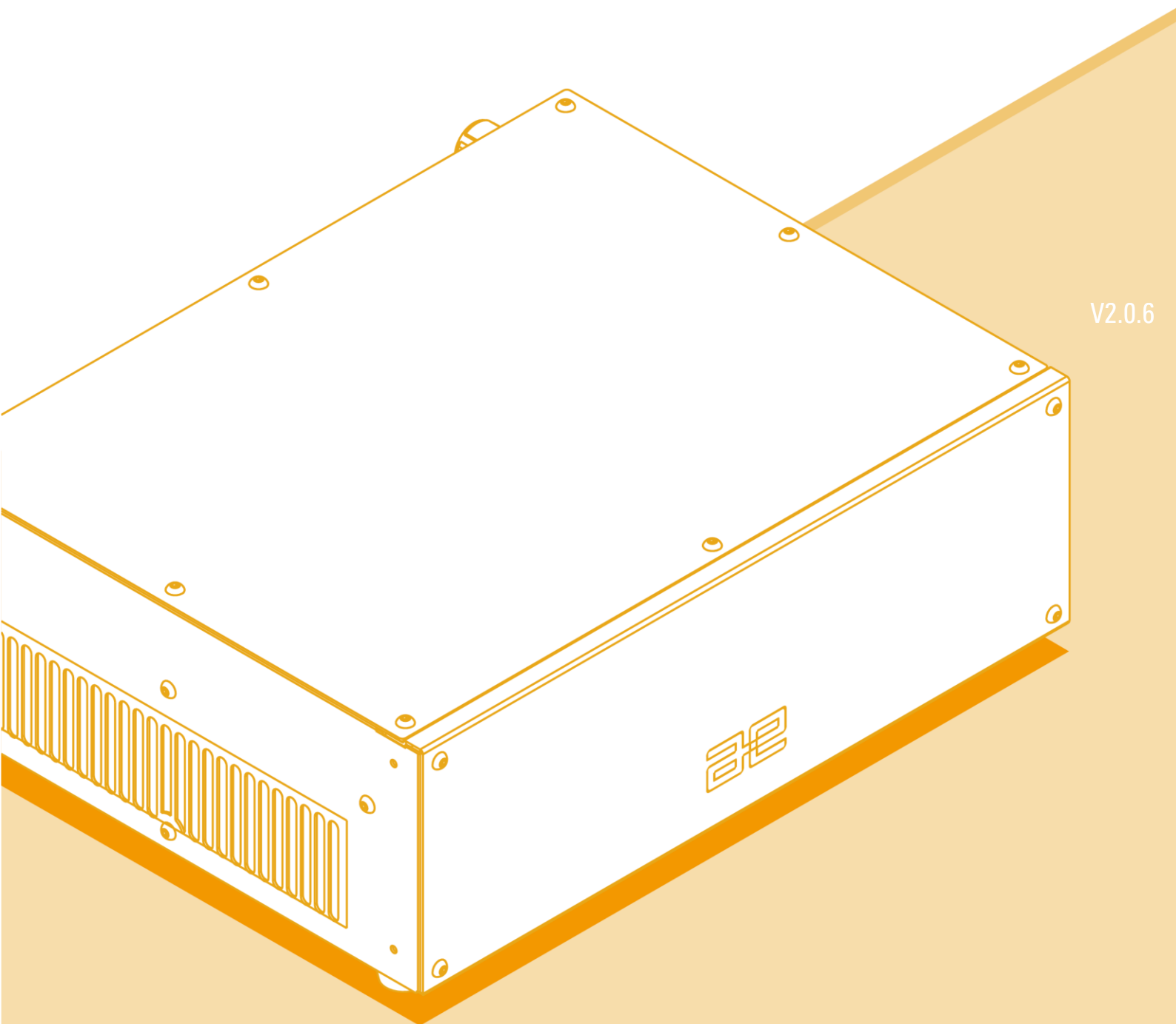


# inCube20

# Control Cabinet Manual

V1.6.3



V2.0.6



## Foreword

---

### About this manual

This manual is for technicians to install, use, and use the inCube20 control cabinet quickly, correctly, and safely, to be familiar with the relevant precautions, and to perform regular routine maintenance work on the control cabinet.

### Prerequisites

Before operating the robot, be sure to read the relevant safety instructions and operation instructions of the product carefully. Users must understand the safety knowledge and basic operation knowledge before using the robot.

Please read the following documents when necessary:

- "AIR6-A industrial robot manipulator manual"
- "AIR6L-A industrial robot manipulator manual"
- "AIR10-1420 industrial robot manipulator manual"
- "AIR-TP type teach pendant operation manual"
- "ARL Programming Manual"



### Target groups



- Operators
- Product technicians
- Technical service personnel
- Robot teachers

### Meaning of common signs

The signs and their meanings in this manual are detailed in Table 1.

Table 1 Signs used in this manual

Sign	Meaning
 Danger	Failure to follow the instructions may result in an accident causing the severe or fatal injury or the great losses of property.
 Warning	Failure to follow the instructions may resulting in moderate injuries or minor injuries, or only material damage may occur.

Sign	Meaning
 Caution	Prompt for the environmental conditions and important things or shortcuts you shall pay attention to
 Prompt	Prompt for additional literature and instructions for additional information or more detailed operating instructions

### Manual description

The contents of this manual are subject to supplementation and modification. Please visit "Download Center" on the website regularly to obtain the latest version of this manual in a timely manner.

Website URL: <http://robot.peitian.com/>

### Revision history

The revision history contains the instructions for each document update. The latest version of the document contains updates to all previous versions of the document.

Table 2 Signs used in this manual

Version	Publication date	Modification description
V1.4.3	2020.03.19	1st official publication
V1.5.0	2020.07.07	2nd official publication Fix known bugs.
V1.5.1	2021.8.10	3rd official release Fix known bugs.
V1.6.0	2021.3.15	4th official release Upgrade the hardware version to P2.0.
V1.6.1	2022.5.13	5th official release Fix known bugs.
V1.6.2	2022.5.23	6th official release Fix known bugs.
V1.6.3	2023.3.23	7th official release Fix known bugs.

### Manual Number and Version

The manual-related information is shown in Table 3.

Table 3 Document-related information

Document name	" inCube20 control cabinet manual "
Document number	UM-P0511000030-001
Document version	V1.6.3

#### Declaration of applicable with product standards

The requirements for industrial robot system design are detailed in Table 4.

Table 4 Declaration of applicable safety standards

Standard	Description	Version
2006/42/EC	Machinery directive: Machinery directive 2006/42/EC (new version) issued by European Parliament and Council on May 17, 2006 to modify 95/16/EC	2006
2014/30/EU	Electromagnetic compatibility directive: 2014/30/EU directive issued by European Parliament and Council on February 26, 2014 to balance the electromagnetic compatibility regulations of member states	2014
2014/68/EU	Pressure facility directive: Electromagnetic compatibility directive: 2014/68/EU directive issued by European Parliament and Council on May 15, 2014 to balance the pressure facility regulations of member states (It is only suitable for the robot with hydraulic balance weight)	2014
ISO 13850	Safety of machinery: Emergency stop function - Principles for design	2015
ISO 13849-1	Safety of machinery: Safety-related parts of control systems - Part 1: General principles for design	2015
ISO 12100	Safety of machinery: General principles for design - Risk assessment and risk reduction	2010
ISO 10218-1	Robots and robotic devices - Safety requirements for industrial robots: Part 1: Robots (Prompt: Information is consistent with ANSI/RIAR.15.06-2012, Part 1)	2011
61000-6-2	Electromagnetic compatibility (EMC): Part 6-2: Generic standards - Immunity for industrial environments	2005
61000-6-4 + A1	Electromagnetic compatibility (EMC): Part 6-4: Generic standards - Emission standard for industrial environments	2011

Standard	Description	Version
60204-1 + A1	Safety of machinery: Electrical equipment of machines - Part 1: General requirements	2009
IEC 60529	IP rating provided by enclosures (IP Code): This standard applies to the IP rating for the electrical equipment with enclosures and the rated voltage exceeding 72.5kv.	2001

## General safety instructions

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Thanks very much for your purchase of the manipulator made by the company. The information described is necessary for safely using the manipulator. Please read associated manual carefully before using the manipulator, and properly use it under the premise of understanding its contents.

Please adequately understand the manipulator specifications through available instructions for detailed function.

### Safety precautions

In general, the manipulator cannot be operated singly, but it is efficient when fitting with end effector, and constructed with peripheral equipment and system.



In consideration of security, the manipulator cannot put into separate consideration, while it shall be placed in the system environment.

Please take corresponding measures for safety barriers during the manipulator operation.


### Warning, caution and notices


This manual contains various attentions including operating personnel safety and preventing manipulator damage. The significance of safety is described in form of "Warning" and "Caution", and other supplementary instructions are stated in form of "Notices".

Please thoroughly read these matters described in "Warning", "Caution" and "Notices".


 Warning	<p>Faulty operation may lead to death or serious injury of operator or other operating personnel.</p>
 Tip	<p>Faulty operation may lead to minor injury of operator or other operating personnel or equipment damage.</p>

### General cautions



 Warning	<ul style="list-style-type: none"> <li>■ When connecting or disconnecting related peripheral devices (such as safety fences, etc.) and various signals of the manipulator, be sure to confirm that the manipulator is in a stopped state to avoid incorrect connections.</li> <li>■ Do not use the manipulator in the following situations. Otherwise, it will not only cause adverse effects on the manipulator and peripheral equipment, but also may cause injury or death to operators:             <ul style="list-style-type: none"> <li>● Use in flammable environment</li> <li>● Use in explosive environment</li> <li>● Use in environments with a lot of radiation</li> <li>● Use in water or high humidity environment</li> <li>● Use for the purpose of transporting people or animals.</li> </ul> </li> </ul>
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	<ul style="list-style-type: none"> <li>● Use as a tripod (such as climbing on top of the manipulator, or hanging below)</li> <li>■ Operators who use the manipulator should wear the following safety equipment before performing work:             <ul style="list-style-type: none"> <li>● Work clothes suitable for the content of the job</li> <li>● Safety shoes</li> <li>● Safety helmet</li> </ul> </li> </ul>
 <p>Tip</p>	<p>Personnel performing programming and maintenance operations must receive appropriate training through relevant training provided by the company.</p>


Installation attentions

 <p>Warning</p>	<ul style="list-style-type: none"> <li>■ Please follow the methods shown in the manual for proper operation during carrying and installing the manipulator. Any operation in wrong methods may lead turnover of the manipulator and then result in injury and death of operating personnel.</li> <li>■ Please operate the manipulator in low speed, and then increase the speed gradually to ensure whether it is abnormal when the manipulator is used for the first time upon installation.</li> </ul>
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Attentions during the operation

 <p>Warning</p>	<ul style="list-style-type: none"> <li>■ During the manipulator operation, please ensure there is no one in the safety barriers for subsequent operation. Accordingly, check whether there are potential risks; when the potential risks are verified, operate it after eliminating the risks.</li> <li>■ During the demonstrator operation, wearing gloves may cause errors in operation, thus, taking the gloves off is necessary for subsequent operation.</li> </ul>
 <p>Tip</p>	<p>Program, system variables and other information can be saved in the storage card and other storage medium. To prevent data loss from unexpected accidents, the users are recommended to backup data regularly.</p>


Attentions during the programming

 <p>Warning</p>	<ul style="list-style-type: none"> <li>■ Operate outside safety barrier as far as possible during the programming. If it is required to operate in the safety barrier for unavoidable conditions, following precautions shall be noticed:             <ul style="list-style-type: none"> <li>● Carefully view the conditions in the safety barrier, and then enter the barrier after ensuring there is no danger;</li> <li>● Make sure the emergency stop button can be pressed at any time;</li> <li>● Operate the manipulator in low speed;</li> <li>● Operate it after ensuring the whole system state to prevent the operating personnel from caught in danger due to the remote-control command or motion for peripheral equipment.</li> </ul> </li> <li>■ Operators who use the manipulator should wear the following safety equipment before performing work:             <ul style="list-style-type: none"> <li>● Work clothes suitable for the content of the job</li> </ul> </li> </ul>
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	<ul style="list-style-type: none"> <li>● Safety shoes</li> <li>● Safety helmet</li> <li>■ When programming, it should be carried out outside the safety fence as much as possible. When it is necessary to carry out inside the safety fence due to unavoidable circumstances, the following matters should be paid attention to: <ul style="list-style-type: none"> <li>● Check the situation inside the safety fence carefully and confirm that there is no danger before entering the inside of the fence.</li> <li>● You can press the emergency stop button at any time.</li> <li>● The manipulator should be operated at a low speed.</li> <li>● The operation should be performed after confirming the status of the entire system to prevent operators from falling into dangerous situations due to remote control commands or actions for peripheral equipment.</li> </ul> </li> </ul>
 <p>Notice</p>	<p>After programming, be sure to perform the test operation in accordance with the prescribed steps. At this time, the operator must operate outside the safety fence.</p>
 <p>Tip</p>	<p>Those who perform programming and maintenance operations must pass the relevant training of our company.</p>

#### Attentions during the maintenance

 <p>Warning</p>	<ul style="list-style-type: none"> <li>■ Some maintenances have electric shock hazard when powered on, thus it shall be carried out under the disconnection of the manipulator and system power supply. Professional maintenance personnel shall be designated to take maintenance as required; other personnel shall be avoided to switch on power in the maintenance, if it is required, the personnel shall press the emergency stop button for subsequent operation.</li> <li>■ Please consult the company if it is necessary to replace the parts.</li> <li>■ If customers replace the parts by themselves, unexpected accidents may occur, and then it will cause damage and injury to the manipulator and operating personnel respectively.</li> <li>■ When entering into the safety barrier, the whole system shall be checked to ensure there is no danger. If there is dangerous situation and there is no choice but to enter the barrier, the system state shall be grasped, and extremely careful.</li> <li>■ If it is necessary to replace any part , please use the one specified by the company. But beyond this, it may cause damage to the manipulator.</li> <li>■ When dismantling motor or brake, it shall be dismantled after crane lifting and other measures are taken to prevent manipulator arm, etc. from falling.</li> <li>■ If the manipulator is moved for unavoidable reasons during the maintenance, the following matters shall be noticed: <ul style="list-style-type: none"> <li>● Make sure the escape routes are unobstructed, and operate it after grasping the whole system operation conditions to avoid manipulator and peripheral equipment blocking the route of retreat.</li> <li>● Constantly notice whether there is danger around, and make preparations for pressing emergency stop button at any time when needed.</li> </ul> </li> <li>■ When mobile motor, reducer, etc. equipped with parts unit with a certain weight, crane and other auxiliary equipment shall be used to prevent overlarge operation burden for operating personnel. Meanwhile, any mistake shall be avoided; otherwise, it will cause injury and death of operating personnel.</li> </ul>
--	---

- Don't tumble due to the lubricating oil scattered on the floor, and wipe it off for ruling out the possibility of danger.
- During the operation, any part of the body cannot be put on the manipulator, and climb on the top of the manipulator to avoid unnecessary damage or adverse effects on the manipulator.
- Note that the following section will become hot. Well prepare heat-resistant gloves and other protective tools when the equipment is required to touch under heating circumstance for unavoidable reasons.
  - Servo motor;
  - Reducer;
  - Components near motor / reducer;
  - Interior control cabinet.
- The parts dismantled from components (such as bolts, etc.) shall be installed in the original position. If the parts are not sufficient or surplus, ensure it again and install it normally.
- When maintaining pneumatic system and hydraulic system, internal pressure shall be released to 0 at first for subsequent operation.
- Testing and operation shall be carried out in accordance with prescribed methods after components replacement. At this moment, the operating personnel shall operate outside the safety barrier.
- After maintenance ends, lubricating oil, debris, water, etc. scattered on the floor around the manipulator and in the safety barriers shall be swept thoroughly.
- Dust and other foreign matters are not allowed in the manipulator during the components replacement.
- Operating personnel who are in charge of maintenance and repair shall accept the company's training and pass the examination.
- During the maintenance, appropriate luminaire shall be equipped, but note that this cannot be the sources to cause new danger.
- Take periodic maintenance with reference to this instruction; if not, it will cause the service life of the manipulator and may result in accidents.

## Safety precautions

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Before operating the manipulator, peripheral equipment and its manipulator system, sufficiently study the safety precaution for operating personnel and system. Figure 1 is a schematic diagram of the safe work of industrial robots.

