Industrial Robot

System Operation Manual

Please ensure that the relevant manuals are in the hands of the end user of this product.

Preface

	■ Before operating the robot, please read this Manual carefully and follow all safety-related matters and instructions set forth in this document. ■ The installation, operation, and maintenance of this robot shall be carried out by the personnel who have participated in the training courses of our Company.
	■ Please be sure to give this Manual to the personnel who actually operate the robot.
	■ If you have any doubt about any part of this Manual or the after-sales service of the robot, please contact the Service Center directly. please see the back cover for the contact information.

Attention:

1. The contents of this Manual are subject to change without prior notice.
2. The illustrated screen of operation button console of the teach pendant stipulated in this Manual is an example written by the author, and if there is any difference from the actual screen, please give understanding.
3. Whilst every care is taken to ensure that the contents recorded in this Manual are correct, no liability can be accepted by the Company for any direct or indirect damage caused by any errors in, or omissions from, the contents given.
4. The Operation Manual shall be deemed as part of the robot product. When moving, transferring or selling the robot, please attach the Operation Manual.
5. All or part of the contents of the Operation Manual shall not be reproduced without the consent of the Company.
6. About product transformation
   - It is strictly prohibited to carry out any transformation or modification to the products of the Company.
   - Fire, failure and malfunction due to transformation may cause personnel injury and machine damage.
   - The transformation of the product carried out by the customer is beyond the warranty scope of our Company, therefore, no liability can be accepted by our Company for such transformation.

Reversion Record of Operation Manual

Version No.	(Month), (Year)	Content of the changes
V1.0	August 2018	1. Reformatting; 2. Content modification.

Chapter 1 Operating Instructions of Teaching Software

1 System Hardware Introduction

1.1 System Overview

CTR-86-ECAT motion controller is a combination of the advanced PC technology and motion control technology. The system processor of this motion controller adopts the Intel four-core processor J1900, which is based on the X86 infrastructure, and the main frequency is up to 2.4 GHz. The motion controller is an ideal integrated solution for FPGA customers. In addition to provide such general computer interfaces for the user as VGA, LAN, USB2.0 / 3.0, etc., the CTR-86-ECAT motion controller can realize the basic functions of general PC, the special interfaces such as ECAT communication interface are provided as well. The memory supports up to 8GB of low-power DDR3, and supports a 32G CFast2.0 solid-state disk (SSD) for storing user data, configuration information, operating system and the like. Four RS-422 / 485 isolated serial communication interfaces are provided for transmission from the DB37 connector to the DB9 connector.

1.2 System function description

Function	Detailed description
Servo control cycle	1ms ECAT communication cycle
Control cycle	900us control cycle
ECAT communication	Support the communication protocol of Panasonic ECAT, TX is connected to external RX interface, RX is connected to external TX interface, support various control modes such as positioning, speed mode, torque, etc., it can realize control of up to 16 nodes, please refer to ECAT communication protocol for details.
External extension	(1) A PCI interface: the PCI interface is used to connect the control card of ECAT master station. (2) A PCIExl interface: the PCIExl interface is used for users to connect different external extension devices according to different requirements;
VGA display	Connect the monitor via the VGA interface.
LAN	(1) Three LAN interfaces: LAN1, LAN2, LAN3: (2) Network speed: 10 / 100 / 1000Mbps, Intel 1211, support Wakeup On LAN (WOL).
Serial communication	(1) COM1～COM2: Support 5V / 12V power supply, jumper setting (default setting is no power supply) (2) USB2.0：two USB2.0 interfaces (3) USB3.0：one USB3.0 interface
Digital I / O communication	15-way digital input, 15-way digital output

2 Teach Pendant Appearance

Front view of teach pendant

Rear view of teach pendant

2.1 Emergency stop

Press the emergency stop button of the robot in an abnormal situation.

Emergency stop button	Rotate the emergency stop button along the direction shown as the RESET key to release it.

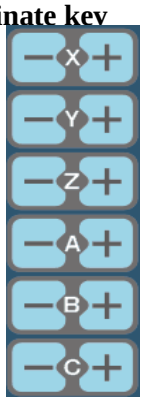
2.2 Mode selection switch

By employing this switch, the user could select the robot operating mode. In this system, there are three modes for selection: TEACH, PLAY, and REMOTE.

2.3 Safety switch

In teach state (TEACH), if the safety switch is located in the middle gear, the robot is powered on; if the safety switch is firmly gripped or released, the power supply of the robot is turned off, and the motor is in the braking state. The safety switch is divided into three gears, the outermost gear and the innermost gear are designed to cut off the power supply of the robot, and the middle gear is designed to turn on the power supply of the robot.

2.4 Coordinate key



Manually control each joint of the robot in the teach state (TEACH).

2.5 Left function key

The function of each key is marked on the key film,  is the standby function key.

2.6 Lower function key

The function of each key is marked on the key film, the details are shown as below:

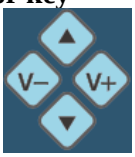
 This key is the back key, which is used for reverse operation of TEACH mode, no reservation state at present.

 This key is the forward key, which is used for forward operation of TEACH mode and trial operation, no reservation state at present.

 The key is the stop (pause) key, and the system pause and stop sharing the same state, that is, the system is in the stop (pause) state after being pressed.

 This key is the standby function key.

2.7 Cursor key



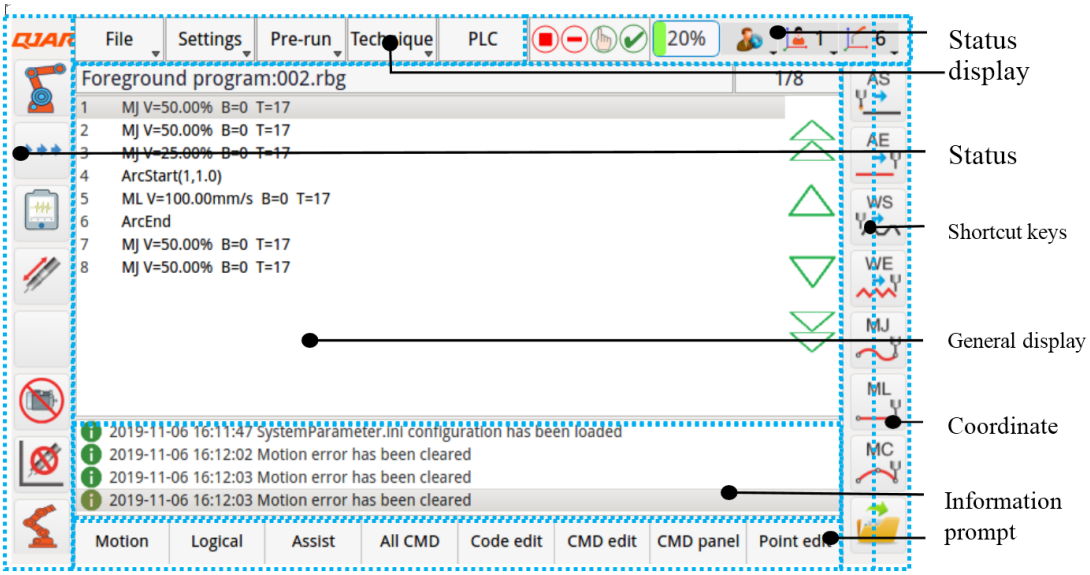
Move the cursor to conduct program selection, parameter selection, as well as the program and parameter editing; at the same time, the left and right keys can be used to control the rise and fall of speed magnification (sometimes, it's referred to as “Override”).

3 Screen display of teach pendant

3.1 Home screen (main interface)

This teach pendant adopts the TFT display screen, and its display interface is mainly divided into three parts (general display area, monitoring area, information prompt area), and the other four boundaries mainly covering such areas as Main menu, Status control, Coordinate, Status display, and Sub-menu.

The specific distribution is shown as below, and the color-changing area is in the selected state:



3.2 General display

The general display area is mainly used for setting such contents as program list, program editing, parameter, coordinate setting, process, etc.; in addition, when displaying the program list and program editing, the general display area will be automatically compressed into half-width when the monitoring window is opened, when the monitoring window is closed, it is automatically expanded to full-width display; when used for setting the process interface, the general display area automatically covers the monitoring area, shortcut key area, status control area, information prompt area and main menu area, and becomes full-width display.

4 System Icons & Functions Description

: switch operation mode: single-step, continuous, cycle

: switch wire feeding mode of welding machine： continuous wire feeding, jog wire feeding

: control robot motion enable: disable motion and enable motion.

: control robot welding mode: simulated welding and actual welding.

Indicate the current motion state of the robot, the motion state including: (run), (pause), (stopping), (stop).

Indicate the current servo state, the servo state including : (servo ON), (servo OFF)

Indicate the current work mode of the robot, and the work mode including: (teach), (play), (remote), (emergency stop), and(alarm)

Indicate the current authority of the robot, and the authority including: (Manufacturer), (administer), and (operator).

10 Indicate the user coordinate number currently in use.

17 Indicate the tool coordinate number currently in use.

Indicate the selected coordinate system in the teach state, including: (joint), (right-angle), (user), and (tool).

20% Indicate the current rapid override (OVR).

Indicate the current working mechanism. The working mechanism is divided into (robot) and (positioner).

5 Correct Operating Gesture of Teach Pendant

1. Use your left hand to hold the black soft-rubber handle with the safety switch on the back of the teach pendant, and put your middle finger on the safety switch (hand press) position. As shown in the figure below:

2. Lift the teach pendant with your left hand, then turn it over, thus the display interface is upward, and hold the teach pendant at the position above your left arm. Use your right hand to operate the teach pendant's keys, switches, etc. As shown in the figure below:

3. Standing position: the operator shall stand outside the range of motion of the robot, and stand at the robot front or side, where is convenient to watch the movement of the robot. At the same time, pay close attention to whether there are obstacles or personnel entering the area. In case of emergency, press the emergency button immediately to stop the robot.

6 Simple Manual Operation

1. Turn on the power supply of the robot control cabinet and power on the robot.
2. Ensure no alarm or warning information is found in the "information prompt" column.
3. Switch the mode switch to the teach mode  .
4. Switch the motion enable switch at the status control area to the  "allow motion" state.
5. Press the "hand press" button, and the servo is energized. After the servo is energized, the icon is displayed as:  .
6. Click the running speed in the status display area, and the speed adjustment window will pop up. It is recommended to adjust to 6% -10%.
7. Select the appropriate coordinate system, it is recommended to select joint coordinates.
8. Move each joint slowly through the corresponding coordinate +, - keys.

Chapter 2 Program Editing

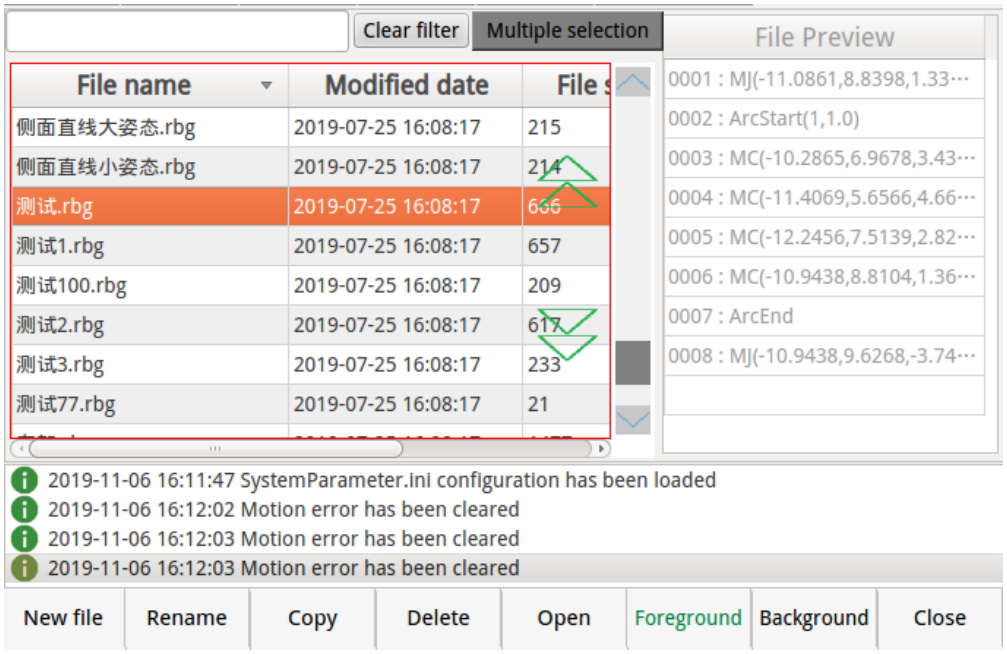
1 New Program

（1） Switch the mode switch to the Teach mode.

（2） Select the appropriate tool coordinate system.

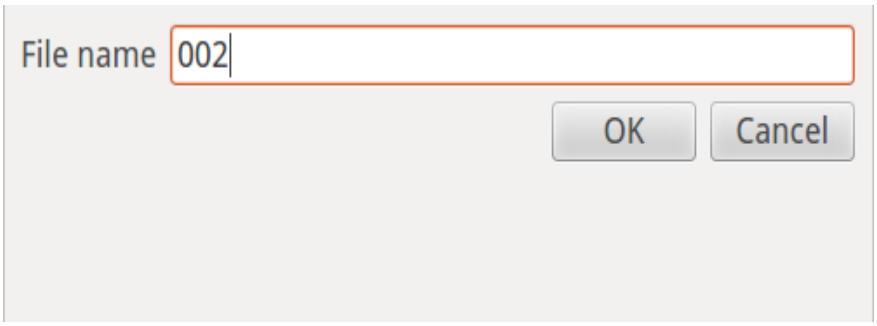
（3） Enter the program list interface.

Click < File Operation > - < Program File Management > to enter the program list interface.

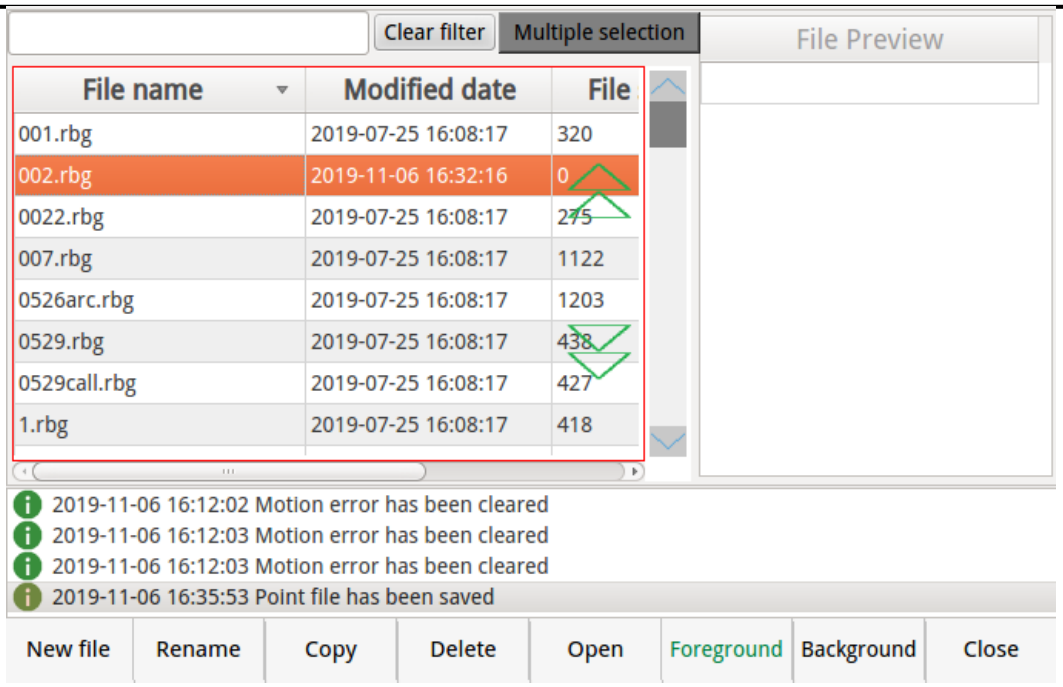


（4） Click the button New file in the sub-menu area.

（5） Enter the name of the new program (e.g. 002) in the pop-up window.

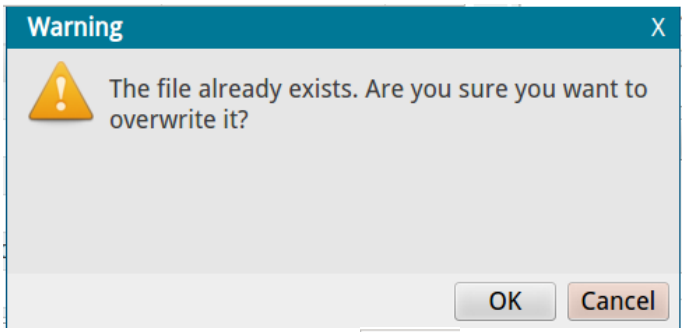


After the file name is entered, click OK. In this case, the new program will be displayed in the program list interface as follows:

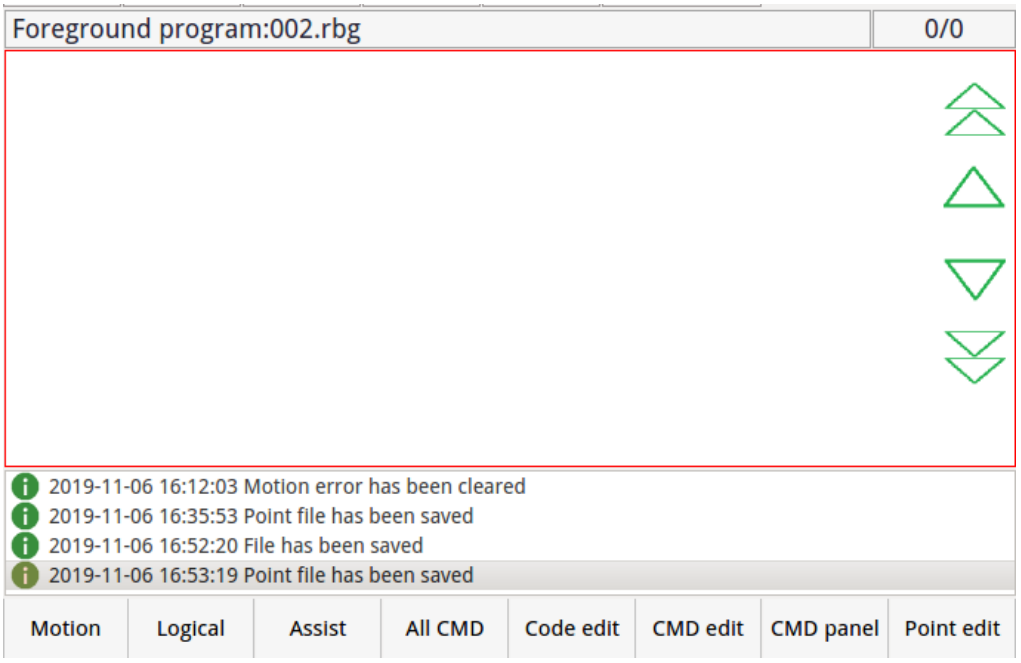


Note: If the program name you entered is a new program name, the system will create a new program with the name you just entered in the list and the blue cursor bar will be highlighted.

If you enter a program name that already exists in the list, a warning box pops up, and select YES to overwrite the original file with the same name. The cursor jumps directly to the blue cursor bar highlighted on the program corresponding to the program name; select No to exit the new operation.

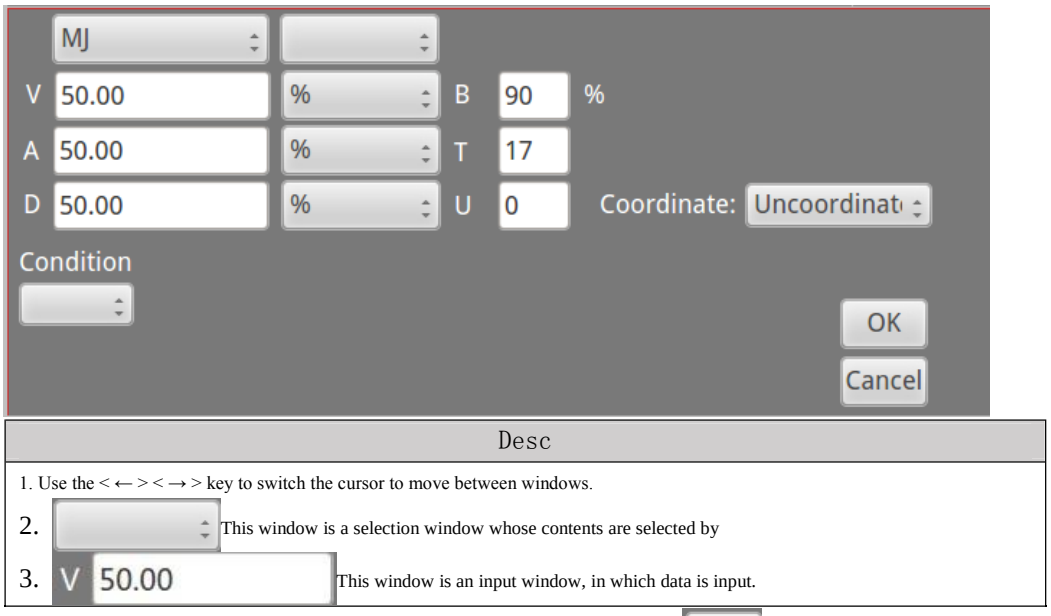


(1) Click the key Open in the sub-menu area.

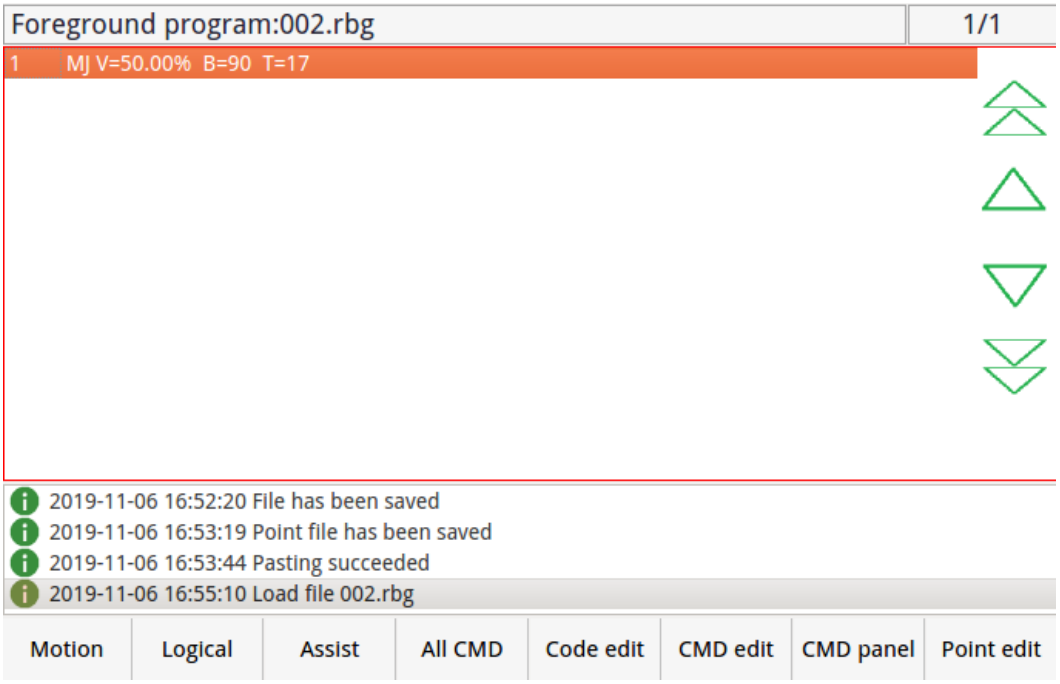


(2) Press and hold the safety switch, then move the robot end to the position of program point 1

through the coordinate key on the teach pendant, and click the sub-menu < Motion > - < MJ >.Pop-up instruction editing window.



After inputting relevant parameters as required, press the icon OK , and the command line will be displayed in the program editing window as follows:

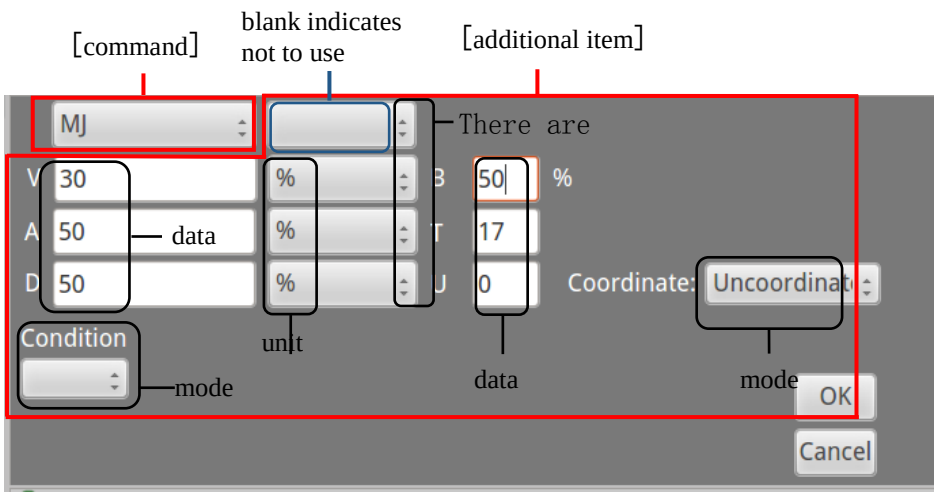


2 Program command

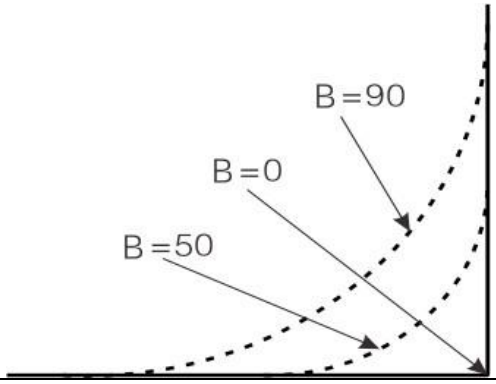
Category	English command		Chinese command
1 Motion	1 MJ		关节移动
	2 ML		直线运动
	3 MC		圆弧运动
2 Logic	1 IF	1 IF	

		2 ELSEIF	条件选择
		3 ELSE	
		4 ENDIF	
	2 WHILE	1 WHILE	条件循环
		2 ENDWHILE	
	3 FOR	1 FOR	固定次数循环
		2 ENDFOR	
	4 SWITCH	1 SWITCH	多分支选择
		2 CASE	
		3 DEFAULT	
		4 BREAK	
		5 ENDSWITCH	
3 Auxiliary	1 WAIT		条件等待
	2 LB		定义跳转标示
	3 GOTO		跳转
	4 CALL		调用子程序
	5 RETURN		返回
	6 DO		数字 IO 输出
	7 SLEEP		延时
	8 NOTE		注释
	9 AO		模拟量输出
4 Expression	1 ADD		加法
	2 SUB		减法
	3 MUL		乘法
	4 DIV		除法
	5 SET		赋值
	6 INC		自加
	7 DEC		自减
	8 MOD		求余

5 Welding command	1 ARCSTART	起弧
	2 ARCEND	熄弧
	3 WEAVEON	摆弧开始
	4 WEAVE END	摆弧结束
	5 SCALESTART	鱼鳞焊开始
	6 SCALEEND	鱼鳞焊结束
	7 ArcIVC	突变电流电压
	8 ArcIVSlowC	渐变电流电压
	9 OPENLASER	打开激光
	10 CLOSELASER	关闭激光
	11 SEARCHLASER	打开激光搜寻
	12 OPENLASERTRACK	打开跟踪
	13 CLOSELASERTRACK	关闭跟踪
6 Arc welding command - arc track	1 ArcTrackStart	电弧跟踪开始
	2 ArcTrackEnd	电弧跟踪结束
7 Arc welding command - arc search	1 SearchStart	接触寻位-搜索开始
	2 MLSearch	接触寻位-搜索
	3 SearchEnd	接触寻位-搜索结束
	4 TouchOffset	接触寻位-点位偏移开始
	5 TouchOffsetEnd	接触寻位-点位偏移结束



Descriptions of additional item:

Format and definition of additional item	Descriptions:
V <percentage>%: Percentage of running speed	The unit is 1%, and the maximum value is 100%. Actual running speed = the highest speed in the parameter × V × Auto. override
V <running speed> mm/s: linear running speed	The unit is mm/s, and the maximum value represents the maximum speed of linear motion set by the parameter. Actual running speed = V × Auto. override
A <percentage> %: Percentage of running acceleration	The unit is 1%, and the maximum value is 100%. Actual running acceleration = the highest acceleration in the parameter × A × Auto. override
A <running acceleration> mm/s2: linear operating acceleration.	The unit is mm/s, and the maximum value represents the maximum acceleration of linear motion set by the parameter. Actual running speed =A × Auto. override
D <percentage> %: percentage of running deceleration.	The unit is 1%, and the maximum value is 100%. Actual running deceleration = the highest deceleration in the parameter × D × Auto. override
D <running deceleration> mm/s2: linear running deceleration	The unit is mm/s2, and the maximum value represents the maximum deceleration of linear motion set by the parameter. Actual running deceleration = D × Auto. override
<Smoothness>: smoothness	Range 0-100. In a nutshell, it is the arc of the transition that determines whether you are transitioning at right angles or in arcs. If two straight lines are to be connected and how they are to be connected, you will need to set this variable. Refer to the figure below for B value selection. 
DI <variable number>: General-purpose input interface	General-purpose input X interface, corresponding to the hardware physical interface, is a state variable (ON = 1, OFF = 0) ,range 8-27. The interface status can be viewed in "Monitoring" - "IO Interface" - "General-purpose Input Interface Monitoring". Please refer to the Hardware Operating Instruction for variable numbers.
LP <Variable number>: Local P variable	Its value records relevant position data such as posture and coordinates of each joint of the robot, and it's a combination of multiple data. Variable number range: 0-999, when different programs call the same variable number, their corresponding data are different, not interfere with each other, and independent of each other. For example, one program calls variable LPO, another program also calls the variable LPO, the two LPO do not interfere with each other, and are independent. This variable appears in the Variable Table only when the calling program is opened.
DO <variable number>: General-purpose output interface	General-purpose output Y interface, corresponding to the hardware physical interface, is a state variable (ON = 1, OFF = 0) , range 3-3. This interface status can be viewed in "Monitoring" - "IO Interface" - "General-purpose Output Interface Monitoring"

	. Please refer to the Hardware Operating Instruction for variable numbers.
VA <Variable Number>: Custom Data Variable	Custom data variables, where the variables are specific data entered by the user. This data can be signed and a decimal can be entered.
==：Equal	To judge whether the variables before and after are equal or consistent, the data variables or state variables can be judged. For example: VA1 = VA3, etc.
>：Greater than	To judge whether the preceding variable is greater than the succeeding variable, the data variable can be judged. For example: VA1>VA3, etc.
<：Less than	To judge whether the preceding variable is less than the succeeding variable, the data variable can be judged. For example: VA1< VA3, etc.
>=：Greater than or equal to	To judge whether the preceding variable is greater than or equal to the succeeding variable, the data variable can be judged. For example, VA1>=VA3, etc. .
<=：Less than or equal to	To judge whether the preceding variable is less than or equal to the succeeding variable, the data variable can be judged. For example, VA1<=VA3, etc. .
=：Assignment character	Assign the preceding variable to one data or expression or set it to a subsequent state, such as VA0 = 19, VA0=VA1+VA3，DO3=1, etc.

1 Motion command

There are three motion commands: MJ, ML, and MC.

1 Joint movement (MJ)	Command function	Move to the teaching position by means of joint interpolation.	
	Additional item	[Blank] LP<Variable number>	Position data, this column displays blank on the screen. LP Variable, variable number: 0-999
		V=<percentage>	V velocity-proportional, percentage:0-100. Each joint is set to speed according to its axis ×V ×Auto. override
		A=<percentage>	A acceleration-proportional, percentage:0-100.
		D=<percentage>	D deceleration-proportional, percentage:0-100.
		B=<smoothness>	B smoothness：0-100
		T=<tool coordinate number>	Selected tool coordinate system number: 0-50
		U=<user coordinate number>	Selected user coordinate system number: 0-50
		Non-collaboration Collaboration1 Collaboration2 Full-collaboration	No use of this item Additional axis 1 Independent collaboration Additional axis 2 Independent collaboration Synchronous collaboration of additional axis 1 and additional axis 2

	For example:	MJ V=40 A=20 D=20 B=0 T=1 U=1 MJ LP0 V=40 A=20 B=0 T=1 U=1	
2 Linear motion (ML)	Command function	Move to the teaching position by means of linear interpolation.	
	Additional item	[Blank] LP<Variable number>	Position data, this column displays blank on the screen. LP Variable, variable number: 0-999
		V=<percentage> V=<linear running velocity>	V velocity-proportional, percentage:0-100. Each joint is set to speed according to its axis × V × Auto. Override, and conducts linear interpolation motion. The unit of linear running velocity is mm/s, and the maximum value represents the maximum velocity of linear motion set by the parameter. Each joint is set to the speed V × Auto. Override, and conducts linear interpolation motion.
		A=<percentage> A=<linear running acceleration>	A acceleration-proportional, percentage:0-100. The unit of linear running acceleration is mm/s, and the maximum value represents the maximum acceleration of linear motion set by the parameter.
		D=<percentage> D=<linear running deceleration>	D deceleration-proportional, percentage:0-100. The unit of linear running deceleration is mm/s, and the maximum value represents the maximum deceleration of linear motion set by the parameter.
		B=<smoothness>	B smoothness：0-100
		T=<tool coordinate number>	Selected tool coordinate system number 0-50
		U=<user coordinate number>	Selected user coordinate system number 0-50
		Non-collaboration Collaboration 1 Collaboration 2 Full-collaboration	No use of this item Additional axis 1 Independent collaboration Additional axis 2 Independent collaboration Synchronous collaboration of additional axis 1 and additional axis 2
	Example of program:	ML V=720mm/s A=360mm/s2 D=360mm/s2 B=0 T=1 U=1 ML LP0 V=40 A=20 D=20 B=0 T=1 U=1	
3 Circular motion (MC)	Command function	Move to the teaching position by means of arc interpolation. The whole circle shall be composed of two segments of arc, and at least four segments of arc commands shall be used. For details, please refer to the comprehensive example.	

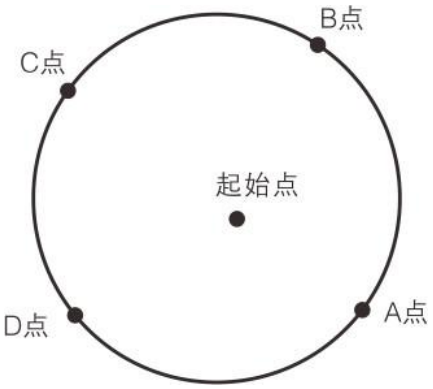
	Additional item	[Blank] LP <Variable number>	Position data, this column displays blank on the screen. LP Variable, variable number: 0-999
		V=<percentage> V=<linear running velocity>	V velocity-proportional, percentage:0-100. Each joint is set to speed according to its axis × V × Auto. Override, and conducts arc interpolation motion. The unit of linear running velocity is mm/s, and the maximum value represents the maximum velocity of linear motion set by the parameter. Each joint is set to the speed V × Auto. Override, and conducts arc interpolation motion.
		A=<percentage> A=<linear running acceleration>	A acceleration-proportional, percentage:0-100. The unit of linear running acceleration is mm/s, and the maximum value represents the maximum acceleration of linear motion set by the parameter.
		D=<percentage> D=<linear running deceleration>	D deceleration-proportional, percentage:0-100. The unit of linear running deceleration is mm/s, and the maximum value represents the maximum deceleration of linear motion set by the parameter.
		B=<smoothness>	B smoothness：0-100
		T=<tool coordinate number>	Selected tool coordinate system number 0-50
		U=<user coordinate number>	Selected user coordinate system number 0-50
		Non-collaboration Collaboration 1 Collaboration 2 Full-collaboration	No use of this item Additional axis 1 Independent collaboration Additional axis 2 Independent collaboration Synchronous collaboration of additional axis 1 and additional axis 2
	Example of program:	MC V=720mm/s A=360mm/s2 A=20 D=360mm/s2 B=0 T=1 U=1 MC LPO V=40% A=20% B=0 T=1 U=1	

Comprehensive example of arc:

For the whole circle, use A, B, C and C, D, A, both ends arc, the robot end is located at the starting point, and the program is as follows:

ML V=720mm/s B=0 T=1 U=1	Run from the starting point to point A, the point A shall be considered as the first point of the arc.
MC V=720mm/s B=0 T=1 U=1	Run from the point A to point B, the point B shall be considered as the second point of the arc.
MC V=720mm/s B=0 T=1 U=1	Run from the point B to point C, the point C shall be considered as the third point of the arc. At the same time, the point C shall be considered as the first point of the arc.
MC V=720mm/s B=0 T=1 U=1	Run from the point C to point D, the point D shall be considered as the second

	point of the arc.
MC V=720mm/s B=0 T=1 U=1	Run from the point D to point A, the point A shall be considered as the third point of the arc.



2 Logic command

1 Conditions (IF→IF)	Command function	IF condition selection command. The complete structure of this command is composed of IF, ELSEIF (which can be omitted or reused), ELSE and ENDIF. First, it is judged whether the IF condition is satisfied; if the IF condition is satisfied, the block after the IF is executed. If the IF condition is not satisfied, then the condition after ELSEIF is judged (this command line can be used or not used according to actual selection; if ELSEIF condition is satisfied, then the program after ELSEIF is executed; if ELSEIF condition is not satisfied, then the program after ELSE is executed. Use ENDIF at the end of the program. The IF command must end with ENDIF and form a complete structure).			
	Additional item	DI <Variable Number> DO <Variable Number> VA <Variable Number> LP <Variable Number> <Data>	== > < >= <=	DI <Variable number> DO <Variable number> VA <Variable number> LP<Variable number> <Data>	For the IF condition selection command, if the condition is satisfied, the program after the block is executed. If the condition is not satisfied, the ELSEIF condition is executed. If the condition after ELSEIF is satisfied, the program after ELSEIF is executed. If the conditions after IF and ELSEIF are not satisfied, the program after ELSE is executed. Use the command ENDIF to finish the IF judgment.

	Example of program	IF(VA0 < 2)	If VA0 < 2，execute
		VA1 = 1	VA1 = 1
		ELSEIF(VA0<3)	If VA0 < 3，execute
		VA1 = 2	VA1 = 2
		ELSE	If all conditions are not satisfied, execute
		VA1 = 3	VA1 = 3
		ENDIF	IF command end

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1 Conditions (IF → ELSEIF)	Command function	IF condition selection command. The complete structure of this command is composed of IF, ELSEIF (which can be omitted or reused), ELSE and ENDIF. First, it is judged whether the IF condition is satisfied; if the IF condition is satisfied, the block after the IF is executed. If the IF condition is not satisfied, then the condition after ELSEIF is judged (this command line can be used or not used according to actual selection; if ELSEIF condition is satisfied, then the program after ELSEIF is executed; if ELSEIF condition is not satisfied, then the program after ELSE is executed. Use ENDIF at the end of the program. The ELSEIF command cannot exist independently and must be within the IF structure.			
	Additional item	DI <Variable Number> DO <Variable Number> VA <Variable Number> LP <Variable Number> <Data>	== > < >= <=	DI <Variable number> DO <Variable number> VA <Variable number> <Variable number> LP<Data>	For the IF condition selection command, if the condition is satisfied, the program after the block is executed. If the condition is not satisfied, the ELSEIF condition is executed. If the condition after ELSEIF is satisfied, the program after ELSEIF is executed. If the conditions after IF and ELSEIF are not satisfied, the program after ELSE is executed. Use the command ENDIF to finish the IF judgment.

	Example of program	IF(DI8 =1) If DI8 =1，execute VA1 ++ VA1 ++ ELSEIF(DI9=1) If DI9 =1，execute VA2 ++ VA2 ++ ELSEIF(DI10=1) If DI10 =1，execute VA4 ++ VA4 ++ ELSE If all conditions are not satisfied, execute VA0 ++ VA0 ++ ENDIF IF command end

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1 Conditions (IF→ELSE)	Command function	IF condition selection command. The complete structure of this command is composed of IF, ELSEIF (which can be omitted or reused), ELSE and ENDIF. First, it is judged whether the IF condition is satisfied; if the IF condition is satisfied, the block after the IF is executed. If the IF condition is not satisfied, then the condition after ELSEIF is judged (this command line can be used or not used according to actual selection); if the ELSEIF condition is satisfied, then the program after ELSEIF is executed; if the ELSEIF condition is not satisfied, then the program after ELSE is executed. Use ENDIF at the end of the program. The ELSE command cannot exist independently and must be within the IF structure.
	Example of program:	IF(DI8=1) If DI8 =1，execute VA1=1 VA1 = 1 ELSE Otherwise, execute VA1=2 VA1 = 2 ENDIF IF(DI8=0) IF command end If DI8 =0， If DI8 =0 execute VA1 =3 VA1 = 3 ELSE Otherwise, execute VA1 =4 VA1 = 4 ENDIF IF command end

1 Conditions （IF→ENDIF）	Command function	IF condition selection command The complete structure of this command is composed of IF, ELSEIF (which can be omitted or reused), ELSE and ENDIF. First, it is judged whether the IF condition is satisfied; if the IF condition is satisfied, the block after the IF is executed. If the IF condition is not satisfied, then the condition after ELSEIF is judged (this command line can be used or not used according to actual selection); if the ELSEIF condition is satisfied, then the program after ELSEIF is executed; if the ELSEIF condition is not satisfied, then the program after ELSE is executed. Use ENDIF at the end of the program. This command cannot be used alone and must be used in pairs with the IF command.

	Example of program:	IF(DI8 =1) If DI8 =1，execute
		VA1 = 1 VA1 = 1
		ELSE Otherwise, execute
		VA1 = 2 VA1 = 2
		ENDIF IF command end
		IF(DI8 =0) If DI8 =0，execute
		VA1 = 3 VA1 = 3
		ELSE Otherwise, execute
		VA1 = 4 VA1 = 4
		ENDIF IF command end

2 Conditional loop (W H I L E → WHILE）	Command function	WHILE conditional loop command, the complete structure of this command is composed of WHILE and ENDWHILE. If the conditions after WHILE meet the requirements, that is, when the conditions are ON, execute the programs in WHILE and ENDWHILE, and exit the loop until the commands after WHILE conditions do not meet the requirements. The conditions must be set in the loop section, otherwise, it will be an endless (infinite) loop.			
	Additional item	DI <Variable Number> DO <Variable Number> VA <Variable Number> LP <Variable Number> <Data>	== > < >= <=	DI <Variable Number> DO <Variable Number> VA <Variable Number> LP <Variable Number> <Data>	If the conditions after WHILE meet the requirements, that is, when the conditions are ON, execute the programs in WHILE and ENDWHILE, and exit the loop until the commands after WHILE conditions do not meet the requirements. The conditions must be set in the loop section, otherwise it will be an endless (infinite) loop.

	Example of program:	VA0 = 0 Set VA0 = 0
		VA1 = 0 Set VA0 = 0
		WHILE(V<=4) If VA1 < = 4, execute the IF block
		IF(DI11=1) IF judgment：If DI11= 1, execute
		VA1 ++ VA1=VA1+1
		ELSE Otherwise, execute
		VA1 =5 VA1 =5
		ENDIF IF command end
		VA0 ++ VA0=VA0+1
		ENDWHILE If VA1 > 4，execute
		VA2 =5 VA2 =5

2 Conditional loop (W H I L E → ENDWHILE)	Command function	WHILE conditional loop command: the complete structure of this command is composed of WHILE and ENDWHILE. If the conditions after WHILE meet the requirements, that is, when the conditions are ON, execute the programs WHILE and ENDWHILE, and exit the loop until the commands after WHILE conditions do not meet the requirements. The conditions must be set in the loop section, otherwise it will be an endless (infinite) loop.

	Example of program:	VA0 = 0 Set VA0 = 0
		VA1 = 0 Set VA1 = 0
		WHILE(VA1 <= 4) If VA1 <= 4，execute the IF block
		IF(DI11= 1) IF judgment：if DI11= 1, execute
		VA1 ++ VA1=VA1+1
		ELSE Otherwise, execute
		VA1 =5 VA1 =5
		ENDIF IF command end
		VA0 ++ VA0=VA0+1
		ENDWHILE If VA1 > 4，execute
		VA2 =5 VA2 =5

3 Fixed number of loop (FOR → FOR)	Command function	Loop command with fixed cycle times The command must end with ENDFOR and form a complete structure. Set the start value for the loop variable, when the loop variable satisfies the conditions, execute the programs in FOR and ENDFOR, and at the same time, the loop variable is changed progressively by step until the loop variable does not meet the requirements, then exit the loop.	
	Additional item	VA <Variable number>	The loop body controls the value of variable for the number of cycles, currently supporting only the VA variable. Variable number Range: 0-99
		<Start value>	VA variable value of loop start
		<End value>	VA variable value of loop end
		<Step>	The value of each increment or decrement of a variable.
	Example of program:	FOR(VA1=0;VA1<9;VA1+=3) VA1=0 , If VA1<9 , VA1= VA1+3 , execute VA0 ++ VA0= VA0+1 ENDFOR If not meet VA1<9，FOR loop end.	
3 Loop command with fixed cycle times (FOR → ENDFOR）	Command function	This command cannot be used alone and must be used in pairs with the FOR command. Constitute a complete loop structure with a fixed cycle times. Set the start value for the loop variable, when the loop variable satisfies the conditions, execute the programs in FOR and ENDFOR, and at the same time, the loop variable is changed progressively by step until the loop variable does not meet the requirements, then exit the loop.	
	Example of program:	FOR(VA1=0;VA1<9;VA1+=3) VA1=0，if VA1<9，VA1= VA1+3，execute VA0 ++ VA0= VA0+1 ENDFOR If not meet VA1<9, FOR loop end.	
4 Condition selection (S W I T C H → SWITCH)	Command function	SWITCH condition selection command: the complete structure of this command is composed of SWITCH, CASE (reusable), BREAK, DEFAULT and ENDSWITCH. Calculate the value of variable after SWITCH, and judge which value is equal to the value after CASE. When an equal CASE is found, the program starts execution at the location and ends execution at the first BREAK, and jumps to the ENDSWITCH line. If an equal value is not found, it shall go to the DEFAULT command line to start execution until ENDSWITCH ends.	

		Pay attention to the location of BREAK; if the location of BREAK is different, the result of the operation will be different as well.	
	Additional item	VA <Variable number>	Data variable, CASE content is specific data. This command currently only supports the VA variable as a condition for judgment.
	Example of program:	SWITCH(VA0) SWITCHS data variable VA0 CASE 1: CASE 1, that is, VA0 = 1 execution VA1 = 1 VA1 = 1 BREAK CASE 1 end, Skip to ENDSWITCH CASE 2: CASE 2, that is, VA0 = 2 execution VA1 = 2 VA1 = 2 BREAK CASE 2 end, Skip to ENDSWITCH CASE 3: CASE 3, that is, VA0 = 3 execution VA1 = 3 VA1 = 3 BREAK CASE 3 end, , Skip to ENDSWITCH DEFAULT Result of VA0 is not equal to the above value, execute VA1 = 4 execute VA1 = 4 ENDSWITCH SWITCH command end	

4 Condition selection (SWITCH→ CASE)	Command function	SWITCH condition selection command: the complete structure of this command is composed of SWITCH, CASE (reusable), BREAK, DEFAULT and ENDSWITCH. Calculate the value of variable after SWITCH, and judge which value is equal to the value after CASE. When an equal CASE is found, the program starts execution at the location and ends execution at the first BREAK, and jumps to the ENDSWITCH line. BREAK end, and skip to ENDSWITCH command line. If an equal value is not found, it shall go to the DEFAULT command line to start execution until ENDSWITCH ends. Pay attention to the location of BREAK; if the location of BREAK is different, the result of the operation will be different as well.	
	Additional item	<Data>	Possible values of variables after SWITCH.
	Example of program:	SWITCH(VA0) SWITCH data variable VA0 CASE 1: CASE 1, that is, VA0 = 1 execution VA1 = 1 VA1 = 1 BREAK Skip to ENDSWITCH after CASE 1 end	

		CASE 2:	CASE 2, that is, VA0 = 2 execution
		VA1 = 2	VA1 = 2
		BREAK	Skip to ENDSWITCH after CASE 2 end
		CASE 3:	CASE 3, that is, VA0 = 3 execution
		VA1 = 3	VA1 = 3
		BREAK	Skip to ENDSWITCH after CASE 3 end
		DEFAULT VA1 = 4	If the result of VA0 is not equal to the above value, execute VA1= 4
		ENDSWITCH	SWITCH command end

4 Condition selection (S W I T C H → DEFAULT)	Command function	SWITCH condition selection command: the complete structure of this command is composed of SWITCH, CASE (reusable), BREAK, DEFAULT and ENDSWITCH.	
		Calculate the value of variable after SWITCH, and judge which value is equal to the value after CASE.	
		When an equal CASE is found, the program starts execution at the location and ends execution at the first BREAK, and jumps to the ENDSWITCH line.	
		BREAK end, and skip to ENDSWITCH command line.	
		If an equal value is not found, it shall go to the DEFAULT command line to start execution until ENDSWITCH ends.	
		Pay attention to the location of BREAK; if the location of BREAK is different, the result of the operation will be different as well.	
	Example of program:	SWITCH(VA0)	SWITCH data variable VA0
		CASE 1:	CASE 1, that is, VA0 = 1 execution
		VA1 = 1	VA1 = 1
		BREAK	Skip to ENDSWITCH after CASE 1 end
		CASE 2:	CASE 2, that is, VA0 = 2 execution
		VA1 = 2	VA1 = 2
		BREAK	Skip to ENDSWITCH after CASE 2 end
		CASE 3:	CASE 3, that is, VA0 = 3 execution
		VA1 = 3	VA1 = 3
		BREAK	Skip to ENDSWITCH after CASE 3 end
		DEFAULT	If the result of VA0 is not equal to the above value, execute
		VA1 = 4 ENDSWITCH	execute VA1 = 4 SWITCH command end

	Command function	SWITCH condition selection command: the complete structure of this command is composed of SWITCH, CASE (reusable), BREAK, DEFAULT and ENDSWITCH. SWITCH condition selection command: the complete structure of this command is composed of SWITCH, CASE (reusable), BREAK, DEFAULT and ENDSWITCH. Calculate the value of variable after SWITCH, and judge which value is equal to the value after CASE. When an equal CASE is found, the program starts execution at the location and ends execution at the first BREAK, and jumps to the ENDSWITCH line. BREAK end, and skip to ENDSWITCH command line. If an equal value is not found, it shall go to the DEFAULT command line to start execution until ENDSWITCH ends. Pay attention to the location of BREAK; if the location of BREAK is different, the result of the operation will be different as well.
4 Condition selection (S W I T C H → BREAK)	Example of program:	SWITCH(VA0) SWITCH data variable VA0 CASE 1: CASE 1, that is, VA0 = 1 execution VA1 = 1 VA1 = 1 BREAK Skip to ENDSWITCH after CASE 1 end CASE 2: CASE 2, that is, VA0 = 2 execution VA1 = 2 VA1 = 2 BREAK Skip to ENDSWITCH after CASE 2 end CASE 3: CASE 3, that is, VA0 = 3 execution VA1 = 3 VA1 = 3 BREAK Skip to ENDSWITCH after CASE 3 end DEFAULT VA1 = 4 If the result of VA0 is not equal to the above value, execute VA1= 4 ENDSWITCH SWITCH command end

4 Condition selection (S W I T C H → ENDSWITCH)	Command function	SWITCH condition selection command: the complete structure of this command is composed of SWITCH, CASE (reusable), BREAK, DEFAULT and ENDSWITCH. Calculate the value of variable after SWITCH, and judge which value is equal to the value after CASE. When an equal CASE is found, the program starts execution at the location and ends execution at the first BREAK, and jumps to the ENDSWITCH line. BREAK end, and skip to ENDSWITCH command line. If an equal value is not found, it shall go to the DEFAULT command line to start execution until ENDSWITCH ends. Pay attention to the location of BREAK; if the location of BREAK is different, the result of the operation will be different as well.
	Example of program:	SWITCH(VA0) CASE 1: SWITCH data variable VA0 VA1 = 1 CASE 1, that is, VA0 = 1 execute VA1 = 1 BREAK Skip to ENDSWITCH after CASE 1 end CASE 2: CASE 2, that is, VA0 = 2 execution VA1 = 2 VA1 = 2 BREAK Skip to ENDSWITCH after CASE 2 end CASE 3: CASE 3, that is, VA0 = 3 execution VA1 = 3 VA1 = 3 BREAK Skip to ENDSWITCH after CASE 3 end DEFAULT If the result of VA0 is not equal to the above value, execute VA1 = 4 ENDSWITCH execute VA1 = 4 SWITCH command end

3.Auxiliary command

1 WAIT	Command function	If the conditions you set are met, the program goes down; if the conditions you set are not met, the program stops here until the conditions you set are met.

	Additional item	<Variable> VA <Variable number> DO<Variable number> DI<Variable number> AI0<Variable number>	== > < >= <=	<Variable> VA <Variable number> DO<Variable number> DI<Variable number> AI0<Variable number>	If the conditions you set are met, the program goes down; if the conditions you set are not met, the program stops here until the conditions you set are met.
	Example of program:	WAIT(VA5 = 3), wait the variable VA5 = 3 condition to be valid. WAIT(AIO = 5), wait the analog input interface AI0 input 5V to be valid.			

2 Jump label (LB)	Command function	Mark the GOTO jump position, and it shall be used in cooperation with GOTO command.	
	Additional item	LB<Variable>	Variables are numbers, ranging from 0 to 99 9
	Example of program:	L001 Mark the jump position 001 ……	

3. Program jump command （GOTO)	Command function	Program jump command Descriptions: 1.When using this command, it shall be used in cooperation with label command (LB). The label line is the position where you want to jump the program to. 2. No additional conditions, once the program is executed to this line, jump directly to the position where the label is located .	
	Additional item	GOTO<Variable>	A jump label, indicating the program shall jump to a position having LB < variable >; Variables are numbers, ranging from 0 to 999
	Example of program:	1 …… …… 5 IF(DI10=1) 6 GOTO L001 7 ELSE ……	If the status of input interface X10 is ON Jump to the label 1 position Otherwise, execute Subsequent programs

		14 ENDIF	IF command end
		15 L001	Label 1 position
		……	Subsequent programs

4 Subprogram call (CALL)	Command function	Subprogram call command, call unconditionally. Descriptions: The only difference between the creation of a subprogram and a main program is that after all the programs have been written, a RETURN command is added at the end of the subprogram. 2. This is the program you want to call. If the program is executed to this command line, the subprogram is called directly.	
	Additional item	CALL<program name>	It means the name of the subprogram called by the program.
	Example of program:	CALL 125	Calling a subprogram with a program name of 125

5Sub-program (Return)	Command function	The RETURN instruction is added at the end of the program to indicate that the current program is a subprogram. Once the system runs to this command, it shall return to the main program.	
	Additional item	None	
	Example of program	…… RETURN	Subprogram return

6Digital IO output (DO)	Command function	It's mainly used to control the state of variable. There are only two forms of digital quantity, so there are only two states when the command is used, that is, "1 (valid)" and "0 (invalid)."		
	Additional item	<Variable number>=	1 0 DO<Variable number>	Control the state (i.e. 1 or 0) of output interface Y <variable number>, or set the variable state of other output interfaces. Please refer to the Hardware Operating Instruction for the range of variable number.
	Example of program	DO3=1 Set the output interface Y3 to the ON state.		

7 Sleep command	Command function	If this command is executed, the program will pause for the set time, and then continue to run.	
	Additional item	<Variable>	Sleep time, unit: millisecond
	Example of program	SLEEP(2000)	Sleep 2 seconds

8Note (NOTE)	Command function	Command introduction and description. When this program is executed, the contents of this part are not executed, just describe the command meanings to the user, thus it is convenient for the user to understand the program more easily.	
	Additional item	<Note content>	It refers to the content noted by the user himself. Easy for user to check and understand the program.
	Example of program	# ljpd note content ljpd, this command doesn't execute.	

9 Analog output (AO)	Command function	Analog voltage of the analog output interface.	
	Additional item	<Variable number>=	Specify the analog interface number to be output, with a range of four channels A1-A4
		<Variable>	Variable is the analog voltage value to be output, range -10 ~ 10.
	Example of program	AO1=0.000	The analog voltage of the output A1 interface is 0V
		AO2=10.000	The analog voltage of the output A2 interface is 10V.

4. Expression command

1 Addition (ADD)	Command function	Add the previous variable to the next variable and assign the result to another variable. This command can only use data variables.			
	Additional item	VA <Variable number>=	<Variable> + VA <Variable number>-	<Variable> VA <Variable number>	Add the previous variable to the next variable and assign the result to another variable.
	Example of program	VA2 = VAO+VA1 Add the variable VA0 to the variable VA1, and assign the result to the variable VA2.			

2 Subtraction (SUB)	Command function	Subtract the next variable from the previous variable and assign the result to another variable. This command can only use data variables.			
	Additional item	VA <Variable number>=	<Variable> - VA <Variable number>-	<Variable> VA <Variable number>	Subtract the next variable from the previous variable and assign the result to another variable.
	Example of program	VA2 = VAO- VA1 Subtract the variable VA1 from the variable VA0, and assign the result to the variable VA2.			

3 Multiplication (MUL)	Command function	Multiply the previous variable by the next variable, and assign the result to another variable. This command can only use data variables.			
	Additional item	VA <Variable number>=	<Variable>* VA <Variable number>*	<Variable> VA <Variable number>	Multiply the previous variable by the next variable, and assign the result to another variable.
	Example of program	VA2 = VAO* VA1 Multiply the variable VA0 by the variable VA1, and assign the result to the variable VA2.			

4 Division (DIV)	Command function	Divide the previous variable by the next variable, and assign the result to another variable. This command can only use data variables.			
	Additional item	VA <Variable number>=	<Variable>/ VA <Variable number>/	<Variable> VA <Variable number>	Divide the previous variable by the next variable, and assign the result to another variable.
	Example of program	VA2 = VAO/ VA1 Divide the variable VA0 by the variable VA1, and assign the result to the variable VA2.			

5Increment (INC）	Command function	Add a number 1 to the variable, and the result is assigned to the variable. This command can only use data variables.	
	Additional item	VA <Variable number>++	Add 1 to the variable, and the result is assigned to the variable.

	Example of program	VA0 ++ VA0 = VA0 + 1

6. Decrement (DEC)	Command function	Subtract 1 from the variable and assign the result to the variable. This command can only use data variables.	
	Additional item	VA <Variable number>--	Subtract 1 from the variable and assign the result to the variable.
	Example of program	VA0 -- VA0 = VA0 - 1	

7 Assignment (set)	Command function	Assign the next variable to the previous variable. This command can only use data variables.		
	Additional item	VA <Variable number>=	<Variable> VA <Variable number>	Assign the next variable to the previous variable.
	Example of program	VA0 = 5 VA2 = VA0	Assign 5 to the variable VA0. Assign the variable VA0 to the variable VA2.	

8 Mod	Command function	Divide the previous variable by the next variable, carry out the MOD operation to the obtained result and assign it to another variable. This command can only use data variables.			
	Additional item	VA <Variable number>=	<Variable> VA <Variable number>	<Variable> VA <Variable number>	Divide the previous variable by the next variable, carry out the MOD operation to the obtained result and assign it to another variable.
	Example of program	VA2 = VAO / VA1	Divide the variable VA0 by the variable VA1, carry out the MOD operation to the obtained result and assign it to the variable VA2.		

5 Arc welding command

Arc start Arc end	Command function	When running this command, the program will call the preset basic parameter, and arc start. The variable number is the file number of basic parameter, ranging from 1 to 10. The two commands are used in pairs.	
	Additional item	<Variable number>	The variable number is the file number of basic parameter to be called.
	Example of program	ArcStart (1,1.0) Call the welding file 1, and arc start. …… start welding ArcEnd End of arc start and completion of welding	

WEVA ON WEAVE END	Command function	When running this command, the program will call the preset WEVA parameter, and the WEVA variable number is the file number of WEVA parameter, ranging from 1-10. The two commands are used in pairs.

