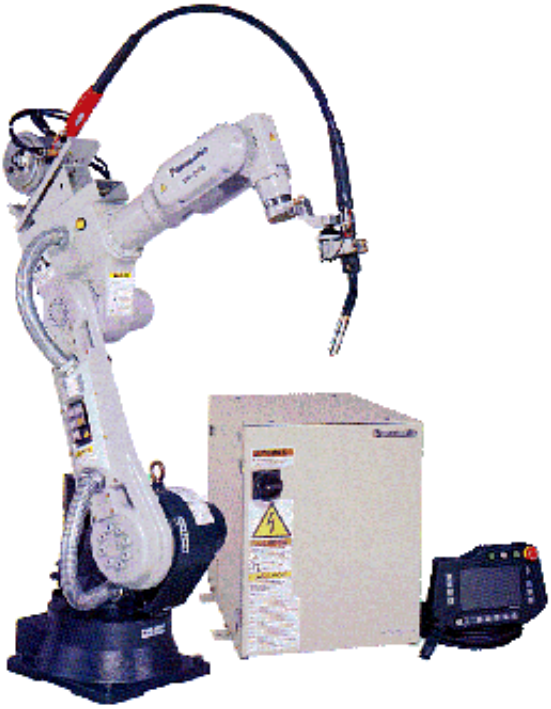
Panasonic

Industrial Robot
Operating Instructions

Standard controller type | Built-in welding machine type

YA-1NA***/ YA-1PA***

VR2 Series



G2/GX Controllers

Before operating this product, please read the instructions carefully and save this manual for future use.

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Systems of “Operating Instructions” of Panasonic Robot VR2 series

Name	Description and remarks	Usage
Safety manual	Panasonic robots are designed and manufactured on the premise that contents of this manual are conformed to by users. Personnel who use any other operating instructions listed in this table must read and understand the contents of this manual first. This manual explains general rules and regulations related to the industrial robots and also basic safety instructions from installation, maintenance and repair all the way down to disposal step by step.	Use this document for training programs at installation and also periodic training on safe operation of the robot, which must be taken by all personnel who handle Panasonic robots.
Robot system Operating instructions	The document explains configuration and installation of standard robot systems, such as CO_2 welding robot system in general.	Use this document to understand robot system configuration and connection system at installation in general.
Robot manipulator Operating instructions	The document explains transportation, installation, connection, initial settings and maintenance and repair of the robot manipulator. The contents of the document are limited to hardware of the equipment.	This document is for personnel who are in charge of installation and/or maintenance.
Robot controller Operating instructions	The document explains transportation, installation, connection, initial settings and maintenance and repair of the robot controller. The contents of the document are limited to hardware of the equipment. Note) Initial settings of software at robot installation are shown in “Operating instructions, Advanced operation”.	This document is for personnel who are in charge of installation and/or maintenance.
Optional equipment Operating instructions	The document explains installation, connection and repair of the optional equipment applicable to G2/GX series. The contents of the document are limited to hardware of the equipment. Note) Initial settings of software at robot installation are shown in “Operating instructions, Advanced operation”.	The document is provided for optional equipment. Each document is for personnel who are in charge of installation and/or maintenance.
Operating instructions **Basic operation**	The document is for operators who operate Panasonic robots G2/GX for the first time. The document explains basic robot functions and basic robot welding operation.	This is a guide for beginners of G2/GX series
Advanced operation	The document explains settings of robot, basic parameters, I/O settings for AUTO play and initial settings of all optional equipment including welding power source and external axis. It explains robot commands in detail.	Refer to the document and try operating the robot for better understanding.

■ Introduction

Thank you for purchasing our Panasonic industrial robot G2/GX controller series. This manual explains basic operation and advanced operation (details of parameters settings and sequene commands) of G2/GX controller series.

Operation procedures explained in this document is based on the **software version J*** .

When you upgrade your software, check our sales office of service engineer if the current manual you have is applicable to the upgraded software version.

<Note>

Higher version of software doesn't necessarily require revision of manual unless changes of software cause change in operation procedures.

Click the  icon on the  Help menu to check the software version.

Version

Help

■ Safety

First of all, please read and understand separately provided "Safety Manual" thoroughly for proper and safe operation of our robots.

Prior to operation, read this manual for proper operation. Keep this manual in an easily accessible place and re-read as necessary.

The contents of manuals are subject to change without further notice.

■ Warnings and Cautions

This manual is also structured on the premise that any personnel who handle industrial robots must complete the appropriate training programs, which can be a requirement of related regulations and standards. Some safety precautions are emphasized using the following symbols for extra caution.
Warnings, Cautions, Mandatory Actions and Prohibitions listed in this manual must be followed without fail. If directions are not followed carefully, potentials for personal injury not only to the operator(s), but also other personnel and potential for property damage to the equipment.
It is also important to ensure that equipment functions correctly at all times.

Panasonic robots are designed and manufactured on the premise that contents of this manual are conformed to by users. Personnel who use any other manuals must read and understand the contents of this manual first.

●Improper operation of the machine may lead to various levels of hazardous conditions. This document classifies all of these hazardous conditions into three levels, namely Danger, Warning or Caution, and indicates these levels by using symbols.
The warning symbols and signal phrases are also used on the warning labels attached on the machine.

Warning symbol	Signal phrase	Description
	**Danger**	When you see this symbol it means that a hazardous accident including death or serious personal injury is imminent, if directions are not followed carefully.
	**Warning**	When you see this symbol it means that the potential for a hazardous accident including death or serious personal injury is high, if directions are not followed carefully.
	**Caution**	When you see this symbol it means that the potential for hazardous accident including medium-level or light personal injury and/or the potential for property damage to the equipment are high if, directions are not followed carefully.

The above warning symbols are commonly used.

“Serious personal injury” refers to loss of eyesight, burns (high-temperature and low-temperature burn), electrical shock, bone fractures and gas poisoning, as well as those that leave after-effects, which require hospitalization or necessitate medical treatment for an extended period of time.

“Medium-level and light personal injury” refers to burns, electrical shock and injuries which do not require hospitalization or necessitate medical treatment for an extended period of time. “Property damage” refers to extensive damage to the surrounding items and equipment.

●Furthermore, the mandatory items or actions that must be performed and those that are prohibited are indicated as follows.

Warning symbol	Signal phrase	Description
	**Mandatory Action**	Action which MUST be performed without fail, such as grounding.
	**Prohibition**	Action which MUST NOT be performed.

The above warning symbols are commonly used.

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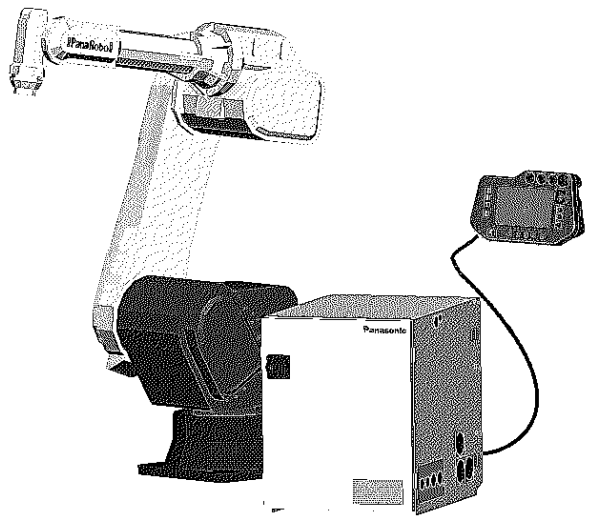
Basic Operation

This manual is for both Welding specification and Handling specification.
As for “Advanced operation”, please refer to the latter part of this manual.



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2. How to use the teach pendant

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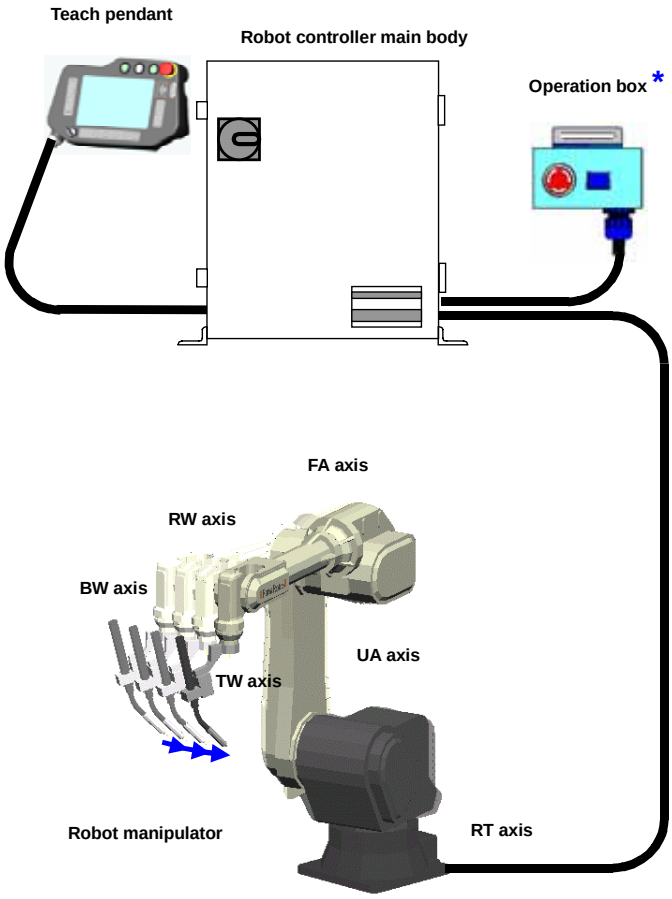
1. Structure

1-1. Parts identification



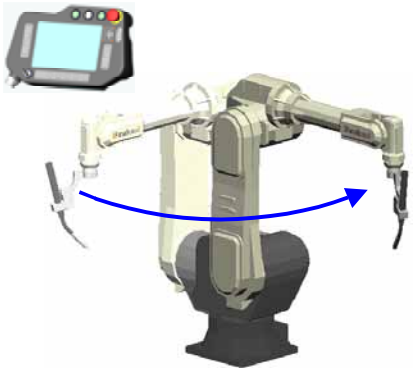
<*>
Operation box is standard specification for specified models only, otherwise optional.

Axis name	Definition
RT axis	Rotate Turn
UA axis	Upper Arm
FA axis	Front Arm
RW-axis	Rotate Wrist
BW axis	Bent Wrist
TW axis	Twist Wrist

(The robot in the above figure is VR-008.)

1-2. Teaching Playback Method

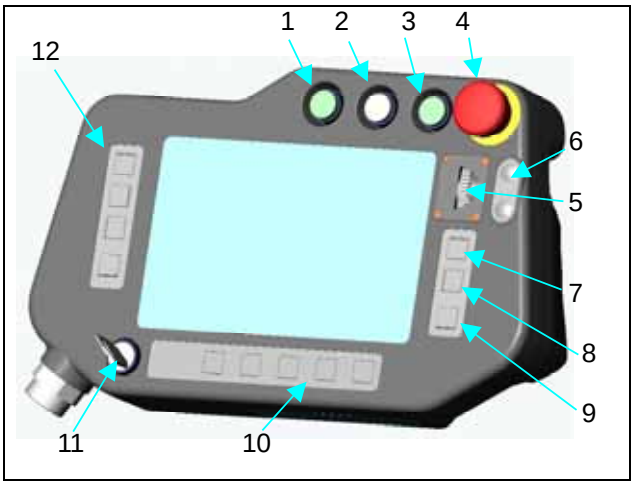
The robot is a teaching playback robot.
A program of robot operation, such as welding or sequential processing, can be created by moving the robot arm. This process, known as “Teaching” can be stored in the controller. By running the program, the robot executes the series of taught operations (or playback the series of taught operations) repeatedly. Therefore, accurate welding or processing is possible continuously.



2. How to use the teach pendant

The teach pendant is used to operate the robot in most cases. Make sure that you understand the functions and how to use each switch on the teach pendant thoroughly before using it.

2-1. Functions



1 Start switch
This switch starts or restarts robot operation in AUTO mode.

2 Hold switch
This switch suspends robot operation with the servo power ON.

3 Servo-ON switch
This switch energizes the servo power.

4 Emergency stop switch
This switch stops the robot and external axis operation immediately by shutting off the servo power.
Turn clockwise to release.

5 Jog dial
This dial is used to control movement of the robot arm, the external axis or the cursor on the screen. It is also used to change data or select a choice.

6 + / - key
This key is used to control continuous movement of the robot arm in the same manner as the Jog dial.

7 Enter key
This key is used to save or specify a teaching point or a choice in the window in teaching operation.

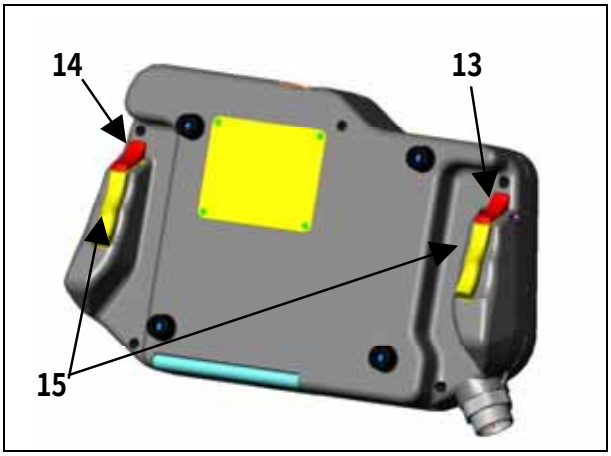
8 Window change key
This key is used to switch an active window if more than one window are displayed at a time.

9 Cancel key
This key cancels the current processing such as addion or change of data, and displays the preious screen.

10 User function keys
Each key is used to perform as per the user function icon shown above each user function key

11 Mode select switch
A two-position switch that allows you to choose which mode (TEACH mode or AUTO mode) you want to work with the robot.
The switch key is removeable.

12 Function keys
Each key is used to perform as per the function icon shown to the right of each function key.



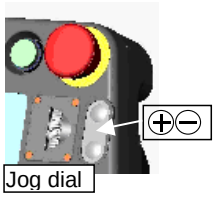
13 L-Shift key
Use this key to switch axes of the coordinate system or to move a digit of an input number
Axes will be switched in order of “Main axes”, “Wrist axes”, and “External axes” (if applied).

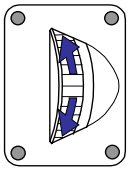
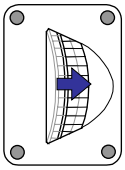
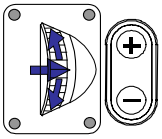
14 R-Shift key
Use this key as shortcut of functions or to move a digit of an input number. It also changes jogging speed of the jog dial.

15 Deadman switch
The servo power is shut off when either switche is released or pressed hard.
Hold either one or both switches lightly to turn on the servo power.

2-1-1. Jog dial and +/- key

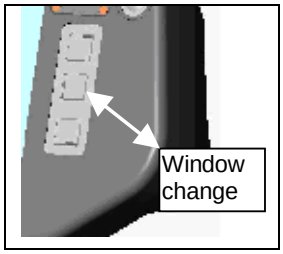
This dial is used to control movement of the robot arm, the external axis or the cursor on the screen. It is also used to change data or select a choice.
The ⊕⊖ key is used to control continuous movement of the robot arm in the same manner as Jog drag opration.



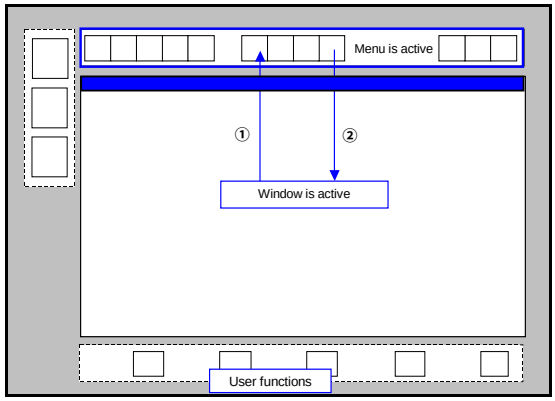
(1) **Jog up/down** 	1. To move the robot arm or the external axis Jog up: in (+) direction Jog down: in (-) direction 2. To move the cursor on the screen. 3. To change data or select a choice.
(2) **Click** 	Specify the selected item and save it.
(3) **Jog drag** Hold down and then jog up/down. 	To retain current operation of the robot arm. · The jog rotation amount of the dial after pressed determines the change value. · Stop the jog rotation to release. · Di rection of movement is the same as that for Jog up/down. · The ⊕⊖ key works in the same manner as Jog drag.

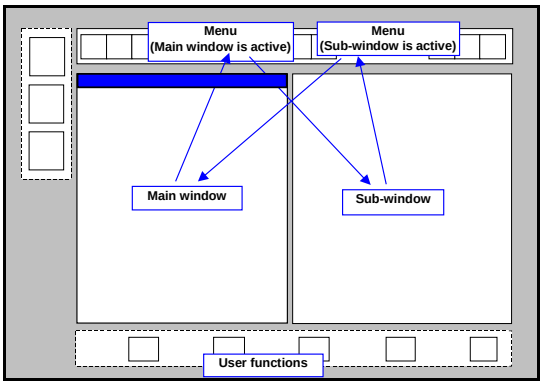
2-1-2. Window change key

- It switches between menu icon bar and edit window.
- It switches between the main window and the sub-window.



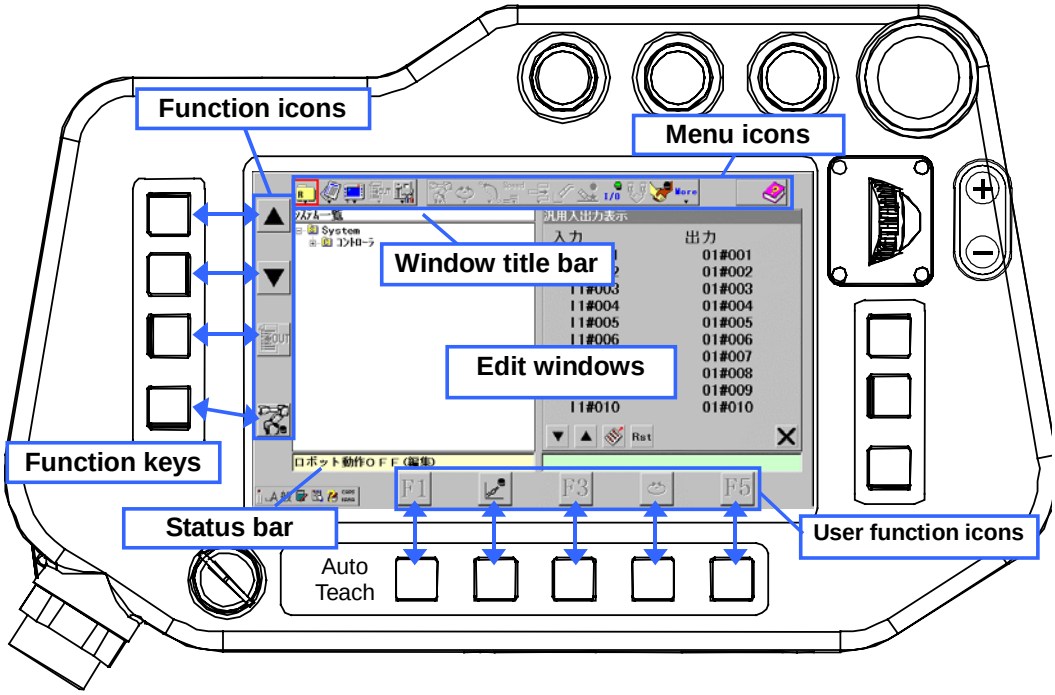
The active window is highlighted.
Keys on the teach pendant are effective only to the active window.





2-2. How to work on the screen

The teach pendant provides a variety of icons that identify functions on the screen that can make your work easier. Move the cursor to the icon you want and click the jog dial to display sub-menu icons or to switch windows.

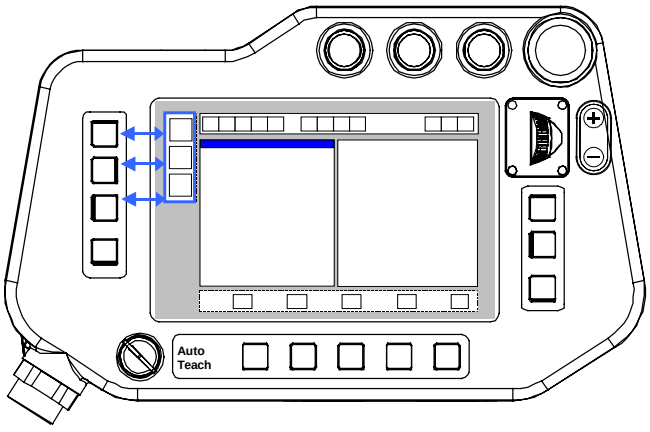


2-3. How to switch the external axes (option)

There are two ways to switch functions of the motion function keys between main axes group and external axes

Click >> External axis **or** Robot in the menu bar.

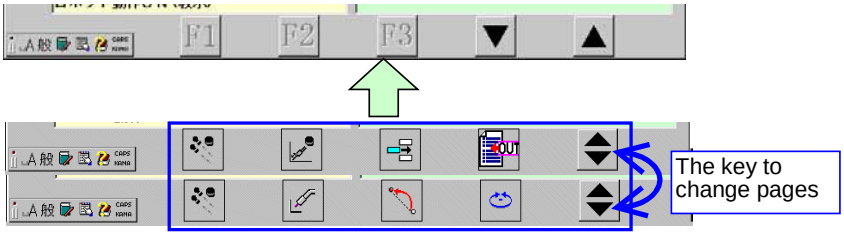
Hold down the **L-shift** key to switch the displays of function keys FI, FII and FIII from **Robot main axes**, **Wrist axes** to **External axes**.



G1	External axis 1
G2	External axis 2
G3	External axis 3
L-shift key to switch functions	
G4	External axis 4
G5	External axis 5
G6	External axis 6

2-4. User function keys

Some functions are allocated to the 5 user function keys (F1 to F5) located at the bottom of the TP.
Press a user function key to execute the function indicated with the icon. The chage page key is allocated to the F5 key to display different set (page) of functions F1 to F4 keys.
The context-sensitive functions are available with those User function keys.



Function keys and operations

Operation	F1	F2	F3	F4	F5
No file is open (Robot motion OFF)		Wire/gas check		Coordinate system change	(Change page)
					(Change page)
Edit Robot motion OFF	Window change	Wire/gas check	Edit mode change	Add command	Change page
	Window change	Cut	Copy	Paste	Change page
Teach Robot motion ON	Trace ON	Wire/gas check	Edit mode change	Add command	Change page
	Trace ON	Weld/No-arc	Interpolation change	Coordinate system change	Change page
Trace	Trace OFF	Wire/gas check	Edit mode change	Add command	Change page
	Trace OFF	Weld/No-arc	Interpolation change	Coordinate system change	Change page
Operation			Arc lock (Note)	Override	(Change page)
					(Change page)
Offline edit A file is open.	Window change		Edit mode change	Add command	Change page
	Window change	Cut	Copy	Paste	Change page
Register teaching points (robot or position variable.)	Trace ON/OFF	Cursor (UP)	Cursor (DOWN)	Coordinate system change	(Change page)

* Shaded items do not appear in the handling specification.

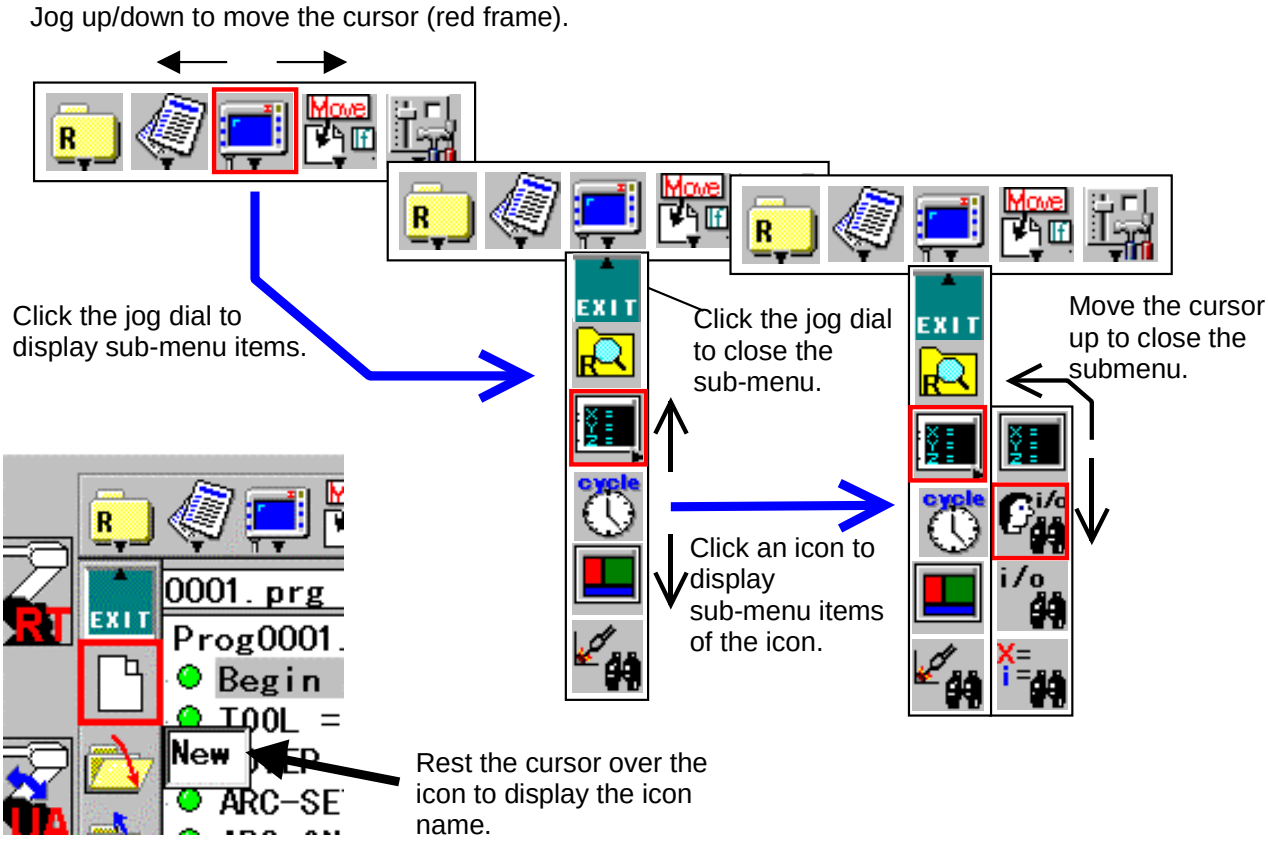
(Note) Arc lock keys:

- While the weld off input is ON, it is not possible to turn OFF the ”Arc lock” key.
- The “Resume” function resumes this “Arc lock “ key status (ON/OFF) before turning off the power when the power is back ON again. However, as the “weld off input has priority over the resume function, if this input is set effective, the state of this “Arc lock” key depends on the state of the input. That is, if the input is ON, the “Arc lock” key is in ON state, and if the input is OFF, the key is in OFF state.

 Arc lock ON	Disable arc generation even in the weld section.
 Arc lock OFF	Allows arc generation in the weld section.

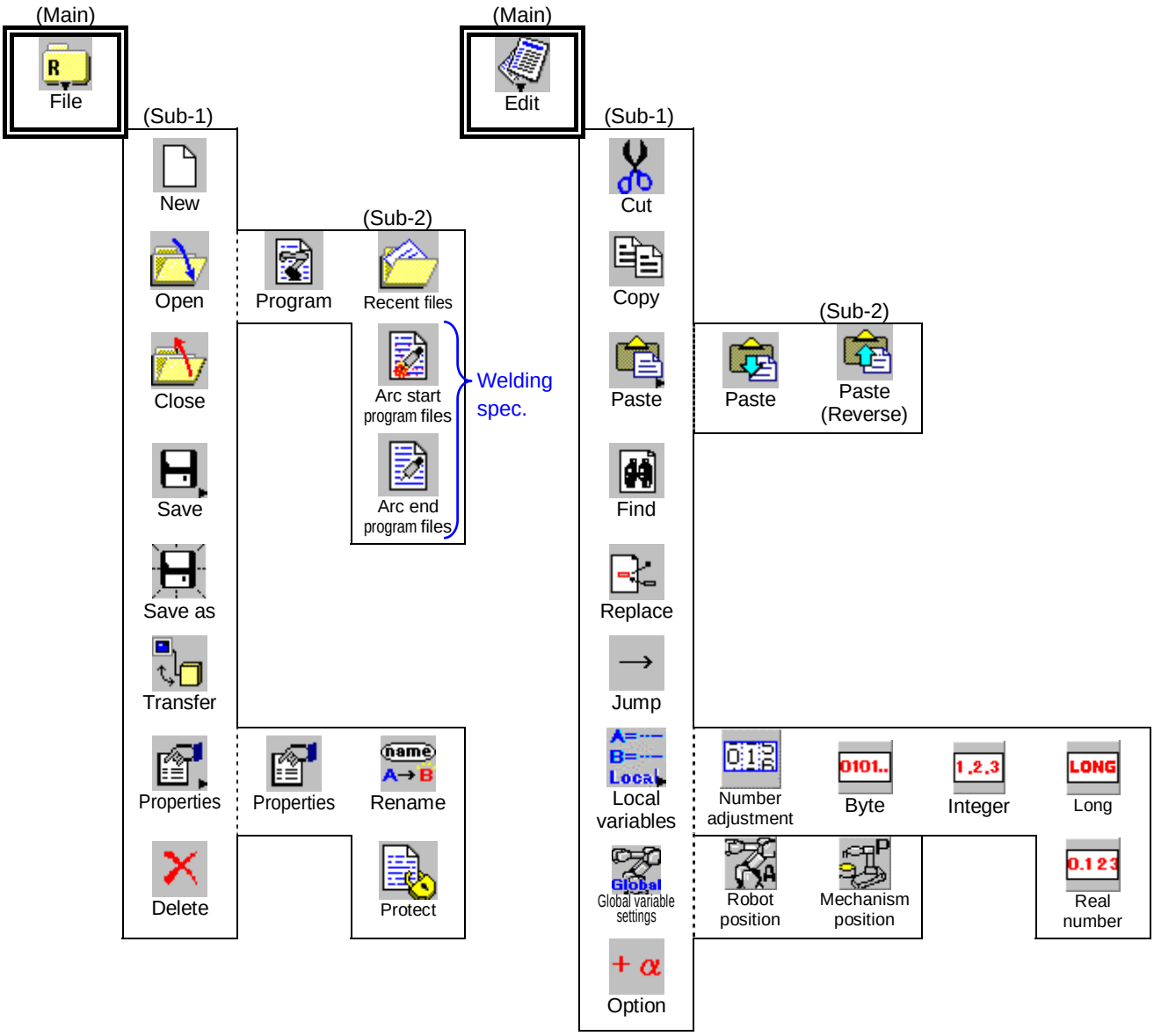
2-5. Menu icons

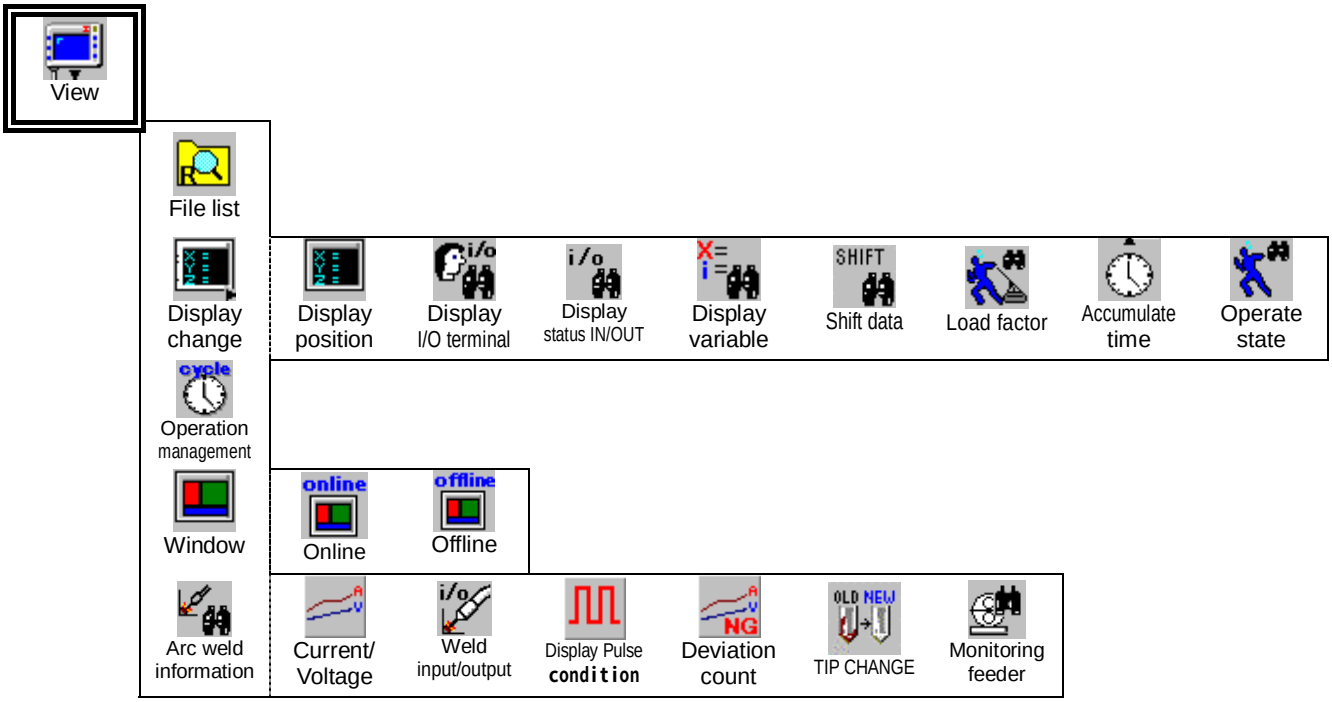
Click on an icon on the menu bar to pull down its sub menu icons.

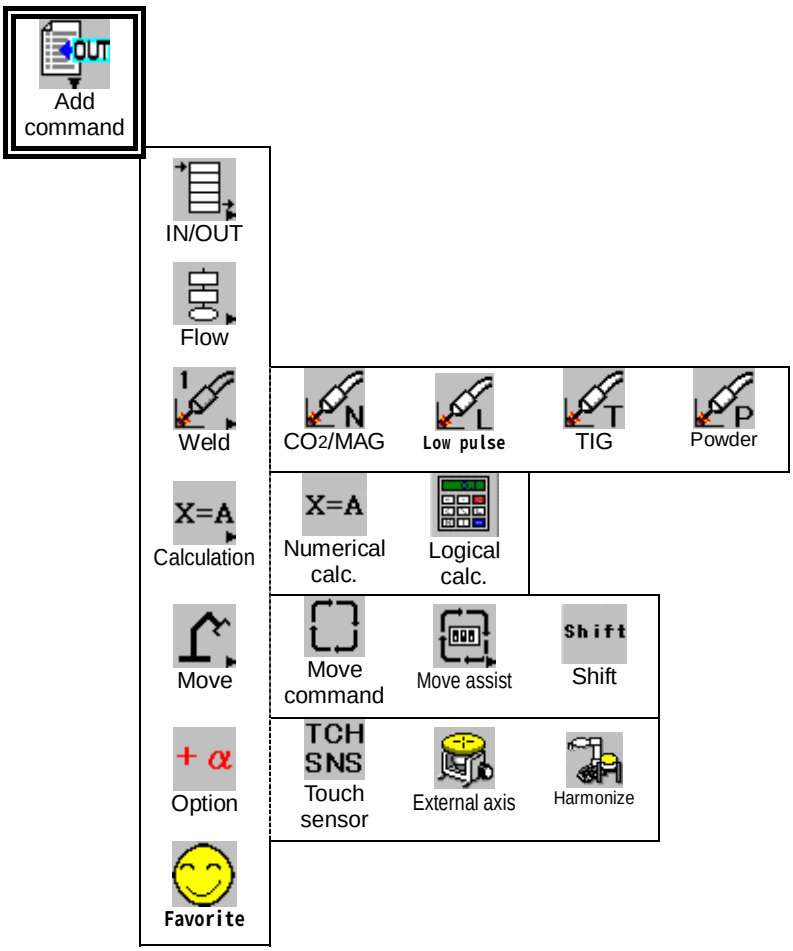


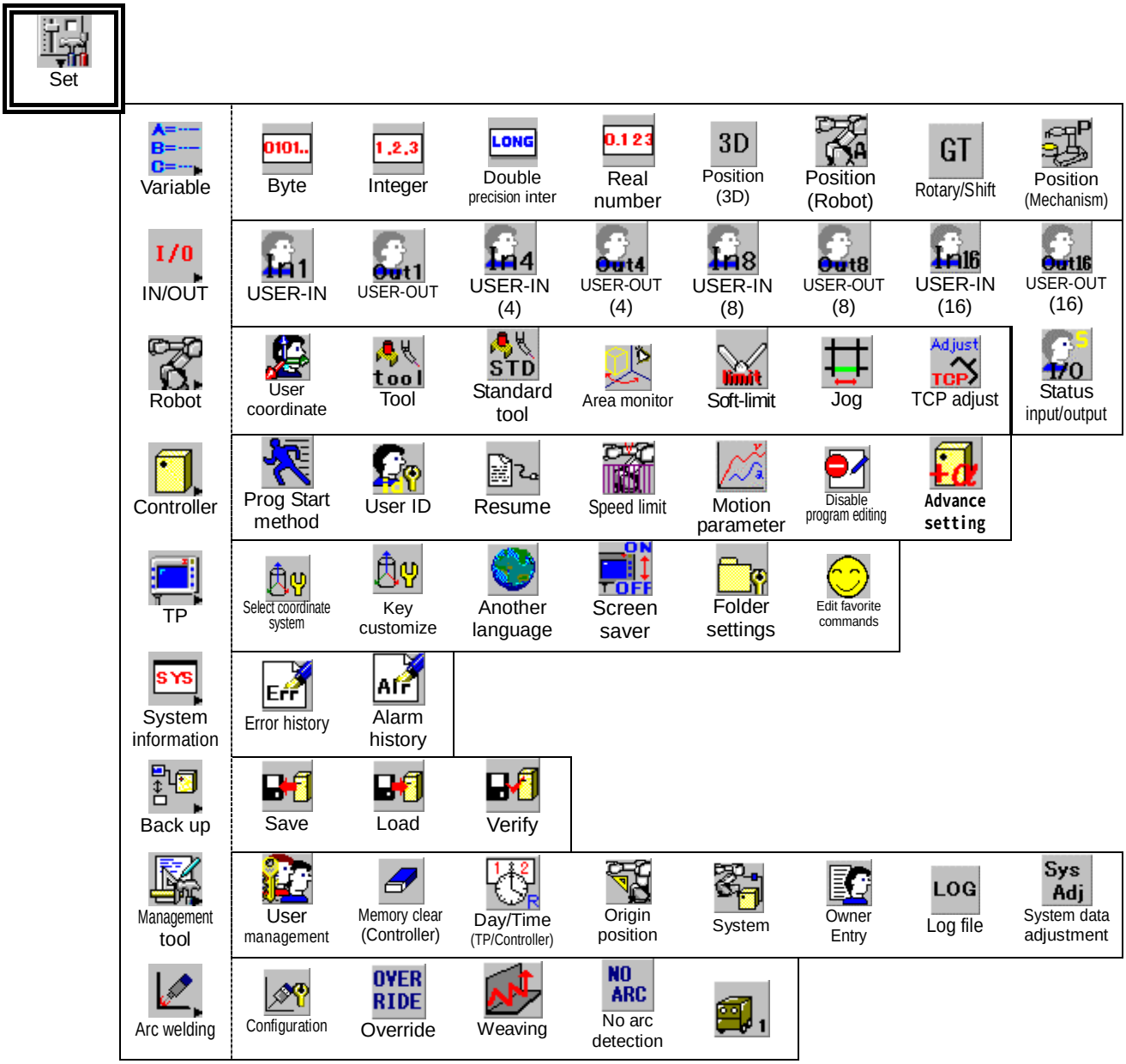
2-5-1. List of icons

Main and submenu icons (down to the 3rd level) are listed as follows.

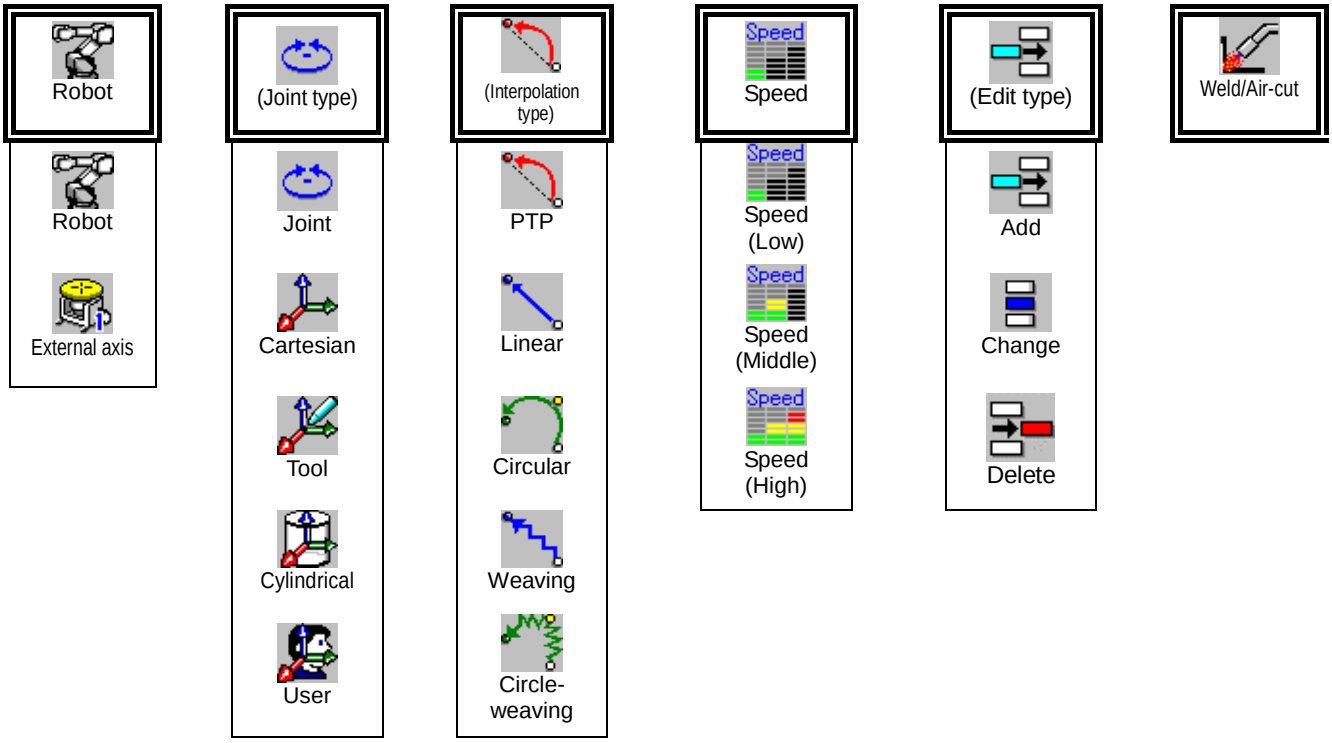



View
File list
Display change
Display position
Display I/O terminal
Display status IN/OUT
Display variable
Shift data
Load factor
Accumulate time
Operate state
Operation management
Window
Online
Offline
Arc weld information
Current/ Voltage
Weld input/output
Display Pulse condition
Deviation count
TIP CHANGE
Monitoring feeder

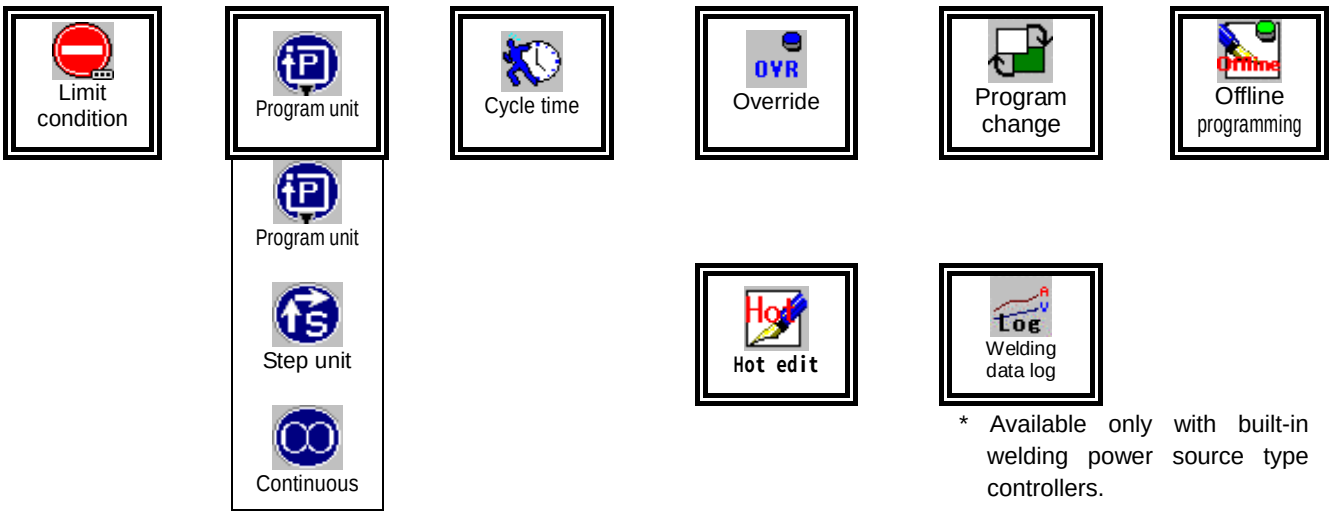

Add command
IN/OUT
Flow
Weld
CO2/MAG
Low pulse
TIG
Powder
Calculation
Numerical calc.
Logical calc.
Move
Move command
Move assist
Shift
Option
Touch sensor
External axis
Harmonize
Favorite


Set
Variable
Byte
Integer
Double precision inter
Real number
Position (3D)
Position (Robot)
Rotary/Shift
Position (Mechanism)
IN/OUT
USER-IN
USER-OUT
USER-IN (4)
USER-OUT (4)
USER-IN (8)
USER-OUT (8)
USER-IN (16)
USER-OUT (16)
Robot
User coordinate
Tool
Standard tool
Area monitor
Soft-limit
Jog
TCP adjust
Status input/output
Controller
Prog Start method
User ID
Resume
Speed limit
Motion parameter
Disable program editing
Advance setting
TP
Select coordinate system
Key customize
Another language
Screen saver
Folder settings
Edit favorite commands
System information
Error history
Alarm history
Back up
Save
Load
Verify
Management tool
User management
Memory clear (Controller)
Day/Time (TP/Controller)
Origin position
System
Owner Entry
Log file
System data adjustment
Arc welding
Configuration
Override
Weaving
No arc detection

■ Icons in TEACH mode



■ Icons in AUTO mode



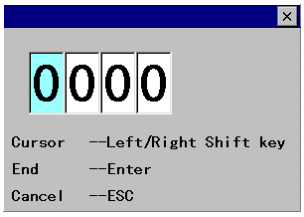
* Available only with built-in welding power source type controllers.

2-6. Input numerical values and characters

2-6-1. Input numerical values

The number input box appears to input a numerical value.

- Use the **L-shift** key or **R-shift** key to switch the digit of the value.
- Use the jog dial to change the numerical value.
- Press the **Enter** key to close the window and save the number you have changed.
- Press the **Cancel** key to close the window without saving the number you have changed

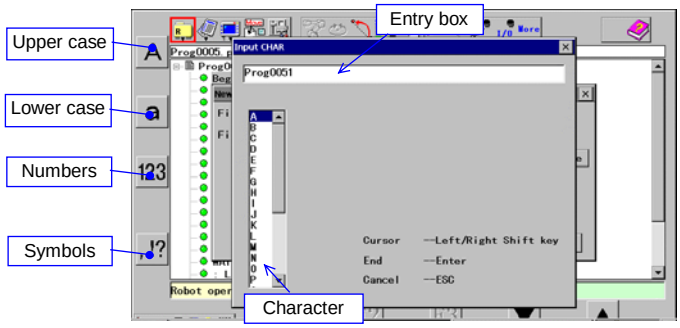


2-6-2. Input characters

The character input box appears to enter characters.

Character input icons appear to the right of the Function keys.

Ⅰ	To display upper case letters.
Ⅱ	To display lower case letters.
Ⅲ	To display numbers.
Ⅳ	To display symbols



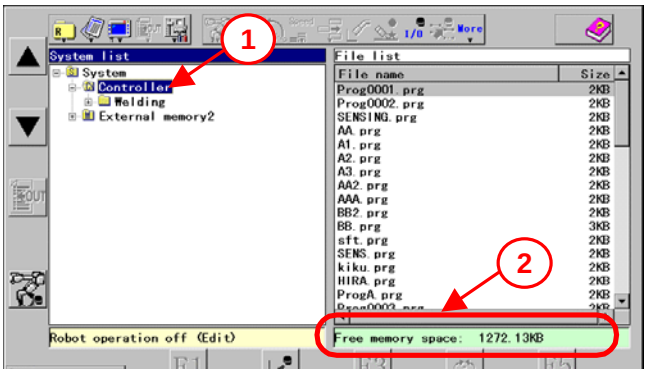
Other keys to input characters.

Jog click	To enter the selected character into the box.
Shift keys (L/R)	To move cursor left (L) and right(R) in the box.
Enter key	To specify the entry.
Cancel key	To cancel and close the dialog box.

2-7. Memory check

Please refer to the following procedure to check the available memory space in the controller.

1. With the “System list” screen, move the cursor to **Controller** and then click the jog dial.
2. Then the free memory space appears in the bottom of the right pane.



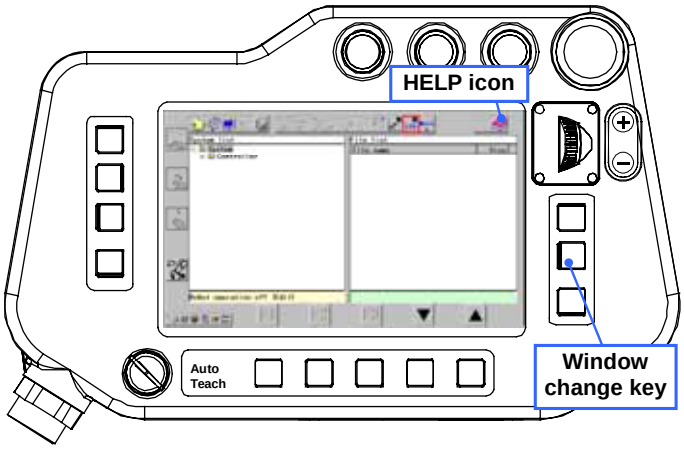
To check the memory space of the External memory, click on the “External memory 2 or 3”.

3. Get assistance while you work (Help)

When you are in the middle of a task and need help, such as you want to know certain operation procedure or you want to know what to do with the alarm or error that occurred, click the Help icon to get the information you need. The Help menu simply rephrases the contents of the manual.

3-1. How to get online Help

1. Move the cursor over the Help menu, and then click the  icon to display Help window.
   Help
   Move the cursor to the topic you want, and then click the jog dial to get information.
2. Press the **Window change** key to return to the robot operation window you were working on.



When the Window change key is pressed, the Help window is closed retaining the current screen.

Function of the keys on the teach pendant in Help window

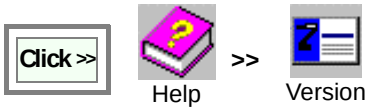
Operation in Help window	Key
Travel over highlight texts (downward)	Jog dial (down)
Travel over highlight texts (upward)	Jog dial (up)
Jump to the linked item.	Jog click and **Ⅳ** key
Back to previous screen	**R-Shift** key, **L-Shift** key
Scroll up	**Ⅰ** key
Scroll down	**Ⅱ** key
Back to robot operation window	**Window change** key
Page forward	**F4** key
Page backward	**F5** key
Exit	**Cancel** key

3-2. What's in the Help menu

Menu	Description
Operation procedures	Explains teaching, operation and file editing procedures.
Sequence command	Explains function, format and arguments of each sequence command.
Controller settings	Explains I/O settings, soft limit setting, pitch, speed limit, tool, welding conditions and other settings on the display.
Errors and alarms	Explains each error and alarm and shows check items to solve the cause of it.

3-3. How to get the version information

To check the software version of your TP,



Help >> Version

4. TEACH mode

When the Mode select switch is in the TEACH position, it is possible to create or edit a robot operation program using the teach pendant.

4-1. How operation procedures are explained

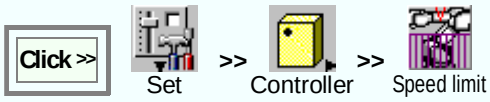
In this manual

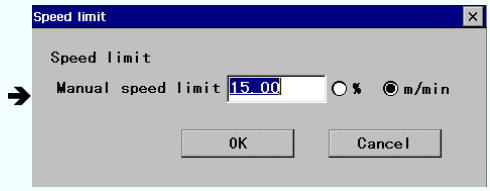
This manual explains the procedure to display a setting dialog box of each setting item using icons.

Click the icon shown to the right of the **Click >>** symbol. Click the following icon(s) if any on the same line.

Then the dialog box displayed after the arrow (➔) will appear after a series of icon operation.

[Example]





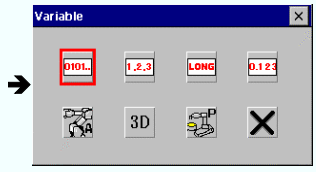
[Operation]

1. Click the **Set** icon on the menu bar.
2. Click the **Controller** icon.
3. Click the **Speed limit** icon.
4. The "**Speed limit**" dialog box shown next to the "➔" in the next line appears.
5. Then complete the required settings, such as selecting the prameters, or entering values or chanracters in the box.
6. and then click the **OK** button to update the new settings.

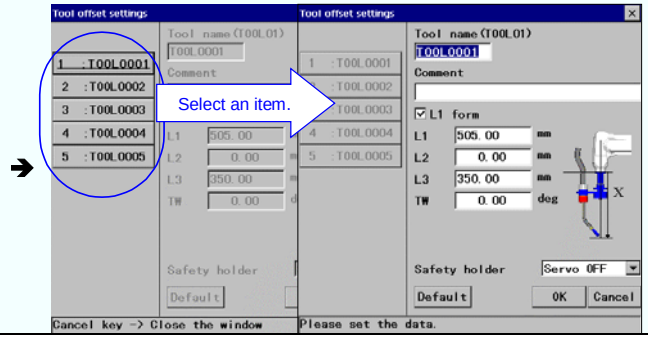
Button	Description
OK	Closes this dialog box and saves any changes you have made
Cancel	Closes this dialog box without saving any changes you have made.

Descriptions of setting items in each dialog box are given near the dialog box. (For setting item names, only the first few words are written to identify and the rest is omitted.)

◎ **In case of the following the dialog boxes:**



See the definition of each icon and select an icon of the intended operation to display the next dialog box.



Selct an appropriate item from the left pane to bring the right pane active for settings.

4-2. Turn ON Servo Power

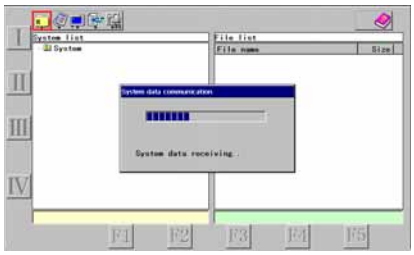
Warning	Prior to turning ON the servo power make sure that no personnel are present within the robot work envelope.

1. Turn ON the power switch of the robot controller main body, then the system data in the controller will be transferred to the teach pendant to enable robot operation from the teach pendant.

2. Hold a Deadman switch lightly. (The servo ON switch starts flashing.)
   Press the Servo-ON switch. (The servo-ON switch lights up solidly.)

3. Keep holding down the Deadman switch lightly while you work. Releasing or holding the Deadman switch hard shuts off the servo power. In that case, hold the Deadman switch lightly and press the Servo-On switch to re-energize the servo power.

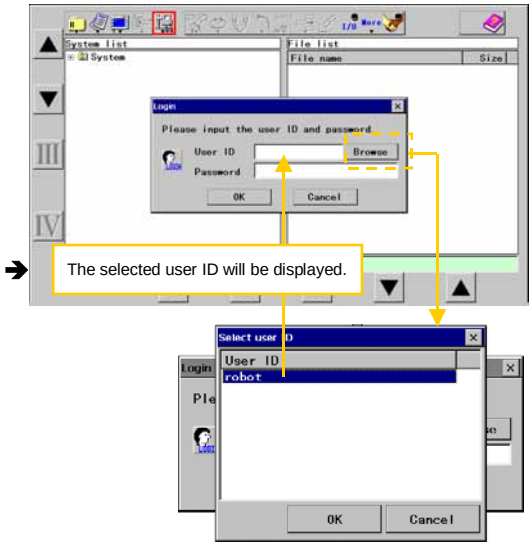
Transferring system data



When you turn ON the power source of the controller,
Make sure to allow at least 3 seconds of cooling time before turning ON the power again.

4-3. User ID setting for the first time

You must set the User ID to perform teaching or changing of robot settings. It is so designed that with the User ID settings that originally came at shipment it is not possible to edit.



[User ID]: Type "robot". (all in lower case)

[Password]: Type "0000". (4 zeros)

[OK]: To logon to the system as a User whose level is to teach and change the robot settings.

[Browse]

You can also press this **Browse** button and select **Robot** from the User ID list in the "Select user ID" box. Then the User ID you have selected appears in the User ID box in the "Login" box.

For details of User registration, refer to section "Setting and changing User ID" in the manual of advanced operation.

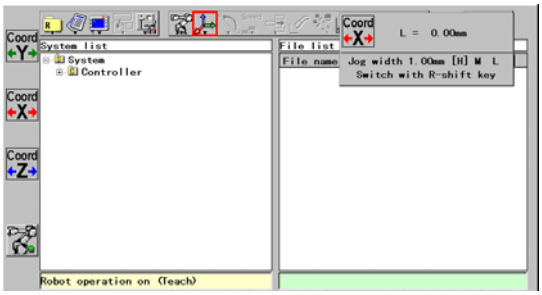
4-4. Manual operation

Operation to move the robot using the teach pendant. Data of robot movement made in manual operation won't be saved.

In teach mode, the maximum robot travel speed of the tool center point (at the end of the welding torch where the arc generates) is limited to 15 m/min. (250 mm/s).

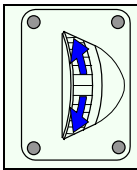
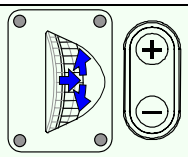
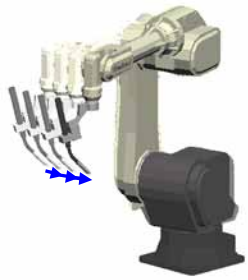
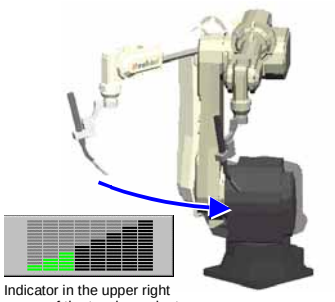
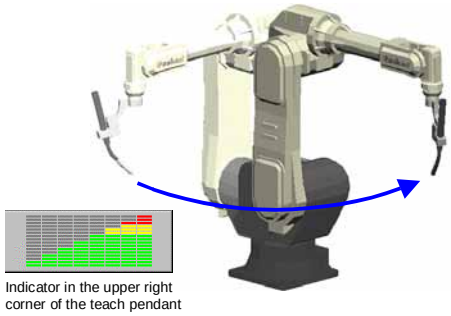
Warning	Prior to turning ON the servo power make sure that no personnel or nothing to interfere with robot movement is present within the robot work envelope.

1. Click the  Robot motion ON icon and turn ON the lamp on the icon to enable manual operation of the robot.
2. While holding down a Function key of the robot motion you want, jog the jog dial to move the corresponding robot arm.
3. Release the Function key to stop the movement.



 Robot motion ON	Moves the robot arm	 Robot motion OFF	Moves the cursor.

- Movement of the robot control point (tool center point) is displayed as a numerical value in the upper right corner of the window. Releasing the Function key reset the value to "0".
- The joint coordinate system is set as default coordinate system unless otherwise specified. To apply another coordinate system, refer to section "Switch the Coordinate system".

 **Jog UP/DOWN**	 **Jog drag or pressing ⊕⊖ key**
The robot moves corresponding to the amount of the jog dial rotation. 	Jog the dial a little to move the robot at a low speed and a lot to move it at a high speed. Moving speed at ⊕⊖ operation is shown at right upper area of the teach pendant.  Indicator in the upper right corner of the teach pendant  Indicator in the upper right corner of the teach pendant

- Use the R-shift key to switch the jog increment (High, Middle, Low).
- Set the parameter of the amount of the robot movement. (See the advance operation manual for detail.)

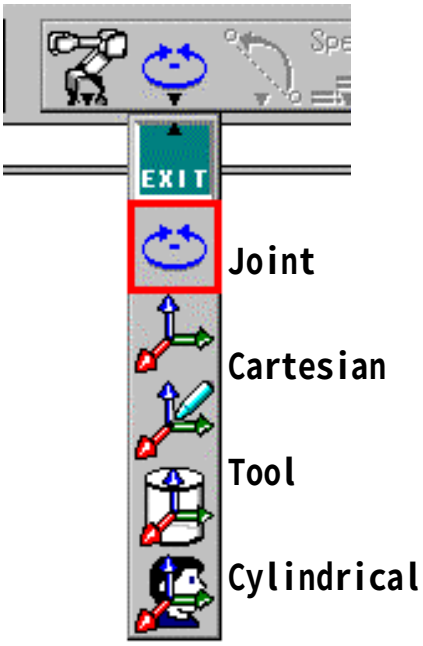
4-5. Switch the coordinate system

It is possible to change the direction of the motion of the robot arm by selecting a coordinate system.

1. There are five coordinate systems to choose from
2. Press the L-Shift key to switch the coordinate system. The Robot motion icon switches correspondingly.

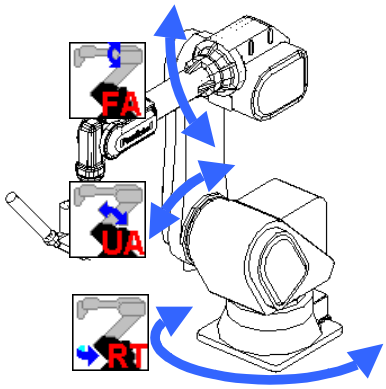
4-5-1. Robot motion icons and robot movement

Robot motion coordinate system select menu

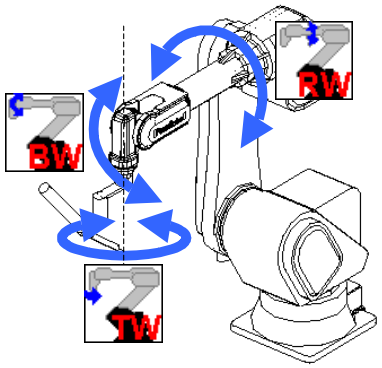


Joint coordinate system

[Control the robot movement by axis individually.]

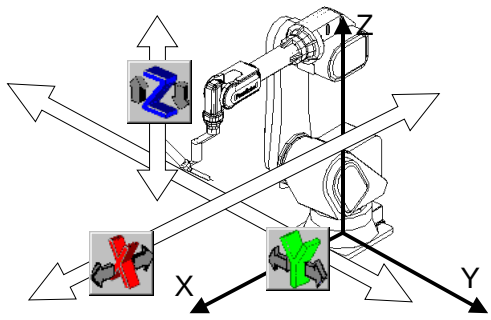


Switch functions (with L-Shift key)

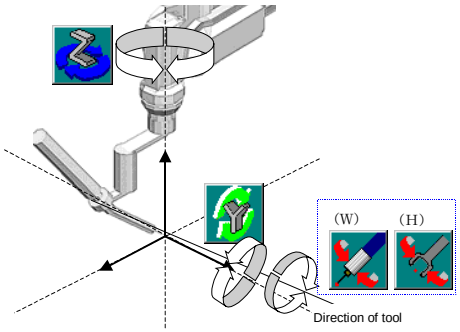


Cartesian coordinate system

[Controls the robot movement based on the robot coordinate system]



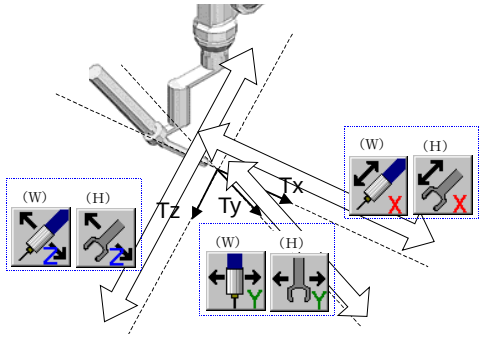
Switch functions (with L-Shift key)



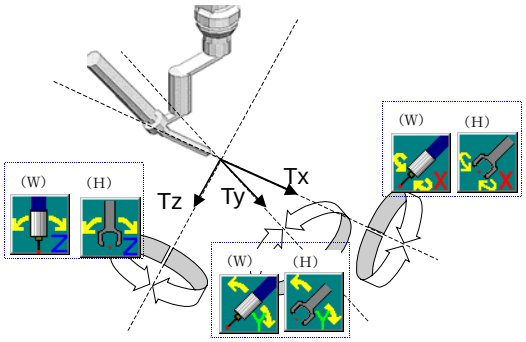
(W): For welding, (H): For handling

Tool coordinate system

[Controls the robot movement based on the direction of the end tool attached to the manipulator]



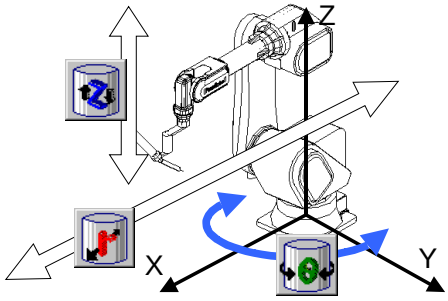
Switch functions (with L-Shift key)



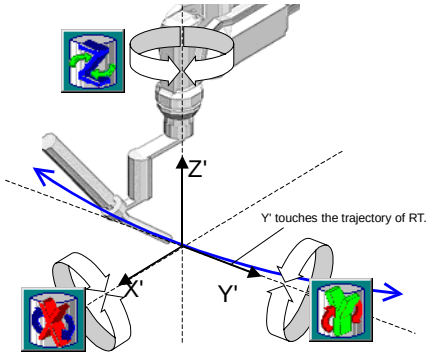
(W): For welding, (H): For handling

Cylindrical coordinate system

[Controls the robot movement based on the cylindrical coordinate system.]

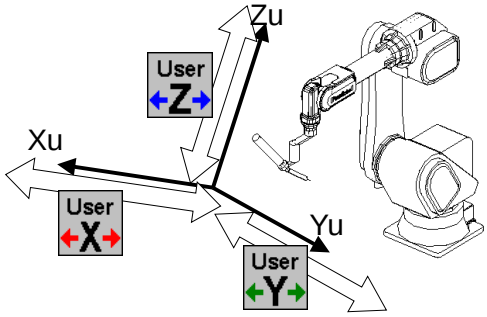


Switch functions (with L-Shift key)

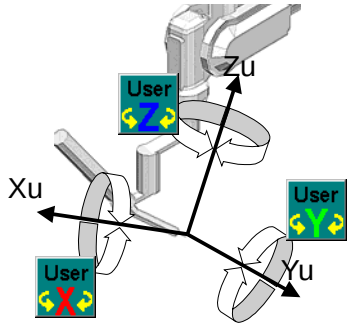


User coordinate system

[Controls the robot movement based on the coordinate system specified by the user.]



Switch functions (with L-Shift key)



4-6. Teach program programming procedure

Perform the teaching operation to create a program of teaching data such as robot movement and task procedures.

[Operation flow]

1. Create a new file (program) where teaching data will be saved.
2. Perform teaching operation to create a program.
3. Perform trace operation to check and correct taught data during or after teaching operation.
4. Edit details during or after completion of teaching or trace operation to complete the program.

＊Once completed, run the program in AUTO mode to move the robot.

4-6-1. Robot movement data.

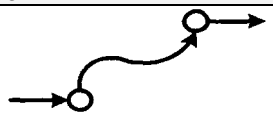
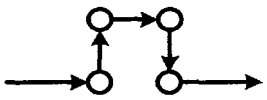
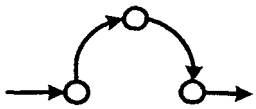
Movement of robot arms is determined by following taught points stored as “teaching points” in a program. Each point contains position data and data for robot travel method from the teaching point to the next teaching point with or without welding.

Data to be stored

- **Position of the teaching point (coordinate data)**
- **Travel speed toward the teaching point.**
- **Robot operation at the teaching point. (Sequence commands)**
- **Travel method toward the teaching point. (Interpolation)**

Move commands (MOVEC, MOVELW etc.) for circular or weaving movement of the robot are stored in teaching points to specify the section of each interpolation.

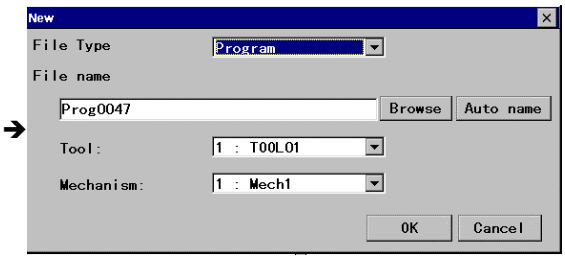
Weaving and circular-weaving are not available for robots for handling specification.

Interpolation	
PTP (**MOVEP**) Joint movement	
Linear (**MOVEL**) The robot follows a straight path from a point to the next.	
Circular (**MOVEC**) The robot follows a circular path determined by three teaching points	
Weaving (**MOVELW**) The robot follows a zigzag course on a straight path.	
Circular-weaving (**MOVECW**) The robot follows a zigzag course on a circular path.	

4-7. Create a new file

Prior to teaching, it is necessary to creat a file in which teaching points data and robot commands will be saved.

Click >> File >> New



[File name] Initially a file name is automatically specified in the file name box. You can either use the name or rename it.

[Tool] Specify the tool number in which offset data of the tool attached to the manipulator is stored in.

[Mechanism] As for the robot system with external axis, it is possible to classify machinery freely. It is factory set to "1: Mech 1" at delivery.

For details of "Tool" and "Mechanism", refer to the operating instructions (advanced operation).

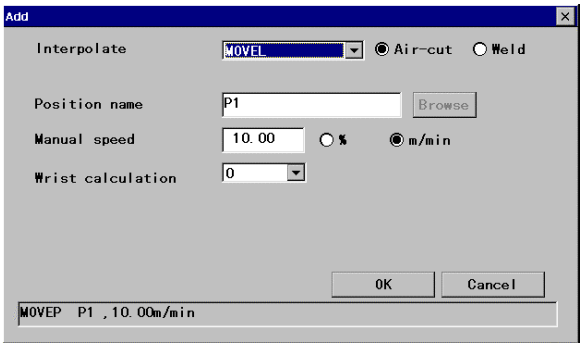
4-8. Teach and save teaching points

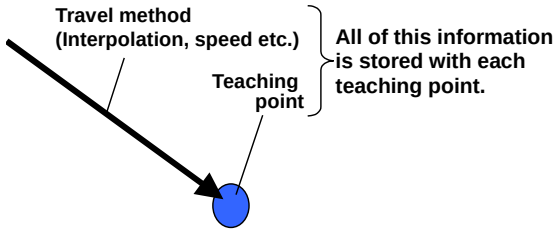
When you save a teaching point, data of the robot orientation and the travel method (interpolation, travel speed etc.) are saved at the same time. The interpolation and travel method saved in the teaching point are the travel method from the preceding teaching point to the current teaching point.

Click >> (Edit type) >> Add

If you are creating a new file, it is set to "Add" automatically.

1. Turn ON the Robot motion ON icon lamp so as to move the robot manually.
2. Bring the edit window to an active state.
3. Move the robot to the start point and then press the **Enter** key. The dialog box below appears.
4. Change fields in the box if necessary and press the **Enter** key or click the **OK** button to save it as the teaching point.





Normally the home position of the robot manipulator is used as the start point.

[Interpolate] Specifies an interpolation type between teaching points. For example, MOVEL means that the robot makes linear movement.

Air-cut: Check the circle of "Weld" for welding operation from the current teaching point to the next teaching point. Otherwise, check the circle of "Air-cut".

Weld: Check the circle of "Weld" for welding operation from the current teaching point to the next teaching point.

