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Contents

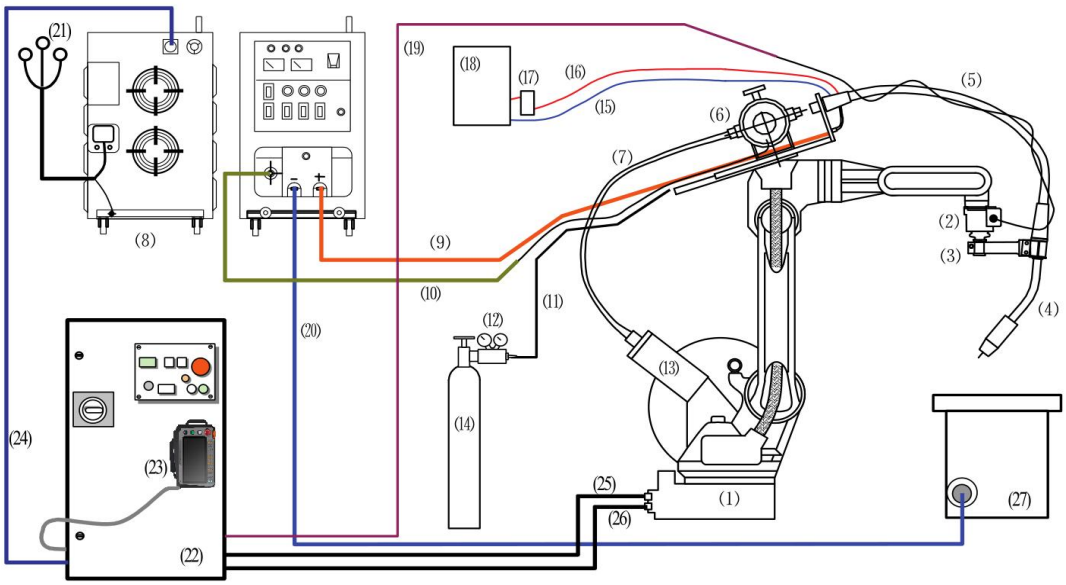
1 Overall Composition of Arc Welding System

1.1 Introduction to Welding Workstation

Introduction to robot welding:

Welding robot mainly includes two parts: robot and welding equipment. The robot consists of a robot body and a control cabinet (hardware and software). The welding equipment consists of its control system, wire feeder (arc welding), shielding gas, welding gun (pliers) and other parts. For intelligent robots, there should also be sensing systems,such as laser or camera sensors and their control devices.

1.2 Detailed Composition of Welding Workstation



Description of the basic structure of welding robot:

(1)	Robot body	(10)	Wire feeding mechanism control cable	(19)	Collision sensor cable
(2)	Anti-collision sensor	(11)	Protective gas hose	(20)	Power cable (-)
(3)	Welding gun holder	(12)	Shielding gas flow regulator	(21)	Welder power supply cable
(4)	Welding gun	(13)	Wire feeding tray rack	(22)	Robot control cabinet
(5)	Welding gun cable	(14)	Protective cylinder	(23)	Robotic teaching apparatus
(6)	Wire feeding mechanism	(15)	Cooling water cooling pipe	(24)	Welder communication cable
(7)	Wire feeding tube	(16)	Cooling water cooling pipe	(25)	Robot power supply cable
(8)	Welding power supply	(17)	Water flow switch	(26)	Robot control cable
(9)	Power cable (+)	(18)	Cooling water tank	(27)	Fixtures and workbenches

2 Welder Wiring Guidance

2.1 Welder Communication Type

2.1.1 Digital Welder

Wiring of digital welder: connect to CAN _ H and CAN _ L of IO module respectively.

2.1.1.1 Analog Welder

Analog welder wiring: The analog wiring is that a signal corresponds to a point. First, determine whether the wire to be connected is output or input, and connect the wire to be connected to the corresponding input and output modules respectively.

2.2 Key Points for the Use of Welder

2.2.1 Megmeet Welder

Megmeet Artsen II PM500 Series

Megmeet Ehave CM350 Series

Megmeet DEX DM3000 Series

Artsen PRO/PLUS Series

Only two wires are required: CAN-H, CAN-L

No additional 24V power supply is required

Select the Devicenet communication protocol, the baud rate is 125Kb, and the mac-id of the welder is 2

FAN (Fanuc) is selected as the welder-end communication type.

2.2.2 Aotai Digital Welder

Model: MAG series, Pulse-MIG series, NBC series, WSM series argon arc

welding

Connect two wires CAN-H, CAN-L

There are two kinds of welder communication boxes

Type 1: ATR-GATEWAY supports selection protocol

Currently supports AOTAICAN and Devicenet

When the protocol selects AOTAI CAN:

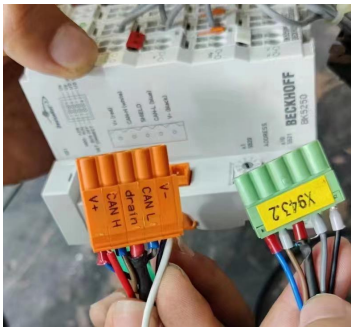
The welder ID is 1 and the dial code is 1

The Baud rate Baud is 125Kb and the dial code is 3

The Function selection FUNC is AOTAI CAN and the dial code is 1

See the figure below for details.

Robot Termination Wiring:



The wiring only needs to be connected to CAN L; CAN H;

If Devicenet is selected as Protocol:

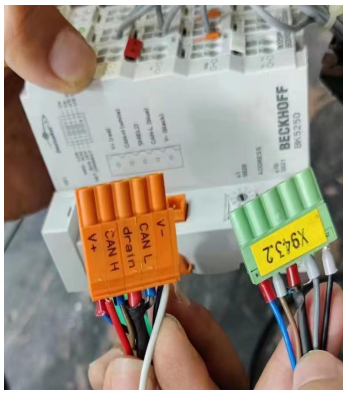
The welder ID is 2 and the dial code is 2

The Baud rate Baud is 125Kb and the dial code is 0

The Function selection FUNC is Devicenet and the dial code is 2

See the figure below for details

Robot Termination Wiring:



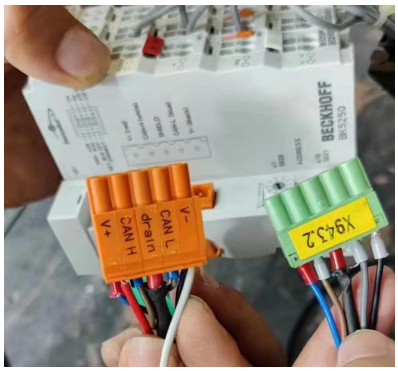
Wiring needs to be connected to CAN L and CAN H, V-(0V); V + (24V).

Type 1: Devicenet communication box

The welder ID is 2 and the dial code is 2

Baud rate Baud is 125Kb and the dial code is 0

Robot Termination Wiring:



Wiring needs to be connected to CAN L and CAN H, V-(0V); V + (24V).

2.2.3 Riland Digital Welder

Connect two wires CAN-H, CAN-L

The welder communication box requires additional 24V power supply from the robot electric control cabinet

Select CAN communication protocol, baud rate 250Kb

2.2.4 BinGo Digital Welder

Connect two wires CAN-H, CAN-L

No additional 24V power supply required

Devicenet, baud rate of 125Kb, welder mac-id of 5

If you choose a BinGo welder, you need to set the maximum current of the welder in the welder parameters.

2.3 Supported Solder Models

No.	Brand	Model or Protocol	Sub-Model	Communication Protocol	Parameter Setting
1	Megmeet	Artsen II Full range	Artsen	DeviceNet	macid = 2 Baud rate = 125KB The welder side communication type is selected as FAN (Fanuc)
			Ehave2-CM350/500	DeviceNet	
			Ehave2-CM630	DeviceNet	
			DEX2	DeviceNet	
		Artsen plus/pro full range	Full range	DeviceNet	
2	Aotai	Aotai gas shielded welding	Full range	DeviceNet/ CAN	macid = 2 Baud rate = 125KB
		Aotai argon arc welding	Full range	DeviceNet	
3	Fornis	Fornis TPS	Full range	DeviceNet	macid = 2 baud rate = 125KB
		Fornis TPSi	Full range	DeviceNet	Same settings as ABB robot, macid = 40 baud rate = 125KB
4	BinGo	BinGo gas shielded welding	Full range	DeviceNet	macid = 5 baud rate = 125KB
		BinGo argon arc welding	Full range	DeviceNet	
5	Zhenkang	General welder Zhenkang V30 protocol		EtherCAT/ CAN	CAN baud rate = 125KB
6	Riland	cloos		CAN	CAN baud rate 250KB
7	Cheng'An			UDP	Welder IP address: 192.168. 1.1 Welder UDP port number 11000
8	General	General welder Zhenkang V10 protocol		EtherCAT/ CAN	CAN baud rate = 125KB
9	Longtai			EtherCAT	

3 Basic Welding Process

3.1 Setting Robot Coordinate System

3.1.1 Establish Tool Coordinate System

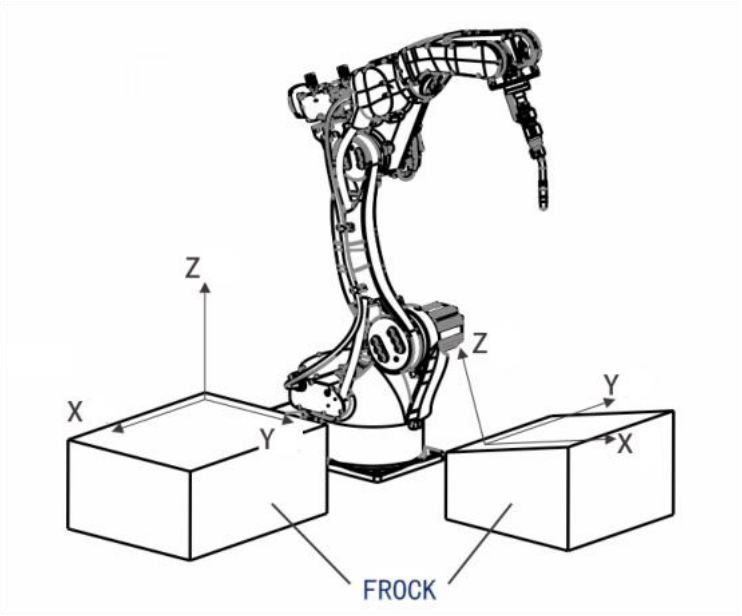
The effective direction of the tool held by the wrist flange of the robot is taken as the Z axis of the tool coordinate system, and the origin of the tool coordinate system is defined at the tip point (or center point) TCP of the tool.

There are {20-point method}, {6-point method}, {4-point method} and {3-point method} for tool coordinate system calibration methods. There are three methods to choose from. {6-point method} can comprehensively teach the position offset and attitude vector of the end tool TCP (TOOL CENTER POINT) of the six-axis joint robot; {4-point method} can only calculate the TCP position offset value of the end of the six-axis robot tool, but cannot calculate the attitude vector of the tool; The {3-point method} can only calculate the TCP attitude vector at the end of the six-axis robot tool, but cannot calculate the position offset value of the TCP at the end of the tool. The {6-point method} is actually a combination of {4-point method} and {3-point method}. The first four search points recorded in {6-point method} use the {4-point method} to calculate the position offset of the TCP at the end of the tool, and the last three search points use the {3-point method} to calculate the TCP pose vector of the tool.

For the specific calibration steps of the three methods, refer to the *User Manual of Intelligent Manifold Control System*.

3.1.2 Establish Workpiece Coordinate System (User Coordinate System)

Establish the workpiece coordinate system to facilitate teaching points during programming. You can set multiple workpiece coordinate systems according to your needs.



The user can enter the calibration management interface through the submenu {Coordinate System Management} under the system application menu.

Step 1: Select the Coordinate System No. and Type

The default coordinate system (1) cannot be modified. Please select calibration from No. 2.

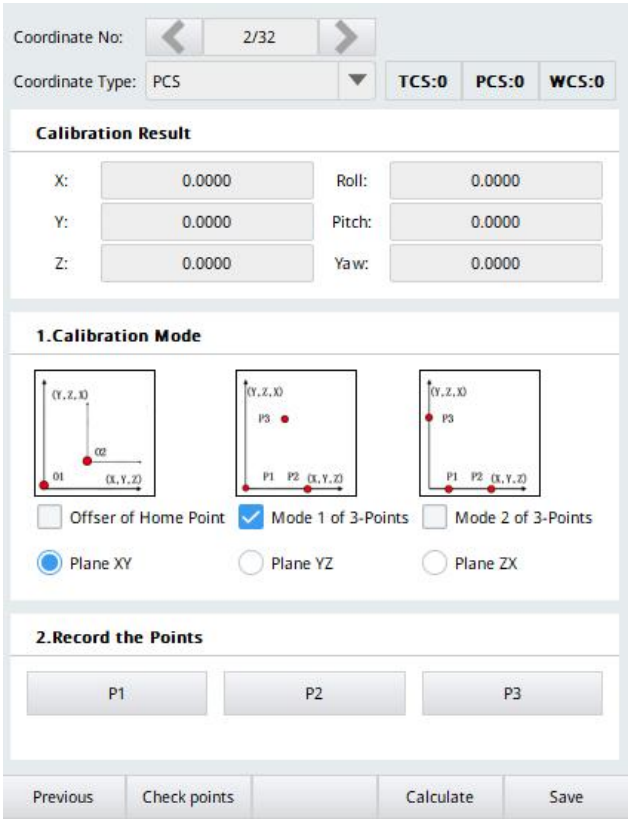
Step 2: Select Calibration Method

Select the calibration methods {three-point method mode 1} and {three-point method mode 2}. In addition, the user can also add a coordinate origin, offset search point, and O_0 point to be recorded. This search point is optional. When the user uses this function, the coordinate system taught by the user using the above two methods can be shifted to O_0 the search point of the teaching record, while the posture of the coordinate system remains unchanged.

The user can select the plane of the coordinate system to be taught by pressing the {XY}, {YZ} and {ZX} buttons on the interface.

Step 3: search point Recording

Move to the search point, click the corresponding button, and the background color of the button changes to green (as shown in the figure below), indicating that the recording is successful. Note that the calibrated search points should not be too close to each other.



Workpiece coordinate system calibration interface

Step 4: Calculate and Save the Results

Click {Calculate}, and if it shows success, click {Save Result}; If it fails, an alarm will be displayed in the status bar, and modify or recalibrate according to the alarm prompt.

In addition, on the search point recording interface, the user clicks the {Teaching Point} button to enter the teaching point management interface. On this interface, the user can view the recorded search point data and can make the robot move to the designated recording point. First, select the recorded search point, then make the robot in the servo-enabled state, select points P1, P2, P3 and {Move to Point}, press and hold [Forward], and the robot moves towards the specified search point according to the linear motion mode. Click {Back} to return to the calibration interface.

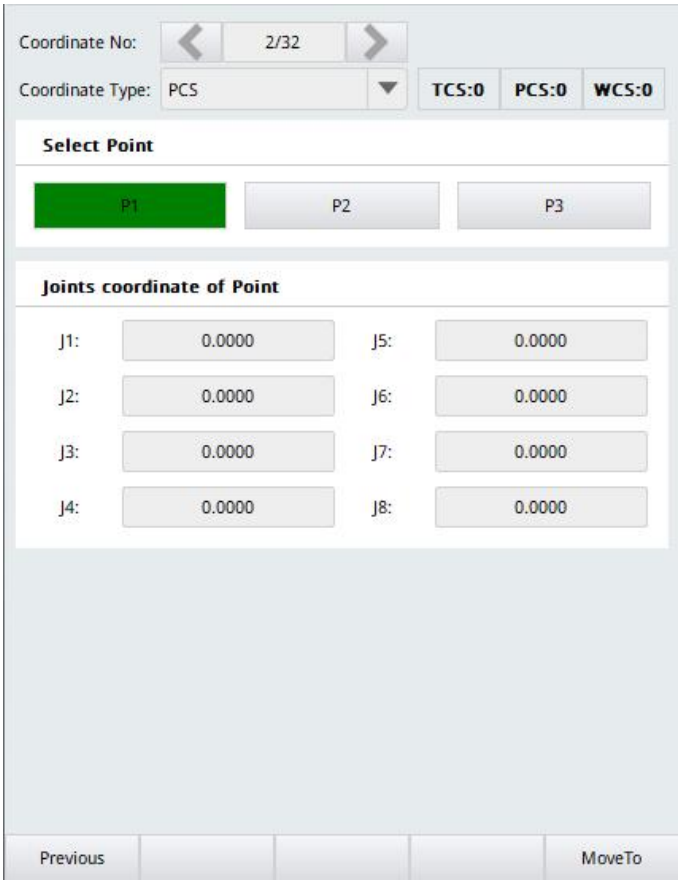


Fig.1Viewing interface of the the teaching point

Step 5: Set Current

After calibrating a workpiece coordinate system, return to the coordinate system management interface and set the calibrated coordinate system to the currently used coordinate system. Check whether 

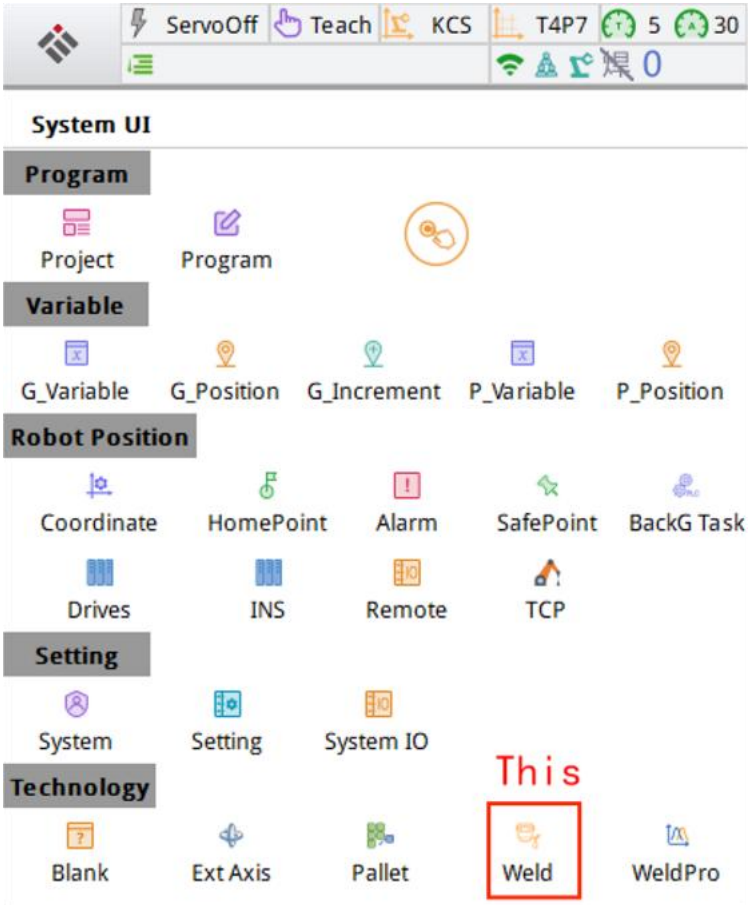
on the status bar displays the set coordinate system serial number, T is the tool coordinate system, and P is the workpiece coordinate system.

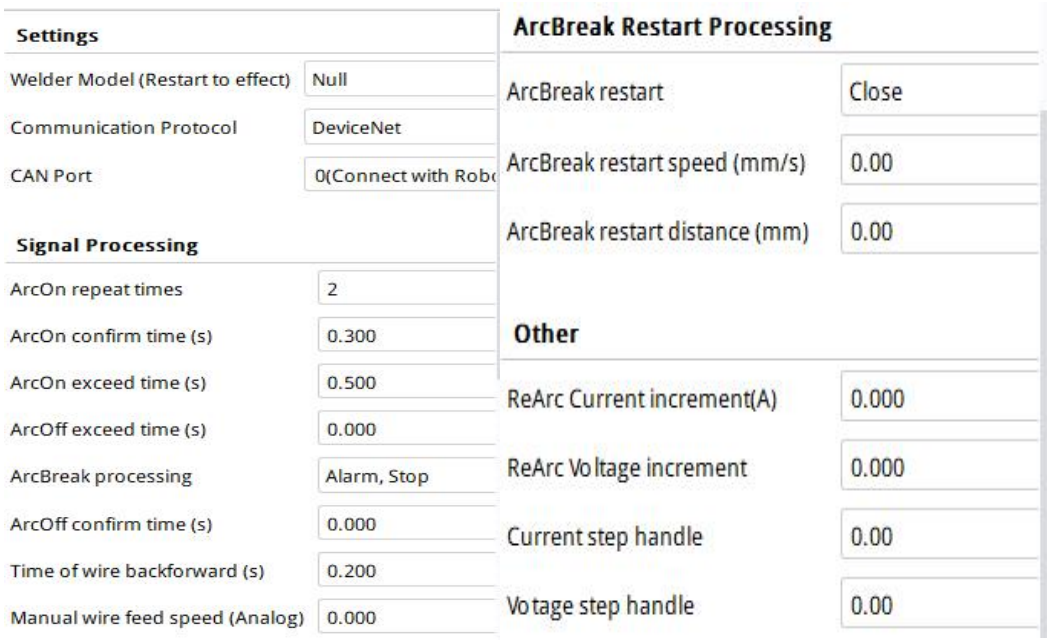
Step 6: Verify the coordinate system

The directional accuracy of the calibrated coordinate system is verified by the translational motion of TCP at the end of the robot tool along the X, Y and Z axes of the PCS coordinate system and the rotational motion around the X, Y and Z axes of the PCS coordinate system of the point (tip).

3.2 Basic Settings

Enter the foundation welding interface



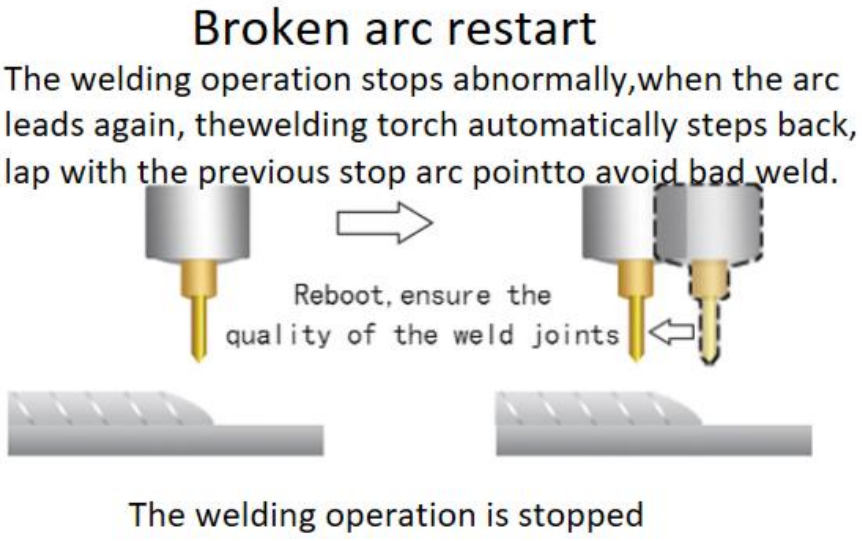


List of parameters:

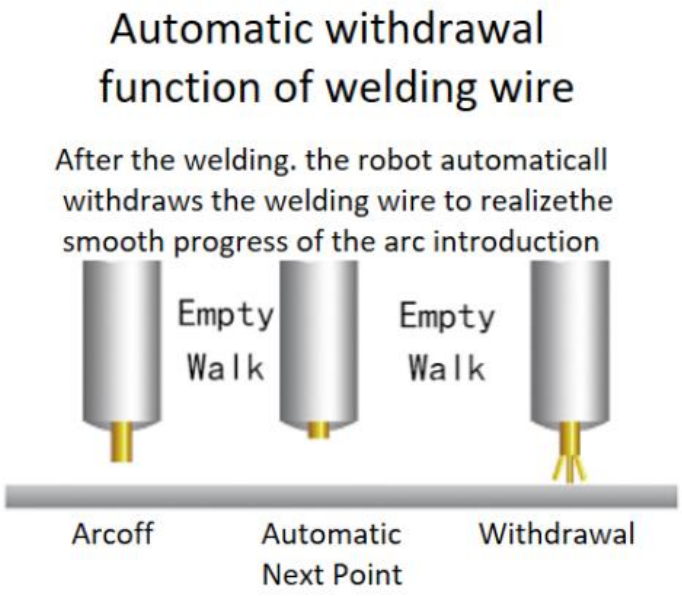
No.	Parameter Name	Parameter Description
1	Welder model	Currently supports Megmeet Artsen, Megmeet Plus (Pro), Aotai Gas Welding, Aotai TIG Welding, Riland, Fornis TPS/TPSi, BinGo Gas Shielded Welding, BinGo TIG Welding. **Some welders need to restart the electric control cabinet and welder after selecting the model and saving settings before it takes effect.**
2	Communication protocol	DeviceNet (CAN) is currently supported, analog
3	Number of arc ignition restarts	Used to set the number of automatic re-arcing times when the first arcing fails
4	Arc ignition confirmation time (s)	It is used to set the continuous time for the system to detect the successful arc starting signal, that is, the system must continuously detect the successful arc starting signal for this parameter time before it is considered that the arc starting is successful.
5	Arc ignition timeout (s)	After the welding gun is turned on, if the arc starting is not confirmed successfully after this time, the alarm will be shut down
6	Arc breaking	Alarm shutdown/warning empty away

	treatment	
7	Wire retreat time	Used to set the duration of wire retraction after welding is completed
8	Arc break confirmation time (s)	It is used to set the continuous time for the system to detect the arc break signal, that is, the system must continuously detect the arc break signal for this parameter time before it is considered that the arc break is successful.
9	Current row restarts arc start	On/Off
10	Recovery speed (mm/s)	Return to speed at arc break point
11	Fallback distance (mm)	Distance of retreat of arc break point
12	CAN port	The CAN port of the controller board is 0. The CAN port of the IO module is the IO number, starting from 1.
13	Manual wire feeding speed	The speed of the wire feeder during manual wire feeding or post-welding withdrawal.

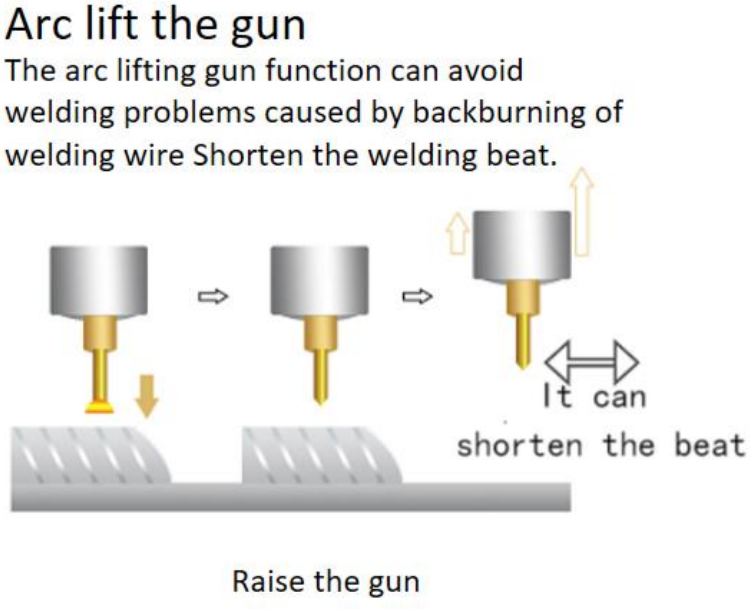
The intention of broken arc re-enlightenment:



Schematic diagram of welding wire withdrawal:

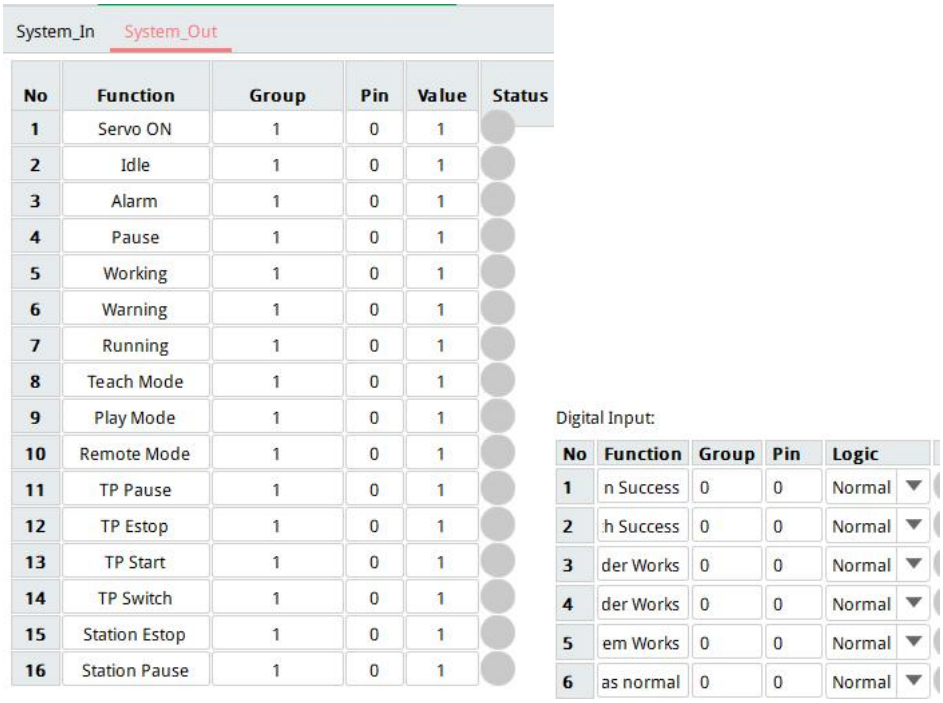


Schematic diagram of arc retraction and gun lifting:



3.3 Analog Welder Settings

3.3.1 I/O Configuration



System_In System_Out

No	Function	Group	Pin	Value	Status
1	Servo ON	1	0	1	
2	Idle	1	0	1	
3	Alarm	1	0	1	
4	Pause	1	0	1	
5	Working	1	0	1	
6	Warning	1	0	1	
7	Running	1	0	1	
8	Teach Mode	1	0	1	
9	Play Mode	1	0	1	
10	Remote Mode	1	0	1	
11	TP Pause	1	0	1	
12	TP Estop	1	0	1	
13	TP Start	1	0	1	
14	TP Switch	1	0	1	
15	Station Estop	1	0	1	
16	Station Pause	1	0	1	

Digital Input:

No	Function	Group	Pin	Logic
1	n Success	0	0	Normal
2	h Success	0	0	Normal
3	der Works	0	0	Normal
4	der Works	0	0	Normal
5	em Works	0	0	Normal
6	as normal	0	0	Normal

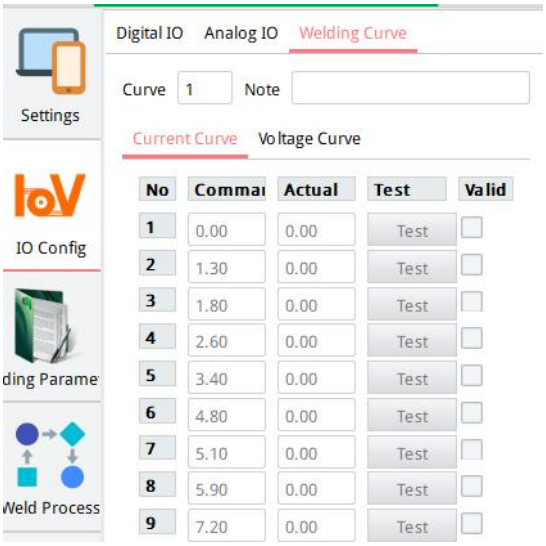
Modules and points: I/O configured modules and points need to be configured according to actual wiring.

Logic: Normally, the signal is output, but the signal is not output. Reverse means not to output the signal, but to stop outputting the signal.

For example, the arcing line is connected to the second point of the first module. Then the module is 1 and the point is 2. Gas picking requires the controller to send a signal to be effective. The logic is normal.

