Peitian Robot

inCube12 | Control Cabinet Manual

A solution provider for intelligent

Equipment manufacturing industry

inCube12 Control Cabinet Manual

V 1.3.1

Declaration

Associated manual shall be carefully read before using the industrial robot, and shall be properly used under the premise of understanding its contents.

Any content in this manual cannot be reproduced or transmitted in any form without permission.
All parameter indexes and design are subject to changes without notice.
We are not liable for any possible mistakes in the manual.

We make an attempt to describe as much information as possible in this manual. However, we haven't described those unnecessary and impossible situations for various reasons.
Therefore, those information which are not described in the manual can be seen as "impossible".

The products described in the manual is in accordance with *Foreign Trade Law of the People's Republic of China*. If the products are exported to other countries, the permission from Chinese government shall be obtained.
In addition, if the products are re-exported to other countries, the permission from the re-exported counties shall be obtained. If these products are exported or re-exported, please consult Affluence & Eternity.

Identifications used in this text

Symbol	Name	Meaning
	Danger	Failure to follow these instructions will lead to accident, and cause serious or fatal personnel injury, or severe articles damage
	Warning	Failure to follow these instructions may lead to accident, and cause serious or fatal personnel injury, or severe articles damage
	Electric shock	This electrical hazard may result in severe personal injury or death.
	Caution	Failure to follow these instructions may lead to accident, and cause damage to robot system
	Prompt	It indicates the environmental conditions and important matters or shortcut operation methods needed to be noticed.
	Notice	It indicates that other references or instructions shall be read to get additional information or more detailed operating instructions

General safety instructions

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 the these matters described in "Warning", "Caution" and "Notices".

⚠ Warning

Faulty operation may lead to death or serious injury of operator or other operating personnel.

ⓘ Caution

Faulty operation may lead to minor injury of operator or other operating personnel or equipment damage.

💡 Notices

It is the supplementary instructions except warning and caution.

General cautions

⚠ Warning

Please ensure that the manipulators are in halted state during connecting or disconnecting associated peripheral equipment (such as safety barrier, etc.) and various signals of the manipulator, to avoid fault connection.

⚠ Warning

Don't operate manipulators under the following conditions. Otherwise, it will cause adverse effects on manipulator and peripheral equipment, and also may result in

operating personnel injury and death.

◆ Apply it in flammable atmosphere;

◆ Apply it in explosive atmosphere;

◆ Apply it in the environment with substantial amount of radiation;

◆ Apply it in water or high-humidity atmosphere;

◆ Apply it for transporting people or animals;

◆ Apply it as foot stool (such as climbing on the manipulator or overhanging underneath)

Warning

Operating personnel using the manipulator shall wear the following safety appliances for subsequent operation.

◆ Appropriate working clothes;

◆ Safety shoes;

◆ Safety helmet.

Notices

The programming and maintenance staff shall accept proper training through the company's training course.

Installation attentions

Warning

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.

Warning

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.

Attentions during the operation

Warning

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.

Warning

During the demonstrator operation, wearing gloves may cause errors in operation, thus, taking the gloves off is necessary for subsequent operation.

Notices

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.

Attentions during the programming

Warning

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:

◆ Carefully view the conditions in the safety barrier, and then enter the barrier after ensuring there is no danger;

◆ Make sure the emergency stop button can be pressed at any time;

◆ Operate the manipulator in low speed;

◆ 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.

Caution

Testing and operation shall be carried out in accordance with prescribed procedures after programming ends, at this moment, the operating personnel shall operate outside the safety barrier.

Notices

The operating personnel who are in charge of programming shall undergo proper training through the course provided by the company.

Attentions during the maintenance

Warning

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.

Warning

Please consult the company if it is necessary to replace the parts.

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.

⚠ Warning

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.

⚠ Warning

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.

⚠ Warning

When dismounting motor or brake, it shall be dismantled after crane lifting and other measures are taken to prevent manipulator arm, etc. from falling.

⚠ Warning

If the manipulator is moved for unavoidable reasons during the maintenance, the following matters shall be noticed:

◆ 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.

◆ Constantly notice whether there is danger around, and make preparations for pressing emergency stop button at any time when needed.

⚠ Warning

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.

⚠ Warning

Don't tumble due to the lubricating oil scattered on the floor, and wipe it off for ruling out the possibility of danger.

⚠ Warning

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.

⚠ Warning

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.

⚠   Warning

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.

⚠   Warning

When maintaining pneumatic system and hydraulic system, internal pressure shall be released to 0 at first for subsequent operation.

Warning

⚠   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.

⚠   Warning

After maintenance ends, lubricating oil, debris, water, etc. scattered on the floor around the manipulator and in the safety barriers shall be swept thoroughly.

⚠   Warning

Dust and other foreign matters are not allowed in the manipulator during the components replacement.

⚠   Warning

Operating personnel who are in charge of maintenance and repair shall accept the company's training and pass the examination.

⚠   Warning

During the maintenance, appropriate luminaire shall be equipped, but note that this cannot be the sources to cause new danger.

⚠   Warning

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

Before operating the manipulator, peripheral equipment and its manipulator system, sufficiently study the safety precaution for operating personnel and system.

Definition of operating personnel

The definition of manipulator operating personnel is as shown below:

Operator

◆   Conduct ON/OFF of manipulator operation

◆   Start manipulator program from the operation panel

Programmer

◆   Carry out operations except for that of the operator;

◆   Carry out demonstration, etc. in the safety barrier.

Maintenance engineer

◆   Carry out operations except for that of the operator;

◆   Carry out demonstration, etc. in the safety barrier;

◆   Perform manipulator maintenance (repair, regulation, replacement, etc.)

"Operator" cannot operate in the safety barrier.

"Programmer" and "maintenance engineer" can operate in the safety barrier.

The operation in the safety barrier includes carrying, setting, demonstration, regulation, maintenance, etc..

During operation, programming and maintenance of the manipulator, operator, programmer and maintenance engineer shall pay attention to safety, and at least wear the following items:

◆   Appropriate working clothes;

◆   Safety shoes;

◆   Safety helmet.

Safety of operating personnel

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;

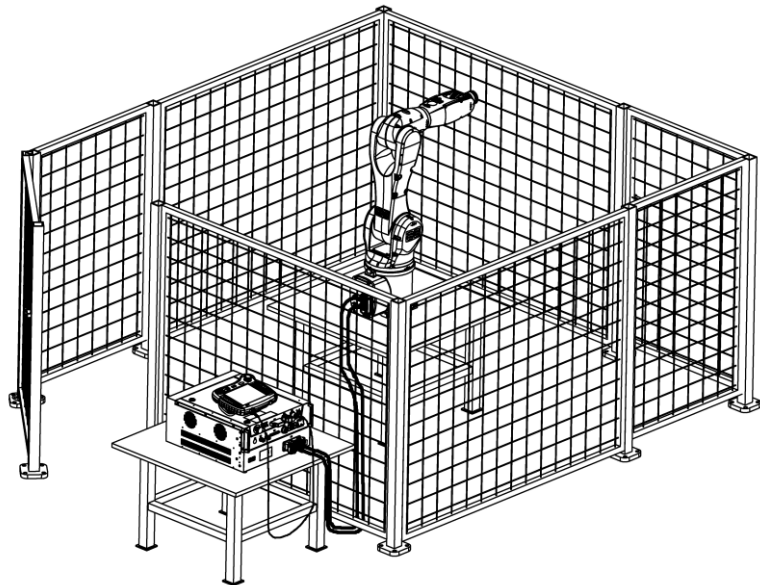◆ When taking single commissioning of peripheral equipment, the manipulator power shall be disconnected.

Figure1-1 Schematic Diagram of Safe Operation of the Industrial Robot

The safety of operator

Operator who is responsible for operating the power ON/OFF of the manipulator system in the daily operation, or starting the manipulator program operation through demonstrator.

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.

Notes

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.

The safety of programmer

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:

(1) Execute for at least one cycle with single cycle at low speed to ensure there is no abnormal sign;

(2) Continuously operate for at least one cycle at low speed to ensure there is no abnormal sign;

(3) Continuously operate for at least one cycle at intermediate speed to ensure there is no abnormal sign;

(4) Continuously operate for at least one cycle at intermediate speed to ensure there is no abnormal sign;

(5) 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 observes 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.

Contents

1   Document Description of inCube12

1.1   Purpose and content of the document

This document is written to help technicians install and use the inCube12 control cabinet quickly, correctly and safely, get familiar with the relevant precautions, and perform regular maintenance.

1.2   Document number and version

The document-related information is shown in Table 1-1.

Table 1-1 Document-related Information

Document name	"inCube12 Control Cabinet Manual"
Document number	UM-P05110000024-001
Document version	V1.3.1

1.3   Document Use Object

◆ Operator

◆ Lecturer

◆ Maintenance engineer

1.4   Related Document Information

The contents in this document may be pertinent to the following documents. Please refer to them when necessary:

◆ "ARL Programming Manual"

◆ "Manipulator Manual of AIR20-1700A Industrial Robot"

◆ "Operation Manual of AIR-TP Teach pendant"

◆ "Failure and Troubleshooting Manual of AIR Series Industrial Robot System"

1.5   Declaration of applicable safety standards

The requirements for system design of industrial robot are shown in Table 1-2.

Table 1-2 Declaration of applicable safety standards

Standard	Description	Version
2006/42/EC	Machinery directive: Machinery Directive 2006/42/EC (new edition) released by the European Parliament and Council on May 17, 2006, including changes to 95/16/EC	2006
2014/30/EU	EMC directive: Directive 2014/30/EU released by the European Parliament and Council on February 26, 2014 to balance EMC regulations among member states	2014
2014/68/EU	Pressure equipment directive: Directive 2014/68/EU released by the European Parliament and Council on May 15, 2014 to balance the pressure equipment regulations among member states	2014

Standard	Description	Version
	(Only applicable for robots with hydro-pneumatic balance weights.)	
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	Safety requirements for industrial robots: Part 1: Robots (tip: The content complies with ANSI/RIAR.15.06-2012, Part 1)	2011
61000-6-2	Electromagnetic compatibility (EMC): Part 6-2: Professional basic standards; Immunity for industrial environments	2005
61000-6-4 + A1	Electromagnetic compatibility (EMC): Part 6-4: Generic standards; Radiated interference for industrial environments	2011
60204-1 + A1	Safety of machinery: Electrical equipment of machines; Part 1: General requirements	2009
IEC 60529	Degrees of protection provided by enclosures (IP code): This standard applies to the classification of degrees of protection provided by enclosures for electrical equipment with a rated voltage above 72.5kv.	2001

2   Overview of inCube12 Control Cabinet

2.1   Overview of industrial robot

The industrial robot is composed of the following components:

■ Manipulator

■ Control cabinet

■ Teach Pendant

■ Connection (power supply) cables, etc.

