FANUC Robot series

TABLET UI

R-30*i*B Plus/R-30*i*B Mate Plus/R-30*i*B Mini Plus CONTROLLER

OPERATOR'S MANUAL

B-84274EN/03

- **Original Instructions**

Thank you very much for purchasing FANUC Robot.
Before using the Robot, be sure to read the "FANUC Robot series SAFETY HANDBOOK (B-80687EN)" and understand the content.

The products in this manual are controlled based on Japan's "Foreign Exchange and Foreign Trade Law". The export from Japan may be subject to an export license by the government of Japan.
Further, re-export to another country may be subject to the license of the government of the country from where the product is re-exported. Furthermore, the product may also be controlled by re-export regulations of the United States government.
Should you wish to export or re-export these products, please contact FANUC for advice.

In this manual, we endeavor to include all pertinent matters. There are, however, a very large number of operations that must not or cannot be performed, and if the manual contained them all, it would be enormous in volume. It is, therefore, requested to assume that any operations that are not explicitly described as being possible are "not possible".

SAFETY PRECAUTIONS

This chapter describes the precautions which must be followed to enable the safe use of the robot. Before using the robot, be sure to read this chapter thoroughly.

For detailed functions of the robot operation, read the relevant operator's manual to understand fully its specification.

For the safety of the operator and the system, follow all safety precautions when operating a robot and its peripheral equipment installed in a work cell.
For safe use of FANUC robots, you must read and follow the instructions in “FANUC Robot series SAFETY HANDBOOK (**B-80687EN)**”.

1 PERSONNEL

Personnel can be classified as follows.

Operator:
- Turns the robot controller power ON/OFF
- Starts the robot program from operator panel

Programmer or Teaching operator:
- Operates the robot
- Teaches the robot inside the safeguarded space

Maintenance technician:
- Operates the robot
- Teaches the robot inside the safeguarded space
- Performs maintenance (repair, adjustment, replacement)

- The operator is not allowed to work in the safeguarded space.
- The programmer or teaching operator and maintenance technician are allowed to work in the safeguarded space. Works carried out in the safeguarded space include transportation, installation, teaching, adjustment, and maintenance.
- To work inside the safeguarded space, the person must be trained on proper robot operation.

Table 1 (a) lists the work outside the safeguarded space. In this table, the symbol "O" means the work allowed to be carried out by the specified personnel.

Table 1 (a) List of work outside the Safeguarded Space

	Operator	Programmer or Teaching operator	Maintenance technician
Turn power ON/OFF to Robot controller	O	O	O
Select operating mode (AUTO/T1/T2)		O	O
Select remote/local mode		O	O
Select robot program with teach pendant		O	O
Select robot program with external device		O	O
Start robot program with operator's panel	O	O	O
Start robot program with teach pendant		O	O
Reset alarm with operator's panel		O	O
Reset alarm with teach pendant		O	O
Set data on teach pendant		O	O
Teaching with teach pendant		O	O
Emergency stop with operator's panel	O	O	O
Emergency stop with teach pendant	O	O	O
Operator's panel maintenance			O
Teach pendant maintenance			O

During robot operation, programming and maintenance, the operator, programmer, teaching operator and maintenance technician take care of their safety using at least the following safety protectors.

- Use clothes, uniform, overall adequate for the work
- Safety shoes
- Helmet

2 DEFINITION OF SAFETY NOTATIONS

To ensure the safety of users and prevent damage to the machine, this manual indicates each precaution on safety with "**WARNING**" or "**CAUTION**" according to its severity. Supplementary information is indicated by "**NOTE**". Read the contents of each **"WARNING"**, "**CAUTION**" and "**NOTE**" before using the robot.

Symbol	Definitions
⚠**WARNING**	Used if hazard resulting in the death or serious injury of the user will be expected to occur if he or she fails to follow the approved procedure.
⚠**CAUTION**	Used if a hazard resulting in the minor or moderate injury of the user, or equipment damage may be expected to occur if he or she fails to follow the approved procedure.
NOTE	Used if a supplementary explanation not related to any of WARNING and CAUTION is to be indicated.

TABLE OF CONTENTS

1 OVERVIEW

This manual will explain about the user interface that can be used on Tablet TP to operate robots.
Software option (S527) is needed to use this user interface. For CRX robot series, Table TP can be used without the option.

1.1 PRECAUTIONS FOR TABLET TP USE

1.1.1 Configurations Supported by Tablet TP

The hardware and software configurations supported by Tablet TP are as follows.

- The OS of the supported tablet devices is Android.
- The Tablet TP app supports Android version 9.0 or later.
- iOS is supported only for CRX.
- Use Google Chrome as a browser when using iOS.
- Cannot use USB port on the tablet base (UT1) with iOS.
- Tablet device must have USB Type-C port.
- When using a tablet other than the standard FANUC tablet, it is recommended to use Tablet TP with a device having a screen size of 9 inches or larger.
- Supported languages are English, Japanese and Chinese. The screen is displayed at English when other language is selected.
- Supported languages for Key Sheet are English and Japanese. Key Sheet is displayed at English when other languages are selected.
- Multi-tapping is not supported while using the touch pen that comes with the standard FANUC tablet.
- Tablet UI Editor has following limitations
  - Only icon instructions that is described in “4.3 Icon instructions” can be used for robot program.
  - If you want to teach other instructions, use the text input instructions.
  - In a multi-group system, programs with motion groups cannot be displayed/edited.
  - Only robots with 6 axes can be programmed.

1.1.2 Options not Available for Tablet TP

Following options are not supported.

- Paint Tool (H596), LR Paint Tool (H558) and functions for Paint Tool
- Wireless accelerometer manufactured by MicroStone co. ltd used by Learning Vibration Control (J573) function and AI Path Control (J574) function
- Robot operation without shift function(J591)
- High speed shift key function (J592)
- TP Hot Swap function (J647)
- No shift jog function (J739)
- Interface panel function (J741)
- TP Mode Select function (J768, S519)
- Interbus DDI Server function (J769)
- iRPickTool/Auto Visual Track Frame setup add-on(J773)
- WeldTip inspection function (J847)
- iRVision 2DV (J901)’s 2D Calibration-free Vision Process
- Panel Wizard (R594)
- iRVision TorchMate (R744)
- EtherNet/IP DN Router (R804)

- Shared TP function (R844)
- Small Hand Guidance (S506)
- Genkotsu Vision Mastering

2 CONNECTION

This section describes the method to connect the Tablet TP and the controller.

2.1 SETUP

To connect to the controller, you must set the TCP/IP setting on your tablet device.
You will need to set the following as the IP address of your tablet device in order to access the controller.

IP address: 1.1.0.12
Subnet Mask: 255.255.255.0

If you are using the FANUC standard tablet, this setting is done beforehand.

2.2 TABLET TP APP

Tablet TP APP can be used in the Android tablet.
If you are using the FANUC standard tablet, this APP is installed by default.

Tablet TP APP can be downloaded from the Fanuc membership site.
FANUC membership site Japan https://store.member.fanuc.co.jp/fanuc/store/
In the case of regions other than the above, please contact the service base of the neighborhood.

For more information about the installation method of the Tablet TP APP, please look at the attached software update procedure for the CRX series robot.

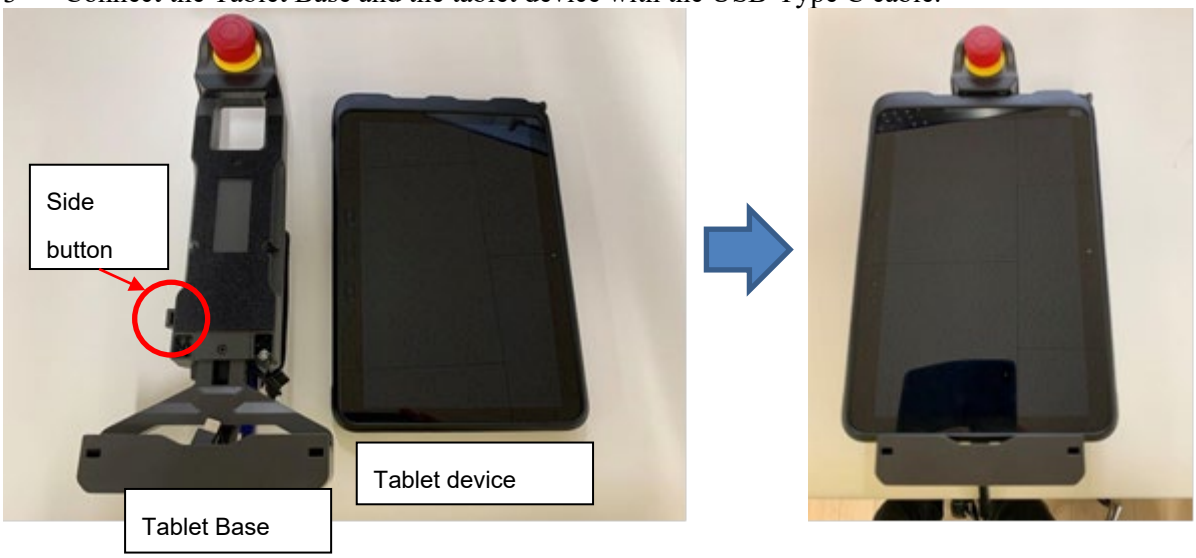
2.3 CONNECT TO THE CONTROLLER

Connection between the tablet device and the controller can be made via the Tablet Base.

Procedure Connect the Tablet Teach Pendant

Step

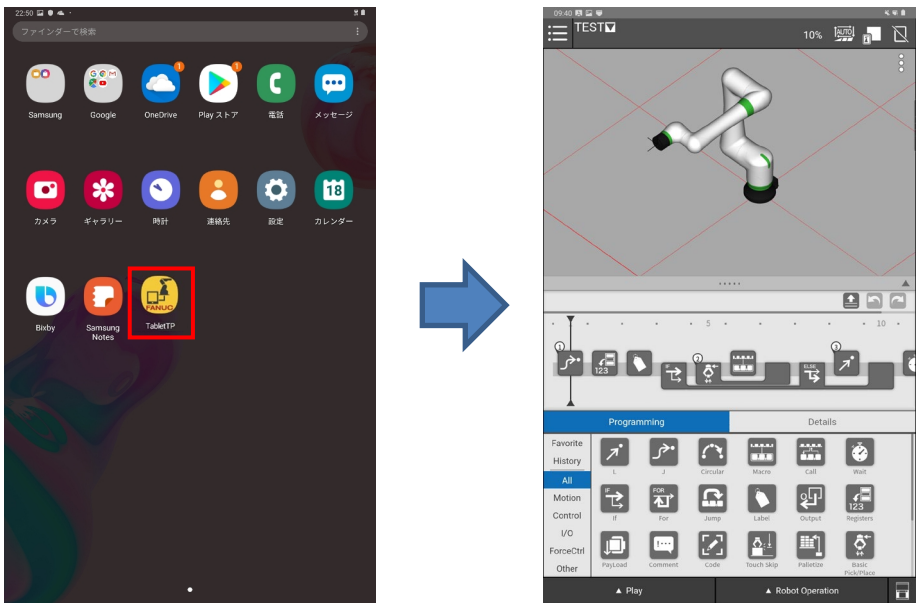
1 Connect the TP cable to the Tablet Base.
2 Combine the tablet device and the Tablet Base. Press the side button and stretch the Tablet Base. Fit the tablet device into the Tablet Base.
3 Connect the Tablet Base and the tablet device with the USB-Type C cable.



Procedure Login to the controller

Step

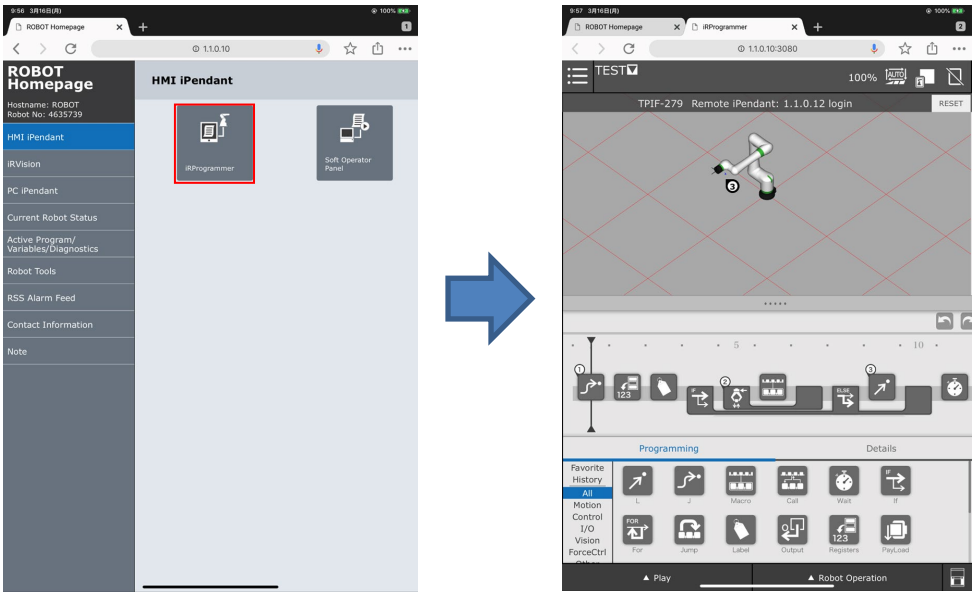
1 Turn on the tablet device.
2 Start the Tablet TP APP.
3 Turn on the controller. When the controller has finished loading, Tablet TP will automatically login to the controller.



Procedure Login to the controller (for iOS)

Step

1 Turn on the controller.
2 Turn on the tablet and open Google Chrome app.
3 Wait until the controller has finished loading, and enter 1.1.0.10 in URL to open ROBOT Homepage
4 Click iRProgrammer on HMI iPendant tab to login to the controller



2.4 CHECK THE DATE AND TIME

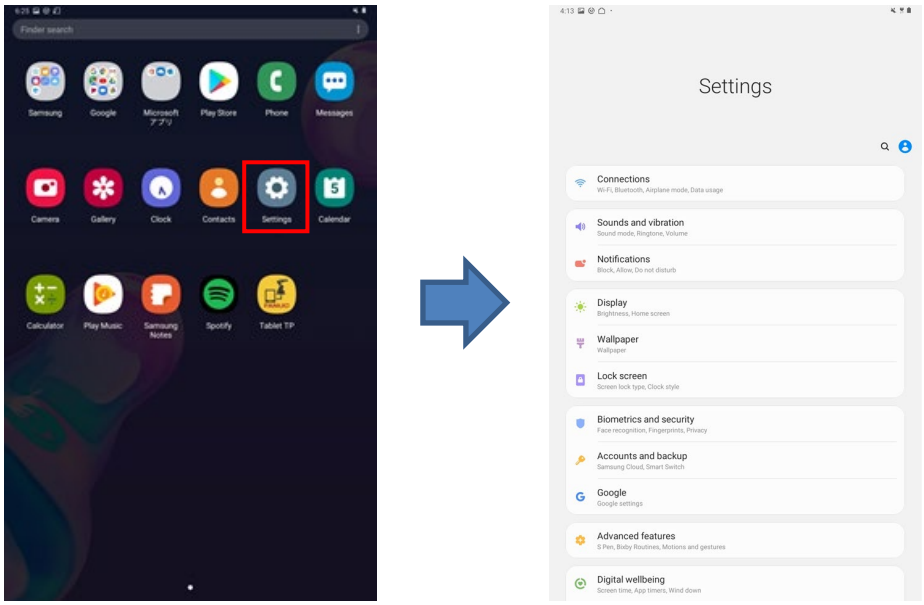
Check the date and time on the tablet device and the controller. If the date or time are wrong, set the correct date and time.

NOTE
If the date and time on the tablet device and the controller are out of sync, the tablet TP screen may be slow to display.

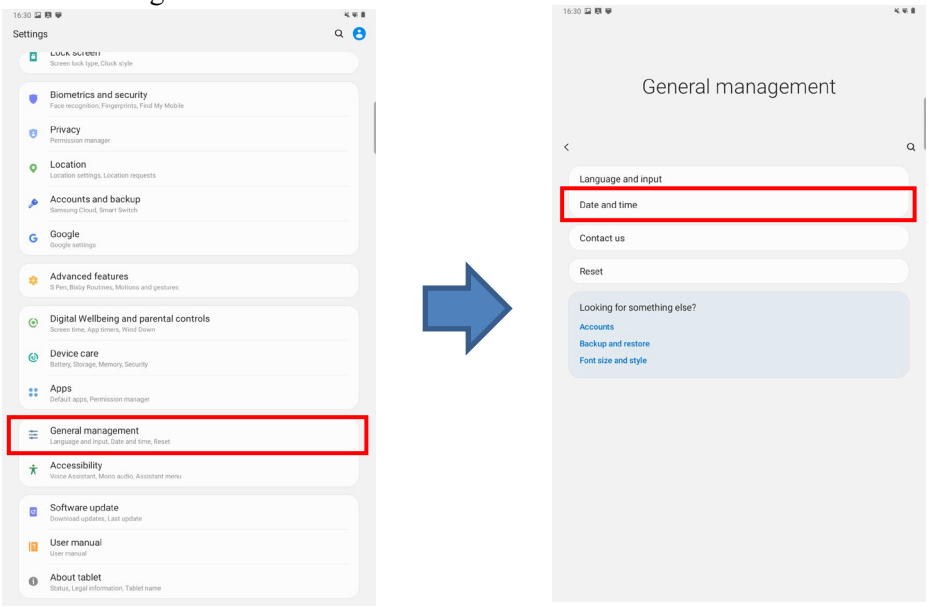
Procedure Check and setup the date and time on the tablet device

Step

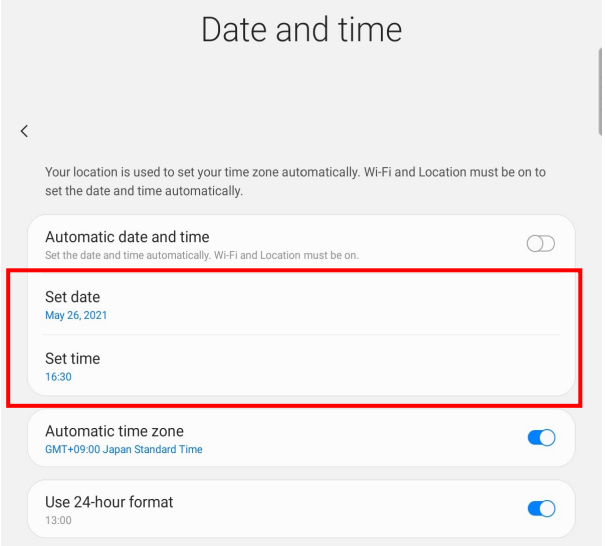
1 Open “Settings” in the tablet device.



2 Go to “General management” -> “Date and time”.



3 Disable “Automatic date and time” and set the date and time.

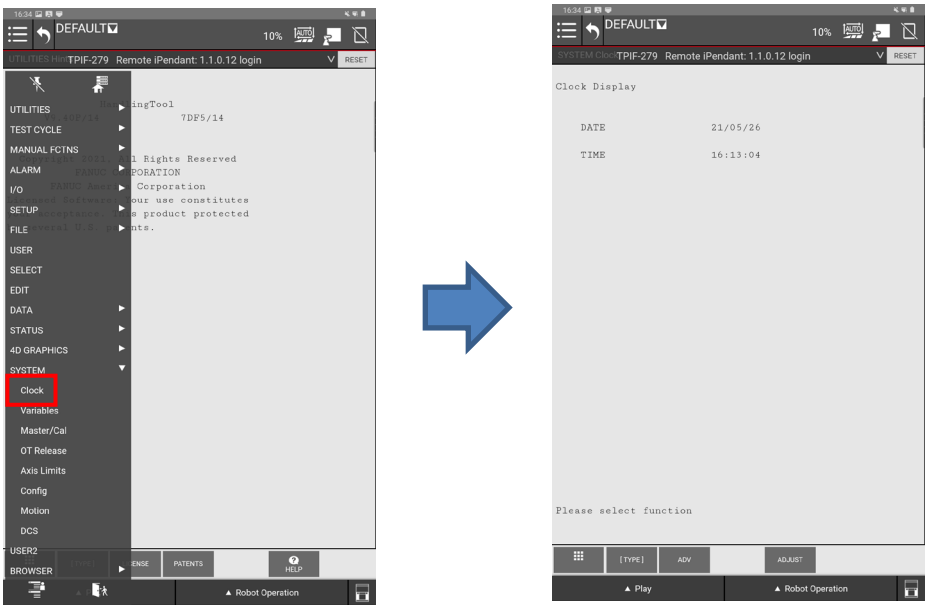


NOTE
The procedure to display the date and time setting screen varies depending on the type of tablet device, OS version, etc.

Procedure Check and setup the date and time on the controller

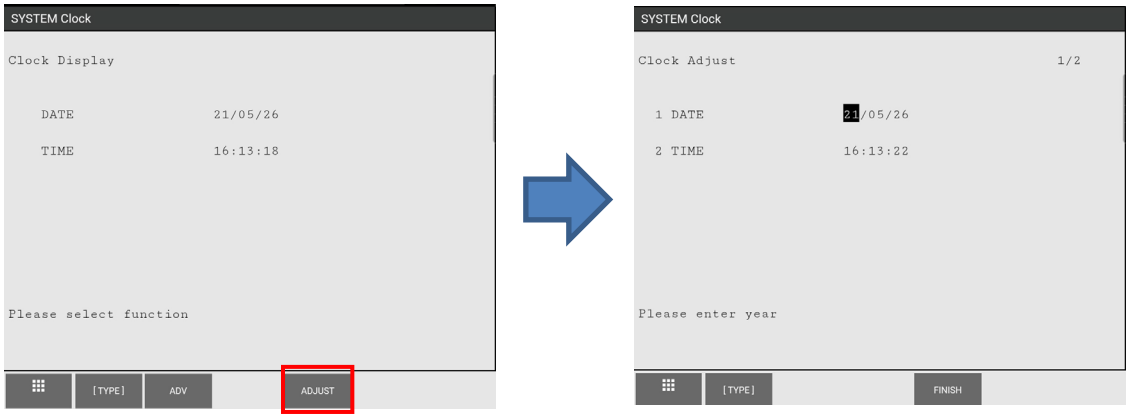
Step

1 Go to “SYSTEM” -> “Clock”.



2 Show the key sheet by touching the key sheet show button.

3 Select “ADJUST” and set the date and time.



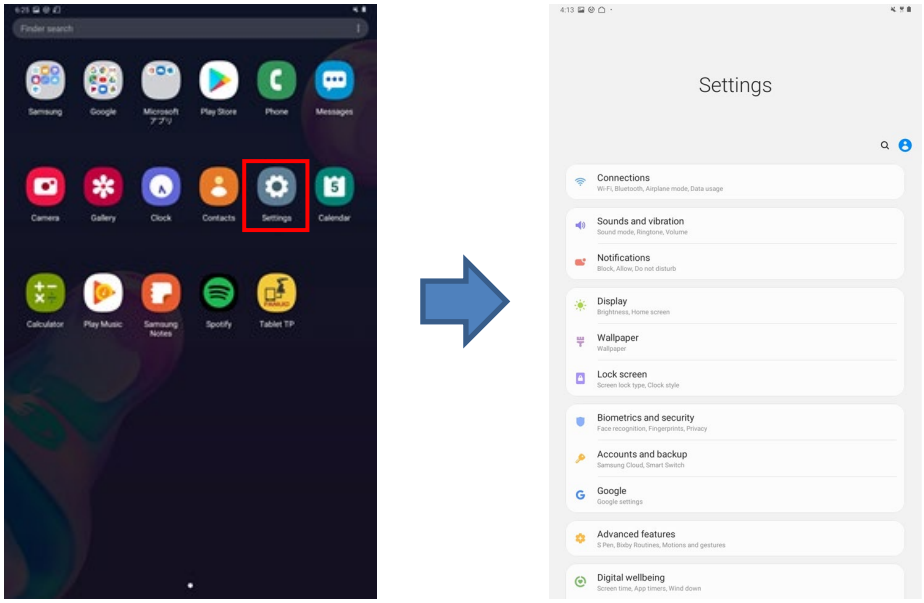
2.5 WHEN THE TABLET TP CANNOT CONNECT TO THE CONTROLLER

If you cannot connect to the controller from the Tablet TP, please confirm the following procedure.

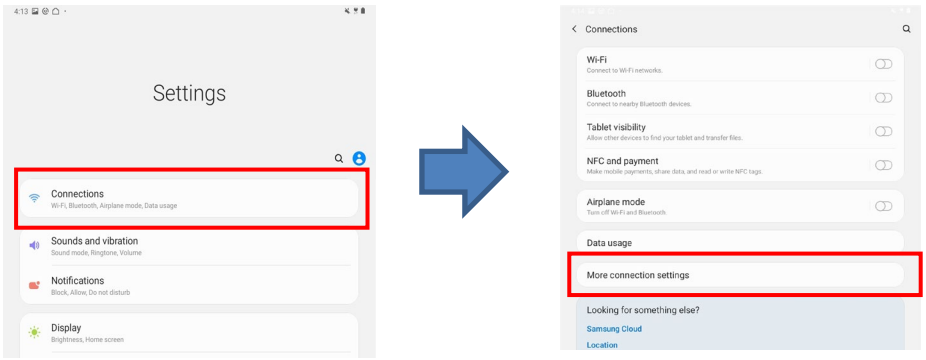
Procedure Setup method of the connection

Step

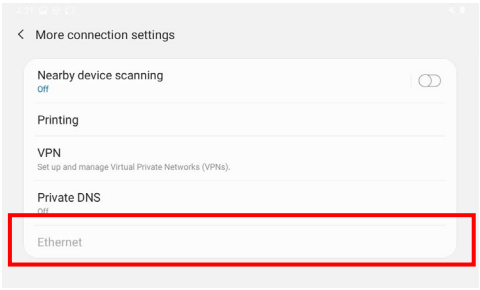
1 Open “Settings” in the tablet device.



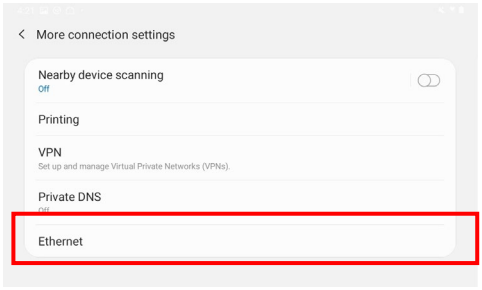
2 Go to “Connections” -> “More connection settings”.



3 Confirm “Ethernet”. If you cannot select this item, the connection of the tablet device and the controller may have a problem. Please confirm that there is no poor contact at the connection of the TP cable or the USB-Type C cable.

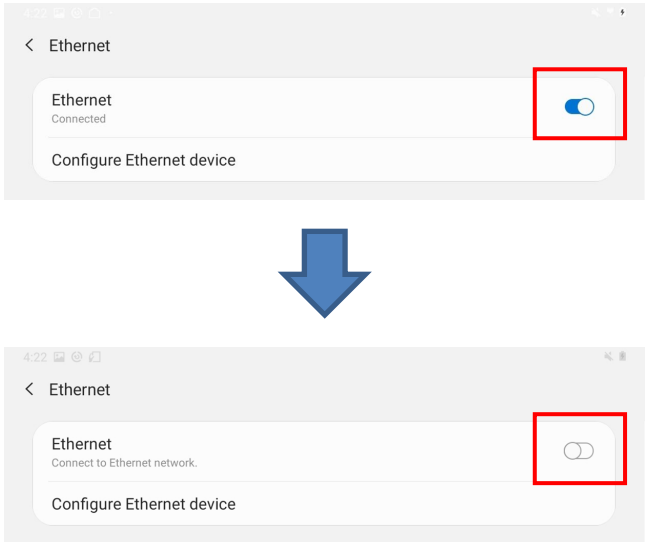


“Ethernet” is not selectable

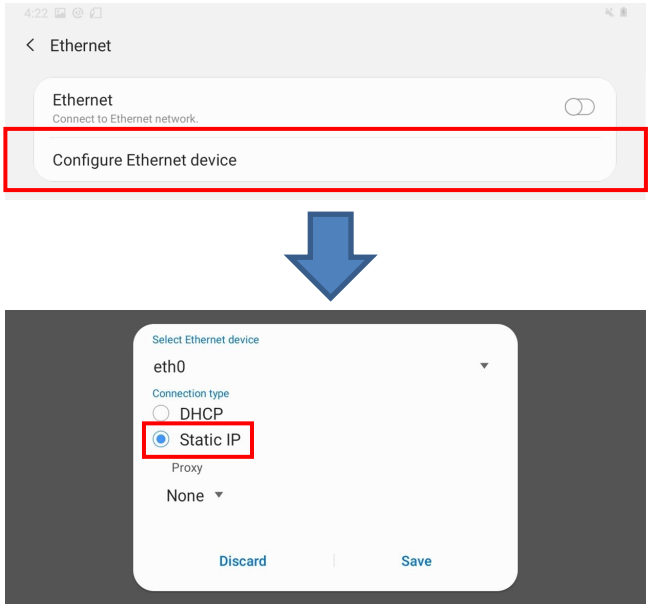


“Ethernet” is selectable

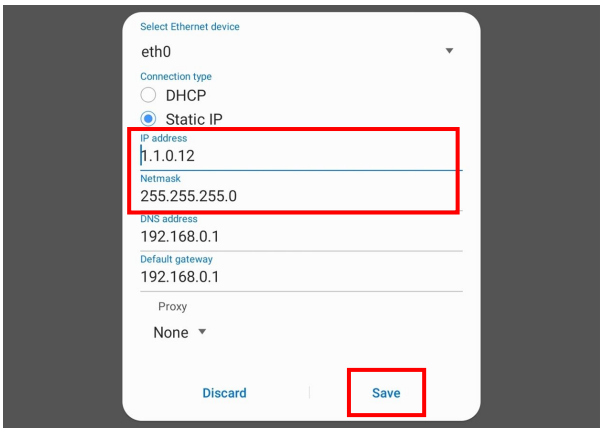
4 Select “Ethernet”.
5 Disable the Ethernet connection.



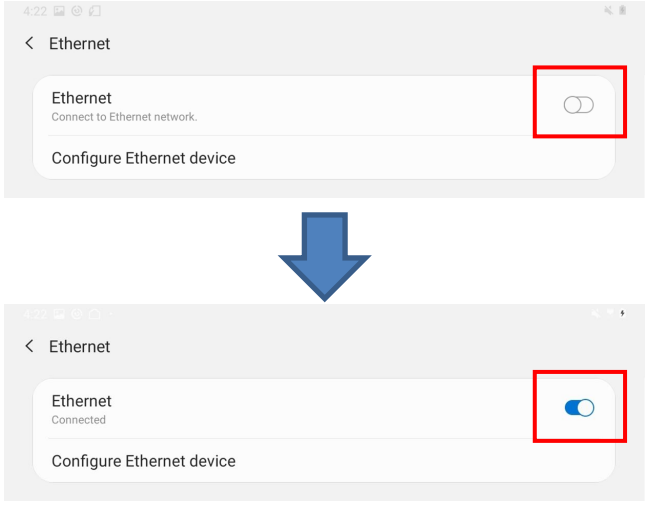
6 Select “Configure Ethernet device” and set the connection type to “Static IP”



7 Select “Static IP” and set the IP address mentioned in section 2.1.



8 Enable the Ethernet connection.



9 Start the Tablet TP APP to connect to the controller.

2.6 EMERGENCY STOP

Tablet Teach Pendant has an emergency stop button (TP E-stop) on the Tablet Base. If the Tablet Teach Pendant is connected to the controller, the following alarm will occur and the robot motion will stop each time the Estop button is pressed.

Table 2.6(a) Alarm of Emergency Stop

	button/signal	Alarm
R-30iB Plus	TP E-stop	SRVO-601 TP/OP E-stop
	OP E-stop	SRVO-601 TP/OP E-stop
	EX E-stop	SRVO-007 External emergency stops
R-30iB Mate Plus	TP E-stop	SRVO-602 TP/External E-stop
	OP E-stop	SRVO-001 Operator panel E-stop
	EX E-stop	SRVO-602 TP/EX E-stop
R-30iB Compact Plus	TP E-stop	SRVO-002 Teach pendant E-stop
	OP E-stop	SRVO-001 Operator panel E-stop
	EX E-stop	SRVO-007 External emergency stops
R-30iB Mini Plus	TP E-stop	SRVO-002 Teach pendant E-stop
	OP E-stop	SRVO-001 Operator panel E-stop
	EX E-stop	SRVO-007 External emergency stops

Please refer to “FANUC ROBOT SAFETY HANDBOOK 4.3 STOP TYPE OF ROBOT” for details of stop type of the robot motion.

2.7 ENABLING DEVICE (DEADMAN SWITCH)

Tablet Teach Pendant has an enabling device (Deadman switch) on Tablet Base. When Tablet TP is connected, the following alarm is occurred.

Table 2.7(a) Alarm of Enabling device

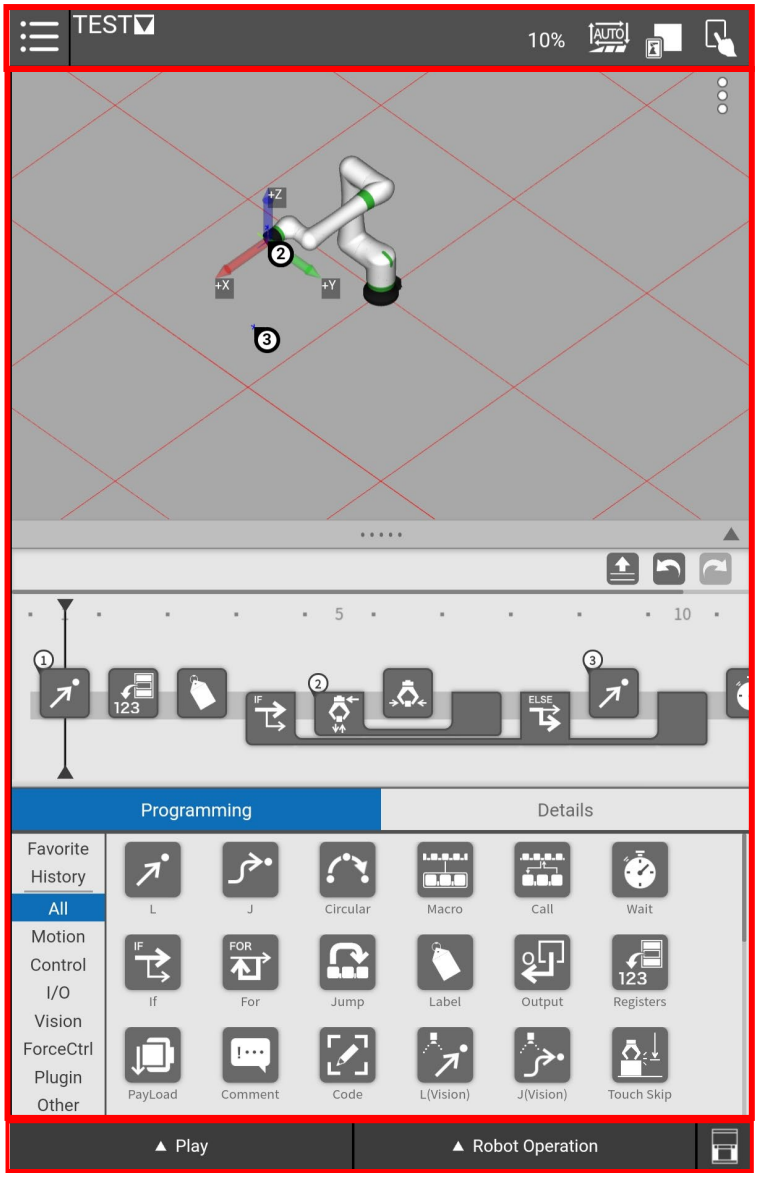
Controller	Enabling device	Alarm
R-30iB Plus	Enabling device (Deadman switch)	SRVO-603 Deadman switch/NTED released
	NTED	SRVO-603 Deadman switch/NTED released
R-30iB Mate Plus	Enabling device (Deadman switch)	SRVO-003 Deadman switch released
R-30iB Compact (Mini) Plus	Enabling device (Deadman switch)	SRVO-003 Deadman switch released
R-30iB Mini Plus	Enabling device (Deadman switch)	SRVO-003 Deadman switch released

Please refer to “FANUC Robot series SAFETY HANDBOOK 4.3 STOP TYPE OF ROBOT” for details of stop types of the robot motion.

3 TABLET UI

The screen of the Tablet UI can be divided into the following areas.

- Status bar, Menu display
- Panel display section
- Screen display / Operation section



Status bar

Screen display / Operation section

Panel display bar

Fig. 3 Tablet UI Screen

Table 3 Tablet UI Screen Layout

Item	Description
Status bar	Displays the robot's status
Robot Graphic	Displays the graphic image of the robot. The graphics will change depending on the robot position and attitude.
Program Line	Displays the selected program with icons. To edit the program, drag & drop an instruction icon from the icon pallet to the program line.

Item	Description
Icon Pallet	Touch the Programming tab to display the icon pallet. The icon instructions supported by this robot will appear in the icon pallet. See “4.3 Icon Instructions” for icon instructions supported by this robot. Select a section on the left to change the icons shown in the icon pallet.
Instruction Details	Touch the detail tab to display the detail settings of the selected instruction on the program line. The instruction settings can be changed here.
Play	Displays the execution panel The program can be executed, paused and stopped using the execution panel.
Robot Operation	Displays the robot operation panel. A robot operation can be performed or manual guided teach settings can be applied using the robot operation panel.

3.1 STATUS BAR

3.1.1 Status Bar

The status bar has the following functions.

- Displays the menu.
- Displays the program selected and line being executed.
- An icon to change the selected program.
- Displays the system’s state.

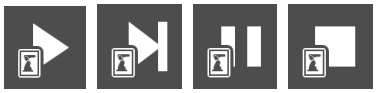
Menu Operation Program State System State TP Enable Key

Fig. 3.1.1(a) Status Bar

The description and usage of each icon is described in Table 3.1.1(a).

Table 3.1.1(a) Status Bar Icons

Icons	Description
	Displays menu.
	Go back to the previous screen.
	Displays the program name of the program being edited. A list of programs will display when the icon on the right of the program name is touched. Select a program on the list to change the program to edit.
	Displays the current operation mode. (AUTO,T1,T2 mode)

Icons	Description
	Displays the current execution status of the program. (Execution, single step execution, pause, end)
	Displays the test execution status of the program. (Execution, single step execution, pause, end)
	This is the TP enable key. Turn TP enable on / off.

Select Program

Touch the icon on the right of the program name to display a list of programs created.
Select a program to change the current program.

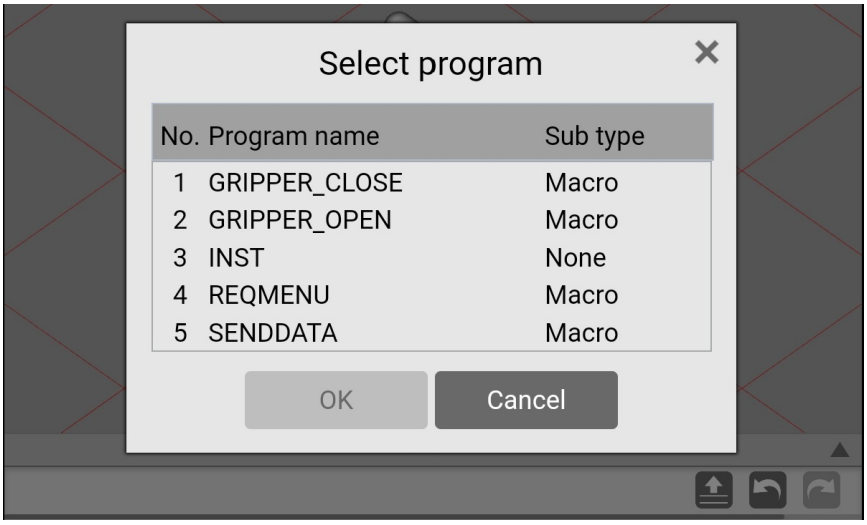


Fig. 3.1.1(b) Program Selection Dialog

Display and Reset Alarm

When an alarm occurs, the alarm message will appear below the status bar.
After the cause of the alarm is removed, touch the reset button to recover from the alarm.

Fig. 3.1.1(c) Alarm Display

If two or more alarms have occurred, a scroll button will show on the left of the RESET button. By touching the scroll button, a list of alarms currently occurring will show under the status bar.

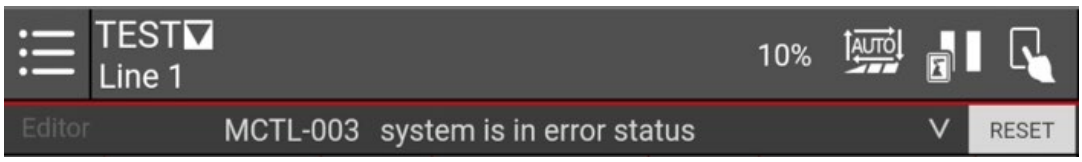


Fig. 3.1.1(d) Alarm Scroll Button

3.1.2 Menu

Touch the menu icon on the status bar to display the menu. In the menu, menu items and a few icons are displayed. When a menu item is touched, the screen display and operation section will switch to the corresponding screen.
The icons in the menu are described in Table 3.1.2(a). For more information about the menu item, see Table 3.1.2(b)

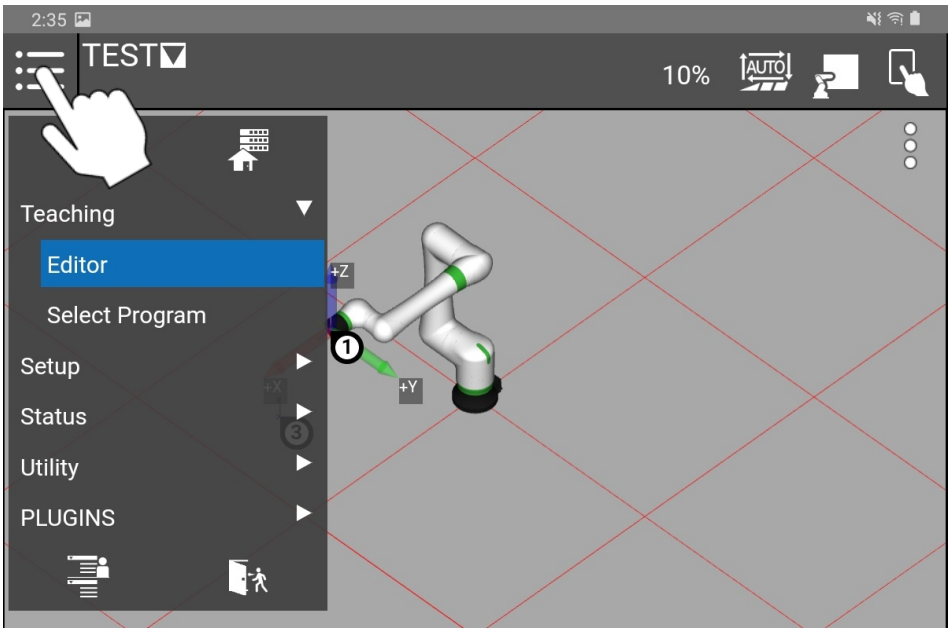


Fig. 3.1.2 (a) Menu Display

Table 3.1.2(a) Icons in Menu

Item	Description
	Use this icon to switch the menu display format. Constant display and the display when the menu icon is touched can be switched with this icon.
	Displays home screen (editor).
	The Tablet UI menu and compatible menu (equivalent to iPendant) can be switched with this icon.
	Disconnects the tablet TP.

Table 3.1.2(b) Description of menus for Tablet UI

Item	Sub Item	Description
Teaching	Editor	Users can edit programs.
	Select Program	Users can create and select programs.
Setup	Initial Setup	Initial setup required to start using the robot. Set the time, network, etc.
	Collabo Robot Setup	Initial setup required for Collaborative Robot. Set the tool, payload, etc. Settings for switching to high speed mode.
	UTool Setup	Initial setup for tool attached to robot. Set the tool center position, tool center of mass, etc.
	Utool Payload Identification	Operate the robot to automatically estimate the mass and center of gravity of the load of tools and workpieces attached to the hand. This menu is displayed only in the CRX series robot.
	UFrame Setup	Users can setup the user frame. There are the teaching method and the direct list method.
	DCS	Users can change the DCS settings and confirm the load for collaborative robots.
	Collabo Speed Setup	Users can set the robot's move speed depending on the area of the body the robot might contact with. This menu is displayed only in the CRX series robot.
	EE Interface Setup	Set up EE Interface communication. When the configuration is changed, the robot controller must be re-started to take effect. This menu is displayed only with CRX series robot.
	*i*RVision	Setup *i*RVision Vision Data. Different from the vision data screen opened from the "Find" icon, users can make settings equivalent to those of conventional *i*RVision.
	Force Coordinate Lists	User can setup the frame for force control. This menu is displayed only with CRX series robot.
Status	Current Position	Indicates the position and posture of the robot in space. There are 2 types of current position display: Joint coordinate values and Cartesian coordinate values.
	Alarm Status	Displays the alarms that are occurring and the history of alarms. Users can check the details of the alarm.
	I/O	Displays I/O status.
	Numeric Register	Users can refer to and set the number of the register.
	Position Register	Users can refer to and set the position data of the position register
Utility	File	Users can perform file operations on the device.
	File Backup	Users can save the backup data of the robot to a device such as USB memory.
	Image Restore	The backup data can be read.
	Cycle Power	Select the start mode and restart.
Plugins	Install	Users can install the plugin software provided by each peripheral device company in the USB memory.
	Plugin List	Users can view the list and details of installed plugin software and also uninstall plugin software.

3.1.3 Panel

Touch the panel display bar at the bottom of the screen to display the execution panel and robot operation panel.
The bar of the displayed panel turns blue. Touch the panel again to hide the panel.
See “3.3 Manual Robot Operation” and “5.1 Executing a Program” for more information on using the operation panel.

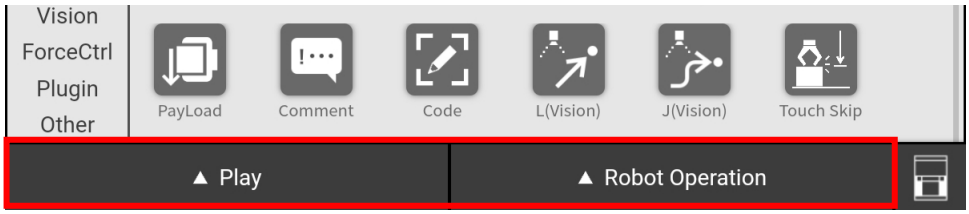


Fig. 3.1.3(a) Panel Display Bar

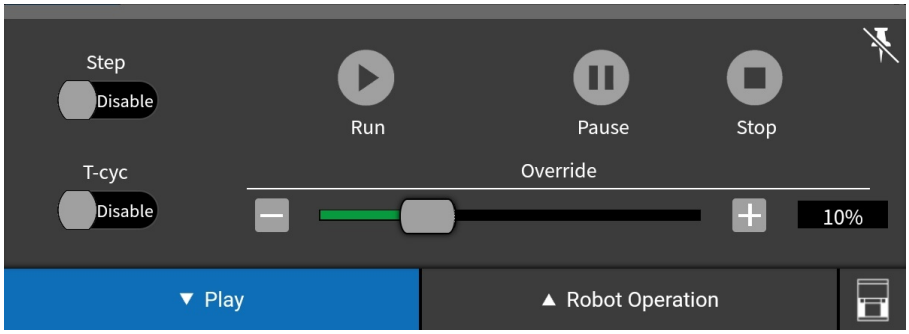


Fig. 3.1.3(b) Displaying Execution Panel

3.2 PAYLOAD CONFIRMATION OPERATION AFTER POWER ON

Users must confirm that the payload setting is consistent with the actual payload at least once after power on for controller. This operation is called Payload Confirmation. The robot cannot move before Payload Confirmation.

A pop-up will be displayed on the tablet screen to confirm payload in the following settings.

- After power on for controller
- Touch RESET button when payload confirmation is not completed (“SYST-374 Need to confirm payload” alarm occurs)

If users need to confirm payload in other settings, see “FANUC Robot series OPERATOR’S MANUAL (Collaborative Robot Function) (B-83744EN)”.

> ⚠ **WARNING**
> If the payload confirmation operation is performed incorrectly, the external force is not detected correctly and the safety function will not work, and a personal injury could result. When the payload confirmation operation is performed, the actual payload of the robot must be confirmed correctly, and anybody must not contact the robot.

Payload Confirmation Operation

Users can confirm payload using the pop-up by following the steps below.

1 If Fig. 3.2(a) is displayed, enter the master code number for DCS. If the code number is not correct, the payload confirmation operation is failed.
If the “Password for CONFIRM” is DISABLE in the collaborative robot screen, it is not necessary to enter the code number.

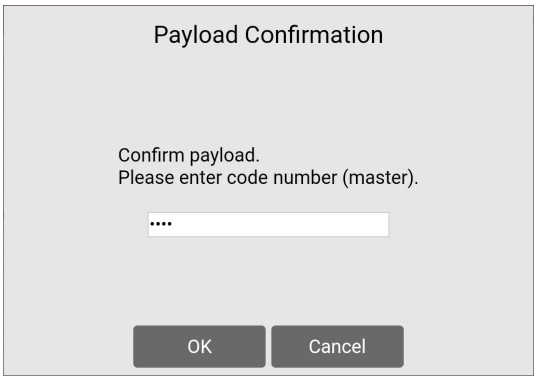


Fig. 3.2(a) Payload Confirmation Popup

2 Fig. 3.2(b) is displayed. Confirm the actual payload of the robot hand/tool/workpiece if it is surely equal to payload No X.
- If No. X is correct, touch Yes and the next question will be displayed
- Else, touch No and the payload confirmation operations is failed. Change the payload setting and try again.

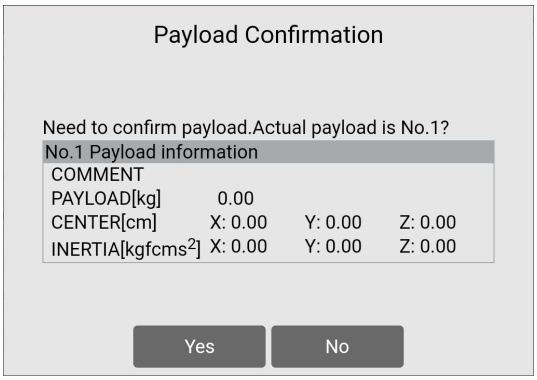


Fig. 3.2(b) Payload Confirmation Popup

3 Fig. 3.2(c) is displayed. Confirm that nobody is in contact with the robot, no foreign object is on the robot, and there is no external force on the robot. Press OK and the result of the payload confirmation will be displayed.

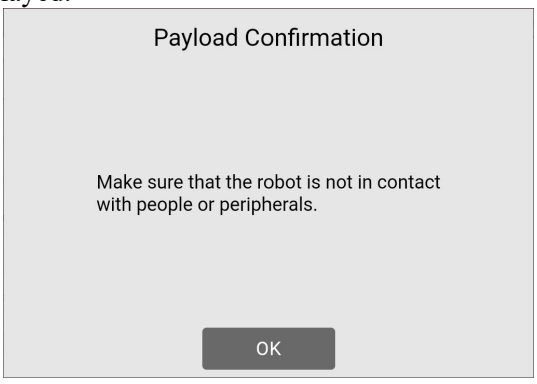


Fig. 3.2(c) Payload Confirmation Popup

The result of the payload confirmation

“Payload confirmation success”

Payload confirmation operation is completed. You can use the collaborative robot after this.

“Payload confirmation failed”

Remove the external force to the robot and try again. For example, a floor vibration may cause the external force.
Wait few seconds and try again. Payload confirmation can fail soon after power up

3.3 MANUAL ROBOT OPERATION

There are 3 methods to manually operate the robot.
- Jog operation using the robot operation panel soft keys
- MPG Jog operation using the robot operation panel dial
- Direct operation with manual guided teach (Only in the CRX series robot)

This section describes the UIF for the 3 operations.

3.3.1 Jog Operation on a Tablet

Touch the robot operation key in the bottom right of the screen to open the robot operation panel.
Users can select Jog, Manual guided teaching, or MPG Jog from the tabs at the top.
If jog operation is selected the jog buttons are displayed. If the manual guided teach panel or the MPG jog panel is displayed, the operation can be switched to the jog operation by touching the jog on the top tab.
Users can jog the robot while sliding the jog button.
Touch the Frame button to switch the jog method between Cartesian, Tool, User or Joint.
The TP enable key in the status bar must be ON in order to jog the robot.

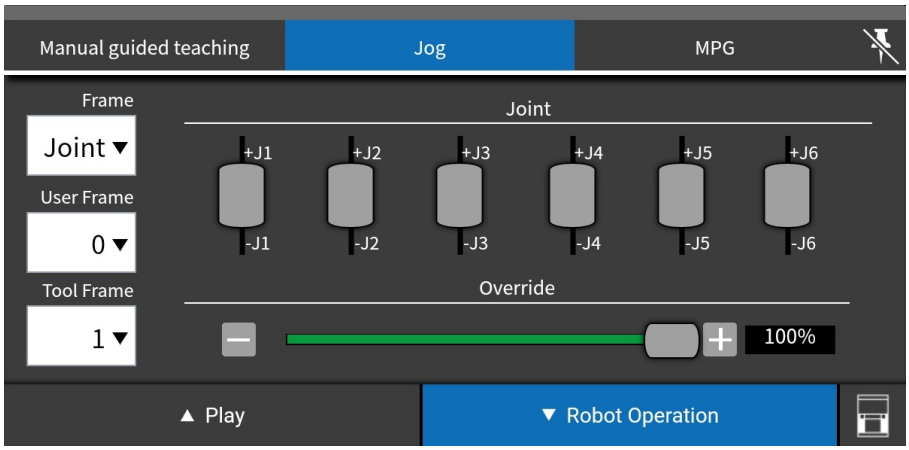


Fig. 3.3.1(a) Jog Panel (Joint)

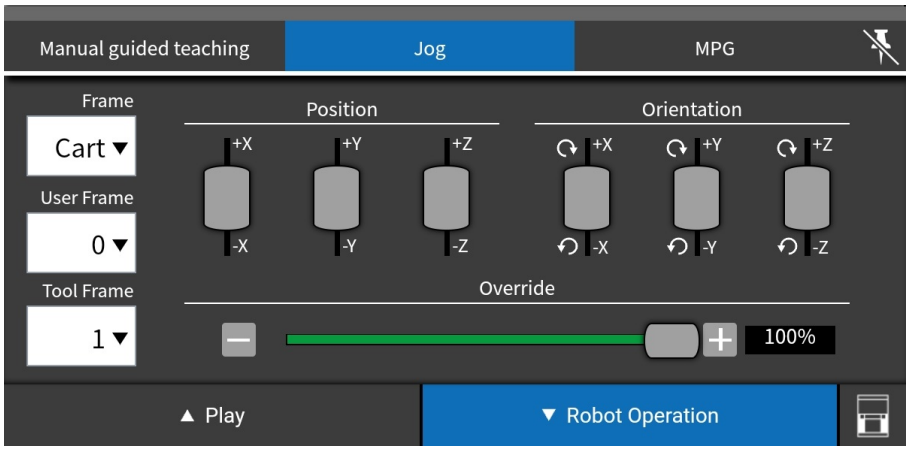
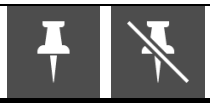


Fig. 3.3.1(b) Jog Panel (Cartesian)

Table 3.3.1(a) Jog Panel

Button	Description
Manual guided teaching	Change the operation method to manual guided teach. Robot operation panel is changed for manual guided teach.
MPG	Change the operation method to MPG Jog. Robot operation panel is changed for MPG Jog.
Frame	Choose frame from cartesian, tool, user, and joint.
Tool Frame	Set tool frame number.
User Frame	Set user frame number
Override	Users can change the override.
	Use this icon to switch the Robot Operation panel display format. Constant display and the display when the Robot Operation key is touched can be switched with this icon.

3.3.2 MPG Jog

Touch the robot operation key in the bottom right of the screen to open the robot operation panel. Then Touch the MPG Jog key in the upper right of the robot operation panel to open the MPG Jog panel.
MPG Jog is a function to jog the robot by rotating the dial.
The robot can move according to amount of rotation of the dial.
Users can select the magnification of movement amount per 1 scale of the dial by Scaling Factor button.
Users can select the direction of robot movement by Motion Dir/Joint button.
This function is available as a standard feature of FANUC Robot CRX series with Tablet TP.