[Position name] Specifies position variable of the teaching point.

[Manual speed] Specifies the robot travel speed from the previous teaching point to the current teaching point.

[Wrist calculation] Normally set "0". Or specify 1, 2 or 3 for special calculation.

(This field is not available if the teaching point is "MOVEP")

4-8-1. Move commands for each interpolation

Interpolation types applicable to welding robots and to handling robots

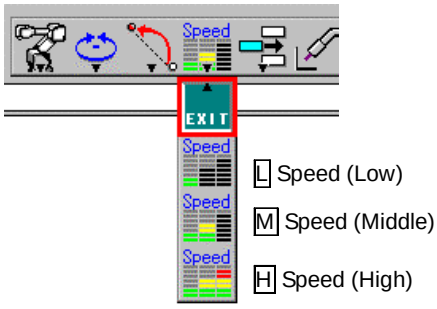
Welding robots		Handling robots	
Move command	Interpolation type	Move command	Interpolation type
MOVEP	PTP	MOVEP	PTP
MOVEL	Linear	MOVEL	Linear
MOVEC	Circular	MOVEC	Circular
MOVELW	Linear weaving		
MOVECW	Circular weaving		

Move command for amplitude points of weaving interpolations is “WEAVEP”.

4-8-2. Change speed

Specify the robot travel speed of the tool center point (arc start point).

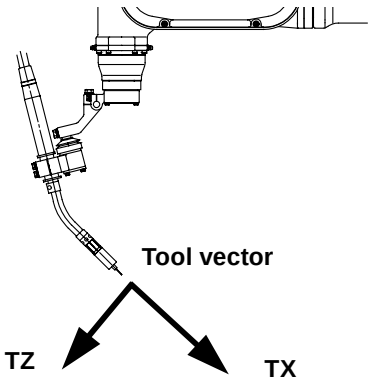
Use the icon on the menu bar to switch the speed range.



4-8-3. Wrist calculation (CL number)

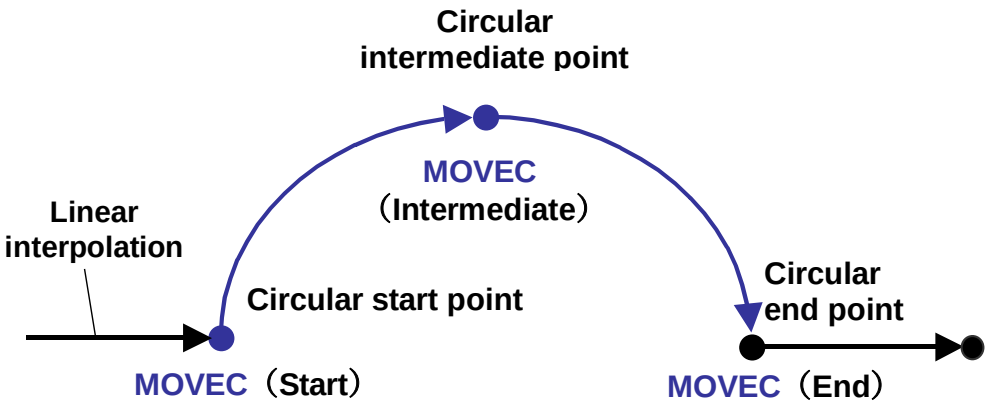
Moving the three wrist axes (RW, BW and TW axes) to a certain position can result in what is called “singular orientation of the robot, which can cause flip-over of the axes. In order to avoid possible flip-over of the axes, specify a calculation type of interpolation (the CL number).

CL No.	Calculation (application)
0	Automatic calculation
1	Suitable in circular interpolation if the arc plane and the tool vector create nearly at right angles (tolerance: within 10 degrees).
2	Suitable in circular interpolation if the arc plane and the tool vector do not create right angle (more than 10 degrees from right angle).
3	Suitable where BW axis is nearly 0 degree (i.e. TW axis is parallel to the RW axis). It avoids the singular orientation error with the following restrictions. Teach the CL=3 section as short as possible. Tool orientaion may not be stable in the CL=3 section. Actual robot travel speed may be slower than teach speed.



4-9. Circular interpolation

The robot control point is capable of following circular path.
The circular path will be determined by teaching at least three consecutive circular interpolation points (MOVEC).

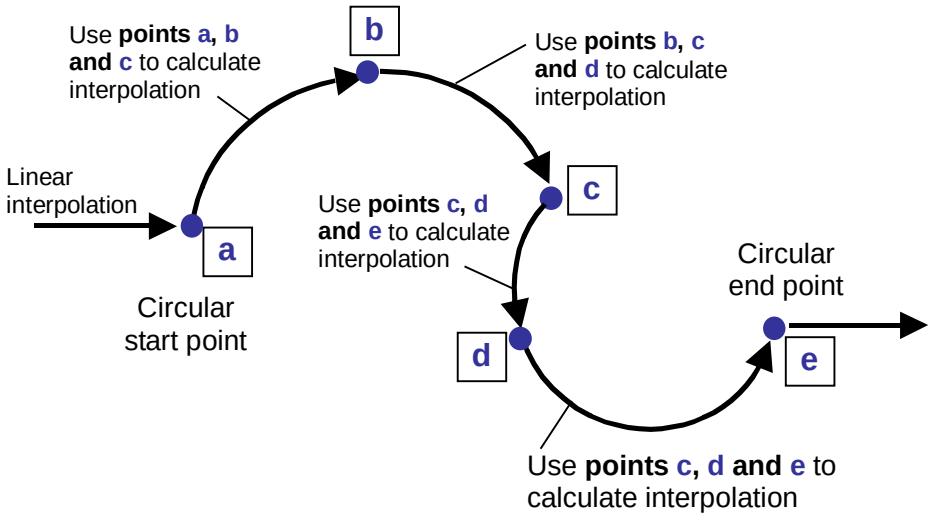


Circular start point	Circular intermediate point	Circular end point
1. Move the robot to the point you want to start a circular line. On the **Interpolation** menu, click **Circle**, and then press the **Enter** key. 2. Then the dialog box to set teaching point appears. Check to make sure that “MOVEC” is set as the interpolation type, and set other parameters in the box. Press the **Enter** key to save the point as a circular start point.	1. Move the robot to an intermediate point of the circular path you want to create and press the **Enter** key. 2. Then the dialog box to set teaching point appears. Press the **Enter** key if change of parameters is not necessary. The point will be saved as a circular intermediate point.	1. Move the robot to the point you want to end the circular line. Press the **Enter** key. 2. Then the dialog box to set teaching point appears. Press the **Enter** key if change of parameter is not necessary. * The point will be saved as a circular end point if the next teaching point is saved with an interpolation type other than circular.

- **Incomplete teaching of circular interpolation**
  Three consecutive points must be taught and saved as circular points to complete a circular interpolation. If circular points taught and saved are less than three (consecutive) points, those teaching points will be automatically switched to linear points.

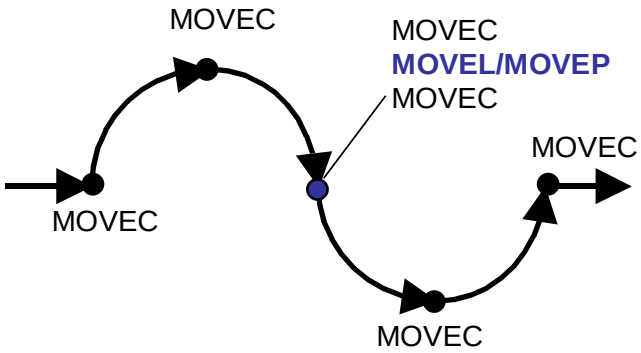
4-9-1. What is circular interpolation

The robot calculates a circle from three teaching points and moves on the circular pattern.
If there are more than one circular intermediate points, the circular pattern of the current point to the next point will be determined from the current point and two consecutive circular teaching points ahead. As for the circular point before the circular end point, the three consecutive points to determine the circular pattern will be the previous circular teaching point, the current point and the circular end point.

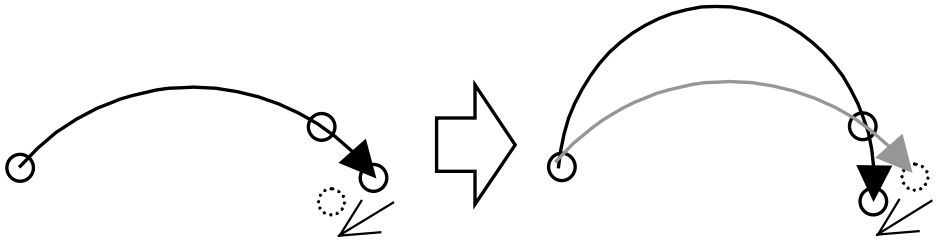


< Supplement >

1. Linear interpolation is applied to the circular start point.
2. To create a locus of a combination of more than one circular pattern, save a Linear interpolation point or PTP interpolation point on the shared teaching point of two circular patterns before saving the circular start point of the next circular pattern to separate patterns.



3. As for a circular pattern created by three circular interpolation points, if two points are positioned close to each other, the slight change of the position of either one of those points creates a significant change in the locus.

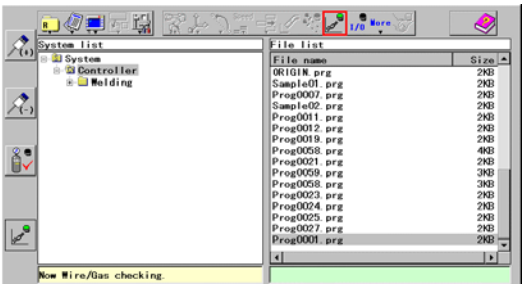


4-10. Teach weld section (Welding spec.)

Welding robots are provided with functions for operation frequently used in welding (welding ON/OFF operation) for easy operation.

4-10-1. Wire/inching Gas check

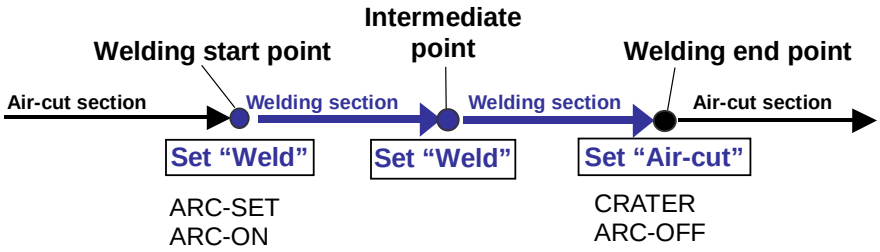
Turn ON the  Wire/gas check icon lamp in the menu bar, to use the Function keys for wire/inching gas check.



Function keys		Functions
	Wire feed forward	While holding down the key, wire feeds forward without outputting welding non-load voltage. The wire will be fed at low speed for the first 3 seconds after the key is pressed. Then the speed will be changed to high.
	Wire feed backward	While holding down the key, wire feeds backward without outputting welding non-load voltage. The wire will be fed at low speed for the first 3 seconds after the key is pressed. Then the speed will be changed to high.
	Gas check	While the green lamp is lit on, the gas valve is open. Each time the key is pressed the gas ON/OFF state is switched.

4-10-2. Teaching welding points and air-cut points

Store the welding start point and the intermediate point as “Weld” points, and the welding end point as “Air-cut” point.

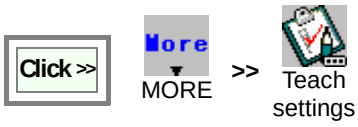


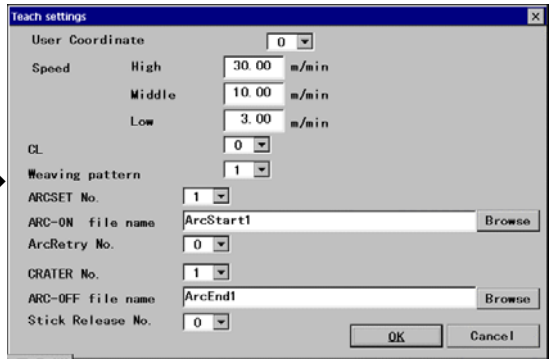
Teaching of a **welding start point**	Teaching of **intermediate point(s)**	Teaching of a **welding end point**
1. Move the robot to the point to you want to start welding and press the **Enter** key. Then the dialog box to set teaching point appears. 2. Change the attribute in the dialog box to “Weld”. 3. Press the **Enter** key to save the point as a welding start point. **Note**) In a welding start point, commands to start welding; ARC-SET (that specifies welding current, voltage and speed) and ARC-ON (that specifies the program to start welding operation) will be saved automatically.	1. Move the robot to a point within the welding section and press the **Enter** key. Then the dialog box to set teaching point appears. 2. Check the attribute in the dialog box that “Weld” is specified. 3. Press the Enter key to save the point as an intermediate point. **Note**) To change welding conditions at an intermediate point, newly save ARC-SET command (to change all welding current, voltage and speed), AMP (to change only welding current) or VOLT (to change only welding voltage).	1. Move the robot to the point you want to end welding and press the **Enter** key. Then the dialog box to set teaching point appears. 2. Change the attribute in the dialog box to “Air-cut”. 3. Press the Enter key to save the point as a welding end point. **Note**) In a welding end point, commands to end welding; CRATER (that specifies crater welding current, voltage and time) and ARC-OFF (that specifies the program to end welding operation) will be saved automatically.

Instead of the Enter key, you can click the OK button on the screen to save a teaching point.

4-10-3. Settings of condition of a teaching point

With the Teach setting dialog box, specify the Arc-ON and Arc-OFF program, welding conditions and crater conditions, then the preset conditions will be automatically programmed to the arc-ON or arc-OFF point when it is saved.





[User Coordinate] Specifies the User coordinate system No. to be applied as the default when the User coordinate system is selected. ("0" indicates the robot coordinate system.)

[Speed] Specifies the default robot travel speeds (High, Middle and Low) to be displayed in the 'Add a teaching point' dialog box.

[CL] (Wrist interpolation type)

0: automatic calculation 1-3: special calculation

[Weaving pattern] Specifies the default weaving pattern.

[ARCSET No.] Specifies the default weld table number to be stored in the ARC-SET command when saving the arc start point.

[ARC-ON file name] Specifies the default file name to be stored in the ARC-ON command when saving the arc start point.

[ArcRetry No.] Specifies a arc retry table number.
[Set range (table #): 1-5]

[CRATER No.] Specifies the default weld table number to be stored in the CRATER command when saving the arc end point.

[ARC-OFF file name] Specifies the default file name to be stored in the ARC-OFF command when saving the arc end point.

[Stick release No.] Specifies a stick release table number.

[Set range(table #): 1-5] *Note)

*** Note)**

As for built-in welding power source controller, the table #6 and #7 are available, which is to retract wire automatically when the stick release functions. (See "Arc welding machine settings" in the advanced operating instructions.)

ArcStart1 and ArcEnd1 at shipment

ArcStart1		Description
1	GASVALVE ON	Gas valve ON
2	TORCHSW ON	Torch switch ON
3	WAIT-ARC	Wait for welding current detection

ArcEnd1		Description
1	TORCHSW OFF	Torch switch OFF
2	DELAY 0.40	Wait 0.4 second.
3	STICKCHK ON	Wire stick detection signal ON
4	DELAY 0.30	Wait 0.3 second.
5	STICKCHK OFF	Wire stick detection signal OFF
6	GASVALVE OFF	Gas valve OFF

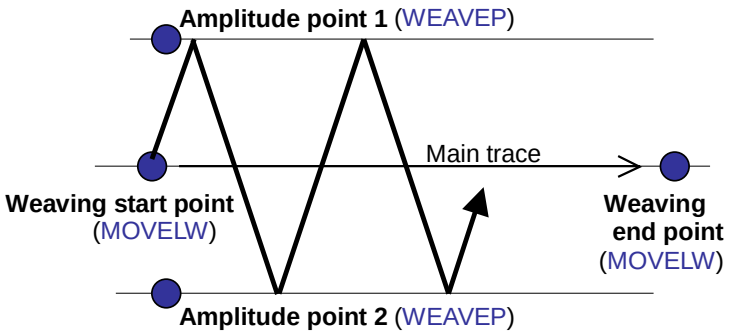
4-10-4. Hold and Restart in welding operation

When the Hold switch is pressed during welding operation, the robot suspends its operation after executing a CRATER command and ARC-OFF command saved in the welding end point of the current welding section.
When it is restarted, the robot resumes welding operation starting with execution of ARC-ON command saved in the welding start point of the current welding section.

4-10-5. Linear weaving interpolation

Teach a weaving start point (MOVELW), two amplitude points (WEAVEP) and weaving end point (MOVELW) to create weaving pattern.

1 Weaving start point	2 Amplitude point 1
1. At the point you want to start weaving, press the **Enter** key. Then the dialog box to set the teaching point appears. 2. Check to make sure that "**MOVELW**" is set as the interpolation type, and set other parameters in the box. 3. Press the **Enter** key or click the **OK** button on the screen to save the point as a weaving start point.	1. Next, move the robot to one of the points to determine the weaving amplitude (Amplitude point 1). 2. Press the **Enter** key, and then the dialog box to set the teaching point appears. 3. Switch the interpolation time to "**WEAVEP**" and set other parameters in the box. Press the **Enter** key or click the **OK** button on the screen to save the point as Amplitude point 1.



3 Amplitude point 2	4 Weaving end point
1. Then, move the robot to the other point to determine the weaving amplitude (Amplitude point 2). Then save it as Amplitude point 2 in the same manner of Amplitude point 1. 2. As for weaving pattern 4 or 5, teach two more amplitude points (3 and 4) in the same manner.	1. Move the robot to the point you want to end weaving, and then press the **Enter** key. The dialog box to set the teaching point appears. 2. Set parameters in the box. Press the **Enter** key or click the **OK** button on the screen to save the point.

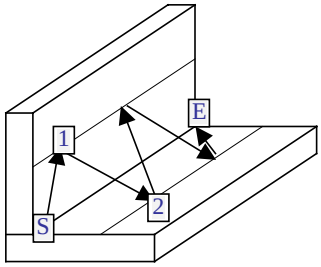
- **To extend weaving movement in succession**
  Simply add another "MOVELW" teaching point at the point you want to end the weaving movement.
  At that time, the amplitude of the extended part of the weaving section is the same.

- **To change weaving amplitude of the extended weaving section**
  Teach and save new weaving amplitude points (WEAVEP) in the extended weaving section.

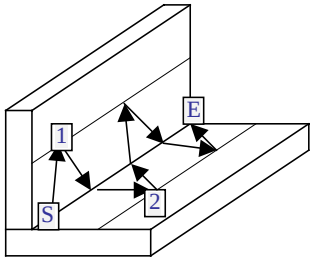
- **Incomplete teaching of linear weaving interpolation**
  Four (or six for pattern 4 and 5) teaching points to determine weaving movement must be taught and saved to complete linear weaving interpolation. If any one of those points is not saved, although those teaching points are saved as weaving points, in trace operation and operation, the robot travels over those points with linear interpolation.

Weaving pattern

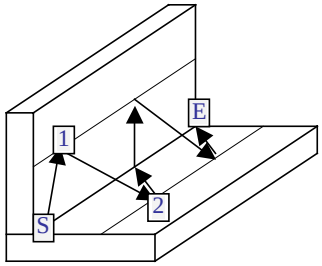
Pattern 1 (Single weaving)



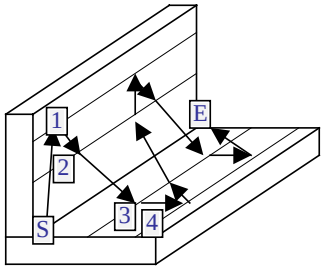
Pattern 2 (L shape)



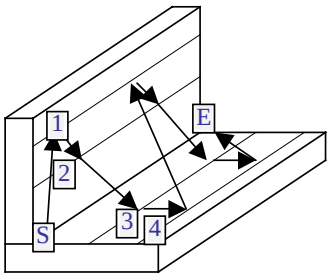
Pattern 3 (Triangular)



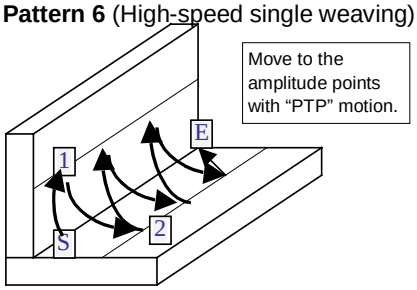
Pattern 4 (U shape)



Pattern 5 (Trapezoid)



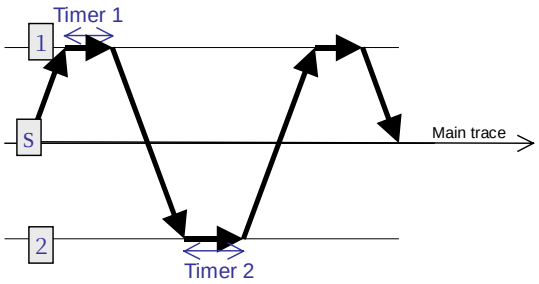
Pattern 6 (High-speed single weaving)



◎ Specify the frequency of the weaving speed on the weaving end point.
◎ In case of the welding section, specify the weaving speed at ARC-SET command.
◎ Specify the weaving pattern on the weaving start point.
◎ Specify the motion speed in the direction of the main trace on the weaving end point.

Weaving timer

It determines how much time (in seconds) the robot waits before traveling to the other amplitude point. During the period specified by the timer, the robot travels forward in the direction of the main trace.



Conditions

- For patterns 1 to 5: [Amplitude × Frequency] must not exceed 60 mm • Hz
- For pattern 6: [Angle of swing × Frequency] must not exceed 125 ° Hz
- **[1/f －(T0＋T1+T2+T3+T4)＞ A]** must be satisfied.

where, f: Frequency (unit: Hz)

T0: Timer set value saved in the weaving start point.

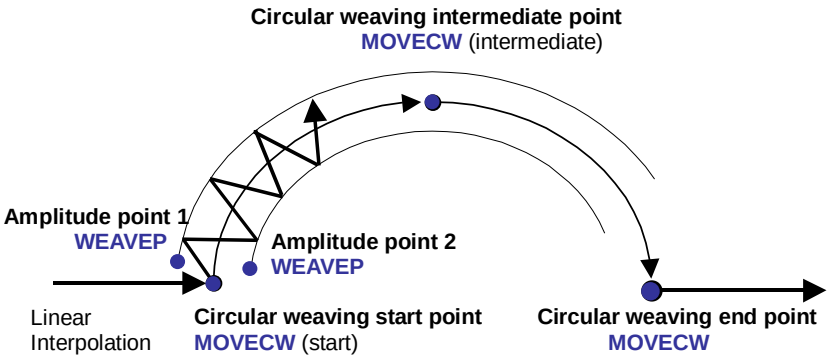
T1 to T4: Timer set values of amplitude points 1 to 4.

A= 0.1 (for patterns 1, 2 and 5),
= 0.75 (for pattern 3),
= 0.15 (for pattern 4),
= 0.05 (for pattern 6)

4-10-6. Circular weaving interpolation

Teach three points to determine a circular line and two amplitude points (WEAVEP) to create circular weaving movement of the robot.

Circular weaving start point	Weaving amplitude 1	Weaving amplitude 2
1. Set the interpolation type to "**Circle-Weaving**". 2. Set the edit type to "**Add**". 3. At the point you want to start circular weaving, press the **Enter** key. Then the dialog box to set the teaching point appears. 4. Set parameters in the box, and then click the **OK** button to save the point as a circular start point.	1. Next, move the robot to one of points to determine the weaving amplitude (Amplitude point 1). 2. Press the **Enter** key, and then the dialog box to set the teaching point appears. 3. Switch the interpolation type to "**WEAVEP**" and set other parameters in the box. 4. Press the click the **OK** button to save the point as Amplitude point 1.	1. Then, move the robot to the other points to determine the weaving amplitude (Amplitude point 2). 2. In the same manner of Amplitude point 1, save this point as Amplitude point 2.



Circular weaving intermediate point	Circular weaving end point
1. Move the robot to a point on and within the circular weaving path you want. 2. Press the **Enter** key. The dialog box to set teaching point appears. 3. Set parameters in the box and then click the **OK** button to save the point as a circular intermediate point.	1. Move the robot to the point you want to end circular weaving, and then press the **Enter** key. The dialog box to set teaching point appears. 2. Set parameters in the box and then click the **OK** button to save the point.

- **Incomplete teaching of circular weaving interpolation**
  Five (or seven for pattern 4 and 5) teaching points to determine circular weaving movement must be taught and saved to complete a circular weaving interpolation. If any one of those points is not saved, although those teaching points are saved as weaving points, in trace operation and operation, the robot travels over those points with linear interpolation.

Weaving pattern
Six patterns are available. (See weaving patterns of linear weaving interpolation.)

4-11. Trace operation

Trace is used to check the actual position or conditions of taught points which have been saved. With this operation, it is also possible to change teaching point data.

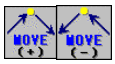
4-11-1. Trace start/end

Use the trace icon and the motion function key to trace points.

Trace icon		Function
	Start	Trace operation is operable while the green lamp is lit.
	End	While the green lamp is off, trace operation is not operable. It is possible to end trace operation by pressing the function key next to the trace function icon.

Function key	Function
 or 	Hold down the  (or ) key and the Jog dial, then the robot moves forward (or backward) until it reaches the next taught point, and then stops.

The robot performs trace operation only while the Jog dial or the ⊕⊖ is held down. Once the Jog dial or the ⊕⊖ is released, the robot stops.

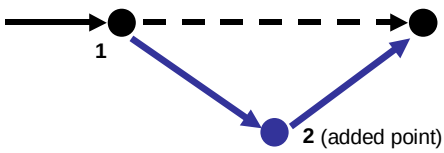
When direction of the  is not matched with the ⊕⊖, the robot cannot move. (Ex.  against ⊖)

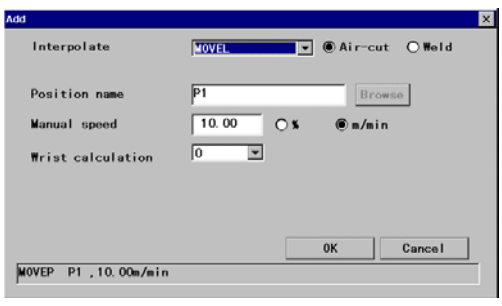
4-11-2. Add teaching points

Turn ON the  Robot motion ON icon lamp, and move the robot to the new location you want to add as a teaching point, and then save it.

You will find the edit type icon used in the preceding edit operation in the menu bar.

1. Bring the edit window to an active state.
2. Press the **Enter** key. The dialog box below appears.
3. Set parameters in the box if necessary and click the **OK** button to add it as the teaching point below the line where the cursor is positioned.





[Interpolate] Specifies an interpolation type between teaching points. For example, MOVEL means that the robot makes linear movement.

[Position name] Specifies position variable of the teaching point.

[Manual speed] Specifies the robot travel speed from the previous teaching point to the current teaching point.

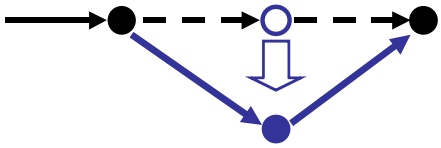
[Wrist calculation] Normally set “0”. Or specify 1, 2 or 3 for special calculation.

(The field is not available if the teaching point is “MOVEP”)

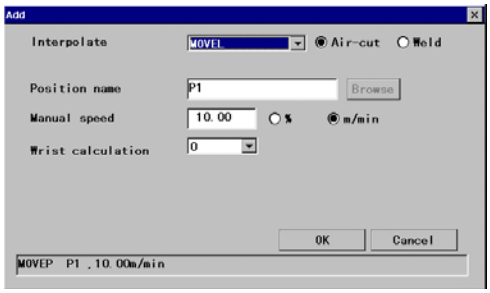
4-11-3. Change teaching points

In trace operation, move the robot to the taught point you want to change. (The cursor moves to the same point in the screen.)

You will find the edit type icon used in the preceding edit operation in the menu bar.



1. Bring the edit window to an active state.
2. Move the robot to the new position.
3. Press the **Enter** key. The dialog box below appears.
4. Set parameters in the box and click the **OK** button to update the teaching point.



[Interpolate] Specifies an interpolation type between teaching points. For example, MOVEL means that the robot makes linear movement.

[Position name] Specifies position variable of the teaching point.

[Manual speed] Specifies the robot travel speed from the previous teaching point to the current teaching point.

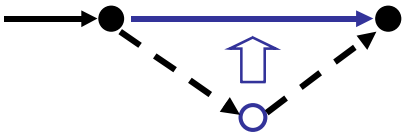
[Wrist calculation] Normally set “0”. Or specify 1, 2 or 3 for special calculation. (The field is not available if the teaching point is “MOVEP”)

4-11-4. Delete teaching points

In trace operation, move the robot to the taught point you want to delete. (The cursor moves to the same point in the screen.)

You will find the edit type icon used in the preceding edit operation in the menu bar.

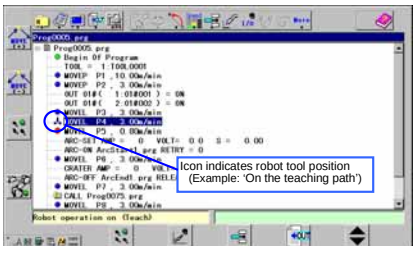
1. Press the **Enter** key. The dialog box on the right appears.
2. Click the **OK** button to delete the point.

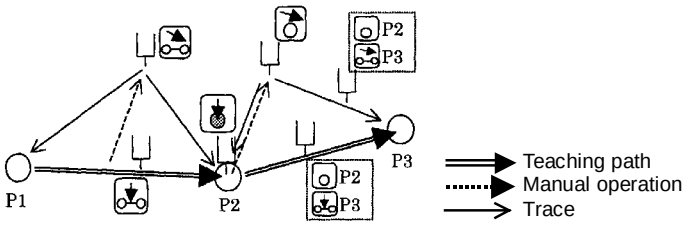


4-11-5. Robot position and icons

With the icon in the screen, you can determine the position of the robot tool (the wire tip of the welding torch) to the teaching point and teaching path.

Icon	Robot tool position
	On a teaching point
	Off a teaching point
	On the teaching path
	Out of teaching path.
	None of above

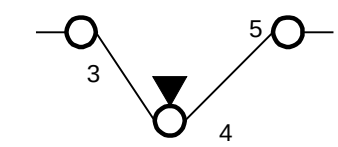
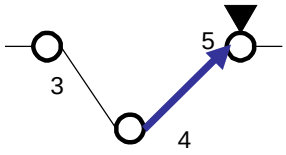
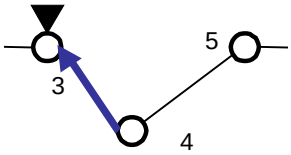
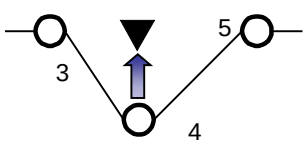
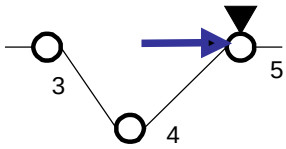
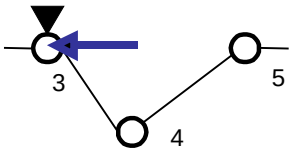
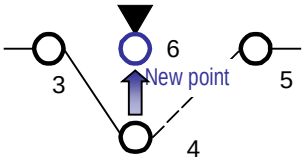
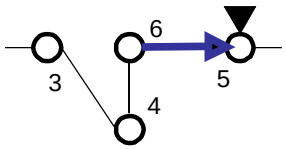
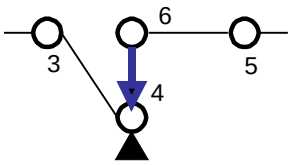
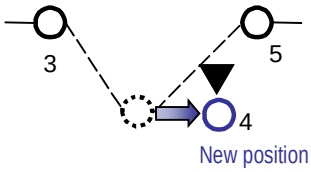
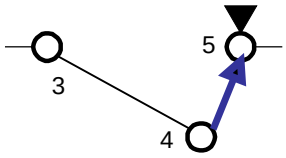
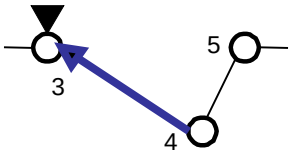
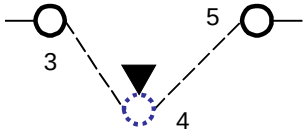
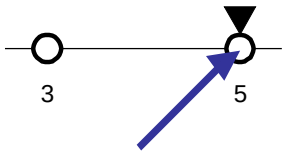
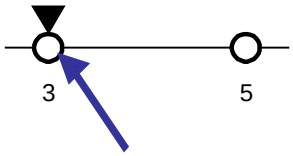




4-12. Trace motion after editing

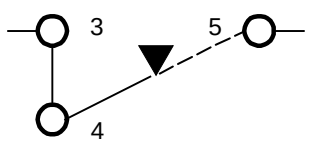
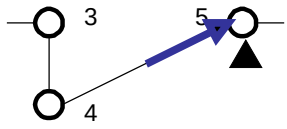
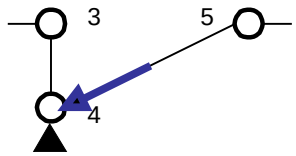
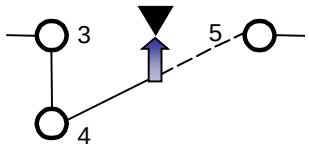
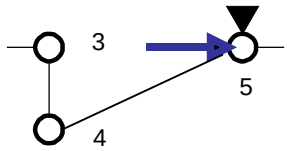
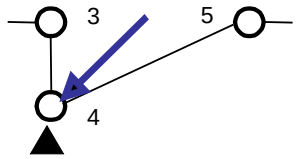
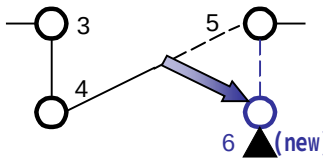
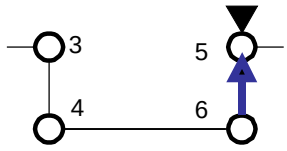
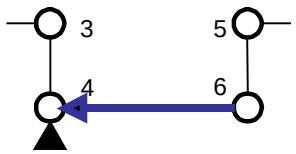
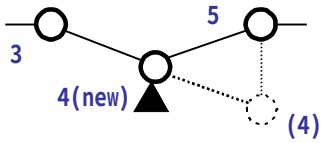
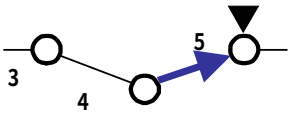
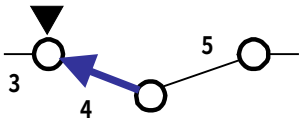
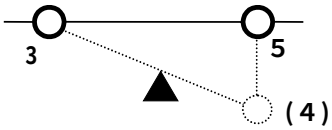
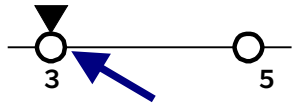
The following examples show the robot movement of trace forward/backward operation after each editing in trace operation

- Stop the robot on the teaching point 4 and then edit the point

Manual edit	Trace forward	Trace backward
Original robot motion 		
Manually move the robot  (Moves the robot manually)		
Add a point  (Add the teaching point 6)		
Change position of a point  (Change the teaching point 4)		
Delete a point  (Delete the teaching point 4)		

(▼ indicates location of the robot control point after exit or trace forward/backward.)

- Stop the robot between teaching points (4 and 5) and then edit the point

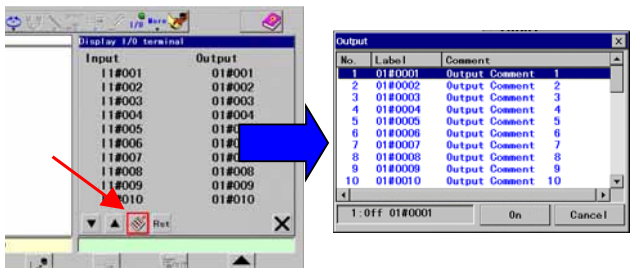
Manual edit	Trace forward	Trace backward
Original robot motion 		
Manually move the robot  (Moves the robot manually)		
Add a point  (Add a teaching point (6) between 4 and 5)		
Change position of a point  (Change the teaching point.)		
Delete a point  (Delete a teaching point (4))		

(▼ indicates location of the robot control point after exit or trace forward/backward.)

4-13. I/O monitor

It displays user input/output state when the robot is in the hold state. It is possible to change ON/OFF state of outputs with this display. (This I/O monitor function is available when the mode select switch is in the TEACH position.)

1. Place the mode select switch in the **Teach** position.
2. Turn ON the  In/Out icon on the menu bar to display the I/O monitor screen in the right pane.
3. Turn ON the  icon to display the box to change OUTPUT state.



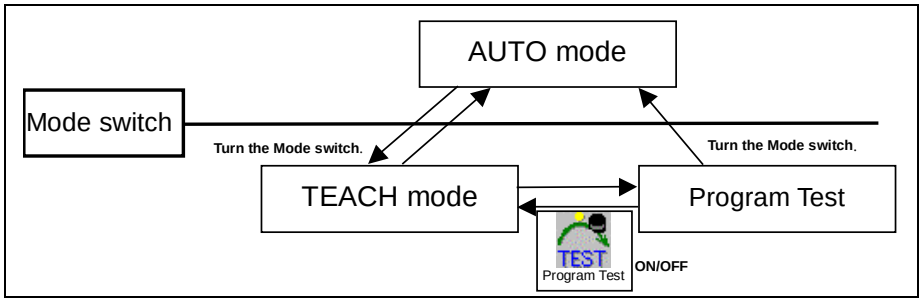
The robot does not retain the ON/OFF state of OUTPUT terminals if ON/OFF state of an OUTPUT terminal is changed using this I/O monitor function while the robot is in the hold state.

4-14. Program test

The program is tested in TEACH mode by performing robot motion and actual welding under the safety condition.
And the override operation is available from the software “J” and later version.

Functions

- Actual welding is available to test.
- The robot moves in accordance with the program under the safety condition of TEACH mode, and executes all robot commands including CALL and PARACALL commands.
- Synchronnized dual robots motion is available to test.



Note
Safety condition of TEACH mode:

- Restricted arm speed defined in Speed limit setting.
- The deadman key is effective.
- The door stop switch is not effective.

Note

- Operational details of the Program Test are set in the Advanced settings.
- When the Mode switch is changed to AUTO during Program Test, the operation will go into the AUTO mode with same robot arm position.
- Even if the Mode switch is changed to AUTO from PROGRAM TEST and is returned to TEACH again, the operation is not returned to PROGRAM TEST. It will go normal TEACH mode.

4-14-1. Procedures

Turn on 

icon to operate the Program Tset.

The Progra Test is operated with Function keys and the User function keys in the Teach box.

Fuction keys		Single hand	Both hands
1	 Test Run	PROGRAM TEST is started and kept while pressing the key.	PROGRAM TEST is started and kept while pressing both this key and the jog dial.
2	—		
3	 Program Test	Press the key to finish the Program Test operation.	
4	—		

User fuction keys	

Note

- When Arc-test is set to **Invalid** in the advanced setting,  (Arc lock) icon is not displayed.
-  (Gas･Wire) icon is pressed in the test, It finishes the Program Test. The operation does not change to “GAS Wire” operation.
- When  or  (Program change) are pressed in the test, each function becomes effective in the Program Test.
- The user function keys of the Program Test are no customized keys.
- Handling software does not show  and  icons.

Available functions in Program Test

Function	Availability	Function	Availablity
“WELD/CUT OFF” key	**O**	Load factor view	Real time display only (No overduty error)
Arc retry, Stick release, Restart overlap	**O**	Accumulated time	No count in Program test.
RT and Cube monitor	**O** (No auto restart)	Arc weld information Weld off input/output	**X**
Resume	**O**	Running output Hold status output	**X**
Tip change	**O**	Arc weld information	**X**
Flying start	**X**	Home return status output	**O** (Output after executing GOHOME command)
Override	**X**	Home return status output	**X**
Back up	**X**	**O**: Avaiable	**X**: Not available

4-14-2. Override in the Program test.

Change Override of Program test in the advanced setting to Valid before operation.

Press the F1 key (Override icon) to turn on the Override in the Program test.

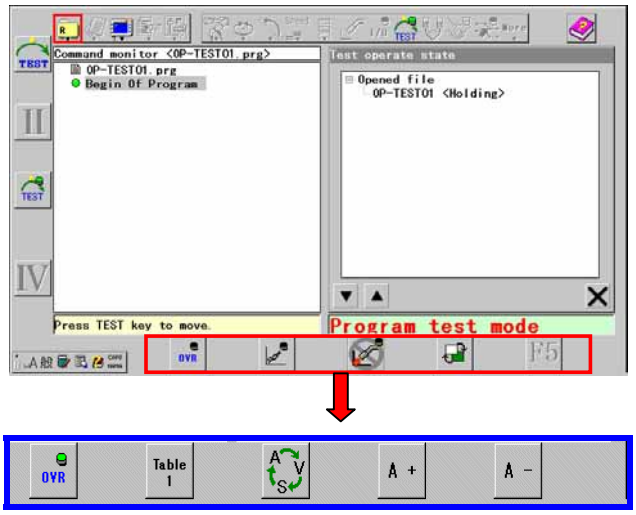
The 

lamp is lit and the function keys are changed to icons for override operations.

Note)

When Overide is set to **Invalid** in the advanced setting, 

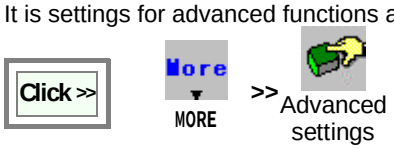
(Override) icon is not displayed in the F1 key.

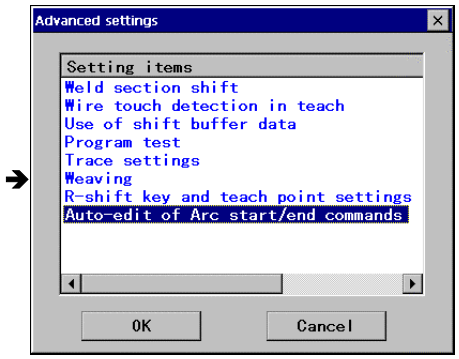


	(F1)	The override is turned ON or OFF.
	(F2)	Changing the adjusting table.
	(F3)	Changing the adjusting object.
	(F4)	Increasing direction
	(F5)	Decreasing direction

4-15. Advanced settings

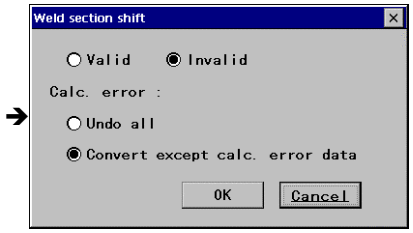
It is settings for advanced functions available.





[Weld section shift] A function to shift all points of a welding section according to the shift value of the welding start point automatically.
[Wire touch detection in teach] *Available if the “Touch sensor (option)” is applied. A function that enables the use of touch sensor in teaching operation to reduce its teaching task.
[Use of shift buffer data] A function to determine whether to execute shift processing, such as sensing resut, in trace operation.
[Program test] The program is tested by performing robot motion and actual welding under the safety condition in TEACH mode.
[Trace settings] A function that enables trace operation at the speed other than teaching speed.
[Weaving] A function that enables to specify weaving settings for each teaching point individually.
[R-shift key and teach point settings] It specifies how the confirmation dialog box is to be displayed at teach point settings.
[Auto-edit of arc start/end commands] It specifies whether to display the confirmation box in case that a significant change in program structure will be made by weld sequence edit operation.

4-15-1. Weld section shift



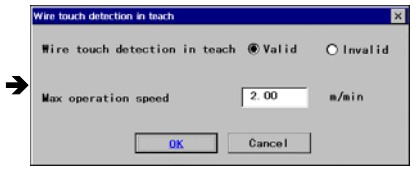
[Valid/Invalid] Specifies the validity of the function.

[Undo all] Select not to shift any point when a calculation error occurs.

[Convert except…] Select to shift points except the points of calculation error data.

4-15-2. Wire touch detection in teach

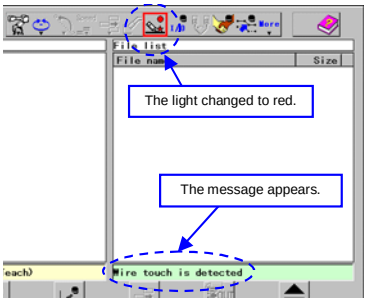
It holds the robot operation when the wire at the end of the torch touches the work.
The function is also useful to set the robot at the accurate welding position by adjusting the wire projection length.



[Valid/Invalid] Specifies the validity of the function.
It is factory set to “Invalid” at shipment.

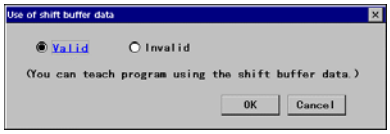
[Max. operation speed] Speed limit while wire touch detection is in process. Set range: 0.01 to 15.00

Select Valid to add “Wire touch” icon on the menu bar. The icon lamp changes its color to indicate the current status.



(Light is OFF)	Wire touch function is not effective.
(Gray is ON)	Wire touch function is effective but not active.
(Yellow is ON)	Wire touch function is active and no wire touch is detecting.
(Red ON)	Wire touch (to the work) is detected. The red light is lit unless corrected.

4-15-3. Use of shift buffer data

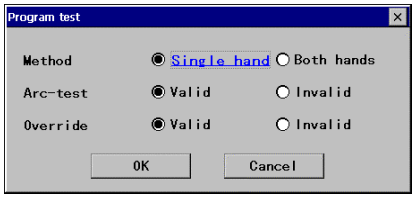


[Valid/Invalid] Specifies the validity of the function.
It is factory set to “Invalid” at shipment.

Select Valid to add “Wire touch” icon on the menu bar.

ON	(Green lamp is ON)	Trace operation using shift buffer data.
OFF	(Light is OFF)	Trace operation of teaching points.

4-15-4. Program Test



[Method]

Single hand: Single hand operation using the Function keys.

Both hands: Operation with the function keys and the jog dial.

[Arc-test]

Valid: Test with welding, **Invalid**: Test without welding

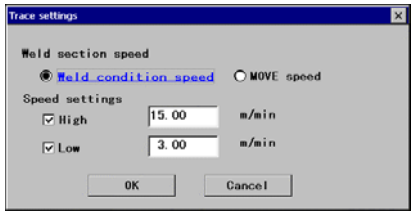
[Override]

Valid / Invalid of the override operation in the program test

Note

- The User ID requires “Programmer” or higher user level to change above settings.
- When any files are opened, the screen cannot change setting data.
- Handling application software does not show the “Arc-test” and “Override” settings.

4-15-5. Trace settings



[Weld section speed]

Specify a trace speed in the weld section.

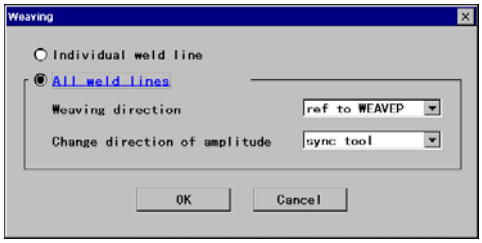
[Speed settings]

Set [High] level and [Low] level speeds respectively.

[Range: 0.01-15.00]

4-15-6. Weaving

In this dialog box, it is also possible to specify weaving direction to be determined based on the vector created by two amplitude points (WEAVP)



[Individual weld line]

Select to specify the weaving direction settings toward the next teaching point individually.

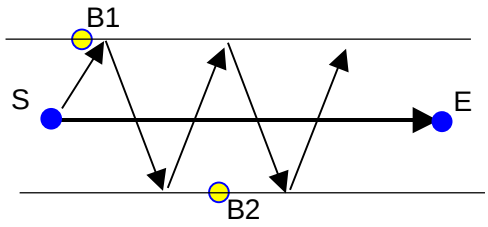
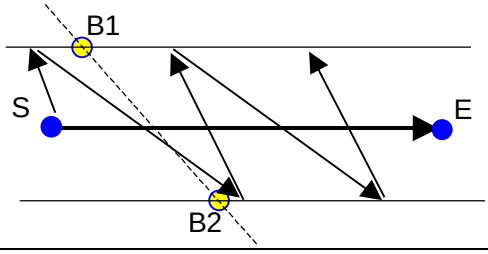
[All weld lines]

Apply weaving direction settings set in this dialog box to all teaching points.

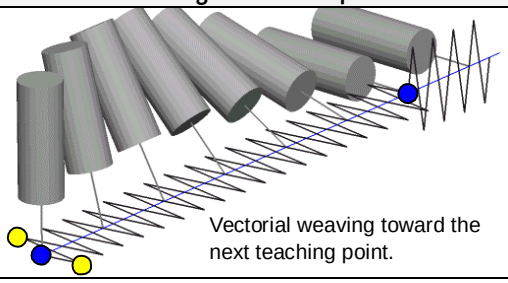
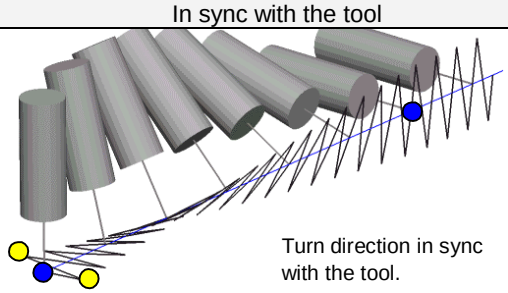
<Supplement>

- As for weaving patterns 6 and 16, this function is not available as they are special weaving patterns.
- As for weaving patterns 11 to 15, the “Weaving direction” is automatically set to “Reference to amplitude points” as the robot movements of those patterns are based on the external axis.

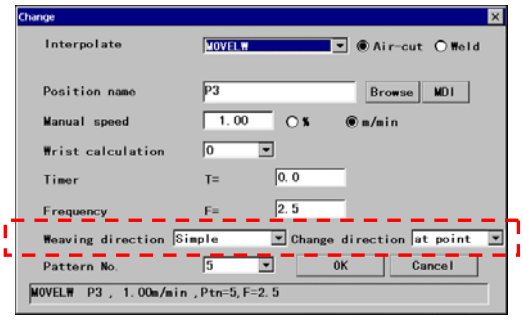
◎ Movements of “Direction of weaving amplitude”

Simple weaving	Reference to amplitude points
	

◎ Movements of “Change direction of weaving amplitude”

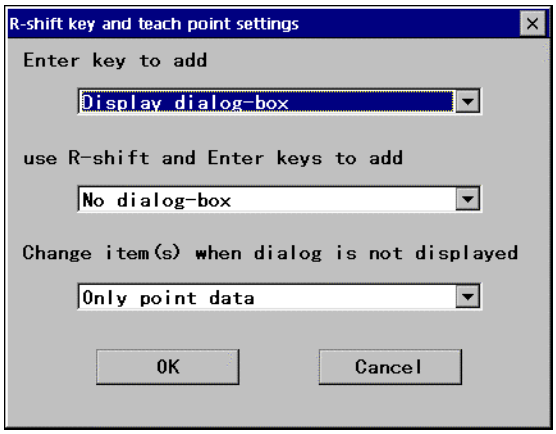
Change at teach point	In sync with the tool
	
Vectorial weaving toward the next teaching point.	Turn direction in sync with the tool.

When “Individual weld line” is selected, the setting items “Welding direction” and “Change direction” appears on the weaving setting dialog box.



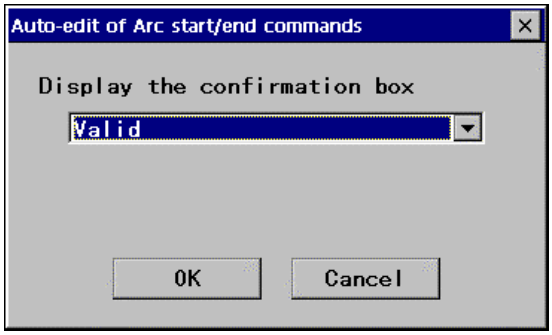
4-15-7. R-shift key and teach point settings

It specifies how the confirmation dialog box is to be displayed at teach point settings - whether to press both the **Enter** and **R-shift** keys or to press only the **Enter** key, or either way.
It also allows you to specify whether to change the menu data together with the teaching point.



[Enter key to add]: Whether to display the confirmation dialog box when only the **Enter** key is pressed.
[Use R-shift and Enter keys to add]: Whether to display the confirmation dialog box when both **Enter** and **R-Shift** keys are pressed.
[Change item(s) when ….]: Whether to change the menu data when to change a teaching point without displaying the dialog box.
・Change only point data.
・Change both point data and menu data which includes Interpolation type, speed and so on.

4-15-8. Auto-edit of Arc start/end commands



[Display the confirmation box]
It specifies whether to display the confirmation box in case that a significant change in program structure will be made by weld sequence edit operation.

*When [Invalid] is selected, the confirmation box won't be displayed at any edit operation.

4-16. Edit files (Basic operation)

While teaching or tracing, file edit operation make possible editing the current working program with operating keys on the teaching pendant.

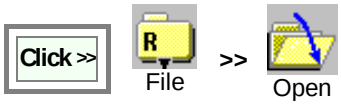
Turn OFF the 

icon lamp to edit files on the window of the teach pendant.

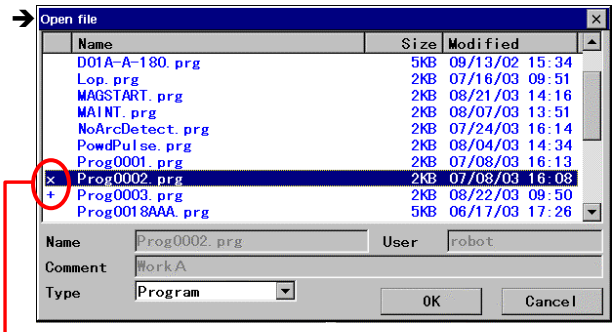
4-16-1. Open a file

To edit a file, you need to open the file you want to edit.

This procedure is necessary only if you want to edit a file other than the current working program.



Program	Displays a list of all program files.	Arc start program files	Displays a list of arc start program files. (Welding spec.)
Recent files	Displays a list of files recently used in Teach mode.	Arc end program files	Displays a list of arc end program files. (Welding spec.)



Symbols indicate those files are protected.
Please refer to section “File protect” for details.

Jog the dial over the files and select the file you want to open. Then click the jog dial to open the file.

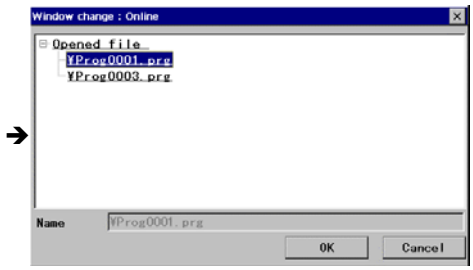
[Name] Specify the name of file to open.
[User] Indicates user name of the specified file.
[Comment] Indicates comments of the specified file.
[Type] Program/Arc start/Arc end

Attention!

Unless otherwise specified, the explanation is on the premise that the file you want to edit is open.

4-16-2. Display a file on top of the screen

When you open more than one window, u se this function to display the specified file on top. You can edit the file that is displayed on top.



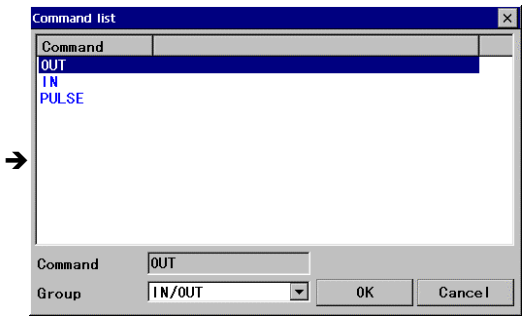
A list of files currently open on the teach pendant appears.

Move the cursor to the file you would like to display on top, and then click the **OK** button.

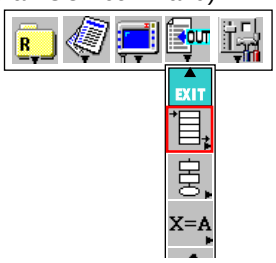
4-16-3. Add a sequence command

Move the cursor to the line you want to add a sequence command below.

You will find the edit type icon used in the preceding edit operation in the menu bar.

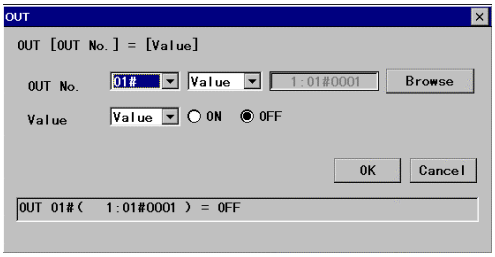


On the **Command** menu, click the sequence command you want to add.
(Example: Add an OUT command)



- Specify the command type you would like to add.

[Command] Indicates the selected command
[Group] Command group of the list to be displayed



[OUT No.] Specifies output terminal and terminal No. Click Browse to select from the list.
[Value] Value to be output

4-16-4. Change a sequence command

Move the cursor to the line of the sequence command you want to change.

You will find the edit type icon used in the preceding edit operation in the menu bar.

* The **Command list** (same as the above) appears.

- Set the parameters and then click the **OK** button.

When you change [CALL] or [PARACALL] command:
Click a CALL (or PARACALL) command you want to change to display the program to be called by the argument. Then change the “Edit type” to “Change” and click the **Enter** key to display the edit dialog box.

4-16-5. Delete a sequence command

Move the cursor to the line of the sequence command you want to delete.

You will find the edit type icon used in the preceding edit operation in the menu bar.

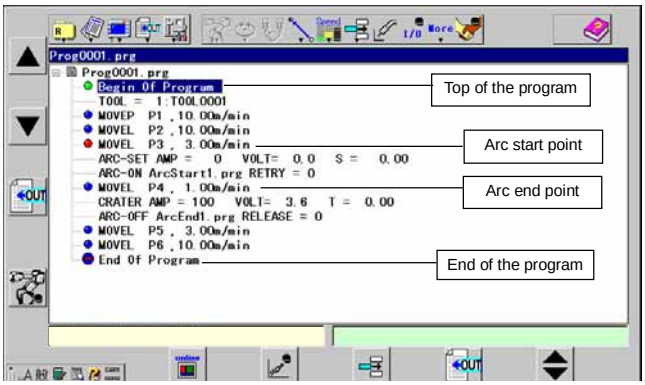
- The teach pendant prompts you to confirm the deletion of the command. Click **OK** button to delete the command.

4-16-6. Setting welding conditions (Welding) –“Auto-edit of arc start/end commands”

Welding robots are provided with commands for operation frequently used in welding (welding start/end sequences) for easy operation.

When creating a program:

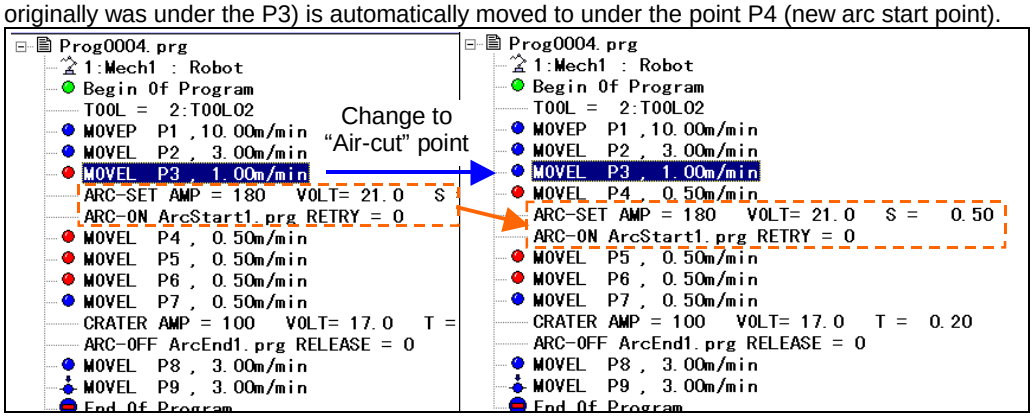
In teaching operation, by entering “Weld point” and “Air-cut point” correctly, preset detail welding conditions will be automatically added to the program. You can change the welding conditions saved in each teaching point in the file edit operation. See section ” Add a sequence command” and “Change a sequence command” for details.



When editing a program:

According to the edited “Weld point” and “Air-cut point”, arc start sequence (ARC-SET and ARC-ON commands) and arc end sequence (CRATER and ARC-OFF command) will be automatically added to or deleted from the program.

<Example> Change the point P3 (Arc start point) to an “Air-cut” point. Then, the arc start sequence (which originally was under the P3) is automatically moved to under the point P4 (new arc start point).



Note

This “Auto-edit of Arc start/end commands” function is not applicable, if
- points are added using “Cut and Paste” operation.
- an editing program that contains a welding command not used in default welder.
- an editing program default welder has not specified.

Sequence commands frequently used in welding operation

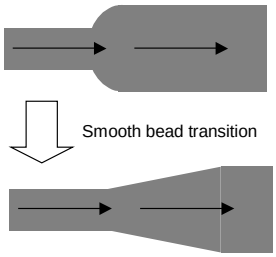
Command	Definition	How to set
ARC-ON	Specifies welding start conditions.	Select one from welding start programs ArcStart1 to ArcStart5 (torch switch ON, welding current detect etc.)
ARC-OFF Note)	Specifies welding end conditions.	Select one from welding end programs ArcEnd1 to ArcEnd5 (torch switch ON, Wire stick detect etc.)
ARC-SET	Specifies welding conditions.	Enter set values of welding current, welding voltage and welding speed.
CRATER	Specifies crater welding conditions.	Enter set values of crater welding current, crater welding voltage and crater welding time.
AMP	Specifies welding current.	Enter the welding current.
VOLT	Specifies welding voltage.	Enter the welding voltage.

Note)

As for built-in welding power source controller, the table #6 and #7 are available, which is to retract wire automatically when the stick release functions. (See “Arc welding machine settings” in the advanced operating instructions.)

Slope control for welding conditions

The slope control makes smooth transition of welding arc and welding bead.



Welding method	Command	Function
CO2/MAG/MIG	**ARCSLP**	Slope command for MAG/MIG welding condition
TIG	**TIGSLP**	Slope command for TIIG welding condition
	WFDSLP	Slope command for filler wire feed speed
TIG/MIG Force	**WSPDSLP**	Slope command for wire feed speed

Note

Refer the details of the command to “Robot command” section in Advanced operation.

Welding start/welding end sequence programs

Five sequence programs each for welding start and welding end are factory set at shipment.
They are stored ArcStart or ArcEnd sequence or “Teach settings”.
Refer to the later section “ArcStart or ArcEnd sequence” in this document for details of sequnce programs.

Arc-ON program	ArcStart1 to ArcStart5
Arc-OFF program	ArcEnd1 to ArcEnd5

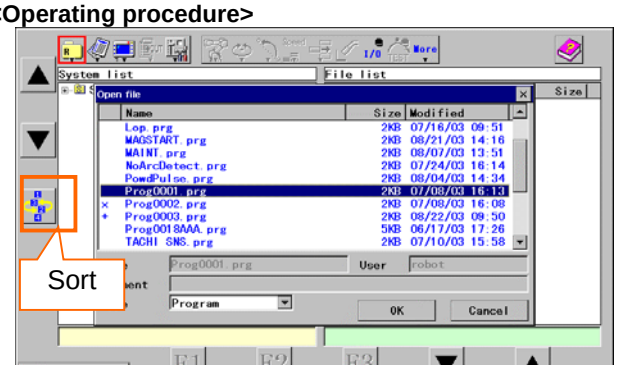
4-16-7. File sort

Files in the displayed file list (by File open operation or so on) can be sorted in the following orders.

Sort key	Sorting order
Name (A to Z)	Alphabetical order* of file name. (from A to Z)
Name (Z to A)	Alphabetical order* of file name. (from Z to A)
Time (New to Old)	In order of time (from latest to old)
Time (Old to New)	In order of time (from oldest to new)
Size (Small to Big)	In order of ascending size (small to big)
Size (Big to Small)	In order of descending size (big to small)

* Alphabetical order applies the order of character code.
Name (A to Z): in order of “symbols”, “numbers” and then “alphabet A to Z”
Name (Z to A): in reverse order of the above. (i.e. alphabet Z to A, “numbers” and then “symbols”.

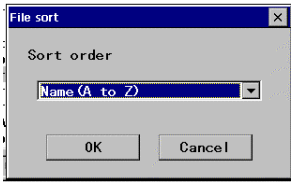
<Operating procedure>



Click the (Sort) icon.

Note:

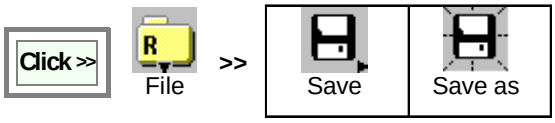
Sorting is available if the (Sort) icon appears on the key position while a list of files is displayed on the screen.



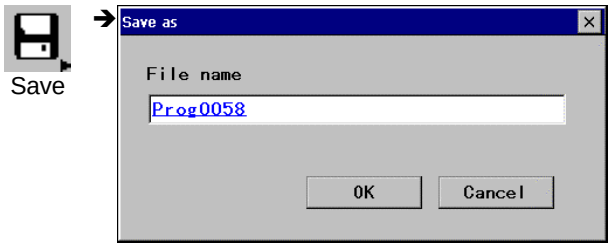
Select a desired sort order, and then click **OK**.

4-17. Save a file

You must save the teaching data after teaching or editing in a file. If you closed the file without saving the data, you loose all teaching data or the changes you have.

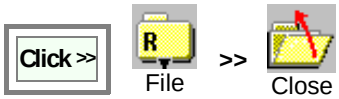


Save	Overwrites data.
Save as	Names the active file and save it.



4-18. Close a file

When you are finished teaching or editing points, you close the file.

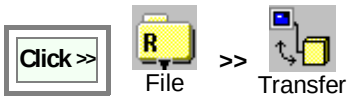


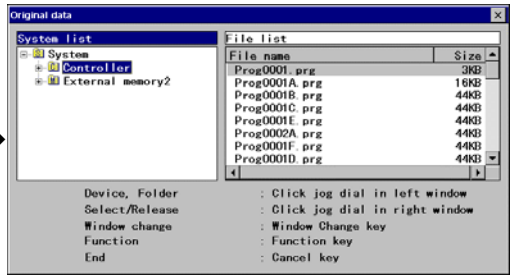
4-19. File transfer

It stores files of program etc. in another folder or memory card.

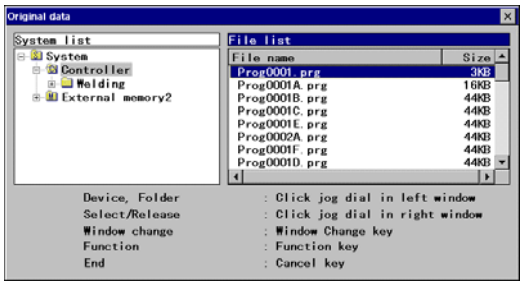
- When you make a backup data on a PC card, insert the PC card (with memory card embedded) into the PC card slot at the near side of the TP. (Please refer to the operating instructions of the controller (OM0105037E))
- If “Storage Memory” items in the ‘Backup’ dialog box do not appear, click the **View** menu, and then click **File list** to display file list, and then retry the above procedure.
- If you make a backup copy, make sure that the PC card is in “ write possible” condition.

- **Close any active program file(s) first.**



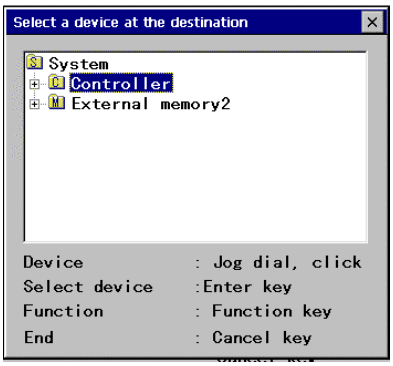


Select and click the folder where the file you would like to transfer is stored. Then a list of files in the specified folder appears in the right window pane.



Press the **Window change** key to bring the right window to an active state.

Click the file(s) to transfer from the list. (You can select more than one file.)
The selected files are marked with “*” to the left of the file name.



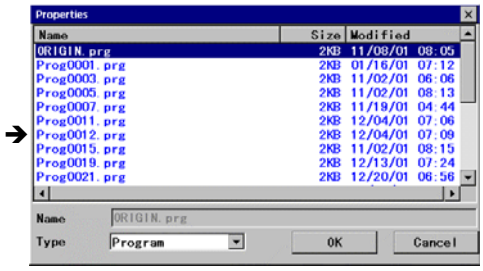
Once selected all files you would like to transfer, press the **F3 (Next)** key to display the “Select a device at the destination” dialog box.
Use the jog dial to select the destination (folder) and press the **Enter** key. Then the dialog box to confirm the action appears.

Click the **OK** button to transfer the file(s).

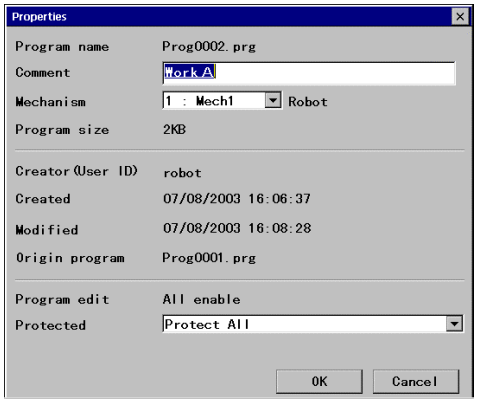
4-20. File properties

4-20-1. File properties

It provides information particular to each file, for example, when it was saved or who create the file.
It also provides a place for you to add a comment.



Specify a file you would like to see the properties of.



[Program name]: Specified program file name.

[Comment]: You can add a comment using up to 30 characters.

[Mechanism]: Applied mechanism.
"0" indicates the newly added axis.

[Program size]: File size

[Creator (User ID)]: User ID who created the program

[Created]: Date when the file was first saved.

[Modified]: Data when the file was saved last.

[Original program]: The original file name if the file was save using "Save as" or was renamed.

[Program edit]: Current file protect state

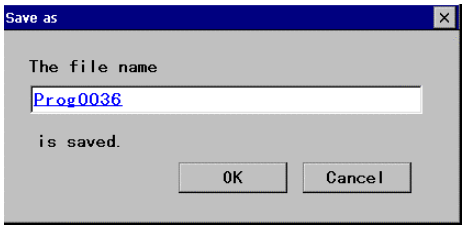
[Protected]: Current protect level.

[OK]: Click to update the Command and/or Mechanism.

4-20-2. Rename a file

You can change the name of a file without changing contents of the file.

- From the file list, select the file you want to rename.



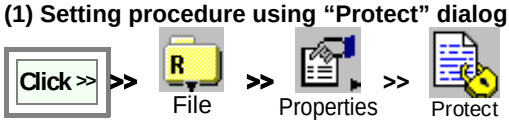
[The file name]: Type a name for the specified file.
The file name can have up to 28 characters.

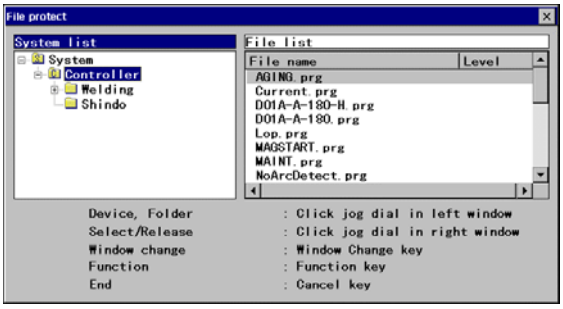
[OK]: to update the file name.

4-20-3. File protect

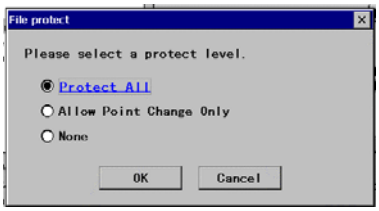
It is a function that allosw you to protect on a file basis.
You can also set a file protection using the “Properties” dialog box.

(1) Setting procedure using “Protect” dialog box



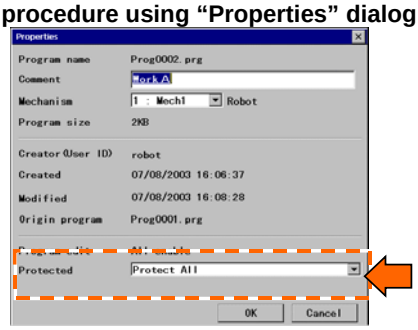


Select a file you want to set/change the protect level.
Then click the [**F3 (NEXT)**] key.