1. AIR series robot

3. Teach pendant

2. inCube12
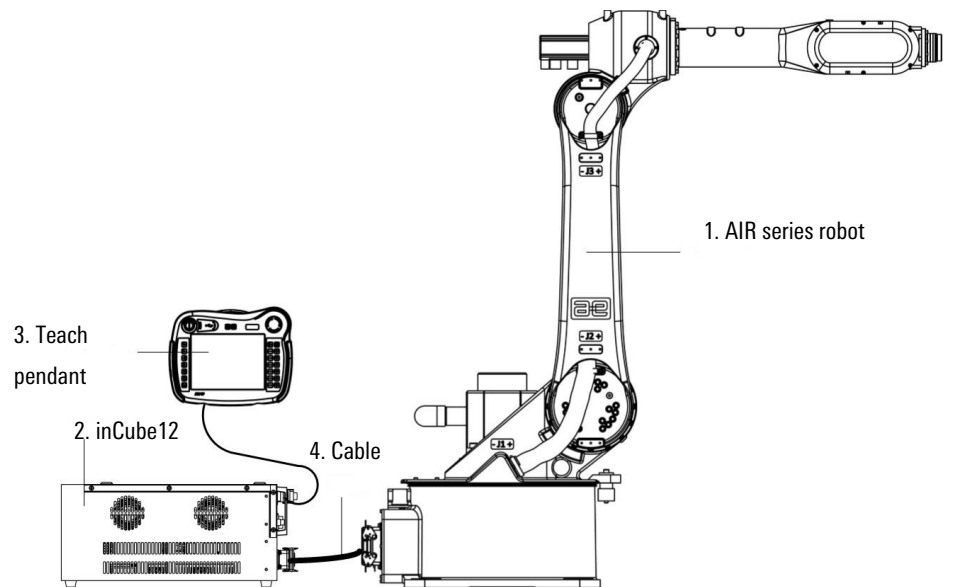
4. Cable

Figure 2-1 Composition of robot system

Figure 2-1 Shows an example for industrial robot system, where:

1. Manipulator   2. Control cabinet

3. Teach pendant   4. Connection (power supply) cable

Robot body

The robot body 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.

2.2 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 2-2~Figure 2-4.
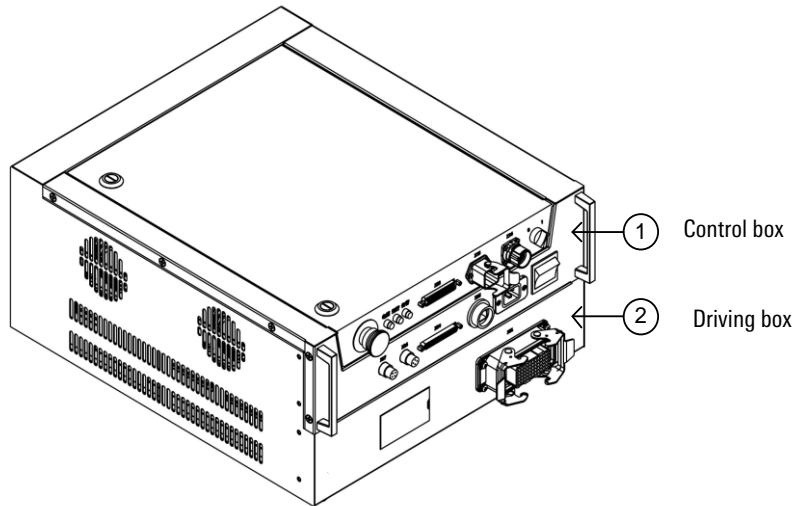
Figure 2-2 Appearance of control cabinet
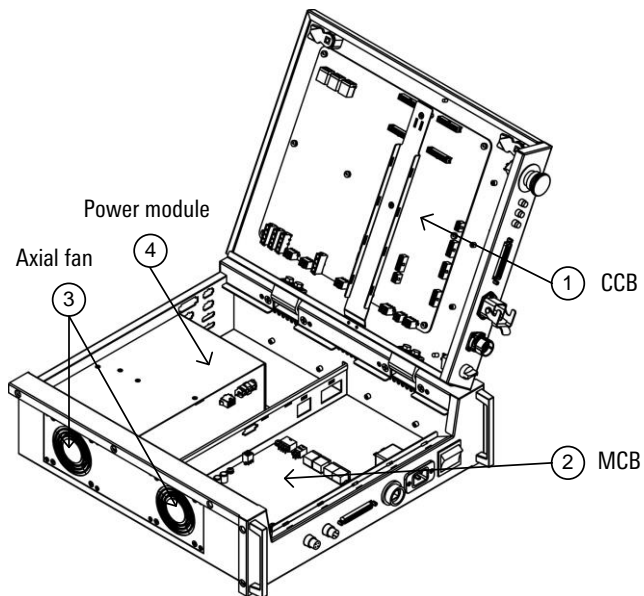
Figure 2-3 Schematic diagram of internal components of upper cavity of control box

Interface filter   DPB   DCB   Fan
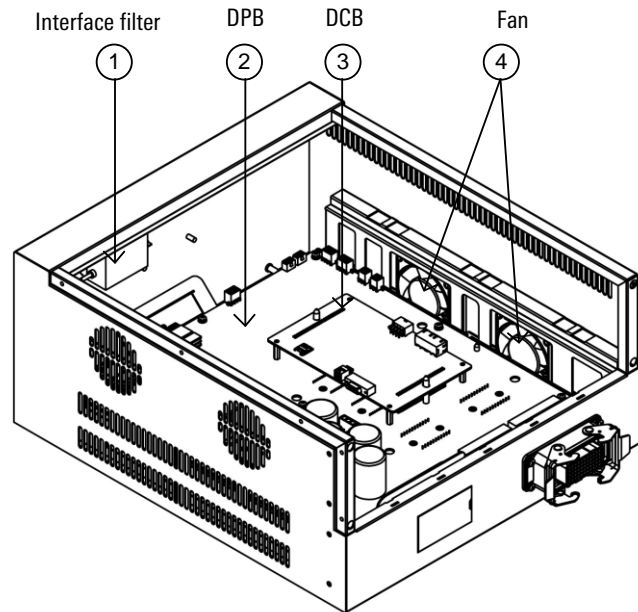
Figure 2-4 Schematic diagram of internal components of drive box

2.3   Control cabinet label and meaning

The inCube12 control cabinet contains 5 types of labels. The specific positions of the labels are shown in Figure 2-5.
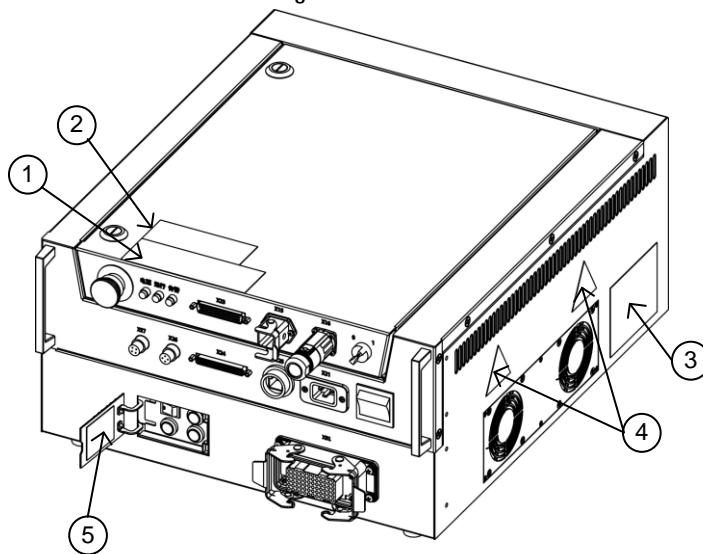
Figure 2-5 Schematic diagram of positions of labels contained in the control cabinet

The meanings of labels are as follows:

Electrical Hazard signboard

The Electrical Hazard signboard is shown in Figure 2-6.

电气危险
Electrical Hazard

维护前请阅读并理解操作
指南和安全手册。
Read and understand product
operation manual and safety
instructions before
maintenance.

Figure 2-6 Electrical Hazard signboard

Door-opening power-off & maintenance signboard

The door-opening power-off & maintenance signboard is shown in Figure 2-7.

Figure 2-7 Door-opening power-off & maintenance signboard

High temperature sign

There may be heat in places where high temperature signs are provided (see Figure 2-8). 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 2-8 High temperature sign on control cabinet

Brake Releasing and Contracting (Manually)

Brake Releasing and Contracting (Manually) sign and the specific steps are as shown in Figure 2-9.
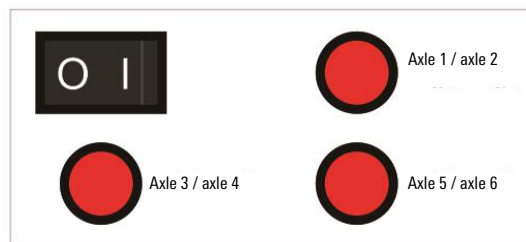
Step 1: Press to the "I" position;

Step 2: Press and hold to drag the corresponding axle

Figure 2-9"Brake Releasing and Contracting (Manually)" Sign of Control Cabinet

2.4   Basic specifications of control cabinet

The basic specifications of inCube12 control cabinet are shown in Table 2-1:

Table 2-1Basic specifications of inCube12 control cabinet

Name	Characteristic	
Cabinet body type	19" cabinet	
Color	Black	
Weight	33kg	
Protection class	IP20 (optional IP54 shield)	
Number of axes	6-axis, 2 axes can be expanded	
Noise	50dB(A)	
Rated supply voltage	AC220V±10%	
Power frequency	49~61Hz	
Full load power	3.5KVA	
Fusing current	20A	
Vibration condition	Operation	Transportation
Vibration acceleration	0.37g	0.37g
Vibration frequency	4~120Hz	
Impact acceleration Instantaneous	Instantaneous	2.5g	10g
	Continuous	0.1g	0.37g
Impact waveform/period	Half sine/11ms	
Operating temperature	0~45 ℃	
Temperature change rate	<1.1K/min	
Storage temperature	-25~45℃	
Operating humidity	3K3 humidity level	
Storage humidity	3K3 humidity level	
Altitude	Normal operation at the altitude of below 1000m	
	Derated by 5%/1000m at the altitude of 1000-4000m	
	Normal operation at the atmospheric pressure of below 86~106kPa	

2.5   Installation environment of control cabinet

■   The ambient temperature should be 0-45°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.

3   Transportation of inCube12 Control Cabinet

➢ Transportation posture

   ◼ Make sure that the control cabinet door is closed

   ◼ Make sure that all connectors on the control cabinet 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 3-1.
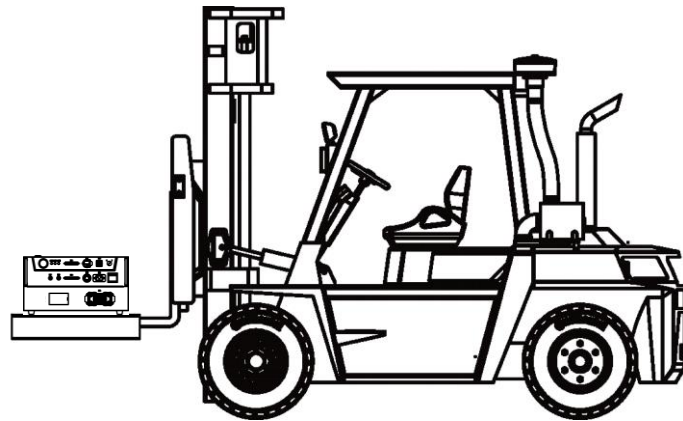
Figure 3-1 Schematic diagram of control cabinet transportation by forklift

4   Unpacking of inCube12 Control Cabinet

4.1   Document applicable objects

- Operators

- Teachers

- Maintenance engineers

4.2   Unpacking method and sequence

The schematic diagram of unpacking box of inCube12 control cabinet and AIR_TP teach pendent is shown in Figure 4-1. The names of parts are shown in Table 4-1.
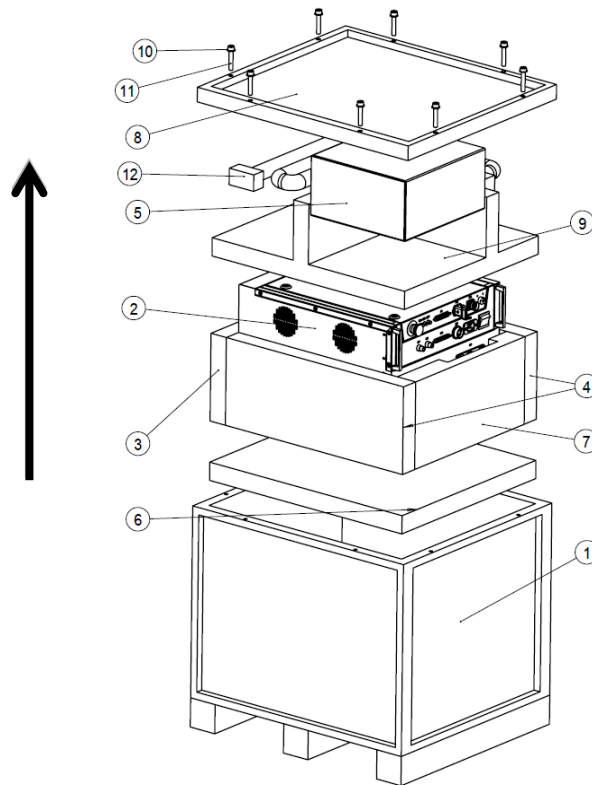
Figure 4-1 Schematic diagram of unpacking box of control cabinet and teach pendent

The unpacking method of inCube12 control cabinet and AIR_TP teach pendent is as follows:

1.   Remove the hexagon socket head cap screws M10×55 from the wooden box cover with a 16MM Allen wrench, and open the wooden box cover .

