

# Rice Mfg. ROBOTICS **Welding**

## **Process Instructions**

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This system is available for several types of robots, while this manual takes 6-joints robots as an example to present some of the instructions. For other types of robots, please refer to this manual and commissioning manual.

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Please make sure that related manual/instructions can be reached by the direct users.

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# Contents

**Welding process refer to the automatic robot welding of controlling the welding tools and manipulating the process, by the meanings that set up coordination of tools, set up parameters of welding machine, set up parameters of welding and set up the basic method of welding.**

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# Safety Attentions

Please read carefully and understand totally of **these** instructions and other related documents BEFORE using this system. Please start using the system ONLY AFTER mastering all equipment knowledge, safety knowledge, and notices.

Safety attentions in this instruction are graded into four categories- DANGER, CAUTION, MUST, and FORBID

 **DANGER** indicating that death or severe injury will result if wrong operation is taken.

 **CAUTION** indicating that medium or slight injury or equipment breakdown will result if wrong operation is taken.

 **MUST** instructions that must be obey.

 **FORBID** operations that mustn't be taken.

It should be noticed that things labled with CAUTION may also result into severe consequences in different situation. So it's very important to pay attention to every CAUTION instructions, and stay strictly with them.

Some instructions even may not be labled with DANGER or CAUTION, but users should also obey them.



★ Before operating the robot, press the “emergency stop” button on the teach box and make sure main power supply of servo is off and motor is in “off-power and brake” status. After cutting off the servo power, servo power button on the teach box is red.

Under an emergency, personal injury or equipment damage may result if robot cannot be stopped in time.



★ When emergency is removed and servo power need connecting, please remove and deal properly with the incidence which causes the emergency, and then connect the servo power.

Personal injury may result due to the unwanted robot movement from wrong operation.



★ When teaching within the robot movement region, please obey the following principle: keep observe the robot from the front

follow the operation manual strictly

consider the backup plan if robot move suddenly toward yourself

set up the shelter just in case

Personal injury may result due to the unwanted robot movement from wrong operation.

★ When following processes are operated, make sure nobody is in the robot movement region and operator is in the safe position: powering the robot control electric tank

controlling the robot using teaching programmer

test run of robot

reoccurrence automatically

Personal injury may result when entering the robot movement region or contacting the robot.

Press the emergency stop button immediately when exception occurs.



**★Following items need confirming before operating robot:**

Operator is well-trained with robot-operation;

Operator has adequate knowledge of the movement feature of robot;

Operator is fully aware of the danger of robot;

Operator hasn't drink alcohol;

Operator hasn't take drugs that affect the nerve system and make reaction slow.

**★Following items need checking before robot teaching process. If any abnormal is found, fix it or take other necessary measurement immediately.**

Movement of robot is normal or not;

Zero point adjustment is correct or not;

Auxiliary equipment connected to robot is normal or not.

**★Please put the teach equipment to original position after usage, and place it firmly.**

Please don't put the teach programmer on robots, claps or ground. Otherwise, personal injury or equipment damage may result when teach programmer has collision with robot or claps.

Please be cautious with the incidental falling of teach programmer, which may leads to wrong movement of robot, personal injury and equipment damage.



# MUST

## Safe operation protocols

- ★ All the operators of robot systems should participate in system training, study safety protection measurements and understand robot functionality.
- ★ Make sure no abnormal or dangerous situation of robot and auxiliary equipment occurs, before starting operating robot.
- ★ Unplug the power or press emergency stop button before entering the operation region, even robots aren't running.
- ★ When programming within the movement region of robot, corresponding guard should be set to make sure that robot can be stopped under emergency circumstances. Please don't wear gloves when teach and inch the robot. Please take the slow mode when inching the robot, in case emergency occurs and robot can be stopped efficiently.
- ★ Operators must be familiar with the emergency stop buttons on the robot controller and periphery controller, to the degree that these buttons can be pressed exactly under emergency.
- ★ Never think that static status of robot means the finish of program. Static robot is likely to receive the input signal to get moving.

# **1 Basic concept description**

## **1.1 Concept of coordination**

When axial operations of robots are taken, the following coordination systems are proper to adapt.

### **1.1.1 Joint coordination**

Axes of robots can operated separately in joint coordination system.

### **1.1.2 Cartesian coordination**

Robots can translational move along the x axis, y axis and z axis in Cartesian coordination system.

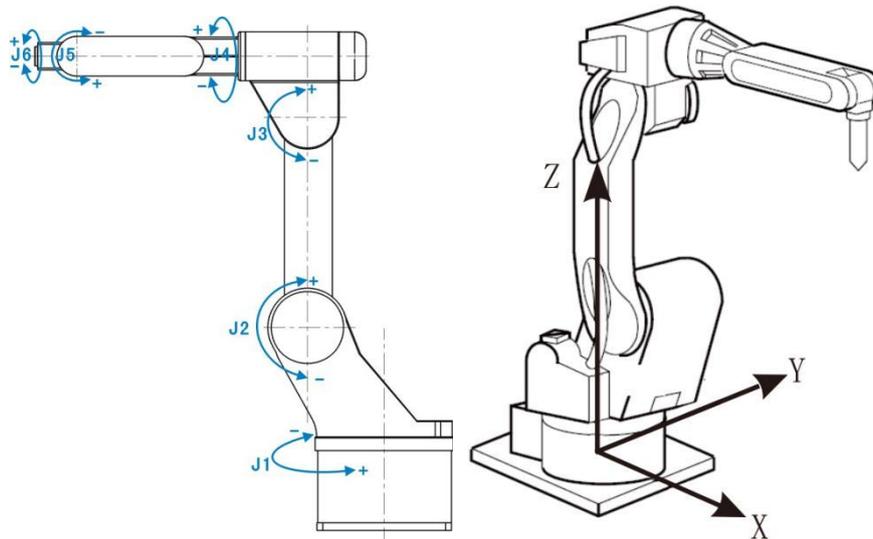
### **1.1.3 Tool coordination**

In tool coordination system, Origin Point is set at the sharp end of the tool, and z axis is set along the effective direction of tool which is taken by the flange in the wrist of robot.

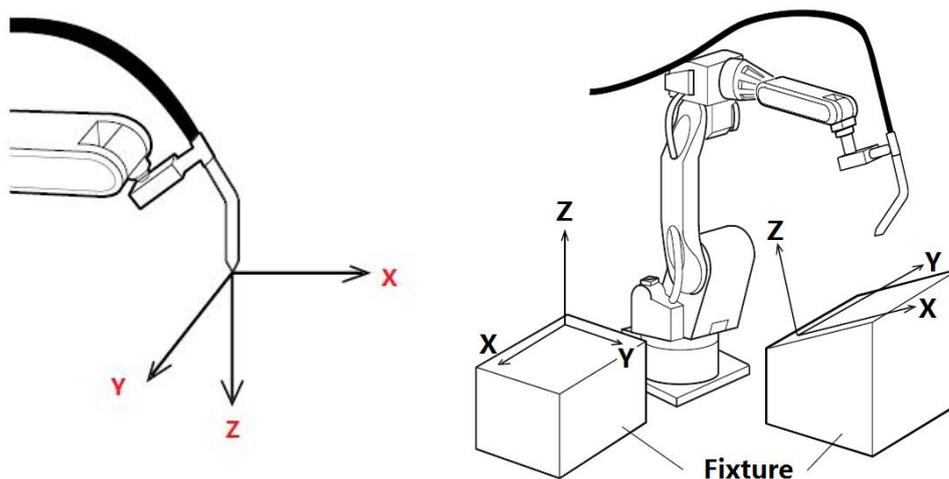
### **1.1.4 User coordination**

Robot can move along the axes which are defined by users.

In the coordination systems except joint coordination system, fixed-control-point-move is refer to the move in which tool gesture is changed while sharp end of tool keeps unchanged.



Joint coordination & Cartesian coordination



Tool coordination & User coordination

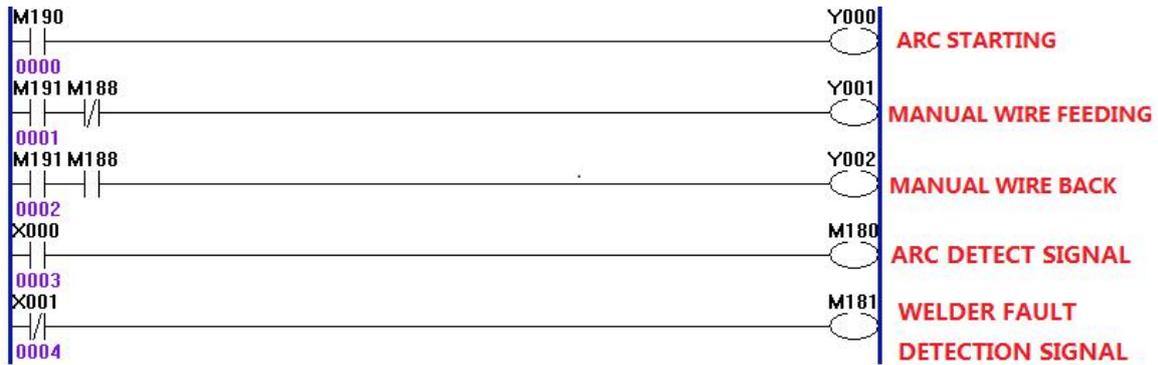
## 1.2 Match with the welding power

CRP system controls the welding power through the following signals: Two ways of 0-10V analog signal to control welding current and voltage.

M190 output, control the **arc starting**. M191 and M188 control the **wire feeding and backward**.

M180 input detects the arc success signal. M181 detects breakdown of welding power.

Logic pin need programming to use. **PLC diagrams** are shown in the user PLC.



Definitions : Inputs and outputs canbe adjusted according to the real wiring connection.

Above PLC means:

M190(Normally open)-----Yxx ( arc starting signal )

M191(Normallyopen)--M188(Normallyclose)-----Yxx ( manual wire feeding, )

M191((Normallyopen)--M188((Normallyclose)-----Yxx ( Manual wire back )

Xxx(open)-----M180 ( arc detect signal , detect if arc is successful )

Xxx(close)-----M181 ( Welding machine fault detectiondetect if there is trouble with welding power )

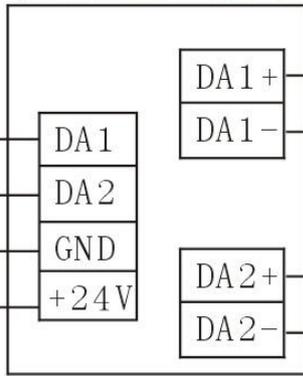
crp-system

welder

**AVO  
INTERFACE**

PIN	DEFINE
1	DA 1
2	DA 2
6	GND
5	+24V
<b>SHELL</b>	

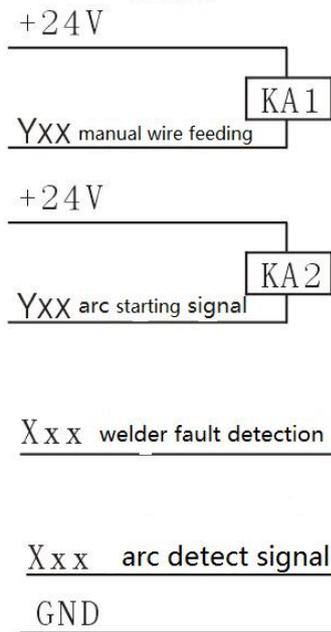
**CRP-S80-DAEX ANALOG  
VOLTAGE ISOLATION BOARD**



**CON2 INTERFACE**

PIN	DEFINE
1	COM-
3	Iset
4	Vset
5	Inch

**SIGNAL COME  
FROM THE  
I/O ADAPTER  
PLATE**



**CON1 INTERFACE**

PIN	DEFINE
1	COM-
2	TS

TMS

PIN	DEFINE
1	READY+
2	READY-
5	WCR+
6	WCR-

Wiring diagram of OTC CPVE-500 ( for reference )

system

AOTAI  
Pulse MIG-350R

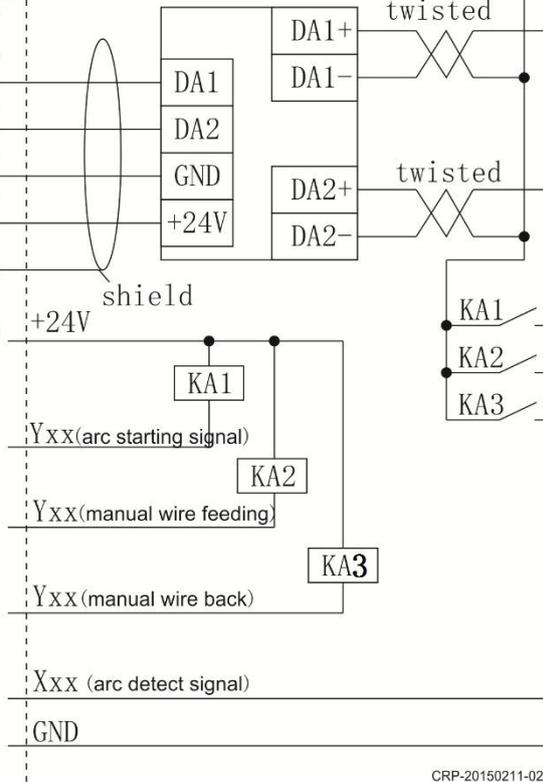
welder

CRP-S80-DAEX ANALOG VOLTAGE ISOLATION BOARD (OPTIONAL)

CONTROL SOCKET Kc2

AVO INTERFACE

PIN	DEFINE
1	DA1
2	DA2
6	GND
5	+24V
SHELL	

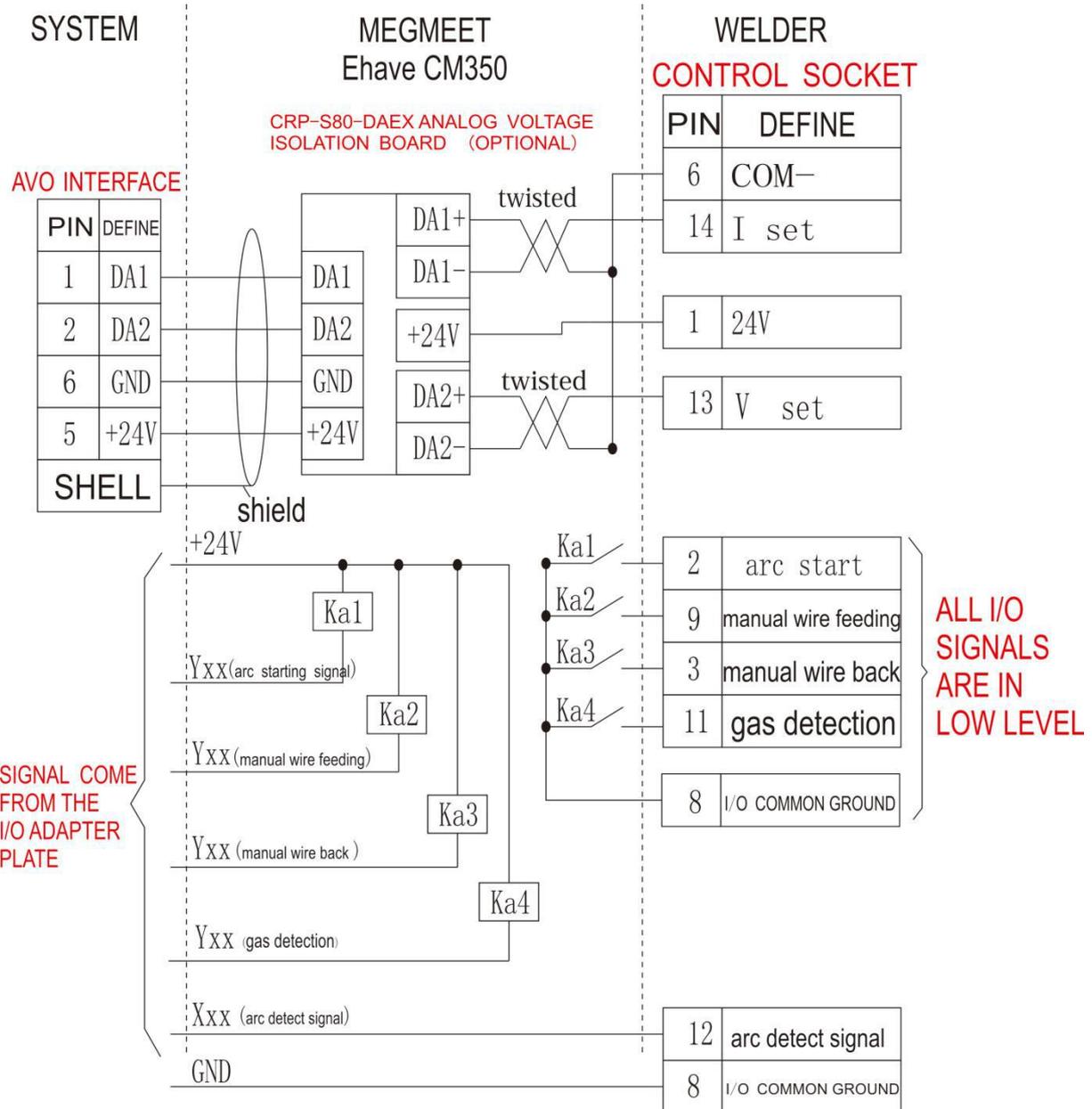


SIGNAL COME FROM THE I/O ADAPTER PLATE

PIN	DEFINE
11	COM-
6	I set
5	V set
9	arc start
7	manual wire feeding
10	manual wire back
12	arc detect signal
13	

CRP-20150211-02

Wiring diagram of AUTAI MIG-350R ( for reference )



Wiring diagram of MegmeetEhave CM350 ( for reference )

### 1.3 Welding instructions

<p>1ARC START 【 fast : 5 1】</p>	<p>Instruction functions</p>	<p>When this instruction is executed, program will invoke the pre-set welding parameters, and then start arc. Variation number is welding document number, ranging from 0 to 7.</p> <p>ArcStart and ArcEnd should be used in pair.</p> <p>Execution between ArcStart and ArcEnd is not controlled by multiplier. Only MOVL and MOVC instructions can be used between ArcStart and</p>
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		<p>ArcEnd.</p> <p>For more information about welding, please refer to "Welding Process Description" .</p>	
Additions	#<variation number>	Variation number is the number of welding document that need invoking.	
	Blank %	<p>Treatment of welding speed.</p> <p>Blank : Program between ArcStart and ArcEnd is executed in 100% speed without the control of multiplier.</p> <p>% : Set the speedpercentage (%)of program execution between ArcStart and ArcEnd.</p>	
	MM/S	<p>MM/S : Set the speed of program execution between ArcStart and ArcEnd. Speed of program instruction will not work anymore.</p>	
	VI	Set welding voltage and current. Arc starting and ending will still executed by the process instruction, while welding voltage and current is set as VI defines.	
Example program	<p>ARCSTART#(1) 8 MM/S</p> <p>V=20V I=200A</p> <p>.....</p> <p>ARCEND#(1)</p>	<p>Invoke welding parameter document 1, start arc, welding speed 8 MM/S, voltage 20V, current 200A.</p> <p>Start welding.</p> <p>End arc, finish welding.</p>	

2ARC END 【fast: 5 2】	Instruction functions	<p>When this instruction is executed, program will invoke the pre-set welding parameters, and then end arc.</p> <p>Variation number is welding document number, ranging from 0 to 7.</p> <p>ArcStart and ArcEnd should be used in pair.</p> <p>For more information about welding, please refer to “Welding Process Description” .</p>	
	Additions	#< variation number>	Variation number is the number of welding document that need invoking.
	Example program	ARCSTART#(1) 50%  ..... ARCEEND#(1)	Invoke welding parameter document 1, start arc, welding program will be executed at 50% of set speed.  Start welding.  End arc, finish welding.
3 WEAVE E 【fast: 5 3】 4 WEAVE EEND 【fast: 5 4】	Instruction functions	<p>When these instructions are executed, program will invoke the pre-set weave parameters, and then weave. Variation number is weld weavedocument number, ranging from 0 to 7.</p> <p>Weave and WeaveEnd should be used in pair.</p> <p>For more information about weave, please refer to “Welding Process Description” .</p>	
	Additions	#< variation number>	Variation number is the number of welding document which is correspondence to weave instruction.
	Example program	WEAVE#(1)  ..... WEAVEEEND#(1)	Invoke weave parameter document 1, weave, weave route,

		weave end.
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Comprehensive welding example:

ARCSTART #(1) 10MM/s V=20V I=200A	Invoke #1 welding parameter document, start arc, speed at 10 MM/S, welding voltage 20V, current 200A.
WEAVESINE #(1)	Invoke #1 weave parameters.
MOVL VL=100MM/S PL=0	Move along the welding route, Speed at 10 MM/S as set in ArcStart.
WEAVEEND	Weave end.
ARCEND #(1)	End arc using #1 welding process.

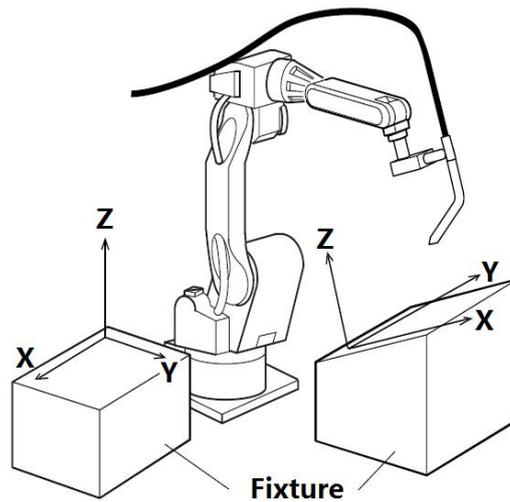
Notice	
MOVL and MOVC instructions are allowed between ARCSTART and ARCSTARTEND, MOVJ is not allowed between them.	
Notice	
Execution speed of program between ARCSTART and ARCSTARTEND is not controlled by multiplier. Specific execution speed is determined by the following rules:	
ARCSTART#(1) Blank: Execution speed is VL speed (as program set) × 100%	
ARCSTART#(1) 50%: Execution speed is VL speed (as program set) × 50%	
ARCSTART#(1) 8MM/S: Execution speed is 8 MM/S (VL speed in program is invalid)	
For details of ARCSTART, Please refer to "Operation Manual"	

## 2 Setup procedures for welding process

### 2.1 preparations

#### 2.1.1 Set up user coordination

User coordination is benefit for teach programming. As shown in below figure, the number of user coordination is the same as the number of tooling surface.



