



Collaborative Robot Elfin Series

Electrical installation

(E03/E05/E10)
V1



Introduction

How to Use This Manual

This manual is intended for operators of Elfin robots, who should have some electrical and programming knowledge. The manual will provide instructions for Elfin operators from the following ways:

- ☐ Safety: The operator should keep all safety instructions in mind.
- ☐ Mechanical Installation: The operator should follow the instructions when installing the robot.
- ☒ Electrical interface: Open ports of Elfin are introduced for the convenience of secondary development.
- ☐ Software Control: It can guide the operator to install software and run the robot.
- ☐ Security Configuration: It introduces the basic safety settings.

Technical Support

Shenzhen Han's Robot Co., Ltd will provide you with long-term technical services. If you have any technical problems or other needs during using our robot, you are welcome to visit our company website: www.hansrobot.com, or directly contact our technical engineers.

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Chapter 1 Electrical Interfaces

This chapter describes all the electrical interfaces of the robot arm and the control box. These interfaces are divided into five categories, each of which has different uses and attributes:

- Controller I/O
- Tool I/O
- Ethernet
- Power connection
- Robot connection

“I/O” The term refers to the digital and analog control signals coming in and out of the interface.

These five types of interfaces are described below, and most types of I/O provide examples.

Precautions



- Please read the Elfin electric control box interface instructions before installing the electric control box.
- The location of electric control box and distribution cable should be away from the noise source as much as possible. If it is too close to the noise source, there may be position deviation or misoperation.
- Don't apply excessive force to the connector or overbend the cable. Otherwise, it may lead to bad contact or broken line.
- Please make sure that the equipment is well grounded.
- Please use the accessory nylon clip to fix the cable after connecting the cable.
- Don't disassemble the electric control box, otherwise it may cause electricity leakage and electric shock.
- The electric control box is equipped with fans at both ends. Don't block them when installing, and keep it well ventilated.

1.1 Connecting cable

As shown in the below figure, the line is the power cable of the electric control box. The cable line is 5m long. The control box must be connected to the power supply. This process must be completed using the corresponding IEC C13 wire connected to the standard IEC C14 plug on the bottom of the control box.

Note:

The power supply shall be equipped with at least the following accessories:

- Grounding;
- Fuse of electric supply;
- Residual current circuit breaker;

It is recommended that all the devices in the robot application should have a power supply switch, so as to lock and hang up a sign during the maintenance.

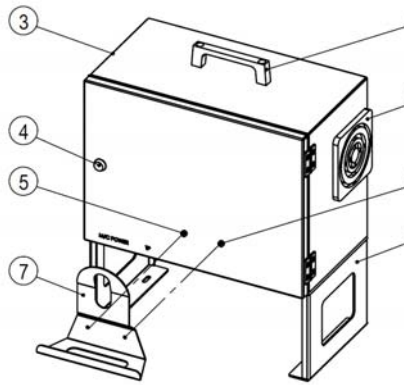


As shown in the following figure, the line is a cable that connects the robot body and electric control box, with a length of 5m. It connects the machine hand and the electric control box. The gray end connects the plug of robot base, and the black end connects the electric control box's aviation plug.



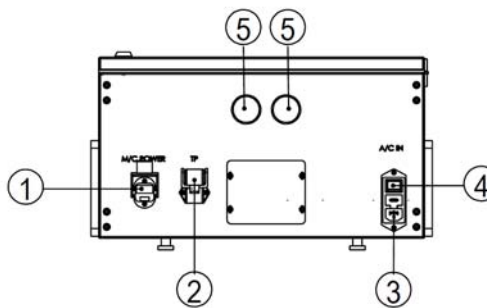
1.2 External Interface and Connection Instructions

Front:



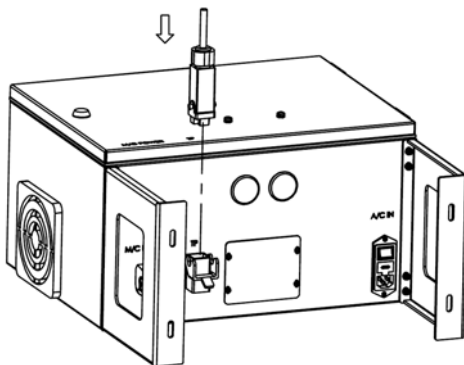
No.	Name
1	Carrying handle
2	Exhaust vent
3	Air inlet
4	Cabinet keyhole
5	Screw
6	fixed foot rack
7	fixed plate of teaching pad

Bottom: :

