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Industrial Robot Arc Welding

User Guide

Industrial Automation | New Energy Vehicle | Intelligent Elevator | Intelligent Robot | Digital Energy | Rail Transit

Data code 19013068A01

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The contents are subject to change without notice due to product upgrade.

Waste Disposal

The storage, use, and disposal of this product (including optional accessories) must comply with local laws and regulations.

Qualified Personnel

The product/system described in this documentation may be operated only by personnel qualified for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel can identify the risks of the product/system and prevent possible dangers.

Proper Use of the Product

Proper transportation, storage, assembly, installation, commissioning, operation, and maintenance are required to ensure the safe operation of the product without any problems. The required ambient conditions must be met. All operations must follow the guidelines provided in this documentation.

Preface

Introduction

The arc welding robot is a highly automated robot system specifically designed to perform arc welding tasks. It primarily consists of the robot, control system, and welding equipment.

This guide introduces the robotic arc welding process principle, arc welding configuration, configuration examples, and related instructions.

More Data

Data name	Data code	Description
Industrial Robot InoRobotLab User Guide	19012861	Describes the software-related operations of the robot InoRobotLab software. Contact Inovance technical support to obtain this guide.
IR-TP200 Series Industrial Robot Teach Pendant User Guide	19012798	Describes the software-related operations of the robot teach pendant.
Industrial Robot Arc Welding User Guide (this guide)	19012726	Describes the robotic arc welding process principle, arc welding configuration, configuration examples, and related instructions.

Revision History

Revision date	Data version	Software version	Revision
2025-12	A01	• Platform version: V4R25C2 • Plugin version: Weld_V4R3C2	Added related functions and instructions.
2025-06	A00	• Platform version: V4R25C1 • Plugin version: Weld_V4R3C1	Initial release.

Access to the Guide

This guide is not delivered together with the product. You can obtain the PDF version in the following ways.

- Visit https://www.inovance.com/global, and choose Service&Support > Support > Documentation Download.
- Scan the QR code on the product with your smart phone.
- Scan the QR code below to install My Inovance app, where you can search for and download user guides.



Warranty Disclaimer

Inovance provides warranty service within the warranty period (as specified in your order) for any fault or damage that is caused by proper operation of the user. Maintenance will be charged after the warranty expires.

Within the warranty period, maintenance fee will be charged for the following damage:

- Damage caused by operations not following the instructions in the user guide
- Damage caused by fire, flood, or unusual voltage
- Damage caused by unintended use of the product
- Damage caused by use beyond the specified scope of application of the product
- Damage or secondary damage caused by force majeure (such as natural disaster, earthquake, and lightning strike)

The maintenance is charged according to the latest Price List of Inovance. If otherwise agreed upon, the terms and conditions in the agreement shall prevail. For details, see Product Warranty Card.

Basic Safety Instructions

Safety Precautions

Safety Disclaimer

- This chapter presents essential safety instructions for a proper use of the equipment. Before operating the equipment, read through the guide and comprehend all the safety instructions. Failure to observe the safety instructions may result in death, severe personal injuries, or equipment damage.
- "DANGER", "WARNING", and "CAUTION" items in this guide do not indicate all safety precautions that need to be followed; instead, they just supplement the safety precautions.
- Use this product according to designated environment requirements. Damage caused by improper use is not covered by warranty.
- Inovance shall take no responsibility for any personal injuries or property damage caused by improper usage.

Safety Levels and Definitions



Indicates that failure to comply with the notice will result in severe personal injuries or even death.



Indicates that failure to comply with the notice may result in severe personal injuries or even death.



Indicates that failure to comply with the notice may result in minor or moderate personal injuries or equipment damage.

Safety Precautions

- Drawings in the guide are sometimes shown without covers or protective guards. Remember to install the covers or protective guards as specified first, and then perform operations in accordance with the instructions.
- The drawings in the guide are shown for illustration only and may be different from the product you purchased.
- Operators must take mechanical precautions to protect personal safety and wear protective equipment, such as safety shoes, safety clothing, safety glasses, protective gloves, and protective sleeves.

Unpacking



- Do not install the equipment if you find damage, rust, or signs of use on the equipment or accessories upon unpacking.
- Do not install the equipment if you find water seepage or missing or damaged components upon unpacking.
- Do not install the equipment if you find the packing list does not conform to the equipment you received.



- Before unpacking, check whether the outer package is intact, damaged, wet, damped, or deformed.
- Unpack the package in the correct layered sequence. Do not strike the package violently.
- Check whether there is damage, rust, or injuries on the surface of the equipment and equipment accessories before unpacking.
- Check whether the package contents are consistent with the packing list before unpacking.

Storage and Transportation



- Large-scale or heavy equipment must be handled by qualified professionals using specialized hoisting equipment. Failure to comply may result in personal injuries or equipment damage.
- Before hoisting the equipment, ensure that components such as the front cover and terminal blocks are secured firmly with screws. Loosely-connected components may fall off and result in personal injuries or equipment damage.
- Never stand or stay below the equipment when the equipment is being hoisted by the hoisting equipment.
- When hoisting the equipment with a steel rope, ensure the equipment is hoisted at a constant speed without suffering from vibration or shock. Do not turn the equipment over or let the equipment stay hanging in the air. Failure to comply may result in personal injuries or equipment damage.



- Handle the product with care and mind your steps to prevent personal injuries or product damage.
- When carrying the equipment with bare hands, hold the equipment casing firmly with care to prevent parts from falling. Failure to comply may result in personal injuries.
- Store and transport the equipment based on the storage and transportation requirements. Failure to comply will result in equipment damage.
- Avoid storing or transporting the equipment in environments with water splash, rain, direct sunlight, strong electric field, strong magnetic field, and strong vibration.
- Avoid storing the product for more than 3 months. When the product needs to be stored for an extended period, take more strict protection and necessary inspection.
- Pack the equipment strictly before transportation. Use a sealed box for long-distance transportation.
- Never transport the equipment with other equipment or materials that may harm or have negative impacts on this equipment.

Installation



- The equipment can only be operated by professionals with electrical knowledge. Non-professionals are not allowed to operate on the equipment.



- Read through the guide and safety precautions before installation.
- Do not install the equipment in places with strong electric or magnetic fields.
- Before installation, check that the mechanical strength of the installation site can bear the weight of the equipment. Failure to comply will result in mechanical hazards.
- Do not wear loose clothes or accessories during installation. Failure to comply may result in an electric shock.
- When installing the equipment in a closed environment (such as a cabinet or casing), use a cooling device (such as a fan or air conditioner) to cool the environment down to the required temperature. Failure to comply may result in equipment over-temperature or a fire.
- Do not retrofit the equipment.
- Do not fiddle with the bolts used to fix equipment components or the bolts marked in red.
- When the equipment is installed in a cabinet or final assembly, a fireproof enclosure providing both electrical and mechanical protections must be provided. The IP rating must meet IEC standards and local laws and regulations.
- Before installing devices with strong electromagnetic interference, such as a transformer, install a shielding device for the equipment to prevent malfunction.
- Install the product on an incombustible object such as metal and do not touch or attach the product to combustibles. Failure to comply can result in fire accident.



- Cover the top of the equipment with a piece of cloth or paper during installation. This is to prevent unwanted objects such as metal chippings, oil, and water from falling into the equipment and causing faults. After installation, remove the cloth or paper on top of the equipment to prevent over-temperature caused by poor ventilation due to blocked ventilation holes.
- Resonance may occur when the equipment operating at a constant speed switches to variable speed operations. In this case, install the vibration-proof rubber under the motor frame or use the vibration suppression function to reduce resonance.

Wiring



- Equipment installation, wiring, maintenance, inspection, or component replacement must be performed only by professionals.
- Before wiring, disconnect all the power supplies of the equipment. Wait for at least the time designated on the equipment warning label before further operations because residual voltage still exists after power-off. Measure the direct voltage of the main circuit and ensure that the voltage is within the safety range. Failure to comply can result in an electric shock.
- Do not perform wiring, remove the equipment cover, or touch the circuit board with power ON. Failure to comply can result in an electric shock.
- Check that the equipment is grounded properly. Failure to comply can result in an electric shock.



- Do not connect the input power supply to the output side of the equipment. Failure to comply can result in equipment damage or even a fire.
- When connecting a drive to the motor, check that the phase sequences of the drive and motor terminals are consistent to prevent reverse motor rotation.
- Cables used for wiring must meet cross sectional area and shielding requirements. The shield of the cable must be reliably grounded at one end.
- Tighten the terminal screws with the tightening torque specified in the user guide. Improper tightening torque may result in overheat, damage to the connecting parts, or a fire.
- After wiring is done, check that all cables are connected properly and no screws, washers or exposed cables are left inside the equipment. Failure to comply may result in electric shock or equipment damage.



- Follow the electrostatic discharge (ESD) procedure and wear an anti-static wrist strap to perform wiring. Failure to comply may result in damage to the equipment or to the internal circuit.
- Use shielded twisted pairs for the control circuit. Connect the shield to the grounding terminal of the equipment for grounding purpose. Failure to comply can result in equipment malfunction.

Power-On



- Before power-on, check that the equipment is installed properly with reliable wiring and the motor can be restarted.
- Check that the power supply meets equipment requirements before power-on to prevent equipment damage or a fire.
- Do not open the cabinet door or protective cover of the product, touch any wiring terminal of the product, or remove any part of the product with power on. Failure to comply can result in an electric shock.



- After the completion of wiring and parameter setting, perform a robot test run to confirm that the robot can operate safely. Failure to comply may result in personal injuries or equipment damage.
- Before power-on, check that the rated voltage of the equipment is consistent with that of the power supply. Failure to comply may result in fire accident.
- Before power-on, check that no one is near the equipment, motor, or machine. Failure to comply may result in death or personal injuries.

Operation



- The equipment must be operated only by professionals. Failure to comply can result in death or personal injuries.
- Do not touch any connecting terminals or disassemble any unit or component of the equipment during operation. Failure to comply can result in an electric shock.



- Do not touch the equipment enclosure, fan, or resistor with bare hands. Failure to comply may result in burns.
- Prevent metal or other objects from falling into the equipment during operation. Failure to comply may result in a fire or equipment damage.

Maintenance



- Equipment installation, wiring, maintenance, inspection, or component replacement must be performed only by professionals.
- Do not maintain the equipment with power ON. Failure to comply can result in an electric shock.
- Before maintenance, cut off all the power supplies of the equipment and wait for at least the time designated on the equipment warning label.
- When a permanent magnet motor is used, do not touch the motor terminals immediately after power-off because the motor terminals can generate induced voltage during rotation even after the equipment is powered off. Failure to comply can result in an electric shock.



- Perform routine and regular inspection and maintenance on the equipment in accordance with maintenance requirements and keep a record.

Repair



- Equipment installation, wiring, maintenance, inspection, or component replacement must be performed only by professionals.
- Do not maintain the equipment with power ON. Failure to comply can result in an electric shock.
- Before inspection and repair, cut off all the power supplies of the equipment and wait for at least the time designated on the equipment warning label.



- Submit a request for repair services in accordance with the product warranty agreement.
- When the fuse is blown or the circuit breaker or earth leakage circuit breaker (ELCB) trips, wait for at least the time designated on the equipment warning label before power-on or further operations. Failure to comply may result in death, personal injuries or equipment damage.
- Troubleshooting and repair must be performed by professionals in accordance with the repair instructions, with repair records kept properly.
- Replace quick-wear parts of the equipment in accordance with the replacement instructions.
- Do not operate on damaged equipment. Failure to comply may result in death, personal injuries, or severe equipment damage.
- After the equipment is replaced, check the wiring and set parameters again.

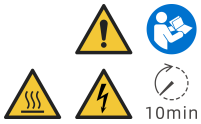
Disposal



- Dispose of retired equipment in accordance with local regulations and standards. Failure to comply may result in death, personal injuries, or property damage.
- Recycle retired equipment in accordance with industry waste disposal standards to avoid environmental pollution.

Safety Label

For safe operation and maintenance, comply with the safety labels on the equipment. Do not damage or remove the safety labels. See the following table for descriptions of the safety labels.

Safety Label	Description
	• Read through the safety instructions before operating the equipment. Failure to comply may result in death, personal injuries, or equipment damage. • Do not touch the terminals or remove the cover with power ON or within 10 min after power-off. Failure to comply can result in an electric shock.

Industrial Information Security

The product provides an interface to connect to the network and transmits data through the network interface. To protect factories, systems, machines, and networks from cyber attacks and ensure safe operation, a proper industrial information security protection mechanism must be implemented.
The customer is responsible for providing and continuously ensuring a secure connection between the product and the customer network or any other network to prevent unauthorized access to its factories, systems, machines, and networks. The system or machine can be connected to the corporate network or the Internet only when secure connections are ensured and appropriate security measures are taken (for example, anti-virus software or firewall installed).
Inovance continuously develops and improves products and solutions to improve safety. It is strongly recommended that you update the product promptly and always use the latest version.



Malware (such as viruses, Trojans, and worms) can put the product in an unsafe running state, which may result in death, serious injuries, and property damage. Observe the following precautions:

- Always use the latest software version. If the product version is no longer supported or the latest version is not used, customers will be exposed to increased risk of cyber attacks.
- Take appropriate protection measures (including but not limited to installing anti-virus software, firewall, WAF, IPS/IDS, and situation awareness system, and applying authentication, data encryption) to prevent files in mobile storage devices from being damaged by malware, and to prevent products, networks, systems, and interfaces from unauthorized access, interference, intrusion, data leakage, or information breach.
- Check all safety-related interfaces and settings after commissioning.

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1 Safety Operation

1.1 Precautions for Robot Operation

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"CAUTION" indicates that failure to comply with the notice may result in minor or moderate personal injuries or equipment damage.

Power-On
 Before power-on, check that the equipment is installed properly with reliable wiring and the motor can be restarted. Check that the power supply meets equipment requirements before power-on to prevent equipment damage or a fire. Do not open the cabinet door or protective cover of the product, touch any wiring terminal of the product, or remove any part of the product with power on. Failure to comply can result in an electric shock.
 After the completion of wiring and parameter setting, perform a robot test run to confirm that the robot can operate safely. Failure to comply may result in personal injuries or equipment damage. Before power-on, check that the rated voltage of the equipment is consistent with that of the power supply. Failure to comply may result in fire accident. Before power-on, check that no one is near the equipment, motor, or machine. Failure to comply may result in death or personal injuries.

Operation
 The equipment must be operated only by professionals. Failure to comply can result in death or personal injuries. Do not touch any connecting terminals or disassemble any unit or component of the equipment during operation. Failure to comply can result in an electric shock.
 Do not touch the equipment enclosure, fan, or resistor with bare hands to sense the temperature. Failure to comply may result in personal injury. Prevent metal or other objects from falling into the equipment during operation. Failure to comply may result in a fire or equipment damage.

1.2 Users

Personnel classification	Job responsibilities	Remarks
Operator	• Perform daily power supply OFF/ON operations for the robot system. • Perform emergency stop operation in emergency situation. • Monitor the normal operation of the robot program.	Shall not perform tasks inside the safety fence.
Programmer	• Perform normal operations of the robot. • Perform programming and commissioning operations for the robot program. • Perform teaching operations for the robot.	Can perform tasks inside the safety fence.
Maintenance personnel	• Perform normal operations of the robot. • Perform maintenance and repair operations on the robot.	Can perform tasks inside the safety fence.

1.3 Emergency Safety Information

1.3.1 Basic Concepts

Emergency Stop

The Emergency Stop is a state that overrides all other manipulator controls, disconnects the drive power from the manipulator motors, stops all moving parts, and disconnects the power from any potentially hazardous functions controlled by the manipulator system.

The emergency stop state means that all power is disconnected from the manipulator, except for the manual brake release circuit. To return to normal operation, a recovery procedure must be performed: reset the emergency stop button and press the motor enable button.

Depending on the manipulator system configuration, an emergency stop can lead to:

- An uncontrolled stop, where the manipulator operation is rapidly stopped by disconnecting motor power.
- A controlled stop, where power is supplied to the motors, thereby maintaining the manipulator path while stopping the manipulator. After the stop is completed, power is disconnected.

The default setting is uncontrolled stop. However, a controlled stop minimizes unnecessary wear on the manipulator and the operations required to return the manipulator system to production status. Therefore, controlled stop should be given priority.

See the factory or workshop documentation for information on configuring the manipulator system.

Safety Stop

A safe stop means that only the power to the manipulator motors is disconnected. Therefore, no recovery procedure is required. Only reconnecting motor power is needed to resume normal operation from a safe stop.

A safety stop is also known as a protective stop. Depending on the manipulator system configuration, a safety stop can lead to:

- An uncontrolled stop, where the manipulator operation is rapidly stopped by disconnecting motor power.
- A controlled stop, where power is supplied to the motors, thereby maintaining the manipulator path while stopping the manipulator. After the stop is completed, power is disconnected.

The default setting is controlled stop.

A controlled stop minimizes unnecessary wear on the robot and the operations required to return the robot system to production status. Therefore, controlled stop should be given priority.

See the factory or workshop documentation for information on configuring the robot system.

Safety stop is used for safety protection. The following explains the concept of safety protection.

Safety Protection

Safety protection is a concept applied in situations where certain hazards cannot be reasonably eliminated or completely designed out through engineering means. Therefore, protective devices are used to keep personnel away from these hazards.

When certain safety protection mechanisms (such as a light curtain) are activated, the protective device can prevent hazardous situations by stopping the manipulator in a controlled manner, which can be achieved by connecting the protective device to any safety stop input on the manipulator controller.

1.3.2 Emergency Stop and Stop

Emergency stop

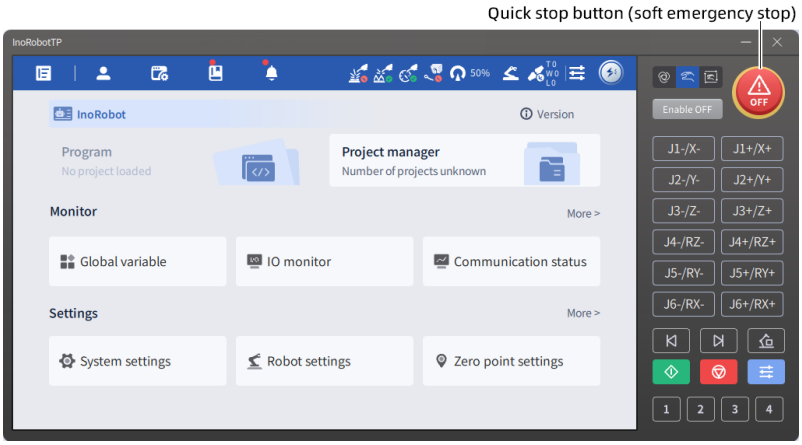
When someone is in danger within the robot working area or the robot is damaging equipment, immediately press any emergency stop button.

When the emergency stop button for the robot is pressed, the motor power is cut off, and the braking system stops the robot in the shortest possible distance.

Use the emergency stop button in the emergency situations.	Do not use the emergency stop button in the non-emergency situations.
If any of the following abnormalities or emergency situations occur during robot operation, immediately press the emergency stop button: • There are personnel within the robot working area. • The robot injures personnel or damages equipment.	Do not use the emergency stop button in non-emergency situations during normal robot operation: • Frequent braking can shorten the lifespan of the motor brake release switch. • Pressing the emergency stop button when the robot is operating at high speed and under heavy load may cause the robot accuracy to exceed the specified range, and in severe cases, may damage the robot. • The normal operating trajectory of the robot may be disrupted, leading to incorrect actions and, in severe cases, collisions with nearby objects, causing dangerous accidents.



When an emergency occurs, pressing the quick stop button immediately stops all robot motion. Note that the quick stop is not a risk reduction measure, but rather a secondary protective device to be used only in critical situations.



> **WARNING**
>
> When the emergency stop button is pressed, the robot system disconnects power from the robot manipulator. In this situation, although the brakes on each axis are automatically engaged, the manipulator may still move downward slightly due to gravity, posing a risk of pinching or impact to personnel.

Stop

To stop the robot in non-emergency situations, press the stop button on the teach pendant. In this case, the motor power is not cut off, and the brake release switch remains open, which does not affect its lifespan.



1.3.3 Emergency Stop Method

The emergency stop is implemented in accordance with the standards GB 11921.1 / ISO 10218-1 and IEC 60204-1. Emergency stop is the highest level of stop mode, which cuts off the power supply to the motor and provides the fastest deceleration to maximumly avoiding other hazards. The emergency stop is effective in all operation modes.

Emergency stop mode

- Class 0 stop is an uncontrolled stop mode, corresponding to Category 0 stop according to IEC 60204-1:2005. The drive stops output and dynamic braking is applied. When the speed decreases, the brake release switch is closed.
- Class 1 stop is a controlled stop mode, corresponding to Category 1 stop according to IEC 60204-1:2005. The stop is planned by the controller. When the planning is complete, the drive is disabled and the brake release switch is closed.

Emergency stop trigger mode

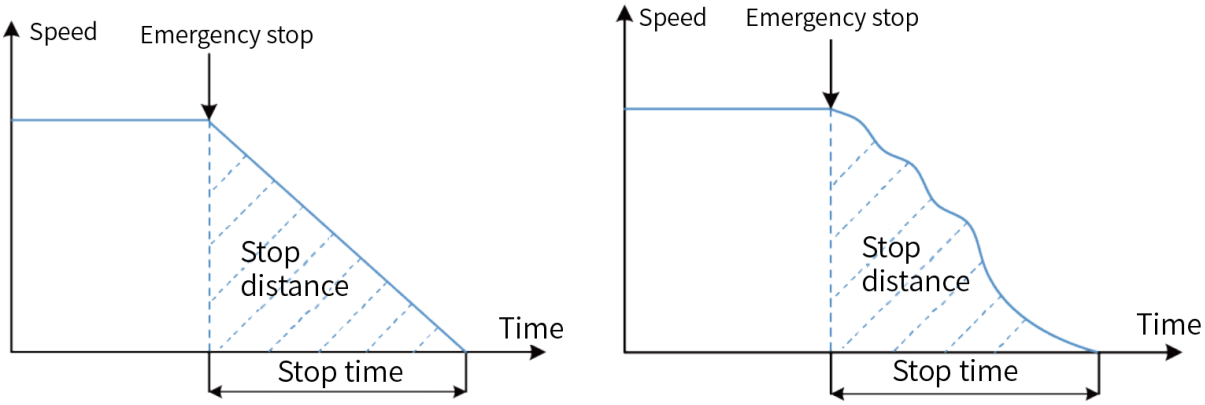
- Mode 1: Use the emergency stop button on the hand-held teach pendant.
- Mode 2: Use the emergency stop button on the PC-based teach pendant or on the InoRobotLab software.
- Mode 3: Use the external wiring (SAFETY terminal, safety door, etc.). Emergency stop modes can be configured according to the controller model. Except for the emergency stop button on the PC teach pendant, which defaults to Category 1 stop, the emergency stop function of other modes is a Category 0 stop.
  When the emergency stop is configured as a Category 0 stop, the emergency stop is an uncontrolled stop, and a corresponding stopping distance should be reserved in the robot's workspace.



- Mode 2 of triggering an emergency stop is implemented via network communication, which may increase the response time due to poor communication. It is recommended to use mode 1 or 3.
- Emergency stop is for emergency situations only and cannot replace normal program stop.
- Frequent emergency stops of an operating robot via the emergency stop button can lead to robot failure and reduce its lifespan.
- During system troubleshooting, maintenance, or grip installation, the emergency stop cannot replace the powering off to the controller .
- External misoperations may cause risks of emergency stop recovery, which could lead to the motor being powered on, resulting in safety accidents.
- The stopping distance and stopping time for Category 1 stop are longer than those for Category 0 stop.
- When using Category 1 stop, it is necessary to conduct a thorough risk assessment of the system, considering the increased stopping distance and stopping time.

Inertial travel distance during emergency stop

When the control system enters a robot emergency stop, the robot does not stop immediately due to kinetic energy. There is a stopping time and stopping distance after the emergency stop is activated. The stopping time (inertial travel time) and stopping distance (inertial travel angle) during an emergency stop vary depending on the stop mode. The stopping time and stopping distance during an emergency stop are determined by the stop mode and stop parameters of different robot models.

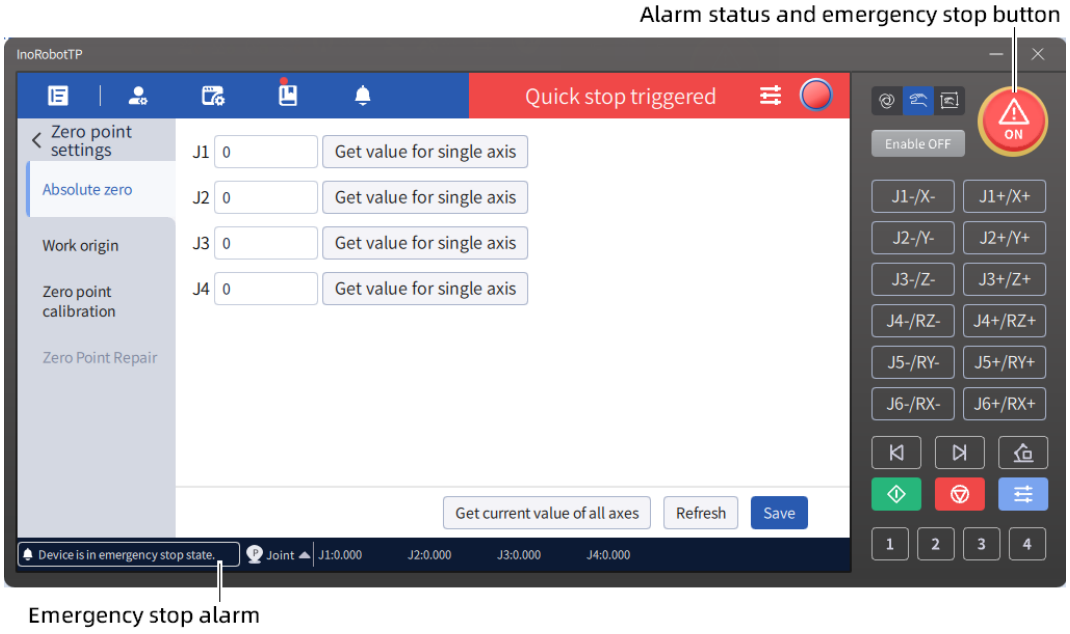


Release of the emergency stop state

Recovery from the emergency stop state must be performed manually by the operator according to safety standards.

The detailed operations are as follows:

1. Check if the robot system and peripheral equipments allow the release of the emergency stop state.
2. If the emergency stop state can be released, the following methods can be used:
   - Release the emergency stop button on the teach pendant.
   - Click the emergency stop icon again on the PC-based teach pendant.
   - Restore the level through the external wiring.
   - Resolve system faults to return to a non-emergency stop state.
3. After recovery from the emergency stop state, the controller remains in an alarm state. You can clear the alarm to resume normal operation.



1.3.4 Recovery from Emergency Stop State

- After the fault is cleared, manually rotate the emergency stop button to release the emergency stop state.

- When starting the robot and resuming operation from a fault state, after powering on the motor, the operator should keep their hand on the emergency stop switch to immediately cut off the motor power in case of any abnormal situation.

1.4 Operation Mode Declaration

1.4.1 Manual Low Speed Mode

The manual low speed mode imposes safety speed limits on robot motion, providing high flexibility for project modifications, teaching and debugging. It subjects to the following safety restrictions:

- The robot motion speed does not exceed 250 mm/s.
- Debugging supports hold-to-run only.
- The enable switch must be kept half-pressed continuously during teaching or debugging.

1.4.2 Manual High Speed Mode

The manual high speed mode further relaxes speed limits on the basis of manual low speed mode. It is used only for debugging, and does not support excessive function modifications. It subjects to the following safety restrictions:

- Project cannot be edited.
- Debugging supports hold-to-run only.
- The initial speed after each switch to manual high speed mode is 1%.
- Speed adjustments can only be made in the enabled state. The speed will automatically return to the initial speed after the enabled state is canceled for more than 5 minutes.

1.4.3 Auto Mode

Auto mode is used for running programs with speed limits released, and does not support multi-function modifications. It subjects to the following safety restrictions:

- Project cannot be edited.
- Axis motion teaching is not allowed.
- Only the start, operation, and stop of the program are supported.

2 Version Description

Version Number	Description
• Platform version: V4R25C2 • Plugin version: Weld_V4R3C2	[What's new] • Added torch collision detection function. For details, see the 7.7 Torch Collision Detection Function section. • Added right-side custom keys for arc welding. For details, see the 9.8 Right-side Custom Keys for Arc Welding section • Added power failure resume function. For details, see the 9.9 Power Failure Resume section • Added API for setting plugin-side parameters and signals. For details, see the 9.10 API section • Added new version welding instructions, including start, end, and parameter change instructions for welding, weaving, laser tracking, arc tracking, and stitch welding functions. For details, see the 10 Instructions section. [Optimized functions] • Optimized the programming examples for basic welding operations. For details, see the 4.6 Programming Examples section. • Added support for Kaierda welders in digital communication. For details, see the 5.2.2 Digital Communication section. • Separated the welding parameter programming examples into new and old instruction versions. For details, see the 4.6 Programming Examples section. • Supplemented weaving with detailed related parameters. For details, see the 9.1.2 Parameter Description section. • Separated the weaving parameter programming examples into new and old instruction versions. For details, see the 9.1.5 Programming Examples section. • Optimized laser seam finding. For details, see the 9.3.2 Laser Seam Finding section. • Separated the laser tracking usage procedure into new and old instruction versions. For details, see the 9.3.3.5 Usage Procedure section. • Separated the arc tracking usage procedure into new and old instruction versions. For details, see the 9.4.5 Usage Procedure section. • Separated the stitch welding usage procedure into new and old instruction versions. For details, see the 9.6.5 Usage Procedure section.

Version Number	Description
• Platform version: V4R25C1 • Plugin version: Weld_V4R3C1	First release

3 Arc Welding System Overview

3.1 Arc Welding Process Introduction and Features

The arc welding robot is a highly automated robot system specifically designed to perform arc welding tasks. It primarily consists of the robot, control system, and welding equipment. The welding equipment includes the welding torch, welding power supply, wire feeder, etc. The main function of the welding power supply is to provide stable electrical energy, ensuring the arc stability during the welding process. Select an appropriate welding power supply based on different welding methods (such as MIG/MAG, TIG, etc.).

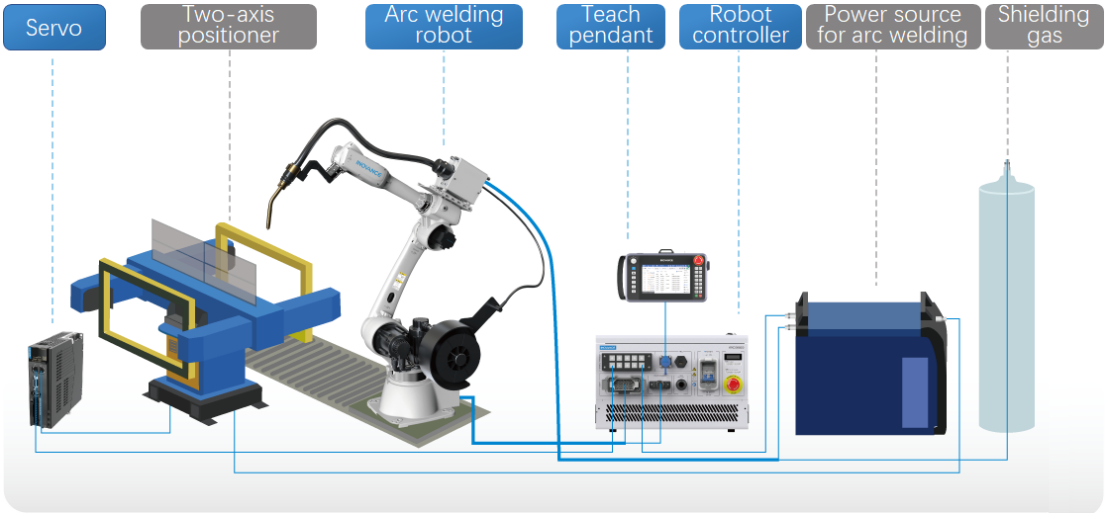
Arc welding is a welding method that uses an electric arc as a heat source to melt the base metal and filler metal (welding wire), and is widely applied in industrial manufacturing. Arc welding robots commonly use welding technologies such as gas metal arc welding (MIG/MAG) and tungsten inert gas welding (TIG).

3.2 Arc Welding System Composition

The common composition of an arc welding system mainly includes the robot manipulator, robot controller, teach pendant, servo positioner, welding torch, welder, wire feeder, welding wire, shielding gas, etc.

- Robot manipulator: The actuating mechanism of the arc welding robot system, responsible for holding the welding torch and completing precise welding path motions. Its mechanical structure, motion performance, and reliability directly affect the welding quality and efficiency.
- Robot controller: The 'brain' of the arc welding robot system, responsible for coordinating robot motion, welding process control, and external device communication, ensuring high-precision and high-efficiency welding operations.
- Teach pendant: The core programming and control terminal of the arc welding robot system, used for manually operating the robot, setting welding paths, adjusting parameters, and monitoring the welding process.
- Positioner (optional): A key device in the arc welding robot system that precisely controls the spatial position and orientation of the workobject, ensuring optimal welding angles to improve welding quality, efficiency, and automation levels. It can be a single-axis positioner, dual-axis positioner, or multi-axis positioner.
- Welder: The core equipment of the arc welding robot, which functions to provide stable welding current and voltage and control the welding process, directly affecting arc stability, penetration depth, and weld quality. It can be a MIG/MAG welder, TIG welder, etc.
- Welding torch: The core component that directly performs the welding operation, which functions to precisely deliver welding current, shielding gas (where applicable) and welding wire (or electrode) to the welding location, forming a stable arc and completing the fusion process. It can be a MIG/MAG welding torch or TIG welding torch, etc.
- Wire feeder: A device that functions to continuously and stably feed the welding wire from the wire spool to the welding torch, ensuring arc continuity and deposited metal uniformity during the welding process. It can be a push-type wire feeder, pull-type wire feeder, or push-pull type wire feeder.
- Welding wire: A consumable that functions to fill metal, conduct current, shield the weld pool and control weld performance. It can be classified into solid wire and flux-cored wire.

- Shielding gas: A medium that functions to exclude atmospheric air, stabilize the arc, control penetration and weld bead formation, and reduce spatter. Common types of shielding gas include carbon dioxide (CO_2), argon (Ar), helium (He), and argon + carbon dioxide mixed gas (Ar+CO_2).



Picture3-2-1 Example of arc welding system composition

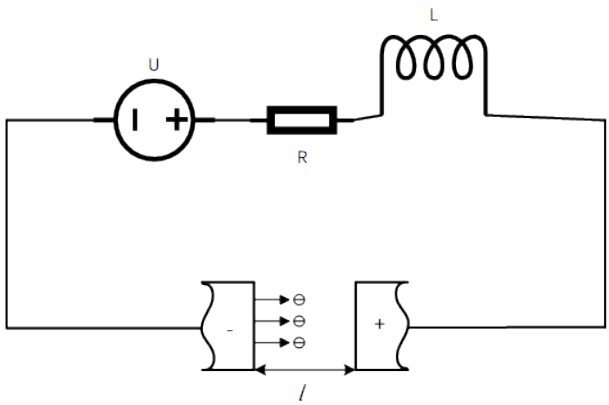
3.3 Working Principle and Process

Arc welding is a method that uses the high temperature generated by electric arc discharge to melt metal for welding. In arc welding, two metal electrodes are connected to a power source to form a circuit. When current passes through the electrodes, an arc discharge occurs between the electrodes, causing the part between the two metal pieces to become heated and melt. The melted metal becomes liquid under the heat of the arc, forming a molten metal pool, which then naturally cools and solidifies to complete the welding.

Basic principle of arc generation:

1. Field emission

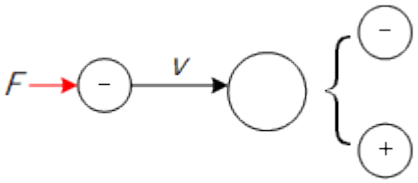
Arc welding principle formulas	Symbol	Variable value meaning	Unit
E=U/l	E	Electric field strength	V/m
	U	Voltage	V
	l	Distance	m



The high electric field strength is generated at the moment the contacts separate. In physics, the magnitude of the electric field strength represents the magnitude of the electric field force acting on a

unit charge. Under the action of the high electric field strength, electrons on the surface of the metal contacts are forcibly pulled out. This process is called field emission.

2. Collision Ionization



Under a high electric field strength, the electric field force is very large. Free electrons in the contact gap gain high acceleration. These free electrons collide with neutral molecules in the gas, ionizing them into positive ions and electrons. The newly ionized electrons, in turn, continue to collide with neutral molecules under the electric field strength. The chain reaction of collisions rapidly increases the concentration of free electrons in the gap, causing the gap to conduct electricity and forming an electric arc.

The working process of arc welding:

1. Power source connection: Connect the positive clamp of the welder to the workobject, and connect the negative clamp to the electrode or wire, establishing a circuit.
2. Arc ignition: Generate an arc using the power source. Briefly touch the electrode or wire to the workobject and then quickly withdraw it to establish the arc.
3. Metal fusion: The high temperature energy of the arc rapidly melts the metal, forming a weld pool. The electrode or wire also melts and is incorporated into the weld pool.
4. Moving the welding torch: Maintain an appropriate welding speed and weld width. Move the welding torch along the intended welding path, controlling the speed and direction of weld pool formation.
5. Arc extinction: Interrupt the arc by changing parameters such as the current or voltage of the welder.

4 Getting Started with Welding

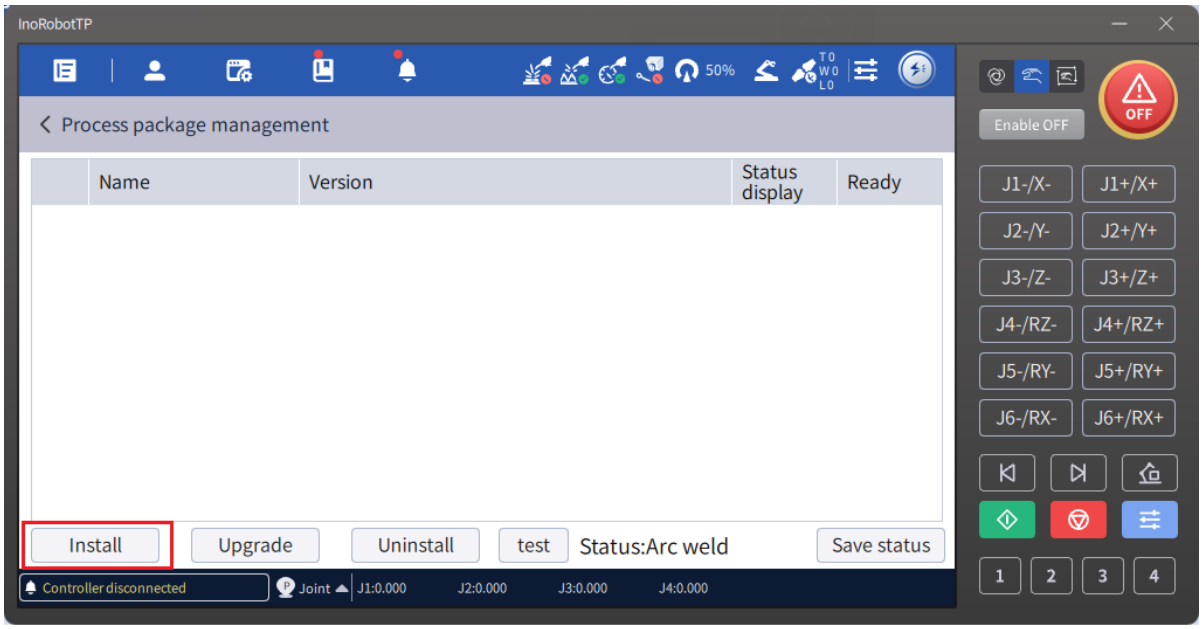
4.1 Checking the Operating Condition

Taking a typical single station of arc welding as an example, the following checks shall be performed before operation:

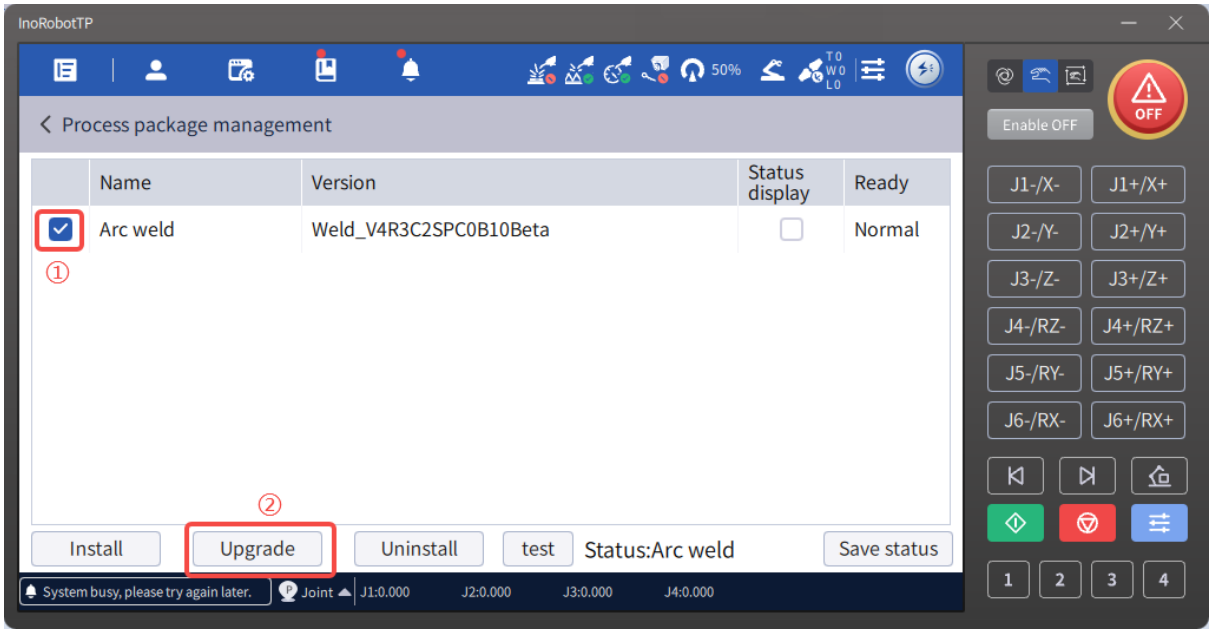
1. IR-R10 and IR-R20 series robot manipulators and controllers: After power-on, verify that the software versions match and check for any abnormal alarms.
2. Dress pack: Move the robot to various reachable positions of the production station, and check whether the dress pack is abnormal.
3. Welder: Check if the welder can be powered on normally, and check the wiring between the welder, controller, wire feeder, and welding torch.

4.2 Installing the Plugin

1. Plugin installation:
   On the main interface of the InoRobotTP teach pendant software, go to "Settings" > "More" > "Process Manager" > "Process package management", click "Install", select the plugin installation package, and click "Open" to install the plugin.

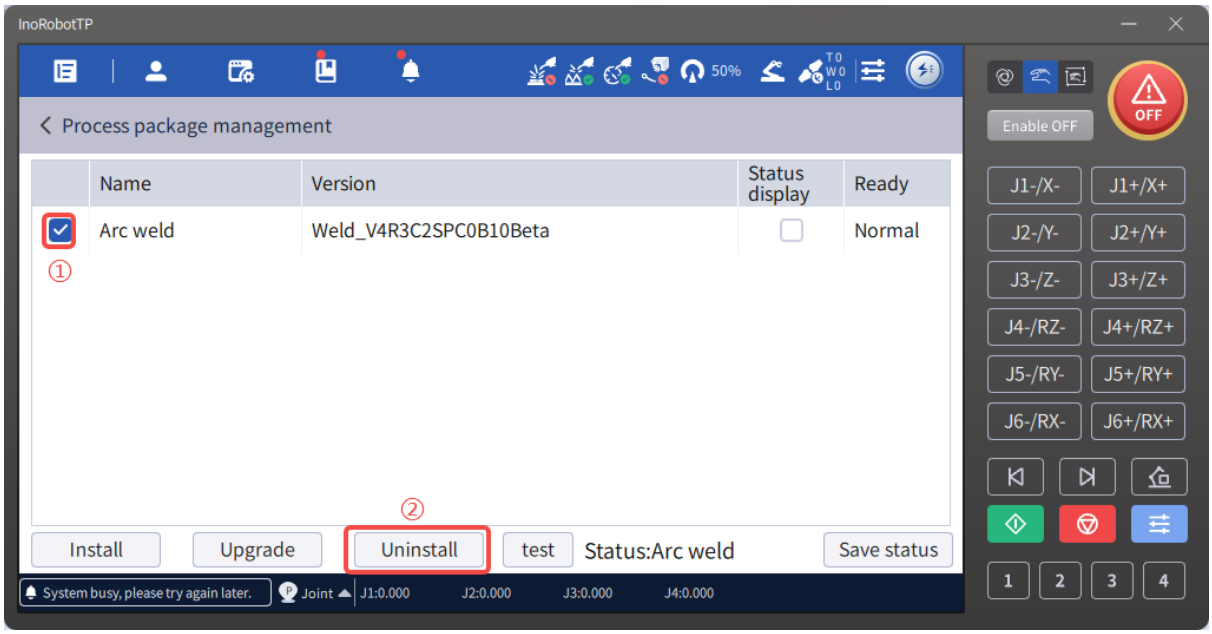


2. Plugin upgrade:
   On the main interface of the InoRobotTP teach pendant software, go to "Settings" > "More" > "Process Manager" > "Process package management", select the plugin that needs to be upgraded, click "Upgrade", select the new plugin installation package, and click "Open" to upgrade the plugin.



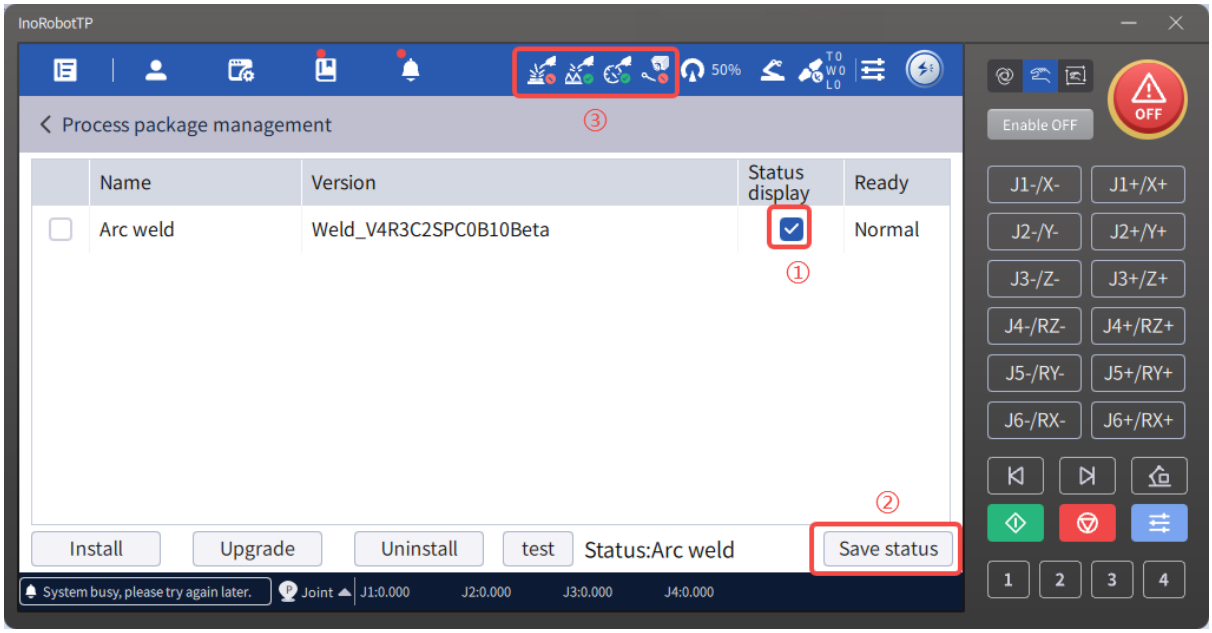
3. Plugin uninstallation:

   On the main interface of the InoRobotTP teach pendant software, go to "Settings" > "More" > "Process Manager" > "Process package management", select the plugin that needs to be uninstalled, click "Uninstall" to remove the plugin.



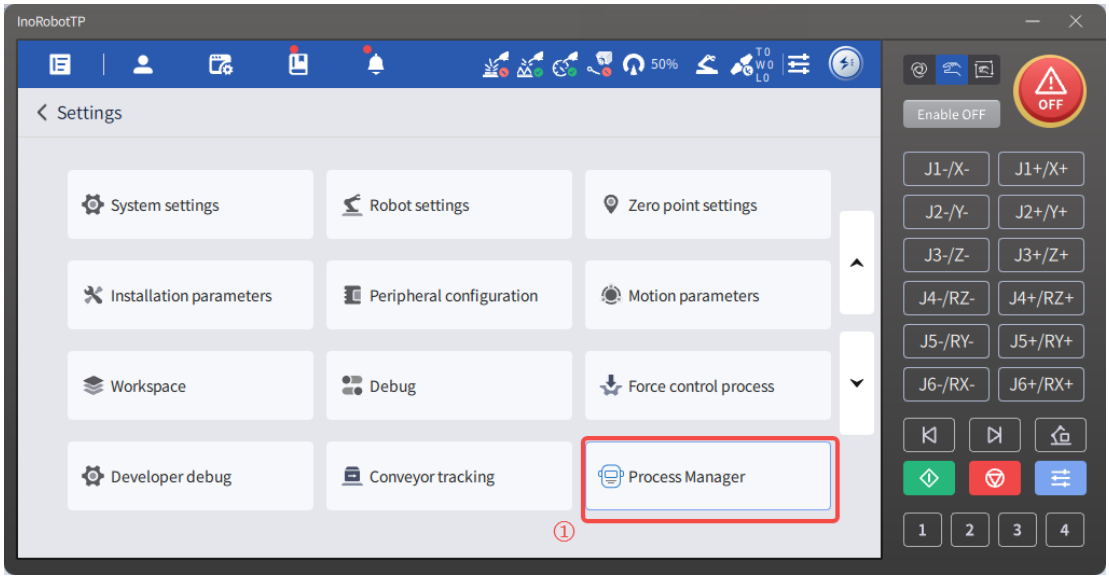
4. Enabling display of key plugin status in status bar:

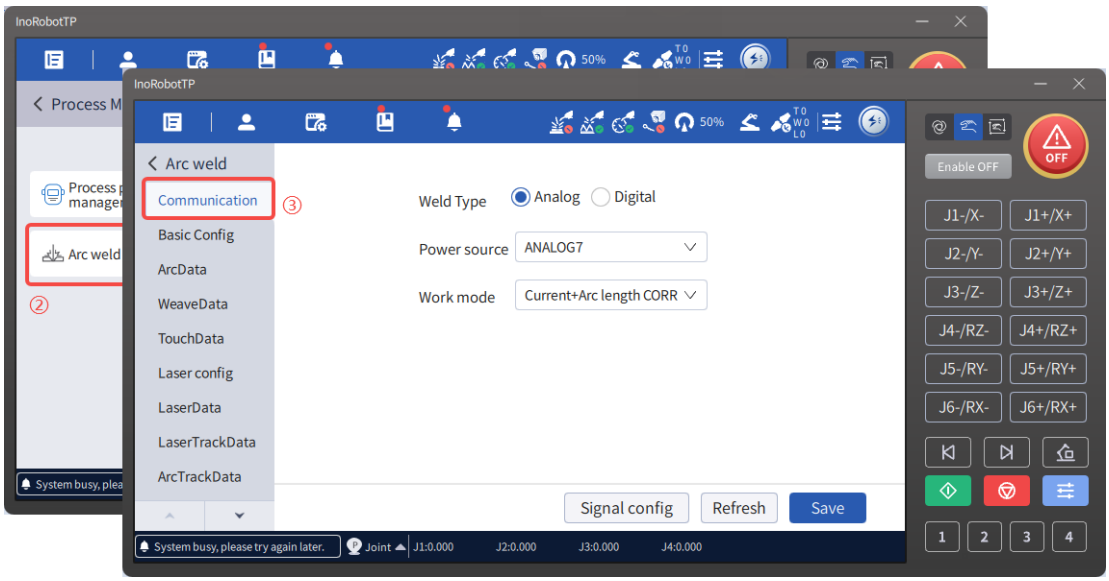
   On the main interface of the InoRobotTP teach pendant software, go to "Settings" > "More" > "Process Manager" > "Process package management", check the "Status display" checkbox corresponding to the plugin in the plugin list, click the "Save status" button, and the key status of the plugin will be displayed in the status bar of the teach pendant. Four statuses can be displayed for the arc welding plugin: welding enable/disable, weaving enable/disable, using welding speed, tracking enable/disable. For detailed descriptions and switching of these four statuses, see 8 Process Teaching Panel section.



4.3 Setting the Welder Communication

On the home page, go to "Settings" > "More" > "Process Manager" > "Arc weld", and click "Communication" to configure the communication settings for the welder.



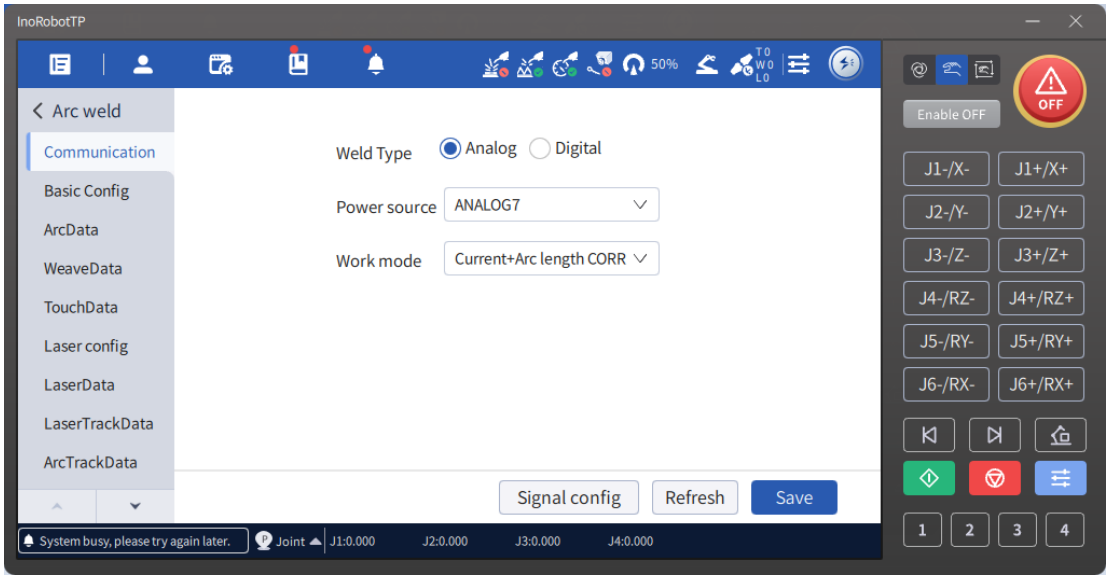


4.3.1 Selecting the Welding Type

The current welding robot supports two weld type: analog communication and digital communication. Select the required type based on actual conditions.

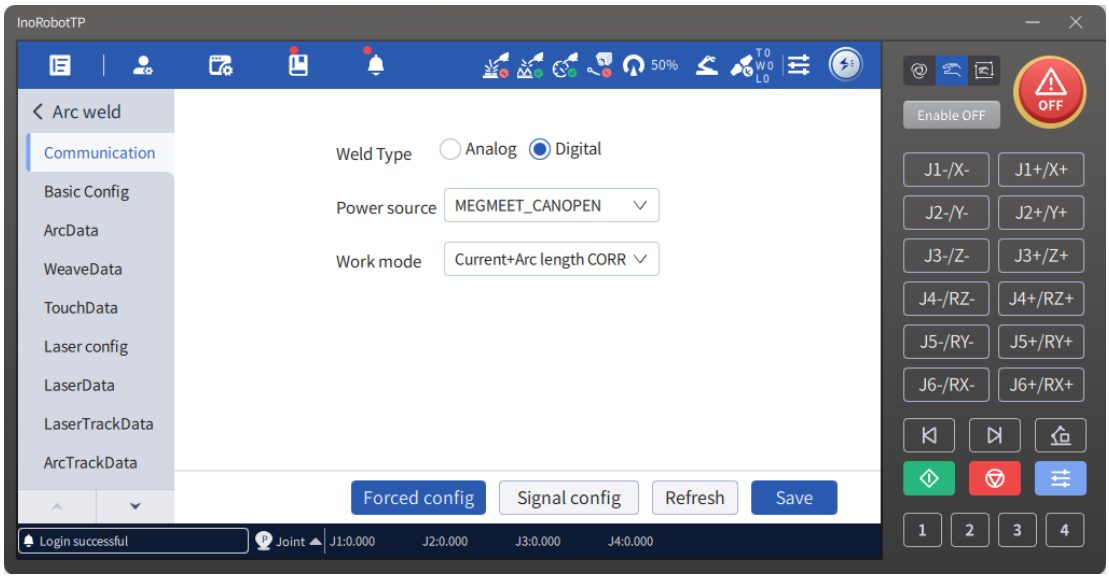
- Analog

"Analog" refers to communication between the controller and the welder through I/O signals and analog quantities. The page contains two settings: power source and work mode.



- Digital

Digital communication supports communication with the welder through CANopen and DeviceNet. The page contains the following settings: power source, work mode, welder signal configuration button, forced configuration button.



4.3.2 Selecting the Welding Power Source

Each welding type supports 8 types of welding power sources.

1. Digital: Supports 6 default welding power sources and 2 custom welding power sources.
   a. MEGMEET_CANOPEN: Communication with MEGMEET welder through CANopen. The signal configurations for common models of MEGMEET welder are already included.

b. AOTAI_CANOPEN: Communication with AOTAI welder through CANopen. The signal configurations for common models of AOTAI welder are already included.

c. MEGMEET_DEVICENET: Communication with MEGMEET welder through DeviceNet. The signal configurations for common models of MEGMEET welder are already included.

d. AOTAI_DEVICENET: Communication with AOTAI welder through DeviceNet. The signal configurations for common models of AOTAI welder are already included.

e. FRONIUS_DEVICENET: Communication with FRONIUS welder through DeviceNet. The signal configurations for common models of FRONIUS welder are already included.

f. ESAB_DEVICENET: Communication with ESAB welder through DeviceNet. The signal configurations for common models of ESAB welder are already included.

g. DIGIT6, DIGIT7: Custom welding power source DIGIT6-DIGIT7, can be personalized by importing configuration files for the welder.

2. Analog: Supports 3 default welding power sources and 5 custom welding power sources. The I/O signals and analog quantities required for welder communication with the default welder power source are pre-configured. You can view the current welder manufacturer signal definitions for wiring through "Signal config", or modify the initial values of the signal mapping table.

a. MEGMEET: Communication with MEGMEET welder through analog signals.

b. AOTAI: Communication with AOTAI welder through analog signals.

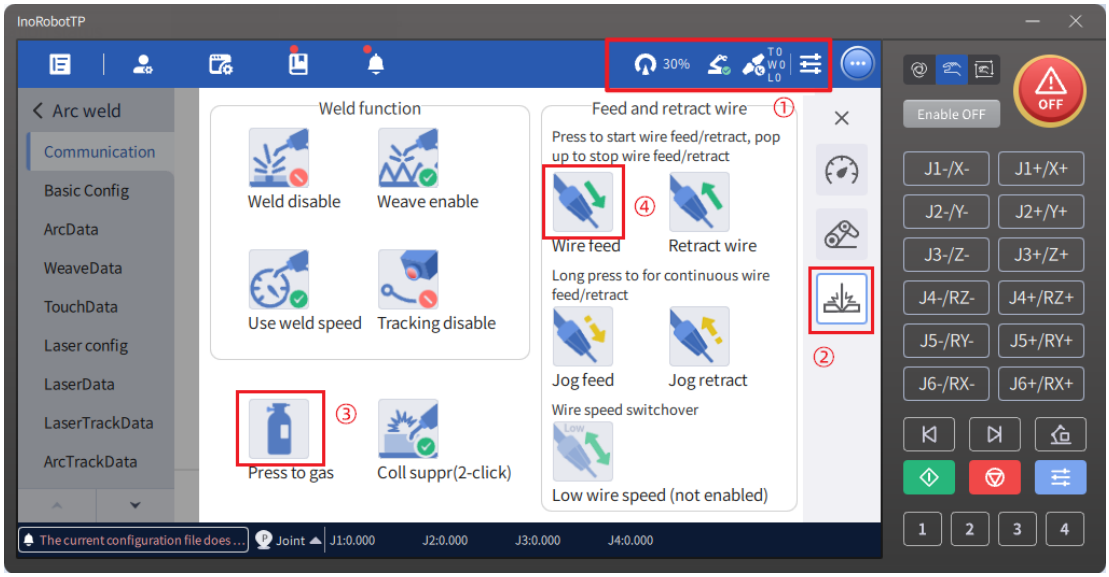
c. ESAB: Communication with ESAB welder through analog signals.

d. ANALOG3-ANALOG7: Custom welding power sources. Signal configurations are required through "Signal config", otherwise normal communication with the welder cannot be established.

4.3.3 Verifying the Communication

1. For digital communication, select the corresponding default power source, then click the "Forced config" button and restart the controller according to the prompts (this step is not required for analog communication).

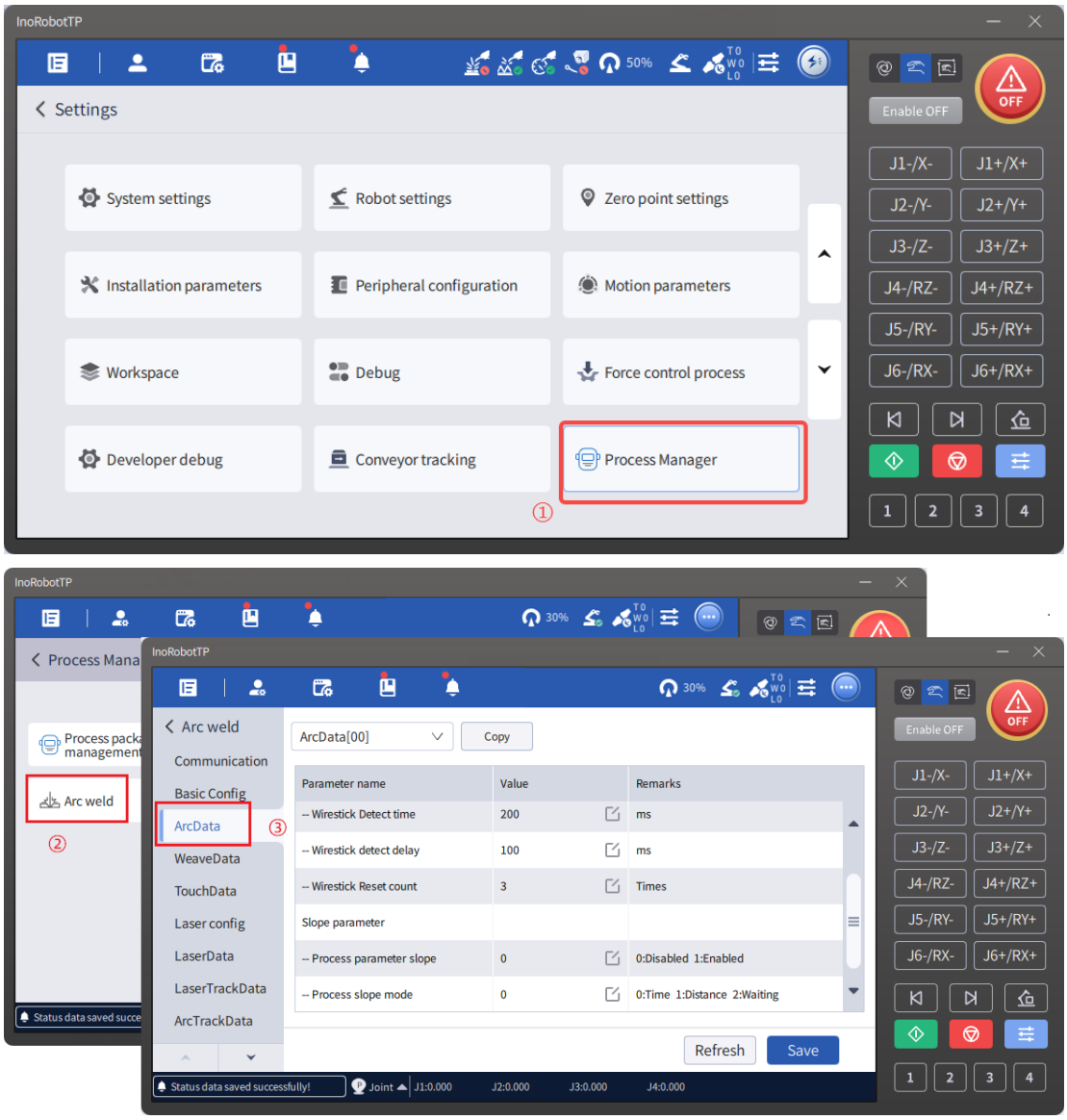
2. Enter the process control panel, click "Press to gas" and "Wire feed" to check if the communication with the welder is normal.



4.4 Setting the Welding Parameters

On the home page, go to "Settings" > "More" > "Process Manager" > "Arc weld", and click "ArcData" to set the relevant welding parameters.

The data type of welding parameters is ArcData. There are 64 groups of ArcData variables, from ArcData[0] to ArcData[63], used to set parameters related to arc initiation, welding, and arc extinction stages, including current, voltage, and welding parameters. For the meaning of the parameters, see the 6 ArcData section.



4.5 Calibrating the Tool and Workobject

1. Calibrate the tool frame of the welding torch.
   a. On the home page, go to "Settings" > "More" > "Installation parameters" > "Tools" to enter the tool configuration page.
   b. In the drop-down box, select the tool frame to be calibrated. Do not select Tool0. Tool0 is the default value and represents the tool number when no tool is installed. The parameters here cannot be changed.
   c. Click the "Calibration" button in the upper right corner to enter the calibration page. See the "Setting the Tools" section in the "IR-TP200 Series Industrial Robot Teach Pendant User Guide".

d. Enter the tool load parameters correctly as they affect the accuracy and stability of the robot motion. Load auto-tuning is recommended when no 3D load model is available. If the 3D load model is available, it is recommended to use 3D software to export the load parameters. Generally, the accuracy of the exported load parameters is higher than that obtained by the load auto-tuning function. For the load auto-tuning procedure, see the "Load Auto-Tuning" section in the "IR-TP200 Series Industrial Robot Teach Pendant User Guide".

2. Calibrate the workobject frame according to actual needs.

   a. On the home page, go to "Settings" > "More" > "Installation parameters" > "Wobj" to enter the workobject configuration page.

   b. In the drop-down box, select the workobject frame to be calibrated. Do not select Wobj0. Wobj0 is the default value and coincides with the world frame. The parameters here cannot be changed.

   c. Click the "Calibration" button in the upper right corner to enter the calibration page. See the "Setting the Workobject" section in the "IR-TP200 Series Industrial Robot Teach Pendant User Guide".

4.6 Programming Examples

1. On the home page, Select "Project manager" > "New", enter the project name and click "OK" to create a new project. Double click the newly created project to open it.

2. Double click "main.pro", select "Add" > "Welding process", and select the welding instruction to be added.

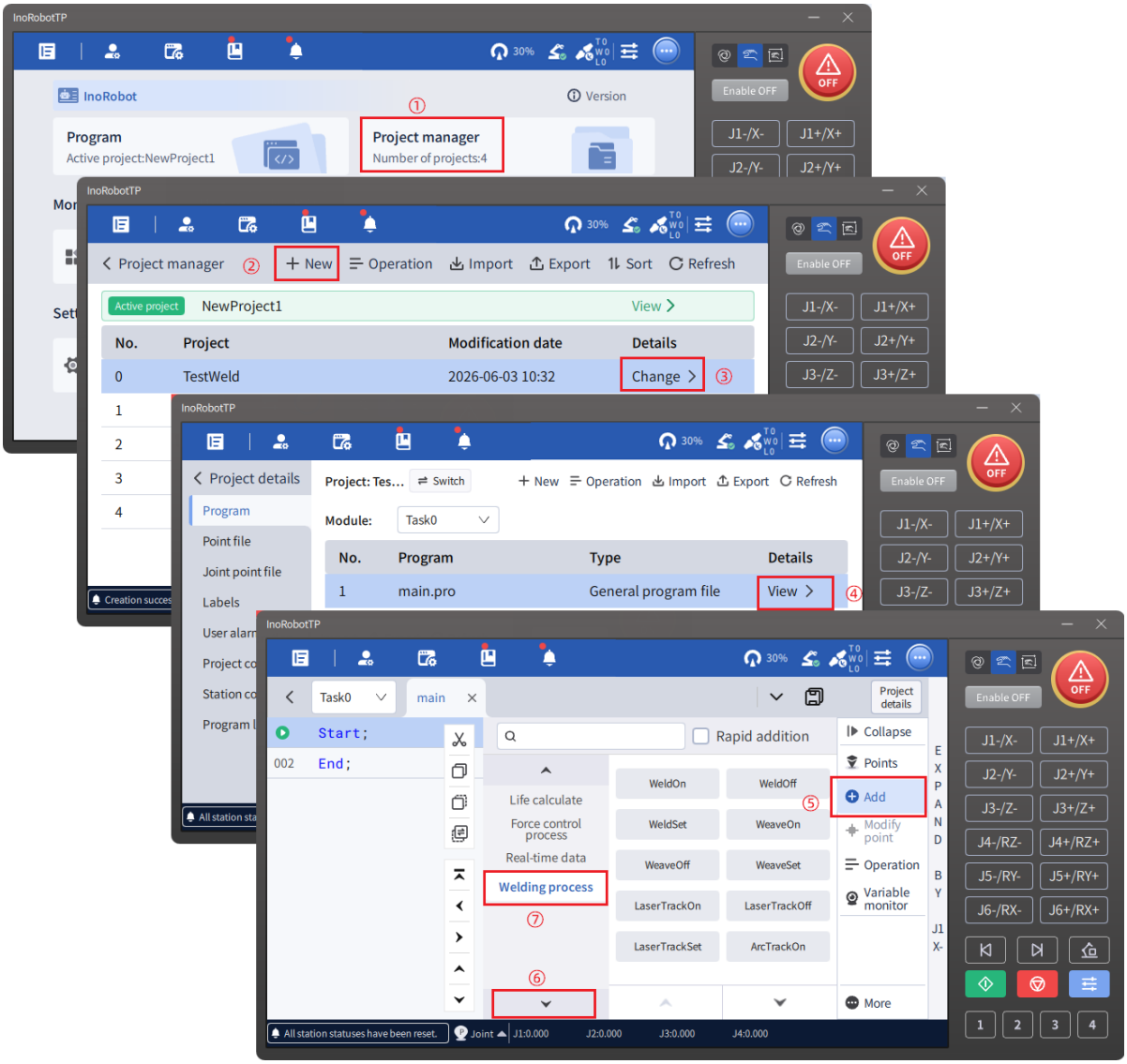




Table4-6-1 WeldOn and WeldOff without optional parameters

No.	Program	Comment
1	Start;	Start
2	Movl P[1],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[1].
3	Movl P[2],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the arc start point P[2].
4	WeldOn ArcData[1];	Start arc, and use welding parameters from ArcData[1].
5	Movl P[3],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the arc-off point P[3].
6	WeldOff ArcData[1];	Extinguish arc, and use the welding parameters from ArcData[1].
7	Movl P[4],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[4].
8	End;	End

Table4-6-2 WeldOn and WeldOff with optional parameters

No.	Program	Comment
1	Start;	Start
2	Movl P[1],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[1].
3	Movl P[2],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the arc start point P[2].
4	WeldOn ArcData[1], AC[120],AV[0],WS[8];	Start arc, and use the welding parameters from ArcData[1]. Since optional parameters are included, the current, voltage/arc length correction, and welding speed during welding use the index values of AC, AV, and WS.
5	Movl P[3],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the arc-off point P[3].
6	WeldOff ArcData[1], AC[120],AV[0];	Extinguish arc, and use the welding parameters from ArcData[1]. Since optional parameters are included, the extinguishing current, voltage/arc length correction use the index values of AC and AV.
7	Movl P[4],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[4].
8	End;	End

5 Welder Communication

5.1 Overview

Welder communication function is used to establish communication between the robot and the welding power source. The system provides configurations for default welding power sources such as AOTAI and MEGMEET. In addition, it supports configuration of custom welding power sources.

Table5-1-1 Basic communication parameters

Parameter	Description
Weld Type	Used to select different signal transmission methods.
Power source	Used to select the welding power source being edited. The welding power sources named "ANALOG+number" or "DIGIT+number" are custom welding power sources, while the rest are default welding power sources.
Work mode	Used to select the method of controlling the welding power source. The work mode must match the weld mode[1] signal of the welding power source. When the work mode is selected as "Current+Voltage" or "Wire speed+Volt", the weld mode should be the separate mode. When the work mode is selected as "Current+Arc length CORR" or "Wire speed+arc LEN CORR", the weld mode should be the synergic mode. When the work mode is selected as "Channel mode", the weld mode should be the JOB mode.

NOTE

[1]: You can find the "Weld mode" function via "Signal config" > "Output Signal" > "Weld mode". For detailed description, see the "Welder Signal Configuration" section.

5.2 Steps

5.2.1 Analog Communication

1. Connect a DA module

   To convert the digital output from the robot into analog quantities that the welder can receive, you need to connect a DA module. Inovance robots supports two connection methods:

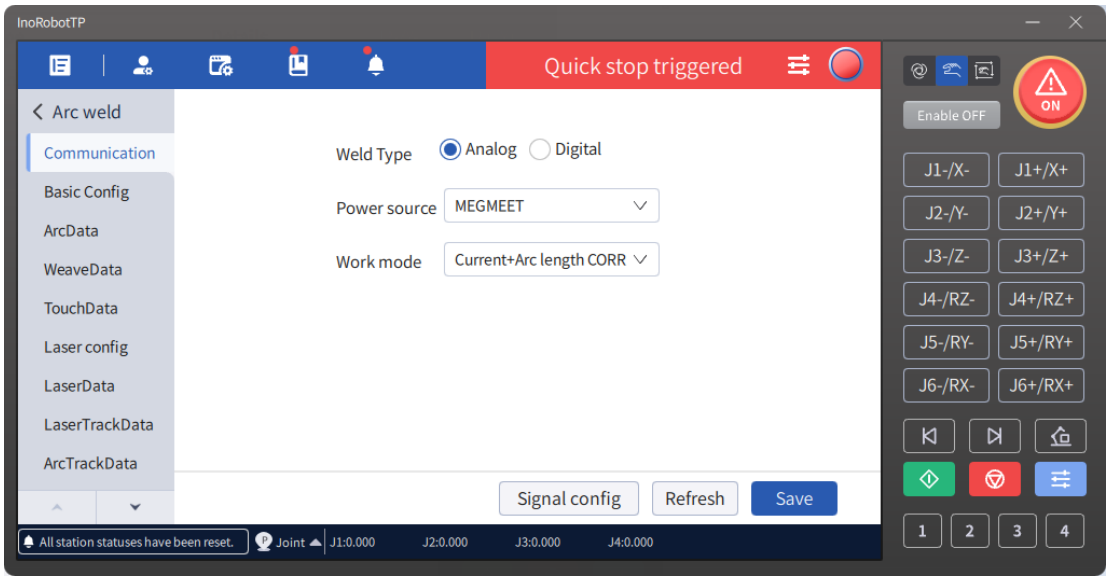
   a. EtherCAT bus

      Only supports configuration using InoRobotLab software. See the "Master Configuration" section in the "InoRobotLab Industrial Robot User Guide".

   b. IR-Link bus

      For the configuration using InoRobotLab software, see the "IR-Link Settings" section in the "InoRobotLab Industrial Robot User Guide"; For the configuration using the teach pendant, see the "IR-Link Settings" section in the "IR-TP200 Series Industrial Robot Teach Pendant User Guide".

2. Go to "Settings" > "More" > "Process Manager" > "Arc weld" > "Communication", and select "Analog" as the welding type.



3. Select the work mode.

The work mode must match the weld mode signal of the welder ("Signal config" > "Output signal" > "Weld mode"). The relationship is as follows:

Work mode	Weld mode
Current+Voltage	Separate
Current+Arc length CORR	Synergic
Wire speed+Volt	Separate
Wire speed+Arc LEN CORR	Synergic
Channel mode	JOB

4. Configure the welder signal.

For details, see 5.3 Welder Signal Configuration section.

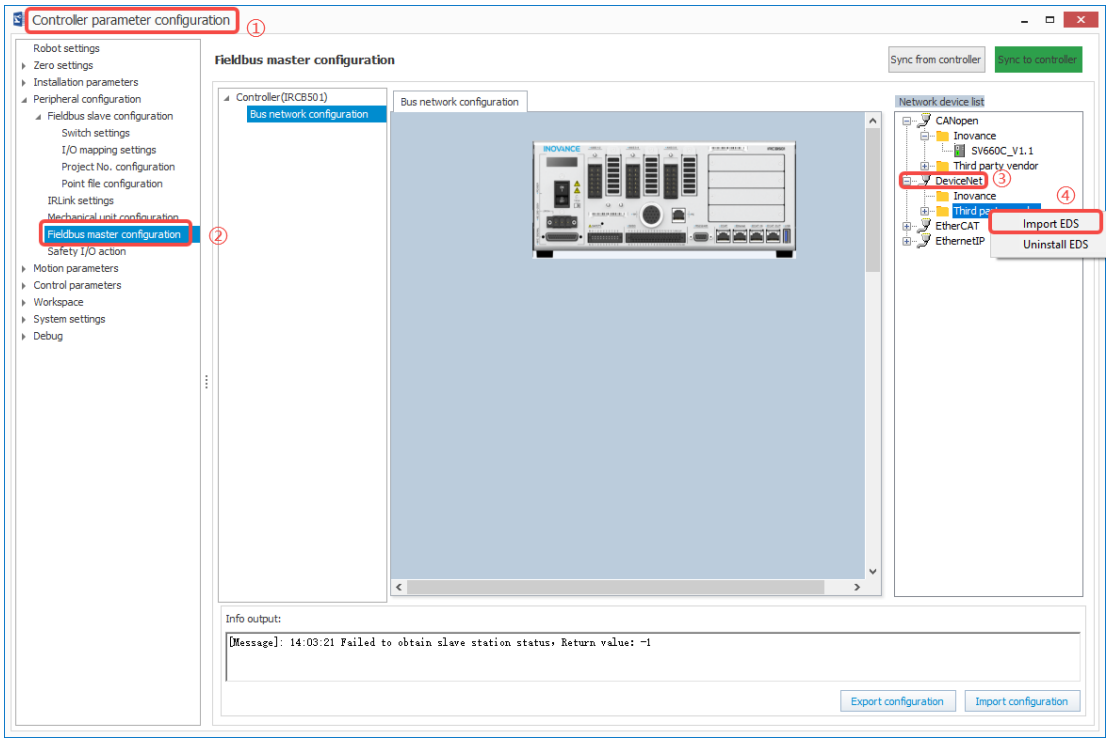
5.2.2 Digital Communication

Digital communication supports two configuration methods: "Non-forced configuration" and "Forced configuration".

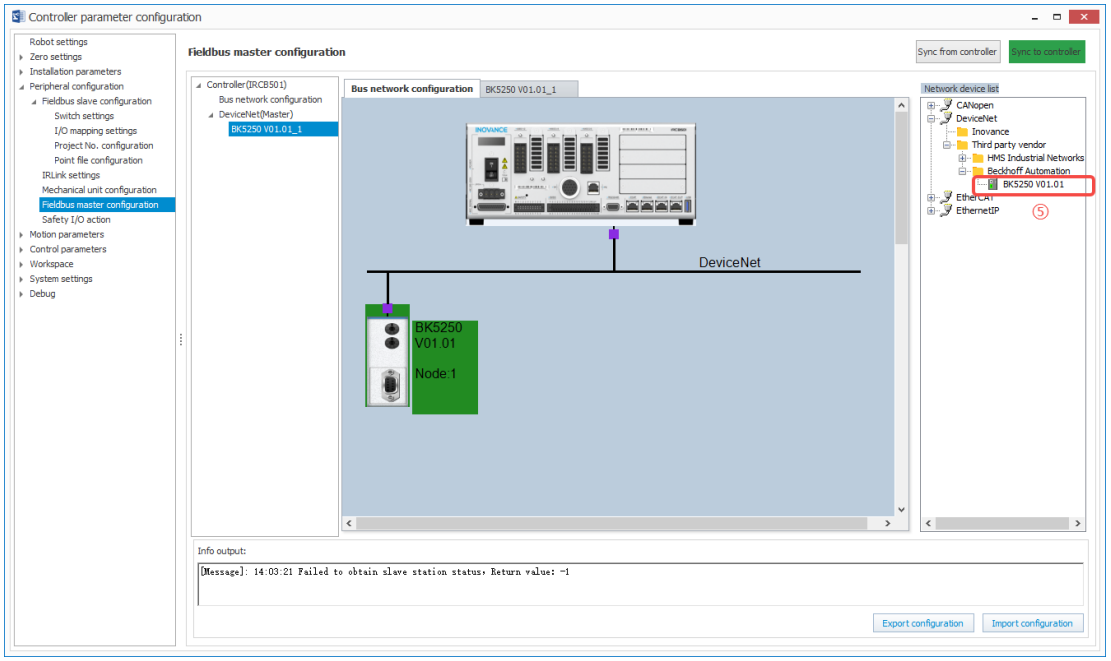
"Non-forced configuration" requires the PC-based software to implement the configuration of the welder bus, while "Forced configuration" can be completed on the teach pendant side alone, but only supports default welders, and after forced configuration, any existing bus configurations will be overwritten and need to be reconfigured.

1. Non-forced configuration method
   a. Configuration in PC-based software
      Configure the welder bus configuration in the PC-based software (original platform function). Using DeviceNet as an example, the specific steps are as follows:
      i. Double-click "Controller parameter configuration" in the device tree, select "Peripheral configuration" > "Fieldbus master configuration", right-click "DeviceNet" and select "Import EDS" to import the welder communication EDS file, or directly select the device under the "Third-party vendor".

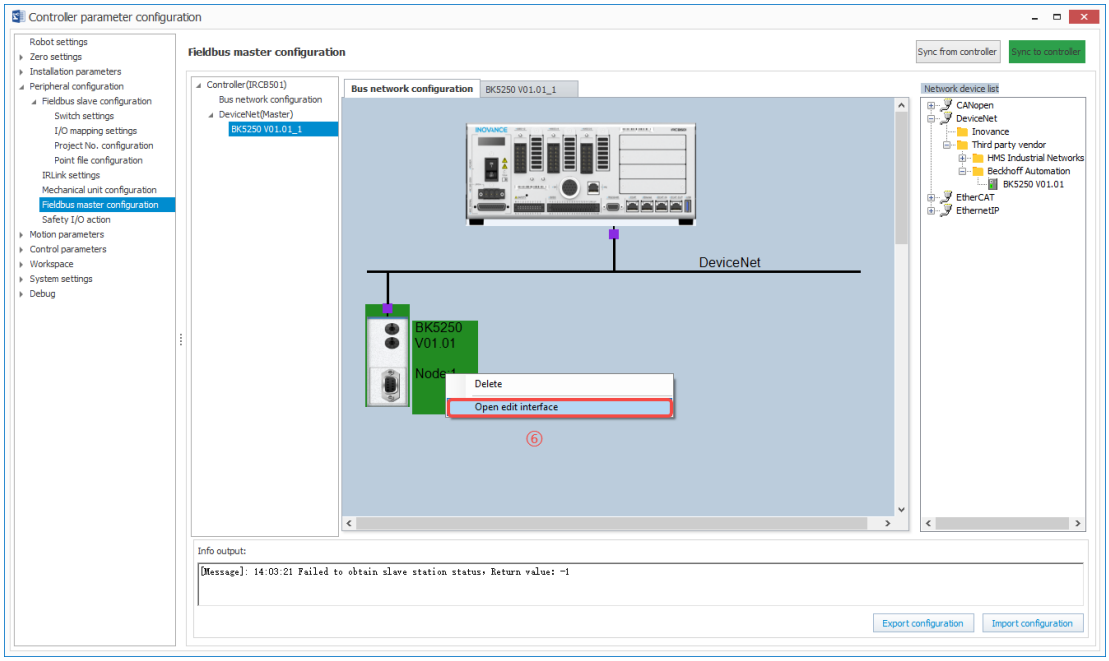
(In the PC-based software, the third-party vendor list already includes MEGMEET welder (Megmet)/ AOTAI welder (Aotai) under CANopen, and MEGMEET welder (Megmet), AOTAI welder (Aotai), ESAB (Esab), Fronius, Kaierda under DeviceNet, so there is no need to re-import the EDS files).

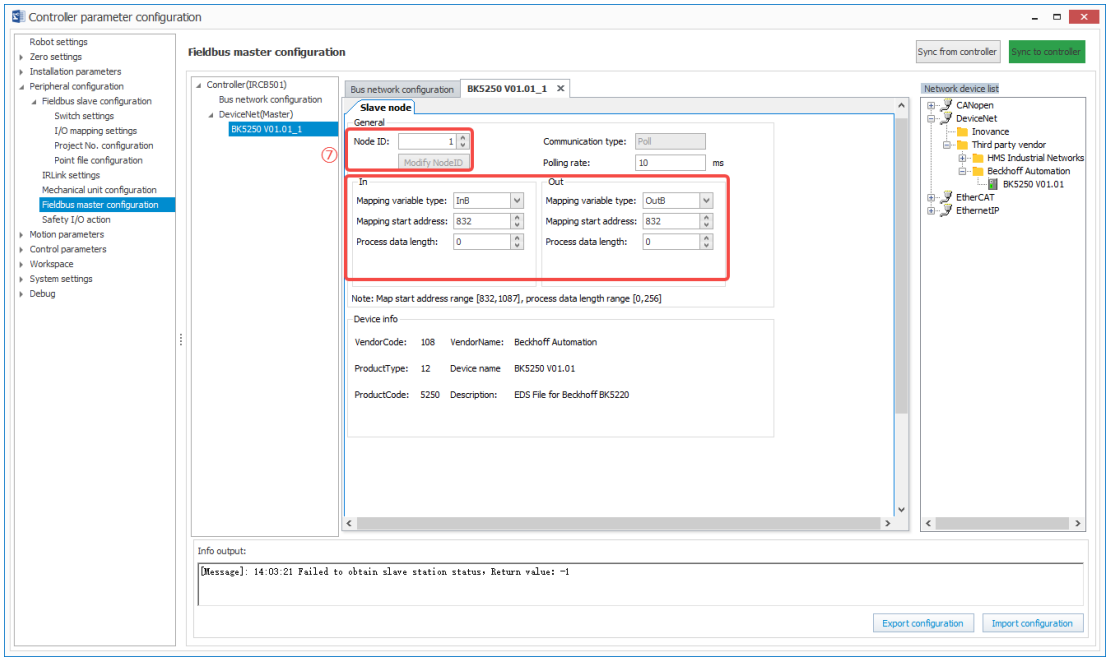


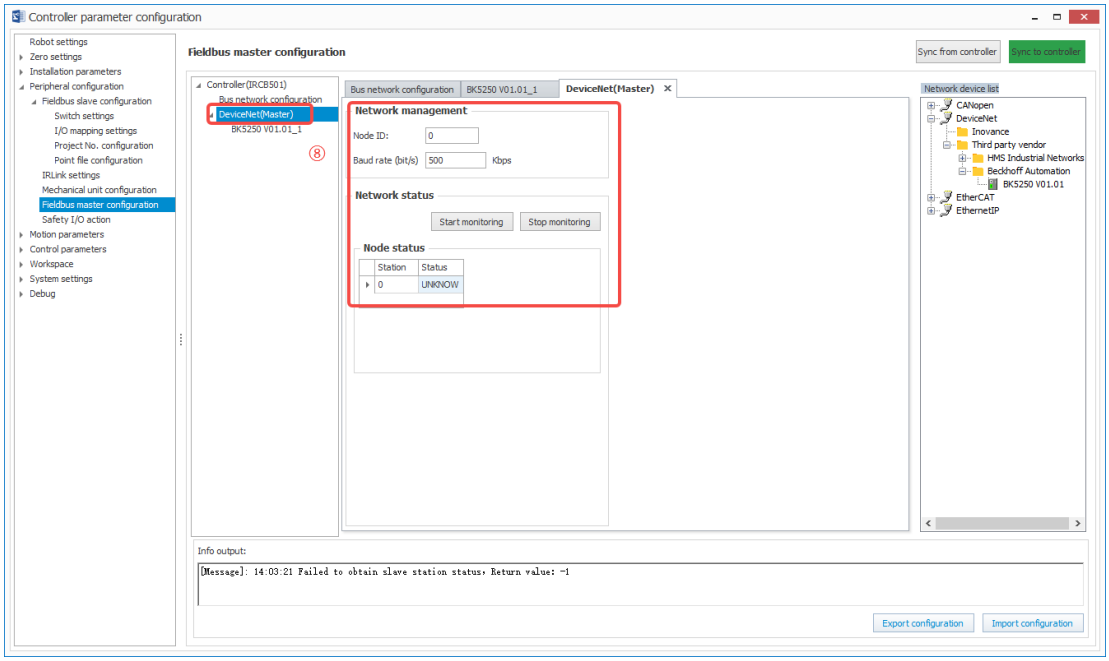
ii. Double-click the required device.



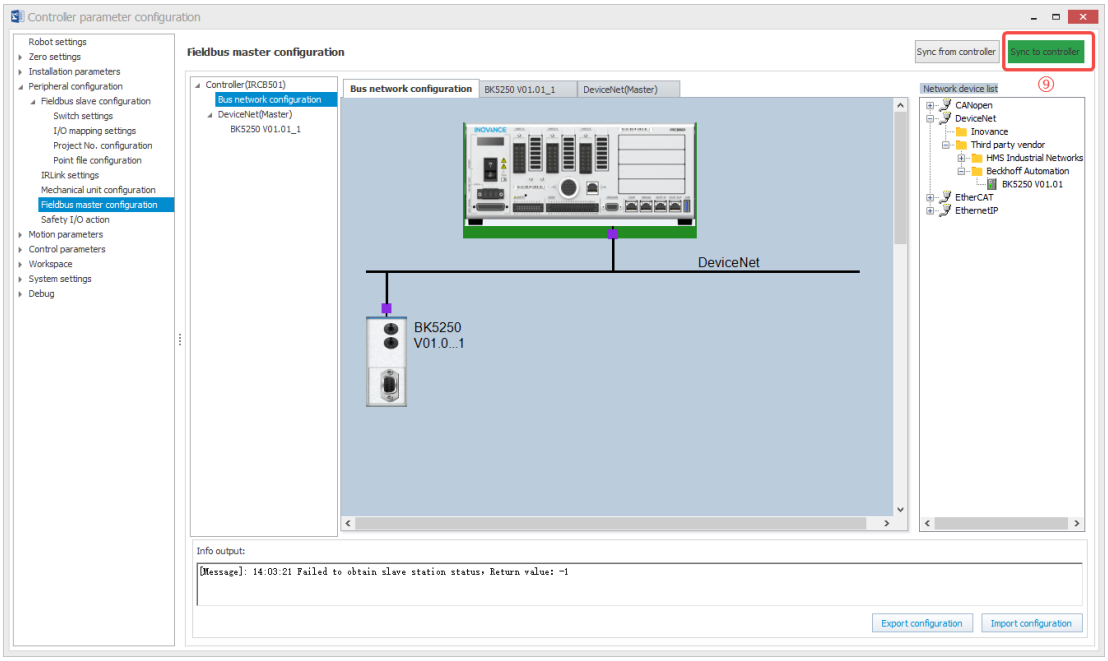
iii. Right-click the device and select "Open edit interface". Set the slave node ID, polling rate, mapping variable type, mapping start address, process data length, master node ID, and baud rate according to the device configuration.


Controller parameter configuration
Fieldbus master configuration
Sync from controller
Sync to controller
Bus network configuration
BK5250 V01.01_1
DeviceNet
BK5250
V01.01
Node 1
Delete
Open edit interface
⑥
Network device list
Info output:
[Message]: 14:03:21 Failed to obtain slave station status, Return value: -1
Export configuration
Import configuration


Controller parameter configuration
Fieldbus master configuration
Slave node
General
Node ID:
Modify NodeID
⑦
Communication type:
Polling rate:
ms
In
Out
Mapping variable type:
Mapping start address:
Process data length:
Note: Map start address range [832,1087], process data length range [0,256]
Device info
VendorCode: 108 VendorName: Beckhoff Automation
ProductType: 12 Device name BK5250 V01.01
ProductCode: 5250 Description: EDS File for Beckhoff BK5220
Info output:
[Message]: 14:03:21 Failed to obtain slave station status, Return value: -1
Export configuration
Import configuration


Controller parameter configuration
Fieldbus master configuration
DeviceNet(Master)
⑧
Network management
Node ID:
Baud rate (bit/s)
Kbps
Network status
Start monitoring
Stop monitoring
Node status
Station
Status
UNKNOW
Info output:
[Message]: 14:03:21 Failed to obtain slave station status, Return value: -1
Export configuration
Import configuration

iv. Click the "Sync to controller" button to synchronize the configuration to the controller.

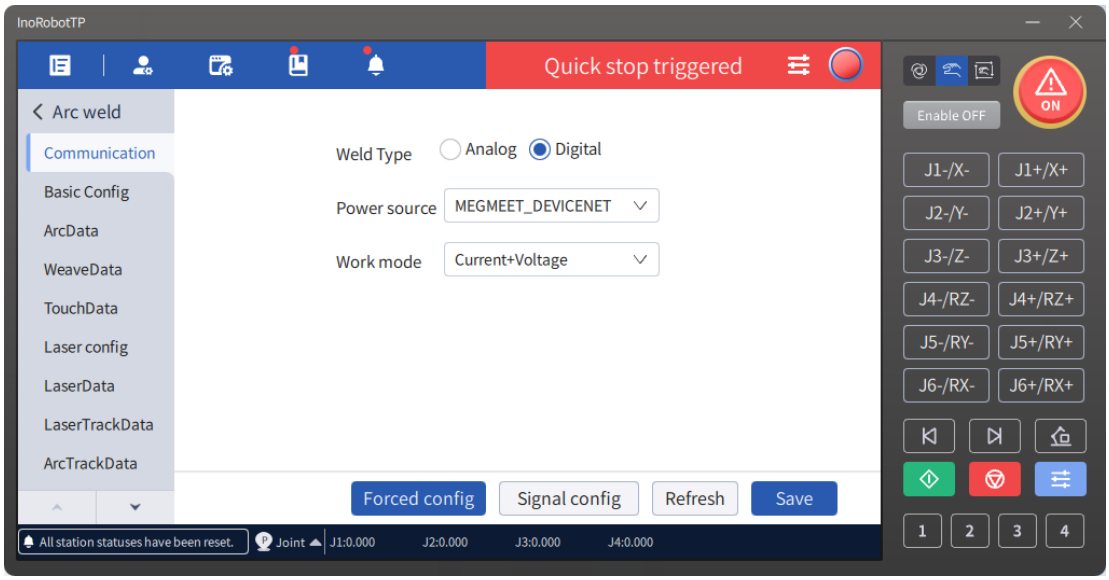


b. Configuration on plugin side

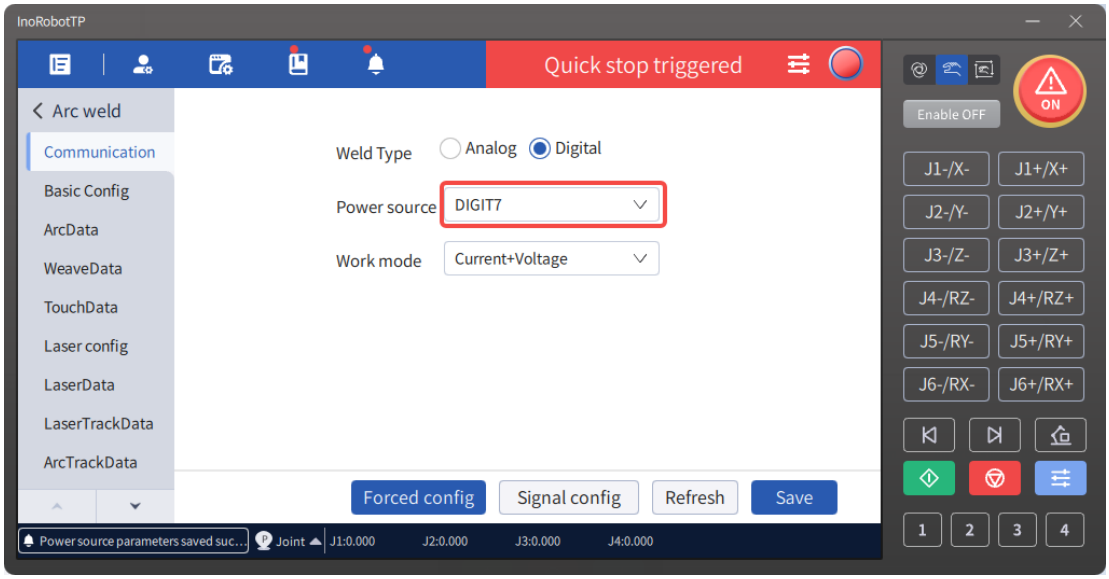
The specific steps are as follows:

i. Go to "Settings" > "More" > "Process Manager" > "Arc weld" > "Communication", select "Analog" as the welding type, and select the required power source.

The following default welding power sources are currently supported: MEGMEET_CANOPEN, AOTAI_CANOPEN, MEGMEET_DEVICENET, AOTAI_DEVICENET, ESAB_DEVICENET, FRONIUS_DEVICENET, KAIERDA_DEVICENET. If the default welding power source configured in the PC-based software is one of the above, select the corresponding default welding power source for "Power source".

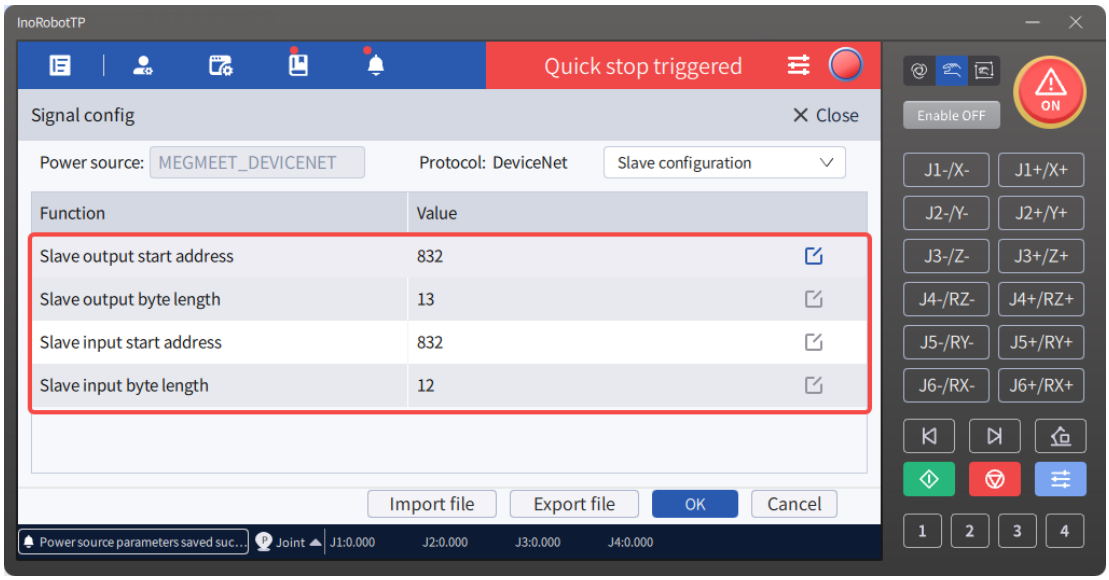


If the welding power source is not configured as the default in the PC-based software, "Power source" needs to be selected as "DIGT6" or "DIGT7".



ii. Configure through "Signal config"

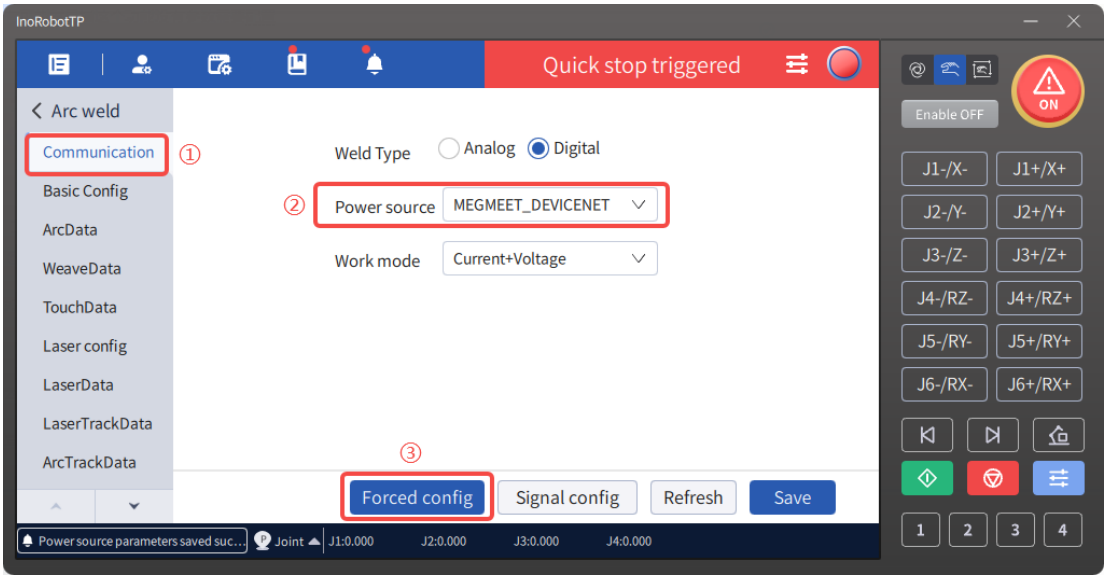
If the default welding power source is used, "Input signal", "Output signal", and "Segmented curve settings" in the "Signal config" do not need to be configured, but the parameters in "Slave configuration" must correspond one-to-one with the configuration on the PC side.



