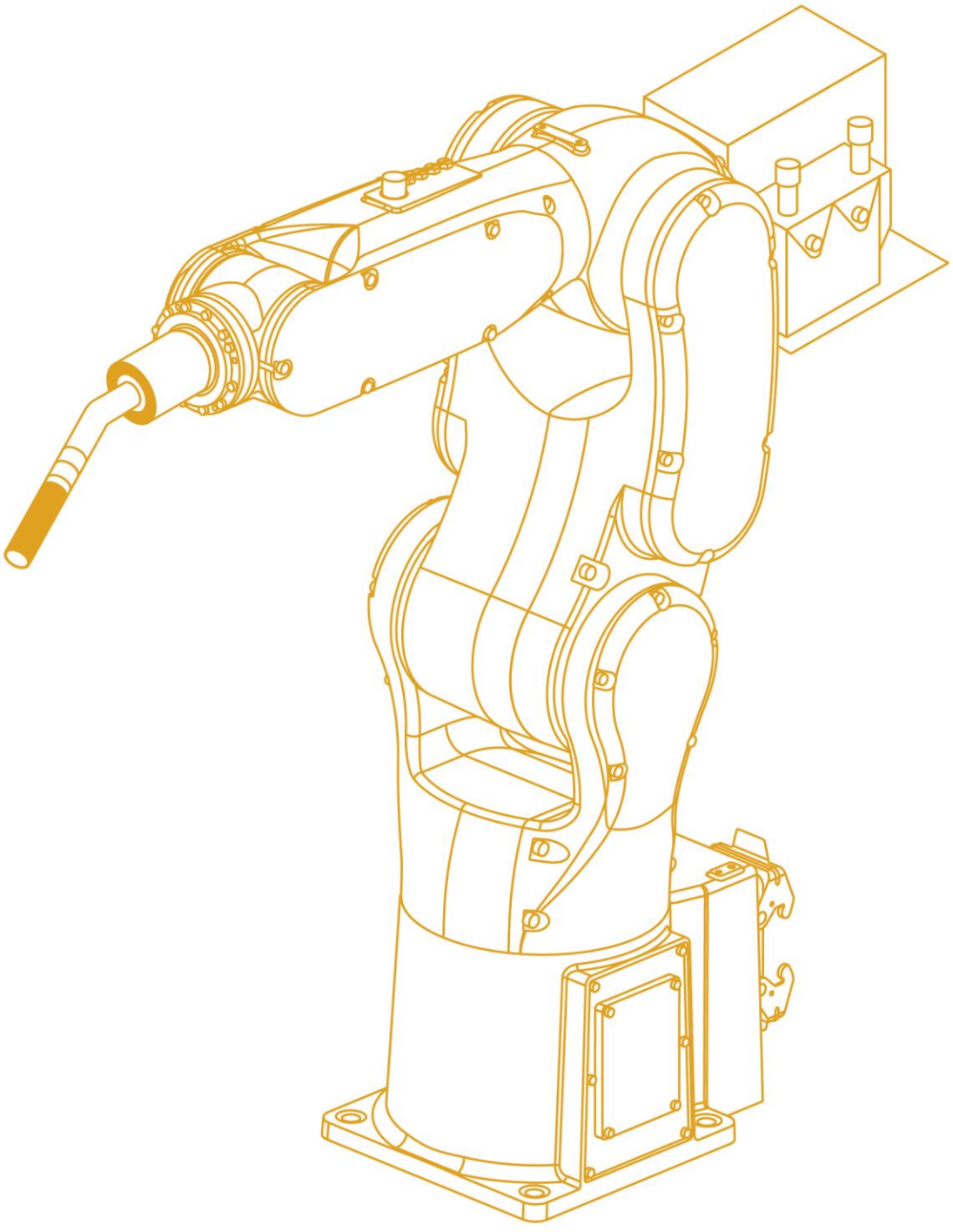
PEITIAN ROBOTICS

Arc Welding Function Pack User Manual

V2.4.4



Foreword

About This Manual

This manual introduces the installation, configuration and operation method of the robot’s arc welding feature pack. Reading this document will help readers install and operate the arc welding feature pack quickly and correctly.

Prerequisites

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

Please read the following documents when necessary:

- “Operation Manual of AIR-TP Teach Pendant”
- “ARL Programming Manual”
- “Fault and Troubleshooting Manual of AIR Series Industrial Robot System”

Target Groups

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

Meaning of Common Signs

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

Table 1 Signs used in this manual

Sign	Meaning
 Danger	Failure to follow the instructions may cause accidents, resulting in serious or fatal personal injury.
 Warning	Failure to follow the instructions may cause accidents, resulting in moderate or minor personal injury, and may also cause damage to materials only.
 Notice	You are prompted to keep in mind environmental conditions and important matters, or quick operation methods.

Sign	Meaning
 Tip	You are prompted to refer to other literature and instructions for additional information or more details about operation instructions.

Manual Description

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

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

Revision History

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

Table 2 Signs used in this manual

Version	Publication date	Modification description
V2.0	2019/07/31	1st official publication
V2.1.0	2019/12/31	2nd official publication Upgrade the software version to V2.6.1
V2.1.1	2020/03/02	3rd official publication Fixed known bugs.
V2.2.0	2020/06/30	4th official publication Upgrade the software version to V2.6.2
V2.3.0	2020/10/10	5th official publication Upgrade the software version to V2.6.3 Added example of multi-layer multi-pass welding configuration
V2.4.0	2021/10/25	6th official publication Upgrade the software version to V2.6.4 Add "Laser Positioning" function Added "Laser Tracking" function Added "laser tracking + swing program example" Added "Welding Gun Calibration" Added "fish scale welding configuration example"
V2.4.1	2021/11/29	7th official publication Fixed known bugs.
V2.4.2	2022/01/13	8th official publication

Version	Publication date	Modification description
		Fixed known bugs.
V2.4.3	2022/03/31	9th official publication Fixed known bugs.
V2.4.4	2022/06/14	10th official publication Fixed known bugs.

Document Number and Version

The document-related information is shown in Table 3.

Table 3 Document-related information

Document name	"Arc Welding Function Pack User Manual"
Document number	UM-S01500000003-011
Software version	V2.6.4

Contents

1 Composition of arc welding system

1.1 Overall composition of arc welding system

The arc welding software package combines the robot with the welding machine, and supports supports CANopen, EtherCAT, DeviceNet and analog communication. A large number of real-time data could be exchanged between robot and welding machine. In addition to the basic welding functions, the software package also supports advanced functions such as weld locating, arc pressure tracking, etc. The programming and teaching can be simplified through configuration of process file to achieve higher welding efficiency.

The overall composition of the arc welding system is shown in Figure 1-1.

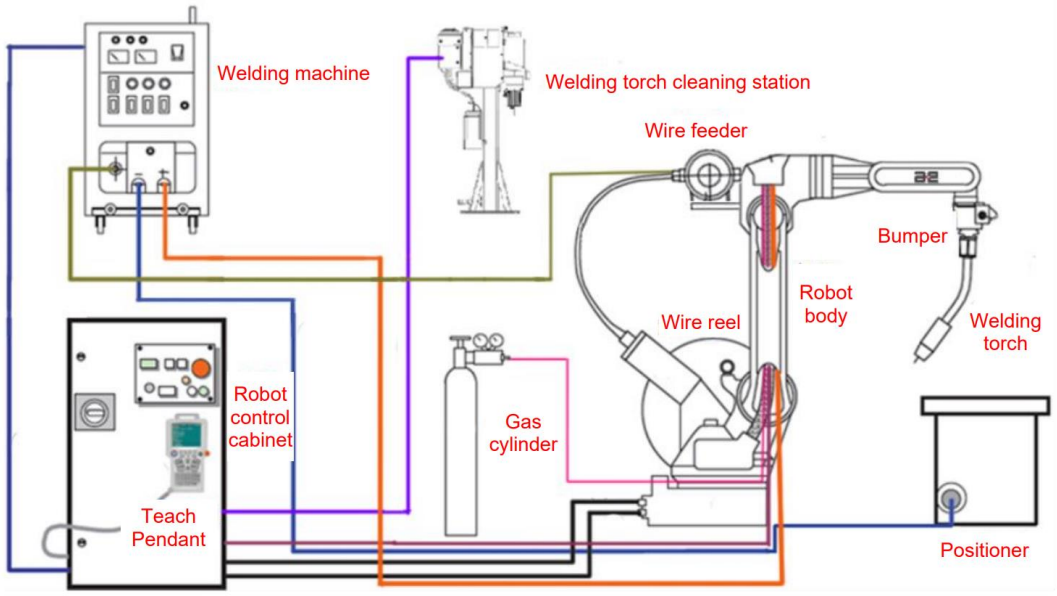


Figure 1-1 Overall composition of arc welding system

The names and specifications of components of the arc welding robot system are detailed in Table 1-1.

Table 1-1 Names and specifications of components of welding robot system

Component	Brand	Spec.	Qty.	Remark
Robot	AE	AIR10	1	-
Teach pendant	AE	-	1	-
Robot control cabinet	AE	ARCCD10/ARCCD12/ARCCD20	1	-
Positioner	-	Single-axis/double-axis single action/double-axis linkage	1	To be matched according to customer needs
Welding machine	Aotai/Megmeet	350MAG air-cooled/500R pulse water-cooled/WSM400R TIG water-cooled	1	To be matched according to customer needs
Welding torch	Aotai	-	1	To be matched according to customer needs
Bumper	ARC	-	1	-
Wire feeding system	Aotai/Megmeet	0.8~1.6mm	1	-

Component	Brand	Spec.	Qty.	Remark
Accessories	-	Contact nozzle, gas shunt, pressure reducing valve,		To be matched according to customer needs
System software	AE	-	1	-

1.2 Welding System

The welding system is composed of the welding machine, the welding torch and the wire feeder.

1.2.1 Supported welding machine

MAG-350RL welding machine

MAG-350RL welding machine is shown in Figure 1-2.

Figure 1-2 Diagram of MAG-350RL welding machine

Characteristics of basic equipment of MAG-350RL welding machine:

- Low spatter, achieving 0.8-3 mm thin plate welding.
- Low welding penetration.

Pulse MIG-350/500RP welding machine

Pulse MIG-350/500RP welding machine is shown in Figure 1-3.

Figure 1-3 Diagram of Pulse MIG-350/500RP welding machine

Product characteristics:

- The pulse welding machine can be applied to all common welding materials.
- Double pulse can weld fish scale pattern when welding aluminum.

WSM-400R welding machine (argon arc welding machine)

The WSM-400R welding machine is shown in Figure 1-4.

Figure 1-4 Diagram of WSM-400R welding machine

Product characteristics:

- Argon arc welding machine, supporting two welding types: wire-filled and wire-free.
- Argon arc welding features high penetration, and can be used without wire-filling or with little wire-filling so as to reduce post-processing.

Artsen Plus500/400 series welding machine

Artsen Plus500/400 series welding machine is shown in Figure 1-5.

Figure 1-5 Artsen Plus500/400 series welding machine

Megmeet pulse welding machine supports a variety of new process modes, which helps improve the quality of weld seam.

1.2.2 Welding torch

Composition of welding torch

The introduction and precautions of components of the welding torch are detailed in Figure 1-6.

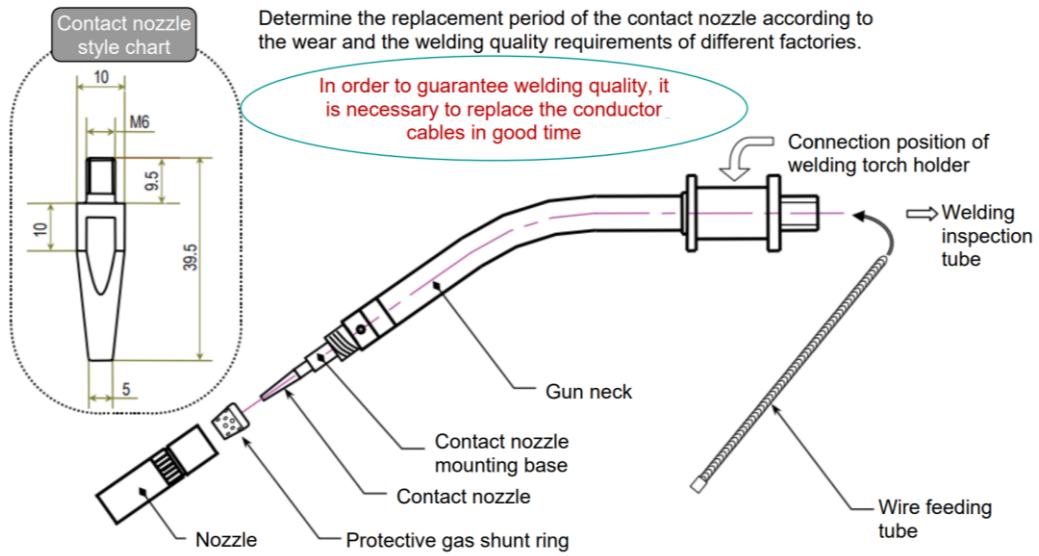


Figure 1-6 Introduction and precautions of components of welding torch

Precautions

- The welding torch should be configured with the European interface (as shown in Figure 1-7), and the type should be selected according to the load factor, cooling method and suitable welding materials.
- Generally the water cooling method should be used when the robot is in a long-time operation state in order to ensure good welding effect and the safety of the welding torch.
- When welding the carbon steel, CO2 itself will have a cooling effect, so the air cooling method can be also used when welding at low current.

Figure 1-7 European interface of welding torch

Tip

When a water-cooled welding torch is used, the water-cooling machine should be filled with pure water, which should be prevented from freezing.

1.2.3 Wire feeder

Composition of wire feeder

The wire feeder of the robot welding system is divided into two parts:

- The wire feeder control box is the control part.
- The wire feeding mechanism is the actuation part.

The wire feeder control box is separated from the wire feeding mechanism, which is convenient for users to upgrade the interface without replacing the wire feeder, and also reduces the bearing load of the robot. The schematic diagram of the wire feeder is shown in Figure 1-8.

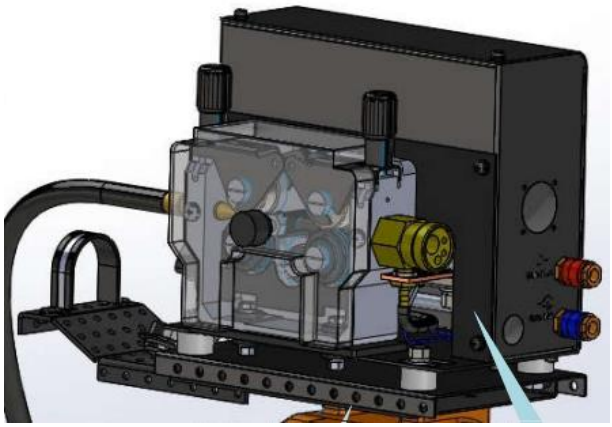


Figure 1-8 Diagram of wire feeder

Product characteristics

- The grating feedback wire feeding motor features high wire feeding accuracy, high wire feeding force and high anti-jamming ability to ensure stable welding.
- It is applied with the damping disc shaft, which features good braking performance.
- It is applied with four-wheel drive wire feeding, which features high wire feeding force and stable wire feeding.
- The wire feeding wheel is easy to replace without tools.
- It is compact and light, and is suitable for installation on robots, helping robots move freely.

Principle of selecting welding wire

Precautions for welding wire selection:

- The welding wire should be selected according to the composition and mechanical properties of the base metal to be welded. When selecting the welding wire, please consult the welding wire manufacturer and the applicable objects.
- The welding current has a certain effect on the wire feeding speed. The maximum wire feeding speed is usually 15 mm/min, and the maximum current for small diameter wires has an upper limit. If high current is used while the metal in the molten pool is insufficient, the appearance of weld seam will be affected adversely, and the low welding penetration will cause welding cracks.
- Different brands of welding machines have different minimum current values.
- During arc welding, the matching relationship between current (I) and voltage (U) has no fixed value. It needs to be confirmed according to the wire diameter, material, shielding gas, etc. Generally, when welding medium and heavy plate carbon steel, this formula can be referred to. : U=0.04I+14.

1.3 Coordination relationship of welding system equipment

The coordination relationship between the welding system equipments is shown in Figure 1-9

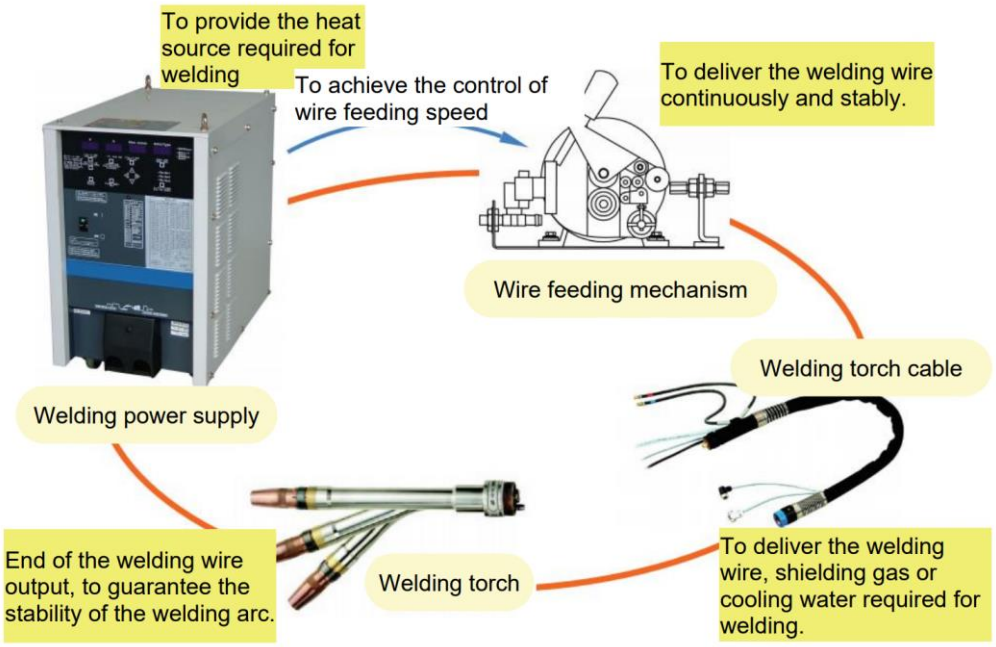


Figure 1-9 Cooperation between welding system equipment

2 Communication debugging description of control cabinet and welding machine

The inCube series control cabinet and the ARC4 series control cabinet have different connection methods when communicating with the welding machine. After the connection is completed, the PLC slave station needs to be configured on the teach pendant.

2.1 Communication and debugging instructions of inCube series control cabinet and welding machine

There are two communication modes for inCube series control cabinets:

- Ethercat industrial ethernet communication
- CANopen bus communication

2.1.1 Ethercat industrial ethernet communication

In Ethercat industrial ethernet communication, the control cabinet needs an external communication controller. The ATR-EtherCAT communication controller implements the mutual conversion between the EtherCAT communication protocol on the robot side and the HDLC communication protocol inside the welding machine, ensuring the real-time and stability of the communication. The connection method is shown in Figure 2-1.

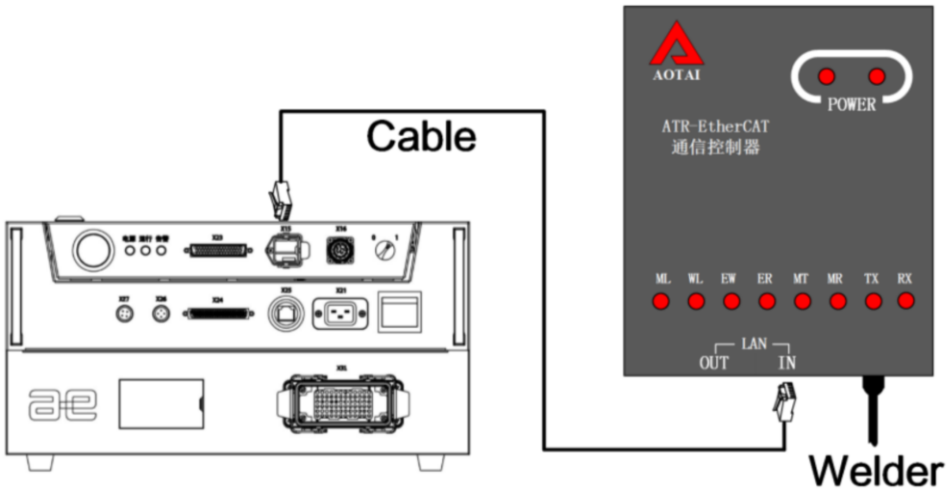


Figure 2-1 Communication between welding machine and control cabinet

Tip

If a inCube10/12control cabinet is used, connect the network cable to the X004A interface of the control cabinet.

Debugging instructions:

Step1. After connecting the wire as shown above, the PLC slave should be selected as Aotai EHTHERCAT slave.

Step2. When the transition light MI stays on, it indicates that the communication between the welding machine and the control box is normal.

2.1.2 CANopen bus communication

Robot digital interface

The pin sequence of the robot digital interface aerial plug on the digital communication box is shown in Figure 2-2, and the pin definitions are shown in Table 2-1.

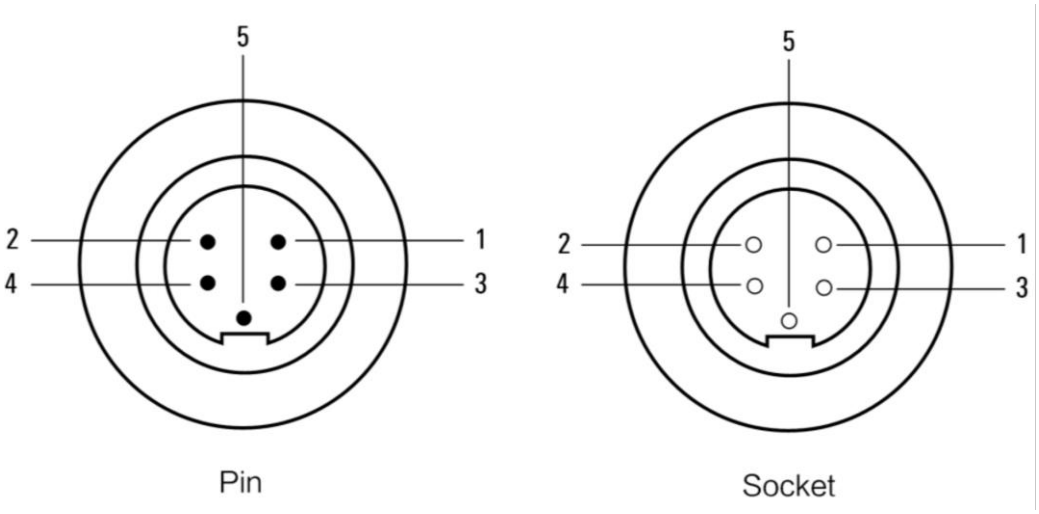


Figure 2-2 Robot digital interface aviation plug

Table 2-1 Aviation pin definition

Pin number	Colour	Signal name	Features
1	Red（18AWG）	24V power supply	Robot power signal
2	White（22AWG）	CAN_H signal line	Communication line CAN_H
3	Black（18AWG）	Ground	Robot power ground
4	Blue（22AWG）	CAN_L signal line	Communication line CAN_L
5	Shielded wire（18AWG）	Shielded wire	Shell PE

CANopen bus

CANopen bus can be used for CANopen bus communication mode and analog communication. CANopen bus diagram and pin definition are shown in Figure 2-3.

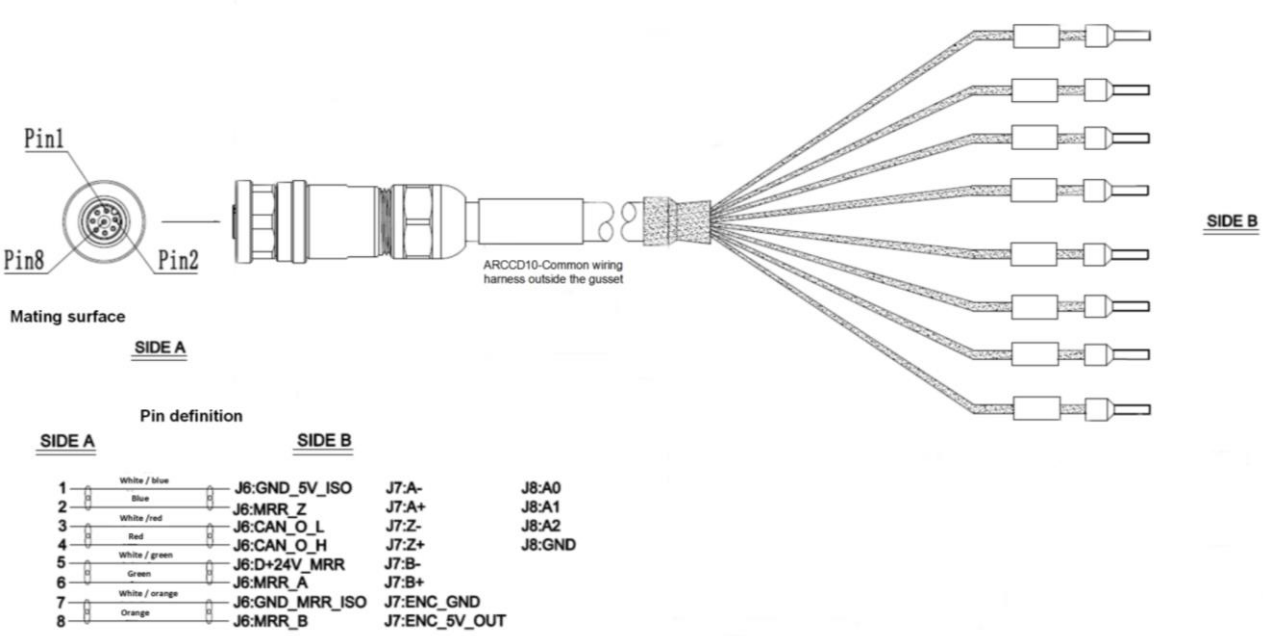


Figure 2-3 CANopen bus diagram

Wiring relationship between CANopen bus and robot digital interface

The connection relationship between CANopen bus and robot digital interface is shown in Table2-2.

Table2-2 Wiring relationship between bus and robot digital interface

CANopen bus SIDEB		Robot digital interface	
Pin number	name	Pin number	Signal name
1	CAN_O_L	4	CAN_L signal line
5	CAN_O_H	2	CAN_H signal line
8	USER_GND	3	Ground

2.2 Analog welding machine connection and configuration (including argon arc welding machine scene)

When using the inCube10/12 control cabinet, the connection line of the analog welding machine is connected to the J5 interface of the MCB-IEB, and the diagram of the connector is shown below.

The pin definition of the robot control cabinet MCB-IEB is shown in Figure 2-4. See Table 2-3 for pin descriptions.

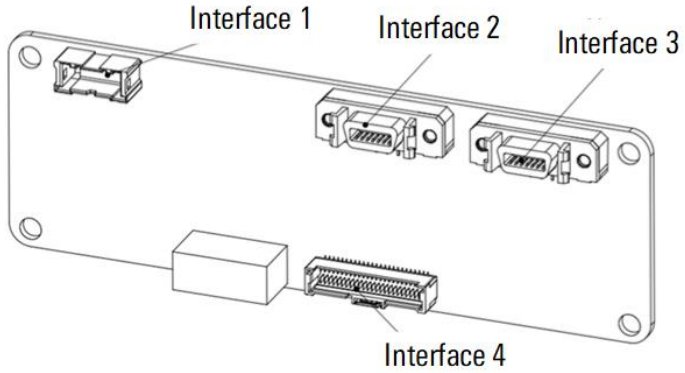


Figure 2-4 Diagram of MCB-IEB

Table 2-3 Serial number description

Item	Description	Remark
Interface 1	Analog output interface	J5
Interface 2	Incremental encoder interface	J7
Interface 3	CAN_Magnetic scale common interface	J6
Interface 4	MCB and MCB-IEB connectors	J2

Refer to Figure 2-5 and Table 2-4 for the diagram and interface description of MCB-R1.2.

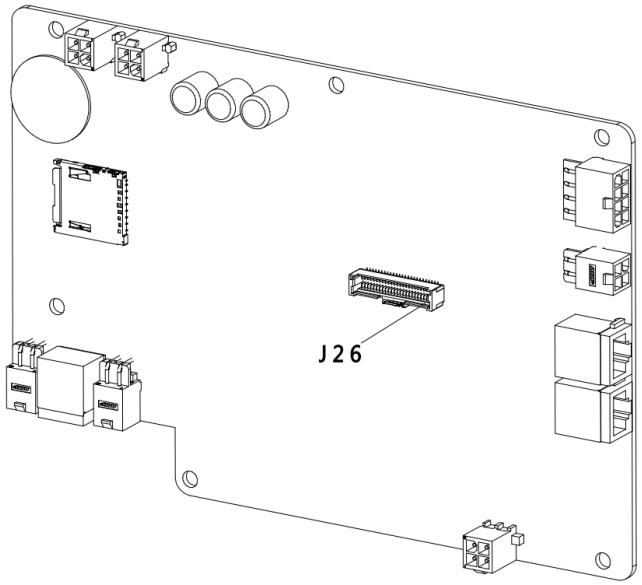


Figure 2-5 MCB-R1.2 diagram

Table 2-4 MCB-R1.2 interface description

Item	Description
J26	MCB-IEB and MCB connectors

For more detailed connection methods, please refer to the "Optional Parts Installation and User Manual".

Analog configuration instructions

At present, the suitable analog welding machine is the Megmeet Ehave 350 series. The welding machine is connected to the robot with an analog interface through the DB15 communication terminal on the back of the welding machine. The DB15 communication terminal pin number sequence is shown in Figure 2-6. The DB15 communication terminal pin definitions are shown in Table 2-5.

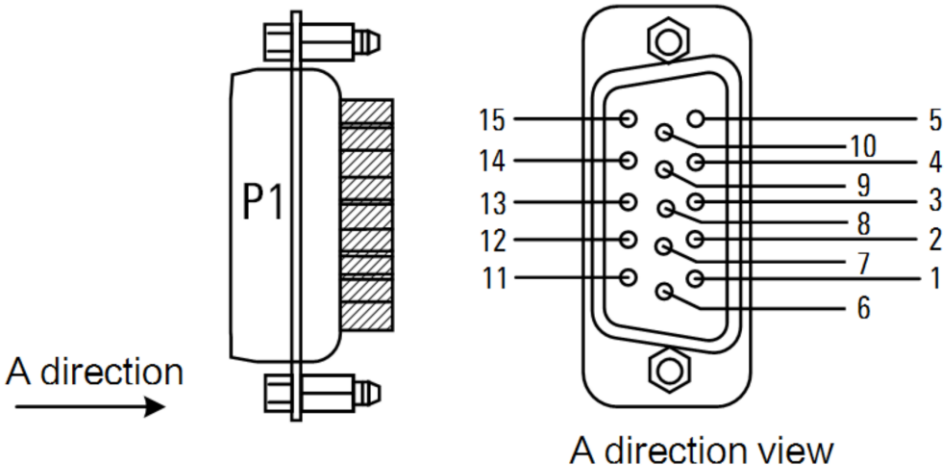


Figure 2-6 DB15 interface definition

Table 2-5 DB15 communication terminal pin description

Pin number	Communication cable DB15 color	Signal name	Features
1	Black 1	24V power supply	The positive pole of the DC power supply is provided by the robot to the welding machine.
2	Black 2	Arcing signal	The I / O signal is output by the robot to the welding machine to control the power output of the welding machine. The low level is valid.
3	Black 3	Reverse wire feed signal	The I / O signal is output by the robot to the welding machine to control the wire feed motor to reverse, and the low level is valid.
4	Brown 1	Arcing success signal	The I / O signal is output by the welding machine to the robot, and the arc start success signal is fed back. When OFF, the low level is valid, and when ON, the high level is valid.
5	Brown 2	Reserve	Reserve
6	Brown 3	Analog signal common ground	Common ground for 7, 13, 14, and 15-pin analog signals.
7	Orange 1	Welding current signal	The analog signal is output by the welding machine to the robot, and the actual welding current value is fed back.
8	Orange 2	I / O signal common ground	1, 2, 3, 4, 9, 11 pin I / O signal common ground.
9	Orange 3	Forward wire signal	The I / O signal is output by the robot to the welding machine and controls the forward rotation of the wire feeding motor. The low level is valid.
10	Purple 1	Reserve	Reserve
11	Purple 2	Gas detection signal	The I / O signal is output by the robot to the welding machine, and controls the gas supply solenoid valve switch. The low level is valid.
12	Purple 3	Seek signal	The I / O signal provides a successful positioning signal to the robot.
13	Blue 1	Given voltage signal	The analog signal is output by the robot to the welding machine with a given voltage value.
14	Blue 2	Given current signal	The analog signal is given by the robot to the welding machine with a given current value.
15	Blue 3	Welding voltage signal	The analog signal is output by the welding machine to the robot, and the actual welding voltage is fed back.

Table 2-6 shows the corresponding relationship between the control cabinet AO output and the Megmeet welder.

Table 2-6 Correspondence between AO output of control cabinet and Megmeet welding machine

Control cabinet AO output		Megmeet Welder	
1	AO1	13	Given current
2	AO2	14	Given voltage
6	GND	6	Analog public

The analog communication interface of Aotai welding machine is directly completed by the analog control cable, and basic welding tasks can be completed through the robot, but it does not have the function of calling the expert library.

See Table 2-7 for the wiring instructions of the analog interface connecting socket X5.

Table 2-7 Wiring instructions for analog interface connection socket X5

Pin	Signal meaning	Function	Direction	Signal form
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	External power supply	Wire feeder relay power supply	R->W	+24VDC Voltage
5	Wire feed speed given	Given wire feed speed setting value, 0~10V corresponds to wire feed speed of 0m/min~7m/min	R->W	0~10V Analog voltage
6	Current given	Given the set value of the output current of the welding power supply, 0V~10V corresponds to 4A~410A	R->W	0~10V Analog voltage
7	Manual wire feed	Realize manual wire feeding	R->W	Contact input (closed: valid)
8	Gas detection switch	Switching the shielding gas solenoid valve	R->W	Contact input (closed: valid)
9	Torch switch	Instruction welding start and stop	R->W	Contact input (closed: valid)
10	Manual unwinding	Realize manual unwinding	R->W	Contact input (closed: valid)
11	Signal ground	Analog given signal ground	R->W	Signal ground
12 13	Current error contact signal	Real-time status of current detection	W->R	Contact input (closed: valid)
14 15	Start feedback contact signal	Reserved	R->W	Contact input (closed: valid)
16 17	Anti-collision contact signal	Reserved	W->R	Contact output (On: Active)
18 19	Start detection enable signal	Reserved	W->R	Contact output (closed: valid)

The corresponding relationship between the AO output of the control cabinet and the Aotai welding machine is shown in the figure.

Table 2-8 The corresponding relationship between the AO output of the control cabinet and the Aotai welding machine

Control cabinet AO output		Aotai welding machine	
1	AO1	6	Given current
2	AO2	5	Given voltage
6	GND	11	Analog common ground

IO configuration instructions

The "X24" port of the robot control cabinet is a user IO interface. X24 is transferred to the user IO terminal module through the user IO terminal module cable to achieve its terminal block transfer function.

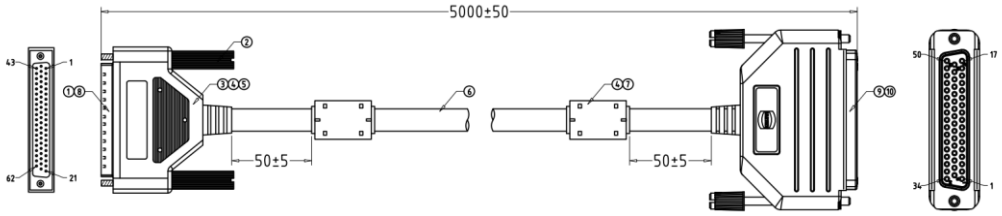


Figure 2-7 IO terminal module cable

The top view of the user IO terminal module is shown below. The board has three connectors J1 / J2 / J3, with J2 on the left, J3 on the top, and J1 on the bottom. J2 is connected to the user IO terminal module cable. J1 is DI terminal block and J3 is DO terminal block, which is connected to the welding machine.

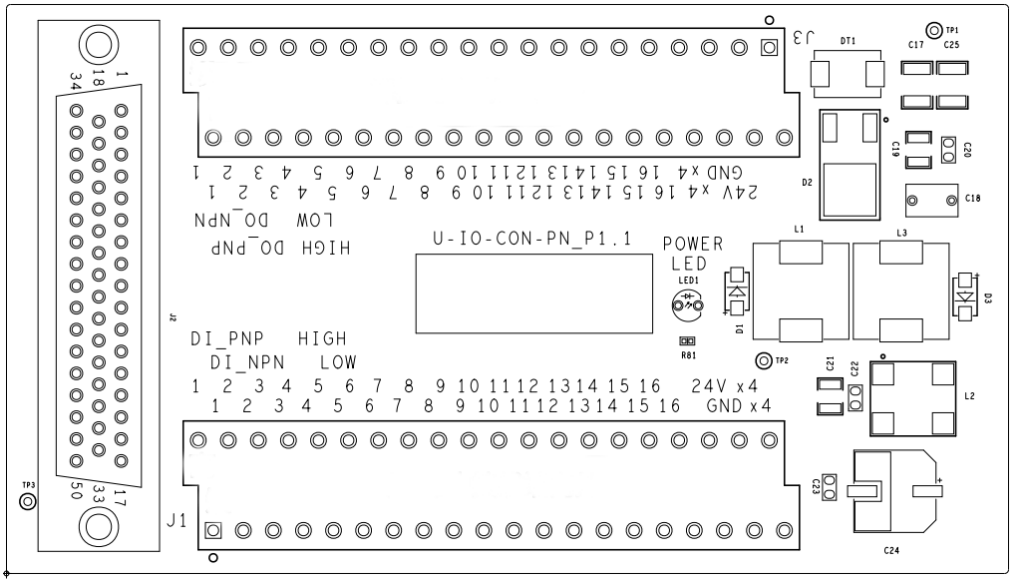


Figure 2-8 User IO terminal module

The figure below is a photo of the side view of J1.

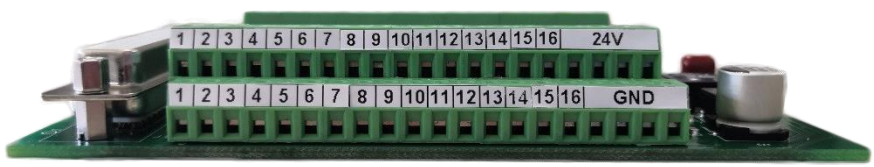


Figure 2-9 Photo of J1 side view

The pin definition of the J1 connector is shown in the following Table 2-9.

Table 2-9 Pin definition of J1 connector

Pin	Name	Label
1	OPERATED_DI_NPN_1	1
2	OPERATED_DI_NPN_2	2
3	OPERATED_DI_NPN_3	3
4	OPERATED_DI_NPN_4	4
5	OPERATED_DI_NPN_5	5
6	OPERATED_DI_NPN_6	6
7	OPERATED_DI_NPN_7	7
8	OPERATED_DI_NPN_8	8
9	OPERATED_DI_NPN_9	9
10	OPERATED_DI_NPN_10	10
11	OPERATED_DI_NPN_11	11
12	OPERATED_DI_NPN_12	12
13	OPERATED_DI_NPN_13	13
14	OPERATED_DI_NPN_14	14
15	OPERATED_DI_NPN_15	15
16	OPERATED_DI_NPN_16	16
17	D+24V_IO_IN-	GND
18	D+24V_IO_IN-	
19	D+24V_IO_IN-	
20	D+24V_IO_IN-	
21	OPERATED_DI1	1
22	OPERATED_DI2	2
23	OPERATED_DI3	3
24	OPERATED_DI4	4
25	OPERATED_DI5	5
26	OPERATED_DI6	6
27	OPERATED_DI7	7
28	OPERATED_DI8	8
29	OPERATED_DI9	9
30	OPERATED_DI10	10
31	OPERATED_DI11	11

Pin	Name	Label
32	OPERATED_DI12	12
33	OPERATED_DI13	13
34	OPERATED_DI14	14
35	OPERATED_DI15	15
36	OPERATED_DI16	16
37	D+24V_IO_IN+	24V
38	D+24V_IO_IN+	
39	D+24V_IO_IN+	
40	D+24V_IO_IN+	

The figure below is a side view of J3.

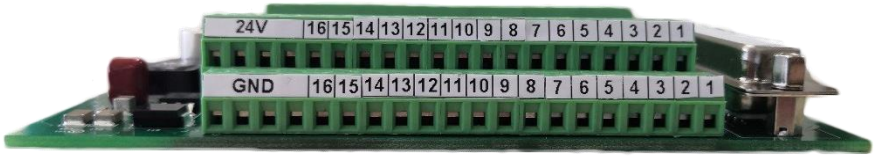


Figure 2-10 Photo of J3 side view

The pin definition of the J3 connector is shown in the following table.