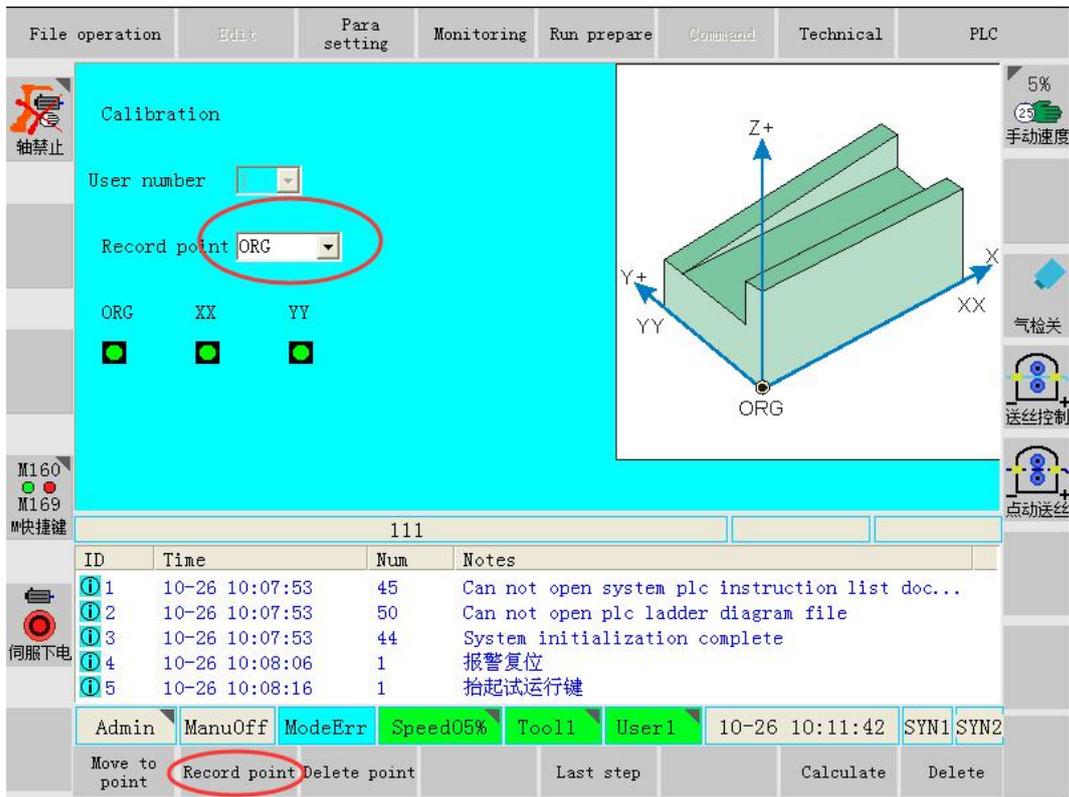
Set up procedures of user coordination:

<Run prepara>-<User coordinate> (as shown in below figure). Every tool needs a user coordination (also refer to working coordination).

#### Setup interface of user coordination

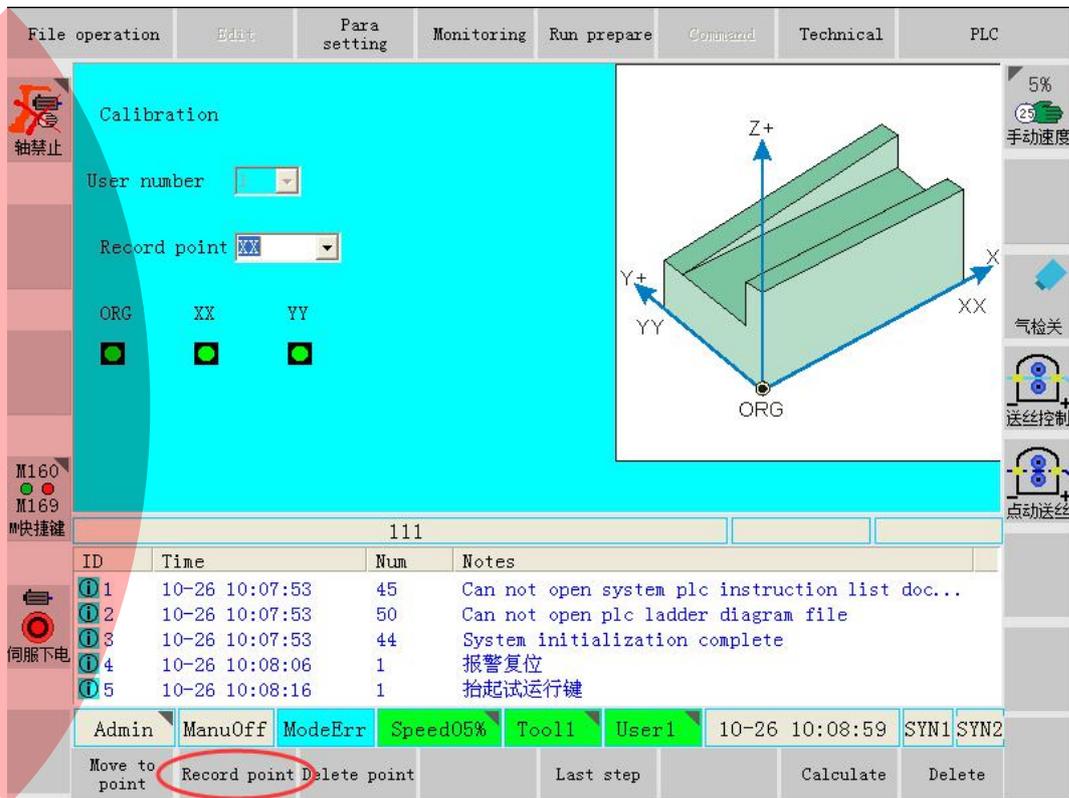
File operation	Edit	Para setting	Monitoring	Run prepare	Command	Technical	PLC	
Program name		Time		1 Tools coordinate		Size (E)		
轴禁止	111	2016-	2016-	2 User coordinate	2500	5%	手动速度	
	ARCLINE	2016-	2016-	3 Basic coordinate	0			
	call	2016-	2016-	4 SYNC coordinate	folder			
	xx	2016-	2016-	5 Robot home	59		气检关	
	视觉抓取	2016-	2016-	6 Variable	8676		送丝控制	
				7 HOME position			点动送丝	
M160	111							
M169								
M快捷鍵								
	ID	Time	Num	Notes				
	1	10-26 09:25:06	45	Can not open system plc instruction list doc...				
	2	10-26 09:25:06	50	Can not open plc ladder diagram file				
	3	10-26 09:25:06	44	System initialization complete				
	4	10-26 09:25:24	1	报警复位				
	5	10-26 09:27:07	1	抬起试运行键				
伺服下电	Admin	ManuOff	ModeErr	Speed05%	Tool1	User1	10-26 09:49:32 SYN1 SYN2	
	New	Rename	Back up	Delete	Open U disk	Open	Copy to U..	

As shown above, after choosing user coordination number, user coordination setup window will prompt, as following figure.



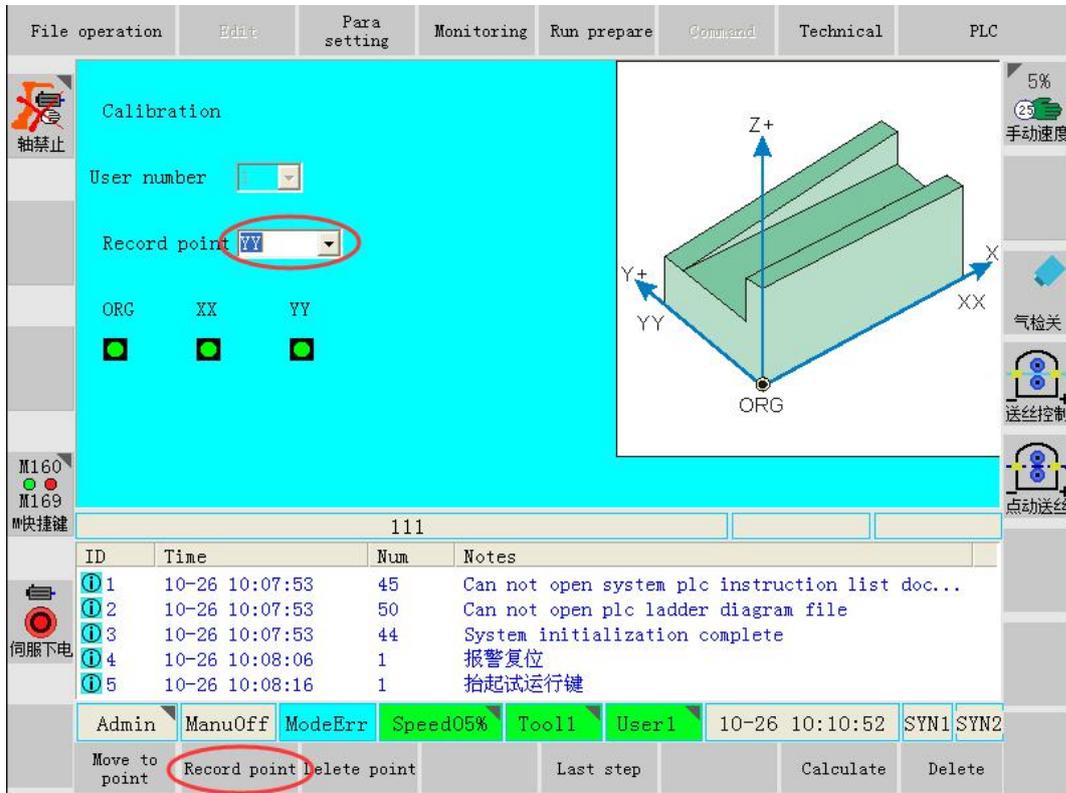
In the above interface, firstly set the zero point of user coordination system, i.e. move the robot's sharp end (using welding wire on the welding gun) onto one edge end of tool. Then click "Record point" to record zero point of user (tool) coordination.

Then choose "xx direction" to define x axis, as shown below.

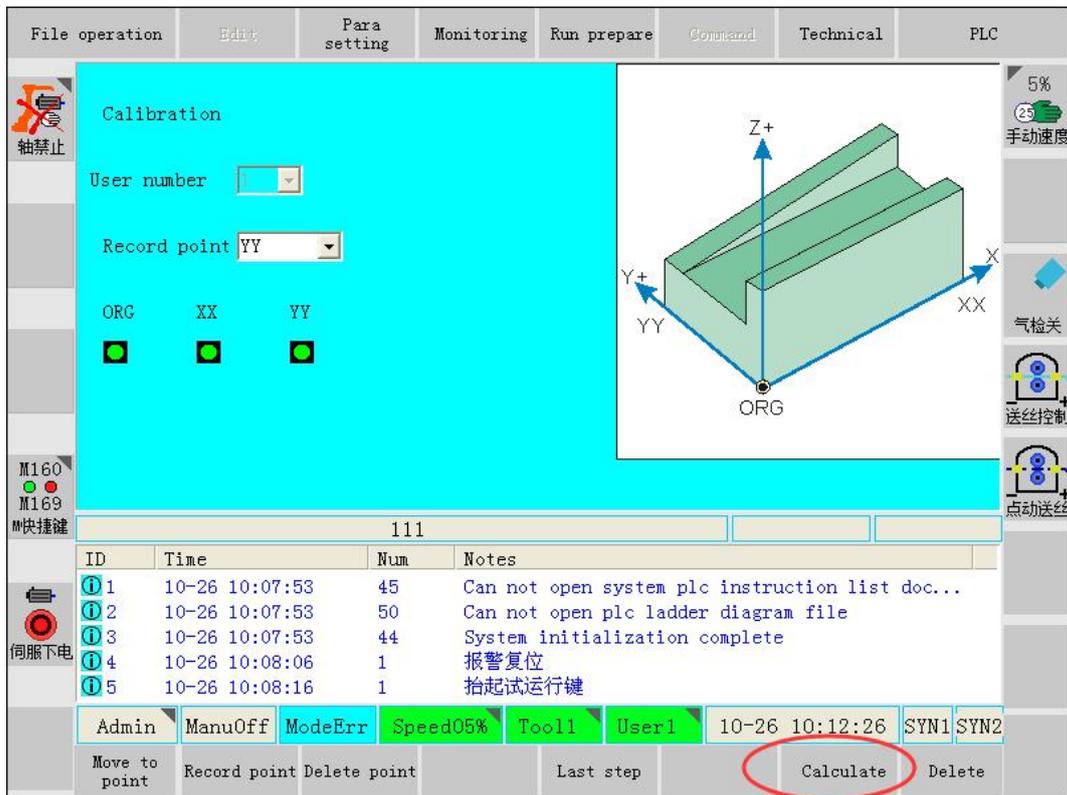


In the above interface, set the x axis of user coordination, i.e. move the robot's sharp end onto one edge of tool. Then click "Record point" to record x axis of user coordination.

Choose "YY direction" to define y axis, as shown below.



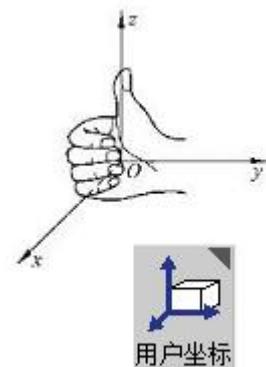
In the above interface, set the y axis of user coordination, i.e. move the robot's sharp end onto the other edge of tool. Then click "record current point" to record y axis of user coordination.



After the setup of zero point, XX direction and YY direction, click the <calculate> button, then system will automatically calculate the coordination of current user tool, determine the coordination system and direction on the tool, which is beneficial for coordination setup when palletizing.

Notice: User coordination takes the right-handed spin rule (shown in below figure), i.e. orientation of Z axis is defined along the thumb direction when right hand is spin from x axis to y axis. Usually when tool coordination is setup, orientation of Z axis points away from the tool, so it should be considered which edge on the tool should be X axis, and which edge should be y axis.

After the calculation of user coordination system, user can switch to the user coordination to



verify if the calculated system takes the desired tool axis orientation.

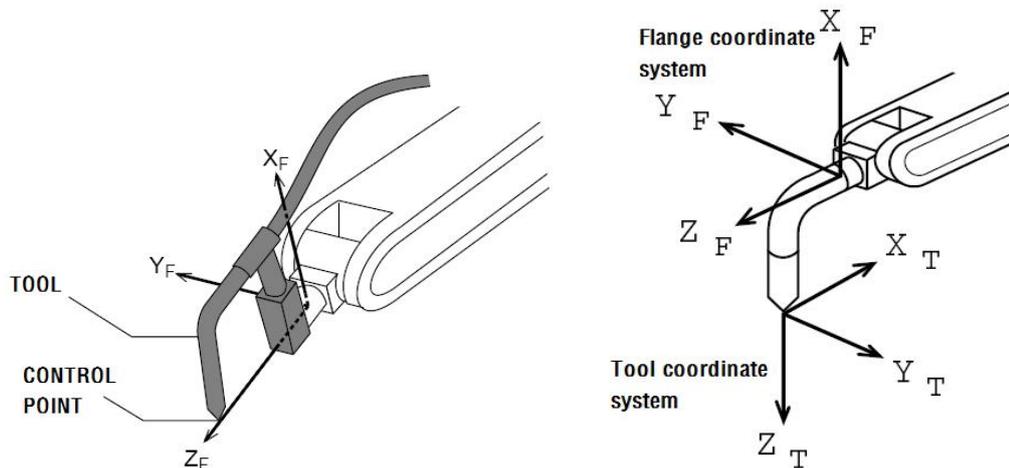
After the verification, click <cancel> to quit.

## 2.1.2 Setup of tool coordination system

In order to control the robot for the correct linear/circle interpolation etc. movement, size information should be inputted correctly and position of control point should be defined.

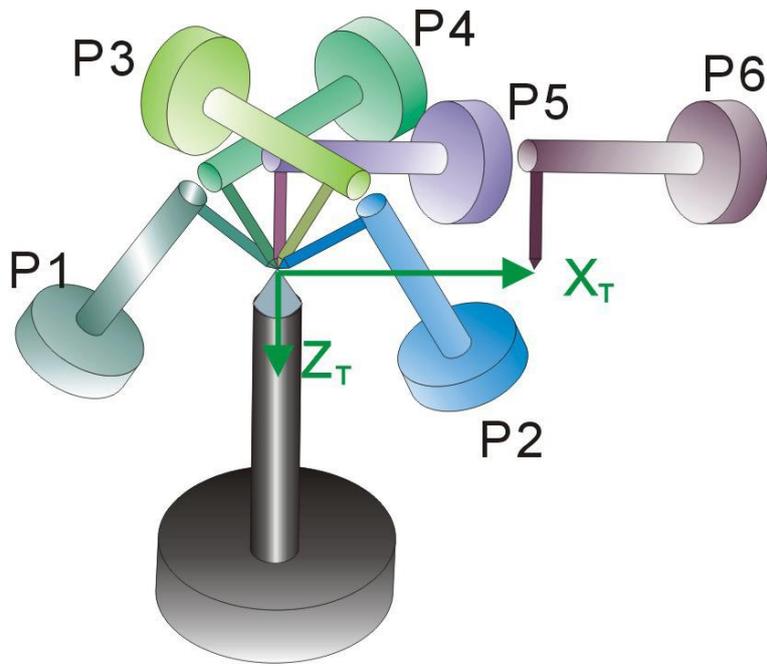
User coordination is determined by setting up 6 sets of terminal end of robots, then automatically calculating the position of tool control point, and inputting into the tool files.

The coordination of control point in flange plate coordination system can be inputted using the tool verification, as shown in below.



Tool size is based on the coordination of robot' s terminal (left figure); Relationship of tool coordination and terminal flange plate coordination (right figure)

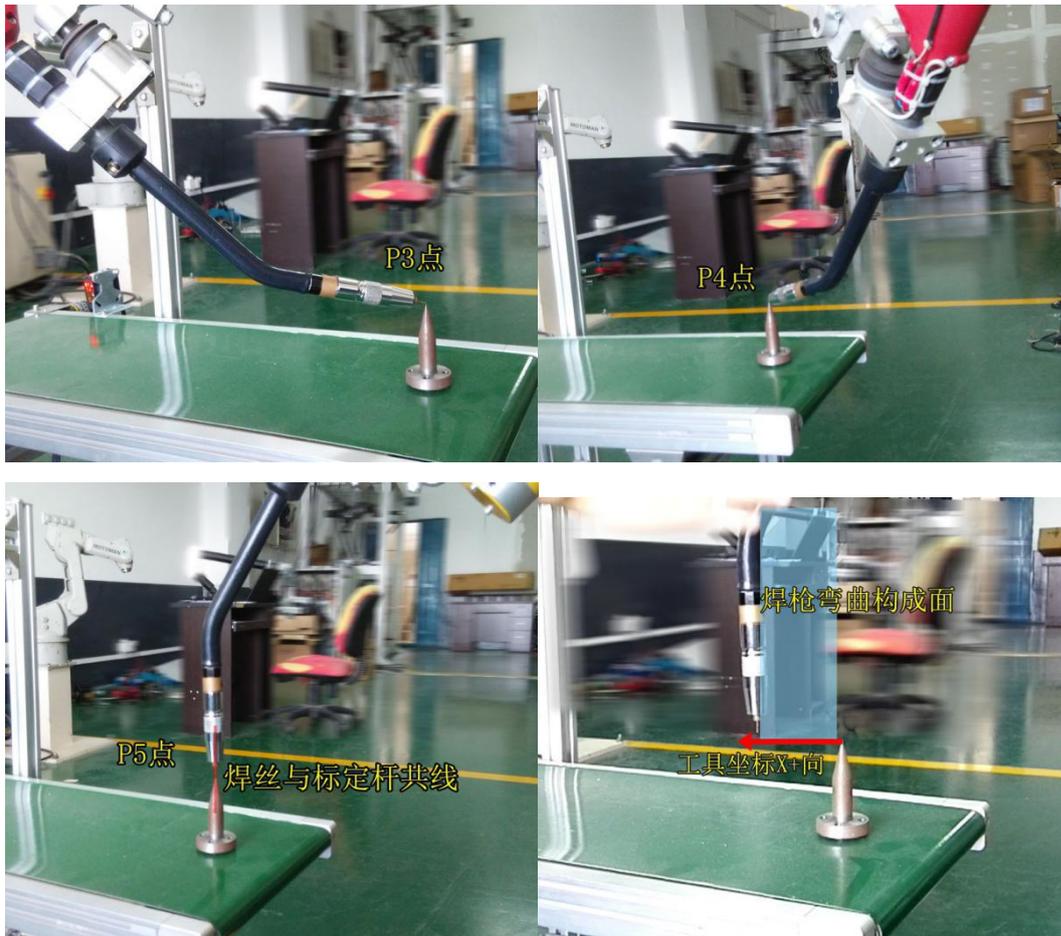
When tool verification is operated, 6 different gestures should be taught based on the control point. Then tool size can be automatically calculated according to these 6 data. Selection of point is shown as below:



Scheme of 6-point verification

Real 6-point verifications are shown below:

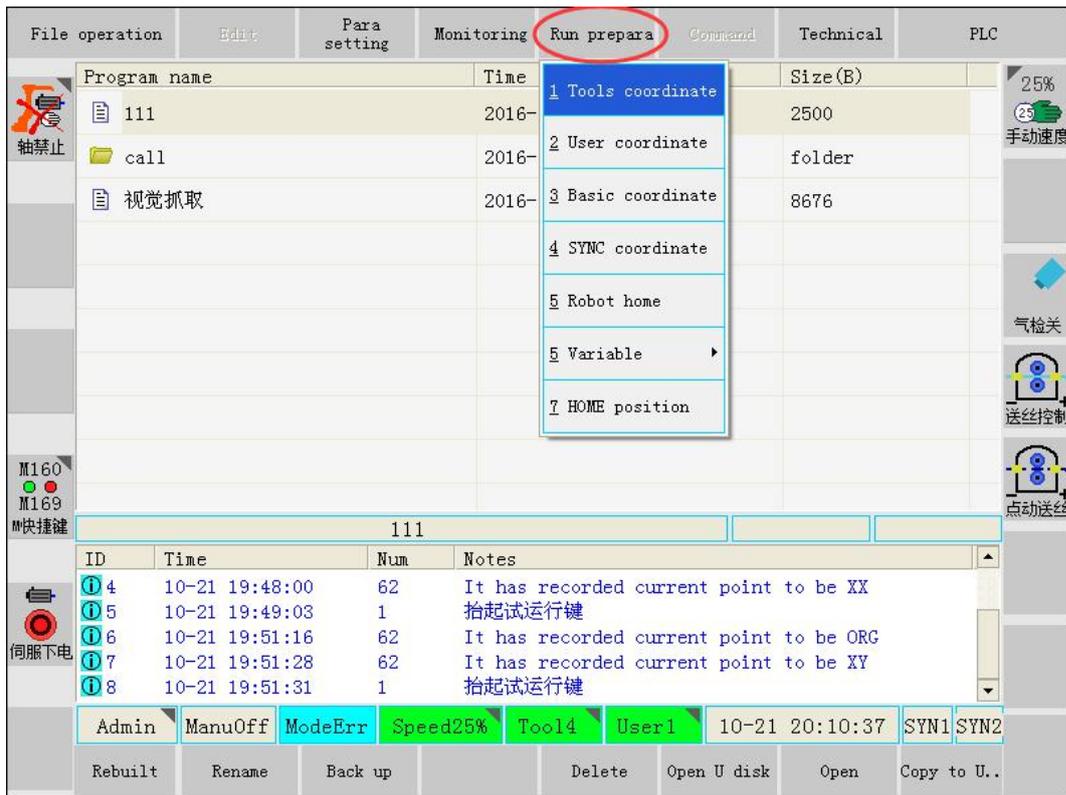




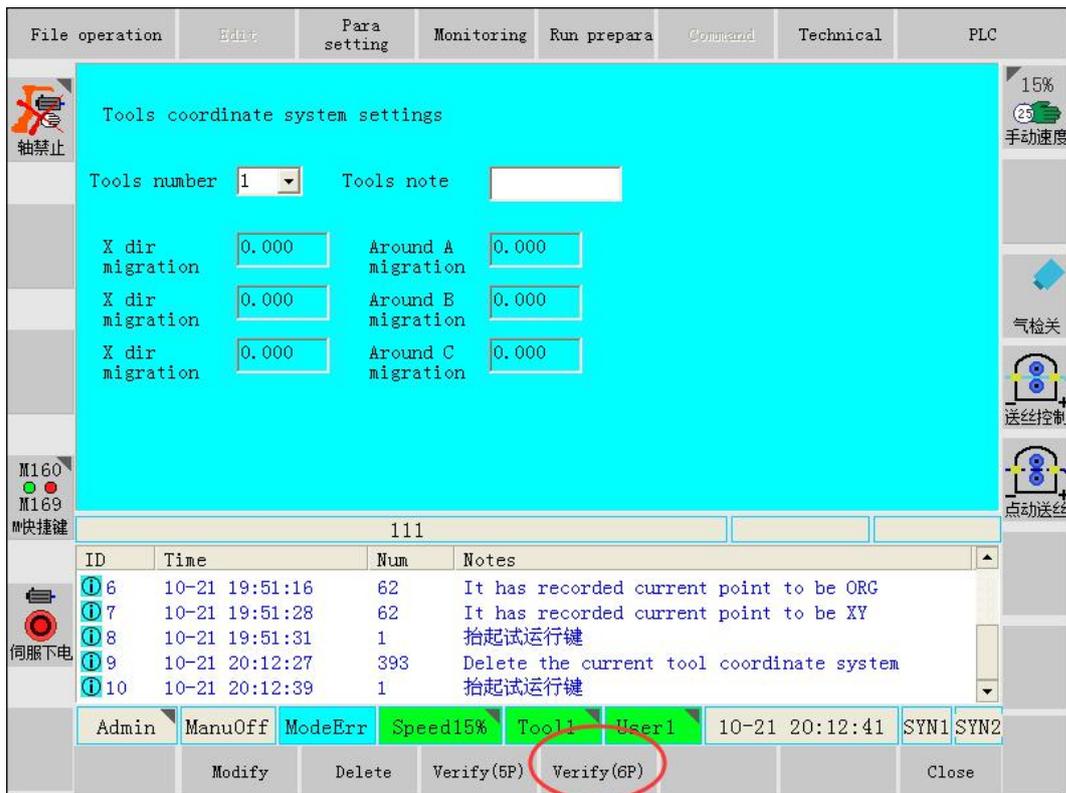
Description
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<p>As shown above, gesture of P1-P4 should be changed as largely as possible. At P5 point, welding wire (the straight part of welding gun) must in a straight line with verification device. P6 point is for determination of x axis of tool coordination system, which means line connected P5 and P6 is the x axis of tool coordination system.</p>
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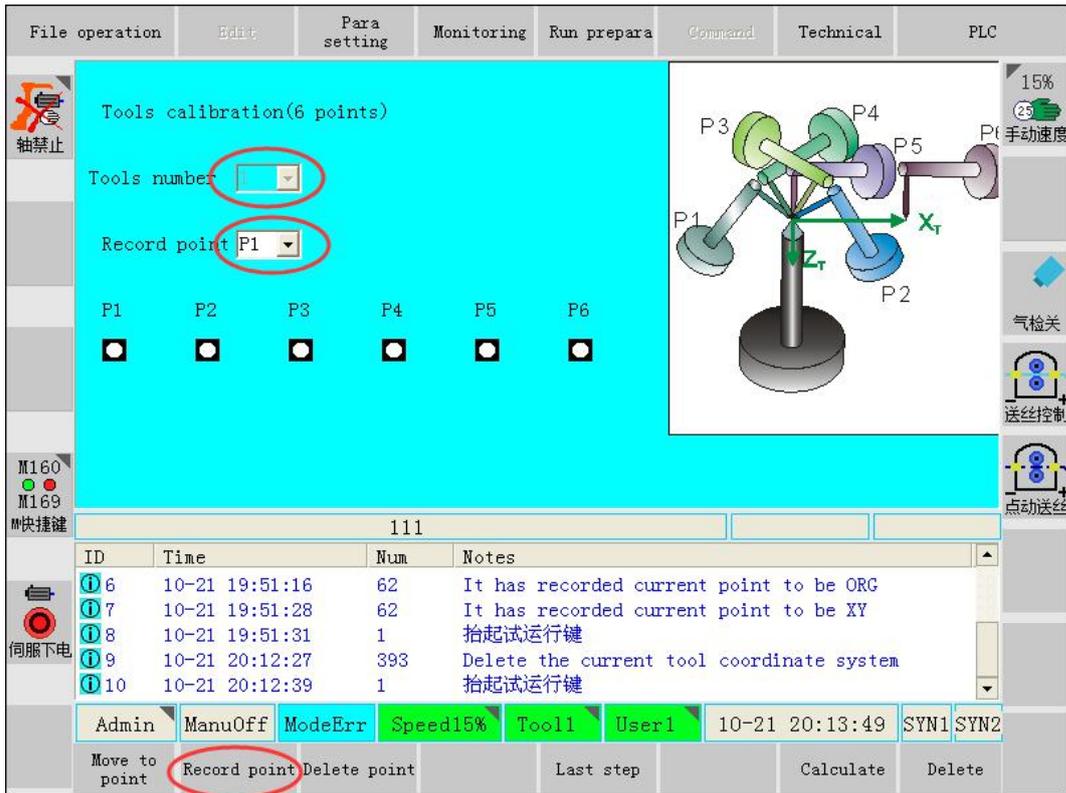
Steps for tool coordination system setup is as following: setting the tool coordination system in <Run prepare> -<Tools coordinate> (shown in below).



Tool coordination system setup interface.



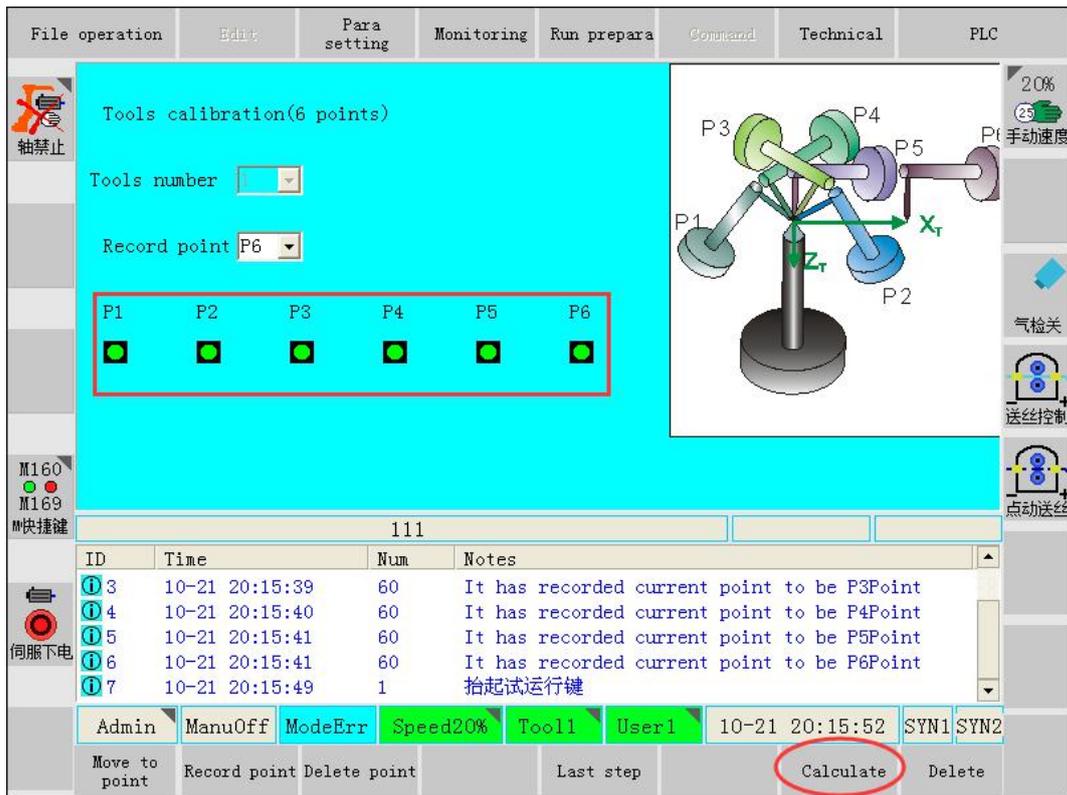
As shown in above, choose (press “↑” “↓” button) the number of tool coordination system, then click <Verify (6P)> to enter the tool coordination system setup interface, as shown in below.



In above interface, after choosing [Tool number], choose the record point number and move the sharp point of welding gun (welding wire) at the correspondent position, press "Record point" . At this time, correspondent indicator light should turn green.

After the recording of P1-P6, all indicator lights should turn green (As shown in below).

Description
As shown above, gesture of P1-P4 should be changed as largely as possible. At P5 point, welding wire (the straight part of welding gun) must in a straight line with verification device. P6 point is for determination of x axis of tool coordination system, which means line connected P5 and P6 is the x axis of tool coordination system.



Click <Calculate> in above interface, system will automatically calculate the current tool coordination, determine the coordination system and orientation on the tool. Click <cancel>, size of tool sharp point in obtained according to the flange plate at the terminal of robot.

File operation Edit Para setting Monitoring Run prepara Command Technical PLC

轴禁止

Tools coordinate system settings

Tools number 1 Tools note

X dir migration 12.500 Around A migration 0.000

X dir migration 24.000 Around B migration 0.000

X dir migration 203.558 Around C migration 0.000

M160  
M169  
快捷健

111

ID	Time	Num	Notes
① 3	10-21 20:15:39	60	It has recorded current point to be P3Point
① 4	10-21 20:15:40	60	It has recorded current point to be P4Point
① 5	10-21 20:15:41	60	It has recorded current point to be P5Point
① 6	10-21 20:15:41	60	It has recorded current point to be P6Point
① 7	10-21 20:15:49	1	抬起试运行键

Admin ManuOff ModeErr Speed20% Tool1 User1 10-21 20:18:10 SYN1 SYN2

Modify Delete Verify(5P) Verify(6P) Close

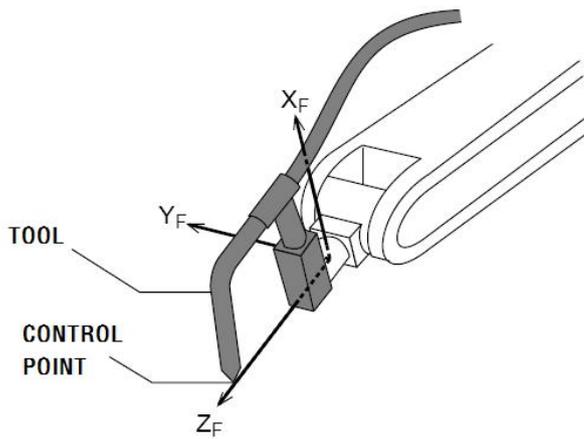
20%  
手动速度

气检关

送丝控制

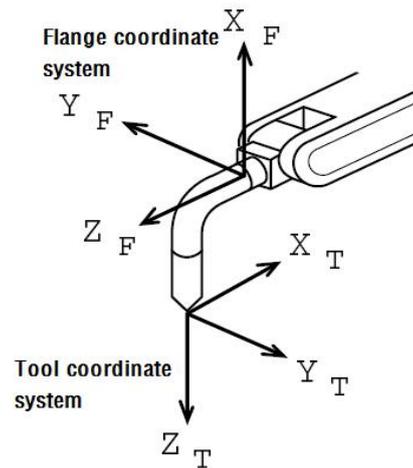
点动送丝

伺服下电



Description

Tool size is determined according to the above figure.



Tool coordination system is Cartesian coordination according to the sharp point of tool, as shown in above.

After the calculation of coordination system, user can verify if the setup coordination has the



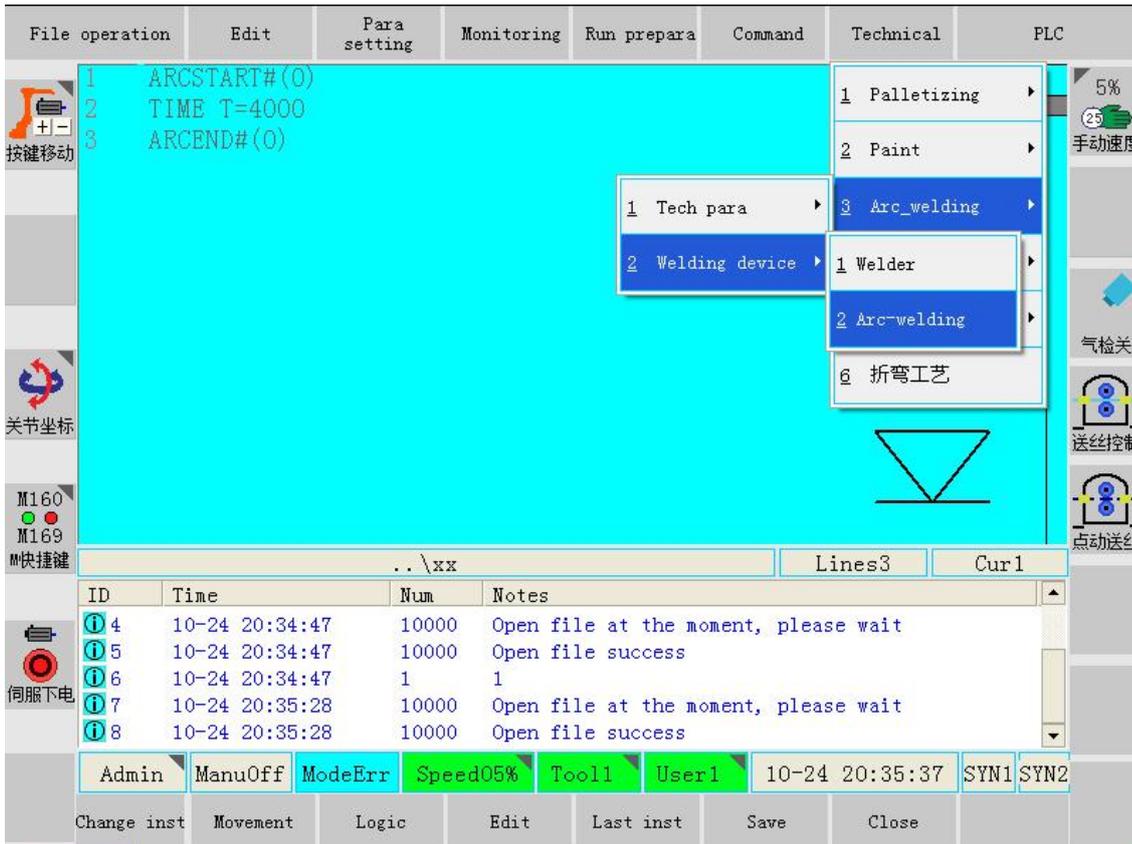
desired orientation of tool axis by switching to Tool coordination 工具坐标.

After the verification, press <close> to quit.

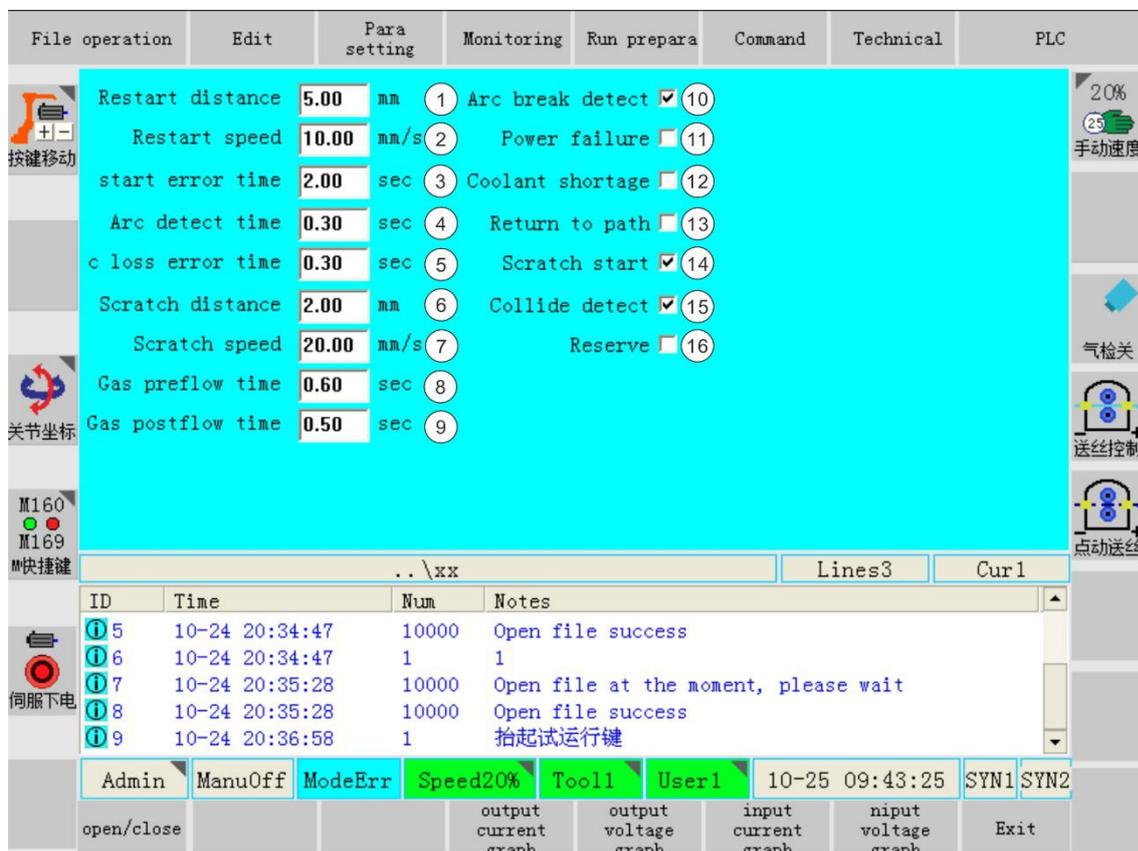
### 2.1.3 Parameters setup for welding machine

In this process, parameters related with the welding machine control are needed.

Parameters related with welding machine control is set up in <Technical>-<Arc-welding>-<Welding device>-<Arc-welding> (as shown in below).



Setup interface of welding machine is shown in below:



Settings include the following items, in mean interface of welding machine setup:

### 2.1.3.1 Basic parameters:

- 1) **Restart distance** : used to define the retreat distance of second-time arc start if first-time arc start failed or arc broken on the half way.
- 2) **Restart speed** : used to define the retreat speed of second-time arc start if first-time arc start failed or arc broken on the half way.
- 3) **Arc start error time** : used define the time delay of arc detection after the arc start.
- 4) **Arc detect time** : used to define the time duration that system can detect the success of arc start, i.e. arc start is successful only when system can detect the arc signal over a specific time, which is arc detection verification time.
- 5) **Arc loss error time** : used to define the time duration that system can detect the arc depletion, i.e. arc depletion is successful only when system can detect the arc depletion signal over a specific time, which is arc depletion detection time.
- 6) **Scratch distance** : used to define the forward movement distance of next-time arc start, if arc re-start is unsuccessful.
- 7) **Scratch retreat speed** : used to define speedbackward to arc-breaking point after next-time arc start succeed, if arc re-start is unsuccessful.
- 8) **Gas preflow time** : used to define the time period to charge the protective gas before arc start.
- 9) **Gas postflow time** : used to define the time period to stop charging the protective gas after arc depletion.

### 2.1.3.2 Function options

- 10) **Arc break detection (during welding)**: used to set if arc broken detection works or not. When this function is effective, if arc-break occurs during welding, system

will stop the welding process and save the break point. When restarting next time, robot will move backward to break point, start arc and then operate.

If user wants to cancel “arc break detection” function, switch to TEACH mode, press



the button to reset the break point. Correspondent auxiliary relay is M180.

- 11) **Power failure:** used to detect if welding power has a problem. When this function works, if welding machine has power emergency, system will stop welding process; otherwise, system will not detect if welding power is normal or not.

Time to make this function work: when system is starting up, select “Welding power abnormal detection” function, and this function will work after the arc start instruction. Correspondent auxiliary relay is M181.

- 12) **Coolant shortage:** used to detect if water cooling system has a problem. When this function works, if water cooling system has a problem, system will stop welding process.

Time to make this function work is very similar to “**Power failure**” function. Correspondent auxiliary relay is M182.

- 13) **Return to path:** used to set if system has the restart function. When this function works, system will restart arc after welding beginning or arc arc depletion. The restart speed and retreat distance is set up according to the basic parameters.

- 14) **Scratch start:** used to set if system has the scratch function. When this function works, if restart is unsuccessful, system will retreat for a certain distance at certain speed. Retreat distance and speed is set up according to the basic parameters.

- 15) **Collide detection:** used to set if system has the anti-collision detection function. When this function works, after anti-collision sensor detects collision, system will stop the welding process and servo power-off.

Time to make this function work: after system has power, anti-collision detection will work. Correspondent auxiliary relay is M13.

#### Notice

For safety reasons, it' s highly recommended to add anti-collision sensor and set **Collide detection** effective. This is beneficial to stop robot quickly if collision occurs

at robot terminals.

Method to cancel **Collide detection**: To add the M193 normally closed in M13 circle in PLC



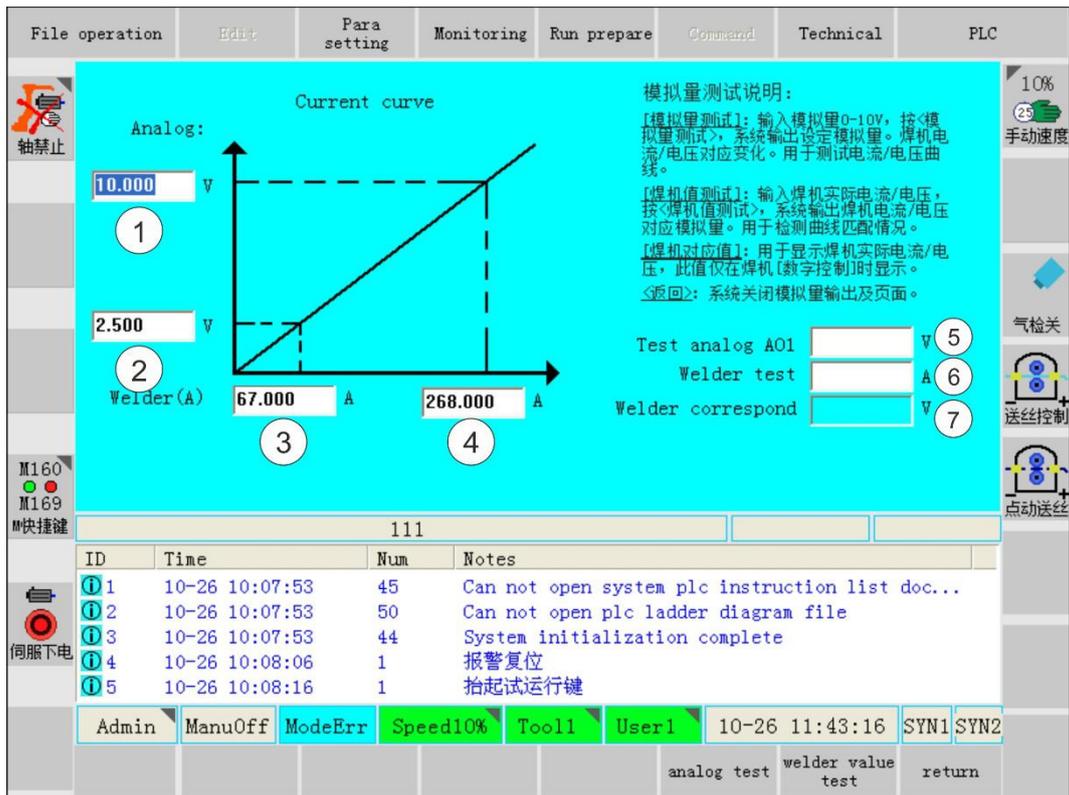
When anti-collision sensor alerts, click logo, a  will disappear, and M193 is effective. M13 circle is disconnected, press to reset alert, press  power servo, and move  bot into safe place manually. 30s later, M193 reset to ineffective automatically, and above circle will work as normal.