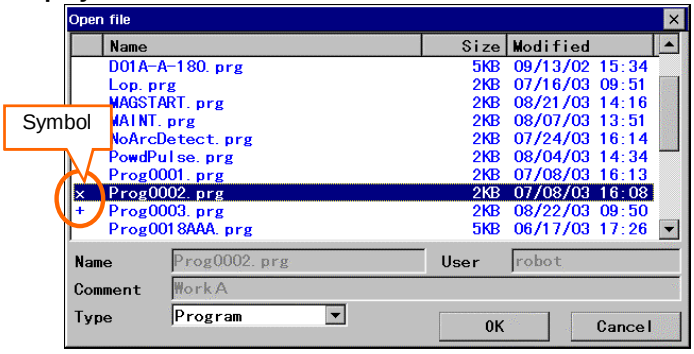
Set the desired protect level and click **OK**.
[Protect All]: The file is protected from any edit operation.
[Allow Point Change Only]: It allows to change position of teaching points, but not possible to change any commands.
[None]: The file is fully editable. (No protection.)

(2) Setting procedure using “Properties” dialog box



[Protected]: Protect level.

<Display>



Depending on the protect level, a symbol is added to before the file name of each protected file on the file list screen.

Symbol	Description
x	**Protect All**
+	**Allow Point Change Only**
(Blank)	**None**

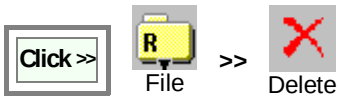
<Note>

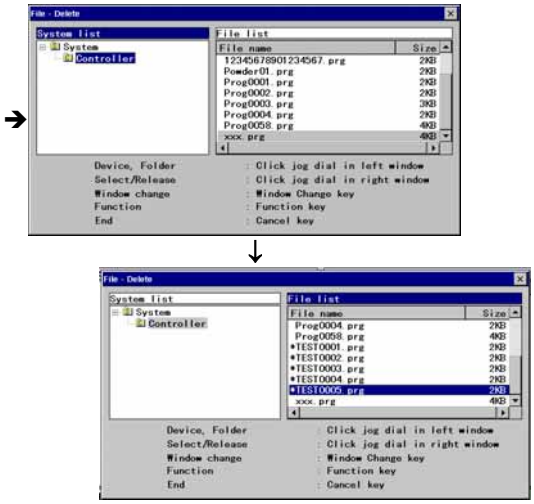
- For a file the “All disable” of the “Disable program editing” is applied, it is not possible to change its protect level.
- It is not possible to change the file name of the protected file.

4-21. Delete files

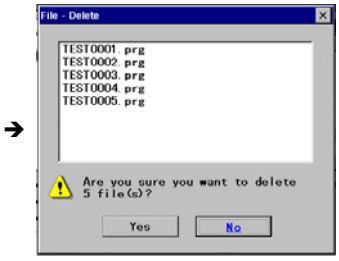
Files saved can be deleted.

Please be advised that it is not possible to undo once deleted



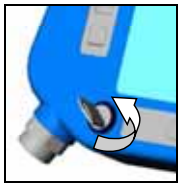


1. Cick “Controller” in the System window to show the file list.
2. Change the window and select the files you want to delete in the file list.
   A seleced file attaches a “ * “ mark.
3. Press “Next” F3 button to show the file list to delete.
4. Press “Yes” to delete.



5. AUTO mode

When the Mode select switch is in the AUTO position, it is possible to operate a program created in teach mode.



5-1. Start

There are two ways to start operation (run the program); one way is to use the start switch on the teach pendant (which is called “manual start”), and the other way is to send a signal from an external device (which is called “auto start”). This document (basic operation) explains manual start method.

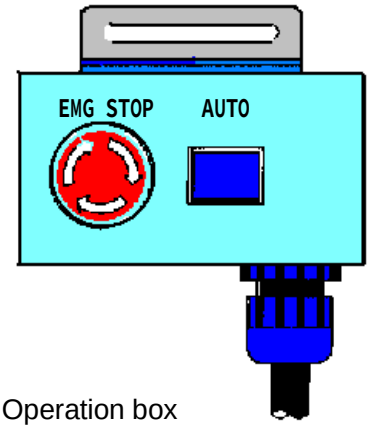
Note) For the auto start method, please also refer to section “Controller settings” in Advanced operation manual or the manual of the robot controller.

Warning	
	· Make sure that no personnel are present within the safety fenced area prior to start. · The operator shall be able to press the **Emergency stop** button at any time the operator observes danger.

1. Position yourself outside of the safety fenced area and lock the door of the safety fence.
2. Place the mode select switch to the **Auto** position.
3. If the robot is provided with the operation box, press the AUTO switch (to bring the robot in AUTO mode).

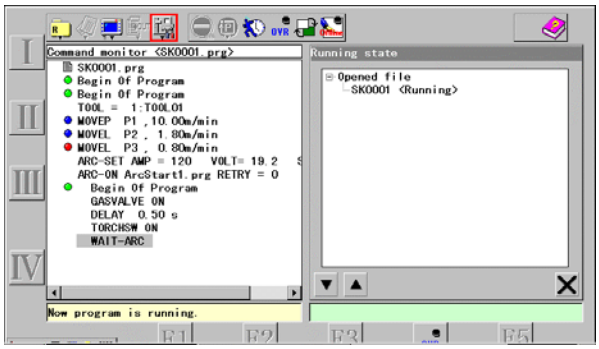
· The operation box is optional for some robot models.

· To ensure safe operation, the operation box must be installed outside of the safety fence.



Operation box

4. Open the file you want to operate.
5. Turn ON the servo power.
6. Press the **Start** switch, then the robot starts to execute the series of taught operations.



<Supplements>

· Each action once executed is indicated in the right pane in order of execution.

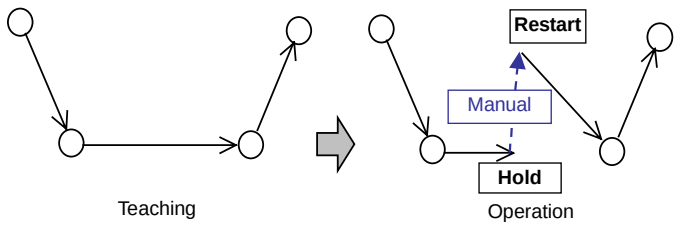
· The program starts where the cursor is positioned.

· Delay in indicating each action may be expected as operation has priority. Some actions may not be indicated depending on the timing.

5-2. Hold and restart

Warning	
	Never enter into the safety fenced area. The robot may move suddenly where it is in HOLD state. Make sure that no personnel or any articles to interfere with the robot are present within the robot work envelope prior to restarting the robot.

1. Press the **Hold** switch, then the robot becomes inactive while keeping the servo power ON.
2. Place the mode select switch in the TEACH position to operate the robot arm manually.
3. Switch the mode select switch to AUTO and press the Start switch to restart the robot.



Robot resumes operation from the position the robot has been manually moved to in the Hold state.

Input/Output states before the robot goes in the hold state are retained until the robot is restarted.

5-3. Emergency stop and restart

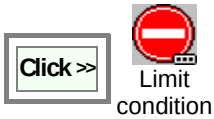
Warning	
	Bring the robot to an emergency stop immediately when you observe hazardous or an abnormal condition. Make sure that no personnel or any articles to interfere with the robot are present within the robot work envelope prior to restarting the robot.

1. Press the Emergency stop switch to bring the robot to an emergency stop.
2. Remove the cause, and then turn on the servo-ON and then start switch to restart.

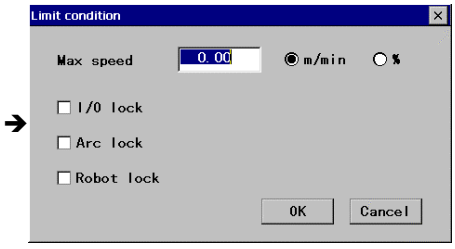
Input/Output states before the robot goes in the emergency stop are retained when the servo power is newly turned ON.

5-4. Limit condition of operation

You can run the specified program adding some limitation(s), such as deactivating some function(s), limit the robot travel speed or execute the operation without welding (check the Arc lock).



Limit condition



[Speed] The speed specified in this box has priority over the max. speed set in teaching operation.

[I/O lock] Deactivates I/O related sequence commands.

[Arc lock] Deactivates welding related commands.

[Robot lock] Deactivates robot motion.

5-5. Program unit

A function to specify a scope of continuous operation.

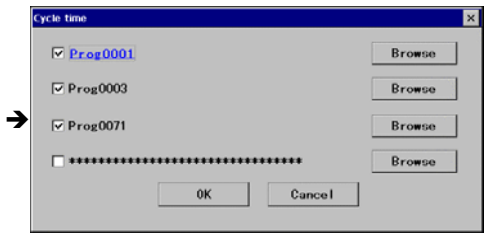
Click >>  >>
Program unit

 Step unit	Stops after completion of each step.
 Program unit	Stops after completion of each program.
 Continuous	**Performs a preset series of programs and then stops.**

5-6. Cycle time

It is to set program(s) to indicate individual cycle time.

Click >> 
Cycle time



Click on the **Browse** button to select a program from a list of registered programs.

Unless a program is specified, asterisks (****) appear to the next to the check box.

To display the cycle time:

Click >>  >> 
View
Operation management

5-7. Override

A function to adjust welding conditions (welding voltage, current or speed) while running a program or while welding.

Functions

- Data changed using the override function is saved automatically.
- Override for travel speed is adjustable from –25% to +25% against the original programmed speed.
- It is not possible to override the travel speed in weaving section.
- Override is available to the program displayed in the window.
- Use the function keys to specify the welding condition you would like to perform fine adjustment.

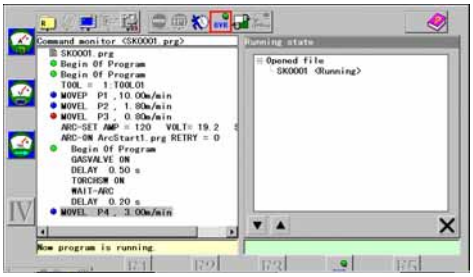
Note

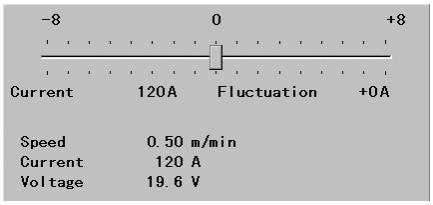
- When the override icon is turned ON, the maximum speed is limited to the one in teach mode.
- Handing software cannot use this function.

Click >> 

Override **(ON)**

Turn off the override icon to end the adjustment.





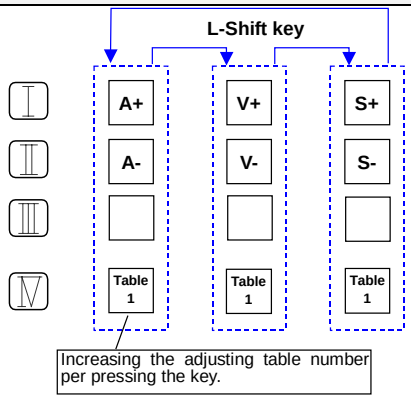
Both hands (Default setting at exfactory)	**Single hand** (Setting change required)
While holding down the function key, jog the jog dial to adjust the setting and click to update.	Check the adjusting table number, which is set adjusting data. L-shift key of the Teach pendant changes the override objects. (Enhanced display shows targetted object.) Function keys: Ⅰ: Increasing direction Ⅱ: Decresing direction Ⅳ: Changing the adjusting table.

Function keys	Objective
	Welding amperage
	Welding voltage
	Speed

Note

See advanced operation of the manual for operation using the  (Program change) icon, settings of “Program change” and “Override”.

Function keys (Example for CO2／MAG welder)



5-8. End of operation

To end the current operation, bring the robot in the hold state and then close the file.

5-9. Advanced use of “AUTO” mode

5-9-1. Offline programming

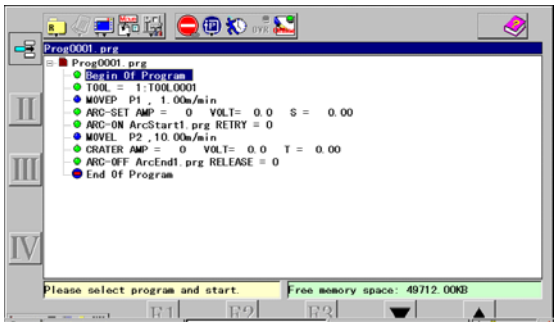
A function to edit the running program.

Please be advised that the changes are applied the next time you run the program.

Click >> Offline programming (ON) >> File >> Open

Procedure is the same as with teaching except you cannot operate the robot.

After completion of offline edit, close the file. Turn OFF the Offline programming icon lamp.



Each time you press the I key, the function changes from **Add** → **Change** → **Delete**.

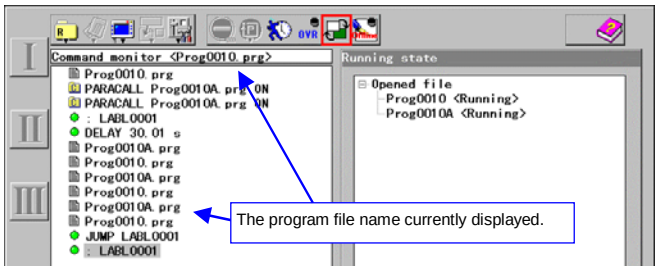
5-9-2. Program change in parallel processing

In AUTO mode, when two programs are executed at a time using PARACALL command etc., it is possible to switch the programs displayed in the window. The program displayed in the window is the object program of override or offline edit.

Click >> Program change

Click once to display the other program.

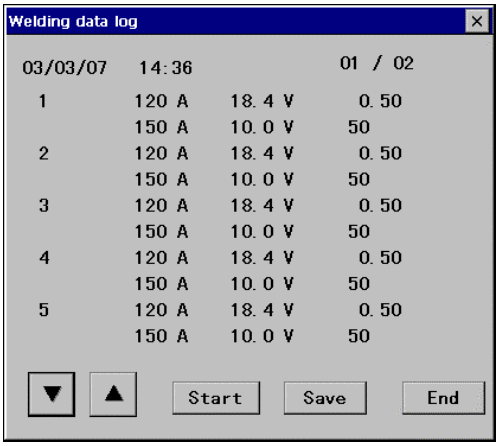
The program file name displayed in the window appears in the title bar of the left pane.



5-10. Welding data log

< A function available only with the built-in welding power source controller.>

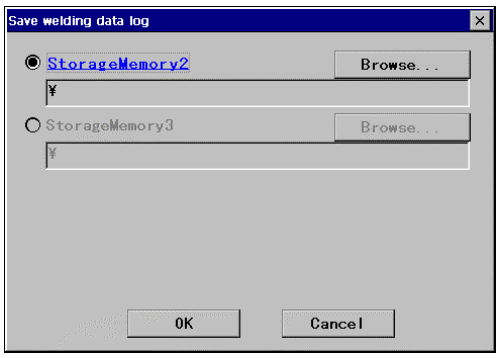
This is a function that receives and records actual welding condition data from the welding power source. Such data is useful to control welding quality.



The "Welding data log" box displays the actual welding condition data, such as welding current, welding voltage and number of wire shorted, of up to 50 sections received from the welding power source.

<Supplimentaly explanation>

- A section represents a period from the arc start to the arc end within 10 minutes long. If such period exceeds 10 minutes, it will be divided into sections by 10 minutes.
- If the robot makes a stop and restarts welding operation within a period, the period is divided into sections before and after the stop.
- Data after the 50th section overwrite an existing data from the top (the lowest-numbered data).



Click **Save** to save the data on the "StorageMemory" card.
Data will be stored in the CSV format as follows using the start date of recording as the file name.
It is easy to make a graph of the data using a spreadsheet software.

File name	Format: **WLYYMMDDhhmm.txt**
	YY: Year (the last 2-digit of calender year), **MM**: Month, **DD**: Date, **hh**: hour, **mm**: minute Example) WL0303071436.txt

Example	Format
03,03,07,14,36,	← The first line:
120,18.4,0.50,121,18.6,50	The date of recording (the last 2-digit of calender year, month, date, hour, minute)
120,18.4,0.50,123,18.5,51	← The remaining lines:
120,18.4,0.50,118,18.0,50	Sectional data from section 1 (Command current(A), command voltage(V), speed(m/min), average current(A), average voltage(V), short-circuit count(times))
120,18.4,0.50,120,18.6,50	
120,18.4,0.50,124,18.1,49	
120,18.4,0.50,121,18.6,50	
:	

<Note>

- If the "StorageMemory" does not appear in the "Save welding data log" dialog box, click the **View** menu, and then click **File list** to display the list of files, and then retry the above procedure.
- Prior to making a backup copy, make sure that the PC card is in "write possible" condition

6. Useful file edit functions

While editing files turn off the 

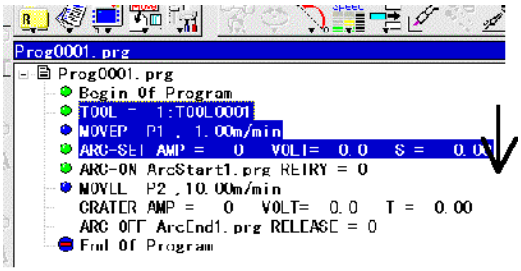
icon lamp to operate the cursor in the edit screen.

6-1. Cut

It removes data of the selected line(s) from the file and move to the clipboard.

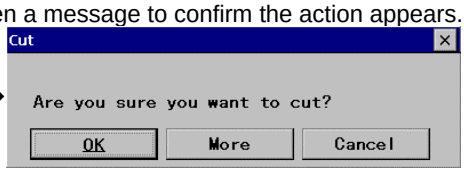
1. Move the cursor to the line you want to delete.

2. Use the jog dial to select (highlight) the range of lines you want to cut and click to specify the range.



3. Click >> Edit >> Cut

Then a message to confirm the action appears.



[OK] To cut the highlighted data.

[Cancel] To cancel the Cut action.

[More] To return to the previous operation to specify another line to cut.

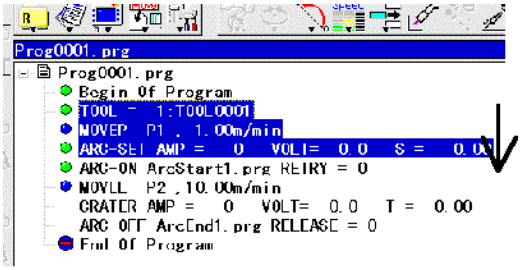
- Clipboard is a temporary storage of character-string data to be used when moving or copying the data.
- If you want to insert the data you have just cut to a different place or file, do **Paste**.
- The character-string data in the clipboard will be stored until execution of the next **Cut** operation.

6-2. Copy

It stores data of the selected line(s) in the clipboard.

1. Move the cursor to the line you want to copy.

2. Use the jog dial to select (highlight) the range of lines you want to copy and click to specify the range.



3. Click >> Edit >> Copy

[OK] To copy the highlighted data.

[Cancel] To cancel the Copy action.

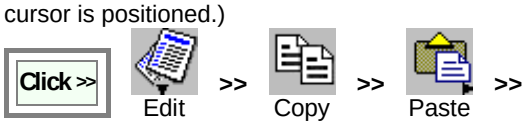
[More] To return to the previous operation to specify another line to copy.

- If you want to insert the data you have just copied to a different place or file, do Paste.
- The character-string data in the clipboard will be stored until execution of the next **Copy** operation.

6-3. Paste

It inserts the data that has been either Cut or Copy in the clipboard into the file.

Move the cursor to the line where you would like to insert the data. (The data will be inserted below the line where the cursor is positioned.)

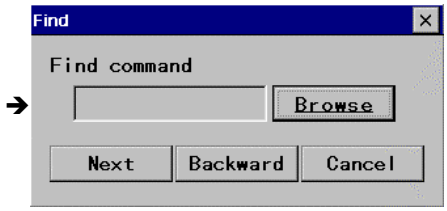


Paste	Insert the data as per stored in the clipboard.
Paste (Reverse)	Insert the data in reverse order.

- **[**Paste (Reverse)] is useful to edit data for reciprocating motion. Teach the first half of the motion and copy it and then do Paste (Reverse) to complete the latter half of the motion.
- Pasting the data stored in the clipboard once does not delete the data from the clipboard. You can Paste the data as many times as you want.

6-4. Find

Find the command in the file that satisfies the condition you specified.



[Browse]: Displays a list of commands

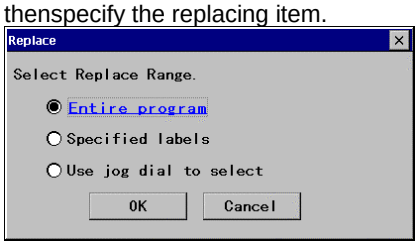
[Next] Search forward, from the cursor position toward the end of the file.

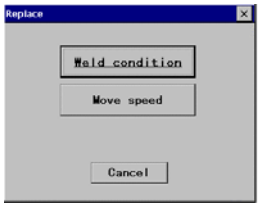
[Backward] Search backward, from the cursor position toward the beginning of the file.

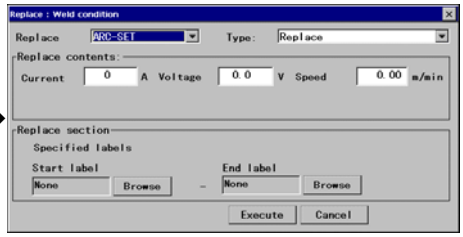
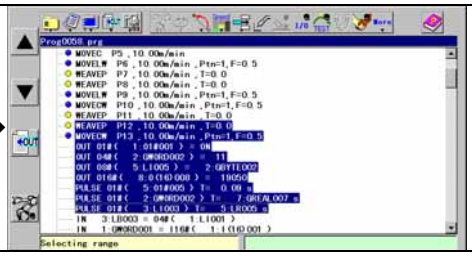
6-5. Replace

It replaces the data in the program with other data. Two kinds of deta input method are prepared.

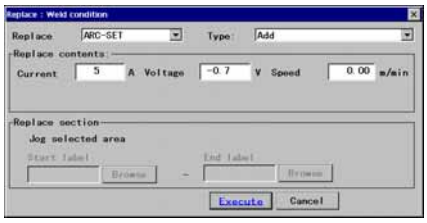
Set the select replace range and thenspecify the replacing item.



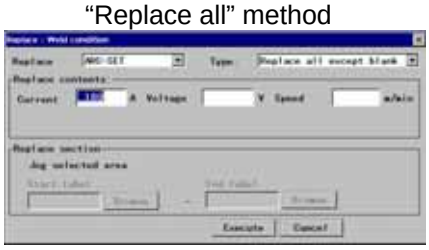


[Entire program]	Replace the entire program.
[Specified labels]	
[Use jog dial to select]	

"Add" method



"Replace all" method



[Type]

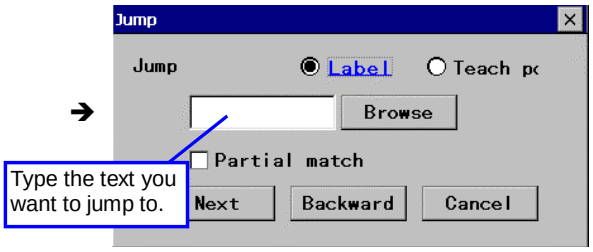
Data input method

Add: Inrement or decrement input for registered data.

Replae all: Entirely Replaced with specified data except blank.

6-6. Jump

It searches for the next instance of the label or teaching point name you specified and jumps the cursor to the location if found.



[Label] Finds a label in the program.

[Teach pt] Finds a teach point in the program.

[Partial match] Check the check box to find data that has partially matches the text you specified.

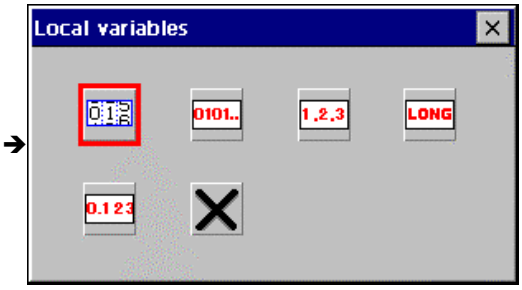
[Next] Search forward, from the cursor position toward the end of the file.

[Backward] Search backward, from the cursor position toward the beginning of the file.

If you select the Label, you can specify the label of the character-string specified to the file. Then the cursor jumps to the same label you specified.

6-7. Edit local variable

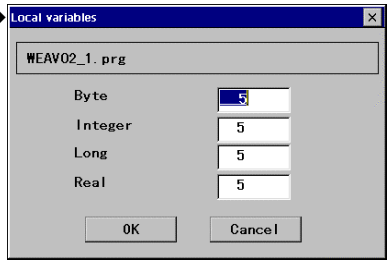
It is a function to change name and/or comment of a local variable, and also edit the value of a local variable. It also can increase the number of local variables to be registered.



Select a variable type you want to edit.

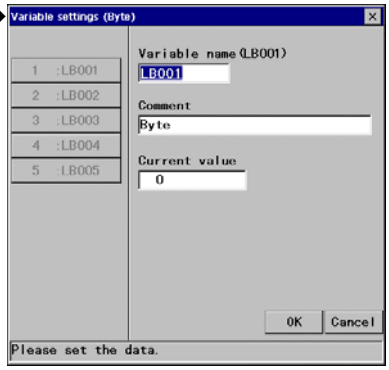
(Examples)

Number adjustment



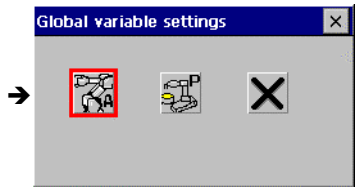
Enter a number of local variable to be registered in the box of the variable type you want to change.
Set range: 5-100

Byte

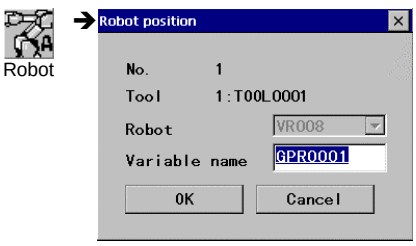


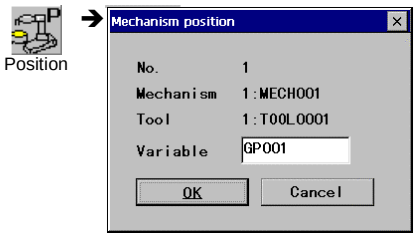
6-8. Global data

Global data is common to all programs. This section explains how to teach “Robot” variable and “Position” variable.



Robot	Robot
Position	Mechanism





[Variable name] Specifies name of the global data.

[OK]: Register as global data.

If the selected variable has been specified as valid variable, the following dialog box appears.

[Apply] To change data.

[Invalid] To invalidate the data.

[Cancel] To cancel the action and close the dialog box.

<How to check the setting>

You can check the settings by moving the robot to the registered position in trace operation.

1. Move the cursor to the number.
2. Turn ON the  (trace) icon lamp and jog the jog dial while holding down the  (Function key).

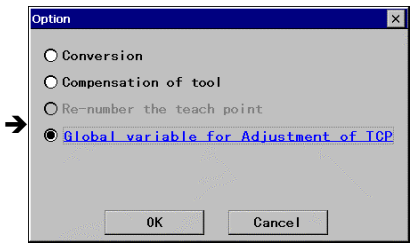
   Then the robot stops at the registered position.

About “Mechanism” and “global variable”, please refer to section “Global variable settings” of “Advanced operation”

6-9. Option

A function for advanced edit such as “Program shift”, “Tool compensation” and so on.

The settings in Option are for advanced operation.



[Conversion] to shift teaching points of the program.

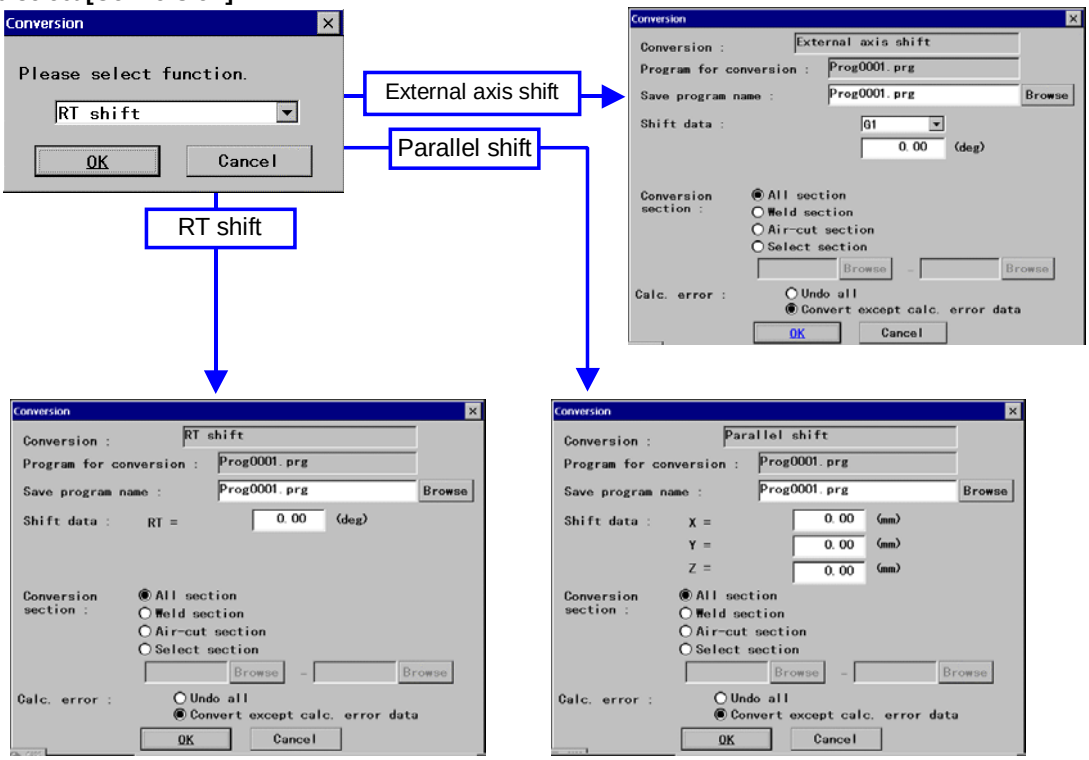
[Compensation of tool]: change to compensation of tool setting mode.

[Global variable for Adjustment..]: Change to global variable setting mode for tool center point (TCP) adjustment.

Refer to the manual for advanced operation for options other than [Conversion].

6-9-1. Conversion

When you select **[Conversion]:**



[Conversion] Specified conversion type

[Program for conversion] Program to work on.

[Save program name] Specifies the file the converted program is saved to. *Change the file name if you want to save the converted program in a different file.

[Shift data] Specifies the shift amount

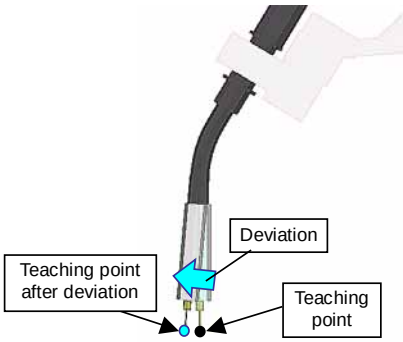
[Conversion section] Specifies the section to be converted.

[Calc. error] Specifies a process to be applied if the calculation error occurs. If the teaching point will be out of operation range, an error occurs.

If there is no file is open when you selected the “Conversion”, a dialog box to specify the file you would like to work on appears prior to setting dialog box. Specify the target program file name and click the **OK** button.

6-9-2. Tool compensation

It is a function to be used when a tool is deviated. It calculates the deviation value and then adjusts taught programs that use the tool according to the calculation.



The tool compensation value is unique to each tool offset. Therefore, once a tool compensation value is set, the adjust value will be applied to all taught programs using the same tool offset. The value is effective until the next time the tool offset value is changed.

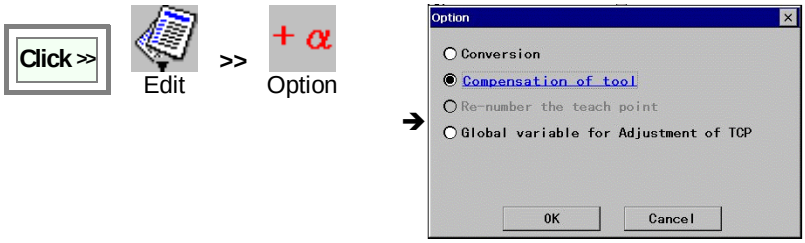
<Note>

- Tool compensation may not be applicable depending on how severe the deviation of the tool is. Tool compensation may not be within allowable range of the users.
  Make sure to perform trace operation to check robot movement of related programs once the tool compensation is applied.
- Please note that in the tool offset dialog box , the original tool offset values are indicated at any time. In other words, the tool compensation value won't be reflected to the tool offset values even if the tool compensation is applied.)
- Such adjust values will be reflected to each teaching point at edit operation.

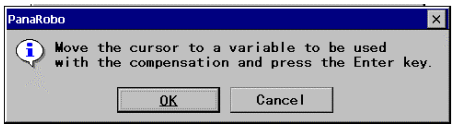
Setting procedure:

There are two ways to set the tool compensation, which are ①using one taught point of a taught program (teaching point method) and ②using the robot variable (robot variable method).

1.
   - With the teaching point method, **Open the program** you would like to use to set tool compensation.
   - With the robot variable method, **Close all active programs** to start settings.

2 

Select the "Compensation of tool" and then click the **OK** button.

3. 

Click the **OK** button.
Move the cursor to the taught point (or to the variable in case of robot variable method is applied) you would like to use as the datum of the tool compensation calculation, and then press the **ENTER** key.

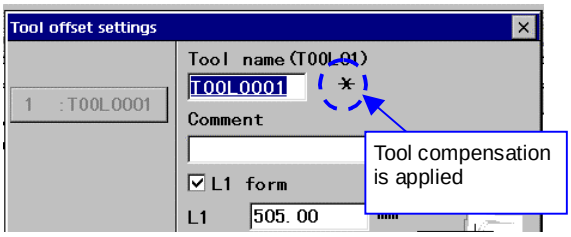
4. Then dialog boxes to confirm the cursor position and the action, click the **OK** button.

5.

Teaching point method	Robot variable method
Move the robot manually and teach a point and then press the ENTER key. (The tool compensation value will be calculated from the data of the current taught point and the taught point specified as the datum in preceding procedure.) In case of a calculation error occurs, repeat the setting procedure from the beginning or change the datum taught point.	Move the robot manually and teach the point of the specified variable, and then press the ENTER key. (The tool compensation value will be calculated from the data of the current taught point and the taught point specified as the datum in preceding procedure.) In case of a calculation error occurs, repeat the setting procedure from the beginning or change the datum taught point.

6. Then click the **OK** buttons on the dialog boxes to confirm the tool compensation and to complete the settings.

7. To check the tool compensation on the screen.



Astarisk (*) after the tool name in the tool offset dialog box indicates that the tool has applied the tool compensation.

6-9-3. Global variable setting for TCP adjustment

(TCP = Tool center point)

It is a setting to assign tool position data to global variable in order to calculate tool offset value.
Please refer to section “TCP (tool center point) adjust” in Advanced operation for further information.

7. View

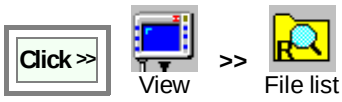
This section explains screen displays available from the View menu.
The View menu is available in both Teach mode and AUTO mode.

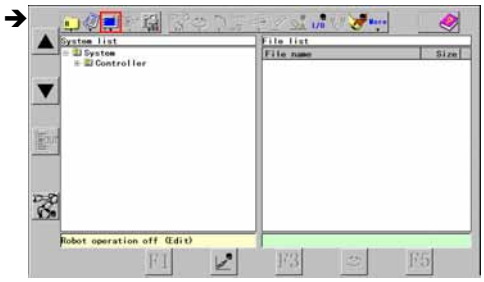
Buttons function as per described in the table on the right unless specified.

Button	Description
	Close the current active window.
	To previous page / To next page

7-1. System list

It displays contents of storage device such as memory and PC card in hierarchical structure.

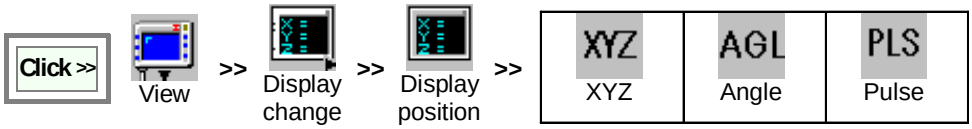




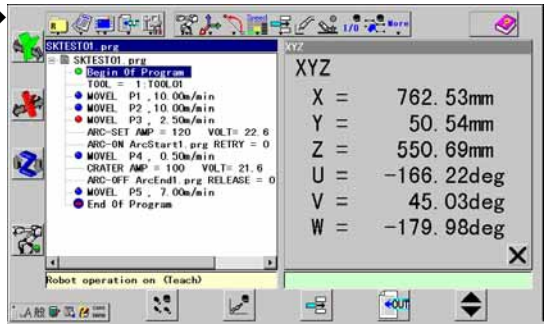
7-2. Display change

7-2-1. Position display

It displays the current position of the robot control point in angles of axes or pulse counts.



XYZ



[XYZ]: Robot control point data on the robot coordinate system.

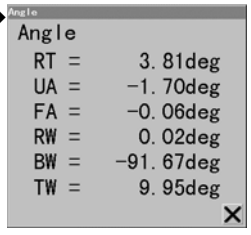
[UVW]: Tool orientation.

U: Angle rotating around the axis parallel to Z-axis including the robot control point while retaining the angle of V.

V: Angle from the vertical surface.

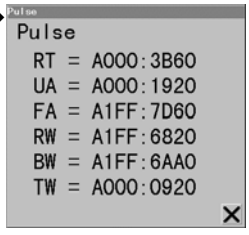
W: Twist angle of the wrist when fixing the direction of the tool.

AGL
Angle



Indicates the angle of each axis.

PLS
Pulse

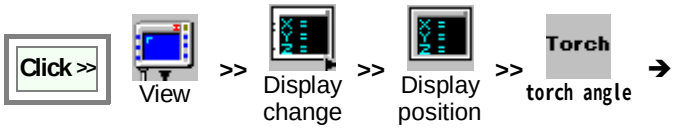


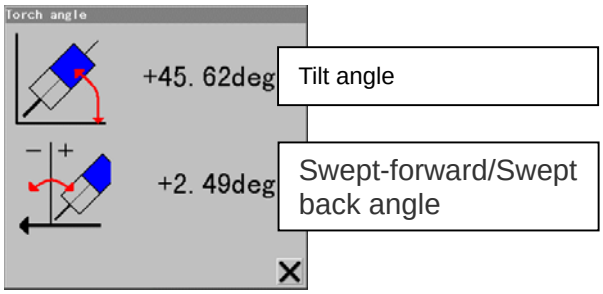
Indicates the encoder pulse of each axis.

7-2-2. Torch angle

< A function available only with the built-in welding power source controller.>

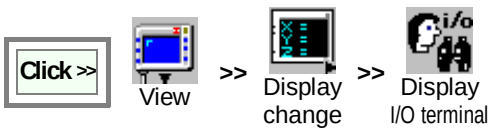
It displays torch angle to the weld line.

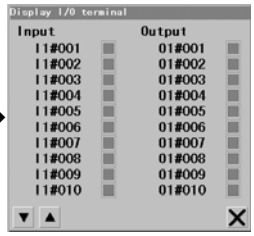




7-2-3. User-IN/OUT

It displays ON/OFF state of each I/O port.

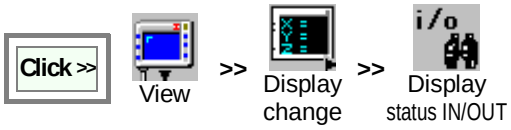


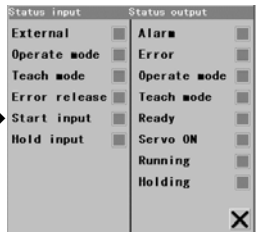


Terminals in ON state are indicated in green. Terminals in OFF state are in gray.

7-2-4. Status IN/OUT

It displays ON/OFF state of each status I/O port.

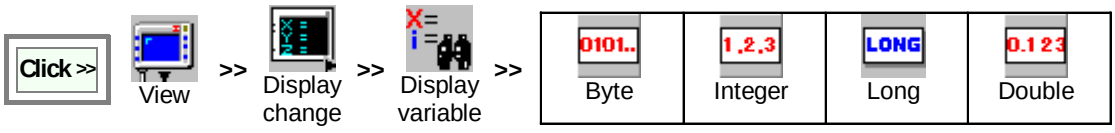




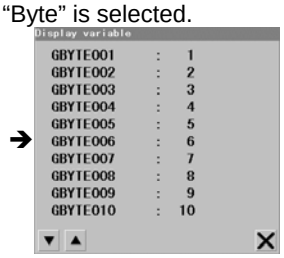
Terminals in ON state are indicated in green. Terminals in OFF state are in gray.

7-2-5. Variable

It displays values saved in global variable.



When “Byte” is selected.

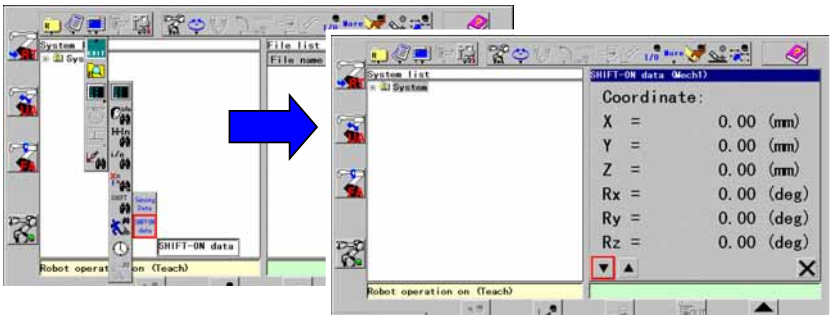


Values stored in variables are displayed to the right of the colon (:).

7-2-6. Display SHIFT-ON data

It displays the shift amount of the SHIFT-ON command in execution.

Click >> View >> Display change >> SHIFT Shift data >> SHIFT-ON data SHIFT-ON data

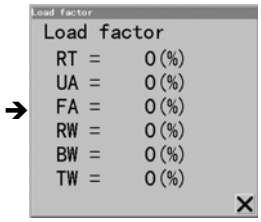


7-2-7. Load factor

It displays the load factor of each axis at the current robot orientation to the rated value in percentage.

Click >> View >> Display change >> Load factor >>

When “Load factor” is selected.



Load factor for each axis is displayed to the right of the colon (:).

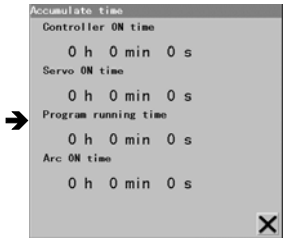
Load factor	Load factor of each axis at the current orientation.
Average load factor	The average load factor of each axis of the program executed.
Peak load factor	The maximum load factor of each axis of the program executed.

<Note> For handling robot, make sure to position each axis so that its load factor does not exceeds 100%.

7-2-8. Accumulated time

It displays accumulated times.

Click >> View >> Display change >> Accumulate time



[Controller ON time] Period of time power to the controller has been ON.

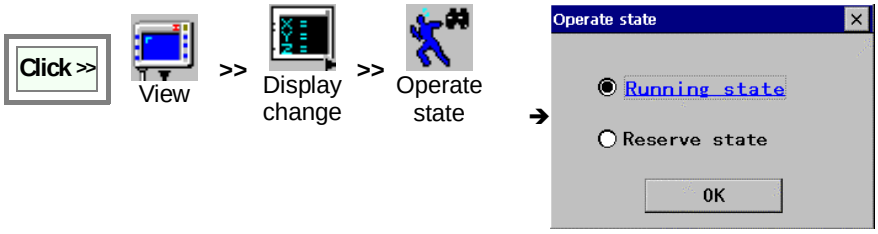
[Servo ON time] Period of time the servo power has been ON.

[Program running time] Period of time the robot has been running a program.

[Arc ON time] Period of time the welding arc has been on in a program.

7-2-9. Operate state

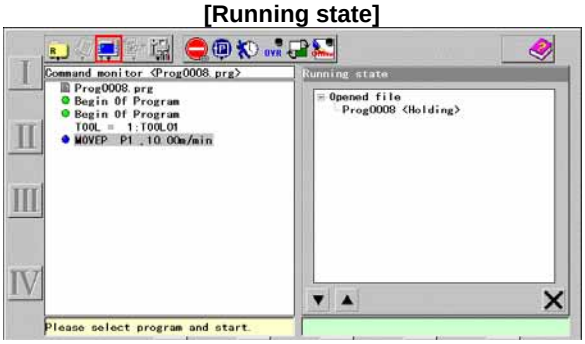
It displays operation state and program schedule.



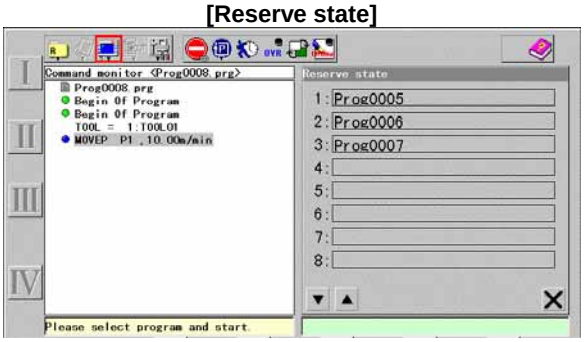
[Running state] Displays state of the current operation. If the current program calls another program, hierarchical structure is used.

[Reserve state] Displays scheduled programs.

[Running state]

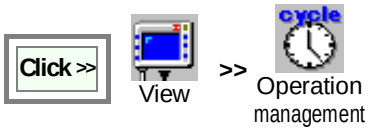


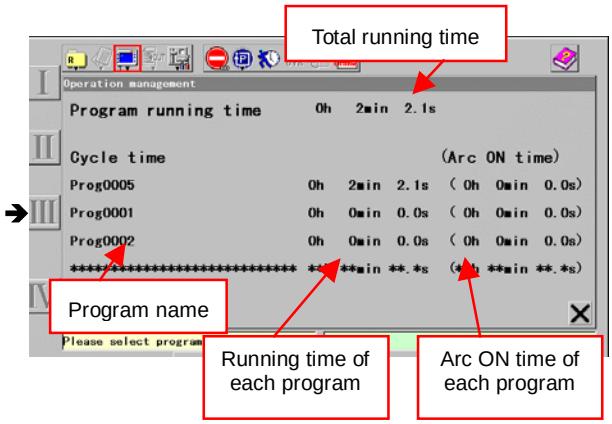
[Reserve state]



7-3. Operation management

This function is to calculate and display a program running time.





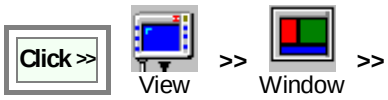
Running time: Time from startto stop of a program is counted.

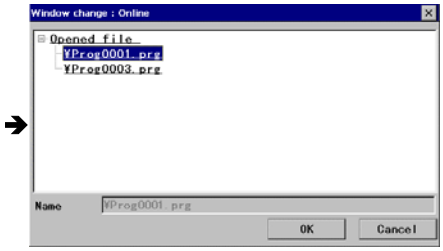
When Re-set operation is executed after a program is stopped with hold, emergency stop or error stop, the running time is reset to “0”, and then newly starts its count.

Specify the program(s) to indicate its running time

7-4. List of open files

It displays the specified program on top of the screen and bring the program to an active state.



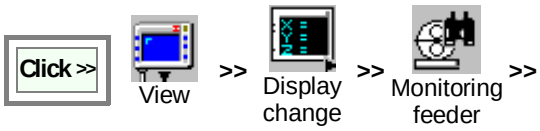


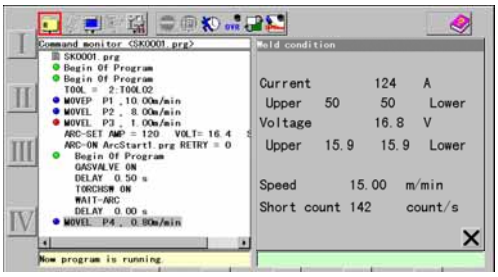
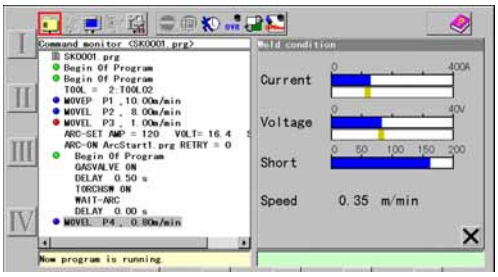
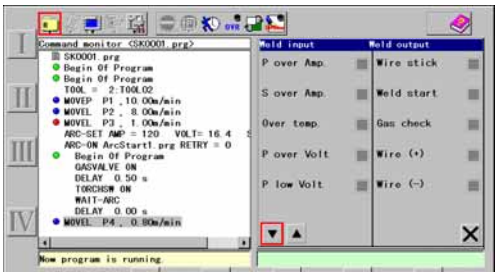
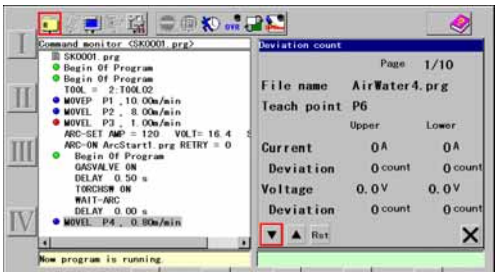
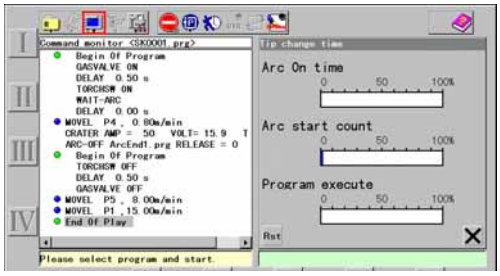
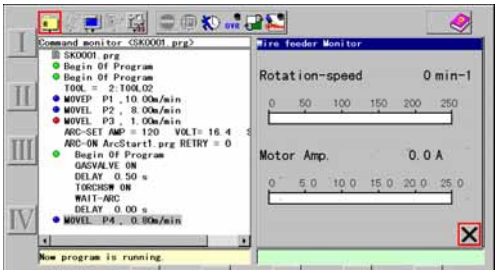
Online	Specify a program from programs currently in operation, teaching or edit operation.
Offline	Specify a program from OFFLINE editing programs.

[OK]: To display the specified file on top.

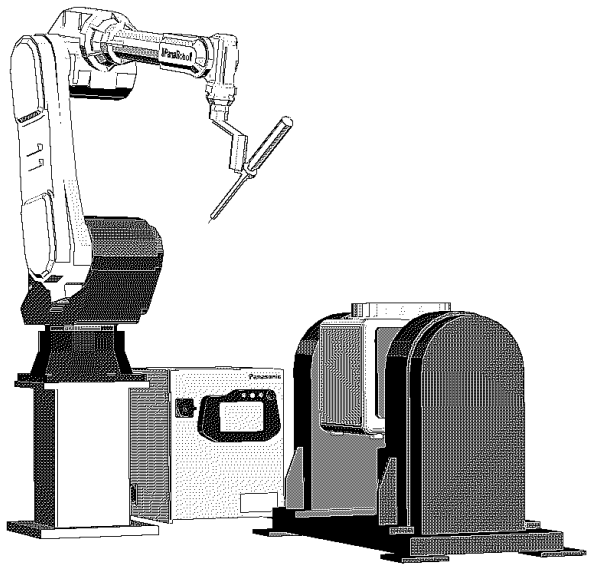
7-5. Arc weld information

A function to display each welding status.



Icon	Screen display
Current/ Voltage	 
Weld input/output	
Deviation count	
TIP CHANGE	
Monitoring feeder	 If a digital controlled wire feeder is applied, it is possible monitor status of the wire feed motor.

Advanced Operation



Contents

8. Variable settings

9. Input/Output settings

10. Robot settings

11. Controller settings

12. Teach pendant (TP) settings

13. System information/Back up setting

14. Management tool settings

15. Arc welding machine settings

16. Commands

17. Errors and Alarms

18. Appendix

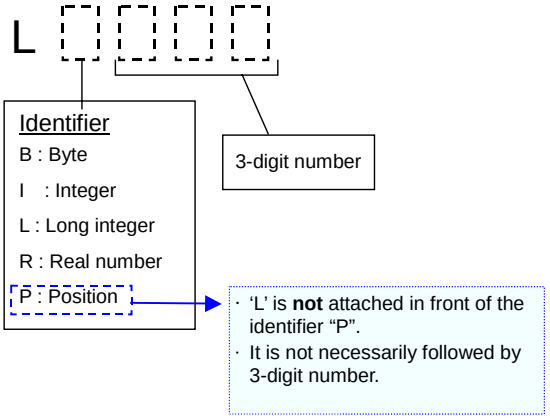
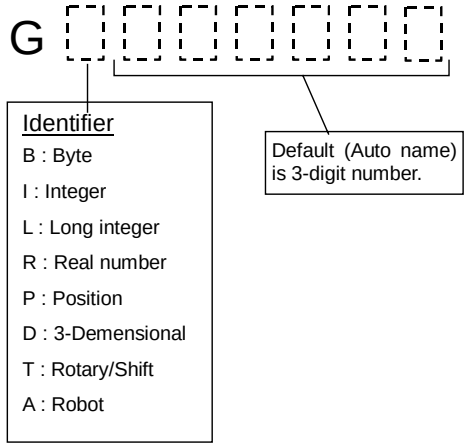
8. Variable settings

8-1. Variables

Note

See application examples
When you see this sign, you can find application example(s) of the item in Chapter 8.

- A quantity capable of assuming any of a set of values, whose value can be changed by such actions as substitution, replacement, arithmetic operation, logic operation etc. in combination with sequence commands.
- Variables can be classified into 2 types; one is called a LOCAL VARIABLE which can be used only in one program, and the other one is called a GLOBAL VARIABLE which is common to all programs.
- It is necessary to specify and register a variable name to each global variable in order to use over an entire system.

Local variables	Global variables
Variable whose values are assigned within that program and which has no value, or a different value, outside the program.	Variable whose values are maintained in all programs.
'L' and an identifier are automatically added to each local variable name. [Local variable name]  	'G' and an identifier are automatically added to each global variable name. [Global variable name]  Global variable names (including the identifier) can be changed to any 8-alphanumeric character name.

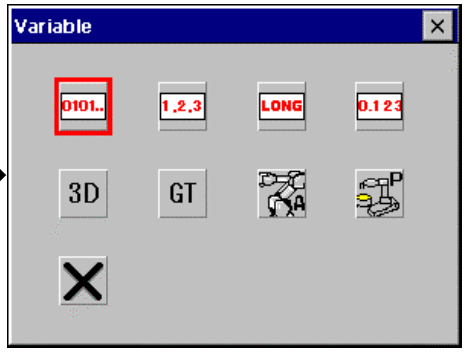
Identifier	Variable type	Definition
B	Byte	1 byte integer (Set range: from 0 to 255) If the variable represents ON or OFF, assign '0' for OFF and '1' for ON.
I	Integer	2-byte integer (Set range: from –32768 to 32767)
L	Long integer	4-byte integer (Set range: from-2147483648 to 2147483647)
R	Real number	4-byte real number. Decimal fraction can be assigned. (-99999.99 to +99999.99)
P	Position	Teaching point, which includes position of an external axis. Position data of X, Y and Z, as well as data of tool vector TX and TZ.
D	3-demensional	Element of X, Y and Z Use the variable as point, vector or shift buffer.
T	Rotary/Shift	Variable to specify the rotary and shift conversion amount With SHIFT-ON command, it executes rotary/shift conversion.
A	Robot	Teaching point on the robot coordinates system, which does not include the position of an external axis. Position data of X, Y and Z on the robot coordinates system and data of tool vector TX and TZ.

8-2. Global variable settings

It is to specify and register a variable name to be used as a global variable.

Click >>

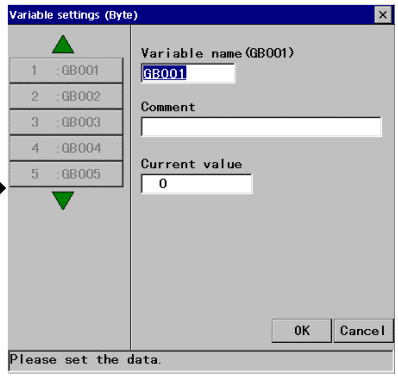
Set >> Variable



Icon	Description	Q'ty
0101.. Byte	Sets 1-byte integer variable. [Range: 0 to 255]	100
1.2.3 Integer	Sets 2-byte integer variable. [Range: -32768 to 32767]	100
LONG Long	Sets 4-byte integer variable. [Range: -2147483648 to 2147483647]	100
0.123 Real number	Sets real number variable. [Range: -9999.999 to 9999.999]	100
3D 3D	Sets three-dimensional variable. (X, Y and Z)	100
GT Rotary/Shift	Sets a rotary/shift variable the rotary/shift conversion amount is to be assigned to.	20
Robot	Sets robot variable.	100
Position	Sets teaching point variable.	100

Click >>

A desired variable button.

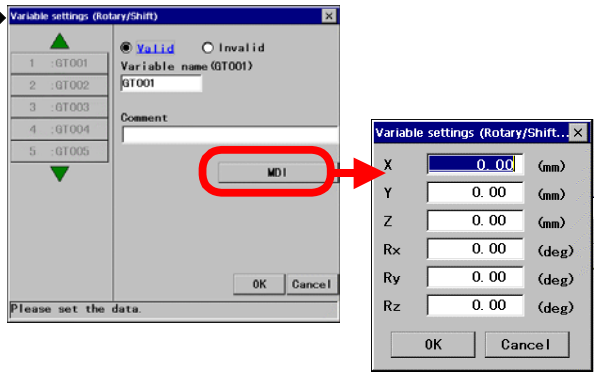


[Variable name] Displays the selected variable name

[Comment] Provides a space for you to add comment about the variable. Comments can have up to 20 characters.

[Current value] Displays the current set value of the selected global variable.

* GT Rotary/Shift



[X] Parallel shift amount in the direction of X axis.

[Y] Parallel shift amount in the direction of Y axis.

[Z] Parallel shift amount in the direction of Z axis.

[Rx] Rotary shift amount with reference to X axis

[Ry] Rotary shift amount with reference to Y axis

[Rz] Rotary shift amount with reference to Z axis.

8-3. Application examples of variables

8-3-1. Byte variable

(1) Group input

A byte variable that stores a 1-byte (means 8 bits) value.
When an 8-bit group input is received by the byte variable, the terminals of the group input are allocated to and stored in ones to 128s of the byte variable as binary number respectively. The value is the sum of the denary number(s) of the digit(s) whose terminal is(are) "ON".

	8-bit group input								
	D07	D06	D05	D04	D03	D02	D01	D00	
	128	64	32	16	8	4	2	1	**Value**
Example 1	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	**0**
Example 2	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	**1**
Example 3	OFF	OFF	OFF	ON	OFF	ON	OFF	ON	**21**
Example 4	OFF	ON	ON	OFF	ON	OFF	ON	OFF	**106**
Example 5	ON	ON	ON	ON	ON	ON	ON	ON	**255**

If the byte variable is used for 4-bit group terminals, the terminals are allocated to and stored in ones to 8s of the byte variable. As for output, 16s to 128s are ignored (or treated as "OFF"). As for input, 16s to 128s are treated as "OFF".

		Ignored				4-bit group input			
						D03	D02	D01	D00
	Output value	128	64	32	16	8	4	2	1
Example 1	**0**	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Example 2	**1**	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON
Example 3	**21**	OFF	OFF	OFF	ON	OFF	ON	OFF	ON
Example 4	**106**	OFF	ON	ON	OFF	ON	OFF	ON	OFF
Example 5	**255**	ON	ON	ON	ON	ON	ON	ON	ON

(2) Logic operation

It is possible to use the byte variable in logic operation. In that case, logic operation is executed with each bit.
For example, logic operations of byte variables LB001=3 and LB002=10 are

AND (Logical multiplication):

LB001	**0000 0011**	
LB002	0000 1010	
LB001 AND LB002	0000 0010	= 2

OR (Logical AND):

LB001	**0000 0011**	
LB002	0000 1010	
LB001 OR LB002	0000 1011	= 11

XOR (Exclusive OR):

LB001	**0000 0011**	
LB002	0000 1010	
LB001 XOR LB002	0000 1001	= 9

NOT (Logical NOT):

LB001	**0000 0011**	
NOT LB001	1111 1100	= 252


The NOT operation is also executed for all 8 bits. To execute a NOT operation for 4 bits, AND the result byte of NOT operation and a byte variable whose value is 15 (00001111 in binary).

8-3-2. Position variable

(1) How to use the position variables

In teaching operation, P1, P2, P3 and so on that are automatically created whenever you register points are local mechanical position variables. As they are variables, it is possible to change values or to reuse them.
For example, if you have taught three points P1, P2 and P3, and you would like to go back to the P1 position as the next movement. Instead of actually moving the robot to the P1 position again, you can either;

- **Add** taught points (edit).

```
MOVEL   P1,   7.5 m/min
MOVEL   P2,   7.5 m/min
MOVEL   P3,   7.5 m/min
```
←Press the **ENTER** key once again.

· Click **OK** in the prompt box to continue the multi-point registration.

· Click **Browse** in the Add dialog box to select **P1** from the list.

```
MOVEL   P1,   7.5 m/min
MOVEL   P2,   7.5 m/min
MOVEL   P3,   7.5 m/min
MOVEL   P1,   7.5 m/min
```
←Then P1 is added below P3.

or

- **Copy** the P1.

```
MOVEL   P1,   7.5 m/min
MOVEL   P2,   7.5 m/min
MOVEL   P3,   7.5 m/min
```
←Copy the whole P1 commands.

· Move the cursor to the P3 line, and then do paste.

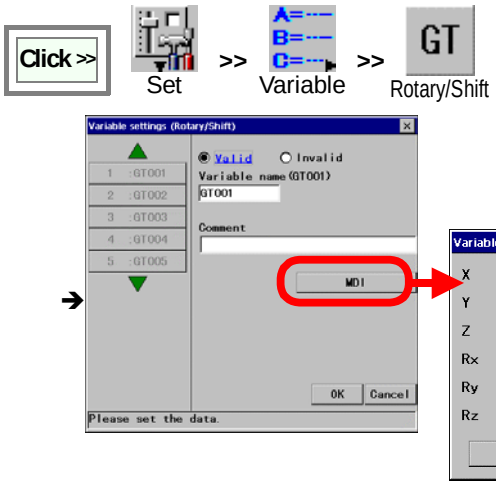
```
MOVEL   P1,   7.5 m/min
MOVEL   P2,   7.5 m/min
MOVEL   P3,   7.5 m/min
MOVEL   P4,   7.5 m/min
```
←Then a new variable name “P4” is assigned.

***** As a new variable name is assigned to the pasted point, editing the value of P1 after pasted does not change the value of the new variable.

Use “**Add**” (the same variable name) to the points you would like to keep them having the same contents at all times and edit them all at once, and use “**Copy**” (assign different variable name) to the points you would like to copy the content but keep them independent.

8-3-3. Rotary/Shift variable

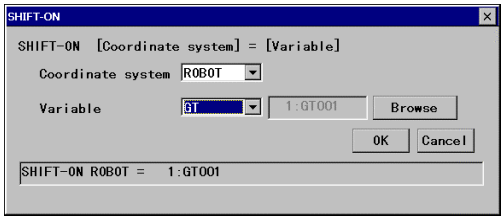
(1) Settings



[X] Parallel shift amount in the direction of X axis.
[Y] Parallel shift amount in the direction of Y axis.
[Z] Parallel shift amount in the direction of Z axis.
[Rx] Rotary shift amount with reference to X axis
[Ry] Rotary shift amount with reference to Y axis
[Rz] Rotary shift amount with reference to Z axis.

(2) Application

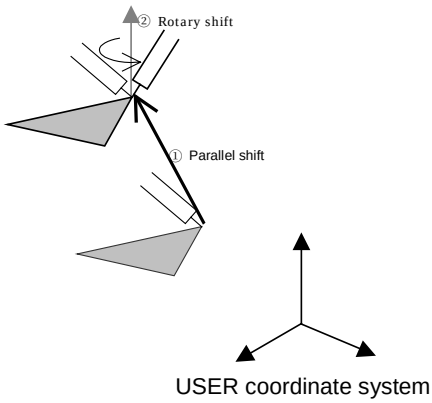
Use SHIFT-ON command to execute the “Rotary/Shift” conversion.



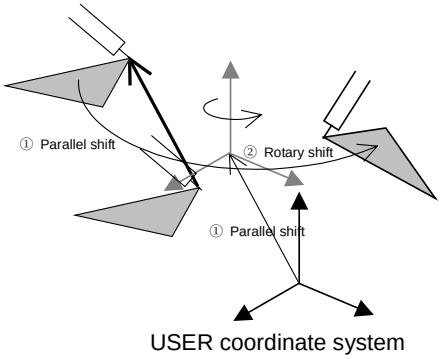
Coordinate system	Rotary shift
ROBOT	It executes the parallel/rotary shift. reference to X, Y and Z axes of the selected coordinate system.
TOOL	
USER	
USER (3D)	It executes the 3D transformation with reference to the user coordinate system.

Please note that if the ROBOT, TOOL or USER Coordinate system is selected, the rotary convertion after the parallel shift is executed on its axis. However, in case of the USER (3D), the rotary conversion after the parallel shift is executed with reference to the shifted User coordinate system as the axis of rotation.

<When “USER” is selected>



<When USER (3D) is selected>



Origin coordinates of the User coordinate system:
Of the positions P1-P2-P3 which determine the User coordinate system, P1 is specified as its origin, P1 and P2 is to determine the X-axis direction, and P1, P2 and P3 to determine the X-Y plane.

9. Input/Output settings

9-1. User Input/Output settings

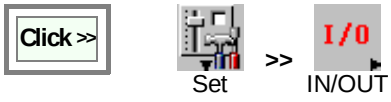
Settings of terminals to be connected to other system equipment to receive signals to the robot (Input terminals or “Input”) or send signals from the robot (Output terminals or “Output”).
User Input or User output terminals are terminals users can freely connect to external equipment to receive to or send signals from programs.
Another type of input/output terminals is called “Status Input/Output terminal”, where task of each terminal is fixed.

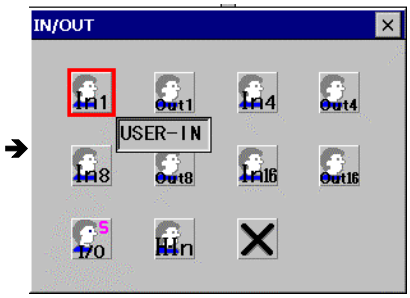
9-1-1. User I/O terminal type

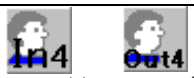
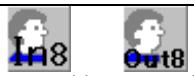
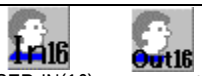
User Input/Output terminals are classified into 1, 4, 8 and 16-bit Input/Output (multi-terminal) types.

Terminal type	Description	Terminal type	Description
I1#	1-bit input	O1#	1-bit output
I4#	4-bit input	O4#	4-bit output
I8#	8-bit input	O8#	8-bit output
I16#	16-bit input	O16#	16-bit output

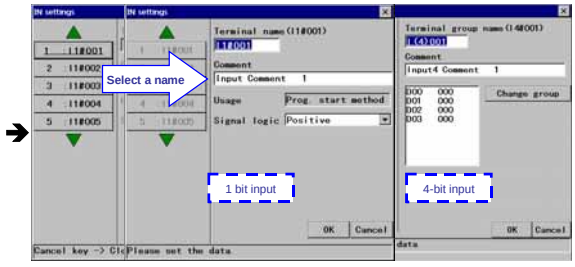
9-1-2. User INPUT - Setting procedure





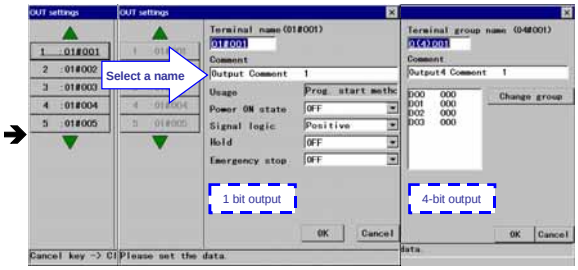
 USER-IN USER-OUT	Sets one-bit input terminal (In) and output terminal (Out).
 USER-IN(4) USER-OUT(4)	Sets 4-bit group input terminal (In) and output terminal (Out).
 USER-IN (8) USER-OUT(8)	Sets 8-bit group input terminal (In) and output terminal (Out).
 USER-IN(16) USER-OUT (16)	Sets 16-bit group input terminal (In) and output terminal (Out).

(1) User input



[Terminal name] Displays the selected terminal name.
[Comment] Provides a space for you to add comment about the terminal. Comments can have up to 20 characters.
[Usage] Displays the function allocated to the terminal.
[Signal logic] Specifies whether the signal should be positive logic [**Positive**] or negative logic [**Negative**].
[Change terminal group] Click it to look for and specify a terminal group you want to change to.

(2) User output



[Terminal name] Displays the selected terminal name.
[Comment] Provides a space for you to add comment about the terminal. Comments can have up to 20 characters.
[Usage] Displays the function allocated to the terminal.
[Power-ON state] Specifies whether the initial state of the output terminal at power-ON should be [ON] or [OFF].
[Signal logic] Specifies whether the signal should be positive logic [**Positive**] or negative logic [**Negative**].
[Hold] Specifies whether the output terminal should retain the ON state at Hold
[Emergency stop] Specifies whether the output terminal should retain the ON state at Emergency stop
[Change terminal group] Click it to look for and specify a terminal group you want to change to.

9-2. Status IN/OUT

Dedicated input/output terminals to send signals when the robot is in specified state or to change the robot status according to the signal received.

9-2-1. Status INPUT

Dedicated input terminals

Status INPUT	Description
External servo ON input	Turn ON to enable servo power ON if the following conditions are all satisfied. Condition 1: Status output signal 'Ready' output signal is ON. Condition 2: Mode select switch is set to operation mode ('AUTO' position) and not in Mode error state. Condition 3: Mode select is set to auto-operation (in operation mode) Condition 4: Mode select switch is not switched to 'TEACH' position due to override in operation. Condition 5: The 'Emergency stop' input is not ON. The Input signal must satisfy the following conditions. • The input signal must be ON in 0.2 seconds after the 'Ready' output signal goes ON. • The input signal must be kept ON for 0.2 seconds or more.
Error release input	When the robot is in an error state and the error dialog box is displayed, turn ON this input to close the dialog box. At that time, the error output goes off if it is in ON state. Input signal is effective when the signal state is switched and kept for 0.2 seconds or more.
Start input	Turn ON this input signal to run a program. In a hold state, turn on to restart. The input signal is ignored under the following conditions. • The servo power is OFF. • Auto-operation is not set. • In error condition. • Stop input is ON. • In override state.
Stop input	• Turn ON this input signal to bring the operating robot into a hold state. • While the signal is ON, re-start, manual operation and trace operation are not operable. • The robot remains in a hold state even if this signal is turned OFF. • To restart operation, turn ON the start input signal.
Operating mode input	• It is to switch the mode from teaching mode to operation mode. • Use this input when the robot is in teaching mode and operation mode is desired. • When the input signal is turned ON, a message to switch the mode select switch to operation mode appears. • Switch the mode select switch to 'AUTO' or turn OFF the operating mode input to close the message box. Please be advised that while the message box is displayed, the robot is in the error state.
Teaching mode input	• It is to switch the mode from operation mode to teaching mode. • Use this input when the robot is in operation mode and teaching mode is desired. • When the input signal is turned ON, a message to switch the mode select switch to teaching mode appears. • Switch the mode select switch to 'TEACH' or turn OFF the teaching mode input to close the message box. Please be advised that while the message box is displayed, the robot is in the error state.