Table 2-10 J3 connector pin definition

Pin	Name	Label
1	D+24V_IO_IN-	GND
2	D+24V_IO_IN-	
3	D+24V_IO_IN-	
4	D+24V_IO_IN-	
5	OPERATED_DO_NPN_16	16
6	OPERATED_DO_NPN_15	15
7	OPERATED_DO_NPN_14	14
8	OPERATED_DO_NPN_13	13
9	OPERATED_DO_NPN_12	12
10	OPERATED_DO_NPN_11	11
11	OPERATED_DO_NPN_10	10
12	OPERATED_DO_NPN_9	9
13	OPERATED_DO_NPN_8	8
14	OPERATED_DO_NPN_7	7
15	OPERATED_DO_NPN_6	6

Pin	Name	Label
16	OPERATED_DO_NPN_5	5
17	OPERATED_DO_NPN_4	4
18	OPERATED_DO_NPN_3	3
19	OPERATED_DO_NPN_2	2
20	OPERATED_DO_NPN_1	1
21	D+24V_IO_IN+	24V
22	D+24V_IO_IN+	
23	D+24V_IO_IN+	
24	D+24V_IO_IN+	
25	OPERATED_DO16	16
26	OPERATED_DO15	15
27	OPERATED_DO14	14
28	OPERATED_DO13	13
29	OPERATED_DO12	12
30	OPERATED_DO11	11
31	OPERATED_DO10	10
32	OPERATED_DO9	9
33	OPERATED_DO8	8
34	OPERATED_DO7	7
35	OPERATED_DO6	6
36	OPERATED_DO5	5
37	OPERATED_DO4	4
38	OPERATED_DO3	3
39	OPERATED_DO2	2
40	OPERATED_DO1	1

IO wiring instructions

- Connect the 24V power supply, arcing signal, forward wire feed, reverse wire feed, and air supply signal (pin numbers 1, 2, 9, 3, 11) of the analog terminals of the Megmeet welding machine to the user On the DO of the IO terminal, the corresponding DO addresses are DO1, DO2, DO3, DO4, (note that the low level is valid, this function needs to be equipped with the company's user IO terminal with NPN conversion function).
- Similarly, connect the 24V power supply, arcing signal, forward wire feed, reverse wire feed, and air supply signal (pin numbers 4, 9, 7, 10, 8) of the analog terminals of the Aotai welding machine to the user IO terminal.
- Connect the arc-starting success signals of the two welding machines to the DI of the user IO terminal. The arc-starting success signal of the Aotai welding machine is a switch value, and one of the pin numbers 12 and 13 needs to be connected to + 24V, the other one is connected to DI, the Megmeet is the I/O signal, which is output by the welding machine to the robot, and feedback the successful arc starting signal. When it is OFF, the low level is valid, and when it is ON, the high level is valid. .

2.3 Configuration of PLC Slave

The robot may be connected to a variety of I/O devices. When the required I/O device is selected in the configuration of PLC slave, the system will automatically assign the corresponding I/O address mapping for the device to complete the I/O interaction between the robot and the equipment.

Step1. On the main interface of the teach pendant, click "System/System Configuration/PLC Slave Configuration" option, as shown in Figure2-11.

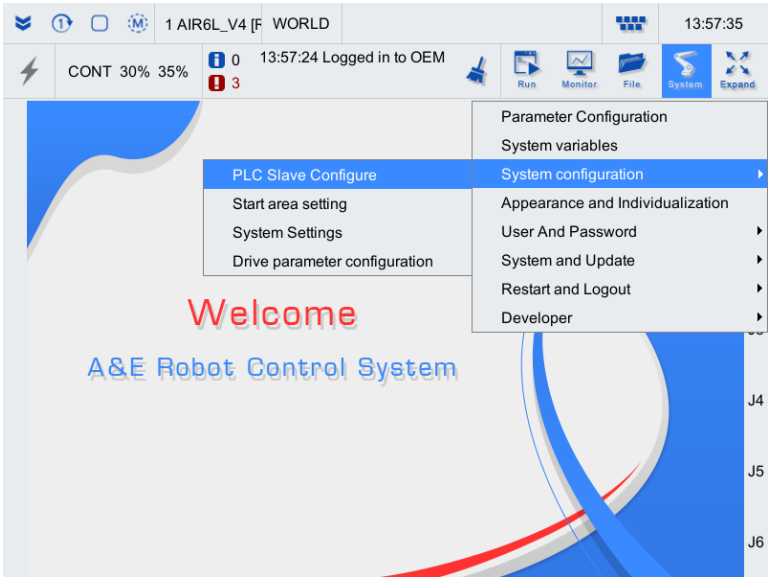


Figure2-11 Configuration selection of PLC slave

Step2. In the pop-up "PLC Slave Configuration" dialog box, select the option to be configured (the first PLC slave configuration cannot be modified) and click the "Configuration" button, as shown in Figure2-12.

Figure2-12 "PLC Slave Configuration" floating window

Step3. In the pop-up dialog box, select "PLC Slave station Type", as shown in Figure2-13. The conversion modules that are related to the welding machine are BECKHOFF DeviceNet conversion module, MFDB (first-generation control cabinet gusset digital welding machine CAN communication, analog welding machine communication) and IEB (second-generation control cabinet gusset CAN communication, analog welding machine communication).

Tip

- When connecting with Aotai welding machine, select the BECKHOFF DeviceNet conversion module.
- When connecting with Megmeet welding machine, select MFDB using inCube10/12 control cabinet.
- When connecting with Megmeet welding machine, select IEB using inCube20/21 control cabinet.
- When using an analog welding machine, two AO signal types must be selected.

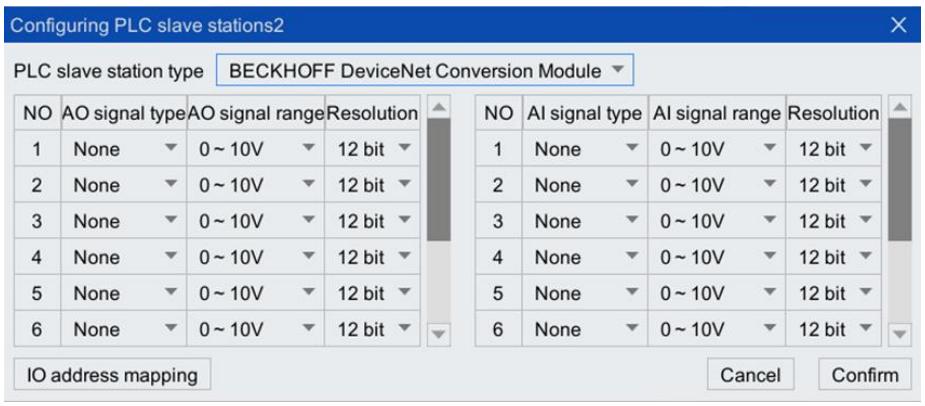


Figure2-13 Configuration interface of PLC slave

Step4. Click "IO Address Mapping" to view the set IO type, physical address head, physical address end, logical address head and logical address end, as shown in Figure2-14.

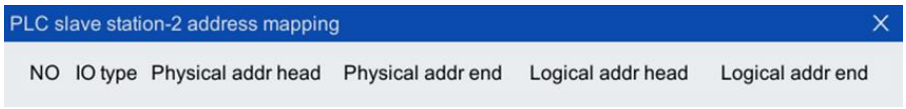


Figure2-14 View IO address mapping

Step5. After the configuration is completed, click "Confirm", a prompt dialog box will pop up, and then click "Yes", the configuration will take effect after power off and restart, as shown in Figure2-15.

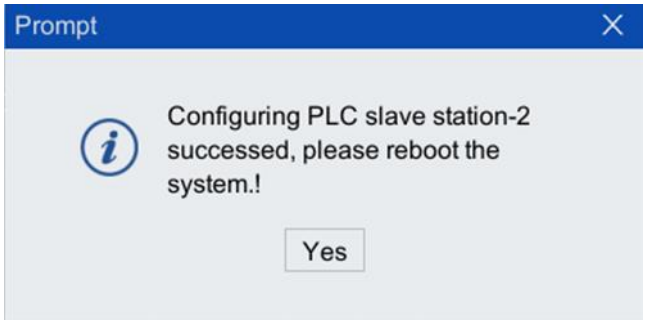


Figure2-15 Prompt dialog box

3 Connection and configuration of anti-collision device

3.1 Wiring instructions

The anti-collision device needs to be connected to two cables, one is the +24V power cable and the other is the signal cable. The wiring method is as follows:

- Connect the +24V power cable to +24V on the user IO terminal module
- Connect the signal line to any DI on the user IO terminal module, such as DI1

3.2 Parameter configuration

The configuration steps are as follows:

Step1. Click [System/Parameter Configuration] on the main interface of the teach pendant, and click [safetyio] in the opened [Parameter Configuration] to enter the user safety IO configuration interface.

Step2. Click the [+] on the left of [USER_SAFETY_DI_SIGNALS], select the sub-item to be configured and click the [+] on the left. As shown in Figure 3-1.

Figure 3-1 User Safety ID Configuration Interface

Step3. Click to select the row of [enable (enable DI signal)], click <Edit>, the configuration interface shown in Figure 3-2 will pop up, and set the parameter in [Value] to "true".

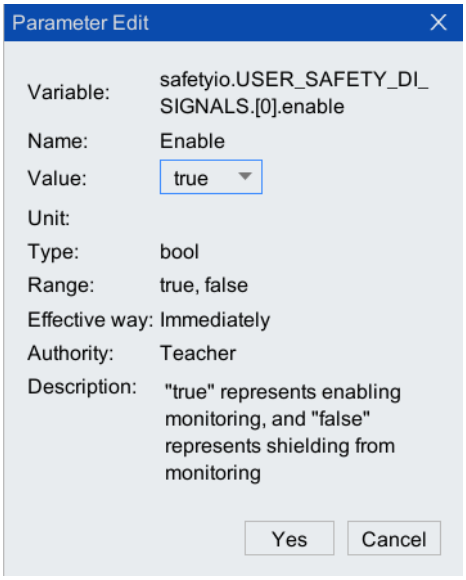


Figure 3-2【Enable DI signal】configuration interface

Step4. Click to select the row of [bit_address (IO physical address)], click <Edit>, the configuration interface as shown in Figure 3-3 will pop up, configure the parameter in [Value] as the DI connected to the anti-collision device, for example: anti-collision device When the collider is connected to DI1, it is configured as "1".

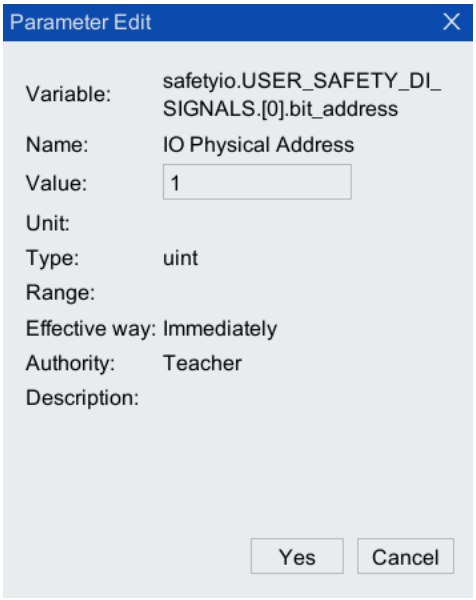


Figure 3-3 [Bit Address] configuration interface

Step5. Click to select the row of [valid_value], click <Edit>, the configuration interface as shown in Figure 3-4 will pop up, and configure the parameter in [Value] to be "false (active low)".

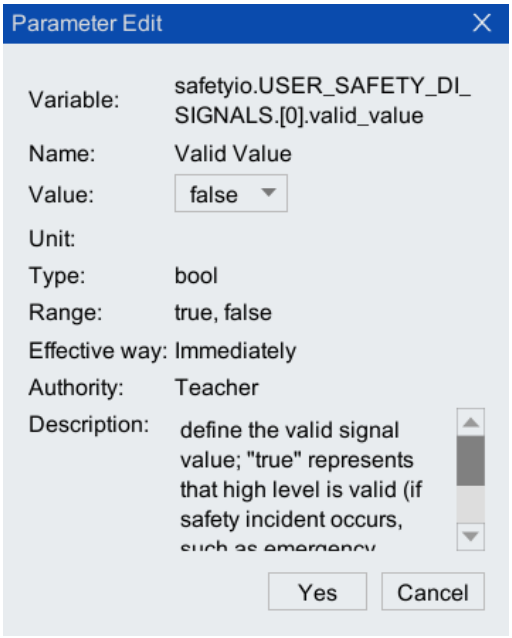


Figure 3-4 [Valid value] configuration interface

Step6. Click to select the row of [stop_type (type of execution stop)], click <Edit>, the configuration interface shown in Figure 3-5 will pop up, and configure the parameter in [Value] as the default value of "0".

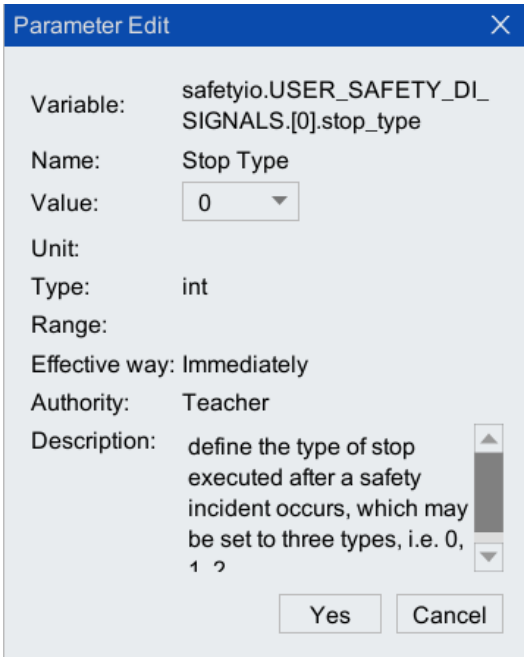


Figure 3-5 [Type of execution stop] Configuration interface

Step7. Click to select the row of [monitor_in_T1 (whether to monitor in T1 mode)], click <Edit>, the configuration interface shown in Figure 3-6 will pop up, and set the parameter in [Value] to "ture".

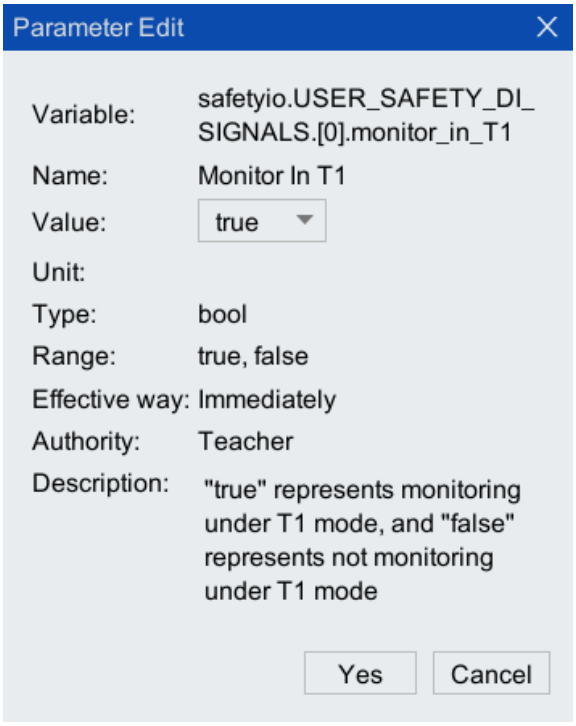


Figure 3-6 [Whether to monitor in TI mode] configuration interface

Step8. Configure [alarm_code (alarm code)] and [alarm_info (alarm information)] as default values.

Step9. After configuration, manually shake the welding torch to check whether there is any alarm information. After returning the welding torch to the normal position, the alarm can be cleared.

4 Basic operation of the arc welding package

4.1 Access level of system parameter configuration

When operating the AIR-TP teach pendant for the first time, the user interface at the first login will be prompted. The user can choose:

- Teacher: Access level 4

The user can perform operations such as programming the robot's running program, and modify some parameters. The initial login password is: PEACE.

- Operator: Access level 5

The user can view the robot's position, basic parameters, and operation conditions, without the permission of modifying the program or parameters. The initial login password is: LOVE.

Tip

The ordinary users can log into the teach pendant only with OEM or Teacher only.

4.2 Installation and upgrade of arc welding feature pack

Before installing the arc welding feature pack, please check whether the HMI/ARCS version has been upgraded to the version that matches with the feature pack. The installation steps are the same as the upgrade steps.

The steps are as follows:

Step1. Copy the installation package to the root directory of USB.

Step2. Log into the teach pendant with the teacher or higher permission, and then insert the USB above.

Step3. Click "Expand" button to pop up the drop-down list shown in Figure 4-1.

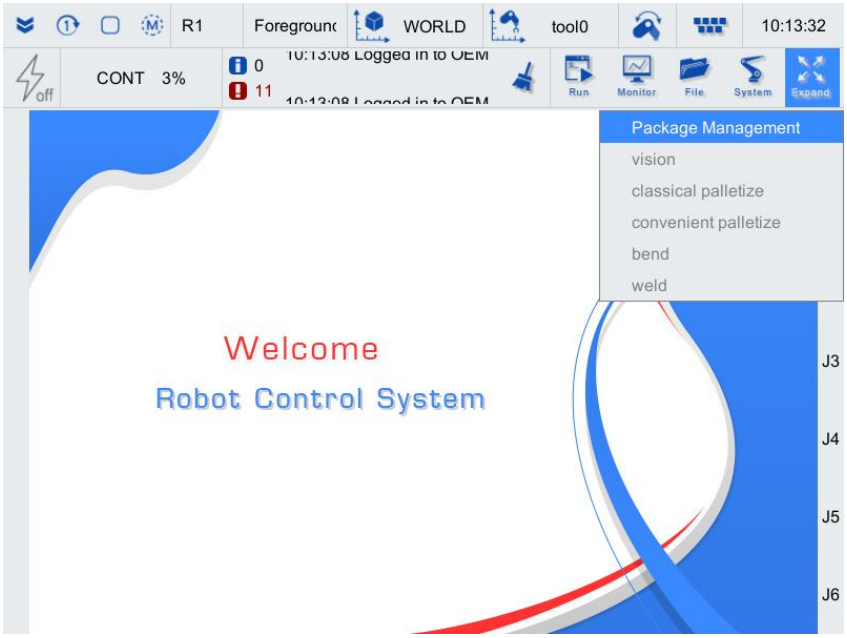


Figure 4-1 List of feature pack

Step4. Click "Package Management" to pop up the package management interface shown in Figure 4-2.

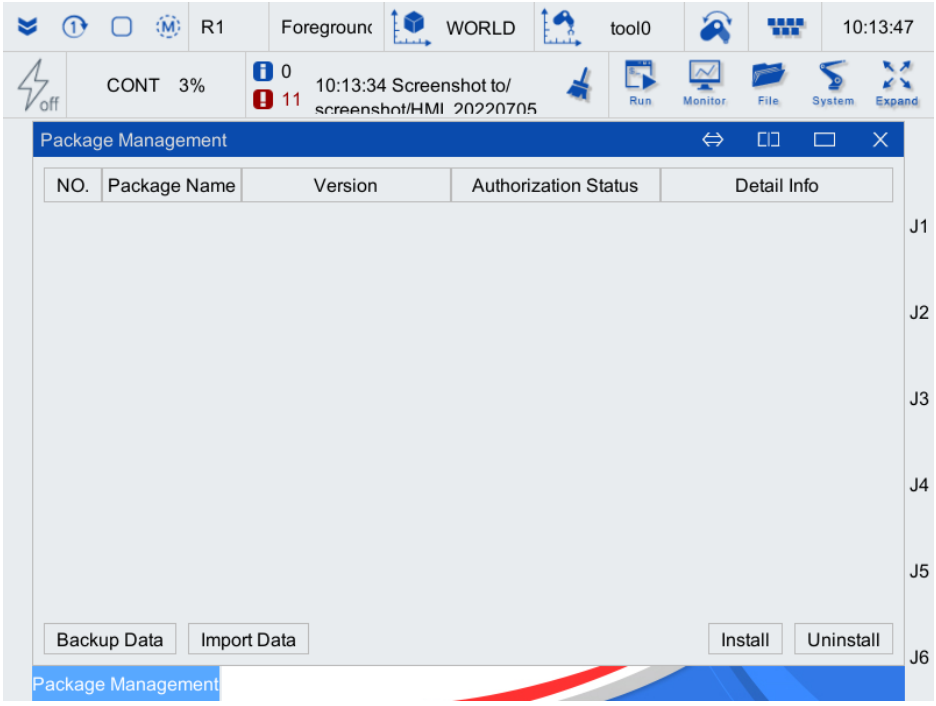


Figure 4-2 Management interface of feature pack

Step5. Click "Install" button to pop up the "Select Package Version" dialog box shown in Figure 4-3.

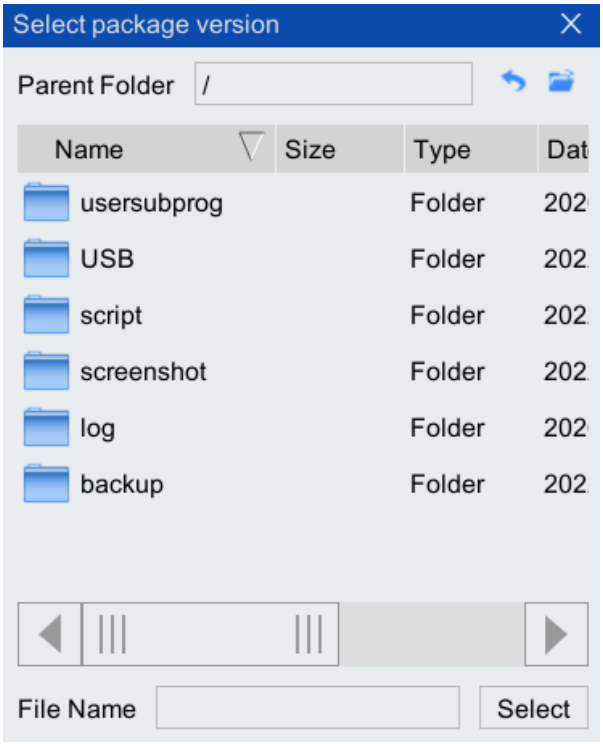


Figure 4-3 "Select Package Version" dialog box

Step6. Double-click "USB" folder, find the arc welding package installation file under the USB folder, enter the interface shown in Figure 4-4, and then click "Select" button.

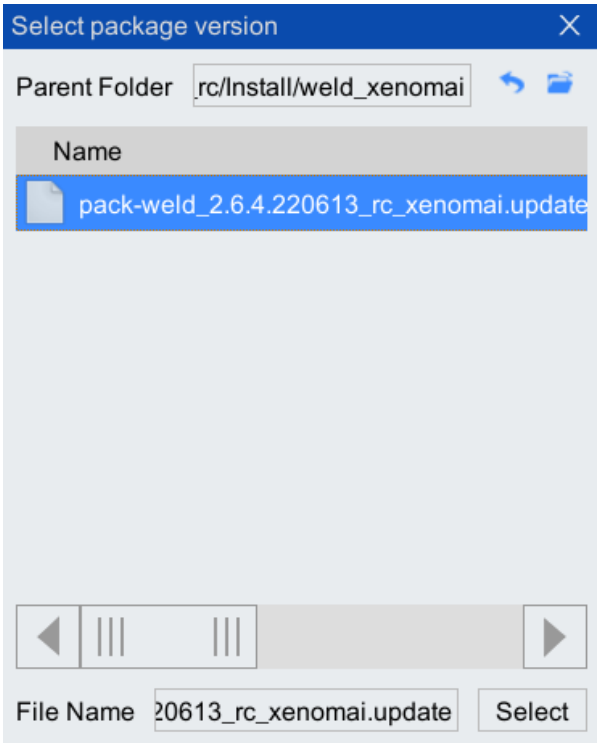


Figure 4-4 Selection interface of install feature pack

Step7. A dialog box shown in Figure 4-5 will pop up to prompt whether to upgrade. After checking, click "Yes" button.

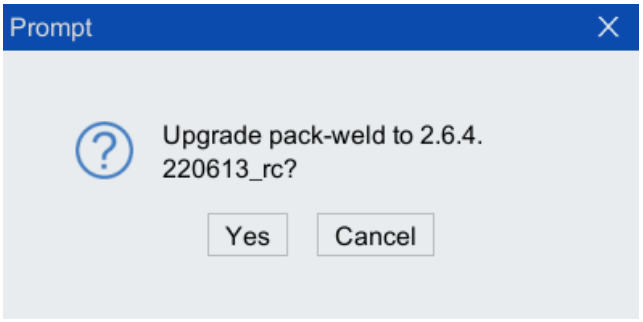


Figure 4-5 Dialog box

Step8. After the progress bar is updated, the "Install Upgrade" dialog box shown in Figure 4-6 will pop up. At this time, the device can be powered off and restarted to complete the feature pack upgrade.

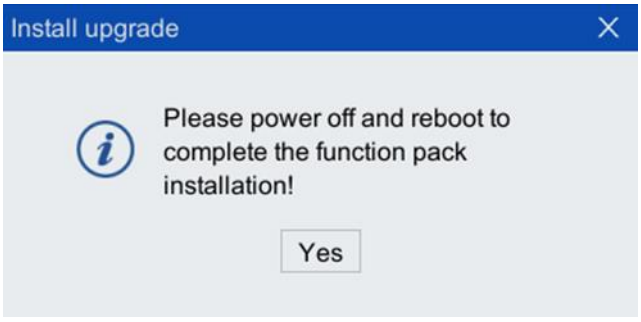


Figure 4-6 "Install and Upgrade" dialog box

4.3 Uninstallation of arc welding feature pack

The steps to uninstall the arc welding feature pack are as follows.

Step1. Click the "Expand" button to pop up a drop-down list, as shown in Figure 4-7.

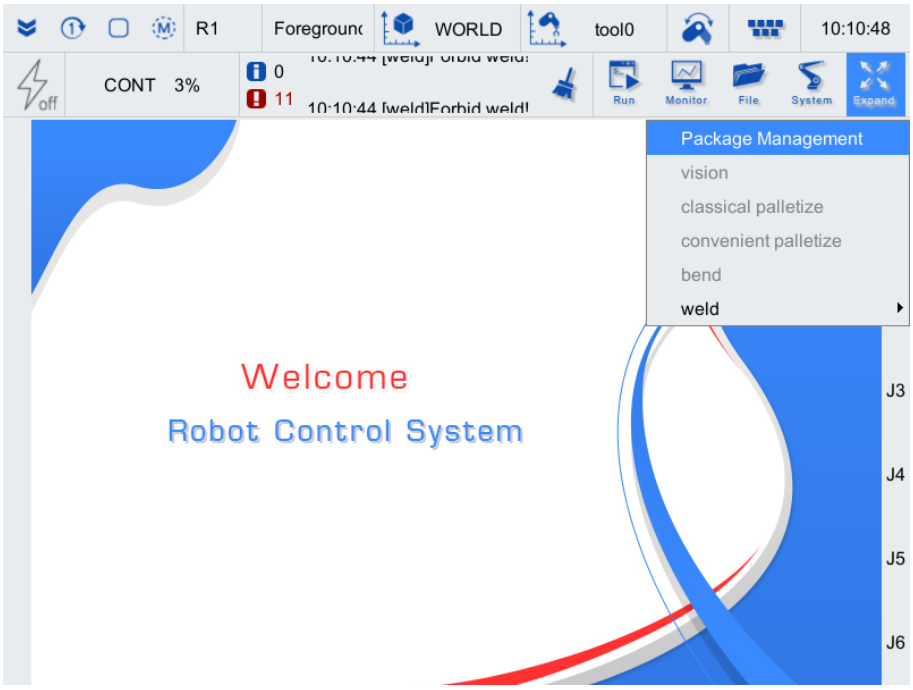


Figure 4-7 List of feature pack

Step2. Click "Feature Pack Management" to pop up the feature pack management interface, as shown in Figure 4-8.

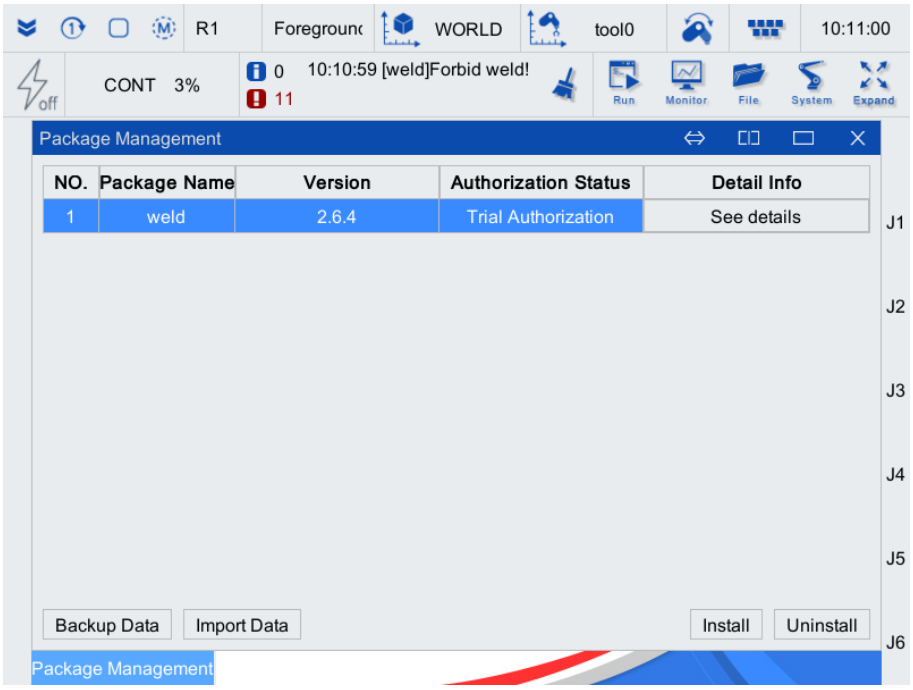


Figure 4-8 "Feature Pack Management" box

Step3. Select the line where the arc welding feature pack is located, and click the "Uninstall" button to pop up the dialog box, as shown in Figure 4-9.

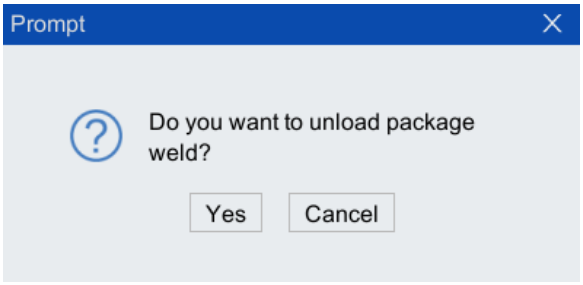


Figure 4-9 "Feature Pack Management" dialog box

Step4. Click the "Yes" button. After the uninstallation is completed, the dialog box shown in Figure 4-10 will pop up. Click "Yes", and the uninstallation of the feature pack will be completed.

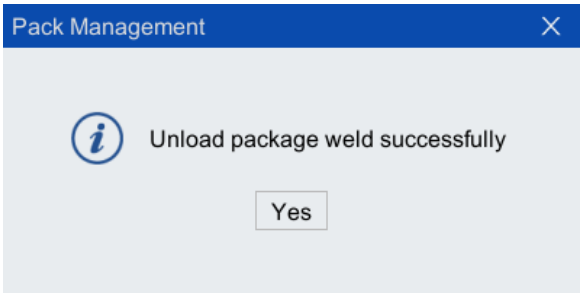


Figure 4-10 "Uninstalled Successfully" dialog box

4.4 Authorization of arc welding feature pack

After the package is installed, you must obtain authorization before using it.

The specific authorization process is as follows:

Step1. Contact the relevant personnel of the company to obtain the corresponding authorization file.

Step2. Put the obtained authorization file into a USB, and then insert the USB into the USB interface on the teach pendant.

Step3. Click the "System" button in the top right corner on main interface of the teach pendant, and then select the "System and Update/Authorization Import" option in the drop-down list, as shown in Figure 4-11.

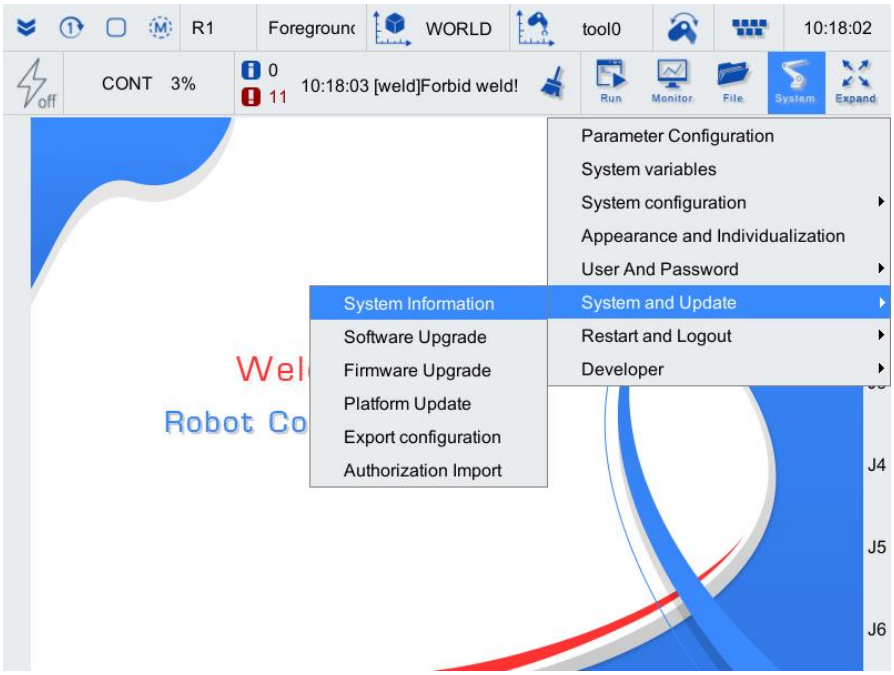


Figure 4-11 Main interface of teach pendant

Step4. Click "Authorization Import" to pop up the "Choose an authorization file" dialog box shown in Figure 4-12. Find the authorization file under the USB folder and click to highlight it. Click the "Select" button to start authorization.

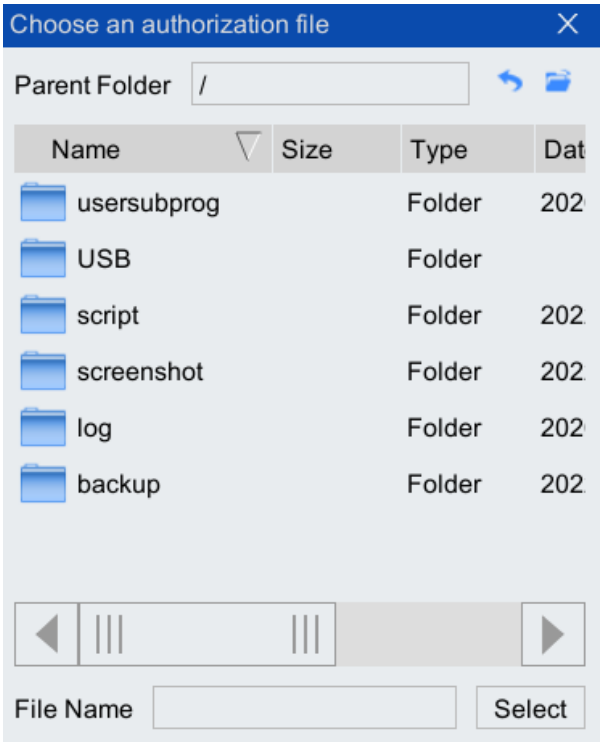


Figure 4-12 "Select Authorization File" dialog box

Step5. After the authorization is successful, the dialog box shown in Figure 4-13 will pop up. Click "Yes" to complete the authorization.

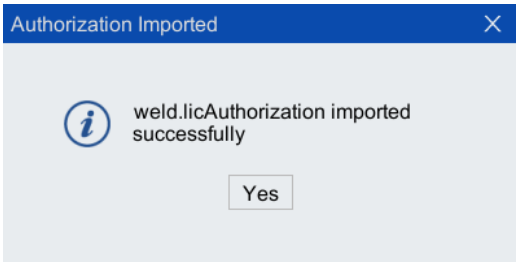


Figure 4-13 "Select the Required Authorization File" interface

Step6. After the authorization is successful, power off and restart it.

4.5 Check of configuration

After the authorization is completed, you can check whether the authorization is successful on the teach pendant.

The steps are as follows:

Step1. Click the "Expand" button to pop up the drop-down list, as shown in Figure 4-14.

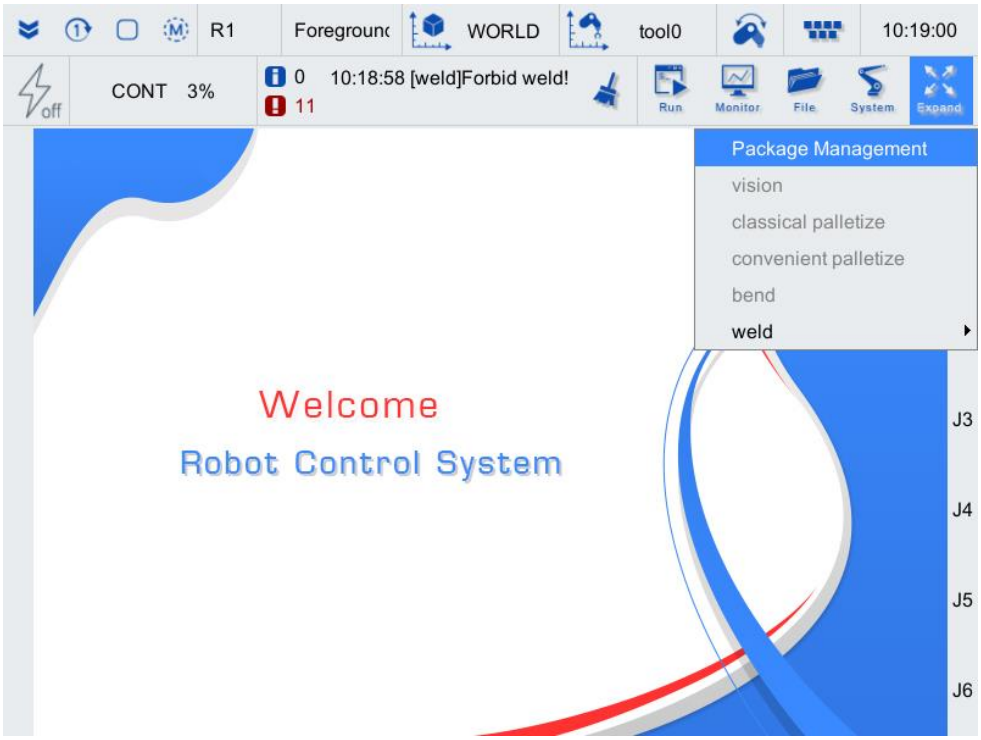


Figure 4-14 List of feature pack

Step2. Click "Package Management" to pop up the feature pack management interface, as shown in Figure 4-15. Check the "Authorization Status" to determine whether the authorization is successful.

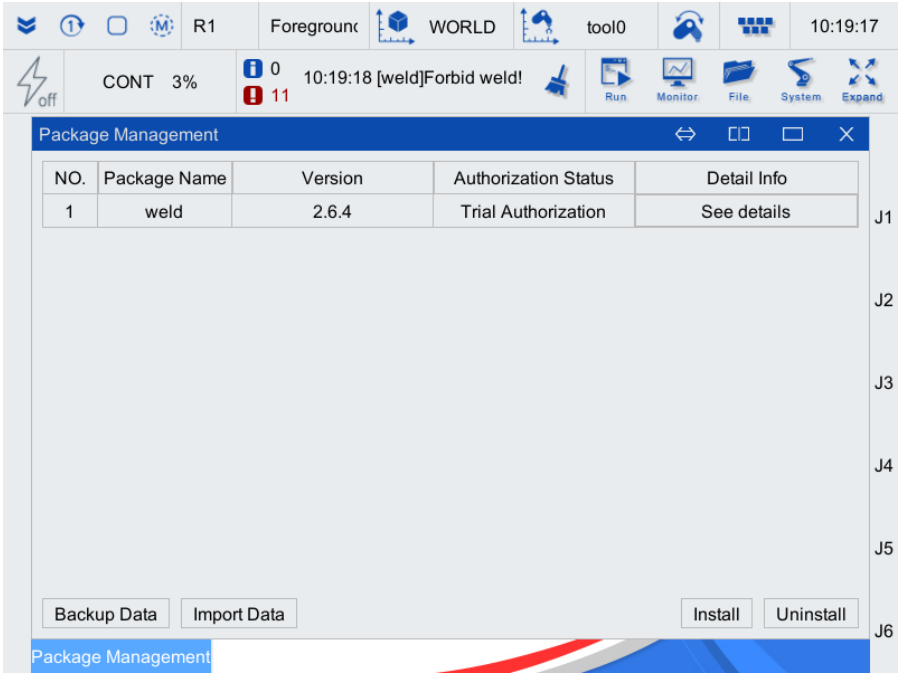


Figure 4-15 "Feature Pack Management" interface

Step3. Click "See details" to view the details about the feature pack, as shown in Figure 4-16.

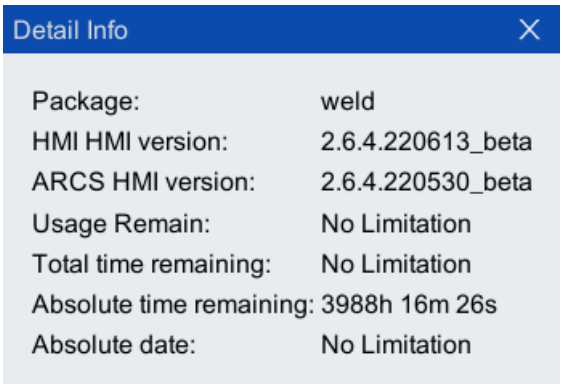


Figure 4-16 "View Details" interface

5 Welding torch calibration

The calibration of the welding torch needs to be completed by calibrating the tool coordinate system. The calibration process of the tool coordinate system is as follows:

Step1. Click [Run/Calibrate/Coordinate cali] on the upper right of the main interface of the teach pendant (as shown in Figure 5-1) to enter the [Coordinate System Measurement] interface.

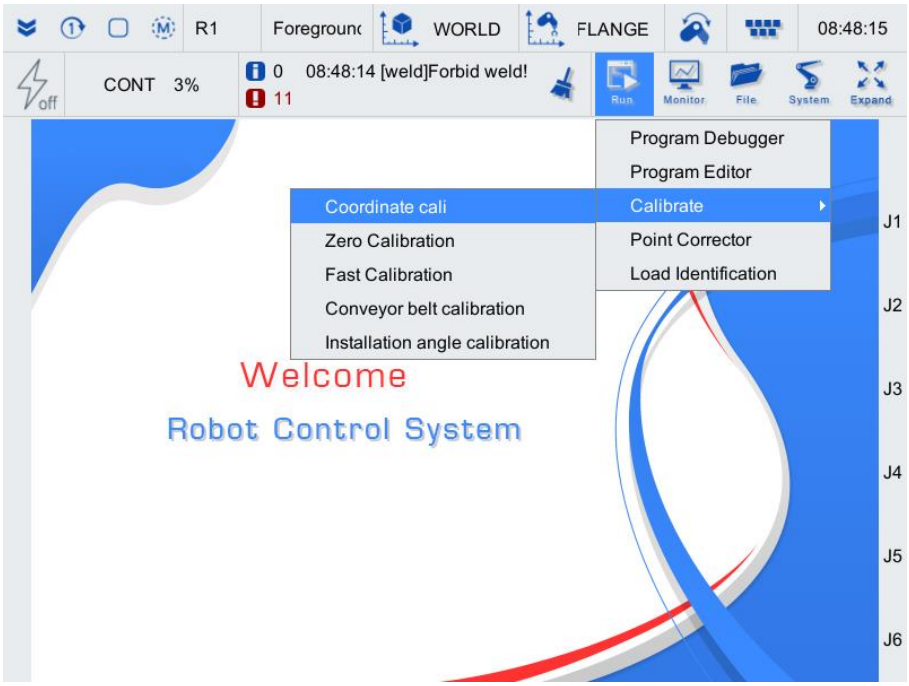


Figure 5-1 The main interface of the teach pendant

Step2. Select "Tool" in [Coordinate System Type], and click to select the row of the tool coordinate system to be calibrated, as shown in Figure 5-2.