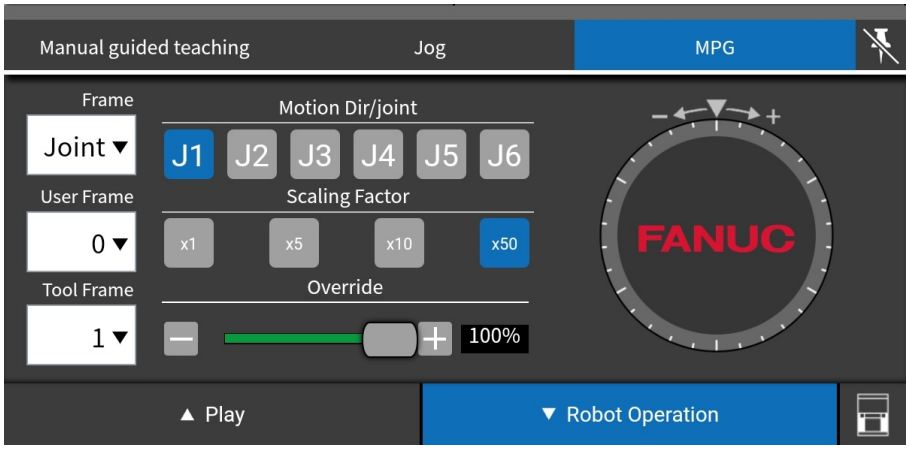


Figure 3.3.2(a) MPG Jog panel(Joint)

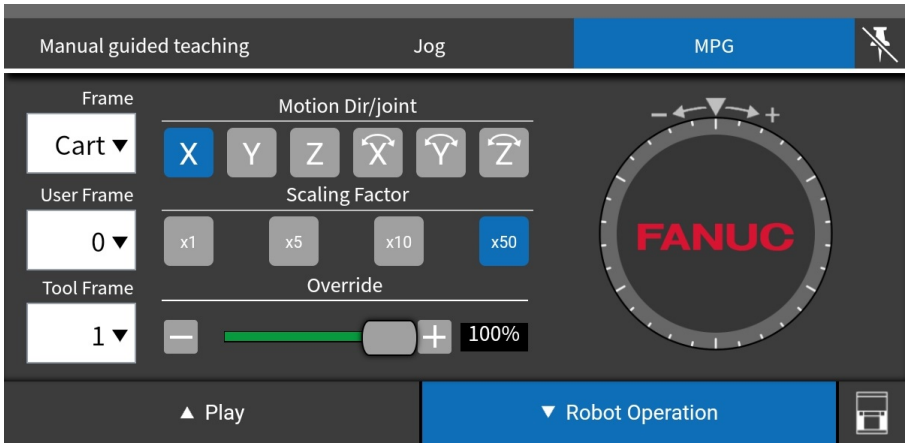


Figure 3.3.2(b) MPG Jog panel(Cartesian)

Table 3.3.2(a) Jog Panel

ボタン	説明
Manual guided teaching	Change the operation method to manual guided teach. Robot operation panel is changed for manual guided teach.
Jog	Change the operation method to Jog. Robot operation panel is changed for Jog.
Frame	Choose frame from Cartesian, tool, user, and joint.
Tool Frame	Set tool frame number.
User Frame	Set user frame number.
Override	Users can change the override.
Motion Dir / joint	Users can select the direction of robot movement. If Joint Frame is selected, J1 to J6 buttons are displayed on the MPG jog panel. If Cartesian, Tool, or User is selected, X, Y, Z, W, P, R buttons are displayed on the MPG jog panel.
Scaling Factor	Users can select the magnification of movement amount per 1 scale of the dial. If liner motion selected, the amount of movement that can be set with each button is as follows. ×1: 0.1mm、×5: 0.5mm、×10: 1mm、×50: 5mm If rotate motion selected, the amount of movement that can be set with each button us as follows. ×1: 0.01°、×5: 0.05°、×10: 0.1°、×50: 0.5°
	Users can jog the robot at a distance according to the amount of rotation of the dial. If users rotate the dial clockwise, robot will move in the + direction. If users rotate the dial Counterclockwise, robot will move in the – direction. If users touch the center of the dial, MPG jog will stop. Because, the amount of movement changes drastically when users touch the center of the dial. If you want to start MPG jog again, release the dial and touch the dial again.

3.3.2.1 Operation

The operation procedure for the MPG Jog function is as follows.

1 On the tablet TP, Touch the robot operation key on the bottom of the screen and press the “MPG Jog” button.
2 The TP enable key in the status bar switch to enable.
3 Select the coordinate system to jog.
4 Select the direction / axis number to jog with the Motion Dir/Joint button.
5 Select the Scaling Factor to jog with the Scaling Factor button.
6 Rotate the dial in the direction you want to jog.

3.3.2.2 Notice

- The robot does not move by MPG Jog function when selecting low speed or slow speed as the override.
- The robot does not move by MPG Jog function when increment jog function is enabled.
- To prevent coasting, when override % is small, the robot cannot move the direction specified with the dial.
- To prevent coasting, when rotate the dial quickly, the robot cannot move the direction specified with the dial.

3.3.3 Manual Guided Teach

The manual guided teaching function enables operators to move the robot by pushing it directly.

The manual guided teaching is enabled when the enabling device (deadman switch) is pressed.
The correct operation is shown in Fig.3.3.3 (a). The tablet TP (or iPendant) and the robot must be held by the same person.

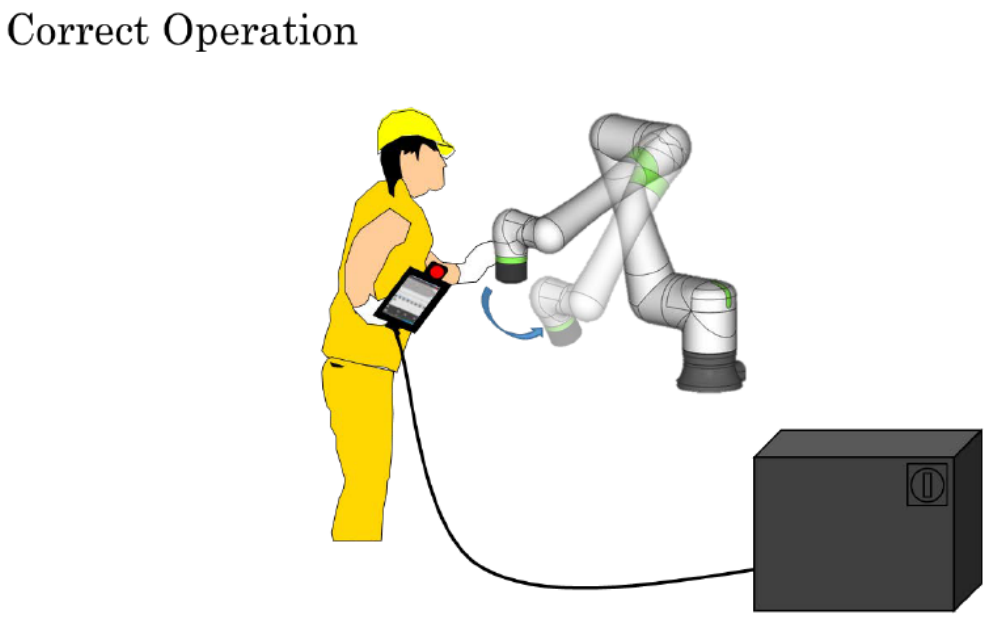


Fig. 3.3.3(a) Correct operation of manual guided teaching

The wrong operation is shown in the Fig.3.3.3 (b). The tablet TP (or iPendant) and the robot are held by two persons.

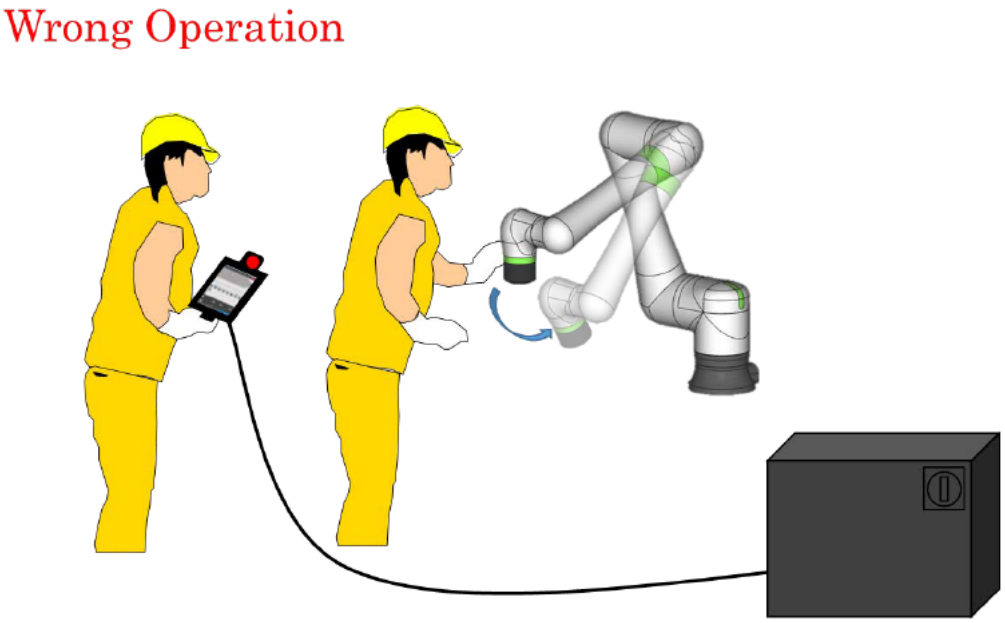


Fig. 3.3.3(b) Wrong operation of manual guided teaching

> **⚠ WARNING**
> - If payload setting is not appropriate, the robot can move unexpectedly in the manual guided teaching operation. Please confirm before operation that the payload setting is correct, and release the enabling device immediately if unexpected movement occurs.
> - The contact stop function is disabled during the manual guided teaching operation. If you feel danger, for example, there is a risk that the work piece collides yourself or the stand etc., please release the enabling device immediately.

3.3.3.1 Operation

1 Enable the manual guided teaching function

- On the tablet TP, open the Robot Operation tab on the bottom of the screen and press the "manual guided teaching" button. The panel in Fig. 3.3.3.1(a) is displayed where you can adjust the weight of the operation.

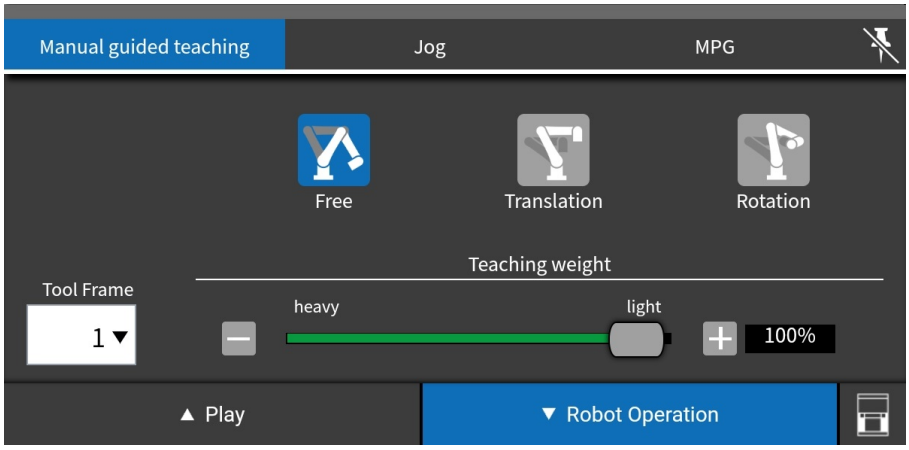


Fig. 3.3.3.1(a) Tablet TP Manual Guided Teach

Table3.3.3.1 (a) Manual Guided Teach Panel

Button	Description
Jog	Change the operation method to Jog. Robot operation panel is changed for jog.
MPG	Change the operation method to MPG Jog. Robot operation panel is changed for MPG Jog.
Free	Users can operate all axes without restrictions with Manual guided teaching.
Translation	Users can operate the robot only translation with Manual guided teaching.
Rotation	Users can operate the robot only translation with Manual guided teaching. You can only rotate the posture around the tool coordinate system
Operation Weight	The weight of manual guided teach operation can be adjusted by sliding the bar. The light setting allows the robot to be operated with weak force. The heavy setting is used to fine-tune the robot position.

- On iPendant, open JOG ASSIST screen, and push the “MANUAL” button.

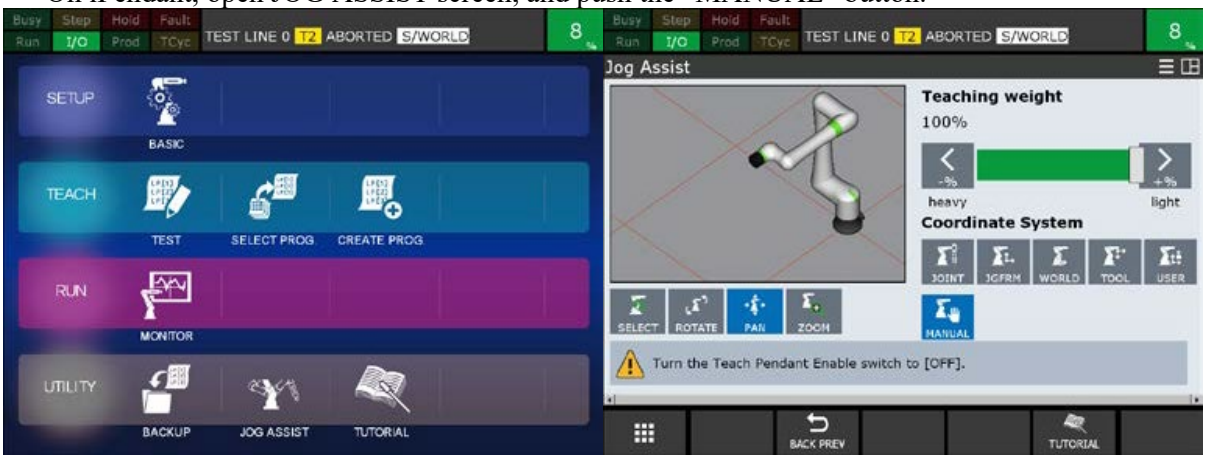


Fig. 3.3.3.1(b) iPendant Manual Guided Teach

2 Press the enabling device in AUTO mode.

3 When all conditions are fulfilled, the green LED on the robot starts flashing and you can start moving the robot.

3.3.3.2 Notice

- When TCP or the elbow speed exceeds 1000[mm/s] during manual guided teaching, the robot stops.
- If manual guided teaching doesn’t start, please check these conditions.
  - The controller is in AUTO mode.
  - All alarms are removed.
  - The robot axes are inside of joint limits.
  - Payload confirmation is done.
  - The robot is stopped

3.3.4 Recovering from Certain Alarms

For certain type of alarms, a pop-up box like the following will show up.

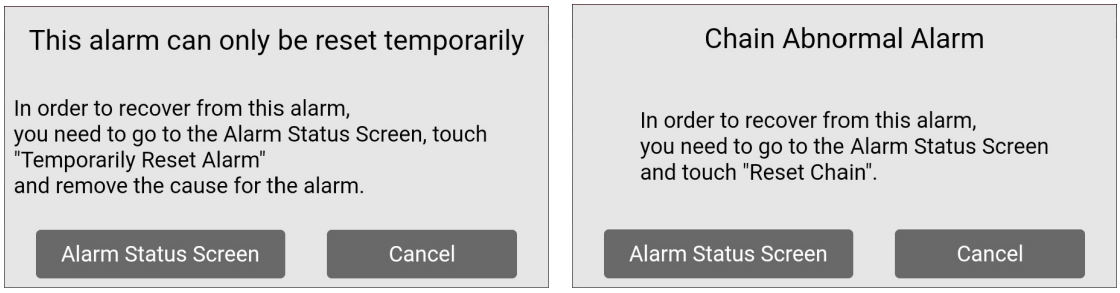


Fig. 3.3.4(a) Pop ups for certain Alarms

When a pop-up box like Fig. 3.3.4(a) shows, users must switch to the Alarm Status Screen and apply some actions. By touching “Alarm Status Screen” in the pop-up box, users can directly switch to the Alarm Status Screen.

Temporarily Reset Alarm

Some alarms must be temporarily reset before removing the cause of the alarm. Such alarms are the following:

SRVO-005 Robot overtravel
SRVO-101 Robot overtravel (G: %d)
SRVO-006 Hand broken
SRVO-050 CLALM alarm (G: %d, A: %d)
SRVO-402 DCS Cart. pos. limit (No. %d: %s, G: %d, M: %d) %02x
SRVO-404 DCS Joint pos. limit (No. %d: %s, G: %d, M: %d) %02x
SRVO-491 Collaborative stroke limit (G: %d, A: %s)
SSPC -101 (G: %d) is close to target
SSPC -103 (G: %d) is near to target

For more information about alarms, refer to the “FANUC Robot series OPERATOR'S MANUAL (Alarm Code List) (B-83284EN-1)”.

When the “Temporarily Reset Alarm” button is touched, users can temporarily reset the alarm for 30 seconds. Jog the robot during the 30 seconds in order to remove the cause of the alarm. After touching the “Temporarily Reset Alarm” button, a pop-up box like Fig. 3.3.4(b) will show. At the bottom of the pop-up box, a timer will count down and users should jog the robot within the given time. If time has run out, the pop-up box will close, but users may touch the “Temporarily Reset Alarm” button again to continue for another 30 seconds.

Fig. 3.3.4(b) Temporarily Reset Alarm

Chain Abnormal Alarm

For chain abnormal alarms, remove the cause of the alarm and then touch the “Chain Reset” button in the Alarm Status Screen. For more information about alarms, refer to the “FANUC Robot series OPERATOR'S MANUAL (Alarm Code List) (B-83284EN-1)”.

3.4 KEY SHEET

Tablet Teach Pendant can show a key sheet that imitates the iPendant by touching the key sheet show button.
Please refer to “FANUC Robot series OPERATORS MANUAL (Basic Function) (B-83284EN) 2.3.1 Teach Pendant” for details of each keys.

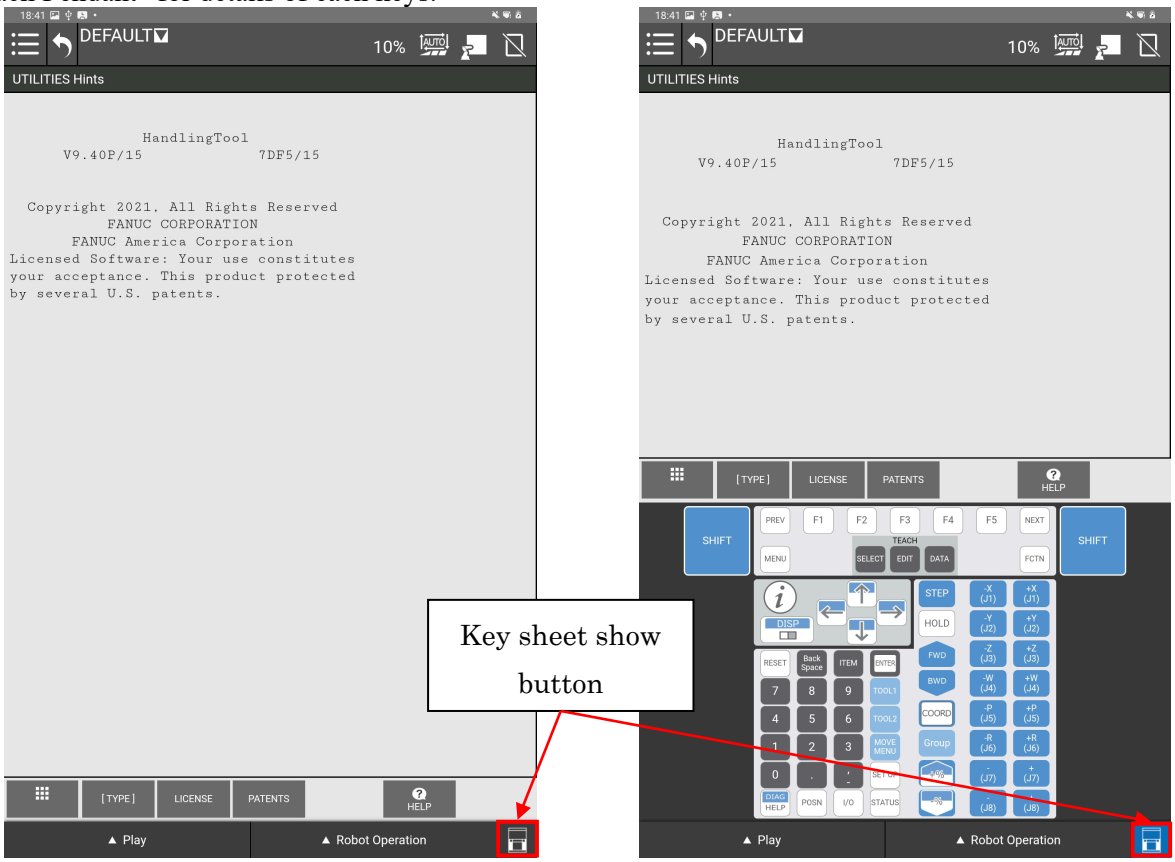


Fig 3.4(a) Show/hide key sheet

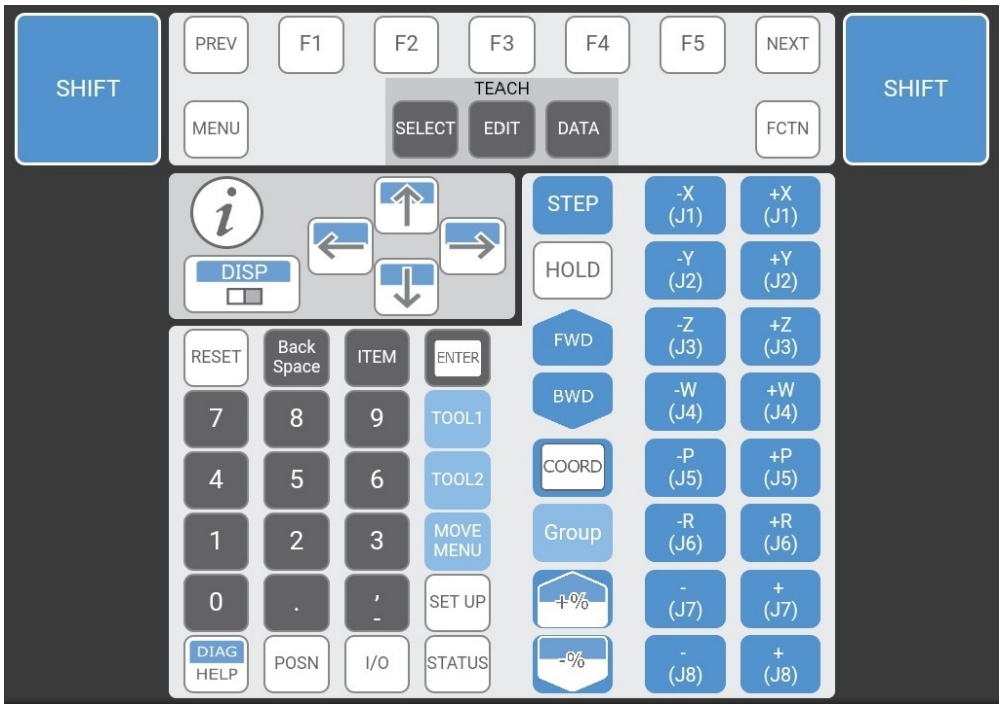


Fig 3.4(b) Key Sheet

Some keys are used with the SHIFT key. You can press the SHIFT key in the following two ways.

- Multi-tap the SHIFT key and another key that needs SHIFT.
- Double-tap the key that needs SHIFT.

The Function key area on the TP screen corresponds to the F1 to F5 key on the Key Sheet.
If you want to press the SHIFT key and the Function key area, the same operation can be performed by pressing the SHIFT and F1 to F5 key.

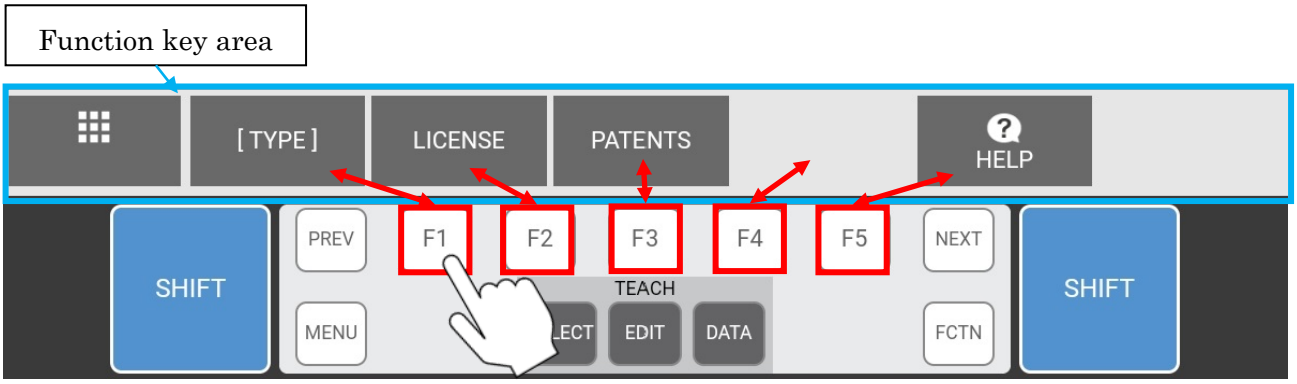


Fig 3.4(c) Function key

3.4.1 Jog Operation and Program Execution

Tablet Teach Pendant has an enable switch on the Tablet Base. If you want to jog the robot or execute the program with the Key sheet, you should press the enable switch while jogging the robot or running the program. Enable switch must be pressed even if AUTO mode is selected.

3.4.1.1 Jog operation

If you want to jog the robot, you have to press the SHIFT and Jog key. You can press the SHIFT and Jog key in the following two ways.

- Tap the Jog Key while pressing the SHIFT key.
- Double-tap the Jog Key.

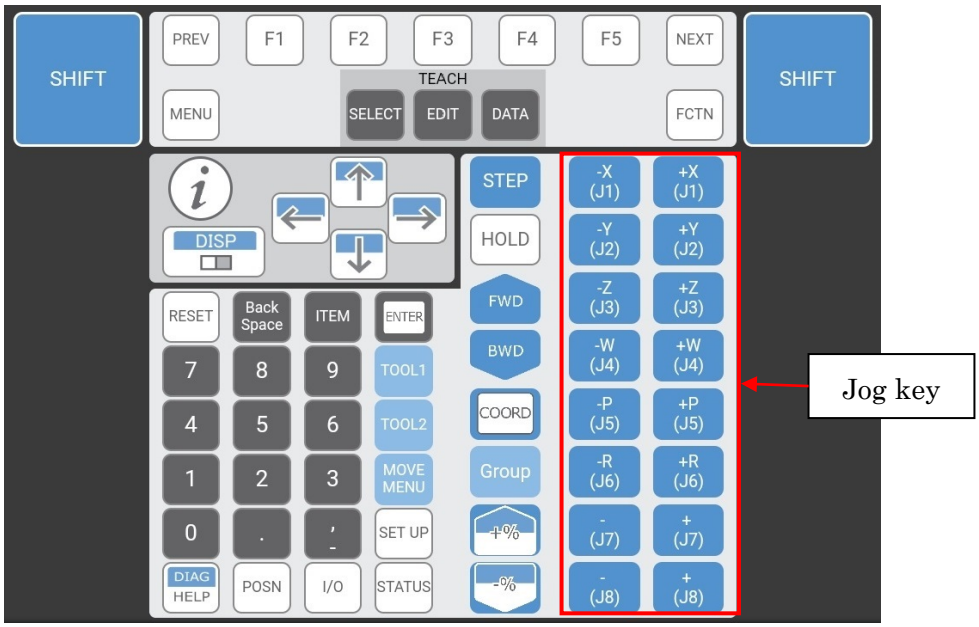


Fig 3.4.1.1(a) Jog key

Please refer to “FANUC Robot series OPERATORS MANUAL (Basic Function) (B-83284EN) 5.2.3 Moving the Robot by Jog Feed” for details of Jog operation.

> ⚠ **WARNING**
> Jog operation must be executed with the robot in sight.

3.4.1.2 Program execution

If you want to execute the program, you have to press the SHIFT and FWD/BWD key. You can press the SHIFT and FWD/BWD key in the following two ways.

- Tap FWD or BWD Key while pressing the SHIFT key.
- Double-tap the FWD or BWD Key.

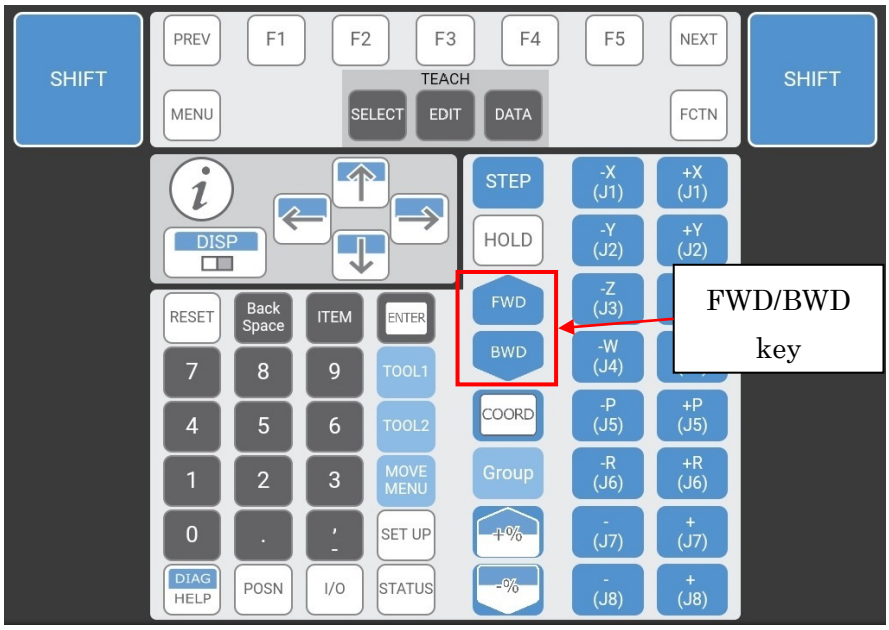


Fig 3.4.1.2(a) FWD/BWD key

> ⚠ **WARNING**
> 1 Verify that the selected program and line number is correct before running a program.
> 2 When you start running programs using Tablet Teach Pendant in AUTO mode, you must strictly adhere to the following precautions.
> - Running programs must be executed from outside of the safeguarded space.
> - You must check that no one is inside in the safety fence.

Please refer to "FANUC Robot series OPERATORS MANUAL (Basic Function) (B-83284EN) 6.2 EXECUTING A PROGRAM" for details.

4 TEACHING

4.1 CREATE PROGRAM

A program can be created in the Select Program screen.
Push Select Program in the Tablet UI menu to display the Select Program screen.

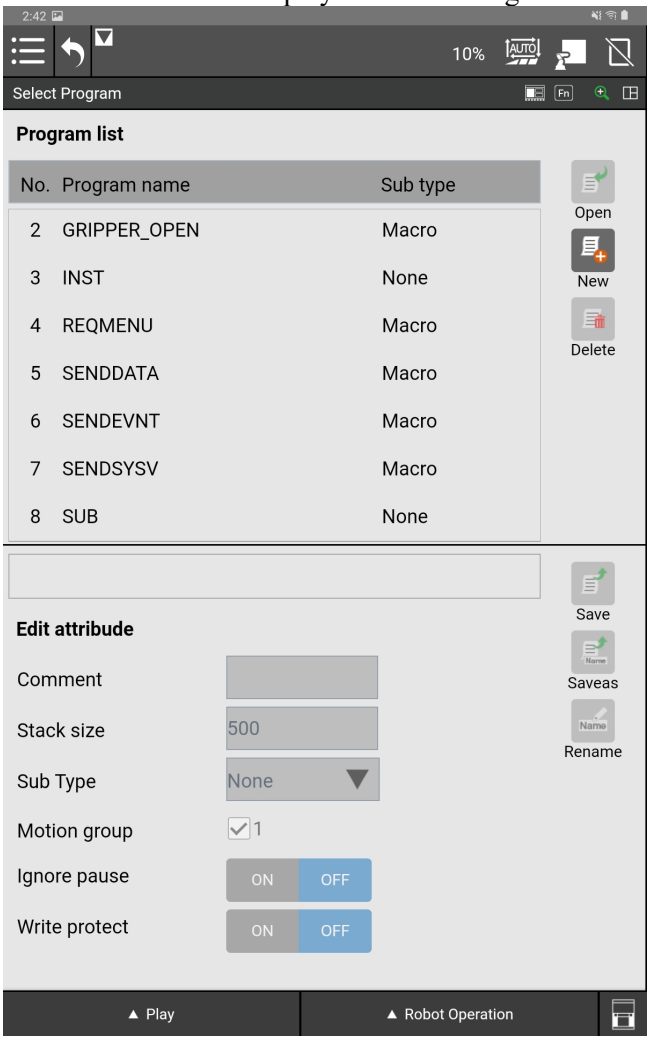


Fig. 4.1(a) Program Select Screen

Click the New button on the screen to display Fig. 4.1(b).
Enter the program name and touch OK.

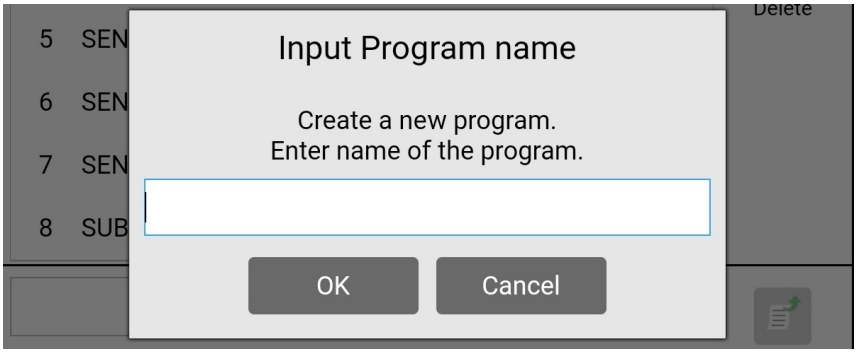


Fig. 4.1(b) Enter Program Name Dialog

A dialog to edit the program attributes will display in Fig. 4.1(c).
Edit the program attributes and touch OK to create the program. The screen will move to the Editor screen.

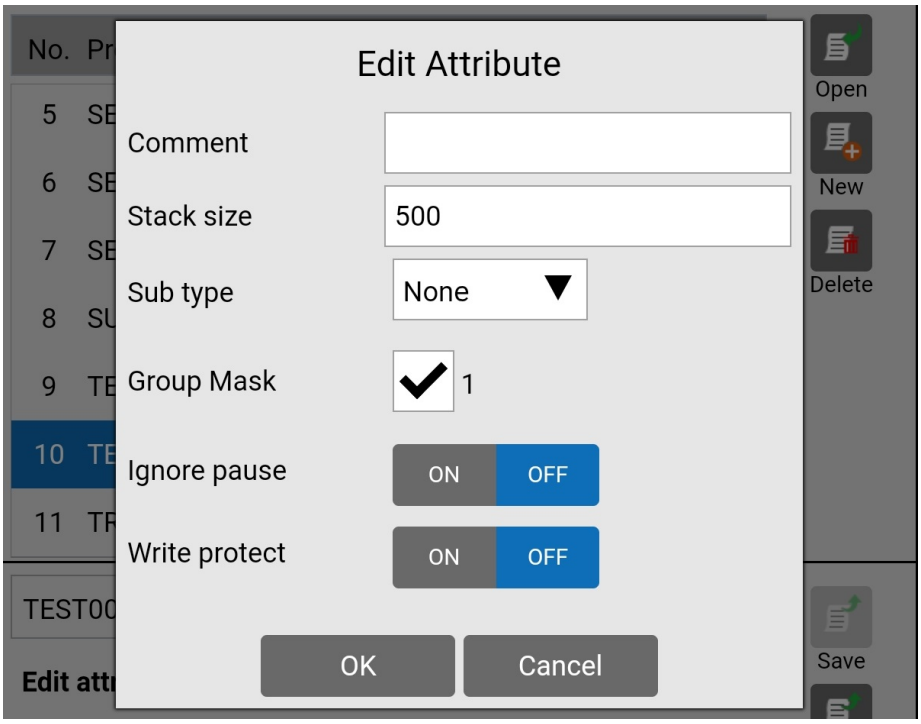


Fig. 4.1(c) Edit Attribute Dialog

4.2 EDIT PROGRAM

Select the home icon from the menu or the editor from the CRX menu, and the screen in Fig. 4.2(a) will display. On this screen, programs can be edited and some of the basic robot operation can be performed. This screen consists of the contents shown in Table 4.2(a).

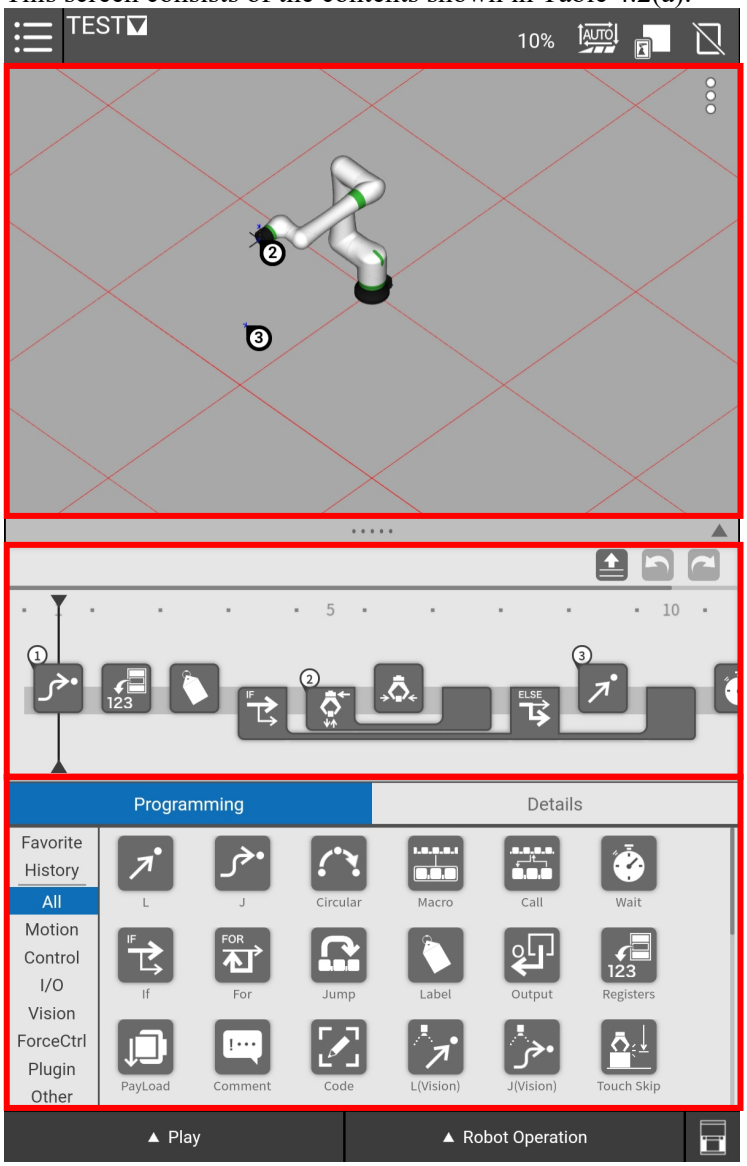


Fig. 4.2(a) Tablet UI Screen

Table 4.2(a) Tablet UI Screen Structure

Item	Description
Robot Graphics	Displays graphic image of the robot. The graphics will change depending on the robot position and attitude.
Program Line	Displays the selected program with icons. To edit the program, drag & drop an instruction icon from the icon pallet to the program line.
Icon Pallet	Touch the Programming tab to display the icon pallet. The icon instructions supported by this robot will appear in the icon pallet. See “4.3 Icon Instructions” for icon instructions supported by this robot. Select a section on the left to change the icons shown in the icon pallet.
Instruction Details	Touch the detail tab to display the detail settings of the selected instruction on the program line. The instruction settings can be changed here.

Add Instruction

Edit the program using icon instructions.

Drag & drop the icon instructions in the icon pallet to the program line to add instructions.

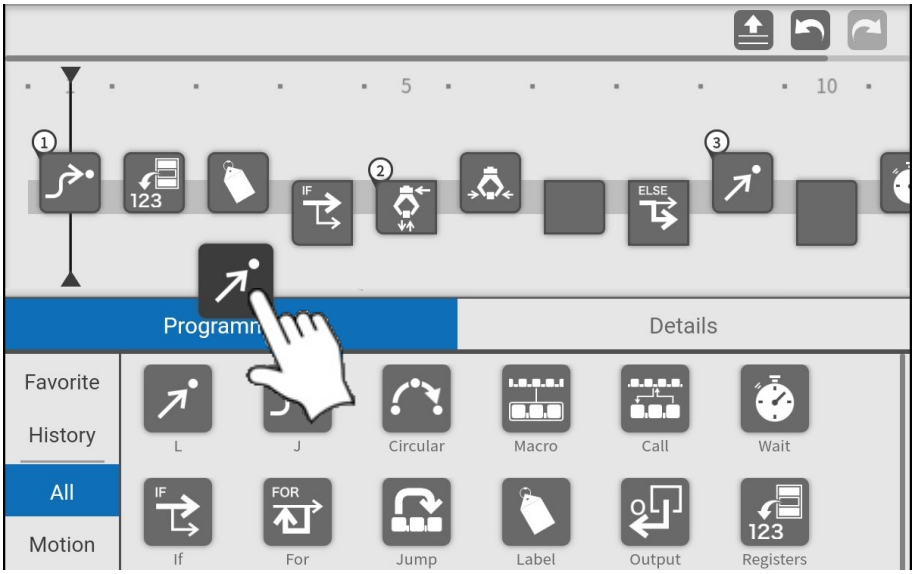


Fig. 4.2(b) Add Instructions

Edit the Instruction Parameters

Touch the icon instruction displayed on the program line to display the detail settings. The icon will turn to blue when selected. In the detail settings, the selected instruction's parameter can be checked and modified.

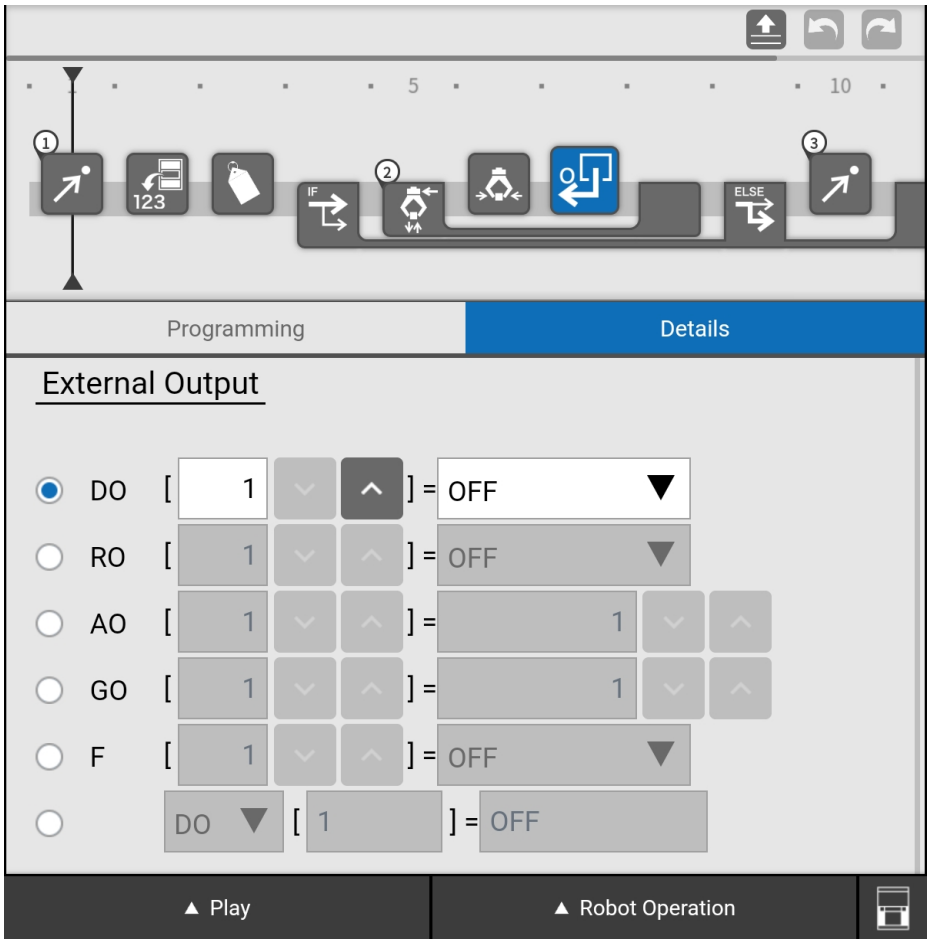


Fig. 4.2(c) Detail Settings

Teach Position Data

Position data is taught in the motion instruction detail settings.
Click the “Touch Up” button to enter the current position. The position data may also be entered directly.

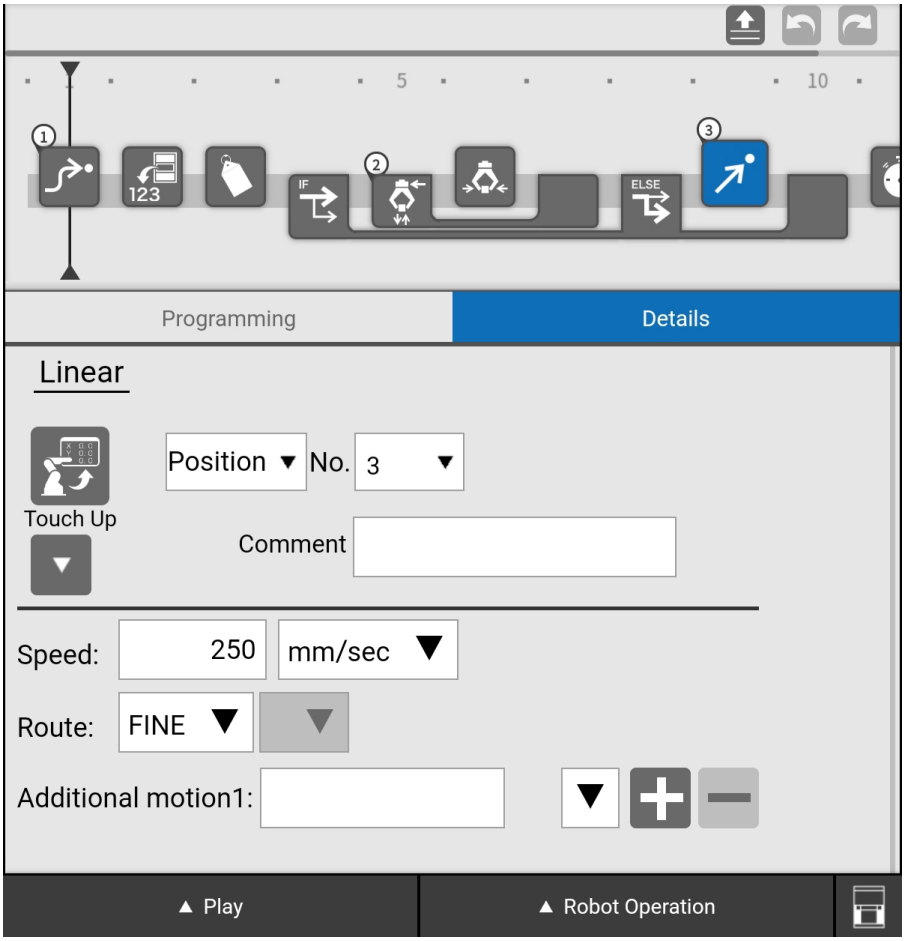


Fig. 4.2(d) Teach Position

Table 4.2(b) Position Table Button

Button	Description
	Teach current position
	Touch the button to display the details of the position data.

Operation on Program Line

・Delete Instructions

Drag & drop the instruction outside program line to delete instruction.

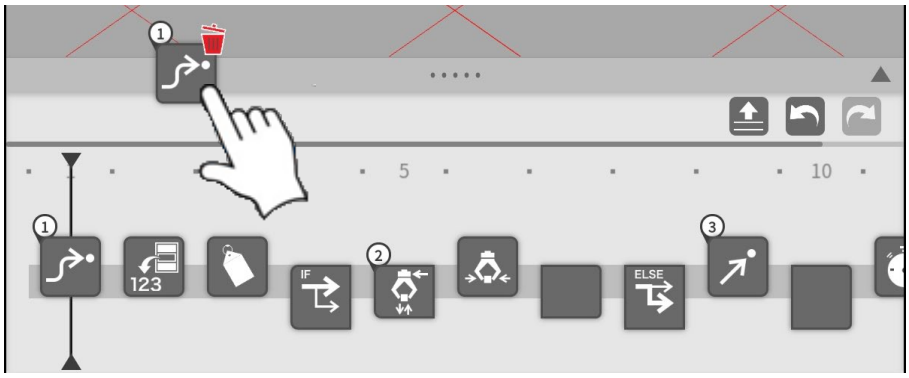


Fig. 4.2(e) Delete Instruction

To delete multiple instructions, touch and hold the icon. The screen shown in Fig. 4.2(f) should display.

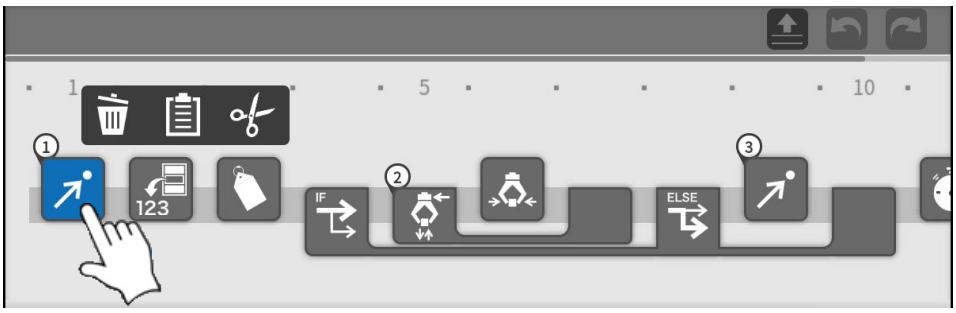


Fig. 4.2(f) Select Instruction

Set the range to be deleted and touch the garbage icon to delete the instructions.

Fig. 4.2(g) Select Instructions

・Copy and Paste Instructions

After touching and holding the icon instruction, set the range and touch the copy icon.

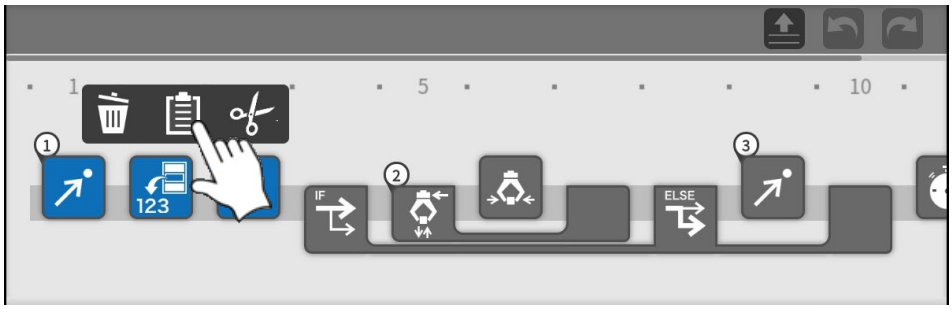


Fig. 4.2(h) Copy Icon Instructions

Drag & drop the icon instruction to the copy destination and the instructions in the selected range will be pasted.

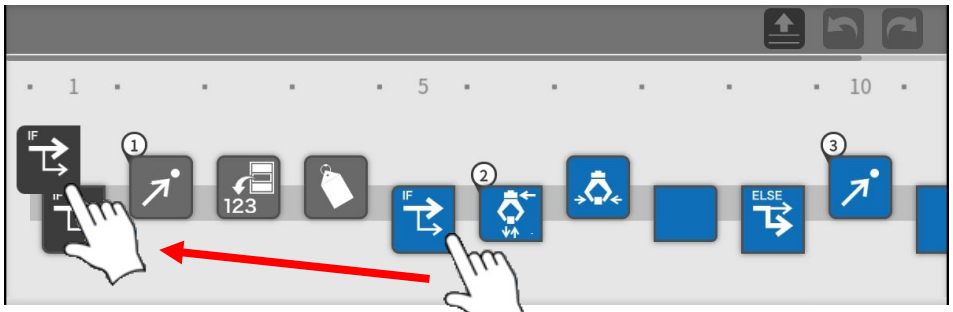


Fig. 4.2(i) Copy Icon Instruction

・Open / Close IF and FOR instructions

To open and close the instruction, touch and hold the IF or FOR icon and touch the Open / Close button.

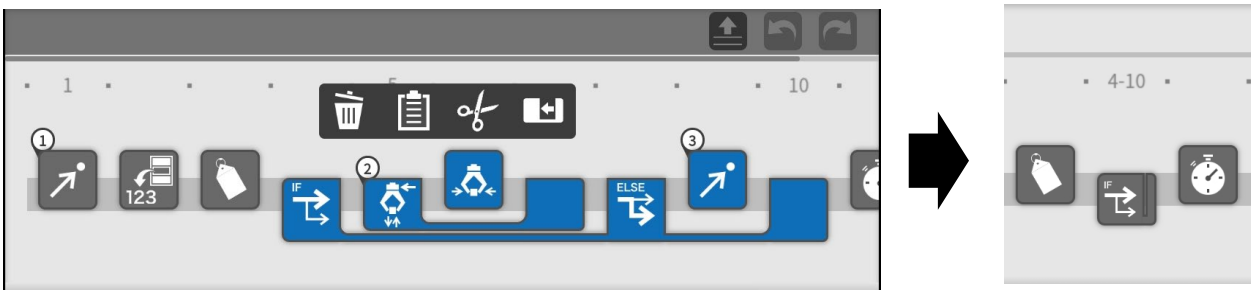
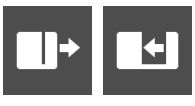


Fig. 4.2(j) Close IF instruction

Table 4.2(c) Program Line Buttons

Button	Description
	Undo editing operations such as changing or deleting instructions.
	Returns to the state before the undo operation.
	Deletes icon instructions.
	Copy and paste icon instructions.
	Cut and paste icon instructions.
	Open and close specific icon instructions.

4.3 ICON INSTRUCTIONS

This section describes the icon commands supported by the tablet UI.

4.3.1 Linear Motion

The linear motion instruction controls the path of the tool center point (TCP) from a start point to an end point.

Fig. 4.3.1(a) L Icon

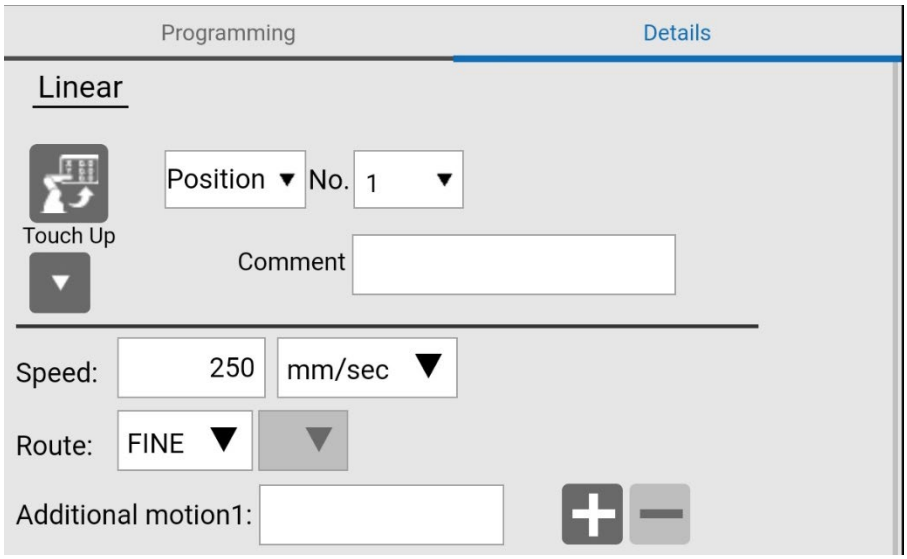


Fig. 4.3.1(b) Detail Settings

Touch ▼ next to Position to change between the position and position register.

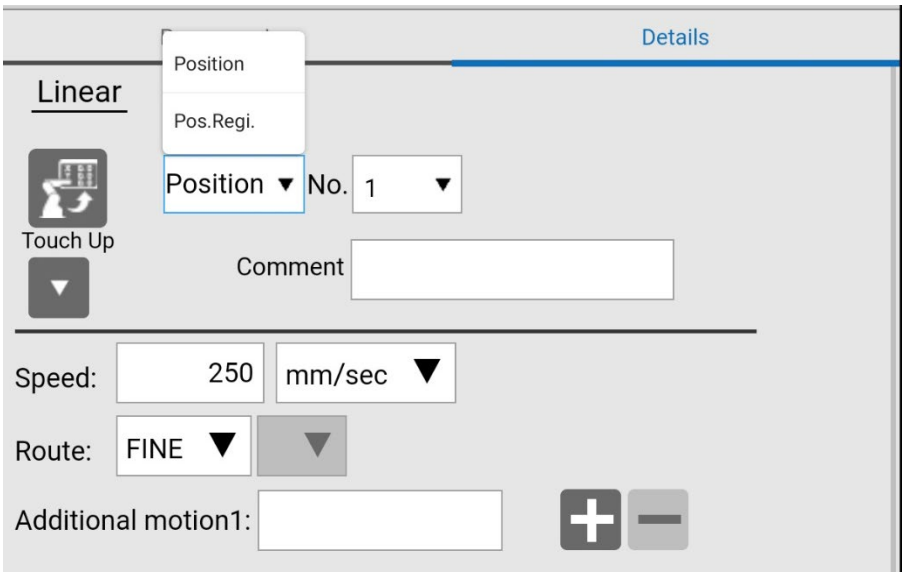


Fig. 4.3.1(c) Switch between position and position register

Touch the button next to the comment to display the position's numeric data.
Users can directly change the position, attitude, configuration, and coordinate system number. Touch the Cartesian / Joint button to switch the format of the displayed position data.

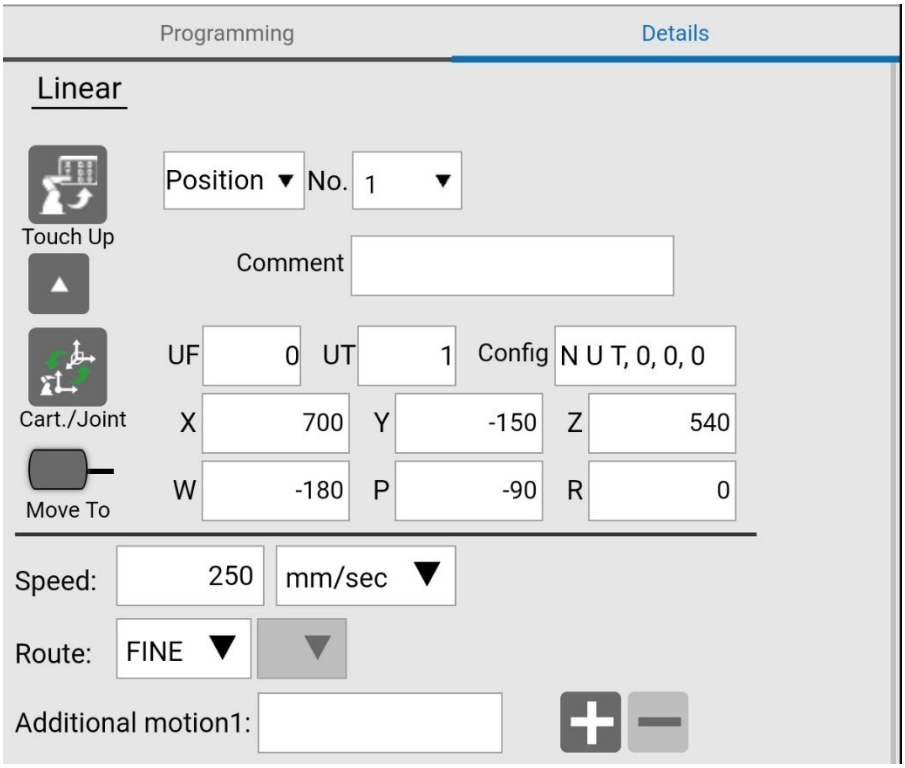


Fig. 4.3.1(d) Position Data

Users can enter additional motion instructions as text. Touch +/- button to increase/decrease the number of additional motion instructions.