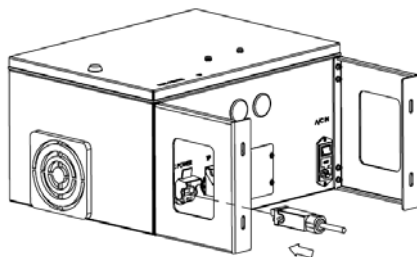


No.	Name
1	Robot connector
2	Teach pendant connector
3	Controller power switch
4	AC power socket
5	grommet

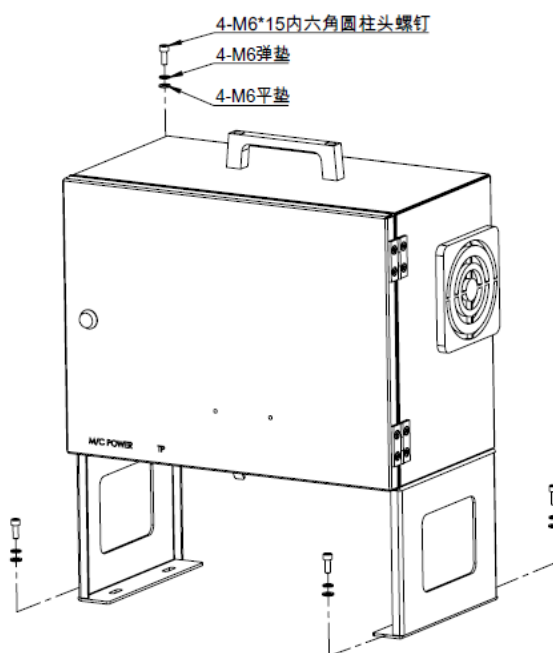
The controller connects the teach pendant:



The controller connects the robot:



Fasten the controller :



1.3 Introduction to Controller I/O

The controller provides a series of external interfaces, for connecting controller I/O with various devices such as external relays, PLC, sensors and emergency stop device.

The port layout of the controller panel I/O is shown below:

Analog I/O	AI0-	AI0+
	AI1-	AI1+
	AO0-	AO0+
	AO1-	AO1+
Power I/O	GND	ON/OFF
	NC	NC
Flexible I/O	GND	CO4
	CO7	CO3
	CO6	CO2
	CO5	CO1
	GND	CO0
	24V	CI4
	CI7	CI3
	CI6	CI2
	CI5	CI1
	24V	CI0
General I/O	24V	DI0
	24V	DI1
	24V	DI2
	24V	DI3
	24V	DI4
	24V	DI5
	24V	DI6
	24V	DI7
	GND	DO0
	GND	DO1
	GND	DO2
	GND	DO3
	GND	DO4
	GND	DO5
	GND	DO6
	GND	DO7
Emergency	GND	24V_IN
	GND	24V_IN
	24S	ESI1
	24S	ESI2
	EI12	EI11
	EI22	EI21
	24S	SDI1+
	GND	SDI1-
	24S	SDI2+
	GND	SDI2-
	24S	SDI3+
	GND	SDI3-
	24S	RST+
	GND	RST-
	EO3	EO1
	EO4	EO2

1.4 General specification for all digital I/O

This section describes the electrical specifications of 24V digital I/O provided by the controller.

- General I/O (Type : PNP)
- Safety I/O (Type : PNP)
- Configurable I/O (Type : PNP)

The digital I/O power supply is provided internally by the controller, and can be supplied externally when needed. The current is limited to 2A when using internal/external power supply. The digital I/O can connect the external power according to the following diagram. The configurable I/O can be configured into general I/O.



The electrical specifications for internal and external power supply are as follows:

Terminal	Parameter	Minimum Value	Typical Value	Maximum Value	Unit
Internal 24V Power Supply					
INT_24 - INT_GND	Voltage	23	24	25	V
INT_24 - INT_GND	Current	0	-	2	A
External 24V Power Supply					
24D - GND	Voltage	20	24	29	V
24D - GND	Current	0	-	2	A

The digital I/O follows the requirements of IEC61131-2. The electrical specifications are as follows.

Terminal	parameter	minimum value	Typical value	Maximum value	unit
Digital output					
COx / DOx	Current	0	-	1	A
COx / DOx	Voltage drop	0	-	0.5	V
COx / DOx	Leakage current	0	-	0.1	mA
COx / DOx	Function	-	PNP	-	Type
COx / DOx	IEC 61131-2	-	1A	-	Type
Digital input					
SIx / DIx	Voltage	-3	-	30	V
SIx / DIx	OFF area	-3	-	5	V
SIx / DIx	ON area	11	-	30	V
SIx / DIx	Current (11-30V)	2	-	15	mA
SIx / DIx	Function	-	PNP	-	Type
SIx / DIx	IEC 61131-2	-	3	-	Type

Safety I/O

This section introduces special safety input (red text font), please follow the 24V digital I/O general specification when using.