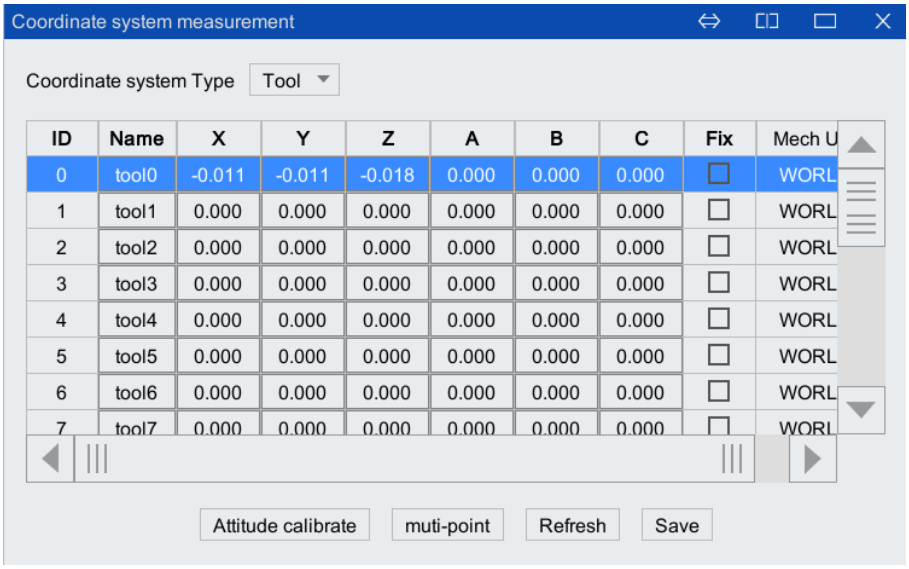


Figure 5-2 Select the row where the tool coordinate system is located

Step3. Click <muti-point> to pop up the configuration interface as shown in Figure 5-3.

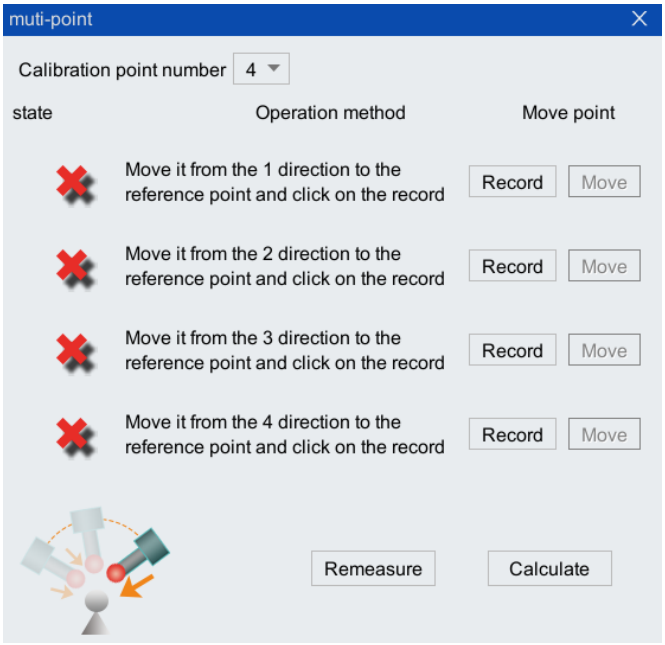


Figure 5-3 "muti-point" calibration interface

Step4. Just follow the operation instructions in the figure to calibrate. After each point is successfully calibrated, the ✘ in front will change to √, as shown in Figure 5-4.

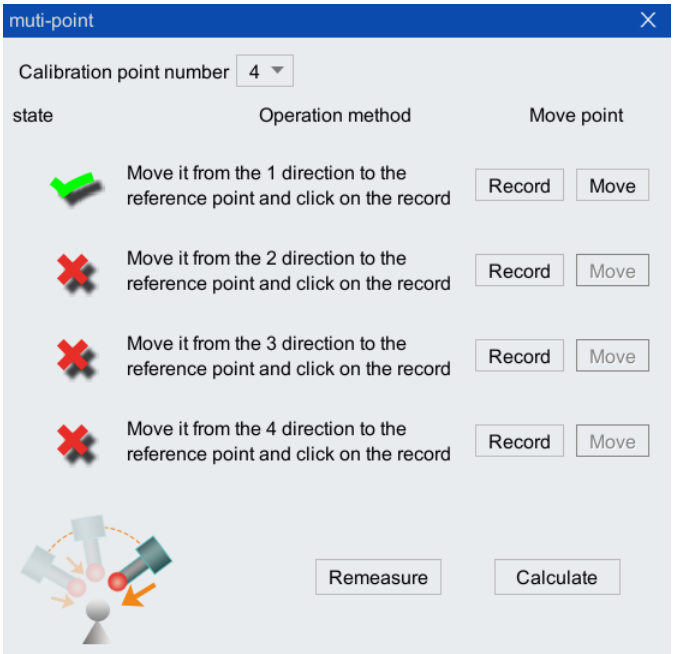


Figure 5-4 The interface status of 1 point successfully calibrated

Step5. After all calibrations are successful, all ✘ will become √, as shown in Figure 5-5. Click the <Calculate> button to calculate the error. If it exceeds the error range (more than 1), it needs to be calibrated again. If it is within the allowable error range, the calibration is completed.

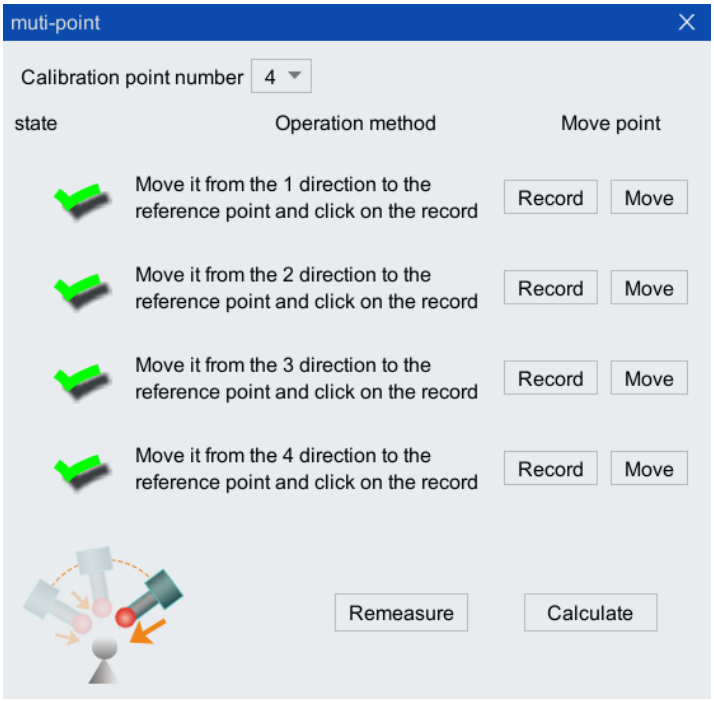


Figure 5-5 Interface status when all 4 points have been calibrated

Step6. After the tool coordinate system calibration is completed, click <Save>, and click <Yes> in the pop-up prompt dialog box to save the configuration.

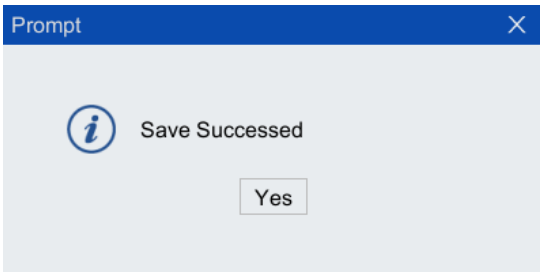


Figure 5-6 Save dialog

6 Arc welding function configuration

On the main interface of the teach pendant, click [Extended/Weld/Weld Package] to enter the [weld-Weld Package] configuration interface.

6.1 Welder configuration

Single welding machine parameters

In the configuration interface of [weld-Weld Package], click the [Welder Config/One Welder Para] option, and the floating window shown in Figure 6-1 will pop up. The parameter description is shown in Table 6-1.

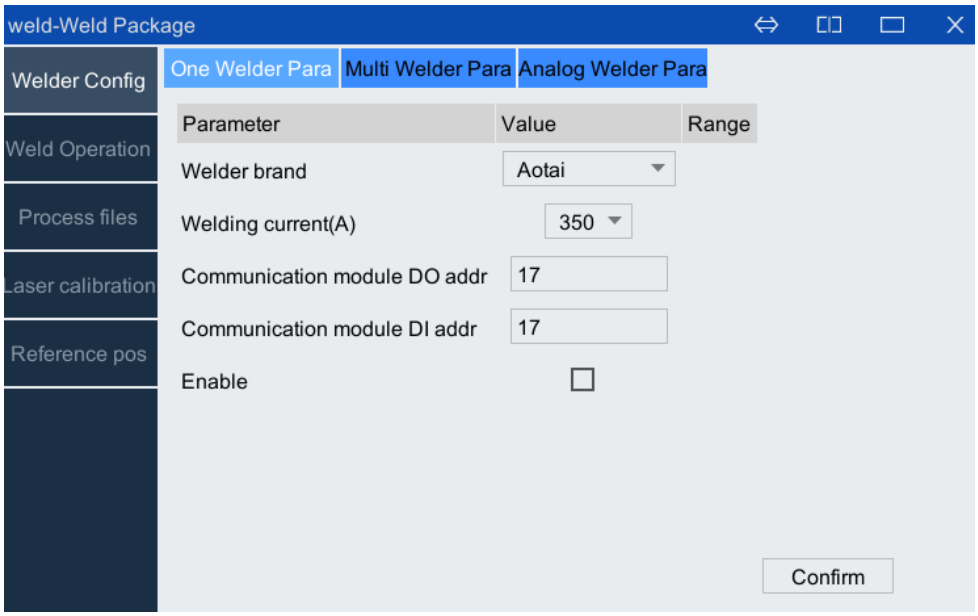


Figure 6-1 Single welding machine parameter configuration

Table 6-1 Parameter Description

Parameter	Description
Welder brand	The welding machine brand is the welding machine brand that supports digital communication, and the supported types are: ■ Aotai ■ Megmeet (CAN open communication method) ■ Megmeet eth (Ethercat communication method) ■ None
Welding current(A)	■ 350 ■ 500
Communication module DO addr	The starting logical address in the corresponding input PLC slave address in the DO address of the communication module. The default value is 17 (only inCube20/21 need not be modified).
Communication module DI addr	The starting logical address in the PLC slave station address corresponding to the DI address of the communication module. The default value is 17 (only inCube20/21 need not be modified).
Enable	Allowed to use

Tip

After the welding machine brand is set, the arc welding function package will configure the I/O addresses of different welding machines. Please refer to "2.3 PLC Slave Configuration" for the viewing method of the starting logical address in the input PLC slave address corresponding to the DO and DI addresses of the communication module.

Double welding machine parameters

In the [weld-Weld Package] configuration interface, click the [Welder Config/Multi Welder Para] option, and the floating window shown in Figure 6-2 will pop up. The parameter description is shown in Table 6-2.

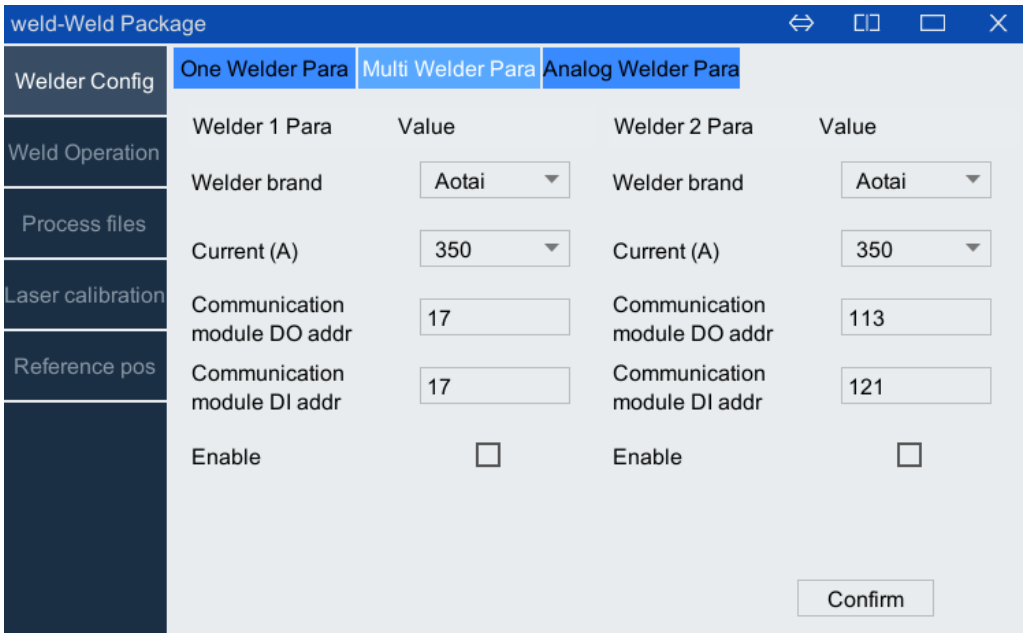


Figure 6-2 Double welding machine parameter configuration

Table 6-2 Parameter Description

Parameter	Description
Welder 1 Para	
Welder brand	The welding machine brand is the welding machine brand that supports digital communication, and the supported types are: ■ Aotai ■ Megmeet (CAN open communication method) ■ Megmeet eth (Ethercat communication method) ■ None
Current(A)	■ 350 ■ 500
Communication module DO addr	The starting logical address in the corresponding input PLC slave address in the DO address of the communication module. The default value is 17 (only inCube20/21 need not be modified).
Communication module DI addr	The starting logical address in the PLC slave station address corresponding to the DI address of the communication module. The default value is 17 (only inCube20/21 need not be modified).
Enable	Allowed to use

Parameter	Description
Welder 2 Para	
Welder brand	The welding machine brand is the welding machine brand that supports digital communication, and the supported types are: ■ Aotai ■ Megmeet (CAN open communication method) ■ Megmeet eth (Ethercat communication method) ■ None
Current(A)	■ 350 ■ 500
Communication module DO addr	The starting logical address in the corresponding input PLC slave address in the DO address of the communication module. The default value is 17 (only inCube20/21 need not be modified).
Communication module DI addr	The starting logical address in the PLC slave station address corresponding to the DI address of the communication module. The default value is 17 (only inCube20/21 need not be modified).
Enable	Allowed to use

Analog welding machine parameters

In the [weld-Weld Package] configuration interface, click the [Welder Config /Analog Welder Para] option, and the floating window shown in Figure 6-3 will pop up. The parameter descriptions are shown in Table 6-3.

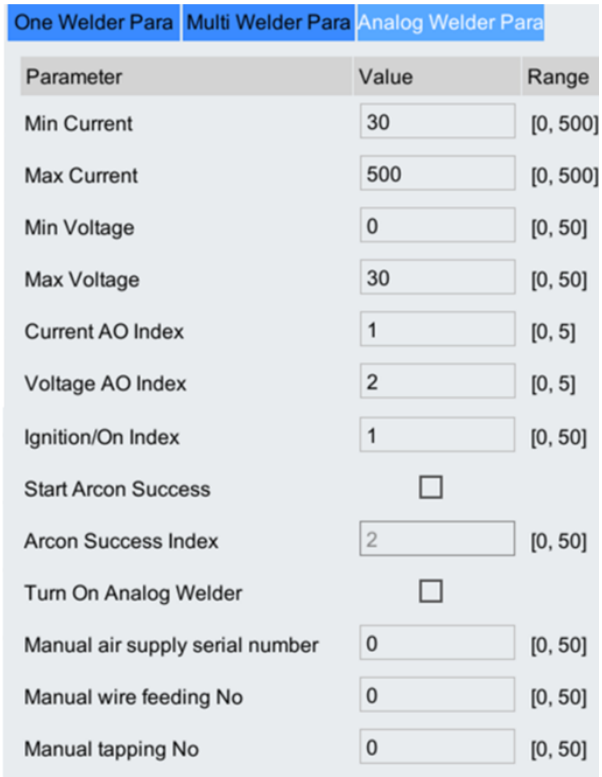


Figure 6-3 Simulate welding machine parameter configuration

Table 6-3 Parameter Description

Parameter	Ranges	Description
Min current	0A~500A	The minimum current value of the analog welding machine
Max current	0A~500A	The maximum current value of the analog welding machine
Min voltage	0V~50V	The minimum voltage value of the analog welding machine
Max voltage	0V~50V	The maximum voltage value of the analog welding machine
Current AO Index	0~5	The current AO serial number of the analog welding machine
Voltage AO Index	0~5	The Voltage AO serial number of the analog welding machine
Ignition/On Index	0~50	Ignition/deactivation serial number of analog welding machine
Start Arcon Success	-	Arc start successful
Arcon Success Index	0~50	The arc starting success serial number of the analog welding machine
Turn On Analog Welder	-	Turn on the analog welding machine
Manual air supply serial number	0~50	Manual air supply serial number of analog welding machine
Manual wire feeding No	0~50	Manual wire feeding serial number of analog welding machine
Manual tapping No	0~50	Manual wire drawing serial number of analog welding machine

6.2 Welding machine operation

In the [weld-Weld Package] configuration interface, click the [Weld Operation] option, and the floating window shown in Figure 6-4 will pop up. Click <Confirm> after the configuration is complete. The button descriptions are shown in Table 6-4, and the parameter descriptions are shown in Table 6-5.

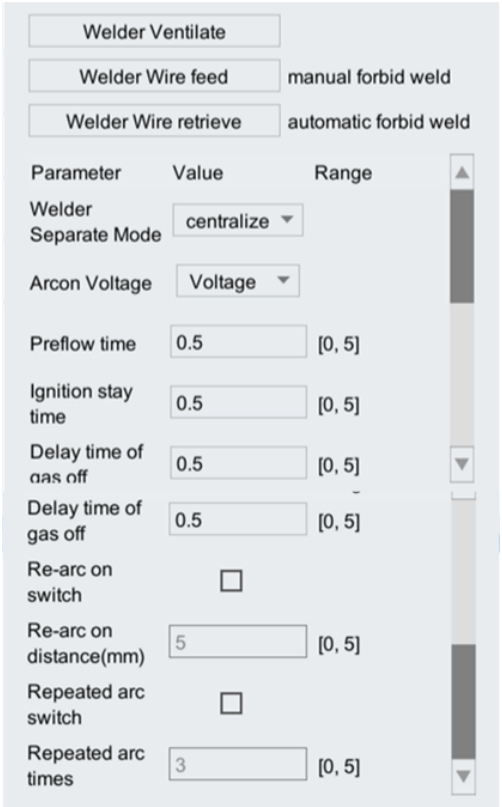


Figure 6-4 Arc Welding Operation Floating Window

Table 6-4 Key Description

Key	Description
Welder ventilate	Welder manually controlled air supply.
Welder Wire feed	Welder manually controlled wire feed.
Welder Wire retrieve	Welder manually controlled wire drawing.
Manual forbid weld	When debugging in manual mode, the robot does not arc when it reaches the arc start command. ■ Before running the arc starting instruction, if this function is turned on, the arc will not start, and when this function is turned off, the welding is prohibited. ■ In the arc starting process, turning on this function will immediately extinguish the arc, and turning off this function will not restart the arc, and the arc starting instruction needs to be re-executed before the arc can be started again. ■ When the robot switches from automatic mode to manual mode, it will automatically turn on "Manual forbid weld".
Automatic forbid weld	When debugging in automatic mode, the arc start instruction of robot arc welding is prohibited. ■ Before running the arc starting instruction, if this function is turned on, the arc will not start, and when this function is turned off, the welding is prohibited. ■ In the arc starting process, turning on this function will immediately extinguish the arc, and turning off this function will not restart the arc, and the arc starting instruction needs to be re-executed before the arc can be started again.

Table 6-5 Parameter Description

Parameter	Description
Welder Separate Mode	There are two separate modes of welding machine: ■ centralize ■ separate When selecting the separate mode, the parameters of the welding machine need to be adjusted to the separate mode correspondingly. For the specific modification method of the welding machine, please refer to the welding machine manual.
Arcon Voltage	There are two welding modes of a welding machine: ■ Voltage ■ Pulse/LS ■ LS RPL
Preflow time	Supply air in advance before welding to protect the molten pool. The value range is 0s~5s, and the minimum unit is 0.1.
Ignition stay time	Dwell time, dwell time after arc strike, increase arc strike point heat input. The value range is 0s~5s, and the minimum unit is 0.1.
Delay time of gas off	Hysteresis to close the shielding gas to protect the molten pool. The value range is 0s~5s, and the minimum unit is 0.1.
Re-arc on switch	When restarting after the arc is interrupted during the welding process, the robot will retreat a certain distance along the current trajectory and continue arc welding.
Re-arc on distance(mm)	The distance to go back after finding no arc. The value range is 0mm~5mm, and the minimum unit is 0.1.

Parameter	Description
Repeated arc switch	During welding, if the surface of the workpiece is not easy to start arcing such as oil stains, you can turn on the repeated arc ignition, and continue to execute the welding after the arc ignition is successful.
Repeated arc times	The number of attempts to start the arc. Integer form, the value range is 0~5.

6.3 Process files

The process file is a set of process parameters that the user needs to save. In the process of generating welding instructions, the saved process parameter file can be selected without resetting all parameters, which simplifies the user's programming.

Tip

This section describes how the user fills in and saves the process file. For the usage and application scenarios of the specific process file, please refer to "Chapter 5 Program Editor Inserting Arc Welding Instructions".

In the [weld-Weld Package] configuration interface, click the [Process Files] option. The configuration files are included as follows:

- Arcon File
- Arcoff Files
- Analog File
- Analog Arcoff file
- Arcpara File
- Arcweave File
- Multilayers File
- Weldtrack File

6.3.1 Arcon file

Click the [Arcon File] option, and the floating window as shown in Figure 6-5 will pop up. The parameter descriptions are shown in Table 6-6.

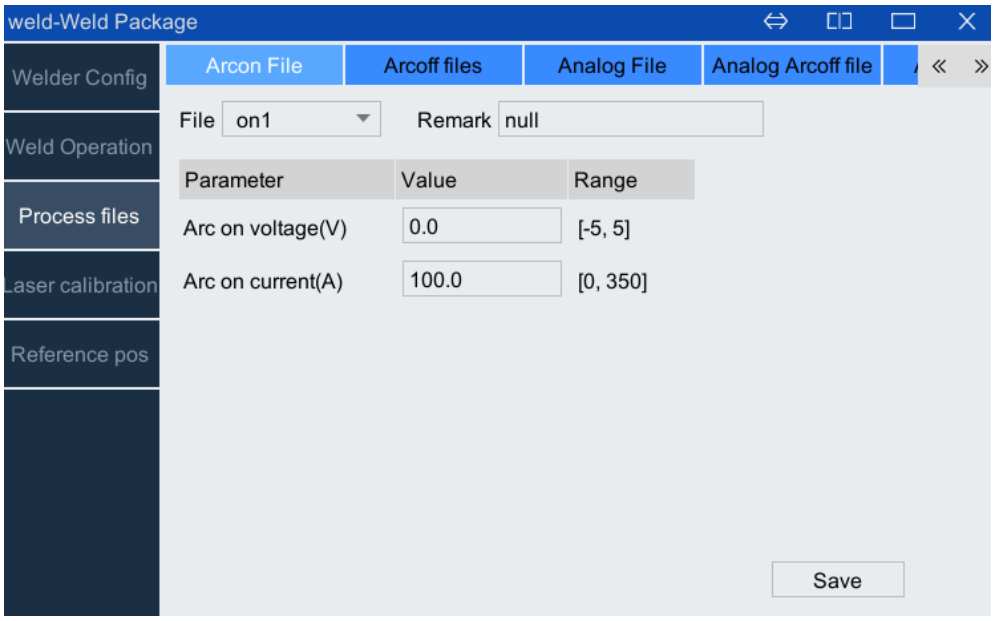


Figure 6-5 Arcon process file

Table 6-6 Parameter Description

Parameter	Value	Description
File	Up to 48 arcon files can be set.	Arcon file name. The arc starting file saves the parameters required for arc starting, and the process file can be directly called when the arc starting instruction is called.
Remark	-	The remark name of the arcon file is convenient for users to call and query the arcon file. The default remark name of the arcon file is null.
Arc on voltage(V)	-5 ~ 5	The voltage value during welding can be divided into two modes: centralize mode and separate mode adjustment. ■ Aotai supports setting centralize and separate mode in the function package, and the voltage range in separate mode is 0V~50V. ■ Megmeet supports setting centralize and separate modes in the function package, and the voltage range in separate mode is 0V~50V.
Arc on current(A)	0 ~ 350	Current value during welding.

6.3.2 Arcoff Files

Click the [Arcoff Files] option, and the floating window as shown in Figure 6-6 will pop up. The parameter descriptions are shown in Table 6-7.

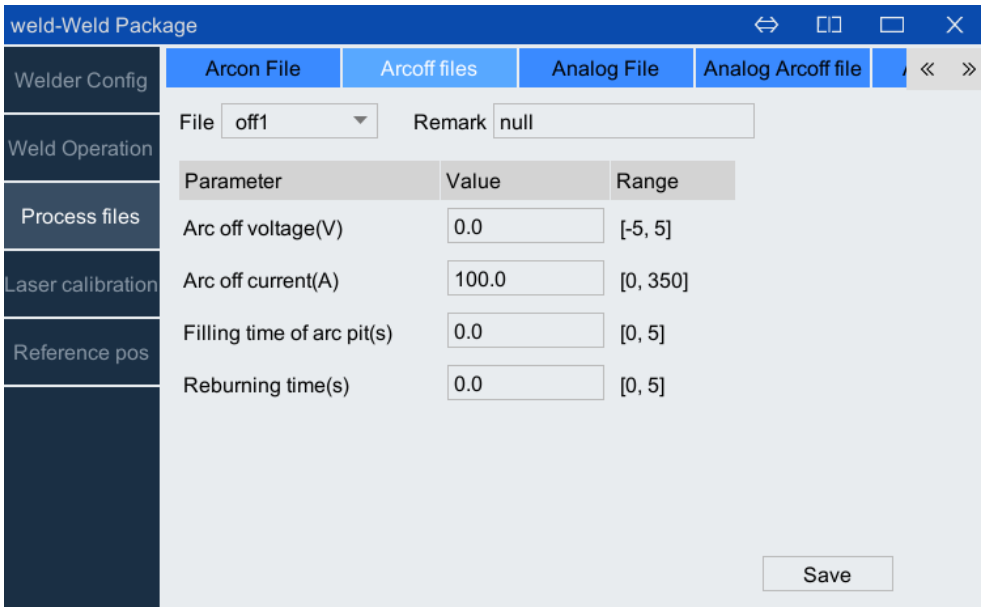


Figure 6-6 Arcoff process parameter file interface

Table 6-7 Parameter Description

Parameter	Value	Description
File	Up to 12 arcoff files can be set.	The name of the arcoff file, the arcoff file saves the parameters required for arcoff, and the process file can be directly called when the arcoff instruction is called.
Remark	-	The remark name of the arcoff file is convenient for users to call and query the arcoff file. The default remark name of the arcoff file is null.
Arc off voltage(V)	-5 ~ 5	The voltage used to fill the crater.
Arc off current(A)	0 ~ 350	The current used to fill the crater.

Parameter	Value	Description
Filling time of arc pit(s)	0s~5s	Set the dwell time in the crater to ensure the crater process.
Reburning time(s)	0s~5s	After the welding is completed, set the time to melt the welding wire, so as to prevent the molten droplet from the tip of the welding wire from not transitioning to the molten pool and forming a small ball at the end of the welding wire.

6.3.3 Analog File

Click the option of [Analog File], and the floating window shown in Figure 6-7 will pop up. The parameter descriptions are shown in Table 6-8.

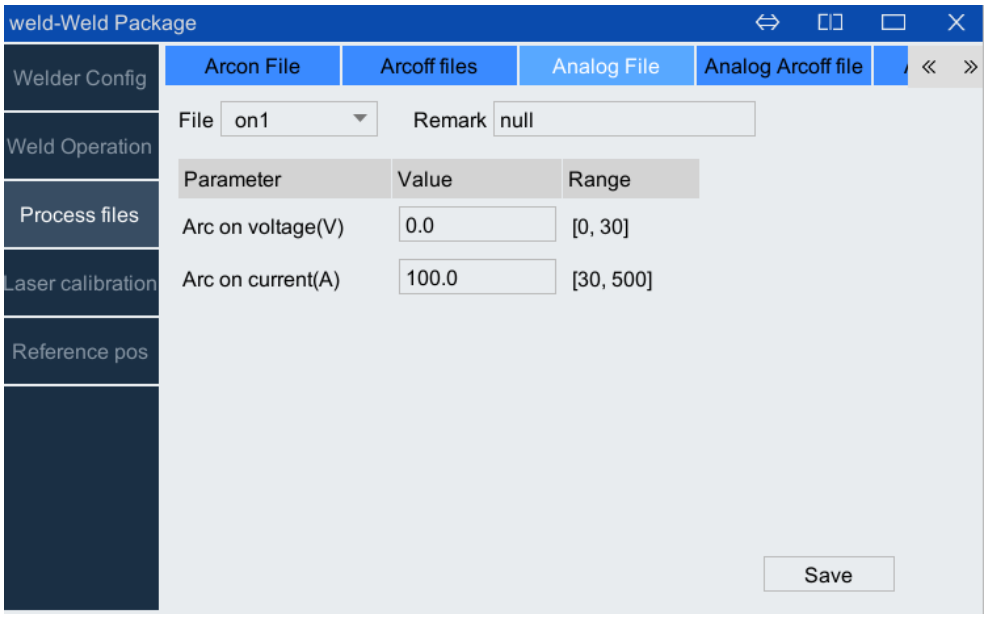


Figure 6-7 Analog arcon file configuration interface

Table 6-8 Parameter Description

Parameter	Value	Description
File	Up to 16 analog files can be set.	Name of analog quantity arcon file. The analog arcon file saves the parameters required for analog arcon, and the process file can be called directly when calling the analog arcon instruction.
Remark	-	Remark name of analog arcong file, which is convenient for users to call and query analog arcon file. The default remark name of analog arcon file is null.
Arc on voltage(V)	0~30	The arcon voltage of the analog welding machine.
Arc on current(A)	30~500	The arcon current of the analog welding machine.

6.3.4 Analog arcoff file

Click the [Analog arcoff file] option, and the floating window as shown in Figure 6-8 will pop up. The parameter descriptions are shown in Table 6-9.

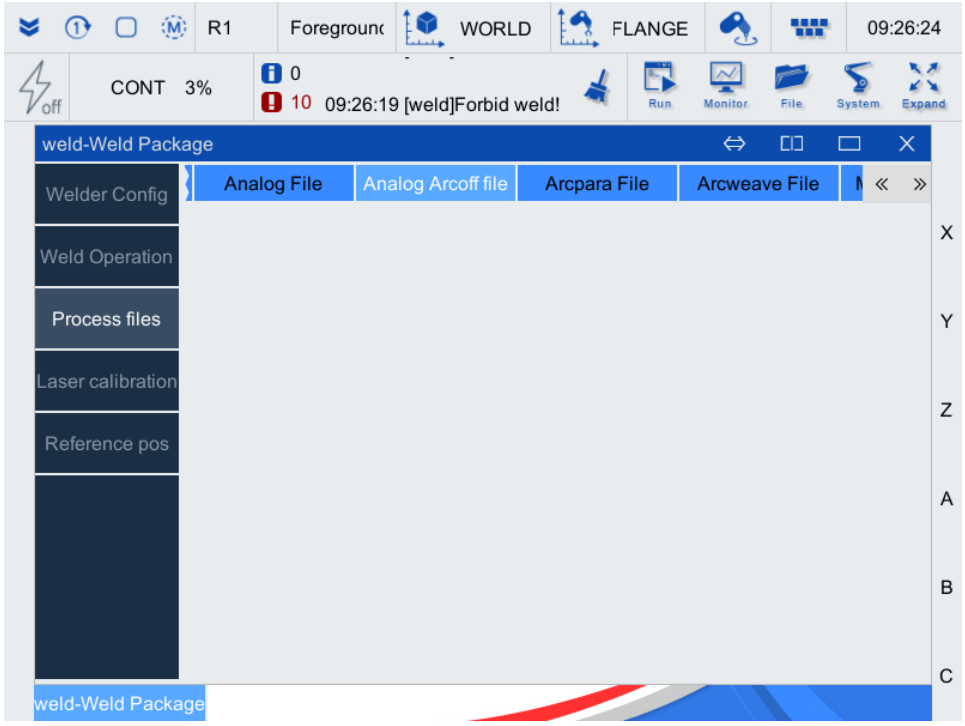


Figure 6-8 Analog arcoff file configuration interface

Table 6-9 Parameter Description

Parameter	Value	Description
File	Up to 16 analog arc off files can be set.	The name of the analog arc off file, the analog arc off file saves the parameters required for the analog arc off, and the process file can be directly called when the analog arc off instruction is called.
Remark	-	The remark name of the analog arc off file is convenient for users to call and query the analog arc off file. The default remark name of the analog arc off file is null.
Arc off voltage(V)	0~30	The arc off voltage of the analog welding machine.
Arc off current(A)	30~500	The arc off current of the analog welding machine.

6.3.5 Arcpara file

Click the [Arcpara File] option, and the floating window as shown in Figure 6-9 will pop up. The parameter descriptions are shown in Table 6-10.

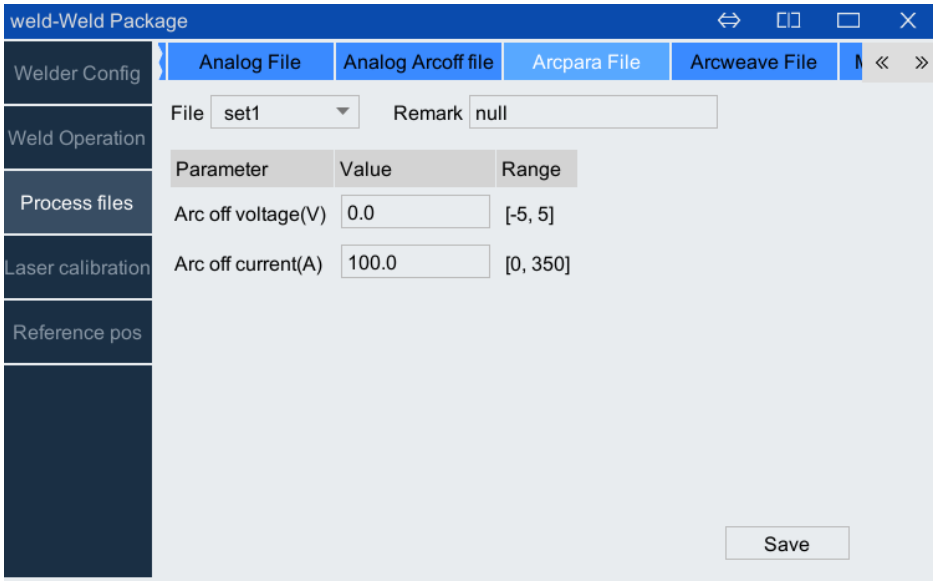


Figure 6-9 Configuration parameter process file setting interface

Table 6-10 Parameter Description

Parameter	Value	Description
File	Up to 48 arcpara files can be set.	The name of the arcpara file, which saves the configuration parameters required for welding. When calling the instruction of configuring welding parameters, you can call the configuration file directly.
Remark	-	Remark name of arcpara file, which is convenient for users to call and query arcpara file. The default remark name of arcpara file is null.
Arc off voltage(V)	-5～5	Arc off voltage
Arc off current(A)	0～350	Arc off current

6.3.6 Arcweave File

Click the [Arcweave File] option to pop up the floating window as shown in Figure 6-10. Parameter descriptions are shown in Table 6-11.

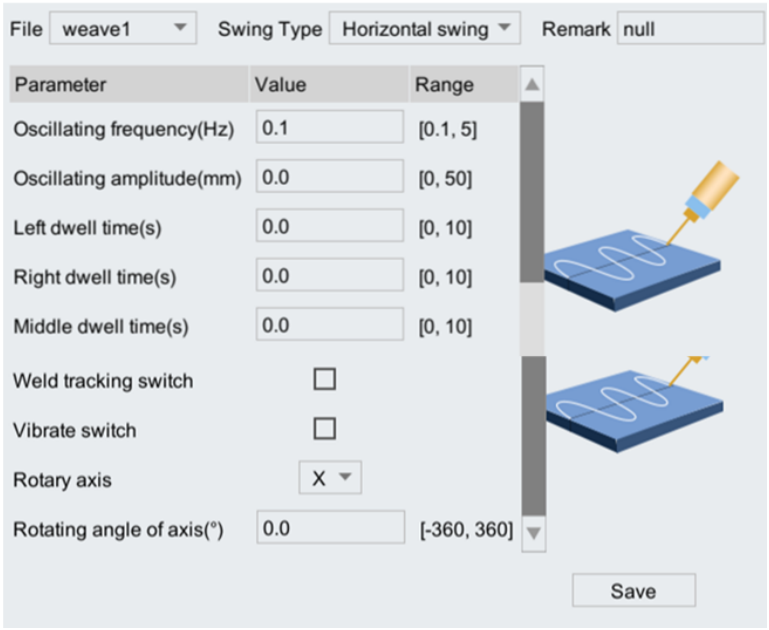


Figure 6-10 Swing parameters setting page

Table 6-11 Parameter Description

Parameter	Value	Description
File	Up to 16 arcweave files can be set.	Arcweave file name. The arcweave file saves the parameters required for arcweave file welding. When calling the swing welding parameter instruction, you can directly call the arcweave file.
Swing type	-	The swing track types supported by the system include: ■ Horizontal swing ■ V shape swing ■ Triangle swing ■ Spiral swing ■ 8 shape swing
Remark	-	Remark name of arcweave file, which is convenient for users to call and query arcweave file. The default remark name of arcweave file is null.
Oscillating frequency (Hz)	0.1 ~ 5	Swing frequency of welding torch weave track
Oscillating amplitude (mm)	0 ~ 50	Swing amplitude of welding torch weave track
Left dwell time(s)	0 ~ 10	The dwell time at the wave crest of the swing trajectory. During the dwell, the robot will advance in a straight line at the current point.
Right dwell time(s)	0 ~ 10	The dwell time at the trough of the swing trajectory. During the dwell, the robot will advance in a straight line at the current point.
Middle dwell time(s)	0 ~ 10	The dwell time of the swing track at 1/2 cycle. During the dwell, the robot will advance in a straight line at the current point.
Weld tracking switch	-	Whether it is necessary to start arc voltage weld tracking
Vibrate switch	-	The starting vibration parameter is to gradually increase or decrease the amplitude at the beginning or end of the swing to increase the stability of the motion
Rotary axis	-	The rotation axis has the following three options: ■ X ■ Y ■ Z
Rotating angle of axis (°)	-360 ~ 360	Rotation angle of XYZ axis

6.3.7 Multilayers File

Click the [Multilayers File] option to pop up the floating window as shown in Figure 6-11. Parameter descriptions are shown in Table 6-12.

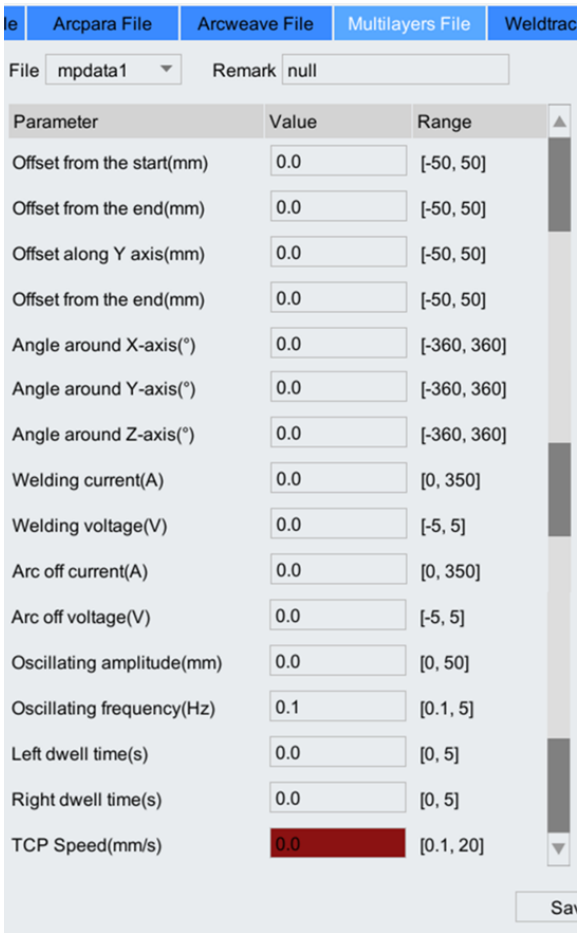


Figure 6-11 Multilayer and multi-channel parameters setting page

Table 6-12 Parameter description

Parameter	Value	Description
File	Up to 16 Multilayer files can be set.	Name of multilayers file. The multilayers file saves the parameters required for multi-layer and multi-channel welding. When calling the multi-layer and multi-channel instruction, you can directly call the multilayers file.
Remark	-	Multilayers file remark name, which is convenient for users to call and query multilayers files. The default remark name for multilayers files is null.
Offset from the start(mm)	-50 ~ 50	Offset distance between welding torch and starting point.
Offset from the end(mm)	-50 ~ 50	Offset distance between welding torch and end point.
Offset along Y axis(mm)	-50 ~ 50	Offset distance of welding torch along Y axis.
Offset along Z axis(mm)	-50 ~ 50	Offset distance of welding torch along Z axis.
Angle around X-axis(°)	-360 ~ 360	Rotation angle of welding torch around X axis.
Angle around Y-axis(°)	-360 ~ 360	Rotation angle of welding torch around Y axis.
Angle around Z-axis(°)	-360 ~ 360	Rotation angle of welding torch around Z axis.
Welding current(A)	0 ~ 350	Welding current.
Welding voltage(V)	-5 ~ 5	Welding voltage.