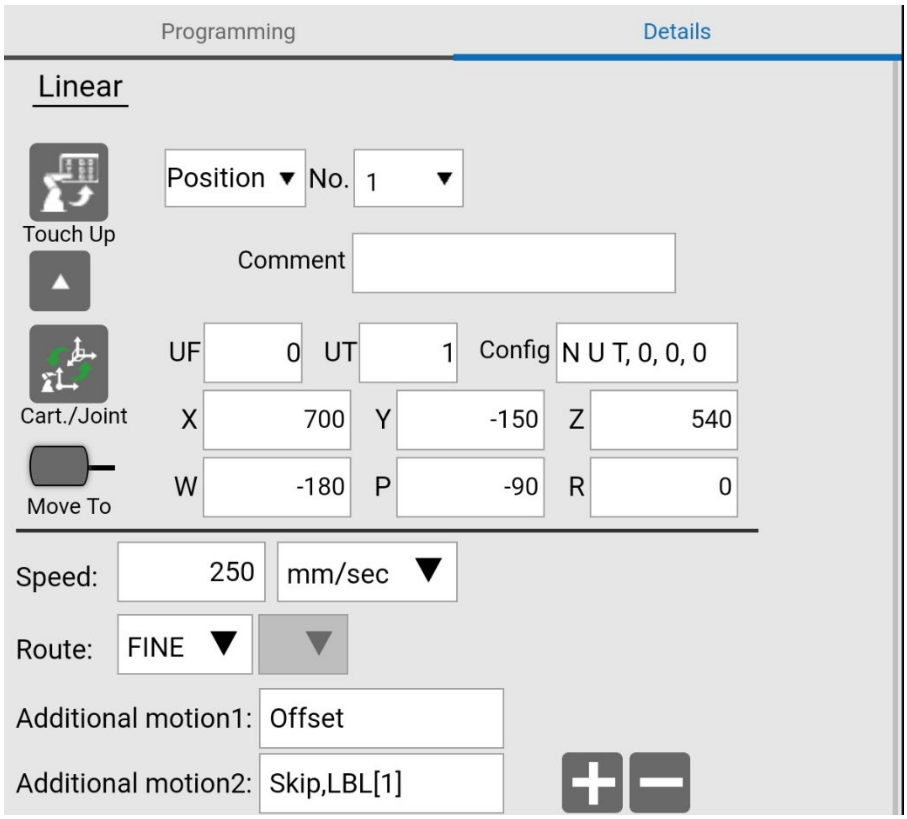
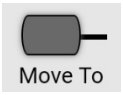
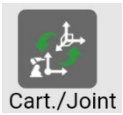


Fig. 4.3.1(e) Additional Motion Instructions

Table 4.3.1(a) Position Table Buttons

Button	Description
	Teach current position.
	Slide the bar to the right to move to the taught position. To move the robot turn on the TP enable key in the status bar.
	The format of the displayed position data can be switched between Cartesian and Joint.
	Touch the button to display the details of the position data.

4.3.2 Joint Motion

The joint motion instruction is the basic instruction for moving the robot to a specified position.

Fig. 4.3.2(a) J Icon

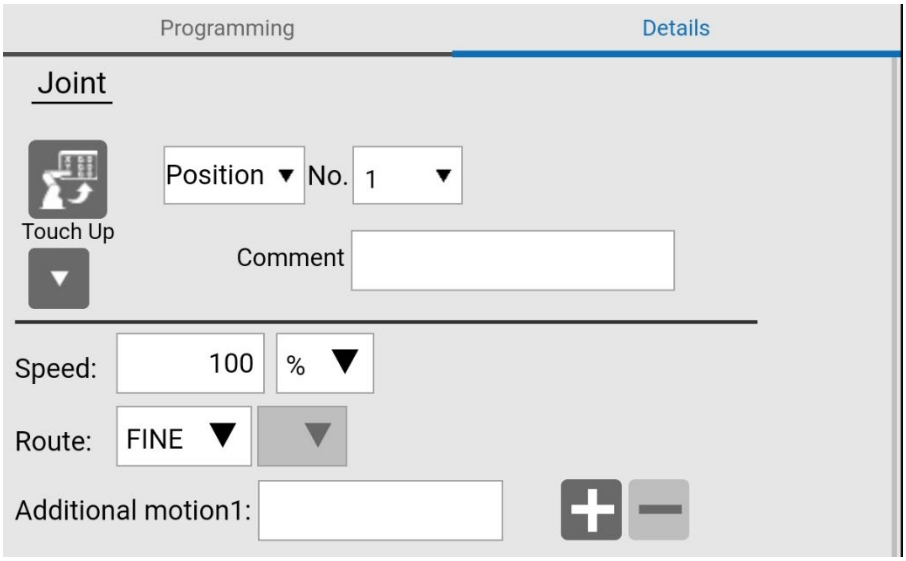


Fig. 4.3.2(b) Detail Setting

Touch ▼ next to position to change between position and position register.

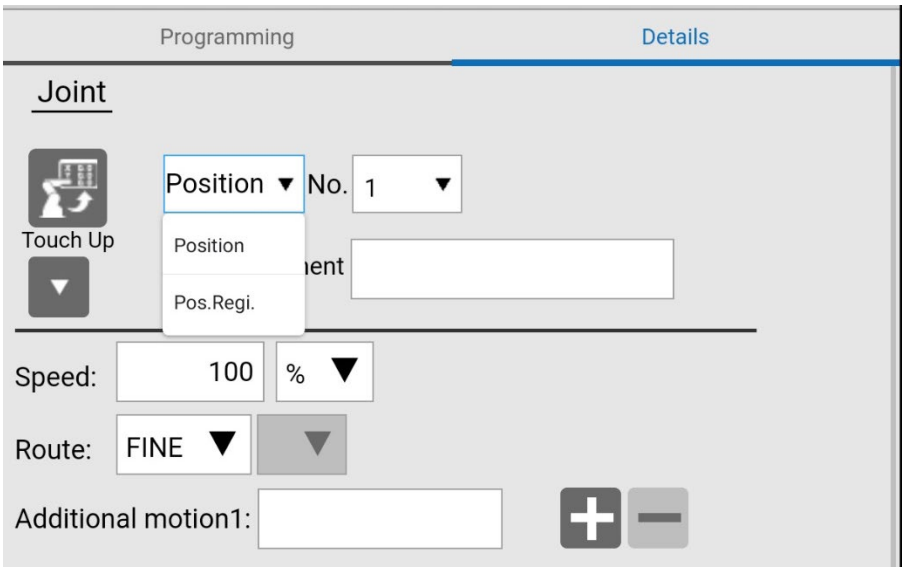


Fig. 4.3.2(c) Switch between position and position register

Touch the button next to the comment to display the position data.
Users can directly change the position, attitude, configuration, and coordinate system number. Touch the Cartesian / Joint button to switch the format of the displayed position data.

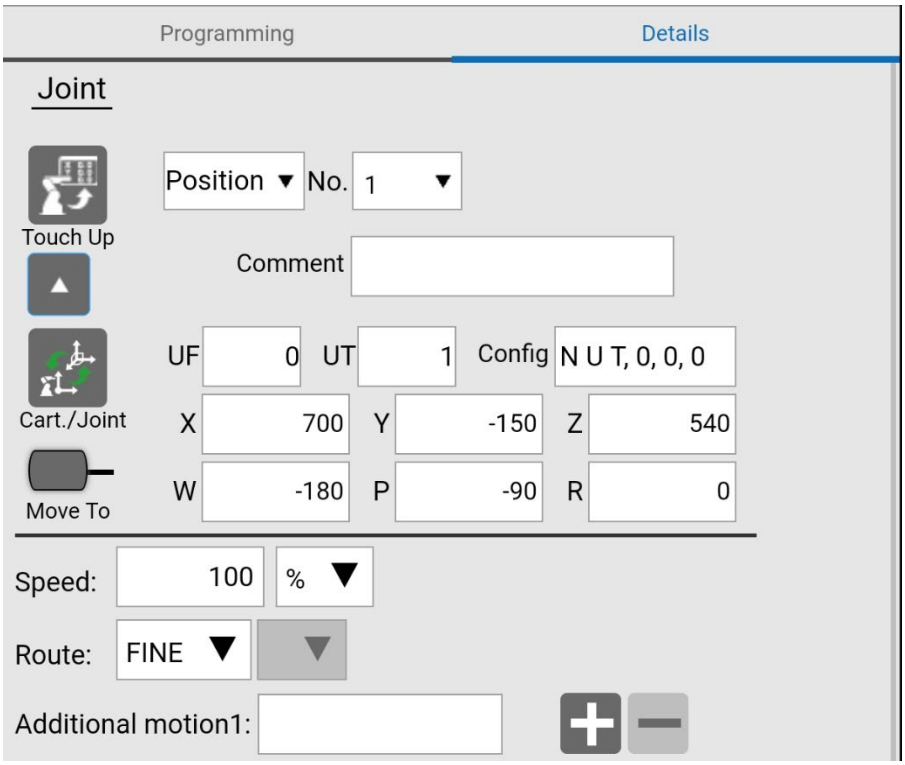


Fig. 4.3.2(d) Position Data

Users can enter additional motion instructions as text. Touch the +/- button to increase/decrease the number of additional motion instructions.

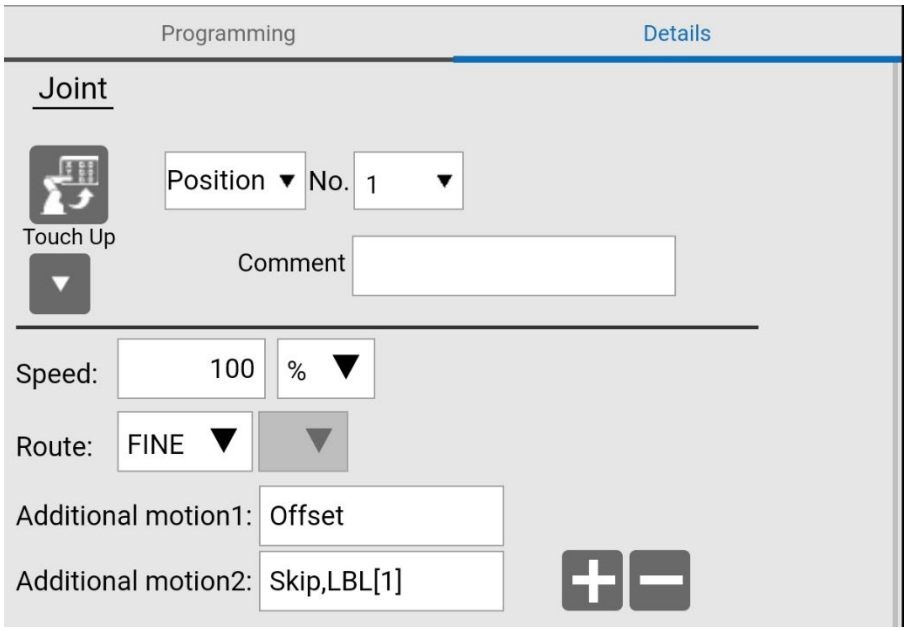
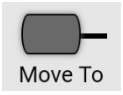
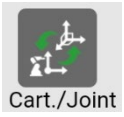


Fig. 4.3.2(e) Additional Motion Instructions

Table 4.3.2(a) Position Table Buttons

Buttons	Description
	Teach current position.
	Slide the bar to the right to move to the taught position. To move the robot turn on the TP enable key in the status bar.
	The format of the displayed position data can be switched between Cartesian and Joint.
	Touch the button to display the details of the position data.

4.3.3 Circular

Circular arc movement is a movement method in which the movement trajectory of the tool tip point is controlled by a circular arc from the movement start point through the via point to the end point.
Set the via point to the upper location information and the end point to the lower location information.
If you drag and drop an arc instruction, the via point and end point will be registered as the current robot position.
The method of registering location information is the same as in 4.3.1 Linear and 4.3.2 Joint.

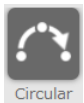


Fig. 4.3.3(a) Circular Icon

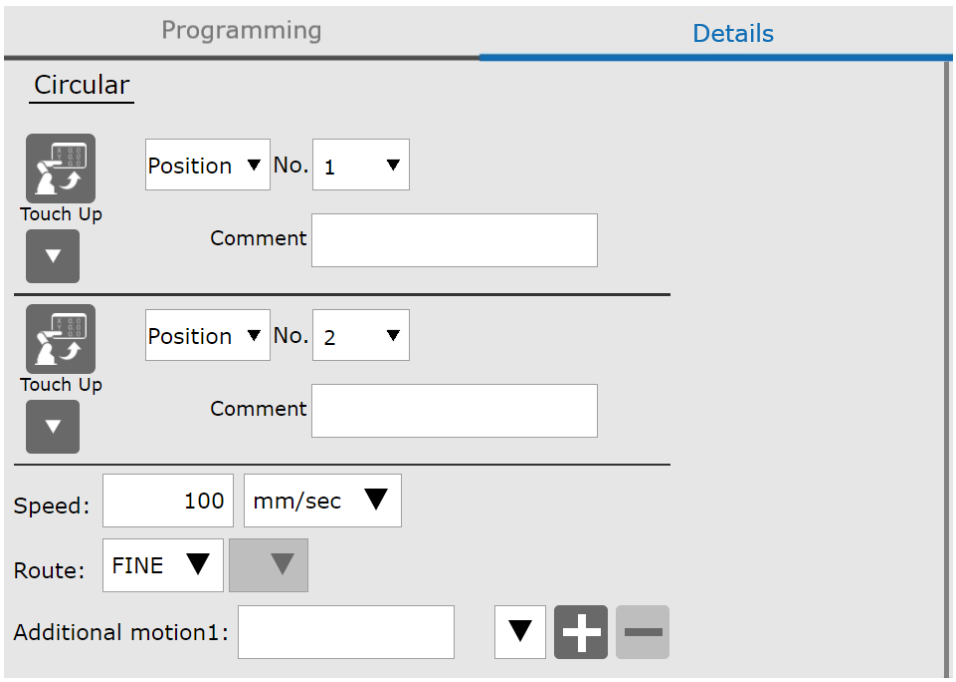


Fig. 4.3.3(b) Detail Setting

*Note that this instruction operates at a speed exceeding the speed set by the speed clamp function. (not support speed clamp)

4.3.4 Macro

The macro instruction is used to register a program consisting a sequence of instruction as one instruction and to call such programs (Macro program) upon execution.

Fig. 4.3.4(a) Macro Icon

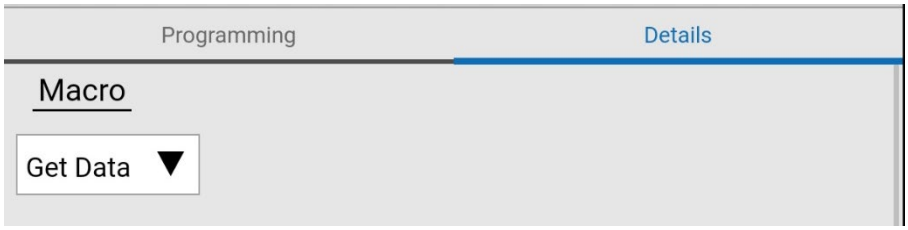


Fig. 4.3.4(b) Detail Settings

Users can choose a macro program by touching the program selection box. A list of macro programs will show under the program selection box.

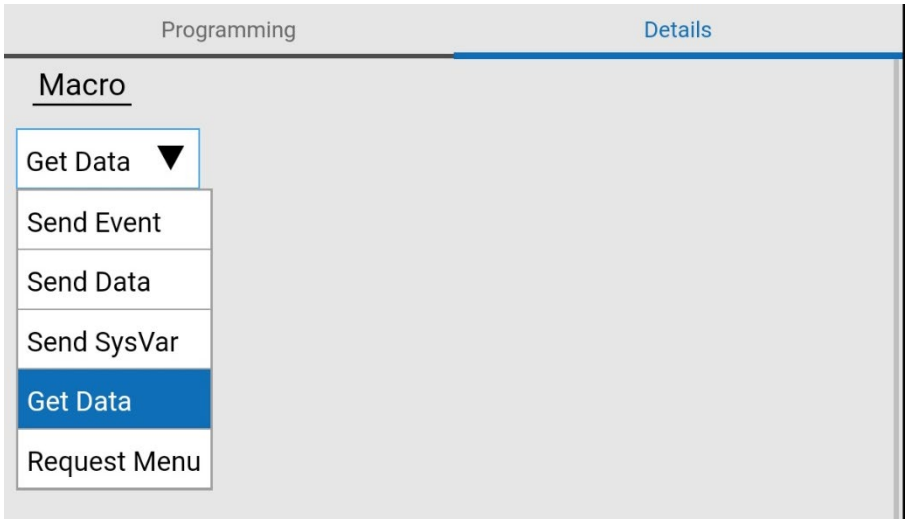


Fig. 4.3.4(c) Choosing the macro instruction

4.3.5 Call

The call instruction is used to execute another program (subprogram) defined in the detail settings. Upon call, the sub program's first line is executed. After the subprogram has been executed, the next line in the main program is executed.

Fig. 4.3.5(a) Call Icon

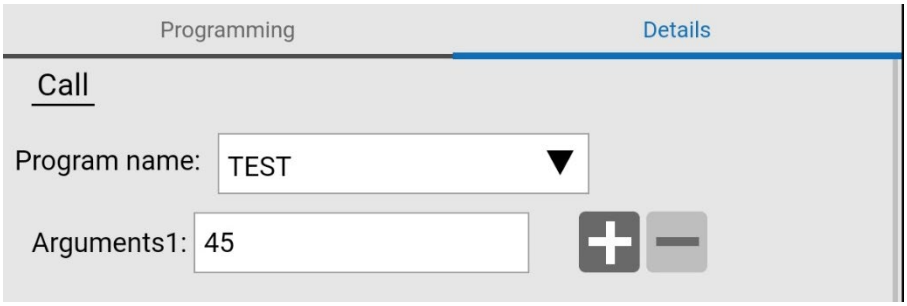


Fig. 4.3.5(b) Detail Settings

Users can choose the subprogram from a program list by touching the program selection box.
Users can also define an argument and use its value in the sub program. Users can define the value through text input or by touching the +/- key.

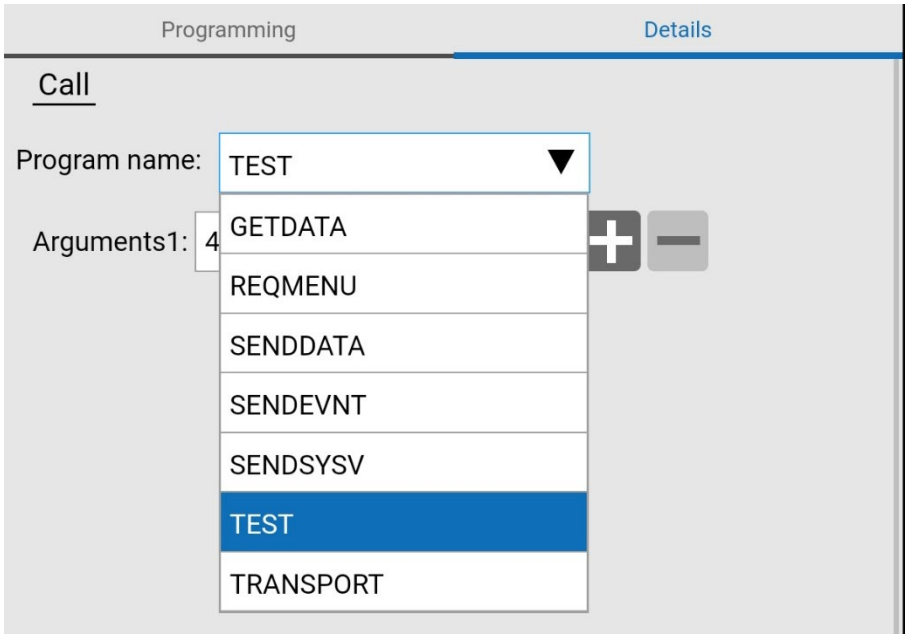


Fig. 4.3.5(c) Choosing a program from the program selection box

4.3.6 Wait

The wait instruction is used to suspend the execution of a program for a specified time or until a certain condition is met.

Fig. 4.3.6(a) Wait Icon

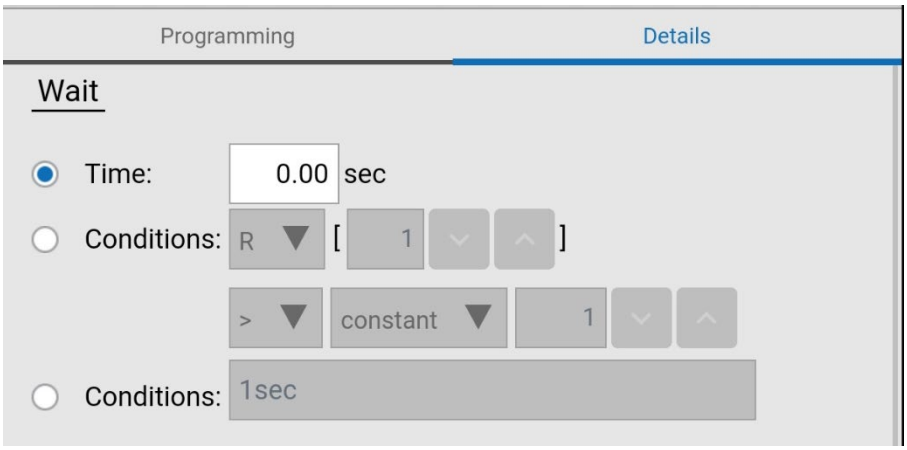


Fig. 4.3.6(b) Detail Settings

Check the button of the item to be used and specify the time or set the condition.
If you cannot set the condition in the center item, you can use the item below to enter the condition as text.

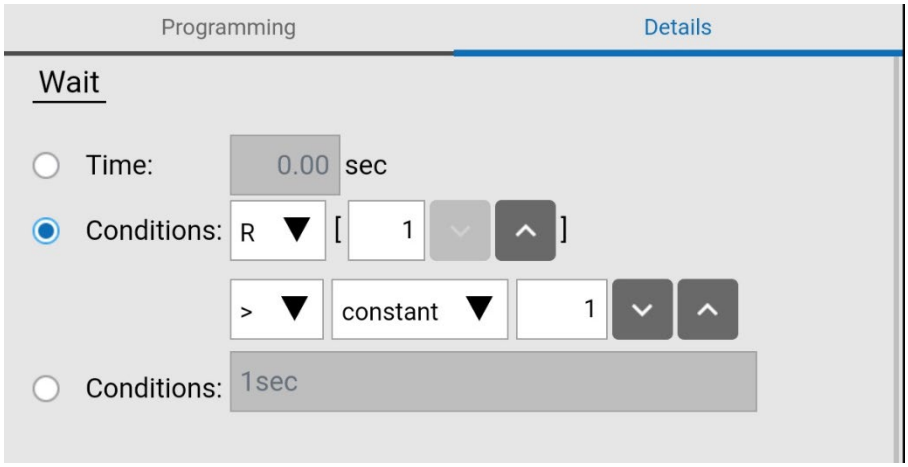


Fig. 4.3.6(c) Choosing conditions for the wait instruction

4.3.7 IF

The IF instruction is used to conditionally execute specified instructions. This instruction will be represented as a bracket on the program line. (Fig.4.3.7(a)) If the condition defined in the detail settings is TRUE, the instructions between the IF and ELSE will be executed. If the condition defined in the detail settings is FALSE, the instructions after ELSE will be executed.

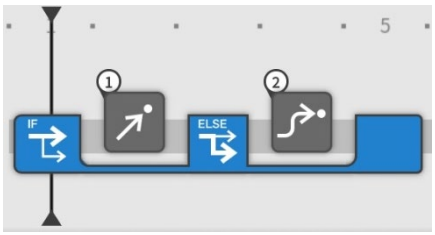


Fig.4.3.7(a) IF Instruction

Fig. 4.3.7(b) IF Icon

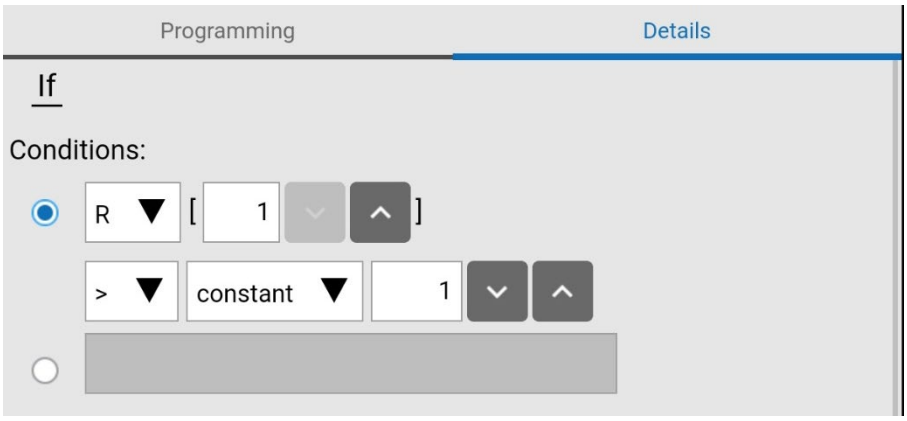


Fig. 4.3.7(c) Detail Settings

The first item is used for simple conditions. Users can type more complex conditions in the second item.

Fig. 4.3.7(d) Text Input to Define Condition

4.3.8 FOR

The FOR instruction is used to repeat the enclosed section for a certain number of times. This instruction will be represented as a bracket on the program line.

Fig. 4.3.8(a) FOR icon

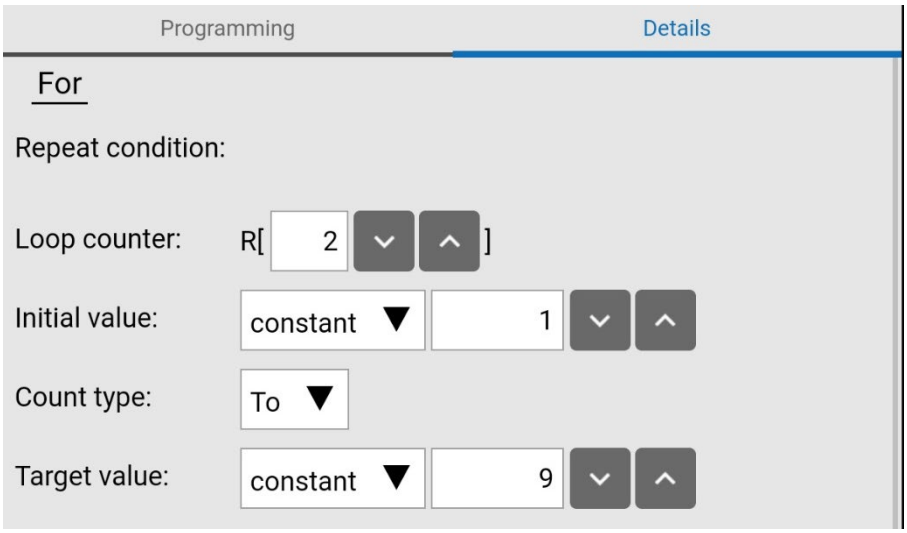


Fig. 4.3.8(b) Detail Settings

Set the following in detail screen.

- Loop Counter : Set register number to be used for the FOR loop.
- Initial value : When the FOR instruction is executed for the first time, the register is initialized with this value.
- Count type : Select “To” to increment for each loop, “DownTo” to decrement for each loop.
- Target value : The loop exit when the register value exceeds this value.

When the set value is Fig. 4.3.8 (b), the section surrounded by the FOR instruction in Fig. 4.3.8 (c) is repeated 9 times.

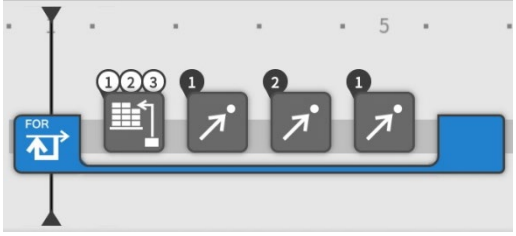


Fig. 4.3.8(c) For Instruction

4.3.9 Jump

When a jump instruction is executed, it branches from a line in the program to the specified label.

Fig. 4.3.9(a) Jump Icon

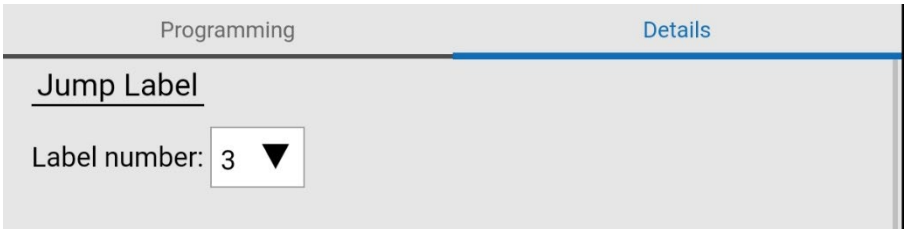


Fig. 4.3.9(b) Detail Settings

By touching the label number, user can select from the label numbers that have already been set.

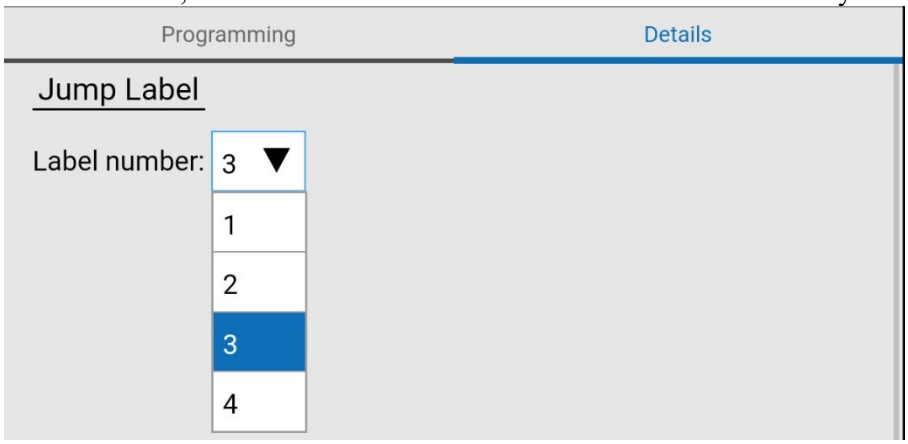


Fig. 4.3.9(c) Choosing the label number

4.3.10 Label

The label instruction is used to specify a branch location in the program. Combine this instruction with the jump instruction.

Fig. 4.3.10(a) Label Icon

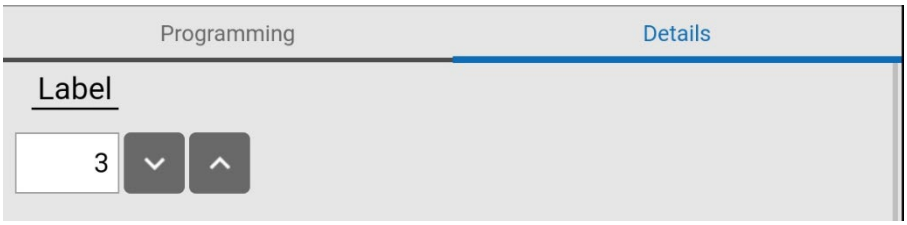


Fig. 4.3.10(b) Detail Settings

4.3.11 Output

The output instruction is used to change the state of signals that are outputted to peripheral devices.

Fig. 4.3.11(a) Output Icon

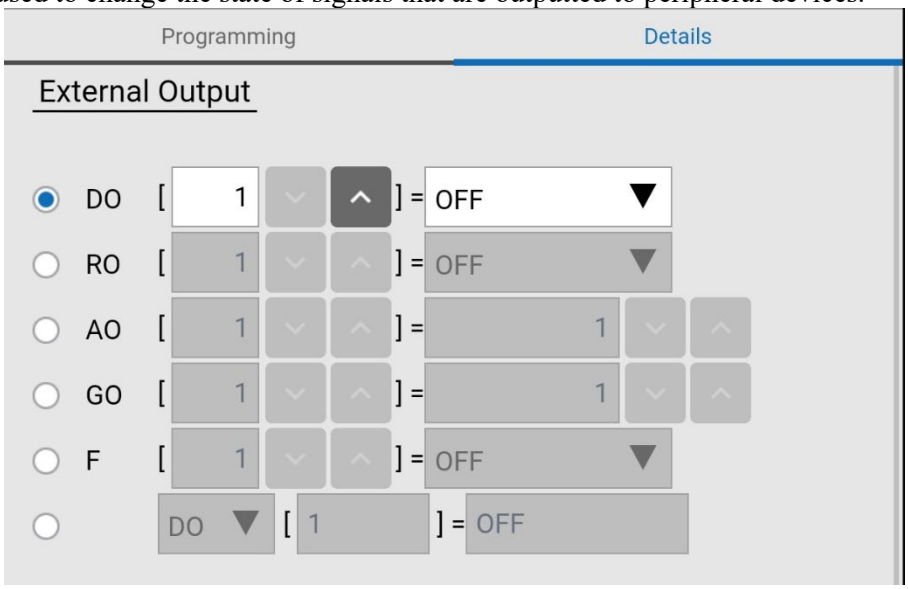


Fig. 4.3.11(b) Detail Settings

Use the last item for other output signals or to define more complex logics.

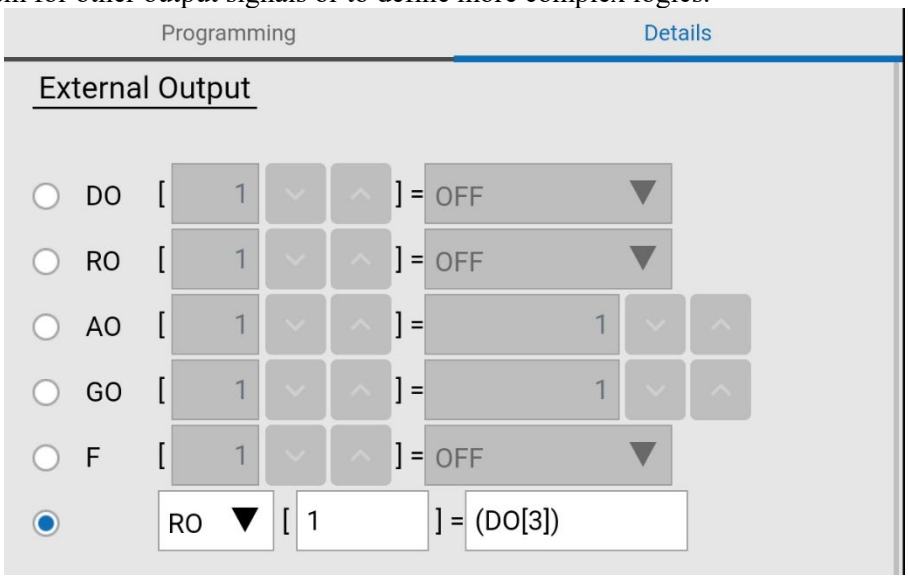


Fig. 4.3.11(c) Text input to define logics for output signals

4.3.12 Registers

The register instruction is used to perform arithmetic operations on registers.

Fig. 4.3.12(a)
Registers Icon

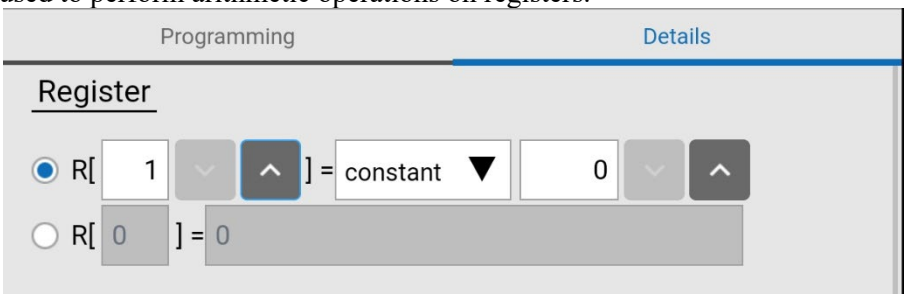


Fig. 4.3.12(b) Detail Settings

If you cannot set the contents in the upper item, you can enter text in the lower item.

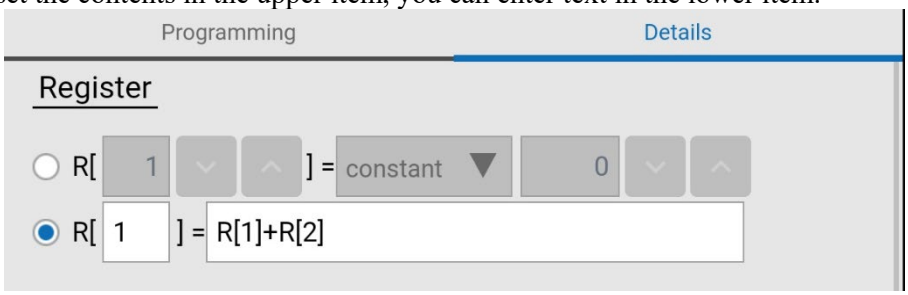


Fig. 4.3.12(c) Text input for register commands

4.3.13 Payload

The payload setting instruction is used to switch the payload data (payload schedule number).

Fig. 4.3.13(a) Payload Icon

Fig. 4.3.13(b) Detail Settings

4.3.14 Comment

The comment instruction is used to include comments on the program line.

Fig. 4.3.14(a)
Comment Icon

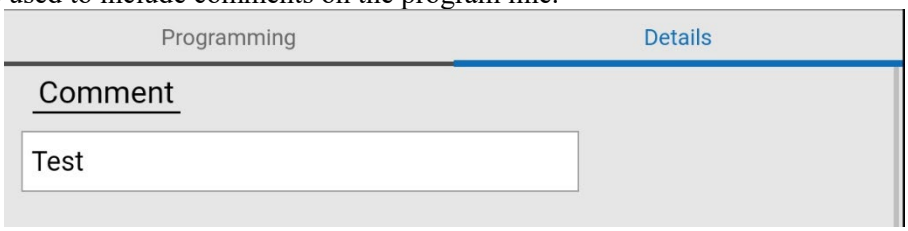


Fig. 4.3.14(b) Detail Settings

4.3.15 Text Code

The text instruction is used to include program instructions that are not included in the icon instructions.

Fig. 4.3.15(a) Text Code Icon

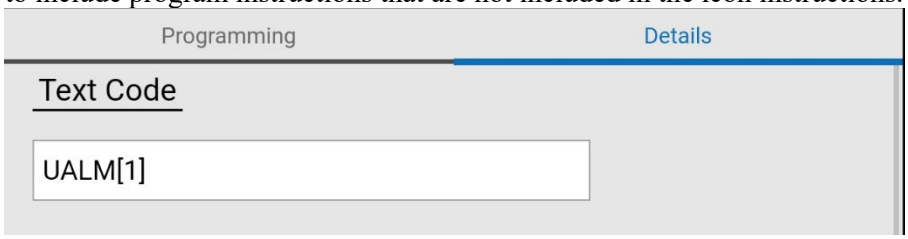
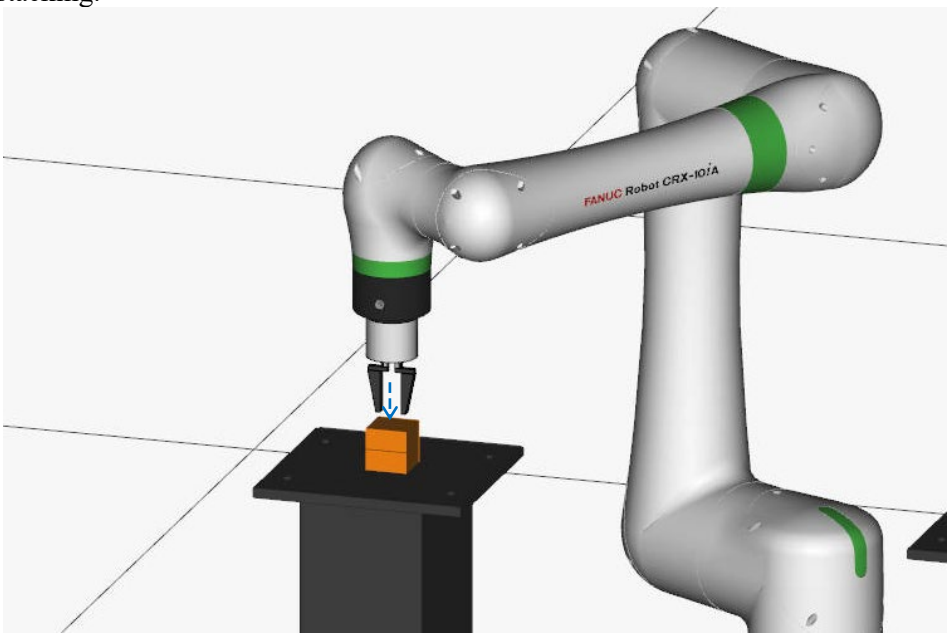


Fig. 4.3.15(b) Detail Settings

4.3.16 Touch Skip (CRX series only)

Touch Skip instruction is a move instruction that moves toward the destination position and ends the move when detecting contact.

You can use this for such applications to detect the height of overlapping objects, such as Stacking/Destacking.



NOTE

- Collaborative robot has a feature of the contact stop function that stops the program when detecting a certain amount of external force. If the contact stop function works during Touch Skip, Touch Skip instruction will stop with alarming.
- If you use Touch Skip instruction, please reduce the speed so that the force at contact doesn't grow a level that will cause the contact stop.

⚠ WARNING

- If it sandwiches a person between the robot and the peripheral equipment, there is a risk of injury.
  For more information, please refer to NOTE TO DESIGN THE COLLABORATIVE WORKSPACE in MECHANICAL UNIT OPERATOR'S MANUAL.
- If the contact stop function is disabled and Touch Skip instruction is used, the robot may not stop even if the external force exceeds the limit, and severe personal injury may occur in the unlikely event that it doesn't. When designing a robot system that disables the contact stop function, it is necessary to conduct a thorough risk assessment of the entire robot system in consideration of the fact disabling the contact stop function.

Fig.4.3.16(a)
Touch Skip Icon

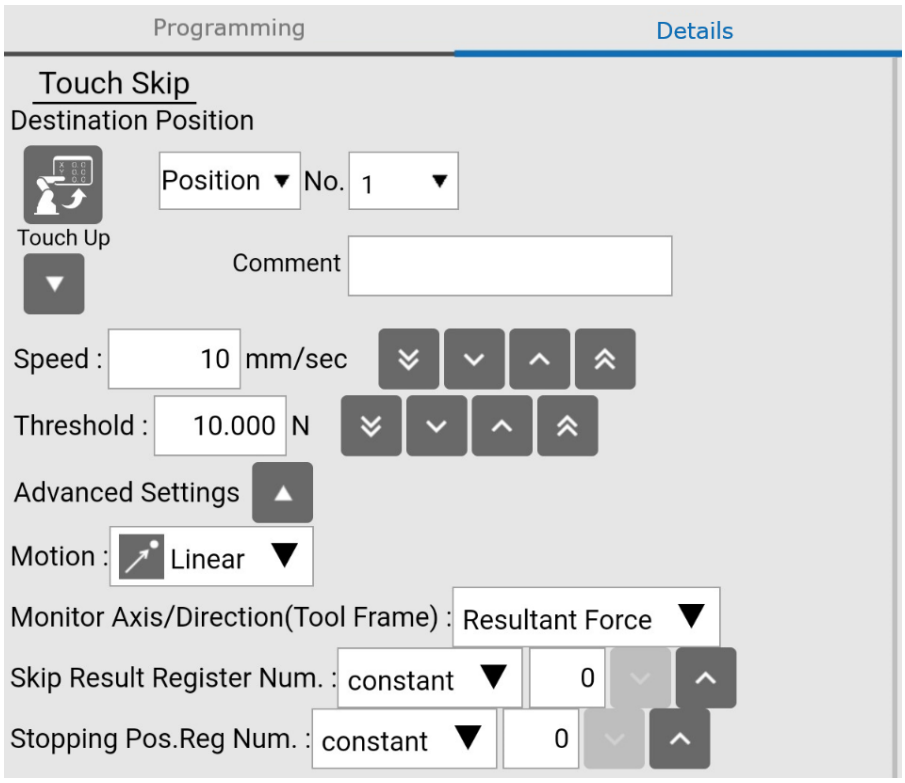


Fig.4.3.16(b) Detail Settings

In the detail settings, you can apply the following settings.

Item	Description
Destination Position	Teach the destination position.
Speed	Set the speed when moving to the destination position.
Threshold	Set the threshold of external force when detecting contact.
Advanced Settings	See below.

If you touch Advanced Settings button, you will see the items those allows you to change some behavior of this instruction.
You don't need to use them basically, but you can change them.

In Advanced Settings, you can apply the following settings.

Item	Description
Motion	You can change the move type to the destination position to Joint motion. The default is a Linear motion.
Monitor Axis/Direction	You can specify the component of force/torque for monitoring when detecting contact. You can select from the X, Y, Z components of the force applied to the tool tip in the tool frame, the resultant force, or the torque applied to each axis. The default is the resultant force.
Skip Result Register Num.	You can output the result of whether it skipped the motion before reaching the destination position to the register of the specified number. The value of the register of the specified number will be 1 if it skips the motion and 0 if it does not. The default is 0 that doesn't output the result.
Stopping Pos. Reg Num.	You can output the contact detecting position, the position when it skipped the motion, in Joint coordinates to the position register of the specified number. It outputs to the position register of the specified number. The default is 0 that doesn't output the result.

4.3.17 Basic Pick/Place

The basic pick/place instruction is used to pick and place workpieces.
Place hand open/close instruction inside the bracket to pick and place workpieces.

Fig. 4.3.17(a)
Basic Pick/Place Icon

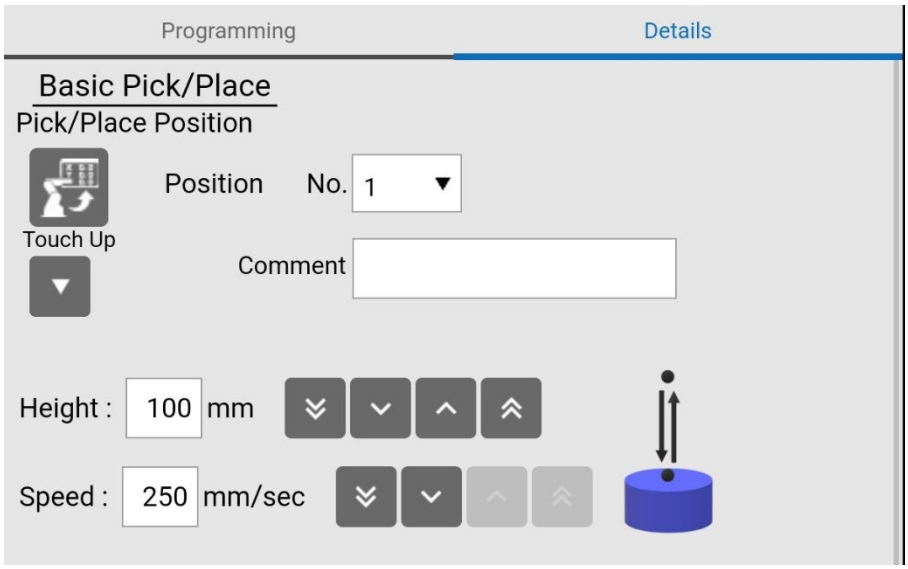


Fig. 4.3.17(b) Detail Settings

In the detail settings, users should apply the following settings:

- Position : Users should teach the position to pick and place.
- Height[mm] : Users should set the height when moving to and away from the taught position.
- Speed[mm/sec] : Users should set the speed when moving to and away from the taught position.

An example using the Pick/Place instruction is shown in Fig. 4.3.17(c). At the start of the bracket, the robot will move to the taught position defined in the detail settings. At the end of the bracket, the robot will move to the height defined in the detail settings.

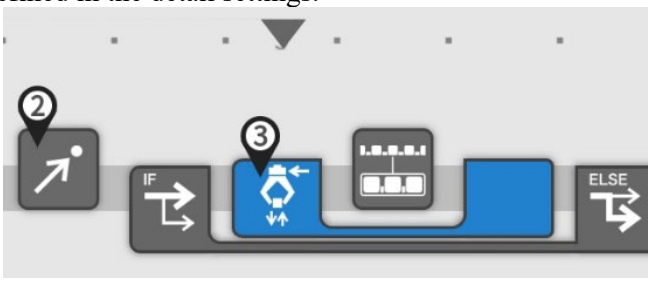


Fig. 4.3.17(c) Basic Pick/Place Instruction

4.3.18 Align

The align instruction is used to align workpieces and to take aligned workpieces. This instruction outputs the stack points and approach/retraction points to the position register. The position register is then used to align workpieces and take aligned workpieces.

Fig. 4.3.18(a) Align Icon

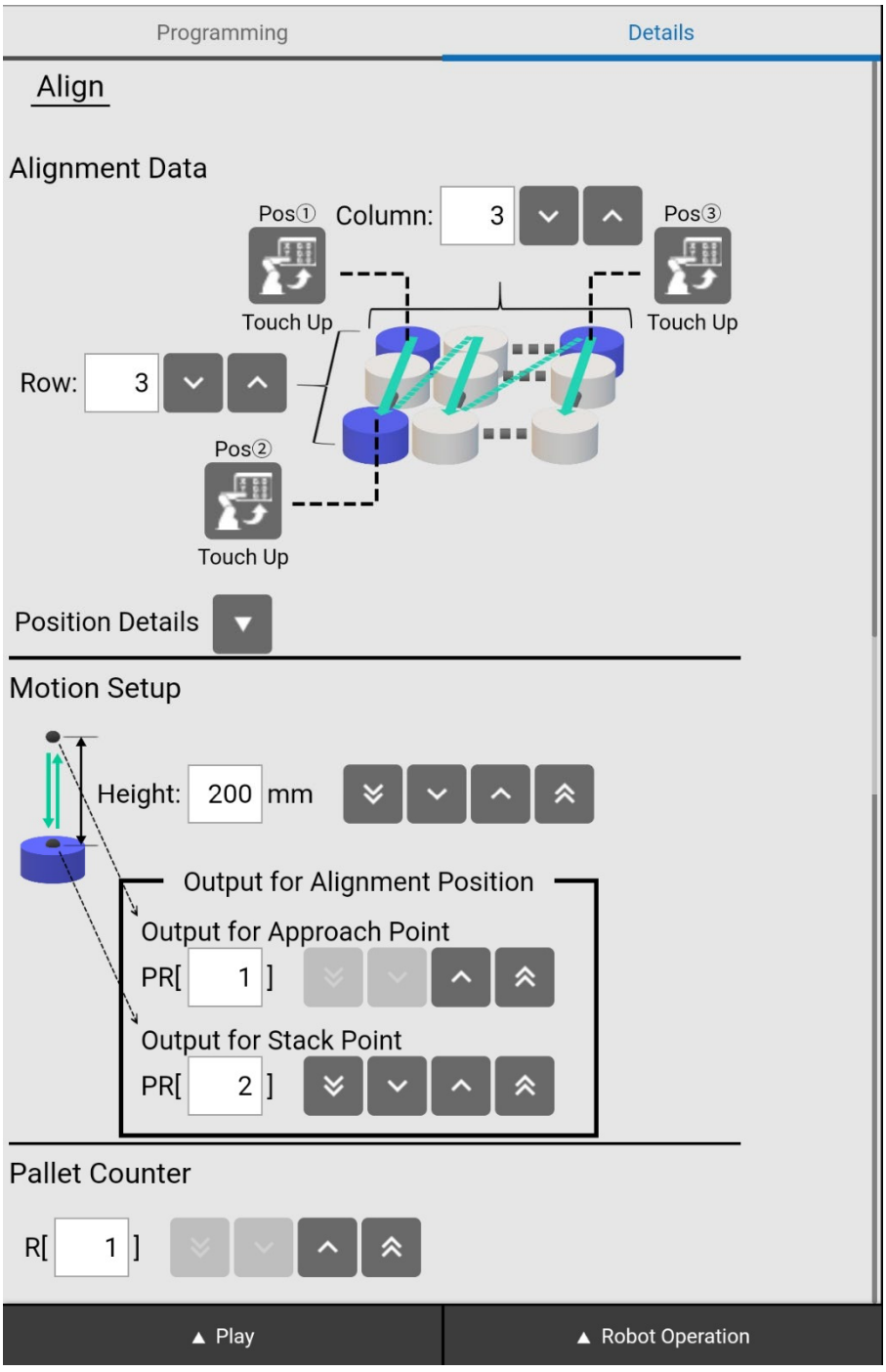


Fig. 4.3.18(b) Detail Settings

In the detail settings, users should apply the following settings:

- Three Position Points： Users should teach the three positions shown in Fig. 4.3.18(b)
- Height[mm]： Users should set the height when moving to and away from the stack points.
- Position Register： Users should choose the position register for saving the stack points and approach/retract points.
- Counter Register： Users should choose a register to count the number of times the align instruction has been executed.

In order to teach the three position points, move the robot to the three position points and touch the Touch up button at each position point. Users can also directly teach these points in the position detail settings.

Fig. 4.3.18(c) Position Detail Settings

Sample Program

In this sample program, the robot will pick and place workpieces. After the counter register is initialized to 0, the FOR instruction controls the robot to pick and place multiple workpieces.

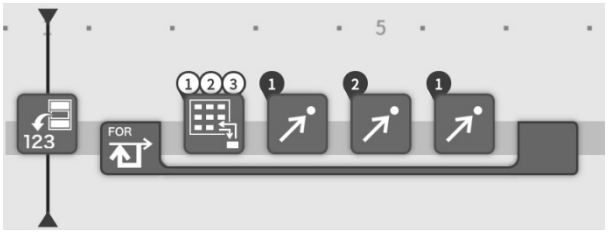


Fig. 4.3.18(d) Sample Program

4.3.19 Palletize

The palletize instruction is used to stack or unload workpieces by teaching few representative positions. This instruction outputs the stack points and approach/retraction points to the position register. The position register is then used to palletize workpieces.

Fig. 4.3.19(a) Palletize Icon

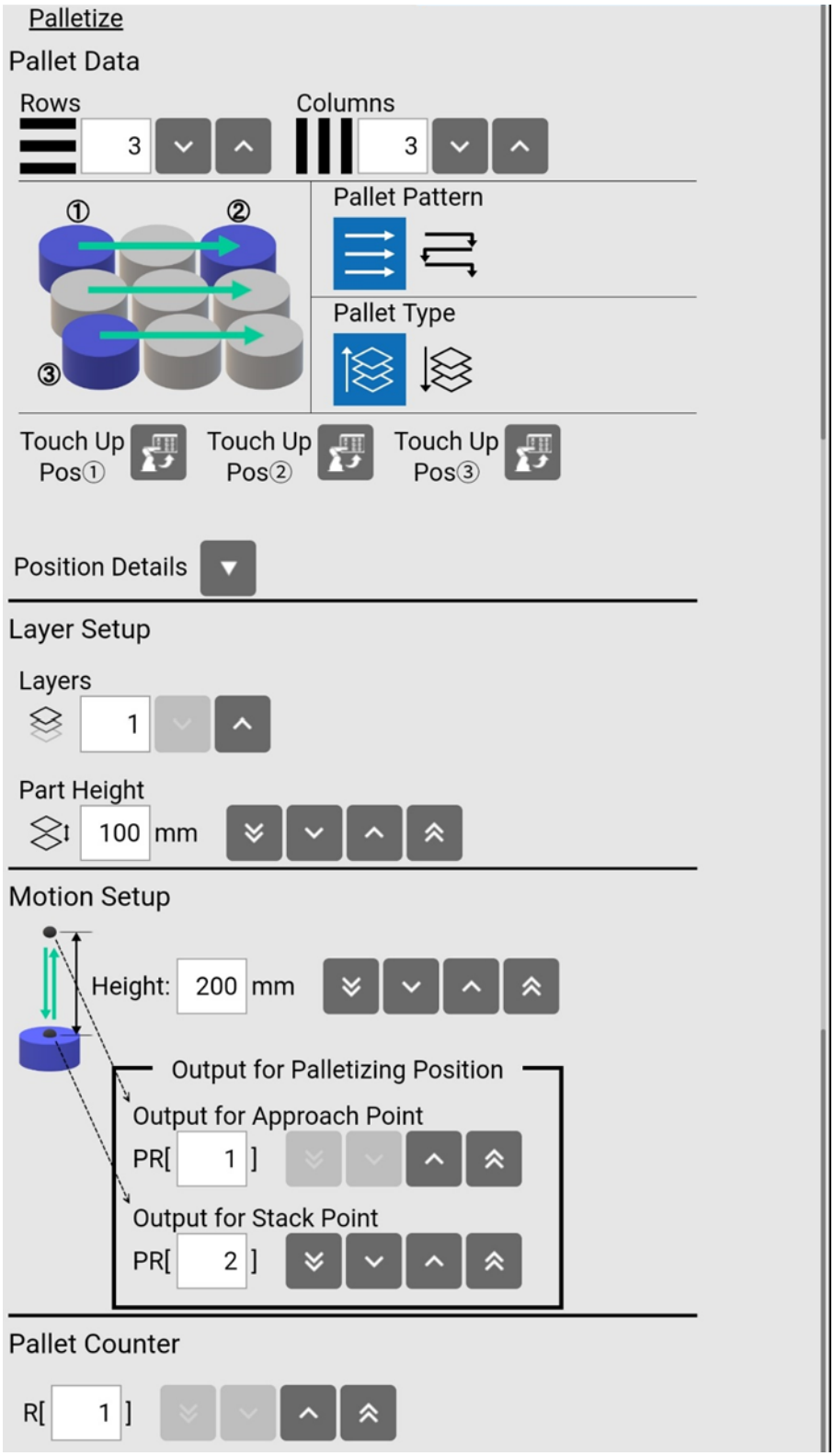


Fig. 4.3.19(b) Detail Settings

In the detail settings, users should apply the following settings:

- Rows/Columns： Set the number of work-pieces to line up
- Pallet Pattern： Set the order in which to line the work-pieces
- Pallet Type： Choose between palletization and depalletization
- Three Position Points： Users should teach the three positions shown in detail screen
- Number of Layer： Set the number of layers to palletize / depalletize
- Part Height： Set the work-pieces height
- Height[mm]： Users should set the height when moving to and away from the stack points
- Position Register： Users should choose the position register for saving the stack points and approach/retract points
- Counter Register： Users should choose a register to count the number of times the align instruction has been executed

In order to teach the three position points, move the robot to the three position points and touch the Touch up button at each position point. Users can also directly teach these points in the position detail settings. To access the position detail settings, touch the arrow next to the “Position details”.