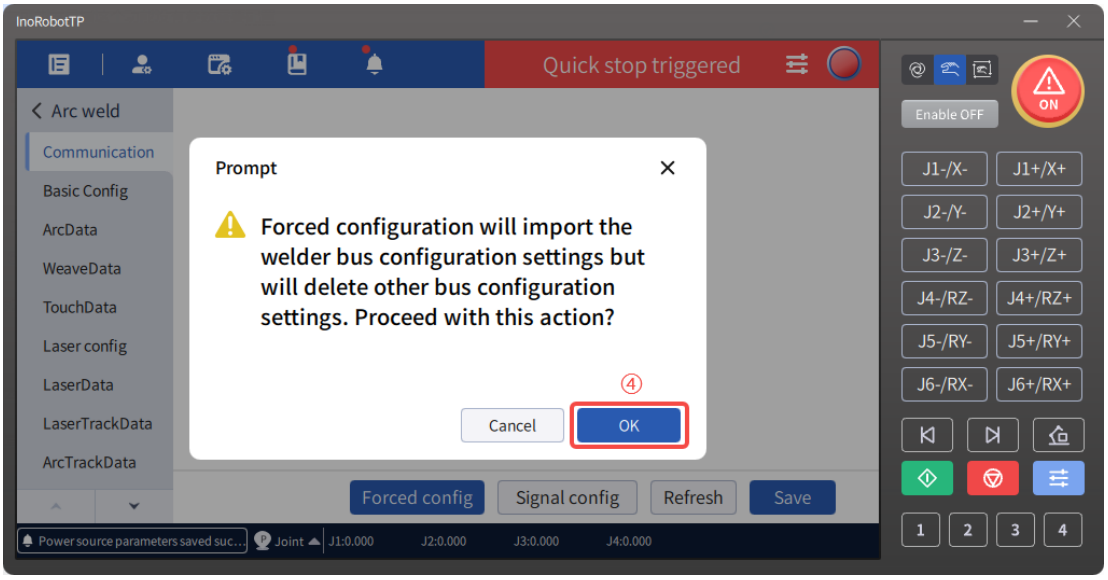
If a non-default power source is used, see the 4.3 Setting the Welder Communication section for configuring the "Input signal", "Output signal", and "Segmented curve settings" in the welding signals. The parameters in "Slave Configuration" must correspond one-to-one with the configuration on the PC side.

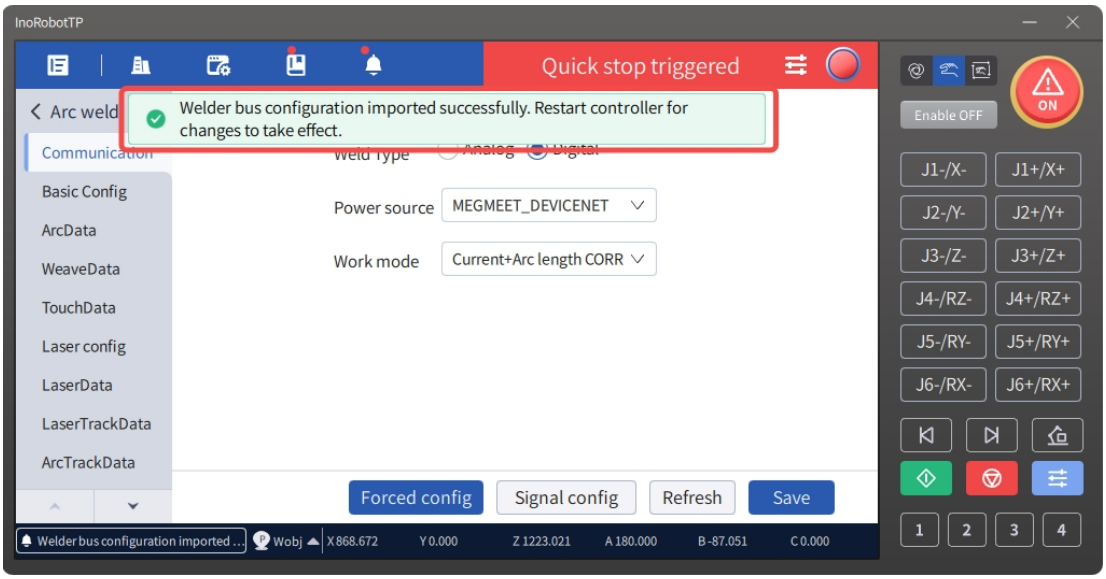
2. Forced configuration method

a. Go to "Settings" > "More" > "Process Manager" > "Arc weld" > "Communication", select "Analog" as the welding type, and select the required power source.



b. In the emergency stop state, click the "Forced config" button and click the "OK" button in the pop-up prompt box to confirm the operation. A message will prompt that the configuration has been successfully imported and the controller will restart.



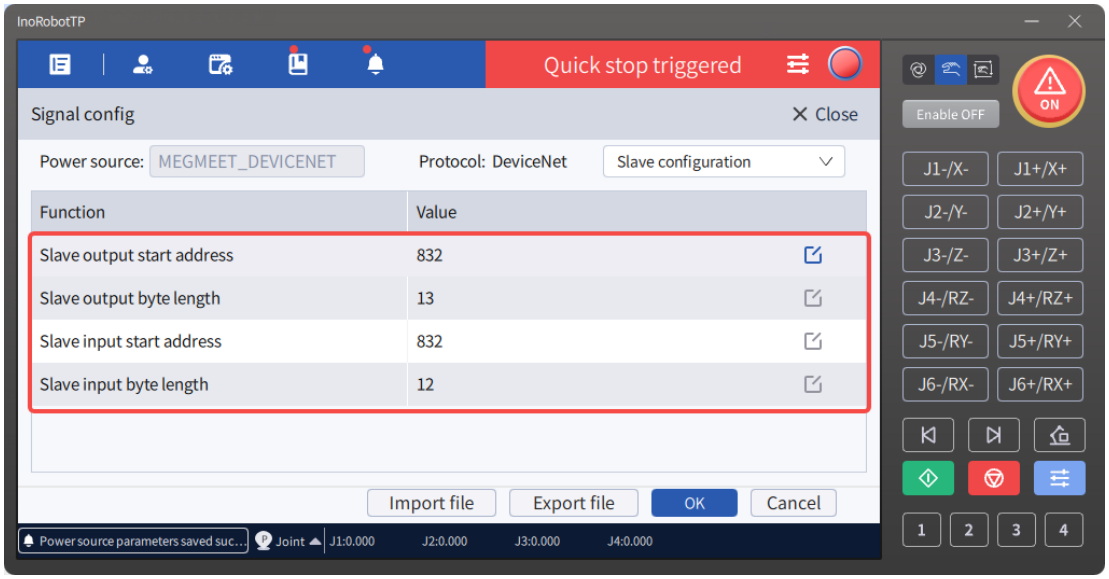


When using forced configuration, the same ID and baud rate must be set on the welder side. The default configuration information for the welder is as follows.

Power source	ID	Baud rate (Kbps)	Input start address	Input byte length	Output start address	Output byte length
MEGMEET_CANOPEN	9	500	832	8	832	8
AOTAI_CANOPEN	9	500	832	12	832	12
MEGMEET_DEVICENET	9	500	832	12	832	13
AOTAI_DEVICENET	9	500	832	12	832	13
FRONIUS_DEVICENET	9	500	832	12	832	13
ESAB_DEVICENET	3	500	832	12	832	13

c. Configure through "Signal config"

If the default welding power source is used, "Input signal", "Output signal", "Segmented curve settings", and "Slave configuration" in the "Signal config" do not need to be configured.



3. Select the work mode

The work mode must match the weld mode signal of the welder ("Signal config" > "Output signal" > "Weld mode"). The relationship is as follows:

Work mode	Weld mode
Current+Voltage	Separate
Current+Arc length CORR	Synergic
Wire speed+Volt	Separate
Wire speed+Arc LEN CORR	Synergic
Channel mode	JOB

5.3 Welder Signal Configuration

1. Input signal

Function	Description
Arc success	This signal indicates the successful establishment of the welding arc. Active signal (ON) indicates welding is in progress; inactive signal (OFF) indicates the arc is extinguished. This signal must be configured when enabling the "Arc break" or "Arc start success" functions.
Wire stick	This signal becomes active (ON) when wire sticking occurs during welding. When the "Wirestick" function is enabled, activation (ON) of this signal during arc extinguishing triggers the "Wirestick reset" function.
Error	This signal becomes active (ON) when an error occurs in the welder.
Fault	This signal becomes active (ON) when a fault occurs in the welder. If the reading from the welder differs from the initial value, a "Welder fault" alarm will be triggered. The polarity of this signal varies for different welders. For example, with MEGMEET welders, when a fault occurs on the ArcsenII model, the welder reads 0; on the Plus model, the welder reads 1.
Dry joint detect	This signal becomes active (ON) when a dry joint occurs during welding.
Torch contact	This signal becomes active (ON) when the welding torch contacts the workobject. This signal must be configured when enabling the "Touch sensing" function.
Feedback voltage	This signal indicates the actual voltage value during welding.
Feedback current	This signal indicates the actual current value during welding.
FB wire speed	This signal indicates the actual value of wire feed speed during welding.
Coolant shortage	This signal becomes active (ON) when a fault occurs in the cooling device during welding.
Gas shortage	This signal becomes active (ON) when the gas runs out during welding. When the "Gas shortage" function is enabled, the activation of this signal will trigger an alarm.
Wire shortage	This signal becomes active (ON) when the welding wire runs out during welding. When the "Wire shortage" function is enabled, the activation of this signal will trigger an alarm.
Welder ready	This signal is emitted by the welder after the welder initialization and other preparatory work, indicating that the equipment has entered an operable state.
Welder heartbeat signal	This signal is periodically generated by the welder. If this signal value does not change within a certain time (i.e., loss of heartbeat), an alarm will be triggered.

2. Output signal

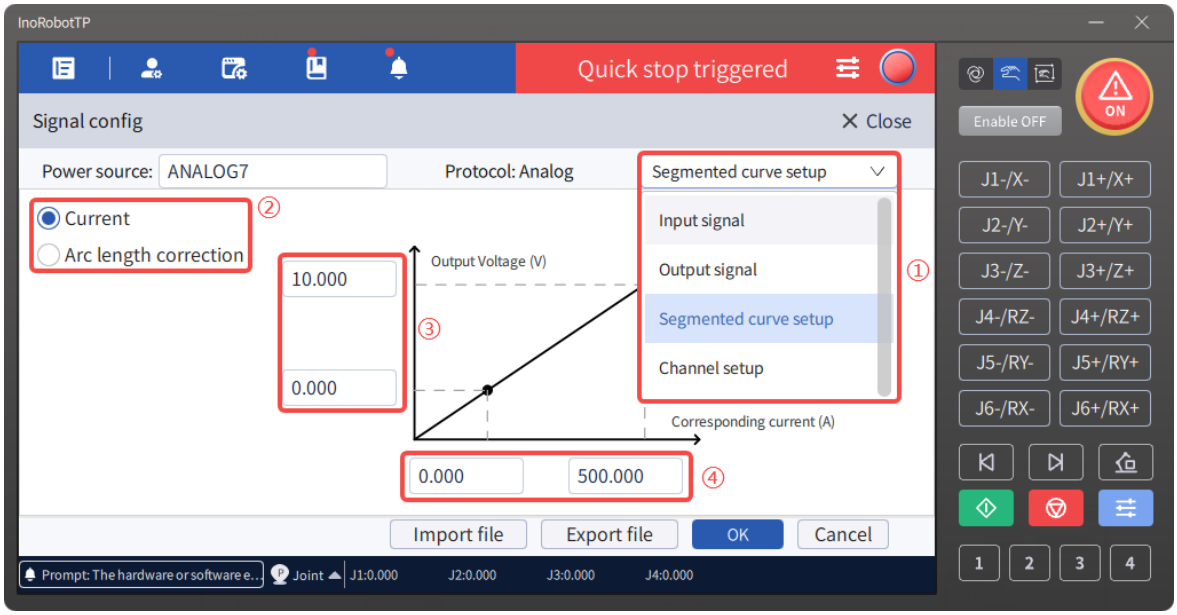
Function	Description
Memory channel	Set the channel number that the welder is to use currently.
Weld Expert No.	Set the welding expert specification number that the welder is to use currently.
Wire speed	Set the wire feed speed that the welder is to output currently. See "Segmented curve settings" for actual output values.
Wire feed	This signal becomes active (ON) to control wire feeding from the welder.
Wire retract	This signal becomes active (ON) to control wire retracting from the welder.
Wirestick alarm	The switch for the wire stick detection function. When this function is enabled, the "Wire stick" signal is output only when wire sticking occurs on the welder.
Gas check	This signal becomes active (ON) to control gas delivery from the welder.
Start welding	This signal becomes active (ON) to control arc generation from the welder, starting the welding operation.
Weld voltage	Set the voltage that the welder is to output currently. See "Segmented curve settings" for actual output values.
Weld current	Set the current that the welder is to output currently. See "Segmented curve settings" for actual output values.
Synergic/Separate	Set the welder to Synergic/Separate mode.
Robot ready	Based on this signal, the welder determines whether welding is allowed to start. When the robot is not ready, welding will not start even if the "Start welding" signal is active (ON).
Touch sensing	The switch for welder contact sensing function. When this function is enabled, the "Torch contact" signal is output only when the welder contacts the workobject.
Burnback	Set the welding burnback time.
Welder fault reset	This signal becomes active (ON) to clear the welder alarm.
Robot heartbeat signal	This signal becomes active (ON) to output the heartbeat value to the welder, to be used in conjunction with the "Weld heartbeat" signal.
Weld mode	Set the work mode of the welder.

3. Segmented curve settings

It is used to set the matching curves for current, voltage, wire feed speed, and arc length correction.

- When the work mode is selected as "Channel mode", the "Segmented curve settings" is not displayed in area ① of the figure below.
- The options in area ② depend on the work mode.
- The values in area ③ indicate the actual output values, which must increase sequentially along the direction of the coordinate values.

◦ The values in area ④ indicate the command value, which must increase sequentially along the direction of the coordinate values.



5. Channel setup (analog communication)

   It is used to set the channels for welding current and voltage.

6. Slave configuration

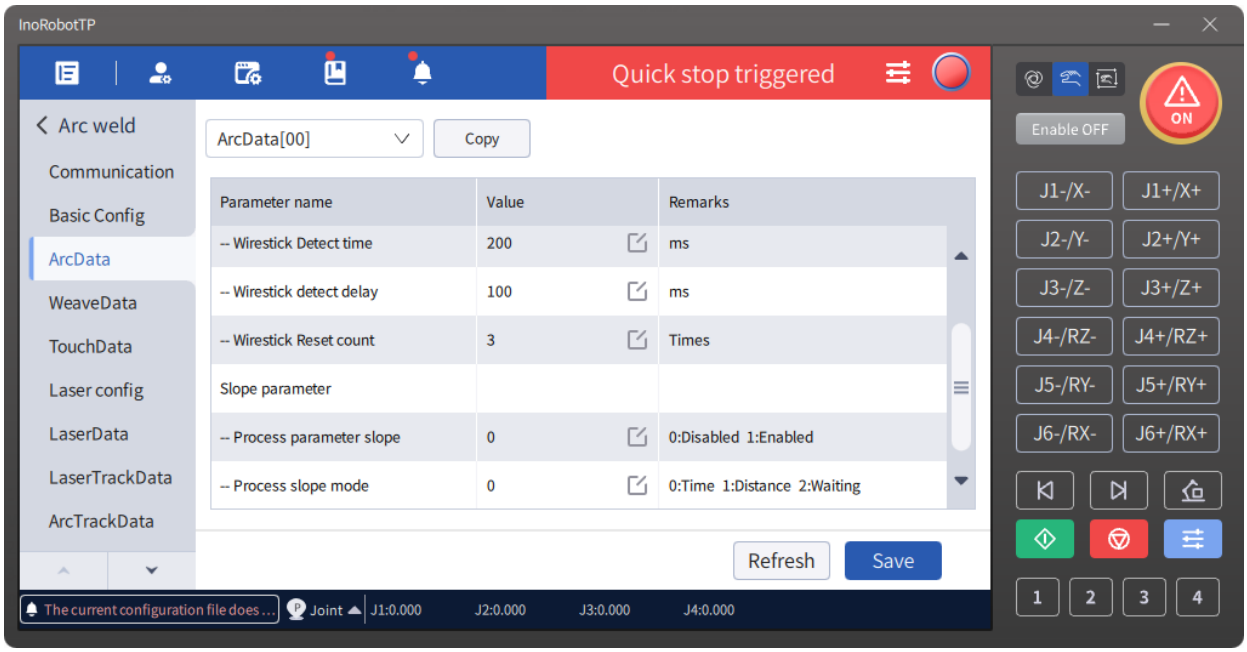
   It is used to set the start address and byte length of the welding power source as a slave.

6 ArcData

6.1 Overview

ArcData is used to set the parameters for arc start, welding process, and arc end during arc welding.

6.2 Parameter Description



Parameter name		Description	Range	Unit
Arc start param	Job No.	The JOB number called on the welder side during arc start.	0 to 255	-
	Current/ Wire speed	The current/wire speed during arc start.	0.0 to 500.0	A/m/min
	Volt/Arc correction	The voltage/arc length correction value during arc start.	-100.0 to +100.0	V
	Wait time	The time the robot waits at the same position after successful arc start before it starts moving.	0 to 10000	ms
	Pre-flow time	The time during which gas flows before reaching the welding arc start point.	0 to 10000	ms

Parameter name		Description	Range	Unit
	Detection time	The time for detecting whether arc start is successful. If the feedback signal of arc start success is not received from the welder within this time, arc start is considered to have failed.	0 to 10000	ms
Process param	Job No.	The JOB number called on the welder side during welding.	0 to 255	-
	Current/ Wire speed	The current/wire speed during welding.	0.0 to 500.0	A/m/min
	Volt/Arc correction	The voltage/arc length correction value during welding.	-100.0 to +100.0	V
	Weld speed	The robot's running speed during welding.	0.0 to 99999.0	mm/s
Arc end param	Job No.	The JOB number called on the welder side during arc end.	0 to 255	-
	Current/ Wire speed	The current/wire speed during arc end.	0.0 to 500.0	A/m/min
	Volt/Arc correction	The voltage/arc length correction during arc end.	-100.0 to +100.0	V
	Arc end pre-time	The time the robot waits at the same position after reaching the arc end point before arc extinction.	0 to 10000	ms
	Post-flow	The time for continued gas delivery after arc extinction.	0 to 10000	ms
	Wire rewind	The time for the welder to retract the wire after arc extinction.	0 to 10000	ms

Parameter name		Description	Range	Unit
	Burnback	The time for the welder to perform burnback after arc extinction.	0 to 10000	ms
	Wirestick reset time	The time to release wire sticking after each arc extinction.	0 to 10000	ms
	Wirestick detect time	The time for wire sticking detection after arc extinction. If the wire sticking signal is received from the welder within this time, it is determined as a sticking condition.	0 to 10000	ms
	Wirestick detect delay	The time for the welder to wait for a delay after arc extinction before performing sticking detection.	0 to 10000	ms
	Wirestick reset count	The number of times to clear the wire sticking condition.	0 to 10	-
Slope parameter	For details, see the 9.7 Welding Condition Slope Specification section.			

6.3 Permission Allocation

Control permission		Operation mode			Authority			
Teach pendant	Other control permissions	Manual low speed mode	Manual high speed mode	Auto mode	User mode	Edit mode	Admin	Manufacturer
√	×	√	×	×	×	×	√	√

6.4 Notes

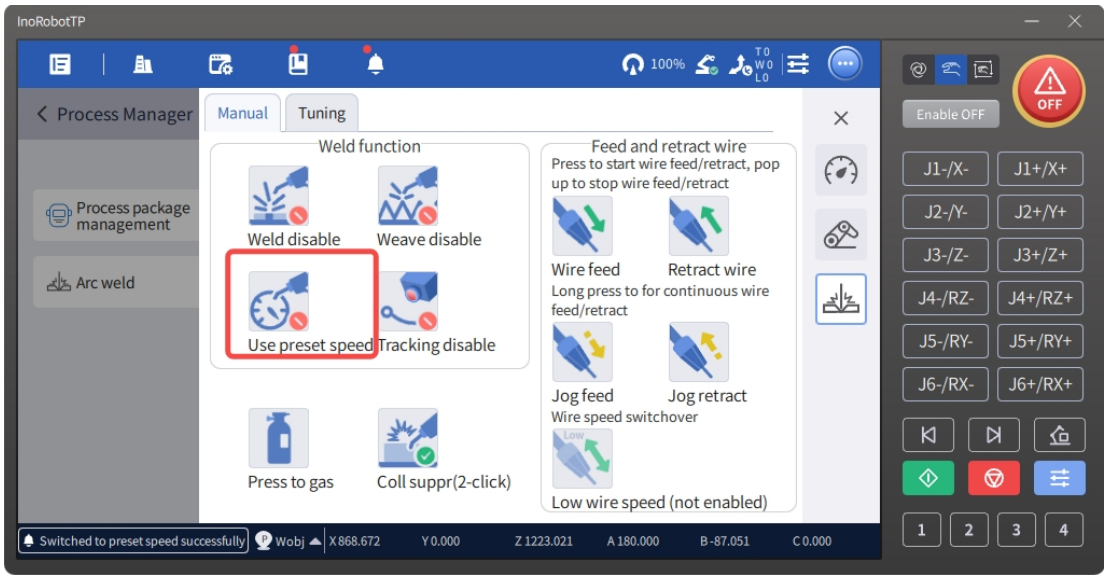
Regarding welding speed, there are two speeds present in the welding instructions: the preset speed in the instruction parameters (V or Speed) and the welding speed in ArcData.

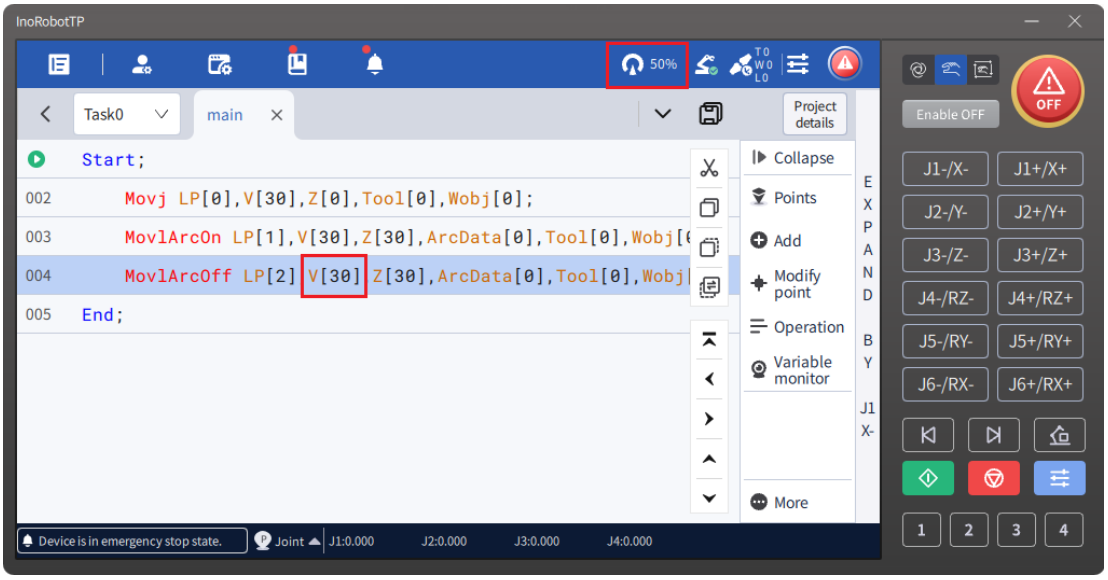
The arc-on instruction MovlArcOn uses the speed specified by the V or Speed parameter in the instruction. The non-arc-on instructions MovlArc, MovcArc, MovlArcOff, and MovcArcOff determine which speed to use based on the status of the welding speed switch button. See the following for details.

1. Use preset speed

   a. When the button status is set to "Use preset speed", if the setting of the instruction parameter V is used, the actual robot running speed is:

   Actual running speed = Set maximum speed × Global speed percentage × Percentage set by instruction parameter V

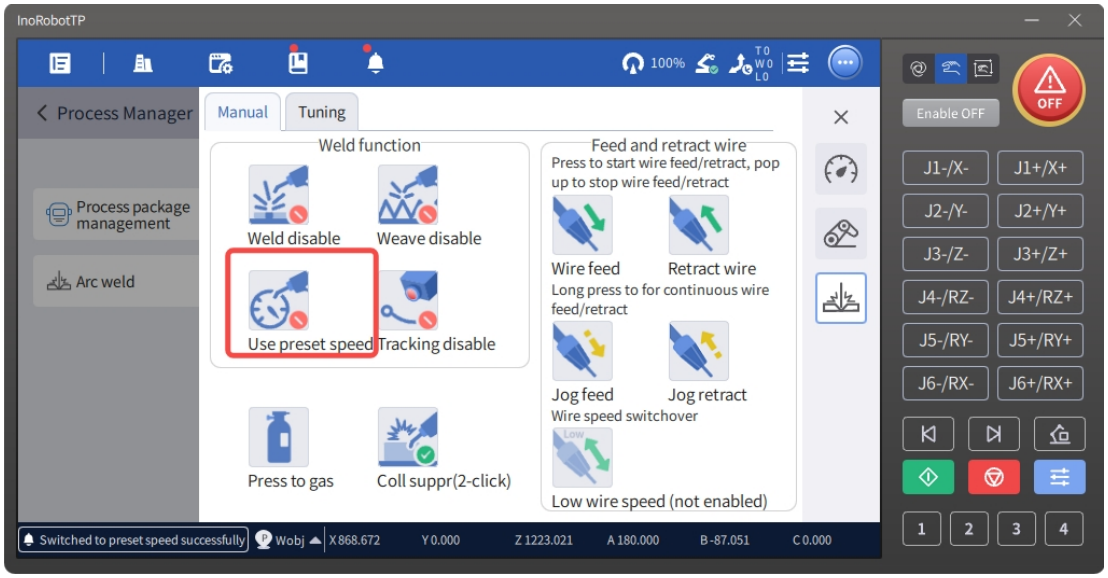


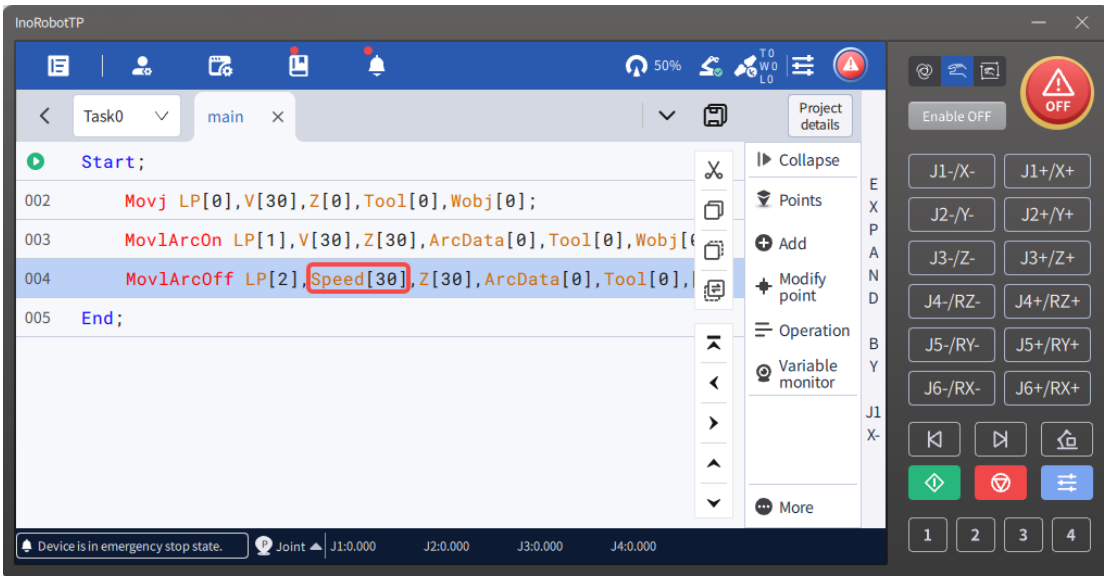


   b. When the button status is set to "Use preset speed", if the setting of the instruction parameter Speed is used, the actual robot running speed is:

   Actual running speed = Value in Speed (mm/s) × Global speed percentage

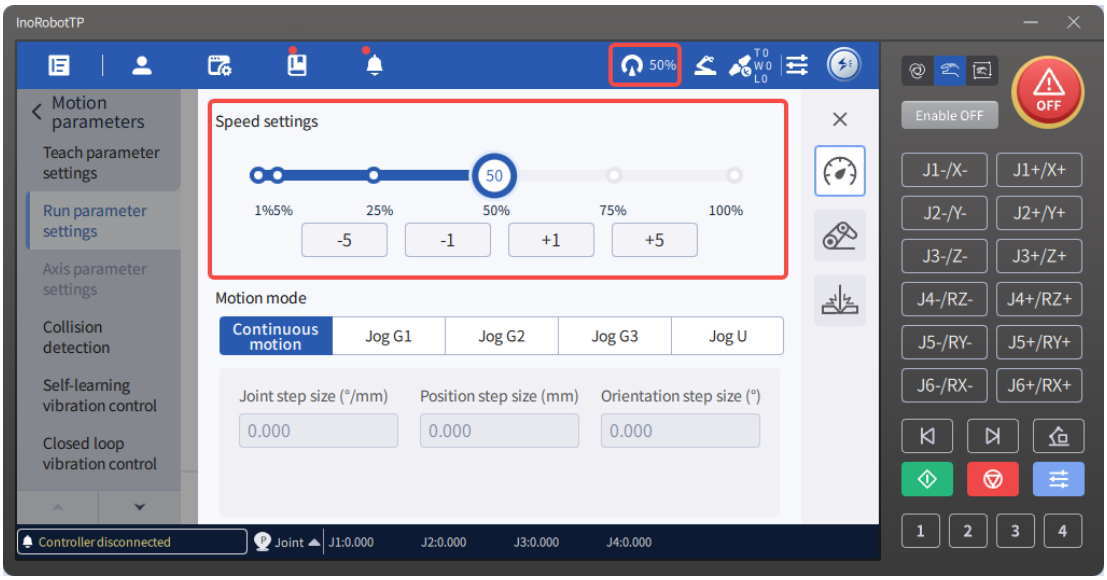
   (For more detailed usage of Speed, see the "Speed" section under "System Parameter-Related Instructions" in "Industrial Robot Instruction Guide").


InoRobotTP
Process Manager
Manual
Tuning
Process package management
Arc weld
Weld function
Weld disable
Weave disable
Use preset speed
Tracking disable
Press to gas
Coll suppr(2-click)
Feed and retract wire
Press to start wire feed/retract, pop up to stop wire feed/retract
Wire feed
Retract wire
Long press to for continuous wire feed/retract
Jog feed
Jog retract
Wire speed switchover
Low wire speed (not enabled)
Enable OFF
OFF
J1-/X-
J1+/X+
J2-/Y-
J2+/Y+
J3-/Z-
J3+/Z+
J4-/RZ-
J4+/RZ+
J5-/RY-
J5+/RY+
J6-/RX-
J6+/RX+
1
2
3
4
Switched to preset speed successfully
Wobj
X 868.672
Y 0.000
Z 1223.021
A 180.000
B -87.051
C 0.000


InoRobotTP
Task0
main
Project details
Start;
002 Movj LP[0],V[30],Z[0],Tool[0],Wobj[0];
003 MovlArcOn LP[1],V[30],Z[30],ArcData[0],Tool[0],Wobj[
004 MovlArcOff LP[2],Speed[30],Z[30],ArcData[0],Tool[0],
005 End;
Collapse
Points
Add
Modify point
Operation
Variable monitor
More
EXPAND
Enable OFF
OFF
J1-/X-
J1+/X+
J2-/Y-
J2+/Y+
J3-/Z-
J3+/Z+
J4-/RZ-
J4+/RZ+
J5-/RY-
J5+/RY+
J6-/RX-
J6+/RX+
1
2
3
4
Device is in emergency stop state.
Joint
J1:0.000
J2:0.000
J3:0.000
J4:0.000

CAUTION

- The set maximum speed can be configured in "Settings" > "More" > "Motion parameters" > "Run parameter settings" > "Running speed".
- The global speed percentage refers to the speed percentage set in the toolbar.

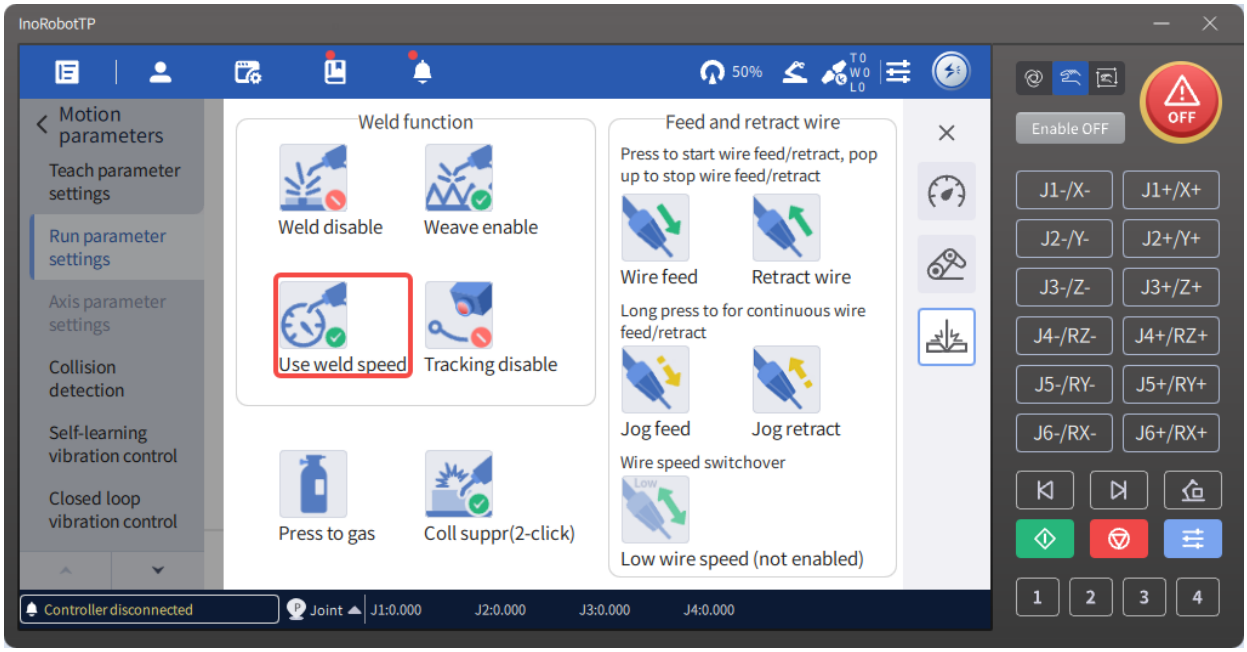


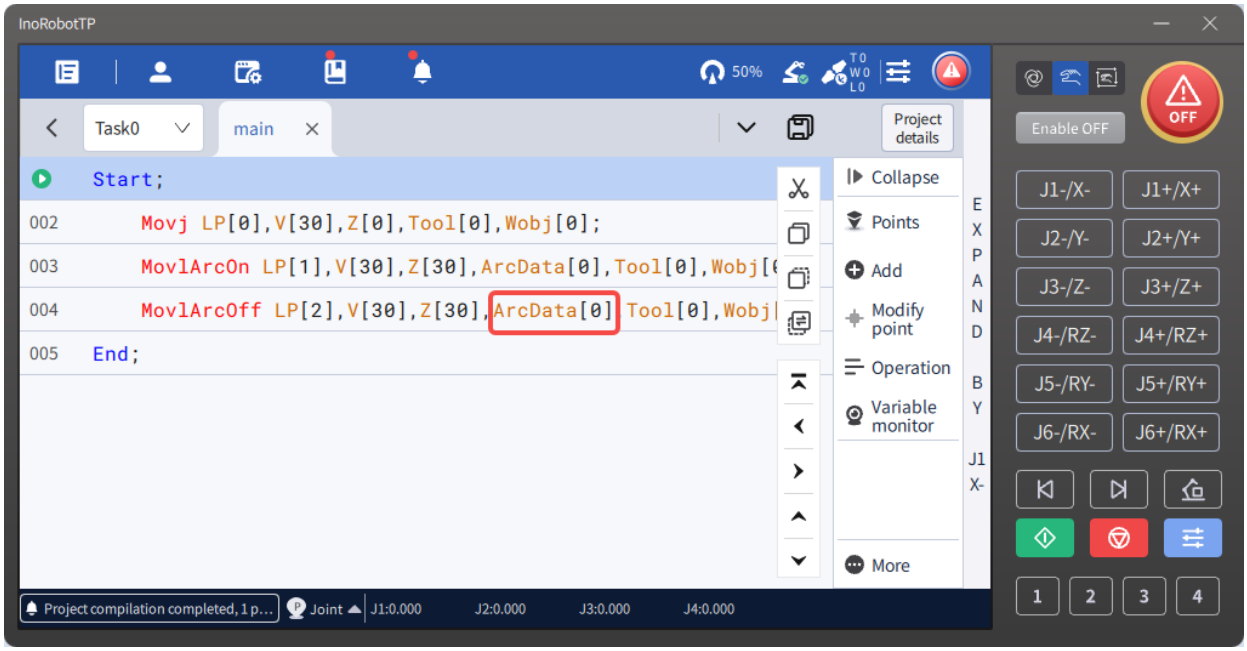
- For the percentage in the instruction parameter V, you can modify the percentage directly within the instruction.
- When the speed parameter in the instruction is "V", in the manual mode of the program, the speed for both stepwise running and continuous running is 50% of the actual running speed.

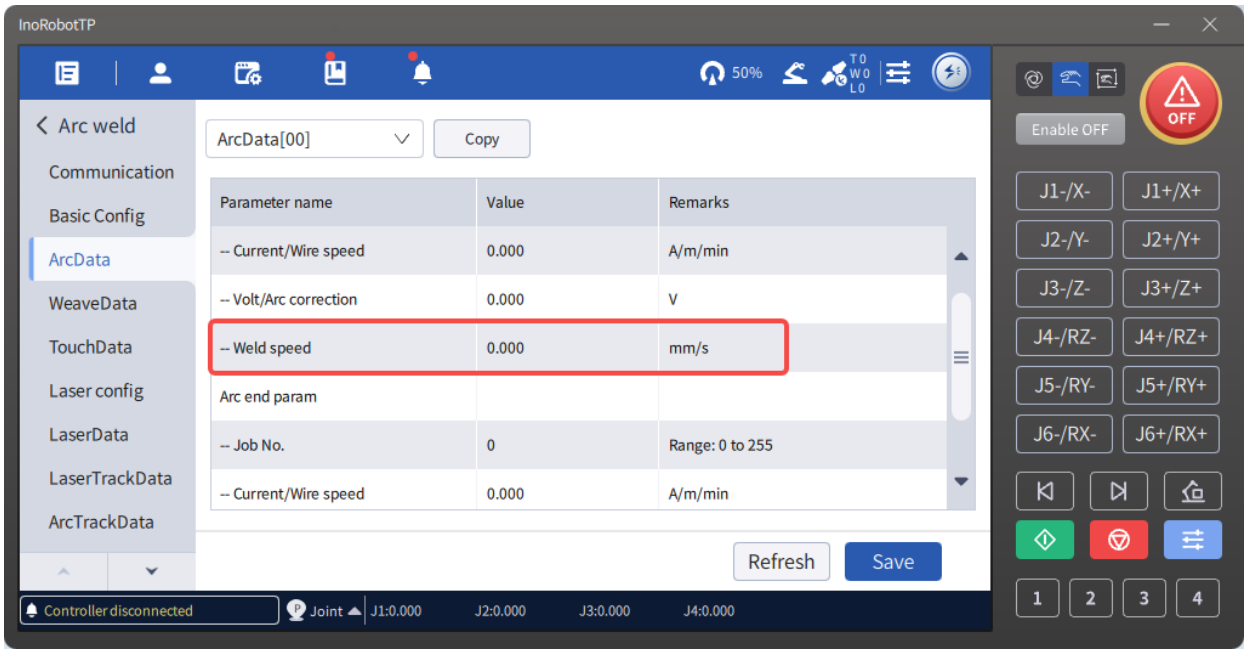
2. Use weld speed

When the button status is "Use weld speed", the welding speed in the ArcData of the instruction is used, and the actual robot running speed is:

Actual running speed = Welding speed set in the ArcData of the instruction







CAUTION

- The welding speed set in the ArcData of the instruction can be configured in "Settings" > "More" > "Process Manager" > "Arc weld" > "ArcData".
- The actual running speed is limited by the maximum speed configured in "Settings" > "More" > "Motion parameters" > "Run parameter settings" > "Running speed". If the set welding speed exceeds the maximum speed, the robot will run at the set maximum speed. If the set welding speed is less than the maximum speed, the robot will run at the set welding speed.

6.5 Programming Examples

The new version instructions and the old version instructions cannot coexist in the same .pro file.

6.5.1 New Version Instructions

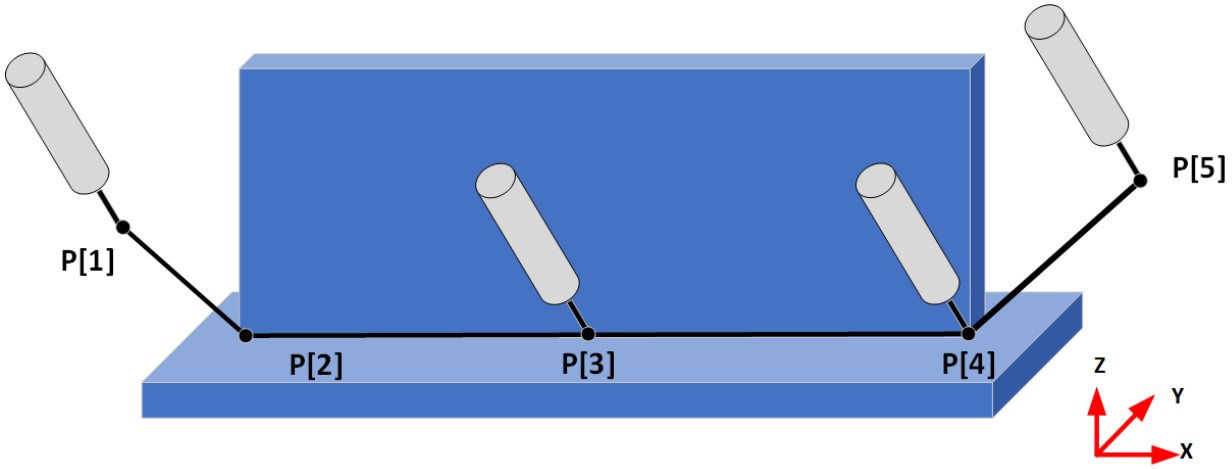


Table6-5-1-1 WeldOn, WeldSet and WeldOff without optional parameters

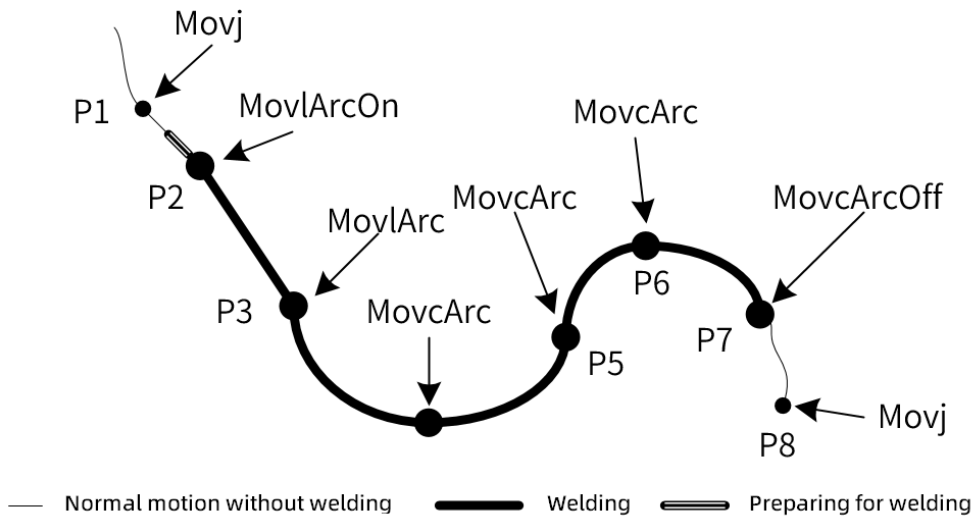
No.	Program	Comment
1	Start;	Start
2	Movl P[1],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[1].
3	Movl P[2],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the arc start point P[2].
4	WeldOn ArcData[1];	Start arc, and use welding parameters from ArcData[1].
5	Movl P[3],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the first welding point P[3].
6	WeldSet ArcData[2];	Change the welding parameters using the settings in ArcData[2]. The changes take effect when moving to the next point.
7	Movl P[4],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the arc-off point P[4].
8	WeldOff ArcData[1];	Extinguish arc, and use the welding parameters from ArcData[1].
9	Movl P[5],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[5].
10	End;	End

Table6-5-1-2 WeldOn, WeldSet and WeldOff with optional parameters

No.	Program	Comment
1	Start;	Start
2	Movl P[1],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[1].
3	Movl P[2],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the arc start point P[2].
4	WeldOn ArcData[1], AC[120],AV[0],WS[8];	Start arc, and use the welding parameters from ArcData[1]. Since optional parameters are included, the current, voltage/arc length correction, and welding speed during welding use the index values of AC, AV, and WS.
5	Movl P[3],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the first welding point P[3].

No.	Program	Comment
6	WeldSet ArcData[2], AC[140],AV[0],WS[8];	Change the welding parameters using the settings in ArcData[2]. The changes take effect when moving to the next point. Since optional parameters are included, the current, voltage/arc length correction, and welding speed during welding use the index values of AC, AV, and WS.
7	Movl P[4],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the arc-off point P[4].
8	WeldOff ArcData[1], AC[140],AV[0];	Extinguish arc, and use the welding parameters from ArcData[1]. Since optional parameters are included, the extinguishing current, voltage/arc length correction use the index values of AC and AV.
9	Movl P[5],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[5].
10	End;	End

6.5.2 Old Version Instructions



Start;

Movj P[1],V[30],Z[0],Tool[0],Wobj[0];

MovlArcOn P[2], V[30], Z[0], ArcData[0], Tool[0], Wobj[0];//Start arc at point P2

MovlArc P[3],V[30],Z[0],ArcData[0],Tool[0],Wobj[0];

MovcArc P[4], V[30], Z[0], ArcData[0], Tool[0], Wobj[0]; //Run the first segment of the first circular arc.

MovcArc P[5], V[30], Z[0], ArcData[0], Tool[0], Wobj[0]; //Run the first segment of the second circular arc.

MovcArc P[6], V[30], Z[0], ArcData[0], Tool[0], Wobj[0]; //Run the first segment of the second circular arc.

MovcArcOff P[7], V[30], Z[0], ArcData[0], Tool[0], Wobj[0]; //Run the second segment of the second circular arc, and extinguish arc at point P7.

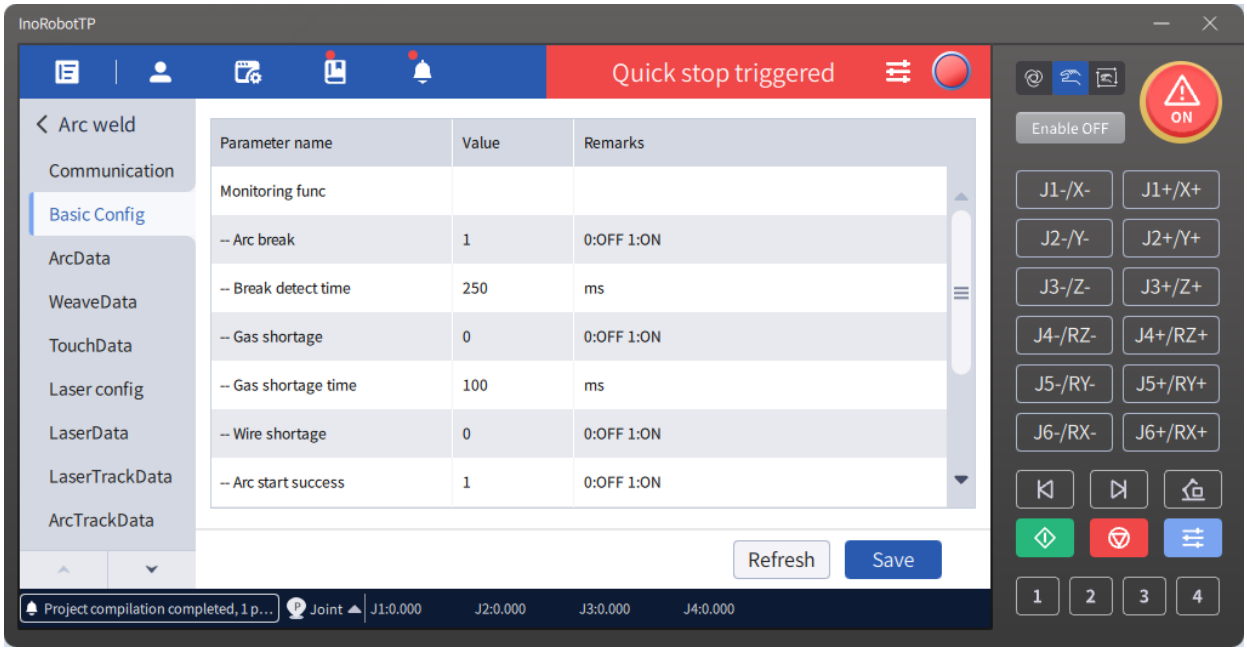
Movj P[8],V[30],Z[0],Tool[0],Wobj[0];

END

7 Basic Function Parameters of Welding

7.1 Overview

This chapter mainly introduces the functions and usage methods of basic welding functions.



7.2 Monitoring Function

Parameter name	Description	Range	Unit
Arc break	The arc breakage detection function switch. When this function is active (ON), if an abnormal arc is detected during the welding, the robot will trigger an alarm.	0: OFF 1: ON	-
Break detect time	Within this time period, if the robot detects no arc signal, it will determine that the arc is abnormal.	10 to 10000	ms
Gas shortage	Gas shortage detection function switch When this function is active (ON), if gas shortage is detected, the robot will trigger an alarm.	0: OFF 1: ON	-
Gas shortage time	Within this time period, if the robot detects no gas signal, it will determine that the gas is exhausted.	10 to 10000	ms

Wire shortage	Wire shortage detection function switch When this function is active (ON), if wire shortage is detected, the robot will trigger an alarm.	0: OFF 1: ON	-
Arc start success	Arc start success detection function switch When this function is active (ON), if arc start failure is detected, the robot will trigger an alarm.	0: OFF 1: ON	-
Wirestick	Wirestick detection function switch When this function is active (ON), if wire sticking is detected during the welder arc end phase, the system will trigger an alarm.	0: OFF 1: ON	-
Power failure	Power failure detection function switch When this function is active (ON), if a power source abnormality occurs, the system will trigger an alarm.	0: OFF 1: ON	-

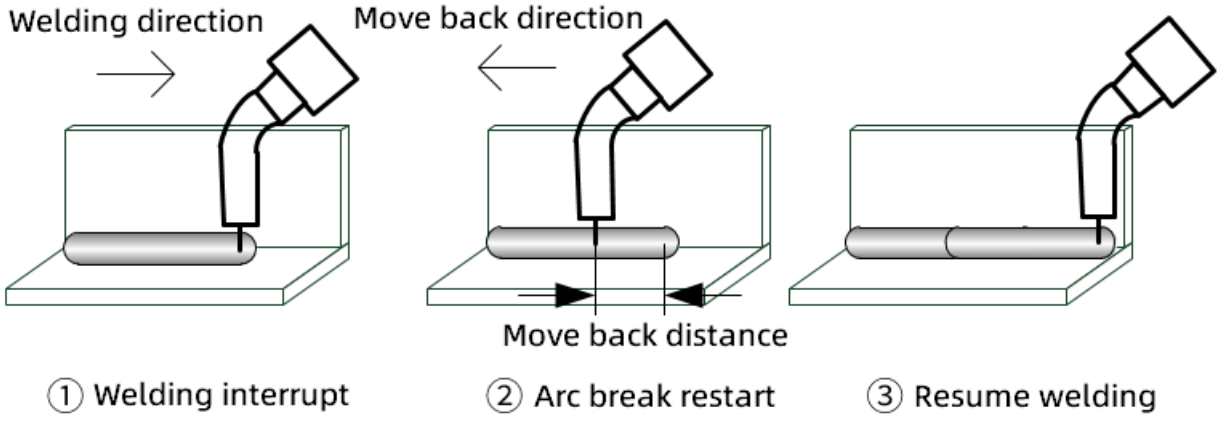
CAUTION

Before using the detection function, switch the "Weld disable"/"Weld enable" setting to "Weld enable" 

.

7.3 Arc Break Restart Function

When the arc break restart function is active, if the welding process restarts after an arc break, pause, etc. during welding, the robot will first move back a certain distance and then resume welding, thereby avoiding a missed weld. The process is shown in the figure below.



Parameter name	Description	Range	Unit
Return to path	Arc break restart function switch	0: OFF 1: ON	-
Overlap distance	The distance from the interruption point moving in the reverse direction of the weld seam trajectory to the retract point; If the overlap distance is greater than the distance from the interruption point to the teaching start point, the robot moves back to the teaching start point.	0 to 100	mm
Return to path speed	The speed from the interruption point moving in the reverse direction of the weld seam trajectory to the retract point.	1 to 100	mm/s

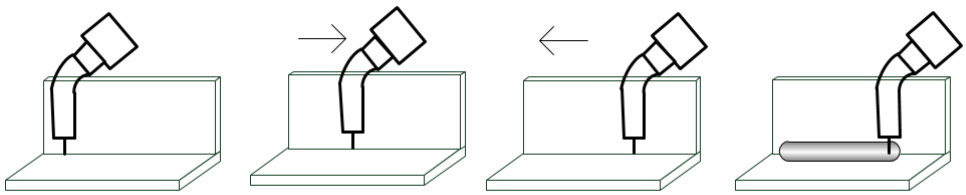
CAUTION

If a second interruption occurs during the restart of an arc after an interruption, the system handling status for the second interruption cannot be predicted. In this case, you need to re-execute the program to restore the status.

7.4 Scrape Start Function

When the scrape start function is active, after an arc start failure, the robot controls the welding wire to rub against the workobject to generate an arc, as shown in the figure below.

1. After an arc start failure, actions ② and ③ will be performed sequentially.
2. If arc start succeeds after action ③, normal welding (action ④) will be performed.
3. Otherwise, actions ② and ③ will be repeated.
4. The repeat times depend on the "Retry count" parameter.



① Arc start failed ② Move forward ③ Move back to welding start point ④ Normal welding

Parameter name	Description	Range	Unit
Scrape start	Scrape start function switch	0: OFF 1: ON	-

Parameter name	Description	Range	Unit
Retry count	Number of times to repeat the scrape action	0 to 10	-
Distance	The distance the robot moves forward when performing the scrape start action. If the scrape start distance is greater than the distance from the welding start point to the teaching end point, the robot can only move forward to the teaching start point.	0 to 100	mm
Return speed	The return speed for performing the scrape action.	1 to 100	mm/s

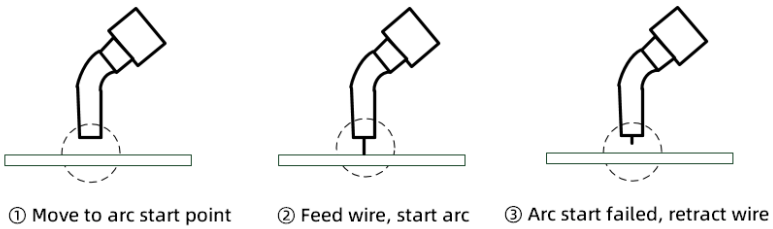
CAUTION

In weaving welding, the scrape start function moves to the scraping target point based on the guide line type, not the weaving pattern.

7.5 Arc Retry Function

When the arc retry function is active, after an arc start failure, the robot will attempt the arc start action again, as shown in the figure below.

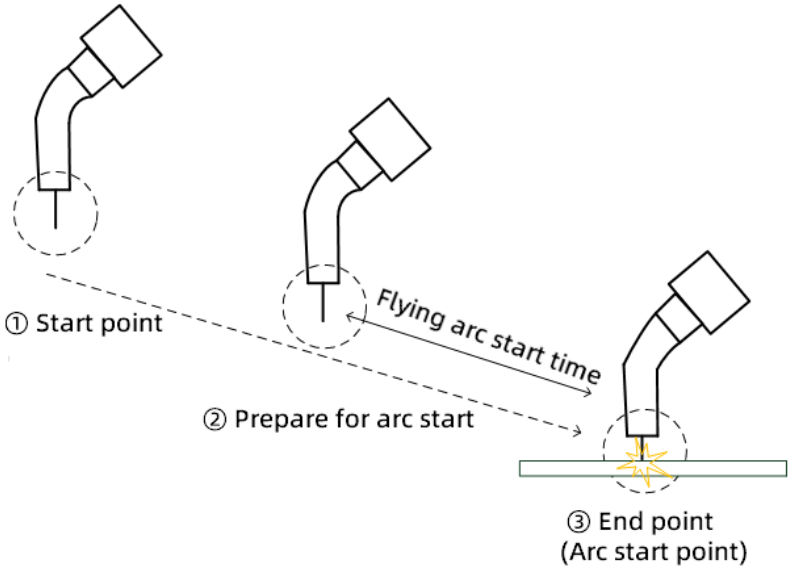
1. The robot will first move to the arc start point, then perform action ② to attempt arc start.
2. After successful arc start, normal welding will be performed.
3. If arc start fails, actions ③ and ② will be repeated. The repeat times depend on the "Retry count" parameter.
4. During the repetition process, if arc start succeeds, welding will proceed and actions ② and ③ will not be repeated.
5. After the restart actions are completed, if arc start fails, a scrape start will be performed.



Parameter name	Description	Range	Unit
Arc retry func	Arc retry function switch	0: OFF 1: ON	-
Retry count	Number of times to repeat the arc retry action	0 to 10	-
Wire rewind time	The wire retraction time during arc retry action	0 to 10000	-

7.6 Flying Arc Function

When the flying arc function is active, the arc start preparation is performed before reaching the arc start point during the arc start action, thereby reducing the arc start cycle time, as shown in the figure below.



Parameter name	Description	Range	Unit
Flying arc	Flying arc function switch	0: OFF 1: ON	-
Wire extension	The distance from the end of the welding wire to the base metal at the arc start point.	0 to 100	mm
Slow wire speed	The slow wire speed setting on the welder side.	0.01 to 100	m/min
Flying arc output port	The signal that triggers the flying arc start action. This parameter is deprecated in versions V4R3C2 and later.	0 to 127	-

NOTE

- Flying arc start time (unit: ms) is calculated using the following formula: **Flying arc start time = (Wire extension × 60)/Slow wire speed** Additionally, the flying arc start time can be adjusted by changing the setting for "Wire extension".
- The flying arc function requires ensuring that the welding wire extension remains as consistent as possible after each weld. This can be achieved by setting the relevant burnback parameter on the welder.

7.7 Torch Collision Detection Function

When the torch collision detection function is active, if a collision occurs with the welding torch, the system will immediately stop and trigger an alarm, maximizing the protection of personnel and equipment safety.

Parameter name	Description	Range	Unit
Input port	The port number for collision signal input. Setting to -1 disables the torch collision detection function.	-1 to +127	-
Trigger action in manl	Triggered action upon collision in manual mode 0: Plan 1: Immediate 2: Rollback	0 to 2	-
Move back dist in manl	Move back distance upon collision in manual mode. This parameter takes effect when the trigger action is set to 2 in manual mode.	5 to 100	mm
Trigger action in auto	Triggered action upon collision in auto mode 0: Plan 1: Immediate 2: Rollback	0 to 2	-
Move back dist in auto	Move back distance upon collision in auto mode. This parameter takes effect when the trigger action is set to 2 in auto mode.	5 to 100	mm
Trigger polarity	The I/O status when a stop is triggered. 0: OFF triggers stop 1: ON triggers stop	0 to 1	-
Collision suppression duration	The duration of shielding the welding torch collision signal.	5 to 300	s

Operating procedure:

1. Set the "Input port" parameter. Ensure that the welding torch collision detection signal is connected to the corresponding I/O terminal. After completing the wiring, you can check the status of the corresponding input I/O in "IO monitor" > "Input". Trigger the collision sensor and check if the I/O status changes. If yes, the wiring is correct.

2. Set the "Trigger polarity" parameter. When the "Trigger polarity" is set to 0, a collision alarm is triggered when the input I/O status of the collision detection signal is OFF. When the "Trigger polarity" is set to 1, a collision alarm is triggered when the input I/O status of the collision detection signal is ON.
3. After a collision, you can disable the torch collision detection function in two ways: either set the "Input port" to -1, or double-tap the collision suppression button on the process teaching panel to clear the alarm.
4. Control the robot to move to a safe position.
5. If the "Input port" is set to -1, you need to reset it.

Meanings of different stop methods:

- Plan: Upon the occurrence of a collision detection alarm, the robot speed will be gradually planned to 0, completing the stop.
- Immediate: Upon the occurrence of a collision detection alarm, the robot speed will be immediately decreased to 0, completing the stop.
- Rollback: Upon the occurrence of a collision detection alarm, the robot will move back a certain distance along the planned path before the collision.

7.8 Jog Wire Feed/Retract Function

Set the jog feed/retract time and distinguish between continuous feed/retract and jog feed/retract.

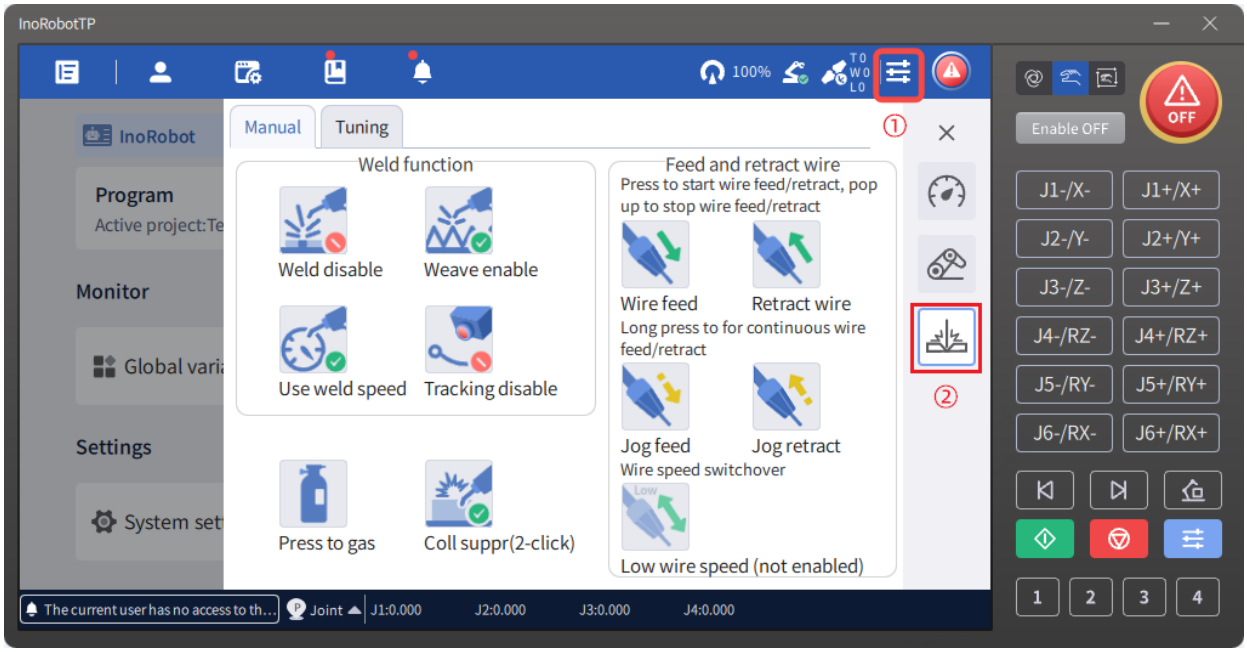
Parameter name	Description	Range	Unit
Jog feed/retract time	When the wire feed/retract button is pressed for a short time, the welder feeds (or retracts) the wire for a short distance based on the Jog feed/retract time.	100 to 1000	ms
Jog pressing judgment time	To distinguish between continuous wire feed/retract and jog feed/retract when the wire feed button is pressed, a press duration threshold is set. If the press duration exceeds this time, continuous wire feed/retract is performed; if it is within this time, jog feed/retract is performed.	200 to 1000	ms

8 Process Teaching Panel

8.1 Overview

The teaching panel contains commonly used shortcut buttons in the welding process, including: welding enable button, Weaving enable button, forward wire feeding button, reverse wire feeding button, wire feed speed mode switchover button, jog wire feeding button, and gas control button.

You can click the button  in the upper right corner of the teach pendant, then click button  to enter the teaching panel.



Button	Icon	Type	Permission	Function	Remarks
Weld enable	Enabled  Disabled 	Toggle button	When the controller is connected, this button is available in User mode or higher.	Single-click toggles the welding to enabled/ disabled state.	In the disabled state, the robot moves along the trajectory without welding. In the enabled state, the robot performs welding according to the instructions.

Button	Icon	Type	Permission	Function	Remarks
Weave enable	Enabled  Disabled 	Toggle button		Single-click toggles the weaving to enabled/ disabled state.	In the disabled state, the robot does not perform weaving; in the enabled state, it performs weaving according to the instructions.
Welding speed toggle button	Use weld speed  Use preset speed 	Toggle button		The button is used to toggle the speed of instructions MovlArc, MovlArcOff, MovcArc, and MovcArcOff.	Use weld speed: Use the welding speed from ArcData. Use preset speed: In this state, welding and weaving are automatically disabled and cannot be enabled. The robot uses the preset speed V from the instruction.
Tracking enable	Enabled  Disabled 	Toggle button		Single-click toggles the laser tracking to enabled/ disabled state.	In the disabled state, the robot does not perform tracking. In the enabled state, the robot performs tracking according to the tracking parameters in the instruction.

Button	Icon	Type	Permission	Function	Remarks
Wire feed		Button		Click to feed wire forward.	Click and hold to feed wire continuously, and release to stop.
Retract wire		Button		Click to retract wire.	Click and hold to retract wire, and release to stop.
Wire speed switchover		Toggle button		Toggle high-speed and low-speed wire feeding.	High-speed and low-speed modes (not currently available)
Jog feed		Button		Click to feed the welding wire by a certain length.	Click and hold to feed the wire for a specific duration.
Jog retract		Button		Click to retract the welding wire by a certain length.	Click and hold to retract the wire for a specific duration.
Gas control		Button		Click and hold to release the inert gas.	The gas is released only while the button is held down, and stops when released.
Collision suppression	Not suppressed  Suppressing 	Button		It is used to mask the welding torch collision signal. The masking time is determined by the "Collision suppression duration" on the "Basic Config" setting page.	Double-click to trigger the collision suppression.

8.2 Permission Allocation

1. User permissions: All buttons can be operated by all users.
2. Control authority: Control authority can only be operated on the teach pendant.
3. Other permissions:
   a. Operation is not allowed in the Emergency Stop state.
   b. Operation is not allowed in the running state.
   c. In manual low speed mode, manual high speed mode, and auto mode, operation is allowed in the Stop state.

8.3 Weld Enable/Disable

Click the button to toggle between enabled and disabled states.

- In the disabled state, running welding motion instructions enable the robot to move but not weld. This state is commonly used during the commissioning phase.
- In the enabled state, running welding motion instructions enable the robot to weld according to the instructions.

> CAUTION
>
> When running a program in single-step motion, welding does not occur regardless of the welding enable state.

Weld disable: 

Weld enable: 

8.4 Use Weld Speed

Click the button to toggle between "Use preset speed" and "Use weld speed" states.

- Use preset speed: In this state, welding, weaving, and tracking are automatically disabled and cannot be enabled. The robot uses the preset speed V or Speed from the instruction for both old version welding motion instructions and the motion instructions contained in the new WeldOn and WeldOff instructions.
- Use weld speed: In this state, welding, weaving, and tracking can be enabled.
  - When executing the old version welding motion instructions, the robot uses the welding speed set in the ArcData parameter of the instruction.
  - When executing the motion instructions Movl and Movc contained in the new WeldOn and WeldOff instructions, if the WeldOn instruction includes the WS parameter, the WS index value is used as the welding speed. Otherwise, the welding speed set in the ArcData parameter is used.

CAUTION

- This button affects the instructions that can perform welding during runtime, such as MovlArc, MovlArcOff, MovcArc, MovcArcOff, MovArcRep, MovArcMultiRep, as well as the motion instructions Movl and Movc contained in the new welding instructions WeldOn and WeldOff.
- The instruction MovlArcOn uses the preset speed V or speed from the instruction and is not affected by this button.

Use preset speed: 

Use weld speed: 

8.5 Weaving Enable/Disable

Click the button to toggle between enabled and disabled states.

- In the "Weave disable" state:
  - When executing the old version welding motion instructions that include the WeaveData parameter, the robot does not perform weaving.
  - When executing the motion instructions contained in the new WeaveOn and WeaveOff instructions, the robot does not perform weaving.
- In the "Weave enable" state:
  - When executing the welding motion instructions that include the WeaveData parameter, the robot performs weaving according to the setting in the WeaveData parameter.
  - When executing the motion instructions contained in the new WeaveOn and WeaveOff instructions, the robot performs weaving.

CAUTION

- New version weaving instructions: When running the program in single-step motion, if the motion instructions are contained in the WeaveOn and WeaveOff instructions, whether weaving is performed is determined by the weaving enable state.
- Old version weaving instructions: When running the program in single-step motion, if the welding motion instructions include the WeaveData parameter, whether weaving is performed is determined by the weaving enable state.

Weave disable: 

Weave enable: 

8.6 Tracking Enable/Disable

Click the button to toggle between enabled and disabled states.

- In the "Tracking disable" state:
  - When executing the welding motion instructions that include the LaserTrackData or ArcTrackData parameter, the robot does not perform tracking.
  - When executing the motion instructions contained in the new LaserTrackOn and LaserTrackOff instructions, or in the ArcTrackOn and ArcTrackOff instructions, the robot does not perform tracking.
- In the "Tracking enable" state:
  - When executing the welding motion instructions that include the LaserTrackData or ArcTrackData parameter, the robot performs tracking according to the setting in the LaserTrackData or ArcTrackData parameter.
  - When executing the motion instructions contained in the new LaserTrackOn and LaserTrackOff instructions, or in the ArcTrackOn and ArcTrackOff instructions, the robot performs tracking.

CAUTION

- New version tracking instruction: When running the program in single-step motion, even if the motion instructions are contained in the LaserTrackOn and LaserTrackOff instructions (or in the ArcTrackOn and ArcTrackOff instructions), and the system is in the "Tracking enable" state, the robot does not perform tracking.
- Old version tracking instruction: When running the program in single-step motion, the robot does not perform tracking regardless of whether the welding motion instructions include the LaserTrackData or ArcTrackData parameter, and whether the system is in the "Tracking enable" state.

Tracking disable: 

Tracking enable: 

9 More Functions

9.1 Weaving

9.1.1 Overview

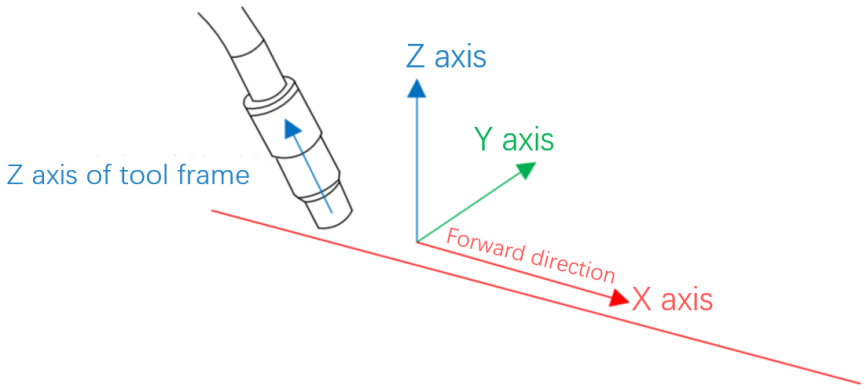
Weaving refers to the process where the robot welding torch oscillates laterally in a regular pattern while moving along the weld seam. The purpose is to achieve a weld seam of a certain width and ensure good fusion on both sides of the seam.

- Weaving instructions

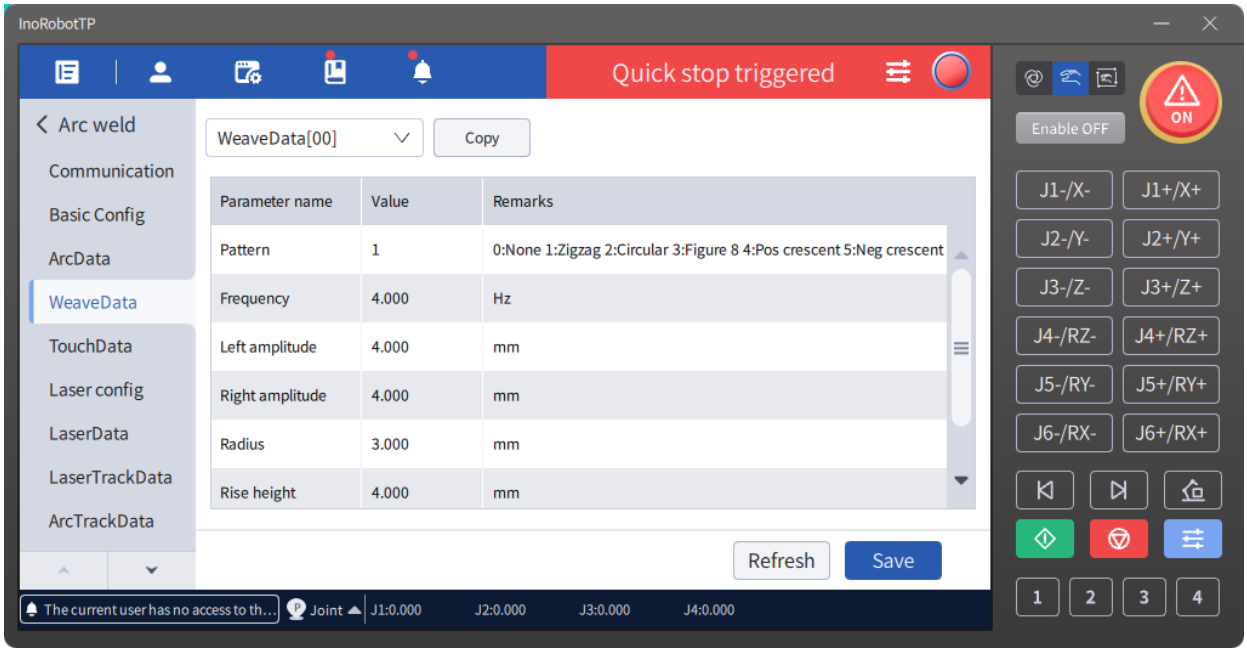
New version instruction: When a motion instruction such as Movl or Movc is contained in the WeaveOn and WeaveOff instructions, the robot performs weaving. For detailed instructions, see the 10.4 WeaveOn and 10.5 WeaveOff instructions.

Old version instruction: Whether weaving is performed is determined by including the WeaveData parameter in welding motion instructions such as MovlArcOn, MovlArc, MovcArc, MovlArcOff, and MovcArcOff. For detailed instruction descriptions, see the 10 Instructions section.

- Weave frame
  - X-axis: If linear interpolation is used, the forward direction is the X-axis direction. If circular interpolation is used, the tangent direction of the arc is the X-axis direction.
  - Z-axis: Project the Z-axis of the tool frame onto the plane perpendicular to the X-axis, and define the direction facing the welding torch as the positive direction of the Z-axis.
  - Y-axis: Perpendicular to the plane formed by the Z-axis and X-axis.
  - The XOY plane is used as the weaving plane, and it is recalculated every time period T.



9.1.2 Parameter Description



Parameter name	Description	Range	Unit
Pattern	Weaving pattern 0: None 1: Zigzag 2: Circular 3: Figure 8 4: Pos crescent 5: Neg crescent	0 to 5	-
Frequency	Weaving frequency	0.0 to 100.0	Hz
Left amplitude	The left amplitude of the weaving pattern. (For circular weaving, this represents the radius perpendicular to the motion direction.)	0.0 to 100.0	mm
Right amplitude	The right amplitude of the weaving pattern. (For circular weaving, this represents the radius perpendicular to the motion direction.)	0.0 to 100.0	mm
Radius	Valid during circular weaving, referring to the radius along the motion direction.	0.0 to 100.0	mm
Rise height	Height of the center rise.	0 to 100	mm
L-angle	L-angle	0 to 360	deg
Center rise flag	Whether to enable center rise function.	0 to 1	-
L-weave flag	Whether to enable the L-type weave function.	0 to 1	-

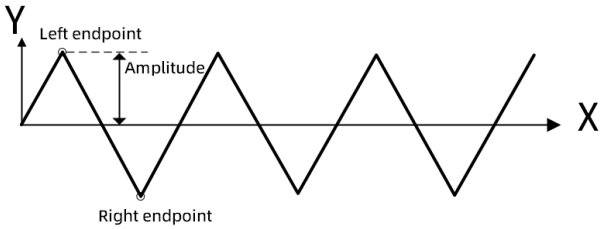
Parameter name	Description	Range	Unit
Left dwell	Valid during zigzag weaving, referring to the dwell time at the left turning point.	0 to 10000	ms
Right dwell	Valid during zigzag weaving, referring to the dwell time at the right turning point.	0 to 10000	ms
Dwell type[1]	Whether to completely stop or continue moving during left and right dwells.	0 to 1	0: Stop 1: Continue
Weave angle	The inclination angle of the zigzag weaving pattern trajectory.	0 to 90	deg

NOTE

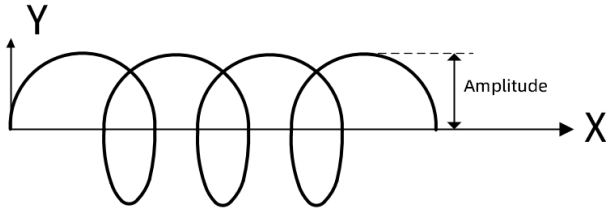
[1]: When the dwell type is "Continue", the forward speed is the welding speed.

The following are descriptions of various weaving patterns:

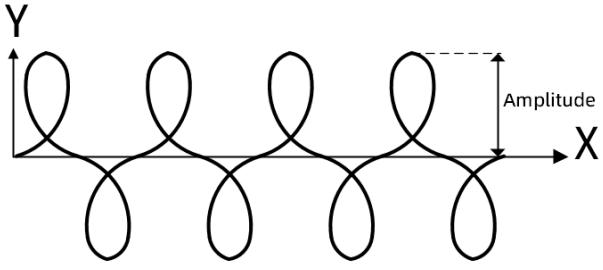
1. Weaving patterns
   - Zigzag: Suitable for most general welding tasks, especially when combined with multi-layer multi-pass and arc tracking functions. It is commonly used for butt welds and fillet welds.



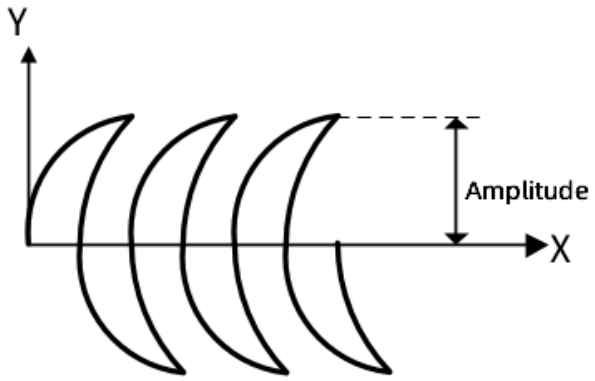
   - Circular: Mainly used for welding that requires a larger cap and overlap welds, such as ship deck welding and thick plate welding of steel structures.



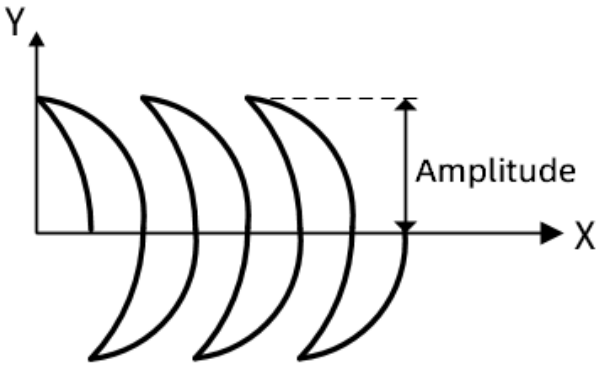
   - Figure 8: Mainly used for thick plate welding or applications requiring high welding strength, such as the welding of large structural components in engineering machinery and the welding of pressure vessels.



   - Positive crescent: Mainly used for cap welding of pipes and medium-thick plates.

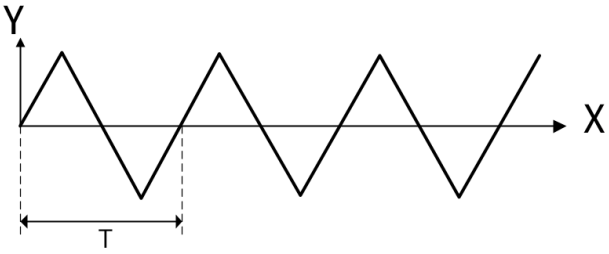


◦ Negative crescent: Mainly used for cap welding of pipes and medium-thick plates.



2. Frequency

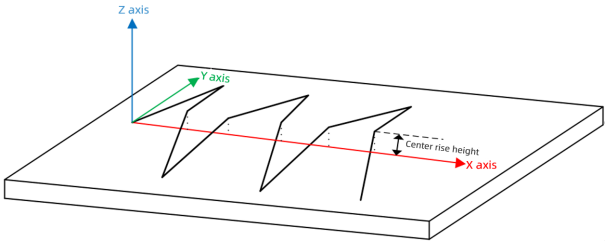
The frequency of the transverse weaving. When the welding speed cannot be reached, priority is given to maintaining the weaving amplitude and frequency.



$f = \frac{1}{T}$ f: Weaving frequency
T: Weaving period

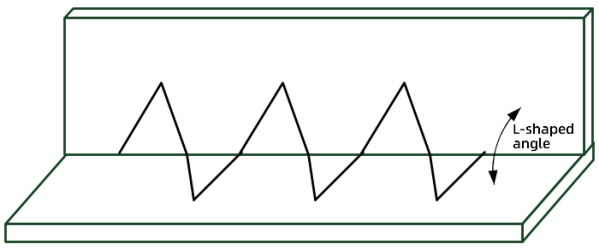
3. Rise height

The amount by which the welding torch rises at the center of the weaving. It is typically used in multi-layer welding to provide clearance over the height of the weld bead at the center.



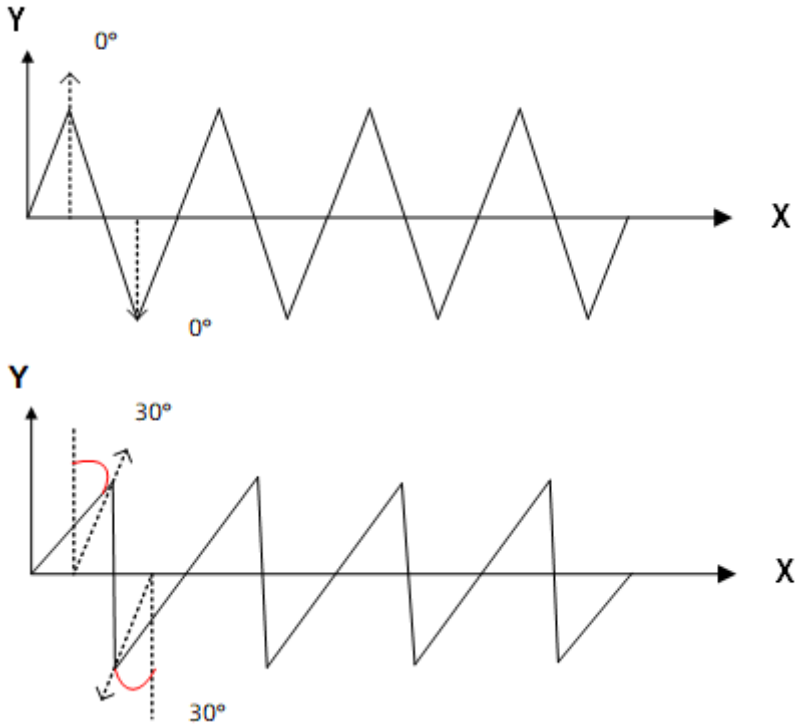
4. L-angle

The included angle of the L-weave pattern, which is mainly used for V-groove and fillet welding.



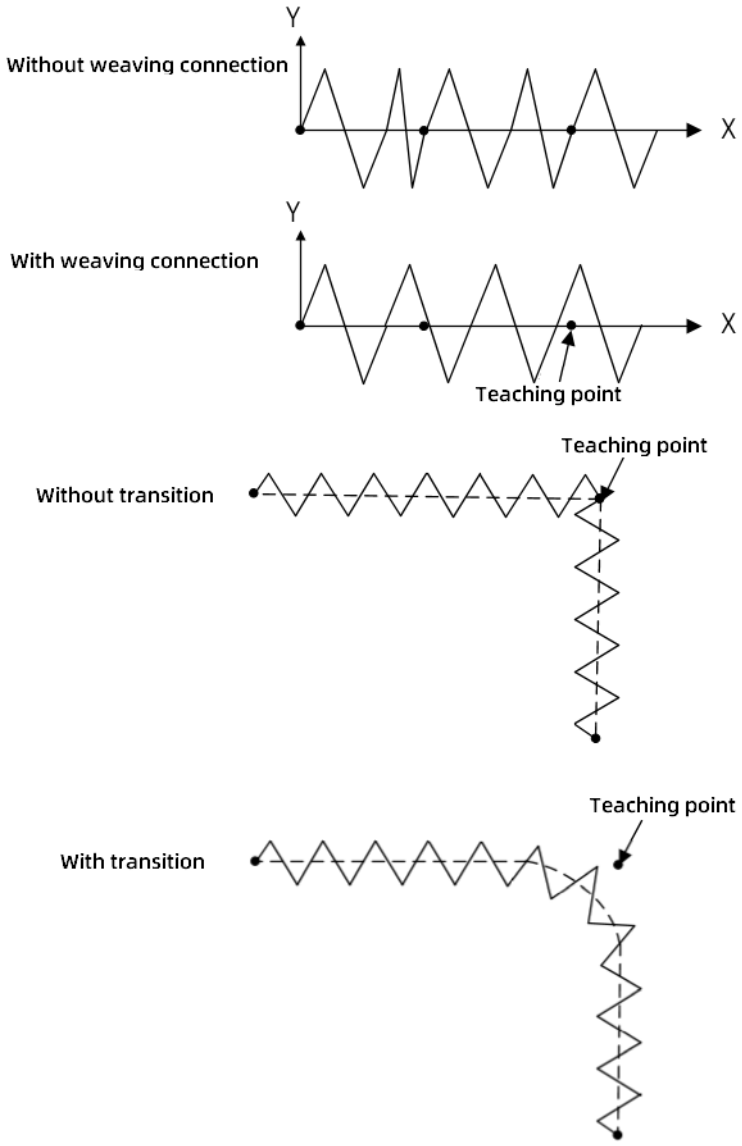
5. Weave angle

The zigzag weaving trajectory is inclined by the corresponding angle (e.g., 30°).



6. Transition parameters in the instruction

- Fine: The weaving guide line does not transition and is precise to the point.
- Z[m], Z[CP], ZR[m]: The weaving guide line transitions and has weaving connection function.
- Weaving connection function: Smoothly connects the weaving trajectories before and after the teaching point. Without weaving connection, the weaving trajectory always pass through the teaching point; with weaving connection, the weaving trajectory may not necessarily pass through the teaching point.



9.1.3 Permission Allocation

Control permission		Operation mode			Authority			
Teach pendant	Other control permissions	Manual low speed mode	Manual high speed mode	Auto mode	User mode	Edit mode	Admin	Manufacturer
√	×	√	×	×	×	×	√	√

9.1.4 Notes

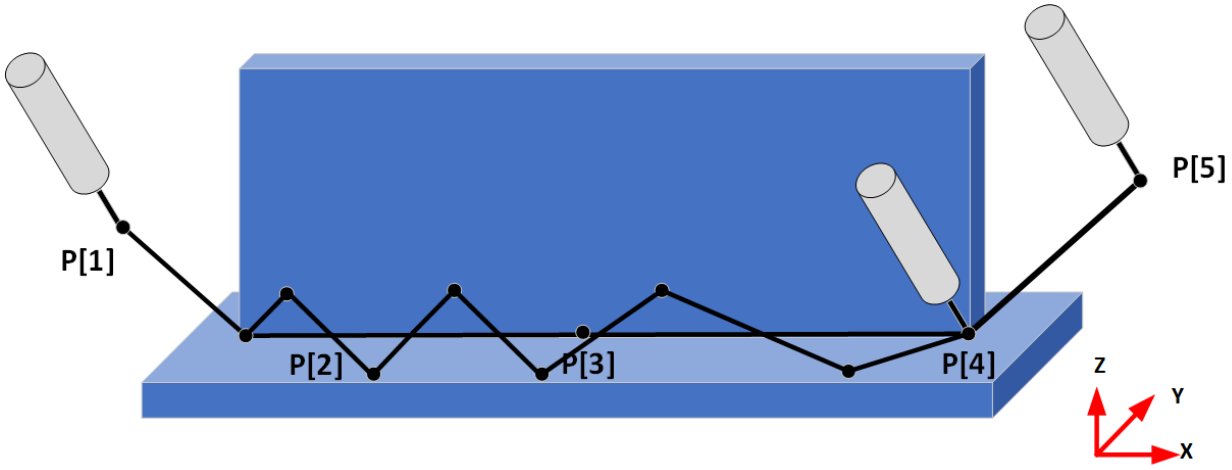
- In Debug mode, whether weaving is performed is determined by the state of the weaving enable button.
- In Auto mode, whether weaving is performed is determined by the state of the weaving enable button.
- During interrupt restart, weaving is not performed while moving back.
- When starting from a specified line, no weaving or arc start occurs; the robot moves directly to the end point of the specified line and then starts the arc.

- When the welding speed cannot be reached, priority is given to maintaining the amplitude and frequency. If the robot speed cannot be reached due to the speed limit function enabled in manual teaching mode, both the welding speed and frequency will be affected.

9.1.5 Programming Examples

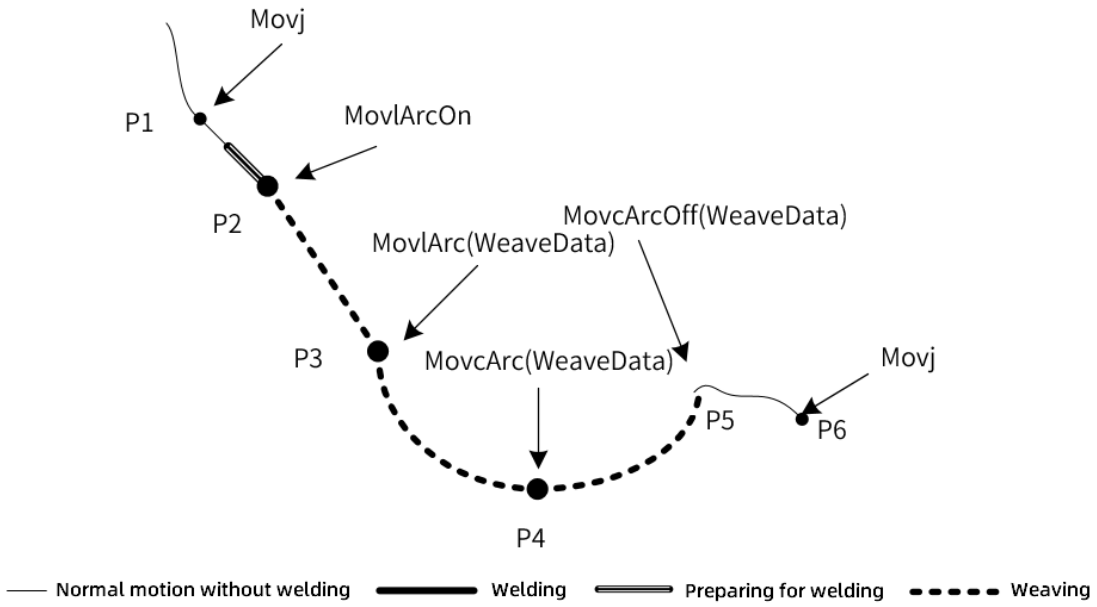
The new version instructions and the old version instructions cannot coexist in the same .pro file.

9.1.5.1 New Version Instructions



No.	Program	Comment
1	Start;	Start
2	Movl P[1],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[1].
3	Movl P[2],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the arc start point P[2].
4	WeldOn ArcData[1], AC[120],AV[0],WS[8];	Start arc
5	WeaveOn WeaveData[0];	Start weaving.
6	Movl P[3],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the first welding point P[3].
7	WeaveSet WeaveData[2];	Change the weaving parameters. The changes take effect when moving to the next point.
8	Movl P[4],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the arc-off point P[4].
9	WeldOff ArcData[1];	Extinguish arc.
10	WeaveOff;	End weaving.
11	Movl P[5],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[5].
12	End;	End

9.1.5.2 Old Version Instructions



Start;

Movj P[1],V[30],Z[0],Tool[0],Wobj[0];

MovlArcOn P[2],V[30],Z[0],ArcData[0],Tool[0],Wobj[0];

MovlArc P[3], V[30],Z[0],ArcData[0], WeaveData[5],Tool[0],Wobj[0];

MovcArc P[4],V[30],Z[0],ArcData[0], WeaveData [5],Tool[0],Wobj[0];

MovcArcOff P[5],V[30],Z[0],ArcData[0], WeaveData [5],Tool[0],Wobj[0];

Movj P[6],V[30],Z[0],Tool[0],Wobj[0];

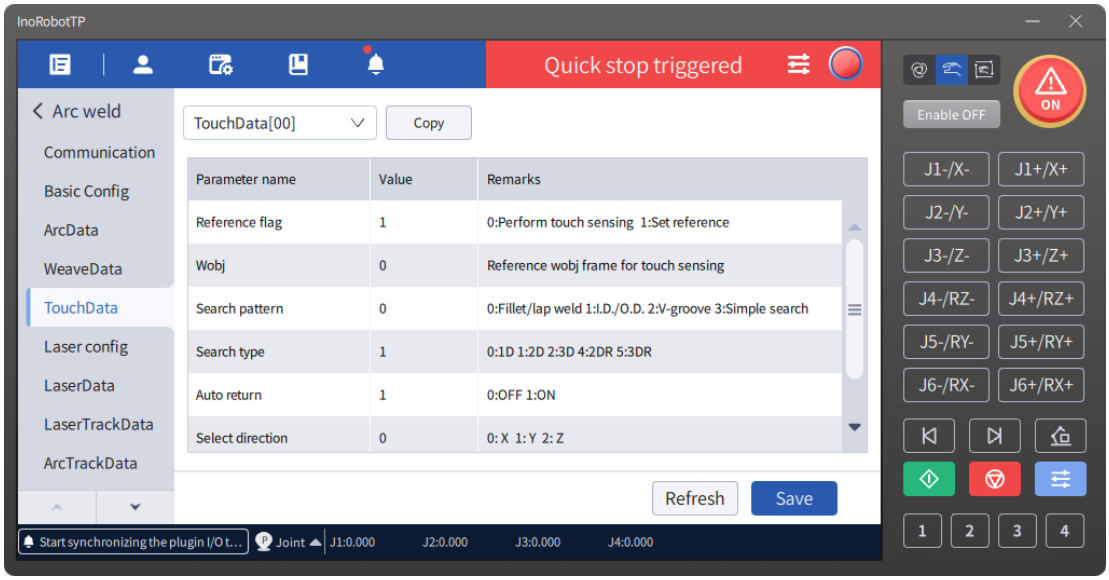
END

9.2 Touch Sensing

9.2.1 Overview

The touch sensing function enables the welding robot to use the welding wire or gas nozzle to make contact with the surface of the workobject (which must be electrically conductive). Upon contact, the robot stops motion and records the current TCP pose. Based on the recorded TCP pose information, the robot calculates the actual workpiece position, corrects the welding trajectory, thereby improving welding quality and efficiency.

9.2.2 Parameter Description



Parameter name	Description	Range	Unit
Reference flag	0: Perform search 1: Set reference	0 to 1	-
Wobj	Reference workobject frame number for touch sensing	0 to 15	-
Search pattern	0: fillet/lap weld (all search types are effective) 1: I.I./O.D. (used to detect the outer diameter/inner diameter of a circle for positioning; valid when the search type is set to "1: 2D") 2: V-groove (valid when the search type is set to "0: 1D") 3: Simple search (valid when the search type is set to "1: 2D")	0 to 3	-

Parameter name	Description	Range	Unit
Search type	0: 1D (one-dimensional translation) 1: 2D (two-dimensional translation) 2: 3D (three-dimensional translation) 4: 2DR (two-dimensional translation and rotation) 5: 3DR (three-dimensional translation and rotation)	0 to 5	-
Auto return	0: OFF 1: ON When the "Auto return" is set to 1, the robot moves back by the set return distance upon contacting the workobject; when it is set to 0, it proceeds directly to the next line.	0 to 1	-
Select direction	0: X 1: Y 2: Z Valid when the search type is 3DR. Select the search point directions for plane fitting.	0 to 2	-
Input port	The input port number occupied during touch sensing. It is used only for internal signal processing of the robot during searching; no actual signal connection is required.	-1 to +127	-
Search speed	The robot motion speed during the search.	1 to 100	mm/s
Search distance	The maximum distance of robot motion during the search.	1 to 500	mm
Return speed	The robot motion speed when moving back after detecting the workobject.	1 to 1500	mm/s

Parameter name	Description	Range	Unit
Return distance	The distance the robot moves back after detecting the workobject.	1 to 500	mm
Max rotation	The maximum deviation of A/B/C calculated by position search. An alarm is triggered when this value is exceeded.	1 to 60	deg
Max offset	The maximum deviation of X/Y/Z calculated by position search. An alarm is triggered when this value is exceeded.	1 to 500	mm

9.2.3 Permission Allocation

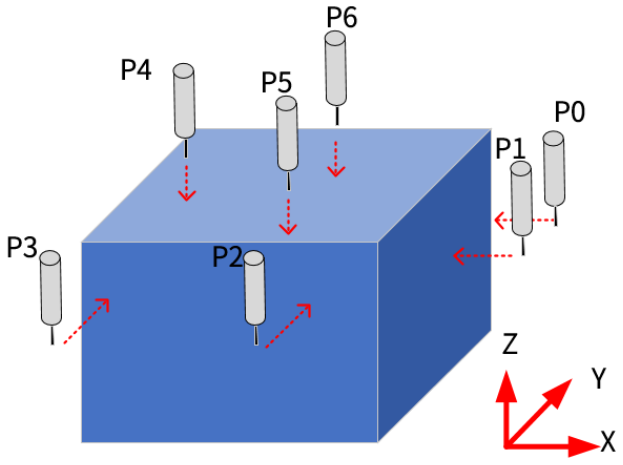
Control permission		Operation mode			Authority			
Teach pendant	Other control permissions	Manual low speed mode	Manual high speed mode	Auto mode	User mode	Edit mode	Admin	Manufacturer
√	×	√	×	×	×	×	√	√

9.2.4 Notes

- Keep the workobject surface that contacts the welding wire as clean as possible during position search, avoiding rust, oil stains, etc.
- Ensure that the welding wire extension is consistent for each position search.

