

Weld Package V3

3.2

DUCO Robots CO., LTD.

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**CHAPTER
ONE**

INTRODUCTION

Welding applications often require direct communication between the robot and the welder to reduce communication latency and thus achieve better weld quality.

1.1 Adaptation Instructions

Before installing the Welding Process Package V2, you need to ensure that the robot's software version is adapted, specifically:

Robot control software version	V3.5.0 and up
Robot Slave Firmware Versions	V1.0.2 and up
Robot Safety Controller Versions	V2.1.0 and above

The version information of the robot can be found in the About screen after powering up the robot. To open the "About" screen, see chapter 7 of the DUCO CORE User Manual.

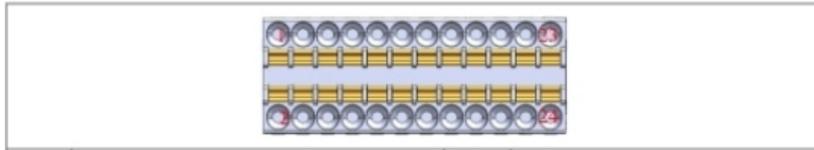
Welding process packages of version V2.0 and above are required to ensure that the robot's software version is V2.7.0 and above.

The welder models supported by the current version are:

1.2 Welder connection

When using CAN communication, you need to refer to the Collaborative Robot User's Manual (Hardware Section), and the welder's manual, and interface the CAN communication interface of the two. Take the example of adapting Aotai NBC-500RP Plus / NBC-350RL series welding machine:

1. Check the Collaborative Robot User's Manual (Hardware Section) to find the CAN communication interface, as shown below:
-

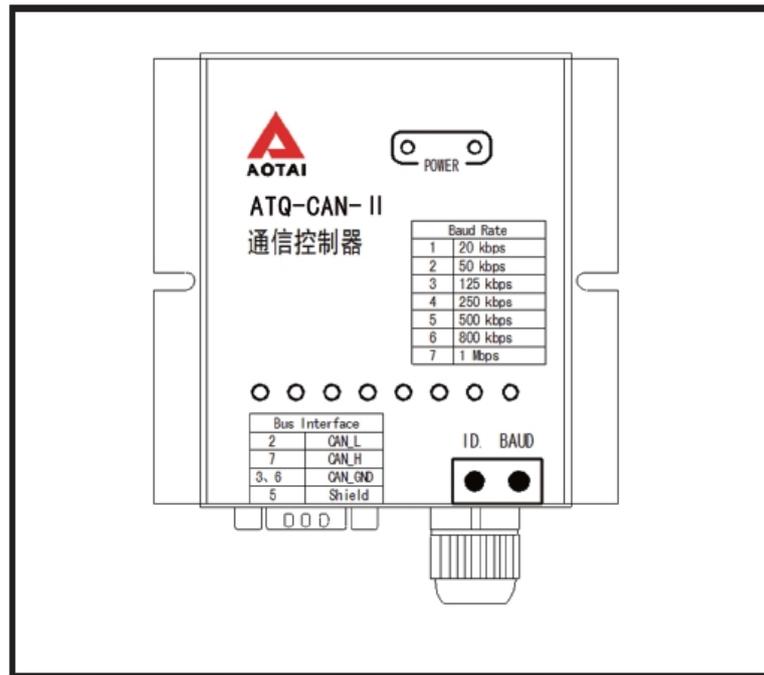


No	Signal Definition	No	Signal Definition
1	AI1(Voltage analog input 1)	2	AG(Analog Grounding)
3	AI2(Voltage analog input 2)	4	AG(Analog Grounding)
5	AO1(Voltage analog output 1)	6	AG(Analog Grounding)
7	AO2(Voltage analog output 2)	8	AG(Analog Grounding)
9	24VE	10	RC1(Remote Switch ON+)
11	GND	12	PowerON(Remote Switch ON-)
13	A+(INC signal A phase +)	14	RC2(Remote Switch OFF+)
15	A-(INC signal A phase -)	16	PowerOFF(Remote Switch OFF-)
17	B+(INC signal B phase +)	18	CAN_L
19	B-(INC signal B phase -)	20	CAN_H
21	Z+(INC signal C phase +)	22	485_B
23	Z-(INC signal C phase -)	24	485_A

From the table, it is clear that CAN communication uses pins 11, 18, and 20.

2. Check the manual of the welder and find the CAN communication interface on the welder side, as shown in the following figure:

CAN 通信控制器



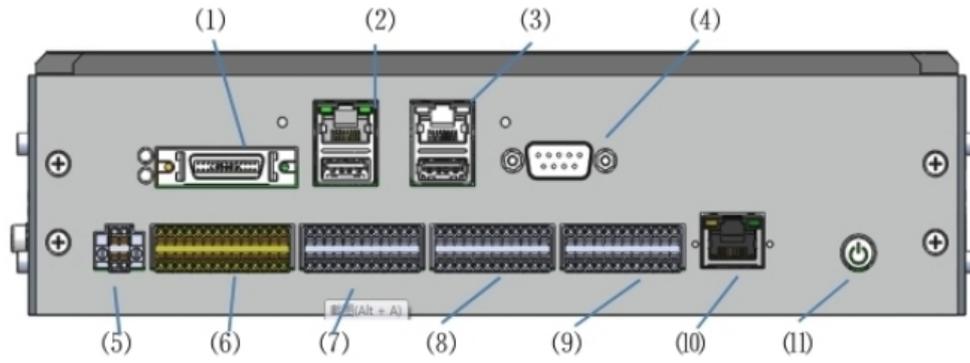
3. according to the instructions of the robot and the welding machine, connect the welding machine communication cable No. 2 to the corresponding line and the robot expansion interface pin 18.

No. 7 to the corresponding line and the robot to expand the interface pin 20, connect the No. 3/6 pin to the corresponding line to the robot expansion interface pin 11 to complete the wiring.

1.3 Installation and Uninstallation

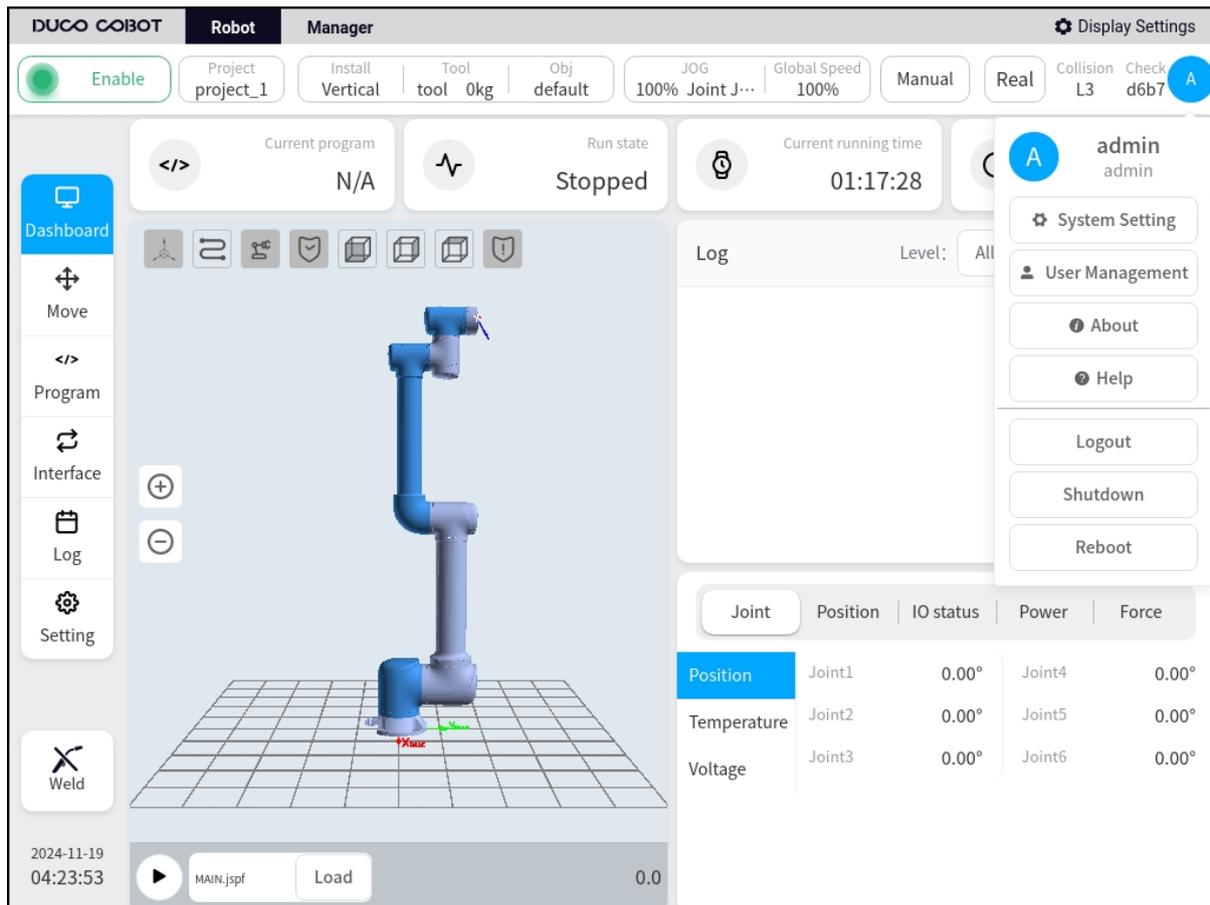
The Weld Process Package V2 plug-in package file is “weld.plugin” and the installation procedure is shown below:

1. Put the Welding Process Kit V2 plug-in package into a USB flash drive, the USB flash drive requires the format of FAT32.
2. After the robot system is started, insert a USB flash disk into the USB port on the robot control cabinet.

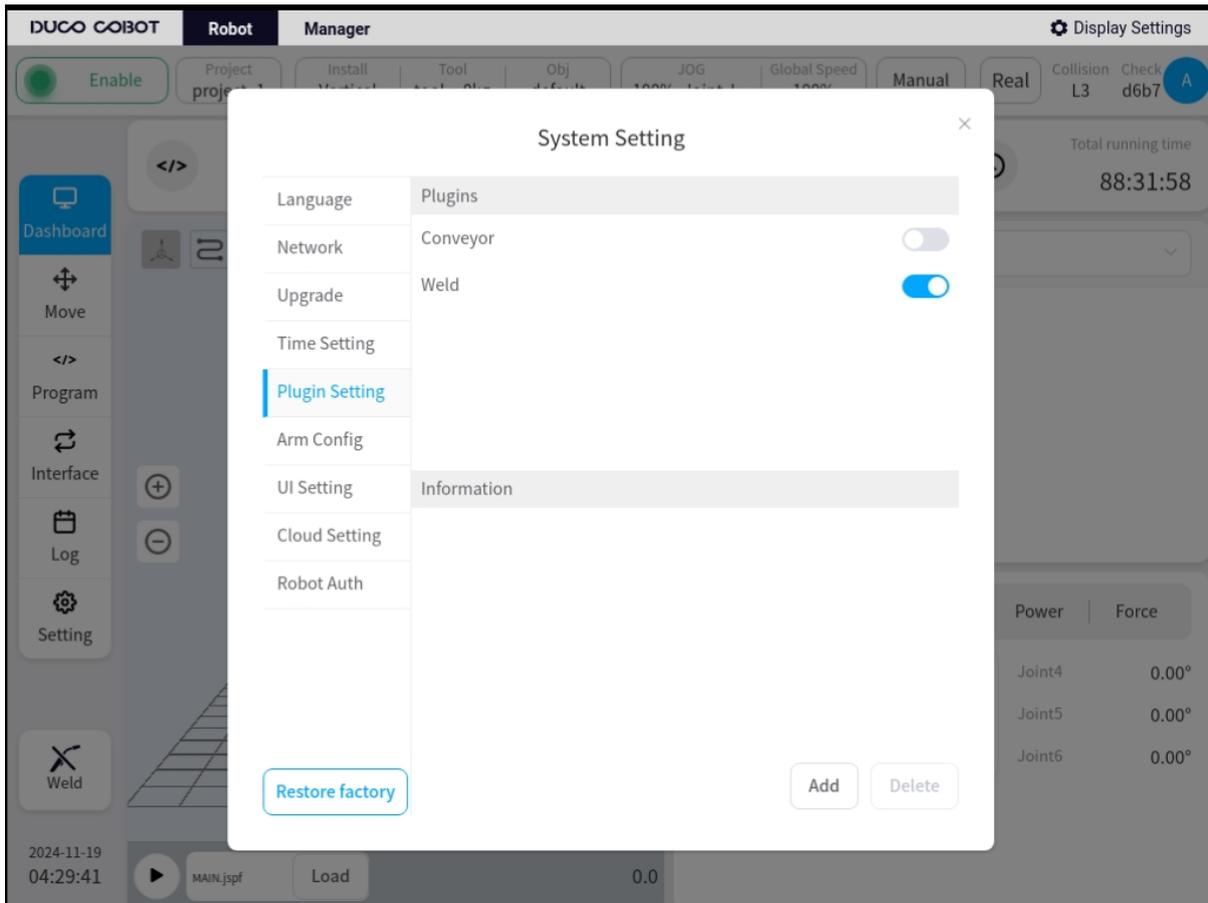


No	Port	No	Port
1	VGA&COM3/4	2	LAN1+USB3.0
3	LAN2+USB2.0	4	COM1
5	IO POWER(IO power supply)	6	SIO(safety IO)
7	DIO(Digital IO)	8	CIO(Configurable IO)
9	EIO(Function Expansion IO)	10	EtherCAT2
11	ON/OFF(Power On and off)		

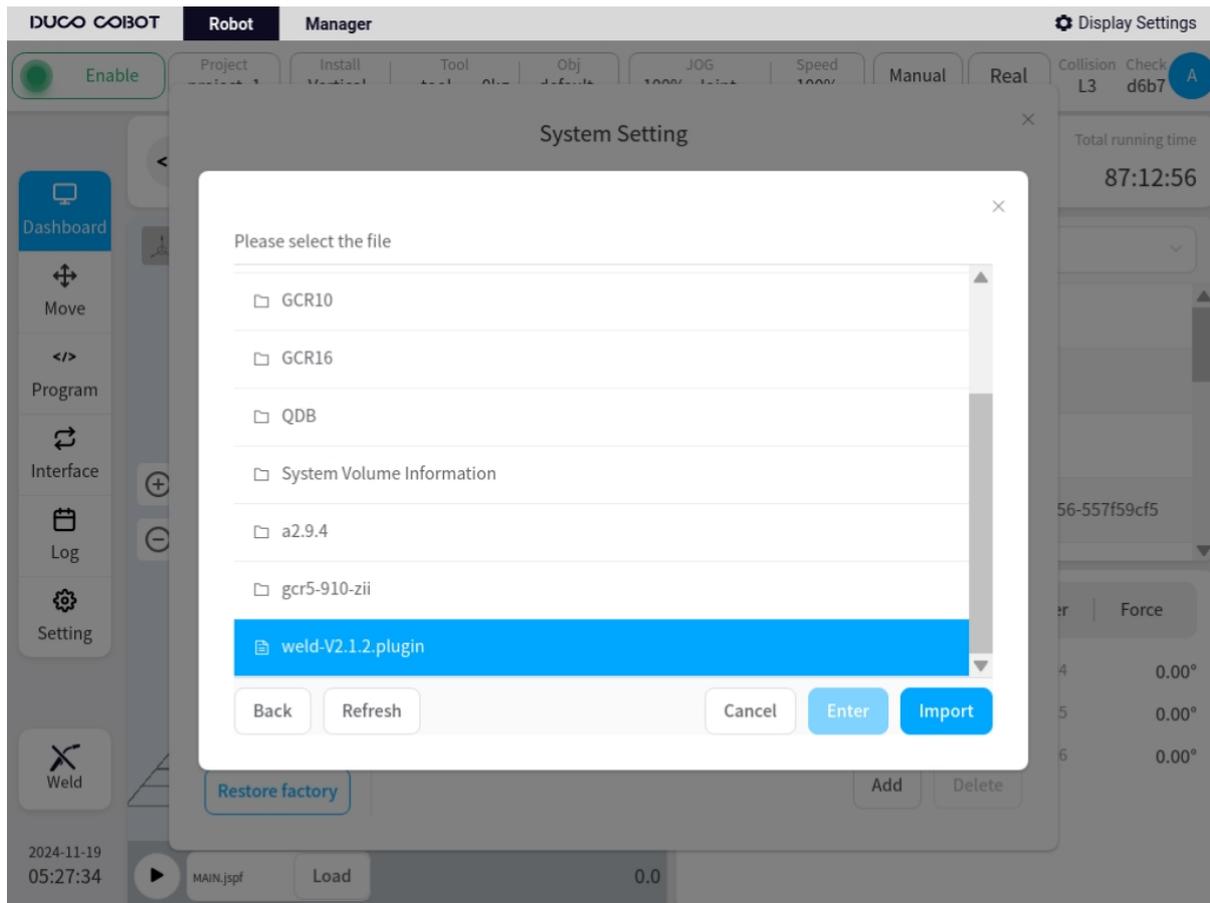
3. Login to the robot system using your admin account, click on the user avatar and select System Settings.



4. Select the plug-in management function, click the Add button.

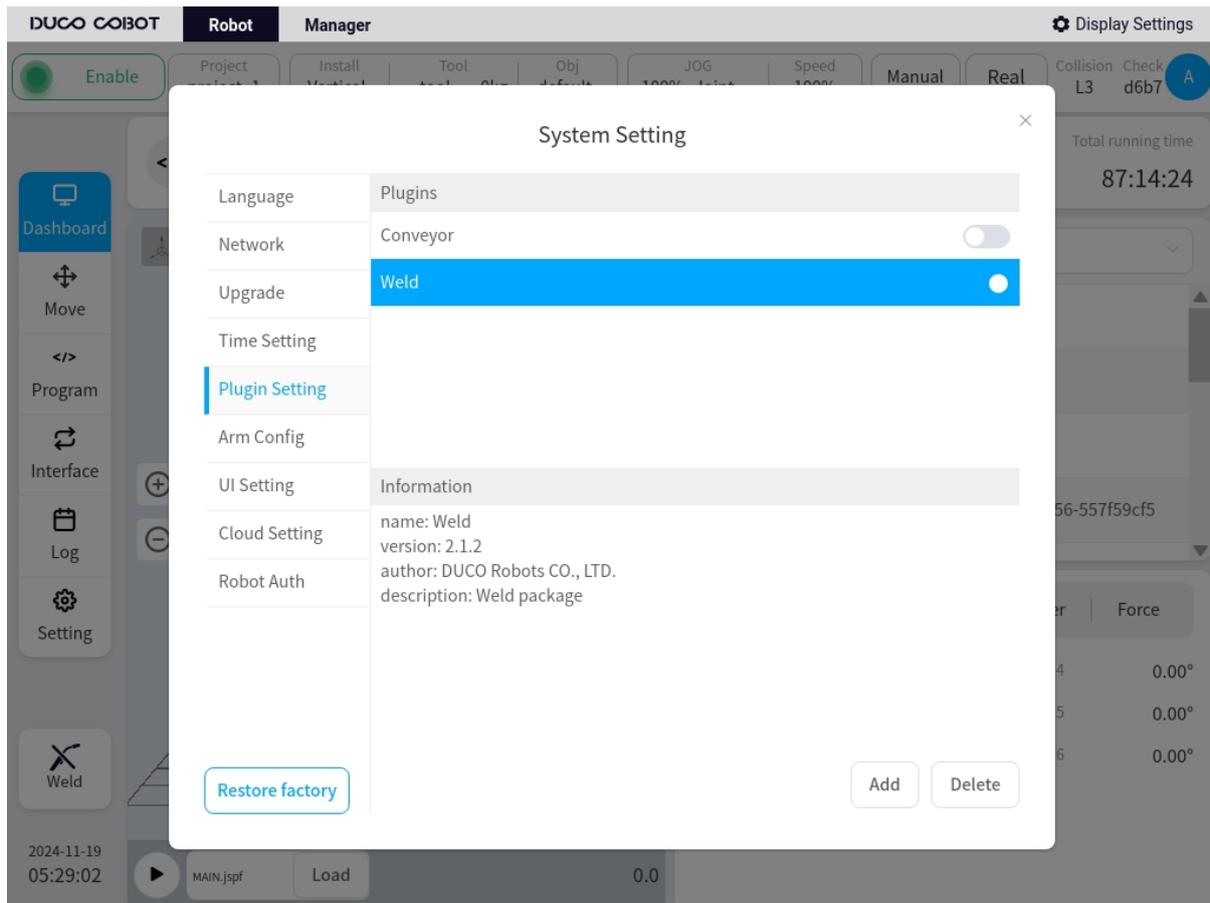


5. Select the USB flash drive and from the file list, find and select the “weld.plugin” package.

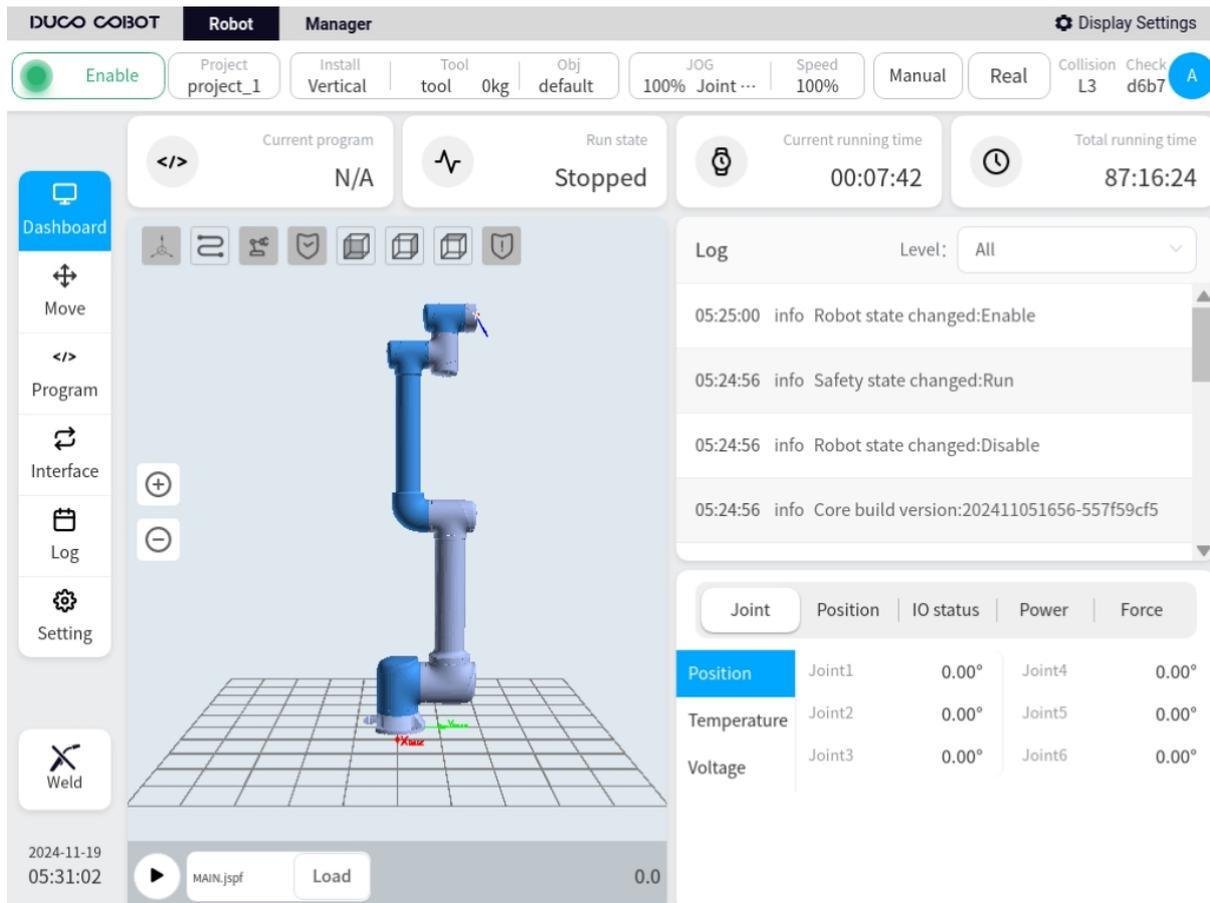


6. After the installation of the plug-in package is complete, as shown in the figure below, the top of the page will show a pop-up window plug-in package installation success.

And select the installed plug-ins in the region of the plug-in package, the bottom of the page details will show the name of the current plug-in package, version and other content.



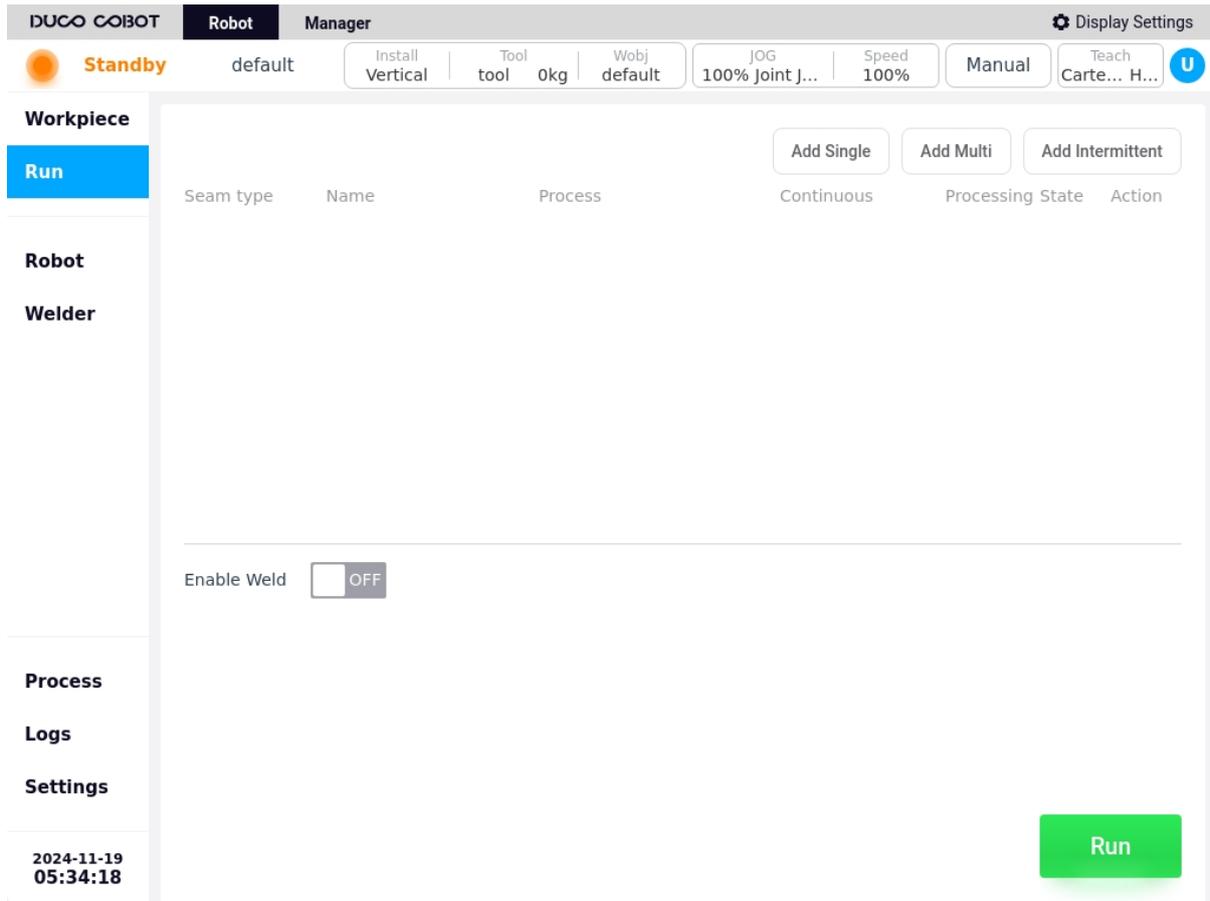
7. After the installation of Welding Process Pack V2 is completed, the Process Pack Setup Portal will appear on the lower left side of the main page.



8. Click on this Process Kit Setup Entry button to access the Welding Process Kit V2 login page.

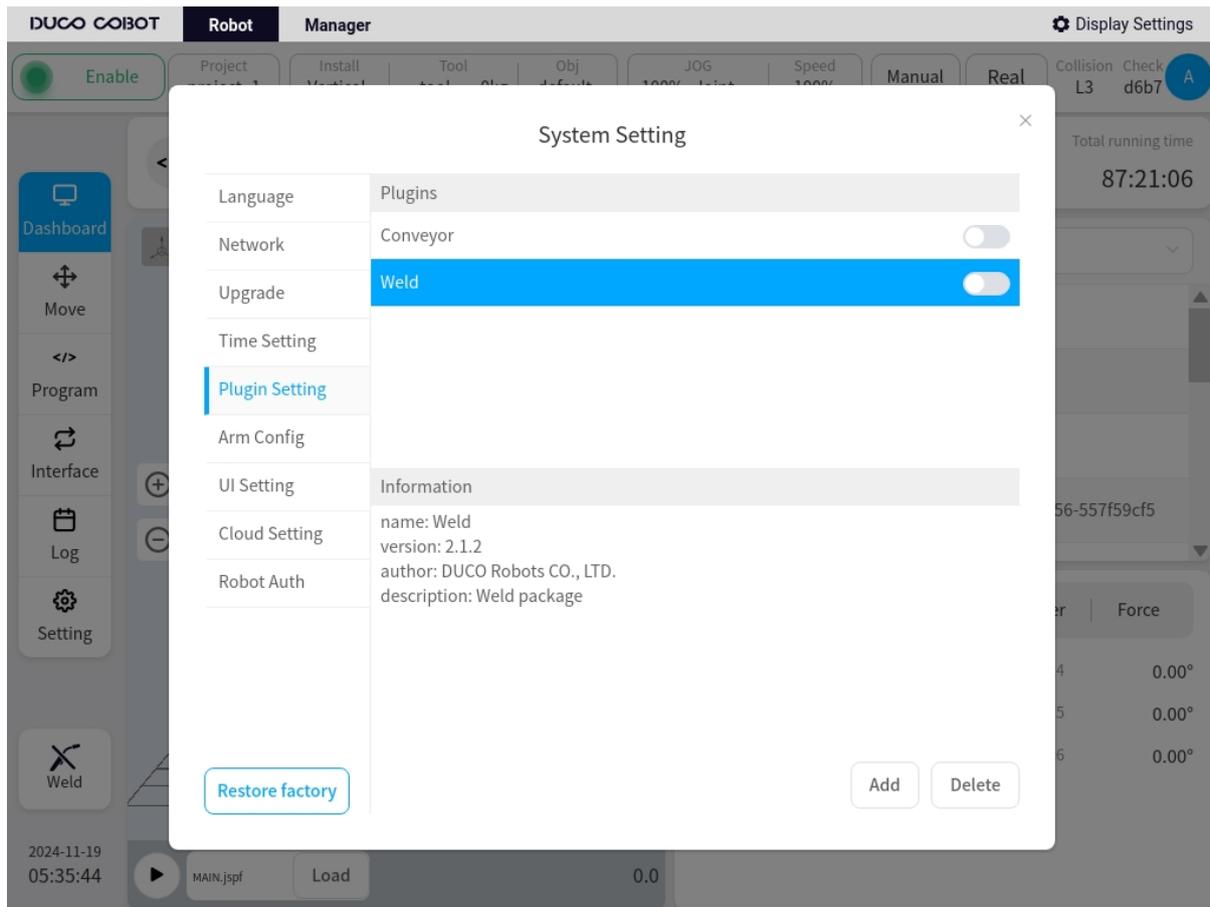


9. Click on the Login button to access Welding Process Kit V2 as shown below.



10. The installed Welding Process Package V2 can be temporarily disabled by going to the System Settings - Plug-in Settings page and turning off the enable signal.

Or click the Delete button to remove the plug-in package completely.

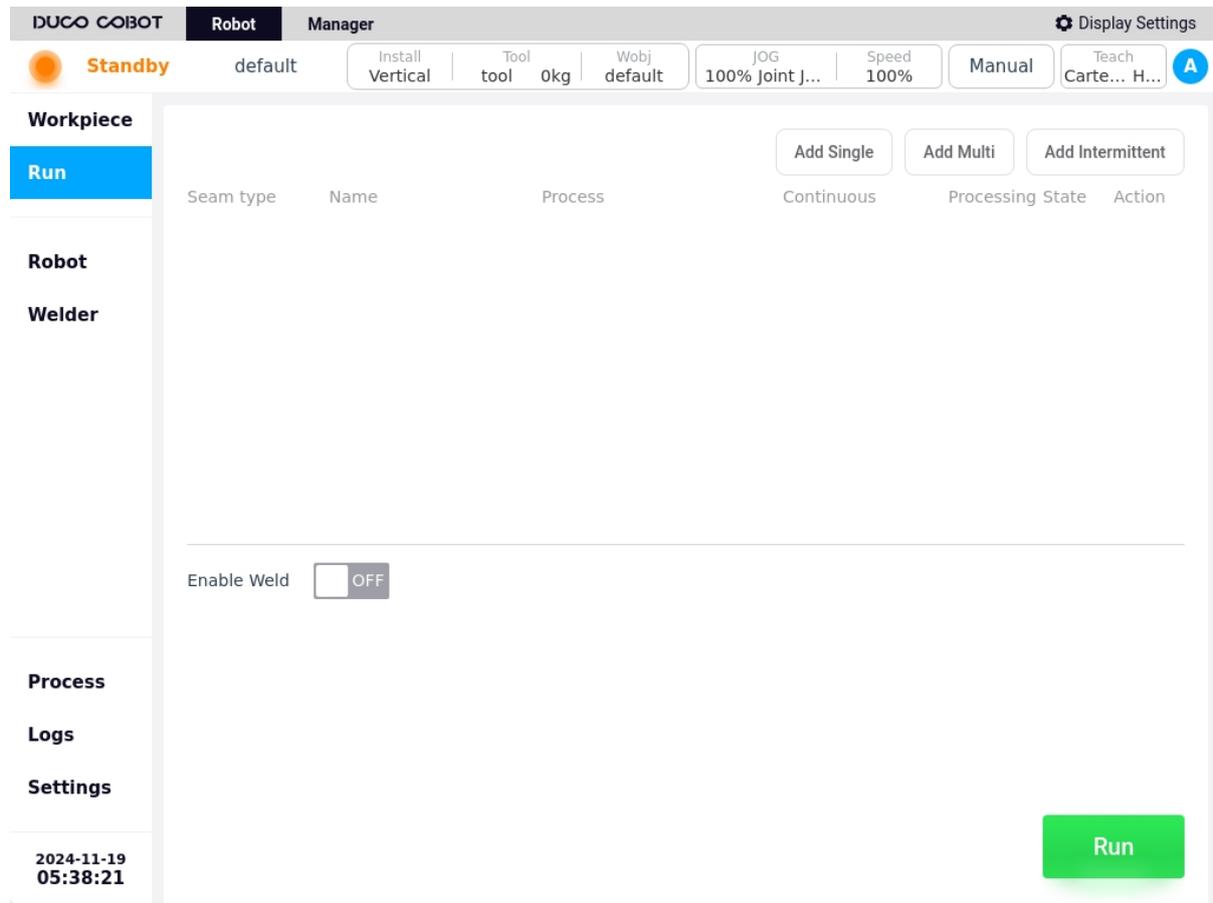


CHAPTER
TWO

STATION

2.1 Summarize

After successfully installing the Welding Process Pack V2 plug-in package, enter the Welding Process Pack V2 software interface. The overall interface of the software is divided into three main areas. The header status bar, the left navigation bar, the right side of the content area, the content area is based on the left side of the navigation bar to choose a different and display the corresponding content.



Status bar:

- Displays the status of the entire station, including robot status, welding power supply status, external axis status, and the corresponding operation buttons;
- Displays the name of the currently open artifact;
- Displays the robot's mounting direction and the coordinate system currently in use;

- Displays JOG speed and type, global speed;
- Displays the mode of operation, i.e., manual mode or automatic mode;
- Displays the currently active traction mode;
- The user's avatar is displayed and clicking on it displays a drop-down system menu.

Navigation bar:

It mainly includes workpiece management, weld execution, robot control, welder control, process library, task log, basic settings and time display.

Content area:

The content is displayed depending on the selection of the left navigation bar.

2.2 Status bar

The interface header status bar is shown below:

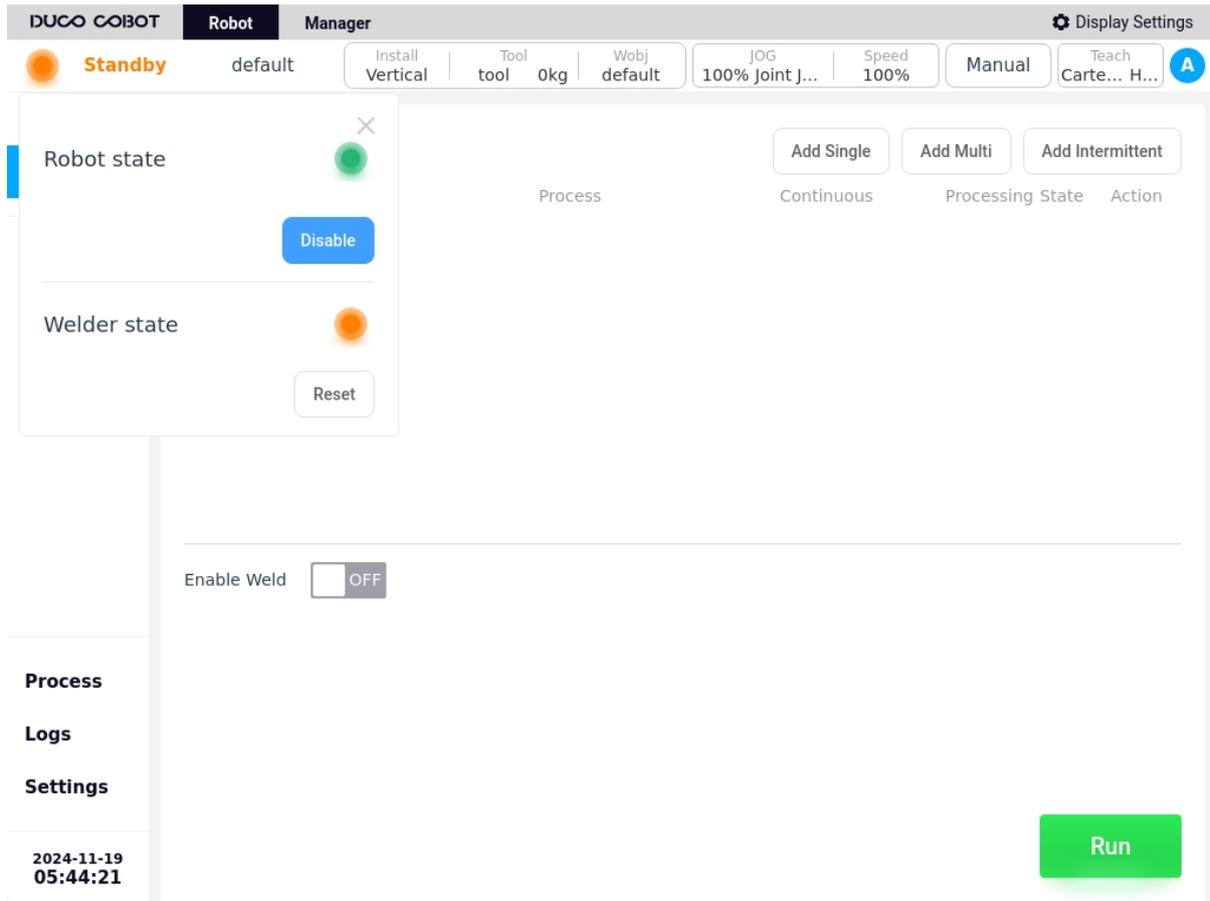


Status indicators:

There are three indicator light colors: red, orange, and green. When the robot is not enabled or the welder is in an error state, the indicator is red; When the robot is enabled and the welder is ready, the indicator is orange; when the program is running, the indicator is green.

Status display:

The status display words are: Robot Not Enabled, Welder Fault, Welding, Running, and Standby. By clicking on the status indicator or any area of the status display, a pop-up box will appear as follows. A pop-up box will appear as follows, allowing you to display or operate the robot status, welder power status, and external axis status.

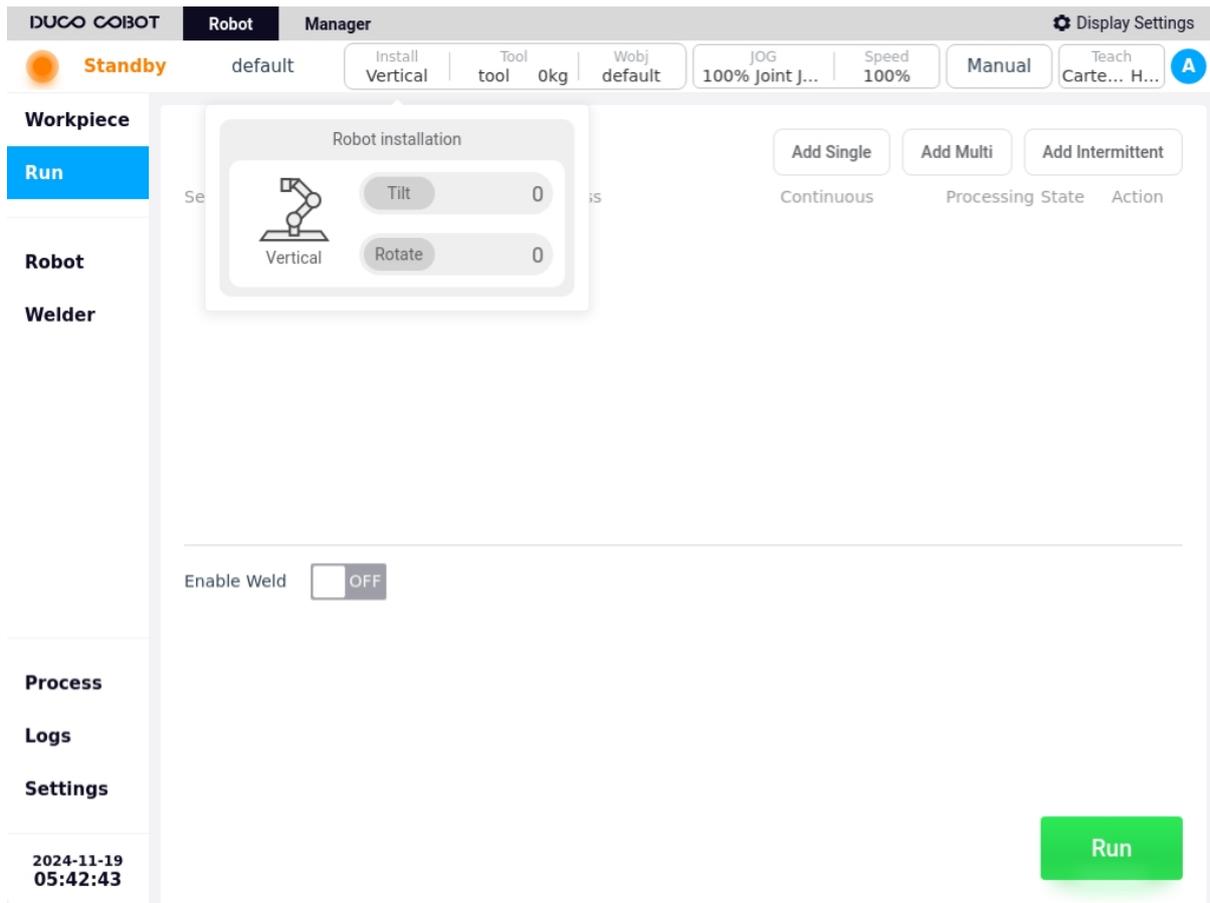


Name of workpiece:

Displays the name of the currently open artifact.

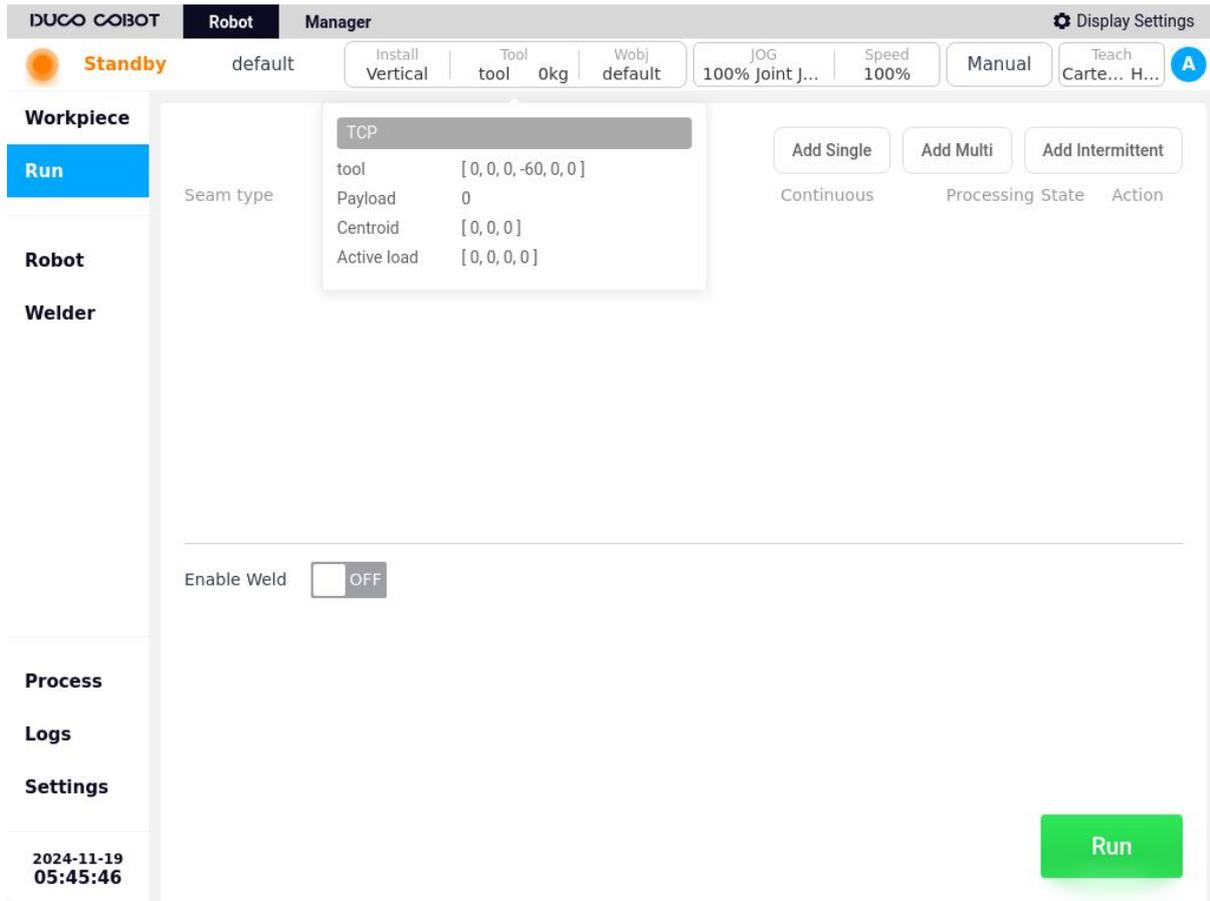
Installation:

Displays the current mounting direction of the robot and a description of the mounting position. Click the Mounting display box to display the Robot Mounting Orientation and Mounting Position Description information pop-up box, as shown in the figure.



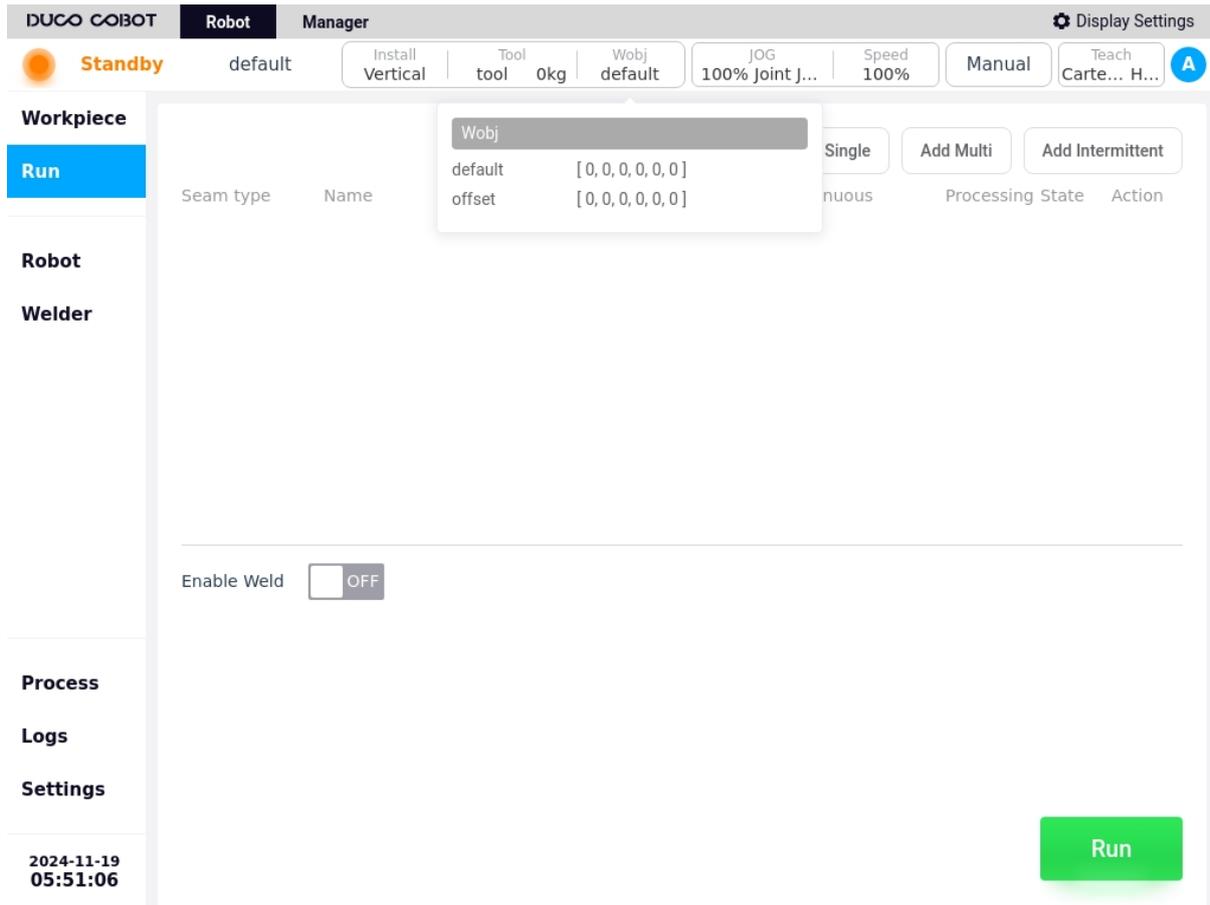
Tools:

Displays the name of the robot’s current tool coordinate system and load mass. Click the Tools display box to display a pop-up box with information about the robot’s tool coordinate system, as shown in the figure.



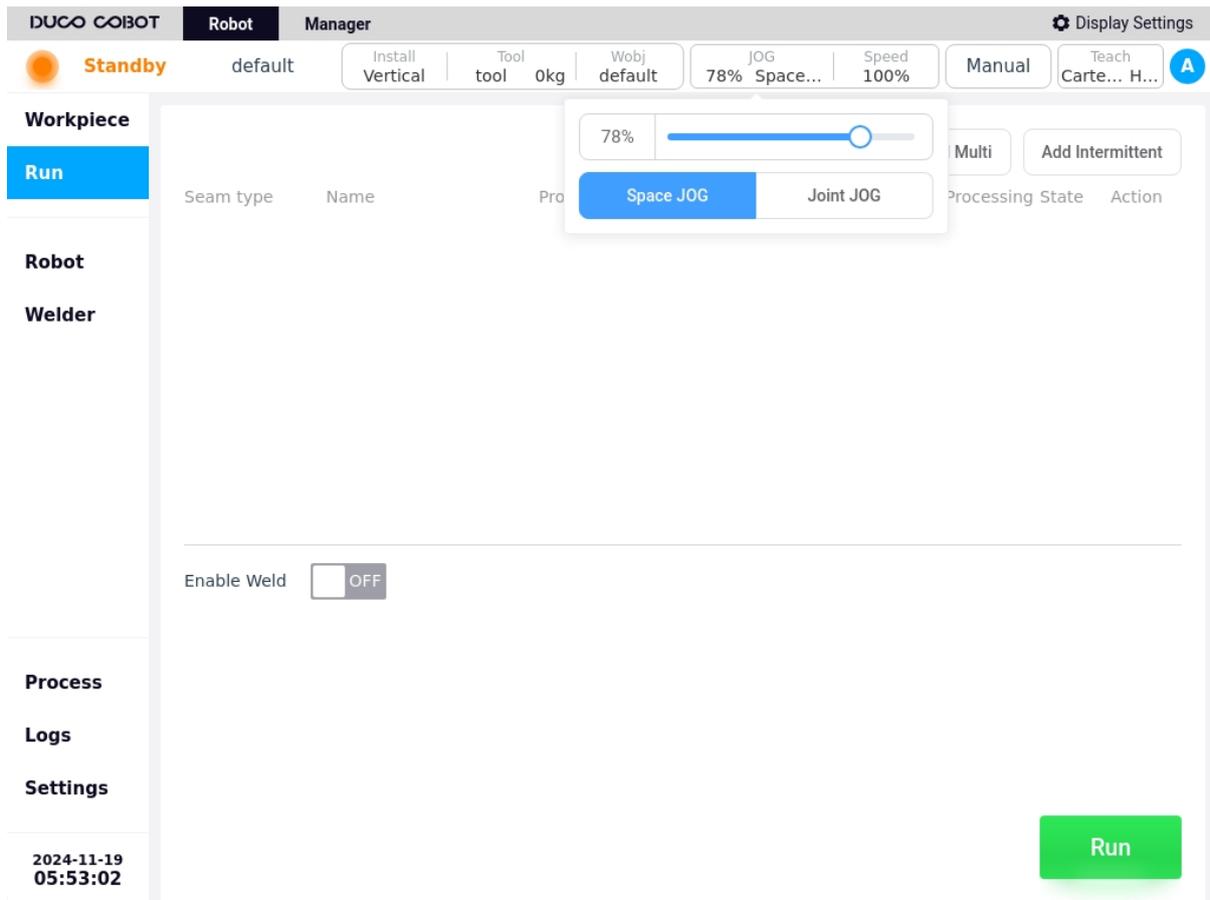
Workpieces:

Displays the name of the current workpiece coordinate system of the robot. Click the Workpiece display box to display a popup box with information about the robot’s workpiece coordinate system, as shown in the figure.



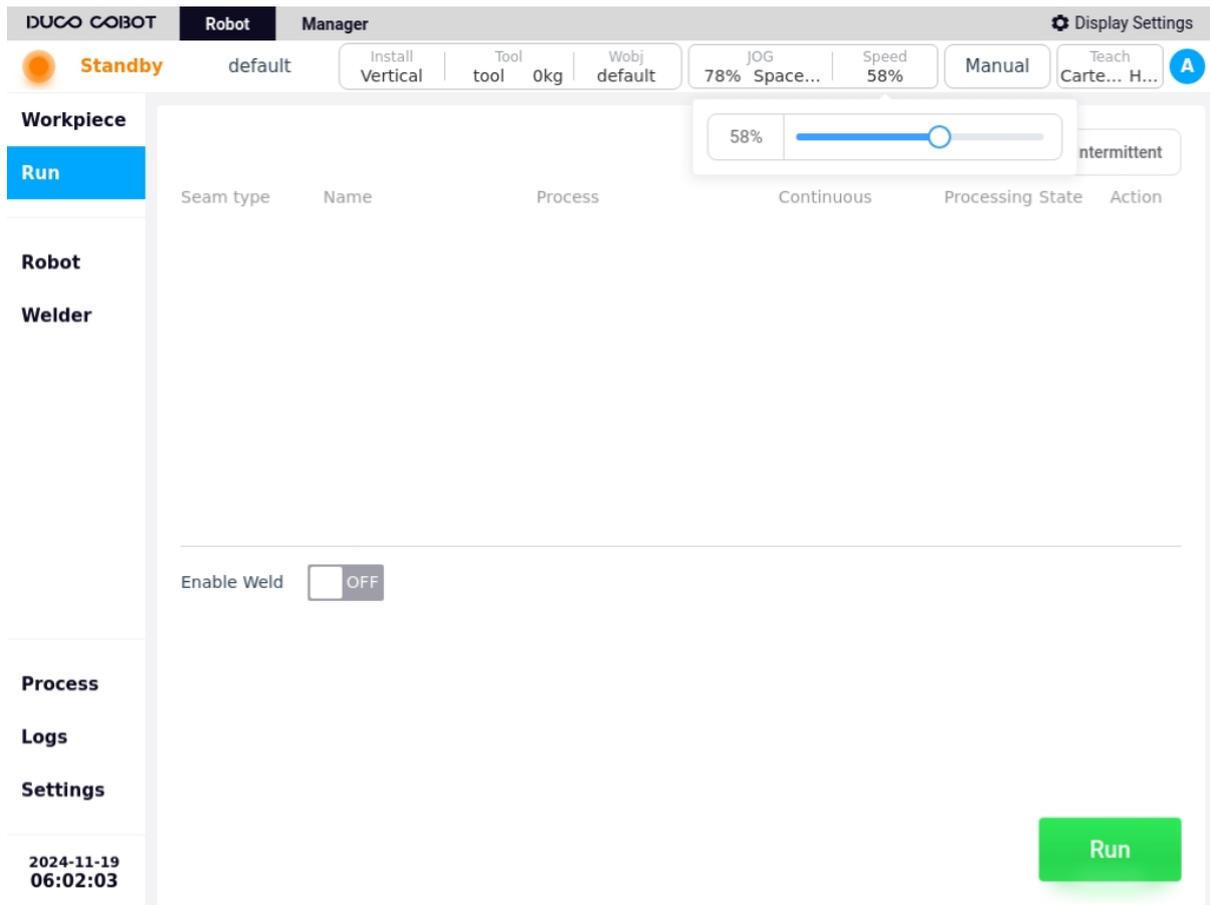
JOG speed/type:

Displays the robot's current JOG speed percentage or JOG type, i.e., Articulated JOG or Spatial JOG. clicking on the JOG display area displays a pop-up box showing the JOG speed adjustment slider and the JOG type selection button, which allows you to adjust the JOG speed or manual input, as well as to switch between spatial JOG or articulated JOG.



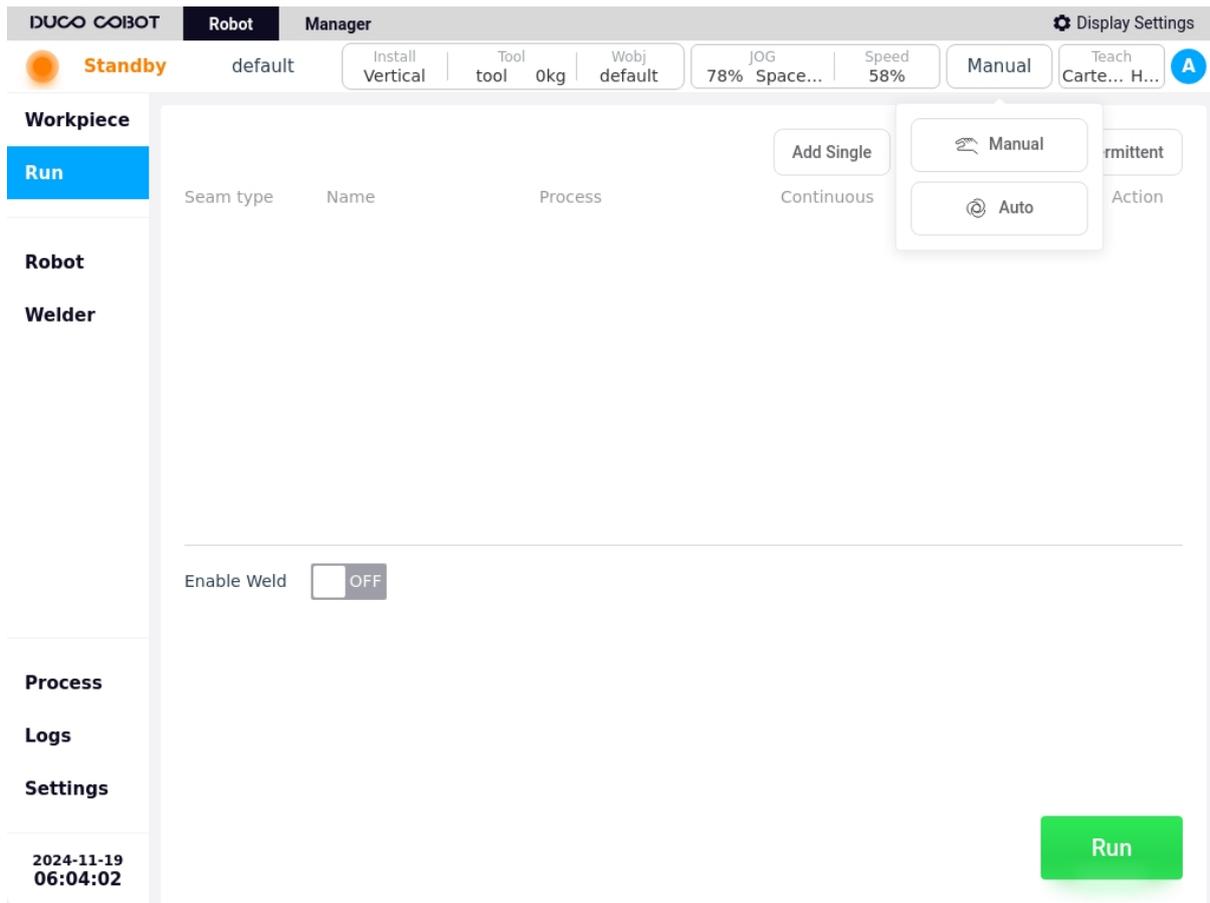
Global speed:

Displays the percentage of the robot’s current global speed. Click the Speed Display box to display the Speed Adjustment slider, which allows you to adjust the global speed or enter it manually.



Mode of operation:

Displays the robot operation modes, which are manual mode and automatic mode. When you click this display box, a popup box containing buttons for manual mode and automatic mode is displayed. The operation mode can be switched by clicking the corresponding button. When the user switches between manual/automatic mode, the user needs to enter the correct password before switching modes.

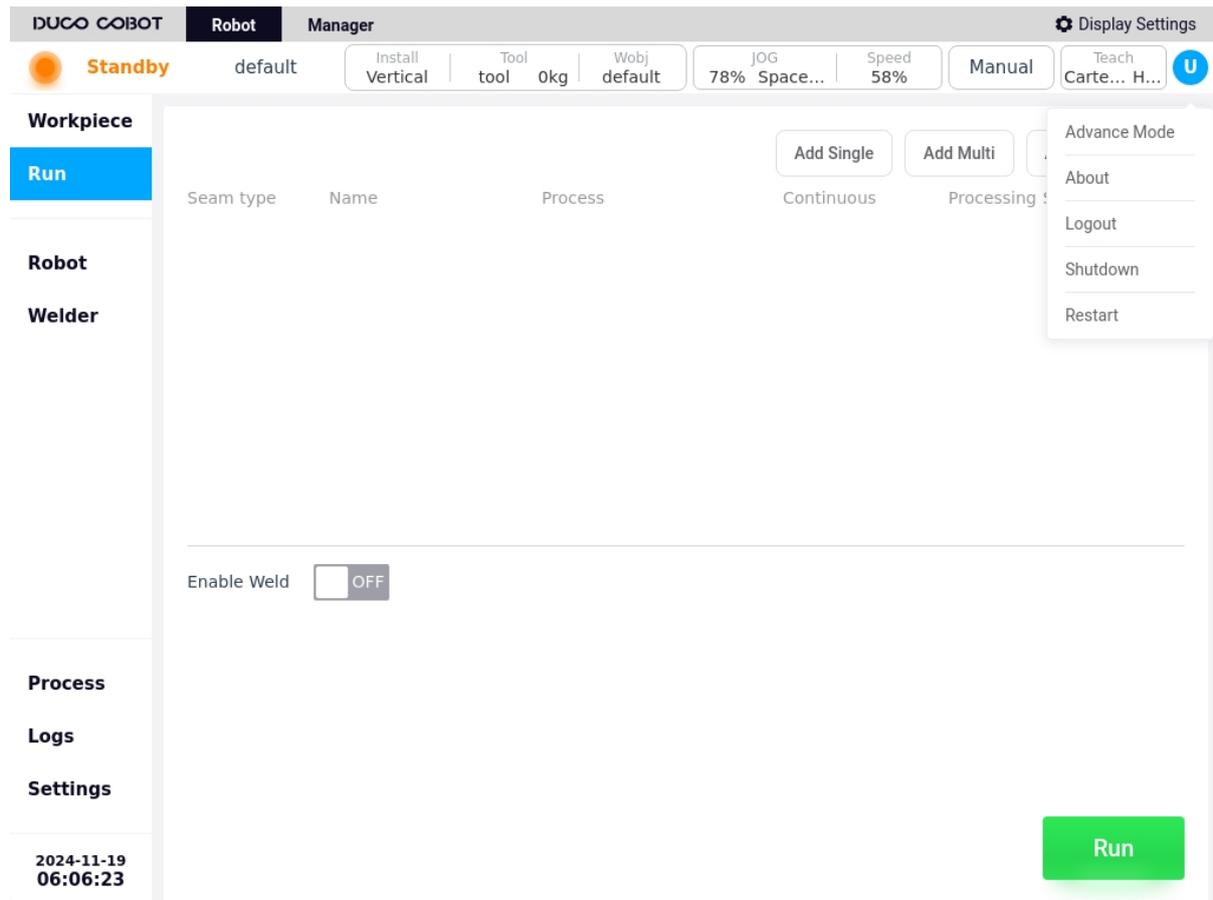


Traction mode:

Displays the currently active mode when using the joystick. Includes Articular Traction/Cartesian Traction; High Speed Traction/Low Speed Traction. The user can use the buttons on the joystick to switch between modes.

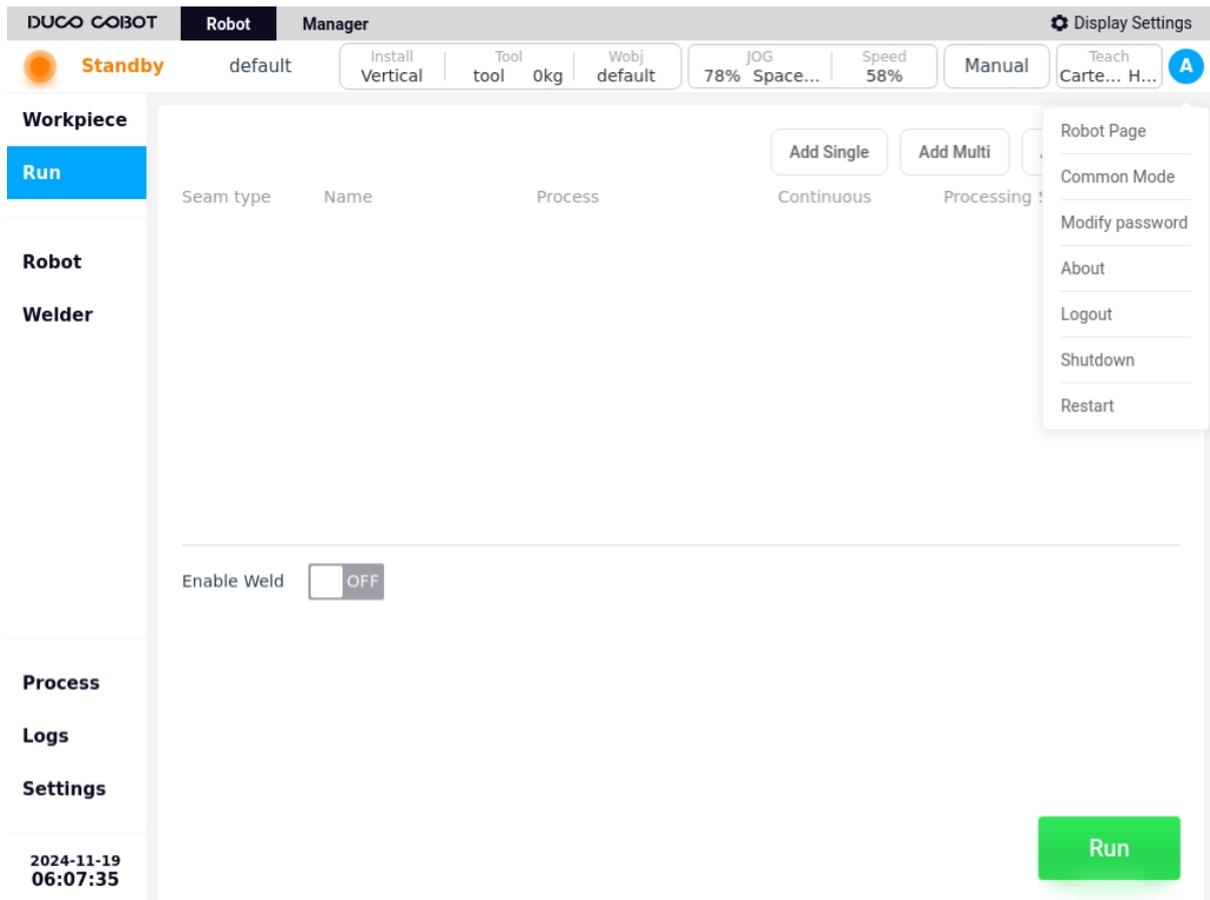
User avatar:

The default login to the craft kit is normal mode and clicking on the user’s avatar displays the pop-up window shown below.