### 2.1.3.3 Welding current match setup.

This process is used to set the welding current of welding machine when system export 0-10V analogous signal. Press “output current graph” to enter the setup interface.

Welding current setup interface

File operation	Edit	Para setting	Monitoring	Run prepara	Command	Technical	PLC																								
	Restart distance	5.00 mm	Arc break detect	<input checked="" type="checkbox"/>				25%																							
	Restart speed	10.00 mm/s	Power failure	<input type="checkbox"/>				手动速度																							
	start error time	2.00 sec	Coolant shortage	<input type="checkbox"/>																											
	Arc detect time	0.30 sec	Return to path	<input type="checkbox"/>																											
	loss error time	0.30 sec	Scratch start	<input checked="" type="checkbox"/>																											
	Scratch distance	2.00 mm	Collide detect	<input checked="" type="checkbox"/>				气检关																							
	Scratch speed	20.00 mm/s	Reserve	<input type="checkbox"/>				送丝控制																							
	Gas preflow time	0.60 sec						点动送丝																							
	Gas postflow time	0.50 sec																													
	<table border="1"> <thead> <tr> <th>ID</th> <th>Time</th> <th>Num</th> <th>Notes</th> </tr> </thead> <tbody> <tr> <td>5</td> <td>10-24 20:34:47</td> <td>10000</td> <td>Open file success</td> </tr> <tr> <td>6</td> <td>10-24 20:34:47</td> <td>1</td> <td>1</td> </tr> <tr> <td>7</td> <td>10-24 20:35:28</td> <td>10000</td> <td>Open file at the moment, please wait</td> </tr> <tr> <td>8</td> <td>10-24 20:35:28</td> <td>10000</td> <td>Open file success</td> </tr> <tr> <td>9</td> <td>10-24 20:36:58</td> <td>1</td> <td>抬起试运行键</td> </tr> </tbody> </table>								ID	Time	Num	Notes	5	10-24 20:34:47	10000	Open file success	6	10-24 20:34:47	1	1	7	10-24 20:35:28	10000	Open file at the moment, please wait	8	10-24 20:35:28	10000	Open file success	9	10-24 20:36:58	1
ID	Time	Num	Notes																												
5	10-24 20:34:47	10000	Open file success																												
6	10-24 20:34:47	1	1																												
7	10-24 20:35:28	10000	Open file at the moment, please wait																												
8	10-24 20:35:28	10000	Open file success																												
9	10-24 20:36:58	1	抬起试运行键																												
<table border="1"> <tr> <td>Admin</td> <td>ManuOff</td> <td>ModeErr</td> <td>Speed25%</td> <td>Tool1</td> <td>User1</td> <td>10-25 10:17:13</td> <td>SYN1 SYN2</td> </tr> <tr> <td>open/close</td> <td></td> <td></td> <td>output current graph</td> <td>output voltage graph</td> <td>input current graph</td> <td>niput voltage graph</td> <td>Exit</td> </tr> </table>								Admin	ManuOff	ModeErr	Speed25%	Tool1	User1	10-25 10:17:13	SYN1 SYN2	open/close			output current graph	output voltage graph	input current graph	niput voltage graph	Exit								
Admin	ManuOff	ModeErr	Speed25%	Tool1	User1	10-25 10:17:13	SYN1 SYN2																								
open/close			output current graph	output voltage graph	input current graph	niput voltage graph	Exit																								



Parament Notes:

- 1 Max voltage of analogous output
- 2 Min voltage of analogous output
- 3 Min output current of welding machine
- 4 Max output current of welding machine
- 5 Test of analogous output of AO1 port
- 6 Test of output of welding machine
- 7 Return value of welding machine

**Discription**

To verify the welding current correspondent to output voltage, user can set system to output 0V and 10V (program : AO#1=0 and AOUT AO#1=10 ), and observe the correspondent current and input into above interface. Process as follows:

a) Program :

AOUT AO#1=0

TIME5000

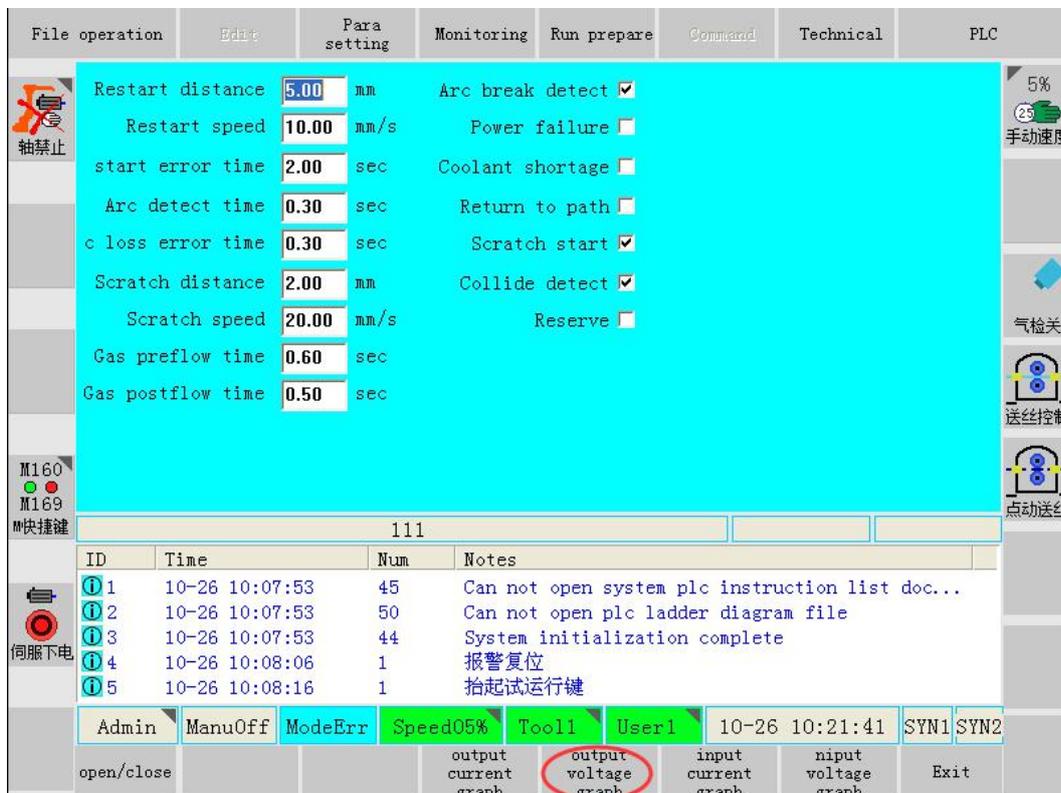
AOUT AO#1=10

b) Execute, and observe the show value on welding current detector.

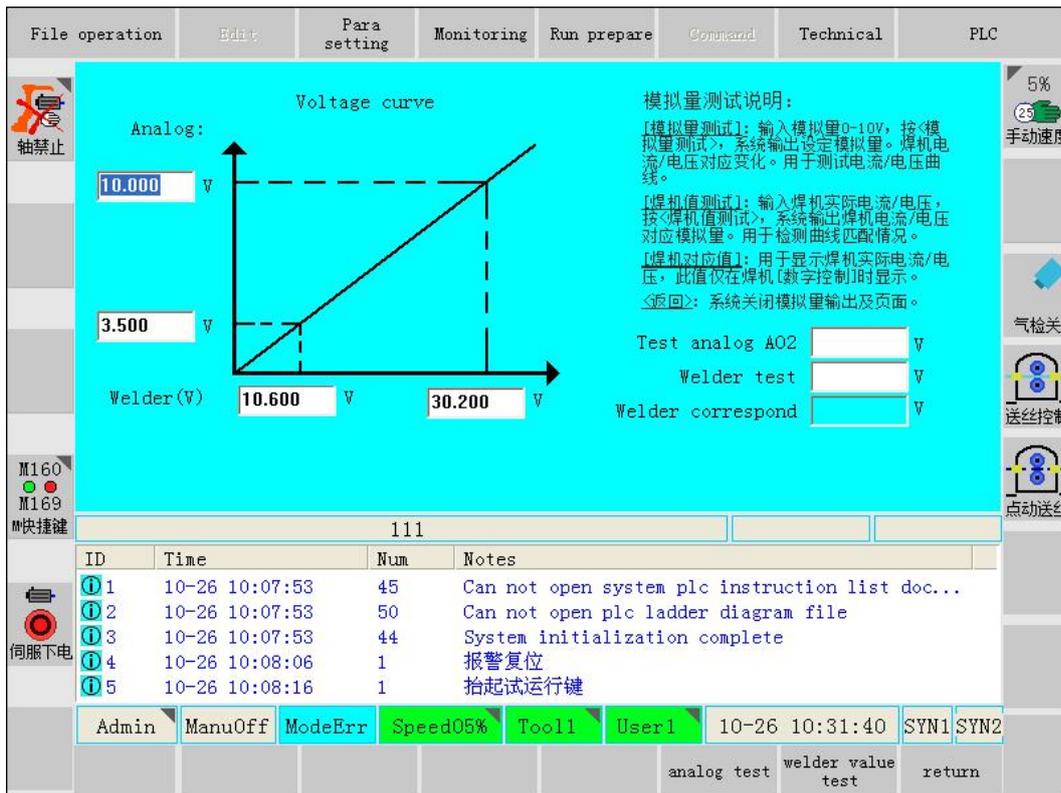
c) Input the current correspondent to 0V and 10V, and input correspondence of curve.

### 2.1.3.4 Welding voltage match setup:

This process is used to set the welding voltage of welding machine when system export 0-10V analogous signal. Press "output voltage graph" to enter the setup interface.



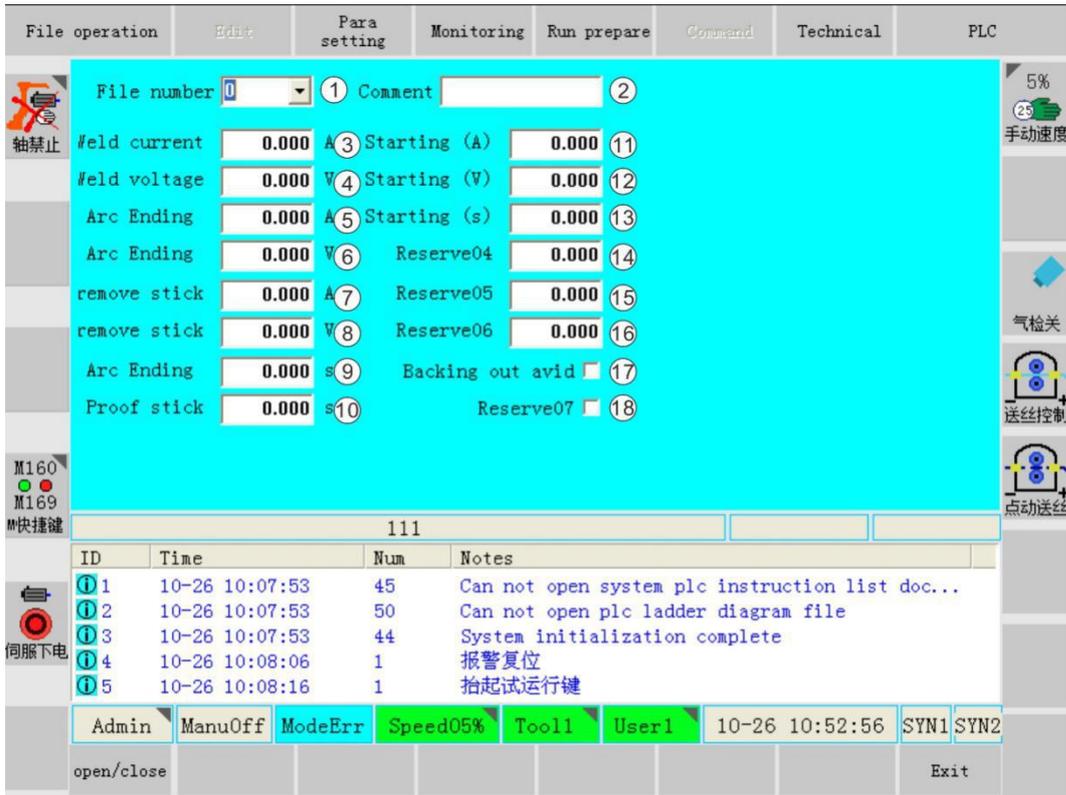
Welding voltage setup interface



Discription	
<p>To verify the welding current correspondent to output voltage, user can set system to output 0V and 10V (program : AO#1=0 and AOUT AO#1=10 ), and observe the correspondent current and input into above interface.Process as follows:</p> <p>a)Program :</p> <pre> AOUT AO#1=0  TIME5000  AOUT AO#1=10 </pre> <p>b) Execute, and observe the show value on welding current detector.</p> <p>c)Input the current correspondent to 0V and 10V, and input correspondence of curve.</p>	
Remarks	



As shown above, <Technical>-<Arc-welding>-<Tech para>-<Welding para>, and enter the welding parameters setting interface, as shown in below figure.



**Every parameter is described as follows:**

- 1 Choose the document number (range 0-7) in the [File number] above. Each number is correspondent with a set of welding parameters.
- 2 Add files comments
- 3、 4 Weld voltage and welding current is the set value for normal welding. Specific value is determined by on-site process.
- 5、 6Arc end voltage and arc end current is used when arc end is not adequate. Normally, values of arc end voltage and arc end current are smaller than welding ones.
- 7、 8 Remove-stick voltage and remove-stick current is used when welding wire adhesion occurs. Normally, remove-stick current is 0, and remove-stick voltage is higher than welding voltage.
- 9Arc end time is defined for duration time when arc end voltage and arc end current is maintained. If arc end time is too long, resurfacing welding may happen at the welding end position. If arc end time is too short, welding crater may occur at the welding end position. So arc end time need setting according to real situation.

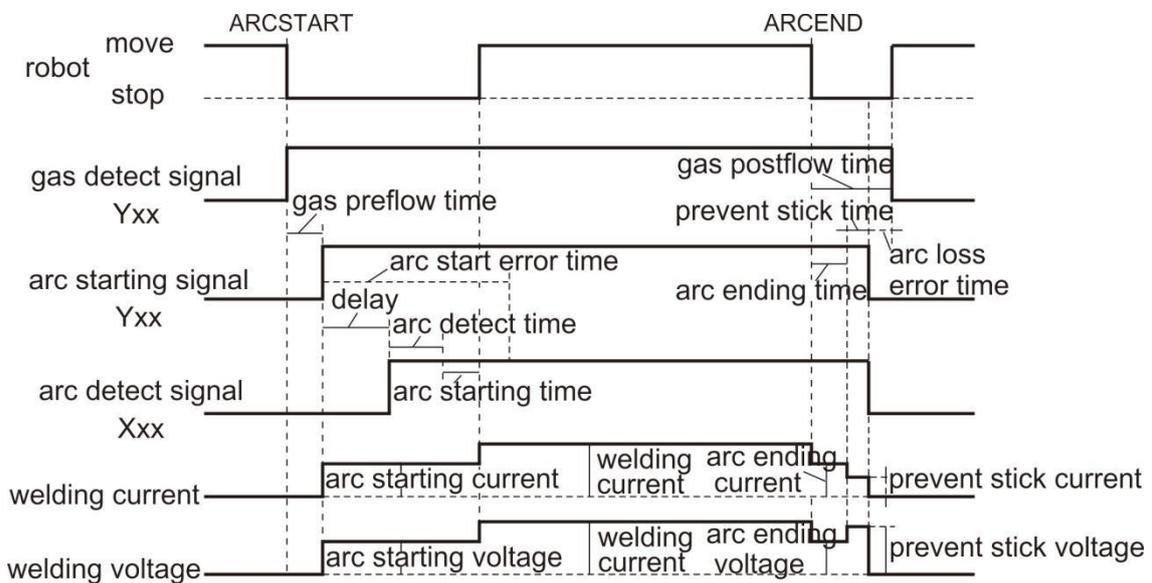
10 Remove-stick time is defined for duration time when remove-stick voltage and remove-stick current is maintained.

11 12 Arc start voltage and arc start current is used when arc start is difficult. Higher voltage and current can be taken for more efficiently arc starting.

13 Arc start time is defined for duration time when arc start voltage and arc start current is maintained. If arc start time is too long, resurfacing welding may happen at the welding start position.

14 15 16 17 18 reserve

Time sequence chart of welding control is shown below:



Welding parameters should be saved as formation of document number after the parameter setup. Then these parameters can be used by invoking the correspondent document number. One program can invoke several set of welding parameters.

Example: How to use welding parameters in program`

ARCSTART#1 Invoke 1# parameters for welding

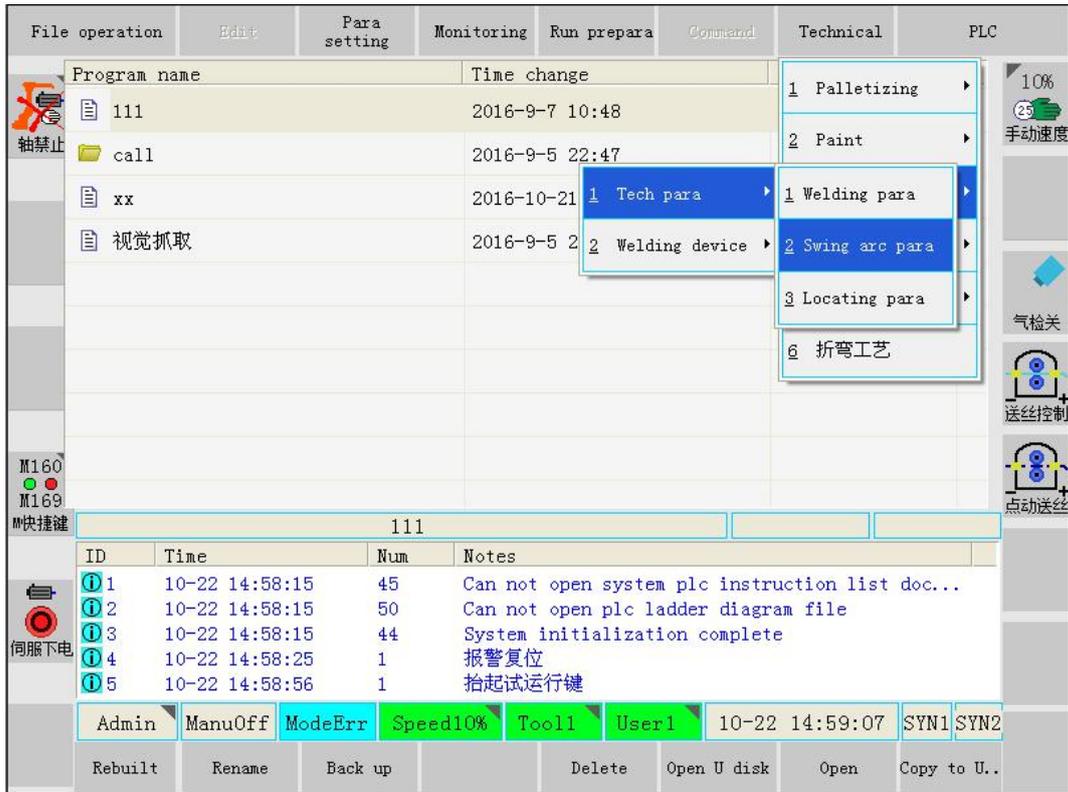
MOVL VL100=MM/S PL=0 Move along the welding track

ARCEND #1 End of 1# welding process

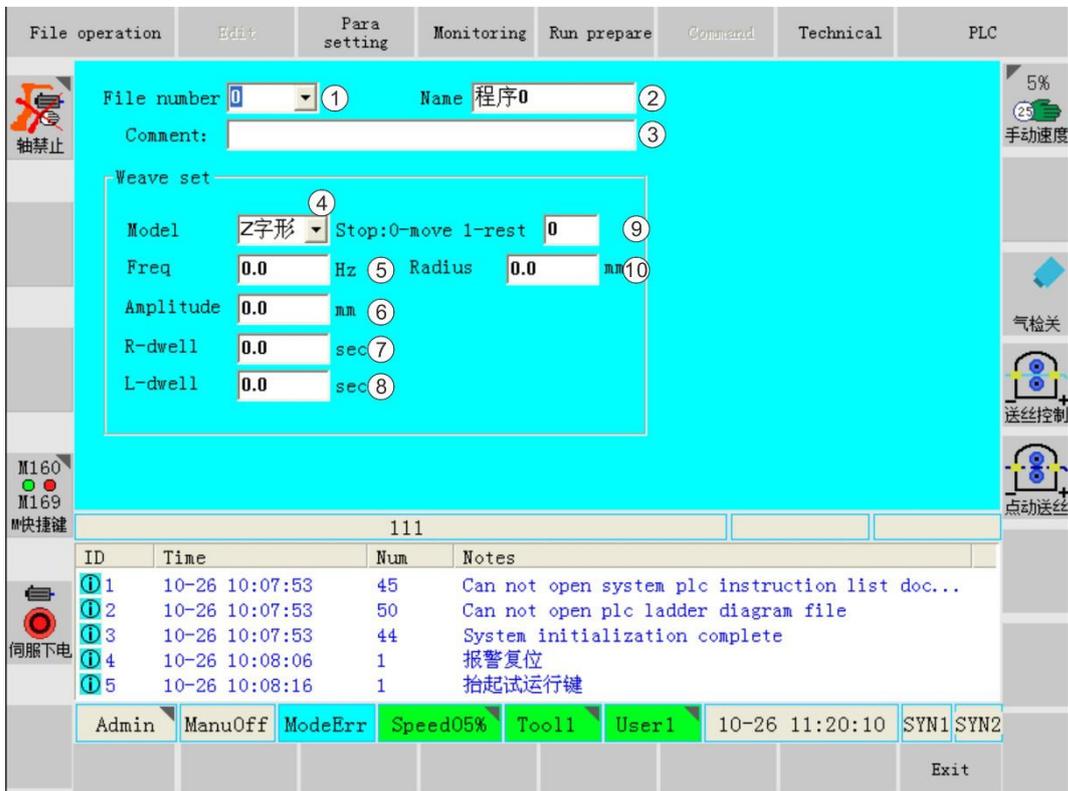
## 2.2.2 Setup welding weaves parameters

This operation is to set welding weave parameters if wide seam need welding.

As shown above, <user process>-<welding process>-<welding setting>-<parameters setting>, and enter the welding parameters setting interface, as shown in below figure.



As shown above, <Technical>-<Arc-welding>-<Teach para>-<swing arc para>, and enter the welding weave parameters setting interface, as shown in below figure.



1 Choose the weave file number (range 0-9) in the [weave document number] above. Each number is correspondent with a set of welding parameters.

2 3 Some detailed information can be input into [Name] and [Comment] column, which is beneficial for operators to understand the welding weave.