	Additional item	<Variable number>	The variable number is the file number of WEVA parameter paired with the WEVA command.
	Example of program	WevaOn (1,1.0) Call the Weva parameter file 1, and Weva on. …… Weva path WevaOff Weva end	

SCALESTART SCALEEND	Command function	When running this command, the program will call the preset SCALE parameter, and the SCALE variable number is the file number of SCALE parameter, ranging from 1-10. The two commands are used in pairs.	
	Additional item	<Variable number>	The variable number is the file number of SCALE parameter paired with the SCALE command.
	Example of program	ScaleStart (1,1.0) Call the Scale parameter file 1, and Scale start. …… Scale (T.I.G Welding) path SCALEEND Scale end	

6 Arc welding command - arc track

1 ArcTrackStart 2.ArcTrackEnd	Command function	When running this command, the program will call the preset arc tracking parameter, and the variable number is the arc track file number, ranging from 1-10. The two commands are used in pairs.	
	Additional item	<Variable number>	The variable number is the arc tracking file number.
	Example of program	ArcTrackStart (1)Call the arc track file 1, and the arc track start. …… 2.ArcTrackEnd ArcTrackEnd	

7 Arc welding command - search

Search start MLSearch SearchEnd	Command function	When running this command, the program will call the preset search parameter, and arc start. The variable number is the file number of basic parameter to be called, ranging from 1 to 10. The three commands are used together.	
	Additional item	<Variable number>	The variable number is the file number of basic parameter to be called.
	Example of program	SearchStart File[1] P[1] Call the search file number 1 with offset parameter P [1] to start search. …… ML V=50.00mm/s T=17 U=0 Search + XPos [1] Search for the direction of specified search coordinate system …… SearchEnd Search end	

TouchOffset TouchOffsetEnd	Command function	When running this command, the program will call the preset offset parameter, and the variable number is the called offset parameter number, ranging from 1-10. The two commands are used in pairs.	
	Additional item	<Variable number>	The variable number is the called offset parameter number.
	Example of program	Offset P[1] Call the offset parameter P[1], offset starts …… OffsetEnd Offset End	

Comprehensive example of welding

ArcStart (1,1.0)	Call the No. 1 welding parameter to carry out welding
WevaOn (1,1.0)	Call the No. 1 WEVA parameter
ML V=100mm/s A=50mm/s2 D=50mm/s2 B=0 T=1 U=1	Start welding and complete the whole welding track
WevaOff	WevaOff
ArcEnd	End of No.1 welding process

3 Teaching programming

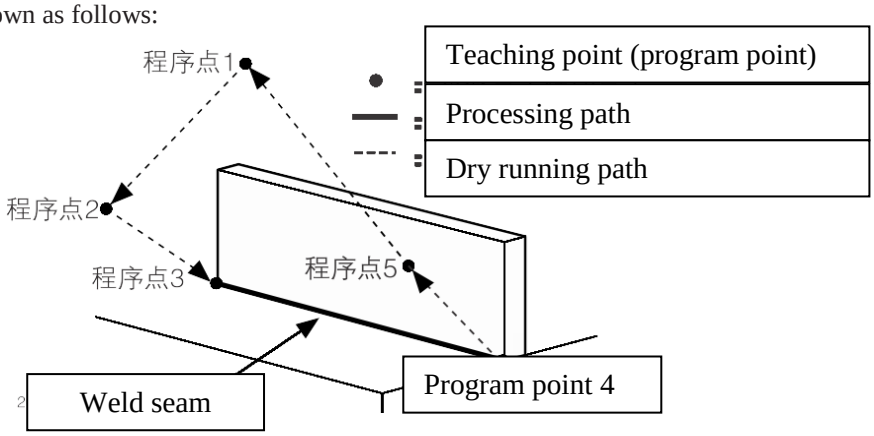
Teaching programming means that in the TEACH mode, the user employs the following procedures to generate a user program: ensure the teach pendant is working in the TEACH mode; select the coordinate system; manually moving the robot end to a desired position; then call such commands as current coordinate data (not visible), motion track, machining

process, etc. by a specific operation (such as click a button to select the command, etc.), thereby generating a user program.

- In case the variables are not used, the program line of motion command contains such data as the motion command, additional speed, acceleration, smoothness, selected tool number and user number, as well as the robot joint data(this data program editing interface is not visible).
- In case the variables are used, the robot shut-down data shall be included in the variables.
- The examples of teaching programming steps are illustrated in later sections. For more programming examples, please refer to the Process Manual.

3.1 Teaching programming of welding

The schematic diagram is shown as follows:



Relevant commands:

MJ: joint motion ML: linear motion ARCSTART: arc start ARCEND: arc end

3.1.1 Program List

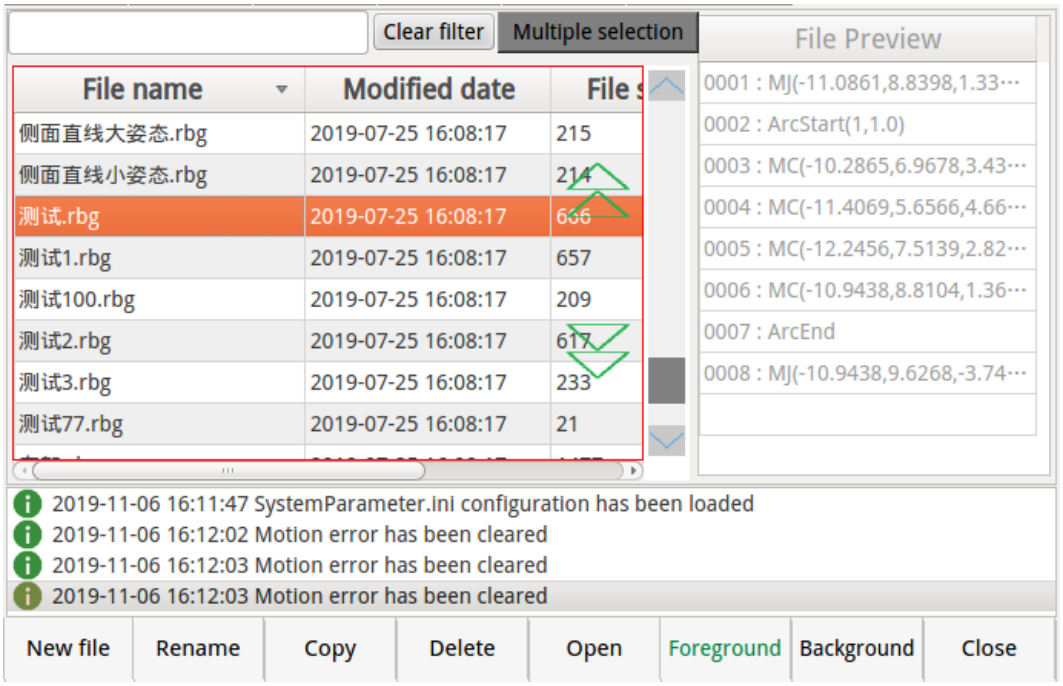
Program command line	Descriptions:
MJ V=50 A=50 D=50 B=90 T=17 U=0	In the tool coordinate system T = 17, according to the MJ joint movement mode, V = 50 velocity, B= 90 smoothness, move to the program point 1 and reach the preparation point.
MJ V=50 A=50 D=50 B=90 T=17 U=0	In the tool coordinate system T = 17, according to the MJ joint movement, V = 50 velocity, B= 90 smoothness, move to the program point 2 and close to the work-piece.
MJ V=25 A=25 D=50 B=0 T=17 U=0	In the tool coordinate system T = 17, according to the MJ joint movement, V = 25 velocity, B= 0 smoothness, move to the program point 3 and touch the work-piece.
ArcStart (1,1.0)	Acr start
ML V=100 mm/s A=50 mm/s2 D=50 mm/s2 B=0 T=17 U=0	In the tool coordinate system T = 17, according to the MJ joint movement, V =100mm/s velocity, B= 0 smoothness, move to the program point 4, and it starts welding the machining path.
ArcEnd	Arc end
MJ V=50 A=50 D=50 B=0 T=17 U=0	In the tool coordinate system T = 17, according to the MJ joint movement, V = 50 velocity, B= 0 smoothness, move to the

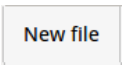
	program point 5 and leave the work-piece.
MJ V=50 A=50 D=50 B=0 T=17 U=0	In the tool coordinate system T = 17, according to the MJ joint movement, V = 50 velocity, B= 0 smoothness, move to the program point 1 and return to the preparation point.

3.1.2 Teaching programming steps

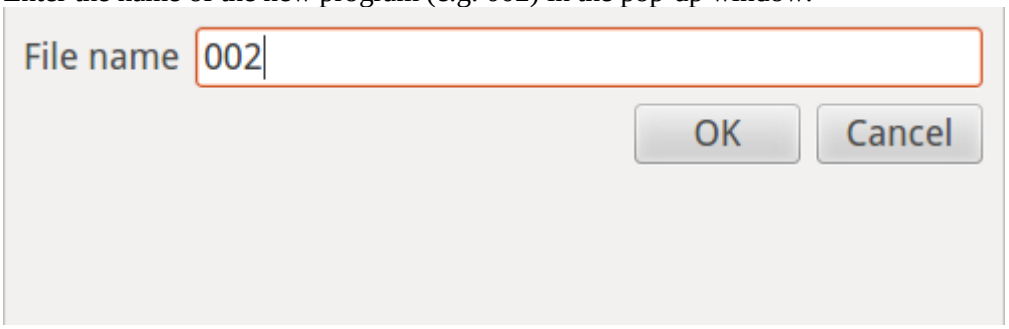
1. Switch the mode switch to the TEACH mode.
2. Select the appropriate tool coordinate system.
3. Enter the program list interface.

Click < File Operation > - < Program File Management > to enter the program list interface.

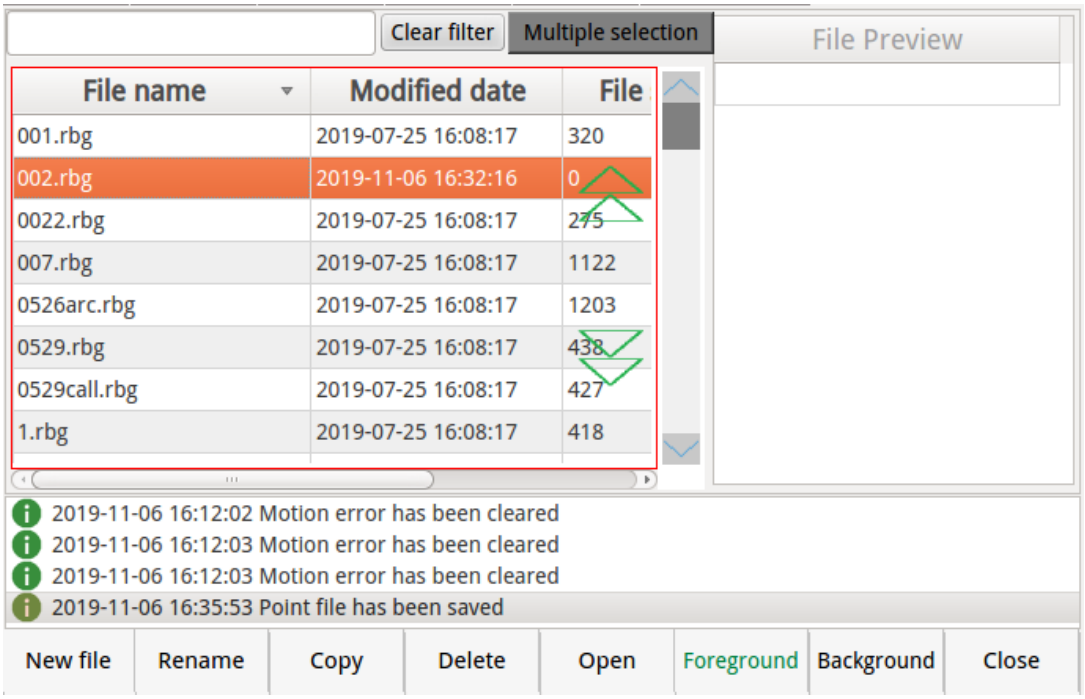


4. Click the button  in the sub-menu area.

5. Enter the name of the new program (e.g. 002) in the pop-up window.

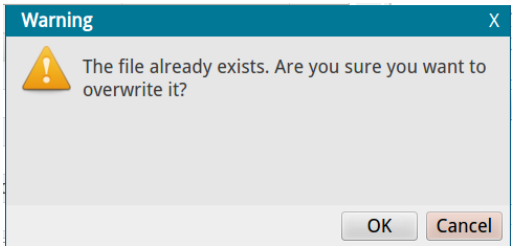


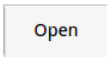
After the file name is entered, click <OK>. In this case, the new program will be displayed in the program list interface as follows:

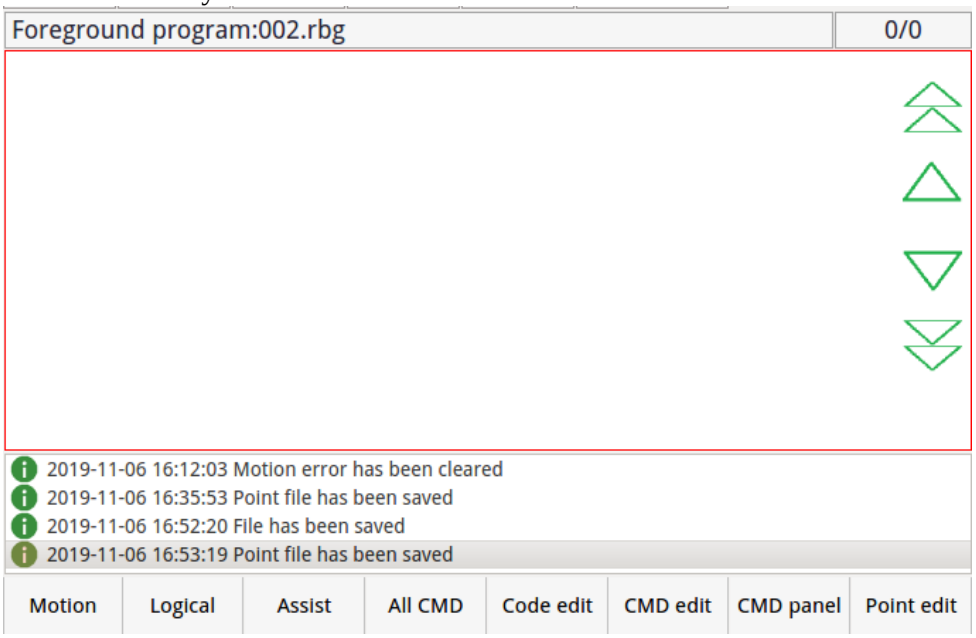


Note: If the program name you entered is a new program name, the system will create a new program with the name you just entered in the list and the blue cursor bar will be highlighted.

If the entered program name is already existing in the list, a warning box will pop up; select Yes to overwrite the original file with the same name, the cursor will jump directly to the blue cursor bar highlighted on the program corresponding to the program name, and select No to exit the new operation.

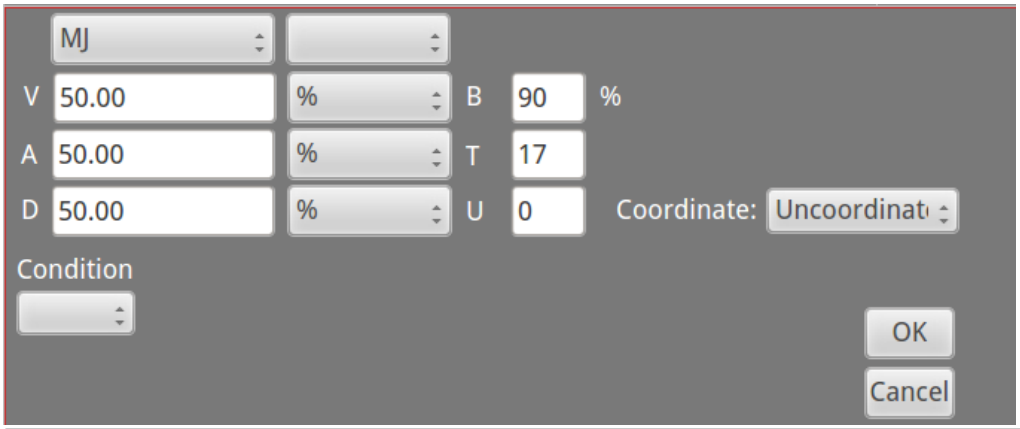


6. Click the key  in the sub-menu area.



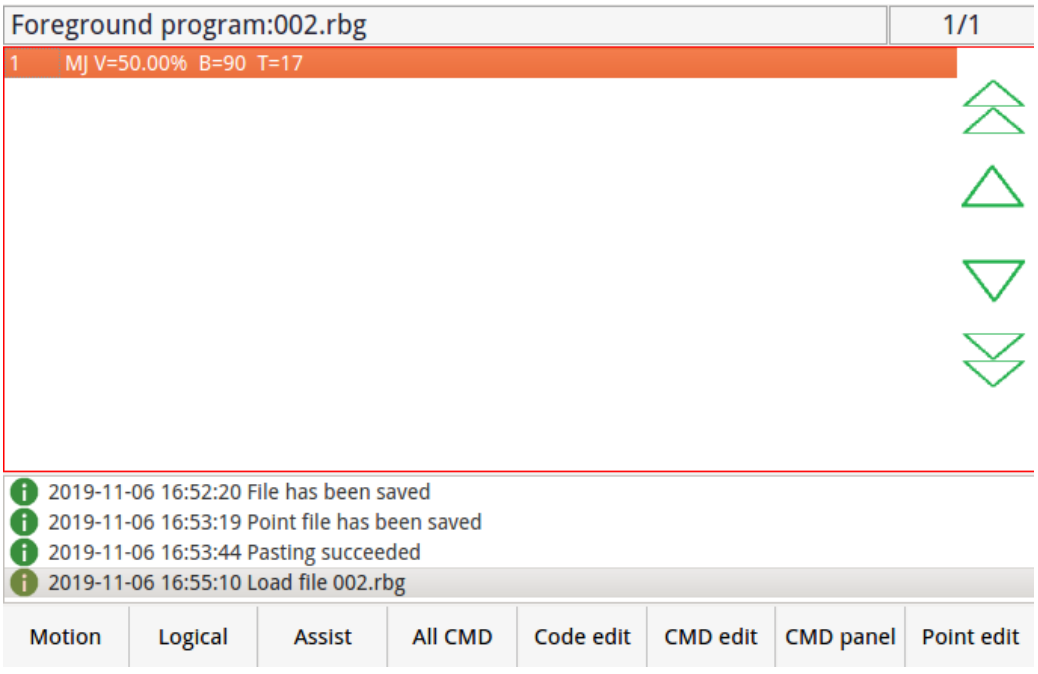
7. Press and hold the safety switch, then move the robot end to the position of program point 1 through the coordinate key on the teach pendant. Click the sub-menu <motion>-<MJ>.

Pop-up command editing window.



Desc
1. Use the < ← > < → > key to switch the cursor to move
2. This window is a selection window whose contents are selected by using < ↑ > <
3. V 50.00 This window is an input window, in which data is input.

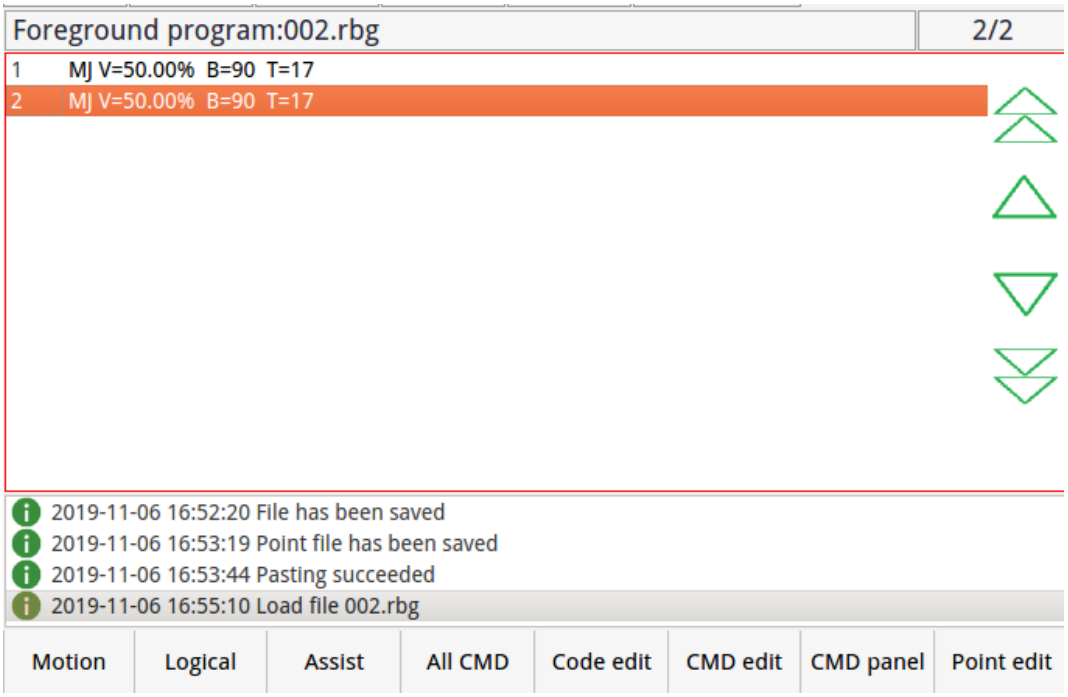
After inputting relevant parameters as required, press the icon OK, and the command line will be displayed in the program editing window as follows.



Command editing of program point 1 is completed.

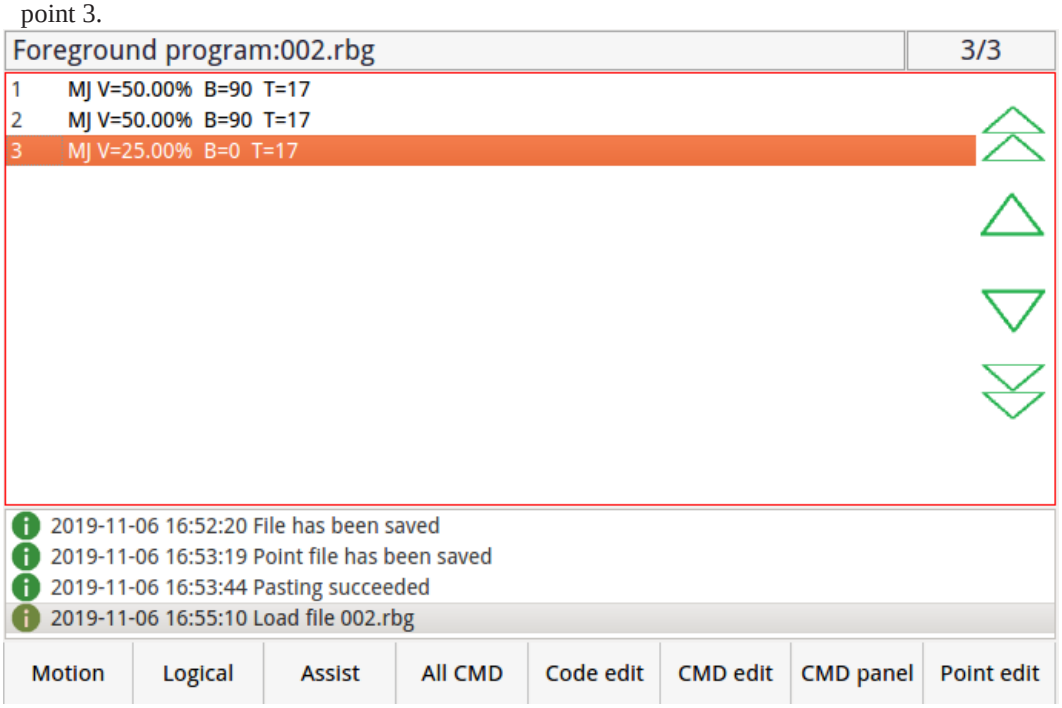
8. Press and hold the safety switch, then move the robot end to the position of program point 2 through the coordinate key on the teach pendant. Click the sub-menu <motion>-< MJ>. Pop-up the MJ command editing window.

After inputting relevant parameters as required, press the icon OK, and the command line will be displayed in the program editing window as follows.

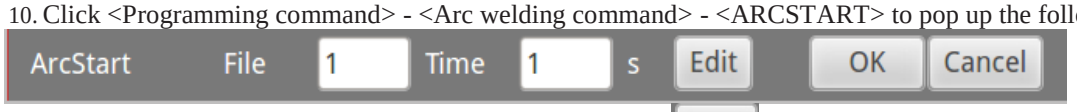


Command editing of program point 2 is completed.

9. Repeat the step 7 or 8, change the velocity (V) to 25%, and change the B value to 0. Input the command line of program point 3.

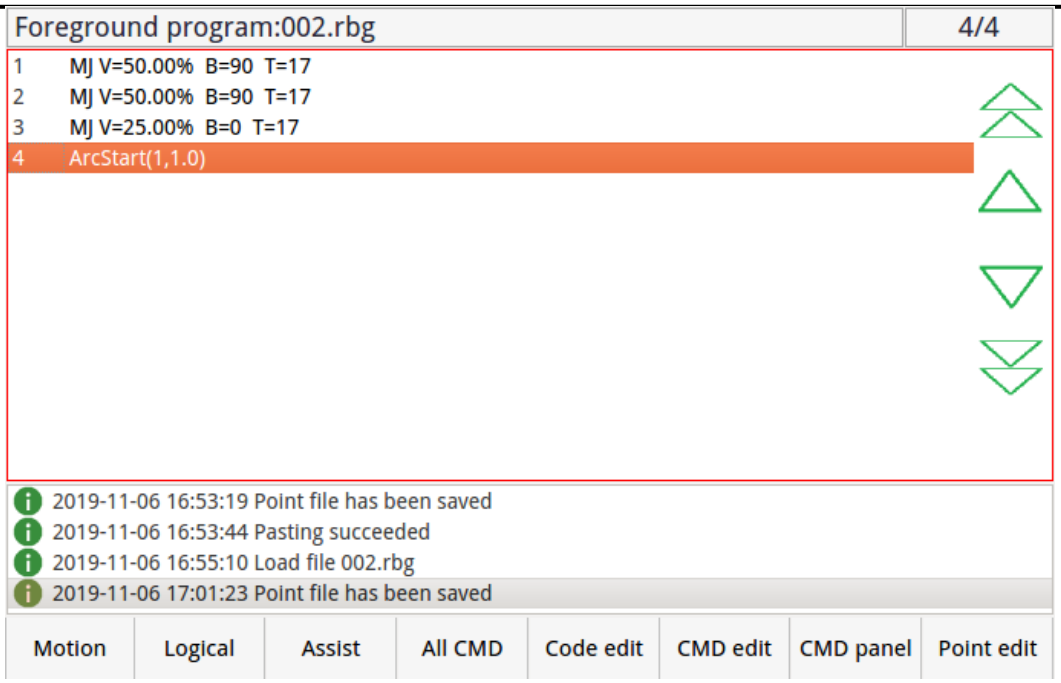


10. Click <Programming command> - <Arc welding command> - <ARCSTART> to pop up the following window.

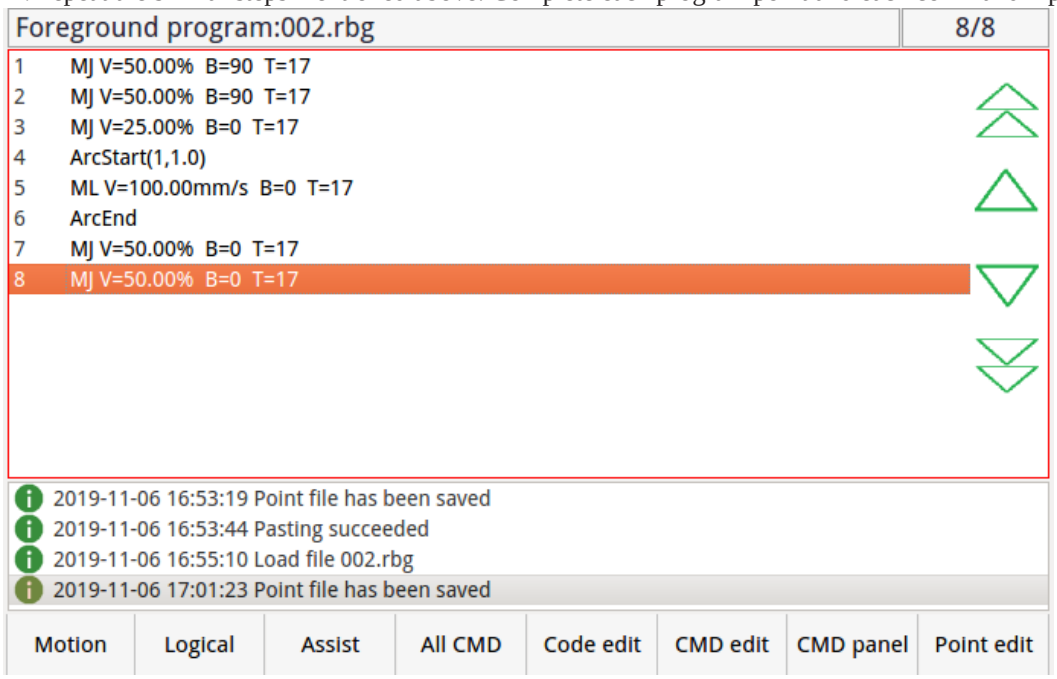


After inputting relevant parameters as required, press the icon 

, and the command line will be displayed in the program editing window as follows.



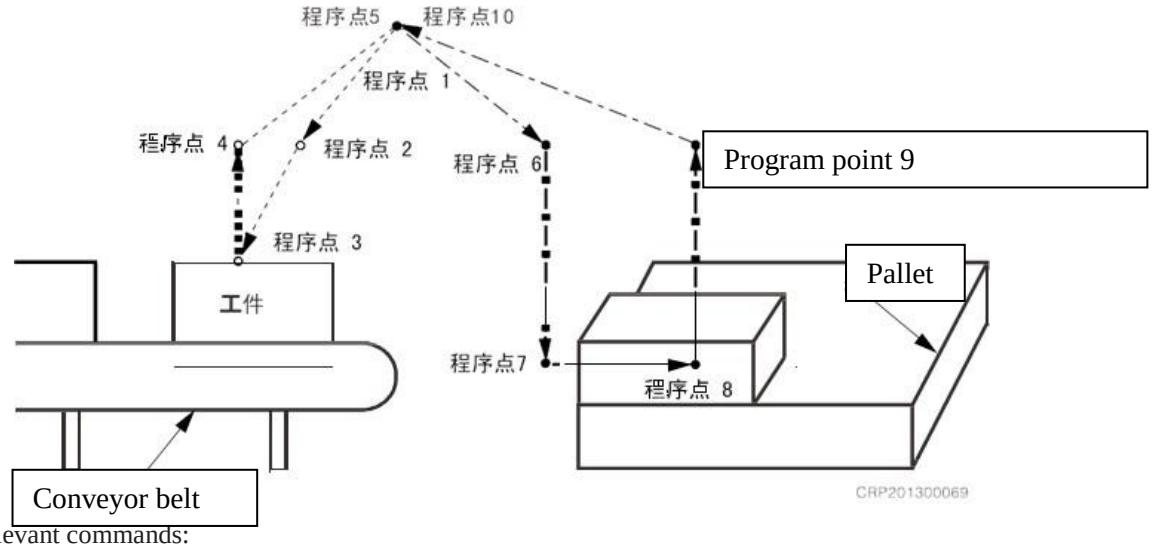
11. Repeat the similar steps mentioned above. Complete each program point and each command input as follows.



By employing the steps mentioned above, the creation of the example program is completed.

3.2 Teaching Programming of Handling

The schematic diagram is shown as follows:



Relevant commands:
MJ: joint motion ML: linear motion D0: digital IO output
WHILE: Conditional loop.

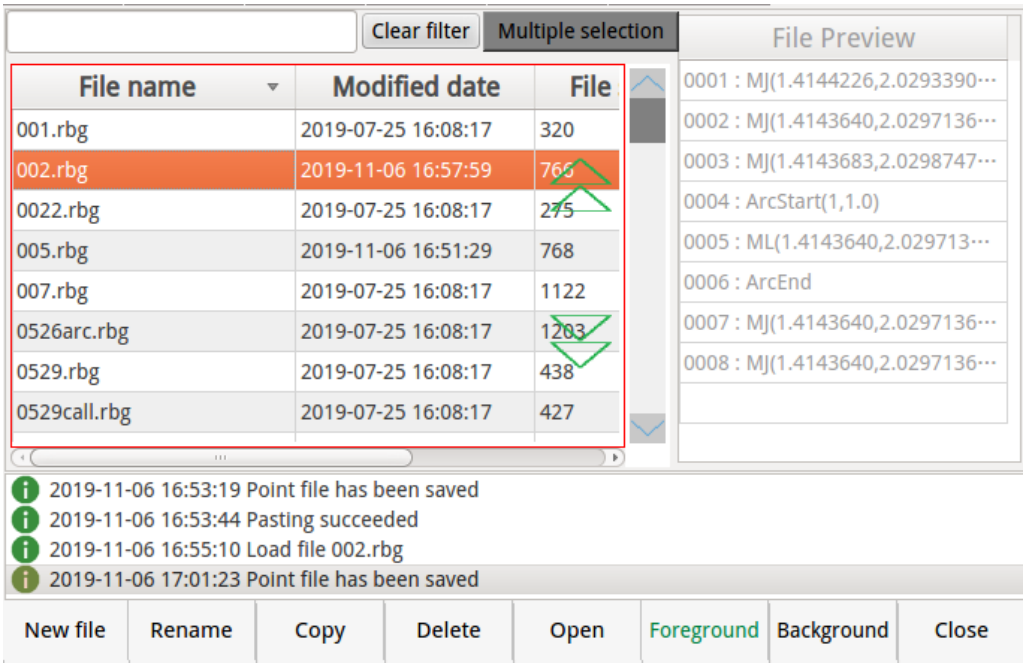
3.2.1 Program List

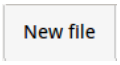
Program command line	Descriptions:
MJ V=50 A=50 D=50 B=90 T=17 U=0	In the tool coordinate system T = 17, according to the MJ joint movement, V = 50 velocity, B= 90 smoothness, move to the program point 1 and reach the preparation point.
MJ V=50 A=50 D=50 B=90 T=17 U=0	Move to the position of program point 2 and close to the workpiece (before clamping)
ML V=100mm/s A=50mm/s2 D=50mm/s2 B=0 T=17 U=0	Move to the program point 3 and touch the workpiece (clamping position)
DO6 = 1	Clamp the work-piece
WAIT(DI8=0)	Wait for clamping in place
ML V=200mm/s A=100mm/s2 D=100mm/s2 B=90 T=17 U=0	Move to the program point 4 and leave the workpiece (after clamping)
MJ V=50 A=50 D=50 B=90 T=17 U=0	Move to the program point 5, that is, the initial position.
MJ V=50 A=50 D=50 B=90 T=17 U=0	Move to the program point 6, where is near the placement position.
MJ V=50 A=50 D=50 B=90 T=17 U=0	Move to the program point 7, that is, the auxiliary position of placement
ML V=100mm/s A=50mm/s2 B=0 T=17 U=0	Move to the program point 8, that is, the placement position.

DO6 = 0	Place the work-piece
WAIT(DI8=1)	Wait for placing in place
ML V=200mm/s A=100mm/s2 D=100mm/s2 B=90 T=17 U=0	Move to the program point 9 and leave the placement position.
MJ V=50 A=50 D=50 B=90 T=17 U=0	Move to the program point 10, that is, the initial position.

3.2.2 Teaching programming steps

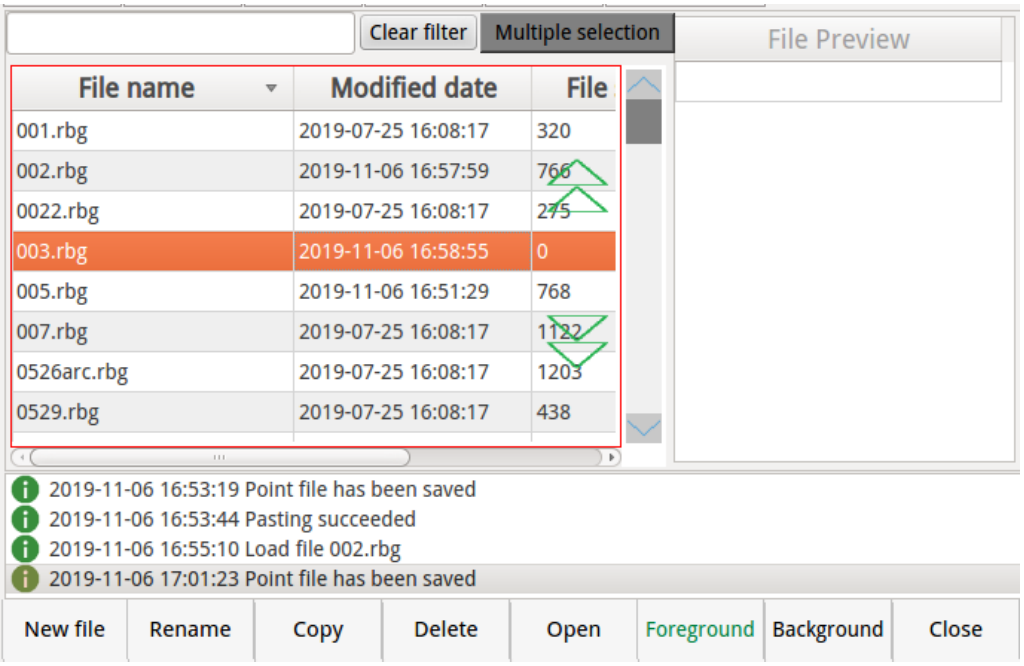
1. Switch the mode switch to the TEACH mode.
2. Select the appropriate tool coordinate system.
3. Enter the program list interface.



1. Click the button 

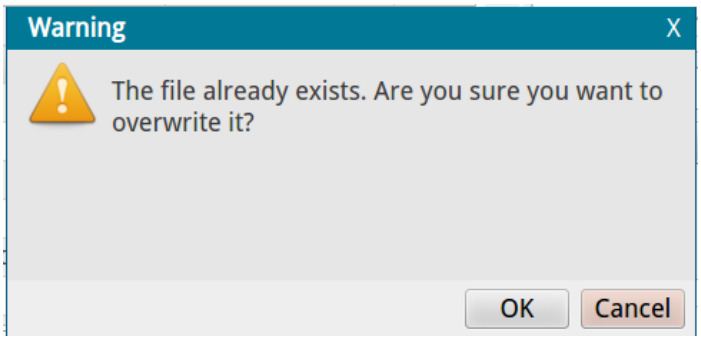
in the sub-menu area.
2. Enter the name of the new program (e.g. 003) in the pop-up window.

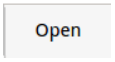
After the file name is entered, click <OK>. In this case, the new program will be displayed in the program list interface as follows:



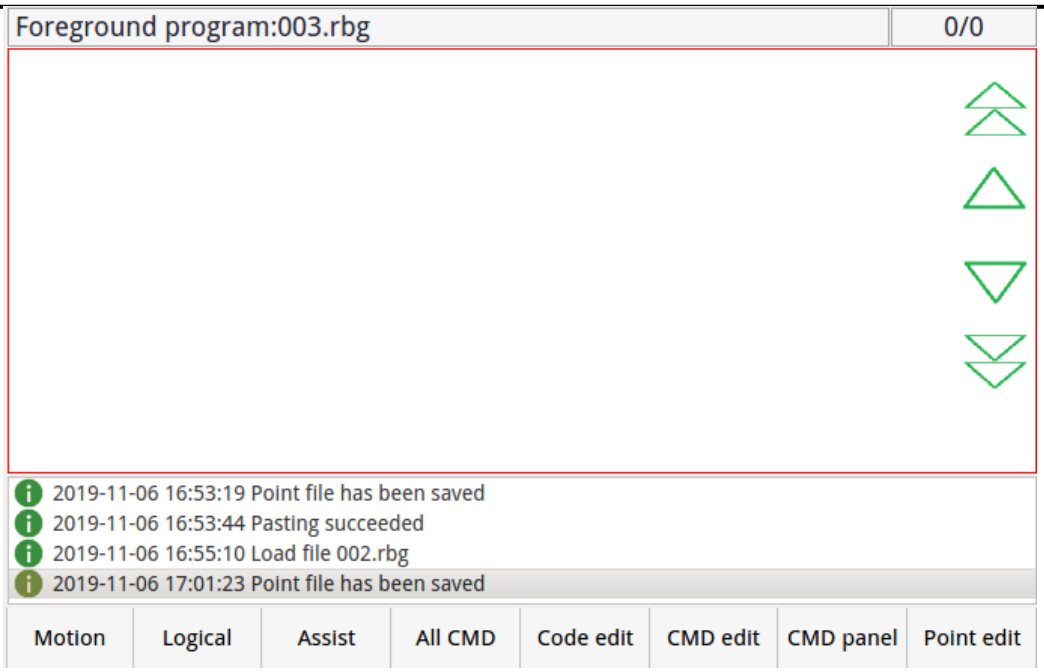
Note: If the program name you entered is a new program name, the system will create a new program with the name you just entered in the list and the blue cursor bar will be highlighted.

If the entered program name is already existing in the list, a warning box will pop up; select Yes to overwrite the original file with the same name, the cursor will jump directly to the blue cursor bar highlighted on the program corresponding to the program name, and select No to exit the new operation.

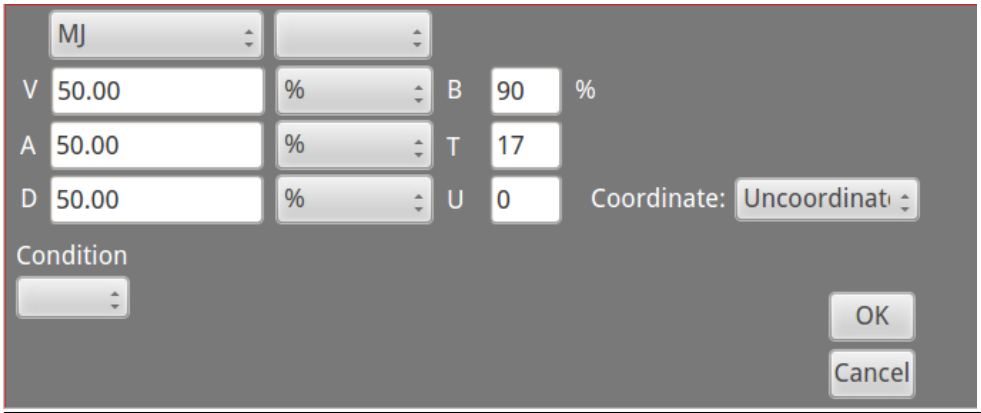


3. Click the key 

in the sub-menu area, open the program editing interface, as shown in the following figure:

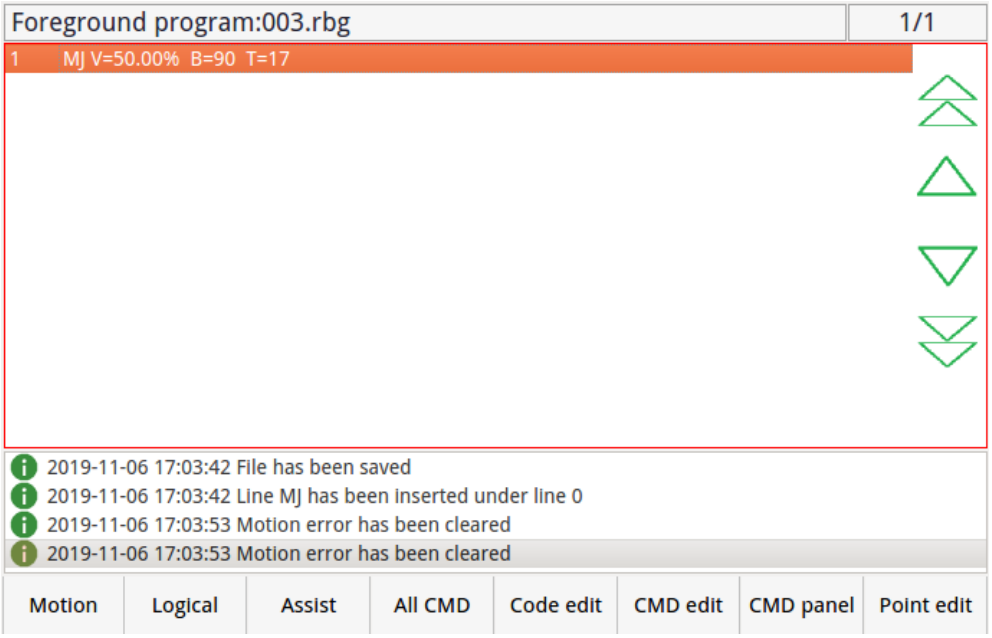


4. Press and hold the safety switch, then move the robot end to the position of program point 1 through the coordinate key on the teach pendant. Click the sub-menu <motion>-< MJ>. Pop-up the MJ command editing window.



Desc
1. Use the < ← > < → > key to switch the cursor to move
2. This window is a selection window whose contents are selected by using < ↑ > <
3. V 50.00 This window is an input window, in which data is input.

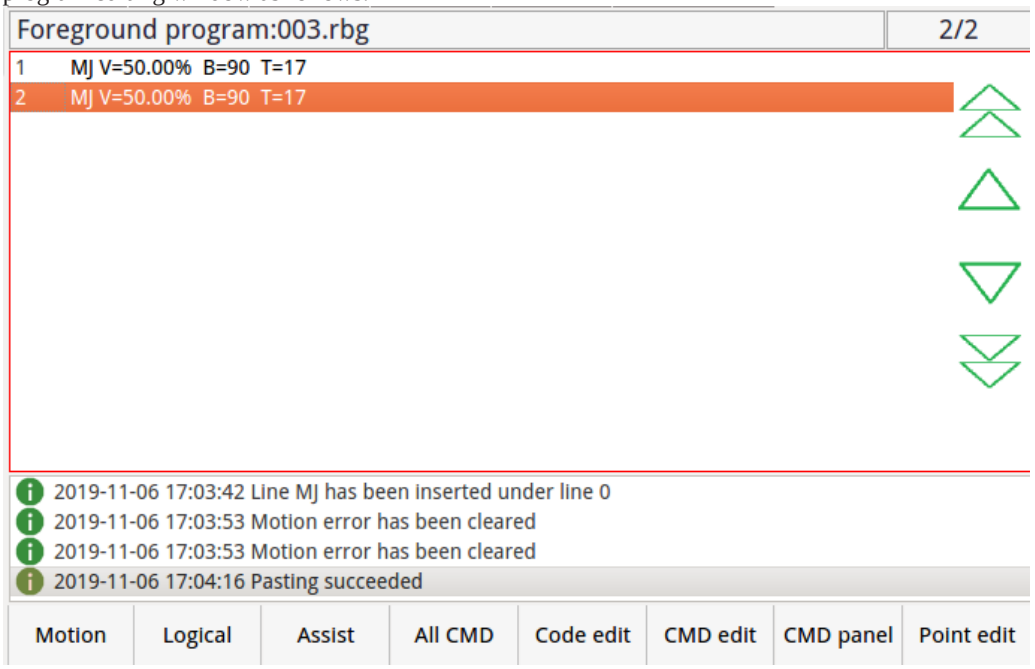
After inputting relevant parameters as required, press the icon OK, and the command line will be displayed in the program editing window as follows.



Command editing of program point 1 is completed

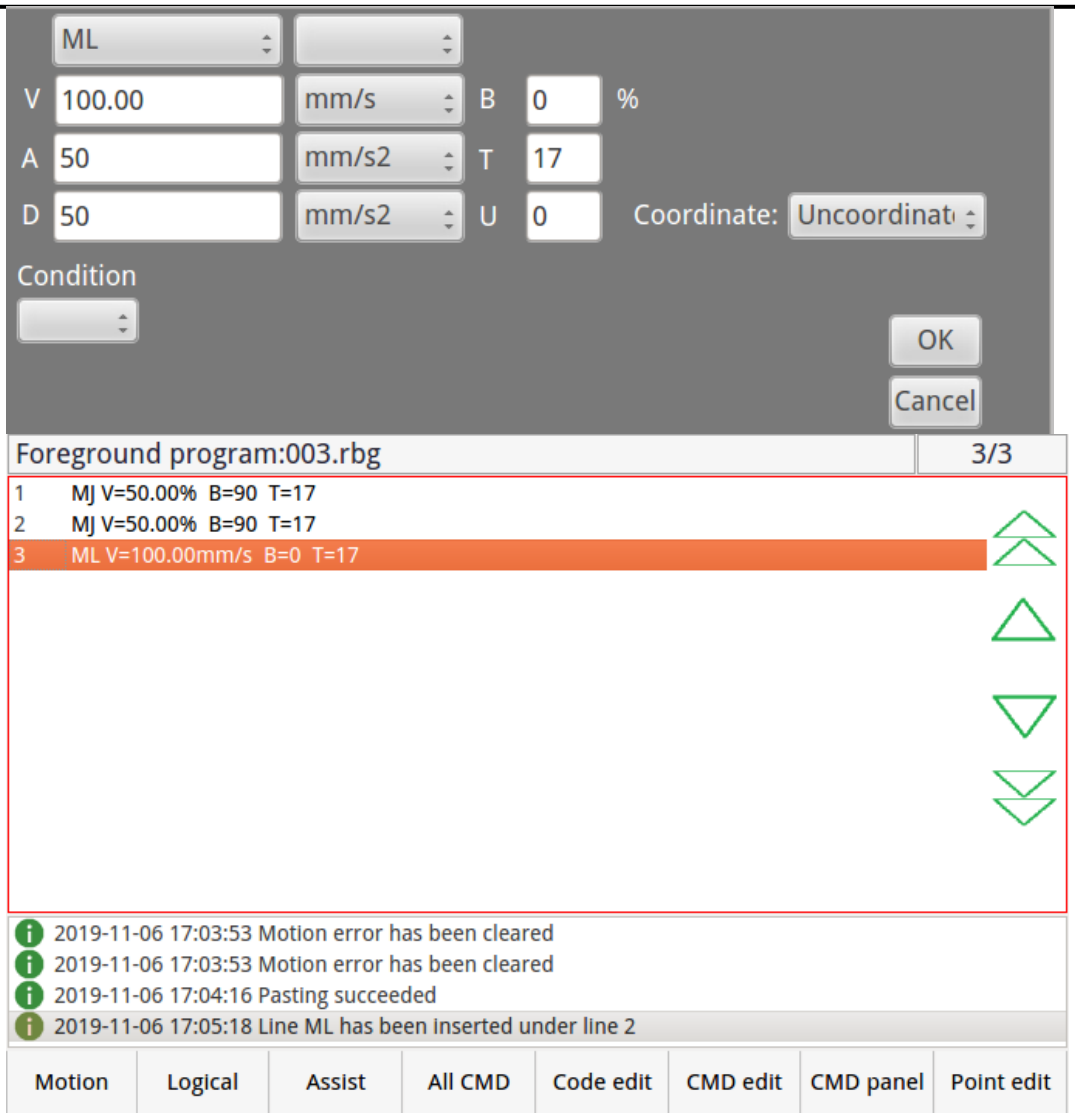
5. Press and hold the safety switch, then move the robot end to the position of program point 2 through the coordinate key on the teach pendant. Click the sub-menu <motion>-< MJ>. Pop-up the MJ command editing window.

After inputting relevant parameters as required, press the icon OK , and the command line will be displayed in the program editing window as follows.

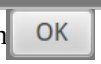


Command editing of program point 2 is completed.

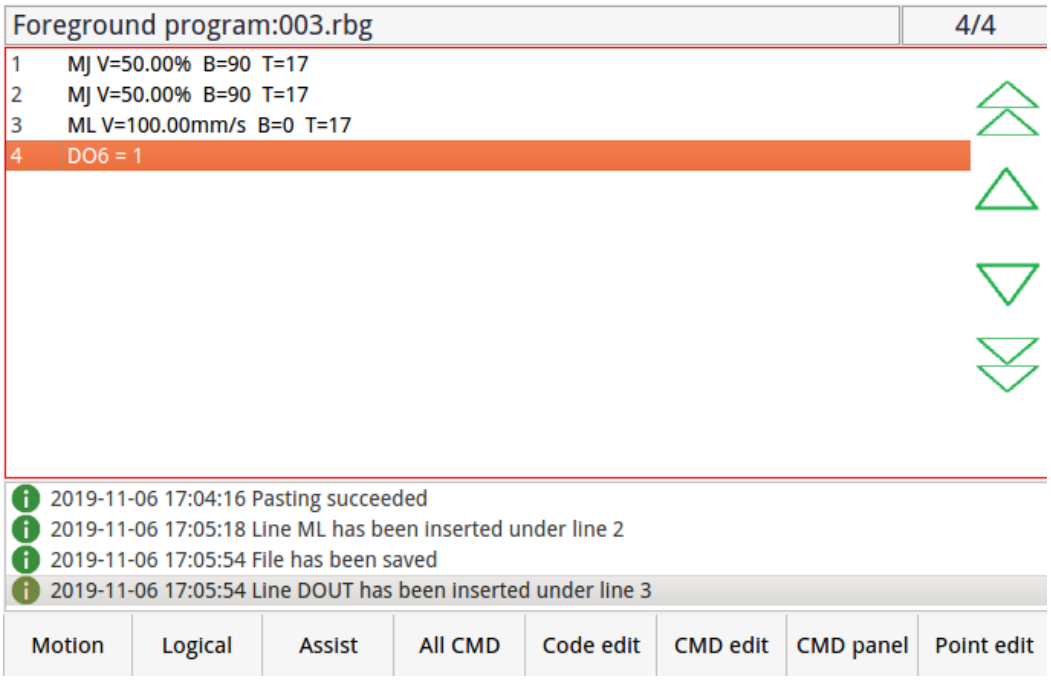
6. Repeat the step 7 or 8, change the command to ML, then change the velocity (V) to 100mm/s, and change the B value to 0. Input the command line of program point 3.



7. Click <Auxiliary> - <DO> to pop up the following window.

After inputting relevant parameters as required, press the icon 

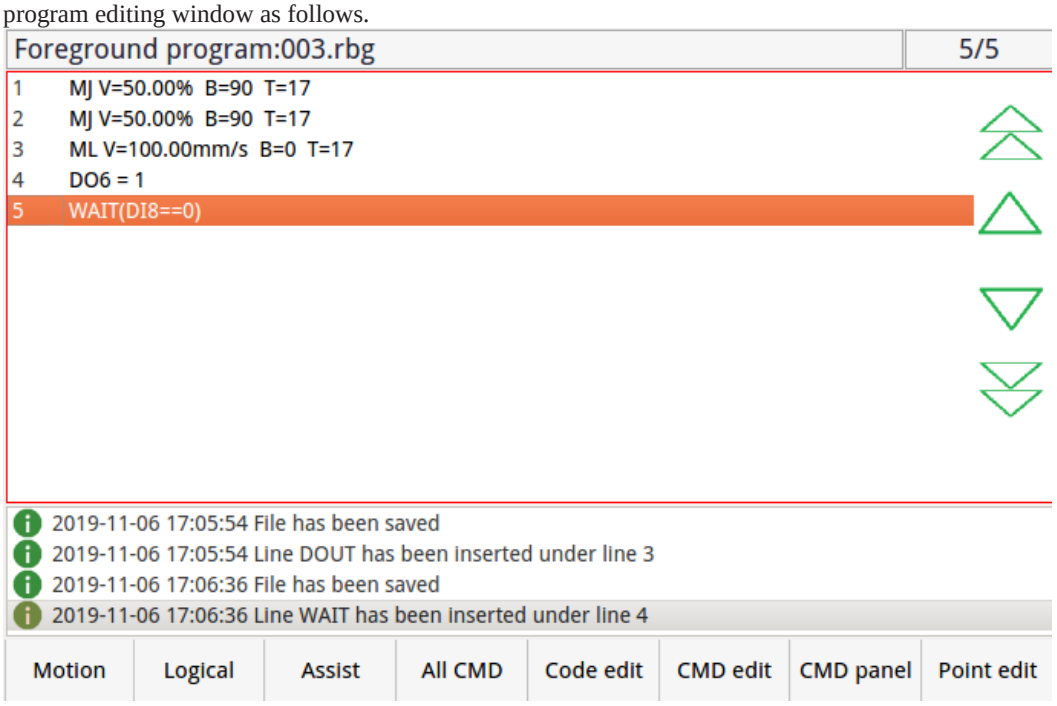
, and the command line will be displayed in the program editing window as follows.



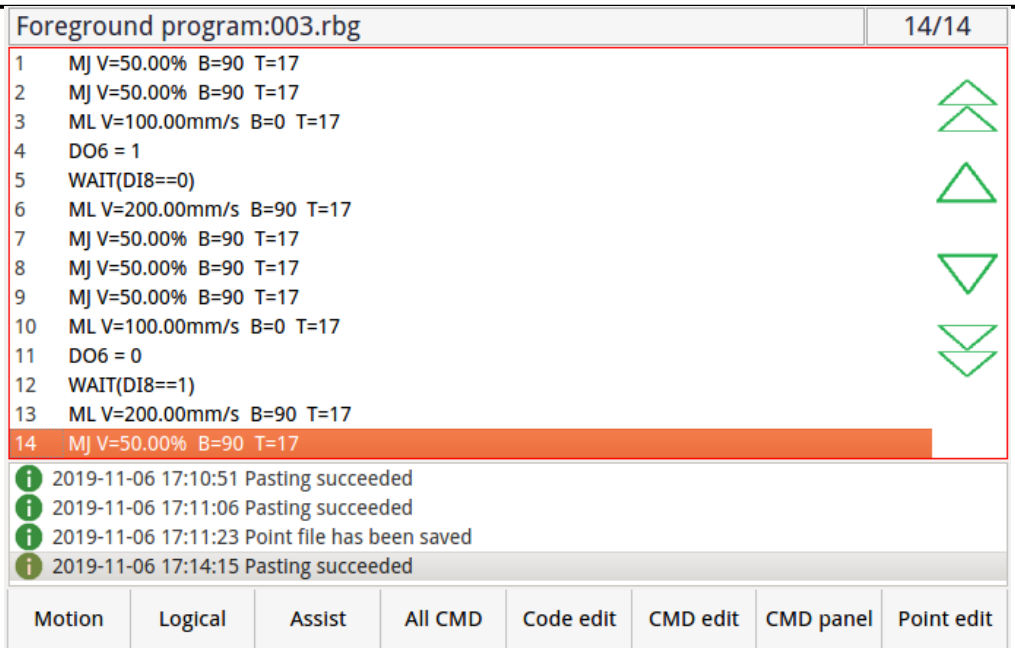
8. Click <Auxiliary> - <WAIT> to pop up the following window.

After inputting relevant parameters as required, press the icon 

, and the command line will be displayed in the program editing window as follows.