- **To switch to Advanced Mode:** Clicking Enter Password will enter Advanced Mode;
- **About:** Displays information about the robot model, software version, and process package version;
- **Logout:** Click to return to the Welding Process Kit V2 startup page;
- **Reboot:** Clicking while the robot is powered off will bring up a dialog box confirming the shutdown of the system; while the robot is not powered off it will prompt to power off first;
- **Shutdown:** When the robot is powered off, clicking will bring up a dialog box confirming the restart of the system; when the robot is not powered off, it will prompt to power off first;

In advanced mode, clicking on the user’s avatar displays the image shown below.

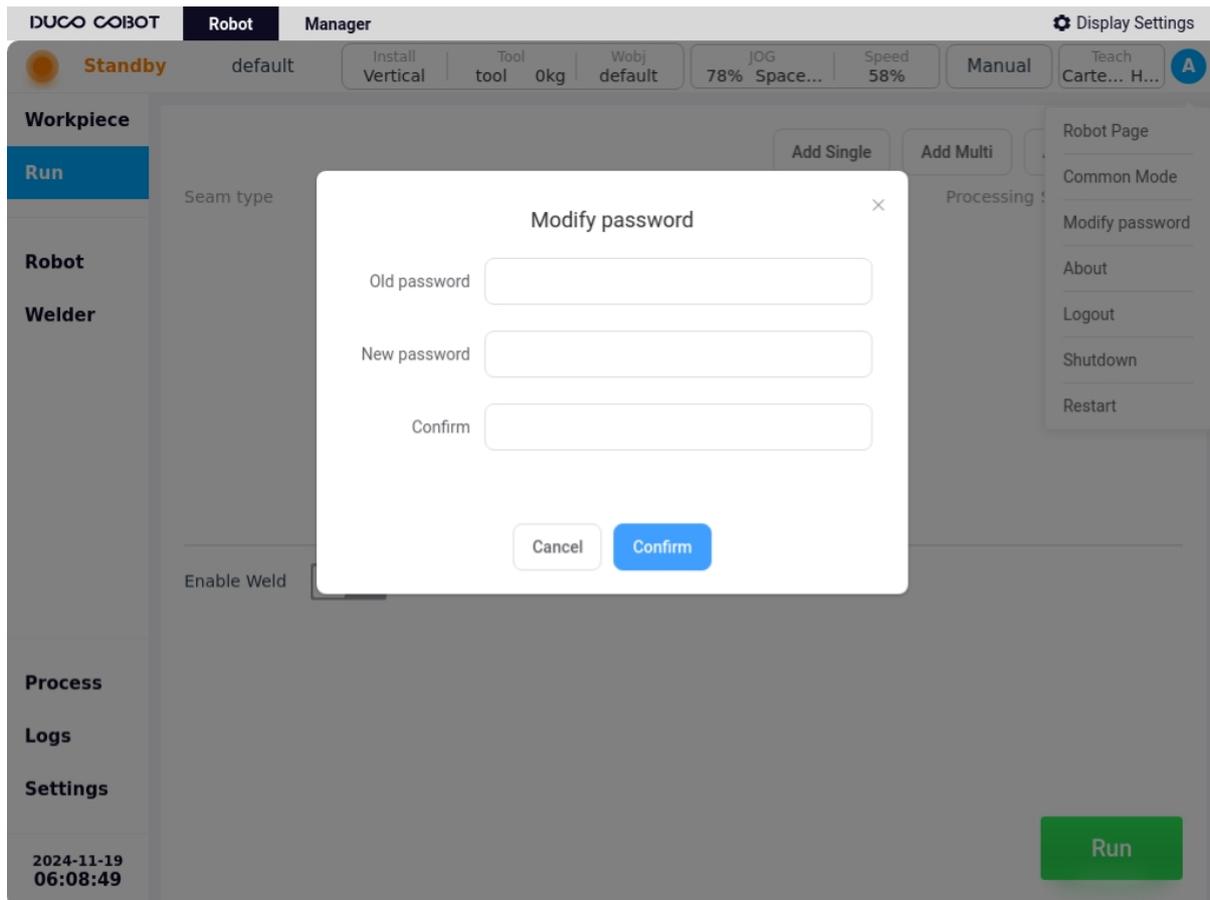


- **To switch the normal mode:** Click to go directly to the advanced mode;

About, logout, shutdown, and restart functions are the same as those in normal mode.

Functions specific to Advanced Mode:

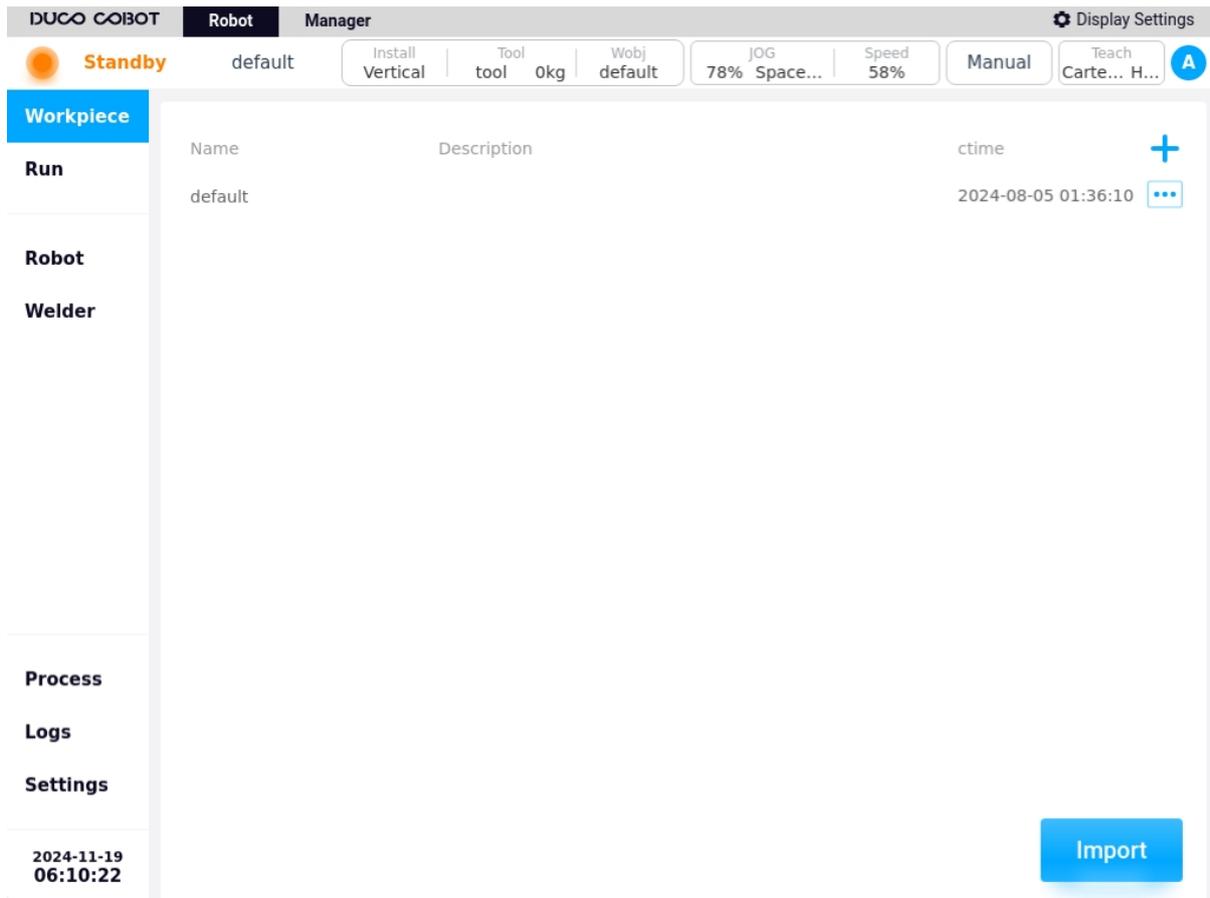
- **Back to Robotics:** Click to go directly to the Robotics System page;
- **Change Password:** Click to bring up a dialog box to change your password;



User Mode for the difference between advanced and normal mode, see “User mode”

2.3 Workpiece management

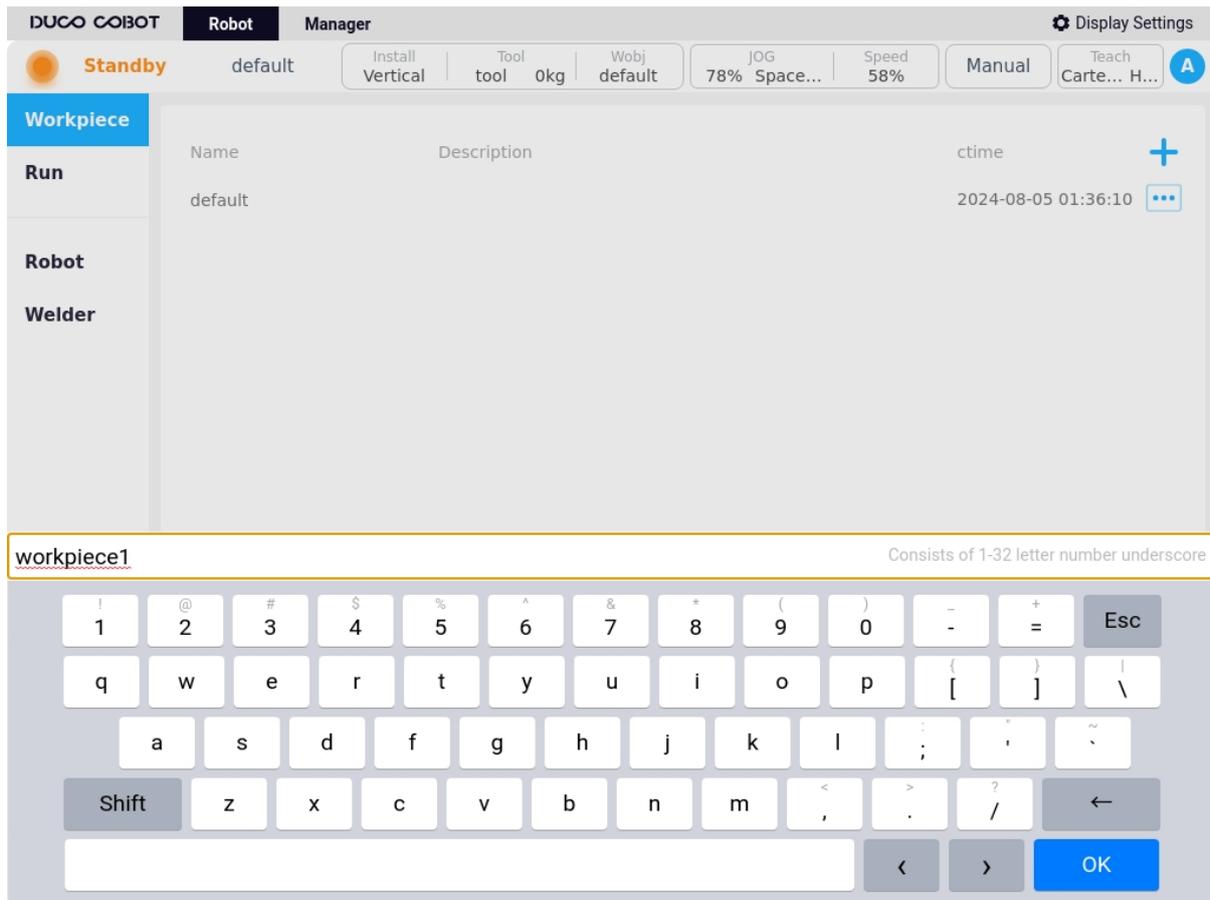
Click “Workpiece Management” in the navigation bar to enter the workpiece management page, as shown in the following figure.



The artifact management page is used to manage all artifacts in the currently active project. A default artifact named default is created when the system is initialized.

The artifact list displays the artifact name, description, and creation time, as well as the new artifact icon

and the artifact operation icon . Click on the icon  to bring up the keyboard and enter the name of the artifact, e.g., “W1”, as shown in the following figure.



Click the keyboard “OK” button, you can add a successful, as shown below.

DUCO COBOT
Robot Manager
Display Settings

Standby
default

Install Vertical
Tool tool 0kg
Wobj default

JOG 78% Space...
Speed 58%

Manual
Teach Carte... H...
A

Workpiece

Run

Robot

Welder

Process

Logs

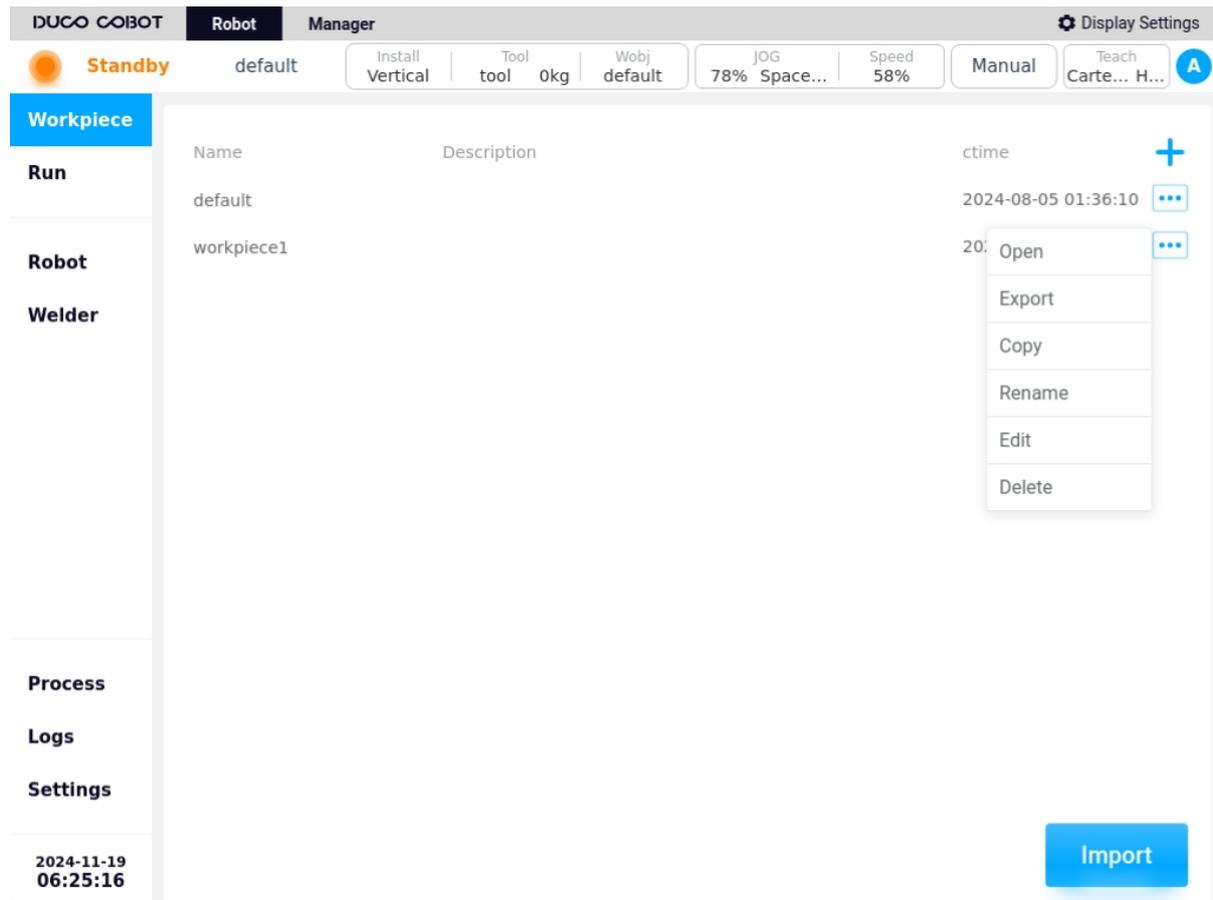
Settings

2024-11-19
06:23:23

Name	Description	ctime	
default		2024-08-05 01:36:10	+
workpiece1		2024-11-19 06:13:32	⋮

Import

Click the operation icon  of any artifact in the artifact list, and the popup window will be displayed as follows.

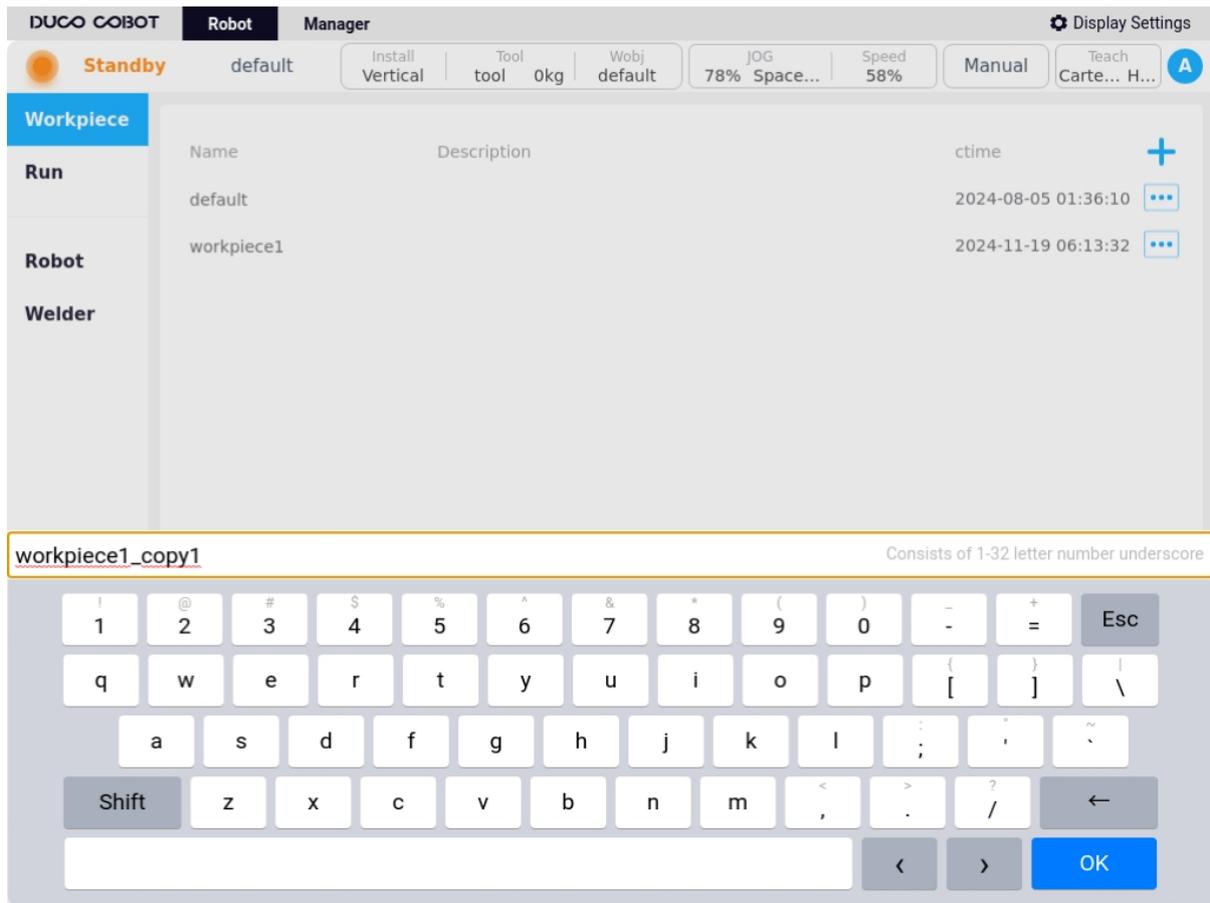


Workpiece operating functions:

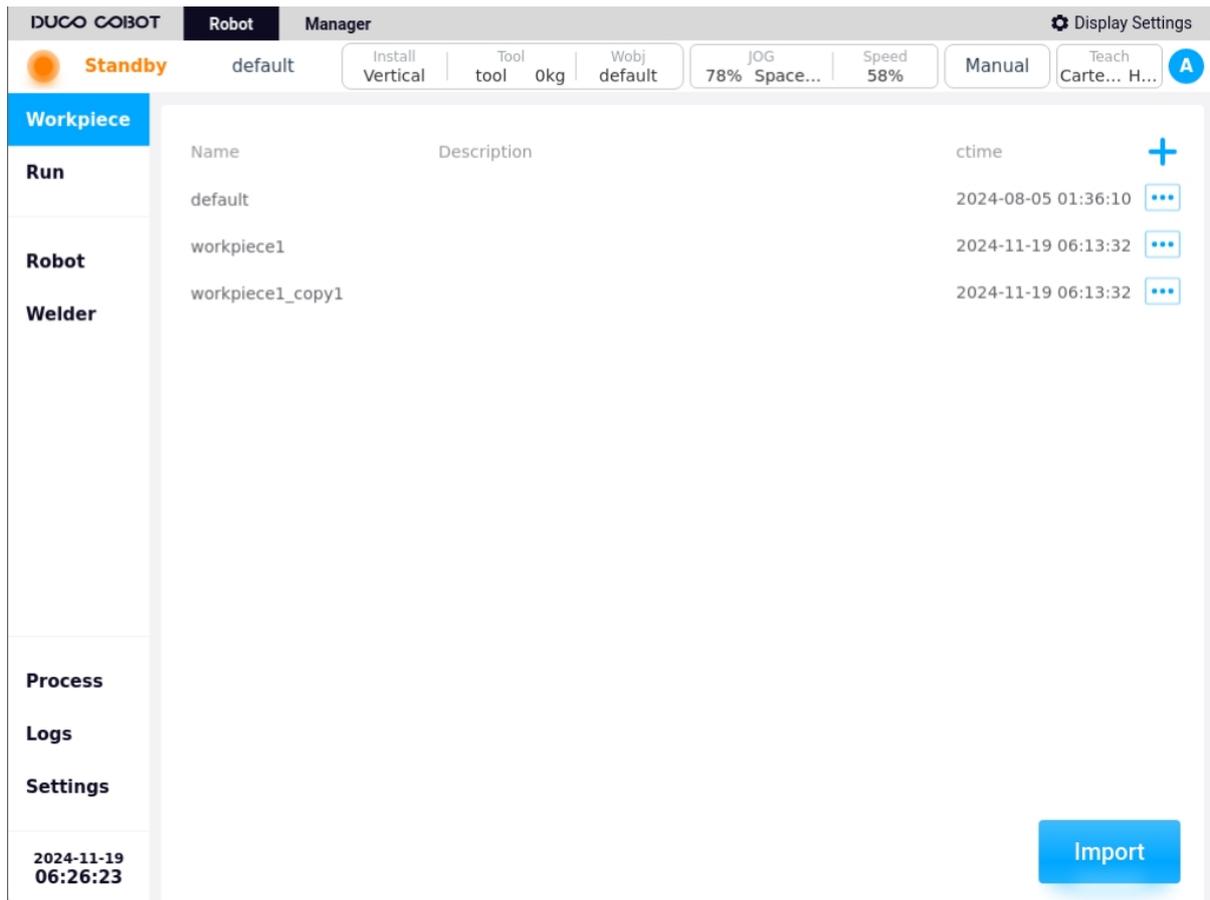
- **Open:** Clicking “Open” will bring up a dialog box, indicating that the currently used workpiece will be closed, and confirming whether to open the workpiece; Click the dialog box “Confirm” button will switch to the new workpiece, and the page will automatically jump to the welding execution page; click the dialog box “Cancel” button to close the dialog box.

Note: Note: The currently opened workpiece will be automatically set as the default workpiece to be opened next time the machine is turned on.

- **Export:** Click “Export” to export the workpiece program to a USB flash drive.
- **Copy:** Clicking “Copy” will bring up the keyboard, and the name of the copied artifact will be suffixed with “_copyxx” by default, as shown below. Users can also modify and rename according to the artifact naming rules.



Click the keyboard “OK” button to copy successfully, the display is as follows.



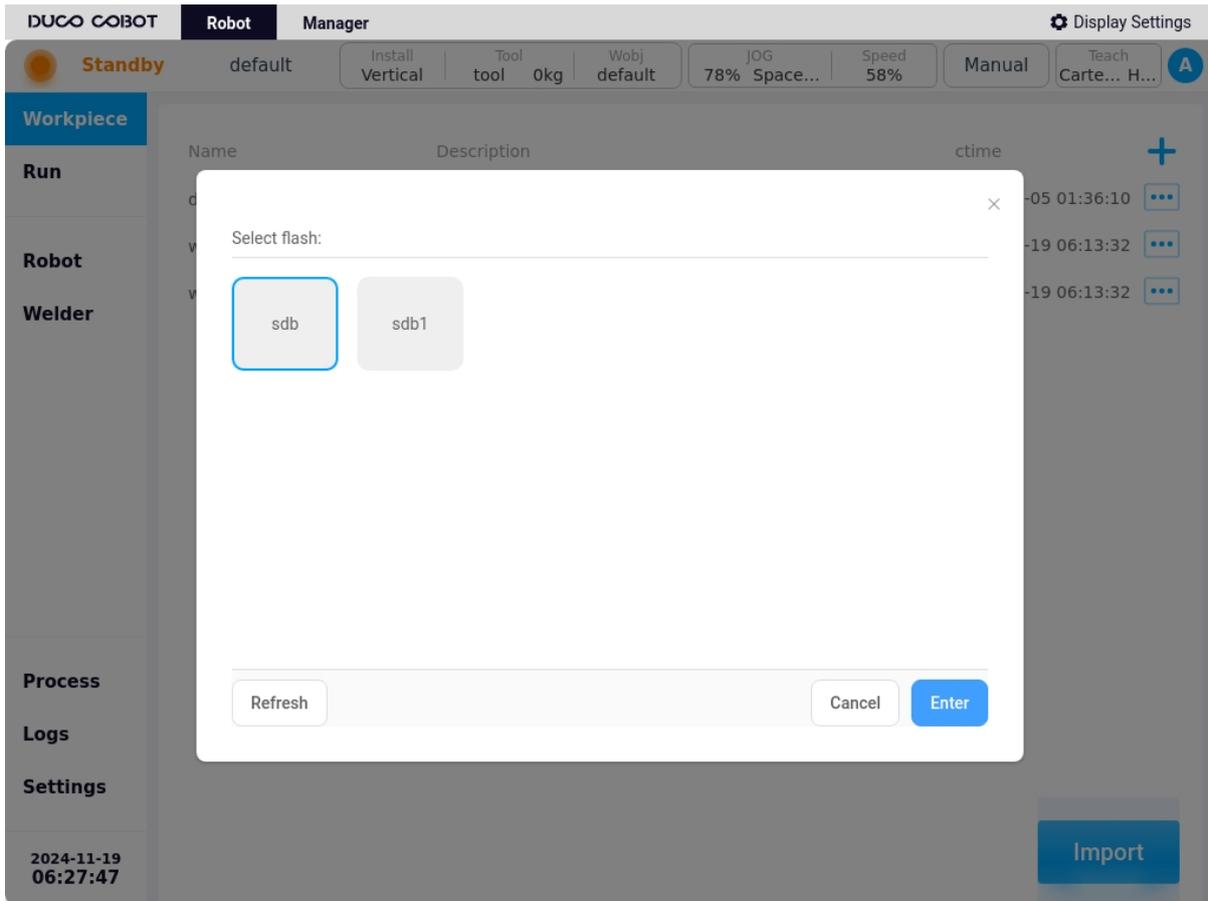
- **Rename:** Click “Rename” will pop up the keyboard, enter the new name of the artifact, then OK to modify.

Note: Note: Opened artifacts cannot be renamed.

- **Modify Description:** Clicking on “Modify Description” brings up the keyboard to add descriptive text to the artifact.
- **Delete:** Clicking “Delete” will bring up a confirmation dialog box, and the workpiece can be deleted after confirmation.

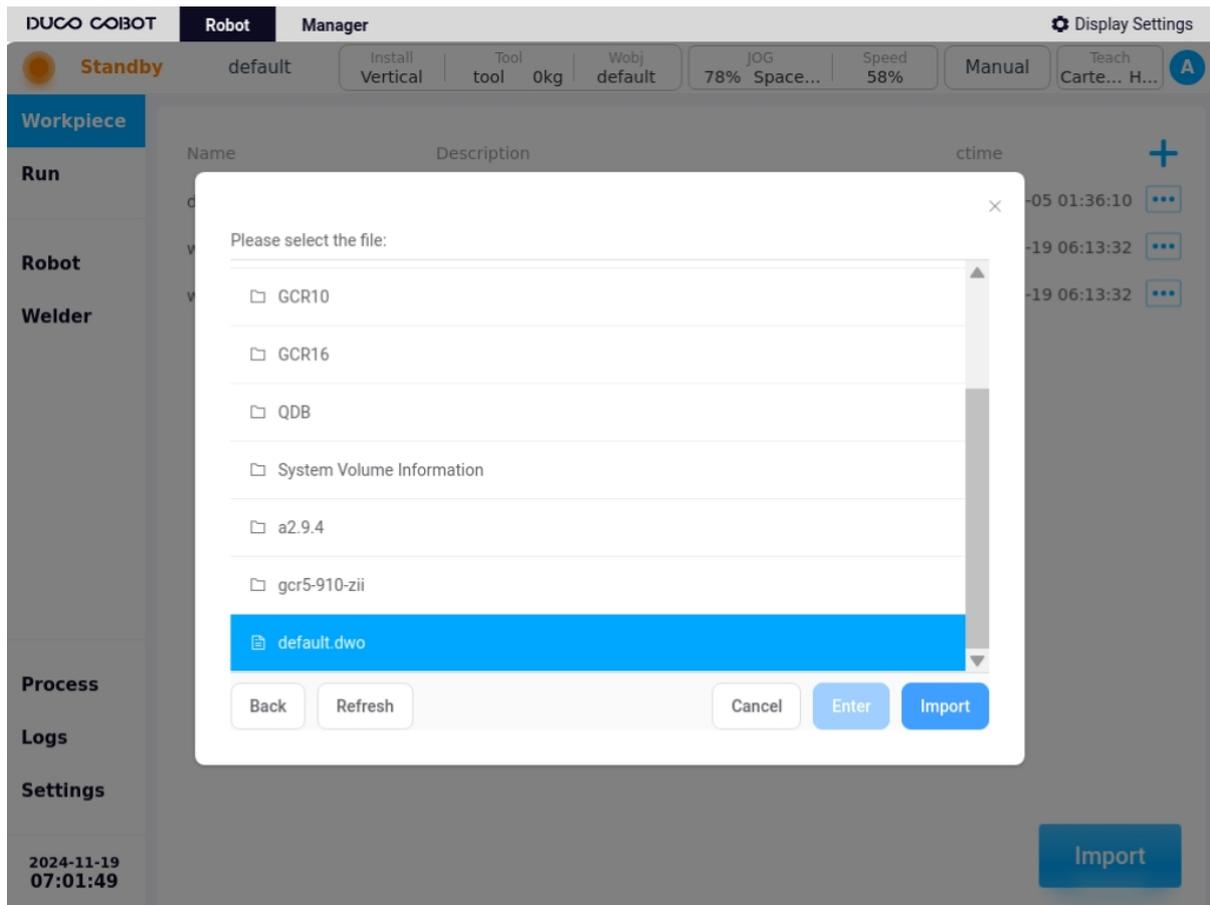
Note: Note: Opened artifacts cannot be deleted.

Click the “Import” button at the bottom right corner of the page to bring up a window showing the USB storage devices currently mounted on the control panel, as shown in the following figure.

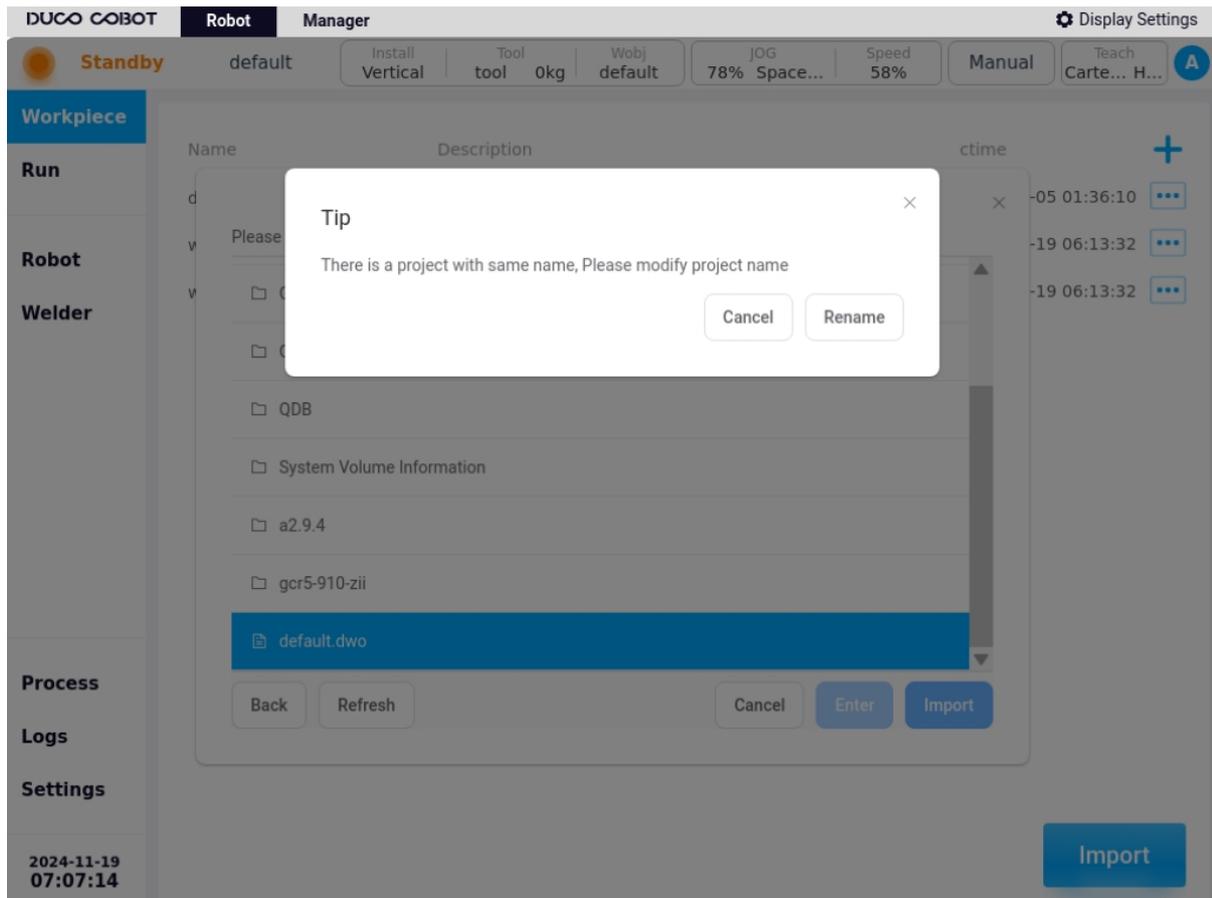


Select a device and the page displays the folders and eligible files (with dwo suffix) in that device, as shown in the following figure. Select a file.

Click on the “Import” button and the file will be imported into the control panel.



When importing a file and checking that the imported file is renamed to an artifact on the control cabinet, a rename prompt box will pop up as shown below.



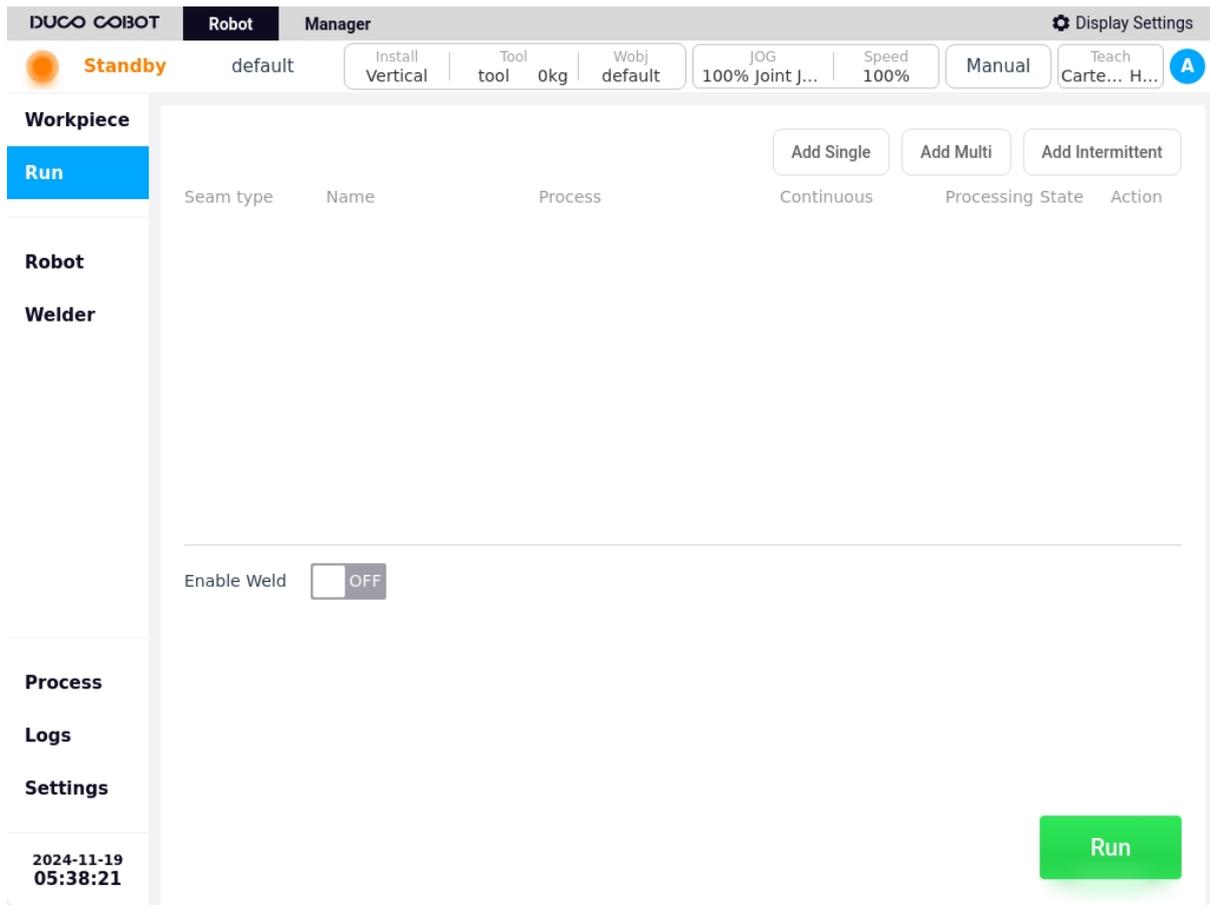
Click the “Change Import Name” button, the keyboard will pop up, enter the new name of the artifact, such as enter “w1”, after the import is successful, it will be displayed as below.

The screenshot shows the 'Robot Manager' interface for a DUCO COBOT. The status is 'Standby'. The current program is 'default'. The interface includes a navigation bar with 'Workpiece', 'Run', 'Robot', and 'Welder' sections. The 'Workpiece' section is active, displaying a table with columns for Name, Description, and ctime. The table lists four workpieces: 'default', 'w1', 'workpiece1', and 'workpiece1_copy1'. Each entry has a timestamp and a menu icon. An 'Import' button is located at the bottom right. The bottom left corner shows the date and time '2024-11-19 07:08:37'.

Name	Description	ctime	
default		2024-08-05 01:36:10	⋮
w1		2024-08-05 01:36:10	⋮
workpiece1		2024-11-19 06:13:32	⋮
workpiece1_copy1		2024-11-19 06:13:32	⋮

2.4 Welding execution

Click “Run” in the navigation bar to enter the Weld Execution page, as shown below.

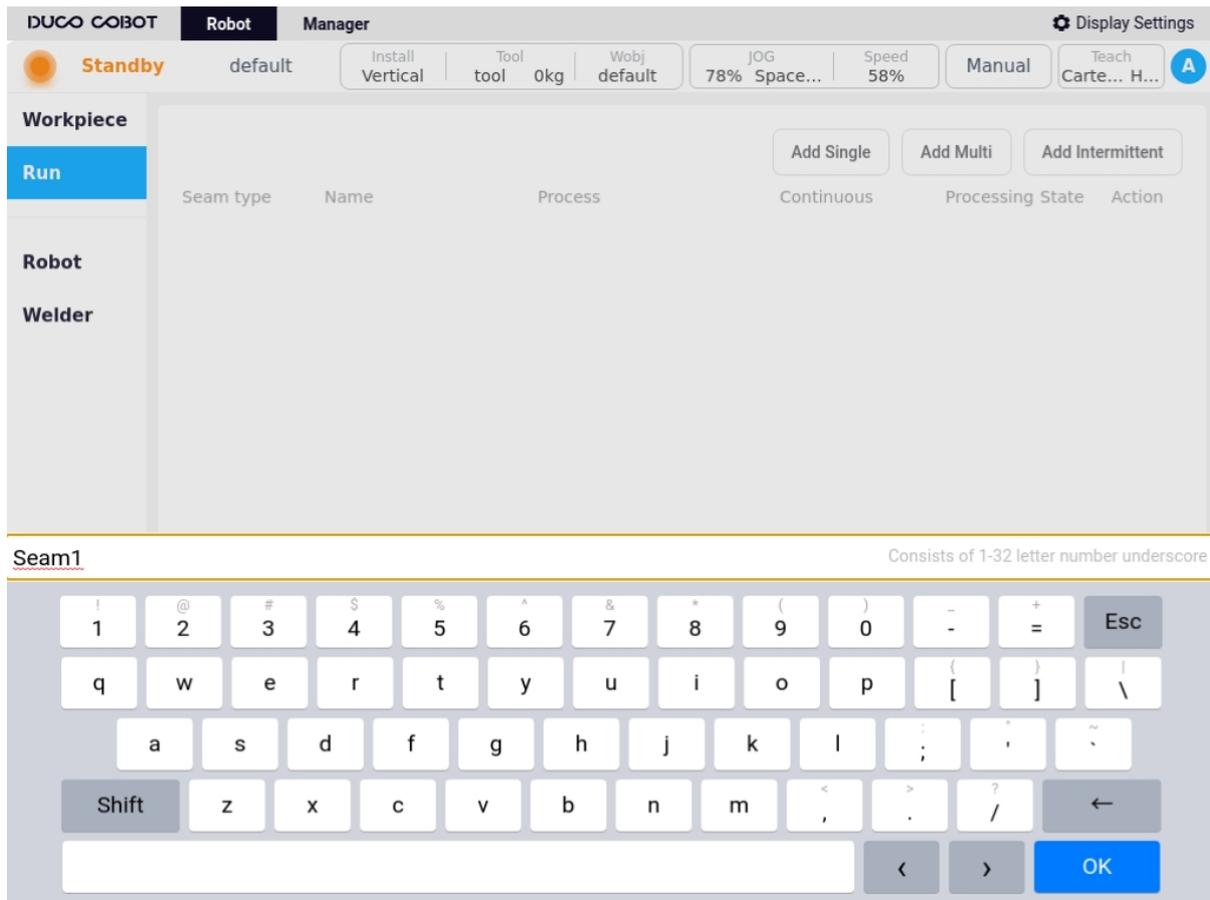


The Weld Execution page is mainly used for adding weld seams, creating weld tasks, displaying the list of weld tasks, and fine-tuning some of the weld parameters during the weld execution process.

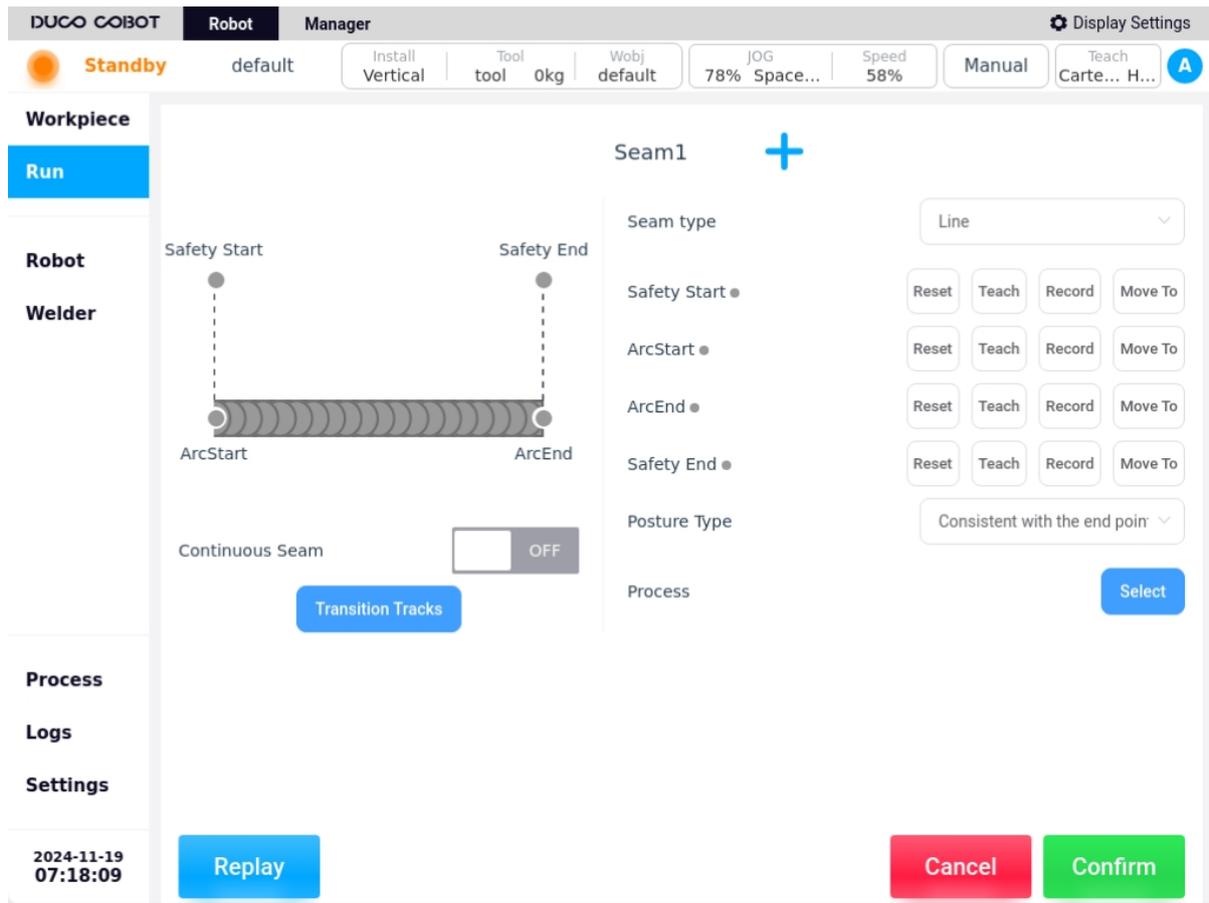
You can add a single weld, a multi-layer weld and an intermittent weld by using the different buttons in the upper right corner of the page.

2.4.1 Single pass weld

Click the “Add Single Weld” button in the upper right corner of the page to bring up the virtual keyboard, which displays the weld name “Weld x” by default, as shown in the figure below.



Users can also customize the weld name. After confirming the weld name, such as “Weld 1”, click the “OK” button on the keyboard to enter the single weld definition page, as shown in the figure below. As shown in the figure below.



Welding seam type: Four options are available: straight line, arc, full circle, and multi-point mode;

Starting Safety Point: The safe position from the arc start point before starting to weld;

Arc Start Point: Position of arc ignition prior to the start of welding;

Arc closing point: The position where the arc is extinguished after finishing the weld;

End Safety Point: The safe position from the arc closing point after finishing the weld;

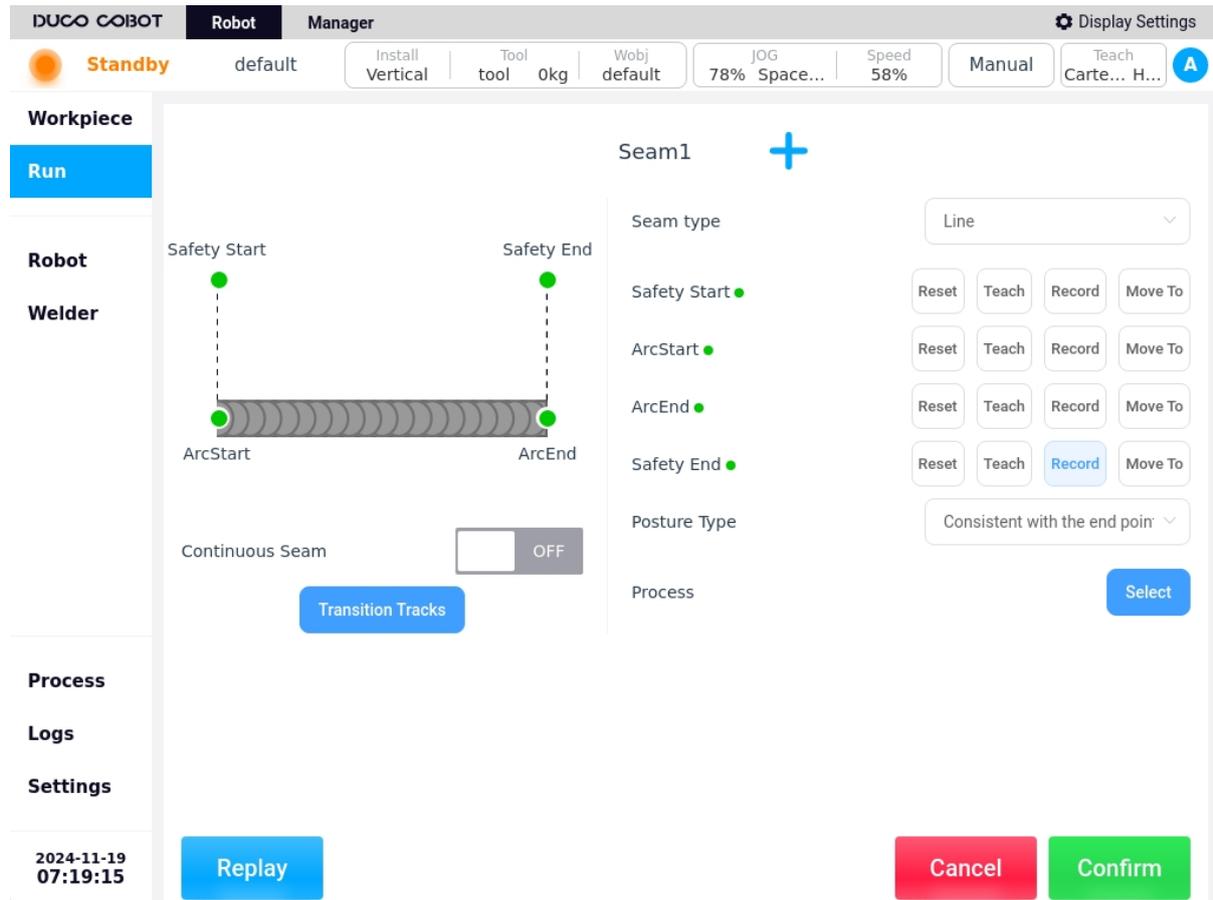
Attitude constraints: Used to set the attitude relationship between the torch and the weld seam. Unconstrained: Executed according to the torch attitude during the demonstration; Consistent with the starting point attitude: During the welding process, the torch maintains the attitude at the starting point; Constrained by the center of the circle: The torch attitude remains unchanged with respect to the circle arc

Process: The name of the process file used is displayed, and clicking the “Select” button after it opens the single-pass process file selection dialog box, where you can select the process file used for the weld;

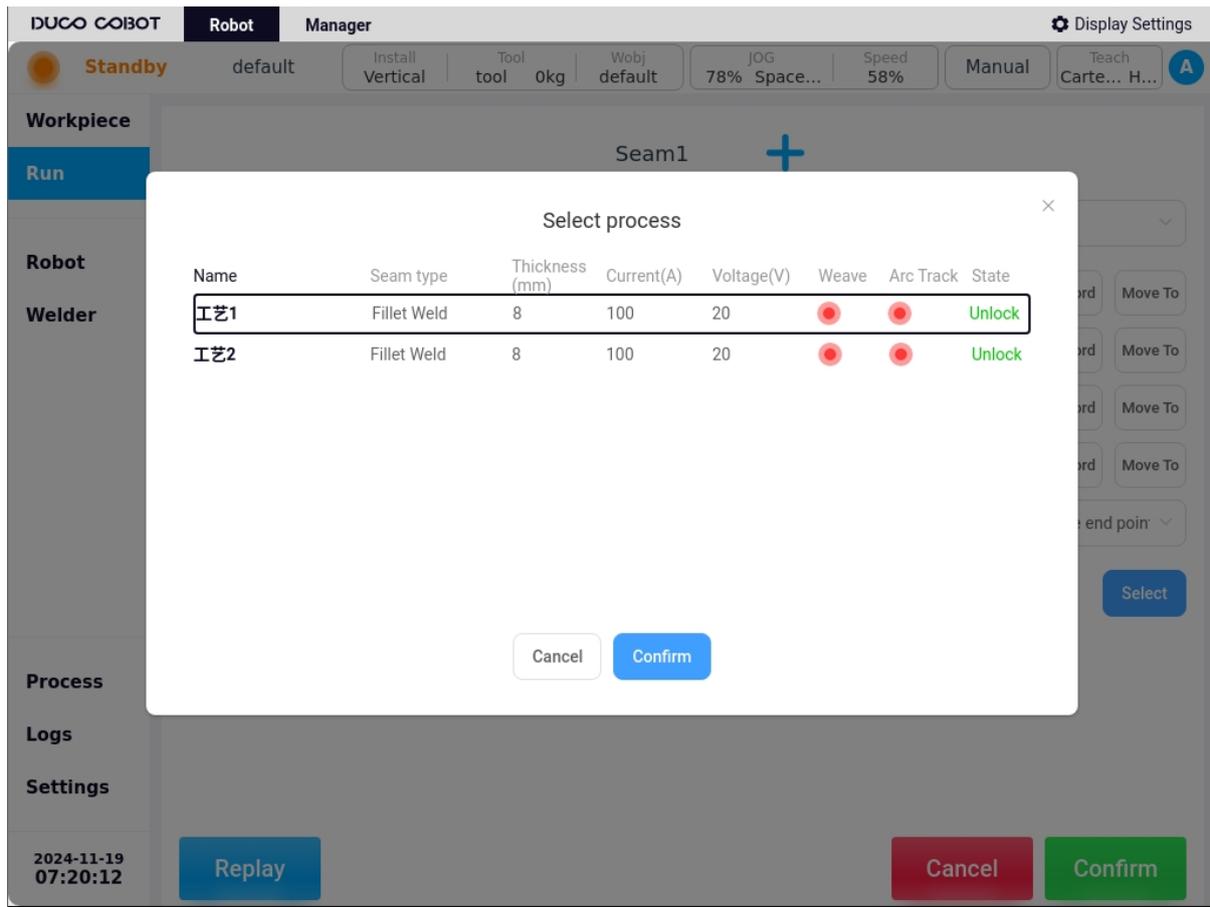
Continuous Weld: Configure whether the weld is continuous or not; when it is continuous, the current weld is continuous with the next section of the weld without restarting the arc, and the closing point of the current weld is the starting point of the next weld; When it is not continuous, the next weld needs to restart the arc, and the current weld trajectory point has an arc closing point and an end safety point.

To teach a point, click the “Teach Point” button after the corresponding point to jump to the robot control page. In the robot control page, teach the robot to determine the point of use, and then jump back to the current weld editing page after teaching is completed and recorded. Users can also teach the point directly through the teach pendant, click the corresponding point and click “Record current point”. Click the button of “Record Current Point” to finish the teaching record. Press and hold the “Move to this point” button to move the robot to this point. Click “Reset” button to clear the value of the point, and the point status light

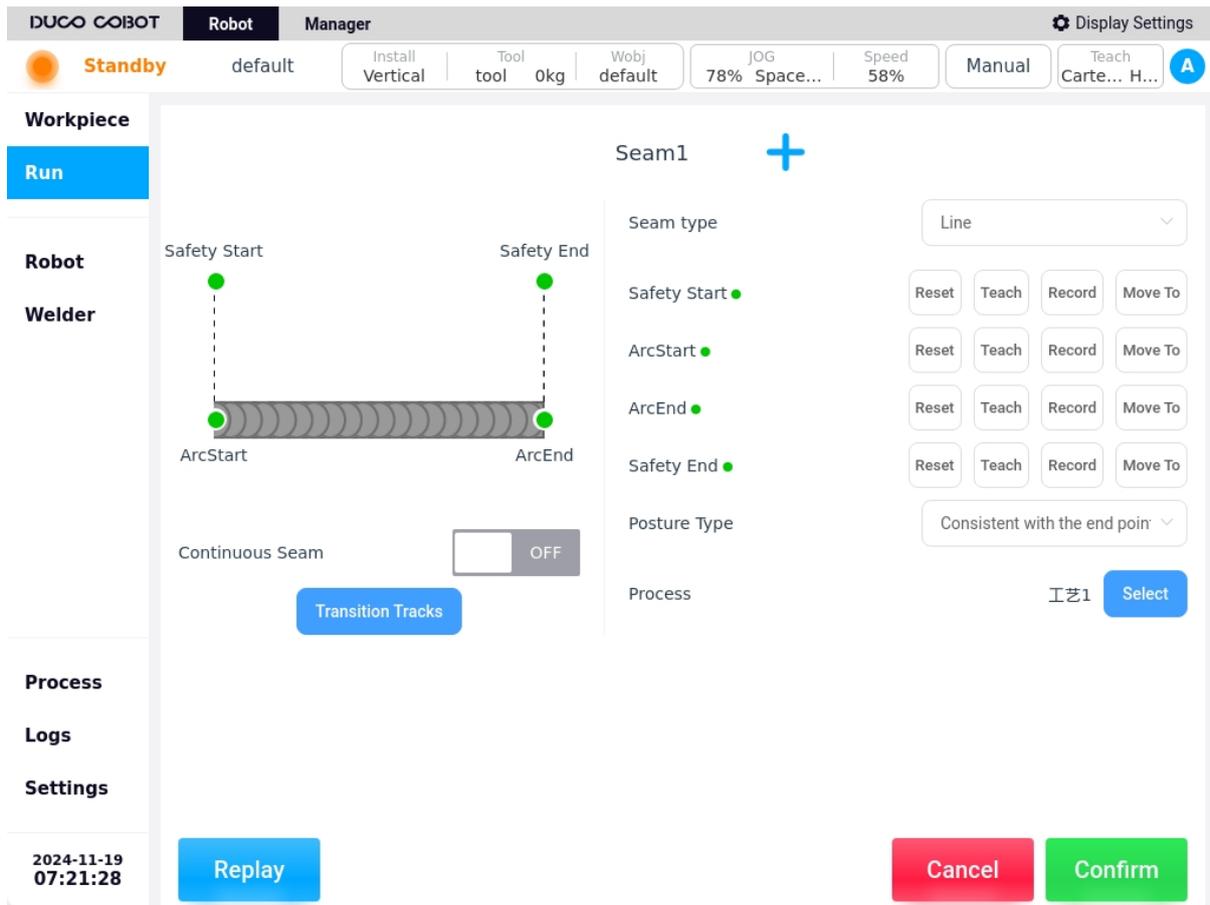
will be restored to gray. When the points are taught sequentially, the corresponding point status light will change from gray to green as shown in the following figure.



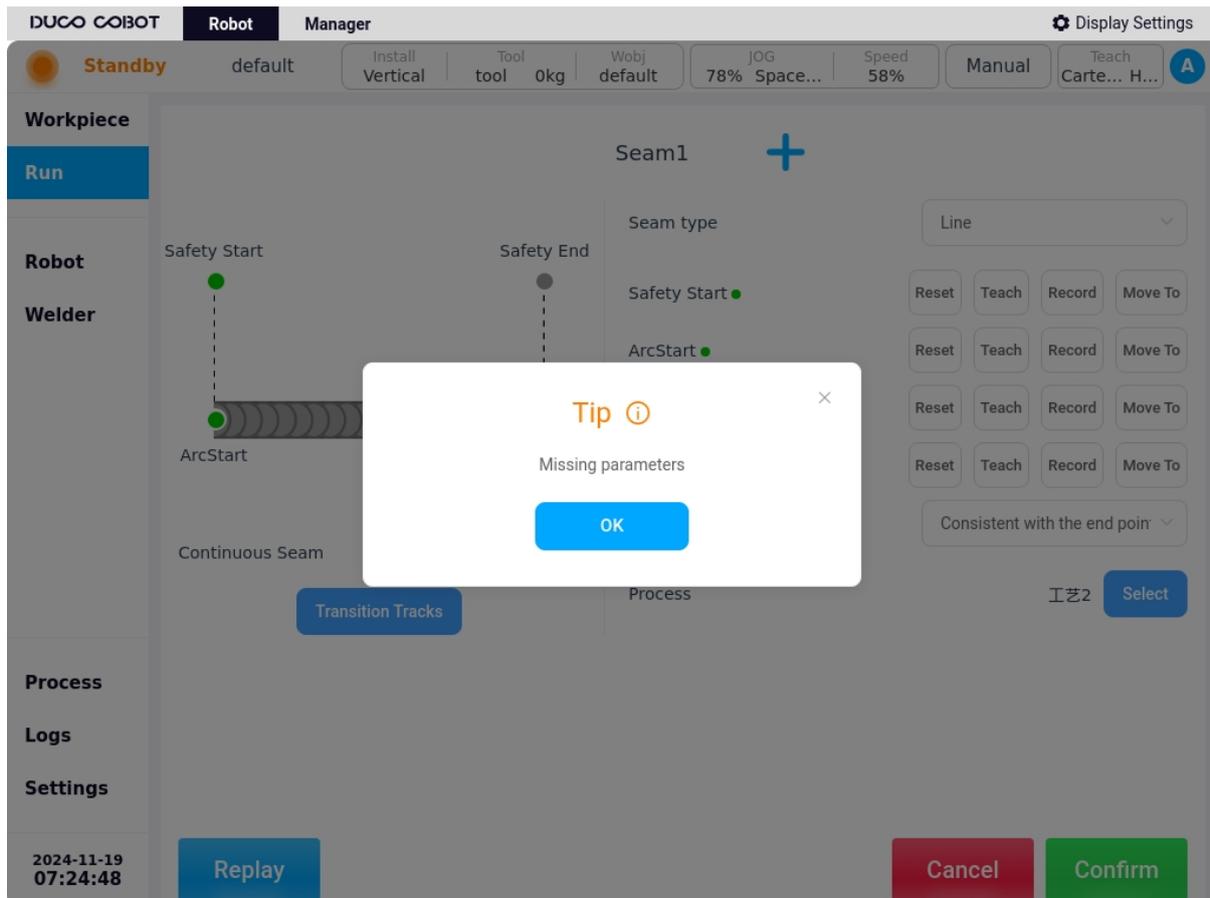
Click the “Select” button after the process, the pop-up single-pass process file selection dialog box is shown in the figure below.



Select the required process file, such as selecting the “process 1”, click “OK” button, select the process dialog box disappears, the weld editing page after the process is displayed in the following chart.



Users can click the “Repeat” button at the bottom left corner of the page, and the robot will run according to the taught points. When the point record is incomplete or the process file is not selected, click the “Repeat” button to pop up a prompt dialog box, as shown in the figure below. As shown in the figure below.



Select the type of weld, in order to teach the beginning of the safety point, the starting point, the closing point and the end of the safety point, configure the attitude constraints and whether the continuous weld, as well as selecting a good process file, and then click the “OK” button on the right corner of the page to save the weld configuration information. Click the “OK” button in the lower right corner of the page to save the seam configuration information, OK will add a weld to the task list of the workpiece, as shown in the figure below. If you want to abandon the current changes Click the “Cancel” button to exit to the welding execution page.

The screenshot shows the DUCO Weld Package V3 interface. At the top, there is a status bar with 'Standby' and 'default' indicators. Below this, there are several control buttons: 'Install Vertical', 'Tool default', 'Wobj 0kg', 'JOG 100% Space ...', 'Speed 100%', 'Manual', and 'Teach Carte... H...'. A blue circle with the letter 'A' is also present.

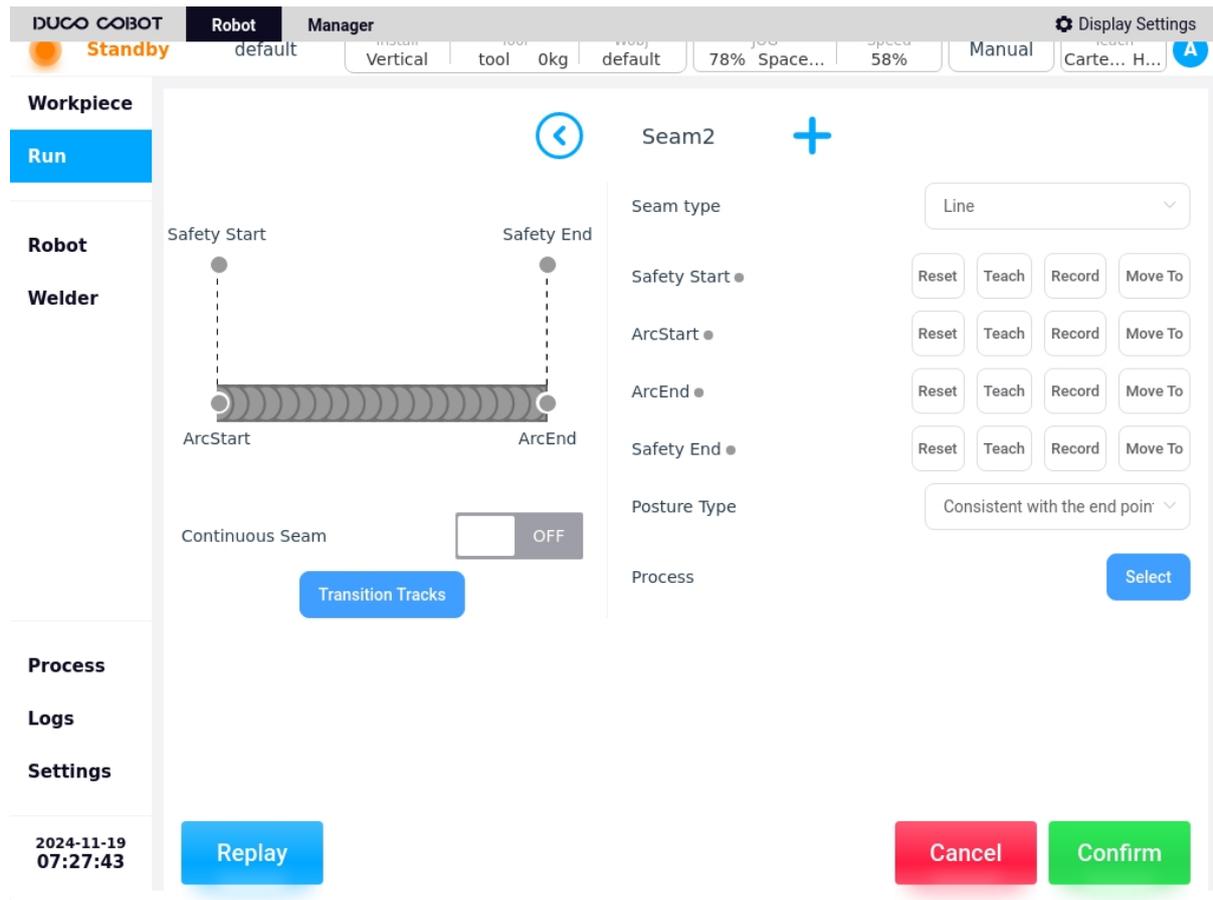
The main area is divided into a sidebar on the left and a main content area. The sidebar has sections for 'Workpiece', 'Robot', and 'Welder'. Under 'Workpiece', there are buttons for 'Run' (highlighted in blue), 'Process', 'Logs', and 'Settings'. At the bottom of the sidebar, the date and time '2024-11-20 18:03:12' are displayed.

The main content area contains a table with the following data:

Seam type	Name	Process	Continuous	Processing	State	Action
Single seam	Seam1	test	<input type="checkbox"/>	<input checked="" type="checkbox"/>	●	⋮

Below the table, there is an 'Enable Weld' toggle switch set to 'OFF'. At the bottom right of the main content area, there is a large green 'Run' button. A blue plus sign is overlaid on the 'Run' button.

Users can also add a weld by clicking on the  icon on the current weld editing page, and the weld name will be generated as “Weld x” by default. For example, if you click the add icon on the “Weld 1” editing page, you will enter the “Weld 2” editing page, as shown in the figure below.



Similarly, after configuring the weld configuration information, click the “OK” button to save the weld configuration information and add it to the list of weld tasks for the current workpiece to return to the

weld execution page. Users can add multiple weld tasks sequentially through the  icon, and switch

to different welds to edit the corresponding weld information through the  and  icons. After editing the weld configuration information, click the “Confirm” button to return to the weld execution page.

For example, in the “Weld 2” editing page, click the Add icon twice in a row to add “Weld 3” and “Weld 4”, and finally click the “Confirm” button to return to the welding execution page as shown below. Finally, click the “Confirm” button to return to the weld execution page, as shown in the figure below.

The screenshot shows the 'Welder' section of the DUCO COBOT Robot Manager. The interface includes a top navigation bar with 'DUCO COBOT', 'Robot', and 'Manager' tabs, and a 'Display Settings' icon. Below the navigation bar, there are status indicators for 'Standby', 'default', 'Install Vertical', 'Tool tool 0kg', 'Wobj default', 'JOG 78% Joint J...', 'Speed 100%', 'Manual', and 'Teach Carte... H...'. The main area is divided into 'Workpiece' and 'Welder' sections. The 'Welder' section contains a table with columns for 'Seam type', 'Name', 'Process', 'Continuous', 'Processing State', and 'Action'. There are also buttons for 'Add Single', 'Add Multi', and 'Add Intermittent'. At the bottom right, there is a large green 'Run' button. The date and time '2024-11-19 08:25:55' are displayed in the bottom left corner.