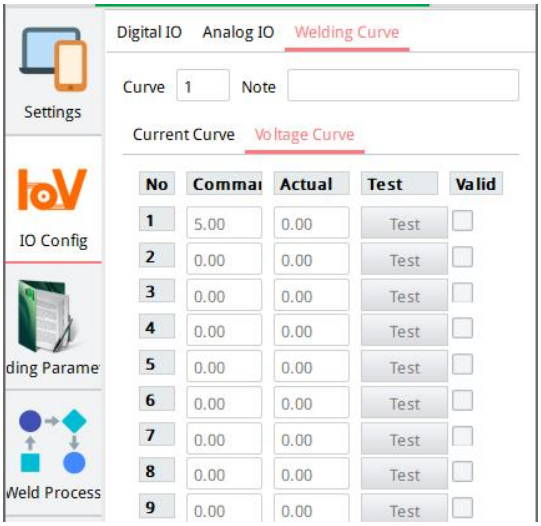
3.3.2 Current-Voltage Characteristic Curve

Configure current curve table.



Check valid → enter the command value current → click send → a current value will be obtained on the welder display panel, fill it in the actual value. Fill in the array current curve, and click Save after filling it out. (There is no strict requirement for the order of current magnitude)

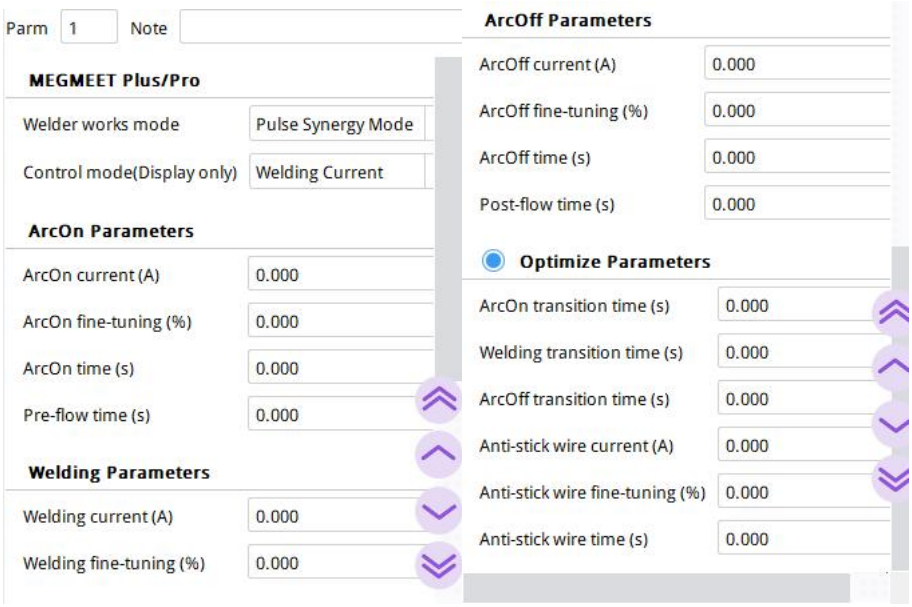
Configuration voltage curve table



Check valid → Enter the command value voltage → Click send → A voltage value will be obtained on the welder display panel, and fill it in the actual value. Fill in the array voltage curve, and click Save after filling it out. (The order of voltage is not strictly required)

3.4 Welding Parameters

Depending on the selection mode configuration parameters are saved to the selected file number, a program can call multiple welds parameter. Different welding machine working modes need to set different welding parameters.

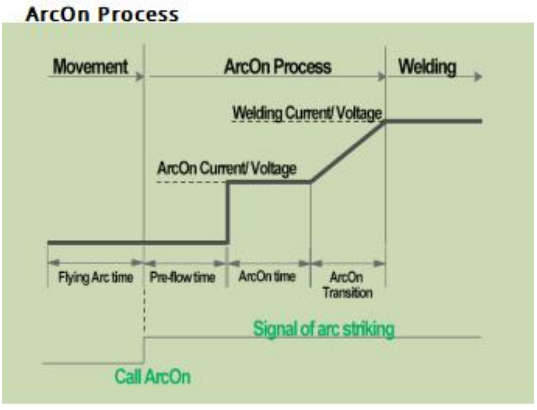


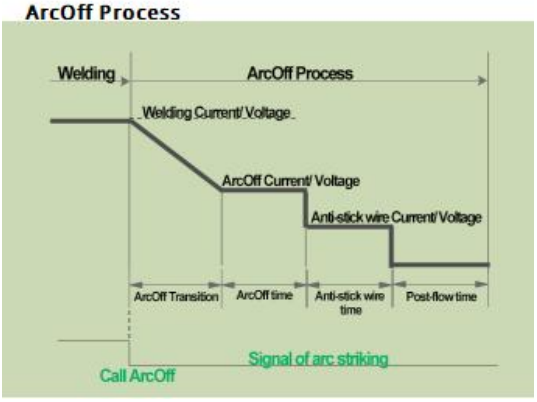
List of parameters

No.	Parameter Name	Parameter Description
1	Welding works mode	DC unification; Pulse unification; JOB mode; Intermittent welding
2	Controlling method	Current/wire feed speed (for display only)
3	JOB Number	Corresponding to JOB mode, the Welding File No. set by the welder
4	Arcing current/voltage	When arcing is difficult, the current can be adjusted appropriately
5	Advance air delivery time	Set the air supply time before arcing to protect the welding area
6	Welding current/voltage	The value set during normal welding. This value is set according to the field process.
7	Arc closing current/voltage	Usually, the arc closing current will be smaller than the value during welding.
8	Delayed gas shutdown time	Set the air supply time after arc breaking to protect the weld
9	Arcing time	Set the holding time of arcing current. If this

		value is set too large, it will be used if there is surfacing at the beginning of the weld
10	Arc closure time	Set the holding time of arc closing current. If this value is set too much, there will be surfacing at the end of the weld
11	Arcing transition	Time of transition from arcing current/voltage to welding current/voltage
12	Welding transition	Transition time when changing voltage and current during welding
13	Arc closing transition	Time of welding current/voltage transition to arc closing current/voltage
14	Anti-stick wire current/voltage	Use only when there is welding wire sticking at the arc closing point
15	Anti-stick silk time	Set the holding time of the anti-stick wire current.
16	Arc starting/welding/arc closing fine-tuning	In the unified mode, the welder adjusts the voltage (current) parameters matched by the set arc starting/welding/arc closing current (voltage)

The welding control timing diagram is as follows:





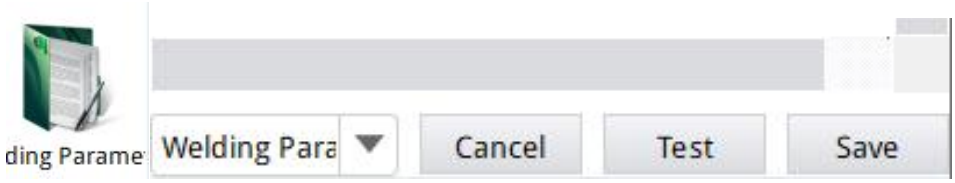
3.5 Welding Manual Testing

The floating menu is popped/**closed** by handheld operation of the [fn2] key on the teach pendant**.**

A common operation before starting welding to detect.

Level 1	Level 2	Function description
		Gas detection signal test
		Wire feeding signal test
		Wire withdrawal signal test

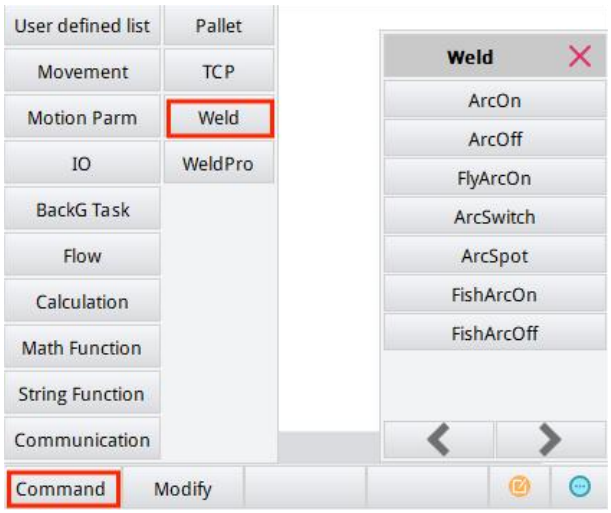
Welding parameter sending test



3.6 Welding Process Instructions and Programming Examples

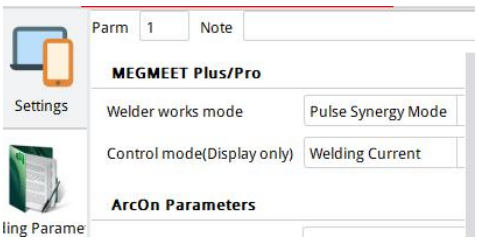
3.6.1 Insert Welding Instructions

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



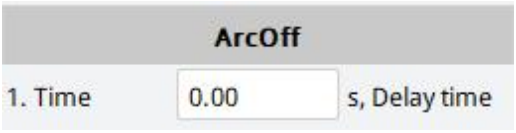
3.6.2 Instruction Parameters

3.6.2.1 ArcOn arcing

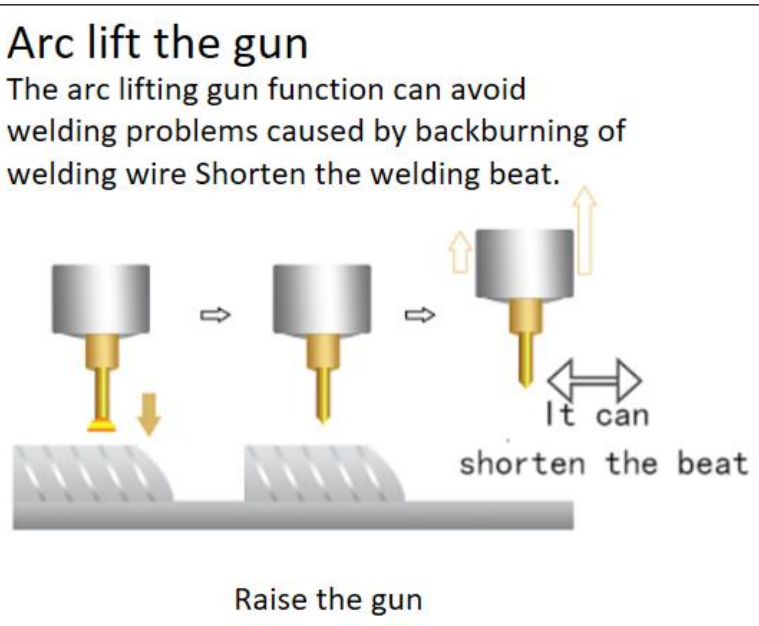
Instruction Example	ArcOn File = 1 Time = 0;	
Settings Interface		
Parameter Description	File	Select the corresponding configured welding parameter file. 

	Time	1. The default situation is Time = 0. After the robot receives the successful arc starting signal of the welder, after waiting for the arc starting Time, the execution of the arc starting instruction ends normally, the subsequent motion instruction is started, and the robot starts to move. 2. After the robot receives the successful arc ignition signal of the welder, it waits for Time and starts to execute subsequent motion instructions. (Time is the arc stabilization Time, which is adjusted by the on-site technologist according to the arc starting situation)
Notes	Use with ArcOff directives	

3.6.2.2 ArcOff Close Arc

Instruction Example	ArcOff Time = 0;	
Settings Interface		
Parameter Description	Time	1. The default situation is Time = 0. After the robot reaches the arc closing point and stops, it starts to execute the arc closing operation, waits for the delayed air supply to be completed, and the arc closing instruction ends normally, and starts to execute the subsequent teaching program. 2. After the robot reaches the arc closing point and stops, it starts to perform the arc closing operation, and then executes the subsequent teaching program after waiting for Time. (Time is adjusted by the welding technician himself. While welding is performing the arc-closing process, the robot can execute subsequent motion instructions in parallel, such as the lifting action of the welding torch during the arc-closing process) 3. If the robot needs to be in place and stationary to

		start the arc closing process, you can immediately perform the subsequent teaching operation without waiting for the successful arc closing signal, and set the parameter to 0.01 (not 0).
Notes	Use with ArcOn directives	

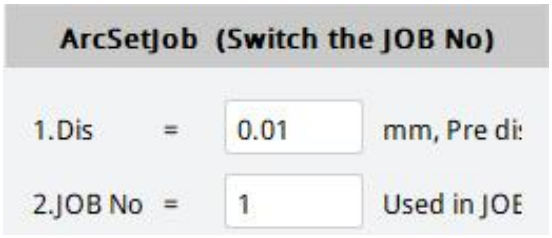
Description and schematic diagram of arc retraction and gun lifting	

3.6.2.3 ArcSet changes Welding Voltage and Current

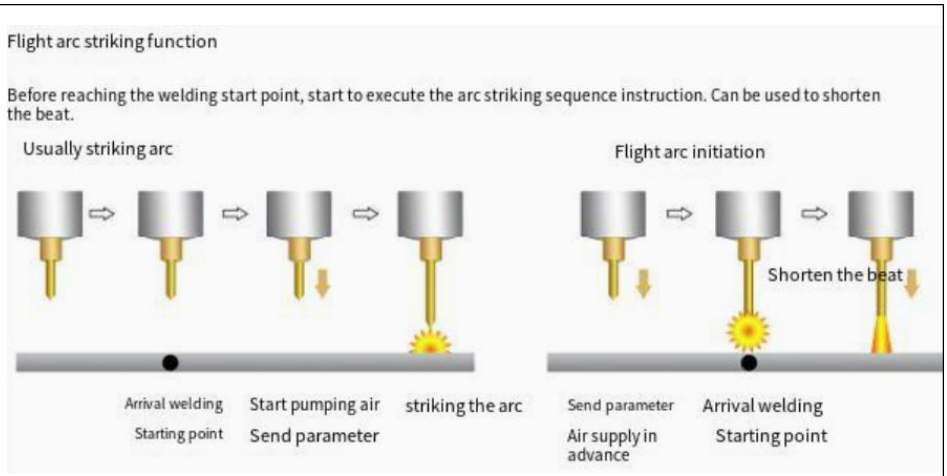
Instruction Example	Movl P = # P2 V = 5 mm/s Bl = 5 mm; ArcSet Dis = 10 C = 100 V = 100;	
Settings Interface		
Parameter Description	Dis	Advance distance, in mm. As a reference example, a command is sent to change the voltage and current when the distance is 10mm from the point P2
	C	Welding current to be set, unit A
	V	Welding voltage to be set in V
Notes	1. The welder mode needs to be set to non-JOB mode;	

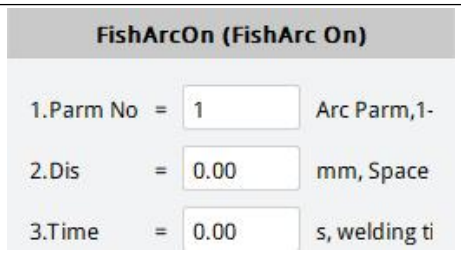
	2. If you want to modify the welding current and voltage while the robot moves without stopping, the motion instruction in the front line of this instruction must have blending; 3. In a welding process, this instruction can only be called once at present, that is, the welding parameters can only be modified once.

3.6.2.4 ArcSetJob Toggle Job

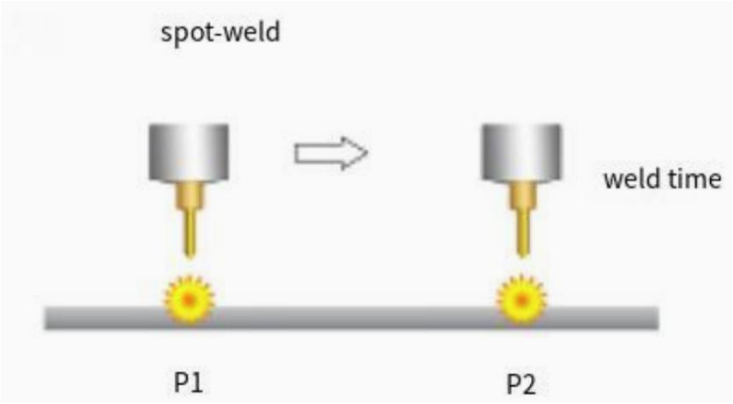
Instruction Example	Movl P = # P3 V = 5 mm/s Bl = 5 mm; ArcSetJob Dis = 10 Job = 1;	
Settings Interface		
Parameter Description	Dis	Advance distance, in mm. As a reference example, an instruction is sent to switch the JOB No. when the distance is 10mm from the P3 point
	job	JOB No. to be switched
Notes	1. The welder mode needs to be set to JOB mode; 2. If you want to modify the welding current and voltage while the robot moves without stopping, the motion instruction in the front line of this instruction must have blending; 3. In a welding process, this instruction can only be called once at present, that is, the welding parameters can only be modified once.	

3.6.2.5 FlyArcOn Flight Arcing

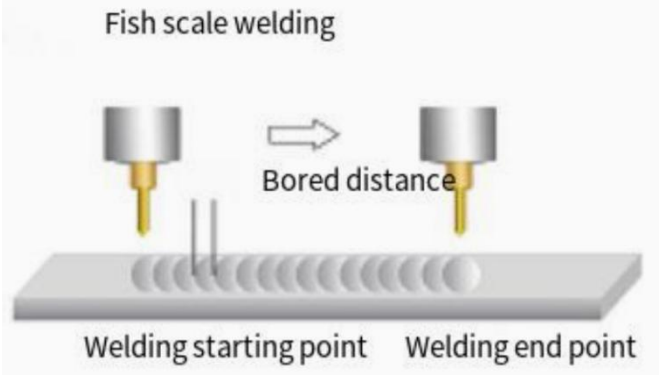
Description and schematic diagram of arcing	

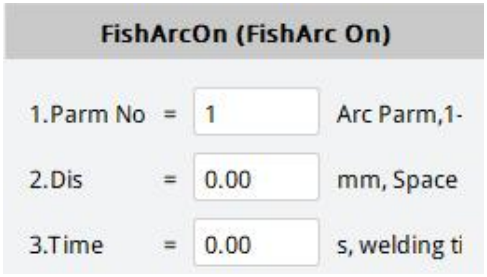
Instruction Example	FlyArcOn Dis = 10 File = 1 Time = 0 C = 9 V = 2; Movl P = # P2 V = 5 mm/s Bl = 5 mm;	
Settings Interface		
Parameter Description	Type	Flight start type, default to distance
	Dis	Flight distance, in mm. Referring to the example, the arc starting process starts at 10 mm from point P2.
	File	Welding Parameter File No.
	Time	1. The default situation is Time = 0. After the robot receives the successful arc starting signal of the welder, after waiting for the arc starting Time, the execution of the arc starting instruction ends normally, the subsequent motion instruction is started, and the robot starts to move. 2. After the robot receives the successful arc ignition signal of the welder, it waits for Time and starts to execute subsequent motion instructions. (Time is the arc stabilization Time, which is adjusted by the on-site technologist according to the arc starting situation)

3.6.2.6 ArcSpot Spot Welding

<table>
<tr><td>Schematics</td><td colspan="2"> 
</td></tr>
<tr><td>Instruction Example</td><td colspan="2">ArcSpot File = 1 Time = 0;</td></tr>
<tr><td>Settings Interface</td><td colspan="2"> 
</td></tr>
<tr><td rowspan="2">Parameter Description</td><td>File</td><td>Select the corresponding configured Welding Parameter File No.</td></tr>
<tr><td>Time</td><td>The default situation is Time = 0, and the waiting Time for the robot to execute the command after receiving the spot welding signal.</td></tr>
</table>

3.6.2.7 FishArcOn Fish Scale Welding On

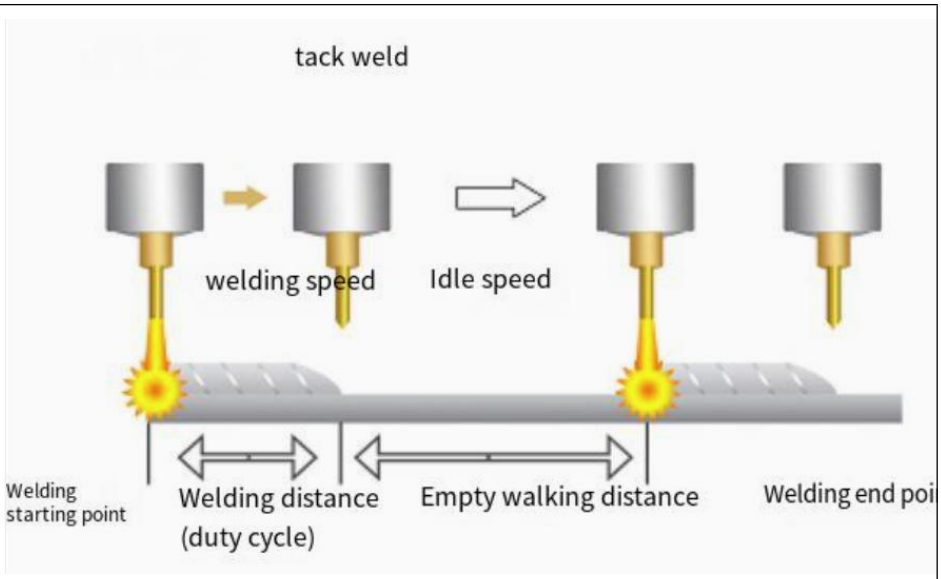
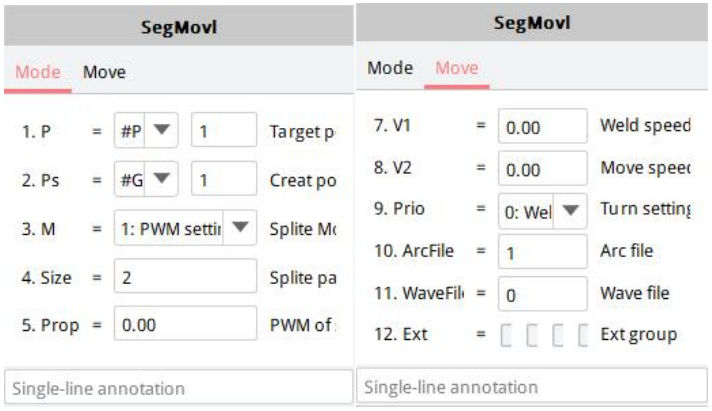
<table>
<tr><td>Schematics</td><td> 
</td></tr>
</table>

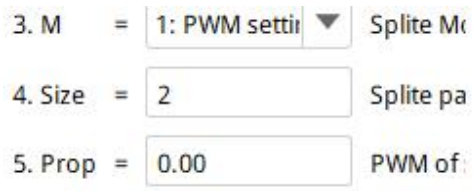
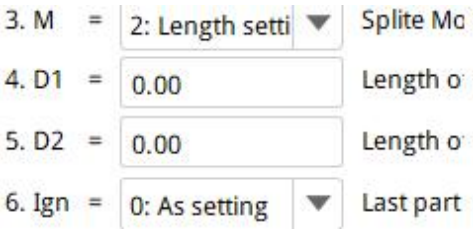
Instruction Example	FishArcOn File = 1 Dis = 0 Time = 0;	
Settings Interface		
Parameter Description	File	Select the corresponding configured Welding Parameter File No.
	Dis	The spacing between the two "fish scales is set according to the process requirements.
	Time	The welding duration of each fish scale is set according to the process requirements.

3.6.2.8 FishArcOff Fish Scale Welding Off

Settings Interface	
Parameter Description	Insert this instruction at the end of the fish scale welding process and use it with the fish scale welding on

3.6.2.9 SegMovl Intermittent Welding Program Generation

<table>
<tr><td>Schematic diagram of intermittent welding</td><td colspan="2"> 
</td></tr>
<tr><td>Instruction Example</td><td colspan="2">SegMovl mode: P = 3 Ps = # GP4, M = input duty cycle, Size = 10, Prop = 0.6;
Motion: v1 = 5 mm/s, v2 = 100 mm/s, Prio = 0, ArcFile = 1 WaveFile = 1, Ext = B;</td></tr>
<tr><td>Settings Interface</td><td colspan="2"> 
</td></tr>
<tr><td rowspan="2">Parameter Description</td><td>P</td><td>Target point, where the end of the weld. The target point coordinate system can only be: robot coordinate system, workpiece coordinate system or world coordinate system, not joint coordinate system.
If changing coordinate systems such as guide rails or positioners are used, both the target point and starting point coordinate systems of intermittent welding should be set to the correct coordinate systems.</td></tr>
<tr><td>PS</td><td>Automatically generate the starting No. of search points: The system will automatically generate several</td></tr>
</table>

		search points according to the settings, and the search points will be stored in the global project position. **To prevent global search points from being overwritten by the intermittent welding procedure**
	M	**3.M = Input duty cycle**  4. Size: The number of segments this taught weld needs to be divided into 5. Prop: The duty cycle is the ratio of the length of the weld to the length of the empty row.
		3.M = Input distance  4. D1: length of each welding section, in mm 5. D2: length of each empty row, in mm 6.Ign = as set: the last segment actually runs as set weld length or blank line length Ign = Ignore setting and merge previous segment: the teaching length ÷ input distance may be inexhaustible, so the last segment is automatically merged into the previous segment. **For example**, the last paragraph is welding, but the welding distance is very short. At this time, you can select this mode and merge it into the blank line of the previous paragraph.
	V1	Welding speed, in mm/s
	V2	Empty line speed, in mm/s
	Prio	Working sequence: weld first/blank rows first. You can modify the order of welds and blank rows based on

		this variable.
	ArcFile	Welding File No., set in basic welding, must be set
	WaveFile	Pendulum Arc File No., set in Advanced Welding. If pendulum arc is not required, set to 0. The default is 0
	Ext	Check the external axis that needs to be linked **Note:** If you move in a changing workpiece coordinate system, both the starting point and the target point need to be points in the workpiece coordinate system

Examples of intermittent welding programming:

Movj P=#P1 V=20% Bl=0%;	**Transition point**
Movl P=#P2 V=20mm/s Bl=0mm;	**Starting point of intermittent welding**
SegMovl P=#P3 From=#GP1 M=1 Size=10 Prop=0.6 V1=5 V2=100 Prio=0 ArcF=1 WavF=0 Ext=0;	**Instruction for the intermittent welding**
CALL "segmovl";	**Invoke a subroutine. First create a new segmovl subroutine** in the project, **and then call the subroutine**
Movj P=#P3 V=20% Bl=0%;	**After the procedure, the robot moves to a safe position**

3.6.2.10 Welding Process Shortcut Keys

The floating menu is popped/**closed** by handheld operation of the [fn2] key on the teach pendant**.**

Level 1	Level 2	Function description
		Turn on the welding gun
		Turn off the welding gun

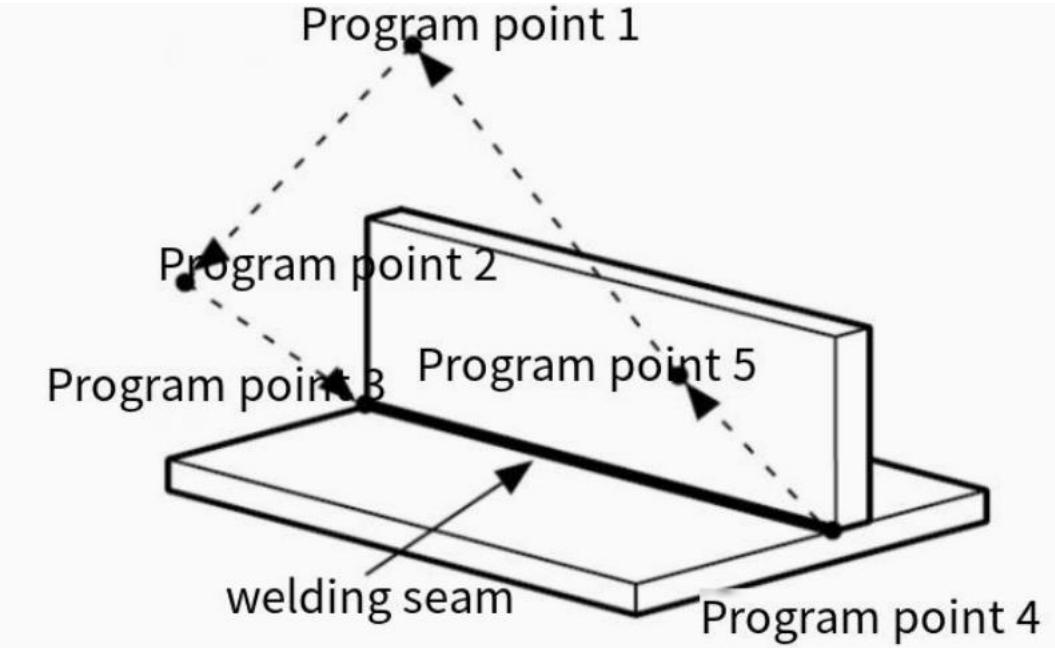
		Manual switching on shielding gas
		Manual wire feeding
		Manual thread withdrawal
		Increase welding current
		Reduce welding current
		Increase welding voltage
		Reduce welding voltage

The status of the welding gun will be displayed in the status bar in the upper right corner to indicate whether the welding is welded during the program running,  indicating real welding;  indicating simulated welding.

3.6.3 Welding Programming Examples

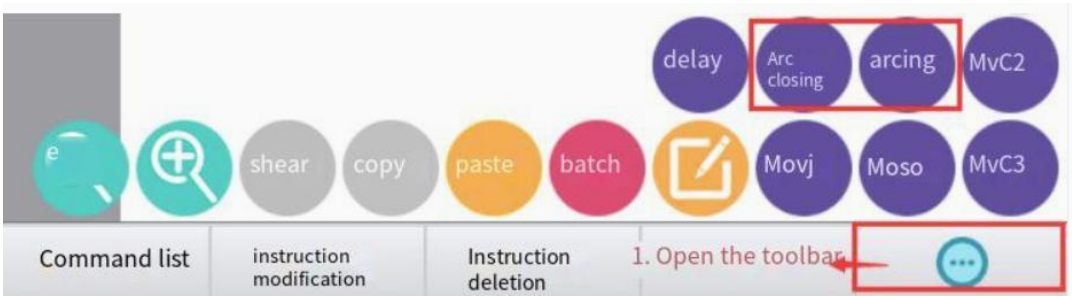
3.6.3.1 Teaching Program

Take the welding workpiece in the following figure as an example.



Movj P=#P1 V=20% Bl=0%;	**Quickly move to program point 1, standby point.**
Movl P=#P2 V=100mm/s Bl=0mm;	**Quickly move to program point 2, ready point.**
Movl P=#P3 V=100mm/s Bl=0mm;	**Move to program point 3, weld starting point.**
ArcOn File=1 Time=0;	**Arc starting command**
Movl P=#P4 V=100mm/s Bl=0mm;	**Follow the welding path and move straight to program point 4**
ArcOff Time=0;	**Arc break command**
Movl P=#P5 V=100mm/s Bl=0mm;	**Move to Program Point 5, Safety Point**

3.6.3.2 Welding Instruction Shortcut Keys

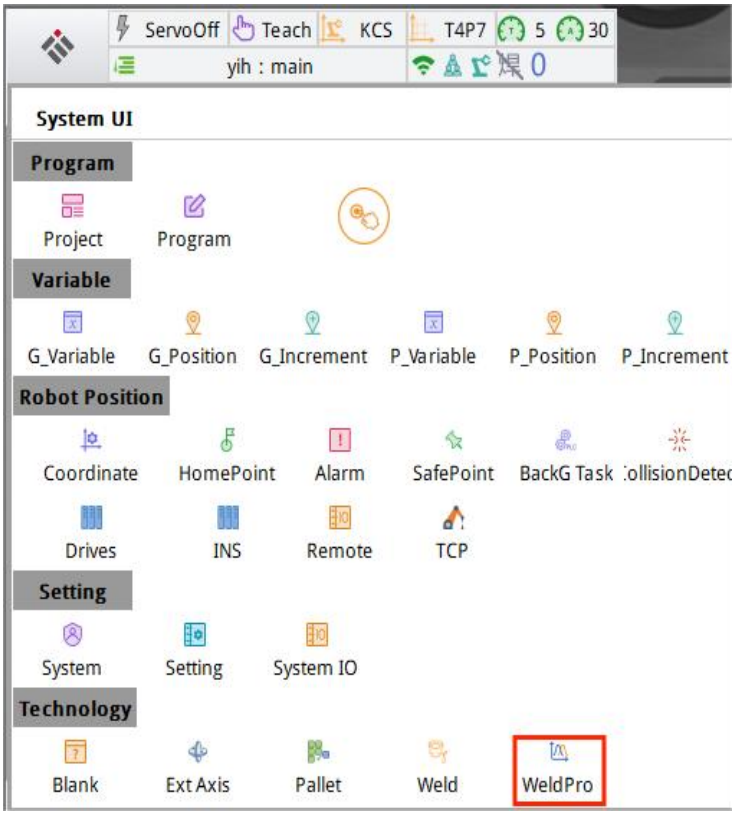


3.6.3.3 Trial Running

Turn off the welding gun before starting welding and let the robot run empty. Open the floating shortcut key with the {Fn2} key, turn off the welding gun with the {Turn Off} button, or modify the {Allow Arc Start} parameter in the welding parameters. After the trial run is successful and there is no problem, open the welding gun and start welding.