Parameter	Value	Description
Arc off current(A)	0 ~ 350	Voltage for arc pit filling.
Arc off voltage(V)	-5 ~ 5	Current for arc pit filling.
Oscillating amplitude(mm)	0 ~ 50	Swing amplitude of welding torch.
Oscillating frequency(Hz)	0.1 ~ 5	Swing frequency of welding torch.
Left dwell time(s)	0 ~ 5	The dwell time at the crest of the swing track. When dwelling, the robot will move straight ahead at the current point.
Right dwell time(s)	0 ~ 5	The dwell time at the trough of the swing trajectory. When dwelling, the robot will move straight ahead at the current point.
TCP speed(mm/s)	0.1 ~ 20	TCP speed of the welding torch.

6.3.8 Weldtrack file

Click the [Weldtrack File] option to pop up a floating window as shown in Figure 6-12. The parameter descriptions are shown in Table 6-13.

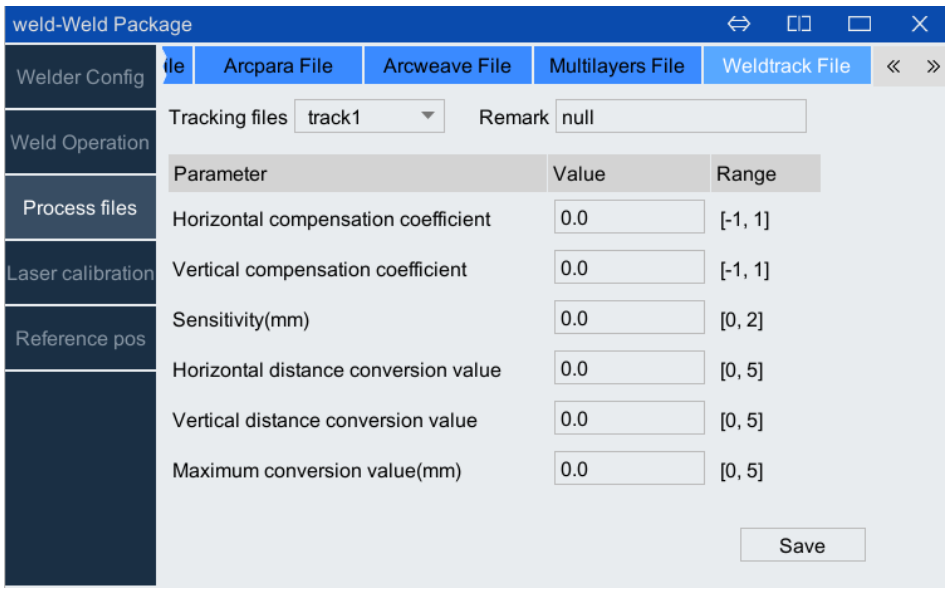


Figure 6-12 Weld Tracking Parameter Setting Page

Table 6-13 Parameter description

Parameter	Value	Description
Tracking files	Up to 16 weldtrack files can be set.	The name of the weldtrack file. The weldtrack file saves the parameters required for the weld seam tracking, and the weldtrack file can be called directly when the weld seam tracking is called.
Remark	-	The remark name of weldtrack file, which is convenient for users to call and query the weldtrack file. The default remark name for the weldtrack file is null.
Horizontal compensation coefficient	-1~1	The conversion factor of the compensation distance in the horizontal direction of the weld seam tracking.
Vertical compensation coefficient	-1~1	The conversion factor for the compensation distance in the vertical direction of weld tracking.
Sensitivity(mm)	0~2	Weld tracking less than this value is not compensated.

Parameter	Value	Description
Horizontal distance conversion value	0~5	The seam tracking is fine-tuned twice based on the horizontal compensation factor.
Vertical distance conversion value	0~5	The seam tracking is fine-tuned twice based on the vertical compensation factor.
Maximum conversion value(mm)	0~5	Weld tracking does not compensate beyond this value.

6.4 Reference pose

The reference pose is used to keep the angle between the welding torch pose and the welding seam unchanged, and is not limited by the teaching pose.

In the [weld-Welding Package] configuration interface, click the [Reference pos] option, and the floating window shown in Figure 6-13 will pop up. The parameter descriptions are shown in Table 6-14.

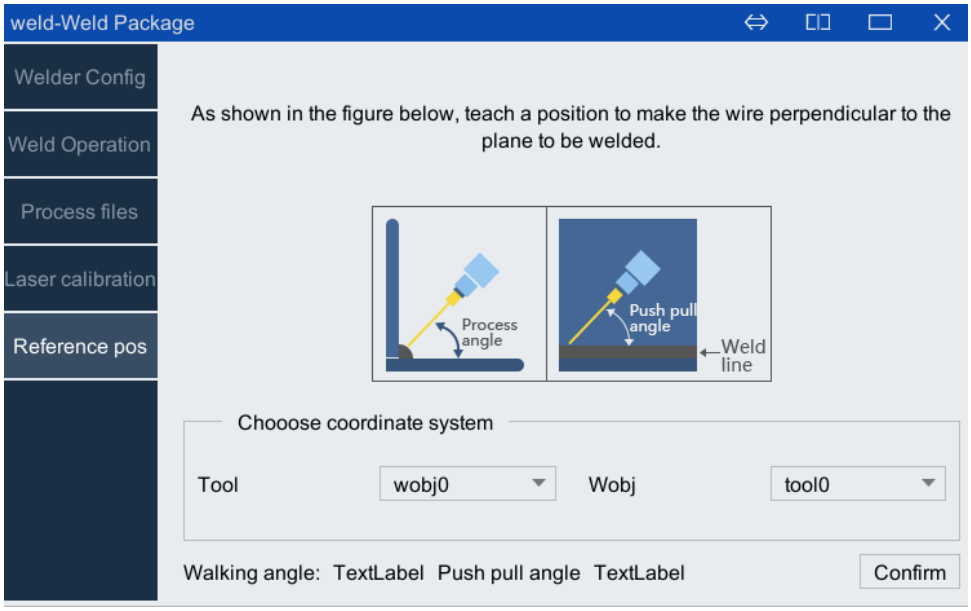


Figure 6-13 Reference pose floating window

Table 6-14 Parameter description

Parameter	Description
Tool	Select the workpiece coordinate system name.
Wobj	Select the tool coordinate system name.

Tip

When using this function, it is necessary to define a reference attitude of the welding torch. In practical applications, it is the attitude of the welding wire perpendicular to the surface of the workpiece, and it only needs to be roughly vertical during teaching. After the reference attitude is recorded, the robot will follow the set walking angle and push-pull angle. The walking angle and the push-pull angle will be based on the reference attitude. The counterclockwise rotation is positive, and the clockwise rotation is negative.

6.5 View and modify configuration

The arc welding database stores the arc welding data, and the arc welding database can view and modify the process files. The process file parameters generated in the process file interface are also stored in the database. In addition, the locating flag and the data in the locating register can also be viewed in the database.

Step1. On the main interface of the teaching tool, click the [System/Parameter Configuration] option, as shown in Figure 6-14.

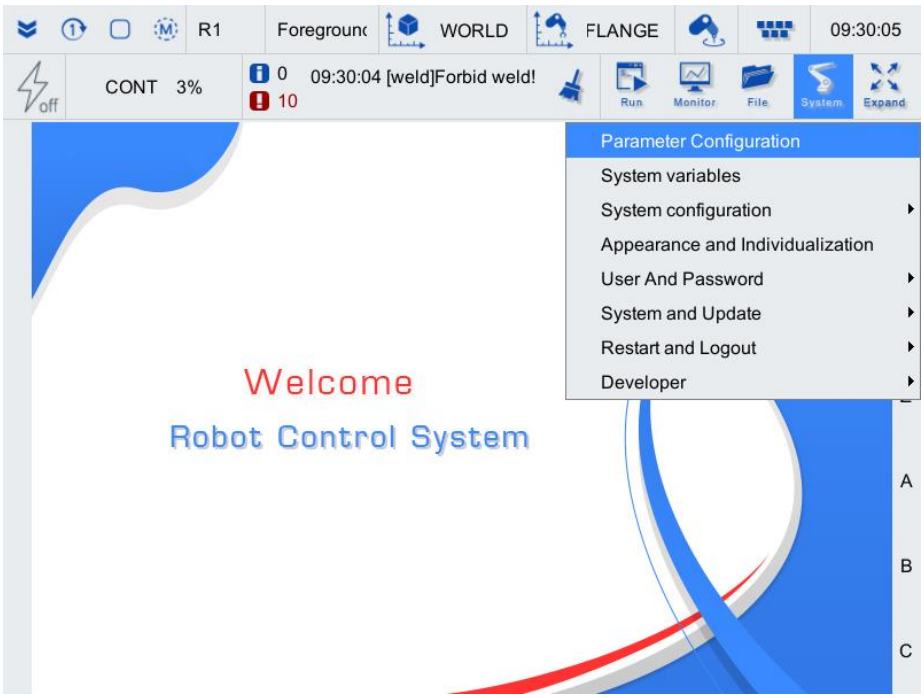


Figure 6-14 The main interface of the teach pendant

Step2. In the pop-up [Parameter Configuration] interface, click the [globalweld] tab. As shown in Figure 6-15.

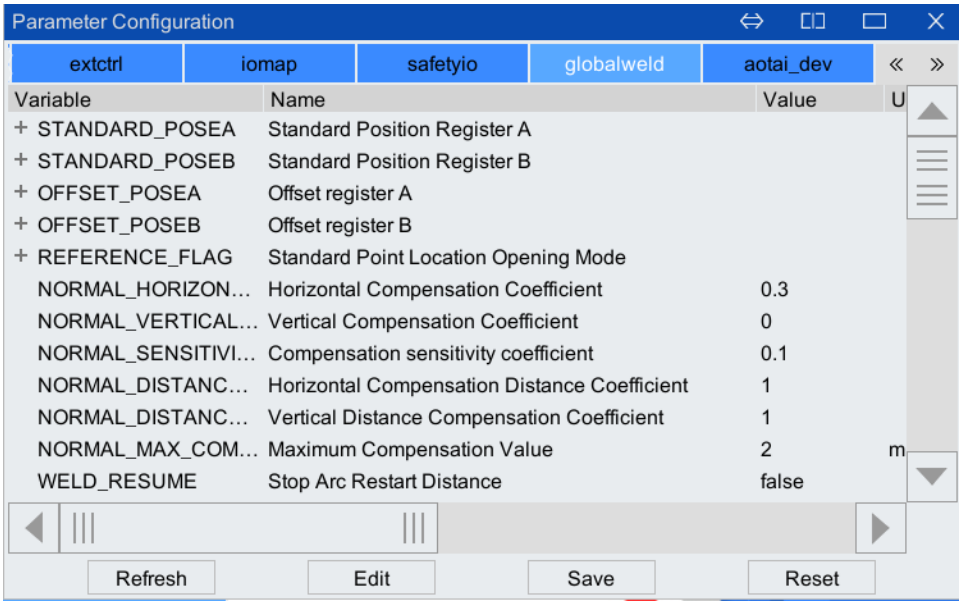


Figure 6-15 Arc Welding Database Page

Step3. Click to select the variable you want to edit or view, and click the <Edit> button. The variable can be viewed or edited.

7 Insert arc welding instruction in program editing area

7.1 Enter the program editing area

The steps to insert the instruction in the program editing area are as follows:

Step1. Click "File/File Management" on the main interface, enter the "File Management" interface and click "New" to create an .arl program, as shown in Figure7-1

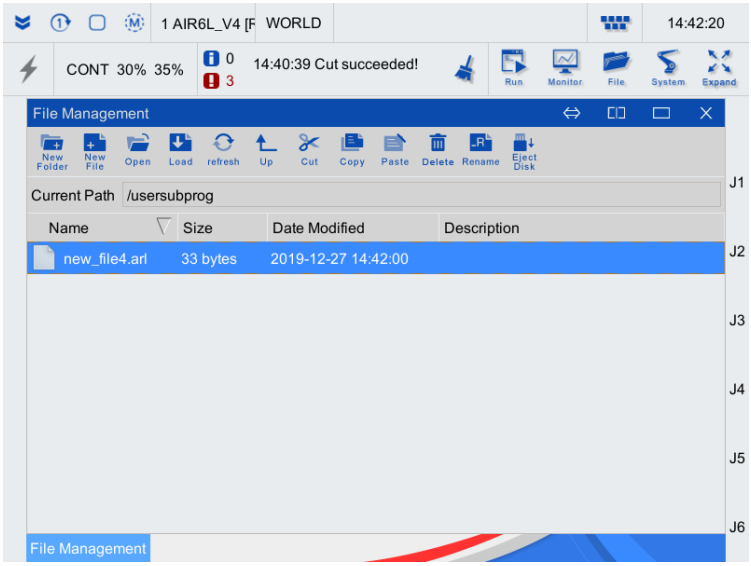


Figure7-1 "File Management" interface

Step2. Double-click the file to open it in the program editor. All arc welding instructions can be inserted in the program editor, as shown in Figure7-2.

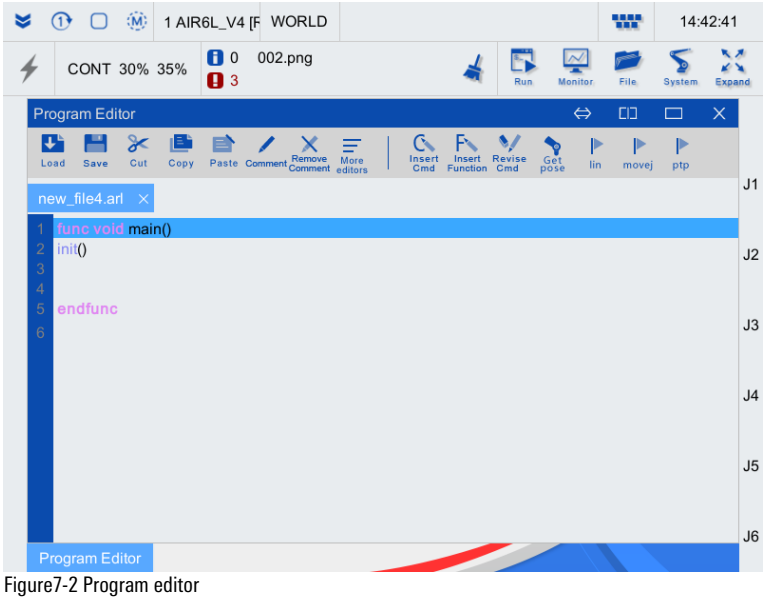


Figure7-2 Program editor

Tip

All instructions are input in the interface input mode by default. You can also choose to import them from the process file. For editing and saving of the process file, please refer to Section 6.3. The format of the interface input is different from that of the selecting process file. The specific format will be given in each instruction.

7.2 Weave instruction

The swing instruction includes a start swing instruction and an end swing instruction.

7.2.1 Turn on the swing instruction

Instruction description

Swing instructions, weldweave and endweldweave need to be used in pairs. They represent the start and end of swing respectively. The motion instructions after weldweave and before endweldweave will superimpose the swing track on the basis of the original track according to the set swing parameters.

Tip

- It is recommended that the user try to use the instruction format of the read process and the parameter filled in by the user, these two formats are more concise. The following describes the instruction parameters in the format of parameters filled in by the user.
- Subsequent instruction descriptions are explained in the user-filled parameter format by default.
- The addition position of the swing instruction weldweave and endweldweave must be outside or inside the arcon and arcoff at the same time. Otherwise, the load will report an error "Missing match".

Import instructions from process files

The interface steps for importing files from the process library and setting parameters are as follows:

Step1. Click [Insert Cmd/Function Pack/Weld/Weld Command/ Start weave Command] in the program editor interface, and the interface shown in Figure 7-3 will pop up.

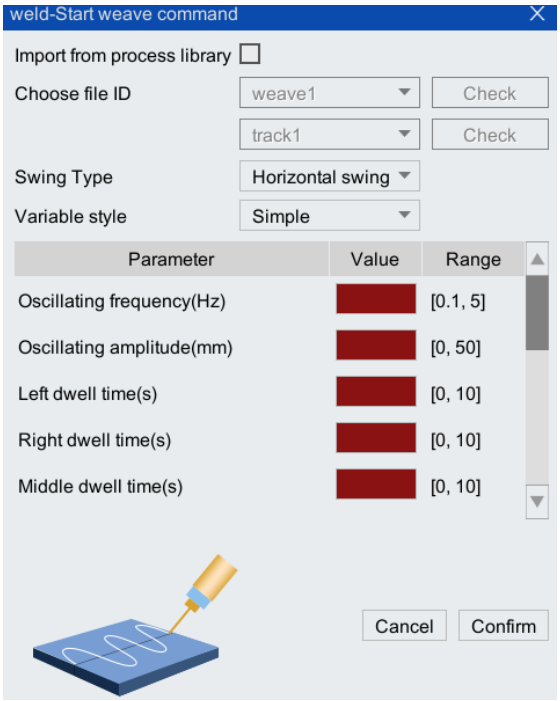


Figure 7-3 Swing instruction parameters are imported from the process library file

Step2. Select the [Import from process library] check box.

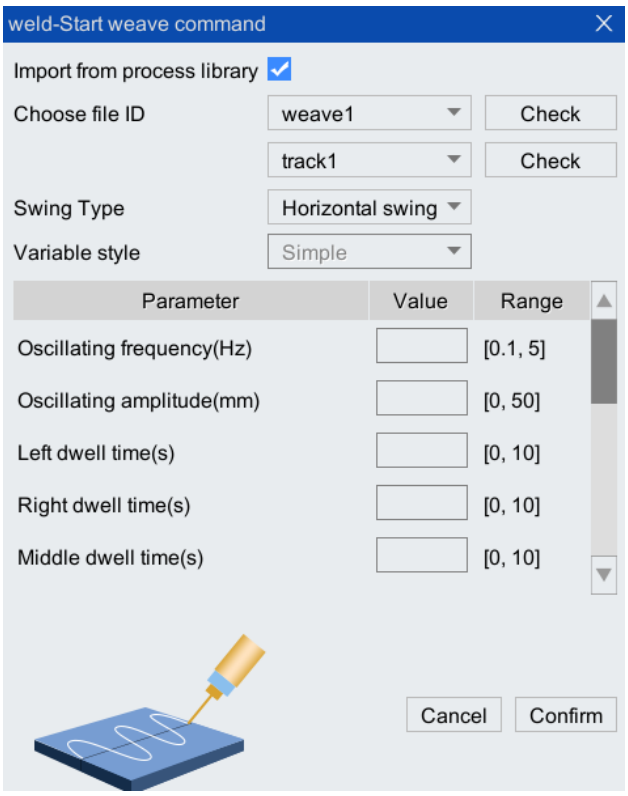


Figure 7-4 Open the swing instruction interface

Step3. Select the file name to be imported in [Choose File ID].

Step4. Select the name of [Swing Type].

Step5. Set the parameter value. After setting, click <Confirm>. Instruction can be generated.

Configure process files and import instructions

Step1. Click [Insert Cmd/Function Pack/Weld/Welding Command/weld-Start weave Command] on the program editor interface, and the interface shown in Figure 7-5 will pop up.

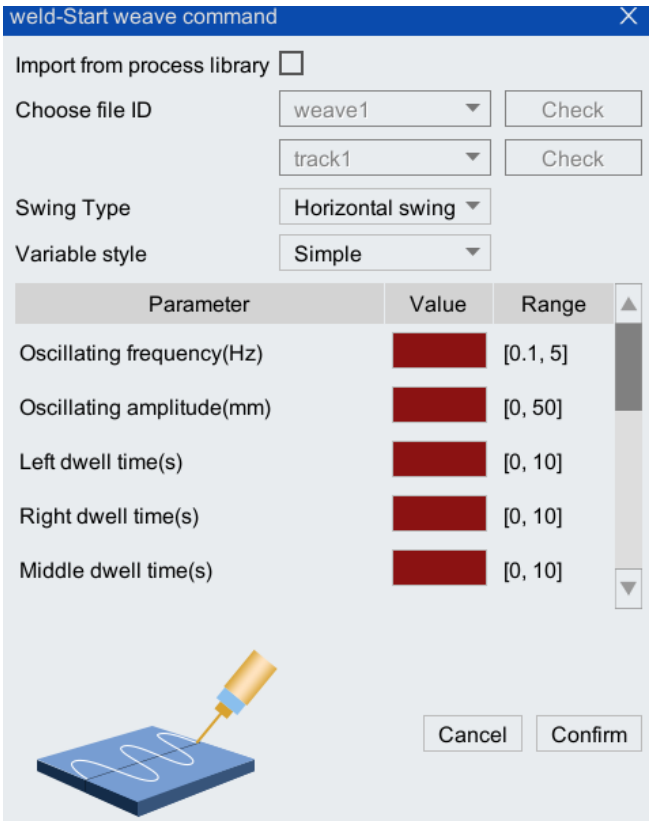


Figure 7-5 Swing instruction parameters are imported from the process library file

Step2. Select the name of [Swing Type].

Step3. Select "Simple" or "Extended" in the [Variable style] parameter.

> Tip
>
> Select "Extended" to display all configured parameter values in the inserted instruction; select "Simple" to display only the inserted selection file number.

Step4. Configure the parameters of the swing instruction. The red input box is the parameter that must be configured.

> Tip
>
> See "6.3.6 Swing File" for parameter description.

Step5. After the parameter configuration is completed, click <Confirm> to insert the instruction.

Fill in instructions manually

Manually input swing instructions directly in the program editing area.

Instruction format

weldweave weave:$WEAVE_FILE_ID【0】 (Read process file format)

endweldweweave

weldweave weave:weave1 (User fills in the parameter format)

endweldweave

weldweave weave:{ weave_type 0, frequency 1, amplitude 10, dwell_left 1, dwell_right 1, dwell_middle 1, track true, swing_angle 0, radius 0, axis 0, rotation_angle 100 }, track:{ horizontal_compensation 1, vertical_compensation 1, sensitive 1, horizontal_distance_transform 1, vertical_distance_transform 1, max_compensation_value 1 }

endweldweave vibend:{ vibendtime 10 } (Extended display mode)

Parameter description

See Table 7-1 for the parameter description of the weave instruction.

Table 7-1 Weave instruction parameter description

Parameter	Name	Description
weave_type	Swing type	The swing track type supported by the system, the values are as follows: ■ 0: Horizontal swing ■ 1: V shape swing ■ 2: Triangle swing ■ 3: Spiral swing ■ 4: 8 shape swing
frequency	Swing frequency	The swing frequency of the wobble trajectory. The unit is Hertz
amplitude	Swing amplitude	The swing amplitude of the swing trajectory. The unit is mm
dwell_left	Left dwell time	The dwell time at the crest of the swing track. When dwelling, the robot will move straight ahead at the current point. The unit is seconds.
dwell_right	Right dwell time	The dwell time at the trough of the swing track. When dwelling, the robot will move straight ahead at the current point. The unit is seconds.
dwell_middle	Intermediate dwell time	The dwell time of the swing trajectory at 1/2 cycle, the robot will move straight ahead at the current point when dwelling, the unit is seconds
track	Whether to weld seam tracking	Whether to enable arc pressure welding seam tracking
horizontal_compensation	Horizontal compensation factor	Conversion factor for compensation distance in horizontal direction of weld seam tracking
vertical_compensation	Vertical compensation factor	Conversion factor for compensation distance in vertical direction of weld seam tracking
sensitive	Sensitivity	Compensate when seam tracking is smaller than this value
horizontal_distance_transform	Horizontal distance conversion value	Weld seam tracking is fine-tuned twice on the basis of horizontal compensation coefficient
vertical_distance_transform	Vertical distance conversion value	Weld seam tracking is fine-tuned twice on the basis of vertical compensation factor
max_compensation_value	Maximum compensation value	No compensation for seam tracking beyond this value

Parameter	Name	Description
vibendtime	End vibration time	The run time to increase to the set amplitude at the end of the swing. The unit is seconds
axis	Axis of rotation	The swing plane can be rotated according to a certain rotation axis
rotation_angle	Rotation angle of the axis	The angle by which the swing plane is rotated about an axis. The unit is degrees

7.2.2 End swing instruction

Insert instruction

Click [Insert Cmd/Function Package/Weld/Weld Command/ End weave command] in the program editor interface, and the interface shown in Figure 7-6 will pop up. Click the <Insert > button in the [endweldweave] prompt interface.

Figure 7-6 End swing instruction insertion diagram

Fill in instructions manually

Directly and manually input the end swing instruction in the program editing area.

Instruction format

endweldweave

7.3 Welding instructions

There are 7 welding instructions, they are:

- arcon (Arc on instruction)
- arcoff (Arc off instruction)
- marcon (Analog arc on instruction)
- marcoff (Analog arc off instruction)
- syncarcon (Synchronous arc on instruction)
- syncarcoff (Synchronous arc off instruction)
- syncarset (Synchronous setting parameter instruction)
- arcset (Modify current and voltage instruction)

Click [insert cmd/function pack/weld/ weld command] to enter the auxiliary programming interface of welding instruction, as shown in Figure 7-7.

Figure 7-7 Welding instruction auxiliary programming interface

7.3.1 Arc on instruction (arcon)

Instruction description

Arc on instruction. It is used to control the arc starting of a single digital welding machine.

Import instructions from process file

Select the [Import from process library] check box, select the arcon file to be imported in [Choose File ID], and click <Confirm> (as shown in Figure 7-8) to generate the arcon instruction.

Tip	Select "Extended" in [Variable style] to display all configured parameter values in the inserted instruction; select "Simple" to display only the inserted selection file number.

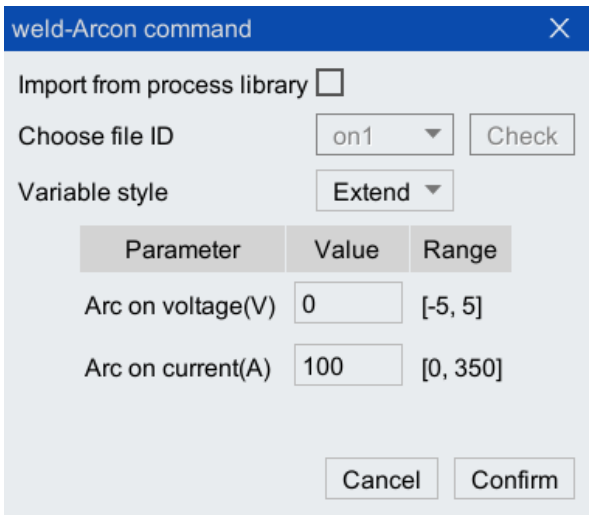


Figure 7-8 User fills in arcon parameters

Configure process files and import instructions

When [Import from process library] is not checked, the parameters of the arcon file can be configured in the parameters below. After modification, click <Confirm> to insert the arcon instruction. The arcon instruction configuration interface is shown in Figure 7-9.

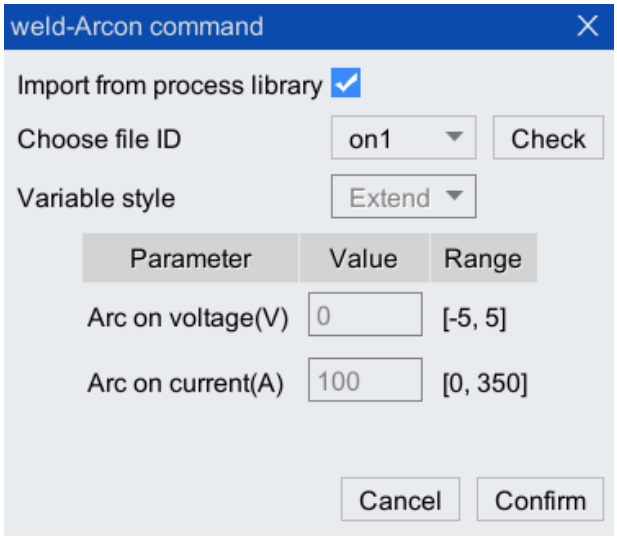


Figure 7-9 Modify arcon process parameters

Tip

For parameter description, see "6.3.1 Arcon file".

Fill in instructions manually

Directly and manually input the arcon instruction in the program editing area.

Instruction format

arcon on:$ARCON_FILE_ID[0] (Read process file format)

arcon on:on1 (User fills in parameter format)

arcon on:{ I 100,U 0} (Extended display mode)

Parameter description

See Table 7-2 for details of Arcon instruction parameters.

Table 7-2 The arcon instruction parameter description

Parameter	Name	Description
U	Arc on voltage (V)	The voltage value during welding can be divided into two ways: unified and binary adjustment. Aotai only supports unified adjustment, and meggitt supports both
I	Arc on current (A)	Current value during welding

7.3.2 Arcoff instruction (arcoff)

Instruction description

Arc off instruction. It is used to control the arc off of a single digital quantity welding machine.

Import instructions from process file

Select the [import from process library] check box, select the arc off file to be imported in the [Choose file ID], and click <Confirm> (as shown in Figure 7-10) to generate the arc off instruction.

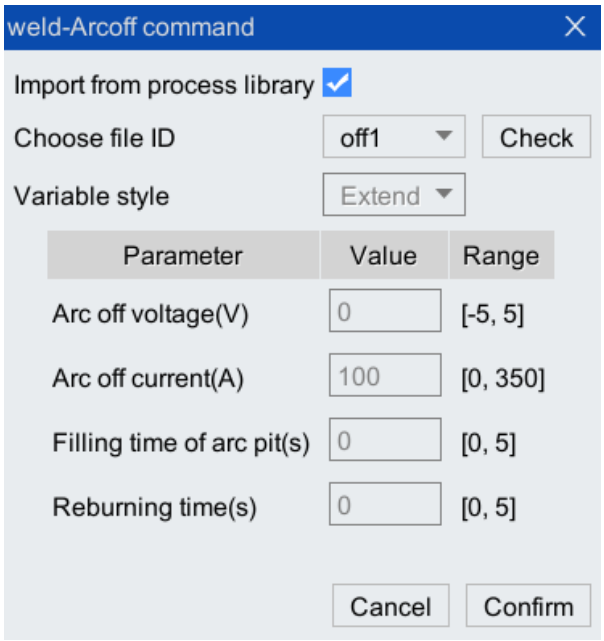


Figure 7-10 Users fill in arcoff process parameters

Configure process files and import instructions

When [Import from process library] is not checked, arc off file parameters can be configured in the parameters below. After configuration, click <Confirm> to insert arc off instruction. The arc off instruction configuration interface is shown in Figure 7-11.

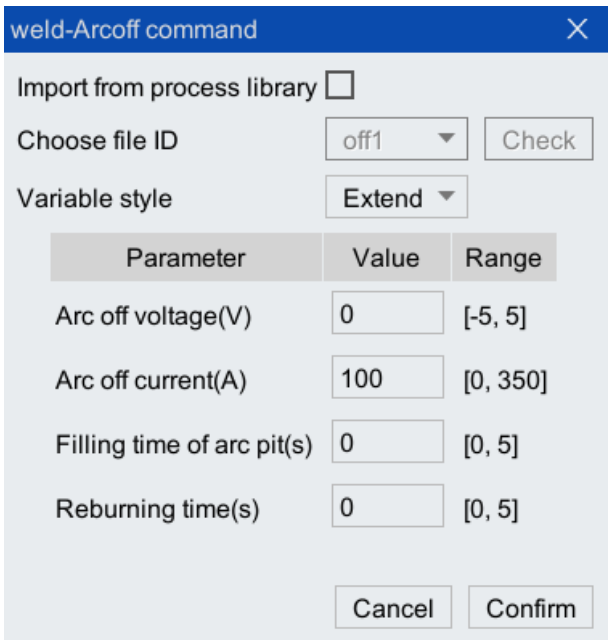


Figure 7-11 The user fills in the arcoff parameter interface

Tip

See "6.3.2 Arcoff Files" for parameter description.

Fill in instructions manually

Input arc off instruction directly and manually in the program editing area.

Instruction format

arcoff off:$ARCOFF_FILE_ID[0] (Read process file format)

arcoff off:off1 (User fills in parameter format)

arcoff off:{I 100, U 0, endcrater 0, burnback 0} (Extended display mode)

Parameter description

See Table 7-3 for details of arcoff instruction parameters.

Table 7-3 The arcoff instruction parameter description

Parameter	Name	Description
I	Arc off current (A)	Current for arc pit filling
U	Arc off voltage (V)	Voltage for arc pit filling
endcrater	Filling time of arc pit (s)	Set the dwell time at the arc stopping to ensure the arc stopping process.
burnback	Reburning time (s)	After the completion of welding, set a time to melt the welding wire, so as to avoid that the droplet at the tip of the welding wire does not transfer to the molten pool and form a small ball at the end of the welding wire.

7.3.3 Analog arc on instruction (marcon)

Instruction description

Analog arc on instruction. It is used to control the arc on of analog quantity welding machine.

Import instructions from process file

Select the [Import from process library] check box, select the analog arc on file to be imported in the [Choose file ID], and click <Confirm> (as shown in Figure 7-12) to generate the analog arc on instruction.

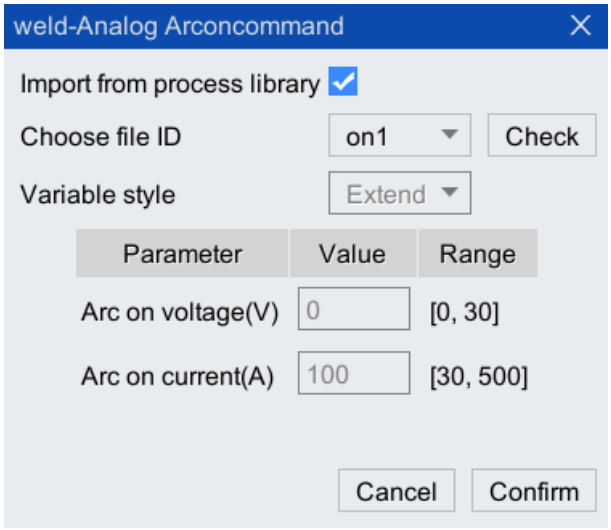


Figure 7-12 Analog arc on command configuration instruction

Configure process files and import instructions

When [Import from process library] is not checked, the parameters of the analog arc on file can be configured in the following parameters. After the configuration is completed, click <Confirm> to insert the analog arc on instruction. The analog arc on instruction configuration interface is shown in Figure 7-13.

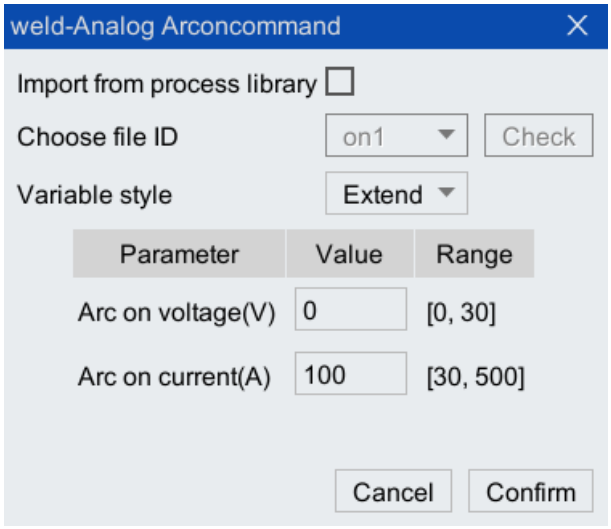


Figure 7-13 Analog arc on instruction configuration interface

Tip

See "6.3.3 Analog File" for parameter description.

Fill in instructions manually

Input the analog arc on instruction directly and manually in the program editing area.

Instruction format

marcon mon:$ARCON_FILE_ID[0] (Read process file format)

marcon mon:mon1 (User fills in parameter format)

marcon mon:{ I 100, U 0, } (Extended display mode)

Parameter description

See Table 7-4 for details of Marcon instruction parameters.

Table 7-4 The marcon instruction parameter description

Parameter	Name	Description
U	Arc on voltage(V)	The arc on voltage of the analog welding machine.
I	Arc on current(A)	The arc on current of the analog welding machine.

7.3.4 Analog arc off instruction (marcoff)

Instruction description

Analog arc off instruction. It is used to control the arc off of analog welding machine.

Import instructions from process file

Select the [Import from process library] check box, select the analog arc off file to be imported in the [Choose file ID], and click <Confirm> (as shown in Figure 7-14) to generate the analog arc OFF instruction.

Figure 7-14 Analog arc off instruction configuration interface

Configure process files and import instructions

When [Import from process library] is not checked, the parameters of the analog arc off file can be configured in the following parameters. After configuration, click <Confirm> to insert the analog arc off instruction. The configuration interface of the analog arc off instruction is shown in Figure 7-15.

Figure 7-15 Analog arc off instruction configuration interface

Tip

See "6.3.3 Analog Filet" for parameter description.

Fill in instructions manually

Input the analog arc off instruction directly and manually in the program editing area.

Instruction format

marcoff moff:$ARCOFF_FILE_ID[0] (Read process file format)

marcoff moff:moff1 (User fills in parameter format)

marcoff moff:{ I 100, U 0, } (Extended display mode)

Parameter description

See Table 7-5 for details of marcoff instruction parameters.

Table 7-5 The marcoff instruction parameter description

Parameter	Name	Description
U	Arc off voltage	Arc off voltage of analog welding machine.
I	Arc off current	Arc off current of analog welding machine.

7.3.5 Synchronous arc on instruction (syncarcon)

Instruction description

Synchronous arc on instruction. Used to control the arc on of a single or two digital welding machines.

Import instructions from process file

In the [Weld - Sync Arconcommand] interface, you can configure the parameters of welding machine A and welding machine B. After the configuration is complete, click <Confirm> to insert the synchronous arc on instruction. The configuration interface of the synchronous arc on instruction is shown in Figure 7-16 and Figure 7-17.

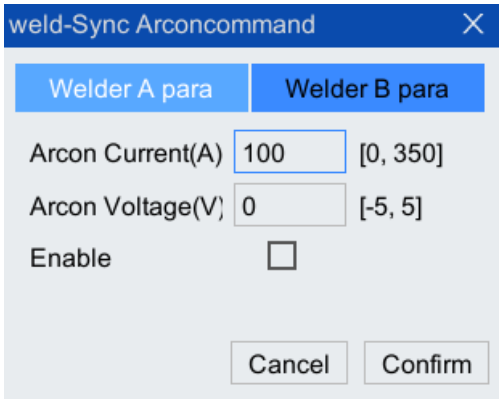


Figure 7-16 Synchronous arc on instruction welding machine A parameter

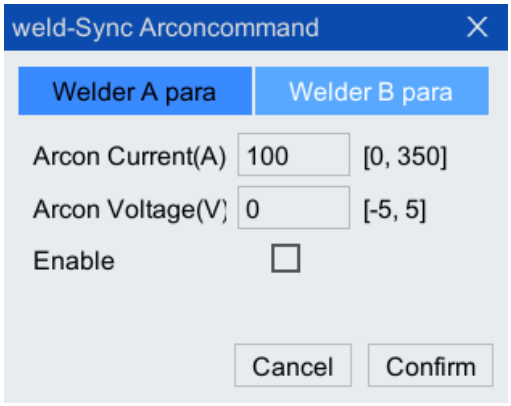


Figure 7-17 Synchronous arc on instruction welding machine B parameter

Fill in instructions manually

Directly and manually input the synchronous arc on instruction in the program editing area.

Instruction format

syncarcon welderA:{ I 100, U 0 }, welderB:{ I 100, U 0 }

Parameter description

See Table 7-6 for the description of the parameters of the syncarcon instruction.

Table 7-6 The syncarcon instruction parameter description

Parameter	Name	Description
welderA		
I	Arcon Current (A)	Synchronous arc on current of welding machine A

Parameter	Name	Description
welderA		
U	Arcon Voltage (V)	Synchronous arc on voltage of welding machine A
welderB		
I	Arcon Current (A)	Synchronous arc on current of welding machine B
U	Arcon Voltage (V)	Synchronous arc on voltage of welding machine B

7.3.6 Synchronous arc off instruction (syncarcoff)

Instruction description

Synchronous arc off instruction. Used to control the arc off of a single or two digital welding machines.

Import instructions from process file

In the [Weld - Sync Arcoffcommand] interface, the parameters of welding machine A and welding machine B can be configured. After the configuration is completed, click <Confirm> to insert the synchronous arc off instruction. The configuration interface of the synchronous arc off instruction is shown in Figure 7-18 and Figure 7-19.

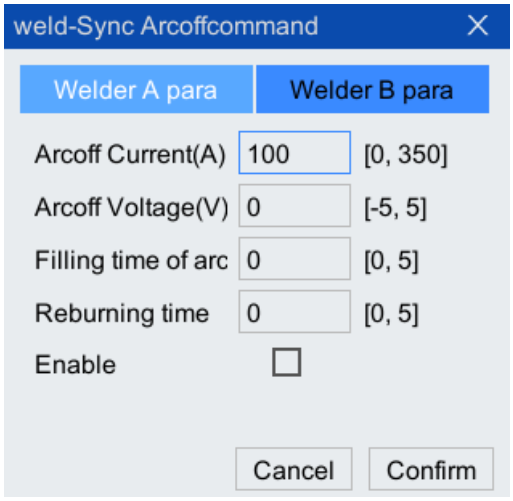


Figure 7-18 Welding machine A parameter of synchronous arc off instruction

Figure 7-19 Welding machine B parameter of synchronous arc off instruction

Fill in instructions manually

Directly and manually input the synchronous arc off instruction in the program editing area.

Instruction format

syncarcoff welderA:{ I 100, U 0, endcrater 0, burnback 0 }, welderB:{ I 100, U 0, endcrater 0, burnback 0 }

Parameter description

See Table 7-7 for the description of the parameters of the syncarcoff instruction.