9.2.5 Usage Procedure

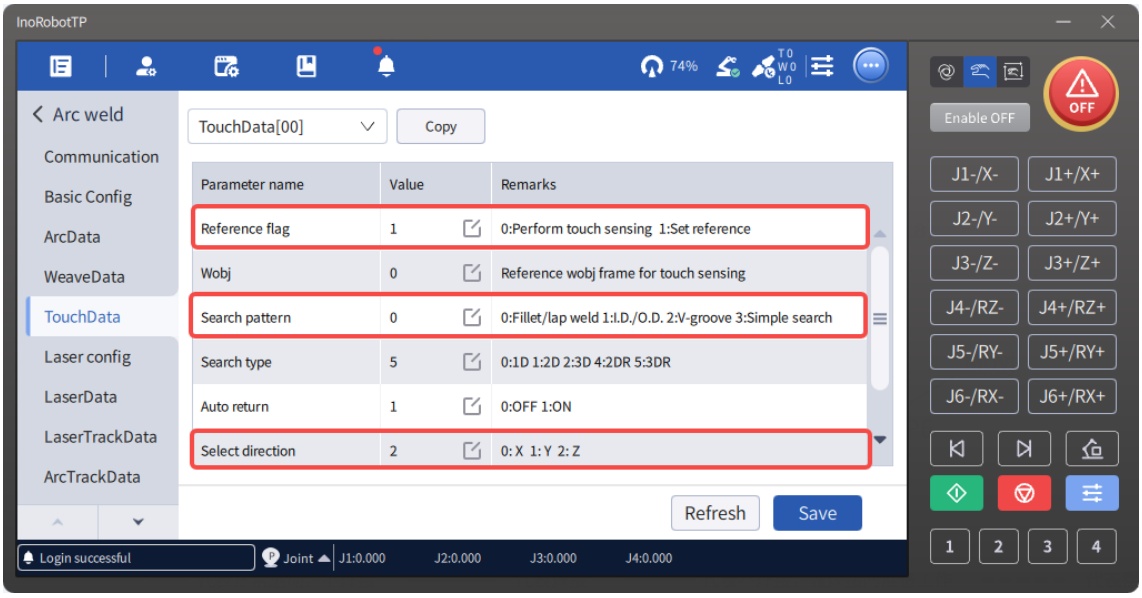
1. Three-dimensional translation and rotation
   Three mutually independent search directions are required. One direction (usually the -Z direction) requires three searches, while each of the other two directions requires two searches.



Usage procedure:

1. Set the corresponding parameters in the parameter "TouchData", such as setting "Search type" to "5: 3DR" and "Select direction" to "2: Z".

2. Before performing the position search for the first time, calculating the offset, and correcting the trajectory based on the offset, first perform the procedure of calculating the position search reference. At this point, set the "Reference flag" in "TouchData" to "1: Set reference", and then execute the following position search program (only once) to complete the calculation of the position search reference.



3. After the calculation is completed, set the "Reference flag" in "TouchData" to "0: Perform touch sensing", and then execute the following position search program (the same program as in step 2) to correct the welding trajectory.

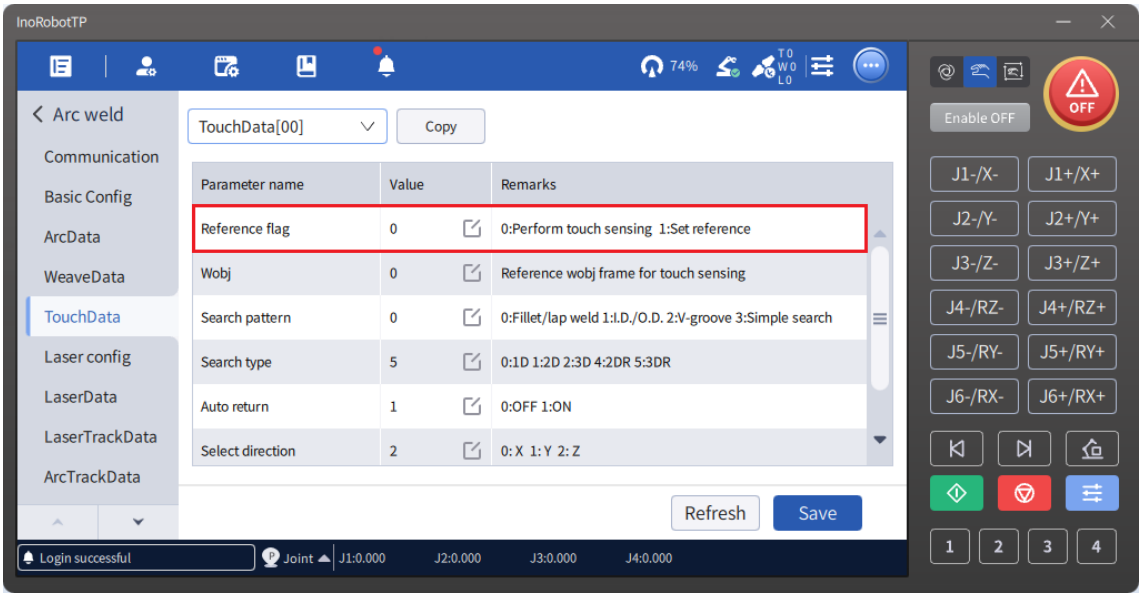


Table9-2-5-1 New version welding instructions

No.	Instructions	Description
1	Start;	Program start

No.	Instructions	Description
2	ClearSearchTempData(0);	Clear the cached data corresponding to condition number 0 of touch sensing.
3	SearchL Dir[-X], P[0], V[30], Z[0], TouchData[0], Tool[1],Wobj[0];	Move to the point P0 using Movl, then search along the -X axis direction of the workobject frame.
4	SearchL Dir[-X], P[1], V[30], Z[0], TouchData[0], Tool[1],Wobj[0];	Move to the point P1 using Movl, then search along the -X axis direction of the workobject frame.
5	SearchL Dir[Y], P[2], V[30], Z[0], TouchData[0], Tool[1],Wobj[0];	Move to the point P2 using Movl, then search along the Y axis direction of the workobject frame.
6	SearchL Dir[Y], P[3], V[30], Z[0], TouchData[0], Tool[1],Wobj[0];	Move to the point P3 using Movl, then search along the Y axis direction of the workobject frame.
7	SearchL Dir[-Z], P[4], V[30], Z[0], TouchData[0], Tool[1],Wobj[0];	Move to the point P4 using Movl, then search along the -Z axis direction of the workobject frame.
8	SearchL Dir[-Z], P[5], V[30], Z[0], TouchData[0], Tool[1],Wobj[0];	Move to the point P5 using Movl, then search along the -Z axis direction of the workobject frame.
9	SearchL Dir[-Z], P[6], V[30], Z[0], TouchData[0], Tool[1],Wobj[0];	Move to the point P6 using Movl, then search along the -Z axis direction of the workobject frame.
10	CalcSearchPR (TouchData[0], PR[0]);	Calculate the offset and store it in PR[0]. When the "Reference flag" in the current condition interface is set to "1: Set reference", the offset calculated by executing this instruction is 0.
11	ROffsOn(PR[0]);	Offset start
12	Movl P[7], V[30], Z[0],Tool[1],Wobj[0];	Move to the arc start point.
13	WeldOn ArcData[1];	Start arc
14	Movl P[8], V[30], Z[0],Tool[1],Wobj[0];	Move to the arc-off point.
15	WeldOff ArcData[1];	Extinguish arc.
16	ROffsOff;	Offset end
17	End;	Program end

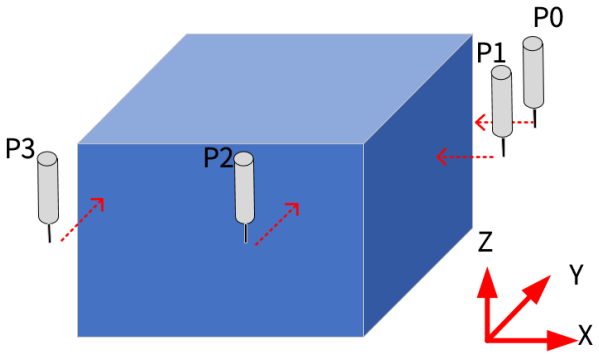
Table9-2-5-2 Old version welding instructions

No.	Instructions	Description
1	Start;	Program start
2	ClearSearchTempData(0)	Clear the cached data corresponding to condition number 0 of touch sensing.
3	SearchL Dir[-X], P[0], V[30], Z[0], TouchData[0], Tool[1],Wobj[0];	Move to the point P0 using Movl, then search along the -X axis direction of the workobject frame.
4	SearchL Dir[-X], P[1], V[30], Z[0], TouchData[0], Tool[1],Wobj[0];	Move to the point P1 using Movl, then search along the -X axis direction of the workobject frame.
5	SearchL Dir[Y], P[2], V[30], Z[0], TouchData[0], Tool[1],Wobj[0];	Move to the point P2 using Movl, then search along the Y axis direction of the workobject frame.
6	SearchL Dir[Y], P[3], V[30], Z[0], TouchData[0], Tool[1],Wobj[0];	Move to the point P3 using Movl, then search along the Y axis direction of the workobject frame.
7	SearchL Dir[-Z], P[4], V[30], Z[0], TouchData[0], Tool[1],Wobj[0];	Move to the point P4 using Movl, then search along the -Z axis direction of the workobject frame.
8	SearchL Dir[-Z], P[5], V[30], Z[0], TouchData[0], Tool[1],Wobj[0];	Move to the point P5 using Movl, then search along the -Z axis direction of the workobject frame.
9	SearchL Dir[-Z], P[6], V[30], Z[0], TouchData[0], Tool[1],Wobj[0];	Move to the point P6 using Movl, then search along the -Z axis direction of the workobject frame.
10	CalcSearchPR(TouchData[0], PR[0]);	Calculate the offset and store it in PR[0]. When the "Reference flag" in the current condition interface is set to "1: Set reference", the offset calculated by executing this instruction is 0.
11	ROffsOn (PR[0]);	Offset start
12	MovlArcOn P[7], V[30], Z[0], ArcData[0], Tool[1],Wobj[0];	Move to the arc start point.
13	MovlArcOff P[8], V[30], Z[0], ArcData[0], Tool[1],Wobj[0];	Move to the arc-off point.
14	ROffsOff;	Offset end

No.	Instructions	Description
15	End;	Program end

2. Two-dimensional translation and rotation

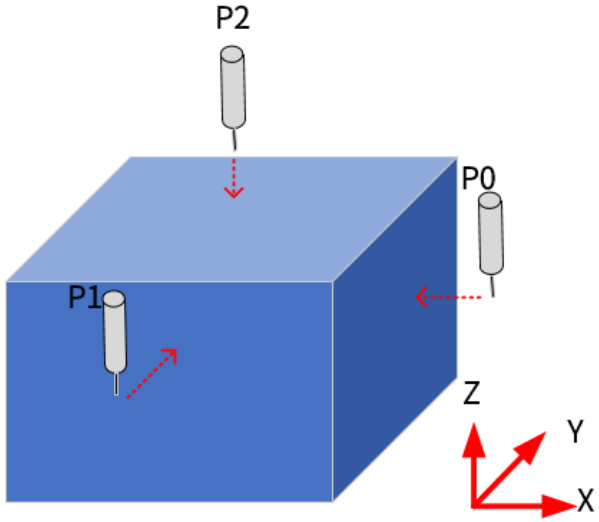
Two mutually independent search directions are required. Each direction requires at least two searches.



The usage procedure is similar to "Three-dimensional translation and rotation", and will not be repeated here.

3. Three-dimensional translation

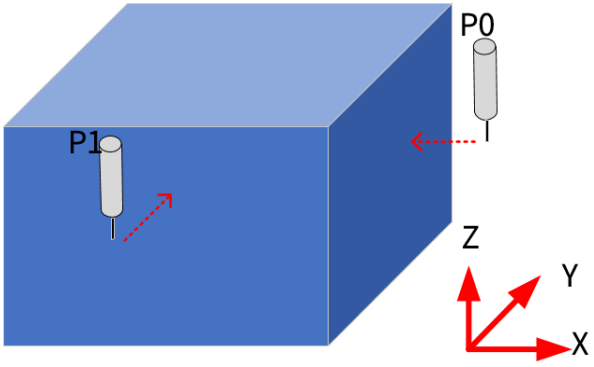
Three mutually independent search directions (X, Y, and Z) are required. Each direction requires at least one search.



The usage procedure is similar to "Three-dimensional translation and rotation", and will not be repeated here.

4. Two-dimensional translation

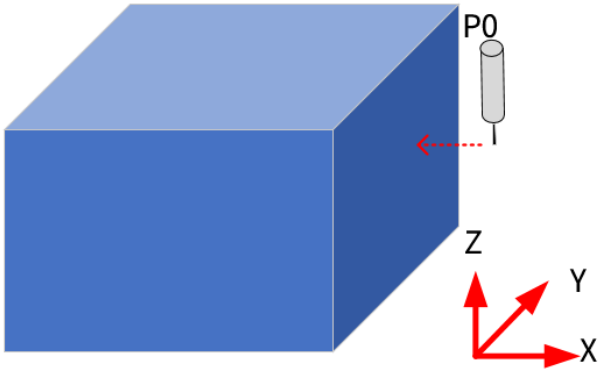
Two mutually independent search directions (X and Y, X and X, Y and Z) are required. Each direction requires at least one search.



The usage procedure is similar to "Three-dimensional translation and rotation", and will not be repeated here.

5. One-dimensional translation

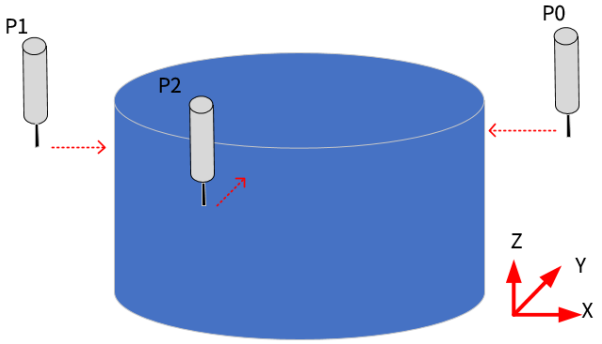
One search direction is required. At least one search is required.



The usage procedure is similar to "Three-dimensional translation and rotation", and will not be repeated here.

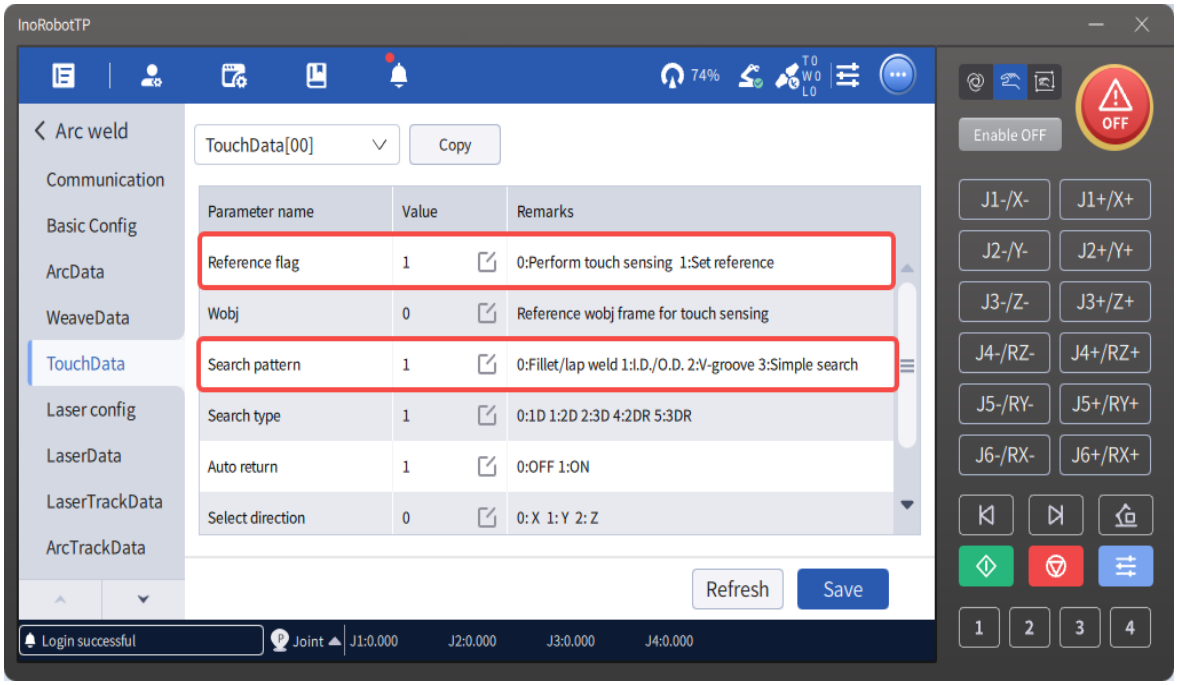
6. Outer diameter/Inner diameter

Two mutually independent search directions are required. A total of three searches is required.



Usage procedure:

1. Set the corresponding parameters in the touch sensing parameter "TouchData". if the "Search pattern" is set to "1: I.I./O.D.", the "Search type" is not applicable.
2. Before performing the position search for the first time, calculating the offset, and correcting the trajectory based on the offset, first perform the procedure of calculating the position search reference. At this point, set the "Reference flag" in "TouchData" to "1: Set reference", and then execute the following position search program (only once) to complete the calculation of the position search reference.



3. After the calculation is completed, set the "Reference flag" in "TouchData" to "0: Perform touch sensing", and then execute the following position search program (the same program as in step 2) to correct the welding trajectory.

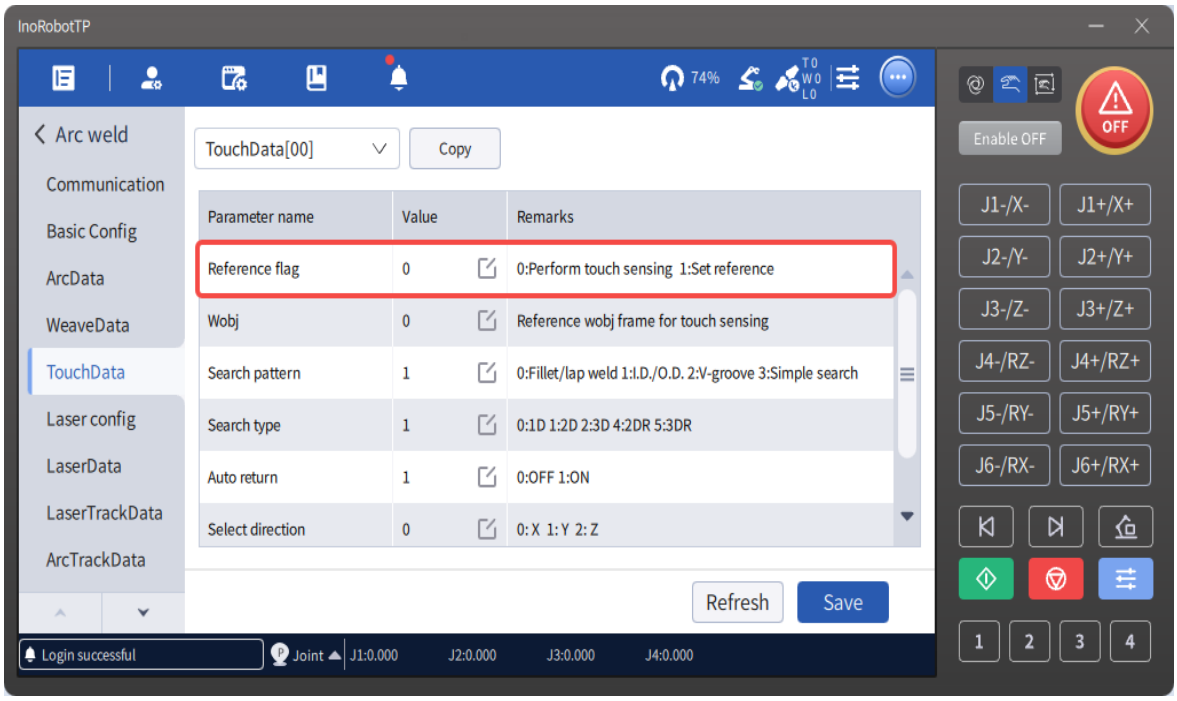


Table9-2-5-1 New version welding instructions

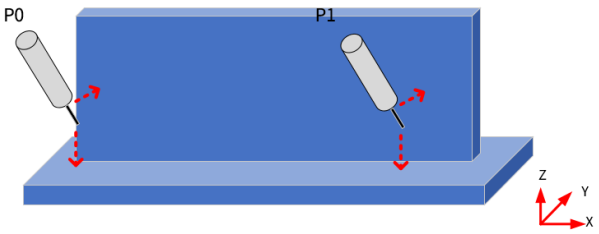
No.	Instructions	Description
1	Start;	Program start
2	ClearSearchTempData(0);	Clear the cached data corresponding to condition number 0 of touch sensing.
3	SearchL Dir[-X], P[0], V[30], Z[0], TouchData[0], Tool[1],Wobj[0];	Move to the point P0 using Movl, then search along the -X axis direction of the workobject frame.
4	SearchL Dir[X], P[1], V[30], Z[0], TouchData[0], Tool[1],Wobj[0];	Move to the point P1 using Movl, then search along the X axis direction of the workobject frame.
5	SearchL Dir[Y], P[2], V[30], Z[0], TouchData[0], Tool[1],Wobj[0];	Move to the point P2 using Movl, then search along the Y axis direction of the workobject frame.
6	CalcSearchPR (TouchData[0], PR[0]);	Calculate the offset and store it in PR[0]. When the "Reference flag" in the current condition interface is set to "1: Set reference", the offset calculated by executing this instruction is 0.
7	ROffsOn (PR[0]);	Offset start
8	Movl P[7], V[30], Z[0], Tool[1],Wobj[0];	Move to the arc start point.

No.	Instructions	Description
9	WeldOn ArcData[0];	Start arc
10	Movl P[8], V[30], Z[0], Tool[1],Wobj[0];	Move to the arc-off point.
11	WeldOff ArcData[0];	Extinguish arc.
12	ROffsOff;	Offset end
13	End;	Program end

Table9-2-5-2 Old version welding instructions

No.	Instructions	Description
1	Start;	Program start
2	ClearSearchTempData(0);	Clear the cached data corresponding to condition number 0 of touch sensing.
3	SearchL Dir[-X], P[0], V[30], Z[0], TouchData[0], Tool[1],Wobj[0];	Move to the point P0 using Movl, then search along the -X axis direction of the workobject frame.
4	SearchL Dir[X], P[1], V[30], Z[0], TouchData[0], Tool[1],Wobj[0];	Move to the point P1 using Movl, then search along the X axis direction of the workobject frame.
5	SearchL Dir[Y], P[2], V[30], Z[0], TouchData[0], Tool[1],Wobj[0];	Move to the point P2 using Movl, then search along the Y axis direction of the workobject frame.
6	CalcSearchPR (TouchData[0], PR[0]);	Calculate the offset and store it in PR[0]. When the "Reference flag" in the current condition interface is set to "1: Set reference", the offset calculated by executing this instruction is 0.
7	ROffsOn (PR[0]);	Offset start
8	MovlArcOn P[7], V[30], Z[0], ArcData[0], Tool[1],Wobj[0];	Move to the arc start point.
9	MovlArcOff P[8], V[30], Z[0], ArcData[0], Tool[1],Wobj[0];	Move to the arc-off point.
10	ROffsOff;	Offset end
11	End;	Program end

7. Simple search



Usage procedure:

1. Set the corresponding parameters in the touch sensing parameter "TouchData". If the "Search pattern" is set to "3: Simple search" and the "Search type" is set to "1: 2D", The "Reference flag" is not applicable.
2. Execute the following search program to obtain accurate welding points.

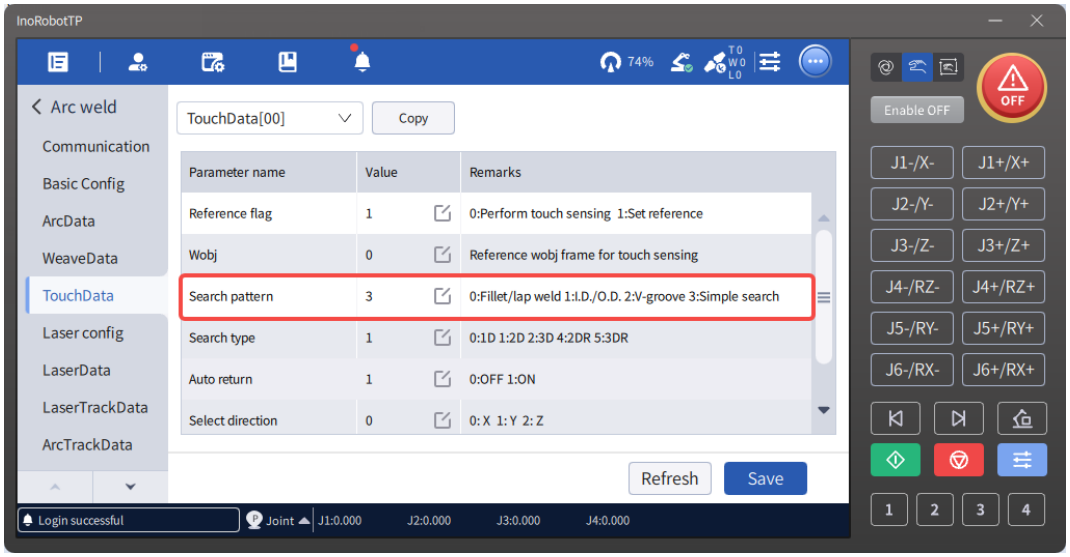


Table9-2-5-1 New version welding instructions

No.	Instructions	Description
1	Start;	Program start
2	ClearSearchTempData(0);	Clear the cached data corresponding to condition number 0 of touch sensing.
3	SearchL Dir[Y], P[0],V[30], Z[0], TouchData[0], Tool[1],Wobj[0];	Move to the point P0 using Movl, then search along the Y axis direction of the workobject frame.
4	SearchL Dir[-Z], P[1],V[30], Z[0], TouchData[0], Tool[1],Wobj[0];	Move to the point P1 using Movl, then search along the -Z axis direction of the workobject frame.

No.	Instructions	Description
5	CalcSearchPR (TouchData[0], PR[0]);	Calculate PR[0]. Replace the Y value of PR[0] with the Y value of the point searched from point P0 along the Y direction. Replace the X and Z values of PR[0] with the X and Z values of the point searched from point P1 along the -Z direction. (Replace the corresponding coordinate in PR depending on the search direction. For the second search point, in addition to replacing the value corresponding to the specified search direction, it also replaces the value of the missing search direction, e.g., the X-axis direction.)
6	SearchL Dir[Y], P[2],V[30], Z[0], TouchData[0], Tool[1],Wobj[0];	Move to the point P2 using Movl, then search along the Y axis direction of the workobject frame.
7	SearchL Dir[-Z], P[3], V[30], Z[0], TouchData[0], Tool[1],Wobj[0];	Move to the point P3 using Movl, then search along the -Z axis direction of the workobject frame.
8	CalcSearchPR (TouchData[0], PR[1])	Calculate PR[1]. Replace the Y value of PR[1] with the Y value of the point searched from point P2 along the Y direction. Replace the X and Z values of PR[1] with the X and Z values of the point searched from point P3 along the -Z direction. (Replace the corresponding coordinate in PR depending on the search direction. For the second search point, in addition to replacing the value corresponding to the specified search direction, it also replaces the value of the missing search direction, e.g., the X-axis direction.)
9	Movl ReplacePos(P[7], PR[0]),V[30], Z[0], Tool[1],Wobj[0];	Replace the X, Y, Z values of P[7] with those in PR[0], keeping the original A, B, C unchanged.
10	WeldOn ArcData[0];	Start arc

No.	Instructions	Description
11	Movl ReplacePos(P[8], PR[1]),V[30], Z[0], Tool[1],Wobj[0];	Replace the X, Y, Z values of P[8] with those in PR[1], keeping the original A, B, C unchanged.
12	WeldOff ArcData[0];	Extinguish arc.
13	End;	Program end

Table9-2-5-2 Old version welding instructions

No.	Instructions	Description
1	Start;	Program start
2	ClearSearchTempData(0);	Clear the cached data corresponding to condition number 0 of touch sensing.
3	SearchL Dir[Y], P[0],V[30], Z[0], TouchData[0], Tool[1],Wobj[0];	Move to the point P0 using Movl, then search along the Y axis direction of the workobject frame.
4	SearchL Dir[-Z], P[1],V[30], Z[0], TouchData[0], Tool[1],Wobj[0];	Move to the point P1 using Movl, then search along the -Z axis direction of the workobject frame.
5	CalcSearchPR (TouchData[0], PR[0]);	Calculate PR[0]. Replace the Y value of PR[0] with the Y value of the point searched from point P0 along the Y direction. Replace the X and Z values of PR[0] with the X and Z values of the point searched from point P1 along the -Z direction. (Replace the corresponding coordinate in PR depending on the search direction. For the second search point, in addition to replacing the value corresponding to the specified search direction, it also replaces the value of the missing search direction, e.g., the X-axis direction.)
6	SearchL Dir[Y], P[2],V[30], Z[0], TouchData[0], Tool[1],Wobj[0];	Move to the point P2 using Movl, then search along the Y axis direction of the workobject frame.
7	SearchL Dir[-Z], P[3], V[30], Z[0], TouchData[0], Tool[1],Wobj[0];	Move to the point P3 using Movl, then search along the -Z axis direction of the workobject frame.
8	CalcSearchPR(TouchData[0], PR[1]);	Calculate PR[1]. Replace the Y value of PR[1] with the Y value of the point searched from point P2 along the Y direction. Replace the X and Z values of PR[1] with the X and Z values of the point searched from point P3 along the -Z direction. (Replace the corresponding coordinate in PR depending on the search direction. For the second search point, in addition to replacing the value corresponding to the specified search direction, it also replaces the value of the missing search direction, e.g., the X-axis direction.)
9	MovlArcOn P[7], PR[0],V[30], Z[0], ArcData[0], Tool[1],Wobj[0];	Replace the X, Y, Z values of P[7] with those in PR[0], keeping the original A, B, C unchanged.

No.	Instructions	Description
10	MovlArcOff P[8], PR[1],V[30], Z[0], ArcData[0], Tool[1],Wobj[0];	Replace the X, Y, Z values of P[8] with those in PR[1], keeping the original A, B, C unchanged.
11	End;	Program end

9.3 Laser Seam Finding and Laser Tracking

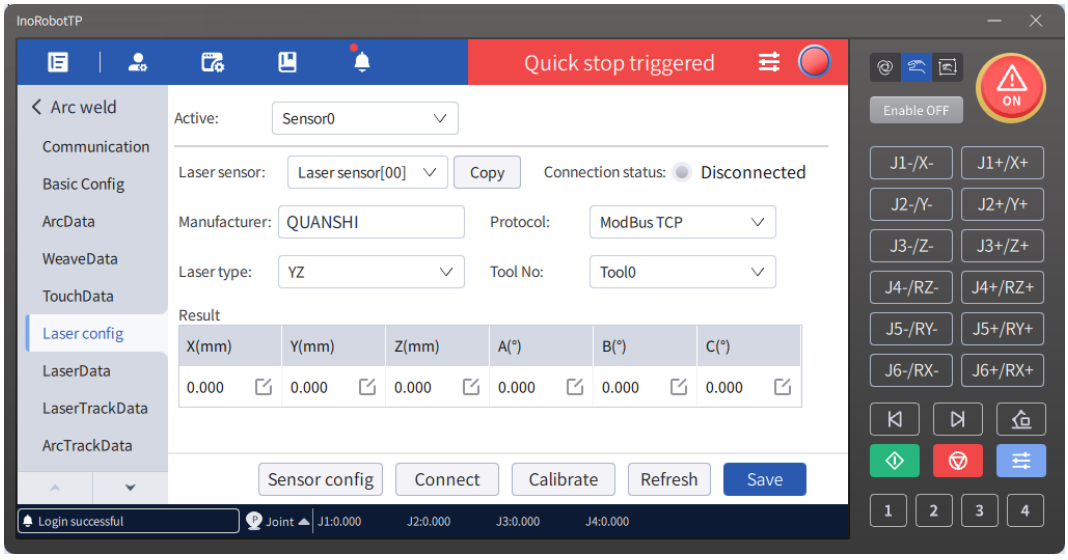
9.3.1 Laser Configuration

9.3.1.1 Overview

Before using the laser seam finding or laser tracking function, you need to configure the laser and complete the laser calibration.

9.3.1.2 Parameter Description

1. Laser configuration home page



This page by default contains sensor configuration data from third-party manufacturers that comply with the Inovance Technology laser sensor protocol. Select the corresponding laser sensor ID based on the manufacturer of the sensor in use, choose the corresponding tool number, and then perform calibration. Do not change the laser type and sensor configuration information arbitrarily, as this may result in communication failure with the sensor.

Parameter name	Description	Range	Unit
Active	Currently active sensor	0 to 15	-
Laser sensor	The sensor currently being edited and viewed	0 to 15	-
Manufacturer	Laser manufacturer name	Up to 12 characters	-

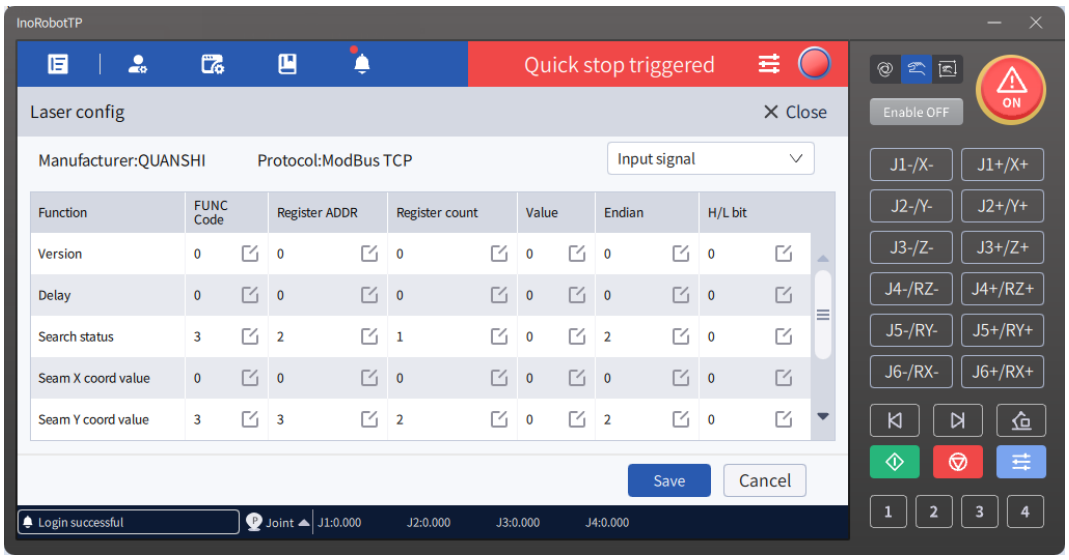
Parameter name	Description	Range	Unit
Protocol	Laser communication protocol type	Modbus-TCP or XML Default: Modbus-TCP	-
Laser type	The laser type.	YZ, XZ, XY, XYZ (default value: YZ)	-
Tool No.	The tool number used for laser calibration. Do not use external tools.	0 to 15 (default value: 0)	-
Result	The value of the laser frame after calibration.	-9999999.999 to +9999999.999 (default value: 0)	(X Y Z) mm (W P R) deg

2. Sensor configuration page

The sensor configuration page is used to adapt different sensors. For the third-party manufacturers that comply with Inovance's laser sensor protocol, contact Inovance technical support for details.

Parameters on this page will affect the functions of laser seam finding and laser tracking. It is recommended to keep the default values. If you need to adapt to other manufacturers' laser sensors, contact Inovance technical support.

Click "Save" to save the changes and return to the "Laser config" home page; click "Cancel" to discard the changes and return to the "Laser Config" home page.



The meanings of signal attributes are shown in the table below.

No.	Name	Description
1	FUNC Code	Corresponding Modbus function code, up to 21 characters
2	Register ADDR	The register address corresponding to this function, range 0 to 65535
3	Register count	The number of registers corresponding to this function, range 0 to 65535
4	Value	Initial value, int type, range 0 to 65535

No.	Name	Description
5	Endian	Endianness 0 to 3 0: ABCD 1: CDAB 2: BADC 3: DCBA
6	H/L bit	0: Both high and low active, 1: low active, 2: high active

Input signal:

Function	Description	Unit
Version	The version number of the sensor firmware.	-
Delay	The delay time, which refers to the difference between the current system timestamp and the current frame timestamp.	1 ms
Search status	Indicates whether the search was successful.	-
Seam X coord value	Weld seam X coordinate	0.01 mm
Seam Y coord value	Weld seam Y coordinate	0.01 mm
Seam Z coord value	Weld seam Z coordinate	0.01 mm
Seam width	Seam width	0.01 mm
Seam depth	Seam depth	0.01 mm
Laser status	Indicates whether the laser is on.	-
Tracker status	Indicates whether the laser is enabled.	-
Job No.	The task number of the currently active bead pattern.	-
Seam alignment	The status indicating whether the weld seam is aligned.	-
System timestamp	The current system timestamp. It starts at 0 when the controller is powered on and is incremented by the hardware.	1 ms
Result frame timestamp	The timestamp of the current result frame. This timestamp shares a common hardware clock source with PT2 and PTS1, and is incremented by the hardware.	1 ms
Sensor status	Indicates the current status of the sensor, which can be success, failure, or in progress.	-

Function	Description	Unit
Seam (μm/unit)	Defines the length per unit of weld coordinate. The unit is μm/unit. For example, if a Full-V (QUANSHI) sensor has a scale of 0.01 mm per unit, the unit weld length is 10 μm/unit; if a CHUANGXIANG sensor has a scale of 0.1 mm per unit, the unit weld length is 100 μm/unit.	μm/unit
System reserved parameters	9 parameters are reserved.	-

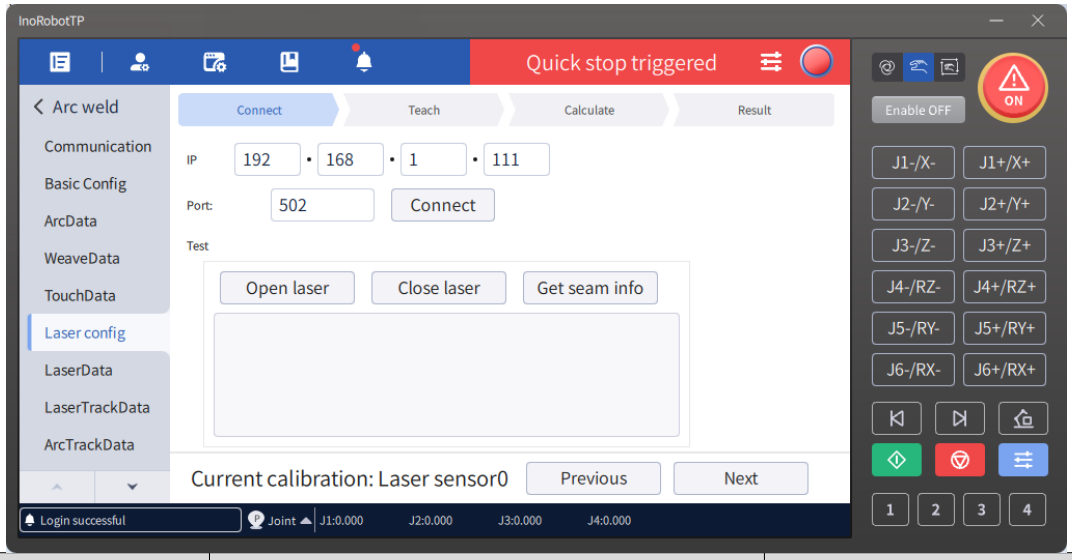
Output signal:

Function	Description	Unit
Open laser	Open the laser.	-
Close laser	Close the laser.	-
Open track	Enable the tracker.	-
Close track	Disable the tracker.	-
Job No.	The task number of bead pattern.	-
Mode	Incremental mode, absolute mode	-
Seam offset X	The offset in the X direction of the weld seam.	1 mm
Seam offset Y	The offset in the Y direction of the weld seam.	1 mm
Seam offset Z	The offset in the Z direction of the weld seam.	1 mm
Seam calibration	Whether to enable the calibration function.	-
System reserved parameters	17 parameters are reserved.	-

3. Connection page

This page is used to connect to the laser sensor. Enter the IP address and port number to connect to the laser sensor. After a successful connection, the "Connect" button will change to "Disconnect". At this point, you can use the three buttons - "Open laser", "Close laser", and "Get seam info" - to perform a communication test and verify whether the communication with the laser sensor is normal.

Click "Next" to go to the "Teach" page; click "Previous" to return to the main "Laser Config" page.



Parameter name	Description	Range
IP	The IP address of the laser sensor.	0 to 255 per octet
Port	The port number used for connection.	0 to 65535

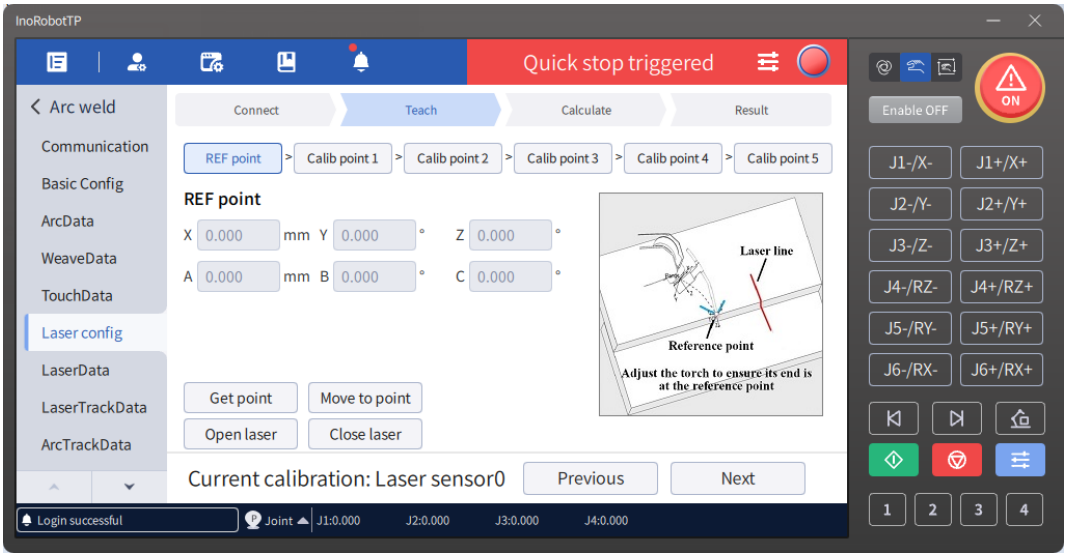
4. Calibration point teaching page

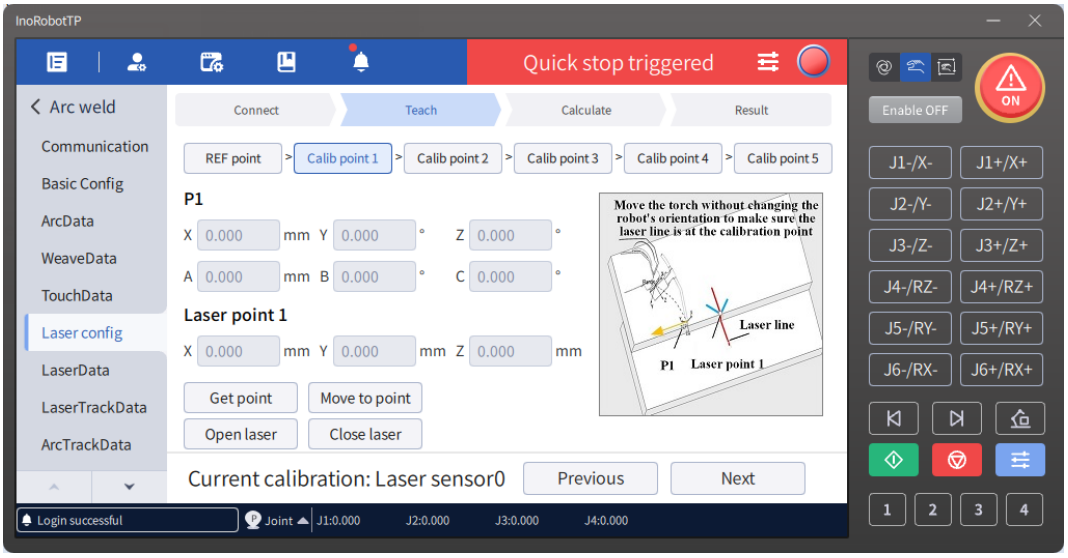
   The Inovance welding robot calibrates the laser sensor using the 5-point method, separately taking 1 reference point and 5 teaching points where the robot orientation remains unchanged and the laser line is at the calibration points.

   When selecting the reference point, move the robot TCP to the calibration point, click "Get point" to obtain the robot coordinates of the tool selected for the sensor relative to the base frame.

   When selecting P[1]-P[5], move the robot with the robot orientation unchanged, so that the laser line is at the calibration points. At 5 different positions, click "Get point" to obtain the robot coordinates of the tool selected for the sensor relative to the base frame and obtain the laser points from the laser sensor.

   Click 'Next" to enter the calibration calculation page; or click "Previous" to return to the connection page.

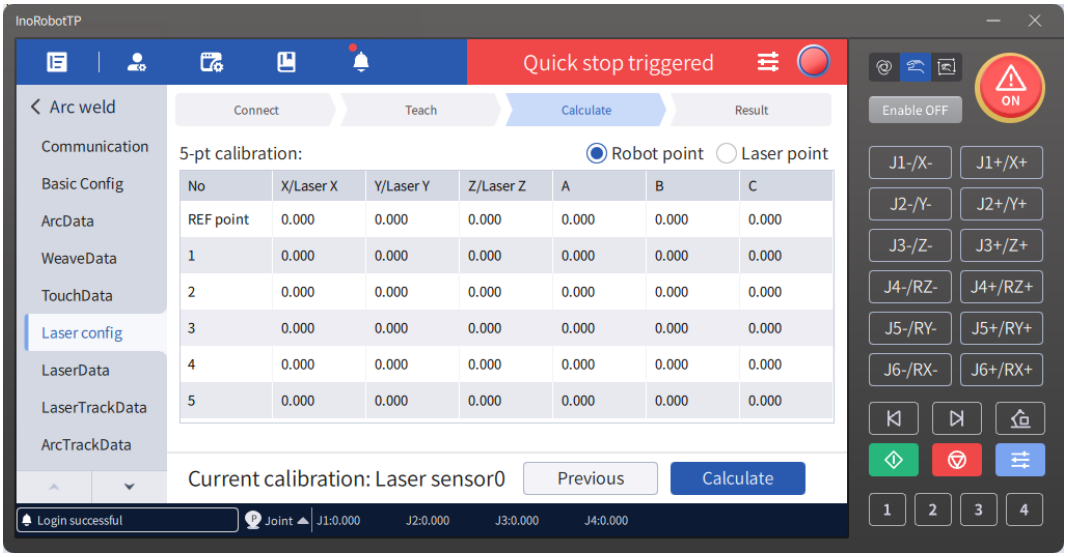




5. Calibration calculation page

   In this page, you can view the obtained robot points and laser points in the table.

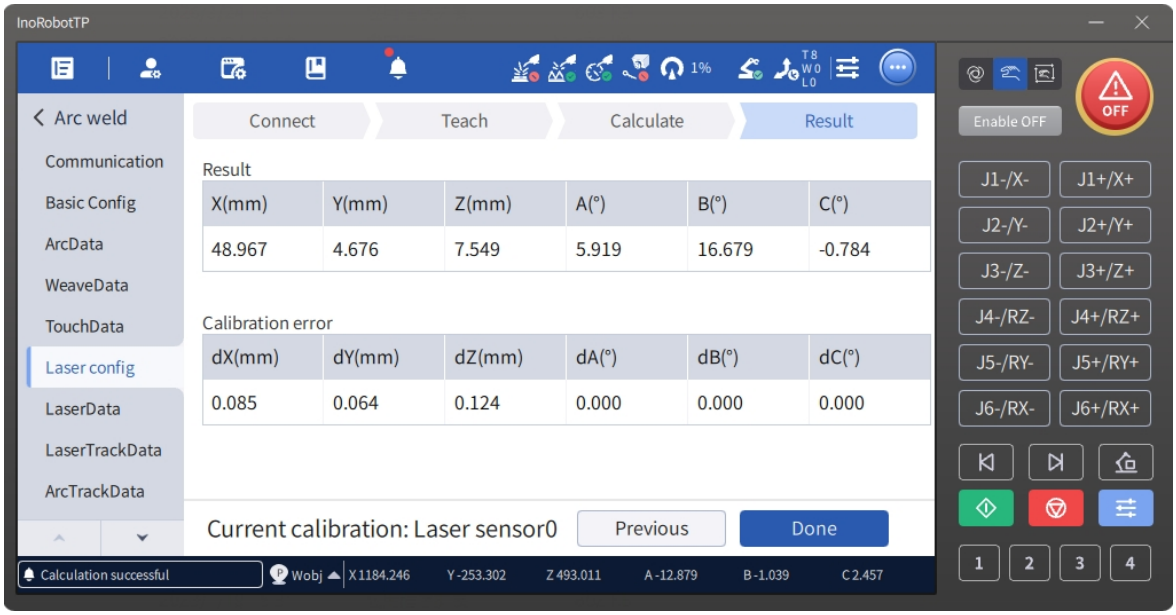
   Click "Calculate"to start the calculation. After successful calculation, you will enter the "Result" page. You can also click the "Previous" button to return to the "Teach" page.



6. Calibration results page

   This page displays the calibration calculation results.

   Click "Done" to enter the laser configurator home page; or click "Previous" to return to the calibration calculation page.



9.3.1.3 Permission Allocation

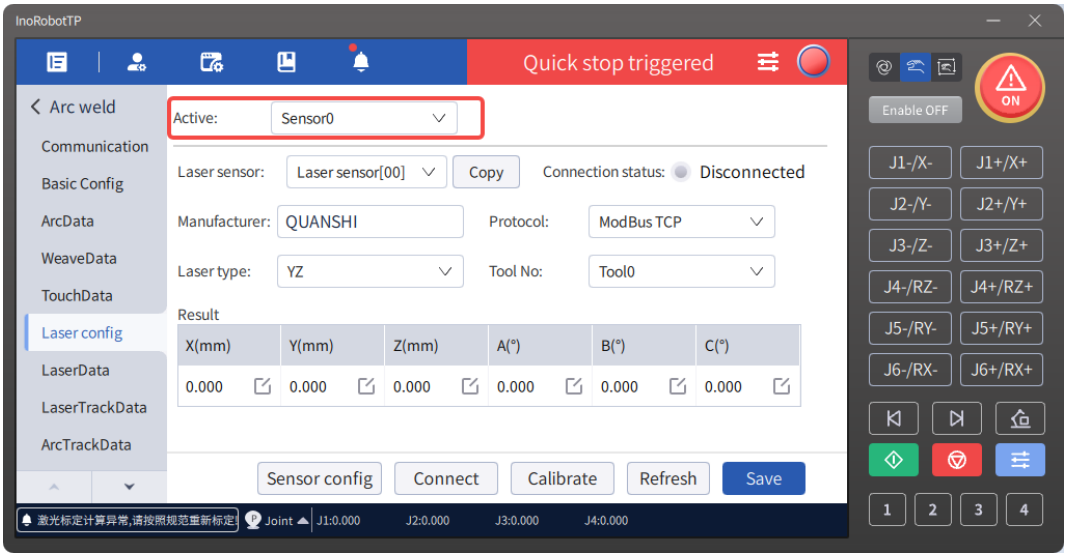
Control permission		Operation mode			Authority			
Teach pendant	Other control permissions	Manual low speed mode	Manual high speed mode	Auto mode	User mode	Edit mode	Admin	Manufacturer
√	×	√	×	×	×	×	√	√

9.3.1.4 Usage Procedure

1. Select a suitable plate and draw reference lines on it (the material of the plate must not affect the normal recognition by the laser sensor).



2. Enter the "Laser Config" home page, select the appropriate sensor number according to the sensor brand, and click "Save".



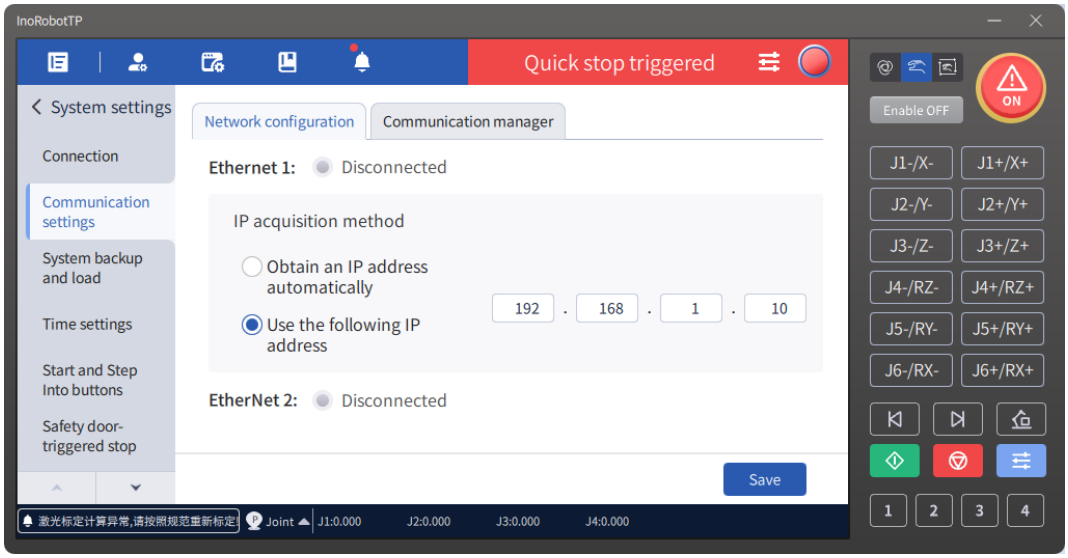
3. Set the IP.

   a. Confirm the IP address and port number of the sensor.

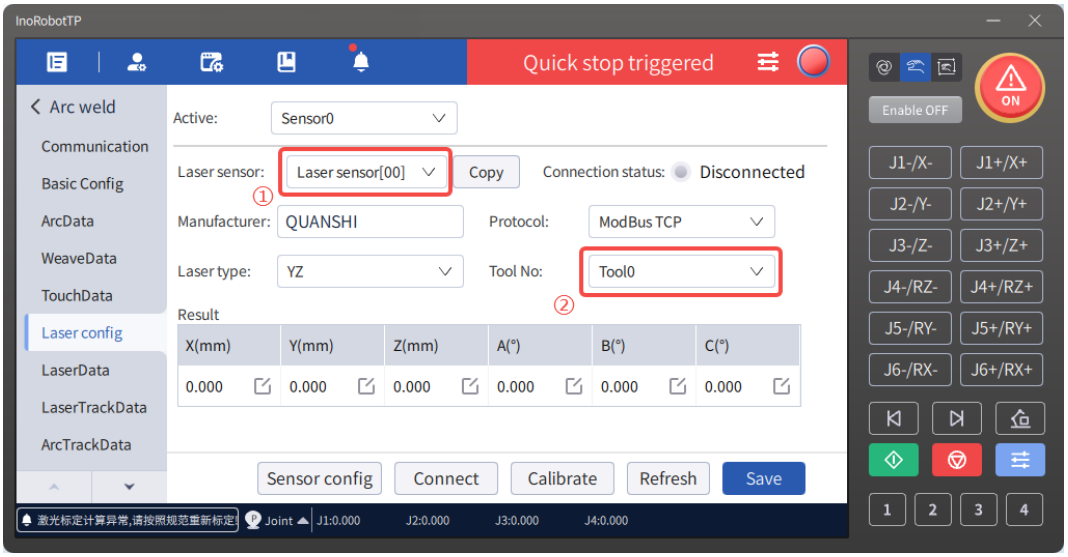
   b. Connect the sensor's Ethernet cable to the Ethernet port of the controller.

   c. Set the robot IP address.

   Go to "Settings" > "System settings" > "Communication settings" > "Network configuration" > "Use the following IP address" to enter an IP address in the same subnet as the laser sensor, for example, if the sensor's IP is 192.168.1.111, set this IP to 192.168.1.xxx, where the last octet differs from the sensor's IP, e.g. 192.168.1.10. Then click the "Save" button in the lower right corner to save the setting.

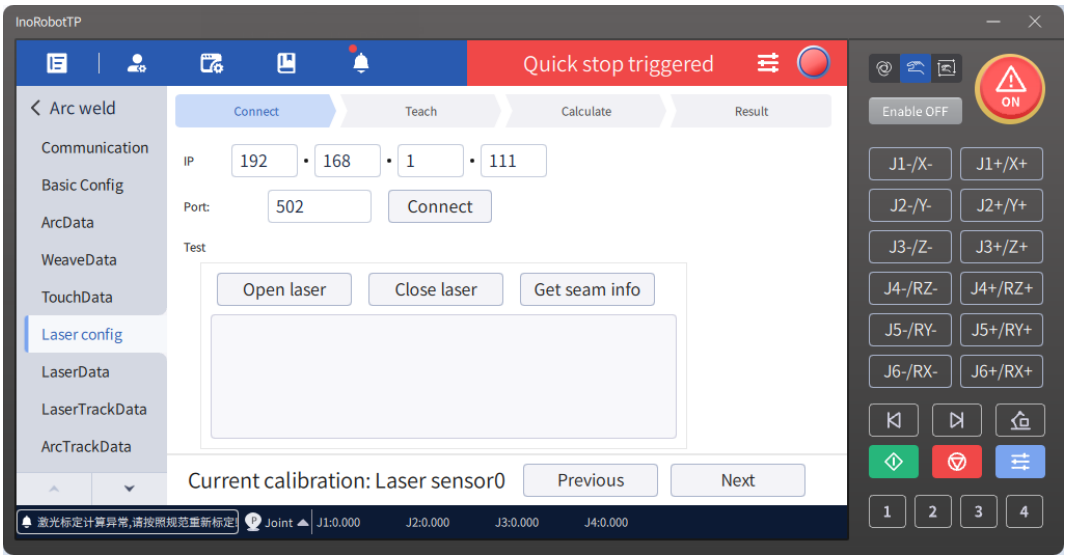


4. In the following page, select the active sensor ①, choose the corresponding tool number ②, click "Connect" to enter the connection page and perform the connection operation.



5. Connect the sensor.

   Enter the IP address and port number of the sensor, click "Connect" to connect the sensor.



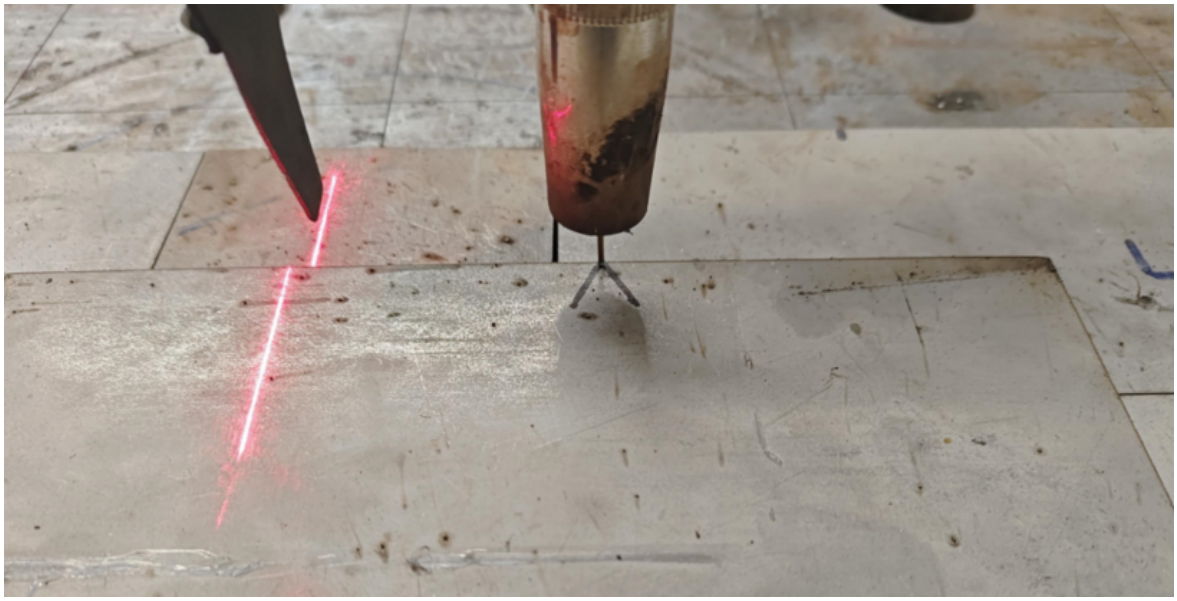
6. Perform the communication test.

   Click "Open laser", "Close laser", and "Get seam info" to perform the communication test and check whether the communication with the sensor is normal (the "Get seam info" is available only after the laser point is recognized).

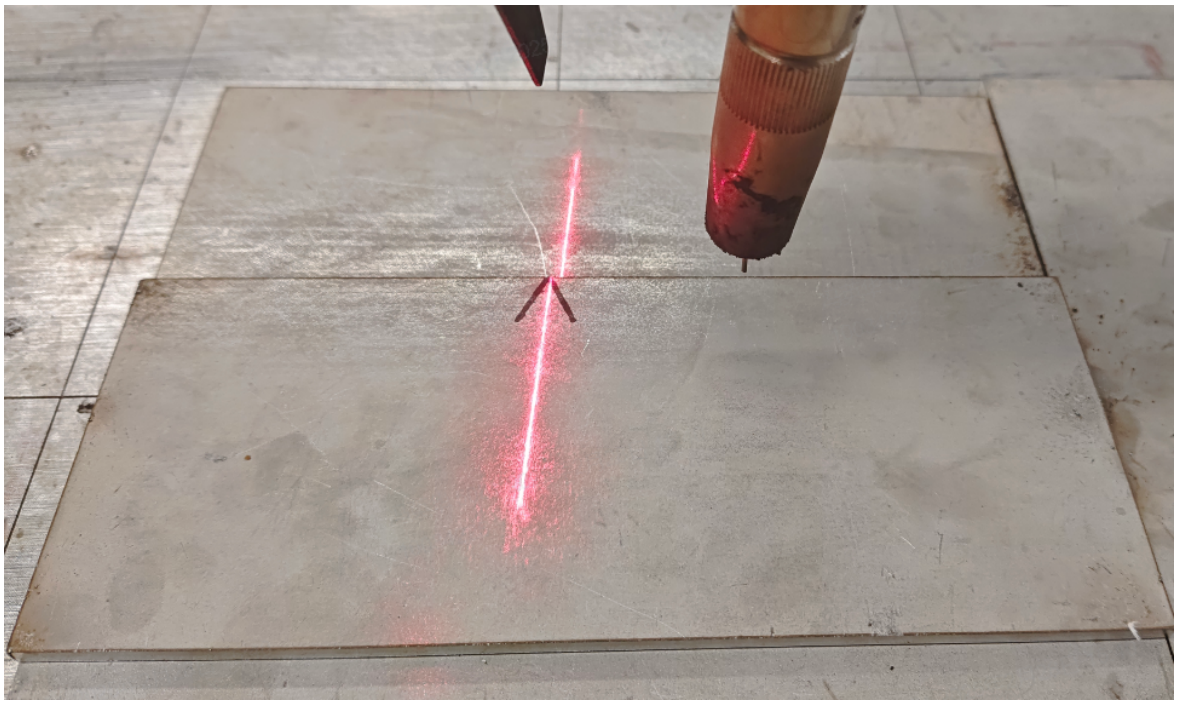
7. Teach calibration points.

   a. After a successful connection, click "Next" to proceed with the calibration point teaching.

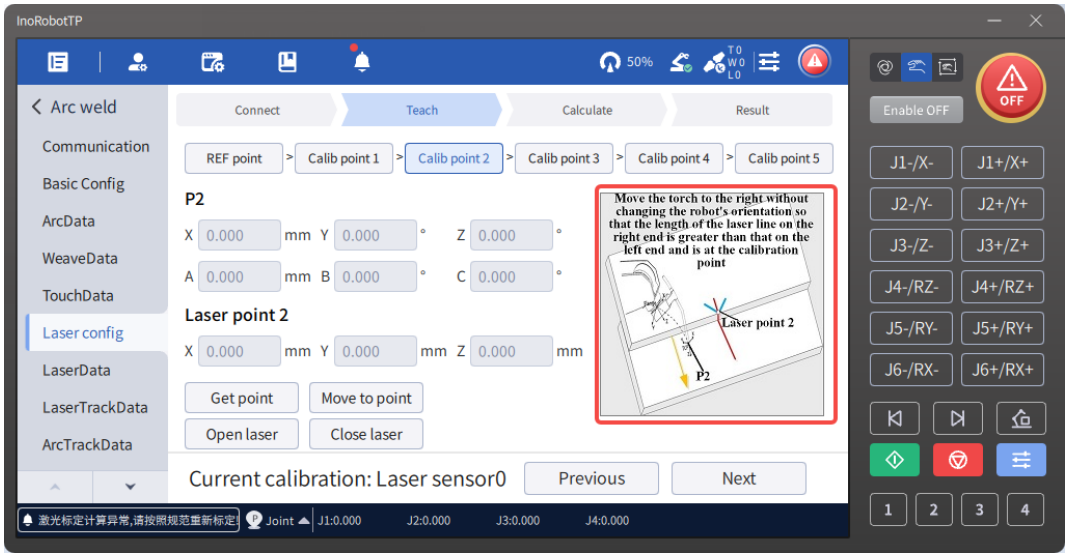
   b. For obtaining the reference point, click the "REF point" button, move the TCP center to the intersection of the reference line and the plate edge, then click "Get point" to obtain the current robot point. After the reference point is successfully obtained, the page will automatically switch to the calibration page for P[1].



c. Obtain 5 pairs of robot points and laser points. Click the "Calib point 1" button, move the robot with the orientation unchanged so that the laser line moves to the reference line, and click "Get point" to obtain the current robot point and laser point. After the point is successfully obtained, the page will automatically switch to the calibration page for P[2].



d. Move the robot up and down, left and right, and front and back by more than 10 mm respectively to move the laser line to the reference line, and similarly obtain the P[2], P[3], P[4], and P[5] points. Follow the interface instructions to obtain each point.



8. View and modify the teaching results.
   After all points are obtained, click "Next" to view the obtained reference point and 5 pairs of robot points and laser points. Double-click the corresponding point to make modification.

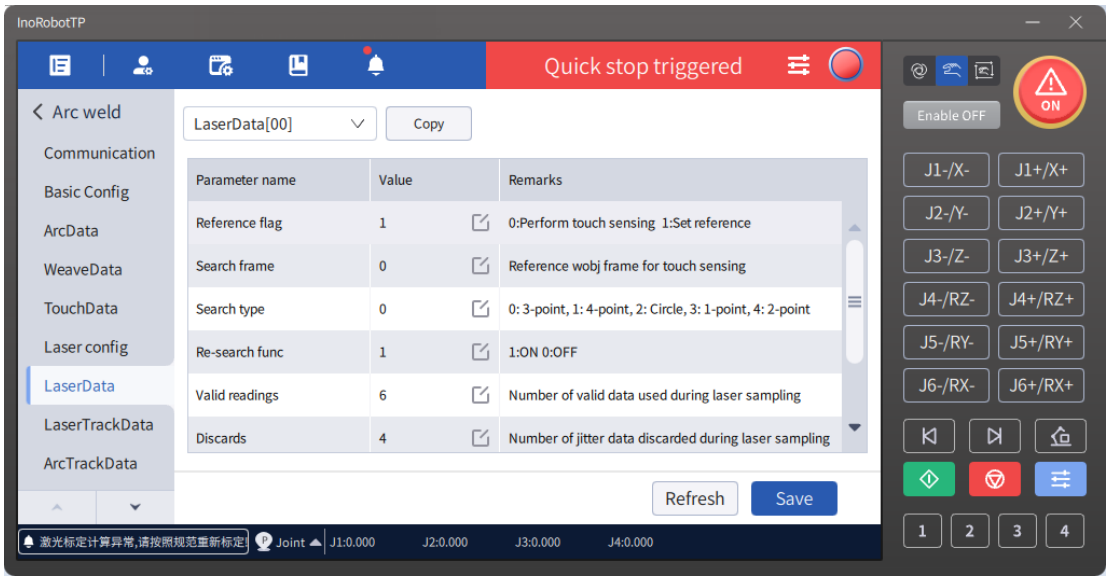
9. Click "Calculate" to perform the calibration calculation.
   If the calculation is successful, it will automatically jump to the next page, displaying the calibration results and calibration error. Click "Done" to complete the calibration. If the calculation fails, the message bar will print "Calculation failed, please try again." The page does not jump, which means the calculation result has excessive error and requires recalibration.

9.3.2 Laser Seam Finding

9.3.2.1 Overview

This function detects the actual position of the weld seam or workobject using a laser sensor and corrects the welding trajectory. This solves the problem of welding path deviation caused by teaching errors, workobject position errors, and thermal deformation of the workobject in actual production, thereby greatly improving welding quality.

9.3.2.2 Parameter Description



Parameter name	Description	Range	Unit
Reference flag	0: Perform search 1: Set reference	0 to 1	-
Search frame	Reference wobj frame for touch sensing	0 to 15	-
Search type	Search method 0: 3-point 1: 4-point 2: Circle 3: 1-point 4: 2-point	0 to 4	-
Re-search func	Used to set whether to search again after the first search fails. After the re-search function is enabled, the system will repeatedly search forward until the weld seam is found or the set maximum search distance is reached. 0: OFF 1: ON	0 to 1	-
Valid readings	The number of valid data obtained from the laser sensor. The position search is considered successful only when the number of valid data reaches this set value.	0 to 20	-
Discards	When reading laser data, in order to eliminate data jitter, this number of data is discarded before valid data acquisition starts.	0 to 20	-
Threshold	The euclidean distance threshold between acquired adjacent data. If the distance is less than this threshold, the current data is considered valid.	0 to 10	mm

Parameter name	Description	Range	Unit
Arrival delay	The time period the robot stops after moving to the search teaching point before acquiring laser data, to prevent instability in the laser data due to vibrations.	0 to 2000	mm
Search distance	The distance the robot moves during the re-search.	0 to 500	mm
Search speed	The speed of robot motion during the re-search.	0 to 100	mm/s
Max rotation	The maximum deviation of A/B/C calculated by position search. An alarm is triggered when this value is exceeded.	0 to 60	deg
Max offset	The maximum deviation of X/Y/Z calculated by position search. An alarm is triggered when this value is exceeded.	1 to +500	mm
Input port	The input port number used during the re-search. An alarm is triggered when the port is not configured.	-1 to +127	-
Output port (not enabled)	-		-
X compensation	The compensation amount for offsetting the point position obtained by searching along the X axis direction of the workobject frame.	-200 to +200	mm
Y compensation	The compensation amount for offsetting the point position obtained by searching along the Y axis direction of the workobject frame.	-200 to +200	mm
Z compensation	The compensation amount for offsetting the point position obtained by searching along the Z axis direction of the workobject frame.	-200 to +200	mm

Parameter name	Description	Range	Unit
Specified X offset	This parameter is only used when the search type is set to "1-point" or "2-point". 0: Do not use the X direction offset calculated from either the first or the second set of detection points. Therefore, the X direction offset is 0. 1: Use the X direction offset calculated from the first set of detection points 2: Use the X direction offset calculated from the second set of detection points	0 to 2	-
Specified Y offset	This parameter is only used when the search type is set to "1-point" or "2-point". 0: Do not use the Y direction offset calculated from either the first or the second set of detection points. Therefore, the Y direction offset is 0. 1: Use the Y direction offset calculated from the first set of detection points 2: Use the Y direction offset calculated from the second set of detection points	0 to 2	-
Specified Z offset	This parameter is only used when the search type is set to "1-point" or "2-point". 0: Do not use the Z direction offset calculated from either the first or the second set of detection points. Therefore, the Z direction offset is 0. 1: Use the Z direction offset calculated from the first set of detection points 2: Use the Z direction offset calculated from the second set of detection points	0 to 2	-

Parameter name	Description	Range	Unit
If search err trig alarm	0: Alarm 1: No alarm but output error status	0 to 1	-
Search Err Status Out IO	The port for output signal when search error occurs.	-1: NULL 0 to 127: Out[0] to Out[127]	-

9.3.2.3 Permission Allocation

Control permission		Operation mode			Authority			
Teach pendant	Other control permissions	Manual low speed mode	Manual high speed mode	Auto mode	User mode	Edit mode	Admin	Manufacturer
√	×	√	×	×	×	×	√	√

9.3.2.4 Notes

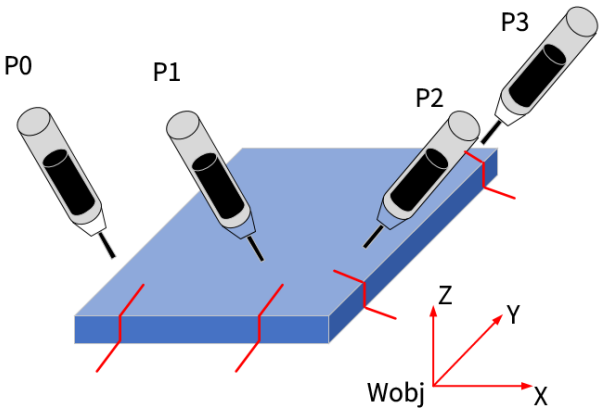
- If the data obtained from the laser sensor is 0, the robot side considers this value as abnormal. Therefore, during function usage, avoid obtaining a 0 value due to the search position, even if the sensor detection is normal at that time.
- Pay attention to the limitations of each search method. See specific usage procedure for details.

9.3.2.5 Usage Procedure

9.3.2.5.1 Detect Points, Calculate Deviation, Correct Trajectory

9.3.2.5.1.1 4-Point Method

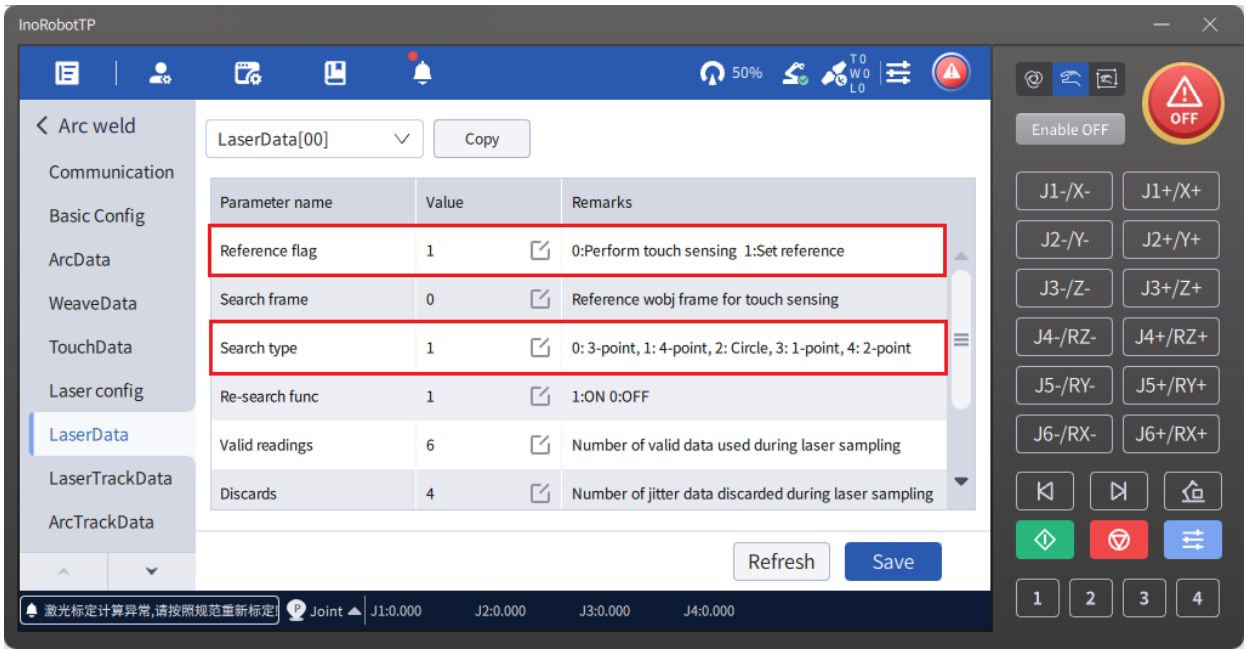
This method is used to determine the workobject position using four characteristic points on the workobject, and to correct the entire welding trajectory based on the calculated translational and rotational offsets (ΔXYZABC).



Usage procedure:

1. Set the corresponding parameters in the laser seam finding parameter "LaserData", such as setting "Search type" to "1: 4-point".

2. Before performing the position search for the first time, calculating the offset, and correcting the trajectory based on the offset, first perform the procedure of calculating the position search reference. Set the "Reference flag" in "LaserData" to "1: Set reference", and then execute the following position search program (only once) to complete the calculation of the position search reference.



3. After the reference position calculation is completed, set the "Reference flag" in "LaserData" to "0: Perform search", and execute the following position search program (the same program as in step 2) to correct the welding trajectory.

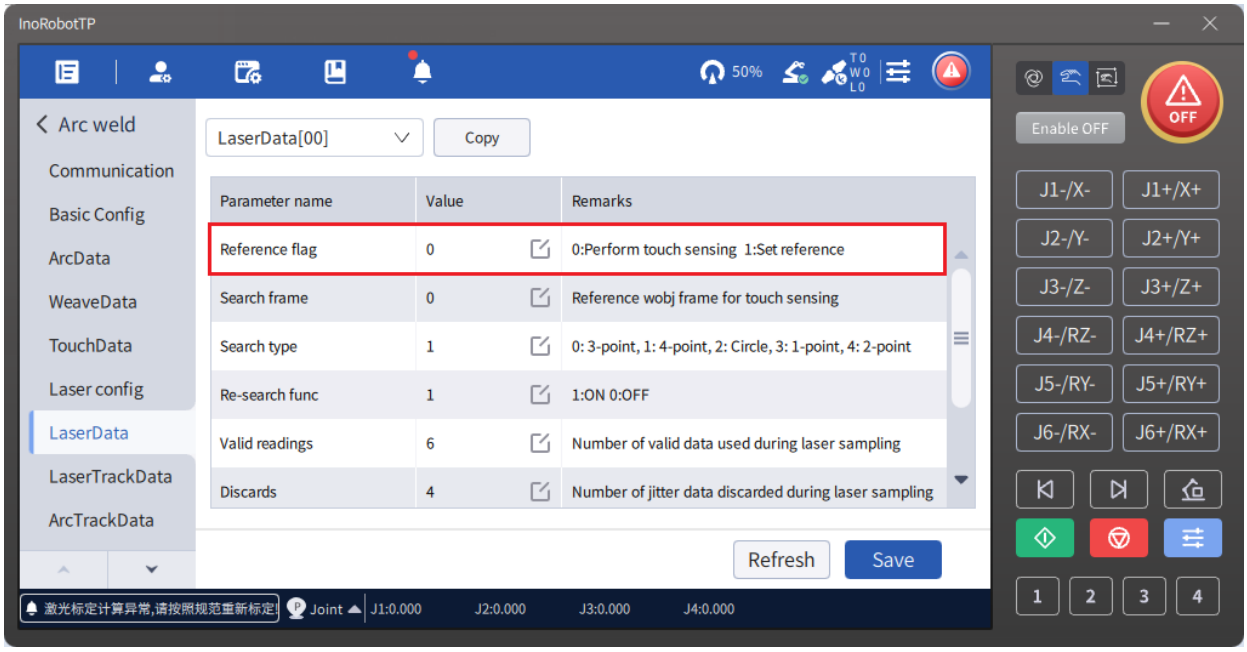


Table9-3-2-5-1-1-1 New version instructions

No.	Program	Description
1	Start;	Program start

No.	Program	Description
2	ClearSearchTempData(0)	Clear the cached data corresponding to condition number 0 of laser seam finding.
3	SearchL Dir[X], P[0], V[30], Z[0], LaserData[0], LaserJob[0],Tool[0], Wobj[0]	Move to point P0, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
4	SearchL Dir[X], P[1], V[30], Z[0], LaserData[0], LaserJob[0],Tool[0], Wobj [0]	Move to point P1, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
5	SearchL Dir[Y], P[2], V[30], Z[0], LaserData[0], LaserJob[1], Tool[0], Wobj [0]	Move to point P2, and use "LaserJob[1]" to specify laser job number 1 for laser seam finding. Dir[Y] indicates that the search starts along the Y direction of the workobject frame during the re-search.
6	SearchL Dir[Y], P[3], V[30], Z[0], LaserData[0], LaserJob[1], Tool[0], Wobj [0]	Move to point P3, and use "LaserJob[1]" to specify laser job number 1 for laser seam finding. Dir[Y] indicates that the search starts along the Y direction of the workobject frame during the re-search.
7	CalcSearchPR (LaserData[0], PR[4], LaserBase[1]);	When the "Reference flag" in the current condition interface is set to "1: Set reference", the offset calculated by executing this instruction is 0, and the calculated reference is stored in "LaserBase[1]". When the "Reference flag" in the current condition interface is set to "0: perform search", the offset is calculated by executing this instruction, and is stored in "PR[4]".
8	ROffson PR[4]	Offset the original trajectory based on the offset value in PR[4].
9	Movl P[8], V[30], Z[0],Tool[0], Wobj[0];	Move to the arc start point.
10	WeldOn ArcData[0];	Start arc
11	Movl P[9], V[30], Z[0],Tool[0], Wobj[0]	Move to the arc-off point.
12	WeldOff ArcData[0];	Extinguish arc.
13	ROffsoff	Offset end
14	END	Program end

Table9-3-2-5-1-1-2 Old version instructions

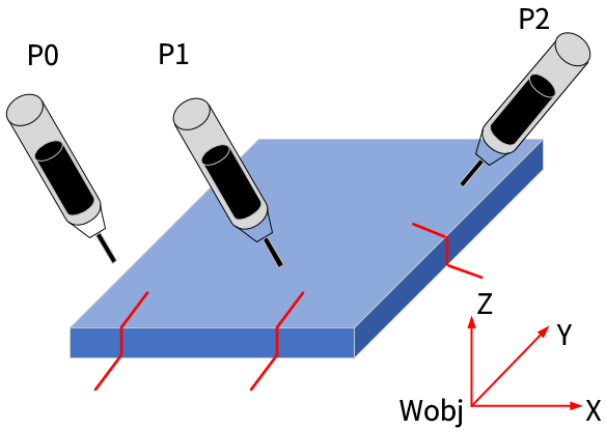
No.	Program	Description
1	Start;	Program starts.
2	ClearSearchTempData(0)	Clear the cached data corresponding to condition number 0 of laser seam finding.
3	SearchL Dir[X], P[0],V[30], Z[0], LaserData[0], LaserJob[0],Tool[0], Wobj[0]	Move to point P0, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
4	SearchL Dir[X], P[1], V[30], Z[0], LaserData[0], LaserJob[0],Tool[0], Wobj[0]	Move to point P1, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
5	SearchL Dir[Y], P[2], V[30], Z[0], LaserData[0], LaserJob[1],Tool[0], Wobj[0]	Move to point P2, and use "LaserJob[1]" to specify laser job number 1 for laser seam finding. Dir[Y] indicates that the search starts along the Y direction of the workobject frame during the re-search.
6	SearchL Dir[Y], P[3], V[30], Z[0], LaserData[0], LaserJob[1],Tool[0], Wobj[0]	Move to point P3, and use "LaserJob[1]" to specify laser job number 1 for laser seam finding. Dir[Y] indicates that the search starts along the Y direction of the workobject frame during the re-search.
7	CalcSearchPR (LaserData[0], PR[4], LaserBase[1]);	When the "Reference flag" in the current condition interface is set to "1: Set reference", the offset calculated by executing this instruction is 0, and the calculated reference is stored in "LaserBase[1]". When the "Reference flag" in the current condition interface is set to "0: perform search", the offset is calculated by executing this instruction, and is stored in "PR[4]".
8	ROffson PR[4]	Offset the original trajectory based on the offset value in PR[4].
9	MovlArcOn P[8], V[30], Z[0], ArcData[0],Tool[0], Wobj[0];	Move to the arc start point.
10	MovlArcOff P[9], V[30], Z[0], ArcData[0],Tool[0], Wobj[0]	Move to the arc-off point.
11	ROffsoff	Offset end
12	END	Program end

CAUTION

- During search detection, first detect two points on one edge, then detect two points on the other edge. As shown in the diagram, the search detection sequence P0>P1>P2>P3 is correct, while the sequence P0>P2>P1>P3 is incorrect.
- The edge to be detected must be a straight line.

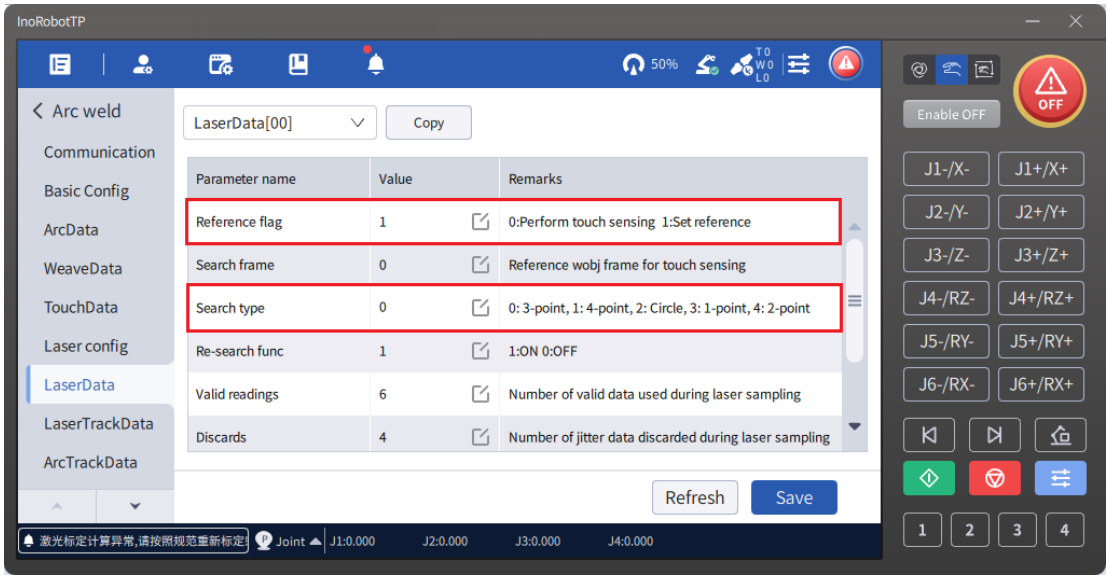
9.3.2.5.1.2 3-Point Method

This method is used to determine the workobject position using three characteristic points on the workobject, and to correct the entire welding trajectory based on the calculated translational and rotational offsets (ΔXYZABC).



Usage procedure:

1. Set the corresponding parameters in the laser seam finding parameter "LaserData", such as setting "Search type" to "0: 3-point".
2. Before performing the position search for the first time, calculating the offset, and correcting the trajectory based on the offset, first perform the procedure of calculating the position search reference. Set the "Reference flag" in "LaserData" to "1: Set reference", and then execute the following position search program (only once) to complete the calculation of the position search reference.



3. After the reference position calculation is completed, set the "Reference flag" in "LaserData" to "0: Perform search", and execute the following position search program (the same program as in step 2) to correct the welding trajectory.

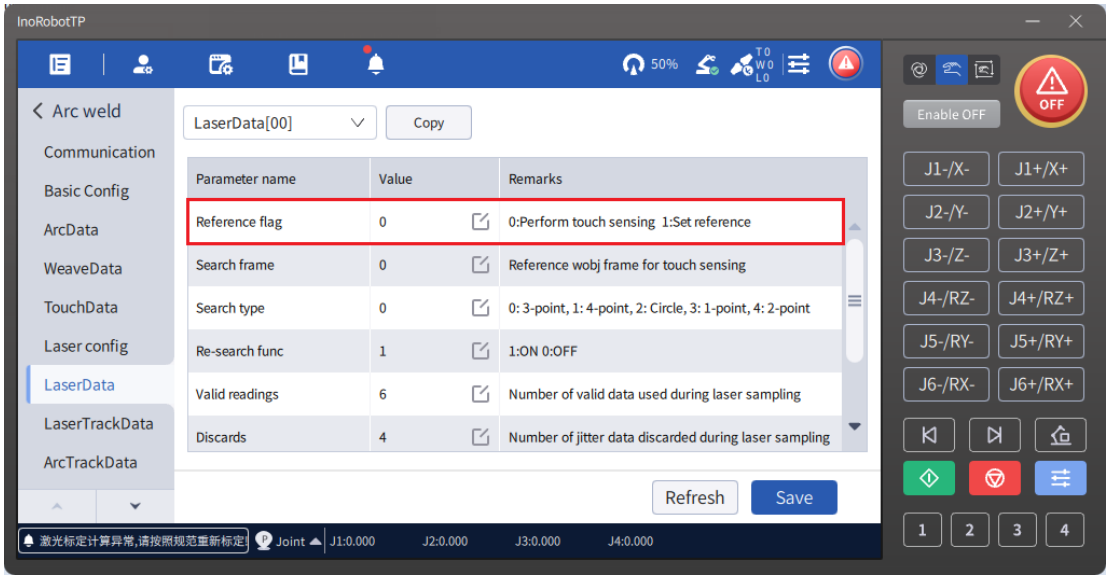


Table9-3-2-5-1-2-1 New version welding instructions

No.	Program	Description
1	Start;	Program start
2	ClearSearchTempData(0)	Clear the cached data corresponding to condition number 0 of laser seam finding.
3	SearchL Dir[X], P[0], V[30], Z[0], LaserData[0], LaserJob[0],Tool[0], Wobj[0]	Move to point P0, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
4	SearchL Dir[X], P[1], V[30], Z[0], LaserData[0], LaserJob[0],Tool[0], Wobj [0]	Move to point P1, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
5	SearchL Dir[Y], P[2], V[30], Z[0], LaserData[0], LaserJob[1],Tool[0], Wobj [0]	Move to point P2, and use "LaserJob[1]" to specify laser job number 1 for laser seam finding. Dir[Y] indicates that the search starts along the Y direction of the workobject frame during the re-search.

No.	Program	Description
7	CalcSearchPR (LaserData[0], PR[4], LaserBase[0]);	When the "Reference flag" in the current condition interface is set to "1: Set reference", the offset calculated by executing this instruction is 0, and the calculated reference is stored in "LaserBase[1]". When the "Reference flag" in the current condition interface is set to "0: perform search", the offset is calculated by executing this instruction, and is stored in "PR[4]".
8	ROffson PR[4];	Offset the original trajectory based on the offset value in PR[4].
9	Movl P[8], V[30], Z[0], Tool[0], Wobj[0];	Move to the arc start point.
10	WeldOn ArcData[1];	Start arc
11	Movl P[9], V[30], Z[0], Tool[0], Wobj[0];	Move to the arc-off point.
12	WeldOff ArcData[1];	Extinguish arc.
13	ROffsoff;	Offset end
14	END;	Program end

Table9-3-2-5-1-2-2 Old version welding instructions

No.	Program	Description
1	Start;	Program start
2	ClearSearchTempData(0);	Clear the cached data corresponding to condition number 0 of laser seam finding.
3	SearchL Dir[X], P[0], V[30], Z[0], LaserData[0], LaserJob[0],Tool[0], Wobj[0];	Move to point P0, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
4	SearchL Dir[X], P[1], V[30], Z[0], LaserData[0], LaserJob[0],Tool[0], Wobj[0];	Move to point P1, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
5	SearchL Dir[Y], P[2], V[30], Z[0], LaserData[0], LaserJob[1],Tool[0], Wobj[0];	Move to point P2, and use "LaserJob[1]" to specify laser job number 1 for laser seam finding. Dir[Y] indicates that the search starts along the Y direction of the workobject frame during the re-search.

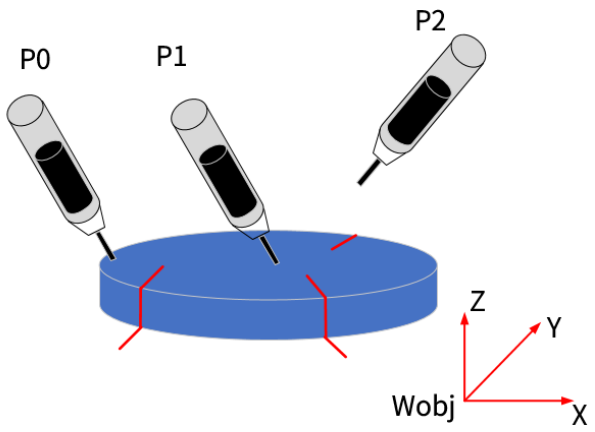
No.	Program	Description
7	CalcSearchPR (LaserData[0], PR[4], LaserBase[0]);	When the "Reference flag" in the current condition interface is set to "1: Set reference", the offset calculated by executing this instruction is 0, and the calculated reference is stored in "LaserBase[1]". When the "Reference flag" in the current condition interface is set to "0: perform search", the offset is calculated by executing this instruction, and is stored in "PR[4]".
8	ROffson PR[4];	Offset the original trajectory based on the offset value in PR[4].
9	MovlArcOn P[8], V[30], Z[0], ArcData[0], Tool[0], Wobj [0];	Move to the arc start point.
10	MovlArcOff P[9], V[30], Z[0], ArcData[0], Tool[0], Wobj [0];	Move to the arc-off point.
11	ROffsoff;	Offset end
12	END;	Program end

CAUTION

- During search detection, first detect two points on one edge, then detect one point on the other edge. As shown in the diagram, the search detection sequence P0>P1>P2 is correct, while the sequence P2>P1>P0 is incorrect.
- The two edges to be detected on the workobject must be straight lines, and the angle between them must be 90°.
- The three points to be detected on the workobject must lie in the same plane.

9.3.2.5.1.3 Circle

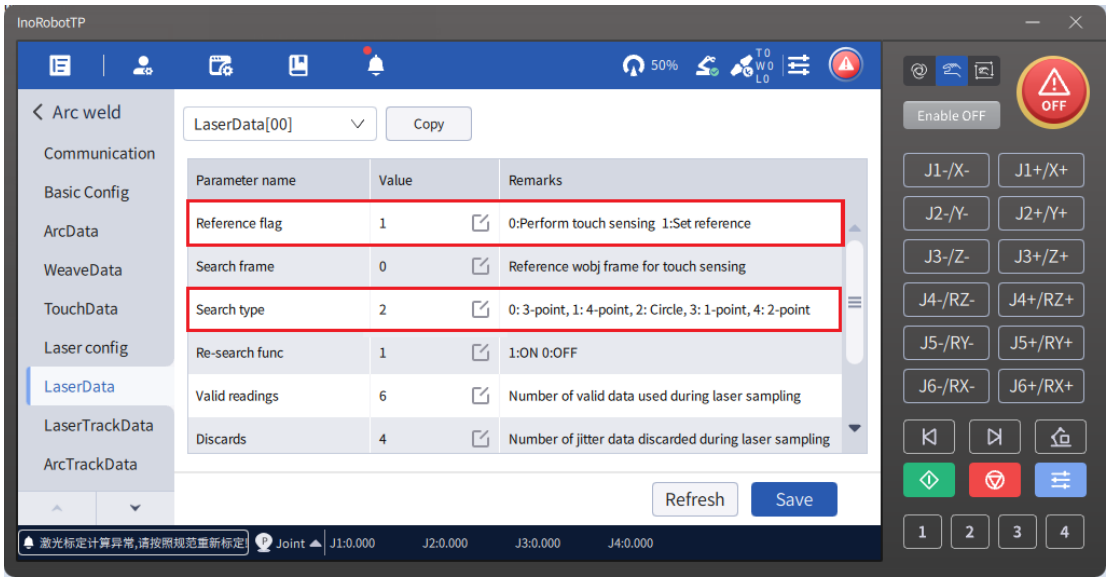
This method is used to determine the workobject position using three characteristic points on the workobject, and to correct the entire welding trajectory based on the calculated translational and rotational offsets (ΔXYZABC).



Usage procedure:

1. Set the corresponding parameters in the laser seam finding parameter "LaserData", such as setting "Search type" to "2: Circle".

2. Before performing the position search for the first time, calculating the offset, and correcting the trajectory based on the offset, first perform the procedure of calculating the position search reference. Set the "Reference flag" in "LaserData" to "1: Set reference", and then execute the following position search program (only once) to complete the calculation of the position search reference.



3. After the reference position calculation is completed, set the "Reference flag" in "LaserData" to "0: Perform search", and execute the following position search program (the same program as in step 2) to correct the welding trajectory.

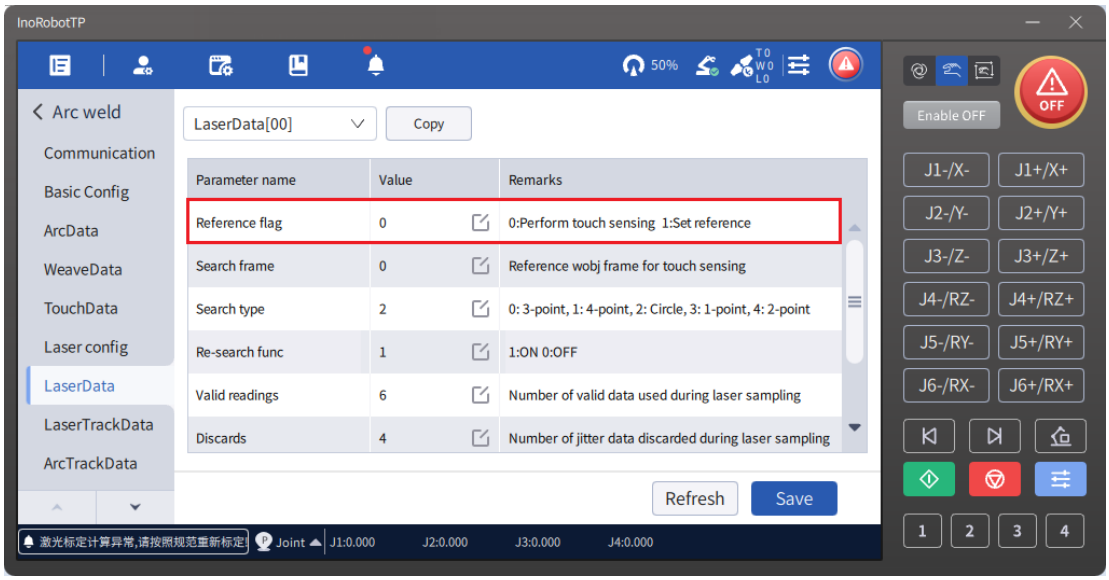


Table9-3-2-5-1-3-1 New version welding instructions

No.	Program	Description
1	Start;	Program start
2	ClearSearchTempData(0);	Clear the cached data corresponding to condition number 0 of laser seam finding.