Sample Program

When the user adds palletizing instruction to the program, Fig. 4.3.19(c) will be displayed.
If the user selects “Yes” the sample program in Fig. 4.3.19(d) will be inserted. If the user selects “No” only the palletizing instruction is added to the program.

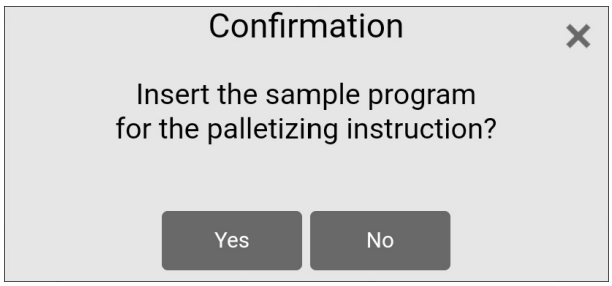


Fig. 4.3.19(c) Palletizing Instruction Popup

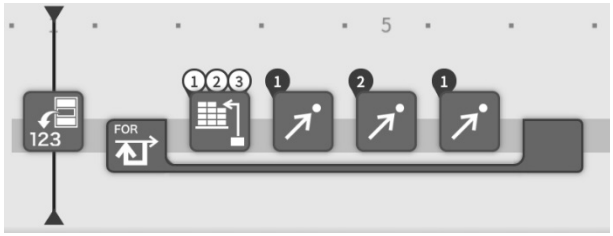


Fig. 4.3.19(d) Sample Program

4.3.20 Open Hand

Open hand instruction is used to open the robot hand.

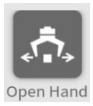


Fig. 4.3.20(a)
Open Hand Icon

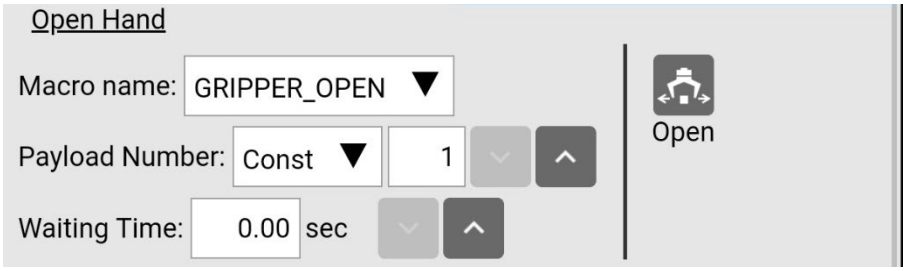


Fig. 4.3.20(b) Detail Settings

In the detail settings, users should apply the following settings:

- Macro name : Set the macro name to execute and open the robot hand
- Payload Number : Set the payload number to switch the payload data
- Waiting Time : Set the time to wait until hand is opened

If the user touches Open, the pop-up below will be displayed.
If the user selects “Yes” the macro set in the open hand instruction will be executed to open hand.

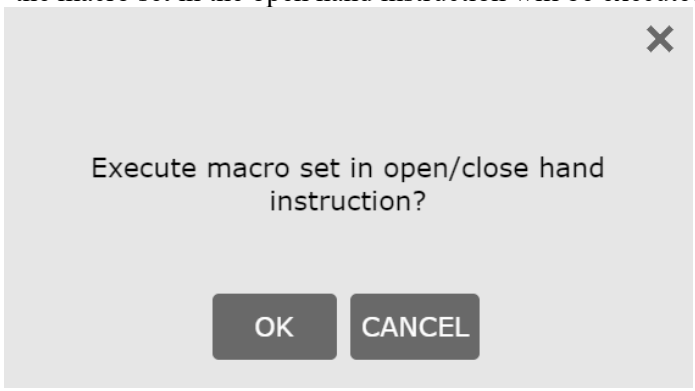


Fig. 4.3.20(c) Popup for open button

4.3.21 Close Hand

Close hand instruction is used to close the robot hand.

Fig. 4.3.21(a)
Close Hand Icon

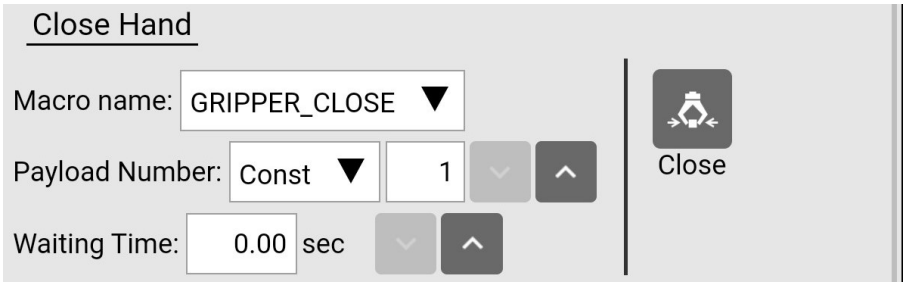


Fig. 4.3.21(b) Detail Settings

In the detail settings, users should apply the following settings:

- Macro name ： Set the macro name to execute and close the robot hand
- Payload Number： Set the payload number to switch the payload data
- Waiting Time： Set the time to wait while hand is closed

If user touches Close, the pop-up below will be displayed.
If the user selects “Yes” the macro set in the close hand instruction will be executed to close hand.

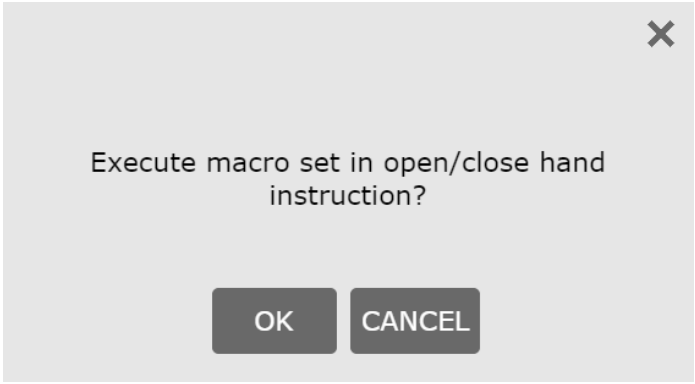


Fig. 4.3.21(c) Popup for close button

4.3.22 Path Teach

Trajectory teaching commands can be used to record the coordinates of the robot being moved in Manual Guide teaching at regular intervals.
Drag and drop the locus teaching icon to display the recording setting and recording wizard.
Please follow the wizard.
This command is available only for robots that can use Manual Guide teaching.

Fig. 4.3.22(a)
Path Teach Icon

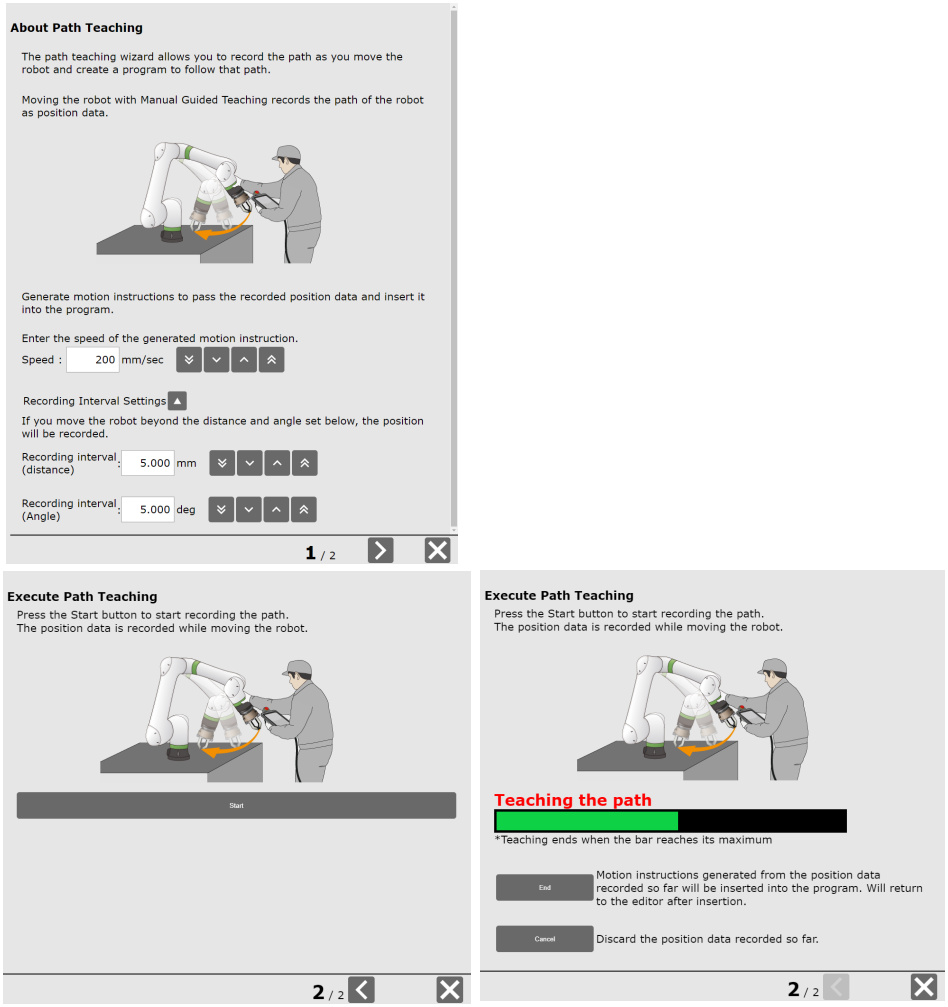


Fig. 4.3.22(b) Wizard setting

4.3.23 Basic Arc

Basic Arc instruction is available if you have included the optional functions for arc welding.
You can execute arc welding by setting weld start/end position, weld mode, weld schedules.
Perform arc welding from the start position to the end positon via some weld points.

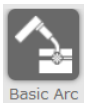


Fig. 4.3.23(a)
Basic Arc Icon

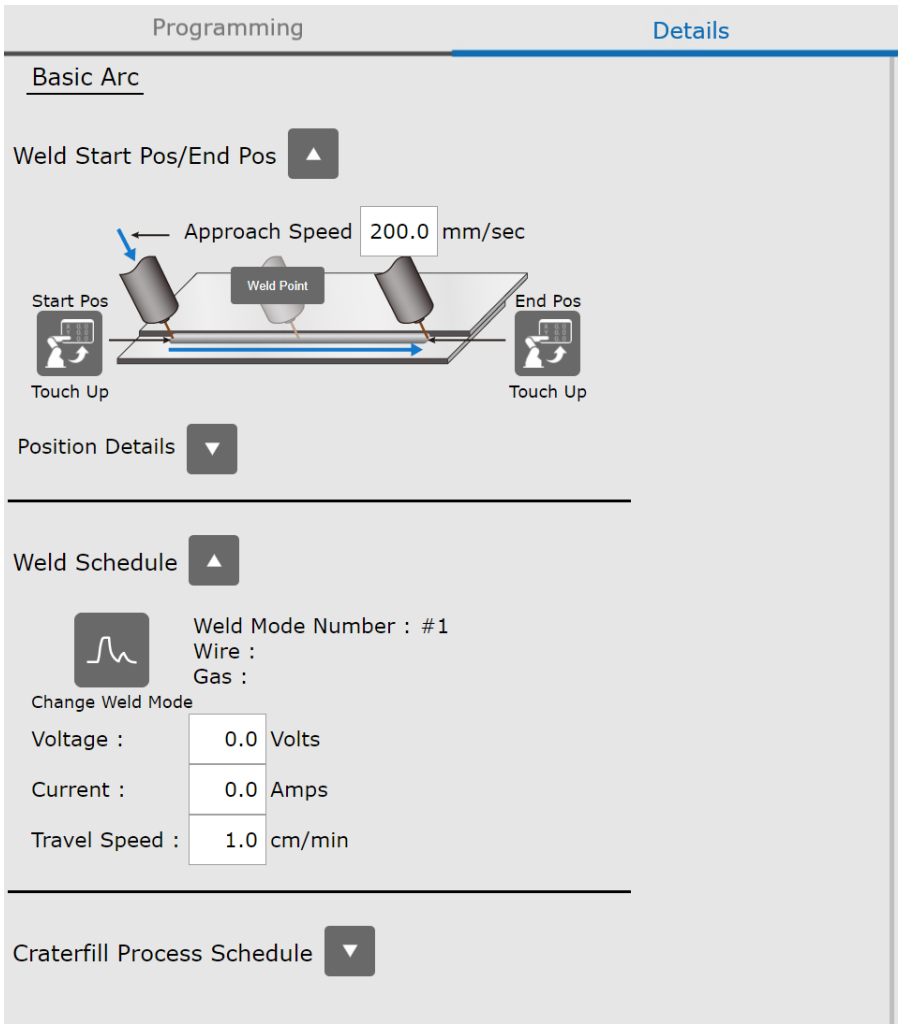


Fig. 4.3.23(b) Detail Settings

4.3.24 Basic Weave

Basic Weave instruction is available if you have included the optional functions for arc welding. Add weaving motion to Basic Arc instruction and perform arc welding.

Fig. 4.3.24(a)
Basic Weave Icon

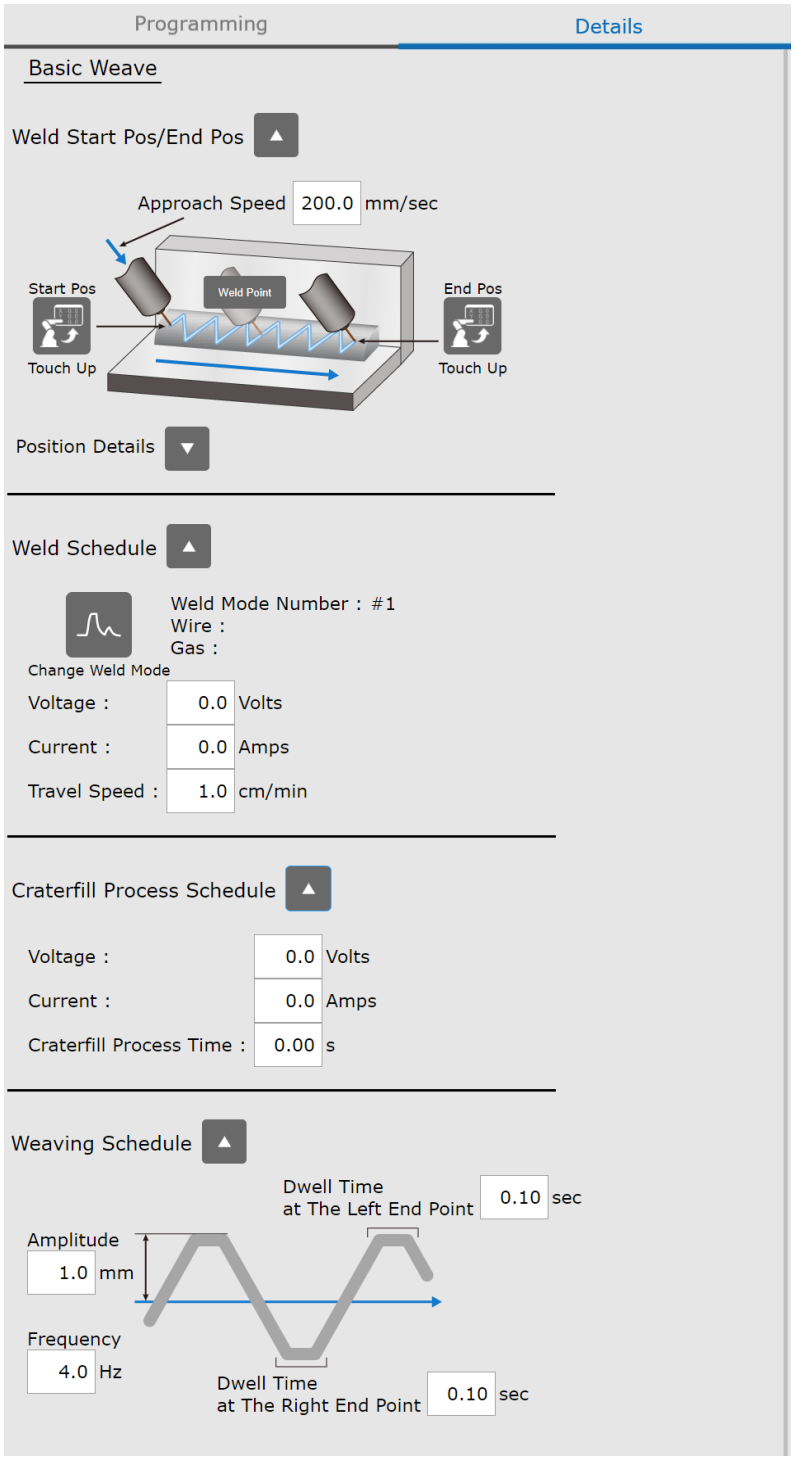


Fig. 4.3.24(b) Detail Settings

4.3.25 Weld Point(Liner)

This weld point instruction is used in the Basic Arc bracket or Basic Weave bracket.
Set the transit point. Move linearly from the previous position to the weld point set by this instruction.
Move at the speed set as the Travel Speed of the Basic Arc or the Basic Weave.

Fig.4.3.25(a)
Weld Point(L) Icon

Fig. 4.3.25(b) Detail Settings

4.3.26 Weld Point(Circle)

This weld point instruction is used in the Basic Arc bracket or Basic Weave bracket.
Set the transit point. Move the previous position and the two weld points set by this instruction in a circular motion. Move at the speed set as the Travel Speed of the Basic Arc or the Basic Weave.
*Note that this instruction operates at a speed exceeding the speed set by the speed clamp function. (not support speed clamp)

Fig.4.3.26(a)
Weld Point(C) Icon

Fig. 4.3.26(b) Detail Settings

4.3.27 HandleTeach

HandleTeach is the instruction to specify the welding path using the handle attached to the CRX tip.

Fig.4.3.27(a)
HandleTeach Icon

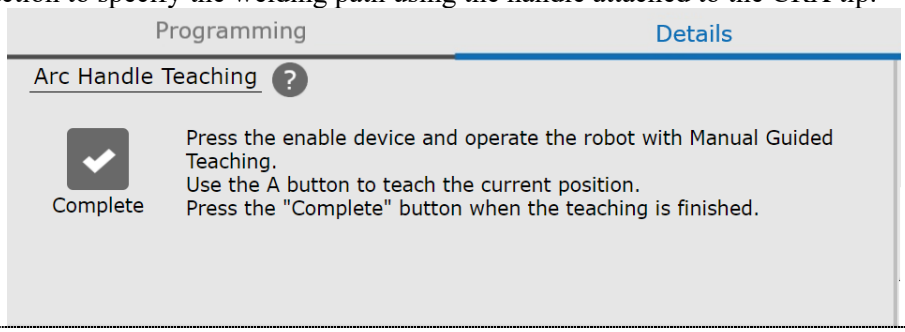


Fig. 4.3.27(b) Detail Settings

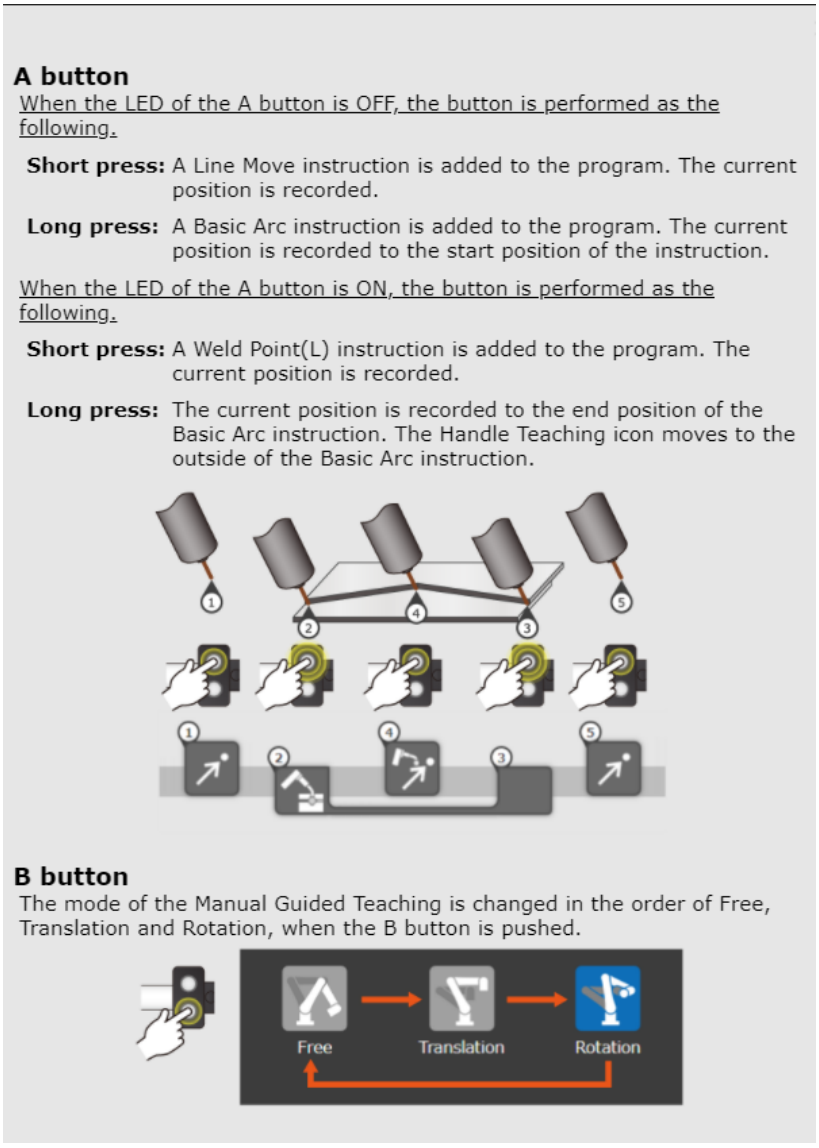


Fig.4.3.27(c) Help

4.4 POSITION DATA NODE MAP

Robot Graphics shows all positions of the specific motion instruction as nodes and connect them with lines. Each node has its positon number.
The motion instructions supporting node map are as follows.

- Linear motion
- Joint motion

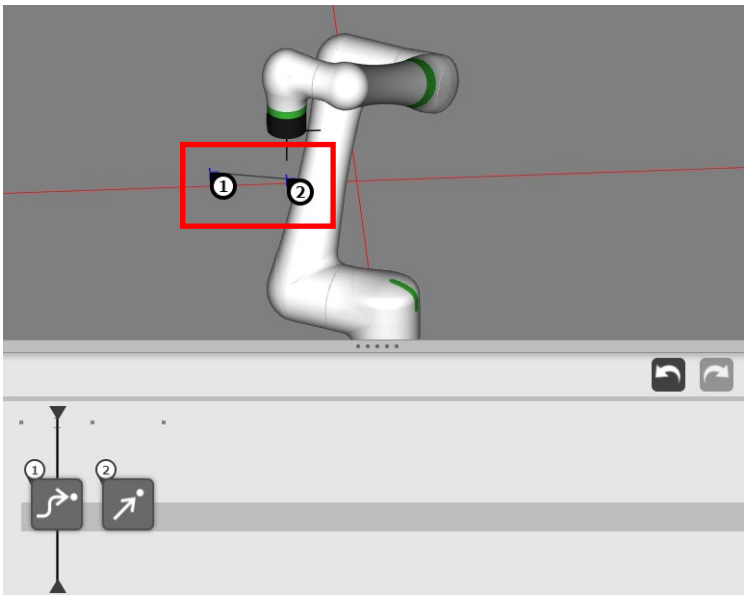


Fig. 4.4(a) Position data node map

The design of positon data displayed in Robot Graphics varies according to the kinds of position data.

Fig. 4.4(b) Position data

Fig. 4.4(c) Positon Register

⚠ CAUTION

1 The position data of the instruction that does not support node map are not displayed.
2 Node map connects two nodes of the supported motion instruction in descending order. Therefore, it is sometimes different from the real motion path.
3 When INC, OFFSET, or Position Register is used in a motion statement or when frame number is changed in a program, the node will be displayed in the different position from the actual position.

4.5 LIMITATIONS OF TABLET UI EDITOR

The following limitations apply to the Tablet UI Editor.

- The program that is set with a motion group cannot be edited when using the robot other than the 6 axes robot.
- The program that is set with a motion group cannot be edited when using the multi-group system.

5 EXECUTING A PROGRAM

5.1 EXECUTING A PROGRAM

Touch the “Play” key on the bottom left of the screen to show the Execution Panel.
Various buttons in the Execution Panel allow the user to control the execution process of a program.

What is shown in the Execution Panel depends on the status of the TP enable key represented at the status bar.
When the TP enable key is turned on, the following Execution Panel is shown.
A program can be executed by sliding the Run button to the right. While the Run button is kept to the right, the program will continue executing. To pause the program, release the Run button or slide it back to the center.

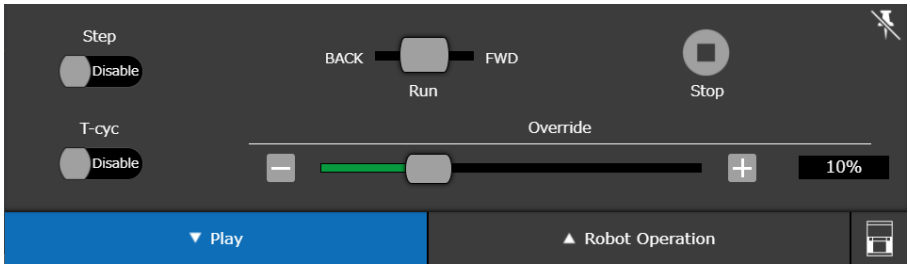
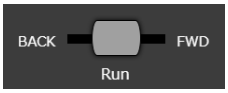
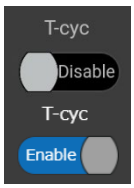


Fig. 5.1(a) Execution Panel (TP enable key : ON)

Table 5.1(a) Buttons in the Execution Panel

Button	Description
	To execute the program forwards, slide the Run button to the right. To execute the program backwards, slide the Run button to the left. To pause a program, slide the Run button back to the center. However, some instructions cannot be executed backwards.
	By touching this button, the current execution will stop.
	When this button is disabled, all steps of the program will be executed continuously. When this button is enabled, the program will be executed step by step.
	By touching this button users can switch from Normal Execution and Test Execution.
Override	Users can change the override.

When the TP enable key is turned off, the following Execution Panel is shown.
When you slide the Run button, a warning dialog will show. By touching “Yes” in the warning dialog, the program will start executing.
Note that in this execution panel, the program will continue executing even though the Run button is released. Furthermore, even if the user switches to a different screen, the program will still continue executing in the background. To pause the program, touch the Pause button.

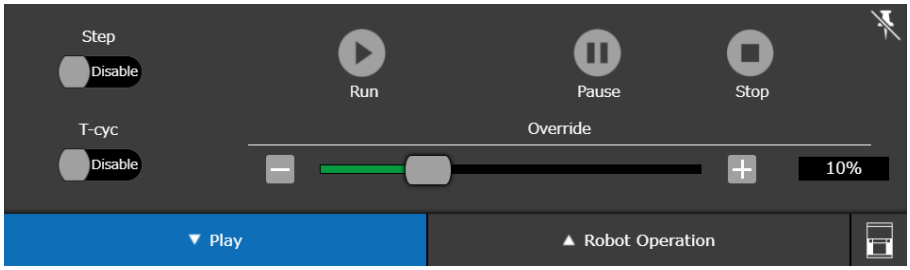


Fig. 5.1(b) Execution Panel (TP enable key : OFF)

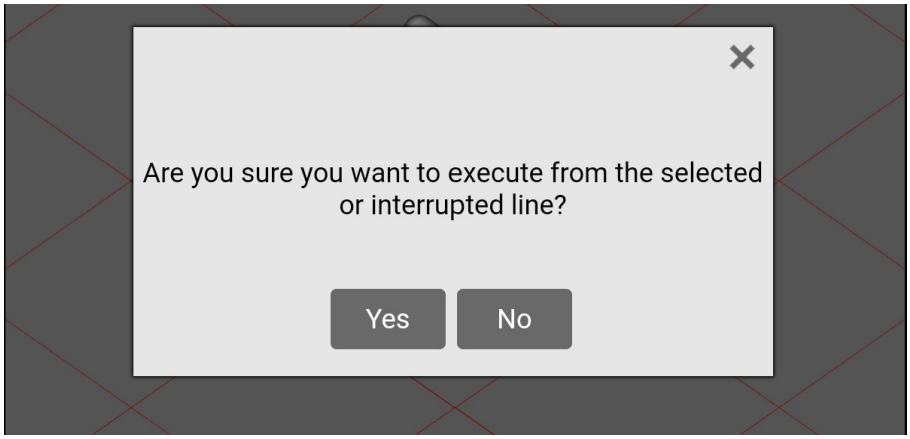
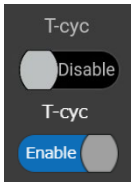


Fig. 5.1(c) Warning Dialog

Table 5.1(b) Buttons in the Execution Panel

Button	Description
	By touching this button, all steps of the program will be executed continuously. In other words, the program will be executed in the Continuous test mode.
	By touching this button, the current execution will halt.
	By touching this button, the current execution will stop.

Button	Description
	When this button is disabled all steps of the program will be executed continuously. When this button is enabled, the program will be executed step by step.
	By touching this button users can switch from Normal Execution and Test Execution.
Override	Users can change the override.

Users can change which line to start the execution by sliding the Execution bar above the program line. After moving the Execution bar to the user's preferred line, touch the Run button and a warning dialog should show. Choose OK and touch the Run button again to start the execution.

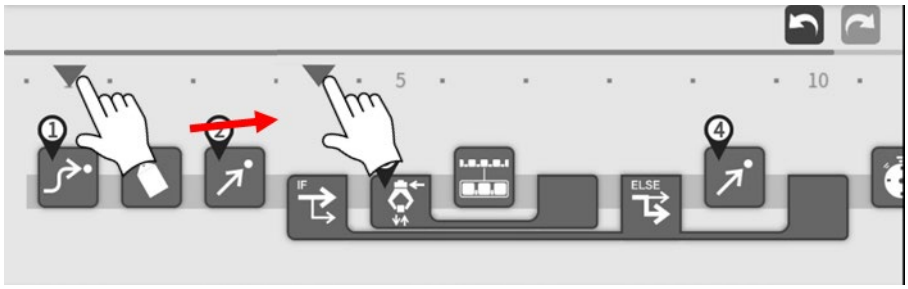


Fig. 5.1(d) Move the Execution bar

When a program is executed, an icon in the status bar will change like the following:

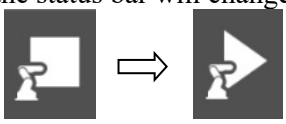


Fig. 5.1(e) Execution Status

> ⚠ **WARNING**
> Check the program and the program line before executing the program.

The following pop-up will show whenever the execution switches between Normal Execution and Test Execution.

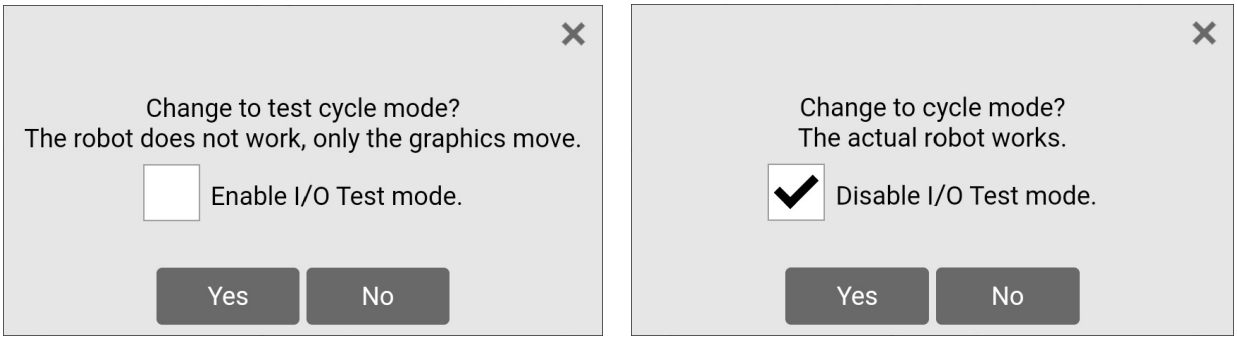


Fig. 5.1(f) I/O Test Mode

The checkbox for “Enable I/O Test mode” and “Disable I/O Test mode” allows users to specify whether to communicate with peripheral devices via Digital I/O, Analog I/O, Group I/O and Robot I/O signal lines. By enabling I/O Test Mode, the robot will not send or receive Digital I/O and Analog I/O signals with peripheral devices. All the signals will be given the simulated flag (S) and these flags cannot be released until the I/O Test Mode is disabled. To disable the I/O Test mode, touch the T-cyc button after switching to Test Execution and then touch the checkbox for “Disable I/O Test mode”.

6 PLUGIN FUNCTION

6.1 OVERVIEW OF PLUGIN FUNCTION

The Plugin function provides the way for the user to load the Plugin software, which is provided by a peripheral equipment supplier, to a FANUC robot. Together with the standardized mechanical and electrical interface, this feature makes the connection and installation of peripheral equipment simple and easy.

Fig. 6.1 (a) shows the overview of the plugin software. This uses a gripper as an example, but the plugin may be provided for any application, such as sensor system, vision system, and so forth.

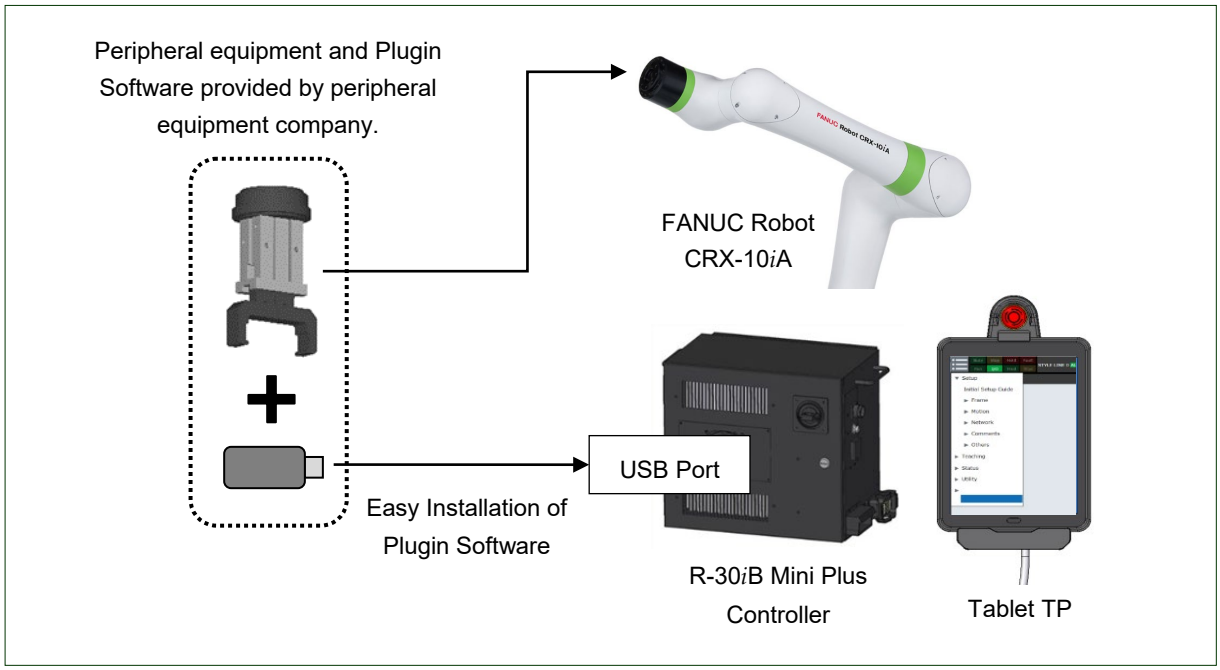


Fig 6.1 (a) Overview of Plugin Software Installation

The following two screens are what the user would see. Installation of the plugin software, and its management can be done in these screens.

Install screen

This screen enables the user to install the Plugin software using a USB memory.

Plugin List screen

This screen shows a list of the installed plugins and detail profile information. This screen also let you uninstall the installed plugin.

> ⚠ **CAUTION**
> 1 When connect the peripheral device compatible to Plugin, please ensure to complete the installation of plugin software before connecting the device to EE connector. If you connect the device before installation, the device might be broken.
> 2 When insert or remove the peripheral device connected to the EE connector, please ensure to turn off the robot controller.

6.2 INSTALL SCREEN OF PLUGIN

A plugin software that has been developed by a peripheral equipment provider can be easily installed using a USB memory. Installation of plugin software is done in the “Install” screen. The screen shows the detail information of the plugin software to be installed, such as the name of the provider of the plugin, the name of the equipment supported, software version number, etc. By installing a plugin software, new screens specifically for the equipment and new program instructions to control the equipment may be added, and also the system may be set up for the equipment, such as tool frame, payload setting, etc.

The following shows the procedure to install a plugin.

Procedure Installing a Plugin Software

Procedure

1 Tap the menu icon on the status bar, and you will see the menu similar to the following.

Fig 6.2 (a) Menu displayed when the menu icon is tapped (English / Japanese)

2 Tap the “Install” item under “Plugins”, and you will see the “Install” screen as shown in Fig. 6.2 (b). The screen shows the information that is stored in the USB memory, such as the name of the plugin install package file, and the detail information of the plugin software.

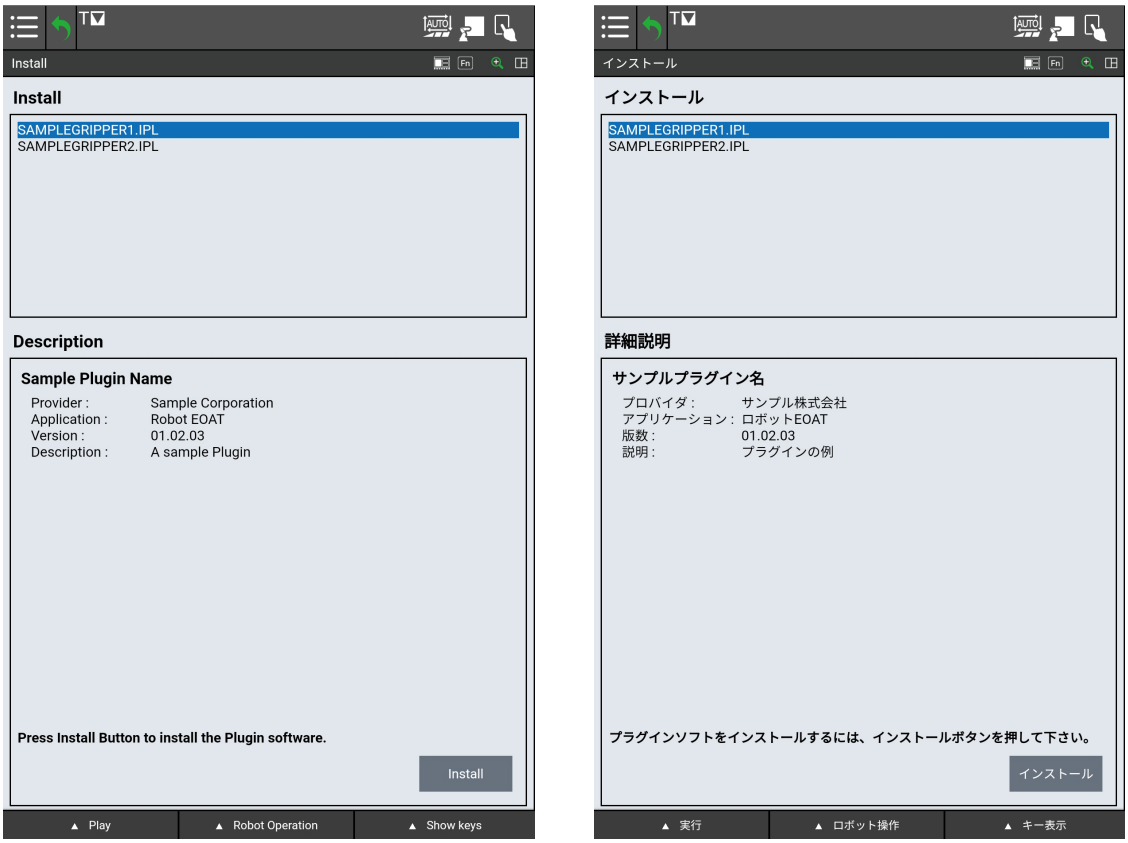


Fig 6.2 (b) Install Screen (English / Japanese)

3 Tap the “Install” button at the bottom right of the screen to start the installation process.
4 The following screen will be displayed when the installation processing is done.

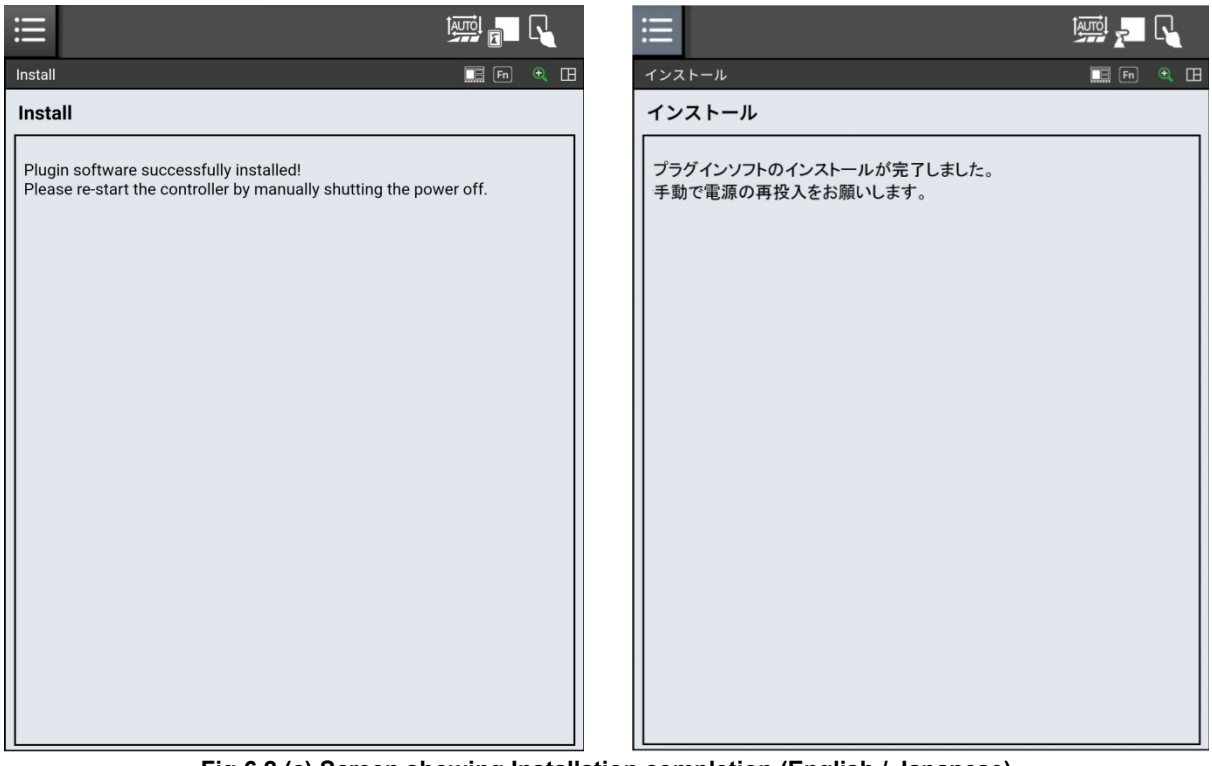


Fig 6.2 (c) Screen showing Installation completion (English / Japanese)

5 Please re-start the controller by manually shutting down the controller power.

6.3 PLUGIN LIST SCREEN

The Plugin List Screen shows a list of installed Plugin software with the detail information of each plugin. You may also uninstall (delete) a plugin software on this screen.

1 A list of installed plugin software
2 Detail information of a selected plugin software
3 Uninstall operation of an installed plugin software

Procedure Displaying a List of Installed Plugin Software

Procedure

1 Touch the menu icon on the status bar, and you will see the menu similar to the following.

Fig 6.3 (a) Menu displayed when the menu icon is tapped (English / Japanese)

2 Tap the “Plugin List” item under “Plugins”, and you will see the “Plugin List” screen as shown in Fig. 6.3 (b).

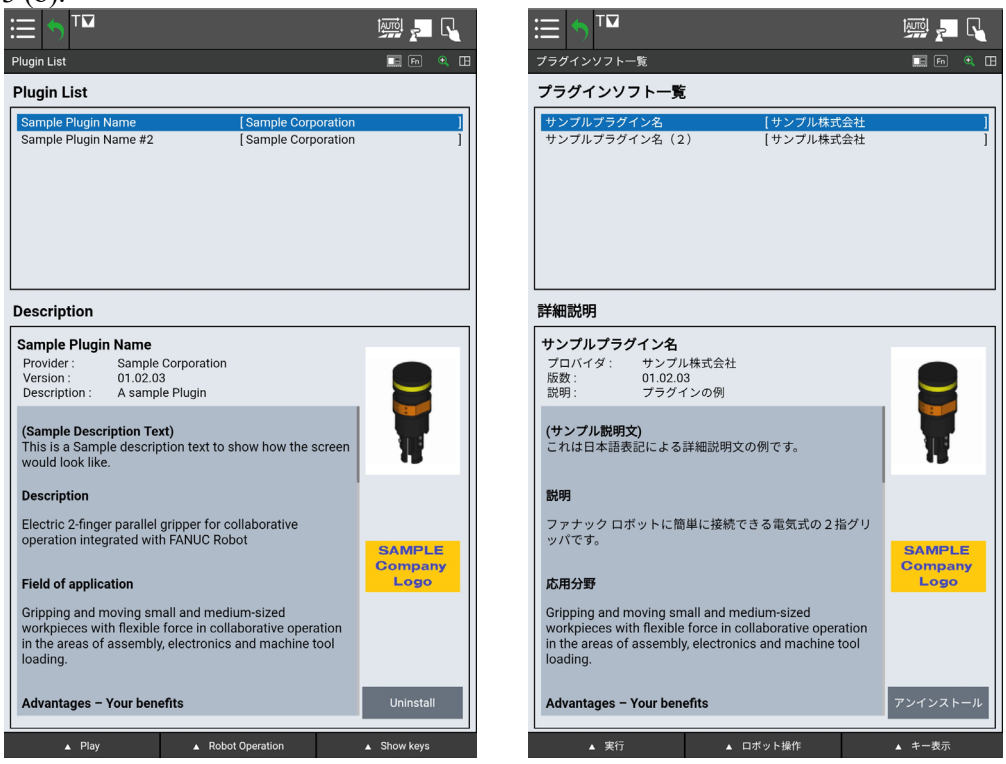


Fig 6.3 (b) Plugin List screen (English / Japanese)

3 Tap an item in the list to select a plugin software, and you will see the detail information of the selected plugin in the lower half of the screen.
4 You can uninstall the selected plugin by tapping the “Uninstall” button on the bottom right of the screen.
5 The following screen will be displayed when the uninstallation processing is done. Please re-start the controller by manually shutting down the controller power.

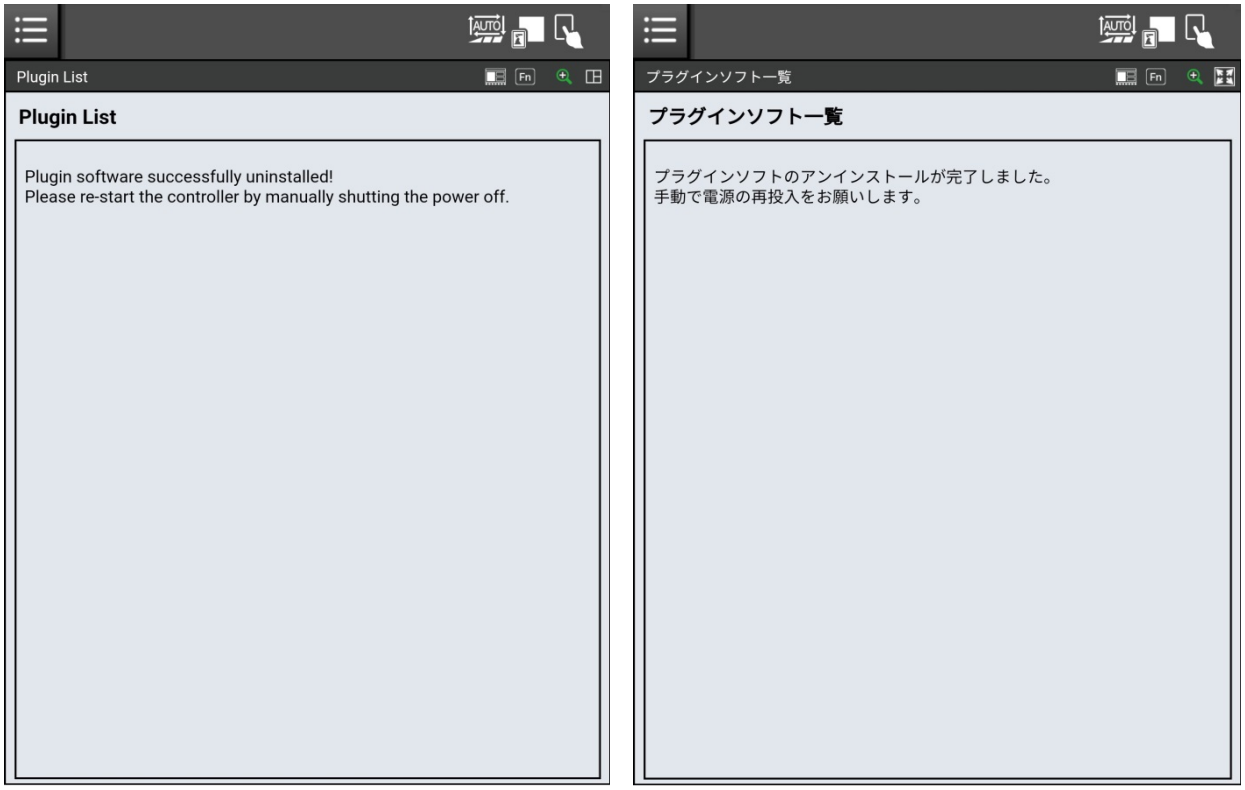


Fig 6.3 (c) Completion of Uninstall Operation (English / Japanese)

6.4 LIMITATIONS OF PLUGIN FUNCTION

The following limitations apply to Plugin Function.

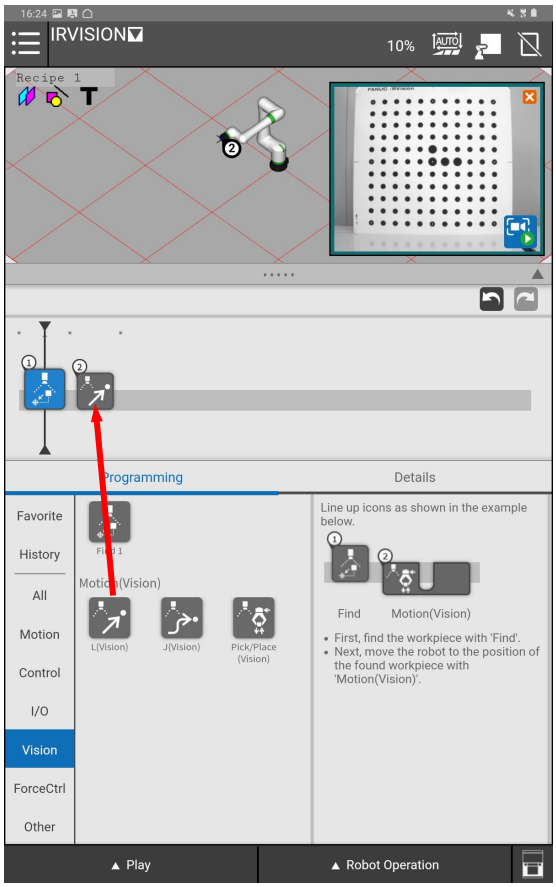
- This feature is only available for 7DF5 series (V9.40P) software.
- Tablet TP is required for this feature.
- This feature is only available on FANUC Robot CRX-10*i*A, CRX-10*i*A/L.

7 VISION FUNCTION

You can use the vision function, which detects the position of the objects using the camera and offsets the robot motion, by using the “Find” icon and various motion command icons with vision offset on the tablet UI.

This chapter describes how to use the vision function on the tablet UI. For the overview and details of the vision function, see “*i*RVision OPERATOR'S MANUAL (Reference) B-83914EN” and “*i*RVision 2D Camera Application OPERATOR'S MANUAL B-83914EN-2”.

When adding the vision function to the Program Line, you can easily find the vision-related icons by opening the “Vision” section in the icon pallet on the editor screen.



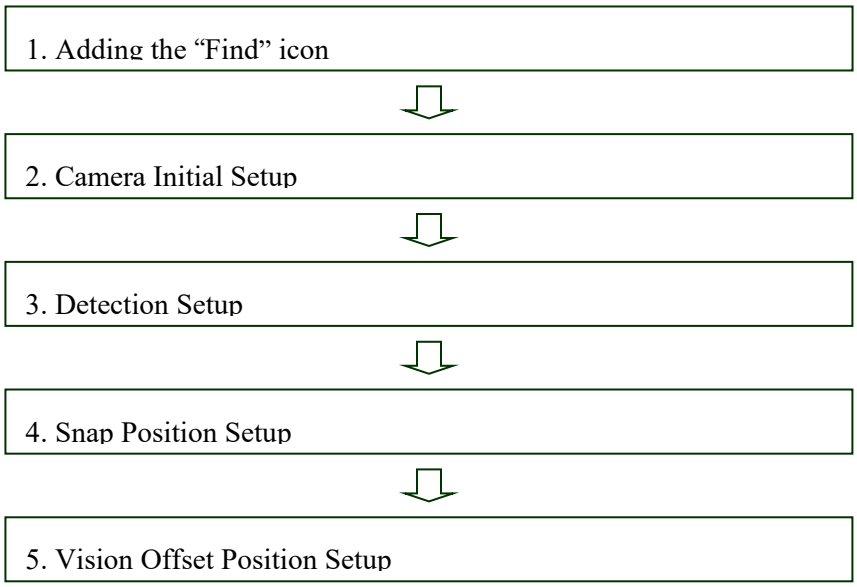
7.1 "FIND" ICON

The "Find" icon allows you to create the following applications that use the vision function:

- Application to offset the position of one fixed 2D camera
- Application to offset the position of one 2D camera equipped with arm tooling
- Application to offset the position of one fixed 3DV sensor
- Application to offset the position of one 3DV sensor equipped with arm tooling

7.1.1 Setup Flow

You can detect the workpiece using the "Find" icon and offset the taught motion by as much as the workpiece was shifted. Use the following setup flow.
To set the "Find" icon, the calibration grid is normally used. If you use a fixed camera, you need to mount the calibration grid on the robot end of arm tooling in advance.

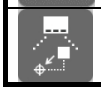


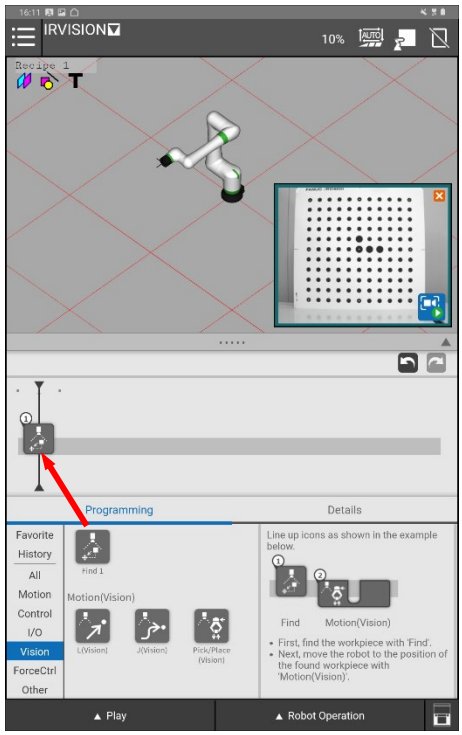
7.1.2 Adding the “Find” Icon

First, add the “Find” icon to the Program Line.

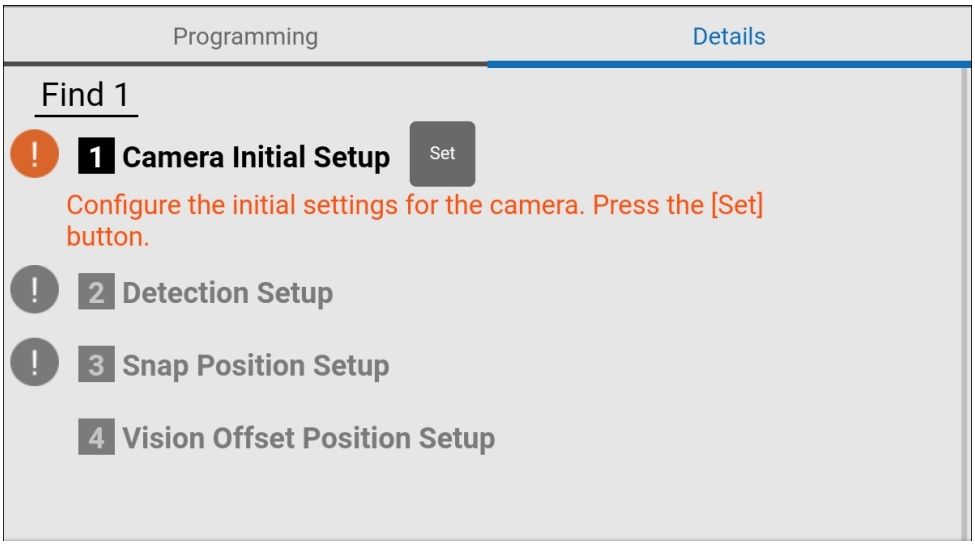
MEMO

The icon pallet displays as many “Find” icons as the number of the connected 2D cameras and the connected 3DV sensors.
The appearances of “Find” icons are different by the device to use: a 2D camera or a 3DV sensor. To the Program Line, add the icon for the type of device you want to use.