The safety inputs include emergency stop and safety protection stop. Emergency stop input is used only for stopping equipment under emergency. The safety protection stop input is used for all types of safety protection devices. Their functional differences are shown in the following table.

Terminal	Emergency Stop	Safety Protection Stop
Robot stops moving	Yes	Yes
Run program	Stop	Suspend
Robot power supply	Close	open
Initialization	Manual	Automatic or manual
Frequency of use	Low	Ordinary
Need to be re-initialized	Only release the brake	No
Shutdown category (IEC 60204)	1	2
Performance rate (ISO 13849-1)	PLd	PLd

Danger:



- Don't connect the safety signal with non-safe PLC. Failure to comply with this warning may lead to casualty accidents due to failure of safety functions. Be sure to separate safety signals from the normal I/O port signal.
- All the Safety I/O are redundant (two independent channels). Keep two channels independent to ensure that the safety function will not fail when one channel fails.
- The robot's safety functions must be checked before using, and safety functions must be tested regularly.

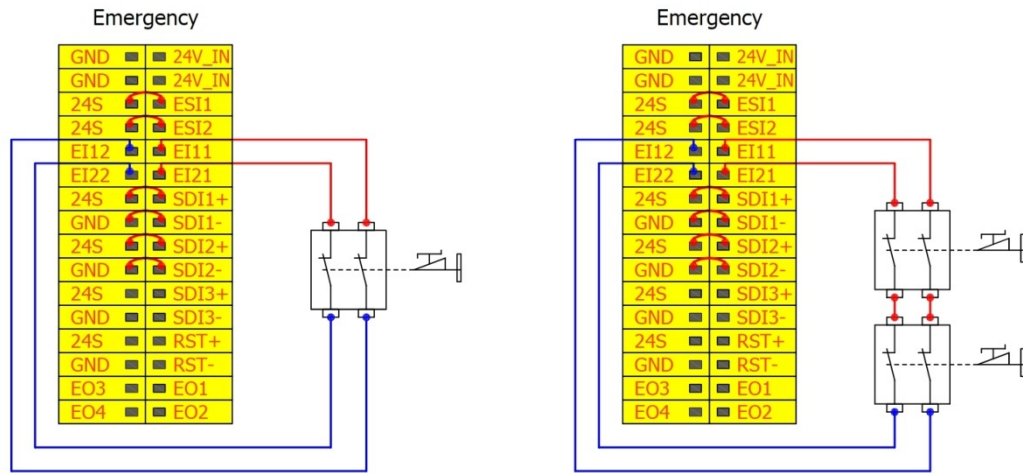
Default Security Configuration

The robot is in default security configuration when it is delivered, and is not connected with other safety devices. Its configuration is as follows:

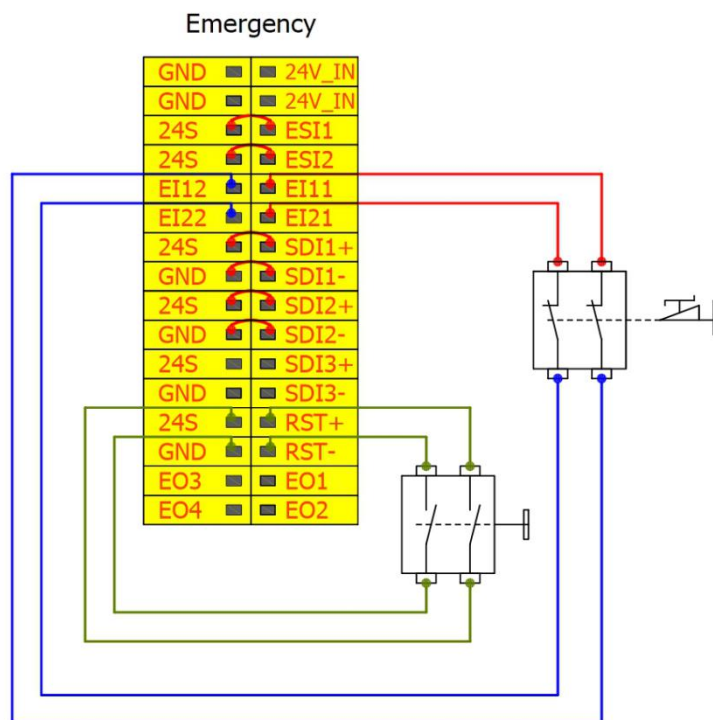
Emergency	GND	■	■	24V_IN
	GND	■	■	24V_IN
	24S	■	■	ESI1
	24S	■	■	ESI2
	EI12	■	■	EI11
	EI22	■	■	EI21
	24S	■	■	SDI1+
	GND	■	■	SDI1-
	24S	■	■	SDI2+
	GND	■	■	SDI2-
	24S	■	■	SDI3+
	GND	■	■	SDI3-
	24S	■	■	RST+
	GND	■	■	RST-
	EO3	■	■	EO1
	EO4	■	■	EO2