In the [weave set] column, [mode selection], [weave frequency], [weave extent], [left stay time], [right stay time] can be input, and press quit after setup.

4 Model: Only zigzag weave function is available up to now. Other types of weave functions are under development.

5 Freq: used to set weave frequency, unit is Hz.

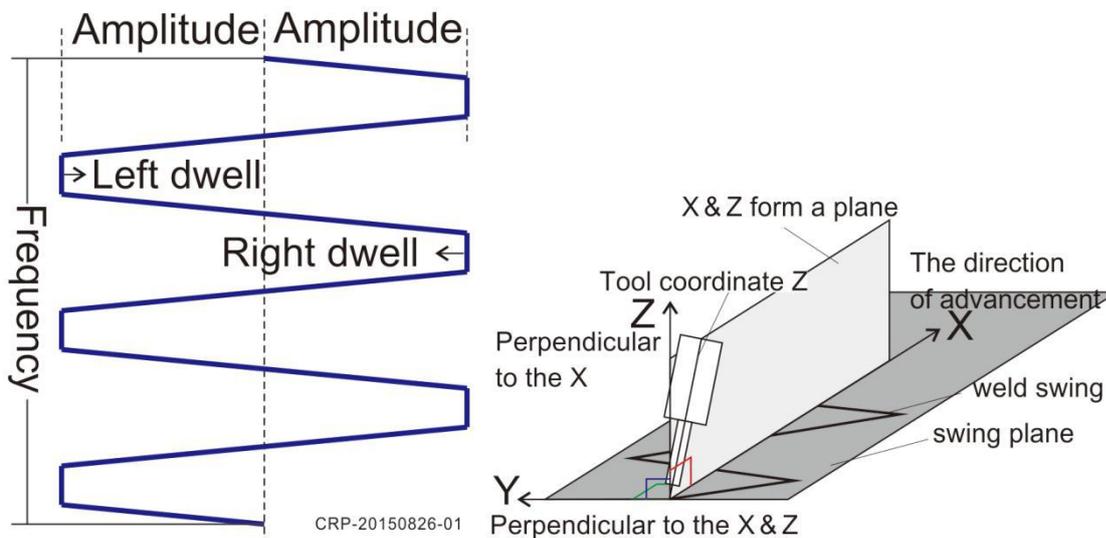
6 Amplitude: used to set one-side movement distance, unit is mm.

7 R-dwell: used to set duration time at the right weave apex, unit is s.

8 L-dwell: used to set duration time at the left weave apex, unit is s.

9 Set left-right stay: 0-no stay, 1-stay.

10 circular radius (not available up to now)



#### Weave scheme Weave coordination

Description: Weave parameters should be saved as formation of document number after the parameter setup. Then these parameters can be used by invoking the correspondent document number. One program can invoke several set of welding parameters.

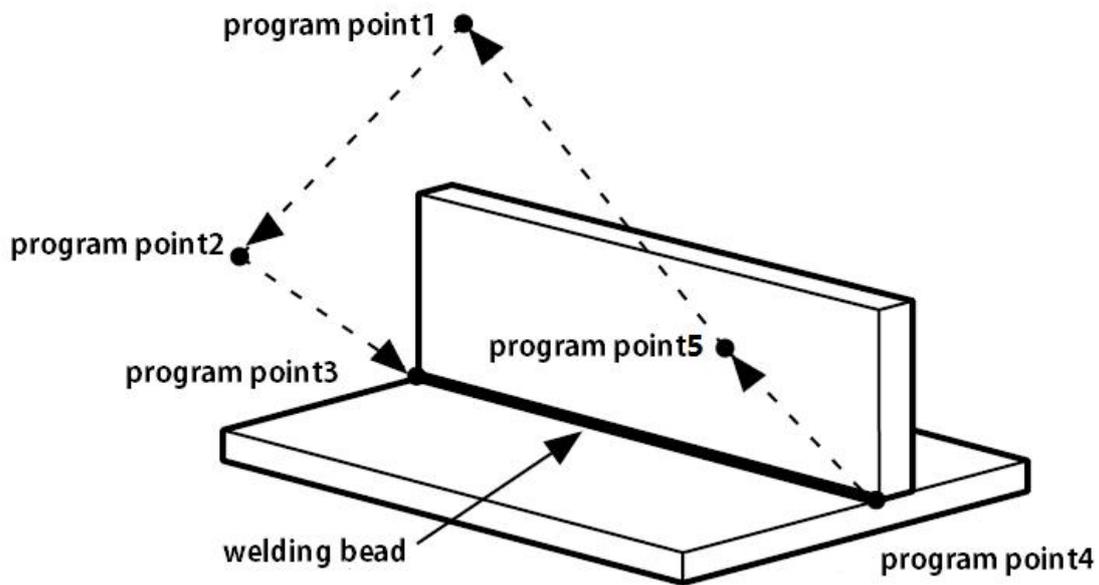
Weave is based in the weave coordination. If forward direction is circle, x axis is orientated along the normal line of circle. e.g. : How to use welding parameters in program

ARCSTART#1 Invoke 1# parameters for welding

WEAVESINE #1 Invoke 1# parameters for weave  
 MOVL VL100=MM/S PL=0 move along the welding track  
 WEAVEEND End of weave  
 ARCEND #1 End of 1# welding process

### 3 Example for welding program

After the above setting, welding program can be operated. Below is an example for welding program steps taking the below welding workpiece as an example.



#### 3.1 Program example

Basic program is as follows for the above workpiece :

MOVJ VJ=50.0% PL=5 move quickly to program point 1, wait  
 MOVJ VJ=50.0% PL=5 move quickly to program point 2, welding prepare  
 MOVL VL=200 MM/S PL=0 move quickly to program point 3, welding start  
 ARCSTART#1 Invoke 1#welding parameters, start arc  
 WEAVESINE #1 Invoke 1# welding weave parameters  
 MOVL VL=50MM/S PL=0 move along the welding track, move straight to program point  
 4  
 WEAVEEND weave end

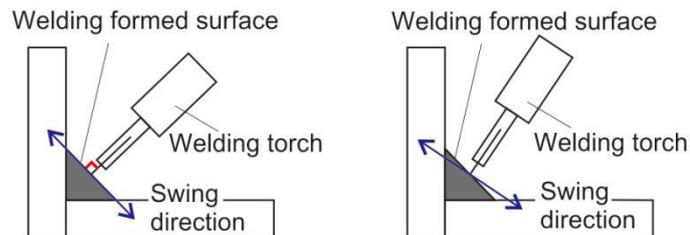
ARCEND #1 1# welding process end

MOVJ VJ=50.0% PL=3 move quickly to program point 5, safe point

## 3.2 Program teach steps

Description :

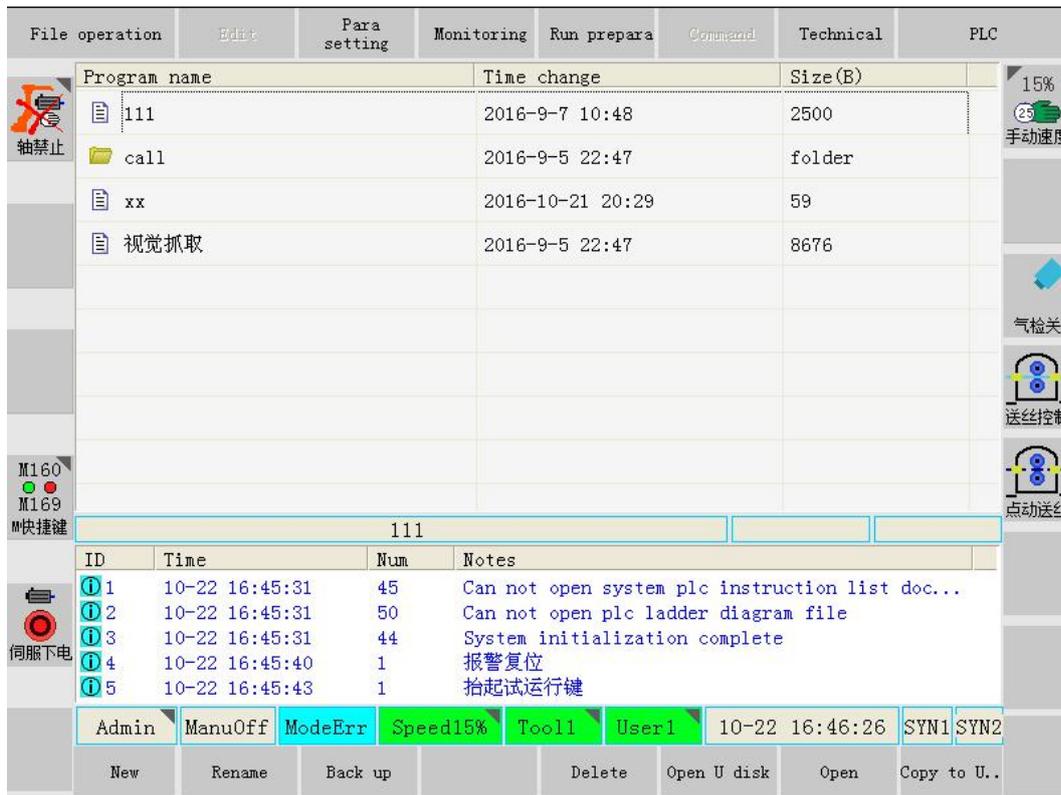
- Wait point of program point 1# should be at the position with no interaction with workpiece and holding clamp.
- When program point 5 is moving toward program point 1, it also should have no interaction with workpiece and holding clamp.
- During welding process (teach program point 3# to point 4#), surface constitute of welding wire and x direction should be perpendicular to welding formation surface (as shown in below). Otherwise, y direction of weave coordination is unparallel with welding formation surface, and weave will be high at one edge and low at the other edge.



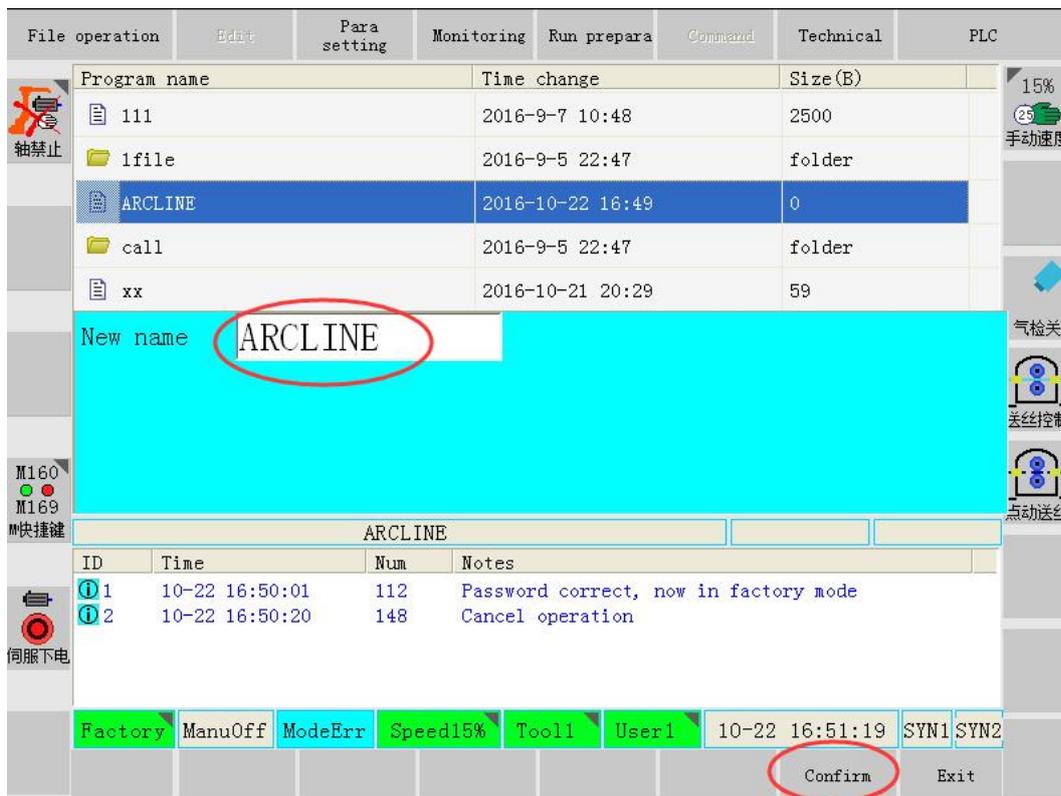
- Wire length in re-production should be same with the length in teach. Use the wirefeeding to give out welding wire. Please cut the welding wire of proper length (~10mm).
- During teach, when welding wire bends after the touch with workpiece, give out welding wire for 50-100mm, cut the welding wire of proper length, and teach continues.
- After teach, please use  for pilot run and check if track is correct.

### 3.2.1 New file

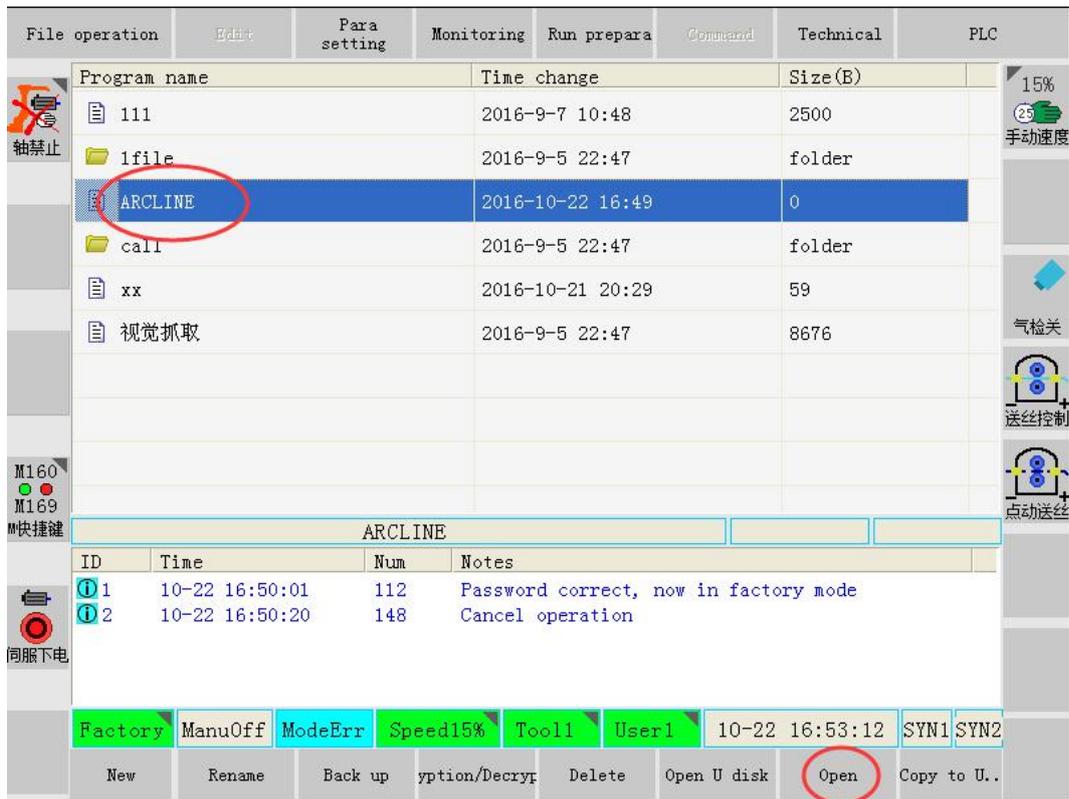
In teach mode. In main interface, press "New" button, establish the new program.



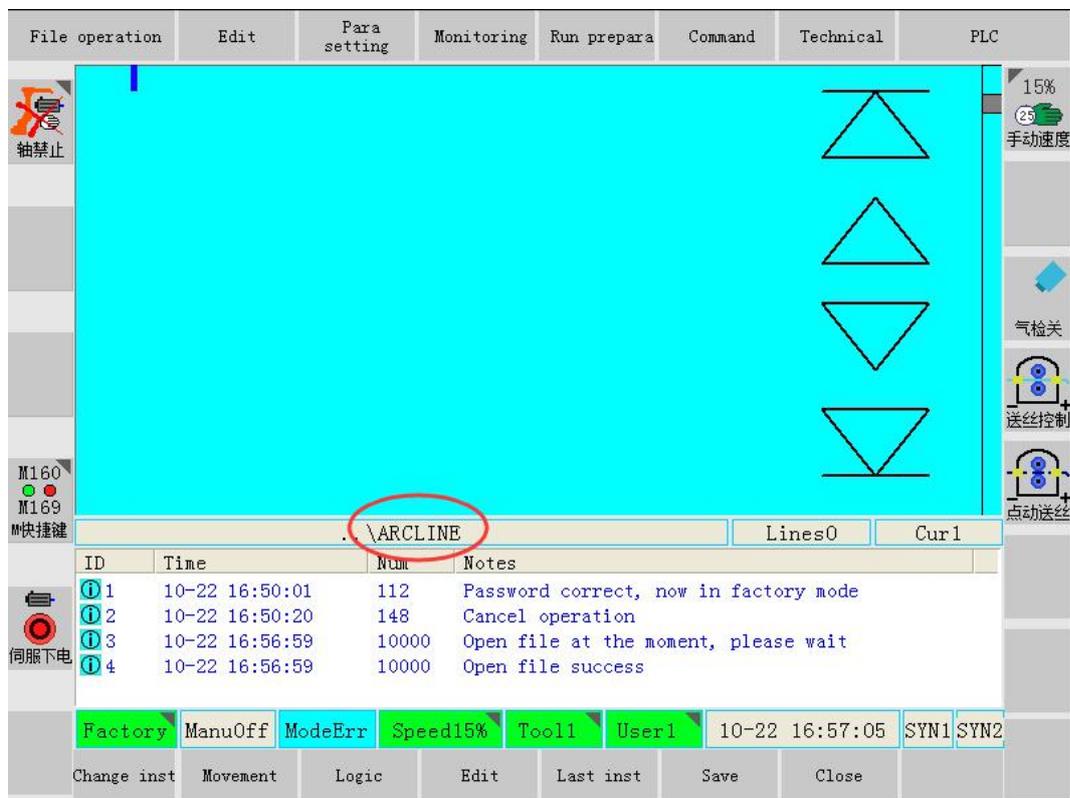
Input program name "ARCLINE" in the below interface.



Click <OK> button, program new name has been selected, and appears in the resource management, as shown in below.



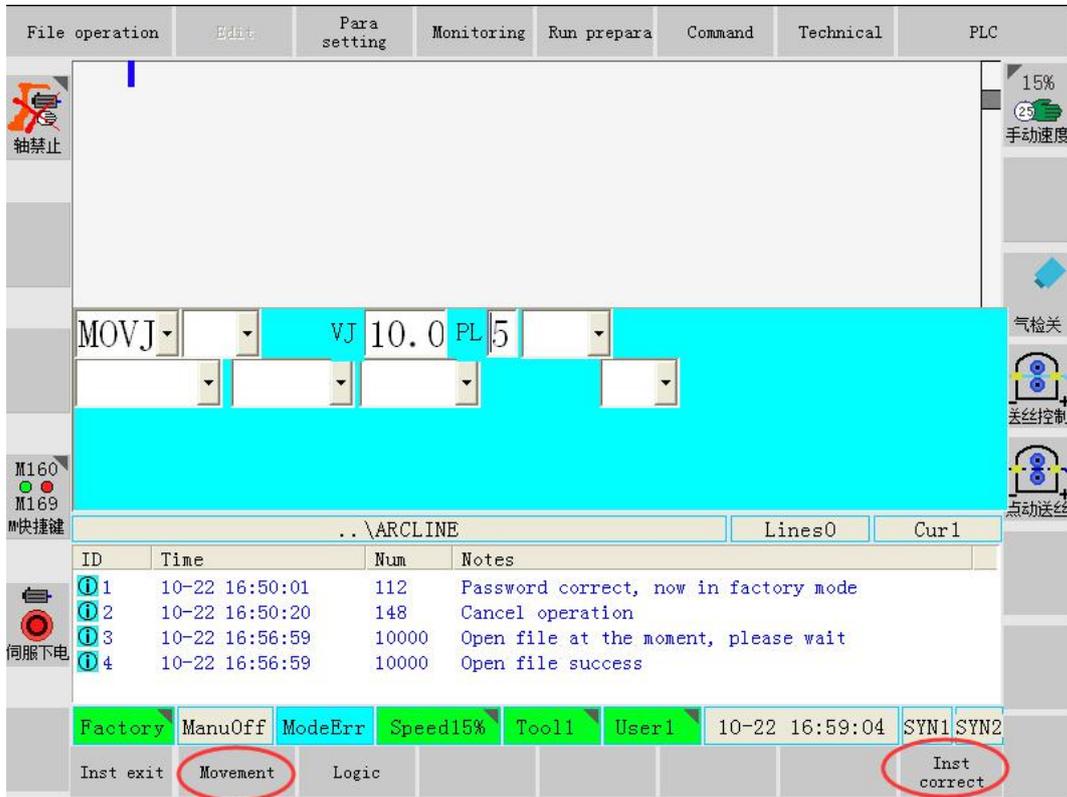
In above interface, press "Open" button, enter the program edit interface, as shown in below.



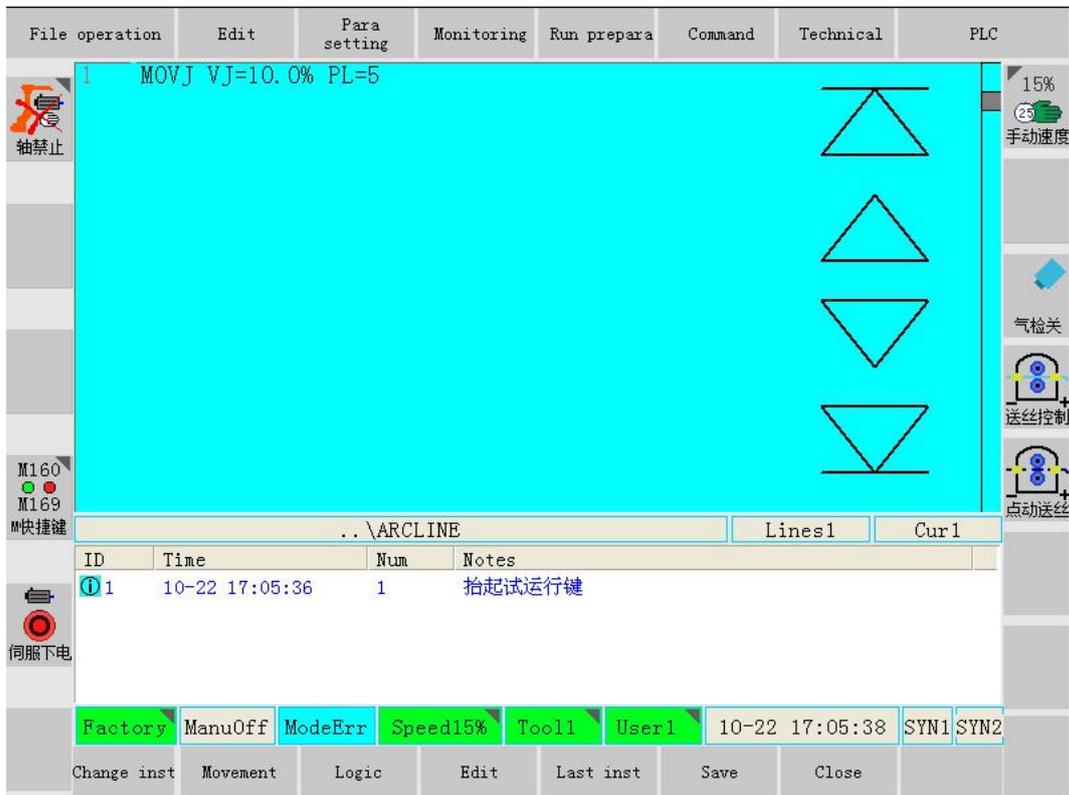
Interface for program edit

## 3.2.2 Program point 1

Adjust the manual operation speed, in robot coordination system, press the safe button, move the robot to program point 1. Press “Movement” button, choose MOVJ mode, and input correspondent speed.