Table 7-7 The syncarcoff instruction parameter description

Parameter	Name	Description
welderA		
I	Arcoff Voltage(V)	The synchronous arc off voltage of welding machine A
U	Arcoff Current(A)	The synchronous arc off current of welding machine A
endcrater	Filling time of arc	Crater filling time of welder A
burnback	Reburning time	Burn-back time of welder A
welderB		
I	Arcoff Voltage(V)	The synchronous arc off voltage of welding machine B
U	Arcoff Current(A)	The synchronous arc off current of welding machine B
endcrater	Filling time of arc	Crater filling time of welder B
burnback	Reburning time	Burn-back time of welder B

7.3.7 Synchronous set parameter instruction (syncarset)

Instruction description

Synchronous set parameter instruction. Used to modify arcing current and voltage during welding.

Import instructions from process file

In the [weld - synchronization set parameter command] interface, you can configure the parameters of welding machine A and welding machine B. After the configuration is complete, click <Confirm> to insert the synchronous setting parameter instruction. The synchronous setting parameter instruction configuration interface is shown in Figure 7-20.

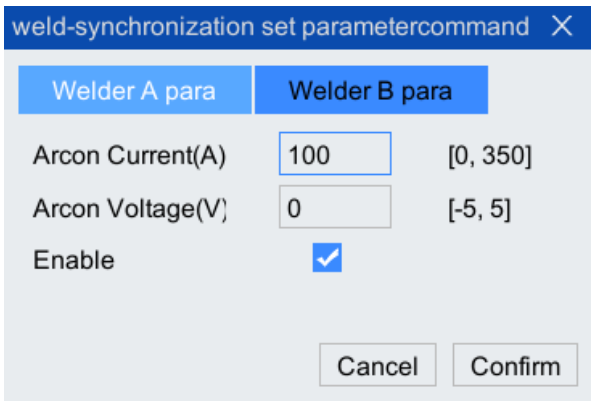


Figure 7-20 Welder A parameter of synchronous arc on instruction

Fill in instructions manually

Directly and manually input the synchronous setting parameter instruction in the program editing area.

Instruction format

syncarset welderA:{ I 100, U 0 }, welderB:{ I 100, U 0 }

Parameter description

See Table 7-8 for the description of the parameters of the syncarcon instruction.

Table 7-8 The syncarcon instruction parameter description

Parameter	Name	Description
welderA		
I	Arcon Current(A)	Modify the synchronous arcon current of welding machine A
U	Arcon Voltage(V)	Modify the synchronous arcon voltage of welding machine A
welderB		
I	Arcon Current(A)	Modify the synchronous arcon current of welding machine B
U	Arcon Voltage(V)	Modify the synchronous arcon voltage of welding machine B

7.3.8 Reset parameters (arcset)

Instruction description

Resetting of arc welding parameters.

Import instructions from process file

Reset parameters is actually modifying the values of arc on current and arc on voltage.

Select the [Import from process library] check box, select the configuration file to be imported in [Choose file ID], and click <Confirm> (as shown in Figure 7-21) to generate the configuration instruction.

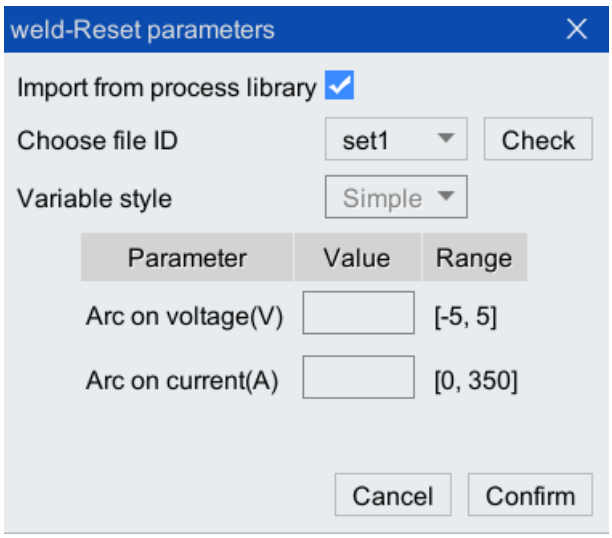


Figure 7-21 User fills in arcoff process parameters

Configure process file and import instructions

When [Import from process library] is not checked, the configuration file parameters can be set in the parameters below. After setting, click <Confirm> to insert the configuration instruction. The configuration instruction interface is shown in Figure 7-22.

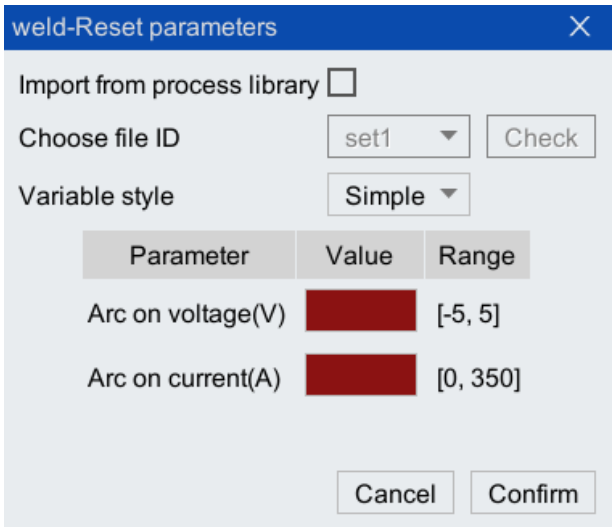


Figure 7-22 Manual input of arc welding parameters reset interface

Fill in instructions manually

Manually input the reset parameter instruction directly in the program editing area.

Instruction format

arcset set:$ARCSET_FILE_ID[0] (Read process file format)

arcset set:set1 (User fills in the parameter format)

arcset set: {I 100,U 0} (Extended display mode)

Parameter description

Please refer to Table 7-9 for the parameter description of arcset instruction.

Table 7-9 The arcset instruction parameter description

Parameter	Name	Description
U	Arc on voltage(V)	Modify the voltage value set by the welding instruction
I	Arc on current(A)	Modify the current value set by the welding instruction

7.4 Get the current welding voltage and current function of the welding machine

7.4.1 Get the current welding current function of the welding machine

Function description

When configuring the welding machine, use this function to output the current welding current of the welding machine.

Function prototype

double getCurrentFromWelderA() // Welder 1

double getCurrentFromWelderB() // Welder 2

Return value

Type: double

Returns the current welding current value of the welding machine.

Import instructions from process file

Step1. Click [Insert Function/Other], the function list interface, as shown in Figure 7-23.

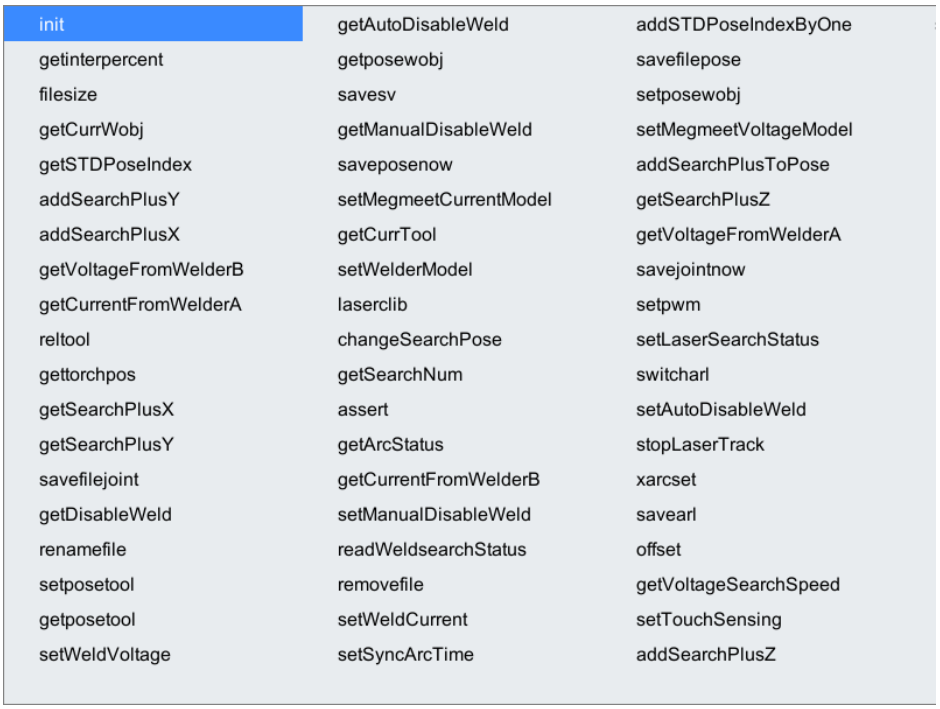


Figure 7-23 Insert function list

Step2. Click "getCurrentFromWelderA" (welder 1) or "getCurrentFromWelderB" (welder 2) to insert the function.

Usage example

When using a single welder, insert the current welding current of welder 1.

print getCurrentFromWelderA() // Returns the current welding current value of welding machine 1

When using a dual welder, insert the current welding current of welder 1 and welder 2.

print getCurrentFromWelderA() // Returns the current welding current value of welding machine 1

print getCurrentFromWelderB() // Returns the current welding current value of welding machine 2

7.4.2 Get the current welding voltage function of the welding machine

Function description

When configuring the welding machine, use this function to output the current welding voltage of the welding machine.

Function prototype

double getVoltageFromWelderA() // Welder 1

double getVoltageFromWelderB() // Welder 2

Return value

Type: double

Returns the current welding voltage value of the welding machine.

Import instructions from process file

Step1. Click [Insert Function/Other], the function list interface, as shown in Figure 7-24.

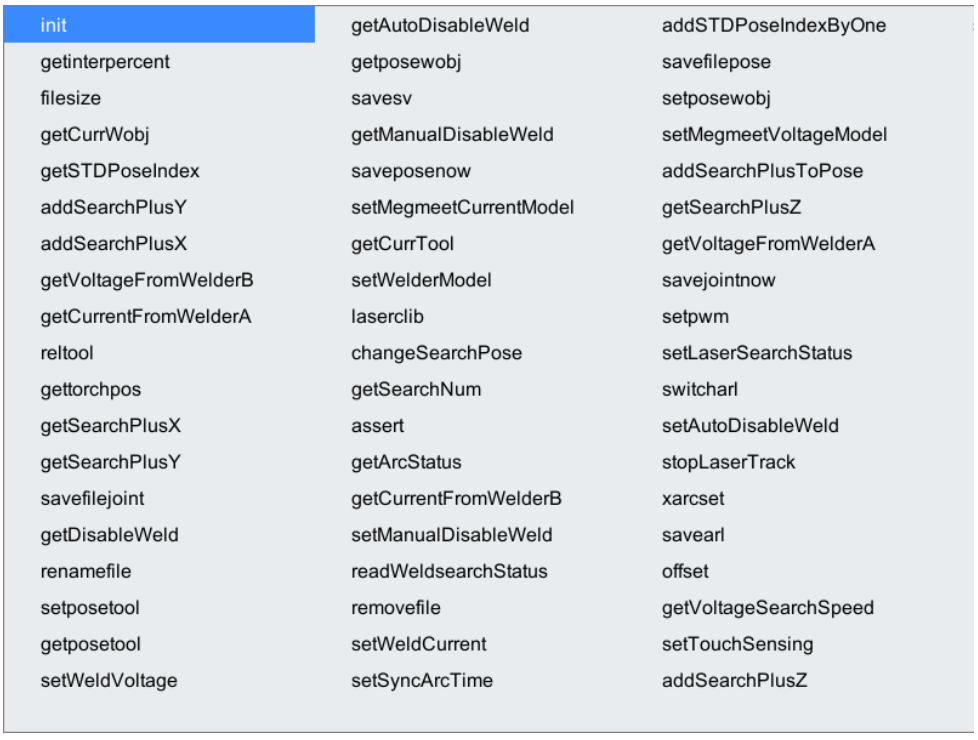


Figure 7-24 Insert function list

Step2. Click "getVoltageFromWelderA" (welder 1) or "getVoltageFromWelderB" (welder 2) to insert the function.

Usage example

When using a single welder, insert the current welding voltage of welder 1.

print getVoltageFromWelderA() // Returns the current welding voltage value of welding machine 1

When using a dual welder, insert the current welding voltage of welder 1 and welder 2.

print getVoltageFromWelderA() // Returns the current welding voltage value of welding machine 1

print getVoltageFromWelderB() // Returns the current welding voltage value of welding machine 2

7.5 Advanced function instructions

7.5.1 Multi-layer multi-pass welding

Instruction description

Multi-layer multi-pass welding instructions. When using this instruction, the user only needs to teach the initial trajectory and specify the position and posture to be offset for each layer and each track in the following layers, and the robot will automatically plan all the trajectories and execute them according to the trajectory. At the same time, the current value, voltage value, swing amplitude, frequency, cycle and welding speed on each layer can be adjusted.

Import instructions from process file

Step1. Click [Insert cmd/Function pack/weld/Weld Command/Multilayers] to enter the multilayers welding auxiliary programming instruction interface, as shown in Figure 7-25.

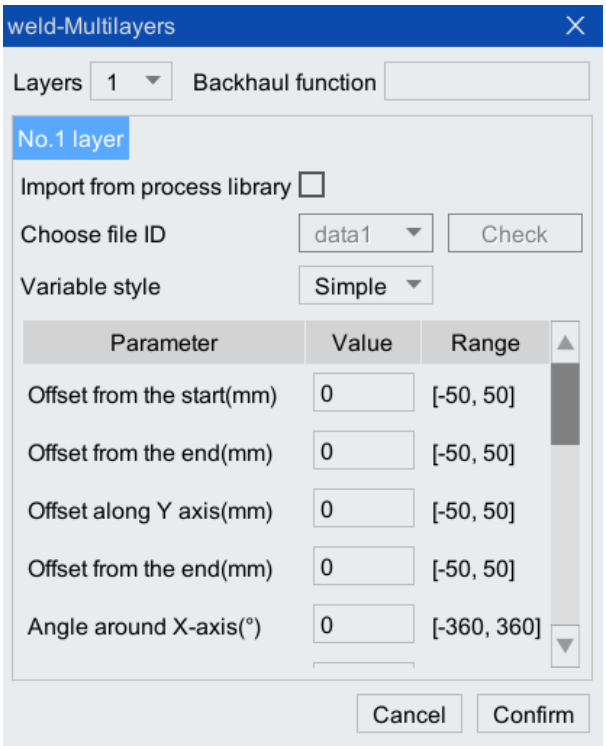


Figure 7-25 Insert multi-layer multi-pass instruction

Step2. Select the [Import from process library] check box, select the multilayers file to be imported in [Choose file ID], and enter the name of the return function in [Backhaul function]. Click <Confirm> (as shown in Figure 7-26) to generate multi-layer and multi-channel instruction.

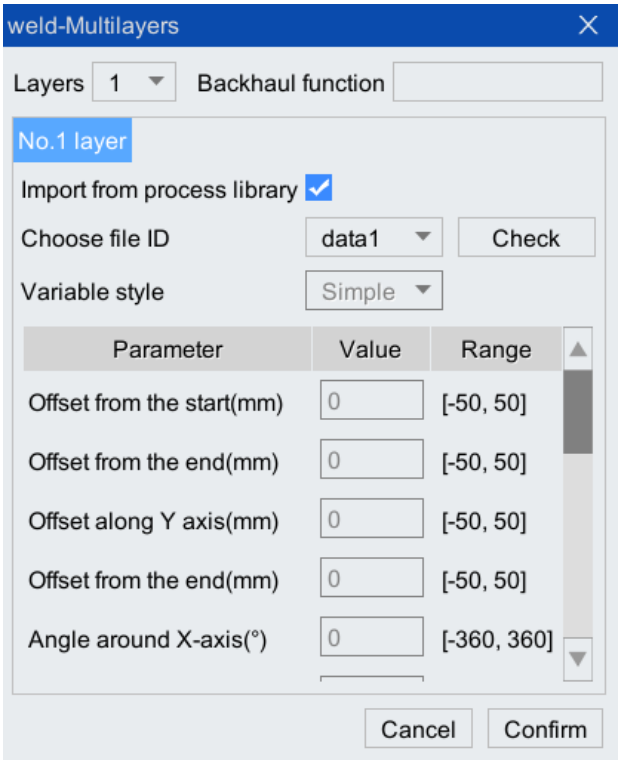


Figure 7-26 Multi-layer multi-channel instruction editing interface

Configure process file and import instruction

When [Import from process library] is not checked, the multi-layer and multi-channel parameters can be configured in the parameters below. After the configuration is completed, click <Confirm> to insert the multi-layer and multi-channel instruction. The multi-layer and multi-channel configuration interface is shown in Figure 7-27.

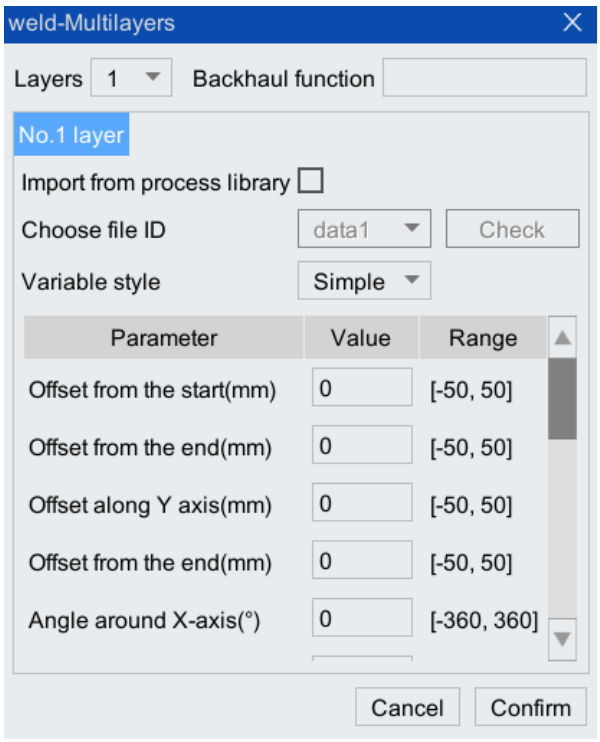


Figure 7-27 Manual input of multi-layer multi-channel parameter reset interface

Tip

For parameter description, see "6.3.7 Multilayers File".

Fill in instructions manually

Directly and manually input multi-layer multi-pass welding instructions in the program editing area.

Instruction format

mpstart

mpend

mplayer data:$MULTIPLY_FILE_ID[0]， do:func() (Read process file format)

mpstart

mpend

mplayer data:data1, do:func() (User fills in the parameter format)

mpstart

mpend

mplayer data:{ x_s 0,x_e 0, z 0, y 0, rx 0, ry 0, rz 0, current 150, voltage 0, off_current 100, off_voltage 0, amplitude 5, frequency 1, left_stay_time 0, right_stay_time 0, tcp_speed 5 }, do:func() (Extended display mode)

Parameter description

See Table 7-10 for the instruction parameter description of multi-layer multi-pass welding.

Table 7-10 Multi-layer multi-channel instruction parameter description

Parameter	Name	Description
x_s	Offset distance from starting point	Offset value at the start of the original trajectory
x_e	Offset distance from end point	Offset value at the end of the original trajectory
y	Offset value from the y-axis	Offset value in the horizontal direction of the original trajectory
z	Offset from the z-axis	Offset value in the vertical direction of the original trajectory
rx	Rotation angle around the x-axis	Rotation angle around the original trajectory TCP coordinate system x direction
ry	Rotation angle around the y-axis	Rotation angle around the original trajectory TCP coordinate system y direction
rz	Rotation angle around the z-axis	Rotation angle around the original trajectory TCP coordinate system z direction
current	Welding current	Set current value for each weld
voltage	Welding voltage	Set voltage proportional value for each weld
off_current	Arc off voltage	Voltage used for crater filling
off_voltage	Arc off current	Current used for crater filling
amplitude	Swing amplitude	When you need to match the swing, this parameter will change the swing amplitude
frequency	Swing frequency	When you need to match the swing, this parameter will change the swing frequency
left_stay_time	Left dwell time	The dwell time at the crest of the swing trajectory, the robot will move straight ahead at the current point when dwelling
right_stay_time	Right dwell time	The dwell time at the trough of the swing trajectory. When dwelling, the robot will move straight ahead at the current point
tcp_speed	TCP speed	TCP speed of the welding torch

7.5.2 Multi-layer multi-pass mode

Instruction description

Configure a multi-layer multi-pass reference coordinate system.

Import instructions from process file

Step1. Click [Insert cmd/Function pack/weld/Weld Command/Multilayers Mode] to enter the [Multilayers Mode] interface, as shown in Figure 7-28.

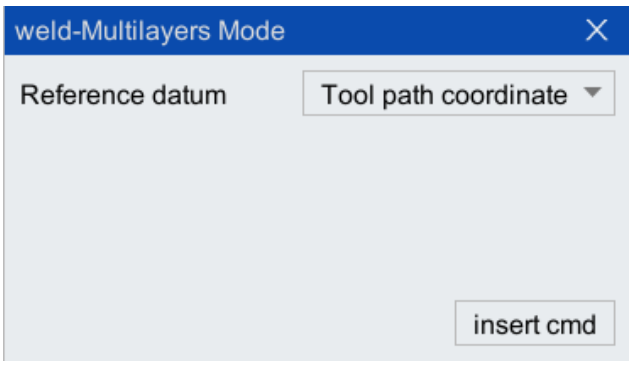
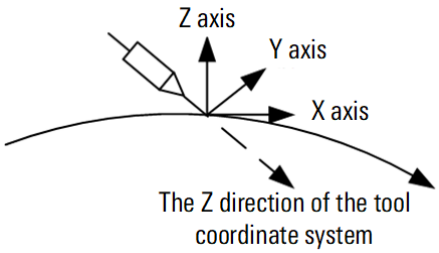
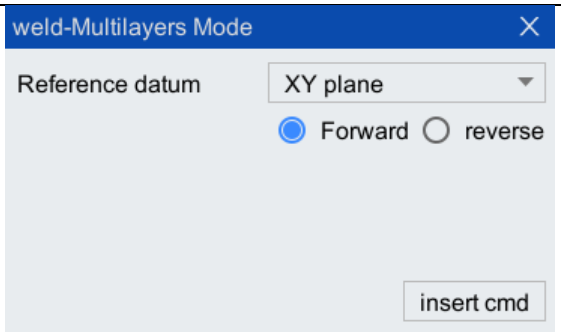
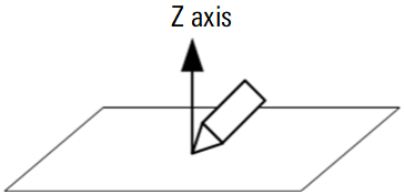
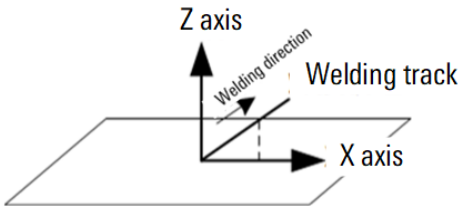
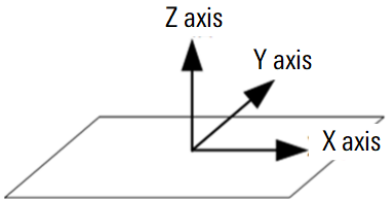


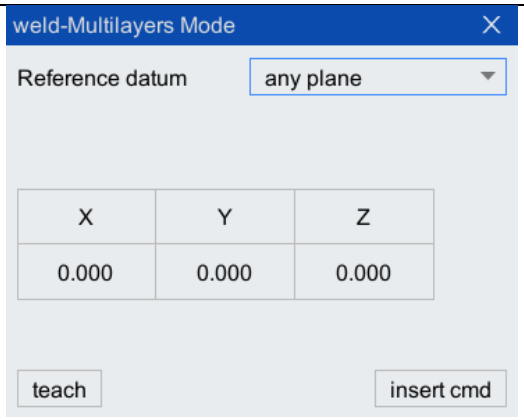
Figure 7-28 [Multilayers mode] configuration interface

Step2. Select [Reference datum], see Table 7-11 for configuration method and parameter description. After the parameter configuration is completed, click <Insert cmd> (as shown in Figure 7-28) to generate multilayers instruction.

Table 7-11 Configuration method and parameter description

Parameter	Description
Reference datum	Configure a multi-layer multi-pass reference coordinate system. The values are as follows: ■ Toolpath coordinate system: 1. The x direction of the coordinate system is the tangent direction of the main trajectory; 2. The y direction of the coordinate system is determined by the cross product of the x direction of the coordinate system and the z direction of the tool coordinate system; 3. The z direction of the coordinate system is determined by the cross product of the x direction of the coordinate system and the y direction of the coordinate system. If the tangent direction of the main track is parallel to the z direction of the tool coordinate system, the y direction of the coordinate system cannot be obtained, and an alarm needs to be given at this time.  ■ Reference plane coordinate system (XY plane/YZ plane/XZ plane/any plane) The origin is the TCP point; ■ The Z direction is the normal vector of the specified reference plane; ■ X direction is the tangent direction of the main trajectory; ■ The Y direction is determined by the cross product of the Z direction and the X direction. If the tangent direction of the main track is parallel to the Z direction of the tool coordinate system, the Y direction of the coordinate system cannot be obtained, and an alarm should be given at this time.
Forward/reverse	When selecting the plane reference coordinate system as "XY plane/YZ plane/XZ plane", you need to select the direction of the plane.

Parameter	Description
	 When the welding datum is selected in [Reference datum], the trajectory offset needs to be performed according to the normal vector of the welding datum passed in by ARCS. The offset direction is defined as follows: ■ Obtain the normal vector of the welding datum plane according to the welding datum plane (recorded as the positive direction of the Z axis in the right-handed system)  ■ According to the projection of the welding track and the direction of the projected track, the track direction vector is obtained (recorded as the positive direction of the X axis in the right-handed system). If the welding track is an arc, take the projection and projection direction of the tangent line at the point above it as the positive direction of the X-axis.  ■ According to the right-handed system rule, the Y axis and its positive direction are determined by the X axis and the Z axis  ■ Definition of offset direction: if the offset is positive, it will offset in the positive direction of the X-axis; if the offset is negative, it will offset in the negative direction of the X-axis.
X/Y/Z	When the reference plane is selected as "any plane", you need to click the <teach> button to teach the X-axis, Y-axis and Z-axis of the plane.

Parameter	Description
	

Fill in instructions manually

Directly and manually input multi-layer multi-channel mode instructions in the program editing area.

Instruction format

mpstart mdl:mdl2 (Read process file format)

mpend

multiModelData mdl6 = { traj_or_panel true, arbitrary_plane false, x 0, y 0, z 0 } (User fills in the parameter format)

mpstart mdl:mdl6

mpend

const multiModelData mdl7 = { traj_or_panel false, arbitrary_plane false, x 0, y 0, z 1 } (Extended display mode)

mpend

Parameter description

Parameter	Name	Description
traj_or_panel	Toolpath Coordinate System	The values are as follows: ■ true: Toolpath coordinate system is not selected ■ false: Toolpath coordinate system is not selected
arbitrary_plane	Reference plane coordinate system	The values are as follows: ■ true: Select one of "XY plane/YZ plane/XZ plane" as the reference plane coordinate system ■ false: Do not select "XY plane/YZ plane/XZ plane" as the reference plane coordinate system
x/y/z	Coordinate value	Coordinate values of the reference plane coordinate system


Warning

When the values of traj_or_panel and arbitrary_plane are both false, it means that "any plane" is selected as the reference plane coordinate system.

7.5.3 Voltage search

Instruction description

Seam search instruction. This instruction is used to find the position of the weld when the workpiece consistency is not high or the positioning is offset. It is suitable for the welding wire touch positioning method.

Insert instruction

The configuration steps are as follows:

Step1. Click [Insert cmd/Function pack/weld/Weld Command//Voltage search] to enter the voltage search auxiliary programming command interface. As shown in Figure 7-29. The parameter description is shown in Table 7-12.

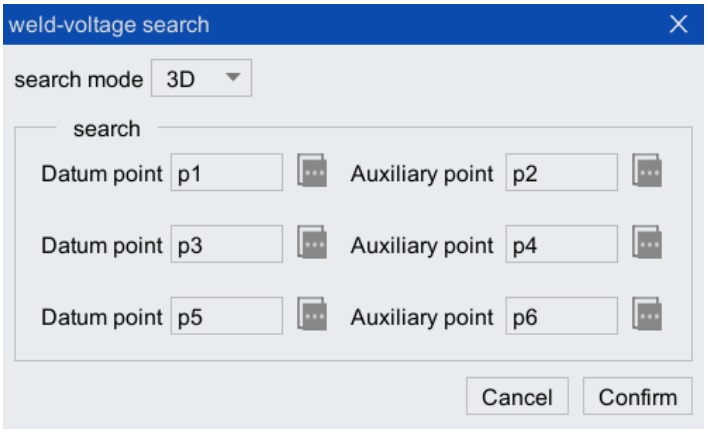


Figure 7-29 Weld seam search parameter configuration

Table 7-12 Parameter Description

Parameter	Description
search mode	Search category. The values are as follows: ■ 1D: One-dimensional searching ■ 2D: Two-dimensional searching ■ 3D: Three-dimensional searching ■ 2DR: Two-dimensional rotational searching ■ 3DR: Three-dimensional rotational searching ■ CIR: Arc searching
Datum point	Searching reference point.
Auxiliary point	Searching auxiliary point.

Step2. Click the icon  after the parameter [Datum point] or [Auxiliary point], and the interface shown in Figure 7-30 will pop up. After completing the parameter configuration, click <Yes>. The parameter descriptions are shown in Table 7-13.

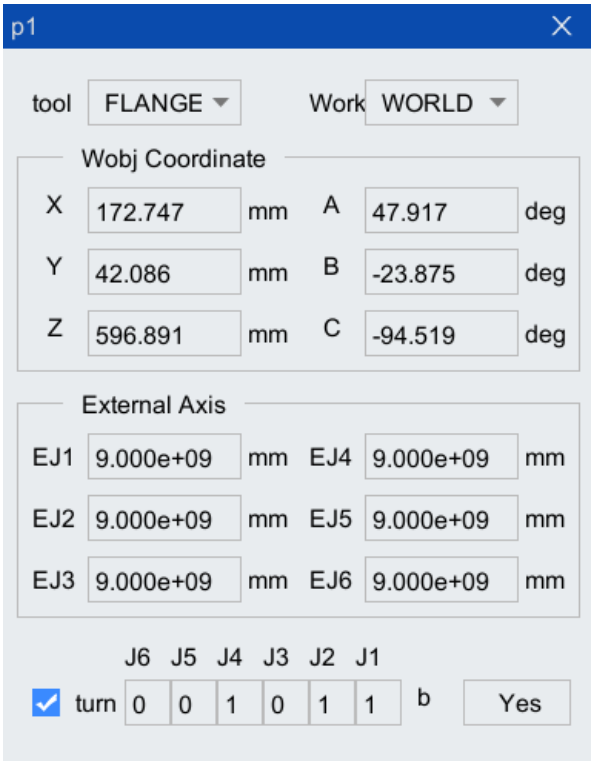


Figure 7-30 Parameter P configuration interface

Table 7-13 Parameter Description

Parameter	Description
tool	Tool coordinate system name.
Work	Workpiece coordinate system. ■ WORLD: World coordinate system ■ BASE: Base coordinate system ■ wobj: Workpiece coordinate system
Wobj Coordinata	Workpiece coordinate system.
External Axis	External axis target point.
turn	TURN component, the default value is -1.

Fill in instructions manually

Directly and manually input the welding seam searching instruction in the program editing area.

Instruction format

wbsearch pst:p1,pmd:p2

Parameter description

See Table 7-14 for the description of the welding seam searching instruction parameters.

Table 7-14 Weld seam searching instruction parameter description

Parameter	Description
pst	The starting point of the searching

Parameter	Description
pmd	Auxiliary point for determining the orientation direction

7.5.4 Linear offset (Search offset)

Instruction description

Linear offset instruction. After voltage search, use this instruction to move the robot to the offset weld position. Offset according to a straight path, as shown in Figure 7-31.

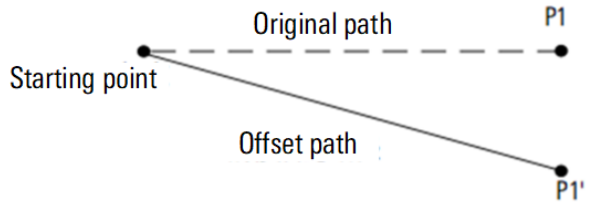


Figure 7-31 Diagram of line offset path

Insert instruction

The configuration steps are as follows:

Step1. Click [Insert cmd/Function pack/weld/Weld Command/wblin] to enter the searching and offset auxiliary programming instruction interface. As shown in Figure 7-32. The parameters description is shown in Table 7-15.

Tip: The search offset should be used in conjunction with the seam search. The wblin instruction generally needs to insert at least two (that is, two searching points to determine a weld).

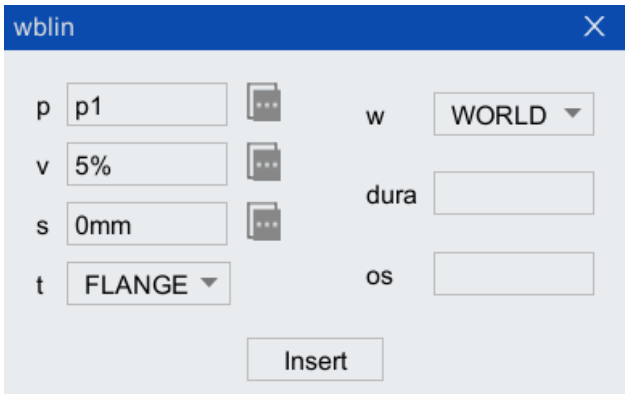


Figure 7-32 Search offset parameter configuration

Table 7-15 Parameter Description

Parameter	Description
P	Searching point, the first time to insert the welding seam start point by teaching, and the second time to insert the welding seam end point by teaching.
v	The speed of TCP must be configured and cannot be used as a percentage.
s	The smoothing parameter of TCP must be configured and cannot be in the form of a percentage.
t	The tool coordinate system name, which will be filled automatically after teaching.
w	Workpiece coordinate system name, it will be filled automatically after teaching.

Parameter	Description
dura	Specifies the trajectory time.
os_name	The calling name of the search offset, "t1" is a custom name

Step2. Click the icon after the parameter [p], and the interface shown in Figure 7-33 will pop up. After completing the parameter configuration, click <Yes>. The parameter descriptions are shown in Table 7-16.

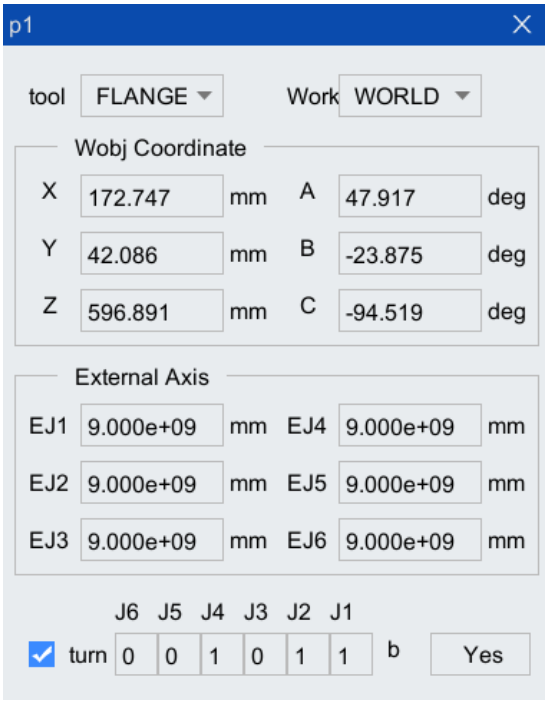


Figure 7-33 Parameter P configuration interface

Table 7-16 Parameter Description

Parameter	Description
tool	Tool coordinate system name.
Work	Workpiece coordinate system. ■ WORLD: World coordinate system ■ BASE: Base coordinate system ■ wobj: Workpiece coordinate system
Wobj Coordinata	Workpiece coordinate system.
External Axis	External axis target point.
turn	TURN component, the default value is -1.

Step3. Click the icon after the parameter [v], and the interface shown in Figure 7-34 will pop up. After completing the parameter configuration, click <Yes>. The parameter descriptions are shown in Table 7-17.

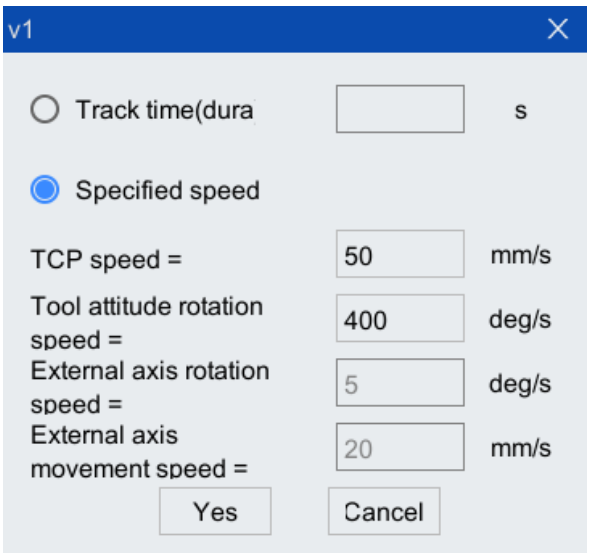


Figure 7-34 Parameters v configuration interface

Table 7-17 Parameter Description

Parameter		Description
Track time		Track time
Specified speed	TCP speed	TCP speed
	Tool attitude rotation speed	Tool attitude rotation speed
	External axis rotation speed	External axis rotation speed
	External axis movement speed	External axis movement speed

Step4. Click the icon  after the parameter [s], and the interface shown in Figure 7-35 will pop up. After completing the parameter configuration, click <Yes>. The parameter descriptions are shown in Table 7-18.

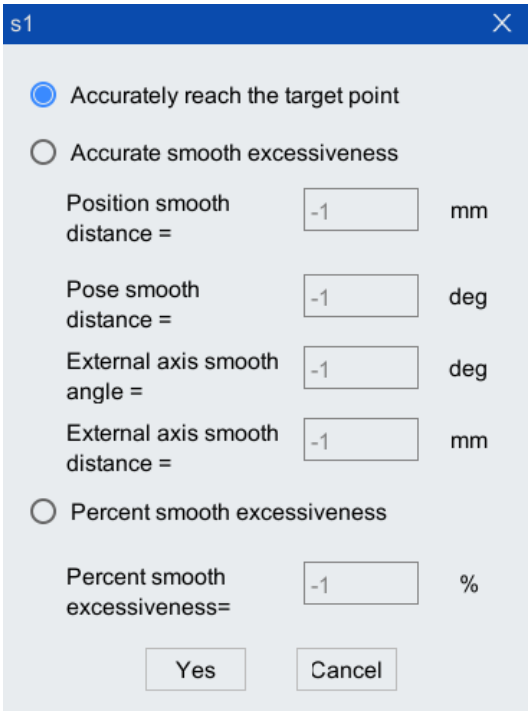


Figure 7-35 Parameter s configuration interface

Table 7-18 Parameter Description

Parameter		Description
Accurately reach the target point		Accurately reach the target point
Accurate smooth excessiveness	Position smooth distance	Used to specify the path distance from the target point axis.
	Pose smooth distance	Used to specify the attitude angle from the target point.
	External axis smooth angle	Used to specify the smoothing angle of the external axis from the target point axis position.
	External axis smooth distance	Used to specify the angle between the outer axis and the axis position of the target point.
Percent smooth excessiveness	Percent smooth excessiveness	Used to specify a percentage from the target point.

Fill in instructions manually

Directly and manually input the positioning offset instruction in the program editing area.

Instruction format

wblin p:p3,vp:5%,s:s1,t:$tool1,w:$WORLD,os_name:"t1"

Parameter description

See Table 7-19 for the description of the parameters of the search offset instruction.

Table 7-19 Parameter description of search offset instruction

Parameter	Description
p	Searching point, the first insertion is the start point of the welding seam, and the second insertion is the end point of the welding seam.
vp	The speed of TCP when searching.
s	The smoothing parameter of TCP must be configured and cannot be in the form of a percentage.
t	The tool coordinate system name, which will be filled automatically after teaching.
w	Workpiece coordinate system name, it will be filled automatically after teaching.
os_name	The calling name of the search offset, "t1" is a custom name

7.5.5 Fish scale welding


Tip

The fish scale welding function directly provided by Aotai and Megmeet welding power sources is not available.

Instruction description

The instructions for fish scale welding are as follows:

- Fish scale welding is mainly used for small current welding of thin plates. For example, bicycle frames can be welded with fish scale effect as required (as shown in Figure 7-36).

Figure 7-36 Fish scale welding effect diagram

- Fish scale welding refers to discontinuous welding. After specifying the dwell time of the robot and the distance of each running, the robot will stop moving and start welding every time the robot moves a set distance. The welding time is the time set by the user; The robot continues to move for a set distance, stops moving and then starts welding. Repeat this step until you reach the end of the weld.

Insert instruction

Click [Insert cmd/Function Pack/weld/fish_shape], and select the command to be inserted in the pop-up drop-down menu.

As shown in Figure 7-37.

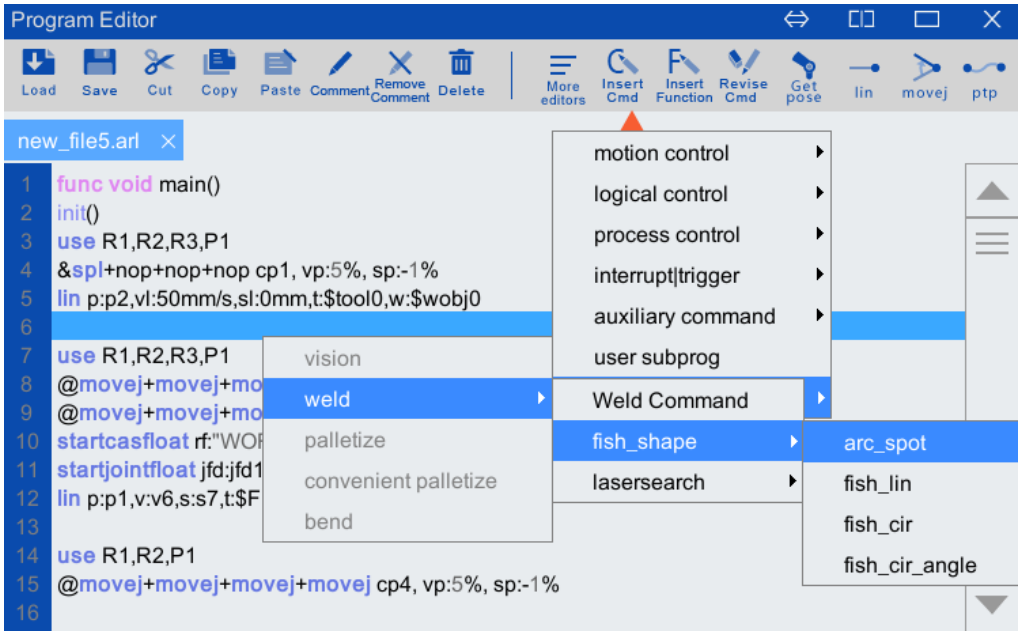


Figure 7-37 Fish scale welding option interface

Fill in instructions manually

Directly and manually input the fish scale welding instructions in the program editing area.

