ligent

Welding Process

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Catalogue

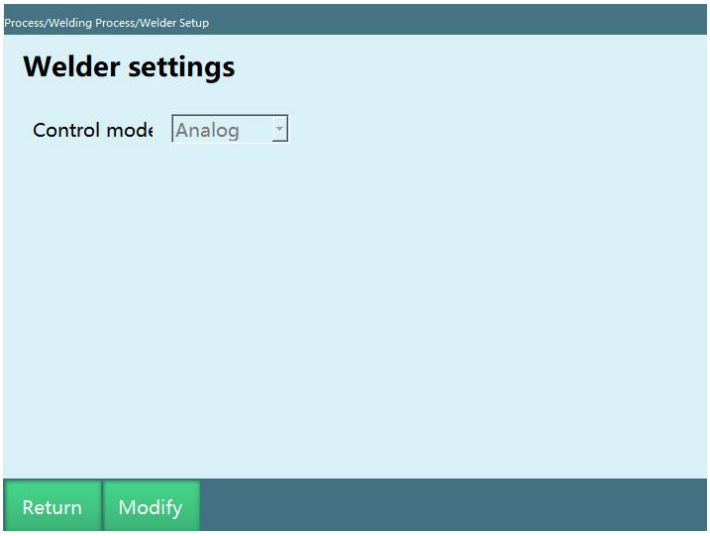
Welding Process

> Welder setting

Enter "Process/Welding process/Welder setting" to modify the welder settings.

The steps are as follows:

1. Enter the "Process/Welding process/Welder setting" page

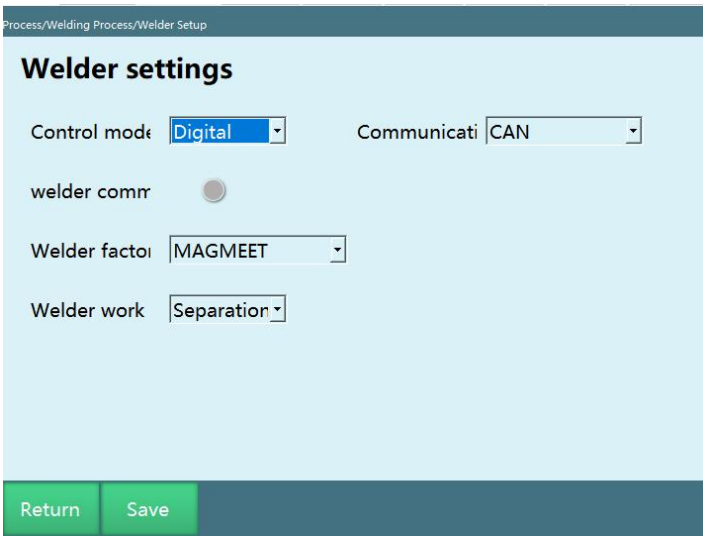


Two ways to control the welder:

Analog control: The full name is analog welder, which refers to the welder controlled by io analog quantity.

Digital control: Set according to the actual needs of the industrial site.

2. Click "Modify" to select the welder control method



Four communication modes of digital welder: CAN, ModBus RTU, EtherCAT, ModBus TCP

When selecting "**ModBus RTU**", you need to fill in the slave ID, port number, and baud rate;

When selecting "**ModBus TCP**", you need to fill in the IP and port number.

Welder communication status: Gray means communication failure, green means communication success.

Welder power supply manufacturers: General, MEGMEET, Shenwei Intelligent, Aotai, Meganice, Ruiling

When selecting "**Ruiling**", you need to select and fill in the parameters in [Material/Wire diameter/Gas].

Welder working mode: "Unified", "Separate".

3. Click "Save" to save successfully

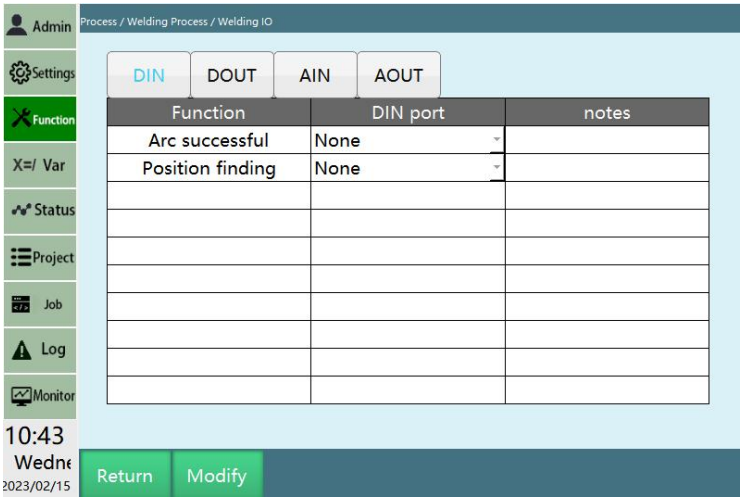
Welding IO setting

Enter "**Process/Welding process/Welding IO**" to modify the welding IO settings. The relevant steps are as follows:

Enter the "Process/Welding process/Welding IO" page.

After clicking "Modify", the "Modify" button becomes "Save", you can select the corresponding IO port after the respective function.

DIN



Ignition success signal: This signal is set to detect whether the ignition is successful. When the ARCON instruction is executed, an ignition signal is required. If the ignition signal is not given in the set welding detection time, an error will be reported (the welding ignition signal has timed out)

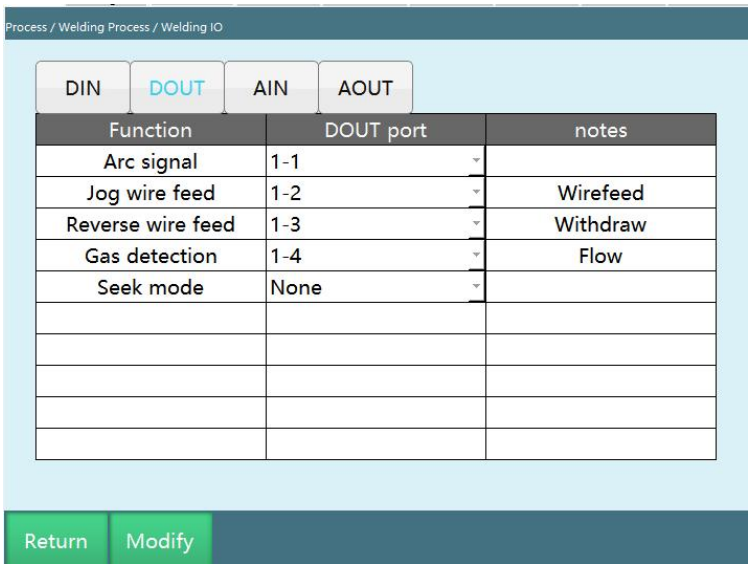
Search success signal: In the arc search, it is necessary to set the search success signal. (You can choose the port for the signal you need)

How to use: 1. In the arc search, find two single-core wires, one end of one wire connects the IO output end 1-5 (search mode signal), and the other end is connected to the iron plate

2. One end of the other wire connects to the IO input end 1-6 (search success signal), and the other end is connected to the end of the tool hand.

3. In the arc search, open the output port 1-5, when the end of the tool hand touches the iron plate, the set 1-6 input signal will change from low level to high level

DOUT



Ignition signal: When ready to ignite the arc, the system will send the output signal to the welder

Inching wire feeding signal: Welder wire feeding. When the corresponding signal port is opened, the welding monitoring window will display simultaneously as follows: Manual operation - Wire feeding switch on

Reverse wire feeding signal: The IO board gives the corresponding output signal when the welder retracts the wire

Gas detection signal: The IO board gives the corresponding output signal when the gas is supplied by the gas pump

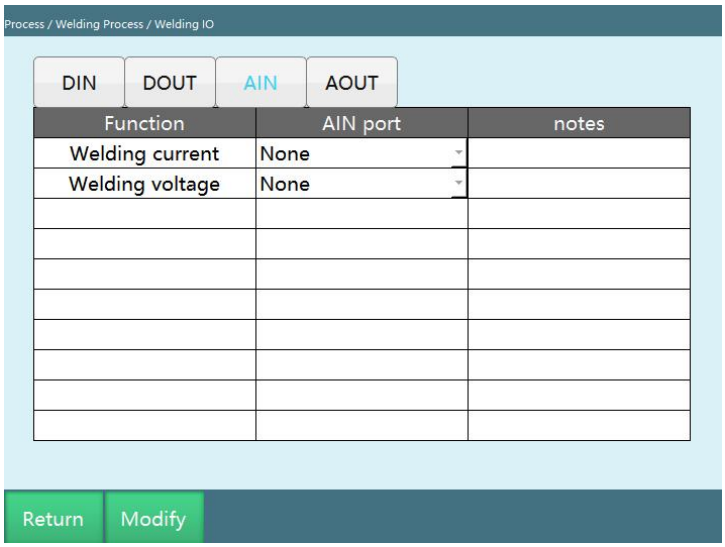
Search mode: It means that the welder enters the search mode, when the robot is moving, if the welding wire touches the workpiece, the welder will give a search success signal

How to use: 1. In the arc search, find two single-core wires, one end of one wire connects the IO output end 1-5 (search mode signal), and the other end is connected to the iron plate

2. One end of the other wire connects to the IO input end 1-6 (search success signal), and the other end is connected to the end of the tool hand.

3. In the arc search, open the output port 1-5, when the end of the tool hand touches the iron plate, the set 1-6 input signal will change from low level to high level

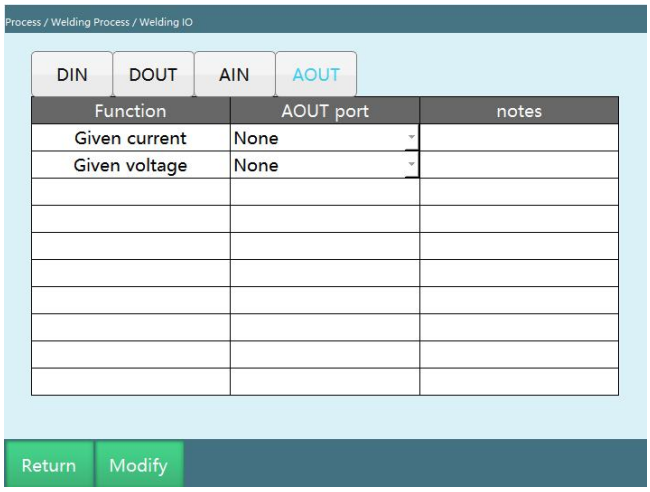
AIN



Welding current signal: input signal of analog welder current

Welding voltage signal: input signal of analog welder voltage

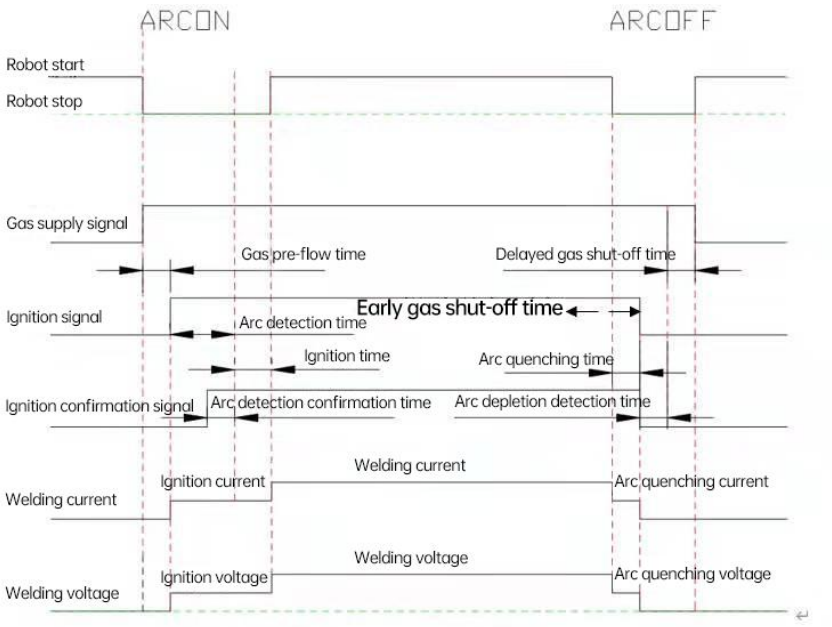
AOUT



Given current signal: the signal of a given current

Given voltage signal: the signal of a given voltage

Welding sequence diagram

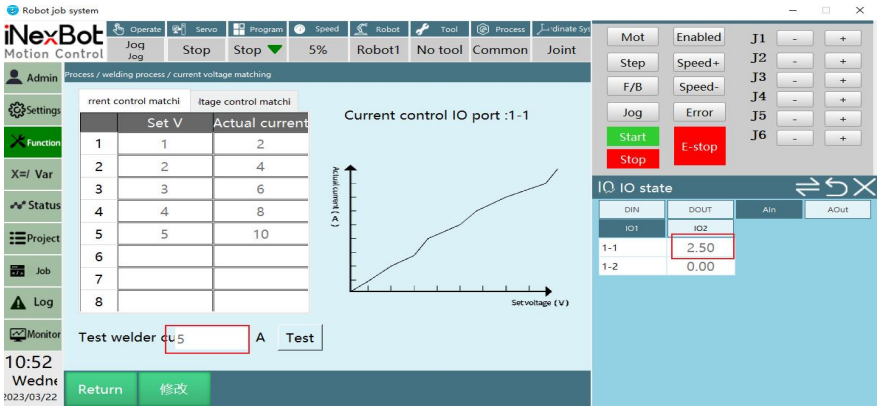


Current-voltage matching

Enter "Process/Welding process/Current-voltage matching" to modify the welding voltage and current. The relevant steps are as follows:

1. Enter the "Process/Welding process/Current-voltage matching" page. Note: This page will be hidden when you select digital welder.
2. At this time, no value can be entered in the current and voltage input box. After clicking "Modify", the "Modify" button becomes "Save", you can enter the value after the respective parameter.

The parameter setting steps of the current control matching interface are as follows:



Connect the controller to the welder, open the teach pendant interface as shown in the figure.

Set voltage: the value of the analog output in IO monitoring

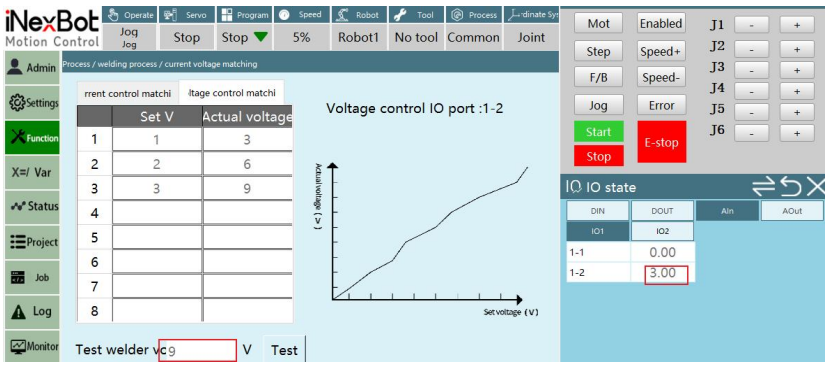
Actual welder current: the actual output current of the welder, which is displayed on the welder

Welder test current: fill in the values in the "Set voltage" column and the "Actual welder current" column, enter the value in the "Welder test current" box, click "Test", and a current value will be calculated.