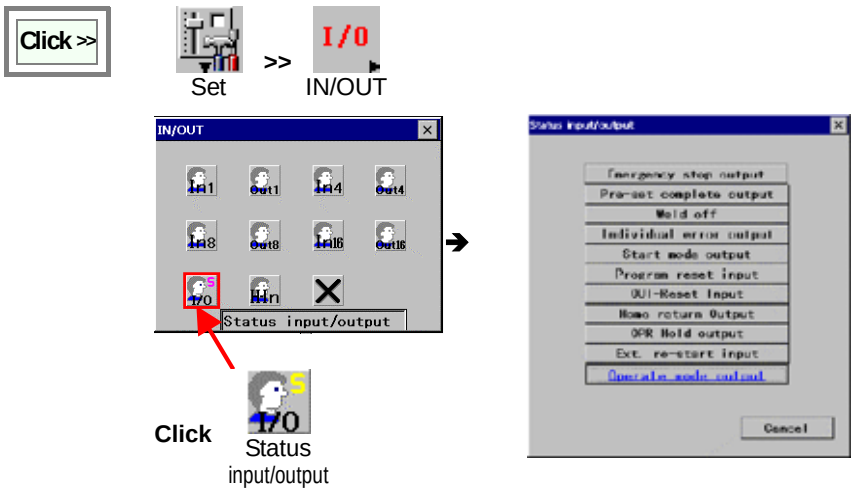
9-2-2. Status OUTPUT

Dedicated output terminals

Status OUTPUT	Description
Alarm output	• The signal is output when the robot goes into an alarm condition. (At servo power OFF) • Unless power is turned OFF, the output signal remains in ON state.
Error output	• The signal is output while the robot is in an error condition. • The signal is turned OFF when the error is released.
Operating mode output	• The signal is output in operation mode (including override.) • While the message box to switch to teaching mode is displayed (by turning on the 'Teaching mode' input), if the operation mode is selected, this signal remains ON. <Note> In case of using an operation box (E and U spec.), allocate this "Operating mode" output to a user output and use it to connect to the operation box.
Teaching mode output	• The signal is output in teaching mode (excluding override.) • While the message box to switch to operation mode is displayed (by turning on the 'Operating mode' input), if the teaching mode is selected, this signal remains ON.
Ready output	• The signal is output when the robot is ready to receive a status input signal. • It goes OFF when the robot is in an alarm condition or when the 'Emergency stop' input is ON.
Servo ON output	The signal is output when the servo power is ON.
Running output	• The signa is output while running a program (including override.) • It is turned OFF when the robot goes in hold or emergency stop state, and turned ON again when the robot is re-started.
Hold status output	• The signal is output when the running program is stopped in operation mode. • The signal is output while the robot is in a hold state due to an error or emergency stop input, and is turned OFF when re-started. • The signal is turned OFF when the mode select switch is placed in 'TEACH' position. When the mode select switch is placed in operation mode and the robot is ready to restart after turning on servo power, the signal is turned ON.

9-2-3. Status I/O to be allocated to user terminals

Procedure (It is necessary for some Status I/O.)

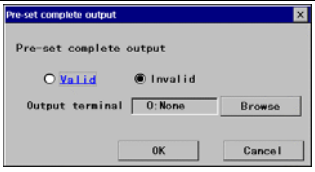
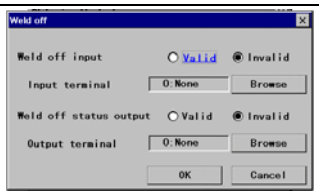
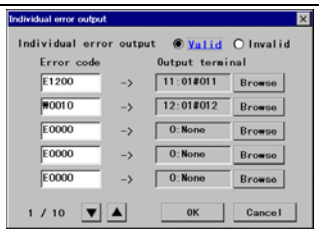


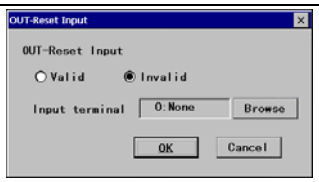
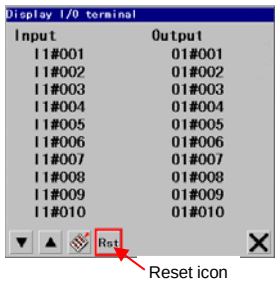
Select the status I/O you want to allocate to the User I/O terminal.

<Note>

For T/Y specifications:
No "Operate mode output" button.

For Handling robots:
No "Weld off" button.

Status output	Description
Emergency stop Output	 **[Valid/Invalid]** Specifies the validity of the function. **[Output terminal]** Specifies the output terminal name to be allocated to the user output terminal. **[Input terminal]** Specifies the input terminal name to be allocated to the user input terminal. The signal is output when the emergency stop is ON. It is turned OFF when the emergency stop goes OFF. If the emergency stop select connector is set to OUTMD0, the signal is turned OFF after the servo power is turned ON. **In teaching mode, if the Deadman switch is OFF, the 'Emergency stop' output of the safety card and the 'Emergency stop' output of the status output do not correspond to each other. In such case, the 'Emergency stop' output of the safety card goes open, and the 'Emergency stop' output of the status output goes OFF.** **In either operation mode or teaching mode, those output signals correspond if the Deadman switch is in ON state.**
Pre-set complete Output	 **[Valid/Invalid]** Specifies the validity of the function. **[Output terminal]** Specifies the output terminal name to be allocated to the user output terminal. The signal is output to indicate completion of preset procedure after the initial servo ON when the main power (200 V) is turned ON. (The preset is executed only after the initial servo power ON.) **The setting is applied the next time you turn ON the power.**
Weld off	 **[Valid/Invalid]** Specifies the validity of the function. **[Input terminal]** Specifies the input terminal name to be allocated to the user input terminal. **[Output terminal]** Specifies the output terminal name to be allocated to the user output terminal. It brings the robot in the weld off state when the specified input is received, and then outputs the signal. It is turned OFF when the weld off is reset. **While the weld off input is ON, it is not possible to reset the weld off state using the teach pendant.** **The weld off input state has priority over the resume function.** **The output goes ON when the teach pendant is used to set to the weld off state.** **No "Weld off" button for handling robots.**
Individual error output	 **[Valid/Invalid]** Specifies the validity of the function. **[Error code]** Specifies the error code when the error occurs. **[Output terminal]** Specifies the output terminal name to be allocated to the user output terminal. **[Switch]** Displays the next page. It outputs the signal when the specified error occurs. It is turned OFF when the error release input is input or when the error dialog box is closed.

Status output	Description
Start mode output	 **[Valid/Invalid]** Specifies the validity of the function. **[Output terminal]** Specifies the output terminal name to be allocated to the user output terminal. It closes the running program file when the input is received. **It accepts the input while the operation is in hold or emergency stop state.** **It accepts the input when the start method is set to "AUTO".**
Program reset input	 **[Valid/Invalid]** Specifies the validity of the function. **[Input terminal]** Specifies the input terminal name to be allocated to the user input terminal. It outputs the signal when the mode select switch is switched to AUTO mode in manual start method. It is turned OFF when the robot goes in Teach mode. (The signal remains ON during override operation.)
Output reset input	 **[Valid/Invalid]** Specifies the validity of the function. **[Input terminal]** Specifies the input terminal name to be allocated to the user input terminal. It is an input to reset all target output terminals to their initial power on state. The target output terminals are user outputs, program reserve outputs and output strobes. • The input is effective only in Auto mode. • The input is not accepted while a file is open. (That is, it is accepted when all files are closed after completion of operation.) • This input is accepted while a file is open in offline edit operation. • The input is ignored when the Override is in the ON state or while setting a dedicated output (such as an allocated output for Cube monitor). • To reset the output in teach mode, click the Rst (reset) icon on the "Display I/O terminal" box. 
Home return output	 **[Valid/Invalid]** Specifies the validity of the function. **[Output terminal]** Specifies the output terminal name to be allocated to the user output terminal. It outputs the signal when the robot reaches the home position while GOHOME command is ON. The signal goes OFF when the robot moves out of the home position. • If the output is ON, the output remains ON even if the robot goes in the emergency stop state. • If the robot or an external axis that is a part of mechanism of the program "GOHOME" command is executed moves out of the home position while the output is in ON state, the output is turned OFF. • This "Home return Output" has priority over the "I/O lock", that is, when this output is set valid, the output is turned ON although I/O lock is set effective in the "Limitation of operation". • In case that the "Robot lock" is set effective in the "Limitation of operation", the GOHOME command is executed and then the home return output goes ON when the robot reaches its home position in internal processing if the output is set valid.

<table>
<tr><th>Status output</th><th>Description</th></tr>
<tr><td>OPR Hold output</td><td>


[Valid/Invalid] Specifies the validity of the function.

[Output terminal] Specifies the output terminal name to be allocated to the user output terminal.

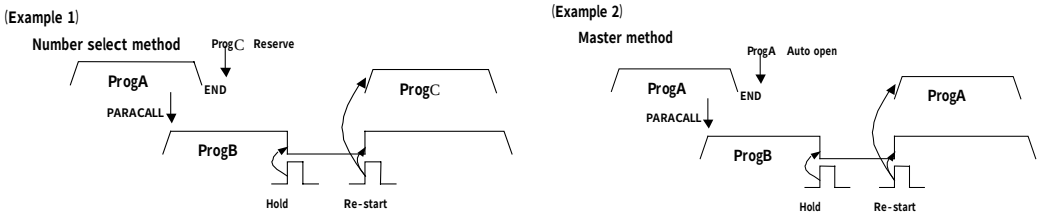
It outputs when the robot goes in a hold state (including error stop) while running a program.

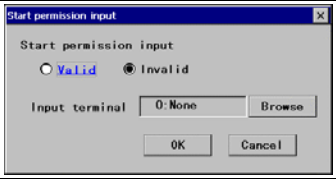
• It is different from “Hold status output” as this output does not turn on at File open.

<table>
<tr><th></th><th>Auto mode
All files closed</th><th>File open</th><th>In operation</th><th>In hold
(error stop)</th><th>After
re-started</th><th>End of
operation</th></tr>
<tr><td>OPR Hold output</td><td>OFF</td><td>OFF</td><td>OFF</td><td>ON</td><td>OFF</td><td>OFF</td></tr>
<tr><td>Hold status output</td><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td><td>OFF</td><td>OFF</td></tr>
</table>
• The “OPR Hold output” is turned OFF if the file is closed in the hold state.
• The “OPR Hold output” is turned OFF if the mode select switch is switched to Teach mode in the hold state.
• If the mode select switch is switched to Teach and then back to Auto mode, the “OPR Hold output” remains OFF state when
- the program in the hold state is closed (including re-opening of the program.)
- the cursor is not located on the program in the hold state.
</td></tr>
<tr><td>External re-start input</td><td>


[Valid/Invalid] Specifies the validity of the function.

[Input terminal] Specifies the input terminal name to be allocated to the user input terminal.

• It is an input that limits the re-start input after the robot goes in the hold state effective only from a specified external re-start input.
• When this “Ext. re-start input” is set effective, the “Start input” of the Status input cannot be used at re-start.
• This setting is effective only in Auto start. The setting is ignored in manual start.
• Re-start won’t be executed when the “Stop input” is ON.
• Re-start won’t be executed during override in TEACH mode.
• Re-start won’t be executed if the file in hold state is closed.
• If a parallel processing program exists, a reserved program may be re-started by this input.
(See the following figure for details.)


</td></tr>
<tr><td>Start permission input</td><td>


Start permission input
[Valid]: Manual and auto program start are effective only when receiving a signal to the designated input terminal.
Intermittent signal to the input terminal generates an error.
</td></tr>
</table>

9-3. High-speed input

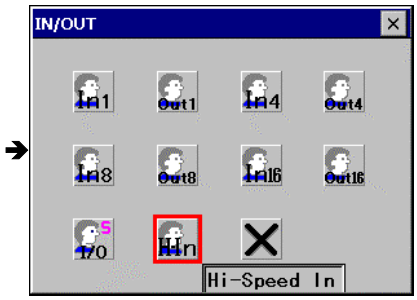
*** Available when "Touch sensor" option is provided or with a MIG/TIG force system.**

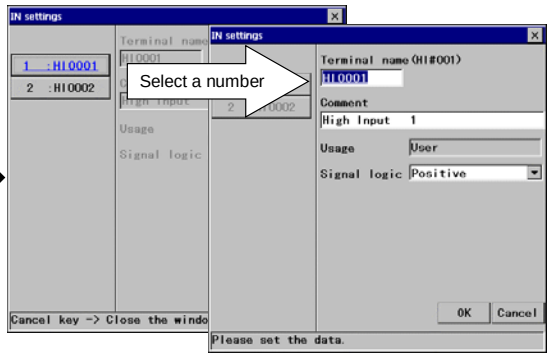
An input which has priority over other user inputs. The input is useful to use with a device that requires immediate response.

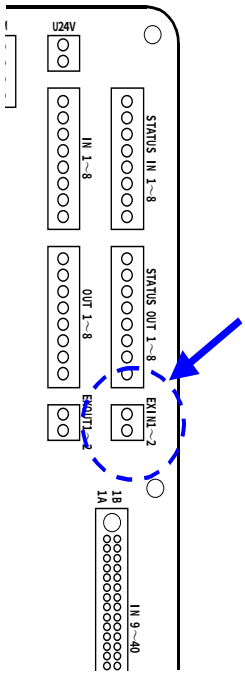
Click >>

Set >> IN/OUT >> Hi-Speed In

Hi-Speed In	Sets one-bit input terminal (In) and output terminal (Out).







Terminals are labeled "**EXIN1-2**" and located between status output terminals and user input terminals 9-40 OUT" on the sequence board ZUEP5711.

Set parameters and click the **OK** button.

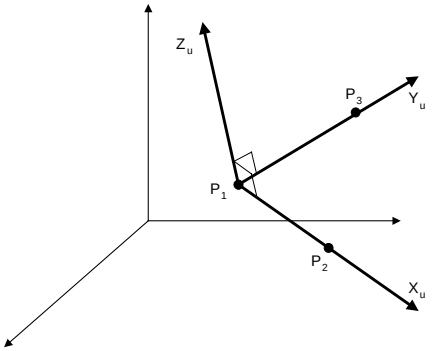
10. Robot settings

10-1. User coordinate system settings

10-1-1. What is a User coordinate system

It is a coordinate system that can be defined by the user.

For example, if you are using a tilted table, you can define a coordinate system based on the table surface and operate the robot in the defined coordinate system.



A user coordinate system is defined by three points, P_1, P_2 and P_3.

Where,

P_1: Origin of the user coordinate system

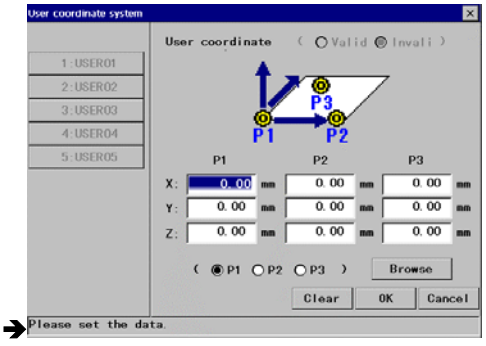
P_1P_2: Direction of X-axis (X_u-axis)

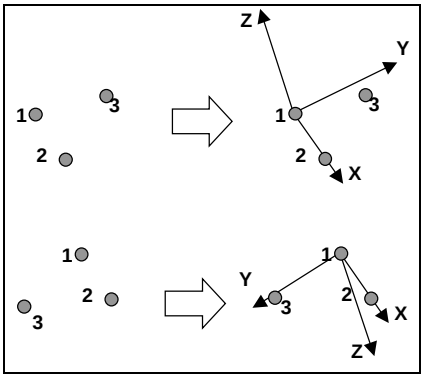
$P_1P_2P_3$: X-Y plane of the user coordinate system

Axis perpendicular to the plane X_u-Y_u(right-handed): Z-axis of the user coordinate system (Z_u-axis)

10-1-2. Setting procedure

Click >> Set >> Robot >> User coordinate





[Valid/Invalid] Specifies the validity of the function.

[P1] Specifies the origin of the user coordinate system

[P2] Specifies a point to define the direction of X-axis from the origin (P1)

[P3] Together with the P2, specifies the X-Y plane.

[Browse] Click the check box of P1, P2 or P3, and then click this button to select a set of X, Y and Z values from the global teach point list.

[Clear] Click to cancel the user coordinate system settings you have made.

[OK] Click to save the user coordinate system settings you have made.

To ensure an accurate system definition, be sure to teach points that are as far apart as possible.

The positions P1-P2-P3 determine the Y-axis and Z-axis direction. Be sure that your points are correct to ensure the desired results.

10-2. Tool offset settings

10-2-1. What is tool offset

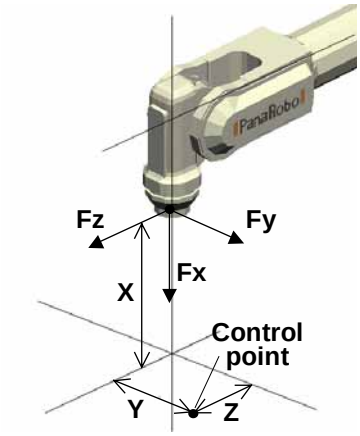
- Tool offset is the dimension surrounding the tool control point orientation of tool to be attached to the TW flange surface of the robot, such as a welding torch or gripper.
- The robot calculates the position of its control point (tip of the tool) and the direction of the tool (the direction of travel in the tool coordinate system) based on the values set up.
- If the tool offset is not correctly set, the robot cannot control travel speed of the tool tip or correct interpolation movement (linear, weaving, etc.) during operation.
- Improper tool offset also causes improper movement when using malfunction in the tool coordinate system in manual operation.
- The robot can handle up to 30 tool offset values and switch between them as needed during operation.

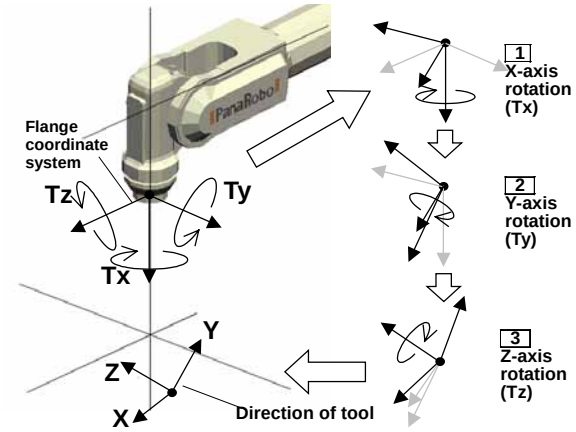
10-2-2. Definition of XYZ type tool offset

It uses 6 parameters, X, Y, Z, Tx, Ty and Tz, to determine the tool offset.

The position of the control point is determined by the parameters of X, Y and Z and is indicated by the flange coordinate system (see the figure on the right) whose origin is the TW-axis rotation center on the flange surface

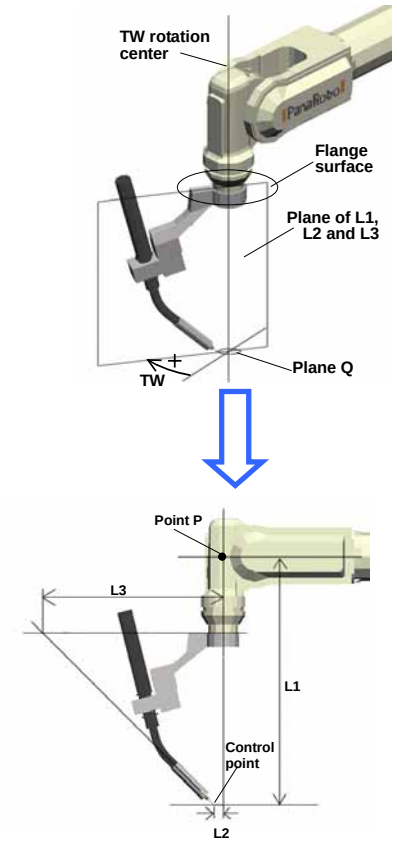
The direction of the tool coordinate is set by parameters of Tx, Ty and Tz and is determined by rotating the X, Y and Z axes in the order of Tx, then Ty then Tz.





10-2-3. Definition of L1 type tool offset

- It uses 4 parameters, L1, L2, L3 and TW, to determine the tool offset.
- When the BW axis is at –90 degrees, define the intersection point of RW-axis and TW-axis as “point P” and the plane on which the control point travels by moving only the TW-axis as “plane Q”.



L1	Distance (in millimeters) between point P and plane Q.
L2	Distance (in millimeters) between the control point and the TW rotation center.
L3	Distance (in millimeters) between the intersection point the extension of the flange surface and the extension of the tool direction intersects and the TW-axis rotation center.
TW	Tool setting angle (in degree) measured from TW=0

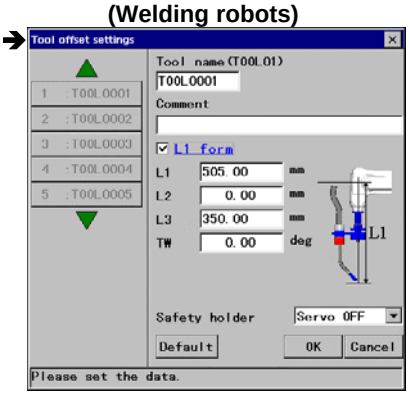
* For details of each parameter, refer to manual of applied equipment.

10-2-4. Setting procedure

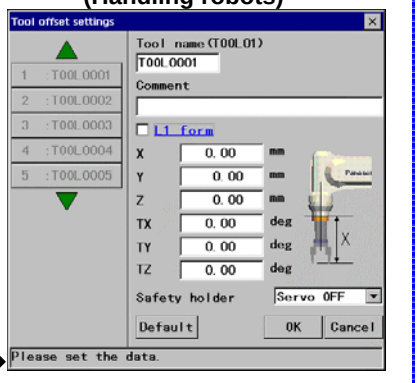
Set the control point of the manipulator on which an interpolation movement of the robot is controlled to be operated.

Click >> Set >> Robot >> Tool

(Welding robots)



(Handling robots)



[Tool name] Type the tool name (the identifier of each tool) you want to work on. The Tool name can have up to 20 characters.

[Comment] Provides a space for you to add comment about the tool. Comments can have up to 20 characters.

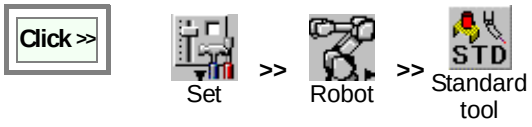
[L1 form] Click this box to apply the L1 form to set parameters.
Clear this box to apply the XYZ form.

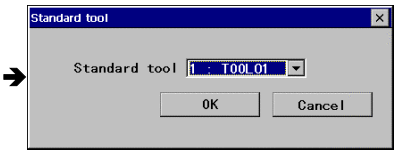
[Safety holder] Specifies whether the robot should be in the [Hold] state or in the [Servo OFF] state when the safety holder activates.

[Default] Resets the settings in this dialog box to the factory settings at shipment.

10-3. Standard tool settings

It specifies the default tool to be used in new teach programs. That is, the tool specified here is that initially will be displayed when you create a new program.





[Standard tool]: Specifies the default tool.

10-4. RT monitor settings

Warning	· Never enter into the safety fenced area although the robot is stopped by this function. · Take measures so that people know if the robot is stopped by the RT monitor function.

10-4-1. What is the “RT monitor” function?

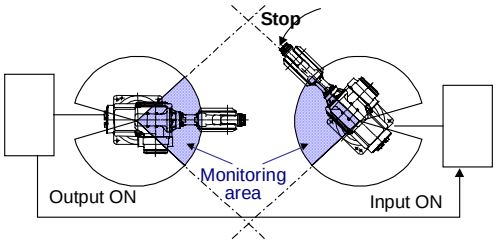
- It finds out the direction of the robot by monitoring the angle of the RT axis. You can set the monitoring area freely.
- The functions of the RT monitor:
  (1) It outputs a signal while the robot is in the specified monitoring area.
  (2) It informs an external device that the robot is in the specified monitoring area.
- The robot stops at the boundary of the specified monitoring area when an external signal is input.
- Use this function:
  (1) When multiple robots are used and interference may be the case depending on the direction of those robots. Use this function to avoid collision.
  (2) In a system where a conveyer is located close to the robot,
  with this function, you can stop or reduce the speed of the conveyer when the robot is at a specific direction, or you can disable the robot to travel toward the conveyer while the conveyer is in operation.

Example application:

Use this function to avoid two robots being in the work area at the same time.

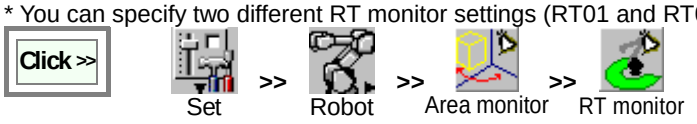
In the figure on the right, as the robot on the left is in the monitoring area, the RT monitor output is output.

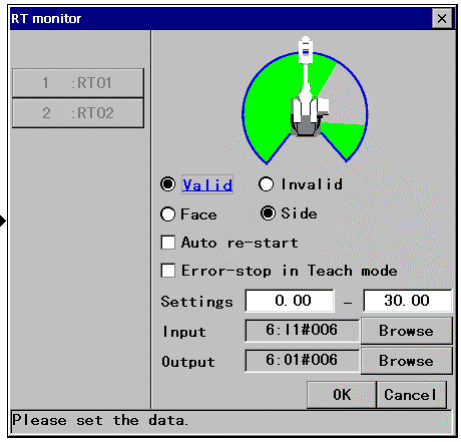
By connecting the RT monitor output terminal of the robot on the left side to the RT monitor input terminal of the robot on the right, the robot on the right will stop at the boundary of the monitoring area.



10-4-2. “RT monitor” setting procedure

* You can specify two different RT monitor settings (RT01 and RT02).





[Valid/Invalid] Specifies the validity of the function.

[Face/Side] Face: To monitor within the set range.
Side: To monitor outside of the set range in the robot work envelope.

[Auto re-start] Click in the box to restart automatically if the input signal goes OFF when the robot is in the wait state at the boundary of the specified monitoring area.

[Error-stop in Teach mode] Click in the box to turn ON the Input of the RT monitor and also bring the robot to an error stop when detected in Teach mode.

[Input terminal] An input terminal to bring the robot to an error stop before entering into the monitoring area.

[Output terminal] Specifies an output terminal that stays in ON state while the robot is in the specified monitoring area.

10-5. Cube monitor settings

Warning	· Never enter into the safety fenced area although the robot is stopped by this function. · Take measures so that people know if the robot is stopped by the Cube monitor function.

10-5-1. What is the “Cube monitor” function?

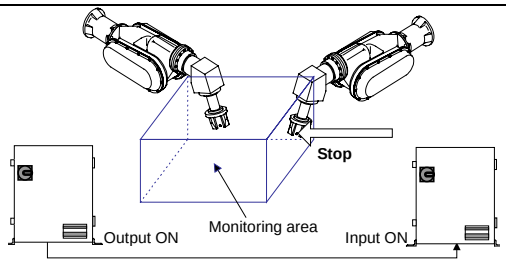
- It monitors if the tool center point of the robot is within the specified monitoring area.
- Rectangular solid area is specified as a monitoring area, therefore, it is called “Cube monitor”.
- By monitoring the movement of the tool center point (the tip position of the tool) with this function, it is possible to prevent interference (collision) of robots if more than one robot is used in the same work area.
- The functions of Cube monitor:
  (1) It outputs signal while the robot is in the specified monitoring area.
  (2) The robot stops at the boundary of the specified monitoring area when an external signal is input.
- You can specify the number of monitoring areas. (See section “System data adjustment” for setting details.)

Example application:

Use this function to share the same work area with two robots.

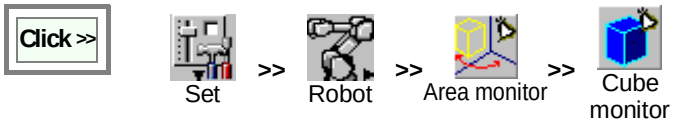
In the figure on the right, as the robot on the left is in the monitoring area, the Cube monitor output is output.

By connecting the Monitor output terminal of the robot on the left side to the Monitor input terminal of the robot on the right, the robot on the right will stop at the boundary of the monitoring area.

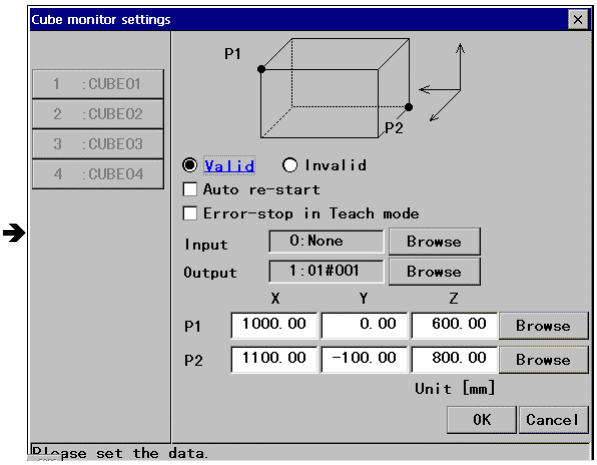


When the mode select switch is in the “Teach” position, it is possible to move the robot within the monitoring area even though the input signal in ON. However, regardless of the position of the mode select switch, the output signal is ON while the robot is within the monitoring area.

10-5-2. “Cube monitor” setting procedure



<Note> The specified output goes ON while the robot is in the preset monitor area regardless of the mode.



[Valid/Invalid] Specifies the validity of the function.

[Auto re-start] Click in the box to restart operation automatically if the input signal goes OFF when the robot is in wait state at the boundary of the specified monitoring area.

[Error-stop in Teach mode] Click in the box to turn ON the Input of the Cube monitor and also bring the robot to an error stop when detected in Teach mode.

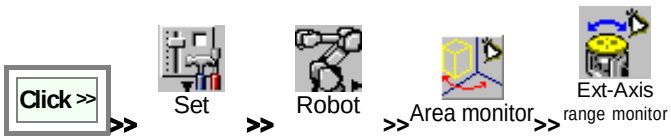
[Input] An input terminal to bring the robot to an error stop before entering into the monitoring area.

[Output] Specifies an output terminal that stays in ON state while the robot is in the specified monitoring area.

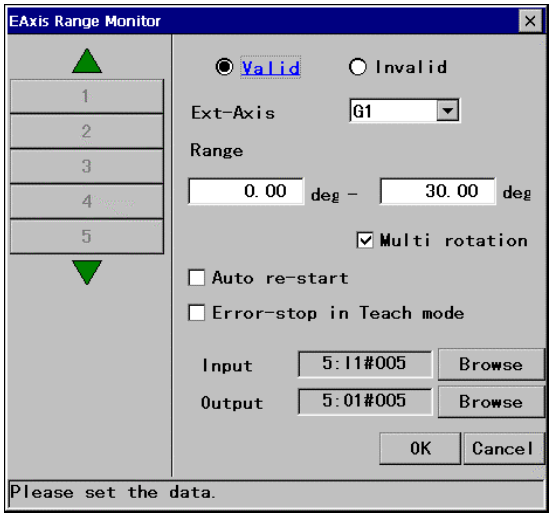
[P1/P2] Two opposite corners of the cubic monitoring range

10-5-3. E-Axis Range Monitor

It is a function to turn ON an output when an external axis is positioned within a specified area. Like RT monitor and Cube monitor, it is possible to bring the robot to an error stop before the external axis enters the specified area.



<Note> This function is available to a person with the “programmer” or higher level.



[Valid/Invalid]: Whether to enable this setting. **[Ext-Axis]:** The axis to be monitored.

[Range]: A range to be monitored (Enter smaller number to the left.)

[Multi rotation*]: It is for rotary type external axis.
Click in the box for multi rotation support

[Auto re-start]: Click in the box to restart operation automatically if the input signal goes OFF when the robot is in wait state before the boundary of the specified monitoring area.

[Error-stop in Teach mode]: Click in the box to turn ON the Input of the Cube monitor and also bring the robot to an error stop when detected in Teach mode.

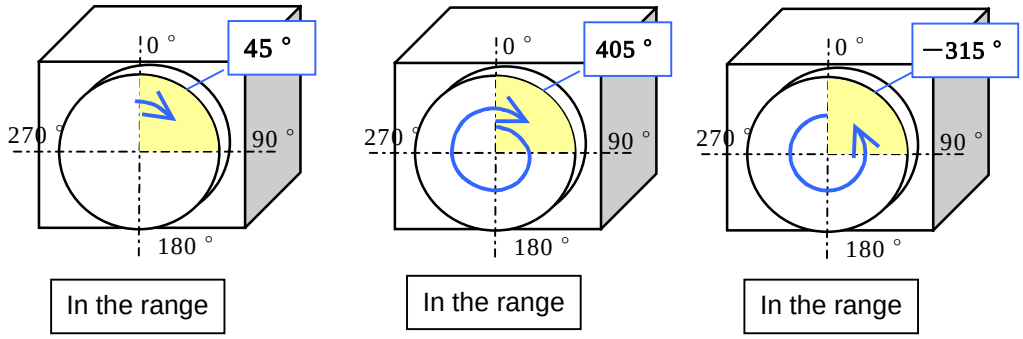
[Input]: An input terminal to bring the robot to an error stop before entering into the monitoring area when it is ON.

[Output]: An output terminal that stays in ON state while the robot is in the specified monitoring area.

Maximum monitoring objects: 10

***Multi rotation:** Click in the box so that the angle from the zero (0) degree point to the current position (not the actual angle of rotation) is used to check whether or not the external axis is in the range.

[In case the monitor range is set to “from 0 to 90 degrees”.]

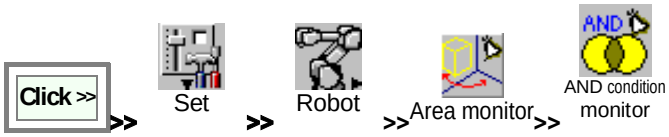


<Note>

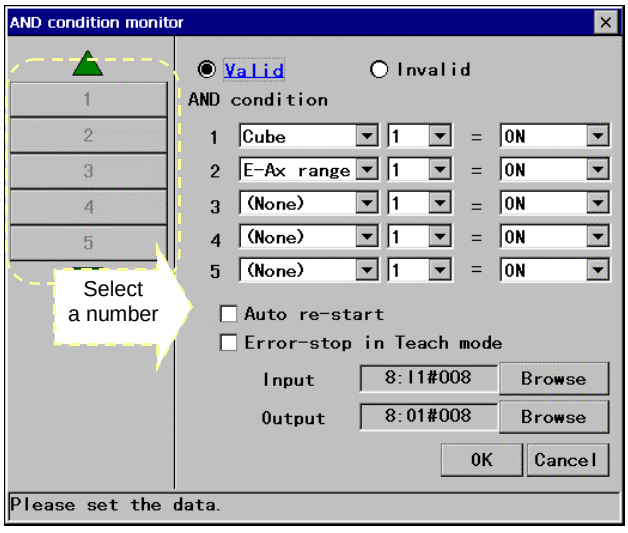
- This function is not applicable in case that no external axis is connected.
- If **[Error-stop in Teach mode]** is applied and the robot is brought to an error stop, the “Error output (status output)” goes ON in Teach mode.

10-5-4. AND condition monitor

It is a function to turn ON an output when preset conditions are satisfied in an “Area monitor” functions (RT monitor, Cube monitor or E-Axis Range Monitor),
It is also possible to bring the robot into an error stop when all conditions are satisfied.



<Note> This function is available to a person with the “programmer” or higher level.



[Valid/Invalid]: Whether to enable this setting.

[AND condition]: Specify [Type of area monitor], [Area number] and [ON/OFF (Within/Out of the area)]

[Auto re-start]: Click in the box to restart operation automatically if the input signal goes OFF when the robot is in wait state as conditions are satisfied.

[Error-stop in Teach mode]: Click in the box to turn ON the Input and also bring the robot to an error stop when conditions are satisfied in Teach mode.

[Input]: An input terminal to bring the robot to an error stop when the conditions are satisfied.

[Output]: An output terminal that goes ON while the conditions are satisfied.

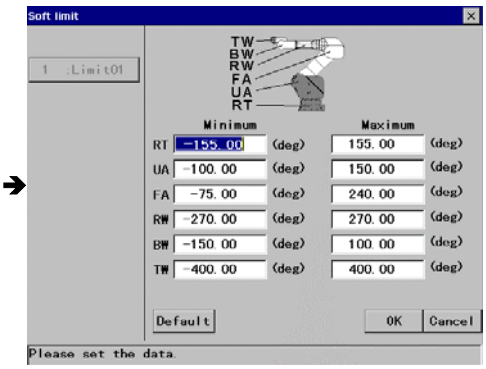
Maximum monitoring objects: 10

<Remarks>

If **[Error-stop in Teach mode]** is applied and the robot is brought to an error stop, the “Error output (status output)” goes ON in Teach mode.

10-6. Soft-limit settings

The operable range of each axis can be limited by means of software, this is called “Soft-limit”.



[RT] Specifies the operating range of the RT-axis

[UA] Specifies the operating range of the UA-axis

[FA] Specifies the operating range of the FA-axis

[RW] Specifies the operating range of the RW-axis

[BW] Specifies the operating range of the BW-axis

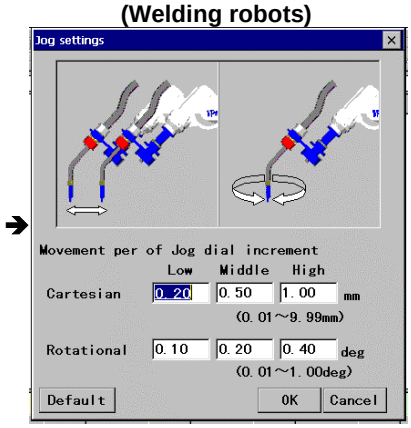
[TW] Specifies the operating range of the TW-axis

[Default] Resets the settings in this dialog box to the factory settings at shipment.

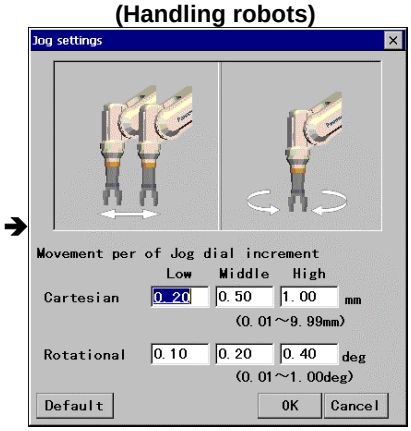
10-7. Jog settings

“Jog” is a type of operation to move the robot a little at a time. The “Jog settings” is to set the robot travel amount corresponding to the jog dial increment.

(Welding robots)



(Handling robots)



[Cartesian] Specifies the Cartesian movement of the robot per jog-dial increment

[Rotational] Specifies the rotational movement of the robot per jog-dial increment

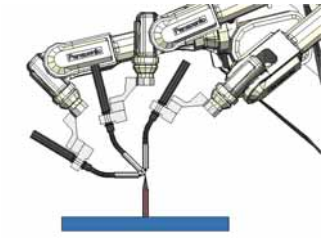
10-8. TCP adjust

10-8-1. What is TCP adjust

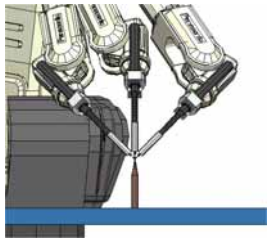
It is a function to set the calculated tool offset value by inputing the specific tool positions at the tool cente point (TCP).It is necessary to teach six tool positions (3 positions each for X-Z plane and X-Y plane).

<Note>

- Please prepare an adjustment jig that can specify a single position.
- Please note that as this function does not calculate the TW value (Tool mounting angle), it is necessary to set the correct TW value previously.
- As for the second position, set the tool so that the direction of the adjustment jig used for the first position and the TW rotation center match.



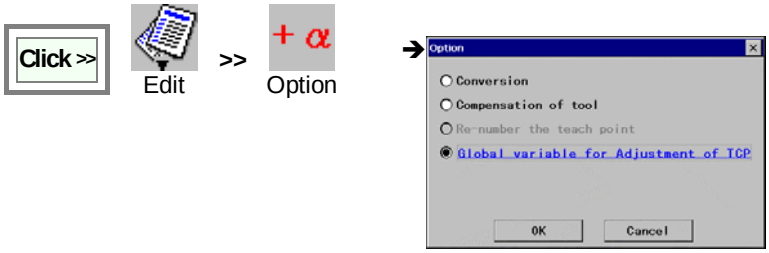
Teach 3 positions
on X-Z plane of the tool



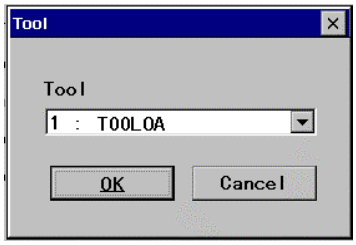
Teach 3 positions
on X-Y plane of the tool

10-8-2. Adjustment

(1) TCP data setting

1. Close all active programs to start adjustment.
2. 

   Select the “Global variable for Adjustment of TCP”.

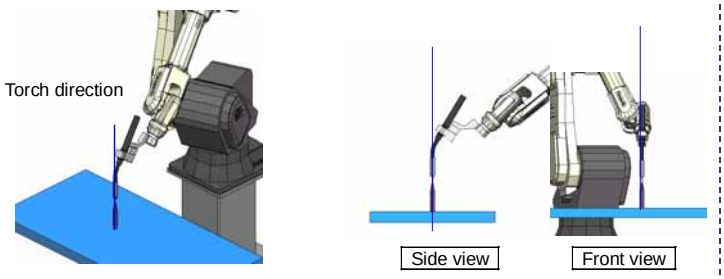
3. 

   Specify a tool you would like to adjust.

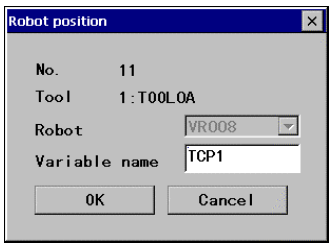
4. Then a list of robot variables appears.
5. <Position 1>

   Align the directions of the tool (wire feed direction) and of the adjustment jig as the first position on the tool X-Z plane.(See the figre **Position 1**.)

   Position 1 Align the directions of the tool (wire feed direction) and of the adjustment jig.

6. Move the cursor to an undefined robot variable and press the **ENTER** key.

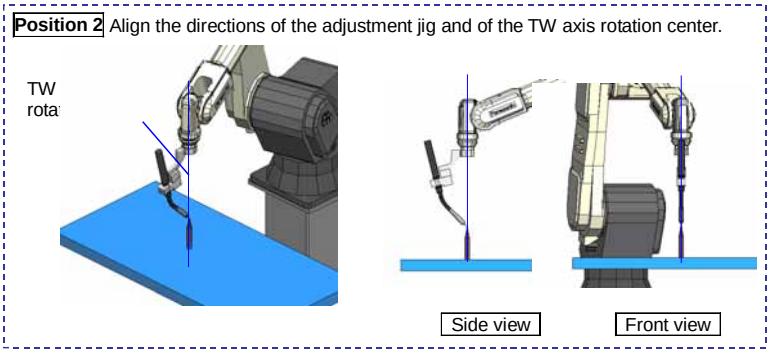


To identify the data as variable name, fill in the variable name box and the click the **OK** button.

7. <Position 2>

Then move the Y-axis of the tool coordinate system to align the directions of the adjustment jig and of the TW axis rotation center as the second position on the tool X-Z plane. (See the figre **Position 2**.)

Only Y-axis of the tool coordinate system is operable.



Move the cursor to the variable for the Position 2, and then press the **ENTER** key.

8. Rotate the Y-axis again to change the position for the third position on the tool X-Z plane. <Position 3>

9. As for Positions 4 to 6, teach position on the tool X-Y plane.

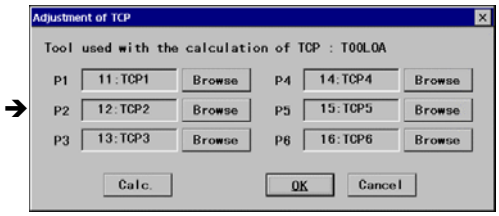
For Positions 5 and 6, only Z-axis of the tool coordinate system is operable.

10. Click >>  File >>  Close to close the list of the robot variables.

Then a dialog box to confirm updating the adjustment appears. Click the **OK** button.

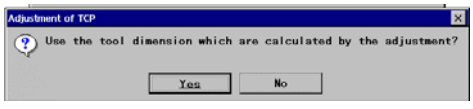
(2) TCP offset value calculation

1. Click >>  Set >>  Robot >>  TCP adjust



If all positions has stored properly, the preset variable names are indicated in the P1 to P6 boxes.

Then click the **Calc.** button.

2. 

Click the OK button, then the dialog box to confirm the adjustment appears. Click the **Yes** button to complete the adjustment.

3. Check the adjusted tool offset value.

Click >>  Set >>  Robot >>  Tool

11. Controller settings

11-1. Program start method settings

- To set the start method, the terminal to which the external signal to start the robot operation is transferred to needs to be allocated to the user I/O terminal.
- There are two types of start methods; ‘Manual’ and ‘Auto’. In Auto-start method, there are two different selection methods; ‘Program select method’ and ‘Master method’.
- With Auto start method, it is not possible to start the robot by pressing the **Start** button on the teach pendant.

Start method	Select method		Description
Manual			Use the **Start** button on the teach pendant to operate a program. (Refer to section “AUTO mode” in the operating instructions (basic operation).)
Auto			Use an external signal input to operate a program.
	Master		Start the specified program when the start signal is received from external.
	Program select	**Signal**	It is possible to start programs whose program numbers are 1, 2, 4, 8, 16, 32,64, 128,256 and 512.
		Binary	To start the program whose program number is equal to the sum of the numbers you specified. It is possible to start programs of program numbers from 1 to 999.
		BCD	A set of four terminals is used to specify each digit of the program number you want to start. It is possible to start programs of program numbers from 1 to 399.


Program name is indicated “ProgXXXX.prg” where XXXX is the result of the specified calculation.
Example: If the result is 16, then the program name becomes “Prog0016.prg”.

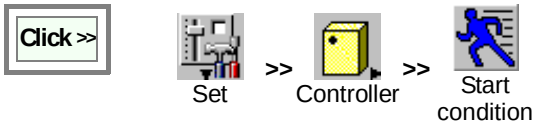
11-1-1. Master method

- It starts the program registered as a master program automatically.
- Place the mode select switch in “Auto” position, then the master program you specified will be ready to start automatically.
- After the completion of the master program, it is ready to start the master program from the beginning automatically.


This master method is good for complex start conditions (interlock etc.) as you can edit start conditions within the master program using the teach pendant, such as interlocking method or criteria of the start conditions.

11-1-2. Start method settings and I/O allocation

It is a function to specify the start method you want and then allocate user I/O terminals to be used to specify the program number and to start a program.



[Start method] Select either Manual or Auto.

[Program select] Select either Program select method of Master method. (in Auto start method).

[Program sel. Method] Select one method from Signal, Binary or BCD.

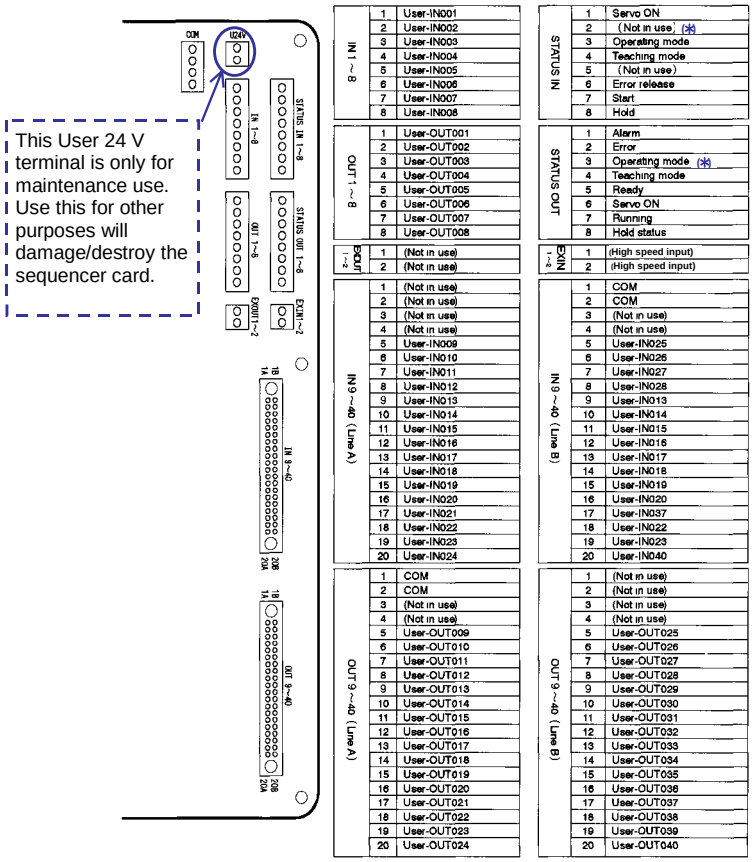
[IN/OUT allocate] Set and edit terminal allocation.

[Start file] Specifies the master program.

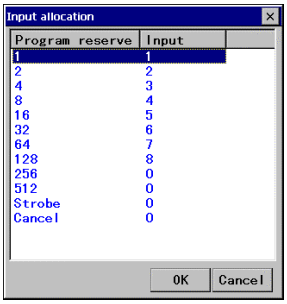
[Re-open input] Select an input terminal to bring the master program in the ready state in case of forced termination of the master program.
* Click the **Browse** button to refer to the list of input terminals.

- The re-open input executes the master program from the beginning. It does not take it from the last operation.
- Re-call input accepts the OFF to ON change.

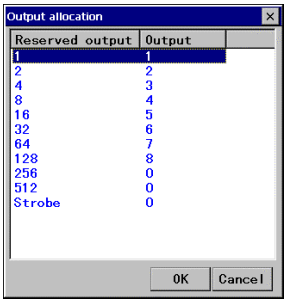
<Terminal layout of the sequencer card>



<INPUT Allocation box>



<OUTPUT allocation box>



Status I/O terminals marked with **(*)** are connected to wires drawn from the operation box if provided.
Configuration of user I/O terminals varies with applied start method. See the next section for details.

11-1-3. Program select method

- If a program is reserved while running another program, the reserved program will be started automatically after the completion of the current program.
- If the result exceeds the set range (from 1 to 999), then the program reservation is disregarded.
- It is possible to reserve up to 16 programs. (Programs on and after the 16th program will be disregarded.)
- When the program select is disregarded, no select response will be output.
- Input 'Cancel' clears all selected programs except the currently running program.
- To check the program select status, click on **Display change** (**View** menu) and then click **Operate state**.
- It is possible to clear all selected programs during operation (except in override) by switching the mode select switch to the 'TEACH' position.

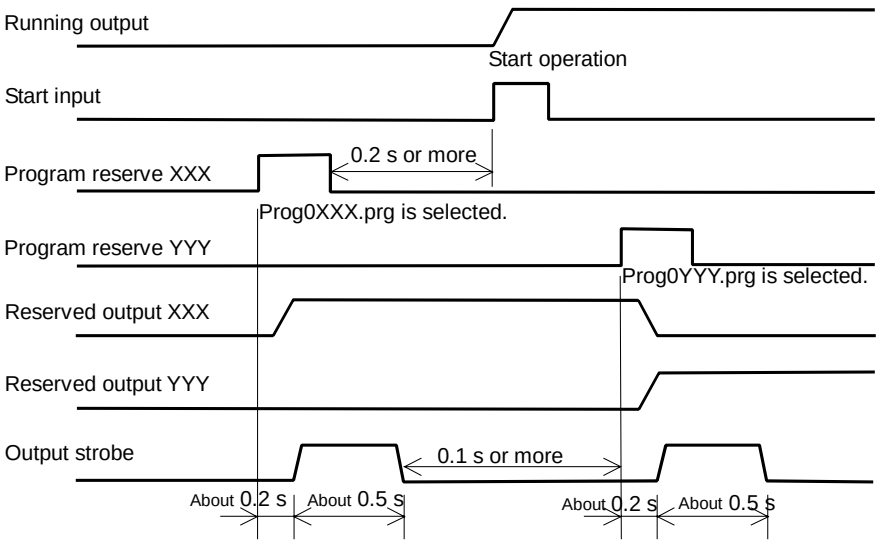
11-1-4. Signal method

When the start input is turned ON, the same numbered program is selected.

Then the selected program will be executed.

With this method, you can only program the program numbers 1, 2, 4, 8, 16, 32, 64, 128, 256 and 512.

Timing chart



- "XXX" and "YYY" indicate 'program reserve' numbers you specified (001,002,004,008,016,032,064,128,256 or 512).
- The input signal must be kept ON for 0.2 seconds or more.
- 'Start input' may not be received if it is input in less than 0.2 seconds after the previous input is received.
- It requires at least 0.1 second after the 'output strobe' signal is turned OFF to reserve the next program select input.
- After the completion of the current program, the robot automatically starts the next reserved program if any.

11-1-5. Binary method

It calculates the sum of ‘Program reserve input’ numbers having been in ON state when the ‘Input strobe’ is turned ON, and then reserves the corresponding program.

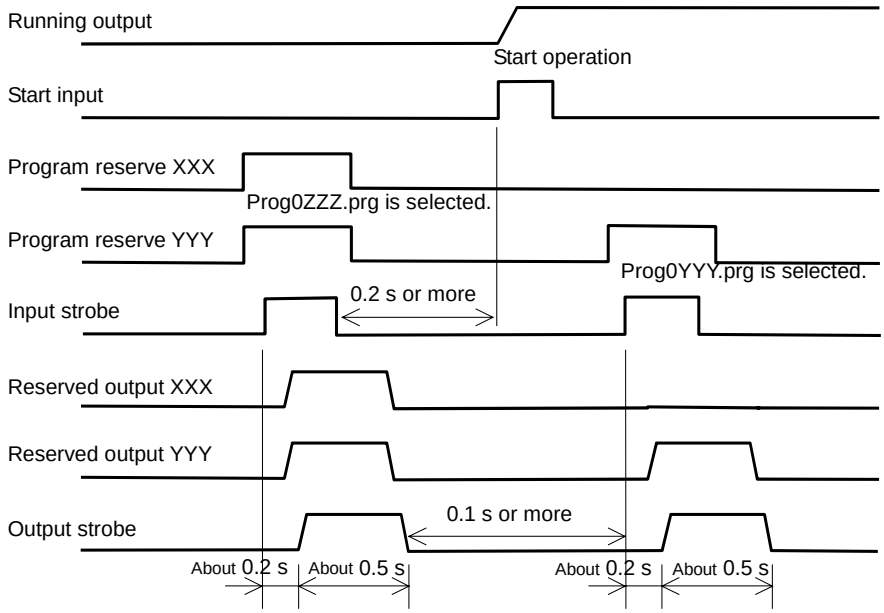
Example:

Program reserve input										Sum	Program name
512	256	128	64	32	16	8	4	2	1		
O	O	O	O	O			O	O	O	999	Prog0999.prg
O				O			O	O		550	Prog0550.prg
				O	O			O		50	Prog0050.prg
					O				O	17	Prog0017.prg
									O	**1**	Prog0001.prg

O.....Input is ON,

(Blank)...Input is OFF

Timing chart



- “XXX” and “YYY” indicate ‘program reserve’ numbers you specified (001,002,004,008,016,032,064,128,256 or 512).
- “ZZZ” is the sum of “XXX” and “YYY”. The above example is of 2 ‘program reserve’ inputs which are turned ON, however, ON/OFF status of all ‘program reserve’ inputs (001,002,004,008,016,032,064,128,256 and 512) are checked for calculation.
- The input signal must be kept ON for 0.2 seconds or more.
- ‘Start input’ may not be received if it is input in less than 0.2 seconds after the previous input is received.
- It requires at least 0.1 second after the ‘Output strobe’ signal is turned OFF to reserve the next ‘program reserve’ input.
- After the completion of the current program, the robot automatically starts the next reserved program if any.

11-1-6. BCD method

- BCD is the abbreviation for binary-coded decimal code.
- It specifies each digit of a number as a binary number using program reserve inputs 1, 2, 4 and 8 for the 1st digit, 16, 32, 64 and 128 for the 2nd digit and 256 and 512 for the 3rd digit. It calculates the sum of 'Program reserve input' numbers having been in ON state when the 'Input strobe' is turned ON, and then reserves the corresponding program.

You can use the rotary switch of BCD specification sourced locally sold at a store for easy operation.

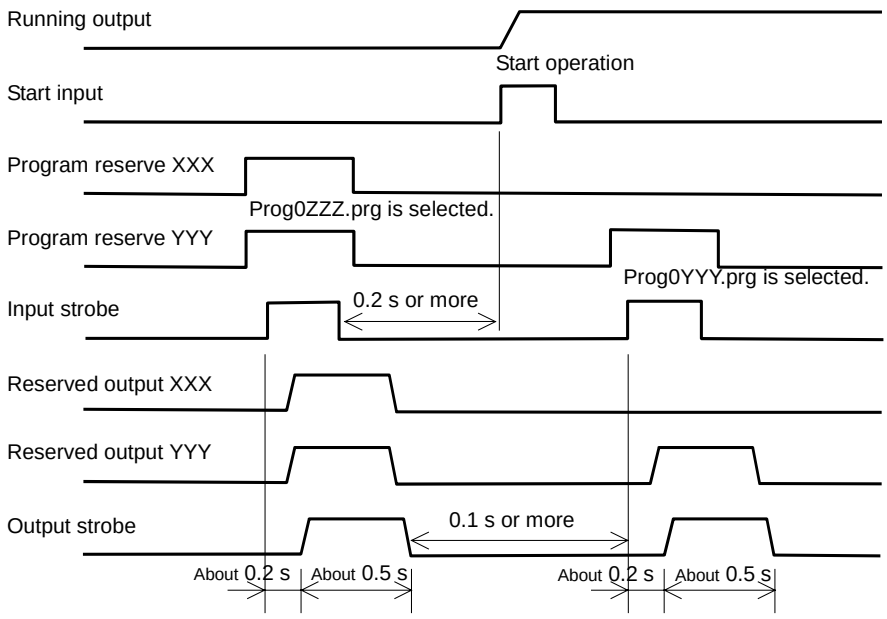
<Example>

Program reserve input										Sum	Program name
512	256	128	64	32	16	8	4	2	1		
3rd digit		2nd digit				1st digit					
200	100	80	40	20	10	8	4	2	1		
O	O	O			O	O			O	399	Prog0399.prg
O				O			O	O		226	Prog0226.prg
				O	O			O		32	Prog0032.prg
					O				O	11	Prog0011.prg
									O	1	Prog0001.prg

O.....Input is ON,

(Blank)...Input is OFF

Timing chart

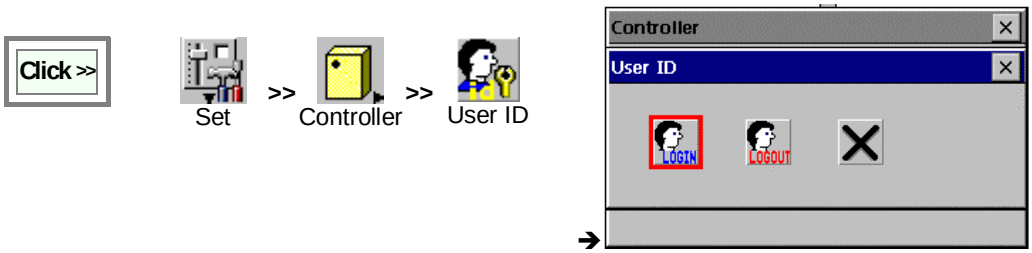


- "XXX" and "YYY" indicate 'program reserve' numbers you specified (001,002,004,008,016,032,064,128,256 or 512).
- "ZZZ" is the sum of "XXX" and "YYY". The above example is of 2 'program reserve' inputs which are turned ON, however, ON/OFF status of all 'program reserve' inputs (001,002,004,008,016,032,064,128,256 and 512) are checked for calculation.
- The input signal must be kept ON for 0.2 seconds or more.
- 'Start input' may not be received if it is input in less than 0.2 seconds after the previous input is received.
- It requires at least 0.1 second after the 'Output strobe' signal is turned OFF to reserve the next 'program reserve' input.
- After the completion of the current program, the robot automatically starts the next reserved program if any.

11-2. Login and Logout

This function is to individualize data by programmer (or user ID) and also to limit scope of authority in settings and programming according to the registered user level.

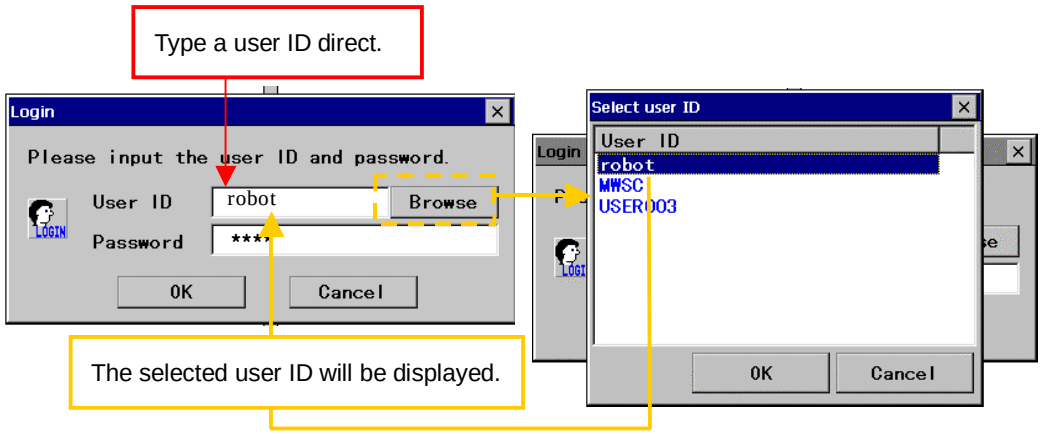
Please refer to section “User management settings” for details of the User ID.



Click the “LOGIN” icon.

Login

Type a user ID that has been registered in the User ID box.
Or you can also click on the **Browse** button and select a User ID form the list.



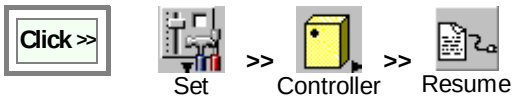
● After operation is completed, click the 

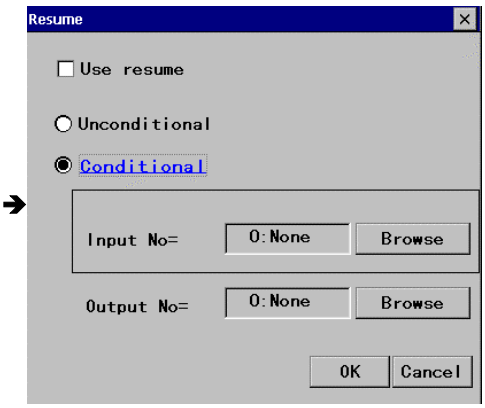
Logout

icon to logout from the current user level and change to the operator level.

11-3. Resume settings

It is a function to resume the settings active at power loss (power off) when power is regained (power on).





[Use resume]: Check the box to enable the resume function.

[Unconditional]: Check the box to enable the resume function at all times.

[Conditional]: Check the box for conditional resume.

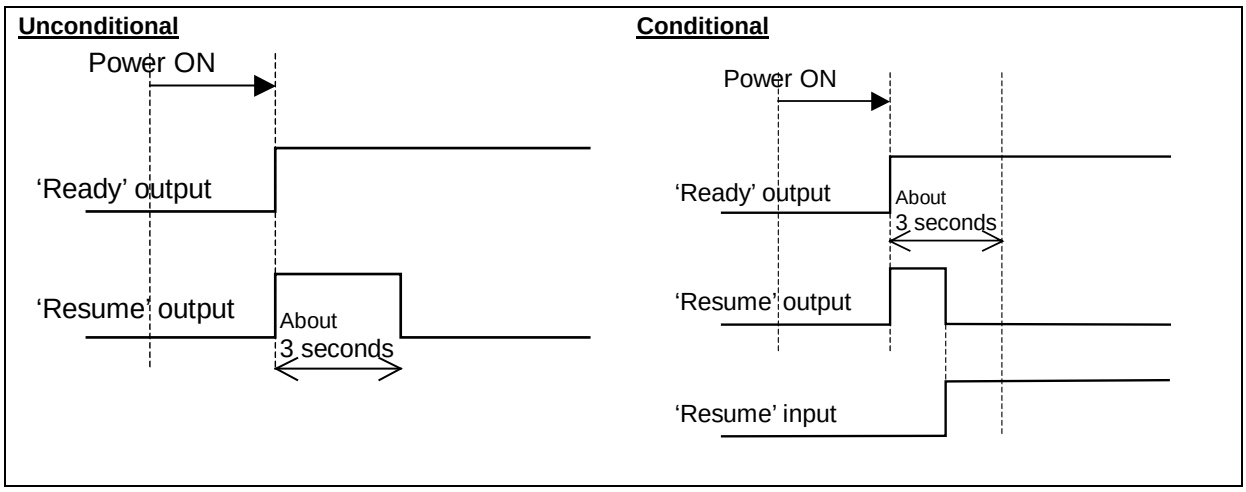
[Input No.]: (for conditional resume)
Resume function is effective only when the input(s) specified here is on.

[Output No.]: (for conditional resume)
When the specified input terminal(s) is ready, the signal is output to the output terminal specified here.

<I/O timing>

When the ready signal goes on at power ON, the output signal turns ON simultaneously and stays on for about 3 seconds.

If conditions are specified, input signal is accepted while the resume output is ON. And once the input signal is accepted, the output signal goes OFF.



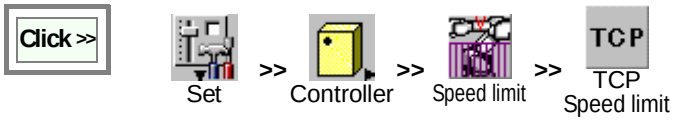
.

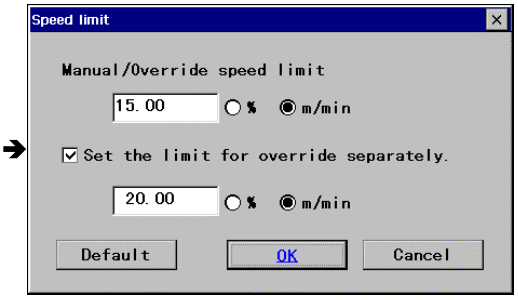
The input signal is accepted only at the moment that it is turned on, therefore, if the input signal has been ON when the 'Resume' output goes ON, the input signal won't be accepted.
To resume teaching data, it is necessary to turn on the "Auto-backup while editing" in the 'Default folder' dialog box. (For "Auto-backup while editing" settings, see "Edit folder (Default folder settings)".)

11-4. Speed limit settings

11-4-1. Manual/Override speed limit

It specifies the maximum robot travel speed in manual operation. It also specifies the override speed limit in AUTO mode separate from the speed in teaching operation.
This function is useful in a system the reference speed is set to the external axis. As in such system the robot motion speed is likely set above the override upper speed limit. Therefore, by setting the override speed limit separately with this function, it can avoid possible termination of welding operation when the override is turned ON.





[Manual /Override speed limit]
Specifies the maximum speed in manual operation.
Set range:(0-12.5 %) or (0-15.00 m/min) *

[Set the limit for override separately]
Set range:(0.1-100.0 %) or (0.01-120.00 m/min)

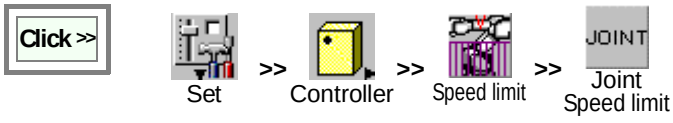
*** For handling robots:**

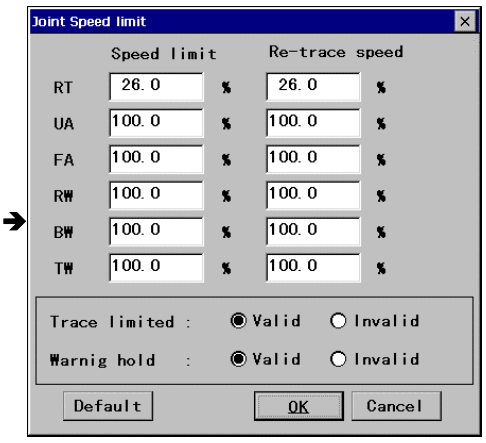
This setting is not effective.

Limit speed set range varies with parts number of the robot controller and the robot manipulator.

11-4-2. Joint speed limit

It specifies the maximum travel speed for each joint axis. Specify a percentage to the rated motor speed.





[Speed limit] Specifies percentage to the rated motor speed.

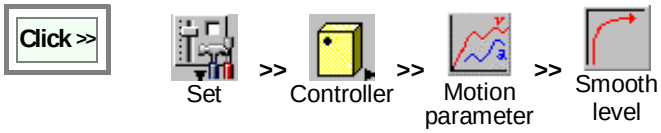
[Re-trace speed] Specifies the speed limit at re-trace after the robot makes a warning hold.

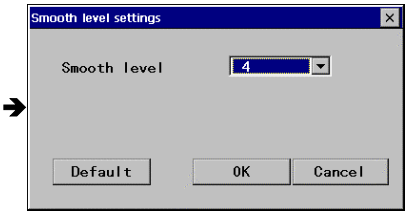
[Trace limited] Specifies the validity of the function in trace operation.

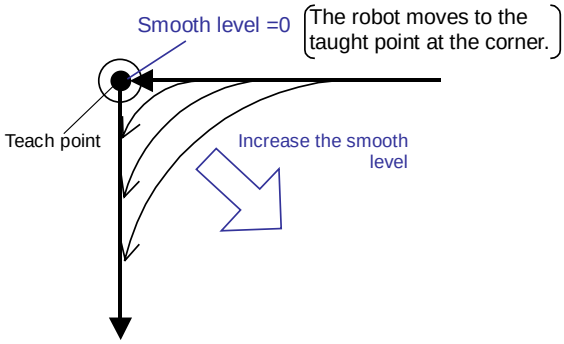
[Warning hold] Select “Valid” to make a warning hold when the travel speed exceeds the preset speed limit. Select “Invalid” to continue robot operation at the speed limit when the travel speed exceeds the preset speed limit.

[Default] Resets the settings in this dialog box to the factory settings at shipment.

11-5. Smooth level







[Smooth level]: Specifies how smooth the robot turns at a corner. [0 to 10]

[Default]: It is factory set to "4" at shipment.

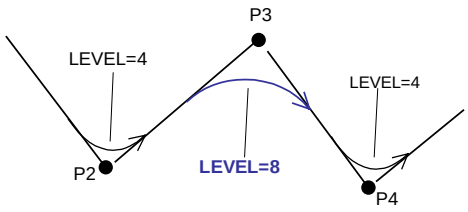
4. When the smooth level is set to "0", the robot pass through the exact taught point (at the corner), therefore, it appears as if the robot makes a brief stop at the corner.

5. The larger the smooth level used, the smoother the turn at a corner becomes and also the farther the actual locus becomes from the teaching point at the corner.

6. In the welding section, in order to ensure smooth movement of the robot (welding) on the welding path the Smooth level automatically is set to 10.

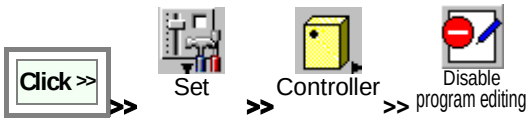
7. +This smooth command has priority over the Smooth level settings. That is, although the smooth level is preset to "4" if there is a command SMOOTH=8 in a program, the robot turns the corner at smooth level 8.

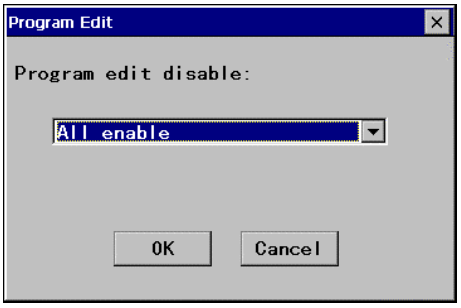
```
  :
MOVEL P2
SMOOTH = 8
MOVEL P3
MOVEL P4
  :
```



11-6. Disable program editing

It is a function that allow you to disable program editing through the teach pendant on whole programs basis.





[All disable]: Disable all programs.
[Position enable]: Only position data is editable.
[All enable]: all programs are editable.

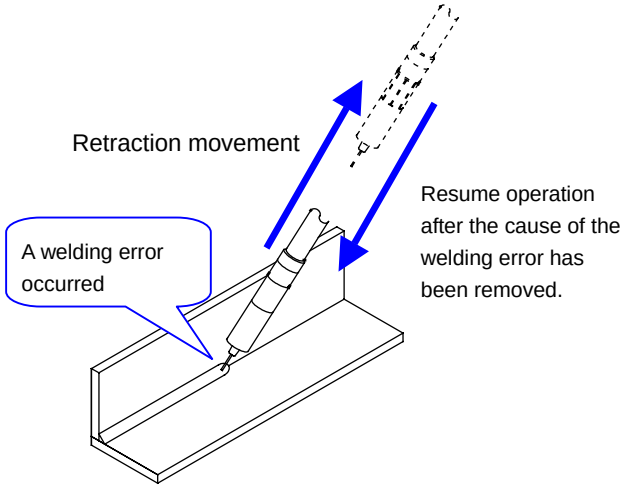
<Note>
Even if [All enable] is selected, files which are individually protected are not editable.

11-7. Error handling

Warning		Make sure that no personnel are present within the safety fence before turning ON the error handling input. The robot starts the error handling motion immediatelly after the error handling input is turned ON.

11-7-1. What is “Error handling”?

A function which is turned on by an external input signal when the robot operation is terminated because of the occurance of a welding error such as “no arc” during welding operation. When this function is executed, the robot automatically retracts the tool (welding torch) in the tool direction the preset distance from the current position (where the error occurred) . When it is re-started after the welding error condition has corrected, the robot moves the torch back to the point where the operation has been suspended to resume welding operation.