Instruction format

fish_shape::arc_spot() // Spot welding time, current value and voltage value

fish_shape::fish_lin() // Straight line fish scale welding

fish_shape::fish_cir() // Arc fish scale welding

fish_shape::fish_cir_angle() // Fish scale welding with specified arc angle

Parameter description

There are four functions in fish scale welding. The function parameters of the four functions are explained as follows:

① arc_spot(arconpara on, arcoffpara off, double time)

Table 7-20 Parameter Description

Parameter	Description
arc_spot	The arc_spot function realizes arc on, stays for a set time after arc ob, and then extinguishes the arc.
on	Arc on parameters
off	Arc off parameters
time	Weld dwell time

② fish_lin(pose p_start, pose p_end, double step_dis, bool weld_end, speed v100, double time, arconpara on, arcoffpara off)

Table 7-21 Parameter Description

Parameter	Description
fish_lin	Realize that a straight line is separated by a set length, stop moving and welding at each separation point, continue to move forward for a set length after welding, and then stop welding, and so on until the end point. weld_end controls whether the end point needs to be welded.
p_start	Fish scale welding starting point
p_end	Fish scale welding end point
step_dis	Fish scale welding spacing, the unit is mm
weld_end	Whether the end point needs to be welded, the values are as follows: ■ ture：Weld end point required ■ false：No welding end point required
v100	Fish scale welding speed, unit is mm/s
time	Welding dwell time, unit is s
on	Arc on parameters
off	Arc off parameters

③ fish_cir(pose p_start, pose p_middle, pose p_end, double step_dis, bool weld_end, speed v100, double time, arconpara on, arcoffpara off)

Table 7-22 Parameter Description

Parameter	Description
fish_cir	Realize that a segment of arc is separated by the set length, stop moving and welding at each separation point, continue to move forward for the set length after welding, and then stop welding, and so on, until the end point, weld_end controls whether the end point needs welding.
p_start	Fish scale welding starting point
p_middle	Fish scale welding intermediate point
p_end	Fish scale welding end point
step_dis	Fish scale welding spacing arc length, unit is mm
weld_end	Whether the end point needs to be welded
v100	Fish scale welding speed
time	Weld dwell time
on	Arc on parameters
off	Arc off parameters

④ fish_cir_angle(pose p_start, pose p_middle, pose p_end, double central_angle, double step_dis, bool weld_end, speed v100, double time, arconpara on, arcoffpara off)

Table 7-23 Parameter Description

Parameter	Description
fish_cir_angle	Realize that a segment of arc is separated by the set central angle, stop moving and welding at each separation point, continue to move forward for the set length after welding, and then stop welding, and so on, until the end point, weld_end controls whether the end point needs welding.
p_start	Fish scale welding starting point
p_middle	Fish scale welding intermediate point
p_end	Fish scale welding end point
central_angle	The user specifies the central angle, the system will specify the target point according to the specified central angle
step_dis	Fish scale welding spacing angle, unit is °
weld_end	Whether the end point needs to be welded
v100	Fish scale welding speed
time	Weld dwell time
on	Arc on parameters
off	Arc off parameters

Configuration example

① Example of linear fish scale welding

Set the start point of fish scale welding as P12, the end point as P13, the fish scale welding spacing as 3mm, the end point welding on, the welding speed at 100mm/s, and the welding dwell time at 0.1s. The schematic diagram of welding is shown in Figure 7-38.

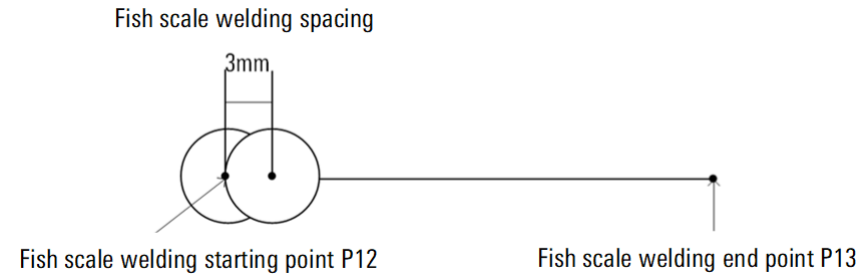


Figure 7-38 Diagram of linear fish scale welding

The welding example program is as follows:

```
func void main()
init()
movej j:j1,v:v1,s:s1
const speed v100={tcp 10,ori 10}
//lin p:p12,v:v9,s:s11,t:$FLANGE,w:$WORLD // Set the starting point of fish scale welding
//lin p:p13,v:v10,s:s12,t:$FLANGE,w:$WORLD // Set fish scale welding end point
fish_shape::fish_lin(p12, p13,3,true,v100,0.1) // Straight fish scale welding
fish_shape::arc_spot(on1,off1,0.1) // Configure arc on and arc off parameters
arcon on:on1 // Arc on command
arcoff off:off1 // Arc off command
endfunc
```

② Arc fish scale welding

Set the start point of fish scale welding as P14, the middle point as P7, the end point as P8, the fish scale welding spacing as 3mm, the end point welding on, the welding speed as 100mm/s, and the welding dwell time as 0.2s. The diagram of welding is shown in Figure 7-39.

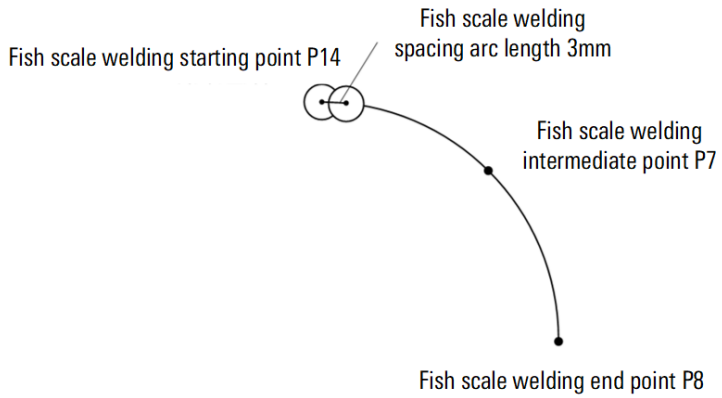


Figure 7-39 Diagram of arc fish scale welding

The welding example program is as follows:

```
func void main()
init()
movej j:j1,v:v1,s:s1
const speed v200={tcp 50,ori 50}
//lin p:p14,v:v11,s:s13,t:$FLANGE,w:$WORLD // Set the starting point of fish scale welding
//cir m:p7,p:p8,v:v6,s:s8,t:$FLANGE,w:$WORLD // Set the middle point and end point of fish scale welding
fish_shape::arc_spot(on1,off1,0.1) // Configure arc on and arc off parameters
fish_shape::fish_cir(p14, p7, p8,3,true,v200,0.2) // Arc fish scale welding
arcon on:on1 // Arc on instruction
arcoff off:off1 // Arc off instruction
endfunc
```

③ Fish scale welding with specified arc angle

Set the start point of fish scale welding as P8, the middle point as P9, the end point as P10, the welding angle is 360° arc, the fish scale welding spacing is 4°, the end point welding is closed, the welding speed is 300mm/s, and the welding dwell time is 0.8s . The diagram of welding is shown in Figure 7-40.

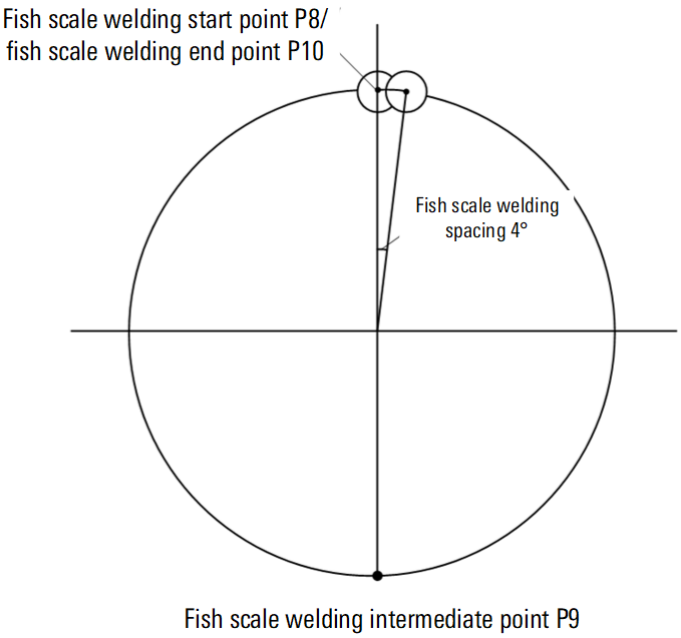


Figure 7-40 Diagram of fish scale welding with specified arc angle

The welding example program is as follows:

```
func void main()
init()
movej j:j1,v:v1,s:s1
const speed v300={tcp 60,ori 50}
//lin p:p8,v:v11,s:s13,t:$FLANGE,w:$WORLD // Set the starting point of fish scale welding
//cir m:p9,p:p10,v:v7,s:s9,t:$FLANGE,w:$WORLD // Set the middle point and end point of fish scale welding
fish_shape::arc_spot(on1,off1,0.1) // Configure arc on and arc off parameters
//fish_shape::fish_cir_angle(p8,p9,p10,360,4,false,v300,0.8) // Fish scale welding with specified arc angle
arcon on:on1 // Arc on instruction
arcoff off:off1 // Arc off instruction
endfunc
```

7.5.6 Arc offset

Instruction description

Arc offset instruction. After voltage search, use this instruction to move the robot to the offset weld position. Offset according to the arc path, as shown in Figure 7-41

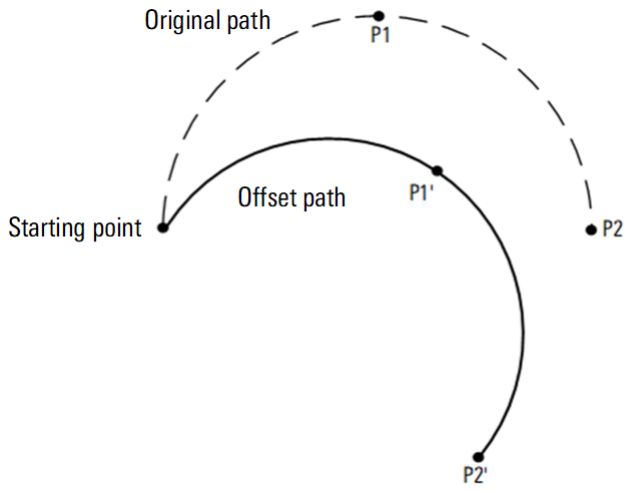


Figure 7-41 Diagram of arc offset path

Insert instruction

The arc search function needs to use the "voltage search" instruction to search first, and then use the "circle offset" instruction to offset.

The steps to insert a instruction are as follows:

Step1. Click [Insert cmd/Function Pack/weld/Weld Command/voltage search] to enter the arc offset auxiliary programming instruction interface. As shown in Figure 7-42.

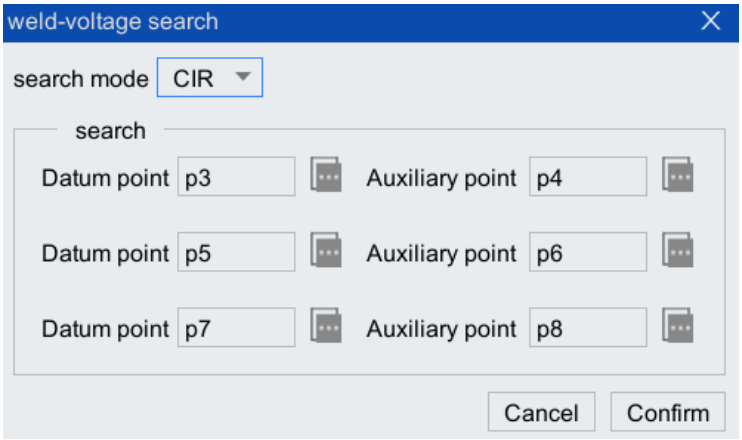


Figure 7-42 Voltage search configuration interface

Step2. Set the [search mode] in the upper right corner of the interface to "CIR". Click <Confirm>.

Step3. Click [Insert Cmd/Function Pack/ weld/Weld Command/wbcir] to enter the arc offset auxiliary programming instruction interface. As shown in Figure 7-43. After completing the parameter configuration, click <Insert>. The parameter descriptions are shown in Table 7-24.

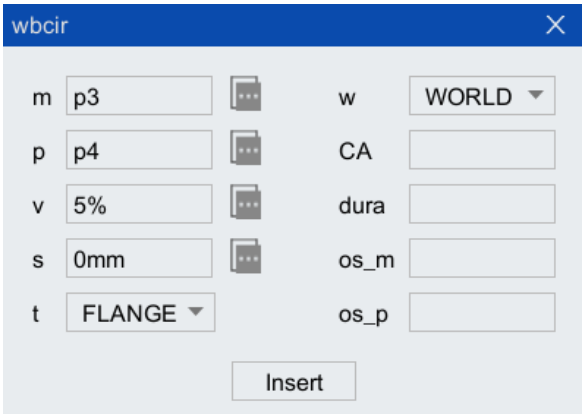


Figure 7-43 Arc offset parameter configuration

Table 7-24 Parameter Description

Parameter	Description
m	Auxiliary point for the arc.
P	The end point of the arc.
v	The speed of TCP must be configured and cannot be used as a percentage.
s	The smoothing parameter of TCP must be configured and cannot be in the form of a percentage.
t	The tool coordinate system name, which will be filled automatically after teaching.
w	Workpiece coordinate system name, it will be filled automatically after teaching.
CA	Arc angle value
dura	Specifies the trajectory time
os_m	The name of the search offset combination called by the middle point of the arc
os_p	The name of the search offset combination called by the arc end point

Fill in instructions manually

Directly and manually input the posture hold instruction in the program editing area.

Instruction format

wbcir m:p1,p:p2,vp:5%,sl:0mm,t:$FLANGE,w:$WORLD

8 Laser tracking debugging instructions

8.1 Preparation

8.1.1 Equipment wiring

The control host takes the IL-HOST03 host as an example, and the sensor takes the IL-HSP-150SD02 sensor as an example (the following device model is used as an example), as shown in Figure 8-1.

Step1. Connect the sensor to the control panel with FUNCTION and LAN cables.

Step2. Connect the control host to the industrial robot control cabinet with a communication cable (X25 network port).

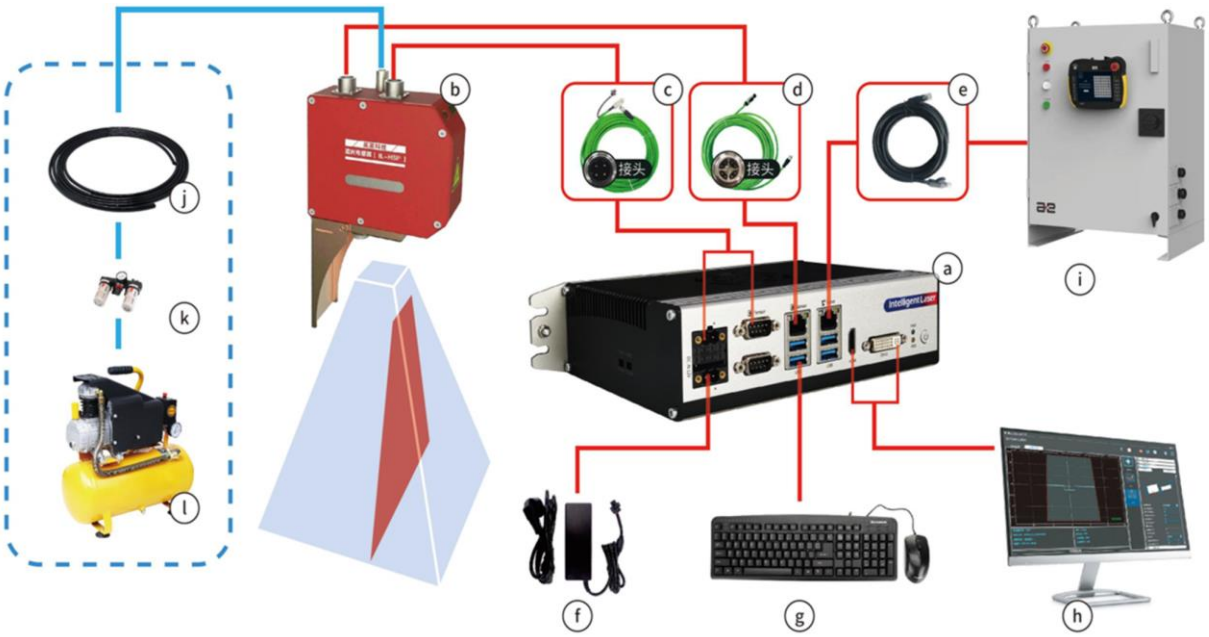
Step3. Use the power adapter to connect the control host to a stable 220V AC power supply.

Step4. Connect the mouse and keyboard to the USB ports.

Step5. Connect the sensor air cooling system. Connect the triplet to the air compressor; connect one end of the trachea to the trachea joint of the triplet, and the other end to the sensor air hole, and adjust the air pressure to 100KPa. (Note: It is necessary to ensure that the air source is dry and free of oil pollution).

Step6. The chassis needs to be grounded separately.

Step7. The operating temperature of the sensor is 5℃~40℃.



Notes:

ⓐ Control host ⓑ Laser sensor ⓒ FUNCTION cable ⓓ LAN cable ⓔ Communication cable

ⓕ Power Adapter ⓖ Mouse and keyboard ⓗ Display (optional) ⓘ Industrial Robot Control Cabinet

ⓙ Trachea* ⓚ Triplet* ⓛ Air compressor*

Note: 1. "*" refers to optional overheating environment; 2. Optional for laptop and tablet

Figure 8-1 Diagram of equipment assembly

8.1.2 Installation of the laser sensor

To install the laser sensor, first adjust the welding posture of the welding torch, move the welding torch to the welding point, and then adjust the installation angle of the laser sensor (5°~15° to the plane of the workpiece). The ideal distance between the laser line and the tip of the welding torch is 35mm~60mm. As shown in Figure 8-2.

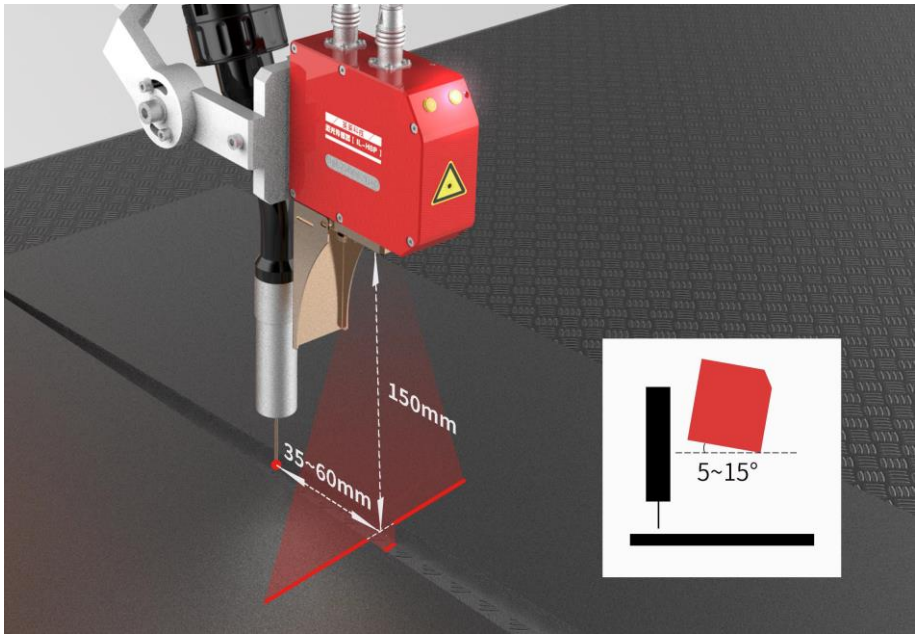


Figure 8-2 Sensor installation diagram

8.1.3 Configuration before software operation

The operation steps are as follows:

Step1. Open [Control Panel/Network and Internet/Network and Sharing Center] on the Inglese display. As shown in Figure 8-3.

Figure 8-3 [Network and Sharing Center] interface

Step2. Click [Local Area Connection 1/Properties/Network/Internet Protocol Version 4 (TCP/IPv4)], configure the IP address of the laser and laser control host as: 192.168.1.50, and the subnet mask as: 255.255.255.0. As shown in Figure 8-4.

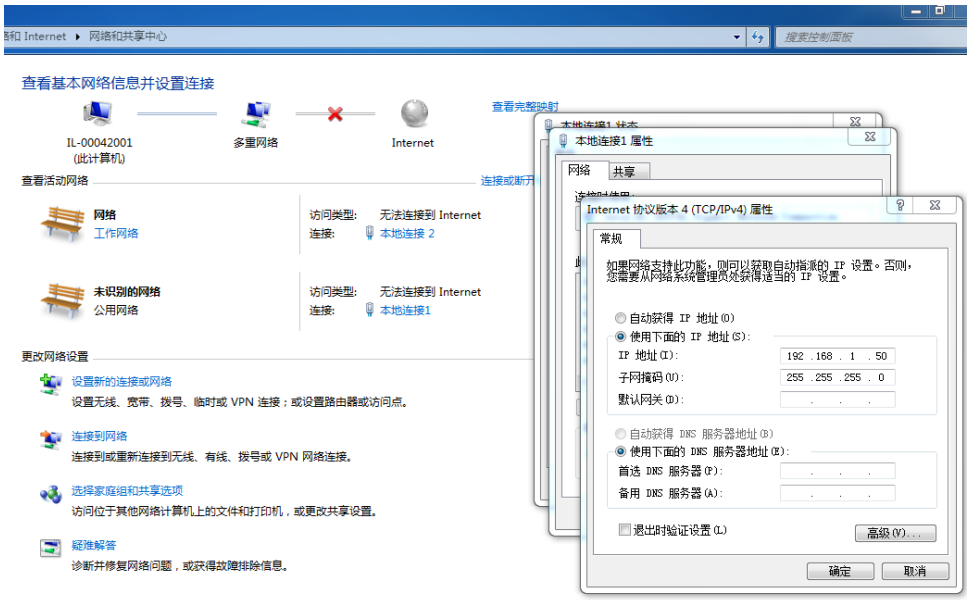


Figure 8-4 [Internet Protocol Version 4 (TCP/IPv4)] interface of local area connection 1

Step3. Click [Local Area Connection 2/Properties/Network/Internet Protocol Version 4 (TCP/IPv4)], configure the IP address of the laser control host and the robot control cabinet as: 192.168.2.50, and the subnet mask as: 255.255.255.0. As shown in Figure 8-5.

Figure 8-5 [Internet Protocol Version 4 (TCP/IPv4)] interface of local area connection 2

Step4. Open the CUTEWELDER software on the desktop to configure the laser.

8.1.4 Laser sensor position adjustment

Step1. Adjust the robot welding torch so that the welding torch is in the normal welding position and posture.

Step2. Click the "  " button on the software.

Step3. Adjust the sensor installation position so that when the robot is in the normal welding posture, the image TP feature point displayed by the software is in the central area as shown in the figure below. The image captured by the sensor in the correct installation position is shown in Figure 8-6.

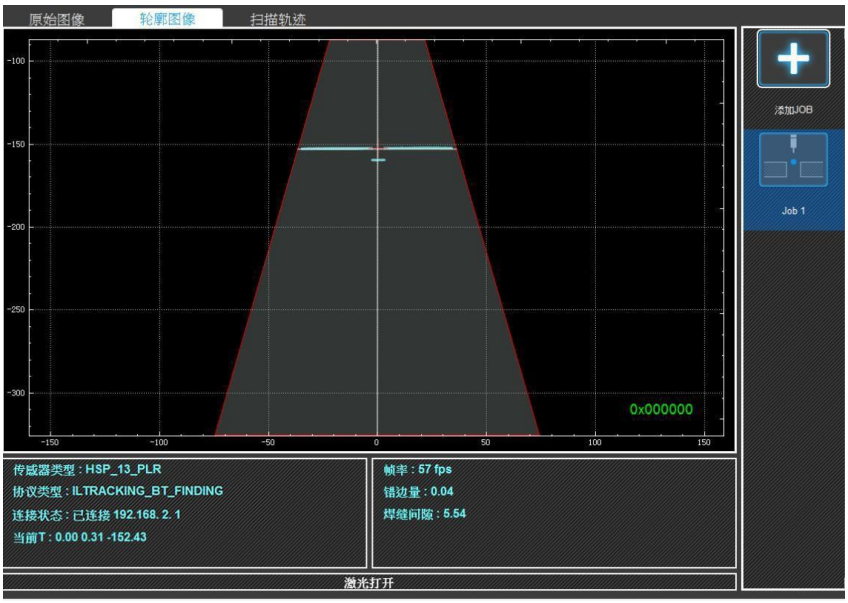


Figure 8-6 Sensor installation image diagram

Step4. The robot whose connection display icon turns red represents the connection status, and the text in the lower left corner indicates that the connection status has been connected, as shown in Figure 8-7.

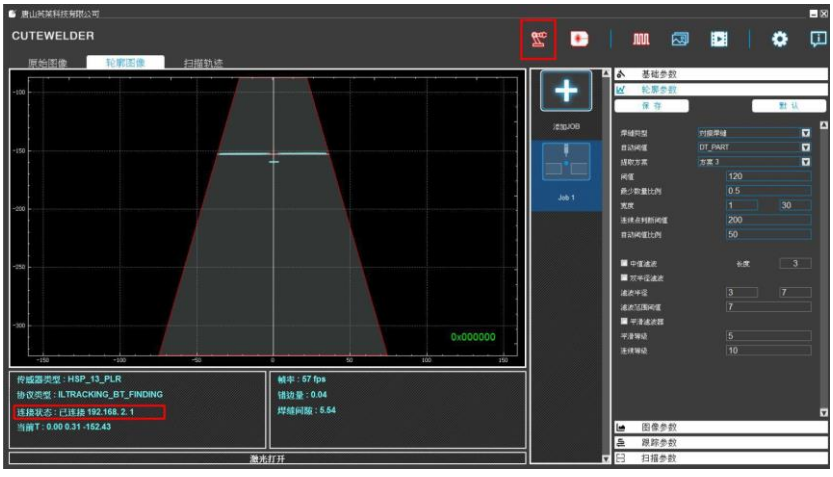


Figure 8-7 Establish a communication connection status with the robot

8.2 Calibration tool coordinate system

The tool calibration needs to be completed by calibrating the tool coordinate system. The calibration process of the tool coordinate system is as follows.

Step1. Click [Run/Calibrate/Coordinate Cali] on the upper right of the main interface of the teach pendant to enter the [Coordinate System measurement] interface, as shown in Figure 8-8.

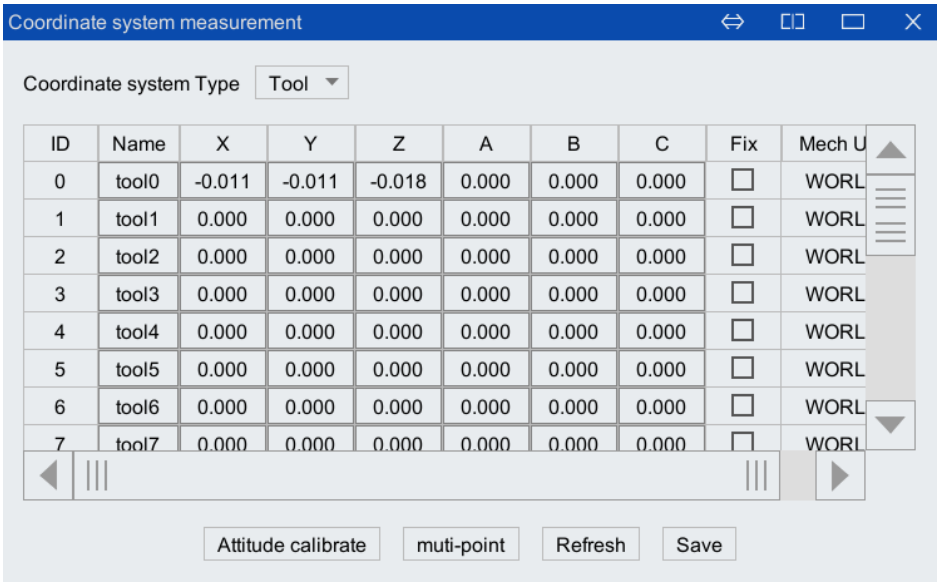


Figure 8-8 Select the row where the tool coordinate system is located

Step2. Click <muti-point> to pop up the configuration interface, as shown in Figure 8-9 below.

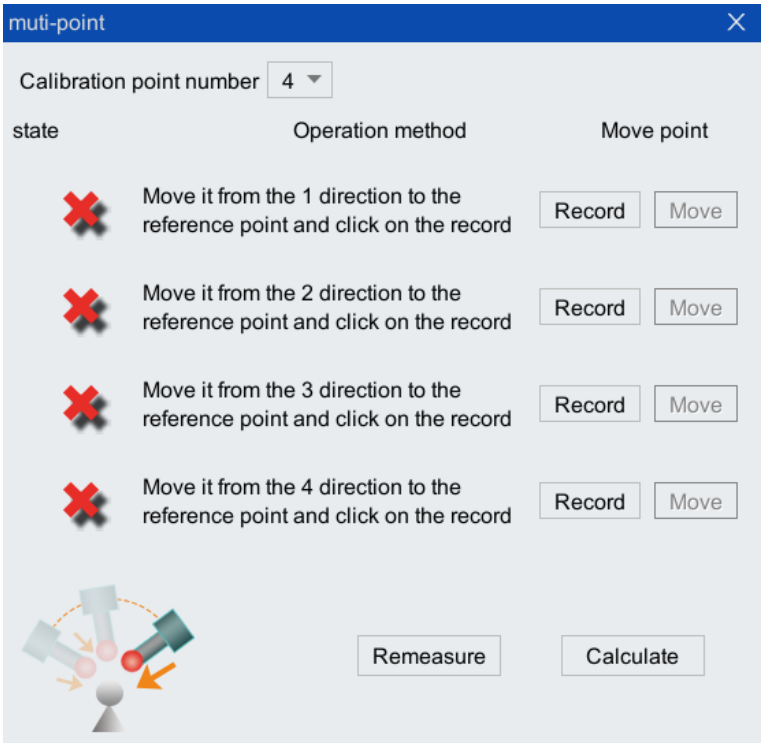


Figure 8-9 Position calibration interface

Step3. Perform calibration according to the operation instructions in the figure. After each point is successfully calibrated, the × in front will become √, as shown in Figure 8-10 and Figure 8-11.

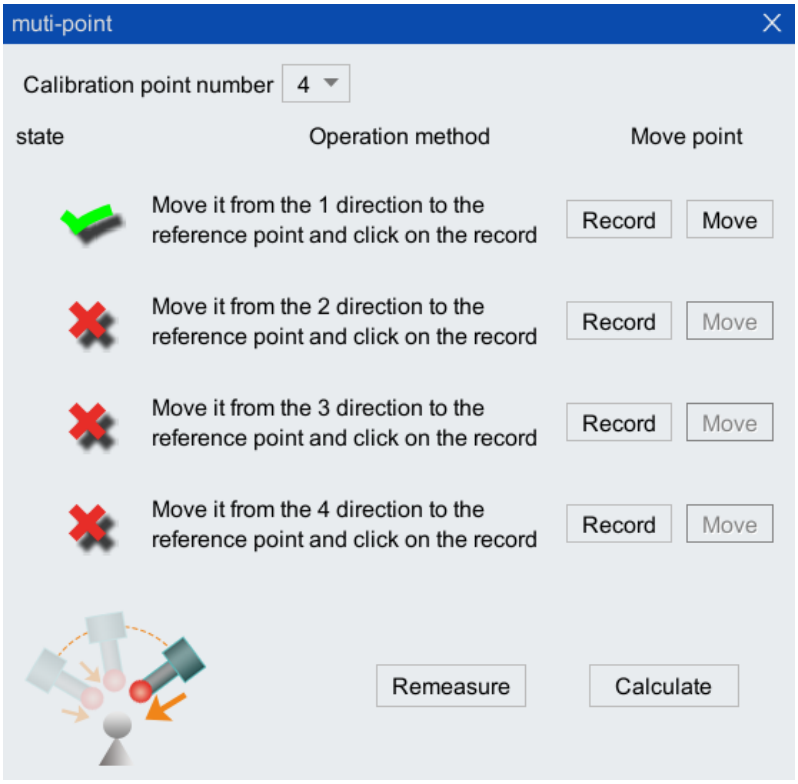


Figure 8-10 The interface status of 1 point successfully calibrated

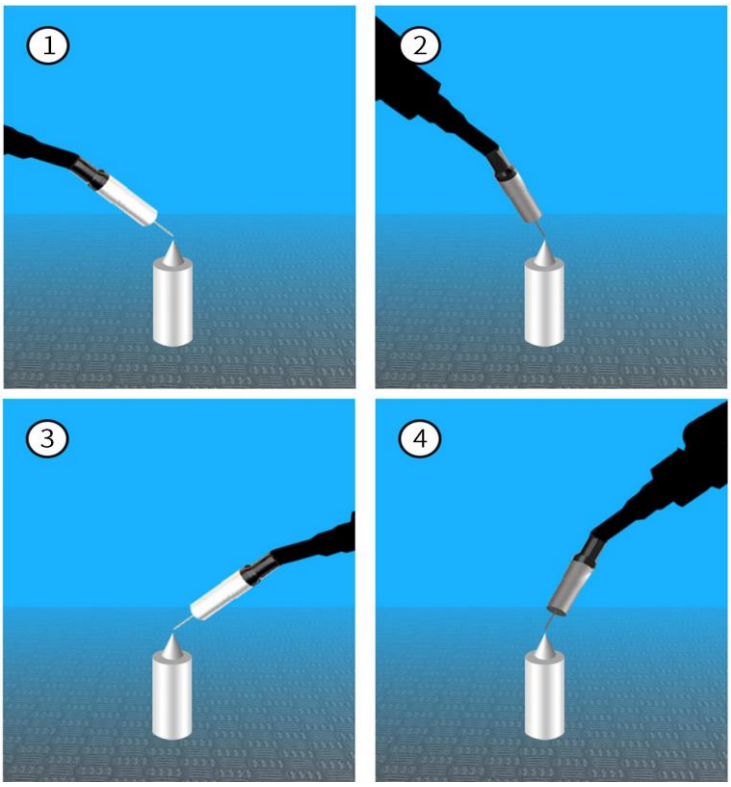


Figure 8-11 The robot teaches four point pose positions

Step4. After all the calibrations are successful, that is, all the × will become √, as shown in Figure 8-12 below. Click the <Calculate> button to calculate the error. If it exceeds the error range (more than 1), it needs to be calibrated again; if it is within the allowable error range, the [Calibration Result] interface as shown in Figure 8-13 will pop up, and the calibration is completed.

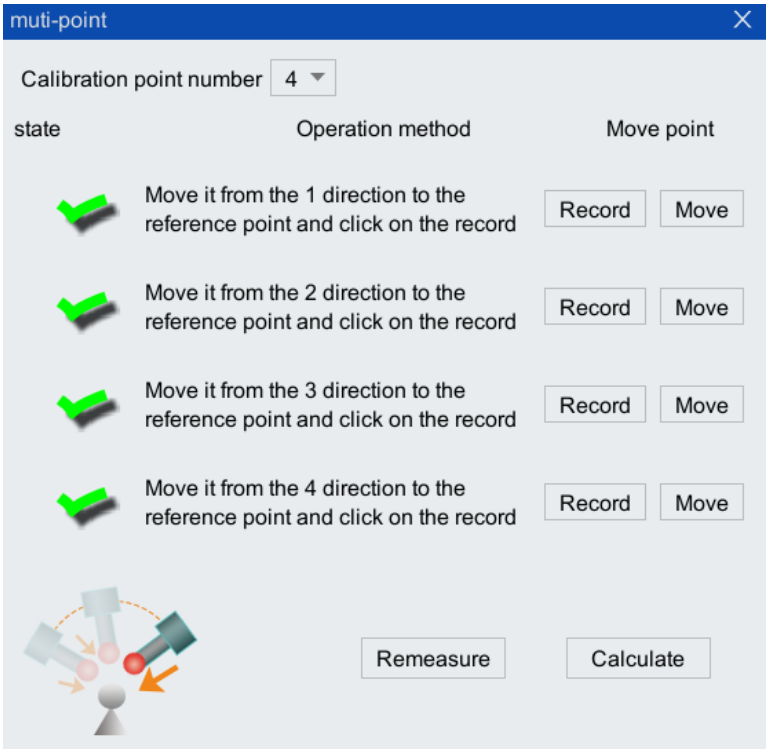


Figure 8-12 The interface where all four points have been calibrated

Figure 8-13 Calibration error

Step5. After the tool coordinate system calibration is completed, click <Save>, and click <Yes> in the pop-up prompt dialog box to save the configuration. As shown in Figure 8-14.

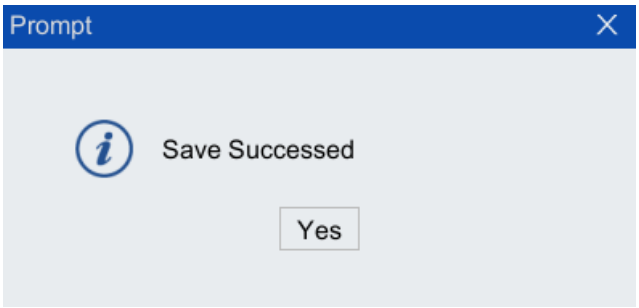


Figure 8-14 Save prompt

8.3 Laser calibration

8.3.1 Configuring IP address and port number

In the [weld- Weld Package] configuration interface, click the [Laser Calibration] option, and the floating window shown in Figure 8-15 will pop up. The parameter description is shown in Table 8-1.

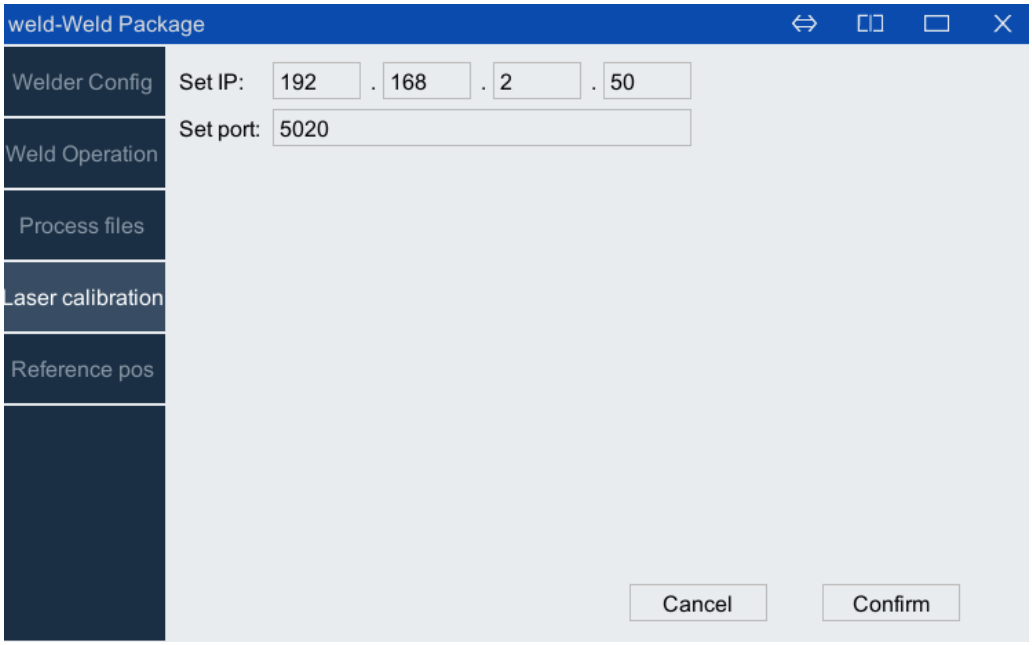


Figure 8-15 Arc Welding - Laser Calibration Window

Table 8-1 Parameter Description

Parameter	Description
Set IP	The IP address of the laser sensor. The default address is 192.168.2.50.
Set port	Port number of the laser sensor.

8.3.2 Laser calibration

The specific steps of calibration are as follows:

Step1. After setting the IP and port number, click <Confirm>, and the dialog box shown in Figure 8-16 will pop up.

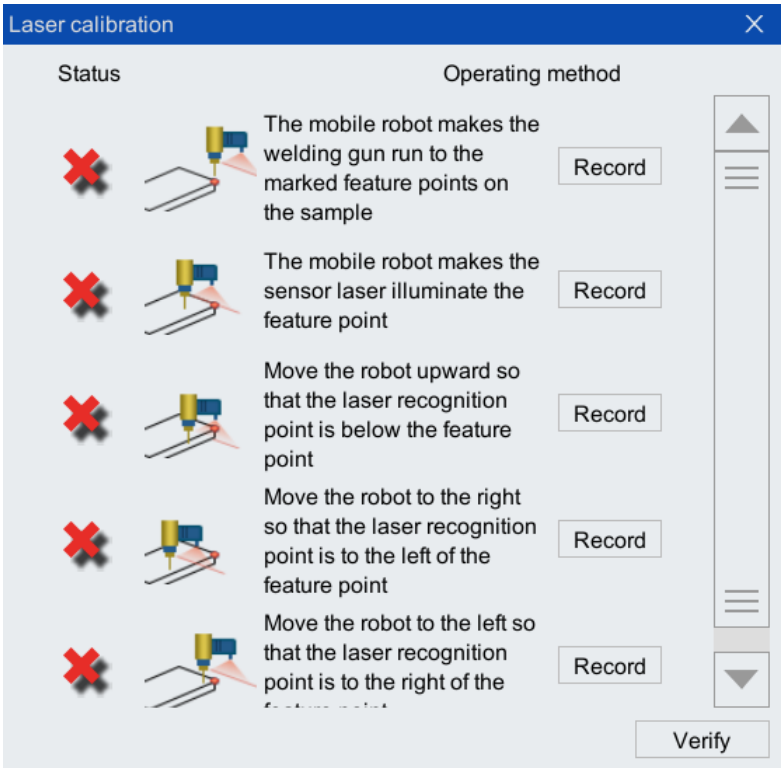


Figure 8-16 Operation steps interface

Step2. Move the robot to move the welding torch to the marked feature point on the sample, click <Record>, the X in front of it will turn into √ after recording. The robot position of the torch tip point is shown in Figure 8-17.