2.   Remove AIR_TP teach pendant-package and cable and put them aside for installation.

3.   Take out pearl wool - cabinet - cover.

4.   Take out pearl wool - cabinet -3.

5.   Remove inCube12 control cabinet and set it aside for installation.

After removing inCube12 control cabinet and AIR_TP teach pendant, it is necessary to properly store each part of the packing box for subsequent packaging during transportation.

Table 4-1Names of parts of packing box of control cabinet and teach pendant

No.	Name
1	Box body
2	inCube12 control cabinet
3	Pearl wool -cabinet -1
4	Pearl wool -cabinet -2
5	AIR_TP teach pendant - package
6	Pearl wool -cabinet - bottom
7	Pearl wool -cabinet -3
8	Wooden box cover
9	Pearl wool -cabinet - cover
10	M10
11	M10×55
12	Cable

4.3 Safe disposal of packaging materials

■ In order to facilitate the repackaging, please properly keep the wooden box, cork base and all the connecting screws and nuts and other parts in a dry and clean indoor place to prevent the materials away from the moisture, pressure, heat or fire.

If it is unnecessary to keep the above materials, please dispose of them according to the relevant treatment methods of industrial wastes.

■ The unpacked packing bag and calcium chloride desiccant cannot be reused. Please dispose of them according to the relevant treatment methods of industrial wastes.

5 Installation and Connection of inCube12 Control Cabinet

5.1 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 2.5* of this manual.

5.2 Installation dimensions

The inCube12 control cabinet is a control cabinet of 5U height that supports installation in a 19" cabinet. The specific dimensions are shown in Figure 5-1.
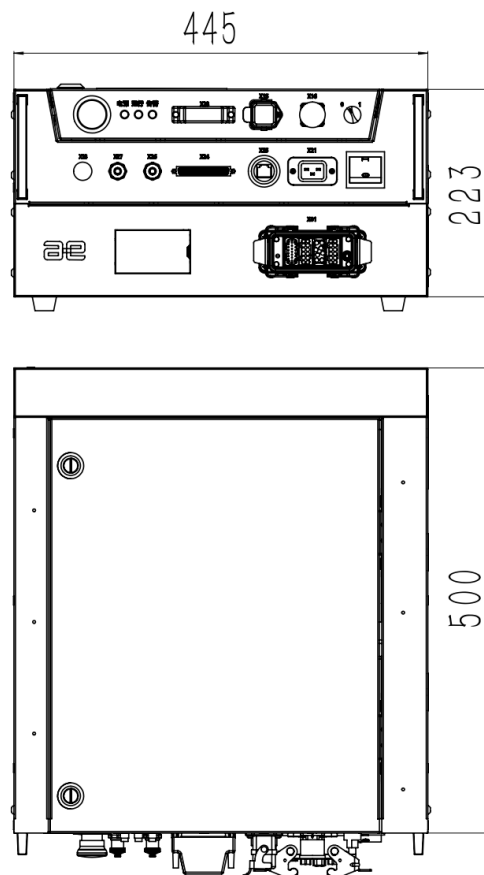
Figure 5-1 Outline dimensions of cabinet

5.3   Installation method

Direct installation

The inCube12 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 foot pads of the control cabinet must be on the same plane.

Requirements:

- The platform will come into contact with the four foot 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 60kg, and the load contact area may not be less than 80% of the top surface of the cabinet.

Installation of 19″ cabinet

The inCube12 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 Figure5-2. For details about the accessories that may be required for installation of the control cabinet, please refer to *Appendix A* "List of Accessories" in this manual.
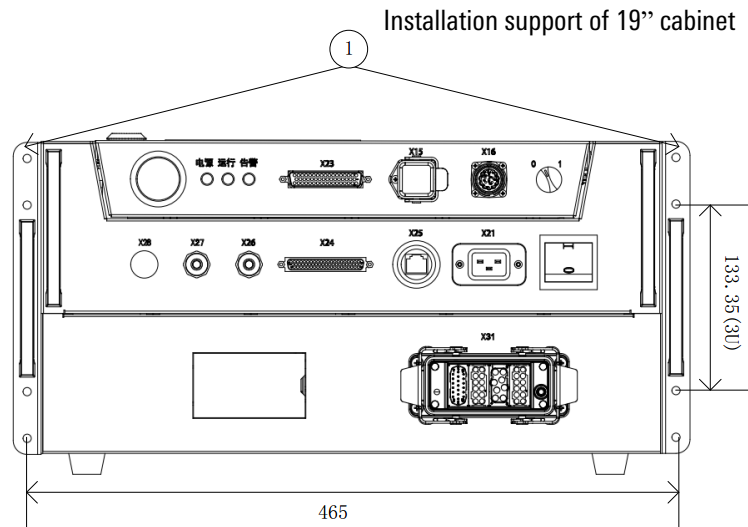
Figure5-2 Installation diagram of 19″ cabinet

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 inCube12 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 Figure5-3. For details about the materials used for stacking, please refer to *Appendix A* "List of Accessories" in this manual.
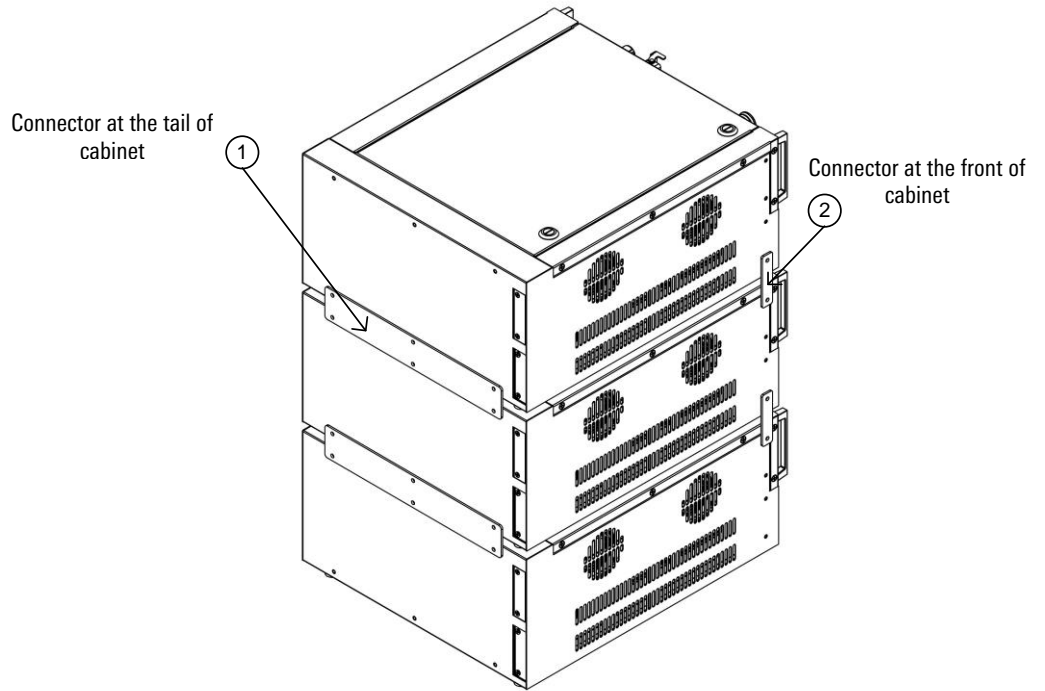
Figure5-3 Cabinet stacking

5.4   Control cabinet interface
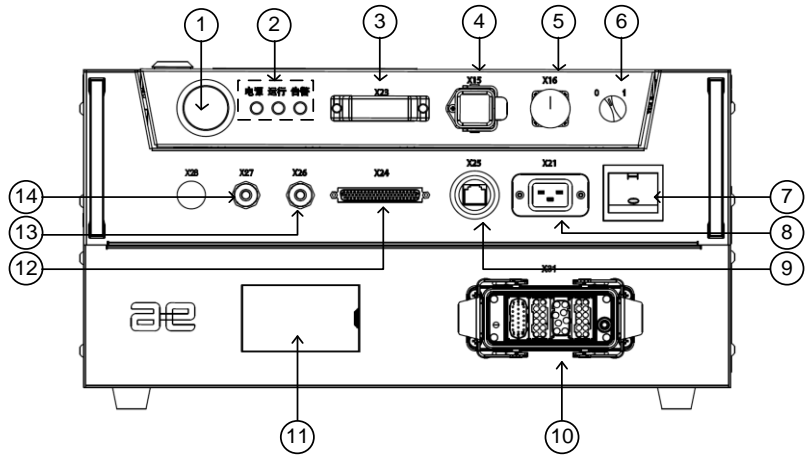
Figure5-4 Position of interface of inCube12 control cabinet

All operation buttons, indicators and connection interfaces of the inCube12 control cabinet are designed on the front panel, as shown in Figure5-4. The names and functions of interface are shown in Table 5-1.

Table 5-1 Description of interface of inCube12 control cabinet

No.	Interface Code	Interface Name
1	X11	Emergency stop button
2	X12	Indicator lamp group
3	X23	System IO interface
4	X15	Ethernet communication interface of external extension axle
5	X16	Teach pendant interface
6	X13	Plug-in knob of teach pendant

No.	Interface Code	Interface Name
7	X22	Power switch
8	X21	Power line entrance
9	X25	User Ethernet interface
10	X31	Power encoder body IO interface
11	X6X	Brake releasing and contracting box
12	X24	User IO interface
13	X26	External extension MF interface
14	X27	User RS232 interface

(i) Prompt

For description of the above interface, please refer to *Section* 6 "Description of control cabinet interface".

5.5 Connection of control cabinet

Connection of teach pendant

In the upper right corner of inCube12 control cabinet panel, X16 represents the connection interface of teach pendant as shown in Figure5-5. The quick connector is used with the plane of No.1 plug flush with that of No.2 socket. At this time, the triangle marks on the plug and socket are aligned. Push in the connector and turn the plug for 45° clockwise to clamp the plug and socket. When removing the plug, rotate the plug for 45° counterclockwise with the plane of No.1 plug flush with that of No.2 socket to pull out the plug.