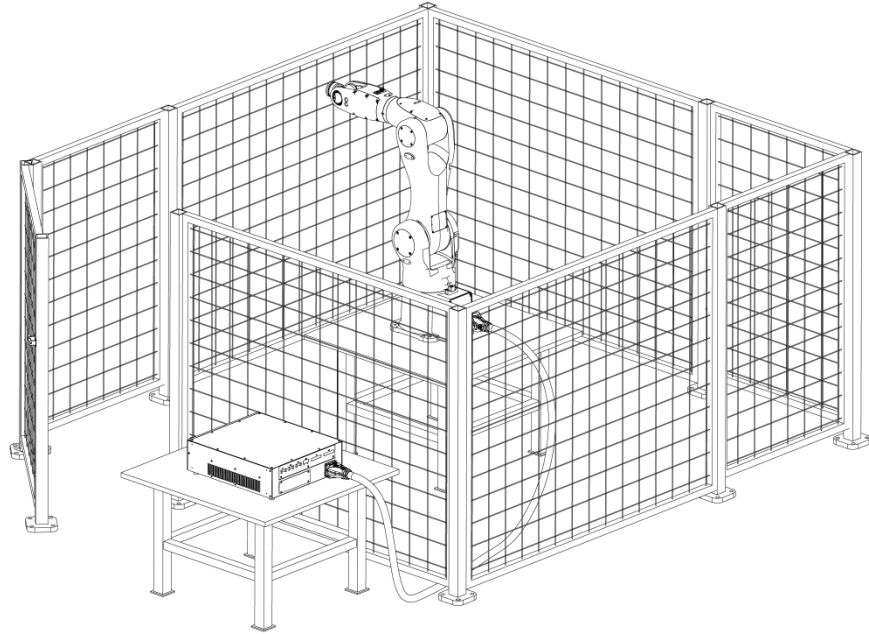


Figure 1 Schematic diagram of the safe work of industrial robots

### Definition of operating personnel

Operators of the manipulator are mainly divided into three types: operators, teachers, and maintenance engineers. The conditions that these three types of operators need to meet are described as follows:

#### Operator

- Carry out the operation of manipulator power ON/OFF;
- Start the manipulator program through the operation panel;
- No right to work in the safety fence.

#### Teacher

- Have the functions of an operator;
- The operation machine can be taught in the safety fence.

#### Maintenance engineer

- Have the function of a demonstrator;
- The operation machine can be maintained (repair, adjustment, replacement, etc.) operations.

### Safety of operating personnel

When operating, programming, and maintaining the manipulator, operators, instructors, and maintenance engineers must pay attention to safety and at least wear the following items for work:

- Appropriate working clothes;
- Safety shoes;
- Safety helmet.

When applying the automatic system, the safety of operating personnel shall be guaranteed.

Since the motion range is very dangerous, measures for preventing the operating personnel from entering into the manipulator motion range shall be applied.

General cautions are shown as below. Proper available measures shall be applied to ensure the safety of operating personnel:

- Operating personnel who are in charge of operating the manipulator system shall accept the company's training and pass the examination.
- During the equipment operation, even the manipulator seems to be shut down, it may be because the manipulator may be in motion state waiting for start signal. This state shall be treated as operation state. To ensure the safety of operating personnel, warning lamps and other equipment display or sound shall be applied to ensure the manipulator is in the operation state;
- Safety barriers and safety door around the system shall be set, so as to make operating personnel cannot enter into the safety barriers if the safety door is not opened. Interlock switch, safety latch, etc. shall be set on the safety door, so as to stop the manipulator when operating personnel open the safety door;
- Electrical grounding shall be applied for peripheral equipment;
- Peripheral equipment shall be set outside the manipulator motion range as far as possible;
- The motion range of the manipulator shall be marked with a line on the ground and other ways, thus, the operator knows clearly about the motion range, including mechanical arm and other tools fitted on the manipulator;
- The ground shall be set with cushion switch or fitted with photoelectric switch, etc. so as to sound alarm through buzzer or to glows, etc. when operating personnel enter into the motion range of the manipulator;
- One lock shall be set as required; no one can connect the manipulator power except the operating personnel;
- When taking single commissioning of peripheral equipment, the manipulator power shall be disconnected.

#### The safety of operator

Operator is not entitled to operate in the safety barriers:

- If the manipulator motion is not required, its control cabinet power shall be disconnected or the emergency stop button shall be pressed;
- Manipulator system shall be operated outside the safety barrier;
- To prevent irrelevant personnel from spraying into manipulator motion range or to prevent operator from entering into hazardous area, protective fence and safety door shall be set;
- Emergency stop button shall be set in arm's reach for operator.



Manipulator control device can connect external emergency stop button. Thus, once the emergency stop button is pressed, the manipulator will be shut down through this connection.

### Safety of teachers

When taking manipulator demonstration operation, if entering into manipulator motion range is required in some cases, please pay particular attention to safety:

- Please operate outside the manipulator motion range in case that there is no need to operate in its range;
- Please ensure the manipulator or peripheral equipment is in safety state before demonstration operation;
- Please confirm location, state, etc. of safety device (such as emergency stop button, emergency stop switch of demonstrator, etc.) in advance if the demonstration is operated in the manipulator range for unavoidable reasons;
- Programmer shall pay special attention to keep other personnel from entering into manipulator motion range;
- Please fully confirm that there is no one in the manipulator range and no abnormal sign before starting;
- Please follow the following procedures to carry out testing and operation after demonstration ends:

Step1. Execute for at least one cycle with single cycle at low speed to ensure there is no abnormal sign;

Step2. Continuously operate for at least one cycle at low speed to ensure there is no abnormal sign;

Step3. Continuously operate for at least one cycle at intermediate speed to ensure there is no abnormal sign;

Step4. Continuously operate for at least one cycle at intermediate speed to ensure there is no abnormal sign;

Step5. Execute programming under automatic operation mode;

- Programmer shall evacuate to the outer place of the safety barrier during automatic operation of the manipulator.

### The safety of maintenance engineer

To ensure the safety of maintenance engineer, the following items shall be fully noticed:

- During the manipulator operation, don't enter into its motion range;
- Take maintenance when the power supply of control device is disconnected. Apply lock, etc. to lock on main circuit breaker to prevent other personnel from connecting the power;
- Press control cabinet or demonstrator emergency stop button if entering into the manipulator motion range is required for unavoidable reasons in an energized state. In addition, operating personnel shall put up the sign of "under maintenance", and remind the other personnel of not operating the manipulator arbitrarily;
- Please ensure the manipulator or peripheral equipment is in safety state before maintenance;

- Don't execute automatic operation when there is someone in the manipulator motion range;
- Don't block the escape routes of the operating personnel when operating near wall, tool, etc. or the distance between personnel is close;
- When the manipulator is equipped with the tool and there are movable appliances such as band carrier, etc. except manipulator, attentions shall be fully paid for these devices;
- One person who is familiar with manipulator system and can easily observe dangers shall be assigned around the manipulator during the operation to ensure that the emergency button can be pressed at any time;
- When replacing the parts or reassembling, attentions shall be paid in case of foreign material adhesion or foreign material invasion;
- When maintaining internal control device, in case of contacting unit, printed circuit board, etc., to prevent electric shock, power supply of main circuit breaker of control device shall be disconnected firstly before the operation;;
- Use parts specified by the company when replacing the parts;
- Fully ensure that there is no one within operation scope of the manipulator and the manipulator and peripheral equipment are in good conditions when restarting the manipulator system after the maintenance.

#### Safety of peripheral equipment

##### Attentions on relevant program

- Checkout equipment such as limit switch, etc. shall be used in order that dangerous condition is detected, and the manipulator shall be shut down as appropriate according to the signal of checkout equipment;
- Applicable measures such as stopping the manipulator, etc. shall be taken against abnormality in other manipulators or peripheral equipment even if there are no problems in this manipulator;
- Mutual interference shall be avoided on system in which the manipulator and peripheral equipment operate synchronously;
- In order to control status of all equipment from manipulator, the manipulator and peripheral equipment can be mutually locked and the operation of manipulator can be stopped according to the needs.

##### Attentions on machinery

- Keep the system of the manipulator clear and use it under environment without influence from grease, water, dust, etc.;
- Cutting fluid and cleaning agent are not allowed to use;
- Control the operation of the manipulator with limit switch and mechanical brake in case of mutual collision between manipulator and peripheral equipment;
- Subscriber cable, hose, etc. are not allowed to be put inside the manipulator;
- Mechanical movement shall be avoided when installing the cable outside the manipulator;
- As for the model of exposed cables in the manipulator, operation for exposed cable shall not be modified;
- Interference in other parts of the manipulator shall be fully avoided when installing peripheral equipment on the manipulator;
- Any frequent outage and shutdown through emergency stop button, etc. on operating manipulator can lead to manipulator fault.

#### Machinery safety of the manipulator

#### Attentions during the operation

Operators shall be on high alert and quickly respond to occurrence of all problems when operating the manipulator through slow feeding mode under any condition.

#### Attentions on relevant program

Mutual interference between manipulators shall be fully avoided during operational scope from multiple manipulators.

Set a specified work origin for manipulator program and create a program starting from work origin and ending at this one to see clearly whether operation of the manipulator is finished or not from the outer edge.

#### Attentions on mechanism

Keep operating environment of the manipulator clear and use it under environment without influence from grease, water and dust, etc..

#### Safety for end effector

Time difference before the command reaches the actual operation shall be fully considered and exercise the control with some extension and contraction after sending control command out when controlling all actuators (pneumatic, hydraulic and electric).

Set the detection unit on end effector to monitor status of end effector and control operation of the manipulator.





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# 1 Overview of inCube20 control cabinet

## 1.1 Overview of industrial robot

The industrial robot is composed of the following components:

- Manipulator
- Control cabinet
- Teach Pendant
- Connection (power supply) cables, etc.

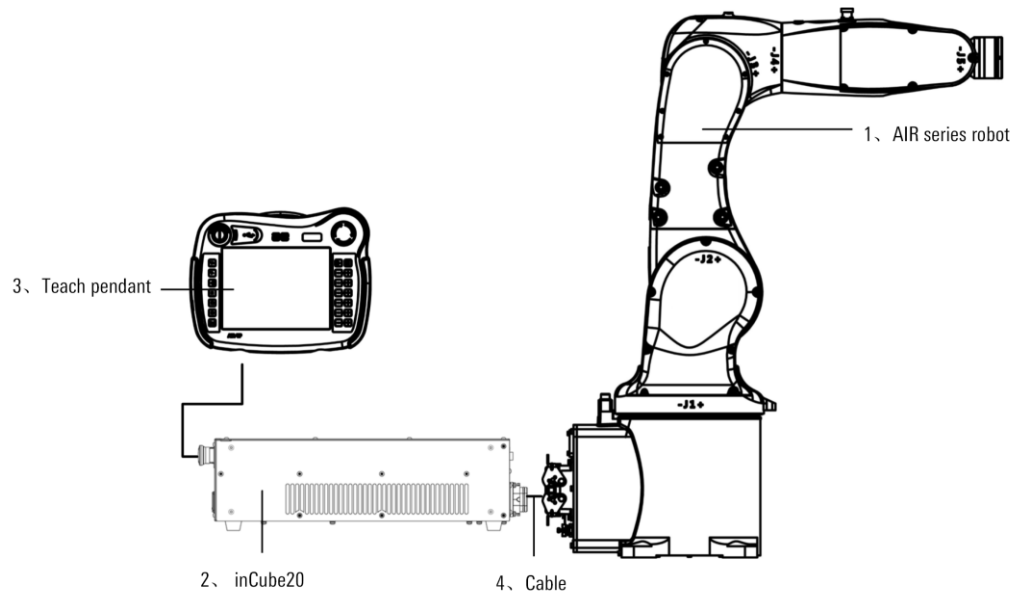


Figure 1-1 Composition of robot system

### Manipulator

The manipulator refers to the mechanism that is used to grab or move an object (tool or workpiece) in the robot system, and also is known as the manipulator.

### Control cabinet

The control cabinet is equipped with the electrical equipment that is required to control the robot, including the motor drive, safety module, power module, movement control module and other components, and provides the connection interfaces with the robot body and other external equipment.

### Teach Pendant

The teach pendant is connected to the master control system of the robot's control cabinet. It is used to remotely control the robot to run manually and automatically, record the running trajectory, display playback or record teach points and program according to the teach points.

## 1.2 Basic composition of control cabinet

The control cabinet is equipped with the electrical equipment that is required to control the robot, including the motor drive, safety module, movement control module and other components, and provides the connection interfaces with the robot body and other external equipment. The appearance of the control cabinet and the names of its various parts are shown in Figure 1-2~Figure 1-4.

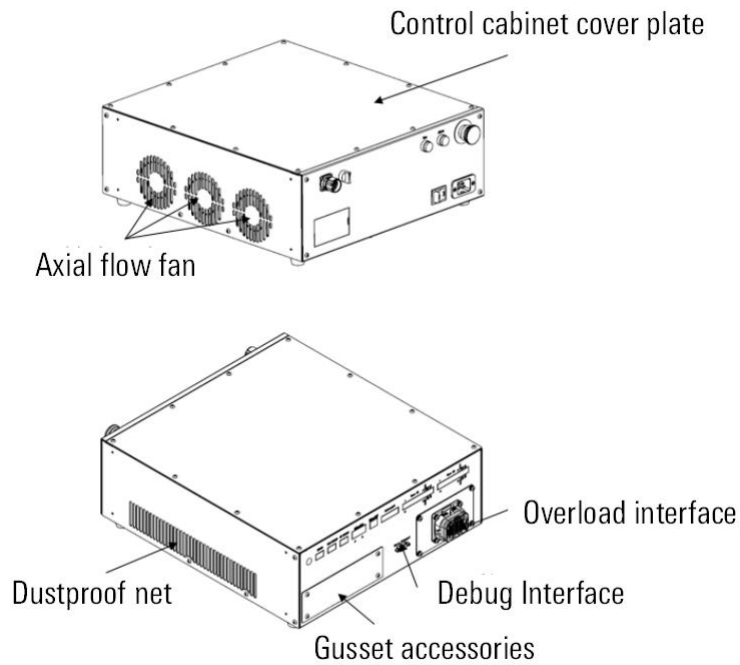


Figure 1-2 Appearance of control cabinet

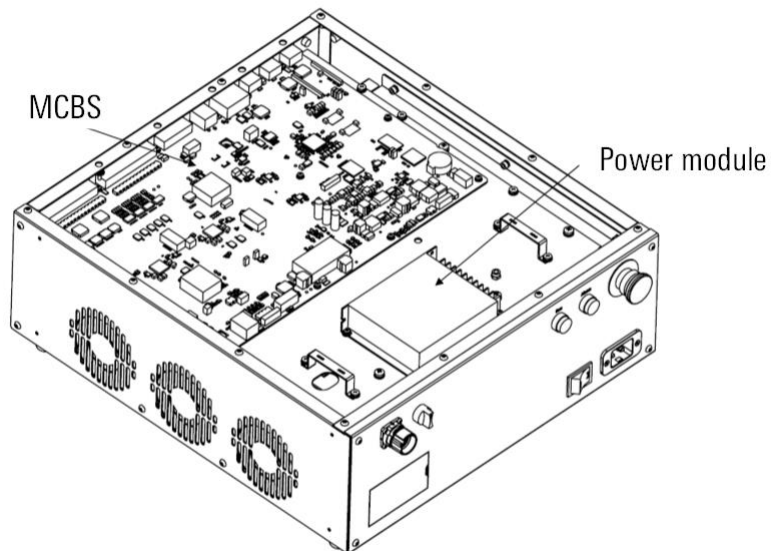


Figure 1-3 Diagram of internal components in the upper cavity

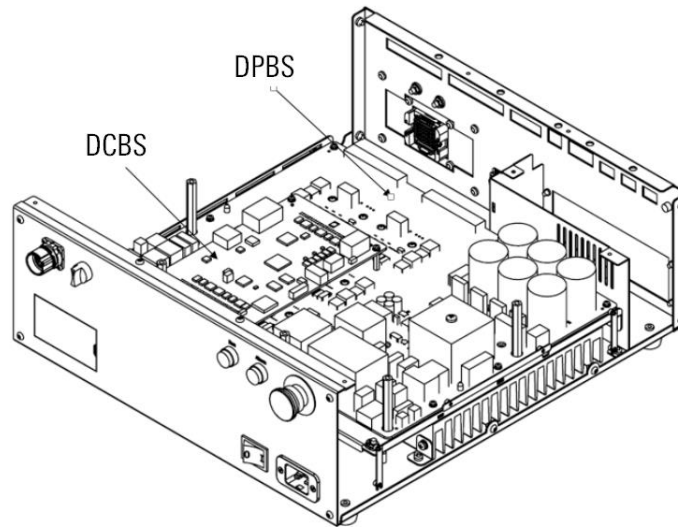


Figure 1-4 Diagram of internal components in the lower cavity

### 1.3 Basic specifications of control cabinet

The basic specifications of inCube20 control cabinet are shown in Table 1-1:

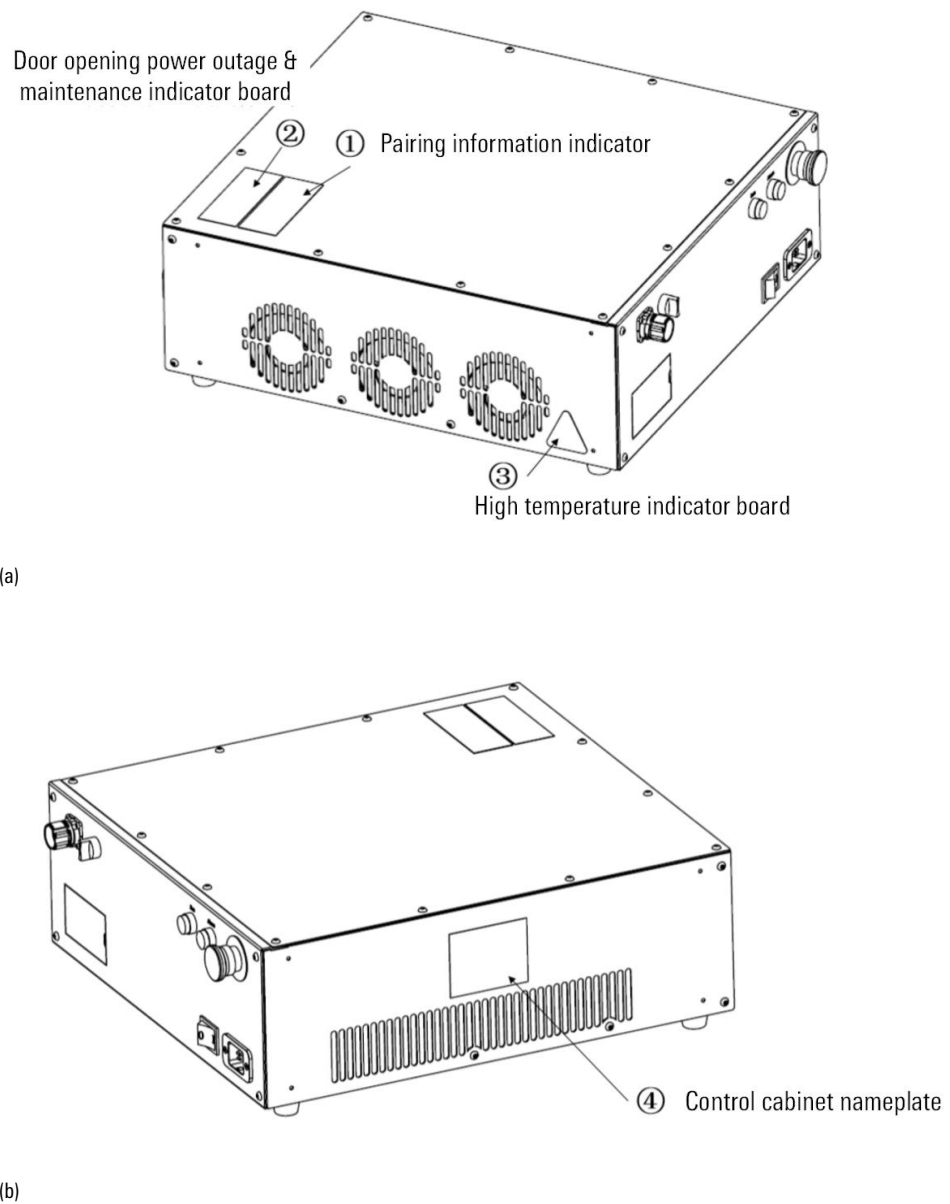
Table 1-1 Basic specifications of inCube20 control cabinet

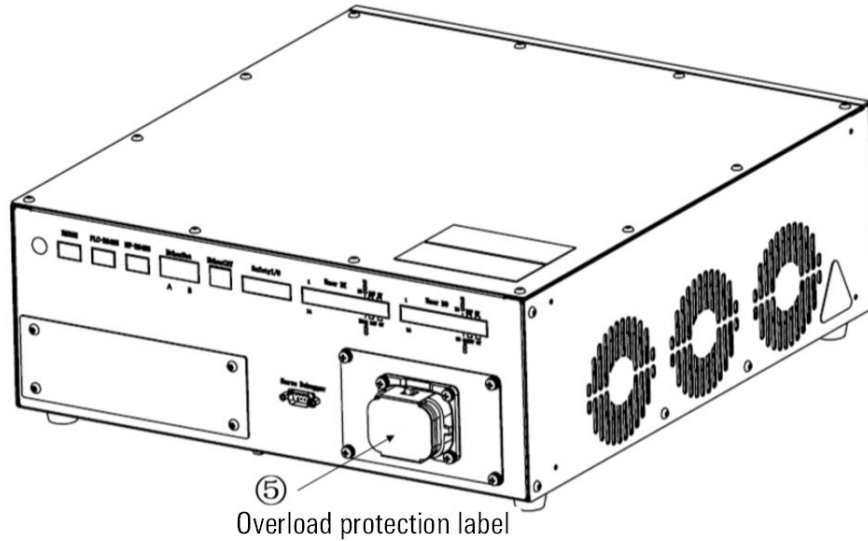
Name	Characteristic	
Cabinet body type	19" cabinet	
Color	Black	
Weight	20kg	
Protection class	IP20	
Number of axes	6-axis, externally expandable servo axis 2	
Noise	50dB(A)	
Rated supply voltage	AC220V±10%	
Power frequency	49Hz~61Hz	
Full load power	2.2KVA	
Fusing current	10A	
Vibration condition	Operation	Transportation
Vibration acceleration	0.5g	6g
Vibration frequency	4Hz~120Hz	5Hz~500Hz
Impact acceleration Instantaneous	2.5g	300g
Impact waveform/period	Half sine/11ms	Sawtooth wave/9ms
Operating temperature	0°C~45°C	

Name	Characteristic
Temperature change rate	<1.1K/min
Storage temperature	-25°C~60°C
Operating humidity	≤80% RH
Storage humidity	≤90%RH
Altitude	Normal operation at the altitude of below 1000m
	Derated by 5%/1000m at the altitude of 1000m-4000m

### 1.4 Control cabinet label and meaning

The inCube20 control cabinet contains 5 types of labels. The specific positions of the labels are shown in Figure 1-5.





(c)

Figure 1-5 Schematic diagram of positions of labels contained in the control cabinet

The meanings of labels are as follows:

① Pairing information signboard

The pairing information signboard is shown in Figure 1-6.

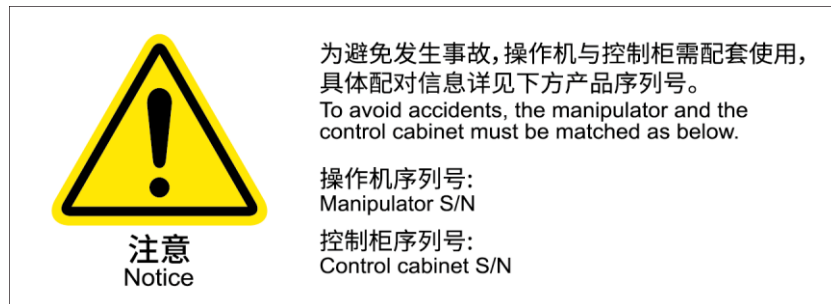


Figure 1-6 Pairing information signboard

② Door-opening power-off & maintenance signboard

The door-opening power-off & maintenance signboard is shown in Figure 1-7.



Figure 1-7 Door-opening power-off & maintenance signboard

③ High temperature sign

There may be heat in places where high temperature signs are provided (see Figure 1-8). When you see the sign, you should be careful not to be burned. If you have to touch the equipment under heat, be sure to wear protective equipment such as heat-resistant gloves before touching it.



Figure 1-8 High temperature sign on control cabinet

④Control cabinet nameplate

The control cabinet nameplate is shown in Figure 1-9. The nameplate indicates the model, serial number, weight, manufacture date and other related information of the control cabinet.



Figure 1-9 Control cabinet nameplate

⑤Overload protection label

The overload protection label on the control cabinet is shown in Figure 1-10. The protection label reminds you to remove the protective film before using the overload.



Figure 1-10 Overload protection label

## 1.5 Installation environment of control cabinet



- The ambient temperature should be 0°C -45°C.
- The relative humidity should be 20%-80% RH.
- The dust, oil mist and water vapor in the installation environment must be minimized.
- The environment must be free of flammable and corrosive liquids or gases.
- The equipment should be installed away from the impact and vibration sources.
- The control cabinet should have a heat dissipation distance of at least 20cm from the surrounding installation environment.



## 2 Transportation of inCube20 control cabinet

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### Transportation posture

- Make sure that all connectors on the control panel are unplugged.
- Make sure that the control cabinet is transported in a horizontal posture.

### Transportation by forklift

- A transportation tray should be provided under the control cabinet during transportation, as shown in Figure 2-1.



Figure 2-1 Schematic diagram of control cabinet transportation by forklift



### 3 Unpacking of inCube20 control cabinet

#### 3.1 Unpacking method and sequence

The schematic diagram of unpacking box of unCube20 control cabinet and ARCSP-AIR\_TP teach pendent is shown in Figure 3-1. The names of parts are shown in Table 3-1.

Table 3-1 Names of control cabinets and teaching pendant packaging boxes

Serial Number	Name
1	Box
2	Pearl Cotton - Cabinet-1
3	Pearl Cotton - Cabinet-2
4	Pearl cotton-cabinet -bottom
5	Pearl Cotton - Cabinet-3
6	Wooden box cover
7	Pearl Cotton - Cabinet - Cover
8	Hexagon socket head cap screw M10 × 80
9	InCube20 control cabinet
10	ARCSP AIR_TP teaching pendant - packaging
11	Cable

Figure 3-1 Diagram of unpacking the control cabinet and teaching pendant

The opening method of the inCube20 control cabinet and ARCSP-AIR\_TP teaching pendant packaging box is:

- Step1. Remove the lower cover ①, as shown in Figure 3-1, and observe the internal cables of the base.
- Step2. Check if there is wear or damage at the fixing point between the cable and the fixing plate.

- Step3. Use a 16MM hex wrench to remove the hex socket head cap screw M10 × 80⑧ from the wooden box cover ⑥ and open the wooden box cover⑥.
- Step4. Remove the ARCSP-AIR\_TP teaching pendant upwards - package⑩ and cable⑪ aside for installation and use.
- Step5. Lift out the pearl cotton-cabinet-cover⑦ upwards.
- Step6. Lift up the inCube20 control cabinet⑨ and place it aside for installation and use.
- Step7. After taking out the inCube20 control cabinet and the ARCSP-AIR\_TP"teaching pendant, it is necessary to properly store the components of the packaging box for future packaging during transportation.

## 3.2 Repacking to prevent damage due to transportation

The schematic diagram of repacking box of inCube20 control cabinet and ARCSP-AIR\_TP teach pendant is shown in Table 3-1. The names of parts are shown in Table 4-1.

In order to prevent damage due to transportation, the original packing box should be used for repacking. The repacking process is as follows:

- Step1. Place pearl cotton-cabinet-bottom④ at the bottom of the box.
- Step2. Place the pearl cotton-cabinet -1② and two pieces of pearl cotton-cabinet -2③ tightly against the side wall of the box on the pearl cotton-cabinet-bottom④. According to the location shown in the explosion diagram,
- Step3. Place the inCube20 control cabinet between the pearl cotton-cabinet -1② and the two pearl cotton-cabinets -2③.
- Step4. Place pearl cotton-cabinet-3⑤ in the gap on the handle side of inCube20 control cabinet⑨.
- Step5. Place pearl cotton-cabinet-cover⑦ above the inCube20 control cabinet.
- Step6. ARCSP-AIR\_TP teaching pendant - packaging⑩ and cables are placed in the position shown in the explosion diagram of pearl cotton - cabinet - cover⑦.
- Step7. Use a 16MM hex wrench to connect the wooden box cover to the box using the hex socket head cap screw M10 × 80⑧ Tighten and complete repackaging work.

## 3.3 Safe disposal of packaging materials

After unpacking, all parts of the packing box should be properly stored, during which attention should be paid to the followings:

- The storage area should be dry and clean.
- The temperature in the storage area should be stable.
- The storage area must be selected to ensure that the materials of component of the packing box will not be damaged.
- The packing box should be stored indoors.

## 4 Installation and connection of inCube20 control cabinet

### 4.1 Check items

Before installing the control cabinet, the following items must be strictly observed:

- Make sure that the installation personnel must pass the relevant training of the company and perform the installation work in compliance with international and local laws and regulations.
- Make sure that the control cabinet is free from bump or damage after unpacking.
- Make sure that the control cabinet installation environment meets the requirements in *Section 1.5* of this manual.

### 4.2 Installation dimensions

The inCube20 control cabinet is a control cabinet of 3U height that supports installation in a 19" cabinet. The specific dimensions are shown in Figure 4-1.

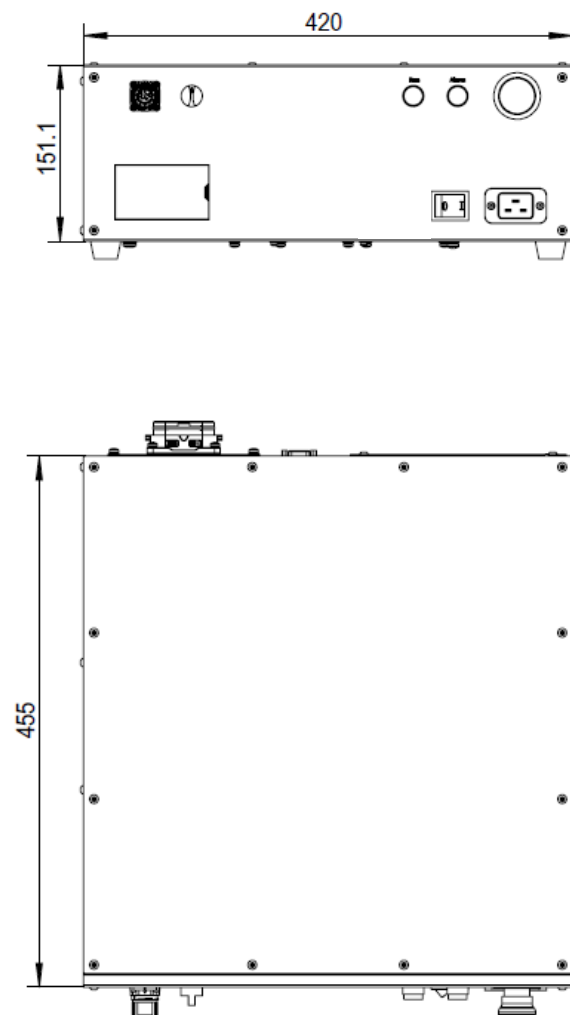


Figure 4-1 Outline dimensions of cabinet

### 4.3 Installation method

## Direct installation

The inCube20 control cabinet can be placed directly on a platform that meets the installation environment, which may not be a movement platform. The contact points between the platform and the four feet pads of the control cabinet must be on the same plane.

Requirements:

- The platform will come into contact with the four feet pads during normal placement. The surface on which the control cabinet is placed can have a certain angle of inclination, which, however, may not be greater than 30°.
- A certain weight load can be placed on the top surface of the control cabinet, but the load weight may not be greater than 40kg, and the load contact area may not be less than 80% of the top surface of the cabinet.

## Installation of 19" cabinet

The inCube20 can be installed in a 19" cabinet, should be greater than 600mm in the direction of the depth of the cabinet, and should be reserved with vents on the left and right sides. The control cabinet can be installed with the accessories shown in Figure 4-2. Please refer to Appendix A for information on the accessories that may be required for installing the control cabinet.