Seam type	Name	Process	Continuous	Processing State	Action
Single seam	Seam1	Process1	<input type="checkbox"/>	<input checked="" type="checkbox"/> ●	⋮
Single seam	Seam2		<input type="checkbox"/>	<input type="checkbox"/> ●	⋮
Single seam	Seam3		<input type="checkbox"/>	<input type="checkbox"/> ●	⋮
Single seam	Seam4		<input type="checkbox"/>	<input type="checkbox"/> ●	⋮
▶ Multi seam	Seam5	/	/	<input checked="" type="checkbox"/> ●	⋮

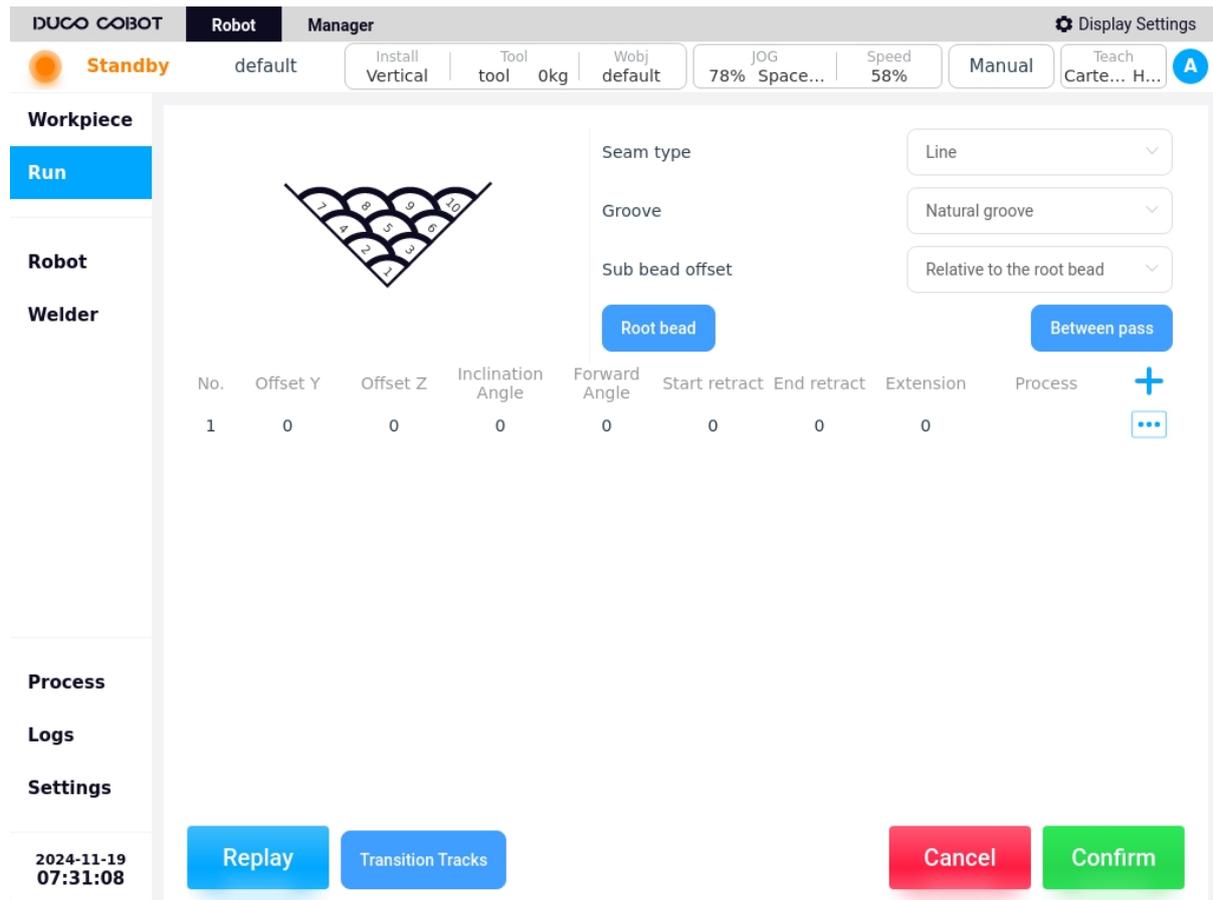
Enable Weld OFF

2024-11-19 08:25:55

Run

2.4.2 Multi-layer, multi-pass welds

Click the “Add Multi-Layer Multi-Pass Weld” button at the top right corner of the page to bring up the virtual keyboard, which displays the weld name “Weld x” by default. Users can also customize the weld name. After confirming the weld name, such as “Weld 5”, click the “OK” button to enter the multi-layer multi-pass weld definition page, as shown in the figure below.



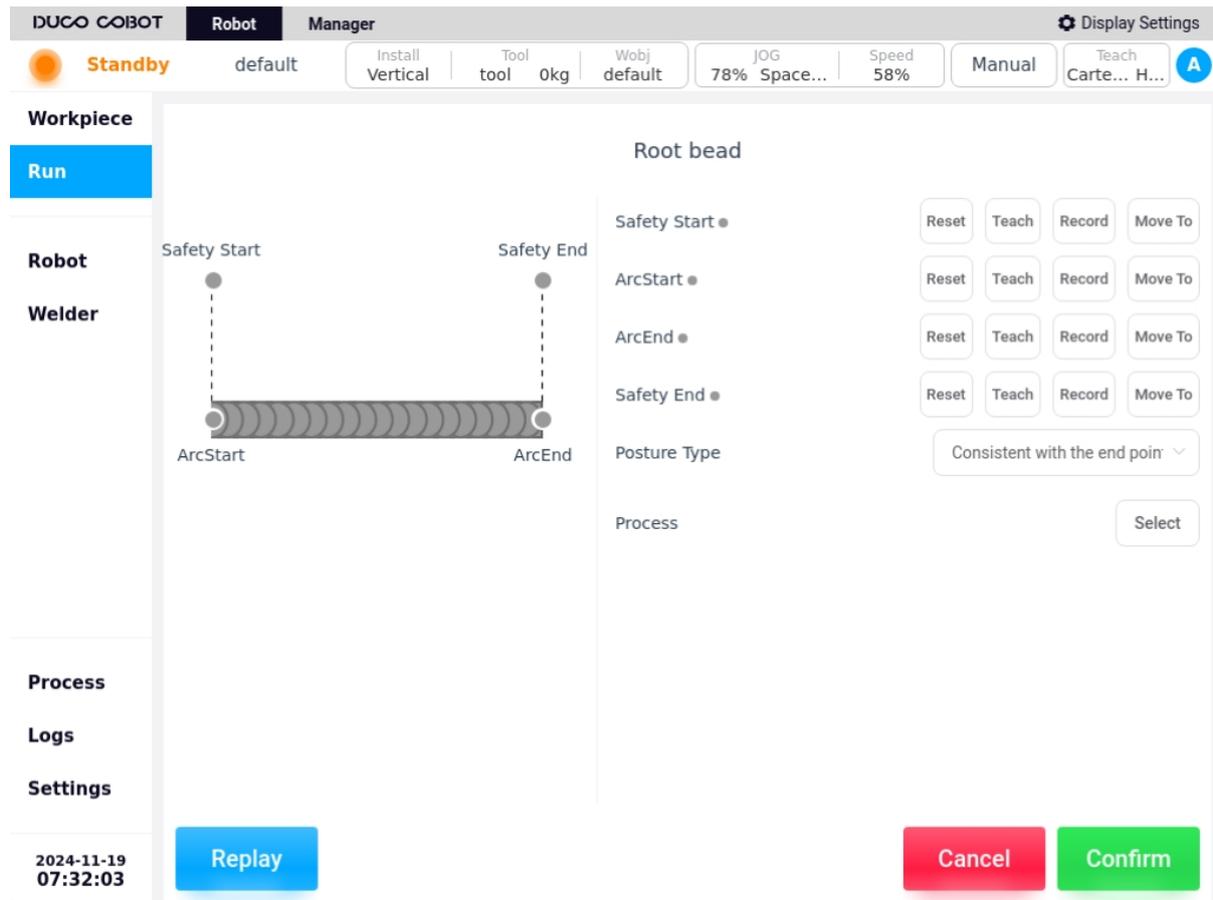
Basic Configuration Information

Welding seam type: Options are straight line, arc, full circle, and composite trajectory;

Bevel Type: Options are Natural, Single V, V-Shape, Steep Edge Bevel, U-Bevel, Single Steep Edge Bevel, J-Bevel;

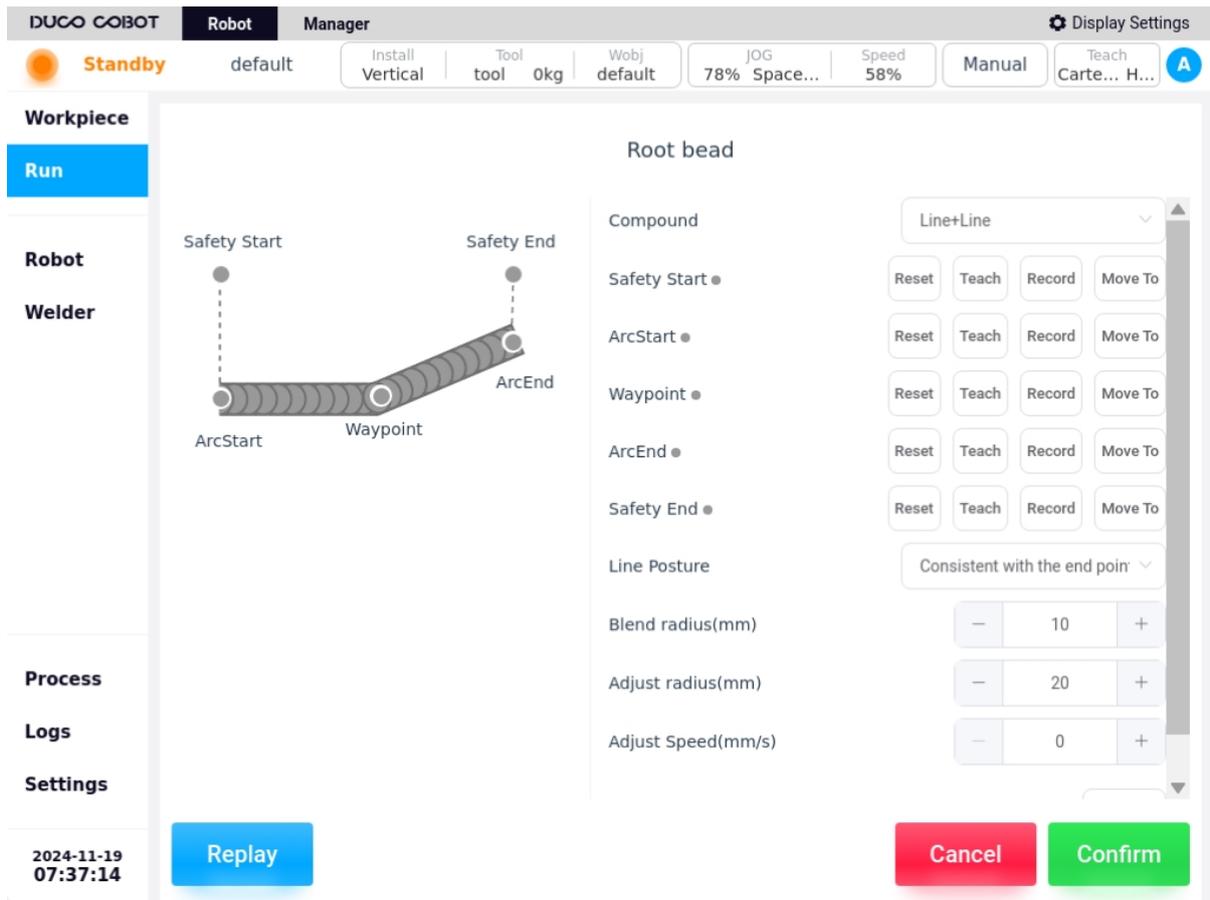
Sub-pass deviation datum: Weld coordinate system offset datum, optionally relative to the root pass, relative to the previous pass;

Click the “Root Path Definition” button to enter the Root Path Definition page, as shown below.



When the type of weld seam is straight line, arc or circle, the configuration information required for the definition of the root weld path is the same as that for the corresponding type of single-pass weld seam, and will not be repeated here.

When the weld type is Composite Trajectory and the Type default is Linear + Linear, the Root Weld Path Trajectory Definition page is shown below.



Among the points to be modeled in the Root Weld Path Definition page are the Start Safety Point, Start Arc Point, Excess Point, Finish Arc Point, and End Safety Point. The configured parameters are: straight line segment attitude constraint, fusion radius and process. The composite trajectory types are straight line + straight line, straight line + arc, straight line + arc + straight line, arc + straight line + arc, totaling four types.

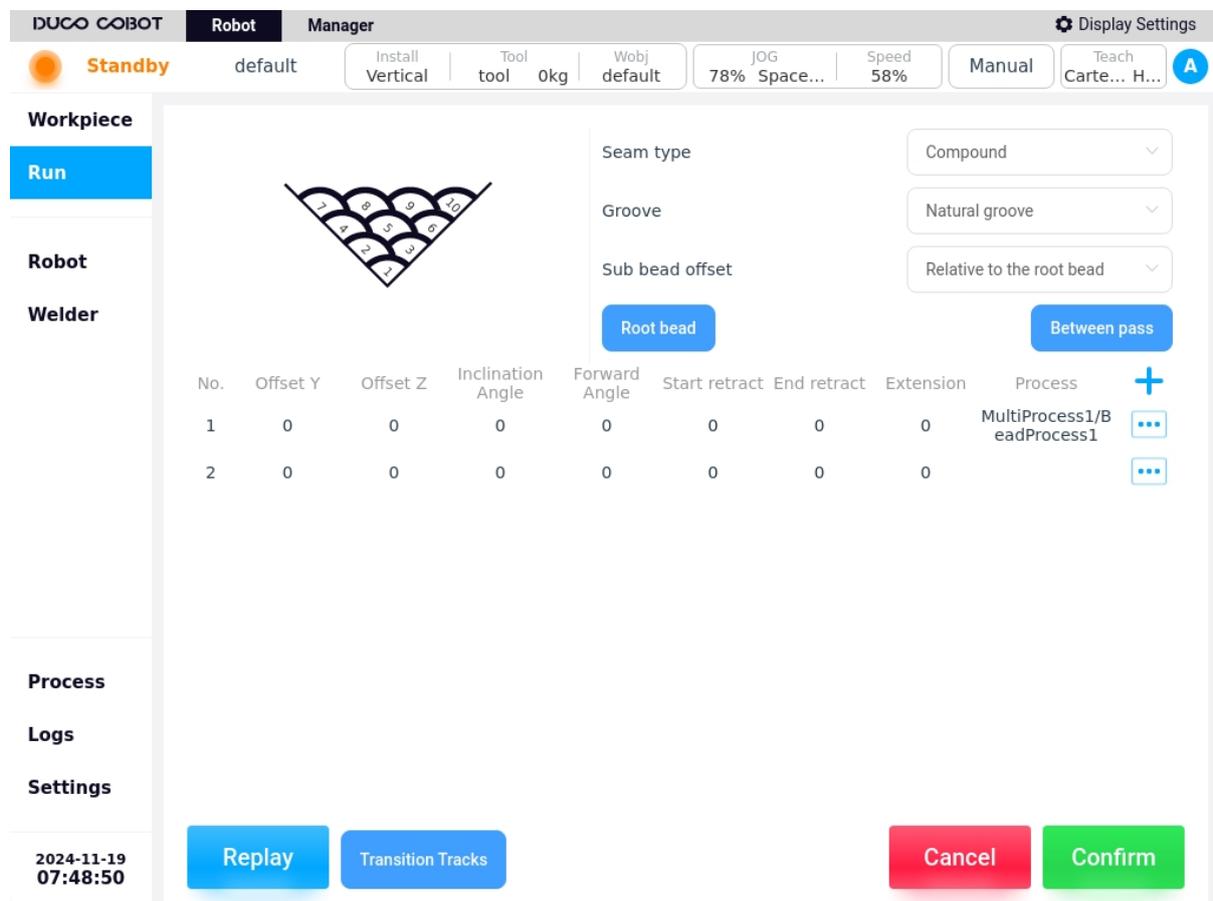
When the composite trajectory is selected as straight line + arc, the points that need to be taught in the definition page of the root weld path trajectory are the start safety point, arc start point, excess point, intermediate point, arc closing point and end safety point. Configuration parameters relative to the straight line + straight line composite trajectory also need to configure the arc segment attitude constraints, adjustment radius, that is: straight line segment attitude constraints, arc segment attitude constraints, fusion radius, adjustment radius and process.

When the composite trajectory is selected as straight line + arc + straight line, the points that need to be taught in the definition page of the trajectory of the root weld channel are the starting safety point, starting arc point, over point, intermediate point, over point, closing arc point, and ending safety point. The configuration parameters are the same as those required for Straight Line + Circular Arc.

When the composite trajectory is arc + straight line + arc, the points to be shown on the root weld path trajectory definition page are the start safety point, arc start point, intermediate point, excessive point, excessive point, intermediate point, arc closing point, and end safety point. The configuration parameters are the same as those required for straight line + arc.

Note: Note: Composite trajectory transitions are rounded by default.

Click the  icon in the upper right corner of the current multi-layer multi-pass weld list to add a weld, e.g., add a weld number 2 as shown in the following figure.

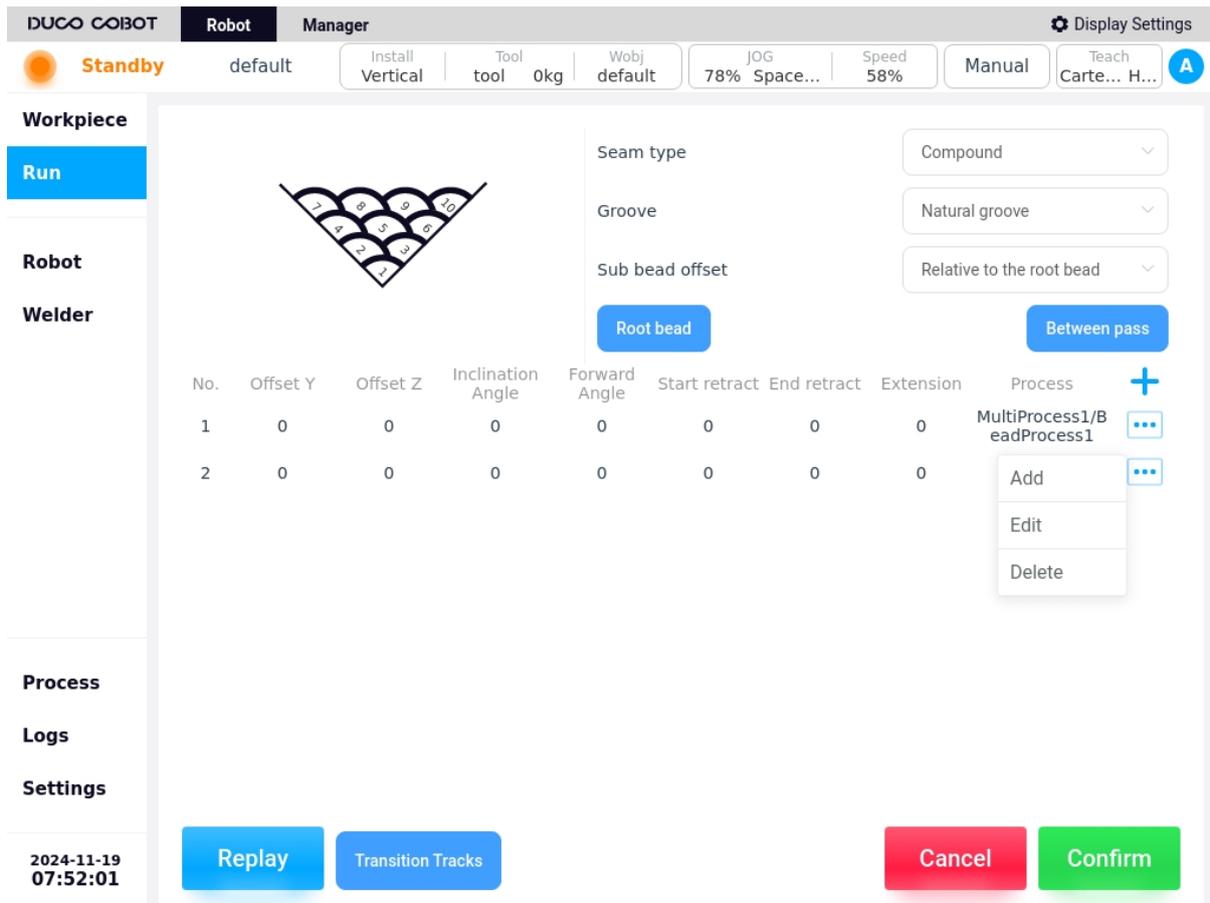


The screenshot shows the 'Welder' configuration screen. At the top, there are tabs for 'Install Vertical', 'Tool tool 0kg', 'Wobj default', 'JOG 78% Space...', 'Speed 58%', 'Manual', and 'Teach Carte... H...'. The main workspace contains a diagram of a multi-pass weld with 10 numbered passes. Below the diagram is a table with the following columns: No., Offset Y, Offset Z, Inclination Angle, Forward Angle, Start retract, End retract, Extension, Process, and an operation icon (+). The table contains two rows of data:

No.	Offset Y	Offset Z	Inclination Angle	Forward Angle	Start retract	End retract	Extension	Process	+
1	0	0	0	0	0	0	0	MultiProcess1/BeadProcess1	...
2	0	0	0	0	0	0	0		...

At the bottom of the workspace, there are buttons for 'Replay', 'Transition Tracks', 'Cancel', and 'Confirm'. The status bar at the bottom left shows the date and time: '2024-11-19 07:48:50'.

The weld pass list mainly displays the weld pass number, Y offset, Z offset, tilt angle, push/pull angle, start indent, end indent, dry elongation, process name, and the weld pass operation icon. Click on the weld pass operation icon  and the popup window will be displayed as follows.



New: Clicking the “New” button will add a new single weld path after the currently selected path;

Note: Note: Clicking on the serial number 1 channel operation icon only adds new functions.

Edit: Click the “Edit” button to enter the weld channel edit page, you can edit the above information mainly displayed in the weld channel list;

Delete: Clicking “Delete” will bring up a confirmation dialog box, after confirmation, you can delete the welding channel.

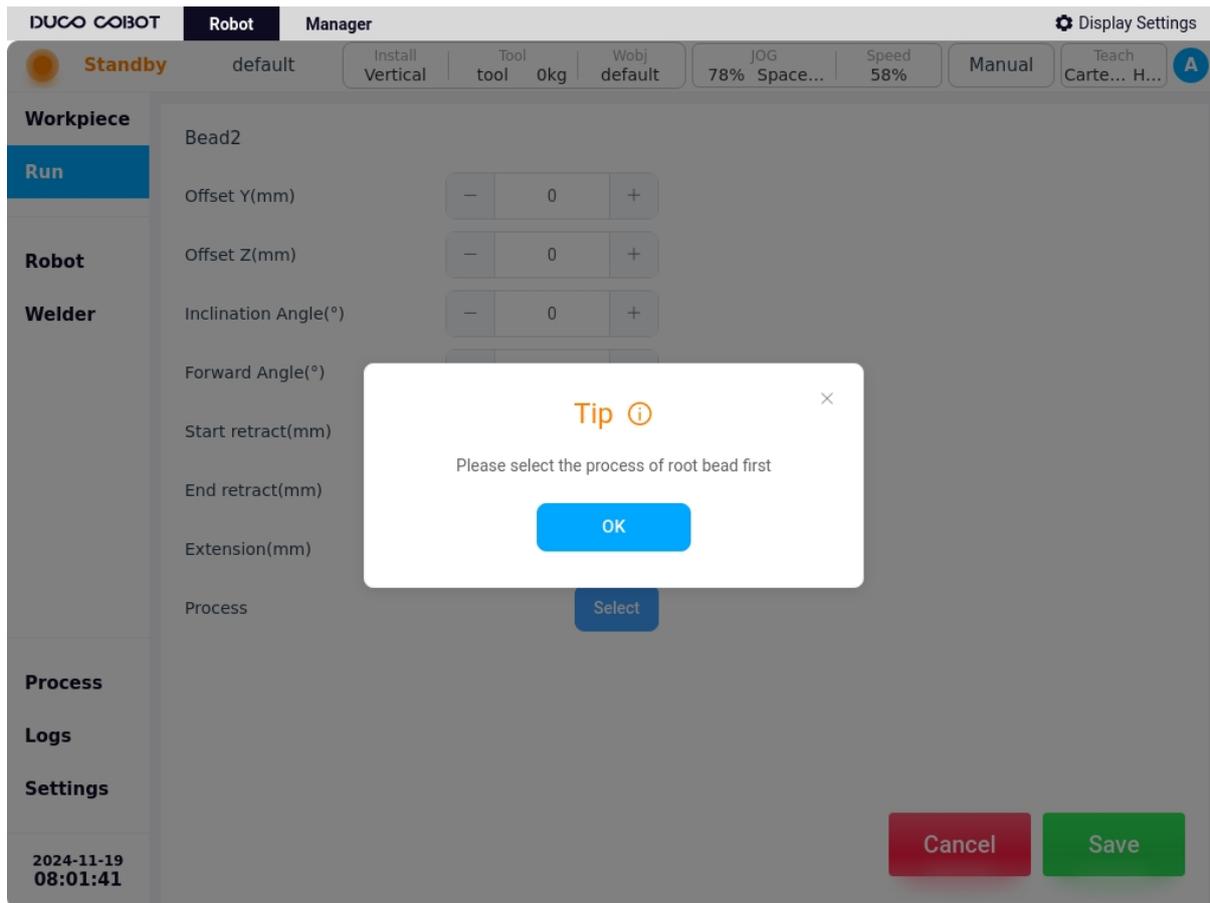
For example, click the “Edit” button in the pop-up window of the weld channel 2 operation icon to enter the weld channel 2 edit page, as shown in the following figure.

The screenshot shows the 'Robot Manager' interface for a DUCO COBOT. The top navigation bar includes 'DUCO COBOT', 'Robot', and 'Manager'. The status is 'Standby' with a 'default' mode. A toolbar contains buttons for 'Install Vertical', 'Tool 0kg', 'Wobj default', 'JOG 78% Space...', 'Speed 58%', 'Manual', and 'Teach Carte... H...'. A left sidebar has tabs for 'Workpiece', 'Run', 'Robot', 'Welder', 'Process', 'Logs', and 'Settings'. The 'Welder' tab is active, showing settings for 'Bead2':

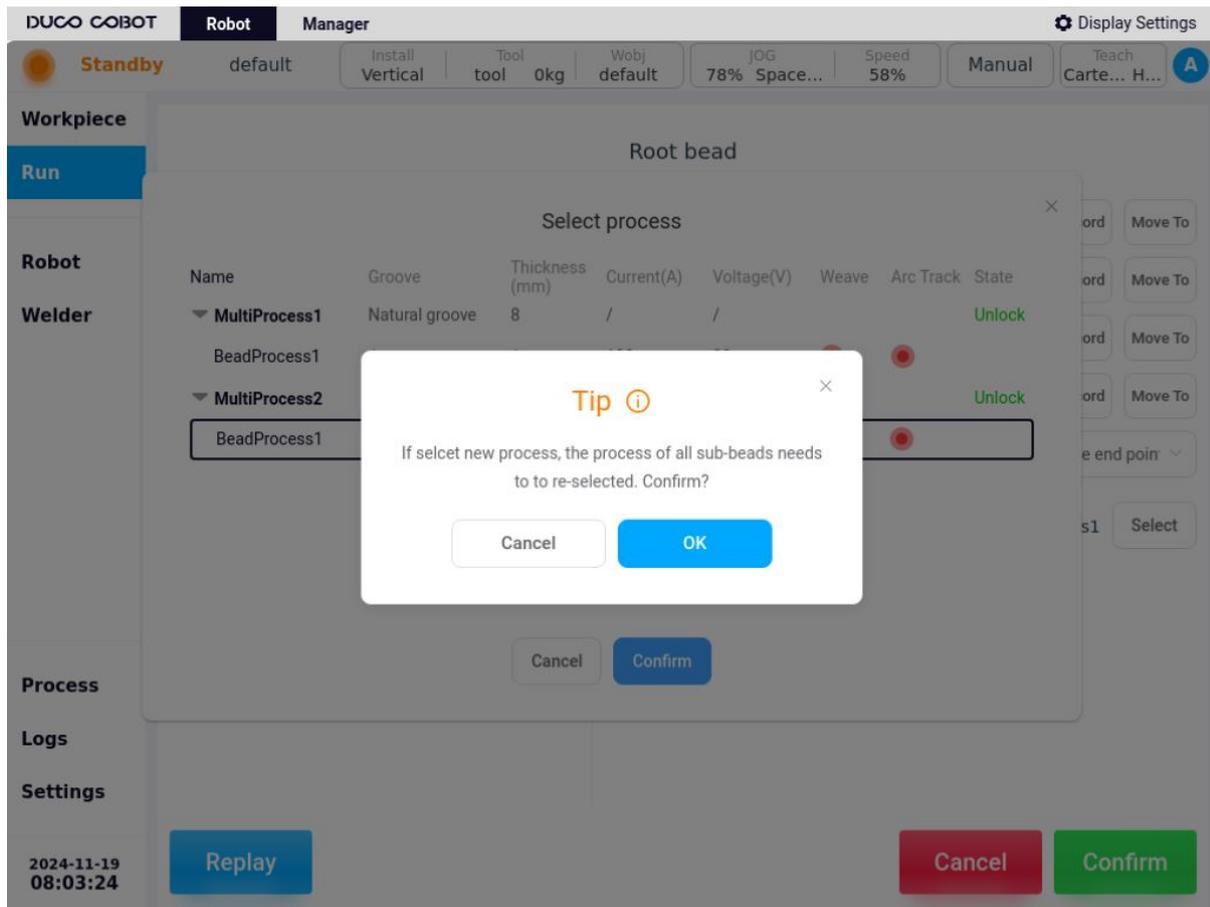
- Offset Y(mm): 0
- Offset Z(mm): 20
- Inclination Angle(°): 0
- Forward Angle(°): 0
- Start retract(mm): 0
- End retract(mm): 0
- Extension(mm): 0
- Process: MultiProcess1/BeadProcess1 (with a 'Select' button)

At the bottom right, there are 'Cancel' and 'Save' buttons. The bottom left corner shows the date and time: '2024-11-19 07:54:30'.

When selecting a process, the Multilayer Multi-Pass Process File dialog box opens, and the process for the root weld pass must be selected first, otherwise a pop-up window will prompt the user as shown below.



The process selected for a sub-pass can only select a single pass process from the process group selected for the root pass. If you want to change the process group, you need to select another process group in the root channel. A pop-up window will appear as shown below.



After confirmation, users can select other groups of process files, such as selecting “Multi-layer multi-channel process 2 / weld channel process 1”, the selection is confirmed and will be cleared of other weld channel selected process files, as shown in the figure below. As shown in the figure below.

DUCO COBOT **Robot** Manager Display Settings

Standby default Install Vertical Tool tool 0kg Wobj default JOG 78% Space... Speed 58% Manual Teach Carte... H... A

Workpiece

Run

Robot

Welder



Seam type Line

Groove Natural groove

Sub bead offset Relative to the root bead

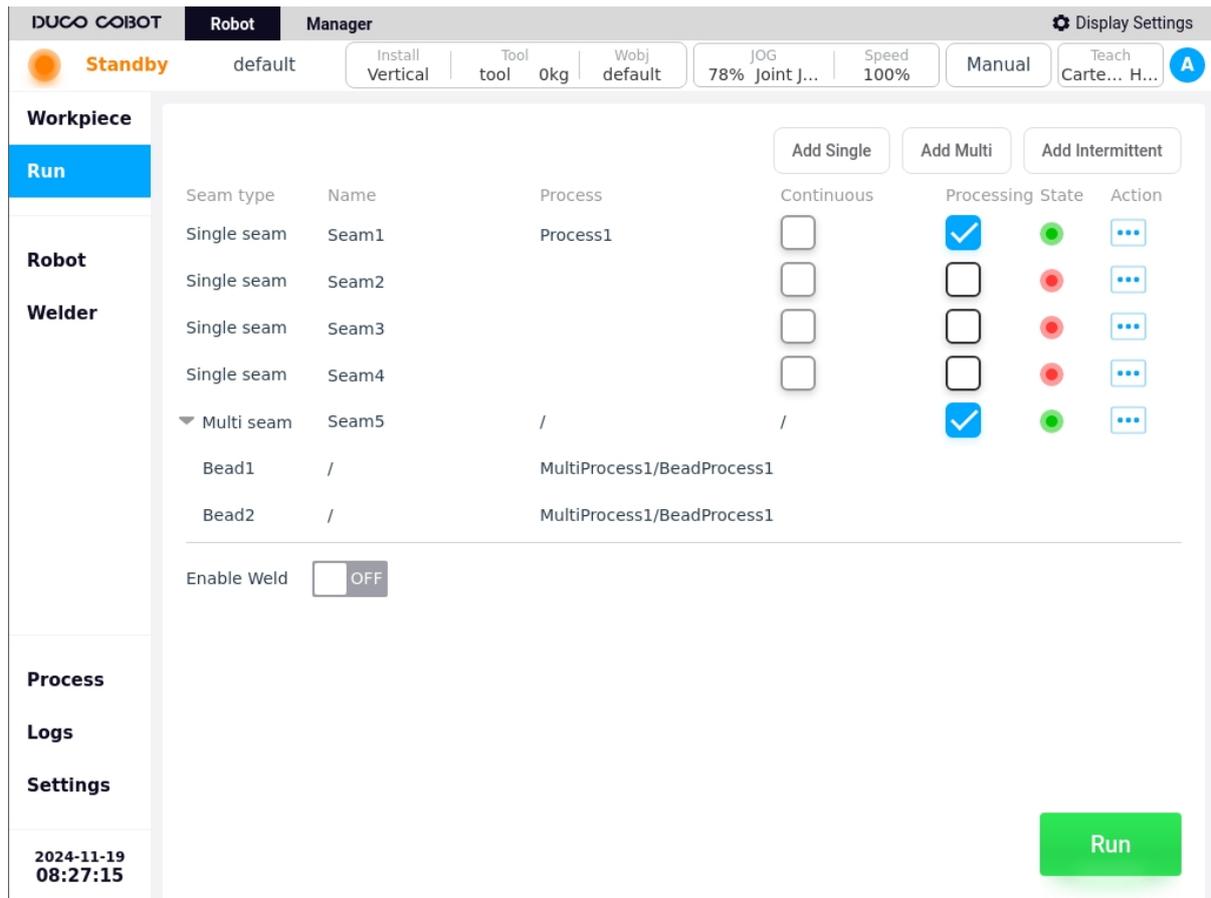
Root bead
Between pass

No.	Offset Y	Offset Z	Inclination Angle	Forward Angle	Start retract	End retract	Extension	Process	+
1	0	0	0	0	0	0	0		⋮
2	0	0	0	0	0	0	0		⋮

2024-11-19 08:04:49

Replay
Transition Tracks
Cancel
Confirm

After configuring the weld channel information, click the “Confirm” button to return to the weld execution page, as shown in the following figure.



Weld channel definition

For multi-layer, multi-pass welds, you can configure the definition of the passes, by clicking on the “Define Passes” button, you will enter the passes definition page. The following options can be configured:

Enable weld channel confirmation:

If Enable is selected, each time a weld is completed, a popup confirmation or a button confirmation is required to proceed to the next weld. Please configure the confirmation method in Basic Settings/Welding Signal.

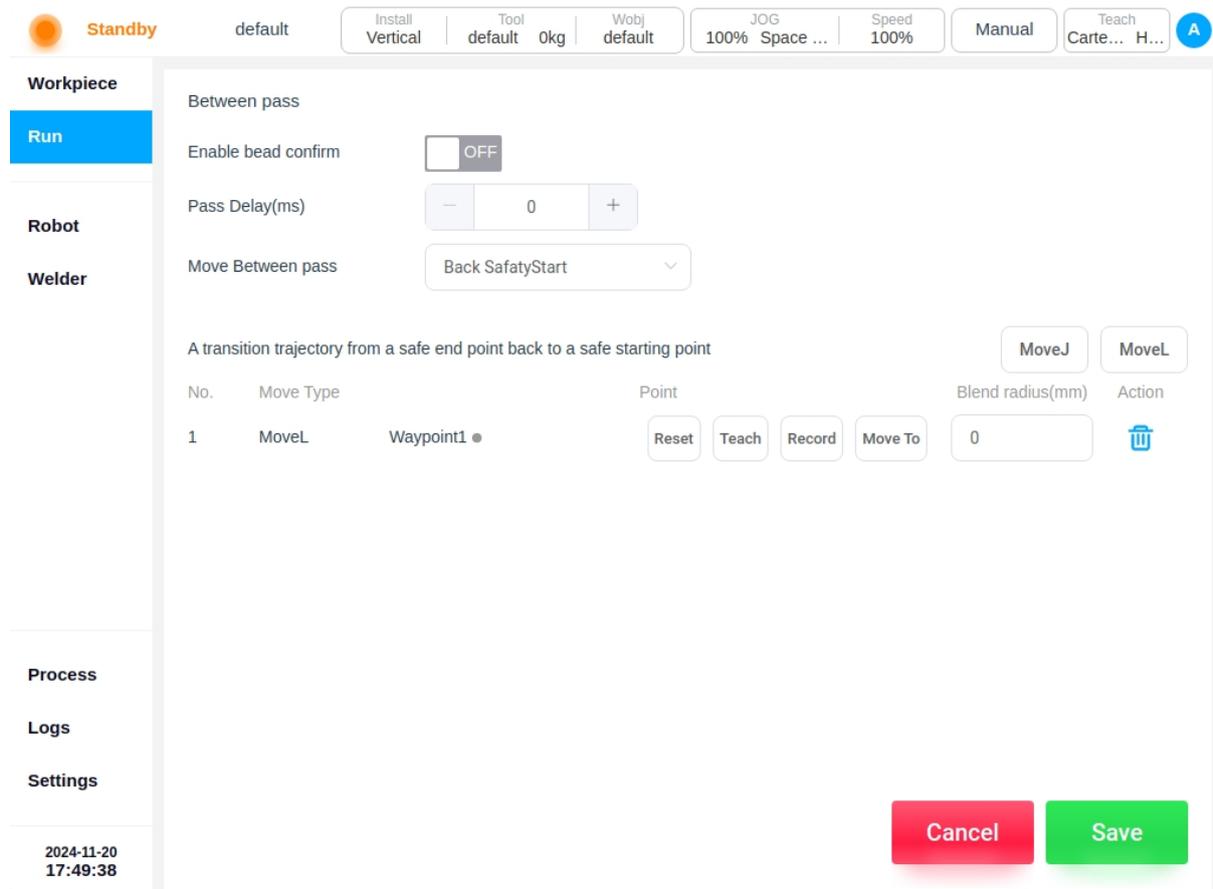
Weld Path Delay:

Without enabling the weld pass confirmation, you can set the weld pass delay time so that after completing the operation of one weld, you can delay the operation of the next weld for a certain period of time.

Movement between weld channels:

You can choose between “Return to safe point” and “Reciprocating motion”, with “Return to safe point” as the default. If “Return to safe point” is selected, after each weld is completed, the robot will return to the safe starting point for the next weld. If “Reciprocate” is selected, after each weld is completed, the robot will work in the opposite direction of the previous weld.

If you select “Return to safe point”. By default, the robot moves from the safe end point to the safe start point in a straight line, which in some cases may be unreachable or collision problem. You can add a transition point and select the way to move to the transition point (straight line/joint). As shown in the picture:

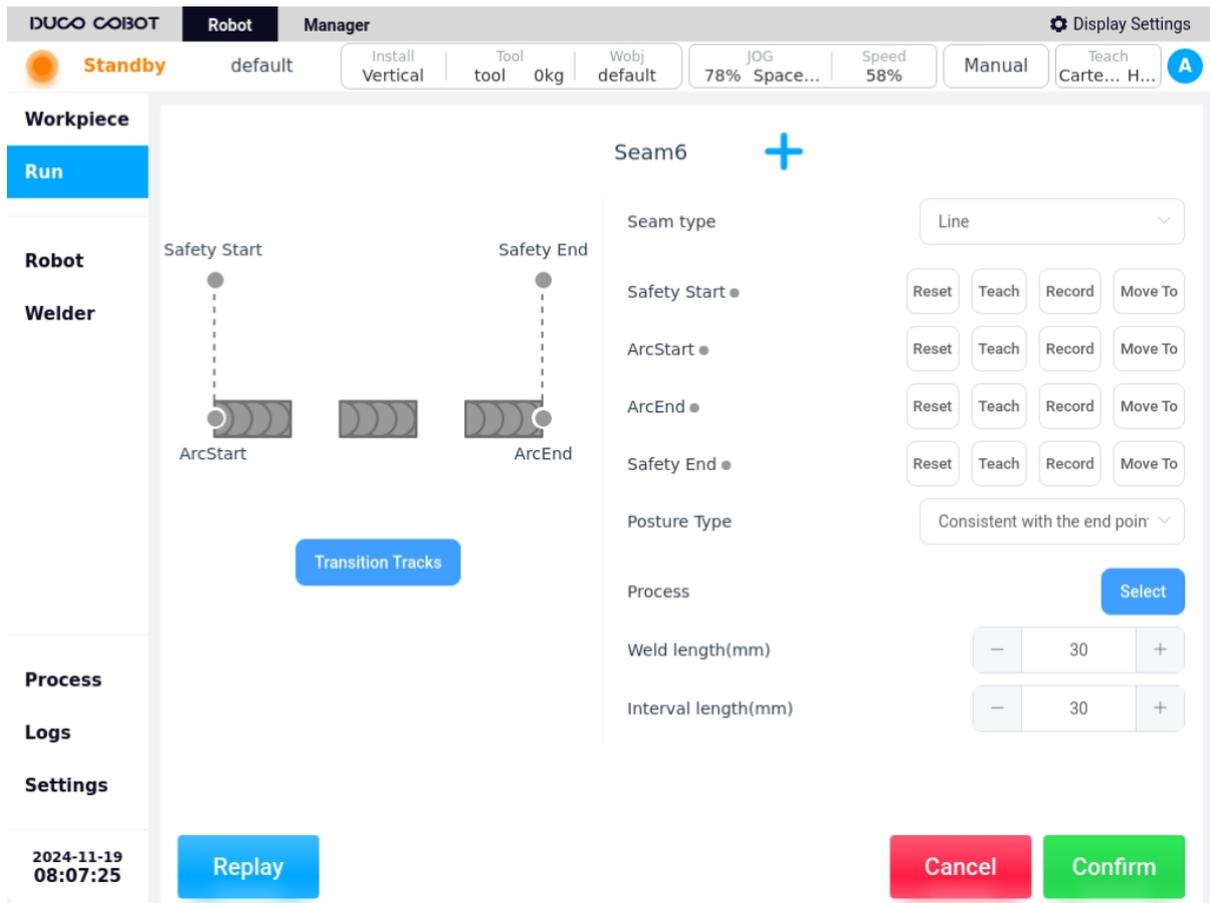


Note: The speed at which the robot runs in the transition trajectory is defined in the process file

Note: When reciprocating motion is selected, the position offset is based on the direction of travel of the root weld channel.

2.4.3 Intermittent weld

Click the “Add Intermittent Weld” button at the top right corner of the page to bring up the virtual keyboard, which displays the weld name “Weld x” by default. Users can also customize the weld name. After confirming the weld name, such as “Weld 6”, click the “OK” button to enter the intermittent weld definition page, as shown in the figure below.



The configuration information required for an interrupted seam definition is similar to that of a single-pass seam definition and will not be repeated here. The difference is that there is no continuous seam parameter configuration for interrupted seams.

In addition, the intermittent weld needs to be configured with two parameters: weld length and interval length. After configuring the weld channel information, click the “Confirm” button to return to the welding execution page, as shown in the figure below.

DUCO COBOT
Robot Manager
Display Settings

Standby default

Install Vertical
Tool tool 0kg
Wobj default

JOG 78%
Joint J...
Speed 100%

Manual
Teach Carte... H...
A

Workpiece

Run

Robot

Welder

Process

Logs

Settings

2024-11-19
08:28:46

Add Single
Add Multi
Add Intermittent

Seam type	Name	Process	Continuous	Processing State	Action
Single seam	Seam1	Process1	<input type="checkbox"/>	<input checked="" type="checkbox"/> ●	⋮
Single seam	Seam2		<input type="checkbox"/>	<input type="checkbox"/> ●	⋮
Single seam	Seam3		<input type="checkbox"/>	<input type="checkbox"/> ●	⋮
Single seam	Seam4		<input type="checkbox"/>	<input type="checkbox"/> ●	⋮
▶ Multi seam	Seam5	/	/	<input checked="" type="checkbox"/> ●	⋮
Intermittent seam	Seam6	/	/	<input checked="" type="checkbox"/> ●	⋮

Enable Weld OFF

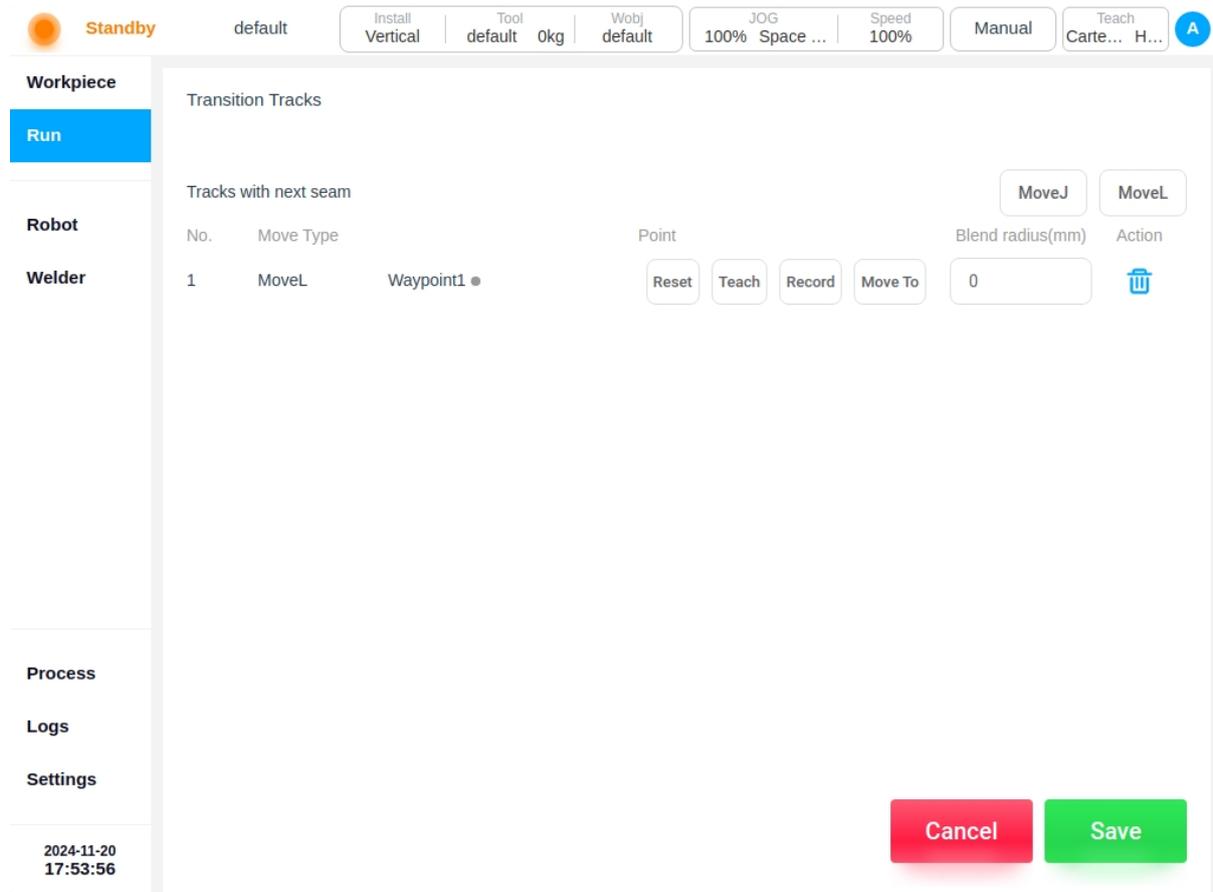
Run

2.4.4 Transition track

When there are multiple weld tasks in the Weld Task List, and you return to the safe end point after executing a job, by default the robot will move to the safe start point of the next job weld by joint movement. In some cases, the robot cannot move safely due to the presence of an obstacle, for example. You can add transition points at the end of each weld. Select how the robot moves to the transition point (linear/articulated).

The transition trajectory of a single weld page is defined as follows

The transition trajectory of a multi-layer, multi-pass weld page is defined as follows

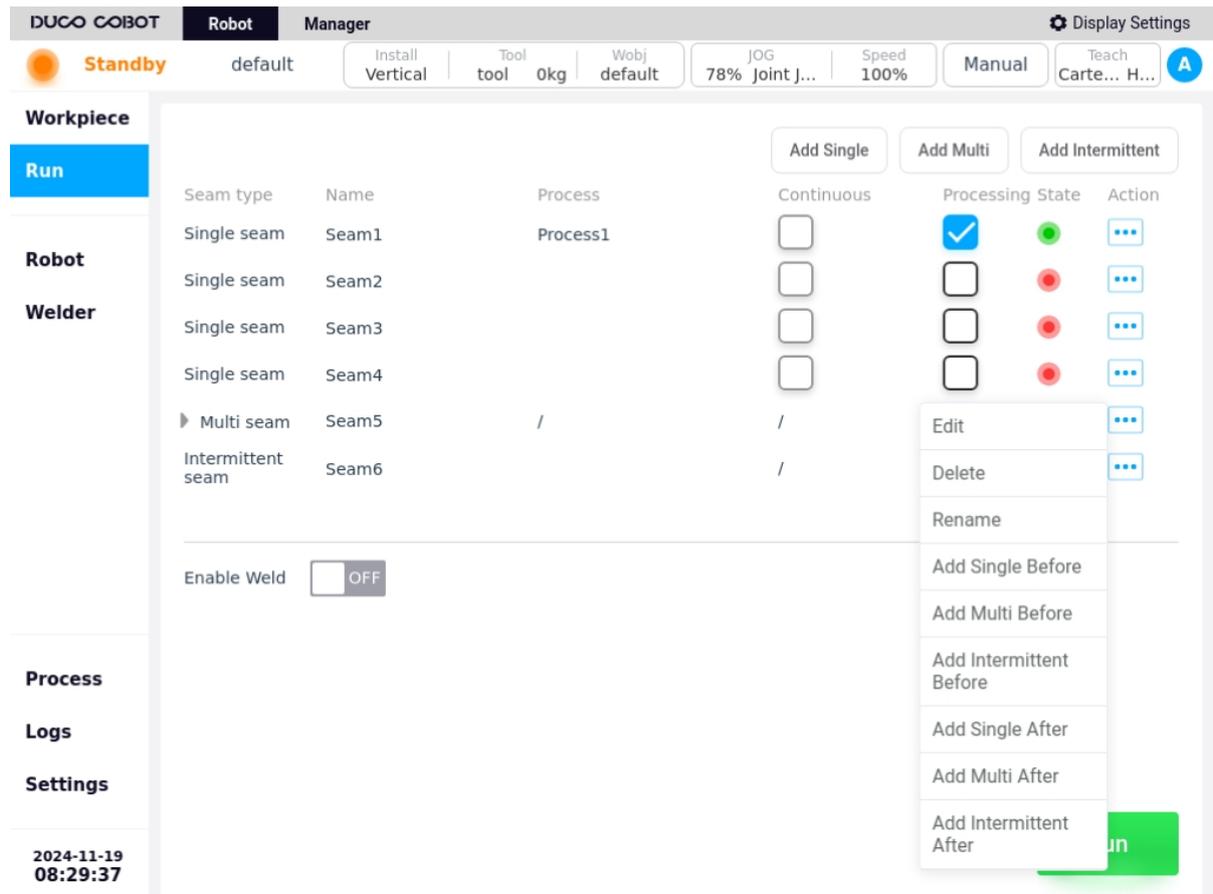


Note: The speed at which the robot runs in the transition trajectory is defined in the process file

2.4.5 Welding tasks

The Weld Job List displays a list of all welds in the current workpiece, in the order they were added. Each weld displays information including type, weld name, process file, The information displayed for each weld includes the type, weld name, process file, whether the weld is continuous with the next one, whether it is processed, status, and the weld task operation icon. Processing is checked by default, and consecutive weld passes can only be checked or unchecked at the same time; The status bar for completed weld configuration shows a green status light, and the status bar for incomplete weld configuration shows a red status light. Click

on any weld in the current workpiece welding task list on the Weld Execution page.icon , the popup window will be displayed as follows.



- **Edit:** Click “Edit” to enter the editing page of the selected weld task, and you can edit the configuration information of the weld.
- **Delete:** Clicking “Delete” will bring up a confirmation dialog box, and the task can be deleted after confirmation.

Note: Note: If the deleted weld has a continuous weld relationship with the front and back weld, a dialog box will pop up indicating that there is an associated weld, and you will need to re-determine the position of the front and back weld after deletion.

- **Rename:** Click “Rename” button, the keyboard will pop up, enter the new name of the weld, OK can be modified.
- **Adding single weld:** Click “Add single weld” button, the keyboard will pop up, confirm the name of the weld, and then enter the editing page of the new single weld.

After confirming the weld configuration information, you can add a single weld task before the current weld task.

- **Adding multiple welds forward:** Click “Add Multiple Welds Forward” button, the keyboard will pop up, confirm the weld name, and then enter the Add Multiple Welds task editing page, and confirm the weld name.

After confirming the weld configuration information, you can add a multi-layer multi-pass weld task before the current task.

- **Add Intermittent Seam:** Click “Add Intermittent Seam” button, the keyboard will pop up, confirm the seam name, and then enter the Add Intermittent Seam page.

After confirming the weld configuration information, you can add a new intermittent weld task before the current weld task.

- **Add single weld backward:** Click “Add single weld backward” button, the keyboard will pop up, confirm the name of the weld, and enter the Add single weld task edit page.

After confirming the weld configuration information, you can add a new one-pass weld task after the current weld task.

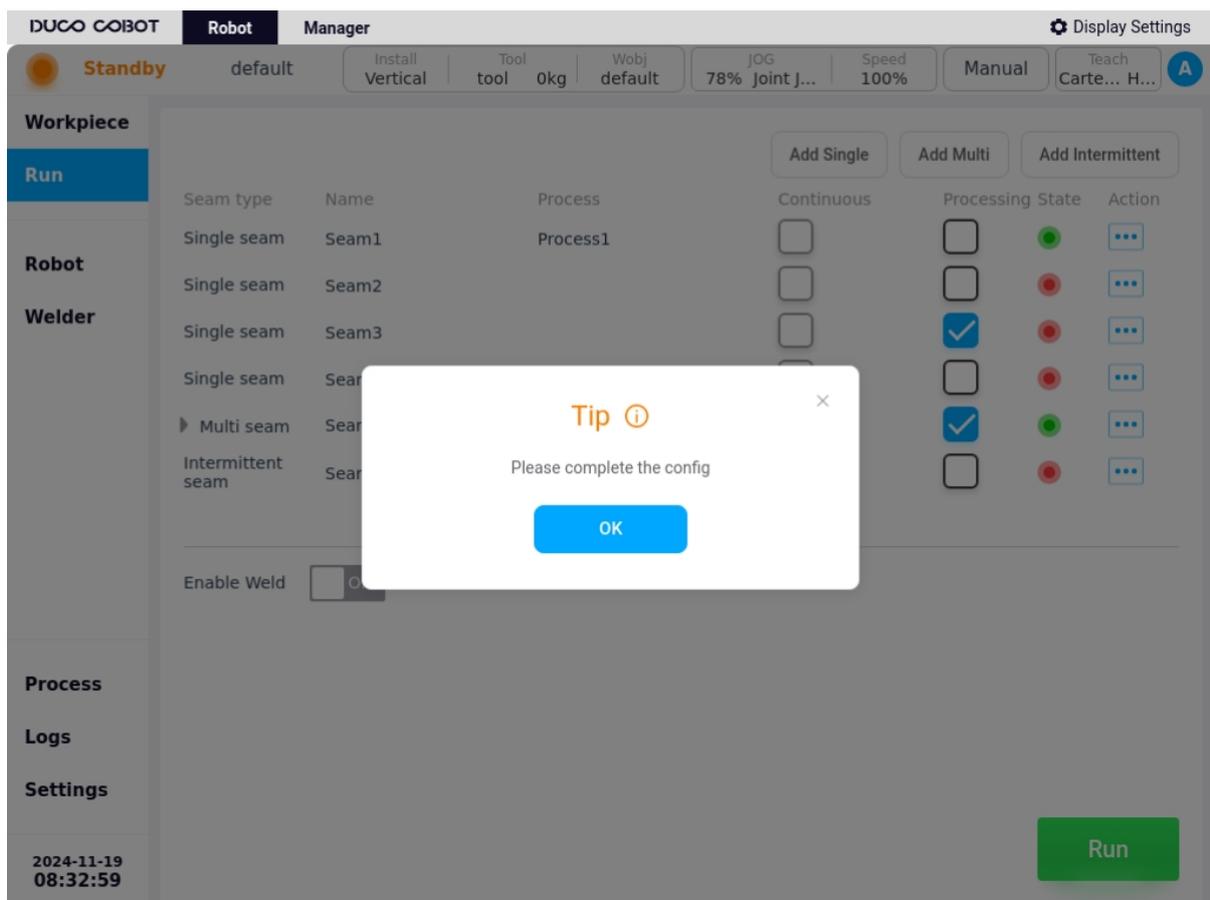
- **Adding multiple welds backward:** Click “Add multiple welds backward” button, the keyboard will pop up, confirm the name of the weld, and enter the Add Multiple Welds task editing page.

After confirming the weld configuration information, you can add a multi-layer multi-pass weld task after the current one.

- **Add Intermittent Seam:** Click “Add Intermittent Seam” button, the keyboard will pop up, confirm the seam name, and then enter the Add Intermittent Seam page.

After confirming the weld configuration information, you can add a new intermittent weld task after the current weld task.

After checking the weld to be processed, click the “Start” button at the bottom right corner of the weld execution page to start executing the weld task. If there are any unfinished configurations for the selected weld, a pop-up window will be displayed as shown below.



After confirming and configuring the weld seams that are checked for processing, the welding task can only be executed when the status bar of all checked weld seams shows a green status light.

Welding Mode When this parameter is enabled, the arc will start to weld, and when it is not enabled, it will weld with an empty running track. If you need to fine-tune some parameters during execution, you need

to turn on the welding online fine-tuning switch. You can turn on the “Enable online fine-tuning” switch in the “Basic Settings–Welding Settings” page. When running a weld, the parameters that can be adjusted are weld current, weld voltage. If you enable the Pendulum setting, you can also adjust the pendulum amplitude, pendulum frequency, and dwell time on both sides, as shown in the following figure.

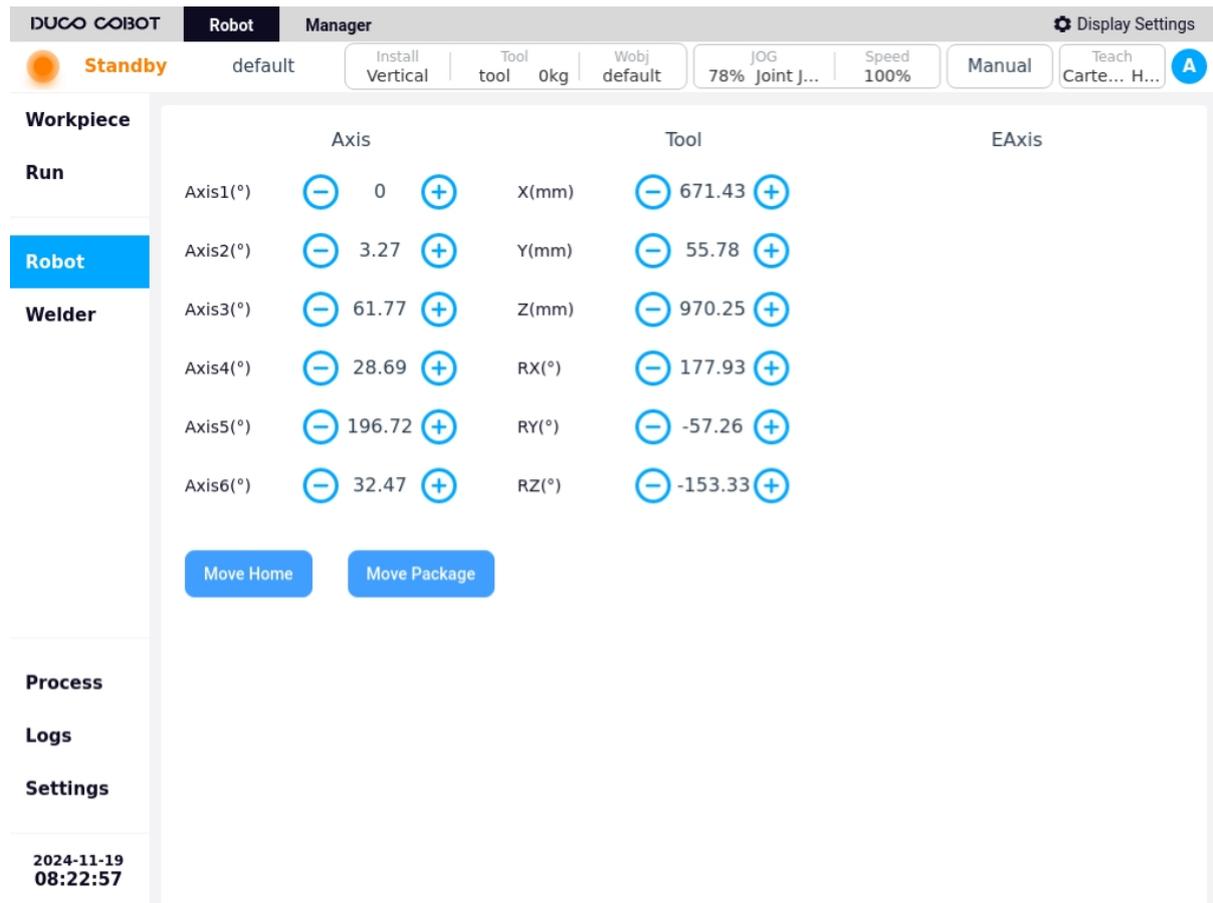
The screenshot displays the 'Robot Manager' interface for a DUCO COBOT. At the top, the status is 'Running' with a green indicator. Below this, various parameters are shown: 'Install Vertical', 'Tool tool 0kg', 'Wobj default', 'JOG 78% Joint J...', 'Speed 100%', 'Manual', and 'Teach Carte... H...'. The main area is divided into sections: 'Workpiece' (with 'Run' selected), 'Robot', 'Welder', 'Process', 'Logs', and 'Settings'. The 'Workpiece' section contains a table of seam configurations:

Seam type	Name	Process	Continuous	Processing State	Action
Single seam	Seam1	Process1	<input type="checkbox"/>	<input type="checkbox"/> ●	⋮
Single seam	Seam2		<input type="checkbox"/>	<input type="checkbox"/> ●	⋮
Single seam	Seam3		<input type="checkbox"/>	<input type="checkbox"/> ●	⋮
Single seam	Seam4		<input type="checkbox"/>	<input type="checkbox"/> ●	⋮
▶ Multi seam	Seam5	/	/	<input checked="" type="checkbox"/> ●	⋮
Intermittent seam	Seam6		/	<input type="checkbox"/> ●	⋮

Below the table, there is an 'Enable Weld' toggle switch set to 'OFF'. Under 'Process', the 'Current(A)' is set to 100 and 'Voltage(V)' is set to 20. At the bottom right, there are 'Pause' and 'Stop' buttons. The bottom left corner shows the date and time: '2024-11-19 08:31:16'.

2.5 Robot control

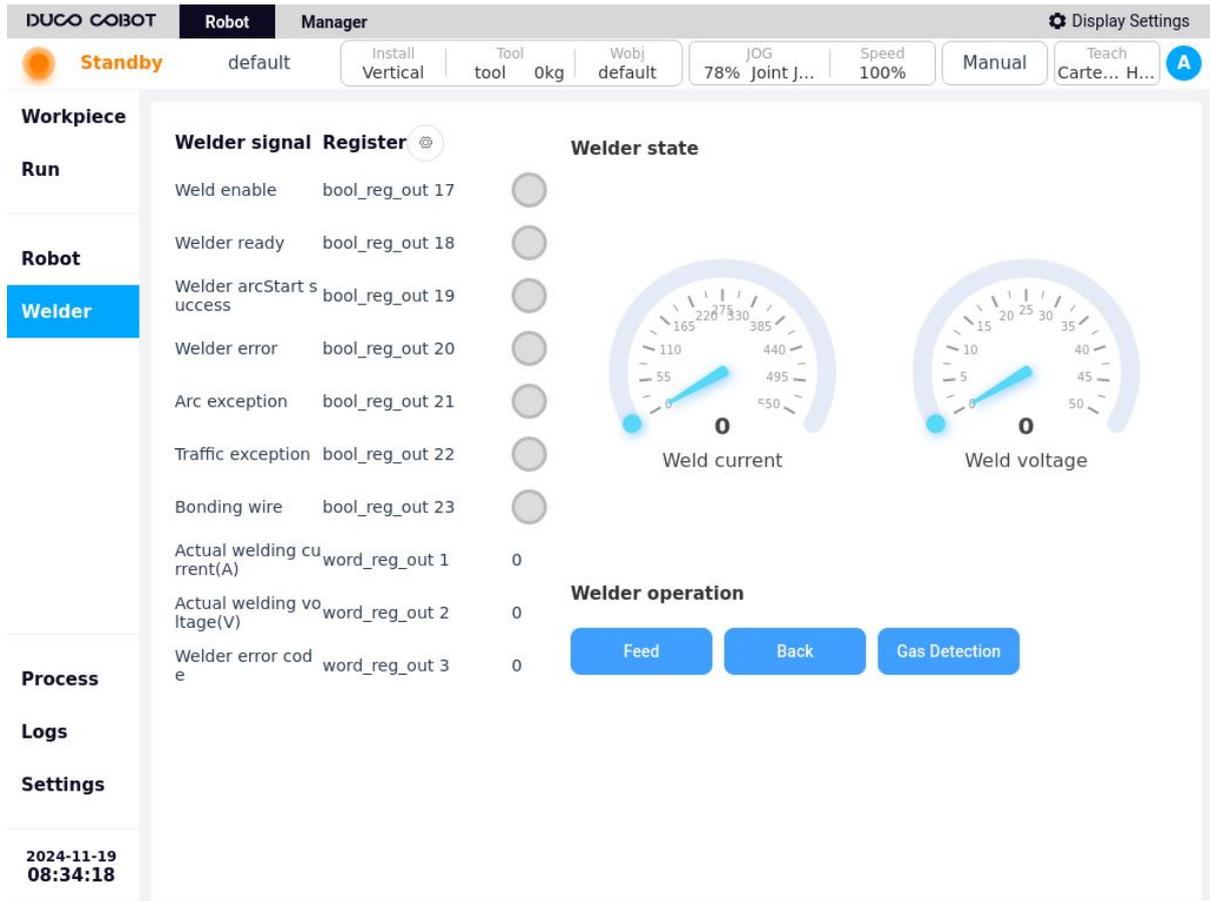
Click “Robot Control” in the navigation bar to enter the robot control page, as shown in the following figure.



The robot control page can do robot joint JOG, end Cartesian space JOG, and if external axes are installed, you can also do JOG operation for external axes. Long-pressing the “Move to HOME” button on the page can control the robot to move to the set home position; long-pressing the “Move to Packing Attitude” button on the page can control the robot to move to the set packing position. Long-pressing the “Move to Packing Position” button on the page can control the robot to move to the set packing position.