As shown in the figure, a proportional coefficient 2 is calculated by the filled voltage and the actual current value of the welder. At this time, the "Welder test current" is 5A. After clicking the "Test", value 2.5 will be calculated through the proportional coefficient in the analog output port.

Note: The output upper limit of welder's current AOUT port is 10, if the test current is greater than 10, then perform the testing according to the upper limit; if the lower limit of welder's current AOUT port is less than 0, then perform the testing according to the lower limit

The parameter setting steps of the voltage control matching interface are as follows:



(Here is to modify the proportional relationship between the voltage and current sent by the controller to the welder and the actual voltage and current of the welder.)

Connect the controller to the welder, open the teach pendant interface as shown in the figure:

Set voltage: the value of the analog output in IO monitoring

Actual welder voltage: the actual output voltage of the welder, which is displayed on the welder

Welder test voltage: fill in the values in the "Set voltage" column and the "Actual welder voltage" column, enter the value in the "Welder test voltage" box, click "Test", and a voltage value will be calculated.

As shown in the figure, a proportional coefficient 3 is calculated by the filled voltage and the actual voltage value of the welder. At this time, the "Welder test voltage" is 9V. After clicking the "Test", value 3 will be calculated through the proportional coefficient in the analog output port.

The output upper limit of welder's voltage AOUT port is 10, if the test voltage is greater than 10, then perform the testing according to the upper limit; if the lower limit of welder's voltage AOUT port is less than 0, then perform the testing according to the lower limit

Operation steps of current-voltage matching when connecting welder

Current-voltage multi-stage matching: The current-voltage matching is divided into multiple stages, which can be any number of stages from 1 to 8

The operation steps are as follows:

1. Select "Current control matching"
2. Fill in 1 in the first line of "Set voltage", check the present current value on the welder, and fill in the value in the first line of "Actual welder current"
3. Fill in 3 in the second line of "Set voltage", check the present current value on the welder, and fill in the value in the second line of "Actual welder current"
4. Repeat the above operations until the 8 lines are set (if you only do 1 stage matching, just set the 1st and 2nd lines)
5. Fill in 220 for the welder test current, check whether the current of the welder is 220

Click "Save" and the modification is successful. This function parameter can be saved in 1 copy without process number.

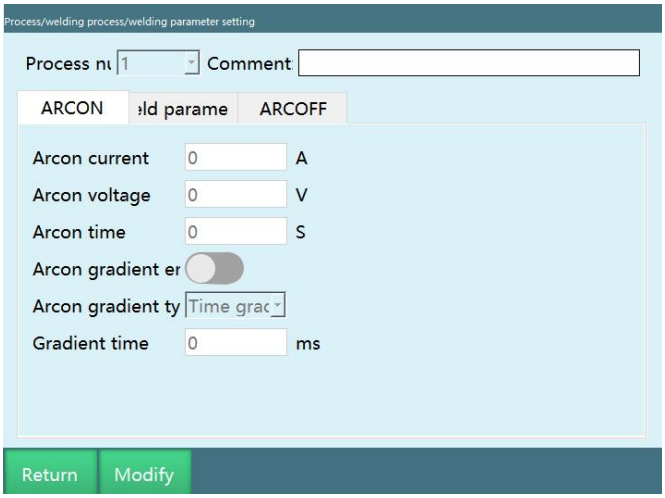
Welding parameter setting

Enter "**Process/Welding process/Welding parameter**" to modify the welding parameters settings. The relevant steps are as follows:

1. Enter the "Process/Welding process/Welding parameter" page.
2. Click "Modify", the "Modify" button becomes "Save", you can select the process number and modify the values of the ignition parameters, welding parameters and arc quenching parameters.

For example: ignition current=10, ignition voltage=8, welding current=15, welding voltage=20, arc quenching current=10, arc quenching voltage=15.

- Turn on "Ignition gradient enable" switch, select [Time gradient] for "Ignition gradient mode", set "Gradient time" to 1s.
- Turn on "Arc quenching gradient enable" switch, select [Time gradient] for "Arc quenching gradient mode", set "Gradient time" to 1s.
- Execution effect: The ignition current reaches 10A and the ignition voltage reaches 8V after the ignition signal is given, and then the current and voltage values gradually change from the the ignition current and voltage to the welding current (15A) and welding voltage (20V) within the set ignition gradient time (1s) for welding, and at the end of the welding, the current and voltage values gradually change from the the welding current and voltage to the arc quenching current and voltage within the set arc quenching gradient time (1s)



Process number: There are many choices of welding wire: carbon steel welding wire, low alloy structural steel welding wire, alloy structural steel welding wire, stainless steel welding wire and non-ferrous metal welding wire; ignition voltage, ignition current, ignition time, welding voltage, welding current, arc quenching voltage, arc quenching current and arc quenching time required by different welding wires are

all different, so 1-99 different welding parameters can be set, you only need to call them later

Notes: You can add a note to this process number to indicate its function

Ignition current: the current applied from the time the wire is heated

Ignition voltage: the voltage applied from the time the wire is heated

Ignition time: The time to maintain the set ignition current and voltage values after the ignition signal is given.

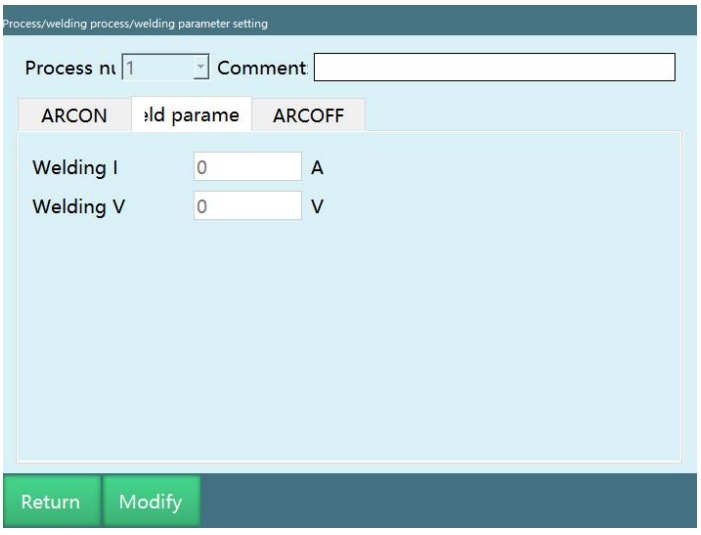
For example, ignition current = 20A, ignition voltage = 10V, and the waiting time is 1 second, which means that after reaching the ignition current and voltage values, it will maintain for one second before reaching the welding current and voltage values.

Ignition gradient enable: Control the time or distance for the gradual change from the ignition current and voltage to the welding current and voltage

Ignition gradient mode: time gradient

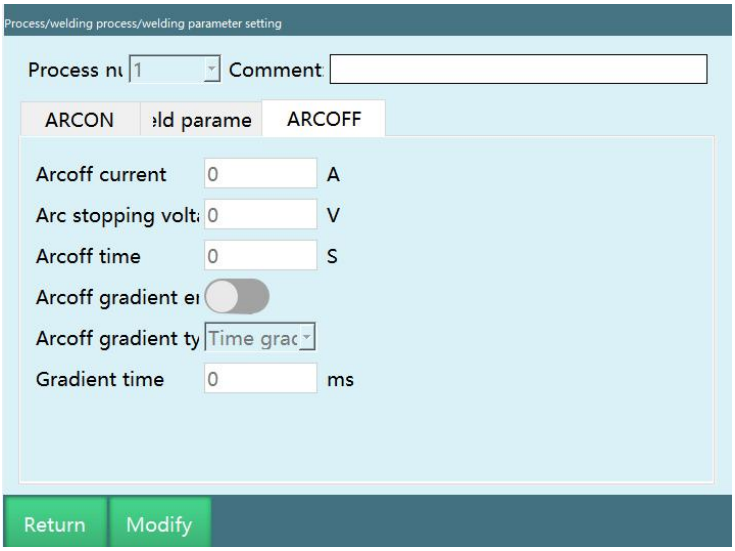
Gradient time: The time required for the gradual change from the ignition current and voltage to the welding current and voltage

For example, if the gradient time is set to 2s, then the current and voltage values will gradually change from the ignition current and voltage to the welding current and voltage within two seconds, instead of directly reaching the set welding current and voltage.



Welding current: The current applied during welding. When welding, the current flowing through the welding circuit is the result of the balance between the wire feed speed and the melting speed

Welding voltage: Welding voltage is the arc voltage, it can provide welding energy and ensure welding quality



Arc quenching current: The current given by the quencher when the arc needs to be quenched during welding

Arc quenching voltage: Refers to the highest power frequency voltage that is allowed to be applied to the arrester under the condition that the arrester can quench the arc when the power frequency freewheeling current crosses the zero value for the first time. The arc quenching voltage should be greater than the highest power frequency voltage that may appear on the working bus of the arrester, otherwise the arrester may explode due to the inability to quench the arc

Arc quenching time: The time for the robot to maintain welding with the arc quenching current and voltage after reaching the arc quenching point.

For example: the arc quenching time is 1s, which means that after the robot reaches the arc quenching point, it will maintain the welding for 1s with the arc quenching current and voltage, and then the welding ends. Different arc quenching mediums have different arc quenching time, generally in seconds.

Arc quenching gradient enable: Control the time for the gradual change from the welding current and voltage to the arc quenching current and voltage. Note: The following gradient parameters will take effect only after the gradient enable is turned on

Arc quenching gradient mode: time gradient

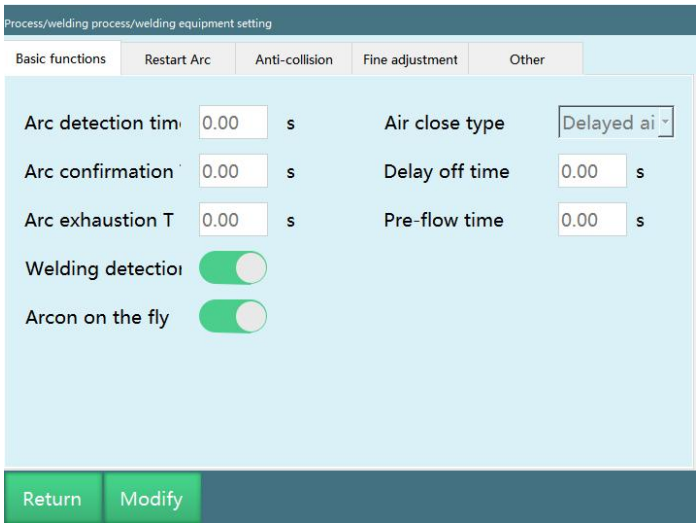
Gradient time: The time required for the gradual change from the welding current and voltage to the arc quenching current and voltage.

For example, if the gradient time is set to 2s, then the current and voltage values will gradually change from the welding current and voltage to the arc quenching current and voltage within two seconds, instead of directly changing from the welding current and voltage to the arc quenching current and voltage.

Welding equipment setting

Enter "**Process/Welding process/Welding equipment setting**" to modify the welding equipment settings. The relevant steps are as follows:

1. Enter the "Process/Welding process/Welding equipment setting" page
2. Click "Modify", the "Modify" button becomes "Save", click on the selection box below and select the functions you nee



Basic functions

Arc detection time: the time from the controller sending the ignition signal to the system receiving the ignition success signal from the welder! If the system does not receive ignition success signal within this time, the system will issue an ignition signal timeout error.

Arc detection confirmation time: In order to prevent disturbing signals due to obstacles such as dust, delay for a period of time to ensure that the arc has signal transmission, and only start welding after the successful ignition signal is continuously detected during this period.

Note: The arc detection time should be greater than the arc detection confirmation time

Arc depletion detection time: The time from the start of arc depletion to the actual end of arc depletion.

For example, if the arc depletion detection time is set to 2 seconds, it means that the time from the start of arc depletion to the actual end of arc depletion is 2 seconds. If the ignition signal is still on after the welding is completed, it will report arc depletion failure.

Delayed gas shut-off time: After the welding is finished and the arc quenching signal is sent, the welding wire has not cooled down, if the protective gas is stopped at this time, oxidation will still occur, so the gas needs to be shut off after a delay, and this operation also has the function of cooling the welding torch.

Set the "Delayed gas shut-off time" to 1s, and you can see that the set gas supply signal will be delayed by 1s before shutdown in the [Monitor] - [IO status - DOUT] interface after the welding is completed.

Early gas shut-off time: the time parameter to terminate the gas supply before arc quenching.

Set the "Early gas shut-off time" to 1s, and you can see that the set gas supply signal will be shut down 1s in advance in the [Monitor]-[IO status - DOUT] interface after the welding is completed.

Gas pre-flow: Start gas supply in advance when the robot moves from the safety point to the welding start point.

Gas pre-flow time: When welding, in order to prevent the wire from being oxidized by air, it may be necessary to supply air to blow off the air around the torch in advance to reduce the appearance of porosity in the welded seam and make the welded seam look flatter and smoother

W1 means safety point, P001 means welding start point, P002 means welding end point, P001-P002 means welding distance

Turn on "Gas pre-flow"

When the set air supply time is less than the time from the safety point to the welding start point

For example: Set the gas pre-flow time to 4s, and it takes 10s for the robot to move from W1 to the welding start point P001

Execution effect: It takes 10s for the robot to move from W1 to P001, the robot starts to supply air at 6s and reaches P001 at 10s, and starts ignition at the same time.

When the set air supply time is greater than the time from the safety point to the welding start point

For example: Set the gas pre-flow time to 4s, and it takes 2s for the robot to move from W1 to the welding start point P001

Execution effect: It takes 2s for the robot to move from W1 to P001, the robot will stay at P001 for 2s, and the ignition will start only after 4s.