No.	Program	Description
3	SearchL Dir[X], P[0], V[30], Z[0], LaserData[0], LaserJob[0],Tool[0], Wobj[0];	Move to point P0, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
4	SearchL Dir[X], P[1], V[30], Z[0], LaserData[0], LaserJob[0],Tool[0], Wobj [0];	Move to point P1, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
5	SearchL Dir[Y], P[2], V[30], Z[0], LaserData[0], LaserJob[0],Tool[0], Wobj [0];	Move to point P2, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[Y] indicates that the search starts along the Y direction of the workobject frame during the re-search.
6	CalcSearchPR (LaserData[0], PR[4], LaserBase[0]);	When the "Reference flag" in the current condition interface is set to "1: Set reference", the offset calculated by executing this instruction is 0, and the calculated reference is stored in "LaserBase[1]". When the "Reference flag" in the current condition interface is set to "0: perform search", the offset is calculated by executing this instruction, and is stored in "PR[4]".
7	ROffson PR[4];	Offset the original trajectory based on the offset value in PR[4].
8	Movl P[8], V[30], Z[0], Tool[0], Wobj[0];	Move to the arc start point.
9	WeldOn ArcData[0];	Start arc
10	Movl P[9], V[30], Z[0], Tool[0], Wobj[0];	Move to the arc-off point.
11	WeldOff ArcData[0];	Extinguish arc.
12	ROffsoff;	Offset end
13	END;	Program end

Table9-3-2-5-1-3-2 Old version welding instructions

No.	Program	Description
1	Start;	Program start
2	ClearSearchTempData(0);	Clear the cached data corresponding to condition number 0 of laser seam finding.

No.	Program	Description
3	SearchL Dir[X], P[0], V[30], Z[0], LaserData[0], LaserJob[0],Tool[0], Wobj[0];	Move to point P0, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
4	SearchL Dir[X], P[1], V[30], Z[0], LaserData[0], LaserJob[0],Tool[0], Wobj [0];	Move to point P1, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
5	SearchL Dir[Y], P[2], V[30], Z[0], LaserData[0], LaserJob[0],Tool[0], Wobj [0];	Move to point P2, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[Y] indicates that the search starts along the Y direction of the workobject frame during the re-search.
6	CalcSearchPR (LaserData[0], PR[4], LaserBase[0]);	When the "Reference flag" in the current condition interface is set to "1: Set reference", the offset calculated by executing this instruction is 0, and the calculated reference is stored in "LaserBase[1]". When the "Reference flag" in the current condition interface is set to "0: perform search", the offset is calculated by executing this instruction, and is stored in "PR[4]".
7	ROffson PR[4];	Offset the original trajectory based on the offset value in PR[4].
8	MovlArcOn P[8], V[30], Z[0], ArcData[0],Tool[0], Wobj[0];	Move to the arc start point.
9	MovlArcOff P[9], V[30], Z[0], ArcData[0],Tool[0], Wobj[0];	Move to the arc-off point.
10	ROffsoff;	Offset end
11	END;	Program end

CAUTION

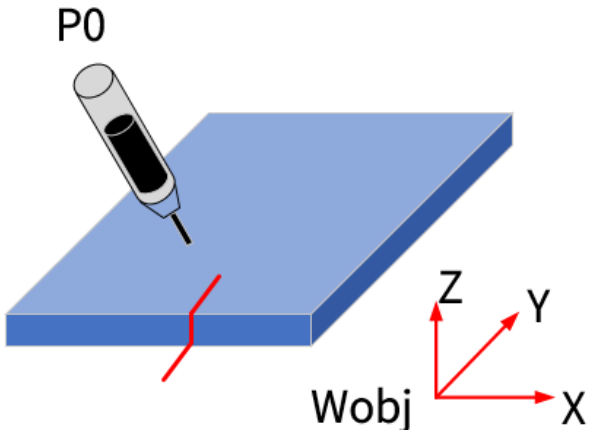
The three points to be detected on the workobject must lie on a regular circle.

9.3.2.5.1.4 1-Point Method/2-Point Method

1-point method

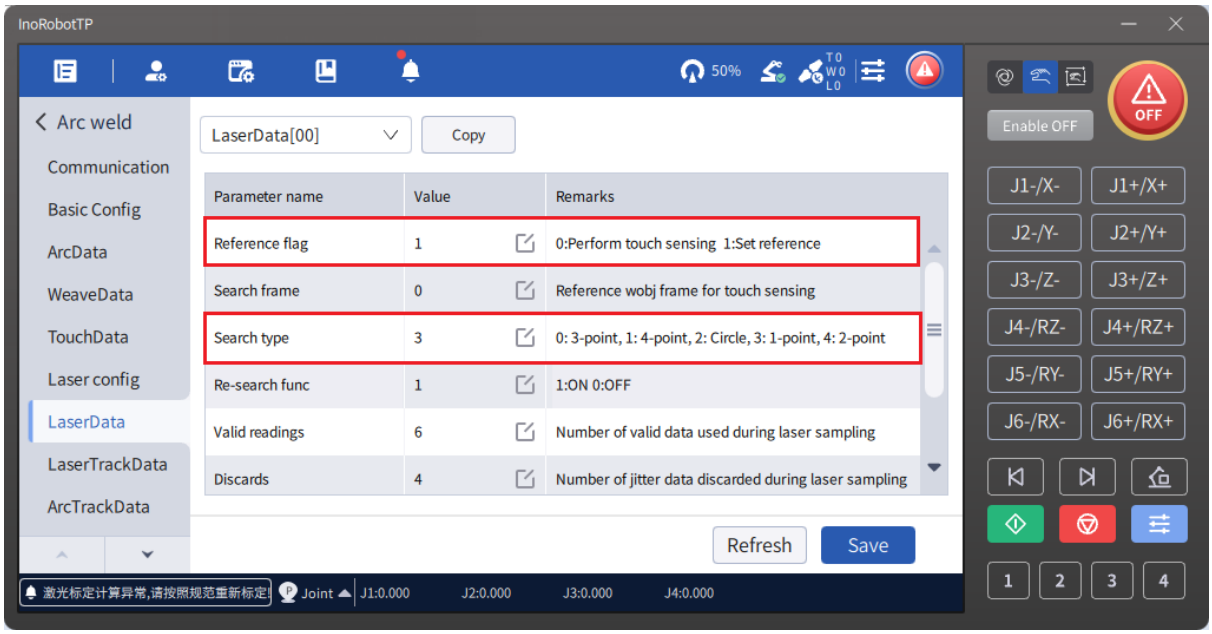
This method is used to determine the workobject position using one characteristic point on the workobject, and to correct the entire welding trajectory based on the calculated one-dimensional translation (X/Y/Z) or, at most, two-dimensional translation offsets (XZ/YZ/YZ).

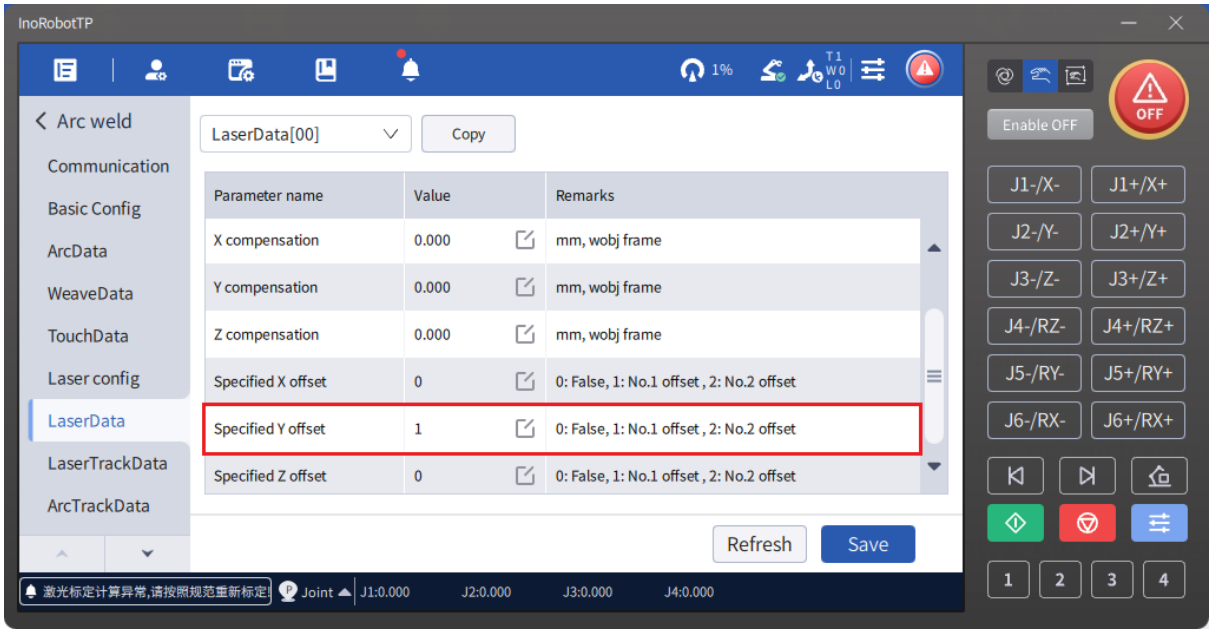
> **CAUTION**
>
> - This method is applicable only when the workobject has translation offsets but no rotational offsets.
> - The edge of the workobject to be detected by the laser sensor must be parallel to the axis direction of the workobject frame (wobj) used in the program.



Usage procedure:

1. Set the corresponding parameters in the laser seam finding parameter "LaserData", such as setting "Search type" to "3: 1-point" and specifying the offset.





The method for specifying the offset is as follows:

- Since the 1-point method uses only one set of detection points, the parameters "Specified X offset", "Specified Y offset", and "Specified Z offset" can only be set to "0: False" or "1: No.1 offset".
- If the "edge" to be detected is parallel to the X axis direction, only the changes in the Y direction and Z direction can be detected. Therefore, set "Specified X offset" to "0: False", and set "Specified Y offset" and "Specified Z offset" to "0" or "1" according to correction requirements, to obtain the corresponding Y or Z offset for correction.
- If the "edge" to be detected is parallel to the Y axis direction, only the changes in the X direction and Z direction can be detected. Therefore, set "Specified Y offset" to "0: False", and set "Specified X offset" and "Specified Z offset" to "0" or "1" according to correction requirements, to obtain the corresponding X or Z offset for correction.
- If the "edge" to be detected is parallel to the Z axis direction, only the changes in the X direction and Y direction can be detected. Therefore, set "Specified Z offset" to "0: False", and set "Specified X offset" and "Specified Y offset" to "0" or "1" according to correction requirements, to obtain the corresponding X or Y offset for correction.

2. Before performing the position search for the first time, calculating the offset, and correcting the trajectory based on the offset, first perform the procedure of calculating the position search reference. Set the "Reference flag" in "LaserData" to "1: Set reference", and then execute the following position search program (only once) to complete the calculation of the position search reference.
3. After the reference position calculation is completed, set the "Reference flag" in "LaserData" to "0: Perform search", and execute the following position search program (the same program as in step 2) to

correct the welding trajectory.

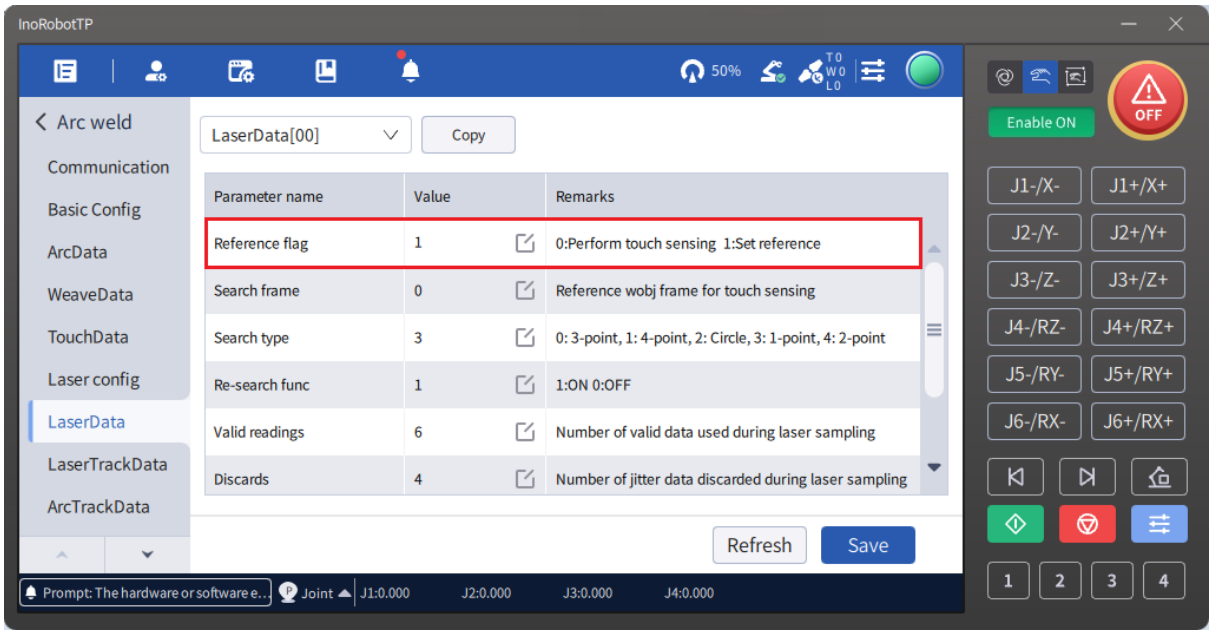


Table9-3-2-5-1-4-1 New version welding instructions

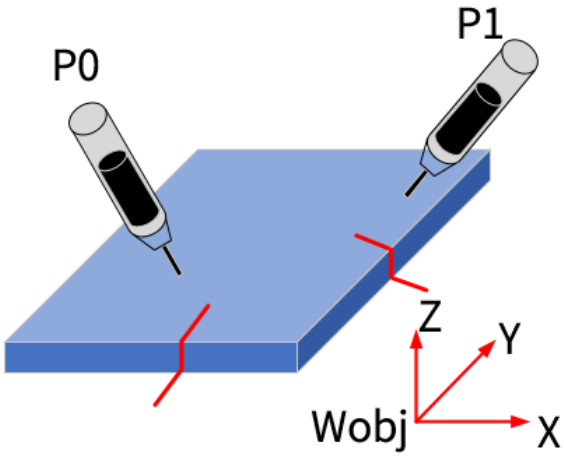
No.	Program	Description
1	Start;	Program starts.
2	ClearSearchTempData(0);	Clear the cached data corresponding to condition number 0 of laser seam finding.
3	SearchL Dir[X], P[0], V[30], Z[0], LaserData[0], LaserJob[0],Tool[0], Wobj[0];	Move to point P0, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
4	CalcSearchPR (LaserData[0], PR[4], LaserBase[0]);	When the "Reference flag" in the current condition interface is set to "1: Set reference", the offset calculated by executing this instruction is 0, and the calculated reference is stored in "LaserBase[1]". When the "Reference flag" in the current condition interface is set to "0: perform search", the offset is calculated by executing this instruction, and is stored in "PR[4]".
5	ROffson PR[4];	Offset the original trajectory based on the offset value in PR[4].
6	Movl P[8], V[30], Z[0],Tool[0], Wobj [0];	Move to the arc start point.
7	WeldOn ArcData[0];	Start arc.
8	Movl P[9], V[30], Z[0], Tool[0], Wobj [0];	Move to the arc-off point.
9	WeldOff ArcData[0];	Extinguish arc.
10	ROffsoff;	Offset end.
11	END;	Program end.

Table9-3-2-5-1-4-2 Old version welding instructions

No.	Program	Description
1	Start;	Program starts.
2	ClearSearchTempData(0);	Clear the cached data corresponding to condition number 0 of laser seam finding.
3	SearchL Dir[X], P[0], V[30], Z[0], LaserData[0], LaserJob[0],Tool[0], Wobj[0];	Move to point P0, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
4	CalcSearchPR (LaserData[0], PR[4], LaserBase[0]);	When the "Reference flag" in the current condition interface is set to "1: Set reference", the offset calculated by executing this instruction is 0, and the calculated reference is stored in "LaserBase[1]". When the "Reference flag" in the current condition interface is set to "0: perform search", the offset is calculated by executing this instruction, and is stored in "PR[4]".
5	ROffson PR[4];	Offset the original trajectory based on the offset value in PR[4].
6	MovlArcOn P[8], V[30], Z[0], ArcData[0],Tool[0], Wobj [0] ;	Move to the arc start point.
7	MovlArcOff P[9], V[30], Z[0], ArcData[0],Tool[0], Wobj [0];	Move to the arc-off point.
8	ROffsoff;	Offset end.
9	END;	Program end.

2-point method

This method is used to determine the workobject position using two characteristic point on the workobject, and to correct the entire welding trajectory based on the calculated two-dimensional translation (XY/XZ/YZ) or, at most, three-dimensional translation offsets (X/Y/Z). The edge of the workobject to be detected by the laser sensor must be parallel to the axis direction of the workobject frame (wobj) used in the program.



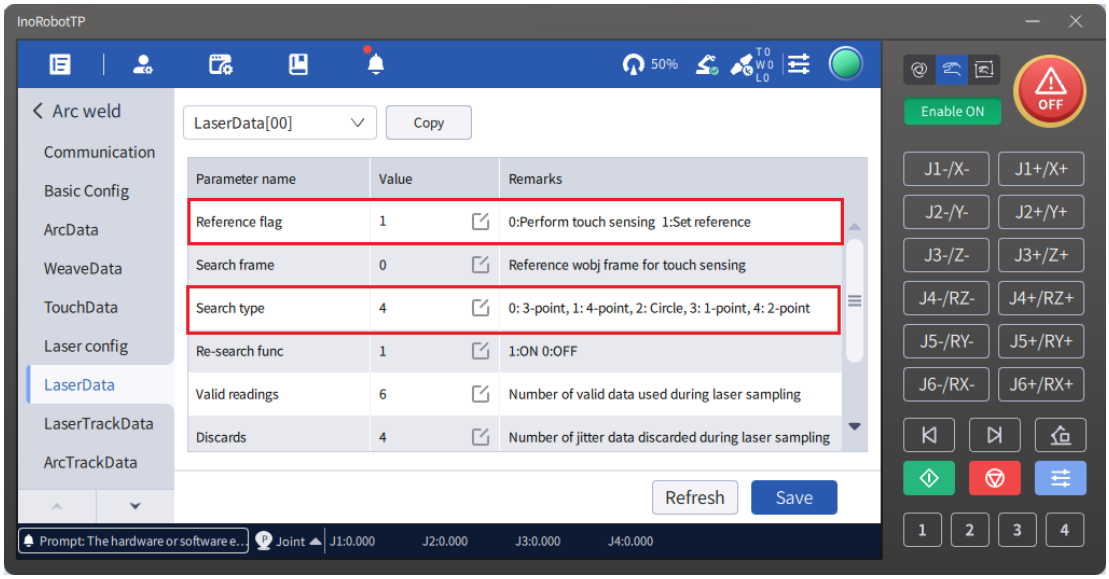
Usage procedure:

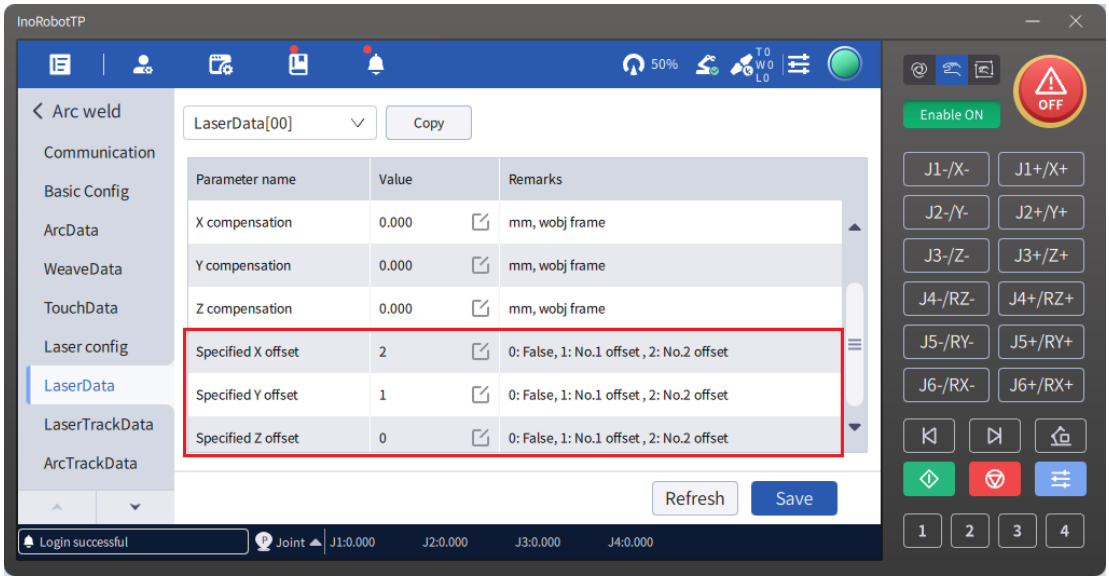
1. Set the corresponding parameters in the laser seam finding parameter "LaserData", such as setting "Search type" to "4: 2-point" and specifying the offset.

   The method for specifying the offset is as follows:

   - According to the detection sequence, if the first detected "edge" is parallel to the X axis direction (the detected point can reflect translation in the Y and Z directions), and the second detected "edge" is parallel to the Y axis direction (the detected point can reflect translation in the X and Z directions), set "Specified X offset" to "2: No.2 offset", "Specified Y offset" to "1: No.1 offest", and "Specified Z offset" to "0", "1" or "2" according to the correction requirements, to obtain the corresponding offset for correction.
   - According to the detection sequence, if the first detected "edge" is parallel to the X axis direction (the detected point can reflect translation in the Y and Z directions), and the second detected "edge" is parallel to the Z axis direction (the detected point can reflect translation in the X and Y directions), set "Specified X offset" to "2: No.2 offset", "Specified Z offset" to "1: No.1 offest", and "Specified Y offset" to "0", "1" or "2" according to the correction requirements, to obtain the corresponding offset for correction.
   - According to the detection sequence, if the first detected "edge" is parallel to the Y axis direction (the detected point can reflect translation in the X and Z directions), and the second detected "edge" is parallel to the Z axis direction (the detected point can reflect translation in the X and Y directions), set "Specified Y offset" to "2: No.2 offset", "Specified Z offset" to "1: No.1 offest", and "Specified X offset" to "0", "1" or "2" according to the correction requirements, to obtain the corresponding offset for correction.

2. Before performing the position search for the first time, calculating the offset, and correcting the trajectory based on the offset, first perform the procedure of calculating the position search reference. At this point, set the "Reference flag" in "LaserData" to "1: Set reference", and then execute the following position search program (only once) to complete the calculation of the position search reference.





3. After the reference position calculation is completed, set the "Reference flag" in "LaserData" to "0: Perform search", and execute the following position search program (the same program as in step 2) to correct the welding trajectory.

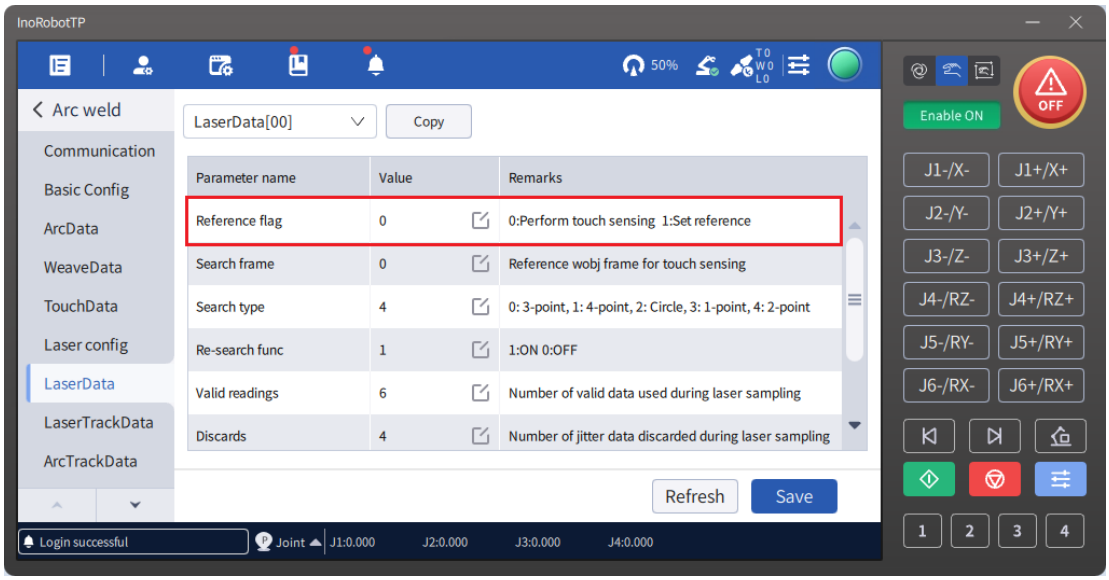


Table9-3-2-5-1-4-1 New version welding instructions

No.	Program	Description
1	Start;	Program starts.
2	ClearSearchTempData(0);	Clear the cached data corresponding to condition number 0 of laser seam finding.
3	SearchL Dir[X], P[0], V[30], Z[0], LaserData[0],LaserJob[0], Tool[0], Wobj[0];	Move to point P0, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
4	SearchL Dir[X], P[1], V[30], Z[0], LaserData[0], LaserJob[0],Tool[0], Wobj [0];	Move to point P1, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
5	CalcSearchPR (LaserData[0], PR[4], LaserBase[0]);	When the "Reference flag" in the current condition interface is set to "1: Set reference", the offset calculated by executing this instruction is 0, and the calculated reference is stored in "LaserBase[1]". When the "Reference flag" in the current condition interface is set to "0: perform search", the offset is calculated by executing this instruction, and is stored in "PR[4]".
6	ROffson PR[4];	Offset the original trajectory based on the offset value in PR[4].
7	MovlArc P[8], V[30], Z[0], Tool[0], Wobj[0];	Move to the arc start point.
9	WeldOn ArcData[0];	Start arc.
10	MovlArc P[9], V[30], Z[0], Tool[0], Wobj[0];	Move to the arc-off point.
11	WeldOff ArcData[1];	Extinguish arc.
12	ROffsoff;	Offset end.
13	END;	Program end.

Table9-3-2-5-1-4-2 Old version welding instructions

No.	Program	Description
1	Start;	Program starts.
2	ClearSearchTempData(0);	Clear the cached data corresponding to condition number 0 of laser seam finding.
3	SearchL Dir[X], P[0], V[30], Z[0], LaserData[0],LaserJob[0], Tool[0], Wobj[0];	Move to point P0, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.

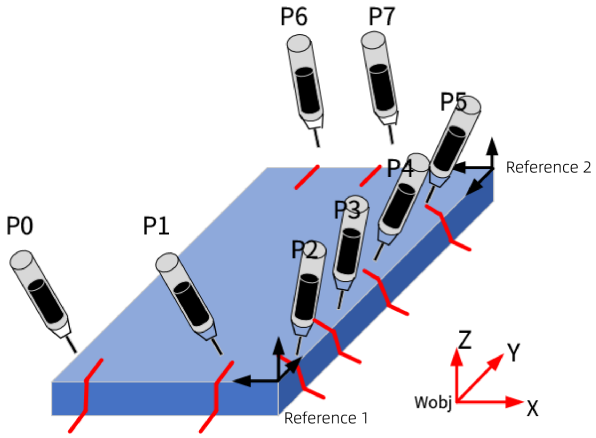
No.	Program	Description
4	SearchL Dir[X], P[1], V[30], Z[0], LaserData[0], LaserJob[0],Tool[0], Wobj [0];	Move to point P1, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
5	CalcSearchPR (LaserData[0], PR[4], LaserBase[0]);	When the "Reference flag" in the current condition interface is set to "1: Set reference", the offset calculated by executing this instruction is 0, and the calculated reference is stored in "LaserBase[1]". When the "Reference flag" in the current condition interface is set to "0: perform search", the offset is calculated by executing this instruction, and is stored in "PR[4]".
6	ROffson PR[4];	Offset the original trajectory based on the offset value in PR[4].
7	MovlArcOn P[8], V[30], Z[0], ArcData[0],Tool[0], Wobj [0];	Move to the arc start point.
8	MovlArcOff P[9], V[30], Z[0], ArcData[0],Tool[0], Wobj [0];	Move to the arc-off point.
9	ROffsoff;	Offset end.
10	END;	Program end.



The edge of the workobject to be detected by the laser sensor must be parallel to the axis direction of the workobject frame (wobj) used in the program.

9.3.2.5.2 Detect Points, Calculate Reference Point, Move to Reference Point

Use this procedure to directly execute the point (XYZ) corresponding to the calculated reference point based on the 3-point or 4-point method. Take the 4-point method as an example of detecting points, calculating the reference point, and moving to the reference point.



Usage procedure:

1. Set the corresponding parameters in the laser seam finding parameter "LaserData", such as setting "Search type" to "1: 4-point".
2. Set the "Reference flag" in "LaserData" to "1: Set reference", and then execute the following position search program.

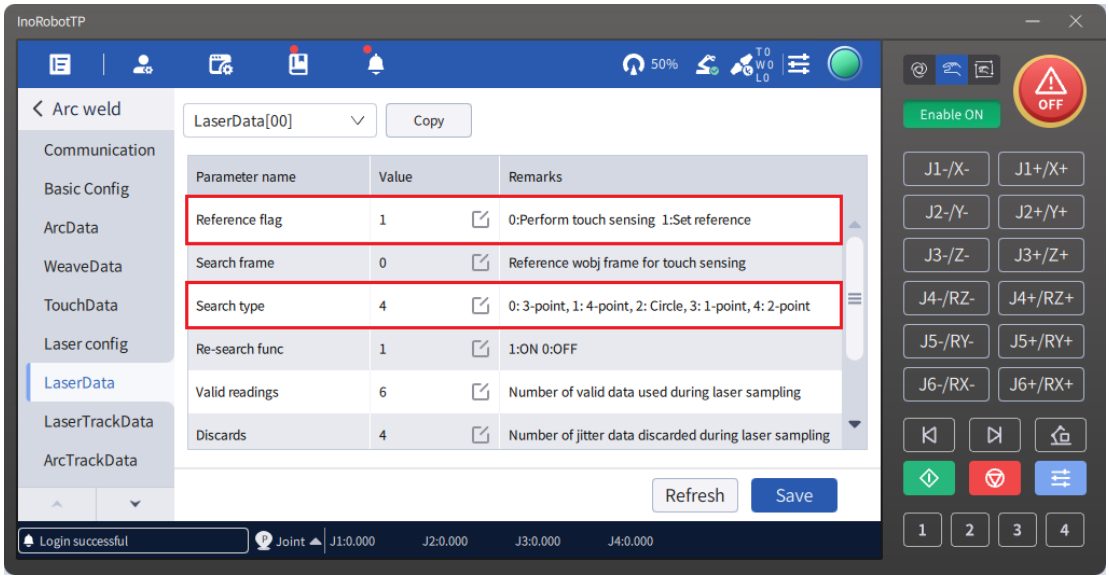


Table9-3-2-5-2-1 New version welding instructions

No.	Program	Description
1	Start;	Program starts.
2	ClearSearchTempData(0);	Clear the cached data corresponding to condition number 0 of laser seam finding.
3	SearchL Dir[X], P[0], V[30], Z[0], LaserData[0], LaserJob[0], Tool[0], Wobj[0];	Move to point P0, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
4	SearchL Dir[X], P[1], V[30], Z[0], LaserData[0], LaserJob[0], Tool[0], Wobj [0];	Move to point P1, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.

No.	Program	Description
5	SearchL Dir[Y], P[2], V[30], Z[0], LaserData[0], LaserJob[0], Tool[0], Wobj [0];	Move to point P2, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[Y] indicates that the search starts along the Y direction of the workobject frame during the re-search.
6	SearchL Dir[Y], P[3], V[30], Z[0], LaserData[0], LaserJob[0], Tool[0], Wobj [0];	Move to point P3, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[Y] indicates that the search starts along the Y direction of the workobject frame during the re-search.
7	CalcSearchPR (LaserData[0], PR[4], PR[5], LaserBase[0]);	Calculate the reference and store in PR[5] and LaserBase[0].
8	ClearSearchTempData(1);	Clear the cached data corresponding to condition number 1 of laser seam finding.
9	SearchL Dir[X], P[4], V[30], Z[0], LaserData[1], LaserJob[0], Tool[0], Wobj[0];	Move to point P4, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
10	SearchL Dir[X], P[5], V[30], Z[0], LaserData[1], LaserJob[0], Tool[0], Wobj[0];	Move to point P5, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
11	SearchL Dir[Y], P[6], V[30], Z[0], LaserData[1], LaserJob[0], Tool[0], Wobj[0];	Move to point P6, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[Y] indicates that the search starts along the Y direction of the workobject frame during the re-search.
12	SearchL Dir[Y], P[7], V[30], Z[0], LaserData[1], LaserJob[0], Tool[0], Wobj[0];	Move to point P7, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[Y] indicates that the search starts along the Y direction of the workobject frame during the re-search.
13	CalcSearchPR(LaserData[1],PR[6],PR[7],LaserBase[1]);	Calculate the reference and store in PR[7] and LaserBase[1].
14	Movl ReplacePos(P[8], PR[5]),V[30], Z[0], Tool[0], Wobj[0];	Replace the XYZ of P[8] with the XYZ of PR[5], and use the resulting point as the arc start point.
15	WeldOn ArcData[1];	Start arc.
16	Movl ReplacePos(P[9], PR[7]),V[30], Z[0], Tool[0], Wobj[0];	Replace the XYZ of P[9] with the XYZ of PR[7], and use the resulting point as the arc-off point.

No.	Program	Description
17	WeldOff ArcData[1];	Extinguish arc.
18	END;	Program end.

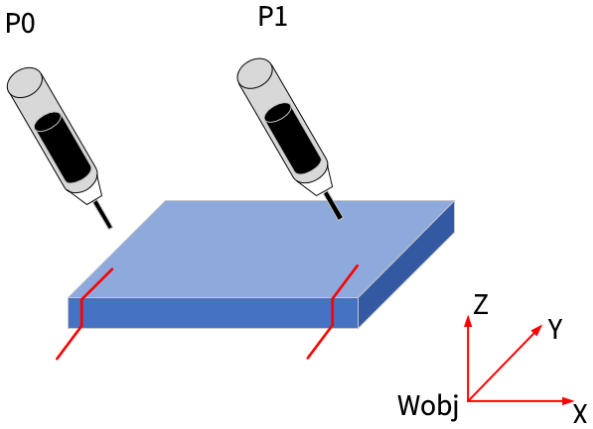
Table9-3-2-5-2-2 Old version welding instructions

No.	Program	Description
1	Start;	Program starts.
2	ClearSearchTempData(0);	Clear the cached data corresponding to condition number 0 of laser seam finding.
3	SearchL Dir[X], P[0], V[30], Z[0], LaserData[0], LaserJob[0], Tool[0], Wobj[0];	Move to point P0, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
4	SearchL Dir[X], P[1], V[30], Z[0], LaserData[0], LaserJob[0], Tool[0], Wobj [0];	Move to point P1, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
5	SearchL Dir[Y], P[2], V[30], Z[0], LaserData[0], LaserJob[0], Tool[0], Wobj [0];	Move to point P2, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[Y] indicates that the search starts along the Y direction of the workobject frame during the re-search.
6	SearchL Dir[Y], P[3], V[30], Z[0], LaserData[0], LaserJob[0], Tool[0], Wobj [0];	Move to point P3, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[Y] indicates that the search starts along the Y direction of the workobject frame during the re-search.
7	CalcSearchPR(LaserData[0],PR[4],PR[5],LaserBase [0]);	Calculate the reference and store in PR[5] and LaserBase[0].
8	ClearSearchTempData(1);	Clear the cached data corresponding to condition number 1 of laser seam finding.
9	SearchL Dir[X], P[4], V[30], Z[0], LaserData[1], LaserJob[0], Tool[0], Wobj[0];	Move to point P4, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
10	SearchL Dir[X], P[5], V[30], Z[0], LaserData[1], LaserJob[0], Tool[0], Wobj[0];	Move to point P5, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.

No.	Program	Description
11	SearchL Dir[Y], P[6], V[30], Z[0], LaserData[1], LaserJob[0], Tool[0], Wobj[0];	Move to point P6, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[Y] indicates that the search starts along the Y direction of the workobject frame during the re-search.
12	SearchL Dir[Y], P[7], V[30], Z[0], LaserData[1], LaserJob[0], Tool[0], Wobj[0];	Move to point P7, and use "LaserJob[0]" to specify laser job number 0 for laser seam finding. Dir[Y] indicates that the search starts along the Y direction of the workobject frame during the re-search.
13	CalcSearchPR(LaserData[1],PR[6],PR[7],LaserBase[1]);	Calculate the reference and store in PR[7] and LaserBase[1].
14	MovlArcOn P[8], PR[5],V[30], Z[0], ArcData[0],Tool[0], Wobj [0];	Replace the XYZ of P[8] with the XYZ of PR[5], and use the resulting point as the arc start point.
15	MovlArcOff P[9], PR[7],V[30], Z[0], ArcData[0], Tool[0], Wobj[0];	Replace the XYZ of P[9] with the XYZ of PR[7], and use the resulting point as the arc-off point.
16	END;	Program end.

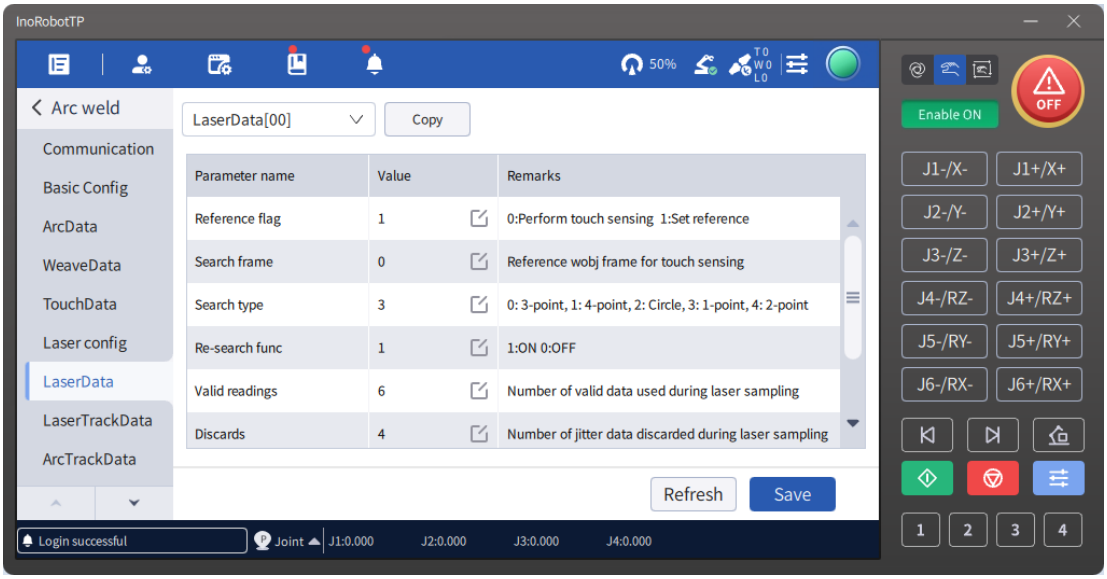
9.3.2.5.3 Detect Points, Move to Points

Use this procedure to directly execute the points (XYZ) on the workobject detected by the laser sensor.



Usage procedure:

1. Set the corresponding parameters in the laser seam finding parameter "LaserData".



2. Execute the following program.

Table9-3-2-5-3-1 New version welding instructions

No.	Program	Description
1	Start;	Program starts.
2	SearchL Dir[X], P[0], PR[0], V[30], Z[0], LaserData[0], LaserJob[0], Tool[0], Wobj[0]	Move to point P0, use "LaserJob[0]" to specify laser job number 0 for laser seam finding, and store the detected position in PR[0]. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
3	SearchL Dir[X], P[1],PR[1] V[30], Z[0], LaserData[0], LaserJob[0],Tool[0], Wobj [0]	Move to point P1, use "LaserJob[0]" to specify laser job number 0 for laser seam finding, and store the detected position in PR[1]. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
4	Movl ReplacePos(P[2],PR[0]), V[30], Z[0], Tool[0], Wobj[0];	Replace the XYZ of P[3] with the XYZ of PR[0], and use the resulting point as the arc start point.
5	WeldOn ArcData[1];	Start arc.
6	Movl ReplacePos(P[3],PR[1]), V[30], Z[0], Tool[0], Wobj[0];	Replace the XYZ of P[3] with the XYZ of PR[1], and use the resulting point as the arc-off point.
7	WeldOff ArcData[1];	Extinguish arc.
8	END	Program end.

Table9-3-2-5-3-2 Old version welding instructions

No.	Program	Description
1	Start;	Program starts.

No.	Program	Description
2	SearchL Dir[X], P[0], PR[0],V[30], Z[0], LaserData[0],LaserJob[0],Tool[0], Wobj[0];	Move to point P0, use "LaserJob[0]" to specify laser job number 0 for laser seam finding, and store the detected position in PR[0]. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
3	SearchL Dir[X], P[1],PR[1] V[30], Z[0], LaserData[0], LaserJob[0],Tool[0], Wobj[0];	Move to point P1, use "LaserJob[0]" to specify laser job number 0 for laser seam finding, and store the detected position in PR[1]. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
4	MovlArcOn P[2],PR[0], V[30], Z[0], ArcData[0],Tool[0], Wobj[0];	Replace the XYZ of P[3] with the XYZ of PR[0], and use the resulting point as the arc start point.
5	MovlArcOff P[3],PR[1], V[30], Z[0], ArcData[0], Tool[0], Wobj[0];	Replace the XYZ of P[3] with the XYZ of PR[1], and use the resulting point as the arc-off point.
6	END;	Program end.

9.3.3 Laser Tracking

9.3.3.1 Overview

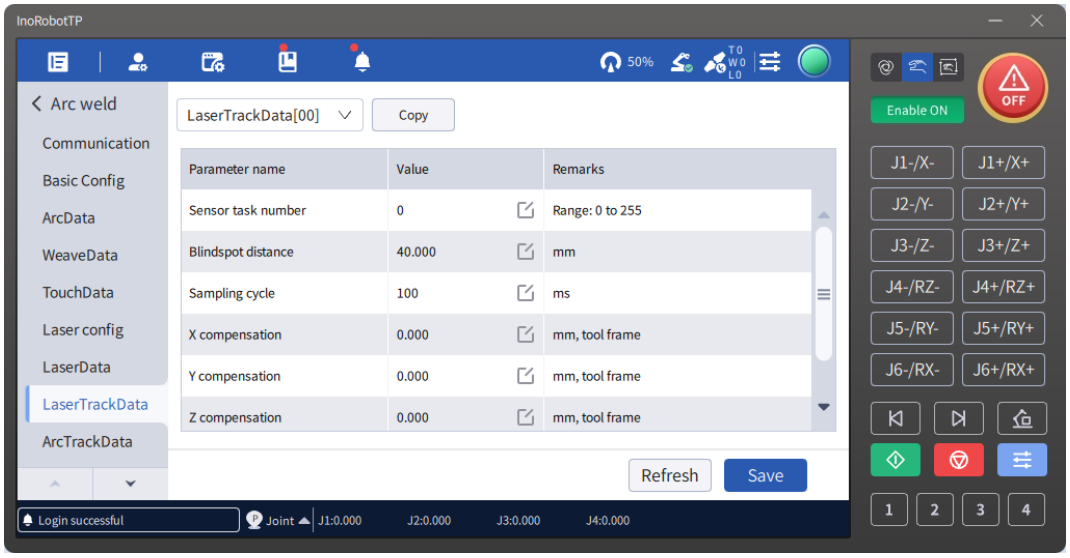
Robot laser seam tracking refers to the process where a laser sensor detects the weld seam of the workobject in real time, and the robot controller adjusts the robot's trajectory in real time based on the seam data obtained from the sensor. This achieves real-time correction of the welding path, and solves the problem of welding path deviation caused by teaching errors, workobject position errors, and thermal deformation of the workobject in actual production, thereby greatly improving welding quality.

- New version instruction: When a motion instruction such as Movl or Movc is contained in the LaserTrackOn and LaserTrackOff instructions, the robot performs laser tracking. For detailed instructions, see the 10.7 LaserTrackOn and 10.8 LaserTrackOff sections.
- Old version instruction: By including the laser tracking parameter LaserTrackData in the MovlArcOn, MovlArc, MovcArc, MovlArcOff, and MovcArcOff instructions, the laser tracking can be achieved. For detailed instruction descriptions, see 10 Instructions section.

LaserTrackData currently supports up to 64 sets of parameters from LaserTrackData[0] to LaserTrackData[63].

9.3.3.2 Parameter Description

You can enter the laser tracking parameter setting page by selecting "Settings" > "More" > "Process Manager" > "Arc weld" > "LaserTrackData", and then configure the laser tracking related parameters. For details, see the parameter table.



No.	Parameter name	Description	Range
1	Sensor task number	The task number used to call the laser sensor for weld seam recognition. Different task numbers in the laser sensor correspond to different weld seam patterns. The specific range depends on the laser sensor brand. Set it as required.	0 to 255
2	Blindspot distance	The laser line of the laser sensor often leads ahead of the robot TCP. This parameter describes the difference in distance between the corner point projected by the laser sensor on the workobject and the robot TCP center. This parameter is involved in defining the minimum communication cycle between the robot and the sensor. It can be set approximately equal to the actual distance.	0 mm to 500 mm
3	Sampling cycle	The cycle at which the robot acquires laser data from the laser sensor. The shorter the sampling cycle, the larger the data volume; It is generally set to 40 ms to 100 ms	20 ms to 1000 ms
4	X compensation	The compensation amount applied along the X axis direction of the tool frame after the acquired laser point is converted to a TCP point in the workobject frame.	-200 mm to +200 mm

No.	Parameter name	Description	Range
5	Y compensation	The compensation amount applied along the Y axis direction of the tool frame after the acquired laser point is converted to a TCP point in the workobject frame.	-200 mm to +200 mm
6	Z compensation	The compensation amount applied along the Z axis direction of the tool frame after the acquired laser point is converted to a TCP point in the workobject frame.	-200 mm to +200 mm
7	Upon track error	Whether to alarm when the weld seam cannot be recognized from the laser sensor. 0: after the weld seam is not recognized, alarm after completing the recognized part of the motion; 1: continue running without alarm if the weld seam is not recognized. When this parameter is setting to "1: Continue", if the weld seam cannot be recognized, the robot first completes the already recognized part of the welding motion, then skip all subsequent welding motion instructions (MovlArc, MovcArc, MovlArcOff, and MovcArcOff), extinguishes the arc, and continues with the subsequent instructions.	0 to 1
8	Adjacent laser points ERR THLD	If the Euclidean distance between two adjacent laser points exceeds this threshold, the current point is skipped. This parameter is used to filter out abnormal laser points.	0.1 mm to 20 mm

No.	Parameter name	Description	Range
9	Smoothing factor	This parameter limits the minimum distance between points obtained from the laser. When the laser point is converted to a TCP point in the workobject frame, if its Euclidean distance to the previous point is less than the minimum distance between points, the point is discarded to prevent the recognized points from being too dense, causing the robot to become jerky. It is generally set to 1. During tracking, if the actual robot speed cannot reach the set welding speed, you can appropriately increase this parameter. The larger the distance between the compensated points, the higher the achievable robot speed. The specific calculation formula is: Minimum distance between points = Motion speed x Data acquisition cycle x Smoothing factor	0.1 to 20
10	Seam detection timeout	If the robot fails to obtain weld seam data from the laser sensor for longer than the time set by this parameter, it is considered a detection timeout. Based on the setting of the "Upon track error" parameter, the robot will either alarm or continue running the program after completing the recognized part of the weld motion.	800 ms to 2500 ms

9.3.3.3 Notes

- In a welding path, if the laser tracking function is required, tracking must start from the arc start point and end at the arc-off point, i.e., all welding motion instructions from MovlArcOn to MovlArcOff must include the LaserTrackData parameter, which allows different indices.
- When performing laser tracking, ensure that the arc start point is accurate and that the weld seam can be properly recognized during the movement from the point before the arc start point to the arc start point. Therefore, laser tracking is generally used together with the "detect points and move to points" method of laser seam finding to ensure that the arc start point is accurate.
- The robot must not move too fast toward the arc start point, i.e., the tracking start point, to prevent failure to recognize the weld seam. The recommended speed is less than 30 mm/s.
- Weaving is allowed during tracking, but currently only zigzag weaving is supported.

- When the tracking enable button on the process teaching panel is in the "Tracking disable" state, tracking will not be performed during actual operation even if the welding motion instructions include the LaserTrackData parameter.
- In single-step mode, the robot will only move to the teaching point and will not perform tracking even if the welding motion instructions include the LaserTrackData parameter.
- During laser tracking, after a pause, resuming is allowed, but the robot will not move back regardless of the set move back distance. To enable the restart function, you can set the "Arc break restart" function in "Process Manager" > "Arc weld" > "Basic Config". For details, see the 7.3 Arc Break Restart Function section.
- Laser tracking allows scrape start. The scraping direction follows the direction from the tracking start point to the target teaching point. To enable the scrape start function, you can set the "Scrape start fun" parameter in "Process Manager" > "Arc weld" > "Basic Config". For details, see the 7.4 Scrape Start Function section.
- Use caution when setting the "Upon track error" parameter to 1. When this parameter is setting to 1, if the weld seam cannot be recognized, the robot first completes the already recognized part of the welding motion, then skip all subsequent welding motion instructions (MovlArc, MovcArc, MovlArcOff, and MovcArcOff), extinguishes the arc, and continues with the subsequent instructions. Example:

No.	Program	Comment
1	Start;	Start
2	Movj P[0], V[30], Z[0], Tool[0], Wobj[0];	Run the robot to the safety point P[0], ensuring that when the robot is at this position, the laser line of the laser sensor can align with the arc start point and can recognize the weld seam.
3	MovlArcOn P[1], V[3], Z[0], ArcData[0], LaserTrackData[0],Tool[1], Wobj[0];	Move to the arc start point, which is also the tracking start point. The robot first turns on the laser and moves to point P[1] using Movl, then start the arc; During this movement, the speed should not be too high. Otherwise, weld seam data may not acquired. The recommended speed is less than 30 mm/s. The speed of the arc-on instruction uses the speed parameter V/Speed in the instruction, which is affected by the global speed percentage.
4	MovlArc P[2], V[30], Z[0], ArcData[0], LaserTrackData [0], Tool[1], Wobj[0];	Move to the welding process point.
5	MovcArc P[3], V[30], Z[0], ArcData[0], LaserTrackData [0], Tool[1], Wobj [0];	Move to the welding process point.
6	MovcArc P[4], V[30], Z[0], ArcData[0], LaserTrackData [0], Tool[1], Wobj [0];	Move to the welding process point.
7	MovlArcOff P[5], V[30], Z[0], ArcData[0], LaserTrackData [1], Tool[1], Wobj [0];	Move to the arc-off point, i.e. tracking end point.
8	Movj P[6],V[30],Z[0],Tool[1],Wobj[0];	Move to the departure point.

No.	Program	Comment
9	Movj P[7],V[30],Z[0],Tool[1],Wobj[0];	Move to the safety point.
10	END;	End

Assume that during tracking from P[1] to P[2], the weld seam is not recognized for a continuous period exceeding the time of "Seam detection timeout" set in LaserData, and the "Upon track error" parameter is set to "Continue". In this case, after completing the tracking of the already recognized part of the weld seam, the robot will directly skip points P[3], P[4], and P[5], extinguish the arc, and move directly to P[6].

In scenarios where the weld seam is not recognized near the arc extinction point, it is common to set the "Upon track error" parameter in the LaserTrackData attached to the arc extinction instruction to 1. For other welding motion instructions, it is recommended to use different tracking parameters and set the "Upon track error" parameter to 0.

In other scenarios, set this parameter to 0.

9.3.3.4 Permission Allocation

Control permission		Operation mode			Authority			
Teach pendant	Other control permissions	Manual low speed mode	Manual high speed mode	Auto mode	User mode	Edit mode	Admin	Manufacturer
√	×	√	×	×	×	×	√	√

9.3.3.5 Usage Procedure

Using laser tracking generally involves the following steps:

1. Calibrate the welding torch. For detailed calibration steps, see the "Setting the Tools" section in the "IR-TP200 Series Industrial Robot Teach Pendant User Guide".
2. Calibrate the laser sensor. For details, see the 9.3.1.4 Usage Procedure section.
3. Set the laser tracking parameter. Generally, the following parameters need to be set: "Sensor task number", "Blindspot distance", "X/Y/Z compensation", "Upon track error".
4. Teach and program according to the site conditions to ensure that the laser sensor can accurately recognize the weld seam during tracking.
5. Run the program to perform tracking.

9.3.3.5.1 New Version Instructions

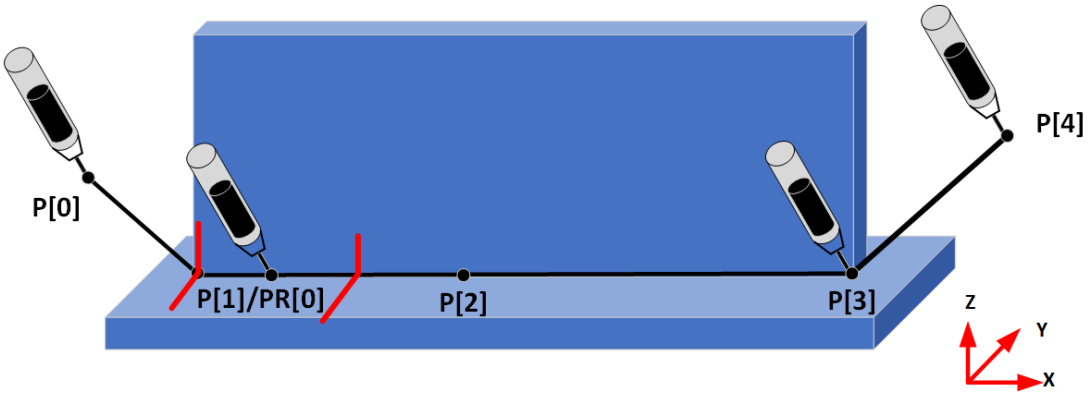


Table9-3-3-5-1-1 Scenario without search

No.	Program	Comment
1	Start;	Start
2	Movl P[0],V[5],Z[0],Tool[10],Wobj[10];	Move to the tracking start point P[0], with the laser line on the arc start point.
3	LaserTrackOn LaserTrackData[1],PR[0], LaserJob[1];	Start tracking, and store the first recognized point to PR[0].
4	Movl ReplacePos(P[1],PR[0]),V[1],Z[0],Tool[10],Wobj[10];	Move to the arc start point, with orientation determined by P[2], position by PR[0], and speed by V, keeping the speed below 30 mm/s.
5	WeldOn ArcData[1], AC[120],AV[0],WS[8];	Start arc
6	Movl P[2],V[5],Z[0],Tool[10],Wobj[10];	Track to the first welding point P[2].
7	LaserTrackSet LaserTrackData[2];	Change the tracking parameters. The changes take effect when moving to the next point.
8	Movl P[3],V[5],Z[0],Tool[10],Wobj[10];	Track to the arc-off point P[3].
9	WeldOff ArcData[1];	Extinguish arc.
10	LaserTrackOff;	End tracking.
11	Movl P[4],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[4].
12	End;	End

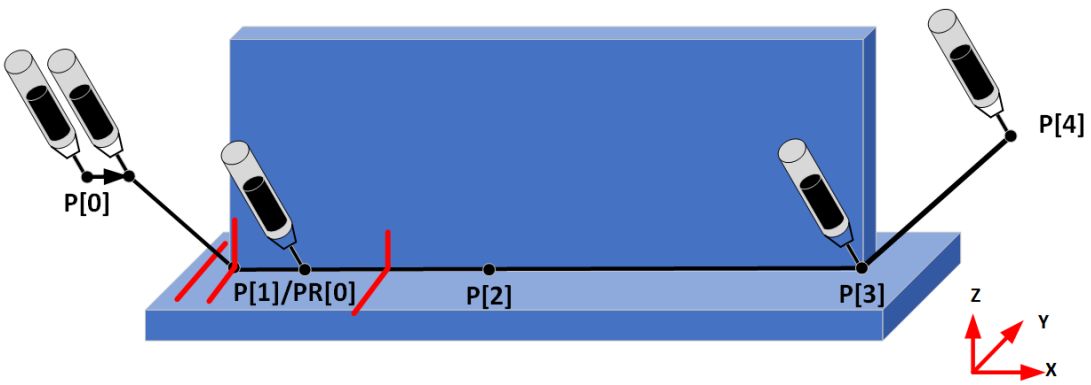


Table9-3-3-5-1-2 Scenario with search

No.	Program	Comment
1	Start;	Start
2	SearchL P[0],Dir[X],V[5],Z[0],LaserData[0],LaserJob[1],Tool[10], Wobj[10];	Move to the search start point P[0], then search along the X direction of Wobj[10] until the weld seam is found, and then stop.
3	LaserTrackOn LaserTrackData[1],PR[0], LaserJob[1];	Start tracking, and store the first recognized point to PR[0]. The task number sent to the sensor is 1.
4	Movl ReplacePos(P[1],PR[0]),V[1],Z[0],Tool[10],Wobj[10];	Move to the arc start point, with orientation determined by P[2], position by PR[0], and speed by V, keeping the speed below 30 mm/s.
5	WeldOn ArcData[1], AC[120],AV[0],WS[8];	Start arc
6	Movl P[2],V[5],Z[0],Tool[10],Wobj[10];	Track to the first welding point P[2].
7	LaserTrackSet LaserTrackData[2];	Change the tracking parameters. The changes take effect when moving to the next point.
8	Movl P[3],V[5],Z[0],Tool[10],Wobj[10];	Track to the arc-off point P[3].
9	WeldOff ArcData[1];	Extinguish arc.
10	LaserTrackOff;	End tracking.
11	Movl P[4],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[4].
12	End;	End

9.3.3.5.2 Old Version Instructions

Since laser tracking requires the arc start point to be accurate, and the process of moving from the approach point to the arc start point needs to detect the weld seam, laser tracking is often used in conjunction with the " detect points and move to points" of laser seam finding.

No.	Program	Comment
1	Start	Start
2	Movj P[0], V[30], Z[0], Tool[0], Wobj[0]	Run the robot to the safety point P[0].
3	SearchL Dir[X], P[1], PR[0], V[30], Z[0], LaserData[0], Tool[1], Wobj[0]	Move in a linear interpolation to the search start point P[1], and start searching along the X axis direction of the workobject frame. When the weld seam is found, save the point in PR[0].

No.	Program	Comment
4	MovlArcOn P[2], PR[0], V[2], ZR[100], ArcData[0], LaserTrackData[0], Tool[1], Wobj[0]	Move to the arc start point. Replace the XYZ of P[2] with the XYZ of PR[0]. P[2] defines the orientation at the start point. When moving to the tracking start point, the laser has already started acquiring weld seam data. During this movement, the speed should not be too high. Otherwise, weld seam data may not acquired. The recommended speed is less than 30 mm/s.
5	MovlArc P[3], V[30], ZR[100], ArcData[0], LaserTrackData[0], Tool[1], Wobj[0]	Perform real-time tracking.
6	MovlArcOff P[4], V[30], ZR[100], ArcData[0], LaserTrackData[0], Tool[1], Wobj[0]	Perform real-time tracking, and run to the arc-off point, end tracking and extinguish the arc.
7	END	End



- If the movement is jerky during tracking, check whether the parameter Z in the welding motion instruction is set to 0 or Fine. It is recommended to set it to ZR[100].
- If, during tracking, the robot stops after moving only a short distance past the arc start point, check whether the speed of moving to the arc start point is too high, or check whether the laser sensor can properly recognize the weld seam during the movement to the arc start point.

9.4 Arc Tracking

9.4.1 Overview

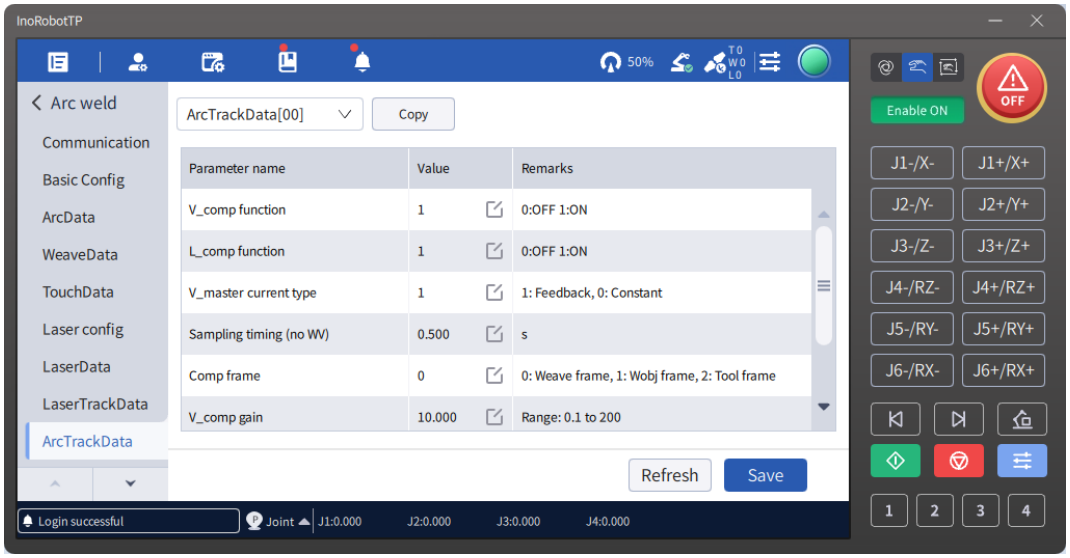
The arc tracking function is mainly used in the thick plate welding. This function uses changes in welding parameters such as welding current and welding voltage during the welding process to determine the deviation of the welding torch relative to the weld seam, calculates path compensation values, and performs real-time compensation of the welding path. This solves the problem of welding path deviation caused by teaching errors, workobject position errors, and thermal deformation of the workobject in actual production, thereby greatly improving welding quality.

New version instruction: When a motion instruction such as Movl or Movc is contained in the ArcTrackOn and ArcTrackOff instructions, the robot performs arc tracking. For detailed instructions, see the 10.10 ArcTrackOn and 10.11 ArcTrackOff sections.

Old version instruction: By including the arc tracking parameter ArcTrackData in the MovlArcOn, MovlArc, MovcArc, MovlArcOff, and MovcArcOff instructions, the arc tracking can be achieved. For detailed instruction descriptions, see the 10 Instructions section.

ArcTrackData currently supports up to 64 sets of parameters from ArcTrackData[0] to ArcTrackData[63].

9.4.2 Parameter Description



Parameter name	Description	Range	Unit
V_comp function	1: ON 0: OFF ON: Enable vertical compensation function. OFF: Disable vertical compensation function.	0 to 1 Default: 1	-
L_comp function	1: ON (default value) 0: OFF ON: Enable lateral compensation function. OFF: Disable lateral compensation function.	0 to 1 Default: 1	-
V_master current type	1: Feedback 0: Constant	0 to 1 Default: 1	-
Sampling timing (no WV)	The sampling time used without weaving.	0.1 to 5.0 Default: 0.5	s
Comp frame	0: Weave frame 1: Wobj frame 2: Tool frame With weaving, compensation is performed in the weave frame. Without weaving, compensation is performed in the tool frame/user frame.	0 to 2 Default: 0	-

Parameter name	Description	Range	Unit
V_comp gain	Used to set the magnitude of fluctuations in the vertical compensation (Z direction of the compensation coordinate system) during arc tracking seam compensation. If overshoot occurs, decrease this value; if lag occurs, increase this value.	0.1 to 200.0 Default: 10.0	-
Min. V_compensation per cycle	If the calculated compensation amount is less than this value, no compensation is performed.	0.05 to 10.0 Default: 0.1	mm
V_offset rate	The compensation amount is obtained by adding the ratio part set here to the calculated compensation amount.	-100 to +100 Default: 0	%
Max. cumulative V_compensation	The maximum value of the cumulative compensation amount in the vertical direction. The cumulative compensation amount is clamped to this value upon exceeding.	0 to 5000.0 Default: 500.0	mm
Max. V_compensation per cycle	The maximum value of each compensation amount in the vertical direction. The amount of each compensation is clamped to this value upon exceeding.	0.5 to 10.0 Default: 5.0	mm
V_compensation start count	The cycle count at which vertical compensation starts. Compensation is performed only when the cycle count exceeds this value. Typically, set this value to a value greater than the sum of "V_master sampling start count" and "V_master sampling count". If the sum of these two settings is greater than the value set here, the larger value is automatically used.	3 to 20 Default: 4	cyc
V_master sampling start count	The cycle count at which reference current sampling starts. Feedback current will be ignored when the cycle count is below this value. This parameter is used when the "V_master current type" is set to "Feedback".	3 to 20 Default: 4	cyc
V_master sampling count	When the cycle count reaches the "V_master sampling start count" value, and after acquiring feedback current for the number of cycles set by this parameter, the average of these current values is used as the reference current for vertical compensation. This parameter is used when the "V_master current type" is set to "Feedback".	1 to 20 Default: 3	cyc

Parameter name	Description	Range	Unit
V_master current data	The vertical reference current value used when the "V_master current type" is set to "Constant". When the "V_master current type" is set to "Feedback", the average value obtained during vertical reference sampling is automatically set here.	0.0 to 1000 Default: 0.0	A
L_comp gain	Used to set the magnitude of fluctuations in the lateral compensation (Y direction of the compensation coordinate system) during arc tracking seam compensation. If overshoot occurs, decrease this value; if lag occurs, increase this value.	0.1 to 200.0 Default: 10	None
Min. L_compensation per cycle	If the calculated compensation amount is less than this value, no compensation is performed.	0.05-10.0 Default: 0.1	mm
L_offset rate	The compensation amount is obtained by adding the ratio part set here to the calculated compensation amount.	-100 to +100 Default: 0	%
Max. cumulative L_compensation	The maximum value of the cumulative compensation amount in the lateral direction. The cumulative compensation amount is clamped to this value upon exceeding.	0 to 5000 Default: 500	mm
Max. L_compensation per cycle	The maximum value of each compensation amount in the lateral direction. The amount of each compensation is clamped to this value upon exceeding.	0.5 to 10.0 Default: 5.0	mm
L_compensation start count	The cycle count at which vertical compensation starts. Compensation is performed only when the cycle count exceeds this value.	3 to 20 Default: 4	cyc (weaving cycle)

9.4.3 Permission Allocation

Control permission		Operation mode			Authority			
Teach pendant	Other control permissions	Manual low speed mode	Manual high speed mode	Auto mode	User mode	Edit mode	Admin	Manufacturer
√	×	√	×	×	×	×	√	√

9.4.4 Notes

- Before setting the "V_master current type" to "Constant", obtain the "Constant" value as follows: First, set the "V_master current type" to "Feedback" and set the "V_master sampling count" to a relatively large value (10 or more is recommended). Then, teach a deviation-free trajectory and perform arc tracking. After the reference current calculation is completed, the "V_master current data" will be updated. Finally, set the "V_master current type" back to "Constant". It is recommended that the "Feedback" mode be used only for obtaining the vertical tracking reference current. After the reference current is obtained, switch to the "Constant" mode.
- When both the "vertical compensation function" and the "lateral compensation function" are enabled, the "compensation start count" of the two directions automatically uses the larger value of the two settings.

9.4.5 Usage Procedure

1. Quick start for arc tracking

a. New version instructions: (take the common arc tracking of weaving and linear trajectory as example)

No.	Program	Description
1	Start;	Start
2	Movl P[0],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[0].
3	Movl P[1],V[5],Fine,Tool[10],Wobj[10];	Move to the arc start point/tracking start point P[1].
4	WeldOn ArcData[1], AC[120],AV[0],WS[8];	Start arc
5	WeaveOn WeaveData[0];	Start weaving.
6	ArcTrackOn ArcTrackData[0];	Start tracking.
7	Movl P[2],V[5],Fine,Tool[10],Wobj[10];	Run the robot to the arc-off point P[2].
8	WeldOff ArcData[1];	Extinguish arc.
9	WeaveOff;	End weaving.
10	ArcTrackOff	End tracking.
11	Movl P[3],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[3].
12	End;	End

a. Old version instructions: (take the common arc tracking of weaving and linear trajectory as example)

Start:

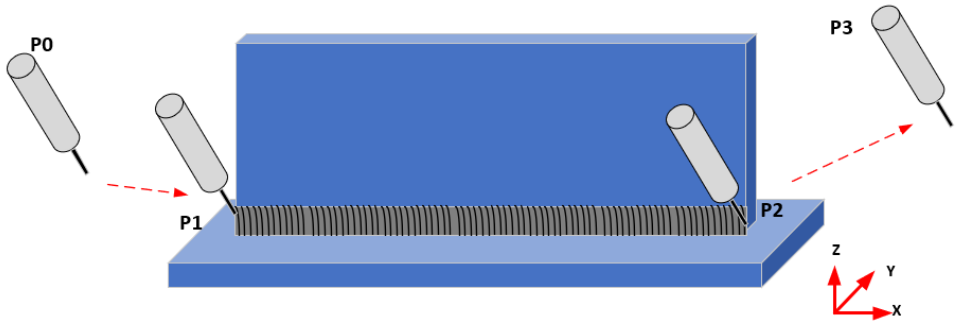
Movl P[0], V[30], Z[0], Tool[0], Wobj[0]; //Run the robot to the safety point P[0]

MovlArcOn P[1], [V100], Fine, ArcData[0], WeaveData[0], ArcTrackData[0], Tool[0], Wobj[0]; //Move to P[1] and start arc, weaving, and tracking

MovlArcOff P[2], [V100], Fine, ArcData[0], WeaveData[0], ArcTrackData[0], Tool[0], Wobj[0]; //Extinguish arc at point P[2] and end tracking and weaving

Movl P[3], V[30], Z[0], Tool[0], Wobj[0]; //Run the robot to the safety point P[3]

END



b. Interface parameters:

The arc tracking parameters can be used directly with the default settings (for common application scenarios).

For the weaving parameters, the following parameters must be set.

i. Pattern: 1 - Zigzag.

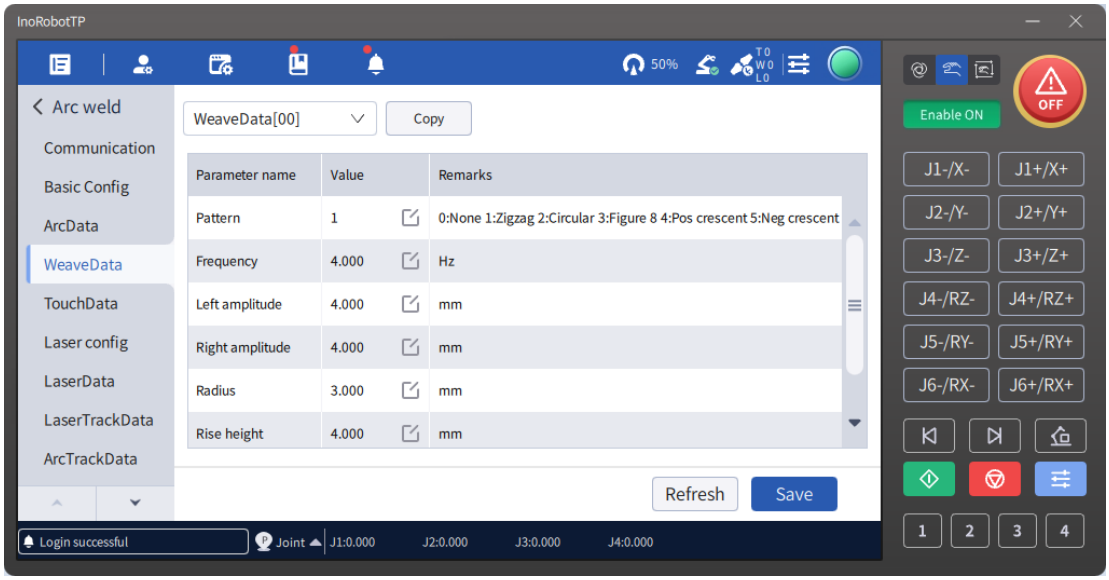
ii. Center rise flag: 0 - No rise.

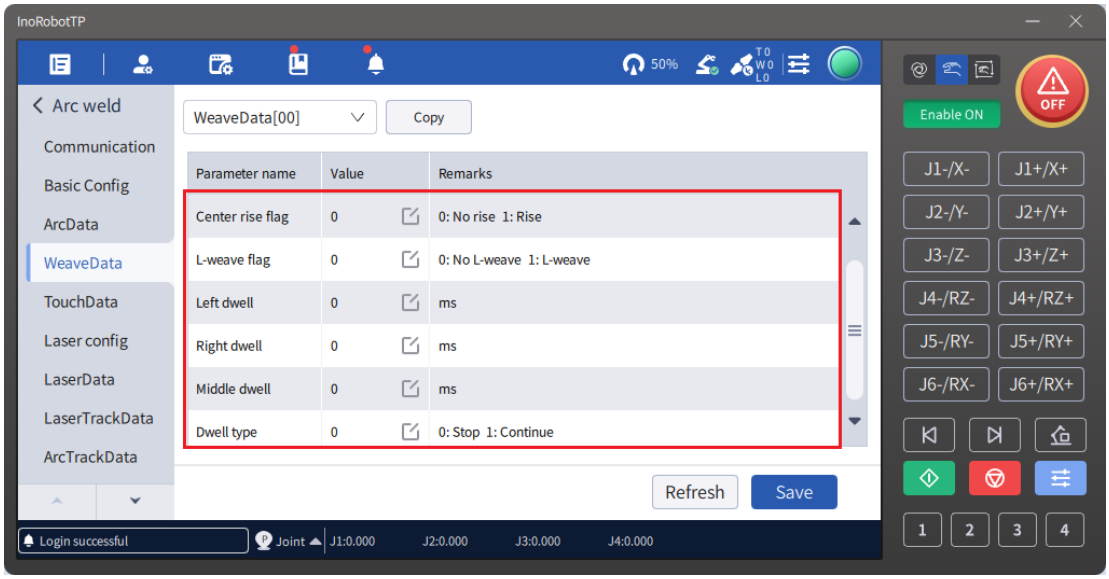
iii. L-weave flag: 0 - No L-weave.

iv. Left dwell: >0 ms.

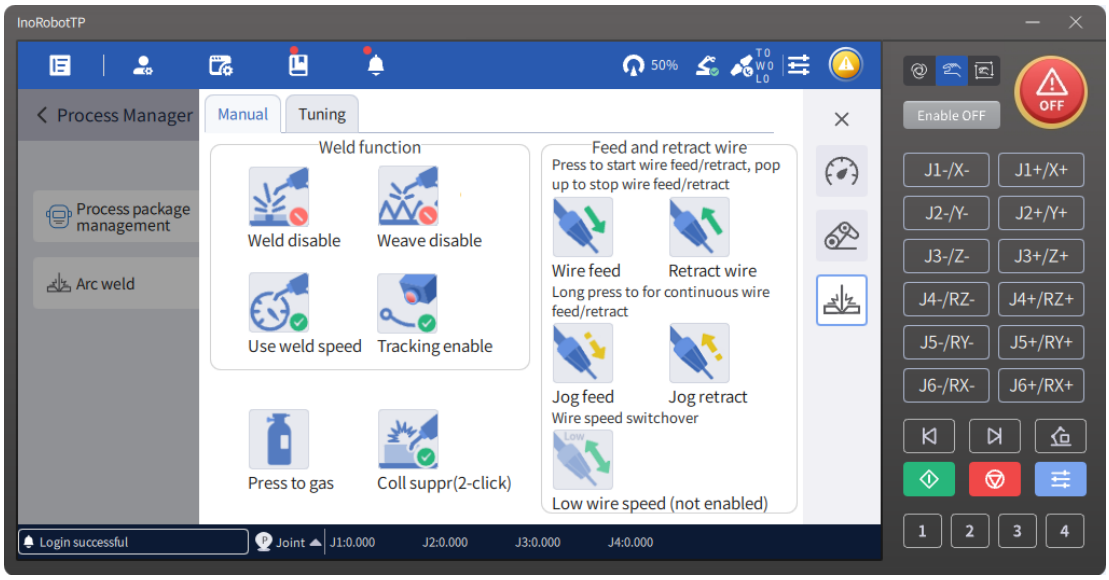
v. Right dwell: >0 ms.

vi. Dwell type: 0.





Toggle to "Tracking enable" state.



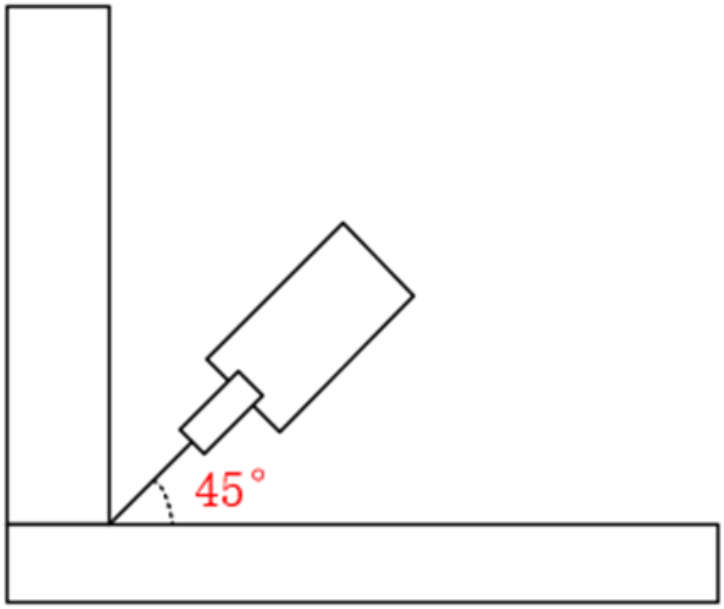
c. Welding torch Z+ direction calibration

Ensure that after the welding torch calibration, the Z direction aligns with the contact tip direction, and the positive (+) direction points away from the weld seam, as shown in the figure below.



d. Welding torch orientation

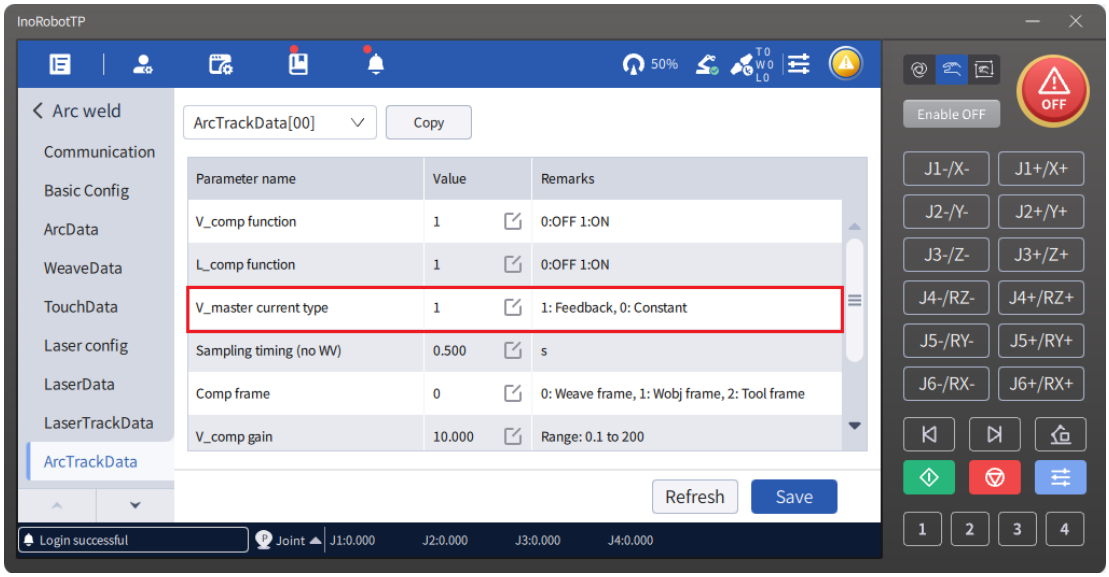
During teaching, the welding torque orientation should be such that the welding wire bisects the weld seam angle as evenly as possible. For example, with a weld seam angle of 90°, the welding wire is at a 45° angle to bisect the weld seam angle.



e. Steps

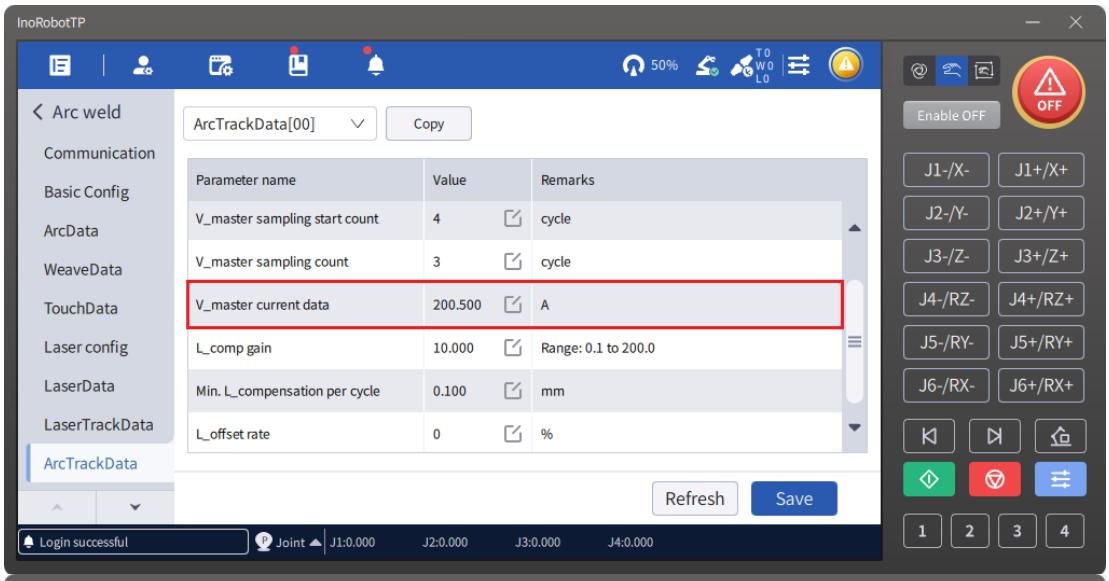
i. Teach an accurate welding trajectory on the workobject to be welded.

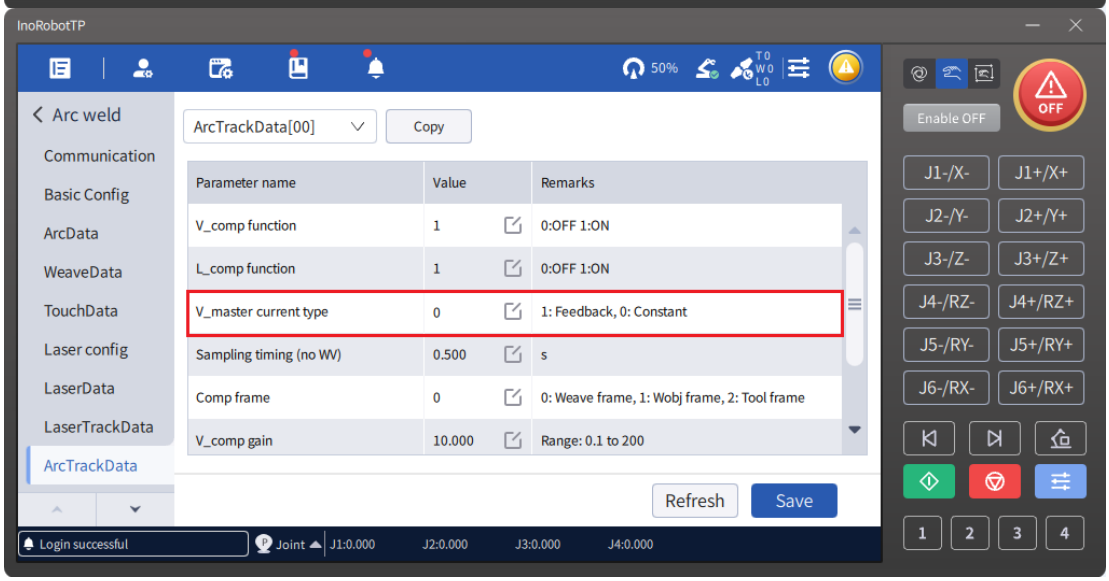
ii. Set the "V_master current type" in the "ArcTrackData" to "1 (Feedback)", as shown in the figure below.



iii. Run the arc tracking program to perform welding.

iv. After welding, the "V_master current data" in the "ArcTrackData" will be refreshed, as shown in the figure below. At this point, set the "V_master current type" to "0 (Constant)".





v. After completing the above 4 steps, you can proceed with subsequent arc tracking welding.

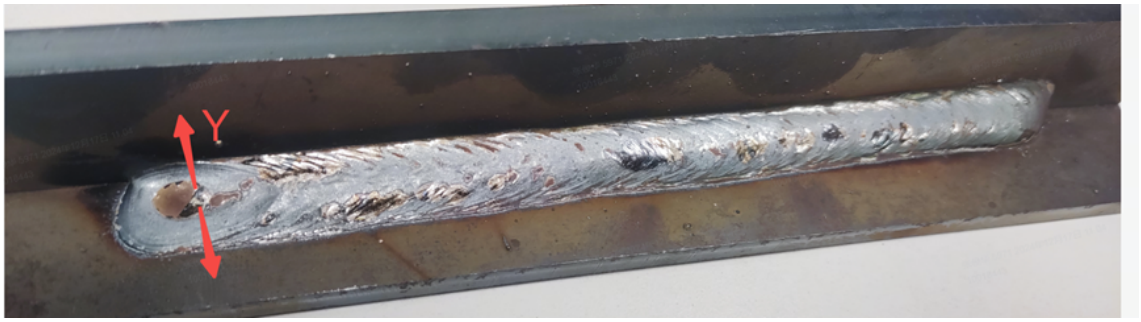
CAUTION

- Before using arc tracking, ensure that the trajectory has no deviation and the welding quality meets the requirements.
- If any welding process parameters change, such as current, voltage, weaving frequency, or weaving amplitude, re-execute steps 1 to 4 in sequence.
- To avoid wasting workobjects, do not perform steps 1 to 4 directly on the workobject; if performing these steps on a scrap piece, the material thickness, weld seam angle, etc., of the scrap piece should be as consistent as possible with those of the actual workobject.

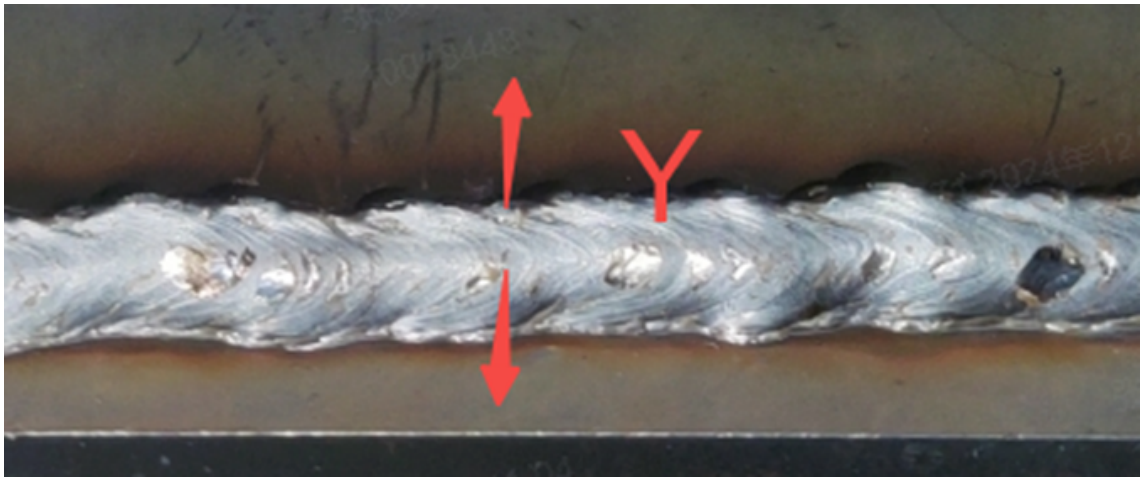
f. Key parameter adjustment

The main key control parameters for arc tracking are the "V_comp gain" and the "L_comp gain". Other control parameters generally do not need adjustment.

- If the tracking gain in the vertical (Z) or lateral (Y) direction is too low, i.e., the tracking fails to keep up, gradually increase the compensation gain for the corresponding direction. Start from the default value of 10 and increase it in steps of 1. The figure below shows "failure to keep up" in the lateral (Y) direction.



- If the tracking gain in the vertical (Z) or lateral (Y) direction is too high, i.e., the weld bead exhibits periodic oscillation, gradually decrease the compensation gain for the corresponding direction. Start from the default value of 10 and decrease it in steps of 1. The figure below shows excessive tracking gain in the lateral (Y) direction.



2. Usage restrictions and troubleshooting for arc tracking

a. Currently, arc tracking is only supported in CANopen and DeviceNet bus communication modes, and is temporarily not supported in analog communication mode.

b. The tack welds should be as small as possible and evenly distributed on both sides of the weld seam. Excessively large or irregularly shaped tack welds should be avoided wherever possible, as they can lead to current instability during welding, which in turn may result in poor tracking performance. If the

condition of the tack welds cannot be improved, decrease the "L_comp gain" as much as possible while ensuring tracking performance, so as to mitigate the impact of current instability on tracking.

c. The base metal surface of the workobject must be kept clean. Rust, oil stains, and other contaminants that may affect welding current stability should be avoided as much as possible. If the cleanliness of the base metal surface cannot be improved, decrease the "L_comp gain" as much as possible while ensuring tracking performance, so as to mitigate the impact of current instability on tracking.

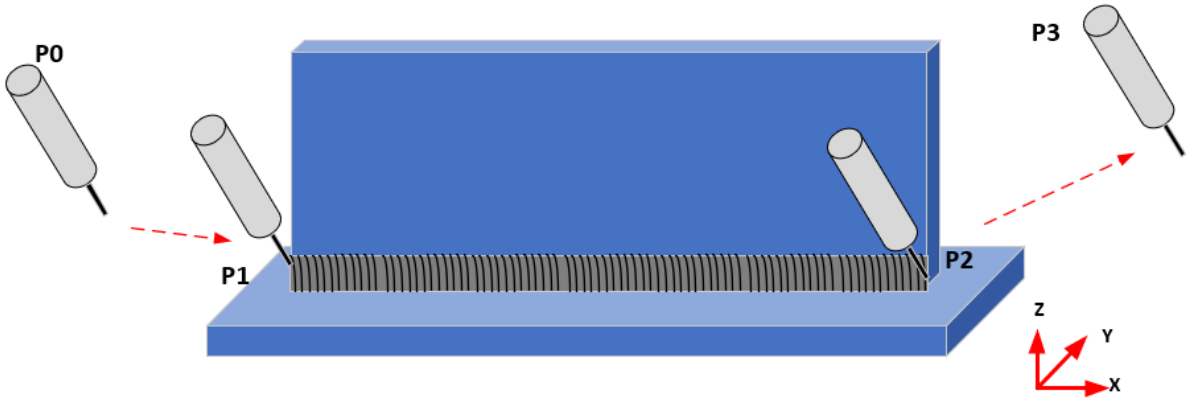
d. Avoid excessive wire feed resistance. Excessive wire feed resistance can cause current instability.

e. Ensure that the welding wire fed out from the torch tip is as centered as possible to minimize deviation from the torch center. This can be achieved by auxiliary measures such as appropriately reducing the stickout length or adding a wire straightener.

f. It is recommended to use the arc tracking function within the range of the following welding process parameters whenever possible.

- Welding type: MAG (recommended: Ar 80%, CO2 20%).
- Welding wire diameter: ≥ ϕ1.0.
- Welding wire extension: 12 mm to 20 mm.
- Weld length, plate thickness: ≥ 6 mm.
- Groove angle: ≤ 90°.
- Welding current: ≥ 200 A.
- Welding speed: ≤ 8 mm/s.
- Weaving amplitude: 3 mm to 5 mm.
- Weaving frequency: 2 Hz to 4 Hz.
- Weaving pattern: Zigzag.
- The angle between the actual welding line and the teaching path: ≤ 10°.
- If the tracking performance cannot be effectively improved even after taking the above measures and remains poor, contact the robot or welder manufacturer to verify the correctness of the "data start bit index" and "data length" for the feedback current. You can view the "data start bit index" and "data length" in "Signal config" > "Input signal".

9.4.5.1 Programming Examples



9.4.5.1.1 New Version Instructions

Take the arc tracking of weaving and linear trajectory as example.

No.	Program	Description
1	Start;	Start
2	Movl P[0],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[0].
3	Movl P[1],V[5],Fine,Tool[10],Wobj[10];	Move to the arc start point/ tracking start point P[1].
4	WeldOn ArcData[1], AC[120],AV[0],WS[8];	Start arc
5	WeaveOn WeaveData[0];	Start weaving.
6	ArcTrackOn ArcTrackData[0];	Start tracking.
7	Movl P[2],V[5],Fine,Tool[10],Wobj[10];	Run the robot to the arc-off point P[2].
8	WeldOff ArcData[1];	Extinguish arc.
9	WeaveOff;	End weaving.
10	ArcTrackOff	End tracking.
11	Movl P[3],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[3].
12	End;	End

9.4.5.1.2 Old Version Instructions

Take the common arc tracking of weaving and linear trajectory as example.

No.	Program	Description
1	Start;	Start
2	Movl P[0],V[30],Z[0],Tool[10], Wobj[0];	Run the robot to the safety point P[0].
3	MovlArcOn P[1], V[30], Fine, ArcData[0], WeaveData[0],ArcTrackData [0],Tool[10], Wobj[0];	Move to P[1], then start the arc, weave, and begin tracking.
4	MovlArcOff P[2], V[30], Fine, ArcData[0], WeaveData[0],ArcTrackData[0],Tool[10], Wobj [0];	Move to P[2], extinguish the arc, and end tracking and weaving.
5	Movl P[3],V[30],Z[0],Tool[10], Wobj[0];	Run the robot to the safety point P[3].
6	End;	End

9.4.5.2 Quick Start

1. Interface parameters:

   The arc tracking parameters can be used directly with the default settings (for common application scenarios).

   Required weaving parameter values:

   a. Pattern: 1 - Zigzag.

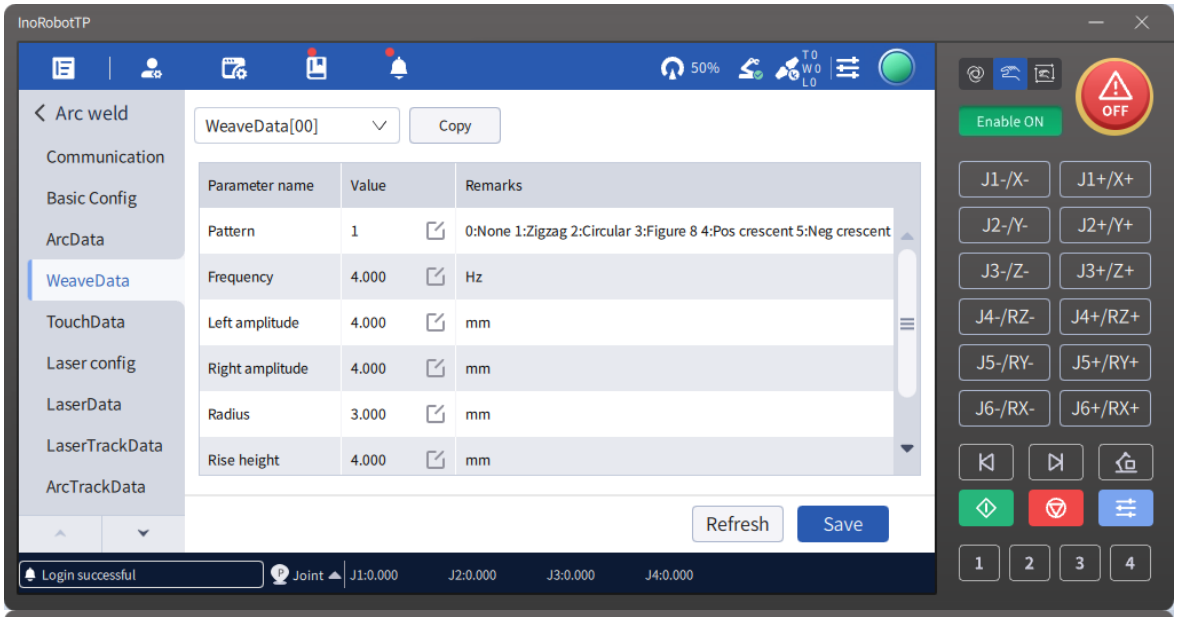
   b. Center rise flag: 0 - No rise.

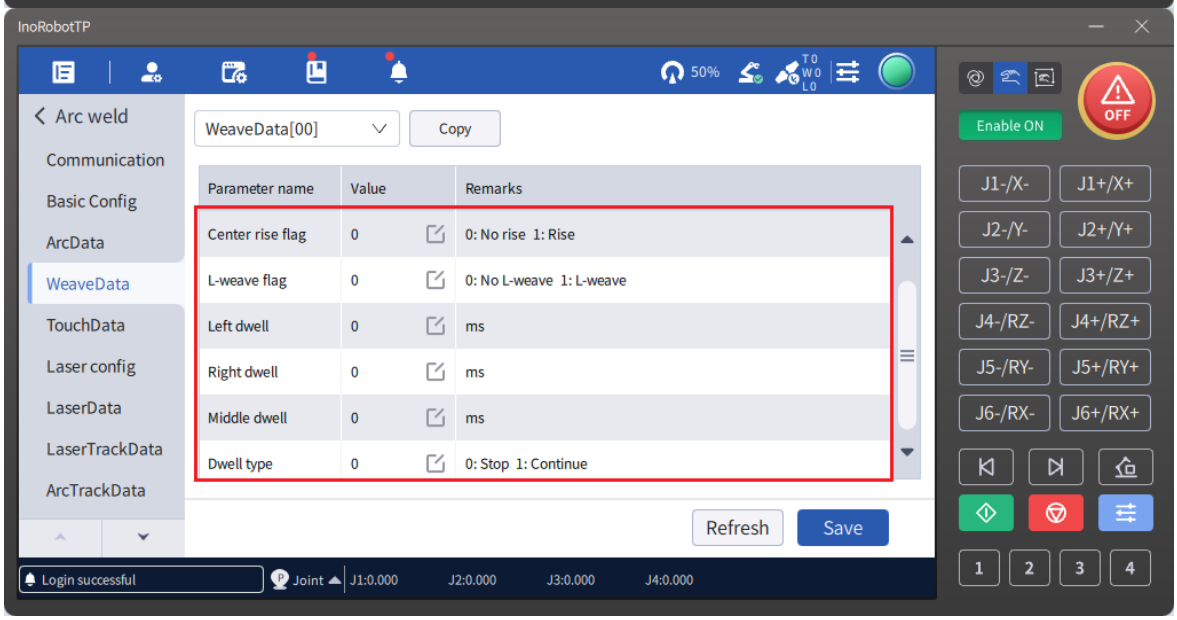
   c. L-weave flag: 0 - No L-weave.

   d. Left dwell: >0 ms.