With this function, it is possible to move the robot to an idle position for tip change or other works arised from a welding error occurred during welding operation without switching to manual operation using the teach pendant. This function is applicable regardless of the interpolation type applied in welding operation.

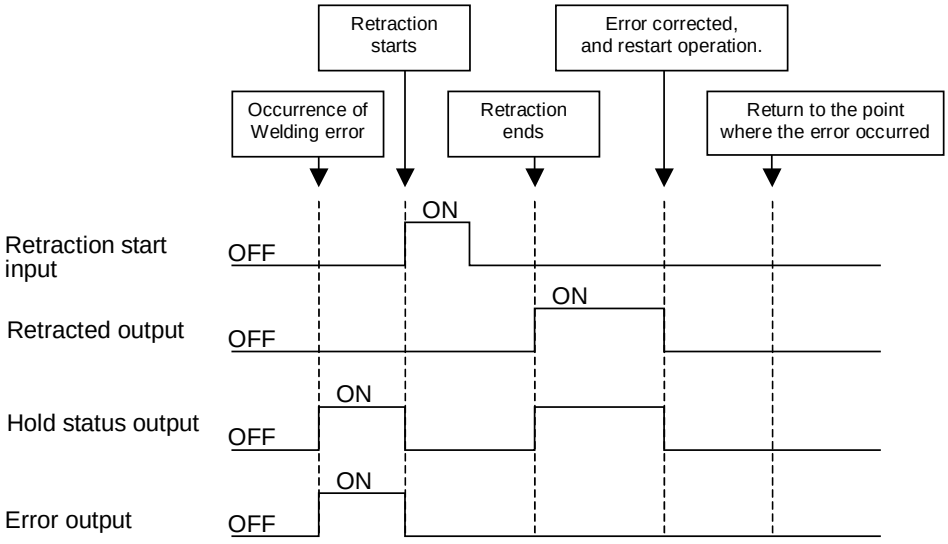
< Errors this function corresponds >

This function corresponds to the errors listed in the following table.

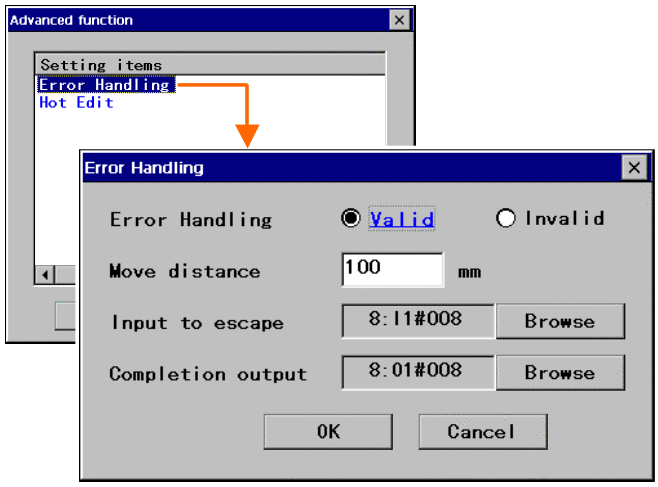
Code No.	Description	Code No.	Description
W0010	No current	W0150	Retry over
W0020	No arc	**W0330**	MIG / TIG Force error
W0025	No arc detected by robot	**W0340**	MIG / TIG Force count over
W0030	Wire stick	**W0350**	MIG / TIG Force Wire buckling
W0031	Stick check time out	**W0360**	MIG / TIG Force buffer over

< Status of I/O signals >

The following figure shows status of each I/O signal when the error handling function is ON.



11-7-2. Setting procedure



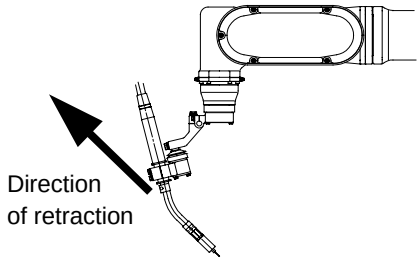
Select “Error Handling”.

[Valid/Invalid]: Select whether or not to enable this “Error handling” function.

[Move distance]: Sets a distance from the point where the welding error occurred to the point where the robot moves in the tool direction* (idle position) with linear movement. (Set range: 1 - 200 mm.)

[Input to escape]: Sets an input terminal (User input) No. to execute the error handling function.
The robot starts the error handling function when the input terminal specified here is turned ON.

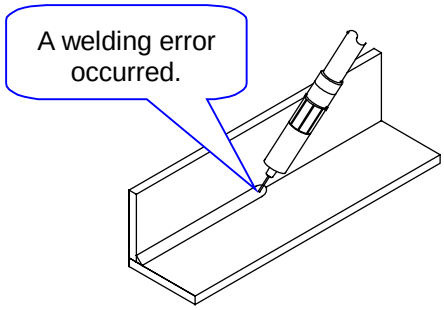
[Completion output]: Sets an output terminal (User input) No. to output the completion of retract movement (the robot reaches the idle position.)
And it goes off when the robot gets away from the idle position.
Select “0:None” if the output is not necessary.



* Tool direction:
X direction of the point in the tool coordinate system.

11-7-3. Operation procedure

The below shows the operation procedure of the “Error Handling” function using an example when the robot operation is terminated because of the occurance of a welding error such as no arc or torch contact.



> **Do not close the error dialog box**.
> **Please note that this Error handling function won’t be executed, if the error dialog is closed.**

<u>Make sure that robot does not interfere with the jig or the work along the retraction route first.</u>

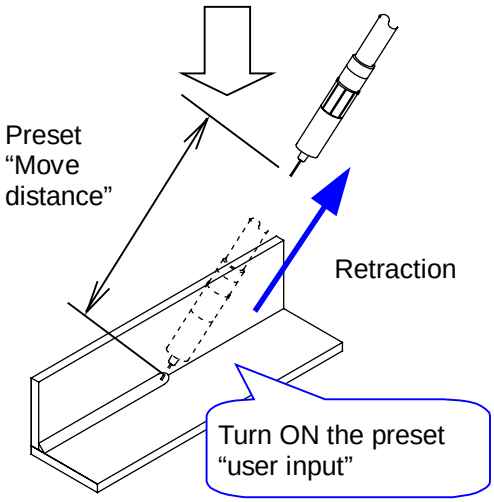
(1) Turn ON the preset user input.

↓

Then, the robot moves in the retraction direction.

↓

When the robot reaches the idle position, the preset user output is turned ON.
(If the preset user output is “0”, there will be no output.)

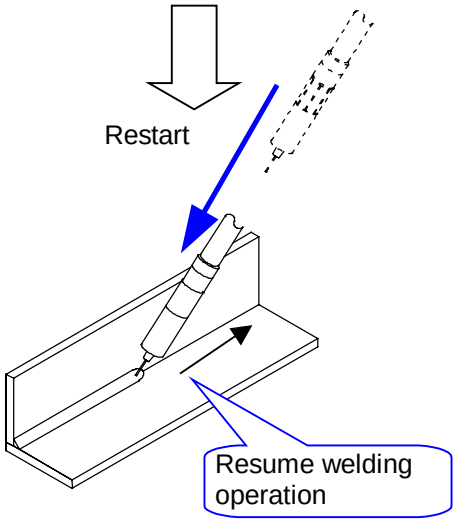


(2) Remove the cause of the welding error.

(3) Press the START button to restart the operation.

↓

The user output is turned OFF and the robot moves back to the point where the error occurred to resume the welding operation. Welding conditions before the stop are referred.



< Relations with other functions >

Function	Response of this “Error Handling” function
Arc overlapping	The robot performs the overlapping process when the operation is restarted after the error handling process.
Resume	If the resume function is turned ON in the process of retraction, the retraction is ignored even thought the preset input is turned on after power has been newly turned on. The robot resumes operation after returning to the point where the error occurred. * The robot resumes the operation in the same manner if the resume function is turned ON after the completion of the retraction or during restart process.
External axis harmonic movement	If the “Error handling” function is used in the section this function is applied, only the robot performs the retraction movement but not the external axis. (i.e. the external axis maintains the current positioin.)
Multi-cooperative robot control	“Error Handling” function is not available.
RT Monitoring **Cube Monitoring**	If a monitoring is turned ON in the process of retraction or re-start, the monitoring function takes priority (over the error handling function) and stops the robot. * The robot will not automatically restart even though the auto restart is set valid in the auto monitor function.

< Notes >

(1) Make sure that robot does not interfere with the jig or the work along the retraction route prior to starting operation.

(2) Even if the welding wire and the work are fused, the robot starts the retraction process when the preset input is turned ON while the robot is in the welding error stop state.

(3) This error handling function is available only when the robot operation is terminated by the welding error. If the robot operation is terminated due to other reasons such as hold or an error other than welding error, this function does not function even though the preset input is turned ON.

(4) If the error dialog box is closed, this error handling function is deemed invalid. Therefore, even if the preset input is turned ON, it won’t function.

(5) If the preset input has been in ON state when the welding error occurs, the robot won’t perform the retraction movement. In that case, turn the preset input OFF and back ON again.

(6) If the preset input is turned ON again during or after the retraction movement, the robot won’t repeat the retraction process.

(7) The retracted output is turned ON only when the robot reaches the preset idle position. The output won’t be turned ON if the robot goes in hold stop or an error stop during the retraction process.

(8) The retraction movement will be interrupted by the following operations. At that time, with restart operation, the robot moves to the point where the error occurred and resumes operation.

- The robot goes in hold stop or emergency stop in the process of the retraction movement.
- The robot goes in error stop such as soft-limit error in the process of the retraction movement.
- If manual operation is executed while the robot is in either one of the above state.

(9) The robot resumes the program from the idle position without returning to the point where the error occurred if the following operation is executed.

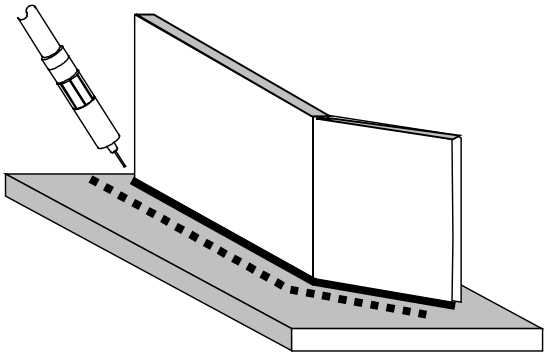
- The robot reaches a teaching point in trace operation in the process of this function.
- A teaching point is changed in the process of this function.

(10) This function is not effective in a program test in TEACH mode.

11-8. Hot edit

11-8-1. What is “Hot edit”?

It is a function to shift the position of a given welding point so that the step makes a parallel translation without stopping the robot operation. As this function is applicable to a running program as well as a program not in operation, it allows you to correct position of teaching points in case of deviation of works or teaching error without stopping the production line.



You can choose a parallel shift direction from robot coordinate system, tool coordinate system or preset user coordinate system. It is also possible to set the maximum shift amount at a time up to 9.99 mm.

Please note that executing this function changes a program itself, that is, the original program is revised once this function is applied.

If you would like to keep the original program, it is necessary to make a copy of the program prior to applying this function.

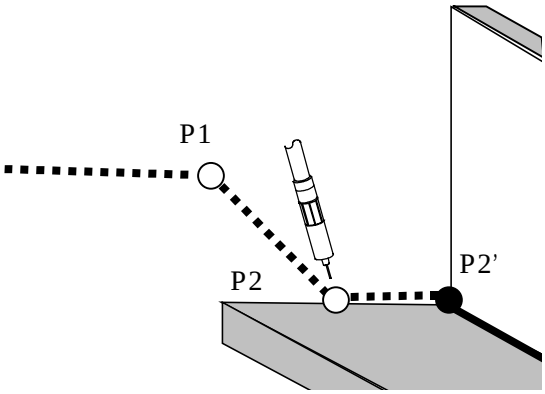
< Shift processing timing >

(1) When setting a program not in use:

The shift processing (conversion and data updating) is carried out immediately.

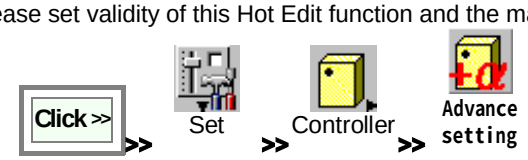
(2) When setting the currently running program:

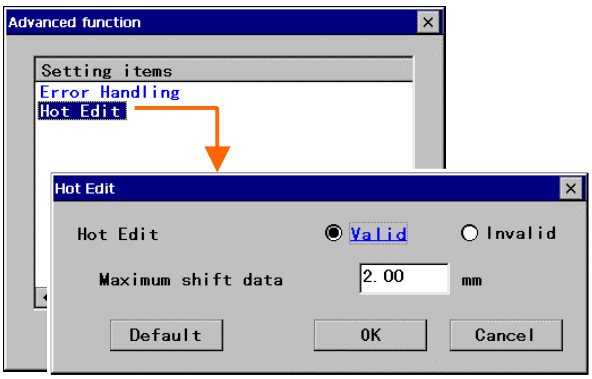
The shift processing (conversion and data updating) is executed when the robot reaches the first arc start point after the execution of Hot edit function.
For example, if the first arc start point after the execution of the “Hot edit” function is P2, the robot stops at P2 for shift processing. After the shift is completed, the robot continues the operation.
If the P2 is the point to be shifted, the robot stops at the original taught position (P2) for conversion and data updating, and then moves to the shifted point (P2’).



11-8-2. Preliminary settings

Please set validity of this Hot Edit function and the maximum shift amount at each shift can be set





Select "**Hot Edit**".

[Valid/Invalid]: When the "Invalid" is selected, the  icon won't be displayed in Auto mode.

Hot edit

[Maximum shift data]: Set range: 0.01 - 9.99 (mm).
[Default]: sets the default value which is 2.00.

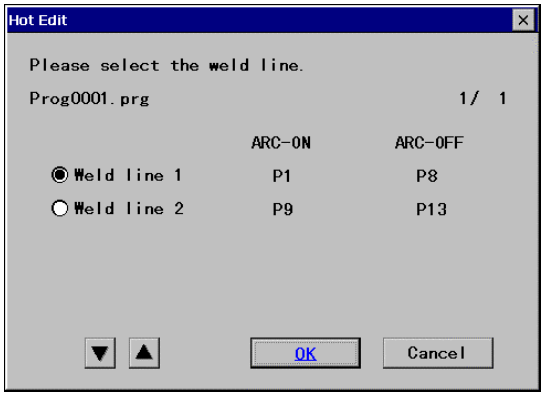
11-8-3. Operation procedure

In Auto mode, select  .

Hot edit

Select a desired program to be shifted.

The program to be selected can be either a running program or a stored one.



Select a weld line (including points) to be shifted.

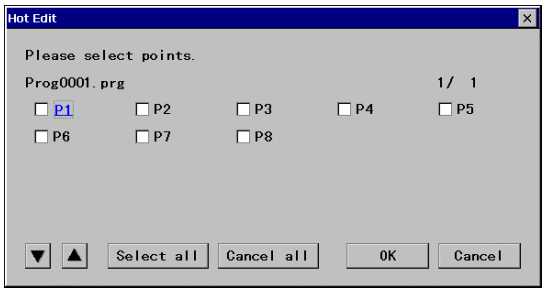
***Please note the following are not in the choice.**

- Weld line with a move command that uses global variables to specify its teach point
- Weld lines taught in the harmonic movement section.

*It is possible to set only one weld line at a time.

 : Displays the previous page.

 : Displays the next page



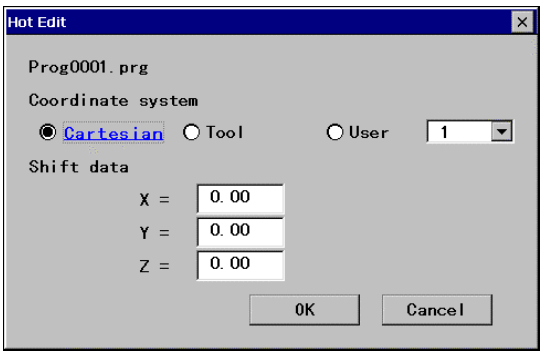
Select the point(s) to be shifted.

 : Displays the previous page.

 : Displays the next page

[Select all]: Selects all teaching points.
[Cancel all]: Deselects all teaching points.

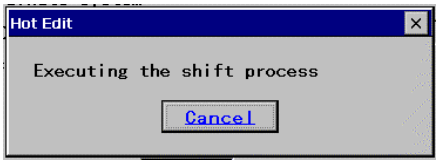
Click the **OK** button to move on to the next dialog box.



Select a desired shift coordinate system to be applied and input shift data.

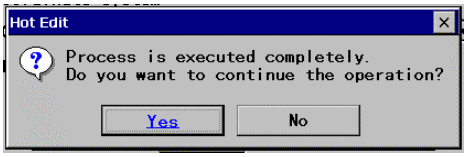
*See the <Definition of the shift coordinate system>.
* Only the preset User's coordinate system numbers are displayed on the screen.

[OK] executes the shift processing



Then the screen on the right appears.

In case of setting the running program:
The robot resumes the operation and stops at the first arc start point, and then start executing the shift process.



After the shift process is completed the screen on the right appears.

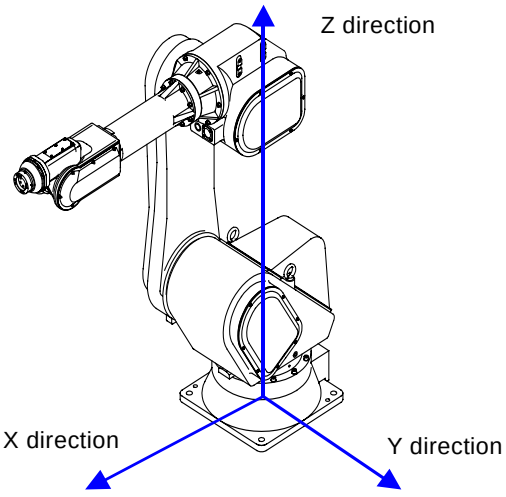
[Yes]: Selects another weld line of the same program. (Then the dialog box shown in the previous procedure (3) appears.)
[No]: Ends the Hot edit function settings.

11-8-4. Definition of shift coordinate system

(1) [Cartesian]

When "Cartesian" is selected, teaching points are shifted along the X-axis, Y-axis and Z-axis on the Cartesian coordinate system of the robot as per shown in the figure on the right.

[Robot coordinate system]



(2) [Tool]

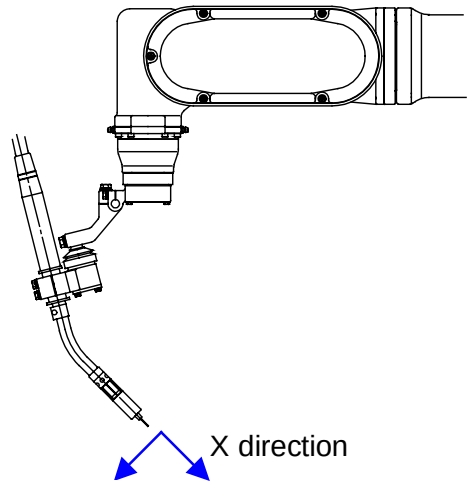
When “Tool” is selected, teaching points are shifted along the X-axis, Y-axis and Z-axis on the tool coordinate system as per shown in the figure on the right.

If the tool No. is changed in the program, such change is reflected and applied to the shift.
(Example)

TOOL 1:TOOL01
○ MOVEL P3
TOOL 2:TOOL02
○ MOVEL P4
● MOVEL P5 (Arc start)
○ MOVEL P6 (Arc end)

To shift the P5 or P6, the tool coordinate system of the tool No.2 is applied.

[Tool coordinate system]



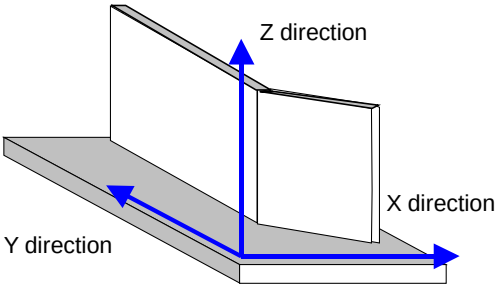
Y direction: a direction perpendicular to this paper toward you.

(3) [User]

When “User’s” is selected as shift coordinate system, teaching points are shifted along the X-axis, Y-axis and Z-axis on the coordinate system specified by the user based on the applied work as per shown in the figure on the right.

With the user’s coordinate system, it is easy to identify the directions of X, Y and Z as they are defined based on the work.

[User’s coordinate system]



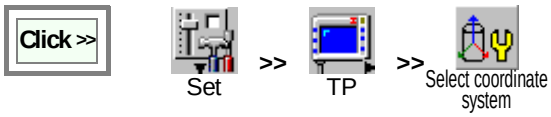
<Relations with other functions>

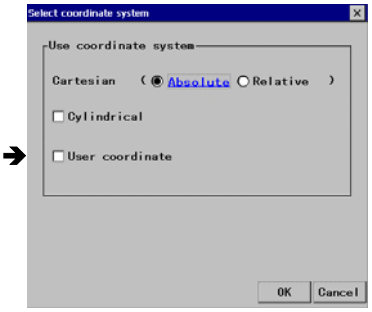
Function	Response of this “Hot Edit” function
Arc retry	If an arc start point is the designated point to be shifted, the arc retry function is executed at the shifted arc start point.
Multi-cooperative robot control **Twin harmonic operating** **External axis harmonic movement**	The “Hot Edit” function is not available in a program with the “Multi-cooperative robot control” or “Twin harmonic operating” function. It is not available in a weld section using the “External axis harmonic movement “ function.
Flying start:	The flying start function does not function if the arc start point is designated as the point for this Hot edit point.

12. Teach pendant (TP) settings

12-1. Coordinate system settings

It is a function to specify a coordinate system to be used when operating the robot with the teach pendant.





[Cartesian] Switches motions of the Cartesian coordinate system.

Absolute: Absolute coordinate system.

Relative: Direction of X-Y is relative to RT direction.

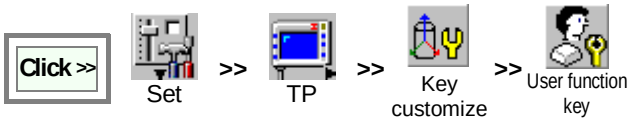
[Cylindrical] Click to enable the cylindrical coordinate system.

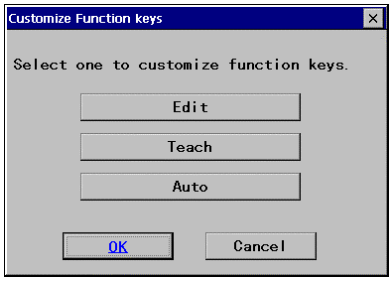
[User coordinate] Click to enable the user coordinate system.

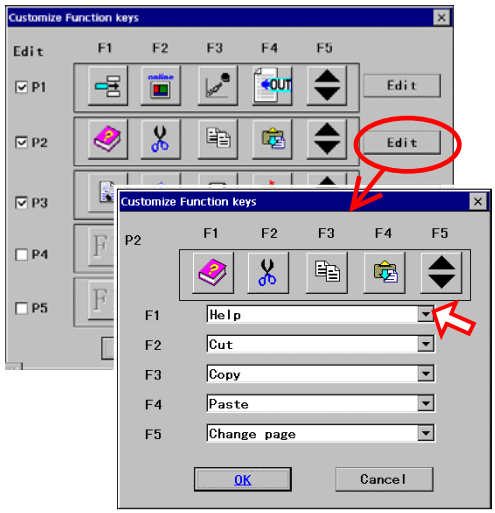
12-2. Customize function keys

12-2-1. User function keys

It is a function that allows you to arrange the function keys settings.







[Edit] Select to customize User function keys to be used in edit operation (Robot motion icon is OFF in TEACH mode.)

[Teach] Select to customize User function keys to be used in teachings operation (Robot motion icon is ON in TEACH mode.)

[Auto] Select to customize User function keys to be used in AUTO operation.

[P1 – P5] Click the check box(es) to display the current User function keys of the selected page(s).

[Edit] Click to display the dialog box to customize the User function keys of the page.

Click the **Edit** button of the page you want to edit. (Figure on the left: an example in case of editing P2.)

Select a function to be assigned to each function key as you want from the list. (Press on the triangle to display the list. Please refer to the "List of functions applicable as User function keys in each operation type" for details.)

Click the **OK** button to end the edit and display the previous dialog box.

<Note>
If you want to make more than one page of customized function keys, make sure to assign "Change page" to one of the function keys ("F5" in the figure).

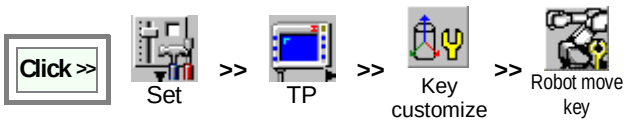
List of functions applicable as User function keys in each operation type

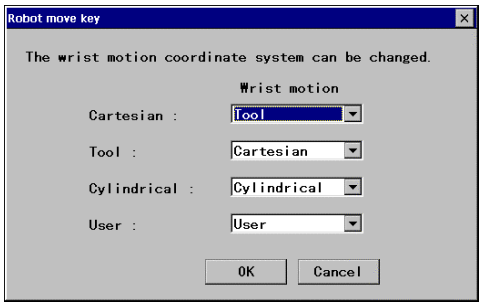
EDIT (Robot motion: OFF)	**TEACH** (Robot motion: ON)	**AUTO**
(None)	(None)	(None)
Change page	Change page	Change page
Online	Trace	Override(*4)
Wire/gas check(*4)	Program test	Arc lock(*4)
Add/Change/Delete	Wire/gas check(*4)	XYZ
Add command	Add/Change/Delete	Angle
Cut	Change Robot E-Axis (*2)	Display I/O terminal
Copy	Select coordinate system	Display status IN/OUT
Paste	Interpolation	Current/Voltage(*4)
Paste (Reverse)	Speed	Weld input(*4)
Teach settings	Add command	Accumulate time
Help	Air-cut/Weld(*4)	Operate state
Option	Teach settings	Sensor data(*1)
Find	Help	SHIFT-ON data
Replace	Save	Program files
Jump	Program files	Recent files
Save	Recent files	Close
Program files	XYZ	Hot edit(*5)
Recent files	Angle	
Close	Display I/O terminal	
XYZ	Display status IN/OUT	
Angle	Select mechanism(*2)	
Display I/O terminal	Harmo-coordinate sys.(*3)	
Display status IN/OUT	Harmonious	

*1 Available when the “Touch sensor” function (option) is added.
*2 Available when the “External axis” or “Multi-cooperative robot control” function (option) is added.
*3 Available when Harmonic movement function (option) is added.
*4 Not available **for Handling robots**.
*5 This icon is displayed when “Hot edit” function is set valid.

12-2-2. Robot move key

It is a function that allows you to change coordinate system of the wrist motion.





Select a wrist motion of a coordinate system you want to change from the list. (Press on the triangle to display the list.)

(*Figure on the left shows when the wrist motion of the Cartesian coordinate system is changed to “Tool” and that of the Tool coordinate system to “Cartesian”.)

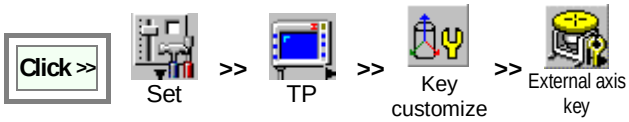
12-2-3. External axis key

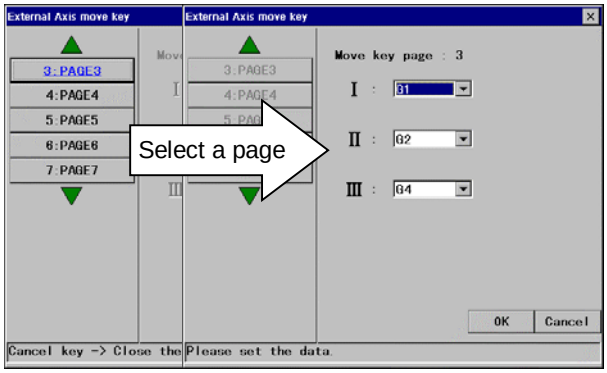
It is a function that allows you to change the external axis key assignments to the keys. **(* This function is available when the external axis function is set.)** (Use page 3 onwards.)

.

Applicable example: In case of a system with two sets of twin-axis positioner, assign external axes of each set on one page for greater availability of the keys

	[I]	[II]	[III]
3 PAGE	G1	G2	-
4 PAGE	G3	G4	-





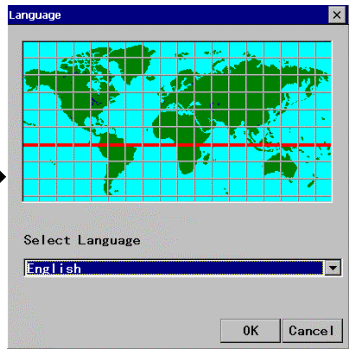
Assign an external axis number to each key (I, II, III).

12-3. Language settings

It specifies the language to be used in menus, dialog boxes etc. (Japanese, English etc.)

Click >>

Set >> TP >> Another language



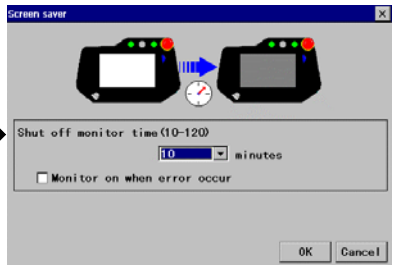
[Select language] Specifies the menu language from the list.

12-4. Screen saver settings

It is a function to lengthen service-life of the LCD by turning OFF the screen after a specified time duration of no operation.

Click >>

Set >> Management tool >> Screen saver



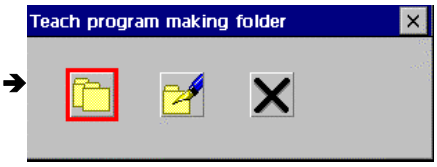
[Shut off monitor time (10-120)] Specify how much time (between 10 to 120 minutes) to wait for the next robot operation before automatically switching off the screen.

Select [Invalid] if you don't want the screen to be switched OFF.

[Monitor on when error occur] Click it to turn ON the screen when an error occurs.
This setting is available only when the shut off monitor time is specified.

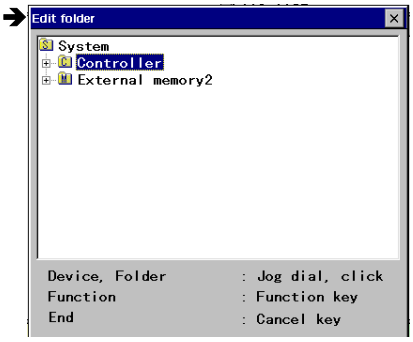
12-5. Programming (Teach) Folder settings

This function allows the user to define the default folder in which teaching programs will be saved.



	Edit folder
	Default folder

(1) To edit a folder

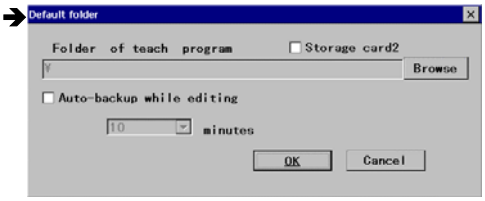


Corresponding **User function** icons appear next to the User function keys F1 to F3.

	To make a new folder under the selected folder.
	To rename the selected folder.
	To delete the select folder.

Press the **Cancel** key to end.

(2) To set default folder details

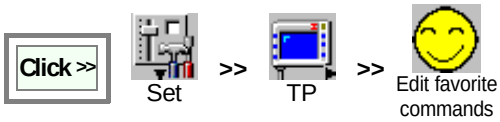


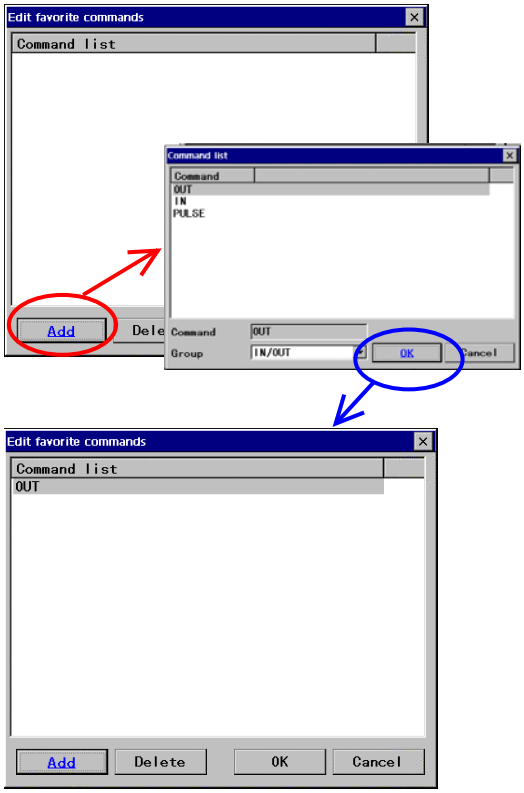
[Folder of teach program] Specifies the folder to save the program in and also to open the program from.

[Auto-backup while editing] Click to make a backup copy of the working program automatically at every specified time interval (in minutes). (Set range 5 and 10 to 120, increment of 10)

12-6. Favorite commands

It is a function to register frequently used commands as favorite command group.





To add a command:

Click the **Add** button to display the “Command list” dialog box.

Select the command you want to add to the favorite command group, and click the **OK** button.

Then the “Edit favorite commands” dialog box reappear with the command you have selected added in the list.

To delete a command from the group list:

Move the cursor to the command you want to delete, and then click the **Delete** button.

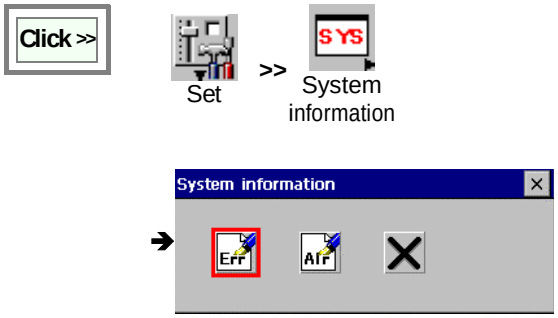
How to use

Select a command you want to use and click the **OK**.

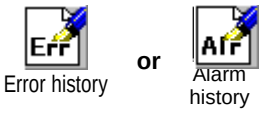
* No command is registered in the favorite group at shipment.

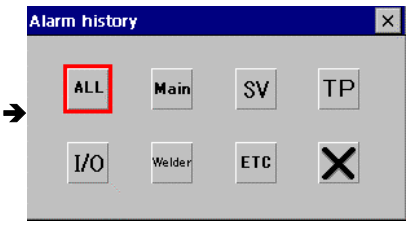
13. System information/Back up settings

13-1. Error/Alarm history



Error history	Displays a history list of errors that have occurred.
Alarm history	Displays a history list of alarms that have occurred.

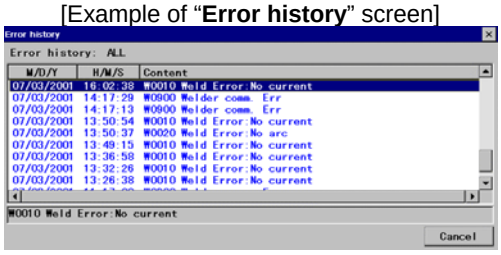




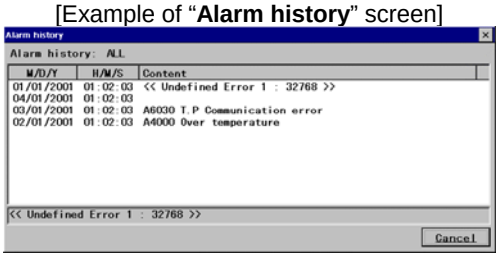
Errors/alarms type:

ALL All	Displays all types	I/O I/O	Input/Output related ones.
Main Main	Main software related ones.	Welder Welder	Welder related ones. **(*)**
SV Servo	Servo related ones.	ETC Others	Other types.
TP TP	Teach pendant related ones.	**(*) For handling robots:** No "Welder"	

[Example of "**Error history**" screen]



[Example of "**Alarm history**" screen]



13-2. Backup

It is recommended to make a backup copy of programs and settings saved in the controller. You can rebuild memory from backup in case of a memory crash.

Note

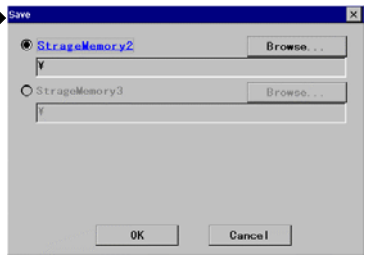
When you make a backup data on a PC card, insert the PC card (with memory card embedded) into the PC card slot at the near side of the TP. (Please refer to the operating instructions of the controller.)

If "Storage Memory" items in the 'Backup' dialog box do not appear, click the **View** menu, and then click **File list** to display file list, and then retry the above procedure.

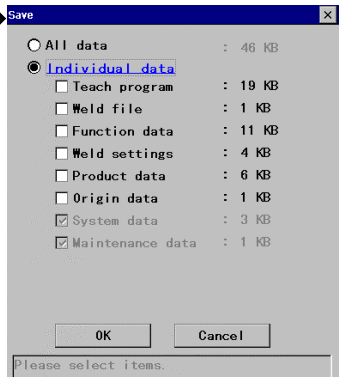
If you make a backup copy, make sure that the PC card is in " write possible" condition.

Save

Saves a backup copy of a specified data in a specified file.



Specify a desired “Save to” file name and click the **OK** button.



[All data] To make a backup copy of all data in the controller.

[Individual data] To specify data to make a backup copy individually. (See below table)

Teach program	All teach programs (except ArcStart and ArcEnd) and folder stored in the controller.
Weld file **(*)**	ArcStart and ArcEnd programs for welding.
Function data	All setting data in “I/O”, “Variable”, “Robot”, “Controller” and “TP”.
Weld settings **(*)**	“Arc-weld” setting data.
Product data	“Management tool” setting data (except origin data).
Origin data	Origin position data (reference position and origin correction value) of robot and external axes.

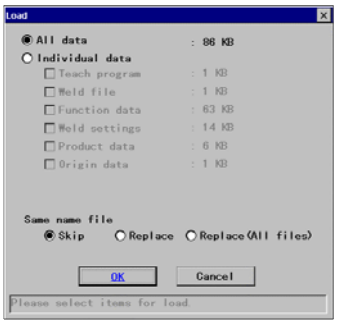
(*) **“Weld file”** and **“Weld settings”** : Not indicated for handling robots.

“System data” and **“Maintenance data”** :
- Backup copy will be made automatically at any time.
- Load is available only by service engineers.

Load

Loads a specified backup data to a specified file.

The dialog box to specify a file to a desired “Save to” file name (similar to the one for “Save”) appears. Specify a file name and click OK.



After you specify a desired “Save to” file name and click the **OK** button.

[Same name file]:
[Skip]: Skips the teach file if the file of the same name has been previously loaded.
[Replace]: Replace data of the teach file if the file of the same name has been previously loaded unless it is protected.
[Replace (All files)]: Replace data of the teach file if the file of the same name has been previously loaded.

Verify

Verifies backup data and the robot memory data after the data have been saved and loaded.

The dialog box to specify a file to a desired “Save to” file name (similar to the one for “Save”) appears. Specify a file name and click OK.
After you click the **OK** button, it prompts you to confirm if you want to verify the backup copy after copying.

14. Management tool settings

14-1. User management settings

Attention!

Please make sure to remember your User ID and password. Remember the system monitors access. So DO NOT give out your user ID or Password.

The robot is designed to administer all robot users individually.

Registration of a User ID allows the robot to record data based on the user logged onto the system.

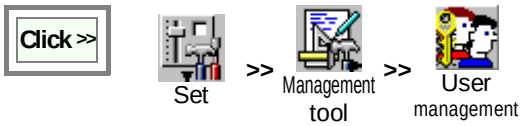
By allocating User ID's to personnel, their range of access to the system (i.e. program edit, system setup, etc.) can be controlled.

User level	Description	Range of operation
Operator	Robot operators	Robot operation
Programmer	Persons who are in charge of teaching	Robot operation and teaching
System administrator	Robot system administrators	Robot operation, teaching and setting

Attention!

Only users of the system administrator level can set, change and delete all parameters.

You can add or delete a user and also change the level of a user.



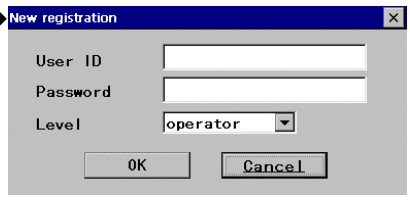
User registration	Registers and changes user(s).
Auto login	Display the login dialog box at power on
Auto logout	Monitors inactivity time and goes in the operator level when that time exceeds the time value. It's provided to prevent another user to work on the current program.

(1) To register a user.

F1	To register a new User ID
F2	To change the registration data (password, user level etc.).
F3	To delete a User ID.

For a new registration or change.

F1 or F2



[User ID] User name

[Password] Login password

[Level] User level

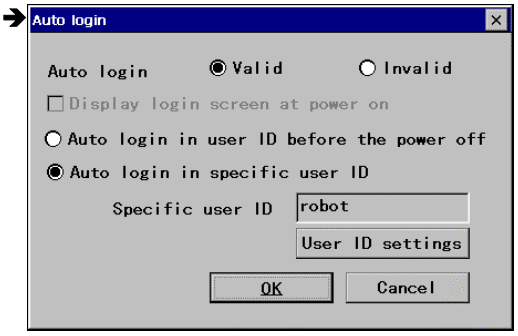
- operator: Robot operators
- programmer: Programmers (do teaching and editing programs)
- system: System administrators.

For deletion

F3 A message to confirm the action appears.
Click the **OK** button to delete the specified user ID.

(2) To set "Auto login"

Auto login



[Auto login Valid/Invalid]：Specifies if you want to make the function valid or invalid.

When Invalid is selected
[Display login screen at power on.] ：Select to display the login box when the power is turned on.

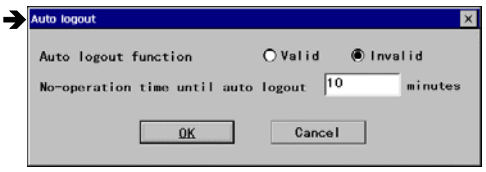
When Valid is selected
[Auto login in user ID before the power off.]：Select to automatically log onto the system with the last logout user ID
※This "Auto login" is not applicable if the last logout user was in the service level.

[Auto login in specific user ID.] ：Select to automatically log onto the system with the preset user ID.

[Specific user ID]： Newly specifies a User ID. Press the **User ID settings** button, and then the "Login" box appears to specify a User ID.

(3) To set "Auto logout"


Auto logout

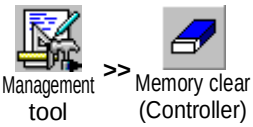


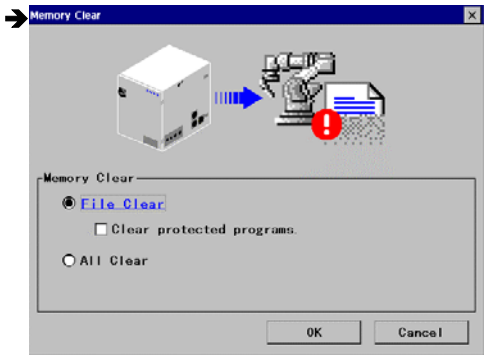
[Time management of user ID] Select "Valid" to display the User login screen automatically after the specified time duration of no operation.

[Monitoring time in valid] Specified how much time (in minutes) to monitor no-operation state before displaying the User login screen.

14-2. Memory clear

This function clears the data saved in the controller. Use this function to remove all of the files that you don't need or use it before you update software.





Note

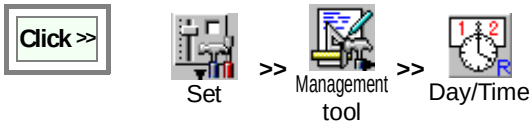
This operation cannot be undone.
It is recommended to make a backup copy before you execute the memory clear operation.

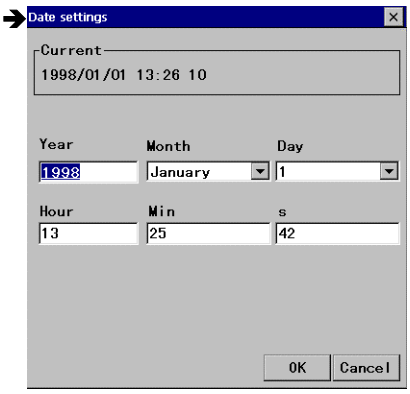
[File clear] To clear teaching programs.

[All Clear] To clear system setup data and teaching programs.

14-3. Date settings

It sets date and time in the robot.

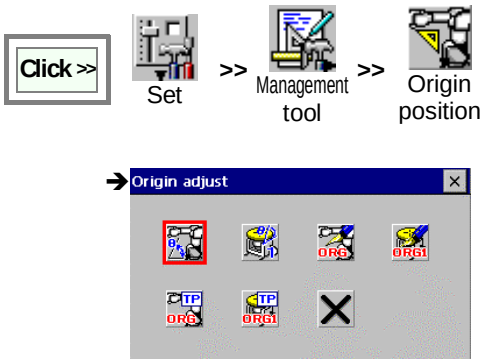




Errors, Alarms, etc. use this setting when they are an event. Please be sure to set up the appropriate time for your time zone.

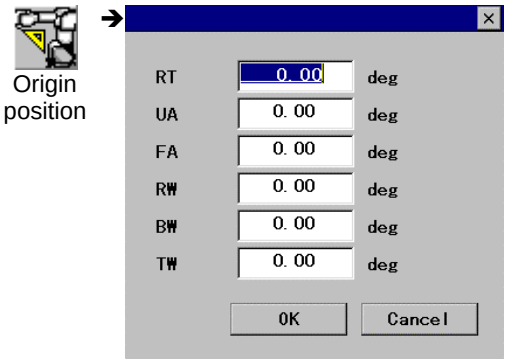
14-4. Origin re-adjustment

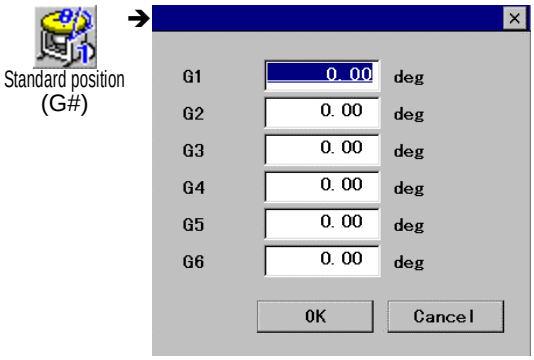
This function is to adjust the mechanical origin point of each axis of the manipulator to match with the origin of the controller (position of 0 degree).



	Standard position (Main axis)	Use a**ngle** to adjust the origin of the manipulator.
	Standard position (G#)	Use **angle** to adjust the origin of the external axis.
ORG	MDI (Main axis)	Use **encoder pulse** to adjust the origin of the manipulator.
ORG1	MDI (G#)	Use **encoder pulse** to adjust the origin of the external axis.
TP ORG	Teach (Main axis)	Use **teaching operation** to adjust the origin of the manipulator.
TP ORG1	Teach (G#)	Use **teaching operation** to adjust the origin of the external axis.

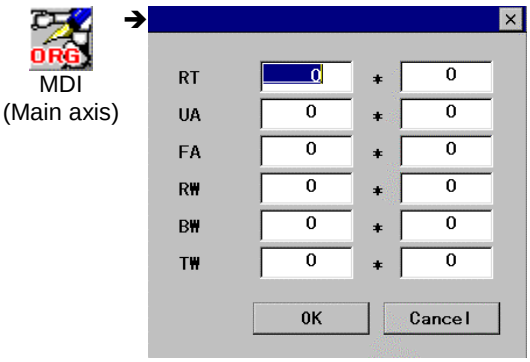
14-4-1. Standard position (Main or External axis)

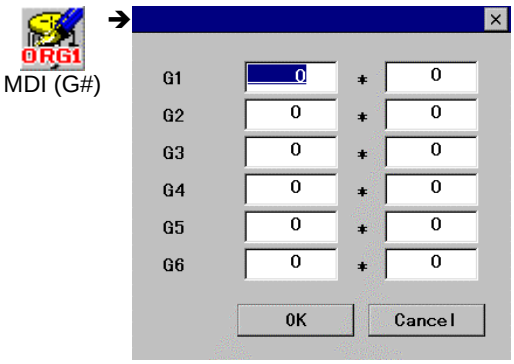




14-4-2. MDI (Main or External axis)

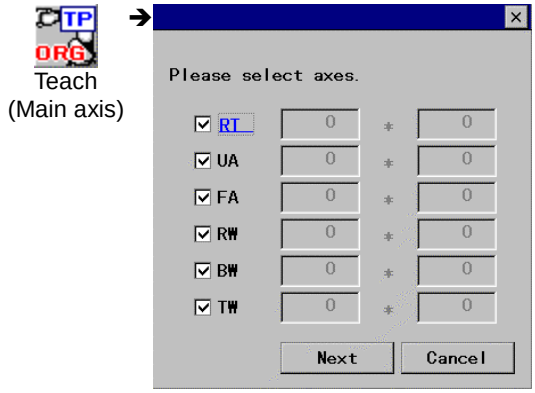
Adjust the encoder pulse of each axis by specifying the "**angle pulse**" to the left box and the "**revolution**" to the right box of the asterisk.

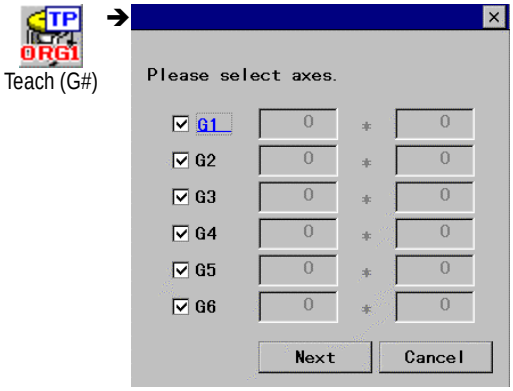


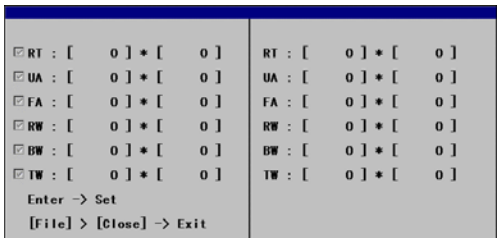


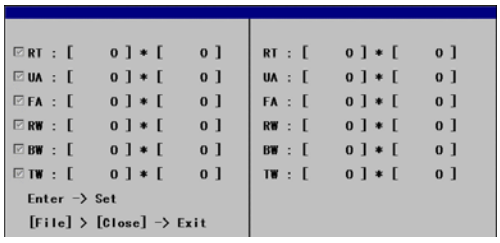
14-4-3. Teaching (Main or External axis)

Check the check-box of the axis you would like to adjust, and then click the **Next** button.
Move the manipulator or external axis to the origin with manual operation and press the **Enter** key to update the values.

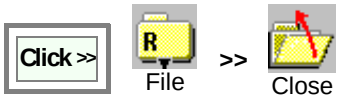






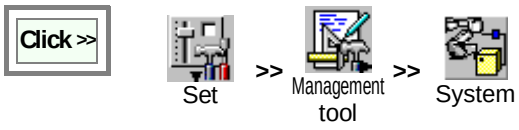


◎ To end the settings

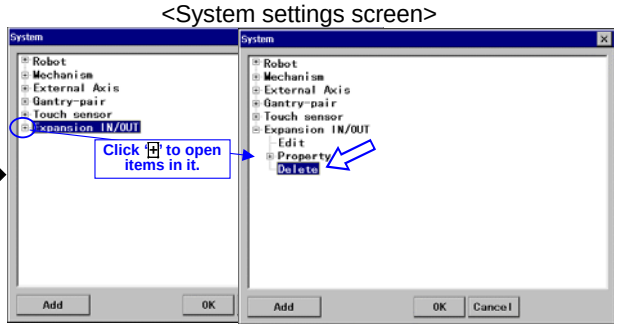


14-5. System settings

The ‘System settings’ are settings that configure all equipment including the robot that comprises the system. You can also check, change or cancel the connection settings among the robot, external axis and optional equipment.



<System settings screen>



⊞ mark to the left of each item, if any, indicates that the item contains sub-item(s). Click the ⊞ mark to open the sub-item(s).

Click ⊟ mark to the left of each item, if there is, to close the sub-item(s).

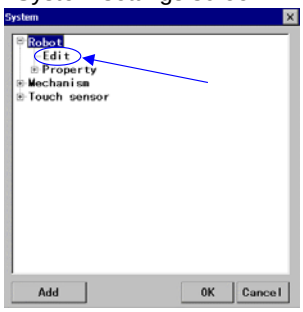
Select the **Delete** to delete the item (cancel the connection settings of the item).

[Add] Displays a setting dialog box to add an item.

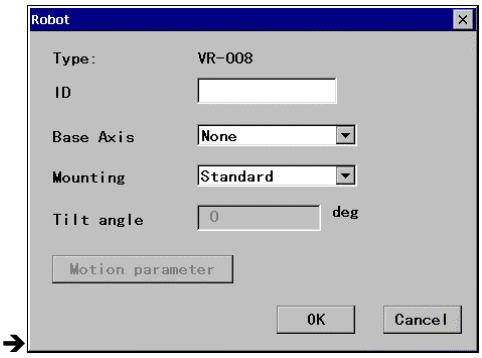
14-5-1. Robot settings

A function to register the applied robot installation type, such as standard, wall, angle or ceiling, and to adjust the XYZ (direction of travel of the robot manipulator) to match with the coordinate axes. It is also possible to register the robot identification name.

<System settings screen>



On the ‘**System settings**’ screen, select **Edit** under **Robot**, and then click the **OK** button to display setting dialog box.



[Type] Specifies the applied manipulator type.

[ID] Specifies the robot identification name. (Character string. Max. 8 characters.)

[Base Axis] Specifies the external axis on which the robot is mounted. If the robot is mounted on more than one external axis, specify the one closest to the robot. If the robot is structure mounted, select “None”.

[Mounting] Robot installation type. (standard, angle, ceiling)

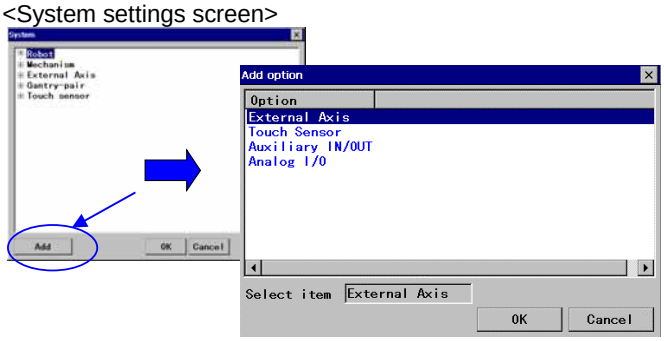
[Tilt angle] Specifies the angle if the robot is installed on an incline slantly.

***[Motion parameter]** Parameters to be set by service engineers.

14-5-2. Add optional functions

It is a function for the settings necessary when you add an optional unit.

<System settings screen>



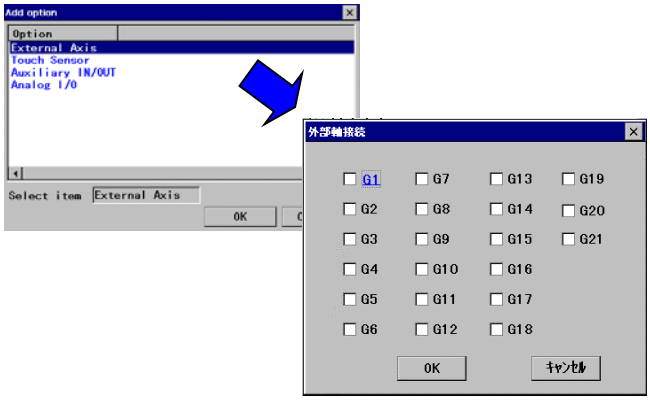
Click on the **Add** button to display the “Add option” dialog box.

Specify an item you would like to add, and then click the **OK** button to register.

14-5-3. External axis

(1) Add an external axis

It is to define the external axis (to specify an external axis number and register its parameters) whenever it is additionally connected to the robot.

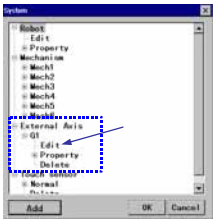


On the “Add option” dialog box,
specify the [**External axis**] and click the **OK** button.

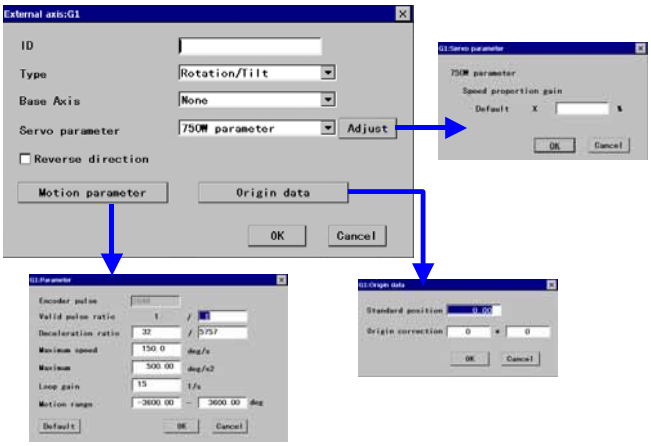
Check the external axis No. added and then click the **OK** button.

(2) Set parameters

<System settings screen>



On the **System settings** screen, click the **External axis**, and **Edit.**



[ID] Specifies the external axis identification name.

[Type] Specifies the external axis type

[Base Axis] The external axis on which this external axis is mounted.

[Servo parameter] Sets parameter of the servo motor of the external axis.

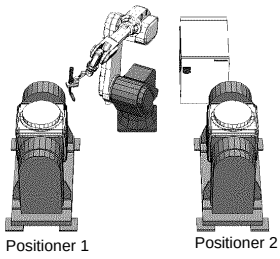
[Reverse direction] Reverses the travel direction of the external axis (+/-).

Set parameters appropriate for the connected external axis. Refer to the manual of the external axis for details of the parameters.

14-5-4. Mechanism settings

What is “Mechanism”?

By classifying all equipment including the robot and external axes that comprise the system into groups, it is possible to control each group separately, such as to assign a different task to each group or to isolate a specific group from operation.



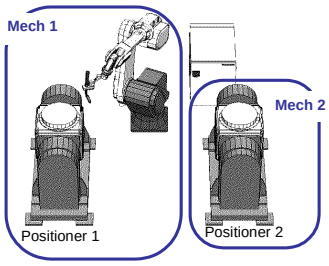
Manual operation is limited only to the axes registered as a mechanism. (See the below table for details.)

[Example application]

A system which is comprised of a robot and 2 sets of twin-axis positioners.

- Register the robot and Positioner 1 as “**Mech 1**”.
- Register Positioner 2 as “**Mech 2**”.
- Create a program using the Mech 1.

- While the program using the Mech 1 is running, the positioner2 is free from the control of the program, therefore, it is possible to assign a different task to Mech2.

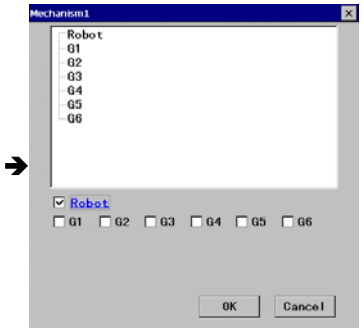


It is also possible to operate multiple robots if they are connected as flexible multi-cooperative robot and registered as one group mechanism.
The Mechanism number can extend up to 30 with “System data Adjustment” operation.

	Robot	Positioner 1	Positioner 2
File not open	O	O	O
Editing the program of Mech 1.	O	O	X
Editing the program of Mech 2.	X	X	O

O…Manual operation is available X…Manual operation is NOT available.

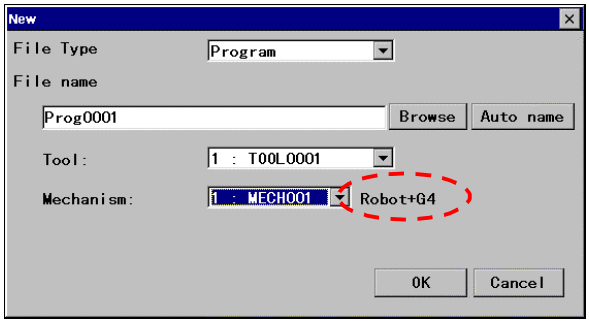
On the **System settings** screen, click **Mechanism** and the click **Edit**.



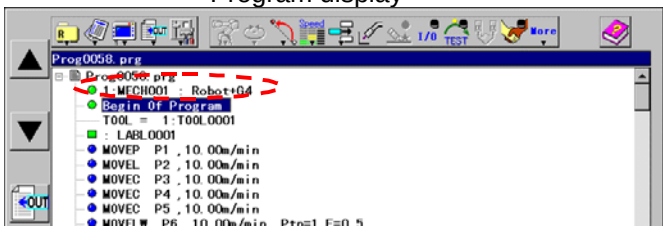
Check the robot and/or external axes you want to define as Mechanism 1. Or clear the check of the item(s) you want to remove from the Mechanism 1.

Configuration of the Mechanism is shown in head in the program display or a window of “New” file creation.

Creation of a new file



Program display

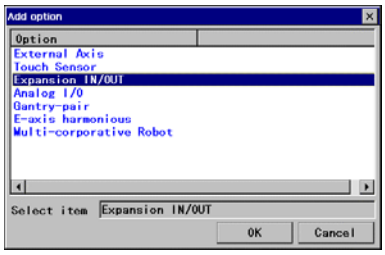


14-5-5. Auxiliary IN/OUT and Analog I/O

With the Auxiliary IN/OUT unit or Analog I/O unit, it is possible to map correspond the Input/Output to optional equipment.
With the Auxiliary IN/OUT unit, it is possible to increase the number of Input/Output terminals.
With the Analog I/O unit, it is possible to convert the Input/Output signals to analog signals.
For more information, please refer to the individual manuals.

ID number The DIP switch number of either expansion I/O unit or analog bard unit (whichever applied). For details, refer to the manual of the adaptor unit.

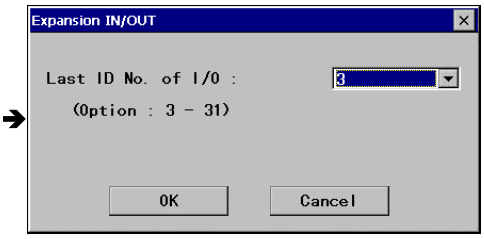
(1) Add units



On the **Add option** dialog box,

Specify either [**Expansion IN/OUT**] or [**Analog I/O**] you want to add and click the **OK** button

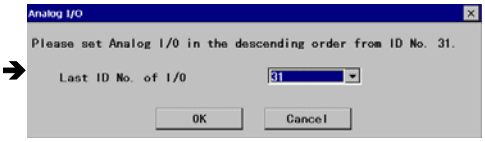
1) Setting ID number of "Expansion IN/OUT" unit



Enter the ID number of the last unit after new unit(s) has added (Last ID number).
The ID number should start from "3" in ascending order (by 1), that is, if you add 3 units, you should enter "5".

Number of unit	1	2	3	4	5	6	7	…
Last ID No. of I/O	3	4	5	6	7	8	9	…

2) Setting ID number of "Analog I/O" unit

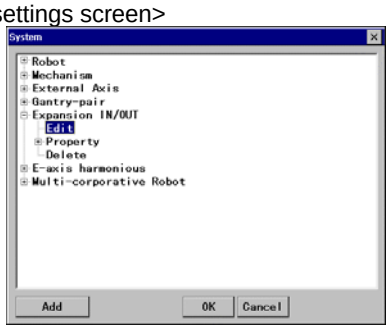


Enter the ID number of the last unit after new unit(s) has added (Last I/D number).
The ID number should start from "31" in descending order (by 1), that is, if you add 3 units, you should enter "29".

Number of unit	1	2	3	4	5	6	7	…
Last ID No. of I/O	31	30	29	28	27	26	25	…

(2) Changing number of units

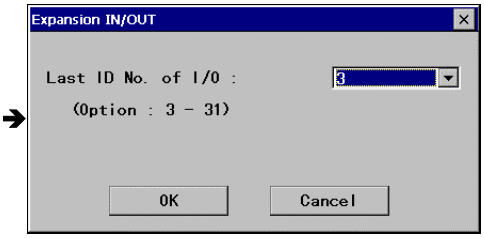
<System settings screen>



On the System settings screen,

click the **Edit** of 'Auxiliary IN/OUT' (or 'Analog I/O'), and then click the **OK** button to display the ID setting dialog box

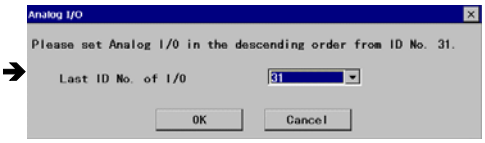
1) To change "Expansion IN/OUT"



Enter the ID number of the last unit after the change (Last I/D number).
The ID number should start from "3" in ascending order (by 1), that is, if you change the unit to 2 units, you should enter "4".

Number of unit	1	2	3	…
Last ID No. of I/O	**3**	**4**	**5**	…

2) To change "Analog I/O"

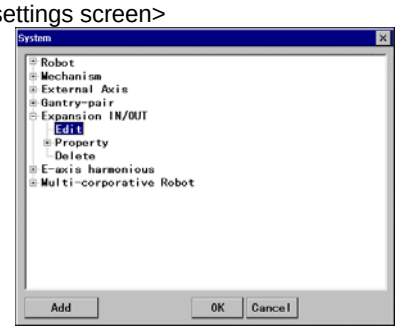


Enter the ID number of the last unit after the change (Last I/D number)..
The ID number should start from "31" in descending order (by 1), that is, if you change to 2 units, you should enter "30".

Number of unit	1	2	…
Last ID No. of I/O	**31**	**30**	…

(3) Remove all units

<System settings screen>



On the System settings screen,

click the **Delete** of 'Expansion IN/OUT' (or 'Analog I/O'), and then click the **OK** button to display the ID setting dialog box

Then the teach pendant prompts you to confirm the action.

Click the **OK** button to delete all units.

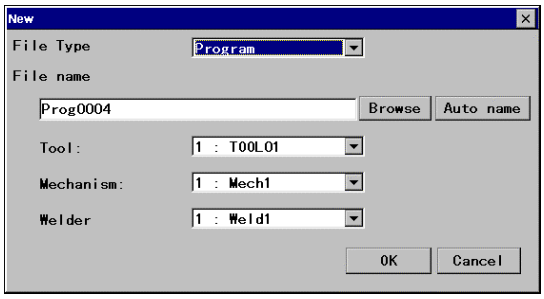
14-5-6. Multi-welders settings

Different welder number is registered in each program. With this function a welder can be changed per program.

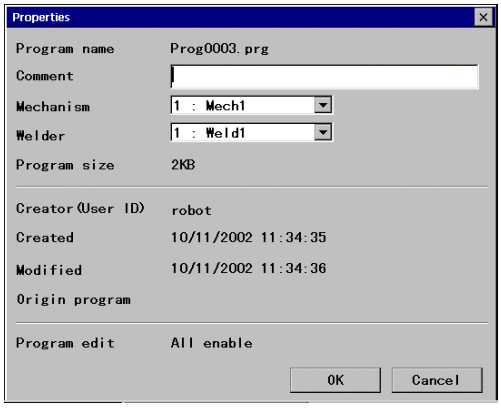
Note
This function is not available in following conditions.
(1) The robot controller is GX type, which is the model with a built-in welding power source.
(2) The system uses Robot coordinating function, MIG/TIG-FORCE or/and Spin arc sensor.

Procedure
After adding a Multi welder in SYSTEM menu, a welder used in the program is registered in NEW or ROPERTY screen in FILE menu.

NEW



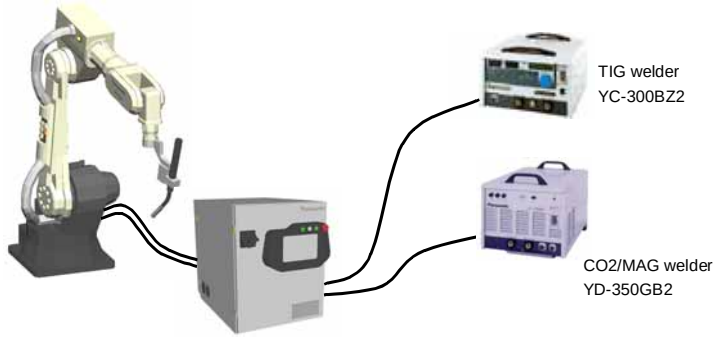
PROPERTY



Note
- A welder is selected in the list of Welder set as default.
- When Multi welder is not added in SYSTEM menu, “welding” column is not displayed.

Example: A system has a CO2/MAG welder and a TIG welder, and the welding torch is automatically changed with a tool changer.

Program **CO2_01.prg** is set ”YD-350GB2” as welder, **Program TIG_01.prg** is set “YC-300BZ2” as welder.



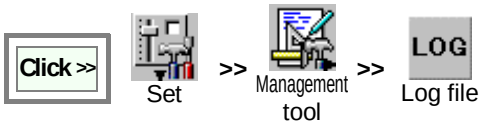
Program example	
CALL CO2_01.prg	CO2/MAG program 1
CALL CO2_02.prg	CO2/MAG program 2
CALL TOOLCHG_CtoT.prg	Changing a tool from MAG torch to TIG torch.
CALL TIG_01.prg	TIG program

14-6. Owner entry

Information on the robot owner is registered. Registered information will be utilized for field servicing activity.

14-7. Log file

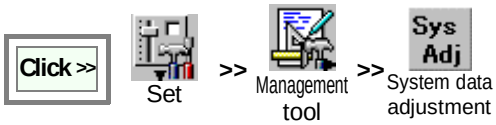
Log file of robot internal system is made. The log file will be used for servicing purpose.

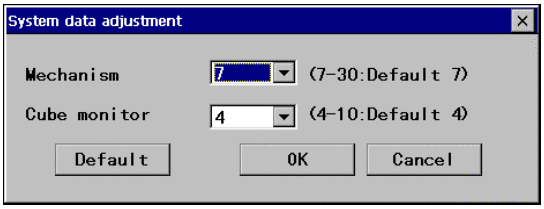


Usual setting is “Invalid”.

14-8. System data adjustment

The Mechanism number can extend up to 30 if required.
It is possible to set up to 10 Cube monitor conditions.





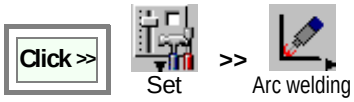
Set parameters and click the OK.

15. Arc welding machine settings

The settings available only for welding robots.

(1) Controller with Built-in welding power source

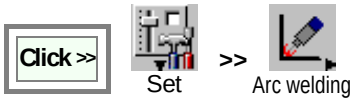
GX type robot controller has a following initial screen for arc welding settings.

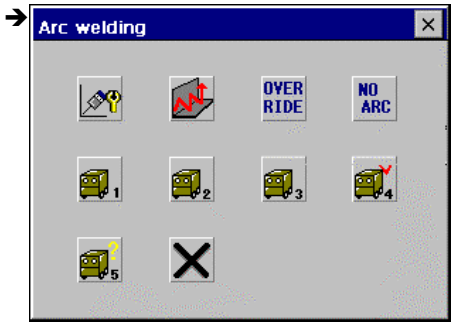


	Set welder characteristics.
	Rename the welder characteristics.
	Initialize the welder characteristics.
	Set parameters of built-in welding power source (up to 5 kinds)
	Weaving settings
	Override
	No arc detection

(2) Standard controller

An initial screen for standard G2 controller is shown below.

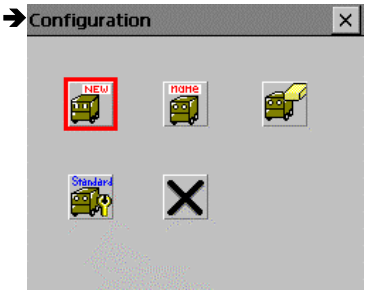




	Configuration
	Weaving
	Override
	No arc detection
	Welder settings

15-1. Configuration settings

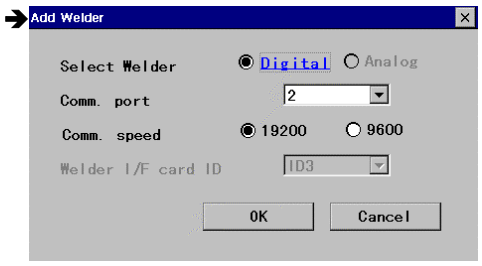
It sets the environment of the connected arc welding machine in the robot.
You can specify up to five welding machines (Welder 1 to 5.) and save their setting data.