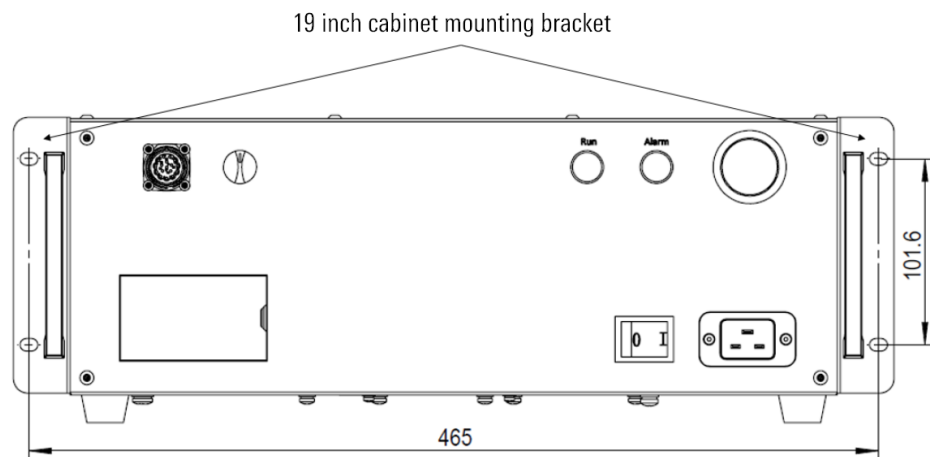


Figure 4-2 Installation diagram of 19" cabinet

When the control cabinet is installed in a 19" cabinet, high-strength screws (such as hexagon socket head screw, grade 12.9, M5X12) should be used, and a 19" cabinet tray should be installed at the bottom of the control cabinet.

## Stacking of control cabinet

The inCube20 control cabinet supports a maximum of three stacking cabinets. If multiple control cabinets are used and high requirements are posed on the footprint of the control cabinet, the cabinets can be stacked in the manner shown in Figure 4-3. For details about the materials used for stacking, please refer to Appendix A "List of Accessories" in this manual.



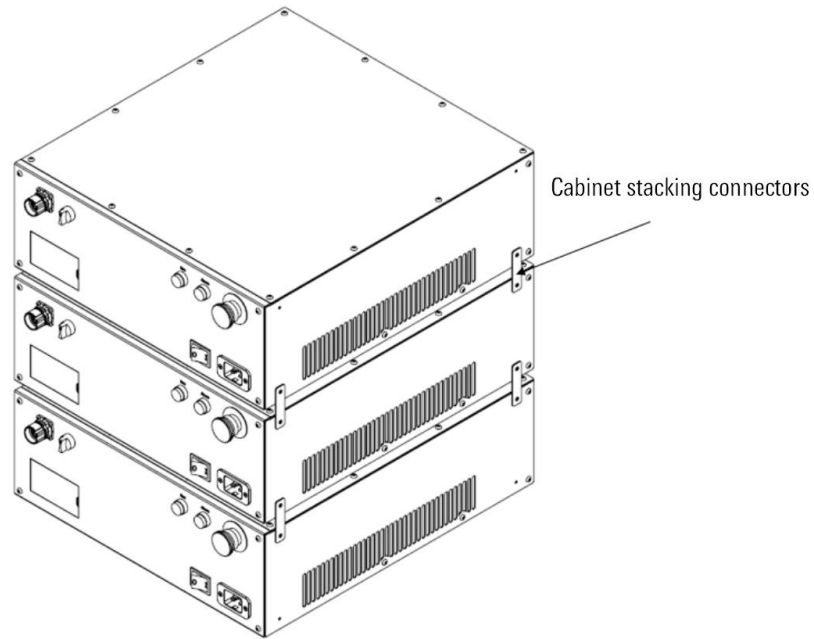
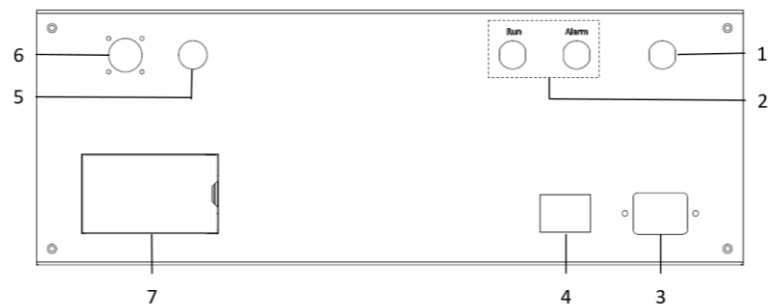
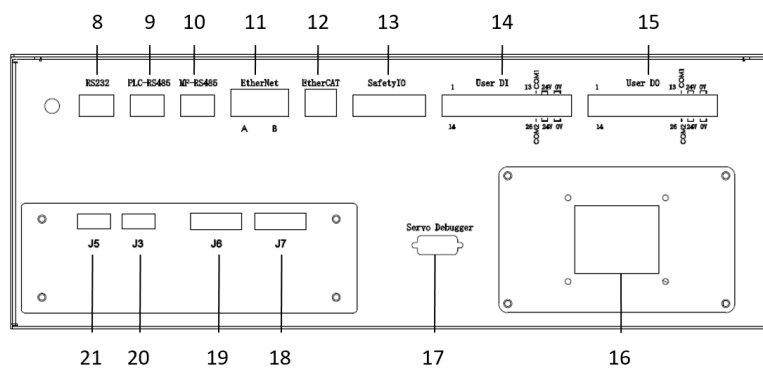


Figure 4-3 Cabinet stacking

### 4.4 Control cabinet interface



(a)



(b)

Figure 4-4 Position of interface of inCube20 control cabinet

All operation buttons, indicators and connection interfaces of the inCube20 control cabinet are designed on the front panel, as shown in Figure 4-4. The names and functions of interface are shown in Table 5-1.

Table 4-1 Description of interface of inCube20 control cabinet

No.	Interface identification	Interface name	Illustrate
1		Emergency stop button	In case of emergency, press the emergency stop button to stop the robot from moving
2		Indicator group	Display the operation and alarm status of the control cabinet
3		Power cord inlet	220V mains interface
4		Power switch	Main power switch of control cabinet
5		Teaching pendant insertion and removal knob	When plugging and unplugging the teaching pendant, it serves as a shield for the teaching pendant
6		Teach pendant interface	Teaching pendant connection port
7		Manual brake release enable box	The button can control the brake release enable switch
8	RS232	User serial port RS232	Connect any device that supports the RS232 serial protocol
9	PLC-RS485	PLC slave interface RS485	Connect any device that supports the Modbus RTU master protocol
10	MF-RS485	PLC-MF master station interface RS485	Connect to the PLC-MF module for extending user DI/DO
11	EtherNet	User EtherNET network port	Connect any device that supports the Ethernet TCP/IP protocol
12	EtherCAT	Expanded external axis EtherCAT network port	Connect any device that supports the EtherCAT bus protocol
13	SafetyIO	Safety IO interface	Implement safety functions such as safety barriers, emergency stop outputs, and emergency stop inputs
14	UserDI	User DI interface	Connect any device that supports DI
15	UserDO	User DO interface	Connect any device that supports DO
16		Overload interface	Control cabinet connection manipulator interface
17	Servo Debugger	Debug interface	Connect to the servo debugging software ServoDebugger
18	J6	Magnetic scale and CAN interface	Connect incremental magnetic grating ruler or CANopen welding machine
19	J7	Encoder connector	Connecting incremental encoders or absolute encoders
20	J3	Voltage input and current input interface	Connect any device that supports AO function, -10V~+10V or 0-20mA
21	J5	PWM output and analog output interface	Connect any device that supports AI function, -10V~+10V or 0-20mA



For description of the above interface, please refer to Section 5.4 "Description of control cabinet interface".

## 4.5 Connection of control cabinet

### Connection of teach pendant

The upper left corner of front panel of inCube20 control cabinet is the teach pendant connection interface, which is connected by a quick-plug connector:

- When connecting, align the plane of #1 plug with that of #2 socket, as shown in Figure 4-5. At this time, align the triangle alignment symbols on the plug and the socket, and then push the connector inside. Turn the plug clockwise 45 degrees to lock the plug onto the socket.
- When removing, turn the plug 45 degrees counterclockwise to align the plane of #1 plug with that of #2 socket, and then pull out the plug.

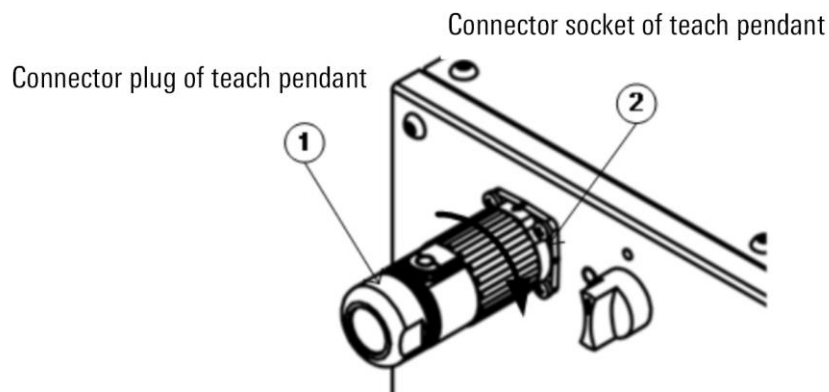


Figure 4-5 Connection of teach pendant

### Manipulator power encoder connection

The lower right corner of the rear panel of the inCube20 control cabinet is the power encoder connection interface of the manipulator. It uses a heavy-duty connector. The heavy-duty connector has the function of clamping and error prevention. When connecting, insert the male plug of the heavy-duty connector into the female. Insert the body and fasten the lock.

The size of the heavy-duty plug is shown in Figure 4-6, the heavy-duty wire diameter is  $20.2 \pm 0.6\text{mm}$ , and the minimum bending radius is 6D (six times the cable diameter).

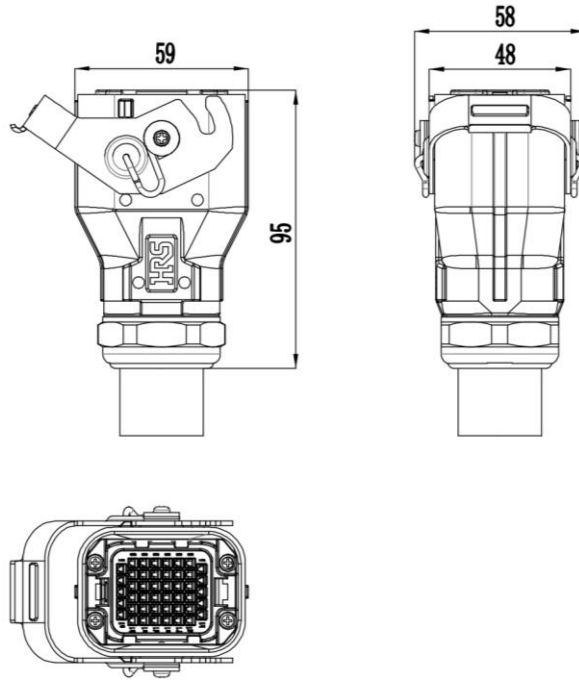



Figure 4-6 Heavy-duty plug size chart

### Connection of other interfaces

"Other interfaces" are the interfaces that are reserved on inCube20 control cabinet for users:

- For user interface connections with threaded locking mechanisms, such as user serial port RS232, Modbus slave interface RS485, PLC-MF master interface RS485, and Safety IO interface, the threads must be tightened during connection.
- For user interface connections without locking mechanisms, such as expanding the external axis EtherCAT network port and user EtherNET network port, the crystal head must be fully inserted into the plug when connecting; When connecting the power cord, fully insert the pin shaped power plug into the socket.



Tip

For details about connection cables with the above interfaces, please refer to Appendix A "List of Accessories".

## 4.6 Definition of control cabinet electrical connection

### Definition of teach pendant interface

The interface of the inCube20 control cabinet teaching pendant is shown in Figure 4-7., and the pin number definition of the connector interface is detailed in Table 4-2.

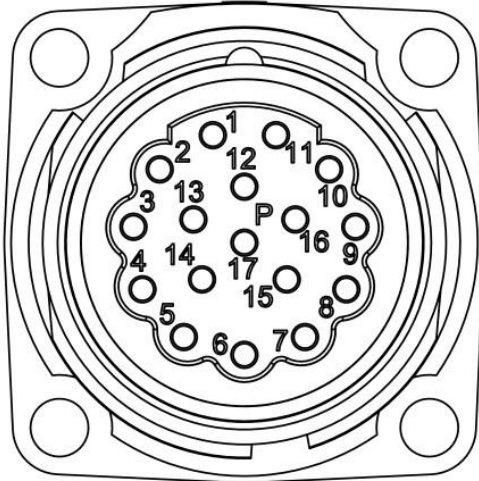


Figure 4-7 Teach pendant interface

Table 4-2 Definition of pin number of teach pendant connector interface

Pin No.	Signal name	Wire color	Pin No.	Signal name	Wire color
1	ESTOP_INT+	White	9	+24VD	Black
2	ESTOP_INT-	Brown	10	+24VD_RTN	Purple
3	ESTOP_SAF+	Green	12	TX+	White/orange
4	ESTOP_SAF-	Yellow	13	TX-	Orange
5	ENA_INT+	Gray	14	RX+	Whit/green
6	ENA_INT-	Orange	15	RX-	Green
7	ENA_SAF+	Blue	17	Shielding layer	Shell
8	ENA_SAF_	Red			

### Definition of overload interface

The definition of the overload interface for the inCube20 control cabinet is shown in Figure 4-8, and the definition of the overload interface is detailed in Table 4-3.

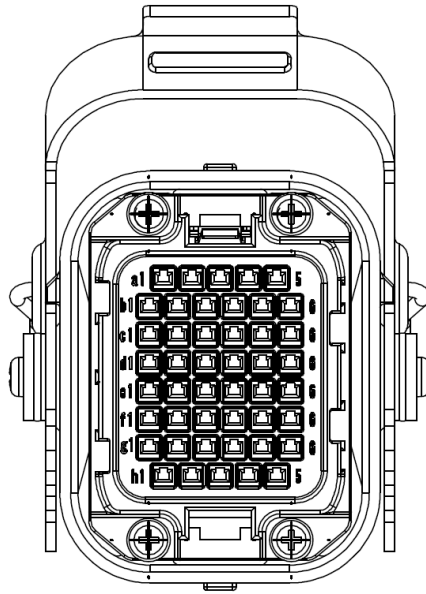


Figure 4-8 Definition of overload interface of inCube20 control cabinet

Table 4-3 Definition of overload interface of inCube20 control cabinet

Pin No.	a	b	c	d	e	f	G	h
1	J1_PS+	J1_PS-	Encoder 0V	PE	GND_24VBR	U1	V1	W1
2	J2_PS+	J2_PS-	Encoder 24V	-	24V_BR+2_0	U2	V2	W2
3	J3_PS+	J3_PS-	E_NAME_BOARD_RS485_B	-	24V_BR+	U3	V3	W3
4	J4_PS+	J4_PS-	E_NAME_BOARD_RS485_A	PE	-	U4	V4	W4
5	J5_PS+	J5_PS-	DC_24V_ISO_RDC	-	U6	U5	V6	W5
6	-	J6_PS+	J6_PS-	GND_ISO_RDC	-	V6	W6	-



Tip

For definition of other interface connectors, please refer to *Section 5*.

## 5 inCube20 control cabinet interface instructions

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### 5.1 Control cabinet indicator light description

The inCube20 control cabinet provides 2 indicator lights, of which:

- The green indicator is a running indicator, which is on when the program is running.
- The red indicator is an alarm indicator, which lights up when the control system is abnormal.

### 5.2 Description of control cabinet operation buttons

#### Switch

The power switch of the inCube20 control cabinet is a rocker switch with light, and the word O/I is printed on the switch. Under normal use:

- When the switch is in the I position, it means that the control cabinet is on, and the indicator light inside the switch is on.
- When the switch is set to O position, it means that the control cabinet is closed, and the indicator light inside the switch is off.



Tip

Refer to *Chapter 8* for the normal startup process of the control cabinet.



Notice

When the cabinet is not in use, the switch must be set to O position.

#### Emergency button

The emergency stop button of the inCube20 control cabinet is a mushroom emergency stop button. When the emergency stop button is pressed, the robot stops immediately (STOP1). When you need to release the safe state, you should turn up the emergency stop button in the direction indicated on the button first.



Notice

Do not use the emergency stop button as a pause function, otherwise it may cause damage to the manipulator.

#### Teach Pendant Plug Knob

inCube20 control cabinet teach pendant plug-in knob, the knob has two positions O/1:

- When the knob is set to gear 1, it means that the teach pendant must be connected for normal use, otherwise the control cabinet will give an alarm.
- When the knob is set to gear 0, it means that the teach pendant can be removed, and the robot system can still continue to run at this time.

When the teach pendant is connected to the normal operation, if you want to unplug the teach pendant, you must first set the knob to 0, and then unplug the teach pendant; if you want to connect the teach pendant again, you need to plug in the teach pendant and wait for the display. The start of the teach pendant is completed, and the interface of the teach pendant shows that the network connection is normal, and then set the knob from 0 to 1. If you operate the knob without waiting for the start of the teach pendant to complete, it may cause the robot to stop.