Connector plug of teach pendant ①   ② Connector socket of teach pendant
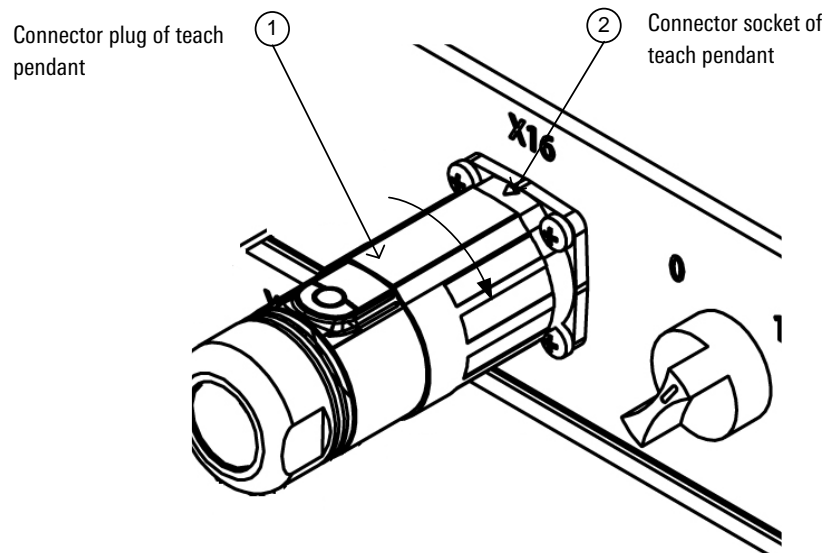
Figure5-5 Connection of teach pendant

Connection of manipulator power encoder

In the lower right corner of inCube12 control cabinet, X31 represents the connecting interface of manipulator power encoder. The heavy-duty connector is used, which has the functions of clamping and error-proof. Insert the male plug of heavy-duty connector into the female socket, and fasten the buckle.

Connection of other interfaces

"Other interfaces" are mainly the interfaces of inCube12 control cabinet reserved for users:

1. For the user interface with mechanical locking mechanism, such as the X15 Ethercat communication interface of external extension axle, insert RJ45 plug into the socket and fasten the buckle.

2. For the user interface with thread locking mechanism, such as X24 user IO interface, X23 system IO interface, X26 external extension MF interface and X27RS232 interface, fasten the thread when connecting.

3. For the user interface without the locking mechanism, such as the X25 user Ethernet interface, insert the crystal head completely into the plug; such as the X21 power cable interface, insert the triangle power plug completely into the socket.

(i) Prompt

For the information on the connecting cables of above interfaces, see the Accessories List in Appendix A.

5.6 Definition of control cabinet electrical connection

Definition of teach pendant Connector

Teach pendant interface X16 of inCube12 control cabinet is as shown in Figure5-6. Connector interface pin number is defined in Table 5-2.
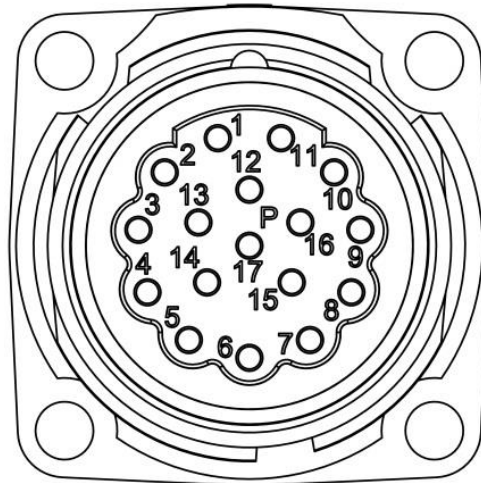
Figure5-6 Teach pendant interface X16

Table 5-2 Definition of pin number of teach pendant connector interface X16

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

Pin No.	Signal name	Wire color	Pin No.	Signal name	Wire color
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			

Definitions of Power Encoder Body IO Connectors

Heavy-duty connector X31 of inCube12 control cabinet is defined in Figure5-7. For the detailed definition of power line encoder interface X31, see Table 5-3.
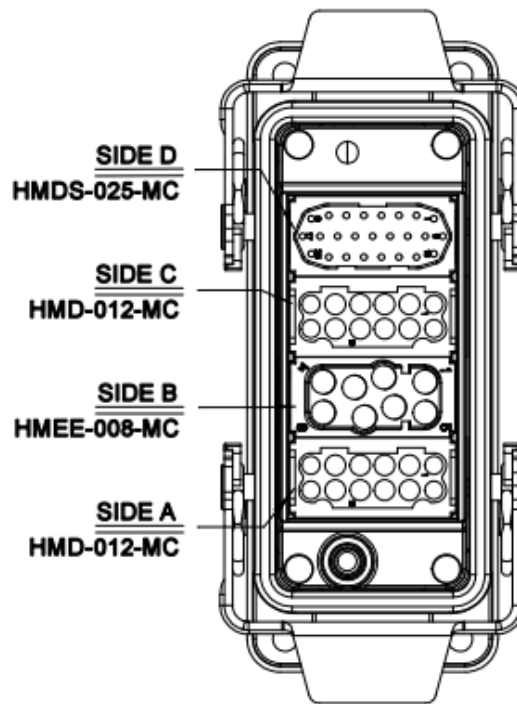
Figure5-7 Power Line Encoder Interface X31

Table 5-3Definition of Power Line Encoder Interface X31

SIDE A

Pin No.	Defintion	Pin No.	Defintion
1	GND	7	A1&A2_BR_24V+
2		8	
3	PE	9	PE
4	U3	10	U5
5	V3	11	V5
6	W3	12	W5

SIDE B

Pin No.	Defintion	Pin No.	Defintion
1	PE	5	PE
2	U2	6	U1

Pin No.	Defintion	Pin No.	Defintion
3	V2	7	V1
4	W2	8	W1

SIDE C

Pin No.	Defintion	Pin No.	Defintion
1	GND	7	A3&A4_BR_24V+
2	GND	8	A5&A6_BR_24V+
3	PE	9	PE
4	U6	10	U4
5	V6	11	V4
6	W6	12	W4

SIDE D

Pin No.	Defintion	Pin No.	Defintion	Pin No.	Defintion	Pin No.	Defintion
1	J1_5V	2	J1_0V	3	J1_PS+	4	J1_PS-
5	J2_5V	6	J2_0V	7	J2_PS+	8	J2_PS-
9	J3_5V	10	J3_0V	11	J3_PS+	12	J3_PS-
13	J4_5V	14	J4_0V	15	J4_PS+	16	J4_PS-
18	J5_5V	19	J5_0V	20	J5_PS+	21	J5_PS-
22	J6_5V	23	J6_0V	24	J6_PS+	25	J6_PS-

(i) Prompt

For definition of other interface connectors, please refer to *Section 7*.

6　Safe Use of inCube12 Control Cabinet

6.1　Grounding of control cabinet

inCube12 control cabinet shall be reliably grounded for the following main purposes:

■　Grounding creates a common reference zero potential for all unit circuits in the inCube12 control cabinet, so that there is no grounding potential difference for circuits to ensure the stable operation of system.

■　The reliable connection of inCube12 control cabinet may prevent the interference from the external electromagnetic fields. Enclosure grounding provides a discharging path for transient interference, allowing a large amount of charge accumulated on the enclosure to discharge through the ground due to electrostatic induction.

■　The working safety may be guaranteed. In case of the electromagnetic induction of direct lightning, the damage to electronic equipment may be prevented; when the input voltage of power frequency AC power source is directly connected to the enclosure due to poor insulation or other reasons, the operators will not be electrically shocked.

inCube12 control cabinet is grounded via the pin PE of interface X21. Ensure the reliable grounding at the input end of cable connecting with control cabinet. Under the normal circumstances, the resistance between the input end PE of cable and the ground is required to be not more than 100 Ω.

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.
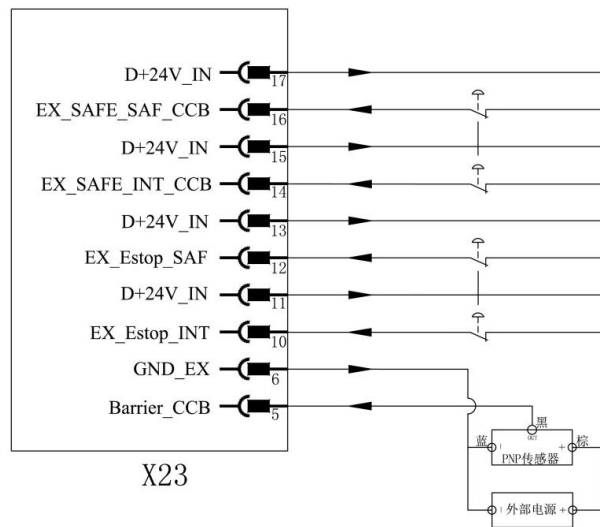

Figure6-1 Connection description of X23 safety input

Table 6-1 Signal description of safety input

Pin No.	Signal name	Signal meaning	Signal type
5	Barrier_CCB	Safety barrier	Level input

6	GND_EX		High level valid
10	EX_Estop_INT	External emergency stop (Two-way backup)	Level input High level valid
11	D+24V_IN		
12	EX_Estop_SAF		
13	D+24V_IN		
14	EX_SAFE_INT_CCB	External safety (Two-way backup)	Level input High level valid
15	D+24V_IN		
16	EX_SAFE_SAF_CCB		
17	D+24V_IN		

The signal definition of the above safety equipment is specified in the X23 Safety IO interface of inCube12 control cabinet. The control cabinet can be used normally only when the above signal is connected to the X23 interface. The connection of X23 safety signal is shown in Figure6-1. The name and role of the pin number are shown in Table 6-1.

The safety input signals include the safety barrier signal, external emergency stop signal, and external safety signal.

■ The safety barrier signal refers to the safety light curtain signal that is equipped for the safety barrier. It supports the PNP sensor and must be equipped with an external DC24V power supply.

■ The external emergency stop input signal refers to the emergency stop signal of the external system that completes the operation in conjunction with the robot. When the emergency stop button of the external system is pressed, the external emergency stop signal of the control cabinet will be valid and the robot will stop according to STOP0. There should have two external emergency stop output signals, one of which is used as the safety link backup. The external emergency stop input signal is valid at high level.

■ The external safety input signal refers to the safety (fault) signal of the external system that completes the operation in conjunction with the robot. The control cabinet will judge whether the robot needs to be stopped according to the status of the external system. The external safety input signal is valid at high level.

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
STOP0	Case1	In case of CCB alarm stop0 indicate, DCB execution stops immediately, and track does not keep. The delay control of CCB turns off power via thyristor, which is an uncontrollable stop
	Case2	The uncontrollable fault of DCB triggers the free stop or contracting brake stop, which is an uncontrollable stop.
	Case3	In case of sudden power failure, DCB can not perform the immediate stop, and the

Type	Description
	contracting brake stop is triggered, which is an uncontrollable stop
STOP1	Robot stops quickly and keeps the current planned path. After the robot stops, the control drive serve_off, and cuts off the power supply via the thyristor, which is a controllable stop.
STOP2	Robot stops quickly and keeps the current planned path. After the robot stops, it does not serve_off and does not cut off the power supply, which is a controllable stop.

6.4 Industrial leakage protection switch

It is worth noting that the tripping problem of the fail-safe switch occurs is after SERVO ON, the system is continuously charged and discharged with the current between the ON and off pair of IPM from the phase line to the PE, thus it generates the change of the high frequency (>=8khz) ground current.

Therefore, the leakage protection switch currently used is too sensitive to high frequency. It is recommended that users use industrial leakage protection switch. The specific manufacturers and models of industrial leakage protection switch are shown in Table 6-3 below:

Table 6-3 Industrial leakage protection switch Specific manufacturers and models

manufacturer name	model
Chint	NB1L-40-C16

7   Description of inCube12 Control Cabinet Interface

7.1   Description of control cabinet indicator

X12 indicator group

The inCube12 control cabinet is provided with 3 indicators, among which:

- The white indicator light is an power indicator, which is on when the control cabinet is startup.

- The green indicator is a running indicator, which is on when the drive power is on.