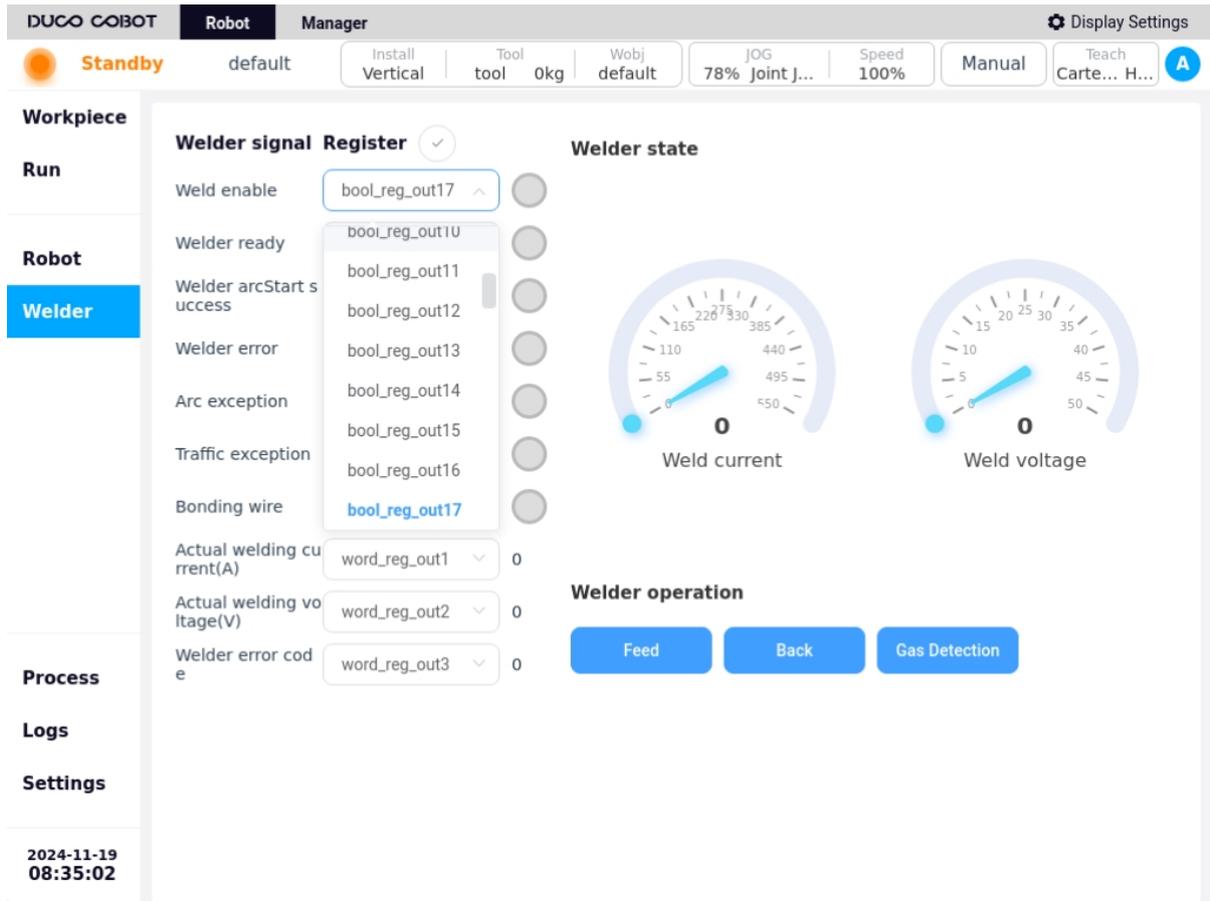
2.6 Welding machine control

Click “Welder Control” in the navigation bar to enter the welder control page, as shown below.



The welder control page is mainly used to display welder signals, welder status and welder operations. Among them, the welder signal can be configured to the register. This allows the robot controller to access

the welder information via profinet, modbus, TCP/IP, etc. Click on the  icon next to the registers to configure the registers. A list of configurable registers is displayed to the right of the signals, as shown in the following figure.



After completing the register configuration, click the  icon to save the configuration.

The status of the welder displays the weld current and weld voltage in real time as fed back from the welder. The unit of welding current is A, the unit of welding voltage is V.

The welder operates as follows:

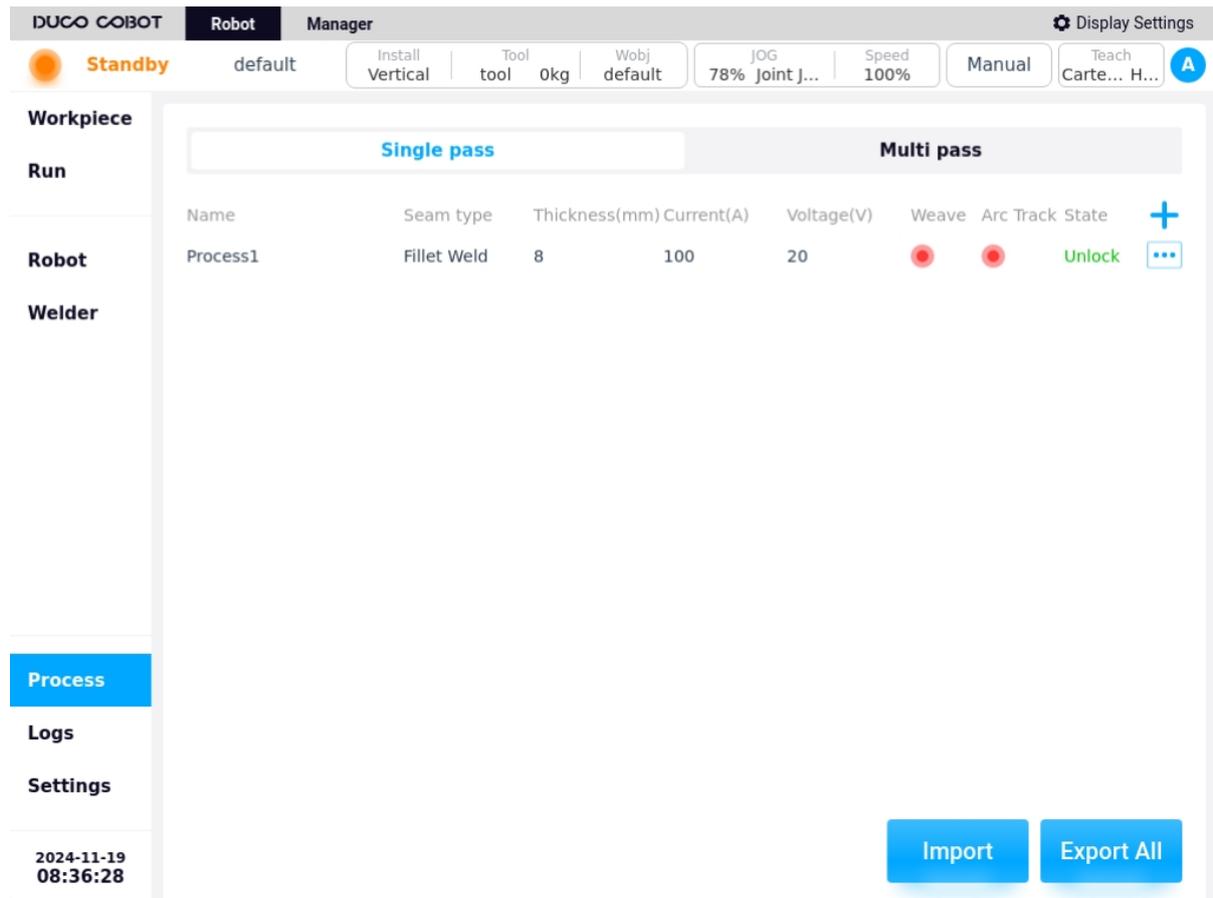
Tap Feed: Push button long press triggers to control the wire feeder to feed the wire, button release stops the wire feed;

Welding wire backdrawing: button long press trigger, control wire feeder back to the wire, button release will stop back to the wire;

Protective Gas Detection: Controls the welder gas valve to open, for detecting whether the gas supply is normal.

2.7 process library

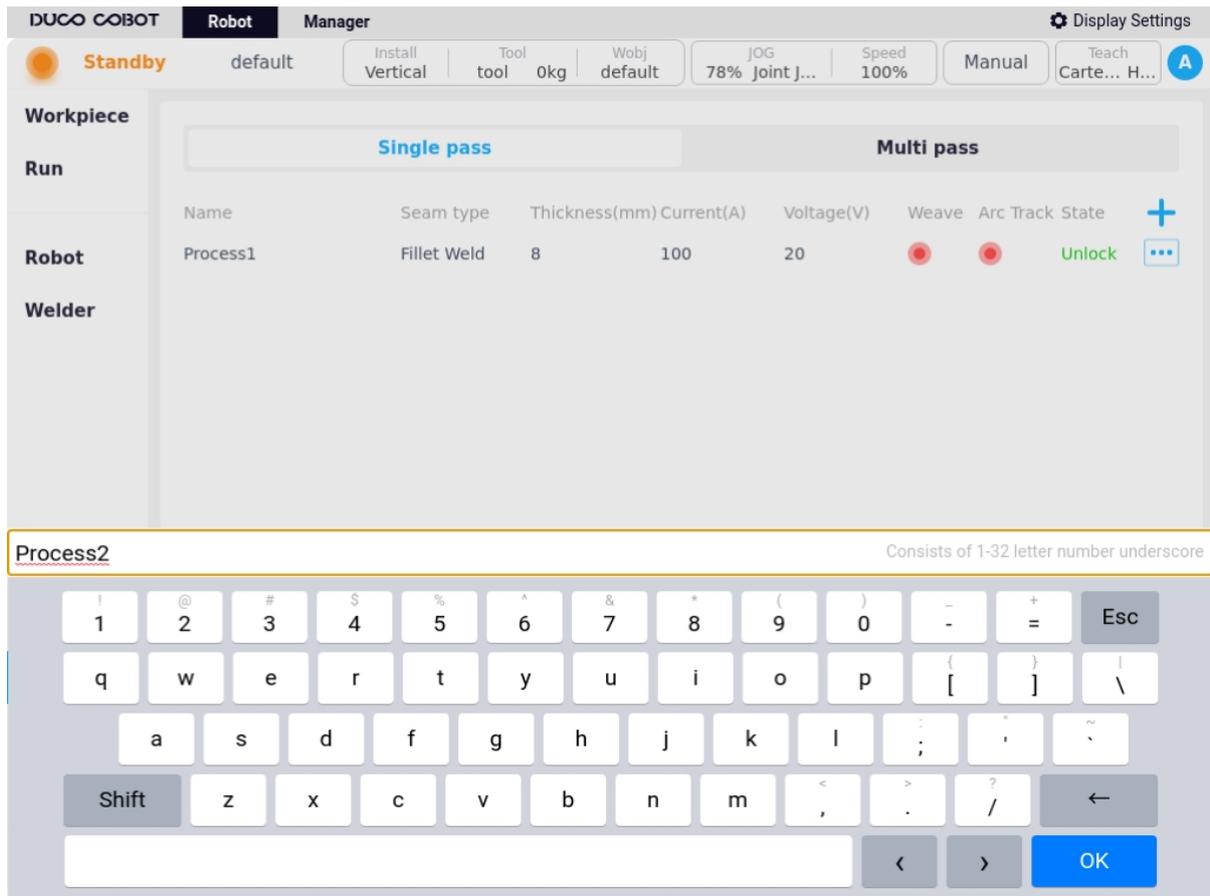
Click “Process Library” in the navigation bar to enter the process library page, the default into the single process list sub-page, as shown in the figure below.



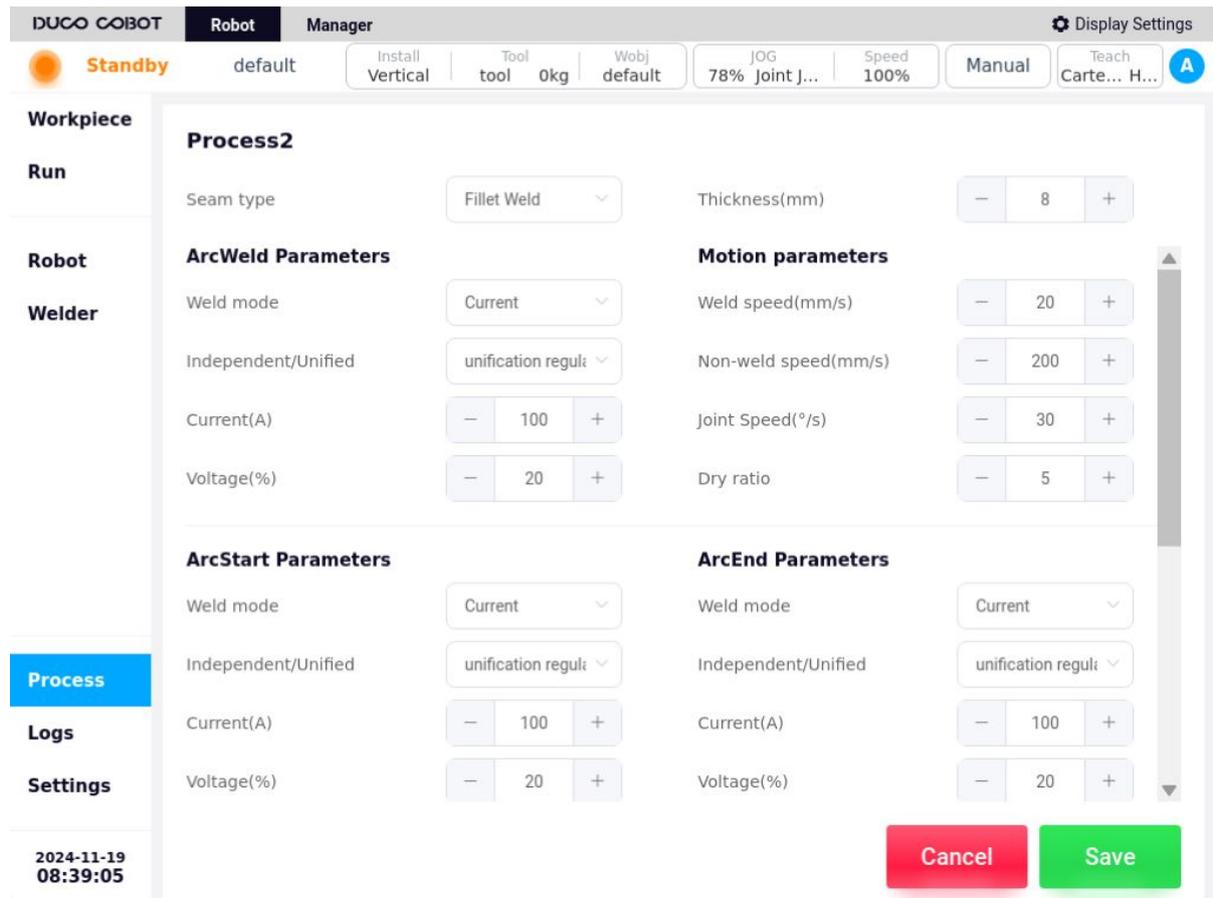
The Process Library page is used to manage all process files within the currently active project. There are two types of processes: single-pass and multi-pass. The process list mainly displays the process name, weld type/bevel type, plate thickness, welding current, welding voltage, whether pendulum welding is enabled or not, whether arc tracking is enabled or not, file status, and process file operation icons and buttons. The weld type is displayed for single-pass processes and the bevel type is displayed for multi-layer multi-pass processes; The unit of welding current is A, the unit of welding voltage is V. The file status includes open and locked.

2.7.1 Single-pass process

In the Single Process List sub-page, click the icon  to bring up the keyboard and generate the process name “Process X” by default, as shown in the following figure.



The process name can also be customized by the user. If you don't need to modify it, select the default process name and click the "OK" button on the keyboard. Enter the process editing page as shown below.



The process parameter editing page contains the following sections: seam type, plate thickness, welding parameters, motion parameters, arc start parameters, arc finish parameters, burnback parameters, pendulum welding settings, and arc tracking settings.

Types of welds: The types of single-pass welds are fillet welds, butt welds, and lap welds;

Plate thickness: Thickness of the weldment plate;

Welding parameters

- Welding mode: used to set the working mode of the welding torch, including: constant voltage mode, pulse mode, JOB mode and low spatter mode four;
- Independent/Unitary Mode: Independent mode is that the welding current and voltage are given separately; Unitary mode is that the welding voltage is automatically matched by the welder according to the current, and the adjustment size of the voltage can be specified;

Note: NOTE: For the Otto welder, set the

- Welding current: the value of current in the welding process, in A;
- Welding voltage: the value of voltage in the welding process, in V;

Movement parameters

- Welding speed: the speed at which the torch runs during the welding process;
- Non-welding section speed: torch running speed during non-welding process;
- Runaway multiplier: the multiplier of the welding speed without turning on the welding enable;

Arc initiation parameters

- **Welding Mode:** Used to set the working mode of the arc starting stage of the welding torch, including: constant voltage mode, pulse mode, JOB mode and low spatter mode four;
- **Independent / one-dimensional mode:** independent mode is the welding current and voltage are given separately; one-dimensional mode is the welding voltage is automatically matched by the welder according to the current, you can specify the size of the voltage adjustment;

Note: NOTE: For the Otto welder, set the

- **Arc current:** the value of welding current in the arc starting stage, in A. **Arc voltage:** the value of welding voltage in the arc starting stage, in V;
- **Arc voltage:** the value of welding voltage at the arc starting stage, in V;
- **Pre-feeding time:** the time to start sending shielding gas before starting the arc, in ms.
- **Arc start time:** the time to use the arc start parameter to weld after the arc start is successful;
- **Arc start pause time:** the time that the robot stays in place at the arc start point after the arc start is successful;
- **Arc detection time:** the maximum detection time from sending the arc command to the arc generated. If the arc is not detected within this time. The arc will be started again according to the “Arc Repeat Count”;
- **Arc Repeat Times:** the number of times the arc is restarted after detecting no arc.

Arc closing parameters

- **Welding mode:** used to set the working mode of the arc closing stage of the welding torch, including: constant voltage mode, pulse mode, JOB mode and low spatter mode four;
- **Independent / one-dimensional mode:** independent mode is the welding current and voltage are given separately; one-dimensional mode is the welding voltage is automatically matched by the welder according to the current, you can specify the size of the voltage adjustment;

Note: NOTE: For the Otto welder, set the

- **Arc closing current:** the value of welding current in A during arc closing stage;
- **Arc closing voltage:** the value of welding voltage at the arc closing stage, in V;
- **Delayed gas feeding time:** the time of delayed stopping and gas feeding after the completion of all welding work;
- **Arc closing time:** the time after the start of arc closing to arc closing parameters welding;
- **Arc closing pause time:** the time that the robot stays in place at the arc closing point after arc closing;
- **Drawback time:** the time to draw back the welding wire after arc closing;
- **Arc recovery and arc restart:** when this function is enabled, the arc will be restarted again after arc recovery to fill the arc crater, when enabled, you can define the delay time and arc start time

Burnback parameters

- **Burnback Parameter Enable Button:** used to enable or disable burnback;

- Burnback time: burnback time of the burnback parameter;

Pendulum welding setup

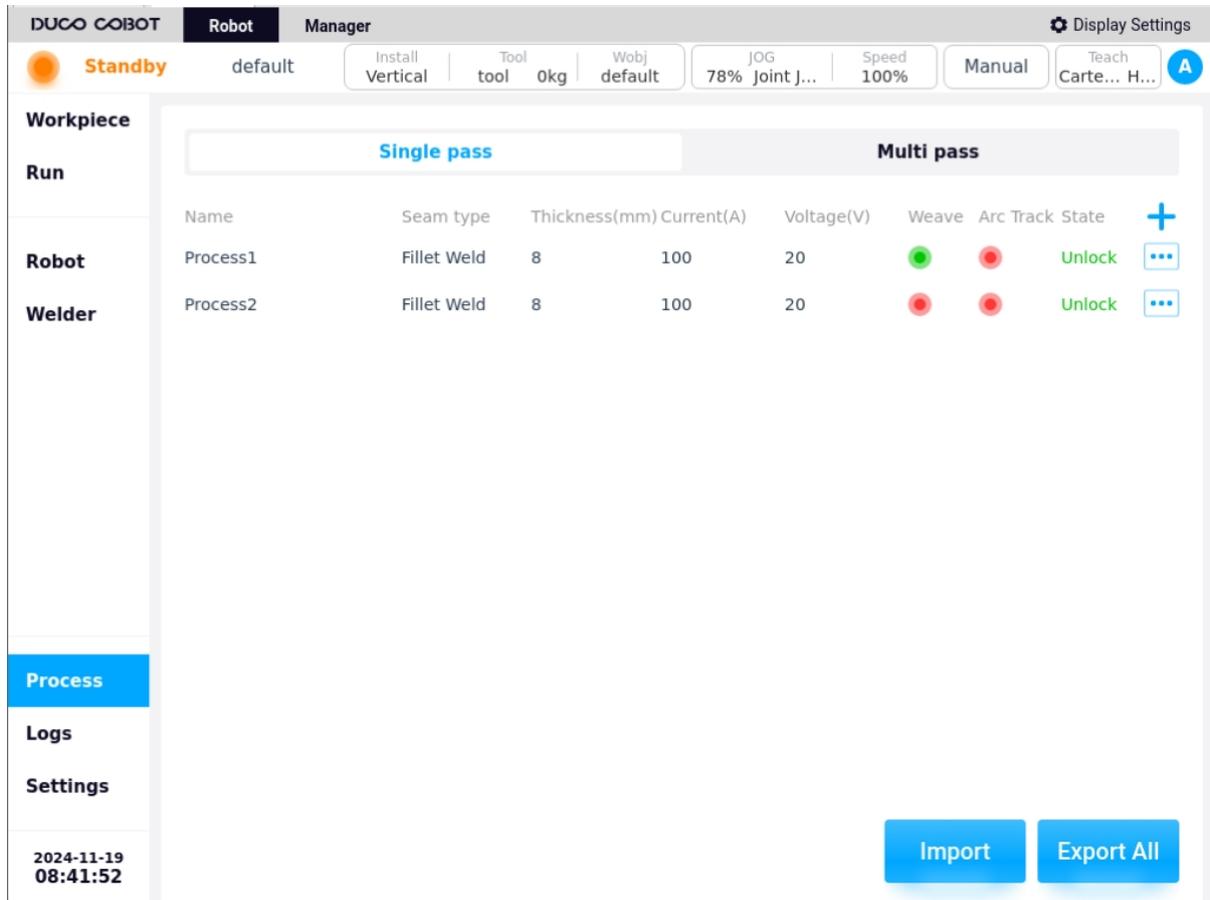
- Pendulum Welding Setting Enable Button: Used to enable or disable pendulum welding;
- Pendulum Welding Type: There are 5 types of pendulum welding types: Triangle, Sine, Arc, Trapezoid, and '8';
- Reference Plane: the plane of reference for the pendulum welding process can be selected as: Tool XOY, Tool XOZ, Tool YOZ, Workpiece XOY, Workpiece XOZ, Workpiece YOZ;
- Oscillation frequency: set the frequency of the pendulum welding process, unit HZ;
- Oscillation amplitude: set the amplitude in the oscillation welding process, unit m;
- Left dwell time: only when the pendulum welding mode is selected as sinusoidal or trapezoidal, the parameter needs to be configured, the unit is ms;
- Right dwell time: a parameter to be configured only when the pendulum welding mode is selected as sinusoidal or trapezoidal, the unit is ms;
- Main path synchronization stay: only when the welding mode is sinusoidal or trapezoidal, the parameter needs to be configured, the default is unchecked; when the parameter is checked, the main path of the robot movement can be stopped at the same time during the left and right stay process;

Arc tracking setup

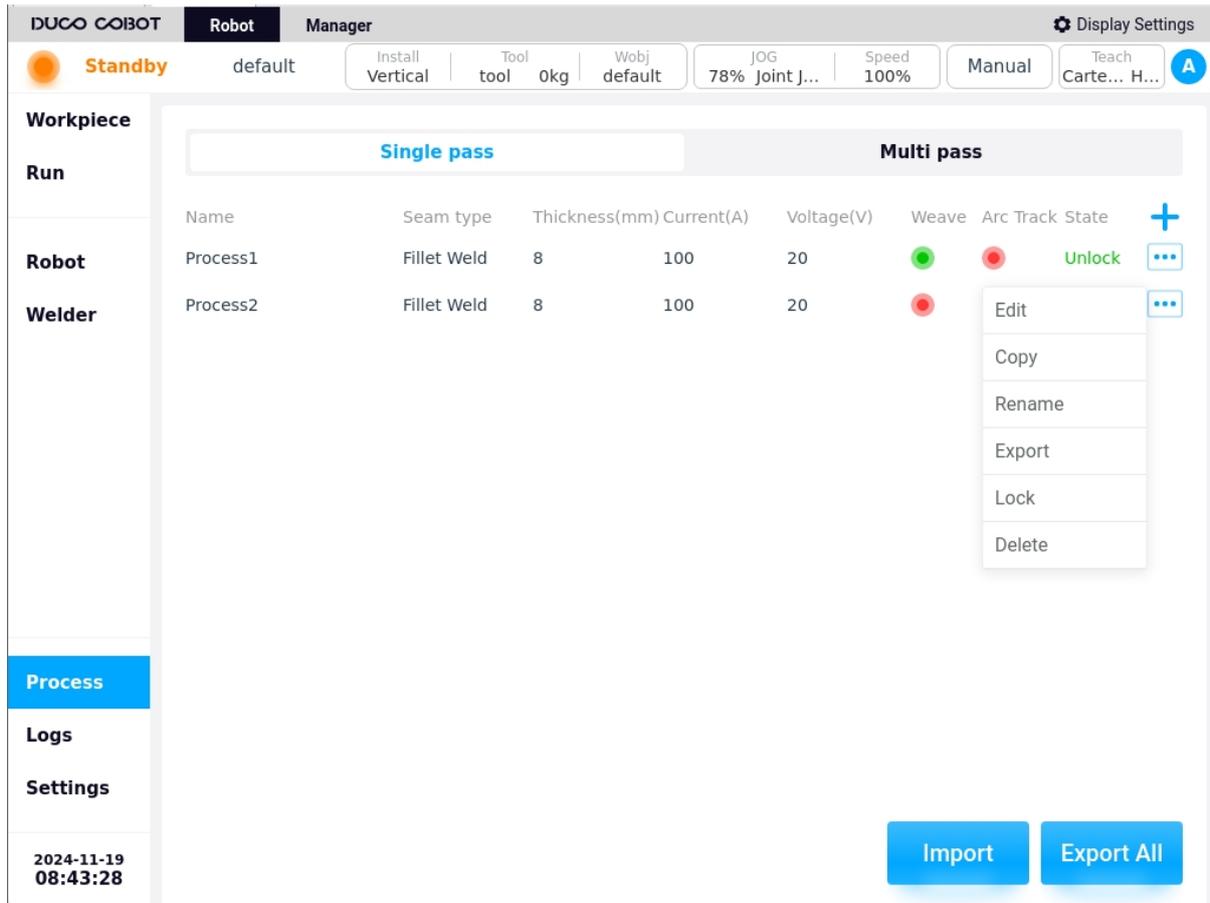
- Arc Trace Enable button: used to enable or disable arc tracing;
- Type: the way of arc tracking, options are end clearing path information, end retaining path information, use recorded path information;
- Compensation direction: set the compensation direction of arc tracking, optional Y direction or Z direction, i.e. left-right direction or up-down direction;
- Reference current (A): arc tracking reference current data value, unit A, default value is 20;
- Maximum compensation distance limit Y (mm): maximum compensation distance value in Y direction, unit mm, default value 100;
- Maximum compensation distance limit Z (mm): maximum compensation distance value in Z direction, unit mm, default value 100;
- Cycle queue coefficient: data acquisition length coefficient, K swing cycles without tracking, unit is times, default value is 2;
- Lag time: current feedback data lag time, different welder, different lag time, unit ms, default value 165;
- Tracking start time: delay tracking time, to avoid current instability at the beginning of the arc start stage, affecting the tracking effect, the unit is ms, the default value is 2000;
- Y-direction sensitivity coefficient: adjust the parameter of Y-direction deskewing ability, the default value is 0.5, and the recommended sensitivity coefficient setting is 0.3-1.0;
- Z-direction sensitivity coefficient: the parameter to adjust the ability of Z-direction deviation correction, the default value is 0.5, and the recommended sensitivity coefficient setting is 0.3-1.0;
- Current Difference Constant: the default value is 12, the constant used for tracking algorithm, the default is 12 when the wire diameter is 1.2mm;

- Current Difference Setting Value: the default value is 2, used for current difference in the set value range without corrective action;

After setting the process parameters, click the “Save” button in the lower right corner of the editing page to return to the process list page, as shown in the figure below.



Click the operation icon  for any process in the process list, and the popup window is displayed as follows.



Process operating functions:

- **Export:** Click “Export” to export the process file to USB flash drive.
- **Copy:** Click “Copy” to bring up the keyboard, the process name to be copied will be suffixed with “_copyxx” by default, as shown in the figure below. Users can also modify and rename the process file according to the naming rules.

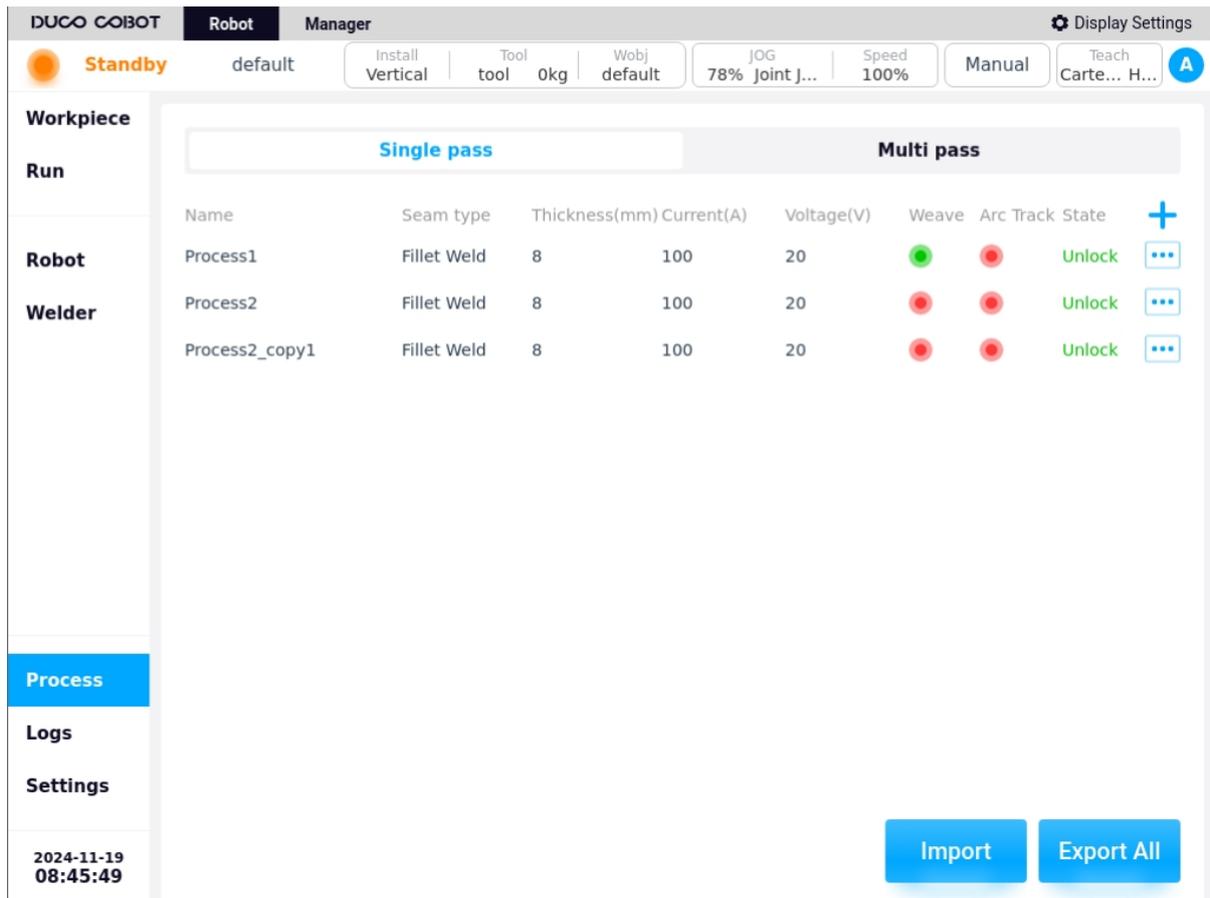
The screenshot shows the DUCO COBOT Manager interface. At the top, it displays 'DUCO COBOT', 'Robot', and 'Manager' tabs. The status is 'Standby' with a 'default' profile. Parameters include 'Install Vertical', 'Tool tool 0kg', 'Wobj default', 'JOG 78% Joint J...', 'Speed 100%', and 'Manual' mode. A 'Display Settings' icon is in the top right.

The main area is divided into 'Workpiece' and 'Run' sections. Under 'Run', there are two tabs: 'Single pass' (selected) and 'Multi pass'. Below these is a table with columns: Name, Seam type, Thickness(mm), Current(A), Voltage(V), Weave, Arc Track, State, and a plus sign icon.

Name	Seam type	Thickness(mm)	Current(A)	Voltage(V)	Weave	Arc Track	State	
Process1	Fillet Weld	8	100	20	●	●	Unlock	⋮
Process2	Fillet Weld	8	100	20	●	●	Unlock	⋮

Below the table, a text input field contains 'Process2_copy1' and a note says 'Consists of 1-32 letter number underscore'. A keyboard overlay is shown at the bottom, with a blue 'OK' button highlighted.

Click the keyboard “OK” button to copy successfully, the display is as follows.



- **Rename:** Clicking “Rename” will bring up the keyboard, enter the new process name and then OK to modify.
- **Edit:** Clicking “Edit” will enter the parameter editing page of the selected process file, and you can edit its parameters.
- **Lock/Open:** You can lock or open the process file.

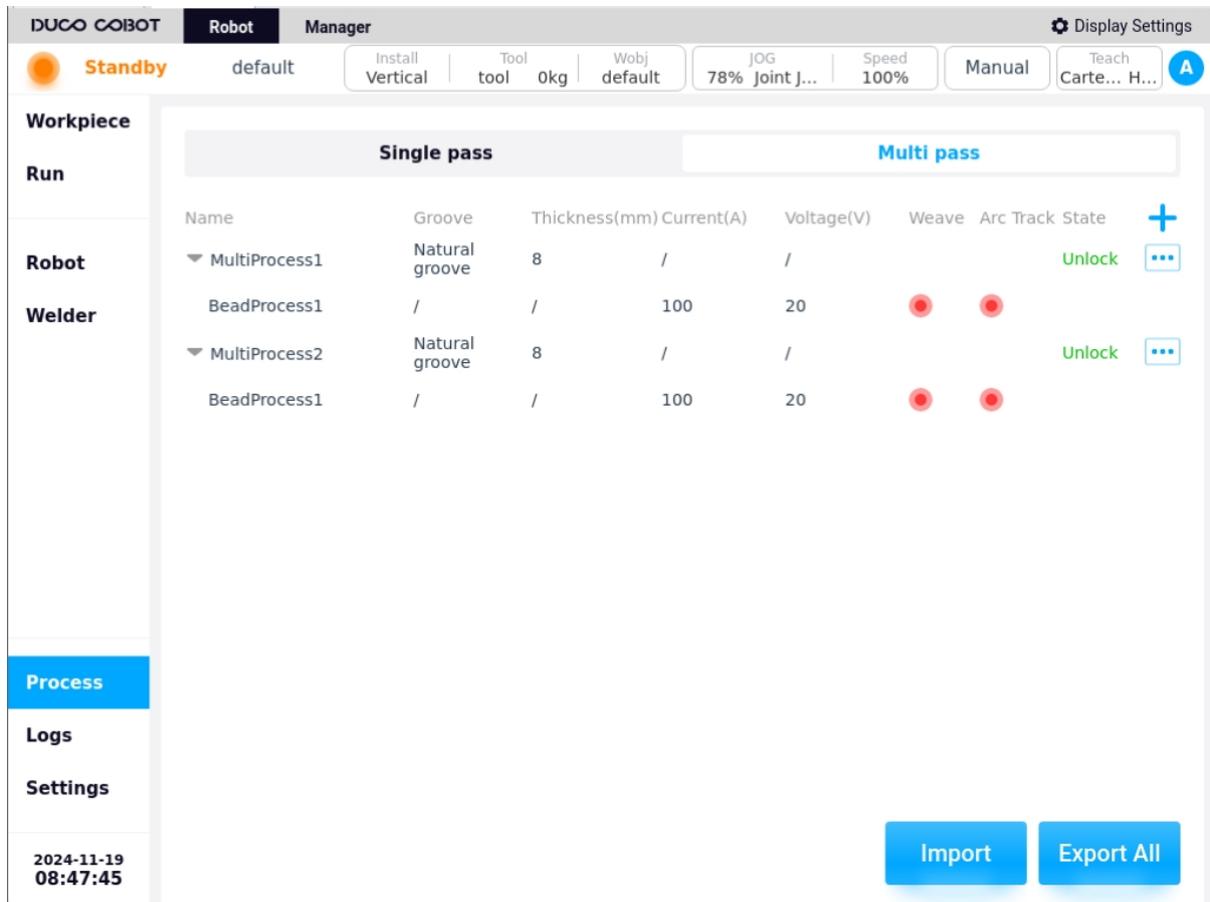
Note: Note: This action is only available in advanced mode

- **Delete:** Clicking “Delete” will bring up a confirmation dialog box, and the process file can be deleted after confirmation.

Note: Note: Locked crafts cannot be deleted

2.7.2 Multi-pass process

Click the “Multi pass” tab at the top of the Process Library page to enter the Multi-layer Multi-channel process list sub-page, as shown in the following figure.

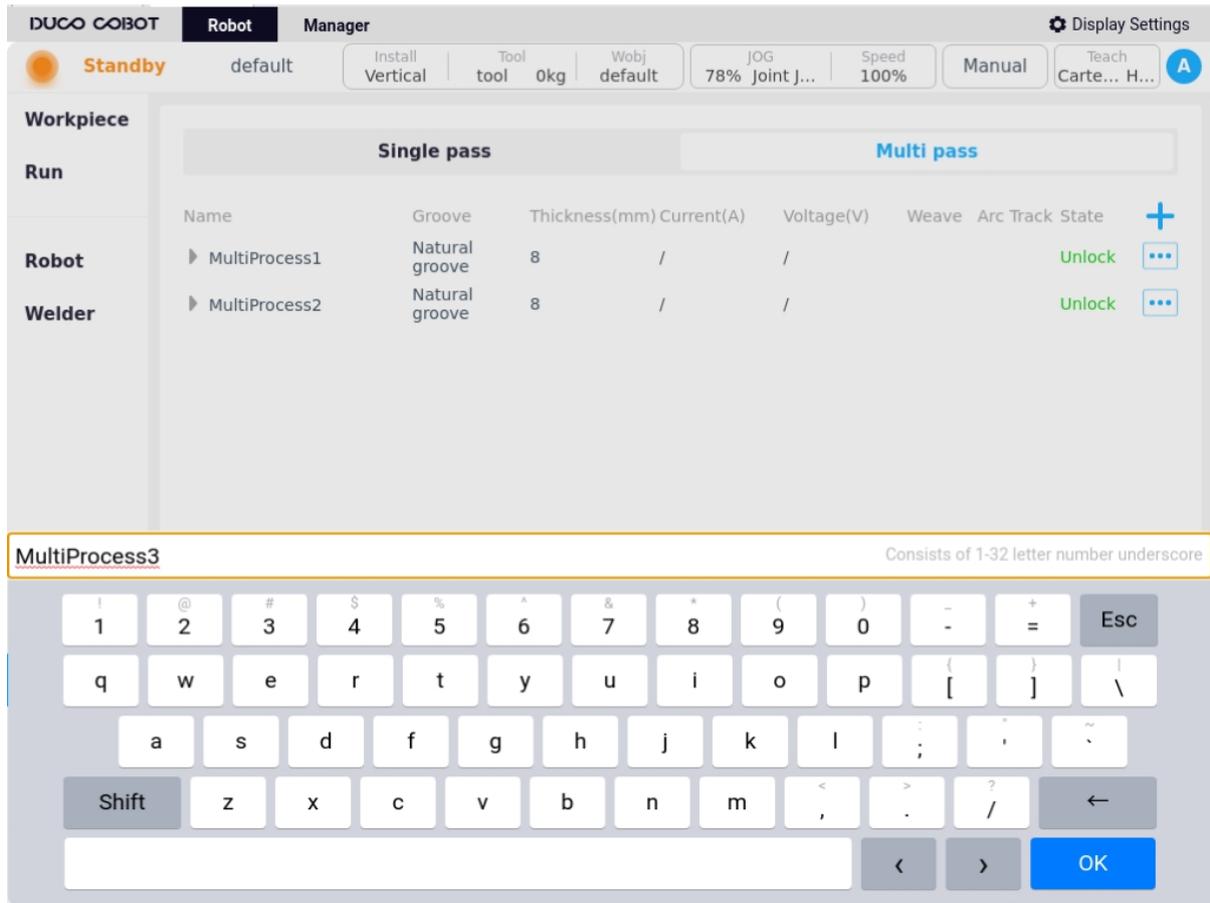


A multi-pass process is a combination of processes containing multiple weld passes and is created in the process list as a combination process. A multi-layer multi-pass process is a combination of multiple weld pass processes. Click on the icon  to expand the multiple weld passes contained in a multi-layer multi-pass process, and click on the icon  to collapse it, as shown in the following figure.

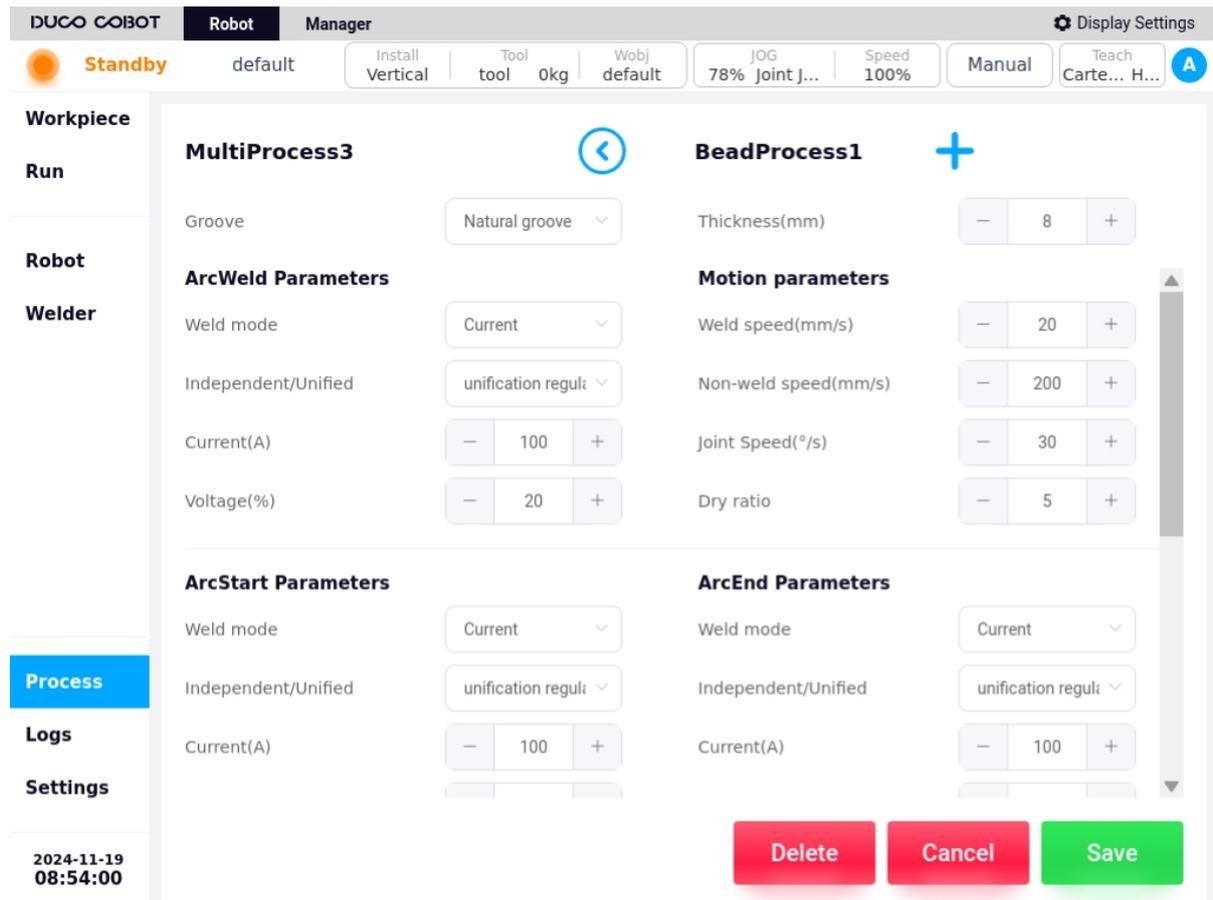
The screenshot shows the 'Robot Manager' interface for a DUCO COBOT. The top bar includes 'Standby' status, 'default' mode, and various control buttons like 'Install Vertical', 'Tool 0kg', 'Wobj default', 'JOG 78% Joint J...', 'Speed 100%', 'Manual', and 'Teach Carte... H...'. The main area displays a table of processes under 'Single pass' and 'Multi pass' tabs. The table has columns for Name, Groove, Thickness(mm), Current(A), Voltage(V), Weave, Arc Track, and State. Two process groups are visible: MultiProcess1 and MultiProcess2, each containing a BeadProcess1. The State column shows 'Unlock' and a plus icon for each group. A sidebar on the left contains 'Workpiece', 'Run', 'Robot', 'Welder', 'Process', 'Logs', and 'Settings'. At the bottom right, there are 'Import' and 'Export All' buttons. The date and time '2024-11-19 08:47:45' are shown in the bottom left corner.

Name	Groove	Thickness(mm)	Current(A)	Voltage(V)	Weave	Arc Track	State
MultiProcess1	Natural groove	8	/	/			Unlock
BeadProcess1	/	/	100	20	●	●	
MultiProcess2	Natural groove	8	/	/			Unlock
BeadProcess1	/	/	100	20	●	●	

Click the icon  to bring up the keyboard and generate the process name “Multi-layer Multi-pass Process X” by default, as shown in the following figure.

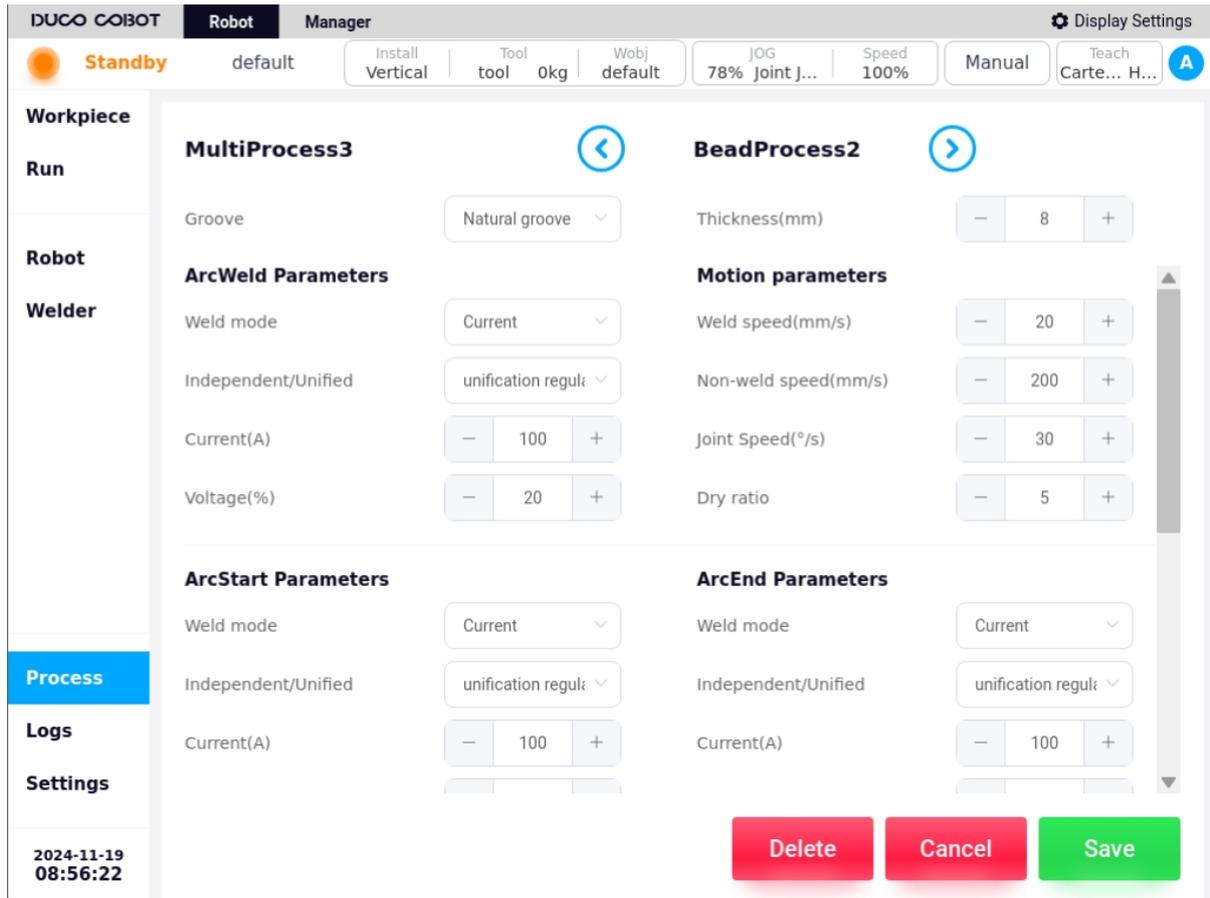


Similarly, the process name can be customized by the user. If you don't need to modify it, select the process name generated by default and click "OK" button on the keyboard. Enter the process editing page as shown below.



The types of process parameters on the Multi-Layer Multi-Pass Process Edit page are the same as those for the Single-Pass Process, and will not be repeated here. The difference is that the multi-layer multi-pass process needs to be configured with bevel types. There are seven types of bevels to choose from: natural,

single V, V-type, steep-edge bevel, U-type bevel, single steep-edge bevel, and J-type bevel. Click the  icon at the top of the page to add a new weld process, the weld process name is generated by default “weld process x”, the process parameters are the same as above, as shown in the figure below.



Users can add multiple weld passes sequentially by using the  icon, and can switch to different weld

passes by using the  and  icons to edit the process parameters of the corresponding weld passes. After editing the process parameters, click “Save” button to return to the process list page. Users can also delete a process by clicking the “Delete” button on the process editing page. For example, the newly created “Multilayer Multi-Pass Process 3” has 3 passes added, as shown in the figure below.

DUCO COBOT Robot Manager Display Settings

Standby default Install Vertical Tool tool 0kg Wobj default JOG 78% Joint J... Speed 100% Manual Teach Carte... H... A

Workpiece

Run

Robot

Welder

Process

Logs

Settings

2024-11-19
08:57:48

Single pass
Multi pass

Name	Groove	Thickness(mm)	Current(A)	Voltage(V)	Weave	Arc Track	State	
▼ MultiProcess1	Natural groove	8	/	/			Unlock	+
BeadProcess1	/	/	100	20	●	●		
▼ MultiProcess2	Natural groove	8	/	/			Unlock	...
BeadProcess1	/	/	100	20	●	●		
▼ MultiProcess3	Natural groove	8	/	/			Unlock	...
BeadProcess1	/	/	100	20	●	●		
BeadProcess2	/	/	100	20	●	●		
BeadProcess3	/	/	100	20	●	●		

Import
Export All

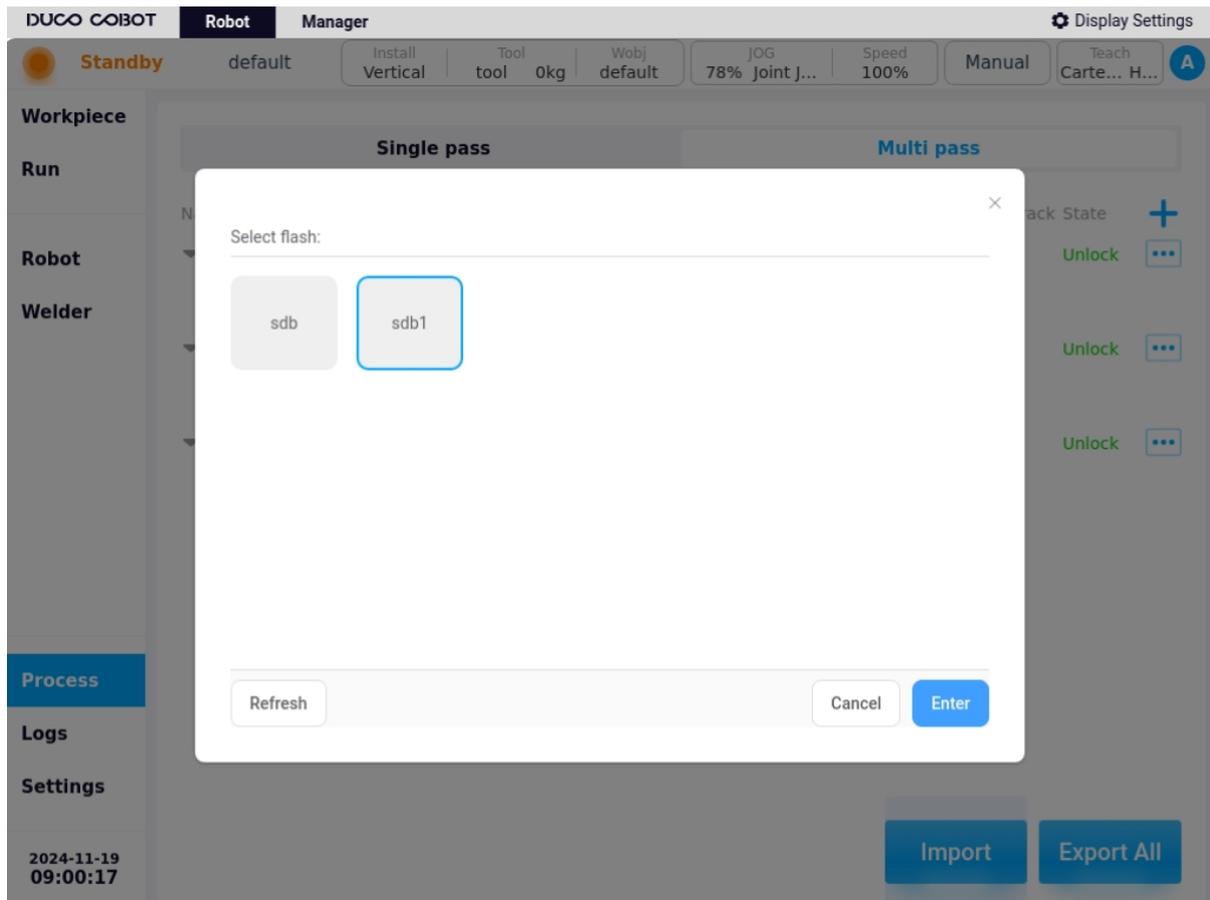
Similarly, clicking on any of the Multi-Layer Multi-Pass Process List  icons results in the pop-up window shown below. The operation functions of multi-layer multi-channel processes are described in the Single Process Operation Functions, which will not be repeated here.

The screenshot shows the DUCO COBOT Robot Manager interface. The top bar includes 'DUCO COBOT', 'Robot Manager', and 'Display Settings'. The status is 'Standby' with 'default' mode. Control buttons include 'Install Vertical', 'Tool 0kg', 'Wobj default', 'JOG 78% Joint J...', 'Speed 100%', 'Manual', and 'Teach Carte... H...'. The left sidebar has 'Workpiece', 'Run', 'Robot', 'Welder', 'Process', 'Logs', and 'Settings'. The main area shows a table of processes:

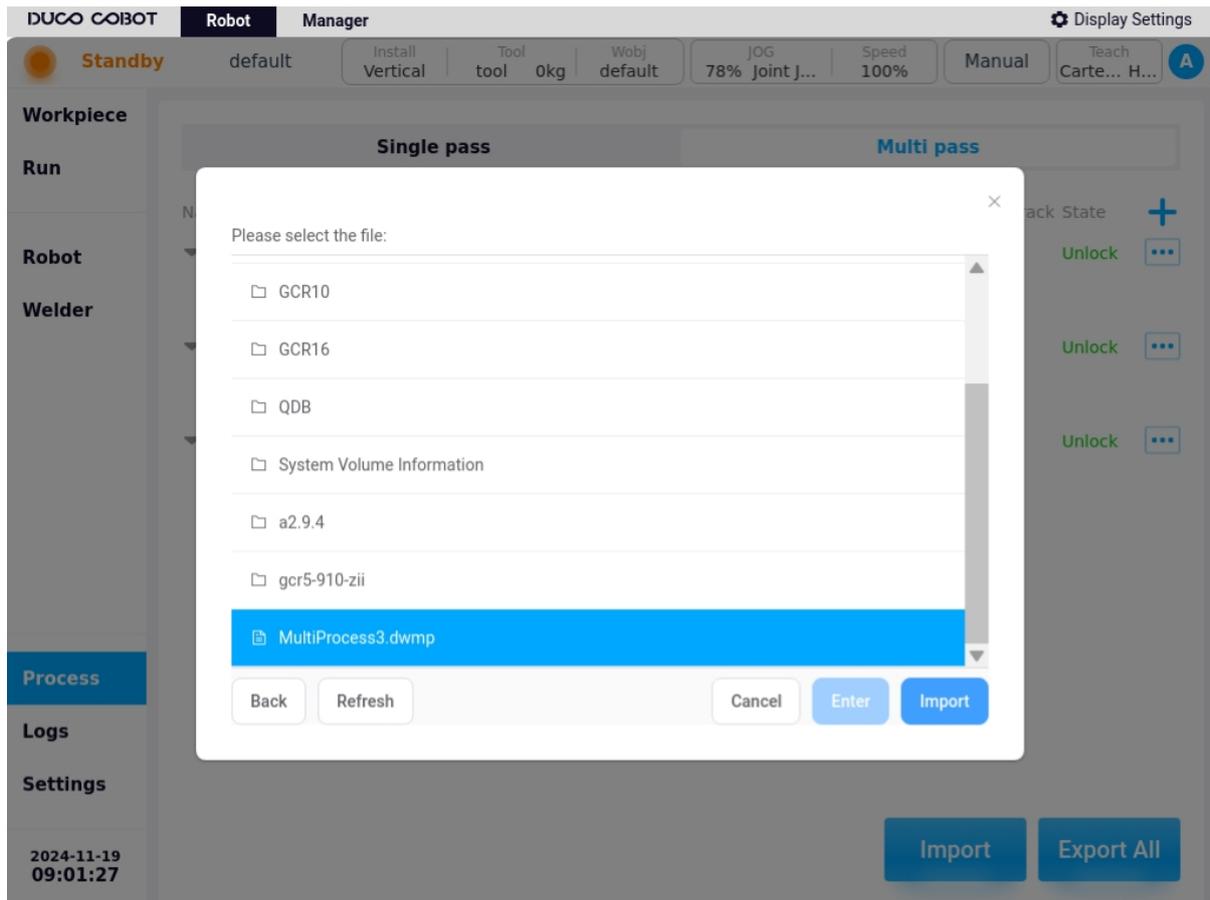
Name	Groove	Thickness(mm)	Current(A)	Voltage(V)	Weave	Arc Track	State
MultiProcess1	Natural groove	8	/	/			Unlock
BeadProcess1	/	/	100	20	●	●	
MultiProcess2	Natural groove	8	/	/			Unlock
BeadProcess1	/	/	100	20	●	●	
MultiProcess3	Natural groove	8	/	/			
BeadProcess1	/	/	100	20	●		
BeadProcess2	/	/	100	20	●		
BeadProcess3	/	/	100	20	●		

The context menu is open over the table, showing options: Edit, Copy, Rename, Export, Lock, Delete. At the bottom right, there are 'Import' and 'Export All' buttons. The date and time '2024-11-19 08:58:44' are shown in the bottom left.

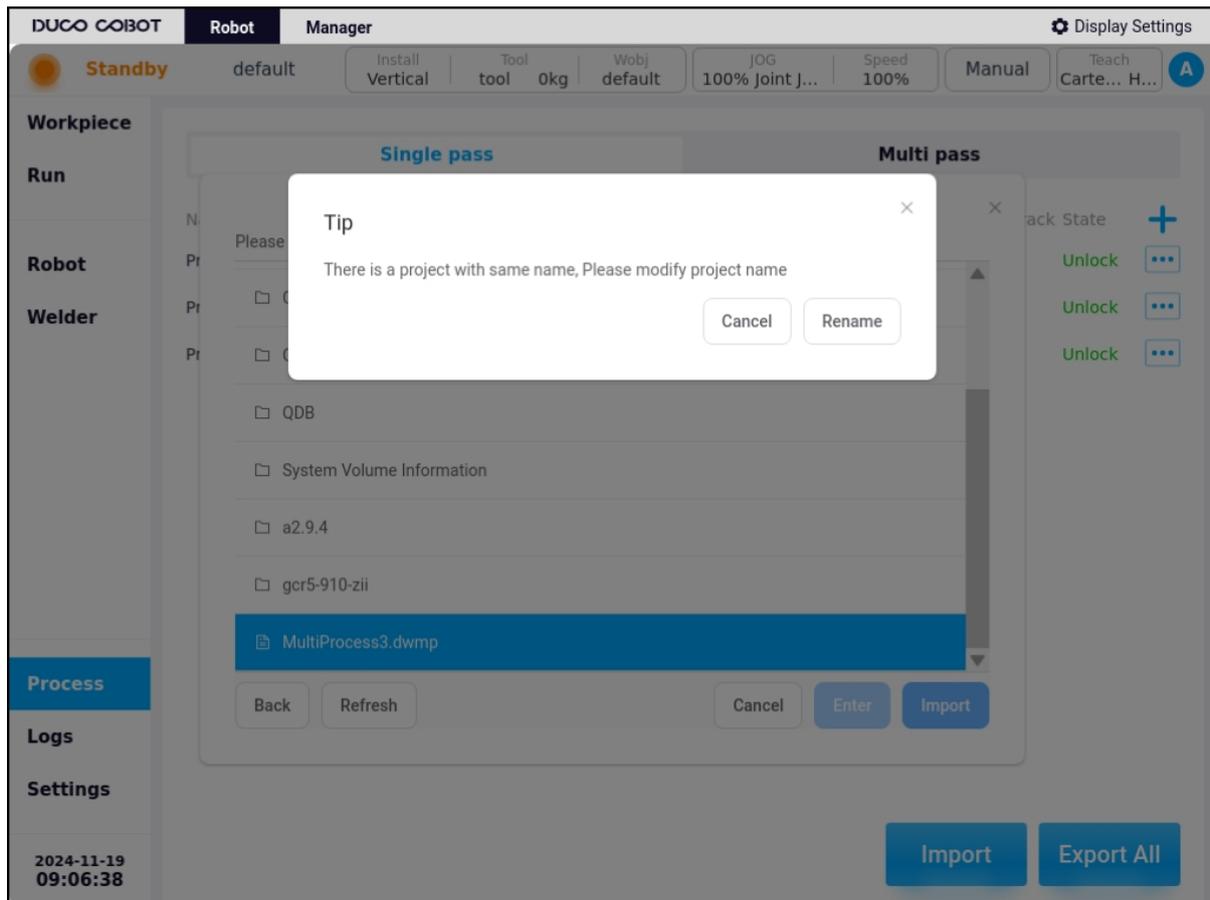
Click the “Import” button in the lower right corner of the process library page to bring up a window showing the USB storage devices currently mounted on the control cabinet, as shown in the following figure.



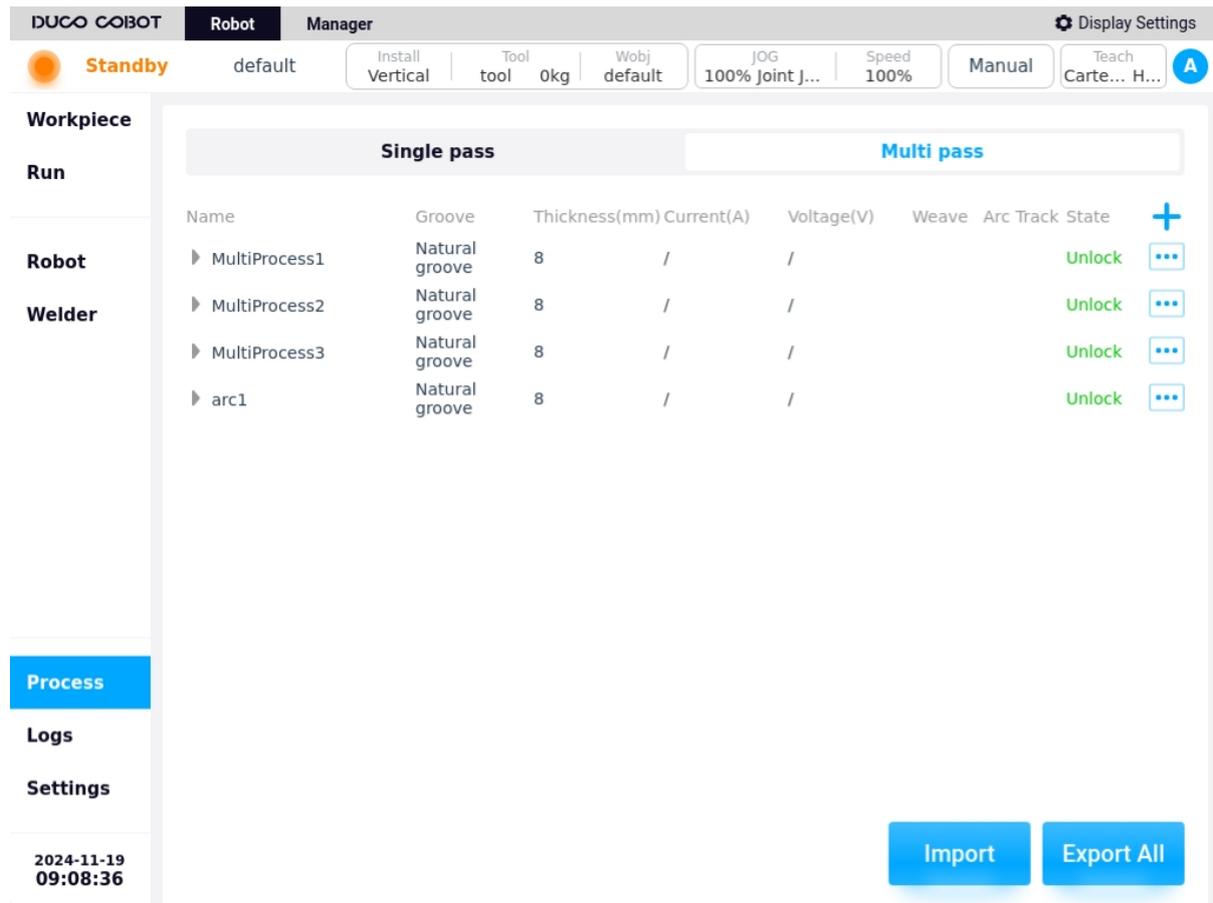
Select a device and the page displays the folders and eligible files in that device. Where the single-pass process file zip package has the suffix dwp, the The multi-layer multi-channel process file zip file has the suffix dwmp, as shown in the figure below. Selecting a file and clicking the “Import” button will import the file into the cabinet.



When importing a file and checking that the imported file is renamed with the workpiece on the control cabinet, a rename prompt box will pop up. For example, if you select the single-pass process zip file “Process 1.dwp”, the pop-up window is shown below.



Click the “Change Import Name” button, the keyboard will pop up, enter the new name of the artifact, such as “pro_test”, after the import is successful, it will be displayed as below in the list of single-pass processes sub-page.

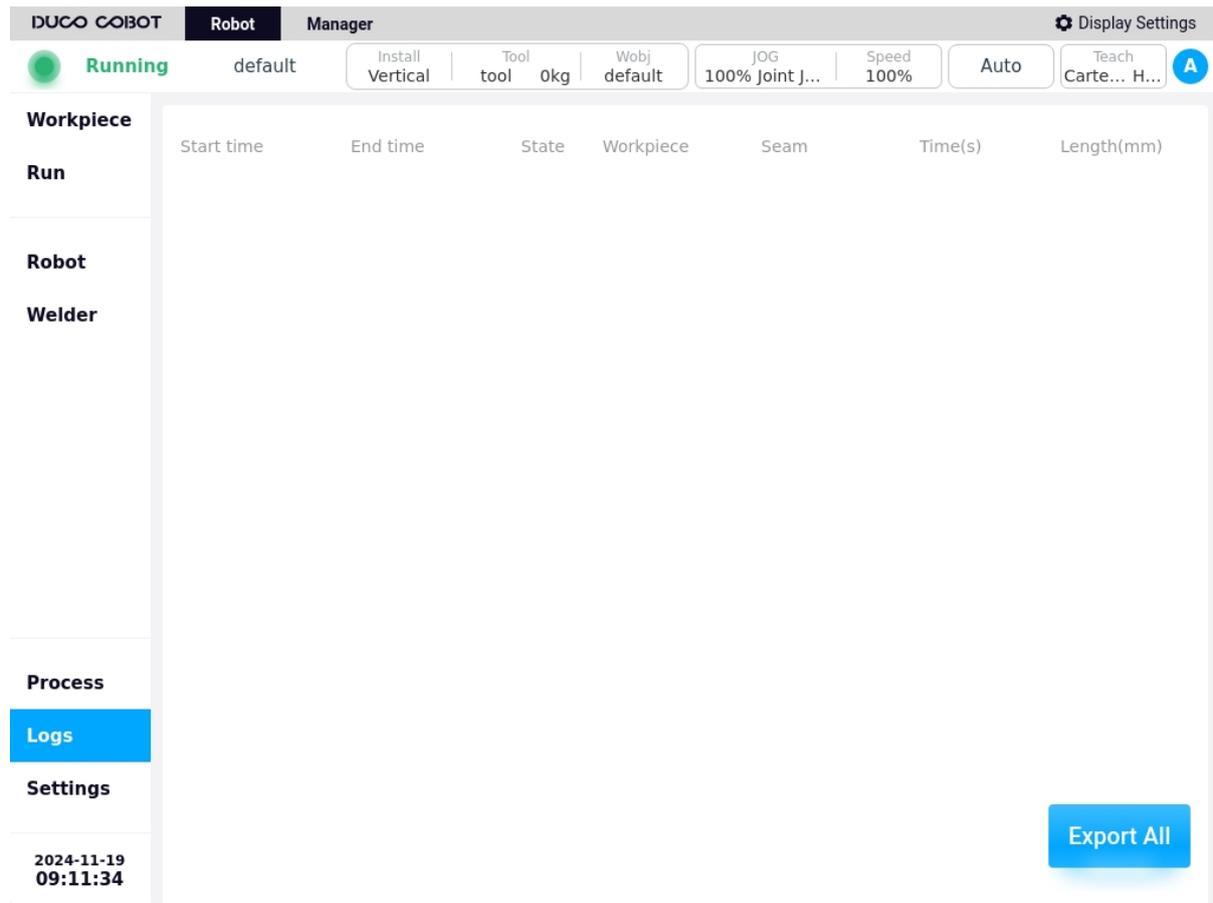


Similarly, if the user selects a multi-layer multi-channel process zip archive will add a new multi-layer multi-channel process information display on the Multi-Layer Multi-Channel Process List sub-page after successful import.