	“Find” icon for 2D camera
	“Find” icon for 3DV sensor



Touching the “Find” icon on the Program Line displays the Details screen of the “Find” icon. Set the items in ascending order. The  mark is displayed on an item that has not been configured or taught yet. The  mark is displayed for an item that has been already configured or taught.



In addition, the snapped image of the camera corresponding to the touched “Find” icon is displayed on the lower-right of 4D graphics area in the editor. The live image of the corresponding camera is displayed right after the “Find” icon on the Program Line is touched, however, the still image of the found result is displayed after the process of "Find" icon is executed.

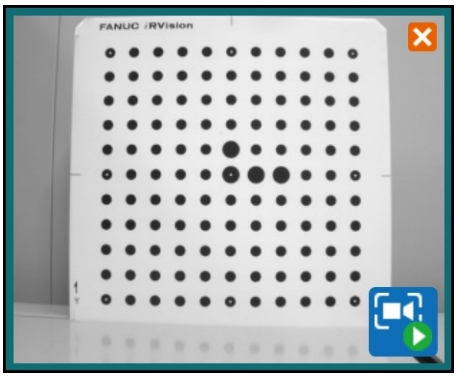
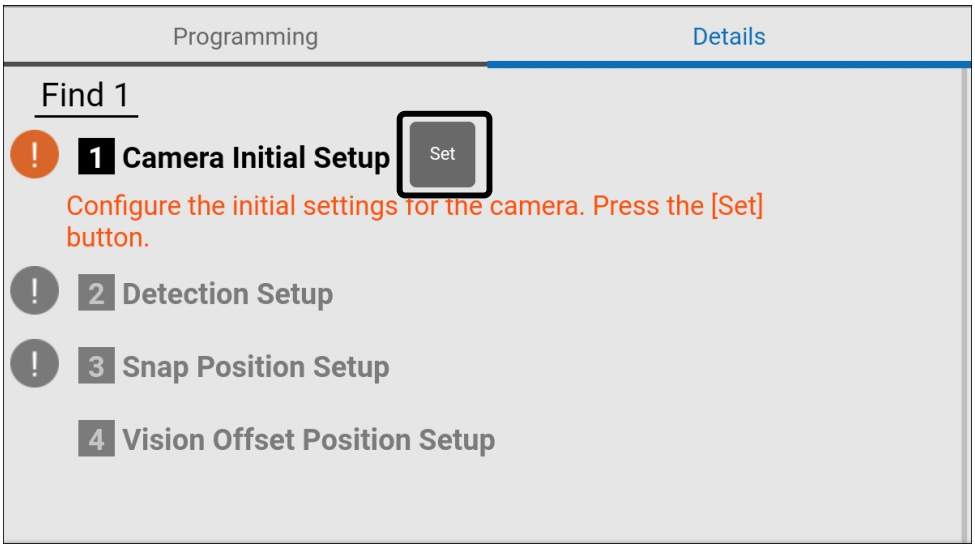


Table 7.1.2 Layout of Camera Image Display Area

Item	Description
 button	Enables / Disables the live display of camera image. The button turns blue when the live display is enabled, and turns gray when the live display is disabled. The live display is automatically disabled after "Find" is executed.
 button	Hides the Camera Image Display Area. If you display the Camera Image Display Area again, touch something other than “Find” on the Program Line once, and the touch “Find” again.

7.1.3 Camera Initial Setup

If you open the Details screen after adding the “Find” icon to the Program Line, the following screen appears. Touch the “Set” button of “Camera Initial Setup” and configure the initial settings for the camera.
Though the following description of the initial setting flow is based on the 2D camera screen, you can setup a 3DV sensor in the same way.



Screen layout

The screen layout of the camera initial setup is as follows.

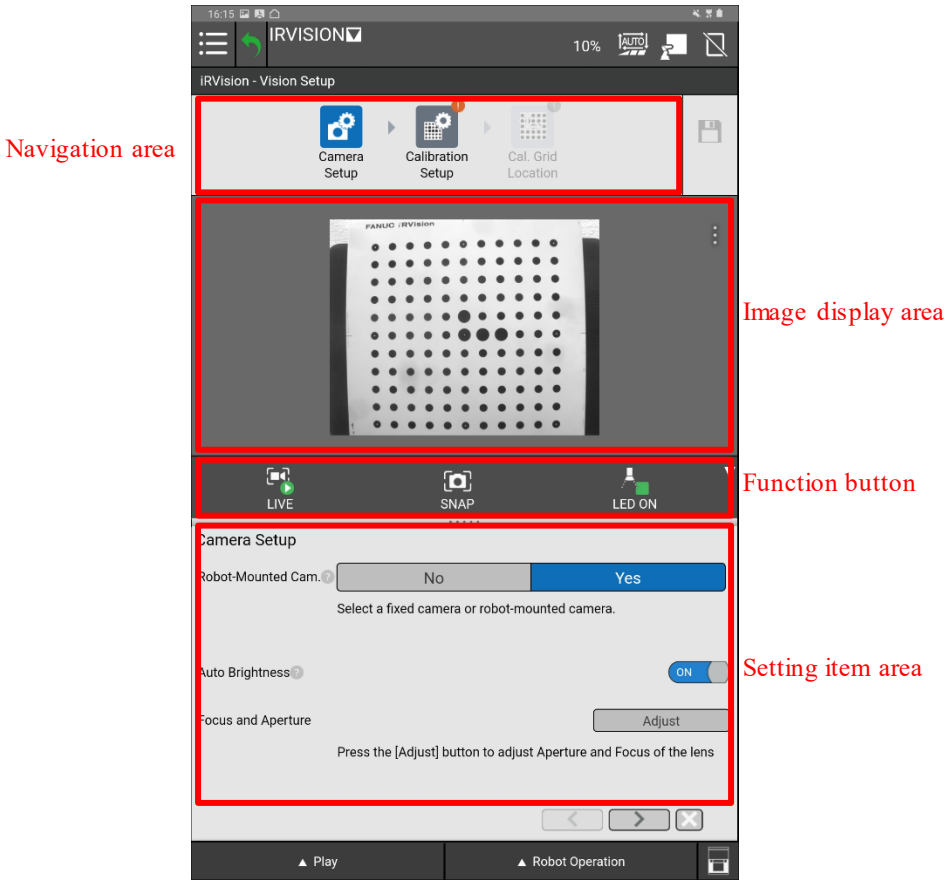
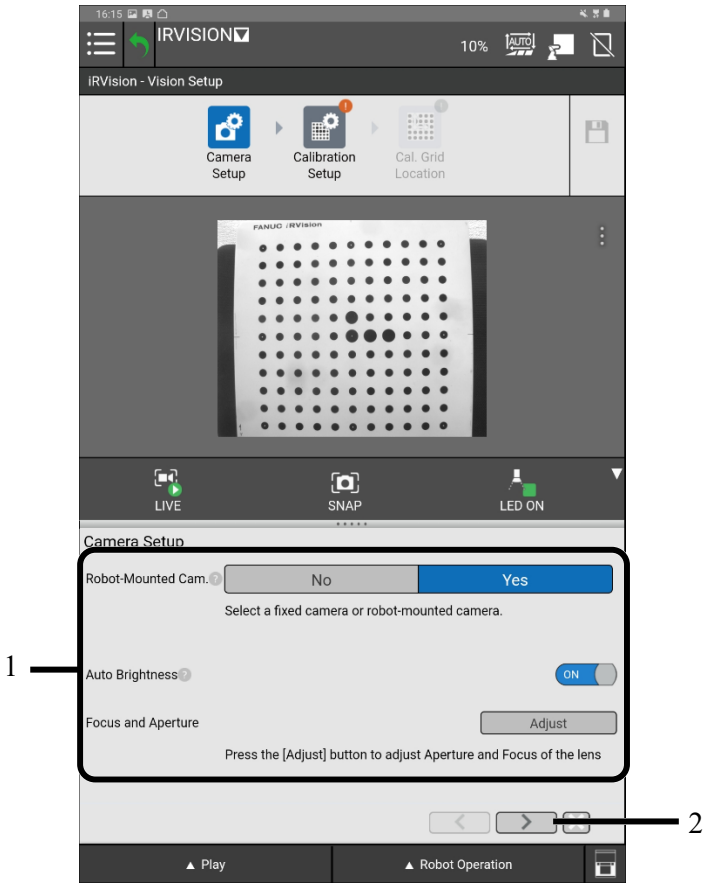


Table 7.1.3 Layout of the Camera Data Screen

Item	Description
Navigation area	Displays the camera data setup procedures in the order from left to right. The icon of the current setup procedure is displayed in blue, and the "!" icon is displayed on procedures that have not been completed yet.
Image display area	Displays the image snapped by the camera.
Function button	Used to operate the camera and lighting LED.
Setting item area	Displays the setting items in each setup procedure for camera data.
button	Saves the camera data.
button	Goes back to the last setup procedure for camera data.
button	Goes to the next setup procedure for camera data.
button	Cancels the camera data setting change.
"FINISH" button	Appears when the setup is completed. This button saves the data and returns to the editor screen.

Camera Setup

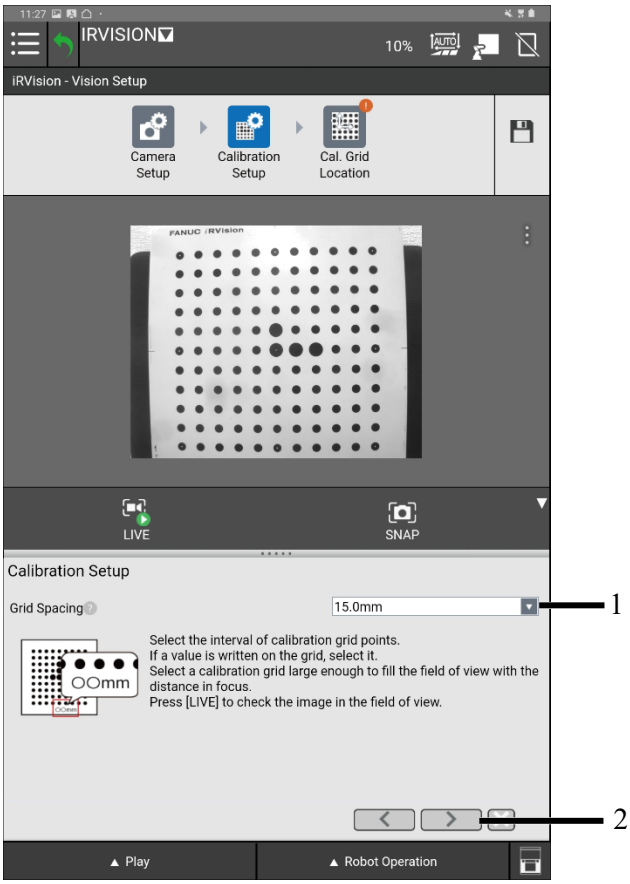


1 Select the camera and camera mounting method to be used and adjust the lens focus and aperture as needed.

MEMO
For a 3DV sensor, the adjustment of the lens focus and aperture are not necessary because they have been adjusted prior to shipment.

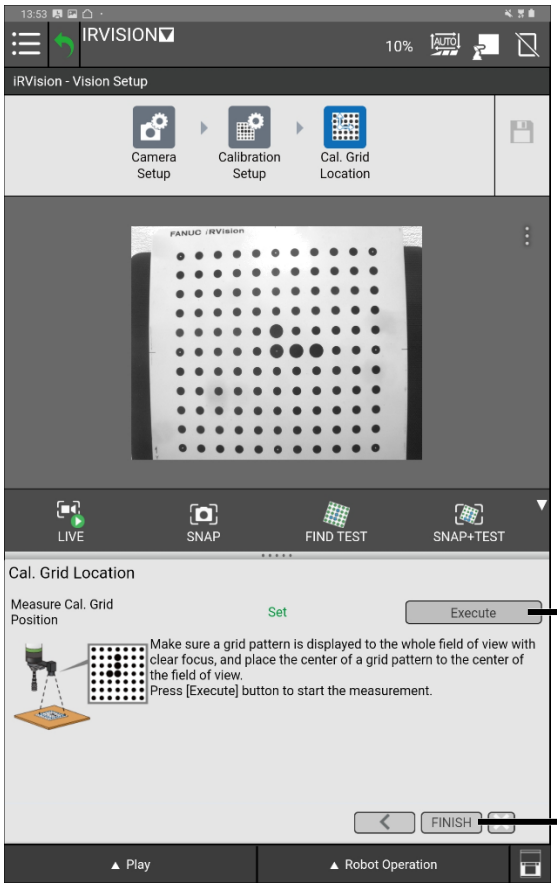
2 Touch ">" to go to the next setup procedure.

Calibration Setup



1 Select the grid spacing of the calibration grid to be used from the available choices in the “Grid Spacing” drop-down box.
2 Touch “>” to go to the next setup procedure.

Cal. Grid Location



1 Move the robot to a position where the center of the camera faces the center of the calibration grid almost straight so that the image comes into focus.
2 Touch the “Execute” button. The robot starts moving and measuring the calibration grid.

> **⚠ CAUTION**
> The robot moves during measurement. Decrease the override and make sure that no person or object remains inside the motion range of the robot before measurement. After starting measurement, increase the override after confirming that there is no problem.

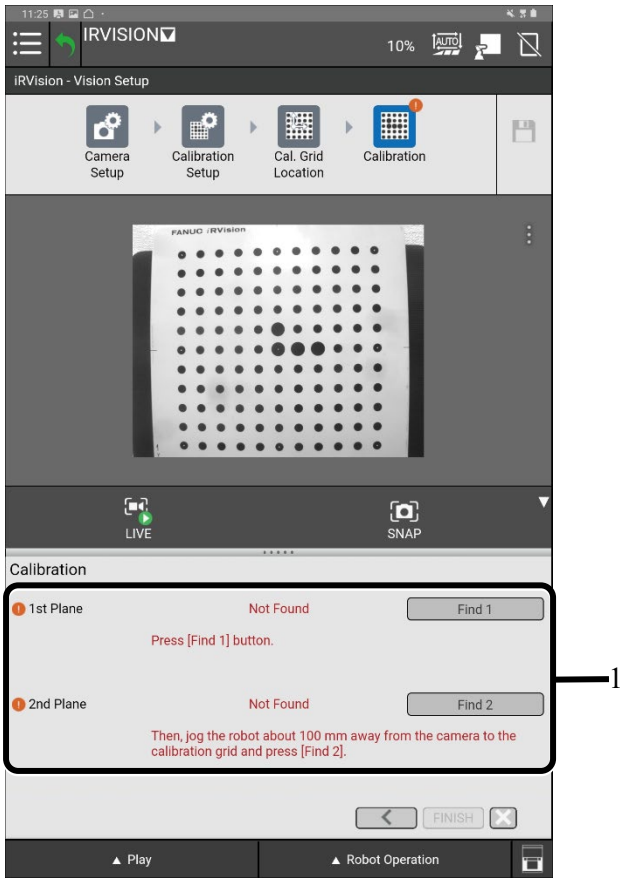
> **MEMO**
> During measurement, press the “MEASURE HERE” button if an interference between the robot and a peripheral device is likely to occur. By pressing “MEASURE HERE”, you can stop the robot moving to the measurement posture and measure the posture at that time as a measurement posture.

3 If the setup procedures have been completed up to calibration, “FINISH” appears. Touch “FINISH” to finish the camera initial setup.
Otherwise, touch “>” to go to the next setup procedure.

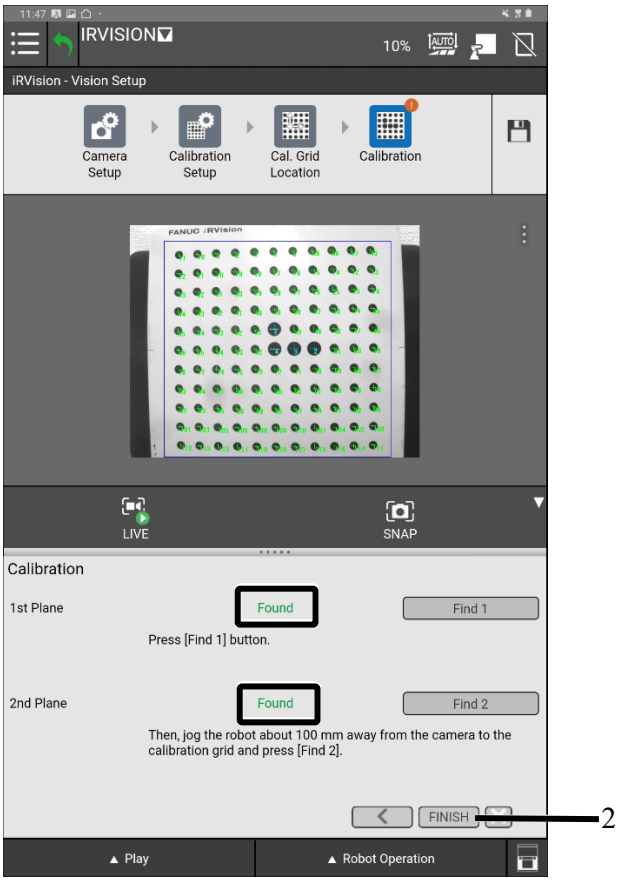
> **⚠ CAUTION**
> If the automatic camera calibration fails at “Cal. Grid Location”, the “Calibration” icon for a 2D camera or the “Mounting Pos. Setup” icon for a 3DV sensor is additionally displayed.

Calibration

"Calibration" is displayed only when the automatic calibration fails at "Cal. Grid Location".



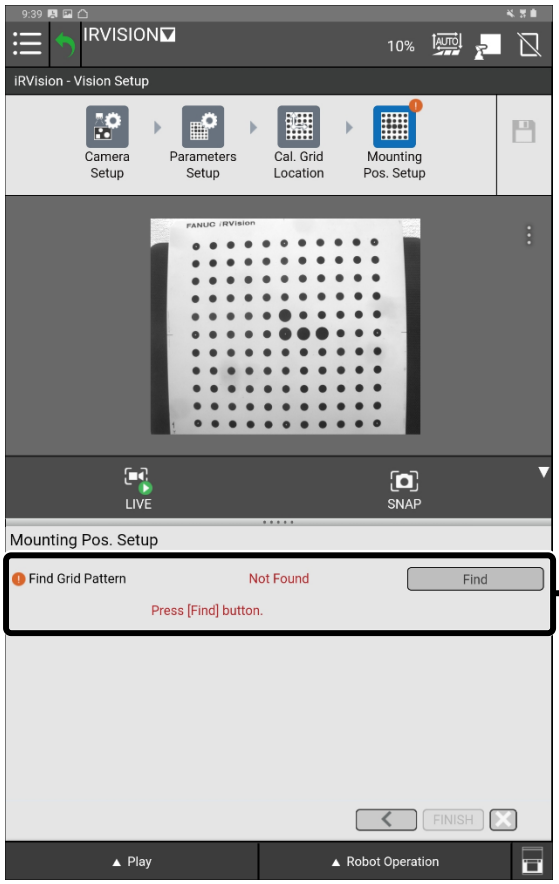
1 Find "1st Plane" and "2nd Plane" according to the instructions on the screen.



2 When “Found” is displayed in green for “1st plane” and “2nd Plane”, touch “FINISH”.

Mounting Pos. Setup

"Mounting Pos.Setup" is displayed only when the automatic calibration fails at "Cal. Grid Location".

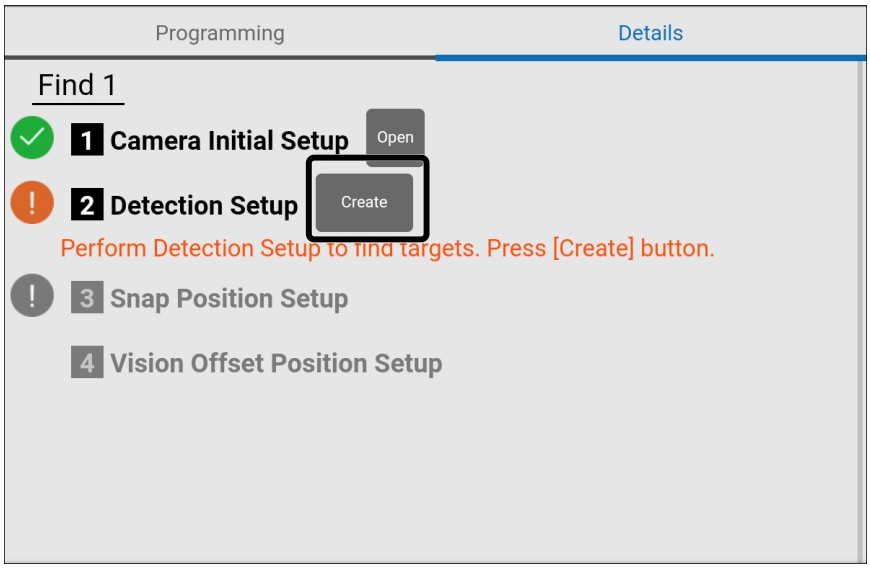


1 Follow the instructions on the screen to perform "Find Grid Pattern".
2 When "Found" is displayed in green text at "Find Grid Pattern", touch "FINISH".

7.1.4 Detection Setup

When you finish the camera initial setup and open the Details screen of the "Find" icon, the "Create" button of "Detection Setup" becomes touchable.
Touch the "Create" button of "Detection Setup" to go to the setting screen of the vision process. On this screen, you will configure the workpiece detection settings.

MEMO
Though the description of the detection setting flow here is based on the 2D camera screen, you can setup a 3DV sensor in the same way.



Screen layout

The screen layout of the vision process setup is as follows.

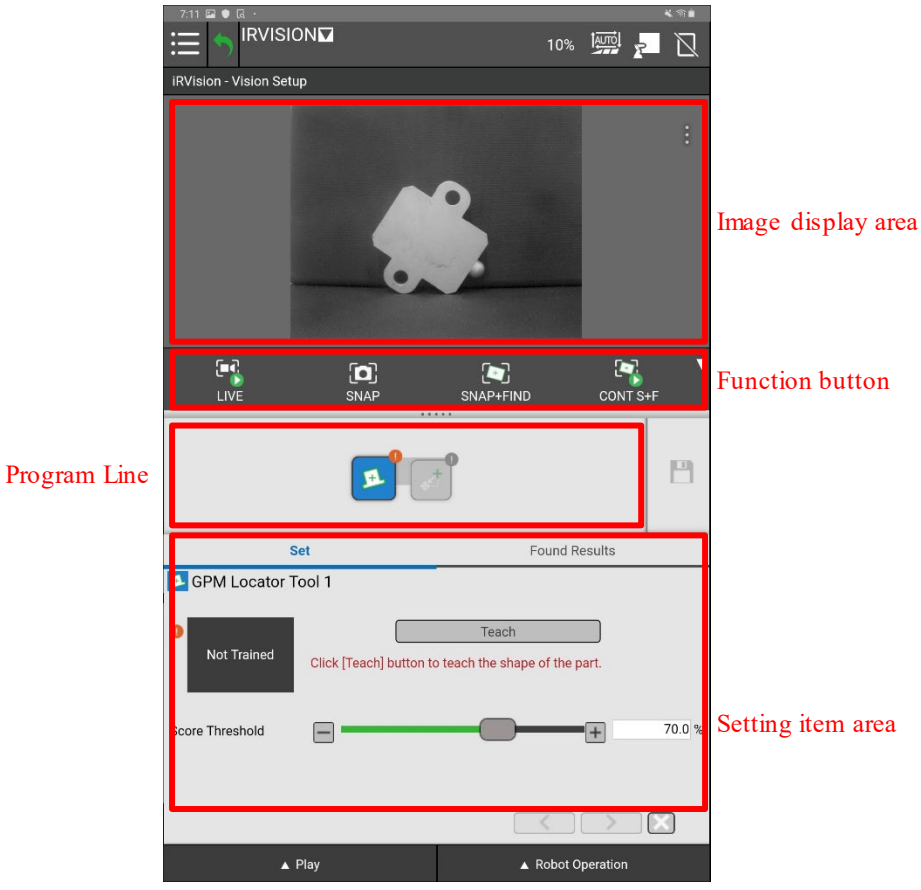
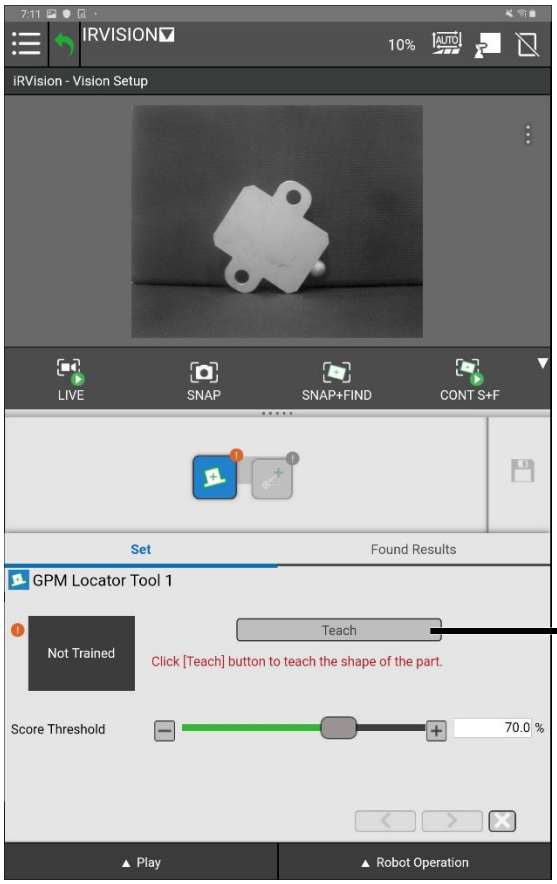


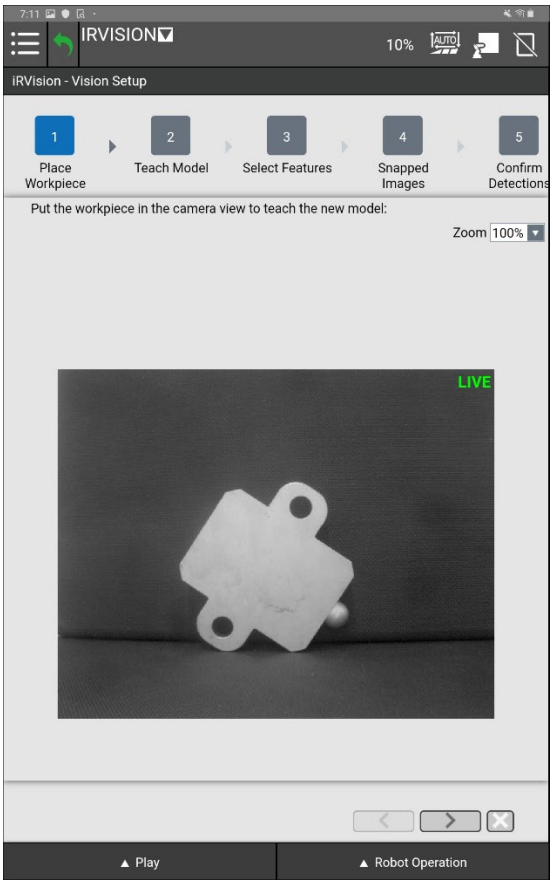
Table 7.1.4(a) Screen Layout of the Vision Process Setup

Item	Description
Image display area	Displays the image snapped by the camera.
Function button	Used to operate the camera and vision process.
Program Line	Displays the vision processes and the command tool icons, which are the components of the vision processes. The icon of the current process/command tool is displayed in blue, and the "!" icon is displayed on processes/command tools that have not been configured yet.
Setting item area	Displays the setting items of the vision process/command tool. Changing the tab allows you to check the find test results.
 button	Saves the vision process.
 button	Goes back to the setting screen of the last vision process/command tool.
 button	Goes to the setting screen of the next vision process/command tool.
 button	Cancels the vision process/command tool setting change.
“FINISH” button	Appears when the setup is completed. This button saves the data and returns to the editor screen.

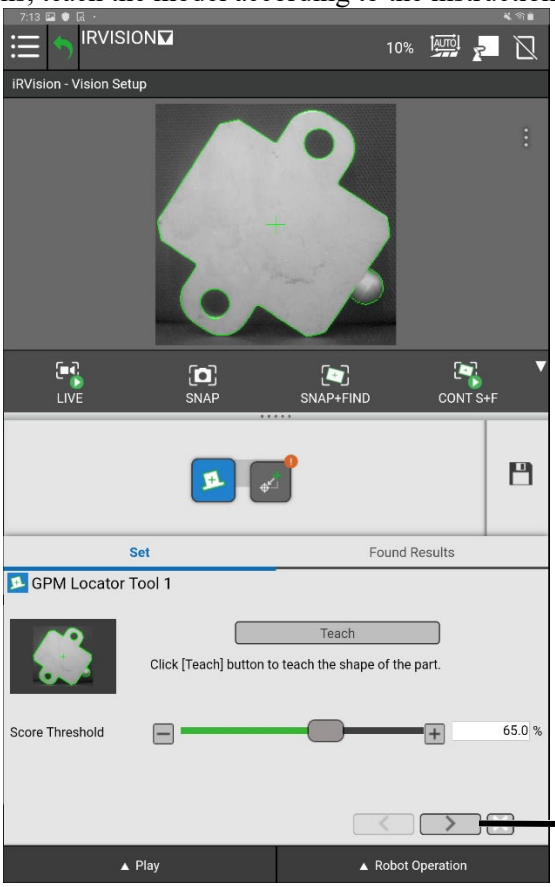
GPM Locator Tool



1 Touch the “Teach” button.



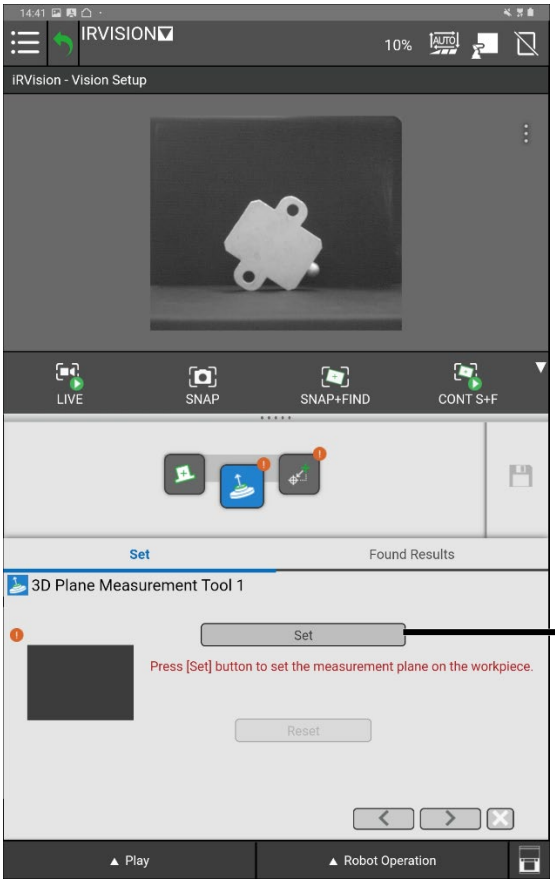
2 When the guide opens, teach the model according to the instructions on the guide.



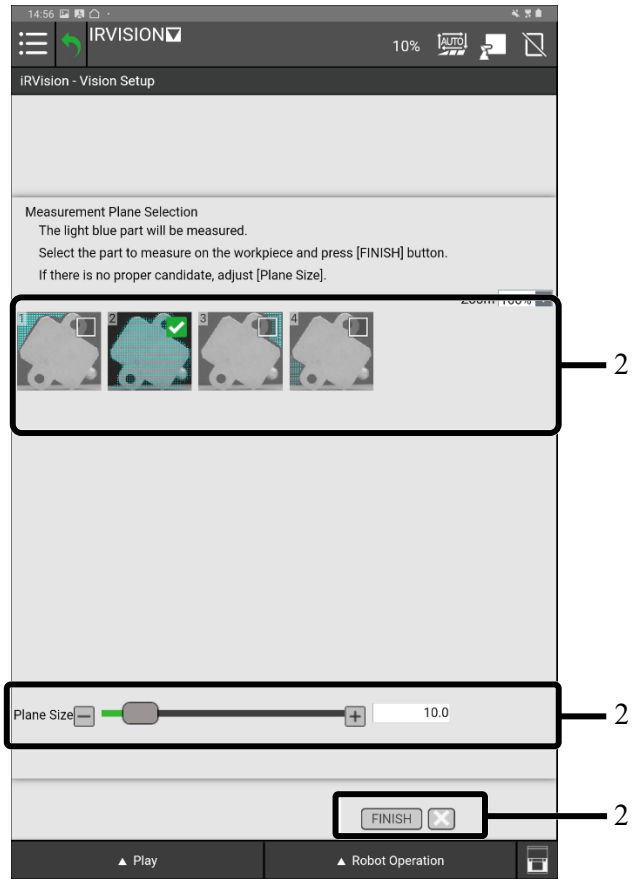
3 Touch “>” to go to the next command tool.

3D Plane Measurement Tool

The following settings are for a 3DV sensor. If you are working with a 2D camera, go to the setting of the Offset Data Calculation Tool.

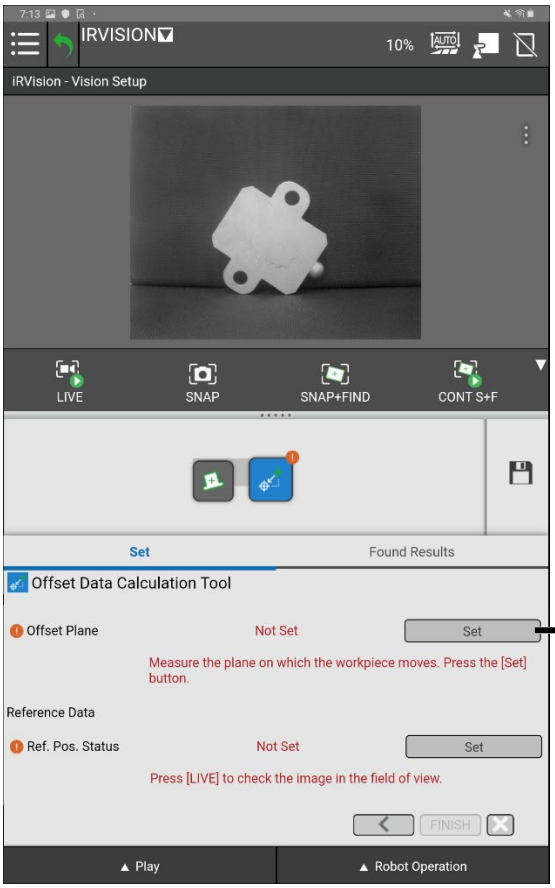


1 Touch the “Set” button.



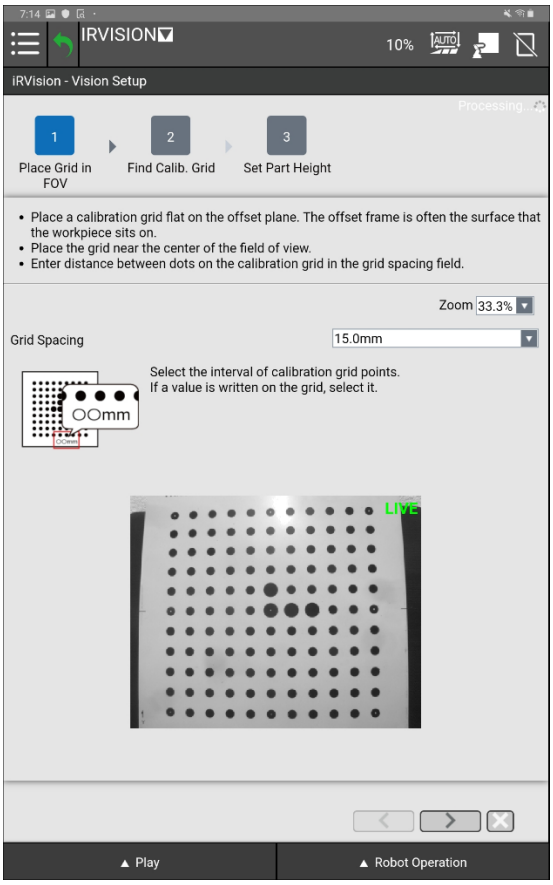
2 The candidates for places to perform the 3D measurement are displayed. Select a place to perform the 3D measurement of the workpiece and touch “FINISH” to go to the next command tool. If a place you want to measure does not appear as a candidate, adjust “Plane Size”.
If a desired place to measure does not appear however “Plane Size” is adjusted, touch “X”.

Offset Data Calculation Tool



1 Touch the “Set” button for “Offset Plane”.

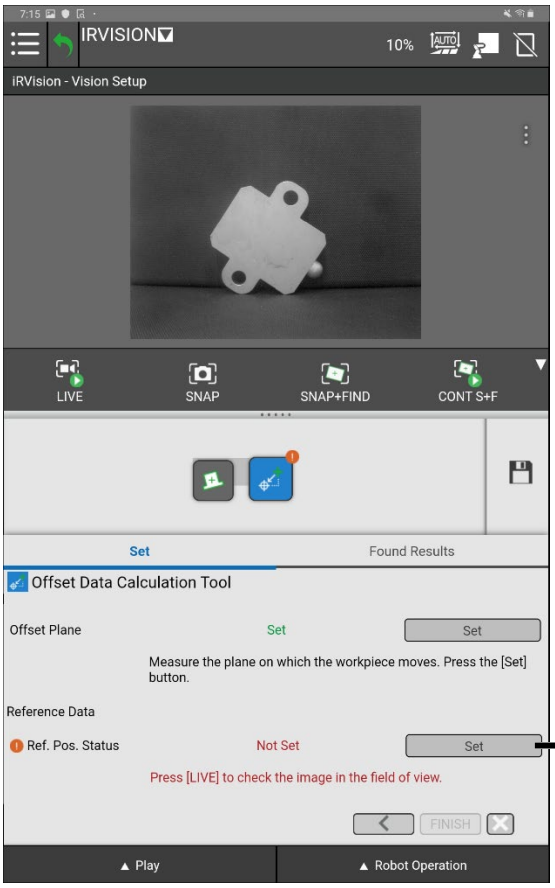
> **MEMO**
> For a 3DV sensor, settings for an offset plane are not necessary. Go to Step 4 to set “Ref. Pos. Status”.



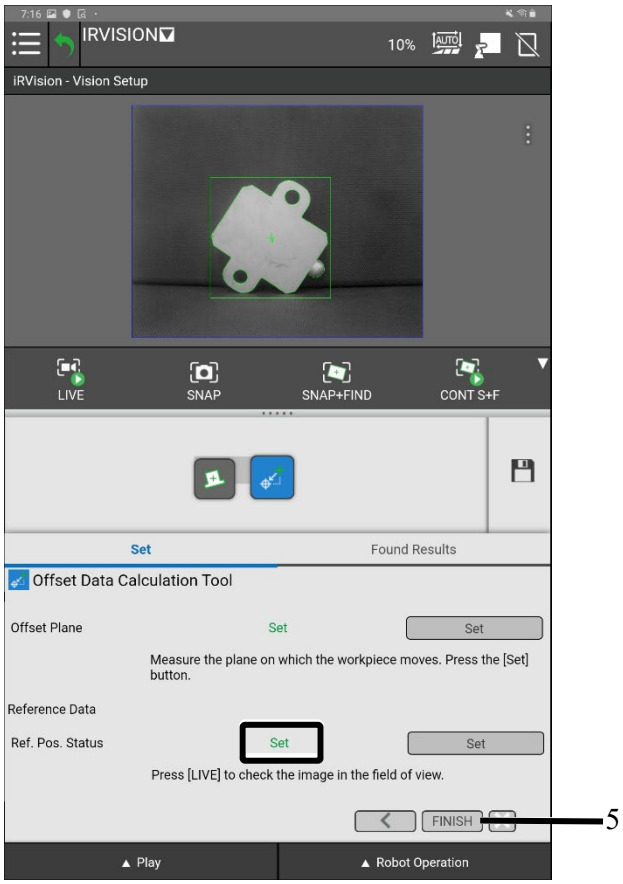
2 When the guide opens, measure the offset plane according to the instructions on the guide.

> ⚠ **CAUTION**
> Use the calibration grid to measure the offset plane.

3 When you finish measuring the offset plane, place the workpiece in the detection reference position.



4 Touch the “Set” button for “Ref. Pos. Status”.



5 When “Set” is displayed in green for “Ref. Pos. Status”, touch “FINISH”.

> ⚠ **CAUTION**
> Afterward, do not move the workpiece until robot motion teaching is completed. In addition, do not change the position of the camera until the teaching of snap position is completed.

“Find” icon setting items after the detection setup is completed

When you finish the detection setup, the Details screen of the “Find” icon is displayed as follows.

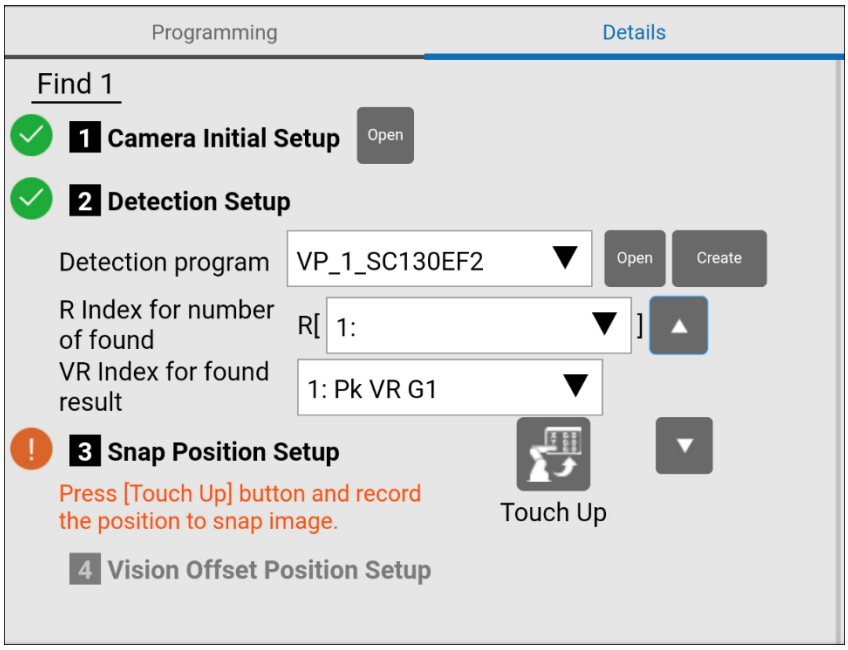


Table 7.1.4(b) Setting Items That Can Be Configured after the Detection Setup Is Completed

Item	Description
Detection program	This is the vision process used for detection. When you touch the drop-down box, you can select a created vision process from the list. When you touch “Open”, you can edit the selected vision process. When you touch the “Create” button, you can create a new vision process used for detection.
R Index for number of found	This is the register number for the register which stores the number of workpieces detected in the vision process. When you touch the drop-down box, you can select a register number from the list. The register set in this item is used to create a robot program that uses a conditional branch to check if any workpiece was detected or not (whether the register value is “0” or “1 or above”). For specific usage examples, see “7.3.3 Action for when the workpiece is not detected” and “7.3.4 Performing the work for Multiple workpieces”.
▼ / ▲ button	Shows or hides the detailed setting items of the detection setup.

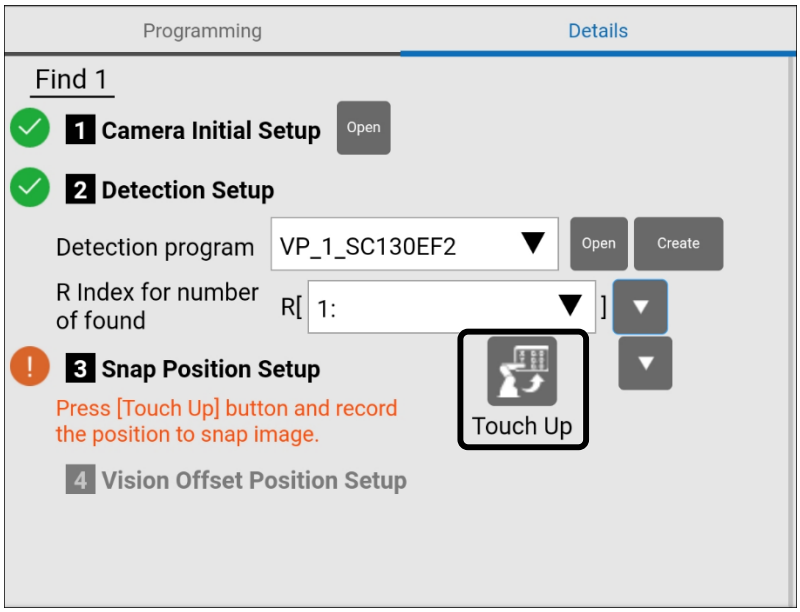
Table 7.1.4(c) Detailed Setting Items

Item	Description
R Index for found result	This is the register number where the detection results of the vision process are stored. You normally do not need to change the automatically set value.

7.1.5 Snap Position Setup

When you finish the camera initial setup and the detection setup and open the Details screen of the “Find” icon, the button of “Snap Position Setup” becomes touchable. Touch and teach the snap position. Normally, set the robot position when the detection setup was completed as the snap position.

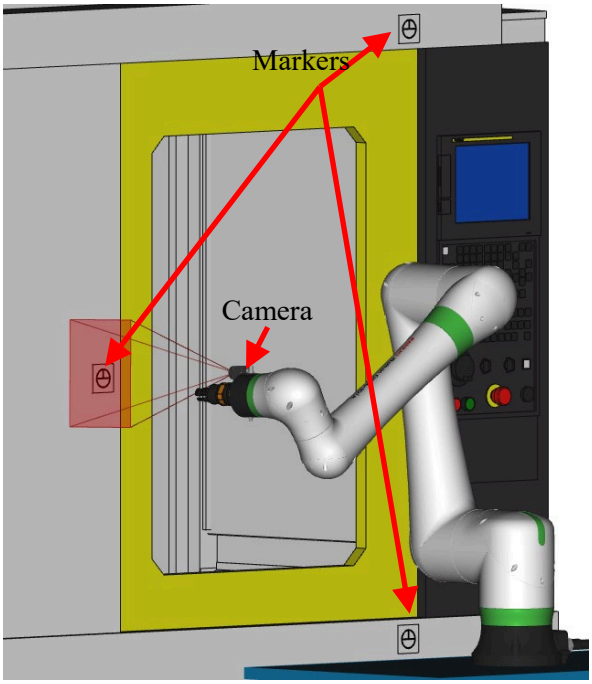
> **⚠ CAUTION**
> If the distance between the workpiece and the camera is changed after you completed the detection settings, the workpiece will not be detected. Do not change the distance between the workpiece and the camera.



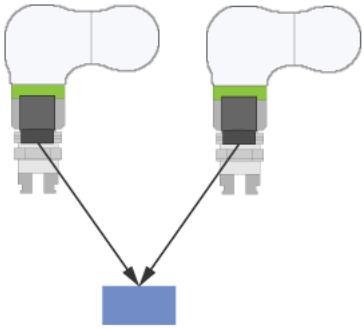
7.2 “3-MARKER RUNTIME OFFSET” ICON

The “3-Marker Runtime Offset” icon is used to offset the positional shift in a work area by snapping each of three markers placed on the work area in stereo and measuring their positions in 3D.

In a scenario where work is performed on machining equipment with a collaborative robot mounted on a cart, by teaching the robot to measure the markers placed in predetermined positions near the work area, the robot’s operation can be offset so that it performs work in the correct position on the machining equipment even if the cart’s position shifts.



Example application of 3-Marker Runtime Offset: Marker placement example



Concept diagram of stereo snapping

> ⚠ **CAUTION**
> “3-Marker Runtime Offset” and the marker measurement performed with the “Find Marker” icon use the 2D camera mounted on the wrist unit of the robot. The 3D vision sensor and the fixed 2D camera cannot be used.

7.2.1 Setup Flow

The setup of the “3-Marker Runtime Offset” icon is performed with the following flow.

1. Selecting and Placing Markers
⇩
2. Adding the “3-Marker Runtime Offset” Icon
⇩
3. “Find Marker” Icon : Camera Initial Setup
⇩
4. “Find Marker” Icon : Detection Setup
⇩
5. “Find Marker” Icon : Snap Position Setup
⇩
6. “3-Marker Runtime Offset” Icon : Output Setup
⇩
7. Teaching Offset Motion

7.2.2 Selecting and Placing Markers

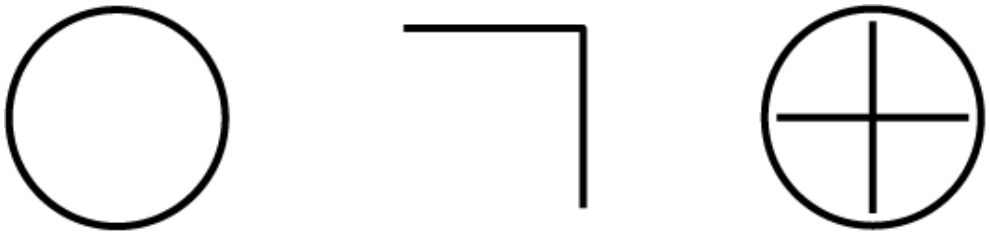
Selecting markers

Specific markers are detected in the processing of the “3-Marker Runtime Offset” icon detects specified markers, therefore, they must can be seen from the camera on the robot. Additionally, the shape of the markers must meet the following conditions.

- The features to be taught are on the same plane.
- The target has a geometry for which any rotation of ±90° or so can be identified. (It is preferable not to be rotationally symmetric as the left shape in “Examples of appropriate marker shape”)
- The target has a geometry whose size can be identified.

Examples of appropriate and inappropriate shapes are shown below.

Examples of appropriate marker shapes



The rotation angle of rotation cannot be identified

The size cannot be identified

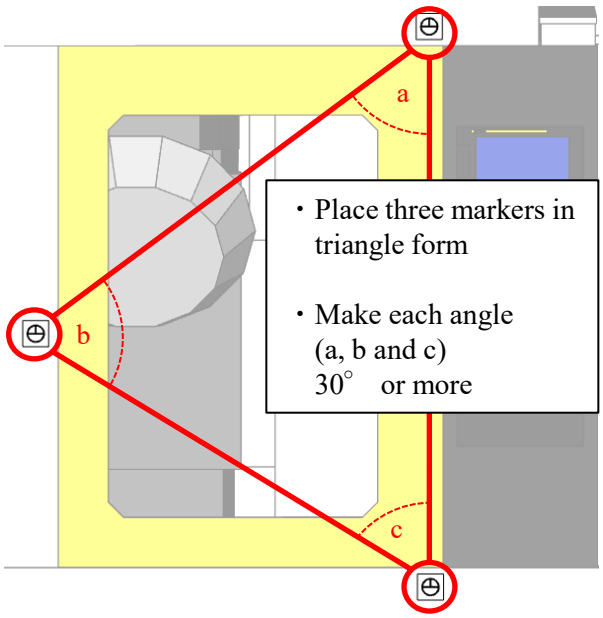
The rotation angle of ±90° cannot be identified

Examples of inappropriate marker shapes

Placing markers

Markers should be placed in the work area in a manner that meets the following conditions.

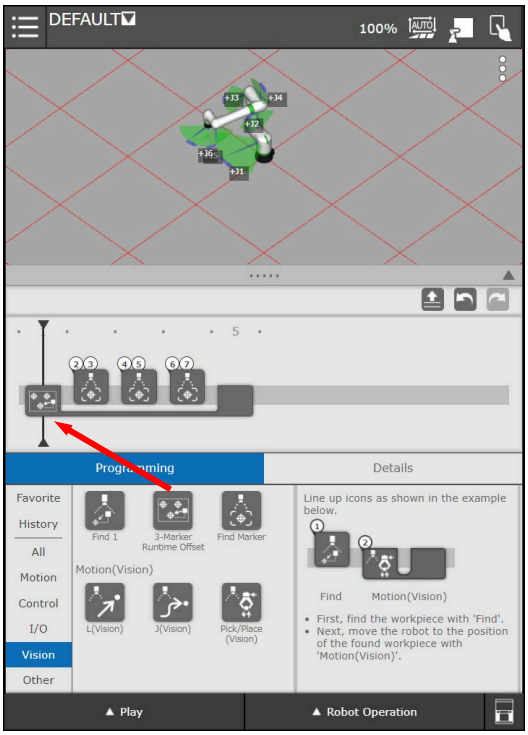
- Markers are placed as far apart from each other as possible.
- All angles of the triangle formed by the three points should be 30° or more; the three markers should not be placed on the same line.



Example of marker placement

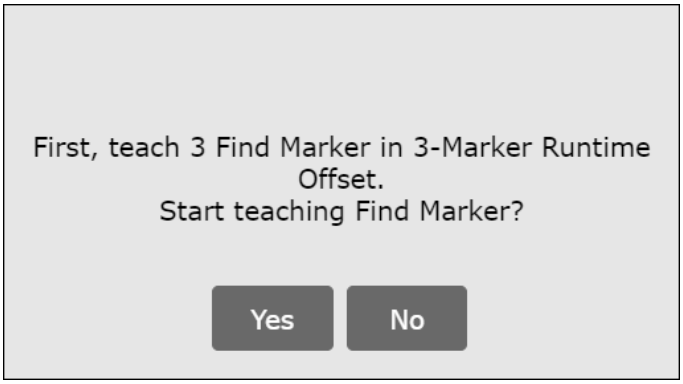
7.2.3 Adding the “3-Marker Runtime Offset” Icon

Add the “3-Marker Runtime Offset” icon to the Program Line.
When the “3-Marker Runtime Offset” icon is added, three “Find Marker” icons are automatically added inside of it.

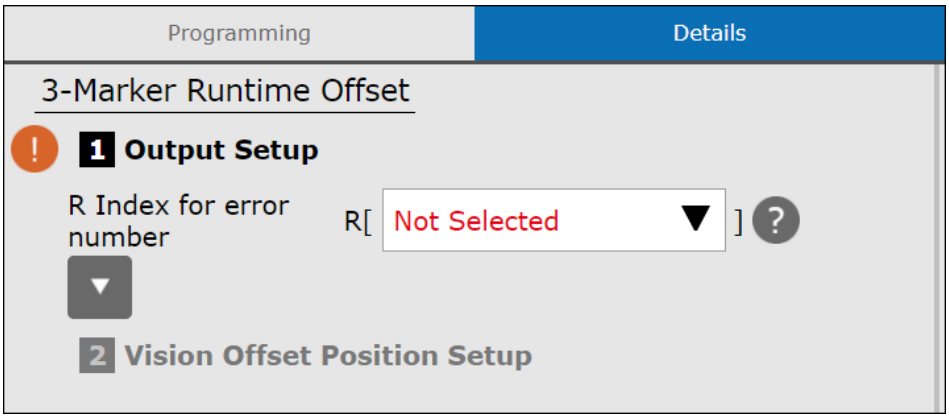


Also, the following popup is displayed when the icon is added. If you touch “Yes”, the details screen of the “Find Marker” icon is displayed. For details about the settings for the “Find Marker” icon, see “7.2.4 “Find Marker” Icon Setup and Teaching”.
If you do not want to open the “Find Marker” icon details screen, touch “No”.

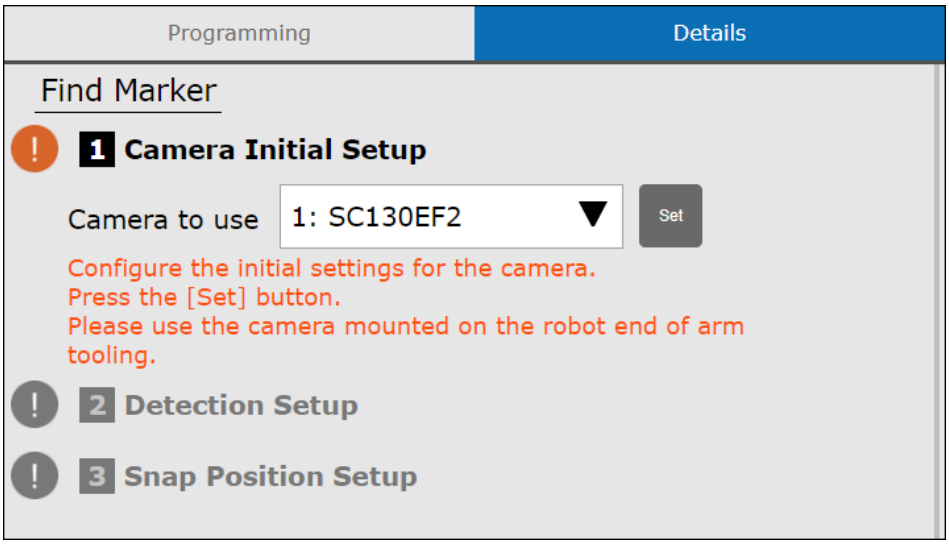
> ⚠ **CAUTION**
> Teach “3-Marker Runtime Offset” and the “Find Marker” icons in each sequential set, and do not teach several sets at the same time.



If you touch an icon on the Program Line, the lower part of the screen switches to the details screen for that icon. Configure the settings in order, starting from the item at the top. The ! mark is displayed on items that have not been set or taught. The ✓ mark is displayed on items that are complete.