- The red indicator light is an alarm indicator, which is on when the control system is abnormal.

7.2   Description of control cabinet operation button

X22 Power switch

The power switch of the inCube12 control cabinet is an illuminated rocker switch, on which O/I letters are printed. Under normal circumstances:

- When the switch is set to I position, it indicates that the control cabinet is opened. At this time, the indicator in the switch will be on.

- When the switch is set to O position, it indicates that the control cabinet is closed. At this time, the indicator in the switch will be off.

Prompt

For normal startup procedure of the control cabinet, please refer to *Section 8*.

Notice

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

X11 Emergency stop button

The emergency stop button of inCube12 control cabinet is a mushroom emergency stop button. The robot will stop immediately (STOP1) after the emergency stop button is pressed. To release the safety state, you must turn the emergency stop button in the direction indicated on the button.

Notice

Do not use the emergency stop button as a pause function. Otherwise the manipulator may be damaged.

X13 Teach pendant

The teach pendant knob of inCube12 control cabinet has two positions, ie 0/1:

■ When the knob is set to 1 position, it indicates that the teach pendant must be connected before normal operation, otherwise the control cabinet will send an alarm.

■ When the knob is set to 0, it indicates that the teach pendant can be removed. At this time, the robot system can still continue to run.

When using the teach pendant knob, you must set the knob to 1 position, and connect the teach pendant, and load the control program via the teach pendant. The teach pendant is not required to control the operating system where the control command is fixed. In this case, you can set the knob to 0 position, unplug the teach pendant, and control the operation of the robot system via external control knobs.

Notice

For the system that still needs to run after the teach pendant is unplugged, make sure that the control cabinet is connected with external control devices before unplugging the teach pendent.

Brake releasing and contracting (manually) box

InCube12 control cabinet provides the brake releasing and contracting (manually) function.

Brake releasing and contracting (manually) box in the lower left corner of control cabinet panel. After the brake releasing and contracting (manually) box cover plate is opened, you will see the brake releasing and contracting button as shown in Figure 7-1. .

The names and functions of the buttons as shown in Table 7-1 are listed in:

Table 7-1 Names and Functions of Brake Releasing and Contracting (Manually) Buttons

Name	Function
X61	Enabling switch of brake releasing and contracting (manually)
X62	Brake releasing and contracting buttons for axes 1 and 2
X63	Brake releasing and contracting buttons for axes 3 and 4
X64	Brake releasing and contracting buttons for axes 5 and 6

Follow the operating instructions on the back of the brake releasing and contracting (manually) box cover plate:

1. Turn the enabling switch to the "l" position ("brake releasing and contracting (manually) is enabled" is displayed on the teach pendant interface).

2. Long press the brake releasing and contracting button and manually drag the corresponding axle of body to the desired position.

X61   X62

X63   X64
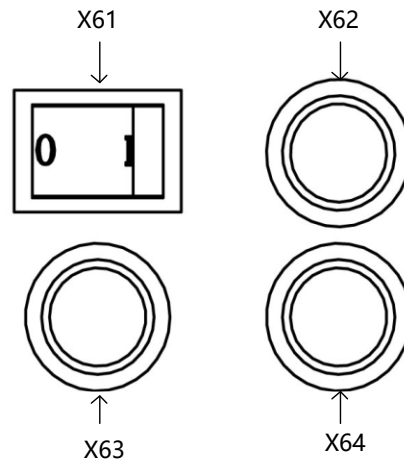
Figure 7-1 Brake Releasing and Contracting (Manually) Button

(i) Prompt

After the brake releasing and contracting button is pressed, the body shall be prevented from falling due to gravity, causing the damage to system.

7.3   Description of control cabinet external interface

X23 system IO interface

The X23 interface of inCube12 control cabinet is a system IO interface. The interface signals include the external emergency stop input, emergency stop output, external pause, external auto operation, safety barrier status, LED tower, external servo switch, external safety signal, program number, etc.The definition of signal of the system IO interface is fixed and cannot be configured by the user.

The definition of 23 system IO interface is given in Table 7-1. Other signals will be specified according to the input and output signals.X23 is a female terminal DB50 in the cabinet, and Connects to a 50 pin terminal platform via a dedicated terminal cable. The users cable is generally connected to the terminal block. For ease of use, the pin definitions is described on the cabinet side and the terminal block side respectively.

The X23 system IO interface provides the output signals such as LED tower, buzzer, emergency stop output, servo-on status output, etc. For the signal use method, please refer to Figure 7-2 (the cabinet side)and Figure 7-3 (the terminal block side).
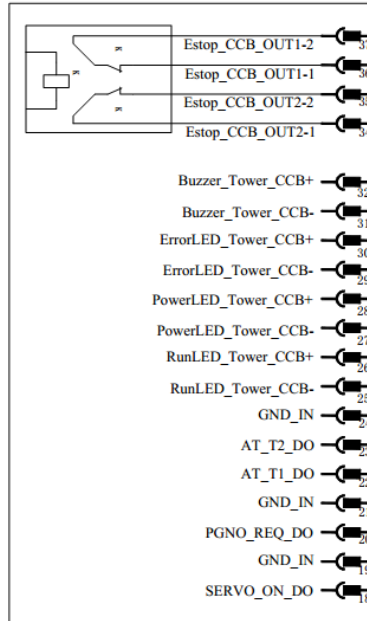
Figure 7-2 X23 system IO output signal(the cabinet side)
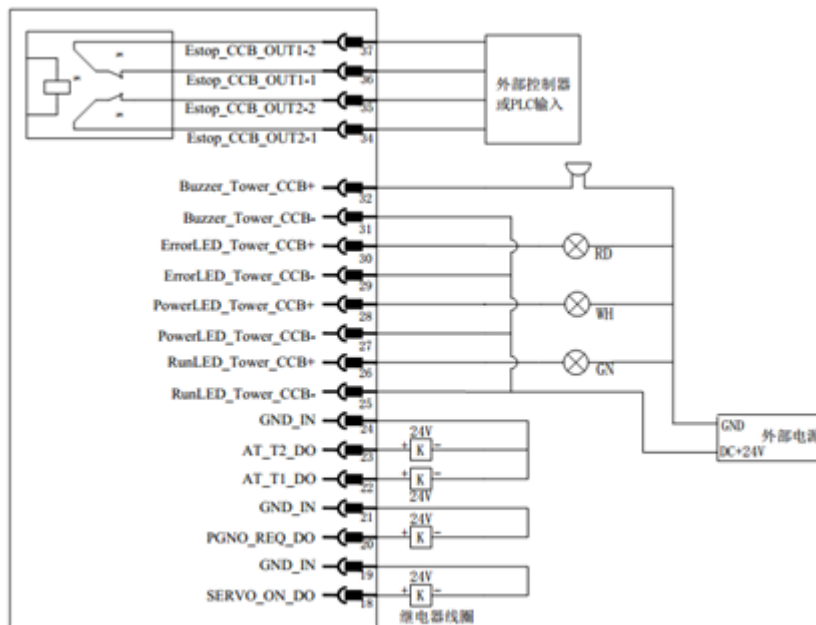
Figure 7-3 X23 system IO output signal(the terminal block side)

Table 7-2Definition of X23 system IO output signal list

Pin No.	Signal name	Signal meaning	In/Out
18	SERVO_ON_DO		Level output, high effective Max20mA
19	GND_IN	Power on status output	
20	PGNQ_REQ_DO	Request program number signal DO	Level output, high
21	GND_IN		

Pin No.	Signal name	Signal meaning	In/Out
			effective Max20mA
22	AT_T1_DO	Manual low speed mode Manual high speed mode Automatic mode	Level output, high effective Max20mA
23	AT_T1_DO	Manual high speed mode	
24	GND_IN	Automatic mode	
25	RUNLED_TOWER_CCB+	The tower run light sigal	contact Out
26	RUNLED_TOWER_CCB-		
27	POWERLED_TOWER_CCB+	The tower power light sigal	contact Out
28	POWERLED_TOWER_CCB-		
29	ERRORLED_TOWER_CCB+	The tower alarm light signal	contact Out
30	ERRORLED_TOWER_CCB-		
31	BUZZER_TOWER_CCB+	The external buzzer signal	contact Out
32	BUZZER_TOWER_CCB-		
34	ESTOP_CCB_OUT2-1	Emergency stop external output signal 2	contact Out
35	ESTOP_CCB_OUT2-2		
36	ESTOP_CCB_OUT1-1	Emergency stop external output signal 1	contact Out
37	ESTOP_CCB_OUT1-2		

Table 7-2, Pin22-24 is the manual high-speed, manual low-speed, and automatic mode output signals in the system IO. It outputs three states in a combined manner. For the combined method, refer to.

Table 7-3Manual high-speed, manual low-speed, automatic mode output combinations

		AT_T1_DO	
		HIGH	LOW
AT_T2_DO	HIGH		Manual high-speed
	LOW	Manual low-speed	Automatic mode

The X23 system IO provides the input signals such as external pause, external running, external alarm clearing, external servo-on/off, program number, etc.
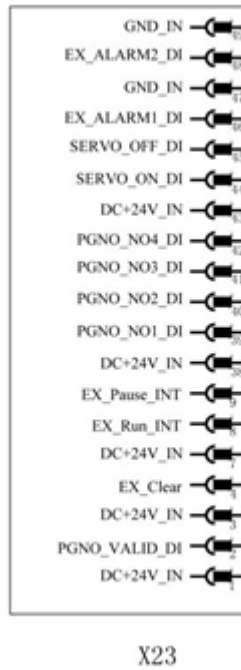For the signal use method, please refer to Figure 7-4and Figure 7-5.

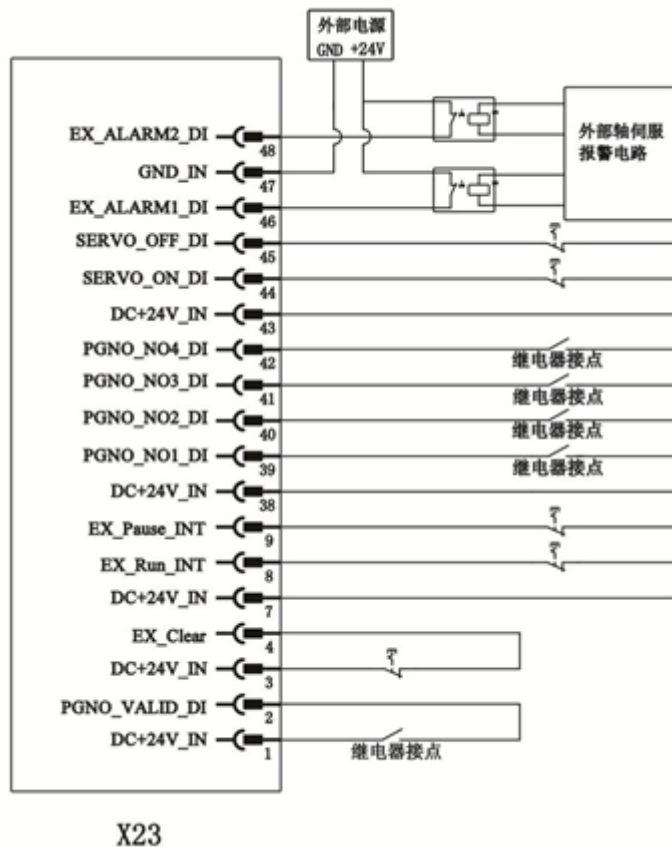Figure 7-4 X23 system IO input signal(the cabinet side)

Figure 7-5X23 system IO input signal(the terminal block side)

Table 7-4Definition of X005 Safety IO interface

Pin No.	Signal name	Signal meaning	In/Out
1	DC+24V_IN	Program number valid signal	Level input
2	PGNO_VALID_DI		

Pin No.	Signal name	Signal meaning	In/Out
			Valid on rising edge
3	DC+24V_IN	External clear alarm signal	Level input
4	EX_Clear		Valid on rising edge
7	DC+24V_IN	External run signal External pause signal	Level input
8	EX_Run_INT		Valid on rising edge
9	EX_Pause_INT		
38	DC+24V_IN		Level input
39	PGNO_NO1_DI	Program number 1	Highly effective
40	PGNO_NO2_DI	Program number 2	
41	PGNO_NO3_DI	Program number 3	
42	PGNO_NO4_DI	Program number 4	
43	DC+24V_IN	External power on signal External power down signal	Level input
44	SERVO_ON_DI		High pulse effective
45	SERVO_OFF_DI		
46	EX_ALARM1_DI	External axis 1 alarm input	Level input
47	GND_IN		High pulse effective
48	EX_ALARM2_DI	External axis 2 alarm input	
49	GND_IN		

X24 User IO interface

The inCube12 control cabinet provides users with 16 DI and 16 DO interfaces. When using the DI and DO interfaces, an external power supply must be provided. X24 is a DB62 female terminal on the cabinet side, which is connected to a 50-pin terminal block through a user IO terminal module cable. The user usually connects to the terminal block when wiring. Similarly, for the convenience of use, the pin definition of the cabinet side and terminal block side of the X24 are now explained separately.For the DI interface use method on the cabinet side and terminal block side, please refer to Figure 7-6 and Figure 7-7, respectively.