Click the “Export All” button at the bottom right corner of the process page to bring up a window showing the USB storage devices mounted on the current control cabinet, select the export location and click the “Export” button. Then all the process files of single-channel process and multi-channel process will be compressed and packaged and exported to the USB device, and the exported compressed package will be named as “processLib.plib”.

2.8 Mission log

Click “Logs” in the navigation bar to enter the Task Log page, as shown in the following figure.



The Task Log page mainly shows that each time a weld task is performed, a weld message is recorded, including start time, end time, status, workpiece name, Weld Name, Weld Time, and Weld Length.

Click the “Export All” button at the bottom right corner of the page to export all the task logs to an external USB flash drive.

2.9 User mode

Welding Process Pack V2 defines two user modes: normal user, advanced user. The main differences are
Advanced Users:

Premium users have access to all features of the system

Common Users:

Ordinary users cannot switch to the robot page. Ordinary users cannot unlock, modify, or delete locked process library files.

Clicking the button on the right side of the top status bar allows you to switch user modes in the drop-down menu, and advanced users can change the password for mode switching.

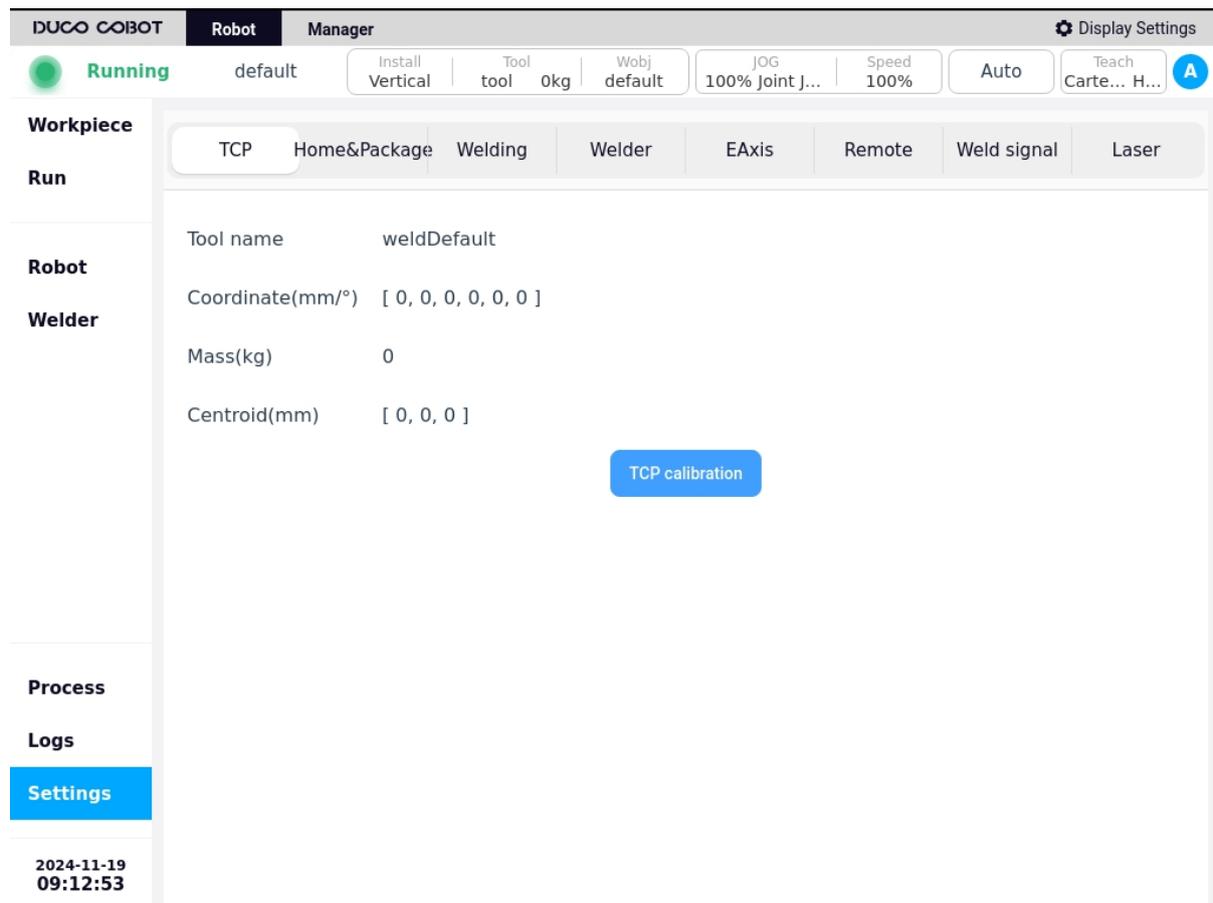
**CHAPTER
THREE**

BASIC SETTINGS

Click “Basic Settings” in the navigation bar to enter the Basic Settings page, and by default, it enters the TCP calibration sub-page. The basic setting mainly includes 6 sub-pages, including TCP calibration, origin setting, packing setting, welding setting, welder setting and external axis configuration.

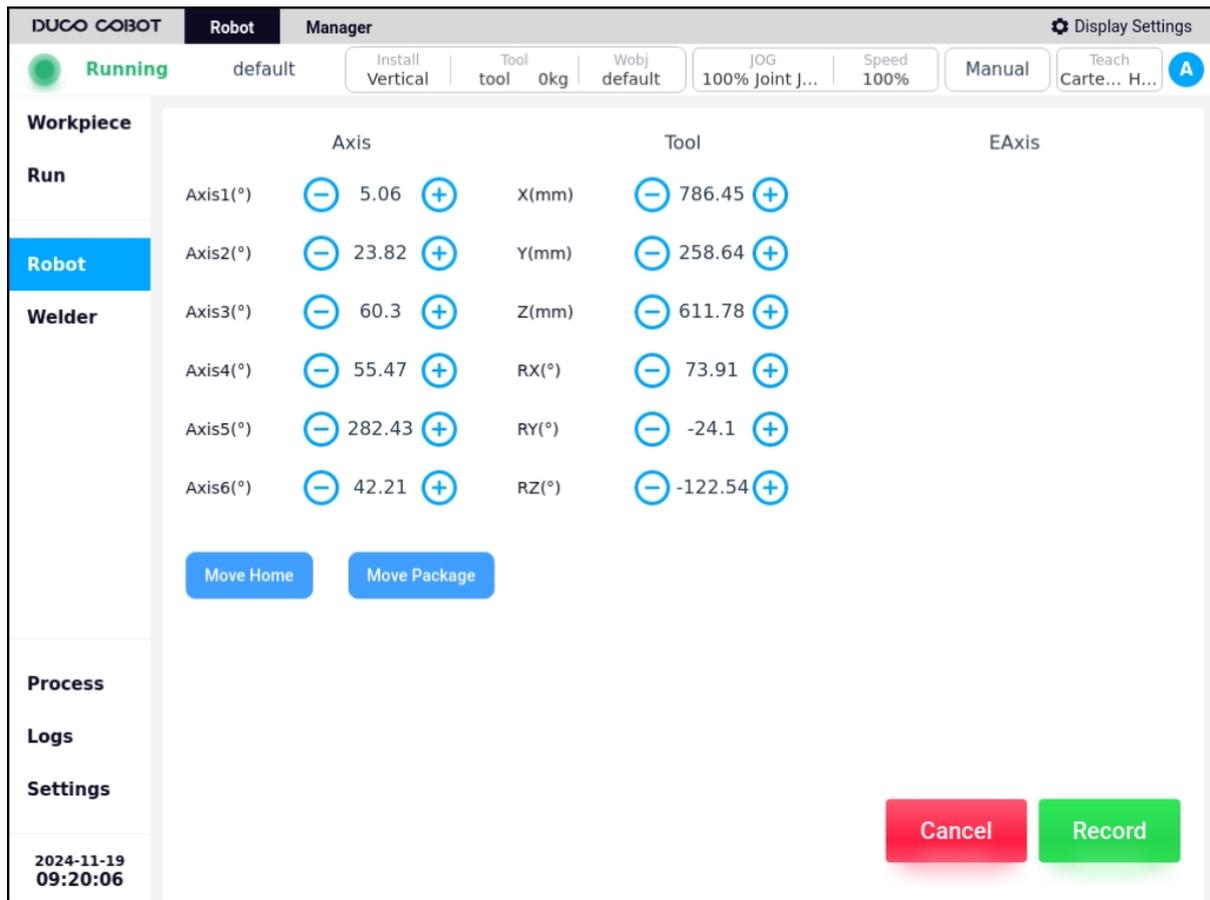
3.1 TCP calibration

The TCP Calibration sub-page is used to display the tool name, coordinate system information, mass, center of mass and TCP calibration operation buttons. The tool name defaults to weldDefault, as shown in the following figure.

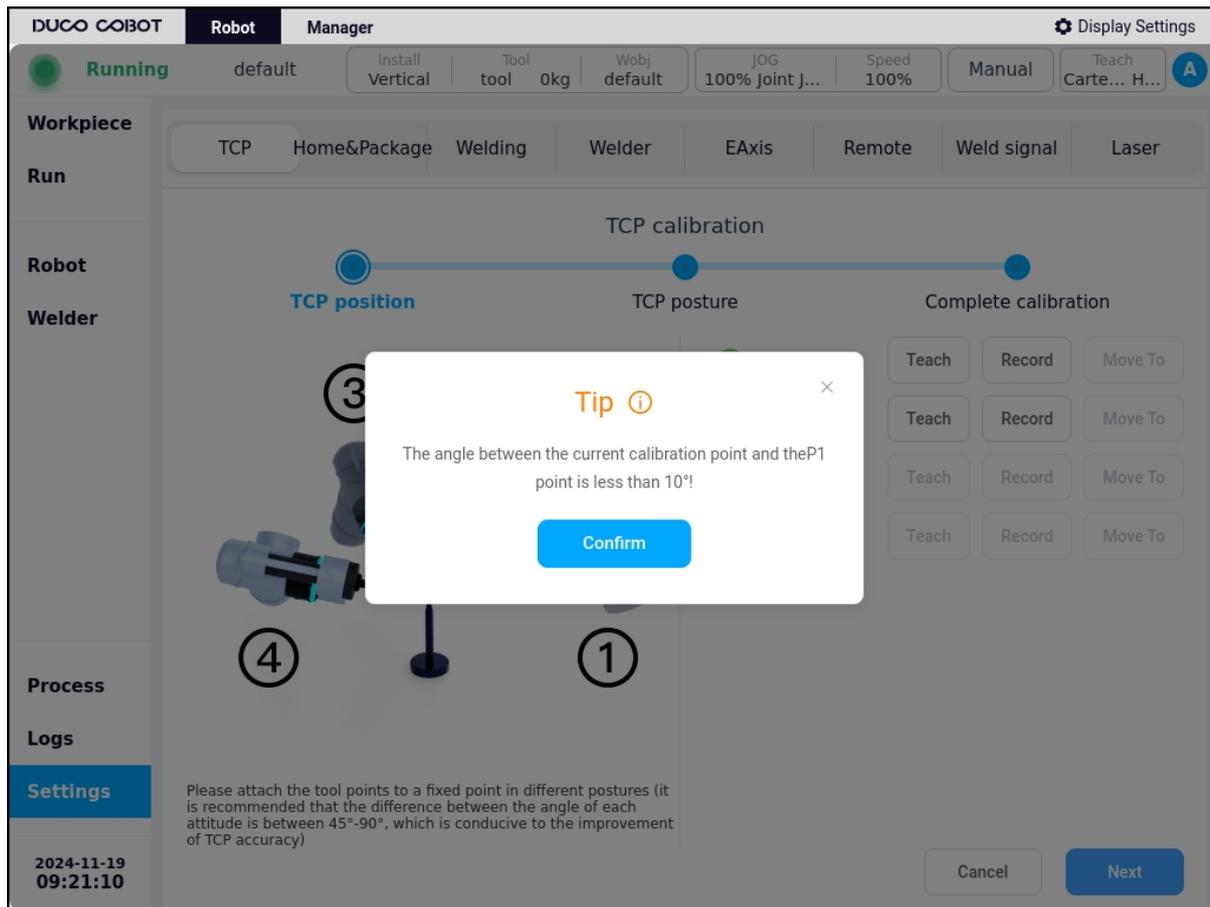


Click the “TCP Calibration” button on the page to enter the TCP calibration process as shown in the following figure.

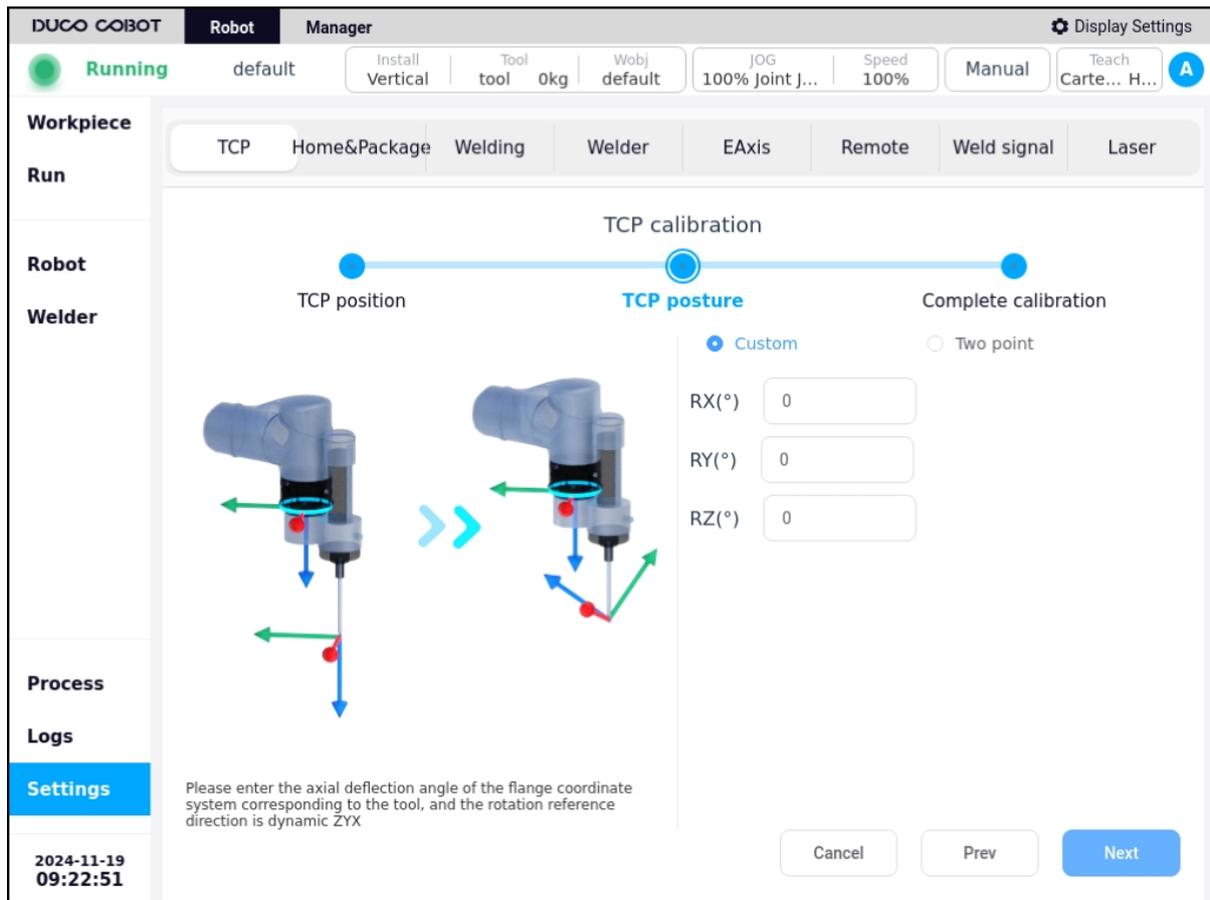
First of all, it is necessary to fit the tool points to the calibration pin fixing points, i.e., teach the points P1-P4, in different attitudes, and it is recommended that the attitude angle change between the points is between 45° and 90°. This is conducive to improving the TCP calibration accuracy. Take point P1 as an example, click the “Teach” button at point P1, the interface will jump to the “Robot Control” page, as shown in the figure below.



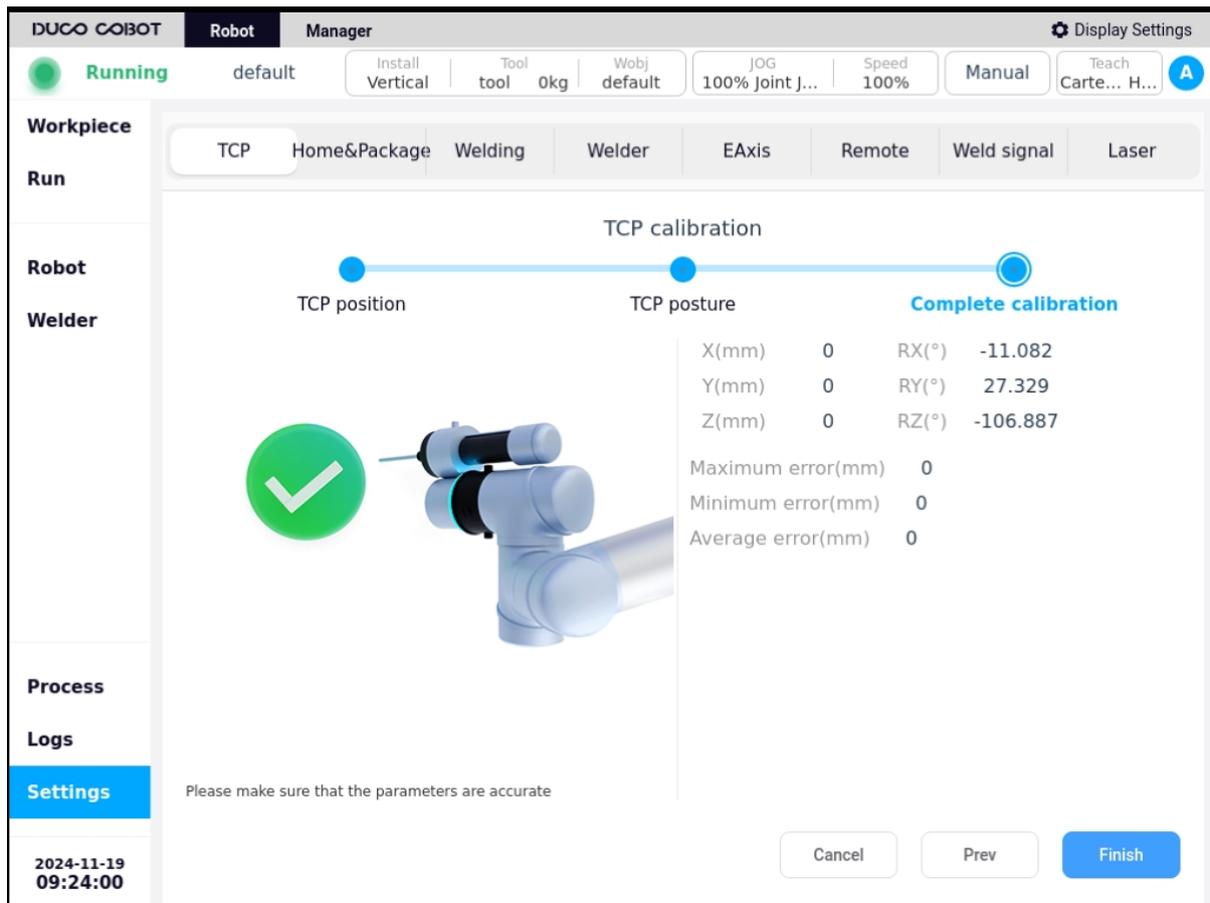
After the JOG robot reaches the target point, click “Record Current Point”, the interface will jump back to the TCP calibration process interface, and after teaching a calibration point, the red dot after the corresponding calibration point will turn green. You can also use the physical buttons of the tutor to direct the JOG robot to the target point, and then click “Record Current Point” on the calibration page directly. In the process of teaching, if the current teaching point does not meet the limitations, a pop-up box will be prompted as shown below.



After teaching all the points of P1-P4 in turn, click the “Next” button at the bottom right corner of the calibration process page to enter the TCP attitude calibration stage. There are two forms of TCP attitude calibration: customized and two-point setup, the default is customized as shown in the figure below. The default is customized, as shown in the following figure.



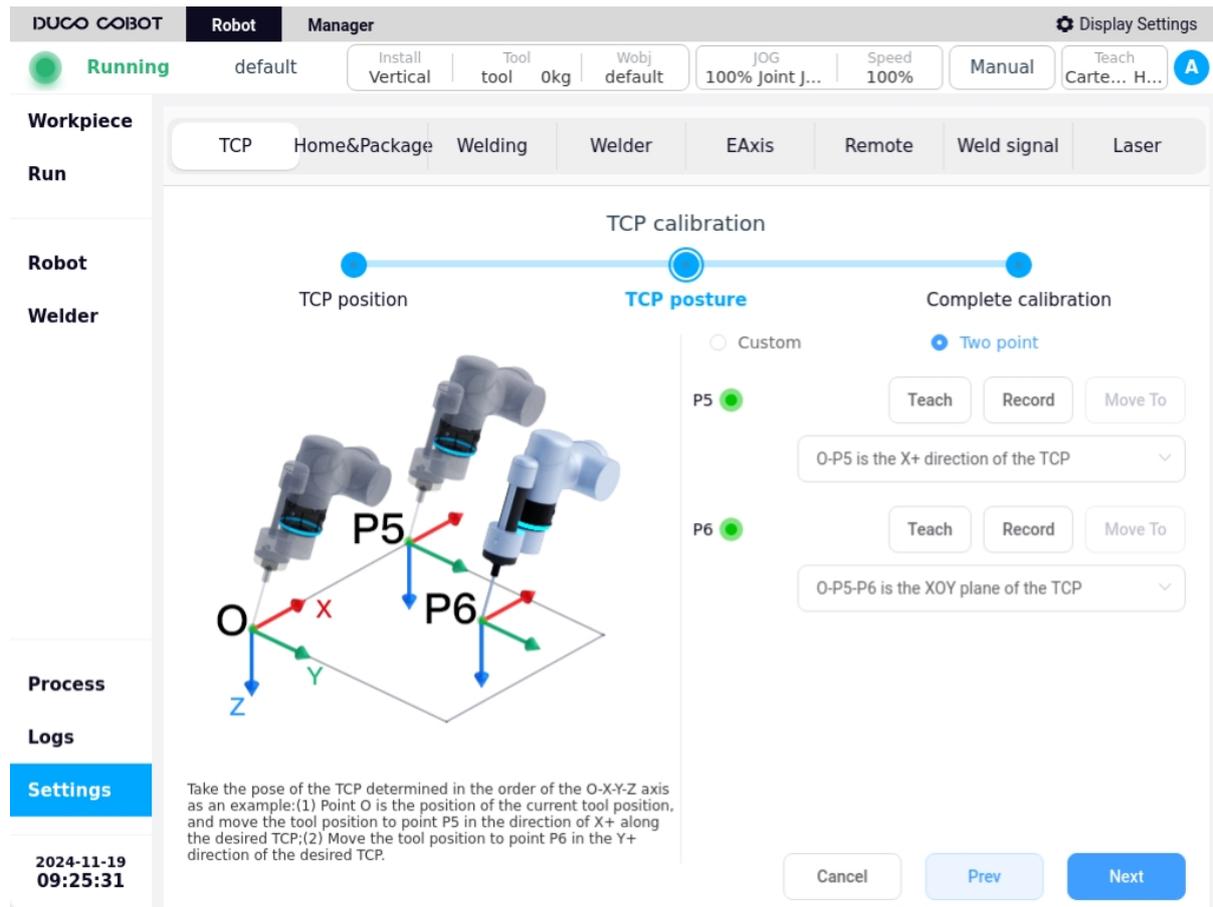
After setting the axial deflection angle of the flange coordinate system corresponding to the tool, click the “Next” button to complete the calibration stage as shown in the figure below, which will display the calibration results and error information. Users can judge the quality of the calibration by the error information, so as to decide whether to load this coordinate system. If you need to load this coordinate system, click “Confirm” button. The information about the calibrated tool coordinate system will be displayed on the TCP calibration page, and the calibrated TCP result will be added to the tool coordinate system list and set as the default and current tool coordinate system; Otherwise, click the “Cancel” button, or click “Previous” to return to re-taught points.



Caution: The error value of the calibration result, the real meaning is the standard deviation of the distance between the calculated TCP position and the 4 calibration points. This data can be used as a reference for the calibration result, but cannot be used as an absolute basis for the calibration accuracy, the actual accuracy is subject to the application effect.

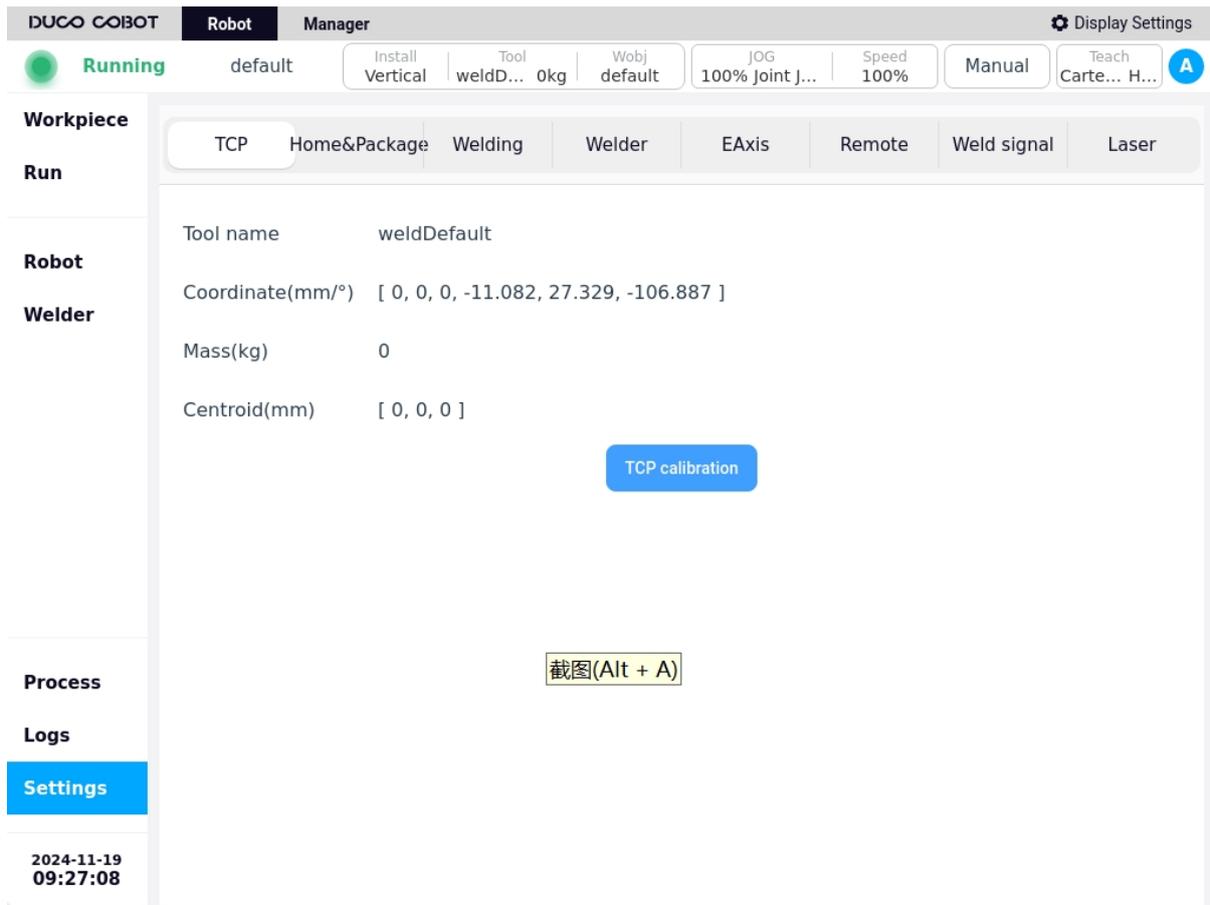
The calibration results of TCP are usually based on an average error of less than 2 mm.

When “Two Points Setting” is selected in the TCP Attitude Calibration stage, as shown in the figure below, the available options for point P5 are O-P5 for X+direction/Y+direction/Z+direction of the tool coordinate system. The corresponding options for point P6 are O-P5-P6 for tool coordinate system XOY plane/XOZ plane, O-P5-P6 for tool coordinate system XOY plane/YOZ plane, and O-P5-P6 for tool coordinate system XOZ plane/YOZ plane. Take the order of O-X-Y-Z axis to determine the attitude of the tool coordinate system as an example: point O is the current location of the tool position, first of all, along the expected tool coordinate system X + direction of the tool position to move to the point P5, then along the expected tool coordinate system Y + direction of the tool position to move to the point P5. Then move the tool position along the desired tool coordinate system Y+ direction to point P6.



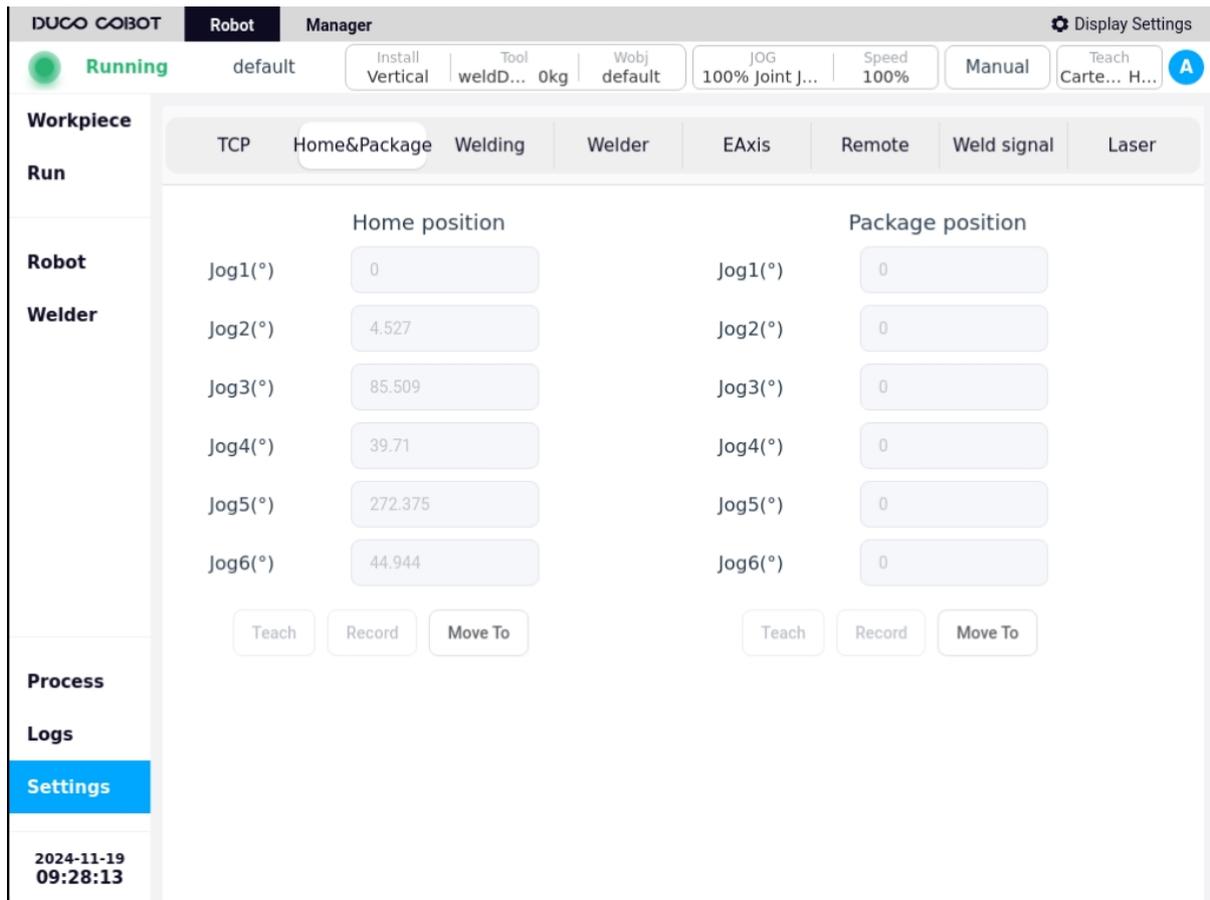
After setting up P5 and P6, click the “Next” button to enter the calibration stage, which will display the calibration result and error information. The user can judge the quality of the calibration by the error information, and decide whether to load this coordinate system or not. Similarly, if you want to load this coordinate system, click “Confirm” button, otherwise click “Cancel” button. Otherwise, click the Cancel button, or click Previous to go back and retest the points.

Click the Confirm button to return to the TCP Calibration sub-page, as shown in the following figure. The page displays the calibrated coordinate system information, mass and center of mass.



3.2 Origin & Crating Setup

The Home & Carton Setup sub-page is used to display the robot HOME position and the values of each joint angle when the robot is packing the carton position, as well as to set up the input boxes and some of the buttons, as shown in the following figure.

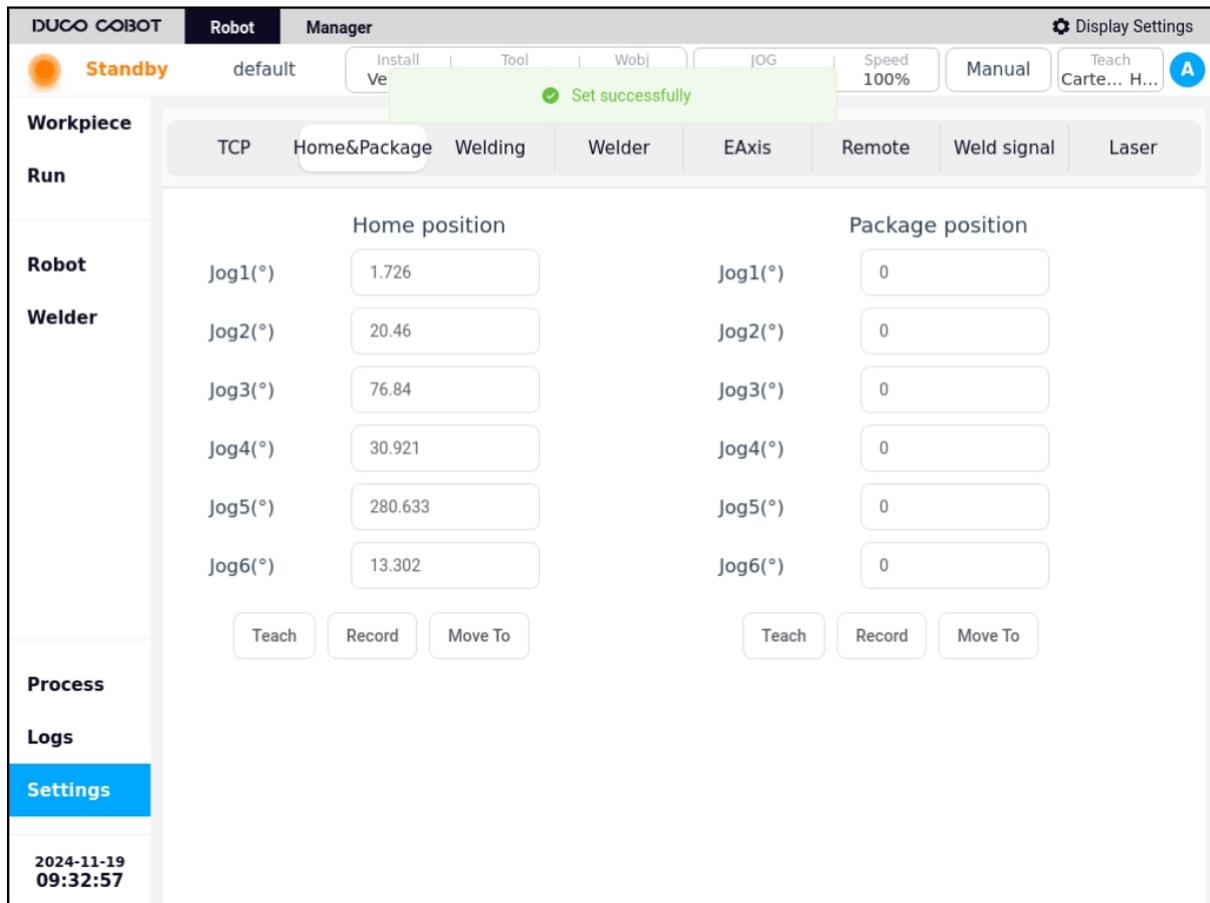


Users can manually input the joint angle by clicking each joint input box, or click the “Teach Point” button to jump to the robot control interface for teaching settings. After the JOG robot reaches the target point, click “Record Current Point”, the interface will jump back to the current sub-interface, and the page will display the taught joint angle values, as shown in the figure below. You can also click “Record Current Point” on the page directly after the JOG robot reaches the target point through the physical button of the teach pendant. If the robot is not in the HOME position, long press the “Move to this point” button. button to move the robot to the home position.

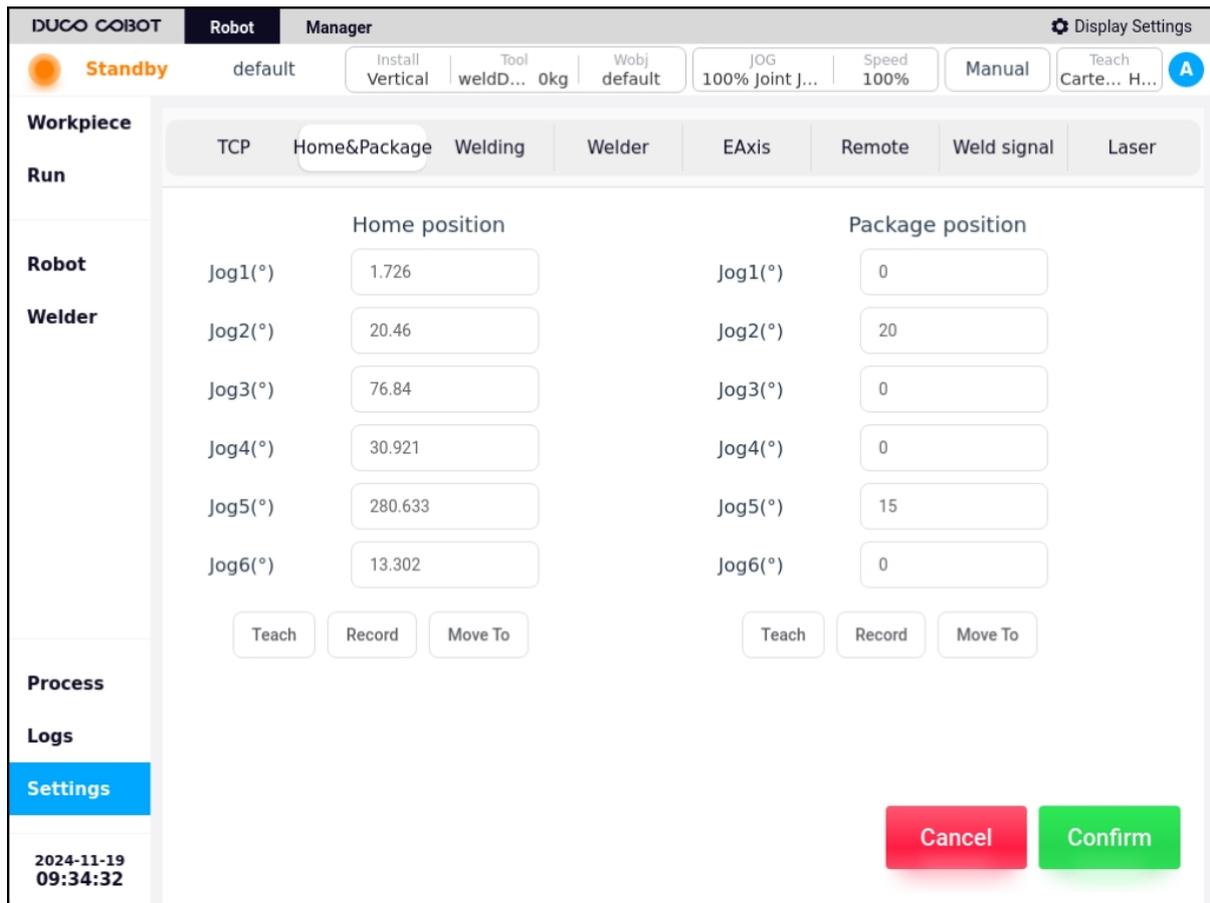
The screenshot shows the 'Robot Manager' interface for a DUCO COBOT. The status is 'Standby'. The 'Workpiece' section is active, showing 'Home position' and 'Package position' settings. The 'Home position' values are: Jog1(°) 1.726, Jog2(°) 20.46, Jog3(°) 76.84, Jog4(°) 30.921, Jog5(°) 280.633, and Jog6(°) 13.302. The 'Package position' values are all 0. There are 'Teach', 'Record', and 'Move To' buttons for both sections. At the bottom, there are 'Cancel' and 'Confirm' buttons. The date and time are 2024-11-19 09:30:46.

Category	Parameter	Value
Home position	Jog1(°)	1.726
	Jog2(°)	20.46
	Jog3(°)	76.84
	Jog4(°)	30.921
	Jog5(°)	280.633
	Jog6(°)	13.302
Package position	Jog1(°)	0
	Jog2(°)	0
	Jog3(°)	0
	Jog4(°)	0
	Jog5(°)	0
	Jog6(°)	0

Click the “OK” button on the above page, and a pop-up message “Setting is successful” will appear as shown in the following figure. Click the “Cancel” button to cancel the setting of the teaching point as the robot’s HOME position.



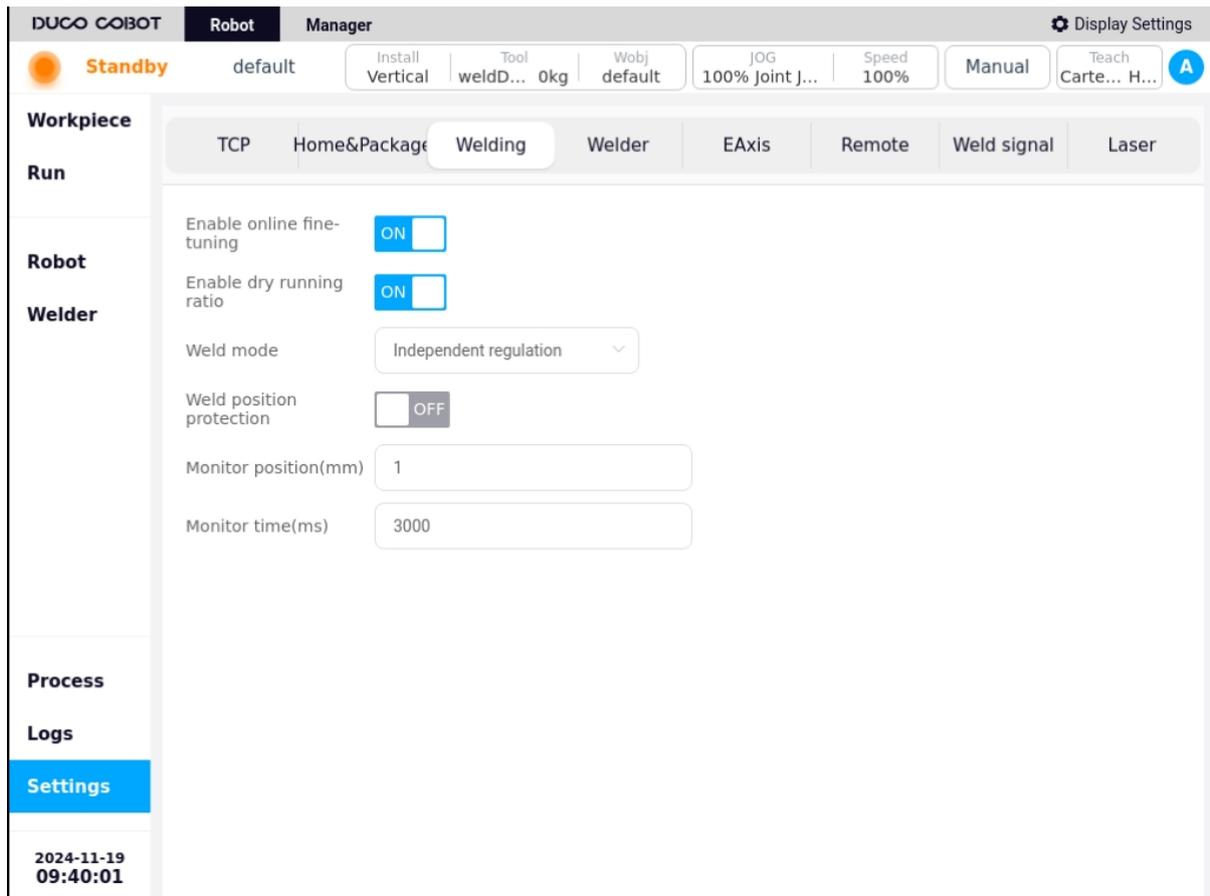
As with the origin setting, the user can manually input the joint angle by clicking the input box of each joint in the crate setting, or jump to the robot control interface for the teaching setting by clicking the “Teach Point” button, as shown in the following figure. After the JOG robot reaches the target point, click “Record Current Point”, the interface will jump back to the current sub-interface, and the page displays the value of the taught joint angle, as shown in the figure below. You can also click “Record Current Point” on the page directly after the JOG robot reaches the target point through the physical button of the tutor. If the robot is not in the packing position, long press the “Move to this point” button to move the robot to the packing position. button to move the robot to the packing position.



Similarly, clicking on the “OK” button in the lower right corner of the above page will bring up the prompt “Setting Successful”. Clicking the “Cancel” button will cancel the setting of the Teach-In Point as the robot’s crating position.

3.3 Welding Settings

The Weld Settings sub-page is used to set the online trim, weld air run multiplier, weld position protection, and monitor position and monitor time, as shown below.



Enable on-line fine-tuning: Process parameters can be fine-tuned and modified on-line during the welding process.

Enable dry running ratio: When enabled, it allows the robot to run at a multiplier speed when the welder is not enabled, for quick observation of the correct weld trajectory. The multiplier is set in the process motion parameters.

Weld Mode: Options are DC mono, pulse mono, JOB mode, and intermittent welding.

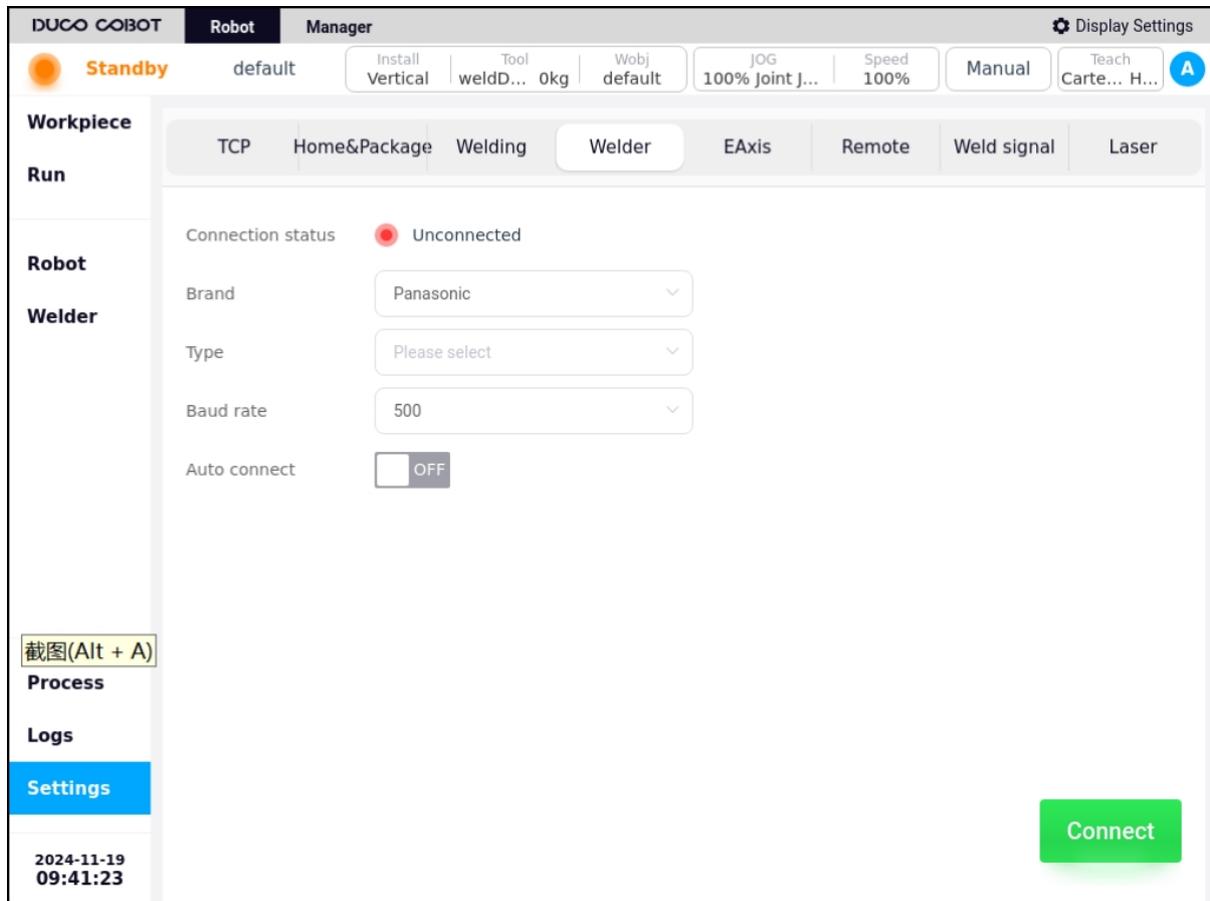
Weld Position Protection: The protection function during welding is based on the principle of real-time monitoring of the end of the robot tool to see if there is any displacement in excess of the monitored displacement. If the end of the robot tool does not produce enough displacement within the set monitoring time, it is judged that the robot is in the same position, and then the welder will be triggered to close the arc command. The purpose of this function is to prevent the robot from having a long welding operation in the same position, in order to prevent the weldment from burning through.

Monitor Displacement(mm): Set the displacement value for monitoring displacement in mm.

Monitor time (ms): The set monitoring time in ms.

3.4 Welding machine settings

The Welder Settings sub-page is used to display the communication status, configure the welder model and the corresponding communication settings, as shown below.



Welder Connection Status: The status indicator will change from red to green when communication is established between the robot and the welder;

Welder Brand: Used to configure the brand of the welder currently being used;

Welder Model: Used to configure the welder model corresponding to the selected welder brand;

Communication Baud Rate: Used to set the baud rate of CAN communication, supporting three baud rates: 125kps, 250kps and 500kps.

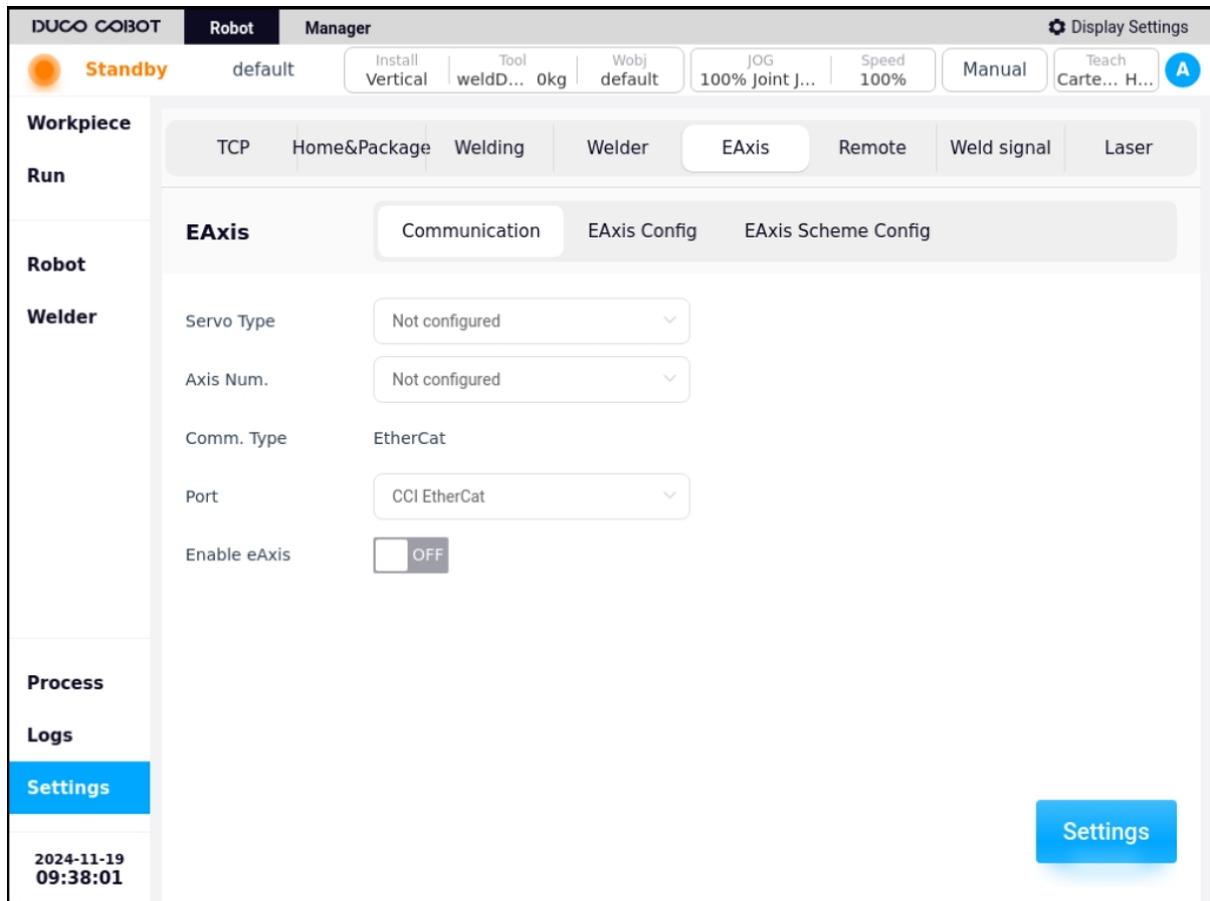
Caution: The baud rate of the robot and the welder need to be set the same in order to realize the communication

Auto-connect: Used to automatically connect to the welder the next time the robot is powered on. When auto-connect is turned on, the robot will save the current setup information, the The next time the robot is powered on, it will automatically connect to the welder after the robot completes the power-up operation.

The “Connect” button is usually used when the robot is first commissioned to communicate with the welder. Clicking on the “Connect” button will initiate a connection request to the welder in the welder’s message format. When correct feedback is received from the welder, the welder connection status light will turn green.

3.5 External Axis Configuration

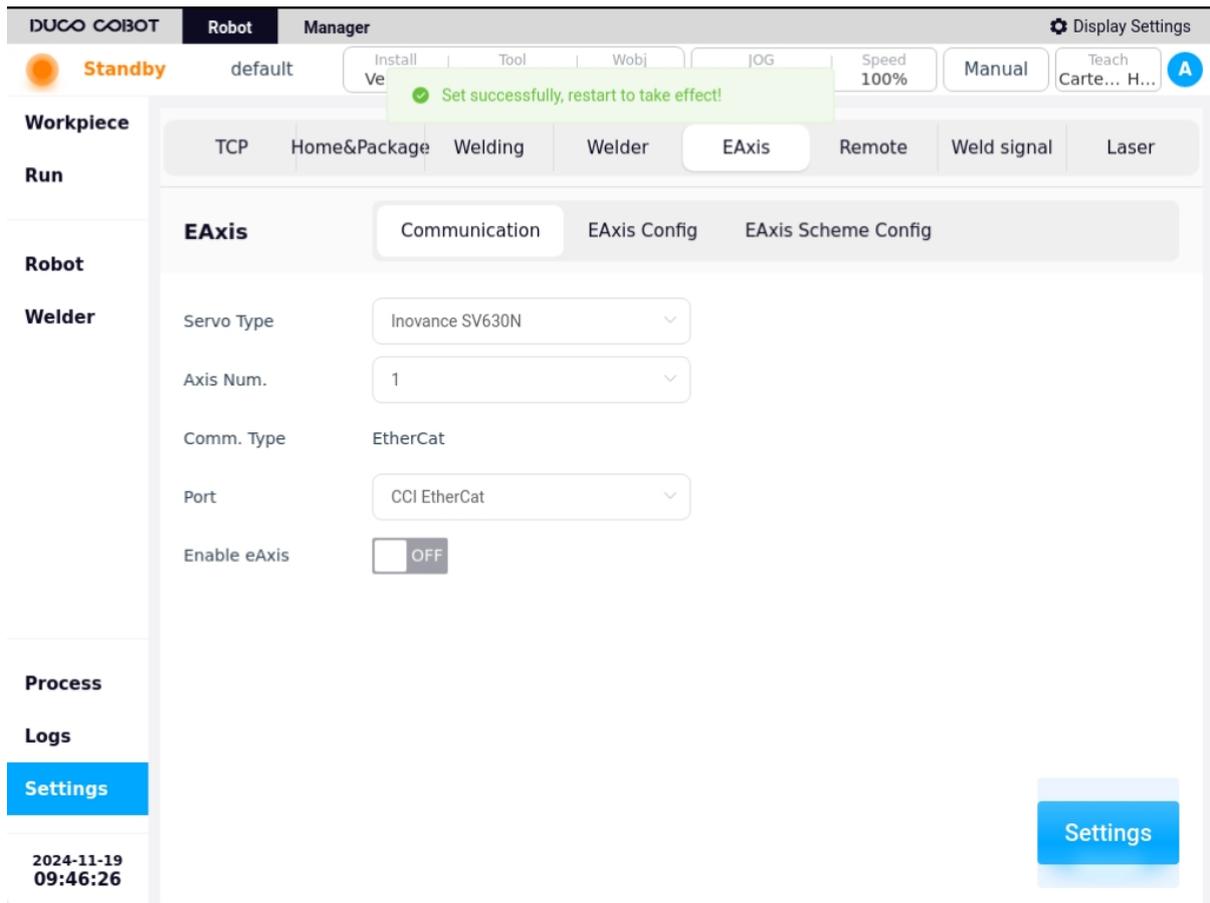
The External Axis Configuration sub-page is used for external axis communication settings, axis configuration, and program configuration, as shown below.



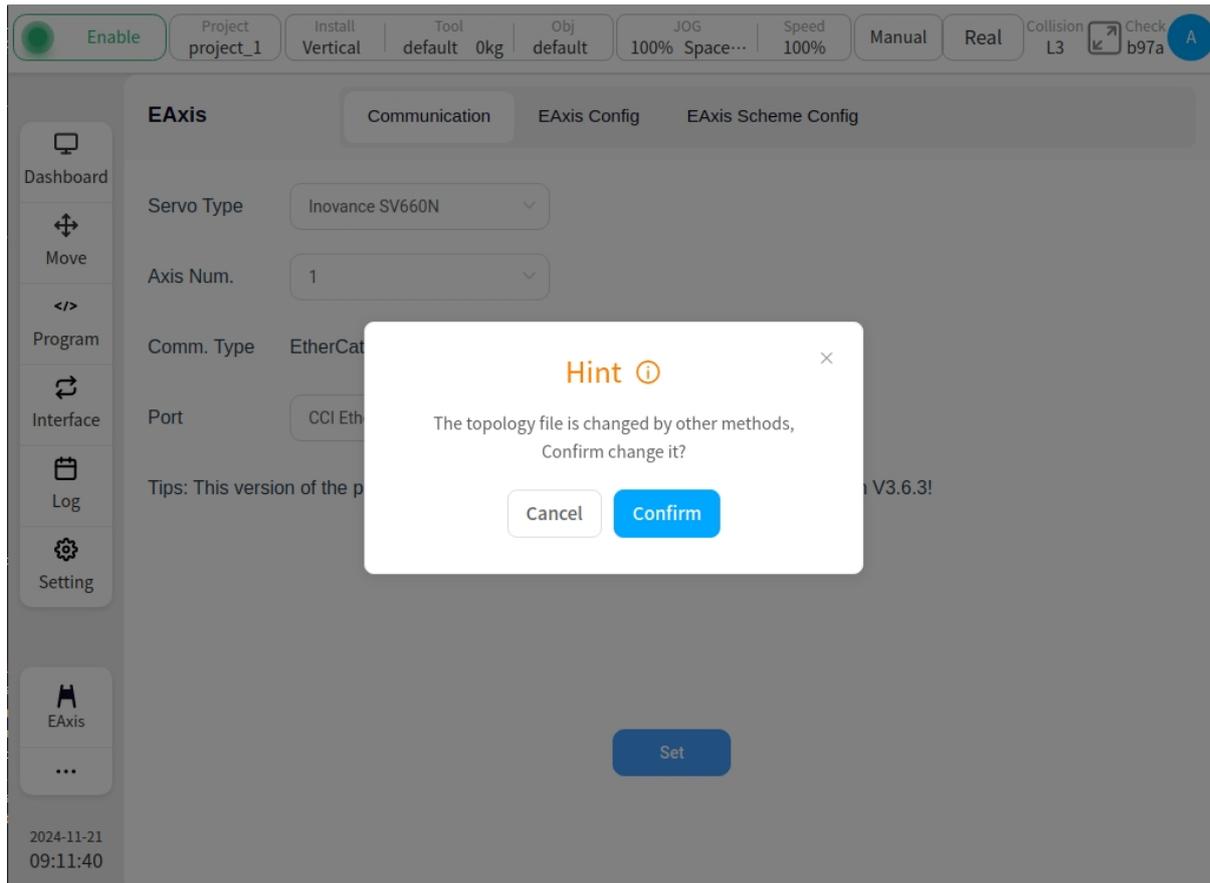
3.5.1 1. Communication settings

The communication settings page allows you to configure the servo model, number of axes, input port, and display the communication method. The servo model and axis number are not configured by default, the input port is only the Ethercat port of the control cabinet at present, and the communication mode is Ethercat by default.

Choose to configure the servo model, the number of axes, as shown in the figure below, and then click on the “Settings” button, a pop-up message “Setting is successful, restart the control cabinet to take effect! The message will pop up “Setting is successful, restart the control cabinet to take effect!”.



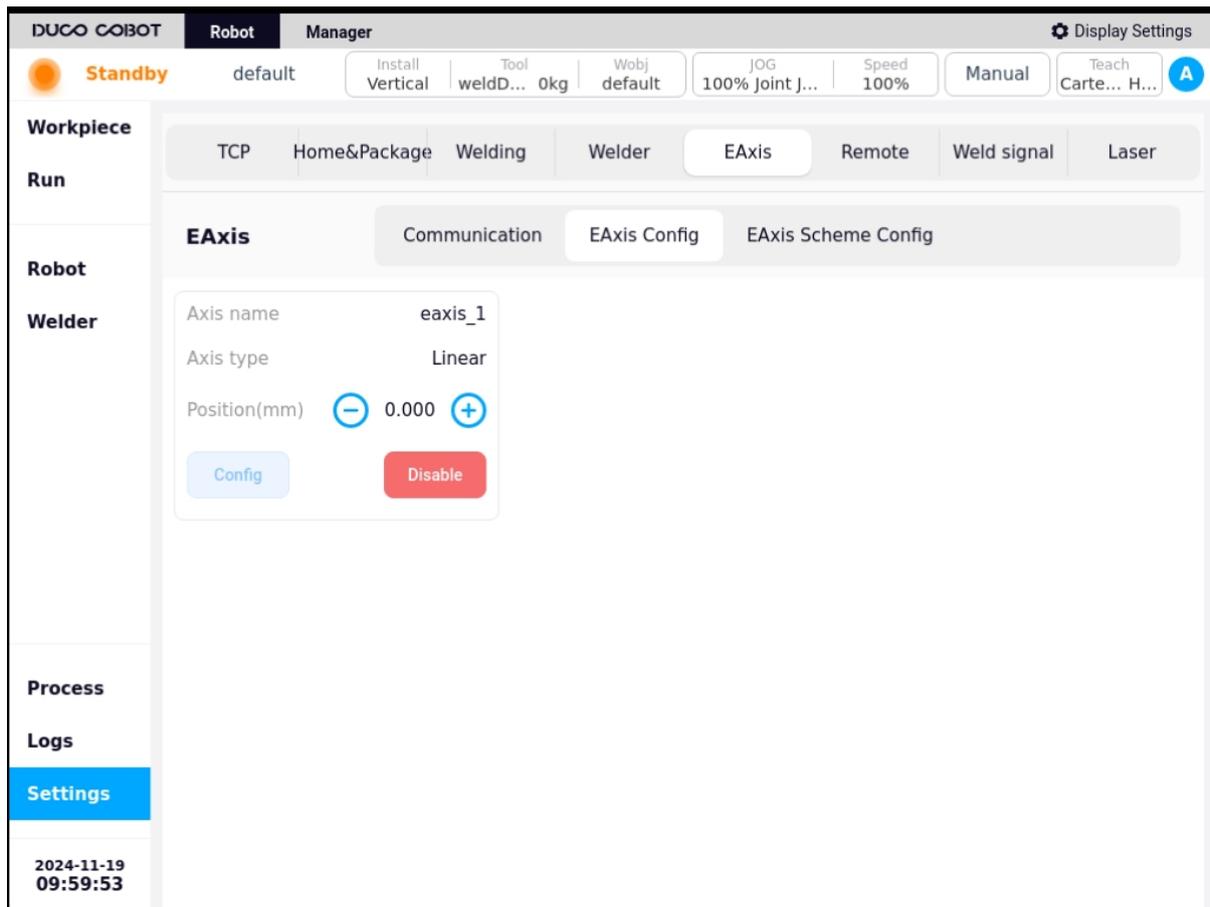
If the topology configured by the user is different from the topology currently in effect on the system, click the “Set” button and a pop-up box will appear in the interface, as shown in the following figure:



If you do not want to modify the topology currently stored in the system, click the “Cancel” button; if you confirm the modification, click the “Confirm” button.

3.5.2 2. Shaft configuration

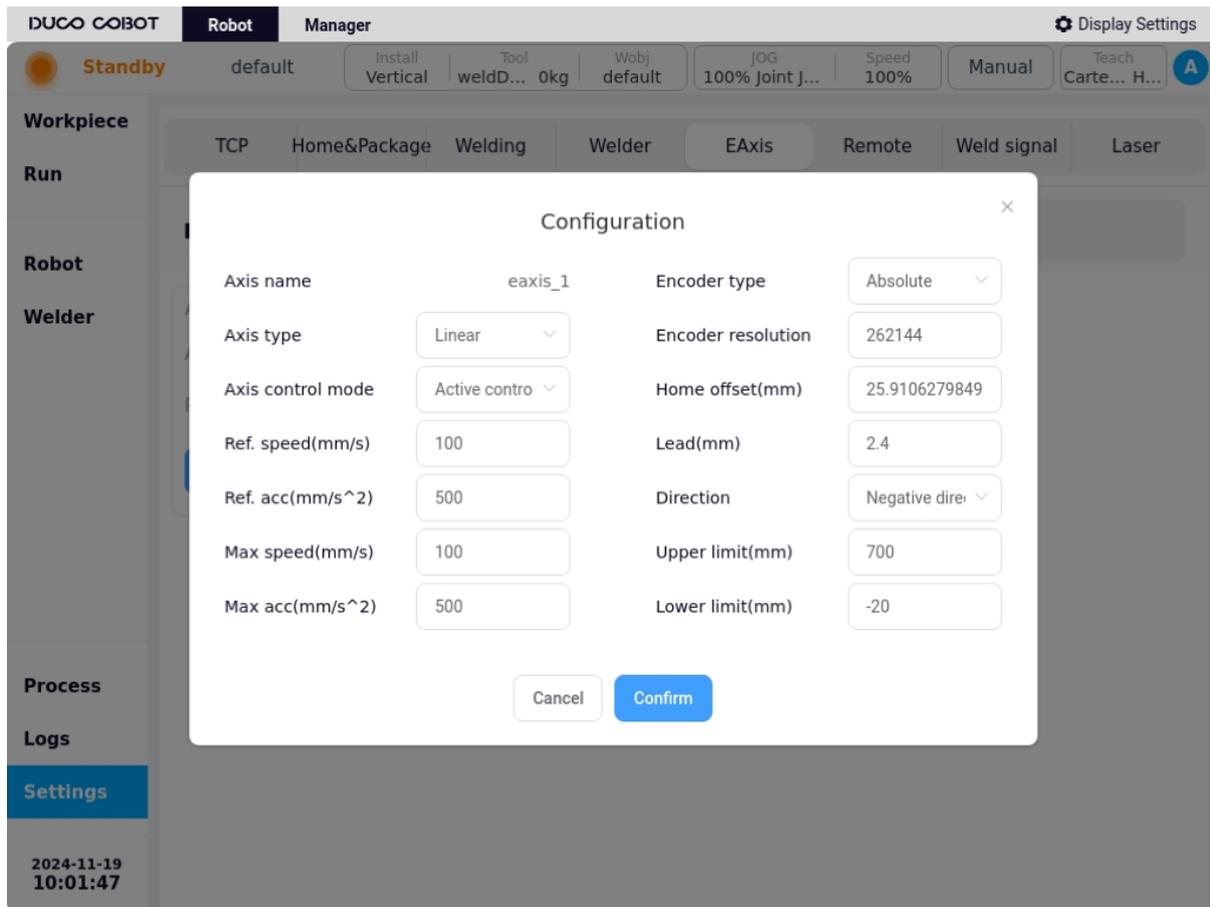
The Axis Configuration page displays basic information such as axis name, axis type, axis position, etc. It allows you to perform point-to-point movement of the axis position, enable or disable operation of the axis, as well as configuration of the axis parameters. One external axis corresponds to one actual single-degree-of-freedom servo unit.



