AUBO (BEIJING) ROBOTICS TECHNOLOGY CO., LTD

AUBO-CB-iS Control Box

User Manual

v0.0.2

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Please read this manual before installing or using the product.

Please keep this manual in a safe place for easy reading and reference.

All pictures in this manual are for reference only; please refer to the actual product received.

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Revision

Version No.//Date	Description
v0.0.1//20241012	Release of trial version v0.0.1.
v0.0.2//20250523	Release of trial version v0.0.2. 1. Update "6.6 Fixed Safety Stop Input".

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1 Safety

1.1 Introduction

This chapter introduces the safety principles and specifications to be observed when operating the control box or robotic system. Integrators and users must carefully read this manual, paying special attention to the content marked with warning signs, which must be strictly followed. Due to the complexity and inherent dangers of the robotic system, operators need to fully understand the risks of operation and strictly adhere to and implement the specifications and requirements outlined in this manual. Users and integrators must have a strong safety awareness and abide by the industrial robot safety standard ISO 10218.

1.2 Warning Signs

The content related to safety in this manual is indicated by the following warning signs. The explanations of the warning signs in the manual represent important information and must be strictly followed.

Table 1 Explanations of Warning Signs

Sign	Explanation
	Potentially dangerous electrical conditions that, if not avoided, could result in death or serious injury.
	Potentially dangerous electrical conditions that, if not avoided, could result in injuries to personnel or serious damage to equipment.
	Potentially dangerous conditions that, if not avoided, could result in injuries to personnel or damage to equipment. Items marked with this symbol may, depending on the specific situation, have the potential for significant consequences.
	A condition that, if not avoided, could result in injuries to personnel or damage to equipment. Items marked with this symbol may, depending on the specific situation, have the potential for significant consequences.

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1.3 Safety Precautions

When starting the machine for the first time, you should understand and follow the basic information below. Other safety-related information is introduced in other sections of the manual. However, due to the multitude of possibilities, it is impossible to document all situations that cannot or should not be addressed.

1. Always install the machine and all electrical equipment in accordance with the requirements and specifications in this manual.
2. Carry out preliminary testing and inspection of the machine and its protective system before the first use and production deployment of the robot.
3. Before the initial startup of the machine and system, be sure to check whether the machine and system are complete, whether the operation is safe, and whether any damage has been detected. During this inspection, check the compliance with the effective production safety regulations and standards of the country or region, and be sure to test all safety features.
4. Users must verify that all safety parameters and user programs are correct, and that all safety features are functioning properly. All safety features shall be checked by personnel qualified to operate the robot. The robot can only be started after passing comprehensive and careful safety testing and meeting the required safety level.
5. The machine should be installed and debugged by qualified professionals in accordance with the installation standards.
6. After the machine installation and construction, a comprehensive risk assessment must be conducted again and documented.
7. The safety parameters shall be set and altered by authorized personnel, and passwords or isolation measures shall be applied to prevent unauthorized personnel from altering or setting the safety parameters. After the safety factor is modified, the relevant safety features need to be analyzed.
8. In the event of an accident or abnormal operation, use the emergency stop switch to stop the robot.
9. The control box generates heat during operation. Therefore, do not operate or touch the machine while it is working or immediately after it has stopped. Cut off the power supply and wait for 1 h for the robot to cool down.
10. Never insert your fingers into the heated area of the control box.

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1. Ensure that the machine is correctly and safely installed.
2. Do not use the robot if it is damaged.
3. Do not connect safety devices to regular I/O interfaces; connect them to safety interfaces only.
4. Ensure that the correct installation settings are made.
5. Connecting different machines may increase hazards or induce new hazards. Always conduct a thorough risk assessment of the entire installation. When different safety and emergency stop performance levels are required, always choose the highest level. Always read and understand the manuals for all equipment used in the installation.
6. Never modify the machine. Modifications to the machine may cause hazards that the integrator cannot foresee. The authorized reconfiguration of the machine should comply with the latest versions of all relevant service manuals. AUBO (Beijing) Robotics Technology Co., Ltd. disclaims any responsibility for the machine that has been modified or altered in any way.
7. Before transporting the machine, users need to check the insulation and protective measures.
8. During handling of the machine, the transportation requirements must be followed. Handle the machine with care to avoid collisions.