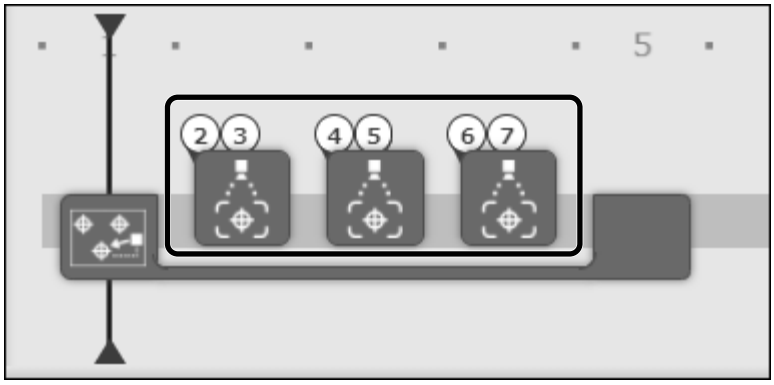
Details screen for 3-Marker Runtime Offset



Details screen for Find Marker

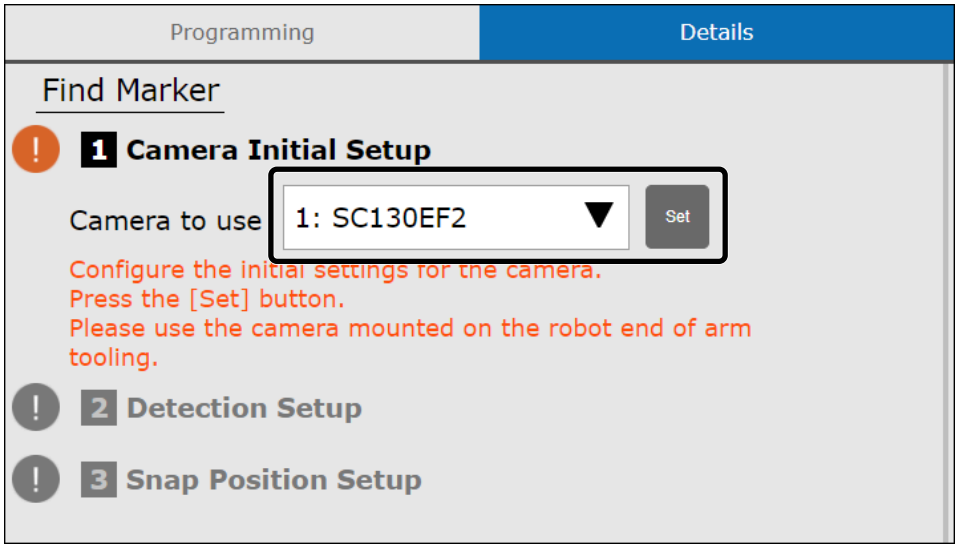
7.2.4 “Find Marker” Icon Setup and Teaching

After adding the “3-Marker Runtime Offset” and touching “Yes” in the displayed popup, setup screen for the “Find Marker” icons is displayed.
“Find Marker” icons can be set by touching the “Find Marker” icon within the “3-Marker Runtime Offset” icon, in the case such that you closed the popup by touching “No”.



7.2.4.1 Camera initial setup

Open the details screen for “Find Marker”, and first perform the initial setup for the camera.
In “Camera to use” under “Camera Initial Setup”, select the camera to use, and then touch the “Set” button.
For the second and subsequent “Find Marker” icons, the same camera data will be used if you select the same camera in “Camera to use”, so you will not need to perform the initial setup again.

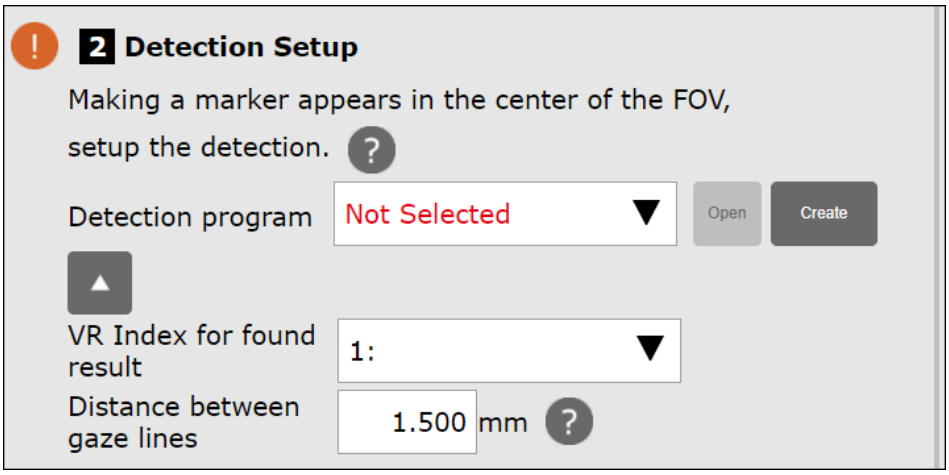


For details about the camera initial setup procedure, see “7.1.3 Camera Initial Setup”.

MEMO
1 If only one 2D camera is connected to the controller, that camera is automatically selected in “Camera to use”.
2 If the camera data for the camera selected in “Camera to use” has already been created, the “Open” button is displayed instead of the “Set” button. Touch this button if, for example, the mounting position of the camera has been changed and the camera data needs to be modified.

7.2.4.2 Detection setup

After you complete the camera initial setup and return to the “Find Marker” details screen, “Detection Setup” can be edited.
In addition to setting up the detection program to use for marker detection, the output destination for detection results and tolerance values for the distance between lines of sight are set up here as necessary.



Setting Items

Table 7.2.5.2 Setting Items for Detection Setup

Item	Description
Detection program	This is the vision process used for detection. When you touch the drop-down box, you can select an existing vision process from the list that uses “Camera to use” in “Camera Initial Setup”. If you touch “Open”, you can edit the vision process selected in the drop-down box. If you touch the “Create” button, you can create a new vision process to use for detection. If there is no vision process that uses “Camera to use” in “Camera Initial Setup”, only the “Create” button is displayed.
▼/▲ button	Show/hide the detailed setting items for detection setup.
VR Index for found result	Specify the vision register where the detection results of the detection program will be output. The default value is 1. Normally, this setting does not need to be changed.
Distance between gaze lines	With the “Find Marker” icon, the marker around the work area are snapped from different left-right positions, but the two gaze lines from each position to the marker do not actually cross perfectly due to slight error. Here, the threshold is set where the gaze lines are considered to be crossing when they reach a certain distance apart. The default value is 1.5. Normally, this setting does not need to be changed.

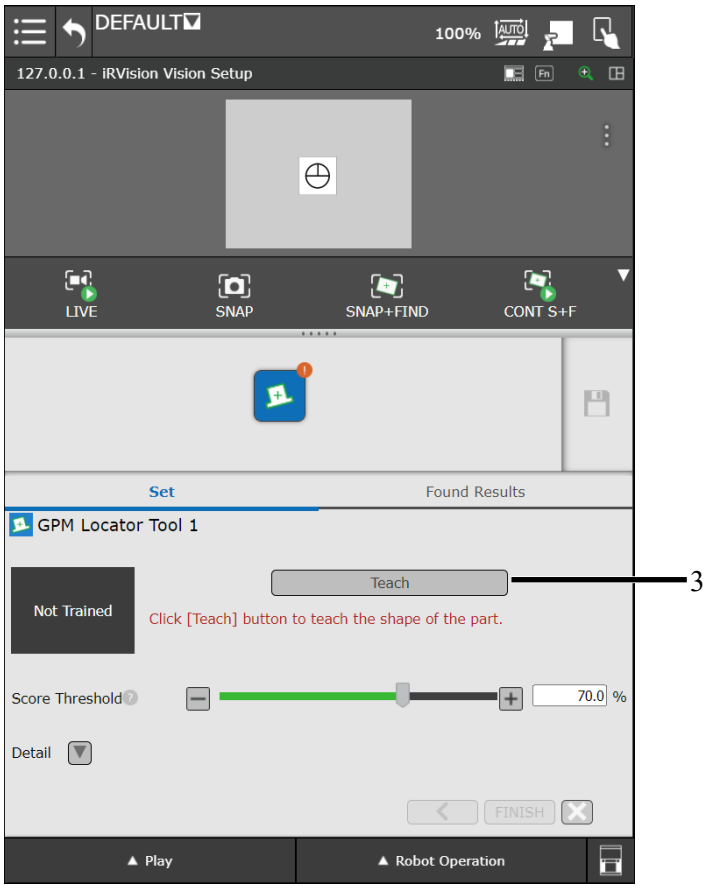
7.2.4.3 Creating the detection program

Create the vision process that will be used to detect the markers.

1 Jog the robot so that a marker placed in the work area is centered in the camera's field of view.
2 In "Detection Setup", touch the "Create" button.

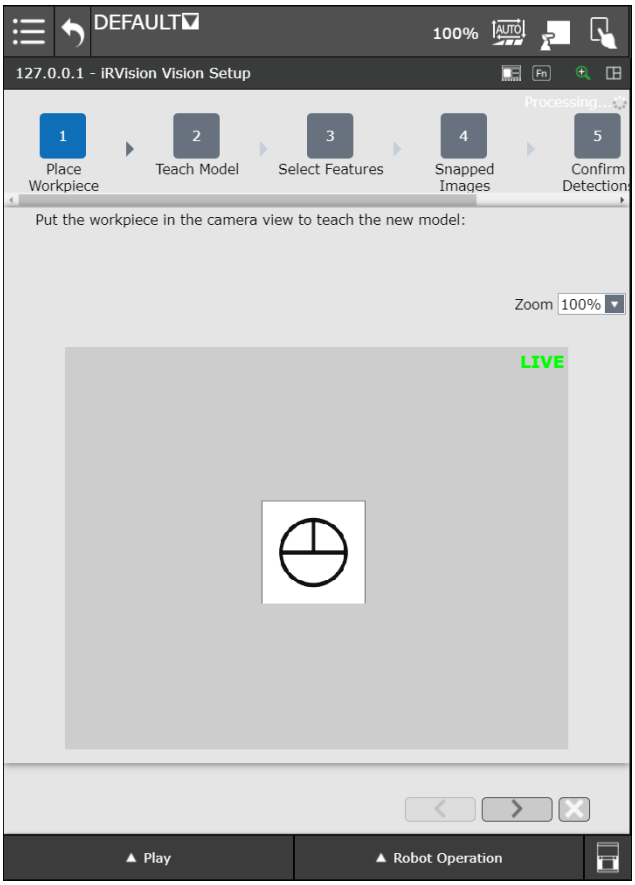
> **MEMO**
> If you want to use an existing vision process to perform detection, select the vision process you want to use from the pull-down list instead of touching the "Create" button. Vision processes that use the camera selected in "Camera to use" in "Camera Initial Setup" are displayed in the pull-down list.
> It is possible to select the same vision process for the second and subsequent "Find Marker" icons as for the first. However, to achieve reliable marker detection, it is recommended that you create and teach a detection program for each of the three "Find Marker" icons.

3 When the GPM Locator Tool settings screen opens, touch the "Teach" button.



4 When the guide opens, teach the marker as the model according to the instructions on the guide.

MEMO
When teaching the model, multiple snapped images of the marker are added. When doing so, detection can be made more stable by adding the following kinds of model images.
1 Use a similar field of view to that which will be used when executing actual marker detection.
2 Snap images of the marker located both at the left and right ends of the field of view.

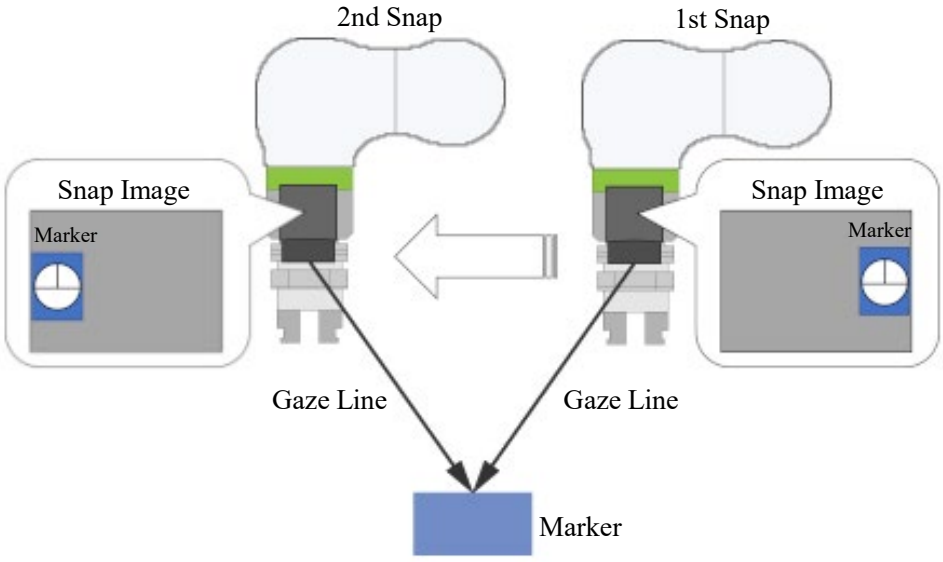


5 When teaching the model is complete, touch the “FINISH” button.

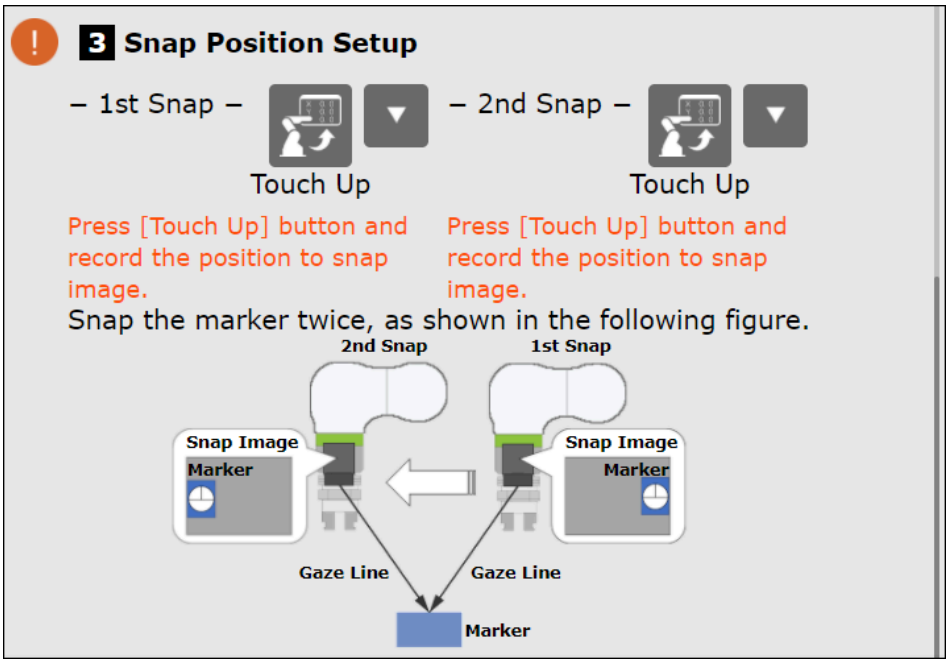
7.2.4.4 Snap position setup

Teach two positions where the marker will be snapped. As shown in the following figure, move and teach the robot so that the marker appears on the right end of the field of view where the first image is snapped (1st Snap) and that it appears on the left end of the field of view for the position where the second image is snapped (2nd Snap).

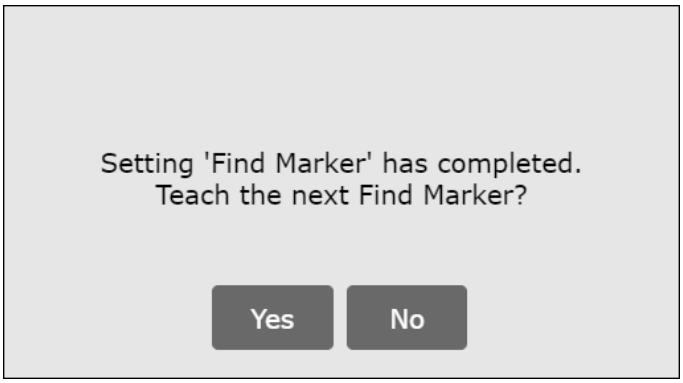
MEMO
When the snap position is memorized, detecting marker and calculating its position are performed, and the reference position of 3-Marker Runtime Offset is set automatically on finishing teaching all three Find Markers.
After teaching the snap position, do not move the robot base or the marker until teaching offset motion is complete.



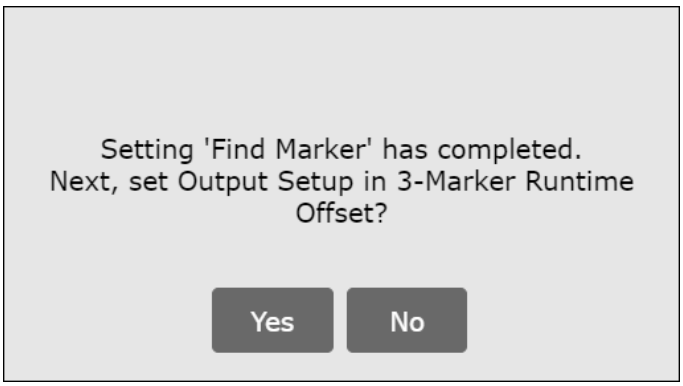
Adjust the position of the robot by looking at the live image of the camera selected in “Camera to use” that is displayed in the lower-right of the robot display area in the editor.



This completes the setup for one of the “Find Marker” icons.
When the snap position teaching is complete, the following popup is displayed. Touch “Yes” to display the details screen for the next “Find Marker” icon. Perform setup and teaching for all three of the “Find Marker” icons.

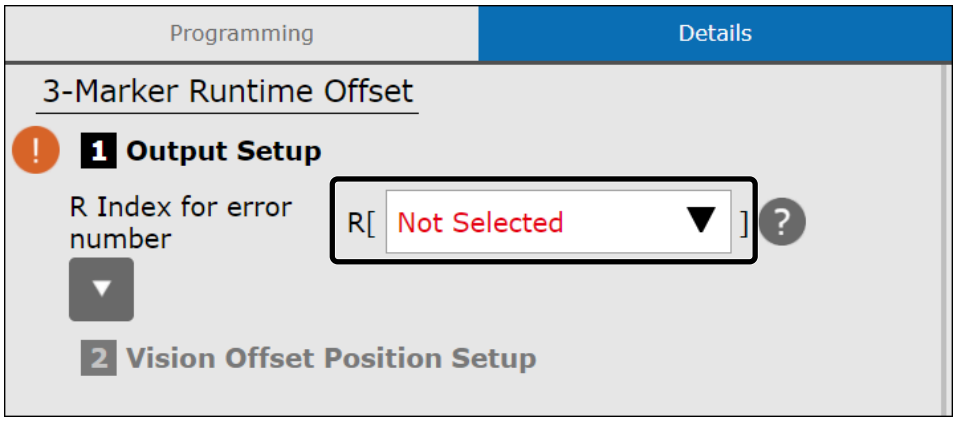


When teaching for the third “Find Marker” icon is complete, the following popup is displayed. Touch “Yes” to continue to the details screen of the “3-Marker Runtime Offset” icon.



7.2.5 Output Setup

On the details screen of the “3-Marker Runtime Offset” icon, specify the register number where error number is output.
If an error occurs while the “3-Marker Runtime Offset” icon or one of the “Find Marker” icons in that icon are executing, the error number will be output to the register specified here.



MEMO

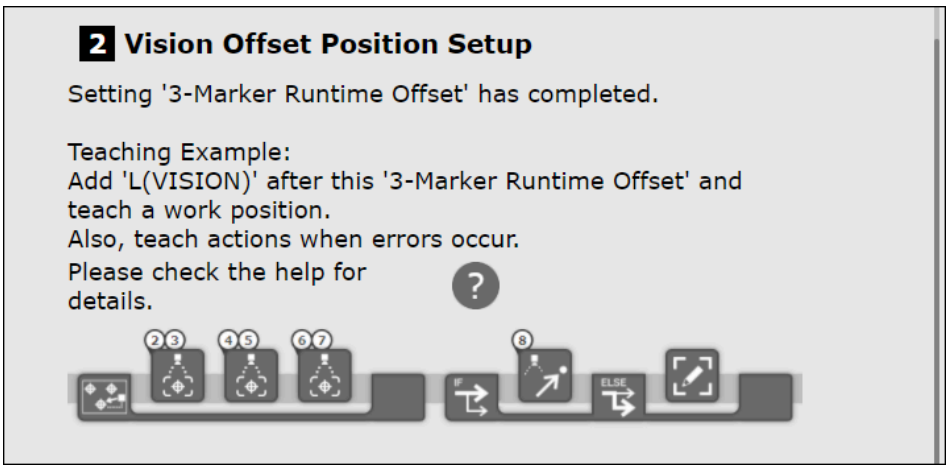
If you touch the "▽" button, the item "VR Index for found result" appears where you can specify the register number where the detection results of 3-Marker Runtime Offset are output. Normally, this setting does not need to be changed from its default value.
If "Use the specified found result" is selected instead of "Use the latest found result" in the settings for the offset operation ("Linear (Vision)", etc.) that is executed after 3-Marker Runtime Offset processing, you must specify the same number as the one specified in "VR Index for found result".

7.2.6 Teaching the Offset Motion

When the teaching of all the "Find Marker" icons and the "3-Marker Runtime Offset" icon is complete, add a motion command icon with vision offset to the Program Line and teach the offset motion.

⚠ CAUTION

Do not move the robot or the markers from the position at the end of teaching of the "3-Marker Runtime Offset" icon (the positional relation between the robot base and the object on which the markers were placed) until teaching the offset motion is complete.
This positional relation is called "reference position".



MEMO

1 In the cases such that the markers' placement is changed, or the offset motion are going to be taught again, the reference position needs to be set again.
If you need to set the reference position again, tap the "▽" button that was displayed after teaching "3-Marker Runtime Offset" icon was completed, and then touch the "Execute" button in "Reset Ref. Pos.". The robot will move, and the reference position will be set again. After that, teach the offset motion again.
However, "Reset Ref. Pos." cannot be executed in any modes other than the CRX Auto mode.

To change the snap positions of the markers (for example, after changing the marker positions, the markers no longer fit in the current field of view of the snap positions), re-teach the snap positions of the Find Markers before executing "Reset Ref. Pos.".

2 If a "3-Marker Runtime Offset" icon is copied, the reference position is shared with the source of copy.

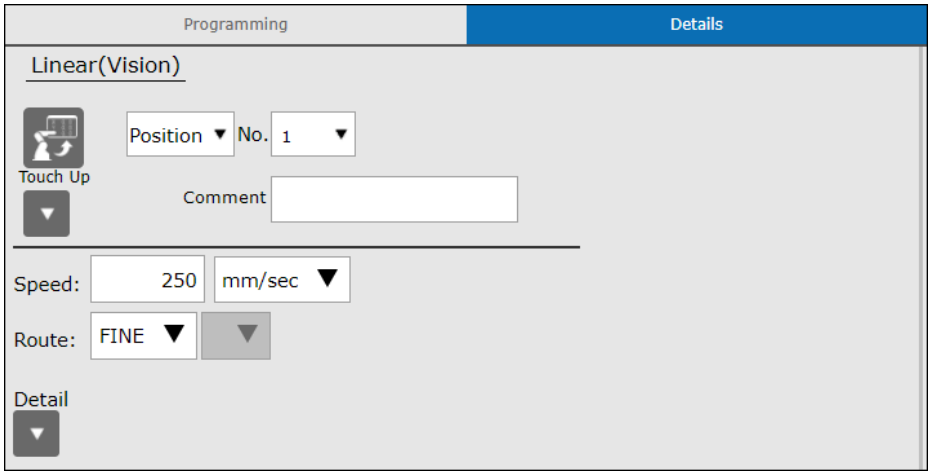
7.3 MOTION COMMAND ICONS WITH VISION OFFSET

To move the robot according to the position detected by vision, you need to teach the robot motion by adding motion command icons with vision offset to the Program Line instead of using normal motion command icons.
The subsequent sections describe the types and functions of motion command icons with vision offset.

7.3.1 Linear (Vision)

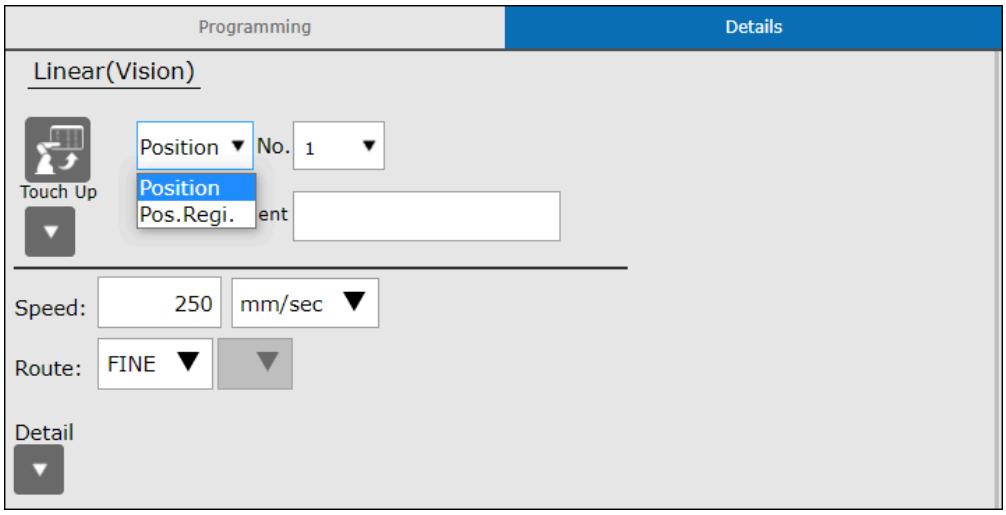
The linear (vision) instruction controls the path of the tool center point (TCP) from a start point to the end point offset by vision.
When teaching the end point, teach the end point with the target object for the vision detection placed in the reference position.

L (Vision) Icon

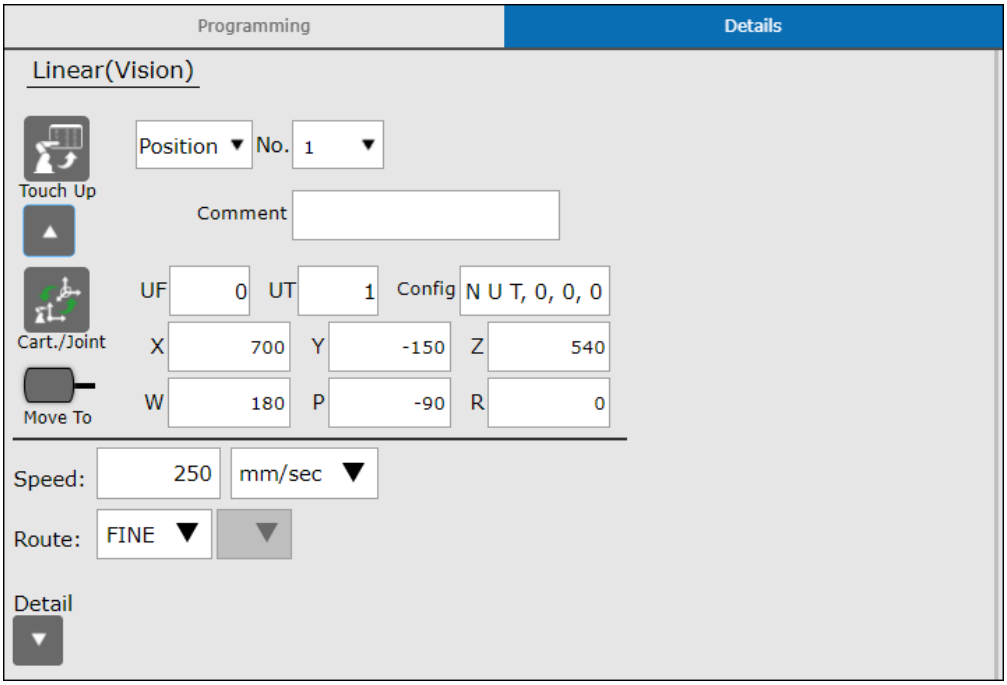


Detail Settings

Touch "▼" in the pull-down list with "Position" displayed to change between position and position register.



Touch the "▽" button under the "Touch Up" button to display the position's numeric data.
Users can directly change the position, orientation, configuration, and coordinate system number.
Touch the "Cart. / Joint" button to switch the format of the displayed position data.



Touch "▽" under "Detail" to display the detailed setting items area. The detailed setting items are as follows.

[Use the latest found result]

Calculates the offset values using the latest vision detection result.
Either this item or "Use the specified found result" can be selected. This item is selected in the default configuration.

[Use the specified found result]

Calculates the offset values using the vision detection result stored in the specified vision register number.
When this item is selected, a pull-down list is displayed to select the vision register number.
For this method, you need to use the vision-detection processing icon to specify the vision register numbers in which detection results are stored.
Either this item or "Use the latest found result" can be selected.

[Additional motion]

Specify additional motion instructions for robot motion. Touch "▼" next to the text box to display a pull-down list to select the additional motion instructions. The selected additional motion instructions will be displayed in the text box.
Touch the "+" / "-" button to increase/decrease the number of additional motion instructions.
In the default configuration, there is one additional motion instruction field with no settings.

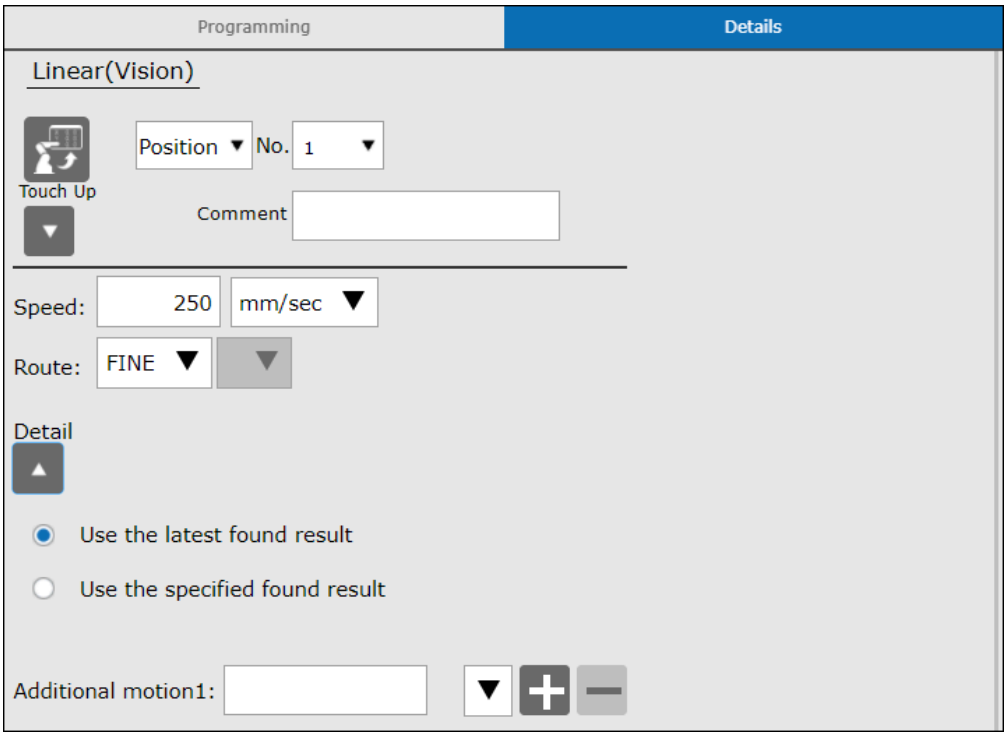


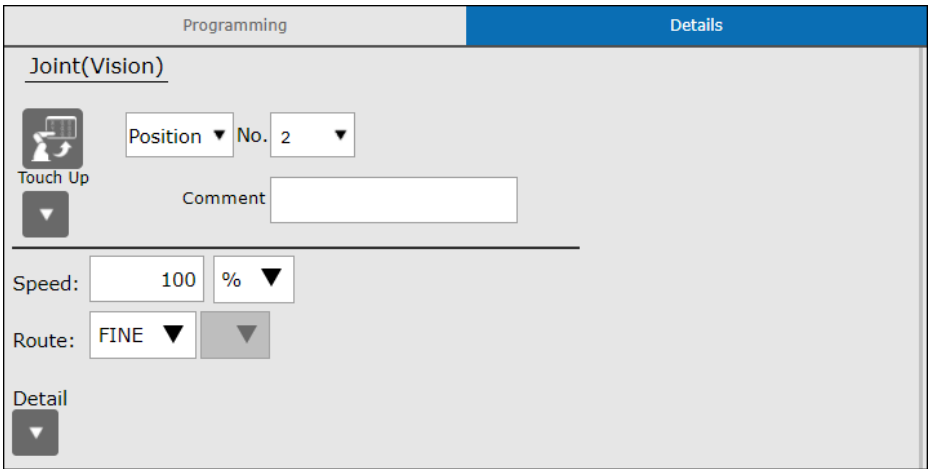
Table 7.3.1 Buttons for Detail Settings for Linear (Vision)

Button	Description
Touch Up	Teach the current position.
Move To	The robot moves to the taught position while the bar is slide to the right. To move the robot, turn on the TP enable key in the status bar.
Cart./Joint	The format of the displayed position data can be switched between Cartesian and Joint.
/	Shows or hides the position data and "Detail" area.

7.3.2 Joint (Vision)

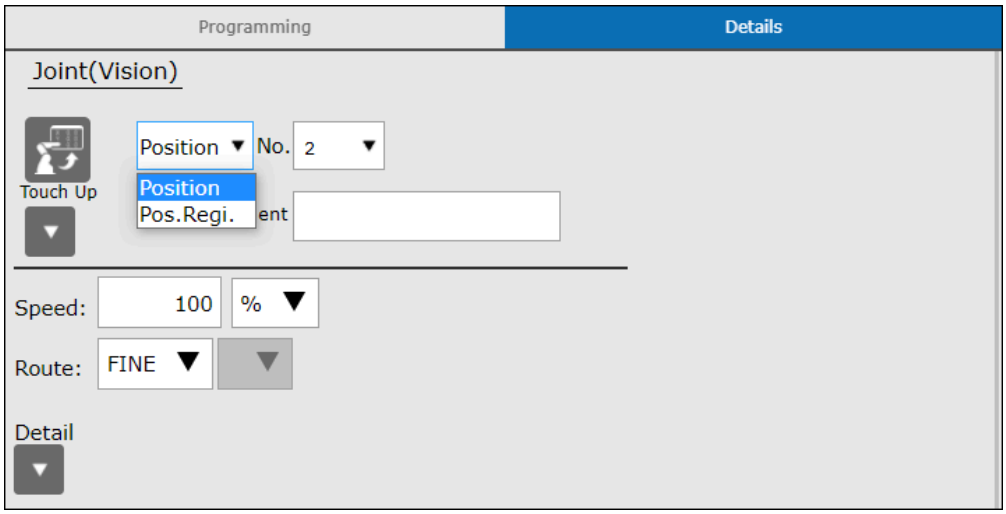
The joint (vision) instruction is the basic instruction for moving the robot to the position offset by vision. With the joint motion instruction, the tool center point (TCP) normally moves non-linearly.
When teaching the position, teach the position with the target object for the vision detection placed in the reference position.

J (Vision) Icon

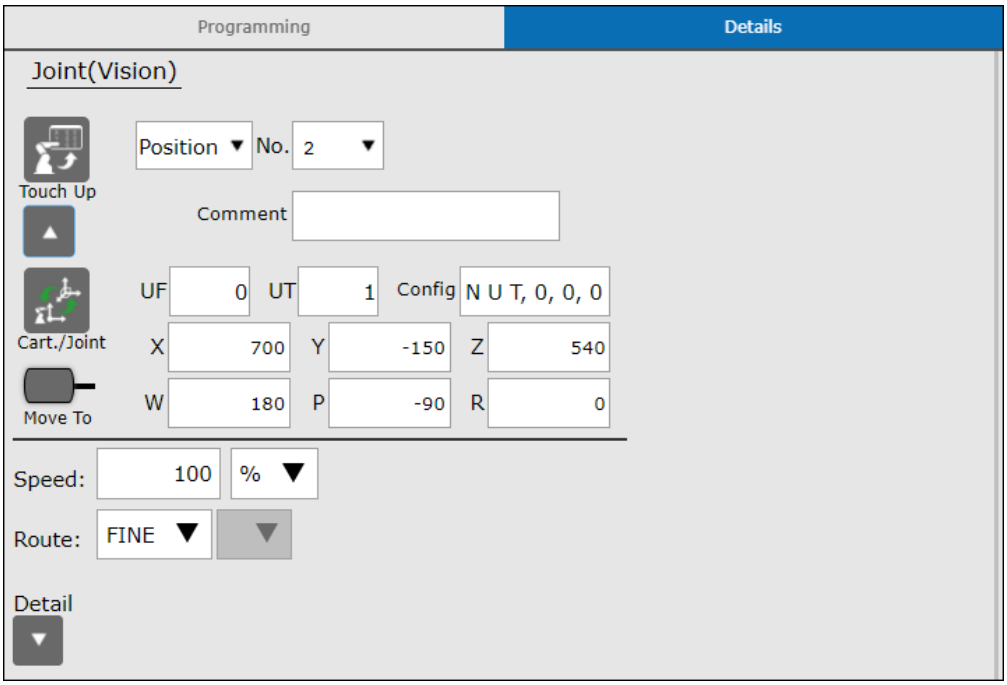


Detail Settings

Touch "▼" in the pull-down list with "Position" displayed to change between position and position register.



Touch the "▽" button under the "Touch Up" button to display the position's numeric data.
Users can directly change the position, orientation, configuration, and coordinate system number. Touch the "Cart. / Joint" button to switch the format of the displayed position data.



Touch "▽" under "Detail" to display the detailed setting items area.

[Use the latest found result]

Calculates the offset values using the latest vision detection result.
Either this item or "Use the specified found result" can be selected. This item is selected in the default configuration.

[Use the specified found result]

Calculates the offset values using the vision detection result stored in the specified vision register number.
When this item is selected, a pull-down list is displayed to select the vision register number.
For this method, you need to use the vision-detection processing icon to specify the vision register numbers in which detection results are stored.
Either this item or "Use the latest found result" can be selected.

[Additional motion]

Specify additional motion instructions for robot motion. Touch "▼" next to the text box to display a pull-down list to select the additional motion instructions. The selected additional motion instructions will be displayed in the text box.
Touch the "+" / "-" button to increase/decrease the number of additional motion instructions.
In the default configuration, there is one additional motion instruction field with no settings.

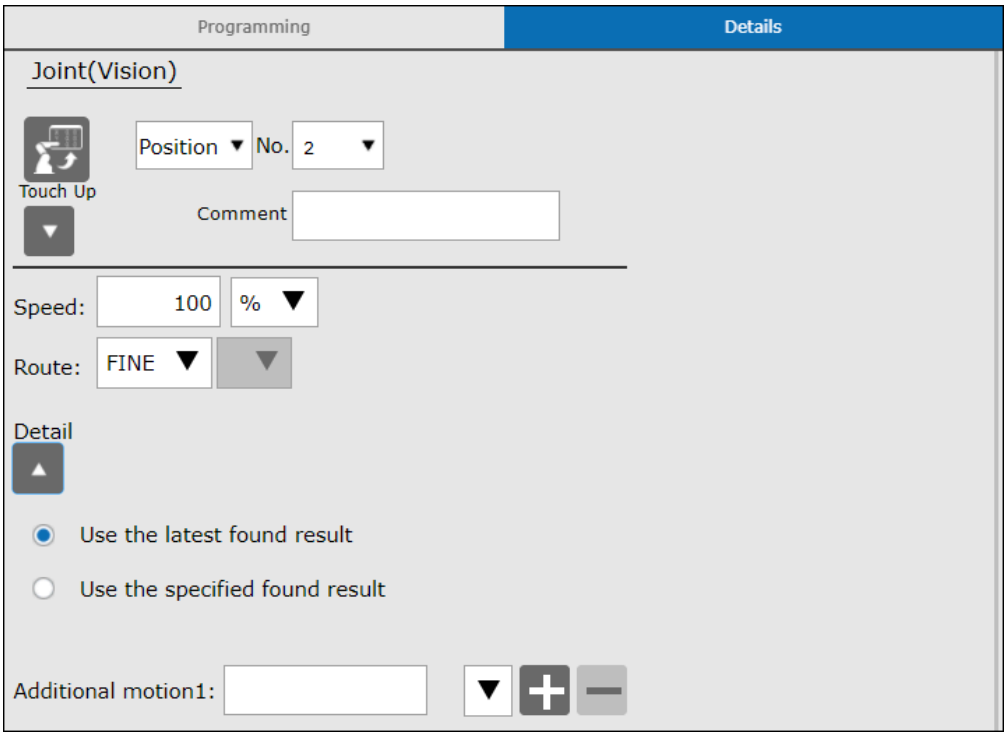


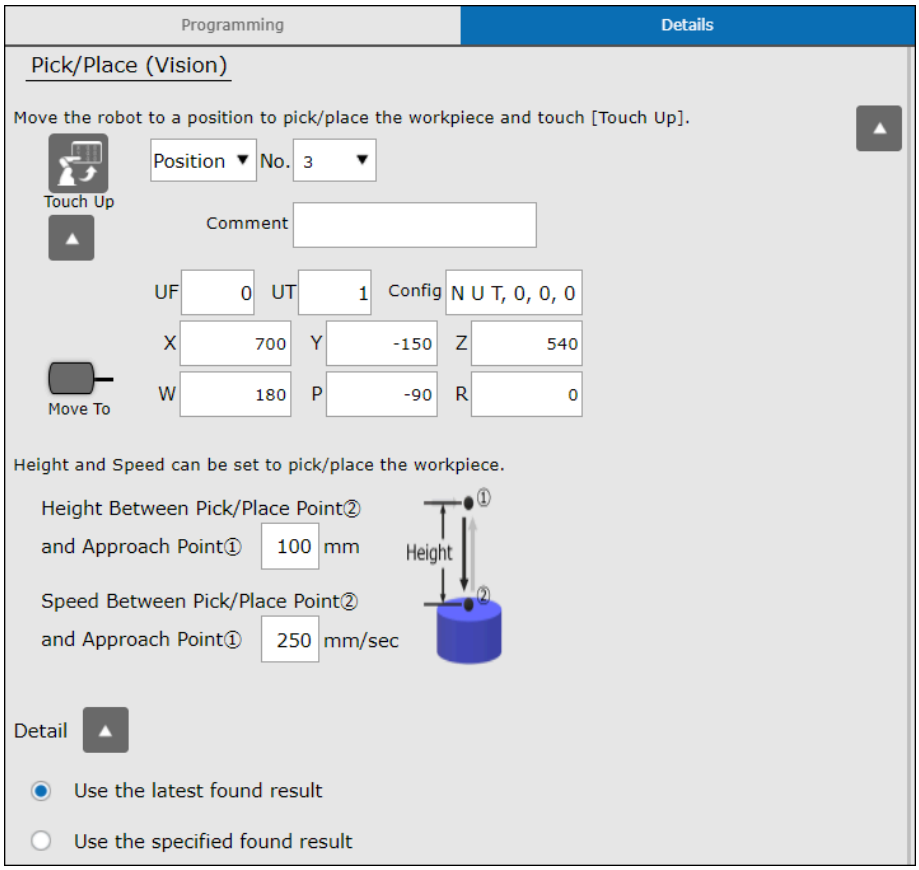
Table 7.3.2 Buttons for Detail Settings for Joint (Vision)

Button	Description
	Teach the current position.
	The robot moves to the taught position while the bar is slide to the right. To move the robot, turn on the TP enable key in the status bar.
	The format of the displayed position data can be switched between Cartesian and Joint.
	Shows or hides the position data and “Detail” area.

7.3.3 Pick/Place (Vision)

The pick/place instruction is used to pick and place the workpiece detected by vision.
Add the hand open/close instructions inside the bracket to pick and place the workpiece.
When teaching the positions where the workpiece is picked up and placed down, teach the positions with the workpiece placed in the reference position.

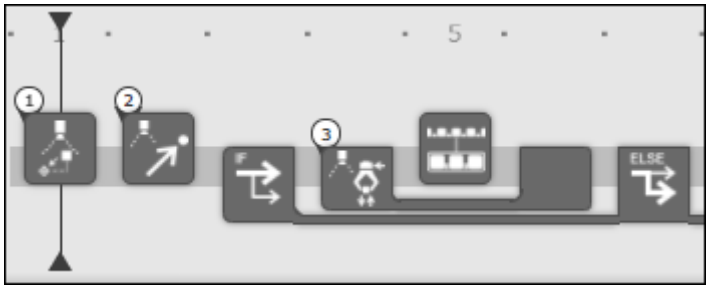
Pick/Place Icon



Detail Settings

In the detail settings, users should apply the following settings:
· Position: Users should teach the positions to pick and place.
· Height[mm]: Users should set the height when moving to and away from the taught position.
· Speed[mm/sec]: Users should set the speed when moving to and away from the taught position.

An example using the pick/place (vision) instruction is shown in the figure below.
At the start of the bracket, the robot will move to the taught position defined in the detail settings. At the end of the bracket, the robot will move to the height defined in the detail settings.



7.4 EXAMPLES OF TEACHING VISION OFFSET MOTION

The subsequent sections describe the typical program components and creation methods using the “Find” icon and motion command icons with vision offset.

> **⚠ CAUTION**
> Do not move the workpiece from the reference position until the teaching process is complete. The reference position for each icon is as follows.
> - “Find” icon
>   The position of the workpiece when the reference position is taught in the offset data calculation tool
> - “3-Marker Runtime Offset” icon
>   The positional relation between the robot base and the object on which the markers were placed when setting up the icon was completed

7.4.1 Teaching the Motion for the Workpiece Detected by Vision

After setting the “Find” icon, teach the robot motion for the workpiece detected by vision.

Example of an icon layout on the Program Line:

1 Move the robot to a position where the actual work is performed for the workpiece.

2 Add the  “L(VISION)” icon right after the  “Find” icon on the Program Line.

3 Touch the  icon on the Program Line to open the setting screen.
To change the position, move the robot to a new position and touch “Touch Up”.

> **MEMO**
> If you want to correct the robot’s operation based on the marker positions detected by the “3-Marker Runtime Offset” icon, read “‘Find’ icon” in the above procedure as “‘3-Marker Runtime Offset’ icon”, and perform teaching.

7.4.2 Teaching the Grabbing Motion for the Workpiece Detected by Vision

The “Pick/Place (Vision)” icon allows you to easily teach the picking motion for the workpiece detected by vision.

Example of an icon layout on the Program Line:

1 Move the robot to the position for picking the workpiece (the Pick Position).

2 Add the  “Pick/Place (Vision)” icon to the Program Line.
This icon creates a U-shaped area (“bracket”) on the Program Line.

3 Touch the  icon on the Program Line to open the setting screen.
To change the position, move the robot to a new position and touch “Touch Up”.

4 Add the  icon to open/close the arm tooling inside the bracket created by the  icon.

7.4.3 Action for when the Workpiece is / is not Detected

Use the following procedure to add actions for when the workpiece is or is not detected.

Example of an icon layout on the Program Line:

1 Touch the  “Find” icon to open the setting screen. Note the numeric register number selected for “R Index for number of found” in “2 Detection Setup”. This will be used in Step 3 below.

2 Add the  “IF” icon right after the  icon.

3 Touch the  icon to open the setting screen and set the condition when the workpiece is detected. When a workpiece is detected, the numeric register from Step 1 above will have a value of 1 or greater.

4 In the bracketed area following the  icon, add the action for the case when the workpiece is detected. See the box marked “a” in the figure above.

5 In the bracketed area following the  icon, add the action for the case when the workpiece is not detected. See the box marked “b” in the figure above.

MEMO

The processing for when an error occurs with the “3-Marker Runtime Offset” icon can be taught with a procedure like the one above.
Since motion does not stop with an alarm when an error occurs during “3-Marker Runtime Offset” icon processing, error processing needs to be taught. Pay attention to the following differences when teaching.

1 Read “‘Find” in the above procedure as “‘3-Marker Runtime Offset’ icon”.
2 In step 1, note the register number in “R Index of error number” in “1 Output Setup” on the settings screen of the “3-Marker Runtime Offset” icon.
3 In step 3, set the condition when marker offset is successful (the register set in “R Index for error number” will have a value of 0).

In error processing for the “3-Marker Runtime Offset” icon, it is possible to change the processing according to the type of error. For example, processing for when a marker cannot be detected can be added as follows.

4 Add the IF icon to the b part in the figure above.
5 Set the condition for when a marker is not detected (the register set in “R Index for error number” has a value of 1413).
6 Add actions in the bracketed area following the IF icon and in the bracketed area following the ELSE icon.

7.4.4 Performing the Work for Multiple Workpieces

Use the following procedure to perform the work for multiple workpieces, such as removing all workpieces.

Example of an icon layout on the Program Line:

1 Add the “LABEL” icon right before the “Find” icon on the Program Line.
2 Touch the icon on the Program Line to open the setting screen and set the label number.
3 Touch the icon to open the setting screen. Note the numeric register number selected for “R Index for number of found” for “2 Detection Setup”. This will be used in Step 5 below.
4 Add the “IF” icon right after the icon on the Program Line.
5 Touch the icon to open the setting screen and set the condition when the workpiece is detected. When a workpiece is detected, the numeric register from Step 3 above will have a value of 1 or greater.
6 In the bracketed area following the icon, add the action for the case when the workpiece is detected. Then add the “JUMP” icon. See the box marked “a” in the figure above.

7 Touch the  icon to open the setting screen and set the operation to jump to the label set in procedure 2.

8 In the bracketed area following the  icon, add the action for the case when the workpiece is not detected. See the box marked “b” in the figure above.

8 FORCE CONTROL FUNCTION

You can use the force control function on the tablet UI and this chapter describes how to use it. Only the CRX supports “Force Control” icon.

For the overview and details of the force control function, see “Force Sensor OPERATOR'S MANUAL B-83934EN”.

8.1 APPLICATIONS THAT CAN BE CREATED WITH THE FORCE CONTROL ICON

The command icons located on the “ForceCtrl” tab can be used to create the following applications.

- “Force.Push” icon: Constant force push function
- “Force.Insert” icon: Insert function
- “Force.FaceMatch” icon: Face match function
- “Force.PhaseMatch” icon: Phase match function

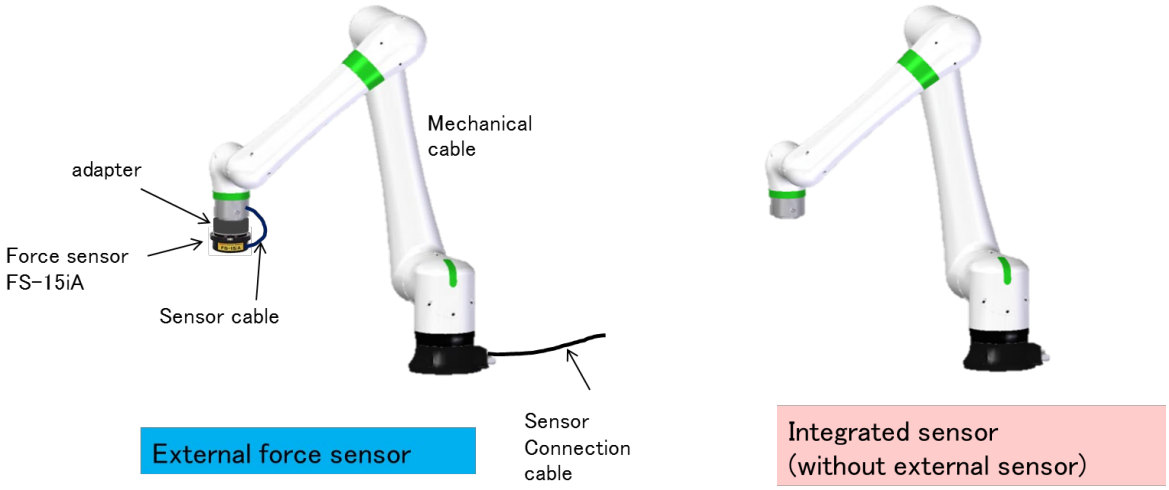
Table 8.1 Force control icons

Item	Description
	“Force.Push” icon Use this icon to execute the constant force push function.
	“Force.Insert” icon Use this icon to execute the insert function.
	“Force.FaceMatch” icon Use this icon to execute the face match function.
	“Force.PhaseMatch” icon Use this icon to execute the phase match function.

8.2 HOW TO USE FORCE CONTROL

The “Force Control” icon enables pushing with constant force by a robot.

With the CRX series, there are 2 methods of using force control: using the external force sensor as shown in the figure at left, and using the integrated sensor as shown in the figure at right.



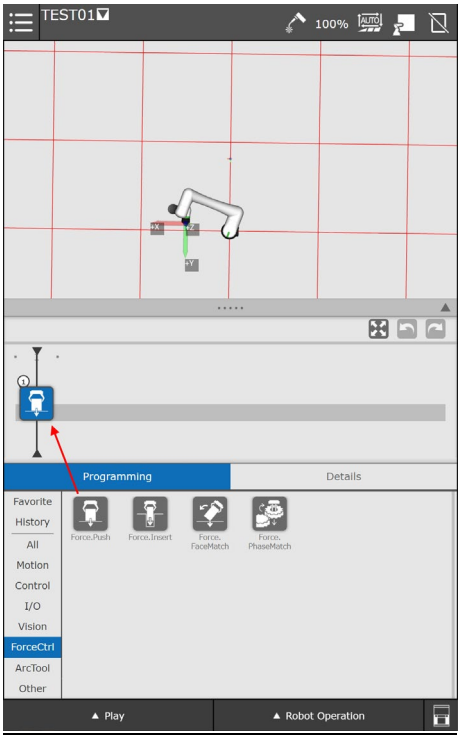
MEMO
The insert function and face match function support only the “External Force Sensor” method.

Following the steps below for setting.

1. Add the “Force Control” icon (8.3).
2. Set the parameters on the “Force Control” settings screens.
   - Set the parameters on the “Force.Push” settings screen (8.4).
   - Set the parameters on the “Force.Insert” settings screen (8.5).
   - Set the parameters on the “Force.FaceMatch” settings screen (8.6).
   - Set the parameters on the “Force.PhaseMatch” settings screen (8.7).

8.3 ADD THE “Force Control” ICON

Select the icon displayed in the “ForceCtrl” tab of the icon palette and add it to the timeline.



8.4 “FORCE.PUSH” SETTINGS SCREEN

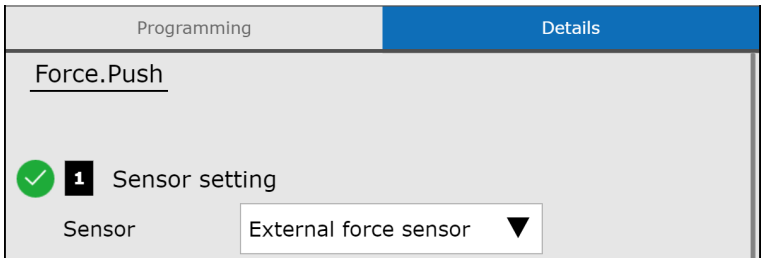
Touching the “Force.Push” icon in the timeline changes the bottom of the screen to display the details of the “Force Push” icon. Configure the settings in order starting from the top. The mark is displayed for items that have not yet been set or taught. The mark is displayed for items that have been completed. When the mark remains, the items below that item cannot be set.

Set in the following order.

1. Sensor setting
2. Push start position
3. Push direction setting or Force control coordinate setting
4. Push settings
5. Automatic tuning
6. Push test

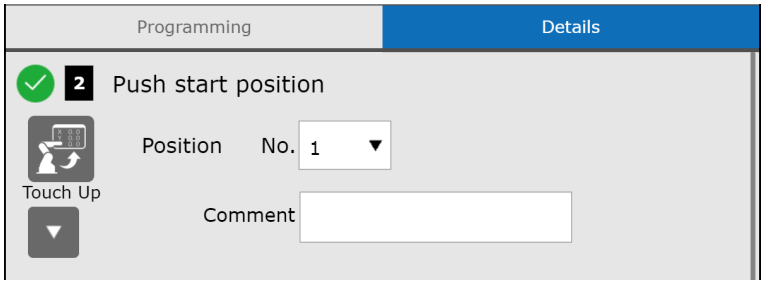
8.4.1 Sensor Setting

If an external force sensor is connected, both “External force sensor” and “Integrated sensor” can be selected. “External force sensor” is selected by default, and the mark is displayed next to it.
If an external force sensor is not connected, it is set as “Integrated sensor” from the beginning and the mark is displayed. In this case, the setting cannot be changed.



8.4.2 Push Start Position

Move the robot by jog operation or manual guided teach to a position where the pushing is executed. Initially, the robot position at the time when the icon was dropped into the timeline is recorded, and the mark is displayed next to it.
The position number and a comment can be input here.
Pressing the “▼” button displays the detailed settings for position information, allowing them to be checked or edited. It is also possible to move the robot to that position.



MEMO
When the “Force.Push” icon is executed, the robot moves to this position then the force control is executed.

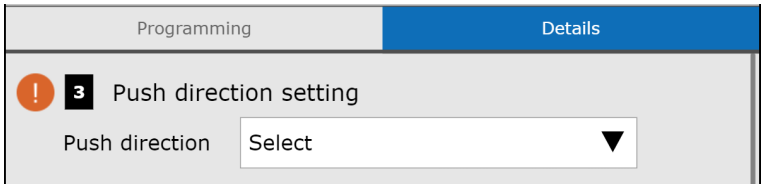
8.4.3 Push Direction Setting or Force Control Coordinate Setting

The setting contents in this subsection differ depending on whether “External force sensor” is selected or “Integrated sensor” is selected in the “Sensor setting”.
In case of “External force sensor”, push direction is set. In case of “Integrated sensor”, force control coordinate is set.
The mark is displayed after setting.

(1) External force sensor

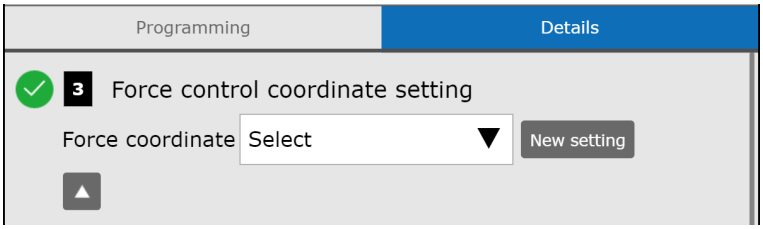
The robot’s push direction is set in here. Select “Perpendicular to the flange face” or “Not perpendicular to the flange face”.

If “Perpendicular to the flange face” is selected, the robot pushes in the direction that is perpendicular to the flange face (+z of a mechanical interface coordinate). Push direction setting is complete.
If “Not perpendicular to the flange face” is selected, set a force control coordinate first. Select one of already set force control coordinates or set new one. Select one of already set force control coordinates or set new one. Refer to “8.8 FORCE CONTROL COORDINATE SETTING” on how to newly set a coordinate.