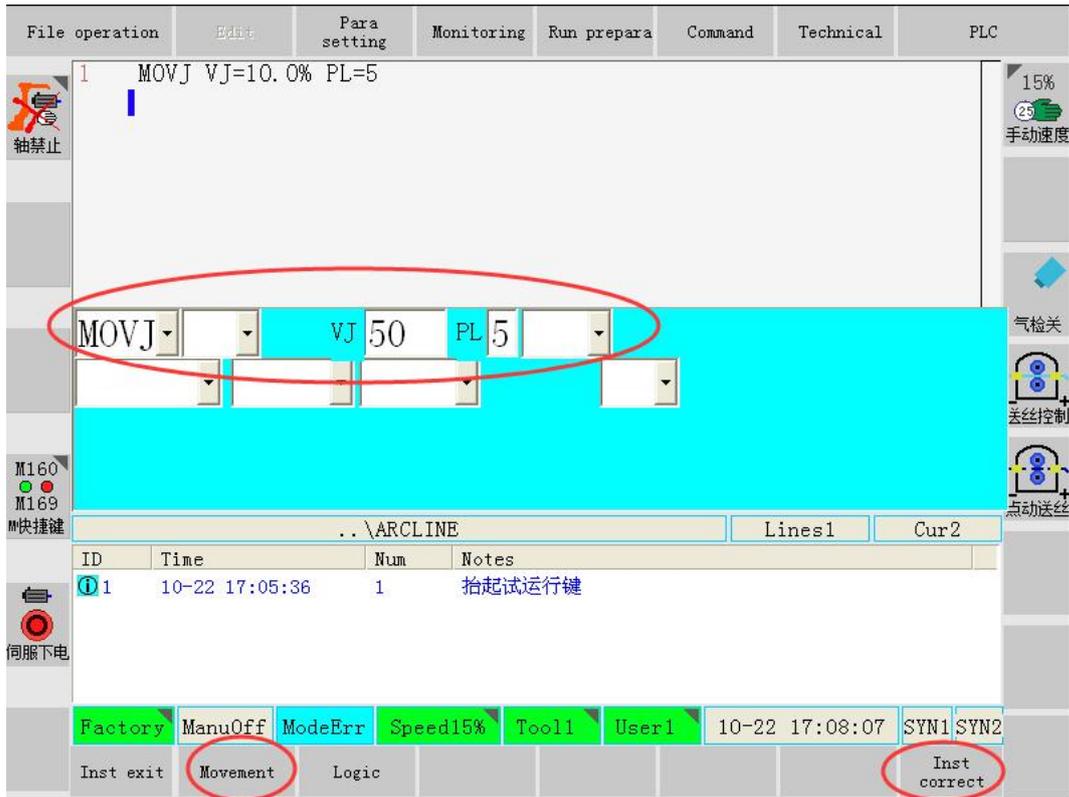


In above interface, click “instruction correct” button to record the point (effective status of safe switch), as shown in below.

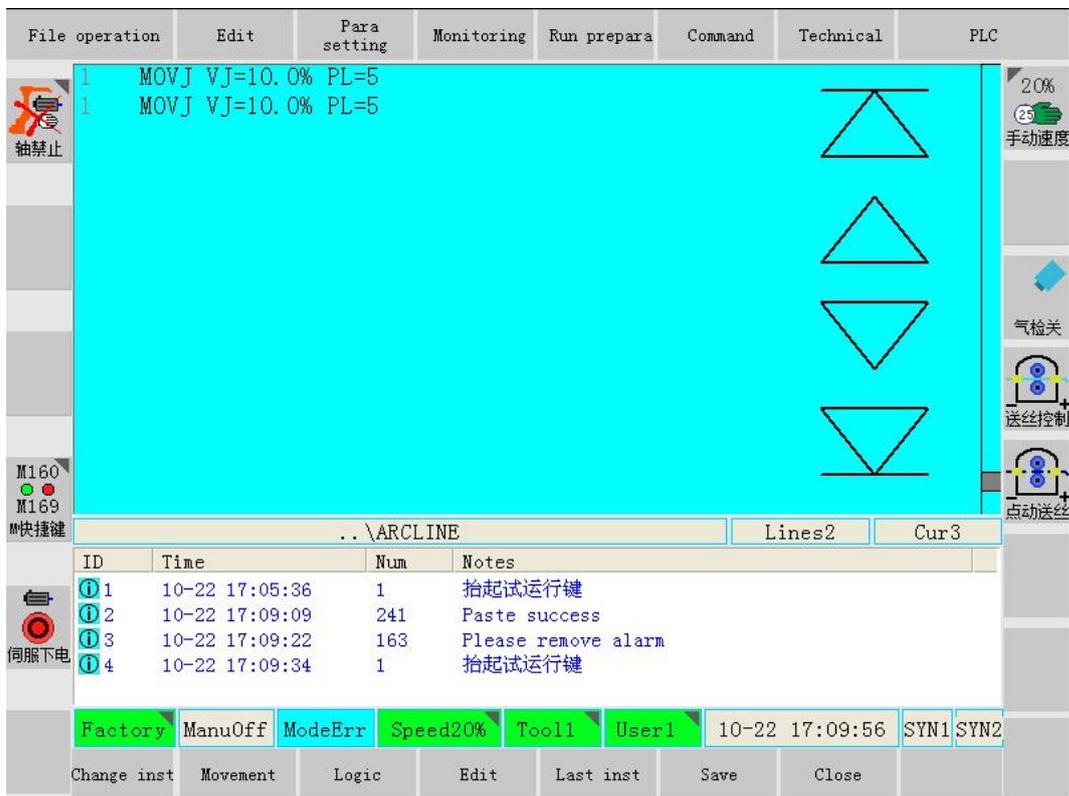


### 3.2.3 Program point 2

Adjust the manual operation speed, in robot coordination system, press the safe button, move the robot to program point 2. Press "move" button, choose MOVJ mode, and input correspondent speed.



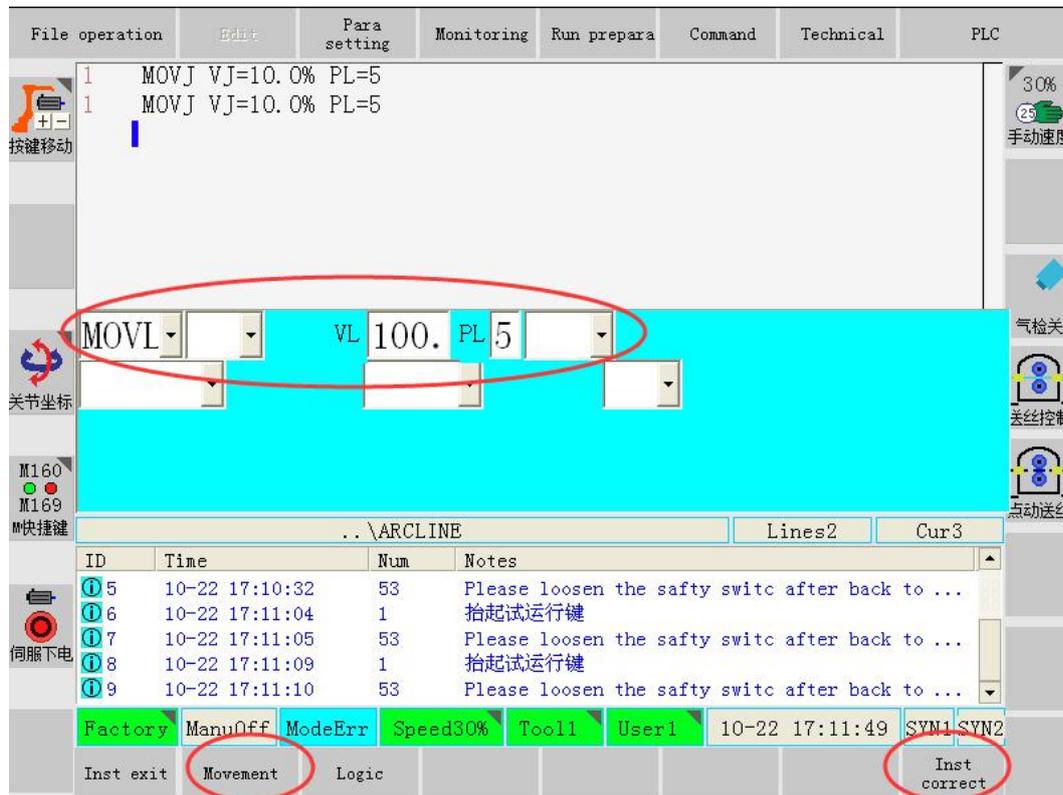
In above interface, click “instruction correct” button to record the point (effective status of safe switch), as shown in below.



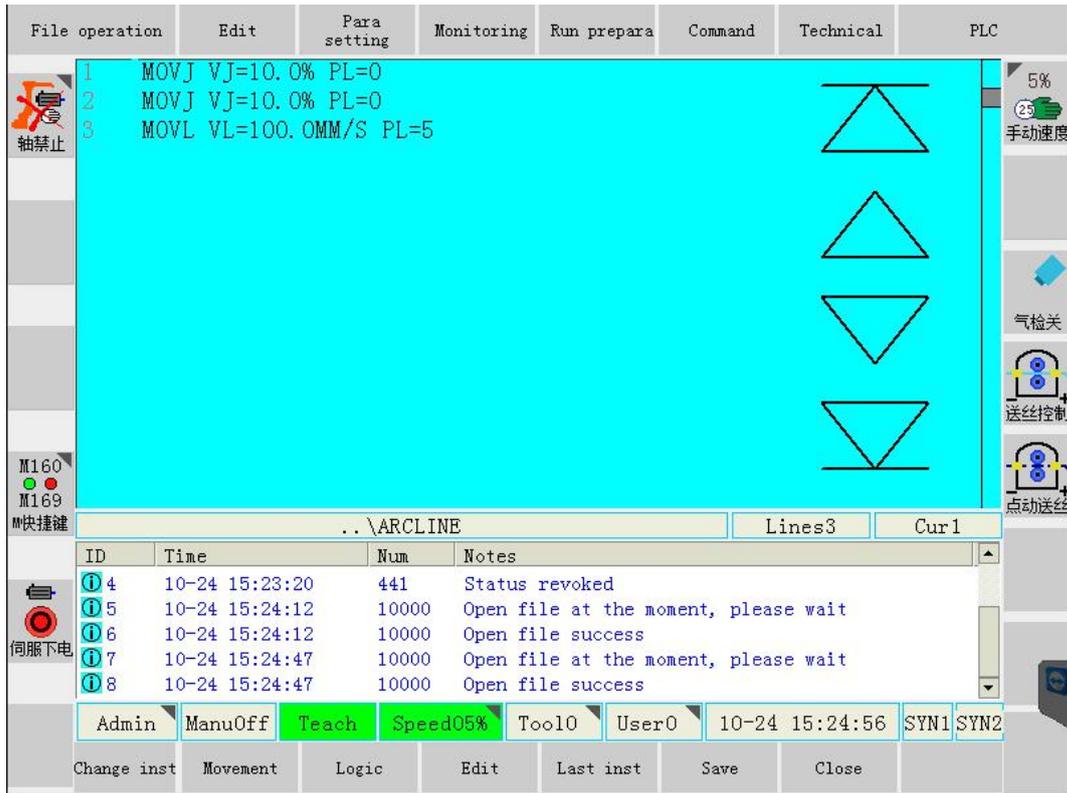
### 3.2.4 Program point 3



Adjust the manual operation speed, in robot rectangular coordination system 直角坐标, press the safe button, move the robot to program point 3. Press “move” button, choose MOVJ mode, and input correspondent speed.



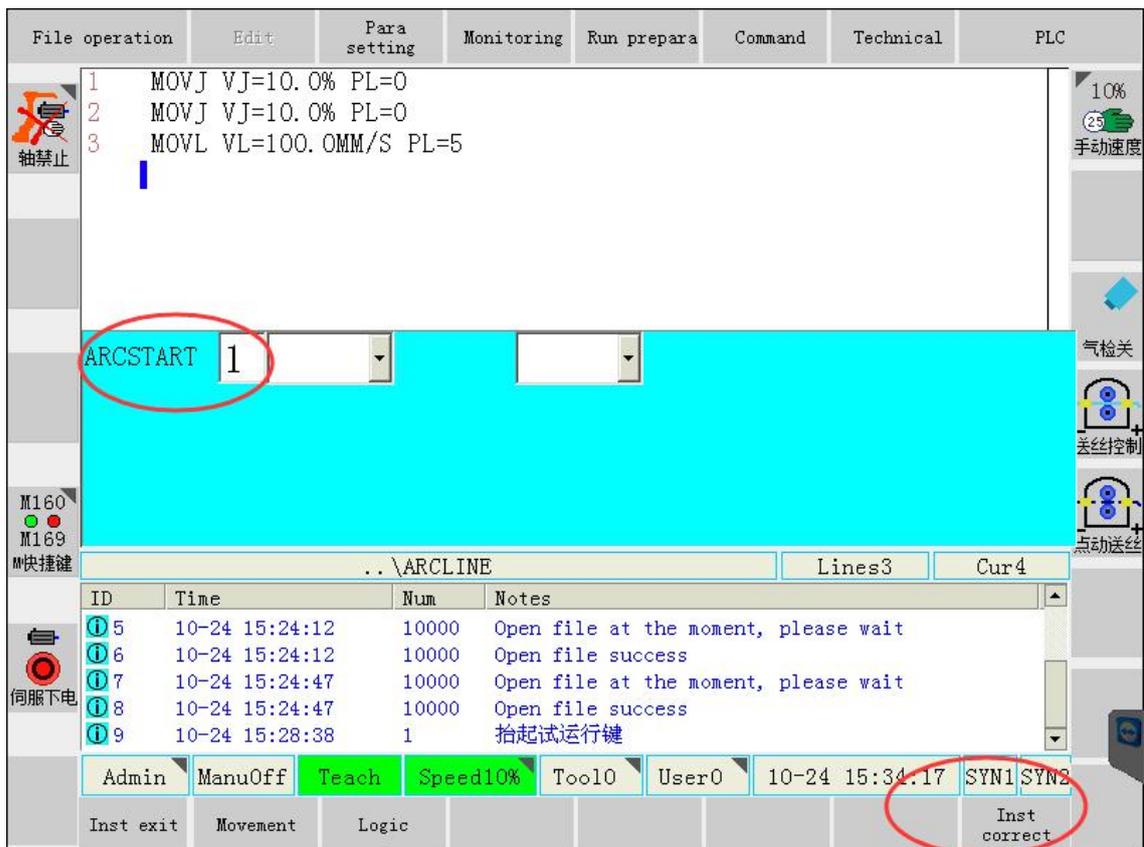
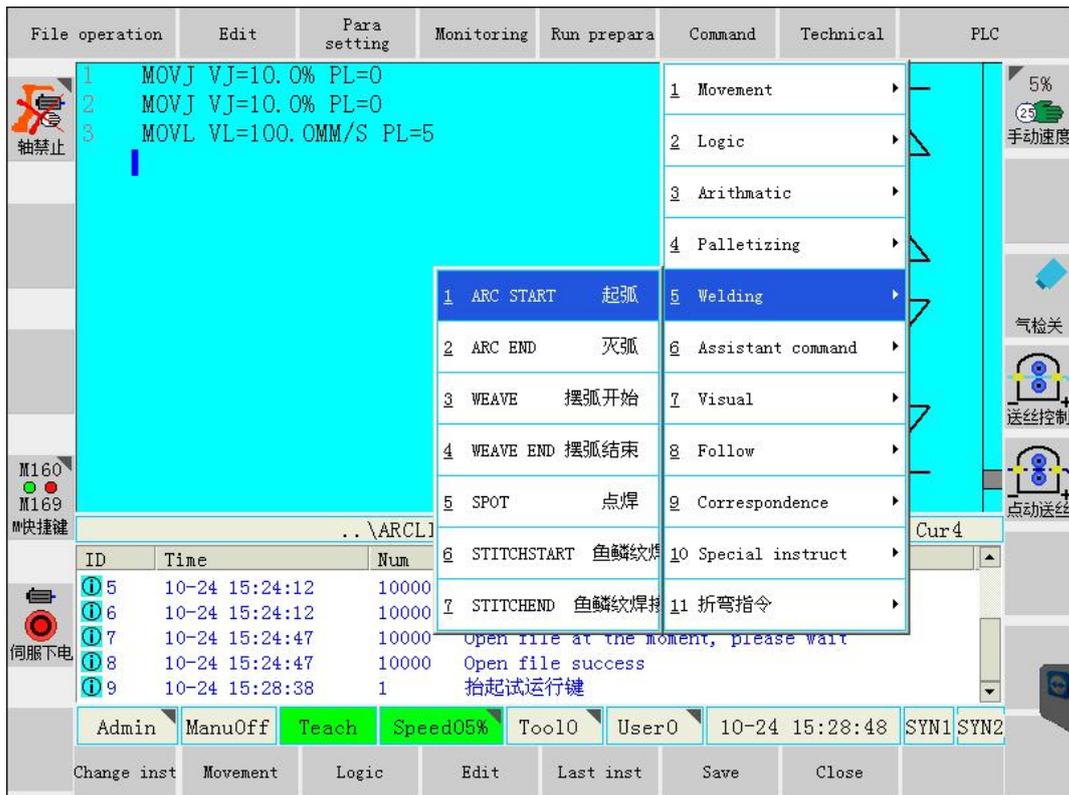
In above interface, click “instruction correct” button to record the point (effective status of safe switch), as shown in below.



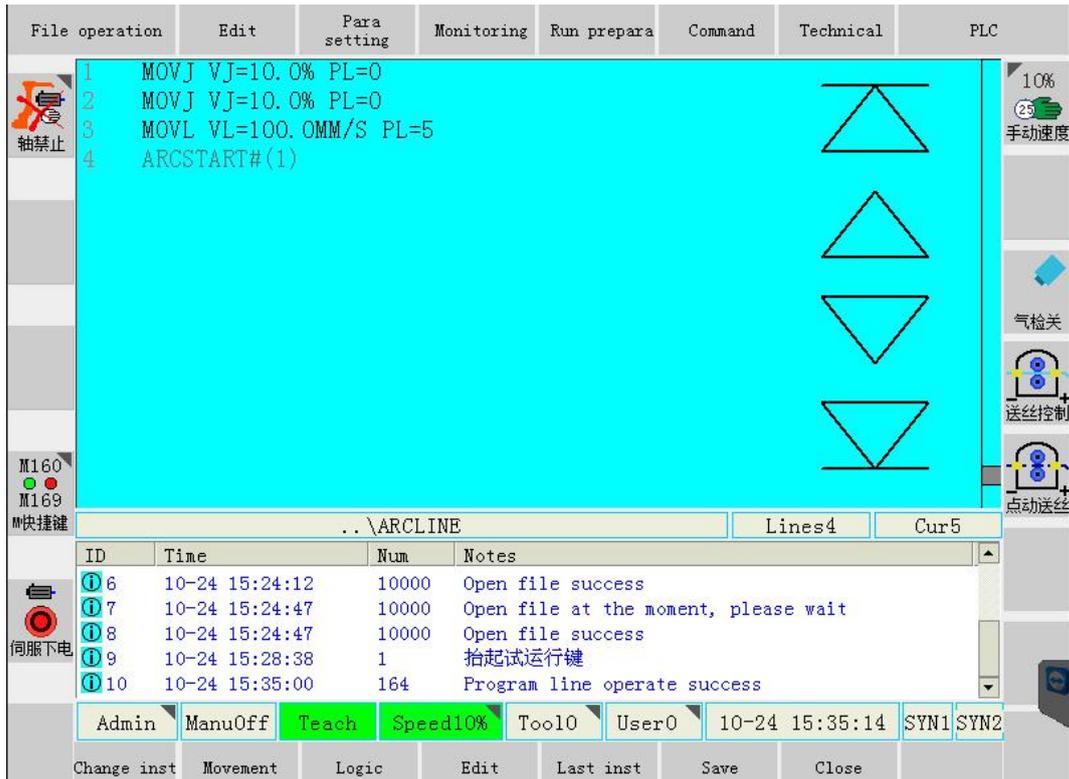
Notice: That is welding starting point. Welding wire should be perpendicular to welding formation surface.

### 3.2.5 arc start; weave

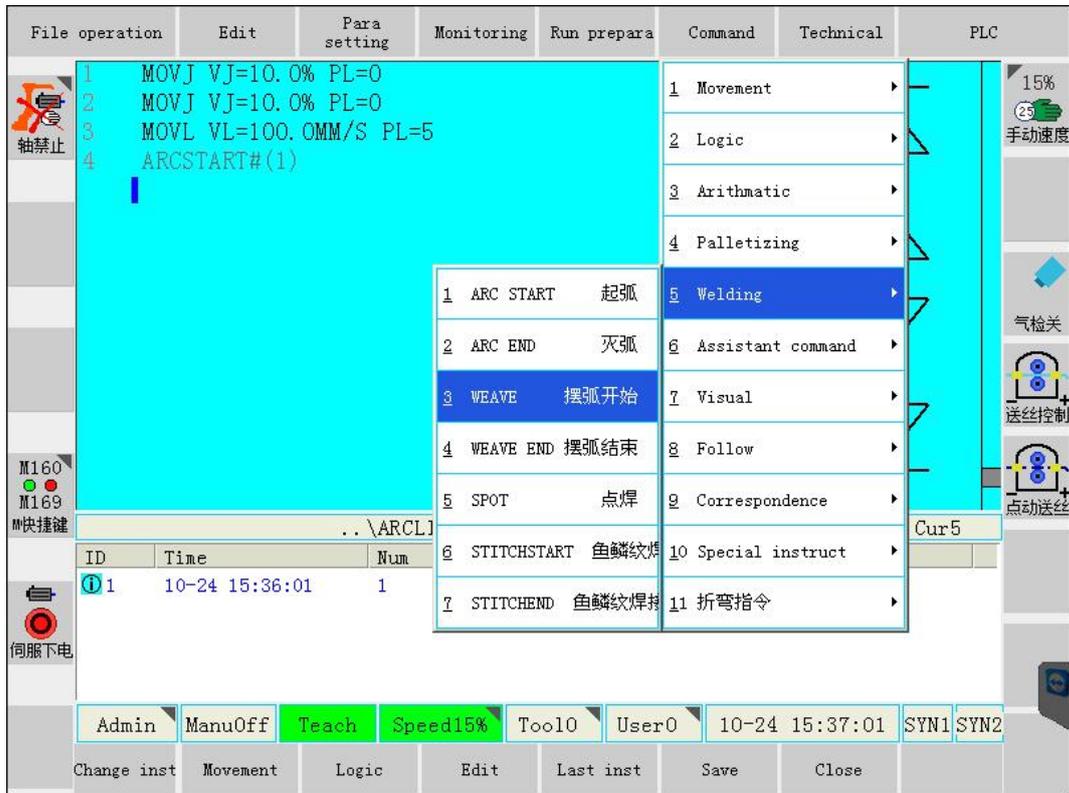
After the determination of welding starting point, arc start and weave instruction should be input. As shown in below, click "arc start" in the "Command" - "Welding" .