4 Advanced Welding Process

Open [Menu] and select {Advanced Welding}. Advanced welding process includes multiple functions: starting point search, arc pendulum process, arc tracking and laser tracking, etc.



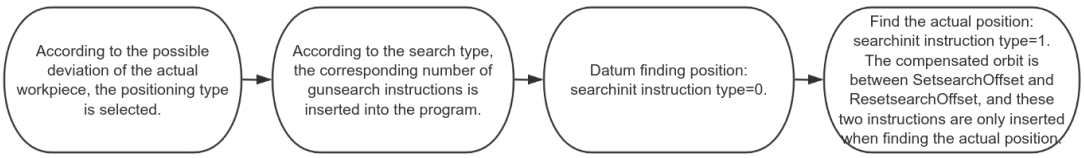
4.1 Starting Point Search

4.1.1 Calculate Offset Search

4.1.1.1 Function introduction

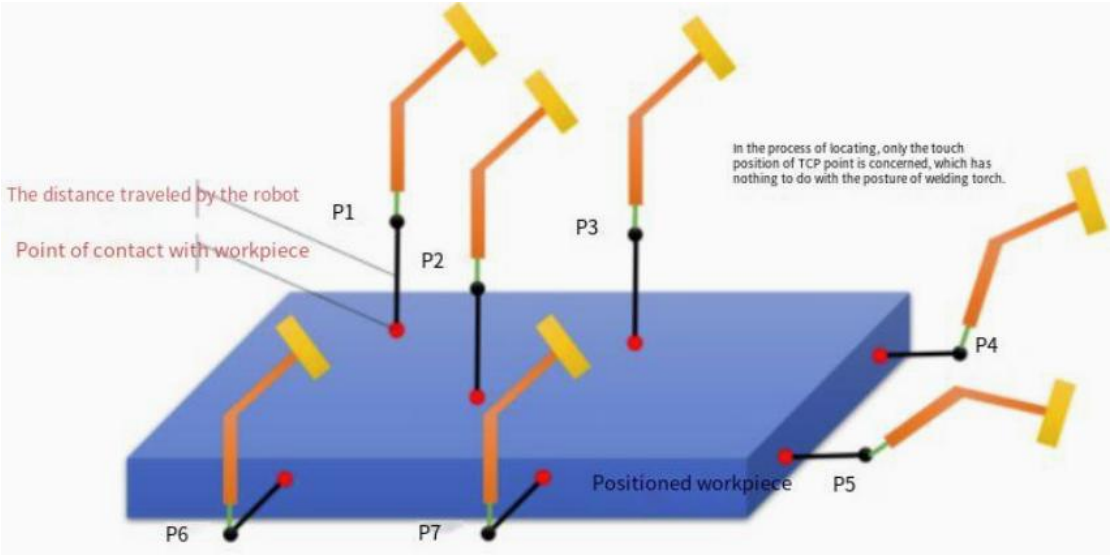
The starting point search is to touch the surface of the workpiece twice through the welding gun. The first touch is to collect a reference position, and the second touch is to collect the moving position of the workpiece. The robot will automatically calculate the offset and send the data to the welding place after the workpiece is offset for welding.

4.1.1.2 Use Process



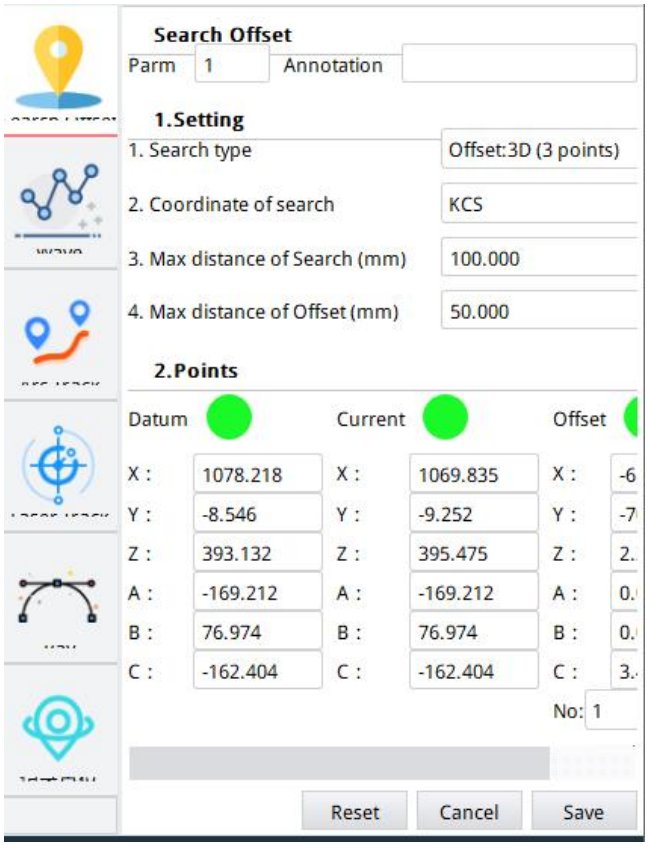
4.1.1.3 Search Parameter

Search method: mechanical search (contact search)



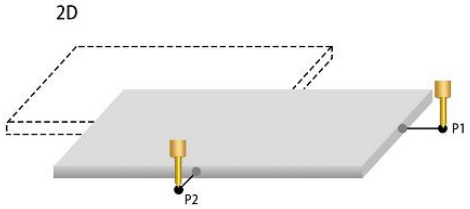
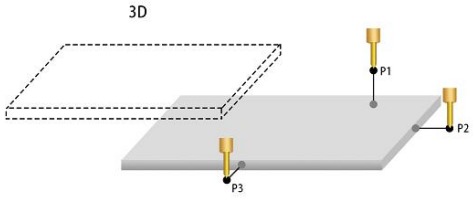
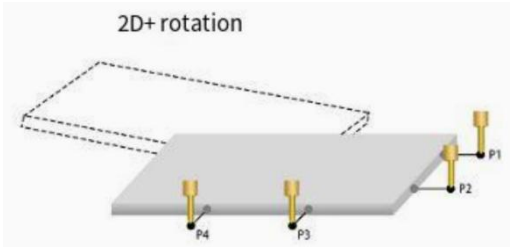
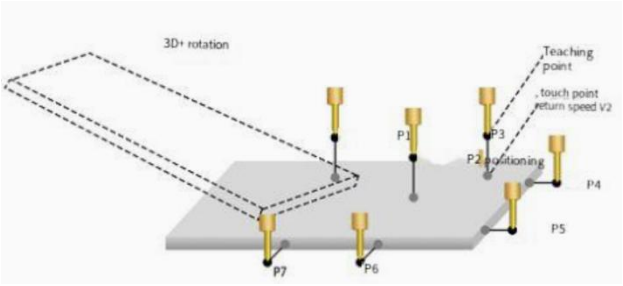
(Seven-point method search)

First, find three points on the plane of the workpiece and record P1, P2 and P3. Two points on each side, recording P4, P5, and P6, P7, respectively. (If the offset in the Z direction is large, the welding wire can be appropriately longer to prevent the height of the welding wire from being too high or too low during search. According to the actual situation in the XY direction, try to adjust the position rationality of the welding wire search point during search initialization.)



List of parameters:

No.	Parameter Name	Parameter Description
1	Search type	1D: The weldment is only offset in one direction of X, Y, and Z, and one point needs to be searched in this direction;  2D: The weldment is only offset in two directions of X, Y

		and Z, and one point needs to be searched in each corresponding direction, totaling two points  3D: The weldment is offset in X, Y and Z directions but does not rotate, and one point needs to be searched in each corresponding direction, totaling three points.  2D + rotation: The weldment is offset in two directions of X, Y, and Z and the formed plane rotates, and two point needs to be searched in each offset direction, totaling four points;  3D + Rotation: The weldment changes in six dimensions, and seven points need to be searched (as shown in the figure). 
2	Search coordinate system	The coordinate system used when search, and the search direction is set by this. Commonly used: Robot coordinate system.
3	Maximum	The maximum search distance along the direction. If the

	search distance mm	search is not successful beyond the distance, an alarm will be given and the search fails. Commonly used: 100
4	Maximum offset distance mm	The offset between the flag point and the search point is the maximum, and if it exceeds it, it is considered that the search has failed. Commonly used: 100
5	Foundation point	Base touch point position coordinates
6	Current point	Position coordinate of touch point after workpiece movement
7	Offset	Offset after workpiece movement and base position

4.1.1.4 Search Instruction

4.1.1.4.1 SearchInit Search Initialization

Instruction Example	SearchInit Type = 1;	
Settings Interface		
Parameter Description	Type	Search the type of point recorded. 0 is the flag punctuation point and 1 is the search finding point.

4.1.1.4.2 GunSearch Starting Point Search

Instruction Example	GunSearch File = 1 Dir = X + Id = 1 V1 = 1 mm/s V2 = 1 mm/s;

Settings Interface		
Parameter Description	File	File No. of Starting Point Search Parameter Setting
	Dir	Search direction corresponding to search setting
	id	Search sequence, as shown in the picture in 4.1. 1, the search point number is fixed (first rotate and then offset)
	V1	Forward speed during search
	V2	Return speed after search
	TP	Record that search of the touch point to the point

4.1.1.4.3 SetSearchOffset Setting Search Offset

Instruction Example	SetSearchOffset File=4; Movl P=#P2 V=100mm/s; Movl P=#P3 V=100mm/s; ResetSearchOffset;	Calling this command calculates the offset of the corresponding search file, flag, punctuation, and search point, and compensates for the search point between SetSearchOffset and ResetSearchOffset
Settings Interface		
Parameter	File	File No. of Start Search Parameter Setting

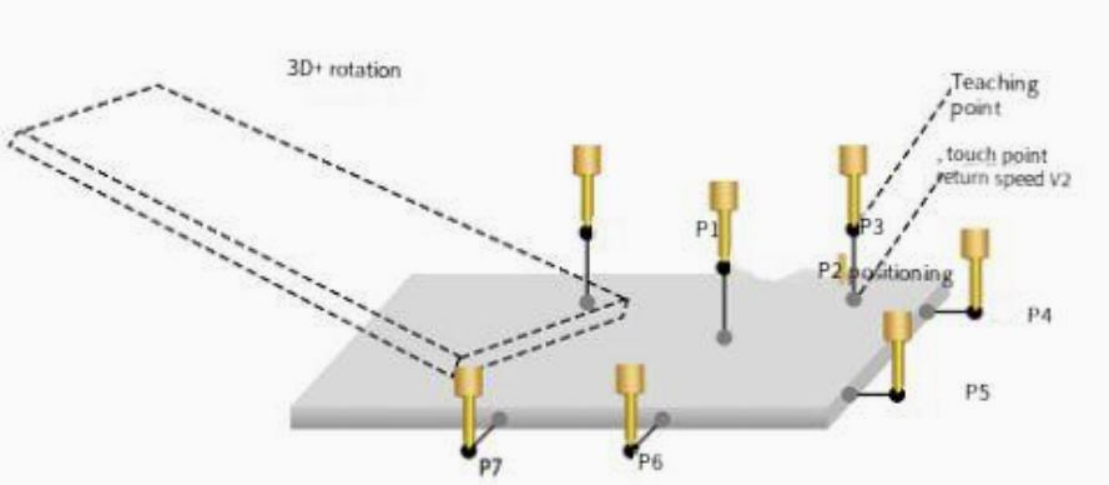
Description		

4.1.1.4.4 OffsetFile Offset File Settings

Instruction Example	OffsetFile File = 1; Dir = 1; Id = X +; P = # P1	
Settings Interface		
Parameter Description	File	File No. of Start Search Parameter Setting
	Id	Which locus to find
	Dir	Search direction. The search direction here can be filled in any direction
	P	Use search points.
Function description	This function is similar to **gunsearch starting search**, but the difference is that the search point P on the workpiece does not need to be touched by welding wire, but is obtained by camera recognition or other means	

4.1.1.4.5 Programming Examples

Seven-point search (3D + rotation) programming example:



Movj P=#P1 V=5%;	Motion to preparation point (transition point)
SearchInit Type=0;	Set the search type (first search reference position)
Movl P=#P2 V=100mm/s;	Move to the starting point of the first point
GunSearch File=4 Dir=Z- Id=1 V1=10mm/s V2=10mm/s;	Start search in the Z-direction according to the parameters of File No. 4, find the first point and return
Movl P=#P3 V=100mm/s;	Move to the starting point of the second point
GunSearch File=4 Dir=Z- Id=2 V1=10mm/s V2=10mm/s;	Second search instruction
Movl P=#P4 V=100mm/s;	Move to the starting point of the third point
GunSearch File=4 Dir=Z- Id=3 V1=10mm/s V2=10mm/s;	Third search instruction
Movl P=#P1 V=100mm/s;	Transition point
Movl P=#P5 V=100mm/s;	Move to the starting point of fourth point
GunSearch File=4 Dir=X+ Id=4 V1=10mm/s V2=10mm/s;	Fourth search instruction
Movl P=#P6 V=100mm/s;	Move to the starting point of fifth point
GunSearch File=4 Dir=X+ Id=5 V1=10mm/s V2=10mm/s;	Fifth search instruction
Movl P=#P1 V=100mm/s;	Transition point

Movl P=#P7 V=100mm/s;	**Transition point**
Movl P=#P8 V=100mm/s;	**Move to the starting point of sixth point**
GunSearch File=4 Dir=Y+ Id=6 V1=10mm/s V2=10mm/s;	**Sixth search instruction**
Movl P=#P9 V=100mm/s;	**Move to the starting point of seven point**
GunSearch File=4 Dir=Y+ Id=7 V1=10mm/s V2=10mm/s;	**Seventh search instruction**
SetSearchOffset File=4;	**The search offset command is inserted before and after the trajectory to be offset respectively when the actual position is found**
Movl P=#P7 V=100mm/s;	**Offset starting point (e.g. starting point of weld trajectory)**
Movl P=#P8 V=100mm/s;	**Offset end point (for example, end point of weld trajectory)**
ResetSearchOffset;	**Cancel search point Offset and search point Offset are a combined instruction to be used together**

Common Alarms

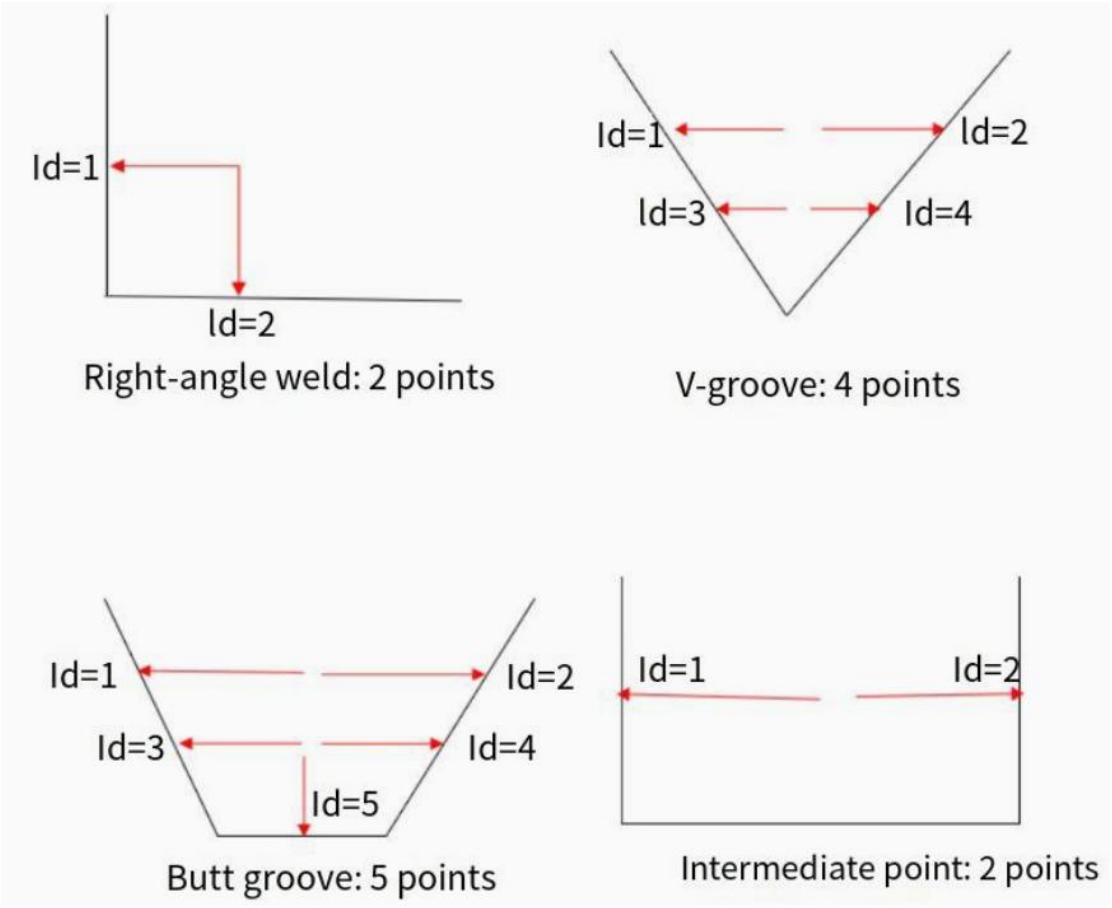
Alarm Content	Solution
SetSearchOffset process: The reference point or actual point has not been collected!	searchinit = 0 is the reference point; searchinit = 1 is the actual point. It is necessary to strictly follow the process of first taking the benchmark and then taking the actual point.
SetSearchOffset procedure: Offset in% 1 direction is% 2, exceeding limit% 3!	If the offset distance exceeds the limit, ensure that the workpiece can be found during search. If it exceeds the search distance, an alarm will be given

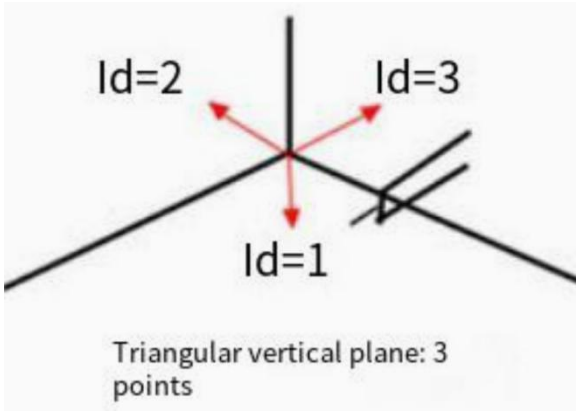
4.1.2 Calculation Point Location Search Method

4.1.2.1 Function Introduction

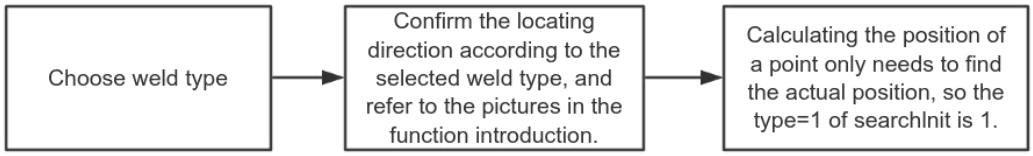
There are four different weld types to choose from in the search method of calculating the point (as shown in the figure below), and the position can be calculated without finding the datum point, only the actual point.

Schematic diagram of calculation point search method:

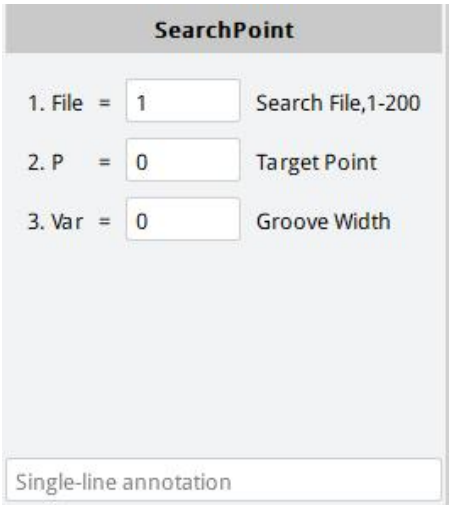




4.1.2.2 Use Process



4.1.2.3 Search Instruction

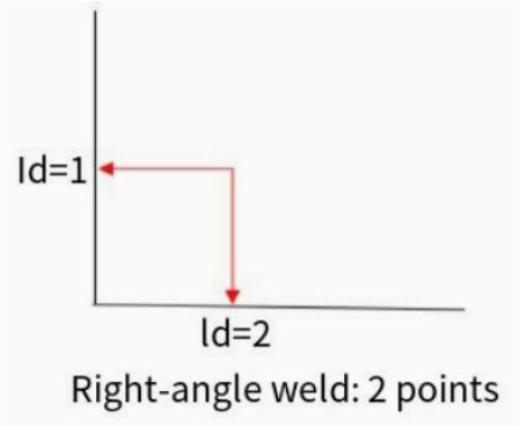
Instruction Example	SearchPoint File = 1 P = 20 Var = 1	
Settings Interface		
Parameter Description	File	File No. of Search Parameter Settings
	P	The calculated position is saved to the position variable
	Var	Calculated groove widths are saved to engineering numerical variables

4.1.2.4 Programming Examples

4.1.2.4.1 Search Procedure of Right Angle Weld

MovlP=#P1	**Advance to search point**

SearchInitFile=1	**SearchInit search initialization**
GunSearch File=1 Dir=Y-, ID=1, V1=50mm/s,V2=100mm/s	**Welding gun search, welding gun to Y-search, saved in the first point in file 1, V1 is the contact point speed, and V2 is the backward speed.**
GunSearchFile=1Dir=Y-, ID=2, V1=50mm/s,V2=100mm/s	**GunSearch welding gun search, welding gun search to Y +, saved in the second point in file 1, V1 is the contact point speed, V2 is the backward speed**
SearchPointFile=1,P=3,Var=1	**SearchPoint calculates the result of search point file 1, the point is saved in P3, and the weld width is saved in variable Var1**

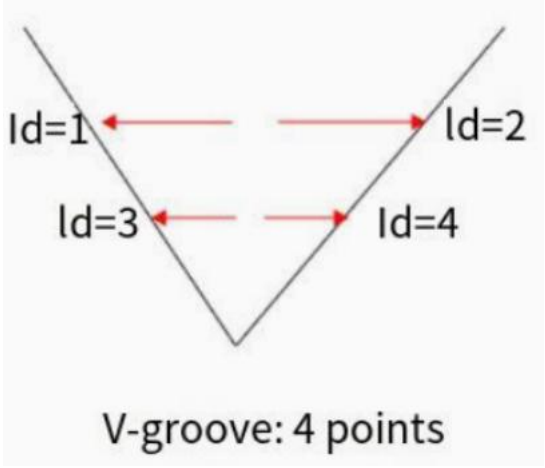
Schematic diagram of right angle weld search:  	Note: 1. The Type of SearchInit must use 1, that is, find the actual search; 2. You can give any Var in SearchPoint, because the weld width will not be calculated for right-fillet welds

4.1.2.4.2 V-Groove Search Procedure

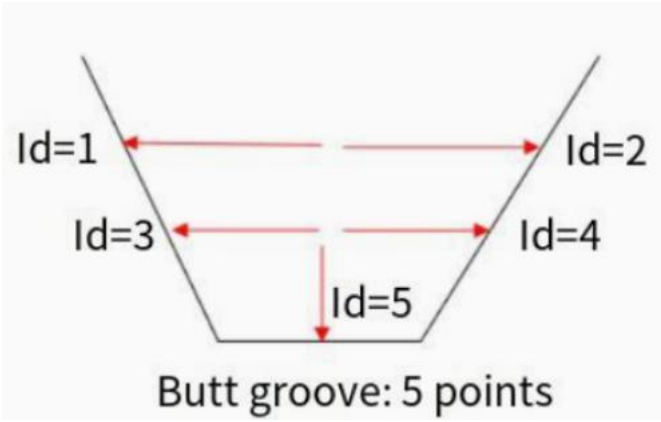
Movl P=#P1 V=100mm/s Bl=0	**Advance to locus search point**

SearchInit File=1 Type=1	SearchInit search initialization. Note that the search File No. is 1, and the Type file Type must be 1
GunSearch File=1 Dir=Y- Id=1 V1=15mm/s V2=150mm/s	GunSearch welding gun search, go to Y-search, and save it in the first point in file 1
GunSearch File=1 Dir=Z- Id=2 V1=15mm/s V2=150mm/s	GunSearch welding gun search to Z-search, saved in the second point in file 1
SearchPoint File=1 P=3, Var=1	SearchPoint calculates the search point, calculates the result of file 1, the point is saved in P3, and the weld width is saved in variable Var1
MovlP=#P3,V=100mm/s	Move to calculation point
Movl P=#P1 V=100mm/s Bl=0	Advance to locus search point
SearchInit File=1 Type=1	SearchInit search initialization. Note that the search File No. is 1, and the type file must be 1

4.1.2.4.3 Search Procedure of Docking Groove

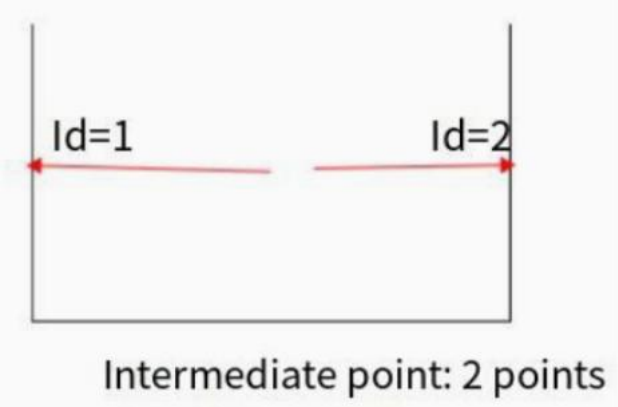
Schematic diagram of V-shaped groove search: 	Note: 1. The Type of SearchInit must use 1, that is, find the actual search; 2. You can give any Var in SearchPoint, because the V-shaped groove will not calculate the weld width; 3. You can find the high point or the low point first, but Id1 and Id2 must be at the same height, and Id3 and Id4 must be at the same height!
MovlP=#P1	Advance to locus search point

SearchInitFile=1 Type=1	Search and initialize File No. 1, note that the Type Type must be 1
GunSearchFile=1 Dir=Y- Id=1 V1=15mm/s V2=150mm/s	The welding gun is searched to Y-and saved in the first point in file 1
GunSearchFile=1 Dir=Y+ Id=2 V1=15mm/s V2=150mm/s	Position of welding gun to Y + and save it in the second point in file 1
MovlP=#P2	Advance to the next search point, increase or decrease the height
GunSearchFile=1 Dir=Y- Id=3 V1=15mm/s V2=150mm/s	The welding gun is searched to Y-and saved in the third point in file 1
SearchPointFile=1 P=3, Var=1	Calculate the result of search point file 1. The point is saved in P3, and the weld width is saved in Var1 variable
MovlP=#P3,V=100mm/s	Move to calculation point
SearchPointFile=1 P=3, Var=1	Calculate the result of search point file 1. The point is saved in P3, and the weld width is saved in Var1 variable

Schematic diagram of butt groove search: 	**Note:** **1. The Type of SearchInit must use 1, that is, find the actual search;** **2. Var in SearchPoint saves the width of the weld;** **3. You can find the high point or the low point first, but Id1 and Id2 must be at the same height, and Id3 and Id4 must be at the same height! There is no requirement for Id5 search and height.**

4.1.2.4.4 Intermediate Point Search Procedure

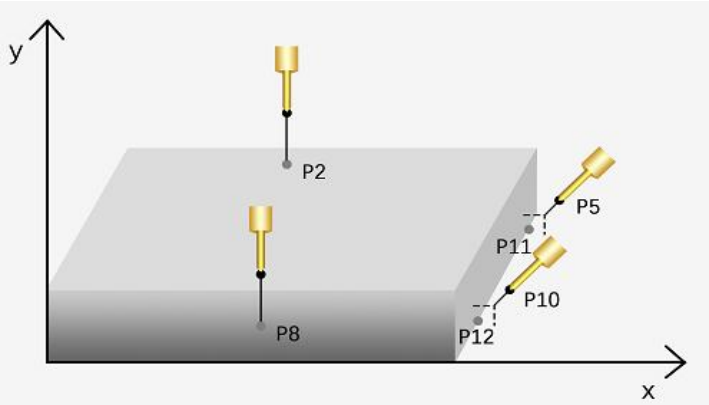
Movl P = # P1 V = 100mm/s Bl = 0	**Advance to locus search point**
SearchInit File = 1 Type = 1	**SearchInit File = 1 Type = 1**
GunSearch File = 1 Dir = Y-Id = 1 V1 = 15 mm/s V2 = 150 mm/s	**Find the Y-search and save it in the first point in file 1**
GunSearch File = 1 Dir = Y + Id = 2 V2 = 15 mm/s V2 = 150 mm/s	**Find Y +search and save it in the second point in file 1**
SearchPoint File = 1 P = 3 Var = 1	**Calculate the results of file 1, the points are saved in P3 and the weld width is saved in Var1**

Schematic diagram of intermediate point search: 	**Note:** **1. The Type of SearchInit must use 1, that is, find the actual search;** **2. Var in SearchPoint saves the width of the weld;**

4.1.3 Search the Start and End of the Weld

1D search and right angle search are used to find the starting and ending points of the weld

Programming examples:

	**Description**
Movl P=#P1 V=200mm/s Bl=10mm;	**Transition point**
Movl P=#P2 V=200mm/s Bl=10mm;	**1D search preparation point**
GunSearch File=1 Dir="X+" Id=1 V1=20mm/s V2=100mm/s TP=21;	**Start 1D search, and save the found search point to P21**
Movl P=#P3 V=200mm/s Bl=10mm;	**Transition point**
Movl P=#P4 V=200mm/s Bl=0mm;	**Transition point**
WaitExecutor Dis=0mm;	**To stop decoding, you must add this instruction before assigning P1. x**
#P1.x = #P21.x+5;	**Assign the coordinate of 1D search search point P21. x to the right-angle search point to avoid search error. Here, 5mm compensation is added, or it may not be added**