1. When the machine is connected to the machinery that can cause damage to the machine or is working alongside, it is strongly recommended to check all functions of the machine separately.
2. AUBO (Beijing) Robotics Technology Co., Ltd. is not responsible for any damage to the machine or personal injuries caused by improper operation of the machine.
3. Do not expose the machine to a permanent magnetic field, as high-intensity magnetic fields can damage the robot.

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1.4 Responsibilities and Regulations

AUBO-CB-iS control box can be integrated with other devices to form a complete machine, but they are not complete by themselves. Therefore, this manual does not include how to comprehensively design, install, and operate a complete robot, nor does it cover all the potential impacts on the safety of the peripheral equipment of this complete system. The safety of a complete robot installation depends on how the robot is integrated. Integrators should abide by the national laws, regulations, and safety standards to conduct a risk assessment for the design and installation of this complete system. Risk assessment is one of the most important tasks that integrators must complete, and they can refer to the following standards to conduct the risk assessment.

- 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 for Industrial Robots - Part 2: 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 and Risk Assessment.
- The integrator must fulfill, without limitation, the following responsibilities:
- Conduct a comprehensive risk assessment of the entire robotic system;
- Ensure the entire system is designed and installed accurately;
- Provide training for users and staff;
- Formulate operating specifications for the entire system, clearly outlining the operation process;
- Establish appropriate safety measures;
- Use appropriate methods to eliminate hazards or minimize all risks to an acceptable level during the final installation;
- Inform the end user of residual risks;
- Label the robot with the integrator's logo and contact information;
- Archive the relevant technical documents.

For information on applicable standards and legal guidelines, please visit the website: www.aubo-robotics.cn.

All safety-related information contained in this manual should not be regarded as a guarantee by AUBO (Beijing) Robotics Technology Co., Ltd. Even with adherence to all safety instructions, injuries to personnel or damage to equipment may still occur.

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1.5 Intended Use

AUBO-CB-iS control box is limited to general industrial equipment use and is only allowed to be used under specified environmental conditions. For specific information regarding operating environment and conditions, please refer to the appendix.

AUBO-CB-iS control box has special safety level characteristics and is limited to general industrial equipment use. Unintended uses must be avoided. Prohibited uses include, but are not limited to, the following situations:

- Use in hazardous environments such as flammable or explosive areas;
- Use in devices that move or handle people or other animals;
- Use in devices related to medical equipment that involves human life;
- Use in devices that have a significant impact on society and the public;
- Use in vehicles, ships, and other environments subject to vibration;
- Use as climbing tools.

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1.6 Emergency Handling

1.6.1 Emergency Stop Device

Press the Emergency Stop button to stop all motions of the robot. Emergency stop shall not be used as a risk reduction measure, but as a secondary protective device. Connection of multiple emergency stop buttons, if required, must be included in the risk assessment of the robot application. The emergency stop button should comply with IEC 60947-5-5.

The control box is equipped with an external Emergency Stop button interface (see 6.4.5 External emergency stop input), which can be used by the integrator or user as appropriate.

Tools or devices connected to the robot end-effector that pose a potential threat must be integrated into the emergency stop circuit of the system. Failure to comply with this warning may result in death, serious personal injury, or substantial property damage.

1.6.2 Recovery From an Emergency

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

Rotate the emergency stop button to open the "lock".

Recovery from the emergency stop state is a simple yet crucial step, which can only be performed after ensuring that all hazards of the robotic system have been completely eliminated.

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2. Handling and Precautions

Before transportation, the robot should be packaged according to packaging standards, and marked with required signs on the outside of the package. During transportation, the robot should be stable and remain fixed in the appropriate position.

The control box should be lifted by the handle. During hoisting and transportation, appropriate measures should be taken to secure the moving parts to prevent any unexpected movement which can cause damage.

Move the robot from the packaging material to the installation position. After securing, power on the robot and check whether it operates normally.