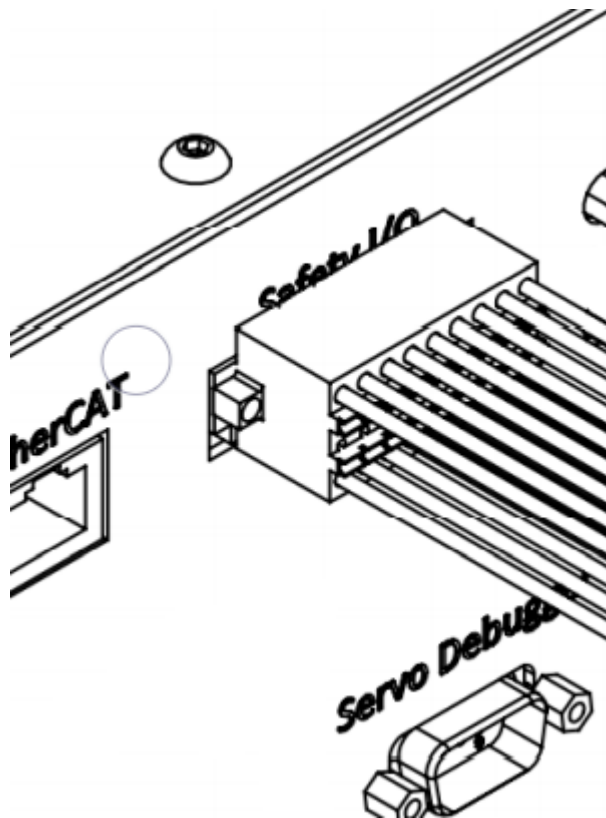


For the system that still needs to run after unplugging the teach pendant, make sure that the control cabinet is connected to an external control device before unplugging it.

## 5.3 Instructions for the external interface of the control cabinet

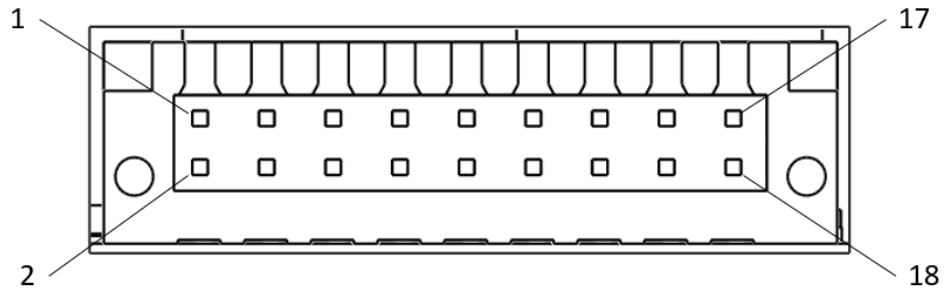
### Safety IO interface

The safety IO interface of the inCube20 control cabinet is fixed and cannot be configured by the user. The wiring diagram and pin identification diagram of the safety IO interface refer to Figure 5-1, and the pin definition refers to Table 5-1.



(a) Safety IO interface wiring diagram





(b) Safety IO interface pin identification diagram

Figure 5-1 Safety IO interface and pin diagram

Table 5-1 Safety IO interface definition list

Pin number	Signal name	Signal significance	In/Out
1	D+24V_EX	24V power supply	Power
2	EX_ESTOP_DI_SAF	External emergency stop input	In
3	D+24V_EX	24V power supply	Power
4	EX_ESTOP_DI_INT	External emergency stop input	In
5	D+24V_EX	24V power supply	Power
6	BARRIER_DI_SAF	Safety barrier input	In
7	D+24V_EX	24V power supply	Power
8	BARRIER_DI_INT	Safety barrier input	In
9	D+24V_EX	24V power supply	Power
10	EX_SAFE_DI_SAF	External security input	In
11	D+24V_EX	24V power supply	Power
12	EX_SAFE_DI_INT	External security input	In
13	GND_EX	Signal ground	GND
14	EX_ALARM_DI	External alarm input, equipped with dedicated alarm input pins for external axis drivers	In
15	ESTOP_OUT_1+	Emergency stop output contact 1 positive	Out
16	ESTOP_OUT_1-	Emergency stop output contact 1 negative	Out
17	ESTOP_OUT_2+	Emergency stop output contact 2 positive	Out
18	ESTOP_OUT_2-	Emergency stop output contact 2 negative	Out

Safety IO provides signals such as emergency stop output, external emergency stop input, external alarm input, external safety barrier input, and external safety confirmation input. The signal usage method is shown in pin numbers 1-18 in Figure 5-2. The 24V of the Safety IO interface does not provide external power supply.

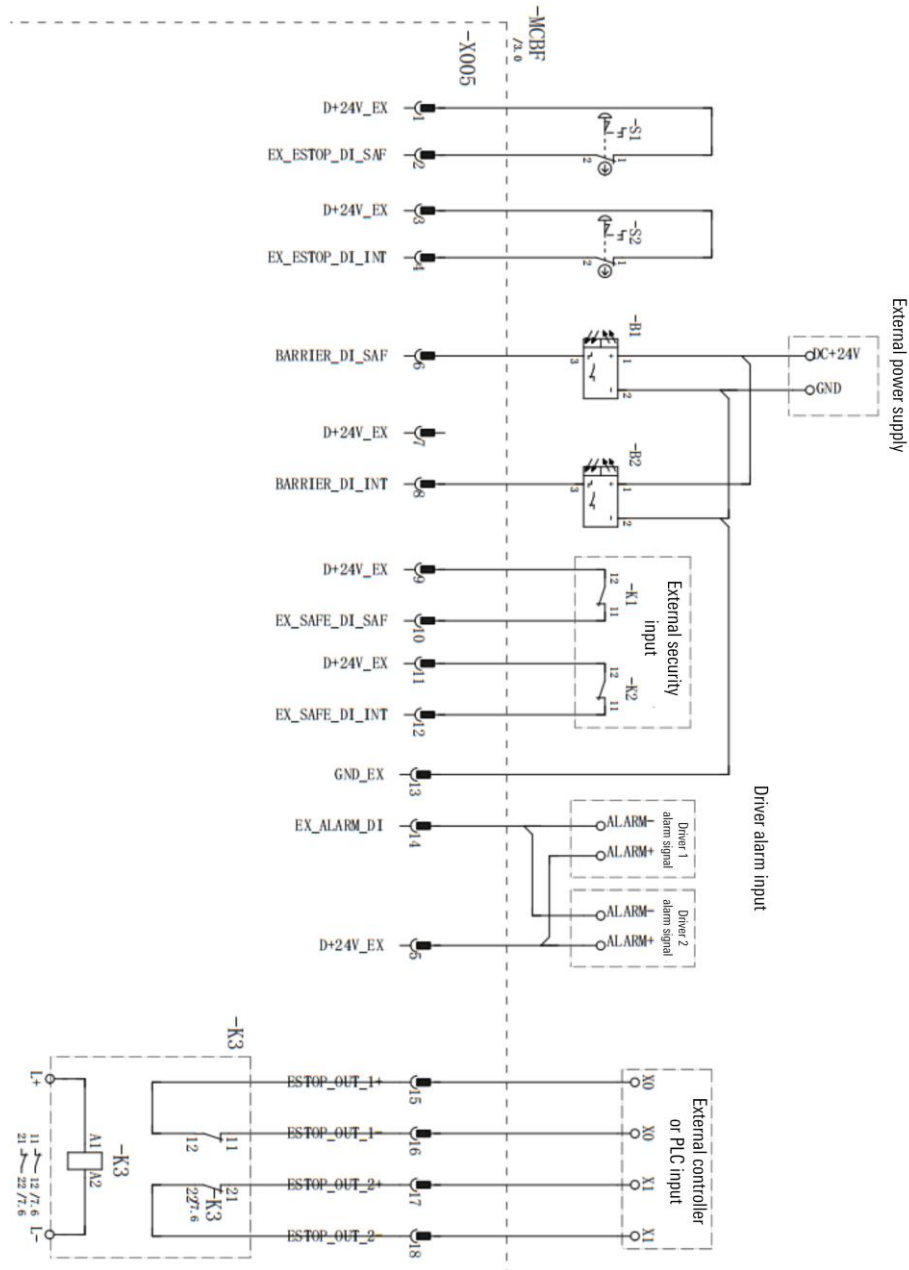


Figure 5-2 Safety IO output signal

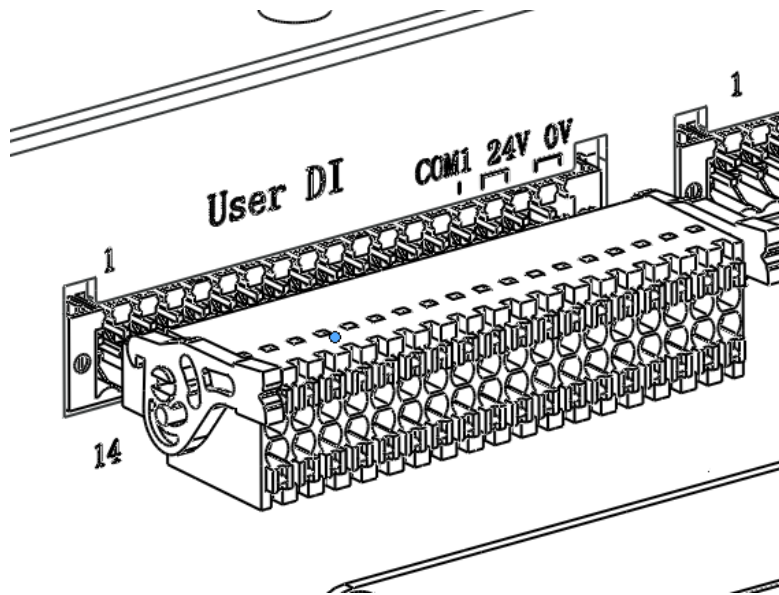
### User DI interface

The inCube20 control cabinet provides users with 26 channels of DI, 2 channels of input common interface, and 4 channels of power interface. The D+24V-EX and GND\_EX of this power interface can only be used for DI function testing, and cannot be used for power output above 0.5W, otherwise it will cause abnormal or ineffective IO function.

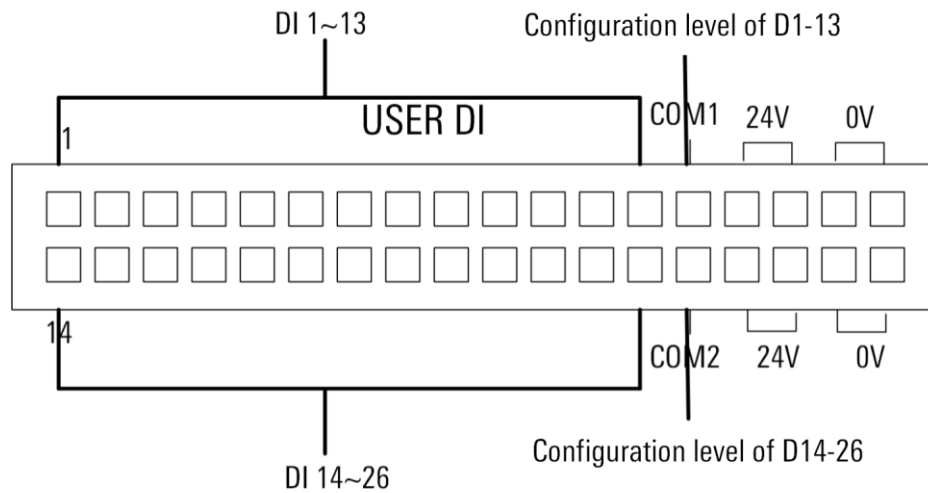
When using the DI interface, an external power supply must be used.

The User DI and User DO of the control cabinet use the same connector, which may result in incorrect insertion. When the User DO is connected to an inductive load, an external 24V power supply needs to be connected. If the User DI and User DO are plugged in incorrectly, it will cause damage to the circuit of the control cabinet. Please ensure that the connectors are connected to the correct sockets when using User DI and User DO.

The wiring diagram and interface pin labels of the User DI interface are shown in Figure 5-3. The definition of the User DI interface is shown in Table 5-2, and the interface usage information is shown in Figure 5-4 and Figure 5-6. The User DI pin number will be identified by screen printing on the sheet metal surface.



(a) User DI interface wiring diagram



(b) User DI interface pin identification diagram

Figure 5-3 User DI interface and pin diagram

Table 5-2 User DI interface definition list

Screen printing position	Signal significance	In/Out
DI 1	Configurable digital input	In
DI 2	Configurable digital input	In
DI 3	Configurable digital input	In
DI 4	Configurable digital input	In
DI 5	Configurable digital input	In
DI 6	Configurable digital input	In

Screen printing position	Signal significance	In/Out
DI 7	Configurable digital input	In
DI 8	Configurable digital input	In
DI 9	Configurable digital input	In
DI 10	Configurable digital input	In
DI 11	Configurable digital input	In
DI 12	Configurable digital input	In
DI 13	Configurable digital input	In
DI 14	Configurable digital input	In
DI 15	Configurable digital input	In
DI 16	Configurable digital input	In
DI 17	Configurable digital input	In
DI 18	Configurable digital input	In
DI 19	Configurable digital input	In
DI 20	Configurable digital input	In
DI 21	Configurable digital input	In
DI 22	Configurable digital input	In
DI 23	Configurable digital input	In
DI 24	Configurable digital input	In
DI 25	Configurable digital input	In
DI 26	Configurable digital input	In
COM 1	DI1-13 input common terminal	
COM 2	DI14-26 input common terminal	
24V	24V power supply	Power
24V	24V power supply	Power
24V	24V power supply	Power
24V	24V power supply	Power
0V	Signal ground	GND
0V	Signal ground	GND
0V	Signal ground	GND
0V	Signal ground	GND

PNP or NPN type sensor signals, switch signals, and relay contact signals can be used as inputs for user DI. The inCube20 control cabinet supports PNP and NPN type sensor inputs. When using an NPN type sensor, the common end corresponding to this DI needs to be directly connected to an external 24V power source. When using a PNP type sensor, the common end corresponding to this DI needs to be connected to an external power source ground. The control cabinet provides two sets of configurable common terminals. Among them, COM1 corresponds to DI1~DI13, and COM2 corresponds to DI14~DI26.

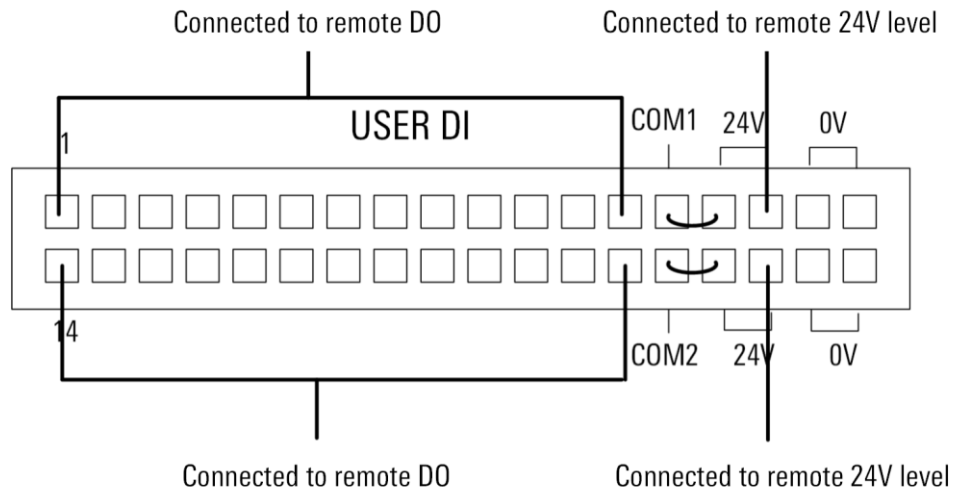


Figure 5-4 User DI interface instructions (NPN Input)

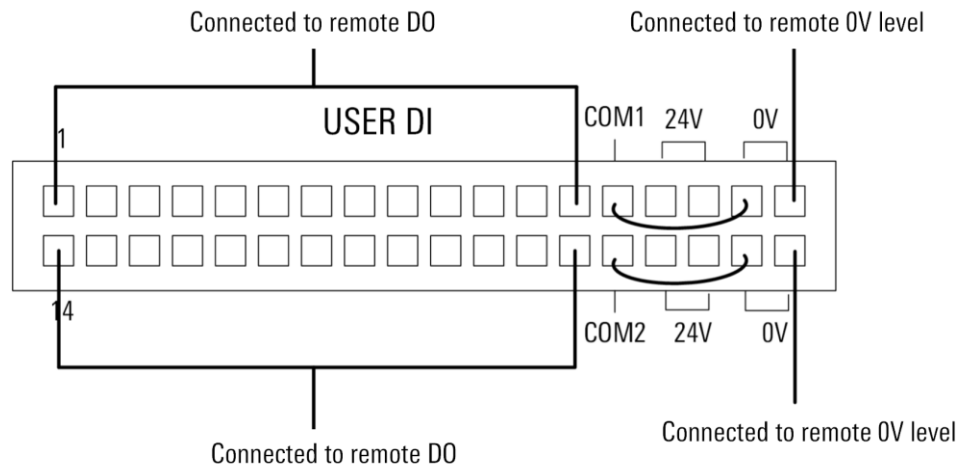


Figure 5-5 User DI interface instructions (PNP Input)