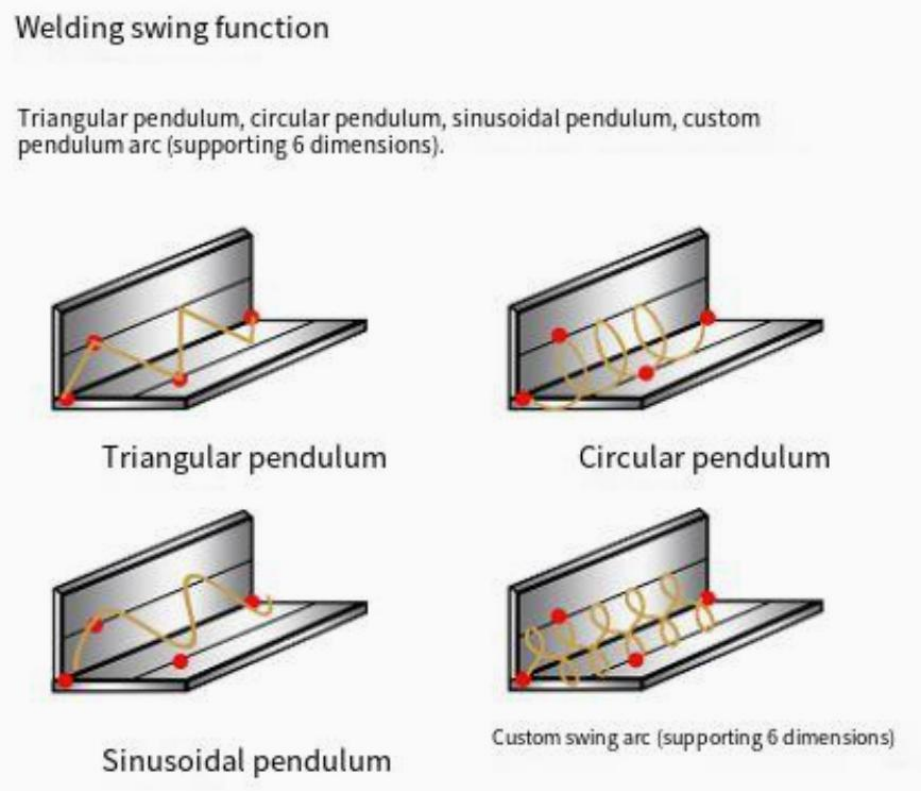
Movl P=#P5 V=200mm/s Bl=10mm;	Right-angle search preparation point
SearchInit Type=1 File=2;	Search initialization
GunSearch File=2 Dir="Y+" Id=1 V1=20mm/s V2=100mm/s TP=30;	Welding wire search
GunSearch File=2 Dir="Z-" Id=2 V1=20mm/s V2=100mm/s TP=31;	Welding wire search
SearchPoint File=1 P=11 Var=5;	Calculate the right angle locus site and save it to P11
Movl P=#P6 V=200mm/s Bl=0mm;	Transition point
Movl P=#P7 V=200mm/s Bl=0mm;	Transition point
Movl P=#P8 V=200mm/s Bl=0mm;	1D search preparation point
GunSearch File=1 Dir="X-" Id=1 V1=20mm/s V2=100mm/s TP=22;	Welding wire search
WaitExecutor Dis=0mm;	Stop decoding
Movl P=#P9 V=200mm/s Bl=0mm;	Transition point
#P10.x = #P22.x - 5;	Assign the search point. x found by search the welding wire to P22. x to avoid search error. 5mm compensation is added here, or it is not necessary to add
Movl P=#P10 V=200mm/s Bl=0mm;	Right-angle search preparation point
SearchInit Type=1 File=2;	Search initialization
GunSearch File=2 Dir="Y+" Id=1 V1=20mm/s V2=100mm/s	Welding wire search

TP=32;	
GunSearch File=2 Dir="Z-" Id=2 V1=20mm/s V2=100mm/s TP=33;	**Welding wire search**
SearchPoint File=1 P=12 Var=6;	**Calculate the right angle locus and save it to P12**
Movl P=#P11 V=200mm/s Bl=0mm;	**Found starting point**
Movl P=#P12 V=200mm/s Bl=0mm;	**End point found**

4.2 Pendulum Arc Process

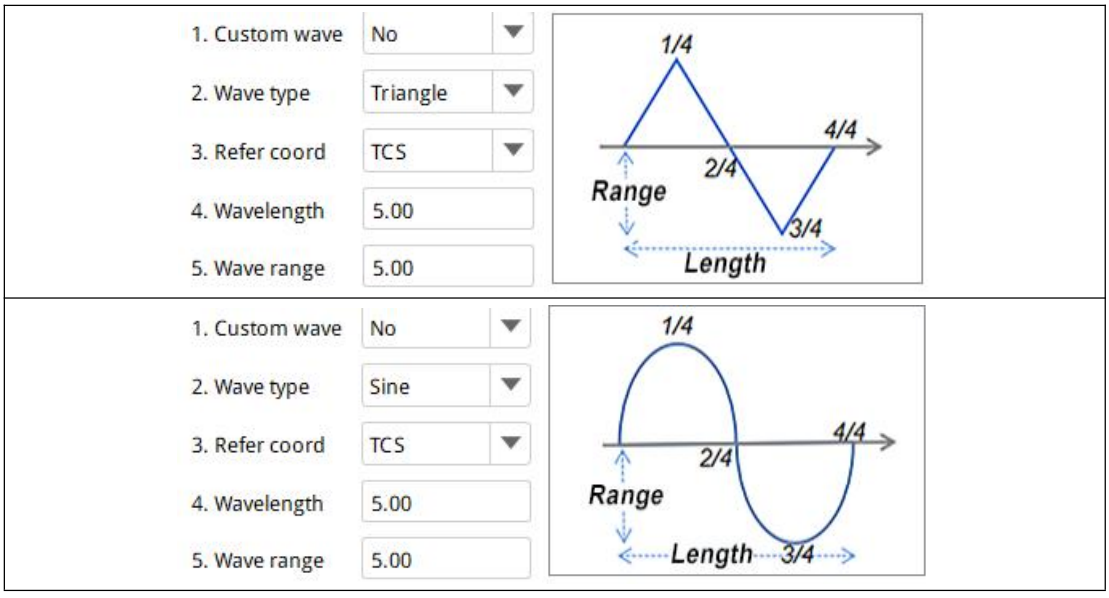
4.2.1 Function Introduction

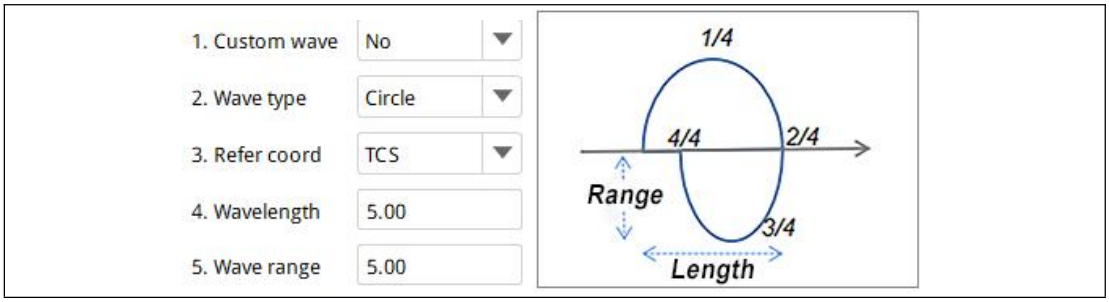
Users can set the pendulum parameters according to their own pendulum process requirements. The system comes with three pendulum modes: sinusoidal pendulum, triangular pendulum, and circular arc pendulum. Users can also customize the pendulum arc type as shown in the figure below to select. You can set up to save different File Nos., which can be called through instructions.



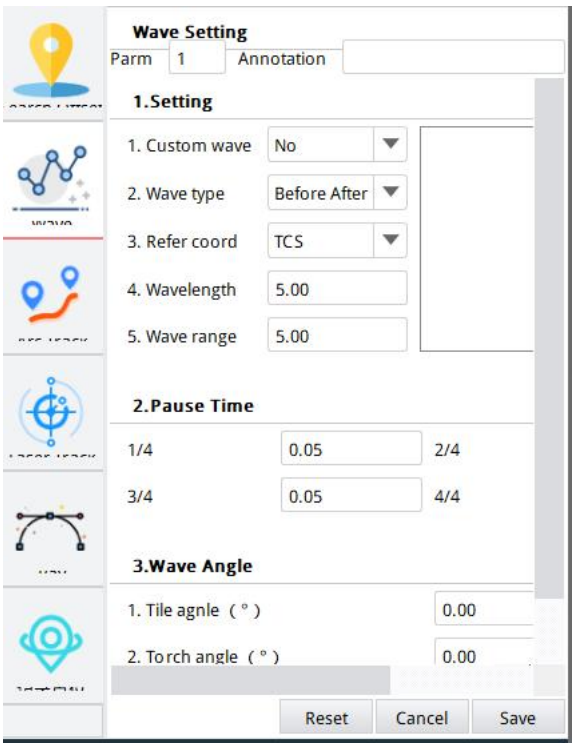
4.2.2 Type of Pendulum Arc

Pendulum. Basics Pendulum includes three types of pendulum arcs: triangular pendulum, sinusoidal pendulum and circular pendulum.



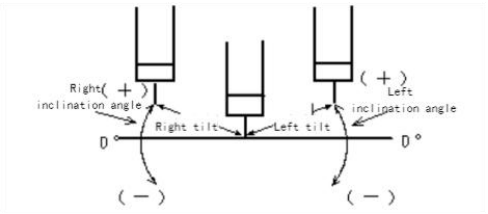
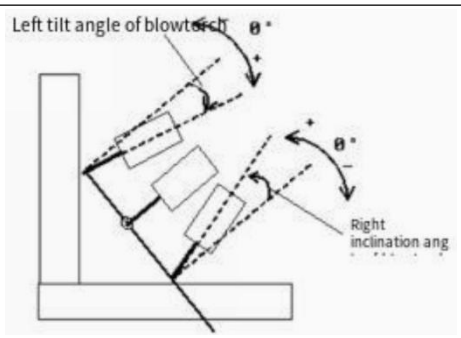
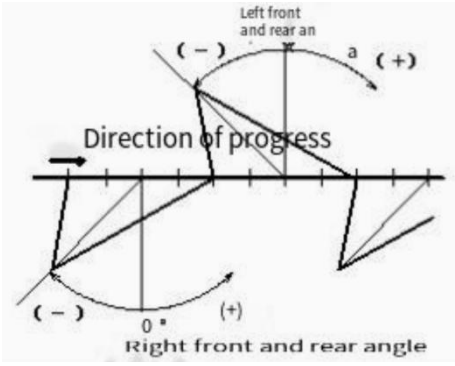


4.2.3 Pendulum Arc Parameters



List of parameters:

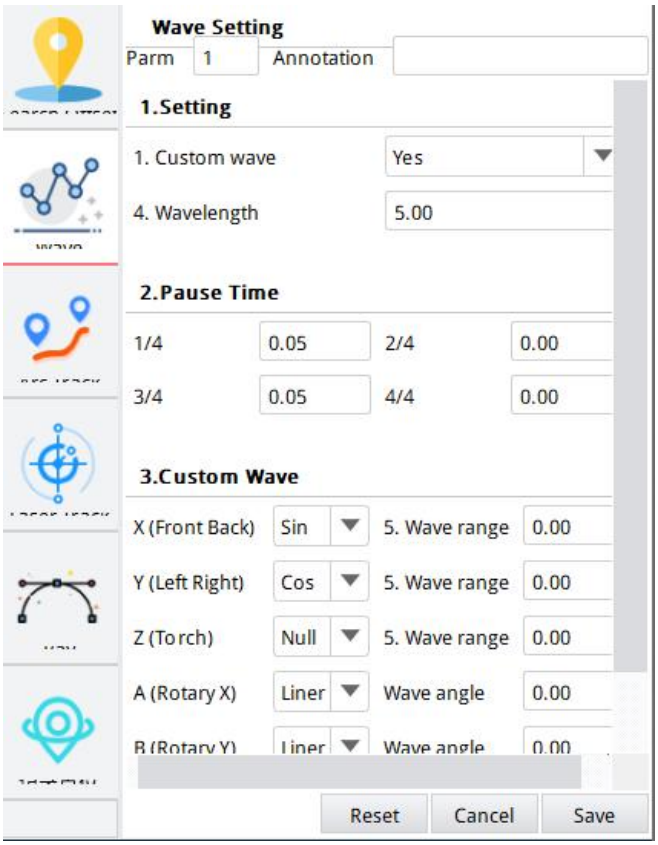
No.	Parameter Name	Parameter Description
1	Custom Pendulum	Select {Yes} to enter the pendulum arc customization interface
2	Type of pendulum arc	Select the base pendulum type: triangular pendulum, sinusoidal pendulum, arc pendulum
3	Reference coordinate system	Select the pendulum direction TCS tools; KCS Robotics; PCS workpieces; WCS World
4	Wavelength	As illustrated, the welding gun pendulums in the direction of movement the length of one advance
5	Pendulum amplitude	As shown, the length off-center of the welding gun

6	Stopping time	As shown in the figure, when the welding gun moves to 1/4 cycle (etc.), the time to stop moving. Does not affect the pendulum trajectory.	
7	Pendulum angle	Inclination angle	
		Torch angle	
		Front-rear angle	

4.2.4 Custom Pendulum

The desired pendulum path is synthesized by customizing the pendulum mathematical function of the welding gun within 6 dimensions.

Forward and backward pendulum welding can be realized by setting the X forward direction as the sin function and there is no pendulum in the Y direction.



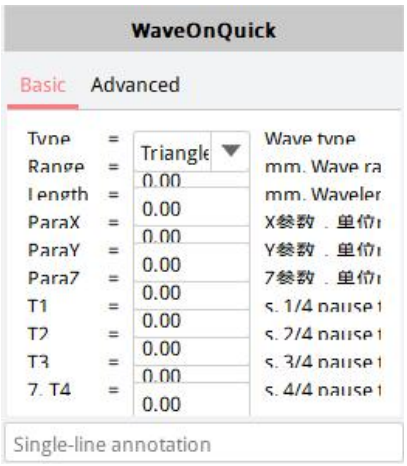
4.2.5 Pendulum Arc Command

4.2.5.1 WaveOn/WaveOff Pendulum Arc On/Off

Instruction Example	WaveOn File = 1; Movl P = # P1 V = 20 mm/s Bl = 10 mm; Movl P = # P2 V = 20 mm/s Bl = 10 mm; WaveOff;	
Settings Interface		
Parameter Description	File	Select the configured pendulum arc File No.

Notes	Used with the command WaveOff, it takes effect on the motion command between two commands.

4.2.5.2 WaveOnQuick Quick Pendulum Arc On

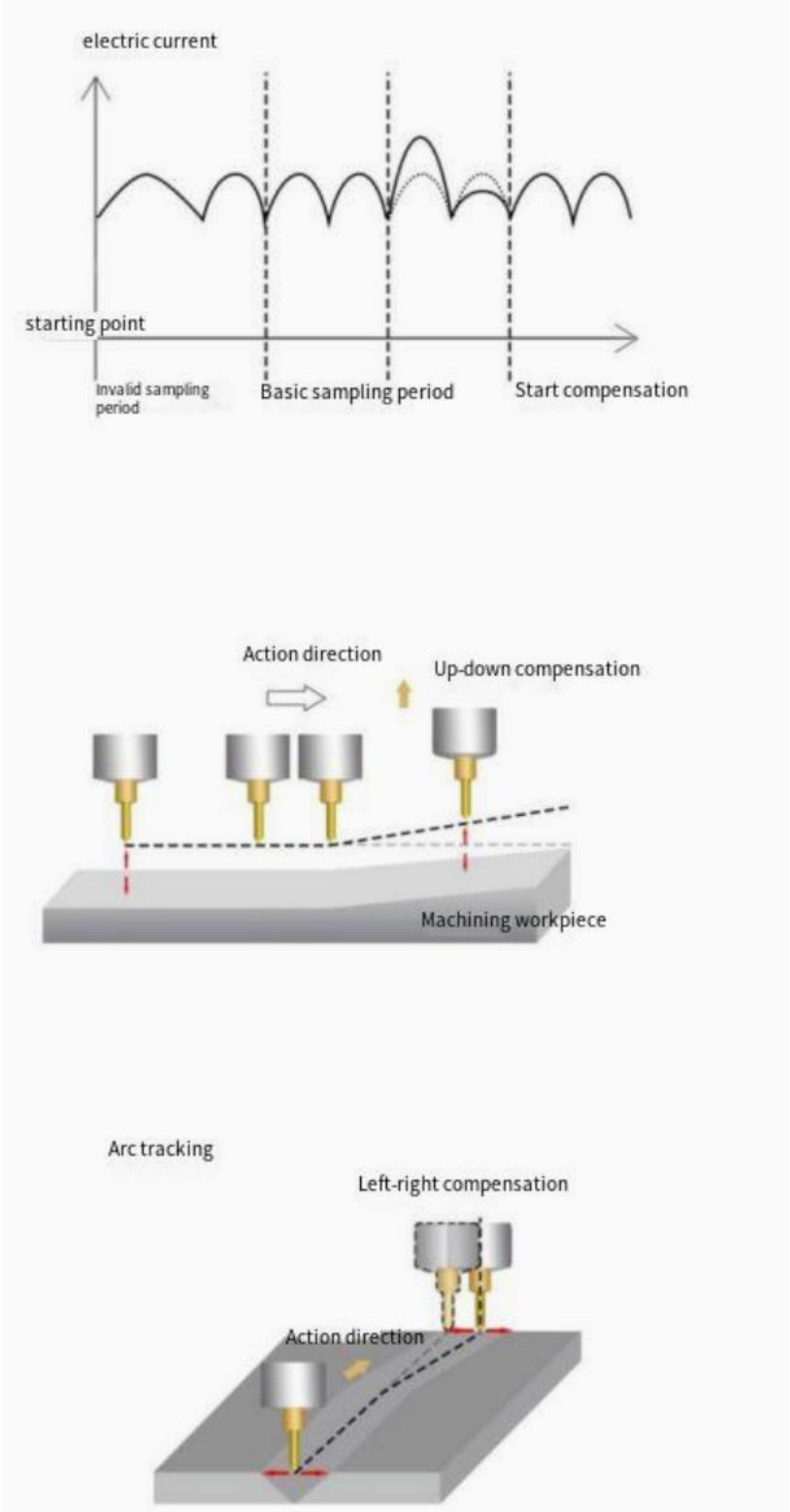
Instruction Example	WaveOnQuick Type=1 Range=3 Length=3 T1=0 T2=0 T3=0 T4=0; Movl P=#P1 V=20mm/s Bl=10mm; Movl P=#P2 V=20mm/s Bl=10mm; WaveOff;
Settings Interface	
Parameter Description	List of reference pendulum arc parameters. Type: 1 is triangular pendulum, 2 is sinusoidal pendulum, 3 is arc pendulum
Notes	Used with the command WaveOff, it takes effect on the motion command between two commands.

4.3 Arc Tracking

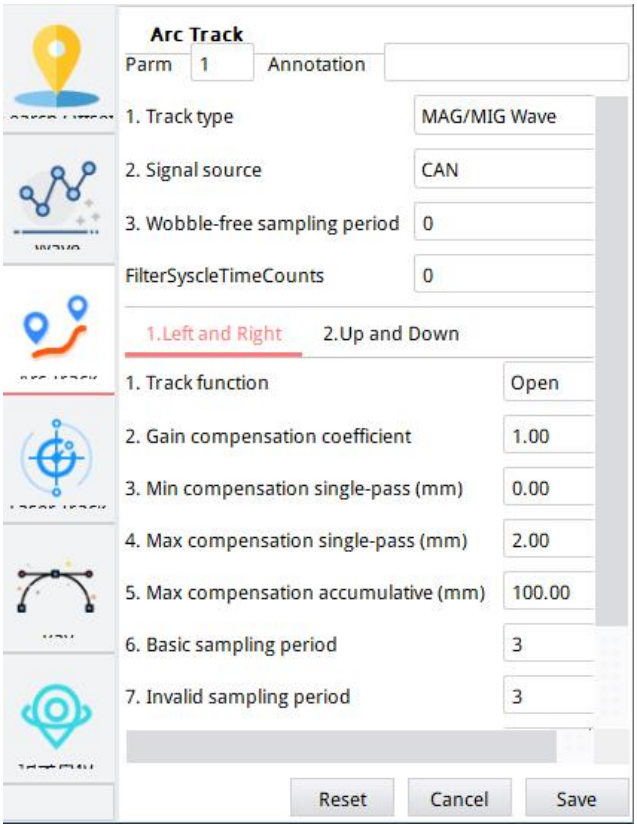
4.3.1 Function Introduction

Arc tracking system refers to a weld seam tracking system that tracks the weld seam by detecting the change of welding current or voltage. The basic principle is to use the change of welding parameters caused by the change of distance between the welding gun and the workpiece to detect the height and left-right deviation of the welding gun. When the welding gun deviates from the workpiece, the welding parameters also change due to the change of arc length. The arc tracking system detects the change of welding parameters, feeds back the deviation information to the control system and adjusts the position of the welding gun.

Schematic diagram of arc tracking:



4.3.2 Interface Parameters



Current tracking	Trace Type	Gas shielded welding pendulum arc (only this option is currently supported)
	Signal source	CAN Communications
	Pendulum-free sampling period	Does not pendulum but requires arc tracking when set the sampling period. (Similar to arc tracking). Generally set to 0.
Left and Right	Left and right tracking function	ON/OFF (ON when using this function)
	Left-right compensation gain coefficient	The strength of left and right compensation capabilities. If the compensation effect is not ideal, the value can be adjusted between 3 and 8
	Left and Right Single Compensation Minimum (mm)	The minimum offset of a single compensation, the minimum amount is set to 0.01, and it is fine-tuned between 0.01 and 0.5. If this parameter is too large, the tracking may be invalid
	Left and Right Single Compensation	The maximum amount of compensation for a single compensation. It can be adjusted

	Maximum (mm)	according to the degree of offset of the weld. Default 10
	Left and Right Cumulative Compensation Maximum (mm)	Sets the maximum amount of compensation accumulated after each compensation when arc tracking is performing weld compensation. Default 500
	Left and right base sampling period	Set the sampling period required for arc tracking when performing weld compensation. The sampling period is set according to the needs, usually 3-6 cycles
	Left and right invalid sampling period	Several invalid sampling periods need to be set at the beginning of the arc pendulum. Start compensating from the number of pendulum arc periods. Because current and voltage are unstable in the first few sampling periods, 3-5 invalid periods are set
	Left-to-left offset (mm)	This parameter is an alternate parameter, please set it to 0 when using it
Upper and lower settings	Up and down tracking function	ON/OFF (ON when using this function)
	Upper and lower compensation gain coefficients	The strength of left and right compensation capabilities. If the compensation effect is not ideal, the value can be adjusted between 3 and 8
	Minimum value of single compensation up and down (mm)	The minimum offset of a single compensation, the minimum amount is set to 0.01, and it is fine-tuned between 0.01 and 0.5. If this parameter is too large, the tracking may be invalid
	Upper and lower single compensation maximum (mm)	The maximum amount of compensation for a single compensation. It can be adjusted according to the degree of offset of the weld. Default 10
	Maximum cumulative compensation up and	Sets the maximum amount of compensation accumulated after each compensation when

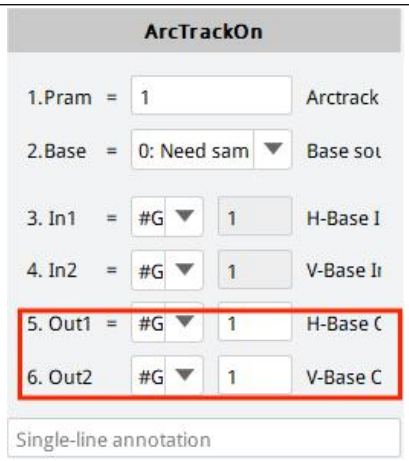
	down (mm)	arc tracking is performing weld compensation. Default 500
	Upper and lower base sampling period	Setting up arc tracking requires several sampling cycles when performing weld compensation. Sampling period is set according to needs, usually 3-6 cycles
	Upper and lower invalid sampling period	Several invalid sampling periods need to be set at the beginning of the arc pendulum. Because current and voltage are unstable in the first few sampling periods, 3-5 invalid periods are set
	Up-down offset (mm)	This parameter is an alternate parameter, please set it to 0 when using it

Arc Tracking Default Parameters

Set the tracking parameters according to the parameters in the figure below, and perform fine-tuning of the parameters if there is any problem

4.3.3 Current Tracking Instruction

Instruction Example	File File = 1; Base Base = 0: Sampling is required; In1 # Gvar 1; In2 # Gvar2 Out1 # Gvar1 Out2 # Gvar2;
Settings Interface	

<table>
<tr><td></td><td colspan="2"> 
</td></tr>
<tr><td rowspan="6">Parameter Description</td><td>File</td><td>Select the configured current tracking File No.</td></tr>
<tr><td>Base</td><td>Base = 0: sampling required; Base = 1: custom benchmark</td></tr>
<tr><td>In1</td><td>Horizontal datum input, calling a saved datum variable</td></tr>
<tr><td>In2</td><td>Vertical datum input, calling a saved datum variable</td></tr>
<tr><td>Out1</td><td>Horizontal reference output, which saves the collected tracking parameters to variables</td></tr>
<tr><td>Out2</td><td>Vertical reference output, which saves the collected tracking parameters to variables</td></tr>
<tr><td>Notes</td><td colspan="2">Base = 0, you need to collect the benchmark and save the benchmark to a variable (Out1, Out2)
Base = 1, directly call the benchmark variables saved when Base = 0 (In1, In2)
First use of current tracking: base = 0. Subsequent welding of the same type of workpiece: base = 1. If the workpiece type, current, and welding gun attitude are changed, the datum needs to be re-collected.</td></tr>
</table>

4.3.4 Programming Examples

Movj P=#P1 V=20% Bl=0%	**Point of articulation**
Movj P=#P2 V=20% Bl=0%	**Transition point**
Movl P=#P3 V=20mm/s Bl=0mm	**Welding starting point**
ArcOn File=1 Time=0	**Arcing command**
WaveOn File=1	**Pendulum arc command**
ArcTrackOn File=1 Base=0	**Current tracking instruction**

In1=#Gvar1 In2=#Gvar2 Out1=#Gvar1 Out1=#Gvar2	
Movl P=#P4 V=20mm/s Bl=0mm	**When Base = 0, teach a sampling track, 50mm-100mm**
Movl P=#P5 V=20mm/s Bl=0mm	**Welding endpoint**
ArcTrackOff	**Current Tracking Off**
WaveOff Time=0	**Pendulum arc closure**
ArcOff Time=0	**Arc closure**
Movj P=#P6 V=20% Bl=0%	**Transition point to move the robot to a safe position**

4.3.5 Precautions For Arc Tracking

1. The tool coordinate system must be calibrated, and the Z-axis of the tool coordinate system must be along the wire direction.

2. Arc tracing and pendulum must be used at the same time, and the pendulum direction must be based on the tool coordinate system.

3. The arc tracking command must be followed by the pendulum command call, and if the order is reversed, there is no tracking effect.

4. In the process of arc tracking, if there are multiple MOVL or MOVC instructions, BL must be added in the middle to ensure that the speed cannot be zero during the welding process, otherwise the tracking will be abnormal.

5. The speed of the motion instructions in welding should be consistent

6. It is recommended that the tracking current is greater than 200A.

7. The arc tracking function can be used in both DC mode and pulse mode, but the tracking effect in pulse mode is more dependent on the process and performance of the welder itself.

8. In the first few cycles of welding pendulum, the arc tracking track needs to collect reference current data, and a welding trajectory must be accurately taught, so the tracking must be used in combination with search to ensure that the welding start position meets the requirements.

9. The welding trajectory behind is not as accurate as the teach, and the robot

will automatically compensate, saving the time for the precise teach-in point.

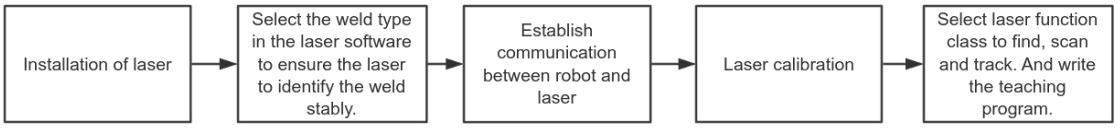
10. During debugging, ArcWatch can be used to record the collected current data, but during normal operation, this command needs to be deleted, otherwise the real-time collected data will always be recorded.

4.4 Laser Tracking

4.4.1 Function Introduction

Laser tracking is a laser projected by a laser sensor, which scans the search point of the weld and feeds it back to the robot. After receiving the signal, the robot converts the coordinates of the search point scanned by the laser into the coordinates of the vertex of the robot tool. This function can realize the laser scanning of the welding seam robot to weld, without the need for people to write the welding track, which can be faster and more accurate.

4.4.2 Use Process

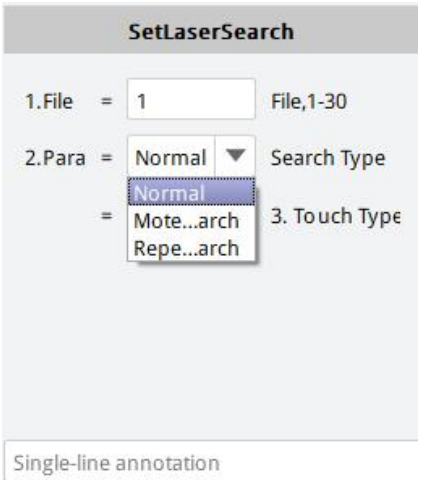


4.4.3 Laser Tracking Instruction

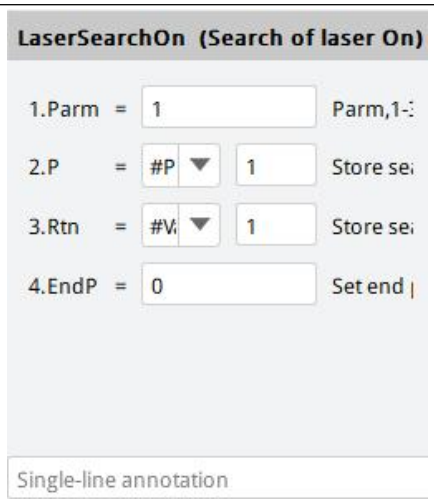
- SetLaserSearch Set laser search
- LaserSearchOn Laser search on
- LaserScanOn Laser scanning on
- LaserScanOff Laser scanning off
- LaserTrackOn Laser tracking on
- LaserTrackMovL Linear laser tracking
- LaserTrackMovC Arc laser tracking
- LaserTrackOff Laser tracking off

4.4.3.1 SetLaserSearch Set Laser Search

Instruction Example	SetLaserSearch File = 1 Para = "0"

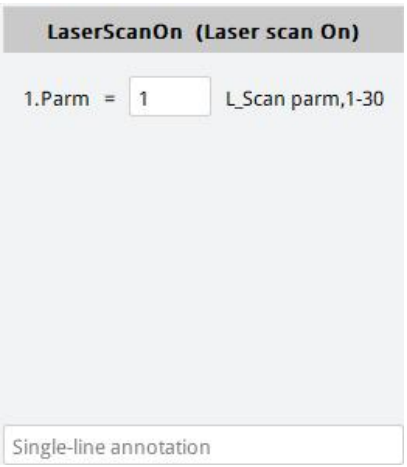
Settings Interface		
Parameter Description	File	Search File No.
	Para	0. Ordinary search: search once 1. Dynamic search: search along the direction of search coordinate system, stop when the search distance is exceeded or valid data is found 2. Search again: set the number of search times, search distance and search speed. Stop when the number of bit search is satisfied or stop when effective data is found

4.4.3.2 LaserSearchOn Laser Search On

Instruction Example		File = 1 P = # P1 Rtn = # Var1 EndP = 0;
Settings Interface		
Parameter	File	Search File No.

Description	P	The found search is stored in this variable
	Rth	The found results are stored in this variable. The value of this variable is 1 if there is data, and 0 if there is no data
	EndP	Default 0, seeks along the search direction set by the search file. Fill in the sequence number of the search point, and find the position in the direction of the search point

4.4.3.3 LaserScanOn Laser Scanning On

Instruction Example		LaserTrackOn File = 1;
Settings Interface		
Parameter Description	File	Scan File No.

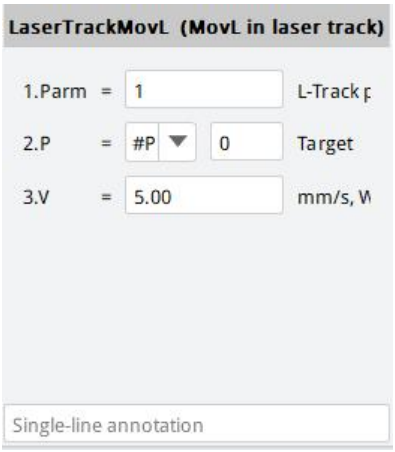
4.4.3.4 LaserScanOn Laser Scanning Off

Instruction Description	Use with **Laser Scanning On**, this command is typically inserted at the end of the scan position

4.4.3.5 LaserTrackOn Laser Tracking On

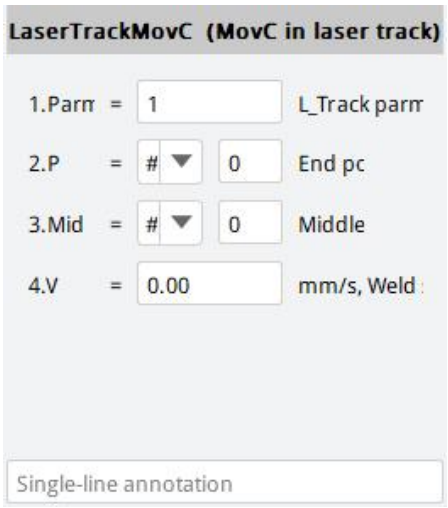
Instruction Example		LaserTrackOn File = 1;
Settings Interface		
Parameter Description	File	Tracking File No.