Connect the e-stop button

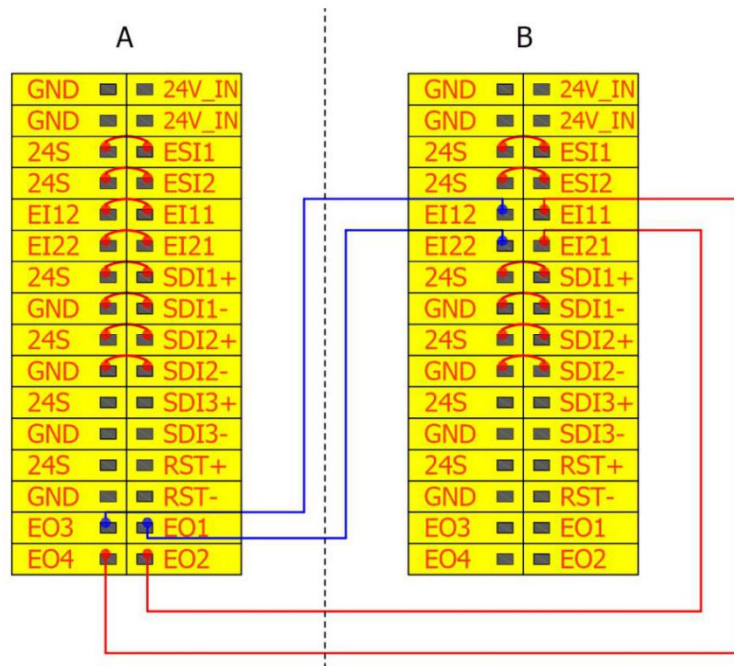
The external connection diagram of one or more e-stops is shown below:



Emergency stop reset function

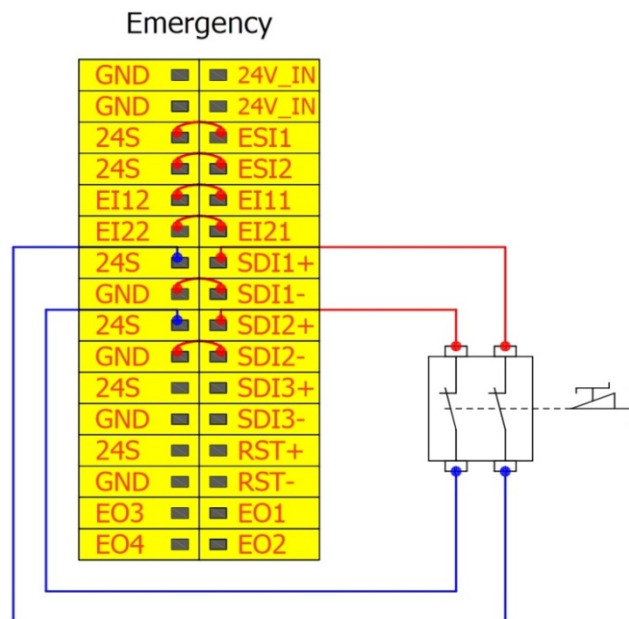


Safe emergency stop with other machines



Safety Protection Stop

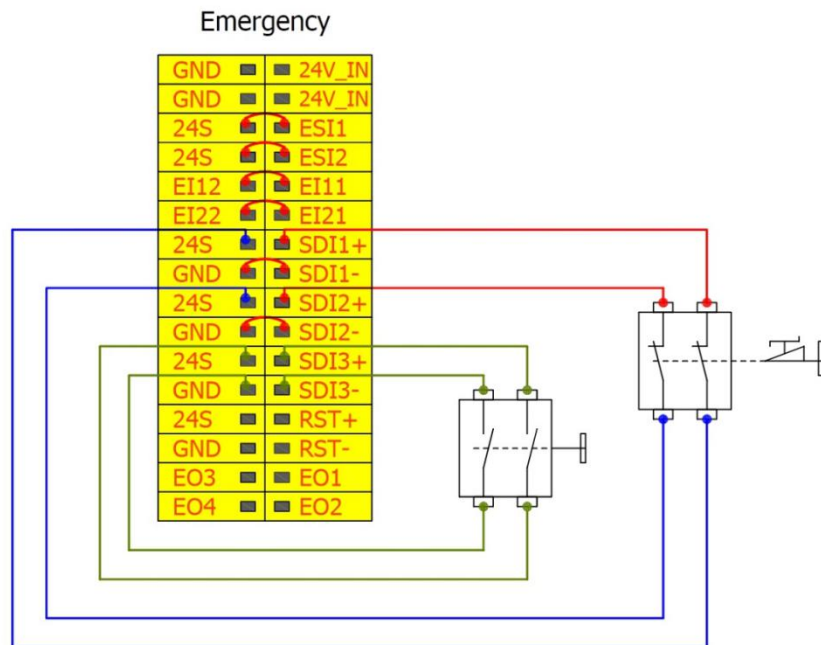
Taking the door switch as an example, the following diagram introduces the construction of basic protection stop function, when the door is opened, robot stops.