In the above figure, input welding document number into arc start instructions. Then click "instruction correct" button to finish the arc start instruction, as shown in below.

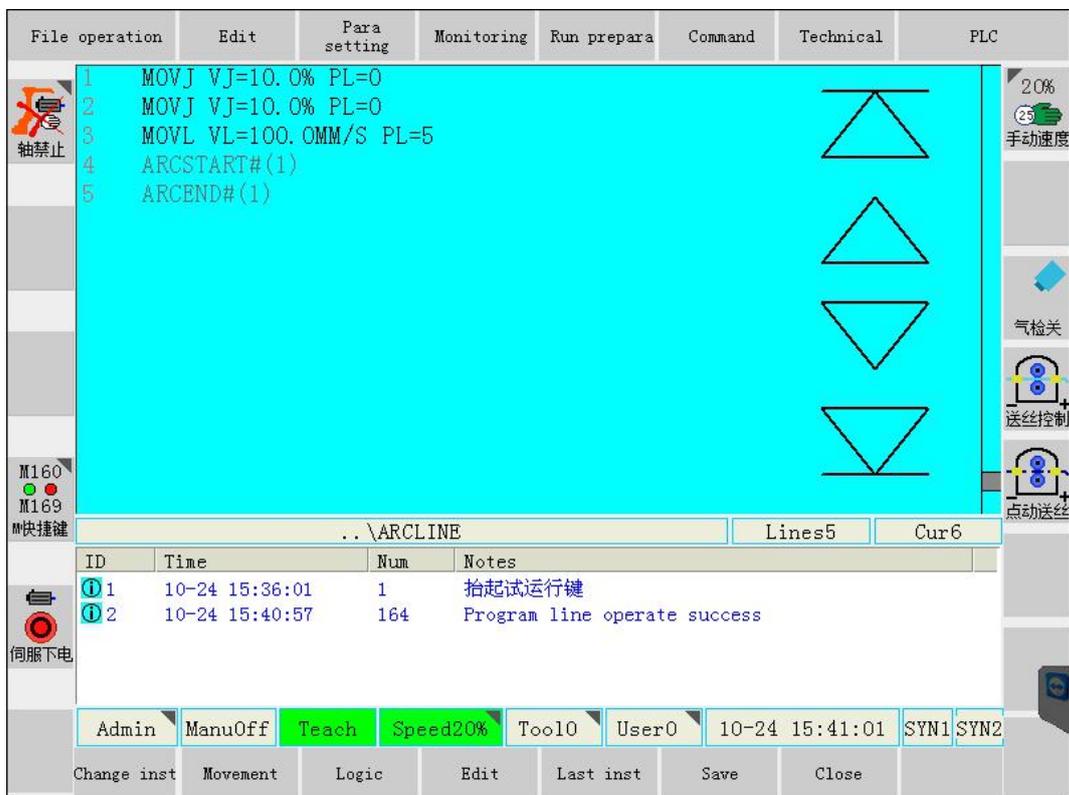


After the input of arc start instructions, as shown in below, choose <Command>-<Welding>-<Weave>.





In above interface, input parameters document number. Then click "instruction correct" button to finish the weave instruction input, as shown in below.



### 3.2.6 Program point 4

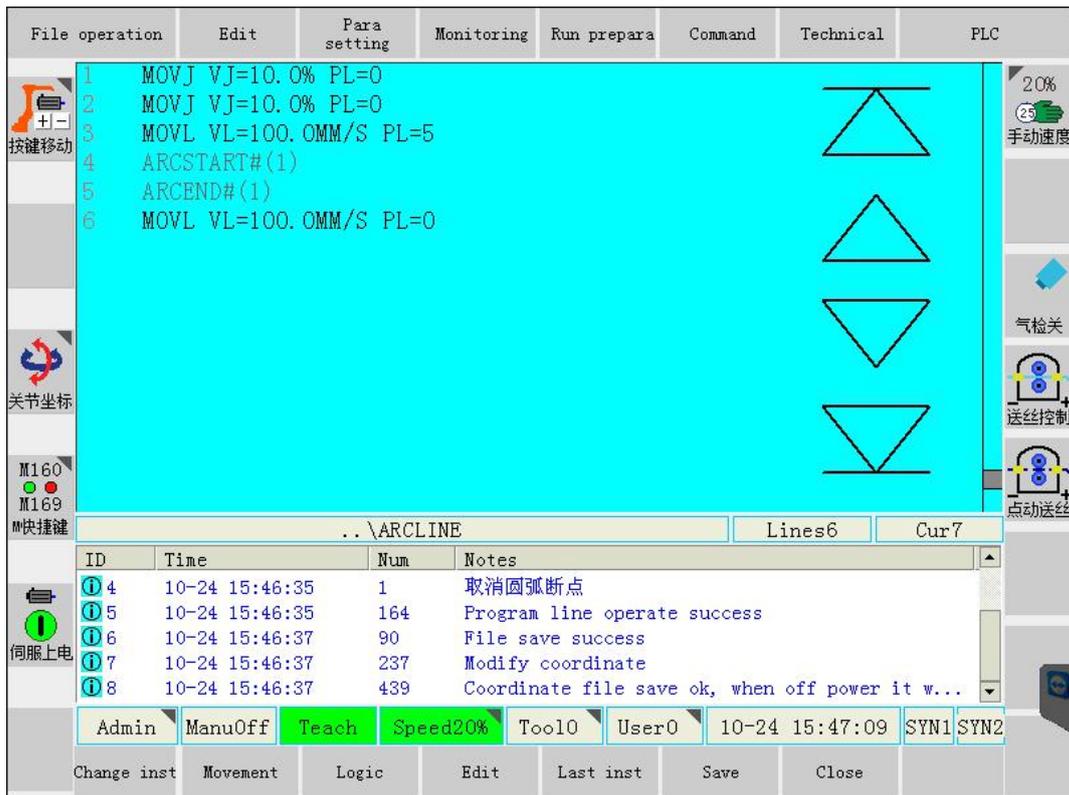


Adjust the manual operation speed, in robot rectangle 直角坐标 coordination system, press the safe button, move the robot to program point 4.

Press “Movement” button at the below interface, choose MOVL function, and input correspondent movement speed.

ID	Time	Num	Notes
①6	10-24 15:42:21	1	第 5 轴正在回零
①7	10-24 15:42:21	1	第 5 轴回零成功
①8	10-24 15:42:23	1	第 6 轴正在回零
①9	10-24 15:42:23	1	第 6 轴回零成功
①10	10-24 15:42:47	53	Please loosen the safty switc after back to ...

In above interface, click “instruction correct” button to finish the weave instruction input (effective status of safe switch), as shown in below.

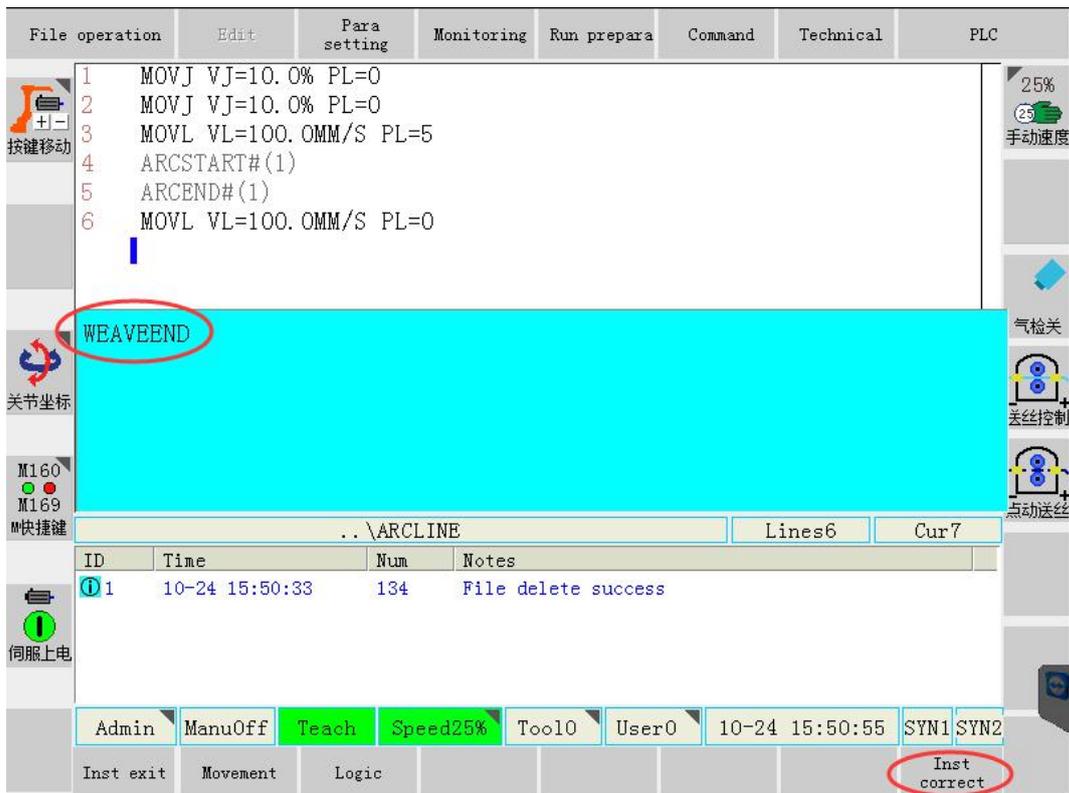
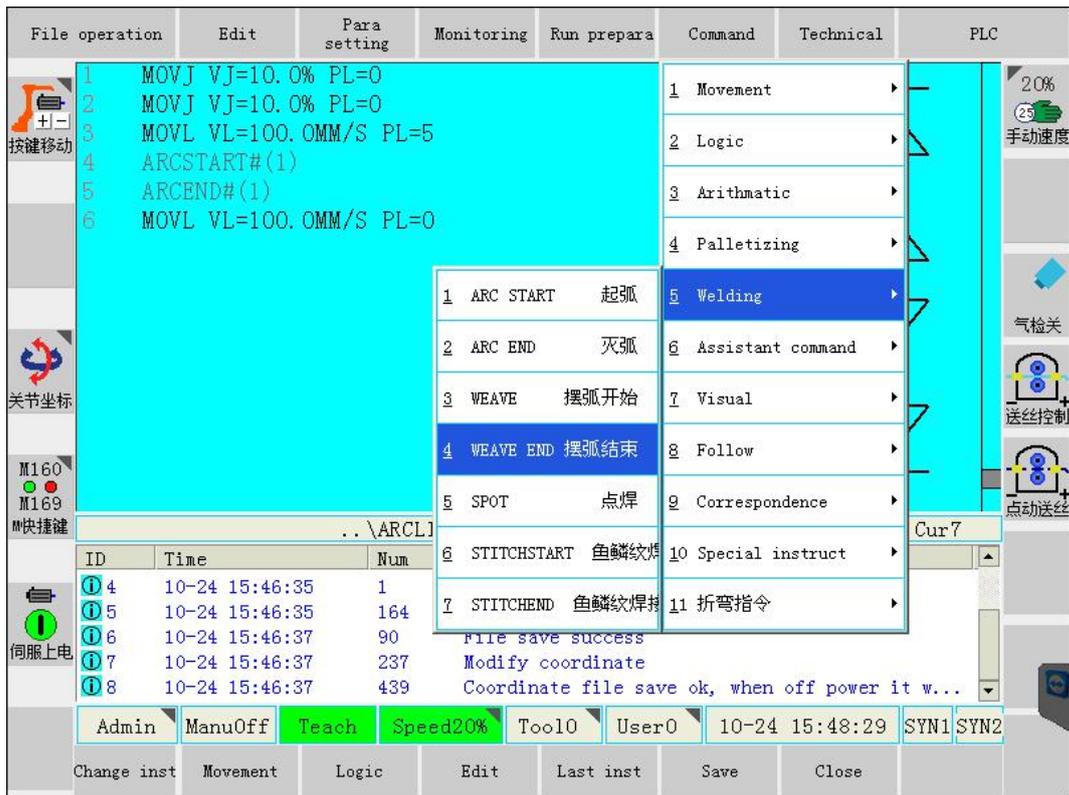


Notice: This is welding end point. In order to finish the weave function, welding wire should be perpendicular to welding formation surface.

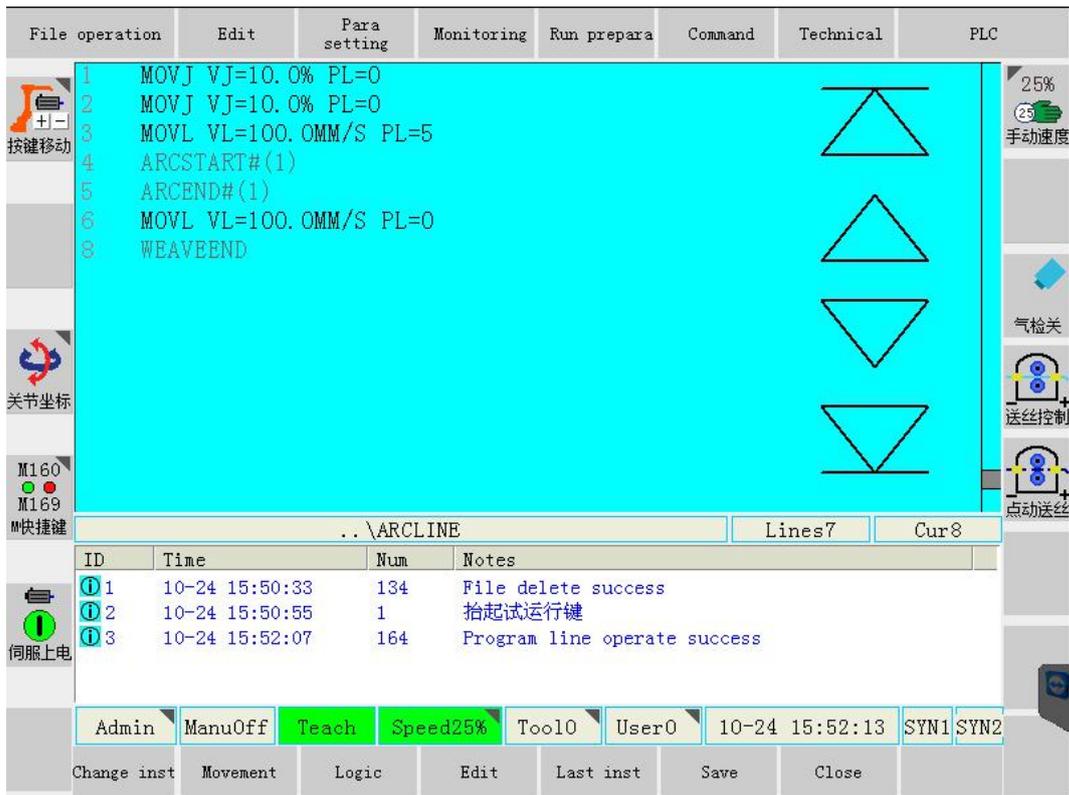
### 3.2.7 Arc end, weave end

After the finish of welding, click OK, and then input weave stop and arc end instruction (weave end first, then arc end).

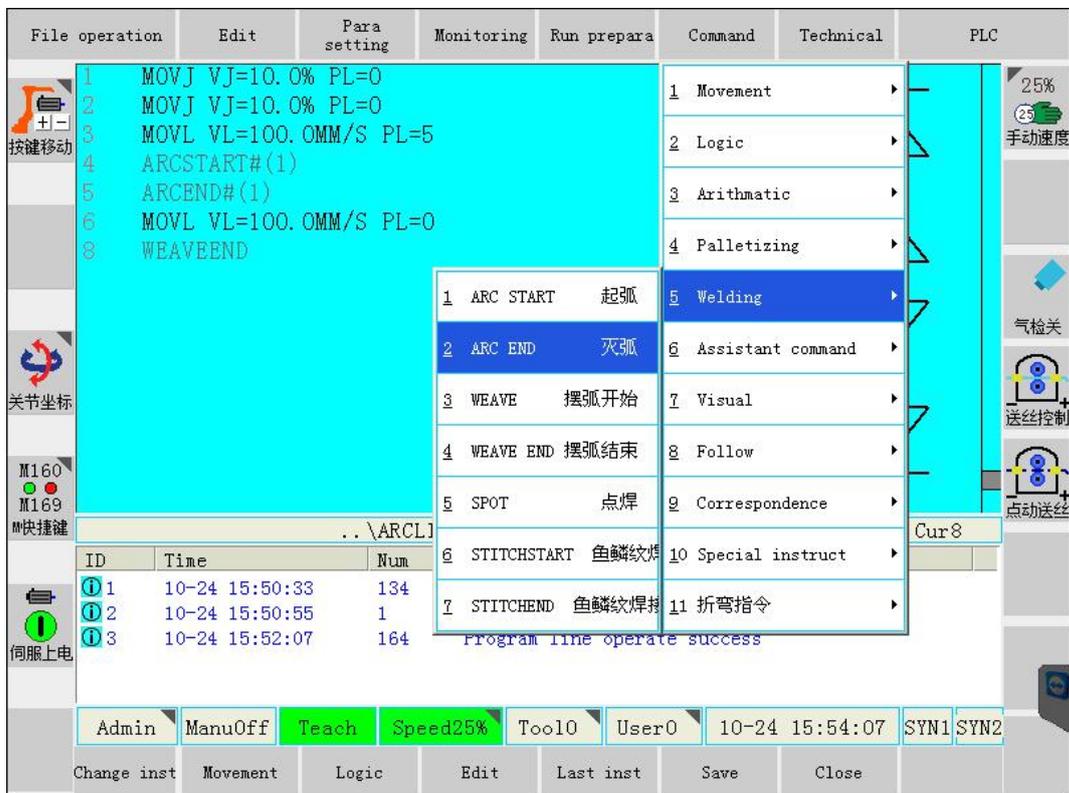
In below figure, choose "WEAVE END" in the <Command>-<Welding>.

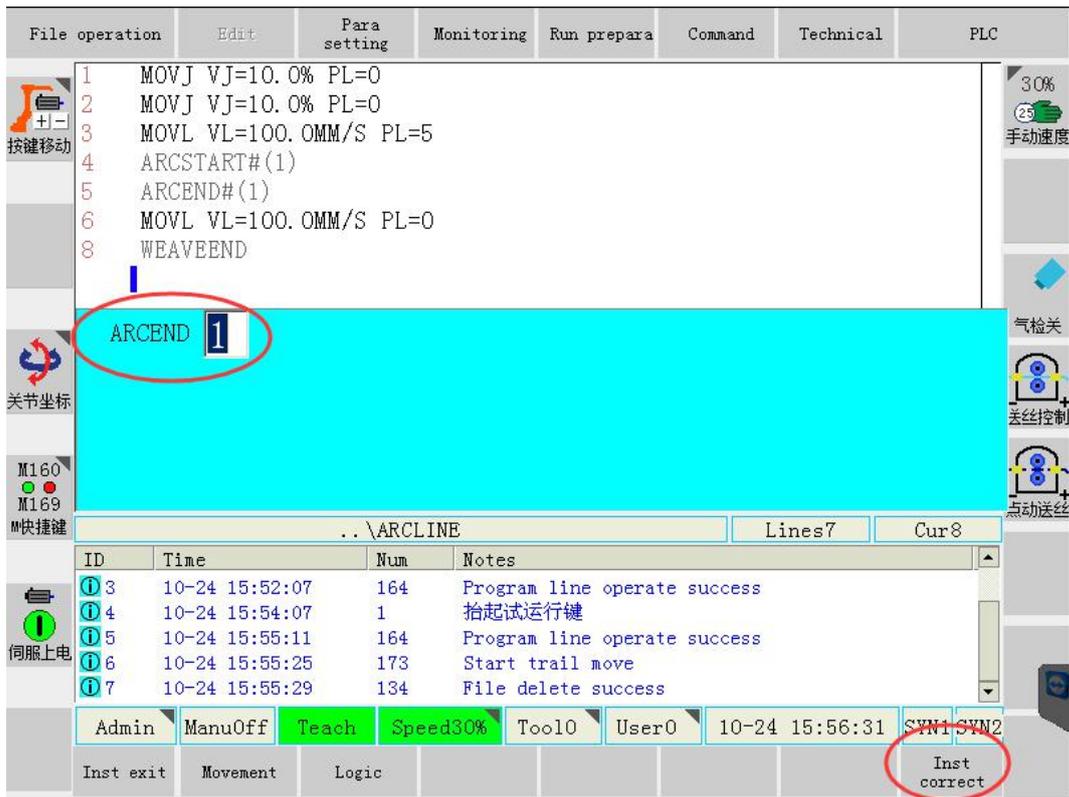


In above figure, press "instruction correct", and finish the input of weave end, as shown in below.

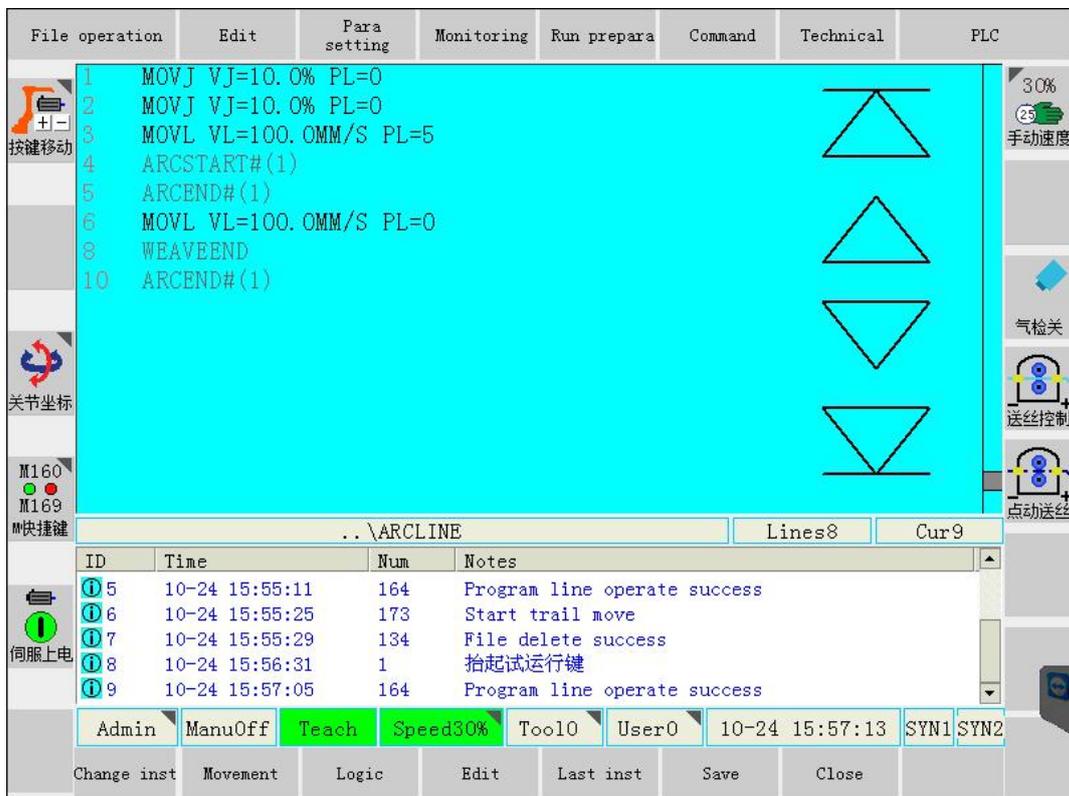


After the input of weave stop, input arc end instruction. Choose "Arc end " in <Command>-<Welding>.