The PNP sensor signal, switch signal and relay contact signal can be used as input of user DI. The inCube12 control cabinet supports the PNP sensor input. When the NPN sensor is used, it should be installed and replaced with a relay.
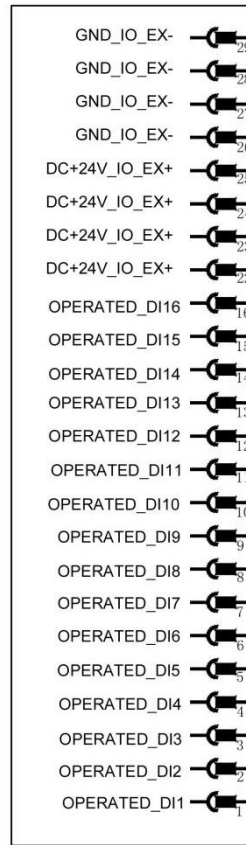
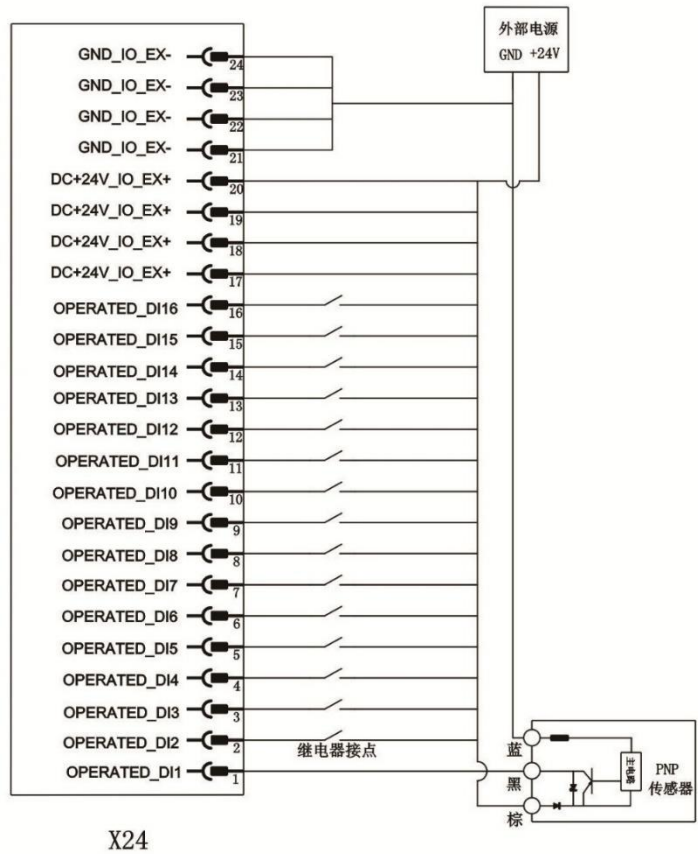Figure 7-6 Description of X24-DI(the cabinet side)

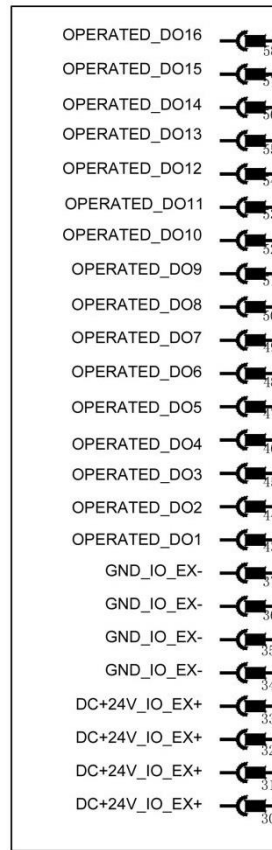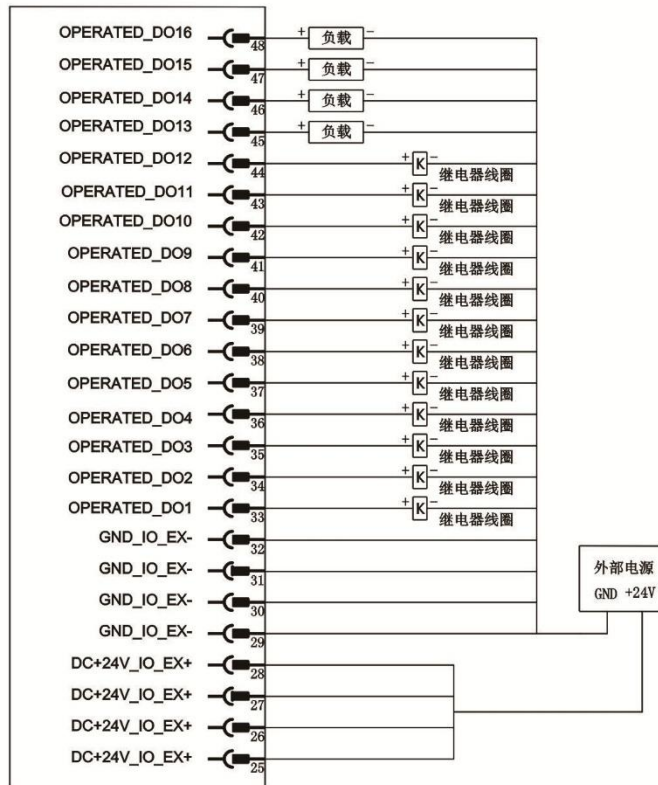Figure 7-7 Description of interface X24-DI(the terminal block side)

Figure 7-8 Description of interface X24-DO(the cabinet side)

Figure 7-9 Description of interface X24-DO(the terminal block side)

The inCube12 control cabinet provides users with 16 DO interfaces. Except DO1~12 are MOSFETs with a maximum output of 160mA ,and DO13~16 are relay with a maximum current output of 500mA,. When the DO interface is used, it must be powered by an external power supply. For the DI interface use method on the cabinet side and terminal block side, please refer to Figure 7-8 and Figure 7-9 respectively.

X27 user RS232 interface

The X27 interface on inCube12 control cabinet is the RS232 communication interface provided for users. X27 interface is a standard M12 connector. When this interface is used, the cable that matches with X27 can be selected according to *Appendix A* "List of Accessories". The cables are available in black, brown and blue. For definition of cables, please refer to Table 7-5.

Table 7-5 Definition of interface X001

Interface	Pin	Cable color	Cable definition
	4	Black	RXD
X27	1	Brown	TXD
	3	Blue	GND

X26 expanded MF interface

The X26 interface of inCube12 control cabinet is the expanded MF interface. When the number of IOs used exceeds 16 DIs and 16 DOs reserved by the system, the inCube12 control cabinet will provide an MF module that extends IO. The MF module has 40 DI and 40 DO signals and communicates with the control cabinet via Modbus protocol.

The X26 interface is a standard M12 connector. When this interface is used, the cable that matches with X26 can be selected according to the *Appendix A* "List of Accessories". The cables are available in black, brown, and blue. For definition of cables, please refer to Table 7-6.

Table 7-6Definition of interface X26

Interface	Pin	Cable color	Cable definition
X26	1	Black	RS485+
	3	Brown	RS485-

X25 user Ethernet network port

The inCube12 control cabinet provides users with an Ethernet interface, which is used to connect the industrial Ethernet and sensors that communicates via Ethernet.

X15 expanded external axis EtherCAT network port

The inCube12 control cabinet is reserved with one EtherCAT interface, which is used as the expanded external axis interface and EtherCAT protocol conversion port. It supports maximum 2 external axes.

The external axis extension method is as follows: The external axis drive is provided outside. The compact cabinet does not provide an external axis motor to supply power to the external axis drive, and also does not provide power for the external axis brake. The external axis communicates with the compact cabinet via EtherCAT bus, and the external axis drive alarm is connected to the compact cabinet via safety IO interface.

Tip

■ It is recommended that the external shaft power supply inlet (RST) be connected to a contactor or relay, and the alarm output of the control cabinet be used to control the power on and off.

■ The inCube12 control cabinet can be connected to the EtherCAT communication port of the expanded external axis using the connectors shown in *Appendix A* "List of Accessories".

Tip

8   Start of inCube12 Control Cabinet

In order to ensure that the inCube12 control cabinet can be started and used normally, it must be started strictly according to the following steps:

1.   Visually check the appearance of the control cabinet and check whether the cabinet is bumped or deformed.

2.   Check that the control cabinet is free of condensation or water drop. Before starting, make sure that there is no water drop inside the cabinet.

3.   Install the control cabinet. Refer to *Section 5.3* "Installation of control cabinet".

4.   Connect the power encoder cable. Refer to *Section 5.5* "Connection of power encoder".

5.   Connect the teach pendent. Refer to *Section 5.5* "Connection of teach pendent".

6.   Make sure that the teach pendant knob is set to I position. Refer to *Section 7.2* "X13 teach pendant knob".

7.   Connect the power cable of the control cabinet. Refer to *Section 5.5* "Connection of other interfaces".

8.   Connect the X005 safety input. Refer to *Section 6.2* "Safety of robot system".

9.   Turn on the control cabinet switch. Refer to *Section 7.2* "Power switch of control cabinet".

10.   Configure the external IO interface. Refer to "Operation Manual of Control Cabinet".

9   Routine Maintenance Items and Cycles

Some versions of inCube12 control cabinet must be maintained through opening the door. The control cabinet door can be opened as follows:

1. Place a slotted screwdriver with a width of 8mm and above into the slot of the cylinder lock of the control cabinet.

2.   Turn the screwdriver 90 degrees clockwise to open the cabinet door, as shown in Figure 9-1.
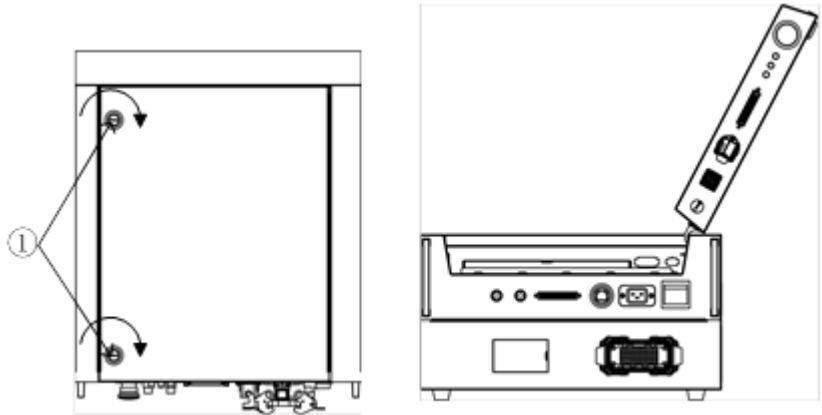
Figure 9-1 Opening method of top cover of control cabinet

The multi-axis drive debugging interface X41 of the inCube12 control cabinet is located on the sheet metal in the middle partition of the control cabinet, as shown in Figure 9-2. When adjusting the multi-axis drive parameters, you must connect RS422 to the interface ① via USB cable. For details about debugging, please refer to "Operation Manual of Robot Body".