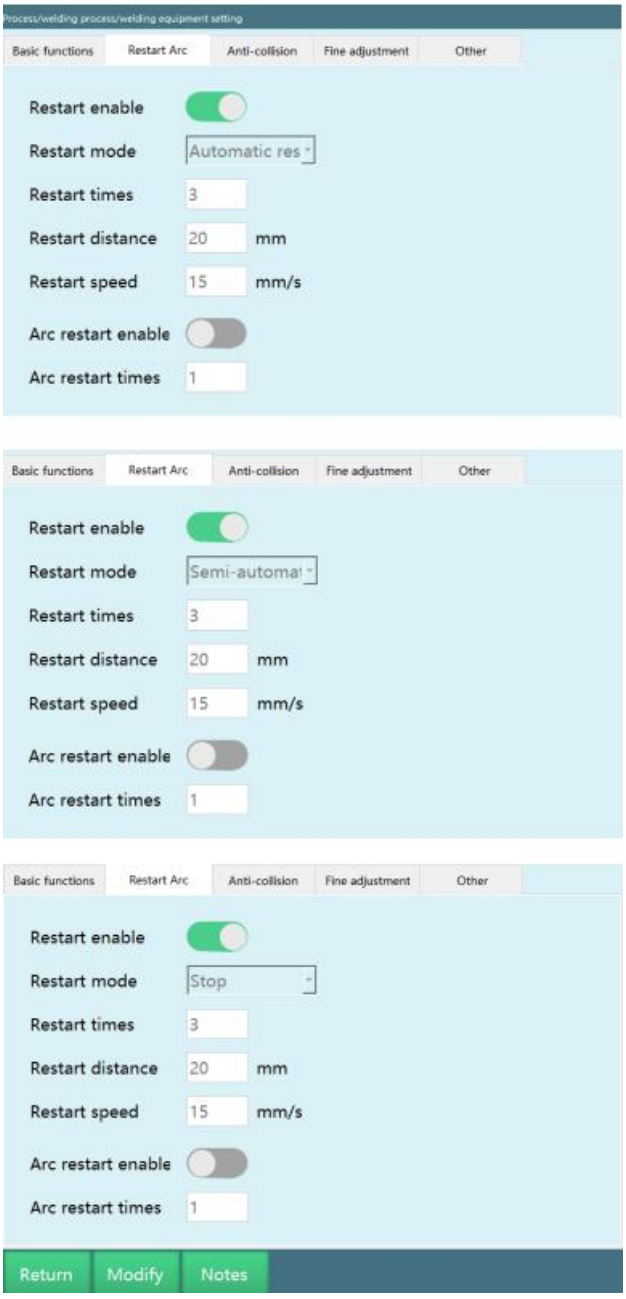
Turn off "Gas pre-flow"

If "Gas pre-flow" is not turned on: start the gas supply after moving from safety point to the welding start point

For example: turn off "Gas pre-flow", set gas pre-flow time to 4s

Execution effect: start the gas supply after the robot moves from point W1 (safety point) to welding start point P001, and the robot will start the ignition only after 4s.

Reignition/Restart



Restart enable: Restart enable, valid only when the ignition signal is given after the arc is broken.

Automatic restart: After detecting the occurrence of arc break, servo and program are running, within the set arc detection time, the ignition signal will be given again, and the program will continue to run

Semi-automatic restart: After detecting the occurrence of arc break, the servo is running and the program is paused. At this time, you need to manually click the "Start" button to give the ignition signal again within the set arc detection time, and the program will continue to run.

Stop: After detecting the occurrence of arc break, the servo is in the ready state and the program is in the stop state. After an arc break occurs, you need to clear the error and then manually click the "Start" button.

Restart distance: The back-off distance of the restart action. During the welding process, when the breakpoint is run again, it is possible to go back a distance (to prevent empty welding).

Restart speed: The back-off speed of the restart action. The welder will not back off when the speed is 0.

Reignition enable: First send a signal to let the welder start the ignition, if the ignition fails, then execute the ignition action again in place; if the ignition is successful, execute the welding action normally; if the ignition is not successful within the set number of times, it will stop and report an error.

Reignition times: The maximum number of times to perform reignition actions within the current welding start and end interval, beyond which no restart will be performed

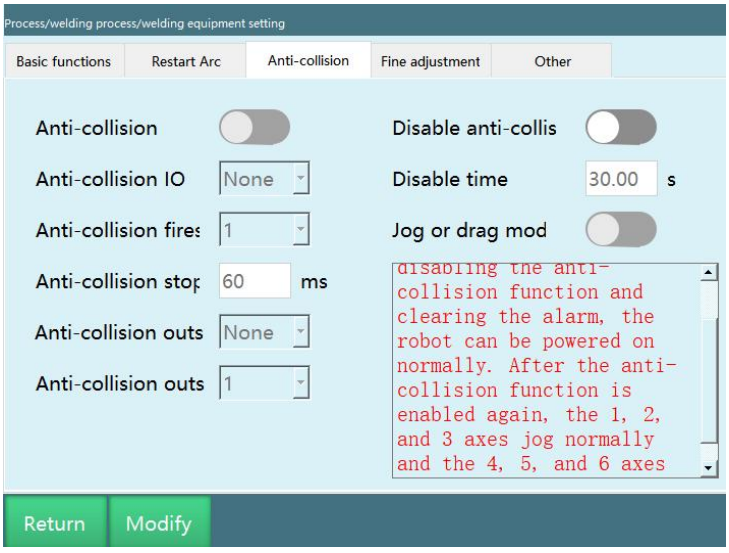
For example, if you set the reignition times to 2, then after an arc break occurs, if the ignition is not successfully started after giving the ignition signal 2 times, the controller will report an error

<table>
<tr><td colspan="2">Restart function (Note: To use this function, you need to turn on the "Welding interruption detection" in the "Basic functions")</td></tr>
<tr><td colspan="2">welding track straight line P001-P002
welding start point P001, welding end point P002,</td></tr>
<tr><td>Automatic restart
Restart distance 20mm
Restart speed 15mm/s</td><td>Execution effect:
After the welding starts, the robot moves from P001 to P002. After an arc break occurs, the controller will issue a warning (arc break detected in welding), and the servo and the program are both in the</td></tr>
</table>

	running state at this time. When the arc is broken during the movement from P001 to P002, the robot will move 20mm at the speed of 15mm/s at the arc break point according to the restart distance and restart speed parameters you set, and give the ignition signal again after reaching the retraction distance, the robot performs the welding operation again
Semi-automatic restart Restart distance 20mm Restart speed 15mm/s	Execution effect: After the welding starts, the robot moves from P001 to P002. After an arc break occurs, the controller will issue a warning (arc break is detected in welding) . At this time, the servo is running, the program is in the pause state, and there will be a pop-up window prompting that the arc breaks Arc break occurs during the movement from P001 to P002, click the "Confirm" button in the pop-up prompt box, and then click the "Start" button, the robot will move 20mm at the speed of 15mm/s at the arc break point according to the restart distance and restart speed parameters you set, and give the ignition signal again after reaching the retraction distance, the robot performs the welding operation again
Stop Restart distance 20mm Restart speed 15mm/s	Execution effect: After the welding starts, the robot moves from P001 to P002. When the arc breaks, the controller reports an error (arc break is detected in welding). At this time, the servo is ready, the program is in the stop state, and there will be a pop-up window prompting that the arc breaks. An arc break occurs during the movement from P001 to P002. After an error is reported, click the "Clear" button first, then click the "Confirm" button in the pop-up window prompt box, and then click the

	"Start" button, and there will be a pop-up window prompt again (breakpoint execution, first line execution) 1. The effect when you select the "Breakpoint execution": the robot will move 20mm at the speed of 15mm/s at the arc break point according to the restart distance and restart speed parameters you set, and give the ignition signal again after reaching the retraction distance, the robot performs the welding operation again 2. The effect when you select the "First line execution": the robot will perform the welding operation from the beginning
Restart times	The number of times the ignition signal can be given when the arc is broken Execution effect: set the restart times to 3, then the ignition signal can be given up to three times after an arc break occurs, and the controller will report an error when the ignition signal is given for the fourth time (arc break is detected in welding)

Anti-collision



Anti-collision enable: Turn on the enable switch to detect the anti-collision signal.

Anti-collision IO: IO input signal when a collision occurs.

Anti-collision trigger level: 1/0 corresponds to high level/low level.

Anti-collision quick stop time: The time required for the robot to stop after anti-collision is triggered.

If the set anti-collision quick stop time is 60ms, then the time from work to stop of the robot after a collision is 60ms

Anti-collision status output port: The specified value output port outputs a signal when anti-collision is triggered.

If the anti-collision status output level is 1, the IO output port is set to port 1-2, when a collision occurs, the output port 1-2 will change from low level 0 to high level 1.

If the anti-collision status output level is 0, the IO output port is set to port 1-2, when a collision occurs, the output port 1-2 will change from high level 1 to low level 0.

Anti-collision status output level: 1/0 corresponds to high level/low level.

Shield anti-collision enable:

When the welding torch collision occurs, the controller reports an error (torch anti-collision is triggered), you can not clear the error at this time, you need to turn on the shielding anti-collision enable, set the shielding time, the anti-collision signal will not be detected within the shielding time, if the anti-collision signal is released, the "Shield anti-collision enable" will be turned off immediately.

Shielding time: the time parameter for shielding anti-collision.

> Turn on "Shield anti-collision enable", set the shielding time to 10s, when a collision occurs,
>
> it will be shielded for 10s in order to to move the torch to a safe position.

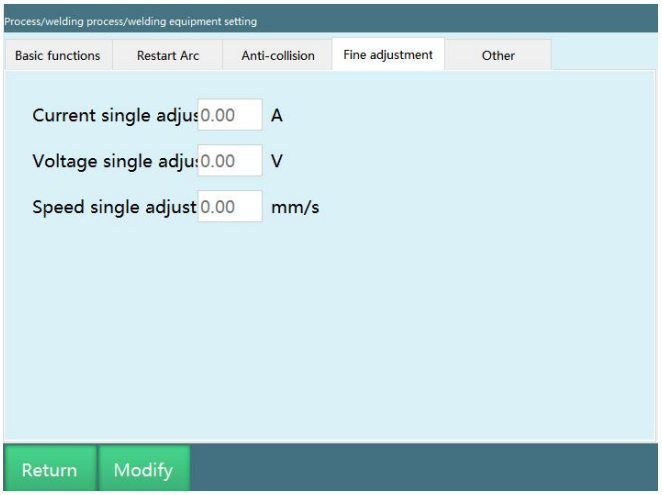
After reaching the shielding time, the controller reports an error (shielding has ended and the torch anti-collision is triggered)

Jogging or dragging mode:

Turn on "Shield anti-collision enable" after a collision occurs and set the shielding time

Turn on the jogging or dragging mode enable, then you can drag 4, 5, 6 axis after the collision (at this time, 4, 5, 6 axis can only drag, 1, 2, 3 axis can jog)

Fine adjustment



Welding current single adjustment amount: single adjustment range of welding current during welding

For example: Welding current single adjustment amount is 5A, if you want to increase or decrease the current value during the welding process, you can click on the process bar - [Welding process] - [Fine adjustment]

Click "**Increase given value**", the current value will increase 5A during the welding process; click "**Decrease given value**", the current value will decrease 5A during the welding process

Note: The increased or decreased value is adjusted according to the welding current single adjustment amount

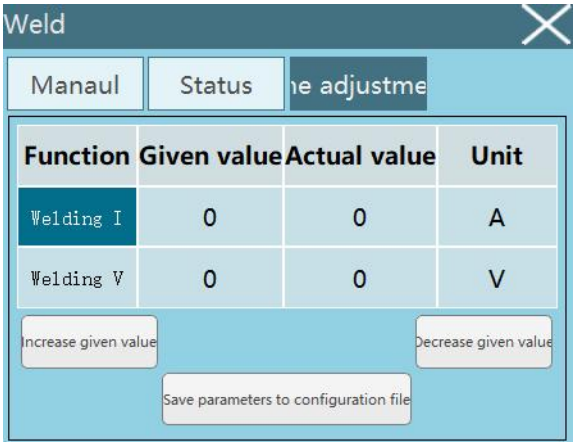
Welding voltage single adjustment amount: single adjustment range of welding voltage during welding

For example: Welding voltage single adjustment amount is 6V, if you want to increase or decrease the voltage value during the welding process, you can click on the process bar - [Welding process] - [Fine adjustment]

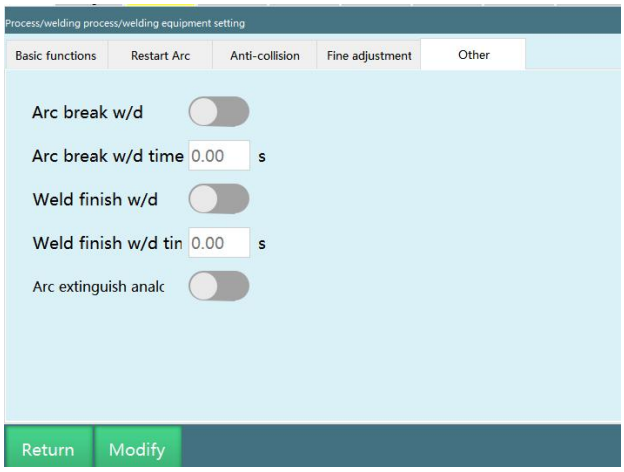
Click "**Increase given value**", the voltage value will increase 6V during the welding process; click "**Decrease given value**", the voltage value will decrease 6V during the welding process

Note: The increased or decreased value is adjusted according to the set welding voltage single adjustment amount

Welding speed single adjustment amount: The increment and subtraction range of a single micro-adjustment can be set in the welding equipment parameters



Other



Retraction after welding enable: When the welding is over, the welding torch will receive a signal, and the welding wire will be retracted to prevent collision with the workpiece when going to the next welding point.

Retraction time after welding: the time for retracting the welding wire after completion of welding.

Turn on "Retraction after welding enable" and set the "Retraction time after welding" to 3 seconds, then at the end of welding, it will take 3 seconds in total from receiving the wire retraction signal to the end of the wire retraction

Arc-break retraction enable: If the welding current exceeds the rated load rate of the welder, the welder will have a short-term protection, the arc will be broken, the welding wire will be retracted to prevent adhesion to the workpiece.

Arc break retraction time: the time for retracting the welding wire after the welding arc is broken.

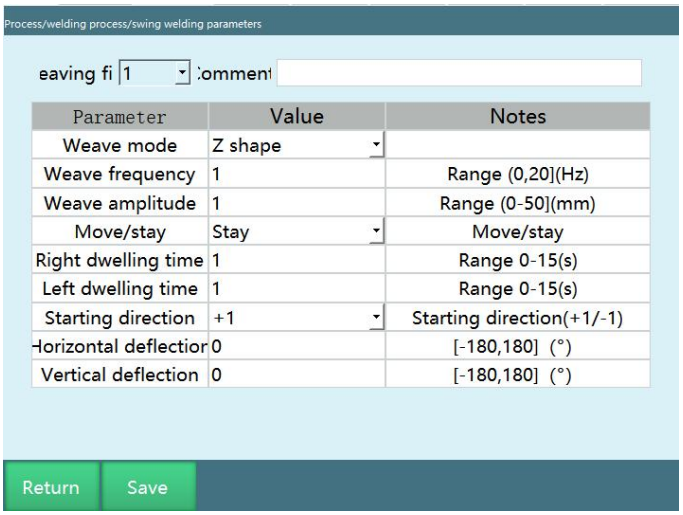
Turn on "Arc break retraction enable" and set the "Arc break retraction time" to 2 seconds, then in order to prevent the welding wire from sticking to the workpiece, the welding wire retraction time needs 2 seconds.

Arc quenching analog zero-setting function: The analog voltage and current signals are reset to zero (analog output) at the end of welding.

Weaving parameters

Enter "**Process/Welding process/Weaving parameters**" to modify the weaving parameters. The relevant steps are as follows:

1. Enter "Process/Welding process/Weaving parameters" page. The weaving file has 9 process numbers to choose from. Select the weaving welding parameters to be modified and click on the "Modify" button at the bottom, all input boxes become available for input.
2. Click the "Save" button to finish saving after the input is completed.



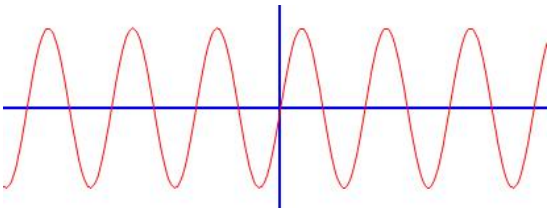
iNexBot supports four swing modes: sine pendulum, Z-shaped pendulum, circular pendulum, and external axis fixed-point pendulum.