9. Repeat the similar steps mentioned above. Complete each program point and each command input as follows.



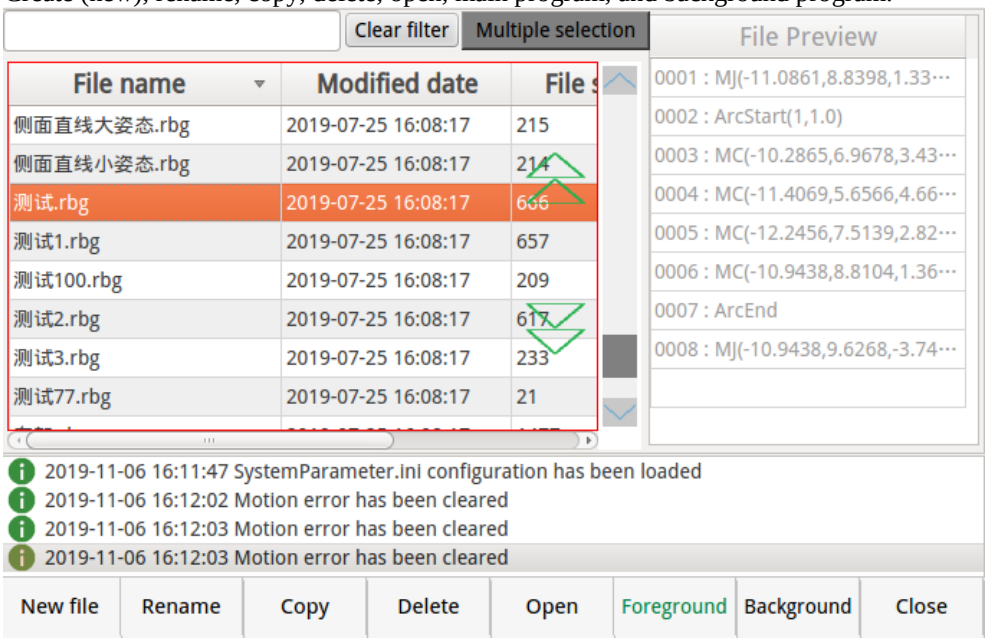
By employing the steps mentioned above, the creation of the example program is completed.

4 Program Editing Function

The program editing function mainly includes: program list editing function (mainly used to create, rename, back up and delete programs) and program content editing function (mainly used to copy, cut, delete, search, and replace program lines.)

4.1 Program List Editing Function

Create (new), rename, copy, delete, open, main program, and background program.

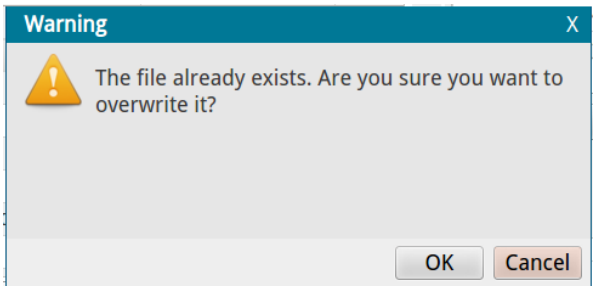


4.1.1 New file : New program

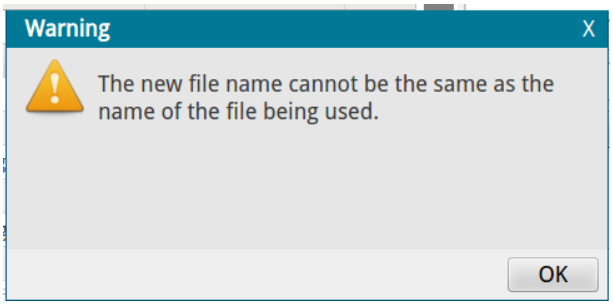
After clicking this button, the new program window will pop up File name , enter the program name in the blank space.then click the icon OK to close the input window, the system will create a new

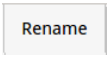
program with the name just entered in the list, and the blue cursor bar will be highlighted.

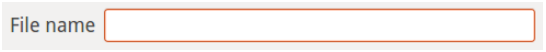
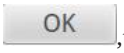
If the entered program name is already existing in the list, a warning box will pop up; select Yes to overwrite the original file with the same name, the cursor will jump directly to the blue cursor bar highlighted on the program corresponding to the program name, and select No to exit the new operation.

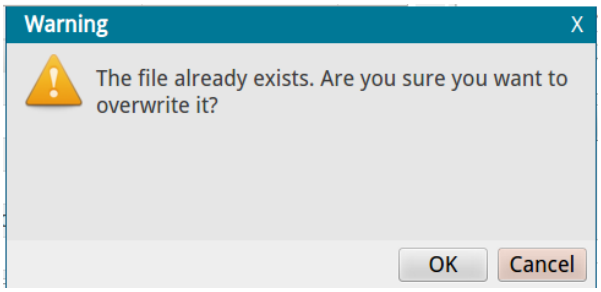


If the entered program name is opened currently, a warning box pops up:



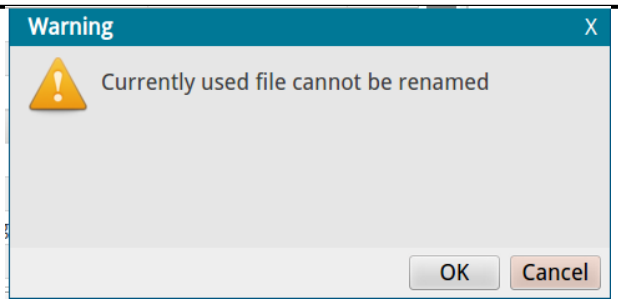
4.1.2  : used to modify the name of an existing program.

First, move the cursor to the program name to be modified, and then click this button, the system will pop up the window  , enter the modified program name in the blank window, and click  ,the input window is closed. At this time, the cursor will be highlighted on the renamed program in the program list.



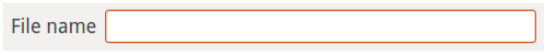
If the entered program name is already existing in the list, a warning box will pop up; select Yes to overwrite the original file with the same name, the cursor will jump directly to the blue cursor bar highlighted on the program corresponding to the program name, and select No to exit the new operation.

If the entered program name is opened currently, a warning box pops up:

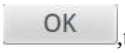


4.1.3 Copy: used to copy the current program, and paste it as a program with another program name.

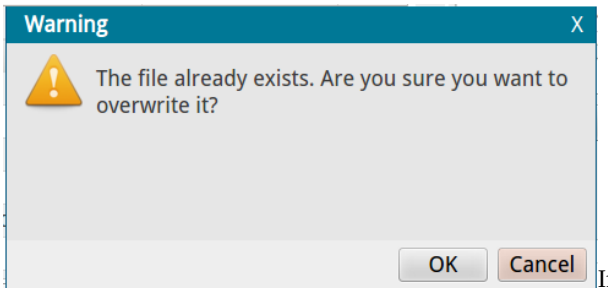
First, move the cursor to the program name to be backed up, and then click this button, the system will pop up the window



, enter a new program name in the blank window, and click

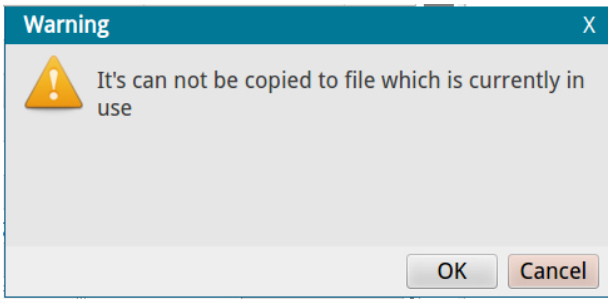


,the input window is closed. At this time, the cursor will be highlighted on the new program in the program list.



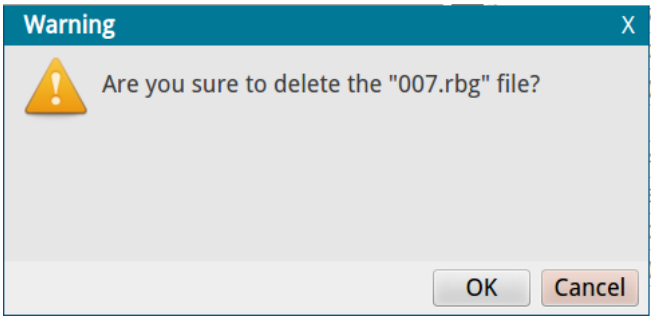
If the entered program name is already existing in the list, a warning box will pop up; select Yes to overwrite the original file with the same name, the cursor will jump directly to the blue cursor bar highlighted on the program corresponding to the program name, and select No to exit the new operation.

If the entered program name is opened currently, a warning box pops up:

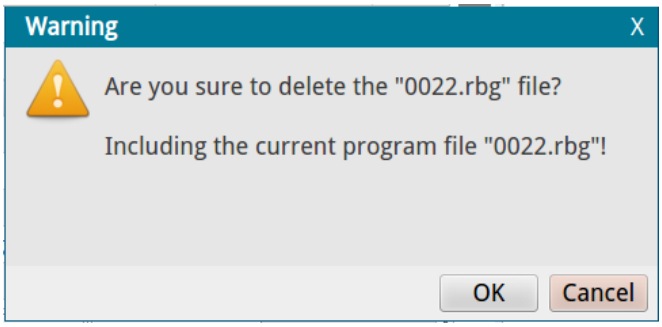


4.1.4 Delete: delete an existing program

First, move the cursor to the program name to be deleted, and then click this button, the system will pop up the window



If you want to cancel this operation, click the key No to exit directly.



If the program to be deleted is opened currently, this window pops up:

If you want to cancel this operation, click the key No to exit directly.

Descriptions:

The deleted program cannot be restored. Please use it carefully!

4.1.5 Open Open the program selected by the cursor and enter the program editing interface.

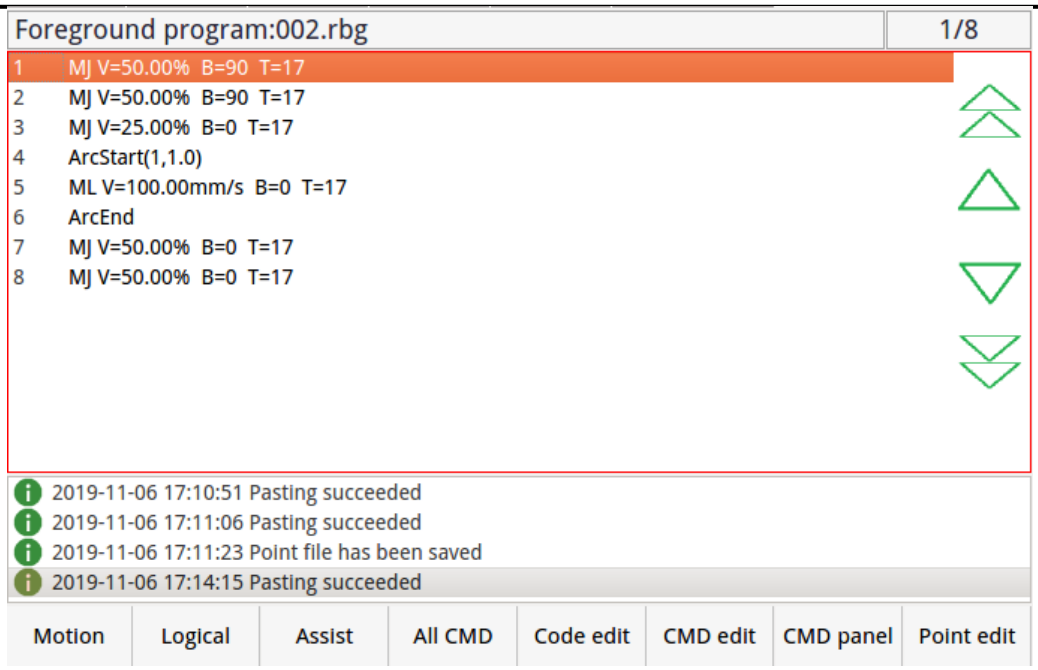
Descriptions:

1. For teaching programming ,the editing of the program needs to be performed in the program editing interface opened by the program. 2. If you want to run the program in Play mode, the program needs to be opened as well.

3. Remote mode, the program does not need to be opened manually; when the drive is energized, the system will automatically open the program which name has been set in the remote process.

First, move the cursor to the program to be opened, and then click this button, the system will enter the editing interface of the program, and the existing program line of the program will be displayed.

The figure is shown as follows:



4.1.6 Foreground: Display the main program list

It is used to switch and display the main program list and the background PLC program list, when clicking Foreground, the currently opened program list is the main program list.

4.1.7 Background: Display the background program list

It is used to switch and display the main program list and the background PLC program list, when clicking Background, the currently opened program list is the background PLC program list.

4.2 Program Content Editing Function

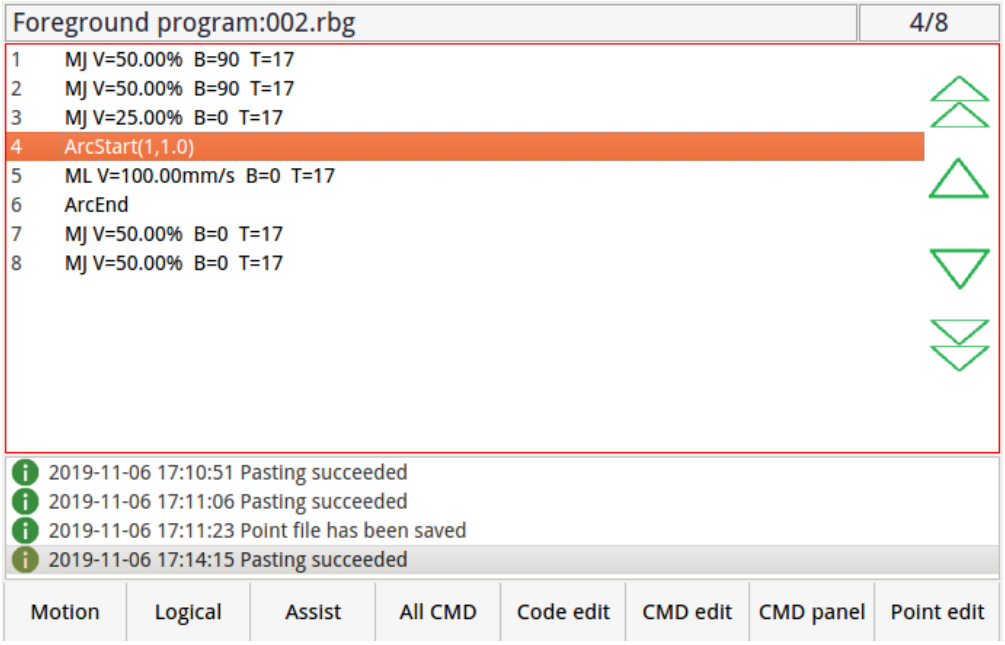
Copy-copy current program line, copy-copy block, paste, cut-cut current program line, cut-cut block, delete-delete current program line, delete-delete block, search/replace, go to.

Attention:

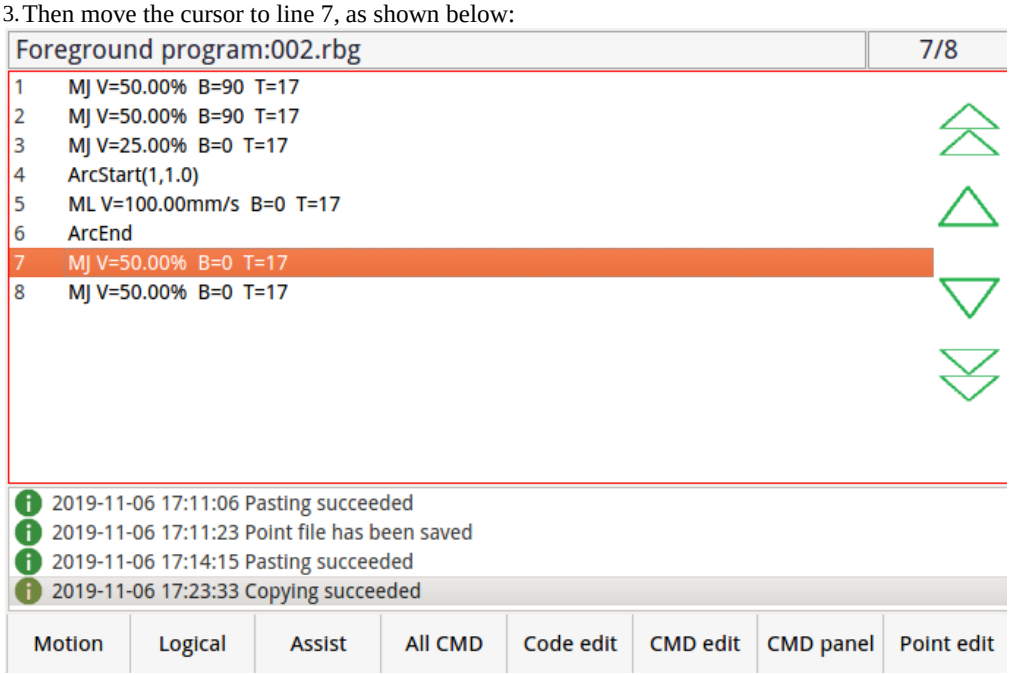
When using the copy function, the data of teaching point of the program line will be copied as well, so please pay attention to the running position of the program line after copying.

4.2.1 Copy->copy current program line:

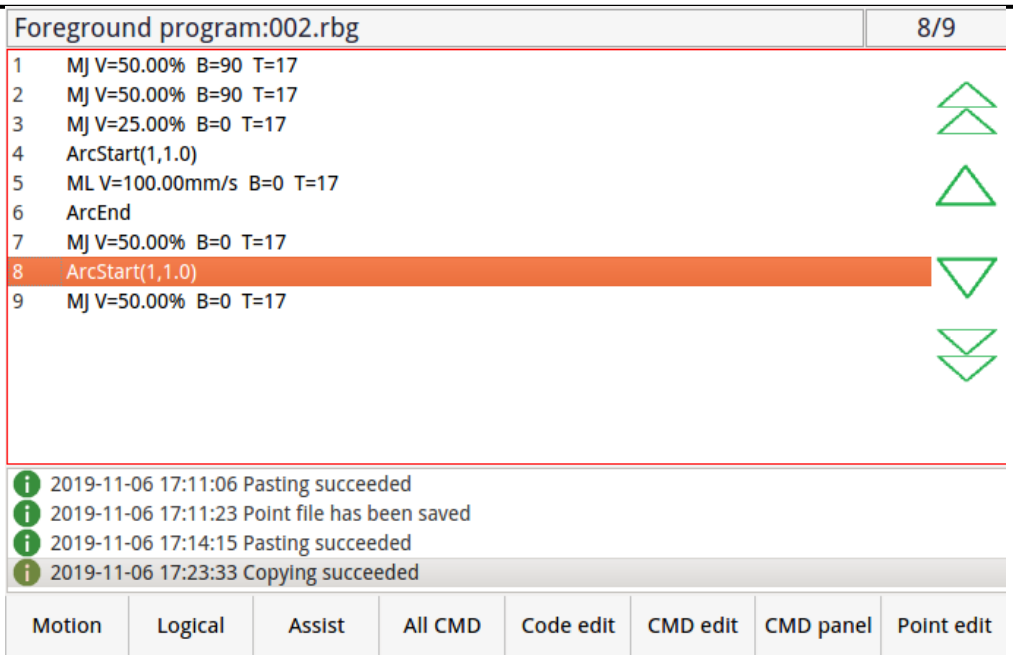
Position the cursor to the program line to be copied, and select <copy current program line>; after moving the cursor to the position where it needs to be pasted, use the <paste> icon to paste the contents of the previously copied program line to the position below the cursor line. For example, copy the following line 4 “ArcStart (1)” to the position below line 7. Specific operations are as follows:



1. First, position the cursor to line 4, as shown above.
2. Select <Program Edit> - <Copy> - <Copy Current Program Line>.
3. Then move the cursor to line 7, as shown below:



4. Select <Program Edit> - <Paste>, and the program contents “ArcStart (1)” of the original program line 4 are copied and pasted to the position between the original line 7 and line 8, and the cursor is positioned in this line. As shown in the following Figure:



4.2.2 Copy - > copy block: copy the contents entered between the start line and the end line to the background.

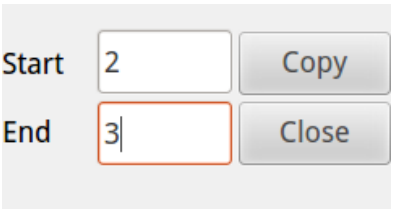
Attention:

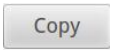
When using the copy function, the data of teaching point of the program line will be copied as well, so please pay attention to the running position of the program line after copying.

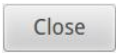
Copy the contents between the start line and the end line, then move the cursor to the position to be pasted, and click the <paste> icon to paste the copied block contents above the cursor.

For example, copy the contents between lines 2-3 of the following figure and paste them under the line 7. The specific operations are as follows:

1. Select <Program Edit> - <Copy> - <Copy Block>. Pop up the following interface：

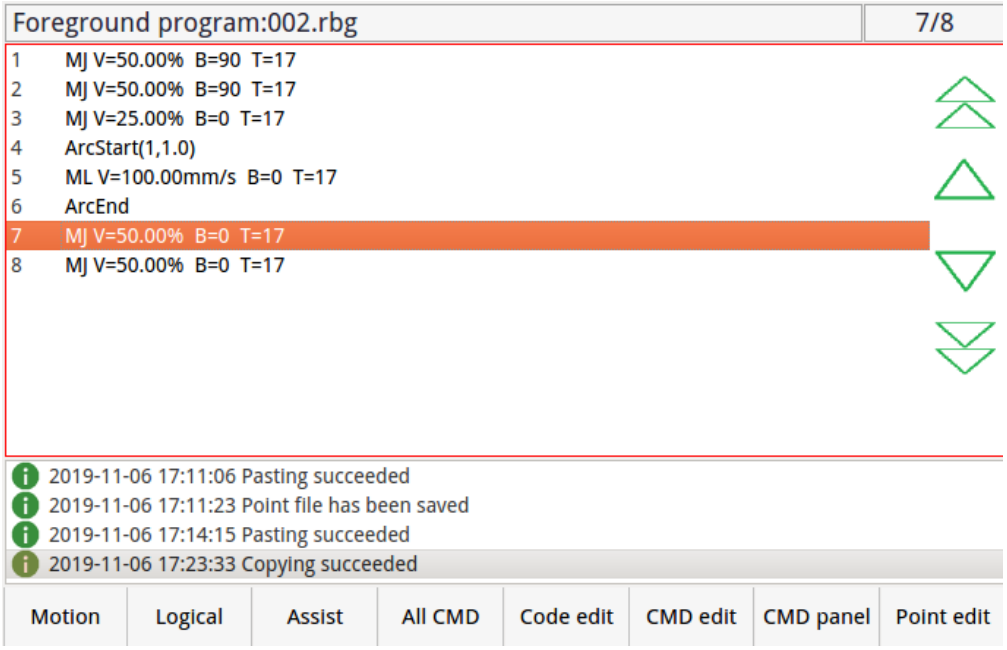


Enter 2 in the window of the start line, and enter 3 in the window of the end line. Press the key 

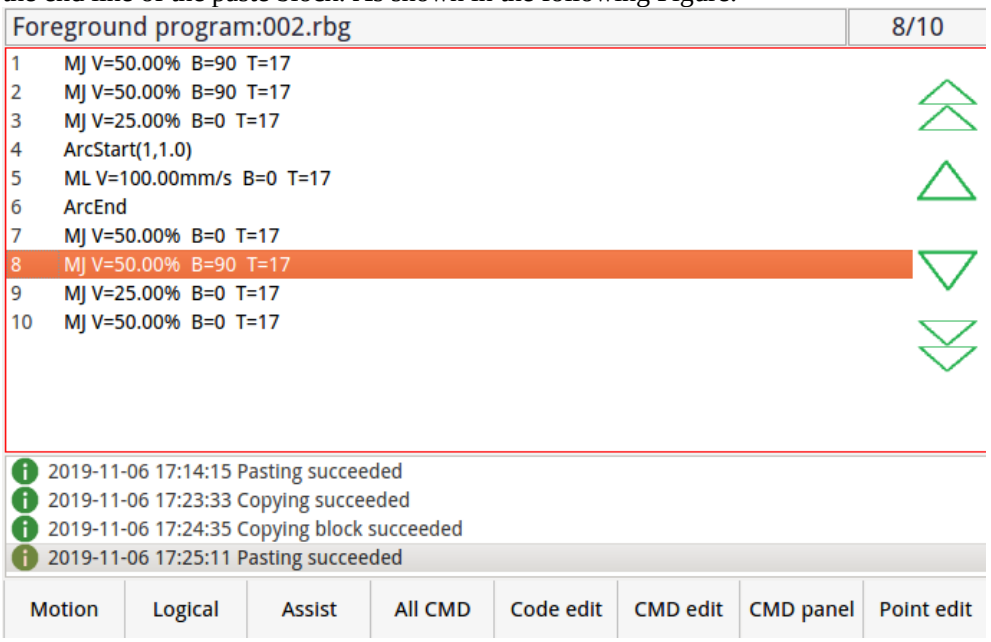
to copy. To cancel the copy operation, click the key 

and exit directly.

2. Then move the cursor to line 7, as shown below:



3. Select <Program Edit> - <Paste>, and the program contents of the original program lines 2-3 are copied and pasted to the position between the original line 7 and line 8, and the cursor is positioned at the end line of the paste block. As shown in the following Figure:

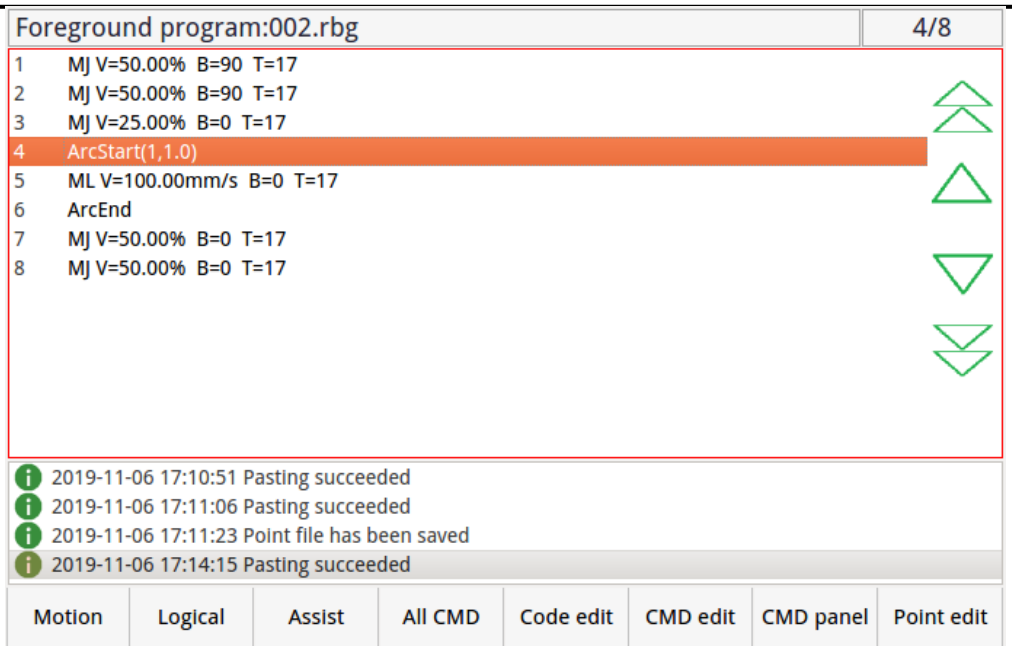


4.2.3 Paste: Paste the contents after copying and cutting.

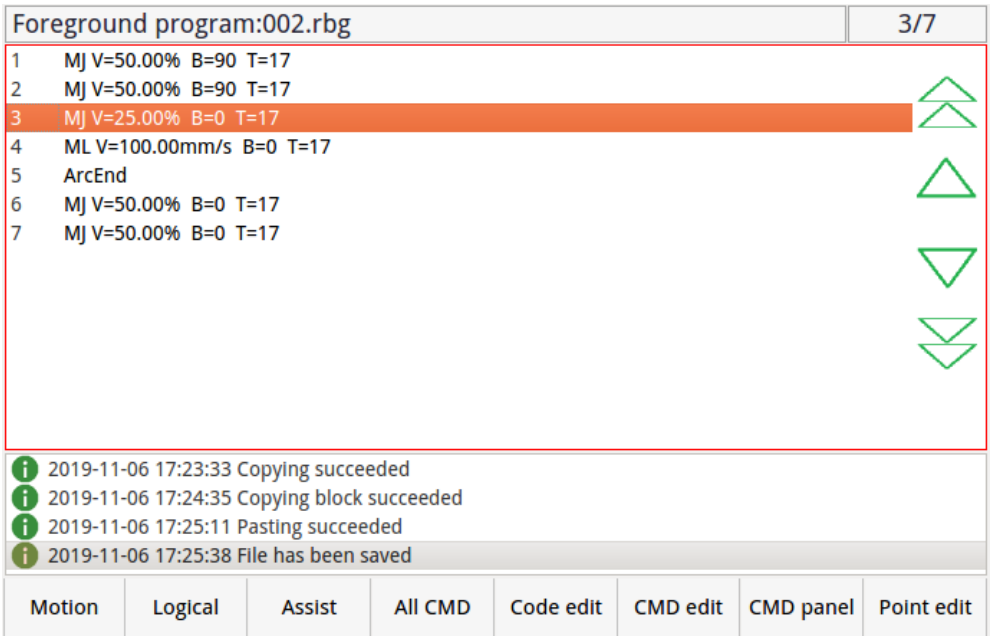
This operation will paste the contents after copying or cutting to the position below the cursor.

4.2.4 Cut - > cut the current line: after copying the contents of the line where the cursor is located to the background, delete the current line.

Position the cursor to the line to be cut, then click <Cut Current Line>; the contents of the program line are copied to the background, and the current line is deleted. Move the cursor to the position where the program line needs to be pasted, and click <Paste> to paste the contents of the line that has just been cut to the current position. For example, cut and paste the following line 4 “ArcStart (1)” to the position below line 7. Specific operations are as follows:

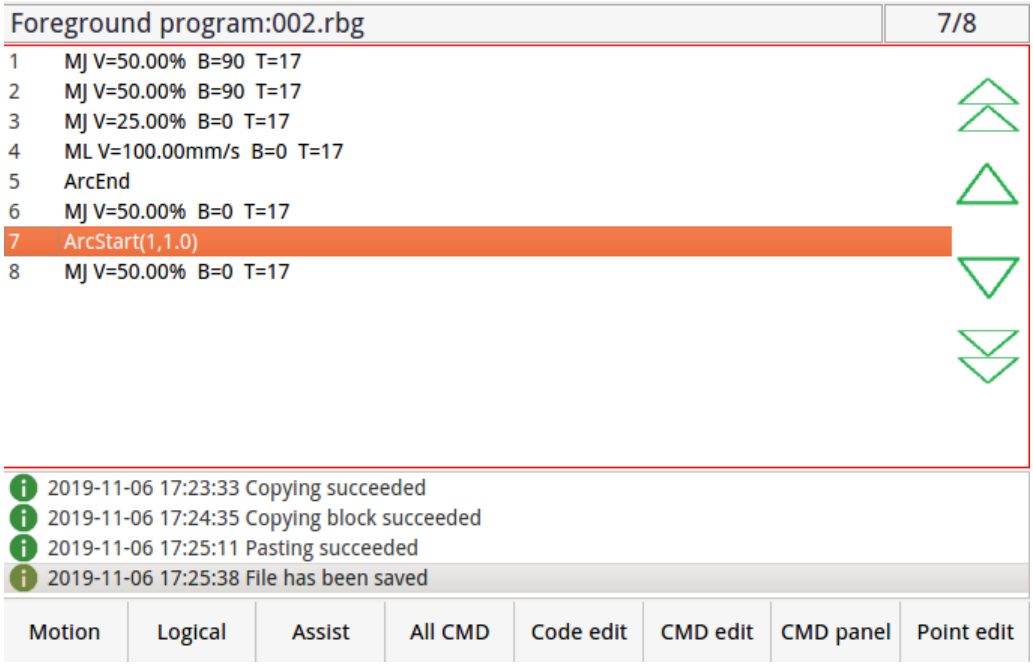


1. First, position the cursor to line 4, as shown above.
2. Click <Program Edit> - <Cut> - <Cut Current Line>. At this time, the content of the original line 4 “ArcStart (1)” is copied to the background, and the content of the line is deleted in the program editing interface. As shown in the following Figure:



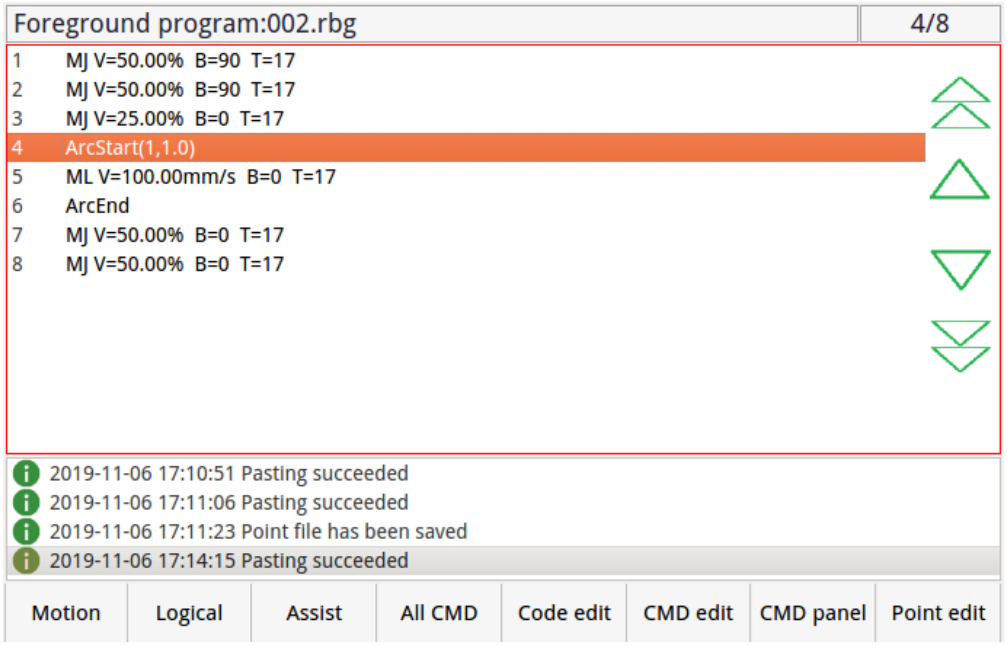
If you want to restore the contents have been cut, move the cursor to the appropriate position and paste it back.

3. Move the cursor to the position of original line 7 (now line 6).
4. Click <Program Edit> - <Paste>. At this time, the content of the program line that has just been cut will be displayed under the original line 7. The figure is shown as follows:



4.2.5 Cut - > cut block: copy the contents between the start line and the end line to the background, and delete the contents between the start line and the end line.

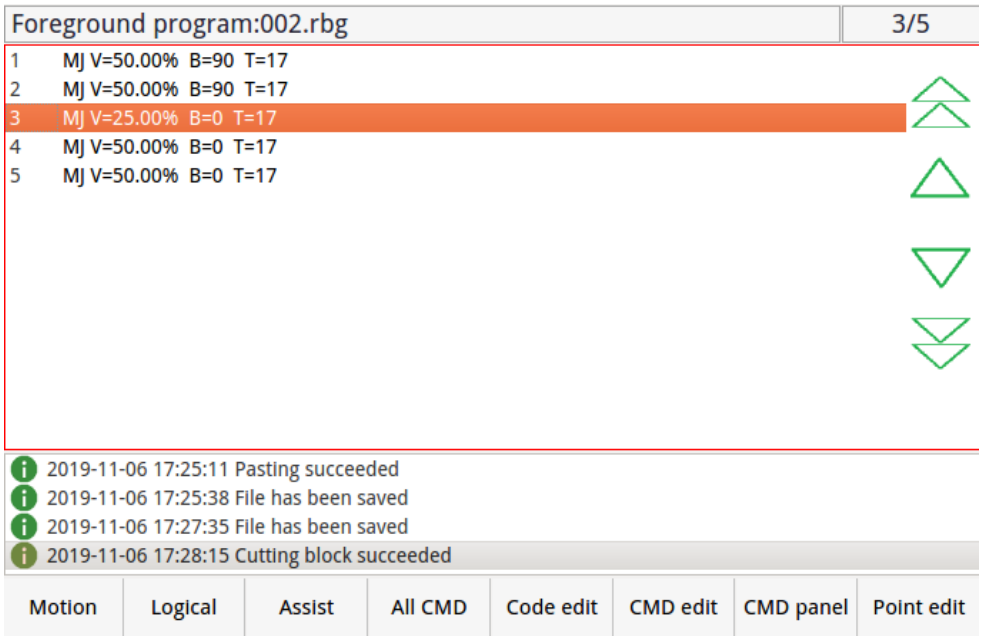
Copy the contents between the start line and the end line to the background, and delete the contents. Then move the cursor to the position where the cut contents need to be pasted, and click the <Paste> key to paste the contents of the cut block under the cursor. For example, copy the contents between lines 4-6 of the following figure and paste them under the line 7. The specific operations are as follows:



1. Click <Program Edit> - <Cut> - <Cut Block>. Pop up the following interface：

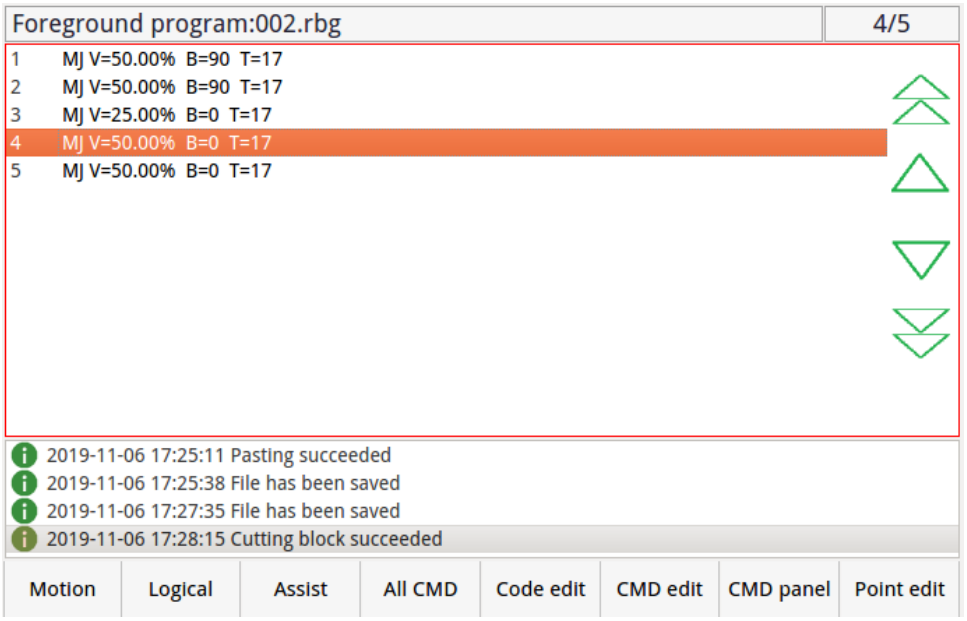
Enter 4 in the window of the start line, and enter 6 in the window of the end line; press the **key** Cut to confirm the cut operation; at this time, the contents in the program editing interface from line 4 to line 4 are deleted, as shown in the

figure below:

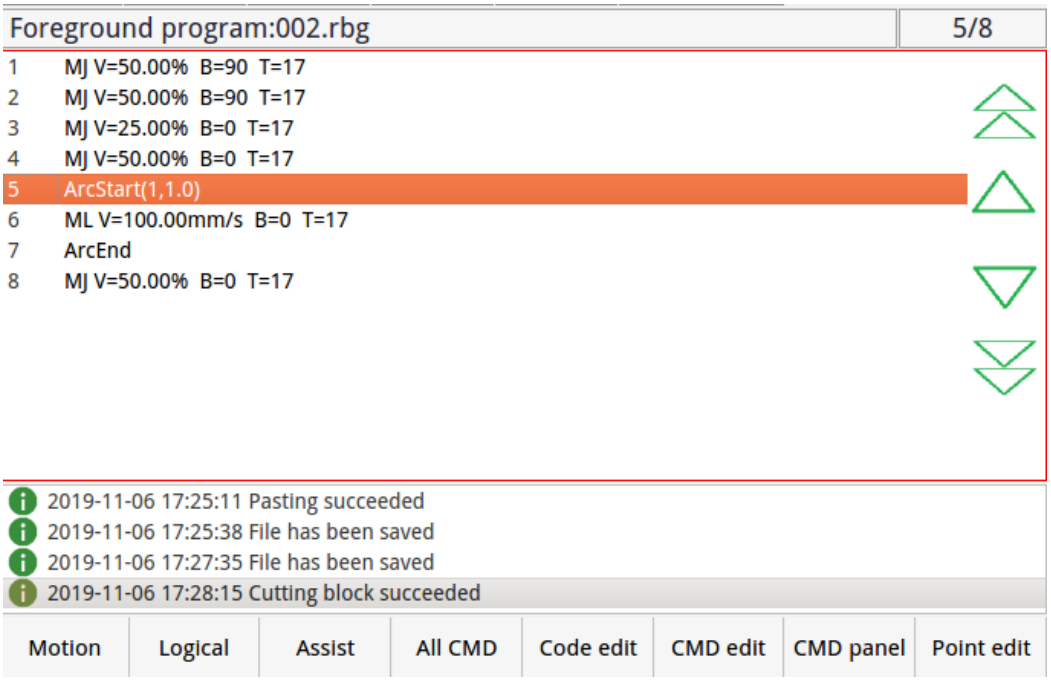


If you want to restore the contents have been cut, move the cursor to the appropriate position and paste it back.

Move the cursor to the position of original line 7 (now line 4), as shown in the following figure.



2. Select <Program Edit> - <Paste>, and the program contents of the original program lines 4-6 are copied and pasted to the position between the original line 7 and line 8, and the cursor is positioned at the end line of the paste block. As shown in the following Figure:

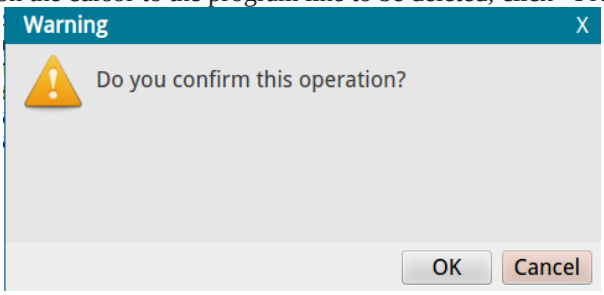


4.2.6 Delete - > delete the current line: delete the line where the cursor is located.

Attention:

The deleted program line cannot be restored. Please use it carefully!

Position the cursor to the program line to be deleted, click <Program Edit> - <Delete>, and the prompt box will pop up:



To cancel this operation, click the key Cancel directly to exit before clicking the key OK. Remember: After clicking OK, the deleted program will not be restored!

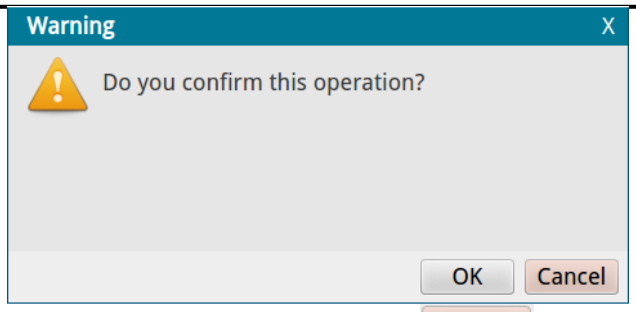
4.2.7 Delete - > Delete Block: delete the contents between the start line and the end line.

Attention

The deleted program block cannot be restored. Please use it carefully!

Click <Program Edit> - <Delete> - <Delete Block>. Pop up the following interface：

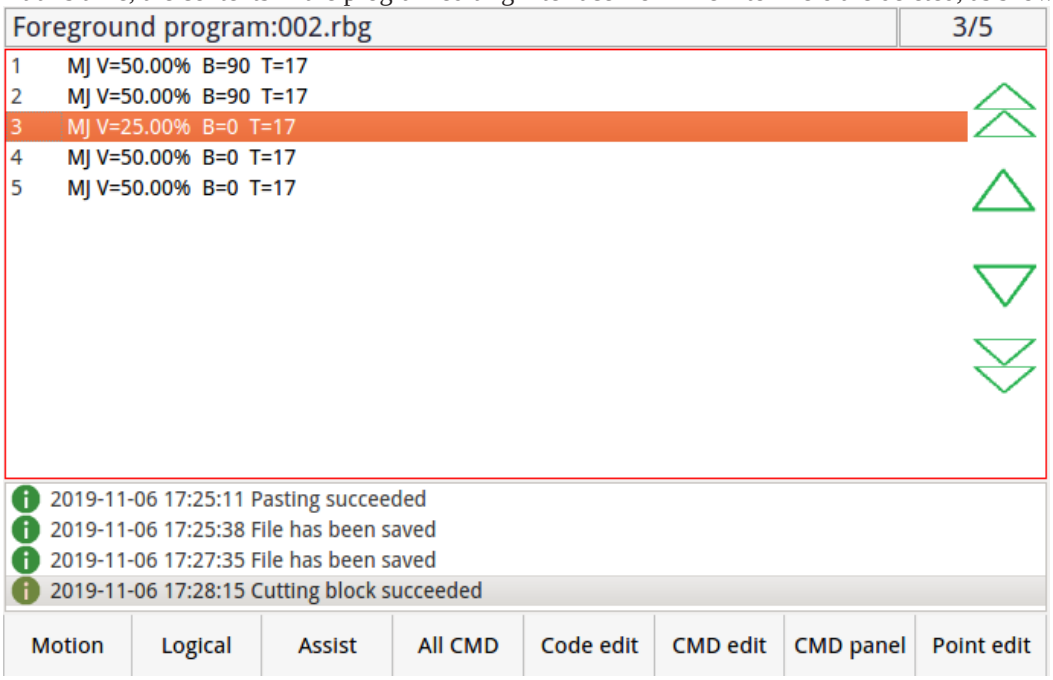
Enter 4 in the window of the start line, and enter 6 in the window of the end line, click the key Delete to confirm the delete operation, and the prompt box will pop up:



To cancel this operation, click the key Cancel directly to exit before clicking the key OK .

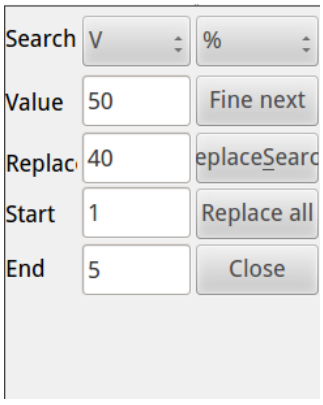
Remember: After clicking OK, the deleted program will not be restored!

At this time, the contents in the program editing interface from line 4 to line 6 are deleted, as shown in the figure below:



4.2.8 Search/Replace - > Search: it is used to search the contents of the program, the cursor is located at the line of the searched contents.

First, position the cursor to the first line, then click <Program Edit> - <Search/Replace > to pop up the following interface:



Select the additional item you want to search, then enter the additional item data. After clicking

Fine next ,the system starts looking down for the closest additional item that matches the settings and positions the cursor to the specific line.

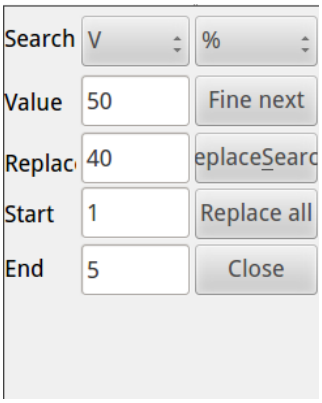
If there's no matched additional item in the searched program, the system prompts: not found.

If there are several matched additional items, each time the button Fine next is clicked, the system will continue to look for the closest matched additional item from the current position and so on.

If you do not want to search anymore data, you can click Close and exit directly.
Additional items that can be searched by the user are V, A, B, Sleep,%, mm / s, mm / s2.

4.2.9 Search/Replace - > Replace: replace the original content of the program with the new content.

First, position the cursor to the first line, then click <Program Edit> - <Search/Replace-> Replace> to pop up the following interface:



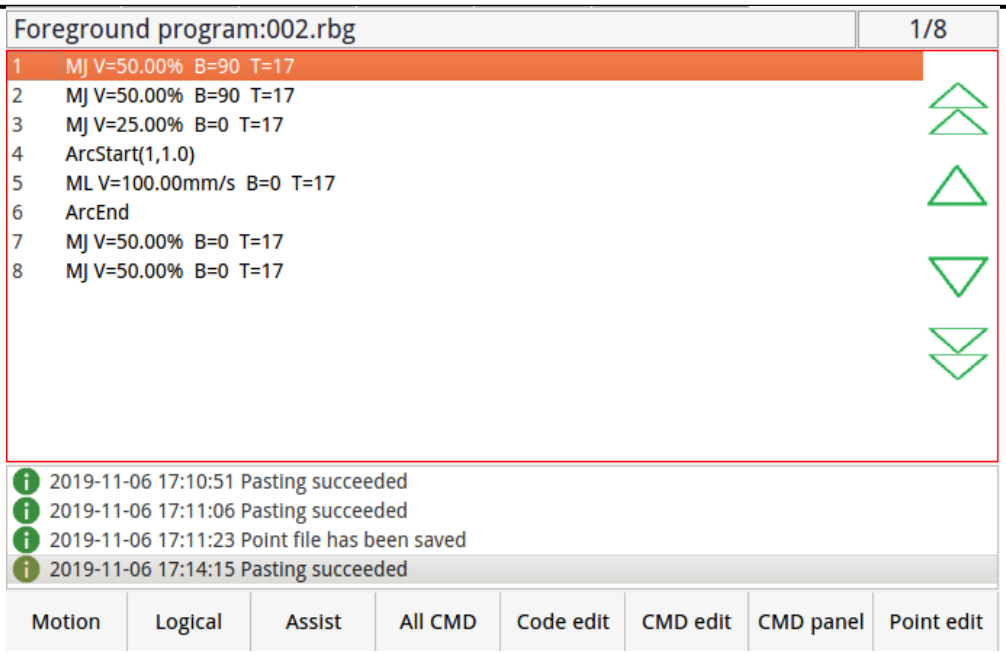
Select the additional item to be replaced, then input the original data of the additional item, and input the new data. After clicking eplaceSearc, the system starts to search for the closest additional item that matches the set content, and the cursor is positioned to the line, and the content of the additional item is replaced with the new content. If there is no matched additional item in the original program, the system prompts: not found.

If there are several matched additional items need to be replaced, each time the button eplaceSearc is clicked, the system will continue to search for the closest matched additional item from the current position, and the cursor is positioned to the line to replace the content of the additional item with the new content. Similarly, until the program is completely replaced, the user can also click the button Replace all to replace all matched additional items from the start line to the end line at one time.

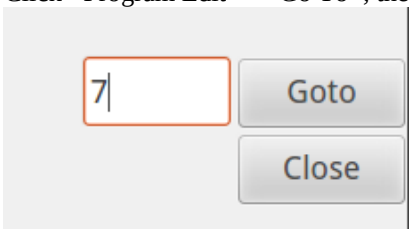
If you do not want to replace any more, you can click the button Close and exit directly.
Additional items that can be replaced by the user are V, A, B, Sleep,%, mm/s, mm/s2.

4.2.10 Go to: Position the cursor directly and jump to the number of line entered in the window.

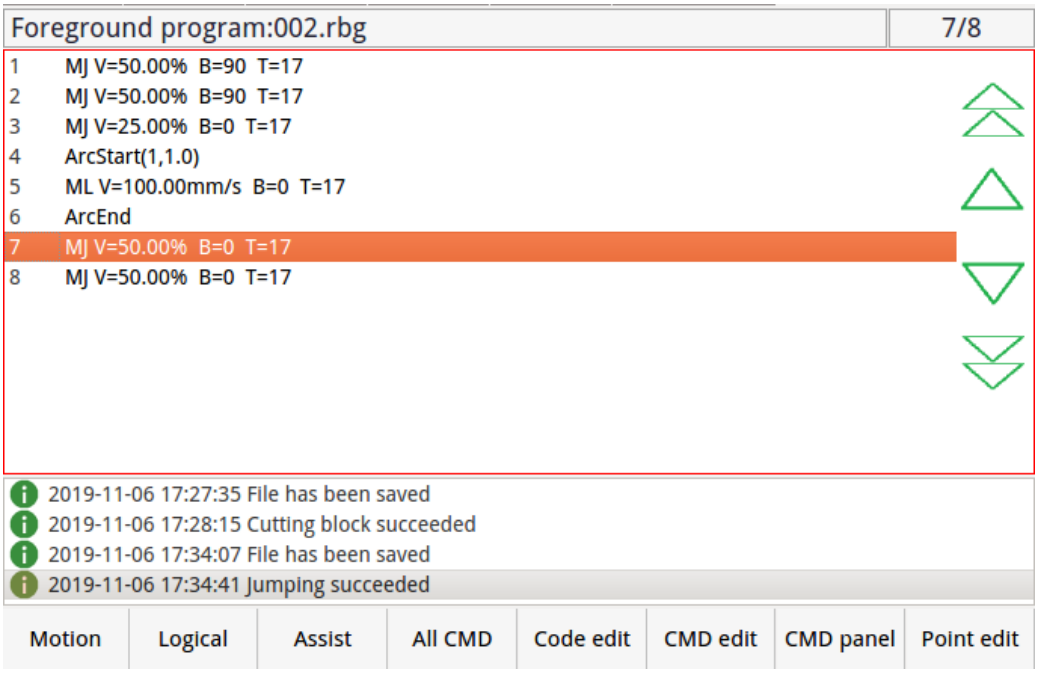
Example: The cursor in the figure below will be positioned in front of line 7 by "go to" function.



Click <Program Edit> - <Go To>, the system pops up the following interface:



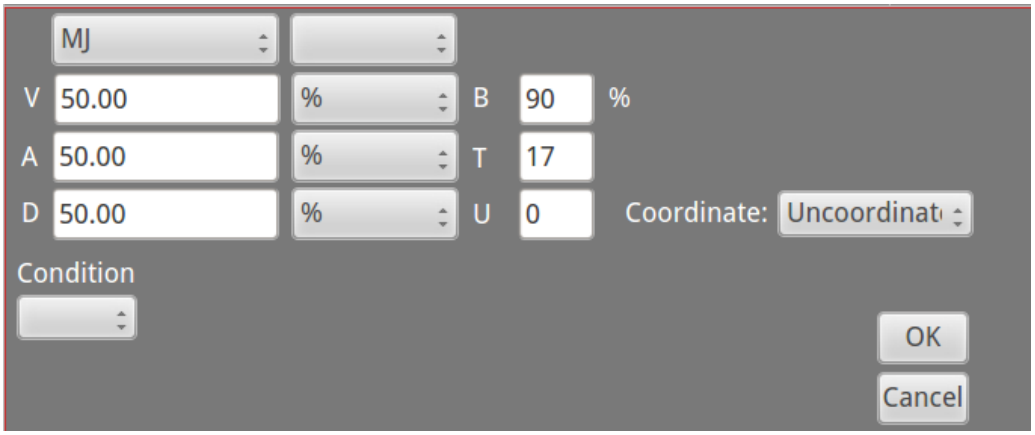
Enter the number 7 in the above window. Then click the corresponded icon and the cursor will be positioned to line 7, as shown below.



If you do not want to use the “Go To” function in the pop-up window of jump program line , you can click the related botton and exit directly.

4.2.11 Motion: call the motion command button.

In the program editing interface, click <Motion> - <MJ>, the system will pop up the following motion command window (which can be called by clicking <Programming> - <Motion> - <MJ>):



The ML, MO, and MC commands can also be selected from the pull-down menu pops up by pressing this button.

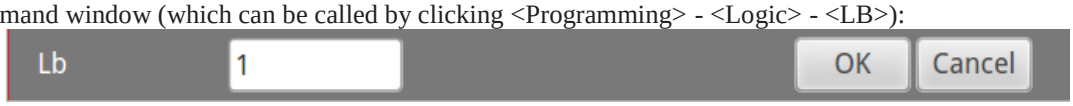
4.2.12 Logic: call the logic command button.

In the program editing interface, click <Logic> - <ELSEIF>, and the system will pop up the following logic command window (which can be called by clicking <Programming> - <Logic> - <ELSEIF>):

The commands such as IF, ELSE, ENDIF, WHILE, ENDWHILE, FOR, ENDFOR, and SWITCH… can also be selected from the pull-down menu pops up by pressing this button.

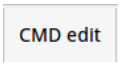
4.2.13 Auxiliary: call the auxiliary command button.

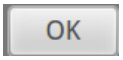
In the program editing interface, click <Logic> - <LB>, and the system will pop up the following auxiliary command window (which can be called by clicking <Programming> - <Logic> - <LB>):



The commands such as GOTO, CALL, RETURN, DO, SLEEP, and NOTE can also be selected from the pull-down menu pops up by pressing this button.

4.2.14 Modify command: modify the content of the current program line.

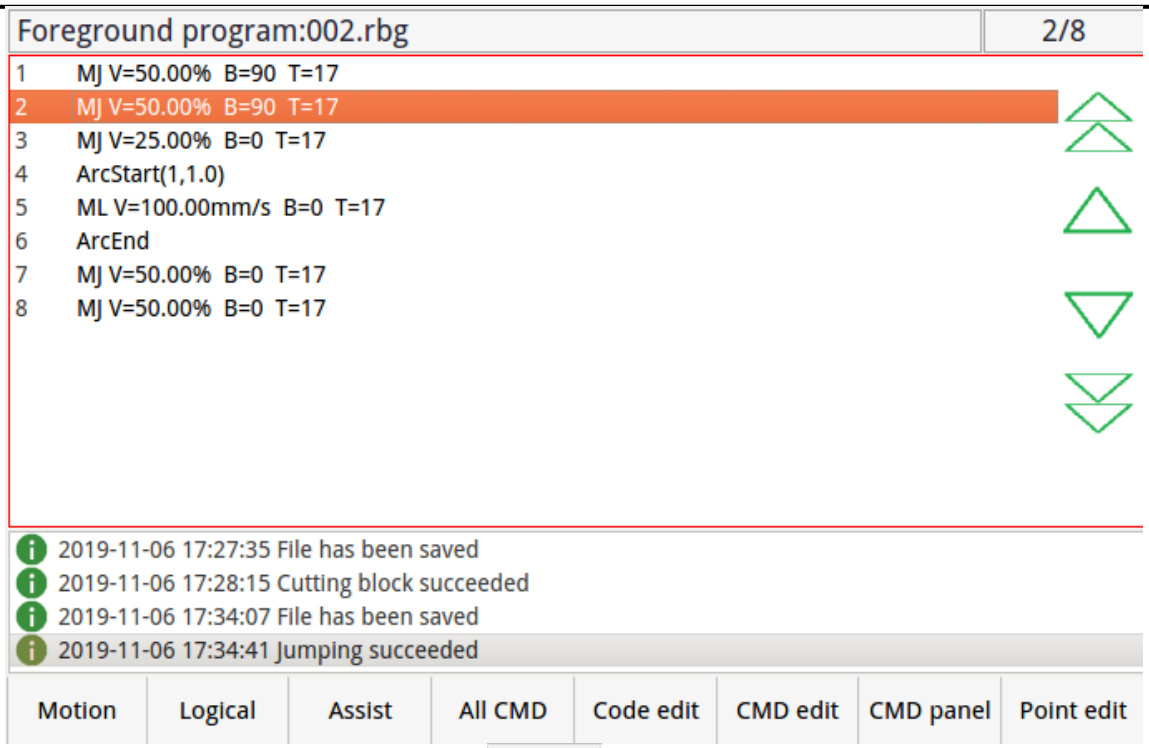
Position the cursor to the program line to be modified, click the button 

, and the system will pop up the editing interface of the current program line. After the user completes the modification, click the button 

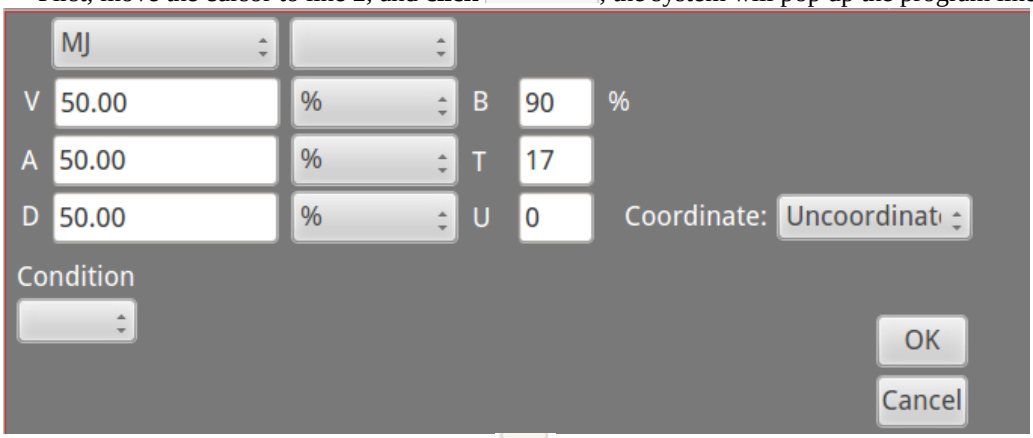
to confirm the modification. You can also click 

to cancel the modification.