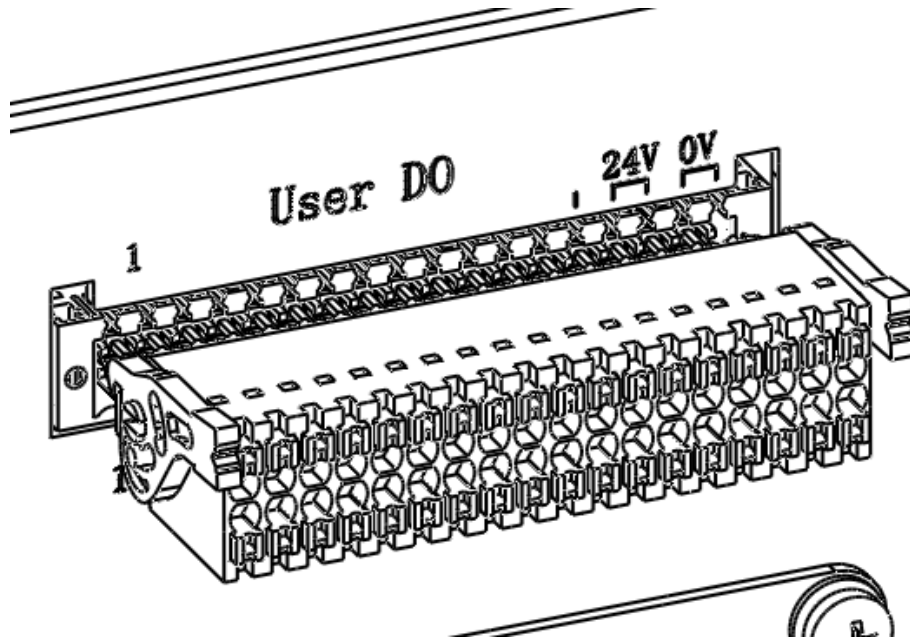
### User DO interface

The inCube20 control cabinet provides users with 26 DO and 4 continuous current power interfaces. The wiring diagram of the User DO interface is shown in Figure 5-6 (a), and the pin labels of the User DO interface are shown in Figure 5-6 (b). The definition of the User DO interface is detailed in Table 5-3.

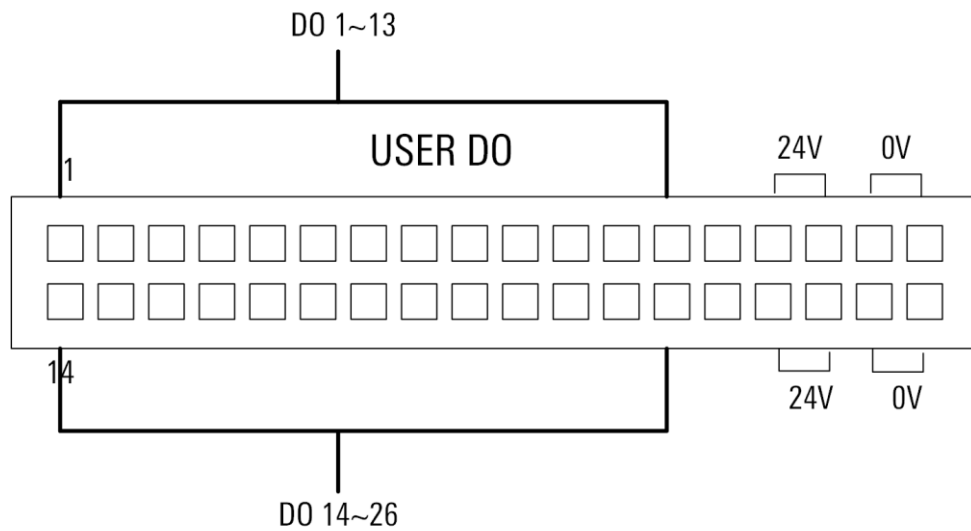
The inCube20 control cabinet provides users with 26 DO interfaces with NPN polarity, and the maximum single input current of all DOs is 160mA. When DO is connected to an external load, to avoid damage to the interface during shutdown, it is necessary to connect "24V" to an external power source. Refer to Figure 5-6 for interface usage information.

If external PNP polarity sensors and switches are required, corresponding polarity transfer equipment needs to be used.

The User DI and User DO of the control cabinet use the same connector, which may result in incorrect insertion. When the User DO is connected to an inductive load, an external 24V power supply needs to be connected. If the User DI and User DO are plugged in incorrectly, it will cause damage to the circuit of the control cabinet. Please ensure that the connectors are connected to the correct sockets when using User DI and User DO.



(a) User DO interface wiring diagram



(b) User DO interface pin identification diagram

Figure 5-6 User DO interface and pin diagram

Table 5-3 User DO interface definition list

Screen printing position	Signal significance	In/Out
DO 1	NPN digital output	Out
DO 2	NPN digital output	Out
DO 3	NPN digital output	Out
DO 4	NPN digital output	Out
DO 5	NPN digital output	Out
DO 6	NPN digital output	Out
DO 7	NPN digital output	Out
DO 8	NPN digital output	Out

Screen printing position	Signal significance	In/Out
DO 9	NPN digital output	Out
DO 10	NPN digital output	Out
DO 11	NPN digital output	Out
DO 12	NPN digital output	Out
DO 13	NPN digital output	Out
DO 14	NPN digital output	Out
DO 15	NPN digital output	Out
DO 16	NPN digital output	Out
DO 17	NPN digital output	Out
DO 18	NPN digital output	Out
DO 19	NPN digital output	Out
DO 20	NPN digital output	Out
DO 21	NPN digital output	Out
DO 22	NPN digital output	Out
DO 23	NPN digital output	Out
DO 24	NPN digital output	Out
DO 25	NPN digital output	Out
DO 26	NPN digital output	Out
NC	Not connected	
NC	Not connected	
24V	Power interface for continuous	Power
24V	Power interface for continuous	Power
24V	Power interface for continuous	Power
24V	Power interface for continuous	Power
0V	Ground	GND
0V	Ground	GND
0V	Ground	GND
0V	Ground	GND

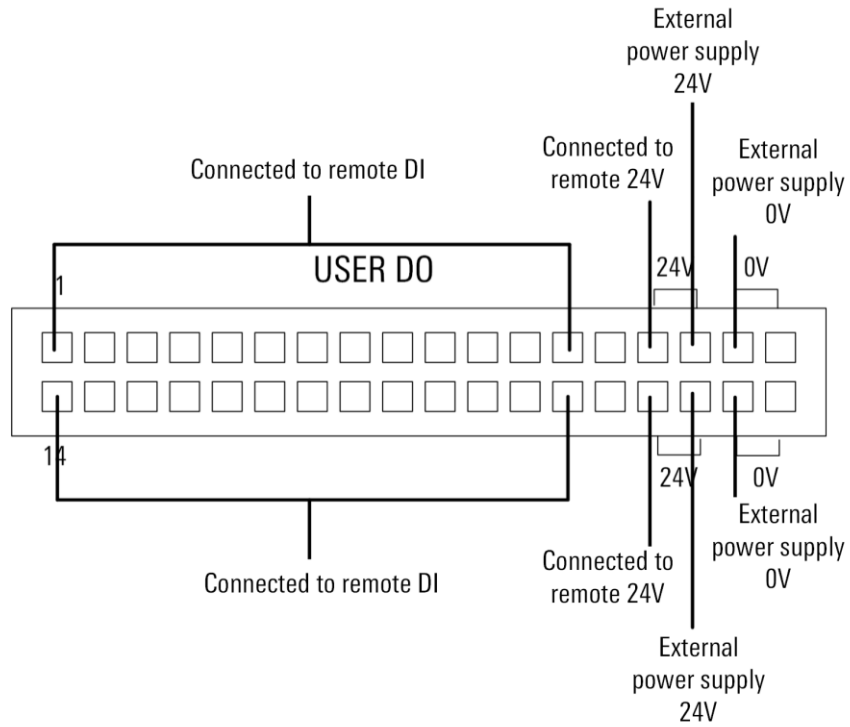
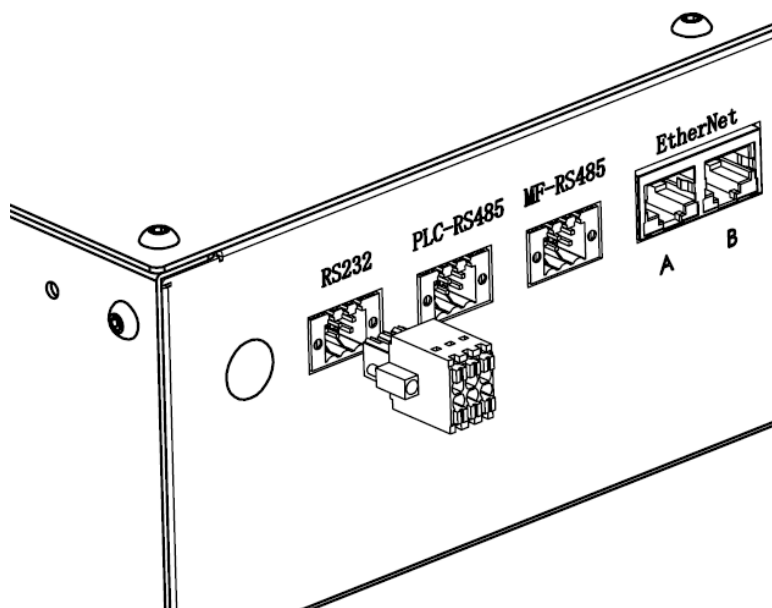


Figure 5-7 User DO Interface Instructions

### User serial port RS232 interface

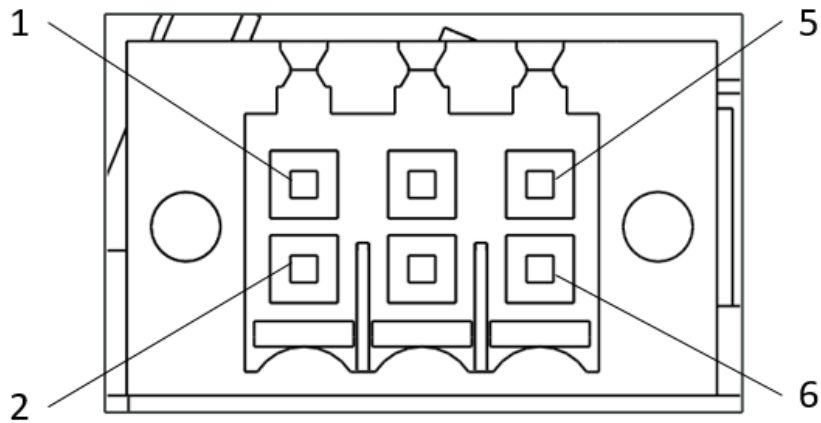
The inCube20 control cabinet RS232 interface is an RS232 communication interface provided to users, and the RS232 interface is a plug-in terminal connector.

When using the RS232 interface, you can select the cable that is paired with the RS232 interface according to Figure 5-8. The wiring diagram and pin identification diagram of the RS232 interface refer to Figure 5-9, and the cable definition refers to Table 5-4.



(a) RS232 interface wiring diagram





(b) RS232 interface pin identification diagram

Figure 5-8 RS232 interface and pin diagram

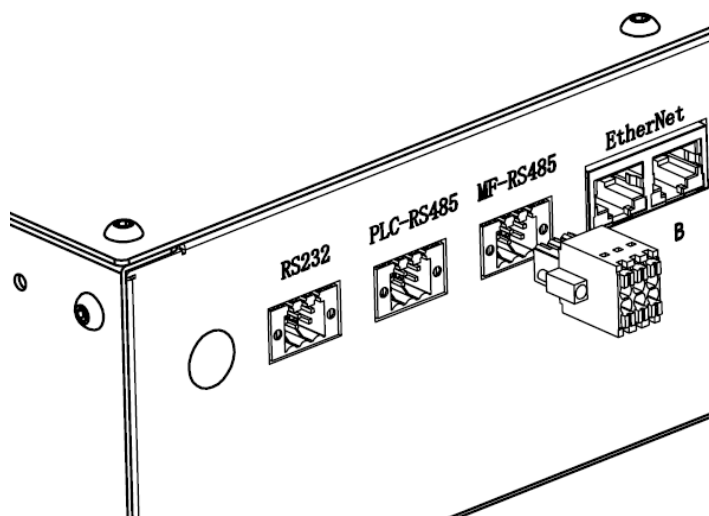
Table 5-4 RS232 interface definition diagram

Interface	Pin	Cable definition	Signal significance	In/Out
RS232	1	PC_UART0_RXD	Control cabinet sending	Out
	2	PC_UART0_TXD	Control cabinet reception	In
	3	GND_ISO_RS232	Signal ground	GND
	4	CHGND	Shield ground	

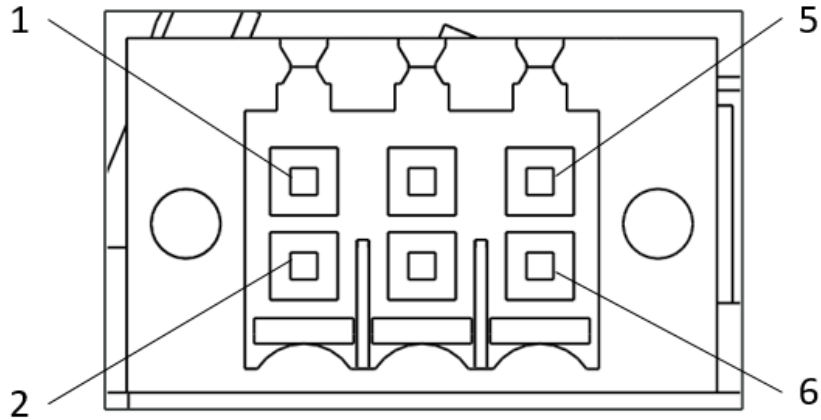
### MF-RS485 interface

The MF-RS485 interface of the inCube20 control cabinet is an external expansion MF interface, and the MF-RS485 interface is a plug-in terminal connector.

When using this interface, you can wire according to the MF-RS485 pin label (see Figure 5-9) and MF-RS485 interface definition (see Table 5-5), or choose the cable to pair with the MF-RS485 interface according to the "Appendix A inCube20 Accessories List".



(a) MF-RS485 interface wiring diagram



(b) MF-RS485 interface pin identification diagram

Figure 5-9 MF-RS485 interface and pin diagram

Table 5-5 MF-RS485 interface definition list

Interface	Pin	Cable definition	Signal significance	In/Out
MF-RS485 interface	1	RS485+	RS485 bus positive	In
	2	RS485-	RS485 bus negative	Out
	3	GND_ISO_MF	Isolation signal	GND
	4	CHGND	Shield ground	

### PLC-RS485 interface

The PLC-RS485 interface of the inCube20 control cabinet is an external PLC slave interface, and the RS485 interface is a plug-in terminal connector.

When using this interface, you can refer to the inCube20 accessory list in Appendix A and the cables paired with the PLC-RS485 interface. The PLC-RS485 interface is the same as MF-RS485, and the wiring diagram and pin identification diagram of the PLC-RS485 interface refer to Figure 5-9, and the cable definition refers to Table 5-5.

### User Ethernet port

The inCube20 control cabinet provides users with two user Ethernet network ports, which are used to connect industrial Ethernet and sensors communicating with Ethernet.

Refer to Figure 5-10 for the interface diagram of the user Ethernet port.