Swing frequency, swing amplitude, starting direction, horizontal declination, vertical declination and other parameters are adjustable, which can be set according to the actual needs of the industrial site.

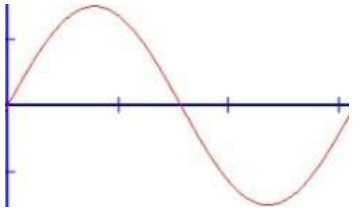
Swing amplitude: the greater the amplitude, the greater the robot swings;

Swing frequency: the greater the frequency, the faster the robot swings.

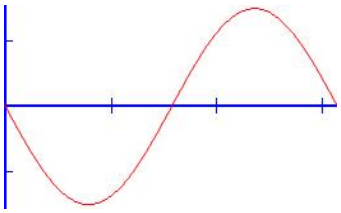
Starting direction: +1, start from a certain point and go up first; -1, start from a certain point and go down first



Original figure

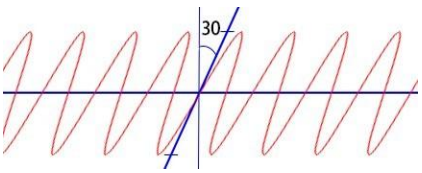


+1 figure



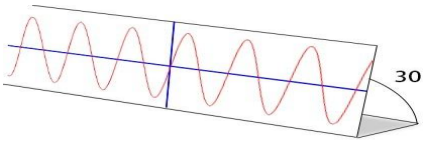
-1 figure

Horizontal declination: The figure shows the weaving trajectory with a horizontal deflection angle of 30 degrees



Horizontal declination figure

Vertical declination: The figure shows the weaving trajectory with a vertical deflection angle of 30 degrees



Vertical declination figure

Move: The robot moves forward for the set time every time it swings, and then enters the next swing;

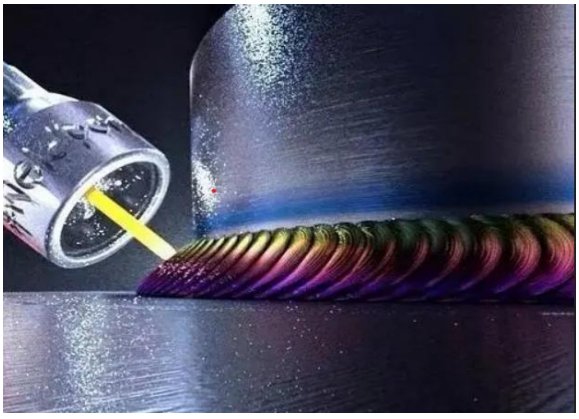
Stay: The robot stays for the set time every time it swings

Left stay time/Right stay time

When the weaving welding method is Z-shaped pendulum and external axis fixed-point pendulum, there will be left stay time/right stay time; here it refers to the time to stay at a target point during Z-shaped pendulum and fixed-point weaving welding (as shown below)

The red trajectory indicates the Z-shaped weaving welding trajectory. If the left and right stay time is set to 1 second, the robot will stay at point a for 1 second and then run to point b, and stay at point b for 1 second and then run to point c, and follow this operating logic to complete the entire weaving track.

Weaving welding is a welding operation in which the welding seam heat source performs regular lateral swinging on the weldment during welding. The weaving welding effect figure is shown below.

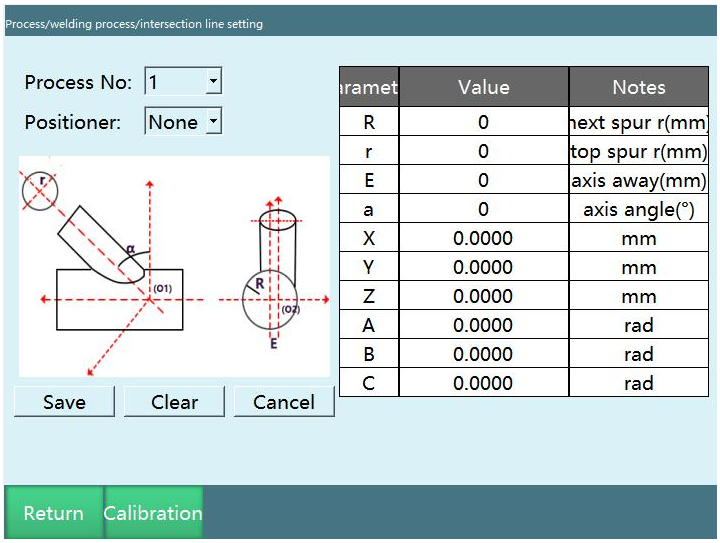


Intersecting line setting

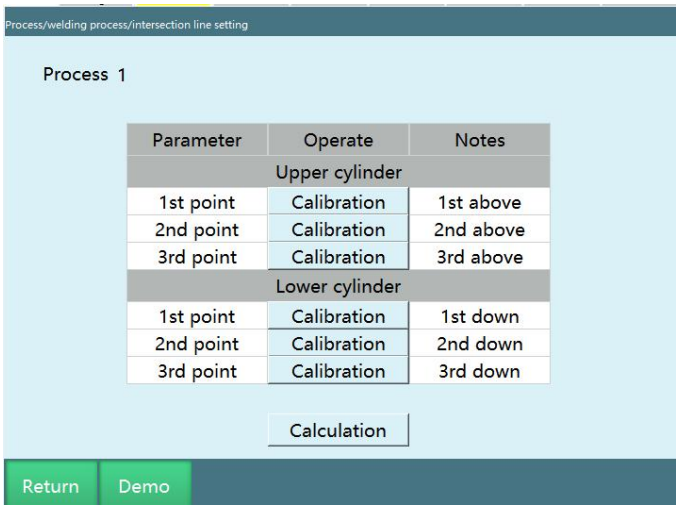
Enter "**Process/Welding process/Intersecting line setting**" to modify the intersecting line settings.

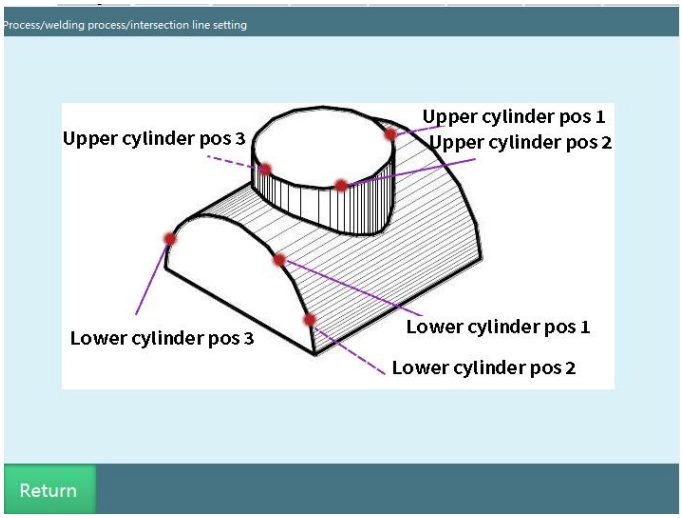
The relevant steps are as follows:

1. Enter "Process/Welding process/Intersecting line setting" page



2. Calibrating before use can reduce the error. Click "Calibrate" to enter the calibration interface, if you do not know how to calibrate, there is a "Demo" button in the interface, you can check it, as shown in the figure

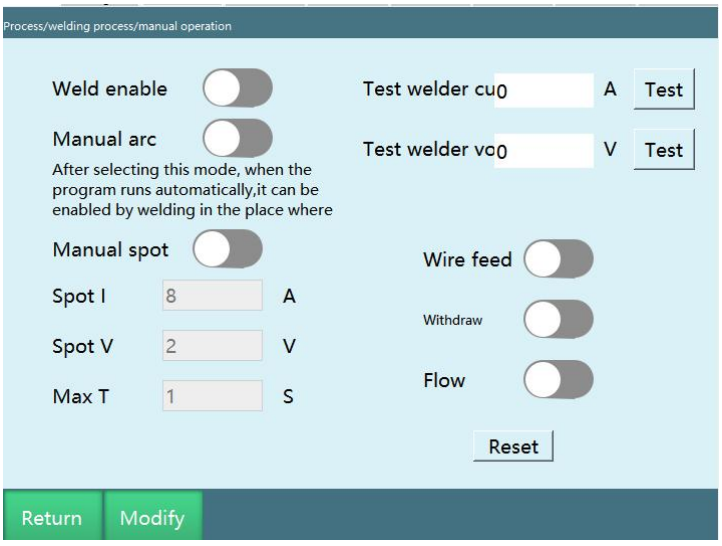




Manual operation

Enter "**Process/Welding process/Manual operation**" to modify the manual operation settings. The relevant steps are as follows:

1. Enter "Process/Welding process/Manual operation" page.



Welding enable: When the "Welding enable" is turned on, the robot will perform the welding function, otherwise it will just walk the track.

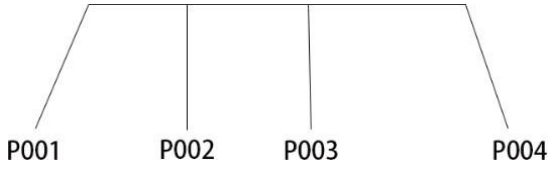
• After the program of the welding trajectory is written, you can first confirm that the running trajectory is correct in the teach mode

• Switch to the running mode and turn on "Welding enable", and the robot will perform the welding function. When the program is in the running mode, press "Stop", and then press "Start", after the program restarts, the welding function will no longer be performed.

Manual ignition mode: If you select this mode, during the automatic operation of the program, you can manually control the ignition or quenching of arc through the welding enable switch

•When the robot moves from the welding start point P001 to the welding end point P004, if the "Welding enable" is turned on, the robot will start the ignition; if the "Welding enable" is turned off, the robot will quench the arc;

•For example, in the running mode, during the movement of the robot, the "Welding enable" is turned on at P002 and turned off at P003, then during the movement from P002 to P003, the robot keeps the ignition state, and when moving from P003 to P004, the robot keeps the quenching state;



•When the robot moves from W1 (safety point) to the welding start point P001, if the "Welding enable" is turned on, the robot will not start ignition; the robot will only start the ignition when it reaches P001;

"Manual ignition mode" is not turned on: When the robot moves from the welding start point P001 to the welding end point P004, the "Welding enable" button is invalid (the robot will not start ignition even if the "Welding enable" button is turned on)

Manual spot welding: Set spot welding current, spot welding voltage and maximum time, click "Save"

Long press the "Manual spot welding" button (valid when pressed and hold, invalid when released), the robot will perform welding, if you release the button, the robot will stop welding

Spot welding current: spot welding output current

Spot welding voltage: spot welding output voltage

Maximum time: The maximum time the "Manual spot welding" button is allowed to be held down.

•For example, the maximum time is set to 5s, then if you press and hold the "Manual spot welding", the robot will weld for 5s. If the time exceeds 5s, even if you press the "Manual spot welding" button, the robot will not weld

Fault reset: Valid when using digital welder. This function can be used to reset the fault of the welder

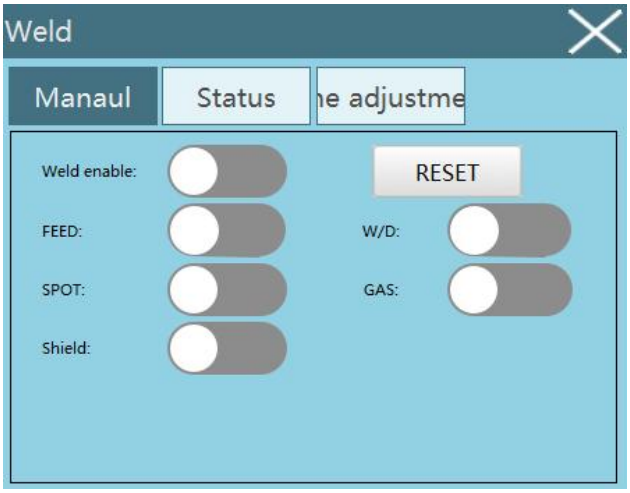
Wire feeding: Feed wire at the start of welding

Wire retraction: Retract the wire after the welding is completed

Gas supply: Turn on to supply gas

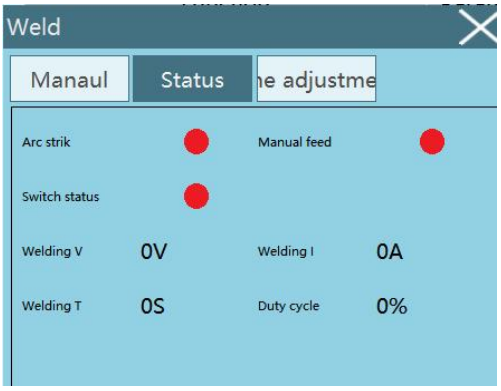
For the convenience of welding, we now add [Process]/[Welding] to the status bar.

Note: You need to select [Welding process] in "Settings/Operation parameters - Process selection", modify and save. The status bar displays [Welding]. Click [Welding], a manual operation window of welding will pop up



[Manual Operation] has the same effect as the manual operation in "Process/Welding process/Manual operation" page. In this status bar, it is more convenient to see the signal during the welding process, the change of current and voltage values and other effects.

Shield anti-collision: After triggering the anti-collision, turn on the "Shield anti-collision" switch, and shield the anti-collision according to the parameters in "Welding equipment setting - Anti-collision". After turning on the "Shield anti-collision" switch, the anti-collision signal will be released within the shielding time, which helps to move the welding torch to a safe position

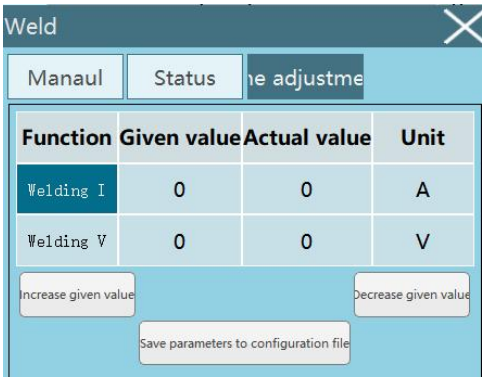


[Status]

Ignition success/Manual wire feeding/Torch switch status: green is on, red is off.

Welding current/voltage: Input current and voltage.

Welding time: The time from the start of welding to the end of welding. Record the welding time after start-up.