4.4.3.6 LaserTrackMovL Linear Laser Tracking

Instruction Example		LaserTrackMovL File = 1 P = # P10 V = 5mm/s
Settings Interface		
Parameter Description	File	Laser Tracking File No.
	P	Linear Laser Tracking Target Point
	V	Robot terminal motion speed during tracking

4.4.3.7 LaserTrackMovC Arc Laser Tracking

Instruction Example	LaserTrackMovL File = 1 P = # P10 V = 5mm/s

Settings Interface		
Parameter Description	File	Laser Tracking File No.
	P	Arc laser tracking target point
	Mid	Intermediate point of arc
	V	Robot terminal motion speed during tracking

4.4.3.8 LaserTrackOff Laser Tracking Off

Instruction Example		LaserTrackOff File = 1;
Settings Interface		
Parameter Description	File	Laser Tracking File No.
Instruction Description		Use with **laser tracking on**, this command is typically inserted at the end of tracking position

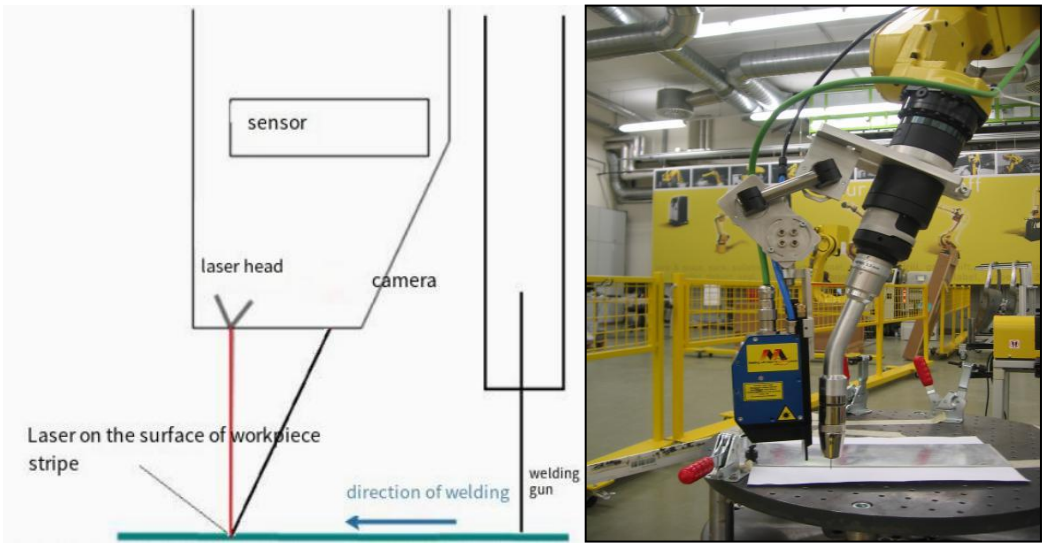
4.4.4 Preparation

Installation of laser

1) Evaluate the welding gun angle during welding first, and then clamp the laser to avoid interference during welding;

2) When the welding gun is moving, the laser line should be kept in front of the welding gun;

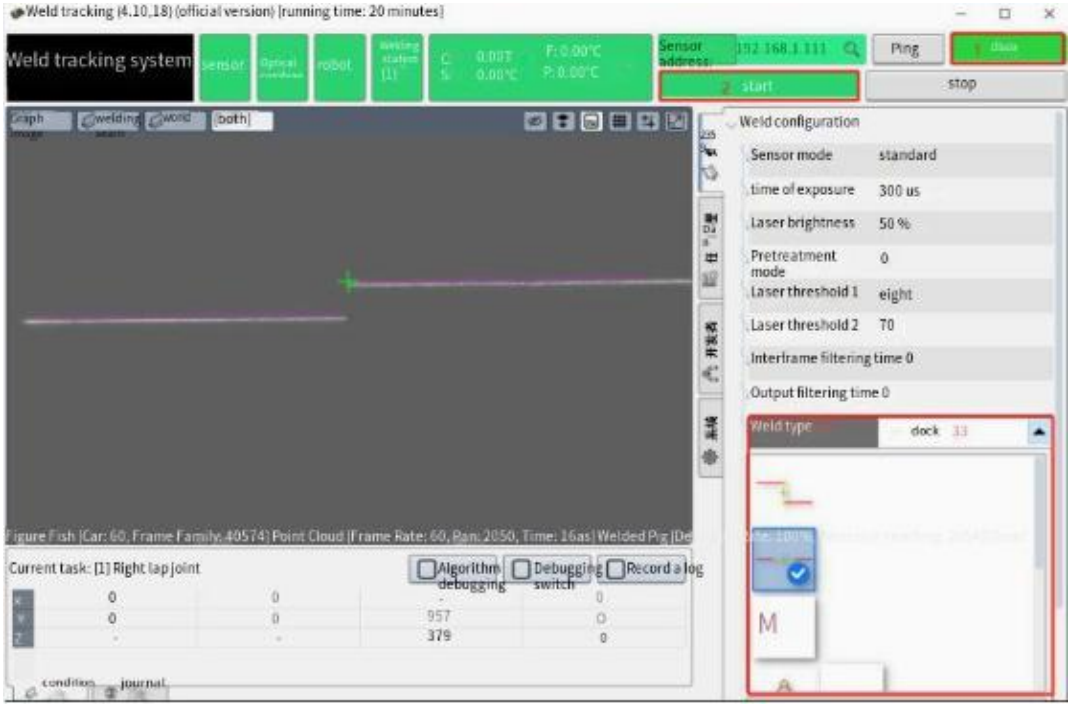
3) During installation, ensure that the laser is firmly installed on the fixture. During use, if the laser shifts, it will affect the welding accuracy and must be recalibrated.



(Schematic diagram of laser installation)

4.5 Laser Software

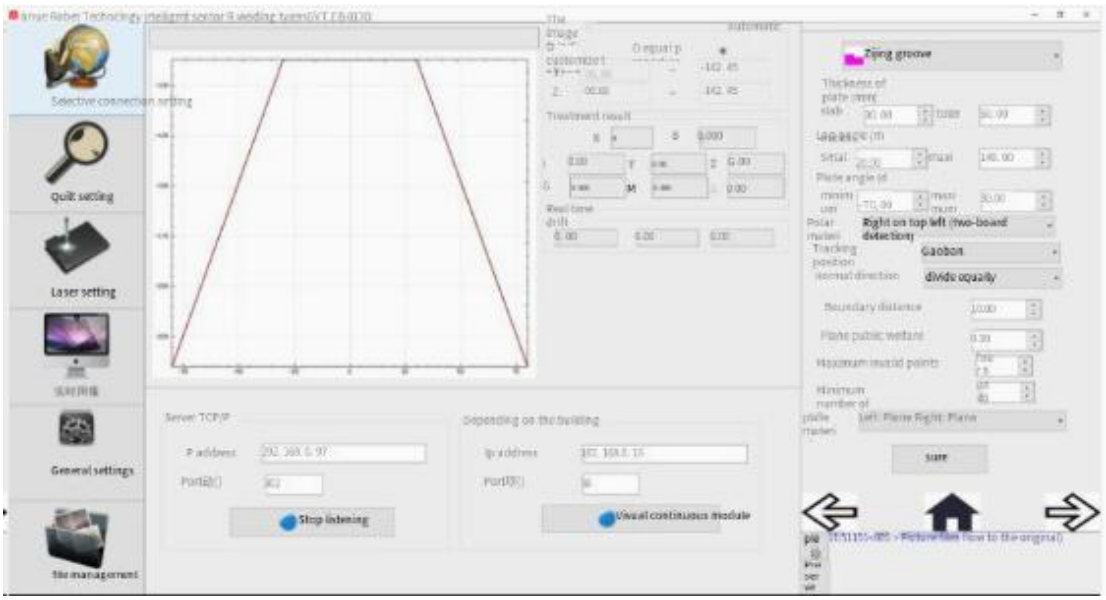
1. How to use all-vision laser software



1) Use the network cable that comes with the laser to connect the laser sensor and the computer respectively.
2) The laser IP is 192.168. 1.111. Change the computer IP to network segment 1, such as 192.168. 1.9
3) Open the all-vision laser software and click Connect and Start respectively. (See the picture above)
4) Choose the correct weld type based on the actual welded workpiece. (See the picture above)
5) Simulate the welding trajectory and welding gun attitude, debug the laser to stabilize the recognition effect, and complete the setting.

Note: If the laser cannot always identify the weld, it is necessary to confirm whether the weld type is consistent with the actual workpiece weld type. If so, the weld configuration needs to be modified. To modify specific parameters, you need to consult a full-sight engineer.

2. How to use Ruiniu laser software



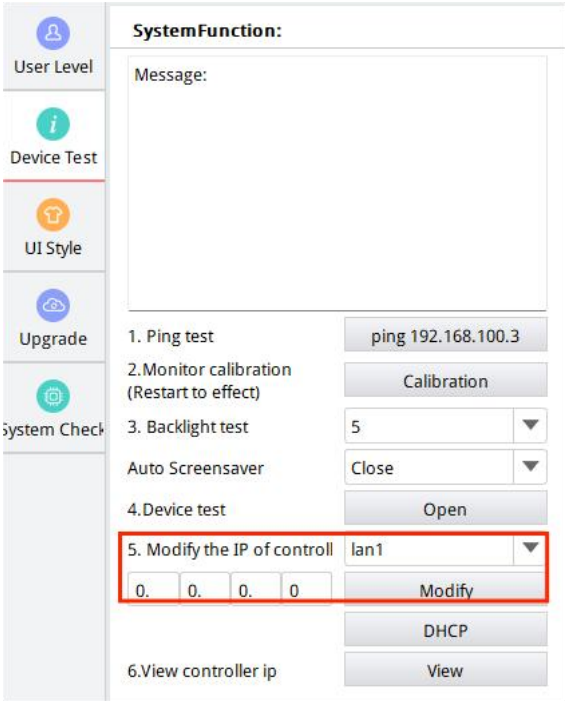
1）Set the communication parameters to ensure that the laser communication function is normal.

2）Select Groove Type

3）Ensure that the laser can stably identify the weld, and you can see the data status in the communication interface of the teaching pendant

Please refer to the Ruiniu software manual for specific usage methods

4.5.1 Communication Settings



1. Establish communication between the controller and the laser. The IP address of the full-view laser is 192.168. 1.111, so the IP of the controller must also be changed to network segment No. 1. Example: 192.168. 1.10

2. Enter the laser tracking communication interface

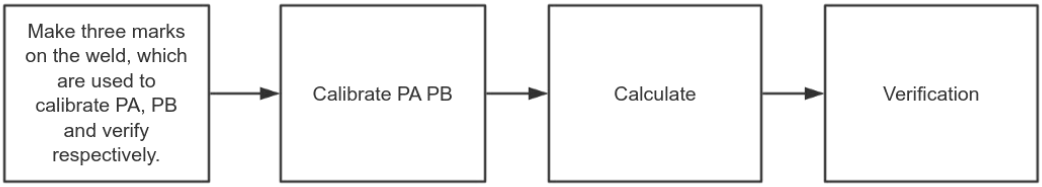
1) Choose a laser brand
2) Modify the laser IP and port number
3) If the connection is normal, the connection normal status light is green; The laser identifies a weld, the data valid status light is green

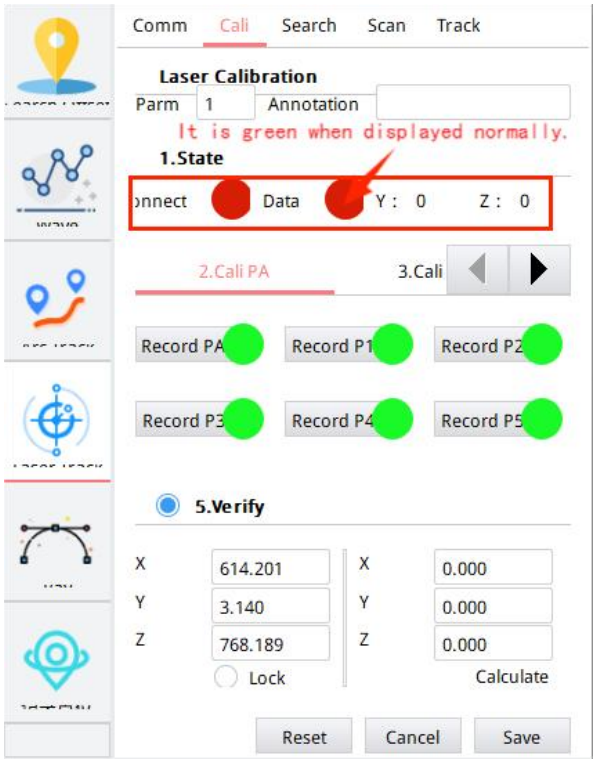
List of parameters:

No.	Parameter Name	Parameter Description
1	Laser Brand	Currently supports Ruiniu and Quanshi
2	Laser IP	Laser server IP address Ruiniu IP: 192.168. 0.97 All-view IP: 192.168. 1.111
3	Laser port number	Laser Server Port Number
4	Communication cycle (ms)	Reservation function
5	Laser forward viewing distance (mm)	Reservation function
6	Automatic connection on power-on	When it is turned on, it will automatically connect the sensor

4.5.2 Laser Calibration

Calibration Process:





1. Make three marks on the workpiece to calibrate PA, PB and verify.

2. We use the 10-point method for calibration, that is, we select two calibration points and scan each calibration point 5 times to calculate the calibration.

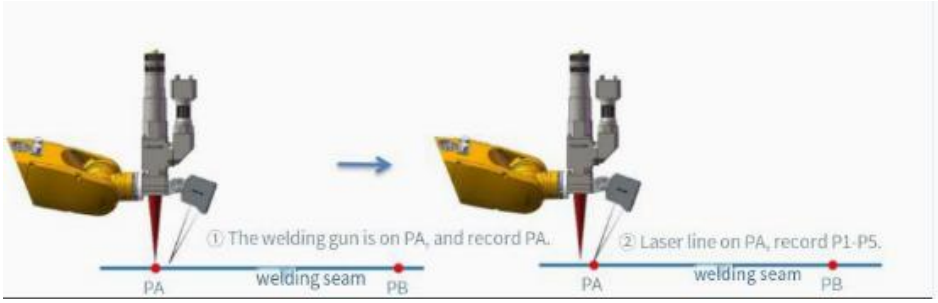
The calibration steps are as follows:

1) PA Point Calibration: (**Note that it needs to be kept enabled when recording points! !)**

A. Select a point on the weld to mark it, move the welding gun to align it with the point, and record PA.

B. Keep the attitude of the robot unchanged, adjust the XYZ position, make the laser line align with the PA point and identify it stably, and record P1-P5 at different

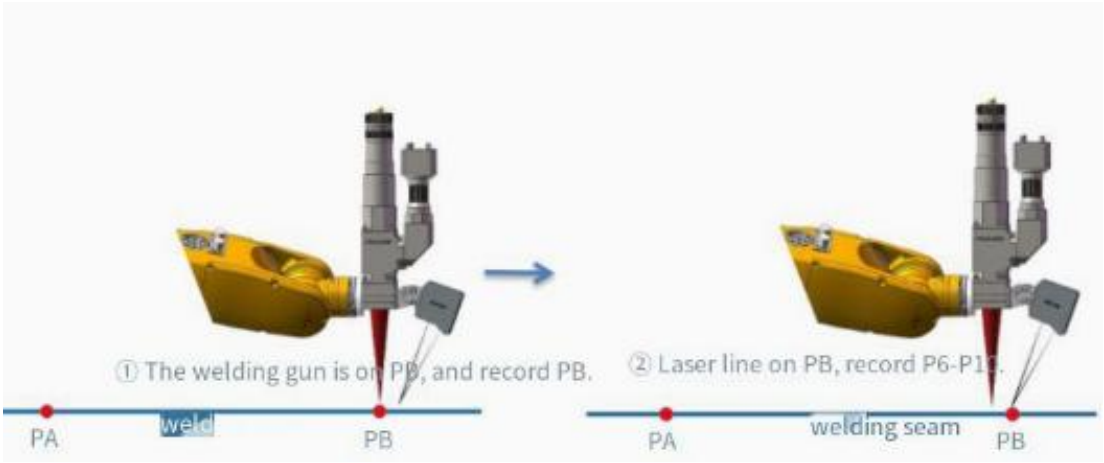
positions.



2) PB point calibration: (**Note that it needs to be kept enabled when recording points! !)**

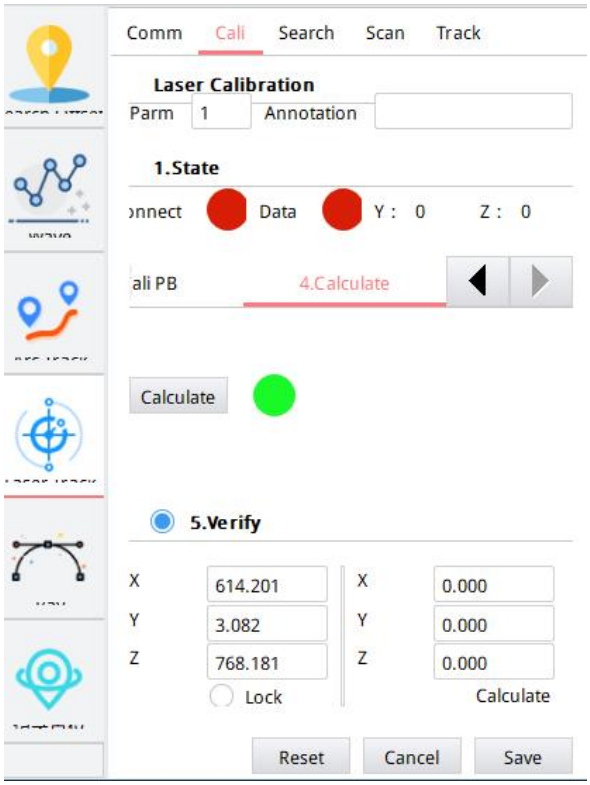
A. Take another point on the weld and mark it, move the welding gun to align it with this point, and record PB.

B. Keep the attitude of the robot unchanged, adjust the XYZ position, make the laser line align with the PB point and identify it stably, and record P1-P5 at different positions.



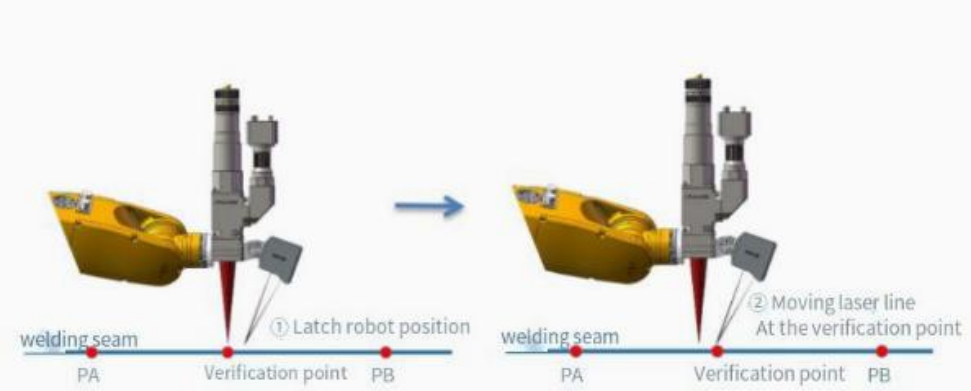
3. Click {Calculate} and {Save}.

(Calibration schematic diagram)



4. Verification. Select other points (except PA and PB) on the weld as verification points, align the end of the robot and lock the search point (the color changes to green), then keep the attitude of the robot unchanged, only jog X, Y and Z to make the verification point coincide with the laser line, and then the position calculated visually will be given at {calculation position}. The difference between the two is about 0.5 mm, which can be considered as successful calibration.

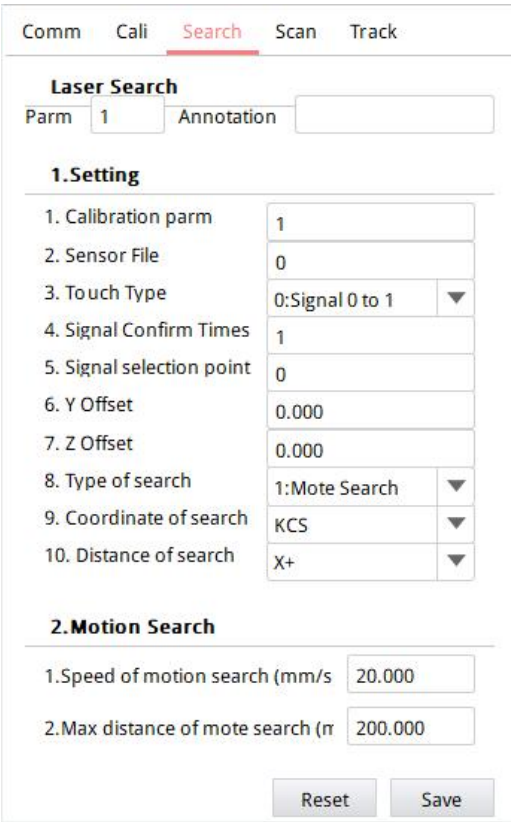
Note: If the difference between the verification accuracy results is too large, the laser coordinate system needs to be recalibrated. If the gap between the two can't meet the requirements after calibration, it may be that the tool coordinate system (TCP) used is not accurate enough and the tool coordinate system needs to be recalibrated, or the robot model is not accurate enough (including zero point, rod length, etc.) and needs to be recalibrated. Calibrate the robot model.



(Verification schematic)

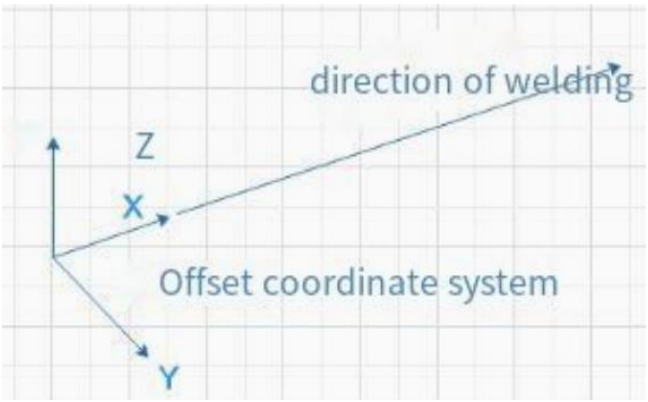
4.5.3 Laser Search

When teaching the starting position of the weld, the laser search function can be used to collect the starting search point, which reduces the teaching workload. Move the robot to the vicinity of the weld as a transition point (ensure that the search point is on the scanning path), and then call the laser search instruction to perform search according to the File No. (laser search parameter) set in advance.

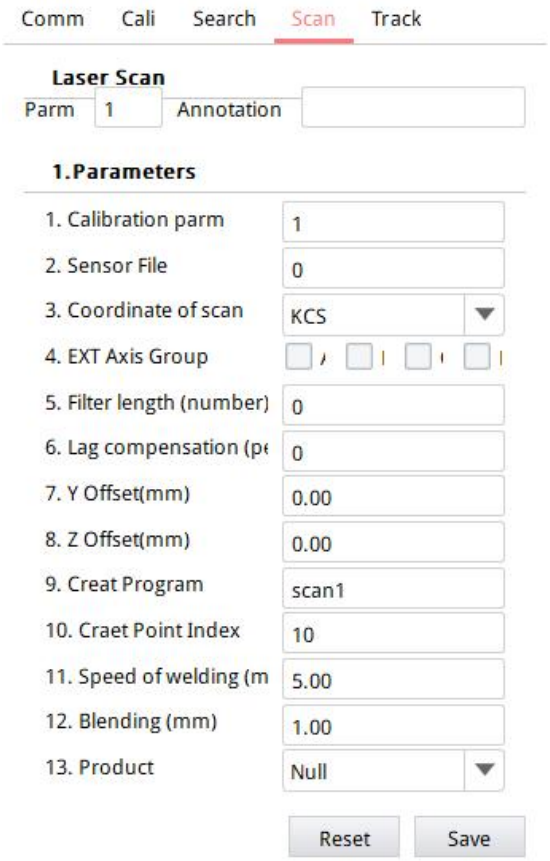


List of parameters:

No.	Parameter Name	Parameter Description
1	Working with	Laser Calibration File No.

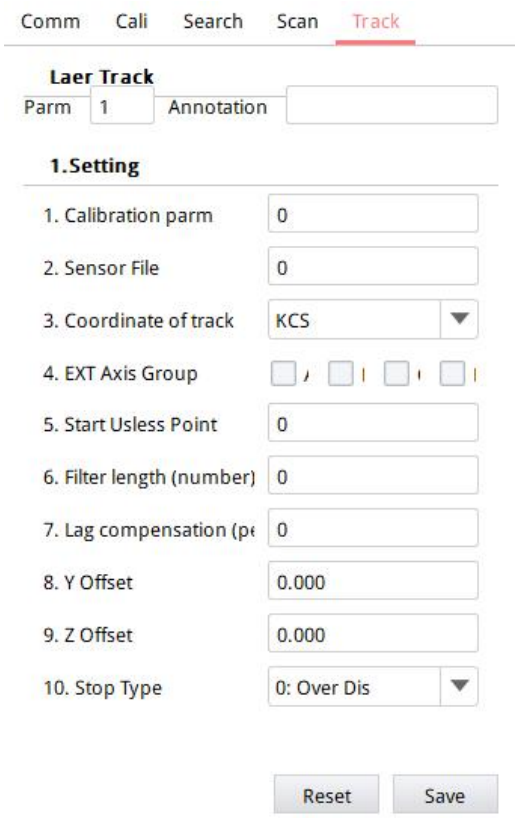
	calibration file	
2	Sensor File	Correspond to the host computer software configuration File No.
3	Method of identification	Ordinary position search must be selected from scratch
4	Signal acknowledgement times	The number of times the laser sensor shoots the weld seam every time the laser sensor receives the position start command
5	Y coordinate compensation	This offset is used to offset the Y coordinate of the weld that is captured by the laser sensor during the weld tracking process Schematic diagram of coordinate system compensation: 
6	Z coordinate compensation	This offset is used to offset the Z coordinate of the weld that is captured by the laser sensor during the weld tracking process
7	Search coordinate system	Specifies the type of coordinate system used by the laser sensor for search. Generally set as the robot coordinate system
8	Search direction	The direction of movement of the laser sensor relative to the coordinate system used when performing search
9	Search type	There are three types: ordinary search, dynamic search and research

List of parameters:

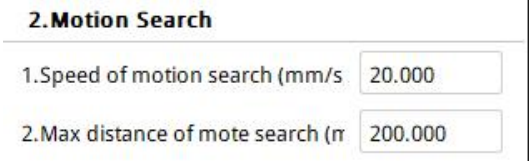
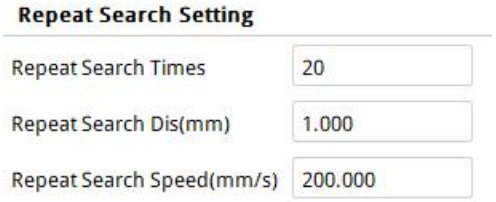


No.	Parameter Name	Parameter Description
1	**Working with calibration file**	Laser Calibration File No.
2	**Sensor File**	Correspond to the host computer software configuration File No.
3	**Scanning coordinate system**	Determine the coordinate system of the motion search point
4	**Linkage shaft group number**	Determine the number of external shafts required for linkage
5	**Filter length**	It is related to the response communication period of the robot. The greater the value, the stronger the filtering ability
6	**Hysteresis compensation**	It is related to the robot response communication cycle. When the following becomes slower, the lag needs to become larger

List of parameters:



No.	Parameter Name	Parameter Description
1	**Working with calibration file**	Laser Calibration File No.
2	**Sensor File**	Correspond to the host computer software configuration File No.
3	**Scanning coordinate system**	Determine the coordinate system of the motion search point
4	**Linkage shaft group number**	Determine the number of external shafts required for linkage
5	**Filter length**	It is related to the response communication period of the robot. The greater the value, the stronger the filtering ability
6	**Hysteresis compensation**	It is related to the robot response communication cycle. When the following becomes slower, the lag needs to become larger

Ordinary search	Search the position once at the current position.	
Dynamic search	Advance along the search direction and find the position, and stop after finding the search point or reaching the maximum search distance. The speed of movement and the maximum distance need to be set.	
Search again	Advance a certain distance along the search direction (re-search distance), then stop and search, and stop after searching the search point or reaching the number of re-searches. You need to set the speed of movement, the distance per advance, and the number of advances (number of search).	

Laser search instruction:

Instruction Example	Movj P=#P1 V=100mm/s; LaserSearchOn File=1 P=#P2 Rtn=#Var1;
Settings Interface	

Parameter Description	File	Select the corresponding configured Locating File No.
	P	Storing the search points calculated by search
	Rtn	The return value of successful search is stored in a numeric variable
Notes	When writing a program, you must judge the Rtn return value	

Examples of laser search programming:

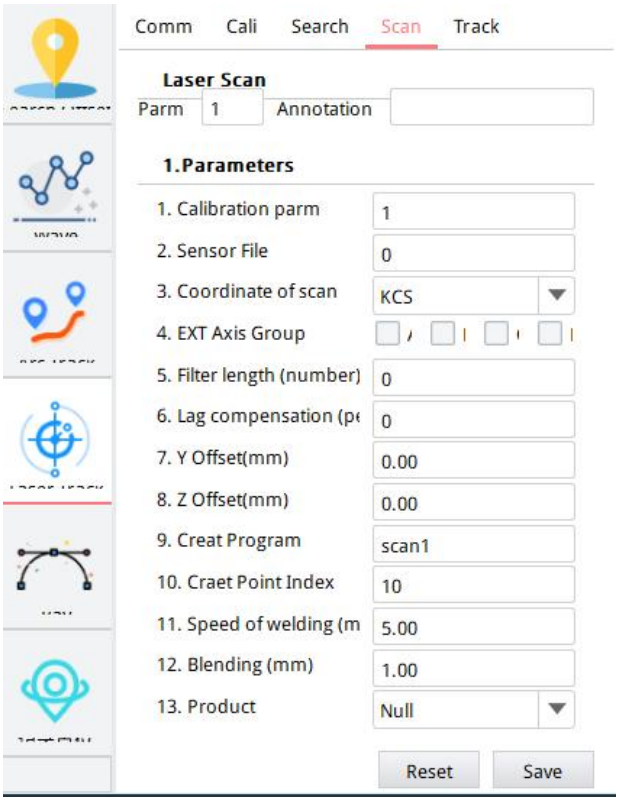
Movj P=#P1 V=20% Bl=0%	**Transition point**
LaserSearchOn File=1 P=#P2 Rtn=#Var1	**Laser search on**

IF (#Var1==1) THEN
Movl P=#P2 V=20% Bl=0%
ELSE
ENDIF
	Judge the return value (judge that the return value is 1 or 0, if it is 1, it means that the laser finds the weld and executes P2; if it is 0, it means that the weld is not found and executes P3)

Movj P=#P3 V=20% Bl=0%	**Transition point**

4.5.4 Laser Scanning

The weld seam is scanned by laser sensor, the weld search points are extracted, and the motion program of the corresponding trajectory is generated. (The robot moves again after the scan is completed)

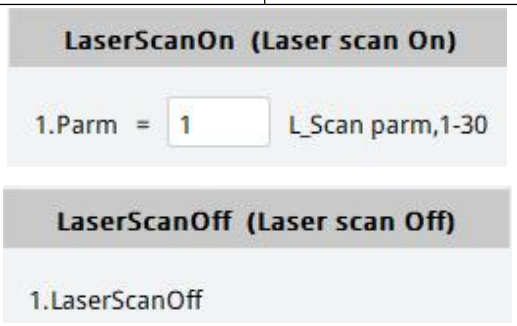


List of parameters:

No.	Parameter Name	Parameter Description
1	Working with calibration file	Laser Calibration File No.
2	Sensor file	Correspond to the host computer software configuration File No.
3	Scanning coordinate system	Set the coordinate system of scan generation points
4	Linkage shaft group number	Set the linkage external axis group that needs to be activated at the scan generation point
5	Y-direction offset (mm)	This offset is used to offset the Y coordinate of the weld that is captured by the laser sensor during the weld tracking process
6	Z-direction offset (mm)	This offset is used to offset the Z coordinate of the weld that is captured by the laser sensor during the weld tracking process
7	Generate program name	Generate the program name of the weld trajectory motion program scanned by the laser sensor (under

		the project where the laser scan command runs)
8	Generate point sequence number	The actual No. (project search) stored at the point scanned by the laser sensor
9	Welding speed	Motion command velocity of the generator program (Movl)
10	Instruction smoothing	Motion command smoothing of the generation program (B 1)
11	Overlay product characteristics	Reservation function

Laser scanning instruction

Instruction Example	Movj P = # P1 V = 5%; LaserScanOn File = 1; Movl P = # P2 V = 30 mm/s; Movl P = # P3 V = 30 mm/s; LaserScanOff;	Starting point Start scanning Scan Off
Settings Interface		
Parameter Description	File	Select the corresponding configured Laser Scanning File No.