X41 debuging port
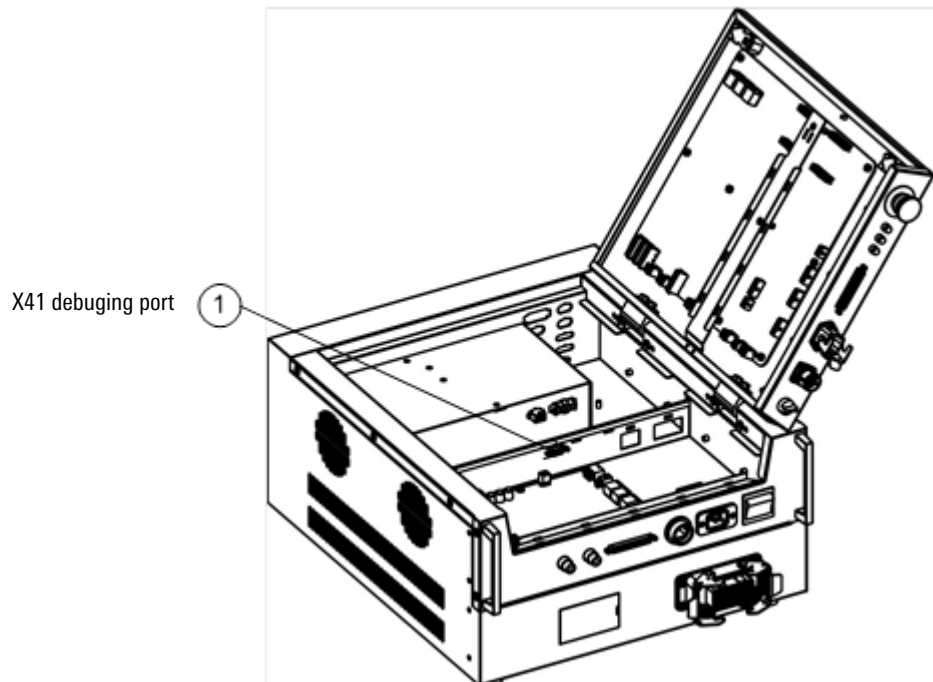
Figure 9-2Schematic diagram of position of debugging port

The inCube12 control cabinet supports the separation of the control box and the drive box to locate cabinet faults and maintain the cabinet. Refer to the

Figure 9-3 for the separation and maintenance of the control box and drive box. Before separation, the 10 screws (5 on the left and right sides) fixed by the control box and the drive box must be removed.

screws
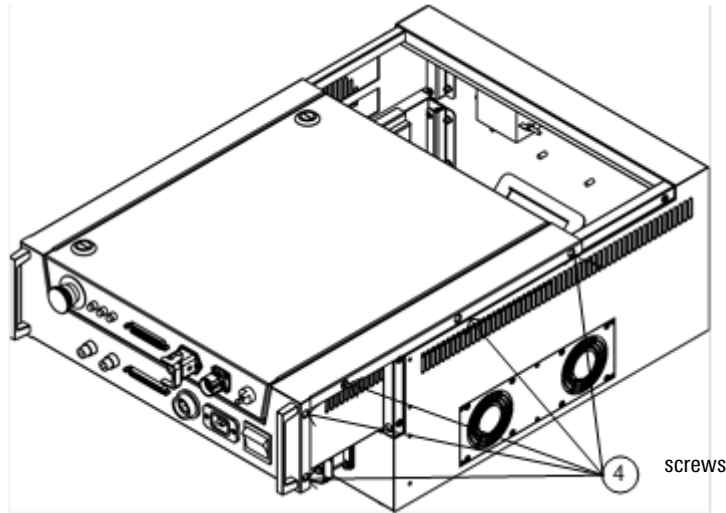
Figure 9-3Control box and drive box separation

When the cabinets are separated, the extraction distance of the control box is not more than 150mm. After the control box is pulled out to a certain position, the connector at the rear of the control box can be removed, and then the control box can be removed for control cabinet maintenance.

For routine maintenance items and cycles of inCube12 control cabinet, please refer to Table 9-1.

Table 9-1Routine 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 inCube12 control cabinet is installed with a dust screen at the inlet of the air duct, as shown in Figure 9-4. 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.

Dust screen ①

Figure 9-4Replacement or cleaning of dust screen

10 Common Faults and Troubleshooting

➢ Indicator light

When the indicating device such as indicator light fails to send signals normally, check whether there is a fault in the connection wire; and if not, replace the indicating device and observe whether the signal can be sent normally.

➢ Overload connector

When the connection device such as the overload connector is loose, separate the overload connector plug from the socket and re-plug it and tighten it to ensure a reliable connection.
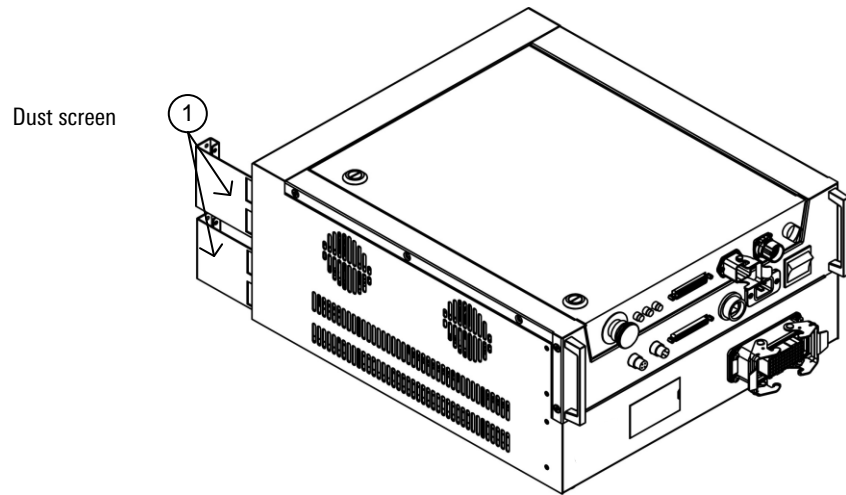
➢ Fan

When the fan fails to rotate normally, check whether the connection wiring harness is faulty; and if not, replace the fan and observe whether 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 10-1.

Table 10-1Role and replacement of fuse

Code	Port	Model	Parameter	Significance
F104	X104	287002	2A/32VDC	Power supply of teach pendant
F112	X112	215016	16A/250VAC	220V power supply of multi-axle drive board
F113	X113	3921160	1.6A/250VAC	Reserved 220V power supply
F116	X116	287015	15A/32VDC	24V digital power supply of control system
F119	X119	287002	2A/32VDC	24V power supply of main control board
F120	X120	287004	5A/32VDC	24V power supply of multi-axle drive board
F121	X121	287005	5A/32VDC	24V power supply of brake contracting
F122	X122	287002	2A/32VDC	Reserved 24V power supply
F114_1	X114	3921160	1.6A/250VAC	Digital power supply 220V power supply of power module
F114_2	X114	3921160	1.6A/250VAC	Power supply of brake contracting 220V power supply of power module
F24		287002	2A/32VDC	Isolated 24V power supply of CCB board
F1	X312	215016	16A/250VAC	Inlet power supply of power board

11 Storage Conditions

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 11-1:

Table 11-1Environmental conditions for long-time storage of control cabinet

Parameter	Value
Min. ambient temperature	-25°C
Max. ambient temperature (without Barry)	70°C
Max. ambient temperature (with Barry)	40°C
Max. ambient humidity	Less than 95% at constant temperature without condensation

Appendix A List Of inCube12 Accessories

Schedule 1 List of installation accessories of inCube12 control cabinet

Accessory name	Accessory number	Ver. No.	Qty.	Accessory property
Handling handle	P01035000188	R1.0	2	Optional
Connector at the tail of cabinet	P01035000261	R1.0	1	Optional
Connector at the front of cabinet	P01035000262	R1.0	2	Optional
Teach pendent bracket	P01035000263	P1.0	1	Optional

Schedule 2 List of cable accessories of inCube12 control cabinet

Accessory name	Accessory number	Corresponding interface	Accessory property
Two in one power encode harness	P04082000345	X31	Standard (length 5 m)
ARCC- External harness of teaching pendant	P04082000346	X16	Standard (length 5 m)
Power cord	P04082000321	X22	Standard (length 5 m)
System IO terminal module cable	P04082000261	X23	Standard
System IO terminal module	P05050000010	X23	Standard
Users IO terminal module cable	P04082000262	X24	Standard
Users IO terminal module	P05050000011	X23	Standard
User RS232 cable	P04082000278	X27	Optional
Industrial network cable & PROFINET/EtherCAT network cable	P04082000279	X25	Optional
Expanded MF cable	P04082000280	X26	Optional
PLC-MF DI cable	P04082000105	X26	Optional
PLC-MF DO cable	P04082000106	X26	Optional
CON_IO module	P05050000007	X26	Optional
APLC-MF-24DC-40-40-B	P05050000001	X26	Optional
External axis Ethercat cable	P04082000281	X15	Optional
RS422/RS485 cable via USB	P04082000251	X41	Optional