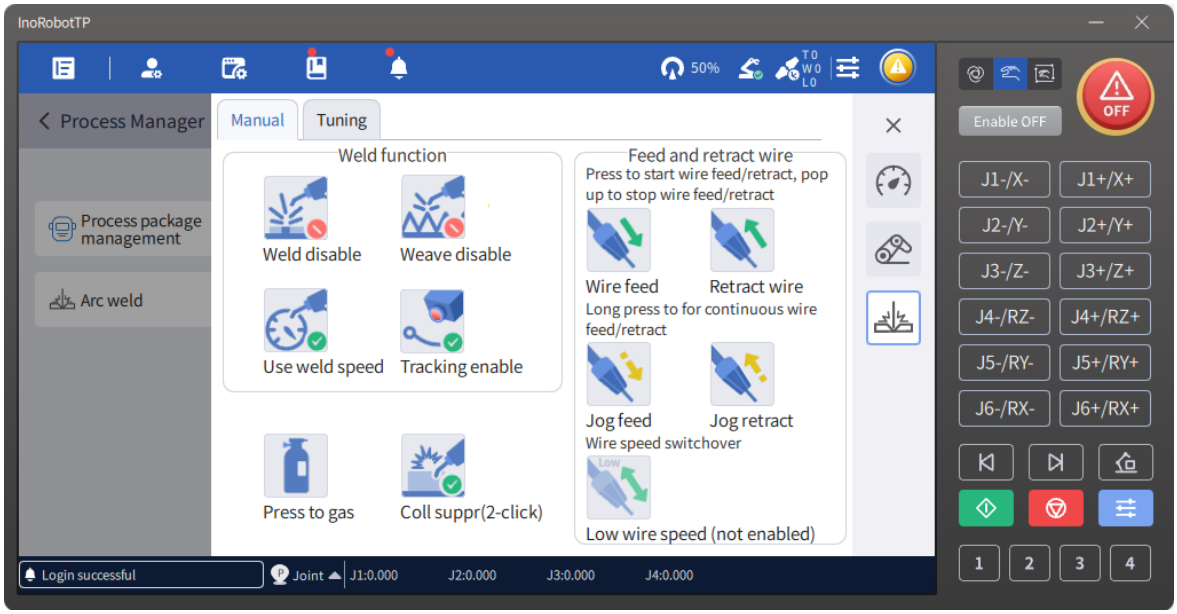
   e. Right dwell: >0 ms.

   f. Dwell type: 0.





Toggle to "Tracking enable" state.



2. Welding torch Z+ direction calibration

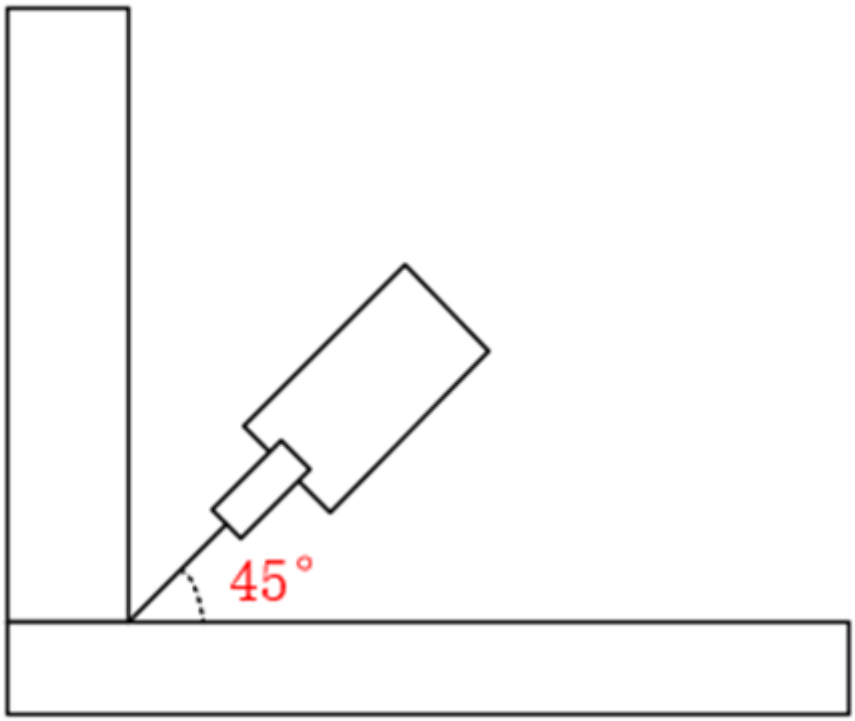
   Ensure that after the welding torch calibration, the Z direction aligns with the contact tip direction, and the positive (+) direction points away from the weld seam, as shown in the figure below.



3. Welding torch orientation

   During teaching, the welding torque orientation should be such that the welding wire bisects the weld seam angle as evenly as possible. For example, with a weld seam angle of 90°, the welding wire is at a

45° angle to bisect the weld seam

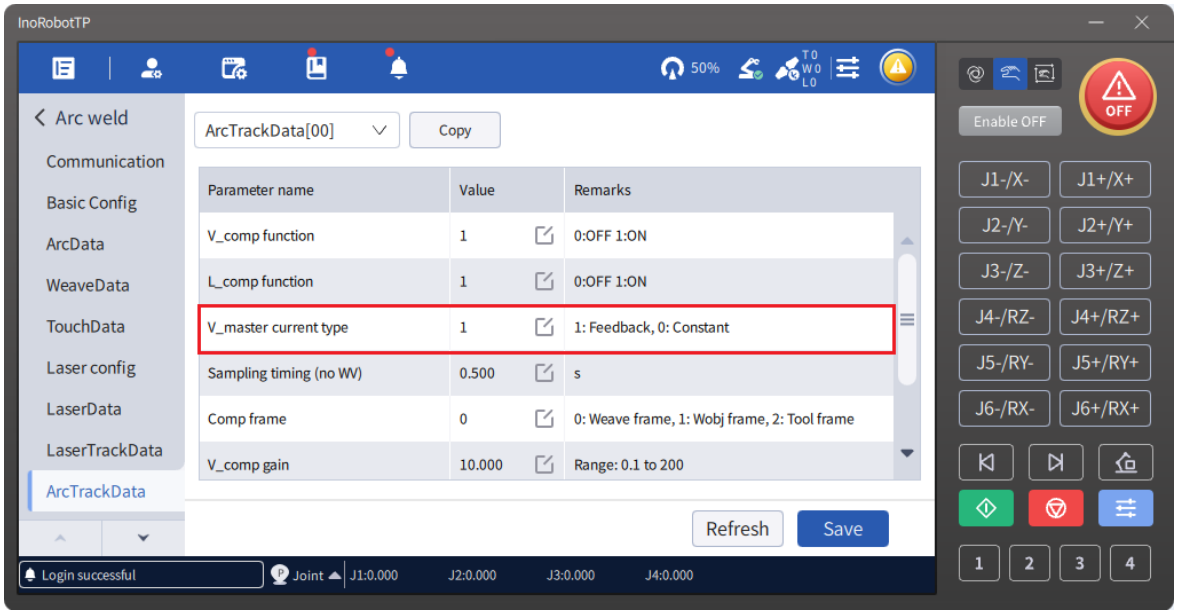


angle.

4. Steps

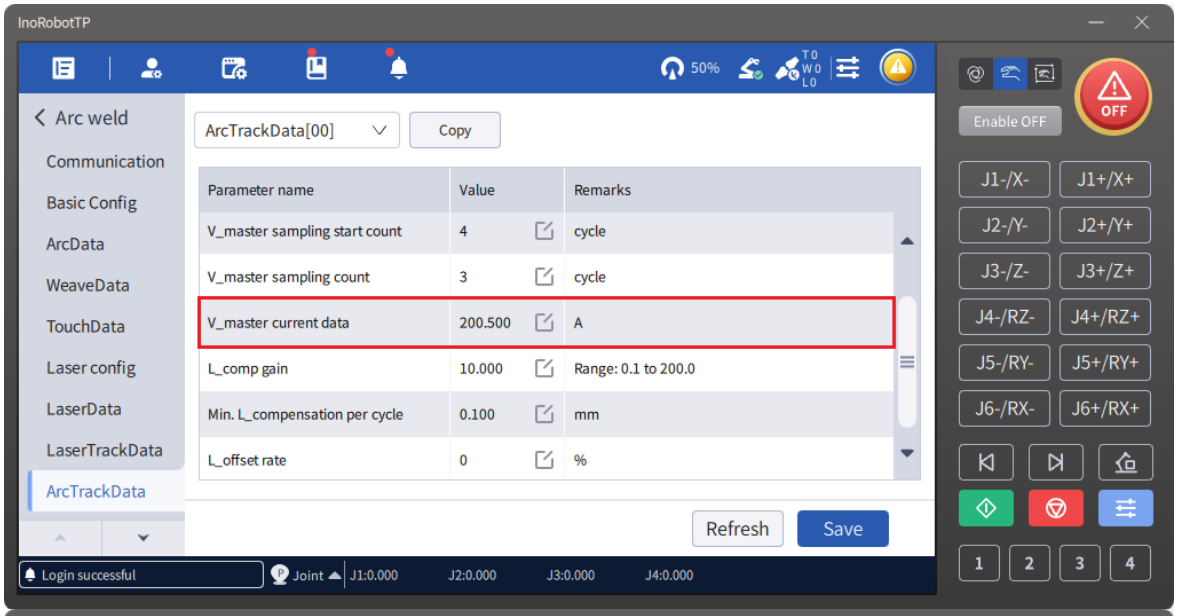
a. Teach an accurate welding trajectory on the workobject to be welded.

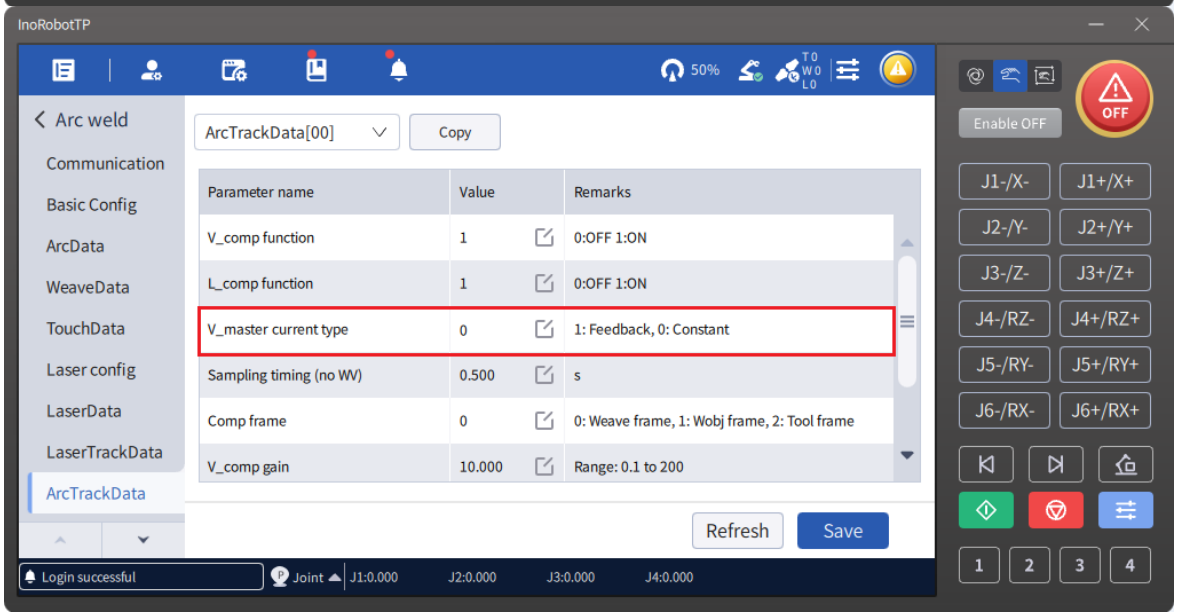
b. Set the "V_master current type" in the "ArcTrackData" to "1 (Feedback)", as shown in the figure below.



c. Run the arc tracking program to perform welding.

d. After welding, the "V_master current data" in the "ArcTrackData" will be refreshed, as shown in the figure below. At this point, set the "V_master current type" to "0 (Constant)".





e. After completing the above 4 steps, you can proceed with subsequent arc tracking welding.

CAUTION

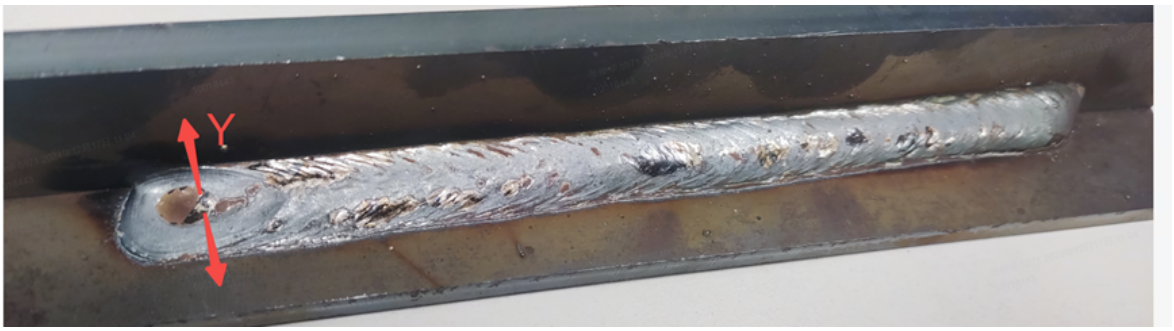
- Before using arc tracking, ensure that the trajectory has no deviation and the welding quality meets the requirements.
- If any welding process parameters change, such as current, voltage, weaving frequency, or weaving amplitude, re-execute steps 1 to 4 in sequence.
- To avoid wasting workobjects, do not perform steps 1 to 4 directly on the workobject; if performing these steps on a scrap piece, the material thickness, weld seam angle, etc., of the scrap piece should be as consistent as possible with those of the actual workobject.

5. Key parameter adjustment

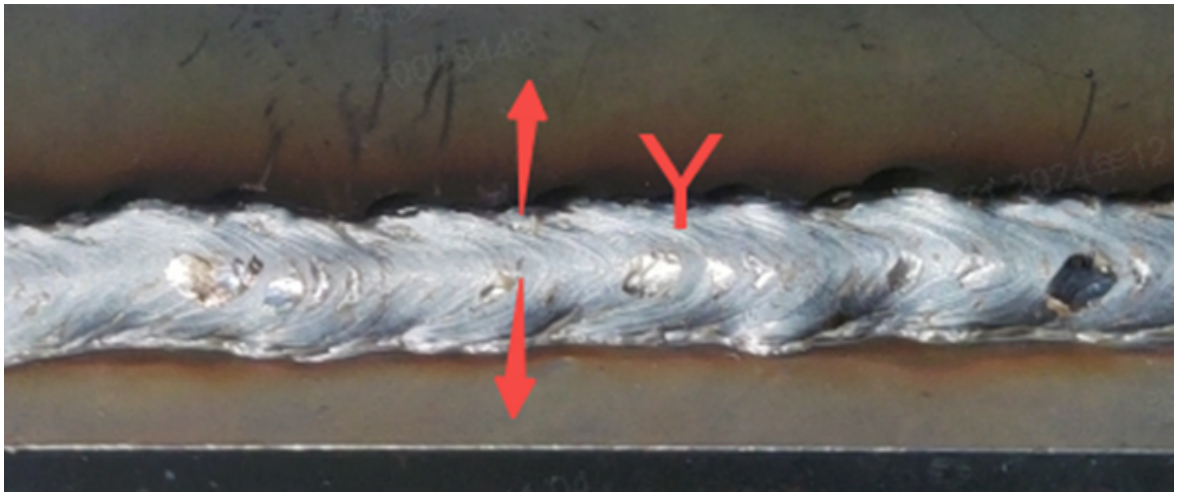
The main key control parameters for arc tracking are the "V_comp gain" and the "L_comp gain". Other control parameters generally do not need adjustment.

- If the tracking gain in the vertical (Z) or lateral (Y) direction is too low, i.e., the tracking fails to keep up, gradually increase the compensation gain for the corresponding direction. Start from the default value of 10 and increase it in steps of 1. The figure below shows "failure to keep up" in the lateral (Y)

direction.



◦ If the tracking gain in the vertical (Z) or lateral (Y) direction is too high, i.e., the weld bead exhibits periodic oscillation, gradually decrease the compensation gain for the corresponding direction. Start from the default value of 10 and decrease it in steps of 1. The figure below shows excessive tracking gain in the lateral (Y) direction.



9.4.5.3 Usage Restrictions and Troubleshooting

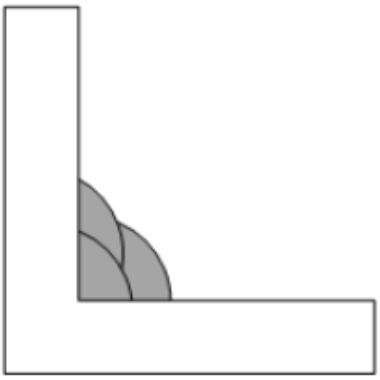
1. Currently, arc tracking is only supported in CANopen and DeviceNet bus communication modes, and is temporarily not supported in analog communication mode.
2. The tack welds should be as small as possible and evenly distributed on both sides of the weld seam. Excessively large or irregularly shaped tack welds should be avoided wherever possible, as they can lead to current instability during welding, which in turn may result in poor tracking performance. If the condition of the tack welds cannot be improved, decrease the "L_comp gain" as much as possible while ensuring tracking performance, so as to mitigate the impact of current instability on tracking.
3. The base metal surface of the workobject must be kept clean. Rust, oil stains, and other contaminants that may affect welding current stability should be avoided as much as possible. If the cleanliness of the base metal surface cannot be improved, decrease the "L_comp gain" as much as possible while ensuring tracking performance, so as to mitigate the impact of current instability on tracking.
4. Avoid excessive wire feed resistance. Excessive wire feed resistance can cause current instability.
5. Ensure that the welding wire fed out from the torch tip is as centered as possible to minimize deviation from the torch center. This can be achieved by auxiliary measures such as appropriately reducing the stickout length or adding a wire straightener.
6. It is recommended to use the arc tracking function within the range of the following welding process parameters whenever possible.
   - Welding type: MAG (recommended: Ar 80%, CO2 20%).

- Welding wire diameter: ≥ ϕ1.0.
- Welding wire extension: 12 mm to 20 mm.
- Weld length, plate thickness: ≥ 6 mm.
- Groove angle: ≤ 90°.
- Welding current: ≥ 200 A.
- Welding speed: ≤ 8 mm/s.
- Weaving amplitude: 3 mm to 5 mm.
- Weaving frequency: 2 Hz to 4 Hz.
- Weaving pattern: Zigzag.
- The angle between the actual welding line and the teaching path: ≤ 10°.
- If the tracking performance cannot be effectively improved even after taking the above measures and remains poor, contact the robot or welder manufacturer to verify the correctness of the "data start bit index" and "data length" for the feedback current. You can view the "data start bit index" and "data length" in "Signal config" > "Input signal".

9.5 Multi-Layer and Multi-Pass

9.5.1 Overview

The welding process in which a groove of a thick plate workobject is welded multiple times to fill the weld passes is called multi-layer and multi-pass welding. Using traditional teaching methods for multi-pass welding requires a significant amount of time to teach all the weld passes. The multi-pass welding function can be used to specify the parts to be welded repeatedly. Compared with teaching all weld passes individually, the teaching time for multi-layer and multi-pass welding is greatly reduced.



The multi-layer and multi-pass function can be divided into two sub-functions:

1. Welding path recording and storage function
   This function uses welding motion instructions to teach the first weld pass, records the points during welding, and saves the points to a file via an instruction. After a power failure restart, the points can be reloaded from the file.
2. Welding path reproduction and offset function
   After the points of the first weld pass are recorded, this function reproduces the second and subsequent weld passes using reproduction instructions. Different passes can be assigned different offsets, welding parameters, and weaving parameters.

9.5.2 Welding Path Recording and Storage Function

Old version instruction: When the RPM parameter is included in the welding motion instructions such as MovlArcOn, MovlArc, MovcArc, MovlArcOff, and MovcArcOff, the system automatically records the points on the welding path to the RPM memory with the corresponding index in the controller.

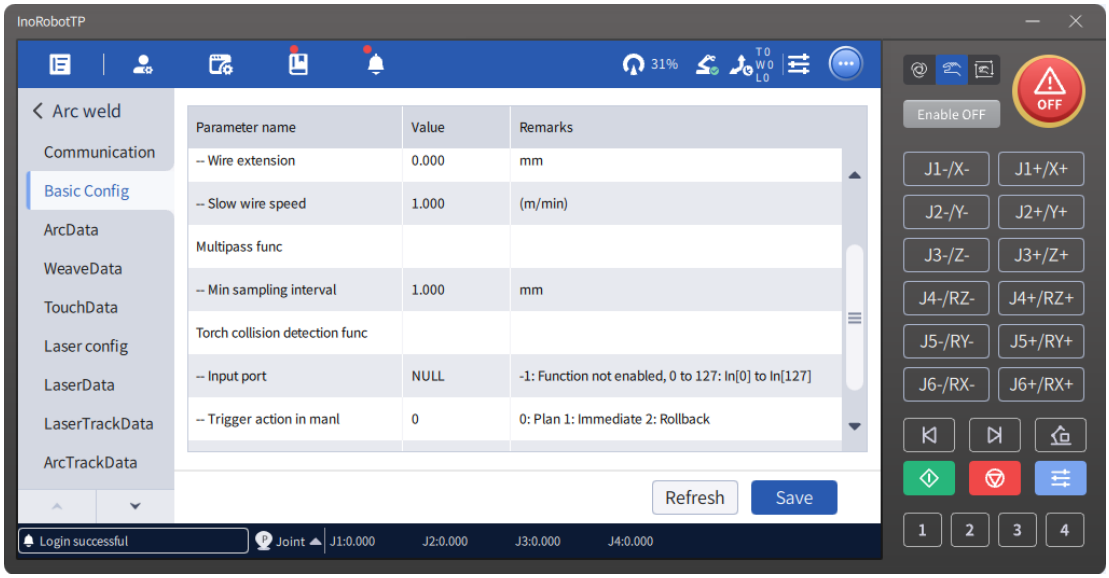
New version instruction: When the RPM parameter is included in the WeldOn instruction, the system automatically records the points on the welding path to the RPM memory with the corresponding index in the controller when executing the motion instructions between WeldOn and WeldOff.

Data in RPM is not retained after power failure. To retain data after power failure, use the MPSaveRPM instruction to record the points in memory to a file. After a power failure restart, if needed, the points in the file can be loaded into the controller memory using the MPLoadRPM instruction.

Point recording supports recording points for weaving, laser tracking and arc tracking. During point recording, a maximum of 1000 points can be recorded at a time. During tracking, points are recorded by default with a minimum distance interval of 1 mm.

When the path is long and a 1 mm interval would prevent recording all points along the path, the minimum distance interval can be adjusted to allow recording of a longer path.

You can adjust the "Min sampling interval" parameter in the range of 1 to 100 mm under "Settings" > "More" > "Process Manager" > "Arc weld" > "Basic Config".



9.5.3 Welding Path Reproduction and Offset Function

After the points of the original weld pass are recorded, this function reproduces the subsequent weld passes using reproduction instructions. Different passes can be assigned different offsets, welding parameters, and weaving parameters.

There are two instructions for path reproduction and offset:

1. MovArcRep
   This instruction can be used to reproduce a stored path. The reproduction direction can be set via the RepDir parameter. Offsets (start and end offsets, X/Y/Z direction offsets, and X/Y direction rotations) can be set in MPOffsData.

This instruction reproduces the stored trajectory only once. If multiple reproductions are required, you can either copy several MovArcRep instructions or use the MovArcMultiRep instruction to reproduce the trajectory multiple times.

The points recorded in RPM are the points on the guide line. During reproduction, weaving shall follow the weaving parameters attached to the MovArcRep instruction.

2. MovArcMultiRep
   This instruction can be used to reproduce a stored path multiple times. The number of reproductions, direction, welding parameters for each pass, weaving parameters, and weld pass offset parameters can be set via the ArcMultiData parameter.

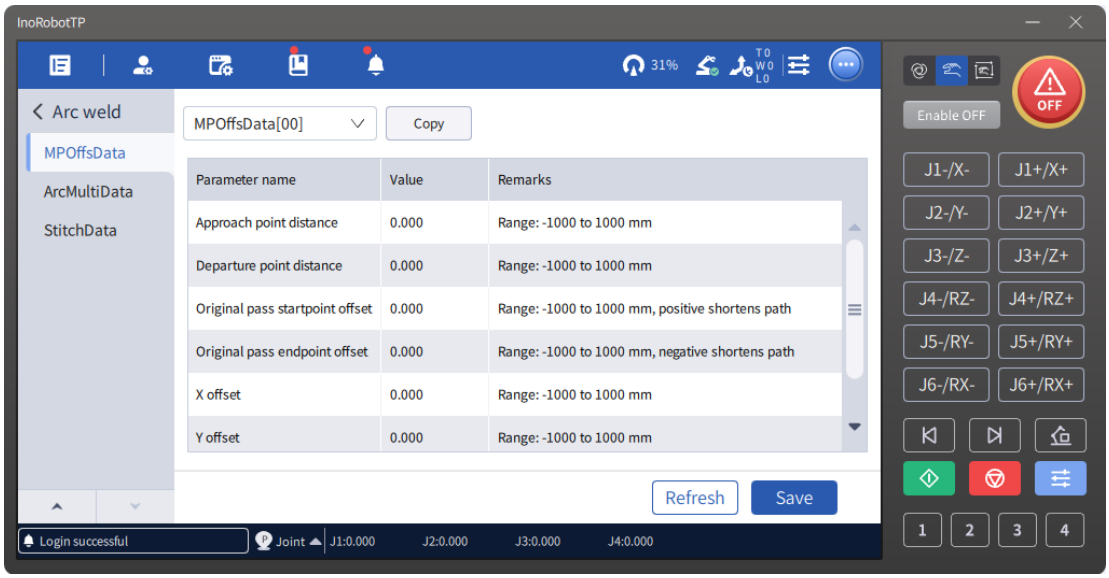
   The points recorded in RPM are the points on the guide line. During reproduction, weaving shall follow the weaving parameters set in ArcMultiData.

   During welding, the upper computer will indicate which pass is starting, and after the pass is completed, a message will appear in the message bar indicating that the corresponding pass has been completed.

9.5.4 Parameter Description

9.5.4.1 MPOffsData

You can enter the weld pass offset parameter setting page by selecting "Settings" > "More" > "Process Manager" > "Arc weld" > "MPOffsData", and then configure the weld pass offset related parameters. For details, see the parameter table.



Parameter name	Description	Range
Approach point distance	The distance by which the first point is offset along the Z-axis of the tool frame to become the approach point.	-
Departure point distance	The distance by which the last point is offset along the Z-axis of the tool frame to become the departure point.	-1000.0 mm to +1000.0 mm (default value: 0)

Parameter name	Description	Range
Start offset	The offset distance along the path direction from the first point of the path (this point refers to the point after XYZABC offset, i.e., the approach and departure offsets for each weld pass are based on the actual start and end points of the path), in mm. A positive value results in a shorter welding path.	-1000.0 mm to +1000.0 mm
End offset	The offset distance along the path direction from the last point of the path (this point refers to the point after XYZABC offset, i.e., the approach and departure offsets for each weld pass are based on the actual start and end points of the path), in mm. A negative value results in a shorter welding path.	-1000.0 mm to +1000.0 mm
X offset	The offset of the point along the X direction of the weld seam frame[1].	-1000.0 mm to +1000.0 mm
Y offset	The offset of the point along the Y direction of the weld seam frame.	-1000.0 mm to +1000.0 mm
Z offset	The offset of the point along the Z direction of the weld seam frame.	-1000.0 mm to +1000.0 mm
X rotation	The rotation amount of the point around the X direction of the weld seam frame.	-90.0 deg to +90.0 deg
Y rotation	The rotation amount of the point around the Y direction of the weld seam frame.	-90.0 deg to +90.0 deg
External axis 1 offset angle[2]	Keep the position relationship between the robot and the external axis unchanged. Change only the relative orientation between the robot and the external axis by adjusting the angle of the external axis. The actual effect is that the robot's orientation relative to the world frame remains unchanged.	-360.0 deg to +360.0 deg
External axis 2 offset angle[2]	Keep the position relationship between the robot and the external axis unchanged. Change only the relative orientation between the robot and the external axis by adjusting the angle of the external axis. The actual effect is that the robot's orientation relative to the world frame remains unchanged.	-360.0 deg to +360.0 deg
External axis 3 offset angle[2]	Keep the position relationship between the robot and the external axis unchanged. Change only the relative orientation between the robot and the external axis by adjusting the angle of the external axis. The actual effect is that the robot's orientation relative to the world frame remains unchanged.	-360.0 deg to +360.0 deg

Parameter name	Description	Range
Max. orientation speed	After applying X or Y direction rotational offset, if the orientation speed during path reproduction exceeds this value, an alarm will be triggered. You can adjust this value according to the actual situation. When adjusting, be sure to run at low speed to prevent collisions.	10°/s to 150°/s

NOTE

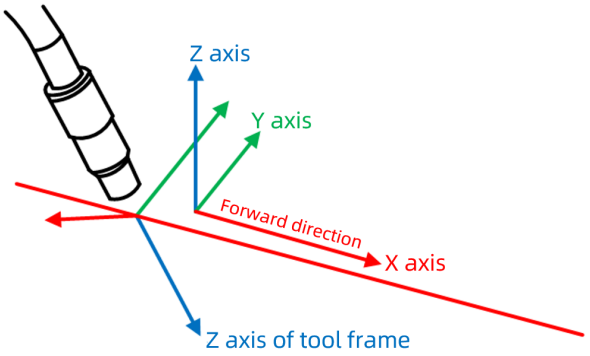
[1]: When offsetting a weld pass, all offsets are based on the weld seam frame.

X-axis: If linear interpolation is used, the forward direction is the X-axis direction. If circular interpolation is used, the tangent direction of the arc is the X-axis direction.

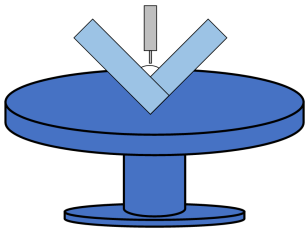
Z-axis: Project the Z-axis of the tool frame onto the plane perpendicular to the X-axis, and define the direction facing the welding torch as the positive direction of the Z-axis.

Y-axis: Perpendicular to the plane formed by the Z-axis and X-axis.

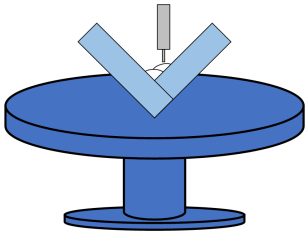
The frame formed by the above XYZ is the weld seam frame, which is consistent with the frame referenced during weaving.



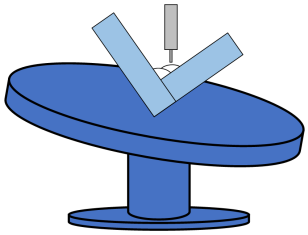
[2]: Assume a two-axis positioner, with external axis 1 as the rotation axis and external axis 2 as the tilting axis, welding a workobject with a V-groove. During welding, it is desired that the groove be perpendicular to the welding torch. The first layer welding is shown in the figure below.



When welding the second layer, the weld trajectory can be offset by using Y and Z direction offsets as follows:



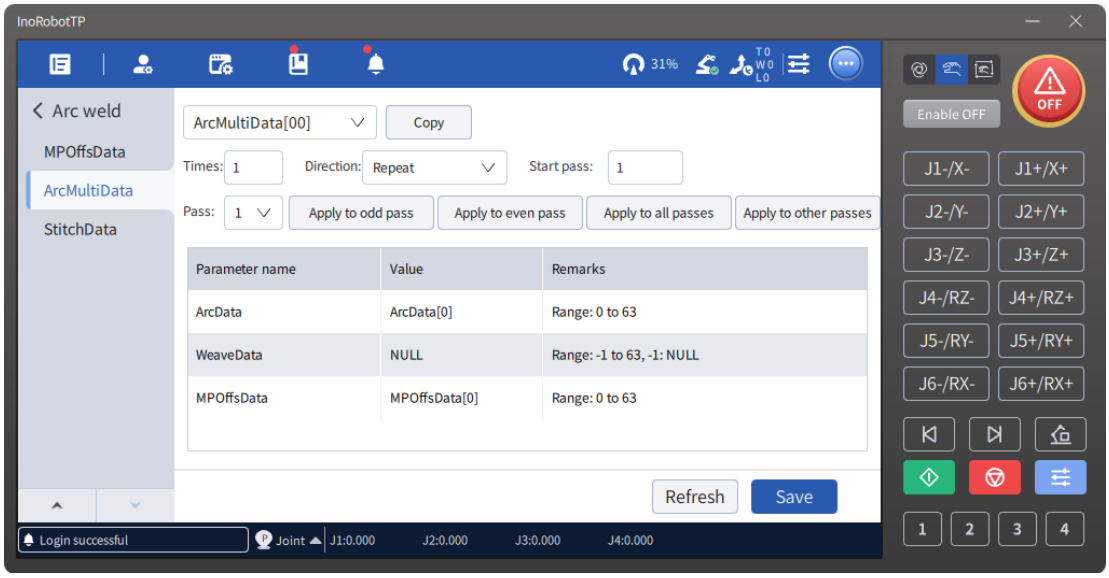
If it is desired that the second layer also be welded in a flat position, the tilting axis (external axis 2) can be rotated by setting an offset angle. During this rotation, the relative position between the welding torch and the workobject remains unchanged, and the torch orientation relative to the world frame remains unchanged, thus changing the relative orientation between the torch and the workobject.



9.5.4.2 ArcMultiData

You can enter the multi-layer and multi-pass parameter setting page by selecting "Settings" > "More" > "Process Manager" > "Arc weld" > "ArcMultiData", and then configure the related parameters. For details, see the parameter table.

- "Pass" drop-down box: After you select the corresponding pass, the table displays the "ArcData", "WeaveData" and "MPOffsData" parameters for that pass. You can also modify the settings.
- Apply to odd passes: Apply the current pass settings to all odd passes.
- Apply to even passes: Apply the current pass settings to all even passes.
- Apply to all passes: Apply the current pass settings to all passes.
- Apply to other pass: Apply the current pass settings to a specific pass.
- Click "Save" after setting.



Parameter name	Description	Type	Range	Unit
Times	Number of reproductions	Integer	1 to 50, Default: 1	Times
Direction	Reproduction direction 0 - Repeat: The motion direction of each pass is the same as the saved path motion direction. 1 - Reciprocating: The motion direction of odd-numbered passes is opposite to the saved path motion direction, and the motion direction of even-numbered passes is the same as the saved path motion direction.	Integer	0 to 1, Default: 0	0: Repeat 1: Reciprocating

Parameter name	Description	Type	Range	Unit
Start pass	The default value is 1 (welding starts from the first pass). You can also specify another pass to start from. This parameter must be less than "Times", otherwise an alarm will be triggered.	Integer	1 to 50, Default: 1	Pass
ArcData	The index of the welding parameters selected for the current pass.	Integer	0 to 63, Default: 0	-
WeaveData	The index of the weaving parameters selected for the current pass.	Integer	-1 to +63, Default: 0	-1 indicates no weaving.
MPOffsData	The index of the weld pass offset parameters selected for the current pass.	Integer	0 to 63, Default: 0	-

9.5.5 Permission Allocation

Control permission		Operation mode			Authority			
Teach pendant	Other control permissions	Manual low speed mode	Manual high speed mode	Auto mode	User mode	Edit mode	Admin	Manufacturer
√	×	√	×	×	×	×	√	√

9.5.6 Usage Procedure

9.5.6.1 New Version Instructions

1. Teach the original path, and include the RPM parameter in the welding motion instruction to record the path.
2. If the path data needs to be retained after a power failure, use the MPSaveRPM instruction to save the path data to a file, and then use the MPLoadRPM instruction to load the path data.
3. Offset and reproduce the original path:
   a. First set the weld pass offset parameters, including the required XYZ offsets and whether a safety point is needed. These are configured under "Settings" > "More" > "Process Manager" > "Arc weld" > "MPOffsData".
   b. Use the MovArcRep instruction to reproduce the path once. For multiple passes, use as many instructions as the number of paths required.

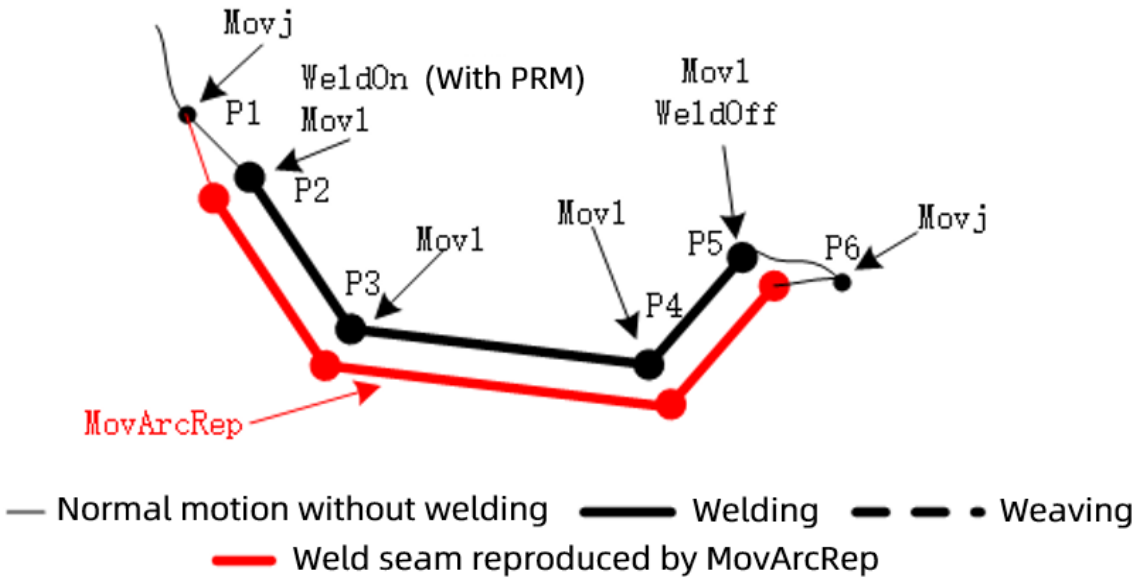


Table9-5-6-1-1 New Version Instructions

No.	Program	Comment
1	Start;	Start
2	Movj P[1], V[30], Z[0], Tool[1], Wobj[0];	Run the robot to the safety point P[1].
3	Movl P[2],V[30],Z[0],Tool[1] ,Wobj[0];	Move to the arc start point P[2], and store P[2] in RPM[0].
4	WeldOn ArcData[0], RPM[0];	Start arc. With RPM attached, the welding path is automatically recorded.
5	Movl P[3],V[30],Z[0],Tool[1] ,Wobj[0];	Move to the point P[3], and store P[3] in RPM[0].
6	Movl P[4],V[30],Z[0],Tool[1] ,Wobj[0];	Move to the point P[4], and store P[4] in RPM[0].
7	Movl P[5],V[30],Z[0],Tool[1] ,Wobj[0];	Move to the point P[5], and store P[5] in RPM[0].
8	WeldOff ArcData[0];	Extinguish arc.
9	Movj P[6],V[30],Z[0],Tool[1],Wobj[0];	Run the robot to the safety point P[6].
10	MPSaveRPM RPM[0];	Store the points in RPM[0] to a file. If it is not required to retain the points in RPM[0] after power loss, this instruction can be omitted.
11	MPLoadRPM RPM[0];	Load the points in RPM[0] from a file. If it is not required to retain the points in RPM[0] after power loss, this instruction can be omitted.

No.	Program	Comment
12	Movj P[1],V[30],Z[0],Tool[1],Wobj[0];	Run the robot to the safety point P[1].
13	MovArcRep ArcOn,ArcOff, RPM[0], MPOffsData[0], RepDir[1], ArcData[1], Tool[1],Wobj[0];	Reproduce the path based on the offset parameters set in MPOffsData[0], with the reproduction direction opposite to the original path, and use the ArcData parameters during the welding process.
14	Movj P[6],V[30],Z[0],Tool[1],Wobj[0];	Run the robot to the safety point P[6].
15	END;	End

c. Alternatively, the MovArcMultiRep instruction can be used to reproduce multiple weld passes with a single instruction. The number of reproductions, direction, and the weld pass offset parameters and welding parameters for each pass are set in ArcMultiData.

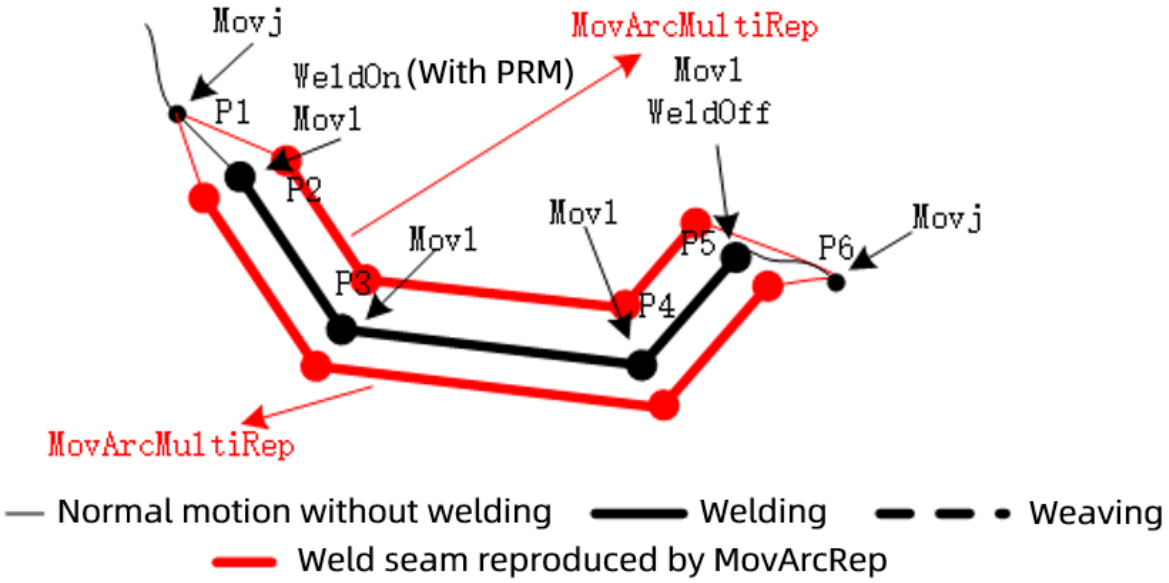


Table9-5-6-1-1 New Version Instructions

No.	Program	Comment
1	Start;	Start
2	Movj P[1], V[30], Z[0], Tool[1], Wobj[0];	Run the robot to the safety point P[1].
3	Movl P[2],V[30],Z[0],Tool[1],Wobj[0];	Move to the arc start point P[2], and store P[2] in RPM[0].
4	WeldOn ArcData[0], RPM[0];	Start arc. With RPM attached, the welding path is automatically recorded.
5	Movl P[3],V[30],Z[0],Tool[1] ,Wobj[0];	Move to the point P[3], and store P[3] in RPM[0].
6	Movl P[4],V[30],Z[0],Tool[1] ,Wobj[0];	Move to the point P[4], and store P[4] in RPM[0].
7	Movl P[5],V[30],Z[0],Tool[1],Wobj[0];	Move to the point P[5], and store P[5] in RPM[0].
8	WeldOff ArcData[0];	Extinguish arc.

No.	Program	Comment
9	Movj P[6],V[30],Z[0],Tool[1],Wobj[0];	Run the robot to the safety point P[6].
10	MPSaveRPM RPM[0];	Store the points in RPM[0] to a file. If it is not required to retain the points in RPM[0] after power loss, this instruction can be omitted.
11	MPLoadRPM RPM[0];	Load the points in RPM[0] from a file. If it is not required to retain the points in RPM[0] after power loss, this instruction can be omitted.
12	Movj P[1],V[30],Z[0],Tool[1],Wobj[0];	Run the robot to the safety point P[1].
13	MovArcMultiRep ArcOn,ArcOff, RPM[0], ArcMultiData[0], Tool[1],Wobj[0];	Reproduce multiple times according to the number of reproductions and other settings in ArcMultiData[0]. The offset, welding parameters, and weaving parameters for each path are taken from the parameter indices set in ArcMultiData[0] for that path.
14	Movj P[6],V[30],Z[0],Tool[1],Wobj[0];	Run the robot to the safety point P[6].
15	END;	End

9.5.6.2 Old Version Instructions

1. Teach the original path, and include the RPM parameter in the welding motion instruction to record the path.
2. If the path data needs to be retained after a power failure, use the MPSaveRPM instruction to save the path data to a file, and then use the MPLoadRPM instruction to load the path data.
3. Offset and reproduce the original path:
   a. First set the weld pass offset parameters, including the required XYZ offsets and whether a safety point is needed. These are configured under "Settings" > "More" > "Process Manager" > "Arc weld" > "MPOffsData".

   b. Use the MovArcRep instruction to reproduce the path once. For multiple passes, use as many instructions as the number of paths required.

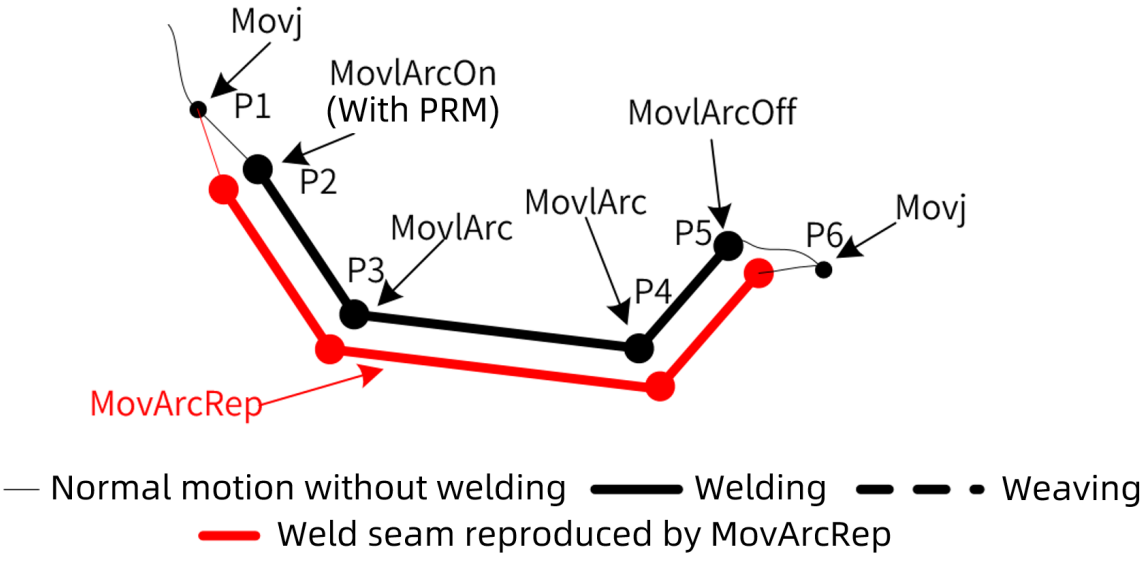


Table9-5-6-2-1 Old Version Instructions

No.	Program	Comment
1	Start;	Start
2	Movj P[1], V[30], Z[0], Tool[1], Wobj[0];	Run the robot to the safety point P[1].
3	MovlArcOn P[2],V[30],Z[0],ArcData[0],RPM[0],Tool[1] ,Wobj[0];	Move to the arc start point P[2], and store P[2] in RPM[0].
4	MovlArc P[3],V[30],Z[0],ArcData[0], RPM[0],Tool[1] ,Wobj[0];	Move to the point P[3], and store P[3] in RPM[0].
5	MovlArc P[4],V[30],Z[0],ArcData[0], RPM[0],Tool[1] ,Wobj[0];	Move to the point P[4], and store P[2] in RPM[0].
6	MovlArcOff P[5],V[30],Z[0],ArcData[0], RPM[0],Tool[1] ,Wobj[0];	Move to the point P[5], and store P[5] in RPM[0].
7	Movj P[6],V[30],Z[0],Tool[1],Wobj[0];	Run the robot to the safety point P[6].
8	MPSaveRPM RPM[0];	Store the points in RPM[0] to a file. If it is not required to retain the points in RPM[0] after power loss, this instruction can be omitted.
9	MPLoadRPM RPM[0];	Load the points in RPM[0] from a file. If it is not required to retain the points in RPM[0] after power loss, this instruction can be omitted.
10	Movj P[1],V[30],Z[0],Tool[1],Wobj[0];	Run the robot to the safety point P[1].
11	MovArcRep ArcOn,ArcOff, RPM[0], MPOffsData[0], RepDir[1], ArcData[1], Tool[1],Wobj[0];	Reproduce the path based on the offset parameters set in MPOffsData[0], with the reproduction direction opposite to the original path, and use the ArcData parameters during the welding process.
12	Movj P[6],V[30],Z[0],Tool[1],Wobj[0];	Run the robot to the safety point P[6].
13	END;	End

c. Alternatively, the MovArcMultiRep instruction can be used to reproduce multiple weld passes with a single instruction. The number of reproductions, direction, and the weld pass offset parameters and welding parameters for each pass are set in ArcMultiData.

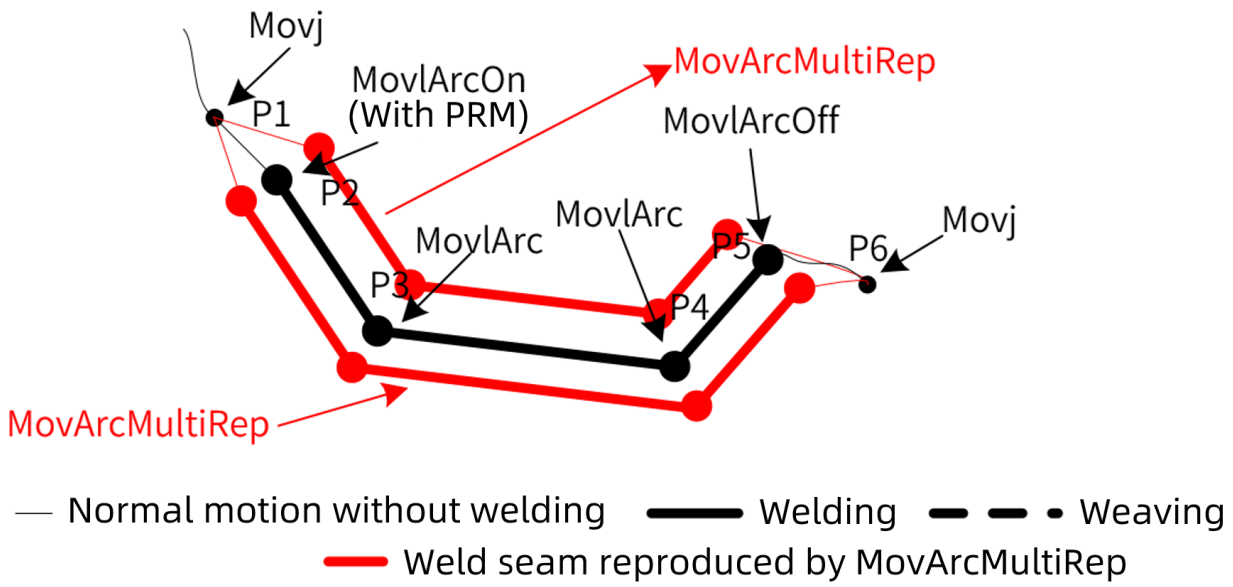


Table9-5-6-2-1 Old Version Instructions

No.	Program	Comment
1	Start;	Start
2	Movj P[1], V[30], Z[0], Tool[1], Wobj[0];	Run the robot to the safety point P[1].
3	MovlArcOn P[2],V[30],Z[0],ArcData[0],RPM[0],Tool[1],Wobj[0];	Move to the arc start point P[2], and store P[2] in RPM[0].
4	MovlArc P[3],V[30],Z[0],ArcData[0], RPM[0],Tool[1] ,Wobj[0];	Move to the point P[3], and store P[3] in RPM[0].
5	MovlArc P[4],V[30],Z[0],ArcData[0], RPM[0],Tool[1] ,Wobj[0];	Move to the point P[4], and store P[4] in RPM[0].
6	MovlArcOff P[5],V[30],Z[0],ArcData[0], RPM[0],Tool[1],Wobj[0];	Move to the point P[5], and store P[5] in RPM[0].
7	Movj P[6],V[30],Z[0],Tool[1],Wobj[0];	Run the robot to the safety point P[6].
8	MPSaveRPM RPM[0];	Store the points in RPM[0] to a file. If it is not required to retain the points in RPM[0] after power loss, this instruction can be omitted.
9	MPLoadRPM RPM[0];	Load the points in RPM[0] from a file. If it is not required to retain the points in RPM[0] after power loss, this instruction can be omitted.
10	Movj P[1],V[30],Z[0],Tool[1],Wobj[0];	Run the robot to the safety point P[1].
11	MovArcMultiRep ArcOn,ArcOff, RPM[0], ArcMultiData[0], Tool[1],Wobj[0];	Reproduce multiple times according to the number of reproductions and other settings in ArcMultiData[0]. The offset, welding parameters, and weaving parameters for each path are taken from the parameter indices set in ArcMultiData[0] for that path.
12	Movj P[6],V[30],Z[0],Tool[1],Wobj[0];	Run the robot to the safety point P[6].

No.	Program	Comment
13	END;	End

9.6 Stitch Welding

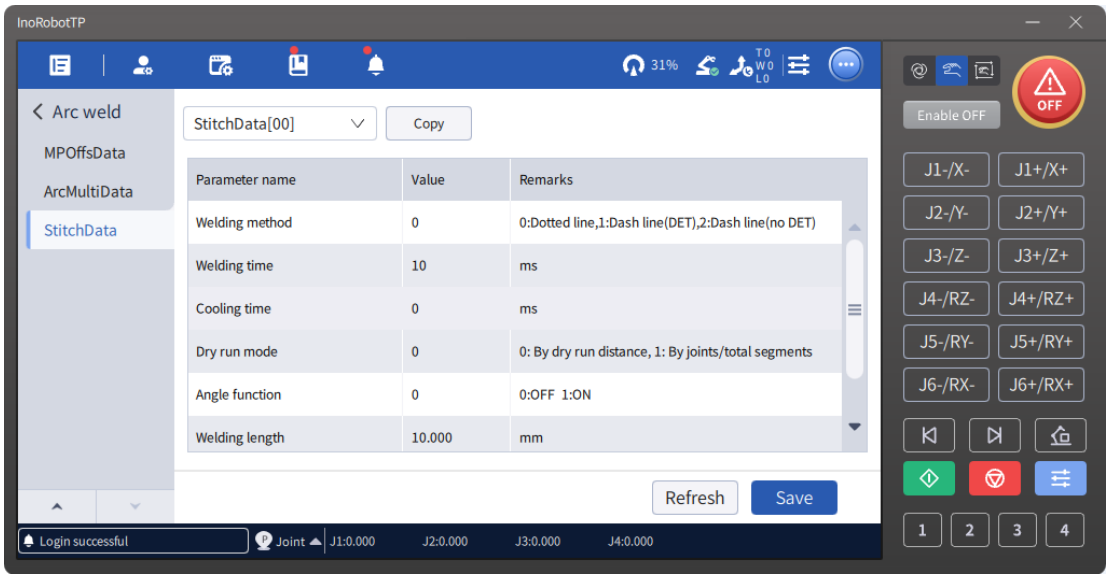
9.6.1 Overview

The stitch welding refers to intermittent welding within a welding segment. This function saves teaching time by eliminating the need to teach welding points one by one.

Stitch welding instruction:

- New version instruction: When a motion instruction such as Movl or Movc is contained in the StitchOn and StitchOff instructions, the robot performs stitch welding. For detailed instructions, see the 10.13 StitchOn and 10.14 StitchOff instructions.
- Old version instruction: Whether stitch welding is performed is determined by including the StitchData parameter in welding motion instructions such as MovlArcOn, MovlArc, MovcArc, MovlArcOff, and MovcArcOff. For detailed instruction descriptions, see the 10 Instructions section.

9.6.2 Parameter Description



Parameter name	Description	Range	Unit
Welding method	Select a welding method. For the "Dotted line" and the "Dash line (DET)" methods, the system detects whether arc start and arc end are successful. For the "Dash line (no DET)" method, during the welding process, the system does not detect whether arc start and arc end are successful. To use this method in V4R3C1 and earlier versions, you must set the "Arc on port" and "Arc off port" parameters.	0 to 2	0: Dotted line 1: Dash line (DET) 2: Dash line (no DET)

Parameter name	Description	Range	Unit
Welding time	The arc spot welding time for the "Dotted line". This parameter is effective only when the welding method is set to 0 (Dotted line).	10 to 10000	ms
Cooling time	The gas cooling time after each arc spot welding for the "Dotted line" method. This parameter is effective only when the welding method is set to 0 (Dotted line).	0 to 10000	ms
Dry run mode	By dry run distance: Enables the "Dry run length" and "Dry run angle" parameters. By total points/segments: Calculates the dry run length based on the total number of welding points/segments, and enables the parameter "Total weld points/segments". In this mode, both ends of the weld seam are always welded.	0 to 1	0: By dry run distance 1: By total joints/ segments
Angle function	Effective only for circular arc stitch welding. When this function is enabled, the welding and dry run segments for circular arc stitch welding are planned according to the welding angle and dry run angle.	0 to 1	0: OFF 1: ON
Welding length	The length of the welding segment for the "Dash line" method. This parameter is effective only when the welding method is set to 1 or 2 (Dash line) and the "Angle function" is set to 0.	0 to 10000	mm
Dry run length	The distance between adjacent welding points or segments. When the trajectory is a circular arc, it represents the arc length. For a linear trajectory, this parameter is effective when the "dry run mode" parameter is set to 0. For a circular-arc trajectory, this parameter is effective when the "Dry run mode" parameter is set to 0 and the "Angle function" is set to 0.	0.1 to 10000	mm
Welding angle	The angle corresponding to a single welding segment. This parameter is effective only when the welding method is set to 1 or 2 (Dash line) and the "Angle function" is set to 1.	0 to 360	deg

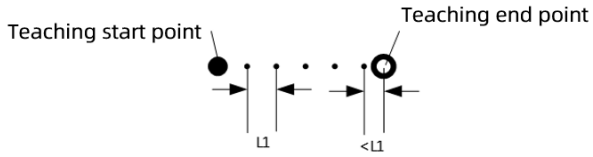
Parameter name	Description	Range	Unit
Dry run angle	For the "Dotted line" type, it represents the angular interval between adjacent welding points. For the "Dash line" type, it represents the angular interval between adjacent welding segments (dry run segment angle). This parameter is effective when the "Dry run mode" parameter is set to 0 and the "Angle function" is set to 1.	0 to 360	deg
Total weld points/ segments	For the "Dotted line" type, it represents the total number of welding points. For the "Dash line" type, it represents the total number of segments. This parameter is effective when the "dry run mode" parameter is set to 1.	2 to 10000	Points/Segments

9.6.3 Permission Allocation

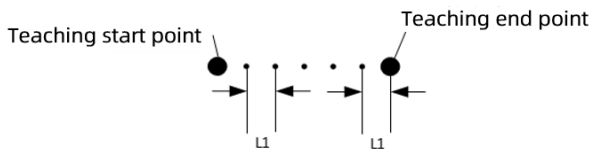
Control permission		Operation mode			Authority			
Teach pendant	Other control permissions	Manual low speed mode	Manual high speed mode	Auto mode	User mode	Edit mode	Admin	Manufacturer
√	×	√	×	×	×	×	√	√

9.6.4 Notes

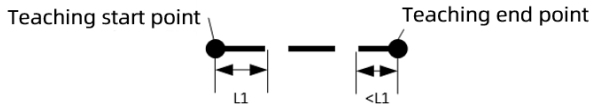
- End position
  a. Dotted line type
    i. When the distance from the welding point to the teaching end point is less than the dry run distance L1, the teaching end point is not welded.



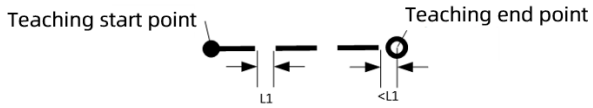
    ii. When the distance from the welding point to the teaching end point is equal to the dry run distance L1, the teaching end point is welded.



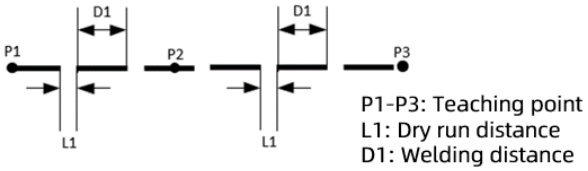
  b. Dashed line type
    I. If the teaching end point lies within a welding segment, stitch welding ends and welding stops when the teaching end point is reached.



II. If the teaching end point lies within a dry run segment, stitch welding ends and dry running stops when the teaching end point is reached.



- Connection



a. Prerequisite: The StitchData index values of the two consecutive rows are the same, and the "Dry run mode" is set to 0.

b. When the prerequisite is met and the "Angle function" is set to 0, a smooth transition is performed.

c. When the prerequisite is met, both the preceding and following segments are circular arcs, the "Angle function" is set to 1, and the arc radii are similar, an arc connection is performed.

d. In cases not mentioned above, no connection is performed by default.

- Support and limitations

a. Supports scenarios with external axis coordination.

b. Does not support laser tracking or restart and retract function.

c. Does not support weaving, multi-layer and multi-pass welding, or arc tracking function.

d. During stitch welding, flying arc start and pre-gas are invalid.

e. During dashed line (no detection) welding, the following functions are invalid: arc start success detection, wirestick detection, and scrape start. Additionally, among the arc start parameters, waiting time and detection time are invalid; among the arc end parameters, only the process number, current, and voltage are valid.

- Interrupt restart

a. Dotted line type

i. Restart at a welding point: the current welding point is not welded, and the robot moves to the next welding point.

ii. Restart in a dry run segment: the robot moves to the next welding point.

b. Dashed line type

i. Restart in a welding segment: welding continues on the current welding segment.

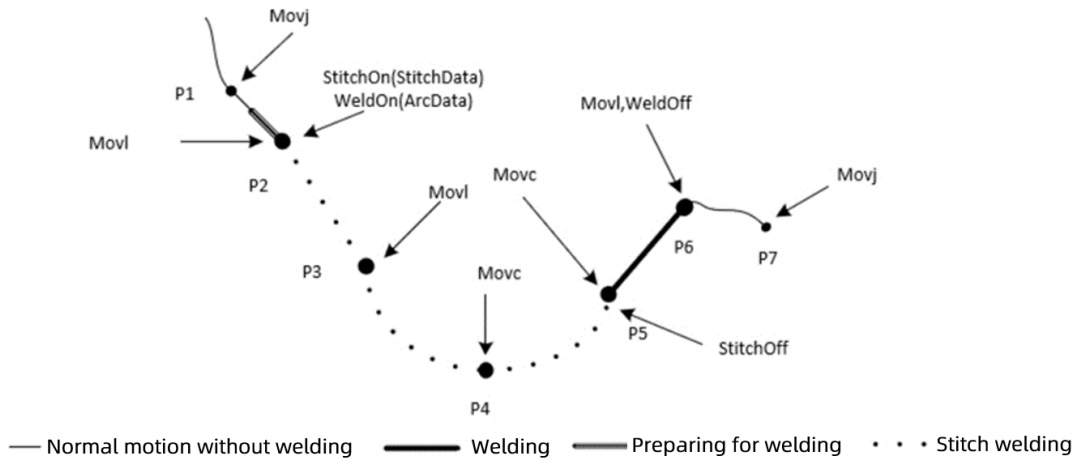
ii. Restart in a dry run segment: the robot moves to the next welding segment.

- Start from a specified line: no stitch welding or arc start occurs; the robot moves directly to the end point of the specified line and then starts the arc.
- When trajectory recovery is not performed, the robot moves directly from the restart point to the motion point of the current stitch welding line, and continues executing stitch welding on the current line.

9.6.5 Usage Procedure

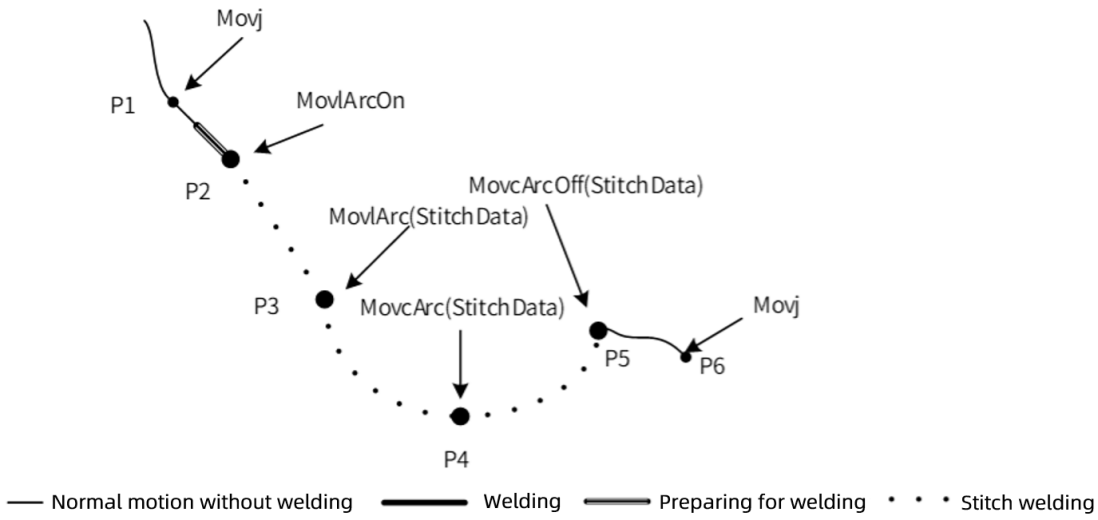
The new version instructions and the old version instructions cannot coexist in the same .pro file.

9.6.5.1 New Version Instructions



No.	Program	Comment
1	Start	Start
2	Movj P[1],V[30],Z[0],Tool[0],Wobj[0]	Run the robot to the safety point P[1].
3	Movl P[2],V[30],Z[0],Tool[0],Wobj[0]	Run the robot to the arc start point P[2].
4	StitchOn StitchData[0]	Enable the stitch welding function.
5	WeldOn AraData[0]	Start arc
6	Movl P[3],V[30],Z[0],Tool[0],Wobj[0]	Move to point P[3] by linear stitch welding.
7	Movc P[4],V[30],Z[0],Tool[0],Wobj[0]	Perform the first segment of circular stitch welding.
8	Movc P[5],V[30],Z[0],Tool[0],Wobj[0]	Perform the second segment of circular stitch welding.
9	StitchOff;	Disable the stitch welding function.
10	Movl P[6],V[30],Z[0],Tool[0],Wobj[0]	Move to point P[6] by linear welding.
11	WeldOff ArcData[0]	Extinguish arc.
12	Movj P[7],V[30],Z[0],Tool[0],Wobj[0]	Run the robot to the safety point P[7].
13	End	Program end

9.6.5.2 Old Version Instructions




```
Start;
Movj P[1],V[30],Z[0],Tool[0],Wobj[0];
MovlArcOn P[2],V[30],Z[0],ArcData[0],Tool[0],Wobj[0];
MovlArc P[3], V[30],Z[0],ArcData[0], StitchData[5],Tool[0],Wobj[0];
MovcArc P[4],V[30],Z[0],ArcData[0], StitchData[5],Tool[0],Wobj[0];
MovcArcOff P[5],V[30],Z[0],ArcData[0], StitchData[5],Tool[0],Wobj[0];
Movj P[6],V[30],Z[0],Tool[0],Wobj[0];
END
```

9.7 Welding Condition Slope Specification

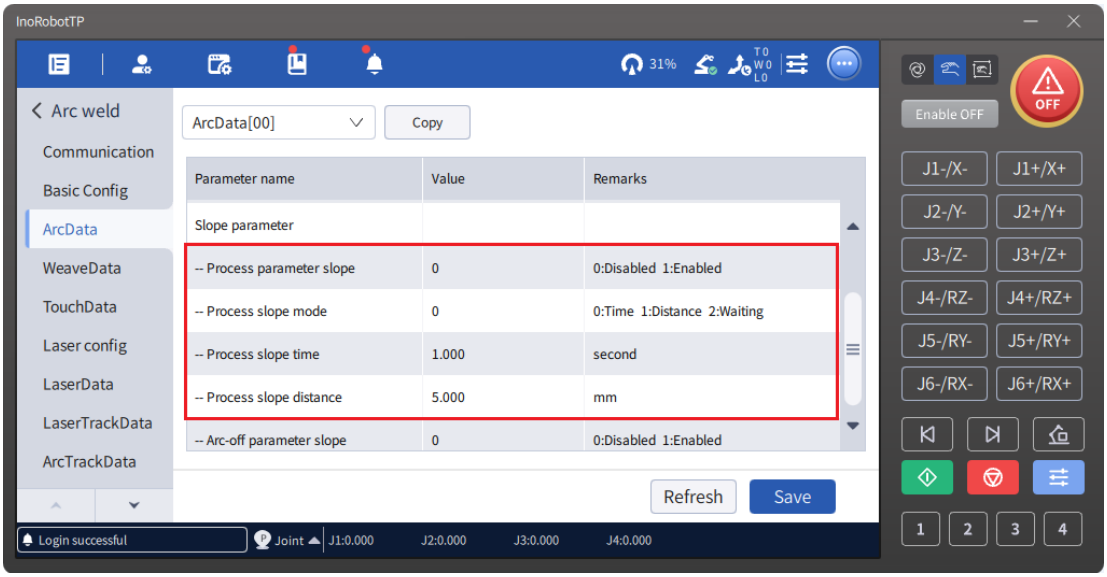
9.7.1 Welding Parameter Slope

9.7.1.1 Overview

Welding parameter slope refers to the function that gradually ramps welding current/voltage parameters up or down within a specified interval (e.g., over time or distance).

9.7.1.2 Parameter Description

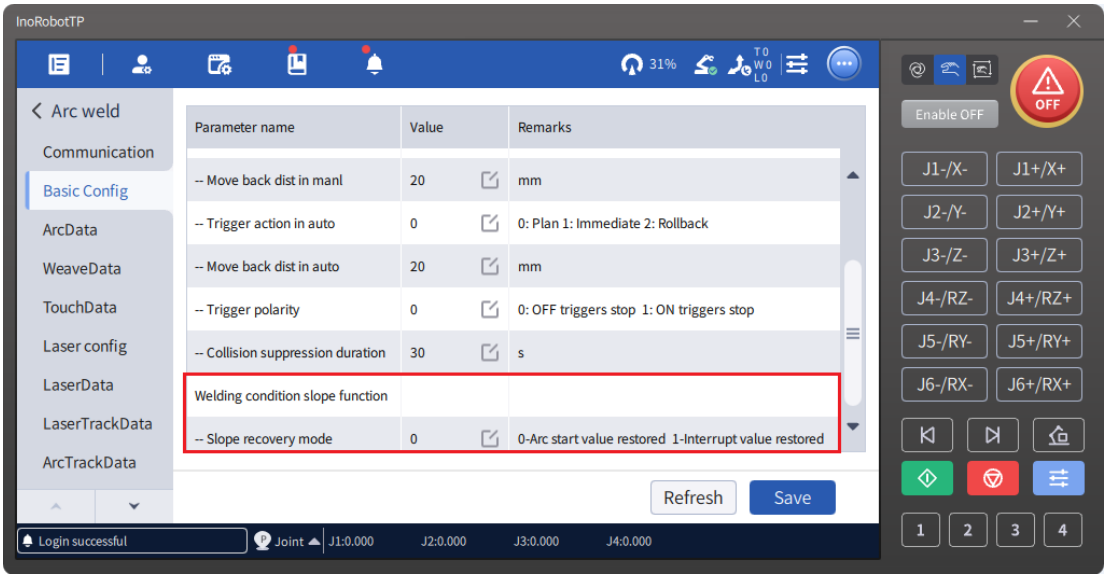
1. Add "Slope parameter" on the original "ArcData" page.



Parameter name	Description	Range	Unit
Process parameter slope	0: Disabled 1: Enabled	0 or 1 Default: 0	-
Process slope mode	0: Time 1: Distance 2: Waiting (The "Waiting" Mode applies only to the arc start stage of the MovlArcOn instruction)	0, 1 or 2 Default: 0	-
Process slope time	The time for linear change in welding parameters.	0.0 to 9.9 Default: 1.0	second
Process slope distance	The distance for linear change in welding parameters.	0.0 to 99 Default: 5 mm	mm (mm)
Arc-off parameter slope	0: Disabled 1: Enabled	0 or 1 Default: 0	-
Arc end slope mode	0: Time 1: Distance	0 or 1 Default: 0	-
Arc end slope time	The time for linear change in welding parameters.	0.0 to 9.9 Default: 1.0	second
Arc end slope distance	The distance for linear change in welding parameters.	0.0 to 99 Default: 5 mm	mm (mm)

> **NOTE**
>
> The "Arc-off slope" related parameters, including "Arc-off parameter slope", "Arc end slope mode", "Arc end slope time", and "Arc end slope distance" are only effective in "MovlArcOff" and "MovcArcOff" instructions.

2. Add the "Welding condition slope function" parameter on the original "Basic Config" page.



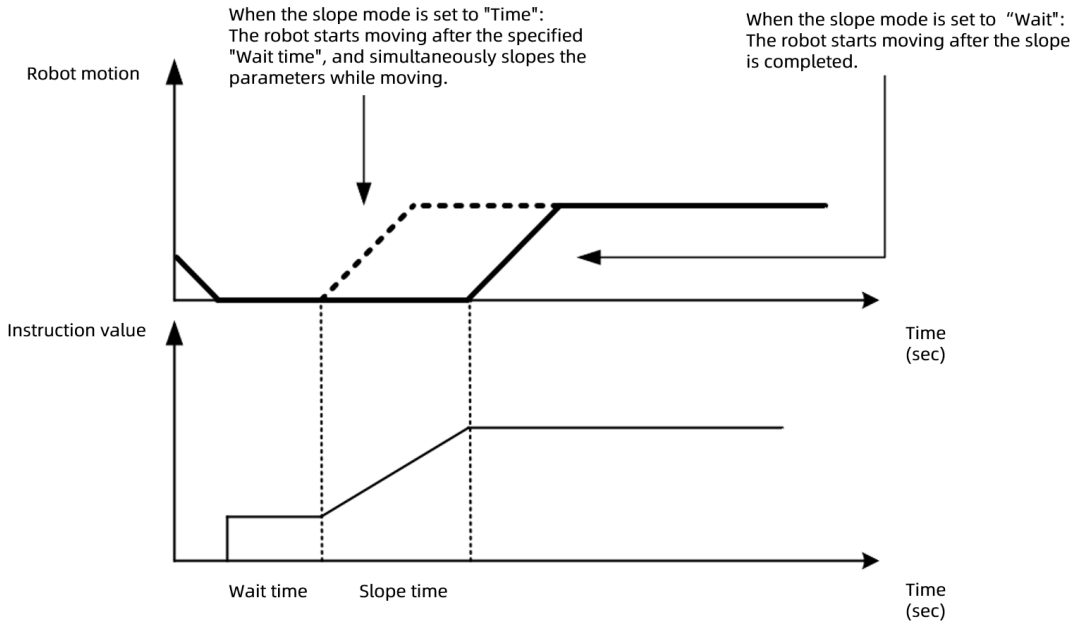
Parameter name	Description	Range
Slope recovery mode	0: Arc start value recovery 1: Interrupt value recovery	0 or 1 Default: 1

9.7.1.3 Permission Allocation

Control permission		Operation mode			Authority			
Teach pendant	Other control permissions	Manual low speed mode	Manual high speed mode	Auto mode	User mode	Edit mode	Admin	Manufacturer
√	×	√	×	×	×	×	√	√

9.7.1.4 Notes

- The new version welding instructions WeldOn and WeldOff do not currently support the welding parameter slope function.
- When the process slope phase of the welding parameter slope overlaps with the arc end slope phase in time or distance, the process slope phase is interrupted by the arc end slope phase, and the arc end slope is performed.
- In Synergic mode, the arc length correction value also supports sloping.
- The timing difference between the "Waiting" and "Time" modes of the process slope is as follows:

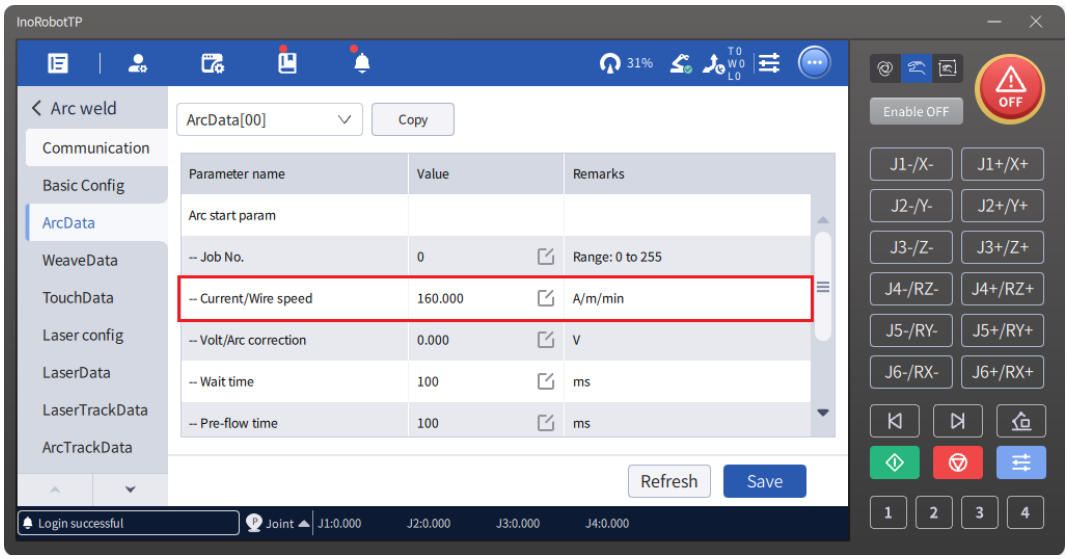


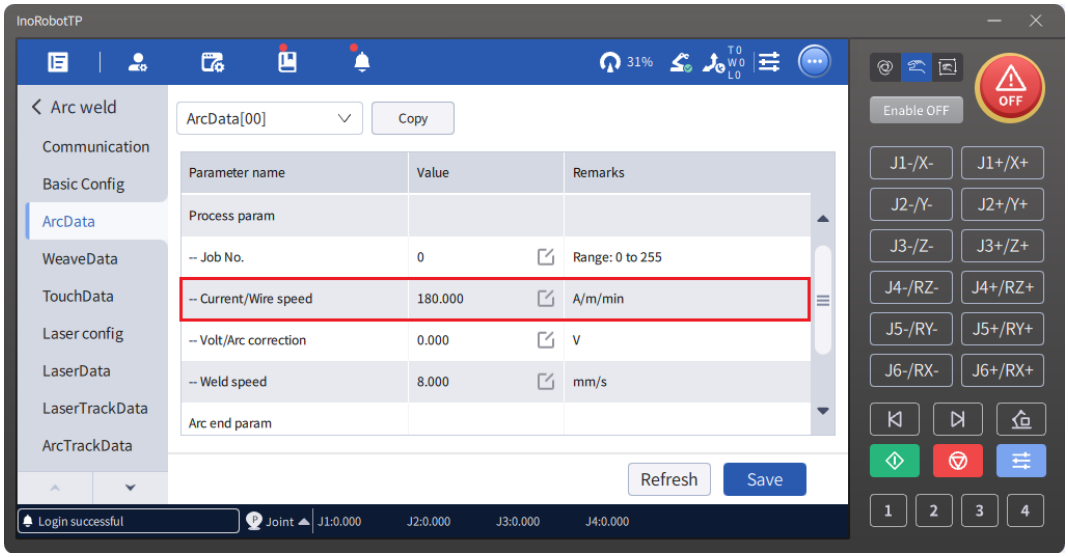
9.7.1.5 Usage Procedure

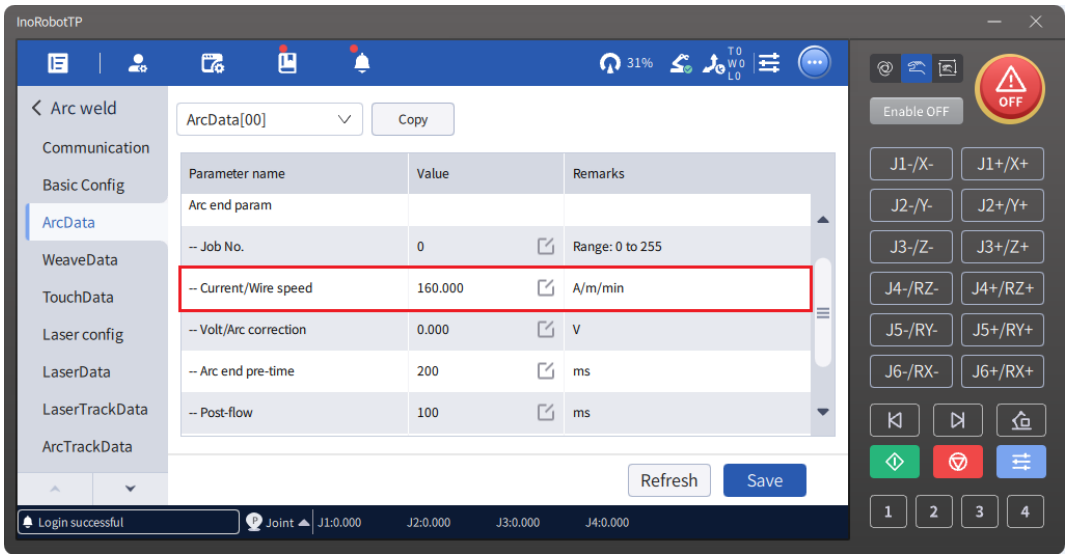
Take current sloping as an example. Voltage or arc length correction sloping are similar and will not be repeated.

1. Interface settings

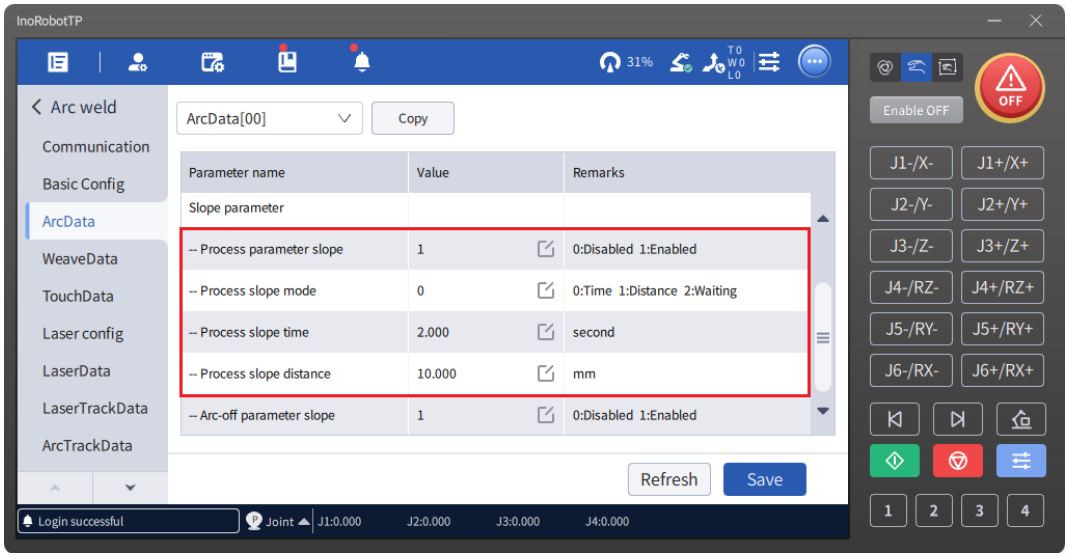
a. Set the arc start current, welding process current, and arc end current.

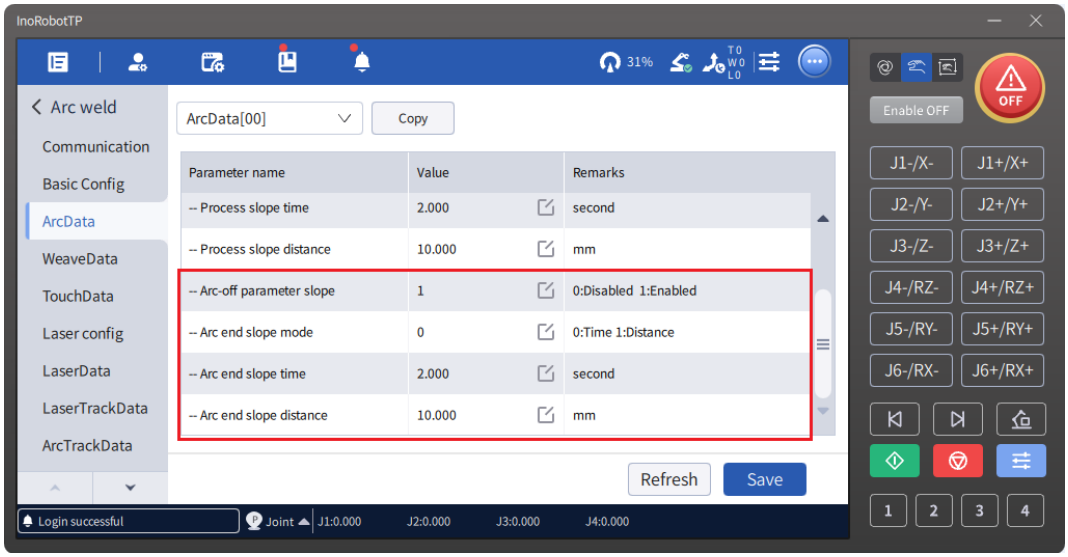






b. Set the slope parameters.





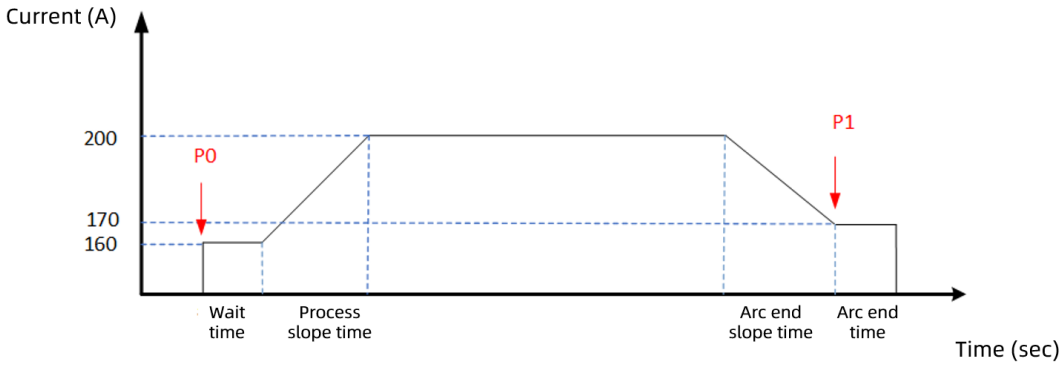
2. Program instruction editing

   Program instructions:

   MovlArcOn P[0],V[30],Z[50],ArcData[0],Tool[0],Wobj[0];

   MovlArcOff P[1],V[30],Z[50],ArcData[0],Tool[0],Wobj[0];

3. Corresponding timing diagram



9.7.2 Welding Speed Slope

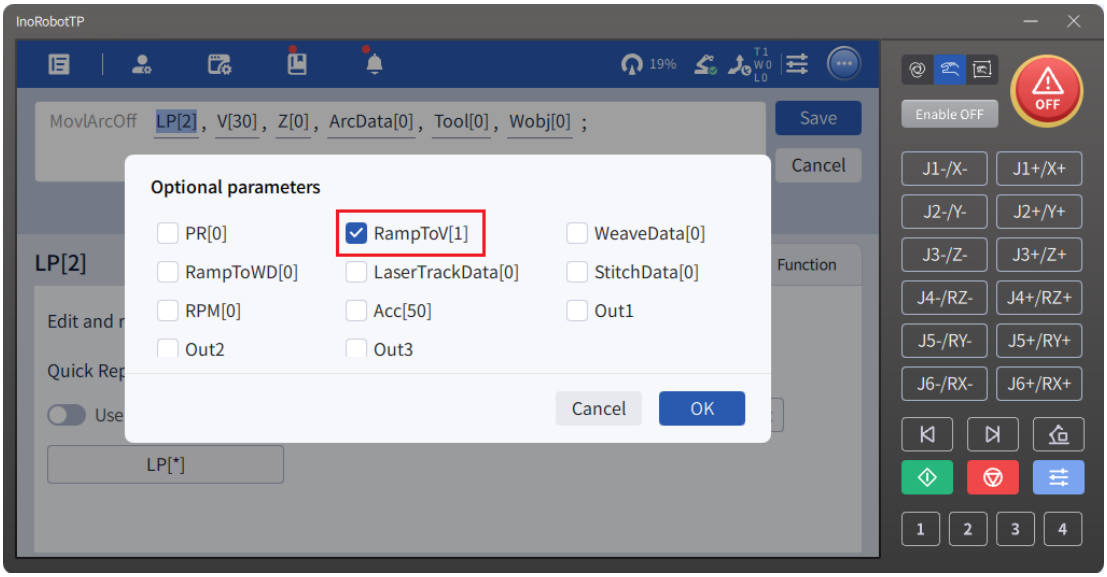
9.7.2.1 Overview

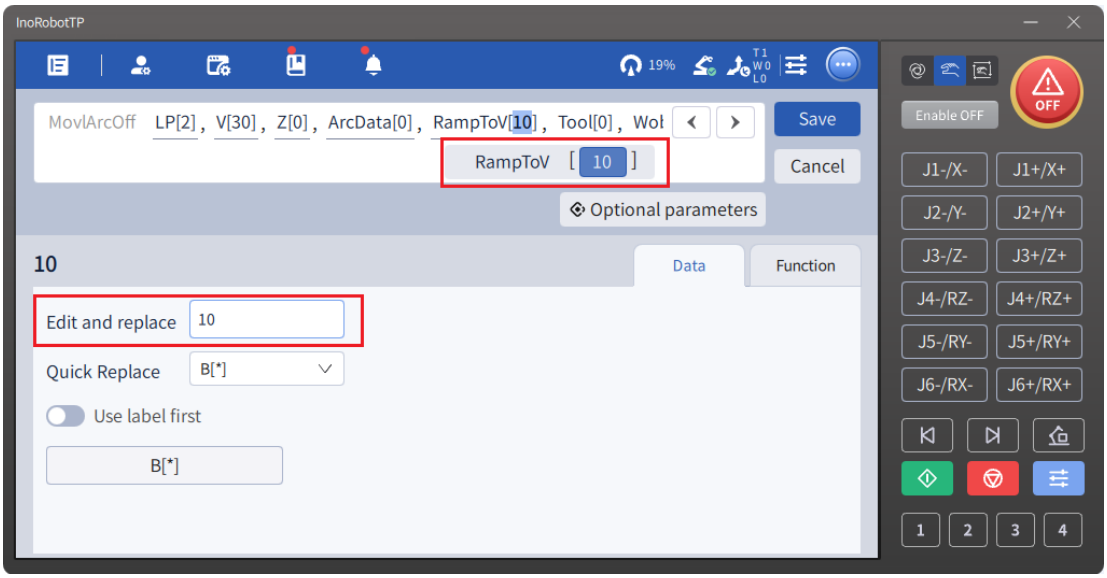
Welding speed slope refers to the gradual linear increase or decrease of the welding speed within a specified distance.

Welding speed slope can be achieved by adding the welding slope parameter RampToV to the MovlArc, MovcArc, MovlArcOff, and MovcArcOff instructions.

9.7.2.2 Parameter Description

1. Add the optional parameter "RampToV[…]" to the original basic welding instruction, and enter the desired welding speed in […], in mm/s, with an input range of 1 to 30.





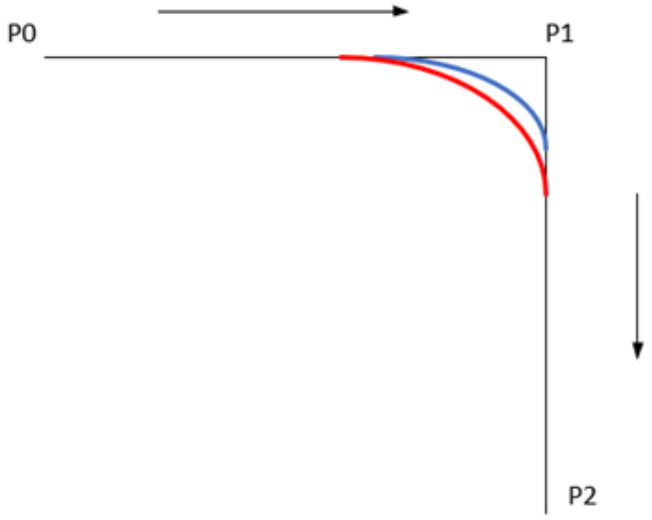
2. The "RampToV [...]" parameter does not take effect in MovlArcOn, so it is not included in that instruction.
3. The welding speed changes from the speed specified in ArcData to the speed specified in "RampToV" for each segment of the welding trajectory.
4. For circular arc instruction, the speed specified in the RampToV parameter of the second circular arc instruction takes precedence.

9.7.2.3 Permission Allocation

Control permission		Operation mode			Authority			
Teach pendant	Other control permissions	Manual low speed mode	Manual high speed mode	Auto mode	User mode	Edit mode	Admin	Manufacturer
√	×	√	×	×	×	×	√	√

9.7.2.4 Notes

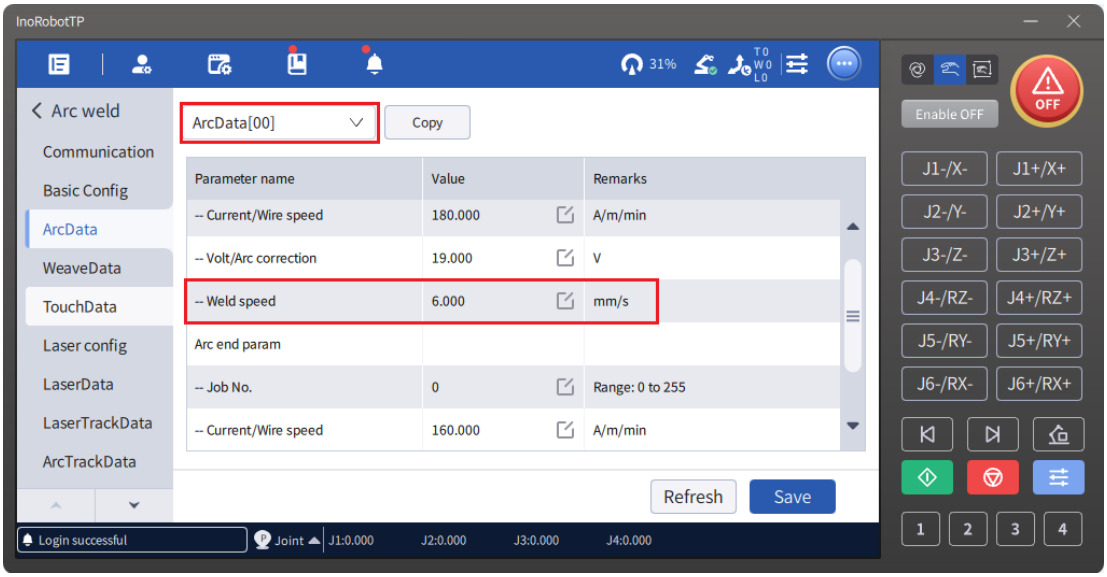
- The new version welding instructions WeldOn and WeldOff do not currently support the welding speed slope function.
- Speed sloping will cause the welding guide line to differ from the original guide line at the transition points. For example, the red line shows the transition trajectory with speed sloping, while the blue line shows the transition trajectory without speed sloping.

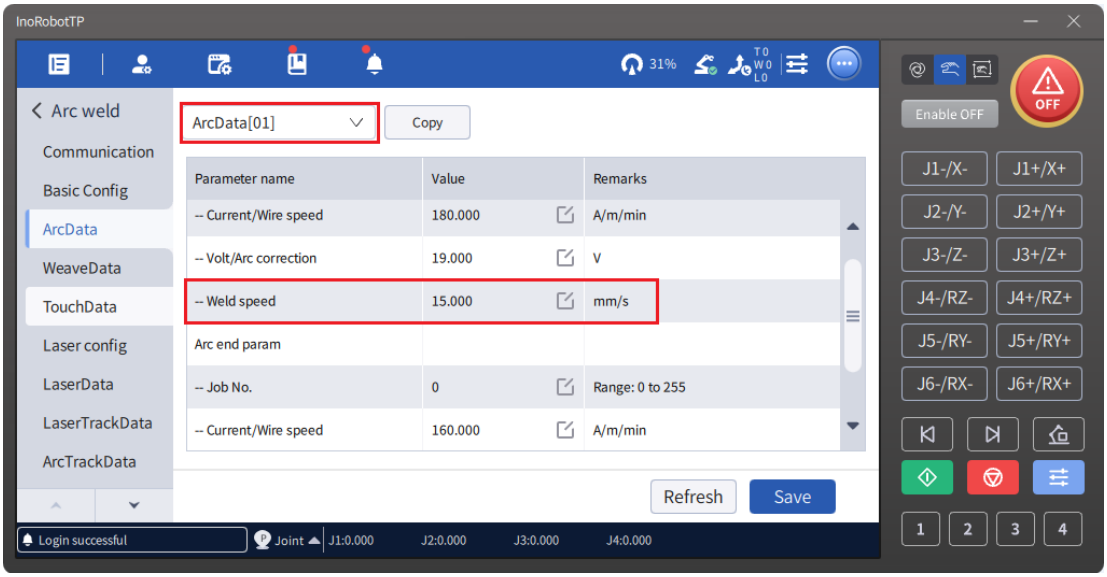


- The speed may not reach the target speed when the trajectory is too short.

9.7.2.5 Usage Procedure

1. Interface settings





2. Program instruction editing

   MovlArcOn P[0],V[30],Z[50],ArcData[0],Tool[0],Wobj[0];

   MovlArc P[1],V[30],Z[50],ArcData[0],RampToV[10.5],Tool[0],Wobj[0];

   MovlArcOff P[2],V[30],Z[50],ArcData[1],RampToV [20],WTool[0],Wobj[0];

   The speed sloping for this program is as follows:

   1. After arc start at point P[0], during the movement toward point P[1], the welding speed gradually changes from "6 mm/s" specified in "ArcData[0]" to "10.5 mm/s" specified in "RampToV".
   2. In the transition segment, the speed remains at 10.5 mm/s.
   3. After exiting the transition segment, during the movement toward point P[2], the welding speed gradually changes from "15 mm/s" specified in "ArcData[1]" to "20 mm/s" specified in "RampToV".

9.7.3 Weaving Slope

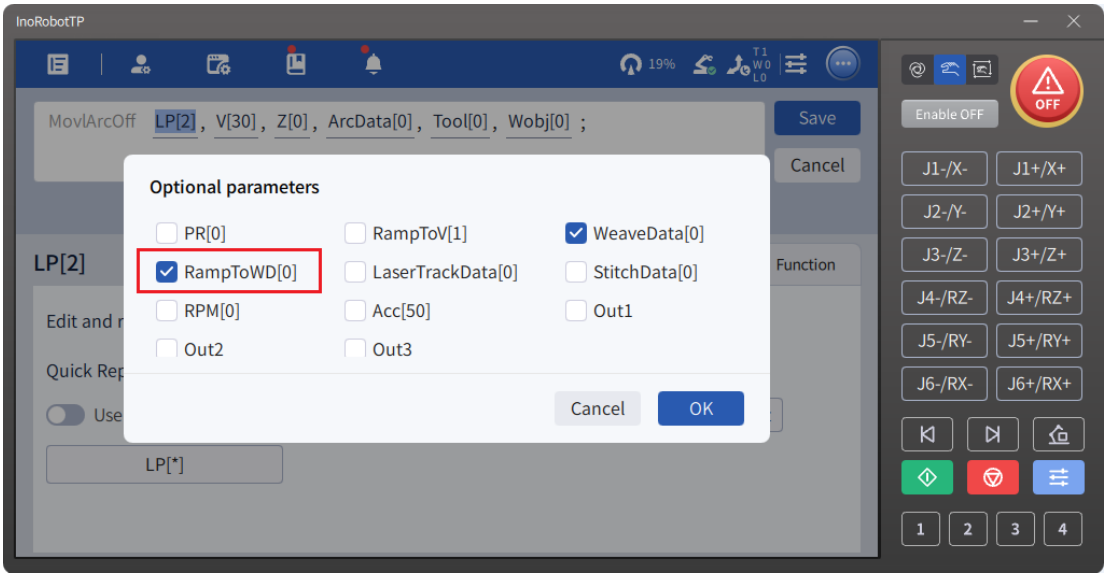
9.7.3.1 Overview

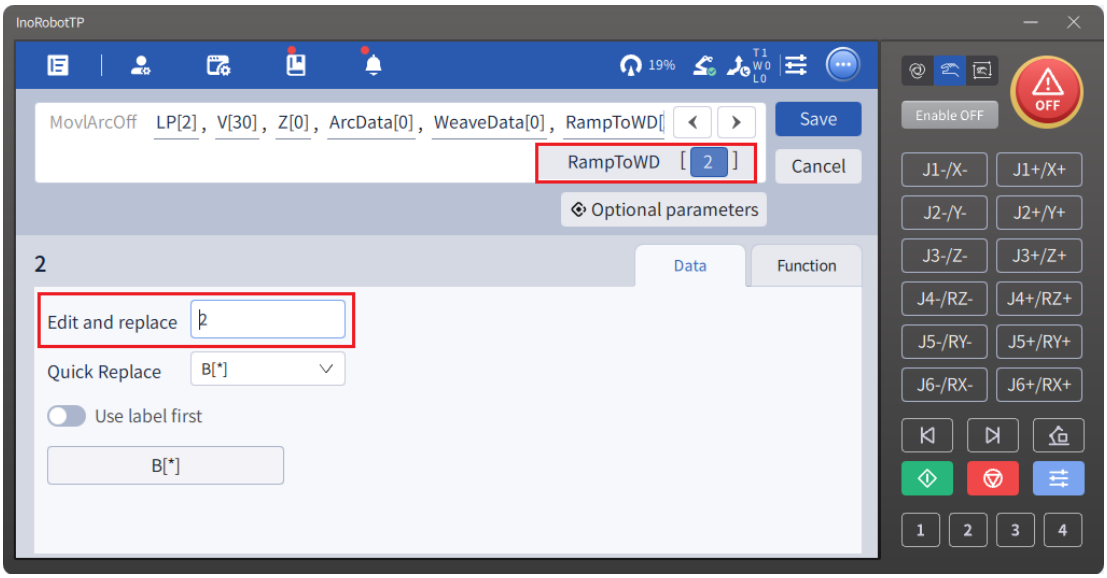
Weaving slope refers to the gradual linear increase or decrease of the weaving frequency/amplitude within a specified distance.