When the external axis is enabled by clicking the Enable button, the external axis can be moved in the reverse or forward direction by pressing and holding the left  icon or the right  icon on the axis position display.

Note: Note: When the external axis break is enabled, no axis pointing operation can be performed.

Click the “Configuration” button, the external axis parameter configuration pop-up box will appear as shown in the figure below, the configurable parameters are axis type, axis control mode, reference speed, reference acceleration, The configurable parameters are axis type, axis control mode, reference speed, reference acceleration, maximum speed, maximum acceleration, encoder type, encoder resolution, zero offset, guide range, direction of motion, upper limit position, lower limit position.



Parameter description:

Axis type: Linear guides or translators;

Axis control modes: active control mode or cooperative control mode. In active control mode, the external axes are directly generated and controlled by the robot controller for planning instructions; In cooperative control mode, the external axes are controlled by independent controllers and communicate with the robot controller, and the robot carries out cooperative control based on the external axis commands. The robot maintains a specific relationship with the external axis coordinate system;

Reference speed: This speed will be used as a reference speed in mm/s or °/s for external axis pointing movements;

Reference Acceleration: This acceleration will be used as the reference acceleration in mm/s² or °/s² for the pointwise motion of the external axis;

Maximum speed: This speed will be used as the maximum speed constraint and monitoring parameter in mm/s or °/s for the joint planning of movements of external axes;

Maximum Acceleration: This acceleration will be used as a parameter for acceleration constraints and monitoring during the joint planning of the movement of the external axes, in mm/s² or °/s²;

Encoder type: incremental or absolute;

Encoder resolution: a dimensionless parameter used to convert the number of encoder communication data cnt into a scale factor of the actual angle value, encoder cnt/number of encoder bits = actual angle;

Zero Offset: only shows configurable and effective if the encoder type is absolute, default is 0, unit is mm or °, user can modify it directly or quickly by setting the current position as zero position;

Lead: Configurable and valid only if the external axis type is a linear guide, in mm, describes the displacement distance generated by the linear guide when the encoder is rotated by 360°, encoder cnt/encoder position * lead = actual position of the linear guide;

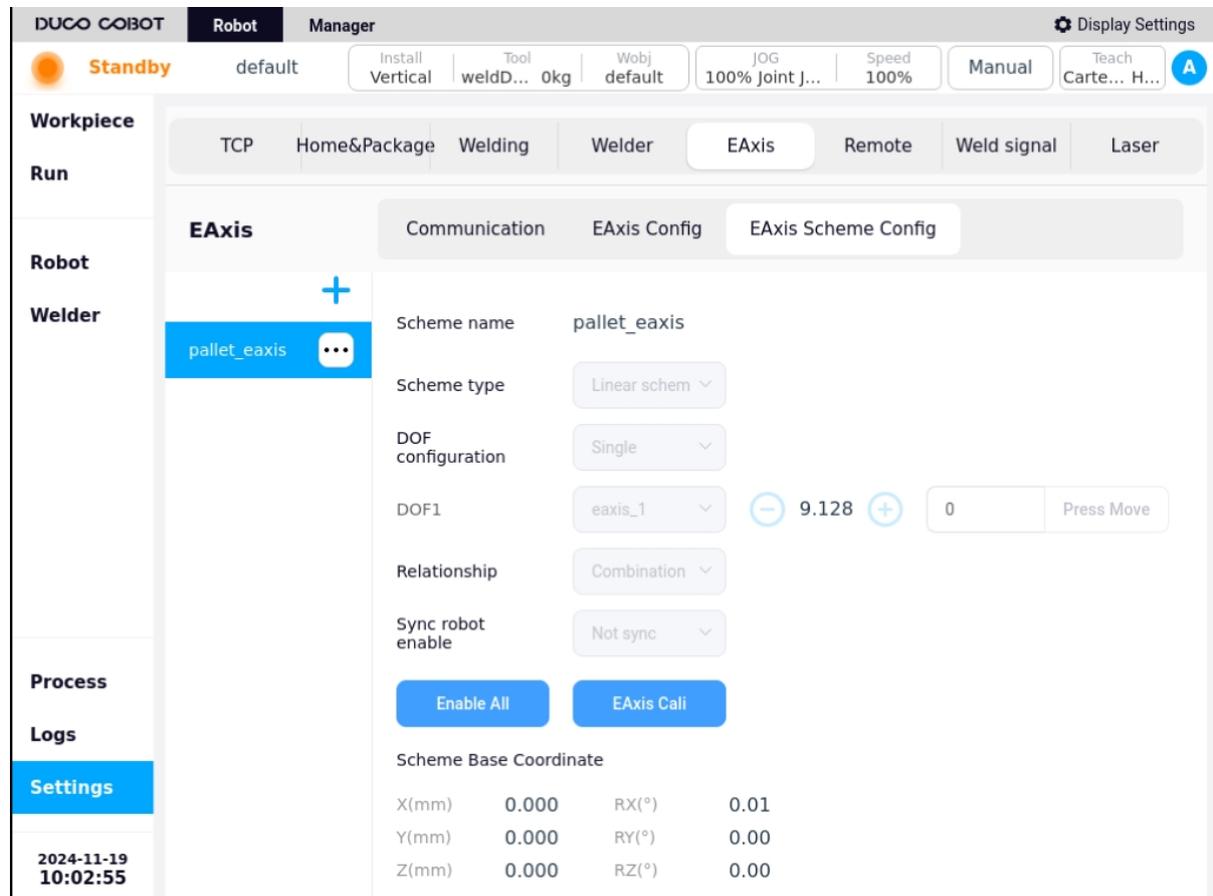
Direction of motion: Forward or reverse, describes the relationship between the encoder’s increasing direction and the actual shaft’s direction of motion, forward is the same direction, reverse is the opposite reverse;

Upper limit/lower limit: to describe the absolute range of motion of the external axis with reference to the current zero position, exceeding the limit will trigger the corresponding safety stop operation in mm or °.

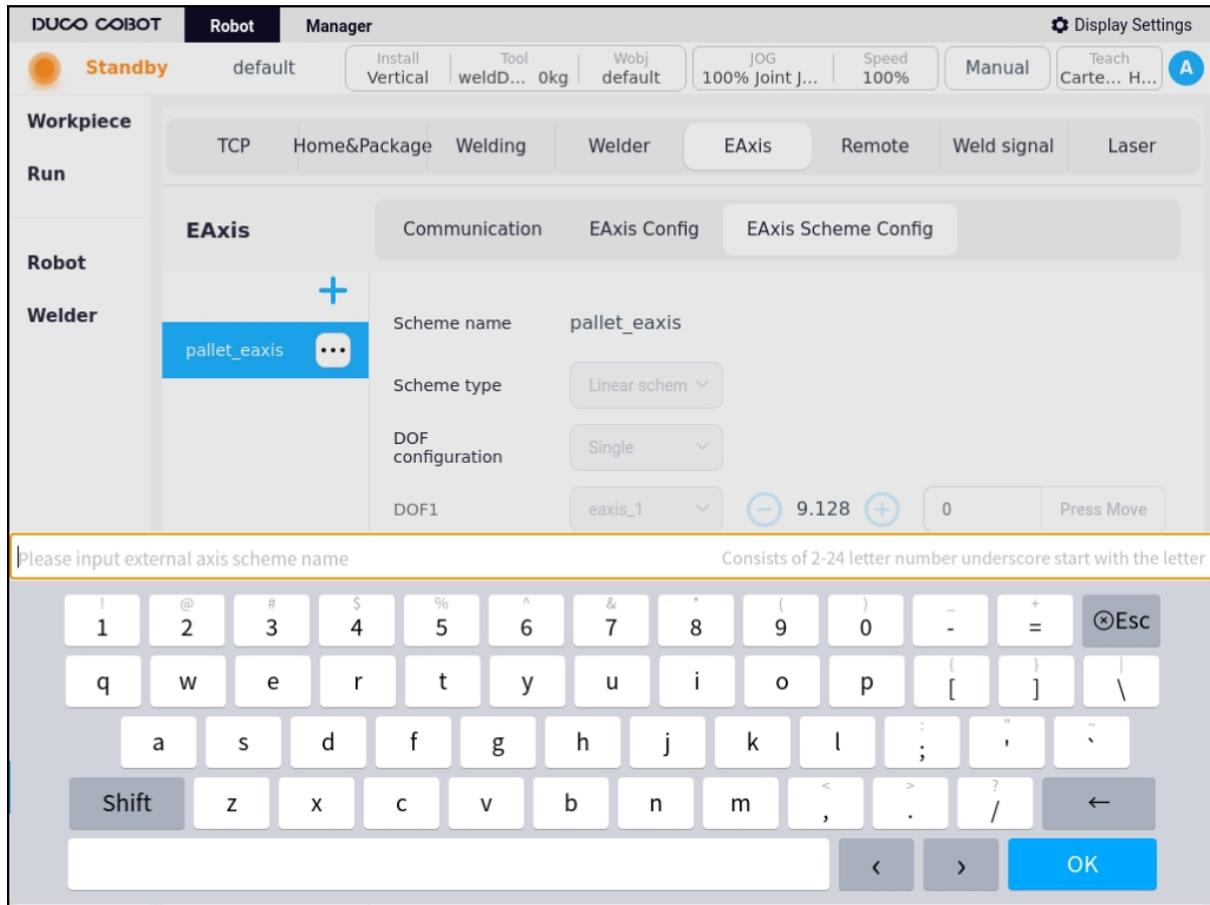
Note: Note: Configuration of external axis parameters is not possible after the external axis is enabled.

3.5.3 3. Program configuration

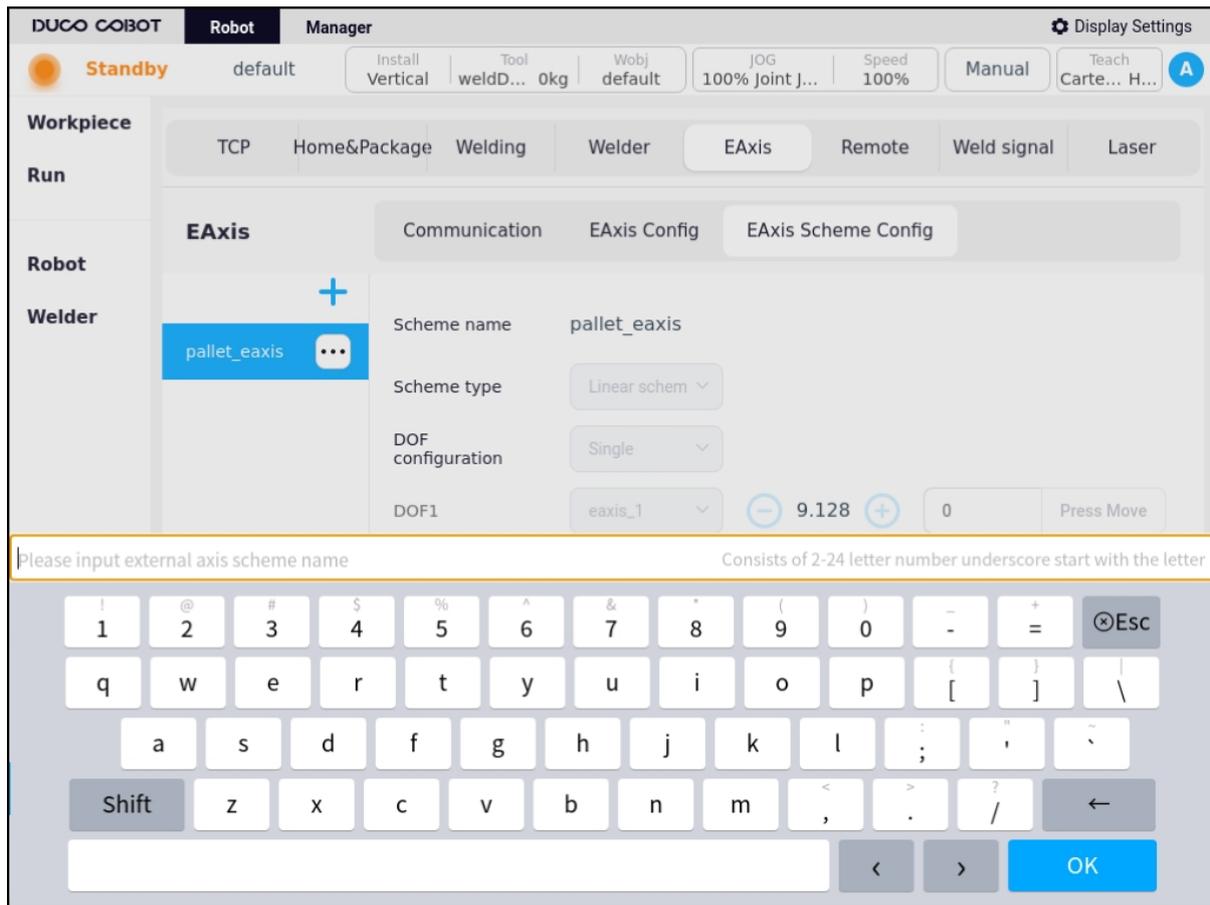
The Program Configuration page allows you to create a new external axis program, as well as edit or delete an existing external axis program. On the left side of the page is the external axis scheme navigation tab, on the right side of the page is the external axis scheme parameter content corresponding to the external axis scheme tab, as well as all enable/disable buttons, external axis calibration, external axis tap buttons. On the right side of the page are the parameters of the external axis scheme corresponding to the external axis scheme tabs, as well as the buttons for All Enable/Disable, External Axis Calibration, External Axis Tap, and you can manually input the target position of the external axis, and so on. You can also enter the target position of the external axis manually by long-pressing the “Press and hold to move” button to move it to the manually entered target position.



Clicking on the  icon in the upper right corner of the left section of the page will bring up the virtual keyboard as follows:



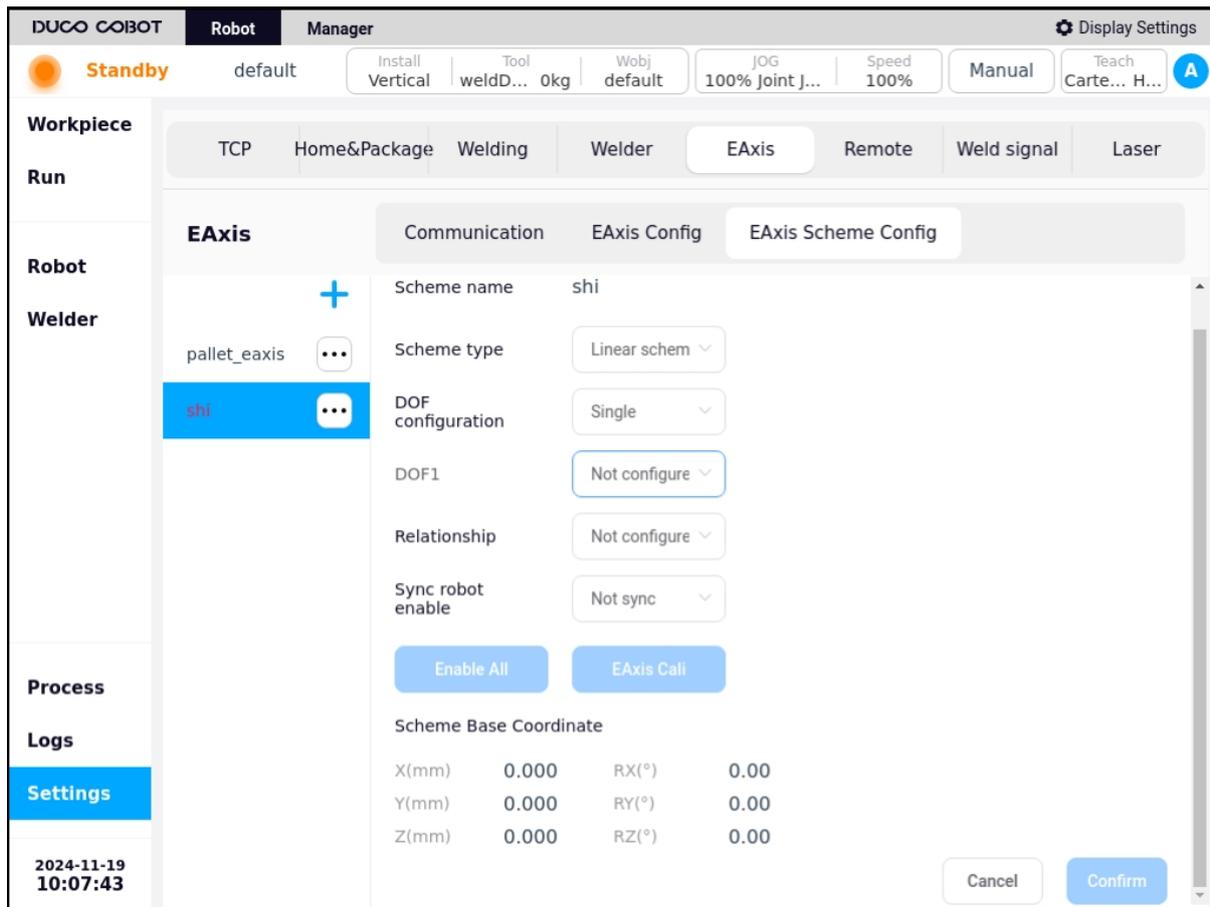
After entering the name of the newly created external axis scheme, e.g. “scheme_test” is displayed as shown in the figure below, the left navigation tab area will display the name of the newly created external axis scheme “scheme_test”, and the color of the font is red, which means that the scheme is invalid, i.e. it is a scheme without configured external axis scheme parameters. If the font color is red, it means that the external axis scheme is invalid, i.e., it is a scheme that has not been configured with external axis scheme parameters. Only when the font color is black, it means the external axis scheme is valid. The content area on the right side displays the content that needs to be configured for this new external axis scheme. The parameters that can be configured are: scheme type, degree of freedom configuration, axis-robot relationship, and synchronized robot enable.



Parameter description:

Type of program: Linear guide program or indexing machine program;

Degree of Freedom Configuration: The linear guide program currently supports only single degree of freedom, and the variator program supports single degree of freedom and two degrees of freedom. After selecting the degree of freedom, you can bind the degree of freedom to the external axis according to the number of degrees of freedom selected. As shown in the figure below, the single degree of freedom linear guide program degrees of freedom 1 bound linear guide external axis eaxis_3;



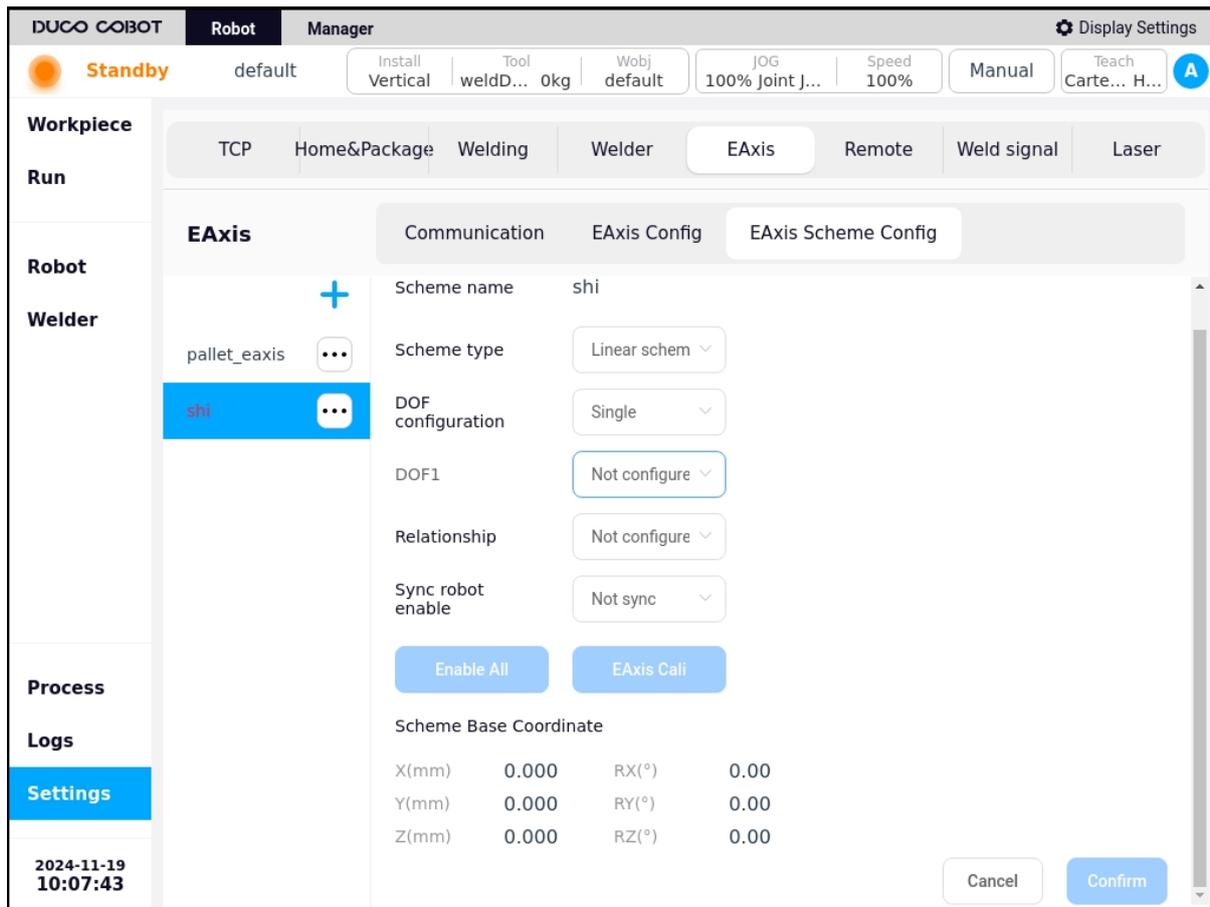
Axis-robot relationship: independent or combined, i.e., the external axis is independent of the robot or the robot is fixed to the external axis;

Note: Note: Axis-robot combinations only support single-degree-of-freedom external axis.

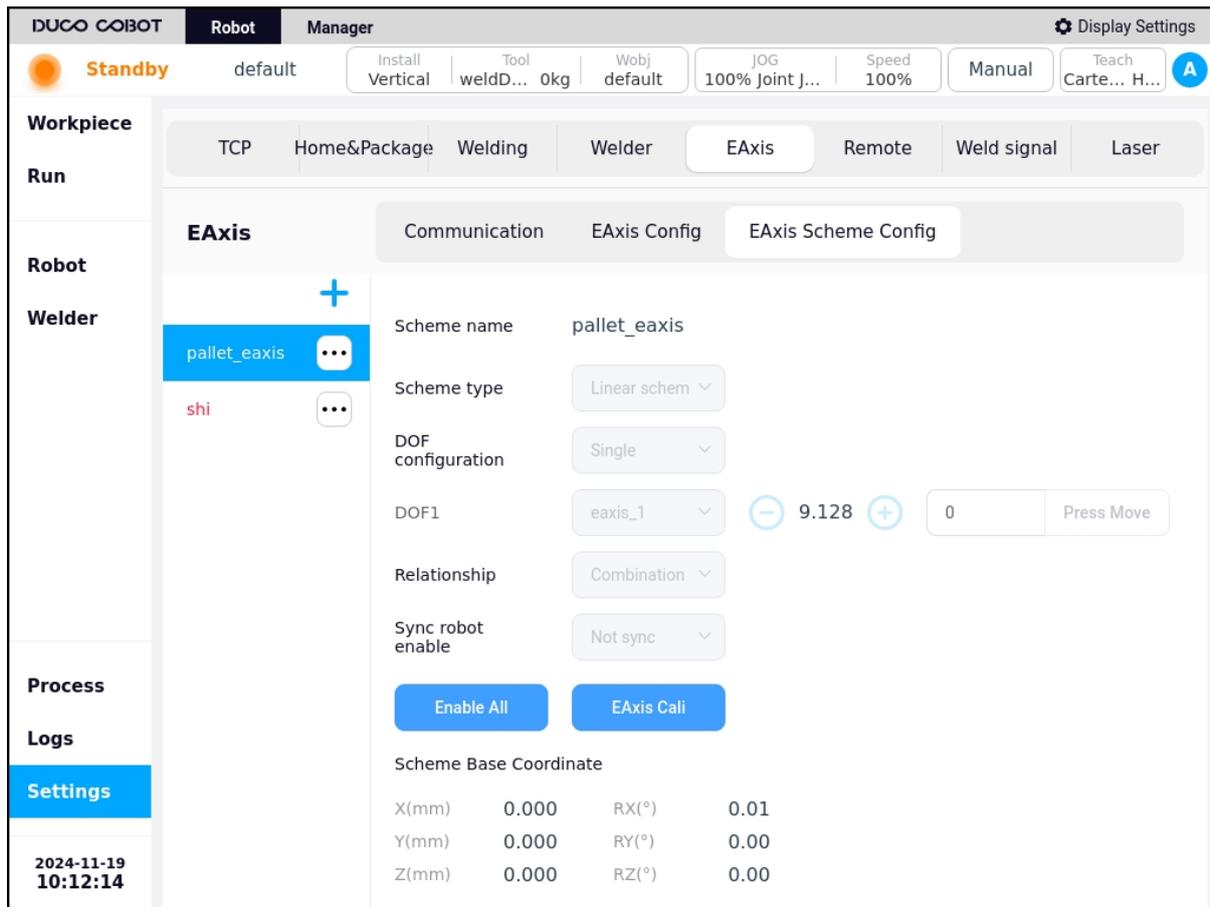
Synchronized Robot Enable: The default is not synchronized, if configured as “Synchronized”, the external axis scheme will synchronize the enable/disable operation after the robot completes the enable/disable;

Schematic base coordinate system: describes the position of the external axis base coordinate system in the world coordinate system, which by default coincides with the world coordinate system, and which is calibrated by the external axis calibration process.

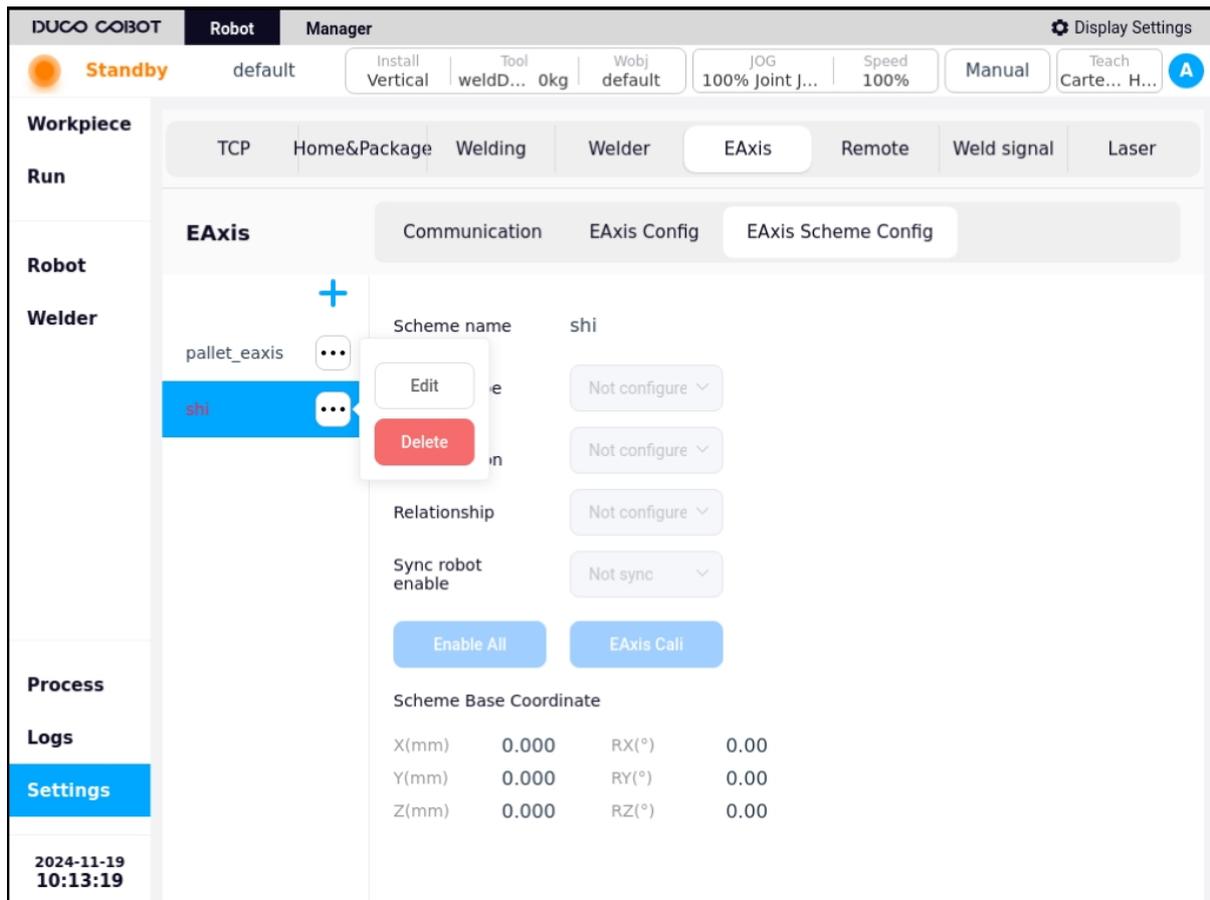
After configuring the above configurable parameters, as shown in the figure below, you can click the “OK” button at the bottom right corner of the page to complete the configuration of the external axis scheme.



In the external axis scheme editing state, the “Enable All” or “Disable All” and “External Axis Calibration” buttons on the page are disabled, and the external axis tap operation buttons are inoperable. The External Axis Push buttons cannot be operated; External axis program enable/disable operations and external axis calibration are only available when the external axis program is not edited. The external axis tap buttons can only be operated when the external axis scheme is enabled, i.e. all external axes are enabled for tap operation.



Clicking on the  icon after the external axis scheme name on the left side of the page will bring up a popup box that displays “Edit” and “Delete” buttons, allowing you to edit or delete the selected external axis scheme.



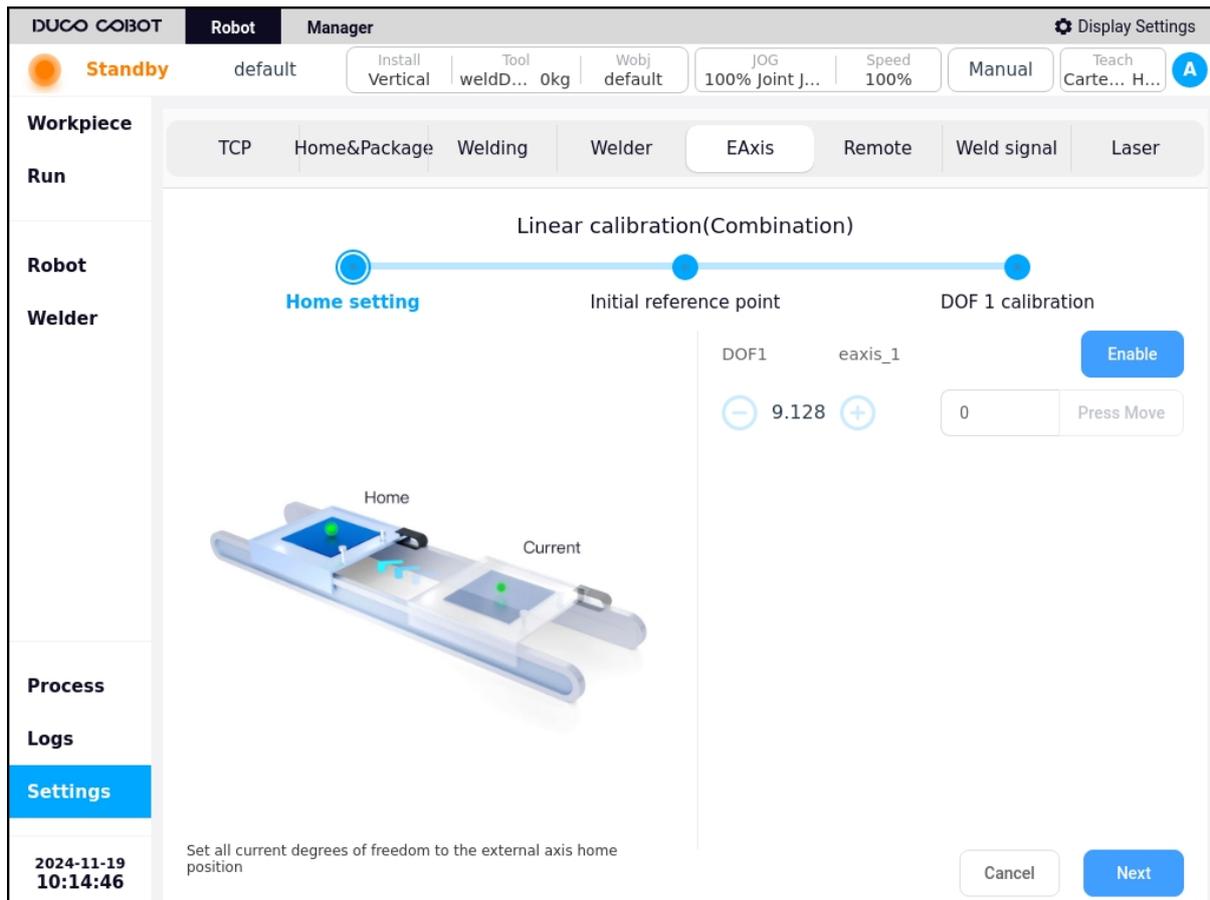
3.5.4 4. External axis calibration

The external axis calibration process is used to calibrate the base coordinate system of the external axis scheme. In the non-editing state of the external axis program, click the “External Axis Calibration” button on the page to enter the external axis calibration process page. According to the different types of external axes, the external axis calibration is divided into two types: linear guide calibration and indexer calibration.

Linear guide calibration

Depending on the type of relationship between the axes and the robot, there are two types of linear guideway calibration: combined and independent. The external axis program “scheme_test” is used as an example to introduce the calibration process of the combined linear guide program.

Click the “External Axis Calibration” button on the page as shown below:



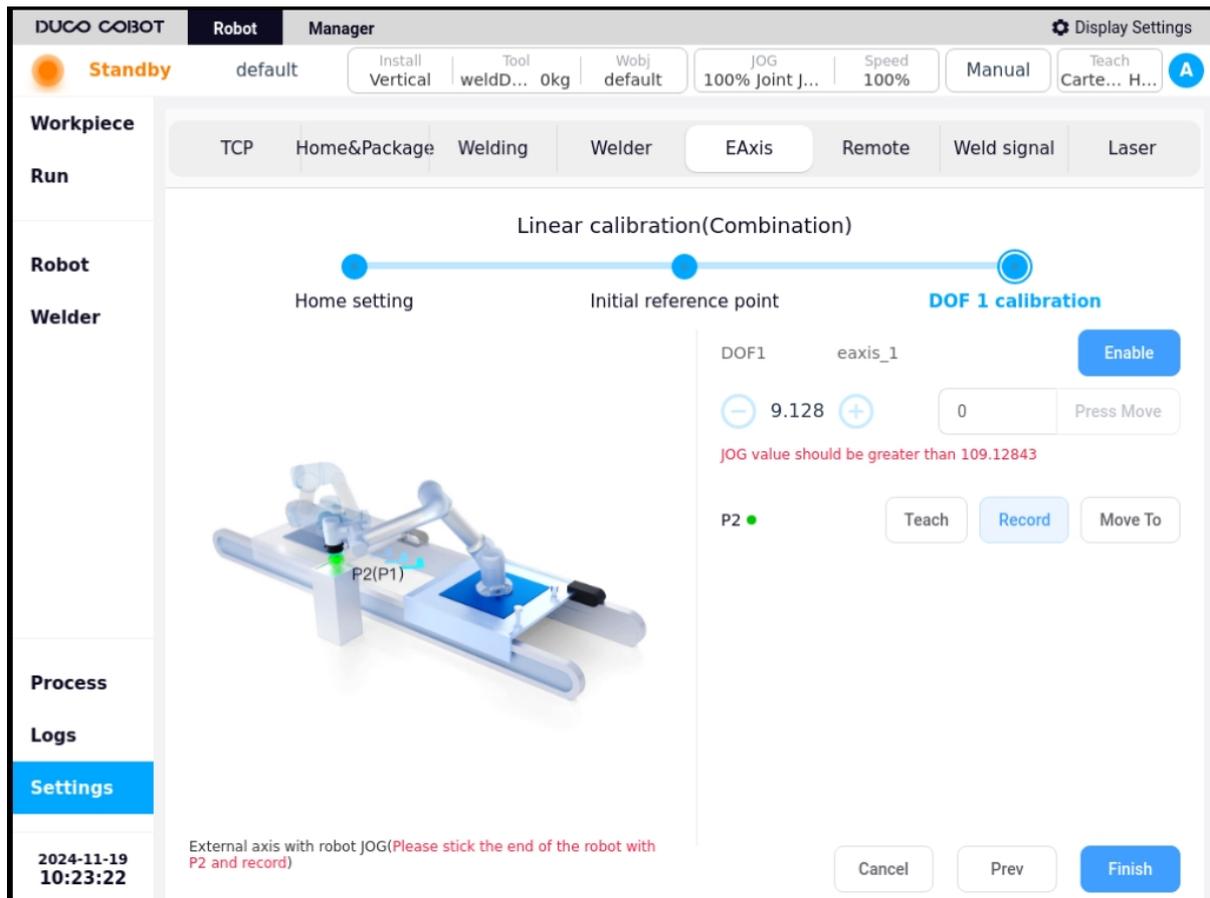
- (1) Determine the zero point: You can press and hold the icons on the left and right sides of the external axis position display to move the external axis, determine the zero point position of the external axis, and then click the “Next” button;

External axis with robot JOG(Please stick the end of the robot with P1 and record,P1 is the fixed point of the robot outside the external axis)

- (2) Initial reference point: P1 point is a fixed point outside the robot and the external axis, respectively JOG external axis and the robot, so that the robot end and P1 point paste and record; teach the robot or external axis position, P1 point after the display from | A5 | | A6 | click on the “Next” button;

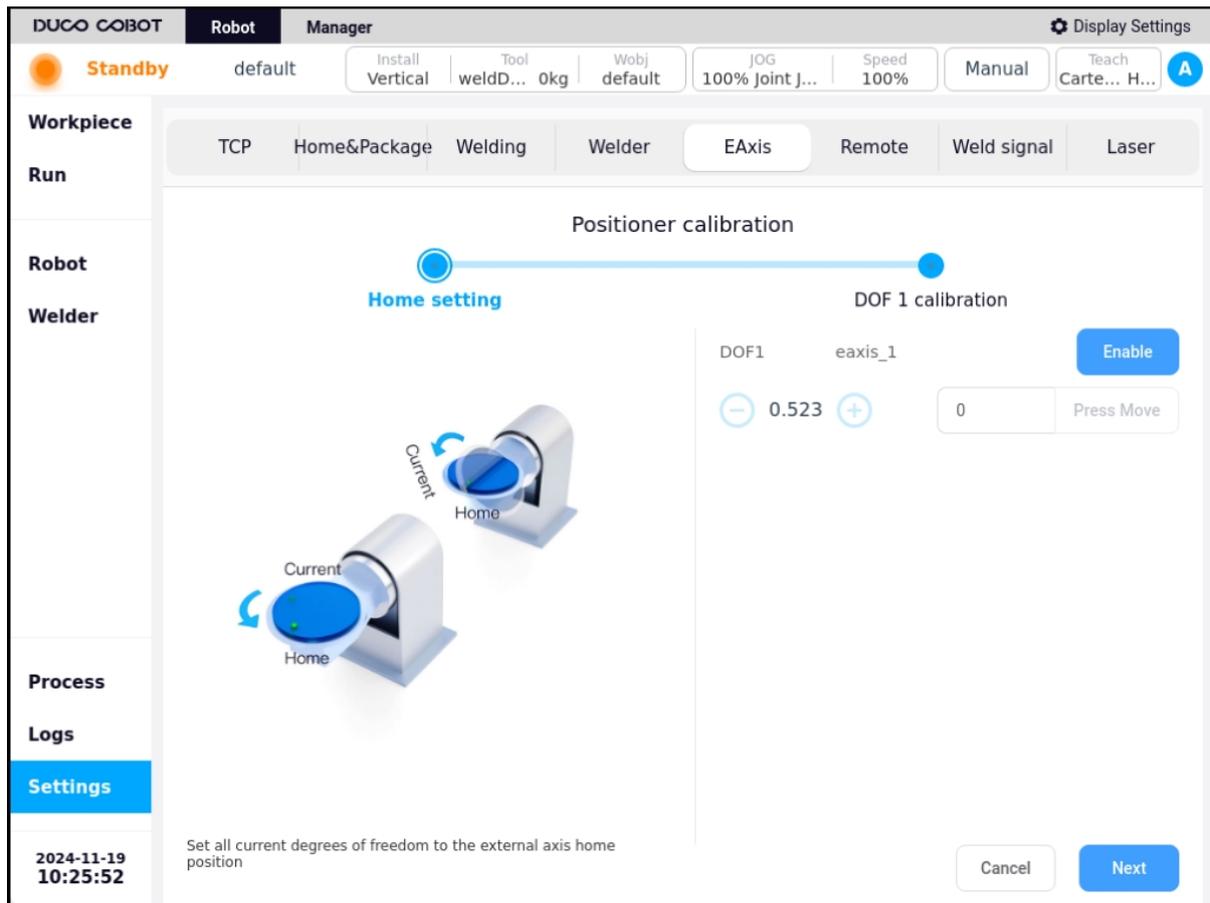
The screenshot displays the 'DOF 1 calibration' interface. At the top, the status is 'Standby'. The left sidebar shows 'Settings' as the active menu. The main workspace features a progress bar with three stages: 'Home setting', 'Initial reference point', and 'DOF 1 calibration'. Below the progress bar, there is a 3D model of the robot with a point labeled 'P2(P1)'. To the right of the model, the 'DOF 1 calibration' control panel is visible, showing 'eaxis_1' as the selected axis, a value of '9.128', and a 'Press Move' button. A red error message indicates 'JOG value should be greater than 109.12843'. At the bottom of the control panel, there are 'Teach', 'Record', and 'Move To' buttons. The bottom left corner shows the timestamp '2024-11-19 10:21:45'.

- (3) Degree of freedom 1 calibration: Similarly, JOG the external axis with the robot, so that the end of the robot and the P2 point (in the physical environment, that is, the original P1 point) affixed to the record; demonstration of teaching and record the robot end position points, click “Finish”.

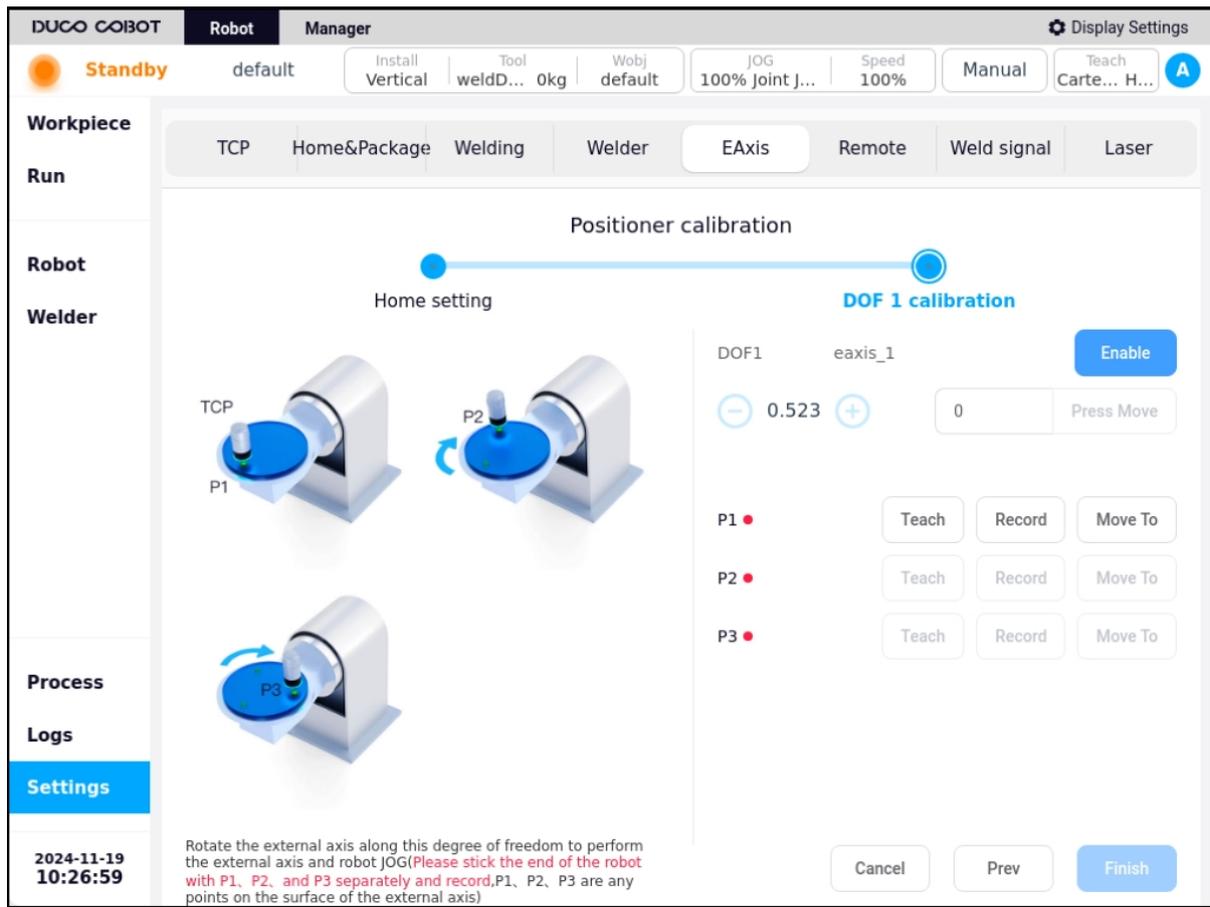


Shifter Calibration

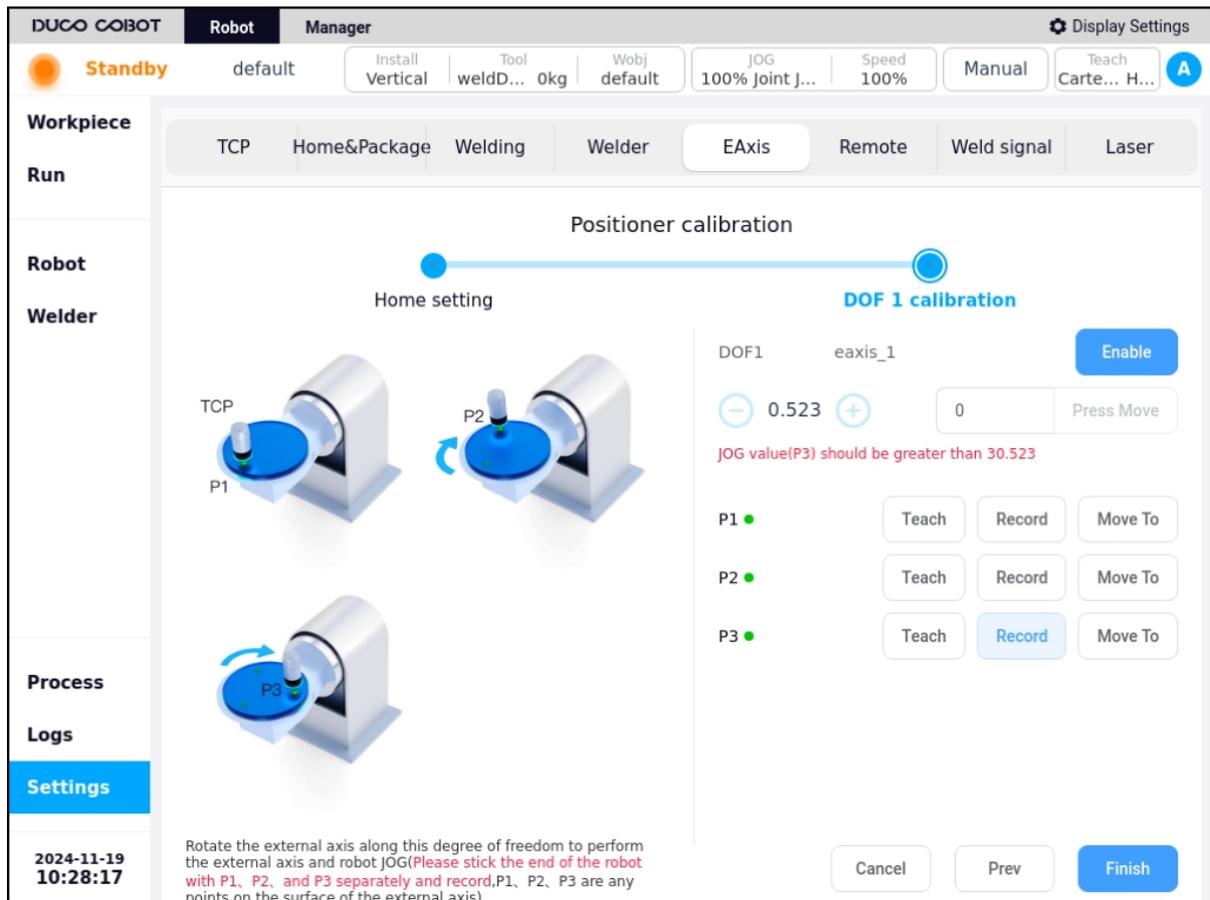
When the external axis type is a shifter, the external axis calibration is the shifter calibration. Here we take the external axis solution of single-degree-of-freedom indexer type as an example to introduce the calibration process of the indexer solution. Click on the “External Axis Calibration” button on the page as shown below:



- (1) Determine the zero point: You can press and hold the icons on the left and right sides of the external axis position display to move the external axis, determine the zero point position of the external axis, and then click the “Next” button;



- (2) Degree of freedom 1 calibration: P1, P2, P3 are any point on the surface of the external axis, JOG external axis and the robot, so that the end of the robot and the P1, P2, P3 points were affixed to the merger record; demonstration of teaching and recording of the robot's end position points, click on the "Finish" can be.



3.5.5 5. External axis programming function block

There are four function blocks related to external axes: Move_Eaxis, MoveJ_Eaxis, MoveL_Eaxis, and MoveC_Eaxis.

Move_Eaxis

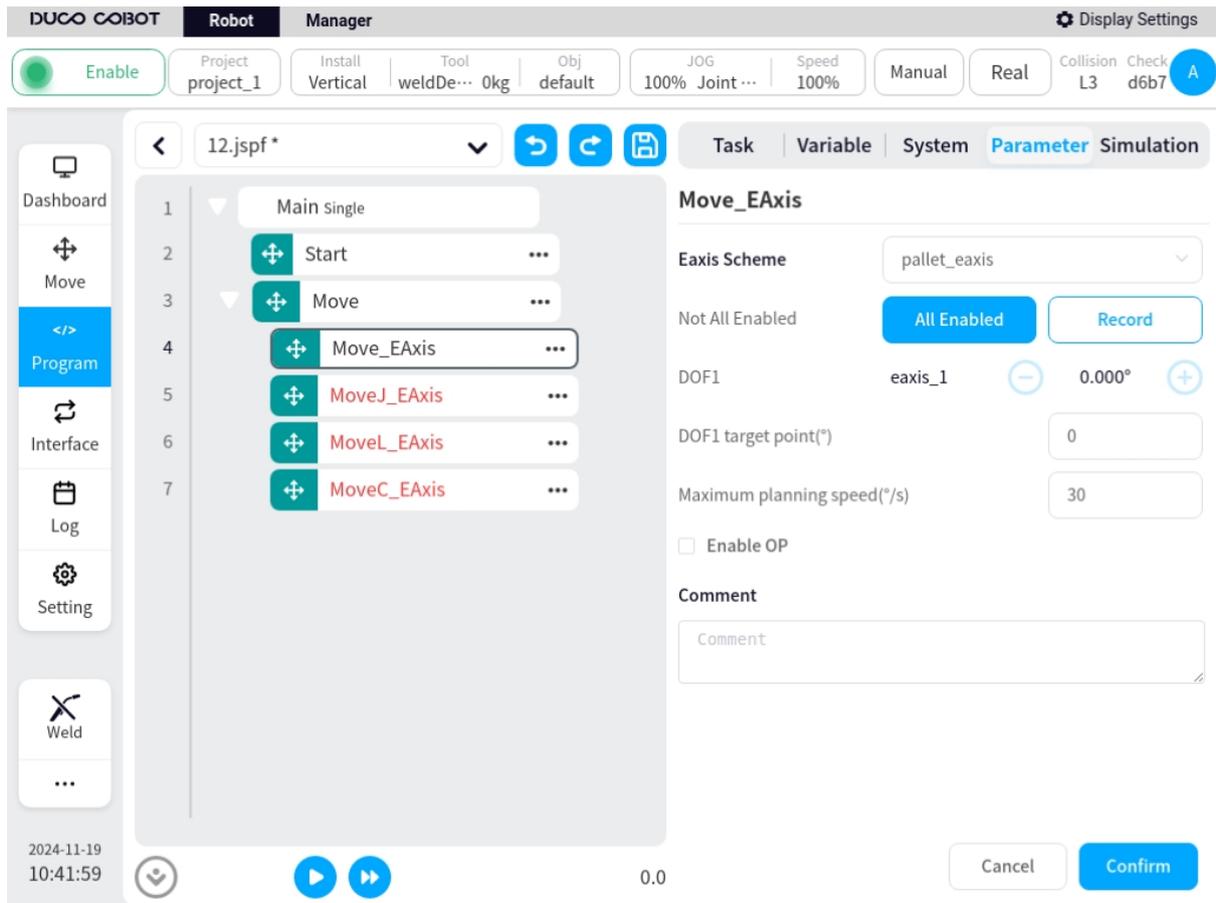
Command block for separate movement of external axes. Parameters can be set:

External Axis Program: name of the target external axis program.

Degree of Freedom Target Point: The position of the degree of freedom corresponding to the target external axis scheme, the recorded position degree of freedom and unit change according to the degree of freedom set by the external axis scheme and the type of external axis scheme, the unit is ° or mm.

Maximum planning speed: Maximum planning speed of the external axes, changed according to the type of the corresponding external axis program, in °/s or mm/s.

Enable OP: The OP function allows you to set the general-purpose digital output port status or operate customized events during trace execution.



If OP is enabled, the following configuration is required:

Can be triggered after the start of the trajectory and before/after the end of the trajectory

Trigger type: can choose no trigger, time trigger, distance trigger

Trigger delay: Setting time, unit ms

Trigger distance: set the distance, unit mm

Trigger action: select the port and port status, or operate a customized event

Enable OP

Reference Start point

Trigger type

Time(ms)

Operation

Reference End point

Trigger Point

Trigger type

Distance(mm)

Operation

Comment

MoveJ_Eaxis

External axis and robot joint motion. The robot moves according to the joint motion and can choose to move to a target joint or a target pose. Parameters can be set:

Target position: can be set by way of demonstration or set as a variable, which can be changed manually after the demonstration is set.

Use parent node coordinate system: can be set when selecting the target position attitude, when checked, this function block uses the reference coordinate system set by the parent node Move function block, checked by default.

Reference coordinate system: can be set when selecting the target position attitude, when the parent node coordinate system is unchecked, the reference coordinate system can be set separately for this function block.

Use parent node parameters: when checked, this function block uses the parameters of joint angular velocity and joint angular acceleration set by the parent node Move function block; when unchecked, you need to set the joint angular velocity and joint angular acceleration for this function block individually, checked by default.

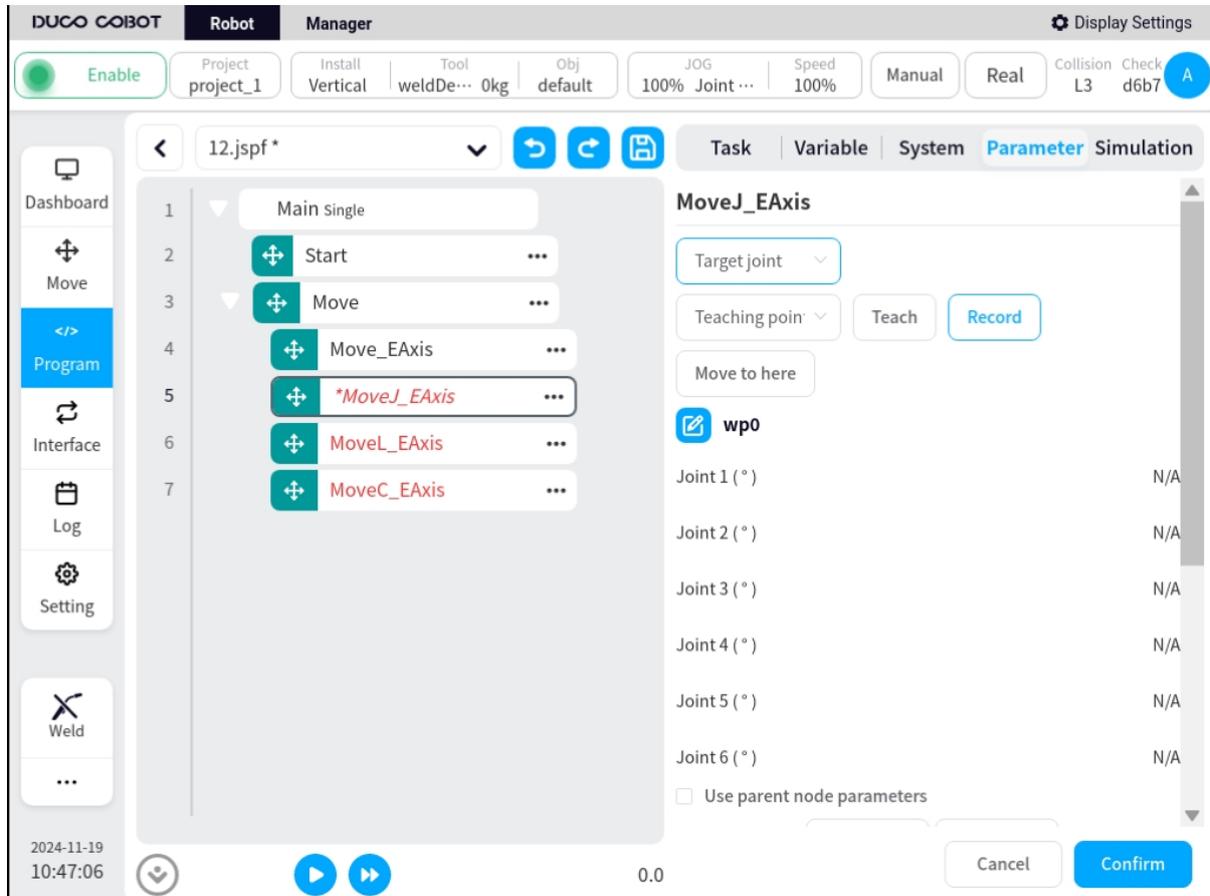
Joint angular velocity: unit %/s, can be entered directly or by selecting the variable.

Joint angular acceleration: unit %/s², can be entered directly or by selecting the variable.

Fusion radius: unit mm0 means no fusion.

Enable OP: The OP function allows you to set the general-purpose digital output port status or operate customized events during trace execution.

The configuration of the external axis parameters is the same as Move_EAxis and will not be repeated here.



If OP is enabled, the following configuration is required:

Can be triggered after the start of the trajectory and before/after the end of the trajectory

Trigger type: can choose no trigger, time trigger, distance trigger

Trigger delay: Setting time, unit ms

Trigger action: select the port and port status, or operate a customized event

Enable OP

Reference Start point

Trigger type

Time(ms)

Operation

Reference End point

Trigger Point

Trigger type

Distance(mm)

Operation

Comment

MoveL_Eaxis

The external axis moves in a straight line with the robot. The robot moves in a straight line to the target attitude, which can be parameterized:

Target attitude: can be set by way of demonstration or set as a variable, which can be changed manually after the demonstration is set.

Use parent node coordinate system: when checked, this function block uses the reference coordinate system set by the parent node Move function block, checked by default.

Reference coordinate system: when the Use parent node coordinate system is unchecked, you can set the reference coordinate system for the function block separately.

Use parent node parameters: when checked, the function block uses the end velocity and end acceleration parameters set by the parent node Move function block; when unchecked, you need to set the end velocity and end acceleration for the function block individually, default is checked.

End speed: unit mm/s, can be entered directly or by selecting a variable.

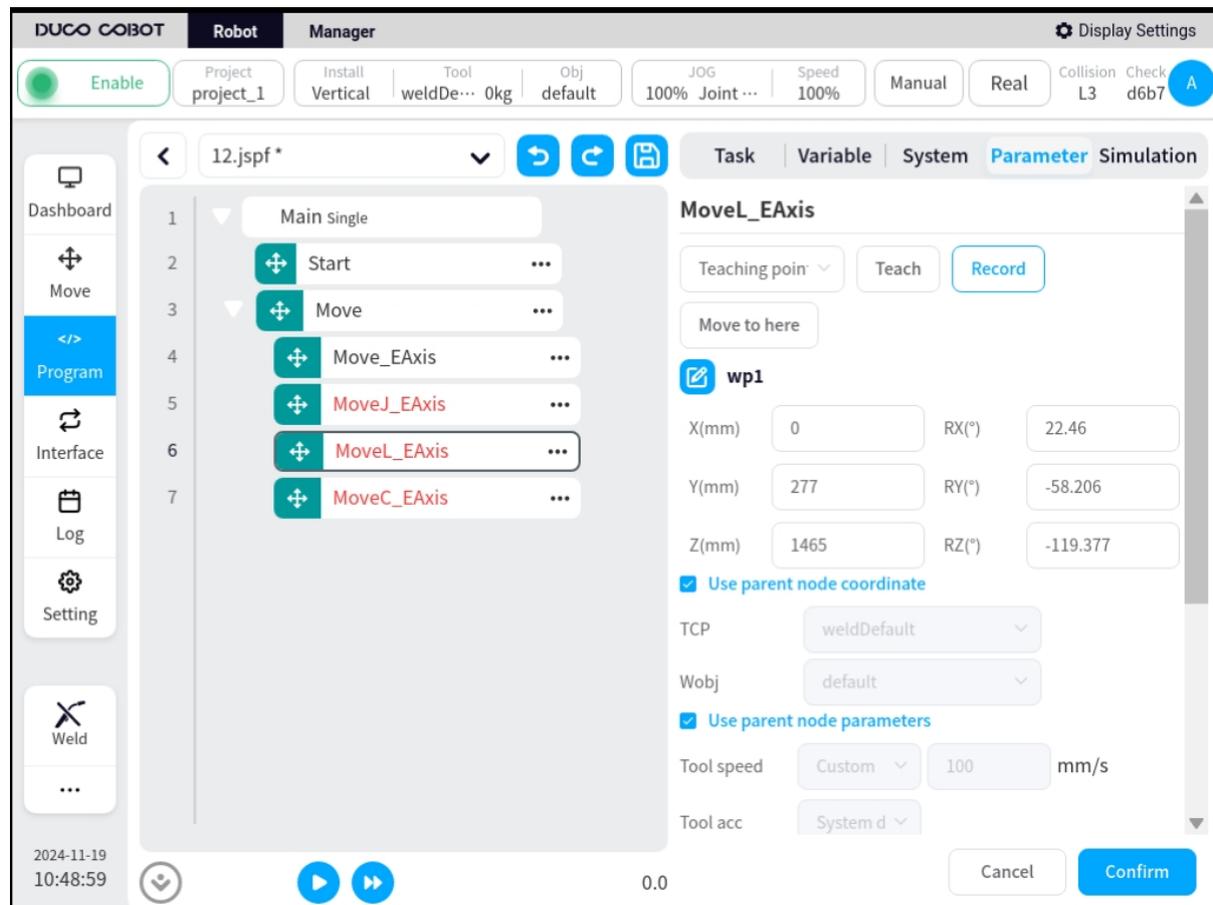
End acceleration: unit mm/s², can be entered directly or by selecting a variable.

Fusion radius: unit mm, 0 means no fusion

Enable OP: The OP function allows you to set the general-purpose digital output port status or operate customized events during trace execution.

OP parameter configuration is the same as Move_EAxis.

The configuration of the external axis parameters is the same as Move_EAxis and will not be repeated here.



MoveC_Eaxis

External axis with robot circular motion. The robot moves according to an arc or a full circle, which can be parameterized:

Pattern: Arc or full circle

Midpoint Attitude/Midpoint 1: Can be set by way of demonstration or set as a variable, which can be changed manually after the demonstration is set.

Target Attitude/Midpoint 2: Can be set by demonstration or set as a variable, which can be changed manually after the demonstration is set.

Use parent node coordinate system: when checked, this function block uses the reference coordinate system set by the parent node Move function block, checked by default.

Reference coordinate system: when the Use parent node coordinate system is unchecked, you can set the reference coordinate system for the function block separately.

Use parent node parameters: when checked, the function block uses the end velocity and end acceleration parameters set by the parent node Move function block; when unchecked, you need to set the end velocity and end acceleration for the function block individually, default is checked.

End speed: unit mm/s, can be entered directly or by selecting a variable.

End acceleration: unit mm/s², can be entered directly or by selecting a variable.

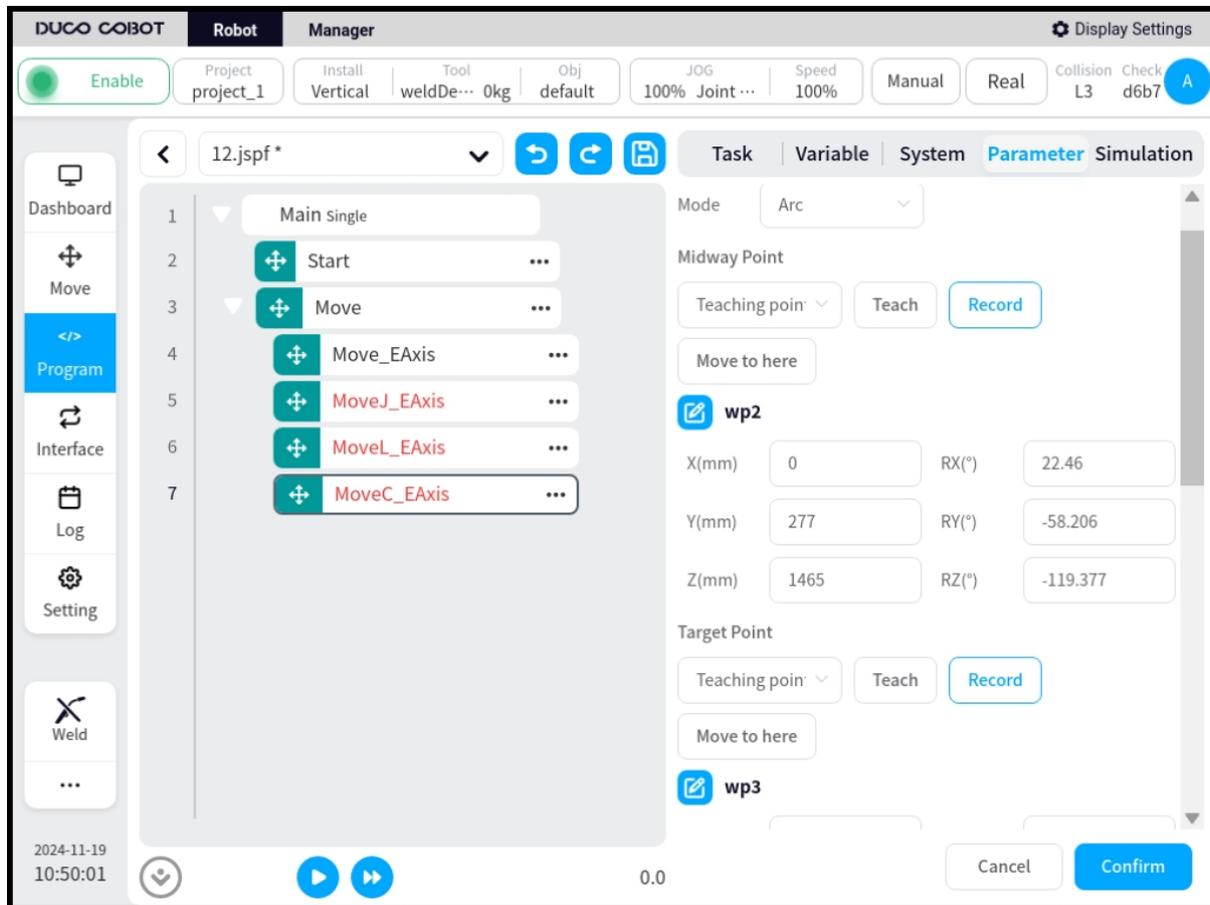
Fusion radius: unit mm, 0 means no fusion

Attitude control mode: If “consistent with the end point” is selected, the robot’s attitude is planned according to the end point attitude for the attitude in the circular arc path; if “consistent with the starting point” is selected, the robot’s attitude is planned according to the starting point attitude for the attitude in the circular arc path, and the attitude during the path is consistent with the starting point; if “constrained by the center of the circle” is selected, the robot’s attitude is constrained by the attitude change relative to the circular arc motion. If “consistent with start point” is selected, the robot’s pose is planned according to the start point pose, and the pose during the path is consistent with the start point; if “constrained by center of circle” is selected, the robot’s pose is constrained by the change of the pose with respect to the movement of the circular arc.