The specific steps are as follows: line 2 refers to the program line already exists.



First, move the cursor to line 2, and **click** CMD edit, the system will pop up the program line modification window:

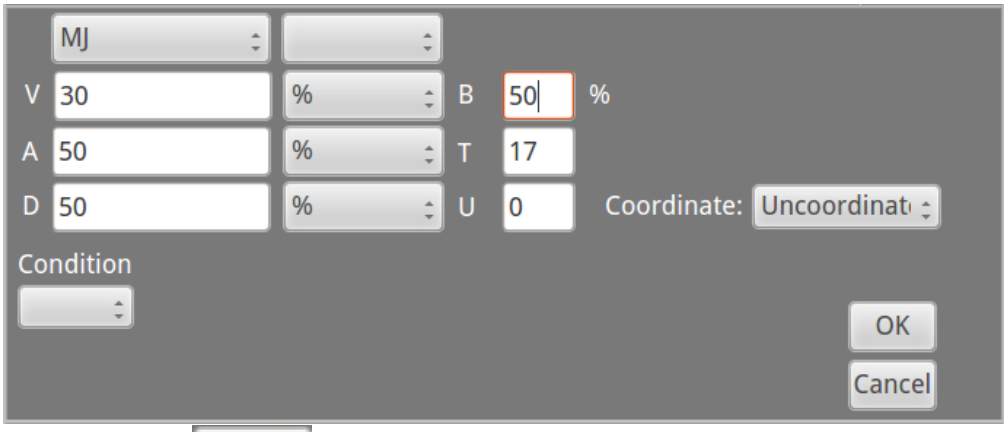


For a motion command, you can click  to modify it to another motion command, or you may not modify the command, but only modify the additional items. For non-motion commands, only additional items can be modified.

Attention:

For the program line of motion command that needs to modify the position and posture, it is necessary to press and hold the safety switch to record the position and posture. For the program line of motion command that not needs to modify the position and posture, and only needs to modify the additional items, do not press and hold the safety switch. For program lines other than motion commands, it is not necessary to press and hold the safety switch.

We modify the velocity “V” to 30% and the smoothness “B”to 50. As shown in the following Figure:



You can also click Cancel to cancel the modification.

4.2.15 Modify the point position: modify the coordinate of motion command of the current program line.

Position the cursor to the program line of motion command to be modified, move the robot to the selected position through the coordinate key on the teach pendant, click the key Point edit to modify the program line of motion command of the position and posture, press and hold the safety switch to record the position and posture.

5 Program test run

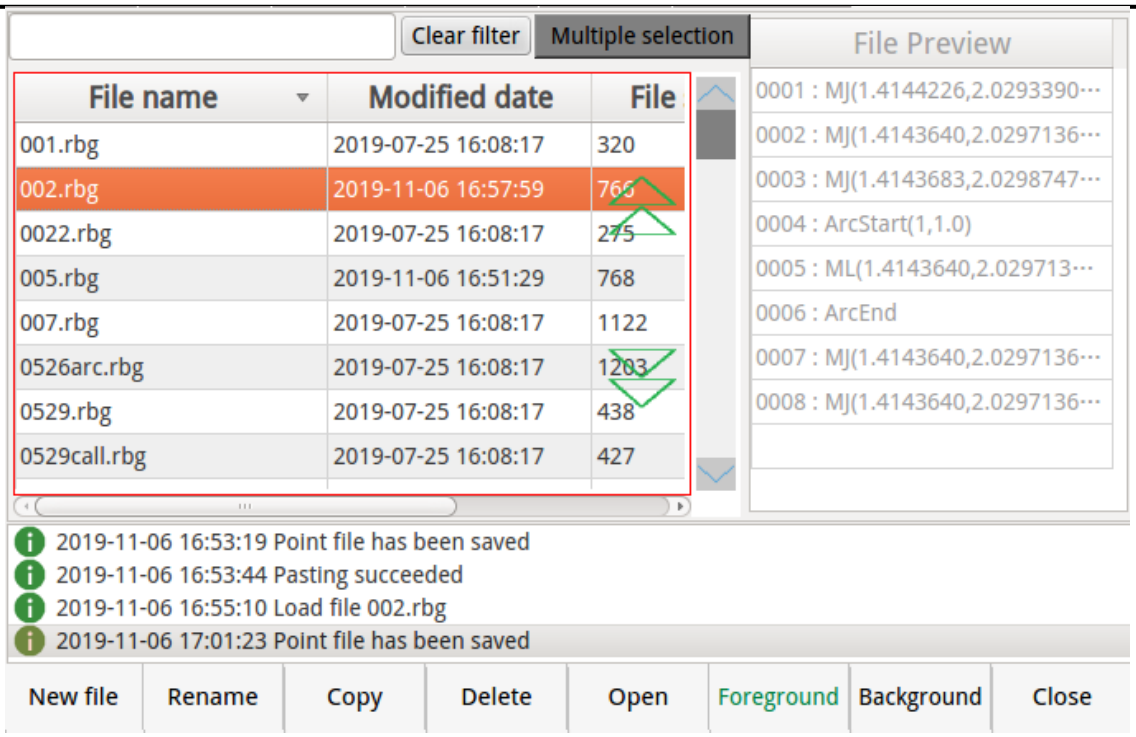
Program test run: after the program editing is completed, the robot can execute the program command line by line through a specific operation, as well as simulate the actual running action and running track. Thus the operator can prejudge whether an action or track is correct or not.

5.1 Preparations:

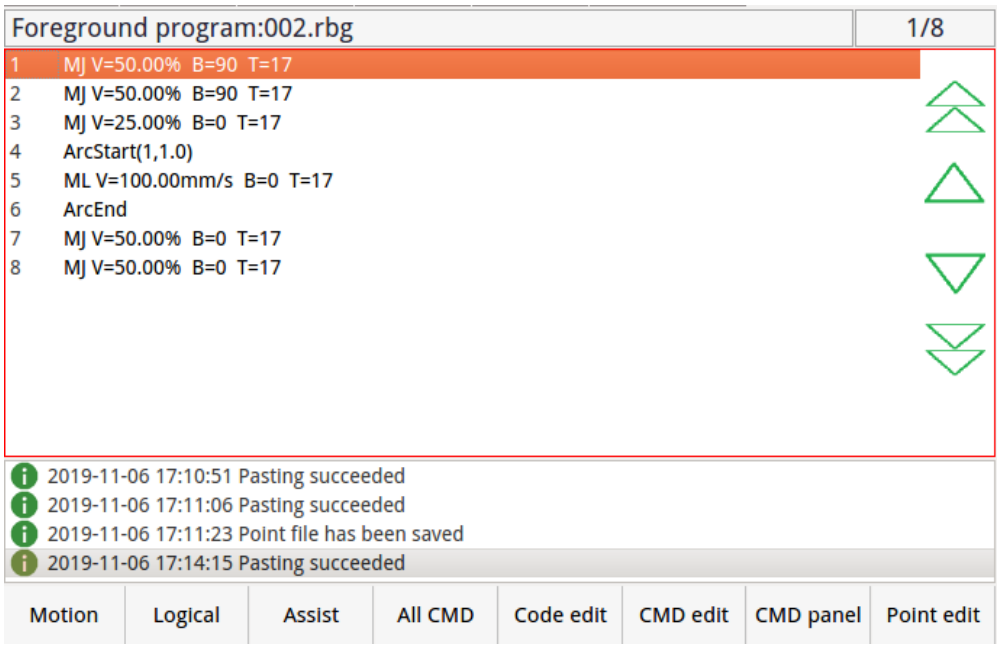
1. Switch the robot to the state that allows actions.
2. By employing the override slide bar, adjust the manual speed to an appropriate value. It is recommended that the adjusted override should not exceed 50%. And the adjusted override can be displayed in the status display area 10%.

5.2 Steps of program test run:

1. Return to the program list is as follows:



2. Move the cursor over the program you want to run. For example, the “002” as shown in above figure. Then click the key <Open> in the sub-menu to open this program and enter the program editing interface. As shown in the following figure.



3. Move the cursor over the program line to be tested, as in the second line.
4. Press and hold the safety switch. Then press and hold the key  . The system controls the robot to execute commands in the line which the cursor is located. Such as robot action, IO output, operation, logic, etc.

Chapter 3 PLAY & REMOTE

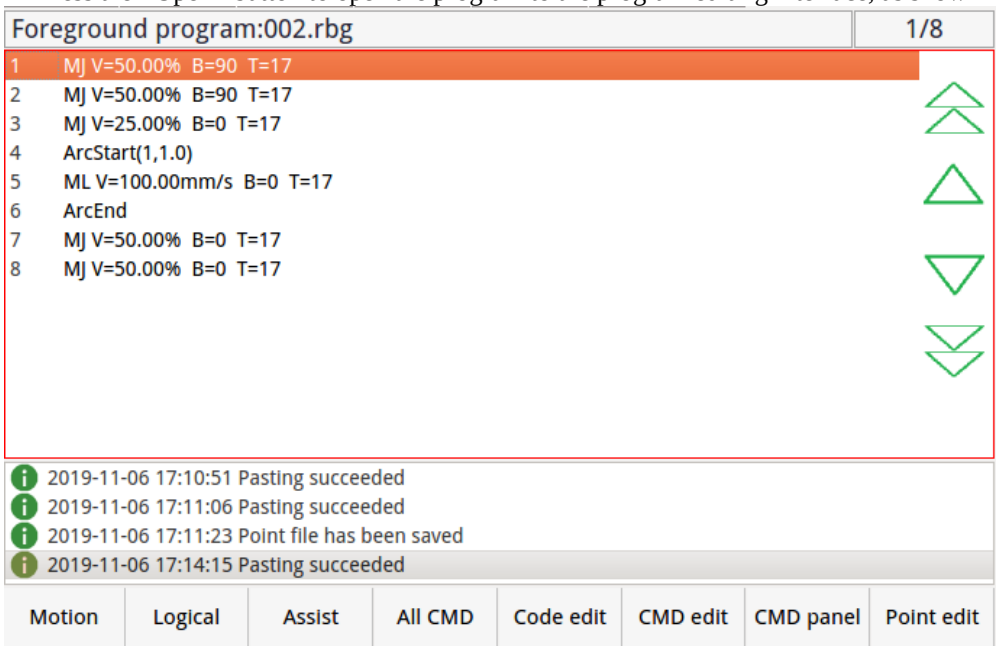
1 PLAY MODE

1.1 Preparations

- First, use the test run method to ensure that the program to be run is correct.
- Ensure that the robot moves within the range of space where has no man and obstacles.

1.2 Call the program

1. First, return to the program list interface.
2. Use <↑> and <↓> keys to move the cursor over the program to be run. For example, running the program 002, which is described in the section 6.1 of Chapter 2 - Teaching programming of welding.
3. Press the <Open> button to open the program to the program editing interface, as shown in the following figure:



4. Move the cursor to the program start position (first line).

1.3 Program running

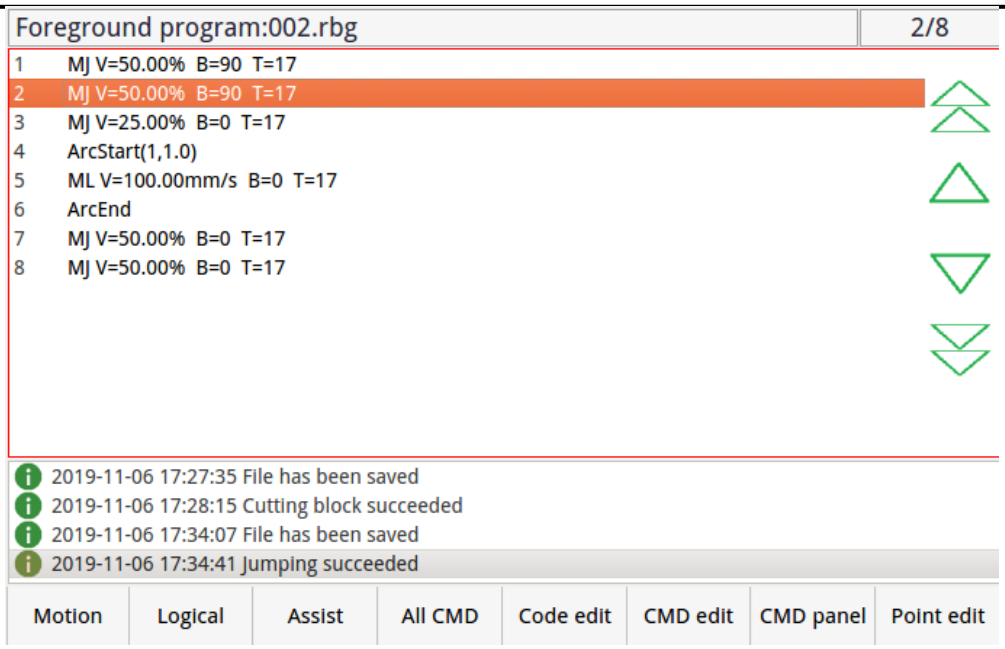
1.3.1 tart up

1. Switch the control mode switch to "PLAY" mode. Display in the status bar:
2. Select the appropriate running speed. Click the slide bar to adjust the override 10%.

Attentio

It is recommended to slow down at first, then speed up after the first-run is correct.
It is also available to adjust the speed under running state, and the speed adjustment takes effect when the next motion is executed.

3. After the previous preparatory work is completed, click the button, and the program will start to operate according to the points, actions and logic taught above. The operation interface is shown as follows:



1.3.2 Pause(stop)

Attention:

The pause and stop of this system share one state, that is, when the stop key is pressed, the system is in the stop (pause) state.

Click the button  again and the program will continue to run.

Switch the mode switch to the teach mode (TEACH), the program exits.

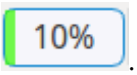
- During the program running, if you need to pause (stop), please click the button  and the system will slow down to stop the program running and robot action.

  After stopping the program in this mode, all internal states, output ports, counters, variables, etc. related to the program will be maintained. When starting again, click the button  directly, and the program will continue to execute normally. It is strongly recommended to use.

- When switching the mode switch to the TEACH mode or the PLAY mode, the program is forcibly stopped. In this case, the system will directly cut off the pulse, close the enable, and open the braking, which will cause impact to the robot, it is not recommended to use.

1.3.3 Speed regulation, operation mode switching.

- Speed regulating:

Click the override sliding bar to adjust the running speed. Display in the status bar: 

. In case the system is running, the override adjustment will take effect when the next motion is executed.

- When the program is running, switch the operation mode:

Currently in the PLAY mode, if the program is running, you need to use the stop key or  key to stop the program. The mode switch is then switched to the desired mode (TEACH mode or REMOTE mode).

1.3.4 Restart the system after stop

- The operation mode is not changed, and it is still working in the PLAY mode.

  In this mode, the program stops running by pressing the stop key or the  button. The system slows down and stops the program running, as well as the robot action. After stopping the program in this mode, all internal states, output ports, counters, variables, etc. related to the program will be maintained. When starting again, click the corresponding button directly, and the program will

continue to execute normally.

■ The operation mode is changed and switched to the TEACH mode.

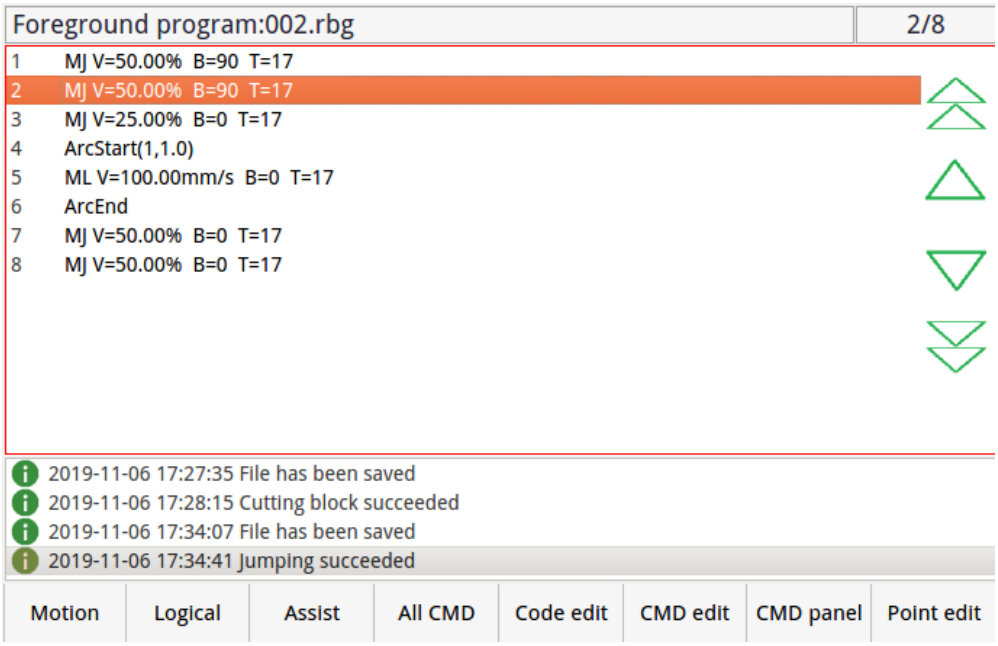
1. Relevant parameters (require the manufacturer authority): <run preparation> - <run setting>

Parameter category	Parameter	Parameter value	Descriptions:
Run Setting	Initial position of PLAY	Current line	Current line: when switching from the TEACH mode to the PLAY mode, and the system is in the continuous operation mode, the program line designated by the program running cursor in the TEACH mode is the current line.
		First line	First line: when switching from the TEACH mode to the PLAY mode, and the system is in the continuous operation mode, the program running cursor jumps to the first line of the program.

2.Start-up process of programs with different parameters.

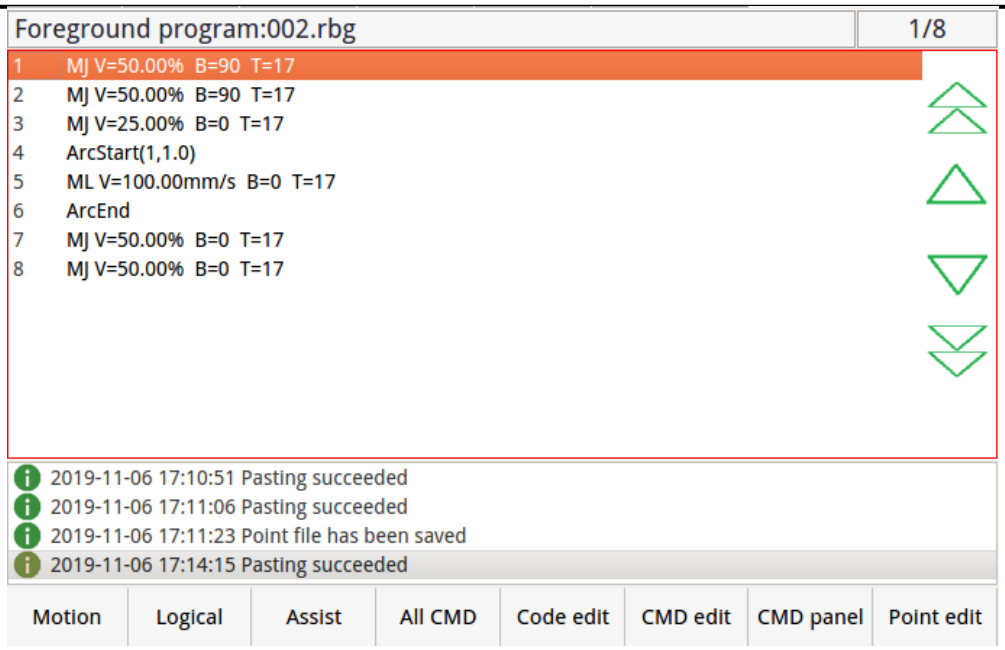
When "Current Line" is set to <Initial position of PLAY> in <Run Setting>.

In the continuous operation mode, switch the operation mode switch to the PLAY mode, then click the button  , the program starts to run from the line where the cursor is in the TEACH mode. As shown in the following Figure:



When "First Line" is set to <Initial position of PLAY> in <Run Setting>.

In the continuous operation mode, switch the operation mode switch to the PLAY mode, the cursor automatically jumps to the first line of the program, click the button  , and the program starts to run from the first line. As shown in the following Figure:



Emergency stop

WARNING:

1. In automatic operation, if the robot is found to be working abnormally, the emergency stop button should be pressed immediately.
2. After pressing the button of emergency stop, the current state of the machine may be abnormal. Special attention shall be paid when resetting the machine alarm.

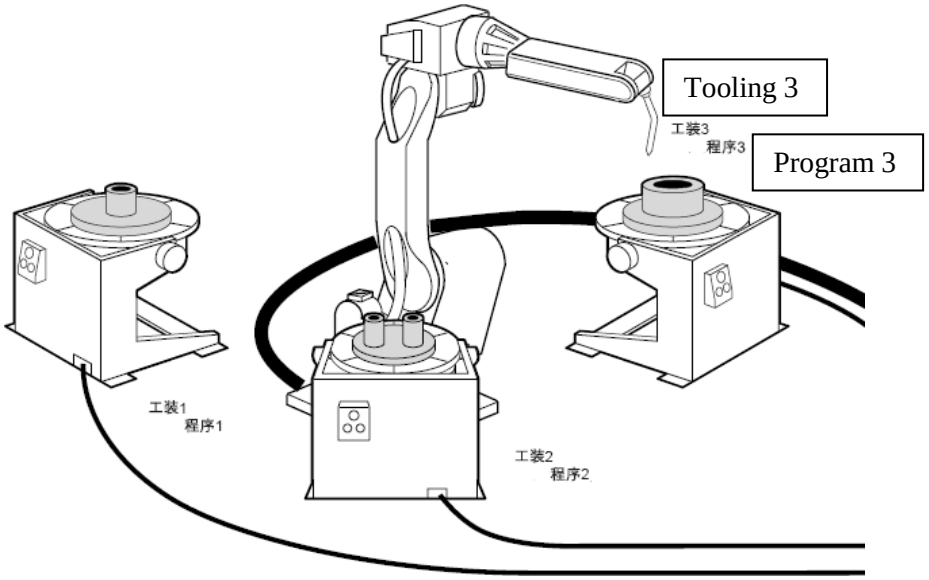
When the robot is in the PLAY mode, the program is in operation. After pressing the button of emergency stop to stop the program. To start the robot operation again, follow the following steps:

1. First, check the robot body, tooling and fixture are under normal conditions. Ensure the program can continue to run.
2. Then rotate and release the emergency stop button, and turn on the servo motor.
3. Reduce the operation speed of PLAY, and switch the operation mode to single-segment operation
4. Press the operation key for several times to check whether the test program is abnormal.
5. After it is confirmed that there is no abnormality in the operation of the robot, the operation speed is increased and the operation mode is switched to the continuous mode.
6. Click the program operation key, and the robot starts working.

2 REMOTE MODE

2.1 Reserved operation mode

Reservation start-up refers to the function of running the programs of each tooling in the order of reservation through the start-up button on each tooling. The following keys are not valid when switching to reservation mode.
The <Run Forward> and <Program Stop> keys on the teach pendant.



2.1.1 Preparations

1. Relevant parameters (manufacturer authority): <Process Menu> - <Remote/Reservation>

Parameter category	Parameter	Parameter value	Descriptions
Remote/Reservation	Reservation response time	200	This parameter sets the hold time required for the remote/reservation start signal. The remote/reservation start signal requires a complete rising edge, a rising edge holding time, and a falling edge to be effective. Timely response of reservation stop signal is not controlled by this parameter.

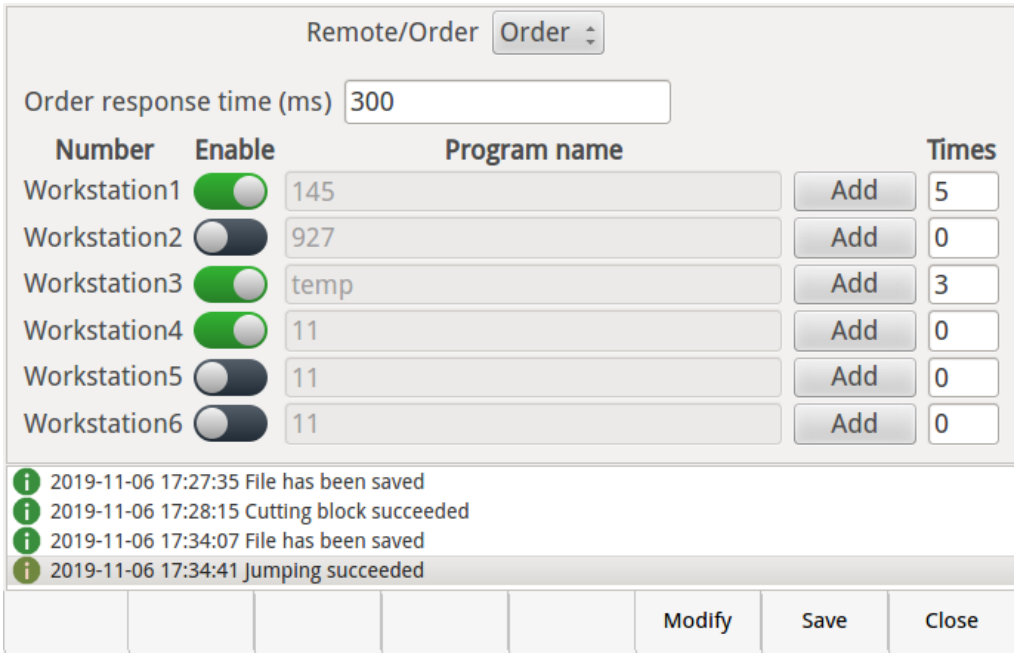
2. Operation program editing
   It is necessary to complete the operation program editing of each station in the TEACH mode, and to test the correctness of the specific program in the PLAY mode.
3. Preparation of robot working conditions
   Check whether the robot fixture is ready and whether the products to be used are reasonable. When testing the working program, please test it with all fixtures and products, and check whether the program, products and fixtures can work normally.

Note: When a robot needs to interact with another robot or external device, be sure to reasonably handle the logic, correlation and timeliness of each signal. Otherwise, the interaction may be abnormal, resulting in equipment damage and personal injury accidents.

2.1.2 Call the program

1. Choose reservation mode

Click the <Process Menu> - <Remote/Reservation> to open the following interface, click the <Remote/Reservation> option to switch up and down to select [Reservation mode].



2. Set the reservation working program

In the interface above, click <Add> after each station [program name] to pop up the program list, and select the program name corresponding to the station. For example, the program name 145 corresponding to station 1, the program name 927 corresponding to station 2, and the program name temp corresponding to station 3 (as shown in the interface above). After the program is added, if you want to realize the reservation function of this station, please perform the operation of reservation enable at first. When the reservation enable state is , the reservation function of this station is turned on; when the reservation enable state is , the reservation function of this station is turned off.

Note: 1. The dialog box "Running Time" in the interface above refers to the total times of reservation; in case this parameter is set to 0, it means no limit of times. In case this parameter is set to a value greater than 0, it represents the total times of reservation. For example, set this parameter to 5, then the station will not take effect after reservation for 5 times.

2. The not enabled reservation station may not enter the program name. The enabled reservation station must enter the program name.

3. When a certain station does not need to work, the reservation of closing the station can be performed.

3. After the setting is completed, click <Save> and <Exit> to exit the setting.

2.1.3 Operation Reservation

2.1.3.1 Start-up Reservation

Descriptions

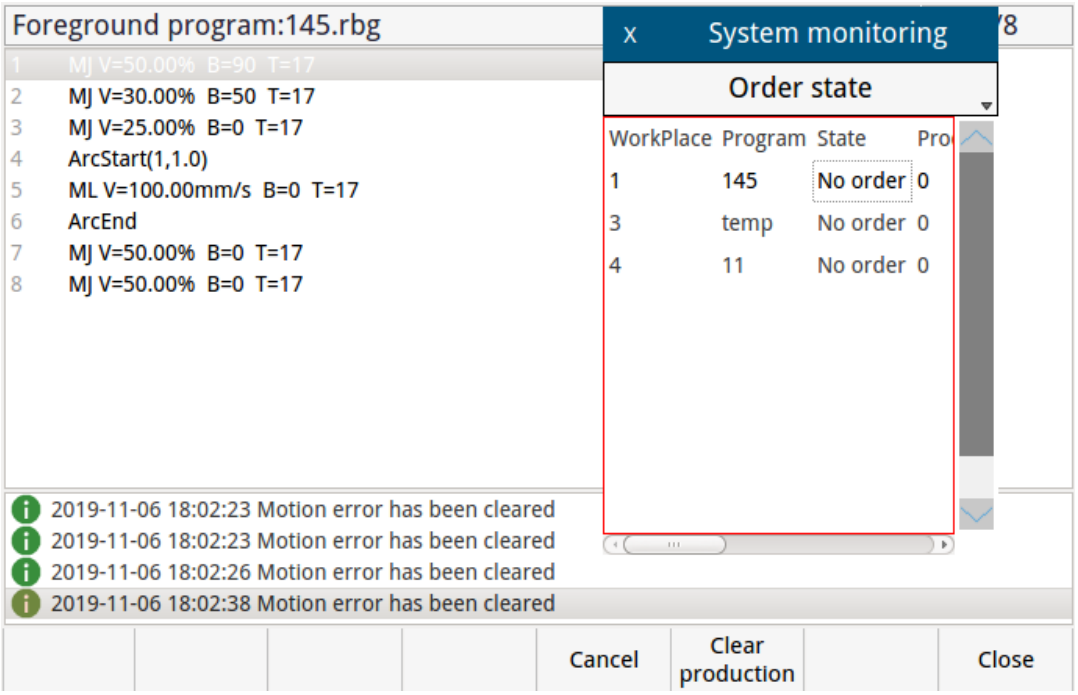
No matter the reservation program is running or not, if you close the opened reservation program when switching to the TEACH mode, all reservation states are canceled; If you do not close the opened reservation, the reservation states other than this program are canceled.

Switch the mode switch to the Reservation Mode (REMOTE).

After the station 1 is ready, press the station 1 reservation start button and hold it for a certain time, then release the start button. Execution of the station working program begins at this time.

After the station 2 is ready, press the station 2 reservation start button and hold it for a certain time, then release the start button. At this time, if the station robot works normally at another station, the station 2 enters the queuing state.

After the station 3 is ready, press the station 3 reservation start button and hold it for a certain time, then release the start button. At this time, if the station robot works normally at another station, the station 3 enters the queuing state.



Attention

Note: when the system collects the reservation start-up signal, it needs to collect such three conditions as the rising edge, the time length of electrical level, and the falling edge.

2.1.3.2 Cancellation of queuing reservation

If you want to cancel the reservation of a station in the queue state, please press and hold the reservation start button, then release it, and the reservation state of the station is canceled.

If you want to make a reservation again, press and hold the reservation start button of this station, then release it. The station enters the queue state.

2.1.3.3 Speed regulation of reservation mode

Speed adjustment shall be carried out after the program is stopped. Therefore, when speed adjustment is required, press the stop button of the corresponding station to stop the operation of the robot, and then modify the operation speed on the teach pendant.

2.1.3.4 Reservation mode pause/stop

Press the stop button of the running station to stop the robot.

Attention: Due to the time-delay problem, after pressing the stop button, the robot will not stop immediately, so in case of emergency, please first press the emergency stop button instead of the stop button.

2.1.3.5 Restart after the reservation is stopped

After the reservation operation is stopped, the robot fixture, station product, tooling and the like can be adjusted, or the robot can be switched to the TEACH mode for adjustment. Attention: when the currently open

reservation program is closed, all the reservations in the queue will be cleared! After being switched to the TEACH mode, when the program is not closed, the cursor shall be moved to the front of the program line to be run when the start-up needs to be reserved again.

Switch to remote mode. Press and hold the reservation start button again, then release the button, and the program starts to run from the line where the cursor is located. After completing the operation of the current station, it continues to execute the subsequent queuing station.

Attention

If, in TEACH mode, the program is shut down, the reservation state is cleared, the restart is similar to the first reservation run.

2.1.3.6 Reset and restart of reservation mode

When an alarm occurs, the robot stops moving, and the remote reset button can be used to reset the alarm state. Or reset the alarm state by using the key on the teach pendant.

Restart after reset: A high level alarm will clear the servo motor power-on status. If you want to restart the system, please press the key to reset the alarm state; after powering on the servo motor, press the station operation button to run the program.

Chapter 4 Process Menu

Descriptions

This chapter mainly shows the interface and path related to each process, please refer to the Process Manual for detailed process introduction!

1 Welding process

Based on the MIG/MAG, TIG welding process package interface, which has been developed at present, we have integrated them into a whole. Among them, the TIG analog communication interface is applicable to all TIG analog communication welding machine, and the digital communication interface is only applicable to the AOTAI TIG welding machine.

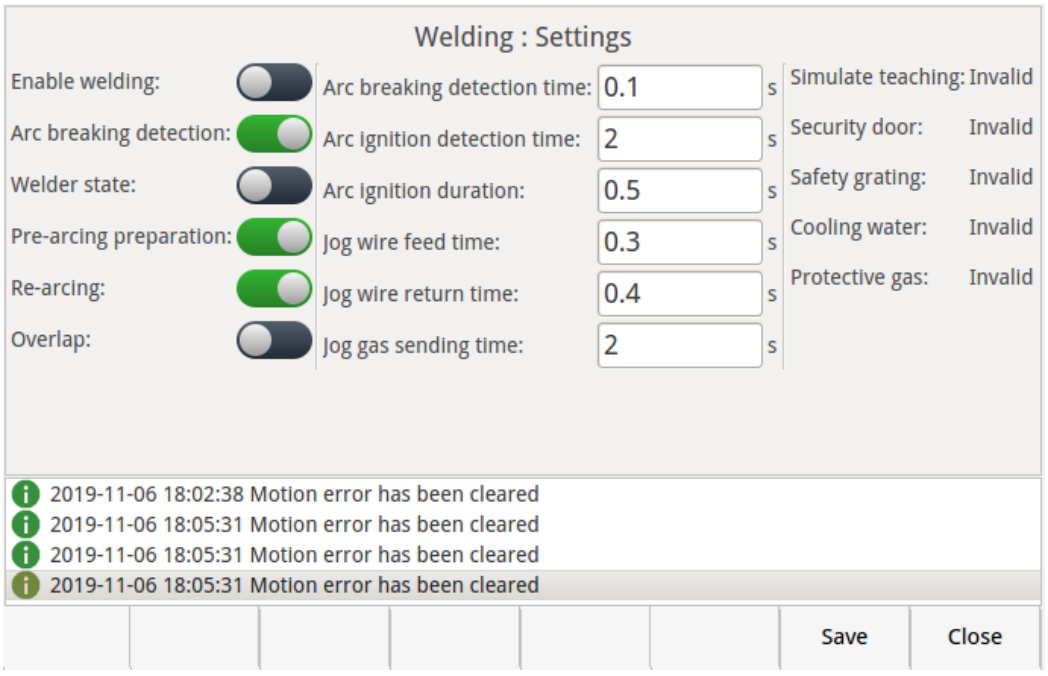
Interface classification of arc welding function package

Welding machine management

Welding process: including all settings and functions related to welding, which are easy to manage and operate. There are six sub-items: welding setup, welding machine management, laser tracking, arc swinging, arc tracking and contact searching.

1.1 Welding setting

Welding setting: all basic function settings related to welding, irrelevant to welding or all welding machine are included in this item, and the parameter setup is valid for all welding machines and programs.



Click <Process Menu> - <Welding Process> - <Welding Setting> to open the welding setup interface:

The welding enable switch (whether the arc welding machine is turned on or off, and turn it off to conduct the simulated welding) is used to simulate whether the welding program is valid or not.

The main interface is equipped with quick switch, which is convenient to switch at any time. When in the simulated welding state, the program runs the welding command without arc start, without air supply or wire supply, but delivers welding current, voltage and other parameters to facilitate observation of parameter setting, including current change of

welding section.

Arc breaking detection switch

It is used during the welding process to check whether the welding is continuing. The welding status signal and arc start successfully signal of the McGmitt analog communication are a signal. In the entire welding process, if it is detected that the welding status signal is invalid within the set time, it is considered that the welding is abnormal, and the system performs abnormal processing.

Welding Machine State Switch

When it is valid, it is used to detect whether the welding machine is in the normal state; when the analog communication welding machine does not support the state feedback of the welding machine, the setting is invalid, and this guarantee system runs normally. Default invalid (not supported by the AOTAI welding machine).

Flying arc-starting switch

Set whether the flying arc-starting function is effective.

Arc re-starting switch

Only set whether the function is valid, and the calling file is set in the welding machine configuration.

Overlapping switch

Only set whether the function is valid, and the calling file is set in the welding machine configuration.

Arc breaking detection duration:

Set how long to confirm the arc breaking after the system detects it. Time：0.01-5.00S

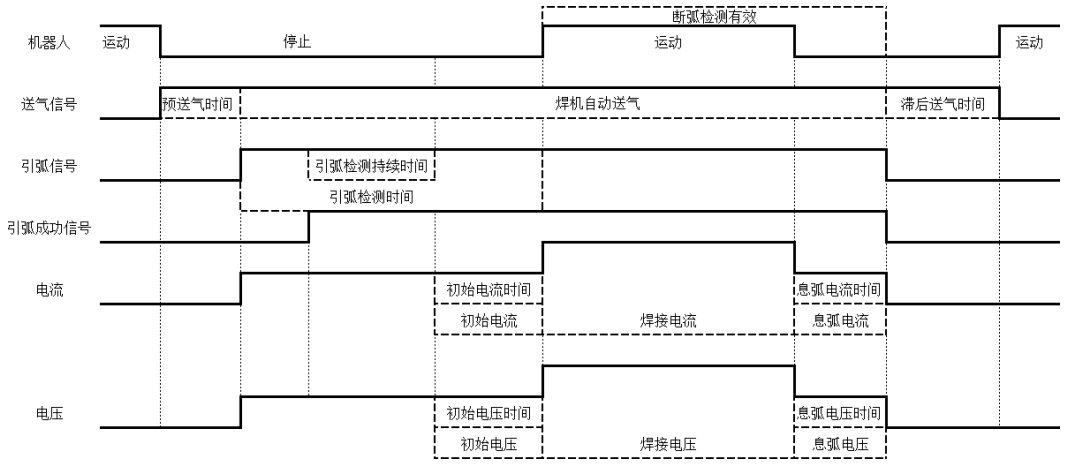
Arc starting detection time:

Detect the time from the arc starting signal (welding machine arc starting signal) takes into effect to the time when the system determines that the arc starting is successful or failed. If the arc starting work signal fails to take effect within the set time, the system considers the arc starting failure Parameter: 0.0-9.9S, default parameter: 2.0S

Arc starting duration:

Set the time from detecting the arc starting signal takes into effect to the system determines that the arc starting is successful. If the arc starting signal is still valid beyond the set time, it is considered that the arc starting signal is valid and arc starting is successful. Parameter: 0.0-9.9S default parameter: 0.0S

Note: The detection time of arc starting shall be greater than the arc starting duration, otherwise the arc starting will fail.



Standard robot welding time sequence

Time of wire feeding by jog:

Used to set the time of wire feeding by jog: Parameter：0.0-15.0S。

Time of wire withdrawal by jog

Used to set the time of wire withdrawal by jog: Parameter：0.0-15.0S。

Time of air supplying by jog:

Used to set the time of air supplying by jog: Parameter：0.0-15.0S。

At present, the following functions are not supported: (Estimated also not used) Simulated teaching: invalid

Safety door: invalid

When it is valid, the system will automatically enter the stop state after detecting that the safety door is opened,

so as to ensure the safety of the personnel entering the robot working area (during application, directly connect to the system-specific IO).

Safety grating: invalid

Similar to the safety gate, the relevant signal is fed back to the robot system through IO signal, and the robot stops running and gives corresponding prompt (during application, directly connect to the system-specific IO).

Cooling water detection: invalid

When welding with high current, the welding gun needs to be water-cooled. For the analogy communication welding machine, it is unable to feedback the abnormal cooling water, it is necessary to connect the sensors (usually flow sensors) in series in the cooling water circuit circulation. In case any trouble occurs to the cooling water circuit, the welding is stopped after IO feedback the occurred trouble to the robot system. (during application, directly connect to the system-specific IO).

Protection gas detection: Invalid

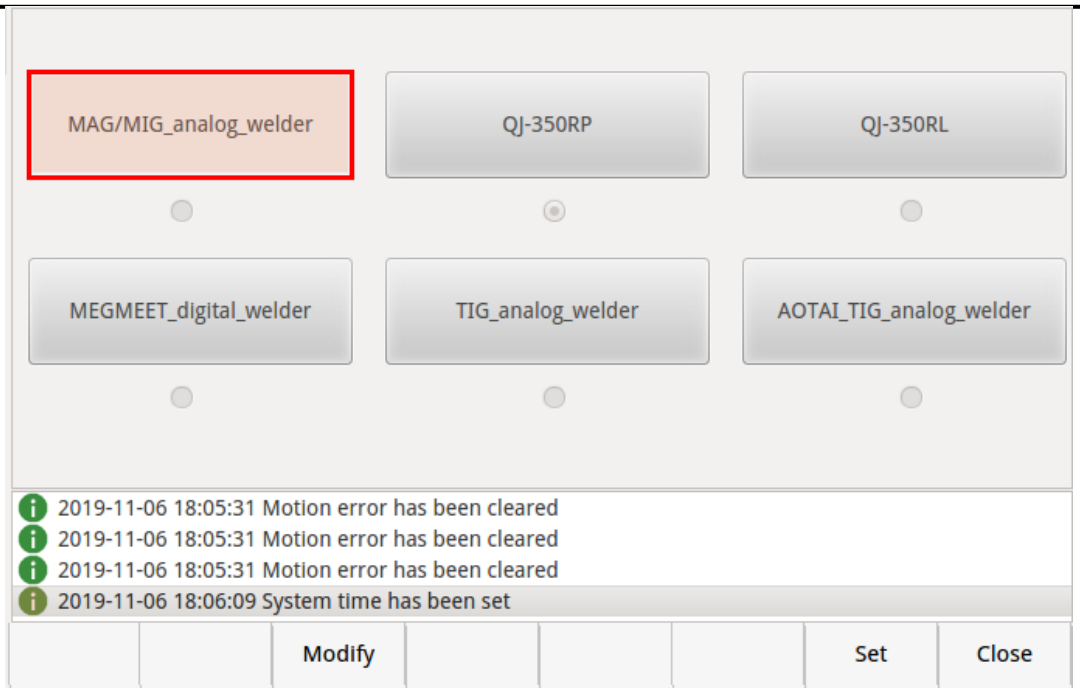
Similar to the cooling water detection, the last gas detection of the system or manual gas detection of the welding machine is only realized by the solenoid valve switch, and it is not possible to detect whether the gas flows or not. Therefore, the air sensors are generally connected in series in the gas circuit according to the needs of the project, when no gas flows through, the IO shall feedback this signal to the robot system, the welding is stopped (during application, directly connect to the system-specific IO).

1.2 Welding machine management

Welding machine management: it is used to set welding machine profile and relevant parameters, and the profiles are set with a unified interface. There is at least one welding machine configuration, otherwise the system shall remind that the welding machine is not set. The feedback current-voltage profile of the analog welding machine is similar to the current-voltage profile, but it does not have a valid switch.

Note: McGmitt analog communication welding machine has current and voltage feedback signal, but AOTAI analog communication welding machine does not have. Currently, the feedback data configuration is not supported.

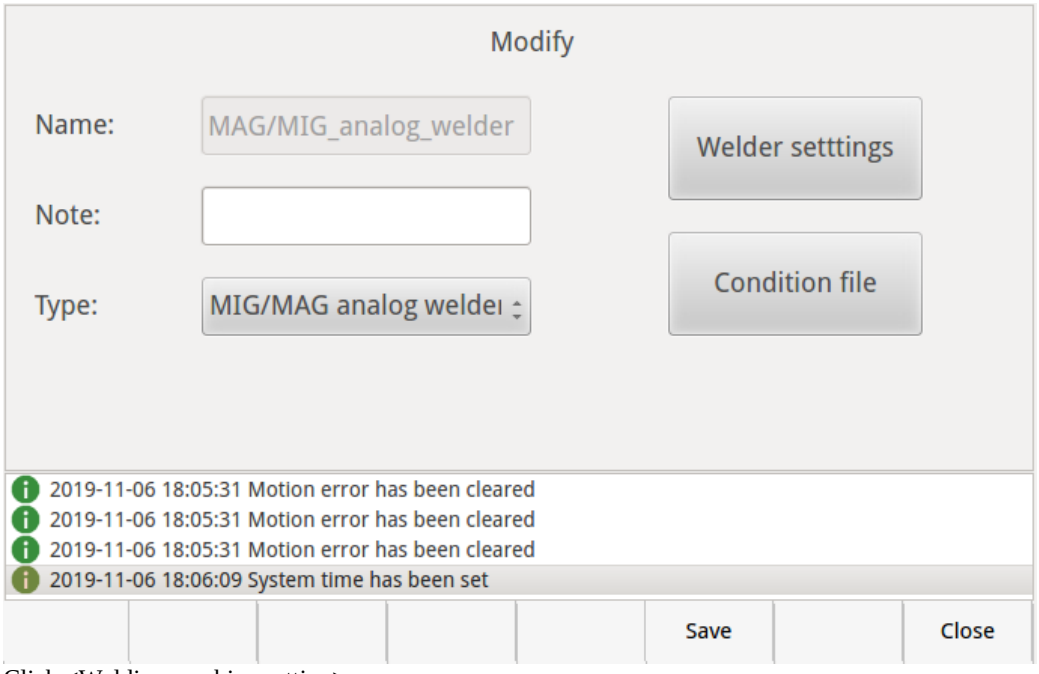
Click the <Process Menu> - <Welding Process> - <Welding Machine Management> to open the welding machine management interface:



Welding machine modification: it is used to modify the profile and relevant parameter settings of the selected welding machine.

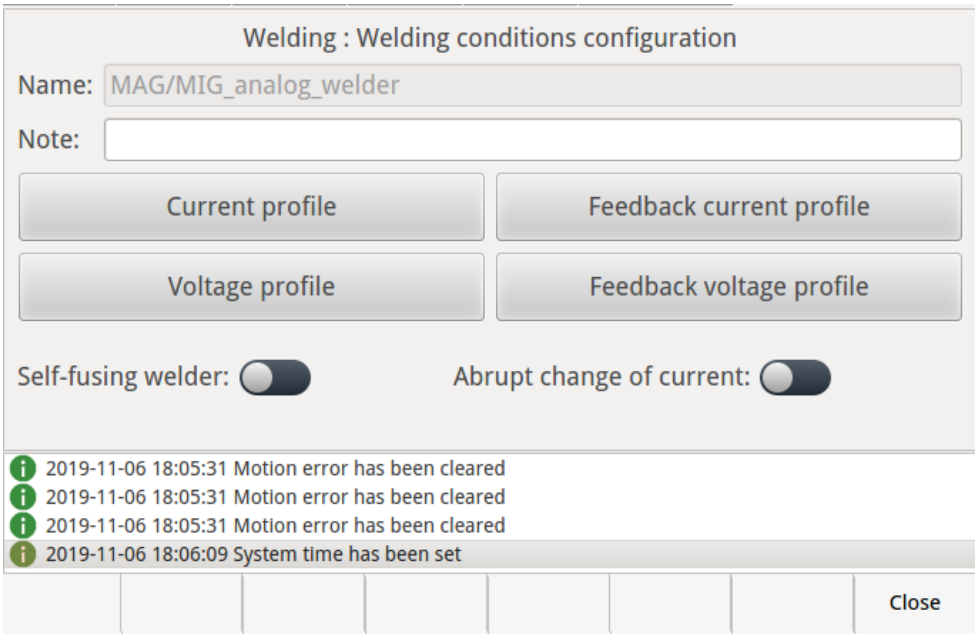
Setting current: setting current welding machine. When the current welding machine is selected, some parameter settings of the welding machine shall be sent before the welding start, or sent at the time of system startup, and the specific parameters sent in advance will be indicated in the setting options.

Click <welding machine modification> to pop up the following interface:

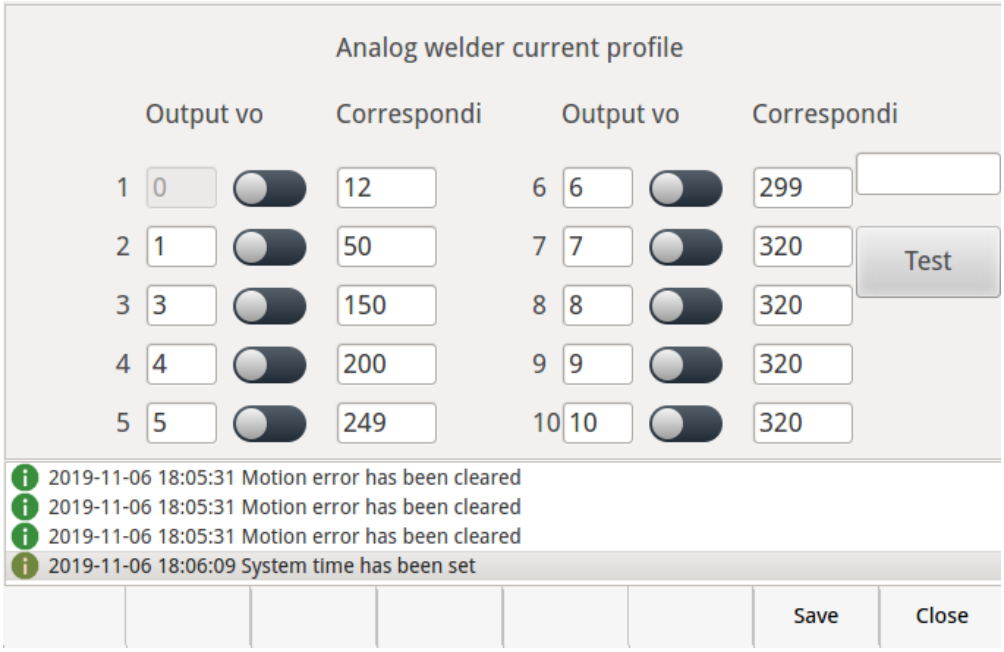


Click <Welding machine setting>,

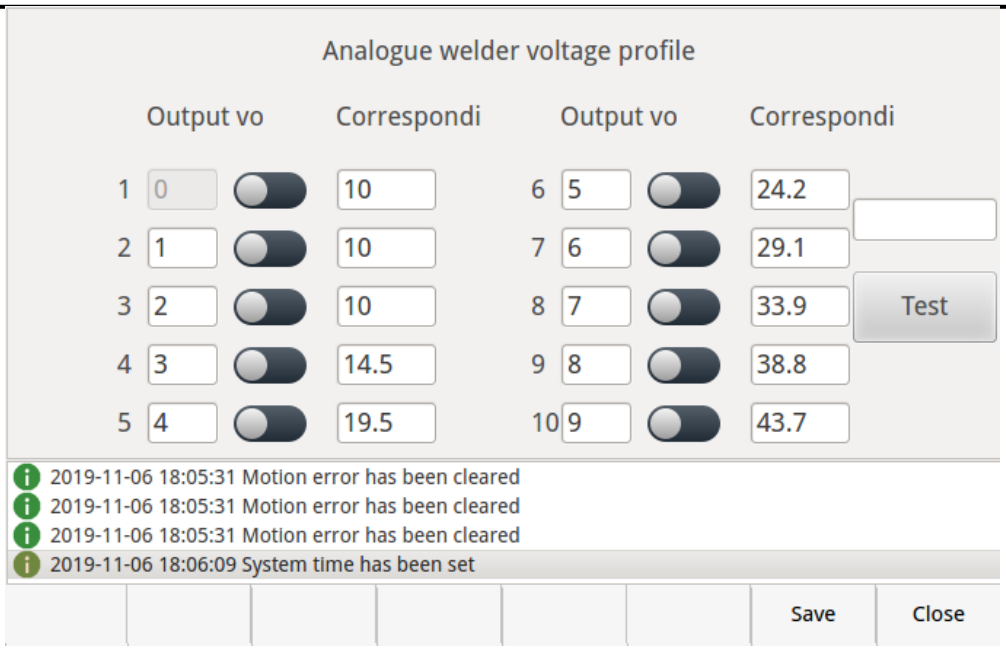
1. If the currently selected welding machine is MAG/MIG analog communication welding machine, the following interface shall display:



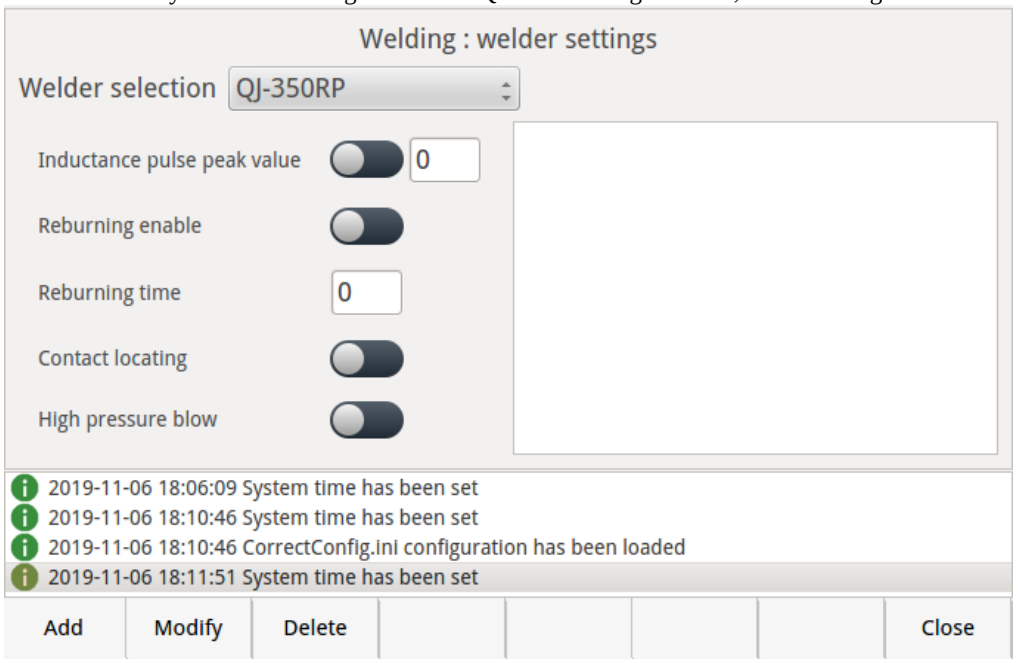
Click <Current Profile>, the interface is shown as follows



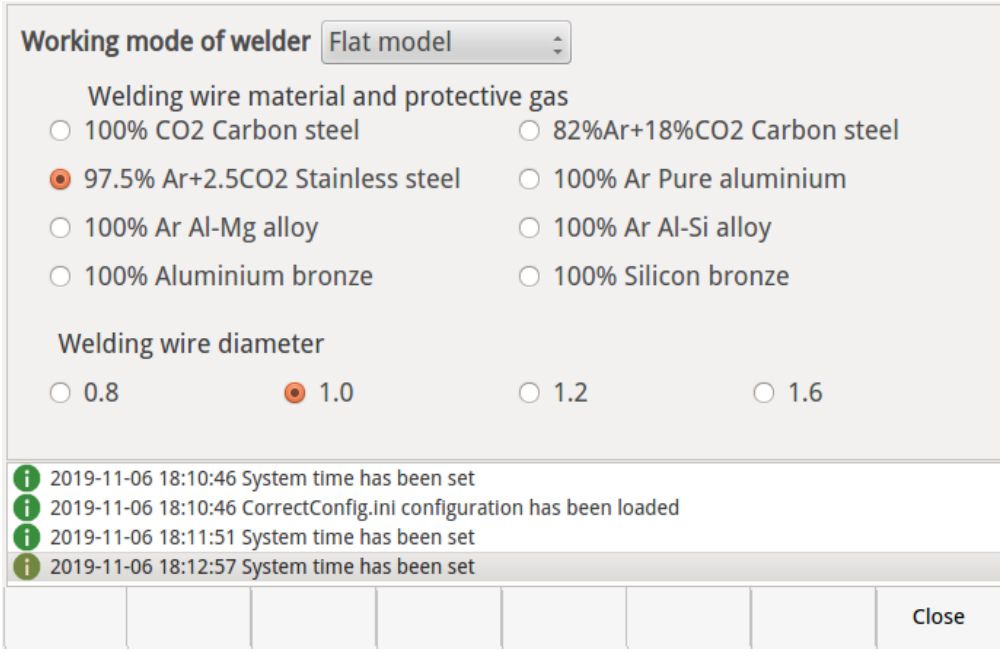
Click <Voltage Profile>, the interface is shown as follows



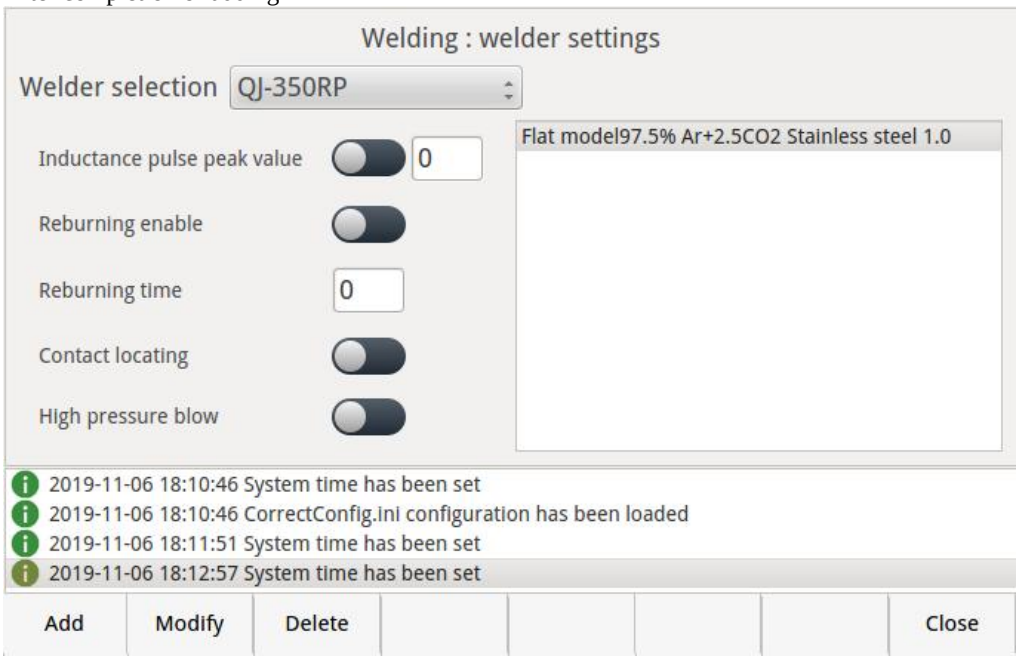
2. If the currently selected welding machine is QJ-350 welding machine, the following interface shall display:



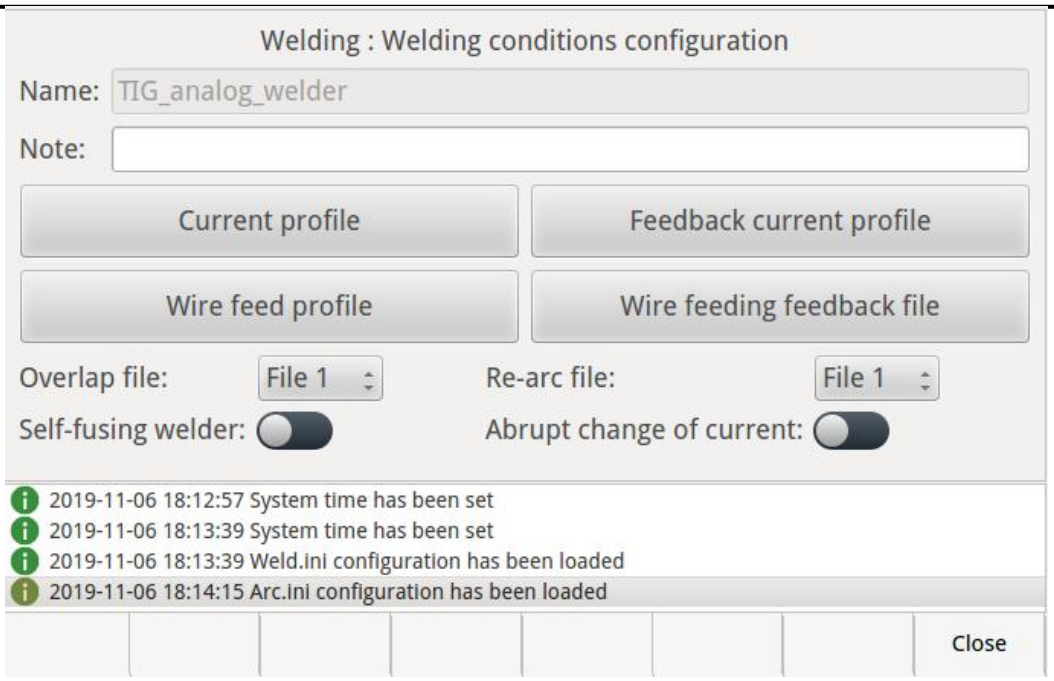
Click the <Add> button,



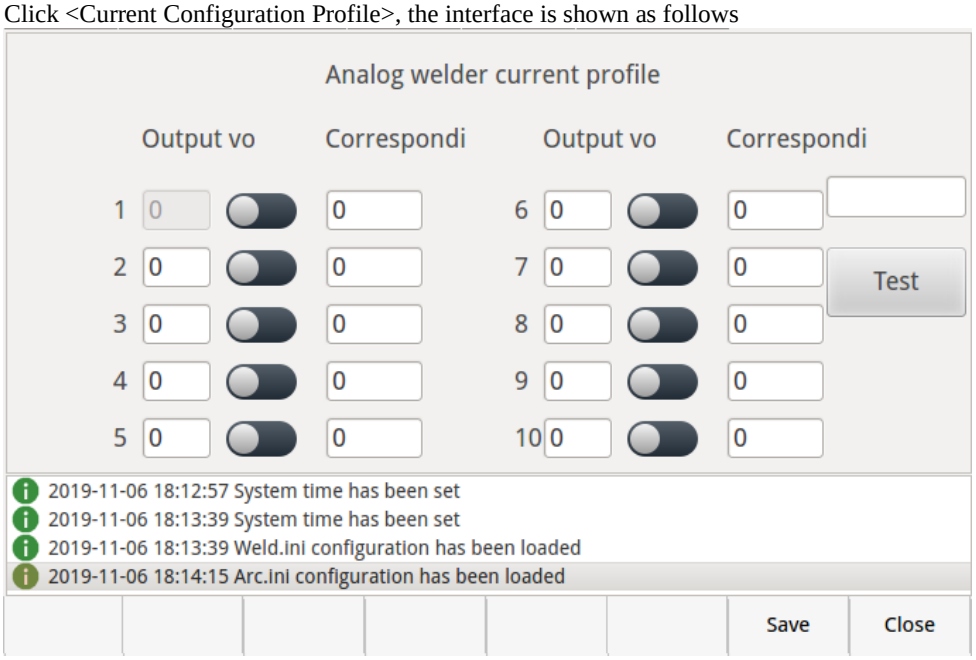
After completion of adding



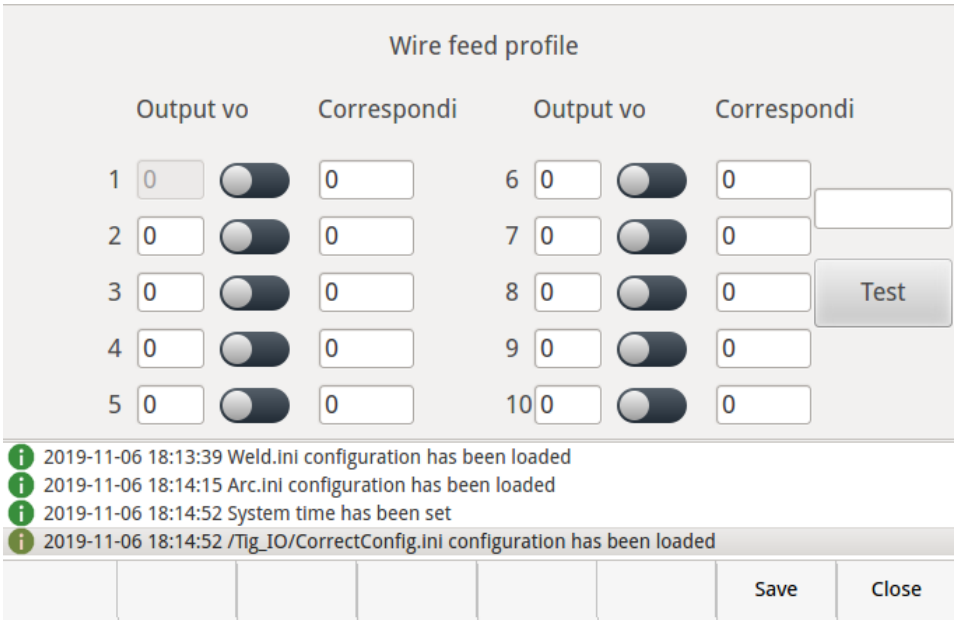
3. If the currently selected welding machine is TIG analog communication welding machine, the following interface shall display:



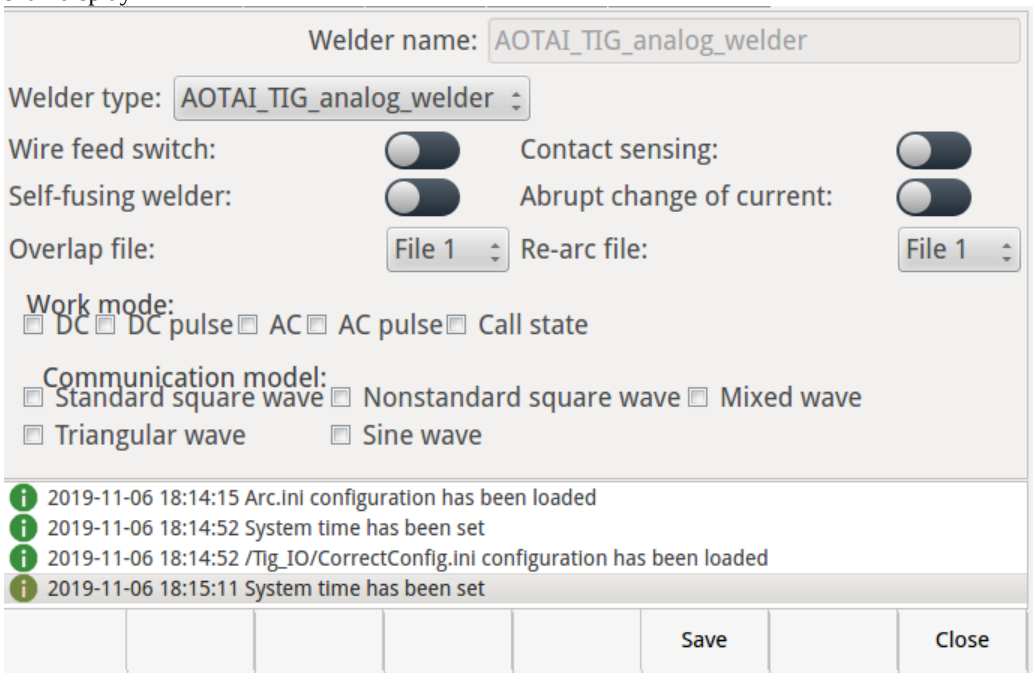
Click <Current Configuration Profile>, the interface is shown as follows

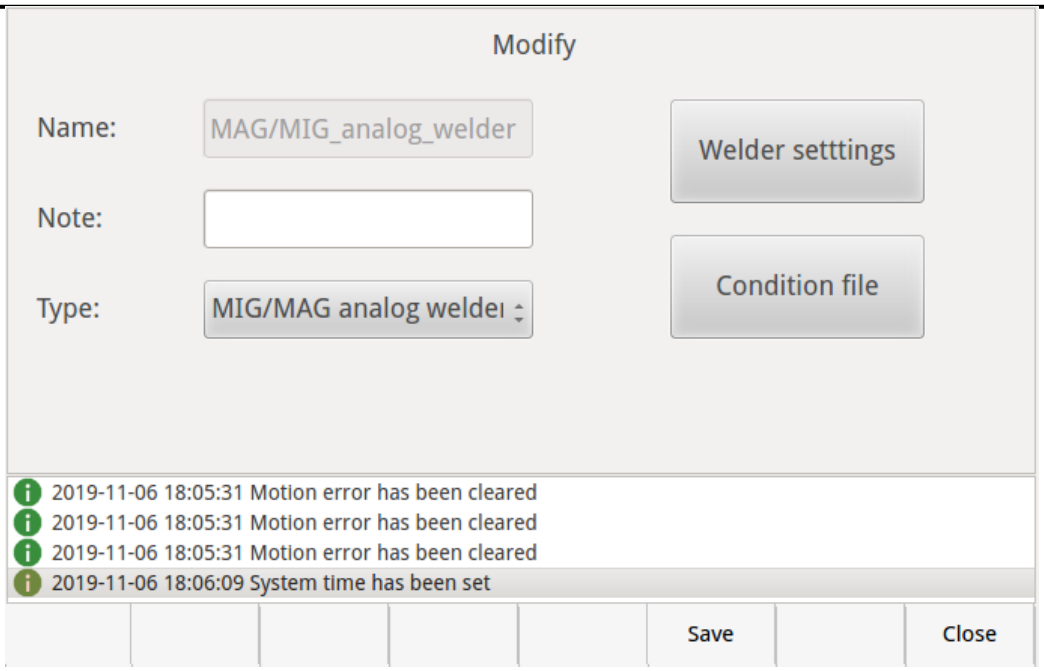


Click <Wire Feeding Profile>, the interface is shown as follows



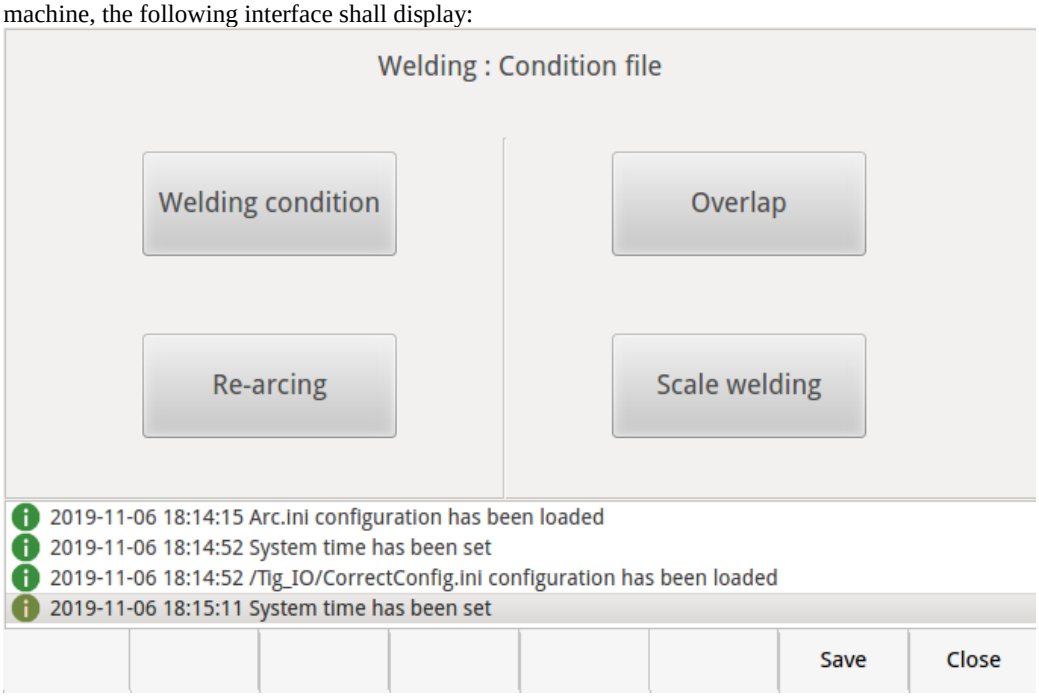
4. If the currently selected welding machine is AOTAI TIG digital communication welding machine, the following interface shall display



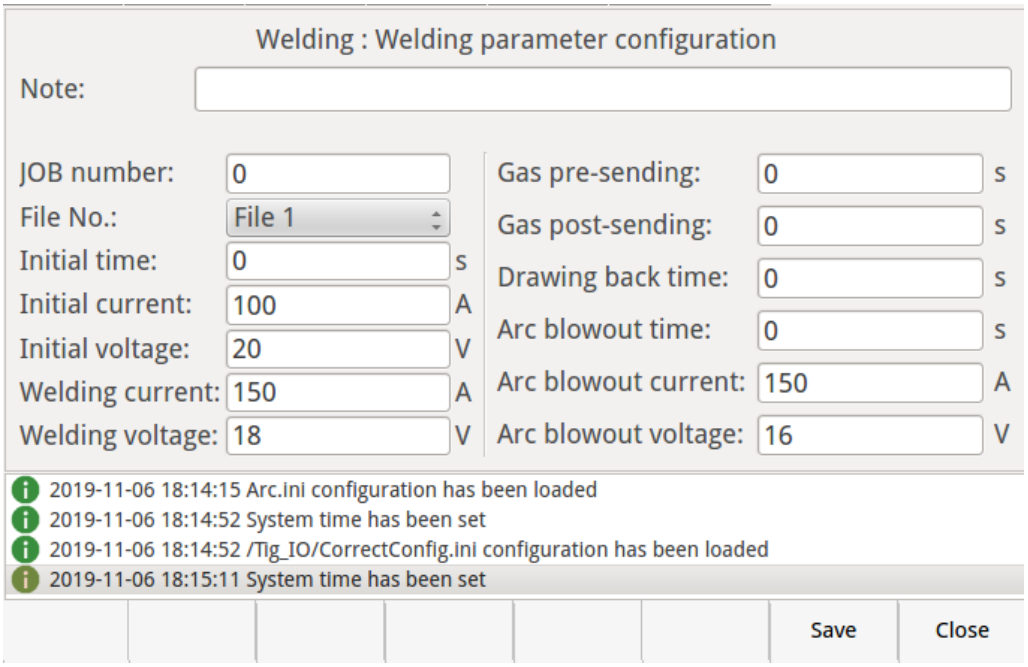


Click <Condition File> in the above interface

1. If the currently selected welding machine are MAG/MIG analog communication welding machine and QJ-350 welding machine, the following interface shall display:

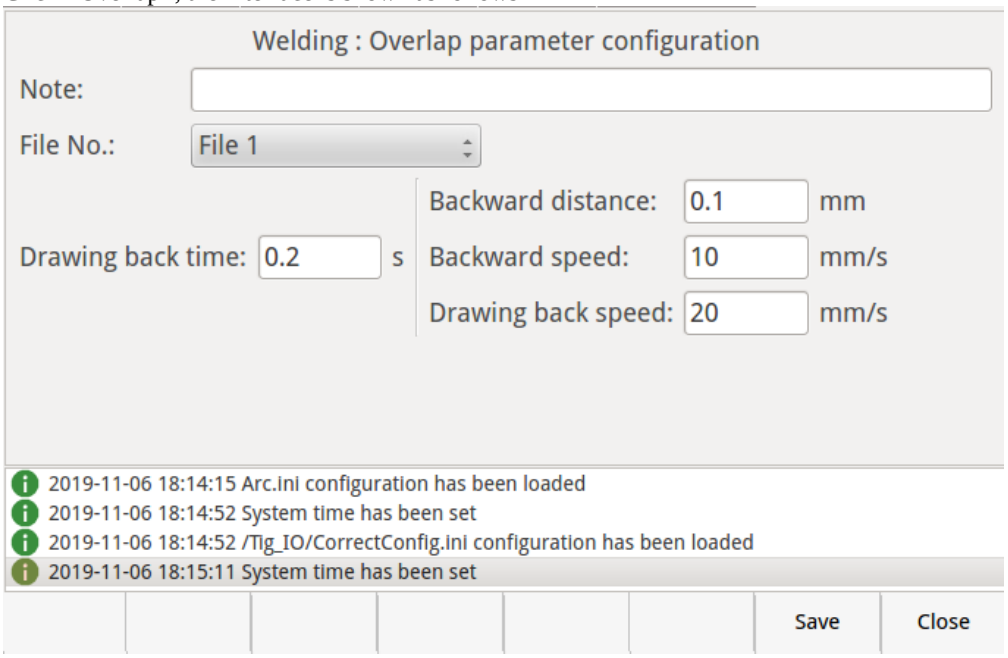


Click <Welding Condition>, the interface is shown as follows



Welding conditions: mainly used to call the welding function and organize parameters in file form, thus it is easy to manage and call. The file contains all the setup parameters required for normal start-up, including arc start, welding, and arc end parameters.

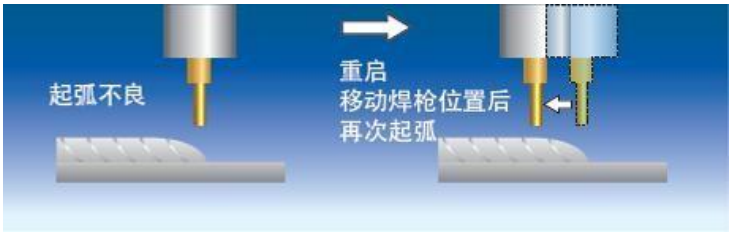
Click <Overlap>, the interface is shown as follows



Overlapping conditions

Overlapping functions and principles

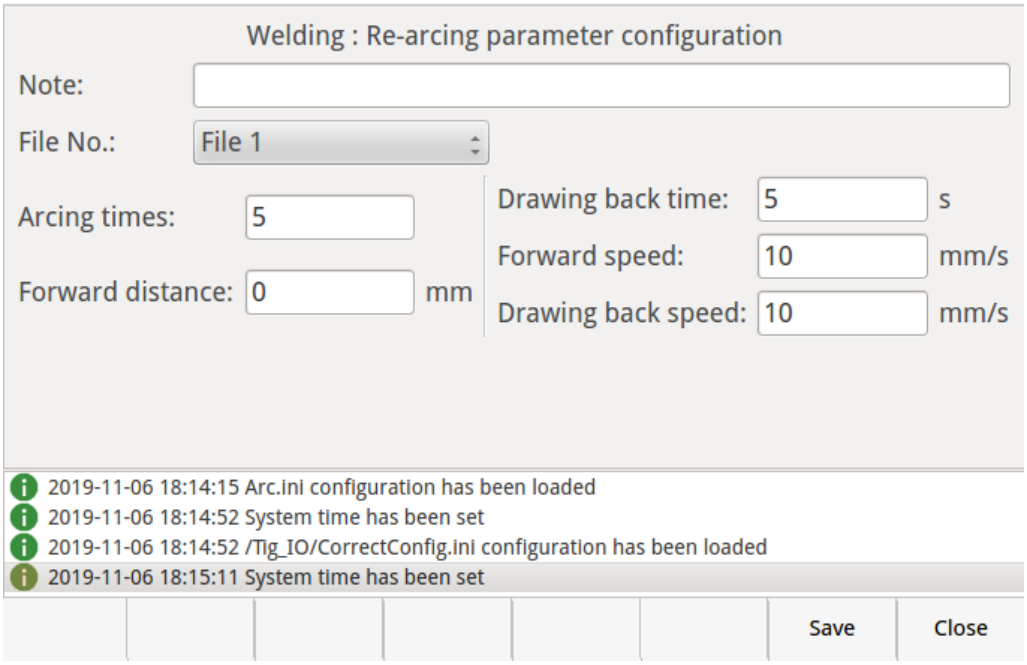
In the welding process, after the welding is interrupted due to some factors, when the interruption program is executed again (the interrupted position is the welding section program), the welding gun shall retreat a certain distance, restart the arc before the pause position, overlap the previous pass, and realize the weld transition.



The overlapping conditions are used to call the parameters after the overlapping function is unlocked and during overlapping.

Note: the welding conditions used for the lapping function are executed according to the welding conditions of the arc start command, and the welding speed is executed according to the original welding speed. After the welding is interrupted due to an unexpected state, when the program is operated at the interruption program again, the welding gun needs to return to the interruption point, and retreat a certain distance, the arc welding is started to complete the welding section.

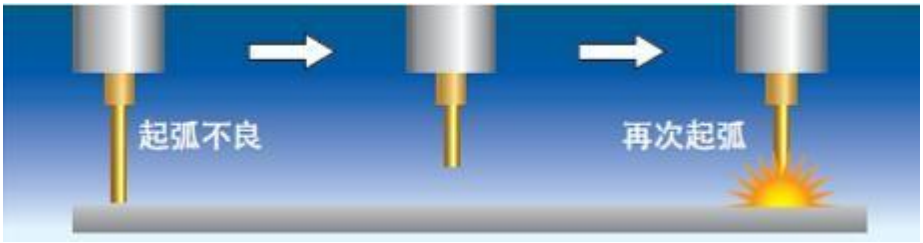
Click <Arc Restriking>, the interface is shown as follows



Arc restarting conditions

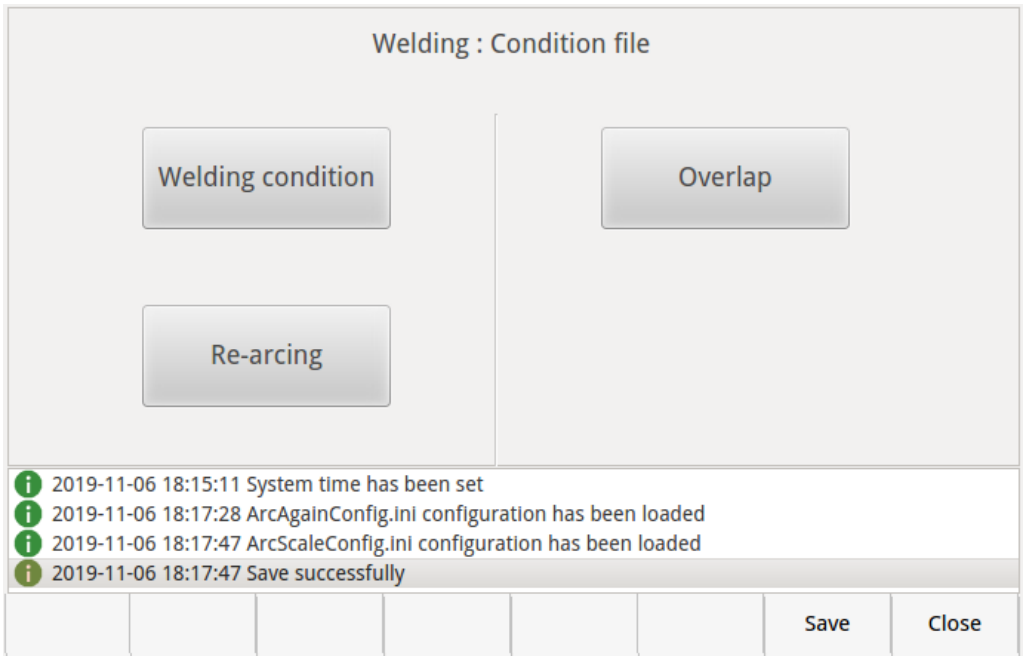
Arc restarting principles

When the robot fails to start the arc at the beginning stage of welding, the robot automatically translates a distance in the direction of the welding seam, re-starts the arc, and then returns to the arc starting point after the arc re-starts successfully.



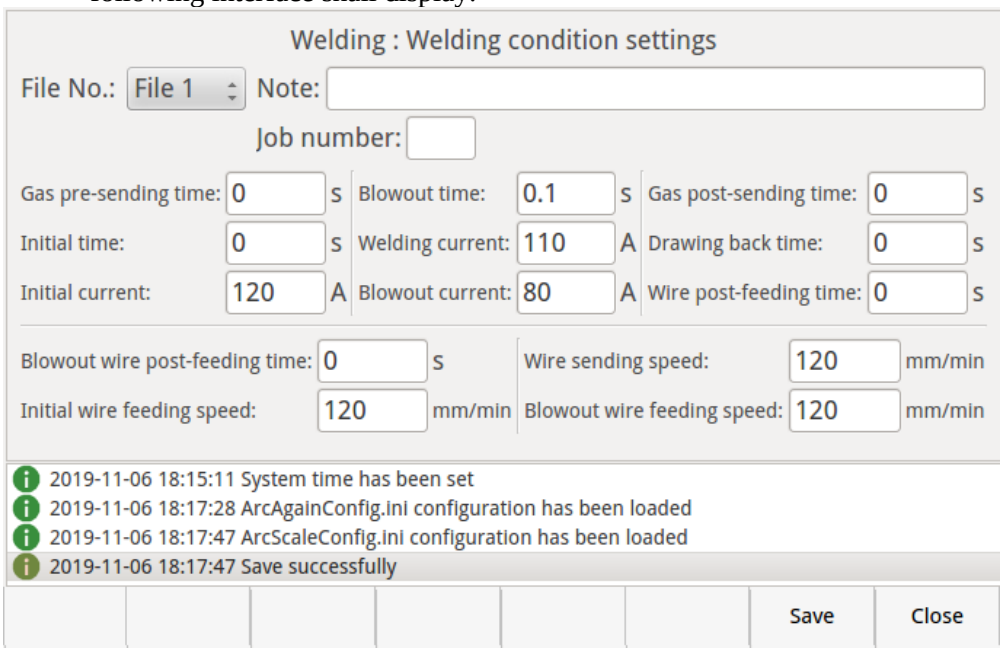
It is used to call the arc re-starting parameter after the arc re-starting function is unlocked.

2. If the currently selected welding machines are TIG analog communication welding machine and AOTAI TIG digital welding machine, the following interface shall display:



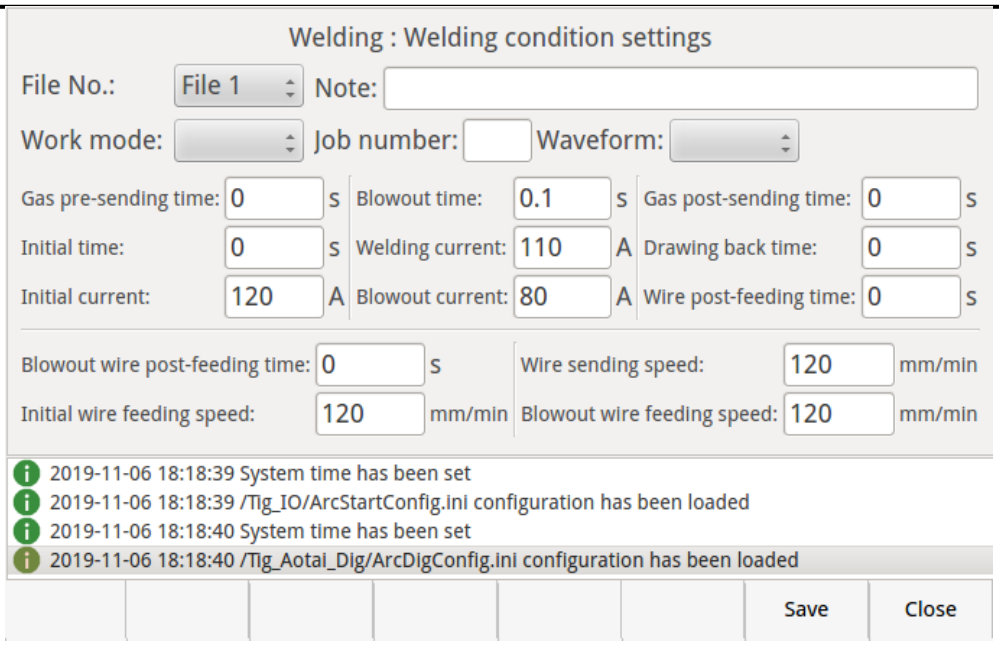
Click <Welding Condition>,

（1） If the currently selected welding machine is TIG analog communication welding machine, the following interface shall display:



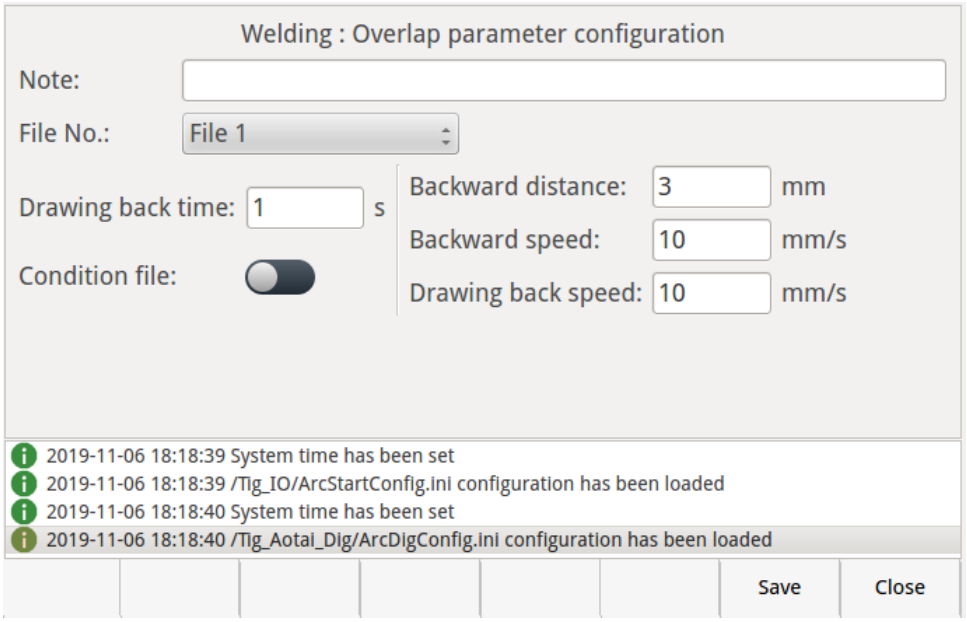
Welding conditions: mainly used to call the welding function and organize parameters in file form, thus it is easy to manage and call. The file contains all the setup parameters required for normal start-up, including arc start, welding, and arc end parameters.

（2） If the currently selected welding machine is AOTAI TIG digital communication welding machine, the following interface shall display：



Welding conditions: mainly used to call the welding function and organize parameters in file form, thus it is easy to manage and call. The file contains all the setup parameters required for normal start-up, including arc start, welding, and arc end parameters.

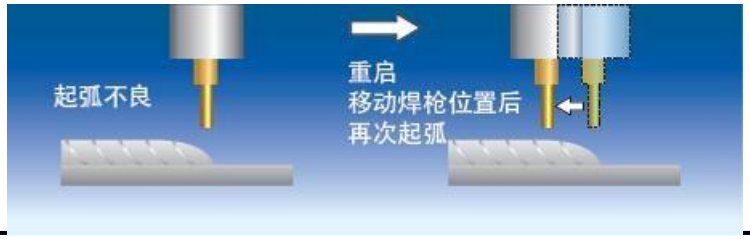
Click <Overlap>, the interface is shown as follows



Overlapping conditions

Overlapping functions and principles

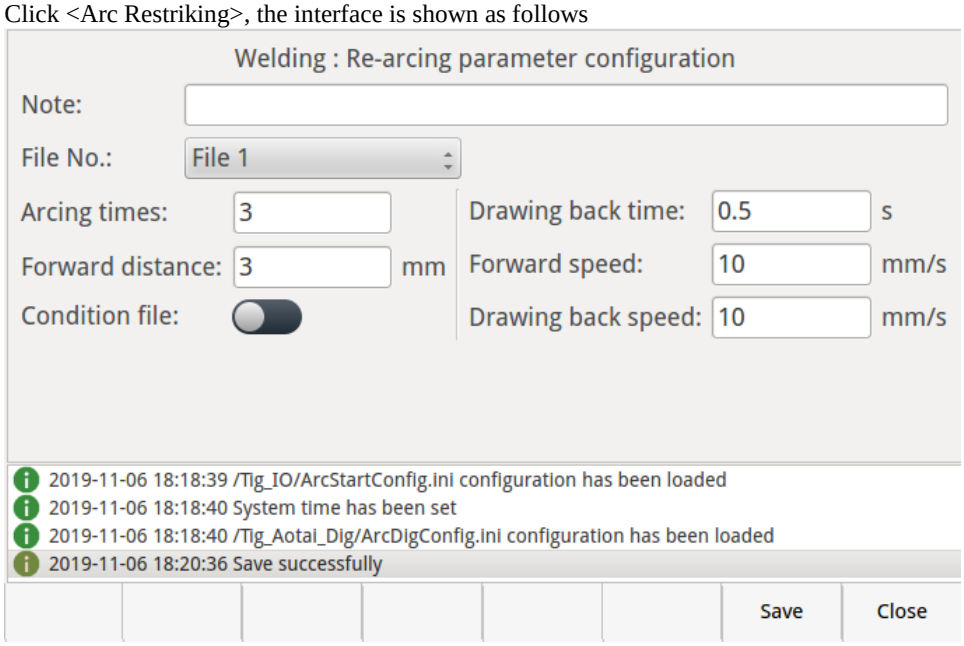
In the welding process, after the welding is interrupted due to some factors, when the interruption program is executed again (the interrupted position is the welding section program), the welding gun shall retreat a certain distance, restart the arc before the pause position, overlap the previous pass, and realize the weld transition.



The overlapping conditions are used to call the parameters after the overlapping function is unlocked and during overlapping.

Note: the welding conditions used for the lapping function are executed according to the welding conditions of the arc start command, and the welding speed is executed according to the original welding speed. In the welding process, after the welding is interrupted due to some unexpected factors, when the interruption program is executed again, the welding gun shall retreat a certain distance, restart the arc before the pause position, and complete the welding section.

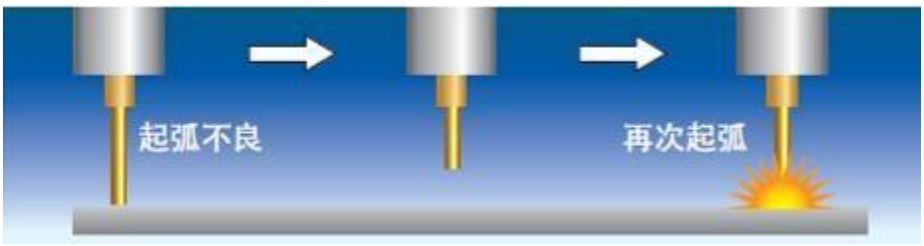
Click <Arc Restriking>, the interface is shown as follows



Arc restarting conditions

Arc restarting principles

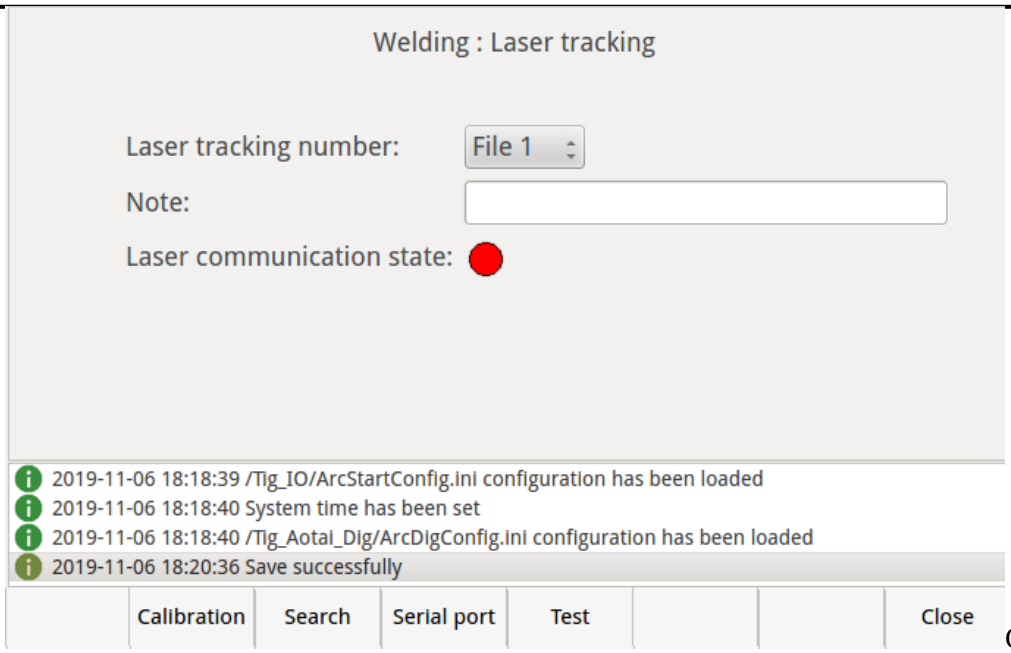
When the robot fails to start the arc at the beginning stage of welding, the robot automatically translates a distance in the direction of the welding seam, re-starts the arc, and then returns to the arc starting point after the arc re-starts successfully.



It is used to call the arc re-starting parameter after the arc re-starting function is unlocked.

1.3 **Laser tracking**

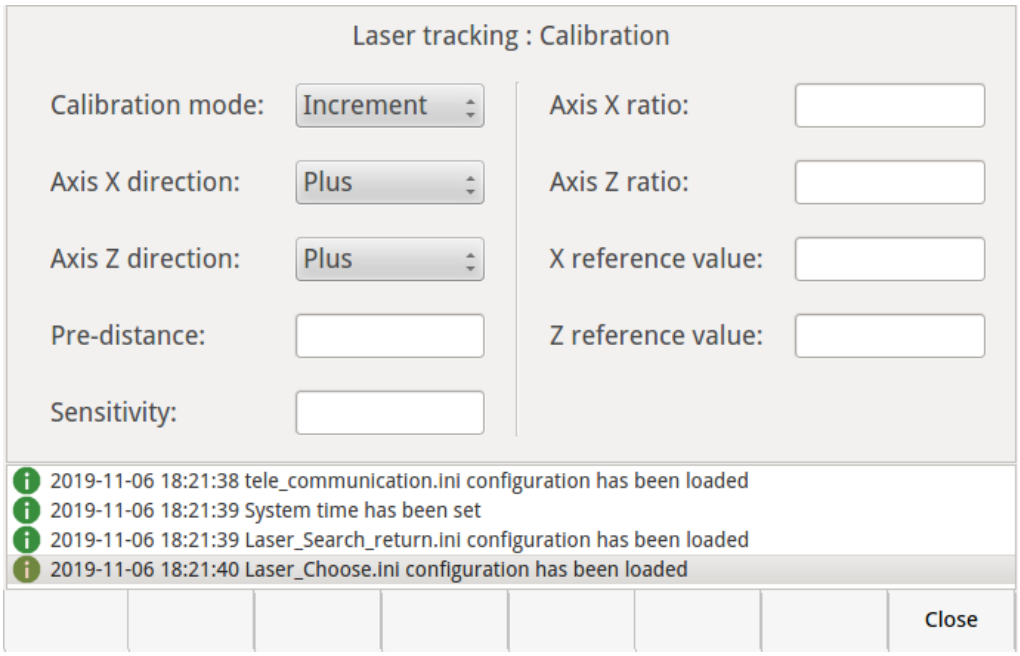
In the laser tracking process, the laser tracking sensor is used to send back the coordinates of the welding seam to the robot controller in real-time, and to guide the robot to track the welding seam when there is deviation in the left-right direction and the up-down direction.



Click the <Process Menu> - <Welding Process> - <Laser Tracking> to open the configuration interface of laser tracking parameters:

Laser tracking process number: the calling file number for laser tracking contains all laser tracking process parameters. Note: Describe the trace file to facilitate call by the operator.

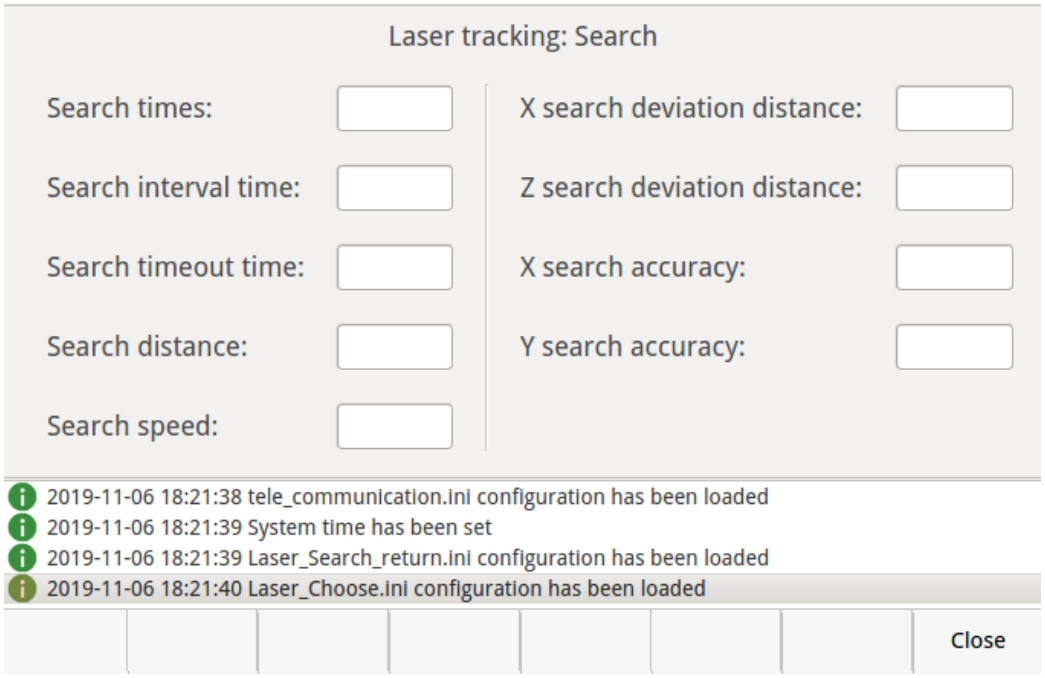
Click <Calibration Setting> in the sub-menu to open the following interface:



Calibration mode: currently, there is only one mode, namely, incremental mode.
X-axis direction: Forward, move to x-axis positive direction; reverse, move to x-axis negative direction.
Z-axis direction: Forward, move to z-axis positive
direction; reverse, move to z-axis negative direction.
Lead distance: Distance from laser line to welding wire
X-axis proportion: after multiplying the feedback value of the

laser tracker by the x-axis proportion to obtain the moving

distance, click <search setting> to open the following interface:

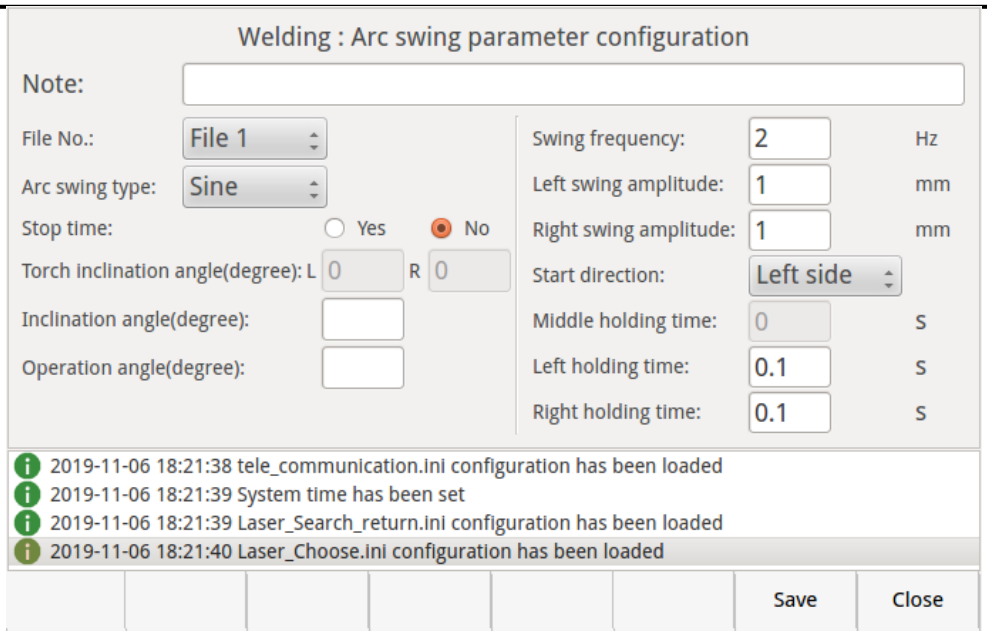


Search times: cumulative number of laser tracking and searching for weld seam Search interval: time interval for each weld seam searching Search timeout: it is determined that the searching exceeds the specified time Search distance: Set the searching distance
Search speed: the moving speed of the robot.
X search deviation distance: the value feedback by the laser tracker shall be compared with this value, in case the feedback value is smaller than the value, it indicates that the search is successful.
Z search deviation distance: the value feedback by the laser tracker shall be compared with this value, in case the feedback value is smaller than the value, it indicates that the search is successful.
X search accuracy: The laser feedback value is multiplied by this accuracy to obtain the moving distance of the robot.
Z search accuracy: The laser feedback value is multiplied by this accuracy to obtain the moving distance of the robot.

1.4 Arc swinging

Swing is a special function of arc welding. TIG and MAG swing have employed the same swinging method, thus it is no need to develop it separately. The conventional swing function is mainly realized by the robot system, and has nothing to do with the welding gun and welding machine (related to TCP).

Click the <Process Menu> - <Welding Process> - <Arc swinging> to open the configuration interface of arc swinging parameters:



File number: it contains all configuration parameters of the swinging arc, and is used to call the swinging arc parameters. Note: The parameters file of swinging arc is described, so as to be convenient for the operator to call.
Swing arc type: It can be set with four types: No swing, sin, trapezoid and Z-shape Initial direction: Left, right
Other parameters
Swing frequency, left side swing, right side swing, intermediate dwell time, left side dwell time, right side dwell time.

1.5 Arc tracking

Arc tracking is divided into two applications, the first is MIG/MAG current tracking, and the other is TIG voltage tracking.

MIG/MAG current tracking

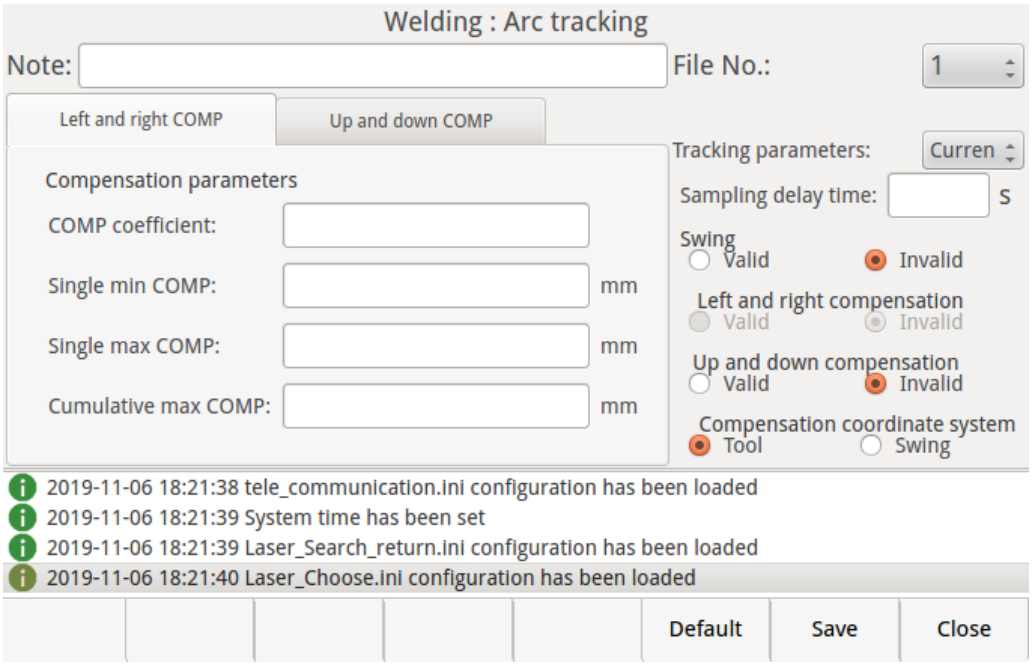
It is used for swing welding of fillet weld, plate V or U-groove weld.

Principle descriptions: MIG/MAG welding process adopts constant velocity wire feeding and power supply level characteristic (power supply external characteristic), namely constant voltage power supply. Therefore, when the welding current and voltage are set, the arc length (the distance from the end of the welding wire to the work-piece) changes for some reasons, and the arc length becomes longer. Due to the characteristics of the arc itself and the power supply, the voltage remains basically unchanged and the current becomes small. In case the arc length becomes short and the voltage is constant, the current will increase, so according to this principle, it can be determined whether the distance between the end of the welding wire and the work-piece becomes large or small, the robot system compensates accord to this given track, and finally keeps the arc length constant, realize the tracking of welding seam.

TIG voltage tracking

Principle descriptions: TIG is a kind of non-consumable gas shielded arc welding, the welding power supply adopts constant current characteristic, therefore, when the arc length (the distance from the tungsten terminal to the work-piece) changes for some reasons, the welding machine output current can be kept unchanged, but the voltage vary and the arc voltage is linearly proportional to the arc growth, the higher the voltage, the longer the arc. According to this principle, the change of arc length can be known according to the change of feedback arc voltage, and the original arc length can be recovered by real-time adjustment.
The setting interface of TIC arc tracking is same as the MIG/MAG, and the

main difference is that the current is changed to voltage. Click the <Process Menu> - <Welding Process> - <Arc Tracking> to open the configuration interface of arc tracking parameters:



File number: collect the arc tracking parameters, so as to conduct arc tracking and call the commands 1-10. Note: Describe the trace file to facilitate call by the operator.

Tracking parameter: current/voltage (matching with the welding machine, MIG/MAG welding machine only tracks current, TIG welding machine only tracks voltage). Swing: Yes/No (it is preferable to use SIN swing), and it shall be edited with the program. Current is default to Yes, and voltage is default to No.

Sampling time-delay: it refers to the time-delay after moving the welding gun and before starting the sampling, it includes the initial value sampling.

Left-right compensation: valid/invalid, select the effective direction of compensation, and provide valid/invalid selection only during yaw movement.

Up-down compensation: valid/invalid, select the effective direction of compensation (when swinging, basically no up-down compensation is performed, if the compensation is valid, the middle of the sampling position is valid).

Compensation coordinate system: select the coordinate system for tracking compensation.

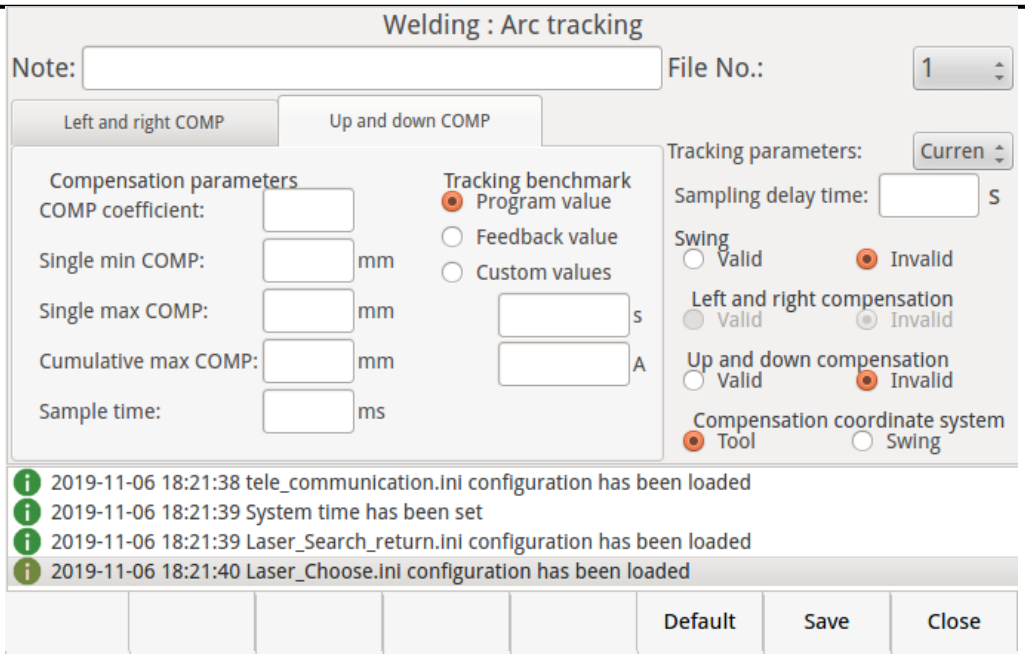
Left-right compensation coefficient: compensation coefficient in left-right direction.

Minimum compensation amount for left and right one time: If the compensation amount is less than this value, the compensation will not be performed, the range is from 0.0 to 99.99,and the default value is 0.0. Maximum compensation amount for left and right one time: maximum compensation amount of one time compensation.

Left-right accumulative maximum compensation amount: the accumulative maximum compensation amount in the left-right direction.

Up-down compensation parameter: compensation coefficient in up-down direction.

When the user clicks the up-down compensation parameter, the interface will be switched to the follow:



Up-down compensation coefficient: compensation coefficient in up-down direction. Minimum up-down compensation amount (one time): If the compensation amount is less than this value, the compensation will not be performed, the range is from 0.0 to 99.99,and the default value is 0.0mm. Up-down maximum compensation amount (one time): maximum compensation amount of one time. The range is from 0.0 to 999.99,and the default value is 1mm.

Up-down accumulative maximum compensation amount: the accumulative maximum compensation amount in the up-down direction. The range is from 0.0 to 999.99,and the default value is 600mm.
Sampling time: this item is valid only when the swing is invalid. If the swing is valid, the sampling period is equal to the swing period, that is 0.0 ~ 99.99S, and the default value is 0.5S. Tracking reference: program value/feedback /set value, select the reference of tracking, the program value is the welding parameter value in Arc Strat command, and the feedback value is the average value of sampling time of welding gun movement feedback value after welding starts. The set value is entered manually.

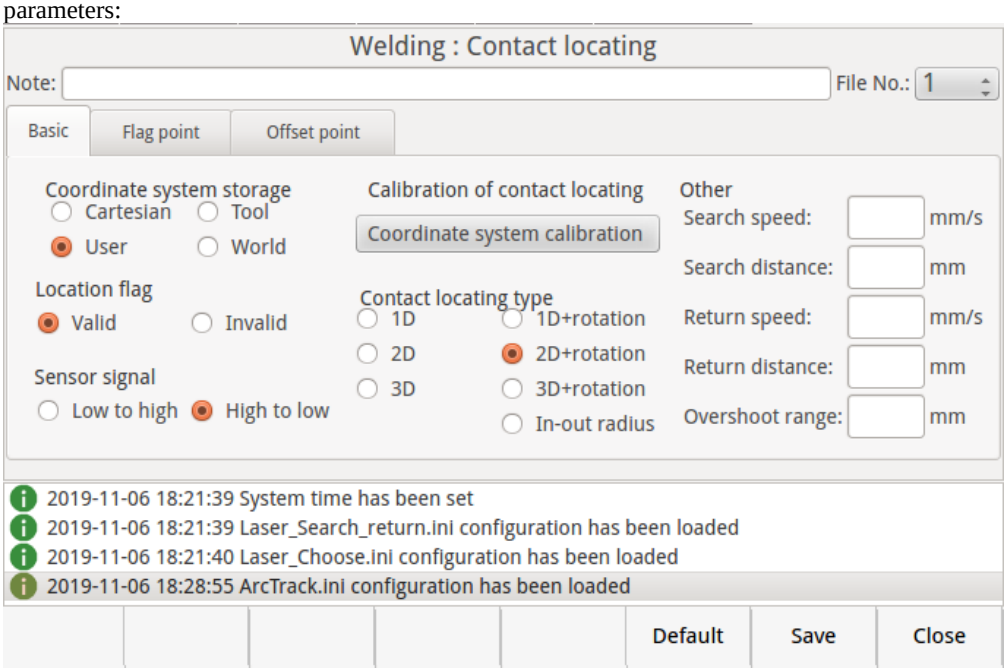
Sampling time of feedback value: the sampling time after the welding gun starts moving, the range is 0.00 ~ 9.99S, and the default value is 0.01s.

1.6 Touch offset

Touch offset function: a function that automatically changes the path of a robot to compensate for a positional deviation of a work-piece. Applied to the work-piece with the same size, but the fixture positioning of the work-piece is deviated.

To correctly use the touch offset function, the following settings are required:
1. Try to correctly set the robot TCP (accuracy meets the requirements of work-piece size).
2. Set the touch offset function to valid state. Set the touch offset IO (the digital communication bit of the welding machine).
3. Set the searched IO signal of touch offset function.

Click the <Process Menu> - <Welding Process> - <Touch Offset> to open the configuration interface of touch offset parameters:

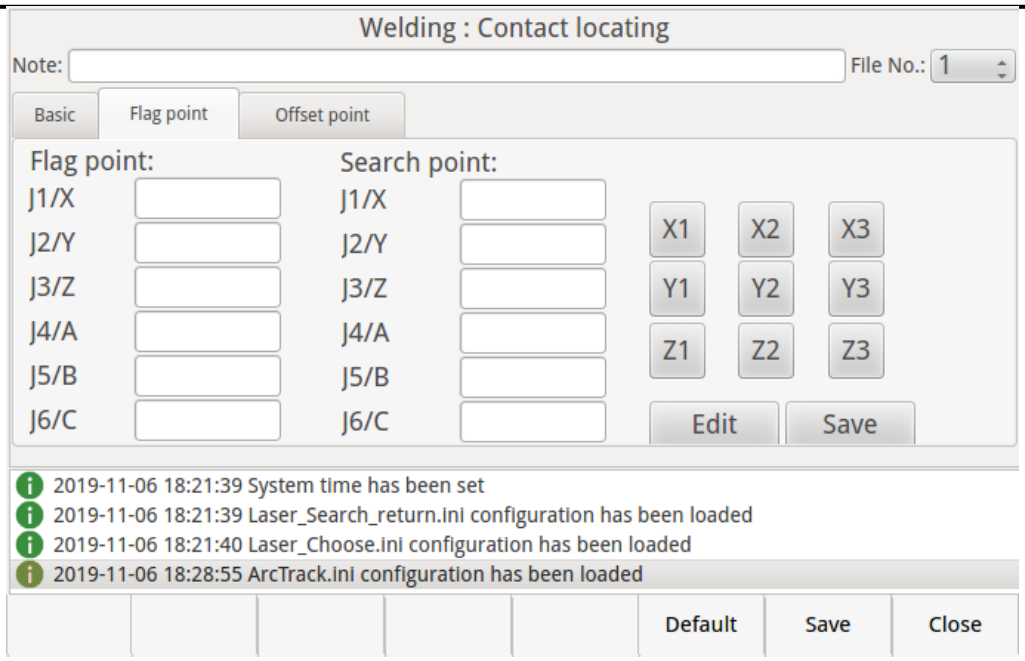


File number: Called file number for touch offset conditions, including all touch offset parameters.
Seek flag: When valid, it is used to determine the initial position of the work-piece. When invalid, it is used to conduct the touch offset operation. Sensor signal: Not added yet
Stored coordinate system: used to determine the search direction of touch offset.
Touch offset type: used to determine the dimensions and manner of search. 1D, 2D, and 3D are deviations of work-piece translation,1D + rotation, 2D + rotation, 3D + rotation, it is the deviation of work-piece translation + rotation.

Search speed: the moving speed of the welding gun during searching.
Search distance: if the search distance is exceeded, the system considers the position searching is failed.
Return speed: the speed at which the welding gun returns to the direction of the search starting point after the touch offset signal is valid. Return distance: the distance at which the welding gun returns to the starting point.
Beyond the deviation range: set the deviation range between the search point and the flag mark. If it is out of range, the system will prompt that the deviation of the work-piece is too large.

