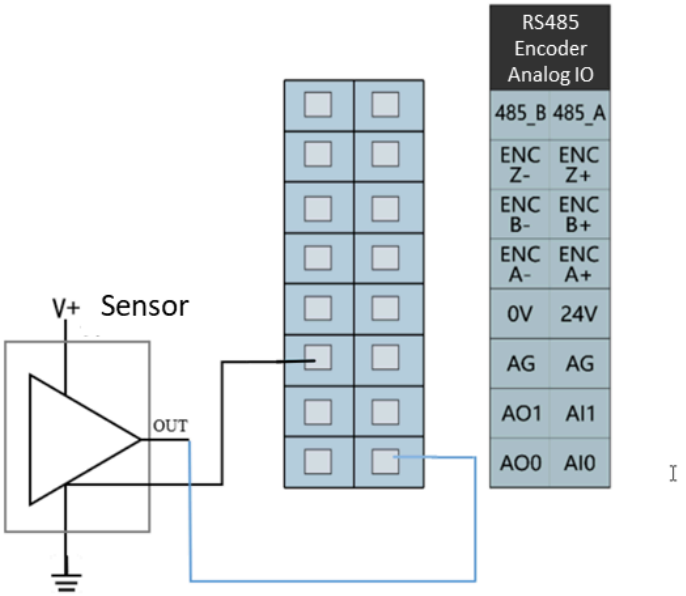


Figure 6-27 Analog voltage input connected to a sensor

2. Analog voltage output wiring method

For the analog voltage output, please refer to the wiring method shown below:

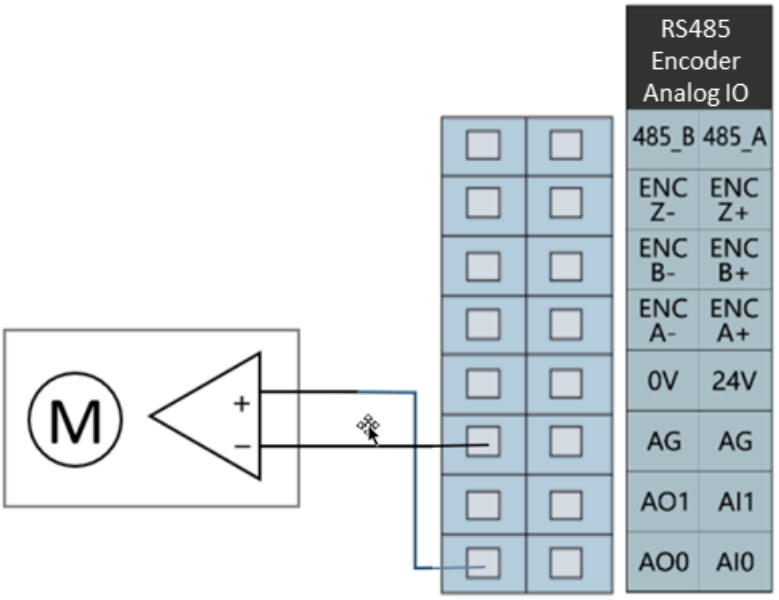


Figure 6-28 Analog voltage output connect drive device

5.7 Remote Switch Control I/O Interface

The remote power on/off control I/O interface is located on the upper panel of the control box. As shown below:

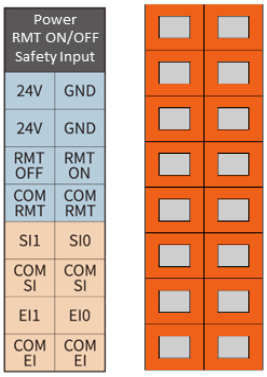


Figure 6-29 Remote control I/O interface

The remote power on/off control I/O interface allows the user to control the teach pendant and robot to be turned on or off without pressing the real bottom at the teach pendant.

Table 18 Remote Switch Control I/O Interface

Input	Function
RMT ON	Remote power-on input
RMT OFF	Remote power-off input

5.7.1 Remote Power On

This example shows how to connect the remote start-up port, when the switch is closed, the teach pendant and the robot will be powered up automatically.

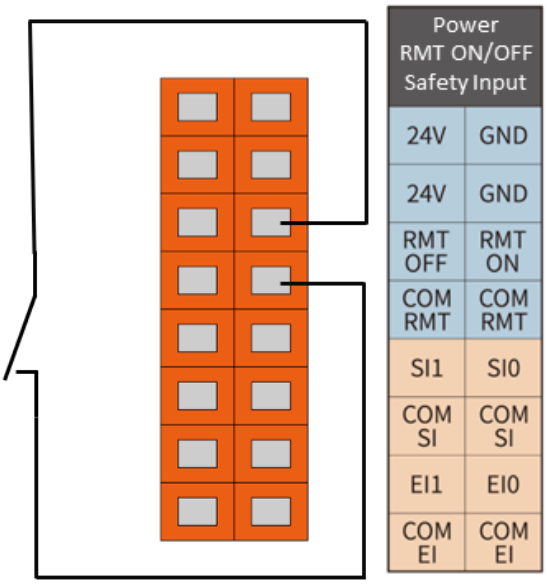


Figure 6-30 Remote power-on connection

5.7.2 Remote Power Off

This example shows how to connect the remote shutdown port, 3 seconds after the icon switch is turned off, the robot arm is powered off and the teaching pendant is turned off.