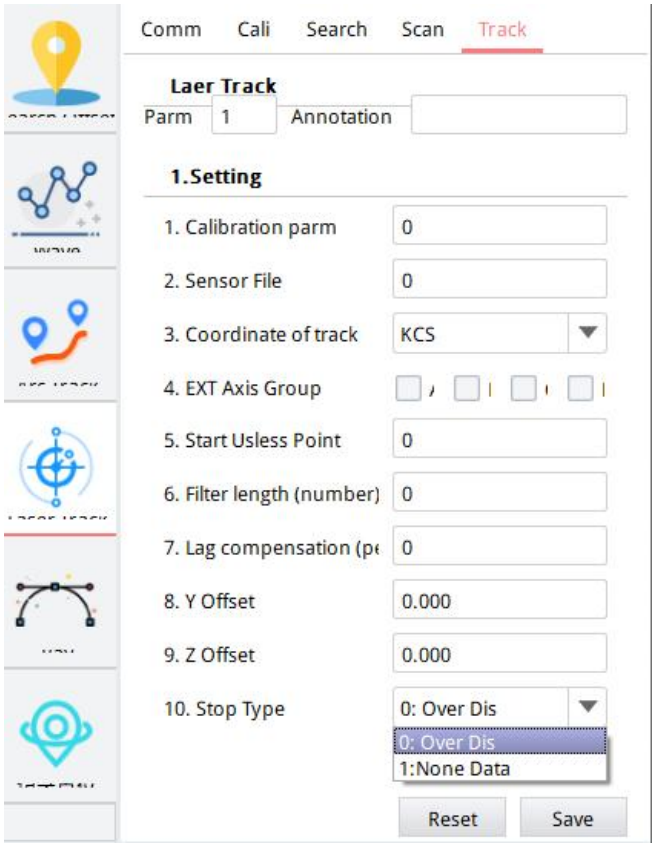
Examples of laser scanning programming:

Movj P = # P1 V = 20% Bl = 0%	**Transition point**
Movl P = # P2 V = 20mm/s Bl = 0mm	**Scan starting point**
LaserScanOn File = 1	**Laser scanning on**
Movl P = # P3 V = 20mm/s Bl = 0mm	**Scan end point**
LaserScanOff	**Laser Off**
Movj P = # P4 V = 20% Bl = 0%	**Transition point**

CALL scan1	**Call the subroutine automatically generated by laser scanning**
Movj P = # P5 V = 20% Bl = 0%	**Transition point**

4.5.5 Laser Tracking

The laser sensor is used to scan the weld seam, extract the weld search point and generate the corresponding trajectory, and the robot will follow the generated trajectory. (Laser tracking will be carried out simultaneously with robot movement)

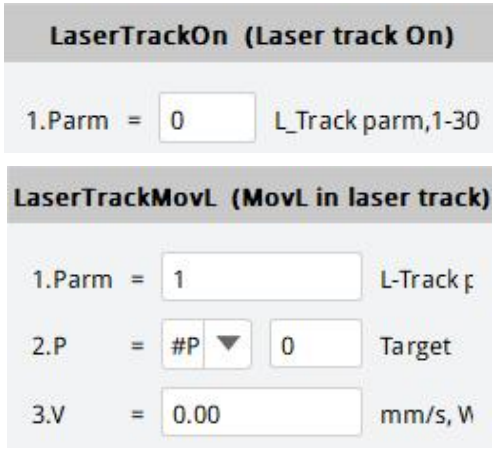


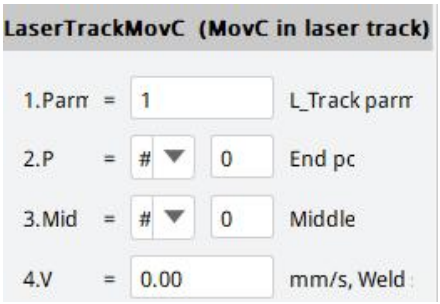
List of parameters:

No.	Parameter Name	Parameter Description
1	Working with calibration file	Laser Calibration File No.
2	Sensor File	Correspond to the host computer software configuration File No.
3	Tracking coordinate system	Set the coordinate system of scan generation points
4	Linkage shaft group	Set the linkage external axis group that needs to be

	number	activated at the scan generation point
5	Starting invalid points	The first few points recognized by the sensor are invalid
6	Y-direction offset (mm)	This offset is used to offset the Y coordinate of the weld that is captured by the laser sensor during the weld tracking process
7	Z-direction offset (mm)	This offset is used to offset the Z coordinate of the weld that is captured by the laser sensor during the weld tracking process
8	Tracking stop condition	0: exceeds the length of the target point: stops when the target point is reached; 1: No valid data: Keep moving along the direction of the target point and will not stop until the scan cannot be reached

Laser tracking instruction

Instruction Example	Movl P=#P1 V=50mm/s Ext=B; LaserTrackOn File=1; LaserTrackMot File=1 P=#P2 V=10mm/s;	Scanning and tracking from point P1 to point P2, the laser sensor stops tracking when it cannot identify a point at a certain distance. Point P2 is only used as a reference point for the robot's motion direction and attitude
Settings Interface		

<table>
<tr><td></td><td colspan="2"> 
</td></tr>
<tr><td rowspan="4">Parameter Description</td><td>File</td><td>Select the corresponding configured Laser Tracking File No.</td></tr>
<tr><td>P</td><td>Target point, direction of motion and reference point for pose interpolation</td></tr>
<tr><td>V</td><td>Welding speed, tracked movement speed</td></tr>
<tr><td>Mid</td><td>Intermediate point of arc</td></tr>
</table>

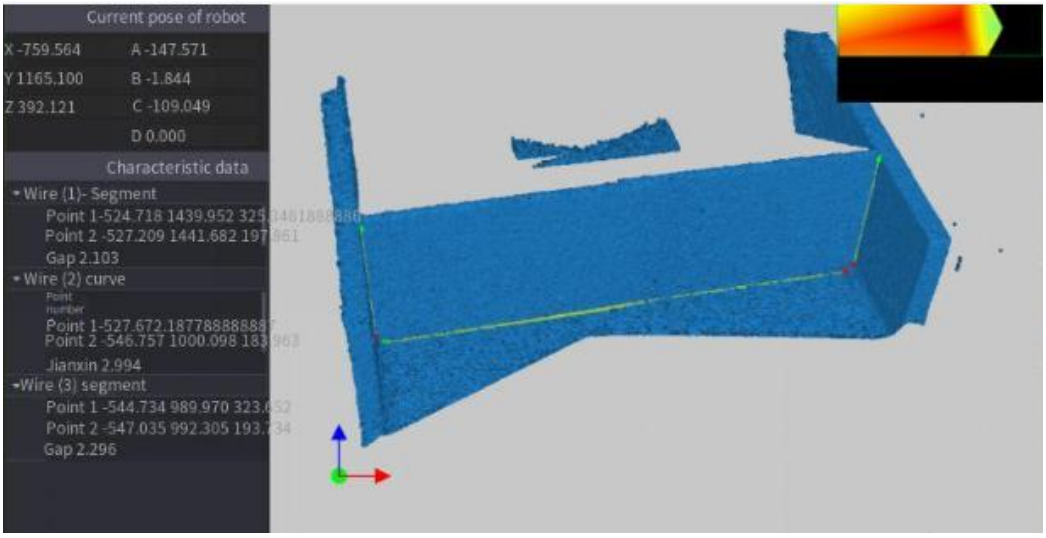
Examples of laser tracking programming:

Movj P = # P1 V = 20% Bl = 0%	**Transition point**
Movl P = # P2 V = 20mm/s Bl = 0mm	**Laser tracking starting point**
LaserTrackOn File = 1	**Laser tracking on command**
LaserTrackMovL File = 1 P = # P3 V = 5mm/s	**Linear laser tracking on command**
Movl P = # P3 V = 20mm/s Bl = 0mm	**Laser tracking target point**
LaserTrackOff File = 0	**Laser tracking off command**
Movj P = # P4 V = 20% Bl = 0%	**Transition point**

4.6 3D Vision

4.6.1 Function Introduction

Through 3D vision, the specific weld seam of the workpiece is identified, and feature data is extracted and sent to the robot controller, such as the starting point coordinates of the weld seam, which reduces a lot of manual teaching time.



In the cooperation of 3D vision, the robot acts as the client and the vision acts as the server, and Tcp/Ip string communication protocol is adopted.

During the debugging process, PING contacts the controller to confirm whether the controller network port IP needs to be modified.

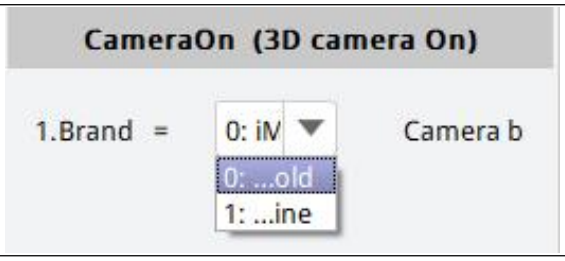
Turn on/off 3D camera communication, send and receive 3D visual data and calibrate 3D camera through 4 commands in [Command List]-[Advanced Welding].

4.6.2 3D Vision Instructions

- CameraOn 3D Visual Connectivity
- CameraData Acquire 3D Visual Data
- CameraOff 3D Visual Shutdown
- CameraCali 3D Visual Calibration

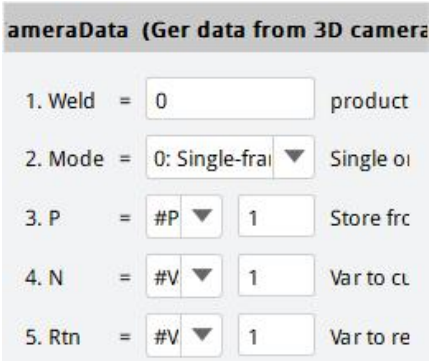
4.6.2.1 CameraOn 3D Visual Connection

Instruction Example	CameraOn Type=0;

Settings Interface	
Parameter Description	When Type = 0, the visual IP is required to be 192.168. 101.97 and the port number is 20000. At this time, the network cable is plugged into the LAN1 network port of the controller, and the IP of the robot is 192.168. 101.3. When Type = 1, the visual IP is required to be 192.168. 3.97 and the port number is 20000. At this time, the network cable is plugged into the LAN2 network port of the controller, and the network port network segment of the controller needs to be modified to keep the same network segment as the visual.
Notes	Other brands can communicate via communication instructions and string instructions

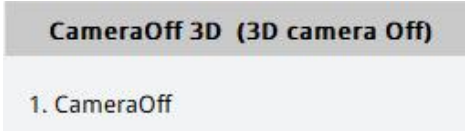
4.6.2.2 CameraData Acquire 3D Visual Data

Tell the camera the type that needs to be identified, whether it is multi-frame (taking multiple photos and fusing), accept the data fed back by the camera after image processing, and store the feature point coordinates in the specified point.

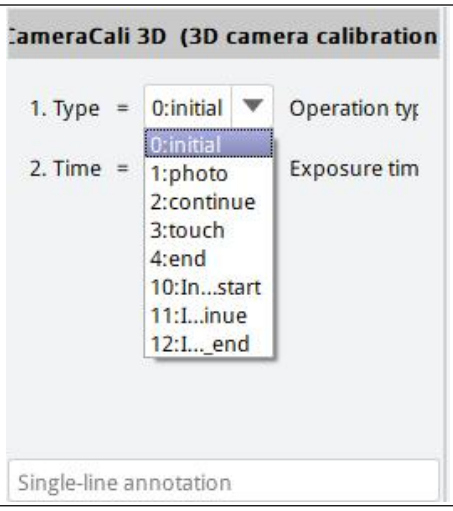
Instruction Example	CameraData Weld = 40 Mode = 0 P = # P1 N = # Var2 Rtn = # Var1;
Settings Interface	

Parameter Description	Weld	The product type defined by the camera, refer to the camera manual for details
	Mode	0: Single frame, the camera only takes one picture Multi-frame: The camera needs to collect multiple combinations, according to the current collection settings. 1: 1 is the first photo 2: 2 is the middle photo 3: 3 is the last photo
	P	The position information sent by the camera is stored sequentially from this search point Assuming that the camera sends four point coordinates from point P10 (only X, Y, and Z, which require pose compensation), the four point coordinates will be stored at P10, P11, P12, and P13 The stored search points need to be added in advance and saved as working coordinate system and tool number (currently only robot coordinate system is supported)
	N	Numerical variable No., which is used to store the number of curve points recognized by the camera
	Rtn	The sequence number of a numerical variable, which is used to store the return value of an instruction and judge whether the recognition is successful

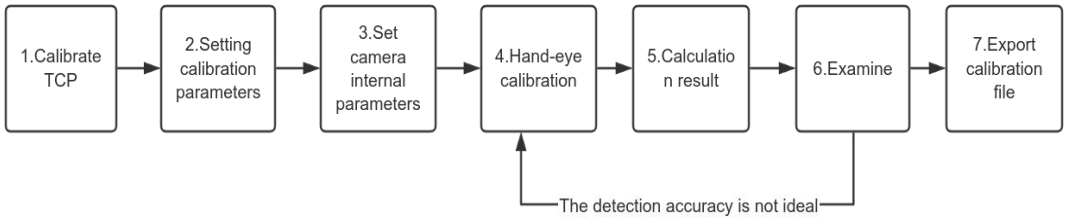
4.6.2.3 CameraOff 3D Vision Off

Instruction Example	CameraOff;
Settings Interface	
Parameter Description	Close the connection to the 3D camera

4.6.2.4 CameraCali 3D Vision Calibration

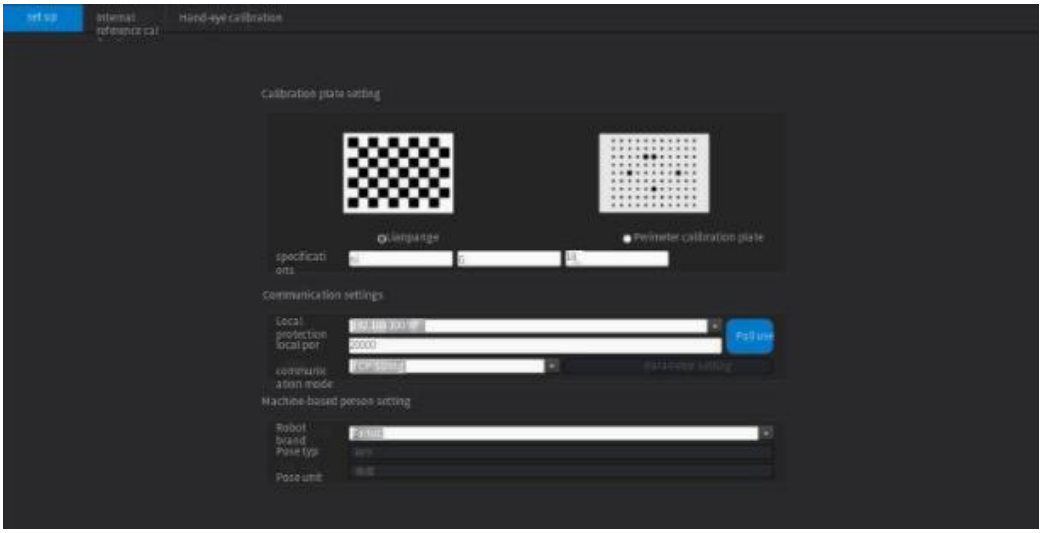
Instruction Example	CameraCali Type = 0;
Settings Interface	
Parameter Description	This instruction is used to communicate with the host computer (calibration software) and send point information during 3D visual calibration.

4.6.3 3D Vision Calibration Process



Step 1: Calibrate the TCP accuracy, which can be calibrated by the 20-point method to ensure that the accuracy is below 0.3 (0.5) mm.

Step 2: Set the calibration parameters. Open the calibration software supporting the camera, select the parameters as shown in the figure, and click Apply.

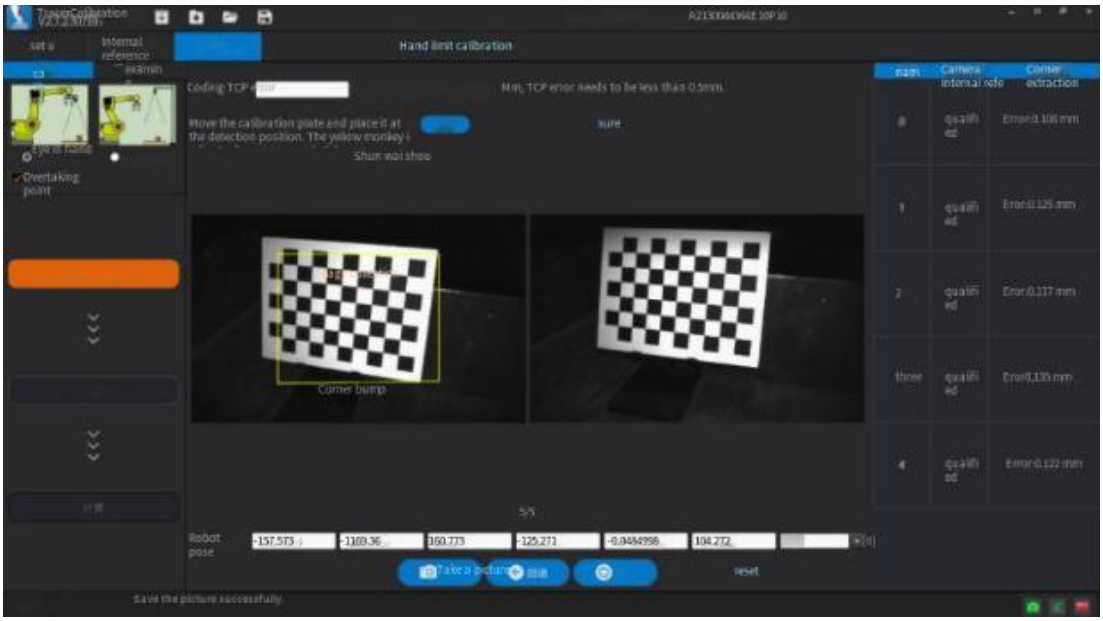


Step 3: Adjust camera internal parameters

If the calibration plate is too dark or too bright, modify the exposure time and gain

Step 4: Hand-eye calibration

Record 5 photo search points and 4 contact points and transition points, and then execute the calibration teaching procedure (refer to calibration example). There is no need to manually enter coordinates in the calibration software interface.



Notes:

1. The calibration board should not be too inclined to facilitate the robot to

take pictures in different postures

2. The calibration plate occupies more than half of the black frame area
3. The actual effect is better with touch
4. It takes a certain time for the camera to take pictures. It is recommended to execute the calibration program in a single line (FN2 key floating menu switch). After confirming that the calibration software displays successfully, proceed to the next step

Step 5: Check the calibration results, and if it does not meet the requirements (generally below 0.5, according to actual needs), adjust the photography point (angle); Make sure that the contact point is accurate and does not touch the calibration plate (select the appropriate transition point).

Step 6: Detection. Move the camera at will to identify the calibration board (the same as the requirements in step 4), enter the position of the robot coordinate system (enabled state), and click the photo button. Check whether the difference between the result and the coordinates of the four vertices of the punctuation board meets the requirements.

Step 7: Export the profile (hand-eye matrix).

4.6.4 Example of Calibration Program Programming

CameraOn Type=1	**Turn on camera communication**
Movl P=#P1 V=100mm/s	**First photo spot**
CameraCali Type=0	**Camera calibration initialization and photographing**
Movl P=#P2 V=100mm/s	**Second photo spot**
CameraCali Type=1	**Photograph**
Movl P=#P3 V=100mm/s	**Third photo spot**
CameraCali Type=1	**Photograph**
Movl P=#P4 V=100mm/s	**Fourth photo spot**
CameraCali Type=1	**Photograph**
Movl P=#P5 V=100mm/s	**Fifth photo spot**
CameraCali Type=1	**Photograph**
Movl P=#P10 V=100mm/s	**Move to transition point (avoid moving directly from touch point 1 to touch point 2, there is no sequence requirement for**

	4 touch points)
Movl P=#P6 V=100mm/s	**First touch point**
CameraCali Type=3	**Send end position**
Movl P=#P10 V=100mm/s	**Transition point**
Movl P=#P7 V=100mm/s	**Second touch point**
CameraCali Type=3	**Send end position**
Movl P=#P10 V=100mm/s	**Transition point**
Movl P=#P8 V=100mm/s	**Third touch point**
CameraCali Type=3	**Send end position**
Movl P=#P10 V=100mm/s	**Transition point**
Movl P=#P9 V=100mm/s	**Fourth touch point**
CameraCali Type=3	**Send end position**
CameraCali Type=4	**Calculated results**
Movl P=#P10 V=100mm/	**Transition point**

4.6.5 3D Vision Usage Process

If there is no offline programming, writing a program in the teaching pendant interface using 3D vision flow is as follows:

Procedure	Description
1 Turn on camera communication	Call the CameraOn command, select the corresponding camera, and check whether the IP is correct
2 Teaching the photo search point	Select the appropriate camera spot through the camera software, and adjust the camera parameters according to the actual situation. Refer to the camera software manual for details
3 Camera and controller data interaction	Call the CameraData instruction, which will tell the camera the type that needs to be identified. Then, after receiving the request, the camera takes a photo for image processing and feeds the data back to the controller. The controller will store the search points according to the instruction parameters (that is, the controller returns the point coordinates X, Y, Z assigned to the set search points)
4 Teaching attitude points for attitude	Because the point coordinates fed back by the camera are only X, Y, and Z, it is necessary to write instructions to assign poses to the points. Several attitude points are taught according to the

compensation	actual situation, and then the attitude (roll/pitch/yaw) of the attitude points is assigned to the stored welding search points. The value can be assigned by the instruction PosToPos; It can also be entered through the Expr instruction in the following format (#P#Var3).roll = (#P#Var4).roll; or #P28.roll = #P30.roll;
5 Write welding program	The search point after compensating the attitude is the search point of actual welding. Just call the welding instruction and MovL. Pay attention to the sequence of each feature point of different types of camera. If it is not clear, please check the camera manual. Check carefully after writing the program

4.6.6 3D Vision Use Cases

This section will use rib welding as an example to illustrate how to use 3D vision instructions and pose interpolation procedures using teaching pendant programming.

4.6.6.1 Procedure 1

First rib plate (left) corresponding to camera welding package type 21

CameraOn Type=1	**Turn on camera communication**
Movl P=#P1 V=300mm/s	**Transition point**
Movl P=#P2 V=200mm/s	**Photography spot**
CameraData Weld=21 Mode=0 P=#P50 N=2 Rtn=1	**Obtain 3D visual data, and store feature points from P50**

WaitExecutor	**Blocking instructions to ensure successful data storage**
CALL zitai021	**Call the corresponding subroutine for pose interpolation and welding**

4.6.6.2 Procedure 2: Fusion Mode

The second rib plate corresponds to the camera welding pack type 20. Because the ribs are too long, the camera can't take all photos at one time, so you can take multiple groups of photos through the fusion mode.

As shown in the figure below, the rib plate 20 can be seen to be composed of 21, 22, 23.

Partial type	serial number	Characteristic data
	ribbed plate Number: 20	Wire-segment [1] Wire-Curve [2] Wire-segment [3]
	Rib-left side Number: 21	Wire-segment [1] Wire-Curve [2]
	Rib plate-middle section Number: 22	Wire-Curve [1]
	Rib-right side Number: 23	Wire-segment [1] Wire-Curve [2]

When writing instructions, the camera instruction type is the current recognition type, and the camera is told that the current photo taken is the first, middle, and last by selecting the Mode value.

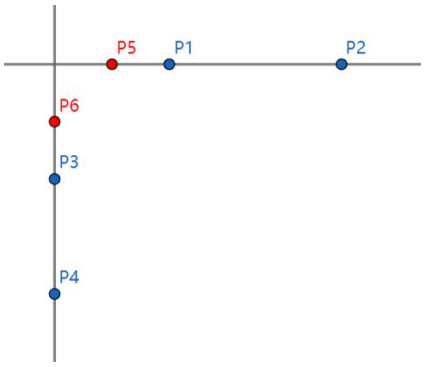
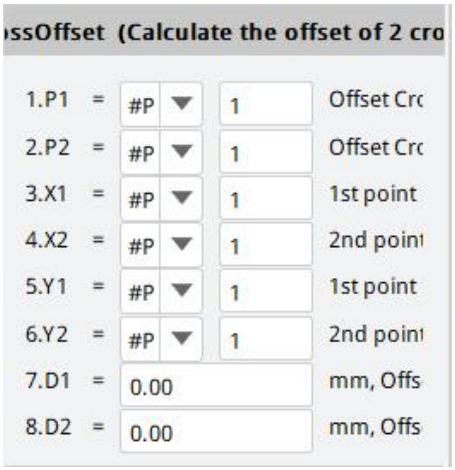
Movl P=#P4 V=200mm/s	Photo spot 1
CameraData Weld=21 Mode=1 P=#P50 N=2 Rtn=1	Identify the left side
WaitExecutor	Blocking instructions to ensure successful data storage
Movl P=#P5 V=100mm/s	Photo spot 2
CameraData Weld=23 Mode=3 P=#P50 N=2 Rtn=1	Identify right side
WaitExecutor	Blocking instructions to ensure successful data storage
CALL zitai020	Call the corresponding subroutine for pose interpolation and welding

4.6.7 Crossoffset Calculates Line Intersection Offsets

Calculate the coordinates (XYZ) of the offset points of the intersection point in

both directions by known two points on two straight lines

An example of a directive is as follows:

<table>
<tr><td colspan="2">Instruction Example</td><td>CrossOffset P = 5, 6 Line = 1, 2, 3, 4 Dis = 5, 5;</td></tr>
<tr><td colspan="2"> 
</td><td> 
</td></tr>
<tr><td rowspan="8">Parameter Description</td><td>P1</td><td>Stores the calculated intersection position No..</td></tr>
<tr><td>P2</td><td>Stores the calculated intersection position No..</td></tr>
<tr><td>X1</td><td>The first point in the X direction, a point on the first line</td></tr>
<tr><td>X2</td><td>2nd point in X direction, another point on the first line</td></tr>
<tr><td>Y1</td><td>The first point in the Y direction, a point on the second line</td></tr>
<tr><td>Y2</td><td>2nd point in the Y direction, another point on the second line</td></tr>
<tr><td>D1</td><td>Offset of line intersection along X1X2 direction</td></tr>
<tr><td>D2</td><td>Offset of line intersection along Y1Y2 direction</td></tr>
</table>

4.6.7.1 Attitude Interpolation

The following is the attitude interpolation template of Type 20. When applying it, you need to pay attention to whether engineering variables and engineering increments are added and whether there are conflicts? If there is any conflict, please modify it completely according to the comments. Please modify welding

instructions according to specific process requirements.

```
//Type 20: Line segment + curve + line segment;
//# Var1 Camera return value;
//# Var2 Curve points;
//# Var3 Starting feature point sequence number;
//# Var4-9 Attitude Point No.; (Attitude points need to be taught manually)
//# Var20 Motion Point No.;
////////////////// Please enter the starting storage search point No.//////////////////
#Var3 = 50;
//////////////////Please enter the attitude reference point No.//////////////////////
#Var4 = 100;
#Var5 = 101;
#Var6 = 102;
//If the identification is unsuccessful, raise the welding gun and proceed to the next plate
IF (# Var1! = 1) THEN;
    WaitExecutor;
    Movl P = # IncP1 V = 100 mm/s;
    JUMP pass;
ELSE;
ENDIF;
//The first feature point;
(#P#Var3).roll = (#P#Var4).roll;
(#P#Var3).pitch = (#P#Var4).pitch;
(#P#Var3).yaw = (#P#Var4).yaw;
//The second feature point;
#Var10 = #Var3 +1;
(#P#Var10).roll = (#P#Var4).roll;
(#P#Var10).pitch = (#P#Var4).pitch;
(#P#Var10).yaw = (#P#Var4).yaw;
//Third feature point (curve starting point);
#Var11 = #Var3 +2;
(#P#Var11).roll = (#P#Var4).roll;
(#P#Var11).pitch = (#P#Var4).pitch;
(#P#Var11).yaw = (#P#Var4).yaw;
```

```
//The third to last feature point (the end point of the curve);
#Var12 =#Var3+ #Var2+1;
(#P#Var12).roll = (#P#Var6).roll;
(#P#Var12).pitch = (#P#Var6).pitch;
(#P#Var12).yaw = (#P#Var6).yaw;
//The penultimate feature point;
#Var13 =#Var3+ #Var2+2;
(#P#Var13).roll = (#P#Var6).roll;
(#P#Var13).pitch = (#P#Var6).pitch;
(#P#Var13).yaw = (#P#Var6).yaw;
//The penultimate feature point;
#Var14 =#Var3+ #Var2+3;
(# P # Var14). roll = (# P # Var6). roll;
(# P # Var14). pitch = (# P # Var6). pitch;
(# P # Var14). yaw = (# P # Var6). yaw;
//If the curve exceeds 2 points;
WHILE(#Var2>2)DO;
#Var15 =#Var3+ #Var2;
(#P#Var15).roll = (#P#Var5).roll;
(#P#Var15).pitch = (#P#Var5).pitch;
(#P#Var15).yaw = (#P#Var5).yaw;
#Var2 = #Var2 -1;
ENDWHILE;
```

//If you actually need to correct and compensate some points, input it through the Expr command, the format is as follows

```
//#P52.z = #P52.z + 2;
//(# P # Var15). z = (# P # Var15). z + 2;

//20 motion command;
WaitExecutor;
#Var20 = #Var3+1;
//Weld line segment 1
WaitExecutor;
ArcOn File=1 Time=0 C=160 V=30;
```