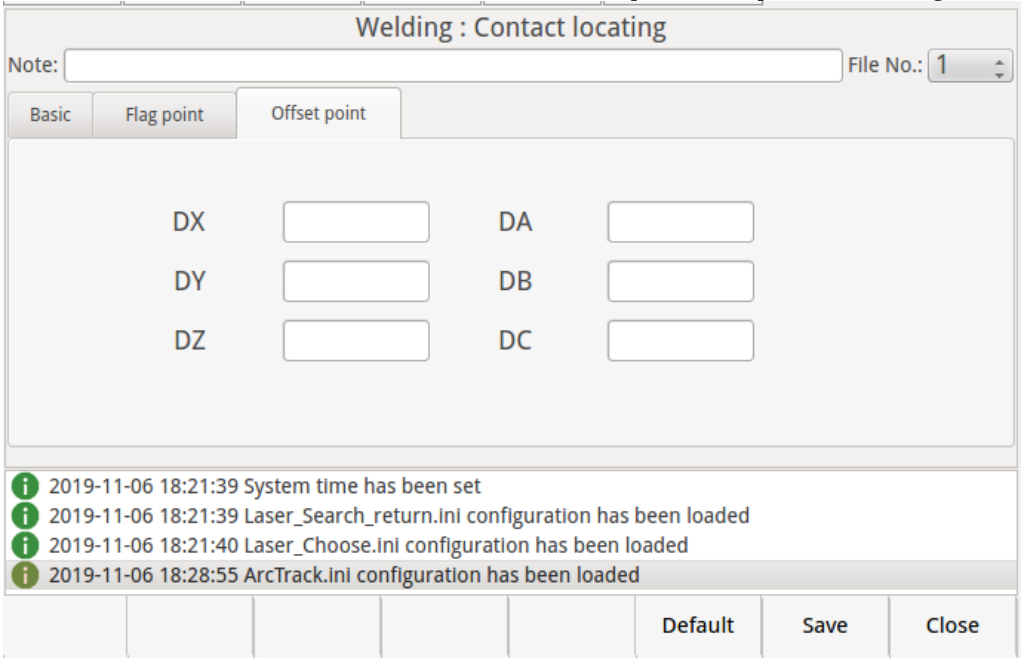
Default value: Set a group of default basic parameters Save: Save the setting value

Switch the sub-menu to information interface of flag position, and open the following interface:



Press X1: The flag points x, y, z, a, b, c of X1 and the searching points x, y, z, a, b, c are displayed. X2-Z3 adopts the same operation method to display the relevant information.
Edit: Click this button to manually edit the coordinate values of selected flag point and searching point Save: Used in conjunction with the Edit button to save manually modified values.

Switch the sub-menu to the information interface of offset point, and open the following interface:



Offset point information: DX, DY, DZ, DA, DB, DC Display the deviation value of flag point and searching point: x, y, z, a, b, c

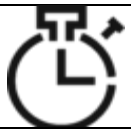
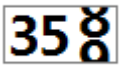
2 PLC

2.1 PLC function description

We have designed the software PLC function for the BOQIANG industrial robot controller system. According to the resources such as system programmable IO, timer and count, the IO of the management system can be processed by logic judgment, timer and count. Realize the detection and control of the input and output ports.

Indicators of PLC:
Editing method: Ladder diagram
Program capacity: 10000
Execution period: 1ms
Execution mode: cycling

Basic symbols for ladder diagrams

No.	Symbol name	Symbolic graphics	Descriptions:
1	Normally On contacts		Normally On contacts for each component (relay)
2	Normally Off contacts		Normally Off contacts for each component (relay)
3	Direct output coil		Coil of each element (relay)
4	Set output coil		Coil of each element (relay) (set and hold)
5	Reset output coil		Coil of each element (relay) (reset and hold)
6	Horizontal connection		Used to horizontally connect the contacts and coils of various elements
7	Vertical connection		Used to vertically connect the contacts and coils of various elements
8	Timer		Realize the system timing function.
9	Counter		Realize the system counting function.

2.2 Element detailed description

2.2.1 Normally On and Off contacts

When the relay is input, the system PLC receives the externally input switching signal. The signal is input in the circuit introducing system from external components such as button, conversion switch, limit switch, or digital switch. The PLC can be programmed with the normally On and normally Off contacts of the appliance and can be used for many times.

2.2.2 Output coil

An element in which the system PLC sends signals to external load when the coil is output.

2.2.3 Timer

For the time in this system, there are three working modes:

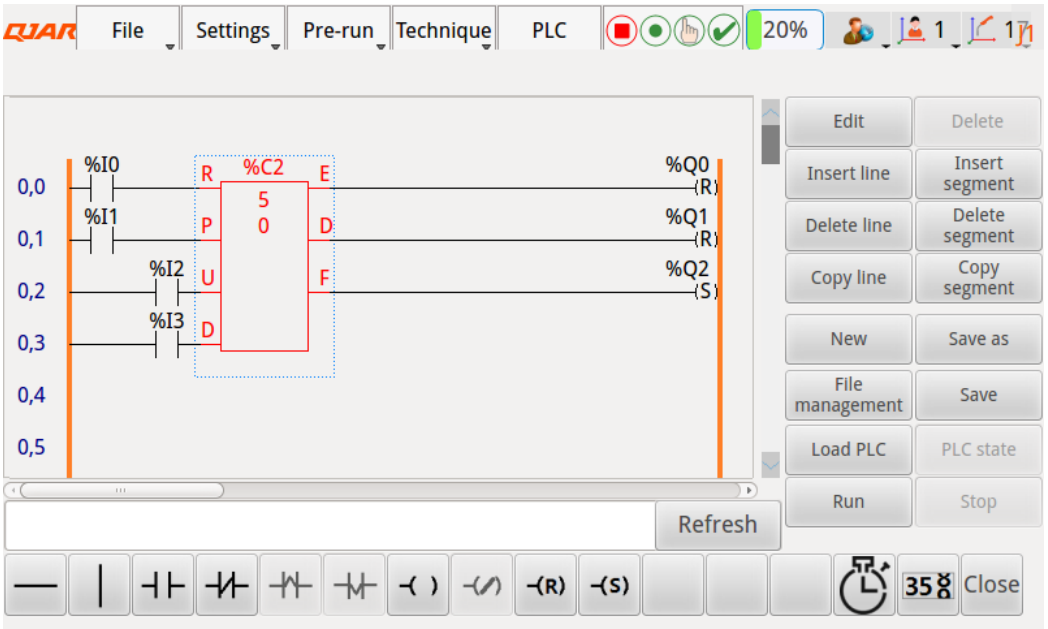
TON：When the input is invalid, the output immediately becomes invalid, and the count value becomes 0. When the input becomes valid, the output becomes valid after the set specified time, after which the output remains valid and the count value remains unchanged.

TOF：When the input is valid, the output immediately becomes valid, the count value becomes 0. When the input becomes invalid, after the set specified time, the output becomes invalid, and the count value becomes 0.

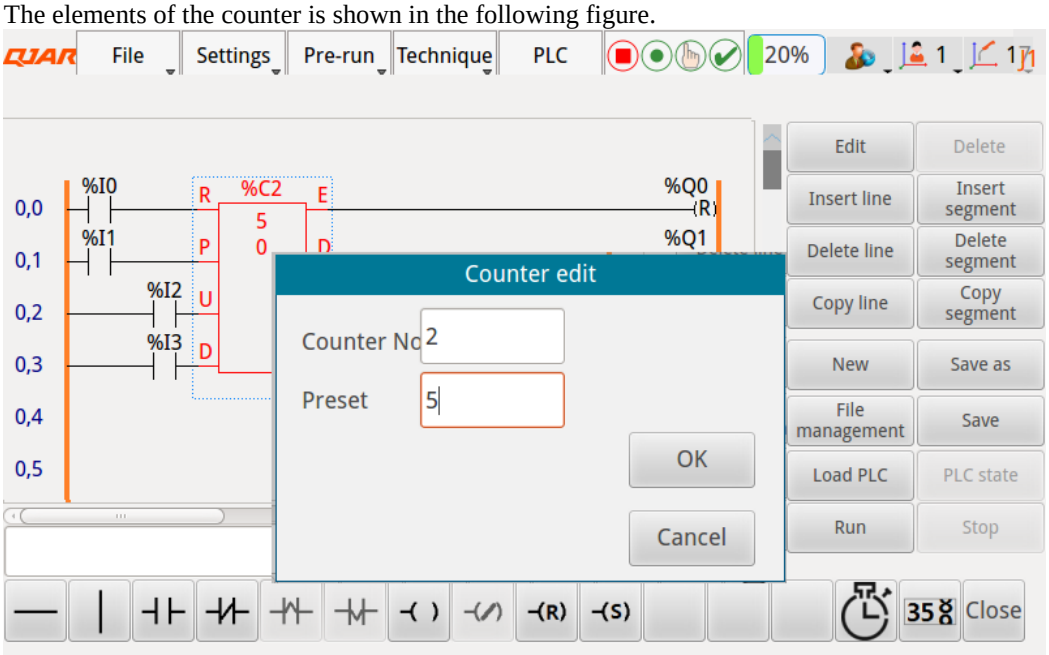
TP：When the input is invalid, the output immediately becomes invalid. When the input becomes valid, the output becomes valid immediately, and after the set specified time, the output becomes invalid again, and the count value becomes 0.

Timer number: 0-9

2.2.4 Counter



The elements of the counter is shown in the following figure.



This is the editing interface of the counter element.

Working Principle:

Signal R: Counter reset signal, all outputs E, D, F are invalid.

Signal P: The counter counts directly to the set count value signal, the D signal output is valid, and E and F are invalid. In this way, the signal is kept valid all the time, and the counter will be kept in the state of being recorded to the set value. The signals of zero clearing, addition and subtraction are invalid. Please pay special attention when using them.

Signal U: Plus signal of counter When this signal changes from valid to invalid, the current count value is incremented by one, and when the count reaches the set count value, the D signal output is valid, and E, F are invalid. When the count value reaches 9999, and count up is performed again, the count overflows, the count value becomes 0,
the E signal is valid and the D and F signals are invalid.

Signal D at the left of the element: minus signal of counter When this signal changes from valid to invalid, the current count value is decremented by one, and when the count reaches the set count value, the D signal output is valid, and E, F are invalid. When the count value is equal to 0, the minus signal is executed again, the count value underflowing to 9999. The E signal is valid and the E and D signals are invalid.

Signal E: Counter overflow signal.

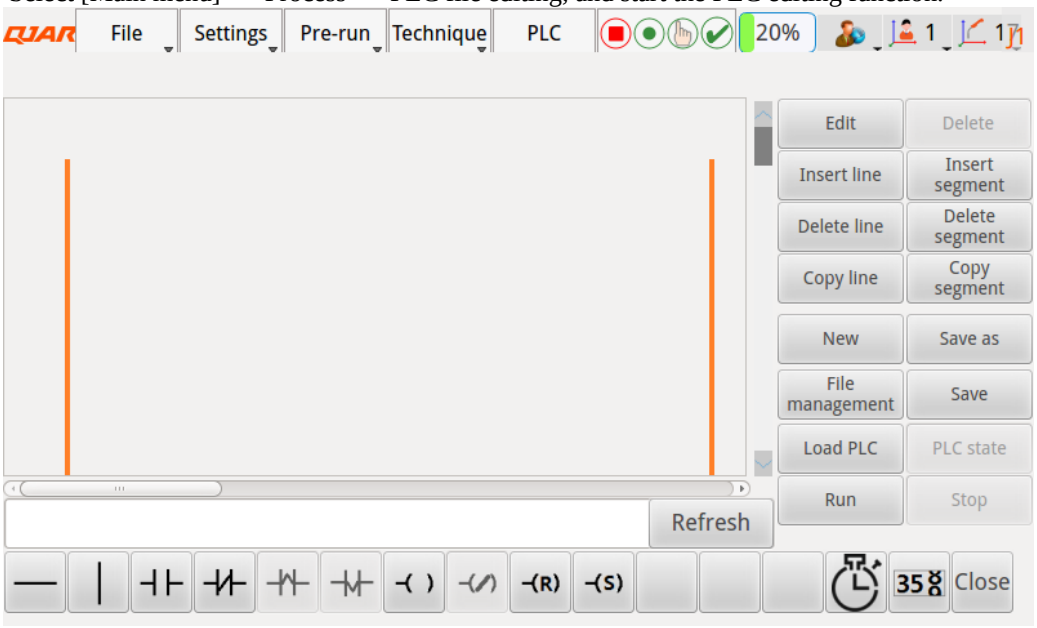
Signal D at the right of the element: no matter the count value is over or below the set value, this signal output is valid. Signal F: Counter underflow signal.

Counter number range: 0-9

Counter value range: 0-9999

2.3 Editing of PLC Ladder Diagram

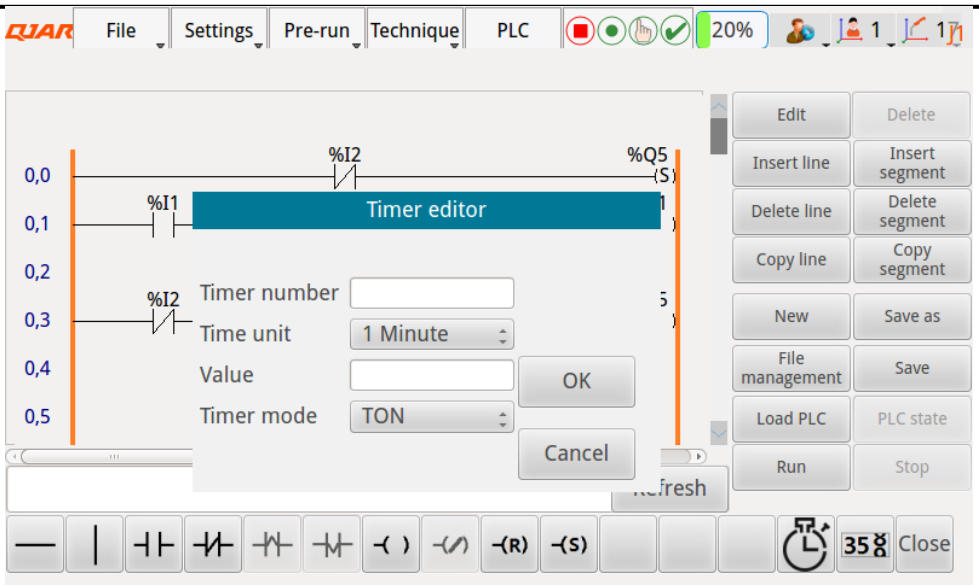
Select [Main menu] - > Process - > PLC file editing, and start the PLC editing function.



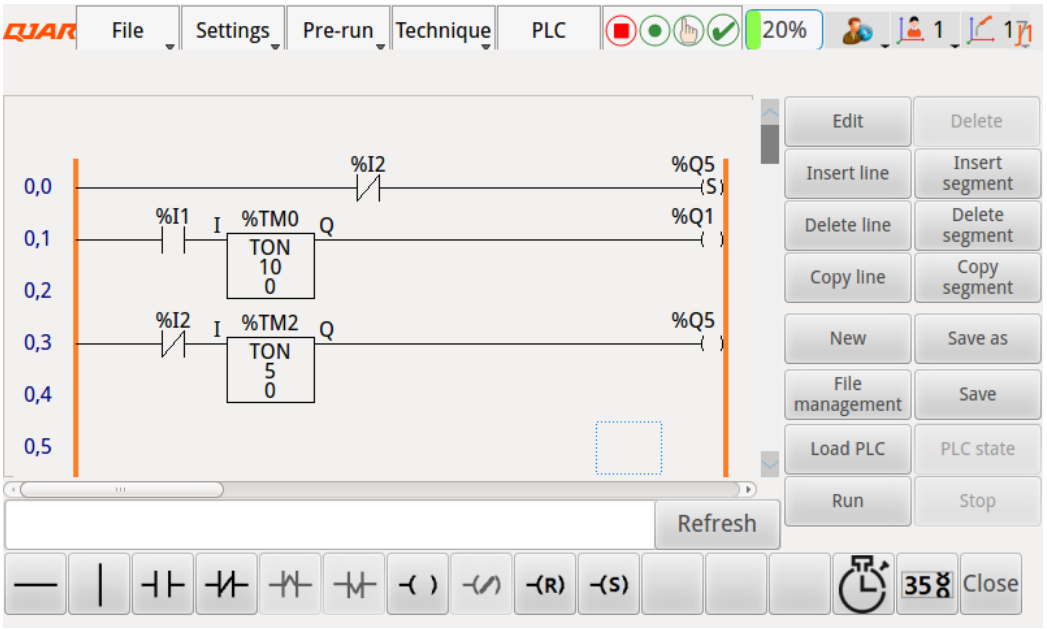
At the bottom of the screen are all the elements supported by the system. At the right side of the screen are editing and running functions.

2.3.1 New file

After the system starts, a new segment must be inserted before the component can be inserted. Click “Insert new segment”, click any position in the new segment, select the cell, and then select the element at the bottom of the screen to pop up a new element. As shown in the following figure:



The above illustration shows the insertion of a timer. Enter the timer number (1-10), time unit, initial count value and timing mode, and click OK. Other elements are inserted by the same method.



This is an example of an edited PLC file.

2.3.2 Element Edit

Select an element in the grid, click “Element Edit”, the editing interface of the element pops up, you can select to modify the element parameters, or you can modify the element type.

2.3.3 Element Delete

Select an element in the grid, click [Delete element], the operation confirmation dialog box will pop up, click [OK] to delete the element, click [Cancel] to cancel this operation.

2.3.4 Delete current segment

Select an element in the current segment, click [Delete segment], the operation confirmation dialog box will pop up, click [OK] to delete the segment, click [Cancel] to cancel this operation.

2.3.5 Reset current segment

Select an element in any grid of the current segment, click “Reset Segment”, the operation confirmation dialog box will pop up, click “OK” to delete all elements in the segment and keep the grid of the current segment, click Cancel to cancel this operation.

2.3.6 New Program

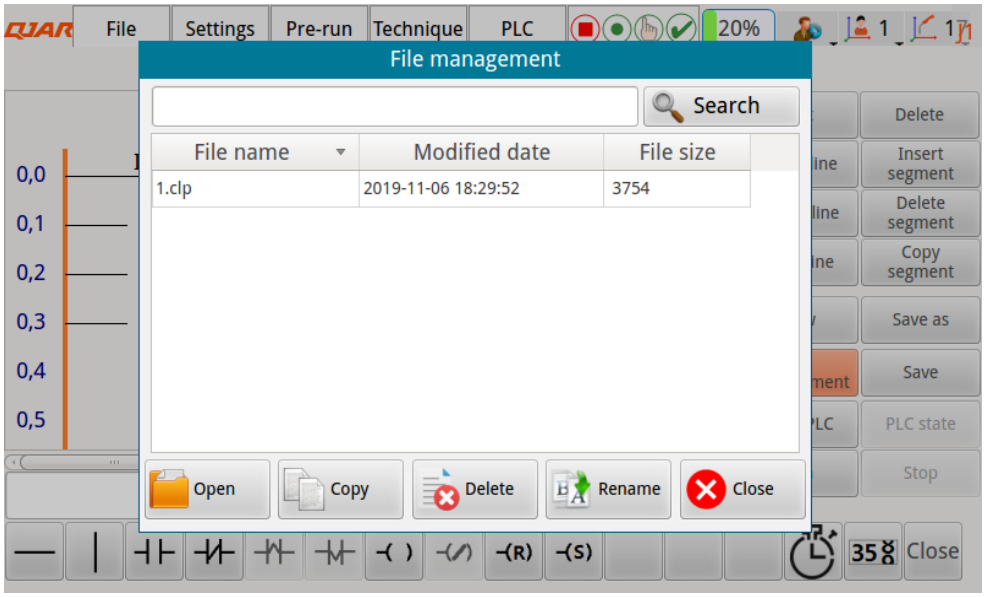
Click "New program" to pop up the operation confirmation dialog box, click "OK" to abandon all operations of the last saving of the current file, and create a new file. Click “Cancel” to cancel this operation.

2.3.7 [Saved as]

Save the current PLC file as another file. Click "Saved as" to pop up the new file name input window, enter the new file name and click "OK,", the operation is completed successfully. Click “Cancel” to cancel this operation.

2.3.8 [File management]

Click “File Management”, and the following file management dialog box will pop up.



By employing this button, you can complete such operations as open file, copy file, delete file, rename the selected file, etc.

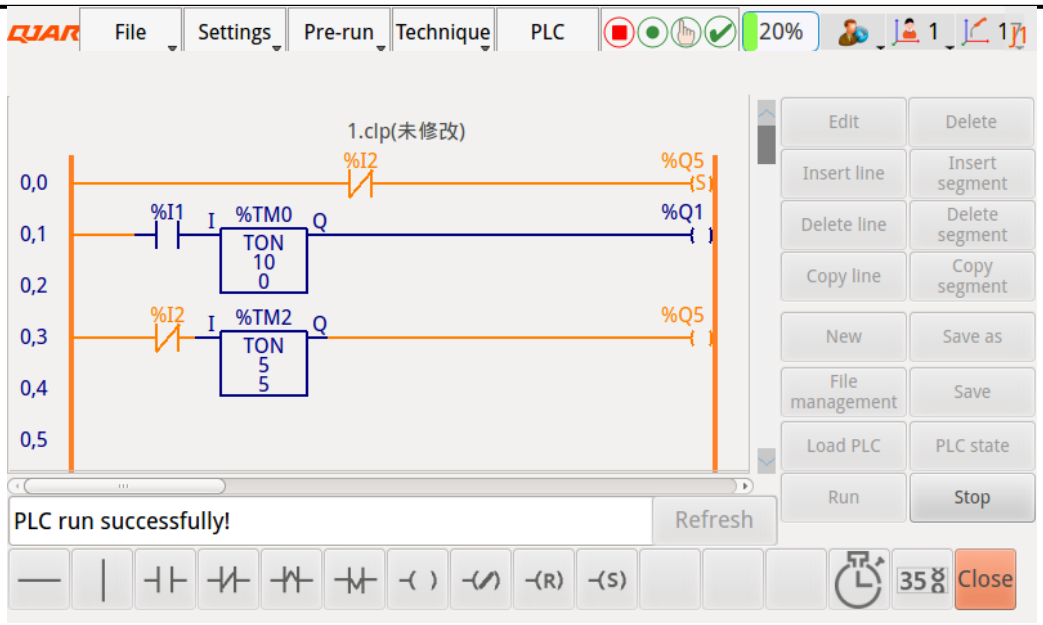
2.3.9 Save file

Perform a save operation to the file that is currently being edited.

2.4 Operation of PLC file

Remember, before running the PLC program, make sure to save the current file, otherwise the PLC file in the system may be inconsistent with the document being edited, and the output result is not expected. Operation Steps:

1. First, click “Save” to save the file.
2. Click “Add” to add a new file.
3. Click “Run” to operate the programs in the file. As shown in the following figure:



The orange element indicates that the element is in the valid state and the blue element indicates that the element is in the invalid state. No matter the timer and counter are invalid or invalid state, the corresponding color is blue.

Click “Stop” to return to the edit mode. The system will refresh according to the real-time state of the element.

3 Background program

3.1 Function descriptions **of background program**

We have designed the background program function for this system. According to the programmable I/O, timer and other resources of the system, all I/O interfaces of the system can be managed, as well as conduct the logic judgment, counting, etc. Thus the detection of the input port and the control of the output port, as well as the data exchange with the system core are realized.

Note: The execution mode of background program is cycle execution.

3.2 Preparations

3.2.1 Operation program editing

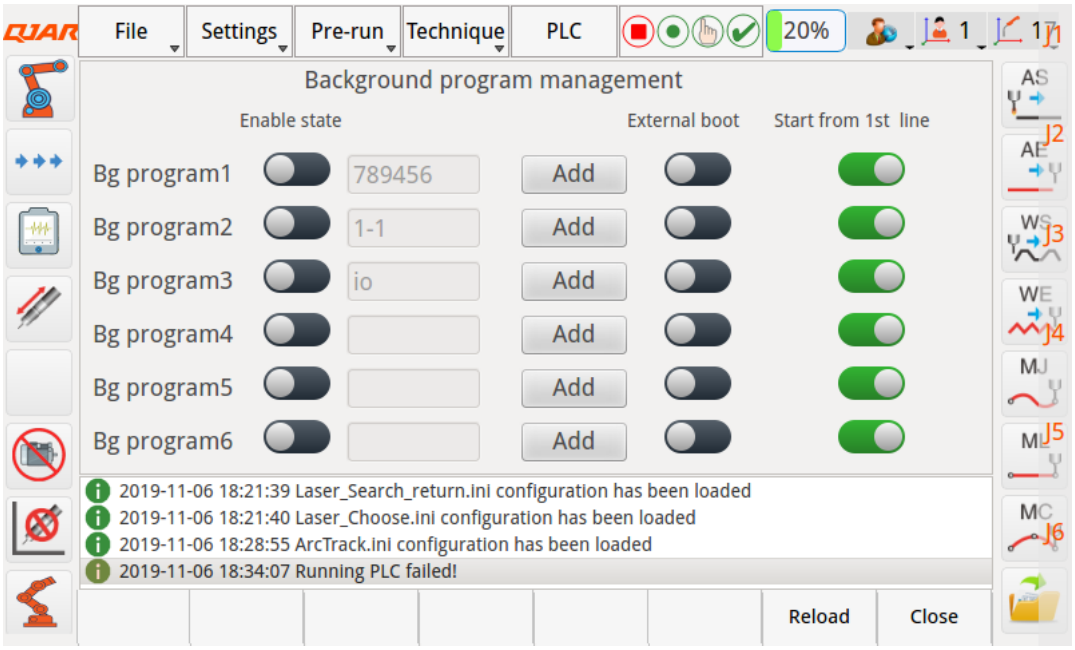
It is necessary to open the background program list file in the TEACH mode, edit the working program in the opened program editing interface, and test the correctness of the program in the PLAY mode.

Note: The background program does not allow to input the motion commands.

3.2.2 Call the program

3.2.2.1 Set the reservation working program

Click the <Process Menu> - <Background Program Management> to open the following interface.



In the above interface, click the <Add> button, which is located behind the [program name] of each background program, and the program list pops up. Then select the program name corresponding to the program number. For example, the program name iotest is corresponding to background program 1 in the figure above. After the program is added, if you want to realize the background execution function, please perform the enable operation at first. When the enable state is , the background execution function is turned on; when the enable state is , the background execution function is turned off. The user can set the starting mode and starting position of background files.

Descriptions: 1. The not enabled background program may not enter the program name. The enabled background program must enter the program name.

2. When a background program does not need to work, the reservation of the station can be closed.

4 Remote/Reservation

Please refer to the Chapter 3 PLAY & REMOTE for the detailed information of remote process.

Chapter 5 Monitoring

Monitoring function is mainly used to observe the robot, as well as check the current working status and data. The system can monitor the following items: coordinate, time, running speed, motor, IO port, software status, reservation status, system log.

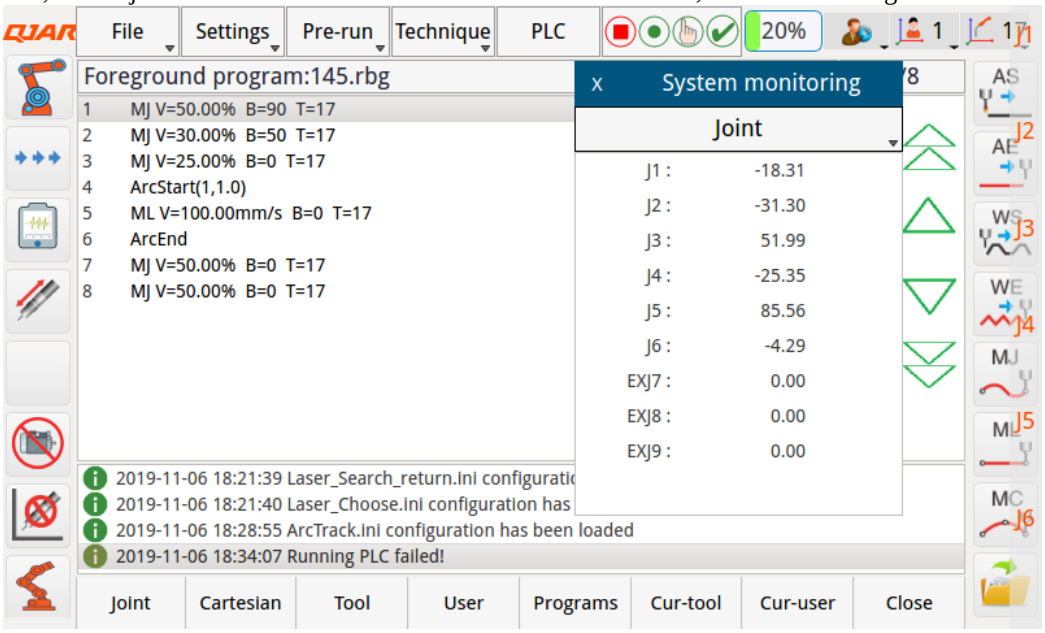
When the monitoring button is clicked, the monitoring window is displayed in the general display area. All contents related to the monitoring are described in detail below.

1 Coordinate

The monitoring coordinates are mainly used for monitoring coordinate data, the specific monitoring data are: joint coordinates, rectangular coordinates, tool coordinates, user coordinates, program point coordinates, current tool and current user.

1.1 Joint coordinates

Click <monitoring> - <coordinate> - <joint coordinates>, or open it on another coordinate monitoring interface, click <joint coordinates> in the sub-menu area of the screen, and the following interface will pop up.



Below [joint coordinates] in the monitoring area

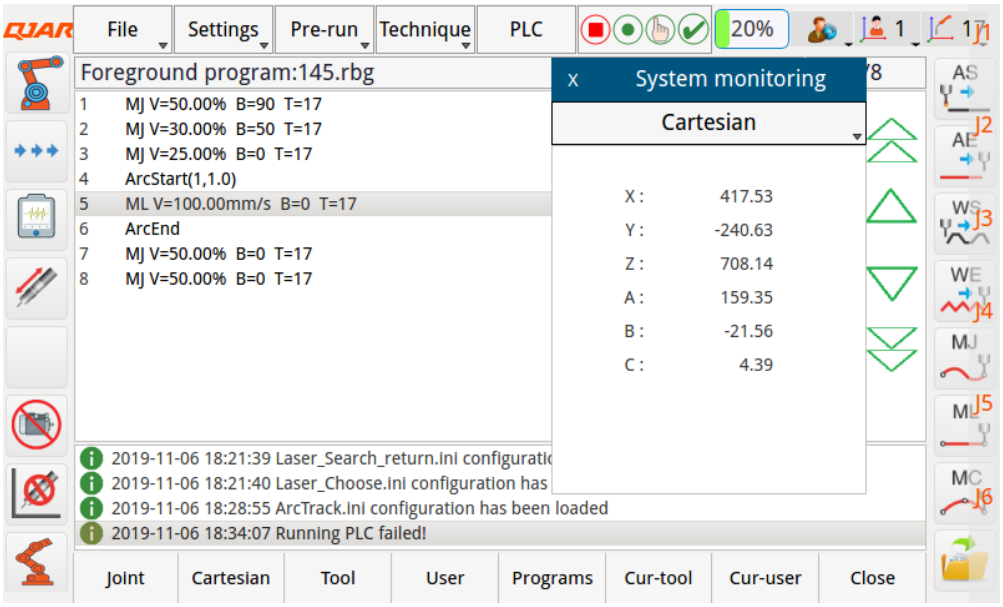
Data subsequent to the J1-J6 lines are angle data corresponding to the axes. Unit: degree（°） EXJ7-EXJ9 lines are the angle data of additional axis. Unit: degree（°）

When setting the soft limit, the reference data is the joint coordinate.

When the monitoring area is in focus state, click the <Close> button in the sub-menu area to exit the monitoring window.

1.2 Rectangular coordinates

Click <monitoring> - <coordinate> - <rectangular coordinates>, or open it on another coordinate monitoring interface, click <joint coordinates> in the sub-menu area of the screen, and the following interface will pop up.



Below [joint coordinates] in the monitoring area：

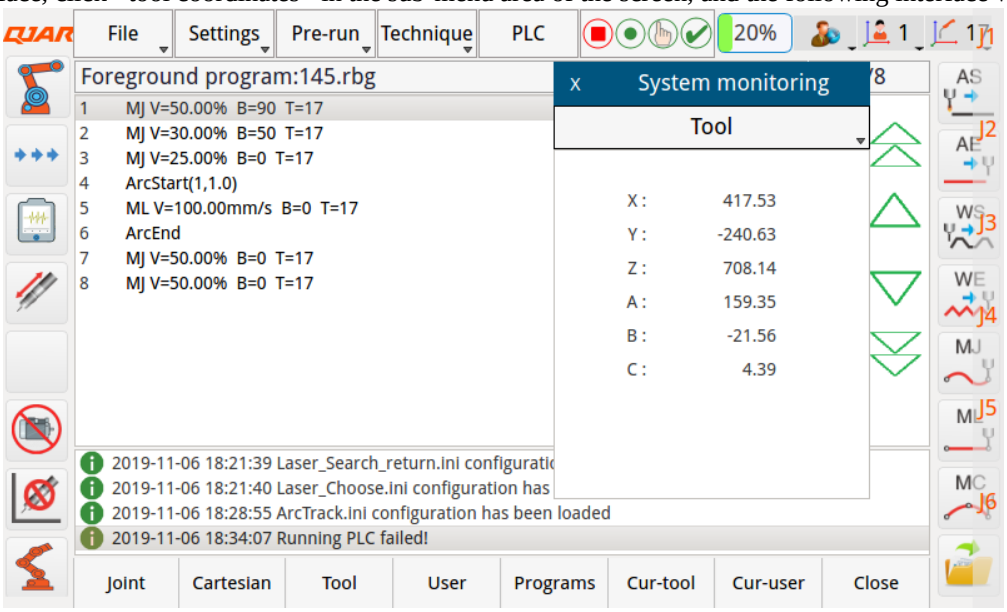
The data after X, Y and Z are rectangular coordinates data of the current point of the robot. Unit: mm.

The data after A, B and C are gesture data of the current point of the robot. Unit: degree（°）

When the monitoring area is in focus state, click the <Close> button in the sub-menu area to exit the monitoring window.

1.3 Tool coordinates

Click <monitoring> - <coordinate> - <tool coordinates>, or open it on another coordinate monitoring interface, click <tool coordinates> in the sub-menu area of the screen, and the following interface will pop up.



Below [tool coordinates] in the monitoring area：

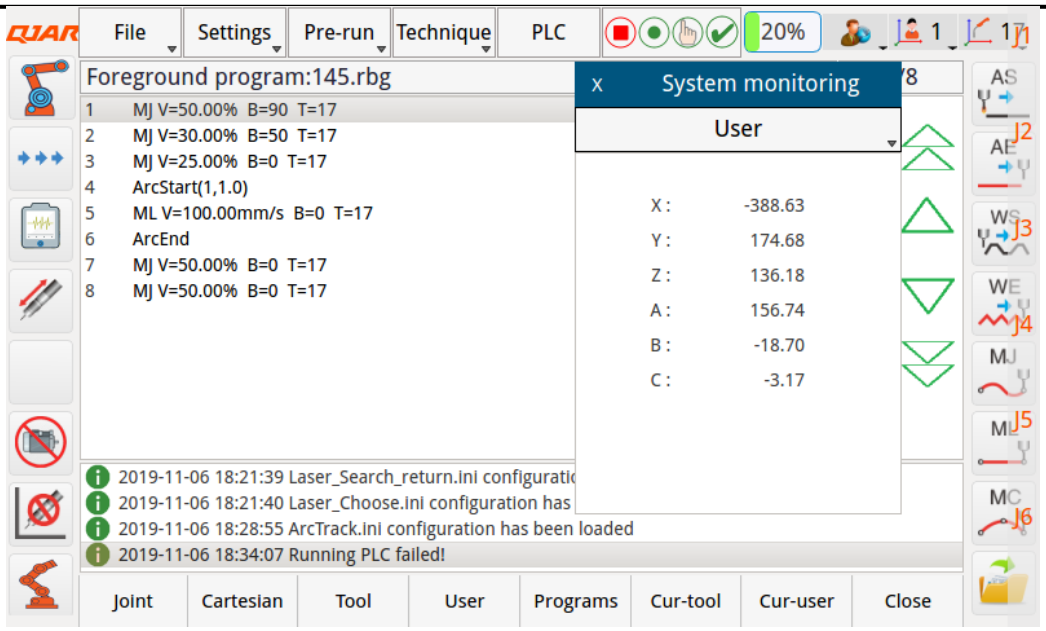
The data after X, Y and Z are tool coordinates data of the current point of the robot. Unit: mm.

The data after A, B and C are gesture data of the current point of the robot. Unit: degree（°）

When the monitoring area is in focus state, click the <Close> button in the sub-menu area to exit the monitoring window.

1.4 **User coordinates**

Click <monitoring> - <coordinate> - <user coordinates>, or open it on another coordinate monitoring interface, click <user coordinates> in the sub-menu area of the screen, and the following interface will pop up.



Below [user coordinates] in the monitoring area：

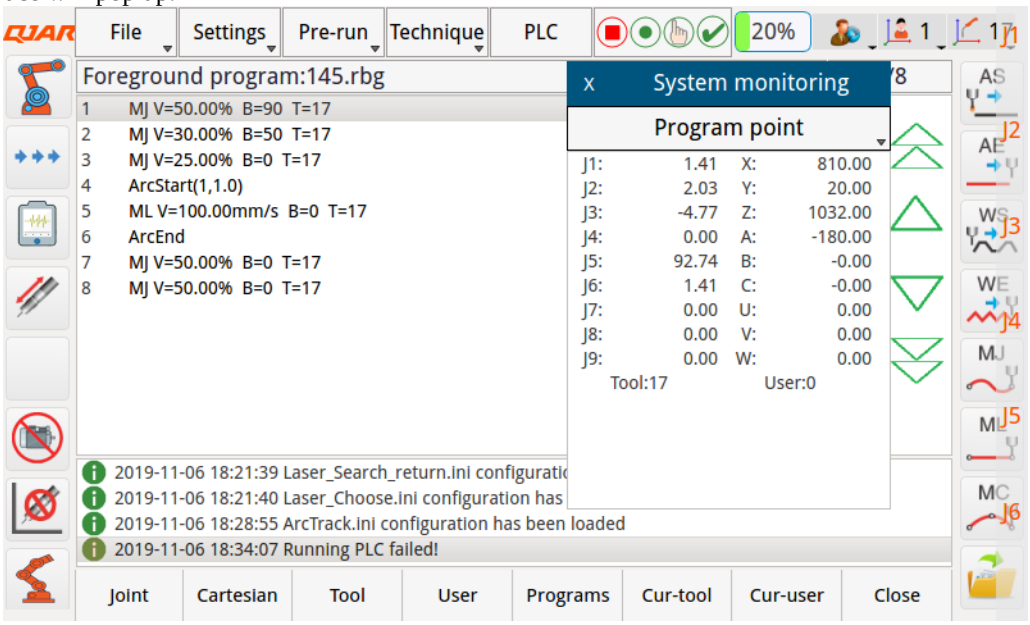
The data after X, Y and Z are tool coordinates data of the current point of the robot. Unit: mm.

The data after N, O and A are the current gesture data of the robot. Unit: degree （°）

When the monitoring area is in focus state, click the <Close> button in the sub-menu area to exit the monitoring window.

1.5 Program point coordinates

Click <monitoring> - <coordinate> - <program point coordinates>, or open it on another coordinate monitoring interface, click <program point coordinates> in the sub-menu area of the screen, and the following interface will pop up.



In the monitoring area of above figure, the corresponding coordinates of the current program line are displayed, and the program editing interface is displayed on the left side. When moves the cursor to the motion command line, the coordinates of the corresponding point in the line will be displayed below the [program point coordinates] on the right side of the screen. Below the [Program point coordinates]：

The data behind the axes J1, J2, J3, J4, J5, J6, are the joint coordinates data of this point, and the unit is: Degree (°).

The data after X Y and Z are rectangular coordinates data of the this point. Unit: mm.

The data after A, B and C are the gesture data corresponding to the point, and the unit is: Degree (°).

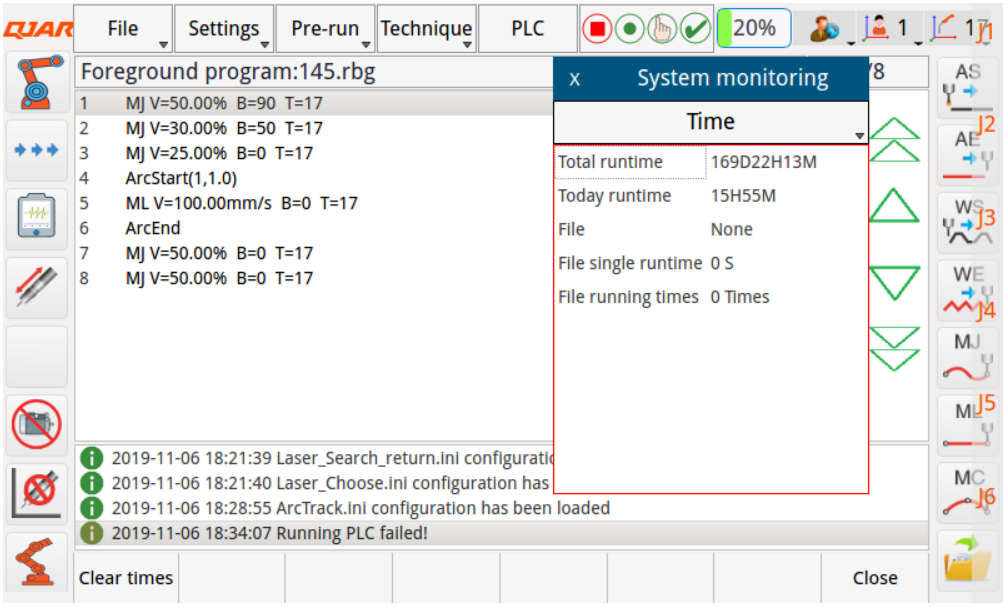
The number after [tool] is the tool coordinates number used at the current point.

The number after [User] is the user coordinates number used by the current point.

When the monitoring area is in focus state, click the <Close> button in the sub-menu area to exit the monitoring window.

2 Time

Click <monitoring> - <time> to pop up the following interface.



[Total Hours]: the total running time of the system from installation to now. Required display format: XX days, XX hours and XX minutes

[Running time of the day]: it refers to the running time of the day. Required display format: XX hours and XX minutes

[Run file]: The file name of the last running.

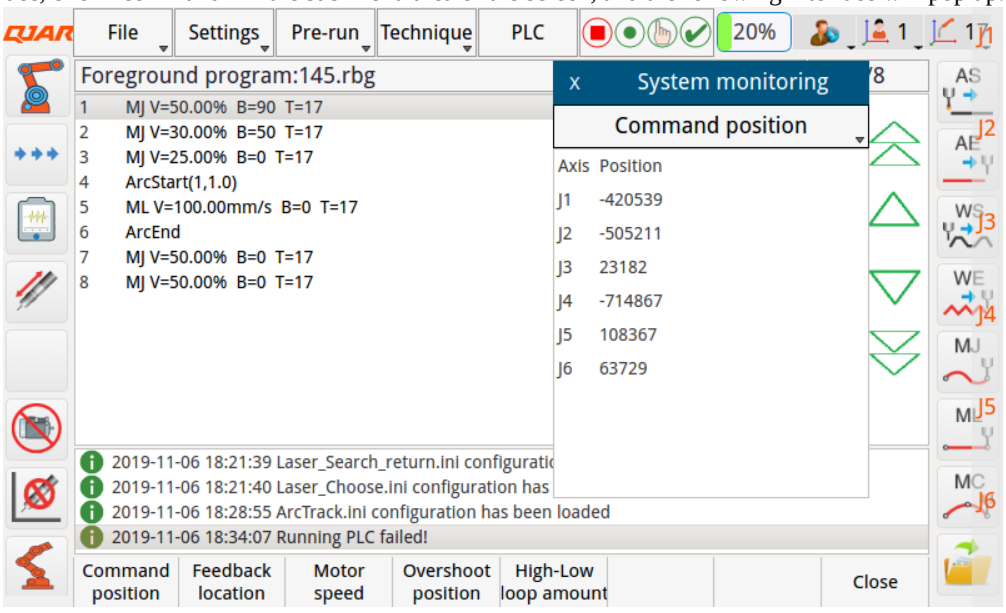
[File Run Time]: it refers to the last running time of the program.

[Number of file runs]: it refers to the total number of programs currently executed in PLAY mode.

3 Motor

3.1 **Command Position**

Click the <Monitoring> - <Motor> - < Command Position>, or open it on another coordinate monitoring interface, click <command> in the sub-menu area of the screen, and the following interface will pop up.



Below [Command position] in the monitoring area：

J1-J6: Display the current commanded

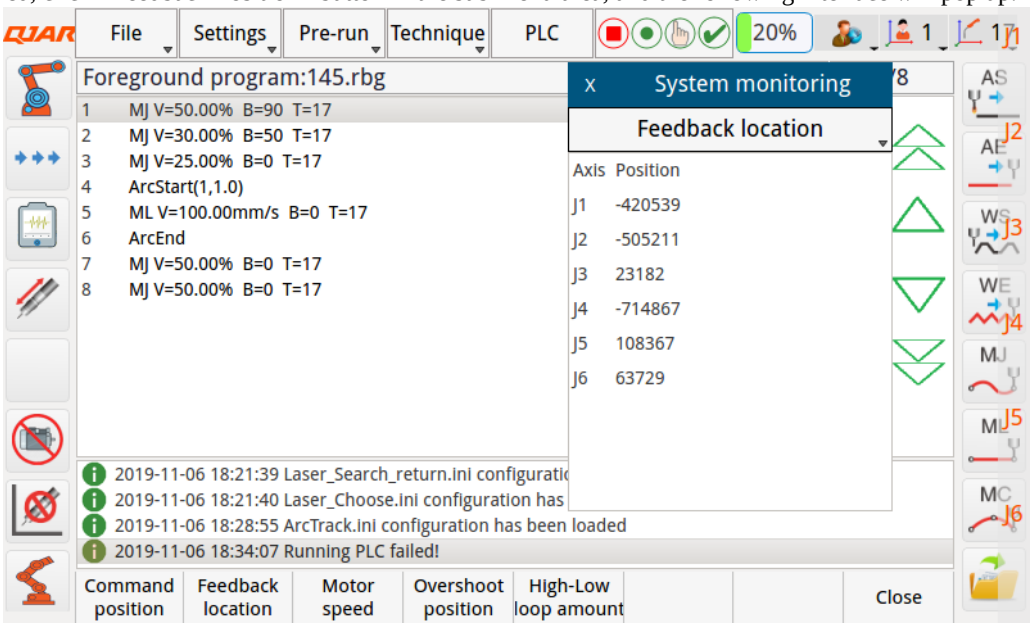
position data of joints 1 to 6. J7-J8: Display
the command position data of external axis.

When the focus is located in the monitoring area, click the <command position>, <feedback position>, <motor speed> and <out-of-tolerance position> buttons in the sub-menu area to pop up the corresponding monitoring interface.

Click the <Close> button to close the monitoring interface.

3.2 Feedback position

Click <Monitoring> - <Motor> - <Feedback Position>, or when the motor-related monitoring interface is opened, click <Feedback Position> button in the sub-menu area, and the following interface will pop up.



Below [Command position] of the monitoring area：

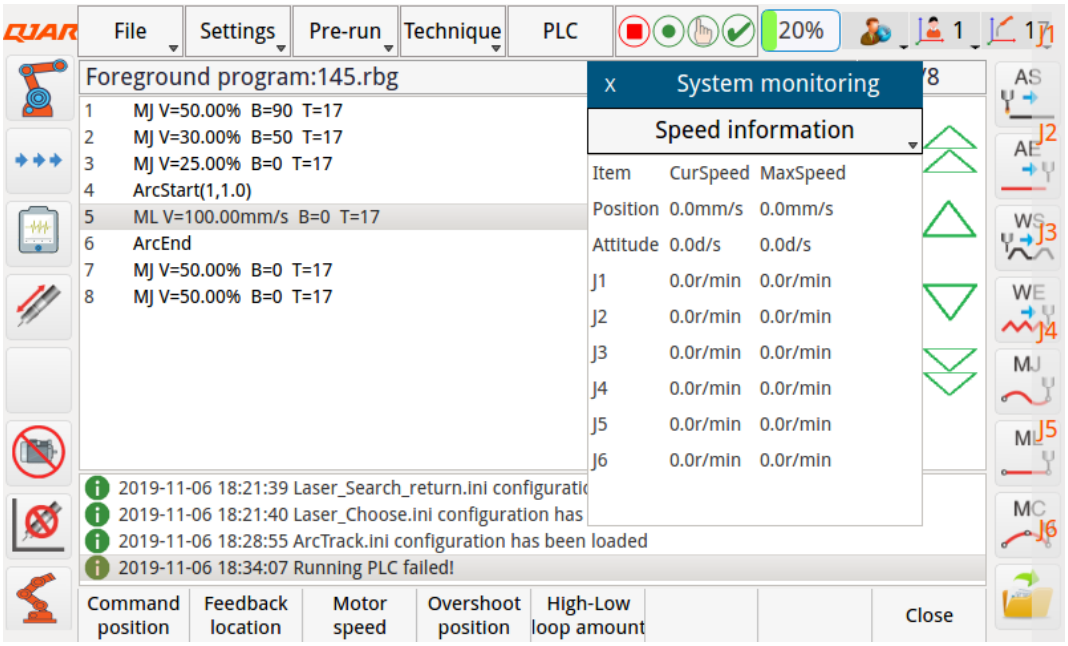
J1-J6： Display the real-time feedback data of joints 1 to 6.

When the focus is located in the monitoring area, click the <command position>, <feedback position>, <motor speed> and <deviation position> buttons in the sub-menu area to pop up the corresponding monitoring interface.

Click the <Close> button to close the monitoring interface

3.3 Motor speed

This speed is the real-time speed of the servo motor, and since the data refresh is slow, there is a difference between the checked data and the actual data of the motor. Click <Monitoring> - <Motor> - <Motor Speed> or click <Motor Speed> in the sub-menu area when the motor-related monitoring interface is opened, and pop up the following interface.



Below [motor speed] of the monitoring area：

Axis J1-J6: Shows current [instantaneous] motor speed and maximum speed of 1-6 joints, the unit is revolutions per minute. EXJ7-EXJ8: Displays the current [instantaneous] motor speed and [maximum value] of the speed of the external axis, the unit is revolutions per minute.

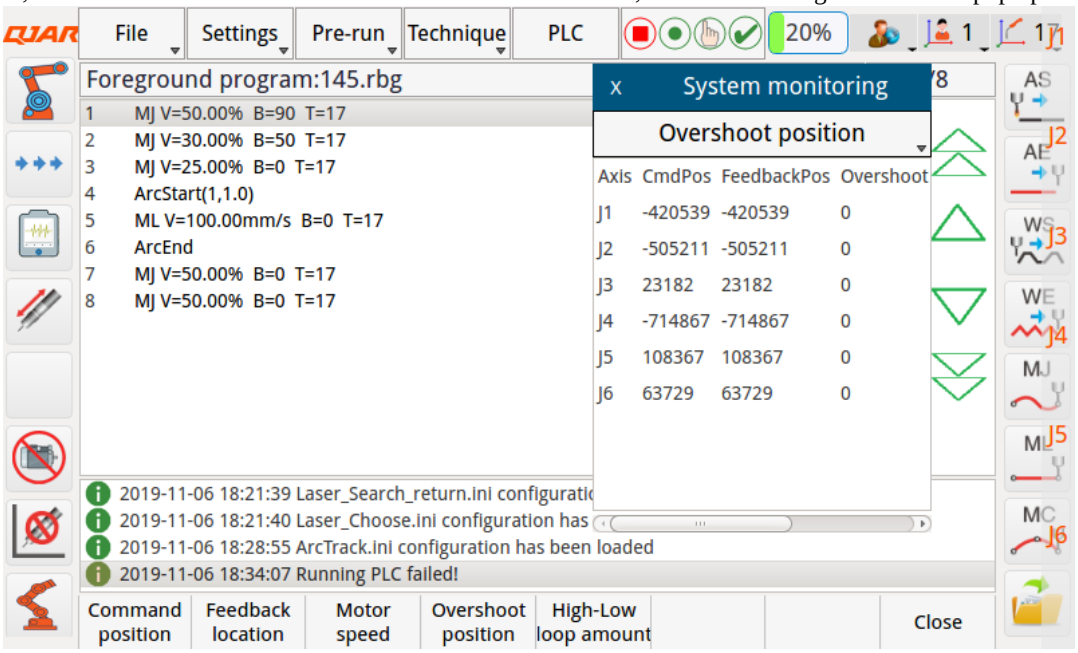
When the focus is located in the monitoring area, click the <command position>, <feedback position>, <motor speed> and <out-of-tolerance position> buttons in the sub-menu area to pop up the corresponding monitoring interface.

Click the <Close> button to close the monitoring interface.

3.4 **Deviation position**

This monitoring interface is used to monitor the deviation value between the actual position of the motor and the theoretical position of the system during the automatic running program of the robot in the PLAY or REMOTE mode.

Click <Monitoring> - <Motor> - <Deviation Position>, or when the motor-related monitoring interface is opened, click the <Deviation Position> button in the sub-menu area, and the following interface will pop up.



Below [Deviation position] of the monitoring area：

Command position: refers to the theoretical pulse value issued by each axis.

Feedback position: Refers to the feedback value of actual position of each axis motor.

Deviation position: refers to the deviation between the theoretical value and the actual value of each axis.

Maximum value: The maximum value of deviation of each axis after the robot starts operation.

When the focus is located in the monitoring area, click the <command position>, <feedback position>, <motor speed> and <deviation position> buttons in the sub-menu area to pop up the corresponding monitoring interface.

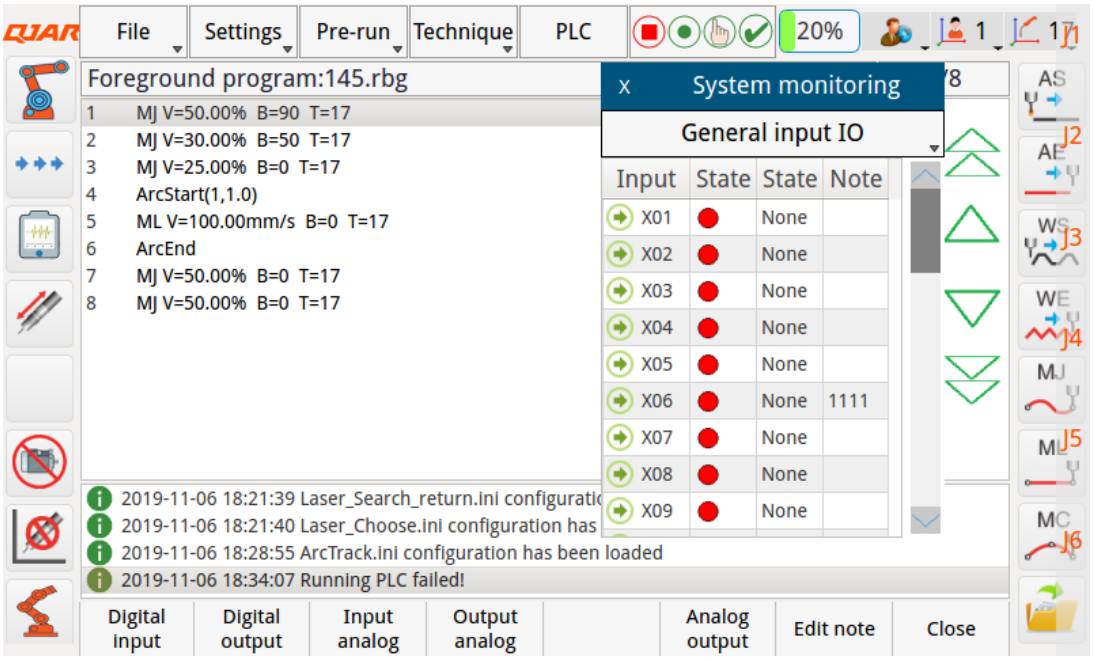
Click the <Close> button to close the monitoring interface.

4 IO interface

4.1 Digital input

Digital input monitoring is mainly used to monitor the input status of general-purpose input interfaces X01-X27. When the input port is valid, the corresponding indicator becomes , otherwise .

Click <monitoring> - <IO interface> - <digital input>, or when the IO monitoring area is opened, click <number input> in the sub-menu area, and the following interface will pop up.



When the focus is located in the monitoring area, click <digital input>, <digital output>, <input analog> and <output analog> in the sub-menu area to pop up the corresponding monitoring interface.

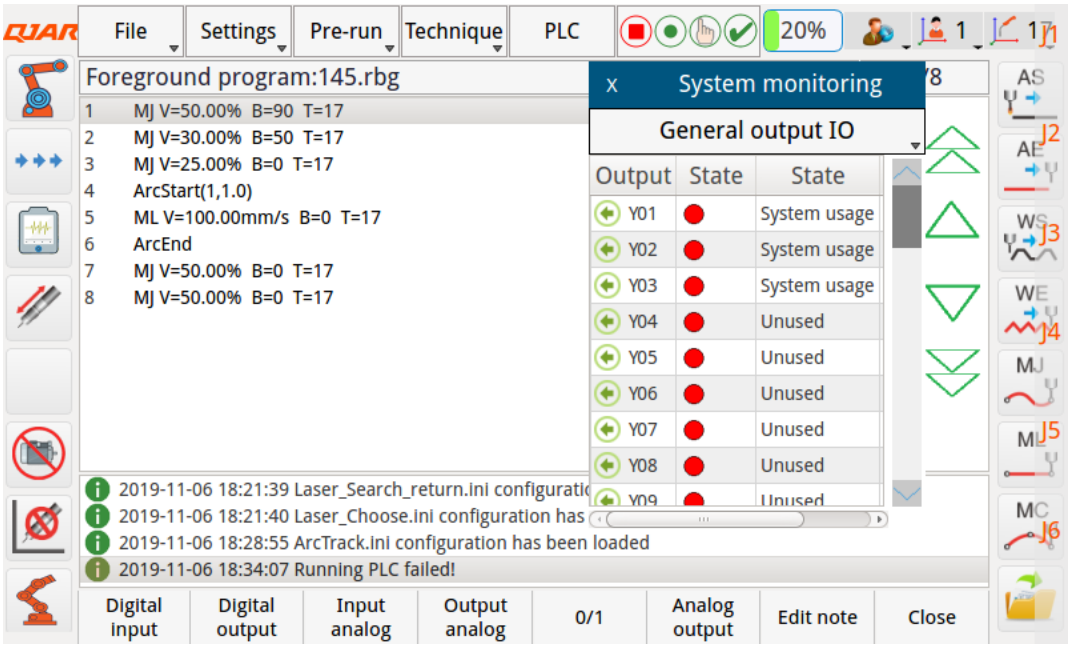
Click the <Edit Comments> button to specify the selected variable.

4.2 Digital output

Digital output monitoring is mainly used to monitor the output status of general-purpose output interfaces Y01-Y13.

When the input interface is valid, the corresponding indicator becomes , otherwise .

Click <Monitoring> - <IO Interface> - <Digital Output>, or when the IO monitoring area is opened, click <Digital Output> in the sub-menu area, and the following interface will pop up.



For the IO variables with "unused" status in the list, use the key 0/1 in the sub-menu to change the output interface status and test the output interface action.