[Fine adjustment]

Save parameters to configuration file: Save the parameters during welding, click the "Save" button, and the parameters will be automatically overwritten into the instructions or parameters;

• When the instruction uses custom parameters, the parameters will be saved to instructions;

• When using the welding process number parameter, the parameters will be saved to the welding parameters;

Increase given value/Decrease given value: Select the parameter to be adjusted, click "Increase given value" and "Decrease given value", the adjustment will take effect immediately

• For example: In the "Welding process-Welding equipment setting-fine adjustment" interface, set the welding current single adjustment amount to 5A, if you want to increase or decrease the current value during the welding process, you can click [Increase given value], [Decrease given value]

• Click [Increase given value], the current value will increase 5A during the welding process, click [Decrease given value], the current value will decrease 5A during the welding process

Note: The increased or decreased value is adjusted according to the set welding current single adjustment amount

• For example: In the "Welding process-Welding equipment setting-fine adjustment" interface, set the welding voltage single adjustment amount to 6V, if you want to increase or decrease the voltage value during the welding process, you can click [Increase given value], [Decrease given value]

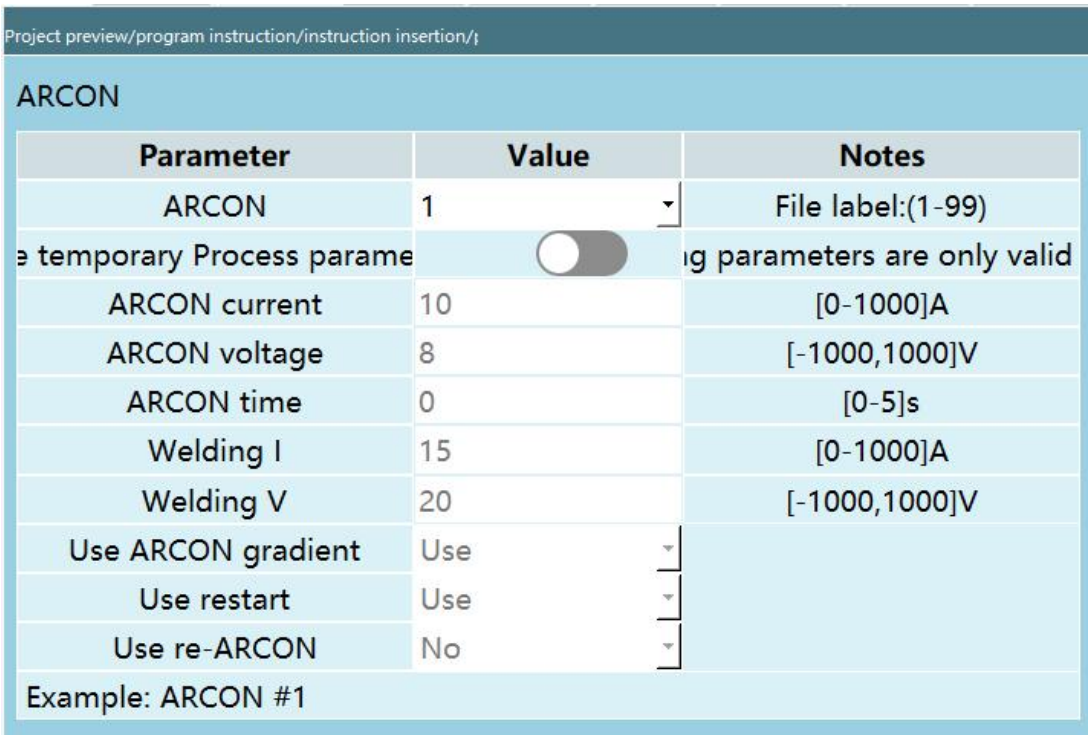
• Click [Increase given value], the voltage value will increase 6V during the welding process, click [Decrease given value], the voltage value will decrease 6V during the welding process

Note: The increased or decreased value is adjusted according to the set welding current single adjustment amount

Welding instructions description

ARCON instruction - Welding start

ARCON instruction - Welding start
Function: This instruction can perform ignition operation
Parameter interface



Parameter	Value	Note
ARCON	1-99	Welding process supports 99 file numbers
Use temporary process	Turn on the "Use temporary process parameters" switch, the current and	Turn on the "Use temporary process

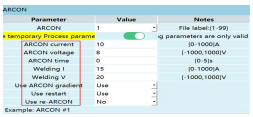
<table>
<tr>
<td>parameters</td>
<td>voltage values at the beginning of welding will depend on the temporary process parameters you set

For example: the ignition current set in the "Welding process-Welding parameter" interface is 50A, if the "Use temporary process parameters" switch is turned on in the ARCON instruction parameter interface, and the set ignition current is 60A, then the ignition current when performing welding operation is 60A

Turn on the "Use temporary process parameters" switch, and the modified parameter values will be displayed with a yellow fill color, as shown below

<table>
<tr><th>Parameter</th><th>Value</th></tr>
<tr><td>ARCON</td><td>1</td></tr>
<tr><td>e temporary Process parame</td><td></td></tr>
<tr><td>ARCON current</td><td>60</td></tr>
<tr><td>ARCON voltage</td><td>15</td></tr>
</table>

If you do not turn on the "Use temporary process parameters" switch, the current and voltage values during welding operation are the current and voltage values set in the "Welding process-Welding parameter" interface</td>
<td>parameters" switch, the parameters below will take effect, as shown in the figure below

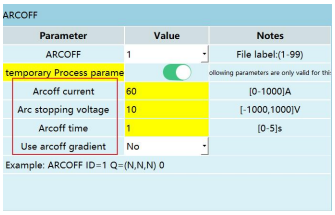
Note: The parameters below are only valid for this instruction</td>
</tr>
</table>

ARCOFF instruction - welding end

ARCOFF instruction - welding end
Function: Execute the arc quenching operation, select the process number corresponding to the ARCON
Parameter interface

ARCOFF

Parameter	Value	Notes
ARCOFF	1	File label:(1-99)
temporary Process parame		ollowing parameters are only valid for thi:
Arcoff current	10	[0-1000]A
Arc stopping voltage	15	[-1000,1000]V
Arcoff time	0	[0-5]s
Use arcoff gradient	No	
Example: ARCOFF ID=1 Q=(N,N,N) 0		

Parameter	Value	Note
ARCOFF	1-99	Welding process supports 99 file numbers
Use temporary process parameters	Turn on the "Use temporary process parameters" switch, the current and voltage values at the beginning of welding will depend on the temporary process parameters you set For example: the quenching current set in the "Welding process-Welding parameter" interface is 50A, if the "Use temporary process parameters" switch is turned on in the ARCOFF instruction parameter interface, and the set quenching current is 60A,	Turn on the "Use temporary process parameters" switch, the parameters below will take effect, as shown in the figure below  Note: The parameters below are only valid for this instruction

	then the quenching current when performing welding operation is 60A Turn on the "Use temporary process parameters" switch, and the modified parameter values will be displayed with a yellow fill color, as shown below  If you do not turn on the "Use temporary process parameters" switch, the current and voltage values during welding operation are the current and voltage values set in the "Welding process-Welding parameter" interface	

ARCSET instruction - welding setting

ARCSET instruction - welding setting
Function: This instruction can set the current and voltage during welding For example: set welding current 50A, voltage 15V in "Welding process-Welding parameter" interface Set welding current 45A, voltage 20V in the ARCSET instruction parameter interface If the ARCSET instruction is inserted after the ARCON instruction, the current and voltage values during welding are the parameter values filled in the ARCSET instruction interface
Parameter interface:

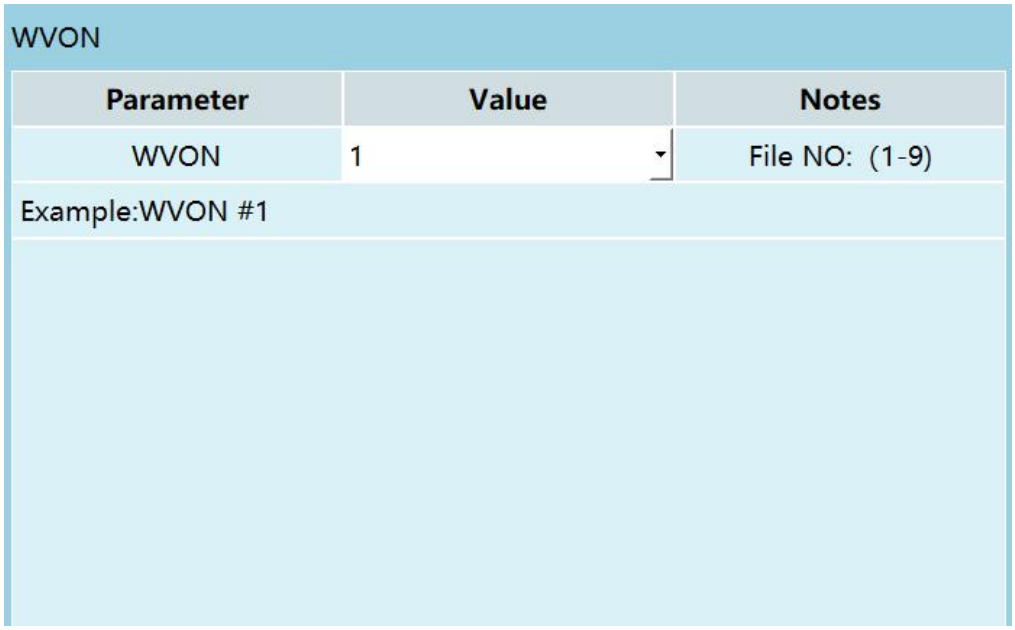
ARCSET

Parameter	Value	Notes
Set welding current	12	[0-1000]A
Set welding voltage	100	[-1000-1000]V
Gradient type	No	
Gradient time		[0-100000]ms
Example: ARCSET V=100 A=12 0 N		

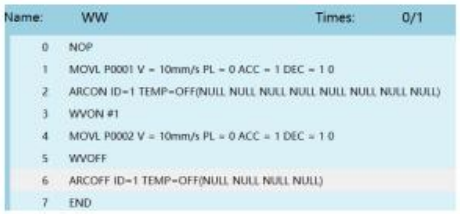
Parameter	Value	Parameter range
Set welding current	Fill in the welding current value during welding operation	[0-1000]A
Set welding voltage	Fill in the welding voltage value during welding operation	[-1000-1000]V
Gradient method	Time gradient No	
Gradient time	The time from the ignition current and voltage to the welding current and voltage For example: the set gradient time is 1s, then the time from the ignition current and voltage to the welding current and voltage is 1s If you not use gradient method, the ignition	[0-100000]ms

	current and voltage will reach the welding current and voltage immediately	

WVON instruction-weaving start

WVON instruction-weaving start
Function: Execute this instruction to start weaving welding, please run the welding start ARCON instruction before executing this instruction.
Parameter interface 

Parameter	Value	Note
WVON	1-9	Different file numbers can be selected during weaving welding, as shown below:

		 Figure 1 For example: in the "Welding process-Weaving parameter" interface, the selected weaving file is 1, and the weaving mode is sine weaving, as shown in Figure 1, select 1 as the weaving start process number, then Sine weaving will be performed while welding.  For example: in the "Welding process - Weaving parameter" interface, the selected weaving file is 2, and the weaving mode is Z-shaped, as shown in Figure 2, select 2 as the weaving start process number, then Z-shaped weaving will be performed during welding.

WVOFF instruction - weaving welding end

WVOFF instruction - weaving welding end
Function: Execute this instruction to end weaving welding.
Parameter interface

WVOFF
Parameter
WVOFF
Example:WVOFF

How to use: Execute the WVOFF instruction as shown in Figure 1, and the robot will end weaving welding

Note: It is necessary to insert the ARCON instruction before the WVON instruction, and insert the ARCOFF instruction after the WVOFF instruction

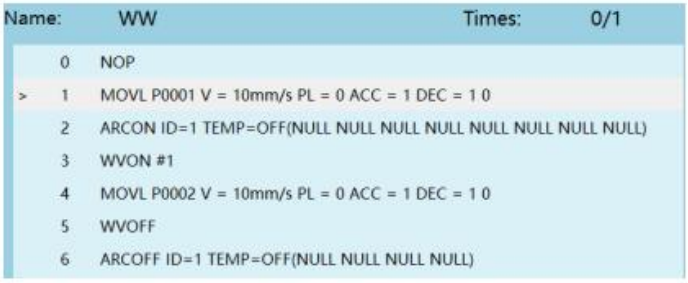
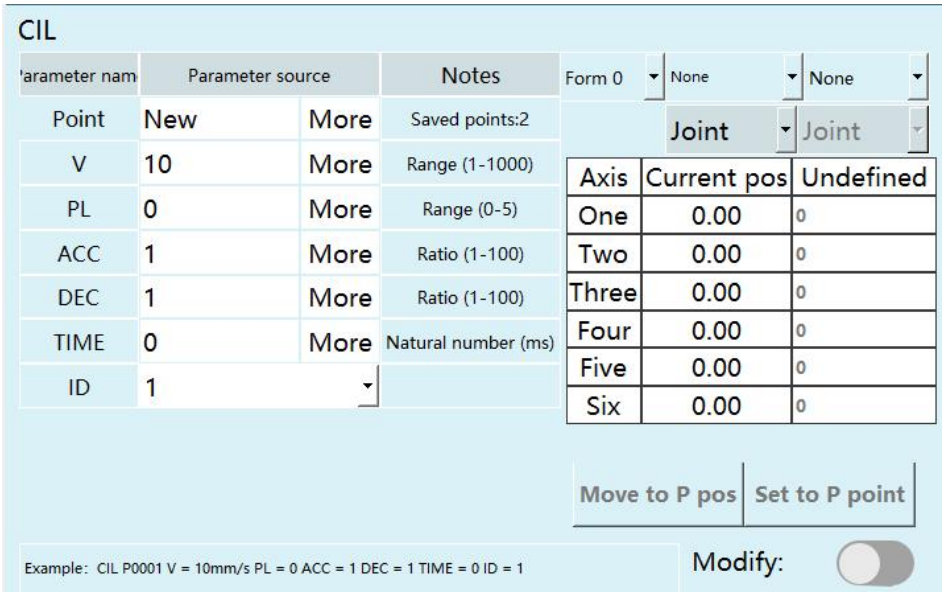
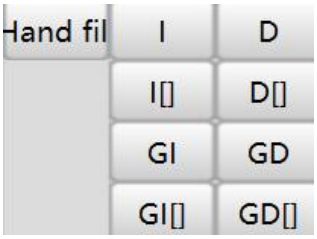


Figure 1

CIL instruction - intersecting line

CIL instruction - intersecting line
Parameter interface

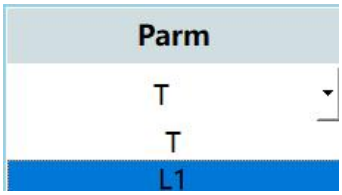
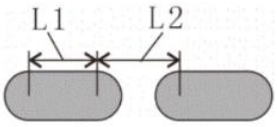
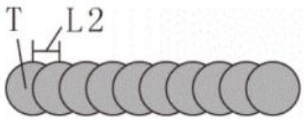


Parameter name	Parameter source	Note
Point: Select "Local position variable"/"Global position variable"/"Bind variable". When the value is "New", inserting this instruction will create a new P variable, and record the current position of the robot to this P variable.	P GP P[] CP[]	New position variable
V: speed, unit mm/s	These parameters can bind variables, as the figure shown below: 	Indicates the range and unit of the parameter
PL: position level For example: create two points, P001 and P002, and walk a straight line. If the PL is set, the degree of connection between the two points will be fine.		
ACC: acceleration, unit percentage		
DEC: deceleration, unit percentage		
TIME: early execution time, unit ms		
ID: intersecting line process number		

TIGWELDON INSTRUCTIONS - T.I.G welding start

TIGWELDON INSTRUCTIONS - T.I.G welding start
Function: Execute this instruction to start the T.I.G welding. Please run the welding start ARCON instruction before executing this instruction.
Parameter interface TIGWELDON Parm / Value / Comment T / Spot welding time(S) L2 / Idle distance(MM) Example: TIGWELDON T=10 L2=1
Picture of T.I.G welding   

Parameter	Value	Note
T/L1	Figure 1 is an example diagram when setting the parameters of welding distance	L1 means welding distance (mm), T means spot

  Figure 1  Figure 2	and idling distance. welding distance The robot continues to weld while moving For example: the set welding distance is 5mm, as shown in Figure 1, the L1 is 5mm L2 means idling distance spot welding time The robot does not move within the set time and keeps welding continuously T means spot welding time L2 means idling distance	welding time (s)
Idling distance L2	Fill in the idling distance parameter For example: the filled distance is 5mm, as shown in Figure 1, the L2 is 5mm	Fill in the idling distance parameter, the unit is mm

TIGWELDOFF instruction - T.I.G welding end

TIGWELDOFF instruction - T.I.G welding end

Function: Execute this instruction to end the T.I.G welding.