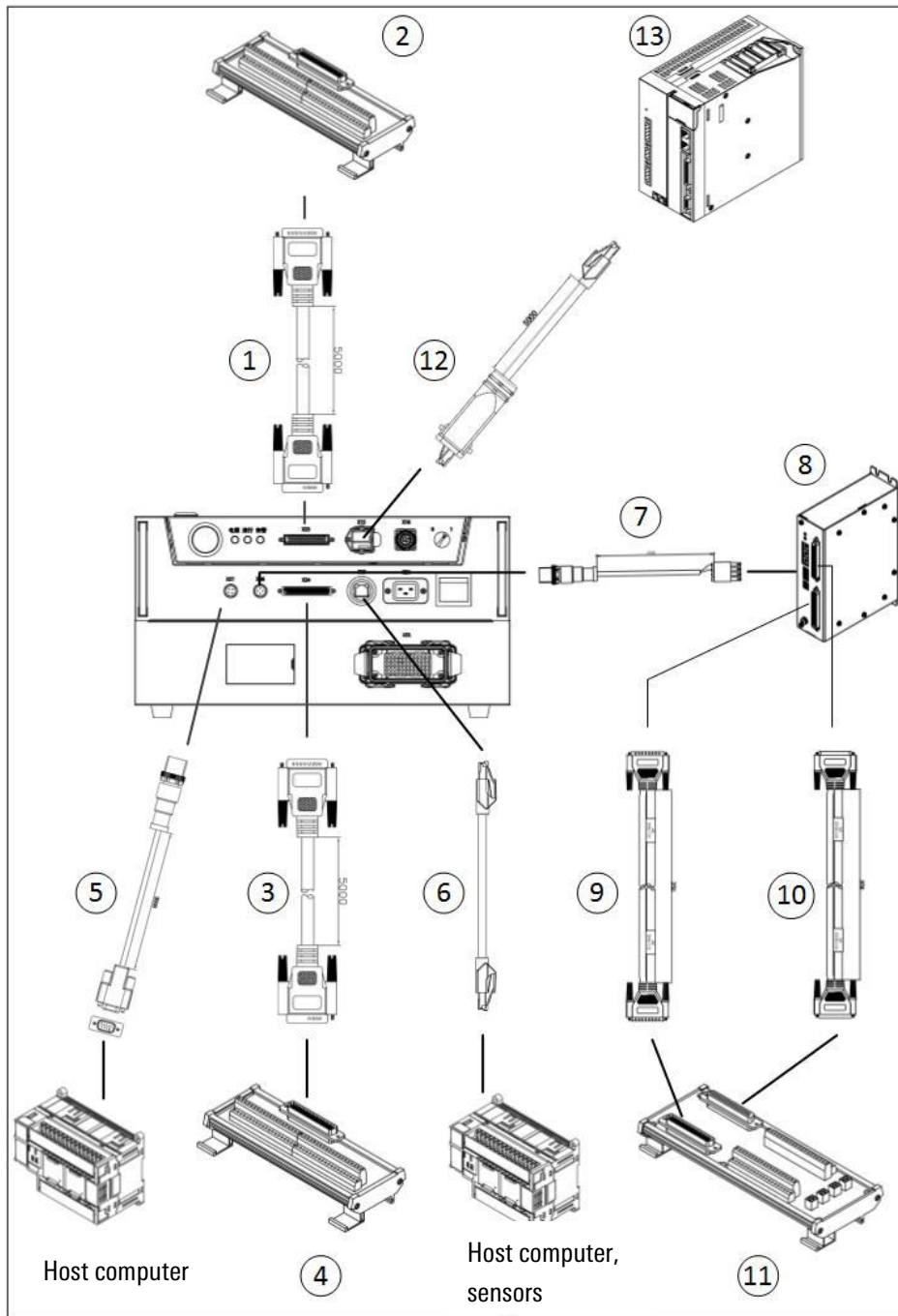# Appendix B Description Of inCube12 Accessories

Fig. 1 Accessories of inCube12 control cabinet

Handling handle

The basic specifications and installation methods of handling handle are shown in Table 1.

Table 1 basic specifications and installation methods of handling handle

S/N		Name	Handling handle	Component code	P01035000188
length	223mm		width	35mm	
height	20mm		thickness	1.5mm	
Installation method	Refer to Section5		Mounting screws	4 hexagon socket countersunk head screws M5X8	
application	For installation in a 19-inch cabinet. During installation, the left and right sides of the cabinet are fixed by carrying handles and 19-inch cabinets, and cabinet pallets are required at the bottom to support				

Front connector

The basic specifications and installation methods of front connector are shown in Table 2.

Table 2 Basic front connection basic specifications and installation methods

S/N		Name	Front connector	Component code	P01035000262
length	88mm		width	20mm	
height	2mm		thickness	2mm	
Installation method	Refer to Section5		Mounting screws	2 hexagon socket countersunk head screws M5X10	
application	Used with cabinet rear connector for cabinet stacking				

Tail connector

The basic specifications and installation methods of Tail connector are shown in Table 3.

Table 3 basic specifications and installation methods of cabinet tail connection

S/N		Name	Front connector	Component code	P01035000261
length	350mm		width	55mm	
height	2mm		thickness	2mm	
Installation method	Refer to Section5		Mounting screws	6 hexagon socket countersunk head screws M5X10	
application	Used with cabinet front connector for cabinet stacking				

Teach pendent bracket

For the basic specification and installation method of teach pendant bracket, please refer to Table 4.

Table 4 Basic specification and installation method of teach pendant bracket

S/N		Name	Teach pendent bracket	Component code	P01035000263
Length		232mm	Width		55mm
Height		872mm	Thickness		1.5mm
Installation method		Refer to Section5	Mounting screw		3 cross recessed pan head combination screws, M5X10
Purpose	Installation of teach pendant				

X31 interface external wiring

X31 interface external wiring is as follows:

1. End line sequence of two in one power encode harness A corresponds one-to-one to B.

2. The X31 all interface number on the robot control cabinet side corresponds one by one to the heavy load interface numbers on the robot body side.

3. Refer to Chapter 5 for the definition of the X31 end. See Table 5 for the basic specifications of the inCube12-power encoder harness.

Table 5 basic specifications of Two in one power encode harness

S/N		Name	Two in one power encode harness	Component code	P040820003 45
A-terminal connector		Heavy load, metal upper case, male ferrule, male pin, metal case, plastic protective cover			
B-terminal connector		Heavy load, metal upper case, female ferrule, female pin, metal shell, plastic protective cover			
Cable		Power line, 25 core 0.75mm2 Encoder cable, 40 cores 0.25mm2	Cable length		5m(standard)

X16 interface external wiring

For the definition of X16 terminal, refer to Chapter 5. For the basic specifications of the ARCC- External harness of teaching pendant, see Table 6.

Table 6 ARCC- External harness of teaching pendant basic specifications

S/N		Name	ARCC- External harness of teaching pendant	Component code	P040820003 46
A-terminal connector		M23 female			
B-terminal connector		Teach Pendant			
Cable		A total of 14 cores, 4 of which are super Category 5 network cables, and the remaining 10 cores are directly connected	Cable length		5m

X21 interface external wiring

The basic specifications of Power cord cable harness are shown in Table 7.

Table 7 Power cord basic specifications

S/N	Name	Power cord	Component code	P040820003 21
A-terminal connector	China Standard，AC Power Cord CCC 3Pin Plug，16A			
B-terminal connector	Loose wire, matching with scurter-4795.0000 power connector plug			
Cable	3 core, 1.5mm^2		Cable length	5m

X23 interface external wiring

The basic specifications of the system IO terminal module cables are shown in Table 8. The external wiring of the X23 interface is as follows:

1. The line order of the two ends of the system IO terminal module cable is one-to-one.

2. The system IO terminal module terminal serial number corresponds to the control cabinet X23 interface serial number.

Table 8 Basic specifications of system IO terminal module cables

S/N	1	Name	System IO terminal module cable	Component code	P040820002 61
A-terminal connector		D_SUB, DB50 male, plug, metal housing			
B-terminal connector		D_SUB, DB50 male, plug, metal housing			
Cable		48 core 0.14mm^2		Cable length	5m

X24 interface external wiring

Table 9 Basic specifications of user IO terminal module cables

S/N	3	Name	User IO terminal module cable	Component code	P040820002 62
A-terminal connector		D_SUB, DB62 male, plug, metal housing			
B-terminal connector		D_SUB, DB62 female, plug, metal housing			
Cable		48 core 0.14mm^2		Cable length	5m

Table 10 Basic specifications of user IO terminal module

S/N	4	Name	User IO terminal module	Component code	P050500000 11
Input		D_SUB, DB50 male, PCB board connector			
Output terminal 1. The cable sequence DB62 (1-16, 22-37, 43-58) of the user IO terminal		Terminal Screw terminal, two layers, total 50pin			

S/N	4	Name	User IO terminal module	Component code	P050500000 11
module corresponds to DB50 (1-16, 17-32, 33-48); 2. The terminal serial number of the user IO terminal module (1-16, 17-32, 33-48) corresponds to the serial number of the control cabinet X24 interface (1-16, 22-37, 43-58);					
Instructions for use	Use 0.3 ~ 0.5mm2 cable, use European terminal C0.5-8 to crimp into the output terminal				

The basic specifications of the user IO terminal module cable and the basic specifications of the user IO terminal module are shown in Table 9 and Table 10 respectively. The specific method of external wiring of the X24 interface is as follows:

1.   The cable sequence of user IO terminal module DB62 (1-16, 22-37, 43-58) corresponds to DB50 (1-16, 17-32, 33-48).

2.   The user serial number of the IO terminal module (1-16, 17-32, 33-48) corresponds to the serial number of the control cabinet X24 (1-16, 22-37, 43-58).

X27 interface external wiring

RS232 Harness Basic Specifications are shown in Table 11

Table 11 RS232 harness basic specifications

S/N	5	Name	User RS232 Cable	Component code	P04082000278
A-terminal connector	M12 straight connector		Brand /tyoe	TE/RPC-M12-MS-3CON-PUR-5.0	
B-terminal connector	D_SUB, DB9 male, plug, plastic housing				
Cable	3 core 0.25mm^2		Cable length	5m	

Notes:

The M12 straight connector is connected to the 2-pin DB9 in black, the 3-pin DB9 in brown, and the 5-pin DB9 in blue.

X25 interface external wiring

Table 12 Industrial network cable & PROFINET/EtherCAT network cable Basic Specifications of Ethernet Cable Harness

S/N	6	Name	Industrial network cable & PROFINET/EtherCAT network cable	Component code	P04082000279
A-terminal connector		RJ45 crystal head		Brand /tyoe	HRS/TM21P(88P)
B-terminal connector		RJ45 crystal head		Brand /tyoe	HRS/TM21P(88P)
Cable		4-core AWG26		Cable length	5m

X26 interface external wiring

Table 13 basic specifications of outer MF wiring harness

S/N	7	Name	Outer MF wiring harness	Component code	P04082000280
A-terminal connector		M12 straight connector		Brand /tyoe	TE/RPC-M12-MS-3CON-PUR-5.
B-terminal connector		3.81Terminal plug		Brand /tyoe	DECA / MPE050-381-4 matching plug or MC421-38104 (MF standard)
Cable		2-core 0.25mm^2		Cable length	5m

Table 14 APLC-MF-24DC-40-40-B basic specifications

S/N	8	Name	APLC-MF-24DC-40-40-B	Component code	P05050000001
Description		Can expand the number of user IOs to 40 DIs and 40 DOs (two can be cascaded, with a maximum of 80 DIs and 80 DOs)			

Table 15 PLC-MF-DI input cable basic specifications

S/N	9	Name	PLC-MF-DI input cable	Component code	P04082000105
A-terminal connector		D_SUB, DB62 male, black rubber core, front nickel back tin shell			
B-terminal connector		D_SUB, DB62 female, black rubber core, front nickel back tin housing			
Cable		52-core0.14mm^2		Cable length	350mm

Table 16 PLC-MF-D0 output cable basic specifications

S/N	10	Name	PLC-MF-DO output cable	Component code	P04082000106
A-terminal connector			D_SUB, DB62 male, black rubber core, front nickel back tin shell		
B-terminal connector			D_SUB, DB62 female, black rubber core, front nickel back tin housing		
Cable		52-core0.14mm^2	Cable length		350mm

Table 17 Con_IO module basic specifications

S/N	11	Name	Con_IO module	Component code	P05050000007
Description			Convert the D_SUB connector on PLC_MF into a terminal screw terminal for easy wiring		

The basic specifications of X26 interface external wiring related accessories are shown in Table 13 ~ Table 17.

Notes:

1. It is recommended to use PLC-MF and supporting cables for the external IO quantity.

2. M12 straight connector is black with Weidmuller connector 1 pin, brown with Weidmuller connector 2 pin.

3. The DB62 pins on both ends of the DI input line and DO output line correspond one to one.

X15 interface external wiring

Table 18 Basic Specifications

S/N	12	Name	External Ethercat cable	Component code	P04082000281
A-terminal connector		H3A RJ45 plug	Brand /tyoe	TE/RPC-M12-MS-3CON-PUR-5.	
B-terminal connector		RJ45 Crystal Head	Brand /tyoe	HRS/TM21P(88P)	
Cable		4-core AWG26	Cable length	5m	

Table 19 Basic drive specifications

S/N	13	Name	Drivers	Component code	
Description			AE5115Ethercat bus driver		

X41 interface external wiring

See Table 20 for basic specifications of the USB to RS422 / RS485 cable.

Table 20 Basic specifications of USB to RS422 / RS485 cable

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

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