Keep the original packaging after transportation. Store the packaging material in a dry place for future repackaging and handling of the robot.

1. Ensure that your back or other body parts are not excessively strained when lifting the robot.
2. All regional and national guidelines must be followed. AUBO (Beijing) Robotics Technology Co., Ltd. is not liable for any damage incurred during the transportation of the equipment.
3. Ensure strict adherence to the installation instructions in the manual when installing the robot.

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3 Maintenance and Disposal

3.1 Maintenance

Maintenance work must be carried out strictly according to all safety instructions in this manual.

Maintenance must be carried out by authorized system integrators or AUBO (Beijing) Robotics Technology Co., Ltd. Parts to be returned to AUBO (Beijing) Robotics Technology Co., Ltd. must be handled according to the service manual.

It is essential to ensure the specified safety level for maintenance work, comply with effective national or regional work safety regulations, and test whether all safety features are functioning properly.

The purpose of maintenance work is to ensure the system operates normally or to help restore normal conditions in the event of a system failure. Maintenance work includes fault diagnosis and maintenance.

1. Remove the main input cable from the control box to ensure it is completely powered off. Take necessary precautions to prevent others from re-energizing the system during maintenance. After the power is turned off, be sure to check that the system is powered off.
2. Please check the ground connection before turning on the system again.
3. Observe the ESD (Electrostatic Discharge) regulations when disassembling the control box.
4. 4 Avoid disassembling the power supply system of the control box. High voltages can be present inside the power supply system for several hours after the control box has been switched off.
5. Avoid water or dust entering the control box.
6. Replace the defective components with new components with the same part number or equivalent components approved by AUBO (Beijing) Robotics Technology Co., Ltd.
7. Reactivate all disabled safety measures immediately after the work is completed.
8. Document all maintenance operations in writing and include them in the technical documentation for the entire robotic system.
9. The control box does not include any parts that can be repaired by the end users themselves. If maintenance services are needed, please contact your dealer or AUBO (Beijing) Robotics Technology Co., Ltd.

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3.2 Disposal

AUBO-CB-iS control box must be disposed of in accordance with applicable national laws, regulations, and standards.

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4 Warranty

4.1 Product Warranty

The AUBO-CB-iS control box comes with a limited warranty period of 18 months.

If new equipment and its components exhibit defects due to manufacturing or material issues within 18 months of being put into use, AUBO (Beijing) Robotics Technology Co., Ltd. shall provide necessary spare parts for replacement or repair of related components.

AUBO (Beijing) Robotics Technology Co., Ltd. shall have the ownership of the equipment or components which have been replaced or returned to AUBO (Beijing) Robotics Technology Co., Ltd.

If the product is no longer under warranty, AUBO (Beijing) Robotics Technology Co., Ltd. shall reserve the right to charge the customer for replacement or repair costs.

If any defects appear in the equipment outside the warranty period, AUBO (Beijing) Robotics Technology Co., Ltd. shall not be liable for any damages or losses arising therefrom, such as production losses or damage to other production equipment.

4.2 Disclaimer

If the equipment defect is caused by improper handling or failure to follow the instructions in the User Manual, the product warranty shall be void.

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

1 Products purchased from non-AUBO approved channels;

2 Installation, wiring, or connection to other control devices that does not comply with industrial standards or the requirements of the User Manual;

3 Use beyond the product specifications or standards;

4 Use for purposes other than those specified;

5. Service conditions that exceed the nominal specifications of the product;

6. Use in a grinding environment or under special service conditions without proper protection;

7. Damage to the product caused by improper transportation；

8. Failures, damages, or consequential damages caused by accidents or human factors.

9. Failures, damages, or consequential damages caused by modifications;

10. Installation of non-genuine parts or accessories;

11. Damage caused by modifications, debugging, or maintenance of original parts by third

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parties other than AUBO (Beijing) Robotics Technology Co., Ltd. or the designated integrator.

12. Failures, damages, or consequential damages caused by natural disasters or other acts of force majeure;

13. Failures caused by reasons other than those mentioned above and not related to the responsibility of AUBO (Beijing) Robotics Technology Co., Ltd.