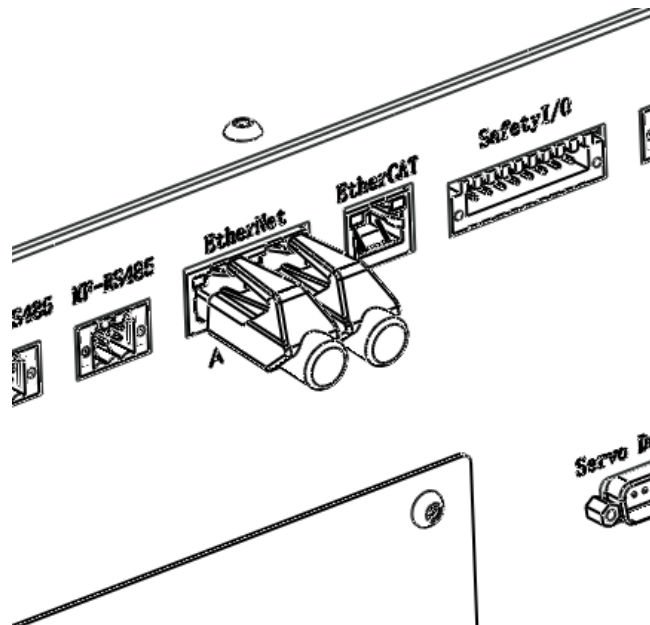


Figure 5-10 Interface diagram of user Ethernet interface

### User EtherCAT network port

The inCube20 control cabinet reserves one EtherCAT interface as the expansion external axis interface and EtherCAT protocol conversion port. Refer to Figure 5-11 for the interface diagram of the user EtherCAT network port.

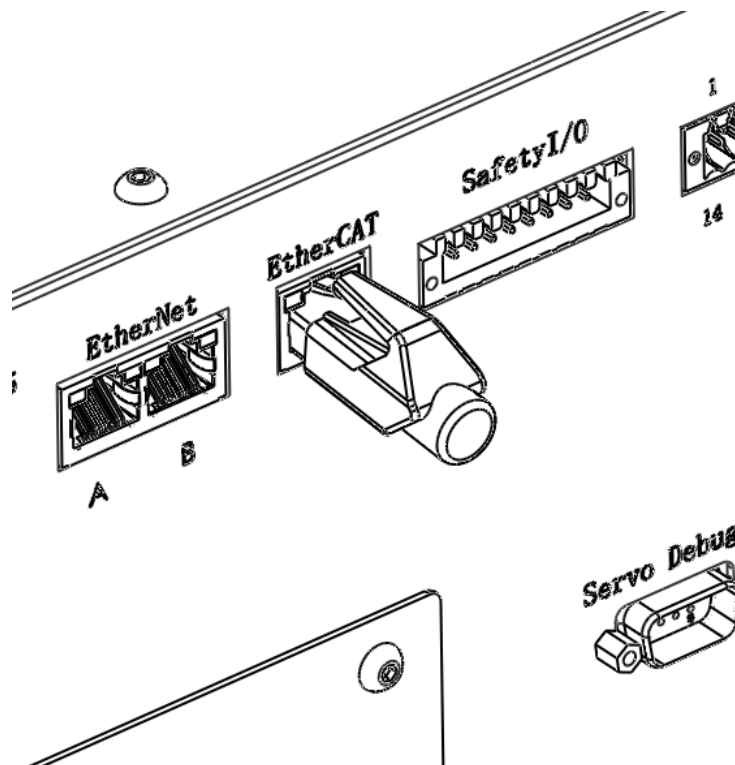


Figure 5-11 Interface diagram of user EtherCAT network interface

The extended use of the external axis is as follows: the external axis driver is external, and the compact cabinet does not provide power supply for the external axis motor and external axis driver, nor does it provide power supply for the external axis brake. The external axis communicates with the compact cabinet through EtherCAT bus, and the external

axis driver alarm can be connected to the compact cabinet through a safety IO interface. The control cabinet provides two safety IO connections.



When connecting the external expansion axis EtherCAT communication port of the inCube20 control cabinet, the connector shown in the "Appendix A inCube20 Accessories List" can be selected for installation and connection.

## 6 Safe use of inCube20 control cabinet

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### 6.1 Grounding of control cabinet

The inCube20 control cabinet must have reliable ground connection. The main purpose of the ground connection is as follows:

- The grounding makes all unit circuits in inCube20 control cabinet have a common reference zero potential, so that there is no potential difference between the grounds of various circuits, which ensures the stable operation of the system.
- The reliable ground connection of inCube20 control cabinet can prevent the jamming from any external electromagnetic field. The case grounding provides a relief channel for transient jamming, which allows a large amount of charge accumulated on the case due to electrostatic induction to be discharged through the ground.
- It can guarantee safe operation. When the electromagnetic induction of direct lightning occurs, it can avoid any damage to electronic equipment; when the input voltage of the power frequency AC power supply is directly connected to the case due to poor insulation or other reasons, it can protect the operator from electric shock.

The inCube20 control cabinet is grounded through the PE pin in the power cord inlet. It must be ensured that the cable input terminal connected to the control cabinet has a reliable ground connection. In addition, the control cabinet is provided with a grounding point. If necessary, the grounding wire can be connected to the grounding point shown below.

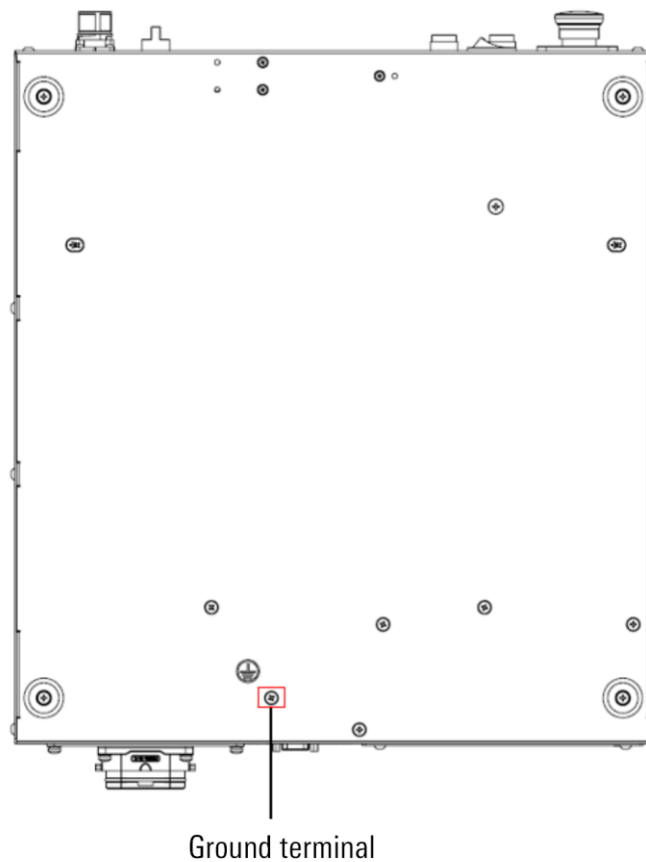


Figure 6-1 Schematic diagram of grounding wire connection point of inCube20 control cabinet

## 6.2 Safety of robot system

The robot system herein (including the manipulator, control cabinet, teach pendant and all software and hardware) can work normally only when the peripheral equipment and system are constructed. The peripheral equipment and system must contain the safety barrier, external emergency stop equipment and external safety input equipment necessary for the safe operation of the robot.

The signal definitions of the above safety devices are fixed in the inCube20 control cabinet Safety IO interface. Only when the safety signal of the SAFETY IO has a reasonable level, the control cabinet can be used normally, otherwise the control cabinet alarms. Refer to Figure 6-1 for the connection of the safety signal of the Safety IO interface, and refer to Table 5-1 for the names and meanings of the pin numbers in the figure.

The safety input signals include safety barrier signals, external emergency stop input signals, and external safety input signals, as shown in Table 6-1.

Table 6-1 Safety input signal description

Signal name	Description
Safety fence signal	Safety light curtain signal equipped for safety fence Support PNP type sensor, must be equipped with external DC24V power supply
External emergency stop input signal	Emergency stop signal for external systems that complete tasks in collaboration with robots When the emergency stop button of the external system is photographed, the external emergency stop signal of the control cabinet is valid, and the robot stops according to STOPO The external emergency stop output signal needs to have two channels, one of which is used as a safety link backup, and the external emergency stop input signal is valid at high level
External safety input signal	It is mainly the safety (fault) signal of the external system that completes the work with the robot. The control cabinet will judge whether the robot needs to be stopped according to the state of the external system. External safety input signal is active high

## 6.3 Robot stop method

According to 9.2.2 "Definition of stop function" of GB5226.1-2008 "Electrical safety of machinery-Part 1: General Conditions", in combination with the specific design of the robot, the three stop methods are defined below. The corresponding description is given in Table 6-2:

Table 6-2 Stop method and corresponding description

Type	Description
STOPO	Case1 MCBS sends an alarm to DCBS through an internal hard wire connection. DCBS execution immediately stops without maintaining its trajectory, and then MCBS delay control is enabled to cut off power through thyristor, which is an uncontrollable stop
	Case2 When an uncontrollable fault occurs in DCBS, the free stop or the brake stop will be triggered, which is an uncontrollable stop.
	Case3 When there is a sudden external power failure and DCBS fails to execute an immediate stop, the brake stop will be triggered, which is an

Type	Description
	uncontrollable stop.
STOP1	It will stop the robot quickly and maintain the current planned path. When the robot stops, it will control the drive to servo_off and cut off the power supply via the thyristor, which is a controllable stop.
STOP2	It will stop the robot quickly and maintain the current planned path. When the robot stops, it will not control the drive to servo_off and cut off the power supply, which is a controllable stop.





## 7 inCube20 control cabinet start

---

In order to ensure the normal startup and use of the inCube20 control cabinet, the startup operation must be carried out in strict accordance with the following steps.

- Step1. Visually inspect the appearance of the control cabinet to check whether the cabinet is knocked or deformed.
- Step2. Confirm that there is no condensation and water droplets in the control cabinet. Make sure that there are no water droplets in the cabinet before starting up.
- Step3. Install the control cabinet, refer to "Chapter 4.3" Control Cabinet Installation.
- Step4. Connect the power encoder cable, refer to "Chapter 4.5" Power Encoder Connection.
- Step5. Connect the teach pendant, refer to "Chapter 4.5" Connect the teach pendant.
- Step6. Make sure that the teach pendant plug-in knob is in the I position, refer to "Chapter 5.2" teach pendant plug-in knob.
- Step7. Connect the power cord of the control cabinet, refer to "Chapter 4.5" for other interface connections.
- Step8. Connect the safety input of Safety IO, refer to "Chapter 6.2" Robot System Safety.
- Step9. Turn on the switch of the control cabinet, refer to "Chapter 5.2" for the power switch of the control cabinet.
- Step10. Configure the external IO interface, refer to the control cabinet operation manual.



## 8 Routine maintenance items and cycles

The inCube20 control cabinet multi axis drive debugging interface is located on the rear panel of the control cabinet, as shown in Figure 8-1. When debugging multi axis drive parameters, it is necessary to use an RS422 to USB cable to connect to the interface shown in the figure.

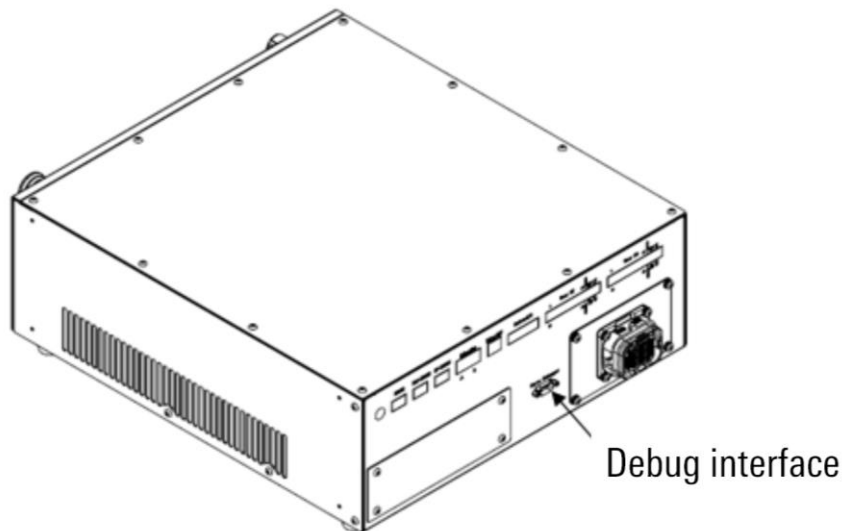


Figure 8-1 X025 multi-axis drive debugging interface of control cabinet

For routine maintenance items and cycles of inCube20 control cabinet, please refer to Table 8-1.

Table 8-1 Routine maintenance items and cycles

Maintenance item	Maintenance cycle
Emergency stop switch	6 months
Power switch	6 months
Indicator light	6 months
Overload connector	6 months
Fan and duct	6 months
Connector	6 months

### Maintenance steps

Check whether the wires inside the cabinet are secure, whether the connector is loose, whether the power switch and emergency stop button can be pressed normally, whether the knob can be rotated, whether the indicator light and other indicating devices can send signals normally, whether the overload connector is loose, whether the fan rotates normally, and whether there is dust accumulated in the cabinet.

## Replacement of dust screen

The inCube20 control cabinet is installed with a dust screen at the inlet of the air duct, as shown in Figure 8-2. Under normal circumstances, the dust screen of the control cabinet should be cleaned every 3 months and replaced every year. In harsh environmental conditions, the replacement and cleaning cycle should be shortened.

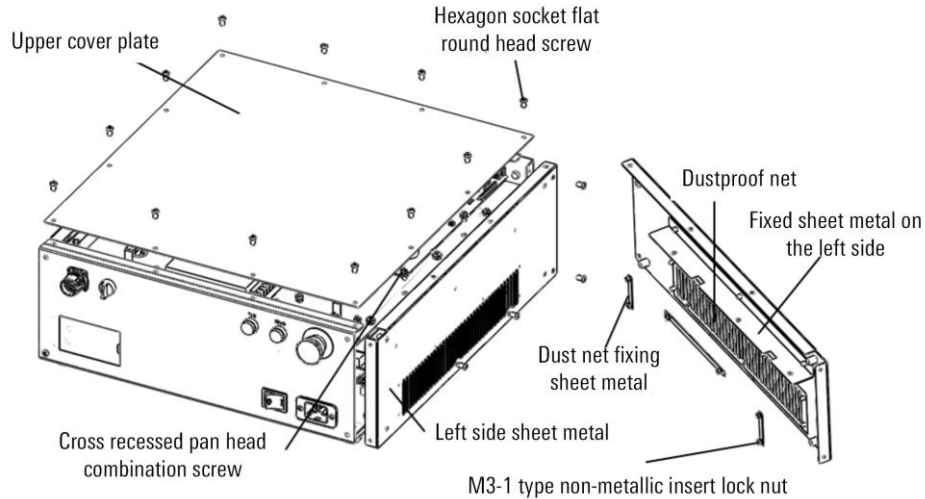


Figure 8-2 Replacement or cleaning of dust screen

Steps for disassembling the dust screen:

- Step1. Use an Allen wrench to remove the  $M4 \times 8$  Allen flat head screws from the upper cover plate and remove the upper cover plate.
- Step2. Use an Allen wrench to remove the  $M4 \times 8$  Allen flat head screw, and use a Phillips screwdriver to remove the  $M4 \times 8$  cross slot pan head combination screw that fixes the left side sheet metal
- Step3. Remove the six M3 type 1 non-metallic insert lock nuts on the inner side of the left side sheet metal using a hex wrench, and remove the sheet metal of dust screen.
- Step4. Remove the six M3 type 1 non-metallic insert lock nuts on the inner side of the left side sheet metal using a hex wrench, and remove the sheet metal of dust screen.
- Step5. Remove the dust screen for cleaning or replacement.

Installation steps for dust screen:

- Step1. Stick the cleaned or new dustproof net onto the left side sheet metal through its built-in double-sided adhesive.
- Step2. Fix the dust net fixing sheet metal to the left side sheet metal using 6 M3 Type 1 non-metallic insert lock nuts.
- Step3. Fix the left side sheet metal and the left side fixed sheet metal on the control cabinet as a whole using  $M4 \times 8$  hexagonal flat head screws, and install the left side sheet metal on the left side of the control cabinet; Use  $M4 \times 8$  cross recessed pan head combination screws to secure the left side fixed sheet metal to the middle partition on the control cabinet.
- Step4. Fix the upper cover plate with  $M4 \times 8$  hexagonal flat round head screws.

## 9 Common faults and troubleshooting

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### Indicator light

When indicator lights and other indicating devices cannot send signals normally, first determine if there are any faults in the connection lines between the indicator lights and the power module; If there is no fault in the circuit, replace the indicating device and observe whether the signal can be sent normally.

### Overload connector

When the connection devices such as heavy-duty connectors become loose, the plug of the heavy-duty connector should be separated from the socket and reinserted and tightened with the power off to ensure reliable connection.

### Fan

When the fan rotates abnormally, first determine if there is a fault in the fan connection circuit; If there are no faults in the circuit, replace the fan and observe if it rotates normally.

### Fuse

When the control cabinet power indicator is on while some electrical components fail to be powered on, please check whether the corresponding fuse on the adapter board is burnt out; and if yes, replace the fuse according to Table 9-1.