Protective stop with reset

When the protective stop is triggered, the following double channel buttons can be reset or reset through the trainer software.

The corresponding construction method is as follows.

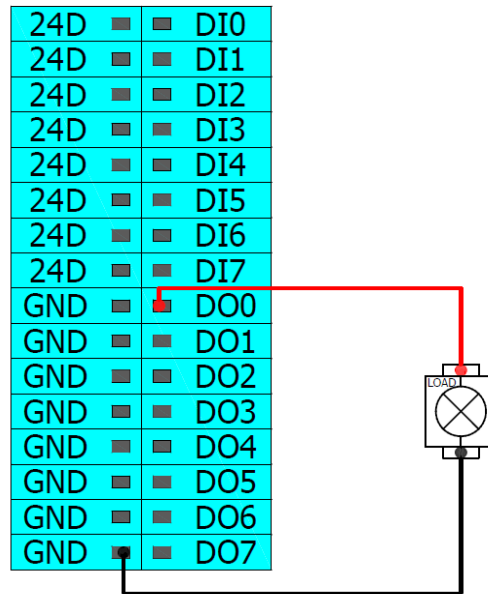


1.5 Build a General Digital I/O

The general digital I/O must follow the general configuration of digital I/O. The flexible I/O, which is not used for safety functions, can be used as general digital I/O.

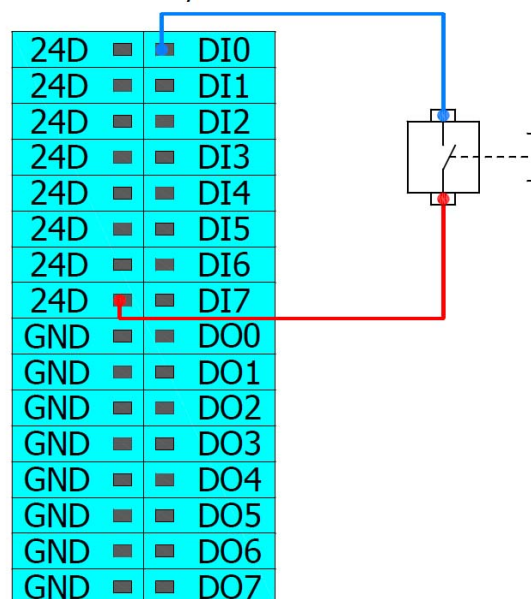
The use of digital output:

General I/O



Control digital input with button:

General I/O



1.6 General Analog I/O

Used to set or measure voltage (0-10v) or current (4-20ma) between devices.

To achieve high precision, please follow the following rules in use:

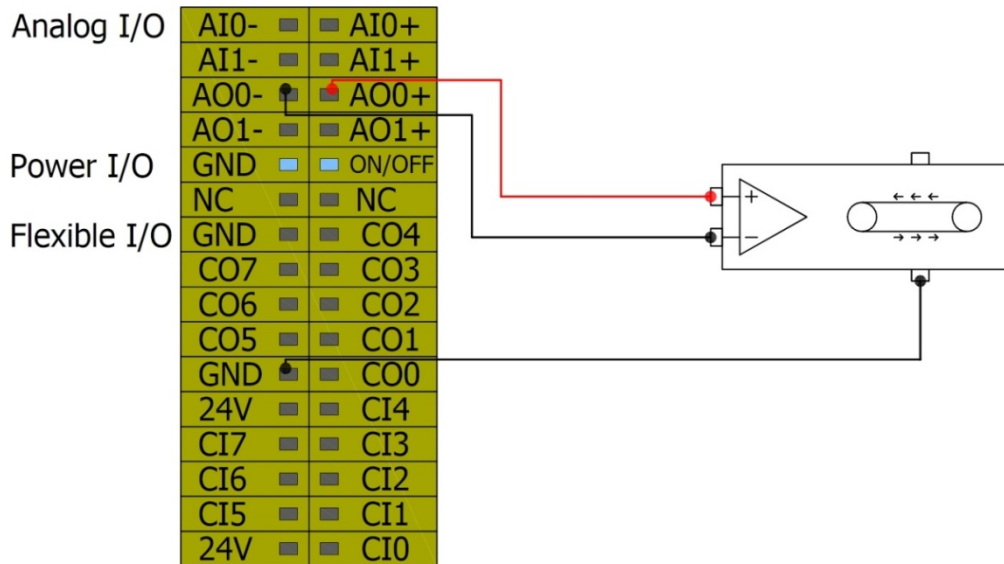
- Use the closest GND to I/O.
- The measuring equipment and the controller use the same ground (GND), and the analog I/O is not isolated from the controller.
- Use shield wire or twisted pair. Connect the shield to the "GND" on the common I/O terminal.
- The current signal is not sensitive to noise. It is preferred to use the equipment in current mode.