Enable OP: The OP function allows you to set the general-purpose digital output port status or operate customized events during trace execution.

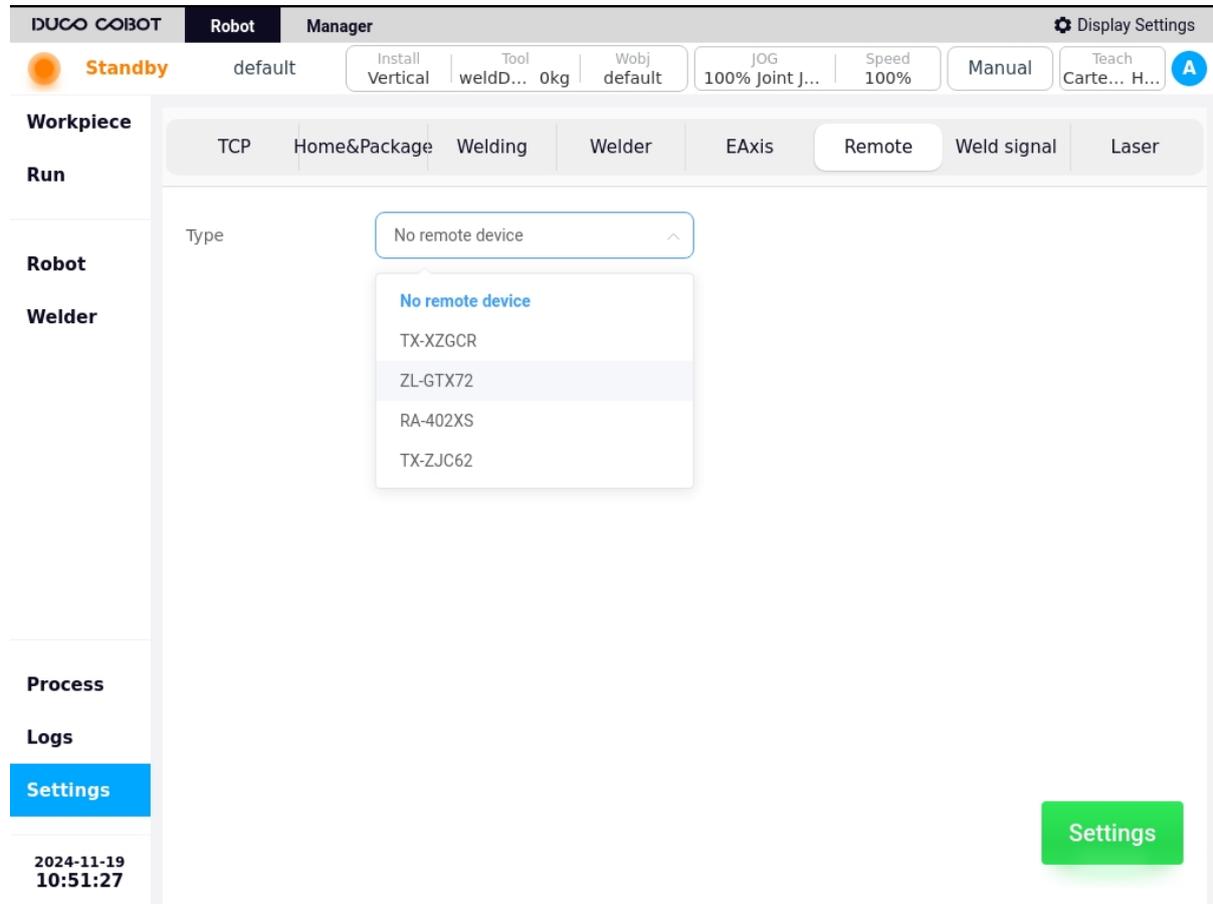
OP parameter configuration is the same as Move_EAxis.

The configuration of the external axis parameters is the same as Move_EAxis and will not be repeated here.



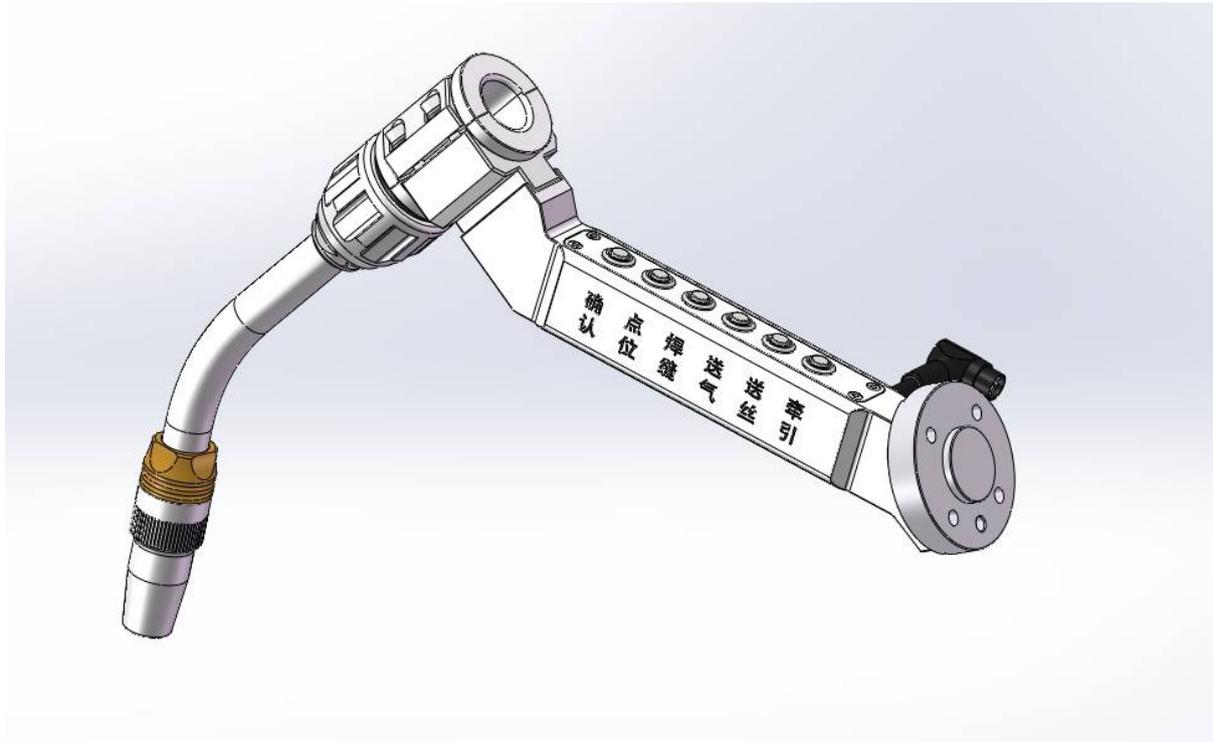
3.6 Remote configuration

The Remote Configuration sub-page is used to set the external remote sensor type, as shown below.



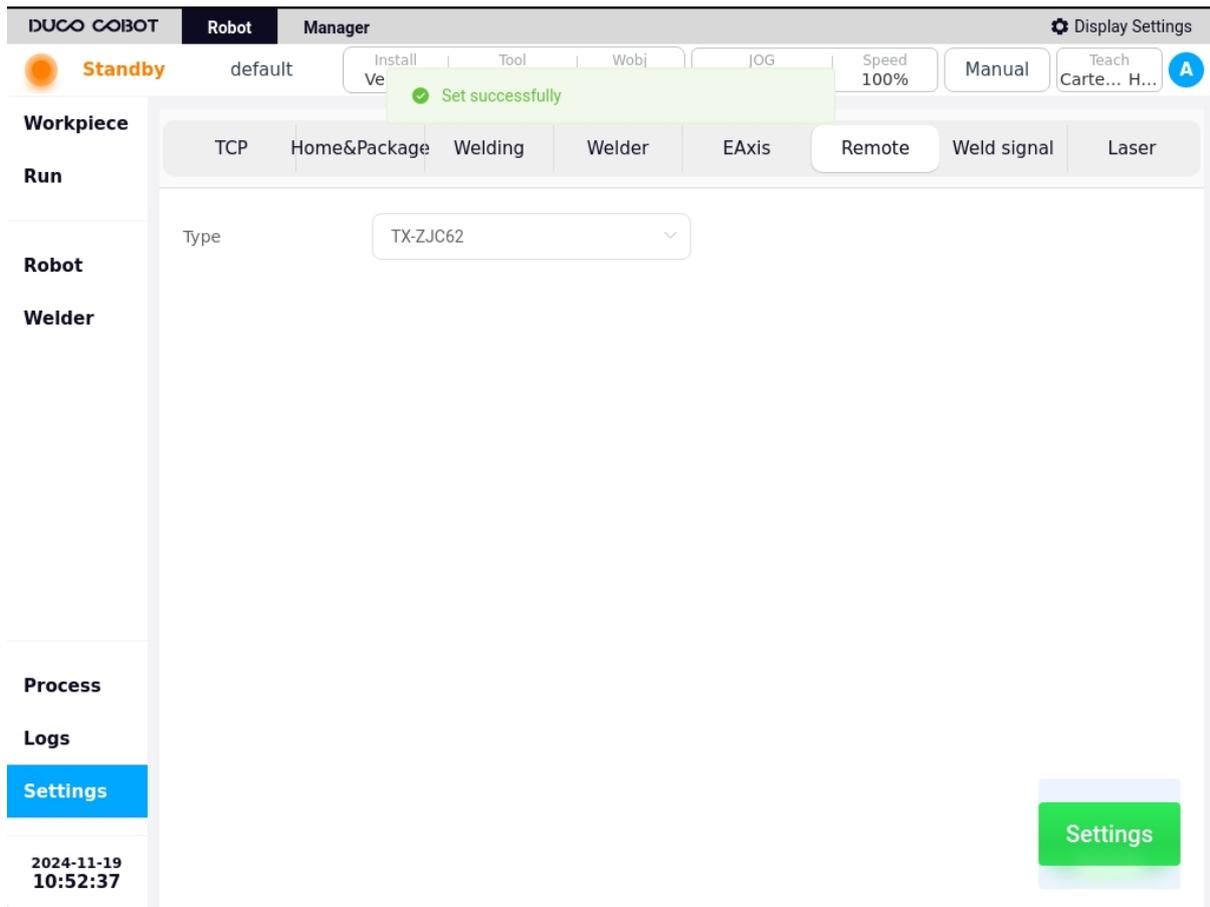
Types of remote sensing: User selectable with or without remote sensing equipment, TX-XZGCR, ZL-GTX72, RA-402XS and TX-ZJC62.

Models TX-XZGCR are end remote levers plus 6 buttons, ZL-GTX72 handheld remote handle, RA-402XS with six-button torch. TX-ZJC62 remote with force control sensor and buttons. Among them, the RA-402XS with six-button torch is set up with six functions of traction, wire feed, gas feed, weld, spot, and confirmation, as shown in the figure below.



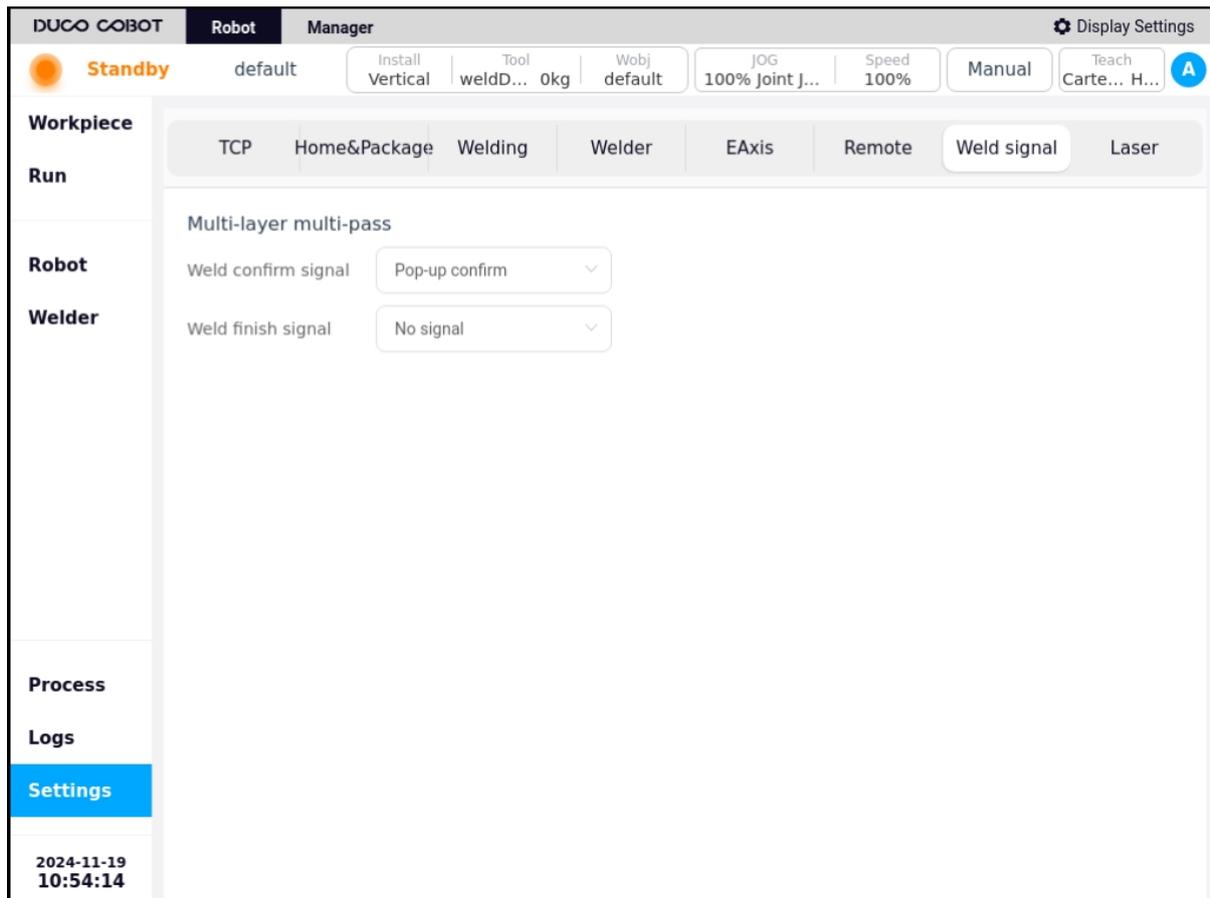
- Traction: Click the traction button to switch the traction mode, you can switch the joint traction or Cartesian traction two modes.
- Wire feeding: Tap wire feeding to adjust the welding stem elongation.
- Gas feeding: Test whether the protective gas is normal before welding.
- Welding seam: set the type of welding seam for single weld, and switch different types of welding seam by pressing the key, i.e. straight line welding seam, circular arc welding seam, and whole circle welding seam.
- Points: Click to confirm the teaching points, long press to delete the teaching points.
- Confirmation: When the weld is taught, click the button to confirm the weld and prepare for execution.

After selecting the configured remote sensing type, click the “Settings” button at the bottom right corner of the page, and a pop-up window will indicate that the settings are successful, as shown in the figure below.



3.7 Welding Signal

The Weld Signal sub-screen is used to set the weld pass confirmation signal and weld pass completion signal for multi-layer multi-pass, as shown in the following figure.



Weld Path Confirmation Signal: Configure a weld path confirmation completion signal for multi-layer multi-pass, with options such as pop-up confirmation, general-purpose digital input port, and Bool input register.

Weld Path Completion Signal: Weld Path Completion Signal Configurable items with or without, General Purpose Digital Output Port, Bool Output Register.

3.8 Laser Configuration

The laser configuration page is used to set up the laser sensor manufacturer, connect the sensor, control the sensor, and calibrate the sensor. As shown in the figure, the left side area for sensor connection and operation, and the right side for the calibration parameters can be viewed as well as the calibration of the laser sensor. See Laser Sensors for details on how to use them.

The screenshot displays the 'Robot Manager' interface for a DUCO COBOT. The top navigation bar includes 'DUCO COBOT', 'Robot', and 'Manager', along with a 'Display Settings' icon. The status bar shows 'Standby' and 'default' mode, with various control buttons like 'Install Vertical', 'Tool weldD... 0kg', 'Wobj default', 'JOG 100% Joint J...', 'Speed 100%', 'Manual', and 'Teach Carte... H...'. A central menu contains tabs for 'TCP', 'Home&Package', 'Welding', 'Welder', 'EAxis', 'Remote', 'Weld signal', and 'Laser'. The 'Laser' tab is active, showing a 'Connect state' indicator (a grey circle) and a 'Sensor setting' section with fields for 'Sensor brand' (Please select), 'IP address' (127.0.0.1), and 'Port' (1000), plus a 'Connect' button. To the right is a 'Sensor calibration' section with 'Check params' and 'Calibrate sensor' buttons. A left sidebar lists 'Workpiece', 'Run', 'Robot', 'Welder', 'Process', 'Logs', and 'Settings' (highlighted in blue). A timestamp '2024-11-19 10:55:29' is visible at the bottom left.

CHAPTER
FOUR

ROBOT PROGRAMMING

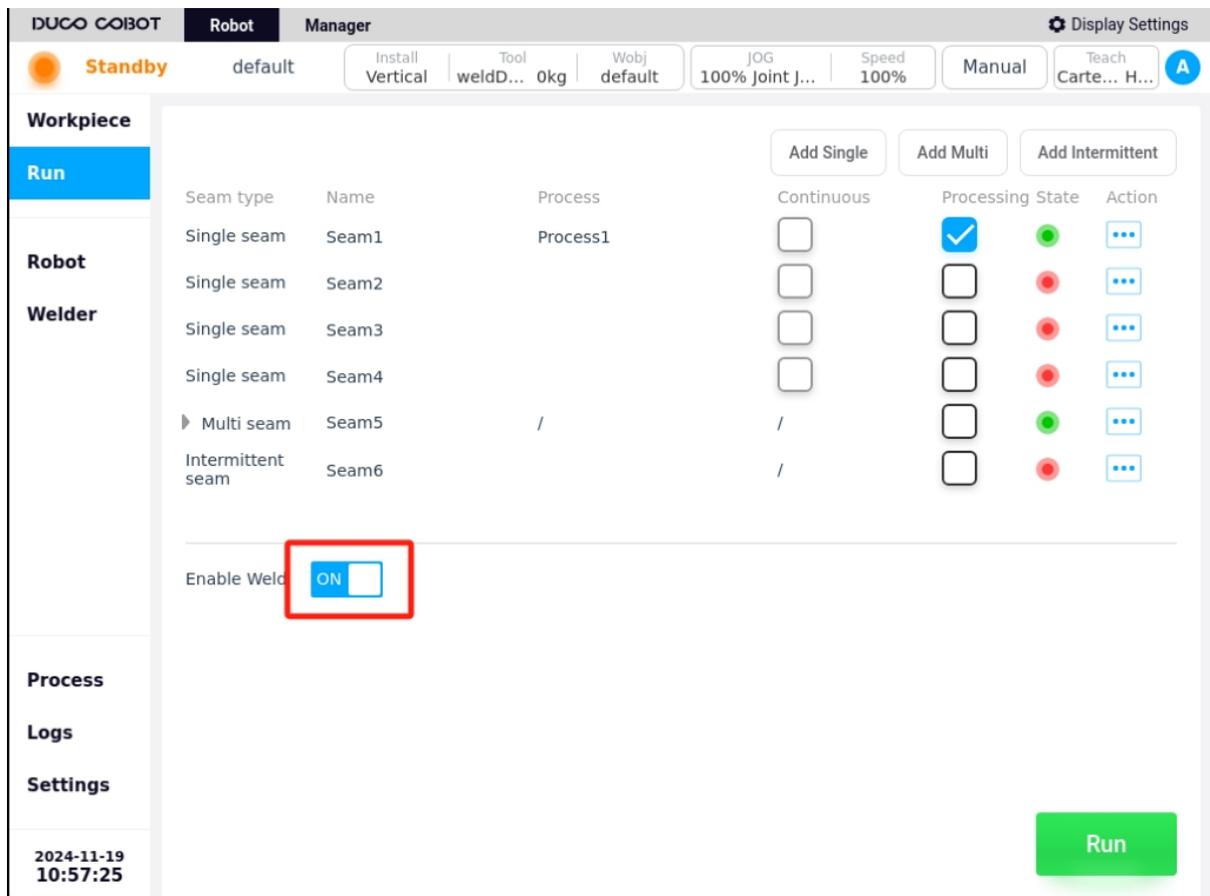
When using the WeldPackage V2, it supports the implementation of the functions inside the robot programming as in version V1. This approach provides a greater degree of freedom.

Note: Calls to process libraries are not supported when used on the programming side of the robot

4.1 Starting condition

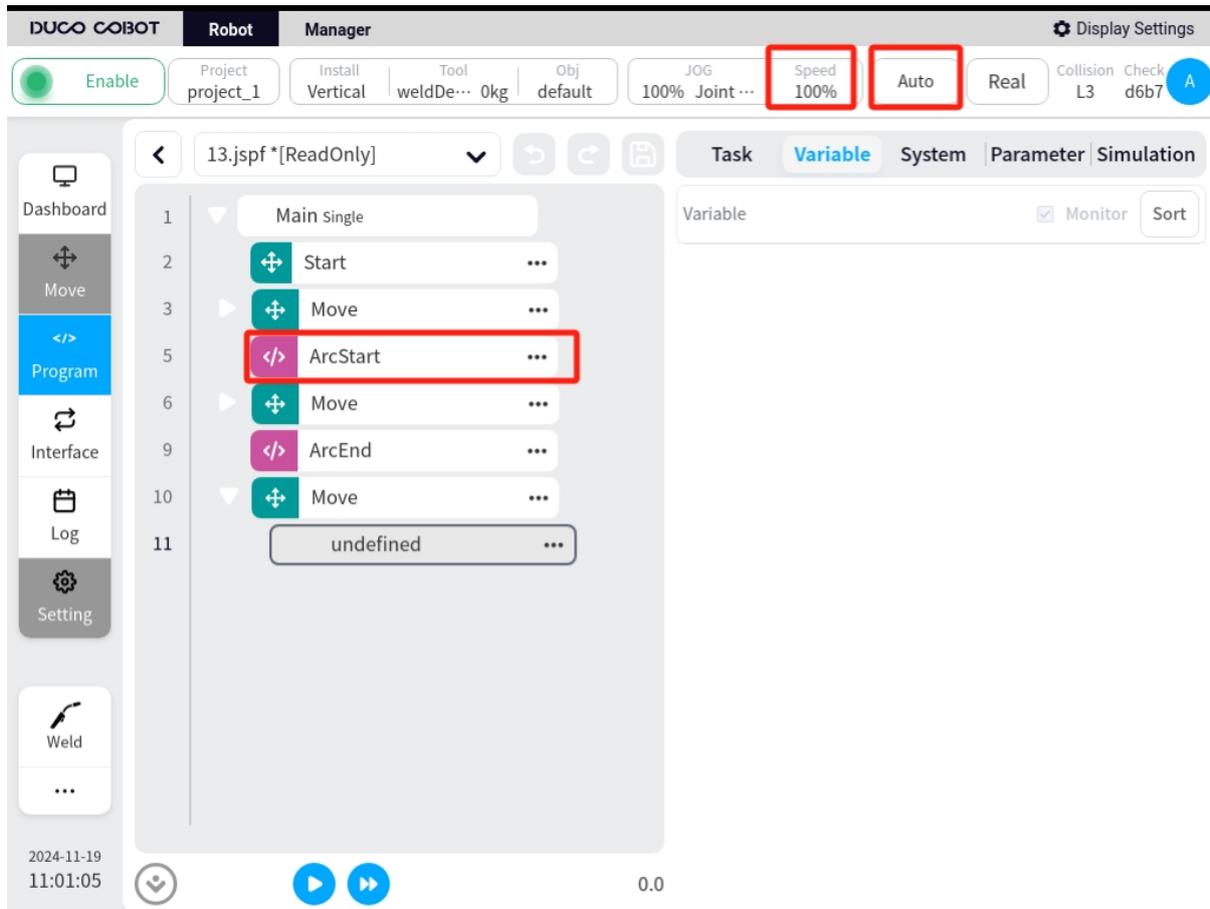
The robot sends an arc start signal to the welder, which needs to fulfill four necessary conditions.

1. Welding mode on



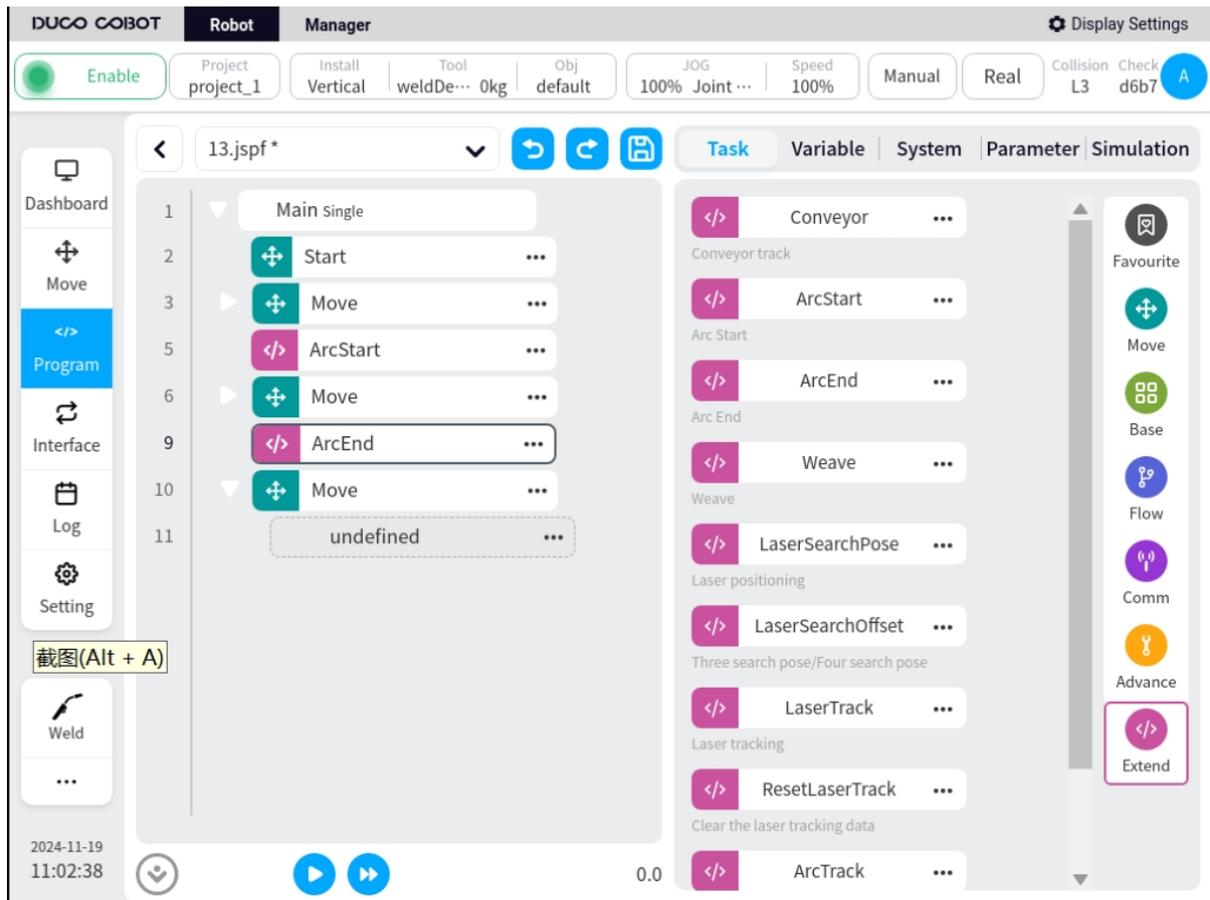
2. Robot motion mode is automatic mode

3. The global speed of the robot is set to 100%
4. In the robot script, there is an arc starting script

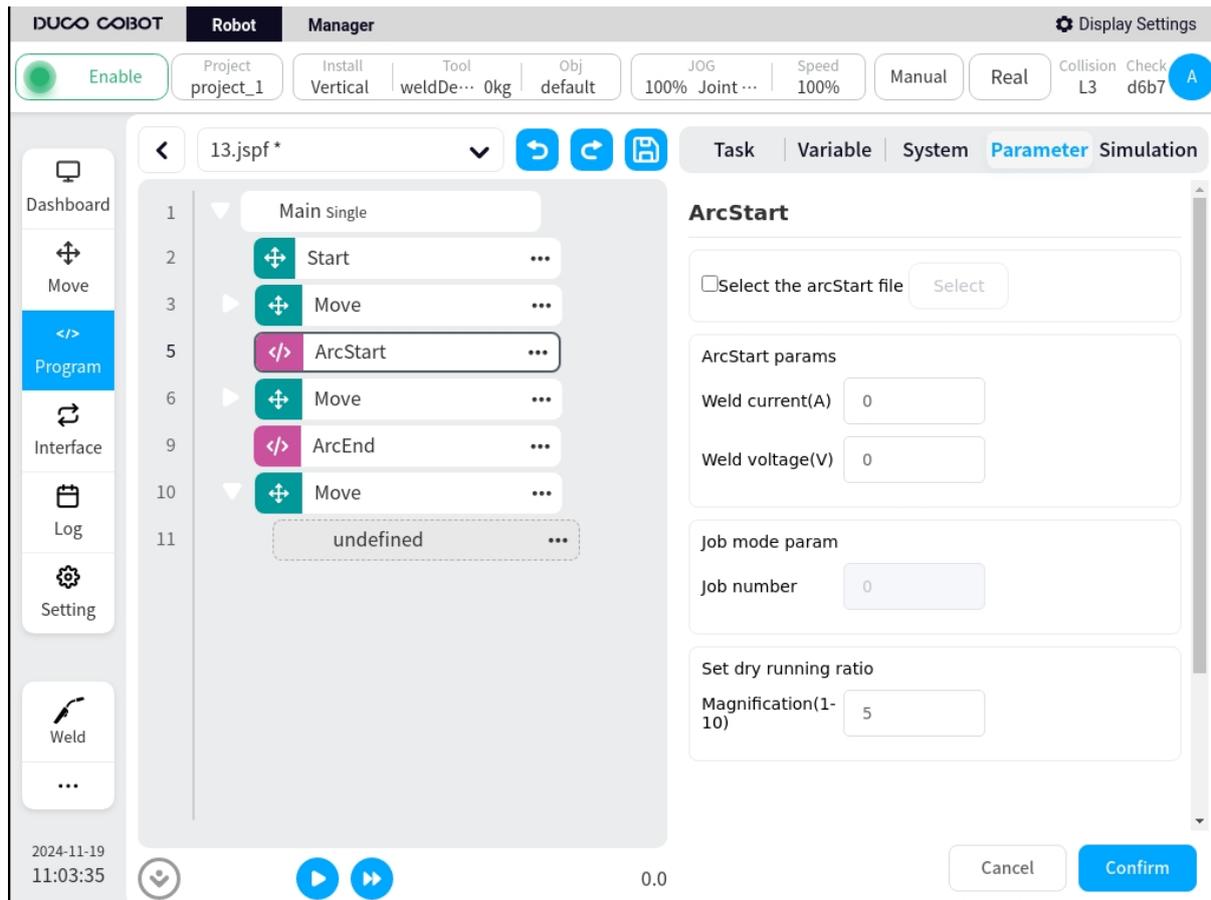


4.2 ArcStart function blocks

Once the Welding Process Package has been installed and the Plug-in Package has been enabled, the two program function blocks, ArcStart and ArcEnd, can be seen in the Robot Program Interface, Extended Function Scripts column.



The Arc Start/Retract function block allows arc start/retract commands to be sent to the welder in two different modes. These are the mode of setting the arc start parameters and the mode of setting the JOB number. The Arc Start function block also allows for the setting of the multiplier when running empty, allowing the robot to run at high speeds when the welding mode or simulation is not turned on, so that the correctness of the welding trajectory can be quickly observed during the commissioning process. When it is necessary to change the welding parameters during the welding process while the robot is running, this can be realized by setting two ArcStart.



ArcStart parameters:

The welding current and voltage at arc start/close are given, and the unit of voltage is % if the control mode of the welder is set to unitary.

Job mode parameters:

To select the Job number to call, make sure the welder control mode is Job mode. When the Job mode parameter is set, the process file and arc start parameter become grayed out and cannot be edited.

Set dry running ratio:

After setting the dry running ratio, when the weld setup is set up with the air run function turned on and welder enable turned off, it will do a multiplier run for all robot motion scripts between ArcStart and ArcEnd. The actual running speed of the robot will be multiplied by the set multiplier. The calculation formula is:

Actual running speed = set weld speed * manual/automatic reduction ratio * global speed * multiplication rate

Take the example of setting the welding speed to 20mm/s, setting the global speed to 70% in manual mode, and setting the air run multiplier to 3:

The manual downsizing percentage is 25% and the automatic downsizing percentage is 100%.

Actual running speed = 10.5 mm/s.

Take the example of setting the welding speed to 20mm/s, setting the global speed to 80% in auto mode, and setting the air run multiplier to 3:

The manual downsizing percentage is 25% and the automatic downsizing percentage is 100%.

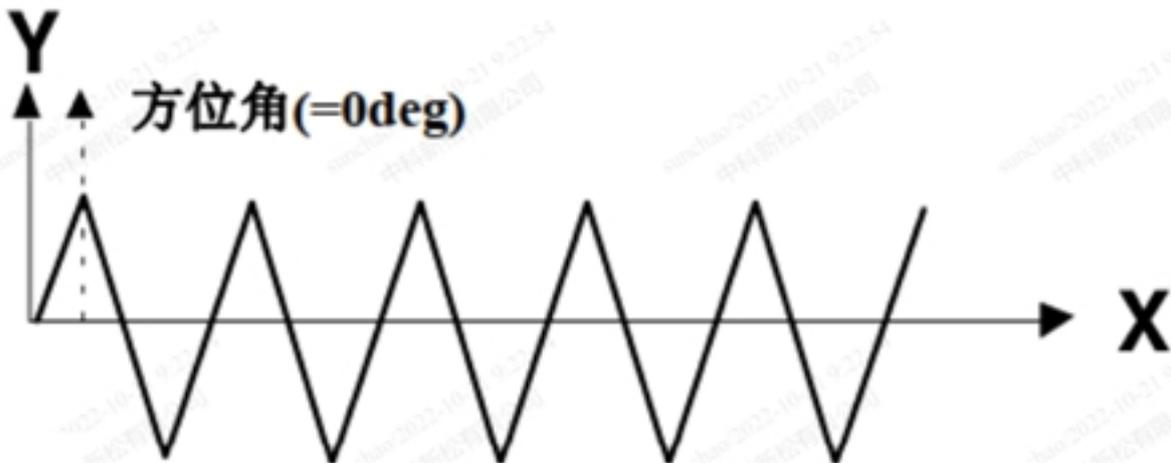
Actual running speed = 42mm/s.

4.3 Weave welding

Version V1.2.0 and above of the Welding Process Package adds the weave function. In the “Expansion” command set in the programming interface, call the “weave” function block to enable the pendulum welding function. As shown in the figure below.

Normally, when using the weave function, it is programmed by adding a weave function block (Weave) after the existing ArcStart function block (ArcStart). In the weave, the trajectory to be welded is added. All motion commands added to the weave will have a swinging motion effect until all motion commands are completed. .. image:: ./image/10.jpg

The business logic of pendulum welding is to superimpose a layer of periodic, regular pendulum trajectory on top of the original set motion trajectory. In the current version, the azimuth angle is 0° by default and cannot be set. As shown in the figure below.



Click on the weave function block to set the swing trajectory. The parameters that can be set are: trajectory type, reference plane, frequency, amplitude, OP. when choosing trapezoidal or sinusoidal trajectory, you need to add the left and right dwell time parameters.

Weave

Track type: Triangle

Ref Plane: Tool XOY

Frequency(Hz): 1

Amplitude(mm): 1

Left point OP
 Trigger action: DO1

Duration(ms): 0

Right point OP
 Trigger action: DO1

Duration(ms): 0

Left-to-right midpoint OP
 Trigger action: DO1

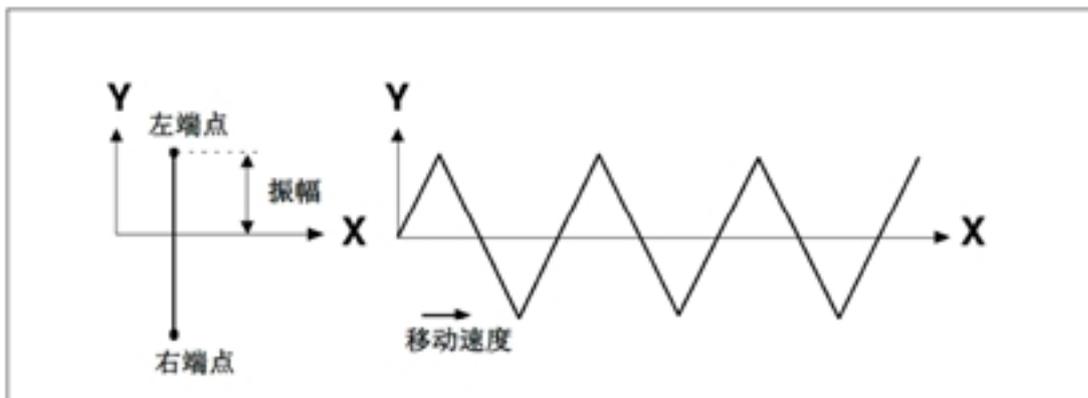
Cancel Confirm

Trajectory type:

The following types are supported, Triangle, Sine, Arc, Trapezoid, Figure of 8

Note: Version 2.1 does not support custom trajectories

Triangle track: Standard pendulum welding mode. Usually used in scenarios such as large weld seams and multi-layer welding.

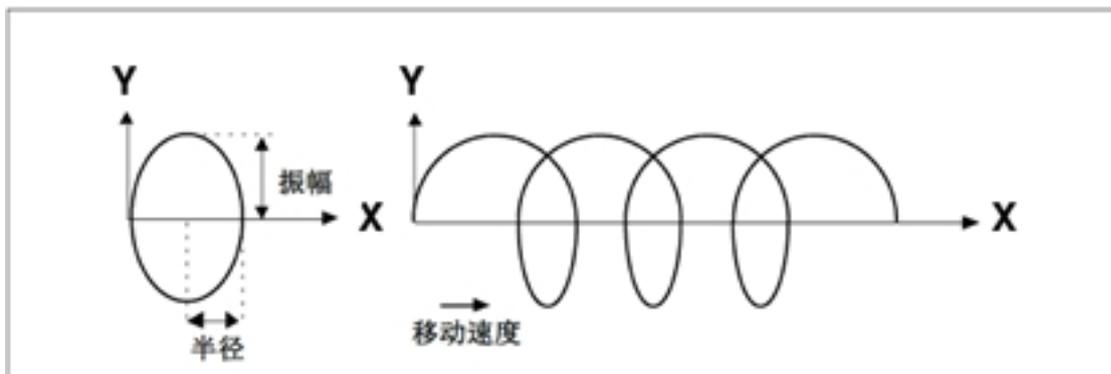


Sine Trajectory: Standard pendulum welding mode. Typically used in scenarios such as large weld seams and multi-layer welding.

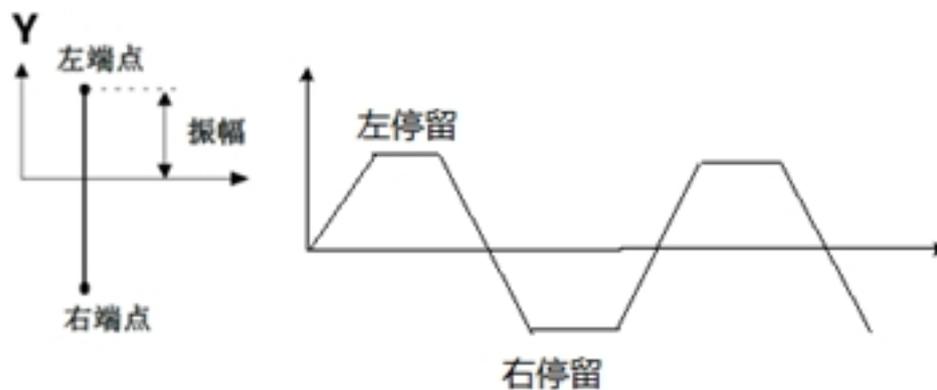


For sinusoidal trajectories, you can set the dwell time for the left and right endpoints, and you can choose whether or not to enable the main path synchronized dwells

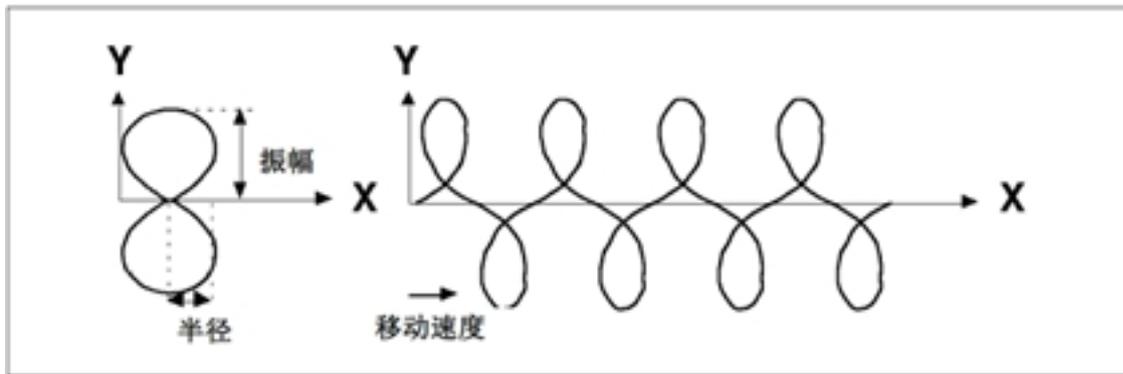
Circular trajectory: mainly used in lap joints and cap welds with a large The circle radius is the same as the amplitude.



Trapezoidal Trajectory: Standard pendulum welding mode. Typically used in scenarios such as large weld seams and multi-layer welding.



“8” trajectory: mainly in applications such as welding of thick plates and surface/external finish grinding, strength improvement, etc.



Reference plane:

Use the current tool coordinate system or workpiece coordinate system as a reference to set the plane where the swing trajectory takes effect. Supports tool XOY, tool XOZ, tool YOZ, workpiece XOY, workpiece XOZ, workpiece YOZ.

Frequency:

The number of cycles per second that the oscillating trajectory executes.

Amplitude:

The maximum value at which the boundary of the oscillating trajectory deviates from the reference trajectory.

Left and right dwell times:

Used to define the length of the top and bottom edges of a trapezoidal or sinusoidal trajectory.

Main Path Synchronized Dwell:

When the main path synchronized dwell is enabled, the robot stops moving when it reaches the ends of the sinusoidal trajectory; when the function is not enabled, the robot will continue to move in the direction of the main path when it is at the ends.

Left endpoint OP:

Action performed when the swing reaches the left endpoint: controls the DO state and duration or triggers an event

Right endpoint OP:

Action performed when the swing reaches the right endpoint: controls the DO state and duration or triggers an event

Left to right midpoint OP:

Action performed when the pendulum crosses the midpoint during the movement from the left endpoint to the right endpoint: controls the DO state and duration or triggers an event

Right to left midpoint OP:

Action performed when the pendulum crosses the midpoint during the movement from the right endpoint to the left endpoint: controls the DO state and duration or triggers an event

4.4 Arc tracking

Arc tracking is mainly used in thick plate welding, where the welding trajectory of the robot is compensated by detecting the value of the current flowing between the wire and the processed workpiece during the welding process.

Compensation is only possible in the up and down direction and the left and right direction, and only in sinusoidal pendulum welding.

Arc tracking command: ArcTrack

Configuration parameters are:

Type: Used to set the type of arc tracking, with the following options:

- End clearing path information, offset information for clearing records at the end of the trace

- End retention path information, offset information for records retained at the end of the trace

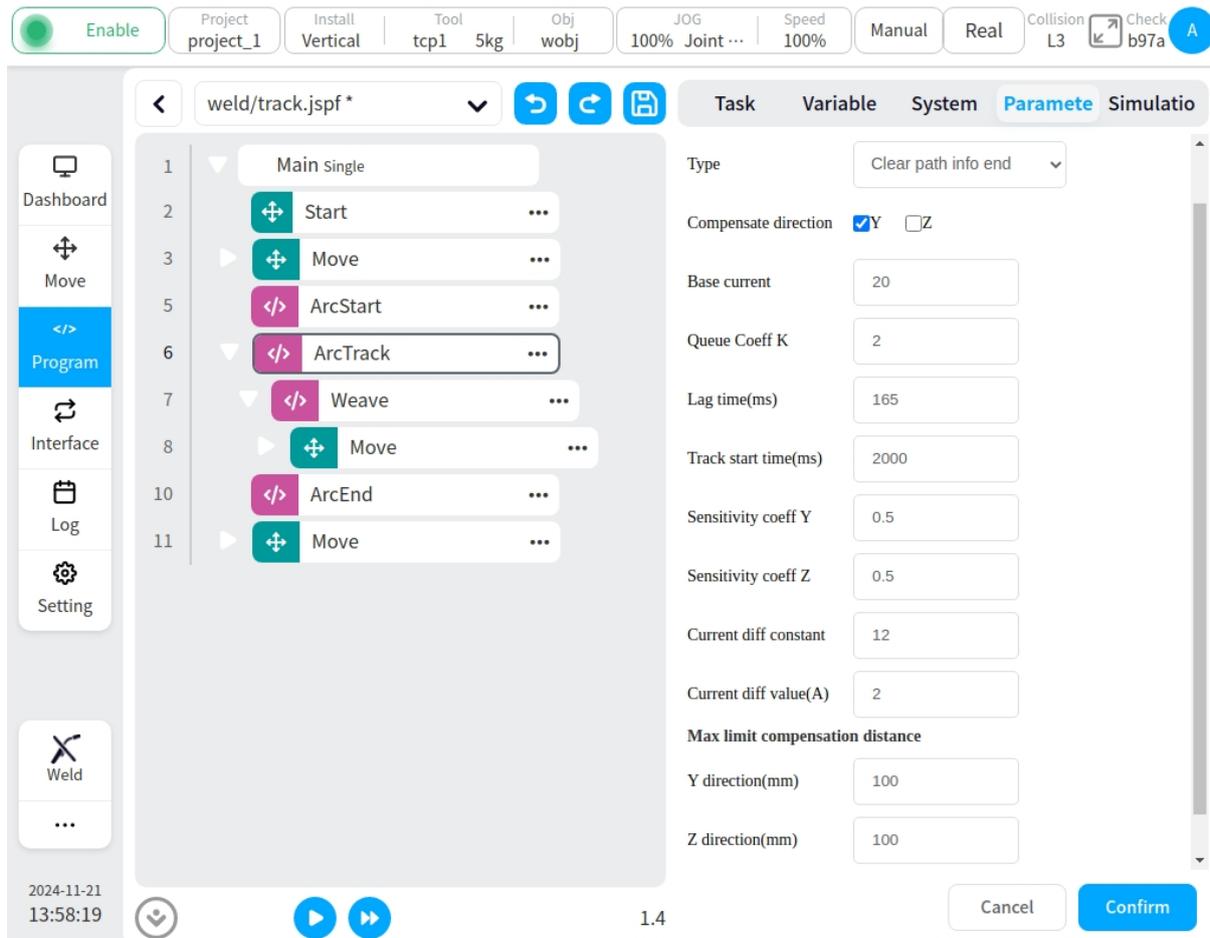
- Use the recorded path information to trace using the offset information from the last trace record (mainly used for multi-layer multi-pass welding)

Compensation direction: Select the direction to enable the compensation function, Y (left and right direction), Z (up and down direction). For sinusoidal pendulum welding, you can choose to enable Y and Z direction compensation, while other types can only enable Z direction compensation.

Reference current: Reference current value

Current-height scale factor: the scale factor of welding current and torch height, default value 4

Maximum Compensation Distance Limit: Maximum allowable offset of the left, right, up and down directions relative to the trajectory.



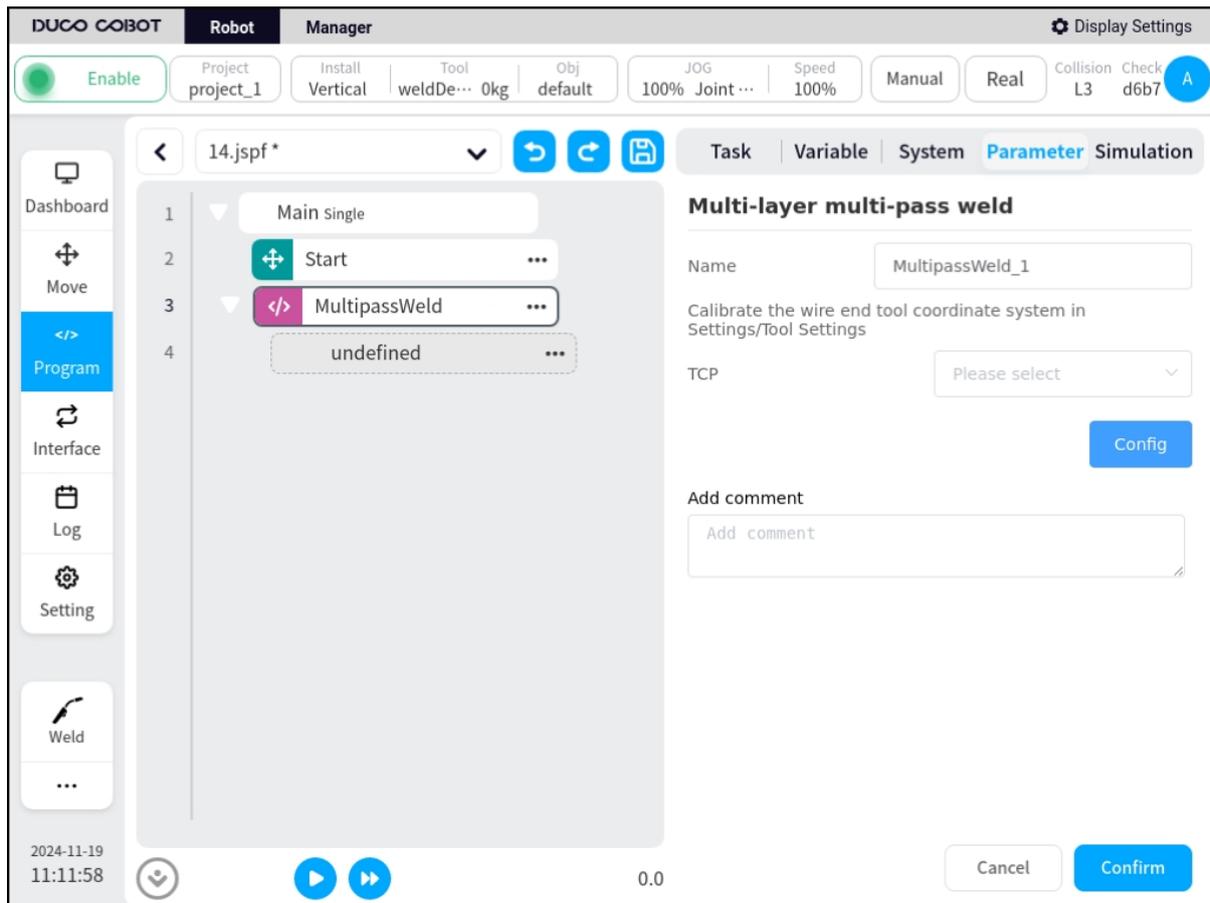
4.5 Multi-layer multi-pass welding

Welding Process Package v1.4 and above, DUCO Core v2.9.0 and above

Welding of medium-thick plates often requires multiple welds on the same part to increase the weld width. The main principle is: record the trajectory of the first weld and the compensation amount; based on the recorded compensation amount, add the overall offset to realize the operation of the subsequent weld pass.

This process package provides a MultipassWeld function block to guide the user through the programming of a multi-layer, multi-pass welding operation.

On the programming page, in the command “Extensions”, look for the “MultipassWeld” function block. Add it to the program, click on it, and the configuration page will look like this



Configure the tool coordinate system: Teach the tool coordinate system with the end of the wire in the setup page.

Click on Parameter Configuration to enter the Multilayer Multi-Pass Welding Guidance Configuration page. It is divided into the following steps, which can be switched by clicking Next or clicking on the navigation menu above.

Weld configuration

Configuration of the initial weld's point positions, mainly the workpiece coordinate system, the weld's start safety point, the start point, the end point, and the end safety point. It is possible to teach the coordinates of the points as well as the speed and acceleration of each point.

DUCO COBOT Robot Manager Display Settings

Enable
Project project_1
Install Vertical
Tool weldDe... 0kg
Obj default
JOG 100% Joint ...
Speed 100%
Manual
Real
Collision L3
Check d6b7
A

Dashboard
Weld seam setting
Track setting
Weave setting
Weld params
Weld bead setting

Move
Program
Interface
Log
Setting
Weld
...

2024-11-19 11:13:40

Exit Next

TCP	Please select						
User	default						
Seam Type	Line						
Start safety pose	MultipassWeld_1_safeP1	Teach	Record	Move here	100	1000	
ArtStart Point	MultipassWeld_1_wayP1	Teach	Record	Move here	100	1000	
EndStart Point	MultipassWeld_1_wayP2	Teach	Record	Move here	100	1000	
End safety pose	MultipassWeld_1_safeP2	Teach	Record	Move here	100	1000	

DUCO COBOT Robot Manager Display Settings

Enable
Project project_1
Install Vertical
Tool weldDe... 0kg
Obj default
JOG 100% Joint ...
Speed 100%
Manual
Real
Collision L3
Check d6b7
A

Dashboard
Weld seam setting
Track setting
Weave setting
Weld params
Weld bead setting

Move
Program
Interface
Log
Setting
Weld
...

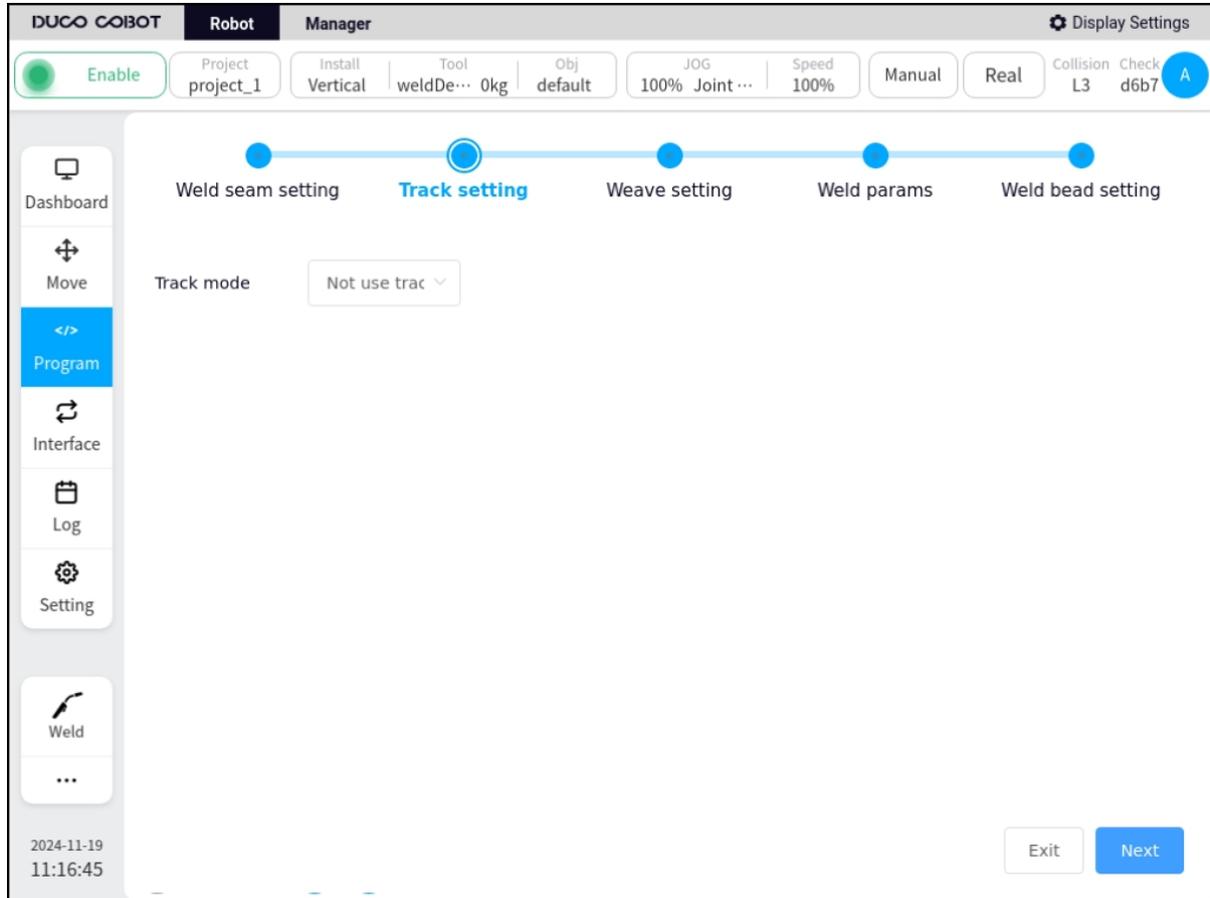
2024-11-19 11:14:43

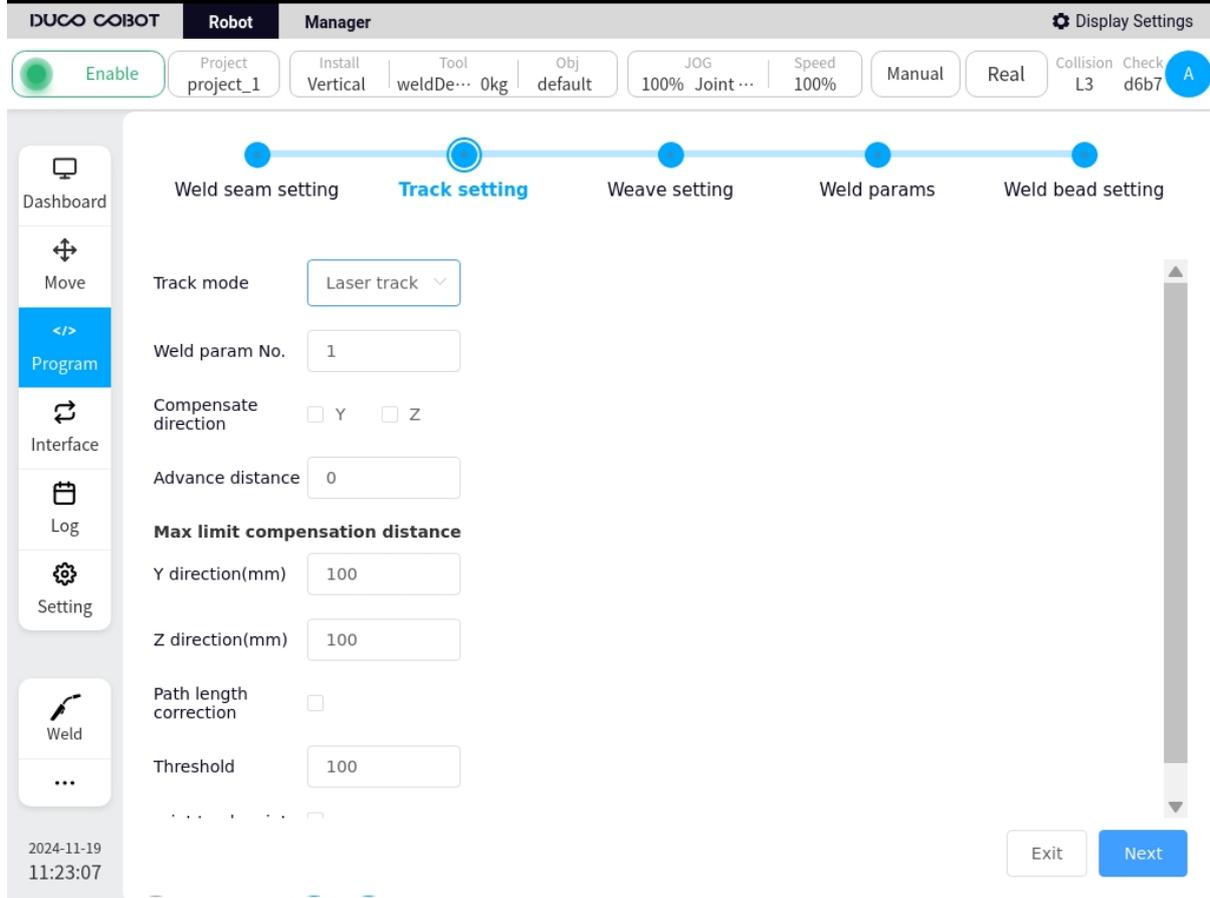
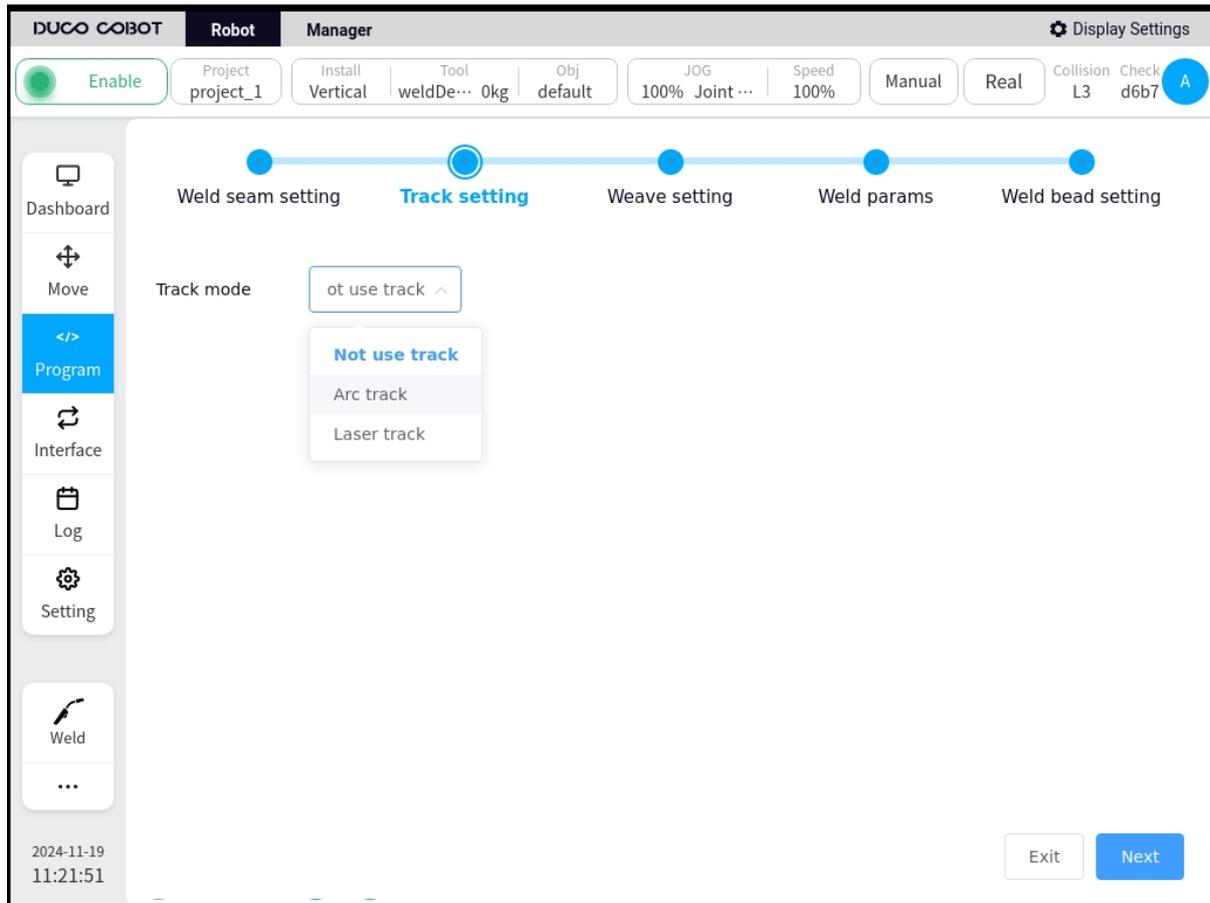
Exit Next

TCP	Please select						
User	default						
Seam Type	Line						
Start safety pose	MultipassWeld_1_safeP1	Teach	Record	Move here	100	1000	
ArtStart Point	MultipassWeld_1_wayP1	Teach	Record	Move here	100	1000	
EndStart Point	MultipassWeld_1_wayP2	Teach	Record	Move here	100	1000	
End safety pose	MultipassWeld_1_safeP2	Teach	Record	Move here	100	1000	

Tracking settings

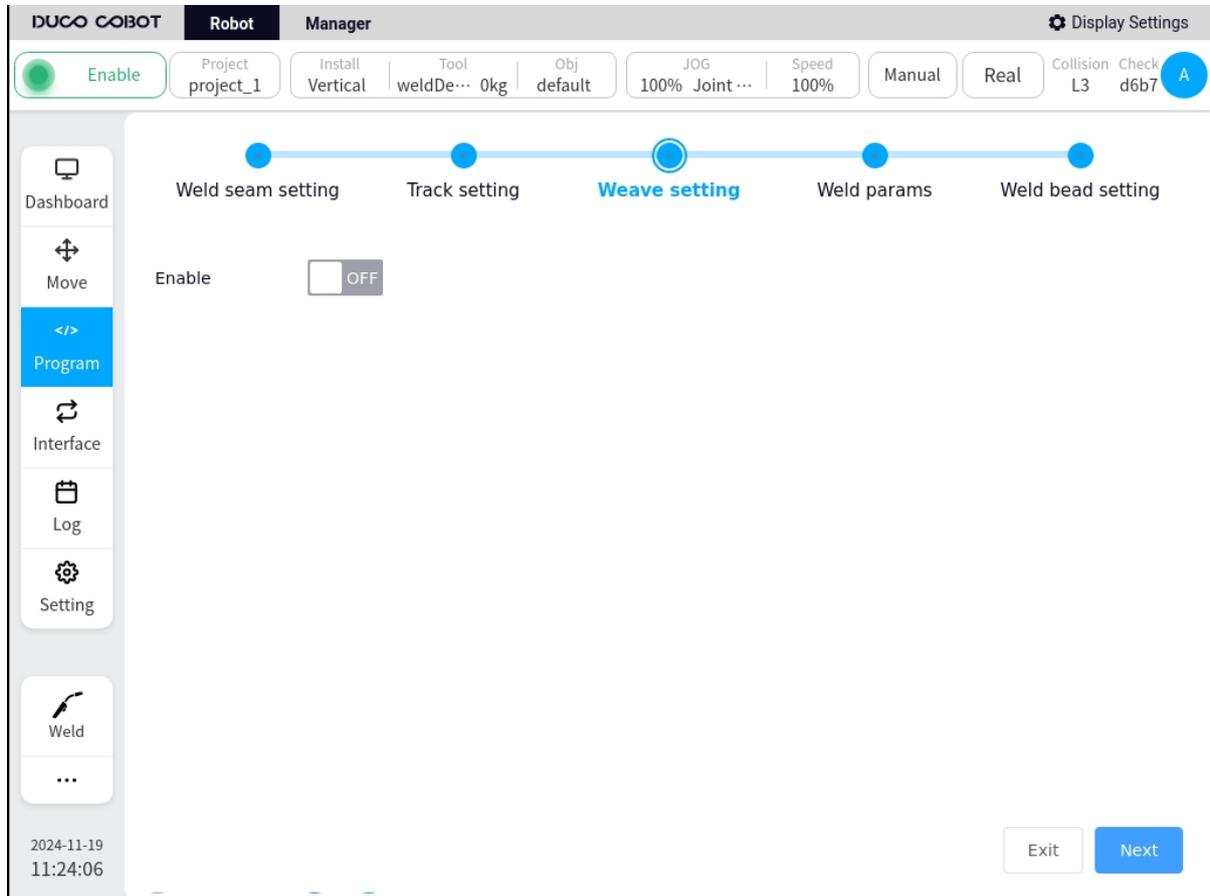
Configure whether the weld uses tracking or not, you can choose not to use tracking, use arc tracking, or use laser tracking. When arc tracking is selected, the configuration parameters are detailed in section 5.4, Arc Tracking, and when laser tracking is selected, the configuration parameters are described in section 7.7, Laser Tracking.