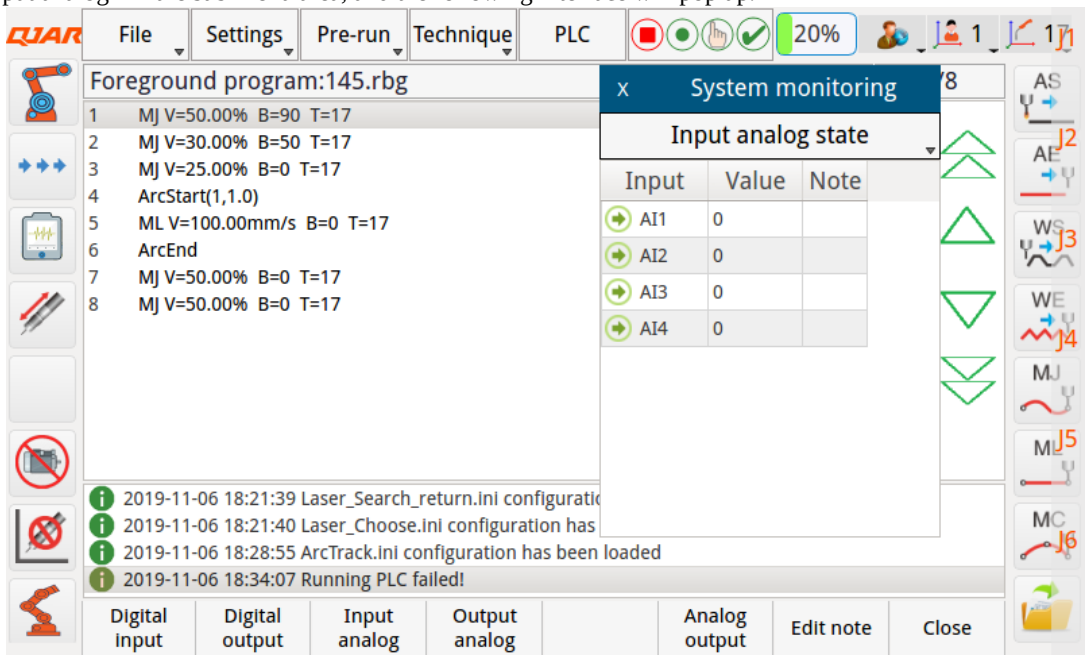
When the focus is located in the monitoring area, click <general input>, <general output>, <input analog> and <output analog> in the sub-menu area to pop up the corresponding monitoring interface.

Click the <Edit Comments> button to specify the selected variable.

4.3 Input analog

The input analog monitoring is mainly used to monitor the current input analog value of the analog input interfaces AI1-AI4, the unit is V.

Click <Monitoring> - <IO interface> - <Input analog>, or when the IO monitoring area is opened, click <Input analog> in the sub-menu area, and the following interface will pop up.



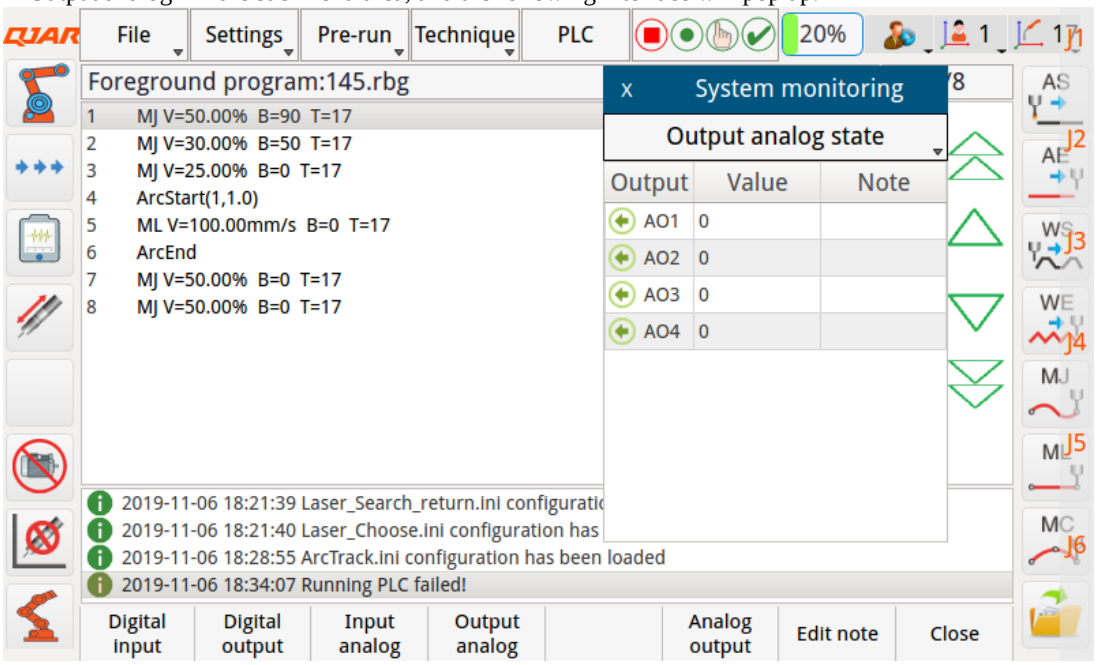
When the focus is located in the monitoring area, click <general input>, <general output>, <input analog> and <output analog> in the sub-menu area to pop up the corresponding monitoring interface.

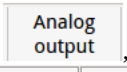
Click the <Edit Comments> button to specify the selected variable.

4.4 **Output analog**

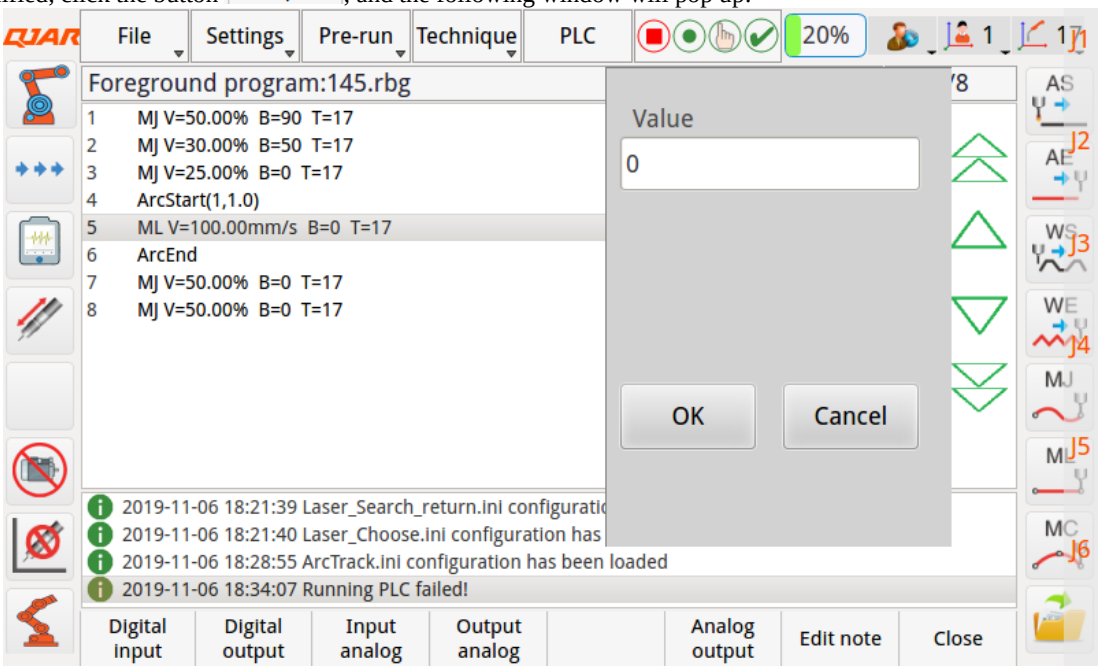
The output analog monitoring is mainly used to monitor the current output analog value of the analog output interfaces AO1-AO4, the unit is V.

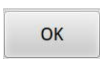
Click <Monitoring> - <IO interface> - <Output analog>, or when the IO monitoring area is opened, click <Output analog> in the sub-menu area, and the following interface will pop up.



The output value of the analog output interface can be modified; select the analog output interface to be modified, click the button 

, and the following window will pop up:



Input the required output value, and click 

to complete the modification.

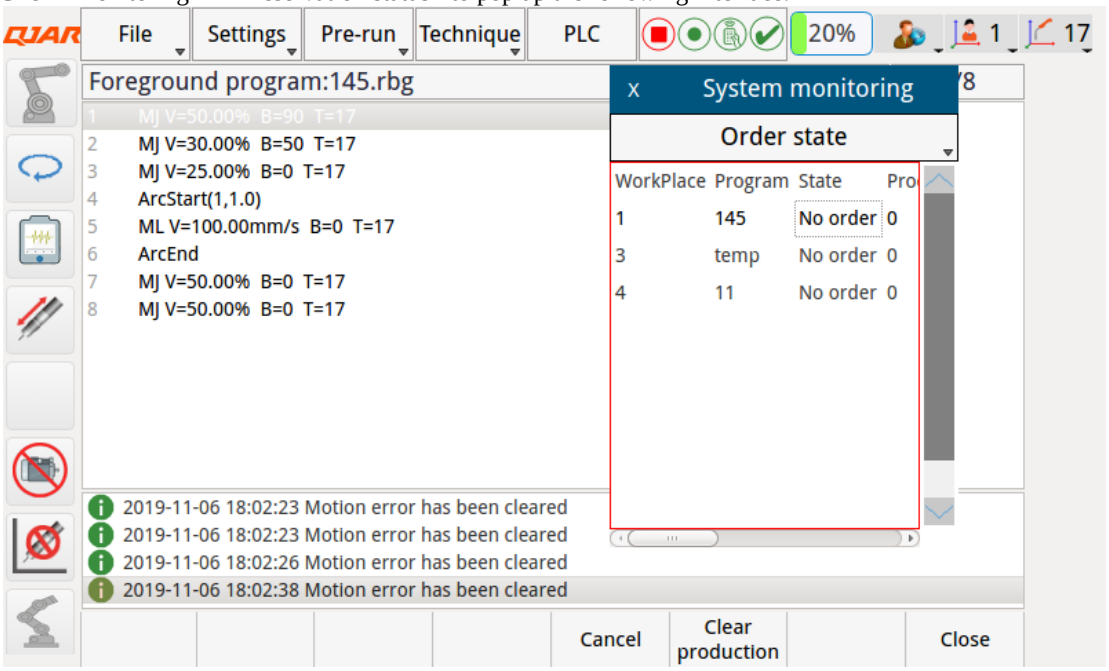
When the focus is located in the monitoring area, click <general input>, <general output>, <input analog> and <output analog> in the sub-menu area to pop up the corresponding monitoring interface.

Click the <Edit Comments> button to specify the selected variable.

5 Reservation status

This monitoring interface is mainly used to display the program corresponding to the station, the status of reservation, the quantity of actual production and the quantity information of distribution under the reservation state of the robot.

Click <Monitoring> - < Reservation status> to pop up the following interface.



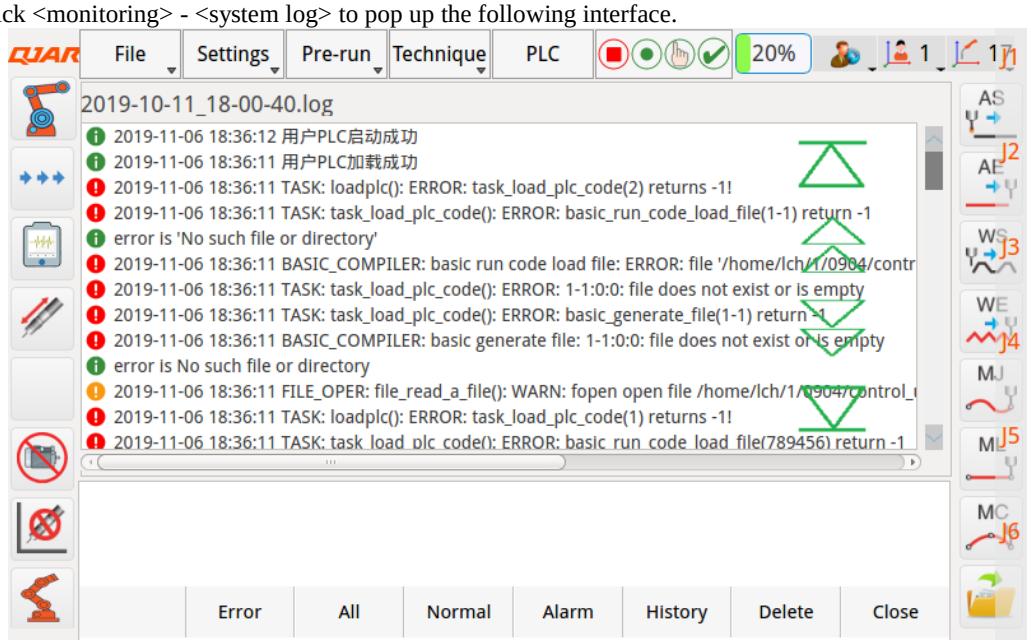
Cancel It is used to cancel the reservation status of all reserved stations, and continue to execute the currently operated program until the end.

Clear production Use this key to clear the production number of all stations.

Click the <Close> button in the sub-menu to exit the monitoring interface.

6 System log

Function description:
The log information of alarm, warning and operation information can be displayed or classified as a whole. It is available to select a single log to check the log details.
You can retrieve and check the historical log information by date.
Click <monitoring> - <system log> to pop up the following interface.



Click the <Close> button in the sub-menu to exit this monitoring interface.

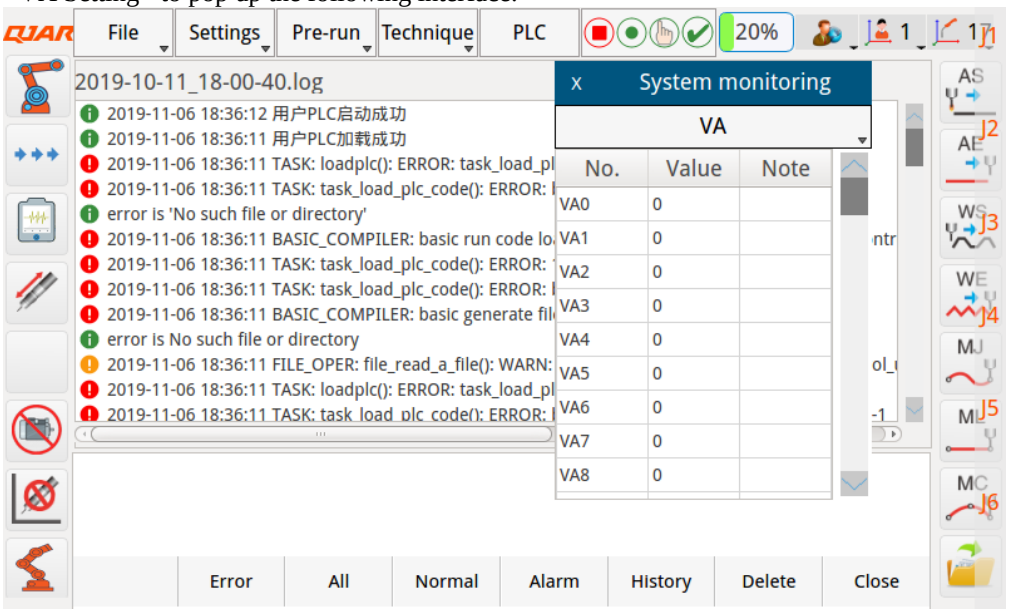
7 <Variable Setting>

The system variables include: Local LP variables (position variables, used by individual program) and global VA variables (floating point variables, used by all programs). How to open the variable monitoring interface:

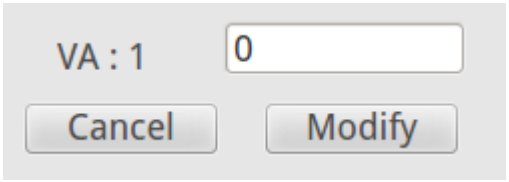
Click the <monitoring> - <variable setting> to select the variable to be opened.

7.1 **VA Setting**

This monitoring interface is mainly used to monitor the value of global variable VA. VA variable range of the system: VA00-VA99. Click <Monitoring> - <Variable Setting> - <VA Setting> to pop up the following interface.



The value in the data column in the monitor interface is the current value of the corresponding variable.
If this value needs to be adjusted, Please click the sub-menu area <Modify value>, and the window will pop up as follows:

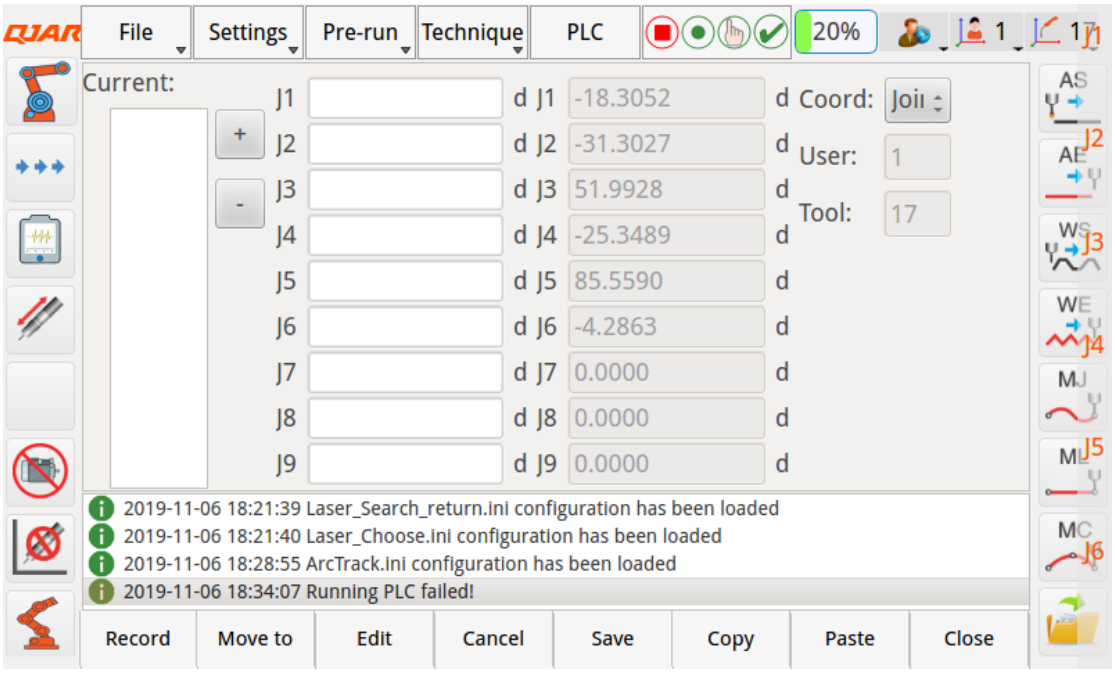


Enter the modified data, and click the <Modify> button according to the prompt of the pop-up interface, then confirm the modification operation. You can also click <cancel> key to cancel the modification. Click the <Close> button in the Menu area to close the monitoring interface.

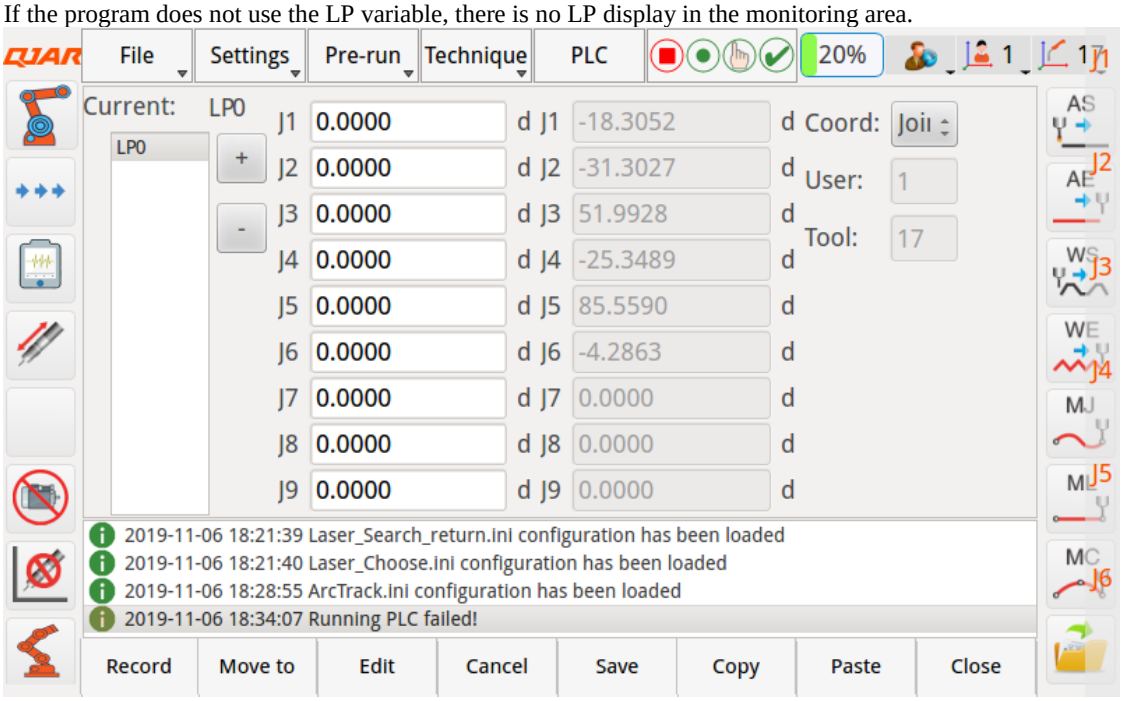
7.2 **Modify temporary position information**

This monitoring interface is mainly used to monitor the usage status of local position LP variables. If the open program does not add an LP variable, there is no LP display in the local P variable monitoring interface.
When the LP variable is added to the open program, the LP variable is displayed on the local P variable monitoring interface. The figure is shown as follows:

Click <Monitoring> - <Variable setting> - <Modify temporary position information> to pop up the following interface.



If the program does not use the LP variable, there is no LP display in the monitoring area.



When the LP variable is added to the program, the LP variable is displayed in the monitoring interface. LP variable range of the system: LP0-LP999.

In the sub-menu area, the keys are used by the following method:

1.  Each time this button is clicked, one LP variable is added to the point list, and the start sequence number of the added variable is LP0.
2.  Delete the LP variable selected in the point list.
3. <Run to Specified Point>: First, move the cursor to the LP variable number already recorded, press and hold the sub-menu area <Run to Specified Point>, and press and hold the <Safety Switch> at the same time, the robot will move to the position recorded by the LP variable point.
4. < Record Point >: Move the cursor to the LP variable number to be recorded, press and hold the < Safety Switch >, use the coordinate move key to move the robot to the desired position. Then click the <record point> in the sub-menu, and the current position of the robot will be recorded in the selected variable number.
5. < Manual modification >: Move the cursor to the LP variable number of the recorded data, click the "Manual modification" button in the sub-menu area, and the data in the "current point information" column will change from the gray non-editable state to the black editable state. Select the data box corresponding to the axis to be modified, enter the modified data, and click "Save manually" in the sub-menu area to confirm the modification operation.

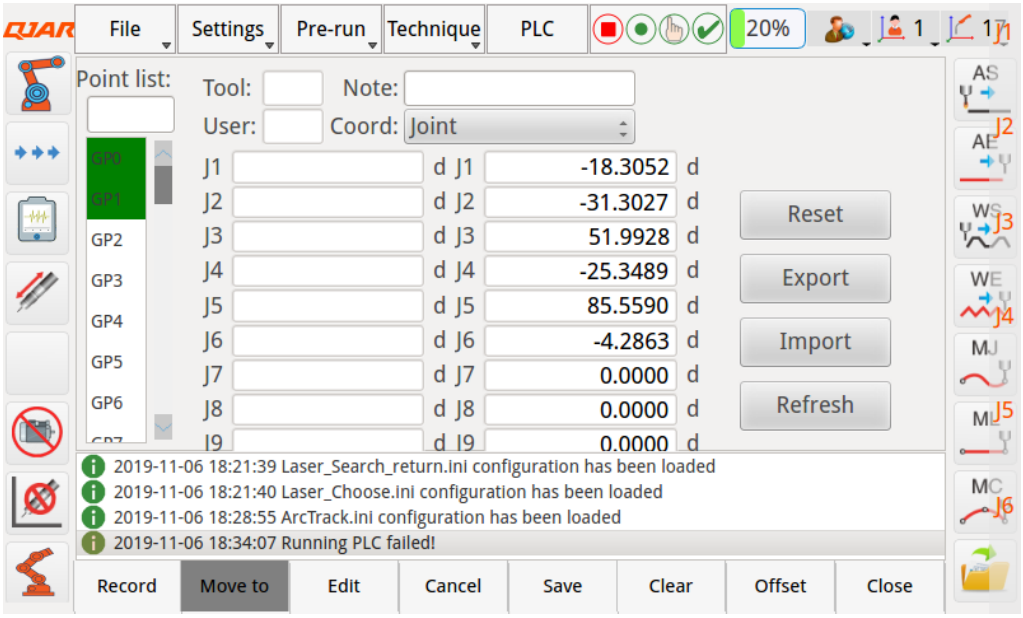
WARNING

It is recommended that the modified data should not have too much difference from the original one. Otherwise, the amplitude of the robot movement will be very large and an accident may occur!

5. <Save Manually>: it is used in pairs with < Modify Manually>, and used for modification of LP variable point information.
6. <Copy Point>: Move the cursor to the LP variable number to be copied, click <Copy Point> in the sub-menu area, then move the cursor to the LP variable number to be changed, and click <Paste Point> in the sub-menu area. The point of the currently selected LP variable becomes the duplicate variable point.
7. <Paste Point >: it is used in pairs with <Copy Point > , and used to copy point information for one LP variable to another LP variable.
8. Click the <Exit> button to close the temporary point information modification interface.

7.3 Global Point Editing

This monitoring interface is mainly used to monitor the usage status of global position LP variables. The figure is shown as follows: Click <Monitoring> - <Variable setting> - <Global position editing> to pop up the following interface.



This system preset 100 GP variables. The GP variable range: GP0-GP99, this variable is global variable, all programs share this variable. In the sub-menu area, the keys are used by the following method:

1. Reset: Click this button to reset and clear the position data saved by all GP variables in the point list.
2. Clear: Delete the position data of GP variable selected in the point list Data.
3. Move to First, move the cursor to the GP variable that has been recorded, press and hold this button, and press and hold the <safety switch>. In this case, the robot will move to the position recorded by this GP variable.
4. Export: Move the cursor to the LP variable number to be recorded, press and hold the < Safety Switch >, use the coordinate move keys to move the robot to the desired position. Then click the <record point> in the sub-menu, and the current position of the robot will be recorded in the selected variable number.
5. Import: Move the cursor to the LP variable number of the recorded data, click the "Manual modification" button in the sub-menu area, and the data in the "current point information" column will change from the gray non-editable state to the black editable state. Select the data box corresponding to the axis to be modified, enter the modified data, and click "Save manually" in the sub-menu area to confirm the modification operation.
6. Save This button can be used in two methods. It can be used to record the current position, move the cursor to the GP variable to be recorded, press and hold the < Safety Switch >, use the coordinate move keys to move the robot to the desired position. Then click this button, the current position of the robot will be recorded in the selected variable number. It can also be used to save the modified value of GP variable. After editing the coordinate of selected GP variable, click this button to save it.

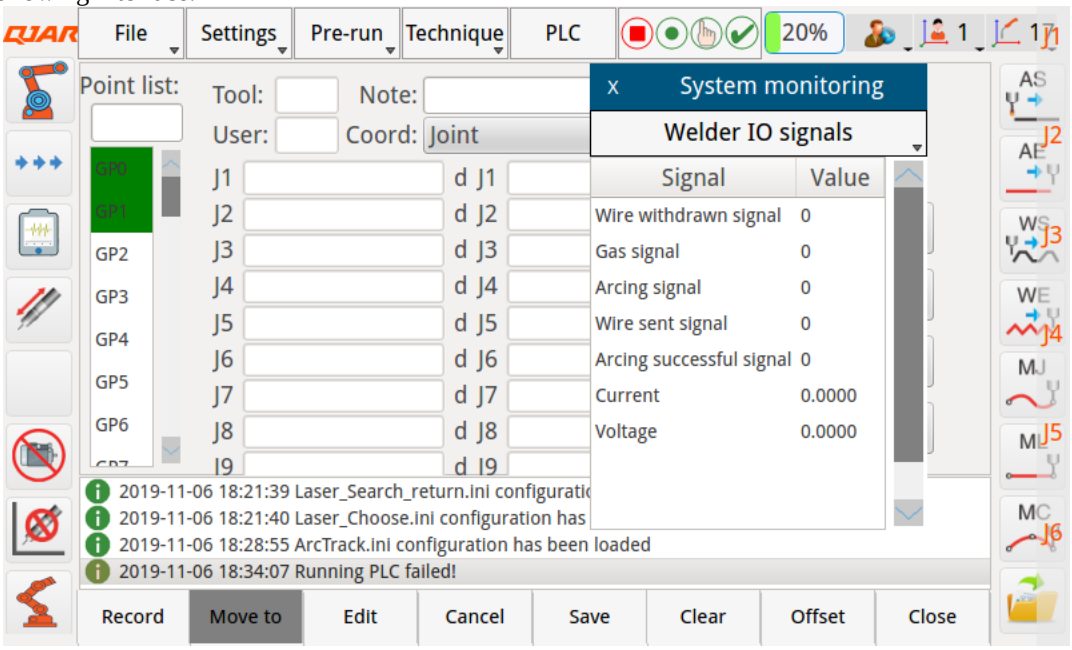
7. Edit After clicking this button, the selected GP variable coordinate box is activated, and the data can be edited and modified.
8. Offset If the selected GP variable is in the calibrated state, click this button to pop up the setting interface, and the space point position can be shifted at the original recorded position (except the recorded point is the joint coordinate).

8 Welding machine monitoring

8.1 **Input/output status of welding**

The input and output status monitoring of welding machine is mainly used to monitor the status of wire return signal, air supply signal, arc start signal, wire feed signal, arc start success signal, welding current and voltage of welding machine.

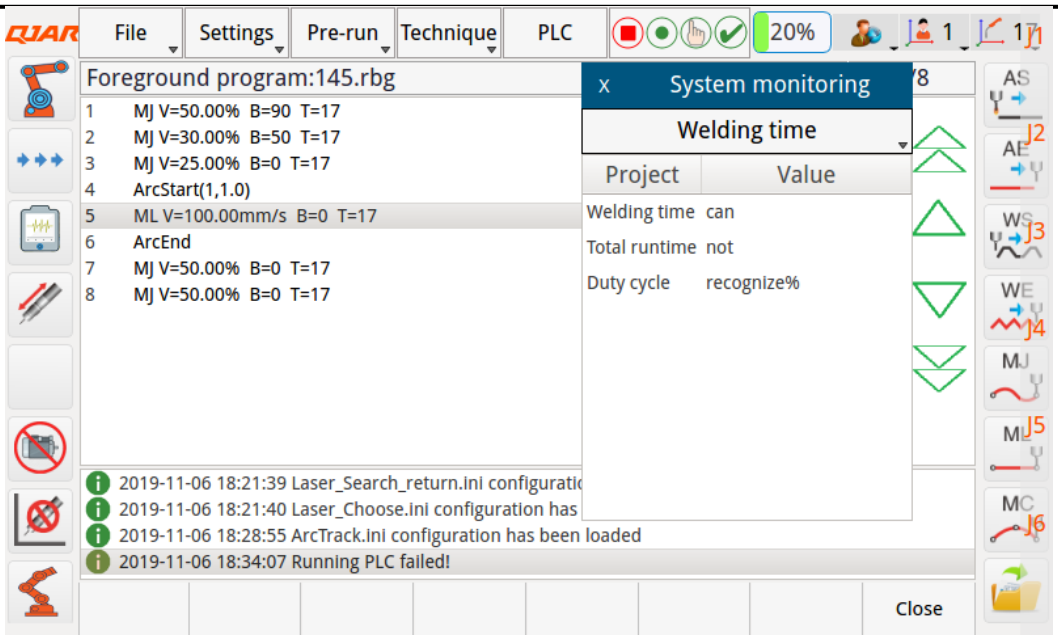
Click the <monitoring window> - <welding machine monitoring> - < welding machine input and output status> to pop up the following interface.



Click the <Close> button in the sub-menu to exit the monitoring interface.

8.2 **Welding time**

The time monitoring of welding machine is mainly used to monitor the welding time, total running time and duty cycle of welding machine. Click the <monitoring> - <welding machine monitoring> - <welding time> to pop up the following interface.



Click the <Close> button in the sub-menu to exit the monitoring interface.

Chapter 6 File Operation

The file operation is mainly used for the interaction between the U disk and the system. Such as software upgrade, parameter backup, data import and export.

After the debugging of the new equipment is completed, it is suggested to back up the parameters of the equipment with OTB (One Touch Backup) in case of unexpected need. Meanwhile, in case any trouble occurs to the system, the customer could conduct one touch backup to the system data, and send it to the company for analysis and processing.

In this Chapter, "*" indicates the U disk character.

Premise:

1. Prepare one U-disk, which can be identified by the computer and suffers the treatment of formatting, ensure its remaining storage space is equal to or more than 20M.

2. When any file needs to be read into the system, the path and file name of the corresponding file shall be accurate.

1 Save the file to U-disk

1.1 **Parameter saved to U-disk**

Insert the U-disk into the USB interface of teach pendant. Click <File Operation> - <File Saved to U-disk> - <Parameter Saved to U-Disk>.

System parameters are saved in the form of tar under the root directory(*:\ ini. Tar) of U-disk, and the information prompt area will prompt that the profile is copied successfully.

WARNING

The system parameters are the core parameters of the equipment, and the backed-up data shall not be modified by themselves, otherwise the data may be deranged and an accident may occur.

If the prompt message of U-disk insertion does not appear in the information prompt area, it means that the U-disk is not inserted or the U-disk is not recognized, the operation of folder copy is invalid at this time

. If anyone fails to copy the parameter folder, the information prompt area prompts that the U disk is not inserted or recognized.

1.2 **User program saved to U-disk**

Insert the U-disk into the USB interface of teach pendant. Click <File Operation> - <File Saved to U-disk> - <User Program Saved to U-Disk>.

The user program shall be saved in the form of tar under the root directory(*:\motion.tar) of U-disk, and the information prompt area will prompt that the user program is copied successfully.

WARN

ROBOT folder contains a lot of system-related data, please do not modify or delete

If the prompt message of U-disk insertion does not appear in the information prompt area, it means that the U-disk is not inserted or the U-disk is not recognized, the operation of folder copy is invalid at this time

. If anyone fails to copy the user program, the information prompt area prompts that the U disk is not inserted or recognized.

1.3 System PLC saved to U-disk

Insert the U-disk into the USB interface of teach pendant. Click <File Operation> - <File Saved to U-disk> - < System PLC Saved to U-Disk>.

System PLC shall be saved in the form of tar under the root directory（*:\plc.tar）of U-disk, and the information

prompt area will prompt that the system PLC is copied successfully.

If the prompt message of U-disk insertion does not appear in the information prompt area, it means that the U-disk is not inserted or the U-disk is not recognized, the operation of folder copy is invalid at this time

. If anyone fails to copy the System PLC folder, the information prompt area prompts that the U disk is not inserted or recognized.

1.4 Operation data saved to U-Disk

Insert the U-disk into the USB interface of teach pendant. Click <File Operation> - <File Saved to U-disk> - <Operation Data Saved to U-Disk>.

Operation data shall be saved in the form of tar under the root directory（*:\data.tar) of U-disk, and the information prompt area will prompt that the operation data are copied successfully.

If the prompt message of U-disk insertion does not appear in the information prompt area, it means that the U-disk is not inserted or the U-disk is not recognized, the operation of folder copy is invalid at this time

. If anyone fails to copy the operation data folder, the information prompt area prompts that the U disk is not inserted or recognized.

1.5 **System log saved to U-disk**

Insert the U-disk into the USB interface of teach pendant. Click <File Operation> - <File Saved to U-disk> - <System Log Saved to U-Disk>.

The system log shall be saved in the form of tar under the root directory（*:\log.tar) of U-disk, and the information prompt area will prompt that the system log is copied successfully.

If the prompt message of U-disk insertion does not appear in the information prompt area, it means that the U-disk is not inserted or the U-disk is not recognized, the operation of folder copy is invalid at this time

. If anyone fails to copy the system log folder, the information prompt area prompts that the U disk is not inserted or recognized.

1.6 **Backup System**

The backup system can back up the system to the U-disk. When anyone needs to restore the data, the person in question can use the <Read-in System> function to read the data in the system.

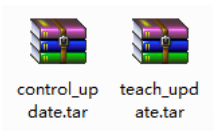
In case any trouble occurs to the system, the customer could also conduct one touch backup to the system data, and send it to us. Our company may use the above data to restore the user's system conditions to help the user deal with the suffered difficulties or problems.

Insert the U-disk into the USB interface of teach pendant. Click <File Operation> - <File Saved to U-disk> - <Backup System>. The relevant files shall be saved to the root directory（*:\) of U-disk, and the information prompt area will prompt: successful backup of controller system and successful backup of teach pendant system

If the prompt message of U-disk insertion does not appear in the information prompt area, it means that the U-disk is not inserted or the U-disk is not recognized, the operation of folder copy is invalid at this time When the operation of backup system fails, the information prompt area will prompt that the U-disk is not inserted or recognized.

WARNING

1. It is strongly recommended to back up the system after debugging is completed.
2. The backed up file consists of two tar packs. As shown in the following figure:



1.7 (One Touch Backup)

One touch backup means that parameters, user program, system PLC, operation data, system log and system are uniformly backed up to the U-disk. Insert the U-disk into the USB interface of teach pendant. Click <File Operation> - <File Saved to U-disk> - <OTB>.

The backup parameters, user program, system PLC, operation data, system log, controller system and teach pendant system will be saved respectively to the U disk root directory *:\ ini.tar, *:\ motion.tar, *:\ plc .tar, *:\ data.tar, *:\ log.tar, *:\ control _ update .tar,and *:\ teach _ update .tar. in the form of tar.

If the prompt message of U-disk insertion does not appear in the information prompt area, it means that the U-disk is not inserted or the U-disk is not recognized, the operation of folder copy is invalid at this time If anyone fails to copy the system log folder, the information prompt area prompts that the U disk is not inserted or recognized.

2 Read-in from U-disk

2.1 Parameters read into system

Insert the U-disk into the USB interface of teach pendant. Click <File Operation> - <Read-in from U-disk> - <Parameters read into system>.

If the operation is successful, the file (*:\ ini. tar) in the root directory of the U-disk will be read into the system and the previous parameters will be overwritten, and the information prompt area will prompt that the profile is successfully updated.

WARNING

1. The system parameters are the core parameters of the equipment, when the read-in parameters are wrong, the equipment will run abnormally, which will cause an accident. Please be careful!
2. The zero position data of the robot is also in the parameter file, please make sure that the read-in parameters are consistent with the equipment. Otherwise, the robot's zero position will be changed. Please be careful!

If the U-disk is not inserted and the U disk is not recognized, the message prompt area prompt that the U-disk is not inserted or recognized.

If the path of the parameter file is incorrect (*:\ ini. tar) or the file does not exist, the information prompt area will prompt that the file does not exist.

2.2 User program read into system

Insert the U-disk into the USB interface of teach pendant. Click <File Operation> - <Read-in from U-disk> - <User program read into system>.

If the operation is successful, the file in the root directory (*:\ motion. tar) of the U-disk will be read into the system and the previous user program will be overwritten, and the information prompt area will prompt that the user program is successfully updated.

If the U-disk is not inserted and the U disk is not recognized, the message prompt area prompt that the U-disk is not inserted or recognized.

If the path of the file is incorrect（*:\ motion.tar）or the file does not exist, the information prompt area will prompt that the file does not exist.

2.3 System PLC read into system

Insert the U-disk into the USB interface of teach pendant. Click <File Operation> - <Read-in from U-disk> - < System PLC read into system>.

If the operation is successful, the file in the root directory (*:\ plc. tar) of the U-disk will be read into the system and the previous system PLC program will be overwritten, and the information prompt area will prompt that the system PLC program is successfully updated.

If the U-disk is not inserted and the U disk is not recognized, the message prompt area prompt that the U-disk is not inserted or recognized.

If the path of the file is incorrect（*:\ plc.tar）or the file does not exist, the information prompt area will prompt that the file does not exist.

2.4 **Update Teach Pendant System**

Insert the U-disk into the USB interface of teach pendant. Click <File Operation> - <Read-in from U-disk> - <Update Teach Pendant System>.

If the operation is successful, the file under the root directory (*:\ teach _ updata.tar) of the U disk will be read into the system, and the previous teach pendant system will be overwritten, and the information prompt area will prompt: successfully update the teach pendant system, please restart the system to complete the update.

If the U-disk is not inserted and the U disk is not recognized, the message prompt area prompt that the U-disk is not inserted or recognized.

If the path of the file is incorrect（*:\ teach_updata.tar）or the file does not exist, the information prompt area will prompt that the file does not exist.

2.5 **Update Controller System**

Insert the U-disk into the USB interface of teach pendant. Click <File Operation> - <Read-in from U-disk> - <Update Controller System>.

If the operation is successful, the file under the root directory （*:\ control_updata.tar）of the U-disk will be read into the system, and the previous controller system will be overwritten, and the information prompt area will prompt: successfully update the controller system, please restart the system to complete the update.

If the U-disk is not inserted and the U disk is not recognized, the message prompt area prompt that the U-disk is not inserted or recognized.

If the path of the file is incorrect（*:\ control_updata.tar）or the file does not exist, the information prompt area will prompt that the file does not exist.

2.6 **Update teach pendant & controller system**

The updated teach pendant & controller system can restore the <System Backup> data backed up by the user to the U-disk to the system. It is mainly used to recover system data.

Insert the U-disk into the USB interface of teach pendant. Click <File Operation> - <Read-in from U-disk> - < Read into system>.

If the operation is successful, the file under the root directory (*:\ teach _ updata.tar, control _ updata.tar) of the U-disk is read into the system, and the file with the same name is overwritten, at the same time, the information prompt area will prompt: the update data is prepared successfully, please restart the system to complete the update;

After the system start-up is completed, the process of read-in system is completed.

If the U-disk is not inserted, the U-disk is not recognized, or there is no file or folder with the correct path in the U-disk, the information prompt area indicates that the U-disk is not inserted or recognized

If the file in the U-disk drive is incomplete, the information prompt area prompts that the file does not exist.

2.7 **Update all system files with one click**

Update all system files with one click means to read parameters, user program, system PLC, teach pendant system and controller system from U-disk, overwrite the same name files and update them.

If the operation is successful, the files under the root directory (*:\ ini. tar, motion. tar, plc. Tar, teach _ updata.tar, control _ updata.tar) of the U-disk are read into the system and overwrites the files of the same name, and the information prompt area prompts in turn:

successfully update profile;

successfully update user program;

successfully update PLC system;

successfully update teach pendant system, please restart the system to complete the update

successfully update controller system, please restart the system to complete the update

After the system start-up is completed, the process of read-in system is completed.

If the U-disk is not inserted, the U-disk is not recognized, or there is no file or folder with the correct path in the U-disk, the information prompt area indicates that the U-disk is not inserted or recognized

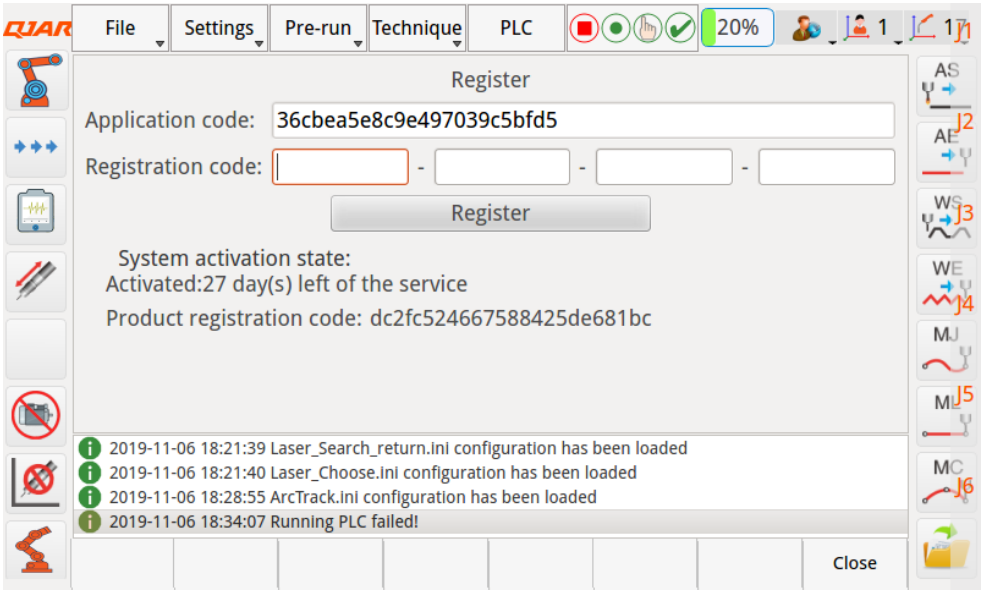
If the file in the U-disk drive is incomplete, the information prompt area prompts that the file does not exist.

WARNING

1. Files and folders in the U-disk have strict path requirements. If the path is incorrect, the data will not be read into the system.
2. Some unnecessary files can be deleted, when conducts the operation of one-click read in, it shall only read in the files existing in the corresponding path of the U-disk. And it shall ignore the files not existing in the corresponding path of the U-disk.

3 Software registration

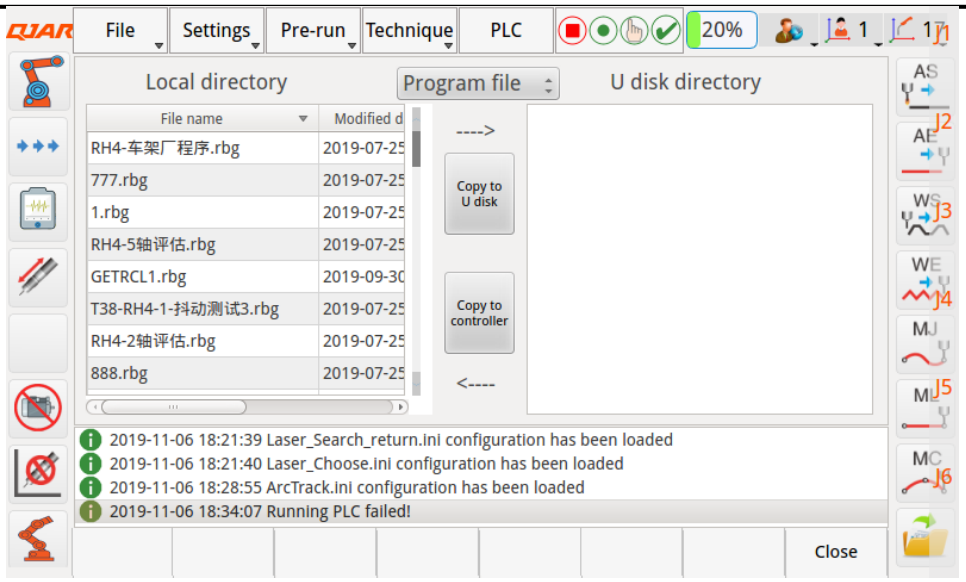
If the information prompt area indicates that "the system is not registered," the registration operation is required, otherwise the robot cannot move. Registration process: Click <File Operation> - <Software Registration> to pop up the following window:



Send back the application code, and the generated registration code will be provided here, enter the registration code into the registration code position of the pop up box mentioned above, enter 6 digits for each box, and click the registration button, successful registration will be prompted when registration is completed.

4 transfer

Click <File Operation> - <File Transfer> to pop up the following window:



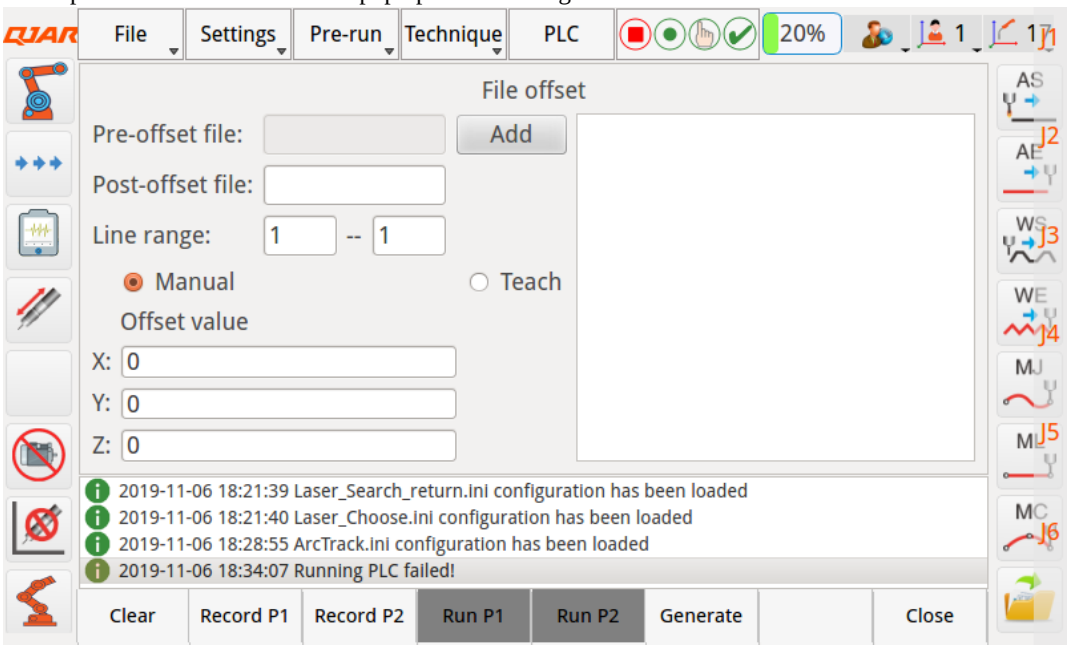
By employing the file transfer, the local program file, parameter file, user PLC and painting file can be copied to the U-disk individually, the U disk document can be copied to the local program directory as well.

5 File Offset

File offset, which can offset the program points of the existing files as a whole, and generate a new program file. For the translation difference, there are two obtaining methods, one is manual setting, and the other is teaching calculation.

First, introduce the manual mode:

Click <File Operation> - <File Offset> to pop up the following window:



<Add> button: select the program file to be translated

Translated file: newly generated file name

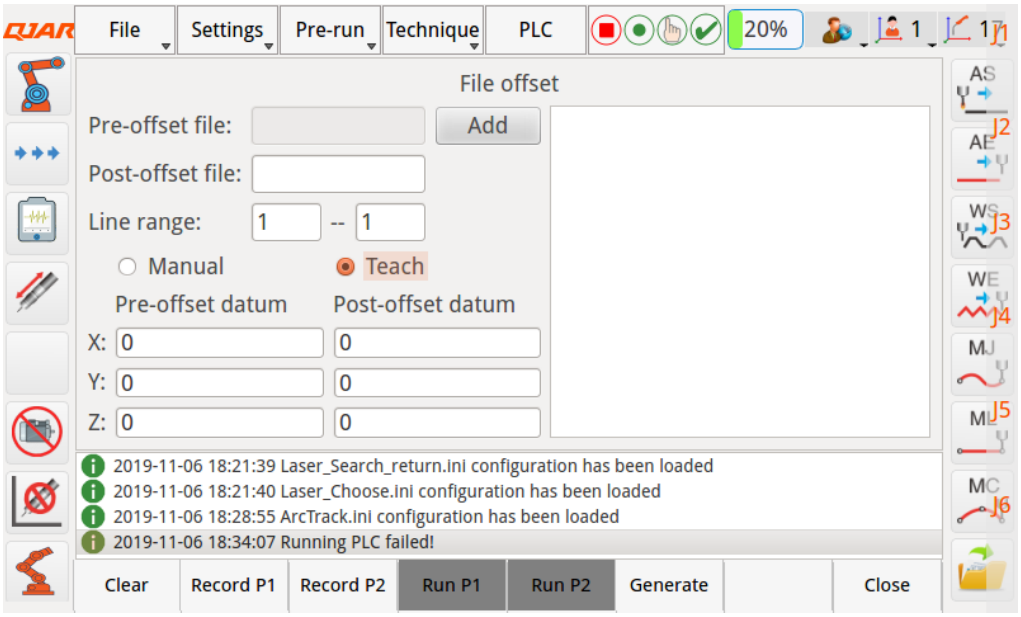
Conversion line range: the range of program line number to be translated

Manual/Teach: select the translation difference obtaining method

Manual/Teach: select the translation difference obtaining method

Translation difference: manually edit the translation difference value in X/Y/Z/A/B/C directions

Switch the Manual/Teach to the Teach mode, and pop up the following interface:



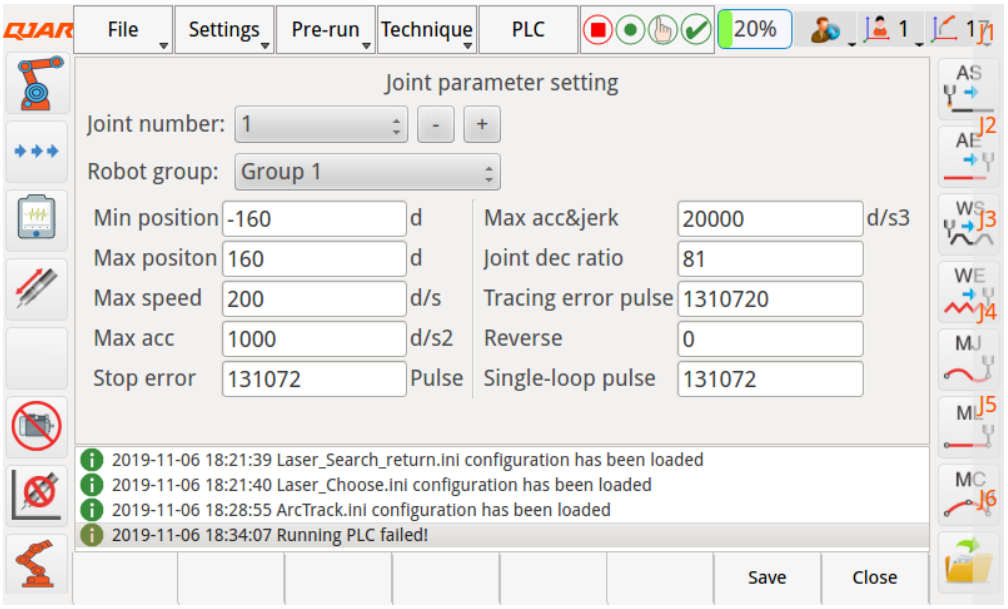
Click <Record Point 1> to record a position, then shift the filling data in the former reference point, then press and hold the safety switch, and move the robot end to the desired translation distance through the coordinate key on the teach pendant, click <Record Point 2>, at this time, fill the data in the reference point after translation, **click** to generate, calculate the translation difference value, and complete the setting.

Chapter 7 Parameter Setting

1 Joint Parameter

This parameter needs to open the: Manufacturer Authority

First, click < parameter setting > - < joint parameter setting >. Pop up the following interface.



1.1 **List of Parameters**

No.	Parameter contents	
1	Joint 1	Minimum position (degree)
2	Joint 2	
3	Joint 3	
4	Joint 4	
5	Joint 5	
6	Joint 6	
7	Joint 7	
8	Joint 8	
9	Joint 9	
10	Joint 1	Maximum position (degree)
11	Joint 2	
12	Joint 3	
13	Joint 4	
14	Joint 5	
15	Joint 6	
16	Joint 7	
17	Joint 8	
18	Joint 9	
19	Joint 1	
20	Joint 2	
21	Joint 3	

22	Joint 4	Maximum speed (degree/s)
23	Joint 5	
24	Joint 6	
25	Joint 7	
26	Joint 8	
27	Joint 9	
28	Joint 1	Maximum acceleration (degree/s2)
29	Joint 2	
30	Joint 3	
31	Joint 4	
32	Joint 5	
33	Joint 6	
34	Joint 7	
35	Joint 8	
36	Joint 9	
37	Joint 1	Stop error (pulse)
38	Joint 2	
39	Joint 3	
40	Joint 4	
41	Joint 5	
42	Joint 6	
43	Joint 7	
44	Joint 8	
45	Joint 9	
46	Joint 1	Maximum jerk (degree/s3)
47	Joint 2	
48	Joint 3	
49	Joint 4	
50	Joint 5	
51	Joint 6	
52	Joint 7	
53	Joint 8	
54	Joint 9	
55	Joint 1	Joint deceleration ratio
56	Joint 2	
57	Joint 3	
58	Joint 4	
59	Joint 5	
60	Joint 6	
61	Joint 7	
62	Joint 8	
63	Joint 9	
64	Joint 1	Servo offset
65	Joint 2	
66	Joint 3	
67	Joint 4	
68	Joint 5	
69	Joint 6	
70	Joint 7	
71	Joint 8	

72	Joint 9	
73	Joint 1	Reverse
74	Joint 2	
75	Joint 3	
76	Joint 4	
77	Joint 5	
78	Joint 6	
79	Joint 7	
80	Joint 8	
81	Joint 9	
82	Joint 1	Servo single-loop pulse
83	Joint 2	
84	Joint 3	
85	Joint 4	
86	Joint 5	
87	Joint 6	
88	Joint 7	
89	Joint 8	
90	Joint 9	

1.2 Parameter Details

Parameter No.	Parameter Definition		Unit
1	Joint 1	Minimum position	Degree
2	Joint 2		Degree
3	Joint 3		Degree
4	Joint 4		Degree
5	Joint 5		Degree
6	Joint 6		Degree
7	Joint 7		Degree
8	Joint 8		Degree
9	Joint 9		Degree

The relevant parameters are used to set the range of motion of each axis. To ensure safety, this value must be greater than the mechanical hard limit value.

Parameter No.	Parameter Definition		Unit
10	Joint 1	Maximum position	Degree
11	Joint 2		Degree
12	Joint 3		Degree
13	Joint 4		Degree
14	Joint 5		Degree
15	Joint 6		Degree
16	Joint 7		Degree
17	Joint 8		Degree
18	Joint 9		Degree

The relevant parameters are used to set the range of motion of each axis. To ensure safety, this value must be less than the mechanical hard limit value.

Parameter No.	Parameter Definition	Unit

19	Joint 1	Maximum speed	degree/s
20	Joint 2		degree/s
21	Joint 3		degree/s
22	Joint 4		degree/s
23	Joint 5		degree/s
24	Joint 6		degree/s
25	Joint 7		degree/s
26	Joint 8		degree/s
27	Joint 9		degree/s

This parameter is used to set the maximum angular velocity of each joint. If the speed and reduction ratio of the servo motor change, this parameter needs to change accordingly.

Parameter No.	Parameter Definition		Unit
28	Joint 1	Maximum acceleration	Degree/s2
29	Joint 2		Degree/s2
30	Joint 3		Degree/s2
31	Joint 4		Degree/s2
32	Joint 5		Degree/s2
33	Joint 6		Degree/s2
34	Joint 7		Degree/s2
35	Joint 8		Degree/s2
36	Joint 9		Degree/s2

This parameter is used to set the maximum angular acceleration of each joint. If the speed and reduction ratio of the servo motor change, this parameter needs to change accordingly.

Parameter No.	Parameter Definition		Unit
37	Joint 1	Stop error	Pulse
38	Joint 2		Pulse
39	Joint 3		Pulse
40	Joint 4		Pulse
41	Joint 5		Pulse
42	Joint 6		Pulse
43	Joint 7		Pulse
44	Joint 8		Pulse
45	Joint 9		Pulse

The relevant parameters are used to set the pulse number of stop error for each axis.

Parameter No.	Parameter Definition		Unit
46	Joint 1	Maximum jerk	Degree/s3
47	Joint 2		Degree/s3
48	Joint 3		Degree/s

			3
49	Joint 4		Degree/s 3
50	Joint 5		Degree/s 3
51	Joint 6		Degree/s 3
52	Joint 7		Degree/s 3
53	Joint 8		Degree/s 3
54	Joint 9		Degree/s 3

This parameter is used to set the maximum angular jerk of each joint. If the speed and reduction ratio of the servo motor change, this parameter needs to change accordingly.