Instruction interface:

TIGWELDOFF
Parameter
TIGWELDOFF
Example:TIGWELDOFF

FEEDWIRE instruction - Wire feeding

FEEDWIRE instruction - Wire feeding

Function: Feed the wire within the set time at the start of welding or after the end of welding, and then cut off the welding wire when it reaches the designated position, in order to make the welding wire uniform during welding

Parameter interface:

FEEDWIRE		
Parm	**Value**	**Remarks**
T	2	Wire feed time(S)
Example: FEEDWIRE T=10		

Parameter	Value	Note
T	Represents wire feeding time	Wire feeding time, unit s

ARCBUILTIN instruction - welder built-in process

ARCBUILTIN instruction - welder built-in process
Instruction interface This instruction can be used with Aotai welder at present

ARCBUILTIN

Parameter	Value	Notes
Built-in process number	1	Welder built-in process numbe
Parameter A		Builtin_a call
Parameter B		$builtin_b call
Parameter C		$builtin_c call
Parameter D		$builtin_d call
Parameter E		$builtin_e call
Example: ARCBUILTIN ID = 1		

Parameter	Value	Note
Built-in process number	1-9	Welder built-in process number
Parameter A		$builtin_a call
Parameter B		$builtin_b call
Parameter C		$builtin_c calls
Parameter D		$builtin_d call
Parameter E		$builtin_e call

WELDPATHSTART instruction - initial weld path recording start

WELDPATHSTART instruction - initial weld path recording start
Instruction interface

The WELDPATHSTART instruction needs to be used in conjunction with the WELDPATHSTOP instruction. Between the two instructions, only MOVL, MOVCA and MOVC instructions are supported.

WELDPATHSTART
Parameter
WELDPATHSTART
Example: WELDPATHSTART

How to use the instruction:

```
    0   NOP
>   1   MOVJ P0002 VJ = 10% PL = 0 ACC = 10 DEC = 10 0
    2   MOVL P0003 V = 10mm/s PL = 0 ACC = 1 DEC = 1 0
    3   ARCON ID=1 TEMP=OFF(NULL NULL NULL NULL NULL NULL NULL NULL)
    4   WELDPATHSTART
    5   MOVL P0003 V = 10mm/s PL = 0 ACC = 1 DEC = 1 0
    6   MOVL P0004 V = 10mm/s PL = 0 ACC = 1 DEC = 1 0
    7   WELDPATHSTOP
    8   ARCOFF ID=1 TEMP=OFF(NULL NULL NULL NULL)
    9   END
```

As shown in the figure: P2 is the safety point, P3 is the welding start point, and P4 is the welding end point, P3-P4 represents the initial weld path of welding

WELDPATHOFFSET instruction - weld path offset calculation

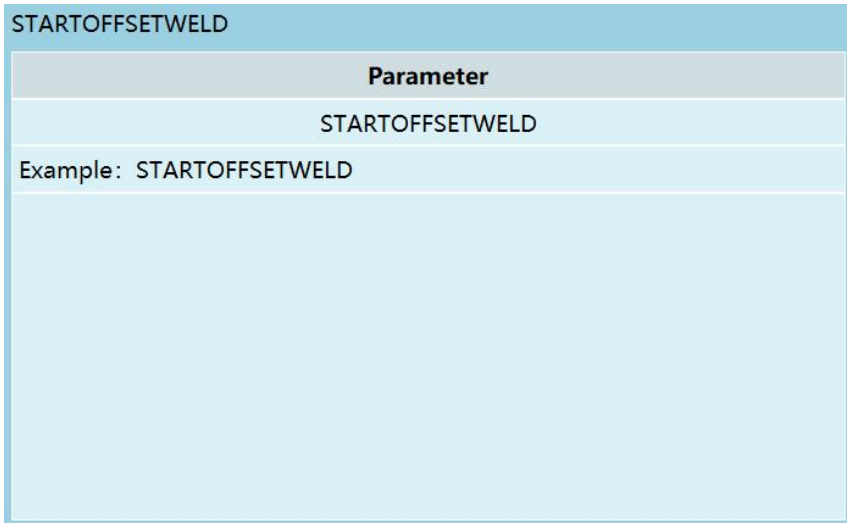
WELDPATHOFFSET instruction - weld path offset calculation
Function: calculate the weld path after offset and run it in the order of calculation
Instruction parameter interface:

WELDPATHOFFSET		
Parameter	**Value**	**Notes**
Original weld bead	WELDPATH0	
X-axis offset	0	
Y-axis offset	0	
Z-axis offset	0	
A-axis offset	0	
B-axis offset	0	
C-axis offset	0	
Store calculation result	WELDPATH1	
Example: WELDPATHOFFSET WELDPATH0 11 22 33 2 2 2 WELDPATH1		

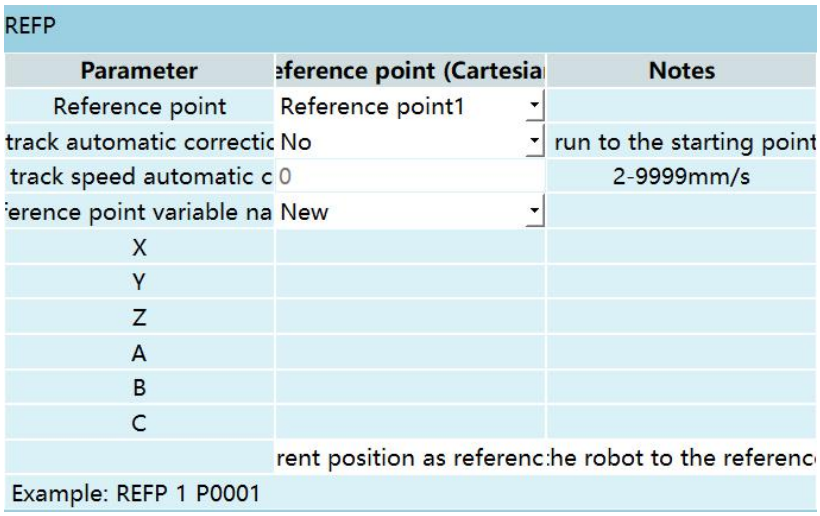
Original weld path	initial weld path, generally starts from weld path 0
X-axis offset Y-axis offset Z-axis offset A-axis offset B-axis offset C-axis offset	Taking the original weld path as the reference weld path, by setting offsets for the X, Y, Z, A, B, and C axes, the weld path will be offset on the basis of the original weld path. For example: on a flat workpiece, use the original weld path as the reference weld path, if you want to offset the weld bead to the left or right by 10mm, then it is necessary to set the offset of the Y axis (10mm), the offset axis and offset of the specific weld path can be set by yourself.
Calculation results storage	WELDPATH1-WELDPATH21 Use the original weld path as the reference weld path, and store the results after setting the offsets on the X, Y, Z, A, B, and C axes into the new weld path

STARTOFFSETWELD instruction - run offset weld path

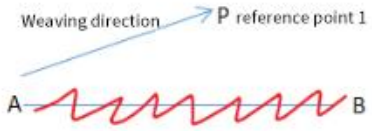
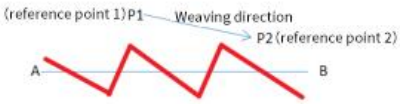
STARTOFFSETWELD instruction - run offset weld path
The trajectory, speed and other parameters of offset weld path are the same as the initial weld path. Take the initial weld path as the reference weld path, set the offset weld path after the offset set by WELDPATHOFFSET instruction, the length of the offset weld bead is

the same as the initial weld path, only the angle and position of the offset weld path are different
Instruction interface  STARTOFFSETWELD Parameter STARTOFFSETWELD Example: STARTOFFSETWELD

REFP instruction-weaving reference point

REFP instruction-weaving reference point
Instruction interface:  REFP Parameter / eference point (Cartesia / Notes Reference point / Reference point1 track automatic correctic / No / run to the starting point track speed automatic c / 0 / 2-9999mm/s erence point variable na / New X Y Z A B C rent position as referenc:he robot to the referenc Example: REFP 1 P0001

Parameter	Reference point (Cartesian)	
Reference point	The red trajectory indicates the trajectory of weaving welding by determining the weaving welding direction Only select reference point 1 or reference	

	point 2  Select both reference point 1 and reference point 2  	
Weaving track automatic correction enable	No/Yes	Calculate and automatically run to the starting point of the correction trajectory
Weaving track automatic correction speed	After the automatic correction enable is turned on, the starting point of the weld path will be offset to the middle of the two reference points The green trajectory indicates the trajectory and direction of weaving welding after correcting the starting point of weaving welding	Speed range 2-9999mm/s

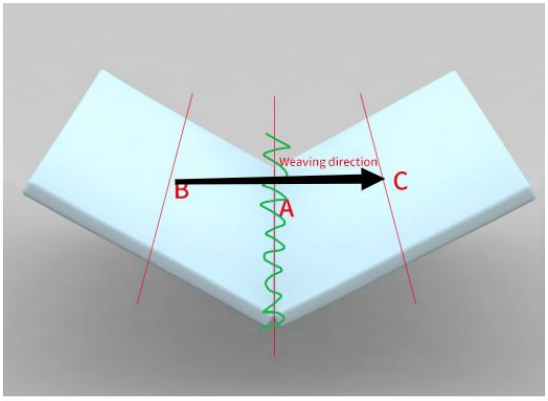


Figure 1

For example: as shown in the figure, B is reference point 1, C is reference point 2, and the starting point of the weld path is the center point between the two reference points after the automatic correction is enabled.

WELDPATHCOUNT instruction - weld path number calculation

WELDPATHCOUNT instruction - weld path number calculation	
Instruction interface	

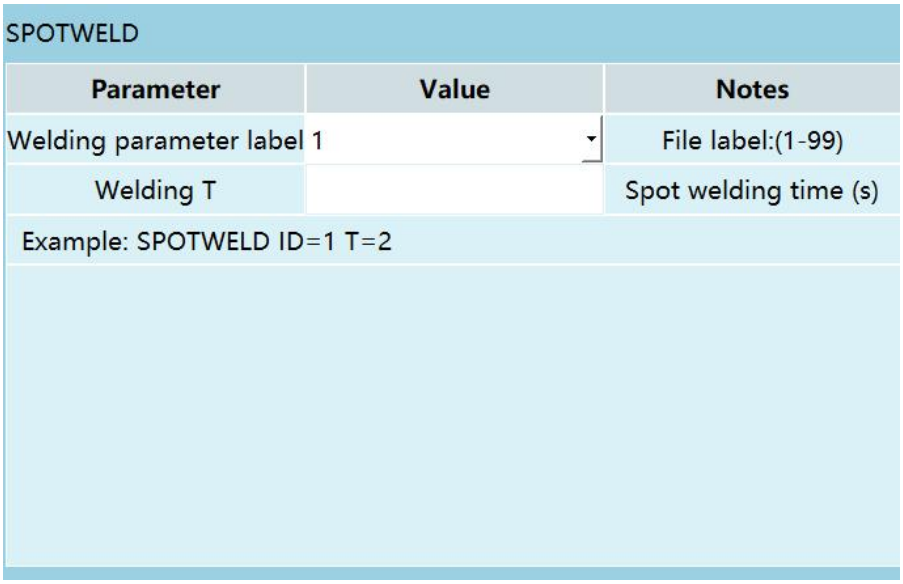
WELDPATHCOUNT

Parameter	Value	Notes
Calculation result stored in the variable type	I001 More	
Choose weld bead		
☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5		
☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10		
☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15		
☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20		
☐ 21		
Select all Reversed		
Example: WELDPATHCOUNT I001 1		

Calculation result storage variable type	Variable and bind variable types can be selected

	INT, GINT, I[], GI[]
Select weld path	1-21

SPOTWELD instruction - spot welding

SPOTWELD instruction - spot welding		
When this instruction is executed, the robot starts to perform spot welding.		
Instruction interface:  		
Parameter	Value	Note
Welding parameter number	1-99	Welding parameter process number used in spot welding (1-99)
Welding time	For example: if the spot welding time is set to 2 seconds, it means that the robot will keep welding within 2 seconds.	The robot does not move within the set time and keeps welding, unit (s)
Usage	Set welding signal, current-voltage matching parameters and welding	

	equipment parameters Set the current, voltage and time parameters of spot welding in the "Welding process-Manual operation" interface After setting the required parameters, click the spot welding enable button on the manual operation interface or the status interface of the welding process, you will find that the set ignition and air supply signal ports are open (because the welder is not connected during the test, the wire feeding and wire retracting signal ports did not respond)

> Use cases

Normal ignition welding

Parameter setting

All parameter values are set without specific meaning and are used as examples only

Enter "**Process/Welding process/Welder setting**", set the "Welder control mode" to "Analog control"

Enter "**Process/Welding process/Welding IO**"- Digital input: ignition success signal 1-1; Digital output: ignition signal 1-2; Analog input: welding current signal DIN1-1, welding voltage signal DIN1-2; Analog output: given current signal DOUT1-1, given voltage signal DOUT1-2

Enter "**Process/Welding process/Current-voltage matching**", fill in [1] for welding current in the first line of "Set current", fill in [10] for actual welding current; fill in [1] for welding voltage in the first line of "Set voltage", fill in [10] for actual welding voltage

Enter "**Process/Welding process/Welding parameter setting**", set the ignition parameters: ignition current [8] A, ignition voltage [8] V, ignition time [2] S; welding parameters: welding current [10] A, welding voltage [10] V; arc quenching current [7] A, arc quenching voltage [7] V, arc quenching time [2] S

Enter "**Process/Welding process/Welding equipment setting**" - Basic functions: arc detection time [2] S, arc detection confirmation time [1] S

Enter "**Process/Welding process/Manual operation**", turn on the "Welding enable" switch and the "Manual ignition mode" and "Manual spot welding", set the manual spot welding current to 8A, spot welding voltage to 8V, maximum time to 2S

Use case

```
0  NOP
1  MOVL P001 V = 10 mm/s  PL = 0 ACC = 1 DEC = 1
2  ARCON #1
3  MOVL P002 V = 10 mm/s  PL = 0 ACC = 1 DEC = 1
4  ARCOFF
5  END
```