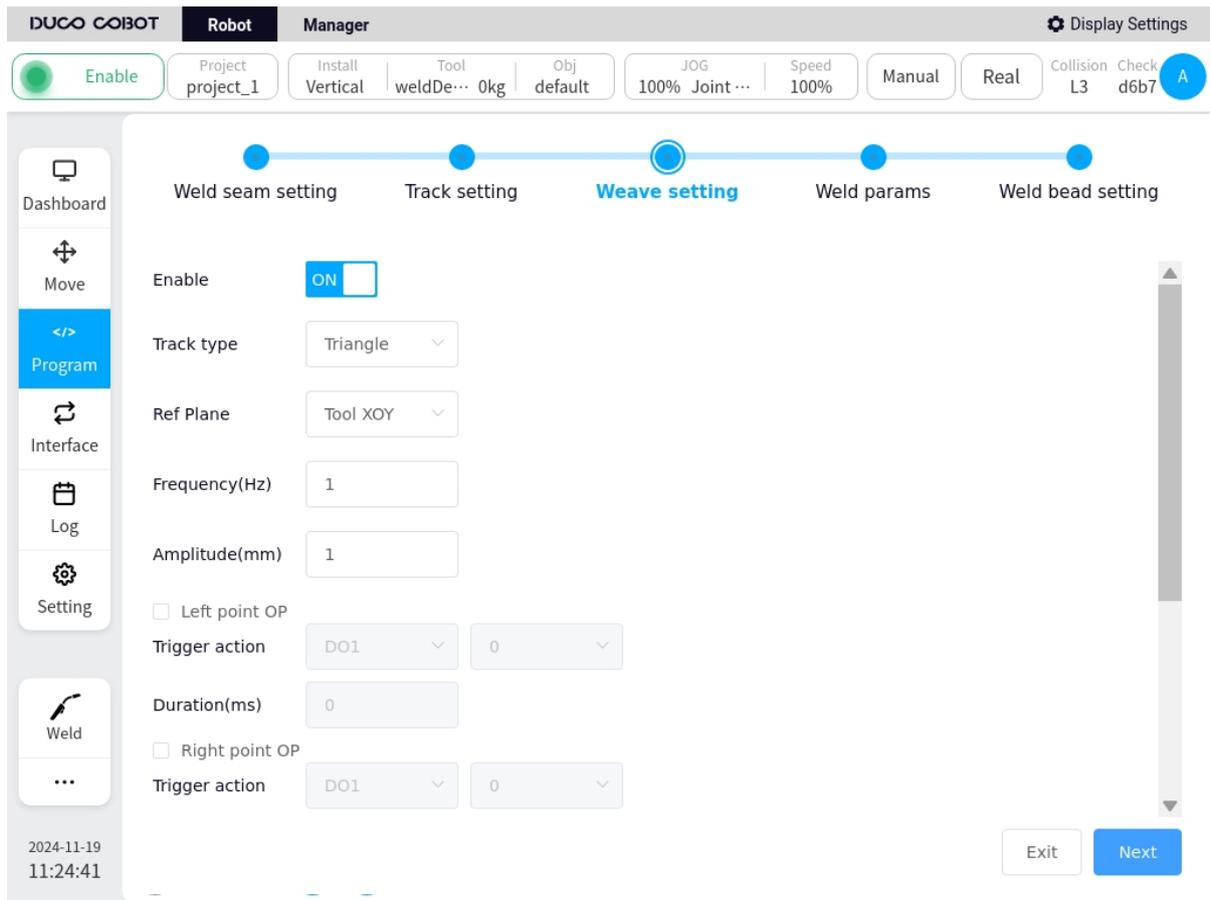




Pendulum welding setup

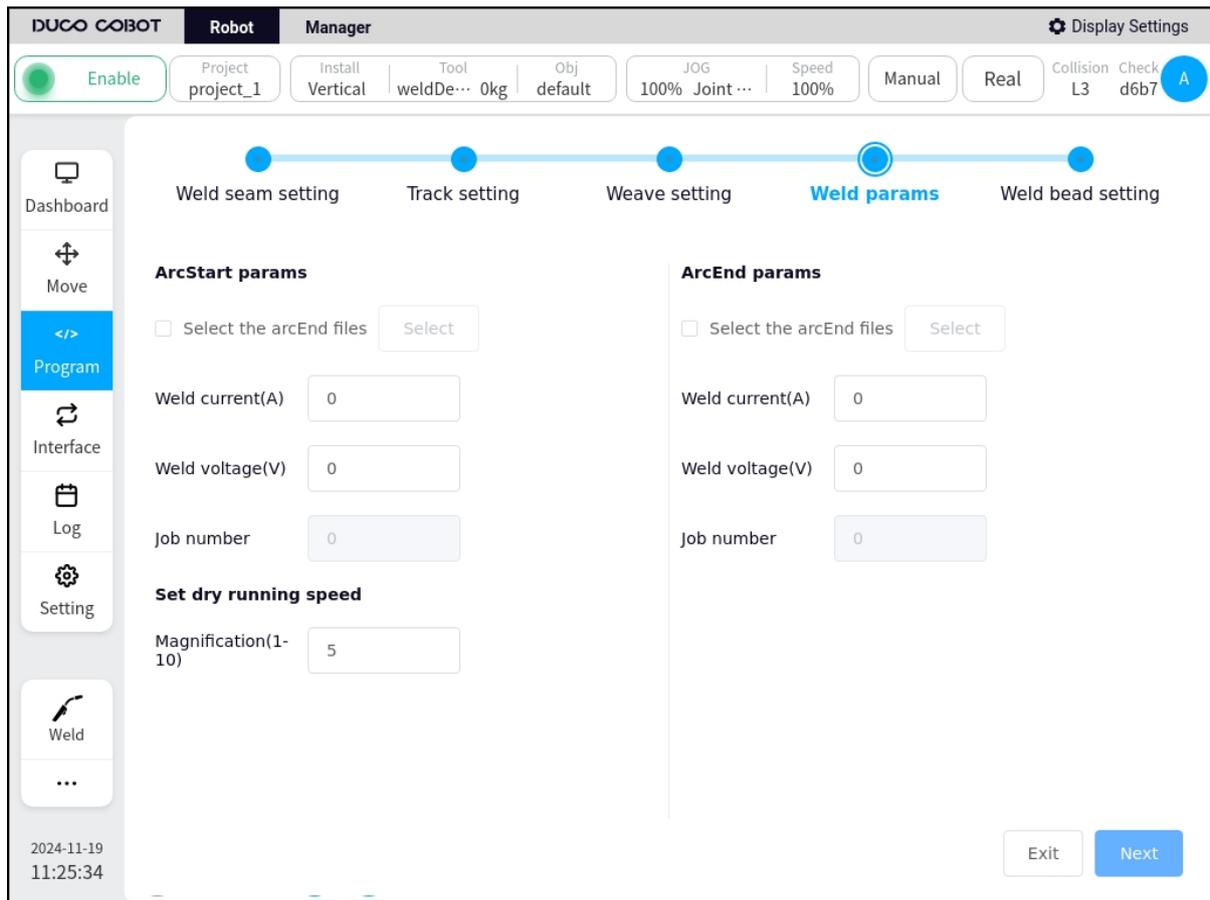
Select whether to enable pendulum welding, configure the type of pendulum welding, reference plane, frequency, amplitude, OP, etc. The specific configuration parameters are detailed in Section 5.3, “Pendulum Welding”.





Welding parameters

Configure the welding parameters, welding current, voltage, JOB number, etc. Specific configuration parameters are detailed in Section 5.2, Arc Start/Retract Function Block



Welding channel setup

Configure the offset, indentation, tool attitude, etc. for each subsequent weld pass, and add up to 9 passes.

The parameters of the weld channel are:

Y offset: Y of the tool coordinate system

Z offset:

Tool-RY: the rotation of the tool in the Y direction of the tool's reference tool coordinate system.

Tool-RZ: the rotation of the tool in the Z direction with reference to the tool coordinate system.

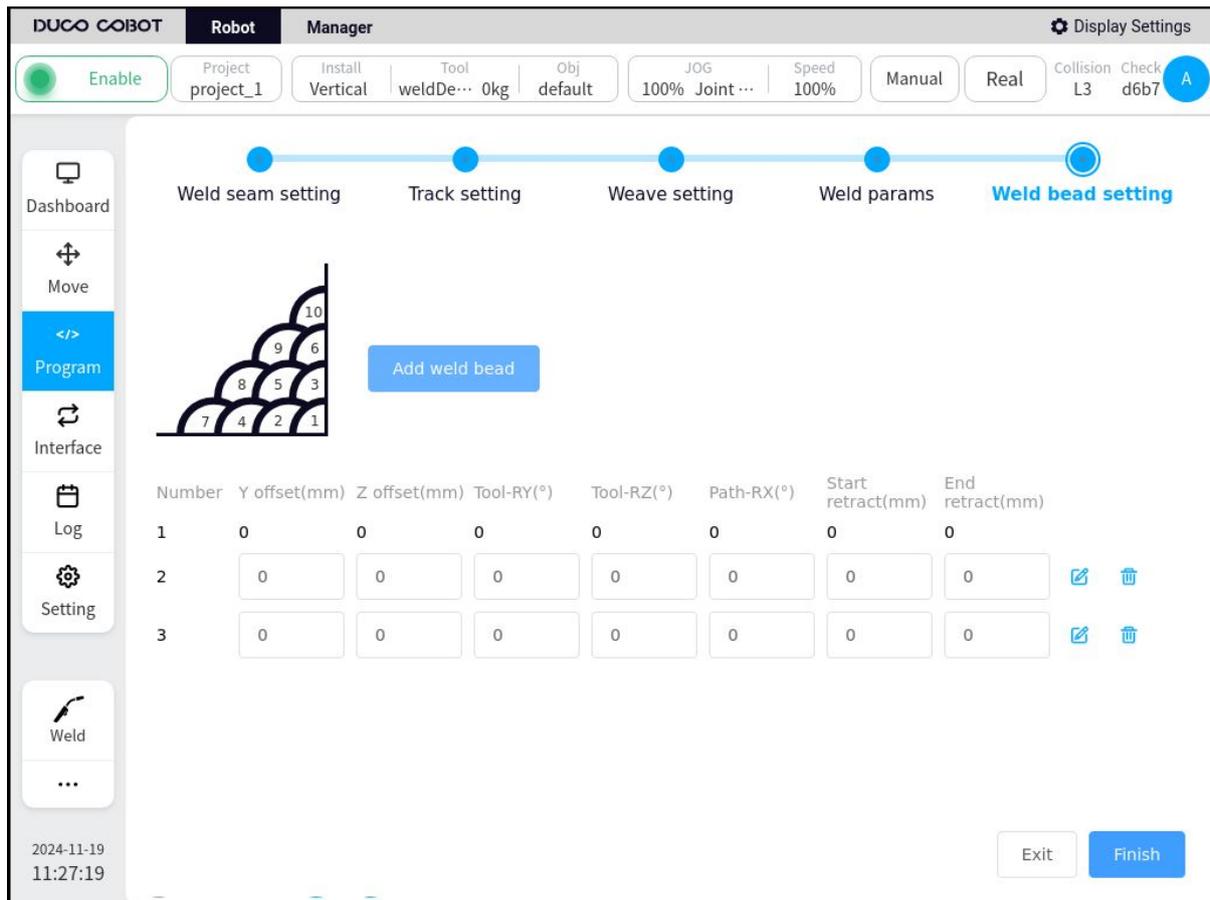
Path-RX: the amount of rotation of the tangent to the path at the start of the tool's reference path coordinate system (for a straight line, i.e., the amount of rotation in the direction of the reference path)

Starting point indentation: the distance that the starting point of the weld is indented in the direction of the path.

End point indentation: the distance that the end point of the weld is indented in the direction of the path.

Number	Y offset(mm)	Z offset(mm)	Tool-RY(°)	Tool-RZ(°)	Path-RX(°)	Start retract(mm)	End retract(mm)
1	0	0	0	0	0	0	0

The default pendulum welding parameters, welding parameters, etc. for individual weld passes are the same as for the initial weld. You can set the parameters for individual weld passes individually by clicking the Edit button.



Detailed configuration of welding channels

DUCO COBOT
Robot Manager
Display Settings

Enable
Project project_1
Install Vertical
Tool weldDe... 0kg
Obj default
JOG 100% Joint ...
Speed 100%
Manual
Real
Collision L3
Check d6b7
A

Dashboard

Move

Program

Interface

Log

Setting

Weld

...

2024-11-19
11:27:52

Weld bead setting-Weld bead2

Offset

Y offset(mm) (mm)	0	Tool-RY(°)	0
Z offset(mm) (mm)	0	Tool-RZ(°)	0
Start retract(mm) (mm)	0	Path-RX(°)	0
End retract(mm) (mm)	0		

Motion params

Weld speed(mm/s)	100
Weld acc(mm/s ²)	1000

Weave setting

Enable ON

ArcStart params

Select the arcEnd files Select

Weld current(A) 0

Weld voltage(V) 0

Job number 0

Set dry running speed

Magnification(1-10) 5

ArcEnd params

Select the arcEnd files Select

Weld current(A) 0

Cancel
Confirm

After the configuration is complete, click OK to automatically generate the program block. Note: The generated block cannot be edited with separate parameters, if you need to change the parameters, please set them in the parameter configuration of the MultipassWeld block.

DUCO COBOT Robot Manager Display Settings

Enable
Project project_1
Install Vertical
Tool weldDe... 0kg
Obj default
JOG 100% Joint ...
Speed 100%
Manual
Real
Collision L3
Check d6b7
A

14.jspf* Task Variable System Parameter Simulation

Dashboard

Move

Program

Interface

Log

Setting

Weld

2024-11-19 11:28:43

1 Main Single

2 Start

3 `</>` *MultipassWeld

4 Group # Weld bead1Pre-proc

5 Move # Move to Start safety p

6 MoveL MultipassWeld_1_saf

7 Script # Handle Weld bead of

8 Group # Weld bead1

9 Move # Move to Start Arc Pos

10 MoveL MultipassWeld_1_wa

11 ArcStart

12 Move # Move to Stop Arc Pos

13 MoveL MultipassWeld_1_wa

14 ArcEnd

Multi-layer multi-pass weld

Name

Calibrate the wire end tool coordinate system in Settings/Tool Settings

TCP

Config

Add comment

Cancel Confirm

0.0

**CHAPTER
FIVE**

LASER TRACKER**5.1 Introduction**

The laser tracker recognizes the weld seam by acquiring laser images and obtaining features of the weld seam. The robot acquires the feature information it recognizes and realizes automatic monitoring and correction of the weld seam. In practical application, it can solve the problems of workpiece placement error, poor workpiece consistency, and weld seam deformation caused by welding heat.

The welding process package supports laser position finding and laser tracking functions.

5.2 laser communication link

Use a network cable to connect the network port on the robot control cabinet to the laser sensor, and configure the IP address of the robot to the same network segment as the IP of the laser sensor. Enter the IP and port number of the laser sensor as shown and click Connect. The connection status will be displayed when the connection is successful. The connection settings for each manufacturer are as follows

Beijing CRNT:

You need to set the protocol of the laser to Modbus first using the Creative's host computer. connection port number 502

Tangshan Yinglai:

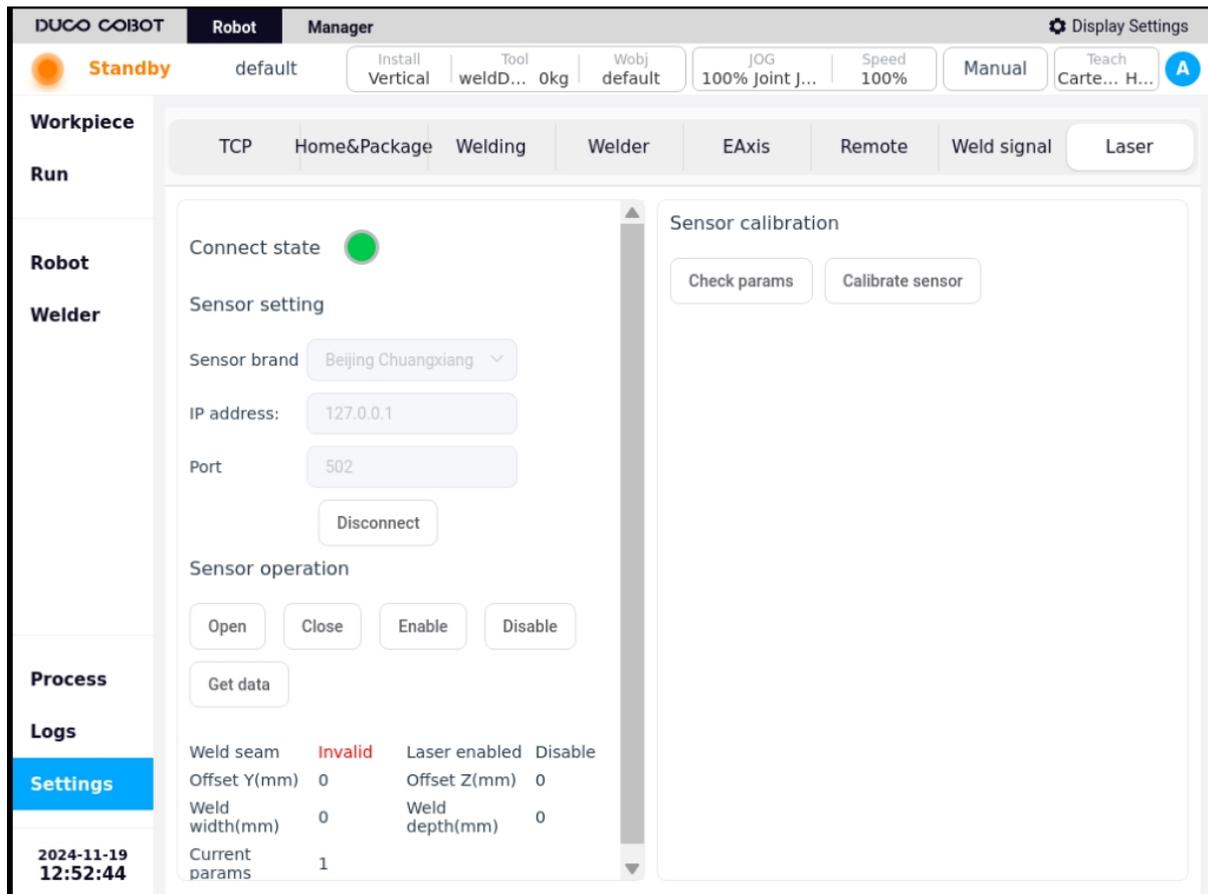
The port number is set to 5020.

Suzhou FullVision:

The port number is set to 502

Laser sensor control

The laser sensor can be operated manually to turn the laser on/off and acquire the data detected by the laser.



5.3 laser calibration

The calibration of the laser sensor is used to calculate the positional relationship between the robot TCP and the sensor. That is, based on the results of the calibration calculation, the feature points recognized by the laser can be converted to their position in the robot coordinate system.

Calibration preparation:

1. Install the welding torch and adjust the length of the welding wire to the length used during the welding operation.
2. Install the laser sensor according to the installation requirements of the laser sensor and the site conditions.
3. Prepare the spikes to be used for calibrating the robot TCP.
4. prepare switches and other network equipment to connect laser sensors, laser sensors used by the host computer, the robot, set it in the same network segment, to ensure that the normal communication
5. Make sure that the laser image is visible on the laser sensor’s host computer.
6. Verify that the laser switch and data acquisition work properly in the sensor setup page of the robot welding process kit.

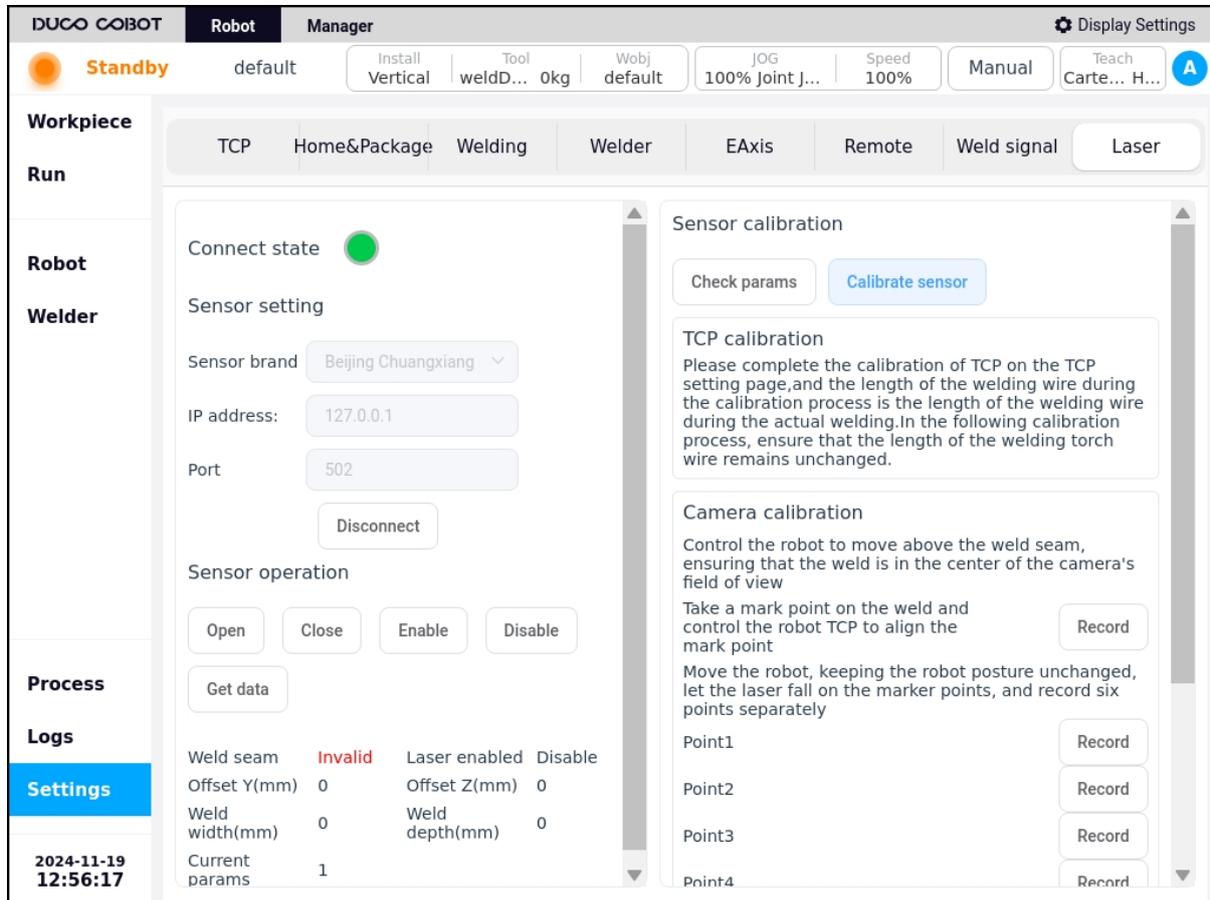
Calibration process:

1. Tool (TCP) calibration, that is, calibration of the position of the end of the wire, at this time the length of the wire is the actual welding wire length. Calibration method see basic settings / TCP

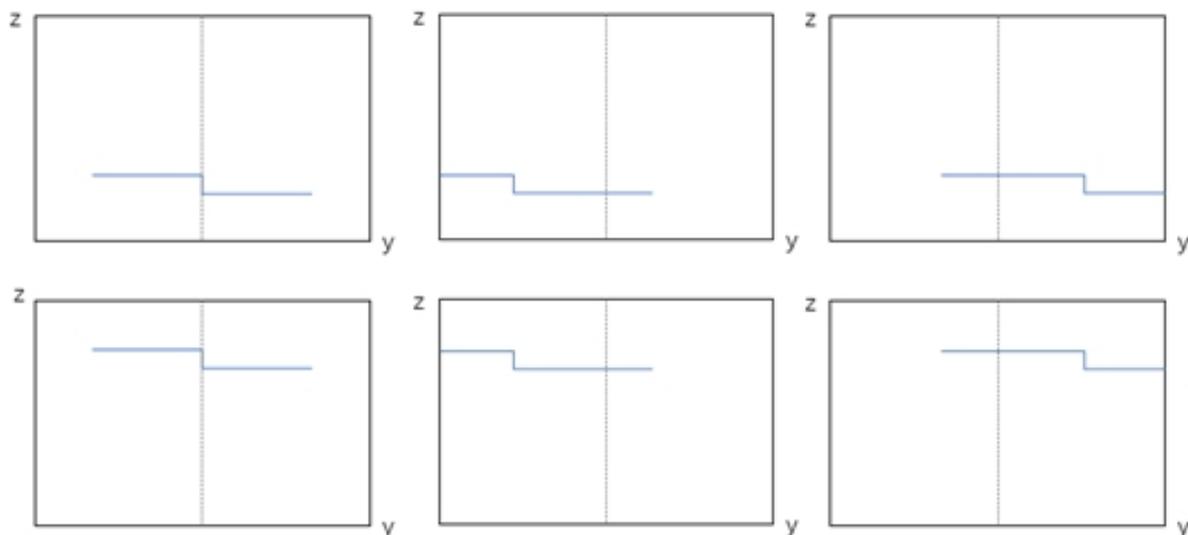
calibration

Set the calibrated TCP as the current TCP

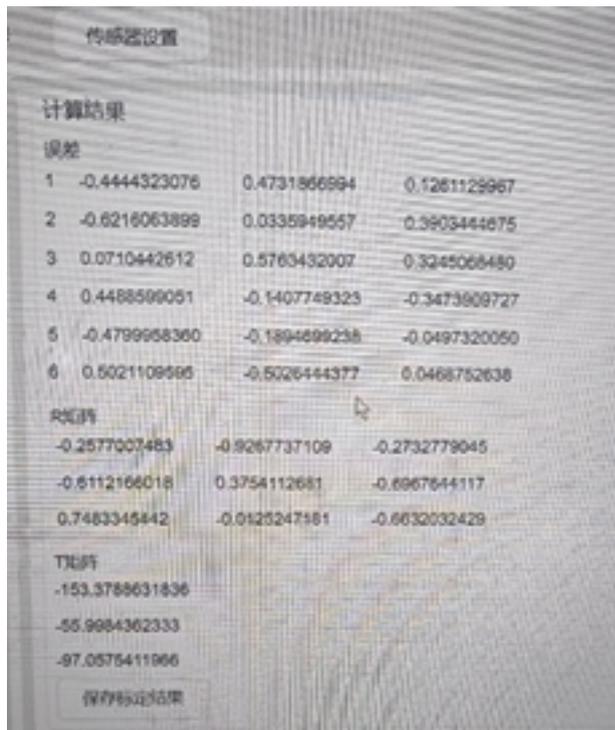
2. Take a marking point on the weld seam, move the robot so that its TCP is aligned with the marking point, and click record.



3. keep the robot attitude unchanged, turn on the laser, turn on the enable, move the robot, let the laser fall on the marking point, observe the laser image on the laser software in the marking process, in turn, make the laser image for the six states in the following figure, record the point 1-6



- Click Calibration Calculation, the calibration error and calculation result will be displayed below. If each value is less than 1mm, the calibration is valid, otherwise recalibrate.



- Click Save Calibration Results to save the calculation results. Note: The calculation results are stored in the current project of the robot, so it is recommended to save the project at this time to prevent loss.

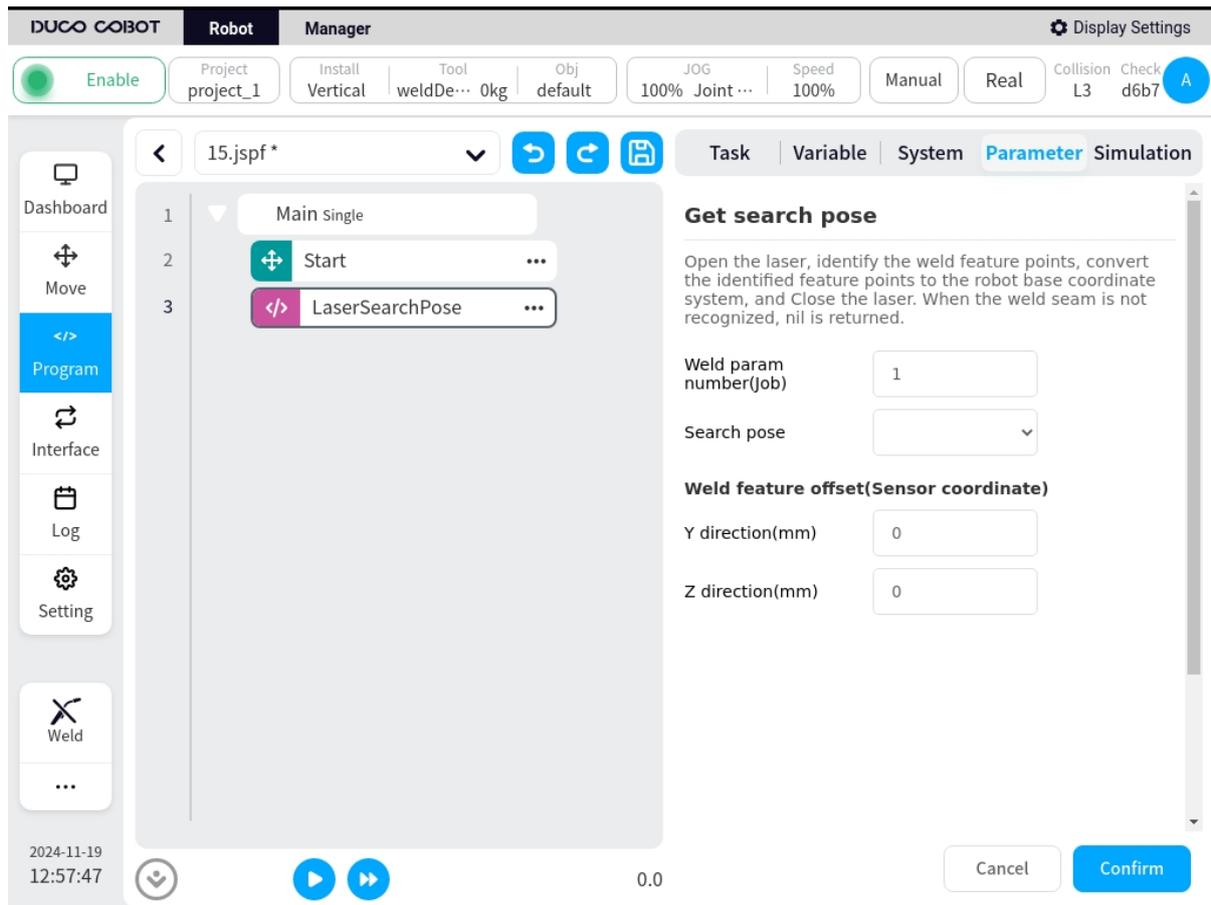
Attention:

- Robot TCP needs to be calibrated before calibration to ensure calibration accuracy
- Before calibration, set the calibrated tool coordinate system as the current one.
- When recording 7 points, the length of the welding wire is consistent with the calibration of the TCP and also with the length of the welding wire during the welding process.
- When recording 7 points, the robot's attitude cannot be changed
- Ensure that the laser image detection is stable when recording the 7 points.

Calibration accuracy verification

After calibrating the sensors and the robot, the accuracy of the calibration can be verified using single point seek. Write the following program, using the function blocks LaserSearchPose and MoveL. LaserSearchPose will turn on and enable the laser, obtain information about the position of the feature point recognized by the laser, convert it to its value in the robot's base scale system, and assign the value to a variable. moveL moves to the variable. Run the program to check if the robot TCP moves to the recognized feature point.

Note: Note: Please make sure that the TCP at this time is the TCP used for the above calibration.



5.4 Programming function blocks

There are three function blocks associated with the laser sensor: LaserSerachPose, LaserSearchOffset, and LaserTrack.

LaserSearchPose

It is mainly used to obtain the position of the feature point recognized by the laser under the base coordinate system of the robot. This function block encapsulates the following operations: select the Job number to be used, turn on and enable the laser, get the position information of the feature point recognized by the laser, get the value of the current TCP of the robot under the base coordinate system, calculate the position information of the feature point under the base coordinate system of the robot according to the calibration relationship, and assign the value to the pose type variable. If no weld seam is detected, return nil. The configuration page is as follows

Get search pose

Open the laser, identify the weld feature points, convert the identified feature points to the robot base coordinate system, and Close the laser. When the weld seam is not recognized, nil is returned.

Weld param number(Job)	<input type="text" value="1"/>
Search pose	<input type="text" value=""/>
Weld feature offset(Sensor coordinate)	
Y direction(mm)	<input type="text" value="0"/>
Z direction(mm)	<input type="text" value="0"/>

Weld Mode Parameters: i.e. Job number, a set of parameters set and saved at the laser tracker end: e.g. weld type, exposure, detection capability, etc.

Finding site: the result of a calculation that can be associated with a variable of type pose

Weld feature point offset: add an offset to the recognized feature point and calculate the position after point conversion after the offset. It can be used to deal with robot error, mismatch between inspection point and welding process, etc. (If the laser tracker provides the function, it can also be set at the laser tracker side)

LaserSearchOffset

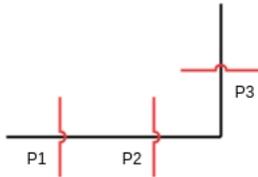
It is mainly used to calculate the position of the coordinate system obtained by three-point or four-point seeking.

The configuration page is as follows

Calculate coordinate

Calculation method

Select the pose



P1

P2

P3

Result

The following settings are available

Calculation method: choose three-point or four-point search

Select Points: Associated Points Information

Result: the result of the calculation, associated to the pose type variable

LaserTrack

Realization of laser tracking function.

The main realized functions: turn on and enable the laser, set the Job number used by the laser, set the compensation direction and advance distance, acquire the characteristic points of the weld seam in real time, calculate the deviation and compensate it to the actual trajectory.

The configuration page is as follows

Laser track

Type	<input type="text" value="Clear path info"/>
Weld param number(Job)	<input type="text" value="1"/>
Compensate direction	<input type="checkbox"/> Y <input type="checkbox"/> Z
Advance distance(mm)	<input type="text" value="0"/>
Max limit compensation distance	
Y direction(mm)	<input type="text" value="100"/>
Z direction(mm)	<input type="text" value="100"/>
Path length correction	<input type="checkbox"/>
Threshold(mm)	<input type="text" value="100"/>
print track points	<input type="checkbox"/>

The following settings are available

Weld pattern parameters: Job number

Compensation direction: Select whether to enable compensation in Y or Z direction.

Advance distance: Set the distance between the laser line and the welding torch in mm.

Maximum compensation distance limit: Maximum permissible deviation of the taught trajectory from the laser-measured trajectory

Weld feature point offset: offset is added to the recognized feature point (can also be set on the laser tracker side if the laser tracker provides the function)

5.5 Script

The following scripts are added to the welding process package and can be called when programming with scripts

Turn on the laser.

```
_plugin_weld.open_laser()
```

Turn off the laser.

```
_plugin_weld.close_laser()
```

Enable Laser (Required for Creation Laser Sensor Recall)

```
_plugin_weld.enable_laser()
```

Down Enable Laser (Required for Creation Laser Sensor Recall)

```
_plugin_weld.disable_laser()
```

Setting the weld type parameter (Job number)

```
_plugin_weld.set_laser_weld_type(type)
```

Position searching, the function is the same as LaserSearchPose function block, turn on the laser, get the feature point of the weld seam, calculate its position in the robot coordinate system, turn off the laser.

```
_plugin_weld.search_pose(pose, offset)
```

pose: pose type, robot TCP pose, in m, rad

offset: number_list type, offset of weld feature point {y, z}, default {0, 0}, unit: mm

Return value: pose type, the position of the feature point in the robot's coordinate system, in m, rad, nil means no weld is detected

Similar to search_pose, the laser is not switched on and off, the weld feature points are acquired and their position in the robot coordinate system is computed

```
_plugin_weld.get_laser_search_pose(pose, offset)
```

pose: pose type, robot TCP pose, in m, rad

offset: number_list type, offset of weld feature point {y, z}, default {0, 0}, unit: mm

Return Value: Pose type, the position of the feature point in the robot coordinate system, in m, rad, nil means no weld is detected.

Acquisition of raw laser data

```
_plugin_weld.get_laser_raw_data()
```

Returns the following array {status, y, z, width, depth}, which represents

status: boolean indicates whether a weld is detected or not

y: number, Y-coordinate of the weld feature in mm.

z: number, z-coordinate of the weld feature in mm.

width: number, width of the detected weld in mm.

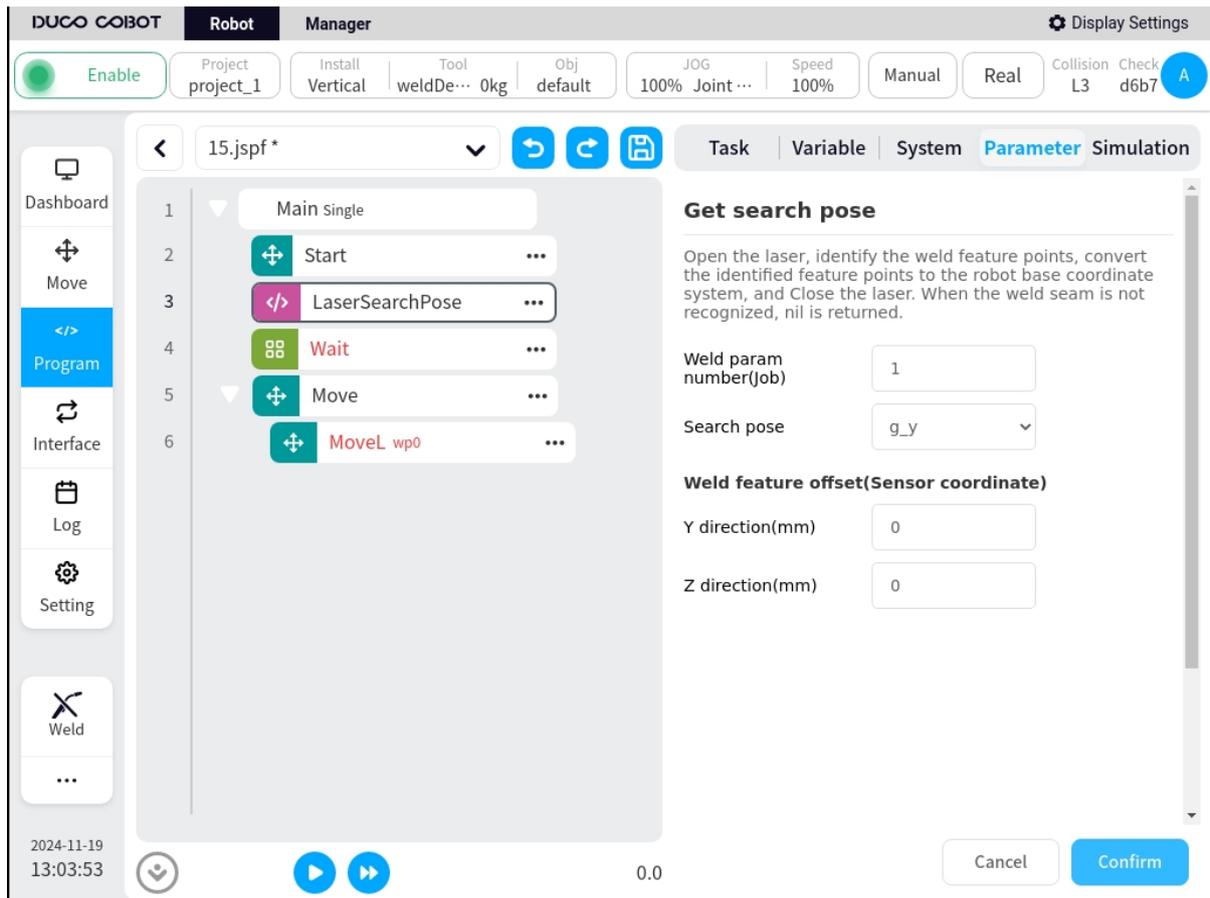
depth: number, depth of the detected weld in mm.

5.6 Laser positioning

single-point seeker (computing)

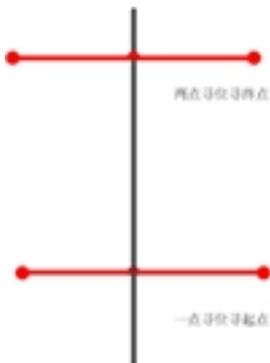
Suitable for applications such as spot welding

A programming example is shown below:

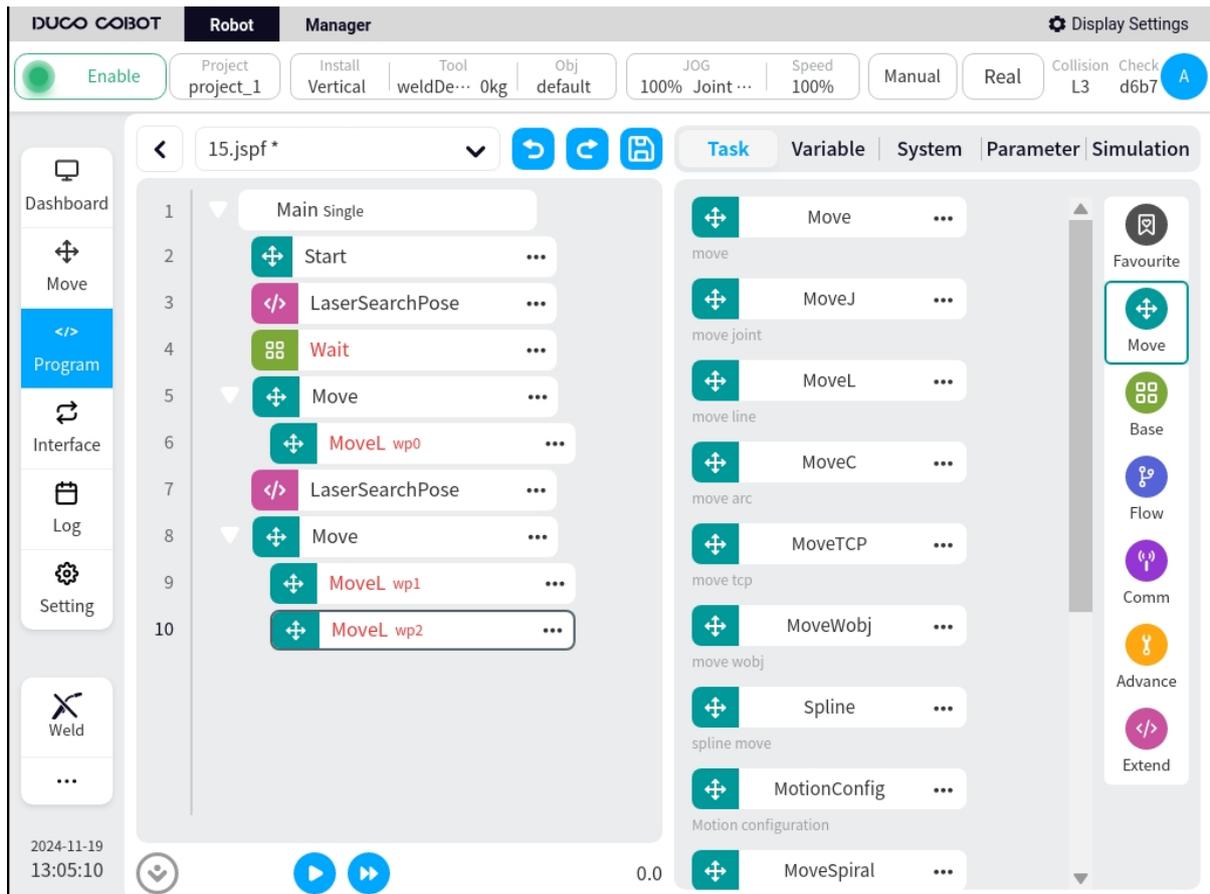


two-point searches

Suitable for applications such as intermittent short welding

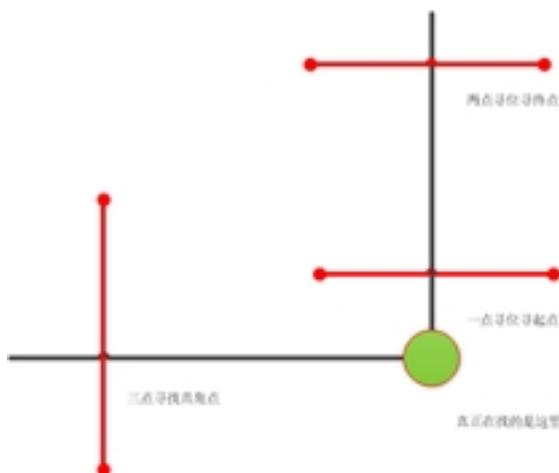


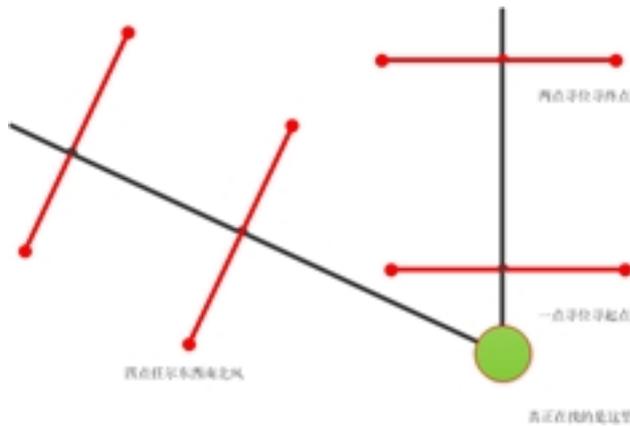
An example of programming is as follows



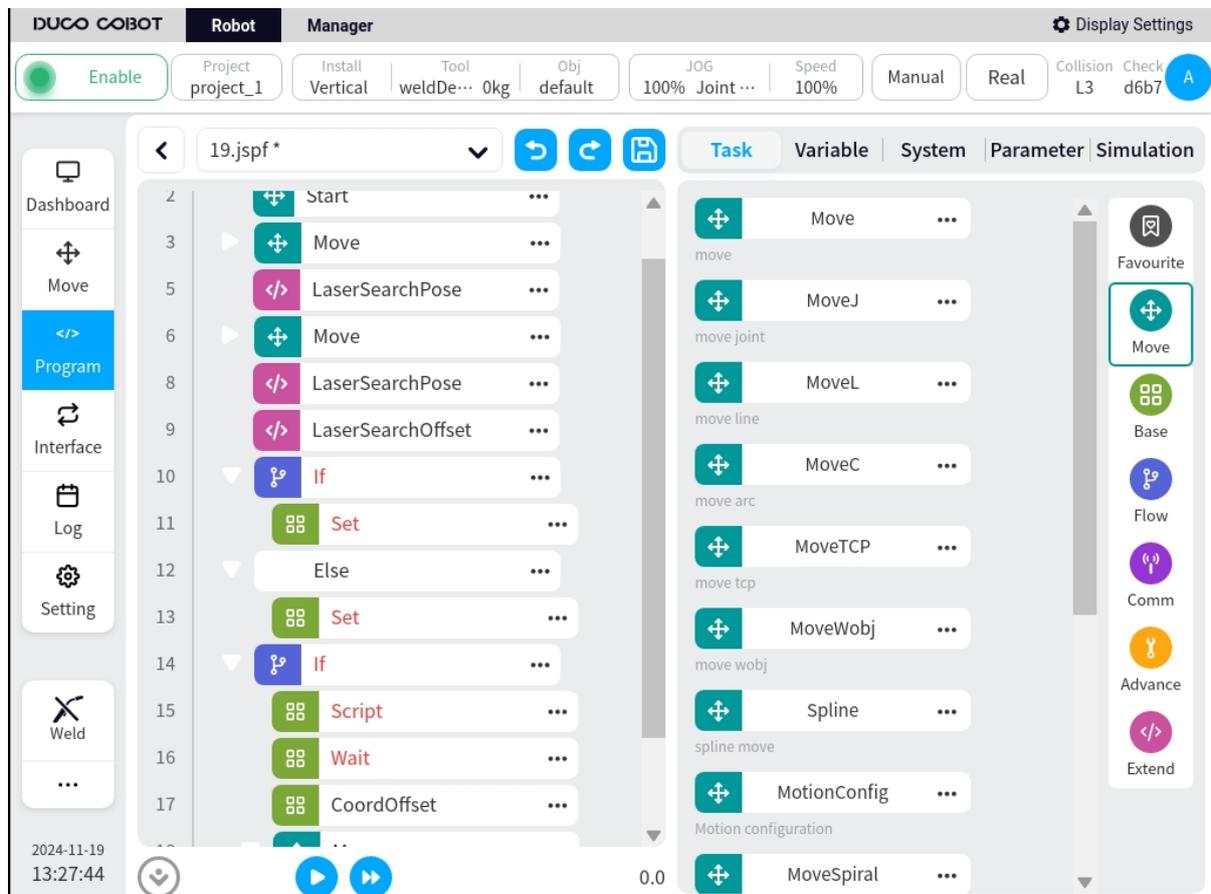
Three-point seeker/four-point seeker

The basic principle is that a workpiece coordinate system is established based on the point position of the laser positioning, and the deviation from the original workpiece coordinate system is calculated to obtain the offset of the weld seam on the workpiece. It can be used for welding complex structural parts. Four-point positioning is better than three-point positioning to deal with the incoming material error and assembly error of the workpiece.





The following is a demo of three-point seeking, and four-point seeking is similar to three-point seeking.



Variable Definition

variable name	type	
P1	pose	first search point
P2	pose	second search point
P3	pose	third search point
teach_pose	pose	result of three-point seek computation
g_enable_offset	boolean	Controls the operation of the program. When false, it is used to do
g_base_pose	pose	computed initial artifact coordinate system
g_pose	pose	result of three seek calculations
g_offset	pose	deviation from initial coordinate system

Program description

Three rows, first locus.

5 line seek, get the seek result, save in variable p1

6 rows, second locus.

8 line seek, get the result of the seek and save it in the variable p2.

9 rows, third locus.

11 line seek, get the seek result, save it in variable p3

12 rows Three-point position finding, calculating the coordinate system determined by p1,p2,p3, stored in the variable teach_pose

Lines 13-16 If variable g_enable_offse is false, assign the value of teach_pose to g_base_pose; otherwise, assign the value to variable g_pose

17 lines Execute subsequent procedures when g_enable_offset is true

18 line script Calculate the deviation of the coordinate systems of g_base_pose and g_pose using pose_offset() and assign the result to the variable g_offset

20 lines Add g_offset as a coordinate system offset to the current coordinate system

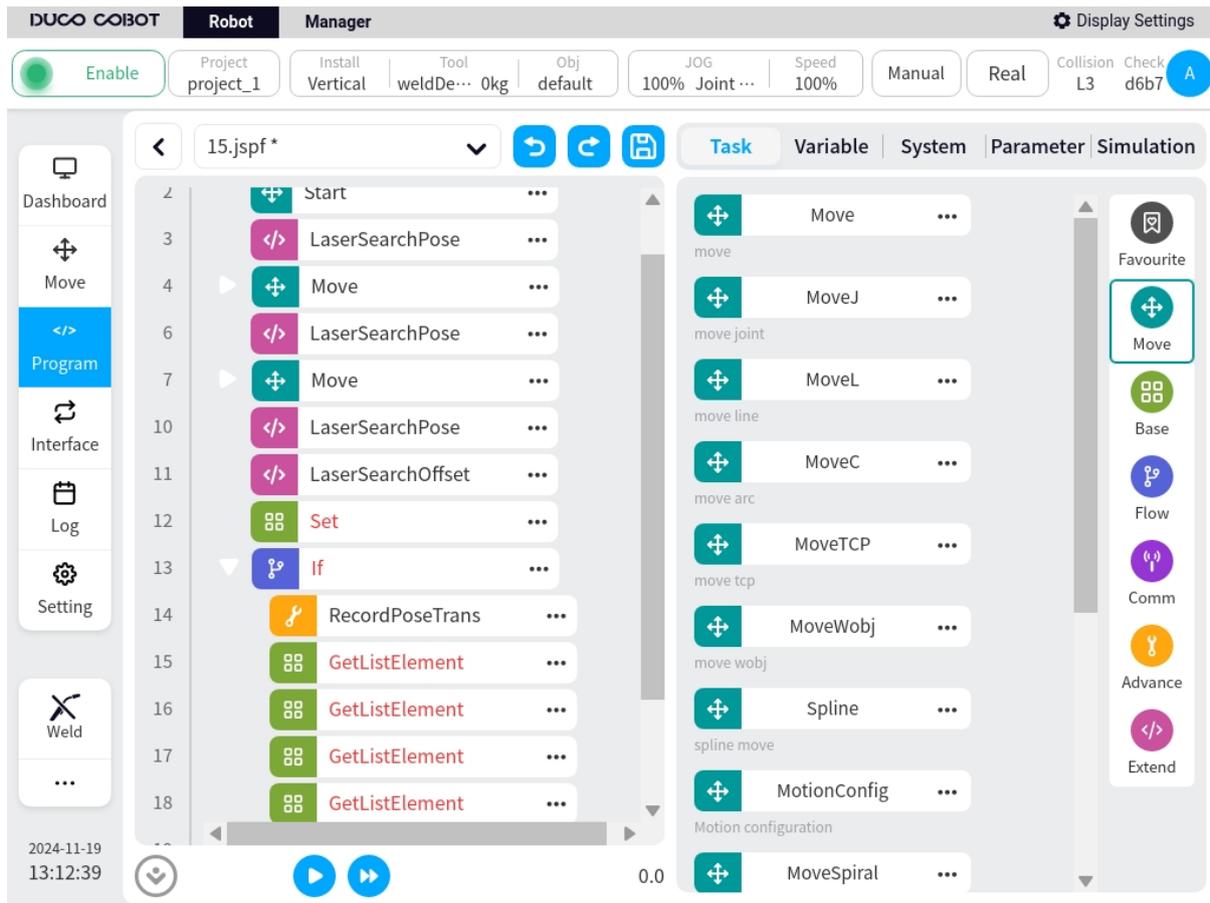
Rows 21-24 Actual work points, using the workpiece coordinate system.

The actual use process is as follows:

1. Instruct the robot to determine the laser's seeking point
2. Set up the workpiece, set the value of g_enable_offset to false, and run the program.
3. Check the value of g_base_pose in the variable area, create a new workpiece coordinate system wobj1, and use the value of g_base_pose for the workpiece coordinate system.
4. Set wobj1 as the current workpiece coordinate system, and use this coordinate system as the reference to teach the workpiece's trajectory, i.e., the points in lines 22-24.
5. Set the value of g_enable_offset to true, run the program, and execute the normal workflow.

The above demo uses a workpiece coordinate system, and by performing the three-point positioning calculation for the first time, an initial workpiece coordinate system is obtained, based on which the work points are taught. It is guaranteed that if the workpiece is shifted due to placement, etc., the deviation of the coordinate system obtained by three-point positioning from the initial coordinate system can be calculated, and the deviation can be added to the workpiece coordinate system so that the trajectory can adapt to the change.

Since this Demo needs to set up the coordinate system of the workpiece, in some cases the demonstration needs to switch the coordinate system frequently, which may be cumbersome. You can refer to the following Demo, which uses the RecordPoseTrans function block, and can all be programmed based on the base coordinate system.



Variable Definition

variable name	type	
P1	pose	first sought site acquired
P2	pose	Acquired second seek site
P3	pose	Acquired third seeker site
teach_pose	pose	result of three-point seek computation
g_enable_offset	boolean	Controls the operation of the program. When false, it is used to do
g_base_pose	pose	computed initial artifact coordinate system
g_result_list	pose_list	position of the actual operating point in the base coordinate system
g_way_pose1	pose	first job point
g_way_pose2	pose	second job point
g_way_pose3	pose	third job point
g_way_pose4	pose	fourth_operation_point

Program description

Three rows, first locus.

5 line seek, get the seek result, save in variable p1

6 rows, second locus.

8 line seek, get the result of the seek and save it in the variable p2.

9 rows, third locus.

11 line seek, get the seek result, save it in variable p3

12 rows Three-point position finding, calculating the coordinate system determined by p1,p2,p3, stored in the variable teach_pose

Line 13 Assign teach_pose value to g_pose

14 lines Execute subsequent procedures when g_enable_offset is true

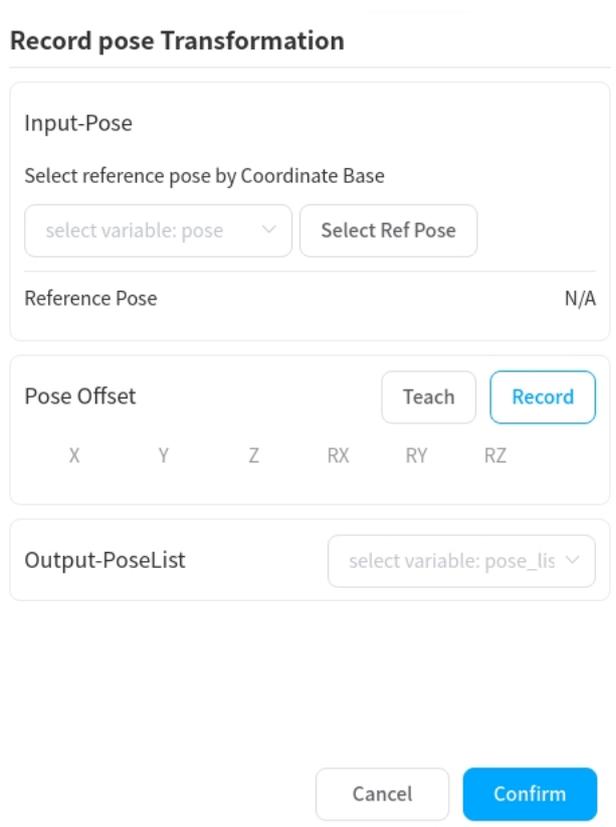
15 lines The operation point teaches the conversion and saves the result in the variable g_result_list.

Lines 16-19 Get each point from g_result_list and assign it to each job point variable

20-24 Lines Execute the actual job, with points using the individual job point variables.

The actual use process is as follows:

1. Teach the robot to determine the laser's search point.
2. Set up the workpiece, set the value of g_enable_offset to false, and run the program.
3. in the variable area to view the value of g_base_pose, open the RecordPoseTrans function block, as shown in the figure, in the input reference position, select the variable g_base_pose, click on the "set to the base" button, the base position at the base position will display the value of the base position at this time.



4. In the operation point offset, teach the addition of operation points, and in the output, select a pose_list type variable to store the results of the calculated operation points.
5. Set the value of g_enable_offset to true, run the program, and execute the normal workflow.

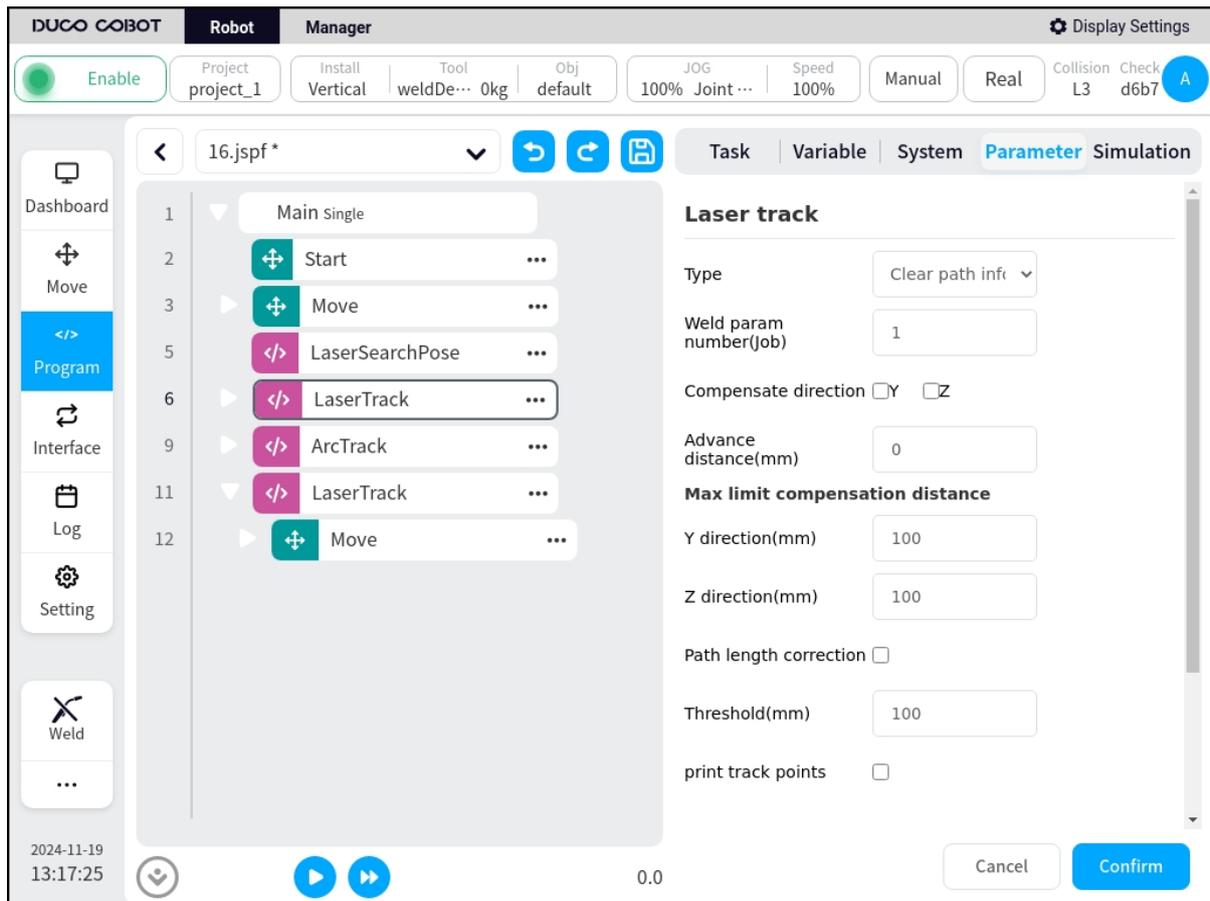
In contrast to the previous demo, variables are used as actual job points, and the points are calculated by RecordPoseTrans. The coordinate system obtained from the first use is used as a reference to teach each work point position and is added to the RecordPoseTrans block. If the workpiece is subsequently shifted,

the RecordPoseTrans function block calculates the value of each job point in the base coordinate system based on the coordinate system calculated by the position finding.

5.7 Laser tracking

When it is necessary to detect changes in the weld seam in real time during the welding process, the laser tracking function is used.

example



Program description

4 rows. Robot turns on tracking at point wp1.

5 rows Starting point seeks bits and puts the result in the variable start

6 lines Turn on tracking, do not turn off tracking at end of setup

Row 7. Move to the start of the arc.

Row 9. Arc up.

10 lines Enable tracking, disable tracking at end of setup

Row 11 Teach a primitive trajectory wp0

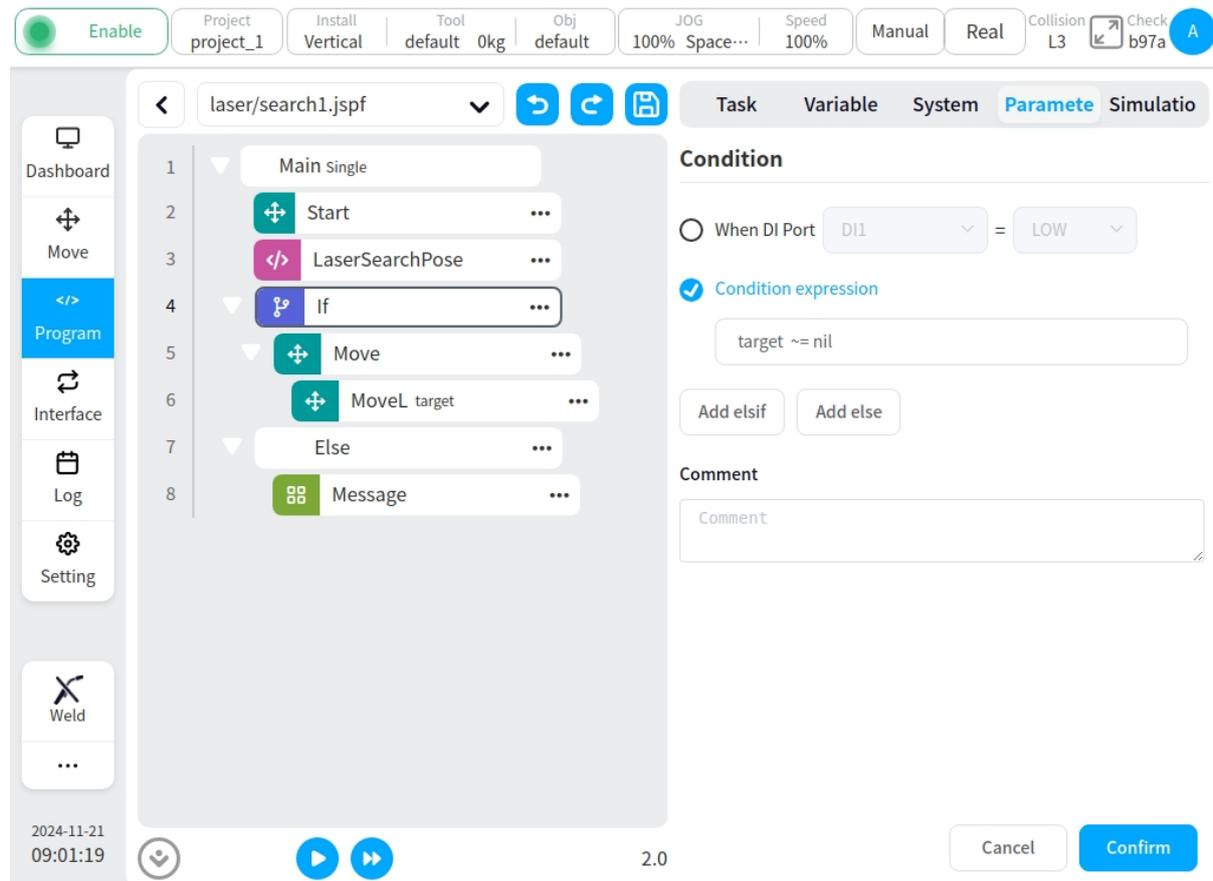
The robot will perform the following operations, turn on and enable the laser, acquire the arc start point, turn on tracking and move to the arc start point, start the arc, turn on tracking, calculate the deviation from the taught trajectory based on the feature points obtained from the real-time acquisition laser sensor, and

compensate the deviation to the taught trajectory, so that the robot TCP will run in accordance with the detected weld seam.

5.8 Error Handler

Weld with or without inspection

LaserSearchPose can determine whether its return value is nil to determine whether the weld is detected. Examples are as follows:

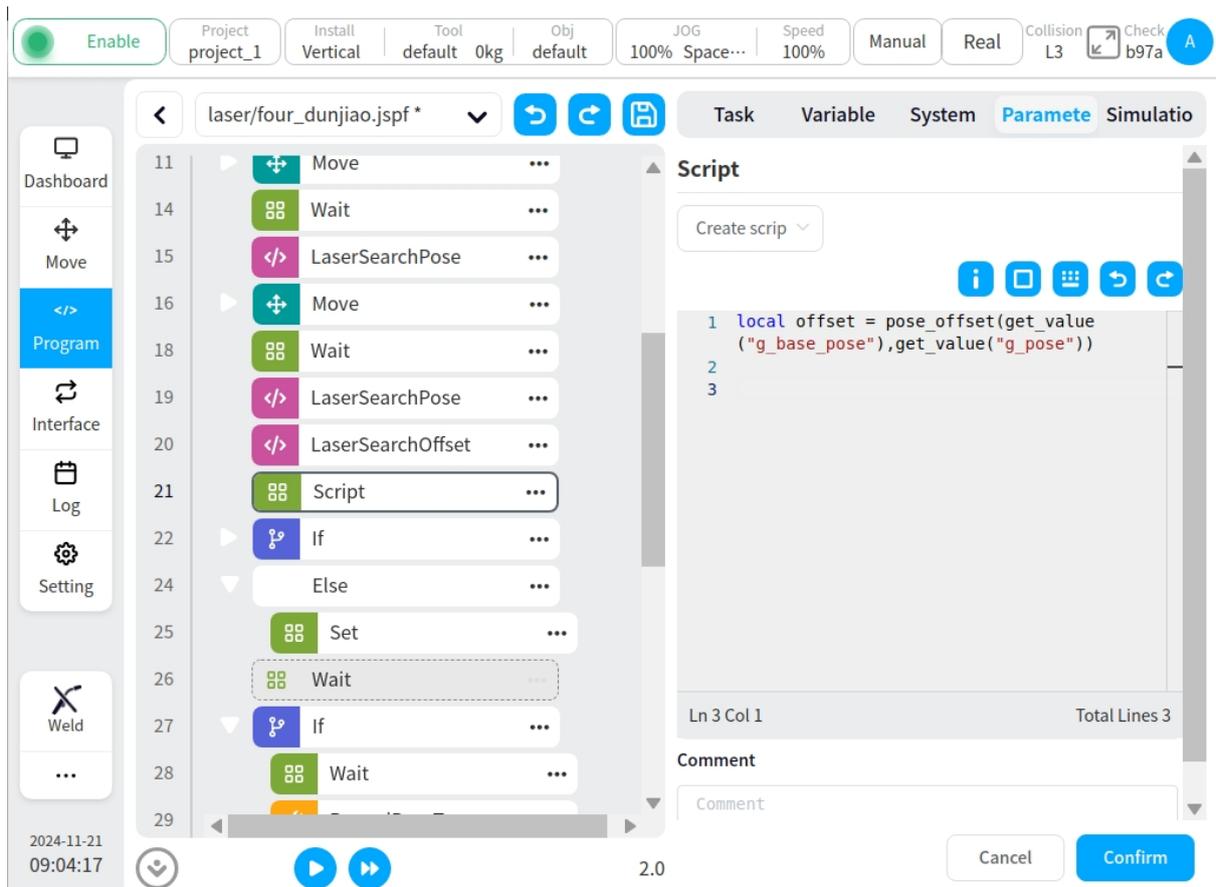


LaserSearchPose puts the seek result in the variable target, If the condition determines whether target is nil to execute the logic when a weld is detected and not detected.

Three/four-point seeker position deviation over-protection

In some cases the weld may be detected incorrectly, resulting in an excessive deviation from the calculated workpiece coordinate system, and a deviation limit can be added to prevent safety issues such as gun bumping.

Examples are shown below:



The Script function block uses the pose_offset script to calculate the deviation between the original and the newly computed coordinate system, adding execution logic to determine if the deviation is greater than a certain range.