Parameter No.	Parameter Definition		Unit
55	Joint 1	Joint deceleration ratio	Joint 1
56	Joint 2		Joint 2
57	Joint 3		Joint 3
58	Joint 4		Joint 4
59	Joint 5		Joint 5
60	Joint 6		Joint 6
61	Joint 7		Joint 7
62	Joint 8		Joint 8
63	Joint 9		Joint 9

The relevant parameters are used to set the mechanical reduction ratio for each axis.

Parameter No.	Parameter Definition		Unit
64	Joint 1	Servo offset	None
65	Joint 2		None
66	Joint 3		None
67	Joint 4		None
68	Joint 5		None
69	Joint 6		None
70	Joint 7		None
71	Joint 8		None
72	Joint 9		None

Parameter No.	Parameter Definition		Unit
73	Joint 1	Reverse	None
74	Joint 2		None
75	Joint 3		None
76	Joint 4		None
77	Joint 5		None
78	Joint 6		None
79	Joint 7		None

80	Joint 8		None
81	Joint 9		None

The relevant parameters are used to set the rotation direction of each axis; in case the parameter value is 1, forward direction of the axis; if the parameter value is 0, reverse direction of the axis.

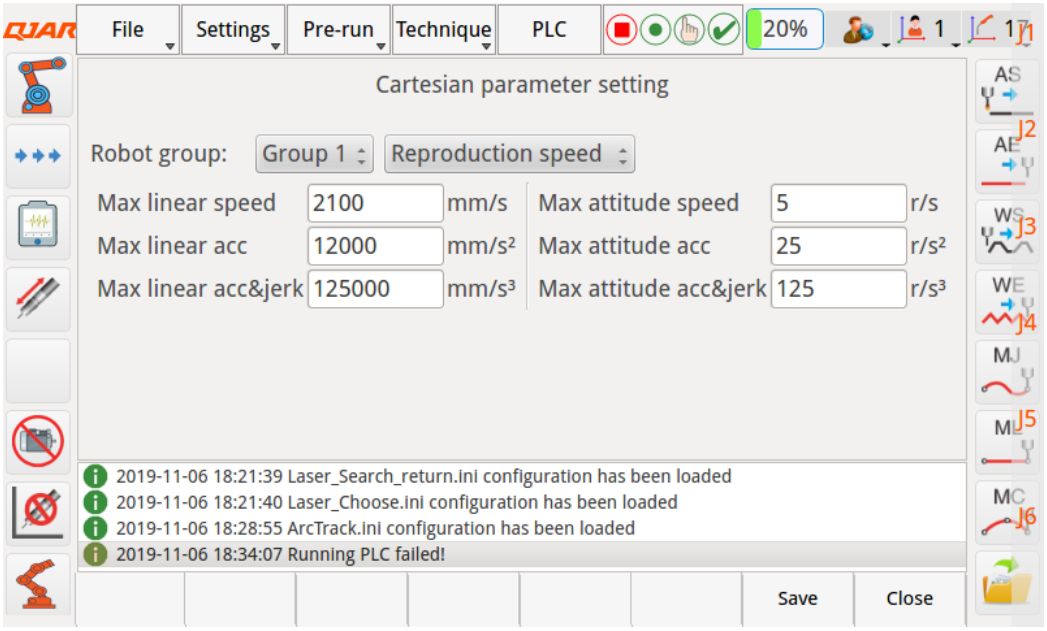
Parameter No.	Parameter Definition		Unit
82	Joint 1	Servo single-loop pulse	None
83	Joint 2		None
84	Joint 3		None
85	Joint 4		None
86	Joint 5		None
87	Joint 6		None
88	Joint 7		None
89	Joint 8		None
81	Joint 9		None

The relevant parameters are used to set the number of servo single-loop pulse for each axis

2 Right-angle parameter

This parameter needs to open the Manufacturer Authority

First, click <parameter setting> - <right angle parameter setting>. Pop up the following interface.



2.1 **List of Parameters**

No.	Parameter contents
1	Linear maximum speed (mm/s)
2	Linear maximum acceleration (mm/s2)
3	Linear maximum jerk (mm /s3)
4	Gesture maximum speed (degree/s)
5	Gesture maximum acceleration (degree/s2)
6	Gesture maximum jerk (degree/s3)

2.2 **Parameter Details**

Parameter No.	Parameter Definition	Unit
1	Linear maximum speed	mm/s

Linear maximum speed of a mobile robot

Parameter No.	Parameter Definition	Unit
2	Linear maximum acceleration	mm/s

Linear maximum acceleration of a mobile robot

Parameter No.	Parameter Definition	Unit
3	Linear maximum jerk	mm/s

linear maximum jerk of a mobile robot

Parameter No.	Parameter Definition	Unit
4	Gesture maximum speed	degre e/s

Gesture maximum speed of a mobile robot

Parameter No.	Parameter Definition	Unit
5	Gesture maximum speed	degre e/s

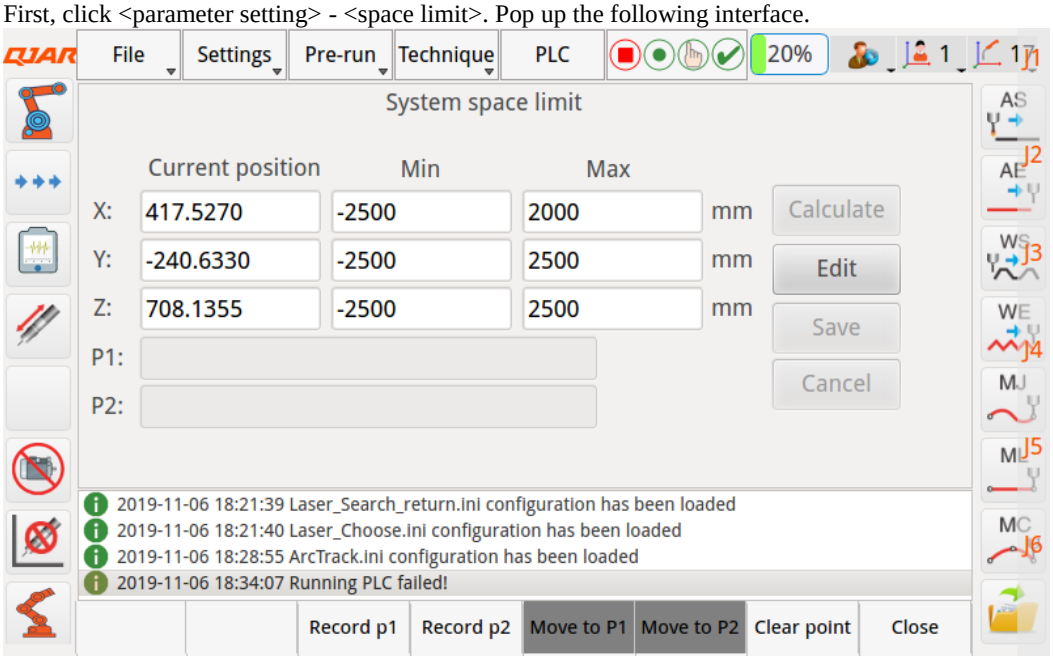
Gesture maximum acceleration of a mobile robot

Parameter No.	Parameter Definition	Unit
6	Gesture maximum speed	degre e/s

Gesture maximum jerk of a mobile robot

3 Space Limit

This parameter needs to open the: Manufacturer Authority
First, click <parameter setting> - <space limit>. Pop up the following interface.



3.1 **List of Parameters**

No.	Parameter contents
1	X＋ Limit
2	X－ Limit
3	Y＋ Limit
4	Y－ Limit
5	Z＋ Limit
6	Z－ Limit

3.2 **Parameter Details**

Parameter No.	Parameter Definition	Unit
1	X＋ Limit	mm
2	X－ Limit	mm

Set the positive and negative limits in the direction of the space limit X axis.

Parameter No.	Parameter Definition	Unit
3	Y direction limit	mm
4	Y direction limit	mm

Set the positive and negative limits in the direction of the space limit Y axis.

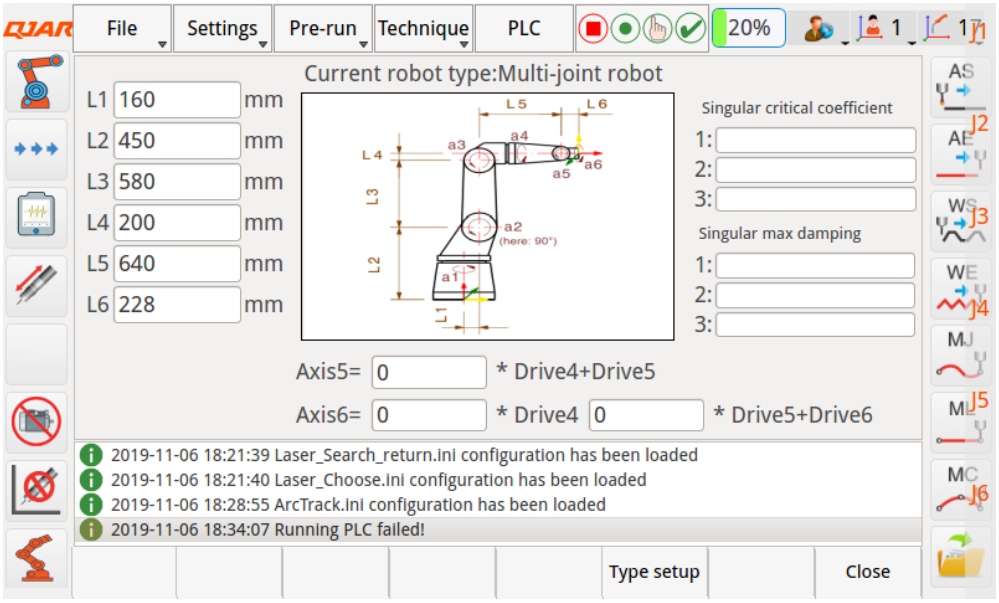
Parameter No.	Parameter Definition	Unit
5	Z direction limit	mm
6	Z direction limit	mm

Set the positive and negative limits in the direction of the space limit Z axis.

4 Mechanism Parameter

This parameter needs to open the: Manufacturer Authority

First, click <parameter setting> - <mechanism parameter setting>. Pop up the following interface.



4.1 **List of Parameters**

No.	Parameter contents
1	Axis-1 X offset L1 (mm)
2	Axis-1 Z offset L2 (mm)
3	Axis-2 arm-length L3 (mm)
4	Axis-3 arm-length L4 (mm)
5	Axis-4 arm-length L5 (mm)
6	Axis-5 arm-length L6 (mm)
7	Axis-1 Y offset L7 (mm)
8	Coupling coefficient of axis-5 and axis-4
9	Coupling coefficient of axis-6 and axis-4
10	Coupling coefficient of axis-6 and axis-5

4.2 **Parameter Details**

Parameter No.	Parameter Definition	Unit
1	Axis-1 X offset L1 (mm)	

Set the axis-1 X offset mechanical parameters of the robot.

Parameter No.	Parameter Definition	Unit
2	Axis-1 Z offset L2 (mm)	

Set the axis-1 Z offset mechanical parameters of the robot.

Parameter No.	Parameter Definition	Unit
3	Axis-2 arm-length L3 (mm)	

Set the mechanical parameters of axis-2 arm-length of the robot.

Parameter No.	Parameter Definition	Unit
4	Axis-3 arm-length L4 (mm)	

Set the mechanical parameters of axis-3 arm-length of the robot.

Parameter No.	Parameter Definition	Unit
5	Axis-4 arm-length L5 (mm)	

Set the mechanical parameters of axis-4 arm-length of the robot.

Parameter No.	Parameter Definition	Unit
6	Axis-5 arm-length L6 (mm)	

Set the mechanical parameters of axis-5 arm-length of the robot.

Parameter No.	Parameter Definition	Unit
7	Axis-1 Y offset L7 (mm)	

Set the axis-1 Y offset mechanical parameters of the robot.

Parameter No.	Parameter Definition	Unit
8	Coupling coefficient of axis-5 and axis-4	None

Set the coupling coefficient of axis-5 and axis-4

Parameter No.	Parameter Definition	Unit
9	Coupling coefficient of axis-6 and axis-4	None

Set the coupling coefficient of axis-6 and axis-4

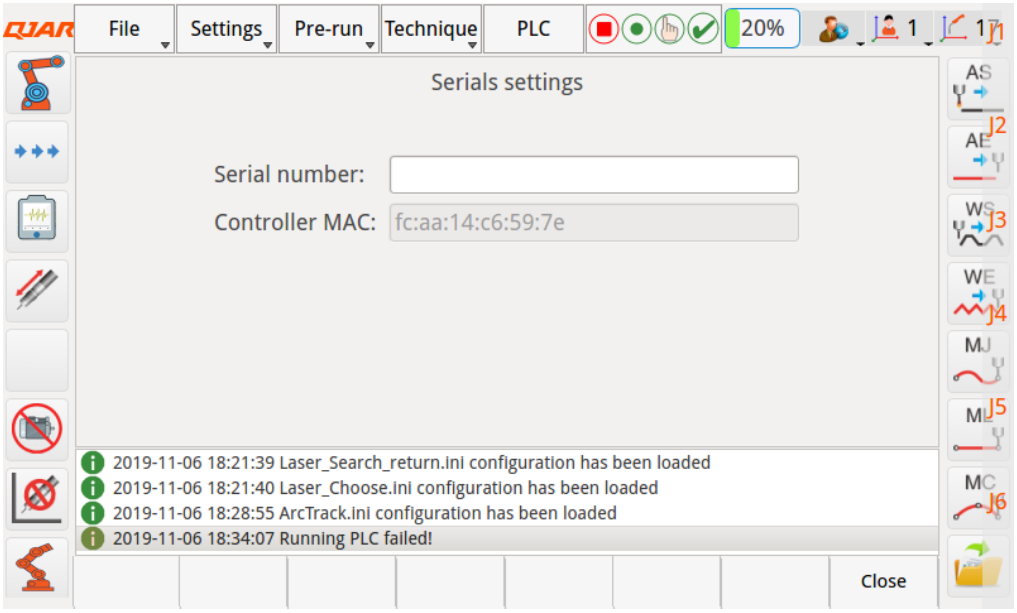
Parameter No.	Parameter Definition	Unit
10	Coupling coefficient of axis-6 and axis-5	None

Set the coupling coefficient of axis-6 and axis-5

5 Set S/N

This parameter needs to open the: Manufacturer Authority

First, click <parameter setting> - <set S/N>. Pop up the following interface.



5.1 Parameter List:

No.	Parameter contents
1	S/N

5.2 Parameter Details:

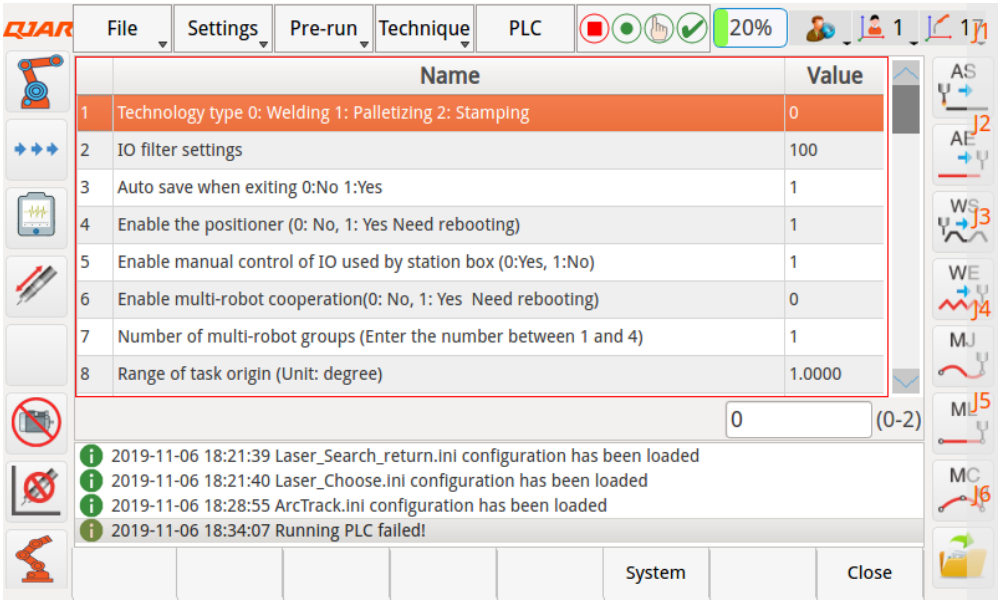
Parameter No.	Parameter Definition	Unit
1	S/N	None

It's used to set the software S/N parameters.

6 System Parameter

This parameter needs to open the: Manufacturer Authority

First, click <parameter setting> - <system parameter>. Pop up the following interface.



6.1 **List of Parameters**

No.	Parameter contents
1	IO filter setting
2	Support the positioner or not
3	Support the positioner or not
4	Allow the manual control of IO occupied by the position box or not
5	Support multi-robot collaborative operation or not
6	The number of multiple robot groups
7	Range judgment of operation origin
8	IO number of the remote IO startup file
9	Start button of position box (0: normally OFF, 1: normally ON)
10	Stop button of position box (0: normally OFF, 1: normally ON)
11	Default value of manual operation speed
12	Manual speed mode during system initialization (0: default value 1: latest value)
13	Default value Automatic operation speed
14	Automatic speed mode during system initialization (0: default value 1: latest value)
15	Teach mode - running mode default value 0: single line 1: single cycle 2: multiple cycles
16	Teach mode - setting method of running mode at system start-up (0: default value 1: latest value)
17	Play mode - running mode default value 0: single line 1: single cycle 2: multiple cycles
18	Play mode - setting method of running mode at system start-up (0: default value 1: latest value)
19	Remote mode - running mode default value 0: single line 1: single cycle 2: multiple cycles
20	Remote mode - setting method of running mode at system start-up (0: default value 1: latest value)
21	External axis - Linear axis - Negative limit (unit: mm)

22	External axis - Linear axis - Positive limit (unit: mm)
23	External axis - Rotation axis - Negative limit (unit: mm)
24	External axis - Rotation axis - Positive limit (unit: mm)

6.2 **Parameter Details**

Parameter No.	Parameter Definition	Unit
1	IO filter setting	millisecond

Input range 0-10000. Please restart the controller after modification

Parameter No.	Parameter Definition	Unit
2	Support the positioner or not	None

0: No, 1: Yes. Please restart the controller after modification.

Parameter No.	Parameter Definition	Unit
3	Start using the positioner or not	None

0: No，1：Yes

Parameter No.	Parameter Definition	Unit
4	Allow manual control of the IO occupied by the position box or not	None

0: Allow，1：Enable

Parameter No.	Parameter Definition	Unit
5	Support multi-robot collaborative operation or not	None

0: No, 1: Yes. Please restart the controller after modification.

Parameter No.	Parameter Definition	Unit
6	The number of multiple robot groups	group

Input range 1-4.

Parameter No.	Parameter Definition	Unit
7	Range judgment of operation origin	Degree

Input range 0-100.

Parameter No.	Parameter Definition	Unit
8	IO number of the remote IO startup file	

Input range 1-8.

Parameter No.	Parameter Definition	Unit

9	Start button of position box	None

0: normally OFF, 1: normally ON

Parameter No.	Parameter Definition	Unit
10	Stop button of position box	None

0: normally OFF, 1: normally ON

Parameter No.	Parameter Definition	Unit
11	Default value of manual operation speed	%

Input range 0-100.

Parameter No.	Parameter Definition	Unit
12	Manual speed mode during system initialization	None

0: default value 1: latest value

Parameter No.	Parameter Definition	Unit
13	Default value of manual operation speed	%

Input range 0-100.

Parameter No.	Parameter Definition	Unit
14	Manual speed mode during system initialization	None

0: default value 1: latest value

Parameter No.	Parameter Definition	Unit
15	Teach mode - running mode default value	None

0: single line 1: single cycle 2: multiple cycles

Parameter No.	Parameter Definition	Unit
16	Teach mode - setting method of running mode at system start-up	None

0: default value 1: latest value

Parameter No.	Parameter Definition	Unit
17	Play mode - running mode default value	None

0: single line 1: single cycle 2: multiple cycles

Parameter No.	Parameter Definition	Unit
18	Play mode - setting method of running mode at system start-up	None

0: default value 1: latest value

Parameter No.	Parameter Definition	Unit
19	Remote mode - running mode default value	None

0: single line 1: single cycle 2: multiple cycles

Parameter No.	Parameter Definition	Unit

20	Remote mode - setting method of running mode at system start-up	None

0: default value 1: latest value

Parameter No.	Parameter Definition	Unit
21	External axis - Linear axis - Negative limit	mm

Input range: -99999999-99999999

Parameter No.	Parameter Definition	Unit
22	External axis - Linear axis - Positive limit	mm

Input range: -99999999-99999999

Parameter No.	Parameter Definition	Unit
23	External axis - Rotation axis - Negative limit	mm

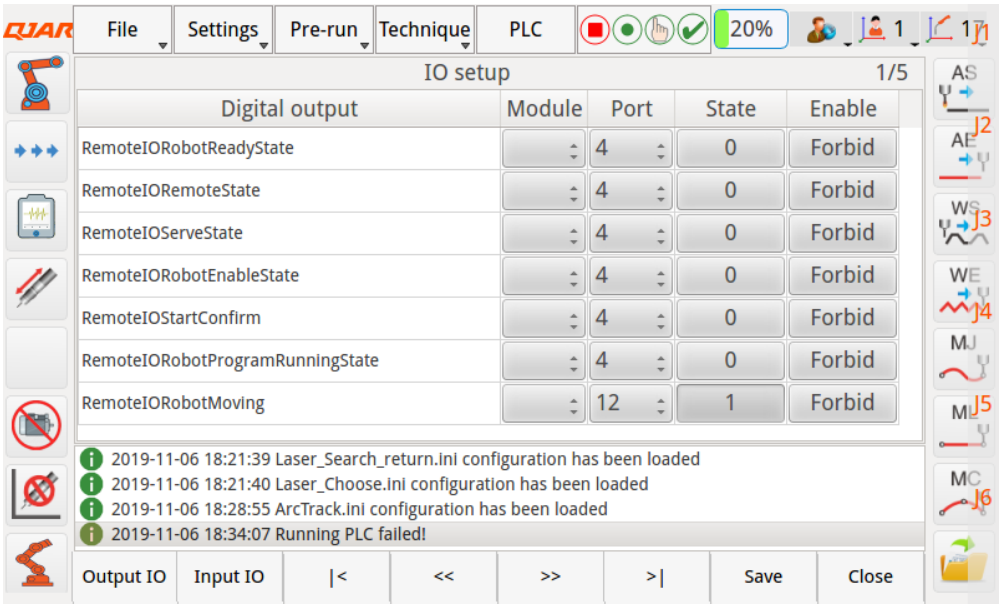
Input range: -99999999-99999999

Parameter No.	Parameter Definition	Unit
24	External axis - Rotation axis - Positive limit	mm

Input range: -99999999-99999999

7 System IO Configuration

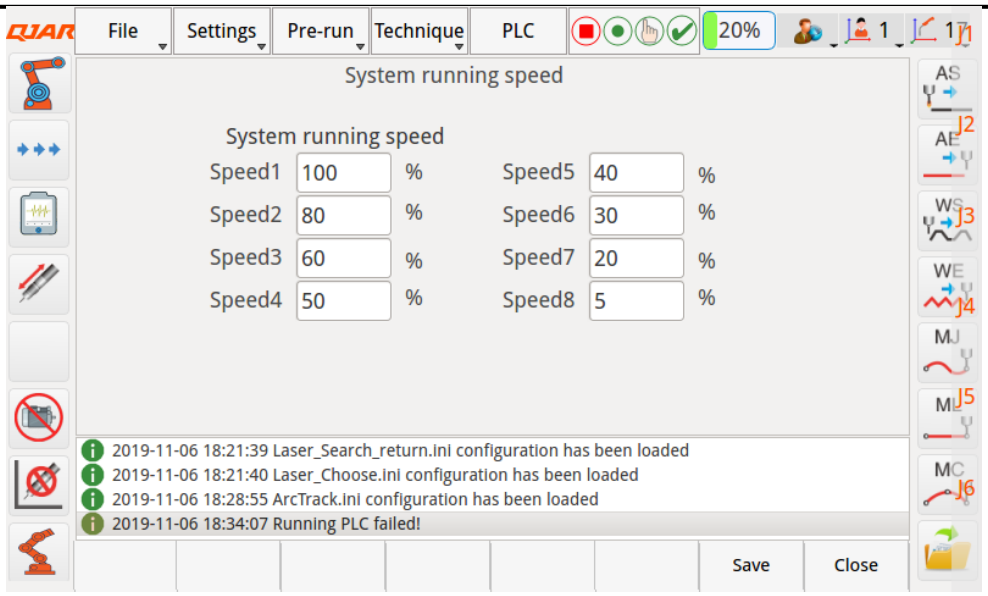
This parameter needs to open the: Manufacturer Authority
First, click <parameter setting> - <system IO configuration>. Pop up the following interface.



Not used yet

8 System speed setting

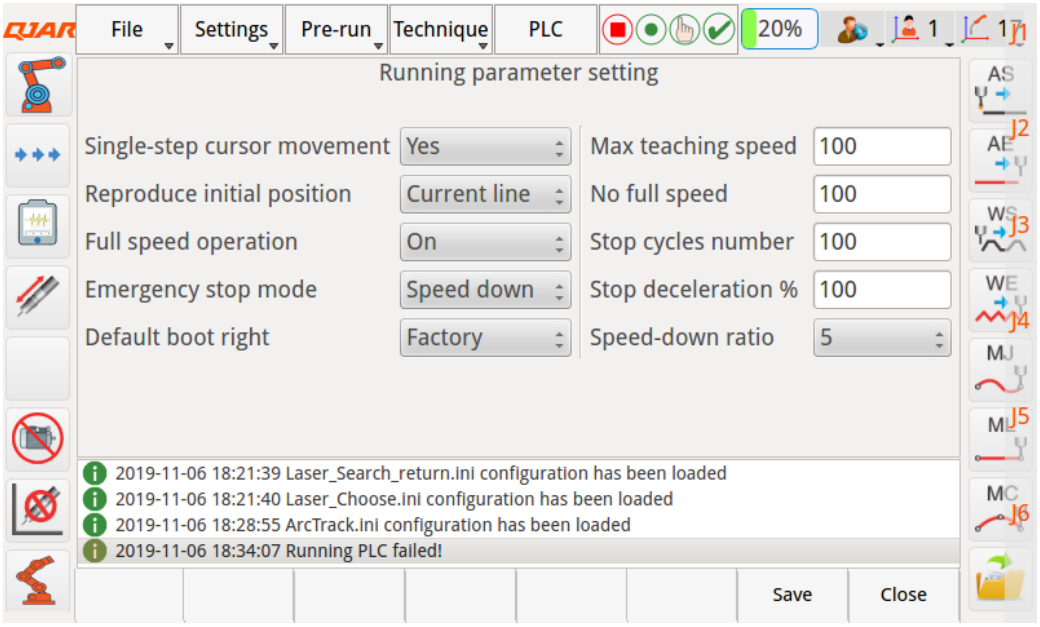
This parameter needs to open the: Manufacturer Authority
First, click <parameter setting> - <system speed parameter>. Pop up the following interface.



Used to set the speed +, - keys and control the speed gear changes.

9 Run Setting

This parameter needs to open the Manufacturer Authority
First, click <run preparation> - <run setting>. Pop up the following interface.



9.1 **Parameter List:**

No.	Parameter contents
1	Single step cursor moving or not
2	Maximum speed of Teach (%)
3	Initial position of Play
4	Not full-speed operation (%)
5	Full-speed operation
6	Stop cycles
7	Stop mode
8	Percentage of stop deceleration
9	Default start-up authority

10	Reduction ratio of process speed

9.2 Parameter Details:

Parameter No.	Parameter Definition	Options
1	Single step cursor moving or not	Yes No

It's used to set whether the cursor moves to the next line when running the single-step program in Teach mode.

Parameter No.	Parameter Definition	Unit
2	Maximum speed of Teach	%

It's used to set the maximum speed percentage of Teach in Teach mode.

Parameter No.	Parameter Definition	Options
3	Initial position of Play	First line Current line

It is used to set the start execution position when running the program in Play mode.

Parameter No.	Parameter Definition	Unit
4	Not full-speed operation	%

Used to set the percentage of speed that is not running at full speed when running at full speed is off.

Parameter No.	Parameter Definition	Options
5	Full-speed operation	On Off

It is used to set the speed processing mode in the PLAY and REMOTE mode, and whether to run at full speed according to the program command setting value.

Parameter No.	Parameter Definition	Unit
6	Stop cycles	

It is used to set the stop cycles when the stop mode is deceleration stop.

Parameter No.	Parameter Definition	Options
7	Emergency stop mode	Decelerati on stop Immediat ely stop

It is used to set the stop mode.

Parameter No.	Parameter Definition	Unit
8	Percentage of stop deceleration	%

Used to set the percentage of stop deceleration

Parameter No.	Parameter Definition	Options
9	Default start-up authority	Manufact urer Admini ster

		Operat or

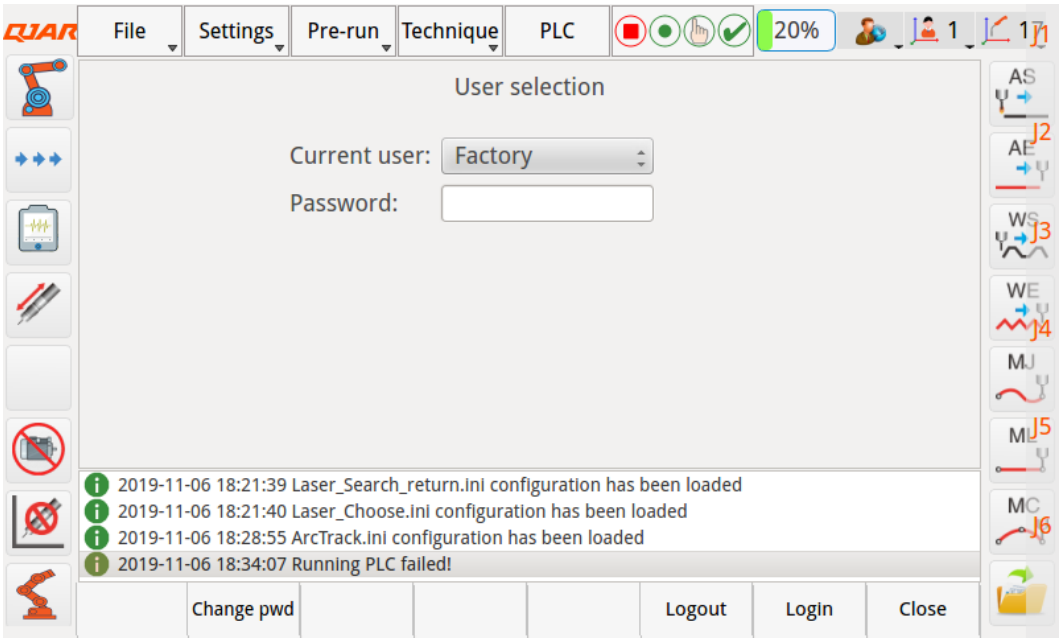
It is used to set the default authority after the robot starts up. If you need to modify it, you can change it in the selection and setting interface of operation authority.

Parameter No.	Parameter Definition	Options
10	Reduction ratio of process speed	1—20% 2—40% 3—60% 4—80% 5—100%

It is used to set the speed, acceleration and deceleration ratio of motion commands in welding process.

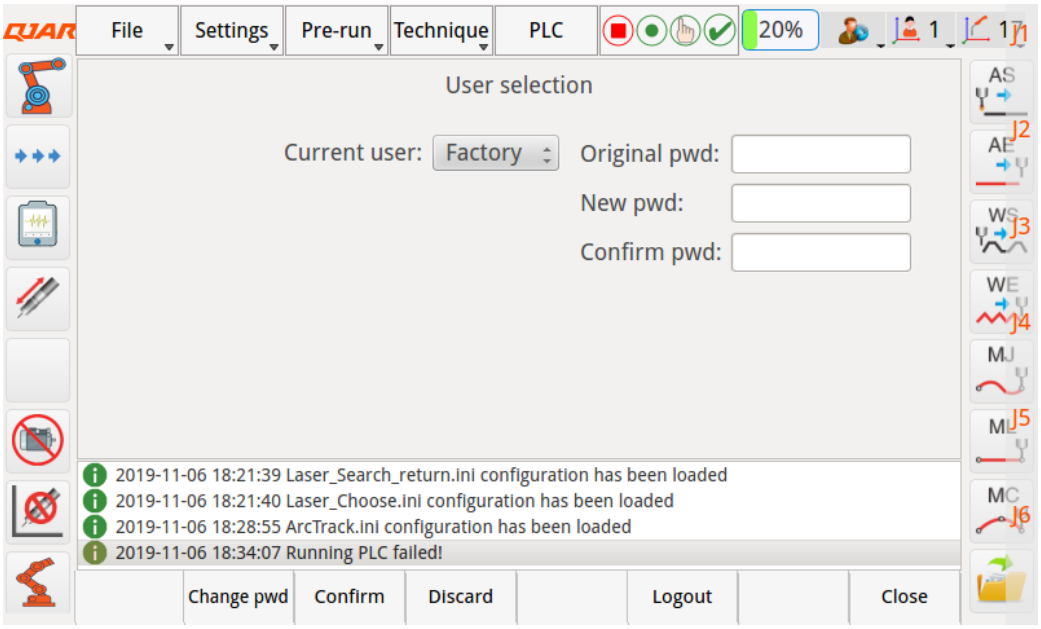
10 Operation authority

First, click <parameter setting> - <operation authority selection>. Pop up the following interface.



The user can switch to the corresponding authority by entering the password, including the manufacturer, administrator and operator. Different authority can unlock different function.

Click the <Modify Password> button to add password modification settings, the interface is shown as follows:



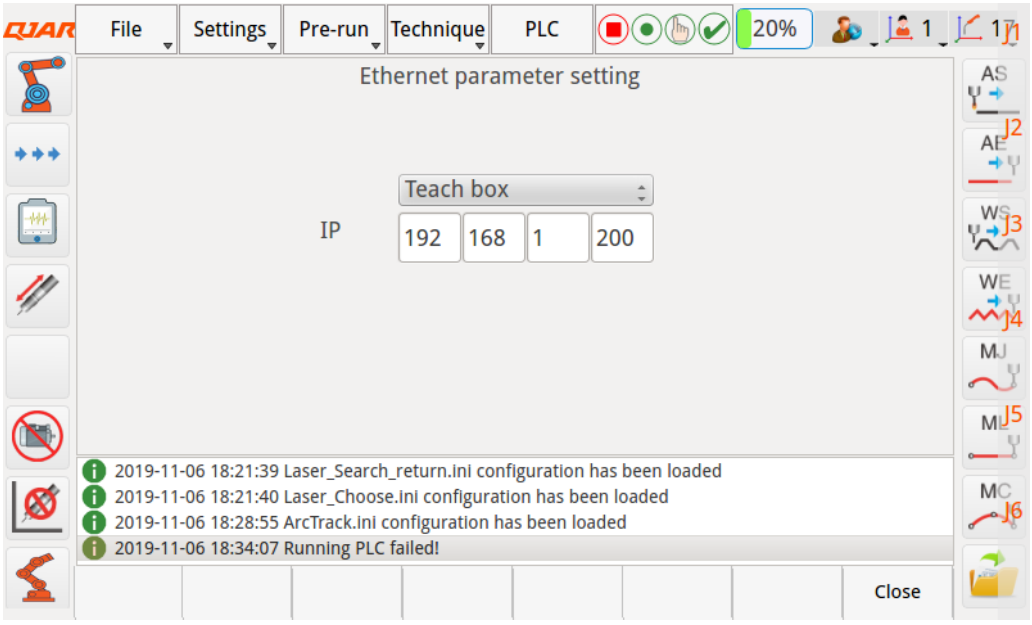
The user can modify the password of corresponded authority, enter the interface through the original password, enter the same new password twice, and confirm the modification. After completing the operations of <confirm modification> and <cancel modification>, the settings related to password modification disappear and the interface is restored.

11 Bus setting

11.1 Ethernet Setting

This parameter needs to open the Manufacturer Authority

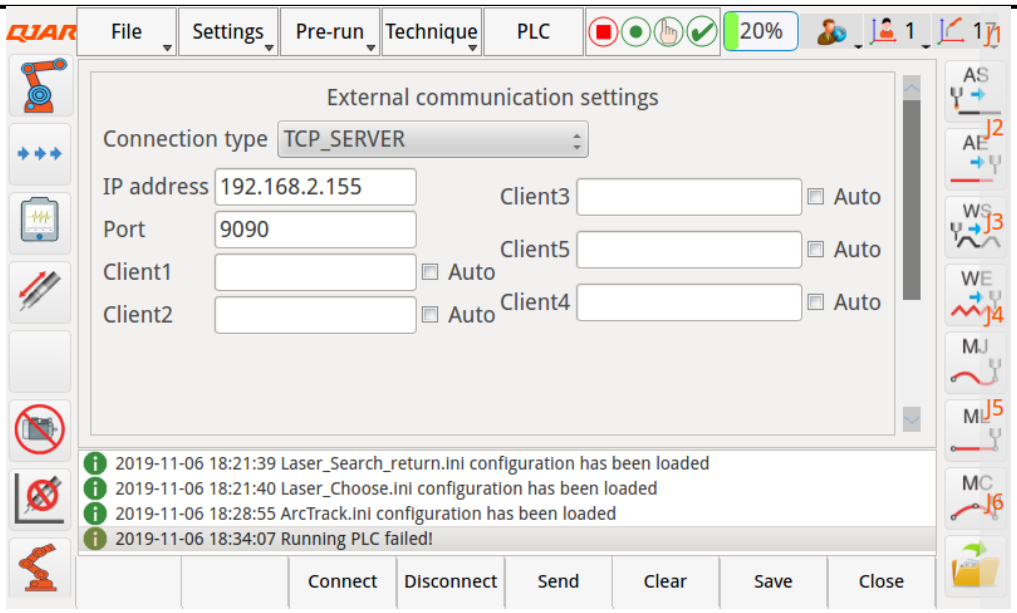
First, click <parameter setting> - <bus setting> - <Ethernet setting>. Pop up the following interface.



This parameter setting is not available.

11.2 External communication setting

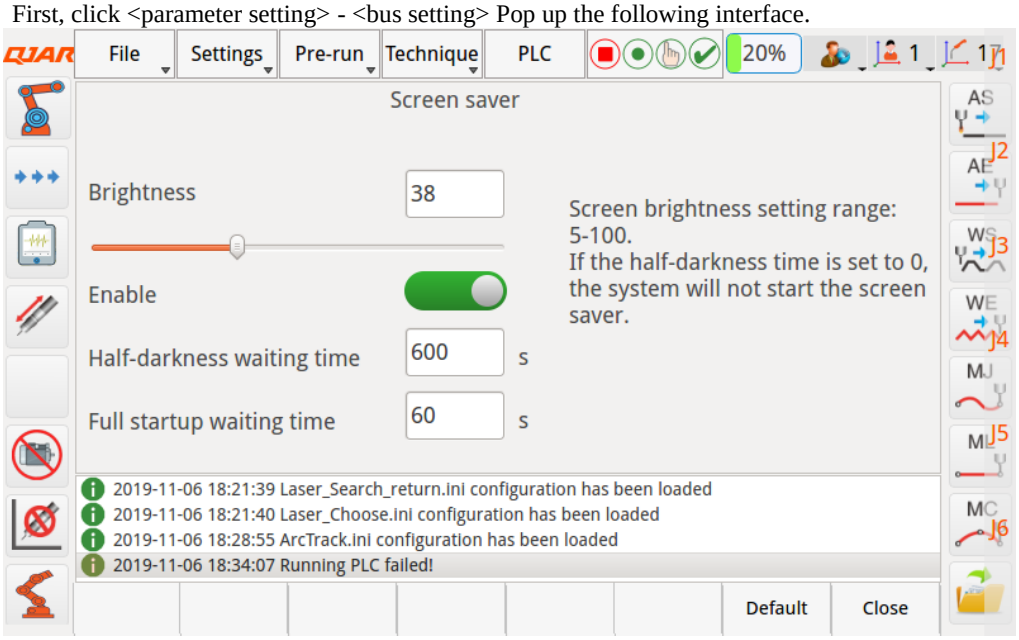
First, click <parameter setting> - <bus setting> - <external communication setting>. Pop up the following interface.



The connection type, server IP, and server port of the external device with which to communicate are available to set.

12 Screen saver parameter setting

First, click <parameter setting> - <bus setting> Pop up the following interface.



12.1 Parameter List:

No.	Parameter contents
1	Screen normal brightness
2	Screen half-dark brightness
3	Screen saver brightness
4	Screen saver enable
5	Screen half-dark waiting time
6	Screen saver full start waiting time

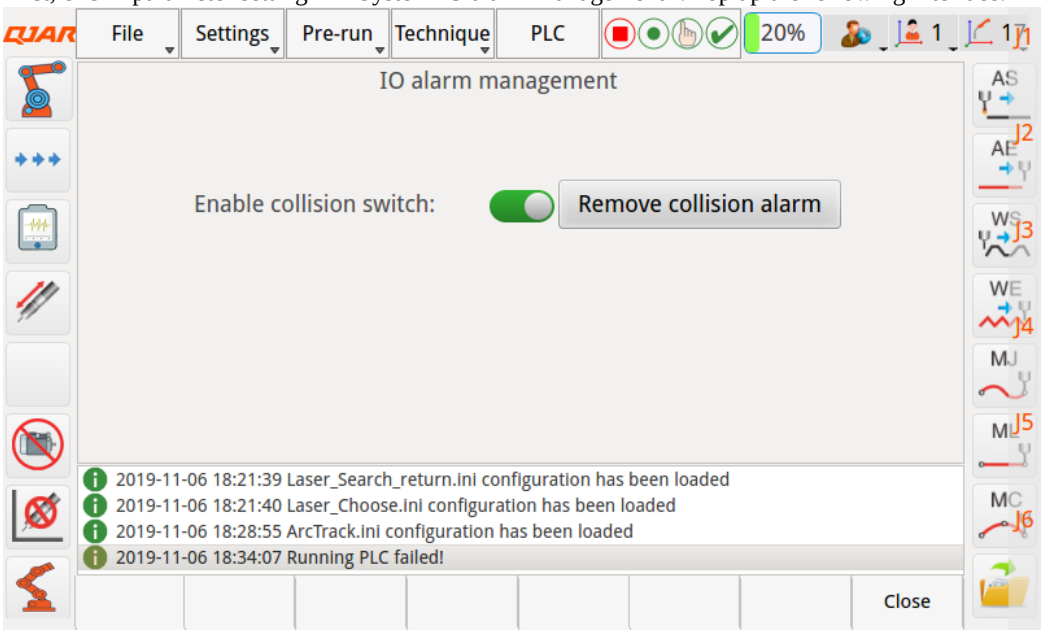
12.2 arameter Details:

Setting range of screen brightness: 1-100
Screen saver half-dark time: time elapsed when the screen entered the half-dark process

Screen saver full start waiting time: after entering the screen saver half-dark state, this time passes to enter the full screen saver state. If the half-dark time is set to 0, the system does not activate the screen saver.

13 System IO alarm management

This parameter needs to open the Manufacturer Authority
First, click <parameter setting> - <System IO alarm management>. Pop up the following interface.



13.1 Parameter List:

No.	Parameter contents
1	Collision switch enable

13.2 Parameter Details:

1. Parameter definition: collision switch enable
2. Parameter function: used to set whether the collision switch is valid or invalid.
   Note: This setting interface is provided with the <Collision Cancel> button, which is used to clear the collision state, so that the robot can be switched to the non-collision state manually.
3. Setting method: This parameter has two states, when setting to the  state, indicating that the collision switch is not turned on, the collision switch is invalid at this time; when setting to the  state, indicating that the collision switch function is turned on, and the collision switch is valid at this time. The initial value is set to  state.

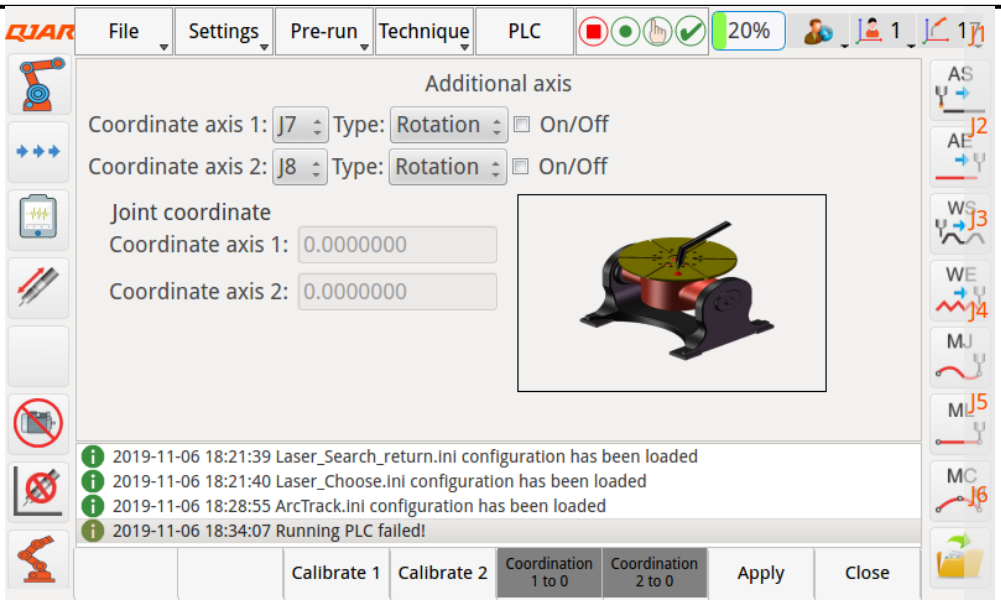
14 Additional axis setting

This parameter needs to open the Manufacturer Authority

The additional axis setting is divided into three interfaces: the additional axis setting interface, collaboration 1 calibrating interface, , and collaboration 2 calibrating interface.

14.1 Additional axis setting interface

First, click <run preparation> - <additional axis setting>. Additional axis setting interface pops up, and the figure is shown as follows:



Interface Content Description:

Collaboration 1 axis and collaboration 2 axis: It means the corresponding collaboration axis number. Now, collaboration 1 axis corresponds to J7 axis and collaboration 2 axis corresponds to J8 axis. At present, it does not support change or change function reservation.

Axis type: It indicates the current collaboration axis type, which is currently the rotation axis, and the sliding axis option and function reservation can be added later.

Collaboration 1 ON / OFF and collaboration 2 ON / OFF: It indicates whether the collaboration of the additional axis is turned on; in case it is selected, it indicates that the collaboration is turned on; otherwise, the collaboration is turned off.

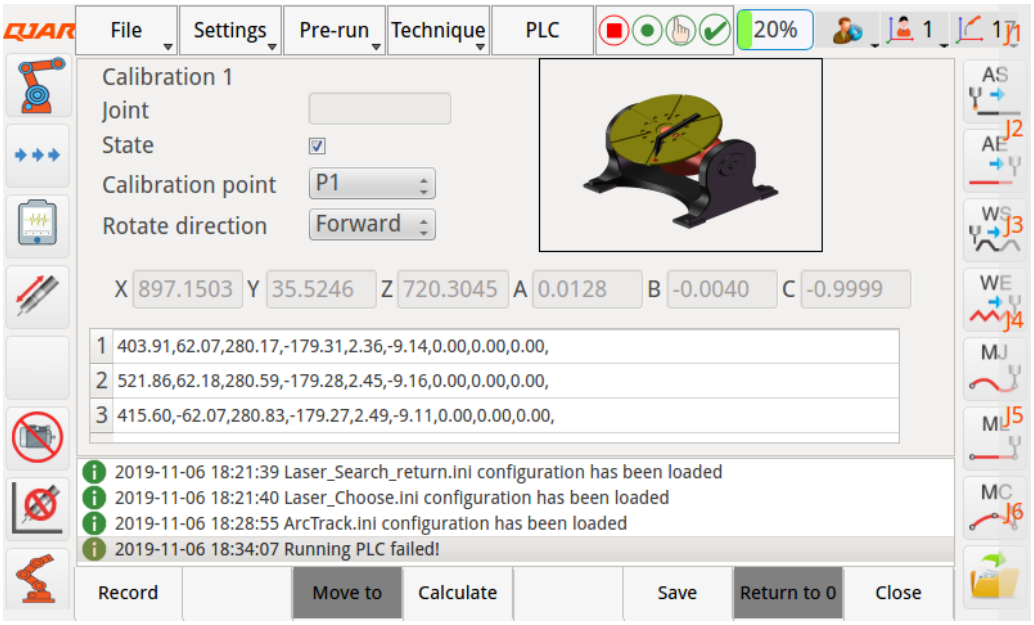
This switch is only valid for the additional axis action in the TEACH state; the additional axis shall operate according to its commands in PLAY and single-step mode. Joint coordinate: it indicates the corresponding angle value of the current collaborative axis. it is convenient to observe the position of the additional axis for the purpose of monitoring.

Coordination 1 to 0: press and hold the safety switch, and click this button to control the 1 to return to the zero position.

Coordination 2 to 0: press and hold the safety switch, and click this button to control the 2 to return to the zero position.

14.2 Collaboration 1 calibrating interface

Click <Run Preparation> - <Additional Axis Setting> - <Collaboration 1 Calibrating> to enter the Collaboration 1 Calibrating interface, as shown in the following figure:



Joint coordinate: it indicates the corresponding angle value of the current collaborative axis. it is convenient to observe the position of the additional axis for the purpose of monitoring. Calibration status: after successful calibration, this state will be displayed as selected; if unsuccessful, the state will not be selected.

Calibration points: there are three calibration points (P1, P2 and P3), which are used to select the point to be recorded or the point to be run to. For example, when P1 is selected, click Record to store the current point as P1, and the point information is displayed in the following list box; when P1 is selected, click Move to, the axis shall move from the current position to P1.

Rotation direction: function reserved, no effect at present.

XYZABC items: after all three points are recorded, click the button Calculate, and the calibration state will be displayed as the selected state, and the generated position information will be displayed in XYZABC items respectively.

The greater the angle difference between the three points, the higher the accuracy.

Return to zero: press and hold the safety switch, and click this button to control the 1 to return to the zero position. This button has the same function as <Collaboration 1 return to zero > in the additional axis setting interface.

For the additional axis teaching, the current working mechanism of the status display area shall be switched from  to  , at this time, the axis keys 456 of teach pendant is corresponds to the 789 axes, and the teaching operation of the collaboration axis of 7 and 8 axes can be performed.

Collaborative calibration process:

1) Record P1 point

collaborative the axis 1: Select a reference point on the positioner turned over by the J7 axis. The figure is shown as

follows:

Rotate the J7 axis to the first point P1 position. Click XYZ to move the robot, ensure the robot tool end is coincide with the positioner reference point. Click <record current point>, and the record of P1 point is completed.

2) Record P2 point

Rotate the J7 axis to the second point P2 position. Rotate the J7 axis to the first point P2 position. Click XYZ to move the robot, ensure the robot tool end is coincide with the positioner reference point.

Click <record current point>, and the record of P2 point is completed.

3) Record P3 point

Rotate the J7 axis to the third point P3 position. Rotate the J7 axis to the first point P3 position. lick XYZ to move the robot, ensure the robot tool end is coincide with the positioner reference point.

Click <record current point>, and the record of P3 point is completed. After all three points are recorded, click the button Calculate, the calibration state will be displayed as the selected state, and the generated position information will be displayed in XYZABC items respectively, the calibration is completed.

Collaboration 1 calibrating interface：

The calibration points must be calibrated strictly in the order P1-P2-P3.

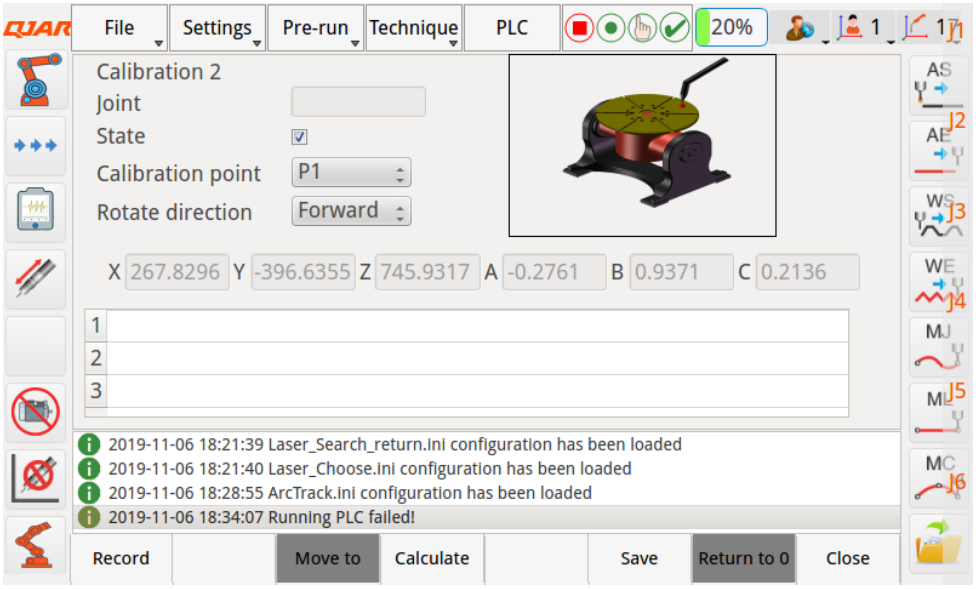
The angles P1-P2 and P2-P3 are greater than 30 degrees, and the angle P1-P3 is greater than 60 degrees. The greater the angle difference between the two points, the higher the accuracy.

In the process of moving and recording the points P1, P2, and P3, it is necessary to ensure that the robot gesture is consistent. That is, the gesture of the tool shall be adjusted before P1 point is recorded, and the gesture cannot be changed during the movement and recording of P1, P2 and P3.

During the calibration of P1, P2, P3 points, any coordinate system other than joint coordinates can be used for the coordinate system. If the calibration reference point is on the collaboration 2 axis, the coordination 2 axis cannot be moved when the coordination 1 is calibrated.

14.3 Collaboration 2 calibrating interface

Click <Run Preparation> - <Additional Axis Setting> - <Collaboration 2 Calibrating> to enter the collaboration 2 calibrating interface.



Joint coordinate: it indicates the corresponding angle value of the current collaborative axis. it is convenient to observe the position of the additional axis for the purpose of monitoring.

Calibration status: after successful calibration, this state will be displayed as selected; if unsuccessful, the state will not be selected.

Calibration points: there are three calibration points (P1, P2 and P3), which are used to select the point to be recorded or the point to be run to. For example, when P1 is selected, click Record to store the current point as P1, and the point information is displayed in the following list box; when P1 is selected, click Move to, the axis shall move from the current

position to P1.

Rotation direction: function reserved, no effect at present.

XYZABC items: after all three points are recorded, click the button Calculate, and the calibration state will be displayed as the selected state, and the generated position information will be displayed in XYZABC items respectively.

Return to zero: press and hold the safety switch, and click this button to control the 2 to return to the zero position. This button has the same function as <Collaboration 2 return to zero > in the additional axis setting interface.

Collaborative calibration process:

1) Record P1 point

collaborative the axis 2: Select a reference point on the positioner rotated by the J8 axis. The figure is shown as

follows:

Rotate the J8 axis to the first point P1 position. Click XYZ to move the robot, ensure the robot tool end is coincide with the positioner reference point. Click <record current point>, and the record of P1 point is completed.

Record P2 point

Rotate the J8 axis to the second point P2 position. Rotate the J8 axis to the first point P2 position. Click XYZ to move the robot, ensure the robot tool end is coincide with the positioner reference point. Click <record current point>, and the record of P2 point is completed.

Record P3 point

Rotate the J8 axis to the third point P3 position. Rotate the J8 axis to the first point P3 position. Click XYZ to move the robot, ensure the robot tool end is coincide with the positioner reference point. Click <record current point>, and the record of P3 point is completed.

After all three points are recorded, click the button Calculate, and the calibration state will be displayed as the selected state, and the generated position information will be displayed in XYZABC items respectively.

Collaboration 2 calibrating description:

When calibrating the collaboration 2 axis, the collaboration 1 axis must run to zero, otherwise the points P1, P2 and P3 cannot be recorded. The calibration points must be recorded strictly in the order P1-P2-P3.

The angles P1-P2 and P2-P3 are greater than 30 degrees, and the angle P1-P3 is greater than 60 degrees. The greater the angle difference between the two points, the higher the accuracy.

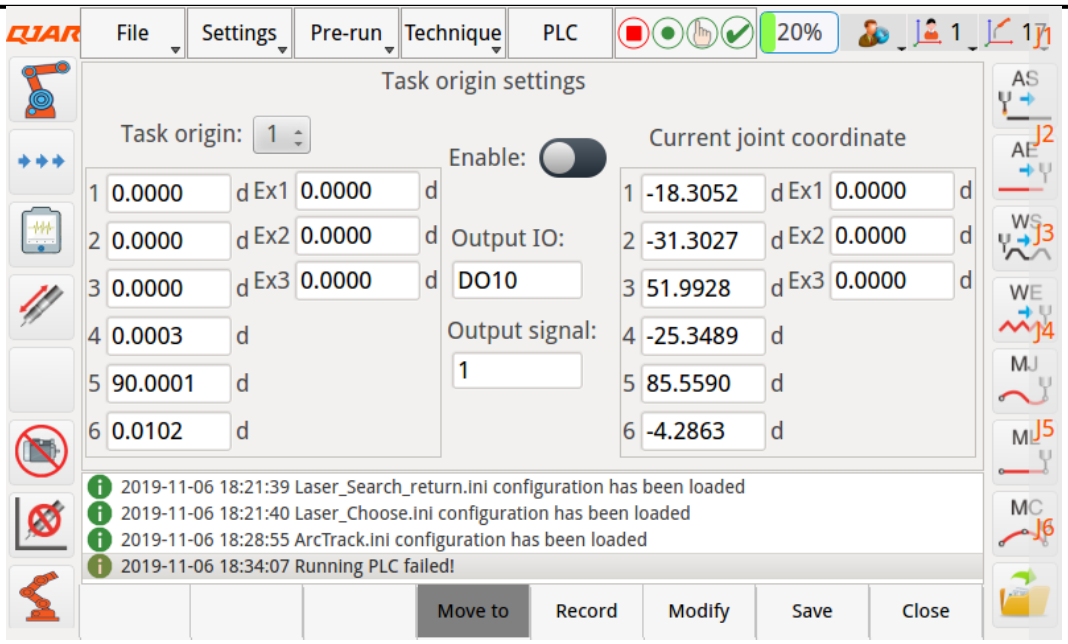
In the process of moving and recording the points P1, P2, and P3, it is necessary to ensure that the robot gesture is consistent. That is, the gesture of the tool shall be adjusted before P1 point is recorded, and the gesture cannot be changed during the movement and recording of P1, P2 and P3.

During the calibration of P1, P2, P3 points, any coordinate system other than joint coordinates can be used for the coordinate system. When calibrating the collaboration 2 axis, the coordination 1 axis cannot be moved.

15 Origin setting

This parameter needs to open the Manufacturer Authority

First, click <parameter setting> - <origin setting> Pop up the following interface.



Origin: the origin 1 - origin 4 are available to use.

Enable switch: The enabled origin is valid, and the not enabled origin is invalid Output IO: Set the output IO interface corresponding to the origin

Output IO: it is used to control the output state of the output IO interface.

Current joint coordinates: Real-time display of the current joint position of the robot

Origin coordinate: Recorded operation origin.

Record point: Record the current joint coordinates of the robot to the operation origin coordinates

Modification: Manually modify operation origin coordinates

Save: Save the operation origin coordinate value manually modified.

Check point: Press and hold the hand pressing switch, click the button “check point”, and the robot will run to the position of operation origin.

Thank you for choosing the products manufactured by our company!

Please read this System Operation Manual carefully and keep it properly for future reference!

If the equipment needs to be transferred to another party, please transfer the relevant data with it!

Keys, functions and options not specified in the System Operation Manual are deemed not available, please do not use them!