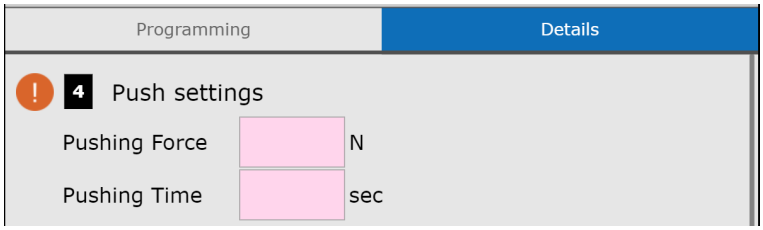
(2) Integrated sensor

Set the force control coordinate. Select one of already set force control coordinates or set new one. Refer to “8.8 FORCE CONTROL COORDINATE SETTING” on how to newly set a coordinate.
Pressing the “▼” button located under “Force coordinate” displays the detailed settings for the force control coordinate, allowing them to be checked or edited.
Pressing the “Delete” button deletes the set contents.



8.4.4 Push Settings

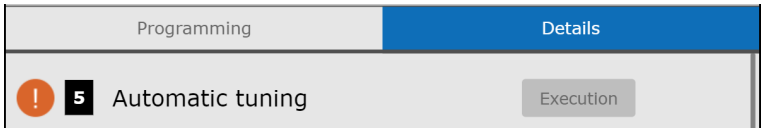
Set “Pushing Force” and “Pushing Time” of force control. As there is no value at the beginning, input appropriate values here. After the “Pushing Time” has elapsed since the force control began, the force control finishes.
The mark is displayed when suitable values are set for both “Pushing Force” and “Pushing Time”.
A pop-up message appears when an unsuitable value is entered.



MEMO
As the “Contact Stop function” is enabled for the CRX, the actual push force will be limited to the value that does not stop the robot.

8.4.5 Automatic Tuning

An automatic tuning is done for an appropriate force control motion. If the “Execution” button is touched, the robot actually pushes on a workpiece about 3 to 10 times. The mark is displayed after normal finish.
The “Execution” button is enabled when the push settings in the previous section have been completed.

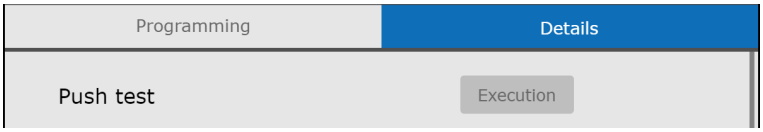


While automatic tuning is in progress, a progress bar is displayed in a pop-up window. When the progress bar reaches the end, a pop-up window appears with the message “Automatic tuning completed”. While automatic tuning is in progress, it is possible to select “Cancel” in the pop-up window.
If automatic tuning failed, a pop-up window appears with the message “Failed”.

MEMO
A pop-up screen for caution appears before the robot moves.

8.4.6 Push Test

Perform a test to confirm that force control operates correctly. If the “Execution” button is touched, the robot performs actual test operation. The “Execution” button is enabled when automatic tuning has been completed.



While the test is in progress, a pop-up window is displayed. When the test is completed, a pop-up window appears with the message “Execution completed”.
If test execution failed, a pop-up window appears with the message “Failed”.

8.5 "FORCE.INSERT" SETTINGS SCREEN

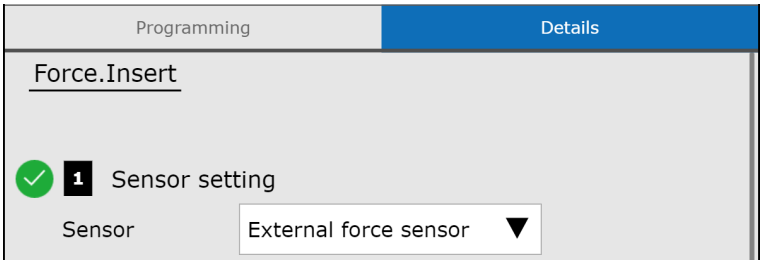
Touching the "Force.Insert" icon in the timeline changes the bottom of the screen to display the details of the "Force Insert" icon. Configure the settings in order starting from the top. The mark is displayed for items that have not yet been set or taught. The mark is displayed for items that have been completed. When the mark remains, the items below that item cannot be set.

Set in the following order.

1. Sensor setting
2. Insert start position
3. Force control coordinate setting
4. Insert settings
5. Automatic tuning
6. Insert test

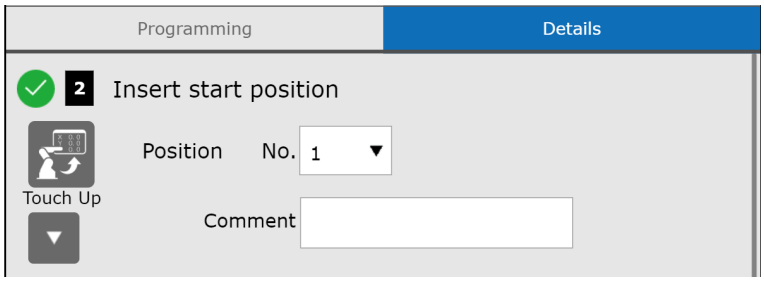
8.5.1 Sensor Setting

"Force.Insert" supports only "External force sensor", and the mark is displayed next to it. In this case, the setting cannot be changed.



8.5.2 Insert Start Position

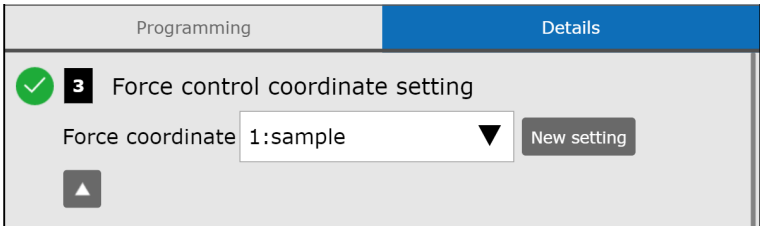
Use manual guided teaching or jog operation to move the robot to the position where insert will be executed. When the "Touch Up" button is touched, that position is recorded and the mark is displayed.
The position number and a comment can be input here.
Pressing the "▼" button displays the detailed settings for position information, allowing them to be checked or edited. It is also possible to move the robot to that position.



MEMO
To execute the "Force.Insert" icon, first move the robot to that position and then execute Force Control.

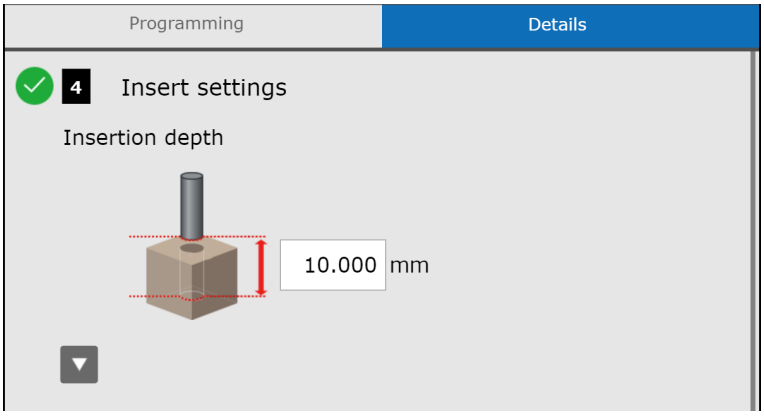
8.5.3 Force Control Coordinate Setting

Set the force control coordinate. Select one of already set force control coordinates or set new one.
The mark is displayed after setting.
Refer to “8.8 FORCE CONTROL COORDINATE SETTING” on how to newly set a coordinate.
Pressing the “▼” button located under “Force coordinate” displays the detailed settings for the force control coordinate, allowing them to be checked or edited.
Pressing the “Delete” button deletes the set contents.



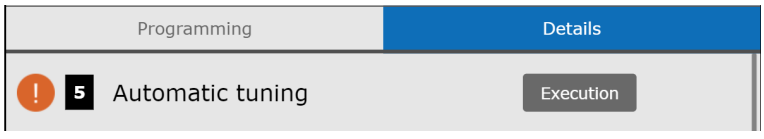
8.5.4 Insert Settings

Set the force control insert depth. As there is no value at the beginning, input appropriate values here.
The mark is displayed when a suitable value is set for “Insertion depth”.
Pressing the “▼” button located below “Insertion depth” allows “Automatic Pull-out”, “Result Output Register No.”, and “Retry count” to be set. These settings may be omitted.



8.5.5 Automatic Tuning

An automatic tuning is done for an appropriate force control motion. If the “Execution” button is touched, the robot performs actual insert operation 3 to 10 times. The mark is displayed after normal finish.
The “Execution” button is enabled when the insert settings in the previous section have been completed.

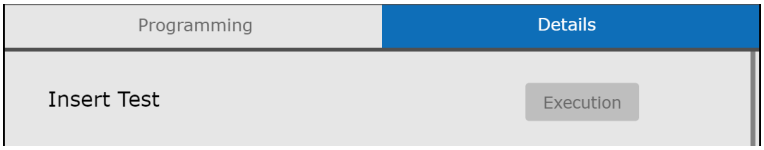


While automatic tuning is in progress, a progress bar is displayed in a pop-up window. When the progress bar reaches the end, a pop-up window appears with the message “Automatic tuning completed”. While automatic tuning is in progress, it is possible to select “Cancel” in the pop-up window.
If automatic tuning failed, a pop-up window appears with the message “Failed”.

MEMO
A warning pop-up window appears before the robot moves.

8.5.6 Insert Test

Perform a test to confirm that Force Control operates correctly. If the “Execution” button is touched, the robot performs actual test operation. The “Execution” button is enabled when automatic tuning has been completed.



While the test is in progress, a pop-up window is displayed. When the test is completed, a pop-up window appears with the message “Execution completed”.
If test execution failed, a pop-up window appears with the message “Failed”.

8.6 “FORCE.FACEMATCH” SETTINGS SCREEN

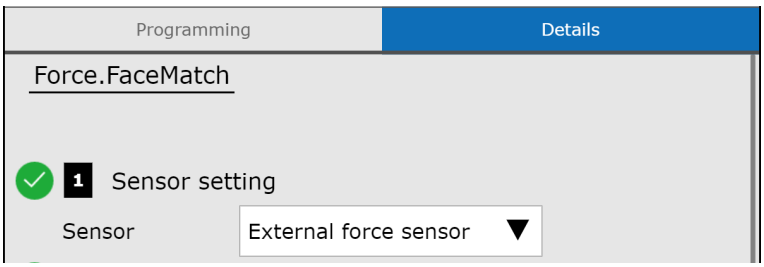
Touching the “Force.FaceMatch” icon in the timeline changes the bottom of the screen to display the details of the “Force.FaceMatch” icon. Configure the settings in order starting from the top. The ! mark is displayed for items that have not been set or taught. The ✓ mark is displayed for items that have been completed. When the ! mark remains, the items below that item cannot be set.

Set in the following order.

1. Sensor setting
2. Face matching start position
3. Force control coordinate setting
4. Automatic tuning
5. Face matching test

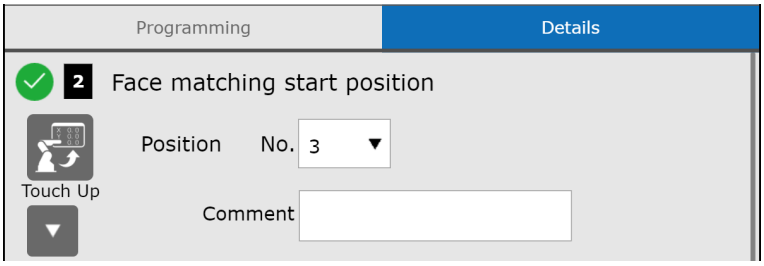
8.6.1 Sensor Setting

“Force.FaceMatch” supports only “External force sensor”, and the ✓ mark is displayed next to it. In this case, the setting cannot be changed.



8.6.2 Face Matching Start Position

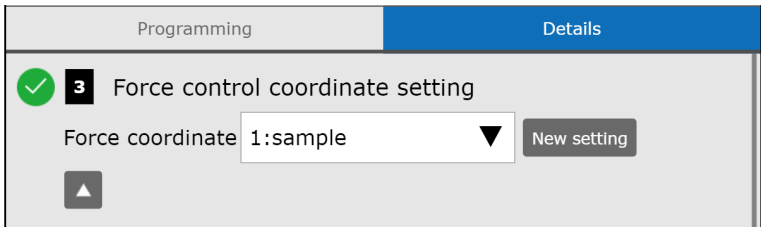
Use manual guided teaching or jog operation to move the robot to the position where face match will be executed. When the “Touch Up” button is touched, that position is recorded and the mark is displayed.
The position number and a comment can be input here.
Pressing the “▼” button displays the detailed settings for position information, allowing them to be checked or edited. It is also possible to move the robot to that position.



MEMO
To execute the “Force.FaceMatch” icon, first move the robot to that position and then execute Force Control.

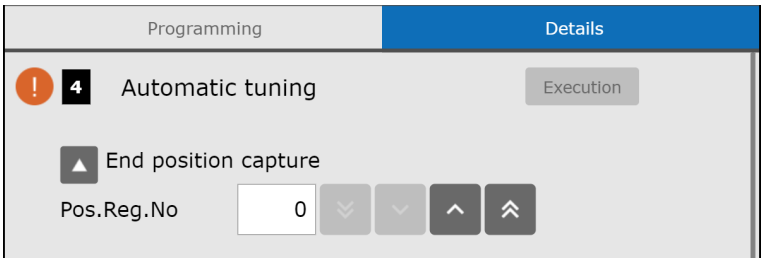
8.6.3 Force Control Coordinate Setting

Set the force control coordinate. Select one of already set force control coordinates or set new one. Refer to “8.8 FORCE CONTROL COORDINATE SETTING” on how to newly set a coordinate.
Pressing the “▼” button located under “Force coordinate” displays the detailed settings for the force control coordinate, allowing them to be checked or edited.
Pressing the “Delete” button deletes the set contents.



8.6.4 Automatic Tuning

An automatic tuning is done for an appropriate force control motion. If the “Execution” button is touched, the robot performs actual face matching operation 3 to 10 times. The mark is displayed after normal finish.
The “Execution” button is enabled when the Force Control system settings in the previous section have been completed.
With "End position capture", the position at the end of face match operation can be recorded in the position register. This operation is not indispensable and should be recorded if you want to move to this position later.
Pressing the “▼” button displays the detailed settings for position register number, allowing them to be checked or edited. Specify the position register number used for position recording. If the position register number is 0, the position will not be recorded.

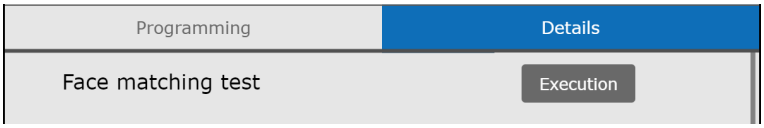


While automatic tuning is in progress, a progress bar is displayed in a pop-up window. When the progress bar reaches the end, a pop-up window appears with the message “Automatic tuning completed”. While automatic tuning is in progress, it is possible to select “Cancel” in the pop-up window.
If automatic tuning failed, a pop-up window appears with the message “Failed”.

MEMO
A warning pop-up window appears before the robot moves.

8.6.5 Face Matching Test

Perform a test to confirm that Force Control operates correctly. If the “Execution” button is touched, the robot performs actual test operation. The “Execution” button is enabled when automatic tuning has been completed.



While the test is in progress, a pop-up window is displayed. When the test is completed, a pop-up window appears with the message “Execution completed”.
If test execution failed, a pop-up window appears with the message “Failed”.

8.7 “FORCE.PHASEMATCH” SETTINGS SCREEN

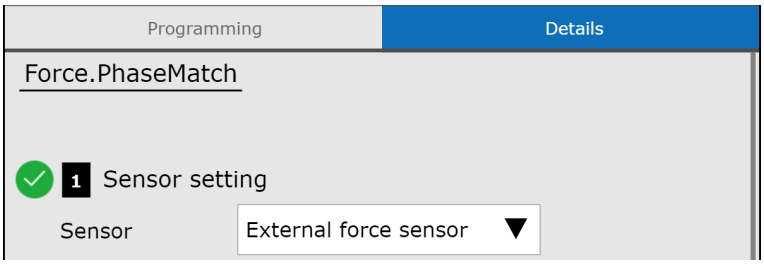
Touching the “Force.PhaseMatch” icon in the timeline changes the bottom of the screen to display the details of the “Force.PhaseMatch” icon. Configure the settings in order starting from the top. The ! mark is displayed for items that have not been set or taught. The ✓ mark is displayed for items that have been completed. When the ! mark remains, the items below that item cannot be set.

Set in the following order.

1. Sensor setting
2. Phase matching start position
3. Force control coordinate setting
4. Phase matching settings
5. Automatic tuning
6. Phase matching test

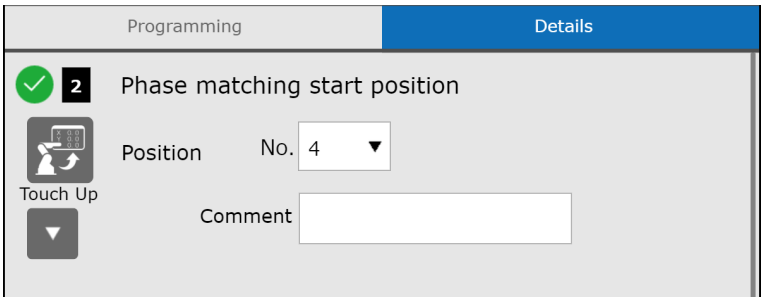
8.7.1 Sensor Setting

If an external force sensor is connected, both “External force sensor” and “Integrated sensor” can be selected. “External force sensor” is selected by default, and the mark is displayed next to it.
If an external force sensor is not connected, it is set as “Integrated sensor” from the beginning and the mark is displayed. In this case, the setting cannot be changed.



8.7.2 Phase Matching Start Position

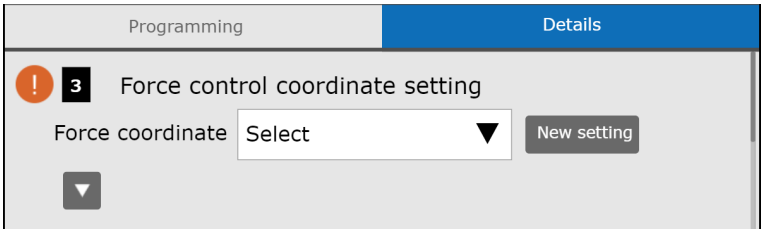
Move the robot by jog operation or manual guided teach to a position where the phase matching is executed. Initially, the robot position at the time when the icon was dropped into the timeline is recorded, and the mark is displayed next to it.
The position number and a comment can be input here.
Pressing the “▼” button displays the detailed settings for position information, allowing them to be checked or edited. It is also possible to move the robot to that position.



MEMO
When the ”Force.PhaseMatch” icon is executed, the robot moves to this position then the force control is executed.

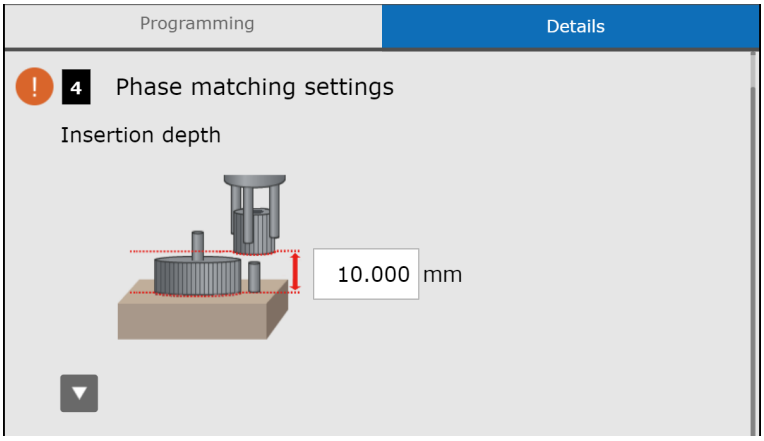
8.7.3 Force Control Coordinate Setting

Set the force control coordinate. Select one of already set force control coordinates or set new one. Refer to “8.8 FORCE CONTROL COORDINATE SETTING” on how to newly set a coordinate.
Pressing the “▼” button located under “Force coordinate” displays the detailed settings for the force control coordinate, allowing them to be checked or edited.
Pressing the “Delete” button deletes the set contents.



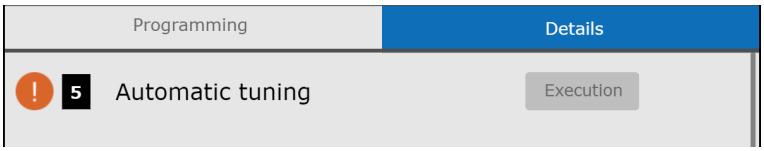
8.7.4 Phase Matching Settings

Set the “Insertion depth” (in the Phase match settings) of force control. As there is no value at the beginning, input appropriate values here. The is displayed when the suitable values are set for “Insertion depth”.
Pressing the “ ” button located below “Insertion depth” allows “Result Output Register No.”, and “Retry count” to be set.



8.7.5 Automatic Tuning

An automatic tuning is done for an appropriate force control motion. If the “Execution” button is touched, the robot performs actual phase matching operation 3 to 10 times. The is displayed after normal finish.
The “Execution” button is enabled when the phase matching settings in the previous section have been completed.

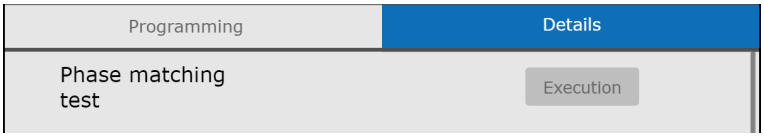


While automatic tuning is in progress, a progress bar is displayed in a pop-up window. When the progress bar reaches the end, a pop-up window appears with the message “Automatic tuning completed”. While automatic tuning is in progress, it is possible to select “Cancel” in the pop-up window.
If automatic tuning failed, a pop-up window appears with the message “Failed”.

MEMO
A warning pop-up window appears before the robot moves.

8.7.6 Phase Matching Test

Perform a test to confirm that Force Control operates correctly. If the “Execution” button is touched, the robot performs actual test operation. The “Execution” button is enabled when automatic tuning has been completed.



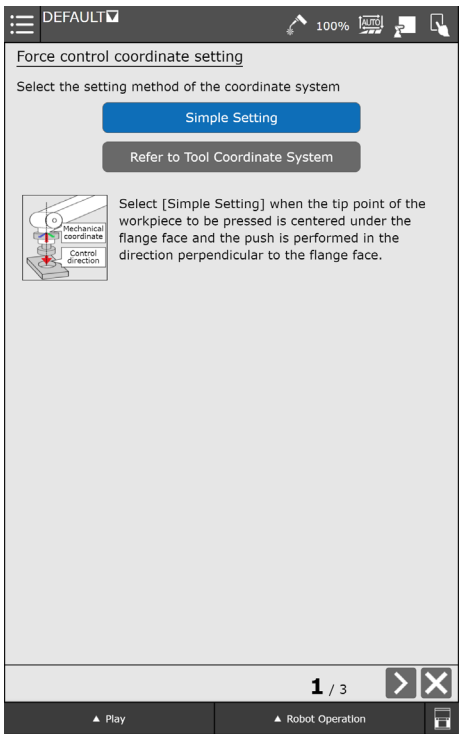
While the test is in progress, a pop-up window is displayed. When the test is completed, a pop-up window appears with the message “Execution completed”.
If test execution failed, a pop-up window appears with the message “Failed”.

8.8 FORCE CONTROL COORDINATE SETTING

Set the force control coordinate in the following cases.

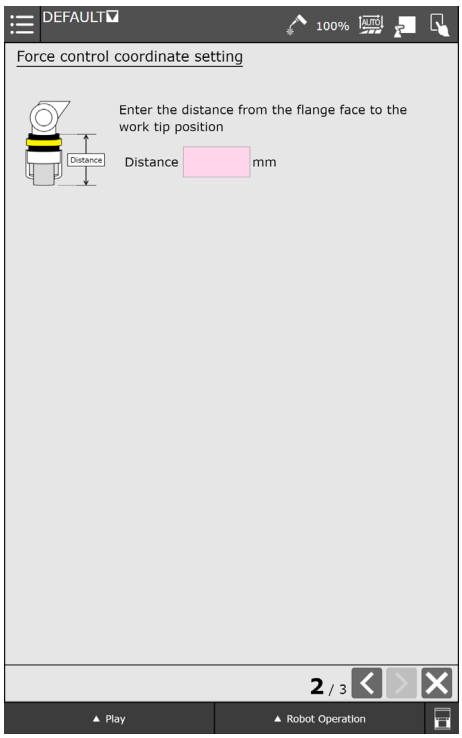
1. “External force sensor” was selected in the sensor setting, and “Not perpendicular to the flange face” was selected for the push direction setting.
2. “Integrated sensor” was selected in the sensor setting.

There are 2 setting methods: “Simple Setting” and “Refer to Tool Coordinate System”. Select the method and touch the “ ” button.
Choose “Simple Setting” when the tip point of the workpiece to be pushed is centered under the robot flange surface and the push is performed in the direction that is perpendicular to the flange face (+Z direction of the mechanical interface coordinate system).
In other cases, select “Refer to Tool Coordinate System”. For example, select this when the tip point of the workpiece is not centered under the robot flange (it is offset from the center) or when the push direction is not perpendicular to the robot flange surface.



8.8.1 Simple Setting

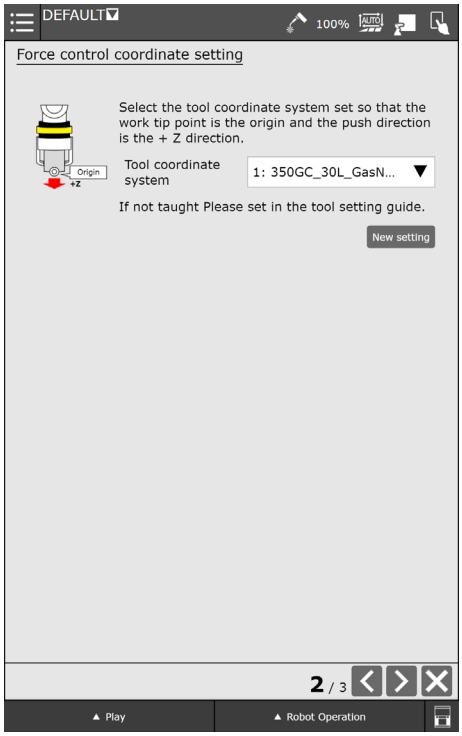
Input the length [units: mm] from the robot flange surface to the tip point of the workpiece, then touch the "" button.



Input a comment and touch the "" button.
The maximum number of characters that can be entered for a comment is 16. If more characters were entered, the 17th and subsequent characters will be ignored.
The coordinate system is now set. Return to the settings screen.

8.8.2 Refer to Tool Coordinate System

Set the tool coordinate system in “UTool Setup” in advance. Set so that the +Z direction of the coordinate system matches the push direction.
Select the set coordinate system and touch the “ ” button.



A comment input window appears in the same way as with simple setting. Input a comment and touch the “ ” button.
The coordinate system is now set. Return to the settings screen.

9 ARC WELDING FUNCTION

You can perform arc welding applications by using the arc welding function of Tablet UI on a robot controller with the function of Arc Tool or LR Arc Tool. The status bar and the jog panel applicable to the applications of arc welding are useable. The Fig. 9 shows Tablet UI for arc welding and the Table 9 shows functions applicable to arc welding.
This chapter shows how to use the arc welding functions on Tablet UI. For the overview of arc welding or its details, refer to "Arc Welding Function OPERATOR'S MANUAL B-83284EN-3"

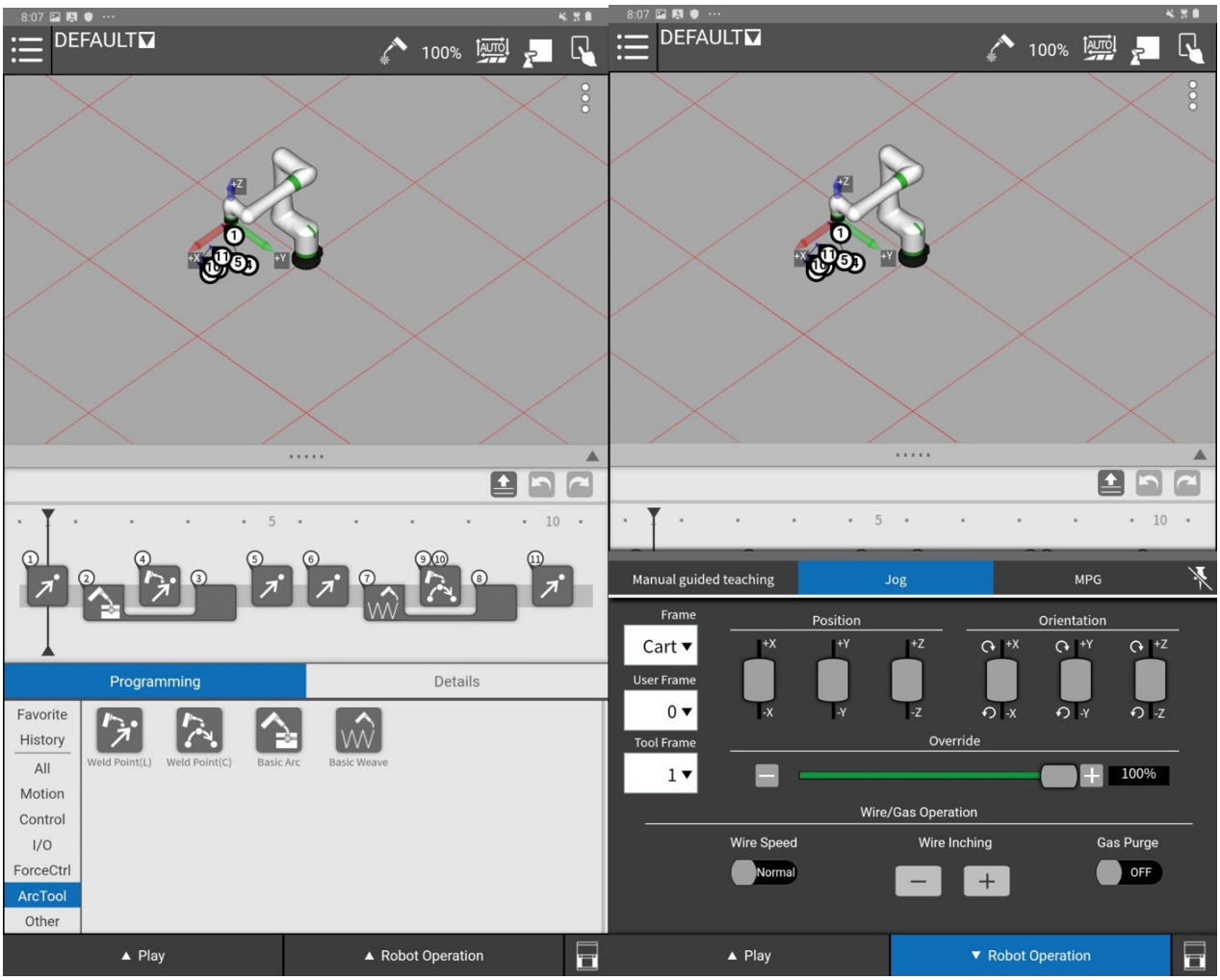
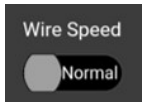
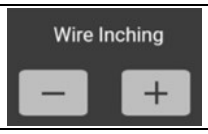
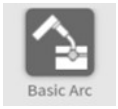


Fig. 9 Tablet UI for arc welding

Table 9 Arc welding functions

Location	Item	Description
Status bar		“Weld Enable/Weld Disable” icon Switch Weld Enable/Weld Disable.
Robot operation panel		“Wire Speed” button Switch Wire Speed at high speed/normal speed.
		“Wire Inching” button Inch and rewind wire manually.
		“Gas Purge” button Purge gas manually.
Program line/ Icon pallet		“Basic Arc” icon Perform arc welding. Configure a weld start position, a weld end position and weld schedules.
		“Basic Weave” icon Perform weaving welding. Configure a weld start position, a weld end position, weld schedules and weaving schedules.
		“Weld Point(L)” icon Move linearly in a weld path. This icon is used in the Basic Arc instruction or the Basic Weave instruction. Welding can be done at the speed set in the Basic Arc instruction or the Basic Weave instruction.
		“Weld Point(C)” icon Move circularly in a weld path. This icon is used in the Basic Arc instruction or the Basic Weave instruction. Welding can be done at the speed set in the Basic Arc instruction or the Basic Weave instruction.

9.1 ROBOT OPERATION PANEL FOR ARC WELDING

In the UI for arc welding, the "Wire/Gas Operation" field was added on the Robot Operation panel in the UI for arc welding as shown in the Fig. 9.1(a).

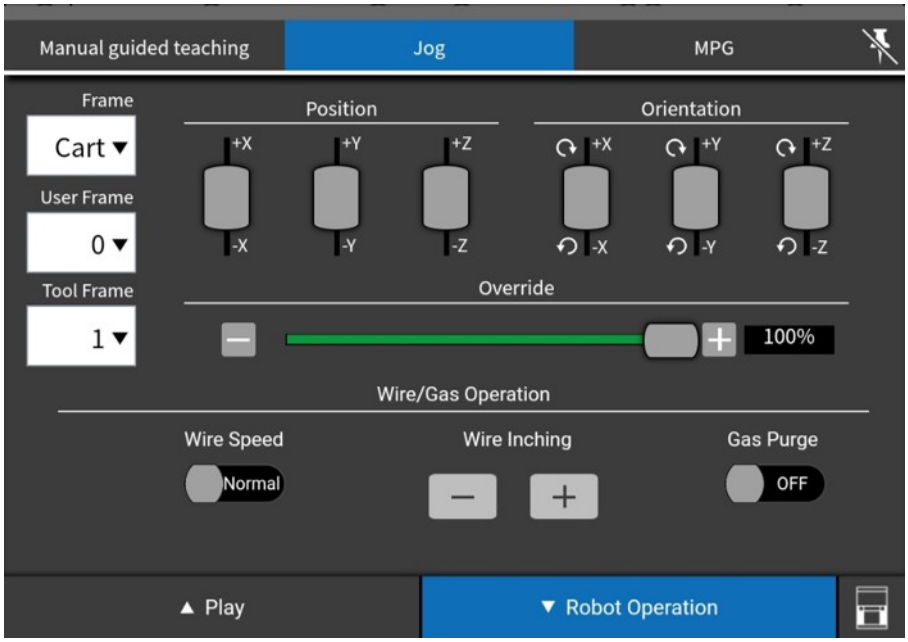


Fig. 9.1(a) The “Robot Operation” panel for arc welding

You can inch/rewind wire by pressing the +key or the -key in the "Wire Inching" button shown in the Fig. 9.1(b).

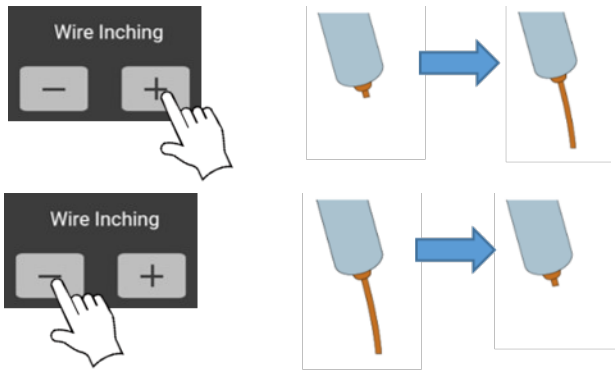


Fig. 9.1(b) The "Wire Inching" button

You can change the wire inching (+) speed to high speed by tapping the "Wire Speed" button shown in the Fig. 9.1(c).

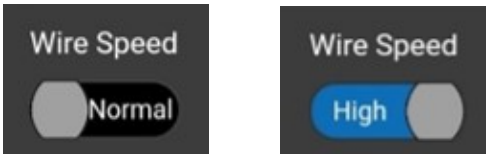


Fig. 9.1(c) The "Wire Speed" button

MEMO
You can inch wire manually at a high speed by pressing the + key of the "Wire Inching" for 2s or more at a high speed. Wire rewinding cannot be changed to high speed.

Pressing the "Gas Purge" button shown in the Fig. 9.1(d) toggles ON/OFF. When the Gas Purge button is ON, you can check the flow rate of gas by purging gas.

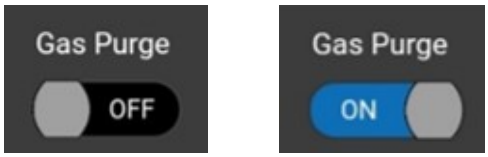


Fig. 9.1(d) The "Gas Purge" button

MEMO
If you turn the "Gas Purge" button ON and perform gas purging, it will turn off automatically after a certain period of time.

9.2 APPLICATIONS OF ICONS FOR ARC WELDING

You can create the following applications using the icons for arc welding.

- Using the “Basic Arc” icon, you can configure arc welding conditions and perform desirable arc welding.
- Using the “Basic Weave” icon, you can configure weaving conditions and perform desirable weaving.

Examples of arc welding applications using the “Basic Arc” are shown in the Fig. 9.2(a) and the Fig. 9.2(b). The Fig. 9.2(a) is an example of a linear welding program. It includes only teaching a weld start position and a weld end position. The Fig. 9.2(b) shows an example that a weld point was added to the previous one to change the posture of a torch. By creating an arc welding program, teaching reference positions and setting the weld schedule, the applications for arc welding can be ready as shown in the Fig. 9.2(a) and the Fig. 9.2(b)

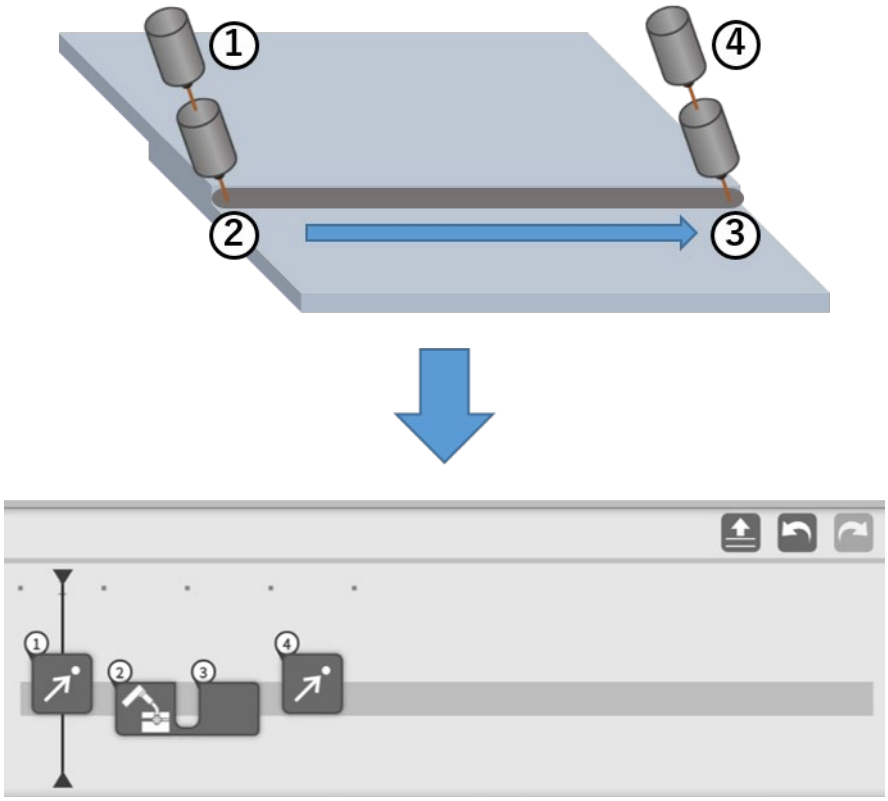


Fig. 9.2(a) An example of arc application 1: an example of liner welding

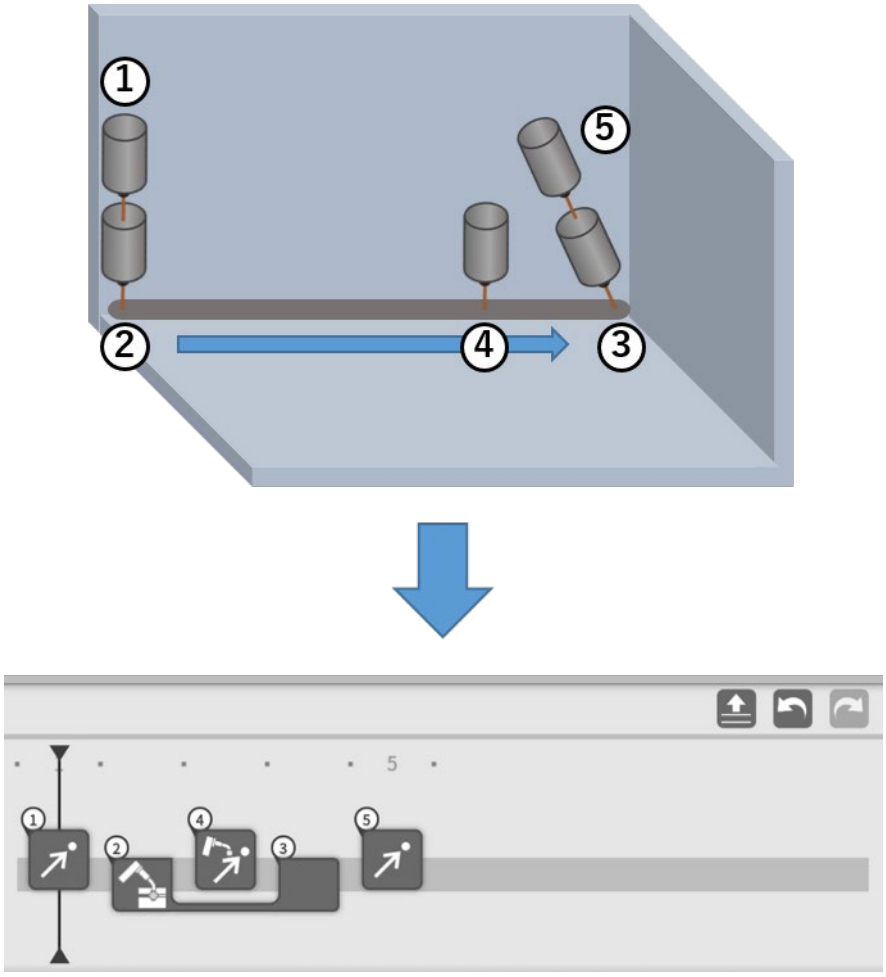


Fig. 9.2(b) An example of arc application 2: an example of welding with the change of a torch's posture

9.3 “BASIC ARC”

Confirm a controller is communicated with a welding power supply when you use the "Basic Arc" icon

9.3.1 Adding the “Basic Arc” icon

The "Basic Arc" icon is in the “Arc Tool” block in the icon pallet as shown in Fig. 9.3.1(a). To add the icon in the program line, drag and drop it to the program line. When you add the "Basic Arc" to the program line, the icon becomes bracket-shape and the enclosed section is the period of arc welding.

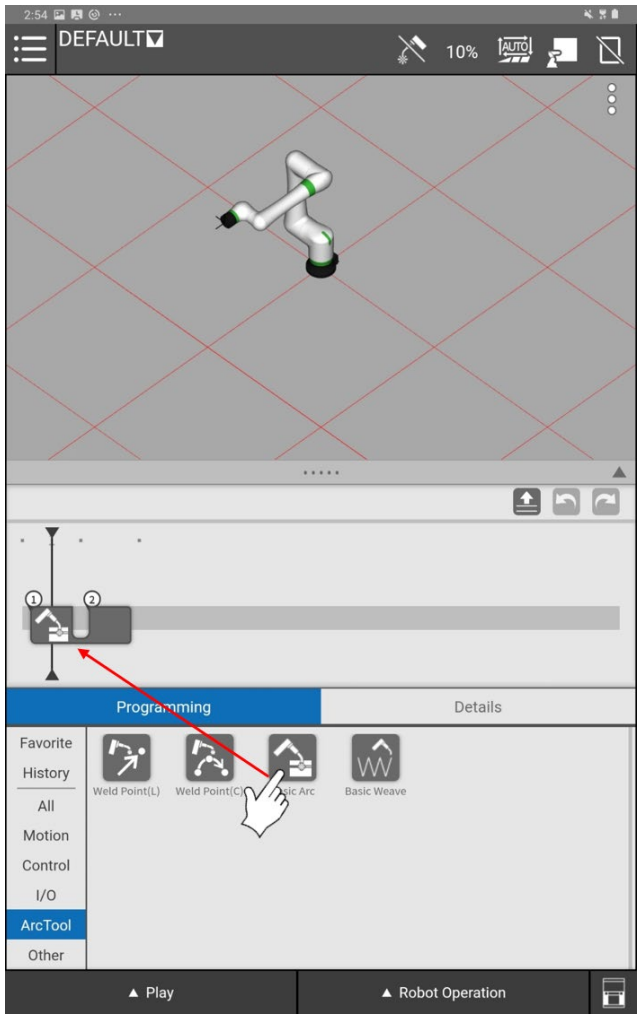


Fig. 9.3.1(a) How to add the “Basic Arc” icon

By tapping the "Basic Arc" icon on the program line, the lower part of the screen switches to the “Details” screen of the "Basic Arc" icon as shown in the Fig. 9.3.1(b). In the "Details" screen of the "Basic Arc", you can teach reference positions and configure the weld schedule.

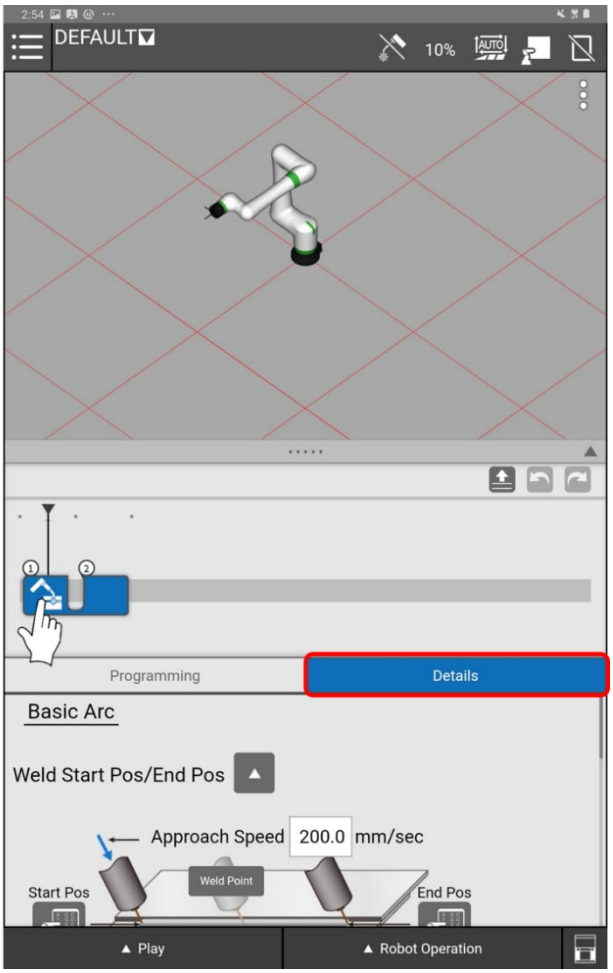


Fig. 9.3.1(b) The "Details" screen of the "Basic Arc" icon

⚠ CAUTION

Do not add the "Basic Arc" or the "Basic Weave" in the section enclosed by the "Basic Arc" or the "Basic Weave".

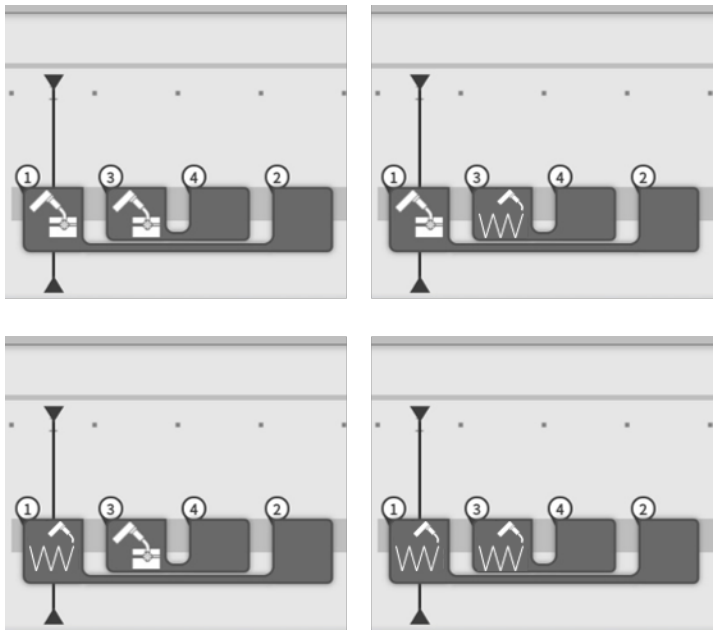


Fig. 9.3.1(c) Things shouldn't be done regarding the "Basic Arc" icon

9.3.2 Teaching Reference Positions

As shown in the Fig. 9.3.2, the "Weld Start Pos/End Pos" field is in the upper part of the “Details” screen. You can teach a weld start position and a weld end position in this field.

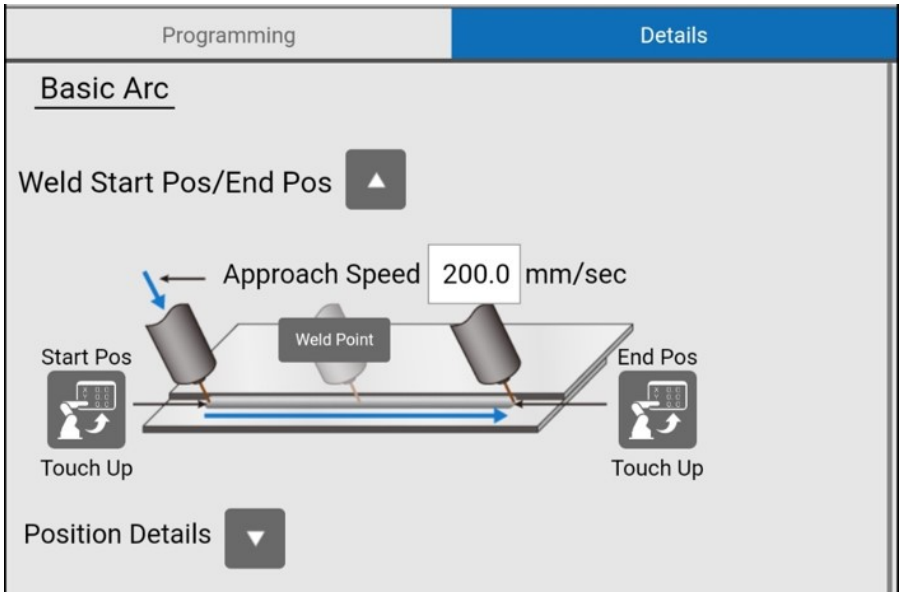


Fig. 9.3.2 The "Weld Start Pos/End Pos" field in the “Details“ screen of the “Basic Arc” icon

9.3.2.1 Teaching a welding start/stop position

To record a weld start position and a weld end position, move the robot by a jog operation or a manual guided teach to the position and press the "Touch Up" button shown in the Fig. 9.3.2. To specify the speed between the weld start position and the position before the weld start position, enter the required speed in the “Approach Speed” text box.

CAUTION
A weld start position and a weld end position are set the current robot position when you add the “Basic Arc” icon in the program line. Make sure to record the weld end position each time you add the icon in the programing line. You can record the weld end position by moving robot to the position and touching the “Touch Up” button of the End Pos.

MEMO
Pay attention to the wire stick-out when you teach reference positions. Set the length of the wire to the same length used to perform the welding.

MEMO
Program is executed in the following order.
moves to the weld start position → starts welding → executes the instructions enclosed by the “Basic Arc” icon → moves to the weld end position → finishes welding

When you press the part of the Details button, details of the “Start Pos” and the “End Pos” will appear as shown in the Fig. 9.3.2.1. You can also record a weld start position or a weld end position by pressing the "Touch Up" button in this field.

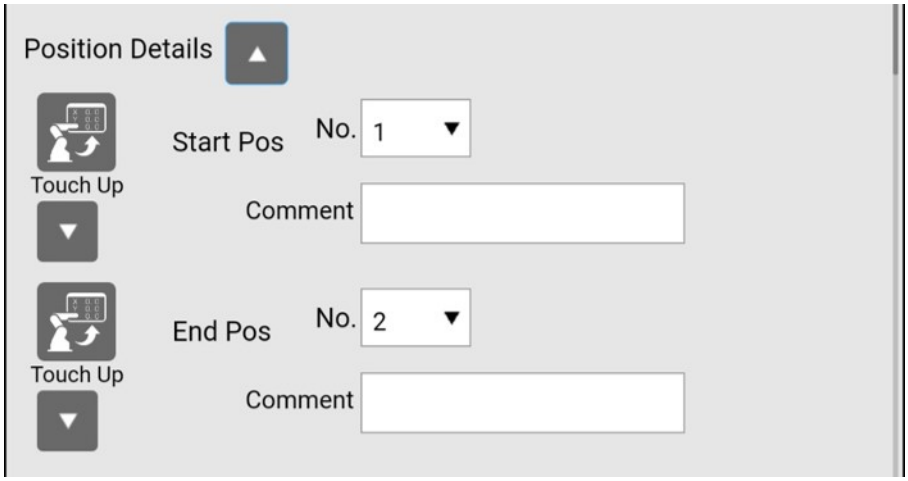


Fig. 9.3.2.1 The ”Position Details” screen

9.3.2.2 Adding a weld point

To teach a weld point, add desirable icons in the section enclosed by the “Basic Arc” icon as shown in the Fig. 9.3.2.2. By tapping the “Weld Point” button, a popup appears and it shows how to teach a weld point.

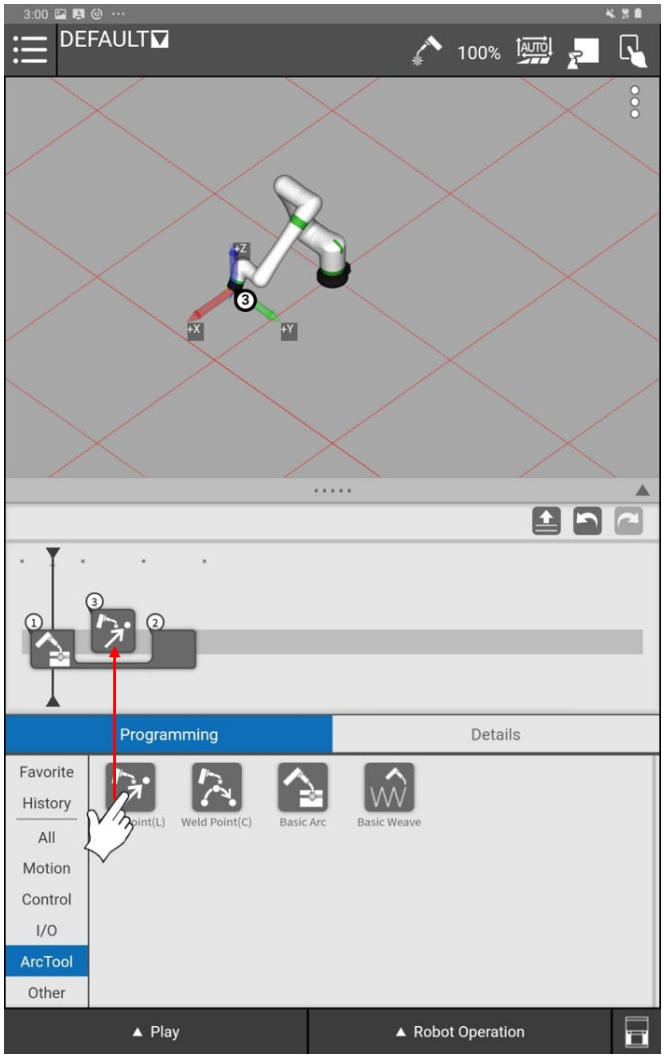


Fig. 9.3.2.2 How to add the “Weld Point” icon

9.3.3 “Weld Schedule” Setting

The "Weld Schedule" field is under the "Weld Start Pos/End Pos" field as shown in the Fig. 9.3.3(a). In the "Weld Schedule" field, you can select a weld mode and configure the weld schedule. The "Craterfill Process Schedule" field is under the "Weld Schedule" field. In the "Craterfill Process Schedule" field, you can configure the craterfill process schedule.

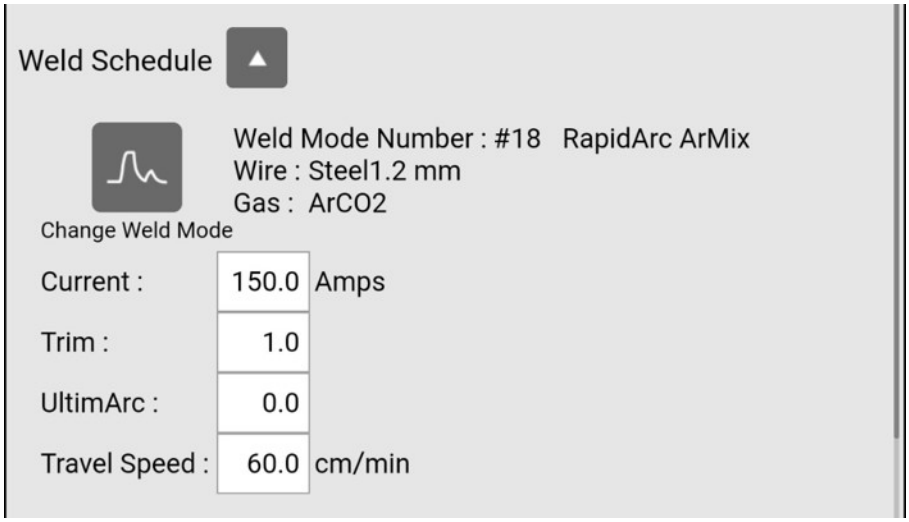


Fig. 9.3.3(a) The “Weld Schedule“ field

MEMO
The display of the “Weld Schedule“ field may differ from the power supply used.