The corresponding I/O configuration is as follows:

Voltage mode input					
AIx - AG	voltage	0	-	10	V
AIx - AG	resistance	-	12	-	Kohm
AIx - AG	dissociation energy	-	12	-	Bit
Current mode output					
AOx - AG	current	4	-	20	mA
AOx - AG	voltage	0	-	10	V
AOx - AG	dissociation energy	-	16	-	Bit
Voltage mode output					
AOx - AG	voltage	0	-	10	V
AOx - AG	electricity	0	-	20	mA
AOx - AG	resistance	-	43	-	ohm
AOx - AG	Dissociation energy	-	16	-	Bit

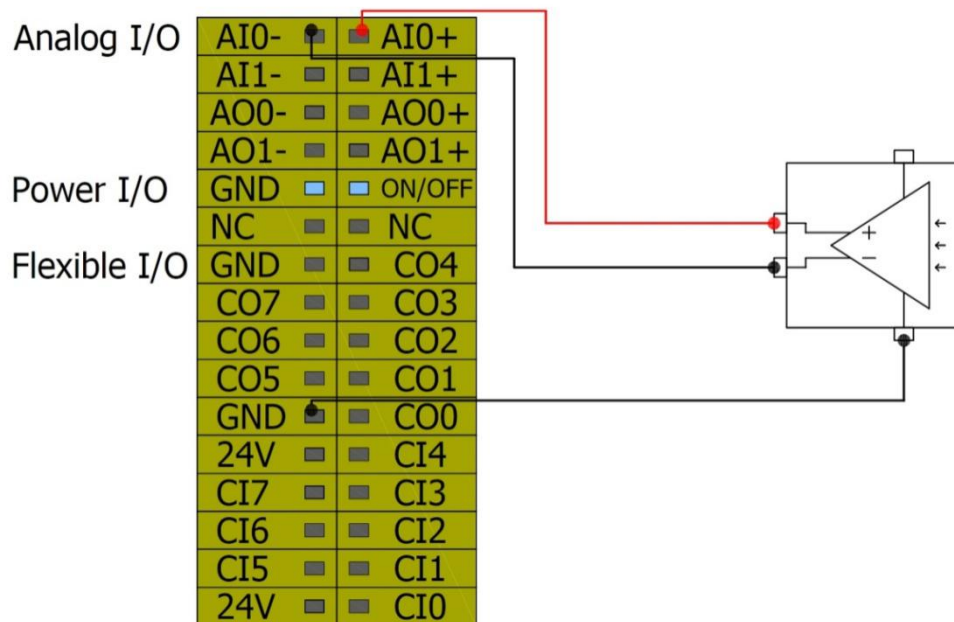
Using analog output

The following example shows how to use analog output to control the speed of conveyor belt.



Using analog input

The diagram below shows how to connect the analog sensors.