The following situations are not covered by the warranty:

1. Failure to identify product traceability number.

2. Failure to identify production date or warranty start date.

3. Changes to software or internal data.

4. Fault cannot be reproduced or cannot be identified by AUBO (Beijing) Robotics Technology Co., Ltd.

5. Use of the product in radioactive equipment, biological testing equipment, or other applications deemed hazardous by AUBO (Beijing) Robotics Technology Co., Ltd.

6. Exterior parts and vulnerable parts.

According to the product warranty agreement, AUBO (Beijing) Robotics Technology Co., Ltd. only provides warranty for flaws and defects in products and parts sold to dealers.

AUBO (Beijing) Robotics Technology Co., Ltd. does not assume any other express or implied warranties or liabilities, including but not limited to, any implied warranties of merchantability or fitness for a particular purpose. In addition, AUBO (Beijing) Robotics Technology Co., Ltd. is not liable for any form of consequential damages or consequences arising from the relevant products.

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5 Use of Control Box

5.1 Introduction

AUBO-CB-iS control box is the control center of the AUBO robot, consisting of control mainboard, safety interface board, switching power supply, safety protection components, etc. The control box adopts 100V-240V AC power supply. Its internal switching power supply can convert 100V-240V AC into 12V, 24V, and 48V DC so as to supply power to the payloads and the robot in the control box. Before use, it is necessary to check whether the connections of the robot, teach pendant, and control box are secure.

The control box is designed with both hardware and software protection to ensure maximum safety during use. The control box uses multiple circuit breakers internally, providing reliable short-circuit protection and overload protection. Additionally, there is an Emergency Stop button on the control box front panel, allowing users to cut off the robot's power supply in the shortest time to protect personnel and equipment safety.

Figure 5-1 Control Box Appearance

1. There are dangerous voltages of 100V-240V AC and 48V DC inside the box. Non-professionals must not open the box while it is powered on.
2. Do not touch the screws or other metal components inside the control box with bare hands, and avoid disassembling connections with power on.

The robotic system only supports upgrade and use of the default software. Installation of other software, such as the ROS, is prohibited. If there is a need to install other software, it is recommended that users use other platforms for installation.

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5.2 Control Box Panel

5.2.1 Control Box Front Panel

The structure of the control box front panel is shown in the figure below:

Figure 5-2 Control Box Front Panel

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Table 5-1 Function Description of Control Box Front Panel

No.	Name	Function
1	EMERGENCY STOP button	The Emergency Stop button can achieve an emergency stop of the robot when pressed. To restore to normal mode, this button must be rotated as arrowed on the button.
2	MODE MANUAL/LINKAGE button	The button is used to select manual mode or linkage mode of the robot. The robot can enter linkage mode when this button is pressed.
3	TEACH PENDANT ENABLE/DISABLE button	The TEACH PENDANT ENABLE/DISABLE button is used when the teach pendant is not required, for example, in linkage mode. Normally, this button pops up and the teach pendant can be used normally (the teach pendant emergency stop function is available). If you need to unplug the teach pendant, press this button; at this time, the teach pendant emergency stop function is not available, and you can unplug the teach pendant cable, and use interface signals to control the robot status.
4	MANIPULATOR ON indicator light	The indicator light comes on to indicate that the robot is powered on.
5	EMERGENCY STOP indicator light	The indicator light comes on to indicate that the machine is in emergency stop status.
6	STANDBY indicator light	The indicator light comes on to indicate that the control box interface board program is initialized.
7	POWER indicator light	The indicator light comes on to indicate that the external power is on.

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5.2.2 Control Box Rear Panel

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

Figure 5-3 Control Box Rear Panel

Table 5-2 Function Description of Control Box Rear Panel

No.	Name	Function
1	Power switch	Power button, where "I" represents on, and "O" represents off.
2	TEACH PENDANT interface	Teach pendant cable interface, used for connecting the teach pendant cable.
3	ROBOT INTERFACE	Robot body cable interface, used for connecting the robot body cable.
4	POWER interface	Power cable interface, used for connecting the power cable.