Instruction meaning

1. The robot moves to the **welding start point P001**

2. **ARCON#1 welding start**

- Set 4s gas pre-flow time and 1s arc detection time, start ignition and execute welding parameter number 1
- 4s gas pre-flow time (the welder feeds gas 4 seconds in advance, detects the gas, the gas detection signal port outputs high level, after 4s, the ignition starts, and the set ignition signal output port outputs high level)
- 1s arc detection time (If the ignition success signal is detected within 1s, the program continues to run, if not, the error "Waiting for the welding ignition success signal timed out" will be reported)

3. The robot moves to the welding end point P002

- The robot starts to weld, the ignition voltage is 60V, the ignition current is 10A, the ignition time is 1s, the welding voltage is 80V, the welding current is 20A, the arc quenching voltage is 50V
- During the movement from P001 to P002, if the welder starts the ignition successfully, the welder will start the ignition with the ignition current and voltage values, and maintain the set ignition current and voltage values for 1 second (ignition time) until the current and voltage reach the welding current and voltage, and then start welding

4. ARCOFF welding end

- Set arc quenching voltage 50V, arc quenching current 10A and arc quenching time 1s on the "Process-Welding parameters" interface
- Start arc quenching after welding is completed, and keep it for 1 second (arc quenching time) after reaching the arc quenching current and voltage values, then the welding ends, the set air supply and ignition signal output ports are changed from high level 1 to low level 0

Programming

Click "Project", click "New", enter the program name, click "OK"

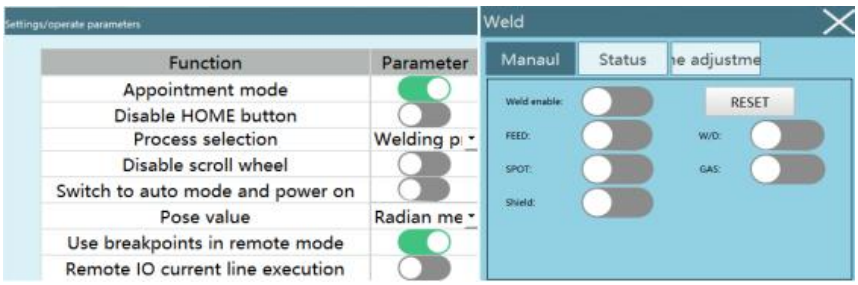
1. Move the robot to the welding start point, click "Insert", select "Motion Control Class", select "MOVL", click "OK", modify the speed value, click "OK"
2. Click "Insert", select "Welding control class", select "ARCON", click "OK", enter the file number (the file number corresponds to the value in the welding parameter setting interface), and click "OK"
3. Move the robot to the welding end point, click "Insert", select "Motion control class", select "MOVL", click "OK", modify the speed value, click "OK"
4. Click "Insert", select "Welding control class", select "ARCOFF", click "OK", and then click "OK" again

Trajectory confirmation: After the program is written, turn the key to switch the teach pendant from the teach mode to the running mode, and click "start" to confirm whether the running trajectory of the robot is correct and whether it meets the needs

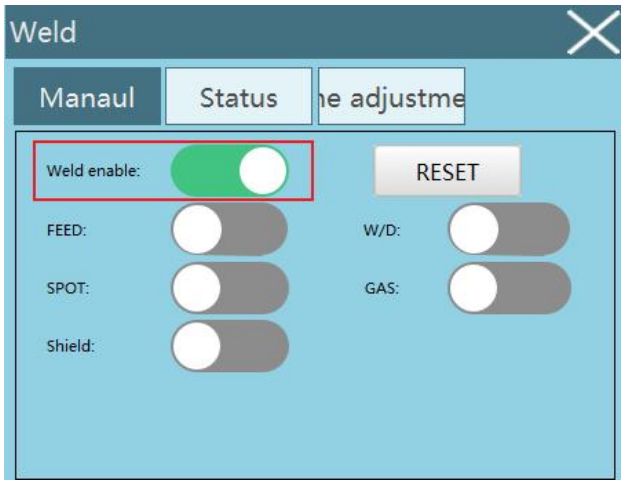
Welding: After confirming that the running trajectory is correct, the robot will perform the welding function only when the "**Welding enable**" is turned on;

When the program is in the running mode, if you press "stop" and then press "start", then after the program restarts, the welding function will no longer be performed.

Welding enable turn-on method: switch the teach pendant to teach mode, click the "Welding" button in the upper right corner, the following picture will appear:



Select "Welding enable" to turn it on;



Weaving welding use case

Parameter setting

All parameter values are set without specific meaning and are used as examples only

- Enter "Process/Welding process/Welder setting", set the "Welder control mode" to "Analog control"
- Enter "Process/Welding process/Welding IO"- Digital input: ignition success signal 1-1; Digital output: ignition signal 1-2; Analog input: welding current signal DIN1-1, welding voltage signal DIN1-2; Analog output: given current signal DOUT1-1, given voltage signal DOUT1-2
- Enter "Process/Welding process/Current-voltage matching", fill in [1] for welding current in the first line of "Set current", fill in [10] for actual welding current; fill in [1] for welding voltage in the first line of "Set voltage", fill in [10] for actual welding voltage
- Enter "Process/Welding process/Welding parameter setting", set the ignition parameters: ignition current [8] A, ignition voltage [8] V, ignition time [2] S; welding parameters: welding current [10] A, welding voltage [10] V; arc quenching current [7] A, arc quenching voltage [7] V, arc quenching time [2] S
- Enter "Process/Welding process/Welding equipment setting" - Basic functions: arc detection time [2] S, arc detection confirmation time [1] S
- Enter "Process/Welding process/Manual operation", turn on the "Welding enable" switch and the "Manual ignition mode" and "Manual spot welding", set the manual spot welding current to 8A, spot welding voltage to 8V, maximum time to 2S

Enter "Process/Welding process/Weaving welding parameters" to set parameters

Use case

```
0  NOP
1  MOVL P001 V = 10 mm/s  PL = 0 ACC = 1 DEC = 1
2  ARCON #1
3  WVON #1
4  MOVL P002 V = 10 mm/s  PL = 0 ACC = 1 DEC = 1
5  WVOFF
6  ARCOFF
7  END
```

Instruction meaning

1. The robot moves to point P001 (weaving welding start point)
2. **ARCON#1 welding start**

- During the movement from P001 to P002, if the welder starts the ignition successfully, the welder will start the ignition with the ignition current and voltage values, and maintain the set ignition current and voltage values for 1 second (ignition time) until the current and voltage reach the welding current and voltage, and then start welding

3. WVON#1 weaving welding start

- Execute the parameters in the weaving file 1; (if it is WVON#2, the weaving starts, and execute the parameters in the weaving file 2)
- After executing this instruction, the robot performs the weaving operation according to the weaving parameters set in **Process/Welding process/Weaving parameters**

4. P002 end point of weaving welding

- P001-P002 is the weaving trajectory that needs to be executed
- The amplitude, frequency, direction/horizontal and vertical deflection angle of the weaving track is performed according to the settings in Figure 1.

5. WVOFF#1 weaving end

- The robot completes the weaving welding operation

6. ARCOFF welding end

- Set arc quenching voltage 50V, arc quenching current 10A and arc quenching time 1s on the "Process-Welding parameters" interface
- Start arc quenching after welding is completed, and keep it for 1 second (arc quenching time) after reaching the arc quenching current and voltage values, then the welding ends, the set air supply and ignition signal output ports are changed from high level 1 to low level 0

Programming

Click "Project", click "New", enter the program name, click "OK"

Move the robot to the **welding start point**, click "Insert", select "Motion control class", select "MOVL", click "OK", modify the speed value and click "OK"

Click "Insert", select "Welding control class", select "ARCON", click "OK", enter the file number (the file number corresponds to the value in the **welding parameter setting** interface), and click "OK"

Click "Insert", select "Welding control class", select "WVON", click "OK", and enter the file number (the file number corresponds to the value in the **weaving welding parameters** interface)

Move the robot to the **welding end point**, click "Insert", select "Motion control class", select "MOVL", click "OK", modify the speed value, click "OK"

Click "Insert", select "Welding control class", select "WVOFF", click "OK", and then click "OK" again

Click "Insert", select "Welding control class", select "ARCOFF", click "OK", and then click "OK" again

Trajectory confirmation: After the program is written, turn the key to switch the teach pendant from the teach mode to the running mode, and click "start" to confirm whether the running trajectory of the robot is correct

Welding: After confirming that the running trajectory is correct, the robot will perform the welding function only when the "**Welding enable**" is turned on; **the welding enable turn-on method has been described in the ignition welding case**

T.I.G welding use case

All parameter values are set without specific meaning and are used as examples only

- Enter "**Process/Welding process/Welder setting**", set the "Welder control mode" to "Analog control"
- Enter "**Process/Welding process/Welding IO**"- Digital input: ignition success signal 1-1; Digital output: ignition signal 1-2; Analog input: welding current signal DIN1-1, welding voltage signal DIN1-2; Analog output: given current signal DOUT1-1, given voltage signal DOUT1-2
- Enter "**Process/Welding process/Current-voltage matching**", fill in [1] for welding current in the first line of "Set current", fill in [10] for actual welding current; fill in [1] for welding voltage in the first line of "Set voltage", fill in [10] for actual welding voltage

- Enter "**Process/Welding process/Welding parameter setting**", set the ignition parameters: ignition current [8] A, ignition voltage [8] V, ignition time [2] S; welding parameters: welding current [10] A, welding voltage [10] V; arc quenching current [7] A, arc quenching voltage [7] V, arc quenching time [2] S
- Enter "**Process/Welding process/Welding equipment setting**" - Basic functions: arc detection time [2] S, arc detection confirmation time [1] S
- Enter "**Process/Welding process/Manual operation**", turn on the "Welding enable" switch and the "Manual ignition mode" and "Manual spot welding", set the manual spot welding current to 8A, spot welding voltage to 8V, maximum time to 2S

Enter "**Process/Welding process/Weaving welding parameters**" to set parameters

Use case

```
0  NOP
1  MOVL P001 V = 10 mm/s  PL = 0 ACC = 1 DEC = 1
2  ARCON #1
3  TIGWELDON L1 = 2 L2 = 3
4  MOVL P002 V = 10 mm/s  PL = 0 ACC = 1 DEC = 1
5  TIGWELDOFF
6  ARCOFF
7  END
```

Instruction meaning

1. P001 (welding start point)
2. ARCON#1 welding start

- The robot starts to weld, the ignition voltage is 60V, the ignition current is 10A, the ignition time is 1s, the welding voltage is 80V, the welding current is 20A, the arc quenching voltage is 50V
- During the movement from P001 to P002, if the welder starts the ignition successfully, the welder will start the ignition with the ignition current and voltage values, and maintain the set ignition current and voltage values for 1 second (ignition time) until the current and voltage reach the welding current and voltage, and then start welding

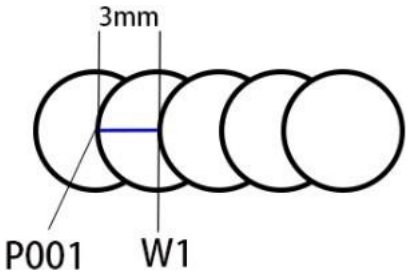
3. TIGWELDON T=2 L2=3 (T.I.G welding start)

Set spot welding time and idling distance

TIGWELDON

Parm	Value	Comment
T	2	Spot welding time(S)
L2	3	Idle distance(MM)
Example: TIGWELDON T=10 L2=1		

- The robot starts ignition, the robot welds at point P001 for 2s (i.e. T=2s), then the robot quenches the arc, and idly walks 3mm (i.e. L2=3mm) to point W1
- The robot starts the ignition at point W1, welds at point W1 for 2s, quenches the arc, and idly walks 3mm to point W2
- ① Start the ignition, ② Weld for 2s, ③ Quench the arc, ④ Idly walk 3mm, and cycle the previous 4 steps until running to the welding end point (P002).

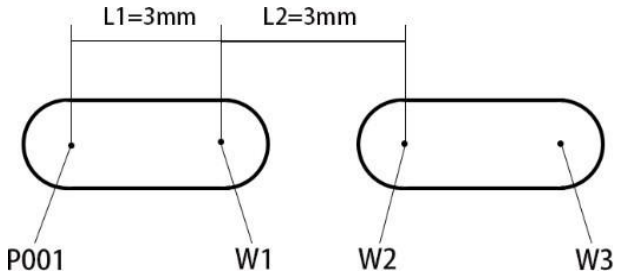


Set welding distance and idling distance

TIGWELDON

Parm	Value	Comment
L1	3	Welding distance(MM)
L2	3	Idle distance(MM)
Example: TIGWELDON T=10 L2=1		

The robot starts the ignition, the robot starts at P001 and runs L1 to W1 in a welding state (the distance between P001 and W1 is 3mm, i.e. the welding distance), then the robot quenches the arc and idly walks 3mm (i.e. L2=3mm) to W2, the robot starts the ignition at W2, the robot runs from W2 to W3 while welding, then the robot quenches the arc and idly walks 3mm to W4. ① Start the ignition, ② Weld for 2s, ③ Quench the arc, ④ Idly walk 3mm, and cycle the previous 4 steps until running to the welding end point (P002).