	Add a welder		Delete a welder.
	Rename a welder.		Set a welder as Default

15-1-1. Add a welder

(1) Digital type welders



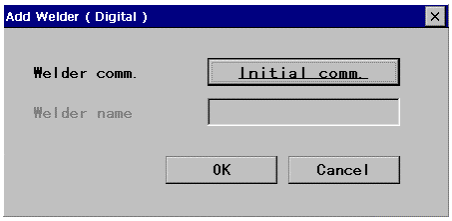
[Select Welder] Specify communication type of the welder.

- Select **Digital**.

[Comm. port] Specify the port number the welder is connected to.

[Comm. speed] Specify communication speed between the controller and welding machine.

- Select **19200** if you use Panasonic welding machine YD-350GB1/YD-350GB2.
- Select **9600** for other welding machines.



Click the **Initial comm.** button.

(2) Analog type welders (User welding machine)

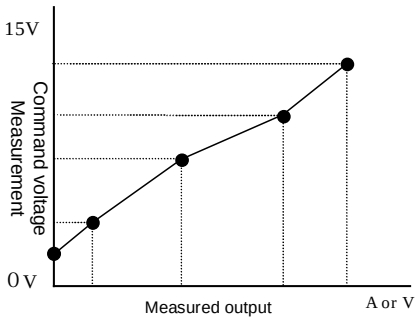
It is possible to add MIG/TIG welders not in the list as analog type welders whose characteristics are editable by users.

Applicable welders	Conditions
CO_2/MIG welders	Power adjustment is Current/Voltage separate setting type. Power adjustment is ranging between 0 to 15 VDC. Current command and voltage commands for power adjustment share the same grand level. Maximum output is 999 A or less and 99.9 V or less.
TIG welders	Current and pulse frequency are adjustable within 24 VDC. Maximum current is 999 A or less and maximum pulse frequency is 25 Hz or less.

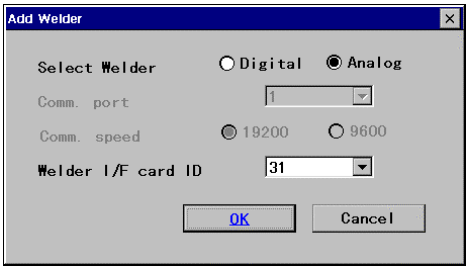
◎ **How to create data for welder characteristics.**

You can set a command voltage to the welder and an output current (or voltage) that responds to the command voltage to create your own welder characteristics freely.

Perform welding operation and then record the outputs (welding current and welding voltage) and command voltages as data for welder characteristics. The data are then used to adjust and create a characteristic curve (sequential line) that matches the output and command value.



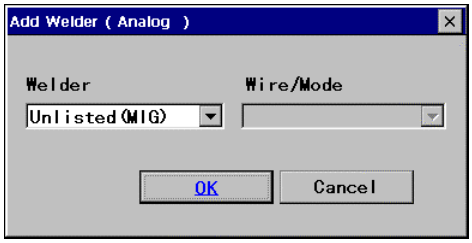
◎ Procedures to add a welder



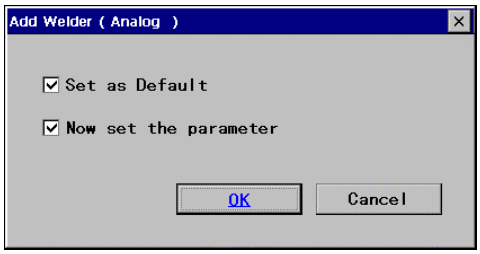
[Select Welder] Specify communication type of the welder.

- Select **Analog**.

[Welder I/F card ID] Specify ID number of the welder I/F card.



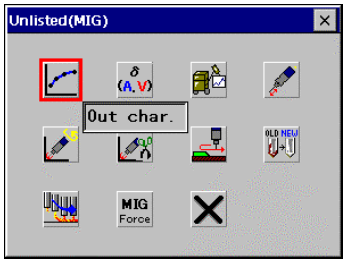
[Welder] Specify type of applied welder (i.e. “Unlisted (MIG)” for MIG welder or “Unlisted (TIG)” for TIG welder.)



* Check the check box next to the “**Now set the parameter**”.

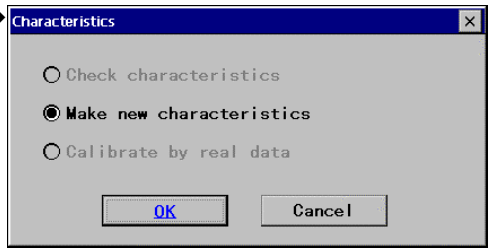
Example: Unlisted (MIG)

*** Parameters vary with selected welder type.**



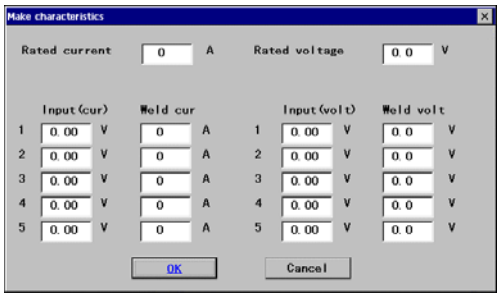
Out Char

➔



As the initial setting, the only “**Make new characteristics**” is effective.

Click the **OK** button

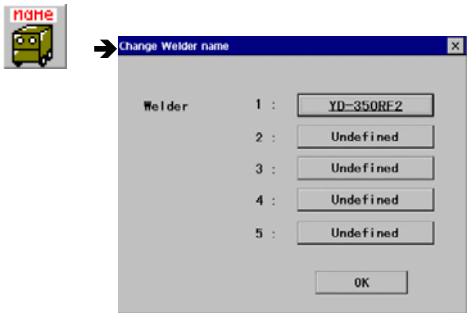


Set all parameters in the dialog box,
and then click the **OK** button.

Then a message to confirm the completion of calculation appears.

Click the **OK** button to end the settings.

15-1-2. Rename a welder

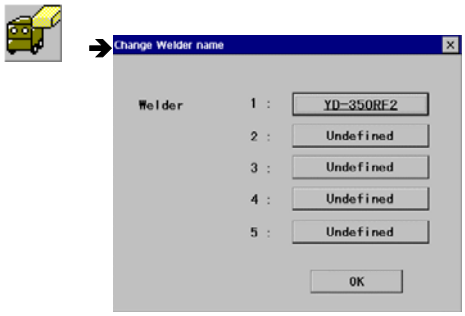


Select the welder you would like to change name (or delete) and click the **OK** button.

Click a welder name you want to rename, then a dialog box appear to type a new name.

You can rename any defined welders freely.

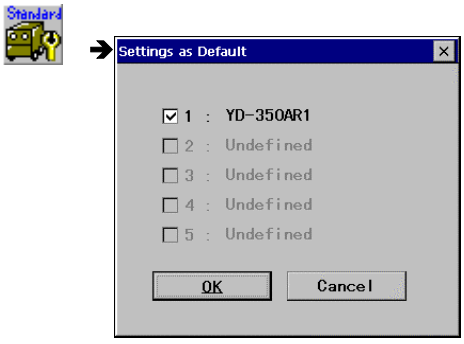
15-1-3. Delete a welder



Select the welder you would like to change name (or delete) and click the **OK** button.

Click a welder name you want to change, and then a message appears to confirm the deletion action.

15-1-4. Set a welder as Default

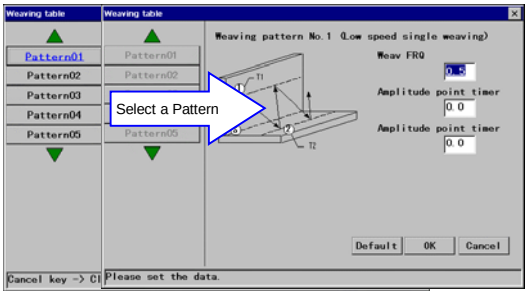


Check the box to the left of the welder you would like to normally use unless specified.

15-1-5. Weaving settings

Weaving

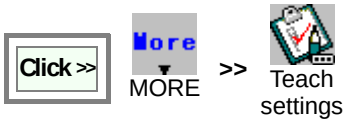
It is to set the initial weaving parameters when a weaving teaching point is added.



Set parameters and click the **OK** button.

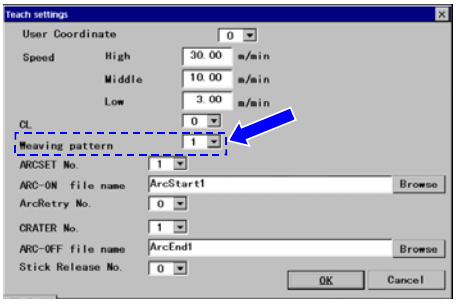
[Weave FRQ] Set the weaving frequency. (Unit: Hz)
[Amplitude timer (T1, T2)] Set how long the robot to move parallel to the main trace at each amplitude point. (Unit: second)

Then, do the following settings:



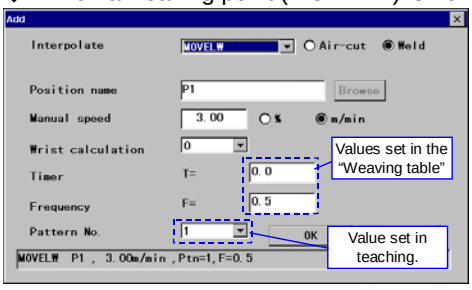
MORE >>

Teach settings



Set a weaving pattern number to register, and then click the **OK** button.

◆ When a weaving point (MOVELW) is newly registered.

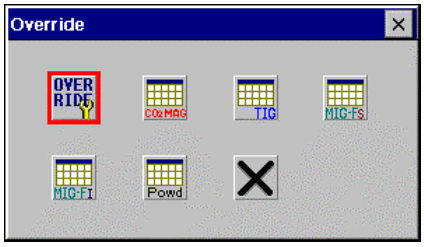


Those preset parameters - amplitude timer (as “Timer”), weaving FRQ (as “Frequency”) and weaving pattern (as “Pattern No.”) – are automatically set.

15-1-6. Override settings

Override

Single hand and both hand (default setting) are selectable, and increments and decrements of override are registered in the adjusting tables.



OVER RIDE	Override settings
CO2 MAG	Adjusting table for CO2/MAG welder
TIG	Adjusting table for TIG welder
MIG-FS	Adjusting table for MIG Force (Subordinate)
MIG-FI	Adjusting table for MIG Force (Independent)
Powd	Adjusting table for powder plasma

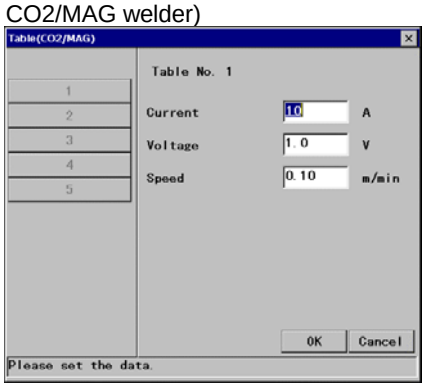
(1) Override settings

[Single hand]: Override operation with single hand

[Both hands]: Override operation with both hands

(2) Adjusting table

(Example: for CO2/MAG welder)



Adjusting quantities per pressing the override button are registered in each table for CO2/MAG welders.

[Current]: Welding current increment or decrement per pressing the override button.

[Voltage]: Welding voltage increment or decrement per pressing the override button.

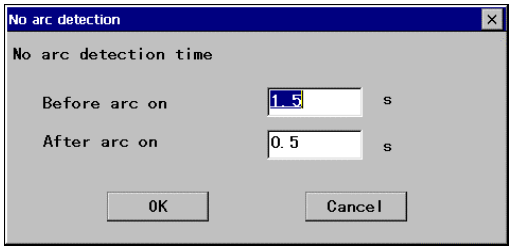
[Speed]: Moving speed increment or decrement per pressing the override button.

15-1-7. No arc detection

No arc detection

The robot is brought to an error stop when either the welding machine or the robot detects the “No arc” condition which means no current is detected during welding operation. The detecting time to determine the “No arc” condition is factory set to three seconds at shipment which, however, can be changed by setting this “No arc detection”.

* This function is available to persons in “System administrator” or higher level.



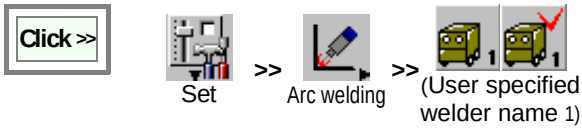
[Before arc on]: A period of time at arc start to determine as "no arc".
[Set range: 0.5-3.0 s]
[After arc on]: A period of time while welding to determine as "no arc".
[Set range: 0.1-3.0 s]

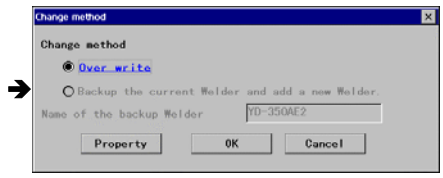
* “No arc detection” error

Before arc on	**W0010**	Weld Error: No current
After arc on	**W0025**	No arc detected by robot

15-2. Welder data settings (CO2 /MAG/MIG)

It is to set the parameters of each defined Panasonic welder.

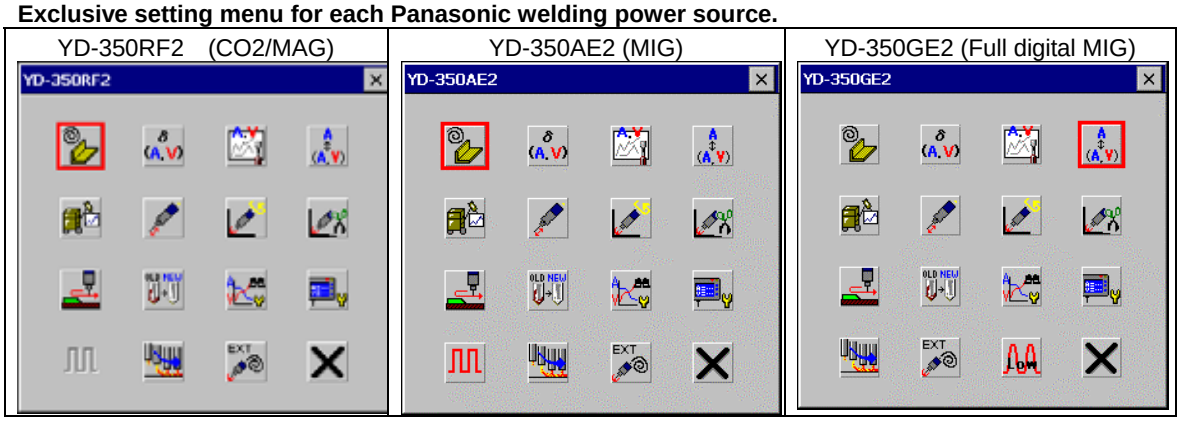




[Over write] Check this item to edit the current settings.

[Backup the current Welder and add a new Welder] Check this item to make a copy of the currently defined welder to add another welder. When you select this item, you must specify the name of the welder you want to make a copy of. ([Name of the backup Welder])

Exclusive setting menu for each Panasonic welding power source.



15-2-1. Wire/Material/Weld method

It is to specify material of the wire and welding method to be applied in welding operation.
Settings must be performed for each welders if more than one welder are connected to the robot.

[Material] Specify the material of the wire to be applied.

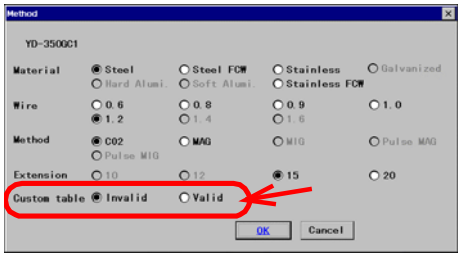
[Wire] Wire size (diameter) to be applied.

[Method] Welding method to be applied.

[Motor] Specifies reduction rate of the wire feed motor.

[Timer] Specifies how much time the robot will wait before detecting a NO ARC state. It is provided to prevent chances to detect the unstable state immediately after the arc start as a NO ARC error.

*** Please note that any function that is not supported by the welder connected to the robot is not selectable.**



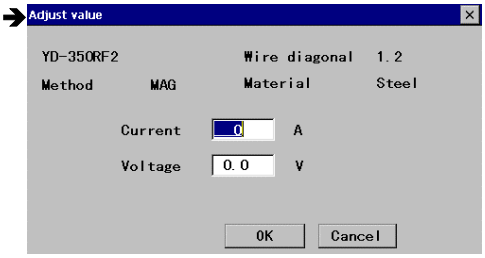
[Custom table] Set to Valid when you use a custom table.

*** Please note that only service level personnel can set the custom table.**

15-2-2. Adjust value

This function allows the user to calibrate the amperage and voltage of the welding machine if needed.

Adjust value



[Current] Specify the correction amperage. [Set range: ±50 A]

[Voltage] Specify the correction voltage. [Set range: ±5.0 V]

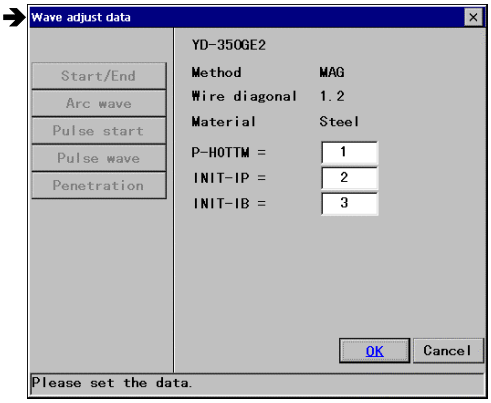
For both current and voltage, the adjust value is calculated by [Input value] – [output value]
That is, when command TP says 200 amp and

If welder says 199 amp.,
then the current adjust value should be +1 (200-199).
If welder says 201 amp.,
then the current adjust value should be –1 (200-201)

15-2-3. Wave adjust data

It is for fine adjustment of each welding parameter on a global scale.

Wave adjust data



[Start/End] Parameters at arc start and arc end.

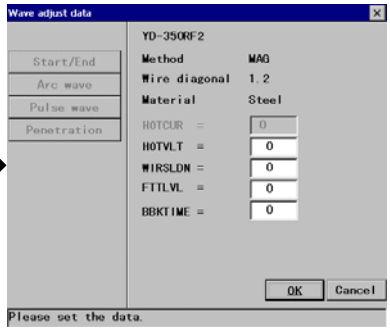
[Arc wave] Parameters of arc waveform.

[Pulse start] Parameters of arc start for pulsed MIG welding

[Pulse wave] Parameters of pulse waveform.

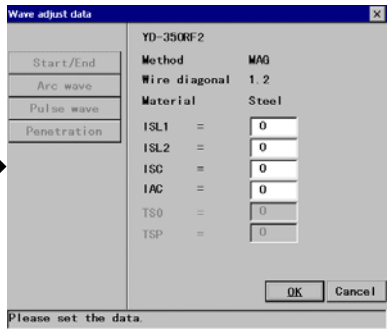
[Penetration] Parameters of penetration.

Start/End:

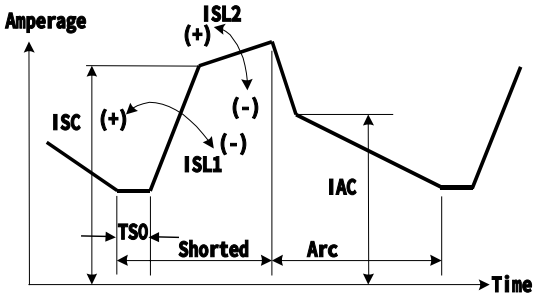


HOTVLT: Specifies the hot voltage adjustment value.[Set range: -50 to +50]
Increase the value to smoothen wire feed immediate after the arc start.
Decrease the value to restrain the burn-back immediate after the arc start.
WIRSLDN: Specifies the wire slow down speed adjustment value. [Set range: -125 to +125]
Increase the value to shorten the time to generate arc.
Decrease the value for better arc start.
FTTLVL: Specifies the FTT voltage level adjustment value. [Set range: -50 to +50]
Increase the value to reduce chances of the wire stick (as the end of the wire is rounded.)
Decrease the value for better arc start (as the end of the wire is sharpened.)
BBKTIME: Specifies the burn back time adjustment value. [Set range: -20 to +20]
Increase the value to reduce chances of a wire stick (as it extends the wire burning time.)
Decrease the value to reduce chances of a burn back to the tip (as it shortens the wire burning time.)

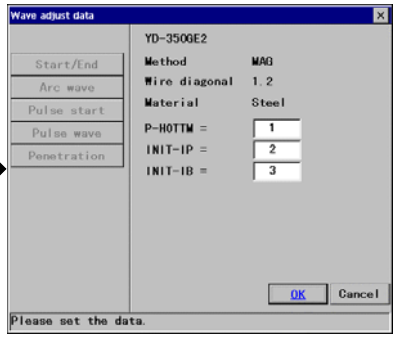
Arc waveform:



ISL1: Specifies the short circuit current slope 1. [Set range: -7 to +7]
ISL2: Specifies the short circuit current slope 2. [Set range: -7 to +7]
ISC: Specifies the short-circuit refraction value. [Set range: -3 to +3]
IAC: Specifies the arc current refraction value. [Set range: -3 to +3]
TSO: Specifies the short circuit transfer delay time (no unit)
TSP: (For expansion)

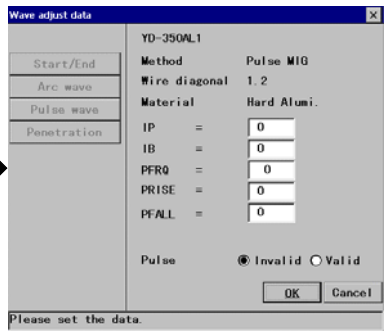


Pulse start:

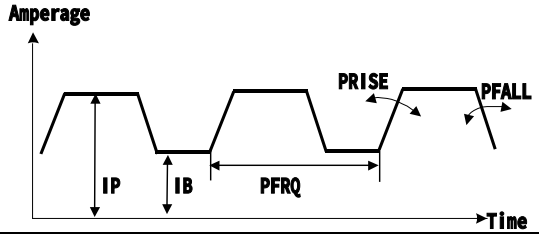


P-HOTTM: Specifies the applying period of arc start hot voltage. [Set range: -10 to +10]
INIT-IP: Specifies the pulse peak current level at arc start portion. [Set range: -50 to +50]
INIT-IB: Specifies the base current level at arc start portion. [Set range: -50 to +50]

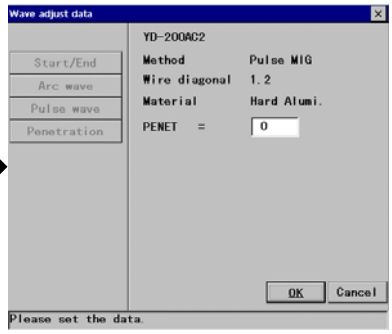
Pulse waveform:



IP: Specifies the peak current level in pulsed welding. [Set range: -50 to +50]
IB: Specifies the base current level in the pulsed welding. [Set range: -50 to +50]
PFRQ: Specifies the pulse frequency level. [Set range: -7 to +7]
PRISE: Specifies the rise angle level of the pulse wave. [Set range: -7 to +7]
PFALL: Specifies the fall angle level of the pulse wave. [Set range: -7 to +7]
Pulse slope: Specifies switch for PRISE and PFALL parameters
(* When the connected welder does not support this parameter, set to Invalid.)



Penetration:

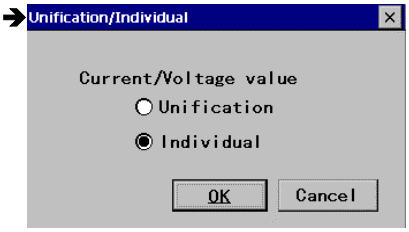


PENET: Specifies the penetration control level based on straight polarity rate.
[Set range: 0 to +30]

15-2-4. Unification/Individual

It specifies how you want to set welding conditions.

Unification/
Individual



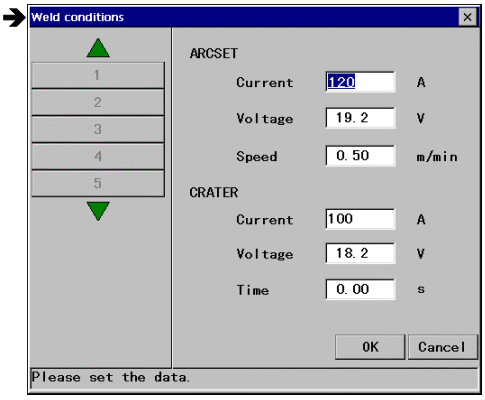
[Unification] Adjusts welding automatically according to the welding table by setting welding current.

[Individual] Sets the welding current and voltage separately.

15-2-5. Weld conditions

Welding conditions can be set easily by selecting a set of conditions preset in the weld condition table if the table is previously prepared.

Weld
condition



It is possible to register up to 50 sets of welding conditions in the table.

Table No.1 to 5: Appropriate set values for each welding method are automatically set.

Table No.6 to 50: Open to users' settings.

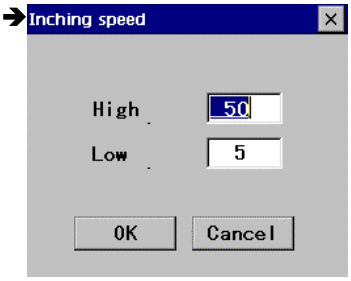
[ARC-SET] Specifies welding conditions at arc start.

[CRATER] Specifies welding conditions at crater welding (i.e. at arc end)

15-2-6. Inching speed

It is to set the speed of wire inching when operated using the teach pendant.

Inching
speed



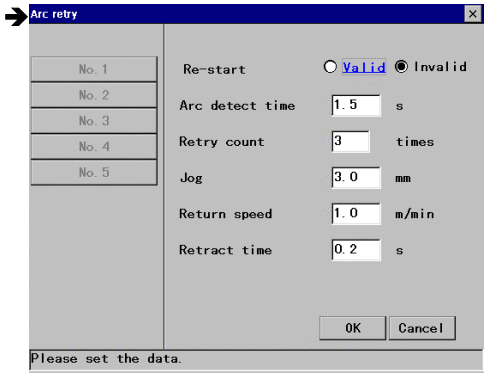
[High] Specifies the inching speed 3 seconds after inching start. [Set range: 1 to +255]
(Coefficient. Set large number for higher speed.)

[Low] Specifies the inching speed for the first 3 seconds ("low" speed period). [Set range: 1 to +255]
(Coefficient. Set large number for higher speed.)

15-2-7. Arc retry

It is a function to be used if the welding machine failed to generate an arc at arc start. The robot automatically shifts its position to retry arc start action.


Arc retry



[Re-start] Specifies whether to use this function (Valid) or not (Invalid).

[Arc detect time] Specifies how much time (in seconds) the robot will wait before retrying the arc start after the arc start error occurs. (Set range: 0.1 to 9.9 sec)

[Retry count] Specifies how many times (1 to 9) the robot will retry the arc start action.

[Jog] Specifies the distance the robot will shift the arc start position in the direction of the welding line during each arc retry. (Set range: 0.0 to 9.9 mm)

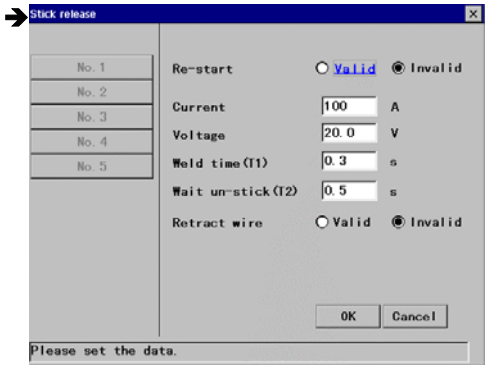
[Return speed] Specifies the speed when the robot returns to the original arc start point after the arc retry. (Set range: 0.1 to 9/9 m/min)

[Retract time] Specifies the wire retract amount time when the arc start error occurs. (Set range: 0.1 to 9.9 s)

15-2-8. Stick release

It is a function that the robot automatically uses to cut the wire at the arc end in case of a wire stick.


Stick release



[Re-start] Specifies whether to use this function (**Valid**) or not (**Invalid**).

[Current] Specifies the wire fusing current.
(Set range: 1 to350 A)

[Voltage] Specifies the wire fusing voltage.
(Set range: 1 to 50V)

[Weld time (T1)] Specify the wire fusing time.
(Set range: 0.0 to 9.9 s)

[Wait un-stick (T2)] Specifies how much time the robot will wait before starting the wire stick check.
(Set range: 0.1 to 9.9 s)

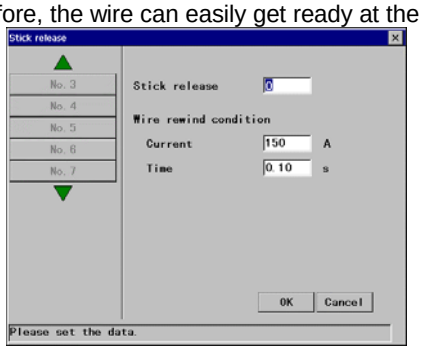
[Retract wire] Specifies whether to retract the wire (Valid) or not (Invalid) before the stick check.

15-2-9. Wire auto retract

<This function is availble only to built-in welding power source type robot controllers.>

To use the “Wire auto retract”, specify the stick release number 6 or 7 in the Arc-OFF command. Then the wire will be automatically rewound the wire automatically to shorten the wire extension to proper length after the completion of welding operation. Therefore, the wire can easily get ready at the next arc start point.


Stick release



[Stick release]: Specifies a stick release condition (0-5)

Wire rewind condition:

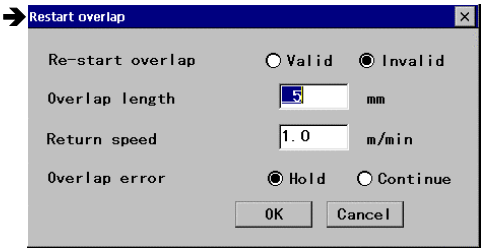
[Current]: Coefficient of motor revolution (0-999) A

[Time]: Motor retraction time (0.01～2.00) s

15-2-10. Restart overlap

It is to automatically move the robot back a preset distance at restart after a hold state in order to restart welding by overlapping the weld bead.

Restart overlap



[Overlap length]: Specifies the overlapping length (or how long the robot should move backward) ［1 to 50 mm］

[Return speed]: Specifies the travel speed when the robot moves backward for overlapping. [0.1 to 9.9 m/min]

[Overlap error]: Selects whether to stop as an error or [Hold] or continue operation [Continue] when the robot goes in the following conditions.

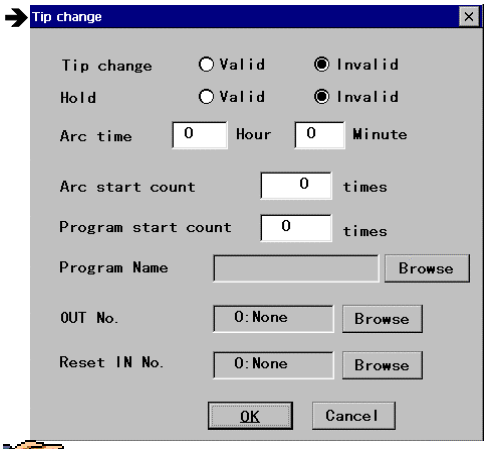
When the robot reaches the preceding teaching point by overlapping the specified length.

When the robot is moved on a teaching point in trace operation in holding state..

15-2-11. Tip change

It is to specify whether to display the Tip change warning message on the teach pendant when tip replacement is needed.

Tip change



The [Reset IN No.] functions independently from tip change. That is, it resets the accumulated values whenever the specified input terminal is turned on regardless of tip change timing.

[Tip change] Specifies whether to use this function (**Valid**) or not (**Invalid**).

[Hold]: Specifies whether to hold the robot when the tip change warning appears (**Valid**) or not (**Invalid**).

[Arc time]: Specifies how much arc on time should be executed before changing the tip.
[Set range: 0 hours 0 minutes to 99 hours 59 minutes]

[Arc start count]: Specifies the number of arc starts to be executed before changing the tip.
[Set range: 0 to 99999]

[Program start count]: Specifies how many times the specified program should be started before changing the tip. [Set range: 0 to 999]

[Program Name]: Specifies the program to count the number of program starts executed.

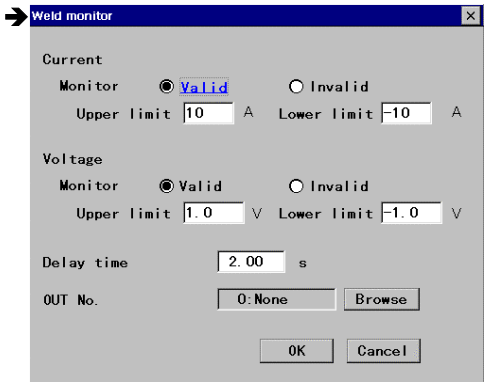
[OUT No.]: Specifies the output terminal to output when the tip change is required.

[Reset IN No.]: Specifies which input terminal to trigger the reset of all the accumulated values.

15-2-12. Weld monitor

It monitors whether the actual welding conditions are within the set ranges or not. This function is useful to maintain and control welding quality.


Weld monitor



[Current]: Specifies whether to use this function (**Valid**) or not (**Invalid**). If valid, then specify the welding current monitoring range. [Set range: -50 A - 50 A]

[Voltage]: Specifies whether to use this function (**Valid**) or not (**Invalid**). If valid, then specifies the welding voltage monitoring range. [Set range: -5.0 - 5.0 V]

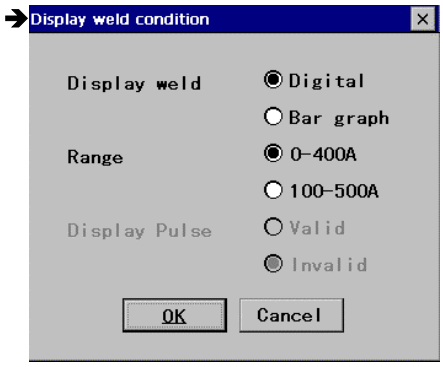
[Delay time]: Specifies how much time (in seconds) the robot will wait before monitoring after the arc start. [Set range: 0.5 - 5.0]

[OUT No.]: Specifies the output terminal when the robot moves out of the monitoring range.

15-2-13. Display weld condition

It displays welding conditions (amperage and voltage) sent from the welding machine on the teach pendant.


Display weld condition



[Display weld] Specifies how the welding conditions are to be displayed.

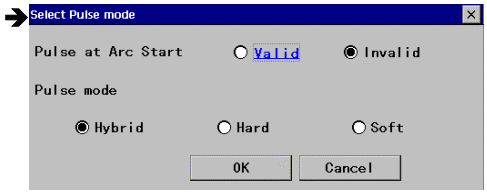
[Range] Specifies the scale range to be displayed.

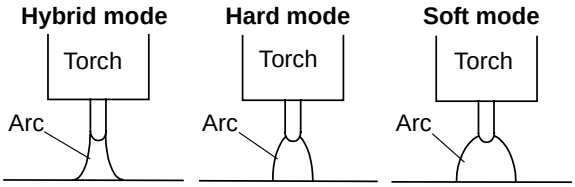
[Display pulse] Specifies whether to display the pulse condition. (Make sure to set to 'Invalid' is the applied welding machine does not support this function.)

15-2-14. Pulse settings

It is to set the default pulse mode of the connected pulse welding machine.


Set pulse mode

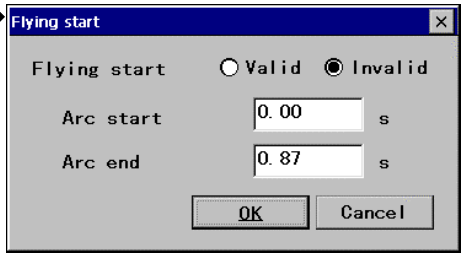




15-2-15. Flying start

This function allows the robot to make a flying start of executing sequence commands for arc start or arc end to reduce tact time.


Flying start



[Flying start]: Specifies whether to use this function (**Valid**) or not (**Invalid**).

[Arc start]: Specifies how much time in seconds the robot to execute arc start prior to the assigned time. [0.00 - 1.00]

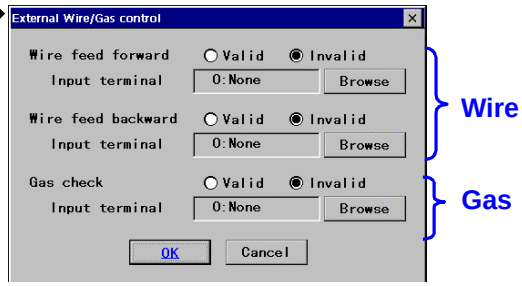
[Arc end]: Specifies how much time in seconds the robot to execute arc end prior to the assigned time. [0.00 - 1.00]

Depending on the system configuration, tolerance may be expected.

15-2-16. External Wire/Gas control

It is a function to control the wire inching and gas check using an external input.
This function is effective when the robot is in AUTO mode but not in operation.


Ext. Wire, Gas



[Valid/Invalid]: Specifies whether to use this function (**Valid**) or not (**Invalid**).

[Input terminal]: Specify User input terminal NO. that received the signal.

Wire feed forward/backward

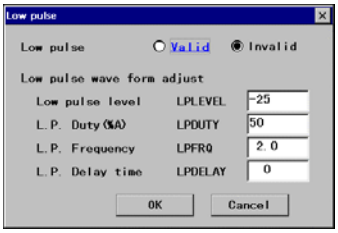
- When the input is ON, the robot feeds the wire forward (or backward) at low speed for the initial 3 seconds, and then switches to high speed.
- When the input goes OFF, the robot stops feeding the wire.

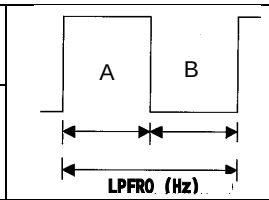
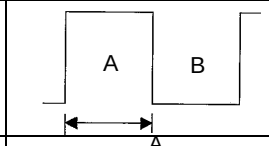
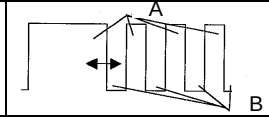
Gas check (Gas purge)

- When the input is ON, the gas valve opens.
- When the input goes OFF, the gas valve closes.

When the both the “wire feed forward” input and the “wire feed backward” input are ON, the robot stops feeding the wire.
When the robot is attempted to start while any of these inputs is ON, the input is turned OFF and an alarm message appears. The start is also ignored.
When the mode select switch is switched to TEACH while any of these inputs is ON, the input is turned OFF and an alarm message appears. Switch back to AUTO mode.

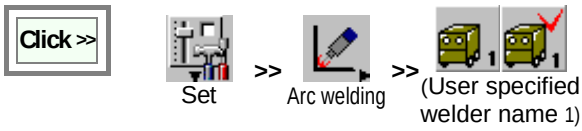
15-2-17. Low pulse setting

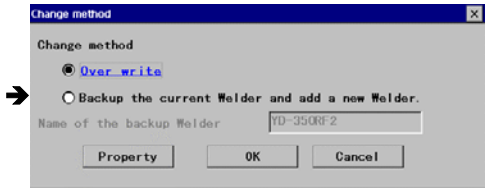


Low pulse level		It sets the B condition level against the **A** condition. [-50 - 0]
Low pulse frequency		Its sets low pulse frequency. [-0.5 - 10.0] Hz
Low pulse duty (%A)		It sets the A condition ratio against pulse period, (A+B) time. [10 - 90] %
Low pulse delay time		It adjusts delay time to start low pulse. [-20 - 20]

15-3. Welder data settings (TIG)

This section explains welder data settings when a Panasonic TIG welding machine is connected.

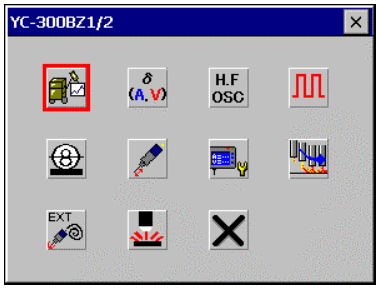




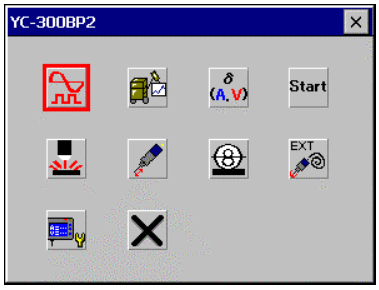
[Over write] Check this item to edit the current settings.

[Backup the current Welder and add a new Welder] Check this item to make a copy of the currently defined welder to add another welder. When you select this item, you must specify the name of the welder you want to make a copy of. ([Name of the backup Welder])

YC-300BZ1/YC-300BZ2 for DC TIG



YC-300BP2 for AC/DC/MIX TIG



15-3-1. Welding mode

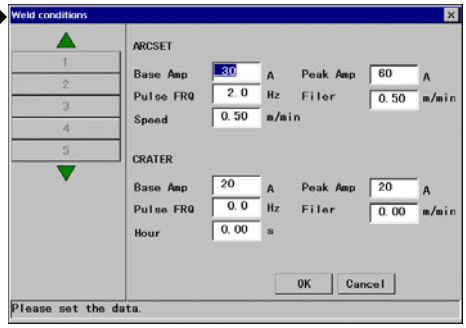
The optimum welding mode is selectable from DC, AC or mixed TIG, and hard or soft pulse wave for YC-300BP2 model.

Welding mode

15-3-2. Weld condition

It sets TIG welding conditions.

Weld condition



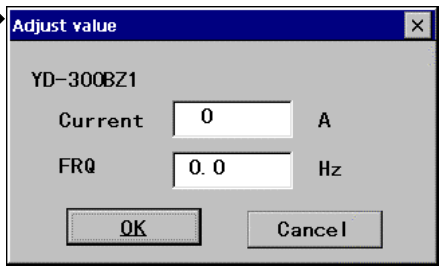
[ARC-SET] Specifies welding conditions at arc start.

[CRATER] Specifies welding conditions at crater welding (i.e. at arc end)

15-3-3. Adjust value

It specifies the differences between the actual values of welding current and pulse frequency and their set values as the adjustment value respectively.

Adjust value



[Current]: Adjustment value of current. [-50 to +50]

[FRQ]: Adjustment value of frequency [-5.0 to +5.0]

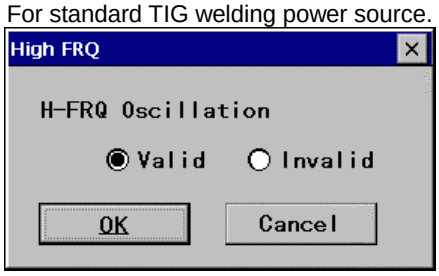
15-3-4. High frequency and arc start process

It specifies whether to apply high frequency oscillation and polarity of start pulse.

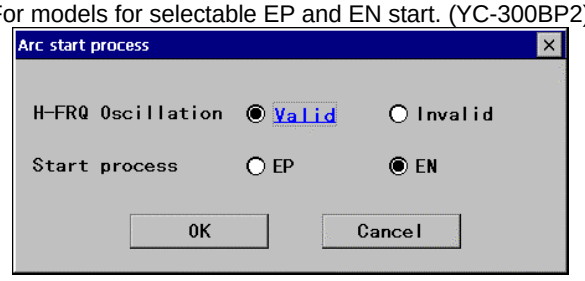
High FRQ

Arc start process

For standard TIG welding power source.



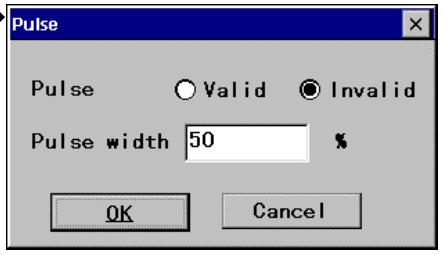
For models for selectable EP and EN start. (YC-300BP2)



15-3-5. Pulse settings

It specifies whether to apply pulse, and pulse width to be applied.


Set pulse mode



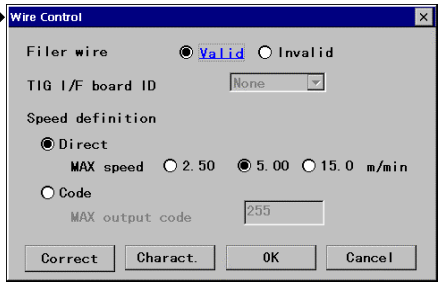
[Pulse]: Specifies whether to use this function (**Valid**) or not (**Invalid**).

[Pulse width]: Pulse width in percentage. [5 to 95]

15-3-6. Wire control

It specifies whether to use filler wire, and conditions to be applied.


Wire control



[Filer wire]: Specifies whether to use the filer wire.

[TIG I/F board ID]: Specifies ID to set DIP switches for the filler wire control card.

[Speed definition]: Specifies wire speed set method.

[Correct] button: Click to display the “Wire speed adjust” dialog box

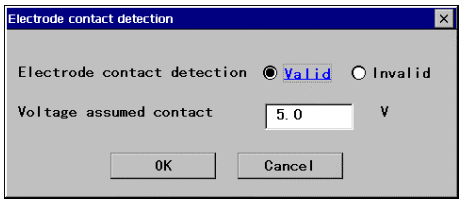
[Charact.] button: Click to display the “Wire spd Character” dialog box.

For details of other items, please refer to section “Welder data settings for CO2/MAG/MIG welding.”

15-3-7. Electrode contact detection

It is a function to bring the robot to an error stop when the electrode and workpiece are short-circuited.

Electrode contact



- In welding operation, the robot detects “Electrode contact” when the voltage is lowered down to or below the preset weld voltage, the error “W0370: Weld Error: Electrode contact”.
- Use the CHKVOLT command to change the benchmark voltage for determining the “electrode contact”.

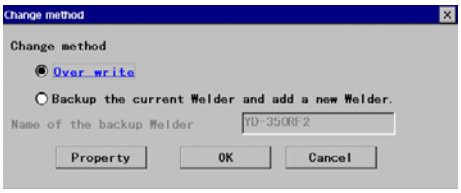
[**Electrode contact detection**]: Whether to use this function.
[**Voltage assumed contact**]: Specifies the benchmark voltage for determining “electrode contact”.

Note

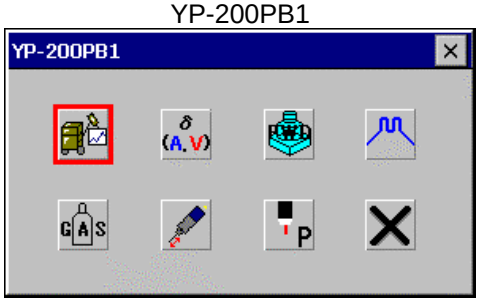
- This function is available to software version 3.00 or higher of the Welding machine “YC-300BZ2”.
- Turn ON the ”Volt. Display” of the Display setting menu of the welding machine”YC-300BZ2” to apply this function.

15-4. Welder data settings (Powder plasma welding)

This section explains welder data settings for Panasonic powder plasma welding machine.



YP-200PB1



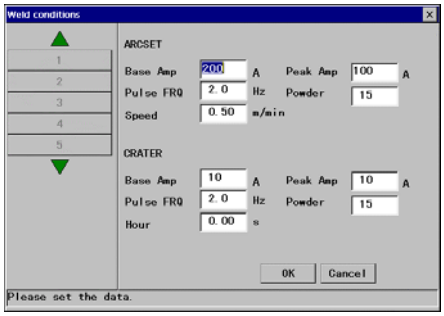
[Over write] Check this item to edit the current settings.

[Backup the current Welder and add a new Welder] Check this item to make a copy of the currently defined welder to add another welder. When you select this item, you must specify the name of the welder you want to make a copy of. ([Name of the backup Welder])

15-4-1. Weld conditions

Powder plasma welding conditions are set.

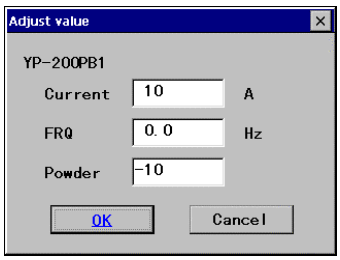
Weld condition



15-4-2. Adjust value

Difference between setting data and actual measured value are compensated.

Adjust value



[Current]: Compensation for current , (-50～+50)A

[FRQ]: Compensation for pulse frequency, (-5.0～+5.0)Hz

[Powder]: Compensation for powder feed, (-50～+50)%

15-4-3. Powder control


Powder control

[Powder]: Feeding powder, (Yes), or no powder, (No).

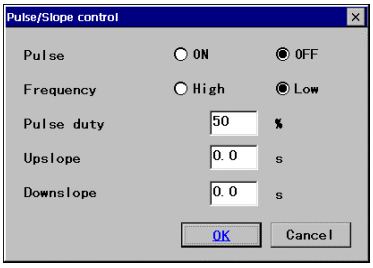
[Delay of motor on]: Time delay for feed motor start, (0.0 - 5.0)s

[Delay of main arc off]: Time delay for main power off, (0.0-5.0)s

[Output for powder warning]: Warning signal output terminal for lower powder level.

15-4-4. Pulse/Slope control


Pulse slope



[Pulse]: With pulse, (Yes), or without pulse, (No).

[Frequency]: Frequency range

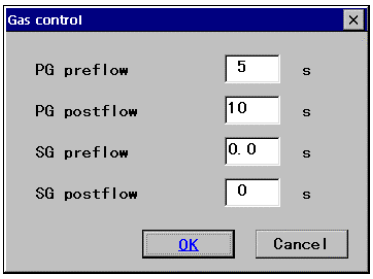
[Pulse duty]: Pulse width setting, (15 - 85)%

[Upslope]: Upslope time, (0.0 - 5.0)s

[Down slope]: Down slope time, (0.0 - 5.0)s

15-4-5. Gas control


Gas control



[PG preflow]: Pre-flow time for Plasma gas, (5 - 25)s

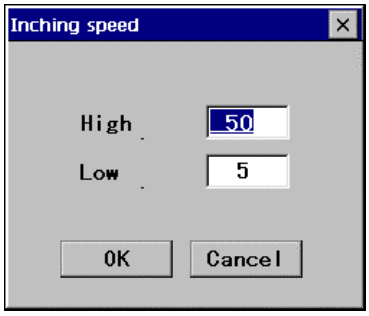
[PG postflow]: Post-flow time for Plasma gas(10 - 30)s

[SG preflow]: Pre-flow time for Shield gas, (0.0 - 5.0)s

[SG postflow]: Post-flow time for Shield0 gas, (0 - 20)s

15-4-6. Inching speed


Inching speed



[High]: High powder feed speed, (0 - 100)(%)

[Low]: Low powder feed speed, (0 - 100)(%)

15-4-7. Pilot arc

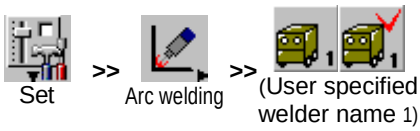

Pilot arc

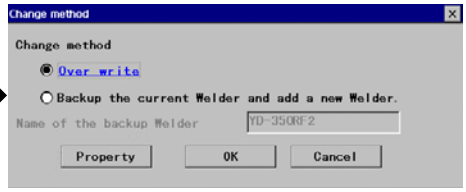
[Output port]: Automatically set by welding machine.
[Output for Pilot]: ON terminal during generating pilot arc.
[Pilot arc•••]: At emergency stop error generation, the pilot arc is discontinued, (Yes), or continued, (NO).

15-5. Changing Analog type welder settings

This section explains welder data settings when analog type welding machines are connected.

Click >>



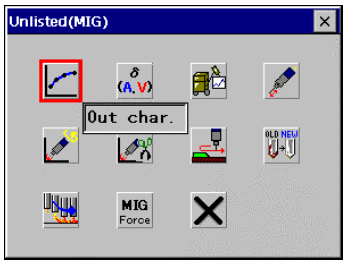


[Over write] Check this item to edit the current settings.

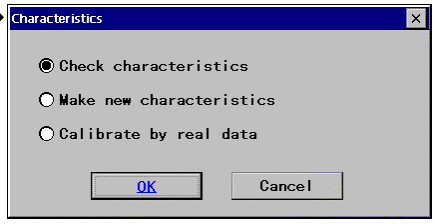
[Backup the current Welder and add a new Welder] Check this item to make a copy of the currently defined welder to add another welder. When you select this item, you must specify the name of the welder you want to make a copy of. ([Name of the backup Welder])

Example: Unlisted (MIG)

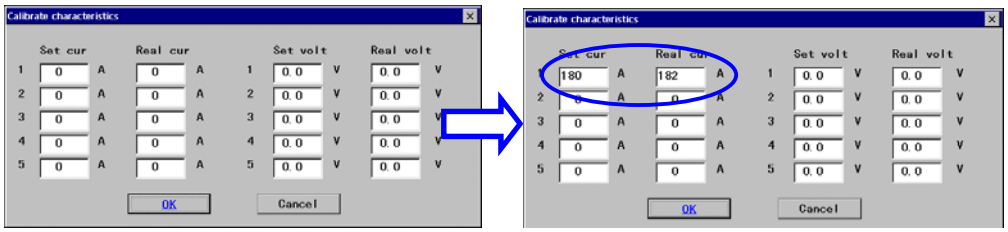
*** Parameters vary with selected welder type.**




Out Char



Select "**Check characteristics**".



(The example shows changes in case that the actual output current is 182A when the set value is 180A.)

Click the **OK** button to end.

Details of other items, please refer to section "Welder data settings for CO2/MAG/MIG welding."

16. Commands

16-1. Move commands

16-1-1. MOVEC

Format	**MOVEC [Position name] [Manual speed]**		
Function	Circular interpolation.	Position name	Teaching position type variable
Lock condition	Robot lock.	Manual speed	The robot travel speed toward this point.
Syntax check	None.		
Example	Travel to the teaching point P3 with circular interpolation at speed 7.5 m/min. **MOVEC P3 7.5m/min**	The same command in conventional models	MOVEC

16-1-2. MOVECW

Format	**MOVECW [Position name] [Manual speed] [Pattern No.] [Frequency] ([Timer])**		
Function	Circular weaving interpolation.	Position name	Teaching position type variable
Lock condition	Robot lock.	Manual speed	The robot travel speed toward this point.
Syntax check	None.	Pattern No.	Weaving pattern (n).
		Frequency	Weaving amplitude.
		Timer	Weaving timer
		The same command in conventional models	MOVECW
Example	Travel to the teaching point P5 with circular weaving interpolation at speed 7.5 m/min. using weaving pattern 1 whose amplitude is 0.5. **MOVECW P5 7.5m/min Ptn=1 F=0.5**	<u>If the next teaching point is MOVECW:</u> Pattern No. specified here is applied to the movement toward the next teaching point. <u>If the preceding teaching point is MOVECW:</u> Frequency specified here is applied to the movement toward this teaching point. “Timer” is applied toward this teaching point.	

16-1-3. MOVEL

Format	**MOVEL [Position name] [Manual speed]**		
Function	Linear interpolation.	Position name	Teaching position type variable
Lock condition	Robot lock.	Manual speed	The robot travel speed toward this point.
Syntax check	None.		
Example	Travel to the teaching point P2 with linear interpolation at speed 7.5 m/min. **MOVEL P2 7.5m/min**	The same command in conventional models	MOVELW

16-1-4. MOVELW

Format	**MOVELW [Position name] [Manual speed] [Pattern No.] [Frequency] ([Timer])**		
Function	Linear weaving interpolation.	Position name	Teaching position type variable
Lock condition	Robot lock.	Manual speed	The robot travel speed toward this point.
Syntax check	None.	Pattern No.	Weaving pattern (n).
		Frequency	Weaving amplitude.
		Timer	Weaving timer
		The same command in conventional models	MOVELW
Example	Travel to the teaching point P4 with circular weaving interpolation at speed 7.5 m/min. using weaving pattern 1 whose amplitude is 0.5. **MOVECW P4 7.5m/min Ptn=1 F=0.5**	If the next teaching point is MOVELW: Pattern No. specified here is applied to the movement toward the next teaching point. If the preceding teaching point is MOVELW: Frequency specified here is applied to the movement toward this teaching point. "Timer" is applied toward this teaching point.	

16-1-5. MOVEP

Format	**MOVEP [Position name] [Manual speed]**		
Function	PTP interpolation.	Position name	Teaching position type variable
Lock condition	Robot lock.	Manual speed	The robot travel speed toward this point.
Syntax check	None.		
Example	Travel to the teaching point P1 at speed 7.5 m/min. **MOVEP P1 7.5m/min**	The same command in conventional models	MOVEP

16-1-6. WEAVEP

Format	WEAVEP [Position name] [Manual speed] [Timer]		
Function	Weaving amplitude point.	Position name	Teaching position type variable
Lock condition	Robot lock.	Manual speed	The robot travel speed toward this point.
Syntax check	None.	Timer	Weaving timer
Example	Set the teaching point P6 as a weaving amplitude point. Timer is 0. **WEAVEP P6 7.5m/min T=0.0**		

16-2. Input/Output commands

16-2-1. IN

Format	**IN [Variable]=[Terminal type] ([Terminal name])**		
Function	Digital input. Import and signal status from I/O port to a variable name.	Variable	The imported terminal value is assigned to (GB, LB).
		Terminal type	I/O terminal type (value or variable (GB, LB)) I1#.....1-bit input I4#.....4-bit input I8#.....8-bit input I16#.....16-bit input O1# .....1-bit output O4# .....4-bit output O8# .....8-bit output O16# .....16-bit output
Condition	Terminal types I4#, I8#, I16#, O4#, O8# and O16# must be defined before to use.		
Lock condition	I/O lock.		
Syntax check	None.	Terminal name	Terminal label or number (value or variable (GI, LI)).
Example	Import the signal status from input terminal 001 of 1-bit output. **IN LB001 = I1#(001)**	The same command in conventional models	IN REG

16-2-2. OUT

Format	**OUT [Terminal type] ([Terminal name]) = [Value]**		
Function	Digital output. (Output the signal to output port.)	Terminal type	Output terminal type (value or variable (GB, LB)). O1# .....1-bit output O4# .....4-bit output O8# .....8-bit output O16# .....16-bit output
Condition	Terminal types O4#, O8# and O16# must be defined before to use.		
Lock condition	I/O lock.	Output value	ON or OFF or variable (GB, LB)
Syntax check	None.	Terminal name	Terminal label or number (value or variable (GB, LB)). (GI and LI for 16-bits)
		The same command in conventional models	OUTB, OUTG, OUTP, ANALOG3
Example	Turn ON the terminal 001 of 1-bit output. **OUT O1#(001) = ON**	**Note:** The value is converted into a binary number and bit of the specified port from the right-hand side of such a number is output. (0: OFF, 1: ON) For example, Port O1#: outputs the right-hand side (the least-significant) bit Port O4#: outputs 4 bits from the right-hand side of the value.	

16-2-3. PULSE

Format	**PULSE[Terminal type]([Terminal name]) T=[Time]**		
Function	Pulse output command. It inverts the port signal for a specified period of time.	Terminal type	Output terminal type (value or variable (GB, LB)). O1# 1-bit input
		Terminal name	Terminal label or number (value or variable (GB, LB)).
Lock condition	None.		
Syntax check	None.	Time	Output time.
Example	Invert the signal of 1 bit output port #001 for 5 seconds. **PULSE O1#(001) T=5.00**	The same command in conventional models	PLSB

16-3. Flow commands

16-3-1. CALL

Format	**CALL [File name]**		
Function	Call a program and execute it. After completion of the called program, it resumes operation of the original program.	File name	Name of the program you want to call.
Condition	Standard.		
Lock condition	None.		
Syntax check	The specified call program doesn't exist.		
Example	Call the program named 'PROG001.prg'. **CALL PRG001.prg**	The same command in conventional models	GOSUB PROG

16-3-2. DELAY

Format	**DELAY T=[Timer]s**		
Function	Delay. It stops operation of the mechanism for a specified period of time.	Timer	Stop time. (Value, GR, LR) [Set range: 0.00 - 99.99]
Condition	Standard.		
Lock condition	None.		
Syntax check	None.		
Example	Stop operation for 10 seconds. **DELAY 10.00s**	The same command in conventional models	DELAY

16-3-3. HOLD

Format	**HOLD [Message]**		
Function	Temporary stop (or User error). This function leads to an error state. Use it to stop operation when the current condition may cause an error, such as interlock.	Message	To be displayed on the screen. (8 bytes)
Condition	Standard.		
Lock condition	None.		
Syntax check	None.		
Example	Display the message "No signal input" and bring the robot to stop state. **HOLD No input**	The same command in conventional models	HOLD

16-3-4. IF

Format	**IF [Factor1][Condition][Factor2] THEN [Execute1] ELSE [Execute2]**		
Function	Conditional branching. Branch the next action according to the result of the condition test.	Factor 1	Comparison operator 1 If it is terminal type. It must be [Terminal type] + [Terminal No.] Terminal type: I4#, I8#, I16#, O4#, O8# and O16#. Variable (GB, LB, GI, LI, GL, LL, GR, LR)
Condition Lock condition Syntax check	Standard. None. None.	Condition	[Relation condition] **=** Value 1 and Value 2 are equal. **<** Value 1 is smaller than Value 2. **>** Value 1 is bigger than Value 2. **<=**Value 1 is equal to or less than Value 2. **>=**Value 1 is equal to or bigger than Value 2. **<>** Value 1 is not equal to Value 2.
		Factor 2	Comparison operator 2
		Execute 1	An instruction to be executed if the condition is satisfied.
		Execute 2	An instruction to be executed if the condition is not satisfied.
Example	If the value of LB001 is 10, jump to Label 'LABL0001". **IF LB001 = 10 THEN JUMP LABL0001 ELSE NOP**	The same command in conventional models	IF…

16-3-5. JUMP

Format	**JUMP [Label]**		
Function	Move to a specified Label (not necessary the next in sequence) and execute operation.	Label	Label name to jump to. (Character string. Max. 8 characters.)
Condition Lock condition Syntax check	Standard. None. The specified Label does not exist in the same program.		
Example	Jump to LABL0001 **JUMP LABL0001**	The same command in conventional models	GOTO STEP, GOTO ADDR

16-3-6. LABEL

Format	**: [Label]**		
Function Condition Lock condition Syntax check	Jump address. Standard. None. None.	Label *	Label name to jump to. (Character string. Max. 8 characters.) You cannot register the same label name more than once in one program.
Example	Create a label "LABL0001" **:LABL0001**	The same command in conventional models	*S, *A

16-3-7. NOP

Format	**NOP**		
Function	No operation. Use it to improve the legibility of the program.		
Condition	Standard.		
Lock condition	None.		
Syntax check	None.		
Example	**NOP**	The same command in conventional models	**NOP**

16-3-8. PARACALL

Format	**PARACALL [File] [ON/OFF]**		
Function	Parallel execution of files. Use it to execute files in parallel with the current file.	File ON/OFF	Character string. (The file name(s) to be executed in parallel. ON = to execute. OFF = to cancel
Condition	None.		
Lock condition	None.		
Syntax check	None.		
Example	Execute PRG002 in parallel. **PARACALL PROG002 ON**	**Note:** · Up to 6 files (or up to 4 if axes are included) can be executed at a time in parallel. · For parallel execution of mechanisms, it is necessary to add “Multi-mechanism” function to the system of the management tool. **Execution errors:** <In ON state> --- Error stop in all cases. · The specified program does not exist. · More than 7 programs have been executed. · The specified program contains the same mechanism as the running program. <In OFF state> *** The specified program has already completed.--- Ignore the command.**	

16-3-9. PAUSE

Format	**PAUSE [message]**		
Function	Temporary stop.	Message	Character string. (max. 32 characters)
Condition	Standard.		
Lock condition	None.		
Syntax check	None.		
Example	Display the message “Test” and bring the robot to stop state. **PAUSE Test**		
Note	When the PAUSE command is executed, the message specified in the argument appears. Unlike the HOLD command, this function does not lead to an error state.		

16-3-10. REM

Format	**REM [comment]**		
Function	Comment Use it to add comments in a file for easy understanding of the file.	Comment	Comment character string. (max. 32 characters)
Condition	Standard.		
Lock condition	None.		
Syntax check	None.		
Example	Add a comment “Start welding”. **REM Start welding**		

16-3-11. RET

Format	**RET**		
Function	Return to the calling (original) program. It terminates the current running program and resume operation of the original program. If the current running program is the original program, then it ends the program.		
Condition	Standard.		
Lock condition	None.		
Syntax check	None.		
Example	**RET**	The same command in conventional models	**RETPRG**

16-3-12. RSV_CANCEL

Format	**RSV_CANCEL**
Function	Use it to clear all lists of the reserved programs.
Condition	Standard.
Lock condition	None.
Syntax check	None.
Note	The command is effective only when “Program select in Auto start method is selected.

16-3-13. RSV_PROG

Format	**RSV_PROG [program name]**		
Function	Use it to add a program at the bottom of the reserved program list.	Program name	A program file name to be reserved.
Condition	Standard.		
Lock condition	None.		
Syntax check	None.		
Note	The command is effective only when “Program select in Auto start method is selected	The same command in conventional models	RSVJOB

16-3-14. STOP

Format	**STOP**		
Function	It terminates the current operation		
Condition	Standard.		
Lock condition	None.		
Syntax check	None.		
Example	**STOP**	The same command in conventional models	**STOP**

16-3-15. WAIT_IP

Format	**WAIT_IP [Input port No.][Condition] [Input value] T=[Value] s**		
Function	It stops operation until the condition is satisfied. If a time condition (T=) is given, it resumes operation after the specified time interval.	Input port No.	Terminal type: I1# ..... 1-bit input I4# ..... 4-bit input I8# ..... 8-bit input I16# ..... 16-bit input Terminal No. Value or variable name (GI, LI)
Condition	Standard.	Condition	Relation condition: =Terminal status and Input value are equal.
Lock condition	I/O lock.		
Syntax check	None.	Input value	A value to compare with the terminal status. (Value or variable name, or ON/OFF for 1-bit input.)
		Value	Specify duration of time for the wait condition to be satisfied before executing the next command. (Value or variable name (GR, LR).) [Set range: 0 - 99.99] **T=0**: to wait until condition is satisfied.
Example	Stop operation until I1# type input terminal is turned ON and resume operation after 20 seconds of time. **WAIT_IP I1#(001) = ON T= 20**	The same command in conventional models	WAIT IPORT=, T=

16-3-16. WAIT_VAL

Format	**WAIT_VAL[Input No.][Condition] [Input value] T =[Timer] s**		
Function	It stops operation until the condition is satisfied. If a time condition (T=) is given, it resumes operation after the specified time interval regardless of the result of the condition test.	Input No.	Variable (GB, LB, GI, LI)
Condition	Standard.	Condition	[Relation condition] **=** Value 1 and Value 2 are equal. **<** Value 1 is smaller than Value 2. **>** Value 1 is bigger than Value 2. **<=** Value 1 is equal to or less than Value 2. **>=** Value 1 is equal to or bigger than Value 2. **<>** Value 1 is not equal to Value 2.
Lock condition	I/O lock.		
Syntax check	None.	Input value	Value or variable
		Timer	Specify duration of time for the condition to be satisfied before executing the next command. (Value or variable name (GR, LR).) [Set range: 0 - 99.99] **T=0**: to wait until condition is satisfied.
Example	Stop operation until I1#type input terminal is turned ON, however, resume operation after 20 seconds of time. **WAIT_VAL I1#(001) = ON T= 20**		

16-4. Arithmetic operation commands

16-4-1. ADD

Format	**ADD [Variable] [Value]**		
Function	It adds a value to variable.	Variable	Variable whose value is to be referred to, and the calculated value is to be assigned to. (GB, LB, GI, LI, GL, LL, GR, LR, GD)
Condition	Standard		
Lock condition	None		
Syntax check	None	Value	Value or variable (of the same type and size)
Example	Add 10 to Variable LR001. **ADD LR001, 10**	**Note:** If the value is another variable, it must be the same type as the other variable.	

16-4-2. ATAN

Format	**[Variable]=ATAN[Variable][Data]**		
Function	It calculates an arc tangent and then assigns the result to specified variable.	Variable 1	Variable (GR, LR) the calculated value is to be assigned to. [Return value: -90 - +90, Unit: degree]
Condition	Standard	Data	Value or variable (of the same type).
Lock condition	None		
Syntax check	None		
Example	Calculate atan **1** (=$\tan^{-1}$ **1**) and then assign the result to LR001. **ATAN LR001 1**		

16-4-3. CLEAR

Format	**CLEAR [Variable] [Parameter]**		
Function	It clears the value of a variable name.	Variable	Variable name or type whose value is to be reset to Zero.
Condition	Standard		
Lock condition	None	Parameter	Individual: to specify a variable name to reset.
Syntax check	None		ALL: to reset all variable values of the specified variable type.
		The same command in conventional models	RSTREG
Example	To clear the value of variable LR001. **CLEAR LR001**	**Note:** Once executed, the applied variable value becomes zero.	

16-4-4. CNVSET

Format	**CNVSET [Variable 1] = [Variable 2]** **See application examples**		
Function	It executes value assignment between different variable types.	Variable 1	Target variable name.
Condition	Standard		
Lock condition	None	Variable 2	Assignment variable name.
Syntax check	None		ALL: to reset all variable values of the specified variable type.
Example		**Note:** 8. An error occurs when the assignment value exceeds the preset scope of the target variable type. 9. An error occurs when the target variable is invalid. 10. When a real value is assigned to integer type variable, the value is rounded off to one's digit.	

16-4-5. COS

Format	**COS [Variable][Data]**		
Function	It calculates a cosine value and assigns the result to specified variable.	Variable	Variable the calculated value is to be assigned to. (GR, LR)
Condition	Standard	Data	Calculation or variable (or the same type) (Unit: degree)
Lock condition	None		
Syntax check	None		
Example	Calculate cos45 and assign the result to LR001. **COS LR001 45**		

16-4-6. DEC

Format	**DEC [Variable]**		
Function	It decrements the variable by 1.	Variable	Variable whose value is to be decremented by 1.
Condition	Standard		(GB, LB, GI, LI, GL, LL)
Lock condition	None		
Syntax check	None		
Example	Decrements the value of LR001 by 1. **DEC LR001**		

16-4-7. DIV

Format	**DIV [Variable 1] [Variable 2]**		
Function	It executes a division. If the integer type is selected as the value of the target variable name, it omits decimals.	Variable 1	Variable whose value is to be referred to and the result is to be assigned to. (GB, LB, GI, LI, GL, LL)
Condition	Standard		
Lock condition	None	Variable 2:	Value or variable (of the same type)
Syntax check	Error if both variable 1 and 2 are teaching point type or 3-D type, or if variable 1 and 2 are teaching point type and 3-D type.		
Example	Divide variable LR001 by 10. **DIV LR001, 10**		

16-4-8. GETEL

Format	**GETEL [Variable 1] = [Variable 2]**		
Function	It refers to the element of the teaching point type, 3-D type or robot type variable.	Variable 1	Target variable (GR, LR)
		Variable 2	Value to be extracted Element (GD, GT) X: a point on the X-axis. Y: a point on the Y-axis. Z: a point on the Z-axis.
Condition	None		
Lock condition	None		
Syntax check	Error if variable to be assigned to is not teaching point type, 3-D type or robot type variable.		
Example	Extract the element X of variable GD001 to LR001. **GETEL LR001 = GD.X GD001**		

16-4-9. GETPOS

Format	**GETPOS [Variable]**		
Function	It saves the current robot orientation in position variable.	Variable	Variable to save position value (GD, GA, GP, P).
Condition	None.		
Lock condition	None.		
Syntax check	None.		
Example	Save the robot position when the command is executed in GD001. **GETPOS GD001**		

16-4-10. INC

Format	**INC [Variable]**		
Function	It increments the variable by 1.	Variable	Variable whose value is to be incremented by 1. (GB, LB, GI, LI, GL, LL)
Condition	Standard.		
Lock condition	None.		
Syntax check	None.		
Example	Increment the value of LR001 by 1. **INC LR001**		

16-4-11. MOD

Format	**[MOD [Variable] [Data]**		
Function	It assigns the remainder to a specified variable name after a division.	Variable	Variable the remainder is to be assigned to. (GB, LB, GI, LI, GL, LL)
Condition	Standard.		
Lock condition	None.	Data	Value or variable (of the same type)
Syntax check	None.		
Example	Calculate the remainder of LR002÷LR003 and assign the result to LR002 **MOD LR002, LR003**		

16-4-12. MUL

Format	**MUL [Variable 1] [Variable 2]**		
Function	It multiplies values of a specified variable and another specified variable name.	Variable 1	Variable whose value is to be referred, and the calculated value is to be assigned to. (GB,LB,GI,LI,GL,LL,GR,LR,GD)
Condition	Standard.		
Lock condition	None.		
Syntax check	Error if both variable 1 and 2 are teaching point type or 3-D type, or if variable 1 and 2 are teaching point type and 3-D type.	Variable 2	Numerical value or variable (of the same type).
Example	Multiply LR001 by 2 **MUL LR001, 2**		

16-4-13. SET

Format	**SET [Variable 1] [Variable 2]**		
Function	It assigns a real number or variable to another variable.	Variable 1	Target variable (GB,LB,GI,LI,GL,LL,GR,LR,GD,GT)
Condition	Standard.	Variable 2	Assigned value or variable (of the same type).
Lock condition	None.		
Syntax check	None.		
Example	Set 10 to variable LR001 **SET LR001 = 10**	The same command in conventional models	SETREG

16-4-14. SETEL

Format	**SETEL [Variable] = [Data]**		
Function	It assigns a value to a constituent of the variable	Variable	Target variable Element (GD, GT) X: a point on the X-axis. Y: a point on the Y-axis. Z: a point on the Z-axis.
Condition	None.		
Lock condition	None.		
Syntax check	Error if variable to be assigned to is not teaching point type, 3-D type or robot type variable.	Data	Assignment value or Variable name (GR, LR, GD, GT)
Example	Set 100 to the element of variable GD001. **SETEL GD.X GD001 = 100**		

16-4-15. SIN

Format	**SIN [Variable] [Data]**		
Function	It calculates a sine value and assigns the result to specified variable.	Variable	Variable the calculated value is to be assigned to.
Condition	Standard.	Data	Calculation or variable (of the same type) (Unit: degree)
Lock condition	None.		
Syntax check	None.		
Example	Calculate sin45 and assign the result to LR001. **SIN LR001 45**		

16-4-16. SQRT

Format	**SQRT [Variable 1] [Variable 2]**		
Function	It calculates a square root and assigns the result to specified variable.	Variable 1	Variable the calculated value is to be assigned to. (GR, LR)
Condition	Standard.	Variable 2	Calculation or variable (of the same type).
Lock condition	None.		
Syntax check	None.		
Example	Calculate square root of 2 and then assign the result to LR001. **SQRT LR001 2**		

16-4-17. SUB

<table>
<tr><td>Format</td><td colspan="3">SUB [Variable 1] [Variable 2]</td></tr>
<tr><td rowspan="2">Function

Condition
Lock condition
Syntax check</td><td rowspan="2">Subtraction of values of two specified variable names.
Standard.
None.
Error if number of element of variable 1 and 2 do not match.
In case of combination of teaching point type, 3-D type or robot type variable, subtract only XYZ elements.</td><td>Variable 1</td><td>Variable whose value is to be referred to, and the calculated value is to be assigned to.
(GB,LB,GI,LI,GL,LL,GR,LR,GD)</td></tr>
<tr><td>Variable 2</td><td>Numerical value or variable (of the same type).</td></tr>
<tr><td>Example</td><td>Subtract 10 from LR001
SUB LR001, 10</td><td colspan="2">Note:
If variable is applied to “Variable 2”, its variable type should be the same as that of “Variable 1”.</td></tr>
</table>

16-5. Welding commands(GMAW and common use)

16-5-1. ADJRST

Format	**ADJRST**		
Function Condition Lock condition Syntax check	To reset welding process fine adjustment to default values. Weld package. Arc lock (Internal execution). None.		
Example	**ADJRST**	The same command in conventional models	ADJRST
	Values to be reset are those changed from their default values using the following sequences.		