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5.3 Cable Connection

1. Connect robot cable to control box: First, unscrew the dust cap of the ROBOT interface on the control box, and then plug the robot cable connector into the ROBOT interface, as shown in Figure 5-4.
2. Connect teach pendant cable to control box: Plug the teach pendant cable connector into the TEACH PENDANT interface on the control box, as shown in Figure 5-4.
3. Connect power cable to control box: First, unscrew the dust cap of the POWER interface on the control box, and then plug power cable connector into the POWER interface, as shown in Figure 5-4.

Figure 5-4 Control Box Cable Connection

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5.4 Power On

1. Place the control box in an appropriate position;
2. Connect the cable to the control box as described in the above sections.
3. Check whether all cables of the control box are properly connected.
4. Insert the power cable three-prong plug into the AC power socket, then press the power switch on the control box rear panel from O (OFF) to l (ON) position, and the power indicator light comes on.

5.5 Power Off

Power off control box: Press the power switch on the control box rear panel to the O (OFF) position to power off the control box.

Shutting down the system by simply unplugging the power cable from the socket may damage the robot file system, leading to robot function failure.

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6 Electrical Interface

6.1 Electrical Warnings and Cautions

When designing and installing the robot and AUBO-CB-iS control box applications, be sure to follow the following warnings and cautions. These warnings and cautions also apply to maintenance work.

1. Never connect safety signals to a non-safety PLC that does not meet the required safety level. Failure to follow this warning may result in serious injury or even death due to the failure of a safeguard stop function.
2. The control box must be powered off during wiring of the electrical interface.

1. Make sure that all non-waterproof equipment remains dry. If water enters the product, please disconnect the power supply and 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 GND connections mentioned in this document are only for power supply and signal transmission. 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 cable to the robot I/O.

1. Interference signals higher than the level specified in the IEC standard will cause the abnormal behavior of the robot. Extremely high signal levels or excessive exposure can cause permanent damage to the robot. EMC problems typically occur in welding process and are usually indicated by error messages in the log. AUBO (Beijing) Robotics Technology Co., Ltd. is not liable for any losses caused by EMC problems.
2. I/O cables used to connect the control box to another machinery and factory equipment may not be longer than 30 m, unless extended tests are performed.

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6.2 Control Box Side Panel

After opening the control box side panel, you can see the following electrical interfaces for users.