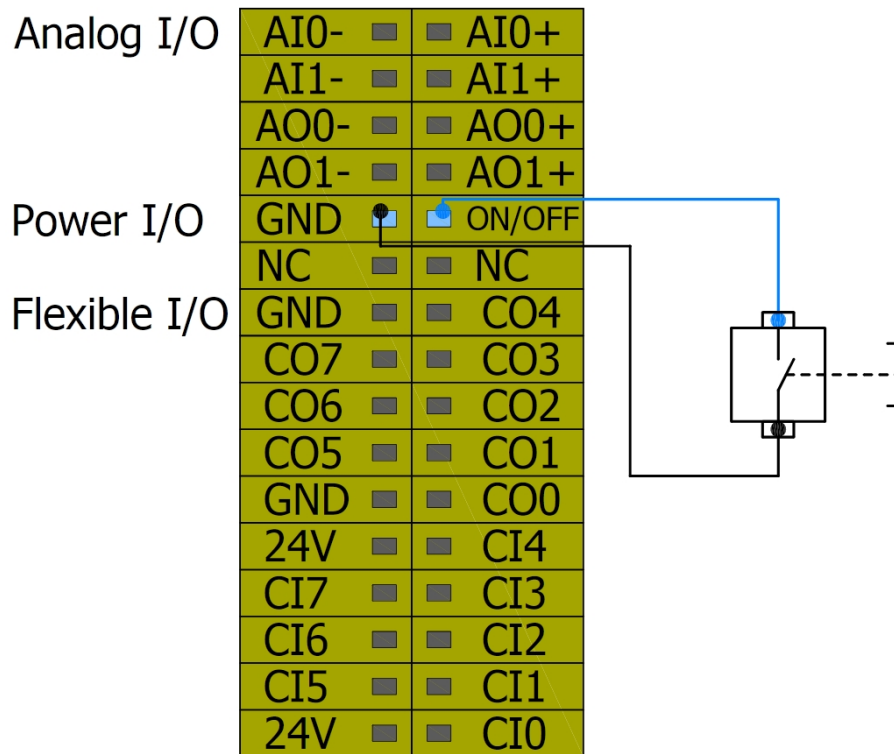


Remote switch control

With Power IO, the control box can be turned on and off without going through the teach pendant. The construction method is as followed:

Power on: contact trigger;

Power off: keep the short connection at 2.5s-3 S

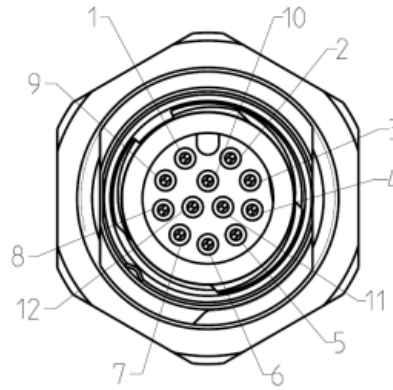


1.7 Safety Guardrail

Users should conduct a risk assessment for specific robot applications to determine whether to install security guardrails in the actual operating environment. If a safety guardrail needs to be installed, you should carefully calculate the space of the safety guardrail.

Suggestions: The circle radius of guardrail space > the length of mechanical arm + the length of mechanical arm's end clamp.

1.8 Robot Terminal IO Interface Description



1、IO external wiring harness is defined as follows:

Connector plug			
PIN	Line color	definition	signal description
1	INPUT_0	Brown	Digital input 0
2	INPUT_1	blue	Digital input 1
3	INPUT_2	White	Digital input 2
4	OUTPUT_0	green	Digital output 0
5	OUTPUT_1	powder	Digital output 1
6	OUTPUT_2	yellow	Digital output 2
7	485_A	black	484 communication A pin
8	485_B	gray	484 communication B pin
9	AIO	red	Analog input 0
10	AI1	purple	Analog input 1
11	24V	Ash powder	Power supply (24V)
12	GND	Red and blue	Ground (0V)

2. Internal power supply specifications:

parameter	Min	Typical value	Max	unit
24V power supply voltage		24		V
24V power supply current		1	1.5	A

If the current exceeds its limit, the software will protect and shut down the output, and the internal control system will generate an error message and display it in the robot log; the power output of these two ports is the output of the same power supply.

3. Digital output (type: PNP)

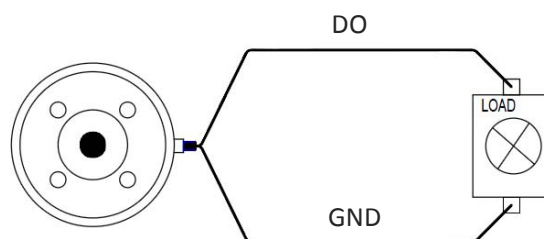
Digital output					
terminal	parameter	Min	Typical value	Max	Unit
DOx	Current	0	-	0.4	A
DOx	Voltage drop	0	-	0.5	V
DOx	Leakage current	0	-	0.5	MA
DOx	Features	-	PNP	-	Type
DOx	IEC 61131-2	-	0.4A	-	Type

The digital output is implemented by sinking current only to GND (0V) instead of sinking current. When the digital output is activated, the corresponding connector will be driven to GND. When the digital output is disabled, the corresponding connector will be open (open/open).

Note: There is no current limit on the digital outputs in the tool. If the specified data is exceeded, it may cause permanent damage.

Example of using a digital output :

This example illustrates the use of an IO board power supply to power external devices. If an external system is to be used to supply power to the external system, it requires common processing.