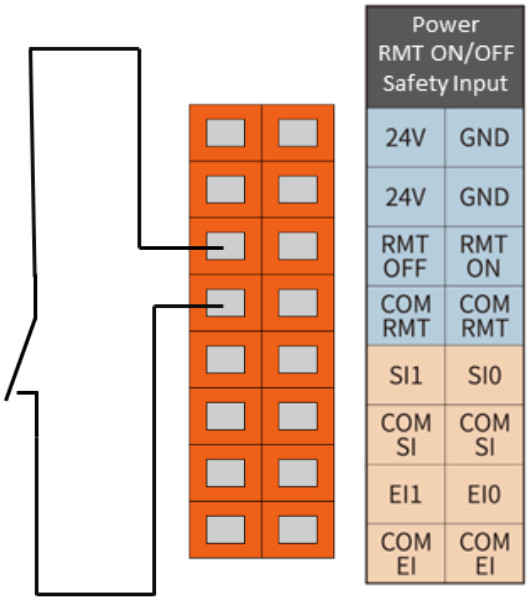


Figure 6-31 Remote shutdown connection

5.8 Linkage Control I/0 Interface

Press the MODE MANUAL/LINKAGE button on the front panel of the control box, and the robot will enter linkage mode. By using the linkage control I/O interface, the robot's movement can be controlled independently from the teaching device. Refer to the wiring method shown in the diagram below:

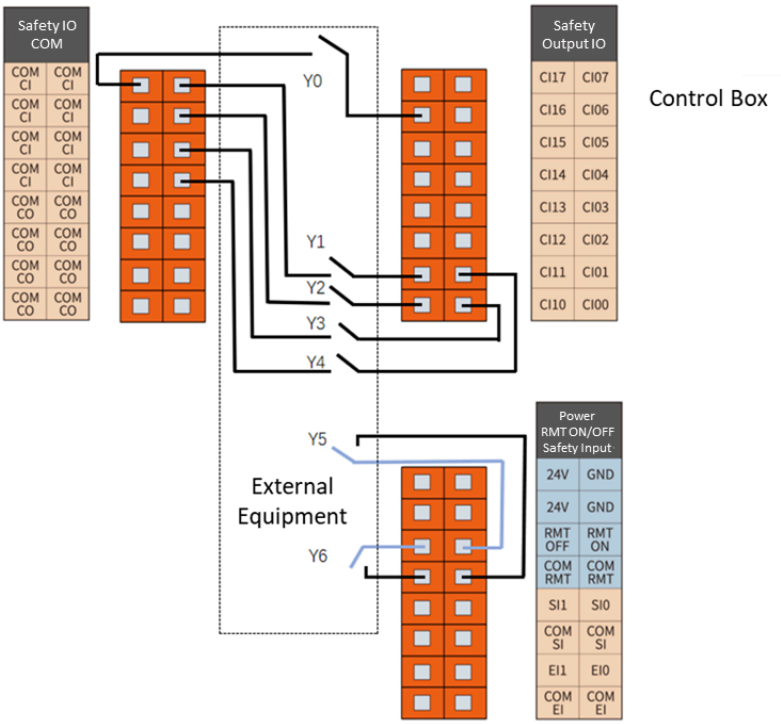


Figure 6-32 Linkage control I/O connection

Table 20 Remote power on/off I/O interface

Input	Function
CI16 (Y0)	Drag Teaching Interface
CI11 (Y1)	Program Pause Signal Input Interface in Linkage Mode
CI10 (Y2)	Program Start Signal Input Interface in Linkage Mode
CI00 (Y3)	Program Stop Signal Input Interface in Linkage Mode
CI01 (Y4)	Program Return to Initial Position Signal Input Interface
RMT ON (Y5)	Remote Power-On Signal Input Interface
RMT OFF (Y6)	Remote shutdown Signal Input Interface

Appendix

Technical specifications

Control box model	AUBO-CB-iS	
IP Protection Grade	IP43	
Control box size (L*W*H)	400mm*320mm*160mm	
Control box weight	12.5 kg	
I/O Port	Digital Input	16 (Normal)/16 (Safety)
	Digital Output	16 (Normal)/16 (Safety)
	Analog input	2
	Analog output	2
	Incremental Encoder	1
	RS485	1（recommend UT-890A）
	Remote switching	Optional
I/O Power Supply	Control Cabinet: 24VDC 3A Tooling Interface: 0V/12VDC/24VDC 0.8A Terminal RS485: 0V/12VDC/24VDC 2A	
Communication Protocols	Standard: ModBus-RTU/TCP Optional: Profinet, Ethernet/IP, EtherCAT	
Interfaces & Openness	SDK: Cross-platform development support (C/C++/C#/Lua/Python) ROS Integration, API	
Operating Temperature	0～50ºC	
Transport and storage temperature	-25 ℃～55 ℃	
Humidity	90% relative humidity (non-condensing)	
Power Input	100-240 VAC，50-60 Hz	
Cable Length	Cable length for connecting to the robot arm (5m) Cable length for connecting to TP (3m) AC power cable (connects external AC power to DC power)（5m）	

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