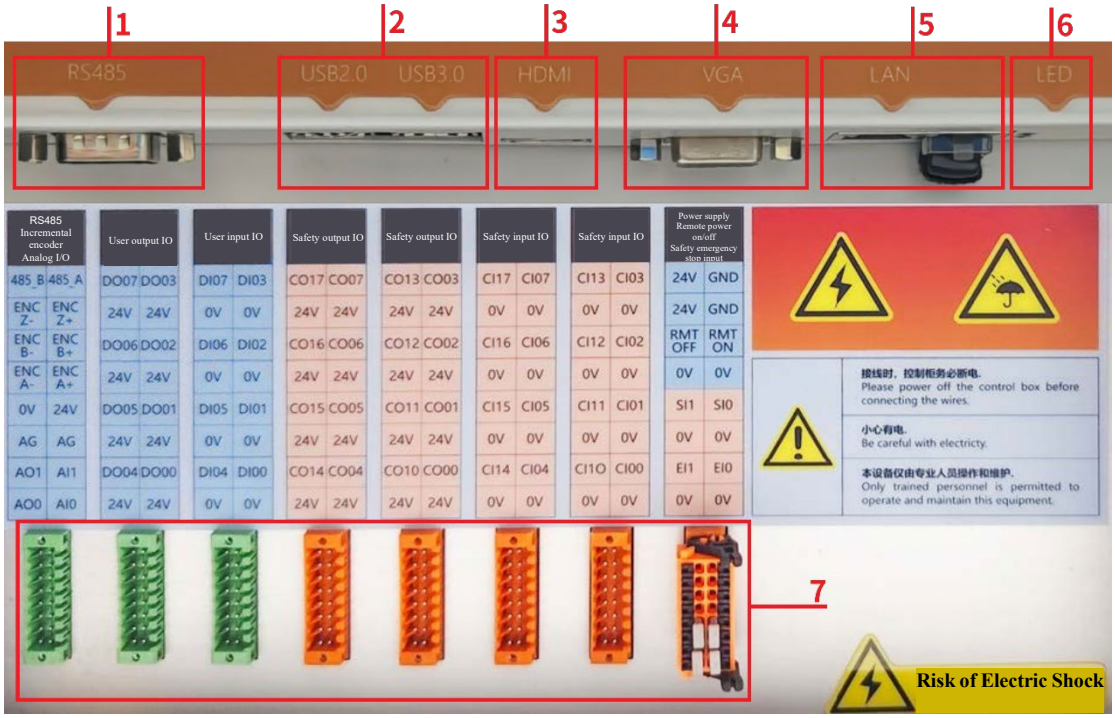

Figure 6-1 Control Box Internal Interface

Table 6-1 Function Description of Control Box Rear Panel

No.	Name	Function
1	RS485 interface	It can be connected to Modbus RTU interface, thus increasing the quantity and type of control box IO interfaces, or increasing the analog interfaces.
2	USB 2.0 and USB 3.0 interfaces	It allows for device connection, software upgrade, and project file export.
3	HTML interface	It can be connected to monitor HDMI.
4	VGA interface	It can be connected to monitor VGA interface.
5	LAN interface	It can be used for remote access and control.
6	LED indicator light	Control box IPC status indicator light.
7	Electrical interface	External I/O interface.

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6.3 Control Box I/O Power Supply

6.3.1 Internal Power Supply

The control box panel IO defaults to the internal power supply mode, as shown in the figure below:

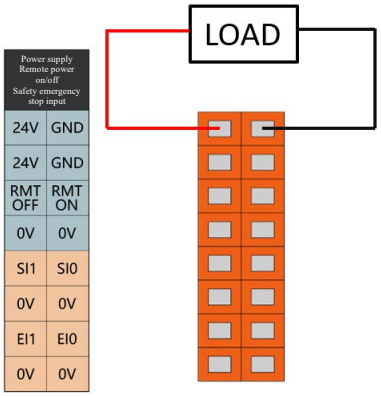

Figure 6-2 Internal Power Supply

6.3.2 External Power Supply

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

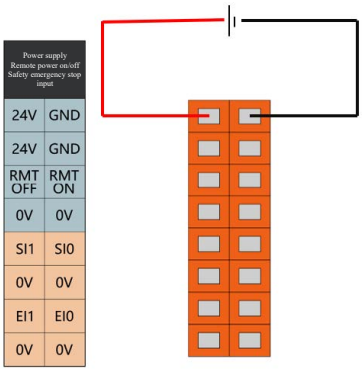

Figure 6-3 External Power Supply

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6.4 Configurable I/O of Control Box

AUBO-CB-iS control box provides 16 configurable DI interfaces and 16 configurable DO interfaces. The configurable I/O has dual-loop safety channels to ensure no loss of safety features in the event of a single failure. Safety devices and equipment must be installed according to the safety instructions and can only be used after a comprehensive risk assessment is conducted.

The configurable I/O can only be used as safety I/O after being configured in the teach pendant software; If not configured, it will be used as general digital I/O of the control box. Safety I/O has a higher priority than general I/O, meaning that when the same I/O is configured as both safety I/O and general I/O, only the function of safety I/O is retained. The specific functions and descriptions of safety I/O can be referenced in the Software User Manual.

Table 6-2 Configurable I/O Function Definition

I/O	Interface type	Function definition
CI00 ~ CI07	NPN	Specific functions can be set via software interface
CI10 ~ CI17	NPN	
CO00 ~ CO07	NPN	Specific functions can be set via software interface
CO10 ~ CO17	NPN	

6.5 General I/O of Control Box

AUBO-CB-iS control box provides 8 (+16) DI interfaces, 8 (+16) DO interfaces, 2 analog voltage input interfaces, and 2 analog voltage output interfaces. The functions of general I/O need to be configured in the teach pendant software, and the specific functions and descriptions can be referenced in the Software User Manual.