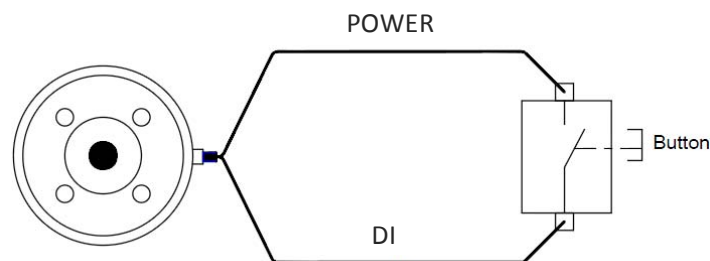


4. Digital input (PNP)

Digital Input					
terminal	parameter	Min	Typical value	Max	Unit
DIx	Voltage	-3	-	30	V
DIx	OFF area	-3	-	5	V
DIx	ON area	11	-	30	V
DIx	Current (11-30V)	2	-	15	MA
DIx	Features	-	PNP	-	Type
DIx	IEC 61131-2	-	3	-	Type

The digital inputs are equipped with weak pull-down resistors. This means that the reading of the floating input is always low.

Example of using a digital input :



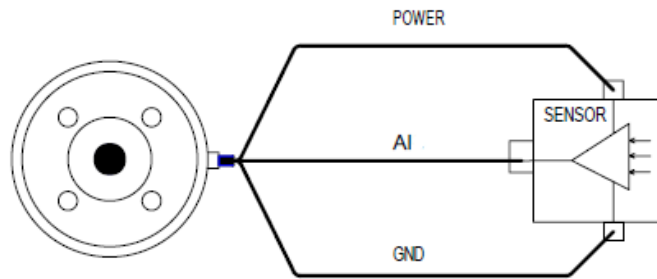
The example above shows how to connect a simple button or switch. This example illustrates the power supply of an IO board to power an external device. If the external system is to be powered by its own power supply, it requires common processing.

5. Analog input

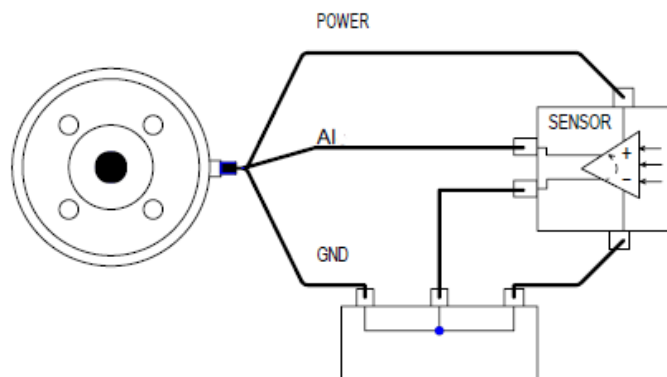
parameter	Min	Typical value	Max	unit
Input voltage range	0		10	V
Input resistance		15K		Ω

The analog input of the tool uses a non-differential input. Any change in the current of the common grounding connector may cause an interference signal to the analog input. It is important to know that there will be a voltage drop on the ground line and inside the connector.

To clarify the ease of using analog inputs, here are some simple examples:



The above figure is connected to the unit when the user output is also a single-ended output analog signal.



The above figure is the connection with the unit when the analog output of the user output is differential output. The use of the sensor with differential output is also relatively simple and straightforward. Simply connect the negative terminal to GND (0V) using a terminal strip, and the differential sensor works the same way as a non-differential sensor.

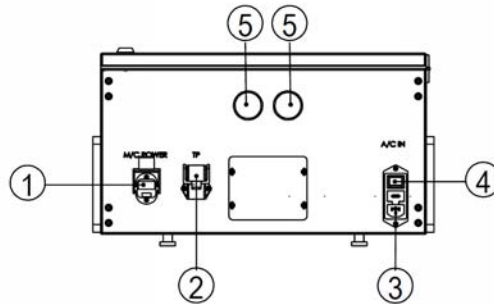
Chapter 2 Teach pendant

As shown in the figure below, Elfin's handheld teach pendant, the button on the left is the power-on button of the robot, and the button on the right is the emergency stop button;

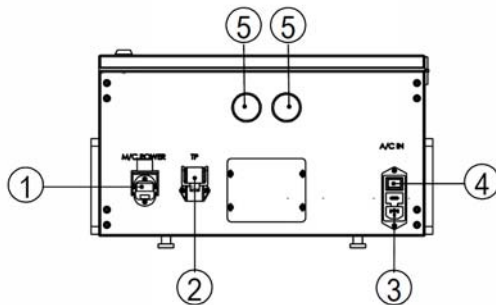


Chapter 3 The process of starting the robot

1. Connect the handheld teach pendant: Connect the interface of the handheld teach pendant to the 2-port (bottom of the electrical control box) shown below:



2. Connect the electric control box power supply: Plug the 4 interface of the following figure into the power cable of the electric control box, and connect the other end of the power cable to the 220V power supply;



3. Press the power switch 3 of the electric control box, then press the power button on the left side of the handheld teach pendant to power on the electric control box. During the power-on of the electric control box, the robot is also powered on, and the HansRobot software starts automatically.