4. P002 (welding end point)
5. TIGWELDOFF (T.I.G welding end)
6. **ARCOFF welding end**

- Set arc quenching voltage 50V, arc quenching current 10A and arc quenching time 1s on the "Process-Welding parameters" interface
- Start arc quenching after welding is completed, and keep it for 1 second (arc quenching time) after reaching the arc quenching current and voltage values, then the welding ends, the set air supply and ignition signal output ports are changed from high level 1 to low level 0

Programming

- Click "Project", click "New", enter the program name, click "OK"

Move the robot to the **welding start point**

- Click "Insert", select "Motion control class", select "MOVL", click "OK", modify the speed value and click "OK"
- Click "Insert", select "Welding control class", select "ARCON", click "OK", enter the file number (the file number corresponds to the value in the **welding parameter setting** interface), and click "OK"
- Click "Insert", select "Welding control class", select "TIGWELDON", click "OK", select T.I.G welding type: Option 1: select T for the first line of parameter // Option 2: select L1 for the first line of parameter and enter the corresponding value
- Move the robot to the **welding end point**, click "Insert", select "Motion Control Class", select "MOVL", click "OK", modify the speed value, click "OK"
- Click "Insert", select "Welding control class", select "TIGWELDOFF", click "OK", and then click "OK" again, click "Insert", select "Welding control class", select "ARCOFF", click "OK", and then click "OK" again

Trajectory confirmation: After the program is written, turn the key to switch the teach pendant from the teach mode to the running mode, and click "start" to confirm whether the running trajectory of the robot is correct

Welding: After confirming that the running trajectory is correct, the robot will perform the welding function only when the "**Welding enable**" is turned on; **the welding enable turn-on method has been described in the ignition welding case**

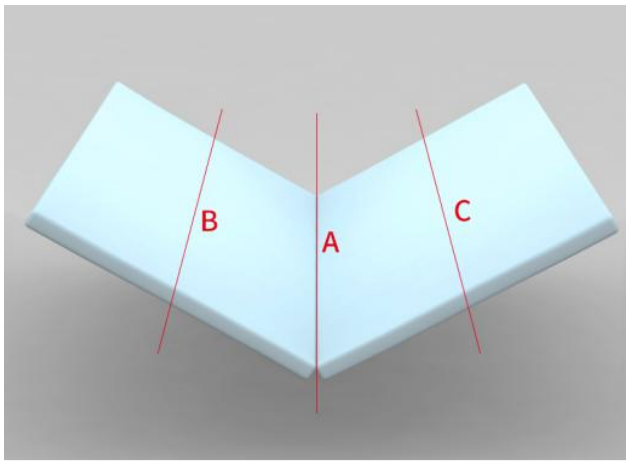
Multi-layer multi-pass welding use case (Two-layer three-pass welding)

Parameter setting

All parameter values are set without specific meaning and are used as examples only

- Enter "**Welding process/Welder setting**", set the "Welder control mode" to "Analog welder"
- Enter "Welding process/Welding IO"- Digital input: ignition success signal 1-1; Digital output: ignition signal 1-2; Analog input: DIN1-1; Analog output: NOUT1-1
- Enter "Welding process/Current-voltage matching", fill in [1] for welding current in the first line of "Set current", fill in [10] for actual welding current; fill in [1] for welding voltage in the first line of "Set voltage", fill in [10] for actual welding voltage
- Enter "Welding process/Welding parameter setting", set the ignition parameters: ignition current [8] A, ignition voltage [8] V, ignition time [2] S; welding parameters: welding current [10] A, welding voltage [10] V; arc quenching current [7] A, arc quenching voltage [7] V, arc quenching time [2] S
- Enter "Welding process/Welding equipment setting" - Basic functions: arc detection time [2] S, arc detection confirmation time [1] S, arc depletion detection time [1] S, turn on "Gas pre-flow". Select "Delayed gas shut-off" for "Gas shut-off mode", delayed gas shut-off time [2] S
- Enter "Welding process/Manual operation", turn on the "Welding enable" switch, turn on the "Manual ignition mode" and "Manual spot welding", set the manual spot welding current to 8A, spot welding voltage to 8V, maximum time to 2S

Welding trajectory diagram



图一

Programming

Name: WW Times: 0/1

```
0   NOP
1   MOVJ P0001 VJ = 10% PL = 0 ACC = 10 DEC = 10 0
2   MOVL P0002 V = 10mm/s PL = 0 ACC = 1 DEC = 1 0
3   ARCON ID=1 TEMP=OFF(NULL NULL NULL NULL NULL NULL NULL NULL)
4   WELDPATHSTART
5   MOVL P0002 V = 10mm/s PL = 0 ACC = 1 DEC = 1 0
6   MOVL P0003 V = 10mm/s PL = 0 ACC = 1 DEC = 1 0
7   WELDPATHSTOP
8   ARCOFF ID=1 TEMP=OFF(NULL NULL NULL NULL)
9   WELDPATHOFFSET WELDPATH0 0 100 50 0 0 0 WELDPATH1
10  WELDPATHOFFSET WELDPATH0 0 -100 50 0 0 0 WELDPATH2
11  WELDPATHCOUNT I001 2097151
12  WHILE (GI001 < 4)
13  MOVJ P0001 VJ = 10% PL = 0 ACC = 10 DEC = 10 0
14  GOTO_WELD_START_POS
15  ARCON ID=1 TEMP=OFF(NULL NULL NULL NULL NULL NULL NULL NULL)
16  STARTOFFSETWELD
17  ADD GI001 1
18  ARCOFF ID=1 TEMP=OFF(NULL NULL NULL NULL)
19  ENDWHILE
20  END
```

Instruction meaning

Line 1: robot safety point

Line 2: start point of initial weld path

Line 3: welding start, start the ignition according to the parameters set in the "Process-Welding process" interface, start to prepare for welding

Lines 4-7: Indicates that P002-P003 is recorded as the initial weld path, as shown in Figure 1 above, the initial weld path is A

Line 8: welding end, initial path welding complete

Line 9: The offset weld bead that needs to be welded. According to Figure 1, B is the offset weld bead 1 that needs to be welded. The Y and Z axes offsets are set on the basis of the initial weld bead

Line 10: the offset weld bead to be welded, according to Figure 1, C is the offset weld bead 2 to be welded, and the Y and Z axis offsets are set on the basis of the initial weld bead

Line 11: Calculation of the number of welds

Lines 12-18: complete the welding of the offset weld bead through a cycle, give the cycle instruction a judgment condition, when a section of weld bead is welded, add 1 to GI001. When GI004<4, jump out of the loop and complete multi-pass welding

The use of spot welding

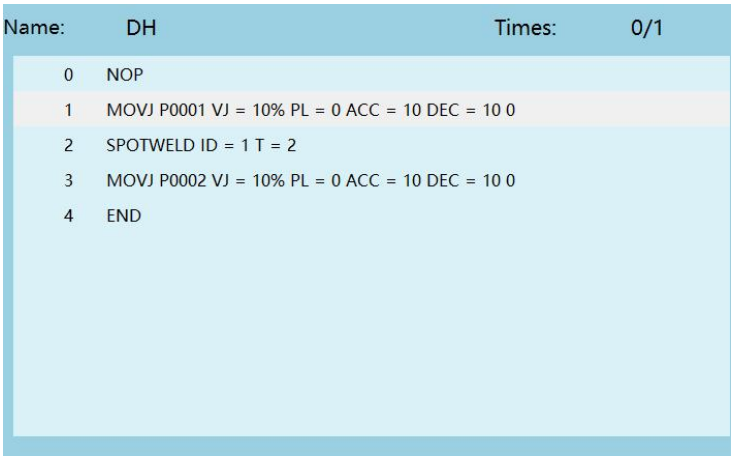
All parameter values are set without specific meaning and are used as examples only

1. Enter "Process/Welder setting", set the welder control mode to "Analog"
2. Set welding signal

Digital input	Ignition success signal 1-1
Digital output	Ignition signal 1-1
	Wire feed signal 1-2
	Wire retract signal 1-3
	Air supply signal 1-4
Analog input	AIN1-1
Analog output	AOUT1-1

3. Enter "Process/Current-voltage matching", fill in [1] for welding current in the first line of setting current, and [10] for actual welding current; fill in [1] for welding voltage in the first line of setting voltage, and fill in [10] for actual welding voltage
4. Enter "Process/Manual operation", turn on the welding enable switch, set the manual spot welding current to 8A, spot welding voltage to 8V, and the maximum time to 2S

Example of use of spot welding instructions:



Instruction meaning

Line 1: The point where the robot needs to perform spot welding

Line 2: set the spot welding time, set the spot welding time to two seconds according to the instruction parameters, the robot will spot weld at P001 point continuously for two seconds, supply air during the welding process, and the ignition signal port changes from low level 0 to high level 1, when the spot welding time is reached, gas will be supplied after welding, and the ignition signal port will change from high level 1 to low level 0

Line 3: the safety point where the robot moves to after the spot welding is completed

Weaving welding reference point use case

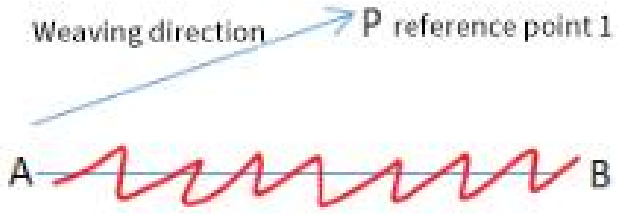
Parameter setting

All parameter values are set without specific meaning and are used as examples only

- Enter "**Welding process/Welder setting**", set the "Welder control mode" to "Analog welder"
- Enter "**Welding process/Welding IO**" - Digital input: ignition success signal 1-1; Digital output: ignition signal 1-2; Analog input: DIN1-1; Analog output: NOUT1-1
- Enter "**Welding process/Current-voltage matching**", fill in [1] for welding current in the first line of "Set current", fill in [10] for actual welding current; fill in [1] for welding voltage in the first line of "Set voltage", fill in [10] for actual welding voltage
- Enter "**Welding process/Welding parameter setting**", set the ignition parameters: ignition current [8] A, ignition voltage [8] V; welding parameters:

welding current [10] A, welding voltage [10] V; arc quenching current [7] A, arc quenching voltage [7] V

- Enter "**Welding process/Welding equipment setting**" - Basic functions: arc detection time [2] S, arc detection confirmation time [1] S, arc depletion detection time [1] S
- Enter "**Welding process/Manual operation**", turn on the "Welding enable" switch
- Insert a REFP (weaving reference point) instruction, set the current position as the the reference point of weaving welding, the MOVL trajectory and the points calibrated by REFP (weaving reference point) form the weaving welding plane, and determine the weaving direction. As shown in Figure 1 below, point A and reference point 1 determine the weaving welding direction, and the red trajectory is the weaving welding trajectory through the weaving welding direction.
- Weaving welding plane: used with the weaving start instruction to determine the coordinate system of the weaving welding



Programming

Name:	BH	Times:	0/1
0	NOP		
1	MOVJ P0001 VJ = 10% PL = 0 ACC = 10 DEC = 10 0		
2	ARCON ID=1 TEMP=OFF(NULL NULL NULL NULL NULL NULL NULL NULL)		
3	WVON #1		
4	MOVL P0002 V = 10mm/s PL = 0 ACC = 1 DEC = 1 0		
5	REFP 1 P0003 0 0		
6	MOVL P0004 V = 10mm/s PL = 0 ACC = 1 DEC = 1 0		
7	WVOFF		
8	ARCOFF ID=1 TEMP=OFF(NULL NULL NULL NULL)		
9	MOVJ P0005 VJ = 10% PL = 0 ACC = 10 DEC = 10 0		
10	END		

Instruction meaning:

Line 1: safety point when welding starts

Line 2: start welding

Line 3: start weaving welding

Lines 4-6: As shown in Figure 1 above, the direction of weaving welding is determined from point A to reference point 1, P2-P4 is the trajectory of weaving welding, and the trajectory of weaving welding is carried out through the direction of weaving welding.

Line 7: Weaving welding is completed

Line 8: welding done

Line 9: Safety point where the robot moves after welding

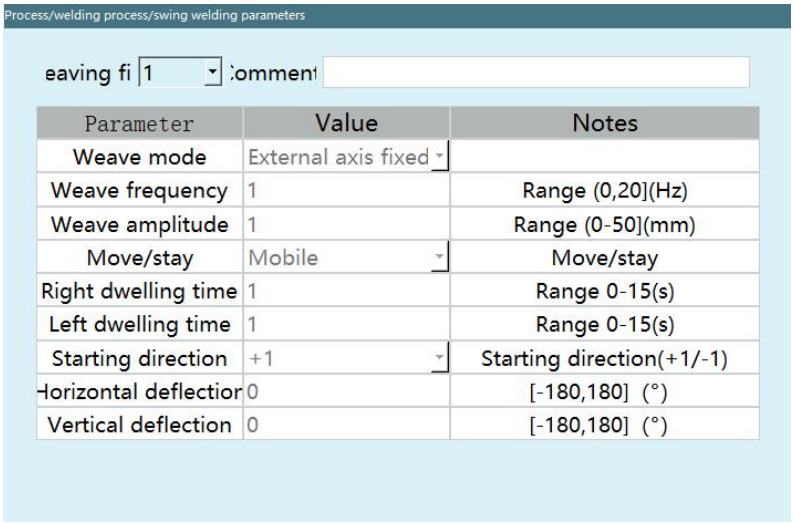
External axis fixed point weaving welding

1. After connecting the external axis, click on the robot on the "Settings-Robot parameters-Slave configuration" interface to see if the external axis has been connected successfully
2. After the external axis is successfully connected, calibrate the external axis and parameter settings on the "Settings-External axis Parameters" interface.
3. Welding process parameter setting

All parameter values are set without specific meaning and are used as examples only

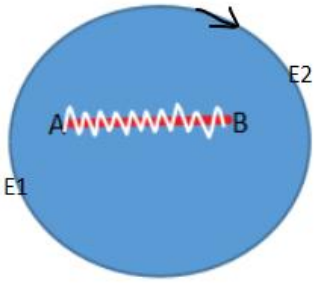
- Enter "**Welding process/Welder setting**", set the "Welder control mode" to "Analog welder"
- Enter "**Welding process/Welding IO**" - Digital input: ignition success signal 1-1; Digital output: ignition signal 1-2; Analog input: DIN1-1; Analog output: NOUT1-1
- Enter "**Welding process/Current-voltage matching**", fill in [1] for welding current in the first line of "Set current", fill in [10] for actual welding current; fill in [1] for welding voltage in the first line of "Set voltage", fill in [10] for actual welding voltage
- Enter "**Welding process/Welding parameter setting**", set the ignition parameters: ignition current [20] A, ignition voltage [10] V, ignition time [1] S; welding parameters: welding current [50] A, welding voltage [20] V; arc quenching current [28] A, arc quenching voltage [15] V
- Enter "**Welding process/Welding equipment setting**" - Basic functions: arc detection time [2] S, arc detection confirmation time [1] S

- Enter "**Welding process/Manual operation**", turn on the "Welding enable" switch, turn on the manual ignition mode, set the manual spot welding current to 8A, the spot welding voltage to 8V, and the maximum time to 2S.
- Enter "**Process/Welding process/Weaving welding parameters**" and set the parameters, as shown in the figure below



Trajectory of fixed-point weaving welding

- Calibrate two points on the external axis: E1 (start point of external axis rotation axis), E2 (end point of external axis rotation axis); P1-P2 determines the direction of rotation of the external axis
- The A-B red line segment indicates the linear trajectory of the weaving welding on the external axis: A (the start point of the linear trajectory, the robot needs to move) and B (the end point of the linear trajectory, the robot needs to move)
- The white curve represents the weaving trajectory when weaving welding is performed after setting the weaving welding parameters.
- While the external axis is rotating, the robot performs fixed-point weaving welding, and the weaving welding trajectory is the part indicated by the white curve in the figure below



Programming:

Name:	Q12	Times:	0/1
0	NOP		
1	MOVLEXT E0001 V = 10 mm/s PL = 0 ACC = 1 DEC = 1 SYNC = 0 0		
2	ARCON ID=1 TEMP=OFF(NULL NULL NULL NULL NULL NULL NULL NULL)		
3	MOVLEXT E0002 V = 10 mm/s PL = 0 ACC = 1 DEC = 1 SYNC = 1 0		
4	ARCOFF ID=1 TEMP=OFF(NULL NULL NULL NULL)		
5	END		

Instruction meaning:

Line 1: Insert the MOVLEXT instruction (both the external axis and the robot need to move), determine the coordinate point and external axis point of the robot, i.e. point E1 and point A in the above figure

Line 2: start welding operation

Line 3: Insert the MOVLEXT instruction (both the external axis and the robot need to move), determine the coordinate point and the external axis point of the robot, i.e. point E2 and point B in the above figure. when inserting the second MOVLEXT instruction, you need to turn on the synchronization function (when the synchronization function is turned on, the robot performs weaving welding on the external axis while the external axis is rotating)

Line 4: welding end

LIGENT TECH CO., LTD

Website YouTube

Official Website: http://ligentrobot.com
E-Mail: info@sotrobot.com
whatsapp:+86-13551010933