Weaving slope can be achieved by adding the weaving slope parameter RampToWD to the MovlArc, MovcArc, MovlArcOff, and MovcArcOff instructions.

9.7.3.2 Parameter Description

1. Add the optional parameter "RampToWD[…]" to the original welding instruction, and enter the desired weaving condition number in […], with an input range of 0 to 63.





2. The "RampToWD [...]" parameter does not take effect in MovlArcOn, so it is not included in that instruction.
3. The weaving frequency/amplitude gradually changes from the frequency/amplitude specified in WeaveData to the frequency/amplitude corresponding to the weaving condition specified in "RampToWD" for each segment of the welding trajectory.
4. For circular arc instruction, the frequency/amplitude specified in the RampToWD parameter of the second circular arc instruction takes precedence.

9.7.3.3 Permission Allocation

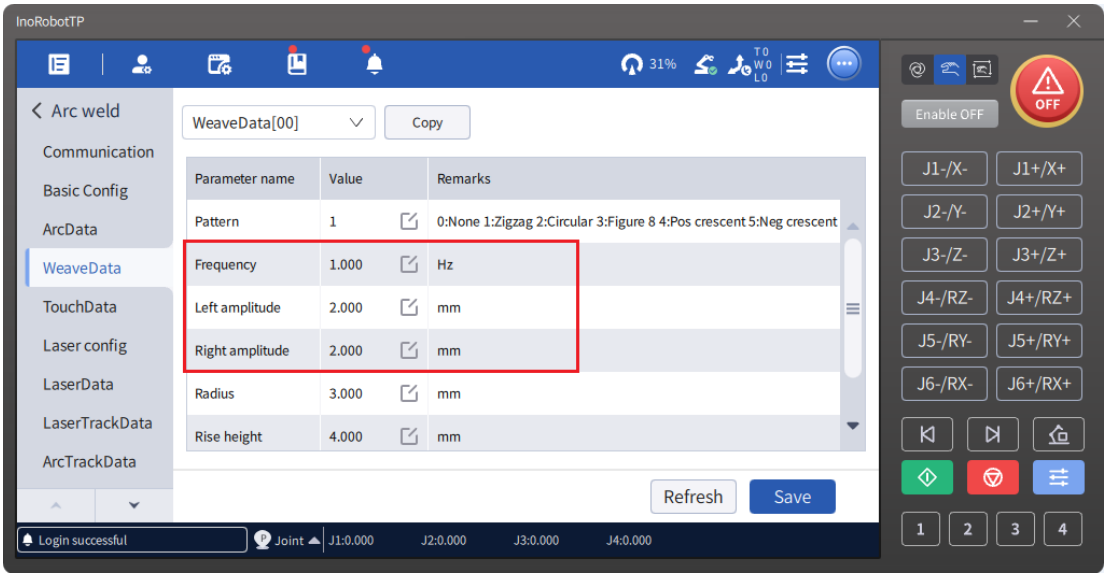
Control permission		Operation mode			Authority			
Teach pendant	Other control permissions	Manual low speed mode	Manual high speed mode	Auto mode	User mode	Edit mode	Admin	Manufacturer
√	×	√	×	×	×	×	√	√

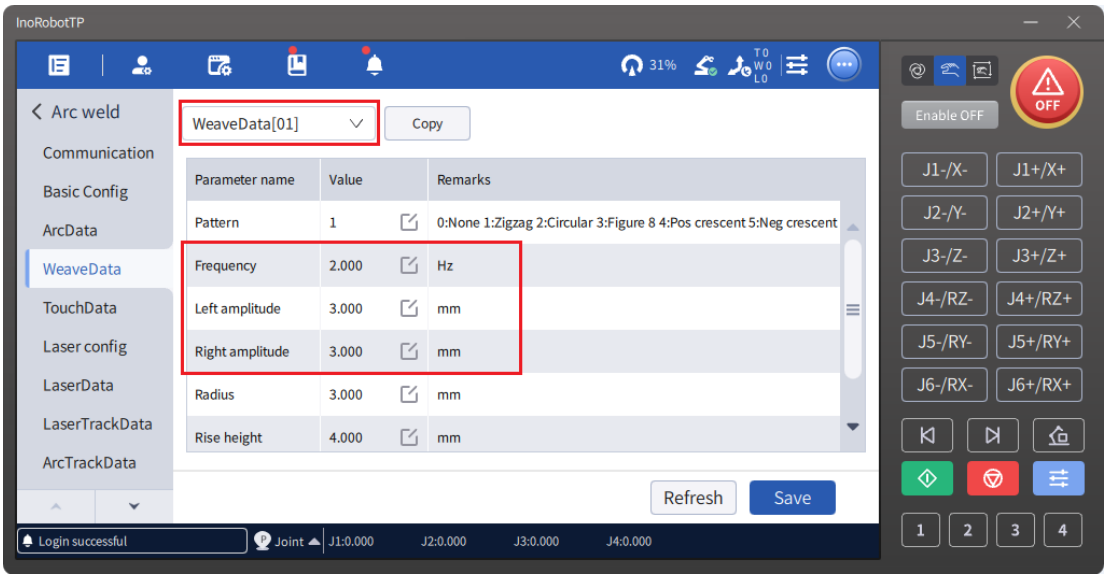
9.7.3.4 Notes

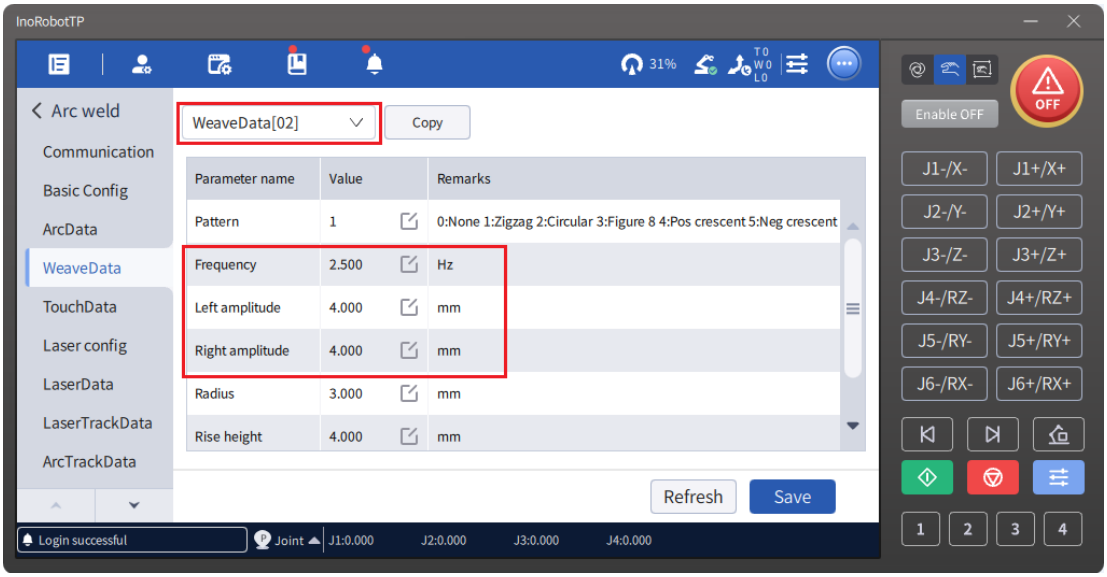
- The weaving slope function only supports Zigzag weaving. It does not support the "Continue" function at the dwell points, nor does it support "Center rise" or "L-weave".
- The new weaving instructions WeaveOn, WeaveSet, and WeaveOff currently do not support the weaving slope function.

9.7.3.5 Usage Procedure

1. Condition interface settings







2. Program instruction editing

   MovlArcOn P[0],V[30],Z[50],ArcData[0],Tool[0],Wobj[0];

   MovlArc P[1],V[30],Z[50],ArcData[0], WeaveData[0], RampToWD [1],Tool[0],Wobj[0];

   MovlArcOff P[2],V[30],Z[50],ArcData[1],WeaveData[0], RampToWD[2],Tool[0],Wobj[0];

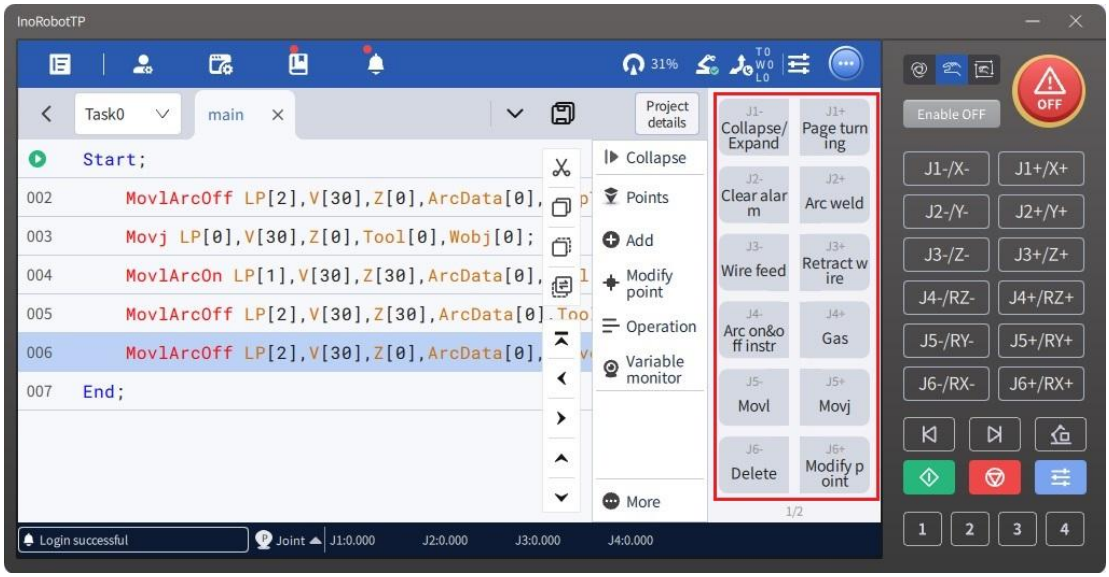
   The weaving sloping for this program is as follows:

   1. After arc start at point P[0], during the movement toward point P[1], the weaving parameters (frequency and amplitude) gradually change from "frequency: 1 Hz, amplitude: 2 mm" specified in "WeaveData[0]" to "frequency: 2 Hz, amplitude: 3 mm" specified in "RampToWD[1]".
   2. In the transition segment, the frequency remains at 2 Hz and the amplitude at 3 mm.
   3. After exiting the transition segment, during the movement toward point P[2], the weaving parameters (frequency and amplitude) gradually change from "frequency: 1 Hz, amplitude: 2 mm" specified in "WeaveData[0]" to "frequency: 2.5 Hz, amplitude: 4 mm" specified in "RampToWD[2]".

9.8 Right-side Custom Keys for Arc Welding

9.8.1 Overview

This function allows you to use the physical axis movement buttons on the right side to perform arc welding related functions and basic functions when the robot is in the "Enable OFF" state. The position of each physical button corresponds to the specific function displayed on the interface. For example, J1- is mapped to collapse/expand, and J1+ is mapped to page turning.



WARNING

- Currently, clicking the button in the red area cannot trigger the corresponding function. The function can only be used through the corresponding physical axis movement button.
- The robot must be in the "Enable OFF" state and the teach pendant must be on the programming page to use the right-side customizable key function.

Currently, the following arc welding shortcut functions are supported: Jog wire feed/retract, continuous wire feed/retract, weld enable/disable, weave enable/disable, use weld speed/preset speed, tracking enable/disable, toggle arc welding settings page, insert paired arc start/end instructions, and insert weave start/end instructions.

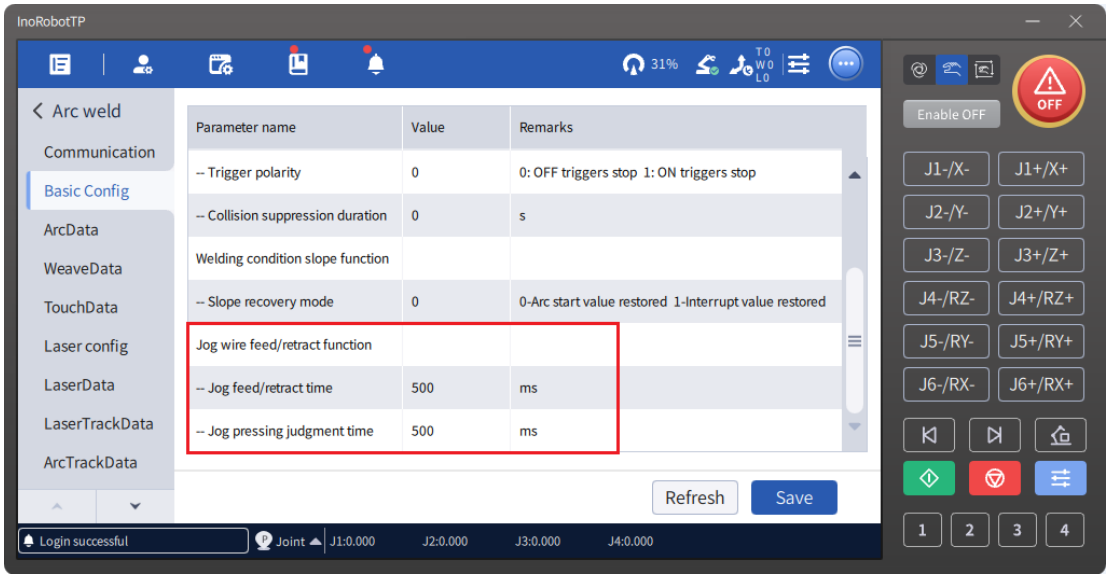
Detailed descriptions of each function are as follows:

Table9-8-1-1 Function key description

Button function name	Function	Status switch type	Description
Wire feed (long press)	Continuous wire feeding	Digital output, 0: release to stop, 1: press to trigger	Press to start timing; if the holding time exceeds the judgment interval, continuous wire feeding begins.
Retract wire (long press)	Continuous wire retraction	Digital output, 0: release to stop, 1: press to trigger	Press to start timing; if the holding time exceeds the judgment interval, continuous wire retraction begins.
Wire feed (short press)	Jog feed	Digital output, 0: release to stop, 1: press to trigger	Press to start timing. If the press-release interval is less than the judgment interval upon release, jog feeding begins.

Button function name	Function	Status switch type	Description
Retract wire (short press)	Jog retract	Digital output, 0: release to stop, 1: press to trigger	Press to start timing. If the press-release interval is less than the judgment interval upon release, jog retraction begins.
Gas	Shielding gas output	Digital output, 0: release to stop, 1: press to trigger	Press to start gas; release to stop.
Weld enable	Enable/disable welding	Toggle, 1: press to toggle	Press to toggle welding enable/disable.
Weave enable	Enable/disable weaving	Toggle, 1: press to toggle	Press to toggle weaving enable/disable.
Use weld speed	Enable welding speed	Toggle, 1: press to toggle	Press to enable welding speed mode.
Use preset speed	Enable preset speed in instruction	Toggle, 1: press to toggle	Press to enable preset speed mode.
Tracking enable	Enable/disable tracking	Toggle, 1: press to toggle	Press to toggle tracking enable/disable.
Arc welding setting page	Switch to arc welding setting page	Switchover, 1: press to switch page	Press to switch to the page.
Arc on&off instr	Insert paired arc start and end instructions	Instruction insertion, 1: press to insert	Press to insert a pair of arc start and end instructions into the program; after insertion, the cursor is positioned on the arc start instruction.
Weave start and end instructions	Insert paired weave start and end instructions	Instruction insertion, 1: press to insert	Press to insert a pair of weave start and end instructions into the program; after insertion, the cursor is positioned on the weave start instruction.

9.8.2 Parameter Description



Parameter name	Description	Range	Unit
Jog feed/retract time	When the wire feed/retract button is pressed for a short time, the welder feeds (or retracts) the wire for a short distance based on the Jog feed/retract time.	100 to 1000	ms
Jog pressing judgment time	To distinguish between continuous wire feed/retract and jog feed/retract when the wire feed button is pressed, a press duration threshold is set. If the press duration exceeds this time, continuous wire feed/retract is performed; if it is within this time, jog feed/retract is performed.	200 to 1000	ms

9.8.3 Permission Allocation

Permission and stop logic for right-side custom keys

(1) The right-side custom keys can be enabled only when the user is in User mode or higher, the robot is in Manual mode, and the robot program is in programming or debug mode.

(2) When the welder is feeding wire or delivering gas, if a mode switch, emergency stop, or alarm occurs, the robot immediately controls the welder to stop wire feeding or gas delivery.

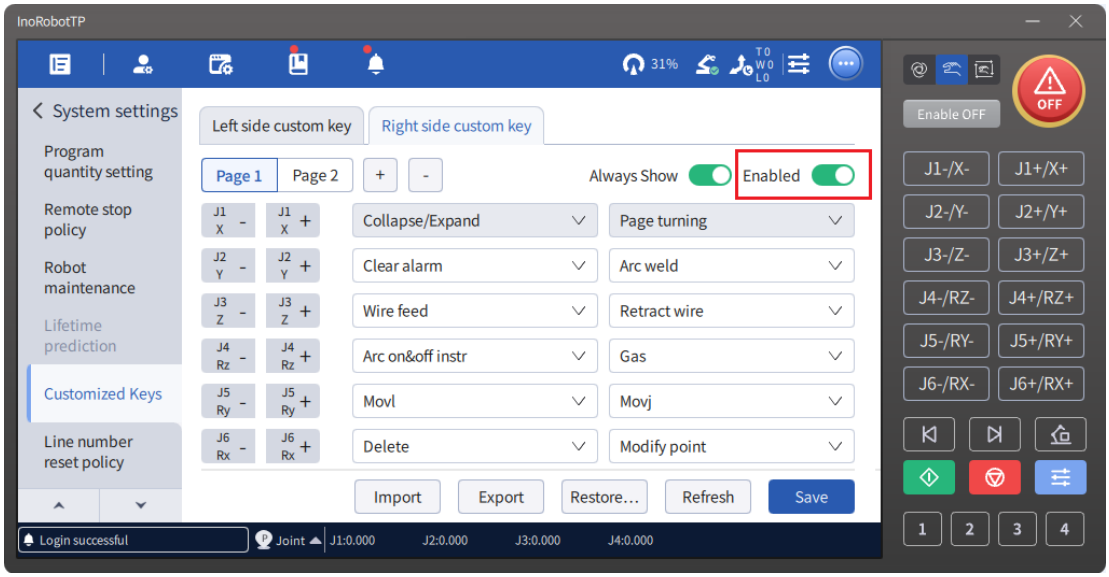
(3) When the robot is in Emergency Stop state, the right-side custom keys cannot be used to toggle welding enable/disable, tracking enable/disable, weaving enable/disable, preset speed, welding speed, wire feed, wire retract, or gas delivery.

(4) When the robot is in an alarm condition, while the user is in user mode, the robot is in manual mode, and the program is in programming or debug mode, the right-side custom keys can be used to toggle welding

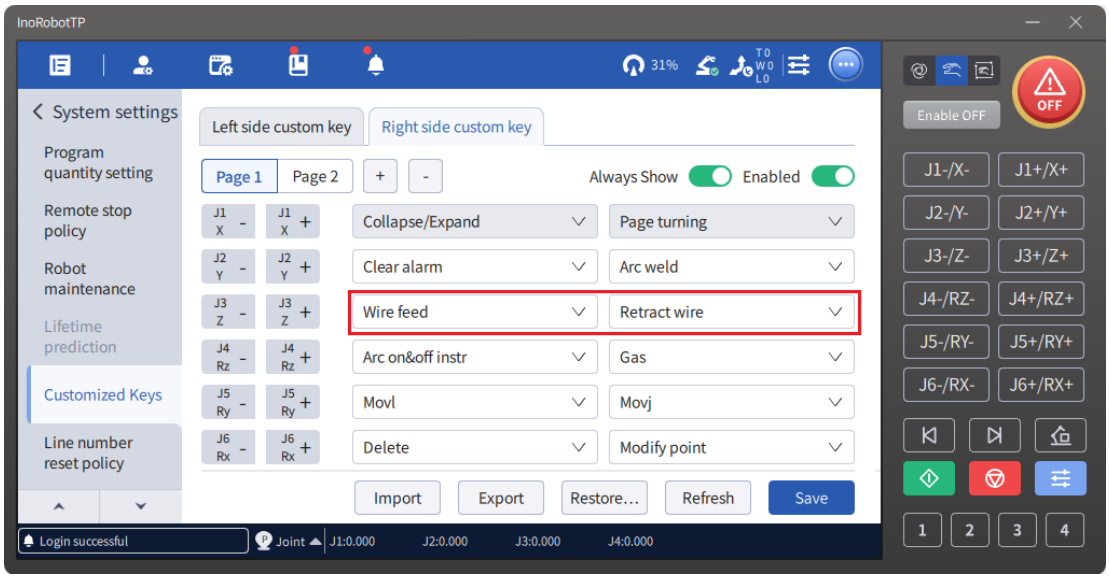
enable/disable, tracking enable/disable, weaving enable/disable, preset speed, welding speed, wire feed, wire retract, or gas delivery.

9.8.4 Notes

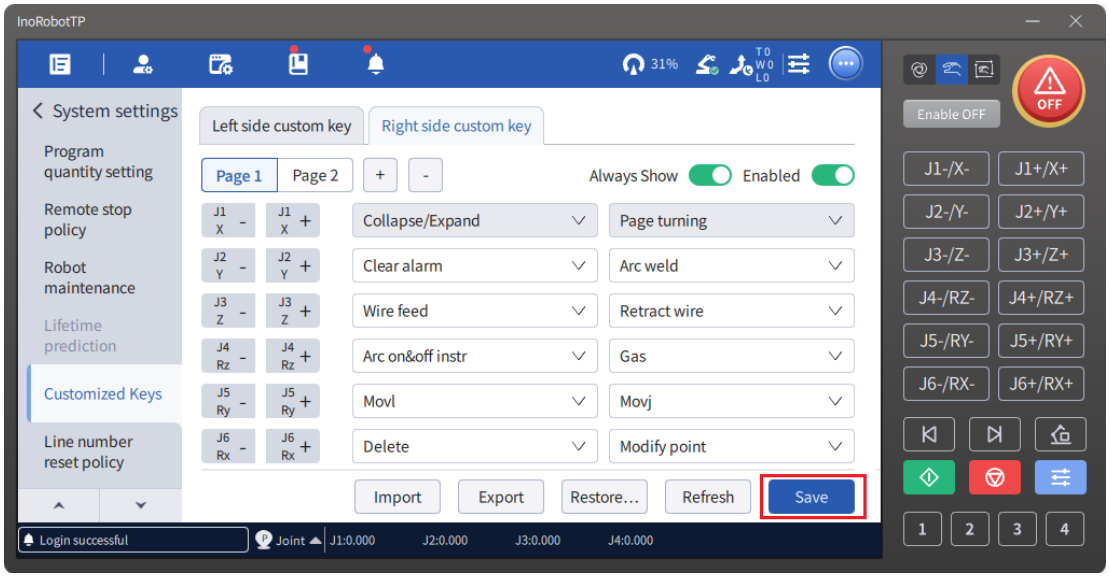
1. Before using the function, you need to switch it to the "Enabled" state in "System settings" > "Customized Keys" > "Right side custom key".



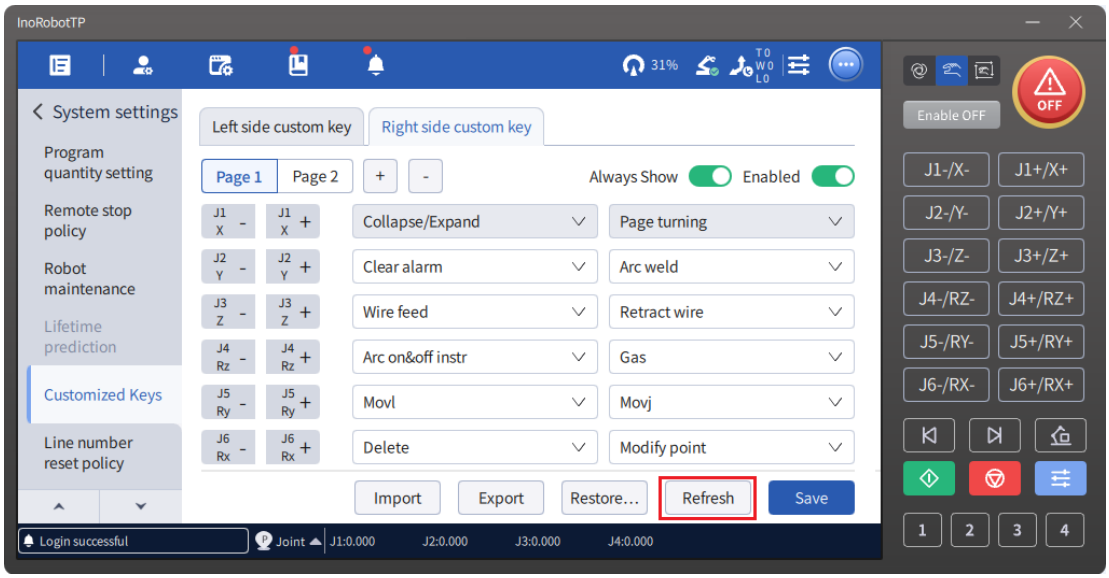
2. Currently, when setting functions, duplicate assignments are allowed and each will take effect. Be sure to check your settings before use to avoid unintended operations.



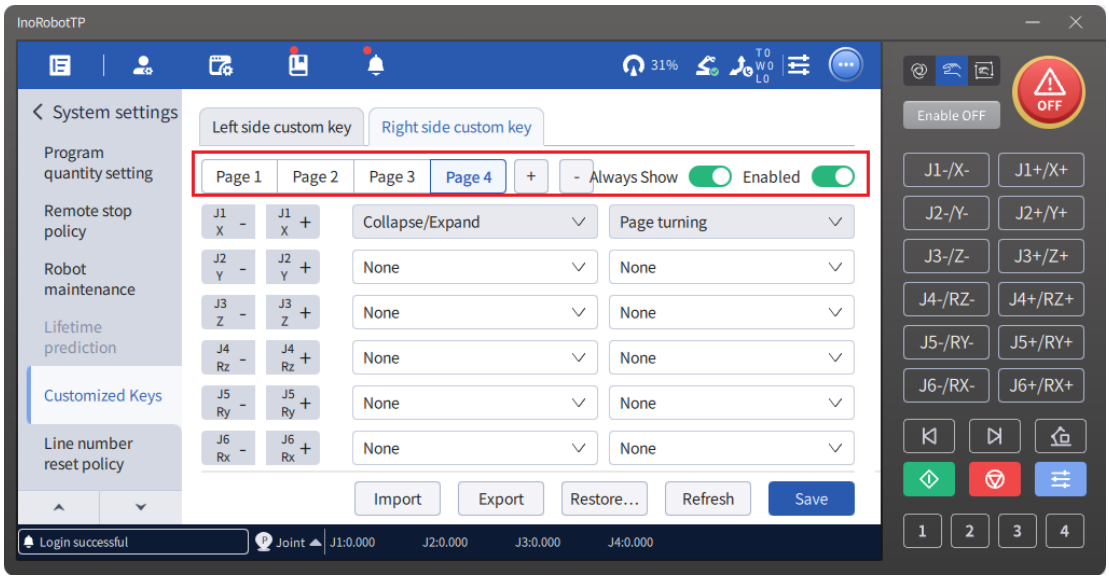
3. After completing the settings, click "Save" to store the configured functions.



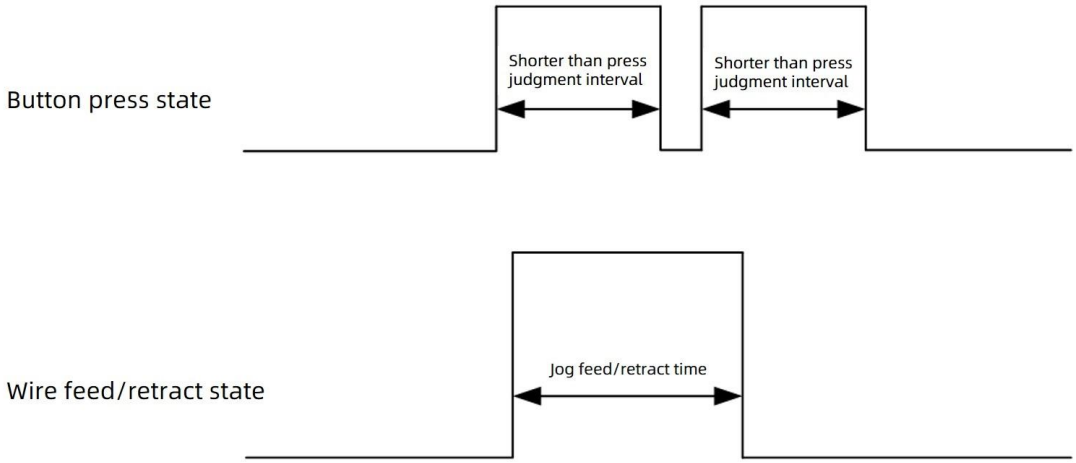
4. If you want to restore the original settings after modifying the key assignments (without having pressed "Save"), click "Refresh".



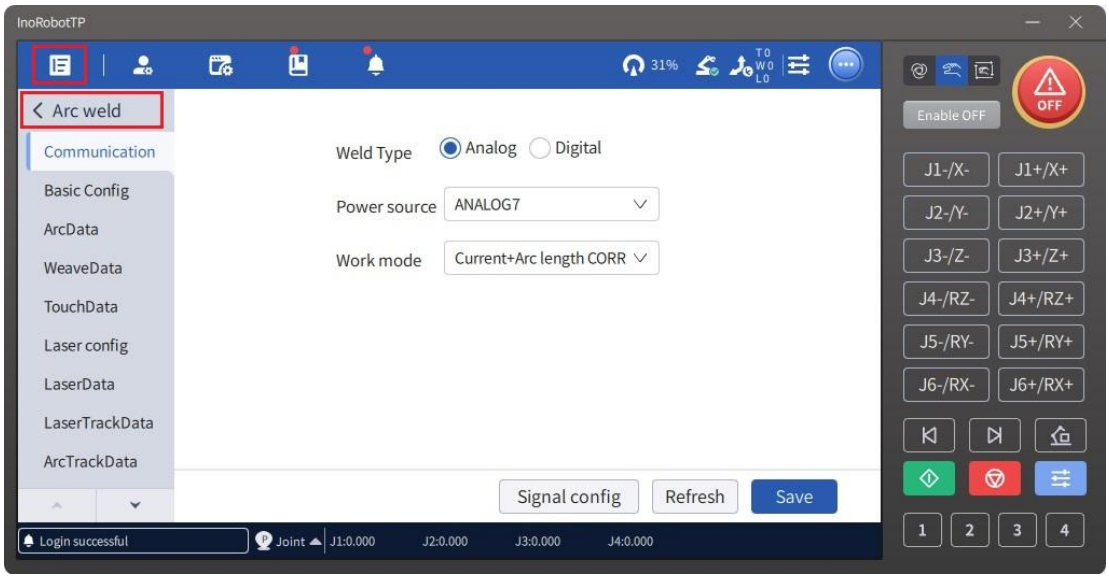
5. You can set a maximum of four pages for shortcut buttons. Pressing the page turn button when on the last page will automatically return to the first page.



6. If you briefly press the "Wire feed" or "Retract wire" button to enter the jog feed/retract state, and then briefly press the same button again, the system will not respond to the current signal.

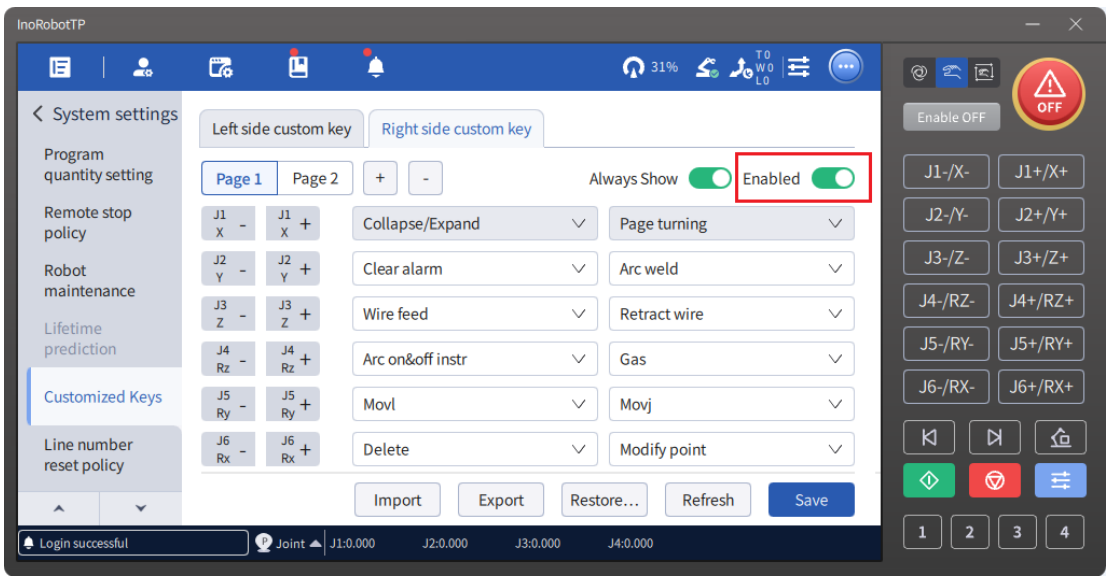


7. The arc welding process shortcut function on the interface allows you to quickly switch to the arc welding setting page. However, to return to the editing page, you currently need to click the navigation button on the teach pendant or the < Arc weld button in the upper-left corner of the interface.

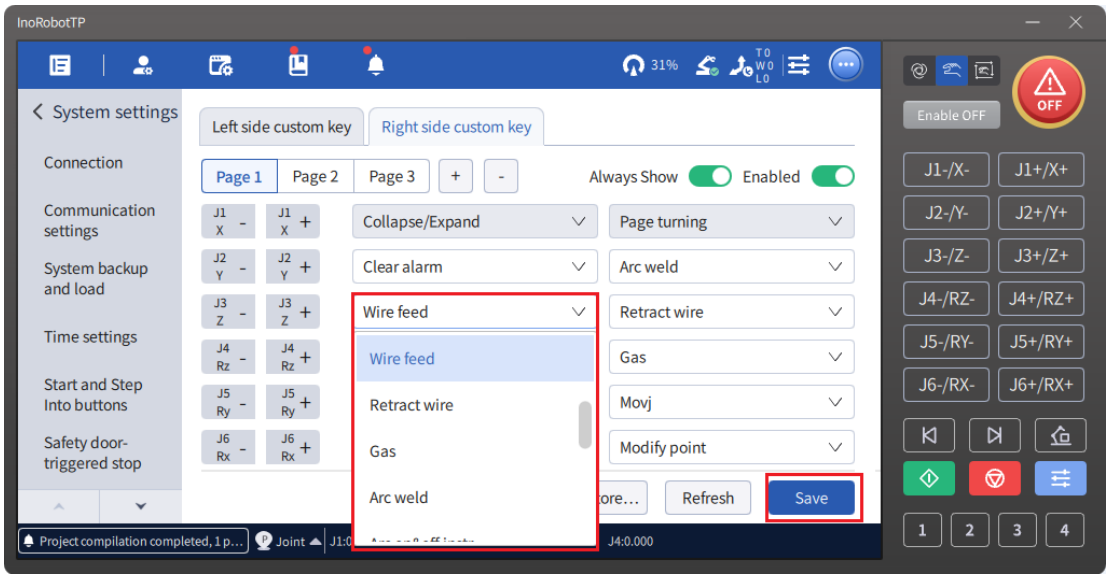


9.8.5 Usage Procedure

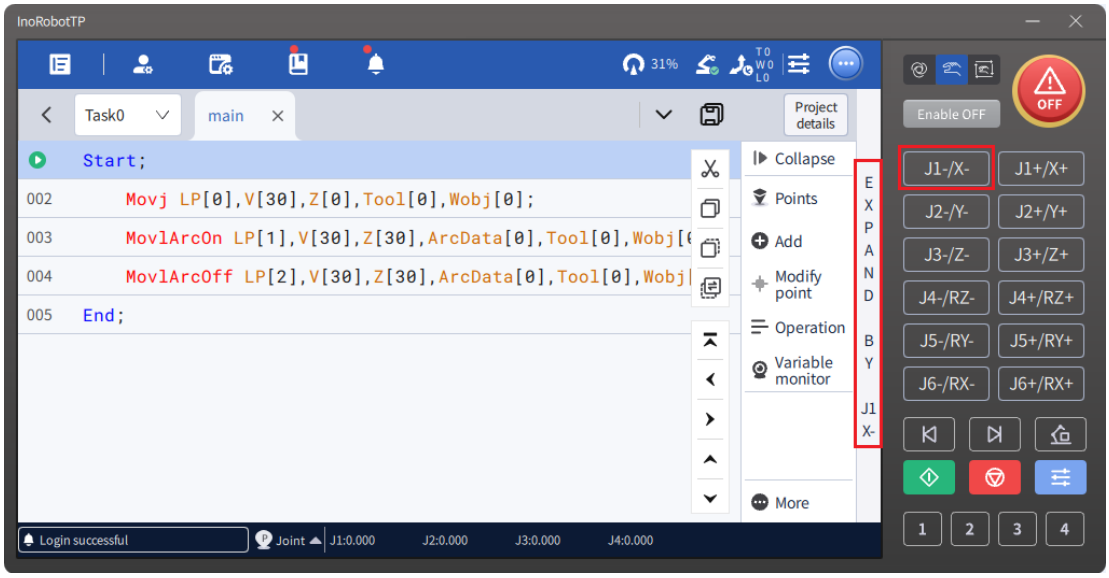
1. Enable the right-side custom key function: go to "System settings" > "Customized Keys" > "Right side custom key" and set "Enabled" to on.

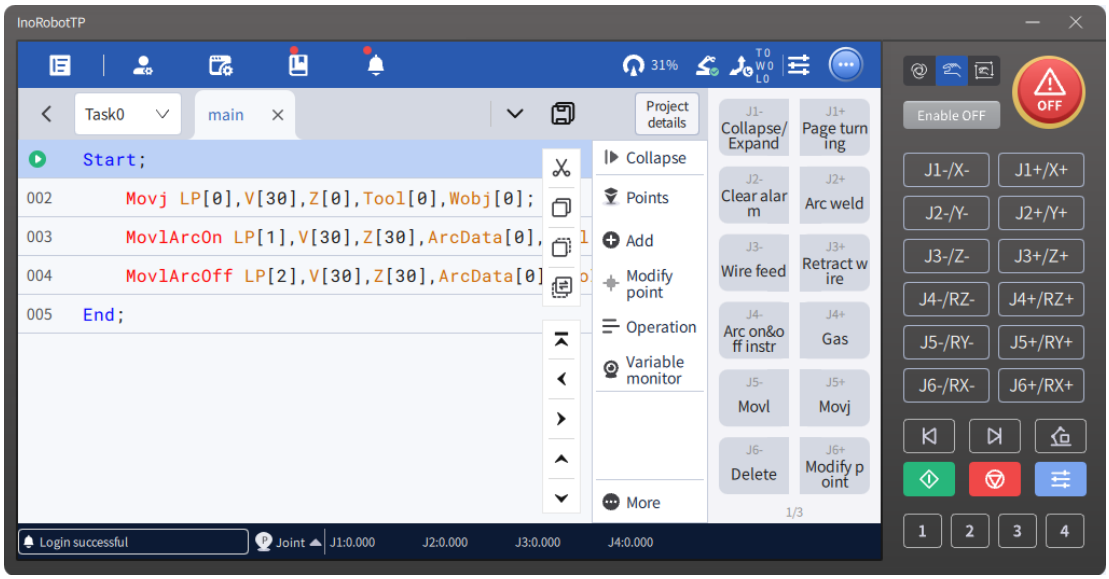


2. If you need to adjust the button functions, modify them according to your requirements. After making the changes, click "Save".

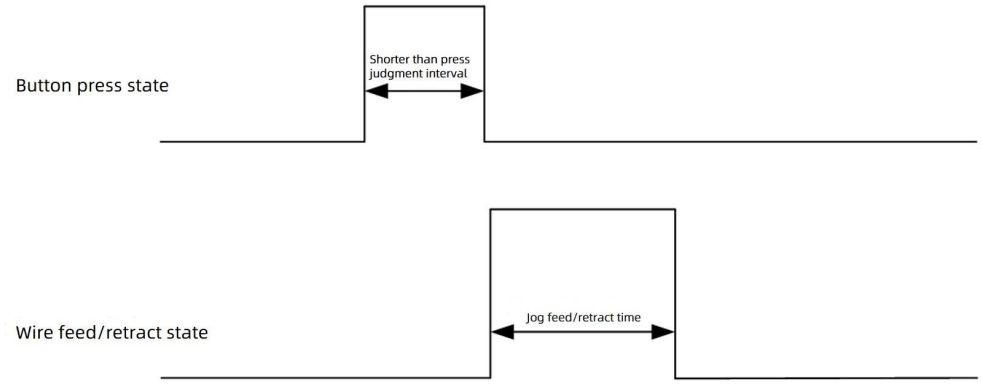


3. Switch to the programming page. When the robot is in the "Enable OFF" state, press the physical button J1- to expand the custom keys.

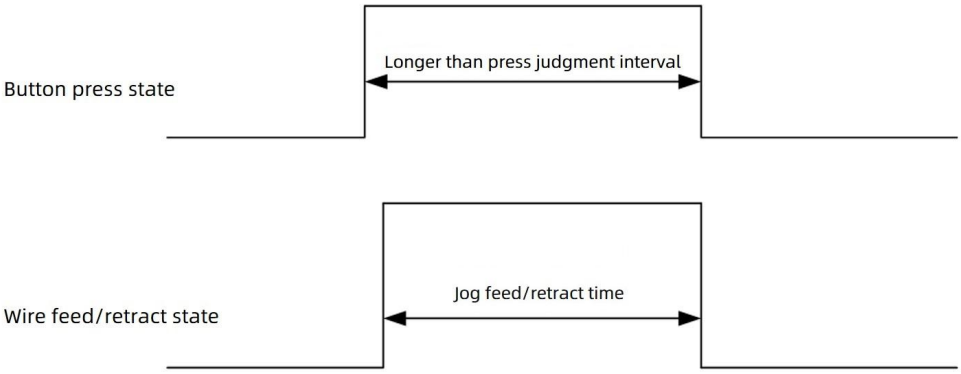




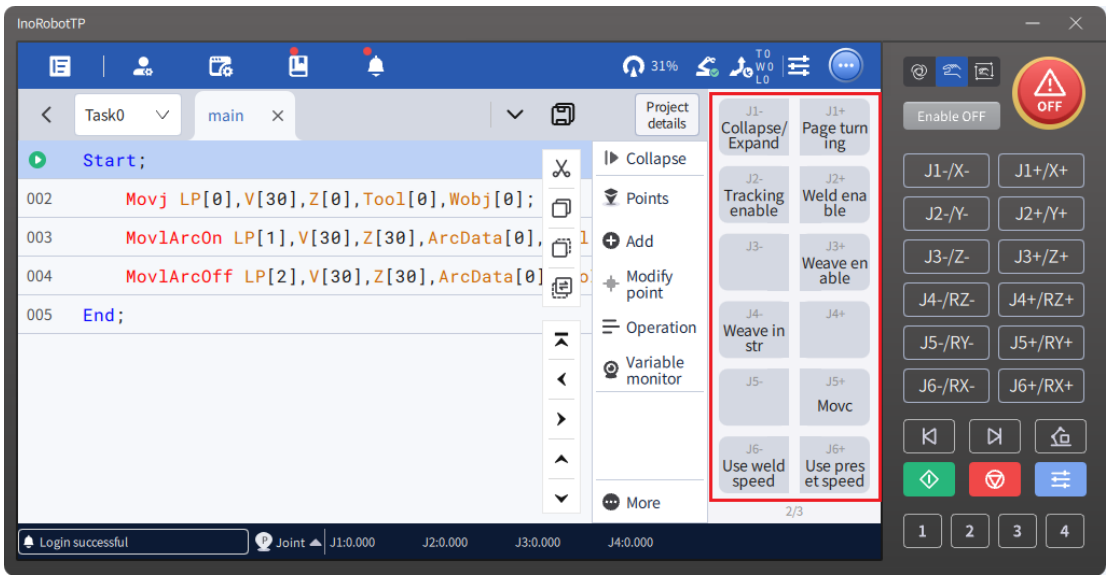
4. If the wire feed/retract button is pressed for a time longer than the set pressing judgment time for jog feed/retract button, continuous wire feed/retract starts.



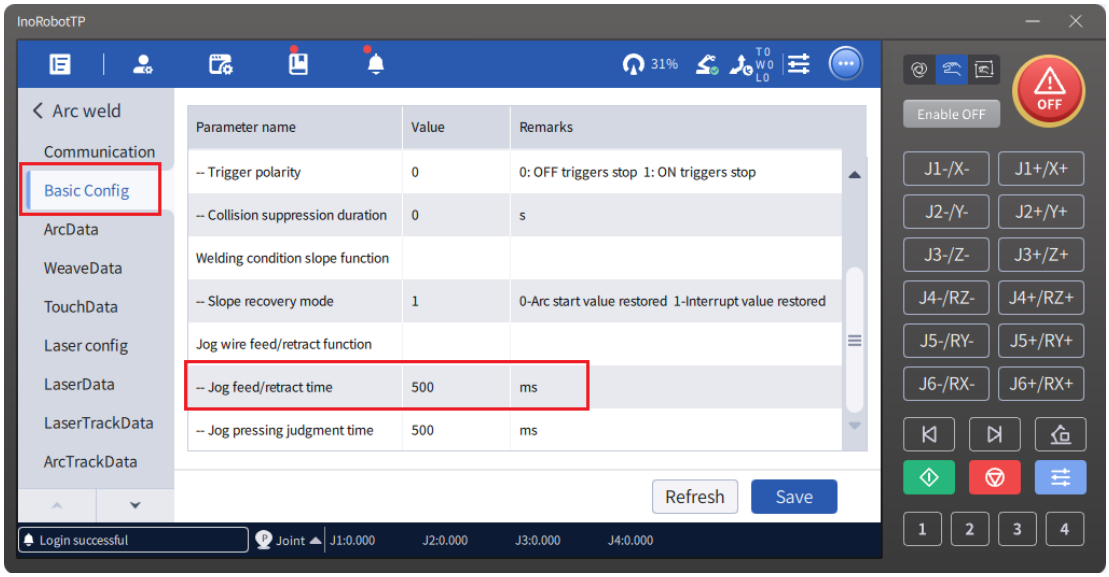
If the button is released within the judgment time, jog feed/retract is performed.



5. Toggle the following functions: welding enable/disable, weaving enable/disable, use welding speed, use preset speed, and tracking enable/disable. Each function has its own button; press the button to toggle its state. For example, pressing the "Weld enable" button toggles the welding enable/disable state.



6. To modify the jog feed/retract time, go to "Settings" > "More" > "Process manager" > "Arc weld" > "Basic Config" > "Jog feed/retract time".



9.9 Power Failure Resume

9.9.1 Overview

This function is used to enable the robot to resuming welding from the point of interruption after a power failure and restart.

9.9.2 Parameter Description

N/A.

9.9.3 Permission Allocation

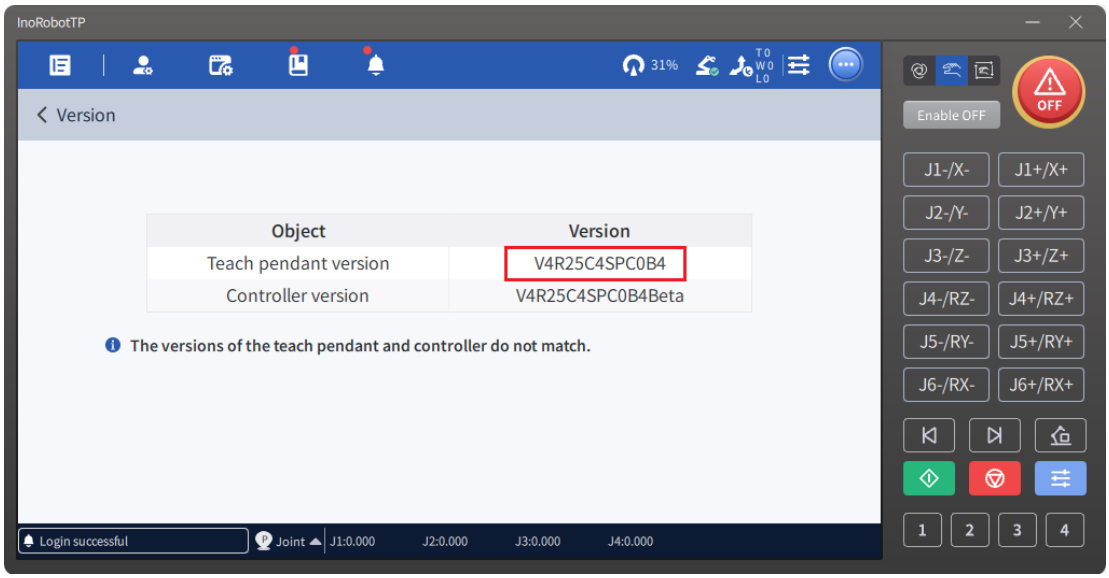
N/A.

9.9.4 Notes

- Only linear arc welding instructions "MovlArcOn", "MovlArc", and "MovlArcOff" are supported.
- Power failure resume during scrape start is not supported.
- Power failure resume during the retract phase of restart is not supported.
- Power failure resume is not supported for weaving.
- Power failure resume is not supported for laser tracking and other advanced functions, but only supported for basic welding functions.
- Pre-gas and flying arc start are not supported during the power failure resume.
- Power failure resume is not supported for external axes.
- Only the following models are supported: IR-R50-250S7, IRS311-7-70TS5, IR-R16-210S5.

9.9.5 Usage Procedure

1. Click the teach pendant version number multiple times to enter "Developer debug mode".



2. In Admin mode or Manufacturer mode, select "Program resumes operation after power reboot" in "System settings" > "Function Tab", then click "Save".



3. After enabling the function, the robot can resume welding from the point of interruption after a power failure and restart.

9.10 API

9.10.1 Overview

Related APIs are provided for setting parameters and signals on the plugin side.

9.10.2 Parameter Description

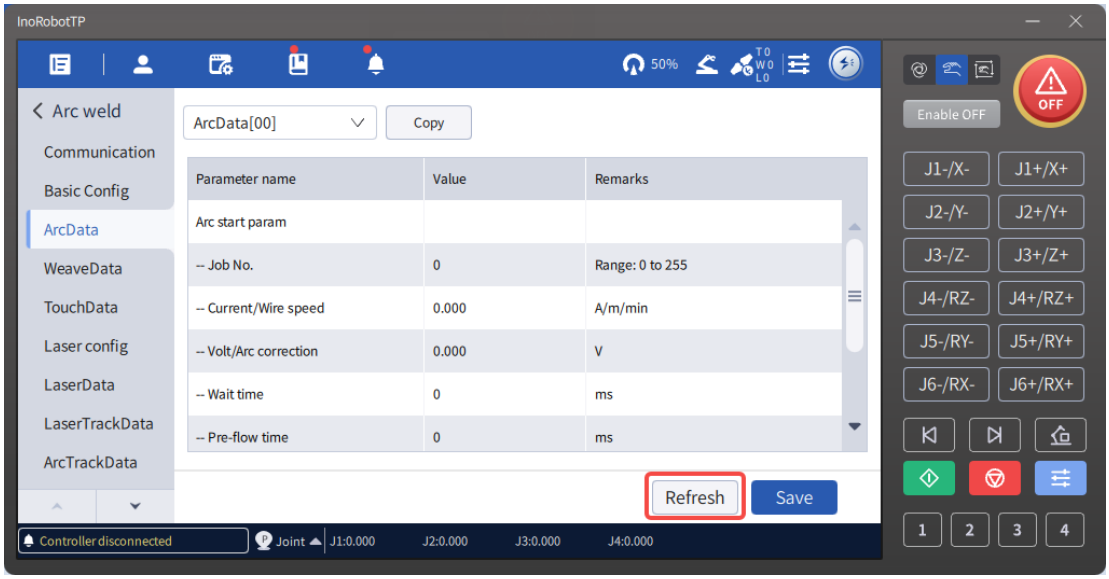
N/A.

9.10.3 Permission Allocation

1. This function can be used in User, Edit, Manager and Manufacturer modes.
2. API read/write is allowed in both remote and non-remote modes.
3. In Auto mode with the program stopped, API read/write is allowed. Additionally, for the welder bus signal, API read/write is allowed in Auto mode when the program is not stopped.

9.10.4 Notes

After setting parameters related to the arc welding interface via API, click the "Refresh" button on the interface to refresh the corresponding parameter values.



9.10.5 Usage Procedure

API function name	Description
IMC100_Get_WeldingCurrent	Get the welding current.
IMC100_Get_WeldingVoltage	Get the welding voltage.
IMC100_Set_WeldReArconSwitch	Set the arc retry function switch state.
IMC100_Get_WeldReArconSwitch	Get the arc retry function switch state.
IMC100_Set_WeldReArconTimes	Set the arc retry times.
IMC100_Get_WeldReArconTimes	Get the arc retry times.
IMC100_Set_WeldScrapSwitch	Set the scrape function switch state.
IMC100_Get_WeldScrapSwitch	Get the scrape function switch state.
IMC100_Set_WeldScrapTimes	Set the scrape times.
IMC100_Get_WeldScrapTimes	Get the scrape times.
IMC100_Get_WeldArcData	Get the ArcData data.

API function name	Description
IMC100_Set_WeldArcData	Set the ArcData data.
IMC100_Get_WeldWeaveData	Get the WeaveData data.
IMC100_Set_WeldWeaveData	Set the WeaveData data.
IMC100_Get_WeldArcTrackData	Get the ArcTrackData parameter.
IMC100_Set_WeldArcTrackData	Set the ArcTrackData parameter.
IMC100_Get_WeldSignal	Get the welder related bus signal.
IMC100_Set_WeldSignal	Set the welder related bus signal.
IMC100_Get_WeldEnableState	Get the welding-related enable states (welding enable, weaving enable, use welding speed, tracking enable)
IMC100_Set_WeldEnableState	Set the welding-related enable states.
IMC100_Get_WeldSeekEnableState	Get the touch sensing enable state.
IMC100_Get_WeldWelderBrand	Get the brand of the currently set welder.

NOTE

For detailed instructions on using the API functions, see the "Industrial Robot Remote Ethernet Control Function User Guide".

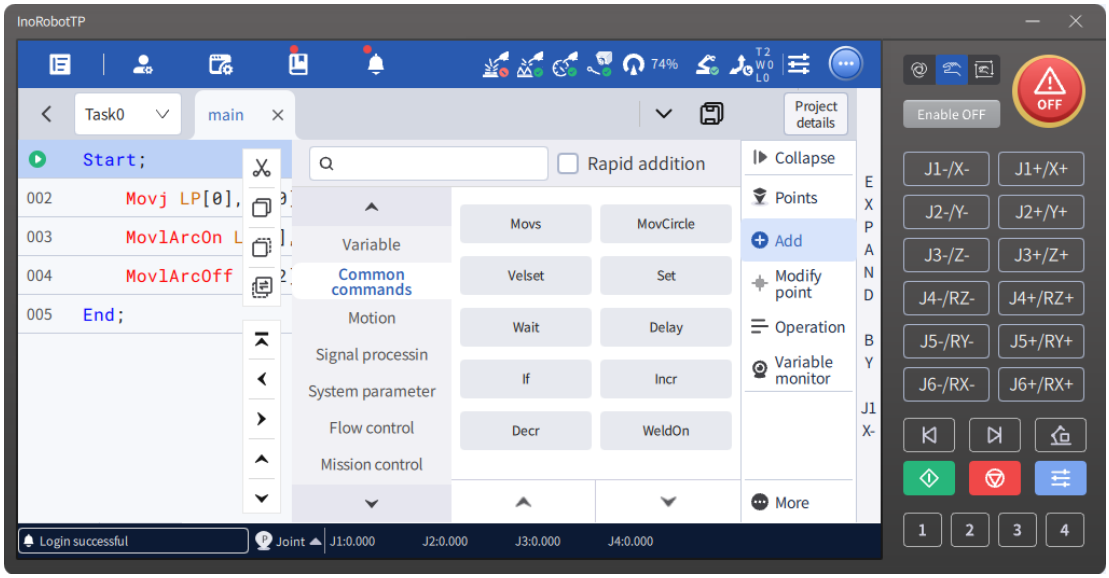
10 Instructions

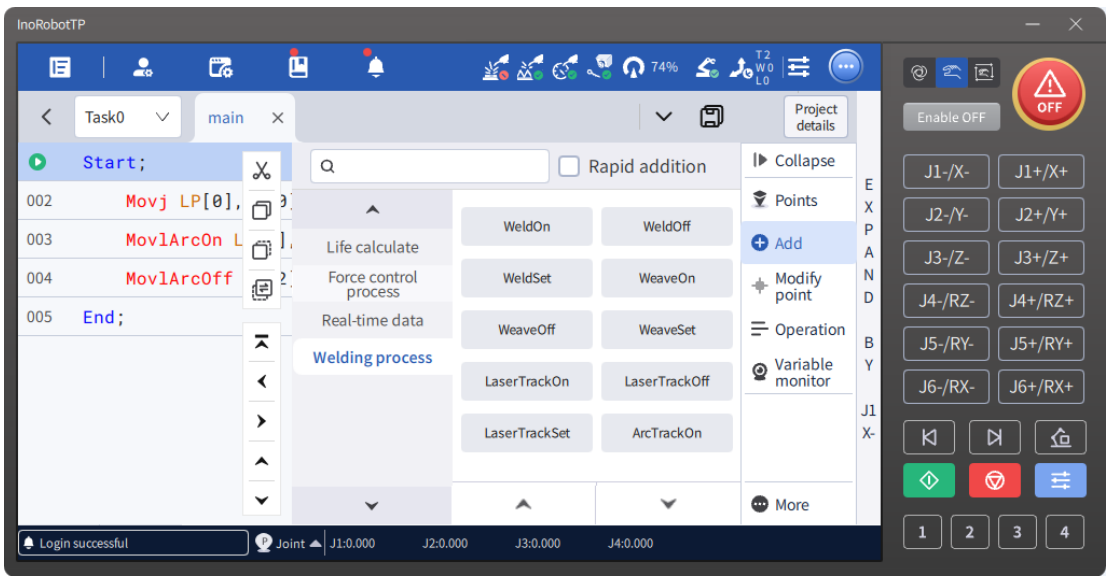
10.1 WeldOn

10.1.1 Description

This is a new version arc start instruction. After this instruction is executed, the robot controls the welding torch to start the arc.

The target point of the previous motion instruction is the arc start point.
After the plugin is installed, the instruction can be added on the "Program" > "Add" > "Common commands" page, or on the "Program" > "Add" > "Welding process" page.





10.1.2 Format

Format 1: with welding parameter number

WeldOn ArcData[1];

Format 2: with welding parameters number, optionally with the following parameters: current (AC), voltage /arc length correction (AV), welding speed (WS), and RPM number. When optional parameters are included, they take precedence over those in ArcData.

WeldOn ArcData[1], AC[100], AV[50], WS[10],RPM[0];



- ArcData is a required parameter with an index range of 0 to 63. The index value cannot be represented by a variable.
- When optional parameters are included, they take precedence over those in ArcData.

10.1.3 Parameter Description

- ArcData: required parameter, type: integer, range: 0 to 63. This parameter specifies the welding parameters, including three sub-parameters: arc start data, welding process data, and arc end data. For details, see the 6 ArcData section.
- AC: optional parameter, type: floating point, representing the welding process current.
- AV: optional parameter, type: floating point, representing the voltage/arc length correction.
- WS: optional parameter, type: floating point, representing the welding speed.
- RPM: optional parameter, type: integer, range: 0 to 63. When this parameter is included, the point path is stored in RPM, which actually records the points on the guide line, i.e., the root pass. These points can then be used by the reproduction instructions MovArcRep and MovArcMultiRep to execute filling passes. For details, see the 9.5 Multi-Layer and Multi-Pass section. Note that these points are not retained after power failure. If power failure retention is required, use MPSaveRPM to save the path to a file, and then use MPLoadRPM to load the path. When this parameter is included, it indicates that the points of the welding segment are recorded in the RPM.

10.1.4 Scope

Multitasking: Only effective in the main tasks. It can exist in a function and can only be called by the main task.

Mode:

In Manual mode:

- When running the program step by step using the single-step button, no welding is performed, regardless of the state of the welding enable switch.
- When the welding enable switch is in the "Weld disable" state, running the instruction via the start button results in no welding. When the welding enable switch is in the "Weld enable" state, running the instruction via the start button performs welding according to the ArcData settings.

In Auto mode:

- When the welding enable switch is in the "Weld disable" state, running the instruction via the start button results in no welding. When the welding enable switch is in the "Weld enable" state, running the instruction via the start button performs welding according to the ArcData settings.

10.1.5 Notes

- If flying arc start and pre-gas functions are required, the motion instruction to the arc start point must be immediately followed by the arc start instruction. If there is any other instruction between them (excluding comment instructions and new version arc welding instructions such as WeaveOn, ArcTrackOn, StitchOn, etc.), gas delivery will only begin after the arc start point is reached.
- The index of ArcData cannot be a variable, while indices of other parameters can be variables.
- Executing WeldOn directly will start the arc in place.
- The arc start instruction is a blocking instruction.
- No jump instructions or function calls are allowed between the arc start instruction and the arc end instruction.
- The arc start point does not allow the Out Until parameter. Otherwise, an alarm will be triggered during runtime.
- When the On instruction is executed, the following checks are performed:
  - No function calls are allowed between the On and Off instructions. Otherwise, an alarm will be triggered.
  - Every On instruction must have a corresponding Off instruction. Otherwise, an alarm will be triggered.
  - The RPM parameter is used to record the points of the welding segment and cannot be changed during welding.
- The current Japanese-style instructions do not support the welding condition slope. An alarm will be triggered if a condition slope is set.

<table>
<tr><th colspan="3">Scenario</th><th>Welding or not</th><th>Restart supported or not</th><th>Remarks</th></tr>
<tr><td rowspan="4">WeldOn instruction executed, welding in progress, then paused.</td><td colspan="2">Restart with no line number change
(welding and interrupt restart enabled)</td><td>Yes</td><td>Yes</td><td>-</td></tr>
<tr><td rowspan="3">Restart with line number change</td><td>Line number changed to that of a motion instruction between WeldOn and WeldOff</td><td>No</td><td>No</td><td rowspan="3">When running to a specified motion line, no welding is performed. The speed follows the speed specified in the instruction and is affected by the global speed setting.</td></tr>
<tr><td>Line number changed to that of a motion instruction outside WeldOn and WeldOff</td><td>No</td><td>No</td></tr>
<tr><td colspan="3">WeldOn not executed; directly jump to a motion instruction between WeldOn and WeldOff.</td><td>No</td><td>No</td></tr>
</table>

Scenario	Welding or not	Restart supported or not	Remarks
Jump directly to the WeldOn instruction.	Start arc in place	-	-

10.1.6 Usage Example



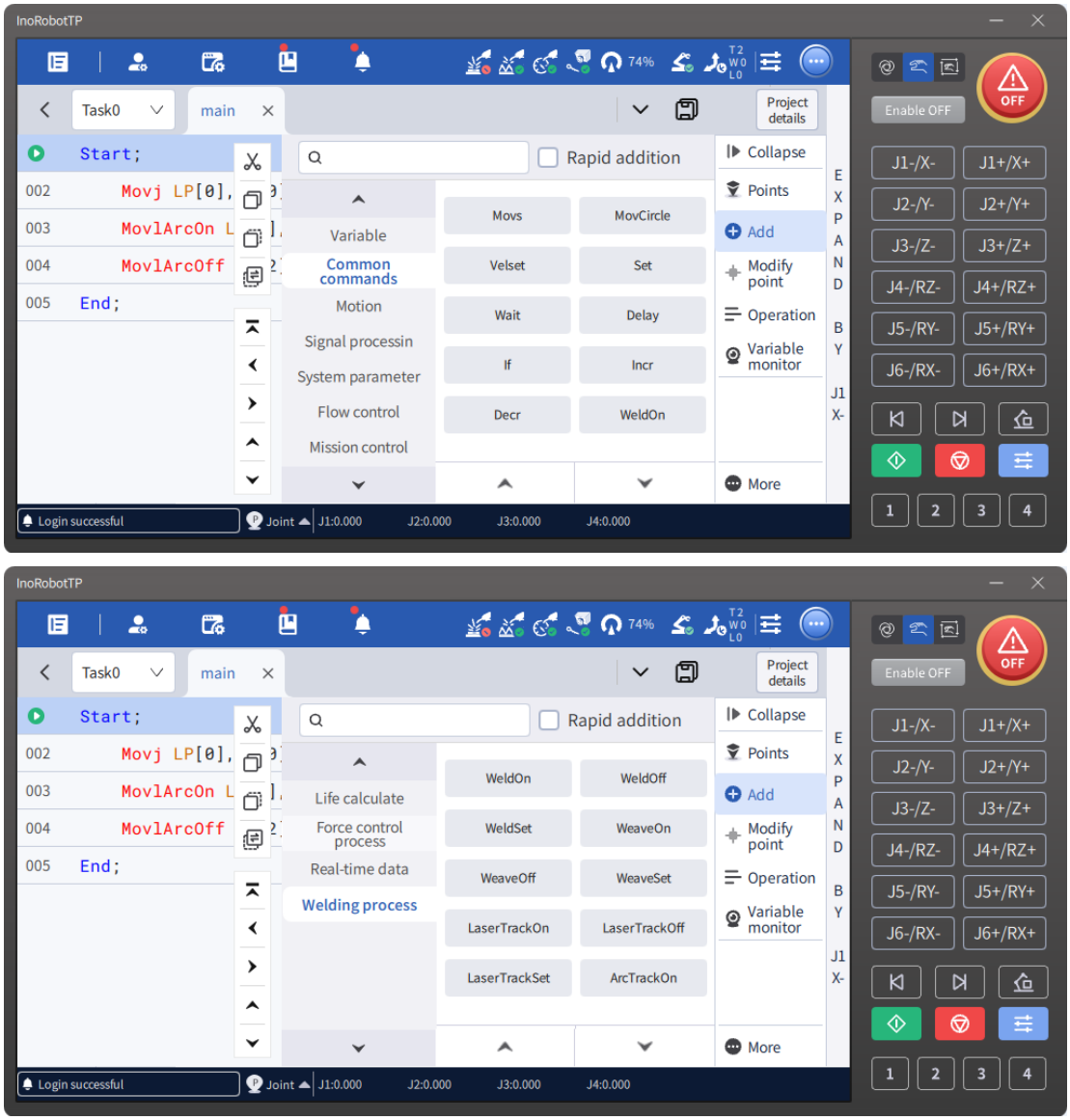
No.	Program	Comment
1	Start;	Start
2	Movl P[1],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[1].
3	Movl P[2],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the arc start point P[2].
4	WeldOn ArcData[1], AC[120],AV[0],WS[8];	Start arc
5	Movl P[3],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the arc-off point P[3].
6	WeldOff ArcData[1];	Extinguish arc.
7	Movl P[4],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[4].
8	End;	End

10.2 WeldOff

10.2.1 Description

This is a new version arc end instruction. After this instruction is executed, the robot controls the welding torch to extinguish the arc.

The target point of the previous motion instruction is the arc-off point.
After the plugin is installed, the instruction can be added on the "Program" > "Add" > "Common commands" page, or on the "Program" > "Add" > "Welding process" page.



10.2.2 Format

Format 1: with welding parameter number

WeldOff ArcData[1];

Format 2: with welding parameters number, optionally with the following parameters: extinguishing current (AC), voltage/arc length correction (AV), and arc-off time (ArcOffT). When optional parameters are included, they take precedence over those in ArcData.

WeldOff ArcData[1], AC[100], AV[50], ArcOffT[200];

CAUTION

- ArcData is a required parameter with an index range of 0 to 63. The index value cannot be represented by a variable.
- When optional parameters are included, they take precedence over those in ArcData.

10.2.3 Parameter Description

- ArcData: required parameter, type: integer, range: 0 to 63. This parameter specifies the welding parameters, including three sub-parameters: arc start data, welding process data, and arc end data. For details, see the 6 ArcData section.
- AC: optional parameter, type: floating point, representing the extinguishing current.
- AV: optional parameter, type: floating point, representing the extinguishing voltage/arc length correction.
- ArcOffT: optional parameter, type: integer, representing the arc-off time.

10.2.4 Scope

Multitasking: Only effective in the main tasks. It can exist in a function and can only be called by the main task.

Mode:

In Manual mode:

- When running the program step by step using the single-step button, no welding is performed, regardless of the state of the welding enable switch.
- When the welding enable switch is in the "Weld disable" state, running the instruction via the start button results in no welding. When the welding enable switch is in the "Weld enable" state, running the instruction via the start button performs welding according to the ArcData settings.

In Auto mode:

- When the welding enable switch is in the "Weld disable" state, running the instruction via the start button results in no welding. When the welding enable switch is in the "Weld enable" state, running the instruction via the start button performs welding according to the ArcData settings.

10.2.5 Notes

- The index of ArcData cannot be a variable, while indices of other parameters can be variables.
- It is allowed to have a WeldOff instruction without a corresponding WeldOn instruction, in which case no action will be performed.

10.2.6 Usage Example



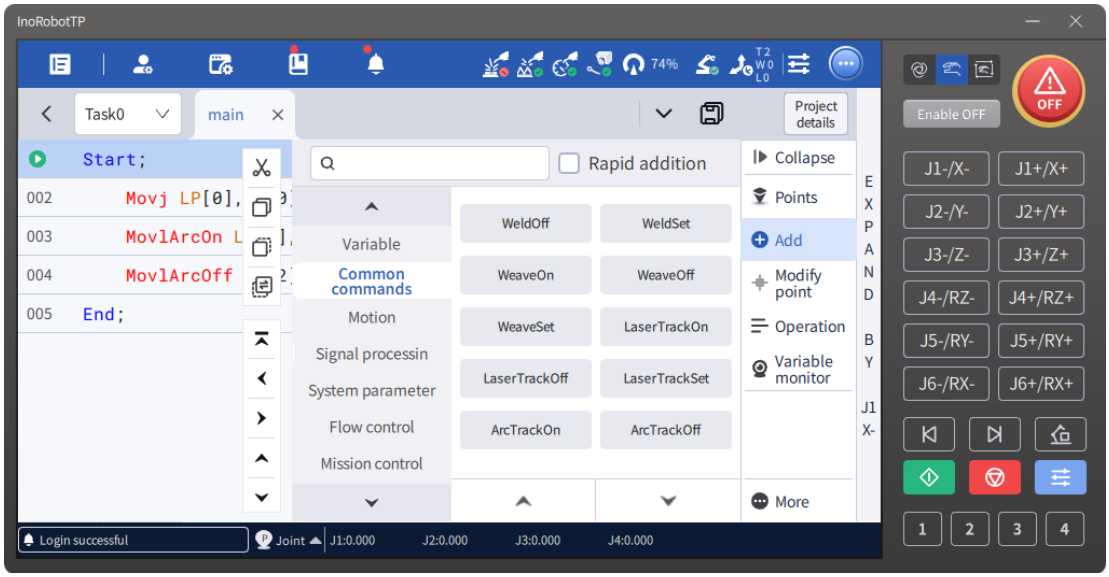
No.	Program	Comment
1	Start;	Start
2	Movl P[1],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[1].
3	Movl P[2],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the arc start point P[2].
4	WeldOn ArcData[1], AC[120],AV[0],WS[8];	Start arc
5	Movl P[3],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the arc-off point P[3].
6	WeldOff ArcData[1];	Extinguish arc.
7	Movl P[4],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[4].
8	End;	End

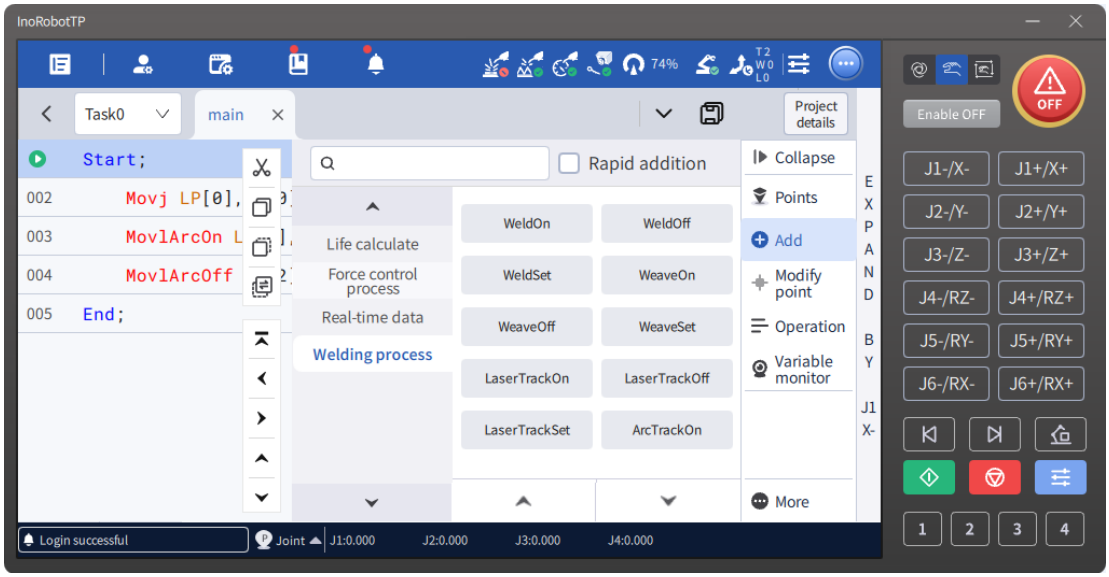
10.3 WeldSet

10.3.1 Description

This is a new version welding parameter change instruction. After this instruction is executed, the changed welding parameters will take effect in the next motion instruction.

After the plugin is installed, the instruction can be added on the "Program" > "Add" > "Common commands" page, or on the "Program" > "Add" > "Welding process" page.





10.3.2 Format

Format 1: with welding parameter number

WeldSet ArcData[1];

Format 2: with welding parameters number, optionally with the following parameters: current (AC), voltage /arc length correction (AV), and welding speed (WS). When optional parameters are included, they take precedence over those in ArcData.

WeldSet ArcData[1], AC[100], AV[50], WS[10];

CAUTION

- ArcData is a required parameter with an index range of 0 to 63. The index value cannot be represented by a variable.
- When optional parameters are included, they take precedence over those in ArcData.

10.3.3 Parameter Description

- ArcData: required parameter, type: integer, range: 0 to 63. This parameter specifies the welding parameters, including three sub-parameters: arc start data, welding process data, and arc end data. For details, see the 6 ArcData section.
- AC: optional parameter, type: floating point, representing the welding process current.
- AV: optional parameter, type: floating point, representing the voltage/arc length correction.
- WS: optional parameter, type: floating point, representing the welding speed.

10.3.4 Scope

Multitasking: Only effective in the main tasks. It can exist in a function and can only be called by the main task.

Mode:

In Manual mode:

- When running the program step by step using the single-step button, no welding is performed, regardless of the state of the welding enable switch.
- When the welding enable switch is in the "Weld disable" state, running the instruction via the start button results in no welding. When the welding enable switch is in the "Weld enable" state, running the instruction via the start button performs welding according to the ArcData settings.

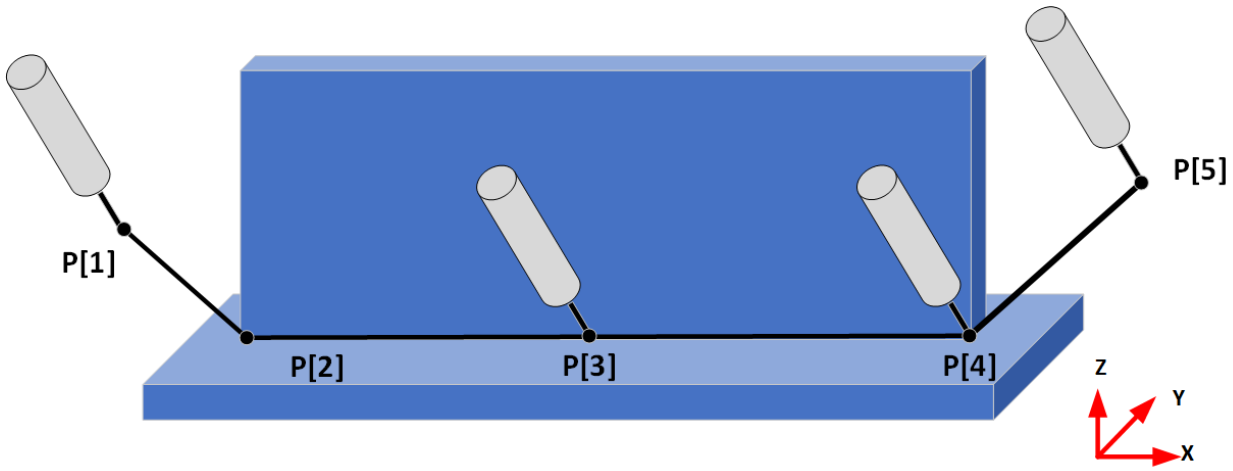
In Auto mode:

- When the welding enable switch is in the "Weld disable" state, running the instruction via the start button results in no welding. When the welding enable switch is in the "Weld enable" state, running the instruction via the start button performs welding according to the ArcData settings.

10.3.5 Notes

- The index of ArcData cannot be a variable, while indices of other parameters can be variables.
- It is allowed to have a WeldSet instruction without WeldOn and WeldOff instructions, in which case no action will be performed.

10.3.6 Usage Example



No.	Program	Comment
1	Start;	Start
2	Movl P[1],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[1].
3	Movl P[2],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the arc start point P[2].
4	WeldOn ArcData[1], AC[120],AV[0],WS[8];	Start arc
5	Movl P[3],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the first welding point P[3].
6	WeldSet ArcData[2], AC[140],AV[0],WS[8];	Change the welding parameters. The changes take effect when moving to the next point.
7	Movl P[4],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the arc-off point P[4].

No.	Program	Comment
8	WeldOff ArcData[1];	Extinguish arc.
9	Movl P[5],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[5].
10	End;	End

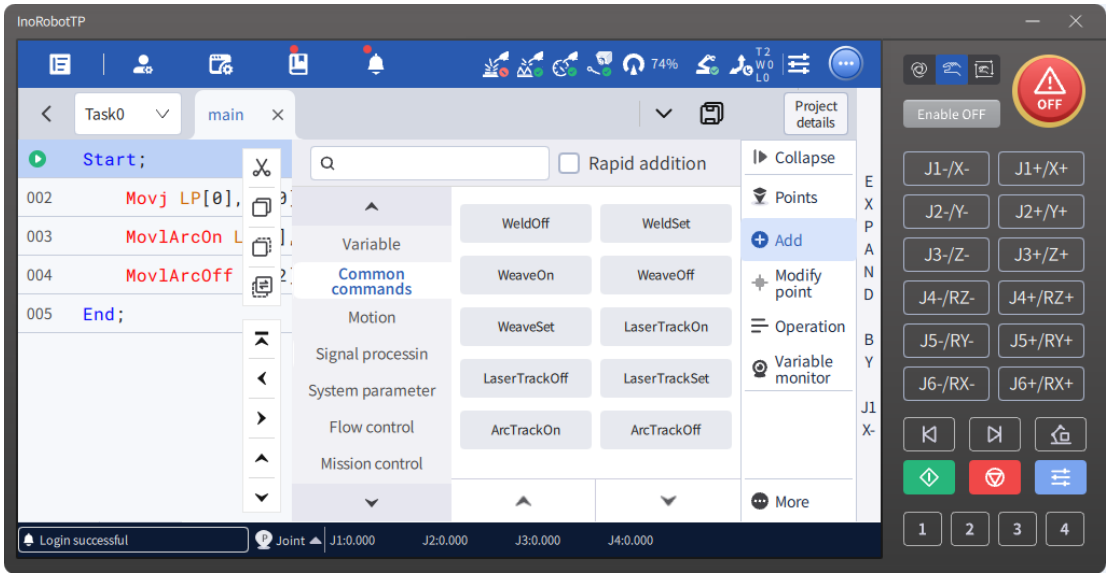
10.4 WeaveOn

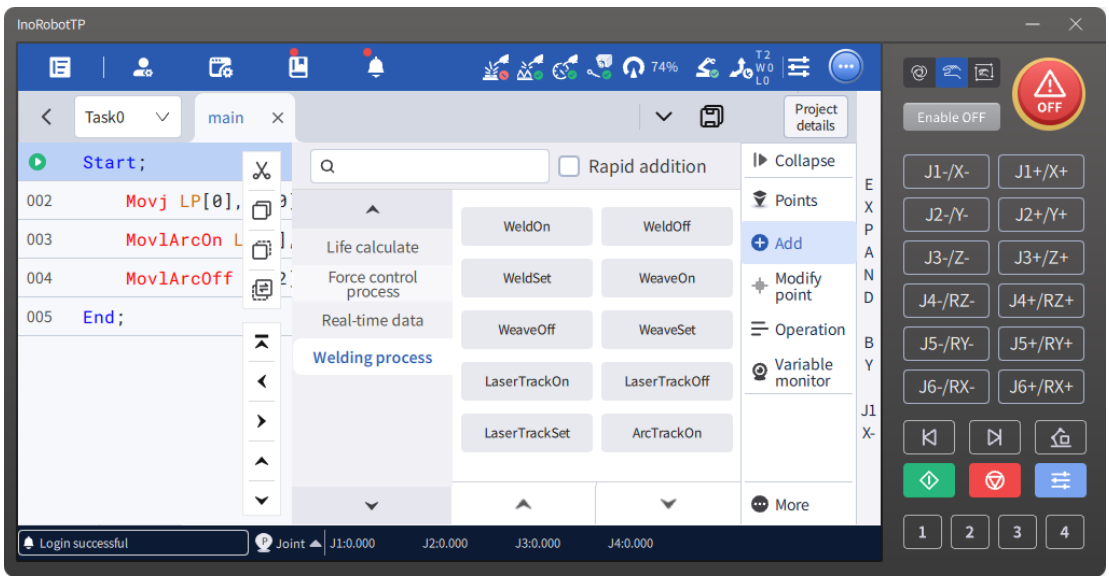
10.4.1 Description

This is a new version weaving start instruction. After this instruction is executed, the robot will perform weaving according to the WeaveData settings during the movement to the next point.

The target point of the previous motion instruction is the weaving start point.

After the plugin is installed, the instruction can be added on the "Program" > "Add" > "Common commands" page, or on the "Program" > "Add" > "Welding process" page.





10.4.2 Format

Format 1: with weaving parameter number

WeaveOn WeaveData[1];

Format 2: with weaving parameter number, and specified pattern, frequency, amplitude, left and right dwell time. Except for the condition number, all other parameters are optional. When optional parameters are included, they take precedence over those in WeaveData.
WeaveOn WeaveData[1], Shape[0], Freq[2], RAmp[5], LAmp[5], RT[1], LT[1];



- WeaveData is a required parameter, with an index range of 0 to 63.
- When optional parameters are included, they take precedence over those in WeaveData.

10.4.3 Parameter Description

- WeaveData: required parameter, type: integer, range: 0 to 63. This parameter specifies the weaving variable. For a welding instruction that includes this parameter, if the weaving enable state is active, weaving is performed according to the parameters in the specified weaving variable. For details, see the 9.1 Weaving section.
- Shape: optional parameter, type: integer, range: 0 to 5, representing the weaving pattern:
  - 0: None.
  - 1: Zigzag.
  - 2: Circular.
  - 3: Figure 8.
  - 4: Pos crescent.
  - 5: Neg crescent.
- Freq: optional parameter, type: floating point, representing weaving frequency, range: 0.0 to 100.0, unit: Hz.
- RAmp: optional parameter, type: floating point, representing the right amplitude of weaving, range: 0.0 to 100.0, unit: mm.
- LAmp: optional parameter, type: floating point, representing the left amplitude of weaving, range: 0.0 to 100.0, unit: mm.
- RT: optional parameter, type: integer, representing the right dwell time, range: 0 to 10000, unit: ms.
- LT: optional parameter, type: integer, representing the left dwell time, range: 0 to 10000, unit: ms.

10.4.4 Scope

Multitasking: Only effective in the main tasks. It can exist in a function and can only be called by the main task.

Mode:

In Manual mode:

- When running the program step by step using the single-step button, if the weaving enable switch is in the "Weave enable" state, weave motion is performed without welding.
- When the weaving enable switch is in the "Weave disable" state, running the instruction via the start button results in no weaving. When the weaving enable switch is in the "Weave enable" state, running the instruction via the start button performs weaving according to the WeaveData settings.

In Auto mode:

- When the weaving enable switch is in the "Weave disable" state, running the instruction via the start button results in no weaving. When the weaving enable switch is in the "Weave enable" state, running the instruction via the start button performs weaving according to the WeaveData settings.

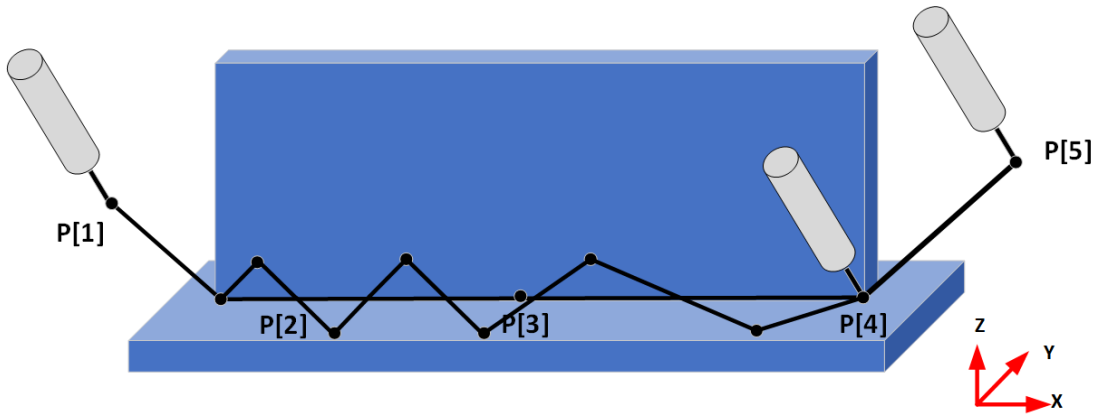
10.4.5 Notes

- First move to the weaving start point, execute WeaveOn, and then start weaving during the movement to the next point.
- When the ON instruction is executed, the following checks are performed:
  - No function calls are allowed between the ON and OFF instructions. Otherwise, an alarm will be triggered.
  - The ON instruction must have a corresponding OFF instruction. Otherwise, an alarm will be triggered during runtime.

<table>
<tr><th colspan="3">Scenario</th><th>Weaving or not</th><th>Restart supported or not</th><th>Remarks</th></tr>
<tr><td rowspan="4">WeaveOn instruction executed, welding in progress, then paused.</td><td colspan="2">Restart with no line number change</td><td>Yes</td><td>Yes</td><td>-</td></tr>
<tr><td rowspan="3">Restart with line number change</td><td>Line number changed to that of a motion instruction between WeaveOn and WeaveOff</td><td>No</td><td>No</td><td rowspan="3">When running to a specified motion line, no weaving is performed. The speed follows the speed specified in the instruction and is affected by the global speed setting.</td></tr>
<tr><td>Line number changed to that of a motion instruction outside WeaveOn and WeaveOff</td><td>No</td><td>No</td></tr>
<tr><td colspan="3">WeaveOn not executed; directly jump to a motion instruction between WeaveOn and WeaveOff.</td><td>No</td><td>No</td></tr>
</table>

Scenario	Weaving or not	Restart supported or not	Remarks
Jump directly to the WeaveOn instruction.	Weaving from the current robot position to the next target point	-	-

10.4.6 Usage Example



No.	Program	Comment
1	Start;	Start
2	Movl P[1],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[1].
3	Movl P[2],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the arc start point P[2].
4	WeldOn ArcData[1], AC[120],AV[0],WS[8];	Start arc
5	WeaveOn WeaveData[0];	Start weaving.
6	Movl P[3],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the first welding point P[3].
7	WeaveSet WeaveData[2];	Change the weaving parameters. The changes take effect when moving to the next point.
8	Movl P[4],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the arc-off point P[4].
9	WeldOff ArcData[1];	Extinguish arc.
10	WeaveOff;	End weaving.
11	Movl P[5],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[5].
12	End;	End

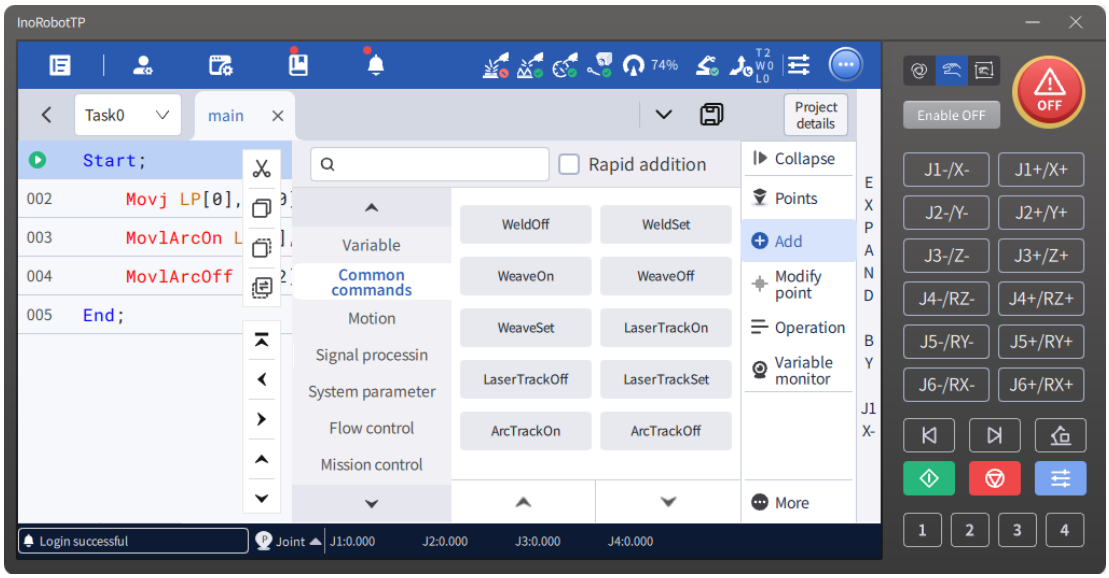
10.5 WeaveOff

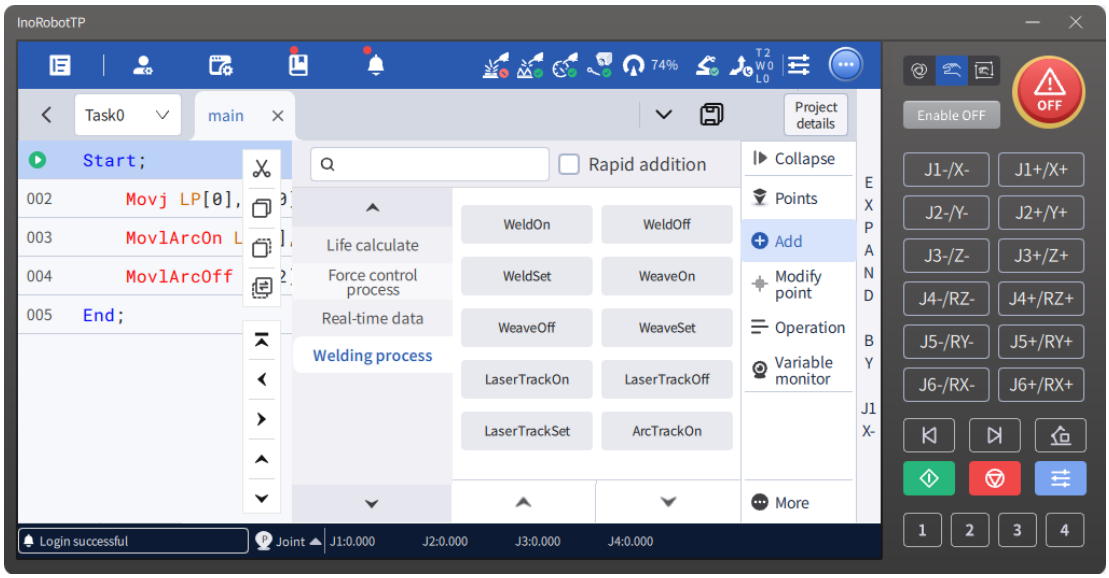
10.5.1 Description

This is a new version weaving end instruction. After this instruction is executed, the robot stops the weave motion.

The target point of the previous motion instruction is the weaving end point.

After the plugin is installed, the instruction can be added on the "Program" > "Add" > "Common commands" page, or on the "Program" > "Add" > "Welding process" page.





10.5.2 Format

WeaveOff;

10.5.3 Parameter Description

WeaveOff has no parameters.

10.5.4 Scope

Multitasking: Only effective in the main tasks. It can exist in a function and can only be called by the main task.

Mode:

In Manual mode:

- When running the program step by step using the single-step button, if the weaving enable switch is in the "Weave enable" state, weave motion is performed without welding.
- When the weaving enable switch is in the "Weave disable" state, running the instruction via the start button results in no weaving. When the weaving enable switch is in the "Weave enable" state, running the instruction via the start button performs weaving according to the WeaveData settings.

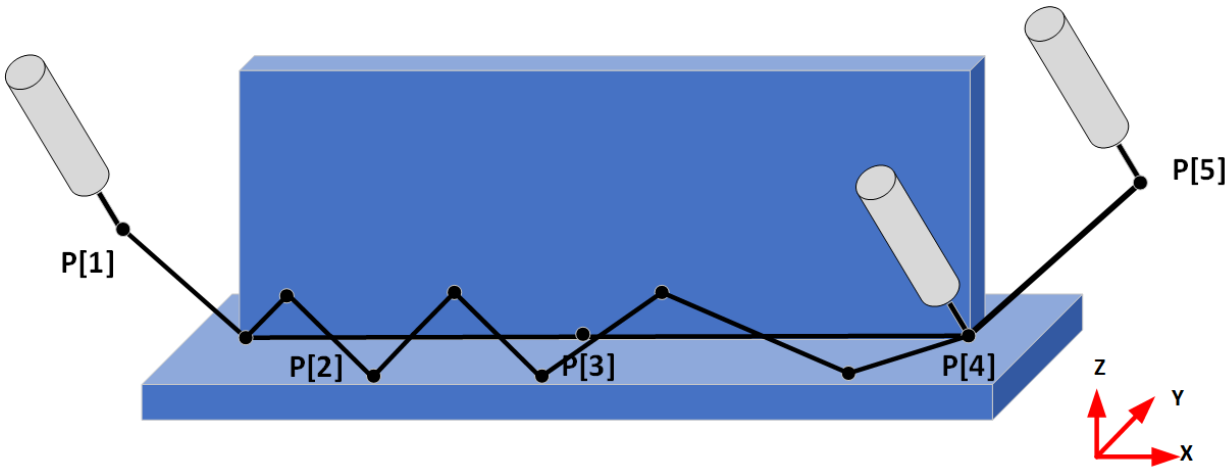
In Auto mode:

- When the weaving enable switch is in the "Weave disable" state, running the instruction via the start button results in no weaving. When the weaving enable switch is in the "Weave enable" state, running the instruction via the start button performs weaving according to the WeaveData settings.

10.5.5 Notes

It is allowed to have a WeaveOff instruction without a corresponding WeaveOn instruction, in which case no action will be performed.

10.5.6 Usage Example



No.	Program	Comment
1	Start;	Start
2	Movl P[1],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[1].
3	Movl P[2],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the arc start point P[2].
4	WeldOn ArcData[1], AC[120],AV[0],WS[8];	Start arc

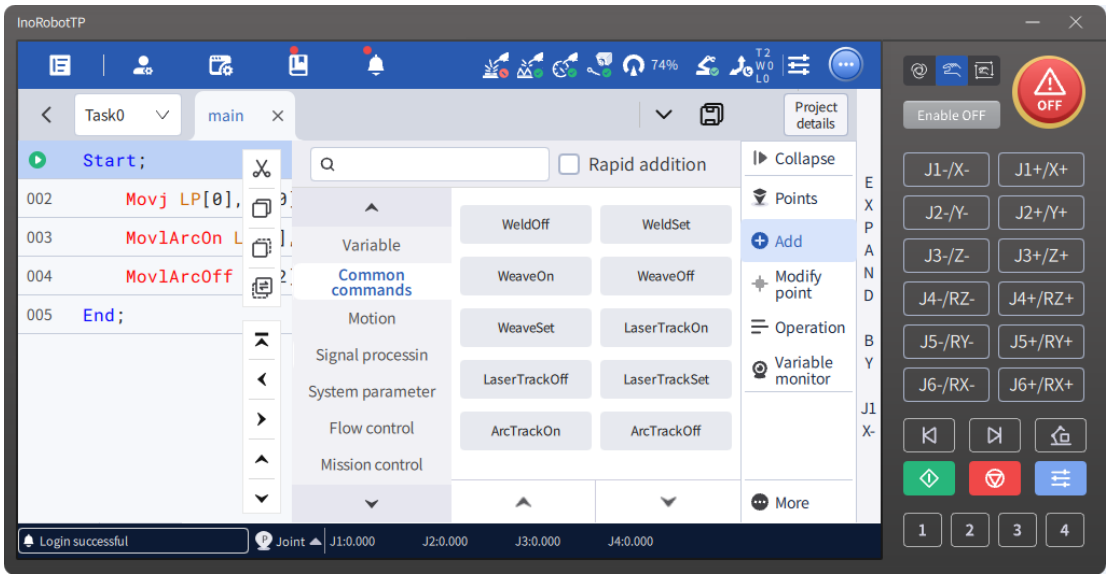
No.	Program	Comment
5	WeaveOn WeaveData[0];	Start weaving.
6	Movl P[3],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the first welding point P[3].
7	WeaveSet WeaveData[2];	Change the weaving parameters. The changes take effect when moving to the next point.
8	Movl P[4],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the arc-off point P[4].
9	WeldOff ArcData[1];	Extinguish arc.
10	WeaveOff;	End weaving.
11	Movl P[5],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[5].
12	End;	End

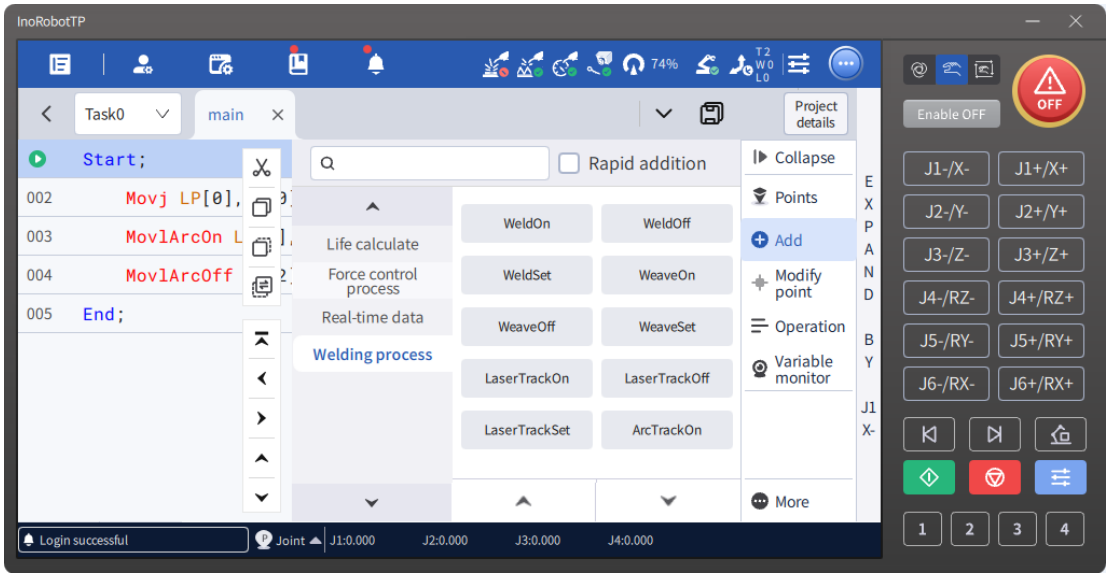
10.6 WeaveSet

10.6.1 Description

This is a new version weaving parameter change instruction. After this instruction is executed, the changed weaving parameters will take effect in the next motion instruction.