Table 9-1 Role and replacement of fuse

MCBS				
No.	Grade	Model	Parameter	Role
1	F1	0454001.	1A/125VAC	Manipulator, 24VDC isolated power supply
2	F2	0454002.	2A/125VAC	Teach pendant, 24VDC power supply
3	F3	0454001.	1A/125VAC	Panel, 24VDC power supply
4	F4	0454001.	1A/125VAC	Fan, 24VDC power supply
5	F5	0454002.	2A/125VAC	MCBS board, 24VDC power supply
6	F6	0454001.	1A/125VAC	Safety IO, 24VDC isolated power supply
DPBS				
No.	Grade	Model	Parameter	Role
1	F1	215010	10A/250VAC	DPBS board, 220VAC power supply



## 10 Storage conditions

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The control cabinet should be placed in a waterproof, cool place protected from sunlight during long-time storage. The specific environmental requirements are shown in Table 10-1:

Table 10-1 Environmental conditions for long-time storage of control cabinet

Parameter	Value
Min ambient temperature	-25°C
Max ambient temperature	+60°C
Humidity	90% non-condensing at constant temperature





## Appendix A List of inCube20 accessories

Schedule 1 List of installation accessories of inCube20 control cabinet

Accessory name	Accessory number	Qty.	Accessory property
inCube20-19 inch cabinet mounting bracket - left	P01035000764	1	Optional
inCube20-19 inch cabinet mounting bracket - right	P01035000765	1	Optional
inCube20- Handle	P01055000251	2	Optional (To be used in conjunction with mounting brackets)
ARCCD20- Cabinet Stacking Connection	P01035000521	8	Optional

Schedule 2 List of cable accessories of inCube20 control cabinet

Accessory name	Accessory number	Corresponding interface	Accessory property
inCube20- Heavy load harness outside the cabinet	P04082000567	Overload interface	Standard (length 5 m)
ARCC - Teaching pendant external harness	P04082000346	Teaching pendant interface	Standard (length 5 m)
inCube20 power cord	P04082001272	Power cord inlet	Standard (length 3 m)
SCRC10- RS232 harness outside the cabinet	P04082000843	RS232	Optional (length 3 m)
SCRC10- RS485 wiring harness outside the cabinet	P04082000844	PLC-RS485	Optional (length 5 m)
SCRC10- RS485 wiring harness outside the cabinet	P04082000844	MF-RS485	Optional (length 5 m)
Industrial network cable	P04082000279	Ethernet	Optional (length 5 m)
	P04082000279	EtherCAT	Optional (length 5 m)
inCube20- User DI terminal module cable	P04082001304	User DI	Optional
inCube20- User DO terminal module cable	P04082001305	User DO	Optional
USB to RS422/RS485 cable	P04082000251	Servo Debugger	Optional
inCube20- Install buckle plate sheet metal	P01035000547	-	Optional (Optional at the same time)
MCBS-IEB gusset board	P05245000108	-	
inCube20-MCBS and gusset board connection cable	P04082000595	-	
PWM and analog output_ Voltage and current input cables	P04082000594	J3\J5	Optional (length 5 m)

Accessory name	Accessory number	Corresponding interface	Accessory property
Magnetic grating ruler and CAN_ Encoder shared wiring harness	P04082000596	J6\J7	Optional (length 5 m)

## Appendix B Description of inCube20 accessories

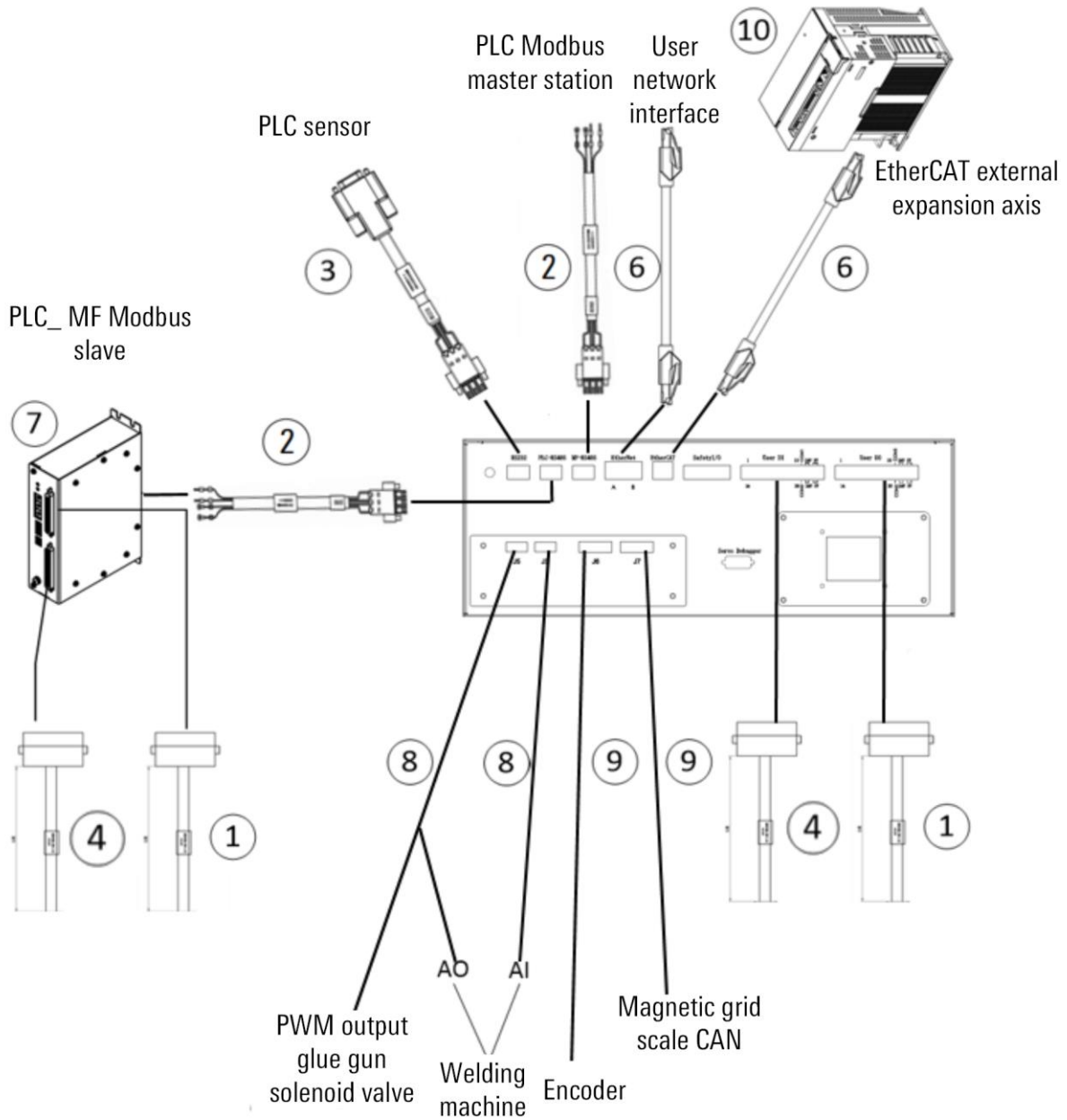


Figure 1 Accessories of inCube20 control cabinet


### Overload interface external wire

For the basic specification and installation method of the external wire of the overload interface, please refer to Schedule 1.

Schedule 1 Basic specification and installation method of external wire of overload interface

S/N	Name	inCube20-cabinet external overload wire harness	Component code	P04082000567
A-terminal	Overload, metal upper case, female terminal, metal case, sticker protective cover			

S/N		Name	inCube20-cabinet external overload wire harness	Component code	P04082000567
B-terminal		Overload, metal upper case, female terminal, metal case, sticker protective cover			
Cable		Custom cable: 8×18AWG+6×20AWG+9×22AWG+ (9×2×24AWG)	Cable length	5m (standard)	


 Tip	<ul style="list-style-type: none"> <li>■ The overload wire harness interfaces on the side of the inCube20-cabinet correspond to those on the body side.</li> <li>■ For definition of overloaded interface, please refer to Section 5.6.</li> </ul>
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### External wire of teach pendant interface

For basic specification and installation method of inCube20-teach pendent wire harness, please refer to Schedule 2.

Schedule 2 Basic specification and installation method of wire harness of inCube20-teach pendent

S/N		Name	ARCC - Teaching pendant external harness	Component code	P04082000346
A-terminal		M23 female			
B-terminal		Teach Pendant			
Cable		14 cores totally, 4 of which are CAT5 network cables, and the remaining 10 cores are connected directly	Cable length	5m	

 Tip	For definition of teach pendant interface, please refer to Section 5.6.
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### External wire of power interface

For basic specification and installation method of inCube20-power wire harness, please refer to Schedule 3.

Schedule 3 Basic specification and installation method of inCube20-power wire harness

S/N		Name	inCube20-power wire harness	Component code	P04082001306
A-terminal connector		Power connector plug			
B-terminal connector		3 cores plug			
Cable		3 cores, 1.0mm <sup>2</sup>	Cable length	3m	

## User DO interface external wiring

The basic specifications and installation method of the inCube20 user DO terminal module cable are detailed in Schedule 4.

Schedule 4 Basic specifications and installation method of inCube20 user DO terminal module cables

S/N	1	Name	InCube20- User DO terminal module	Component code	P04082001305
A-terminal connector	Weidmuller, C2P 3.50_36_180LR SN OR BX quick plug terminal connector				
B-terminal connector	European style cold pressed terminal				
Cable	36 core 0.3mm <sup>2</sup>				



Tip

- The connector wire sequence at both ends of the inCube20 user DO terminal module cable corresponds one-to-one with the number tube label.
- The cable numbers of the inCube20 user DO terminal module correspond one-to-one with the control cabinet and user DO interface numbers.
- If selecting a wiring harness, it is recommended to choose a cable with a wire diameter of AWG26-AWG16.

## User DI interface external wiring

The basic specifications and installation method of inCube20 user DI terminal module cables are detailed in Schedule 5.

Schedule 5 Basic specifications and installation method of inCube20 user DI terminal module cable

S/N	1	Name	inCube20- User DI terminal module	Component code	P04082001304
A-terminal connector	Weidmuller, C2P 3.50_36_180LR SN OR BX quick plug terminal connector				
B-terminal connector	European style cold pressed terminal				
Cable	36 core 0.3mm <sup>2</sup>				

## RS232 interface external wiring

The basic specifications and installation method of external wiring for the inCube20 RS232 interface are detailed in Schedule 6.

Schedule 6 Basic specifications and installation method of external wiring for inCube20 RS232 interface

S/N	3	Name	ISCRC10- RS232 harness outside the cabinet	Component code	P04082000843
A-terminal connector	Weidmuller, C2P 3.50/06/180F SN BK BX quick plug terminal type connector				
B-terminal connector	D_ SUB, DB9 male, plug, plastic casing				

Cable	3×0.25mm <sup>2</sup> shielding wire	Length	3m
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### PLC-RS485 interface external wiring

The basic specifications of inCube20- PLC-RS485 cable are detailed in Schedule 7.

Schedule 7 inCube20- basic specifications for external expansion Modbus cables

S/N	2	Name	SCRC10- RS485 harness outside the cabinet	Component code	P04082000844
A-terminal connector	Weidmuller, C2P 3.50/06/180F SN BK BX quick plug terminal type connector				
B-terminal connector	Cold-pressed Terminal				
Cable	2×2×0.25mm <sup>2</sup> shielded twisted-pair cable	Length	5m		

### MF-RS485 interface external wiring

The basic specifications of inCube20-MF-RS485 cable are the same as Schedule 7

### Ethernet interface external wiring

The basic specifications of industrial network cables are detailed in Schedule 8.

Schedule 8 Basic specifications of inCube20 industrial network cable

S/N	6	Name	Industrial network cable	Component code	P04082000279
Brand	Hellolink	Cable	4-core AWG26	Length	5m

### EtherCAT interface external cable

The basic specifications of industrial network cables are the same as Schedule 8.

### Servo Debugger external wiring

The basic specifications of the USB to RS422/RS485 cable are detailed in Schedule 9.

Schedule 9 Basic specifications of USB to RS422/RS485 cable

S/N	-	Name	USB to RS422/RS485 cable	Component code	P04082000251
A-terminal connector	DB9		Brand/Model	Z-TEK	
B-terminal connector	USB		Brand/Model	Z-TEK	
Cable	5-core		Length	1.8m	

### Related optional accessories of buckle

For the basic specification and installation method of inCube20-buckle sheet metal, please refer to Schedule 10~11.

Schedule 10 Basic specification and installation method of inCube20-mounting sheet metal

S/N	\	Name	inCube20-mounting buckle sheet metal	Component code	P01035000547
Length		185mm	Width		\
Height		60mm	Thickness		1.2mm
Installation method		\	Mounting screw		4 hexagon socket flat head screws, M4X8
Purpose	It is used to fix the buckle MCBS-IEB in the inCube20 control cabinet				

Schedule 11 Basic specifications of buckle MCBS-IEB

S/N	\	Name	MCBS-IEB buckle	Component code	P05245000108
Description	Buckle				



The DF50S numbers at both ends correspond to each other.

### External wire of interface J3\J5

For the basic specifications of the PWM and analog output \_ voltage/current input cables, please refer to Schedule 12.

Schedule 12 Basic specifications of PWM and analog output \_voltage/current input cable

S/N	8	Name	Cable between PWM and analog output _voltage/current input	Component code	P04082000594
A-terminal connector	Hirose, DF51-10DS-2C				
B-terminal connector	European terminal C0.5-8				
Cable	10CX0.2mm <sup>2</sup>	Cable	10C×0.2mm <sup>2</sup>		

### External wire of interface J6\J7

For the basic specifications of the wire harness shared between the magnetic scale and CAN\_encoder, please refer to Schedule 13.

Schedule 13 Basic specifications of wire harnesses shared between magnetic scale and CAN\_encoder

S/N	9	Name	Wire harness shared between magnetic scale and CAN_encoder	Component code	P04082000596
A-terminal connector	JYR SCSI 14P M				
B-terminal	European terminal C0.5-8				

connector			
Cable	JYR 10.0 12 cores (6 pairs) shielding braided black wire, $\varphi$ 10	Cable	JYR 10.0 12 cores (6 pairs) shielding braided black wire, $\varphi$ 10

### Mounting rack of inCube20-19" cabinet

For the basic specification and installation method of inCube20-19" cabinet mounting rack, please refer to Schedule 14-Schedule 16.

Schedule 14 Basic specifications and installation method of inCube20-19 inch cabinet installation bracket

S/N	-	Name	inCube20-19 inch cabinet mounting bracket - left	Component code	P01035000764
Length	31.5mm		Width	31mm	
Height	150.8mm		Plate thickness	1.5mm	
Installation method	Refer to Section 4.3		Installing screws	4 cross recessed pan head combination screws M4X10	
Use	Used for installation in a 19 inch cabinet. During installation, the left and right sides of the cabinet are fixed to the 19 inch cabinet by handling handles, and cabinet pallets need to be placed at the bottom to support the load.				

Schedule 15 Basic specifications and installation method of inCube20-19 inch cabinet installation bracket

S/N	-	Name	inCube20-19 inch cabinet mounting bracket - right	Component code	P01035000765
Length	88mm		Width	15mm	
Height	150.8mm		Plate thickness	1.5mm	
Installation method	Refer to Section 4.3		Installing screws	2 cross recessed pan head combination screws M4X10	
Use	Used for installation in a 19 inch cabinet. During installation, the left and right sides of the cabinet are fixed to the 19 inch cabinet by handling handles, and cabinet pallets need to be placed at the bottom to support the load.				

Schedule 16 Basic specifications and installation method of inCube20 handle

S/N	-	Name	Handle	Component code	P0105500021
Length	112.5mm		Width	11mm	
Height	23mm				
Installation method	Refer to Section 4.3		Installing screws	2 cross recessed pan head combination screws M5X10	
Use	Used for installation in a 19 inch cabinet. During installation, the left and right sides of the cabinet are fixed to the 19 inch cabinet by handling handles, and cabinet pallets need to be placed at the bottom to support the load.				



## inCube20-cabinet stacking connector

For the basic specification and installation method of inCube20-cabinet stacking connector, please refer to Schedule 17.

Schedule 17 -Basic specification and installation method of inCube20-cabinet stacking connector

S/N		Name	inCube20-cabinet stacking connector	Component code	P01035000521
Length		88mm	Width		15mm
Height		-	Thickness		1.5mm
Installation method		Please refer to Section 4.3	Mounting screw		2 cross recessed pan head combination screws, M4X10
Purpose		It used for cabinet stacking			





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