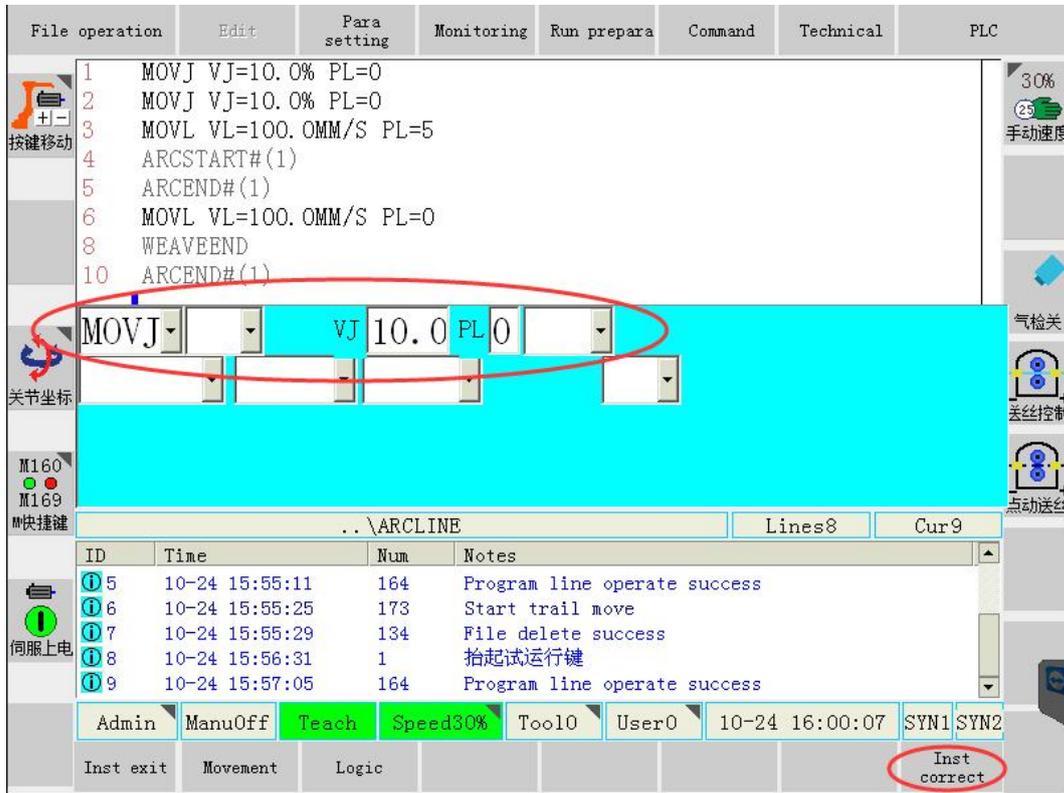
In above figure, after input the welding document number in arc end instructions, click "instruction correct" , shown below.



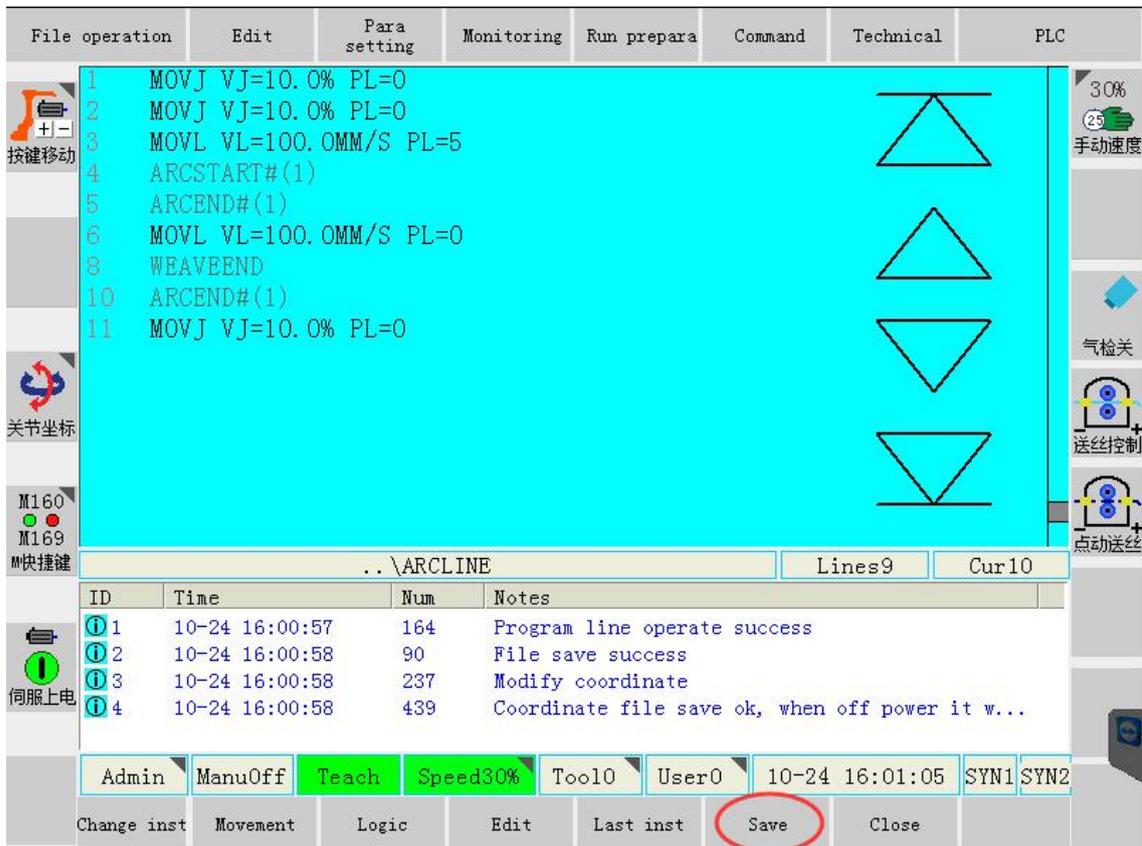
Finish the arc end instruction.

### 3.2.8 Program point 5

Adjust the manual operation speed, in robot coordination system, press the safe button, move the robot to program point 1. Press “Movement” button, choose MOVJ mode, and input correspondent speed.



In above interface, click “instruction correct” button to finish the point record (effective status of safe switch is needed), as shown in below.



Finish of program edit, click “save” to save program in the above interface.

### 3.3 Program test-run verification

After the program edition, test-run can be launched in teach mode to test if program track is correct. Operation methods are as follows:

Open the program in teach mode.

Move the cursor to the correspondent program line.

Press security switch and press  button at the same time. Then program will be executed in low speed of test-run.

Discription
1、 After the execution of current program line, cursor will move to next line automatically.
2、 Arc start, arc end, weave, weave end can be tested in test-run.
3、 Weave movement will not be executed.

## 3.4 Program reoccurrence

### 3.4.1 Empty run without arc

After the verification of movement track, it's needed to automatically execute the program without arc to verify the actual welding speed and weave situation.



#### Notice

Pay attention to following items, otherwise personal injury or equipment damage may happen:

- 1、 Make sure nobody is stay around the robot before the program running
- 2、 Make sure no interaction can be involved around the robot before the program running
- 3、 Prepare to press emergency stop button during the program running, to make sure stop the machine quickly if any emergency happens.

Open the program in teach mode, move the cursor to the first line.

Switch to reoccurrence mode.

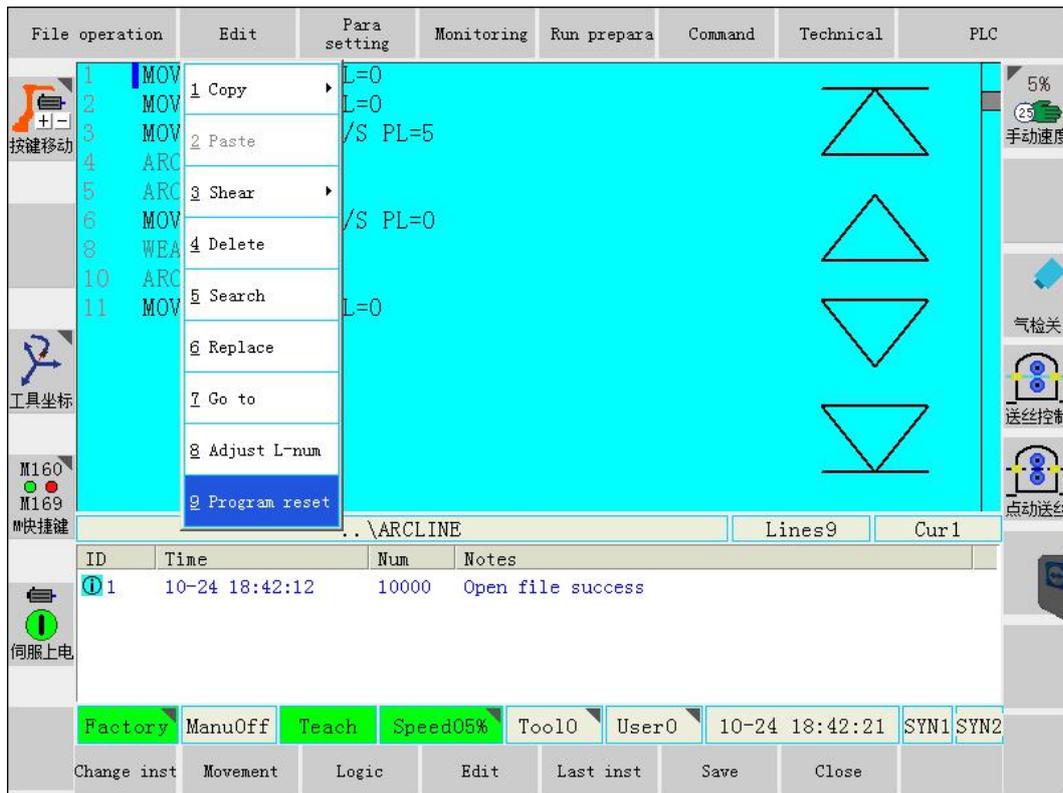
Set the operation speed and operation mode. Switch the arc starting mode into



Press  to start the program.

#### Description

- 1、 Press  for stop in the half way.
- 2、 After the intermediate stop, if program need executing from the beginning, user should reset the program (as shown in below figure). Otherwise, welding program will be executed from the stop position.



### 3.4.2 Arc start and operation

After the verification of actual speed and weave situation on-track, actual welding process can be operated.

 **notice**

Pay special attention to following items, otherwise personal injury or equipment damage may happen:

- 1、 Make sure nobody is stay around the robot before the program running
- 2、 Make sure no interaction can be involved around the robot before the program running
- 3、 Prepare to press emergency stop button during the program running, to make sure stop the machine quickly if any emergency happens.
- 4、 Check the situation of welding power and auxiliary equipment before program running.

Open the program in teach mode, move the cursor to the first line.

Switch to program re-occurrence mode.

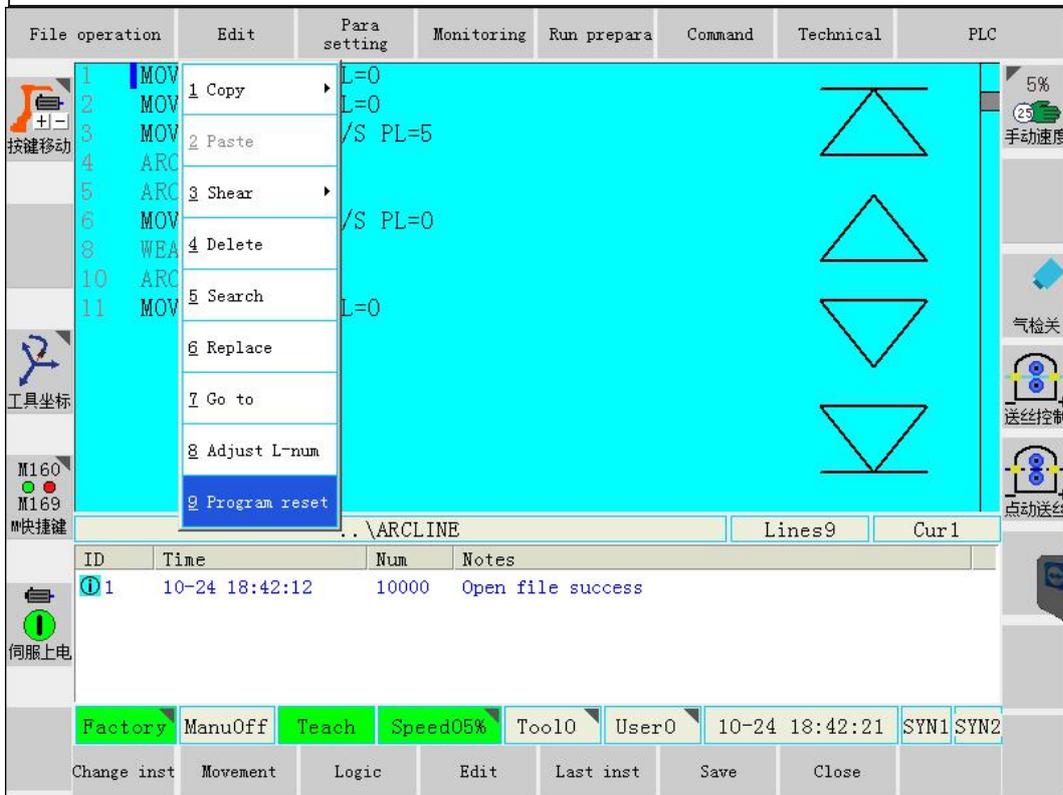
Set the operation speed and operation method.

Switch the arc starting mode into 

Press  to start the program.

**Description**

- 1、 Press  for stop in the half way.
- 2、 After the intermediate stop, if program need executing from the beginning, user should reset the program (as shown in below figure). Otherwise, welding program will be executed from the stop position.

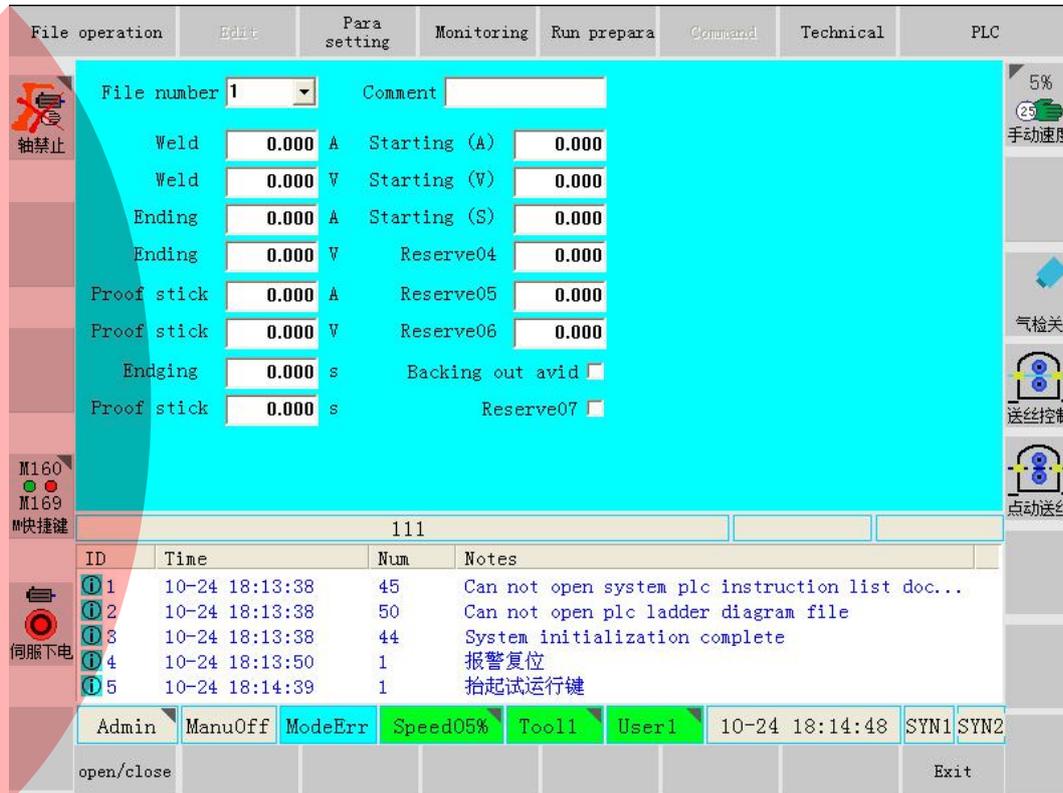


### 3.5 Welding performance adjustment

Welding parameters can be adjusted according to the actual welding.

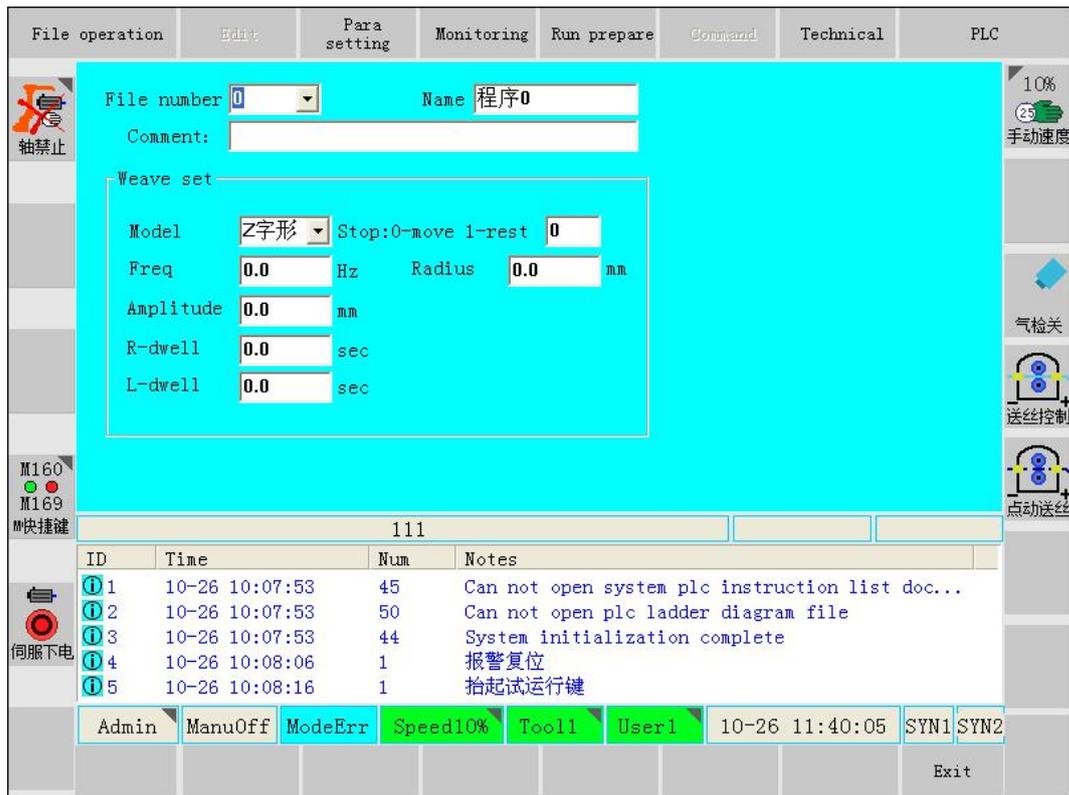
### 3.5.1 Welding current and voltage

Welding current and voltage can be adjusted in the correspondent parameters document, as shown in below.



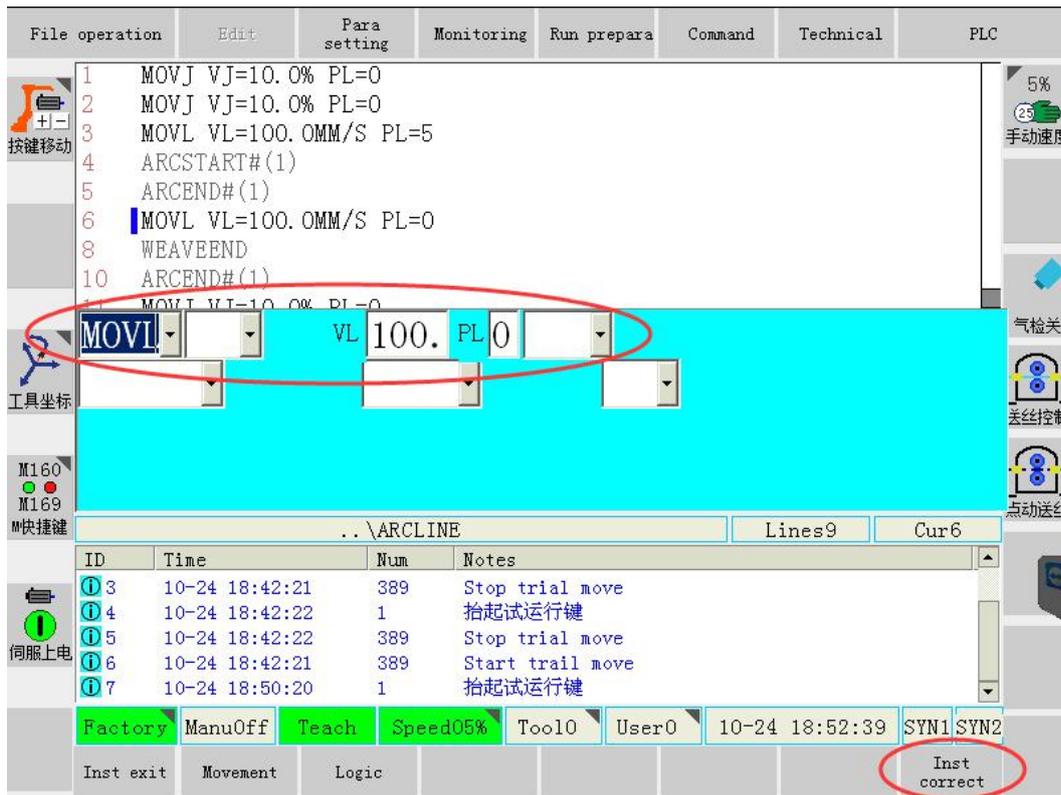
### 3.5.2 Weave frequency and weave amplitude adjustment

Weave frequency and weave extend can be adjusted in the correspondent parameters document number, as shown in below.



### 3.5.3 Welding speed

Welding speed can be adjusted by modify the program. In program interface, move the cursor to correspondent program line, click "change instruction" , then below interface will appear.



Input the correspondent speed in above interface.

Click “instruction correct” to finish the speed adjustment.

Discription	
During the program modification, security button should not be pressed, otherwise, program coordination will change.	

After the adjustment, press  to start program and verify the operation performance.

Thank you very much to choose our product!

Please keep all related manuals safely for check if necessary! If equipment is passed to third party, please give the related documents along with the equipment!

Buttons, functions or options not mentioned in related manuals should be regarded as invalid, please don't use!

Modification log:

2014-9-26 modify the PLC scheme and description

2015-2-11 add AOTAI connection description and wiring diagram