After the plugin is installed, the instruction can be added on the "Program" > "Add" > "Common commands" page, or on the "Program" > "Add" > "Welding process" page.





10.6.2 Format

Format 1: with weaving parameter number
WeaveSet WeaveData[1];

Format 2: with weaving parameter number, and specified pattern, frequency, amplitude, left and right dwell time. Except for the condition number, all other parameters are optional. When optional parameters are included, they take precedence over those in WeaveData.
WeaveSet WeaveData[1], Shape[0], Freq[2], RAmp[5], LAmp[5], RT[1], LT[1];

CAUTION

- WeaveData is a required parameter, with an index range of 0 to 63.
- When optional parameters are included, they take precedence over those in WeaveData.

10.6.3 Parameter Description

- WeaveData: required parameter, type: integer, range: 0 to 63. This parameter specifies the weaving variable. For a welding instruction that includes this parameter, if the weaving enable state is active, weaving is performed according to the parameters in the specified weaving variable. For details, see the 9.1 Weaving section.
- Shape: optional parameter, type: integer, range: 0 to 5, representing the weaving pattern:
  - 0: None
  - 1: Zigzag
  - 2: Circular
  - 3: Figure 8
  - 4: Pos crescent
  - 5: Neg crescent

- Freq: optional parameter, type: floating point, representing weaving frequency, range: 0.0 to 100.0, unit: Hz.
- RAmp: optional parameter, type: floating point, representing the right amplitude of weaving, range: 0.0 to 100.0, unit: mm.
- LAmp: optional parameter, type: floating point, representing the left amplitude of weaving, range: 0.0 to 100.0, unit: mm.
- RT: optional parameter, type: integer, representing the right dwell time, range: 0 to 10000, unit: ms.
- LT: optional parameter, type: integer, representing the left dwell time, range: 0 to 10000, unit: ms.

10.6.4 Scope

Multitasking: Only effective in the main tasks. It can exist in a function and can only be called by the main task.

Mode:

In Manual mode:

- When running the program step by step using the single-step button, if the weaving enable switch is in the "Weave enable" state, weave motion is performed without welding.
- When the weaving enable switch is in the "Weave disable" state, running the instruction via the start button results in no weaving. When the weaving enable switch is in the "Weave enable" state, running the instruction via the start button performs weaving according to the WeaveData settings.

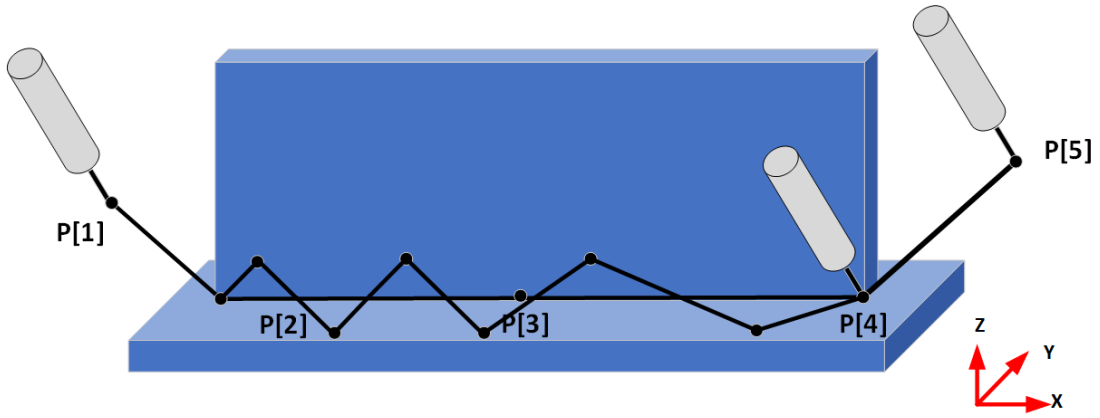
In Auto mode:

- When the weaving enable switch is in the "Weave disable" state, running the instruction via the start button results in no weaving. When the weaving enable switch is in the "Weave enable" state, running the instruction via the start button performs weaving according to the WeaveData settings.

10.6.5 Notes

It is allowed to have a WeaveSet instruction without WeaveOn and WeaveOff instruction, in which case no action will be performed.

10.6.6 Usage Example



No.	Program	Comment
1	Start;	Start
2	Movl P[1],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[1].
3	Movl P[2],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the arc start point P[2].
4	WeldOn ArcData[1], AC[120],AV[0],WS[8];	Start arc
5	WeaveOn WeaveData[0];	Start weaving.
6	Movl P[3],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the first welding point P[3].
7	WeaveSet WeaveData[2];	Change the weaving parameters. The changes take effect when moving to the next point.
8	Movl P[4],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the arc-off point P[4].
9	WeldOff ArcData[1];	Extinguish arc.
10	WeaveOff;	End weaving.
11	Movl P[5],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[5].
12	End;	End

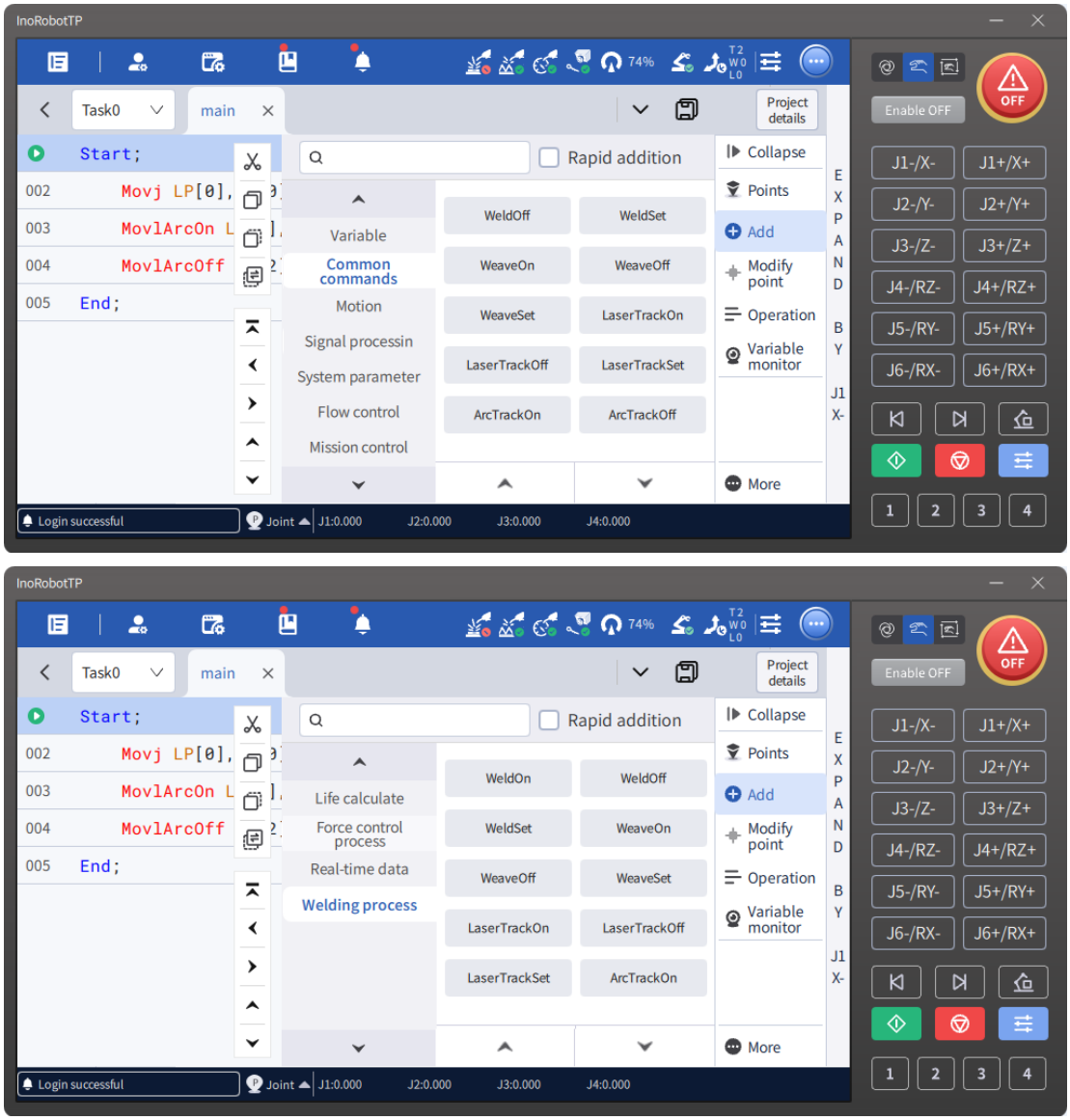
10.7 LaserTrackOn

10.7.1 Description

This is a new version laser tracking start instruction. After this instruction is executed, the robot first recognizes the weld seam in place and stores the recognized point in PR. If recognition fails, an alarm will be triggered.

The target point of the previous motion instruction is the laser tracking start point. At this point, the laser line must be on the arc start point.

After the plugin is installed, the instruction can be added on the "Program" > "Add" > "Common commands" page, or on the "Program" > "Add" > "Welding process" page.



10.7.2 Format

Format 1: with laser tracking parameter number and PR parameter

LaserTrackOn LaserTrackData[1], PR[0];

Format 2: with laser tracking parameter number, PR parameter, and specified sensor task number, search failure alarm parameter. Except for the condition number, all other parameters are optional. When optional parameters are included, they take precedence over those in LaserTrackData.

LaserTrackOn LaserTrackData[1], PR[0], LaserJob[2], LaserAlarm[0];

CAUTION

- LaserTrackData is a required parameter, with an index range of 0 to 63.
- When optional parameters are included, they take precedence over those in LaserTrackData.

10.7.3 Parameter Description

- LaserTrackData: required parameter, type: integer, range: 0 to 63. This parameter specifies the laser tracking parameters. If the tracking enable state is active, tracking is performed according to the parameters in the specified laser tracking parameters. For details, see the 9.3.3 Laser Tracking section.
- PR/LPR: required parameters, choose either PR or LPR. PR: system offset variable, type: integer, range: 0 to 255. LPR: local offset variable, type: integer, range: 0 to 255. Used to store the weld seam recognized during LaserTrackOn.
- LaserJob: optional parameter, laser process number, type: integer, range: 0 to 255.
- LaserAlarm: optional parameter. Determines whether to trigger an alarm when the laser sensor fails to recognize the weld seam.
  - 0: After the weld seam cannot be recognized, an alarm is triggered after completing the already recognized part of the motion.
  - 1: Continue running without alarming when the weld seam cannot be recognized. When this parameter is setting to "1: Continue", if the weld seam cannot be recognized, the robot first completes the already recognized part of the motion, then skip all subsequent motion instructions until reaching the LaserTrackOff instruction, and continues with the subsequent instructions.

10.7.4 Scope

Multitasking: Only effective in the main tasks. It can exist in a function and can only be called by the main task.

Mode:

In Manual mode:

- When running the program step by step using the single-step button, no tracking is performed, regardless of the state of the tracking enable switch. However, during LaserTrackOn, weld seam recognition will still be performed, and an alarm will be triggered if it fails.
- When the tracking enable switch is in the "Tracking disable" state, running the instruction via the start button results in no tracking. When the tracking enable switch is in the "Tracking enable" state, running the instruction via the start button performs tracking according to the LaserTrackData settings.

In Auto mode:

- When the tracking enable switch is in the "Tracking disable" state, running the instruction via the start button results in no tracking. When the tracking enable switch is in the "Tracking enable" state, running the instruction via the start button performs tracking according to the LaserTrackData settings.

10.7.5 Notes

- Laser tracking supports scrape start, and the scrape direction follows the direction of the teaching point.
- Laser tracking supports restart but not moving back. When the move back distance is set to a value greater than 0, the robot still does not move back, no alarm is triggered, and a related message appears in the message bar.
- When the ON instruction is executed, the following checks are performed:
  - No function calls are allowed between the ON and OFF instructions. Otherwise, an alarm will be triggered.

◦ The ON instruction must have a corresponding OFF instruction. Otherwise, an alarm will be triggered during runtime.

Scenario			Tracking or not	Restart supported or not
LaserTrackOn instruction executed, welding in progress, then paused.	Restart with no line number change		Yes	Yes
	Restart with line number change	Line number changed to that of a motion instruction between LaserTrackOn and LaserTrackOff	No	No
		Line number changed to that of a motion instruction outside LaserTrackOn and LaserTrackOff	No	No
LaserTrackOn not executed; directly jump to a motion instruction between LaserTrackOn and LaserTrackOff.			No	No

10.7.6 Usage Example

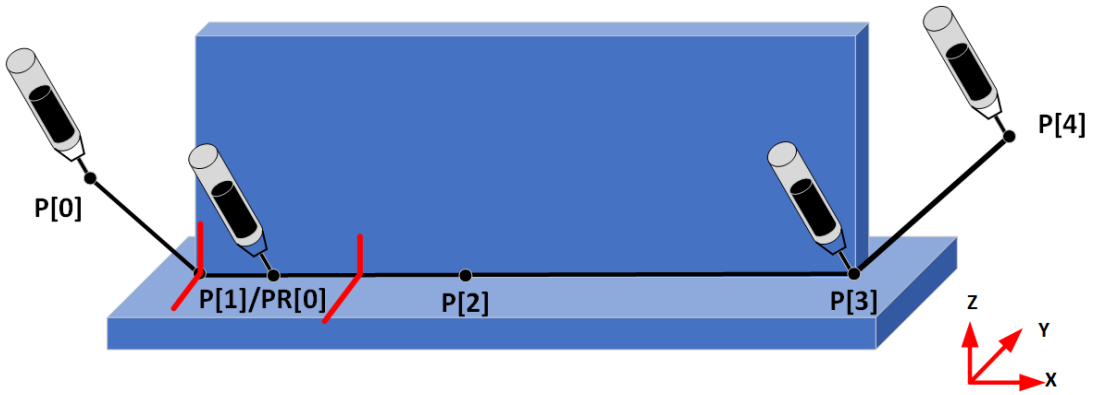


Table10-7-6-1 Scenario without search

No.	Program	Comment
1	Start;	Start
2	Movl P[0],V[5],Z[0],Tool[10],Wobj[10];	Move to the tracking start point P[0], with the laser line on the arc start point.
3	LaserTrackOn LaserTrackData[1],PR[0],LaserJob[1];	Start tracking, and store the first recognized point to PR[0].
4	Movl ReplacePos(P[1],PR[0]),V[1],Z[0],Tool[10],Wobj[10];	Move to the arc start point, with orientation determined by P[1], position by PR[0], and speed by V, keeping the speed below 30 mm/s.
5	WeldOn ArcData[1],AC[120],AV[0],WS[8];	Start arc

No.	Program	Comment
6	Movl P[2],V[5],Z[0],Tool[10],Wobj[10];	Track to the first welding point P[2].
7	LaserTrackSet LaserTrackData[2];	Change the tracking parameters. The changes take effect when moving to the next point.
8	Movl P[3],V[5],Z[0],Tool[10],Wobj[10];	Track to the arc-off point P[3].
9	WeldOff ArcData[1];	Extinguish arc.
10	LaserTrackOff;	End tracking.
11	Movl P[4],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[4].
12	End;	End

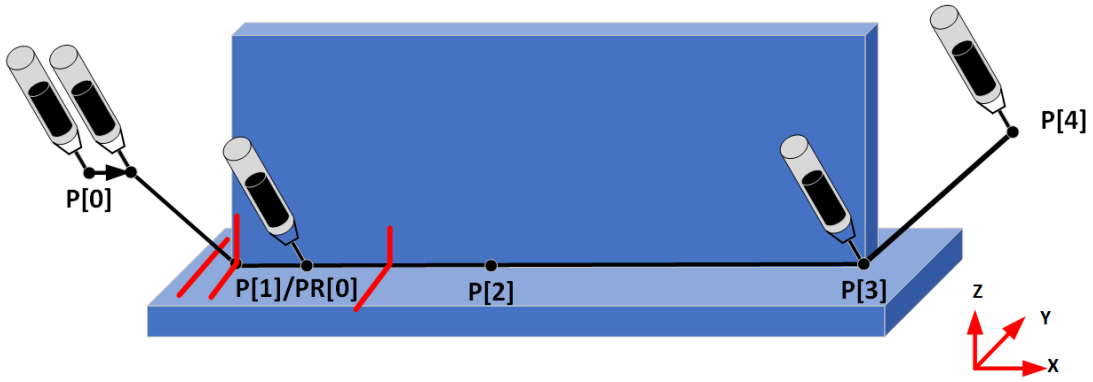


Table10-7-6-2 Scenario with search

No.	Program	Comment
1	Start;	Start
2	SearchL P[0],Dir[X],V[5],Z[0],LaserData[0],LaserJob[1],Tool[10], Wobj[10];	Move to the search start point P[0], then search along the X direction of Wobj[10] until the weld seam is found, and then stop.
3	LaserTrackOn LaserTrackData[1],PR[0], LaserJob[1];	Start tracking, and store the first recognized point to PR[0].
4	Movl ReplacePos(P[1],PR[0]),V[1],Z[0],Tool[10],Wobj[10];	Move to the arc start point, with orientation determined by P[1], position by PR[0], and speed by V, keeping the speed below 30 mm/s.
5	WeldOn ArcData[1], AC[120],AV[0],WS[8];	Start arc
6	Movl P[2],V[5],Z[0],Tool[10],Wobj[10];	Track to the first welding point P[2].
7	LaserTrackSet LaserTrackData[2];	Change the tracking parameters. The changes take effect when moving to the next point.
8	Movl P[3],V[5],Z[0],Tool[10],Wobj[10];	Track to the arc-off point P[3].
9	WeldOff ArcData[1];	Extinguish arc.

No.	Program	Comment
10	LaserTrackOff;	End tracking.
11	Movl P[4],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[4].
12	End;	End

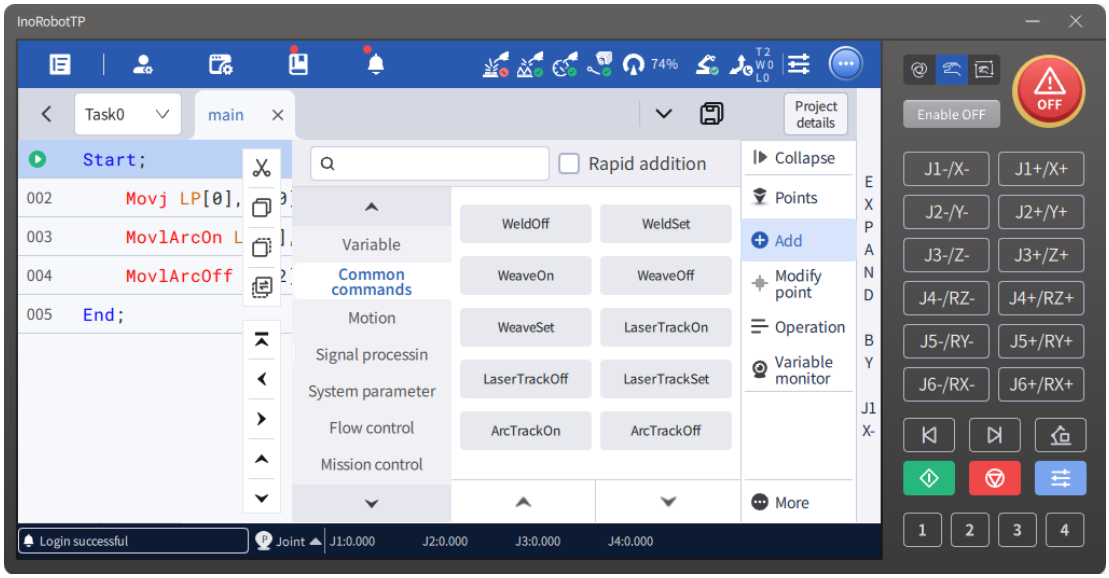
10.8 LaserTrackOff

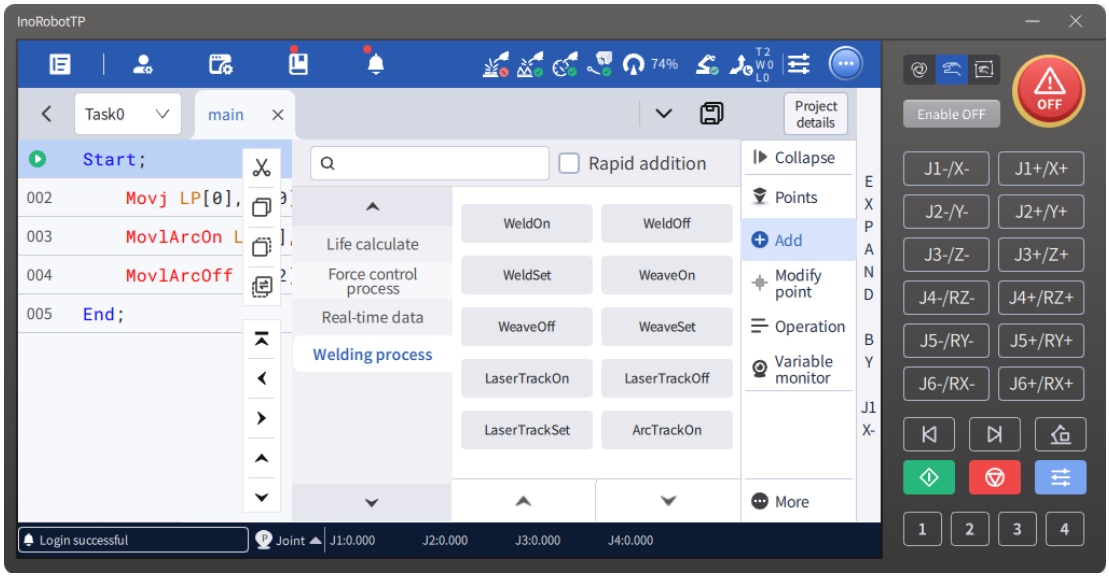
10.8.1 Description

This is a new version laser tracking end instruction. After this instruction is executed, the robot stops the tracking motion.

The target point of the previous motion instruction is the laser tracking end point.

After the plugin is installed, the instruction can be added on the "Program" > "Add" > "Common commands" page, or on the "Program" > "Add" > "Welding process" page.





10.8.2 Format

LaserTrackOff;

10.8.3 Parameter Description

LaserTrackOff has no parameters.

10.8.4 Scope

Multitasking: Only effective in the main tasks. It can exist in a function and can only be called by the main task.

Mode:

In Manual mode:

- When running the program step by step using the single-step button, no tracking is performed, regardless of the state of the tracking enable switch. However, during LaserTrackOn, weld seam recognition will still be performed, and an alarm will be triggered if it fails.
- When the tracking enable switch is in the "Tracking disable" state, running the instruction via the start button results in no tracking. When the tracking enable switch is in the "Tracking enable" state, running the instruction via the start button performs tracking according to the LaserTrackData settings.

In Auto mode:

- When the tracking enable switch is in the "Tracking disable" state, running the instruction via the start button results in no tracking. When the tracking enable switch is in the "Tracking enable" state, running the instruction via the start button performs tracking according to the LaserTrackData settings.

10.8.5 Notes

It is allowed to have a LaserTrackOff instruction without a corresponding LaserTrackOn instruction, in which case no action will be performed.

10.8.6 Usage Example

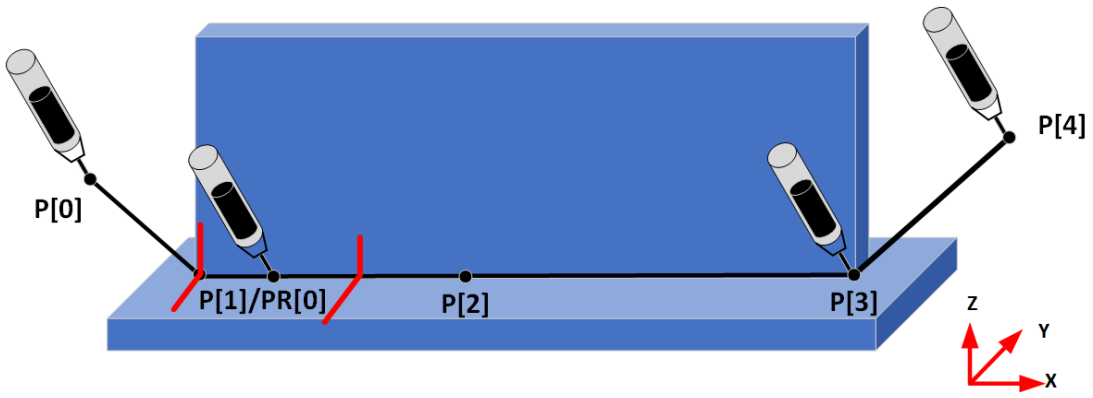


Table10-8-6-1 Scenario without search

No.	Program	Comment
1	Start;	Start

No.	Program	Comment
2	Movl P[0],V[5],Z[0],Tool[10],Wobj[10];	Move to the tracking start point P[0], with the laser line on the arc start point.
3	LaserTrackOn LaserTrackData[1],PR[0], LaserJob[1];	Start tracking, and store the first recognized point to PR[0].
4	Movl ReplacePos(P[1],PR[0]),V[1],Z[0],Tool[10],Wobj[10];	Move to the arc start point, with orientation determined by P[1], position by PR[0], and speed by V, keeping the speed below 30 mm/s.
5	WeldOn ArcData[1], AC[120],AV[0],WS[8];	Start arc
6	Movl P[2],V[5],Z[0],Tool[10],Wobj[10];	Track to the first welding point P[2].
7	LaserTrackSet LaserTrackData[2];	Change the tracking parameters. The changes take effect when moving to the next point.
8	Movl P[3],V[5],Z[0],Tool[10],Wobj[10];	Track to the arc-off point P[3].
9	WeldOff ArcData[1];	Extinguish arc.
10	LaserTrackOff;	End tracking.
11	Movl P[4],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[4].
12	End;	End

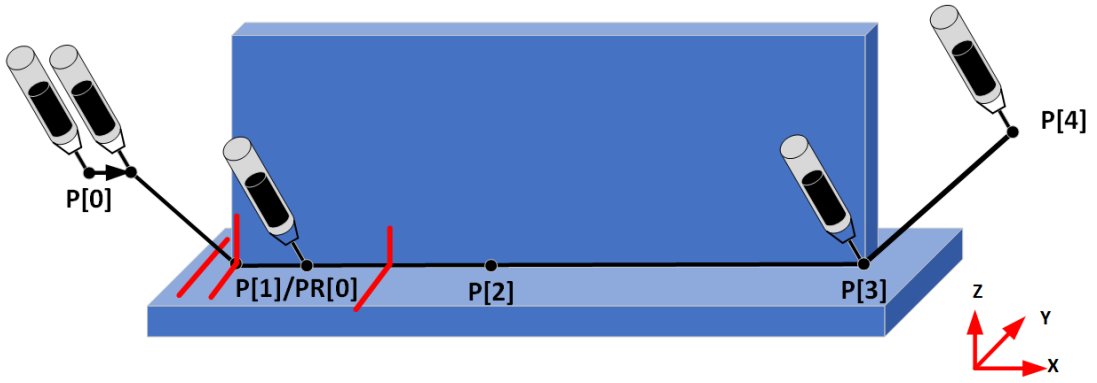


Table10-8-6-2 Scenario with search

No.	Program	Comment
1	Start;	Start
2	SearchL P[0],Dir[X],V[5],Z[0],LaserData[0],LaserJob[1],Tool[10], Wobj[10];	Move to the search start point P[0], then search along the X direction of Wobj[10] until the weld seam is found, and then stop.
3	LaserTrackOn LaserTrackData[1],PR[0], LaserJob[1];	Start tracking, and store the first recognized point to PR[0].
4	Movl ReplacePos(P[1],PR[0]),V[1],Z[0],Tool[10],Wobj[10];	Move to the arc start point, with orientation determined by P[1], position by PR[0], and speed by V, keeping the speed below 30 mm/s.

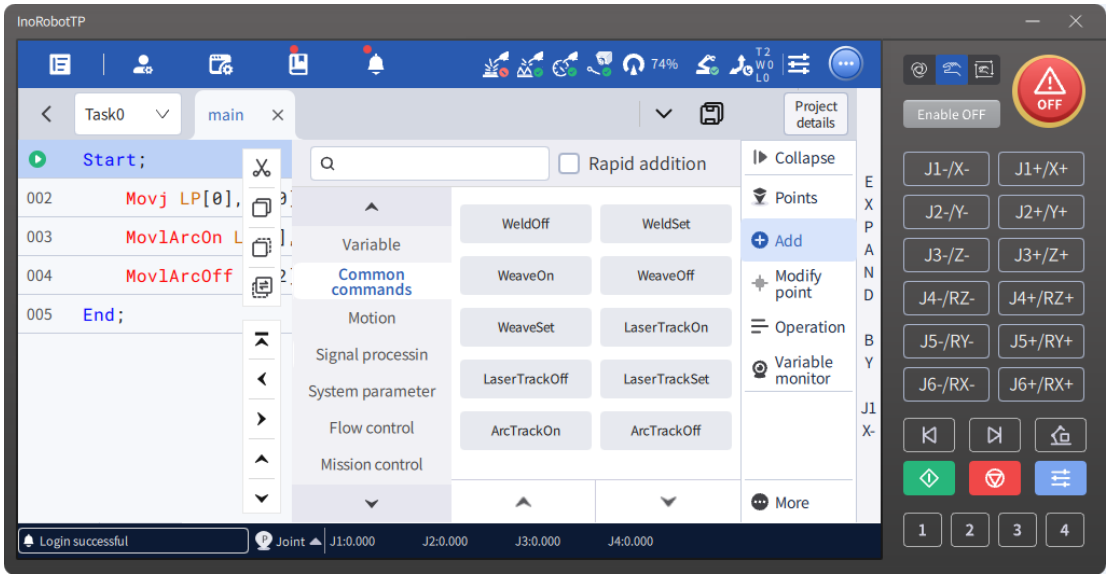
No.	Program	Comment
5	WeldOn ArcData[1], AC[120],AV[0],WS[8];	Start arc
6	Movl P[2],V[5],Z[0],Tool[10],Wobj[10];	Track to the first welding point P[2].
7	LaserTrackSet LaserTrackData[2];	Change the tracking parameters. The changes take effect when moving to the next point.
8	Movl P[3],V[5],Z[0],Tool[10],Wobj[10];	Track to the arc-off point P[3].
9	WeldOff ArcData[1];	Extinguish arc.
10	LaserTrackOff;	End tracking.
11	Movl P[4],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[4].
12	End;	End

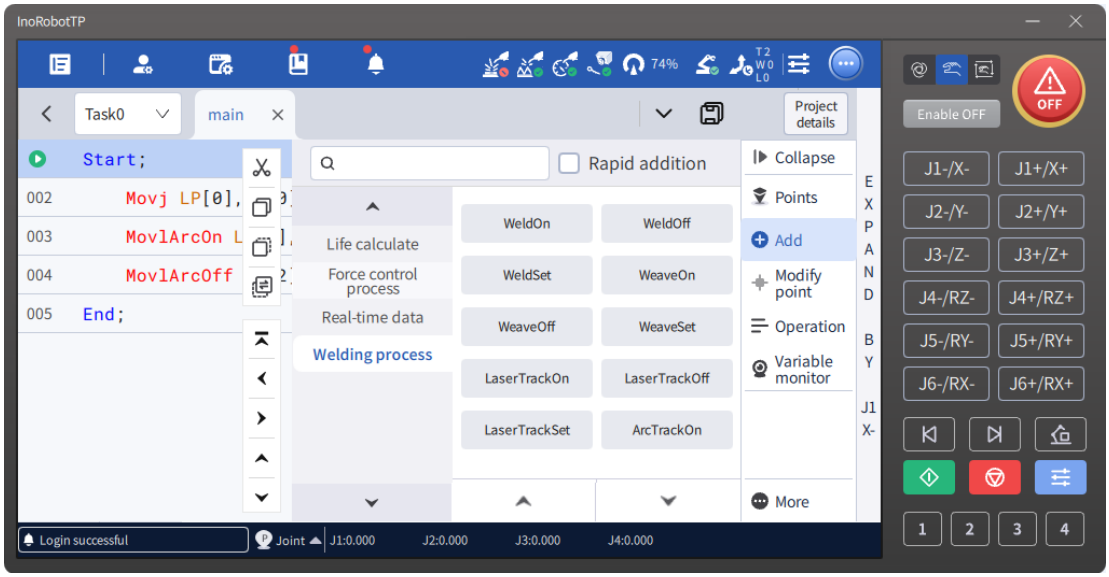
10.9 LaserTrackSet

10.9.1 Description

This is a new version laser tracking parameter change instruction. After this instruction is executed, the changed laser tracking parameters will take effect in the next motion instruction.

After the plugin is installed, the instruction can be added on the "Program" > "Add" > "Common commands" page, or on the "Program" > "Add" > "Welding process" page.





10.9.2 Format

Format 1: with laser tracking parameter number and PR parameter

LaserTrackSet LaserTrackData[1];

Format 2: with laser tracking parameter number, PR parameter, and specified sensor task number, search failure alarm parameter. Except for the condition number, all other parameters are optional. When optional parameters are included, they take precedence over those in LaserTrackData.

LaserTrackSet LaserTrackData[1], LaserJob[2], LaserAlarm[0];

CAUTION

- LaserTrackData is a required parameter, with an index range of 0 to 63.
- When optional parameters are included, they take precedence over those in LaserTrackData.

10.9.3 Parameter Description

- LaserTrackData: required parameter, type: integer, range: 0 to 63. This parameter specifies the laser tracking parameters. If the tracking enable state is active, tracking is performed according to the parameters in the specified laser tracking parameters. For details, see the 9.3.3 Laser Tracking section.
- LaserJob: optional parameter, laser process number, type: integer, range: 0 to 255.
- LaserAlarm: optional parameter. Determines whether to trigger an alarm when the laser sensor fails to recognize the weld seam.
  - 0: After the weld seam cannot be recognized, an alarm is triggered after completing the already recognized part of the motion.
  - 1: Continue running without alarming when the weld seam cannot be recognized. When this parameter is setting to "1: Continue", if the weld seam cannot be recognized, the robot first completes

the already recognized part of the motion, then skip all subsequent motion instructions until reaching the LaserTrackOff instruction, and continues with the subsequent instructions.

10.9.4 Scope

Multitasking: Only effective in the main tasks. It can exist in a function and can only be called by the main task.

Mode:

In Manual mode:

- When running the program step by step using the single-step button, no tracking is performed, regardless of the state of the tracking enable switch. However, during LaserTrackOn, weld seam recognition will still be performed, and an alarm will be triggered if it fails.
- When the tracking enable switch is in the "Tracking disable" state, running the instruction via the start button results in no tracking. When the tracking enable switch is in the "Tracking enable" state, running the instruction via the start button performs tracking according to the LaserTrackData settings.

In Auto mode:

- When the tracking enable switch is in the "Tracking disable" state, running the instruction via the start button results in no tracking. When the tracking enable switch is in the "Tracking enable" state, running the instruction via the start button performs tracking according to the LaserTrackData settings.

10.9.5 Notes

It is allowed to have a LaserTrackSet instruction without LaserTrackOn and LaserTrackOff instructions, in which case no action will be performed.

10.9.6 Usage Example

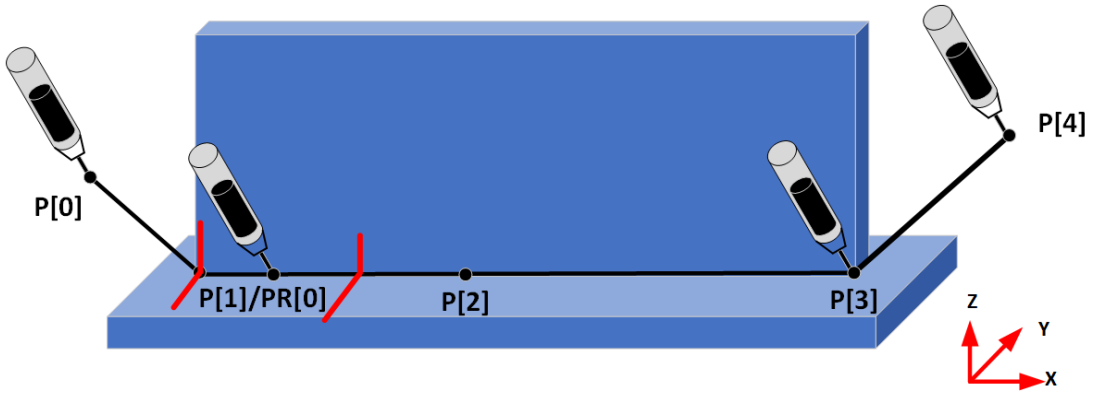


Table10-9-6-1 Scenario without search

No.	Program	Comment
1	Start;	Start
2	Movl P[0],V[5],Z[0],Tool[10],Wobj[10];	Move to the tracking start point P[0], with the laser line on the arc start point.
3	LaserTrackOn LaserTrackData[1],PR[0], LaserJob[1];	Start tracking, and store the first recognized point to PR[0].

No.	Program	Comment
4	Movl ReplacePos(P[1],PR[0]),V[1],Z[0],Tool[10],Wobj[10];	Move to the arc start point, with orientation determined by P[1], position by PR[0], and speed by V, keeping the speed below 30 mm/s.
5	WeldOn ArcData[1], AC[120],AV[0],WS[8];	Start arc
6	Movl P[2],V[5],Z[0],Tool[10],Wobj[10];	Track to the first welding point P[2].
7	LaserTrackSet LaserTrackData[2];	Change the tracking parameters. The changes take effect when moving to the next point.
8	Movl P[3],V[5],Z[0],Tool[10],Wobj[10];	Track to the arc-off point P[3].
9	WeldOff ArcData[1];	Extinguish arc.
10	LaserTrackOff;	End tracking.
11	Movl P[4],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[4].
12	End;	End

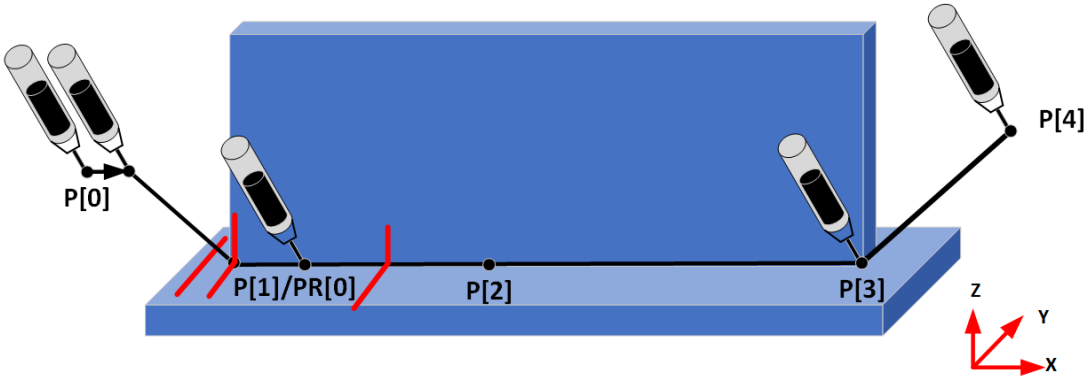


Table10-9-6-2 Scenario with search

No.	Program	Comment
1	Start;	Start
2	SearchL P[0],Dir[X],V[5],Z[0],LaserData[0],LaserJob[1],Tool[10],Wobj[10];	Move to the search start point P[0], then search along the X direction of Wobj[10] until the weld seam is found, and then stop.
3	LaserTrackOn LaserTrackData[1],PR[0],LaserJob[1];	Start tracking, and store the first recognized point to PR[0].
4	Movl ReplacePos(P[1],PR[0]),V[1],Z[0],Tool[10],Wobj[10];	Move to the arc start point, with orientation determined by P[1], position by PR[0], and speed by V, keeping the speed below 30 mm/s.
5	WeldOn ArcData[1], AC[120],AV[0],WS[8];	Start arc
6	Movl P[2],V[5],Z[0],Tool[10],Wobj[10];	Track to the first welding point P[2].

No.	Program	Comment
7	LaserTrackSet LaserTrackData[2];	Change the tracking parameters. The changes take effect when moving to the next point.
8	Movl P[3],V[5],Z[0],Tool[10],Wobj[10];	Track to the arc-off point P[3].
9	WeldOff ArcData[1];	Extinguish arc.
10	LaserTrackOff;	End tracking.
11	Movl P[4],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[4].
12	End;	End

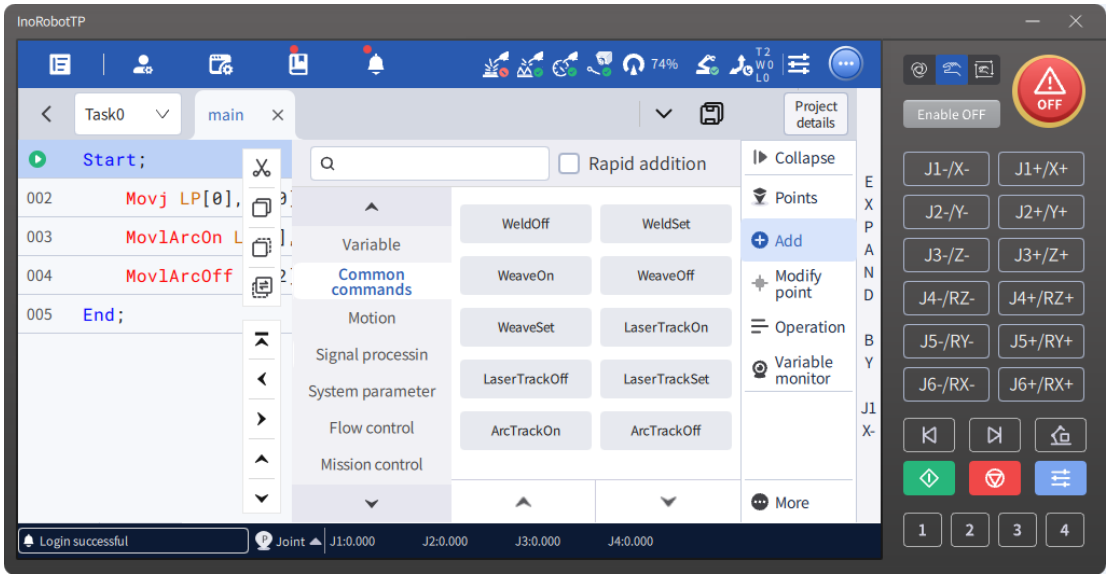
10.10 ArcTrackOn

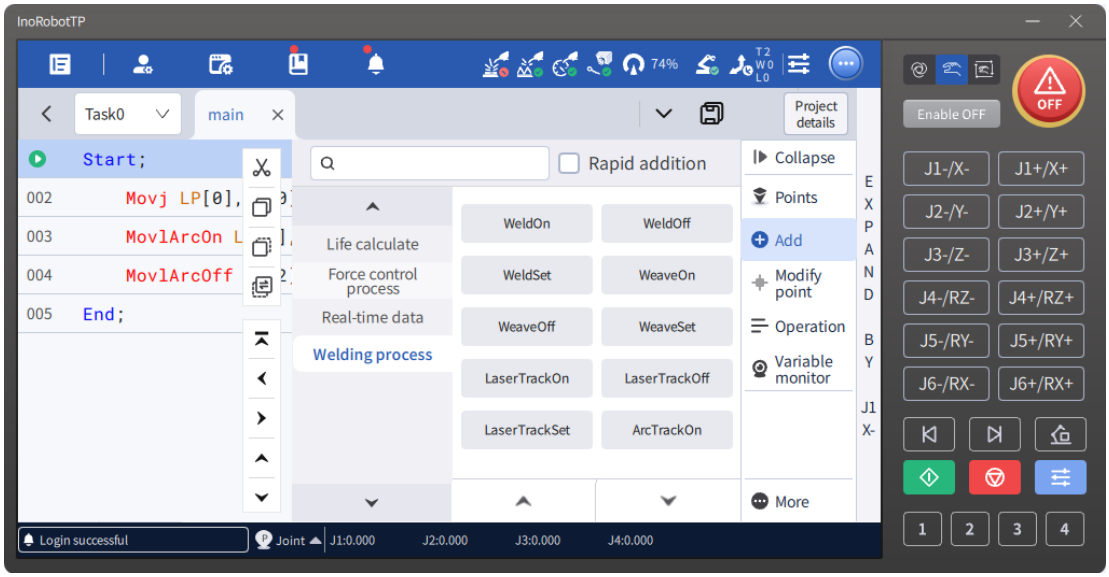
10.10.1 Description

This is a new version arc tracking start instruction. After this instruction is executed, the robot first recognizes the weld seam in place and stores the recognized point in PR. If recognition fails, an alarm will be triggered.

The target point of the previous motion instruction is the arc tracking start point.

After the plugin is installed, the instruction can be added on the "Program" > "Add" > "Common commands" page, or on the "Program" > "Add" > "Welding process" page.





10.10.2 Format

With arc tracking parameter number: ArcTrackOn ArcTrackData[1];

10.10.3 Parameter Description

ArcTrackData: optional parameter, type: integer, range: 0 to 63. If the tracking enable state is active, tracking is performed according to the parameters in the specified arc tracking parameters. For details, see the 9.4 Arc Tracking section.

10.10.4 Scope

Multitasking: Only effective in the main tasks. It can exist in a function and can only be called by the main task.

Mode:

In Manual mode:

- When running the program step by step using the single-step button, no tracking is performed, regardless of the state of the tracking enable switch.
- When the tracking enable switch is in the "Tracking disable" state, running the instruction via the start button results in no tracking. When the tracking enable switch is in the "Tracking enable" state, running the instruction via the start button performs tracking according to the ArcTrackData settings.

In Auto mode:

- When the tracking enable switch is in the "Tracking disable" state, running the instruction via the start button results in no tracking. When the tracking enable switch is in the "Tracking enable" state, running the instruction via the start button performs tracking according to the ArcTrackData settings.

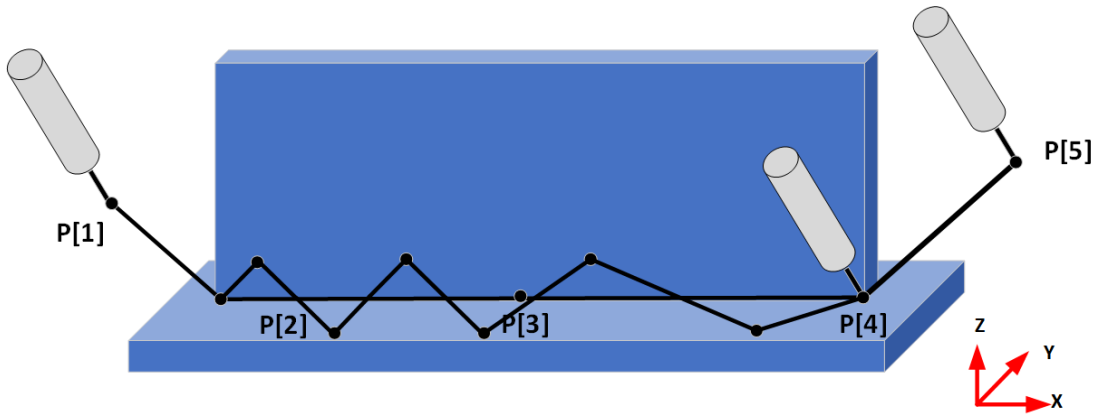
10.10.5 Notes

- First move to the tracking start point, execute ArcTrackOn, and then start tracking during the movement to the next point.

- When the ON instruction is executed, the following checks are performed:
  - No function calls are allowed between the ON and OFF instructions. Otherwise, an alarm will be triggered.
  - The ON instruction must have a corresponding OFF instruction. Otherwise, an alarm will be triggered during runtime.

Scenario			Tracking or not	Restart supported or not
ArcTrackOn instruction executed, welding in progress, then paused.	Restart with no line number change		Yes	Yes
	Restart with line number change	Line number changed to that of a motion instruction between ArcTrackOn and ArcTrackOff	No	No
		Line number changed to that of a motion instruction outside ArcTrackOn and ArcTrackOff	No	No
ArcTrackOn not executed; directly jump to a motion instruction between ArcTrackOn and ArcTrackOff.			No	No

10.10.6 Usage Example



No.	Program	Comment
1	Start;	Start
2	Movl P[1],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[1].
3	Movl P[2],V[5],Fine,Tool[10],Wobj[10];	Move to the arc start point/ tracking start point P[2].
4	WeldOn ArcData[1], AC[120],AV[0],WS[8];	Start arc
5	WeaveOn WeaveData[0];	Start weaving.

No.	Program	Comment
6	ArcTrackOn ArcTrackData[0];	Start tracking.
7	Movl P[3],V[5],Fine,Tool[10],Wobj[10];	Run the robot to the first welding point P[3].
8	WeaveSet WeaveData[2];	Change the weaving parameters. The changes take effect when moving to the next point.
9	ArcTrackSet ArcTrackData[2];	Change the tracking parameters. The changes take effect when moving to the next point.
10	Movl P[4],V[5],Fine,Tool[10],Wobj[10];	Run the robot to the arc-off point P[4].
11	WeldOff ArcData[1];	Extinguish arc.
12	WeaveOff;	End weaving.
13	ArcTrackOff	End tracking.
14	Movl P[5],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[5].
15	End;	End

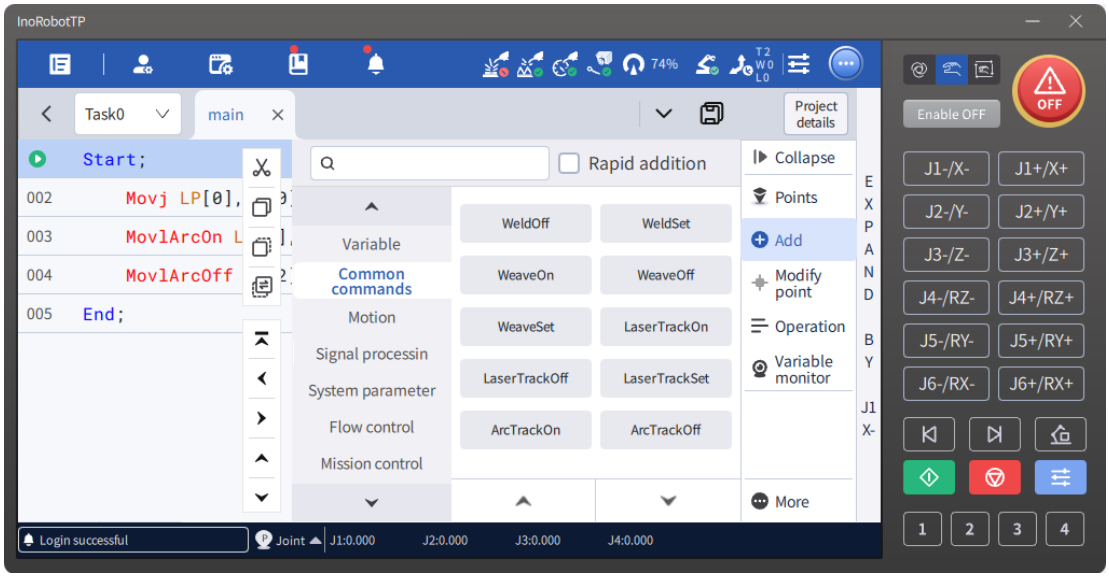
10.11 ArcTrackOff

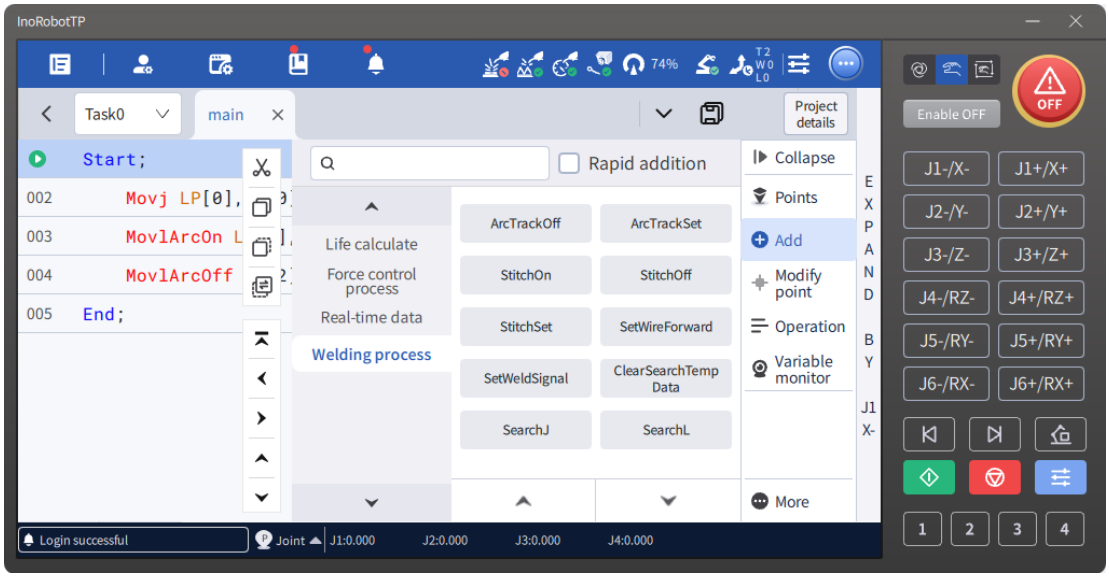
10.11.1 Description

This is a new version arc tracking end instruction. After this instruction is executed, the robot stops the tracking motion.

The target point of the previous motion instruction is the arc tracking end point.

After the plugin is installed, the instruction can be added on the "Program" > "Add" > "Common commands" page, or on the "Program" > "Add" > "Welding process" page.





10.11.2 Format

ArcTrackOff;

10.11.3 Parameter Description

ArcTrackOff has no parameters.

10.11.4 Scope

Multitasking: Only effective in the main tasks. It can exist in a function and can only be called by the main task.

Mode:

In Manual mode:

- When running the program step by step using the single-step button, no tracking is performed, regardless of the state of the tracking enable switch.
- When the tracking enable switch is in the "Tracking disable" state, running the instruction via the start button results in no tracking. When the tracking enable switch is in the "Tracking enable" state, running the instruction via the start button performs tracking according to the ArcTrackData settings.

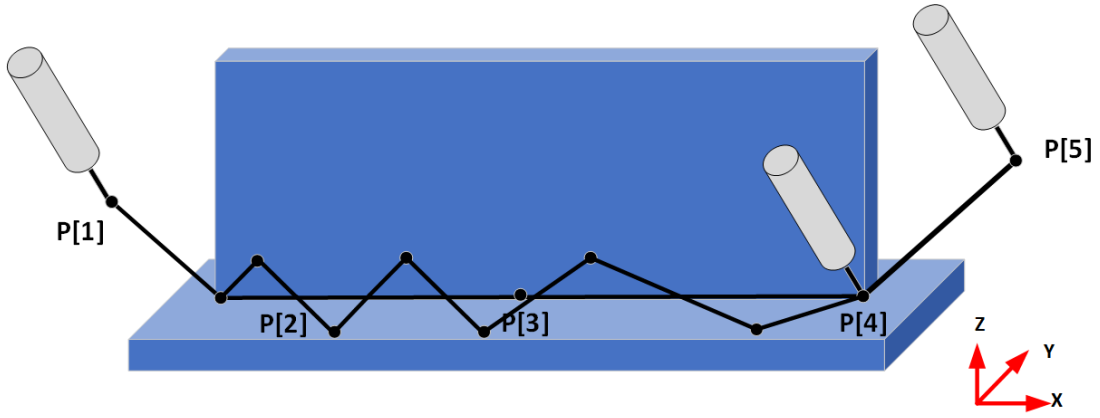
In Auto mode:

- When the tracking enable switch is in the "Tracking disable" state, running the instruction via the start button results in no tracking. When the tracking enable switch is in the "Tracking enable" state, running the instruction via the start button performs tracking according to the ArcTrackData settings.

10.11.5 Notes

It is allowed to have a ArcTrackOff instruction without a corresponding ArcTrackOn instruction, in which case no action will be performed.

10.11.6 Usage Example



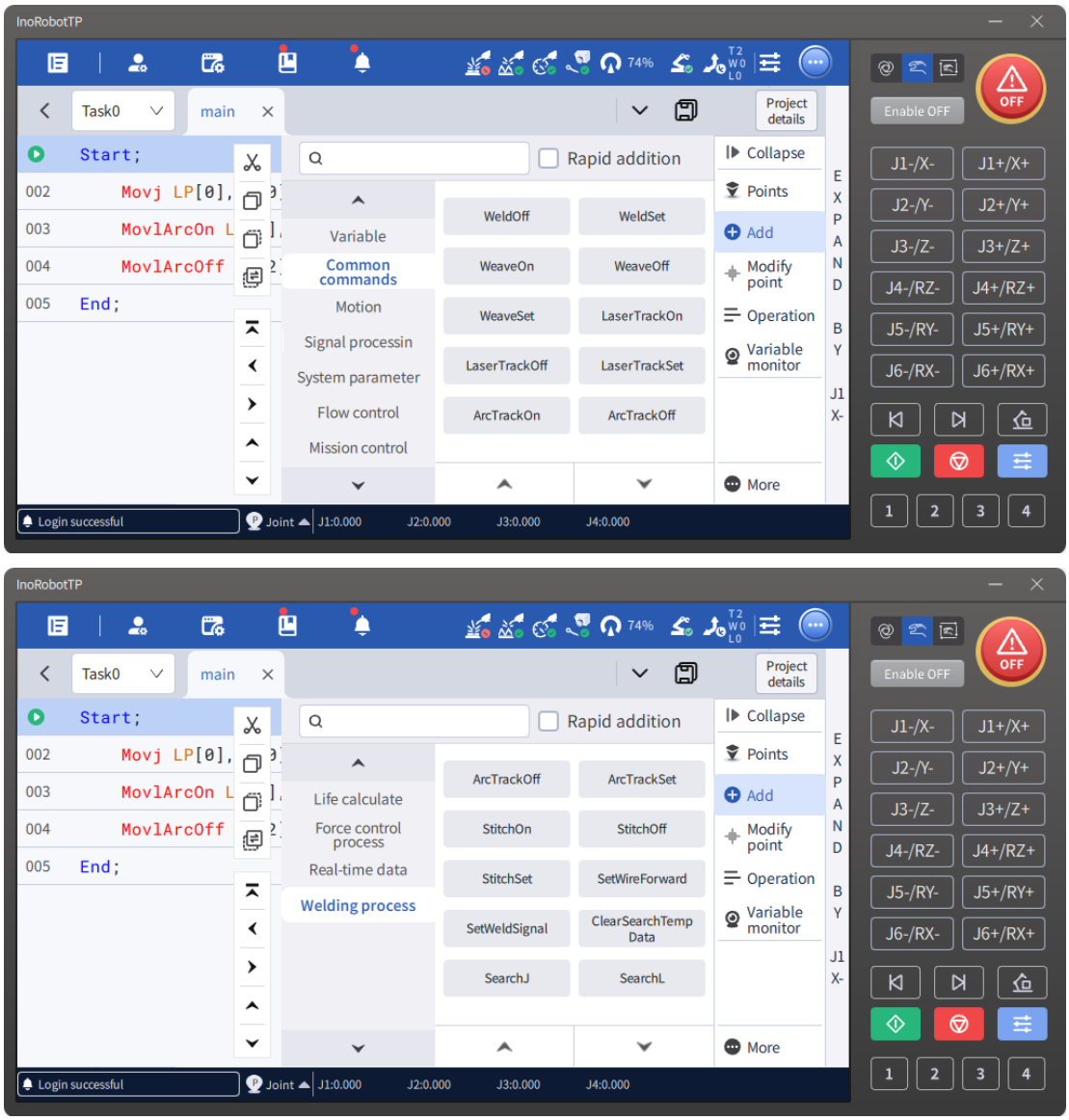
No.	Program	Comment
1	Start;	Start
2	Movl P[1],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[1].
3	Movl P[2],V[5],Fine,Tool[10],Wobj[10];	Move to the arc start point/tracking start point P[2].
4	WeldOn ArcData[1], AC[120],AV[0],WS[8];	Start arc
5	WeaveOn WeaveData[0];	Start weaving.
6	ArcTrackOn ArcTrackData[0];	Start tracking.
7	Movl P[3],V[5],Fine,Tool[10],Wobj[10];	Run the robot to the first welding point P[3].
8	WeaveSet WeaveData[2];	Change the weaving parameters. The changes take effect when moving to the next point.
9	ArcTrackSet ArcTrackData[2];	Change the tracking parameters. The changes take effect when moving to the next point.
10	Movl P[4],V[5],Fine,Tool[10],Wobj[10];	Run the robot to the arc-off point P[4].
11	WeldOff ArcData[1];	Extinguish arc.
12	WeaveOff;	End weaving.
13	ArcTrackOff	End tracking.
14	Movl P[5],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[5].
15	End;	End

10.12 ArcTrackSet

10.12.1 Description

This is a new version arc tracking parameter change instruction. After this instruction is executed, the changed arc tracking parameters will take effect in the next motion instruction.

After the plugin is installed, the instruction can be added on the "Program" > "Add" > "Common commands" page, or on the "Program" > "Add" > "Welding process" page.



10.12.2 Format

With arc tracking parameter number: ArcTrackSet ArcTrackData[1];

10.12.3 Parameter Description

ArcTrackData: optional parameter, type: integer, range: 0 to 63. If the tracking enable state is active, tracking is performed according to the parameters in the specified arc tracking parameters. For details, see the 9.4 Arc Tracking section.

10.12.4 Scope

Multitasking: Only effective in the main tasks. It can exist in a function and can only be called by the main task.

Mode:

In Manual mode:

- When running the program step by step using the single-step button, no tracking is performed, regardless of the state of the tracking enable switch.
- When the tracking enable switch is in the "Tracking disable" state, running the instruction via the start button results in no tracking. When the tracking enable switch is in the "Tracking enable" state, running the instruction via the start button performs tracking according to the ArcTrackData settings.

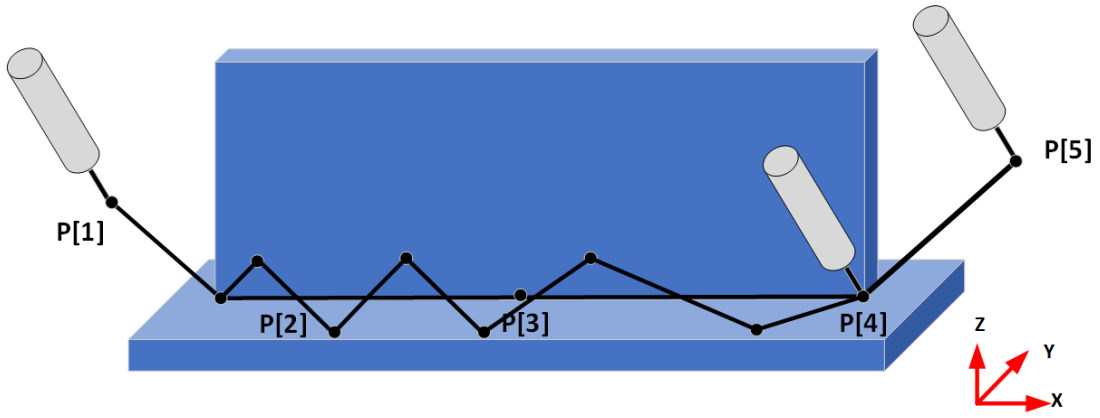
In Auto mode:

- When the tracking enable switch is in the "Tracking disable" state, running the instruction via the start button results in no tracking. When the tracking enable switch is in the "Tracking enable" state, running the instruction via the start button performs tracking according to the ArcTrackData settings.

10.12.5 Notes

It is allowed to have a ArcTrackSet instruction without ArcTrackOn and ArcTrackOff instructions, in which case no action will be performed.

10.12.6 Usage Example



No.	Program	Comment
1	Start;	Start
2	Movl P[1],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[1].
3	Movl P[2],V[5],Fine,Tool[10],Wobj[10];	Move to the arc start point/tracking start point P[2].
4	WeldOn ArcData[1], AC[120],AV[0],WS[8];	Start arc
5	WeaveOn WeaveData[0];	Start weaving.
6	ArcTrackOn ArcTrackData[0];	Start tracking.
7	Movl P[3],V[5],Fine,Tool[10],Wobj[10];	Run the robot to the first welding point P[3].
8	WeaveSet WeaveData[2];	Change the weaving parameters. The changes take effect when moving to the next point.

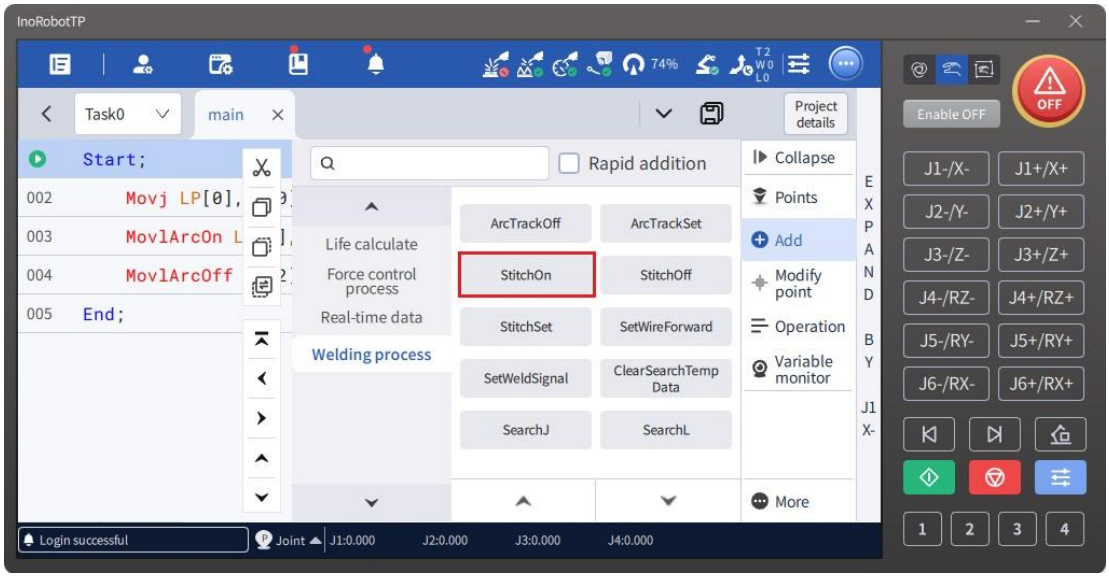
No.	Program	Comment
9	ArcTrackSet ArcTrackData[2];	Change the tracking parameters. The changes take effect when moving to the next point.
10	Movl P[4],V[5],Fine,Tool[10],Wobj[10];	Run the robot to the arc-off point P[4].
11	WeldOff ArcData[1];	Extinguish arc.
12	WeaveOff;	End weaving.
13	ArcTrackOff;	End tracking.
14	Movl P[5],V[5],Z[0],Tool[10],Wobj[10];	Run the robot to the safety point P[5].
15	End;	End

10.13 StitchOn

10.13.1 Description

This instruction starts stitch welding. After this instruction is executed, subsequent welding motion instructions will perform stitch welding. Stitch welding instruction currently supports both linear and circular arc welding.

After the plugin is installed, the StitchOn instruction can be added on the "Program" > "Add" > "Welding process" page.



10.13.2 Format

StitchOn StitchData[0];

> **CAUTION**
>
> StitchData is a required parameter, with an index range of 0 to 63.

10.13.3 Parameter Description

StitchData: required parameter, type: integer, range: 0 to 63. This parameter specifies the stitch welding parameter. For details, see the 9.6 Stitch Welding section.

10.13.4 Scope

Multitasking: Only effective in the main tasks. It can exist in a function and can only be called by the main task.

Mode:

- In Manual mode:
  - When running the program step by step using the single-step button, the robot moves according to the stitch welding parameters, but welding is not performed., regardless of the state of the welding enable switch.
  - When running the program step by step using the single-step button, for circular motion, the robot does not stop at the intermediate point of the arc; instead, it completes the entire arc.
- In Auto mode:
  - When the welding enable switch is in the "Weld disable" state, running the instruction via the start button results in no welding, but performs stitch welding motion according to the StitchData setting. When the welding enable switch is in the "Weld enable" state, running the instruction via the start button performs welding according to the parameters (ArcData, WS, AC, AV) set in WeldOn or WeldSet.

10.13.5 Notes

- The stitch welding instruction only takes effect on the welding segments enclosed by the WeldOn and WeldOff instructions.

```
001 Start;
002     Movj P[0],V[30],Z[0],Tool[0];
003     StitchOn StitchData[0];
004     WeldOn ArcData[0];
005     WeaveOn WeaveData[0];
006     Movl P[1],V[30],Z[0],Tool[0];
007     WeldOff ArcData[0];
008     StitchOff;
009     WeaveOff;
010 End;
```

CAUTION

StitchOn can be placed either before or after WeldOn, with no strict order required.

- The welding segment where the stitch welding instruction is active does not support the simultaneous use of the weaving instructions WeaveOn and WeaveOff. Using them as shown in Figure 1 will trigger an alarm. The correct usage method is to perform weaving after finishing stitch welding, as shown in Figure 2.

```
001 Start;
002     Movj P[0],V[30],Z[0],Tool[0];
003     StitchOn StitchData[0];
004     WeldOn ArcData[0];
005     WeaveOn WeaveData[0];
006     Movl P[1],V[30],Z[0],Tool[0];
007     WeldOff ArcData[0];
008     StitchOff;
009     WeaveOff;
010 End;
```

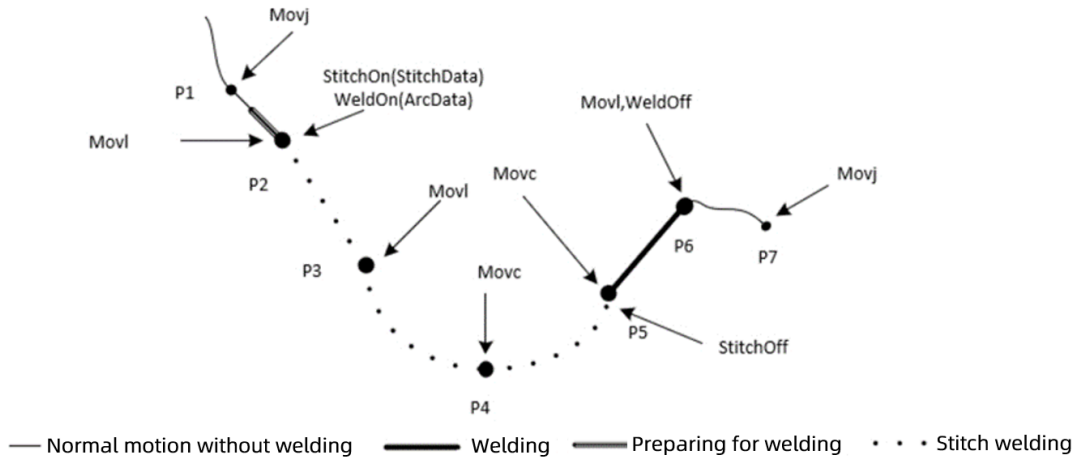
Figure 1

```
001 Start;
002     Movj P[0],V[30],Z[0],Tool[0];
003     StitchOn StitchData[0];
004     WeldOn ArcData[0];
005     Movl P[1],V[30],Z[0],Tool[0];
006     StitchOff;
007     Movl P[3],V[30],Z[0],Tool[0];
008     WeaveOn WeaveData[0];
009     Movl P[2],V[30],Z[0],Tool[0];
010     WeaveOff;
```

Figure 2

- A typical Japanese stitch welding instruction supports program line-specific start. Regardless of the robot's current position, once the start line is set to "StitchOn", the robot will begin stitch welding motion from its current point.

10.13.6 Usage Example



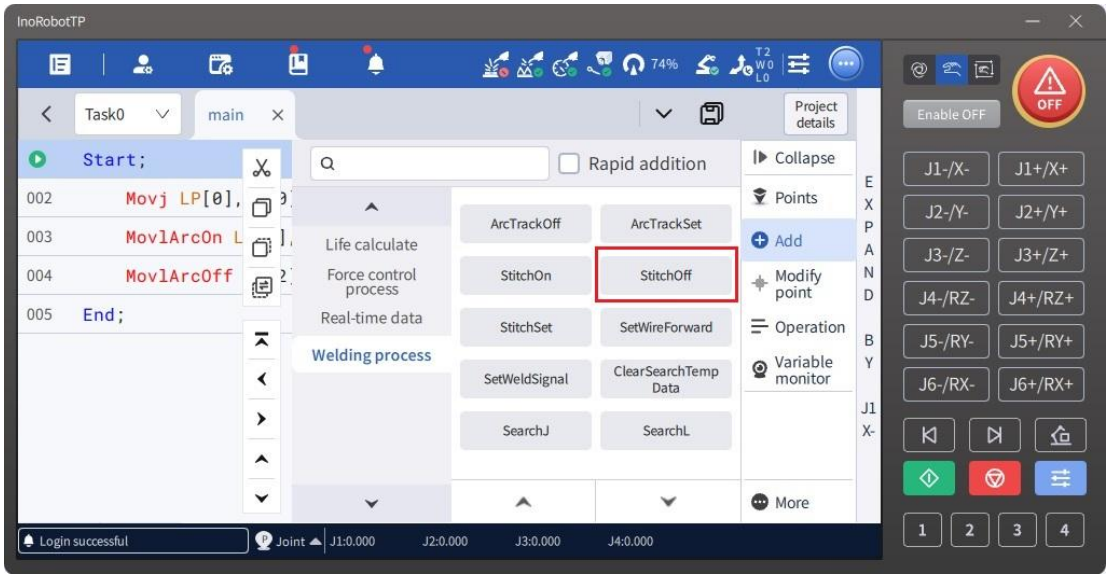
No.	Program	Comment
1	Start	Start
2	Movj P[1],V[30],Z[0],Tool[0],Wobj[0]	Run the robot to the safety point P[1].
3	Movl P[2],V[30],Z[0],Tool[0],Wobj[0]	Run the robot to the arc start point P[2].
4	StitchOn StitchData[0]	Enable the stitch welding function.
5	WeldOn AraData[0]	Start arc
6	Movl P[3],V[30],Z[0],Tool[0],Wobj[0]	Move to point P[3] by linear stitch welding.
7	Movc P[4],V[30],Z[0] ,Tool[0],Wobj[0]	Perform the first segment of circular stitch welding.
8	Movc P[5],V[30],Z[0],Tool[0],Wobj[0]	Perform the second segment of circular stitch welding.
9	StitchOff;	Disable the stitch welding function.
10	Movl P[6],V[30],Z[0],Tool[0],Wobj[0]	Move to point P[6] by linear welding.
11	WeldOff ArcData[0]	Extinguish arc.
12	Movj P[7],V[30],Z[0],Tool[0],Wobj[0]	Run the robot to the safety point P[7].
13	End	Program end

10.14 StitchOff

10.14.1 Description

This instruction ends stitch welding. After it is executed, subsequent welding motion instructions will stop performing stitch welding.

After the plugin is installed, the StitchOff instruction can be added on the "Program" > "Add" > "Welding process" page.



10.14.2 Format

StitchOff;

10.14.3 Parameter Description

StitchOff has no parameters.

10.14.4 Scope

Multitasking: Only effective in the main tasks. It can exist in a function and can only be called by the main task.

Mode:

- After this instruction is executed in Manual mode: linear and circular movements are performed normally.
- After this instruction is executed in Auto mode: linear and circular movements are performed normally.

10.14.5 Notes

- The stitch welding instruction only takes effect on the welding segments enclosed by the WeldOn and WeldOff instructions.

```
001 Start;
002     Movj P[0],V[30],Z[0],Tool[0];
003     StitchOn StitchData[0];
004     WeldOn ArcData[0];
005     Movl P[1],V[30],Z[0],Tool[0];
006     WeldOff ArcData[0];
007     StitchOff;
008 End;
```

CAUTION

StitchOff can be placed either before or after WeldOff, with no strict order required.

- The welding segment where the stitch welding instruction is active does not support the simultaneous use of the weaving instructions WeaveOn and WeaveOff. Using them as shown in Figure 1 will trigger an alarm. The correct usage method is to perform weaving after finishing stitch welding, as shown in Figure 2.

```
001 Start;
002     Movj P[0],V[30],Z[0],Tool[0];
003     StitchOn StitchData[0];
004     WeldOn ArcData[0];
005     WeaveOn WeaveData[0];
006     Movl P[1],V[30],Z[0],Tool[0];
007     WeldOff ArcData[0];
008     StitchOff;
009     WeaveOff;
010 End;
```

Figure 1

```
001 Start;
002     Movj P[0],V[30],Z[0],Tool[0];
003     StitchOn StitchData[0];
004     WeldOn ArcData[0];
005     Movl P[1],V[30],Z[0],Tool[0];
006     StitchOff;
007     Movl P[3],V[30],Z[0],Tool[0];
008     WeaveOn WeaveData[0];
009     Movl P[2],V[30],Z[0],Tool[0];
010     WeaveOff;
```

Figure 2

10.14.6 Usage Example

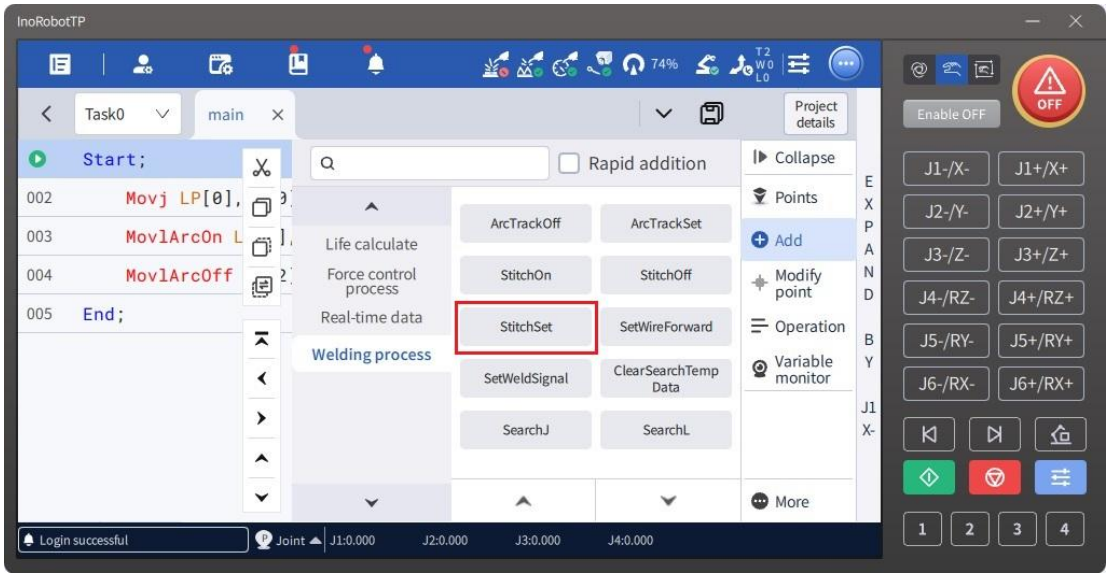
For details, see the 10.13.6 Usage Example section under "StitchOn".

10.15 StitchSet

10.15.1 Description

This instruction sets the stitch welding parameters. After it is executed, subsequent welding motion instructions will perform stitch welding according to the corresponding parameters.

After the plugin is installed, the StitchSet instruction can be added on the "Program" > "Add" > "Welding process" page.



10.15.2 Format

StitchSet StitchData[0];

> **CAUTION**
>
> StitchData is a required parameter, with an index range of 0 to 63.

10.15.3 Parameter Description

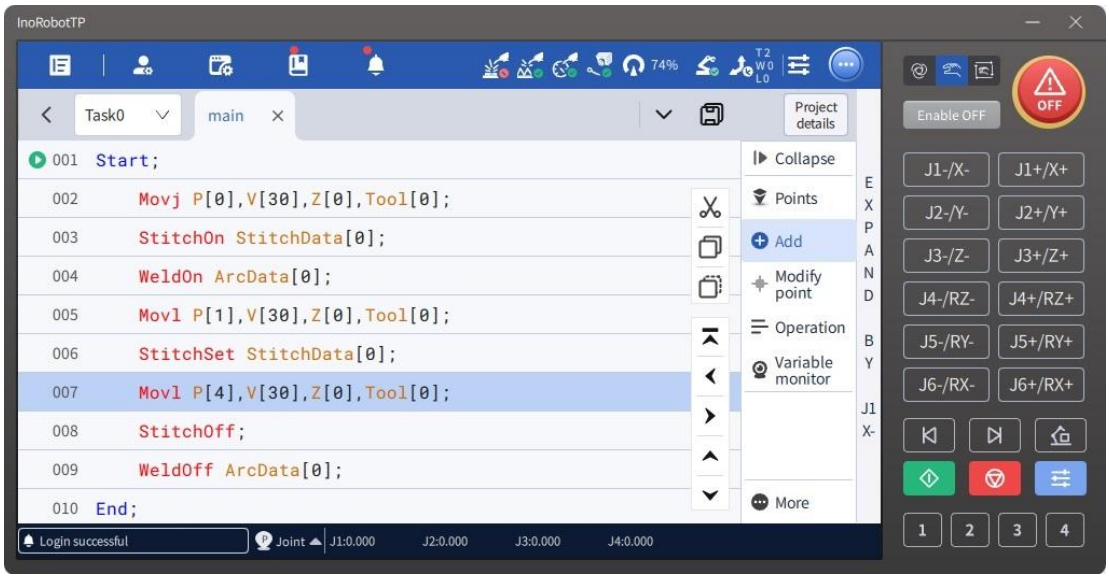
StitchData: required parameter, type: integer, range: 0 to 63. This parameter specifies the stitch welding parameter. For details, see the 9.6 Stitch Welding section.

10.15.4 Scope

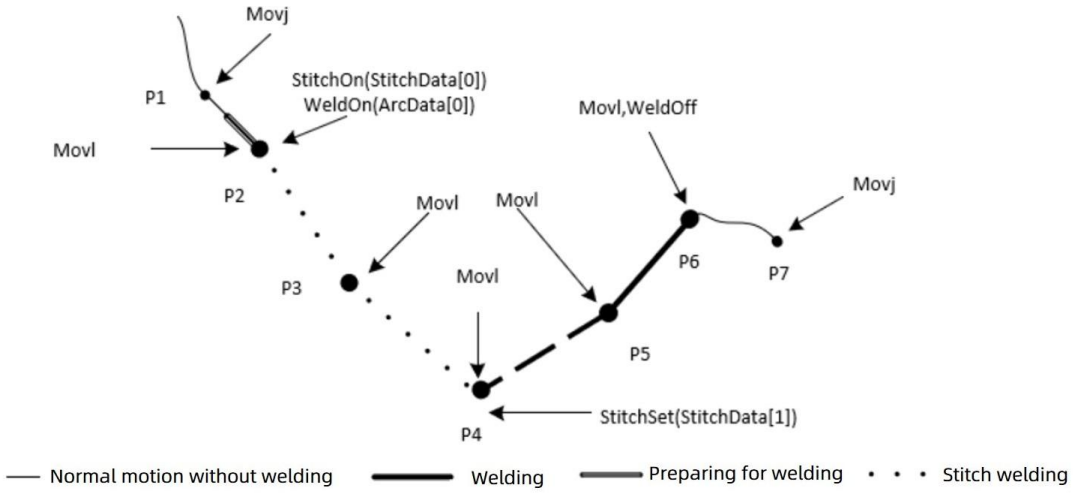
Multitasking: Only effective in the main tasks. It can exist in a function and can only be called by the main task.

10.15.5 Notes

The StitchSet instruction only takes effect on the welding segments enclosed by the WeldOn and WeldOff instructions.



10.15.6 Usage Example



No.	Program	Comment
1	Start	Start
2	Movj P[1],V[30],Z[0],Tool[0],Wobj[0]	Run the robot to the safety point P[1].
3	Movl P[2],V[30],Z[0],Tool[0],Wobj[0]	Run the robot to the arc start point P[2].
4	StitchOn StitchData[0]	Enable the stitch welding function.
5	WeldOn AraData[0]	Start arc
6	Movl P[3],V[30],Z[0],Tool[0],Wobj[0]	Stitch welding moves linearly to point P[3] according to the StitchData[0] parameters.
7	Movl P[4],V[30],Z[0],Tool[0],Wobj[0]	Stitch welding moves linearly to point P[4] according to the StitchData[0] parameters.
8	Movl P[5],V[30],Z[0],Tool[0],Wobj[0]	Stitch welding moves linearly to point P[5] according to the StitchData[1] parameters.
9	StitchOff	Disable the stitch welding function.
10	Movl P[6],V[30],Z[0],Tool[0],Wobj[0]	Move to point P[6] by linear welding.
11	WeldOff ArcData[0]	Extinguish arc.
12	Movj P[7],V[30],Z[0],Tool[0],Wobj[0]	Run the robot to the safety point P[7].
13	End	Program end

10.16 ClearSearchTempData

10.16.1 Description

This instruction clears the temporary data obtained during the search under the position search process number condition. It is recommended to call this instruction at the start of each position search to clear the temporary variables in the system.

After installing the welding process plugin, the ClearSearchTempData instruction can be added on the "Program" > "Add" > "Welding process" page.

10.16.2 Format

ClearSearchTempData(techNum)

10.16.3 Parameter Description

techNum: Temporary variable data associated with the process number of laser seam finding and touch sensing, range: 0 to 63.

10.16.4 Scope

Multitasking: Only effective in the main tasks. It can exist in a function and can only be called by the main task.

10.16.5 Usage Example

- Take 4-point method laser seam finding as an example (For more usage details, see the 9.2 Touch Sensing and 9.3.2 Laser Seam Finding sections)

No.	Program	Description
1	Start;	Program start
2	ClearSearchTempData(0)	Clear the cached data corresponding to condition number 0 of laser seam finding.
3	SearchL Dir[X], P[0], V[30], Z[0], LaserData[0], Tool[0], Wobj[0]	Move to point P0 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
4	SearchL Dir[X], P[1], V[30], Z[0], LaserData[0], Tool[0], Wobj [0]	Move to point P1 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
5	SearchL Dir[Y], P[2], V[30], Z[0], LaserData[0], Tool[0], Wobj [0]	Move to point P2 for laser seam finding. Dir[Y] indicates that the search starts along the Y direction of the workobject frame during the re-search.
6	SearchL Dir[Y], P[3], V[30], Z[0], LaserData[0], Tool[0], Wobj [0]	Move to point P3 for laser seam finding. Dir[Y] indicates that the search starts along the Y direction of the workobject frame during the re-search.

No.	Program	Description
7	CalcSearchPR (LaserData[0], PR[4])	Calculate the offset and store it in PR[4]. When the "Reference flag" in the current condition interface is set to "1: Set reference", the offset calculated by executing this instruction is 0.
8	ROffson PR[4]	Offset the original trajectory based on the offset value in PR[4].
9	MovlArcOn P[8], V[30], Z[0], ArcData[0],Tool[0], Wobj [0]	Move to the arc start point.
10	MovlArcOff P[9], V[30], Z[0], ArcData[0],Tool[0], Wobj [0]	Move to the arc-off point.
11	ROffsoff	Offset end
12	END	Program end

10.17 SearchJ/SearchL

10.17.1 Description

The robot moves to the search start point by joint or linear motion, and then searches along the direction of the workobject frame at the search start point.

After installing the welding process plugin, the SearchJ/ SearchL instruction can be added on the "Program" > "Add" > "Welding process" page.

10.17.2 Format

SearchJ instruction: SearchJ P[1] ,PR[0]/LPR[0], Dir[*],V[30], Z[0], TouchData[0]/ LaserData[0],LaserJob[0], Tool[0], Wobj[0];

SearchL instruction: SearchL P[1] , PR[0]/LPR[0], Dir[*], V[30], Z[0], TouchData[0]/ LaserData[0], ,LaserJob[0],Tool[0], Wobj[0];

Parameters underlined are optional, while others are required parameters.

10.17.3 Parameter Description

1. Dir[*]: Includes six direction options: X, -X, Y, -Y, Z, and -Z. This direction is along the workobject frame.
2. PR/LPR: choose either PR or LPR. PR: system offset variable, type: integer, range: 0 to 255. LPR: local offset variable, type: integer, range: 0 to 255.
3. TouchData: process number of touch sensing, type: integer, range: 0 to 63, used for touch sensing. When TouchData is included, the PR parameter is not allowed. Otherwise, an alarm will be triggered during runtime. In touch sensing, after moving to the search start point, the robot searches along the direction of

the workobject frame at the search start point until it contacts the workobject, then stops immediately. The return motion is performed according to the "Auto return" parameter in the TouchData parameter.

4. LaserData: process number of laser seam finding, type: integer, range: 0 to 63, used for laser seam finding. When LaserData is included, the PR parameter is optional. In this case, PR is used to store the weld seam position obtained by the search. In laser seam finding, the robot moves to point P by linear or joint motion and then directly detects the weld seam. If a seam point is obtained from the laser sensor, the point is stored in PR[1]. If no seam point is detected, the system determines whether to perform a re-search along the specified [DIR] direction based on the re-search function enable state in LaserData. If the re-search distance exceeds the maximum distance set in the laser seam finding process parameters and still no seam point is detected, the system triggers an alarm. If the re-search function is not enabled, an alarm is triggered directly.
5. LaserJob: laser process number, type: integer, range: 0 to 255.

10.17.4 Scope

Multitasking: Only effective in the main tasks. It can exist in a function and can only be called by the main task.

10.17.5 Notes

- External tools are not supported in the Search instruction. Otherwise, an alarm will be triggered during runtime.
- In single-step mode, the SearchL/SearchJ instruction only executes the movement to the search start point. This is used to check whether the teaching point is correct, instead of performing the search operation.

10.17.6 Usage Example

- Take "detect points and move to points" as an example (For more usage details, see the 9.2 Touch Sensing and 9.3.2 Laser Seam Finding sections)

No.	Program	Description
1	Start;	Program start
2	SearchL Dir[X], P[0], PR[0],V[30], Z[0], LaserData[0], LaserJob[0],Tool[0], Wobj[0];	Move to point P0, use "LaserJob[0]" to specify laser job number 0 for laser seam finding, and store the detected position in PR[0]. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
3	SearchL Dir[X], P[1],PR[1],V[30], Z[0], LaserData[0], LaserJob[0],Tool[0], Wobj [0];	Move to point P1, use "LaserJob[0]" to specify laser job number 0 for laser seam finding, and store the detected position in PR[1]. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
4	MovlArcOn P[2],PR[0], V[30], Z[0], ArcData[0],Tool[0], Wobj [0];	Replace the XYZ of P[2] with the XYZ of PR[0], and use the resulting point as the arc start point.

No.	Program	Description
5	MovlArcOff P[3],PR[1], V[30], Z[0], ArcData[0],Tool[0], Wobj [0];	Replace the XYZ of P[3] with the XYZ of PR[1], and use the resulting point as the arc-off point.
6	END;	Program end

10.18 CalcSearchPR

10.18.1 Description

This instruction is used to calculate the offset position under the search process conditions and store it in the PR variable.

After installing the welding process plugin, the CalcSearchPR instruction can be added on the "Program" > "Add" > "Welding process" page.

10.18.2 Format

CalcSearchPR (TouchData[0], PR[0]/ LPR[0]);

CalcSearchPR (LaserData[0], PR[0]/ LPR[0], PR[0]/ LPR[0], LaserBase[0]);

10.18.3 Parameter Description

- PR/LPR: choose either PR or LPR.
  - PR: system offset variable, type: integer, range: 0 to 255.
  - LPR: local offset variable, type: integer, range: 0 to 255.
- TouchData: process number of touch sensing, type: integer, range: 0 to 255. When TouchData is included, it is used for touch sensing. In this case, there is only one PR parameter, which is used to store the calculated offset.
- LaserData: process number of laser seam finding, range: 0 to 63. The first PR/LPR is used to store the offset calculated in the non-flag state. In the flag state, the parameter value is 0. The second PR/LPR is used to store the reference point calculated in the flag state. When LaserData is included, it is used for laser seam finding. In this case, there are two PR parameters. The first one is used to store the offset calculated in the non-flag state. In the flag state, the parameter value is 0. The second one is used to store the reference point calculated in the flag state.
- LaserBase: Used to store reference data of laser seam finding, range: 0 to 4095.

10.18.4 Scope

Multitasking: Only effective in the main tasks. It can exist in a function and can only be called by the main task.

10.18.5 Usage Example

- Take 4-point method laser seam finding as an example (For more usage details, see the 9.2 Touch Sensing and 9.3.2 Laser Seam Finding sections)

No.	Program	Description
1	Start;	Program start
2	ClearSearchTempData(0);	Clear the cached data corresponding to condition number 0 of laser seam finding.
3	SearchL Dir[X], P[0], V[30], Z[0], LaserData[0], Tool[0], Wobj[0];	Move to point P0 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
4	SearchL Dir[X], P[1], V[30], Z[0], LaserData[0], Tool[0], Wobj [0];	Move to point P1 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
5	SearchL Dir[Y], P[2], V[30], Z[0], LaserData[0], Tool[0], Wobj [0];	Move to point P2 for laser seam finding. Dir[Y] indicates that the search starts along the Y direction of the workobject frame during the re-search.
6	SearchL Dir[Y], P[3], V[30], Z[0], LaserData[0], Tool[0], Wobj [0] ;	Move to point P3 for laser seam finding. Dir[Y] indicates that the search starts along the Y direction of the workobject frame during the re-search.
7	CalcSearchPR (LaserData[0], PR[4]);	Calculate the offset and store it in PR[4]. When the "Reference flag" in the current condition interface is set to "1: Set reference", the offset calculated by executing this instruction is 0.
8	ROffson PR[4];	Offset the original trajectory based on the offset value in PR[4].
9	MovlArcOn P[8], V[30], Z[0], ArcData[0],Tool[0], Wobj [0];	Move to the arc start point.
10	MovlArcOff P[9], V[30], Z[0], ArcData[0],Tool[0], Wobj [0];	Move to the arc-off point.
11	ROffsoff;	Offset end
12	END;	Program end

10.19 ROffsOn/ROffsOff

10.19.1 Description

This instruction is a search offset start instruction used to offset the original trajectory according to the PR position offset variable calculated from the search result, thereby obtaining the actual position of the workobject after change. ROffsOn and ROffsOff are used in pairs to enable overall path translation. The final motion path will undergo additional translation in the X/Y/Z directions and rotation in the RX/RY/RZ directions in the base frame. Once turned on, it remains active until the instruction ROffsOff disables the path translation/rotation.

NOTE

- Do not use this instruction with EOffsOn. Starting from V4R25C2, all position search results must be offset using the ROffsOn instruction; the EOffsOn instruction is no longer used.
- ROffsOn must be used in pair with ROffsOff, and ROffsOn must be used before ROffsOff. Failure to follow this specification will result in a compilation error.
- The path offset applies only to instructions between ROffsOn and ROffsOff. The path translation/rotation is not related to the program logic, but only to the context. For example:
  Movj P[1],V[30],Z[0],Tool[1];

  B[1] = 2;

  ROffsOn(10,10,10,10,10,10);##The offset takes effect from this instruction, regardless of whether the instruction is executed.

  Movl P[2],V[30],Z[0],Tool[1];##Translation/rotation is applied to this instruction.

  If B[1]>1

  Goto L[1];

  EndIf;

  L[2]:

  Movl P[3],V[30],Z[0],Tool[1]; ##Regardless of where else the program jumps to this instruction, this instruction is subject to translation/rotation because it is located between ROffsOn and ROffsOff.

  Func1();###This is a function call. The motion instructions in the function are not subject to translation/rotation.

  ROffsOff;

  L[1]:

  Movl P[4],V[30],Z[0],Tool[1];##Even if the program jumps to this instruction, this instruction is not subject to offset because it is outside ROffsOn and ROffsOff.

  Goto L[2];
- Although the motion instruction with ROffsOn is independent of the program logic, the value of the PR variable in the ROffsOn instruction takes effect upon the execution of instruction. Therefore, do not add a conditional judgment before the ROffsOn instruction to prevent the offset variable from not taking effect. For example:

  If B[1] >1

  ROffsOn(10,10,10,10,10,10);

  EndIf;

  Movl P[2],V[30],Z[0],Tool[1];

  Movl P[3],V[30],Z[0],Tool[1];

  ROffsOff;

  In the above program, the translation/rotation instruction takes effect, but the offset variable corresponding to the offset instruction does not. That is, the value of the PR variable is the previous one.

10.19.2 Format

ROffsOn (PR[0]/ LPR[0]/ X,Y,Z,A,B,C)

ROffsOff

10.19.3 Parameter Description

- PR/LPR/X,Y,Z: Choose any one of PR, LPR, or XYZ.
- PR: system offset variable, type: integer, range: 0 to 255.
- LPR: local offset variable, type: integer, range: 0 to 255.
- X,Y,Z,A,B,C: X, Y, Z, A, B, C coordinate values, type: floating point, range: -9999999.999 to +9999999.999.

10.19.4 Scope

Multitasking: Only effective in the main tasks. It can exist in a function and can only be called by the main task.

10.19.5 Notes

- When the PR/LPR parameter is included, it can only be applied to the motion instructions other than MovArcRep and MovMultiRep.
- Do not use this instruction with EOffsOn. Starting from V4R25C2, all position search results must be offset using the ROffsOn instruction; the EOffsOn instruction is no longer used.

10.19.6 Usage Example

- Take 4-point method laser seam finding as an example (For more usage details, see the 9.2 Touch Sensing and 9.3.2 Laser Seam Finding sections)

No.	Program	Description
1	Start;	Program start
2	ClearSearchTempData(0);	Clear the cached data corresponding to condition number 0 of laser seam finding.
3	SearchL Dir[X], P[0], V[30], Z[0], LaserData[0], Tool[0], Wobj[0];	Move to point P0 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
4	SearchL Dir[X], P[1], V[30], Z[0], LaserData[0], Tool[0], Wobj[0];	Move to point P1 for laser seam finding. Dir[x] indicates that the search starts along the X direction of the workobject frame during the re-search.
5	SearchL Dir[Y], P[2], V[30], Z[0], LaserData[0], Tool[0], Wobj[0] ;	Move to point P2 for laser seam finding. Dir[Y] indicates that the search starts along the Y direction of the workobject frame during the re-search.