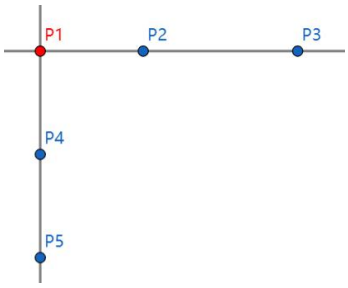
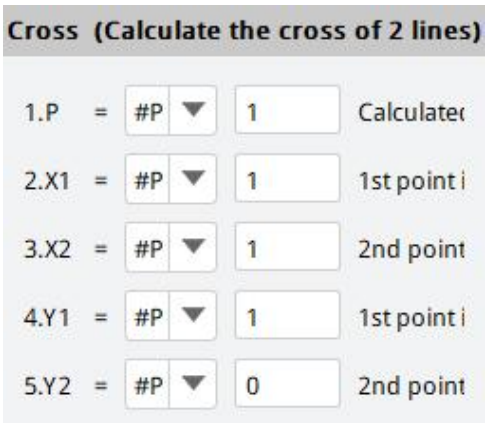
```
Movl P=#P#Var20 V=100mm/s;
#Var20 = #Var3 ;
WaitExecutor;
Movl P=#P#Var20 V=100mm/s;
ArcOff Time= 0;

//Welding curve
#Var20 = #Var3 + 2;
WaitExecutor;
Movl P=#P#Var20 V=50mm/s;
ArcOn File=1 Time=0 C=160 V=30;
WHILE(#Var20<=#Var3+#Var2+1)DO;
        WaitExecutor;
        Movl P=#P#Var20 V=50mm/s;
        #Var20 = #Var20 + 1;
        WaitExecutor;
ENDWHILE;
ArcOff Time= 0;

//Weld line segment 2
Movl P = # P # Var14 V = 50 mm/s;
ArcOn File = 1 Time = 0 C = 160 V = 30;
Movl P = # P # Var13 V = 50 mm/s;
ArcOff Time = 0;
//transition point;
Movl P = # IncP2 V = 100 mm/s;
LABEL pass;
```

4.7 Other Instructions

4.7.1 Cross Calculates The Intersection of Straight Lines

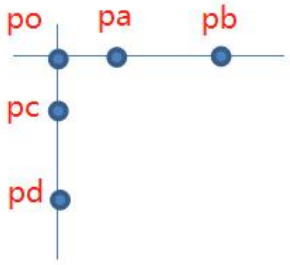
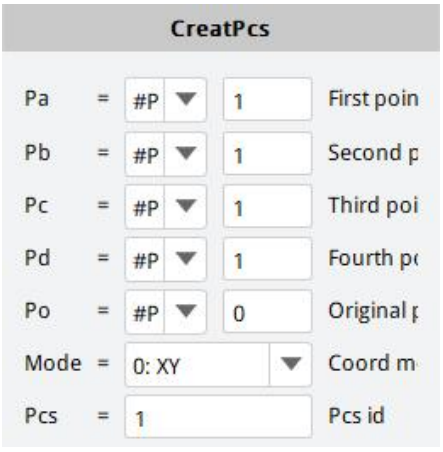
Calculate the coordinates of the intersection point (XYZ) from two known points on two straight lines

An example of a directive is as follows:

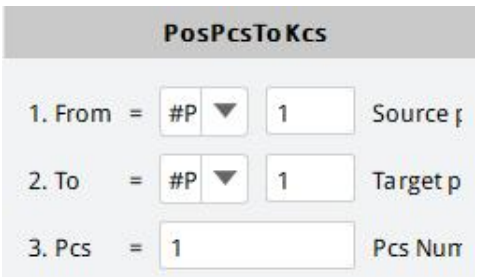
<table>
<tr><td colspan="2">Instruction Example</td><td>Cross P = # P1 Line = 2, 3, 4, 5;</td></tr>
<tr><td colspan="2"> 
</td><td> 
</td></tr>
<tr><td rowspan="5">Parameter Description</td><td>P</td><td>Stores the calculated intersection position No..</td></tr>
<tr><td>X1</td><td>The first point in the X direction, a point on the first line</td></tr>
<tr><td>X2</td><td>2nd point in X direction, another point on the first line</td></tr>
<tr><td>Y1</td><td>The first point in the Y direction, a point on the second line</td></tr>
<tr><td>Y2</td><td>2nd point in the Y direction, another point on the second line</td></tr>
</table>

4.7.2 Creatpcs Generates Pcs

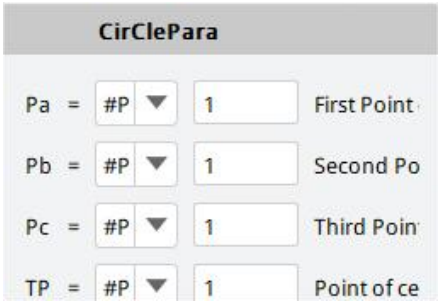
Instruction Example	CreatPcs Pa = # P1 Pb = # P2 Pc = # P3 Pd = # P4 Po = 0 Mode = 0 Pcs = 1;

<table>
<tr><td colspan="2"> 
</td><td> 
</td></tr>
<tr><td rowspan="6">Parameter Description</td><td>Pa</td><td>First point on workpiece</td></tr>
<tr><td>Pb</td><td>Second point on workpiece</td></tr>
<tr><td>Pc</td><td>Third point on workpiece</td></tr>
<tr><td>Pd</td><td>Fourth point on workpiece</td></tr>
<tr><td>Po</td><td>Po = 0 uses the origin calculated by default; Po ≠ 0 custom origin</td></tr>
<tr><td>Mode</td><td>Six modes: XY, YX, XZ, ZX, YZ, ZY</td></tr>
<tr><td>Pcs</td><td>Save the generated Pcs to the coordinate system sequence number</td></tr>
</table>

4.7.3 Pospcstokcs Workpiece to Robot Position

<table>
<tr><td>Instruction Example</td><td colspan="2">PosPcsToKcs From = # P1 To = # P2 Pcs = 3</td></tr>
<tr><td>Settings Interface</td><td colspan="2"> 
</td></tr>
<tr><td rowspan="3">Parameter Description</td><td>From</td><td>Robot Position Source point</td></tr>
<tr><td>To</td><td>Go to the workpiece position target point</td></tr>
<tr><td>Pcs</td><td>Use workpiece coordinate system sequence number</td></tr>
</table>

4.7.4 Circlepara Calculates Circle Parameters

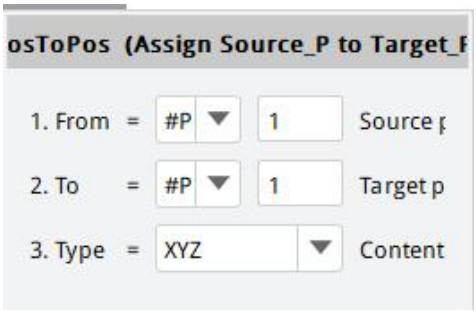
Instruction Example	CirClePara Pa = # P1; Pb = # P2; Pc = # P3; Tp = # P4	
Settings Interface		
Parameter Description	Pa	The first point on the arc
	Pb	The second point on the arc
	Pc	The third point on the arc
	Tp	Calculate the point where the center of the circle is stored at the project search

4.7.5 Circlepara Calculates Circle Parameters

4.7.6 Postopos Search Point Assignment

Assign the XYZABC of one point to another

An example of a directive is as follows:

Instruction Example		PosToPos From = # P1 To = # P2 Type = XYZ;
Interface settings		
Parameter Description	From	Source point
	To	Target point
	Type	XYZ coordinate values, ABC pose

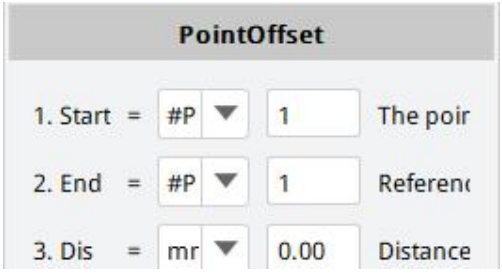
4.7.7 Gunoffset Welding Gun Offset

The search point between the GunOffsetOn and GunOffsetOff instructions is offset along the current tool direction.

An example of a directive is as follows:

Instruction Example		GunOffsetOn X = 1 mm Y = 0 mm Z = 0 mm A = 0 B = 0 C = 0;
Interface Settings		
Parameter Description	X	Orientation of the current tool coordinate system X
	Y	Orientation of the current tool coordinate system Y
	Z	Orientation of the current tool coordinate system Z
	A	Orientation of the current tool coordinate system A
	B	Orientation of the current tool coordinate system B
	C	Orientation of the current tool coordinate system C

4.7.8 Pointoffset Search Point Offset

Instruction Example		PointOffset Start = # P1 End = # P2 Dis = 5;
Interface settings		
Parameter	Start	Starting point

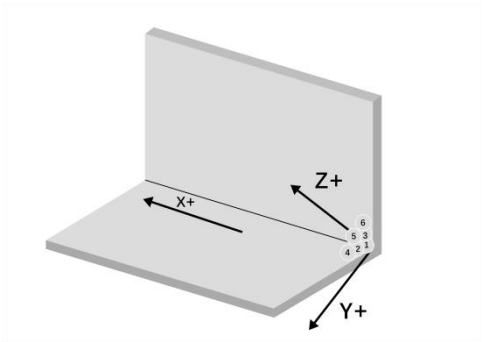
Description	To	Target point
	Dis	The distance at which the starting point is offset from the target point

5 Multi-Layer and Multi-Channel

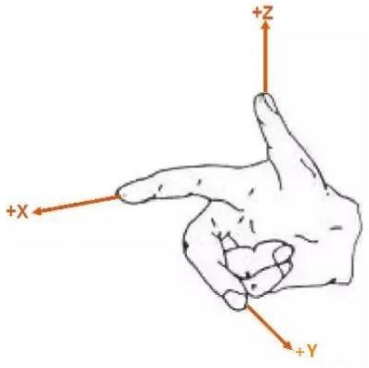
Abstract: In order to use robots to realize the automatic welding of multi-layer and multi-channel complex spatial trajectories, and improve the processing quality and efficiency of specific welding structures, a multi-layer and multi-channel weld bead arrangement strategy was developed, and the position of each weld bead was determined. At the same time, the end pose of the robot welding gun was planned, and in the actual welding experiment, the robot welding had good continuity, high efficiency, and the weld filling was uniform, dense and beautiful. This function is used when arc welding of thick plates is performed and it is necessary to weld repeatedly due to the length of the required welding leg that cannot be solved by one-time welding, or when the volume of welding is too large.

Weld Seam Coordinate System:

The sampling travel direction is x +, the negative direction of the welding gun is z +, and the y direction is determined according to the right-hand rule



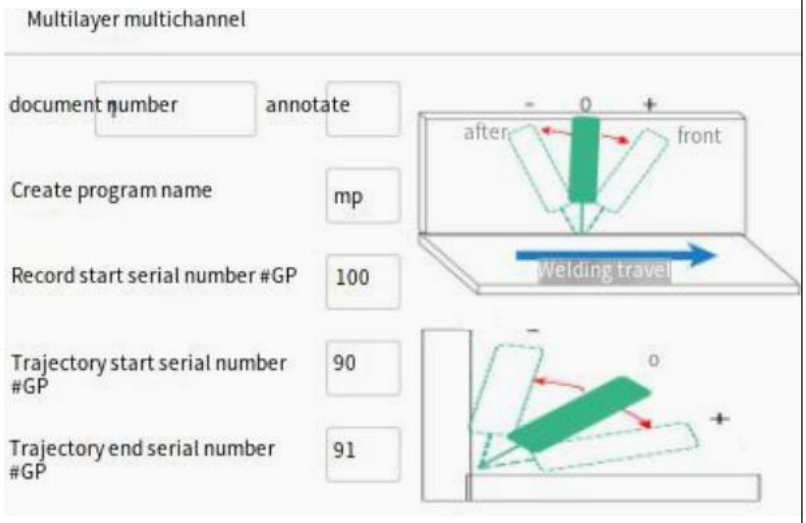
Welding seam coordinate system



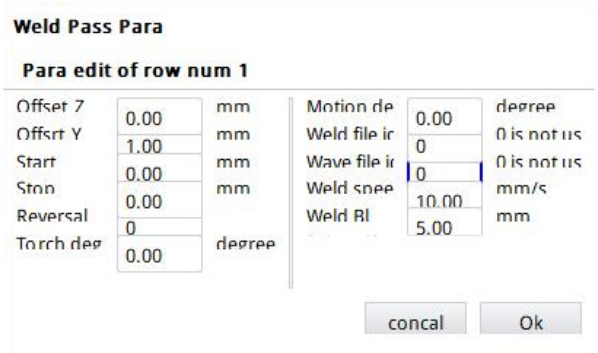
Right-hand coordinate system of robot

5.1 Multi-Layer Multi-Channel Parameters

5.1.1 Basic Parameters

No.	Parameter Name	Parameter Description
1	Parametric interface	
2	Create program name	Subroutine names for multi-layer multi-channel generation
3	Record Start No. # GP	The first point sequence number of multi-layer and multi-channel generation
4	Track Start No. # GP	Copies the first point generated to that point. The point can be used for operations such as offset
5	Track End No. # GP	Copies the last point generated to that point. The point can be used for operations such as offset

5.1.2 Bead Parameters

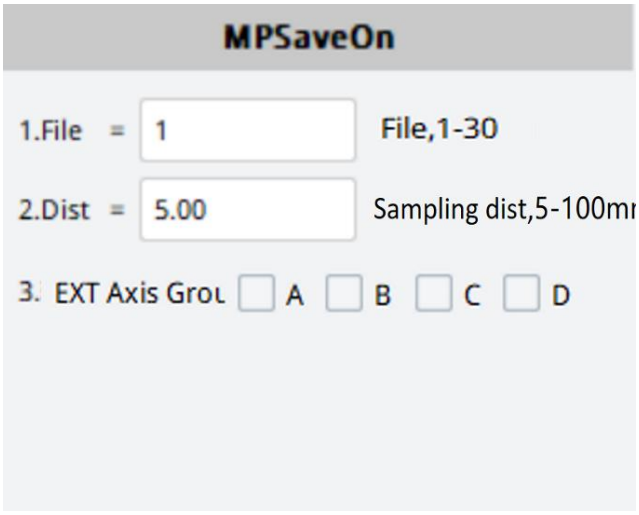
No.	Parameter Name	Parameter Description
1	Parametric interface	
2	Up and down offset	Z-direction offset of weld coordinate system
3	Left-right offset	Y-direction offset of weld coordinate system
4	Front and back indentation	Length of weld indentation
5	Reversed	0: No reverse (when multilayer welding is in the same direction as the first layer) 1: reverse (when multilayer welding is in the opposite direction as the first layer)
6	Front-rear angle	Adjust the welding traveling angle, according to the welding traveling direction, front negative and back positive
7	Left-right angle	Welding angle adjustment, left negative and right positive according to welding travel direction
8	Welding File No.	Foundation Welding Parameters File No.
9	Pendulum Arc File No.	Pendulum Arc Parameter File No.
10	Welding speed	Multi-layer and multi-pass welding speed
11	Welding BL	Multi-layer and multi-pass welding smoothness

5.1.3 Key Description

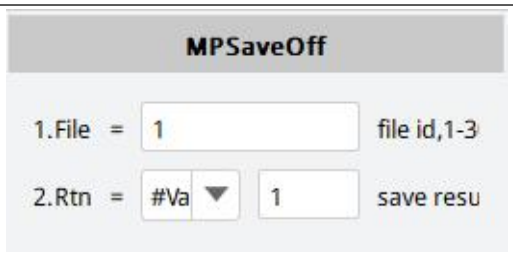
No.	Parameter Name	Parameter Description
1	Parametric interface	
2	Add weld bead	Create a new weld bead parameter
3	Edit weld bead	Edit Bead Parameters
4	Remove weld bead	Delete selected bead parameters
5	Duplicate weld bead	Copy the selected bead to the next row
6	Weld bead moving up	Move up selected bead parameters
7	Weld bead moving down	Move down selected bead parameters
8	Refresh	Refresh parameters
9	Copy	Copy multi-layer multi-channel files (all parameters of this interface)
10	Paste	Paste multi-layered files
11	Cancel	Cancel Modification
12	Save	Save the parameters to fix this

5.1.4 Instruction Parameter Description

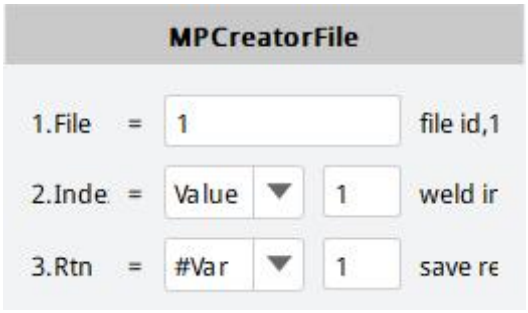
5.1.4.1.1 MPSaveOn record on

<table>
<tr><td>Instruction Example</td><td colspan="2">MPSaveOn File = 1 Dist = 5 Ext = A</td></tr>
<tr><td>Settings Interface</td><td colspan="2"> 
</td></tr>
<tr><td rowspan="3">Parameter Description</td><td>File</td><td>Multi-layer Multi-channel File No.</td></tr>
<tr><td>Dist</td><td>Interval between two sampling points</td></tr>
<tr><td>Shaft set</td><td>Positioner shaft group number to be linked</td></tr>
</table>

5.1.4.1.2 MPSaveOff Record closed

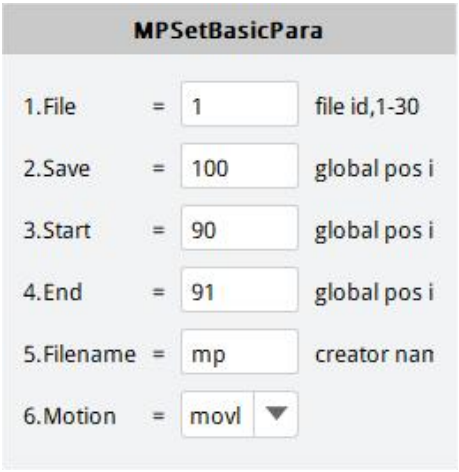
Instruction Example	MPSaveOff File = 1 Rth = # Var1	
Settings Interface		
Parameter Description	File	Multi-layer Multi-Channel File No.
	Rth	Variables for storing sampling results

5.1.4.1.3 MPCreatorFile creates a file

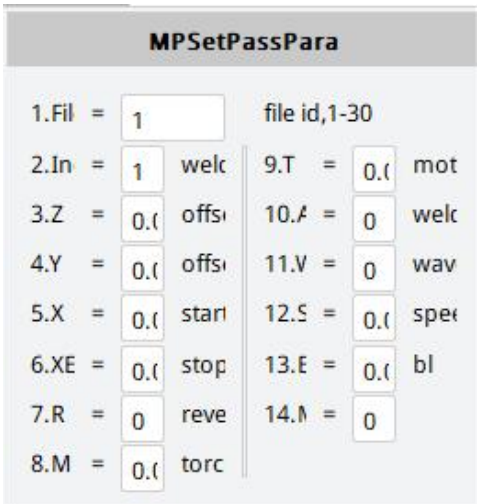
Instruction Example	MPCreatorFile File = 1 Index = # Var2 Rth = Var3	
Settings Interface		
Parameter Description	File	Multi-layer Multi-channel File No.
	Index	Bead No., optional value or variable
	Rth	The variable that holds the result created

5.1.4.1.4 MPSetBasicPara base parameters

Instruction Example	MPSetBasicPara File = 1 Save = 100 Start = 90 End = 91 Filename = multipass

Settings Interface	
Parameter Description	Use instructions to edit basic parameters, and the meaning of parameters is consistent with that of basic parameters

5.1.4.1.5 MPSetPassPara **offset parameter**

Instruction Example	MPSetPassPara File = 1 Index = 1 Z = 5 Y = 5 X = 5 R = 1 M = 0 T = 0 A = 1 W = 1 S = 5 B = 5
Settings Interface	
Parameter Description	Use commands to edit the weld bead parameters, and the meaning of the parameters is the same as that of the weld bead parameters

5.2 Programming Examples

Movl P=#P1 V=100mm/s Bl=0mm	**Sampling starting point (starting point of weld)**
MPSaveOn File=8 Dist=10 Ext=0	**Sampling record on**
Movl P=#P2 V=100mm/s Bl=0mm	**Sampling End Point (End of Weld)**

MPSaveOff File=8 Rtn=#Var1	Sampling record is closed, if the sampling is successful var1 = 1
FOR #Var2 FROM 1 TO 5 STEP 1 DO	Five cycles represent five multi-layer and multi-pass welds
MPCreatorFile File=8 Index=#Var2 Rtn=#Var1	Create a file
GunOffsetOn X=0mm Y=0mm Z=-10mm A=0 B=0 C=0	Welding gun offset, the starting point of multi-layer and multi-pass offset 10mm to the negative direction of welding gun
Movl P=#GP90 V=100mm/s Bl=0mm	The multi-layer multi-pass starting point is copied to P90, which can be quickly moved near the weld starting point to save time
GunOffsetOff	End of offset
Movl P=#GP90 V=100mm/s Bl=0mm	Move to the arc starting point GP90 position
CALL "multipass"	Call the generated multi-layer multi-channel subroutine
GunOffsetOn X=0mm Y=0mm Z=-20mm A=0 B=0 C=0	Welding gun offset, the end point of multi-layer and multi-pass offset 20mm to the negative direction of welding gun
Movl P=#GP91 V=100mm/s Bl=0mm	Multi-layer multi-channel endpoint
GunOffsetOff	End of offset
ENDFOR	End of Cycle

6 False Alarm

6.1 Foundation Welding Error Alarm

Error Code	Error messages	Error analysis	Solution
80010001	weld database open failed	Welding database failed to open	Contact the manufacturer
80010002	welder communication disconnect	Welder communication disconnected	Check welder status, check welder communication cable
80010003	welder error id = %1	Welder reported error, error code =% 1	Welder alarm code (see attachment for Megmeet welder alarm code, see welder body label for details)
80010004	weld basic parameters files open failed	Failed to open welding base profile	Contact the manufacturer
80010005	weld basic parameters files version dismatch	Welding base configuration version mismatch	Contact the manufacturer
80010006	re_arc times exceed setting value	The number of restarts exceeds the default	The default is to restart 3 times. Check the welding environment and change the starting position to restart the arc
8001000B	read weld modbus error	Failed to read welding process modbus	Internal error report, contact manufacturer
8001000C	can comm open failed	can communication failed to open	Check the connection of the can port of the controller. The can port on the IO module is used by default

8001000D	can comm error	can communication error	Check the wiring of the welder and the working status of the welder. The default is 0.5 s. If the welder signal cannot be received, an alarm will be given.
8001000E	read system modbus input data error	Error in reading system modbus input data	Contact the manufacturer
8001000F	write weld modbus error	Writing soldering process modbus failed	Contact the manufacturer
80010010	arc break warning	Arc break warning	In the basic settings of welder, select no alarm for arc break. When an arc break is encountered during welding, the robot will issue a yellow warning, but it will not stop and continue to run the teaching program
80010011	write to db error: arc break info	Write to database failed-arc break parameter	Contact the manufacturer
80010012	Do not support this welder brand	This welder brand is not supported	Restart Robot
80010014	welder error	Welder alarm	Check welder status
80010015	Cannot change cur and vol in Welder Job Mode	Modification of current and voltage is not allowed in welding JOB mode	Improper use by user
80010018	weld cmd parameters	Welding instruction parameter error	Check welding instruction parameters

	error!		
80010019	elapsed time mode cannot be supported now!	Remaining time mode is not currently supported	Improper user operation, only remaining distance trigger is supported
8001001A	Parameters cannot be changed in this welder mode	Current and voltage can only be changed in separate or unified mode	Improper user operation, welder is not allowed to modify current and voltage in this mode
8001001B	JOB No. cannot be changed in this welder mode	Only the JOB No. in JOB mode can be changed	Improper user operation
8001001C	JOB No. cannot be changed in this welder mode	Only the JOB No. in JOB mode can be changed	Improper user operation
8001001D	Distance is not trigged	Remaining distance not triggered	Flight arc ignition call failed, contact manufacturer
8001001E	Check GetCmdRtnData-actionif failed	Failed to query the execution status of actionif directive	Internal error, contact manufacturer
8001001F	Set actionif failed	Failed to set actionif directive	Internal error, contact manufacturer
80010020	arc break alarm	Arc break alarm	Accidental arc break during welding, need to check the status of welder
0x80010022	set target speed error	Target speed setting failed	Internal error, contact manufacturer
0x80010023	recover original speed error	Failed to restore original speed	Internal alarm, contact manufacturer
0x80010026	current property files open	Failed to open current profile file, File No.	Check current characteristic curve file

	failed, id = %1	=% 1	
0x80010027	voltage property files open failed, id = %1	Failed to open voltage profile file, File No. =% 1	Check Voltage Characteristic Curve File
0x80010028	restart welding is not supported in advanced mode	Advanced welding does not support arc break restart for the time being	Advanced welding does not support arc break restart for the time being
0x80010029	analog welder io config error	Analog welder IO configuration error	Check Analog Welder IO Configuration
0x8001002A	arcon cmd file index error	arcon arcing instruction File No. parameter error	Check arcon arc start File No. parameter
0x8001002B	arcon cmd time param error	arcon arc start command time parameter error	Check arcon arc start time parameter
0x8001002C	arcoff cmd time param error	Arcoff arc closing command time parameter error	Check arcoff arc closing time parameter
0x8001002D	arcset cmd cur param error	Arcset instruction current parameter error	Check arcset instruction current parameters
0x8001002E	arcset cmd vol param error	arcset command voltage parameter error	Check arcset command voltage parameter
0x8001002F	arcset cmd dis param error	arcset directive distance parameter error	Check arcset directive distance parameter
0x80010030	arcsetjob cmd job param error	Arcsetjob directive job parameter error	Check the arcsetjob directive job parameter
0x80010031	arcsetjob cmd dis param error	Arcsetjob directive distance parameter error	Check instruction distance parameter
0x80010032	flyarcon cmd trigger dis param error	Flyarcon instruction triggers distance parameter error	Check flyarcon instruction trigger distance parameter
0x80010033	flyarcon cmd	Flyarcon instruction	Check flyarcon

	trigger time param error	trigger time parameter error	instruction trigger time parameter
0x80010034	flyarcon cmd file param error	Flyarcon Directive File No. Parameter Error	Check Flyarcon Instruction File No. Parameter
0x80010035	flyarcon cmd time param error	flyarcon instruction time parameter error	Check flyarcon instruction time parameter
0x80010036	arcsetjob cmd trigger mode error	arcsetjob instruction trigger mode error	Contact the manufacturer
0x80010037	arctrackon cmd file index error	arctrackon directive File No. error	Check arctrackon directive File No.
0x80010038	wireforward cmd time param error	wireforward directive time parameter error	Check the wireforward directive time parameter
0x80010039	wirebackward cmd time param error	wirebackward directive time parameter error	Check the wirebackward directive time parameter
0x8001003A	arcspot cmd file index error	arcspot directive File No. parameter error	Check arcspot directive File No. parameter
0x8001003B	arcspot cmd time param error	arcspot instruction time parameter error	Check arcspot instruction time parameter
0x8001003C	arcwatch cmd file index error	arcwatch directive File No. error	Check arcwatch directive File No.
0x8001003D	arcfishon cmd time param error	arcfishon instruction time parameter error	Check arcfishon instruction time parameter
0x8001003E	arcfishon cmd dis param error	arcfishon instruction distance parameter error	Modify arcfishon instruction distance parameter
0x8001003F	arcfishon cmd file index error	arcfishon directive File No. error	Check arcfishon instruction File No.

0x80010040	arcon signal io is occupied	Arcing signal IO port is occupied	Change Arc Signal IO Port
0x80010041	gas test signal io is occupied	Gas detection signal IO port occupied	Change gas detection signal IO port
0x80010042	wire feed signal io is occupied	Wire feed signal IO port is occupied	Change the wire feed signal IO port
0x80010043	wire feed back signal io is occupied	Unwire signal IO port is occupied	Change the unwire signal IO port
0x80010044	search enable signal io is occupied	Find enable IO port is occupied	Change the Find Enable IO Port
0x80010045	arcon success signal io is occupied	Arc start successfully IO port is occupied	Change Arc Successful IO Port
0x80010046	search success signal io is occupied	The IO port is occupied after successful search	Change the successful search IO port
0x80010047	welder status signal io is occupied	Welder status IO port occupied	Change Welder Status IO Port
0x80010048	feeder status signal io is occupied	Wire feeder status IO port occupied	Change Wire Feeder Status IO Port
0x80010049	cool-system status signal io is occupied	Cooling System Status IO Port Occupied	Change Cooling System Status IO Port
0x8001004A	gas-system status signal io is occupied	Shielding gas system status IO port occupied	Change Shielding Gas System Status IO Port
0x8001004B	current comand signal io is occupied	Current command signal analog IO port is occupied	Change Current Command Signal Analog IO Port
0x8001004C	voltage comand signal io is occupied	Voltage command signal analog IO port is occupied	Change the voltage command signal analog IO port

0x8001004D	current actual signal io is occupied	The actual current analog IO port is occupied	Change actual current analog IO port
0x8001004E	voltage actual signal io is occupied	Actual voltage analog IO port occupied	Change actual voltage analog IO port
0x8001004F	arcfile cmd file index error	ArcFile Directive File No. Error	Check ArcFile instruction File No., correct range 1-30
0x80010050	arcfile cmd para error	ArcFile directive para parameter error	Check the ArcFile directive para parameter
0x80010051	arctrack config file - track type is not supported	Arc Tracking Configuration-Tracking Type Unsupported	Select the welding type supported by the welder
0x80010052	SegMovl cmd P index error	SegMovl instruction target search point sequence number P error	Check whether the target search point exists and is reasonable
0x80010054	SegMovl cmd param-M error	SegMovl instruction mode M error	Check whether parameter M is reasonable
0x80010055	SegMovl cmd param-Size error	SegMovl instruction number of segments Size error	The segment should be greater than 1
0x80010056	SegMovl cmd param-prop error	SegMovl directive proportional prop error	Duty cycle value range 0-1
0x80010057	SegMovl cmd param-D1 error	SegMovl instruction welding distance D1 error	The D1 distance should be greater than 0
0x80010058	SegMovl cmd param-D2 error	SegMovl instruction blank line distance D2 error	The D2 distance should be greater than 0
0x80010059	SegMovl cmd param-Ign error	SegMovl instruction parameter Ign error	Contact the manufacturer

0x8001005A	SegMovl cmd param-V1 error	SegMovl instruction parameter V1 is wrong	Modify V1 speed
0x8001005B	SegMovl cmd param-V2 error	SegMovl instruction parameter V2 is wrong	Modify V2 speed
0x8001005C	SegMovl cmd param-Prio error	SegMovl instruction parameter Prio error	Contact the manufacturer
0x8001005D	SegMovl cmd param-ArcF error	SegMovl instruction parameter ArcF error	Check arc firing file parameters
0x8001005E	SegMovl cmd param-WavF error	SegMovl instruction parameter WavF error	Check pendulum arc file parameters
0x8001005F	SegMovl cmd param-Ext error	SegMovl instruction parameter Ext error	Check external axis command parameters
0x8001006A	SegMovl target P read error!	SegMovl instruction target point read failed	Contact the manufacturer
0x8001006B	SegMovl target P coord error!	SegMovl instruction target point coordinate system error	The SegMovl instruction target point coordinate system cannot be a joint coordinate system
0x8001006C	SegMovl target P too near!	SegMovl instruction target point is too close < 10mm	SegMovl instruction target point should be greater than 10mm from starting point
0x8001006D	SegMovl seg size>64!	SegMovl instruction number of segments > 64	The number of SegMovl instruction segments cannot be greater than
0x8001006E	SegMovl target distance < any one	SegMovl Target Total Distance Less than Minimum in Weld or Empty Row	The total SegMovl target distance needs to be greater than the minimum value in the weld or empty row
0x8001006F	SegMovl	SegMovl Generate	Contact the

	result point write failed!	search point Write Failed	manufacturer
0x80010070	welder comm thread initial failed!	Welding communication thread initialization failed	Check Welder Communication
0x80010071	welder type is unselected	Welder type not selected	Select Welder Type
0x80010072	current property file %1 config invalid	Current characteristic file % 1 configuration error	Check current characteristic file
0x80010073	voltage property file %1 config invalid	Voltage characteristic file % 1 configuration error	Check voltage characteristic file
0x80010074	udp comm error	UDP communication error	Check UDP Communications