BBKTIME	FTTLVL	HOTCUR	HOTVLT	IAC
IB2	INIT-IB	INIT-IP	I-PFALL	I-PRISE
ISC	ISL1	ISL2	PFALL	P-HOTTM
PPEAK	PRISE	TSO	TSP	WIRSLDN

16-5-2. AMP

Format	**AMP [Amperage]**		
Function Condition Lock condition Syntax check	Welding current setting. Weld package. Arc lock (Internal execution, specify values). None.	Amperage	Welding amperage [1 - 999] A
Example	Sets welding amperage to 200A. **AMP=200**	The same command in conventional models	AMP

16-5-3. ARC-OFF

Format	**ARC-OFF [File name] RELEASE=[Table]**		
Function	It ends the welding operation	File name	Name of the weld end operation file.
Condition Lock condition Syntax check	Weld package. Arc lock (Internal execution). The specified file name does not exist.	Table *** Note)**	Table number to execute automatic stick release. [0 - 5] Input “0” for no stick release. As for built-in welding power source controller, the table #6 and #7 are available, which is to retract wire automatically when the stick release functions.
Example	Execute ArcEnd1 file to end welding operation. **ARC-OFF ArcEnd1**	The same command in conventional models	AES

16-5-4. ARC-ON

Format	**ARC-ON [File name] RETRY=[Table]**		
Function	It starts welding operation Specify the file name for a series of torch ON operation which has been store in another file. The sample file using file name ArcStart1-5 is set at shipment.	File name	Name of the file for weld start operation.
Condition Lock condition Syntax check	Weld package. Arc lock (Internal execution). The specified file name does not exist.	Table	Table number to execute arc retry. [0 - 5] Input “0” for no arc retry.
Example	Execute ArcStart1 file to terminate welding operation. Do not apply the arc retry function. **ARC-OFF ArcStart1 RETRY=0**	The same command in conventional models	ASS

16-5-5. ARC-SET

Format	**ARC-SET AMP=[Amperage] VOLT=[Voltage] S=[Speed]**		
Function	It specifies welding conditions.	Amperage	Welding current. [1 – 999] A
Condition	Weld package.	Voltage	Welding voltage. [0.1 - 99.9] V
Lock condition	Arc lock (Internal execution, specify values.)	Speed	Welding speed. [0.01 - 120.00] m/min
Syntax check	None.		
Example	Set parameters for welding operation whose welding current is 180A, welding voltage is 20 V and speed is 0.5 m/min. **ARC-SET A=180 V=20 S=0.50**	The same command in conventional models	AJO
Note	When the welding is set to “Unitary”, by setting “VOLT” to “0.0”, the appropriate welding voltage for the set welding current is automatically set referring to the unitary table.		

16-5-6. ARCSLP

Format	**ARCSLP_AMP=[Amperage] VOLT=[Voltage] [Slope range]=[Value]**		
Function	It slopes welding conditions to make smooth ramped bead.	Amperage	Final slope amperage. [1 – 999] A
		Voltage	Final slope voltage. [1 – 999] A
Condition	Weld package.	Slope range	Slope range definition T=: Time range D=: Distance range NEXT: To the next step
Lock condition	Arc lock (Internal execution)		
Syntax check		Value	T=: Time [0.01 - 999.99] s D=: Distance [0.01 - 999.99] mm NEXT: No value
Example	**ARCSLP AMP=180 VOLT=23.0 NEXT**		

16-5-7. BBKTIME

Format	**BBKTIME [Value]**		
Function	It adjusts the burn back time. Increase the value to extend the wire burning time, which reduces chances of a wire stick. Decrease it to shorten the wire burning time, which as a result reduces chances of the tip burn back.	Value *	Fine adjustment value which will be added to the system set value. [-20 - +20] Executing +1 adjustment twice does not result in +2.
Condition	Weld package.		
Lock condition	Arc lock (Internal execution).		
Syntax check	None.		
Example	Adjust the system set value by “+1”. **BBKTIME +1**	The same command in conventional models	BBKTIME

16-5-8. CRATER

Format	**CRATER AMP=[Amperage] VOLT=[Voltage] T=[Timer]**		
Function	It sets crater welding conditions.	Amperage	Crater welding amperage. [1 – 999] A
Condition	Weld package.		
Lock condition	Arc lock (Internal execution, set values).	Voltage	Crater welding voltage. [0.1 - 99.9] V
Syntax check	None.		
Example	Set parameters for crater welding whose current is 120 A and voltage is16 V for 0.2 seconds. **CRATER A=120 V=16 T=0.2**	Timer	Crater welding time. [0.00 - 99.99] s
		The same command in conventional models	CJO

16-5-9. FTTLVL

Format	**FTTLVL [Value]**		
Function	It adjusts the FTT voltage level. Increase the value to round the end of the wire. As a result it reduces chances of the wire stick. Decrease it to sharpen the end of the wire for better arc start.	Value *	Fine adjustment value which will be added to the system set value. [-50 - +50] Executing +1 adjustment twice does not result in +2.
Condition	Weld package.		
Lock condition	Arc lock (Internal execution).		
Syntax check	None.		
Example	Adjust the system set value by +1. **FTTLVL +1**	The same command in conventional models	FTTLVL

16-5-10. GASVALVE

Format	**GASVALVE [ON/OFF]**		
Function	It opens or closes the gas valve.	ON/OFF	ON to open the gas valve. OFF to close the gas valve.
Condition	Weld package.		
Lock condition	Arc lock.		
Syntax check	None.		
Example	Open the gas valve. **GASVALVE ON**	The same command in conventional models	OUTB OPORT#210=*

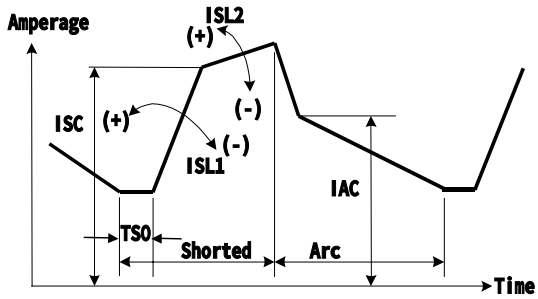
16-5-11. HOTCUR

Format	**HOTCUR [Value]**		
Function	It adjusts Hot current.	Value	Adjustment value [－3 - ＋3]
Condition			
Lock condition	Arc lock		
Syntax check	None		
Example	Set the Hot current to +1. **HOTCUR +1**	The same command in conventional models	

16-5-12. HOTVLT

Format	**HOTVLT [Value]**		
Function	It adjusts the hot voltage. Increase the value to smoothen wire feeding immediately after the arc start. Decrease it to restrain the burn-back immediately after the arc start.	Value *	Fine adjustment value which will be added to the system set value. [-50 - +50] Executing +1 adjustment twice does not result in +2.
Condition	Weld package.		
Lock condition	Arc lock (Internal execution).		
Syntax check	None.		
Example	Adjust the system set value by +1. **HOTVLT +1**	The same command in conventional models	HOTVLT

16-5-13. IAC

Format	**IAC [Value]**		
Function Condition Lock condition Syntax check	It adjusts the arc current refraction point of the welding current waveform. Weld package. Arc lock (Internal execution). None.	Value *	Fine adjustment value which will be added to the system set value. [-3 - +3] Executing +1 adjustment twice does not result in +2.
Example	Adjust the system set value by +1. **IAC +1**	The same command in conventional models	IAC
			

16-5-14. IB

Format	**IB [Base amperage]**		
Function Condition Lock condition Syntax check	It adjusts base amperage. Weld package. Arc lock (Internal execution). None.	Base amperage	Panasonic fully digital welding power sources: [-50 - +50] Other power sources: [-5 - +5]
Example	Adjust the system set value by +1. **IB = +1**	The same command in conventional models	IB

16-5-15. IB2

Format	**IB2 [Value]**		
Function Condition Lock condition Syntax check	It adjusts the secondary base amperage. Arc lock (Internal execution). None.	Value	Adjustment value [−50 - +50]
Example	Set the secondary base current to +1. **IB2 +1**	The same command in conventional models	

16-5-16. IF-ARC

Format	**IF-ARC =[ON/OFF]THEN [Execute 1]ELSE [Execute 2]** See application examples		
Function Condition Lock condition Syntax check	It applies different actions depending on whether or not the arc is generated. Arc lock (Internal execution) None	[ON/OFF] [Execute 1] [Execute 2]	Arc state (ON: Arc is ON / OFF: No arc) An instruction to be executed if the condition is satisfied. Select from “JUMP”,“CALL” or “NOP”. An instruction to be executed if the condition is not satisfied. Select from “JUMP”, “CALL” or “NOP”
Example	If arc generation is detected, jump to LABL0001, otherwise, execute the next command. **IF-ARC=ON THEN JUMP LABL0001 ELSE NOP**	The same command in conventional models	
Note	Arc lock is treated in the same manner as arc generation.		

16-5-17. INIT-IB

Format	**INIT-IB [Value]**		
Function Condition Lock condition Syntax check	It adjusts the initial base amperage. Arc lock (Internal execution). None.	Value	Adjustment value [−50 - +50]
Example	Set the initial base current to +1. **INIT-IB +1**	The same command in conventional models	

16-5-18. INIT-IP

Format	**INIT-IP [Value]**		
Function Condition Lock condition Syntax check	It adjusts initial peak amperage. Arc lock (Internal execution). None.	Value	Adjustment value [−50 - +50]
Example	Set the initial peak amperage to +1. **INIT-IP +1**	The same command in conventional models	

16-5-19. IP

Format	**IP [Peak amperage]**		
Function Condition Lock condition Syntax check	It adjusts peak amperage. Weld package. Arc lock (Internal execution). None.	Peak amperage	Panasonic fully digital welding power sources: [-50 - +50] Other power sources: [-5 - +5]
Example	Adjust the system set value by +1. **IP = +1**	The same command in conventional models	IP

16-5-20. I-PFALL

Format	**I-PFALL [Value]**		
Function Condition Lock condition Syntax check	It adjust s gradient of falling pulse current. Arc lock (Internal execution). None.	Value	Adjustment value [−7 - +7]
Example	Adjust the falling pulse gradient by +1. **I-PRISE +1**	The same command in conventional models	

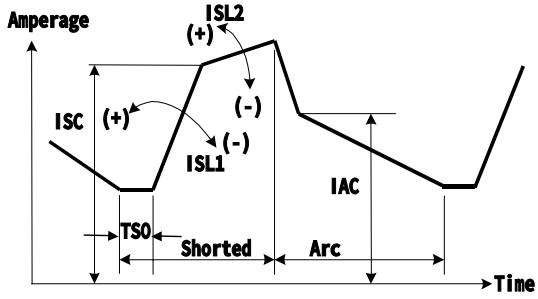
16-5-21. I-PRISE

Format	**I-PRISE [Value]**		
Function Condition Lock condition Syntax check	It adjust s gradient of rising pulse current. Arc lock (Internal execution). None.	Value	Adjustment value [−7 - +7]
Example	Adjust the rising pulse gradient by +1. **I-PRISE +1**	The same command in conventional models	

16-5-22. ISC

<table>
<tr><td>Format</td><td colspan="4">ISC [Value]</td></tr>
<tr><td>Function

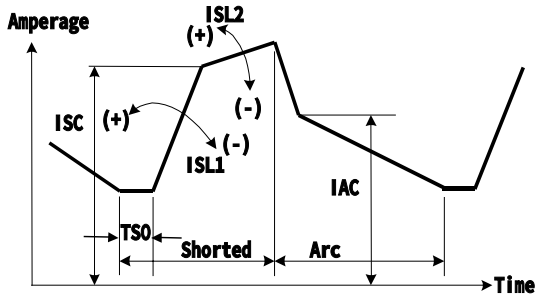
Condition
Lock condition
Syntax check</td><td>It adjusts short-circuit amperage slope of the welding current waveform.
Weld package.
Arc lock (Internal execution).
None.</td><td>Value

*</td><td colspan="2">Fine adjustment value which will be added to the system set value. [-3 - +3]
Executing +1 adjustment twice does not result in +2.</td></tr>
<tr><td>Example</td><td>Adjust the system set value by +1.
ISC +1</td><td colspan="2">The same command in conventional models</td><td>ISC</td></tr>
<tr><td></td><td colspan="4"> 
</td></tr>
</table>

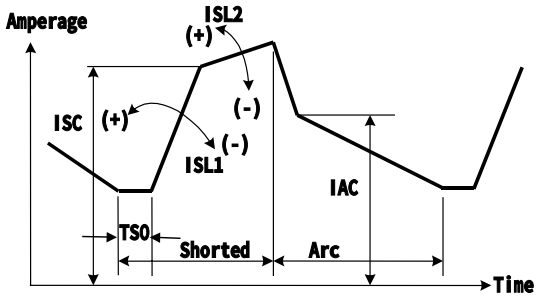
16-5-23. ISL1

<table>
<tr><td>Format</td><td colspan="4">ISL1 [Value]</td></tr>
<tr><td>Function

Condition
Lock condition
Syntax check</td><td>It adjusts short-circuit amperage slope 1 of welding current waveform.
Increase the value to make the slope gentler.
Weld package.
Arc lock (Internal execution).
None.</td><td>Value

*</td><td colspan="2">Fine adjustment value which will be added to the system set value. [-7 - +7].
Executing +1 adjustment twice does not result in +2.</td></tr>
<tr><td>Example</td><td>Adjust the system set value by +1.
ISL1 +1</td><td colspan="2">The same command in conventional models</td><td>ISL1</td></tr>
<tr><td></td><td colspan="4"> 
</td></tr>
</table>

16-5-24. ISL2

Format	**ISL2 [Adjustment value]**		
Function	It adjusts short-circuit amperage slope 2 of welding current waveform. Increase the value to make the slope gentler.	Value	Fine adjustment value which will be added to the system set value. [-7 - +7].
Condition	Weld package.	*	Executing +1 adjustment twice does not result in +2.
Lock condition	Arc lock (Internal execution).		
Syntax check	None.		
Example	Adjust the system set value by +1. **ISL2 +1**	The same command in conventional models	ISL2
			

16-5-25. PENET

Format	**PENET [Adjustment value]**		
Function	It adjusts penetration control value.	Value	Fine adjustment value which will be added to the system setting value.
Condition	Weld package.	*	Executing +1 adjustment twice does not result in +2.
Lock condition	Arc lock (Internal execution).		
Syntax check	None.		
Example	Adjust the system set value by +1. **PENET +1**	The same command in conventional models	PENET

16-5-26. PFALL

Format	**PFALL [Adjustment value]**		
Function	It adjusts the pulse fall angle.	Value	Panasonic fully digital welding power sources: [-50 - +50] Other power sources: [-5 - +5]
Condition	Weld package.		
Lock condition	Arc lock (Internal execution).		
Syntax check	None.		
Example	Adjust the pulse fall angle set value by +1. **PFALL +1**		

16-5-27. PFRQ

Format	**PFRQ [Pulse frequency]**		
Function	It adjusts pulse frequency.	Pulse frequency	Panasonic fully digital welding power sources: [-50 - +50] Other power sources: [-5 - +5]
Condition	Weld package.		
Lock condition	Arc lock (Internal execution).		
Syntax check	None.		
Example	Adjust the system set value by +1. **PFRQ +1**	The same command in conventional models	PFRQ

16-5-28. P-HOTTM

Format	**P-HOTTM [Value]**		
Function	It adjusts pulse hot time.	Value	Adjustment value [−10 - +10]
Condition			
Lock condition	Arc lock (Internal execution).		
Syntax check	None.		
Example	Adjust the pulse hot time to +1. **P-HOTTM +1**	The same command in conventional models	

16-5-29. PMODE

Format	**PMODE [Mode]**		
Function	It sets pulse mode.	Mode	Pulse mode [SOFT/HARD/HYBRID].
Condition	Weld package.		
Lock condition	Arc lock (Internal execution).		
Syntax check	None.		
Example	Change pulse mode to “SOFT”. **PMODE SOFT**	The same command in conventional models	PMODE

16-5-30. PPEAK

Format	**PPEAK [Value]**		
Function	It adjusts pulse peak time.	Value	Adjustment value [−50 - +50]
Condition			
Lock condition	Arc lock (Internal execution).		
Syntax check	None.		
Example	Adjust the pulse peak time to +1. **PPEAK +1**	The same command in conventional models	

16-5-31. PRISE

Format	**PRISE [Adjustment value]**		
Function	It adjusts the pulse rise angle.	Value	Panasonic fully digital welding power sources: [-50 - +50] Other power sources: [-5 - +5]
Condition	Weld package.		
Lock condition	Arc lock (Internal execution).		
Syntax check	None.		
Example	Adjust the pulse rise angle set value by +2. **PFALL +2**		

16-5-32. STICKCHK

Format	**STICKCHK [ON/OFF]**		
Function	It starts or terminates the stick check operation.	ON/OFF	ON: to start the stick check. OFF: to terminate the stick check.
Condition	Weld package.		
Lock condition	Arc lock.		
Syntax check	None.		
Example	Do stick check. **STICKCHK ON**	The same command in conventional models	OUTB OPORT#211=*

16-5-33. TORCHSW

Format	**TORCHSW**		
Function Condition Lock condition Syntax check	It turns ON or OFF the torch switch. Weld package. Arc lock. None.	ON/OFF	ON: to turn ON the torch switch. OFF: to turn OFF the torch switch.
Example	Turn ON the torch switch. **TORCHSW ON**	The same command in conventional models	OUTB OPORT#209=*

16-5-34. TSO

Format	**TSO [Value]**		
Function Condition Lock condition Syntax check	It adjusts initial short time. Arc lock (Internal execution). None.	Value	Adjustment value [−3 - +3]
Example	Set the initial short time to +1. TSO +1	The same command in conventional models	

16-5-35. TSP

Format	**TSP [Value]**		
Function Condition Lock condition Syntax check	It adjusts wire sticking prevention time. Arc lock (Internal execution). None.	Value	Adjustment value [−3 - +3]
Example	Adjust the wire sticking prevention time to +1. TSP +1	The same command in conventional models	

16-5-36. VOLT

Format	**VOLT [Voltage]**		
Function Condition Lock condition Syntax check	It sets welding voltage. Weld package. Arc lock (Internal execution, set values). None.	Voltage	Welding voltage. [0.1 - 99.9] V
Example	Set welding voltage to 24 V. **VOLT=24**	The same command in conventional models	VOLT

16-5-37. WAIT-ARC

Format	**WAIT-ARC**		
Function Condition Lock condition Syntax check	It stops operation of the mechanism until arc generation is detected (detects welding current). Weld package Arc lock None		
Example	**WAITARC**	The same command in conventional models	WAIT IPORT#217=1

16-5-38. WFED

Format	**WFED [Feed rate]**		
Function	It sets wire feed rate.	Feed rate	Wire feed rate.
Condition	Weld package		[0.00 - 15.00] m/min
Lock condition	Arc lock (Internal execution)		
Syntax check	None		
Example	Set wire feed rate to 10 m/min. **WFED 10.00**	The same command in conventional models	WFED

16-5-39. WIREFWD

Format	**WIREFWD [ON/OFF]**		
Function	It starts or terminates wire forward feed.	ON/OFF	ON: to feed wire. OFF: to terminate wire feed.
Condition	Weld package	*	Prior to this command, it is necessary to insert the “AMP=” command that specifies wire speed.
Lock condition	Arc lock		
Syntax check	None		
Example	Feeds wire forward. **WIREFWD ON**	The same command in conventional models	OUTB OPORT#212=*

16-5-40. WIRERWD

Format	**WIRERWD [ON/OFF]**		
Function	It starts or terminates wire retraction.	ON/OFF	ON: to start wire retraction.
Condition	Weld package		OFF: to terminate wire retraction.
Lock condition	Arc lock	*	Prior to this command, it is necessary to insert the “AMP=” command that specifies wire speed.
Syntax check	None		
Example	Retracts wire **WIRERWD ON**	The same command in conventional models	OUTB OPORT#213=* DELAY 0.1 OUTB OPORT#212=*

16-5-41. WIRSLDN

Format	**WIRSLDN [Value]**		
Function	It adjusts the wire slow-down speed. Increase the value to shorten the time to generate an arc. Decrease it for better arc start.	Value	Fine adjustment value which will be added to the system set value. [-125 - +125]
		*	Executing +1 adjustment twice does not result in +2.
Condition	Weld package		
Lock condition	Arc lock (Internal execution)		
Syntax check	None		
Example	Adjust the system set value by +1. **WIRSLDN +1**	The same command in conventional models	WIRESLDN

16-5-42. WLDCHK

Format	**WLDCHK [ON/OFF]**		
Function	It turns ON or OFF the weld check function (check for abnormal welding).	ON/OFF	Weld check flag. ON: to check. OFF: no check.
Condition	Weld package		
Lock condition	Arc lock (Internal execution)		
Syntax check	None		
Example	**WLDCHK OFF**	The same command in conventional models	WLDCHK
Note	It is ON at operation start and automatically checks when the robot reaches the next teaching point. It detects weld current regardless of weld check setting. (See the table below)		

	Current detect	Torch contact	Gas /wire	NO ARC	Stick
ON section	Check	Check	Check	Check	Check
OFF section	Check	NO-check	NO-check	NO-check	NO-check

16-5-43. WLDSPD

Format	**WLDSPD = [Speed]**		
Function	It specifies welding speed.	Speed	Set value [0.01 – 120.00] m/min .
Condition	Weld package		
Lock condition	None (Also valid in the arc-cut state.)		
Syntax check	None		
Example	Set the weld speed to 0.50 m/min. **WLDSPD = 0.50**	The same command in conventional models	
Note	It changes welding speed in the weld section.		

16-5-44. WPLS

Format	**WPLS [ON/OFF]**		
Function	It specifies whether to apply the pulse control (ON) or not (OFF).	ON/OFF	ON: to apply the pulse control. OFF: not to apply the pulse control .
Condition	Weld package		
Lock condition	Arc lock (Internal execution)		
Syntax check	None		
Example	**WPLS ON**	The same command in conventional models	PLS

16-6. Weld commands（Low pulse MIG）

16-6-1. LPDELAY

Format	**LPDELAY [Value]**		
Function Condition Lock condition Syntax check	It finely adjusts low pulse start time. Arc lock (Internal execution). None.	Value	Fine time adjustment [0.5 - 10.0] Hz
Example	Set the fine time adjustment to +1. **LPDELAY +1**	The same command in conventional models	

16-6-2. LPDUTY

Format	**LPDUTY [Value]**		
Function Condition Lock condition Syntax check	It sets the low pulse duty. Arc lock (Internal execution). None.	Value	Low pulse duty [10 – 90]%
Example	Set the low pulse duty to 50%. **LPDUTY 50**	The same command in conventional models	

16-6-3. LPFRQ

Format	**LPFRQ [Frequency]**		
Function Condition Lock condition Syntax check	It sets low pulse frequency. Arc lock (Internal execution). None.	Frequency	Low pulse frequency [0.5 - 10.0] Hz
Example	Set the low pulse frequency to 2.0. **LPFRQ 2.0**	The same command in conventional models	

16-6-4. LPLEVEL

Format	**LPLEVEL [Value]**		
Function Condition Lock condition Syntax check	It sets the low pulse level. Arc lock (Internal execution). None.	Value	Low pulse level [－50 – 0]
Example	Set the low pulse level to –25%. **LPLEVEL -25**	The same command in conventional models	

16-6-5. LPLS

Format	**LPLS [ON/OFF]**		
Function Condition Lock condition Syntax check	It turns on or off low pulse control. Arc lock (Internal execution). None.	ON/OFF	Low pulse control
Example	Start the low pulse control. **LPLS ON**	The same command in conventional models	

16-7. Weld commands（For TIG welding）

16-7-1. ACFRQ

Format	**ACFRQ = [Frequency]**		
Function Condition Lock condition Syntax check	It sets AC TIG frequency. Arc lock (Internal execution). None.	Frequency	Frequency [50 – 400] Hz
Example	Set the AC TIG frequency to 70Hz. **ACFRQ = 70**	The same command in conventional models	

16-7-2. ARC-SET_TIG

Format	**ARC-SET_TIG Ib=[Base Amp] Ip=[Peak Amp] WF=[Filler spd] FRQ=[Frequency] S=[Speed]**		
Function Condition Lock condition Syntax check	It specifies TIG welding conditions. Weld package. Arc lock (Internal execution, specify values.) None.	Base Amp	Base amperage. [1 – 999] A
		Peak Amp	Peak amperage. [1 – 999] A
		Filler spd	Filler speed. [0.00 - 99.99]
		Frequency	Frequency. [0.0 - 500.0] Hz
Example	Set parameters for TIG welding operation whose base amperage is 120A, peak amperage is 180 A, filler speed is 10, frequency is 0.5 Hz and speed is 0.50 m/min. **ARC-SET_TIG Ib=120 Ip=180 WF=10 FRQ=0.5 S=0.50**	Speed	Welding speed. [0.01 - 120.00] m/min
		The same command in conventional models	AJO(TIG)

16-7-3. CHKVOLT

Format	**CHKVOLT = [Detection voltage for electrode short]**		
Function Condition Lock condition Syntax check	It sets detection voltage for electrode short. Arc lock (Internal execution). None.	Detection volt.	Detection volt. [0.0 - 15.0] V
Example	Set the detection voltage to 5.0V.. **CHKVOLT = 5.0**	The same command in conventional models	

16-7-4. CLEAN

Format	CLEAN = [Value]		
Function Condition Lock condition Syntax check	It sets cleaning width. Arc lock (Internal execution). None.	Value	EN ratio [50 – 90] %
Example	Set the cleaning width to 70%. CLEAN = 70	The same command in conventional models	

16-7-5. CRATER_TIG

Format	**CRATER_TIG Ib=[Base Amp] Ip=[Peak Amp] WF=[Filler spd] FRQ=[Frequency] T=[Timer]**		
Function	It sets crater welding conditions for TIG welding.	Base Amp	Base amperage. [1 – 999] A
Condition	Weld package.	Peak Amp	Peak amperage. [1 – 999] A
Lock condition	Arc lock (Internal execution, set values).	Filler spd	Filler speed. [0.00 - 99.99]
Syntax check	None.	Frequency	Frequency. [0.0 - 500.0] Hz
Example	Set parameters for TIG welding operation whose base current is 100A, peak current is 120 A, filler speed is 10 and frequency is 1.0 Hz for 0.2 seconds. **CRATER_TIG Ib=100 Ip=120 WF=10 FRQ＝1.0 T=0.2**	Speed	Welding speed. [0.00 - 99.99] m/min
		The same command in conventional models	CJO(TIG)

16-7-6. IB_TIG

Format	**IB_TIG [Base amperage]**		
Function	It sets base amperage for TIG welding.	Base amperage	Amperage [0 - 999] A.
Condition	Weld package.		
Lock condition	Arc lock (Internal execution).		
Syntax check	None.		
Example	Set the base amperage to 100 A. **IB_TIG = 100**	The same command in conventional models	IB

16-7-7. IP_TIG

Format	**IP_TIG [Peak amperage]**		
Function	It sets peak amperage for TIG welding.	Peak amperage	Amperage [0 to 999] A.
Condition	Weld package.		
Lock condition	Arc lock (Internal execution).		
Syntax check	None.		
Example	Set peak current to 150 A. **IP_TIG = 150**	The same command in conventional models	IP

16-7-8. MIXFRQ

Format	**MIXFRQ = [Frequency]**		
Function	It sets MIX-TIG frequency.	Frequency	Frequency [0.5 - 10.0] Hz
Condition			
Lock condition	Arc lock (Internal execution).		
Syntax check	None.		
Example	Set the MIX-TIG frequency to 1.0Hz. **MIXFRQ = 1.0**	The same command in conventional models	

16-7-9. MIXRATE

Format	**MIXRATE = [Value]**		
Function	It sets the AC ratio of MIX-TIG welding.	Value	AC ratio [10 – 90] %
Condition			
Lock condition	Arc lock (Internal execution).		
Syntax check	None.		
Example	Set the AC ratio to 50%. **MIXRATE = 50**	The same command in conventional models	

16-7-10. PDUTY_TIG

Format	**PDUTY_TIG [Pulse width]**		
Function Condition Lock condition Syntax check	It adjusts pulse width for TIG welding. Weld package. Arc lock (Internal execution). None.	Pulse width	Pulse width. [5 - 95] %
Example	Set pulse width to 50%. **PDUTY_TIG 50%**	The same command in conventional models	PDUTY

16-7-11. PFRQ_TIG

Format	**PFRQ_TIG [Pulse frequency]**		
Function Condition Lock condition Syntax check	It sets pulse frequency for TIG welding Weld package. Arc lock (Internal execution). None.	Pulse frequency	[0 and 0.8 - 500.0] Hz for the digital TIG specifications. [0 to 49.9] Hz for the analog type welding machines.
Example	Set the pulse frequency to 10 Hz. **PFRQ_TIG 10.0**	The same command in conventional models	PFRQ

16-7-12. TIGSLP

Format	**TIGSLP Ib= [Base amp] Ip= [Peak amp] [Slope range]=[Value]**		
Function	It slopes welding amperage.	Base amp	Final slope base amp. [1 – 999] A
Condition	Weld package.	Peak amp	Final slope peak amp. [1 – 999] A
Lock condition	Arc lock (Internal execution).	Slope range	Slope range definition T=: Time range D=: Distance range NEXT: To the next step
Syntax check	None.	Value	T=: Time [0.01 - 999.99] s D=: Distance [0.01 - 999.99] mm NEXT: No value
Example	**TIGSLP Ib= 30 Ip=60 NEXT**		

16-7-13. WFDSLP

Format	**WFDSLP WFED= [Filler wire speed] [Slope range]=[Value]**		
Function	It slopes filler wire feed speed.	Filler wire speed	Final wire feed speed
Condition	Weld package.		[0 - 15.00] m/min
Lock condition	Arc lock (Internal execution).	Slope range	Slope range definition T=: Time range D=: Distance range NEXT: To the next step
Syntax check	None.	Value	T=: Time [0.01 - 999.99] s D=: Distance [0.01 - 999.99] mm NEXT: No value
Example	**WFDSLP WFED= 10 NEXT**		

16-7-14. WMODE_TIG

Format	**WMODE_TIG = [Weld method] [Wave mode]**		
Function Condition Lock condition Syntax check	It sets welding method and the AC TIG wave mode. Arc lock (Internal execution). None.	Weld method Wave mode]	Selection: [AC, DC or MIX] Selection: [STD, Hard or Soft]
Example	Set to AC TIG welding with standard wave mode. **WMODE_TIG = AC STD**	The same command in conventional models	

16-8. Weld commands（Powder plasma welding）

16-8-1. ARC-SET_POWD

Format	**ARC-SET_POWD Ib= [Base amp] Ip= [Peak amp] PF= [Powder] FRQ= [Freq] S= [Speed]**		
Function Condition Lock condition Syntax check	It sets a powder plasma welding condition. Arc lock (Internal execution). None.	Base amp Peak amp	Welding amperage or base amperage at pulsed welding [5 - 200] A No designation at no-pulsed welding. Peak amperage at pulsed welding [5 - 200] A
Example	Set the base amp to20A、the peak amp to 95A、the powder to 38、the pulse frequency to 6.0Hz and the weld speed to 0.26m/min. **ARC-SET_POWD Ib=20 Ip=95 PF=38 FRQ=6.0 S=0.26**	Powder Freq Speed	Powder feed [0, 14 - 100] Pulse frequency [0.5 - 25.0] Hz Weld speed [0.01 - 120.00] m/min

16-8-2. CARRYGAS

Format	**CARRYGAS [ON/OFF]**		
Function Condition Lock condition Syntax check	It turns on or off the carrier gas. Arc lock (Internal execution). None.	ON/OFF	Carrier gas control
Example	Turn on the carrier gas. **CARRYGAS ON**	The same command in conventional models	

16-8-3. CRATER_POWD

Format	**CRATER_POWD Ib= [Base amp] Ip= [Peak amp] PF= [Powder] FRQ= [Freq] T= [Time]**		
Function Condition Lock condition Syntax check	It sets a crater filler welding condition. Arc lock (Internal execution). None.	Base amp Peak amp	Welding amperage or base amperage at pulsed welding [5 - 200] A No designation at no-pulsed welding. Peak amperage at pulsed welding [5 - 200] A
Example	Set the base amperage to 15A, the peak amperage to 75A, the powder to 38, the frequency to 6.0Hz and the time to 0.50s. **CRATER_POWD Ib=15 Ip=75 PF=38 FRQ=6.0 T=0.50**	Powder Freq Time	Powder feed [0, 14 - 100] Pulse frequency [0.5 - 25.0] Hz welding time [0.00 - 99.99]

16-8-4. F-RANGE

Format	**F-RANGE = [High / Low]**		
Function Condition Lock condition Syntax check	It changes the frequency range. Arc lock (Internal execution). None.	High / Low	Frequency range selection
Example	Change the frequency range to the high. **F-RANGE High**	The same command in conventional models	

16-8-5. IB_POWD

Format	**IB_POWD = [Value]**		
Function	It sets base amperage for powder plasma welding application.	Value	Base amperage [5 – 200] A
Condition			
Lock condition	Arc lock (Internal execution).		
Syntax check	None.		
Example	Set the base amperage to 20A. **IB_POWD 20**	The same command in conventional models	

16-8-6. IP_POWD

Format	**IP_POWD = [Value]**		
Function	It sets the peak amperage for powder plasma welding application.	Value	Peak amperage [5 – 200] A
Condition			
Lock condition	Arc lock (Internal execution).		
Syntax check	None.		
Example	Set the peak amperage to 95A. **IP_POWD 95**	The same command in conventional models	

16-8-7. PDUTY_POWD

Format	**PDUTY_POWD = [Value]**		
Function	It sets the pulse width.	Value	Pulse width [15 – 85]
Condition			
Lock condition	Arc lock (Internal execution).		
Syntax check	None.		
Example	Set the pulse width to 50. **PDUTY_POWD 50**	The same command in conventional models	

16-8-8. PFRQ_POWD

Format	**PFRQ_POWD = [Pulse frequency]**		
Function	It sets pulse frequency.	Frequency	Pulse frequency [0.5 - 25.0]
Condition			
Lock condition	Arc lock (Internal execution).		
Syntax check	None.		
Example	Set the pulse frequency to 6.0. **PFRQ_POWD 6.0**	The same command in conventional models	

16-8-9. PLARC

Format	**PLARC [ON/OFF]**		
Function	It turns on or off the pilot arc.	ON/OFF	Pilot arc control
Condition			
Lock condition	Arc lock (Internal execution).		
Syntax check	None.		
Example	Turn on the pilot arc. **PLARC ON**	The same command in conventional models	

16-8-10. PLASMAGAS

Format	**PLASMAGAS [ON/OFF]**		
Function	It turns on or off the plasma gas.	ON/OFF	Plasma gas control
Condition			
Lock condition	Arc lock (Internal execution).		
Syntax check	None.		
Example	Turn on the plasma gas. **PLASMAGAS ON**	The same command in conventional models	

16-8-11. POWDFED

Format	**POWDFED = [Feed rate]**		
Function	It sets the powder feed rate.	Feed rate	Powder federate (Motor speed) [0, 14 – 100]
Condition			
Lock condition	Arc lock (Internal execution).		
Syntax check	None.		
Example	Set the powder feed rate to 20. **POWDFED 20**	The same command in conventional models	

16-8-12. PWDMOTOR

Format	**PWDMOTOR [ON/OFF]**		
Function	It turns on or off the powder feed motor power.	ON/OFF	Powder feed motor control
Condition			
Lock condition	Arc lock (Internal execution).		
Syntax check	None.		
Example	Turn on the powder feed motor **PWDMOTOR ON**	The same command in conventional models	

16-8-13. PWDSLP

Format	**PWDSLP Ib= [Base amp] Ip= [Peak amp] [Slope range] [Value]**		
Function	It sets a slope control condition for powder plasma welding application.	Base amp	End base amperage of the slope [5 – 200] A
		Peak amp	End peak amperage of the slope [5 – 200] A
Condition		Slope range	Slope range
Lock condition	Arc lock (Internal execution).		T=: Time designation
			D=: Distance designation
			NEXT: By the next point.
Syntax check	None.	Value	T=: Time [0.01 - 999.99] s
Example	Change the base amperage to 25A and the peak amperage to 100A for 10seconds. **PWDSLP Ib=25 Ip=100 T=10.00**		D=: Distance [0.01 - 999.99] mm NEXT: Nothing

16-8-14. SHLDGAS

Format	**SHLDGAS [ON/OFF]**		
Function Condition Lock condition Syntax check	It turns on or off the shield gas. Arc lock (Internal execution). None.	ON/OFF	Shield gas control
Example	Turn on the shield gas. SH**LDGAS ON**	The same command in conventional models	

16-8-15. STARTGAS

Format	**STARTGAS [ON/OFF]**		
Function Condition Lock condition Syntax check	It turns on or off the start gas. Arc lock (Internal execution). None.	ON/OFF	Start gas control
Example	Turn on the start gas. **STARTGAS ON**	The same command in conventional models	

16-8-16. WAIT-PLARC

Format	**WAIT-PLARC**		
Function Condition Lock condition Syntax check	It waits pilot arc. Arc lock (Internal execution). None.		Non
Example	Wait by starting pilot arc. **WAITPLARC**	The same command in conventional models	

16-8-17. WPLS_PWD

Format	**WPLS_PWD [ON/OFF]**		
Function Condition Lock condition Syntax check	It turns on or off welding pulse control. Arc lock (Internal execution). None.	ON/OFF	Pulse control
Example	Turn on the pulse. **WPLS_PWD ON**	The same command in conventional models	

16-9. Weld commands（MIG、TIG-FORCE application）

16-9-1. ARC-SET_TIGFC

Format	**ARC-SET_TIGFC Ib=[Base Amp] Ip=[Peak Amp] WFb=[Base WFS] WFp=[Peak WFS] FRQ=[Frequency] S=[Speed]**		
Function	It specifies welding conditions for TIG Force.	Base Amp	Base amperage: [1-999] A
Condition	Using TIG-FORCE.	Peak Amp	Peak amperage: [1-999] A
Lock condition	Arc lock (Internal execution)	Base WFS	Min. wire speed: [0.10-30.00] m/min
Syntax check	None.	Peak WFS	Max. wire speed: [0.10-30.00] m/min
		Frequency	Frequency: [0.0-500.0] Hz
		Speed	Welding speed: [0.01-120.00] m/min
Example	Perform TIG welding with base amp at 120A, peak amp. At 180A, base wire feed speed at 1 m/min, peak wire feed speed at 12 m/min and frequency at 0.5 Hz at the speed of 0.5 m/min. **ARC-SET_TIGFC Ib=120 Ip=180 WFb=1 WFp=12 FRQ=0.5 S=0.50**		

16-9-2. CRATER_TIGFC

Format	**CRATER_TIGFC Ib=[Base Amp] Ip=[Peak Amp] WFb=[Base WFS] WFp=[Peak WFS] FRQ=[Frequency] T=[Time]**		
Function	It specifies crater conditions for TIG Force.	Base Amp	Base amperage: [1-999] A
Condition	Using TIG-FORCE.	Peak Amp	Peak amperage: [1-999] A
Lock condition	Arc lock (Internal execution)	Base WFS	Min. wire speed: [0.10-30.00] m/min
Syntax check	None.	Peak WFS	Max. wire speed: [0.10-30.00] m/min
		Frequency	Frequency: [0.0-500.0] Hz
		Time	Crater time: [0.00-99.99] s
Example	Perform crater welding with base amp at 120A, peak amp. At 180A, base wire feed speed at 12 m/min, peak wire feed speed at 1 m/min and frequency at 0.5 Hz for 0.2 second. **ARC-SET_TIGFC Ib=120 Ip=180 WFb=1 WFp=12 FRQ=0.5 S=0.50**		

16-9-3. LOAD TIGFC

Format	**LOAD TIGFC**		
Function	It loads the temporarily stored welding conditions for TIG Force.		
Condition	Using TIG-FORCE.		
Lock condition	Arc lock (Internal execution)		
Syntax check	None.		
Example	**LOAD TIGFC**		

16-9-4. SAVE TIGFC

Format	**SAVE TIGFC**		
Function	It temporarily stores welding conditions for TIG Force in buffer.		
Condition	Using TIG-FORCE.		
Lock condition	Arc lock (Internal execution)		
Syntax check	None.		
Example	**SAVE TIGFC**		

16-9-5. WFACC

Format	**WFACC [Acceleration]**		
Function Condition Lock condition Syntax check	It specifies acceleration time of wire feeding. Using TIG-FORCE. Arc lock (Internal execution) None.	Acceleration	Acceleration time: [0.10 – 0.99] s
Example	WFACC 0.5		

16-9-6. WFDCC

Format	**WFDCC [Deceleration]**		
Function Condition Lock condition Syntax check	It specifies deceleration time of wire feeding. Using MIG,MAG、TIG-FORCE. Arc lock (Internal execution) None.	Deceleration	Deceleration time: [0.10 – 0.99] s
Example	WFDCC 0.5		

16-9-7. WFEED

Format	**WFEED [Condition]**		
Function Condition Lock condition Syntax check	It starts or stops wire feeding. Using MIG,MAG、TIG-FORCE. Arc lock (Internal execution) None.	Condition	**Stop**: Stop Forward on: Start wire feed to forward direction. **Reverse on**: Start wire feed to reverse direction. **Preset FWD**: Start forward wire feed by preset amount with the WFLENGTH command. **Preset RVS**: Start reverse wire feed by preset amount with the WFLENGTH command.
Example	**WFEED Preset FWD**		
Note	Wire is fed with LOW speed when the feed speed is not specified.		

16-9-8. WFSLDN

Format	**WFSLD =[Speed] m/min**		
Function Condition Lock condition Syntax check	It specifies wire feed speed from the arc start to the arc generation. Arc lock (Internal execution) None	Speed	Wire feed speed Range: [0.1 – 2.5 m/min]
Example	Set the wire feed speed at arc start to 1.5 m/min. **WFSLDN 1.5**	The same command in conventional models	
Note	* Please refer to section “Input of sequence commands” in the operation manual (OM0205052JE) of push pull welding torch (YT-MBT501T**/YT-BMT501Y**).		

16-9-9. WFSPEED

Format	**WFSPEED [Feed speed]**		
Function	It specifies wire feed speed.	Feed speed	Feed speed:
Condition	Using MIG,MAG、TIG-FORCE.		[0.10 – 30.00] m/min
Lock condition	Arc lock (Internal execution)		
Syntax check	None.		
Example	WFSPEED 2.00 **WFEED Forward on**		

16-9-10. WFLENGTH

Format	**WFLENGTH [Feed length]**		
Function	It specifies wire feed length.	Feed length	Feed length
Condition	Using MIG,MAG、TIG-FORCE.		[0.0 – 99.9] mm
Lock condition	Arc lock (Internal execution)		
Syntax check	None.		
Example	Feed wire 10mm to forward direction. WFLENGTH = 10mm **WFEED Preset FWD**		
Note	Set wire feed length, and then feed the wire with the preset **WFEED** command.		

16-9-11. WSPDSLP

Format	WSPDSLP WFSPEED = [Filler wire speed] [Slope range]=[Value]		
Function	It slopes wire feed speed.	Filler wire speed	Final wire feed speed
Condition	Weld package.		[0.10 - 30.00] m/min
Lock condition	Arc lock.	Slope range	Slope range definition T=: Time range D=: Distance range NEXT: To the next step
Syntax check	None.	Value	T=: Time [0.01 to 999.99s] D=: Distance [0.01 to 999.99mm] NEXT: No value
Example	**WSPDSLP WFSPEED = 20.0 NEXT**		
Note	· By executing “Resume” after the robot having been brought to a stop either temporally or by turning off power in a slope section, the robot resumes operation with the welding conditions after the completion of slope operation. (Please note this command is effective only when the WFSPEED command is used in the arc start program.) · The override operation is not effective in the slope section.		

16-10. Logic operation commands

16-10-1. AND

Format	**AND [Variable] [Data]**		
Function	It carries out logical multiplication.	Variable	Variable whose value is to be referred to, and the calculated value is to be assigned to. (GB, LB)
Condition	Standard.		
Lock condition	None.	Data	Value or variable (GB, LB) Variable should be byte type.
Syntax check	Error if variable other than byte type variable is specified.		
Example	Store the result of logical multiplication of LB001 and LB002 to LB001. **AND LB001, LB002**	**Note:** It carries out logical multiplication of each bit.	

A	B	A AND B
0	0	0
0	1	0
1	0	0
1	1	1

16-10-2. NOT

Format	**NOT [Variable] [Data]**		
Function	It carries out logical NOT.	Variable	Variable whose value is to be referred to, and the calculated value is to be assigned to. (GB, LB)
Condition	Standard.		
Lock condition	None.		
Syntax check	Error if variable other than byte type variable is specified.	Data	Value or variable (GB, LB) Variable should be byte type.
Example	Store the result of logical not of LB002 to LB001. **NOT LB001, LB002**	**Note:** As logical not is carried out for each bit, NOT 0 = 11111111 ＝ 255	

A	NOT A
0	1
1	0

16-10-3. OR

Format	**OR [Variable] [Data]**		
Function	It carries out logical OR.	Variable	Variable whose value is to be referred to, and the calculated value is to be assigned to. (GB, LB)
Condition	Standard.		
Lock condition	None.		
Syntax check	Error if variable other than byte type variable is specified.	Data	Value or variable (GB, LB) Variable should be byte type.
Example	Store the result of logical OR of LB001 and LB002 to LB001. **OR LB001, LB002**	**Note:** It carries out logical multiplication of each bit.	

A	B	A OR B
0	0	0
0	1	1
1	0	1
1	1	1

16-10-4. SWAP

Format	**SWAP [Variable 1] [Variable 2]**		
Function Condition Lock condition Syntax check	It swaps values of two variable names. Standard. None. Error if number of element of variable 1 and 2 do not match.	Variable 1	Variable whose value is to be referred to, and the calculated value is to be assigned to. (GB, LB, GI, LI, GL, LL, GR, LR, GD)
		Variable 2	Value or variable (GB, LB). Variable should be type.
Example	Swap the value of LB001 with LB002. **SWAP LB001, LB002**	The same command in conventional models	SWPREG

16-10-5. XOR

Format	**XOR [Variable] [Data]**		
Function Condition Lock condition Syntax check	It carries out exclusive OR. Standard. None. Error if variable other than byte type variable is specified	Variable	Variable whose value is to be referred to, and the calculated value is to be assigned to. (GB, LB)
		Data	Value or variable (GB, LB) Variable should be byte type.
Example	Store the result of exclusive OR of LB001 and LB002 to LB001. **XOR LB001, LB002**	**Note:** It carries out exclusive OR of each bit.	

A	B	A XOR B
0	0	0
0	1	1
1	0	1
1	1	0

16-11. Motion assist commands

16-11-1. GOHOME

Format	**GOHOME [Interpolation type] [Position name] [Speed]**		
Function	It returns the robot to the home position.	Interpolation type	An interpolation type to be applied when the robot travels to the home position.
Condition	Standard.	Position name	A position variable name (P, GP or GA) to be assigned as home position.
Lock condition	None.		
Syntax check	None.	Speed	Travel speed to the home position.
Example	GOHOME	The same command in conventional models	GOHOME V=
Note	The home position output is turned ON when the robot reaches the home position.		

16-11-2. SMOOTH

Format	**SMOOTH=[Parameter]**		
Function	It sets smoothing level.	Parameter	Level [0 - 10]:
Condition	Standard.		Increase the level for larger smoothing size.
Lock condition	None.	*	This command is not reflected in trace operation only auto.
Syntax check	None.		
Example	Set smoothing level to 3. **SMOOTH 3**	The same command in conventional models	SMOOTH

16-11-3. TOOL

Format	**TOOL [Tool No.]**		
Function Condition Lock condition Syntax check	It switches tools. Standard. None. None.	Tool No.	Applied tool No. and tool name.
Example	Change tool to [1:STD]. **TOOL 1:STD**	The same command in conventional models	TOOL

16-12. Shift commands

16-12-1. SHIFT-OFF

Format	**SHIFT-OFF**
Function Condition Lock condition Syntax check	It terminates coordinate system shift Standard. None. None.
Example	To reset shift. **SHIFT-OFF**

16-12-2. SHIFT-ON

Format	**SNSSFT-ON [Coordinate systems] = [Variable]**		
Function Condition Lock condition Syntax check	It starts coordinate system shift Standard. None. None.	Coordinate systems	A coordinate system to be shifted.
		Variable	Shift amount. (GD, GT)
Example	Shift the operation onwards on the robot coordinate system by GD001. **SHIFT-ON ROBOT = GD001**		

16-13. Touch Sensor commands (Optional)

16-13-1. SNSSFTLD

Format	**SNSSFTLD [Variable]**		
Function Condition Lock condition Syntax check	It assigns the value of specified variable as the sensor shift amount. Standard. None. Error if variable types do not match.	Variable	Shift amount. (GD)
Example	Assign GD001 as sensor shift amount. **SNSSFTGD GD001**	The same command in conventional models	LDBUF

16-13-2. SNSSFT-OFF

Format	**SNSSFT-OFF**		
Function Condition Lock condition Syntax check	It terminates sensor shift Standard. None. None.		
Example	Terminate sensor shift. **SNSSFT-OFF**	The same command in conventional models	SFTBUF=0

16-13-3. SNSSFT-ON

Format	**SNSSFT-ON**		
Function Condition Lock condition Syntax check	It starts sensor shift Standard. None. None.		
Example	Start sensor shift. **SNSSFT-ON**	The same command in conventional models	SFTBUF=1

16-13-4. SNSSFTRST

Format	**SNSSFTRST**
Function Condition Lock condition Syntax check	It clears the sensor shift amount. Standard. None. None.
Example	Reset sensor shift amount. **SNSSFTRST**

16-13-5. SNSSFTSV

Format	**SNSSFTSV [Variable]**		
Function Condition Lock condition Syntax check	It stores the current sensor shift amount to the specified variable. Standard. None. Error if variable types do not match.	Variable	Shift amount (GD)
Example	Store the sensor shift to GD001. **SNSSFTSV GD001**	The same command in conventional models	RSTBUF

16-13-6. TCHSNS

Format	**TCHSNS SPD= [Speed]**		
Function Condition Lock condition Syntax check	It starts touch sensing Standard. None. None.	Speed	Sensing speed in m/min.
Example	Start touch sensing at speed 0.5 m/min. **TCHSNS SPD=0.5**	The same command in conventional models	TCHSNS
Note	The result of the touch sensing (shift amount) is stored in the sensor shift amount.		

16-13-7. TRANSBASE

Format	**TRANSBASE [Number]** See application examples		
Function	It registers the reference point for the rotary shift	Number	Reference point [1 – 3]
Condition	Touch sensor		Priority: 1, 2, 3
Lock condition	None.		
Syntax check	None.		
Example	Specify a reference point 1. **TRANSBASE 1**		
Note	· To execute the rotary shift, register reference points 1 to 3, and then execute the SNSSFT-ON command. · The TRANSBASE command can be used together with the TRANSBASV command.		

16-13-8. TRANSBASV

Format	**TRANSBASV [Number] [Reference point] [Target point]** See application examples		
Function	It uses variable to specify the reference point for the rotary shift conversion.	Number	Reference point [1 – 3] Priority: 1, 2, 3
Condition	Touch sensor	Reference point	A variable name the value of which is assigned to the reference point [P, GP, GA, GD]
Lock condition	None.		
Syntax check	None.	Target point	A variable name the value of which is assigned to the target point [P, GP, GA, GD]
Example	Specify a reference point 1 using P1, G0001. **TRANSBASV 1 P1 GD001**		
Note	· To execute the rotary shift, register reference points 1 to 3, and then execute the SNSSFT-ON command. · The TRANSBASV command can be used together with the TRANSBASE command.		

16-14. Spin Arc Sensor commands (Optional)

16-14-1. SPNARC

Format	**SPNARC [Switch]**		
Function	It starts or stop the spin arc sensor function.	Switch	Start/Stop switch
Condition	Spin arc sensor		ON： Start
Lock condition	Arc lock (Internal execution)		OFF： Stop
Syntax check	None.		
Example	Start Spin arc sensor. SPNARC ON	The same command in conventional models	SPNARC

16-14-2. SNSOFS

Format	**SNSOFS [Offset 1] [Offset 2]**		
Function	It adjusts offset values of the sensor.	Offset 1	Offset to perpendicular direction to both welding and torch directions. Current tracking: [-99 - 99] Voltage tracking: [-9.9 - 9.9]
Condition	Arc sensor and spin arc sensor		
Lock condition	Arc lock (Internal execution)	Offset 2	Offset to the torch direction: Current tracking: [-99 - 99] Voltage tracking: [-9.9 - 9.9]
Syntax check	None.		
Example	Adjust 0.2 to the torch direction. **SNSOFS 0 0.2**	The same command in conventional models	SNSOFS

16-14-3. SNSGN

Format	**SNSGN [Gain 1] [Gain 2]**		
Function	It adjusts the sensor gain.	Gain 1	Sensor gain to perpendicular direction to both welding and torch directions: [-99 to +99] **%**
Condition	Arc sensor and spin arc sensor		
Lock condition	Arc lock (Internal execution)	Gain 2	Sensor gain to the torch direction: [-99 - +99] **%**
Syntax check	None.		
Example	Set the sensor gains to –80 and –90. **SNSGN -80 -90**	The same command in conventional models	SNSGN

16-14-4. SPNPRM

Format	**SPNPRM [Type] = [Parameter]**		
Function	It sets the spin parameters.	Type	Type of parameters 1:MAXTRK: Max. tracking distance 2:PHASE1: Detecting phase 1 3:PHASE2: Detecting phase 2 4:REVFRQ: Revolving frequency 5:REVDIR: Revolving direction 12:STPPOS: Revolution stop position
Condition	Spin arc sensor		
Lock condition	Arc lock (Internal execution)	Parameter	1:MAXTRK: [0 - 1000] mm 2:PHASE1: [0 - 180] deg 3:PHASE2: [0 - 180] deg 4:REVFRQ: [0 - 50] Hz 5:REVDIR: [0(AUTO), 1(CW), 2(CCW)] 12:STPPOS: [1(AUTO), 2(FRONT), 3(REAR), 4(LEFT), 5(RIGHT)]
Syntax check	None.		
Example	Change the max. tracking distance to 100mm. **SPNPRM 1:MAXTRK = 100.0**	The same command in conventional models	SPNPRM

16-14-5. SNSLINE

Format	**SNSLINE [Switch] [User coordinate]**		
Function	It specifies welding direction.	Switch	Start/Stop switch: ON: Start OFF: Stop
Condition	Arc sensor and spin arc sensor		
Lock condition	Arc lock (Internal execution)	User coordinate	User coordinate
Syntax check	None.		
Example	Tacking the sensor to X direction of the USER coordinate 1. **SNSLINE ON USER#(1:SPN)**		
Note	The sensor tracks to X direction of the user coordinate in the range from ON to OFF.		

16-14-6. SPNREV

Format	**SPNREV [Spinning speed]**		
Function	It specifies spinning speed of the sensor.	Spinning speed	Selection: 1:Low: 10Hz 2:Middle: 30Hz 3:High: 50Hz
Condition	Spin arc sensor		
Lock condition	Arc lock (Internal execution)		
Syntax check	None.		
Example	Change the spinning speed to the low. SPNREV 3:Low		

16-14-7. SPNOFS

Format	**SPNOFS [Offset 1] [Offset 2]**		
Function	It adjusts the spin arc offsets.	Offset 1	Offset to perpendicular direction to both welding and torch directions. Current tracking: [-99.9-99.9] Voltage tracking: [-9.99-9.99]
Condition	Spin arc sensor		
Lock condition	Arc lock (Internal execution)	Offset 2	Offset to the torch direction: Current tracking: [-99.9 - 99.9] Voltage tracking: [-9.99 - 9.99]
Syntax check	None.		
Example	Offset 0.12 to the torch direction. **SPNOFS 0 0.12**		
Note	The offsets can set to two places of decimal. It is different from SNSOFS command.		

16-15. External axis commands (Optional)

16-15-1. EAXS_SFT-OFF

Format	**EAXS_SFT-OFF [Ext-Axis]**	See application examples	
Function	It terminates the external axis shift (EAXS_SFT) command.	[Ext-Axis]	The external axis number the applied EAXS_SFT processing to be terminated. [G1-G21 (including ones for slave robot)
Condition			
Lock condition	None		
Syntax check	None		
Example	Terminate the shift of the external axis G1. **EAXS_SFT-OFF G1**	The same command in conventional models	
Note	The section between EAXIS_SFT-ON and EAXIS_SFT-OFF becomes shift section.		

16-15-2. EAXS_SFT-ON

Format	**EAXS_SFT-ON [Ext-Axis]=[Value]**	See application examples	
Function	It shifts position of the external axis. .	[Ext-Axis]	The external axis number to be shifted by this command. Range: G1-G21 and defined as the system (including external axes for slave robot.)
Condition			
Lock condition	None	[Value]	Shift amount (Real number, GR, LR) [Real number: -99999.99- +99999.99] Unit: depending on the type of the external axis. (i.e. shift axis: mm, rotary axis:°.)
Syntax check	None		
Example	Shift the external axis G1 by +100. **EAXS_SFT-ON G1 = +100**	The same command in conventional models	
Note	The section between EAXIS_SFT-ON and EAXIS_SFT-OFF becomes shift section.		

16-15-3. RSTREV

Format	**RSTREV [Ext axis]**		
Function Condition Lock condition Syntax check	It adjusts the rotation angle. The value should be within -180 to +180. A rotary type external axis is connected. None. None.	Ext axis	Name of the external axis (rotary type).
Example	Reset multi-rotation of G1 axis. **RSTREV G1**	The same command in conventional models	RSTREV
Note	If the specified external axis is not rotary type, the command is ignored.		

16-15-4. VELREF

Format	**VELREF [Speed reference]**		
Function Condition Lock condition Syntax check	It calculates speed according to the specified mechanism. Standard. None. None.	Speed reference	Robot axis: Motion speed is calculated based on the robot movement. External axis: Motion speed is calculated based on the movement of the external axis.
Example	From this command onward, calculate speed based on the robot. **VELREF ROBOT**	The same command in conventional models	VELREF

16-16. ARC-ON/ARC-OFF sequences

The following sequence commands are available only for welding robots.

16-16-1. CO2/MAG/MIG welding

Welding start programs factory set at shipment

	ArcStart1	ArcStart2	ArcStart3	ArcStart4	ArcStart5
1	GASVALVE ON	GASVALVE ON	GASVALVE ON	DELAY 0.10	DELAY 0.10
2	TORCHSW ON	DELAY 0.10	DELAY 0.20	GASVALVE ON	GASVALVE ON
3	WAIT-ARC	TORCHSW ON	TORCHSW ON	DELAY 0.20	DELAY 0.20
4		WAIT-ARC	WAIT-ARC	TORCHSW ON	TORCHSW ON
5				WAIT-ARC	DELAY 0.20
6					WAIT-ARC

Welding end programs factory set at shipment

[G2 Controller]

	ArcEnd1	ArcEnd2	ArcEnd3	ArcEnd4	ArcEnd5
1	TORCHSW OFF	DELAY 0.10	DELAY 0.20	DELAY 0.30	TORCHSW OFF
2	DELAY 0.40	TORCHSW OFF	TORCHSW OFF	TORCHSW OFF	DELAY 0.40
3	STICKCHK ON	DELAY 0.40	DELAY 0.40	DELAY 0.40	AMP=150
4	DELAY 0.30	STICKCHK ON	STICKCHK ON	STICKCHK ON	WIRERWD ON
5	STICKCHK OFF	DELAY 0.30	DELAY 0.30	DELAY 0.30	DELAY 0.10
6	GASVALVE OFF	STICKCHK OFF	STICKCHK OFF	STICKCHK OFF	WIRERWD OFF
7		GASVALVE OFF	GASVALVE OFF	GASVALVE OFF	STICKCHK ON
8					DELAY 0.30
9					STICKCHK OFF
10					GASVALVE OFF
11					

Welding end programs factory set at shipment

[GX Controller]

	ArcEnd1	ArcEnd2	ArcEnd3	ArcEnd4	ArcEnd5
1	TORCHSW OFF	DELAY 0.10	DELAY 0.20	DELAY 0.30	TORCHSW OFF
2	STICKCHK ON	TORCHSW OFF	TORCHSW OFF	TORCHSW OFF	DELAY 0.40
3	STICKCHK OFF	STICKCHK ON	STICKCHK ON	STICKCHK ON	AMP=150
4	GASVALVE OFF	STICKCHK OFF	STICKCHK OFF	STICKCHK OFF	WIRERWD ON
5		GASVALVE OFF	GASVALVE OFF	GASVALVE OFF	DELAY 0.10
6					WIRERWD OFF
7					STICKCHK ON
8					STICKCHK OFF
9					GASVALVE OFF
10					
11					

<Note>

Wire retract at welding end:

Wire retract (feed backward) amount is determined by ["AMP"] x ["DELAY" for WIRERWD OFF].

Some welders ignore the welding current command during the burn back time. If so, the wire may hardly be retracted. In such case, set the DELAY for the torch switch OFF to 1.2 seconds or more to ensure the wire retract after the burn back operation.

16.16.2. TIG welding

Arc start/arc end sequences for CO2/MAG/MIG welding are factory registered at shipment. It is necessary to change the settings for TIG welding prior to teaching operation of TIG welding.

TIG welding without filler

	Arc start program	Arc end program
1	GASVALVE ON	TORCHSW OFF
2	DELAY 0.20s	DELAY 1.00s
3	TORCHSW ON	GASVALVE OFF
4	WAIT-ARC	
5	DELAY 0.50s	

* DELAY times in the above table are reference values. Adjust them suitable for each application.

TIG welding with filler

	Arc start program	Arc end program	Note
1	GASVALVE ON	OUT o1#(XXX) =OFF	
2	DELAY 0.50s	DELAY 1.00s	
3	TORCHSW ON	TORCHSW OFF	
4	WAIT-ARC	DELAY 1.00s	
5	DELAY 2.00s	STICKCHK ON	
6	OUT o1#(XXX) =ON	DELAY 1.00s	Terminal No.XXX represents the terminal that has been connected to the wire feed terminal of the filler wire controller.
7		STICKCHK OFF	
8		GASVALVE OFF	

* DELAY times in the above table are reference values. Adjust them suitable for each application.

16.16.3. Powder plasma welding

Arc start/arc end sequences for CO2/MAG/MIG welding are factory registered at shipment. It is necessary to change the settings for powder plasma welding prior to teaching operation of powder plasma welding.

	Arc start program	Note
1	CARRYGAS ON	Carrier gas ON
2	PWDMOTOR ON	Powder feed ON
3	DELAY 1.0s	For stable powder feed
4	TORCHSW ON	Torch switch ON
5	WAIT-ARC	
6	DELAY 0.20s	

	Arc end program	Note
1	TORCHSW OFF	Torch switch OFF
2	PWDMOTOR OFF	Powder feed OFF
3	CARRYGAS OFF	Carrier gas OFF
4	DELAY 0.20s	

17. Errors and Alarms

17-1. Alarm codes

* If the remedy doesn't reset the error or alarm condition, consult our service office.

Alarm code	Message	Probable Cause	Remedy
A4000	Over temperature	Abnormal temperature rise is detected. Continued operation may damage interior equipment.	Turn OFF the power and allow the machine to cool, and then newly turn on the power.
A4010	Contact welded: Spare Emergency stop	Circuit is fused. Safety card may be damaged.	Check the circuit connected to the terminal indicated in the alarm message and replace safety card as needed.
	Contact welded: TP Emergency stop		
	Contact welded: Door stop		
	Contact welded: HAND Emergency stop		
	Contact welded: Over run		
	Contact welded: External Emergency stop		
	Contact welded: Software Emergency stop		
	Contact welded: Safety relay stop		
	Contact welded: Harmony Emergency stop 1		
	Contact welded: Harmony Emergency stop 2		
	Contact welded: TP Dead Man's switch Feedback		
	Contact welded: Mode switch		
A4020	Overrun release input is detected	Overrun release input is not consistent.	Turn off the power and then check the overrun release switch.
A4030	Safety-circuit 24V error	Error in supply voltage at safety circuit is detected.	Turn off the power and then check the fuse of the safety card.
A4040	Sequencer PWR24V error	Error in supply voltage at the sequence circuit.	Turn off the power. Then check fuse on the sequencer board and power control board. Check also connection of the supply voltage.
A4050	Contact welded: Independent E-axis servo Off input (**) ＊＊is Axis name.	Fuse at servo OFF input of the Independent E-axis servo is detected.	Check the wiring of servo OFF input of the independent E-axis servo.
A5000	System alarm	An error occurred in the system.	Turn off the power and then newly turn it on.
A5001	Robot Comm. error	An error occurred in robots communication. The other robot was brought to an alarm stop. Noise in the robots communication.	Check the other robot for the cause of the alarm. Check the communication cable.
A6000	Servo power off	Error in controller, or inclusion of noise.	Turn off the power and then newly turn it on.
A6010	Servo comm. error	Error in controller or servo circuit board, or inclusion of noise.	
A6020	Sequencer communication error	Error in sequencer circuit.	

Alarm code	Message	Probable Cause	Remedy
A6030	T.P. Communication error	Error in controller or teach pendant, or inclusion of noise.	
A6040	Main CPU error	Error in controller, or inclusion of noise.	
A6050	Servo CPU Error		
A6060	I/O CPU Error	Error in controller.	Turn off the power and consult our service office near you.
A6110	Ext.1 Servo comm. error	Error in controller, or inclusion of noise.	Turn off the power and then newly turn it on.
A6210	Ext.2 Servo comm. error		
A7010	Amp ready error	Servo amp. ready error.	
A7020	IPM error	Error in controller or inclusion of noise.	
	Amp low-volt		
	Servo Power error		
A7030	Motor speed over	Speed exceeds rated value.	
	Current detect error	Current exceeds rated value	
	Position count over	The actual robot position exceeds the allowable range specified by the controller.	
	Pre-set count over	Pre-set count exceeds rated value.	
	Servo control error	Error in distribution process.	
	Drift error	Drift error occurred.	
A7040	Servo memory error	Error in servo circuit.	
	Servo CPU timer error		
	Servo CPU Comm error		
	Servo receive data error		
A7050	Servo undefined code error	Error occurred between servo and main.	
	Servo undefined code over		
A7110	Ext.1 Amp ready error	Servo amp. ready error.	Turn off the power and then newly turn it on. In case of a recurrent error, contact sales distributor or Panasonic representatives.
A7120	Ext.1 IPM error	Error in controller or inclusion of noise.	
	Ext.1 Amp low-volt		
	Ext.1 Servo Power error		
A7130	Ext.1 Motor speed over	Speed exceeds rated value.	
	Ext.1 Current detect error	Current exceeds rated value	
	Ext.1 Position count over	The actual robot position exceeds the allowable range specified by the controller.	
	Ext.1 Pre-set count over	Pre-set count exceeds rated value.	
	Ext.1 Servo control error	Error in distribution process.	
	Ext.1 Drift error	Drift error occurred.	
A7140	Ext.1 Servo memory error	Error in servo circuit.	
	Ext.1 Servo CPU timer error		
	Ext.1 Servo CPU Comm error		
	Servo receive data error		
A7150	Ext.1 Servo undefined code error	Error occurred between servo and main.	
	Ext.1 Servo undefined code over		
A7210	Ext.1 Amp ready error	Servo amp. ready error	
A7220	Ext.2 IPM error	Error in controller or inclusion of noise.	
	Ext.2 Amp low-volt		
	Ext.2 Servo Power error		

Alarm code	Message	Probable Cause	Remedy
A7230	Ext.2 Motor speed over	Speed exceeds rated value.	Turn off the power and then newly turn it on. In case of a recurrent error, contact sales distributor or Panasonic representatives.
	Ext.2 Current detect error	Current exceeds rated value.	
	Ext.2 Position count over	The actual robot position exceeds the allowable range specified by the controller.	
	Ext.2 Pre-set count over	Pre-set count exceeds rated value.	
	Ext.2 Servo control error	Error in distribution process.	
	Ext.2 Drift error	Drift error occurred.	
A7240	Ext.2 Servo memory error	Error in servo circuit. Error occurred between servo and main.	
	Ext.2 Servo CPU timer error		
	Ext.2 Servo CPU Comm error		
	Servo receive data error		
A7250	Ext.2 Servo undefined code error	Servo amp. ready error	
	Ext.2 Servo undefined code over		
A8000	Encoder battery error	Voltage of encoder data backup battery is running out.	Replace batteries.
	Encoder over speed	Encoder speed exceeds rated value.	Turn off the power and then newly turn it on.
	Encoder counter over	Encoder speed exceeds rated value.	
A8010	Encoder data error	Encoder data error is detected.	
A8020	Absolute encoder error	Absolute encoder data is not readable.	Turn off the power and then newly turn it on. If it occurs frequently, consult our service office.
A8030	Encoder cable error	Encoder cable is disconnected.	Consult our service office.
A8040	Absolute data speed error	Difference between position counter and absolute data exceeds allowable range.	Turn off the power and then newly turn it on. If it occurs frequently, consult our service office.
A8050	Skew error	Difference in encoder pulse between gantry axis and pair axis exceeds allowable range.	
A8110	Ext.1 Encoder data error	Encoder data error is detected.	Turn off the power and then newly turn it on.
A8120	Ext.1 Absolute encoder error	Absolute encoder data is not readable.	Turn off the power and then newly turn it on. If it occurs frequently, consult our service office.
A8130	Ext.1 Encoder cable error	Encoder cable is disconnected.	Consult our service office.
A8140	Ext.1 Absolute data speed error	Difference between position counter and absolute data exceeds allowable range.	Turn off the power and then newly turn it on. If it occurs frequently, consult our service office.
A8210	Ext.2 Encoder data error	Encoder data error is detected.	Turn off the power and then newly turn it on.
A8220	Ext.2 Absolute encoder error	Absolute encoder data is not readable.	Turn off the power and then newly turn it on. If it occurs frequently, consult our service office.
A8230	Ext.2 Encoder cable error	Encoder cable is disconnected.	Consult our service office.
A8240	Ext.2 Absolute data speed error	Difference between position counter and absolute data exceeds allowable range.	Turn off the power and then newly turn it on. If it occurs frequently, consult our service office.