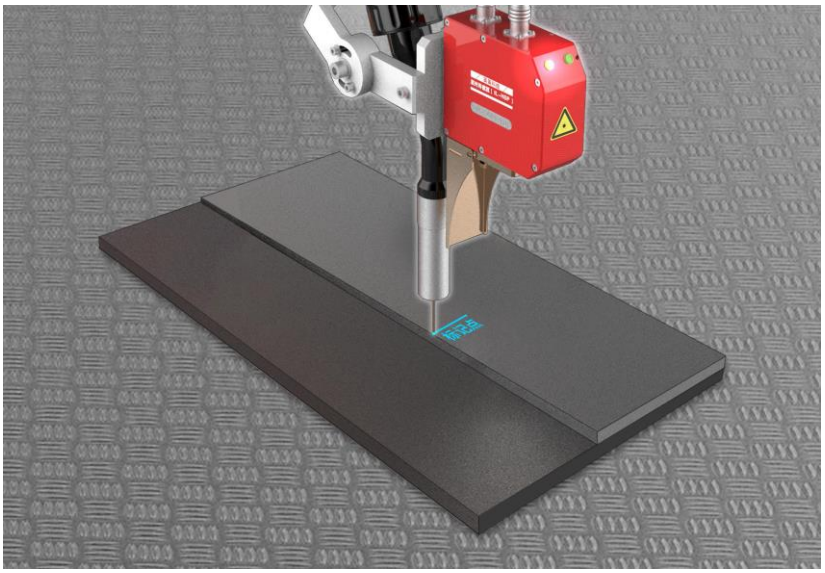


Figure 8-17 Diagram of the position of the gun tip

Step3. Move the robot so that the sensor laser irradiates the feature point, that is, the laser irradiates the mark point, and the red cross feature point under the contour image interface of the CUTEWELDER software is located in the center of the image window, as shown in Figure 8-18. Click <Record>, and the X in front of it will turn into √ after the record is completed.

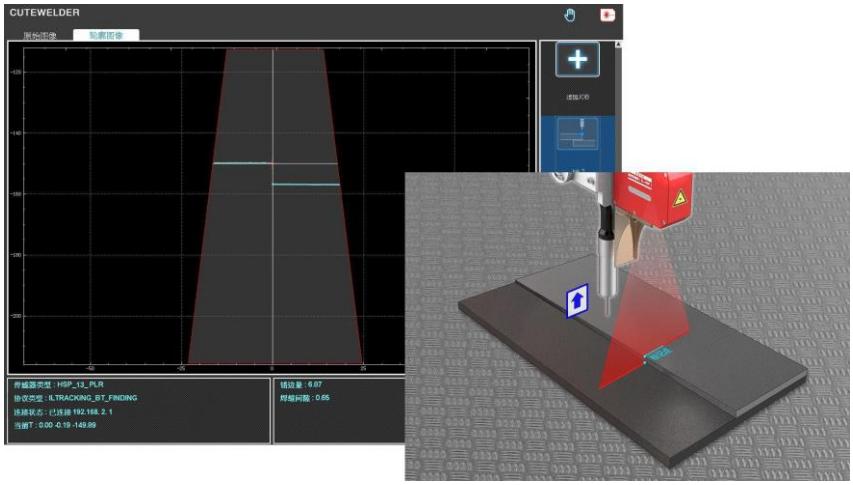


Figure 8-18 Location diagram

Step4. Move the robot down so that the laser recognition point is directly below the feature point, that is, the laser irradiates the mark point, and the red cross feature point under the contour image interface of the CUTEWELDER software is located directly above the image window, as shown in Figure 8-19. Click <Record>, and the X in front of it will turn into √ after the record is completed.

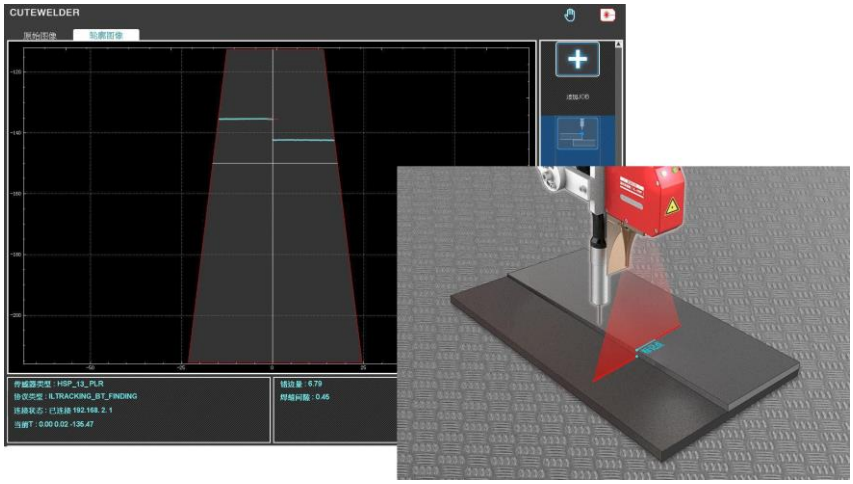


Figure 8-19 Location diagram

Step5. Move the robot to the left so that the laser recognition point is located to the left of the feature point, that is, the laser irradiation mark point, and the red cross feature point under the contour image interface of the CUTEWELDER software is located at the lower left of the image window. As shown in Figure 8-20, click <Record>, and the × in front of the record will turn into √.

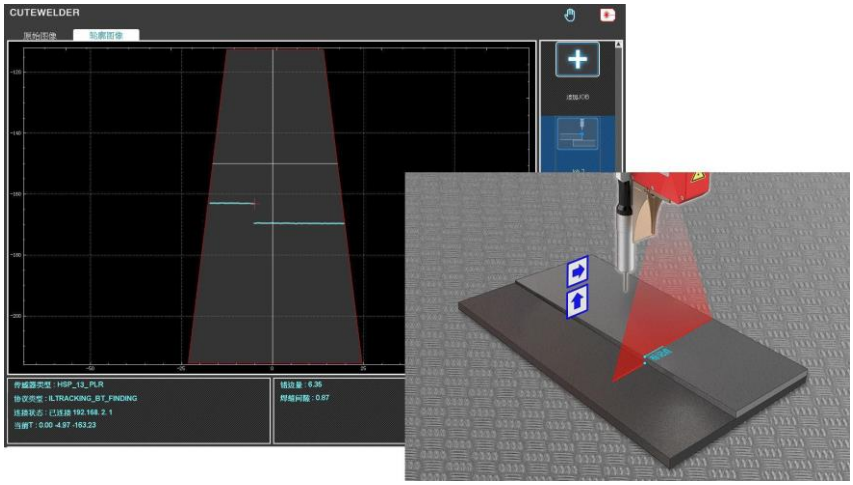


Figure 8-20 Location diagram

Step6. Move the robot to the right, so that the laser recognition point is located to the right of the feature point, that is, the laser irradiates the mark point. At the same time, the Red Cross feature point under the CUTEWELDER software outline image interface is located at the bottom right of the image window. As shown in Figure 8-21, click <Record> to record the × Will become √.

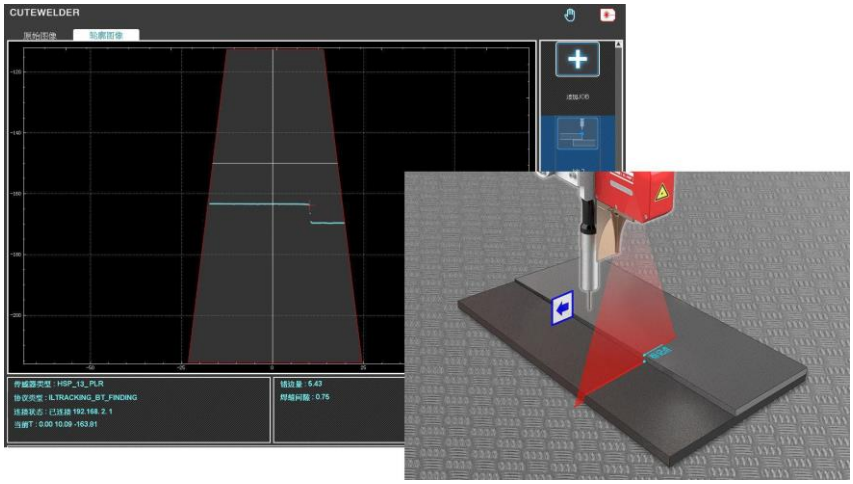


Figure 8-21 Location diagram

Step7. It is necessary to mark a feature point on the sample again, which is the calibration accuracy verification point, and the teaching position is the laser line irradiation position. As shown in Figure 8-22. First move the sensor to shine on this point, and then click <Verify>.

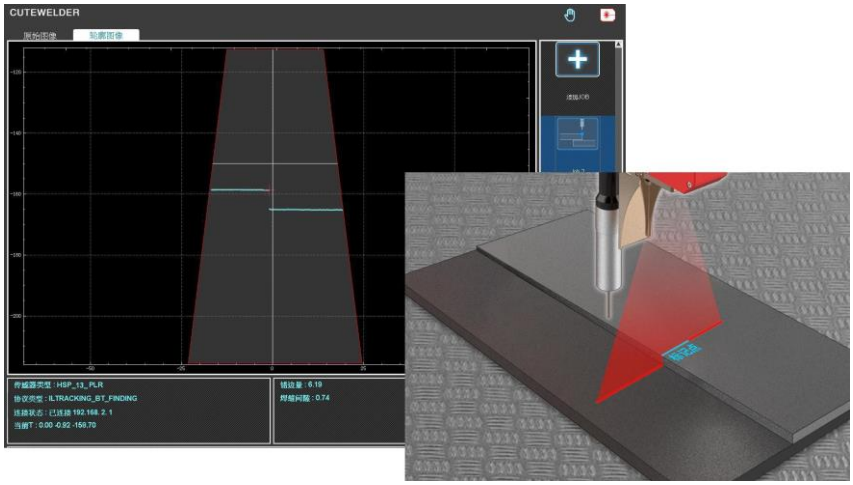


Figure 8-22 Location diagram

Step8. As shown in Figure 8-23 below, click < move >, the welding torch will automatically move to the calibration point, and the calibration is successful.

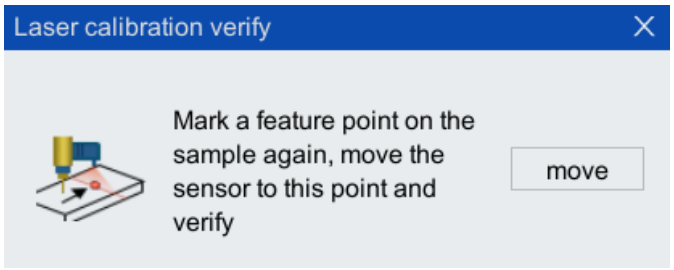


Figure 8-23 Calibration completion interface

Step9. Click < move >, the welding gun will automatically move to the calibration point, and the calibration is successful.

8.4 Laser tracking instruction

8.4.1 Laser tracking start instruction

Instruction description

Laser tracking start instruction. Used to configure the current tool coordinate system, the current point coordinate system and the weld type corresponding to the laser software side.

Insert instruction

The configuration steps are as follows:

Step1. Click [Insert cmd/Function Pack/weld/Welding command /lkstart] to enter the laser tracking start instruction interface. As shown in Figure 8-24. The parameter description is shown in Table 8-2.

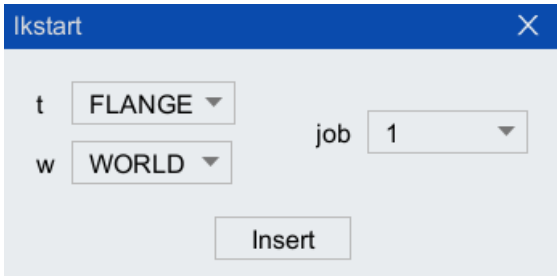


Figure 8-24 Laser tracking enable parameter configuration

Table 8-2 Parameter Description

Parameter	Description
t	Indicates the current tool coordinate system
w	Indicates the current point coordinate system
job	The welding seam type corresponding to the laser software side. Usually set on the laser software side.

Step2. After the configuration is complete, click <Insert> to complete the insertion of the instruction.

Fill in instructions manually

The laser tracking start instruction can be manually entered directly in the program editing area.

Instruction format

lkstart t:$tool0,w:$BASE[0], job:3

Parameter description

See Table 8-3 for the parameter description of the laser tracking start instruction.

Table 8-3 Laser tracking start instruction parameter description

Parameter	Description
t	Indicates the current tool coordinate system
w	Indicates the current point coordinate system
job	The welding seam type corresponding to the laser software side. Usually set on the laser software side.

8.4.2 Laser tracking end instruction

Instruction description

Laser tracking end instruction.

Insert instruction

The configuration steps are as follows:

Step1. Click [Insert cmd/function pack/weld/welding command/weldendweave] to enter the laser tracking end instruction interface. As shown in Figure 8-25.

Figure 8-25 Laser tracking end parameter configuration

Step2. After the configuration is completed, click <Insert>, and complete the instruction insertion.

Fill in instructions manually

You can manually input the laser tracking end instruction in the program editing area.

Instruction format

Lkend

8.4.3 Search offset instruction

Refer to section 7.5.4 for the introduction and usage of search offset instruction.

8.5 Laser search instruction

8.5.1 Laser search initialization

Instruction description

Laser search initialization instruction. It is used to configure the laser search mode and the weld type corresponding to the laser software end.

Insert instruction

The configuration steps are as follows:

Step1. Click [Insert cmd/Function Pack/weld/Welding command /Lasersearchinit] to enter the laser search initialization instruction interface. As shown in Figure 8-26. The parameter description is shown in Table 8-4.

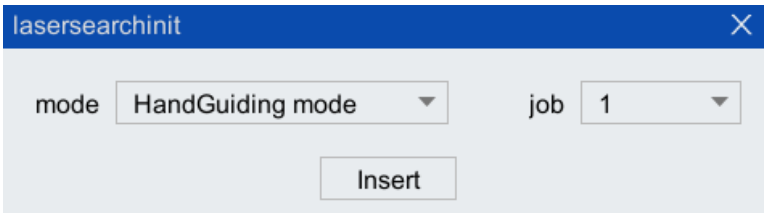


Figure 8-26 Laser search initialization parameter configuration

Table 8-4 Parameter Description

Parameter	Description
search	Search mode. The parameter values are as follows: ■ true: Indicates search mode ■ false: Indicates that the teaching mode is to find the standard position
job	The welding seam type corresponding to the laser software side. Usually set on the laser software side.

Step2. After the configuration is complete, click <Insert> to complete the insertion of the instruction.

Fill in instructions manually

The laser search initialization instruction can be manually entered directly in the program editing area.

Instruction format

lasersearchinit search:true,job:3

Parameter description

See Table 8-5 for the parameter description of the laser search initialization instruction.

Table 8-5 Laser search initialization instruction parameter description

Parameter	Description
search	Search mode. The parameter values are as follows: ■ true: Indicates search mode ■ false: Indicates that the teaching mode is to find the standard position
job	The welding seam type corresponding to the laser software side. Usually set on the laser software side.

8.5.2 Laser search

Instruction description

Laser search instruction. When the workpiece consistency is not high or the positioning is offset, use this instruction to find the position of the weld. Suitable for line laser search.

Insert instruction

The configuration steps are as follows:

Step1. Click [Insert cmd/Function Pack/weld/Welding command/Lasersearch] to enter the laser search auxiliary programming instruction interface. As shown in Figure 8-27. The parameter description is shown in Table 8-6 Parameter Description.

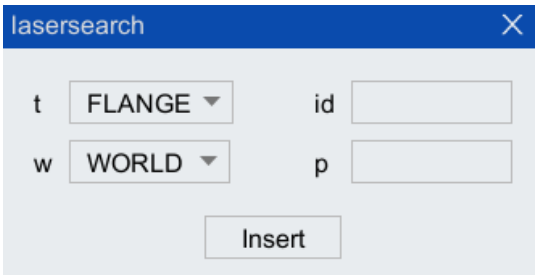


Figure 8-27 Laser search parameter configuration

Table 8-6 Parameter Description

Parameter	Description
t	Indicates the current tool coordinate system
w	Indicates the current point coordinate system
id	The address of the register that stores the search point, starting from 1, and the id value increases by 1 for each additional search point
p	Absolute search point

Step2. After the configuration is complete, click <Insert> to complete the insertion of the instruction.

Fill in instructions manually

The laser search instruction can be directly and manually entered in the program editing area.

Instruction format

lasersearch t:$tool0,w:$B,p:7

Parameter description

See Table 8-7 for the parameter description of the laser search instruction.

Table 8-7 Parameter description of laser search instruction

Parameter	Description
t	Indicates the current tool coordinate system
w	Indicates the current point coordinate system
id	The address of the register that stores the search point, starting from 1, and the id value increases by 1 for each additional search point
p	Absolute search point

8.5.3 Laser search offset

Instruction description

Laser search offset instruction. Used to configure laser search offset direction and offset distance.

Insert instruction

The configuration steps are as follows:

Step1. Click [Insert cmd/Function Pack/weld/ Welding Command/Lasersearchoffset] to enter the laser search offset auxiliary programming instruction interface. As shown in Figure 8-28. The parameter description is shown in Table 8-8.

Figure 8-28 Laser search offset parameter configuration

Table 8-8 Parameter Description

Parameter	Description
x_id	The offset in the x direction, the following value represents the register address where the x offset value is stored
y_id	The offset in the y direction, the following value represents the register address where the y offset value is stored
z_id	The offset in the z direction, the following value represents the register address where the z offset value is stored
os	The calling name of the search offset, "t1" is a custom name

Step2. After the configuration is complete, click <Insert> to complete the insertion of the instruction.

Fill in instructions manually

The laser search offset instruction can be directly and manually entered in the program editing area.

Instruction format

lasersearchoffset x_id:1,y_id:1,z_id:1,os_name:"t1"

Parameter description

See Table 8-9 for the parameter description of laser search offset instruction .

Table 8-9 Parameter description of laser search offset instruction

Parameter	Description
x_id	The offset in the x direction, the following value represents the register address where the x offset value is stored
y_id	The offset in the y direction, the following value represents the register address where the y offset value is stored
z_id	The offset in the z direction, the following value represents the register address where the z offset value is stored
os_name	The calling name of the search offset, "t1" is a custom name

8.5.4 Laser tracking program example

Search mode program example

The relative searching program template is shown in Figure 8-29 below, and the workpiece diagram is shown in Figure 8-30.

find.arl

```
1  func void main()
2  init()
3
4  lasersearchinit search:false,job:1
5  lin p:p1,vl:30mm/s,s:s1,t:$tool3,w:$WORLD
6  lasersearch t:$tool3,w:$WORLD,id:1
7  lin p:p2,vl:30mm/s,s:s1,t:$tool3,w:$WORLD
8  lasersearch t:$tool3,w:$WORLD,id:2
9  lin p:p3,vl:30mm/s,s:s3,t:$tool3,w:$WORLD
10 lasersearch t:$tool3,w:$WORLD,id:3
11 lin p:p6,vl:30mm/s,s:s3,t:$tool3,w:$WORLD
12 lasersearchoffset x_id:1,y_id:2,z_id:2,os:"q1"
13 lasersearchoffset x_id:1,y_id:3,z_id:3,os:"q2"
14 wblin p:p4,v:v1,s:s3,t:$tool3,w:$WORLD,os:"q1"
15 wblin p:p5,v:v2,s:s4,t:$tool3,w:$WORLD,os:"q2"
16 endfunc
```

Figure 8-29 Relative search template (record mode)

Program notes are as follows:

Line 4: Search initialization. (Search is not checked as the search mode)

Line 5: It is the position point that makes the laser light shine at the ID1 position shown in Figure 8-29.

Line 6: Laser search instruction, store the position information in the id1 register.

Line 7: It is the position point that makes the laser light shine at the ID2 position shown in Figure 8-29.

Line 8: It is the laser search instruction, which stores the position information in the id2 register.

Line 9: It is the position point, and also makes the laser light shine at the ID3 position shown in Figure 829.

Line 10: It is the laser search instruction that stores the position information in the id3 register.

Line 11: Space Safe Point

Line 12: Laser search offset instruction, combine the X direction of id1 into id2, and store the result in "q1".

Line 13: Laser search offset instruction, combine the X direction of id1 into id3, and store the result in "q2".

Line 14: It is the welding starting point position, and the deviation value of q1 is called.

Line 15: It is the welding end position, and the deviation value of q2 is called.

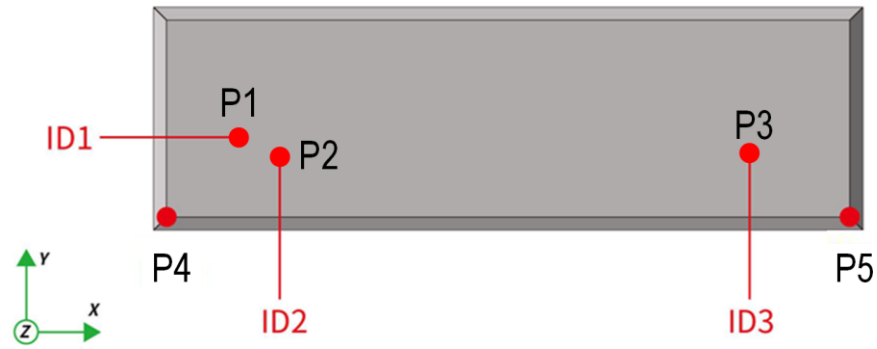


Figure 8-30 Diagram of relative positioning workpiece

Correction mode program example

After the program is written in the program editor, click <Load>, run the program in the program debugger, and record and store the original position data of the workpiece. Then change the search mode to the correction mode, as shown in Figure 8-31 below.

find.arl

```
1  func void main()
2  init()
3
4  lasersearchinit search:true,job:1
5  lin p:p1,vl:30mm/s,s:s1,t:$tool3,w:$WORLD
6  lasersearch t:$tool3,w:$WORLD,id:1
7  lin p:p2,vl:30mm/s,s:s1,t:$tool3,w:$WORLD
8  lasersearch t:$tool3,w:$WORLD,id:2
9  lin p:p3,vl:30mm/s,s:s3,t:$tool3,w:$WORLD
10 lasersearch t:$tool3,w:$WORLD,id:3
11 lin p:p6,vl:30mm/s,s:s3,t:$tool3,w:$WORLD
12 lasersearchoffset x_id:1,y_id:2,z_id:2,os:"q1"
13 lasersearchoffset x_id:1,y_id:3,z_id:3,os:"q2"
14 wblin p:p4,v:v1,s:s3,t:$tool3,w:$WORLD,os:"q1"
15 wblin p:p5,v:v2,s:s4,t:$tool3,w:$WORLD,os:"q2"
16 endfunc
```

Figure 8-31 Relative search program template (correction mode)

Program notes are as follows:

Line 4: Search initialization. (Search is checked for correction mode)

Line 5: It is the position point that makes the laser light shine at the ID1 position shown in Figure 8-29.

Line 6: Laser search instruction, store the position information in the id1 register.

Line 7: It is the position point that makes the laser light shine at the ID2 position shown in Figure 8-29.

Line 8: It is the laser search instruction, which stores the position information in the id2 register.

Line 9: It is the position point, and also makes the laser light shine at the ID3 position shown in Figure 829.

Line 10: It is the laser search instruction that stores the position information in the id3 register.

Line 11: Space Safe Point

Line 12: Laser search offset instruction, combine the X direction of id1 into id2, and store the result in "q1".

Line 13: Laser search offset instruction, combine the X direction of id1 into id3, and store the result in "q2".

Line 14: It is the welding starting point position, and the deviation value of q1 is called.

Line 15: It is the welding end position, and the deviation value of q2 is called.

9 Arc welding application example

Configuration requirements

Configuring the arc welding function generally requires the instruction shown in Figure 9-1.

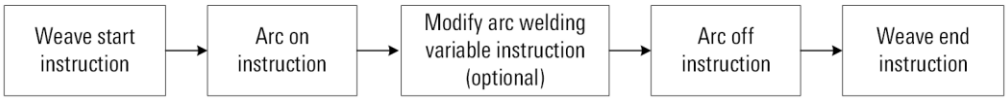


Figure 9-1 General process of configuring arc welding function

Configuration steps

The arc welding application generation steps are as follows:

Step1. Open a new .arl program in the program editor, click [movej] to pop up the movej configuration interface (as shown in Figure 9-2), complete the configuration of parameters j2, v2, s2, click <insert>, the generated code is as shown in the Figure 9-3.

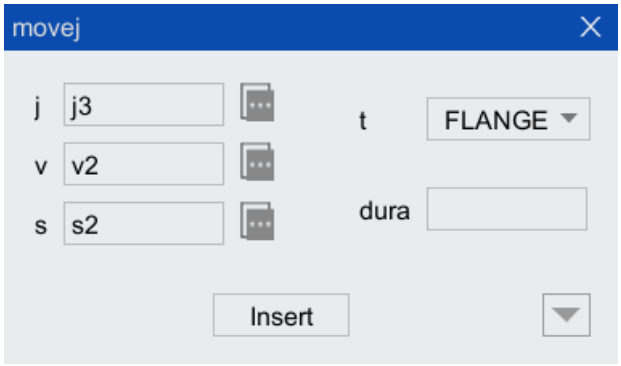


Figure 9-2 movej instruction configuration

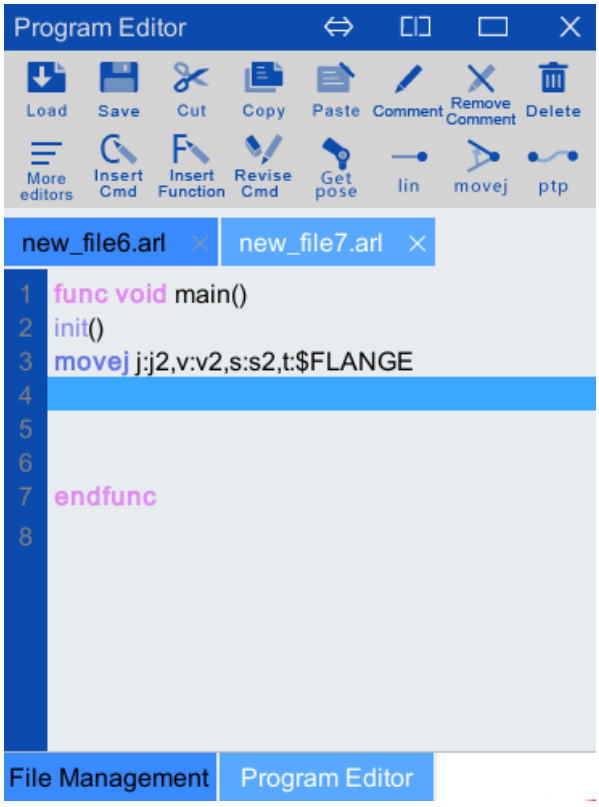


Figure 9-3 Generate movej instructions

Step2. Click [lin] in the program editor to pop up the lin instruction configuration interface (as shown in Figure 9-4), complete the configuration of parameters p1, v6, s 7, and configure t to be tool0, w to be $WORLD, and click <insert>, the generated code is shown in Figure 9-5.

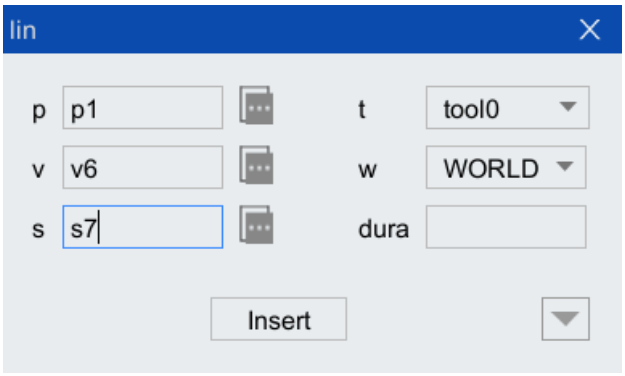


Figure 9-4 lin instruction configuration

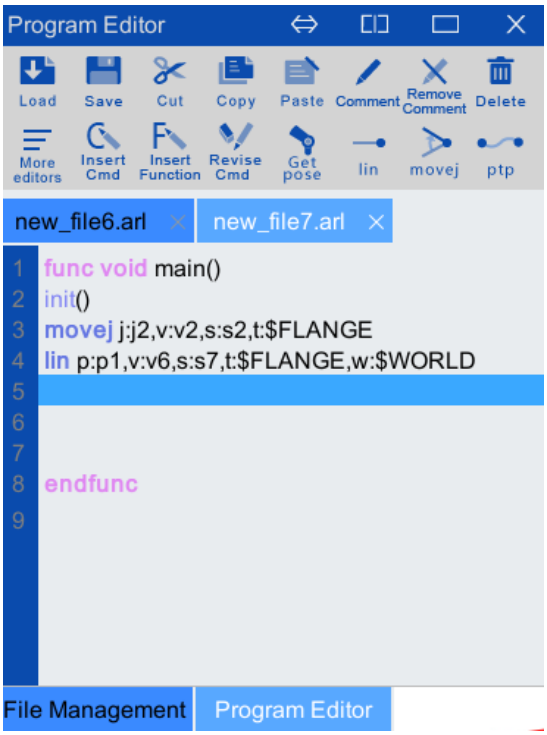


Figure 9-5 Generate lin instruction

Step3. Click [Insert Cmd/Function Pack/weld/Welding Command/Start weave command]. As shown in Figure 9-6.

Figure 9-6 Insert weave command menu

Step4. Complete the parameter configuration on the pop-up [weld- Start weave command] interface (as shown in Figure 9-7), and click <Confirm>. A start weave command is automatically generated. As shown in Figure 9-8.

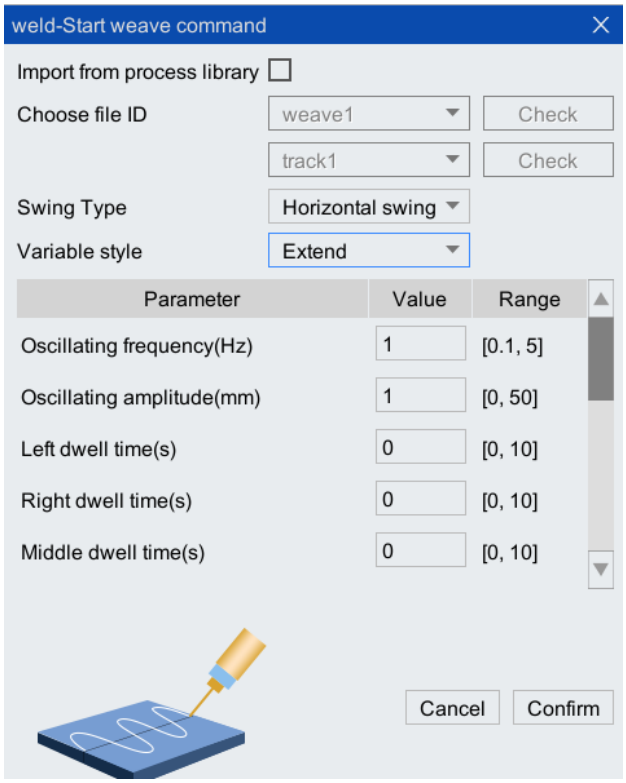


Figure 9-7 Weld-start weave command interface

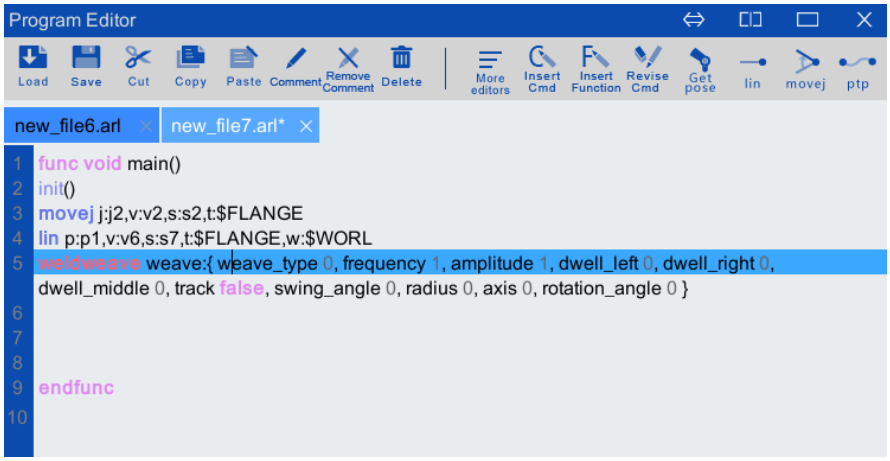


Figure 9-8 Generate weave command

Step5. Click [Insert cmd/Function Pack/weld/Welding Command/Start weave command]. As shown in Figure 9-9.

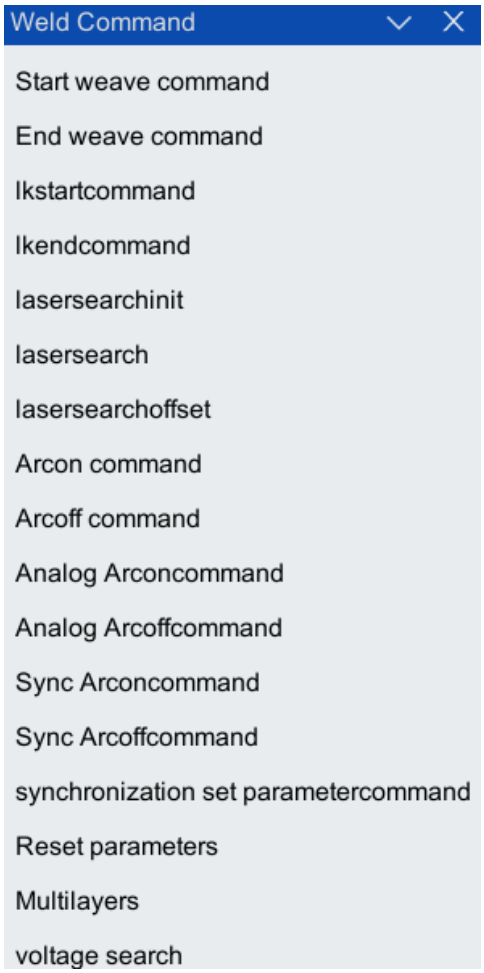


Figure 9-9 Arc on command menu

Step6. Complete the parameter configuration on the pop-up [weld-Arcon command] interface (as shown in Figure 9-10), and click <Confirm>. A start weave command is automatically generated. As shown in Figure 9-11.

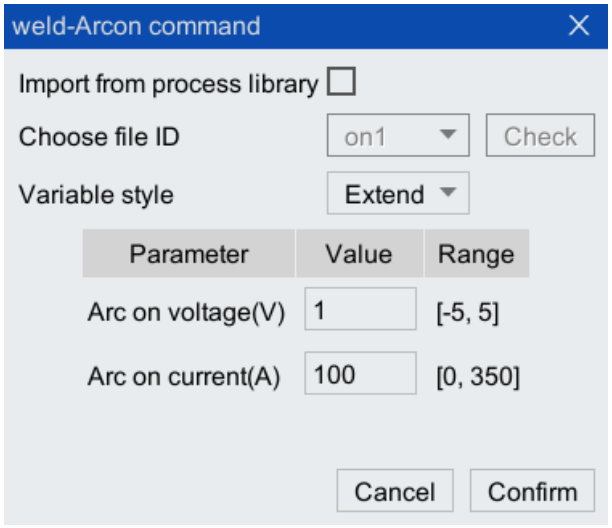


Figure 9-10 Arc on command configuration interface

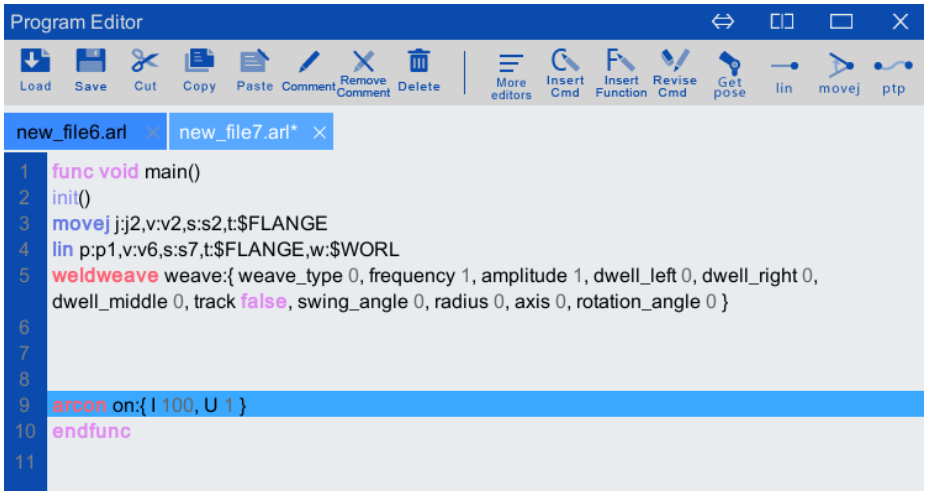


Figure 9-11 start weave command

Step7. Click [Insert cmd/motion control/lin] to pop up the lin instruction configuration interface (as shown in Figure 9-12), complete the configuration of parameters p2, v14, s15, and configure t to be tool0, w to be $WORLD, click <Insert>. The generated code is shown in Figure 9-13.

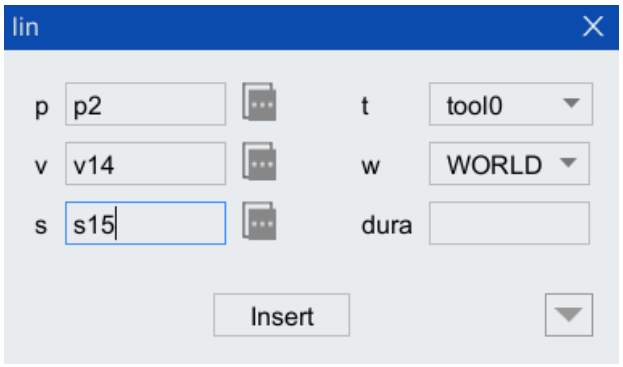


Figure 9-12 The lin instruction configuration interface

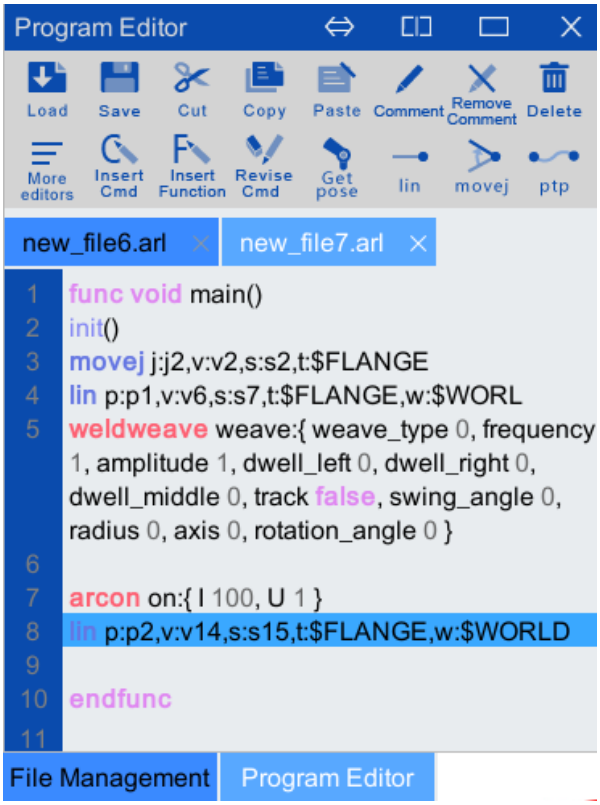


Figure 9-13 Generate lin instruction

Step8. Click [Insert cmd/motion control/cir] to pop up the cir instruction configuration interface (as shown in Figure 9-14), complete the configuration of parameters p3, p4, v6, s7, and configure t to be tool0, w to be $WORLD, click <Insert>. The generated code is shown in Figure 9-15.

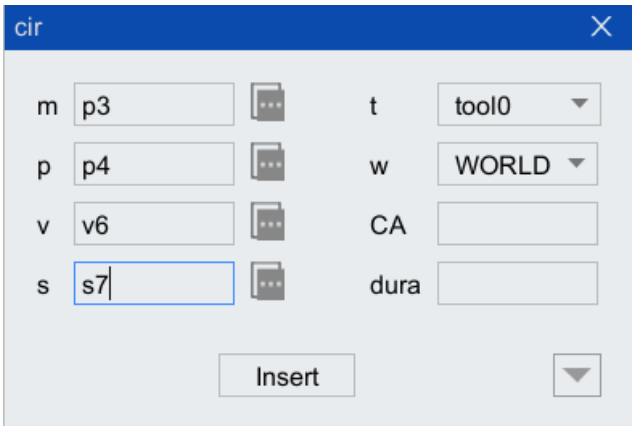


Figure 9-14 The cir instruction configuration interface

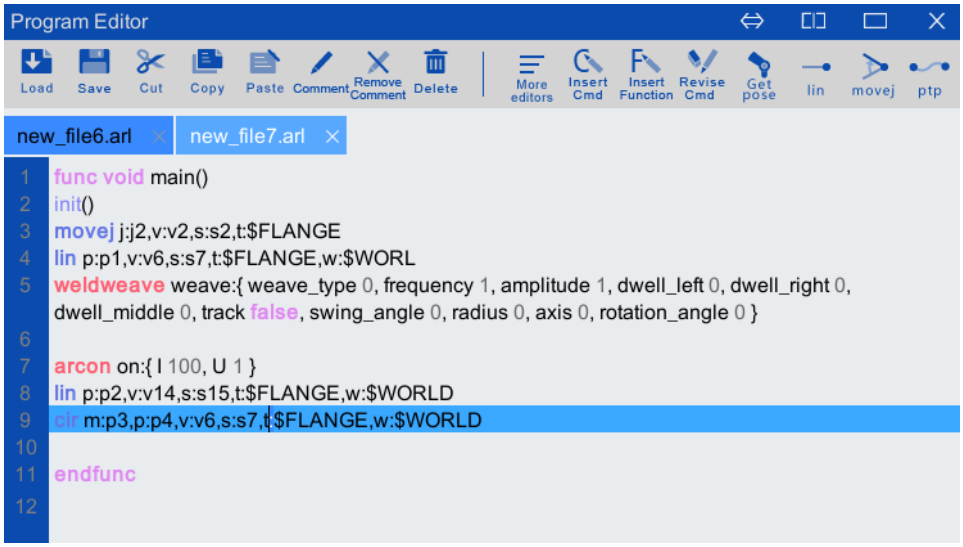


Figure 9-15 Generate cir instructions

Step9. Click [Insert cmd/Function Pack/weld/Welding Command/Reset Parameters]. In the pop-up [weld-Reset parameters] interface (as shown in Figure 9-16), complete the parameter configuration, and click <Confirm>. Automatically generate instructions to reset parameters. As shown in Figure 9-17.