No.	Program	Description
6	SearchL Dir[Y], P[3], V[30], Z[0], LaserData[0], Tool[0], Wobj[0];	Move to point P3 for laser seam finding. Dir[Y] indicates that the search starts along the Y direction of the workobject frame during the re-search.
7	CalcSearchPR(LaserData[0], PR[4]);	Calculate the offset and store it in PR[4]. When the "Reference flag" in the current condition interface is set to "1: Set reference", the offset calculated by executing this instruction is 0.
8	ROffson PR[4];	Offset the original trajectory based on the offset value in PR[4].
9	Movl P[8], V[30], Z[0], Tool[0], Wobj[0];	Move to the arc start point.
10	WeldOn ArcData[0];	Start arc
11	Movl P[9], V[30], Z[0], Tool[0], Wobj[0];	Move to the arc-off point.
12	WeldOff ArcData[0];	Extinguish arc.
13	ROffsoff;	Offset end
14	END;	Program end

10.20 SetWeldSignal

10.20.1 Description

This instruction is used to set the welding signal function.

10.20.2 Format

SetWeldSignal(bit, value)

10.20.3 Parameter Description

- bit: welder signal bit, type: integer, range: 0 to 447.
- value: Bit attribute value, type: integer, range: 0 to 1.

10.20.4 Scope

Multitasking: Only effective in the main tasks. It can exist in a function and can only be called by the main task.

10.21 SetWireForward

10.21.1 Description

This instruction is used to control the wire feeding or wire retracting.

10.21.2 Format

SetWireForward(dir, time)

10.21.3 Parameter Description

- dir: 0: retract, 1: feed, type: integer, range: 0 to 1.
- time: wire feed/retract time, type: floating point, range: 0 to 10, unit: s, valid to two decimal places.

10.21.4 Notes

- If the previous motion instruction before Setwireforward includes the NWAIT parameter, Setwireforward will be executed in advance.
- When a conflict occurs with other wire feed/retract functions, SetWireForward execution is terminated.
- When the program status is "Finished", SetWireForward execution is terminated.

10.21.5 Usage Example

- Example 1

No.	Program	Comment
1	Start	Start
2	Movj P[1], V[30], Z[0], Tool[1], Wobj[0]	Run the robot to the safety point P[1].
3	Setwireforward (1,5)	Start wire feeding for 5s, while moving to P[2].
3	Movj P[2],V[30],Z[0],Tool[1],Wobj[0]	Run the robot to the safety point P[2].
4	END	End

- Example 2

No.	Program	Comment
1	Start	Start
2	Movj P[1], V[30], Z[0], Tool[1], Wobj[0]	Run the robot to the safety point P[1].
3	Setwireforward (1,5)	Start wire feeding for 5s.
4	Delay(5)	Add a Delay instruction after the SetWireForward instruction to achieve fixed-point wire feeding at point P[1].
5	Movj P[2],V[30],Z[0],Tool[1],Wobj[0]	Run the robot to the safety point P[2].

No.	Program	Comment
6	END	End

10.22 MPSaveRPM

10.22.1 Description

This instruction is the path storage instruction for multi-layer and multi-pass welding. Path data stored in RPM is not retained after power failure. If the data needs to be used after restarting the controller, this instruction can be used to write the path data in RPM to the corresponding file. 0 to 63 are written separately at fixed positions and distinguished by index.

File names: RPM00.dat to RPM63.dat.

If a file already exists for the corresponding path, it is directly replaced; if not, a new file is created.

After installing the welding process plugin, the MPSaveRPM instruction can be added on the "Program" > "Add" > "Welding process" page.

10.22.2 Format

MPSaveRPM (RPM[0]);

RPM: required parameter, type: integer, range: 0 to 63.

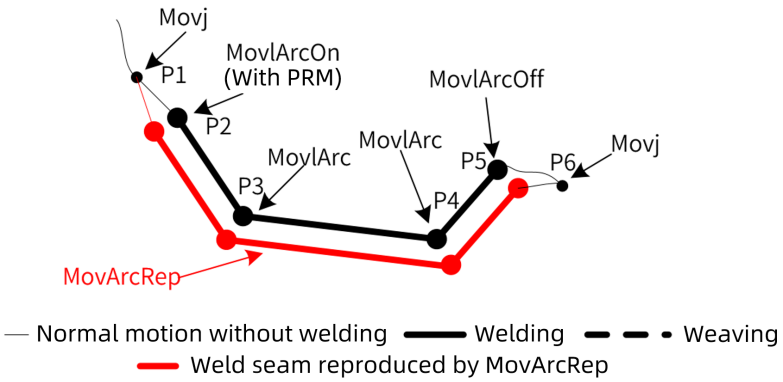
10.22.3 Parameter Description

RPM: used to store path points, index range: 0 to 63.

10.22.4 Scope

Only effective in the main task.

10.22.5 Usage Example



No.	Program	Comment
1	Start	Start
2	Movj P[1], V[30], Z[0], Tool[1], Wobj[0]	Run the robot to the safety point P[1].

No.	Program	Comment
3	MovlArcOn P[2],V[30],Z[0],ArcData[0],RPM[0],Tool[1] ,Wobj[0]	Move to the arc start point P[2], and store P[2] in RPM[0].
4	MovlArc P[3],V[30],Z[0],ArcData[0], RPM[0],Tool[1] ,Wobj[0]	Move to the point P[3], and store P[3] in RPM[0].
5	MovlArc P[4],V[30],Z[0],ArcData[0], RPM[0],Tool[1] ,Wobj[0]	Move to the point P[4], and store P[2] in RPM[0].
6	MovlArcOff P[5],V[30],Z[0],ArcData[0], RPM[0],Tool[1] ,Wobj[0]	Move to the point P[5], and store P[5] in RPM[0].
7	Movj P[6],V[30],Z[0],Tool[1],Wobj[0]	Run the robot to the safety point P[6].
8	MPSaveRPM RPM[0]	Store the points in RPM[0] to a file. If it is not required to retain the points in RPM[0] after power loss, this instruction can be omitted.
9	MPLoadRPM RPM[0]	Load the points in RPM[0] from a file. If it is not required to retain the points in RPM[0] after power loss, this instruction can be omitted.
10	Movj P[1],V[30],Z[0],Tool[1],Wobj[0]	Run the robot to the safety point P[1].
11	MovArcRep ArcOn,ArcOff, RPM[0], MPOffsData[0], RepDir[1], ArcData[1], Tool[1],Wobj[0]	Reproduce the path based on the offset parameters set in MPOffsData[0], with the reproduction direction opposite to the original path, and use the ArcData parameters during the welding process.
12	MovArcRep ArcOn,ArcOff, RPM[0], MPOffsData[1], RepDir[0], ArcData[1], Tool[1],Wobj[0]	Reproduce the path based on the offset parameters set in MPOffsData[1], with the reproduction direction the same as the original path, and use the ArcData parameters during the welding process.
13	Movj P[6],V[30],Z[0],Tool[1],Wobj[0]	Run the robot to the safety point P[6].
14	END	End

10.23 MPLoadRPM

10.23.1 Description

This instruction is the path loading instruction for multi-layer and multi-pass welding. It loads the points from the path file saved by the MPSaveRPM instruction from a fixed location into the corresponding RPM memory.

File names: RPM00.dat to RPM63.dat.

During loading, if the file does not exist, an alarm will be triggered.

After installing the welding process plugin, the MPLoadRPM instruction can be added on the "Program" > "Add" > "Welding process" page.

10.23.2 Format

MPLoadRPM (RPM[0]);

RPM: required parameter, type: integer, range: 0 to 63.

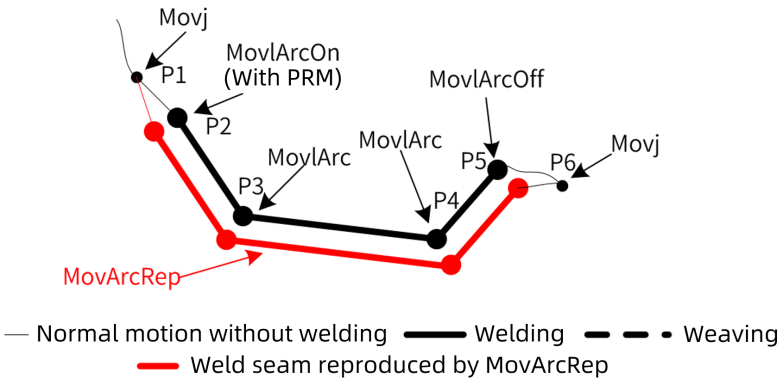
10.23.3 Parameter Description

RPM: used to store path points, index range: 0 to 63.

10.23.4 Scope

Only effective in the main tasks. It can exist in a function and can only be called by the main task.

10.23.5 Usage Example



No.	Program	Comment
1	Start	Start
2	Movj P[1], V[30], Z[0], Tool[1], Wobj[0]	Run the robot to the safety point P[1].
3	MovlArcOn P[2],V[30],Z[0],ArcData[0],RPM[0],Tool[1] ,Wobj[0]	Move to the arc start point P[2], and store P[2] in RPM[0].
4	MovlArc P[3],V[30],Z[0],ArcData[0], RPM[0],Tool[1] ,Wobj[0]	Move to the point P[3], and store P[3] in RPM[0].
5	MovlArc P[4],V[30],Z[0],ArcData[0], RPM[0],Tool[1] ,Wobj[0]	Move to the point P[4], and store P[2] in RPM[0].
6	MovlArcOff P[5],V[30],Z[0],ArcData[0], RPM[0],Tool[1] ,Wobj[0]	Move to the point P[5], and store P[5] in RPM[0].
7	Movj P[6],V[30],Z[0],Tool[1],Wobj[0]	Run the robot to the safety point P[6].
8	MPSaveRPM RPM[0]	Store the points in RPM[0] to a file. If it is not required to retain the points in RPM[0] after power loss, this instruction can be omitted.

No.	Program	Comment
9	MPLoadRPM RPM[0]	Load the points in RPM[0] from a file. If it is not required to retain the points in RPM[0] after power loss, this instruction can be omitted.
10	Movj P[1],V[30],Z[0],Tool[1],Wobj[0]	Run the robot to the safety point P[1].
11	MovArcRep ArcOn,ArcOff, RPM[0], MPOffsData[0], RepDir[1], ArcData[1], Tool[1],Wobj[0]	Reproduce the path based on the offset parameters set in MPOffsData[0], with the reproduction direction opposite to the original path, and use the ArcData parameters during the welding process.
12	MovArcRep ArcOn,ArcOff, RPM[0], MPOffsData[1], RepDir[0], ArcData[1], Tool[1],Wobj[0]	Reproduce the path based on the offset parameters set in MPOffsData[1], with the reproduction direction the same as the original path, and use the ArcData parameters during the welding process.
13	Movj P[6],V[30],Z[0],Tool[1],Wobj[0]	Run the robot to the safety point P[6].
14	END	End

10.24 MovArcRep

10.24.1 Description

This instruction is a single reproduction instruction for multi-layer and multi-pass welding. It can be used to reproduce a stored path in RPM. The reproduction direction can be set via the RepDir parameter. Offsets (start and end offsets, X/Y/Z direction offsets, and X/Y direction rotations) can be set in MPOffsData.

After installing the welding process plugin, the MovArcRep instruction can be added on the "Program" > "Add" > "Welding process" page.

10.24.2 Parameter Description

- ArcOn: required parameter, indicating the first point as the arc start point.
- ArcOff: required parameter, indicating the last point position is the arc-off point.
- RPM: required parameter, type: integer, range: 0 to 63. It indicates the path to be reproduced.
- MPOffsData: required parameter, type: integer, range: 0 to 63. This parameter contains the offset data for reproduction. Path offsets are set in this parameter. For details, see the 9.5.4.1 MPOffsData section.
- RepDir: required parameter, type: integer, range: 0 to 1. This parameter indicates the reproduction direction: 0 indicates the same direction as the recorded path, 1 indicates the opposite direction.
- V, Tool, Wobj, Acc: same as in standard motion instructions. The transition parameter Z is not included. The transition behavior remains consistent with that of the original trajectory.
- ArcData, WeaveData: same as in welding motion instructions. Among them:
  - ArcData: required parameter, type: integer, range: 0 to 63. This parameter specifies the welding parameters, including three sub-parameters: arc start data, welding process data, and arc end data. For details, see the 6 ArcData section.

- WeaveData: optional parameter, type: integer, range: 0 to 63. This parameter specifies the weaving variable. For a welding instruction that includes this parameter, if the weaving enable state is active, weaving is performed according to the parameters in the specified weaving variable. For details, see the 9.1 Weaving section.



Whether welding or weaving is performed is influenced not only by whether WeaveData is included but also by the state of the welding enable button, weaving enable button, and tracking enable button on the process operation panel.

10.24.3 Scope

Multitasking: Only effective in the main tasks. It can exist in a function and can only be called by the main task.

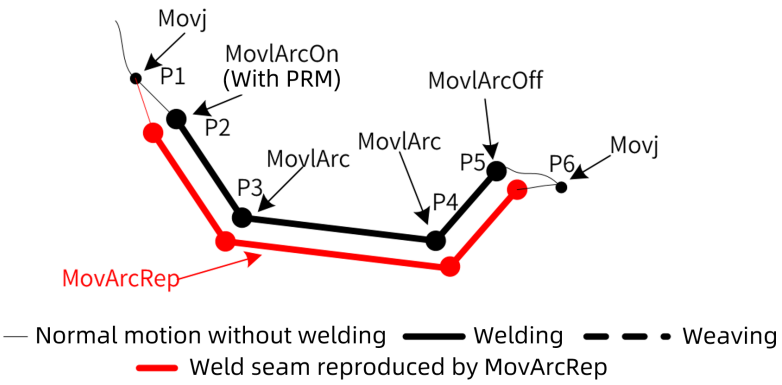
Mode:

- In Manual mode:
  - When running the program step by step using the single-step button, neither welding nor weaving is performed, regardless of the states of the welding enable switch and the weaving enable switch.
  - When the welding enable switch is in the "Weld disable" state, running the instruction via the start button results in no welding. When the welding enable switch is in the "Weld enable" state, running the instruction via the start button performs welding according to the ArcData settings.
  - If the WeaveData parameter is included, whether weaving is performed is determined by the state of the weaving enable button: when the button is in the "Weave enable" state, weaving is performed; when it is in the "Weave disable" state, weaving is not performed.
- In Auto mode:
  - When the welding enable switch is in the "Weld disable" state, running the instruction via the start button results in no welding. When the welding enable switch is in the "Weld enable" state, running the instruction via the start button performs welding according to the ArcData settings.
  - If the WeaveData parameter is included, when the instruction is run via the start button, whether weaving is performed is determined by the state of the weaving enable button: when the button is in the "Weave enable" state, tracking is performed; when it is in the "Weave disable" state, tracking is not performed.

10.24.4 Notes

MovArcRep does not support the EOffsOn and EOffsOff instructions. Even if it is placed between them, no offset will be applied. To apply an offset, use the MPOffsData parameter in the instruction.

10.24.5 Usage Example



No.	Program	Comment
1	Start	Start
2	Movj P[1], V[30], Z[0], Tool[1], Wobj[0]	Run the robot to the safety point P[1].
3	MovlArcOn P[2],V[30],Z[0],ArcData[0],RPM[0],Tool[1] ,Wobj[0]	Move to the arc start point P[2], and store P[2] in RPM[0].
4	MovlArc P[3],V[30],Z[0],ArcData[0], RPM[0],Tool[1] ,Wobj[0]	Move to the point P[3], and store P[3] in RPM[0].
5	MovlArc P[4],V[30],Z[0],ArcData[0], RPM[0],Tool[1] ,Wobj[0]	Move to the point P[4], and store P[2] in RPM[0].
6	MovlArcOff P[5],V[30],Z[0],ArcData[0], RPM[0],Tool[1] ,Wobj[0]	Move to the point P[5], and store P[5] in RPM[0].
7	Movj P[6],V[30],Z[0],Tool[1],Wobj[0]	Run the robot to the safety point P[6].
8	MPSaveRPM RPM[0]	Store the points in RPM[0] to a file. If it is not required to retain the points in RPM[0] after power loss, this instruction can be omitted.
9	MPLoadRPM RPM[0]	Load the points in RPM[0] from a file. If it is not required to retain the points in RPM[0] after power loss, this instruction can be omitted.
10	Movj P[1],V[30],Z[0],Tool[1],Wobj[0]	Run the robot to the safety point P[1].
11	MovArcRep ArcOn,ArcOff, RPM[0], MPOffsData[0], RepDir[1], ArcData[1], Tool[1],Wobj[0]	Reproduce the path based on the offset parameters set in MPOffsData[0], with the reproduction direction opposite to the original path, and use the ArcData parameters during the welding process.
12	MovArcRep ArcOn,ArcOff, RPM[0], MPOffsData[1], RepDir[0], ArcData[1], Tool[1],Wobj[0]	Reproduce the path based on the offset parameters set in MPOffsData[1], with the reproduction direction the same as the original path, and use the ArcData parameters during the welding process.
13	Movj P[6],V[30],Z[0],Tool[1],Wobj[0]	Run the robot to the safety point P[6].
14	END	End

10.25 MovArcMultiRep

10.25.1 Description

This instruction is a multiple reproduction instruction for multi-layer and multi-pass welding. It can be used to reproduce a stored path multiple times. The number of reproductions, direction, welding parameters for each pass, weaving parameters, and weld pass offset parameters can be set via the ArcMultiData parameter.

The points recorded in RPM are the points on the guide line. During reproduction, weaving shall follow the weaving parameters set in ArcMultiData.

When each pass starts, the upper computer will indicate which pass is starting, and after the pass is completed, a message will appear in the message bar indicating that the corresponding pass has been completed.

After installing the welding process plugin, the MovArcMultiRep instruction can be added on the "Program" > "Add" > "Welding process" page.

10.25.2 Format

MovArcMultiRep ArcOn, ArcOff, RPM[0], ArcMultiData[0],V[30], Tool[0], Wobj[0], Acc[50];

Parameters underlined are optional, while others are required parameters.

10.25.3 Parameter Description

- ArcOn: required parameter, indicating the first point as the arc start point.
- ArcOff: required parameter, indicating the last point position is the arc-off point.
- RPM: required parameter, type: integer, range: 0 to 63. It indicates the path to be reproduced.
- ArcMultiData: required parameter, type: integer, range: 0 to 63. This parameter includes the number of reproductions, reproduction direction, welding parameters for each pass, weaving parameters, and weld pass offset parameters, etc. For details, see the 9.5 Multi-Layer and Multi-Pass section.
- V, Tool, Wobj, Acc: same as in standard motion instructions. The transition parameter Z is not included. The transition behavior remains consistent with that of the original trajectory.

10.25.4 Scope

Multitasking: Only effective in the main tasks. It can exist in a function and can only be called by the main task.

Mode:

- Manual mode:
  - When running the program step by step using the single-step button, neither welding nor weaving is performed, regardless of the states of the welding enable switch and the weaving enable switch.
  - When the welding enable switch is in the "Weld disable" state, running the instruction via the start button results in no welding. When the welding enable switch is in the "Weld enable" state, running the instruction via the start button performs welding according to the ArcData settings.

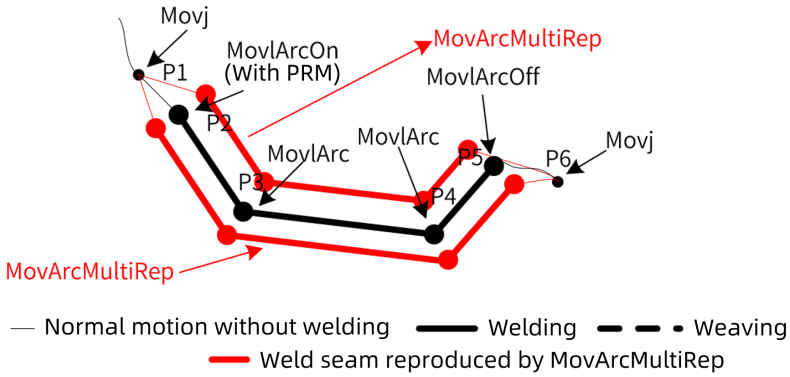
- If the WeaveData parameter is included, whether weaving is performed is determined by the state of the weaving enable button: when the button is in the "Weave enable" state, weaving is performed; when it is in the "Weave disable" state, weaving is not performed.

- Auto mode:
  - When the welding enable switch is in the "Weld disable" state, running the instruction via the start button results in no welding. When the welding enable switch is in the "Weld enable" state, running the instruction via the start button performs welding according to the setting of ArcData selected in ArcMultiData.
  - If the WeaveData parameter is selected in ArcMultiData, when the instruction is run via the start button, whether weaving is performed is determined by the state of the weaving enable button: when the button is in the "Weave enable" state, tracking is performed; when it is in the "Weave disable" state, tracking is not performed.

10.25.5 Notes

MovArcMultiRep does not support the EOffsOn and EOffsOff instructions. Even if it is placed between them, no offset will be applied. To apply an offset, use the MPOffsData parameter in ArcMultiData.

10.25.6 Usage Example



No.	Program	Comment
1	Start	Start
2	Movj P[1], V[30], Z[0], Tool[1], Wobj[0]	Run the robot to the safety point P[1].
3	MovlArcOn P[2],V[30],Z[0],ArcData[0],RPM[0],Tool[1] ,Wobj[0]	Move to the arc start point P[2], and store P[2] in RPM[0].
4	MovlArc P[3],V[30],Z[0],ArcData[0], RPM[0],Tool[1] ,Wobj[0]	Move to the point P[3], and store P[3] in RPM[0].
5	MovlArc P[4],V[30],Z[0],ArcData[0], RPM[0],Tool[1] ,Wobj[0]	Move to the point P[4], and store P[4] in RPM[0].
6	MovlArcOff P[5],V[30],Z[0],ArcData[0], RPM[0],Tool[1] ,Wobj[0]	Move to the point P[5], and store P[5] in RPM[0].
7	Movj P[6],V[30],Z[0],Tool[1],Wobj[0]	Run the robot to the safety point P[6].

No.	Program	Comment
8	MPSaveRPM RPM[0]	Store the points in RPM[0] to a file. If it is not required to retain the points in RPM[0] after power loss, this instruction can be omitted.
9	MPLoadRPM RPM[0]	Load the points in RPM[0] from a file. If it is not required to retain the points in RPM[0] after power loss, this instruction can be omitted.
10	Movj P[1],V[30],Z[0],Tool[1],Wobj[0]	Run the robot to the safety point P[1].
11	MovArcMultiRep ArcOn,ArcOff, RPM[0], ArcMultiData[0], Tool[1],Wobj[0]	Reproduce multiple times according to the number of reproductions and other settings in ArcMultiData[0]. The offset, welding parameters, and weaving parameters for each path are taken from the parameter indices set in ArcMultiData[0] for that path.
12	Movj P[6],V[30],Z[0],Tool[1],Wobj[0]	Run the robot to the safety point P[6].
13	END	End

10.26 MovlArcOn

10.26.1 Description

This instruction is an arc start instruction used to move the robot to the welding start point by linear interpolation. During this process, instead of welding, only welding preparations (e.g., pre-gas) are performed. After reaching the start point, arc ignition begins.

After installing the welding process plugin, the MovlArcOn instruction can be added on the "Program" > "Add" > "Welding process" page.

10.26.2 Format

MovlArcOn P[1], PR[0]/LPR[0], V[30], Z[0], ArcData[1], WeaveData[0], LaserTrackData[0],ArcTrackData[0], StitchData[0], RPM[0], Tool[0], Wobj[0] , Acc[50], Out(0, OFF, T[0]);

Parameters underlined are optional, while others are required parameters.

10.26.3 Parameter Description

- Compared with motion instructions, the following parameters are added: PR, ArcData, WeaveData, LaserTrackData, StitchData, and RPM. The following parameters are omitted: Until, SLMode, and NWait. The ArcOn instruction includes the NWait function by default, which is not displayed in the instruction. Other parameters are consistent with those in the motion instructions.
- PR/LPR: optional parameters, choose either PR or LPR. PR: system offset variable, type: integer, range: 0 to 255. LPR: local offset variable, type: integer, range: 0 to 255. When the instruction includes this parameter during motion, the XYZ values of PR are directly replaced into the point P of the motion instruction. Only the XYZ coordinates of the instruction's target point are changed; the values of P[0] remains unchanged. For example, assume P[0] = {(1,2,3,4,5,6),(0,0,0,0),(0,0,0,0,0,0)}; PR[0] = (11,22,33,44,55,66); then during actual operation, the target point for the motion is {(11,22,33,4,5,6),

(0,0,0,0),(0,0,0,0,0,0)}. This parameter is generally used with the laser seam finding instruction SearchL or SearchJ for scenarios such as detecting points and moving to points, detecting reference and moving by reference, or searching for the tracking start point. PR is used to record the weld seam position obtained by the search. In this case, P[0] is only used to specify the motion orientation and external axis values.

- ArcData: required parameter, type: integer, range: 0 to 63. This parameter specifies the welding parameters, including three sub-parameters: arc start data, welding process data, and arc end data. For details, see the 6 ArcData section.
- WeaveData: optional parameter, type: integer, range: 0 to 63. This parameter specifies the weaving variable. For a welding instruction that includes this parameter, if the weaving enable state is active, weaving is performed according to the parameters in the specified weaving variable. For details, see the 9.1 Weaving section.
- LaserTrackData: optional parameter, type: integer, range: 0 to 63, mutually exclusive with ArcTrackData and StitchData. This parameter specifies the tracking variable. For a welding instruction that includes this parameter, if the tracking enable state is active, tracking is performed according to the parameters in the specified tracking variable. For details, see the 9.3.3 Laser Tracking section.
- ArcTrackData: optional parameter, type: integer, range: 0 to 63, mutually exclusive with LaserTrackData and StitchData. This parameter specifies the tracking variable. For a welding instruction that includes this parameter, if the tracking enable state is active, tracking is performed according to the parameters in the specified tracking variable. For details, see the 9.4 Arc Tracking section.
- RPM: optional parameter, type: integer, range: 0 to 63. When this parameter is included, the point path is stored in RPM, which actually records the points on the guide line. Note that these points are not retained after power failure. If power failure retention is required, use MPSaveRPM to save the path to a file, and then use MPLoadRPM to load the path. When MovlArcOn includes RPM, after the program runs to the ArcOn instruction, the points in the corresponding RPM index are cleared first, and then recording starts. Subsequent welding motion instructions must include the same RPM parameter until the arc end instruction. Otherwise, an alarm occurs. For details, see the 9.5 Multi-Layer and Multi-Pass section.
- StitchData: optional parameter, type: integer, range: 0~63, mutually exclusive with WeaveData, LaserTrackData, and ArcTrackData. This parameter specifies the stitch welding parameters. When used in the MovlArcOn instruction, StitchData has no effect; it is included solely for consistency in parameter syntax with other four instructions. For details, see the 9.6 Stitch Welding section.

10.26.4 Scope

Multitasking: Only effective in the main tasks. It can exist in a function and can only be called by the main task.

Mode:

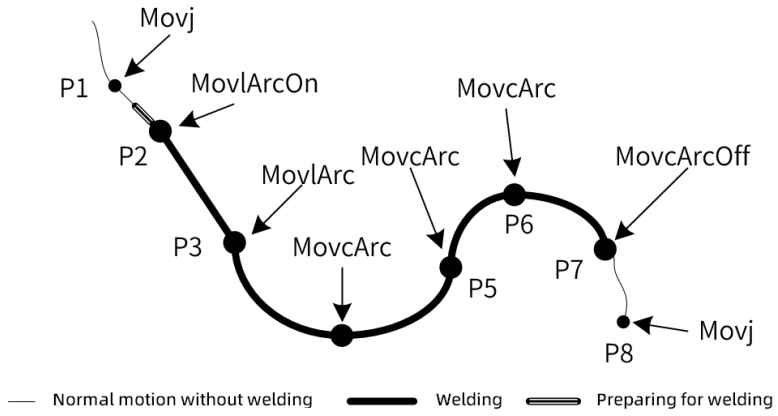
- In Manual mode:
  - When running the program step by step using the single-step button, neither welding nor weaving is performed, regardless of the states of the welding enable switch and the weaving enable switch.
  - When the welding enable switch is in the "Weld disable" state, running the instruction via the start button results in no welding. When the welding enable switch is in the "Weld enable" state, running the instruction via the start button performs welding according to the ArcData settings.
  - If the WeaveData parameter is included, whether weaving is performed is determined by the state of the weaving enable button: when the button is in the "Weave enable" state, weaving is performed; when it is in the "Weave disable" state, weaving is not performed.

- In Auto mode:
  - When the welding enable switch is in the "Weld disable" state, running the instruction via the start button results in no welding. When the welding enable switch is in the "Weld enable" state, running the instruction via the start button performs welding according to the ArcData settings.

10.26.5 Notes

- This instruction performs welding preparations (e.g., pre-gas) instead of welding.
- After reaching the welding start point, arc ignition begins.
- After the MovlArcOn instruction, the program must contain an arc end instruction (MovlArcOff or MovcArcOff). Otherwise, a compilation error will be reported when saving.
- Two arc start instructions are not allowed consecutively. After using MovlArcOn, you must use MovlArcOff or MovcArcOff to end the arc before using MovlArcOn again. Repeated use without an intervening arc end instruction will cause a compilation error when saving.
- Non-welding motion instructions (e.g., Movl, Movj, Movc, home, etc.) are not allowed between an arc start instruction and an arc end instruction during the welding segment; they can only be used after the arc has been ended, or a compilation error will be reported.
- The welding instructions must include the ArcData parameter. Otherwise, an error will be reported when the project is saved.
- If the welding motion instruction ArcOn includes LaserTrackData, then ArcOff and all welding motion instructions between ArcOn and ArcOff must also include the LaserTrackData. Otherwise, an error will be reported during running.
- When running the program in single-step mode to a line between ArcOn and ArcOff, if you need to click "Continuous" button to switch the mode, set the start line to the ArcOn motion instruction. Otherwise, an error will be reported.
- To perform the laser tracking, the weld seam must be recognized during the movement to the arc start point. It is recommended to use it together with laser seam finding function. The start point for laser tracking is assumed to be accurate by default. The speed to the start point should not be too high. Otherwise, the weld seam may not be recognized. The recommended speed is less than 30 mm/s.
- If the welding motion instruction ArcOn includes RPM, then ArcOff and all welding motion instructions between ArcOn and ArcOff must also include the same RPM. Otherwise, an error will be reported during running.
- If the movement is jerky during tracking, check whether the transition parameter Z in the welding motion instruction is set to 0 or Fine. It is recommended to set it to ZR[100].
- During laser tracking, the welding speed must be less than 30 mm/s.
- If WeaveData, LaserTrackData, ArcTrackData, or StitchData is included, the Out parameter is not supported.

10.26.6 Usage Example



No.	Program	Comment
1	Start	Start
2	Movj P[1],V[30],Z[0],Tool[0],Wobj[0]	Run the robot to the safety point P[1].
3	MovlArcOn P[2],V[30],Z[0],ArcData[0],Tool[0],Wobj[0]	Run the robot to the arc start point P[2].
4	MovlArc P[3],V[30],Z[0],ArcData[0],Tool[0],Wobj[0]	Run the robot to the point P[3].
5	MovcArc P[4],V[30],Z[0],ArcData[0],Tool[0],Wobj[0]	Run the first segment of the first circular arc.
6	MovcArc P[5],V[30],Z[0],ArcData[0],Tool[0],Wobj[0]	Run the second segment of the first circular arc.
7	MovcArc P[6],V[30],Z[0],ArcData[0],Tool[0],Wobj[0]	Run the first segment of the second circular arc.
8	MovcArcOff P[7],V[30],Z[0],ArcData[0],Tool[0],Wobj[0]	Run the second segment of the second circular arc, and extinguish arc at point P7.
9	Movj P[8],V[30],Z[0],Tool[0],Wobj[0]	Run the robot to the safety point P[8].
10	END	End

10.27 MovlArc

10.27.1 Description

This instruction is a welding process instruction used to move the robot by linear interpolation.

After installing the welding process plugin, the MovlArc instruction can be added on the "Program" > "Add" > "Welding process" page.

10.27.2 Format

MovlArc P[1], PR[0]/LPR[0], V[30], Z[0], ArcData[1], RampToV[0],WeaveData[0],RampToWD[0], LaserTrackData[0], ArcTrackData[0], StitchData[0], RPM[0], Tool[0], Wobj[0], Acc[50], Out(0, OFF, T[0]);

Parameters underlined are optional, while others are required parameters.

10.27.3 Parameter Description

- Compared with motion instructions, the following parameters are added: PR, ArcData, WeaveData, LaserTrackData, StitchData, and RPM. The following parameters are omitted: Until, SLMode, and NWait. The ArcOn instruction includes the NWait function by default, which is not displayed in the instruction. Other parameters are consistent with those in the motion instructions.
- PR/LPR: optional parameters, choose either PR or LPR. PR: system offset variable, type: integer, range: 0 to 255. LPR: local offset variable, type: integer, range: 0 to 255. When the instruction includes this parameter during motion, the XYZ values of PR are directly replaced into the point P of the motion instruction. Only the XYZ coordinates of the instruction's target point are changed; the values of P[0] remains unchanged. For example, assume P[0] = {(1,2,3,4,5,6),(0,0,0,0),(0,0,0,0,0,0)}; PR[0] = (11,22,33,44,55,66); then during actual operation, the target point for the motion is {(11,22,33,4,5,6),(0,0,0,0),(0,0,0,0,0,0)}. This parameter is generally used with the laser seam finding instruction SearchL or SearchJ for scenarios such as detecting points and moving to points, detecting reference and moving by reference, or searching for the tracking start point. PR is used to record the weld seam position obtained by the search. In this case, P[0] is only used to specify the motion orientation and external axis values.
- ArcData: required parameter, type: integer, range: 0 to 63. This parameter specifies the welding parameters, including three sub-parameters: arc start data, welding process data, and arc end data. For details, see the 6 ArcData section.
- WeaveData: optional parameter, type: integer, range: 0 to 63. This parameter specifies the weaving variable. For a welding instruction that includes this parameter, if the weaving enable state is active, weaving is performed according to the parameters in the specified weaving variable. For details, see the 9.1 Weaving section.
- LaserTrackData: optional parameter, type: integer, range: 0 to 63, mutually exclusive with ArcTrackData and StitchData. This parameter specifies the tracking variable. For a welding instruction that includes this parameter, if the tracking enable state is active, tracking is performed according to the parameters in the specified tracking variable. For details, see the 9.3.3 Laser Tracking section.
- ArcTrackData: optional parameter, type: integer, range: 0 to 63, mutually exclusive with LaserTrackData and StitchData. This parameter specifies the tracking variable. For a welding instruction that includes this parameter, if the tracking enable state is active, tracking is performed according to the parameters in the specified tracking variable. For details, see the 9.4 Arc Tracking section.
- RPM: optional parameter, type: integer, range: 0 to 63. When this parameter is included, the point path is stored in RPM, which actually records the points on the guide line. Note that these points are not retained after power failure. If power failure retention is required, use MPSaveRPM to save the path to a file, and then use MPLoadRPM to load the path. When MovlArcOn includes RPM, after the program runs to the ArcOn instruction, the points in the corresponding RPM index are cleared first, and then recording starts. Subsequent welding motion instructions must include the same RPM parameter until the arc end instruction. Otherwise, an alarm occurs. For details, see the 9.5 Multi-Layer and Multi-Pass section.
- StitchData: optional parameter, type: integer, range: 0~63, mutually exclusive with WeaveData, LaserTrackData, and ArcTrackData. This parameter specifies the stitch welding parameters. When used in the MovlArcOn instruction, StitchData has no effect; it is included solely for consistency in parameter syntax with other four instructions. For details, see the 9.6 Stitch Welding section.
- RampToV: optional parameter, type: double-precision floating-point, range: 1.0 to 30.0. This parameter specifies the speed slope parameter. For details, see the 9.7.2 Welding Speed Slope section.

- RampToWD: optional parameter, type: integer, range: 0 to 63. This parameter specifies the weaving slope parameter. For details, see the 9.7.3 Weaving Slope section.

10.27.4 Scope

Multitasking: Only effective in the main tasks. It can exist in a function and can only be called by the main task.

Mode:

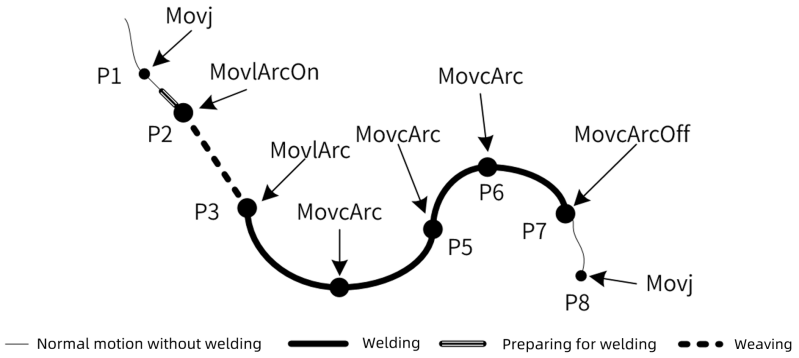
- In Manual mode:
  - When running the program step by step using the single-step button, neither welding nor weaving is performed, regardless of the states of the welding enable switch and the weaving enable switch.
  - When the welding enable switch is in the "Weld disable" state, running the instruction via the start button results in no welding. When the welding enable switch is in the "Weld enable" state, running the instruction via the start button performs welding according to the ArcData settings.
  - If the WeaveData parameter is included, whether weaving is performed is determined by the state of the weaving enable button: when the button is in the "Weave enable" state, weaving is performed; when it is in the "Weave disable" state, weaving is not performed.
  - If the LaserTrackData parameter is included, when the instruction is run via the start button, whether tracking is performed is determined by the state of the tracking enable button: when the button is in the "Tracking enable" state, tracking is performed; when it is in the "Tracking disable" state, tracking is not performed.
- In Auto mode:
  - When the welding enable switch is in the "Weld disable" state, running the instruction via the start button results in no welding. When the welding enable switch is in the "Weld enable" state, running the instruction via the start button performs welding according to the ArcData settings.
  - If the WeaveData parameter is included, when the instruction is run via the start button, whether weaving is performed is determined by the state of the weaving enable button: when the button is in the "Weave enable" state, tracking is performed; when it is in the "Weave disable" state, tracking is not performed.
  - If the LaserTrackData parameter is included, when the instruction is run via the start button, whether tracking is performed is determined by the state of the tracking enable button: when the button is in the "Tracking enable" state, tracking is performed; when it is in the "Tracking disable" state, tracking is not performed.

10.27.5 Notes

- The arc start instruction MovlArcOn must be present before this instruction.
- The previous instruction of this instruction must be an ArcOn instruction or a welding process instruction.
- Do not add standard motion instructions, such as Movl, Movj, Movc, before or after MovlArc.
- If the welding motion instruction Arc includes LaserTrackData, then ArcOn, ArcOff and all welding motion instructions between ArcOn and ArcOff must also include the LaserTrackData. Otherwise, an error will be reported during running.

- When running the program in single-step mode to a line between ArcOn and ArcOff, if you need to click "Continuous" button to switch the mode, set the start line to the ArcOn motion instruction. Otherwise, an error will be reported.
- If the welding motion instruction ArcOn includes RPM, then ArcOff and all welding motion instructions between ArcOn and ArcOff must also include the same RPM. Otherwise, an error will be reported during running.
- If the movement is jerky during tracking, check whether the transition parameter Z in the welding motion instruction is set to 0 or Fine. It is recommended to set it to ZR[100].
- During laser tracking, the welding speed must be less than 30 mm/s.
- If WeaveData, LaserTrackData, ArcTrackData, or StitchData is included, the Out parameter is not supported.

10.27.6 Usage Example



No.	Program	Comment
1	Start	Start
2	Movj P[1],V[30],Z[0],Tool[0],Wobj[0]	Run the robot to the safety point P[1].
3	MovlArcOn P[2],V[30],Z[0],ArcData[0],Tool[0],Wobj[0]	Run the robot to the arc start point P[2].
4	MovlArc P[3],V[30],Z[0],ArcData[0], WeaveData[0],Tool[0],Wobj[0]	Perform weaving from P[2] to P[3].
5	MovcArc P[4],V[30],Z[0],ArcData[0],Tool[0],Wobj[0]	Run the first segment of the first circular arc.
6	MovcArc P[5],V[30],Z[0],ArcData[0],Tool[0],Wobj[0]	Run the second segment of the first circular arc.
7	MovcArc P[6],V[30],Z[0],ArcData[0],Tool[0],Wobj[0]	Run the first segment of the second circular arc.
8	MovcArcOff P[7],V[30],Z[0],ArcData[0],Tool[0],Wobj[0]	Run the second segment of the second circular arc, and extinguish arc at point P[7].
9	Movj P[8],V[30],Z[0],Tool[0],Wobj[0]	Run the robot to the safety point P[8].
10	END	End

10.28 MovcArc

10.28.1 Description

This instruction is a welding process instruction used to move the robot by circular interpolation.

MovcArc instructions must appear in pairs. For all parameters except P, the values from the second instruction of the pair take precedence. A MovcArc instruction can also be paired with MovcArcOff.

After installing the welding process plugin, the MovcArc instruction can be added on the "Program" > "Add" > "Welding process" page.

10.28.2 Format

MovcArc P[1], PR[0]/LPR[0], V[30], Z[0], ArcData[1],RampToV[0], WeaveData[0], RampToWD[0],LaserTrackData[0],ArcTrackData[0], StitchData[0], RPM[0], Tool[0], Wobj[0] , Acc[50], Out(0, OFF, T[0]);

Parameters underlined are optional, while others are required parameters.

10.28.3 Parameter Description

- Compared with motion instructions, the following parameters are added: PR, ArcData, WeaveData, LaserTrackData, StitchData, and RPM. The following parameters are omitted: Until, SLMode, and NWait. The ArcOn instruction includes the NWait function by default, which is not displayed in the instruction. Other parameters are consistent with those in the motion instructions.
- PR/LPR: optional parameters, choose either PR or LPR. PR: system offset variable, type: integer, range: 0 to 255. LPR: local offset variable, type: integer, range: 0 to 255. When the instruction includes this parameter during motion, the XYZ values of PR are directly replaced into the point P of the motion instruction. Only the XYZ coordinates of the instruction's target point are changed; the values of P[0] remains unchanged. For example, assume P[0] = {(1,2,3,4,5,6),(0,0,0,0),(0,0,0,0,0,0)}; PR[0] = (11,22,33,44,55,66); then during actual operation, the target point for the motion is {(11,22,33,4,5,6), (0,0,0,0),(0,0,0,0,0,0)}. This parameter is generally used with the laser seam finding instruction SearchL or SearchJ for scenarios such as detecting points and moving to points, detecting reference and moving by reference, or searching for the tracking start point. PR is used to record the weld seam position obtained by the search. In this case, P[0] is only used to specify the motion orientation and external axis values.
- ArcData: required parameter, type: integer, range: 0 to 63. This parameter specifies the welding parameters, including three sub-parameters: arc start data, welding process data, and arc end data. For details, see the 6 ArcData section.
- WeaveData: optional parameter, type: integer, range: 0 to 63. This parameter specifies the weaving variable. For a welding instruction that includes this parameter, if the weaving enable state is active, weaving is performed according to the parameters in the specified weaving variable. For details, see the 9.1 Weaving section.
- LaserTrackData: optional parameter, type: integer, range: 0 to 63, mutually exclusive with ArcTrackData and StitchData. This parameter specifies the tracking variable. For a welding instruction that includes this parameter, if the tracking enable state is active, tracking is performed according to the parameters in the specified tracking variable. For details, see the 9.3.3 Laser Tracking section.

- ArcTrackData: optional parameter, type: integer, range: 0 to 63, mutually exclusive with LaserTrackData and StitchData. This parameter specifies the tracking variable. For a welding instruction that includes this parameter, if the tracking enable state is active, tracking is performed according to the parameters in the specified tracking variable. For details, see the 9.4 Arc Tracking section.
- RPM: optional parameter, type: integer, range: 0 to 63. When this parameter is included, the point path is stored in RPM, which actually records the points on the guide line. Note that these points are not retained after power failure. If power failure retention is required, use MPSaveRPM to save the path to a file, and then use MPLoadRPM to load the path. When MovlArcOn includes RPM, after the program runs to the ArcOn instruction, the points in the corresponding RPM index are cleared first, and then recording starts. Subsequent welding motion instructions must include the same RPM parameter until the arc end instruction. Otherwise, an alarm occurs. For details, see the 9.5 Multi-Layer and Multi-Pass section.
- StitchData: optional parameter, type: integer, range: 0~63, mutually exclusive with WeaveData, LaserTrackData, and ArcTrackData. This parameter specifies the stitch welding parameters. When used in the MovlArcOn instruction, StitchData has no effect; it is included solely for consistency in parameter syntax with other four instructions. For details, see the 9.6 Stitch Welding section.
- RampToV: optional parameter, type: double-precision floating-point, range: 1.0 to 30.0. This parameter specifies the speed slope parameter. For details, see the 9.7.2 Welding Speed Slope section.
- RampToWD: optional parameter, type: integer, range: 0 to 63. This parameter specifies the weaving slope parameter. For details, see the 9.7.3 Weaving Slope section.
- Arc intermediate point single-step stop (supported in V4R3C2 and later): When LaserTrackData, ArcTrackData, or StitchData is included, this parameter does not take effect and no related effects are produced. When WeaveData is included, the robot does not weave at the intermediate point and stops if weaving is disabled; if weaving is enabled, the robot weaves and does not stop at the intermediate point.

10.28.4 Scope

Multitasking: Only effective in the main tasks. It can exist in a function and can only be called by the main task.

Mode:

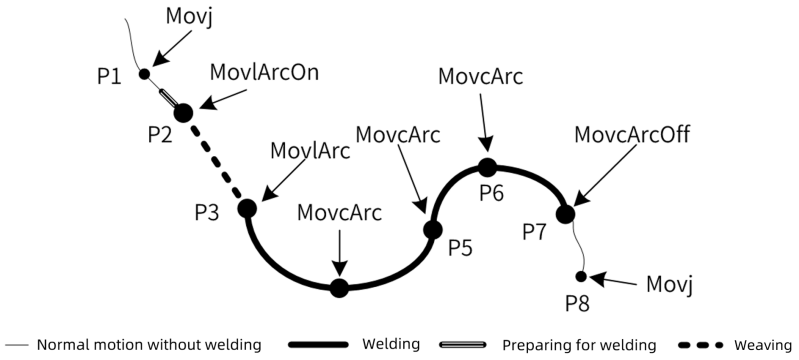
- In Manual mode:
  - When running the program step by step using the single-step button, neither welding nor weaving is performed, regardless of the states of the welding enable switch and the weaving enable switch.
  - When the welding enable switch is in the "Weld disable" state, running the instruction via the start button results in no welding. When the welding enable switch is in the "Weld enable" state, running the instruction via the start button performs welding according to the ArcData settings.
  - If the WeaveData parameter is included, whether weaving is performed is determined by the state of the weaving enable button: when the button is in the "Weave enable" state, weaving is performed; when it is in the "Weave disable" state, weaving is not performed.
  - If the LaserTrackData parameter is included, when the instruction is run via the start button, whether tracking is performed is determined by the state of the tracking enable button: when the button is in the "Tracking enable" state, tracking is performed; when it is in the "Tracking disable" state, tracking is not performed.

- In Auto mode:
  - When the welding enable switch is in the "Weld disable" state, running the instruction via the start button results in no welding. When the welding enable switch is in the "Weld enable" state, running the instruction via the start button performs welding according to the ArcData settings.
  - If the WeaveData parameter is included, when the instruction is run via the start button, whether weaving is performed is determined by the state of the weaving enable button: when the button is in the "Weave enable" state, tracking is performed; when it is in the "Weave disable" state, tracking is not performed.
  - If the LaserTrackData parameter is included, when the instruction is run via the start button, whether tracking is performed is determined by the state of the tracking enable button: when the button is in the "Tracking enable" state, tracking is performed; when it is in the "Tracking disable" state, tracking is not performed.

10.28.5 Notes

- Three points determine an arc, so MovcArc instructions must appear in pairs and can be paired with MovcArcOff. They cannot be separated by any instructions; even a comment will affect the results and cause alarms.
- In a circular arc movement defined by two MovcArc instructions, all parameters except P are taken from the second instruction.
- The previous instruction of this instruction must be an ArcOn instruction or a welding process instruction.
- Do not add standard motion instructions, such as Movl, Movj, Movc, before or after MovcArc.
- The welding instructions must include the ArcData parameter. Otherwise, an error will be reported when the project is saved.
- If the welding motion instruction Arc includes LaserTrackData, then ArcOn, ArcOff and all welding motion instructions between ArcOn and ArcOff must also include the LaserTrackData. Otherwise, an error will be reported during running.
- When running the program in single-step mode to a line between ArcOn and ArcOff, if you need to click "Continuous" button to switch the mode, set the start line to the ArcOn motion instruction. Otherwise, an error will be reported.
- If the welding motion instruction ArcOn includes RPM, then ArcOff and all welding motion instructions between ArcOn and ArcOff must also include the same RPM. Otherwise, an error will be reported during running.
- If the movement is jerky during tracking, check whether the transition parameter Z in the welding motion instruction is set to 0 or Fine. It is recommended to set it to ZR[100].
- During laser tracking, the welding speed must be less than 30 mm/s.
- If WeaveData, LaserTrackData, ArcTrackData, or StitchData is included, the Out parameter is not supported.

10.28.6 Usage Example



No.	Program	Comment
1	Start;	Start
2	Movj P[1],V[30],Z[0],Tool[0],Wobj[0];	Run the robot to the safety point P[1].
3	MovlArcOn P[2],V[30],Z[0],ArcData[0],Tool[0],Wobj[0];	Run the robot to the arc start point P[2].
4	MovlArc P[3],V[30],Z[0],ArcData[0], WeaveData[0],Tool[0],Wobj[0];	Perform weaving from P[2] to P[3].
5	MovcArc P[4],V[30],Z[0],ArcData[0],Tool[0],Wobj[0];	Run the first segment of the first circular arc.
6	MovcArc P[5],V[30],Z[0],ArcData[0],Tool[0],Wobj[0];	Run the second segment of the first circular arc.
7	MovcArc P[6],V[30],Z[0],ArcData[0],Tool[0],Wobj[0];	Run the first segment of the second circular arc.
8	MovcArcOff P[7],V[30],Z[0],ArcData[0],Tool[0],Wobj[0];	Run the second segment of the second circular arc, and extinguish arc at point P7.
9	Movj P[8],V[30],Z[0],Tool[0],Wobj[0];	Run the robot to the safety point P[8].
10	END	End

10.29 MovlArcOff

10.29.1 Description

This instruction is an arc end instruction used to move the robot by linear interpolation.

After installing the welding process plugin, the MovlArcOff instruction can be added on the "Program" > "Add" > "Welding process" page.

10.29.2 Format

MovlArcOff P[1], PR[0]/LPR[0], V[30], Z[0], ArcData[1], RampToV[0],WeaveData[0], RampToWD[0],LaserTrackData[0], ArcTrackData[0], StitchData[0], RPM[0], Tool[0], Wobj[0] , Acc[50], Out(0, OFF, T[0]);

Parameters underlined are optional, while others are required parameters.

10.29.3 Parameter Description

- Compared with motion instructions, the following parameters are added: PR, ArcData, WeaveData, LaserTrackData, StitchData, and RPM. The following parameters are omitted: Until, SLMode, and NWait. The ArcOn instruction includes the NWait function by default, which is not displayed in the instruction. Other parameters are consistent with those in the motion instructions.
- PR/LPR: optional parameters, choose either PR or LPR. PR: system offset variable, type: integer, range: 0 to 255. LPR: local offset variable, type: integer, range: 0 to 255. When the instruction includes this parameter during motion, the XYZ values of PR are directly replaced into the point P of the motion instruction. Only the XYZ coordinates of the instruction's target point are changed; the values of P[0] remains unchanged. For example, assume P[0] = {(1,2,3,4,5,6),(0,0,0,0),(0,0,0,0,0,0)}; PR[0] = (11,22,33,44,55,66); then during actual operation, the target point for the motion is {(11,22,33,4,5,6),(0,0,0,0),(0,0,0,0,0,0)}. This parameter is generally used with the laser seam finding instruction SearchL or SearchJ for scenarios such as detecting points and moving to points, detecting reference and moving by reference, or searching for the tracking start point. PR is used to record the weld seam position obtained by the search. In this case, P[0] is only used to specify the motion orientation and external axis values.
- ArcData: required parameter, type: integer, range: 0 to 63. This parameter specifies the welding parameters, including three sub-parameters: arc start data, welding process data, and arc end data. For details, see the 6 ArcData section.
- WeaveData: optional parameter, type: integer, range: 0 to 63. This parameter specifies the weaving variable. For a welding instruction that includes this parameter, if the weaving enable state is active, weaving is performed according to the parameters in the specified weaving variable. For details, see the 9.1 Weaving section.
- LaserTrackData: optional parameter, type: integer, range: 0 to 63, mutually exclusive with ArcTrackData and StitchData. This parameter specifies the tracking variable. For a welding instruction that includes this parameter, if the tracking enable state is active, tracking is performed according to the parameters in the specified tracking variable. For details, see the 9.3.3 Laser Tracking section.
- ArcTrackData: optional parameter, type: integer, range: 0 to 63, mutually exclusive with LaserTrackData and StitchData. This parameter specifies the tracking variable. For a welding instruction that includes this parameter, if the tracking enable state is active, tracking is performed according to the parameters in the specified tracking variable. For details, see the 9.4 Arc Tracking section.
- RPM: optional parameter, type: integer, range: 0 to 63. When this parameter is included, the point path is stored in RPM, which actually records the points on the guide line. Note that these points are not retained after power failure. If power failure retention is required, use MPSaveRPM to save the path to a file, and then use MPLoadRPM to load the path. When MovlArcOn includes RPM, after the program runs to the ArcOn instruction, the points in the corresponding RPM index are cleared first, and then recording starts. Subsequent welding motion instructions must include the same RPM parameter until the arc end instruction. Otherwise, an alarm occurs. For details, see the 9.5 Multi-Layer and Multi-Pass section.

- StitchData: optional parameter, type: integer, range: 0~63, mutually exclusive with WeaveData, LaserTrackData, and ArcTrackData. This parameter specifies the stitch welding parameters. When used in the MovlArcOn instruction, StitchData has no effect; it is included solely for consistency in parameter syntax with other four instructions. For details, see the 9.6 Stitch Welding section.
- RampToV: optional parameter, type: double-precision floating-point, range: 1.0 to 30.0. This parameter specifies the speed slope parameter. For details, see the 9.7.2 Welding Speed Slope section.
- RampToWD: optional parameter, type: integer, range: 0 to 63. This parameter specifies the weaving slope parameter. For details, see the 9.7.3 Weaving Slope section.

10.29.4 Scope

Multitasking: Only effective in the main tasks. It can exist in a function and can only be called by the main task.

Mode:

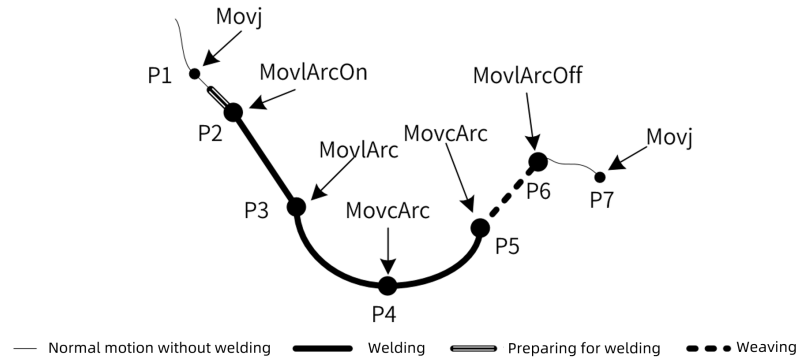
- In Manual mode:
  - When running the program step by step using the single-step button, neither welding nor weaving is performed, regardless of the states of the welding enable switch and the weaving enable switch.
  - When the welding enable switch is in the "Weld disable" state, running the instruction via the start button results in no welding. When the welding enable switch is in the "Weld enable" state, running the instruction via the start button performs welding according to the ArcData settings.
  - If the WeaveData parameter is included, whether weaving is performed is determined by the state of the weaving enable button: when the button is in the "Weave enable" state, weaving is performed; when it is in the "Weave disable" state, weaving is not performed.
  - If the LaserTrackData parameter is included, when the instruction is run via the start button, whether tracking is performed is determined by the state of the tracking enable button: when the button is in the "Tracking enable" state, tracking is performed; when it is in the "Tracking disable" state, tracking is not performed.
- In Auto mode:
  - When the welding enable switch is in the "Weld disable" state, running the instruction via the start button results in no welding. When the welding enable switch is in the "Weld enable" state, running the instruction via the start button performs welding according to the ArcData settings.
  - If the WeaveData parameter is included, when the instruction is run via the start button, whether weaving is performed is determined by the state of the weaving enable button: when the button is in the "Weave enable" state, tracking is performed; when it is in the "Weave disable" state, tracking is not performed.
  - If the LaserTrackData parameter is included, when the instruction is run via the start button, whether tracking is performed is determined by the state of the tracking enable button: when the button is in the "Tracking enable" state, tracking is performed; when it is in the "Tracking disable" state, tracking is not performed.

10.29.5 Notes

- The previous instruction of this instruction must be an ArcOn instruction or a welding process instruction.
- The welding instructions must include the ArcData parameter. Otherwise, an error will be reported when the project is saved.

- If the welding motion instruction Arc includes LaserTrackData, then ArcOn, ArcOff and all welding motion instructions between ArcOn and ArcOff must also include the LaserTrackData. Otherwise, an error will be reported during running.
- When running the program in single-step mode to a line between ArcOn and ArcOff, if you need to click "Continuous" button to switch the mode, set the start line to the ArcOn motion instruction. Otherwise, an error will be reported.
- If the welding motion instruction ArcOn includes RPM, then ArcOff and all welding motion instructions between ArcOn and ArcOff must also include the same RPM. Otherwise, an error will be reported during running.
- If the movement is jerky during tracking, check whether the transition parameter Z in the welding motion instruction is set to 0 or Fine. It is recommended to set it to ZR[100].
- During laser tracking, the welding speed must be less than 30 mm/s.
- If WeaveData, LaserTrackData, ArcTrackData, or StitchData is included, the Out parameter is not supported.

10.29.6 Usage Example



No.	Program	Comment
1	Start;	Start
2	Movj P[1],V[30],Z[0],Tool[0],Wobj[0]	Run the robot to the safety point P[1].
3	MovlArcOn P[2],V[30],Z[0],ArcData[0],Tool[0],Wobj[0]	Run the robot to the arc start point P[2].
4	MovlArc P[3],V[30],Z[0],ArcData[0],Tool[0],Wobj[0]	Perform weaving from P[2] to P[3].
5	MovcArc P[4],V[30],Z[0],ArcData[0],Tool[0],Wobj[0]	Run the first segment of the first circular arc.
6	MovcArc P[5],V[30],Z[0],ArcData[0],Tool[0],Wobj[0]	Run the second segment of the first circular arc.
7	MovlArcOff P[6],V[30],Z[0],ArcData[0],Tool[0],Wobj[0]	Run the robot to the arc end point P[6].
9	Movj P[7],V[30],Z[0],Tool[0],Wobj[0]	Run the robot to the safety point P[7].
10	END	End

10.30 MovcArcOff

10.30.1 Description

This instruction is an arc end instruction used to move the robot by circular interpolation.

MovcArcOff must be paired with MovcArc and must serve as the second segment of the circular arc.

After installing the welding process plugin, the MovcArcOff instruction can be added on the "Program" > "Add" > "Welding process" page.

10.30.2 Format

MovcArcOff P[1], PR[0]/LPR[0], V[30], Z[0], ArcData[1],RampToV[0], WeaveData[0], RampToWD[0],LaserTrackData[0], ArcTrackData[0], StitchData[0], RPM[0], Tool[0], Wobj[0] , Acc[50], Out(0, OFF, T[0]);

Parameters underlined are optional, while others are required parameters.

10.30.3 Parameter Description

- Compared with motion instructions, the following parameters are added: PR, ArcData, WeaveData, LaserTrackData, StitchData, and RPM. The following parameters are omitted: Until, SLMode, and NWait. The ArcOn instruction includes the NWait function by default, which is not displayed in the instruction. Other parameters are consistent with those in the motion instructions.
- PR/LPR: optional parameters, choose either PR or LPR. PR: system offset variable, type: integer, range: 0 to 255. LPR: local offset variable, type: integer, range: 0 to 255. When the instruction includes this parameter during motion, the XYZ values of PR are directly replaced into the point P of the motion instruction. Only the XYZ coordinates of the instruction's target point are changed; the values of P[0] remains unchanged. For example, assume P[0] = {(1,2,3,4,5,6),(0,0,0,0),(0,0,0,0,0,0)}; PR[0] = (11,22,33,44,55,66); then during actual operation, the target point for the motion is {(11,22,33,4,5,6),(0,0,0,0),(0,0,0,0,0,0)}. This parameter is generally used with the laser seam finding instruction SearchL or SearchJ for scenarios such as detecting points and moving to points, detecting reference and moving by reference, or searching for the tracking start point. PR is used to record the weld seam position obtained by the search. In this case, P[0] is only used to specify the motion orientation and external axis values.
- ArcData: required parameter, type: integer, range: 0 to 63. This parameter specifies the welding parameters, including three sub-parameters: arc start data, welding process data, and arc end data. For details, see the 6 ArcData section.
- WeaveData: optional parameter, type: integer, range: 0 to 63. This parameter specifies the weaving variable. For a welding instruction that includes this parameter, if the weaving enable state is active, weaving is performed according to the parameters in the specified weaving variable. For details, see the 9.1 Weaving section.
- LaserTrackData: optional parameter, type: integer, range: 0 to 63, mutually exclusive with ArcTrackData and StitchData. This parameter specifies the tracking variable. For a welding instruction that includes this parameter, if the tracking enable state is active, tracking is performed according to the parameters in the specified tracking variable. For details, see the 9.3.3 Laser Tracking section.
- ArcTrackData: optional parameter, type: integer, range: 0 to 63, mutually exclusive with LaserTrackData and StitchData. This parameter specifies the tracking variable. For a welding instruction that includes this

parameter, if the tracking enable state is active, tracking is performed according to the parameters in the specified tracking variable. For details, see the 9.4 Arc Tracking section.

- RPM: optional parameter, type: integer, range: 0 to 63. When this parameter is included, the point path is stored in RPM, which actually records the points on the guide line. Note that these points are not retained after power failure. If power failure retention is required, use MPSaveRPM to save the path to a file, and then use MPLoadRPM to load the path. When MovlArcOn includes RPM, after the program runs to the ArcOn instruction, the points in the corresponding RPM index are cleared first, and then recording starts. Subsequent welding motion instructions must include the same RPM parameter until the arc end instruction. Otherwise, an alarm occurs. For details, see the 9.5 Multi-Layer and Multi-Pass section.
- StitchData: optional parameter, type: integer, range: 0~63, mutually exclusive with WeaveData, LaserTrackData, and ArcTrackData. This parameter specifies the stitch welding parameters. When used in the MovlArcOn instruction, StitchData has no effect; it is included solely for consistency in parameter syntax with other four instructions. For details, see the 9.6 Stitch Welding section.
- RampToV: optional parameter, type: double-precision floating-point, range: 1.0 to 30.0. This parameter specifies the speed slope parameter. For details, see the 9.7.2 Welding Speed Slope section.
- RampToWD: optional parameter, type: integer, range: 0 to 63. This parameter specifies the weaving slope parameter. For details, see the 9.7.3 Weaving Slope section.
- Arc intermediate point single-step stop (supported in V4R3C2 and later): When LaserTrackData, ArcTrackData, or StitchData is included, this parameter does not take effect and no related effects are produced. When WeaveData is included, the robot does not weave at the intermediate point and stops if weaving is disabled; if weaving is enabled, the robot weaves and does not stop at the intermediate point.

10.30.4 Scope

Multitasking: Only effective in the main tasks. It can exist in a function and can only be called by the main task.

Mode:

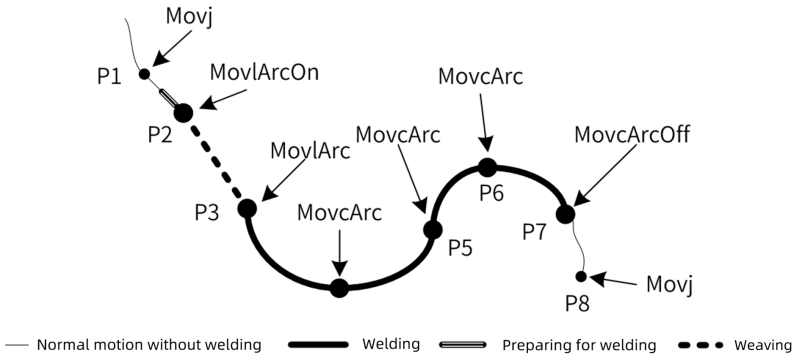
- In Manual mode:
  - When running the program step by step using the single-step button, neither welding nor weaving is performed, regardless of the states of the welding enable switch and the weaving enable switch.
  - When the welding enable switch is in the "Weld disable" state, running the instruction via the start button results in no welding. When the welding enable switch is in the "Weld enable" state, running the instruction via the start button performs welding according to the ArcData settings.
  - If the WeaveData parameter is included, whether weaving is performed is determined by the state of the weaving enable button: when the button is in the "Weave enable" state, weaving is performed; when it is in the "Weave disable" state, weaving is not performed.
  - If the LaserTrackData parameter is included, when the instruction is run via the start button, whether tracking is performed is determined by the state of the tracking enable button: when the button is in the "Tracking enable" state, tracking is performed; when it is in the "Tracking disable" state, tracking is not performed.
- In Auto mode:
  - When the welding enable switch is in the "Weld disable" state, running the instruction via the start button results in no welding. When the welding enable switch is in the "Weld enable" state, running the instruction via the start button performs welding according to the ArcData settings.

- If the WeaveData parameter is included, when the instruction is run via the start button, whether weaving is performed is determined by the state of the weaving enable button: when the button is in the "Weave enable" state, tracking is performed; when it is in the "Weave disable" state, tracking is not performed.
- If the LaserTrackData parameter is included, when the instruction is run via the start button, whether tracking is performed is determined by the state of the tracking enable button: when the button is in the "Tracking enable" state, tracking is performed; when it is in the "Tracking disable" state, tracking is not performed.

10.30.5 Notes

- Three points determine an arc, so MovcArcOff must be paired with MovcArc. They cannot be separated by any instructions; even a comment will affect the results and cause alarms.
- When pairing MovcArcOff with MovcArc, MovcArcOff must be the second segment of the arc. Otherwise, an error will be reported when the project is saved.
- The previous instruction of this instruction must be MovcArc.
- Before the MovcArcOff instruction, the program must contain an arc start instruction MovlArcOn. Otherwise, an error will be reported when the project is saved.
- Non-welding motion instructions (e.g., Movl, Movj, Movc, Home, etc.) are not allowed between an arc start instruction and an arc end instruction. Otherwise, an error will be reported when the project is saved.
- If the welding motion instruction ArcOff includes LaserTrackData, then ArcOn and all welding motion instructions between ArcOn and ArcOff must also include the LaserTrackData. Otherwise, an error will be reported during running.
- When running the program in single-step mode to a line between ArcOn and ArcOff, if you need to click "Continuous" button to switch the mode, set the start line to the ArcOn motion instruction. Otherwise, an error will be reported.
- If the welding motion instruction ArcOn includes RPM, then ArcOff and all welding motion instructions between ArcOn and ArcOff must also include the same RPM. Otherwise, an error will be reported during running.
- If the movement is jerky during tracking, check whether the transition parameter Z in the welding motion instruction is set to 0 or Fine. It is recommended to set it to ZR[100].
- During laser tracking, the welding speed must be less than 30 mm/s.
- If WeaveData, LaserTrackData, ArcTrackData, or StitchData is included, the Out parameter is not supported.

10.30.6 Usage Example



No.	Program	Comment
1	Start	Start
2	Movj P[1],V[30],Z[0],Tool[0],Wobj[0]	Run the robot to the safety point P[1].
3	MovlArcOn P[2],V[30],Z[0],ArcData[0],Tool[0],Wobj[0]	Run the robot to the arc start point P[2].
4	MovlArc P[3],V[30],Z[0],ArcData[0], WeaveData[0],Tool[0],Wobj[0]	Perform weaving from P[2] to P[3].
5	MovcArc P[4],V[30],Z[0],ArcData[0],Tool[0],Wobj[0]	Run the first segment of the first circular arc.
6	MovcArc P[5],V[30],Z[0],ArcData[0],Tool[0],Wobj[0]	Run the second segment of the first circular arc.
7	MovcArc P[6],V[30],Z[0],ArcData[0],Tool[0],Wobj[0]	Run the first segment of the second circular arc.
8	MovcArcOff P[7],V[30],Z[0],ArcData[0],Tool[0],Wobj[0]	Run the second segment of the second circular arc, and extinguish arc at point P7.
9	Movj P[8],V[30],Z[0],Tool[0],Wobj[0]	Run the robot to the safety point P[8].
10	END	End

11 Appendix

11.1 Arc Welding Alarm Information Table

Fault code	Description	Fault cause	Solution
0x20D0	Received collision signal	Collision signal is received.	1. Check if the robot manipulator has collided. If a collision has occurred, move the robot to a safe position 2. If the welding torch anti-collision function is used, check if the welding torch has collided. If a collision has occurred, move the welding torch to a safe position.
0xE201	Arc api error	The until parameter is not allowed in welding instructions.	Check the instructions.
0xE202	Arc params error	The parameter in the welding instruction is out of range.	Refer to the line number indicated in the message bar and check if any parameter in the instruction at that line number is set out of range.
0xE203	Arc communication error	The communication between the welder and the robot is abnormal.	Check the welder communication.
0xE204	Wire stick check alarm, Please check if there is any adhesion between the welding wire and the workpiece	The welding wire sticks to the workobject.	1. Check whether the welding wire sticks to the workobject or contact tip. 2. Check the wire drive roll for any damage, and clean the wire conduit and contact tip.
0xE205	Arc Parameters Reading Error	1. The parameter value is abnormal. 2. The parameter writing is abnormal.	1. Check the parameter range. 2. Check the secondary development environment.

Fault code	Description	Fault cause	Solution
0xE206	Arc On Error	1. The welding parameter settings are inappropriate. 2. The welding procedure is incorrect.	Check the welding process parameters and the procedure
0xE207	Arc Off Error	1. The welding parameter settings are inappropriate. 2. The welding procedure is incorrect.	Check the welding process parameters and the procedure
0xE208	Arc Initial Parameters Reading Error	Reading or writing the welding PF file failed.	Check whether the PF file exists.
0xE209	Arc Machine Error	A welder fault has occurred.	Refer to the corresponding welder troubleshooting guide based on the welder display.
0xE20A	Weave from joint point to cartesian pose error	The point selection of weaving guide line and the weaving process parameter settings are unreasonable.	Perform the point selection again and check the process parameters.
0xE20B	Weave get point error	The point selection of weaving guide line and the weaving process parameter settings are unreasonable.	Perform the point selection again and check the process parameters.
0xE20C	Weave from cartesian pose to joint point error	The point selection of weaving guide line and the weaving process parameter settings are unreasonable.	Perform the point selection again and check the process parameters.
0xE20D	Weave shape param setting error	The weaving type is set incorrectly. The controller does not support this weaving type.	Check the weaving process parameters.
0xE20E	Error welding restart backward	The parameter settings are unreasonable.	1. Set a reasonable move back distance. 2. Select a reasonable teaching point for welding.

Fault code	Description	Fault cause	Solution
0xE211	The guide line distance is insufficient or the stay time is too long	The parameter settings are unreasonable.	1. The end point dwell time is too long. 2. Re-acquire the point positions of the weaving guide line.
0xE212	The parameters of swing welding are not reasonable	The weaving parameter settings are abnormal.	1. Increase the frequency. 2. Reduce the welding speed.
0xE213	Flight arc error	1. The parameter value is abnormal. 2. The parameter writing is abnormal.	Check the parameter range.
0xE214	The welder power supplier does not exist	The parameter value is abnormal.	1. Check the parameter range. 2. Reconfigure the parameter.
0xE215	Welding power supply failure	An internal error is present in the welder.	Check the welder.
0xE216	Gas depletion	The gas runs out.	Check the gas cylinder.
0xE217	Welding interruption arc	An abnormal arc break occurs during welding.	Check the welding signal.
0xE218	The welding wire is exhausted	The welding wire is exhausted, or another wire-related abnormality has occurred.	Check whether the welding wire is exhausted and check the wire feeding condition of the welder.

Fault code	Description	Fault cause	Solution
0xE219	I/O configuration conflict	1. The flying arc start or pre-gas function is enabled, and Out[12] or Out[13] is occupied by another function. 2. The laser seam finding, touch sensing, stitch welding, welding torch anti-collision, or the welder signal configuration under analog communication has the same I/O settings as each other, or the set I/O is already occupied by another function.	1. If the flying arc start function is enabled in the welder configuration, check whether another function occupies Out[12]. 2. If the pre-gas time is set in the ArcData welding parameter, check whether another function occupies Out[13]. 3. Check whether the laser seam finding, touch sensing, stitch welding, welding torch anti-collision, or the welder signal configuration under analog communication has the same I/O settings as each other, or an I/O setting that is already occupied by another function.
0xE21A	External tools are not supported for welding	The welding function does not support external tools.	Check whether the tool is set as an external tool.
0xE21B	PRs are not allowed in the contact position-finding command	The PR parameter is not allowed in touch sensing instructions.	Remove the PR parameter from the touch sensing instructions.
0xE21C	No PR is allowed in the calculation of the seek point offset	The PR parameter is not allowed when calculating the search point offset.	Remove the PR parameter in welding instructions under the offset effect.
0xE21D	The laser binding tool number does not match the programming	The tool number in the welding motion instruction is inconsistent with the tool number bound to the currently active laser sensor.	Check the laser sensor configuration page and verify whether the tool number bound to the corresponding laser sensor matches the tool number in the instruction.

Fault code	Description	Fault cause	Solution
0xE21E	The homing input signal port is not set	The position search input signal port is not set.	Check whether the position search input signal is set in the search parameters.
0xE21F	It is not allowed to enable or disable swing during the weave welding	It is not allowed to toggle the state of the weaving enable button during welding.	Do not toggle the state of the weaving enable button during welding.
0xE221	No Touch WorkPiece Seek Fail	1. The distance parameter in the position search settings is unreasonable. 2. The deviation between the workobject position and the reference template position is too large.	Check the distance setting for search.
0xE222	Calculate Seek Error Fail	1. The search parameter settings are abnormal. 2. The search frame calibration is abnormal.	1. Check the search parameter settings. 2. Recalibrate the search frame.
0xE223	X Direct Over Setting Max Distance	1. The parameter value is abnormal. 2. The parameter writing is abnormal.	1. Check the parameter range. 2. Check the workobject position.
0xE224	Y Direct Over Setting Max Distance	1. The parameter value is abnormal. 2. The parameter writing is abnormal.	1. Check the parameter range. 2. Check the workobject position.
0xE225	Z Direct Over Setting Max Distance	1. The parameter value is abnormal. 2. The parameter writing is abnormal.	1. Check the parameter range. 2. Check the workobject position.
0xE226	Seek inverse solution fail	1. The parameter settings are inappropriate. 2. The point selection is unreasonable.	1. Check the search process parameters. 2. Reset the teaching point.

Fault code	Description	Fault cause	Solution
0xE227	Seek Point Over Max Point Numbers	The accumulated number of position searches during programming exceeds the maximum allowed count of 15.	Reduce the number of position searches during programming.
0xE228	Setting Seek Type Error	The position search type does not match the program.	1. Check the set position search type. 2. Check the edited position search program.
0xE229	Setting Seek Number Error	The position search process number used in the program is incorrect.	Check the edited position search program.
0xE22B	The current workpiece coordinate system is inconsistent with the homing coordinate system	The frame used in the instruction is inconsistent with the workobject frame selected in the touch sensing parameters.	Check whether the workobject frame used in the search instruction is consistent with the workobject frame selected in the touch sensing parameters.
0xE22C	Easy retrieval of two consecutive homing substitution directions are the same	In simple search, the replacement directions of two consecutive position searches are the same.	Check whether the replacement directions of two consecutive position searches are the same.
0xE22D	The search type for Easy Search is not set to 2D	The search type for simple search is not set to 2D.	Check whether simple search is enabled in the touch sensing parameters but the search type is not set to 2D.
0xE22E	The number of position-finding action instructions in the program does not meet the requirements of simple retrieval of two position-seeking action commands	The number of position search motion instructions in the program does not meet the requirement of two instructions for simple search.	Check whether simple search is set in the touch sensing parameter, but the number of position search motion instructions is not two.
0xE230	Get Torch Position Fail	The system is busy or a system processing error has occurred.	1. Restart the controller. 2. Contact the manufacturer.

Fault code	Description	Fault cause	Solution
0xE231	Failed to turn on the laser	1. The sensor is not connected. 2. The sensor configuration information does not match the manufacturer's specifications.	1. Check the connection status of the laser sensor. 2. Check whether the IP address and port number of the laser sensor are correct. 3. Check whether the manufacturer selected in the sensor configuration corresponds to the actual sensor.
0xE232	Turning off the laser failed	1. The sensor is not connected. 2. The sensor configuration information does not match the manufacturer's specifications.	1. Check the connection status of the laser sensor. 2. Check whether the IP address and port number of the laser sensor are correct. 3. Check whether the manufacturer selected in the sensor configuration corresponds to the actual sensor.
0xE233	The actual number of search points does not match the number of search points of the lookup type	The number of laser position search instructions does not match the search type specified in the position search parameters.	Modify the number of search instructions or the search type in the search parameters.
0xE234	The position-finding process number exceeds the maximum process number	Access to the position search parameter index exceeds the maximum access limit of 63.	Resave the parameters, and check the parameter index in the instruction.
0xE235	Laser jitter is greater than the threshold	After the robot recognizes the weld seam, during data acquisition, robot vibration or unstable sensor data causes the data to exceed the error threshold.	Adjust the threshold appropriately or reduce the position search speed to ensure stable sensor recognition.

Fault code	Description	Fault cause	Solution
0xE236	Laser homing error calculation failed	The position search condition is not satisfied. For circular position search, the three points must not be collinear.	Adjust the search parameters or re-teach the search point.
0xE237	The X-direction homing distance exceeds the maximum distance	The X-direction offset distance exceeds the maximum limit set in the parameter.	Adjust the search point or modify the maximum distance in the parameter.
0xE238	The Y direction homing distance exceeds the maximum distance	The Y-direction offset distance exceeds the maximum limit set in the parameter.	Adjust the search point or modify the maximum distance in the parameter.
0xE239	The Z direction homing distance exceeds the maximum distance	The Z-direction offset distance exceeds the maximum limit set in the parameter.	Adjust the search point or modify the maximum distance in the parameter.
0xE23A	The angle of rotation is too large	The angular difference between the current position search workobject and the reference position search workobject is too large.	Readjust the workobject position or modify the corresponding parameters, and then re-establish the reference.
0xE23B	The current workpiece coordinate system used is inconsistent with the position-finding workpiece coordinate system	The workobject frame used in the instruction is inconsistent with the workobject frame used in the position search parameters.	Modify the workobject number in the instruction or modify the workobject number in the parameters.
0xE23C	Setting the finding type does not match programming	This type of search is not supported.	Check the search parameter settings.
0xE23D	Laser positioning did not find the weld	The position search has exceeded the maximum distance without recognizing any weld seam information.	Re-teach the position search points or modify the maximum search distance.
0xE23E	Laser position-finding backsolution calculation failed	Conversion of the Cartesian values of the search point to joint values failed.	Check the maximum search distance or whether the instruction parameters are correct

Fault code	Description	Fault cause	Solution
0xE23F	Weld misidentification occurs on the laser position-finding path	An object similar to the weld seam exists on the position search path, causing the robot to stop prematurely without actually detecting the weld seam, possibly due to the laser sensor mistakenly recognizing that object as a weld seam.	Check whether any object similar to a weld seam is present on the weld seam search path. If yes, remove it.
0xE240	The parameter setting for the specified X, Y, and Z offset in LaserData is incorrect	The X, Y, Z offset parameters in the laser seam finding parameters are set incorrectly. 1. The set value is not in the range of 0 to 2. 2. When the search type is set to "1-point" or "2-point" method, all three X, Y, Z offset parameters are set to 0.	1. Set the X, Y, Z offset parameters within the range of 0 to 2. 2. When the search type is set to "1-point" or "2-point" method, ensure that at least one of the X, Y, Z offset parameters is not 0.
0xE241	When the search type for LaserData is either the 1-point or 2-point method, the CalcSearchPR command permits only one PR parameter	When the search type in the laser seam finding parameters is set to the "1-point" or "2-point" method, the CalcSearchPR instruction allows only one PR parameter.	Ensure that the CalcSearchPR instruction includes only one PR parameter when the search type is "1-point" or "2-point".
0xE270	The laser is not connected	The laser sensor is not connected.	Check the connection status of the laser sensor, and check whether the IP and port number are correct.

Fault code	Description	Fault cause	Solution
0xE271	Failed to send laser sensor task number	1. The sensor is not connected. 2. The sensor configuration information does not match the manufacturer's specifications.	1. Check the connection status of the laser sensor. 2. Check whether the IP address and port number of the laser sensor are correct. 3. Check whether the manufacturer selected in the sensor configuration corresponds to the actual sensor. 4. Check whether the task number of the laser sensor is correctly set in the used LaserData or LaserTrackData parameters. The default task number in the parameter is 0. Note that for some sensors, sending task number 0 may result in a transmission failure.

Fault code	Description	Fault cause	Solution
0xE272	Failed to obtain valid weld data during laser tracking, check the sensor recognition status, and re-execute the project	1. The sensor is not connected. 2. The sensor configuration information does not match the manufacturer's specifications. 3. The laser cannot stably recognize the weld seam.	1. Check the connection status of the laser sensor. 2. Check whether the IP address and port number of the laser sensor are correct. 3. Check whether the manufacturer selected in the sensor configuration corresponds to the actual sensor. 4. Check whether the laser sensor can stably recognize the weld seam. 5. Check the weld seam for the presence of large weld spatter or debris that might cause the laser sensor to fail in recognition. Note: After tracking is stopped due to this alarm, the program must be re-executed from the arc start position.
0xE273	When the Arc command contains LaserTrackData, the ArcOn command must contain LaserTrackData	The Arc or ArcOff instruction includes laser tracking parameters, but the ArcOn instruction does not.	1. Check whether ArcOn instruction does not include the laser tracking parameter, but the Arc or ArcOff instruction does. 2. Check whether Arc or ArcOff instruction is executed directly without first running the ArcOn instruction.

Fault code	Description	Fault cause	Solution
0xE274	Laser tracking failed to convert the workpiece coordinate system from the laser coordinate system	An abnormal point was obtained, causing the conversion to fail.	1. Check whether the acquired point is near a singularity. 2. Check whether the laser sensor can stably recognize the weld seam and whether any false recognition occurs.
0xE275	Laser tracking fails to convert joint values into Cartesian space	An abnormal point has occurred.	Check whether an abnormal point is detected.
0xE276	If the ArcOn command contains LaserTrackData, and the welding command between the ArcOn and ArcOff needs to be carried out with LaserTrackData	The ArcOn includes laser tracking parameters, but the Arc or ArcOff instruction does not.	Ensure that the Arc and ArcOff instructions include the laser tracking parameter if ArcOn includes it.
0xE277	The distance between the arc segment points is too small	The distances between the three points of the circular arc are too small.	Check whether the distances between the three points of the circular arc are too small.
0xE278	Failed to obtain motion data in the instruction, please check whether the point, tool, wobj and other parameters in the instruction are reasonable	Failed to decode and obtain the motion data in the instruction.	1. Check whether the point in the instruction is an abnormal point, e.g., a singular point. 2. Check whether the tool in the instruction is reasonable and whether parameters such as Dec, Acc, V, Z, Out, Tool, Wobj are within valid ranges. 3. Check whether there is any other instruction (including comments) between the circular arc motion instructions near the line number where the alarm occurred. Arc instructions must appear in pairs, and no other instructions are allowed between them.

Fault code	Description	Fault cause	Solution
0xE279	Unreasonable setting of swing frequency and blind distance for laser tracking in swing welding	1. The weaving frequency and blind zone distance settings for laser tracking are unreasonable. 2. The welding speed is too high. 3. The weaving frequency is too low.	1. Adjust the installation of the laser sensor, and set the blind zone distance in the laser tracking parameters to the actual blind zone distance. 2. Reduce the welding speed. 3. Increase the weaving frequency.
0xE27A	When laser tracking, the actual starting point of the arc segment exceeds the midpoint of the teaching	During laser tracking, the actual start point of the circular arc segment is located after the intermediate point defined during teaching. This may cause a sudden change in the orientation of the external axis or the welding torch.	1. Check the relationship between the actual start point of the circular arc segment and the teaching start point and intermediate point, to determine whether the start point is located after the intermediate point. 2. Adjust the actual start point of the circular arc segment.
0xE27B	The calibration results of the currently activated laser sensor are all 0	All calibration results of the currently active laser sensor are zero.	1. Check if the calibration results of the active sensor on the laser sensor configuration page are all 0, and whether the correct laser is selected. 2. If the active sensor has not been calibrated, calibrate it before use.
0xE280	The number of current data exceeds the limit	The amount of data collected in one cycle is too large.	Reduce the tracking cycle time, for example, by decreasing the left and right dwell times.
0xE281	Wrong weave type	The weaving type is not "Zigzag".	Set the weaving type to "Zigzag".
0xE282	Insufficient effective current data	The current data is unstable.	Adjust the welding site conditions or the welding process parameters.

Fault code	Description	Fault cause	Solution
0xE283	Tracking condition not enabled for tracking	The vertical or lateral compensation function is not enabled in the arc tracking conditions.	Enable the vertical or lateral compensation function in the arc tracking conditions.
0xE286	Under effective arc tracking, missing track instructions	In the tracking enabled state, the ArcTrackData parameter is missing.	Add the ArcTrackData parameter when arc tracking is enabled.
0xE287	Under effective arc tracking, central uplift is not supported	Central rise is enabled in the weaving conditions.	Disable central rise in the weaving conditions.
0xE288	Under effective arc tracking, L-WEAVE is not supported	L-weave is enabled in the weaving conditions.	Disable L-weave in the weaving conditions.
0xE289	Abnormal reference current data	The reference current data is much smaller or much larger than the current value in the welding conditions.	First, check whether the reference current has been obtained using the "Feedback" method. If the issue persists, then inspect the welding site conditions to stabilize the current.
0xE28A	Both laser tracking and arc tracking commands exist in programming instructions	The programming instruction contains both the laser tracking variable LaserTrackData and the arc tracking variable ArcTrackData.	Remove either LaserTrackData or ArcTrackData.
0xE28B	Under effective arc tracking, weave amplitude is too small	The weaving amplitude is too small.	Set the weaving amplitude to ≥ 1 mm.
0xE28C	Under effective arc tracking, weave frequency is too big	The weaving frequency is too high.	Set the weaving frequency to ≤ 4 Hz.
0xE28D	Under effective arc tracking, weld speed is too big	The welding speed is too high.	Set the welding speed to ≤ 8 mm/s.

Fault code	Description	Fault cause	Solution
0xE28E	Changes in the enabling state of arc tracking	The tracking enable state has changed.	During welding, the tracking enable state is not allowed to change.
0xE28F	Offset frame selection error	The compensation frame selected in the arc tracking conditions is incorrect.	Select the correct compensation frame: For weaving tracking, select the weaving frame; for non-weaving tracking, select either the workobject frame or the tool frame.
0xE290	Linear trajectory tracking interval is too small in non weave welding mode	The tracking interval is less than 3 mm.	Adjust the welding speed or the sampling time so that the interval is ≥ 3 mm (interval = welding speed × sampling time).
0xE291	Circle trajectory tracking interval is too small in non weave welding mode	The tracking interval is less than 4 mm.	Adjust the welding speed or the sampling time so that the interval is ≥ 4 mm (interval = welding speed × sampling time).
0xE292	Under effective arc tracking, arc detection has not been turned on	Arc start detection is not enabled.	Enable arc start detection.
0xE293	Under effective arc tracking, arc break detection has not been turned on	Arc break detection break not enabled.	Enable arc break detection.
0xE294	Under the effective arc tracking, the program jumps and executes abnormally	During program resume, the program is run by manually skipping lines.	During program resume, manual line skipping is not allowed.
0xE295	Tracking condition not enabled for tracking	The vertical compensation function is not enabled in the arc tracking conditions.	Enable the vertical compensation function in the arc tracking conditions.

Fault code	Description	Fault cause	Solution
0xE296	Under the effective arc tracking, three points collinear during non_weave welding tracking process	During tracking of a non-weaving circular arc trajectory, the three points are collinear.	Adjust the teaching points of the circular arc so that they are not collinear.
0xE297	Under effective arc tracking, the left and right dwell time of weave welding is zero	The left and right dwell times for weaving are zero.	Set the left and right dwell times for weaving to a value greater than zero.
0xE298	Under effective arc tracking, the endpoint dwell type is incorrect	The weaving endpoint dwell type is incorrect.	Select the endpoint dwell type as "0: Stop". (Weaving only)
0xE29A	Under effective arc tracking, the transition level of welding instructions is not Fine	The transition level is not set to Fine. (Weaving tracking only)	Set the instruction transition level to Fine.
0xE29B	Under weave weld tracking, the weave frequency cannot be zero	The weaving frequency is zero.	Set the weaving frequency to > 0 Hz.
0xE29C	Under effective arc tracking, the weld machine or protocol is not supported	The welder or protocol is not supported.	Currently only supports: "AOTAI_DEVICENET" "AOTAI_CANOPEN" "MEGMEET_DEVICENET" "MEGMEET_CANOPEN" "EASA_DEVICENET"
0xE29D	Under effective arc tracking, the spacing between teaching point positions is too small	The distance between teaching points is less than 1 mm.	Adjust the distance between teaching points to greater than 1 mm.
0xE29E	Under effective arc tracking, there are overlapping teaching points	A position judgment error has caused a current anomaly.	Contact the manufacturer.

Fault code	Description	Fault cause	Solution
0xE29F	Under effective arc tracking, the difference in dwell time between the left and right endpoints is not an integer multiple of 20ms	The difference between the left and right endpoint dwell times is not an integer multiple of 20 ms.	Adjust the dwell times so that the difference becomes an integer multiple of 20 ms.
0xE2A0	There are more than 1,000 points recorded in MultiPass Welding	When recording the original path for multi-layer and multi-pass welding, the path is too long and the number of recorded points exceeds 1000.	Record the path in segments or increase the minimum interval distance.
0xE2A1	The merging of the points during MultiPass Welding is Fail	Failed to merge points after recording.	1. Check whether the number of points is 1. 2. For a circular arc, check whether the number of points is odd.
0xE2A2	Fail to Run to the approach point	The approach point calculation failed.	Check whether the robot is near a singular position, or whether the path is normal.
0xE2A3	Fail to Run to the depart point	The departure point calculation failed.	Check whether the robot is near a singular position, or whether the path is normal.
0xE2A4	The points in the path of MultiPass are exceptional	The recorded path points are abnormal and cannot be offset.	Check whether the number of points is less than 2. Check whether there is an odd number of Movc points. Check whether the three points on the circular arc are collinear. Check whether the X direction of the weaving frame coincides with the Z direction of the tool frame.
0xE2A5	The indexes of the start and end points in MultiPass Welding are incorrect	The start point index and the end point index are the same or are out of valid range.	Check whether the start point index and the end point index are the same or are out of valid range.
0xE2A6	Fail to save the RPM file	Failed to save the file.	Check whether the RPM index is correct.

Fault code	Description	Fault cause	Solution
0xE2A7	Fail to load the RPM file	The file does not exist in the controller.	The corresponding RPM file has not been saved.
0xE2A8	When the ArcOn command contains RPM, the Arc and ArcOff command must contain RPM	The ArcOn includes RPM parameter, but the Arc or ArcOff instruction does not.	Check whether all welding motion instructions between the ArcOn instruction and the ArcOff instruction include the RPM parameter.
0xE2A9	The start offset or end offset of EOffsData is unreasonable, resulting in the curvature of the arc segment being greater than 2π	The start point offset or end point offset in the weld pass offset parameters is unreasonable, causing the arc angle to exceed 2π.	Adjust the start point offset and the end point offset.
0xE2AA	Failed to create directory during welding process backup	Failed to create the arc welding process directory during backup.	The system is abnormal. Restart and try the backup again, or contact the manufacturer.
0xE2AB	The timeout time for weld detection in LaserTrackData is set incorrectly	The weld seam detection timeout in the laser tracking parameters is set incorrectly.	Check whether the weld seam detection timeout in the laser tracking parameters is within the valid range. Note that a value of 0 is not allowed.
0xE2AC	Weld seam coordinate system generation failed	The motion direction coincides with the tool Z-axis direction.	Check whether the motion direction coincides with the tool Z-axis direction.
0xE2AD	The three points on the welding arc guide line are approximately three points collinear	Three points on the circular arc segment are collinear, so a circular arc cannot be formed.	Check whether the teaching points are collinear.

Fault code	Description	Fault cause	Solution
0xE2AE	During the multi-pass welding, the posture speed of robot is too high due to the posture deviation	An orientation offset is set during the reproduction process, causing the orientation speed to become too high during motion.	1. Reduce the orientation offset. 2. Increase the maximum allowable orientation speed in the weld pass offset parameters, then reduce the speed to check whether the requirement is met. Note: reduce the speed to prevent collisions.
0xE2AF	Secondary restart not supported	After the first interrupt restart fails during the welding process, a second interrupt restart is not allowed.	1. Return to the start line. 2. Re-teach the welding.
0xE2B0	Torch collision	The welding torch has collided.	Move the welding torch away from the collision position.
0xE2B1	Stitch welding parameters are not set properly	The stitch welding parameter settings are unreasonable.	Check the messages in the message bar and verify the stitch welding parameters being used.
0xE2B2	Prohibit functions other than dased line not detected stitch welding from triggering stitch welding I/O Function	A function other than stitch welding (with the welding method set to "Dash line (no DET)") triggered the stitch welding I/O.	Do not use the function that triggers stitch welding I/O.
0xE2B5	Stitch welding execute abnormal	An internal error occurred during stitch welding operation.	Export the system diagnostic file and contact the manufacturer.
0xE2B6	The weld start point is duplicated with the previous teach point, resulting in failure of the point calculation	The arc start point coincides with the previous teaching point, causing point calculation failure.	1. Modify the preceding teaching point of the arc start point. 2. Move the robot within a small range, specify the arc start line as the current line, and then re-run the program.

Fault code	Description	Fault cause	Solution
0xE2B7	Welder bus configuration not configured or welder error	1. The welder bus configuration is not set up. 2. The welder is faulty. 3. The initial values of the "Fault" and "Weld ready" signals in the welder input signals are set opposite to the required state.	1. Check whether the welder bus configuration has been completed. If not, complete the welder bus configuration. 2. Check whether there is an alarm on the welder. If so, resolve the alarm on the welder side. 3. After the welder bus configuration is completed and the welder has no alarms, invert the initial values of the "Fault" and "Weld ready" signals in "Signal config" > "Input signal" (for example, if the value is 0, set it to 1).
0xE2BA	Output byte setting error from the slave station	The setting of slave output bytes is not within the range of 1 to 512.	Set the slave output byte within the range of 1 to 512.
0xE2BB	Input byte setting error from the slave station	The setting of slave input bytes is not within the range of 1 to 512.	Set the slave input byte within the range of 1 to 512.
0xE2BC	The address starting from the output of the station is set incorrectly	The setting of slave output start address is not within the range of 832 to 1343.	Set the slave output start address within the range of 832 to 1343.
0xE2BD	The address starting from the input of the station is set incorrectly	The setting of slave input start address is not within the range of 832 to 1343.	Set the slave input start address within the range of 832 to 1343.
0xE2BE	The total length of the address from the station exceeds the limit, please modify the starting address and byte length	(Start address + byte length – 1) > 1343.	Modify the start address and byte length so that (start address + byte length – 1) < 1343.

Fault code	Description	Fault cause	Solution
0xE2C0	Read data error	An arc welding data read exception has occurred.	Export the system diagnostic file and contact the manufacturer.
0xE2C1	Write data error	An arc welding data write exception has occurred.	Export the system diagnostic file and contact the manufacturer.
0xE2C2	Null input error	An arc welding parameter transfer exception has occurred.	Export the system diagnostic file and contact the manufacturer.
0xE2C3	The Slope I/O not configured	The slope I/O is not configured when the slope function is enabled during the arc end phase.	Configure the "Slope signal output port" to a value other than "NULL" in "Basic Config" > "Welding condition slope function".
0xE2C4	This application does not support the slope function	The slope specification function is used in combination with functions such as laser tracking, arc tracking, and multi-layer multi-pass welding.	Do not use the slope specification function (including welding parameter slope, welding speed slope, and weaving slope) in combination with laser tracking, arc tracking, or multi-layer multi-pass welding.
0xE2C5	Weave welding does not support slope of welding parameters	The welding parameter slope specification is used in combination with weaving.	Do not use the welding parameter slope specification in combination with weaving.
0xE2C6	Weave welding does not support slope of welding speed	The welding speed slope specification is used in combination with weaving.	Do not use the welding speed slope specification in combination with weaving.
0xE2C7	Weave welding slope lacks WeaveData parameter	The WeaveData parameter is absent in the program instruction when using weaving slope specification.	Add the WeaveData parameter in the program instruction when using weaving slope specification.
0xE2C8	Not supporting mixed use of various slope methods	More than two types of slopes (welding parameter slope, welding speed slope, and weaving slope) are used simultaneously.	Do not use more than two of these slopes at the same time.

Fault code	Description	Fault cause	Solution
0xE2C9	Weave welding slope does not support the current swing welding conditions	When weaving slope is used, the weaving conditions are set as follows: 1. The weaving pattern is set to a pattern other than "Zigzag". 2. The center rise flag is set to "Rise". 3. The L-weave flag is set to "L-weave". 4. The dwell type is set to "Continue" at the dwell point.	When weaving slope is used, the weaving conditions are set as follows: 1. Set the weaving pattern to "Zigzag". 2. Set the center rise flag to "No rise". 3. Set the L-weave flag to "No L-weave". 4. Set the dwell type to "Stop".
0xE2CA	This application does not support weave direction angles greater than 0 degrees	When the weaving direction angle is greater than 0°, the following applications are used: Multi-layer and multi-pass welding, laser tracking, arc tracking, weaving slope, weaving center rise, L-weave, and unequal left/ right weaving amplitudes.	When the weaving direction angle is greater than 0°, do not use the following applications: Multi-layer and multi-pass welding, laser tracking, arc tracking, weaving slope, weaving center rise, L-weave, and unequal left/ right weaving amplitudes.
0xE2CB	This function does not support weave weldingwith inconsistent left and right amplitudes	When the weaving direction angle is greater than 0°, the following applications are used: Multi-layer and multi-pass welding, laser tracking, arc tracking, weaving slope, weaving center rise, and L-weave.	When the weaving direction angle is greater than 0°, do not use the following applications: Multi-layer and multi-pass welding, laser tracking, arc tracking, weaving slope, weaving center rise, and L-weave.

Fault code	Description	Fault cause	Solution
0xE2CC	Failed to restart welding after power down	1. Power failure restart is not supported for instructions other than MovlArcOn, MovlArc, and MovlArcOff. 2. Power failure restart during the scraping process, or scraping interruption upon restart, is not currently supported. 3. The power failure restart function does not support the following applications: weaving, arc tracking, laser tracking, stitch welding, multi-layer and multi-pass welding, speed slope, and weaving slope.	Do not use the power failure restart function beyond its designated applications.
0xE2CD	Virtual I/O function of arc craft executes abnormally	The virtual I/O function is abnormal.	Export the system diagnostic file and contact the manufacturer.

NOTE

For operating instructions on the station reservation function, see the "IR-TP200 Series Industrial Robot Teach Pendant User Guide" (data code: 19012798).

Service and Support

Should you encounter a safety accident during the use or operation of the product, or face challenges in operating and maintaining the equipment, which remain unresolved after the relevant documentation is consulted, we provide multiple channels to ensure prompt resolution:

- Channel #1: Contact service@inovance.com.
- Channel #2: Visit https://www.inovance.com/global to access document downloads, after-sales support, spare parts ordering, repair applications, and authenticity verification services.
- Channel #3: Download My Inovance app (https://zshc-eu.inovance.com/download-pc/) where you can access products info and documentation, and query product parameters.

We are committed to providing you with quick and professional technical support, and we look forward to your satisfaction and trust.

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