Alarm code	Message	Probable Cause	Remedy
A9020	Sensor communication error	Sensor detects receive command error or interruption error.	Turn off the power and remove the cause of the error, and then newly turn on the power.
A9030	Sensor power failure	Sensor detects power failure.	Turn off the power and remove the cause of the error.
A9040	Sensor CPU Error	Error in sensor CPU occurred.	
A9050	Sensor memory error	Error in contents of the sensor memory.	
A9060	Arc sensor: Input parameter	Tool No., current detector or RPM exceeds set range.	
A9070	Arc sensor: Main communication	Time out.	

17-2. Error codes

Error code	Message	Probable Cause	Remedy
E1010	Impossible to start	Robot does not start.	Check if start program is selected. Check if servo power is turned ON.
E1020	Weaving parameter error	Selected weaving pattern, speed, frequency or timer is out of set range.	Correct (speed, frequency or timer) settings.
E1030	Coordinates error (Operation) (Manual)	Interpolation does not function.	Check the program.
E1040	Move data over (Operation) (Manual)		
E1050	Position does not match	Robot cannot make the orientation taught in the program.	Change robot orientation data.
E1060	Wrist swing over 180 °	CL number (wrist calculation number) specified in the teaching point is not applicable to the applied interpolation.	Correct the CL number.
E1070	You try to start the program that does not exist or cannot be started.	Program specified by CALL command does not exist.	Check and correct the program.
E1080	The label does not exist. Please confirm the label.	The label specified by the Jump command does not exist in the program.	
E1090	No global position variable	Specified global variable does not exist.	
E1100	Cannot call any more.	CALL command exceeds hierarchical limit (max. 8).	
E1120	No local position variable	Specified local variable does not exist.	
E1130	PULSE counter over	More than 16 PULSE commands were executed at a time.	Correct the program by reducing the number of PULSE commands to be executed at a time.
E1140	Multi program execution error.	Due to the current combination of the parallel execution programs, No further execution is possible.	Check and correct the program.
E1150	Calculation command error	Calculation is impossible. (Example: Zero divisor, square root of negative number etc.)	
E1160	Undefined command	The system does not support the specified command.	
E1170	Command parameter error	Parameter of the command is out of support range.	
E1180	Soft-limit Error	Soft-limit Error	Articulated axis is at the soft-limit.
E1190	RT monitoring Error	Robot is about to enter the monitored area when the RT monitor input is ON.	Robot is capable of restarting operation when the RT monitor input goes OFF.
E1191	RT monitoring Error (Slave)	Slave robot is about to enter the monitored area when the RT monitor input is ON.	Slave robot is capable of restarting operation when the cube monitor input goes OFF.
E1200	Cube monitoring Error	Robot is about to enter the monitored area when the cube monitor input is ON.	Robot is capable of restarting operation when the cube monitor input goes OFF.
E1201	Cube monitoring Error (Slave)	Slave robot is about to enter the monitored area when the cube monitor input is ON.	Slave robot is capable of restarting operation when the cube monitor input goes OFF.

Error code	Message	Probable Cause	Remedy
E1210	Overlap is not available	Overlap at re-start will bring the robot to the preceding teaching point.	Move the robot back to the preceding teaching point in trace operation before re-starting operation.
E1220	Overlap failed	The robot reached the preceding teaching point during overlap operation.	Turn off the power and then newly turn it on.
E1230	Harmonic data Error occurred	The specified harmonic coordinate system has not defined. The specified mechanism is inadequate for the structure.	Check the settings of the harmonic coordinate system and the mechanism.
E1240	The mechanism overlaps	An axis in the mechanism of the program executed by the PARACALL command is duplicated.	Check the mechanism structure of the program.
E1250	Weld slope command error	“D” or “Next” is used as argument in a program with no mechanism. Value of an argument to which variable (GR or LR) is assigned, is either “0” or negative number.	Check and modify the program.
E1260	Mechanism is unmatched	Processing is not possible as the mechanism of the running program and mechanism specified in the variable do not match.	Re-set the mechanism either of the running program or of the variable. Or use another variable.
E1270	TOOL No. Error	The specified tool number is not correct. For example, a tool number for the slave robot is selected in the program for the master robot.	Check the program.
E1280	No mechanism specified by the program	The mechanism number in the running program is not in the range of mechanisms of this system.	Check and modify the program and system settings.
E1290	"Start permission input" was turned off	The "Start permission input" goes off while running the program.	Restart the program when the "Start permission input" turns ON.
E1300	"Start permission input" is turned off	The "Start permission input" was in the OFF state when the program was started.	Start the program when the "Start permission input" turns ON.
E1310	Ext-Axis range monitoring Error	The robot attempted to enter the area specified by the "Ext-Axis range monitor". (The monitor input is in the ON state.)	Re-start is enabled when the "Monitor input" goes OFF.
E1311	Ext-Axis range monitoring Error (Slave)	The slave robot attempted to enter the area specified by the "Ext-Axis range monitor". (The monitor input is in the ON state.)	
E1320	AND condition monitoring Error	All the AND conditions are satisfied. (The monitor input is in the ON state.)	
E1321	AND condition monitoring Error (Slave)	The AND conditions of the slave robot are satisfied. (The monitor input is in the ON state.)	
E1330	Cannot update variable value.	The command that assigns a value to a position variable was executed in a protected program.	Change the protect level of the target program to "Allow Point Change Only".
E1900	(User defined message)	HOLD command is executed.	

Error code	Message	Probable Cause	Remedy
E2010	Sensing not possible.	The input signal had been ON when the touch sensor command was executed. The three reference points for rotary shift calculation have not been specified correctly.	Trace backward and then restart. Check the program structure.
E2020	Sensing no input	Work is not within the sensing range.	Trace forward or backward to restart.
E2030	Shift calculation error	Calculation error. Reference points for rotary shift calculations are not correct.	Change position or speed of the teaching point. In case of weaving operation, check conditions.
E2040	Compensation limit over. Compensation data of tool is not stored.	The calculation result exceeds the auto compensation range.	Check if the applied tool compensation method is correct.
E2041	Cannot calculate the compensation data, because of compensation reference data not stored.	Compensation reference date for auto compensation of tool does not exist.	
E2042	Cannot calculate the compensation data, because of the invalid data or the lack of data.	Invalid data exists. Or data is not enough for calculation.	
E2044	TOOLCAL command error	TOOLCAL command has executed before TOOL commands.	Check and correct the program structure.
E2120	Arc sensor: Welder	Welder settings are not proper.	Correct welder settings.
		Spin arc sensor: Motor in the rotary head is defective. P.C. Board is defective. Connectors are disconnected/severed.	Turn off the power to the robot and spin arc sensor control unit. And then newly turn them ON.
E2130	Arc sensor: Wire	Wire settings are not proper.	Correct wire settings.
		Spin arc sensor: Counter data error.	Turn off the power, and then newly turn it on.
E2140	Arc sensor: Weld current	Welding current set out of range (100 to 400 A).	Check welding current set value.
E2150	Arc sensor: Welding speed	Welding speed setting is out of rated value (0.1 to 1.2 m/min.).	Check and correct the welding speed set value.
E2160	Arc sensor: Weave frequency	Weaving frequency setting is out of rated value (1 to 5 Hz).	Check and correct the weaving frequency set value.
		Spin arc sensor: RPM exceeds 4500rpm.	Turn off the power of the spin unit, and then newly turn it on.
E2170	Arc sensor: Weave amplitude	Weaving amplitude is out of allowable range (2 to 6 mm).	Teach correct weaving amplitude points.
E2180	Arc sensor: Weave pattern	The system does not support the specified weaving pattern.	Check and correct the weaving pattern.
E2190	Arc sensor: Current detection	No input of current detect signal in 3 seconds or more after turning on the torch switch.	Check causes of no current signal input and no arc generation.
E2200	Arc sensor: Buffer-over	Deviation of the actual work from teaching path exceeds allowable range.	Change position of the teaching point(s).
E2210	Arc sensor: Distance-over	Distance between tracking and programmed welding path exceeds tracking range.	Change position of the teaching point. Change tracking range setting.

Error code	Message	Probable Cause	Remedy
E2220	Arc sensor: Data communication	Error in controller, or inclusion of noise. Power to the arc sensor is OFF.	Turn off the power, and newly turn it on.
E2230	Arc sensor: Amp. Error	Servo driver inside the spin controller is defective. Error of the motor temperature inside the spin head.	Remove the cover of the spin controller and check the error display. Investigate the cause of the error.
E2240	Arc sensor: Operation error	Shift amount calculation error due to error in controller or inclusion of noise.	Turn off the power, and newly turn it on.
E2260	Arc sensor: Rotational speed	RPM of the motor inside the spin head is either too high or too low.	
E2270	Arc sensor: Data communication	Error in controller, or inclusion of noise. Power to the arc sensor unit is OFF.	
E2280	Arc sensor: Detection phase	Detection phase settings are not consistent.	Press the Cancel key. Check the detection phase set values.
E2290	Arc sensor: Encoder phase	Encoder phase is out of range.	
E2320	Arc sensor: Tool number error	Tool number 9 or higher is specified in spin arc sensing range.	Modify the program.
E2330	Arc sensor: Arc sensing is not available in a parallel processing program.	Arc sense command is executed during processing parallel programs.	Change structure of the program.
E2340	Arc sensor: Execution error (Arc slope)	Arc slope and arc sensing is executed in same time.	Change structure of the program.
E2350	Spin Sensor: Execution error (Weaving)	In the "Multi-cooperative robot control" movement, weaving and spin sensor were executed at the same time.	Modify the program.
E3020	M-rot reset: position	Due to load inertia, external axis is not in complete stop by the multi rotation reset command.	Add DELAY command (about 1 to 2 seconds) in front of RSTREV command.
E3030	Connect error (Mode)	Not accessible. Modes do not match.	Change the mode of the slave robot.
E3030	Connect error (Robot No.)	Not accessible. The specified slave robot No. is inadequate.	Check the harmonic movement settings.
E3030	Connect error (constant)	Not accessible. Constant of the slave robot has changed.	Check the settings of the slave robot.
E3040	Hold (slave err)	The slave robot stopped due to an error.	Remove cause(s) of the error of the slave robot.
E3050	Safety holder(slave)	Safety holder of the slave robot is activated.	Correct the tool interference of the slave robot.
E3060	Multi-mechanism is not set	Multi-mechanism has not specified. Calculation area not secured.	On the **Set** menu, click **Management tool** and **System**. Then add the “Multi-mechanism”.
E3080	COUPLE Timeout	Failed to connect to the master robot within the preset time period after executing COUPLE command.	Check the program.
E3100	Please turn on Servo(**) **is Axis name.	The target independent E-axis servo power is OFF.	Turn ON the target independent E-axis servo power, and then re-start.
E3110	Independent E-axis: Out of servo off enable section error(**) **is Axis name.	Servo power off is conducted to the Independent E-axis to which "Servo off enable section" is not applicable.	Turn ON the servo power on again, and then re-start.

Error code	Message	Probable Cause	Remedy
E4000	Over run	The hard-limit switch input is activated due to overrun.	With the overrun release mode, move the axis within the range.
E4010	Safety-holder working	Safety holder is activated due to interference etc.	Remove the cause of interference.
E4020	24V input error	Error in 24 V input of the sequencer I/O circuit is detected.	Check the fuse on the sequencer board. Check if I/O power is supplied.
E4030	Teaching mode input is turned on.	Teaching mode input is turned on.	Place the mode select switch in "Teach" position.
E4040	Operating mode input is turned on.	Operating mode input is turned on.	Place the mode select switch in "Auto" position.
E4050	I/O unit connect error.	Connection and settings of the expansion inconsequent.	Check connecting method of the expansion I/O unit. Check the settings.
E4060	DeviceNet: Setting error.	Inadequate DeviceNet settings. • A node ID is duplicated. • Invalid DIP switch settings.	Check connection of the DeviceNet. Correct the settings.
E4061	DeviceNet: Card error.	Error in interface with the DeviceNet.	Check if the network card settings are correct.
E4062	DeviceNet: error 01.	Communication error.	Check communication cable connection. Check the settings of the master robot.
E4063	DeviceNet: error 02.	Devices on the DeviceNet are not ready.	Check the connection to other devices.
E4064	DeviceNet: No power supply.	No power supply (24V) to the DeviceNet.	Check power supply to the DeviceNet.
E4065	DeviceNet: Comm. stop.	Master scan stopped	Check devices of the master robot.
E4066	DeviceNet:Configuration Error	An error occurred while writing data on the DeviceNet card.	Check the connection of the device.
E4070	PROFIBUS:Setting error	Configuration error in the master device. Setting of invalid node address(0,127)	Check the configuration of the master device. Check the DipSW of the PROFIBUS card.
E4071	PROFIBUS:Card error	Error in the PROFIBUS card.	Check if the card is set properly.
E4073	PROFIBUS error02	Failed to detect communication speed automatically. (Communication error)	Check the communication cable connection.
E4075	PROFIBUS:Comm.stop	PROFIBUS master stopped scanning. Received invalid data from the master.	Check the communication cable connection.
E4080	A-B Remote I/O: Invalid Setting	Wrong settings.	Check the settings.
E4081	A-B Remote I/O Card Error	A-B Remote I/O card is defective.	Check if the card is set properly.
E4083	A-B Remote I/O: No Communication	A-B Remote I/O master side is not executing scan.	Check the connection to other devices.
E4085	A-B Remote I/O: Comm. stop	A-B Remote I/O master side stops scanning. Or invalid data is received from I/O master side.	Check if the communication cable is correctly connected.
E6100	Ethernet Card Initialization Error	Fail to initialize at power ON.	Insert the card once again.
E6102	Ethernet Card I/F Error	An error that occurs during initialization after Ethernet card communication settings has changed or in communication process.	Check if the communication settings are correct.

Error code	Message	Probable Cause	Remedy
E6105	Ethernet Cable Disconnect	Ethernet cable connection is insufficient.	Check communication cable connection.
E6106	Ethernet IP address Duplicate	The specified IP address has already been used to other equipment.	Check IP address settings.
E6107	Ethernet TCP Connect Error	Unable to connect Ethernet card to TCP.	Check the destination equipment.
E6108	Ethernet Comm. Error01	The destination equipment not found.	Check the destination equipment.
	Ethernet Comm. Error02	Data communication time out occurred.	Check the destination equipment.
	Ethernet Comm. Error03	Fail to convert transmission data, or transmission data is destroyed.	Check the network environment
	Ethernet Comm. Error04	Frequency of data transmission exceeded receivable range.	Check the destination equipment.
E6200	Can't open the file External Comm.is executing.	Program open is attempted while conducting external communication.	Re-open it after completion of external communication.
E7000	Over duty (Average)	Servo current average load factor exceeds its limit.	Reduce the load or speed, change robot orientation or add DELAY command.
	Over duty (Peak)	Servo current exceeds its limit.	Change the robot orientation so as to minimize load to the motor. Check if the primary input voltage is sufficient.
E7010	Motor over load error	Motor load exceeds its limit.	Change the robot orientation so as to minimize load to the motor.
E7020	Lock detect	Motor cannot rotate.	Check if the motor and the robot interfere.
E7030	Collision Hold	Collision or the similar disturbance occurred.	Remove cause of interference and restart.
E7110	Ext.1 Motor over load error	Motor load exceeds its limit.	Reduce the load or speed, change robot orientation or add DELAY command. Change the robot orientation so as to minimize load to the motor. Check if the primary input voltage is sufficient.
E7120	Ext.1 Lock detect	Motor cannot rotate.	Check if the motor and the robot interfere.
E7130	Ext.1 Collision Hold	Collision or the similar disturbance occurred.	Remove cause of interference and restart.
E7210	Ext.2 Motor over load error	Motor load exceeds its limit	Reduce the load or speed, change robot orientation or add DELAY command. Change the robot orientation so as to minimize load to the motor. Check if the primary input voltage is sufficient.
E7220	Ext.2 Lock detect	Motor cannot rotate.	Check if the motor and the robot interfere.
E7230	Ext.2 Collision Hold	Collision or the similar disturbance occurred.	Remove cause of interference and restart.
E9000	System data error	Error is found in the system data.	Turn off the power, and then newly turn it on.

17-3. Welder error codes

Error codes start with “W” indicates either error occurred in the applied digital communication welding equipment or data communication error between the robot and the applied digital communication welding equipment.

Error code	Message	Probable Cause	Remedy
W0000	Weld Error: P-side ov/curr	Received "P-side ov/curr" error from welding machine	Check welding machine.
W0010	Weld Error: No current	Received no "Current detect" message from welding machine in the preset period of time after the torch switch was turned ON.	Investigate why welding current doesn't flow. If gas pressure detector is applied, check if the gas pressure is low.
W0020	Weld Error: No arc	Received "No arc" error from welding machine.	Check welding conditions. Check if wire feed route is clear and proper.
W0025	No arc detected by robot	Robot recognized "No arc" error.	Check welding conditions. Check if wire feed route is clear and proper. If the same error occurs repeatedly, check if the current "No arc detection time" setting is adequate.
W0030	Weld Error: Wire stick	Received "Wire stick" error from welding machine.	Cut off the contacted part of the wire. Change position of teaching points so as to avoid wire stick. Check welding power source.
W0031	Stick check time out	No return stick check signal from welding power source in specified time.	Check welding power source and turn on the power again.
W0040	Weld Error: Torch contact	Received "Torch contact" error from welding machine.	Remove cause of the error.
W0050	Weld Error: No wire/gas	Received "No wire/gas" error from welding machine.	
W0060	Weld Error: Fused tip	Received "Fused tip" error from welding machine.	Replace tip.
W0070	Weld Error: Nozzle contact	Received "Nozzle contact” error from welding machine.	Check around the torch nozzle and remove cause of the error.
W0080	No characteristic table	There is no characteristic table. Welding conditions command cannot be executed or corrected. ("W0900 Welder comm. Err 0003" error occurred at power on, but operation has been continued without correcting the error.)	Turn off the controller power switch. Check the cables and turn on the power to the welding machine. Then turn on the controller power switch.
W0090	Weld Error: S-side ov/curr	Received "S-side ov/curr" error from welding machine.	Check welding machine.
W0100	Weld Error: Temp Err	Received "Temp Err" error from welding machine.	
W0110	Weld Error: P-side ov/volt	Received "P-side ov/volt" error from welding machine.	
W0120	Weld Error: P-side L-volt	Received "P-side L-volt" error from welding machine.	
W0130	Weld Error: Trigger Switch	Received "Trigger Switch" error from welding machine.	
W0140	Weld Error: Lack of Phase	Received "Lack of Phase" error from welding machine.	Check welding machine.
W0150	Retry Over (NO ARC)	No arc has generated within the arc retry set value.	Check and remove cause and then restart.

Error code	Message	Probable Cause	Remedy
W0160	Water circuit error	Received "Water circuit error" error from welding machine.	Check welding machine.
W0170	Weld Error: Cooling water circuit	Received "Cooling water circuit" error from welding machine.	
W0180	Weld Error: Gas pressure reduction	Received "Gas pressure reduction" error from welding machine.	Check gas pressure.
W0190	Weld Error: Temp Err	Received "Temp Err" error from welding machine.	Check welding machine.
W0200	Weld Error: Wire feed motor	Received "Wire feed motor" error from welding machine.	
W0210	Weld Error: External input 1	Received "External input 1" error from welding machine.	
W0220	Weld Error: External input 2	Received "External input 2" error from welding machine.	
W0230	Weld Error: Emergency stop	Received "Emergency stop" error from welding machine.	
W0240	Weld Error: CPU error	Received "CPU error" error from welding machine.	
W0250	Weld Error: Memory error	Received "Memory error" error from welding machine.	
W0260	Weld Error: Wire feed governor	Received "Wire feed governor" error from welding machine.	
W0270	Weld Error: Wire feed encoder	Received "Wire feed encoder" error from welding machine.	
W0280	Weld Error: CT offset	Received "CT offset" error from welding machine.	
W0290	Weld Error: VT offset	Received "VT offset" error from welding machine.	
W0300	Weld Error: Start input signal	Received "Start input signal" error from welding machine.	
W0310	Weld Error: Initial output voltage	Received "Initial output voltage" error from welding machine.	
W0320	Weld Error: Please replace the tip.	One of the tip change conditions is satisfied.	Replace the tip with new one. Then reset the value in the tip change dialog box. (On the [View] menu, click [Arc weld information] and [TIP CHANGE] to display the dialog box.)
W0330	MIG/TIM Force error	MIG force unit does not respond.	Check if the connection to the power source of the MIG force unit is correct.
W0331	MIG/TIG Force: Servo power error	A wire feed command is executed while MIG/TIG Force servo power is OFF.	Check the MIG/TIG Force.
W0340	MIG/TIG Force count over	Deviation counter of MIG force motor exceeds (which occurs when some load is applied to the motor while the motor is stopping.) Or the error may occur if the motor is pulled by the retracting wire when the servo is turned off.	Specify and correct the cause of the error.
W0350	MIG/TIG Force Wire buckling	Overload is detected in the MIG force wire feed system. (Most probable cause is buckling of the wire in the wire feed route.	Check the wire feed route and remove the cause of the buckling.

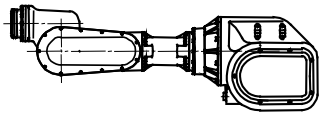
Error code	Message	Probable Cause	Remedy
W0360	MIG Force buffer over	Exceeded the processible number of MIG/TIG force commands at a time.	Review the commands structure. Or add “DELAY” command between commands.
W0361	TIG Force: Motor stop over time	Wire feed does not stop within the preset time period after execution of the wire feed stop command.	Check the TIG Force.
W0370	Weld Error: Electrode contact	Received "Electrode contact" error from welding machine.	Check and correct the distance between the electrode and the base metal.
W0380	Weld Error: S-side over voltage	Received "S-side over voltage" error from welding machine.	Specify and correct the cause of the error.
W0390	MIG Force Slowdown process error	Received a command while the motor or "Current detect" was in the ON state. No indication of "Current detect" in three seconds after the execution of the command.	Check the position of the command in the program. Investigate why the current wasn't detected.
W0400	Failed in pilot arc ignition	Failed to ignite the pilot arc.	Specify and correct the cause of the error.
W0410	Pilot circuit error	An error was found while controlling the pilot arc.	Specify and correct the cause of the error.
W0420	W-Err1:P-side over current	Received "P-side over current" error from welding machine.	Welding machine may be damaged.
W0430	W-Err1:Electrode	The electrode and tip were short-circuited.	Correct the position of the electrode.
W0440	W-Err1:Tip contact	The tip and the base metal are short-circuited.	Change the teaching point.
W0450	W-Err1:Powder blocked	Received "Powder blocked" error from welding machine.	Check the feed motor. Check the powder path and clear the clog.
W0460	W-Err1:No carrier gas	Torch switch was turned ON with no carrier gas supplied.	Modify the program.
W0470	Pilot arc disappear	Received "Pilot arc disappear" error from welding machine.	Clean the electrode and the tip.
W0480	Main arc disappear	Received "Main arc disappear" error from welding machine.	Specify and correct the cause of the error (electrode, gas, condition and etc.).
W0490	Pilot arc isn't excited	Torch switch was turned ON without pilot arc.	Modify the program.
W0500	Pilot gas is insufficient	Received "Pilot gas is insufficient" error from welding machine.	Specify and correct the cause of the insufficient gas pressure.
W0510	Carrier gas is insufficient	Received "Carrier gas is insufficient" error from welding machine.	Specify and correct the cause of the insufficient gas pressure.
W0520	Welder is different.	A command not for the connected welder (or weld method) is executed.	Modify the program.
W0530	Com error between units of welder	A communication error between welder and wire feeder is detected.	Check both welder and wire feeder.
W0800	No welding power source specified in program.	Welder used in the program is not registered in the default welder setting.	Check the default welder setting.
W0810	No welder number in program	No registered program number in the program.	Register the welder number. (**PROPERTY** in **FILE** menu)

Error code	Message	Probable Cause	Remedy
W0900	Welder comm. Err 0001	Error occurred while communicating to welding machine.	Press the Cancel key to clear the error message. If the error occurred in operation mode, exit from Operation mode and newly set to Operation mode.
	Welder comm. Err 0002	Communication to welding machine is interrupted. Or cable is disconnected.	Press the Cancel key to clear the error message. If the error occurred in operation mode, exit from Operation mode and newly set to Operation mode.
	Welder comm. Err 0003	Power to the welding power source is off. Or cable is disconnected or severed.	Turn off the controller power switch. Check cables and turn on the power to the welding power source. Then turn on the controller power switch.
	Welder comm. Err 0004	Error is found while verifying characteristic data.	Newly set the welding characteristics.
	Welder comm. Err 0005	Power to the welding machine is shut off while communicating with welding machine while communicating to the welding machine.	Check welding machine.
W0910	Welder undefined	Unauthorized welder has been connected.	Upgrade software version of the robot. Consult our service office.
W0920	Welder power failure	Power to the welding machine	Check welding machine is shut off.
W0930	Welder com interrupting	Welding operation is attempted before completion of the communication to the welder.	Turn ON the power to the welder and check the connecting cable for breaking. Then press the Cancel key.
W0940	Received code is different from the set welder.	A welder code different form the set welder code is received.	Check if the welder settings are correct or if the correct welder is connected.
W0950	The welder is busy in initializing. Please restart several seconds later.	Robot start operation is attempted while the welder is in initializing process.	Restart the robot in a few second.

17-4. Supplements

17-4-1. Remedy of E1050

E1050 occurs when the actual axis position and the teaching position data do not match while the actual tool end position and the tool orientation match their teaching data.

	Probable causes	Remedies
1	In trace operation or operation, the robot moves between two teaching points of linear interpolation where RW axis and TW axis are taught to rotate more than 180 degrees.	Switch these points to PTP interpolation. Change teaching data of the point so that the FA arm and the BW axis create angle. (Change the tool orientation only and keep the current tool end position data.)
2	RW axis and TW axis are not at appropriate position when the robot performs trace operation toward the teaching point 1 or when the robot performs trace operation after the wrist is manually moved.	
3	FA arm is nearly parallel to the BW axis (singular orientation).  **Note)** The point where the angle of BW axis is nearly 0 degree, i.e. the TW axis is parallel to the RW axis (singular orientation), is called “Singular point”.	Add a teaching point of wrist calculation 3(CL=3) after the singular point. (Make sure to add another teaching point before the singular point so as to keep the CL=3 interpolation section as short as possible.) If there is a teaching point of linear interpolation or circular interpolation near the singular point, the wrist calculation 3 (CL-3) is automatically stored.

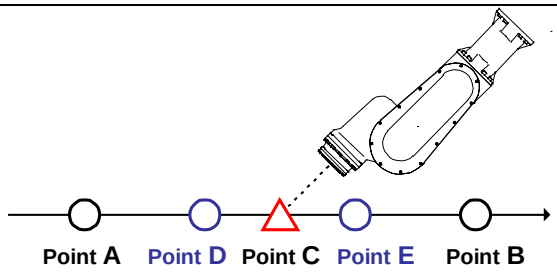
<Example>
The robot goes in an error condition at the point C due to singular orientation of the robot when the robot was moving from point A toward point B with linear interpolation (see figure on the right).

Remedy:
Trace the robot backward toward the point A.

Add a teaching point of wrist calculation 0 (CL=0) (point D).

Move the robot after the point of singular orientation with Joint coordinates system.

Add a teaching point of wrist calculation 3 (CL=3) (Point E).



<Cautions>

- **The tool orientation may be unstable in the CL=3 section (the wrist calculation is set to 3). Therefore, add another point before the singular point (the point D) so as to keep the CL=3 section (point D to point E) as short as possible.**
  Ensure the robot operation at such section by tracing at low speed.
- **If the CL=3 section is short but creates big change of tool orientation, the robot travel speed is reduced in order to ensure safe operation.**
- **To increase the robot travel speed, change the interpolation of the teaching point from linear to PTP and specify the speed you want in %.**

17-4-2. E7XXX (Load factor error)

Motor current of each axis of the manipulator is monitored during operation. The robot is stopped when over-current is detected. Excessive load applied to the machinery elements (bearing or reduction gear) is the probable cause of the error.

E7000	Over duty (Average)
	Over duty (Peak)
E7010	Motor over load error
E7110	Ext.1 Motor over load error
E7210	Ext. 2 Motor over load error

· The “Over duty (Peak)” error occurs when the load factor reaches 150%.

· The “Over duty (Average)” error occurs when average load factor reaches 125 %.

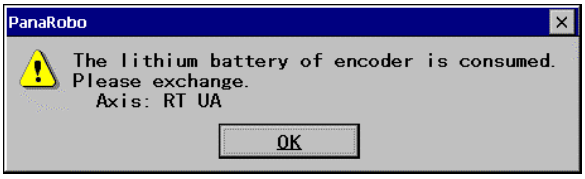
< Cautions >

- **This function works based on the measured motor current. Therefore, we assume about 10 % of tolerance may be the case due to individual difference of motors or servo drivers and also temperature characteristic of frictional load.**
- **This function is provided to warn users that improper application of load to the robot may shorten the service life of its machinery parts. Please be advised that the function is not to ensure duty cycle etc. (Make sure to operate the machine within the rated values specified in the specifications, especially load.)**

17-4-3. Lithium battery error

This robot uses lithium batteries in order to retain encoder data (encoder= a device to store the position data of each axis of the manipulator)

The message on the right appears at the power ON when voltage of the lithium batteries are lowered. Refer to the manual of the robot manipulator and replace the battery with new one.



Attention!

Due to the lithium battery characteristics, sharp voltage drop may occur when it is consumed. If occurred, the robot may not be able to maintain its required voltage to display the above warning message the next time power is turned ON.

Make sure to replace the lithium battery periodically in order to avoid data crash.

The service-life of the lithium battery under the standard operation (10-hour per day) is approximately 2 years.

17-4-4. At power failure

The system continues its operation if the instantaneous power failure lasts 0.01 second or less.

In case that power failure lasts for 0.01 second or more, although the processing data will be retained the servo power is shut off. Newly turn on power to the controller in order to turn on the servo power.

17-4-5. Overrun release

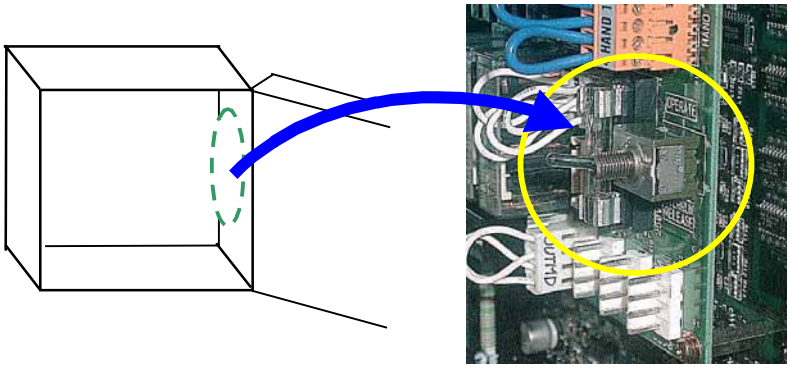
The robot is provided with software that monitors the operating range and stops the rbot operation when an axis reaches the soft-limit. However, if an arm moves beyond its soft-limit, the robot detects the overrun error of the arm electrically and shut off the servo power for safe operation.
To restart the robot, it is necessary to disable the overrun monitor temporary and correct the error condition. It is called “Overrun release”.

Overrun release procedure

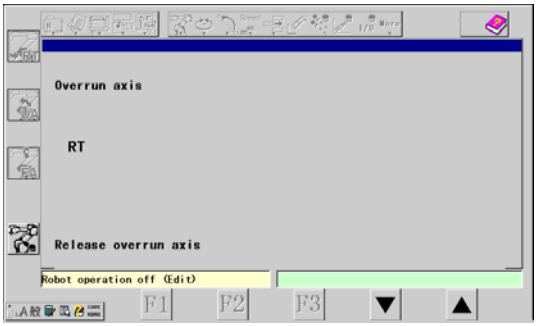
> **During the overrun release procedure, the robot arm moves at low speed.**
> **Work with caution and pay attention to the direction of the movement of the axis.**

Turn OFF the power to the controller.

Open the front panel of the controller to access the overrun release switch located on the safety card (ZUEP5702) (right side P.C. Board).
Then switch it to “OVERRUN RELEASE” (down) side.



Close the front panel of the controller, and place the mode select switch on the teach pendant in “Teach” position, and then turn ON the power.
Then the overrun release mode screen appears indicating the overrun axis.



Turn ON the servo power and manually move the overrun axis back to within its soft limit.
(At that time the robot travel speed is controlled to 0.5% or below.)

Turn OFF the power to the controller.

Open the front panel of the controller, and then switch the overrun release switch to “OPERATE” (up) side.

Close the front panel of the controller.

18. Appendix

18-1. Sample programs

(1) Repeat a program for a preset times and then turn ON the lamp to end.

Preconditions:
Applied processing program: Prog0100.prg,
Variable to store the program count: GB001,
Lamp ON output terminal: #5,
Number of the program execution: 10 times.

1	SET GB001 10	Sets the program execution time.
2	LABL0001	A label for loop action.
3	CALL Prog0100.prg	A command to execute the processing program.
4	DEC GB001	Subtract 1 from the program execution time “GB001”.
5	IF GB001 > 0 THEN JUMP LABL0001 ELSE NOP	If the program execution time is not equal to zero “0”, go back to “LABL0001". If it is equal to zero “0”, then go to the next line.
6	OUT O1#005 = ON	Turn ON the lamp.
7	STOP	End of operation (… It can be omitted.)

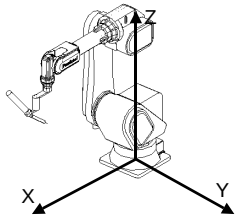
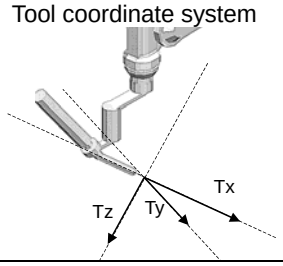
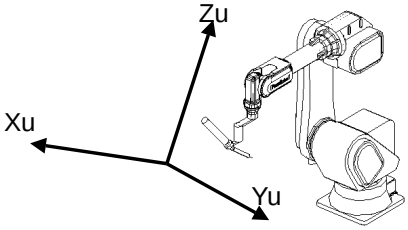
(2) In auto operation, shift the taught position(s) by a preset parameter.

Preconditions:
Variable to store the shift parameter: GB001,
Shift the contents in the GD001 using the SHIFT command.

1	TOOL = 1:TOOL00001	
2	MOVEL P1 ,10.00 m/min	
3	SHIFT-ON ROBOT = 1:GD001	Starts SHIFT action.
4	MOVEL P2 , 8.00 m/min	
5	MOVEL P3 ,3.00 m/min	
6	ARC-SET AMP=120 VOLT=19.0 S=0.50	
7	ARC-ON ArcStart1.prg RETRY=0	
8	MOVEL P4 ,0.50 m/min	
9	CRATER AMP=100 VOLT=19.0 T=0.00	
10	ARC-OFF ArcEnd1.prg RELEASE=0	
11	MOVEL P5 , 5.00 m/min	
12	SHIFT-OFF	Ends SHIFT action.
13	MOVEL P1 ,3.00 m/min	

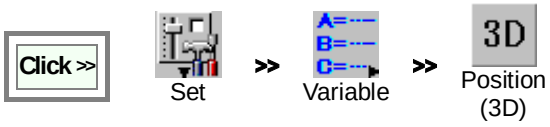
- This sample program, once started, shifts all points between SHIFT-ON command and SHIFT-OFF command by GD001.
- For example, if the value of GD001 is X=100.00, Y=0.0 and Z=0.0, then points P2 to P5 will be shifted 100 mm in X direction on the robot coordinate system.

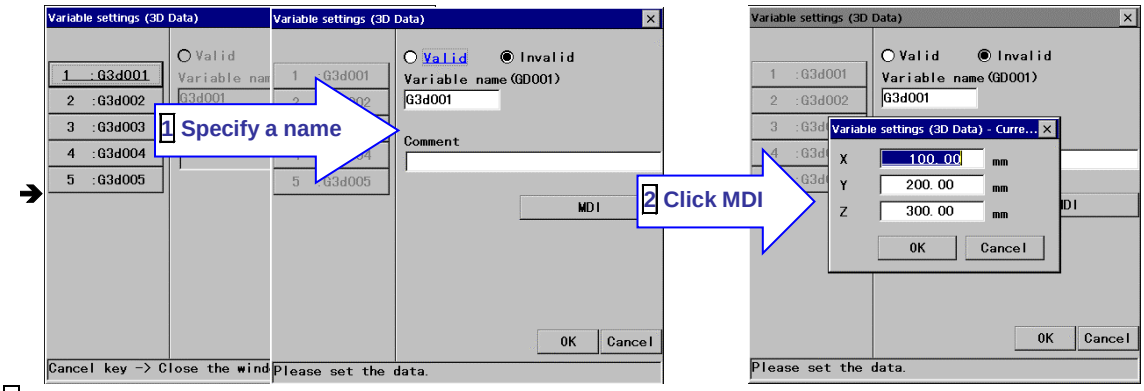
Supplement 1 You can specify the coordinate system the shift will be based on using the argument of the SHIFT-ON command.

ROBOT	Robot coordinate system 
TOOL	Tool coordinate system 
USER	User coordinate system 

Supplement 2 There are two ways to change settings of 3-D position global variable.

(1) Use the menu:





1. Specify the variable name you would like to change.
2. Click MDI.
3. Set X, Y and Z values and click the OK button.

(2) Use a sequence command "**SETEL**":

For example, to change the value of GD001 "X" to "100".

```
SETEL GD.X   1:GD001  =  100.00
```

(3) Count the number of production by counting the number of execution of the processing program and assigned to a variable.

Preconditions:

Variable the production count is to be assigned to: GI001,
Processing program: WORK01.prg

Production count program : Prog0001.prg

1	CALL WORK01.prg	Execute the processing program.
2	INC GI001	Add “1” to GI001.

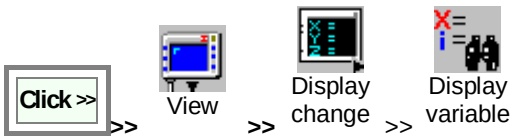
Counter reset program : Prog0002.prg

◎ To reset the value of the variable, execute a program (Counter reset program) to assign “0” to the variable.

1	SET GI001 = 0	Assign “0” to GI001.

• You can use the counter reset program every morning if you want to count the production of a day, or use it at the beginning of each month if you want to count the production of a month.

To see the value of the variable:

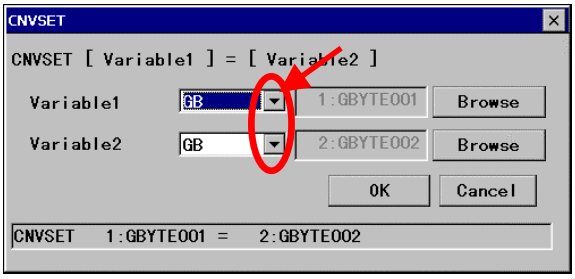


18-2. Application examples of CNVSET

18-2-1. How to add the command

The procedure is the same as other sequence commands (starting from the **Add command** menu).
Use the dialog box to add commands. It is in the arithmetic operation commands group.

(1) Setting dialog box



[Variable 1 or 2]: Select an element from the list. Click the small triangle button to the right of the box to display the list of variable types.

The list of variable type contains:
GB、LB、GI、LI、GL、LL、GR、LR、GP.X,GP.Y,GP.Z、P.X,P.Y,P.Z,GD.X,GD.Y,GD.Z,GA.X,GA.Y,GA.Z,GP.G**、P.G**
(** represents the external axis number (1,2,3,4…).)

Only the external axis numbers used in the mechanism of the target program are displayed. You cannot register any variables if the specified variable is not used in the mechanism of variable GP.

(2) Assignment rules

Table 1. Type conversion assignment rules

Assignment var. / Target var.	GB, LB	GI, LI	GL, LL	GR, LR	GP, P	GP, P [Element]	GD	GD [Element]	GA	GA [Element]
GB, LB	◎	◎	◎	○	×	○	×	○	×	○
GI, LI	◎	◎	◎	○	×	○	×	○	×	○
GL, LL	◎	◎	◎	○	×	○	×	○	×	○
GR, LR	◎	◎	◎	◎	×	◎	×	◎	×	◎
GP,P	×	×	×	×	◎	×	XYZ	×	Rob	×
GP, P [Element]	◎	◎	◎	◎	×	◎	×	◎	×	◎
GD	×	×	×	×	XYZ	×	◎	×	XYZ	×
GD [Element]	◎	◎	◎	◎	×	◎	×	◎	×	◎
GA	×	×	×	×	Rob	×	XYZ	×	◎	×
GA [Element]	◎	◎	◎	◎	×	◎	×	◎	×	◎

Where
◎ ：Assignable
○ ：Round off to one's digit to assign
× ：Not assignable
XYZ ： Only XYZ coordinate values are assignable.
Rob ： Only robot articular angles are assignable.

(3) Errors in CNVSET command

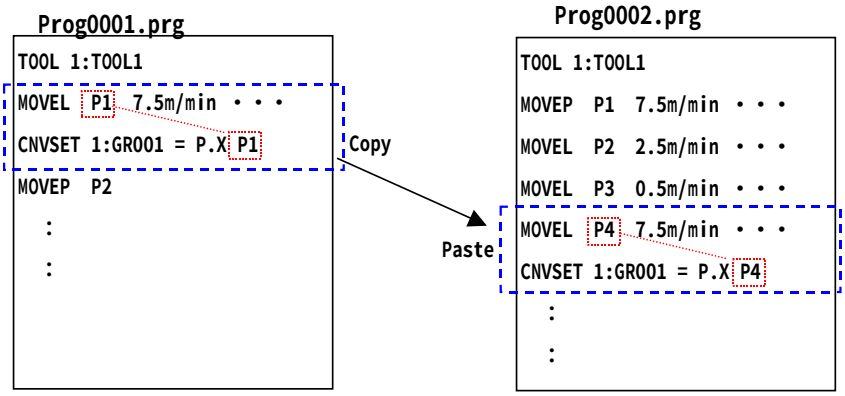
An error occurs when
- The assignment value exceeds the preset scope of the target variable type.
- The target variable is set invalid.
- The subject external axis no longer exists due to change of mechanism.

(4) Supplementary explanation

Cut, Copy and Paste

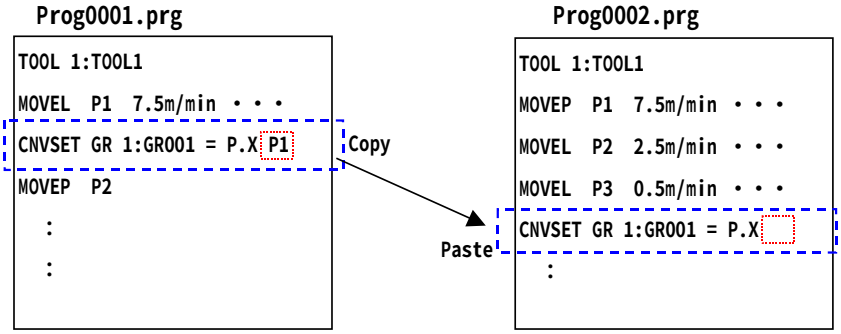
The following rules are applied when a sequence command which contains local position variable (P) is cut, copied and then pasted.

When both programs have a move command of the same teaching point name.
If a CNVSET command which contains a move command of the local position variable is cut or copied together with the move command, the local position variable of the CNVSET command changes its variable name when it is pasted in another program. The teaching point name of the move command changes in conjunction with the variable.



In the above example, “P1” is already used in the new program “Prog0002”, therefore, “P1” in the “Prog0001” changes its name to “P4” when the command is pasted in the “Prog0002”. The teaching point name of the CNVSET command then is automatically changed to “P4”.

Other cases
If a CNVSET command which contains a move command of the local position variable is cut or copied without the move command, the local position variable in the CNVSET command won’t be indicated when it is pasted in another program.



The rule is provided not to misapply the “P1” in the “Prog0001” in the “Prog0002” as “P1” in the “Prog0001” and the “P1” in the “Prog0002” are not the same.

18-3. Application examples of TRANSBASE/TRANSBASV

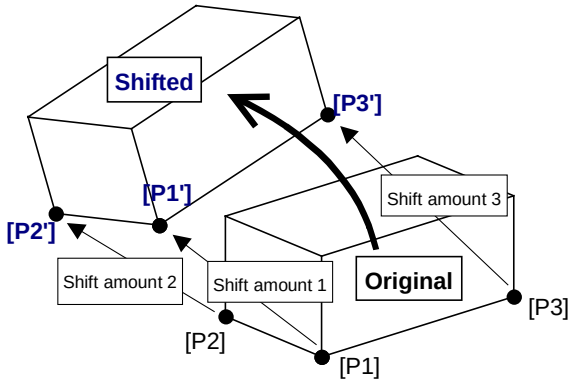
* Both commands can be used when the touch sensor is used.
* Use TRANSBASV command in case of using variable to specify the reference point for the rotary shift conversion.

18-3-1. How to add the command

The procedure is the same as other sequence commands (starting from the **Add command** menu).
Use the dialog box to add commands. It is in the touch sensor commands group.

(1) Sample program

Specify the three reference points for conversion using either TRANSBASE or TRANSBASV command.
Execute SNSSFT-ON to start rotary shift. The rotary shift continues until the SNSSFT-OFF command is executed.



The rotary shift to be executed by the SNSSFT-ON command shifts teaching points so that the shape formed by the shifted reference points (triangle [P1']-[P2']-[P3']) retain the original form (triangle [P1]-[P2]-[P3]).

Sample program

```
        :
1   MOVEL  • • •
    TRANSBASE 1              [P1'] ← [P1]+Sensor shift amount
        :
2   MOVEL  • • •
    TRANSBASE 2              [P2'] ← [P2]+Sensor shift amount
        :
3   MOVEL  • • •
    TRANSBASE 3              [P3'] ← [P3]+Sensor shift amount
        :
    MOVEL  • • •
    SNSSFT-ON
    MOVEL  • • •
        :                    } Rotary shift section
        :
    MOVEL  • • •
    SNSSFT-OFF
        :
```

(2) Supplementary explanation

- If the triangle [P1']-[P2']-[P3'] won't match its original form (the triangle [P1]-[P2]-[P3]), then the shifted teaching points are corrected with reference to the shifted reference points in ascending order so that the shapes of those two triangles match.
  (i.e. Using the shifted point [P1'] as the base, correct the point [P2'] and then [P3'] so as to create the same triangle as the triangle [P1]-[P2]-[P3] on the line determined by [P1'] and [P2'] and the plane determined by [P1'], [P2'] and [P3'].
- There is no specific order to assign those three reference points 1, 2 and 3.
- In case of execution of the command with the repeated operand, the data of the operand will be updated by the newly executed command.
- The rotary shift executed by the SNSSFT-ON command ends when the SNSSFT-OFF command is executed.
- The SNSSFTRST command is a command to clear the rotary shift.
- If the program is terminated without executing the SNSSFT-OFF or SNSSFTRST command, the rotary shift of the program will be applied to the next program.
- The error "E2010 Sensing not possible" occurs if three reference points have not specified correctly when the TRANSBASE or TRANSBASV command is executed.
- The rotary shift is applied to the program called by the CALL command during the rotary shift operation.
- It is possible to apply the shift buffer data to the rotary shift.
- As commands are ignored in trace operation,
  If the operation is switched from auto to trace within the rotary shift section and moved to the out of the rotary shift section in trace operation and then re-started auto operation, then the robot resumes the rotary shift.

  If the robot is moved into the rotary shift section in trace operation and then re-started auto operation within the rotary shift section, then the rotary shift won't be executed.
- Those TRANSBASE and TRANSBASV commands can be used together.

18-4. Teaching for powder plasma welding

Arc start/arc end programs for CO2/MAG/MIG welding are factory registered at shipment. It is necessary to change those settings for powder plasma welding prior to teaching operation of powder plasma welding.

18-4-1. Teaching welding program

The different point in teaching in powder plasma welding from CO2/MAG welding is that in powder plasma welding, it is necessary to ignite the pilot arc prior to starting welding operation.
The pilot arc serves as pilot burner to generate plasma arc. Therefore, provide a pilot arc firing teaching point before the arc start point and also a teaching point to pilot arc extinguishing teaching point after the arc end point. That is, turn ON and OFF the pilot arc before and after the weld section respectively. (In case of welding consecutive weld sections, it is not necessary turn off and then on the pilot arc at each weld section.)

Example of welding program

	Program	Definition
○	MOVEL P4 15.00	
	WAIT-PLARC	: Pilot arc ON
	PLARC ON	: Wait until the pilot arc ignites
●	MOVEL P5 1.0	
	ARC-SET_POWD Ib=10 Ip=20 PF=10 FRQ=2.0 S=0.50	: Set welding conditions
	ARC-ON ArcStart1Powd.prg	: Start welding
○	MOVEL P6 0.50	
	CRATER_POWD Ib=10 Ip=10 PF=10 FRQ=2.0 T=0.40	: Set crater conditions
	ARC-OFF ArcEnd1Powd.prg	: End welding
○	MOVEL P7 7.50	
	PLARC OFF	: Pilot arc ON

(○ … air-cut point, ● … welding point)

18-4-2. Powder / Gas flow check

Prior to operation, check if powder and gas flow properly.

Place the mode select switch in the Teach position, and then turn ON the  LED (User function key).

Then the motion function key shows the following icons.

	It feeds powder while holding it down. It feeds powder at the low speed for the first three seconds, and then feeds at the high speed. * Turn ON the carrier gas prior to feeding powder without fail.
	It switches ON/OFF the carrier gas feeding. Press once to switch ON/OFF state.
	It switches ON/OFF the shield gas feeding. Press once to switch ON/OFF state.
< L-Shift key to change the icons >	
	It switches ON/OFF the plasma gas feeding. Press once to switch ON/OFF state.
	It switches ON/OFF the start gas feeding. Press once to switch ON/OFF state.

18-4-3. Hold / Emergency stop

Pilot arc

Hold	It stops robot movements while keeping the pilot arc on.
Emergency stop	It turns off servo power and stops robot movements. Response of the pilot arc (remain ON or goes OFF) depends on the settings **(Set > Arc welding > Welder name > Pilot arc)** If the pilot arc is set to turn OFF at an emergency stop, it automatically goes ON when the robot is restarted.

Plasma arc

Hold	It stops welding operation and switches from plasma arc to pilot arc.
Emergency stop	It turns off servo power and stops welding operation. Response of the pilot arc (remain ON or goes OFF) depends on the settings **(Set > Arc welding > Welder name > Pilot arc)** If the pilot arc is set to turn OFF at an emergency stop, it automatically goes ON when the robot is restarted.

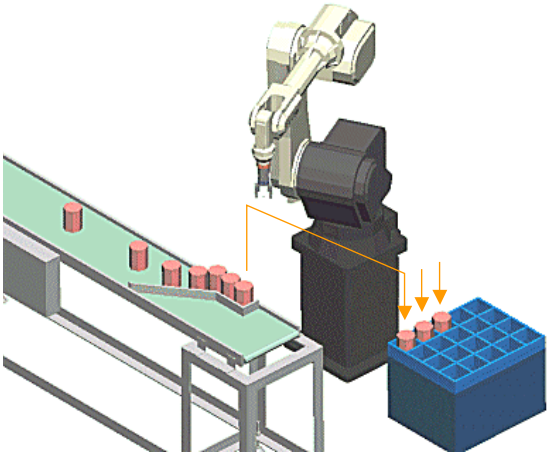
18-4-4. Gas control

Normally, it is necessary to control the “Carrier gas” through the robot. Make sure to turn it ON in case of welding with powder or feeding powder.

Gases other than carrier gas will be controlled through the welding machine according to the pilot input signal or torch switch signal to be sent from the robot.

18-5. Sample programs of palletizing

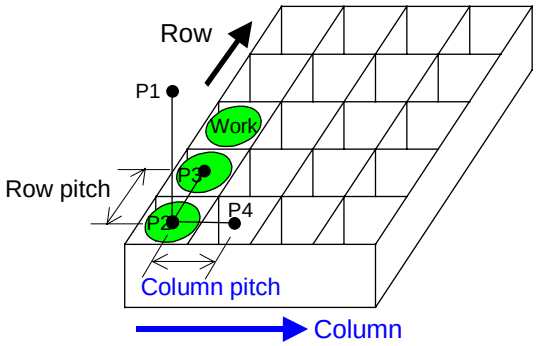
Operation:
Pick up unloaded works and put in a pallet one by one in good order.



Precondition:
This sample program is a program to put the workpiece in a pallet one by one in good order using minimum teaching points. Therefore, the sample program abbreviated a program to pick up unloaded a work with “PICK-UP.prg” and a program to release the work with “WORK-Rel.prg”

18-5-1. Sample 1

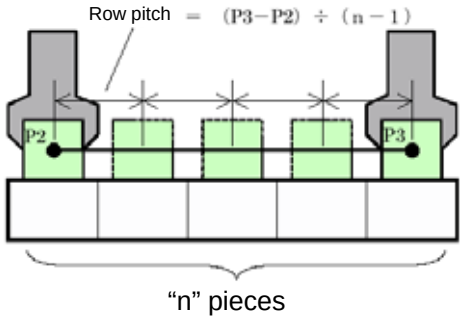
In this sample program, teaching points are used to specify the row pitch and column pitch.



Relationship between work and teaching points

P1-P2:	Placing the work.
P3:	Specifying the row pitch.
P4:	Specifying the column pitch.

<Note>
For better understanding, this sample program simply multiplied the taught row pitch and column pitch to specify the position. That means, the pitch errors at teaching are also multiplied. Therefore, the sample program is not suitable for a system that requires precision.
To ensure precision, teach the end points of both row and column and then divide each point value by (the number of column/row (“n”) –1). With this way, the pitch errors may be reduced.

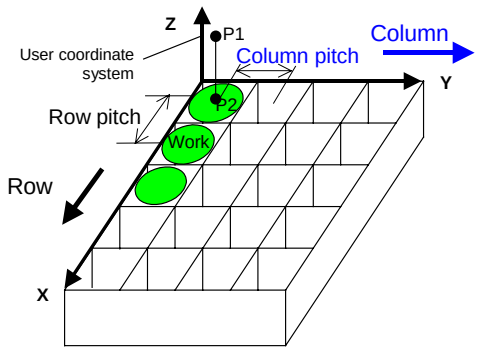


Sample program 1 (Pallet01.prg)

	Program	Description
	TOOL 1:TOOL001	Specify a tool
	JUMP START	Jump to START
●	MOVEL P1 5.00m/min	Specify the shunting point (Before insertion)
●	MOVEL P2 5.00m/min	Specify the inserting point
●	MOVEL P3 5.00m/min	Specify the row pitch (P2-P3 distance)
●	MOVEL P4 5.00m/min	Specify the column pitch (P2-P4 distance)
■	:START	Operation starting point
	SET GI001 =5	Specify the number of rows.
	SET GI002 =4	Specify the number of column.
	SET LI001 =0	Reset the row counter.
	SET LI002 =0	Reset the column counter.
	CNVSET GD002 P2	Get coordinates only.
	CNVSET GD003 P3	Get coordinates only.
	CNVSET GD004 P4	Get coordinates only.
	SUB GD003 GD002	Calculate row pitch.
	SUB GD004 GD002	Calculate column pitch
■	:LOOP2	For row loop
■	:LOOP1	For column loop
	[C]CALL PICK_UP.prg	Pick up a work.
	SET GD001 GD003	Assign the row pitch value to the shift variable.
	CNVSET LR001 LI001	Convert the row counter into a real number.
	MUL GD001 LR001	Multiply the row pitch by (the row counter value –1).
	SET GD005 GD004	Assign the column pitch to the shift variable.
	CNVSET LR001 LI002	Convert the column counter into a real number.
	MUL GD005 LR001	Multiply the column pitch by (the column counter value –1).
	ADD GD001 GD005	Row shift value + Column shift value.
	SHIFT-ON ROBOT =GD001	Shift (on the robot coordinate system).
●	MOVEL P1 15.00m/min	Move to the shunting point before insertion.
●	MOVEL P2 0.50m/min	Move to the inserting point.
	[C]CALL WORK_Rel.prg	Release the work.
●	MOVEL P1 5.00m/min	Move to the shunting point.
	SHIFT-OFF	End shift
	INC LI001	Add to the row counter.
	IF LI001 <GI001 THEN JUMP LOOP1 ELSE NOP	If the row counter is less than the preset number of rows, then jump to LOOP 1.
	SET LI001 =0	Reset the row counter.
	INC LI002	Add to the column counter.
	IF LI002 <GI002 THEN JUMP LOOP2 ELSE NOP	If the column counter is less than the preset number of columns, jump to LOOP 2.
	GOHOME MOVEP GPHOME 15 m/min	Move to the shunting point.
	STOP	End of operation.

18-5-2. Sample 2

In this sample program, teach a user coordinate system taking the direction row as “X” and the direction of column as “Y”.
Specify the row pitch and column pitch with numerical values.



Relationship between work and teaching points

P1-P2:	Placing the work.

Sample program 1 (Pallet01.prg)

	Program	Description
	TOOL 1:TOOL001	Specify a tool
	JUMP START	Jump to START
●	MOVEL P1 5.00m/min	Specify the shunting point (Before insertion)
●	MOVEL P2 5.00m/min	Specify the inserting point
■	:START	Operation starting point
	SET GI001 =5	Specify the number of rows.
	SET GI002 =4	Specify the number of column.
	SET LI001 =0	Reset the row counter.
	SET LI002 =0	Reset the column counter.
	SETEL GD.X#GD003 =100	X element of row pitch
	SETEL GD.Y#GD003 =0	Y element of row pitch
	SETEL GD.Z#GD003 =0	Z element of row pitch
	SETEL GD.X#GD004 =0	X element of column pitch
	SETEL GD.Y#GD004 =80	Y element of column pitch
	SETEL GD.Z#GD004 =0	Z element of column pitch
■	:LOOP2	For row loop
■	:LOOP1	For column loop
	[C]CALL PICK_UP.prg	Pick up a work.
	SET GD001 GD003	Assign the row pitch value to the shift variable.
	CNVSET LR001 LI001	Convert the row counter into a real number.
	MUL GD001 LR001	Multiply the row pitch by (the row counter value –1).
	SET GD005 GD004	Assign the column pitch to the shift variable.
	CNVSET LR001 LI002	Convert the column counter into a real number.
	MUL GD005 LR001	Multiply the column pitch by (the column counter value –1).
	ADD GD001 GD005	Row shift value + Column shift value.
	SHIFT-ON USER#(1)=GD001	Shift (on the user coordinate system.)
●	MOVEL P1 15.00m/min	Move to the shunting point before insertion.
●	MOVEL P2 0.50m/min	Move to the inserting point.
	[C]CALL WORK_Rel.prg	Release the work.
●	MOVEL P1 5.00m/min	Move to the shunting point.
	SHIFT-OFF	End shift
	INC LI001	Add to the row counter.
	IF LI001 <GI001 THEN JUMP LOOP1 ELSE NOP	If the row counter is less than the preset number of rows, then jump to LOOP 1.
	SET LI001 =0	Reset the row counter.
	INC LI002	Add to the column counter.
	IF LI002 <GI002 THEN JUMP LOOP2 ELSE NOP	If the column counter is less than the preset number of columns, jump to LOOP 2.
	GOHOME MOVEP GPHOME 15 m/min	Move to the shunting point.
	STOP	End of operation.

18-6. A program to calculate distance between points

A program to calculate distance between points by calculating differences of X, Y and Z of two points respectively, and then find the distance from the square root of sum of the squares of X, Y and Z.

[Equation: $\sqrt{(x_1-x_2)^2+(y_1-y_2)^2+(z_1-z_2)^2}$ **]**

Program (PtoPlen.prg)

The following is a program to calculate distance between points (point-1 and point-2) and then add the result to “GR001”. The coordinate of the point-1 is assigned to “GD001” and that of the point-2 to “GD002”.

Program	Description
SUB GD001 GD002	Difference between GD001 and GD002.
GETEL LR001 = GD.X#(1:GD001)	Take X element of GD001.
MUL LR001 LR001	Raise the X element to the second power.
GETEL LR002 = GD.Y#(1:GD001)	Take the Y element of GD001.
MUL LR002 LR002	Raise the Y element to the second power.
ADD LR001 LR002	Add the square of the Y element to the square of the X element.
GETEL LR003 = GD.Z#(1:GD001)	Take the Z element of GD001.
MUL LR003 LR003	Raise the Z element to the second power.
ADD LR001 LR003	Add the square of the Z element to the sum of the square of the X element and of the Y element.
SQRT LR001 LR001	Calculate the square root of the sum to find the distance.
ADD GR001 LR001 ***1)**	Add the distance to GR001.
RET	End of the program

● **Application example**

TOOL 1:TOOL0001	
MOVEL P1	
MOVEL P2	
CNVSET GD001 P1	
CNVSET GD002 P2	
CALL PtoPLen.prg	

***1)**

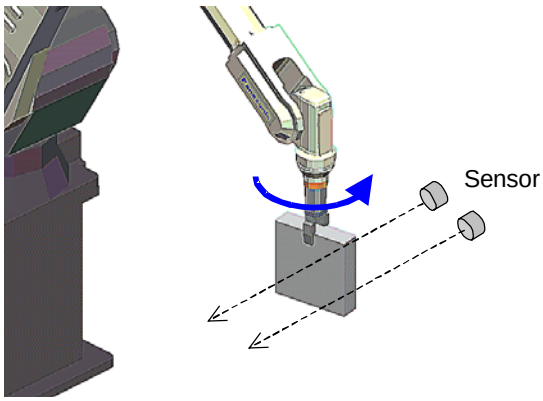
Please note that in the above sample program, result of the calculation (distance) is added to the GR variable. Since the maximum value of the GR variable is “99999.99”, in case of calculation distance longer than 100 m, it is necessary to use the GL variable. (See the following example.)

ADD GR001 LR001	➔	**CNVSET LL001 LR001** **ADD GL001 LL001**

18-7. Sample program of TW seek

Flow of the program:

1. A handling robot clamps a work and transfers the work to above the work inserting hole.
2. Then the robot stops and rotates the TW axis.
3. While rotating the TW axis, the sensor detect the work-and-hole matching position and send the detect signal to the robot.
4. After receiving the detect signal, the robot stops the TW axis rotation and then insert the work into the hole.



[Structure of the program]

Program name	Contents
TWTEST.prg	Main program. No mechanism.
TWTEST1.prg	Transfer the work to the loading point. Rotate the TW axis.
TWTEST2.prg	Move back to the shunting point.
TWTEST3.prg	Insert the work.

TWTEST.prg (main program)

	Program	Description
[C]	PARACALL TWTEST1.prg ON	Transfer the work to above the inserting position. Parallel processing of the TW axis rotation.
	WAIT_IP i1#(40:I1#040) ON T=0.00 s	Wait for input signal from the sensor. Go on to the next step when the signal is received.
[C]	PARACALL TWTEST1.prg OFF	End the program to rotate the TW axis.
	DELAY 0.50 s	
[C]	CALL TWTEST3.prg	Execute the work insertion program.
[C]	CALL TWTEST2.prg	Execute the program to move to the shunting point.

TWTEST1.prg (TW rotation)

	Program	Description
	TOOL = 1:TOOL01	
●	MOVEL P1 3.00 m/min	
●	MOVEP P2 3.00 m/min	Work inserting point.
	OUT o1#(40:o1#040) = ON	Notify the sensor to start sensing.
●	MOVEP P3 25.00 %	Rotate TW axis
●	MOVEP P4 25.00 %	Rotate TW axis
	HOLD NoSignal	Error due to no signal from the sensor.

TWTEST3.prg (Work insertion)

	Program	Description
	TOOL = 1:TOOL01	
	GETPOS P#(P1)	Get the current position and orientation to “P1”.
	CNVSET LR#(1:LR001) = P.Z#(P1) ADD LR#(1:LR001) -100.00 CNVSET P.Z#(P1) = LR#(1:LR001)	Add “-100” to the Z direction value of “P1”.
●	MOVEL P1 1.00 m/min	Move to the new P1 position.
	OUT o1#(39:o1#039) = ON	Release the work.
	DELAY 3.0s	Wait for time.
	CNVSET LR#(1:LR001) = P.Z#(P1) ADD LR#(1:LR001) 100.00 CNVSET P.Z#(P1) = LR#(1:LR001)	
●	MOVEL P1 1.00 m/min	

TWTEST3.prg (Move to the shunting point)

	Program	Description
	TOOL = 1:TOOL01	
●	MOVEL P1 3.00 m/min	Move to the shunting point.

18-8. Application example of EAXS_SFT-ON/EAXS_SFT-OFF

A command that shifts position of the external axis(axes) between the EAXS_SFT-ON and EAXS_SFT-OFF commands.

<Notes>

(1) This “External axis shift” command is applicable to a called program within the shift section.

(2) This “External axis shift” command is not applicable to a program called by PARACALL command.

(3) Make sure to use EAXS_SFT-ON and EAXS_SFT-OFF commands as a set.
The EAXS_SFT-ON command is effective once executed until execution of the EAXS_SFT-OFF command, therefore, if a program having the EAXS_SFT-ON command executed ends without execution of the EAXS_SFT-OFF command, the shift made by the EAXS_SFT-ON command will also be retained the next time the program is started.
You can insert EAXS_SFT-OFF command together at the end of the program or at the beginning of the program additionally. Adding an EAXS_SFT-OFF command other than the shift section won’t cause an error.

(4) This function is not applicable to an operation moved into the shift section using trace operation.

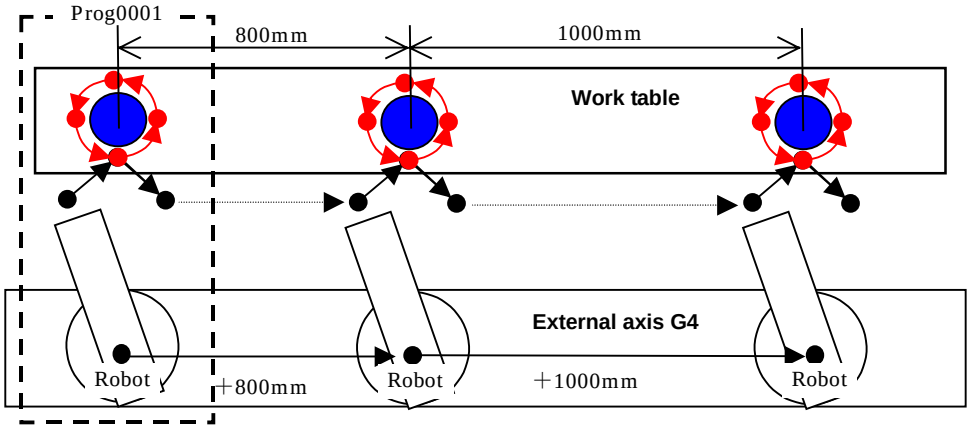
Sample program:

```
● Begin of Program
  TOOL =1
● MOVEP P1
  EAXS_SFT-ON G1= +100
● MOVEP P2
● MOVEP P3
● MOVEP P4
  EAXS_SFT-OFF
● MOVEP P5
● End of Program
```

Shift section

18-8-1. Application example 1

Do the same operation to works aligned on the same work table at certain distances
By using these commands, you only need to teach the operation once.



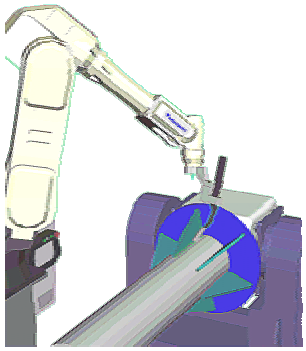
Precondition : Distance between 1st and 2nd works : +800 mm
Distance between 2nd and 3rd works: +1000 mm

CALL Prog0001	Processing the first work
EAXS_SFT-ON G4 = +800	Shift the external axis (G4) by +800mm.
CALL Prog0001	Processing the second work
EAXS_SFT-ON G4 = +1800	Shift the external axis (G4) by+1800mm
CALL Prog0001	Processing the third work
EAXS_SFT-OFF G4	Terminate the shift of the external axis (G4).

18-8-2. Application example 2

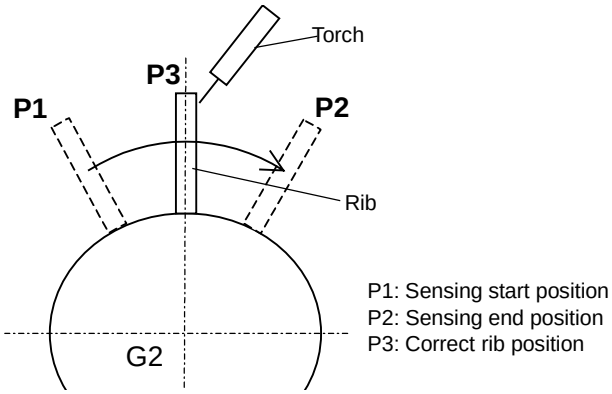
A system to weld stiffening ribs to a pipe shape work.

Deviation of the rib is measured using the touch sensor and then adjusted by shifting the angle of the positioner.



< Notes >

- Only the positioner is shifted while sensing the position of the rib. The robot maintains its position and orientation.
- The difference between the measured position of the rib (TOUCH position) and the correct rib position will be treated as deviation and applied as shift amount to the positioner.
- As robot does not move in this touch sensing operation, unlike normal touch sensor, the touch sensor stops sensing operation at the farthest at the sensing end point. Therefore, it is necessary to teach the sensing end point at the point after the correct rib position (P3).
  (No sensing end point causes an error.)



<Sample program>

Preconditions:

Processing program: EAXSSFT-WORK01.prg（Mechanism: Robot＋G1＋G2）
Production program: EAXSSFT-SAMPLE00.prg（Mechanism: Robot＋G1＋G2）

	Program	Description
	TOOL = 1:TOOL01	
○	MOVEP P1 3.00m/min	Move to the sensing start position (P1)
	TCHSNS SPD=1.00	Start touch sensing.
○	MOVEP P2 2.00m/min	Sensing end position (P2)
	GETPOS GP001	Assign the TOUCH position data to GP001.
	JUMP LABL0001	Jump to the specified address without moving to P3.
○	MOVEP P3 2.00m/min	The correct rib position is the TOUCH position.
■	:LABL0001	Jump address
	CNVSET LR001 = GP.G2#(GP001)	Get the position data of the positioner at the TOUCH position.
	CNVSET LR002 = P.G2#(P3)	Get the position data of the positioner at P3.
	SUB LR001 LR002	Find deviation value by calculating the difference between LR001 and LR002.
	EAXS_SFT-ON G2 = LR001	Start the shift of the external axis.
[C]	CALL EAXSSFT-WORK01.prg	Execute the rib welding program
	EAXS_SFT-OFF G2	Terminate the shift of the external axis.

18-9. Application example of IF-ARC

It applies different actions depending on whether or not the arc is generated.
This command is useful to adjust the arc start timing in a system using a multi-cooperative robot control or two torches.

18-9-1. Application example:

In a multi-cooperative robot control system, a program to start a weld start program when either the master robot or slave robot generates the arc.

SET LB001 20	Upper limit of the loop count. (This example shows 20)
+GASVALVE ON	Open the gas valve of the slave robot.
GASVALVE ON	Open the gas valve of the master robot.
+TORCHSW ON	Turn ON the torch switch of the slave robot.
TORCHSW ON	Turn ON the torch switch of the master robot.
:LABL0001	Loop label
DELAY 0.1s	Delay time
+IF-ARC=ON THEN JUMP LABL0002 ELSE NOP	If the slave robot is generating the arc, jump to the “End label (LABL0002).
IF-ARC=ON THEN JUMP LABL0002 ELSE NOP	If the master robot is generating the arc, jump to the “End label (LABL0002).
DEC LB001	Subtract “1” from the loop count.
IF LB001 > 0 THEN JUMP LABL0001 ELSE NOP	If the loop count is larger than “0”, return to the loop label.
HOLD No-ARC	Error stop (No arc has generated after checking 0.1s ×20 times.)
:LABL0002	End label.

*** Commands start with “+” are one for the slave robot.**