Table 6-3 General I/O Function Definition

I/O	Interface type	Function definition
AI0, AI1	NPN	Specific functions can be set via
AO0, AO1	NPN	Specific functions can be set via
DI00 ~ DI07	NPN	Specific functions can be set via
DO00 ~ DO07	NPN	Specific functions can be set via
CI00 ~ CI07	NPN	Specific functions can be set via software interface
CI10 ~ CI17	NPN	
CO00 ~ CO07	NPN	Specific functions can be set via software interface
CO10 ~ CO17	NPN	

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6.6 Fixed Safety Stop Input

AUBO-CB-iS control box provides two fixed safety stop inputs:

- Linkage Emergency Stop Input (EI0, EI1): used only for emergency stop devices.
- External Safeguard Stop Input (SI0, SI1): used for other safety protection devices.

The functional differences are as follows:

Table 6-4 Difference between External Emergency Stop Input and External Protection Stop Input

	LINKAGE EMERGENCY STOP	**EXTERNAL SAFEGUARD STOP**
ROBOT STOP MOVING	Yes	Yes
PROGRAM EXECUTION	Stop	Pause
ROBOT POWER SUPPLY	Off	On
RESET	Manual	Auto or Manual
OPERATING FREQUENCY	Infrequent	No more than once per operating cycle
NEED FOR REINITIALIZATION	Only brake released	No
SHUTDOWN CATEGORY	1	2

Table 6-5 Safety Related Electrical Inputs

Safety input function	**Limit case**		
	Detection time	**Power-off time**	**Response time**
Linkage Emergency Stop	100ms	1200ms	1300ms
External Safeguard Stop	100ms	——	1200ms

6.7 Remote Power On/Off

When the system is in manual mode, the robotic system can be powered on/off via the I/O interfaces for remote on/off control.

Table 6-6 I/O Interfaces for Remote On/Off Control

Input	**Interface type**	**Function definition**
RMT-ON	NPN	Remote startup signal input interface
RMT-OFF	NPN	Remote shutdown signal input interface

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6.8 RS485 Interface

The RS485 interface is shown in the figure and can be used for Modbus RTU communication.

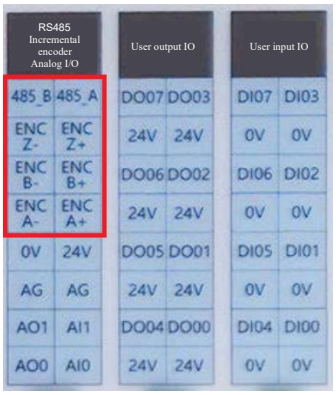

Figure 6-4 RS485 Interface

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Appendix

Specifications

Control box model	AUBO-CB-iS	
IP rating	IP43	
Control box dimensions (Length*Height*Width)	400mm *320mm *160mm	
Control box weight	12.5 kg	
I/O port	Digital input	8 (standard)/16 (configurable)
	Digital output	8 (standard)/16 (configurable)
	Analog input	2
	Analog output	2
	Incremental encoder	1
	RS485	1
	Wireless module	Optional
I/O power supply	24V 3A for control box; 0V/12V/24V 0.8A for tools	
Communication protocol	Ethernet, ModBus-RTU/TCP, Profinet (optional)	
Interface and openness	SDK (supporting C/C++/C#/Lua/Python development), ROS, API	
Operating temperature	0 ºC～50ºC	
Transportation and storage temperature	-25 ℃～55 ℃	
Humidity	90% RH (non-condensing)	
Power supply	100-240 VAC, 50-60 Hz	
Connecting cable	Cable connecting robot arm and control box (5m) Cable connecting teach pendant and control box (3m) Cable connecting power supply and control box (5m)	

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Stop Method

Stop method	Stop operation
Type 0 stop	Robot arm power off
Type 1 stop	Robot arm decelerated to 0 - braked - powered off
Type 2 stop	Robot arm decelerated to 0
Type 3 stop	Robot arm braked and powered off

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