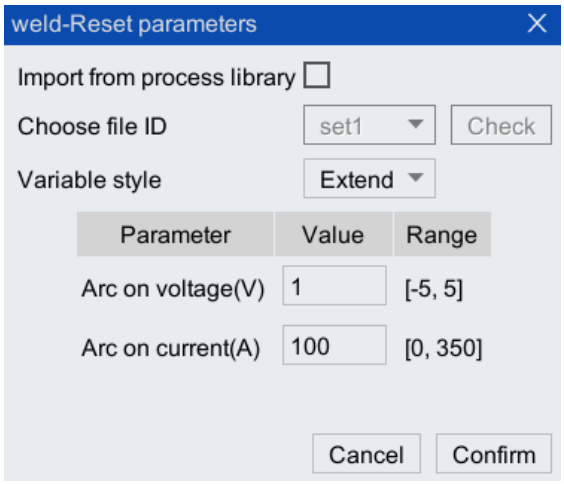


Figure 9-16 Weld - Reset Parameters

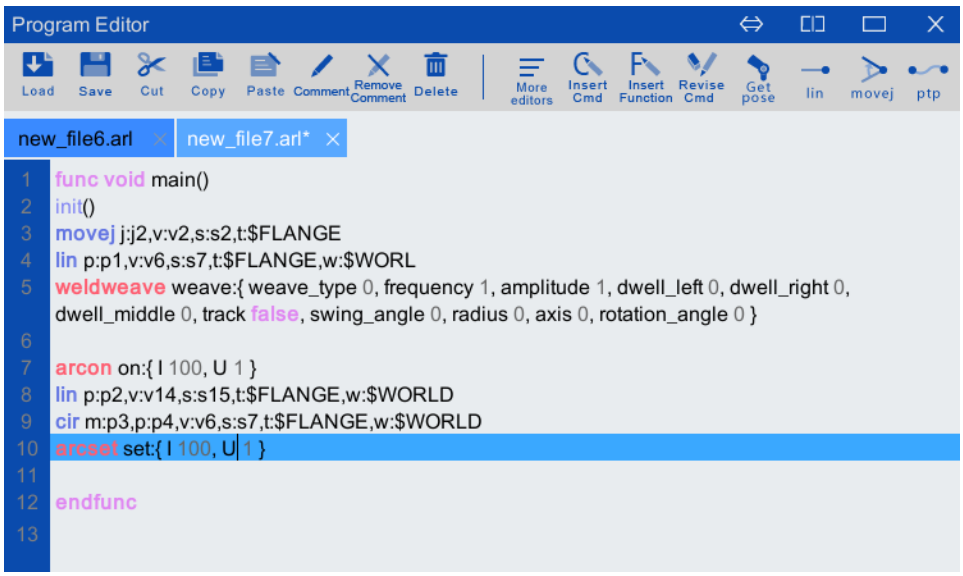


Figure 9-17 Generate a reset parameter instruction

Step10. Click [Insert cmd/Function Pack/weld/Welding Command/Arcoff Command]. The interface shown in Figure 9-18 will pop up, complete the parameter configuration, and click <Confirm> to automatically generate the arcoff instruction (as shown in Figure 9-19).

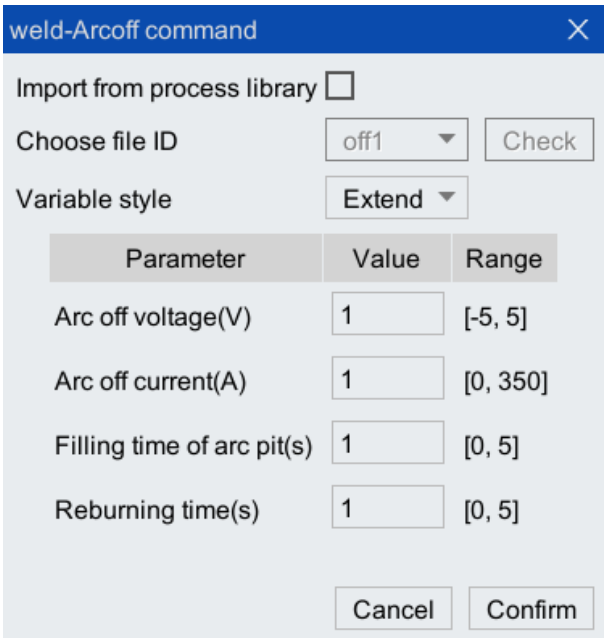


Figure 9-18 Weld - arc off instruction interface

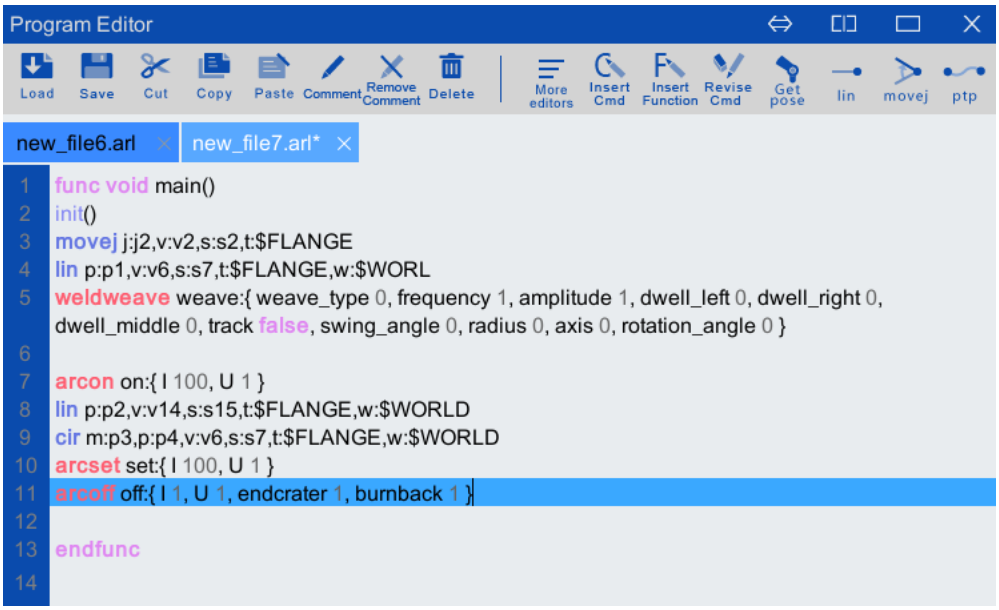


Figure 9-19 Insert an arc off instruction

Step11. Click <Load> to complete the program loading.

Sample program

The resulting arc welding application is as follows:

func void main()

init()

movej j:j2,v:v2,s:s2

```
lin p:p1,v:v6,s:s7,t:$tj,w:$WORLD

// Weave start

startweave weave1:{weave_type 0, frequency 1, amplitude 1, dwell_left 0, dwell_right 0, dwell_middle 0, track false, vibrate false, swing_angle 0, radius 0, axis 0, rotation_angle 0}

arcon on:{preflow_time 1, ignition_stay_time 1, voltage 1, current 100, weld_resume true, resume_distance 5, rearcon true, rearcon_numbers 3}// Arc on

lin p:p2,v:v14,s:s15,t:$tj,w:$WORLD

cir m:p3,p:p4,v:v6,s:s7,t:$tj,w:$WORLD

arcset set:{voltage 1, current 100} // Modify arc welding variables

cir m:p5,p:p6,v:v6,s:s7,t:$tj,w:$WORLD

// Arc stop

arcoff off:{endcracter_time 1, burnback_time 1, postflow_time 1, voltage 1, current 100}

endweave // Weave ends

endfunc
```

10 Examples of advanced functions of arc welding

10.1 Seam search

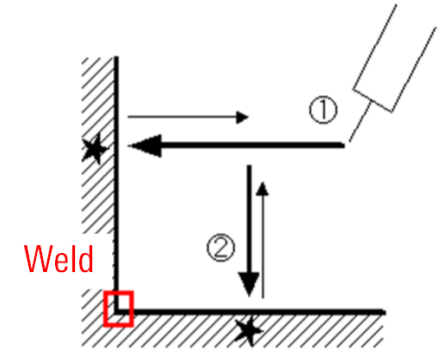
Function description

Weld seam search is a method to detect the position deviation of the object workpiece. When the consistency of the workpiece cannot meet the requirements of the welding seam, it is used to automatically judge the welding seam deviation before welding.

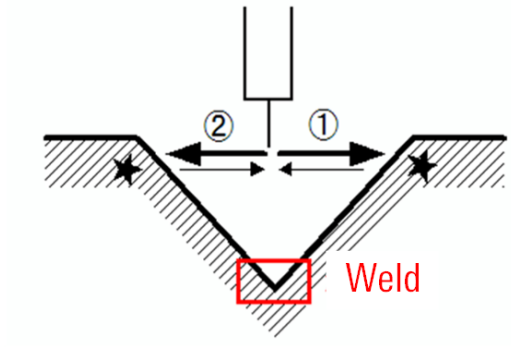
There are 6 types of seam search in the arc welding package:

- 1D: One-dimensional searching. For workpieces that have translation in only one direction.
- 2D: Two-dimensional searching. For workpieces that have translation in both directions.
- 3D: Three-dimensional searching. For workpieces with translation in three directions.
- 2DR: 2D rotational searching
- 3DR: 3D rotational searching
- CIR: Arc searching

Figure 10-1 shows the location of the weld by touching the two directions of the weldment.



(a)



(b)

Figure 10-1 Diagram of welding seam search function

Principle description

Figure 10-2 is a detailed diagram of the principle of welding seam search. When the welding seam search function is turned on, the welding wire will pass through the low voltage of 24V. When the welding wire touches the workpiece, a loop is formed to trigger the relay to give a contact signal.

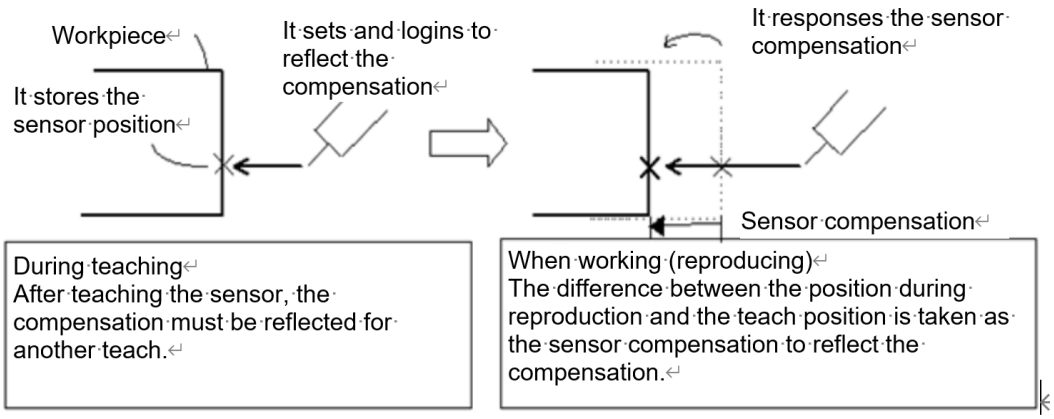


Figure 10-2 Detailed diagram of welding seam search principle

During teaching, the reference position of the workpiece needs to be measured first, and then a workpiece position is detected during work (reproduction), and the offset of the weld seam can be calculated from the two positions.

Sample program

Example of a 3D panning program:

```
func void main()
init()
//toolswitch(-1) // Default tool load
lin p:p1,v:v1,s:s1,t:$tool0,w:$WORLD
offsetInit
wbsearch pst:p2, pmd:p3 // Find the offset in the 1st direction.
lin p:p10,vp:5%,sp:-1%,t:$FLANGE,w:$WORLD
wbsearch pst:p4, pmd:p5 // Find the offset in the 2nd direction.
lin p:p11,vp:5%,sp:-1%,t:$FLANGE,w:$WORLD
wbsearch pst:p6, pmd:p7 // Find the offset in the 3rd direction.
offsetrecord otype:"3D"
wblin p:p8,vp:5%,sl:0mm,t:$tool0,w:$WORLD // The first insertion is the weld start point.
wblin p:p9,vp:5%,sl:0mm,t:$tool0,w:$WORLD // The second insertion is the end point of the weld.
endfunc
```

Tip

The position-searching start instruction "$REFERENCE_FLAG" searches for the correct initial position in the first welding seam search, and should be set to true. Then, when searching for the welding seam, this value needs to be changed to false to find the position of the workpiece after offset.

10.2 Arc voltage tracking

Principle description

Figure 10-3 shows the detailed diagram of the arc voltage tracking principle. The arc sensor tracks the welding seam by detecting the change of the welding current.

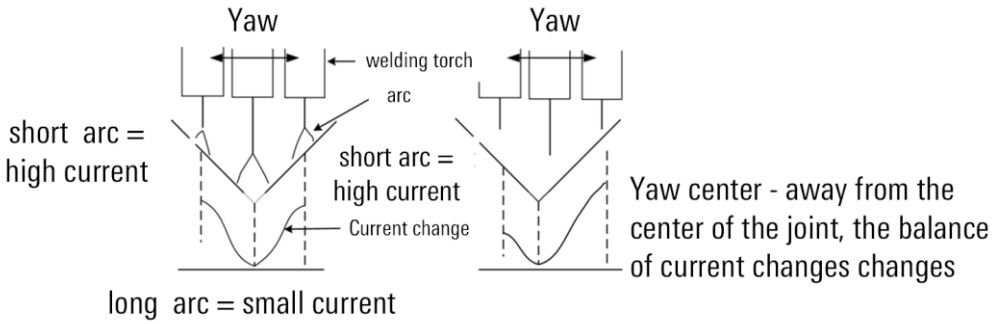


Figure 10-3 Detailed diagram of arc voltage tracking principle

The principle is that when weave welding is performed on a fillet weld, the welding current intensity also changes due to the change of the arc length at both ends and the center of the weave. The deviation between the weave center and the center of the fillet weld is the balance difference between the left and right changes of the welding current. The arc sensor captures this change in welding current for position compensation. The basic function of arc sensing is to perform profiling control of the welding seam offset caused by thermal deformation and warping of the welding material.

Precautions for use

In the process of use, you need to pay attention to the following points:

- Excessive welding spots, welding slag, and leftover wire tips on the surface of the welding seam may affect the judgment of arc sensing, and should be cleaned before use.
- TCP adjustment must be accurate.
- High current (above 250 A) works better.
- Recommended for MAG welding.
- Recommended for pulse welding.
- The thickness of the welding plate is recommended to be at least 8mm.
- Arc voltage tracking needs to be used together with weave.

Configuration example

The configuration steps are as follows:

Step1. On the main interface of the teach pendant, click the option [Extended/weld/Welding Package/Process files/Arcweave File], and the interface shown in Figure 10-4 will pop up.

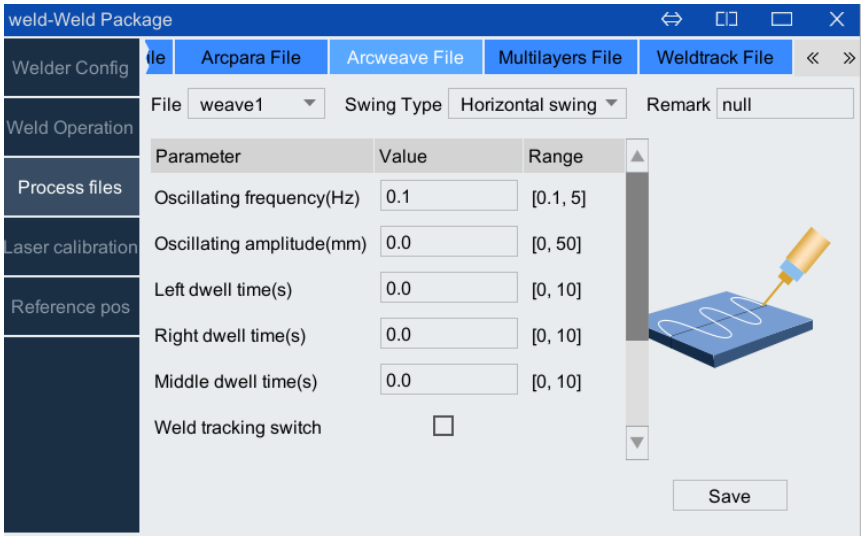


Figure 10-4 Weave parameter setting page

Step2. Click to select the check box next to [Weld tracking switch], and click <Save> to enable the arc voltage tracking function.

10.3 Multi-Layer Multi-Pass Welds—Linear Weld

Principle description

Weld line translation is a necessary method to realize multi-layer multi-pass welding. It is based on the first weld bead, and subsequent weld passes are arranged in sequence with the first weld bead as a reference. Take Figure 10-5 as an example to illustrate related terms. The reference datum is the positive direction of the XY plane, and the X direction is the welding direction.

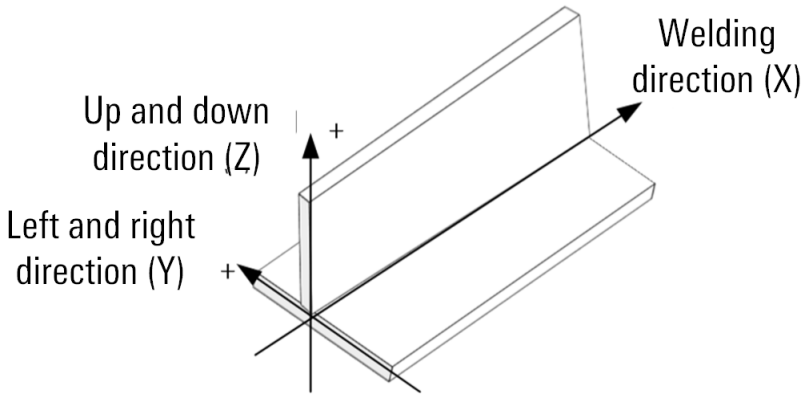


Figure 10-5 Diagram of term description

Figure 10-6 shows an example of two-layer three-pass welding. The translation position of the welding line is based on the welding line of the first track, and the translation of the welding bead is represented by the left and right coordinate values and the upper and lower coordinate values. When teaching, you only need to teach the first welding line once, and the second and third lines are automatically arranged and shifted according to the set value. See Table 10-1 for picture descriptions.

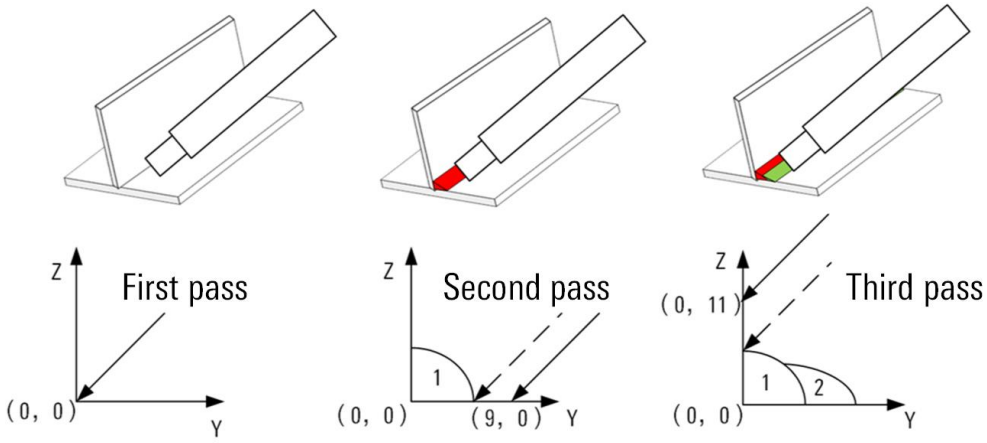


Figure 10-6 Diagram of two-layer three-pass welding

Table 10-1 Description of the picture

	1st pass	2nd pass	3rd pass
Arc left and right	0	9	0
Arc up and down	0	0	11

Configuration steps

The configuration steps are as follows:

Step1. Open a new .arl program in the program editor, click [lin] to pop up the lin configuration interface (as shown in Figure 10-7), complete the parameter configuration, and click <Insert > to generate the arc welding starting point instruction.

Figure 10-7 The lin instruction configuration interface

Step2. Click [Insert cmd/Function Package/weld/ Welding Command/Multilayers Mode], configure [Reference datum] as "XY plane" in the pop-up configuration interface (as shown in Figure 10-8), and click to select [Forward]. After the configuration is complete, click <Insert cmd>.

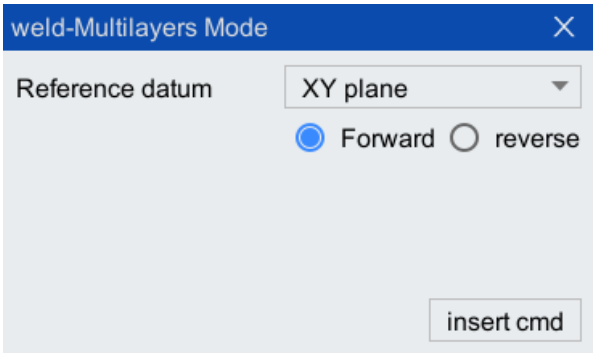


Figure 10-8 Multi-layer multi-channel mode instruction configuration interface

Step3. Move the cursor between "mpstart" and "mpend". Click [lin] to pop up the lin configuration interface (as shown in Figure 10-9), complete the parameter configuration, and click <Insert> to generate the arc on point instruction.

Figure 10-9 The lin instruction configuration interface

Step4. Click [Insert cmd/Function Package/weld/Welding Command/Arcon Command], and configure [Arc on voltage] and [Arc on current] in the pop-up configuration interface (as shown in Figure 10-10). After the configuration is complete Click on <Confirm>.

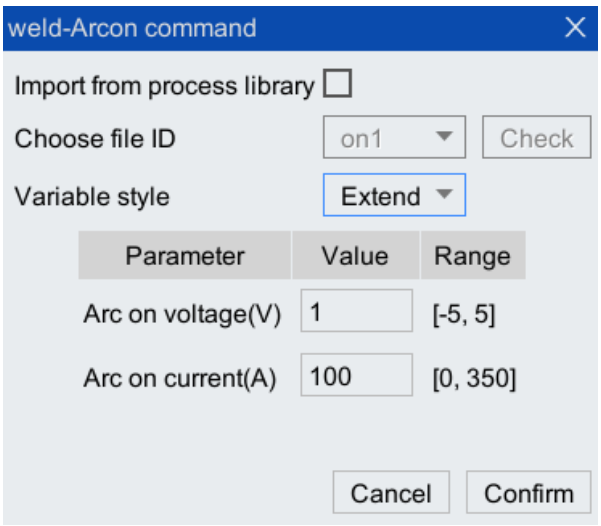


Figure 10-10 Arc on instruction configuration interface

Step5. Click [lin] to pop up the lin configuration interface (as shown in Figure 10-11), complete the parameter configuration, and click <Insert > to generate the first track start instruction.

Figure 10-11 The lin instruction configuration interface

Step6. Click [lin] to pop up the lin configuration interface (as shown in Figure 10-12), complete the parameter configuration, and click <Insert> to generate the first track end-point instruction.

Figure 10-12 The lin instruction configuration interface

Step7. Click [Insert cmd/Function Package/weld/Welding Command/Arcoff command], and configure [Arc off voltage] and [Arc off current] in the pop-up configuration interface (as shown in Figure 10-13). Click on <Confirm>.

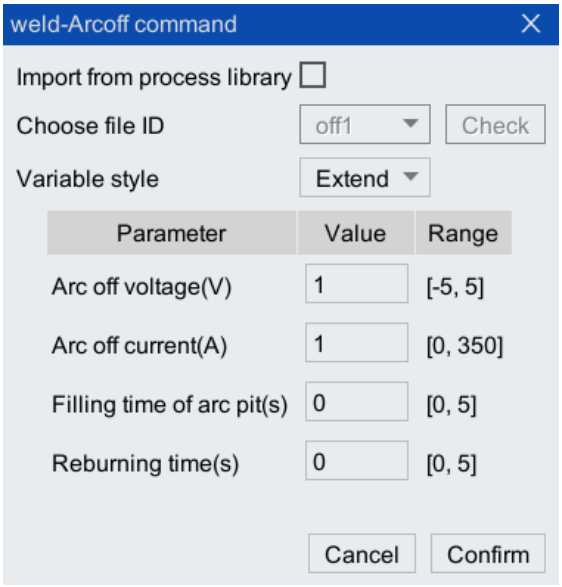


Figure 10-13 Arc off instruction configuration interface

Step8. Click [Insert cmd/Function Package/weld/Welding Command/Multilayers], click [No.1 Layer] in the pop-up configuration interface (as shown in Figure 10-14), and configure [Layers] as "2" ", [Backhaul function] is "o", [Offset along Y axis] is "9".

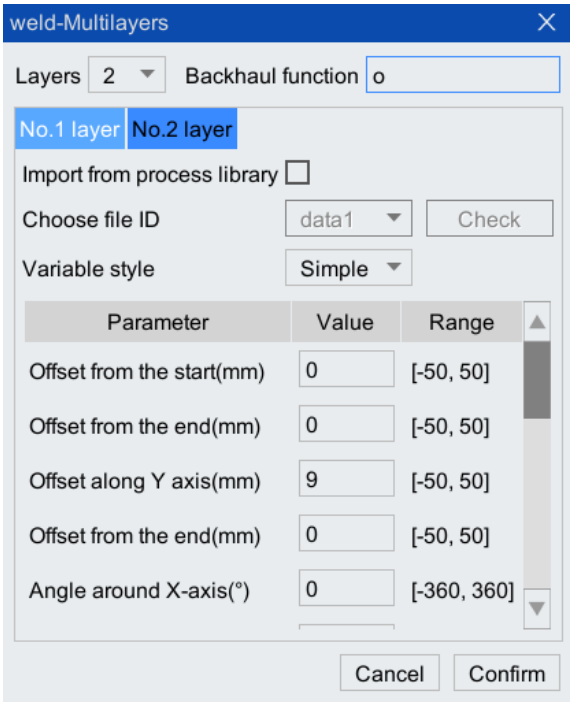


Figure 10-14 Multi-layer multi-channel instruction configuration interface

Step9. After the configuration is completed, click [No.2 Layer], and configure [Offset along Y axis] to "11". Click <Confirm> to insert the instruction. As shown in Figure 10-15.

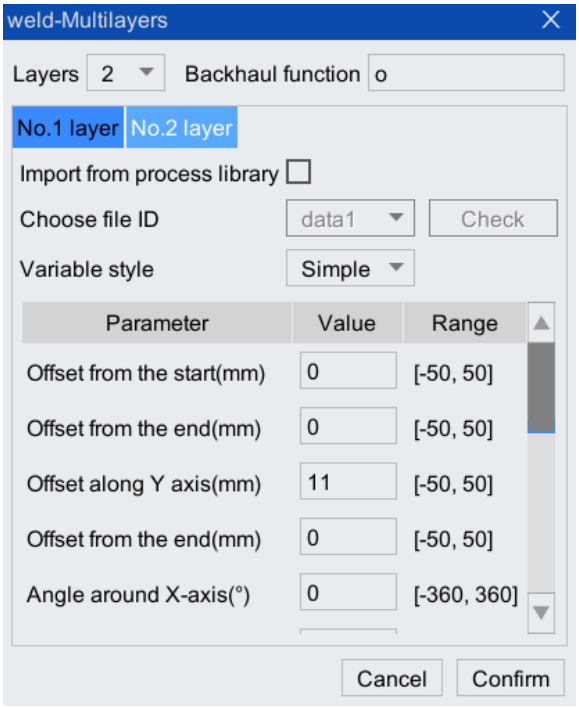


Figure 10-15 Multi-layer multi-channel instruction configuration interface

Sample program

```
func void o()    // The return function is used to return the safe point of the arc on position
endfunc
func void main()
init()    //toolswitch(-1) // Default tool load
```

```
lin p:p1,vl:50mm/s,sl:0mm,t:$FLANGE,w:$BASE[0]    // Arc welding starting point
mpstart mdl:mdl1    // Multi-layer multi-lane start sign
lin p:p2,vl:50mm/s,sl:0mm,t:$FLANGE,w:$BASE[0]    // Arc on point
arcon on:$ARCON_FILE_ID[0]    // Arc on instruction
lin p:p3,vl:50mm/s,sl:0mm,t:$FLANGE,w:$BASE[0]    // The starting point of the first track
lin p:p4,vl:50mm/s,sl:0mm,t:$FLANGE,w:$BASE[0]    // The end point of the first track
arcoff off:{ I 100, U 0 }    // Arc off instruction
mpend    // Multi-layer multi-lane end sign
mplayer data:data1, do:o()    // Second offset instruction
mplayer data:data2, do:o()    // The third offset instruction
endfunc
```

10.4 Multi-layer multi-pass welding—circular arc weld

Principle description

Figure 10-16 are examples of arc weld offsets. The reference datum is the positive direction of the XY plane, and the X direction is the welding direction. The translation position of the welding line is based on the taught arc welding line, and the translation of the welding bead is represented by the coordinate value. In this example, the arc welding seam after the offset is configured expands outward along the teaching arc, that is, offsets in the negative direction of the Y axis.

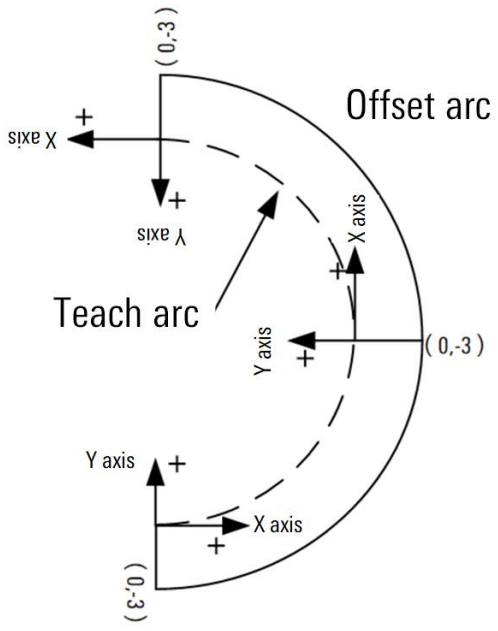


Figure 10-16 Diagram of arc welding bead

Configuration example

The configuration steps are as follows:

Step1. Open a new .arl program in the program editor, click [lin] to pop up the lin configuration interface (as shown in Figure 10-17), complete the parameter configuration, and click <Insert > to generate the arc welding starting point instruction.

Figure 10-17 The lin instruction configuration interface

Step2. Click [Insert cmd/Function Package/weld/ Welding Command/Multilayers Mode], configure [Reference datum] as "XY plane" in the pop-up configuration interface (as shown in Figure 10-18), and click to select [Forward]. After the configuration is complete, click <Insert cmd>.

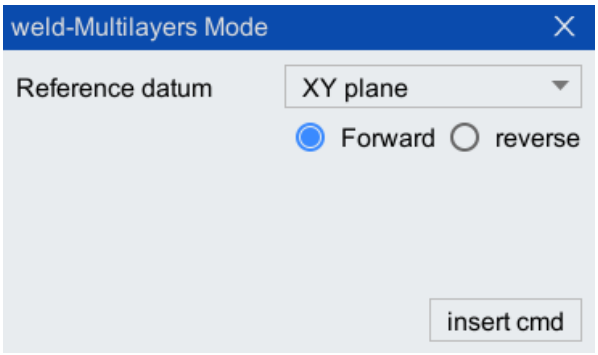


Figure 10-18 Multi-layer multi-channel mode instruction configuration interface

Step3. Move the cursor between "mpstart" and "mpend". Click [lin] to pop up the lin configuration interface (as shown in Figure 10-19), complete the parameter configuration, and click <Insert> to generate the arc starting point command.

Figure 10-19 The lin instruction configuration interface

Step4. Click [Insert cmd/Function Package/weld/Welding Command/Start weave command], configure the parameters in the pop-up configuration interface (as shown in Figure 10-20), and click <Confirm> after the configuration is complete.

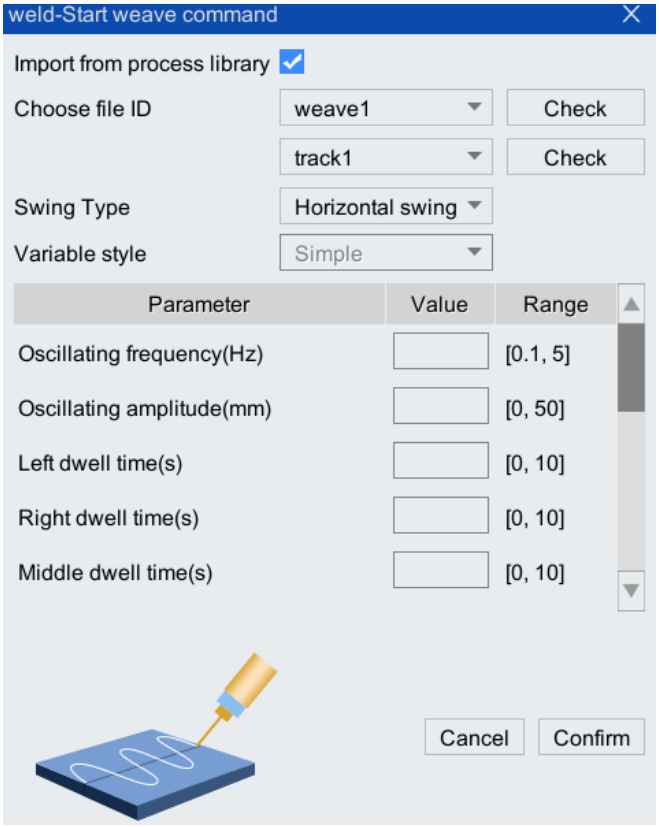


Figure 10-20 Start weave instruction interface

Step5. Click [Insert cmd/Function Package/weld/Welding Command/Arcon command], and configure [Arc on voltage] and [Arc on current] in the pop-up configuration interface (as shown in Figure 10-21). Click on <Confirm>.

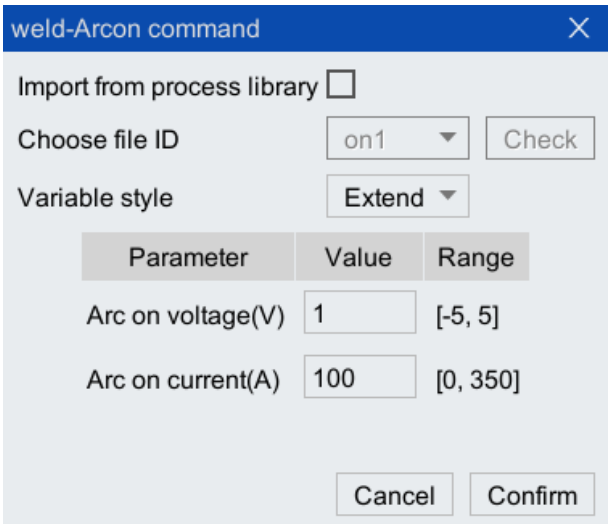


Figure 10-21 Arc on instruction configuration interface

Step6. Click [lin] to pop up the lin configuration interface (as shown in Figure 10-22), complete the parameter configuration, and click <Insert> to generate the first track start point instruction.

Figure 10-22 The lin instruction configuration interface

Step7. Click [cir] to pop up the cir configuration interface (as shown in Figure 10-23), complete the parameter configuration, and click <Insert> to generate the first track end-point command.

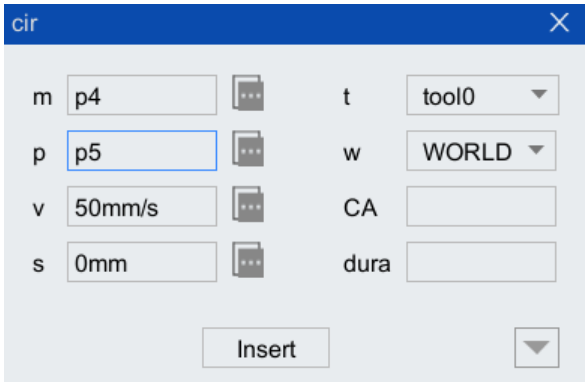


Figure 10-23 The cir instruction configuration interface

Step8. Click [Insert cmd/Function Package/ weld/Welding Command/Arcoff command], and configure [Arc off voltage] and [Arc off current] in the pop-up configuration interface (as shown in Figure 10-24). Click on <Confirm>.

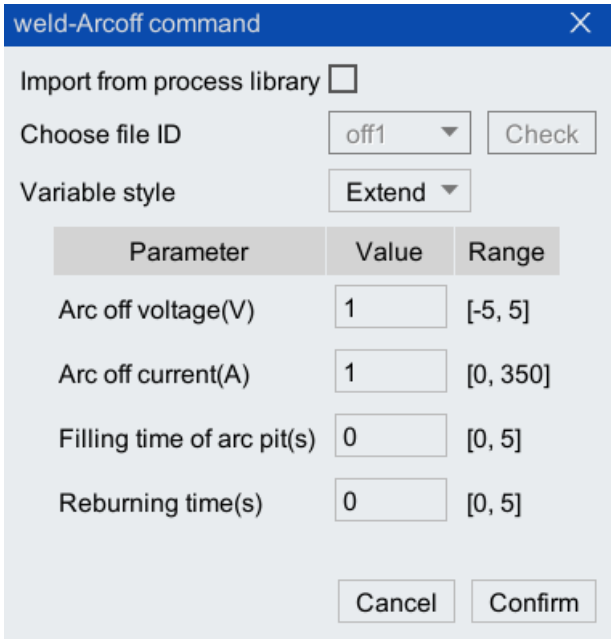


Figure 10-24 Arc off instruction configuration interface

Step9. Click [Insert cmd/Function Package/weld/Welding Command/weldendweave], and click <Insert>. As shown in Figure 10-25.

Figure 10-25 End weave instruction interface

Step10. Click [Insert cmd/Function Package/weld/Welding Command/Multilayers], click [No.1 layer] in the pop-up configuration interface (as shown in Figure 10-26), and configure [Layers] as "1" ", [Backhaul function] is "o", [Offset distance along the Y axis] is "-3".

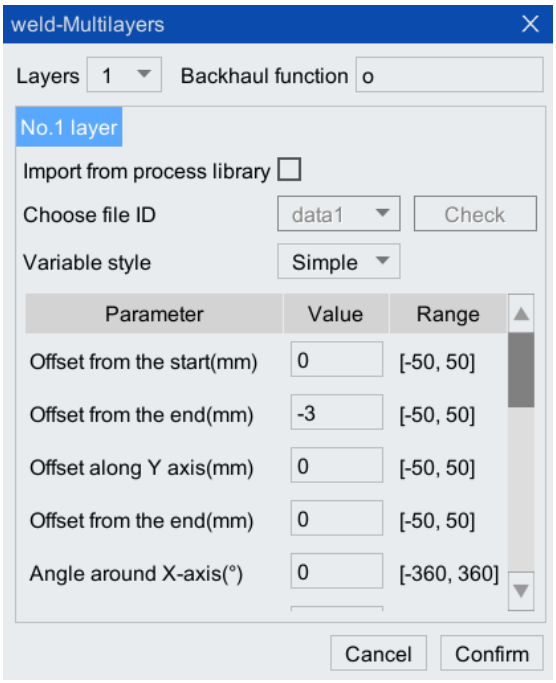


Figure 10-26 Multi-layer multi-channel instruction configuration interface

Sample program

```
func void o()//The return function is used to return the safe point of the arc on position
lin p:p5,vl:50mm/s,s:s1,t:$tool0,w:$WORLD
endfunc
func void main()
init()
//toolswitch(-1) // Default tool load
lin p:p1,vl:50mm/s,sl:0mm,t:$tool0,w:$WORLD
mpstart mdl:mdl1// Multi-layer multi-pass start
lin p:p2,vl:50mm/s,sl:0mm,t:$tool0,w:$WORLD// Arc on point
weldweave weave:weave1// Weave instruction
arcon on:{ I 200, U 0 }// Arc on instruction
```

```
lin p:p3,v:v2,s:s2,t:$tool0,w:$WORLD
cir m:p4,p:p5,v:v2,s:s2,t:$tool0,w:$WORLD
arcoff off:{ I 180, U 0 }// Arc off instruction
weldendweave //End weave
mpend// End multi-layer multi-pass
mplayer data:data1, do:o()//The first offset parameter
endfunc
```

10.5 Laser Tracking + Weave

Function description

While the laser scans the weld, the torch oscillates at a fixed amplitude to weld.

Sample program

```
func void main()
init()
//toolswitch(-1) // Default tool load
//setAutoDisableWeld(1)
lin p:p1,vl:50mm/s,sl:0mm,t:$tool0,w:$BASE[0]
lkstart t:$tool0,w:$BASE[0],job:3 // Turn on laser tracking
weldweave weave:weave1 // Turn on weave
arcon on:{ I 100, U -12 } // Arc on
lin p:p2,vl:5mm/s,sl:0mm,t:$tool0,w:$BASE[0]
arcoff off:{ I 100, U 20 } // Arc off
weldendweave    // End weave
lkend // Turn off laser tracking
endfunc
```

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