6.2 Advanced Welding Error Alarm

0x80020000	Wave Para: file index required 1-30	Pendulum parameters: The file number must be between 1-30!	The pendulum arc File No. is set incorrectly, must be between 1-30
0x80020001	Wave Para: wave type required %1-%2!	Pendulum Parameters: The pendulum type must be between %1-%2!	Modify pendulum arc parameters
0x80020002	Wave Para: tilt degree required %1-%2!	Pendulum parameters: the tilt angle must be between %1 - %2!	Tilt angle value range 1-3
0x80020003	Wave Para: wire tilt degree required %1-%2!	Pendulum arc parameters: torch inclination angle must be between %1-%2!	Torch angle value range 1-3
0x80020004	Wave Para: dir tilt degreerequired %1-%2!	Pendulum arc parameters: the front and back angles must be between %1-%2!	Value range of front and rear angle 1-3
0x80020005	Wave Process: call api %1 failed!	Pendulum Procedure: Call to function %1 failed!	Contact the manufacturer
0x80020006	Wave Process: set wave parameterfailed!	Penduluming process: Failed to set the pendulum parameters!	Wrong setting of pendulum arc parameter, check pendulum arc parameter
0x80020100	Laser comm process: connect over time!	Laser sensor communication: connection timed out, please check the network connection!	If the laser tracking status light is red, it means communication failure. Check the network cable

			connection, ip address and port number
0x80020101	Laser comm process: receive data over time!	Laser sensor communication: Received data timed out, please check the network connection!	If the laser tracking status light is red, it means communication failure. Check the network cable connection, ip address and port number
0x80020102	Laser comm process: connect error when getting data!	Laser sensor communication: the network is abnormal during the communication process, please check the network connection!	If the laser tracking status light is red, it means communication failure. Check the network cable connection, ip address and port number
0x80020200	Laser cali process: cali matrix is 0!	Laser sensor calibration: The calibration result is 0, please check the parameters!	Check the calibration file number; Whether the calibration process is correct; Recalibration
0x80020201	Laser cali process: laser data is the same!	Laser sensor calibration: The recorded laser positions cannot all be the same!	Laser calibration requires scanning of five search points P1-P5, which cannot be recorded at the same position
0x80020300	LaserSearchOn para invalid!	The LaserSearchOn command parameter is not valid!	Check instruction parameter error, check instruction

			parameter
0x80020301	LaserSearchOn: file invalid!	LaserSearchOn Instruction: File is not legitimate!	Find file file error, check file file
0x80020302	LaserSearchOn: P invalid!	LaserSearchOn Instruction: P is not legitimate!	The search point P found by the storage laser is wrong, check the search point
0x80020303	LaserSearchOn: result invalid!	LaserSearchOn Directive: The result is not valid!	Store the search result error, check the variable
0x80020304	LaserSearchOn file: motion search speed invalid!	LaserSearchOn Files: Dynamic Search Speed Is Not Legitimate!	The dynamic locating speed is too fast, and the locating speed is reduced
0x80020305	LaserSearchOn file: motion search distance invalid!	LaserSearchOn Files: Dynamic Search Distance Is Not Legitimate!	The dynamic locating distance is too long, so the locating distance is reduced
0x80020306	LaserSearchOn file: auto search times invalid!	LaserSearchOn Files: Research Times Not Legal!	The maximum number of search is 30 times
0x80020307	LaserSearchOn file: auto search speed invalid!	LaserSearchOn Files: Research Speed Is Not Legitimate!	The research speed is too large, and the search speed is reduced
0x80020308	LaserSearchOn file: auto search distance invalid!	LaserSearchOn Files: Re-search Distance Degree is not legal!	Research distance is too long, so the search distance is reduced
0x80020309	LaserSearchOn file: search direction invalid!	LaserSearchOn Files: Search Direction Is Not Legitimate!	Modify search direction
0x8002030A	LaserSearchOn file: robot is not	LaserSearchOn process: not at rest before	Need to be in a stationary state

	in stanby state befor search!	searching!	before finding the position
0x8002030B	LaserSearchOn process: call imf::Movl failed!	LaserSearchOn Process: Call Movl Failed!	Contact the manufacturer
0x8002030C	LaserSearchOn process: call imf::ActionIf failed!	LaserSearchOn Process: Call ActionIf Failed!	Contact the manufacturer
0x8002030D	LaserSearchOn process: call imf::GetCmdRtn Data failed!	LaserSearchOn Procedure: Call to GetCmdRtnData Failed!	Contact the manufacturer
0x8002030E	LaserSearchOn process: laser point to robot point failed!	LaserSearchOn Process: Laser Position Conversion to Robot Position Failed!	Contact the manufacturer
0x8002030F	LaserSearchOn process: call robot_data::setGl obalVar(Point) failed!	LaserSearchOn Procedure: Call to setGlobalVar(Point) failed!	Contact the manufacturer
0x80020310	LaserSearchOn process: call robot_data::setGl obalVar(Number) failed!	LaserSearchOn Procedure: Failed to call setGlobalVar(Number)!	Contact the manufacturer
0x80020311	LaserSearchOn process: call imf::GetDo failed!	LaserSearchOn Procedure: Call to GetDo Failed!	Contact the manufacturer
0x80020312	LaserSearchOn process: step protect!	LaserSearchOn Process: Trigger State Machine Protection!	Contact the manufacturer

0x80020313	LaserSearchOn process: call imf::GetCmdBufferData failed!	LaserSearchOn Procedure: Call to GetCmdBufferData Failed!	Contact the manufacturer
0x80020314	LaserSearchOn process: call imf::SetDo failed!	LaserSearchOn Procedure: Call to SetDo Failed!	Contact the manufacturer
0x80020315	LaserSearchOn file: call file transite invalid!	LaserSearchOn Files: The Calibration File Conversion Matrix Used Is Not Legitimate!	Calibration error, calibrate according to laser calibration instructions
0x80020316	LaserSearchOn file: call file index invalid!	LaserSearchOn Files: The Calibration File Conversion Matrix Used Is Not Legitimate!	Calibration error, calibrate according to laser calibration instructions
0x80020317	LaserSearchOn file: y offset invalid!	LaserSearchOn File: Y Direction Offset Is Not Legitimate!	The offset in the y direction is too large, so the offset value is reduced
0x80020318	LaserSearchOn file: z offset invalid!	LaserSearchOn File: Z Offset Is Not Legitimate!	The offset in z direction is too large, and the offset value is reduced
0x80020400	LaserScanOn file: cali file invalid!	LaserSearchOn File: Calibrating File Number Is Invalid!	Check calibration files
0x80020401	LaserScanOn file: blanding invalid!	LaserSearchOn Files: Motion Smoothing BL is not legitimate!	Adjust BL value
0x80020402	LaserScanOn file: weld speed invalid!	LaserSearchOn Files: Welding Speed Is Not Legit!	The welding speed is too fast, which reduces the welding speed
0x80020403	LaserScanOff	LaserSearchOff	No weld is identified,

	process : none laser or robot data!	process: The data queue is empty, and no data was identified during the scanning process!	ensure that the weld type is consistent with the actual workpiece; Adjust the laser distance to ensure that the distance stably identifies the weld
0x80020408	LaserScanOn file: point start index invalid!	LaserSearchOn File: The set starting point sequence number is not valid!	Check starting point No.
0x80020409	LaserScanOff process: call robot_data::setProjectVar(point)!	LaserScanOff Procedure: Failed to call setProjectVar(point)!	Contact the manufacturer
0x8002040A	LaserScanOff process: call robot_data::setProjectVar(project)!	LaserScanOff Procedure: Call to setProjectVar(project) failed!	Contact the manufacturer
0x8002040B	LaserScanOff process: cali trans data invalid!	LaserScanOff Process: The Conversion Matrix Used in the Calibration File Is Not Legal!	Calibration error, calibrate according to laser calibration instructions
0x80020500	LaserTrackMot para: file invalid!	LaserTrackMot Instruction: Laser Track File Number Is Not Legitimate!	Check calibration and sensor files for correctness
0x80020501	LaserTrackMot file : cali file invalid!	LaserTrackMot File: The calibration file number used is not legitimate!	The calibration file number must be 1-30
0x80020502	LaserTrackOn para : get setting	LaserTrackMot Instruction: The	Check instruction parameters

	failded!	Parameter Is Invalid!	
0x80020503	LaserTrackMot process : call SafeImfMovl failded!	LaserTrackMot Process: Failed to Invoke Instruction SafeImfMovl!	Contact the manufacturer
0x80020504	LaserTrackMot process : call GetCmdBufferData failded!	LaserTrackMot Process: Failed to call GetCmdBufferData!	Contact the manufacturer
0x80020505	LaserTrackMot process : vision point to robot point transite failded!	LaserTrackMot Process: Visual Position Conversion Robot Position Failed!	Contact the manufacturer
0x80020506	LaserTrackMot process : push movl buffuer length is invalid!	LaserTrackMot Process: Wrong Data Length in Motion Buffer!	Contact the manufacturer
0x80020507	LaserTrackMot process : cali transition is invalid!	LaserTrackMot Process: Calibration Data Errors for Vision and Robot!	Contact the manufacturer
0x80020508	LaserTrackMot file : Y offset value invalide!	LaserTrackMot Files: Offset in the Y direction is out of bounds!	Reduce Y-direction offset
0x80020509	LaserTrackMot file : Z offset value invalide!	LaserTrackMot Files: Offset in the Z direction is out of bounds!	Reduce Z-direction offset
0x8002050A	LaserTrackMot file : weld speed value invalide!	LaserTrackMot Files: Welding Speed Overrun!	Reduce welding speed
0x8002050B	LaserTrack process : call api failded!	LaserTrackMot Process: Failed to Call System Function!	Contact the manufacturer
0x8002050C	LaserTrack	LaserTrackMot process:	The target point

	process : searchmot P coord = %1, but searchmot coord is %2!	the target point coordinate system is %1, and the tracking coordinate system is %2!	coordinate system and the tracking coordinate system should be consistent
0x80020600	SearchOffset process: call motion api %1 failded!	Startpoint search: Failed to call function %1!	Contact the manufacturer
0x80020601	SearchInit Para: search init type required %1 to %2!	SearchInit directive: The initialization type must be between %1 and %2!	Initialization type must be 0 or 1
0x80020602	SetSearchOffset Para: file index required %1 to %2!	SetSearchOffset directive: The file number must be between %1 and %2!	Check File Number, range 1-30
0x80020603	SetSearchOffset process: basic point or actual point state invalid!	SetSearchOffset process: Datum or actual points are not collected!	searchinit = 0 is the reference point; searchinit = 1 is the actual point. It is necessary to strictly follow the process of first taking the benchmark and then taking the actual point.
0x80020604	SetSearchOffset process: search point 1-2 requird diffrent dir!	SetSearchOffset process: Point 1 and point 2 in a 2D search cannot be in the same direction!	For example, X and Y plane offset, the search direction must be X and Y directions
0x80020605	SetSearchOffset process: search point 1-3 requird	SetSearchOffset process: Points 1, 2, and 3 cannot be in the same	In three-dimensional space, the three directions must be X,

	diffrent dir!	direction in a 3D search!	Y and Z
0x80020606	SetSearchOffset process: search point 1-3 not same dir!	SetSearchOffset process: 3D plus rotation search points 1, 2, and 3 must be in the same direction!	In the seven-point method, points 1-3 are the contact points on the workpiece surface, and the search direction must be consistent. You can refer to the pictures in Advanced Welding Technology → Starting Point Search → Search Parameters
0x80020607	SetSearchOffset process: search point 4-5 not same dir!	SetSearchOffset process: 3D plus rotation search midpoint 4, point 5 must be in the same direction!	Because the seven-point method requires two contact points in one direction, 4 points and 5 points must be in the same direction. You can refer to the picture in Advanced Welding Technology → Starting Point Search → Search Parameters
0x80020608	SetSearchOffset process: search point 6-7 not same dir!	SetSearchOffset process: 3D plus rotation search point 6 and point 7 must be in the same direction!	Because the seven-point method requires two contact points in one direction, 4 points and 5 points must be in the same direction.

			You can refer to the picture in Advanced Welding Technology → Starting Point Search → Search Parameters
0x80020609	SetSearchOffset process: 7 points required 3 diffrent dir!	SetSearchOffset process: The point in the 3D plus rotation search must have 3 directions!	Because the X, Y and Z directions are shifted in 3D plus rotation, the midpoint search needs to have three directions
0x8002060A	SetSearchOffset process: dir %1 actual offset %2 > limit %3!	SetSearchOffset process: The offset in the direction of %1 is %2, exceeding the limit %3!	If the offset distance exceeds the limit, ensure that the workpiece can be found during search. If it exceeds the search distance, an alarm will be given
0x8002060B	SearchMot process: search input is touching befor start mot!	SearchMot Process: The Pre-Search Signal Has Been Triggered!	Contact the manufacturer
0x8002060C	SearchMot process: search finish but not touched!	SearchMot Process: Search Ends But No Signal Triggers!	Contact the manufacturer
0x8002060D	SearchMot Para: file index required %1 to %2!	SearchMot Directive: The file number must be between %1 and %2!	Search File No. 1-30
0x8002060E	SearchMot Para: i required %1 to %2!	SearchMot Command: The search point sequence number i must	Contact the manufacturer

		be between %1 and %2!	
0x8002060F	SearchMot Para: i required < %1!	SearchMot command: The search point sequence number i must be less than %1 of the search type!	Contact the manufacturer
0x80020610	SearchMot Para: Dir %1 is not allowed!	SearchMot Command: %1 of search direction is not legitimate!	Contact the manufacturer
0x80020611	SearchMot Para: V1 = %1, required 1 to 100 mm/s!	SearchMot Command: Search speed V1 must be between 1 and 100 mm/s, currently %1!	Contact the manufacturer
0x80020612	SearchMot Para: V2 = %1, required 1 to 999 mm/s!	SearchMot Command: The return speed V2 must be between 1 and 999 mm/s, currently %1!	Contact the manufacturer
0x80020613	SearchPoint Para: file index required %1 to %2!	SearchPoint Directive: The file number must be between %1 and %2!	Contact the manufacturer
0x80020614	SearchPoint Para: p index required %1 to %2!	SearchPoint Command: The location point must be between %1 and %2!	Contact the manufacturer
0x80020615	SearchPoint Para: var index required %1 to %2!	SearchPoint Directive: var must be between %1 and %2!	Contact the manufacturer
0x80020616	SearchPoint Para: Id 1 is invalid!	SearchPoint Directive: Id 1 Not Searched!	ld1 reference calculation point search method → pictures in the

			function introduction
0x80020617	SearchPoint Para: point state invalid!	SearchPoint Command: Required location point not searched!	The necessary search points refer to the calculation point position finding method → the picture in the function introduction
0x80020618	SearchPoint Para: point dir invalid!	SearchPoint Command: The direction of the found point does not meet the requirements!	Refer to the point direction of search. Calculate the point search method → Pictures in the function introduction
0x80020700	CrossL Para: P1 %1 required >=0!	CrossL Command: P1 %1 must be greater than 0!	p1 No. must be greater than 0
0x80020701	CrossL Para: P2 %1 required >=0!	CrossL Command: P2 %1 must be greater than or equal to 0!	p2 No. must be greater than 0
0x80020702	CrossL Para: x1 %1 required >0!	CrossL Command: x1 %1 must be greater than 0!	x1 No. must be greater than 0
0x80020703	CrossL Para: x2 %1 required >0!	CrossL command: x2 %1 must be greater than 0!	x2 No. must be greater than 0
0x80020704	CrossL Para: y1 %1 required >0!	CrossL Command: y1 %1 must be greater than 0!	y1 No. must be greater than 0
0x80020705	CrossL Para: y2 %1 required >=0!	CrossL Command: y2 %1 must be greater than or equal to 0!	y2 No. must be greater than 0
0x80020706	CrossL Para: d1 %1 required -499~499!	CrossL Command: d1 %1 must be between -499 and 499!	The value range of d1 is-499 ~ 499

0x80020707	CrossL Para: d2 %1 required -499~499!	CrossL Command: d2 %1 must be between -499 and 499!	The value range of d2 is-499 ~ 499
0x80020708	CrossL Para: o1 %1 required >=0!	CrossL Command: o1 %1 must be greater than or equal to 0!	Modify o1 instruction
0x80020709	CrossL Para: o2 %1 required >=0!	CrossL Command: o2 %1 must be greater than or equal to 0!	Modify o2 instruction
0x8002070A	CrossL process: call api %1 failded!	SearchOffset procedure: Call to function %1 failed!	Contact the manufacturer
0x80020800	Locus Para: File %1 required 1-30!	Locus Instruction: File number %1 must be between 1-30!	File No. must be between 1-30
0x80020801	Locus process: call api %1 failded!		Contact the manufacturer
0x80020802	Locus para: tailboard_point have same data!	Locus procedure: Call to function %1 failed!	Modify the No. of the search point
0x80020900	Vision 3D process: connect over time!	Locus command: search point sequence number cannot be repeated!	Check Communications
0x80020902	Vision 3D process: receive datat over time!	3D Vision: Communication Connection Timed Out!	Check Communications
0x80020903	Vision 3D process: get vision data over time!	3D Vision: Received data timed out!	Check Communications
0x80020904	Vision 3D process: get weld type and send weld type is	3D Vision: Failed to acquire visual data!	Make sure the product type obtained is consistent with the request

	diffrent!		
0x80020905	Vision 3D process: call api %1 failded!	3D vision: the type of product obtained is inconsistent with the request!	Contact the manufacturer
0x80020A00	PosToPos para: from P invalid!	3D Vision: Call to function %1 failed!	There is no such search point in the project search, please add it
0x80020A01	PosToPos para: to P invalid!	PosToPos Directive: Source Point Does Not Exist!	There is no such search point in the project search, please add it
0x80020A02	PosToPos para: coord invalid!	PosToPos Directive: The target point does not exist!	Make sure that the coordinate system of the two search points is consistent
0x80020A03	PosToPos process: call api %1 failded!	PosToPos Command: The coordinate system of the two points is inconsistent!	Contact the manufacturer
0x80020A04	GunOffsetOn para: offset %1 invalid!	PosToPos directive: Call function %1 failed!	Reduce offset
0x80020B00	process: call api %1 failded!	GunOffsetOn Command: Offset %1 Exceeds Limit!	Contact the manufacturer
0x80020B01	%1 para:para %2 is invalid!	Call to function %1 failed!	Check Parameters

7 Common Welder Problems

7.1 The System Reports CAN Communication Error

1: Confirm whether the welder is a DeviceNet welder. If it is an external communication box, confirm that the communication box is DeviceNet

2: Check whether the two wires CAN _ L and CAN _ H of the communication cable are connected correctly and loose

3: Confirm whether the following welder communication parameters are set correctly

Communication protocol: FAN FANUC standard protocol

Baud rate: 125K

Some welder MAC ID (station number) is OFF by default, and some need to be set, the welder station number is 2

Robot control mode: On

Robot communication module activation : On (some welders do not have this parameter)

4: If the parameters and hardware wiring are confirmed to be correct and an error is reported, use the CAN analyzer to capture the sending and receiving data of the controller and welder; On the controller side, etc/usart _ stm32. json can be set to turn on printing and receiving data.

7.2 Communication is Unstable and Often Disconnected

Check whether the power supply of the external communication box is stable

7.3 Welder Alarm When Arc Starts

The welding power supply readiness signal polarity switch shall be set to high active (ON)

8 Appendix

8.1 Adjustment of Welding Effect

Adjust the welding parameters according to the actual welding situation.

Common welding defects and their prevention methods are shown in the following table:

Causes	Preventive measures
Weld metal crack	
1. The weld aspect ratio is too large 2. The weld bead is too narrow (especially fillet weld and bottom weld bead) 3. The crater at the end of the weld is cooling too fast	Increase the arc power supply or reduce the welding current to widen the weld bead and reduce the penetration Slow down the travel speed to increase the cross-section of the weld bead Adopting attenuation control to reduce the cooling speed; Filling the crater properly; Sectional unwelding technology is applied at the top of the finished bead until the end of the weld
Slag inclusion	
1. Adopt multi-pass welding rectangular transition (welding slag inclusions) 2. High traveling speed (oxide film-type inclusion)	Before welding the subsequent bead, remove the slag shell from the edge of the weld Reducing the walking speed; Adopting a welding wire with higher deoxidizer content; Increase arc voltage
Stomata	
1. Insufficient protective gas coverage 2. Welding wire	Increasing the flow rate of the shielding gas and excluding all the air in the welding zone; Reducing the flow rate of the protective gas to prevent entrapment of

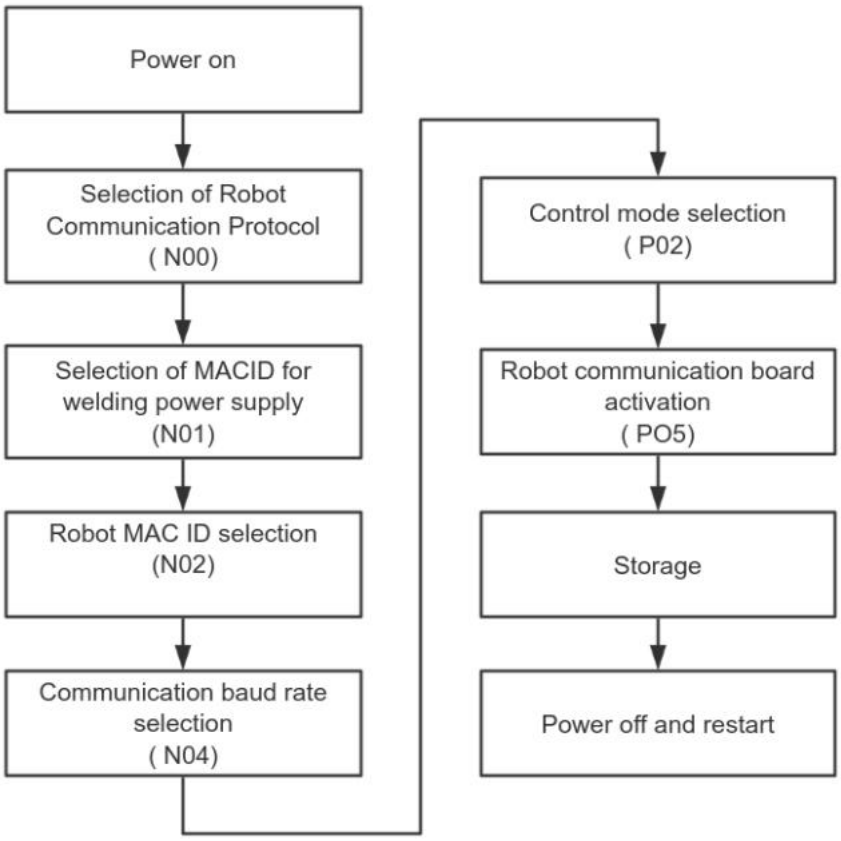
contamination. 3. Contamination of workpiece 4. Arc voltage is too high 5. The distance between nozzle and workpiece is too large	the air; Removing the splash in the gas nozzle; Avoid excessive air flow in the surrounding environment and damage to gas protection; Reducing the welding speed; Reducing the distance from the nozzle to the workpiece; At the end of welding, the welding gun nozzle should be removed after the molten pool has solidified. Using clean and dry welding wire; Removing the lubricant adhered to the welding wire in the wire feeding device or the wire guide tube, and removing all grease, rust, paint and dust on the surface of the workpiece before welding; Use welding wire containing deoxidizer. Reduce the arc voltage. Reduce the extension length of the welding wire.
Undercut edge	
1. Welding speed is too high 2. Arc voltage is too high 3. Excessive current 4. Insufficient residence time 5. Incorrect welding gun angle	Slow down the welding speed Reducing voltage Reduce wire feeding speed Increase the residence time at the edge of the molten pool. Change the angle of the welding gun so that the arc force pushes the metal flow
Unfused	
1. There is oxide film or rust skin on the surface of the weld zone	Before welding, cleaning the rolling oxide scale or impurities on the surface of all groove surfaces and weld seam areas to improve the wire feeding speed and

2. Insufficient heat infusion 3. The welding pool is too large 4. Inappropriate welding technology 5. Unreasonable joint design	the arc voltage; Reduce welding speed. Reduce arc pendulum to reduce weld puddle. When the pendulum technology is adopted, it should stay at the edge of the molten pool near the groove surface; The welding wire should be pointed towards the leading edge of the molten pool. The groove angle should be large enough to reduce the length of the wire extension (increase the current) and allow the arc to directly heat the bottom of the molten pool: the groove is designed to be J-shaped or U-shaped.
Lack of penetration	
1. Inappropriate groove processing 2. Inappropriate welding technology 3. Heat input is not appropriate	The joint design must be appropriate, and the groove angle must be appropriately increased, so that the welding gun can directly act on the bottom of the molten pool, and at the same time, the distance between the welding gun and the workpiece must be kept appropriate; Reducing blunt edge height; Sets or increases the underlying clearance in the butt joint. The welding wire keeps a proper traveling angle to achieve the maximum penetration depth; Keep the arc at the front of the molten pool. Increase the wire feeding speed to obtain a larger welding current, and keep the distance between the nozzle and the workpiece appropriate.
Large melting permeation	
1. Excessive heat input 2. Inappropriate groove processing	Reducing wire feeding speed and arc voltage; Increase welding speed Reduce oversized interbasal glands; Increase blunt edge

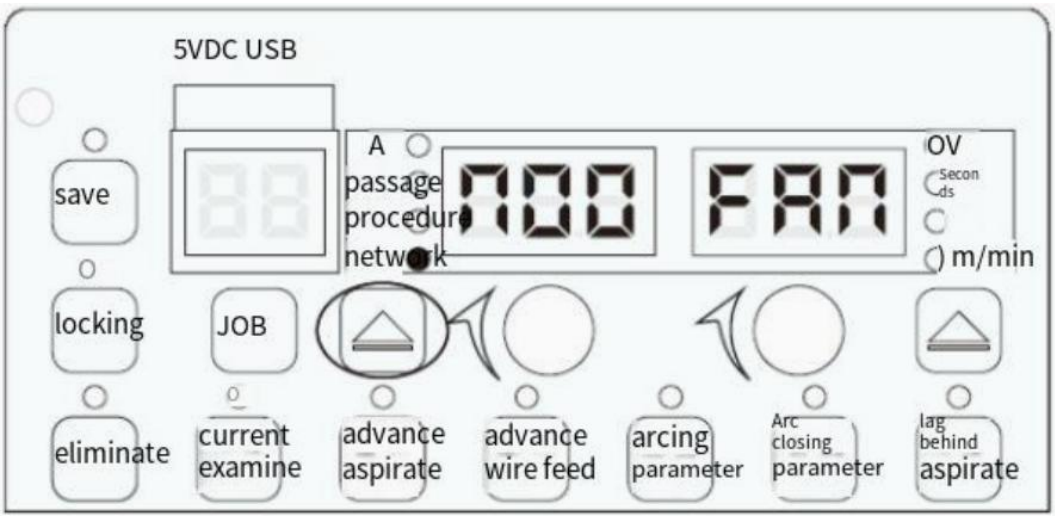
	height
Serpentine weld bead	
1. The extension length of welding wire is too large 2. The correction mechanism of the welding wire is poorly adjusted. 3. The tip is seriously worn	Maintain appropriate wire extension length Adjust carefully Replace the tips with new ones
Splash	
1. Arc voltage is too high or too low 2. Poor cleaning of welding wire and workpiece 3. Uneven welding wire 4. The tip is seriously worn 5. Inappropriate welding maneuver characteristics	Carefully adjusting the voltage according to the welding current; Adopt unified adjustment welder. Clean the welding wire and groove carefully before welding. Inspect the wire press wheel and wire feed hose (repair or replace). Replace the tip with a new one. For the rectifier welder, the DC inductance should be adjusted; For inverter welders, the electronic reactor of the control loop must be adjusted.

8.2 Megmeet Plus

When the Megmeet PLUS welder is connected to the controller, the operation steps are:

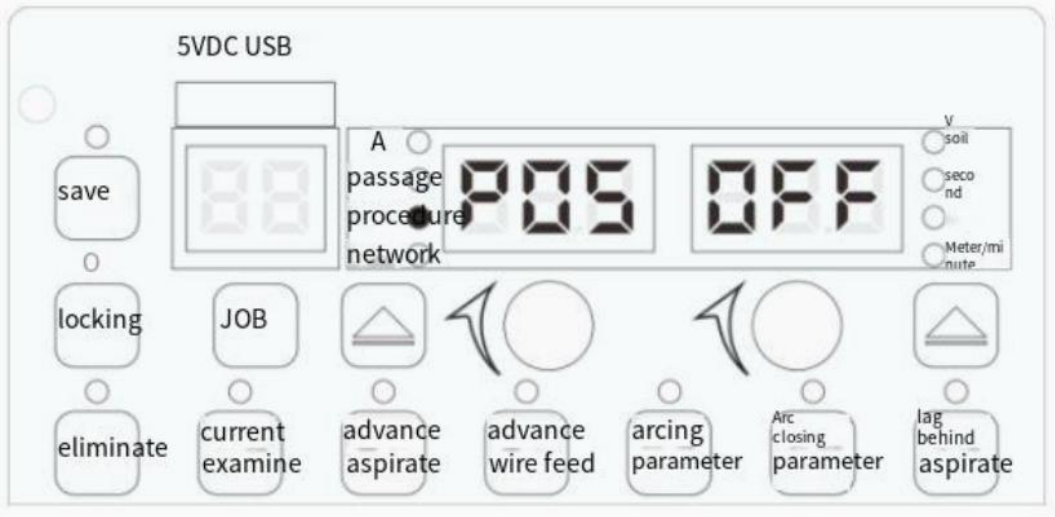


Communication protocol selection



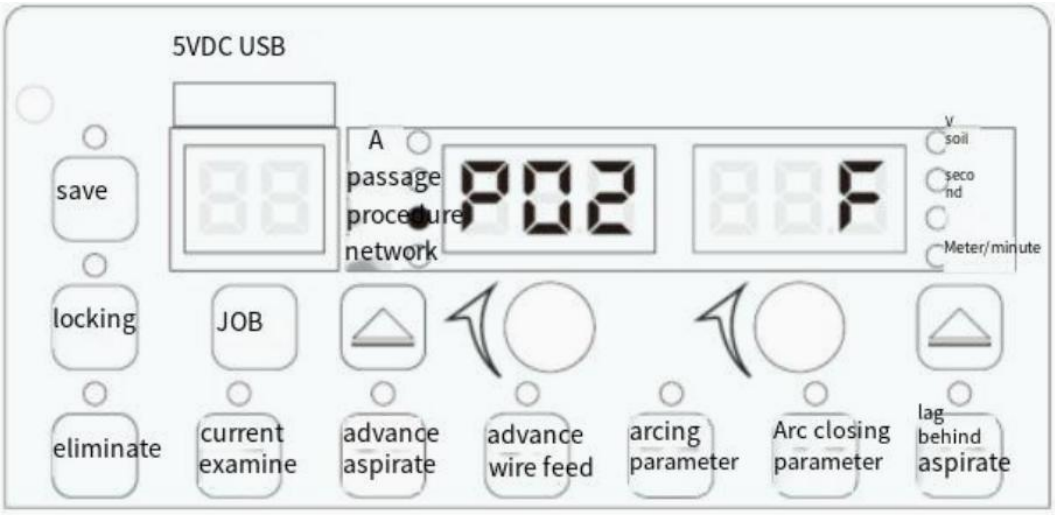
Network-Choose FAN

Robot communication module activation



ON is active, default is OFF

Welding power supply control mode P02



Show	F	N	DF	DN
Control Mode	Wire feeder control	Power display panel control	Unified control of robot	Robot JOB No. call control

Under normal circumstances, it is changed to DF and unified control

Advance air delivery time

JOB No. 1 C01 sets the advance air supply time by default 0.1

Advance wire feed

JOB No. 2 C01 set the welding wire forward speed in arc starting state by

default to 5.0 cm

JOB No. 2 C03 sets the welding wire advance feeding speed in arc starting state to be 3min by default

Arcing time

JOB No. 4 C01 Set hot arc start time by default 0

Arc closure time

JOB No. 5 C01 Set the crater filling time by default 0

Pull-back parameter

JOB No. 6 C01 sets the default arc closing and withdrawal time to 0.04

JOB No. 6 C03 sets arc withdrawal speed by default-9.8

Hysteretic air supply

JOB No. 7 C01 Set the hysteresis air supply time default 1.0

Manual wire feeding parameters

JOB No. 9 C03 Active Wire Feed Speed Default 6.0

JOB No. 9 C06 Active Wire Feeding Speed Slope Factor Default-3

All other parameters are the default parameters.

Devicenet Station No.

n01 Welder ID: 2 n02 Robot ID: 1

When the communication sending parameters are verified, it is displayed in JOB 10.