9.3.3.1 “Weld Mode” setting

Several welding control methods are registered as weld modes in the “Weld Mode” in a power supply. These methods are optimum according to the combination of a wire material, a wire diameter and a gas type. You can choose an optimum method by selecting a Weld Mode Number. The Fig. 9.3.3(a) shows an example of a weld mode provided in a Lincoln welding power supply. By pressing the "Change Weld Mode" button shown in the Fig. 9.3.3(a), a popup appears as shown in Fig. 9.3.3.1(a). In this popup, you can change a Weld Mode Number. This popup has 3 tabs.

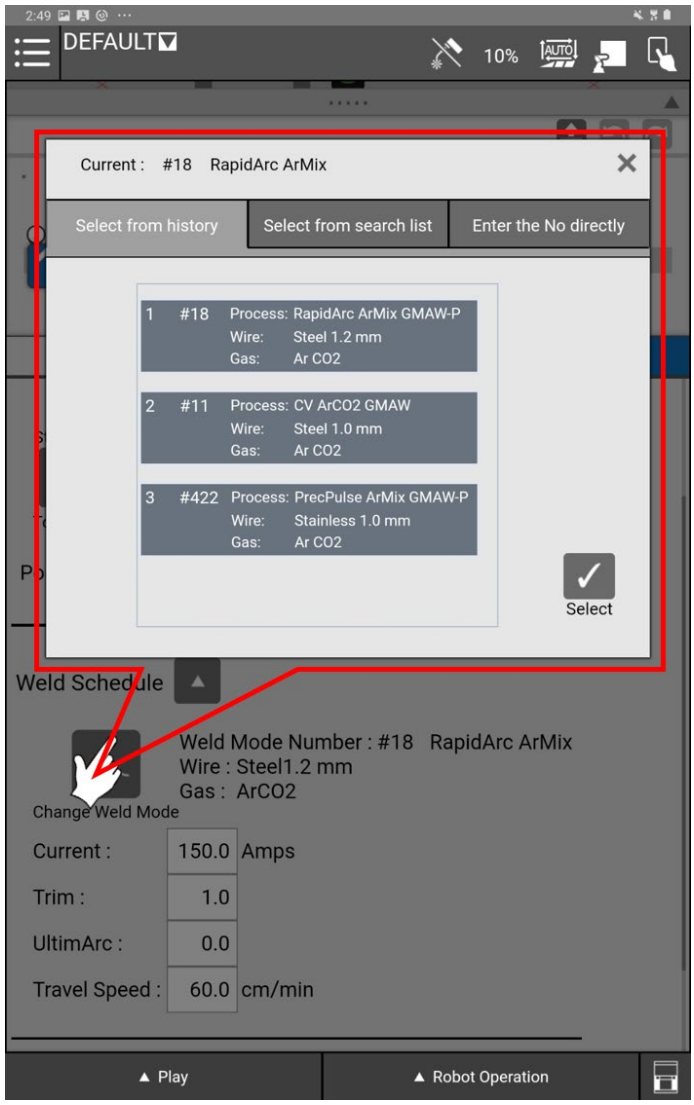


Fig. 9.3.3.1(a) The “Change Weld Mode” popup

1. The “Select from history” tab

In the "Select from history" tab, you can see the weld modes selected before as shown in the Fig. 9.3.3.1(b). By selecting a mode in the history and pressing the Select button, you can change a weld mode.

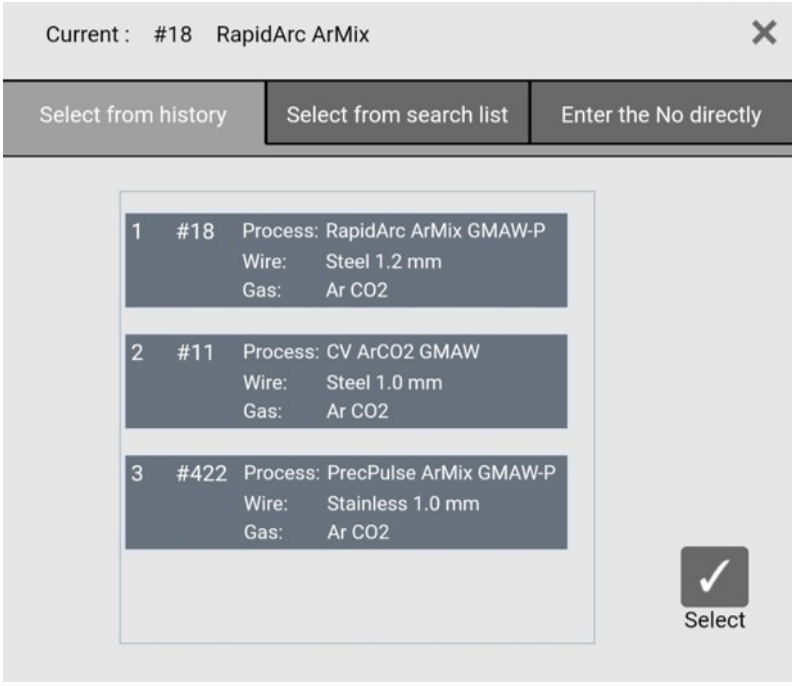


Fig. 9.3.3.1(b) The “Select from history” tab

2. The “Select from search list” tab

In the "Select from history" tab, by selecting a wire material, a wire diameter and a gas type and pressing the Select button, you can view the search result of the applicable weld modes as shown in the Fig. 9.3.3.1(c). By selecting a Weld Mode Number in the list and pressing the Select button, you can change a weld mode.

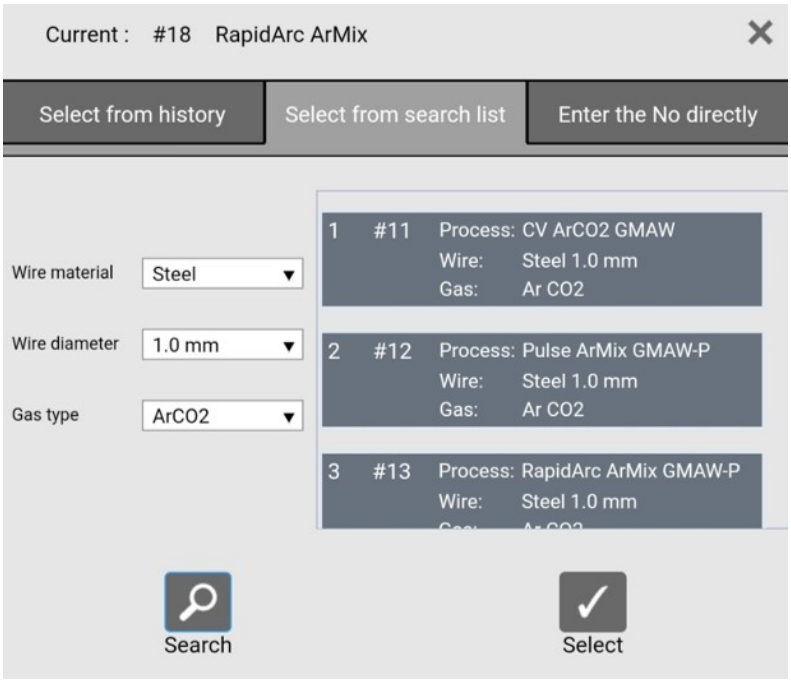


Fig. 9.3.3.1(c) The “Select from search list” tab

3. The “Enter the No directly” tab

In the “Enter the No directly” tab, you can search a weld mode by entering a Mode Number as shown in the Fig.9.3.3.1(d). If the number is not present, a warning appears. By pressing the Select button, you can change a weld mode to the one shown in the tab.

Fig. 9.3.3.1(d) The “Enter the No directly” tab

> ⚠ **CAUTION**
> When you change a weld mode, the values of the weld schedule such as a current, a voltage etc. are initialized.

When a power supply is Fronius TPS/i, you can select the Weld Schedule Setting Mode. When you set the “Weld Schedule Setting Mode” to “Robot”, a setup menu is be displayed as shown in the Fig. 9.3.3.1(e) and you can configure the Weld Schedule sent to the power supply in the screen (Special 2 step). By pressing the “Change Weld Mode”, you can change Synergic ID.

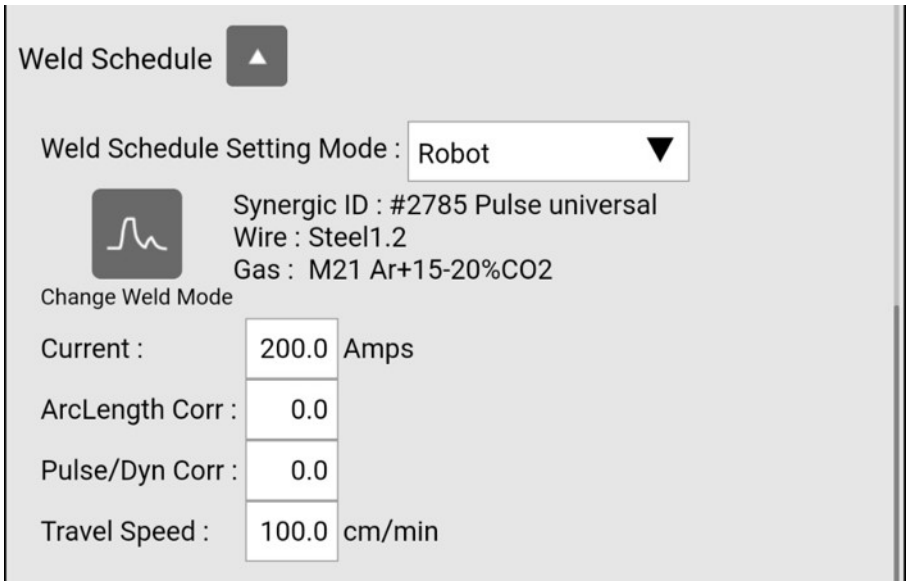


Fig. 9.3.3.1(e) A picture of the Robot mode under the Weld Schedule Setting Mode

When you set “Weld Schedule Setting Mode” to “Weld Equipment”, a setup menu is displayed as shown in the Fig. 9.3.3.1(f). In the screen, you can select the Job number and perform the welding in the weld schedule set in a power supply as the Job number (Job Mode).

Fig. 9.3.3.1(f) A picture of the Weld Equipment mode under the Weld Schedule Setting Mode

9.3.3.2 “Weld Schedule” setting

Command values such as a current are shown in the "Weld Schedule" field. You can perform welding in the schedule you define in this field as shown in the Fig. 9.3.3.2.

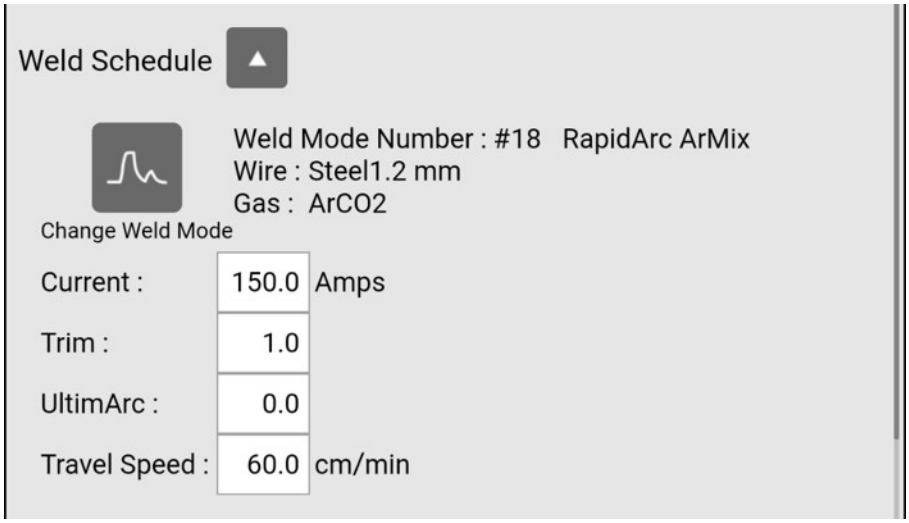


Fig. 9.3.3.2 The “Weld Schedule” field

A warning appears if you enter an instruction value outside the input range. A value is shown in red if you enter an instruction value outside the input range. Make sure to enter a value in input range.

> ⚠ **CAUTION**
> The Travel Speed is set 0.0 initially. If you execute a program without setting the Travel Speed, the alarm occurs and the robot stops. If that happens, finish the program and enter an instruction value in the Travel Speed.

9.3.3.3 “Craterfill Process Schedule” setting

The "Craterfill Process Schedule" field is under the "Weld Schedule" field as shown in Fig. 9.3.3.3. You can see its details by pressing the button. You can perform craterfilling in the schedule you define in this field.

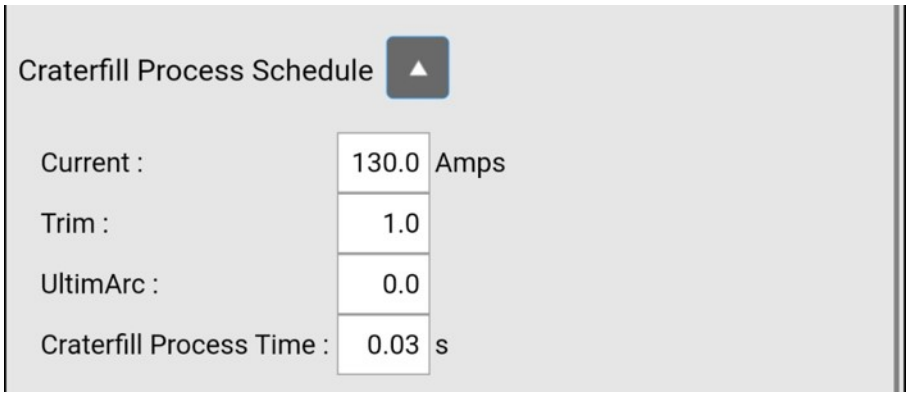


Fig. 9.3.3.3 The “Craterfill Process Schedule” field

A warning appears if you enter an instruction value outside the input range. A value is shown in red if you enter an instruction value outside the input range. Make sure to enter a value in input range. Craterfill Process Time is set 0.00s initially. If the value is 0.00s, craterfilling is enabled and cannot be performed. If you enter a value except 0.00s in Craterfill Process Time, craterfilling becomes enabled.

9.4 ”BASIC WEAVE”

Confirm a controller is communicated with a welding power supply when you use the "Basic Weave" icon.

9.4.1 Adding the “Basic Weave” Icon

The "Basic Weave" icon is in the Arc Weld block in the icon pallet as shown in the Fig. 9.4.1(a). To add it in the program line, drag and drop it to the program line. When you add the "Basic Weave" to the program line, the icon becomes bracket-shape and the enclosed section is the period of arc welding and weaving.

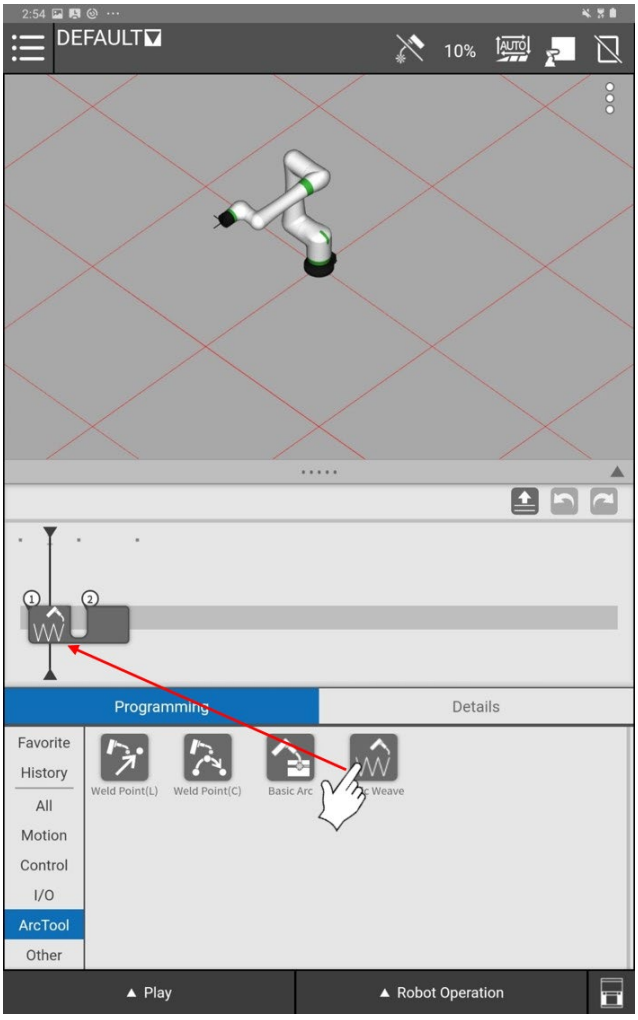


Fig. 9.4.1(a) How to add the “Basic Weave” icon

By tapping the “Basic Weave” icon in the program line, the lower part of the screen switches to the “Details” screen of the "Basic Weave" icon as shown in the Fig. 9.4.1(b). In the “Details” screen, you can teach reference positions and configure the weld schedule.

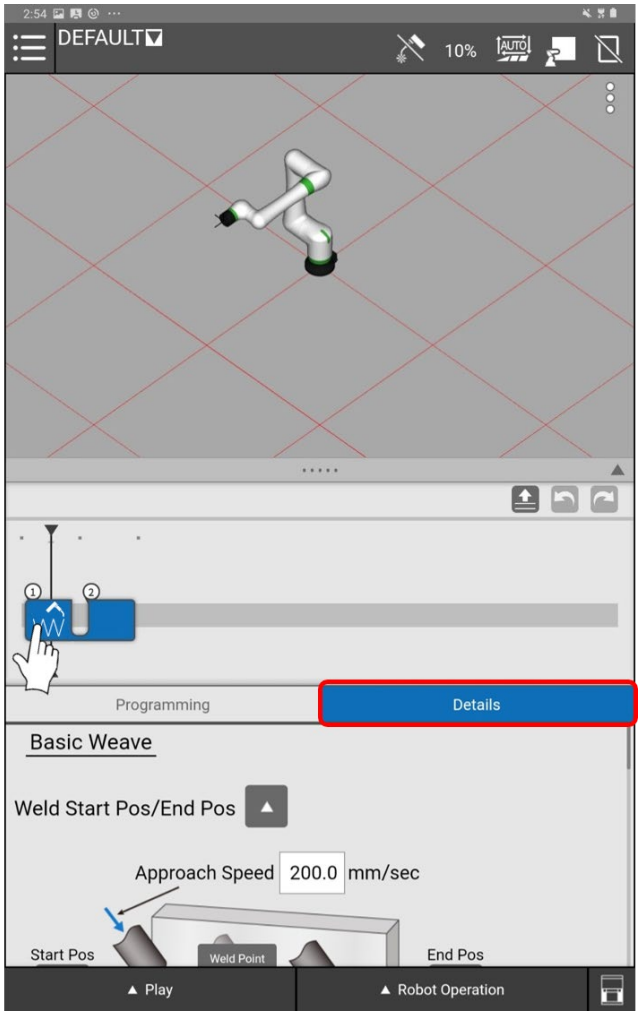


Fig. 9.4.1(b) The ”Details” screen of the “Basic Weave” icon

9.4.2 Teaching Reference Positions

As shown in the Fig. 9.4.2, the "Weld Start Pos/End Pos" field is in the upper part of the “Details” screen. You can teach a weld start position and a weld end position in this field.

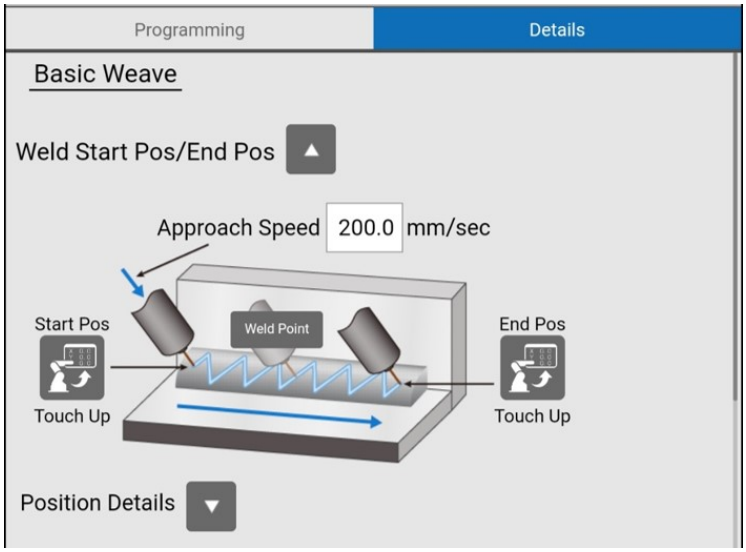


Fig. 9.4.2 The "Weld Start Pos/End Pos" field in the “Details“ screen of the “Basic Weave” icon

You can teach reference positions using the “Basic Weave” icon in the same way as using the “Basic Arc” icon. Refer to the section 9.3.2.

9.4.3 “Weld Schedule” Setting

The "Weld Schedule" field is under the "Weld Start Pos/End Pos" field. In this field, you can configure a weld mode and the weld schedule. The "Craterfill Process Schedule" field is under the "Weld Schedule" field. In this field, you can configure the craterfill process schedule.
You can configure the weld schedule in the “Basic Weave” icon in the same way as in the “Basic Arc” icon. Refer to the section 9.3.3.

9.4.4 “Weaving Schedule” Setting

As shown in the Fig. 9.4.4, the "Weaving Schedule" field is under in the “Craterfill Process Schedule” field. You can configure a weaving schedule.

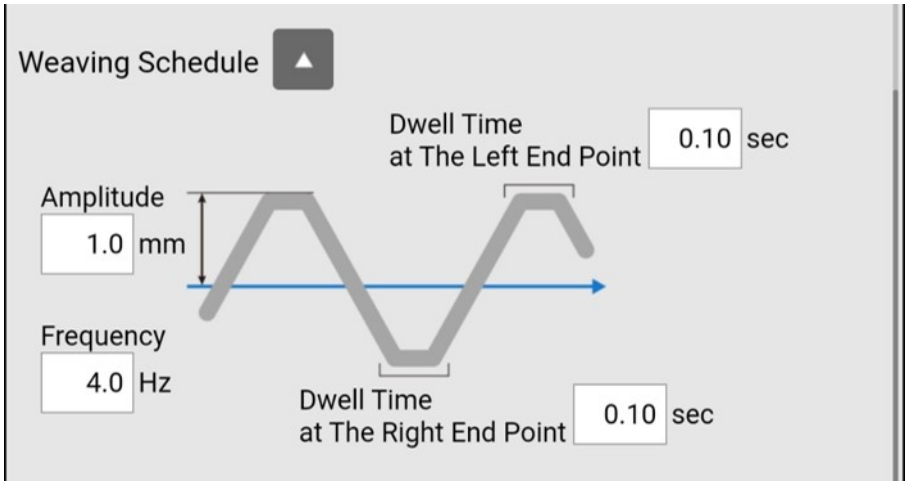


Fig. 9.4.4 The “Weaving Schedule”

A warning popup appears if you enter an instruction value outside the range.

MEMO
Weaving is limited to a sine wave motion as shown in the Fig. 9.4.4.

9.5 EXECUTING THE ARC WELDING PROGRAM

This chapter shows the settings and the things to check when perform the arc welding applications. Follow the next flow when you perform them. Following the flow will make welding safe.

1. Verify the program
⇩
2. Check wire inching and gas purge
⇩
3. Execute the arc welding program

9.5.1 Confirming the ”Weld Enable/Disable” Icon

When you verify a program, confirm welding is enabled or disenabled. In the UI for arc welding, the ”Weld Enable/Disable” icon is shown in the status bar. Arc welding is enabled when the “Weld Enable/Weld Disable” icon is same to the one shown in the Fig. 9.5.1(a) and arc welding is disabled when it is same to the one shown in the Fig. 9.5.1(b). When you execute the “Basic Arc” instruction or the “Basic Weave” instruction while arc welding is disabled, those cannot be performed. Note even if arc welding is enabled, arc welding cannot be performed when the Step button is Enable.

Fig. 9.5.1(a) The ”Weld Enable” icon

Fig. 9.5.1(b) The ”Weld Disable” icon

When you tap the "Weld Enable/Weld Disable" icon, a popup appears as shown in Fig. 9.5.1(c). You can switch arc welding enabled/disenabled by tapping the “Weld Enable” icon or the “Weld Disable” icon in the popup.

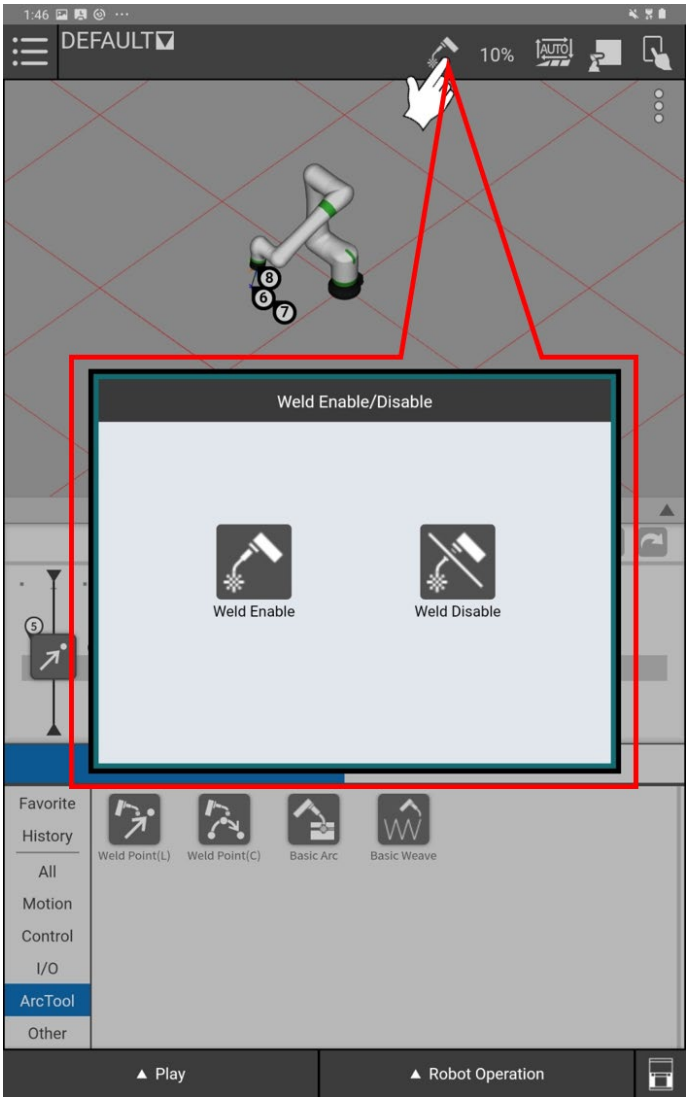


Fig. 9.5.1(c) The ”Weld Enable/Disable” popup

> **⚠ CAUTION**
> When you check a welding program, make sure to set welding disabled.

9.5.2 Verifying the Program

Once you teach reference positions and set a speed, confirm the program is normal before welding. Confirm the following checklist as shown in the Fig. 9.5.2(a) and verify the program.

1. Confirm welding is disabled.
2. Check the speed override. Set the speed override a low value initially, increase it gradually while verifying the program.
3. Confirm the TP enable switch is ON.
4. Execute the program.

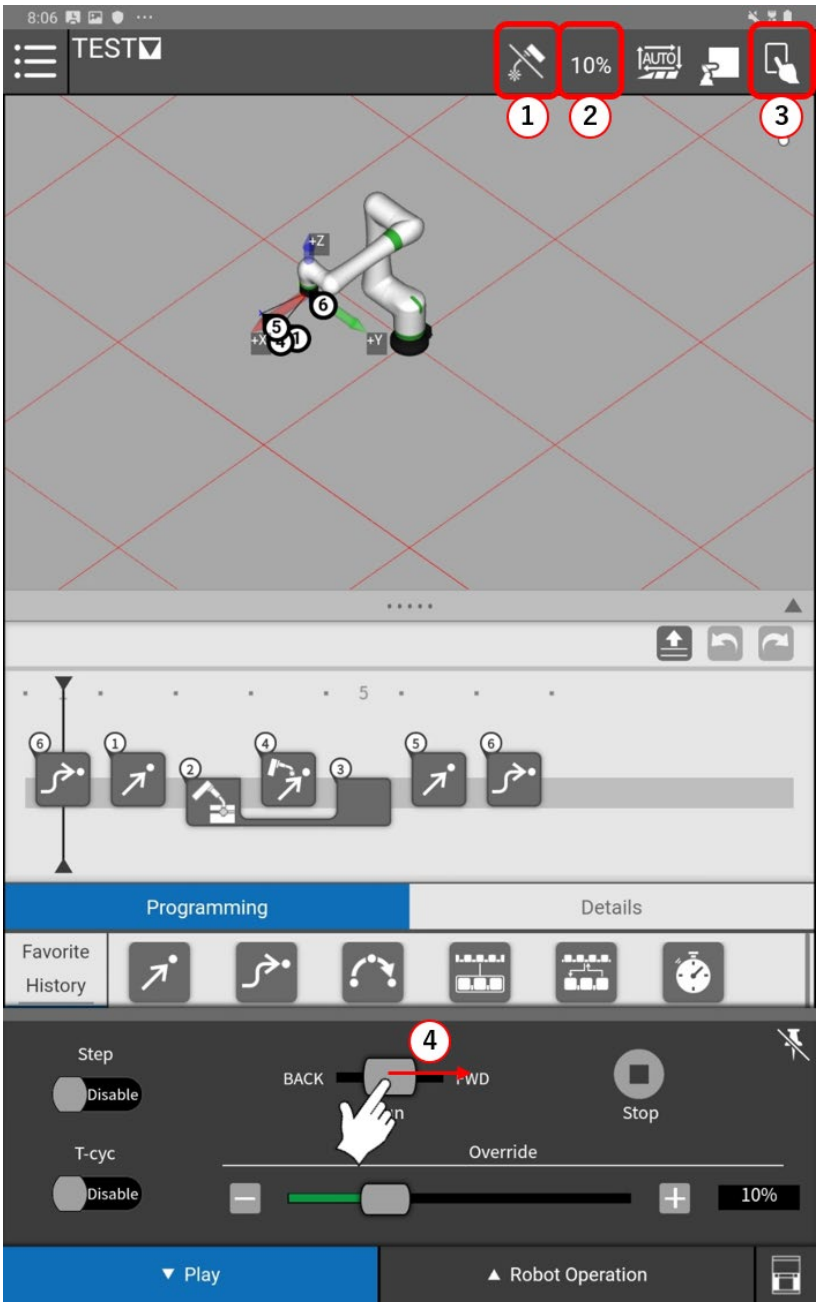


Fig. 9.5.2(a) The checklist before verifying the program

MEMO
When T-cyc is Enable (Test Execution), the program can be verified moving the virtual robot in the Robot Graphics screen instead of moving the robot. For the details of Test Execution, refer to the section 5.1.

MEMO
When the Step button is Enable(Step Execution), you cannot perform welding. For the details of Step Execution, refer to the section 5.1.

9.5.3 Checking Wire Inching and Gas Purging

Before welding, make sure wire inching and gas purging can be normally performed. You can confirm the setting of the Wire/Gas operation in the Robot Operation panel shown in the Fig. 9.5.3. For the details of the Wire/Gas operation, refer to the section 9.1.

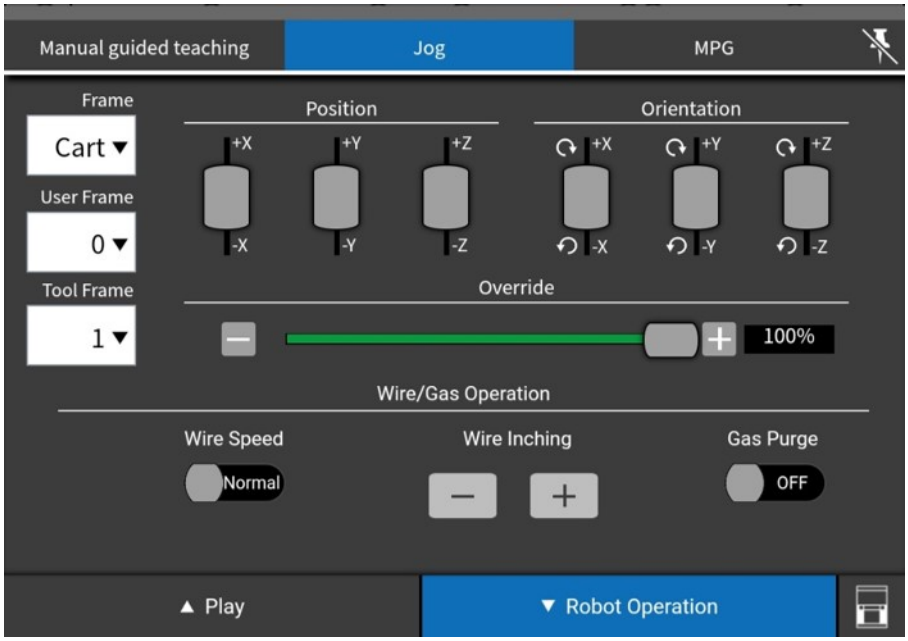


Fig. 9.5.3 The Robot Operation panel for arc welding

9.5.4 Executing the Arc Welding Program

Execute the arc welding program in the following steps.

1. Confirm Step Execution and Test Execution are disabled.
2. Set welding enabled.
3. Set the speed override 100%.
4. Execute the program.

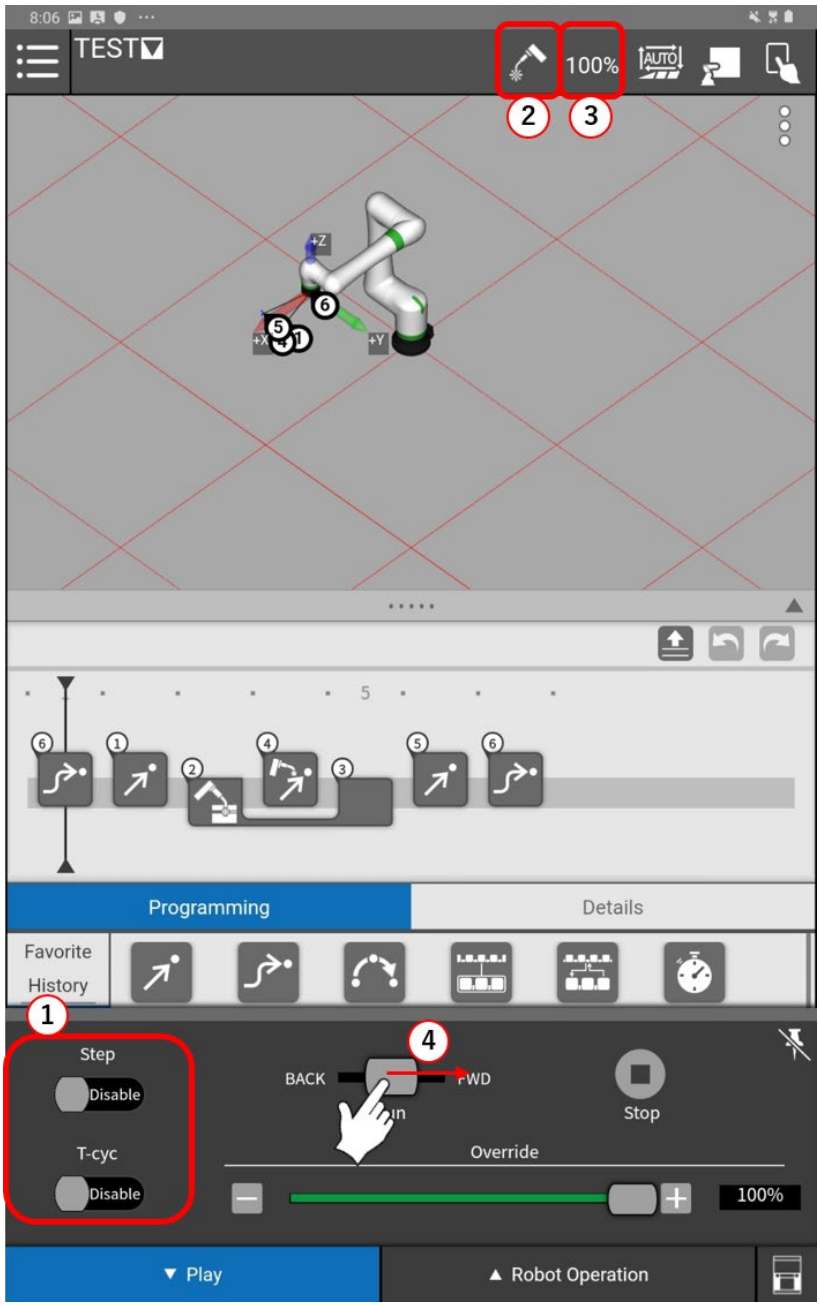


Fig. 9.5.4(a) The checklist when the arc welding program is verified

5. Arc welding can be performed when the instructions enclosed by the "Basic Arc" or the "Basic Weave" are executed.

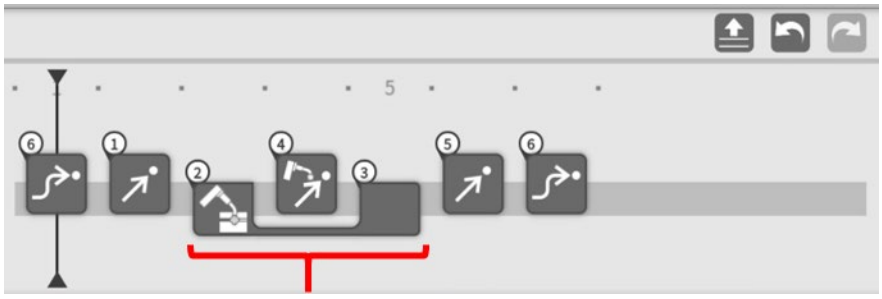


Fig. 9.5.4(b) The arc welding section

> ⚠ **CAUTION**
> If the “Basic Arc” instruction or the “Basic Weave” instruction is executed while the speed override is not 100%, "ARC-033 Override must be 100%" alarm occurs and the program pauses.

> ⚠ **CAUTION**
> If an arc is not generated at the beginning of arc welding, "ARC-013 Arc Start failed " alarm occurs and the program pauses.

9.6 Manual Guided Teaching Handle

9.6.1 Overview

To enable the Manual Guided Teaching function, user has to grip the enabling divide (deadaman switch). For the detail

Manual Guided Teaching Handle is a device to operate robot two-handed by the Manual Guided Teaching function. It has an additional enabling device to enable the function.

Fig. 9.6.1 Manual Guided Teaching Handle system

To use this device S530 software option has to be ordered, In case of this option is ordered safety input SFDI1 is used for the enabling device on the Handle. And RI[1] and RI[2] is used for operation buttons They cannot be used for other pourpuse.

⚠ WARNING

1. This device enables to move the robot by the Manual Guided Teaching function. Extreme caution must be exercised when using this function. When you operate the robot by the device, you must strictly adhere to the following precautions.
   - The Tablet TP or an external emergency stop button must be prepared near the operator to use the emergency stop button any time.
   - Two or more persons must not operate robot by the Manual Guided Teaching. You must check the person does not stay in the operation area.
   - The contact stop is disabled while High Speed mode of Collaborative robot. If the High Speed mode is used, adequate risk assessment for the whole robot system is necessary to verify that the contact stop can be disabled. Please refer 7.2 High Speed Mode" section in OPERATOR'S MANUAL (Collaborative Robot Function) (B-83744EN).

9.6.2 Manual guided teaching handle

Manual Guided Teaching Handle consists of Operation Handles, a Enabling device and two Operation Buttons. Operation Handle 1 equips the enabling. The user grips these handles with both hands and moves the robot arm.

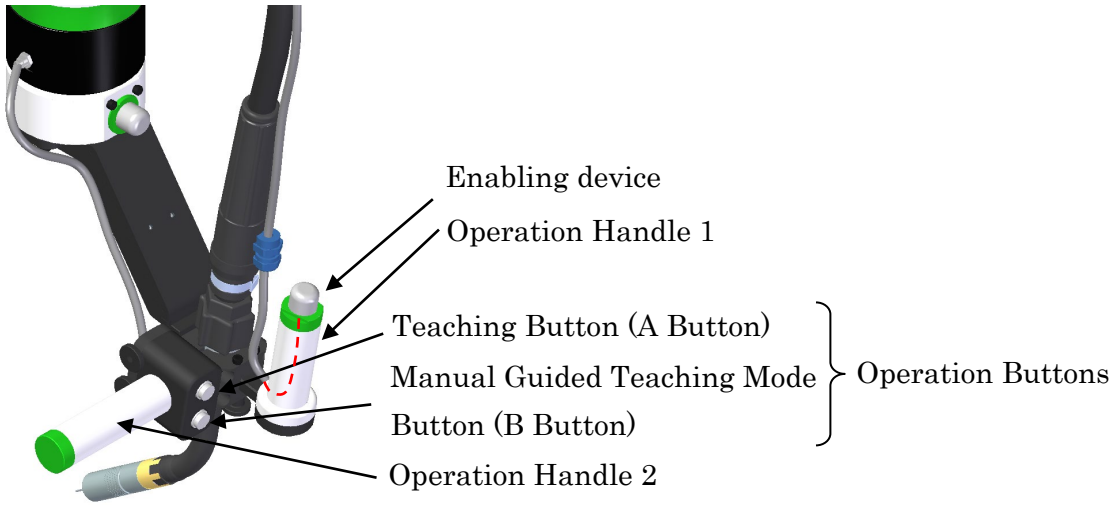


Fig. 9.6.2(a) Manual Guided Teaching Handle

Operation Handle 1 and Operation Handle 2 are removable easily without using any tool.
When removing Operation Handle 1, the Enabling device is needed to be removed and mounted on Adapter.
The Enabling device can be separated at the Relay connector.
The procedure how to moving the Enabling device is below.

1. Separate Relay connector.
2. Remove the enabling device from Operation Handle1.
3. Attach the enabling device to Adapter.
4. Connect Relay connector.

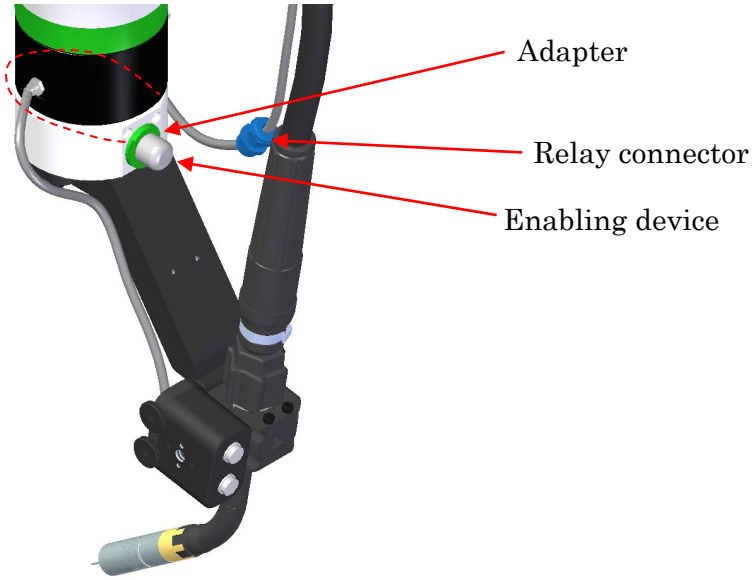


Fig. 9.6.2(b) Appearance after removing Manual Guided Teaching Handle

9.6.3 Connection

Fig 9.6.3(a), Fig 9.6.3(b) shows constructions of the Manual Guided Teaching Handle.
Torch block and torch bracket specification in the diagram is DAIHEN torch BT350RD(A14L-0193-0351).
Please arrange the torch block and torch bracket according to torch specification.

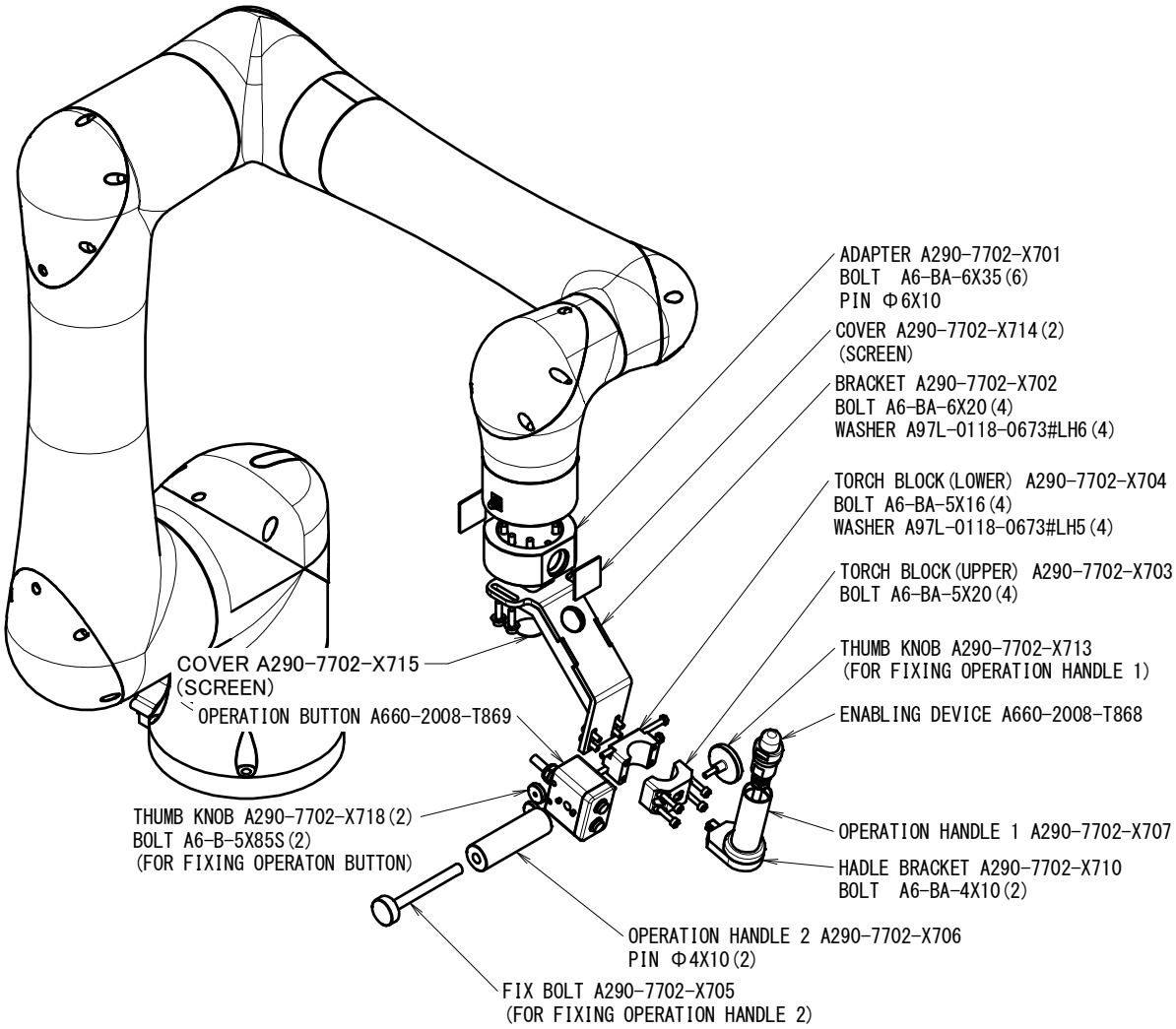


Fig. 9.6.3(a) Manual guided teaching handle constructions.

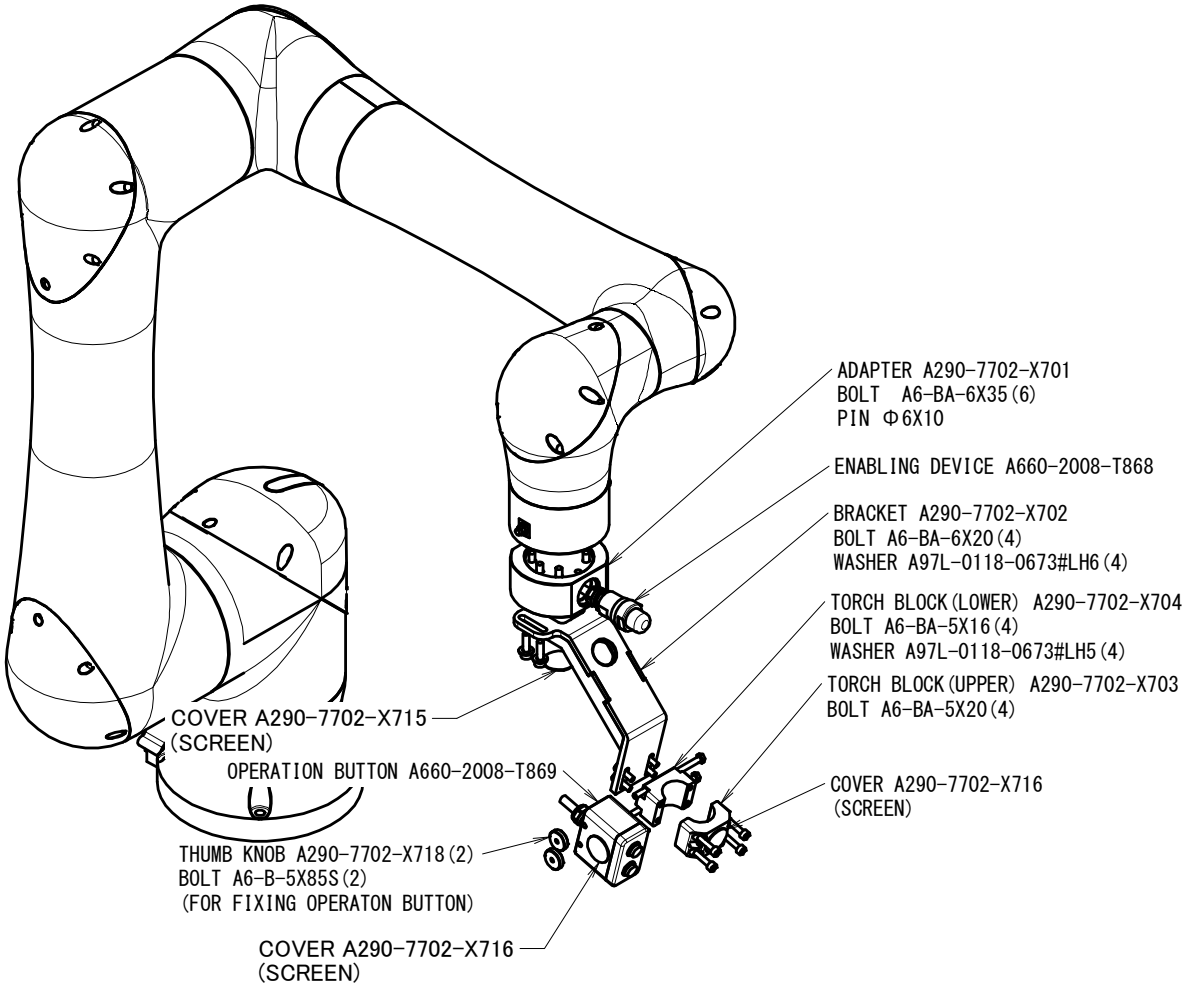


Fig.9.6.3(b) Manual guided teaching handle constructions (after removing Manual Guided Teaching Handle).

Fig 9.6.3(c) shows the Cable connection instruction.
The enabling device Switch is connected with the controller (CMRC15) via enabling device Cable.
Teaching Button and Manual Guided Teaching Mode Button are connected with CRX EE interface via Operation Handle Button Cable.

The enabling device cable and Device cable (User arranged device) should be suspended by cable hanger. Please decide the optimal suspending position in consideration of Device cable weight and robot operation range.

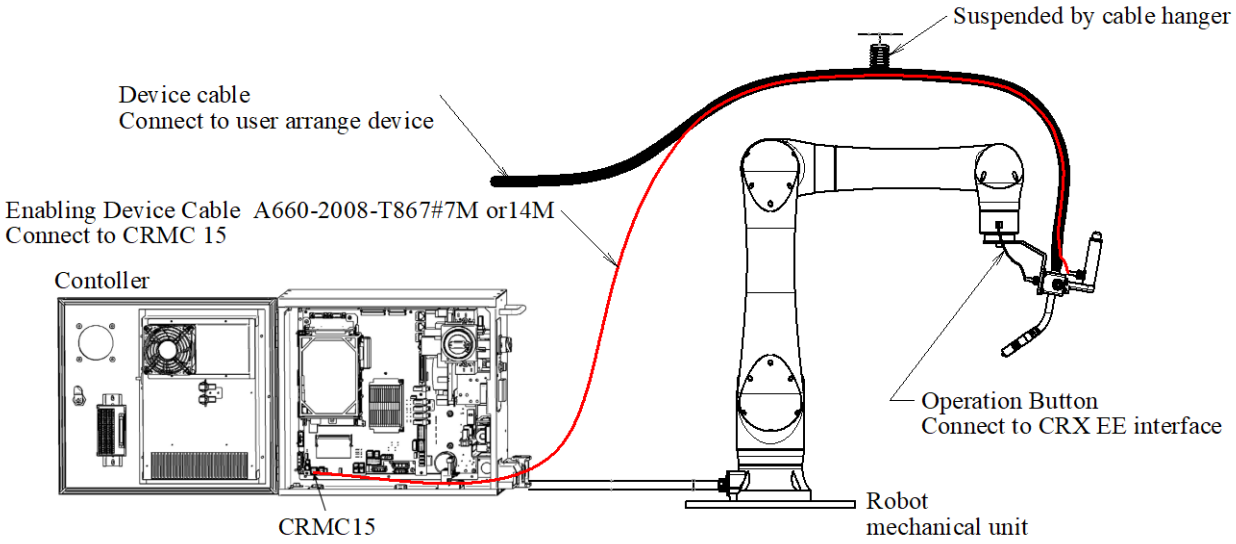


Fig. 9.6.3(c) Cable connection.

> ⚠ **WARNING**
> Please power off both the controller and the welding power source when connecting the cable connectors.

9.6.4 Robot Operation

Enabling device of the Manual Guided Teaching Handle

The Enabling device is located on the Manual Guided Teaching Handle. Manual Guided Teaching is enabled when the enabling device (the deadman switch) of the Teach Pendant or The Enabling device of the Manual Guided Teaching Handle is pressed.
The robot must not operate by two persons. If both the enabling switch of the Teach Pendant and the Manual Guided Teaching Handle are gripped, Manual Guided Teaching will not be enabled.

Manual Guided Teaching can be used in AUTO mode. This function does not perform in T1/T2 mode.

> ⚠ **WARNING**
> - Two or more persons must not operate robot by Manual Guided Teaching. Otherwise, serious personal injury could result.
> - Don’t execute the welding process during Manual Guided Teaching.

Teaching Button (A button)

A Teaching Button is located on the Switch Box of the Manual Guided Teaching Handle and it is labeled “A”. When the Teaching Button is pushed, robot motion instruction is added to the selected program and current robot position is recorded. This button is enabled only while at a teaching instruction is displayed on a program line. Please refer “1.2.5 Teaching” in this manual.

Manual Guided Teaching Mode button (B button)

A Manual Guided Teaching Mode button is located on the Switch Box of the Manual Guided Teaching Handle and it is labeled “B”. When the Manual Guided Teaching Mode button is pushed, Manual Guided Teaching Mode is changed. The Manual Guided Teaching function has three modes, “Free”, “Translation” and “TCP Fixed”.

The Mode is changed as following sequence.

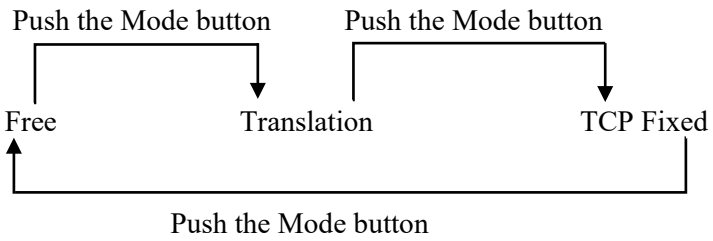


Fig. 9.6.4(a) Manual Guided Teaching Mode

When the button is pushed, Robot Operation Panel in the Tablet TP is opened automatically. You can check witch the mode is selected in the Panel.

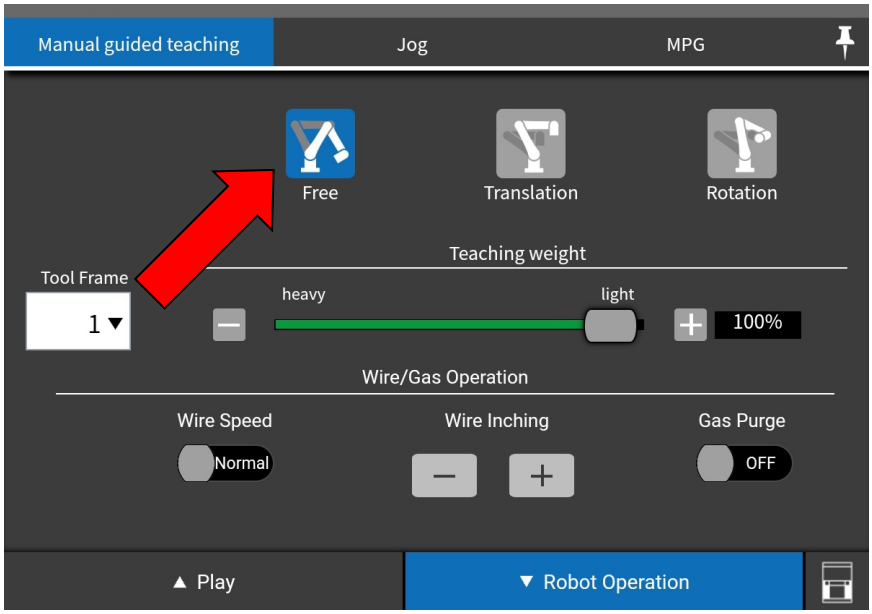


Fig. 9.6.4(b) Display Robot Operation Panel

9.6.5 Teaching

When user drag & drop “Handle Teach” instructions from the icon pallet to the program line, teaching by the handle device starts.

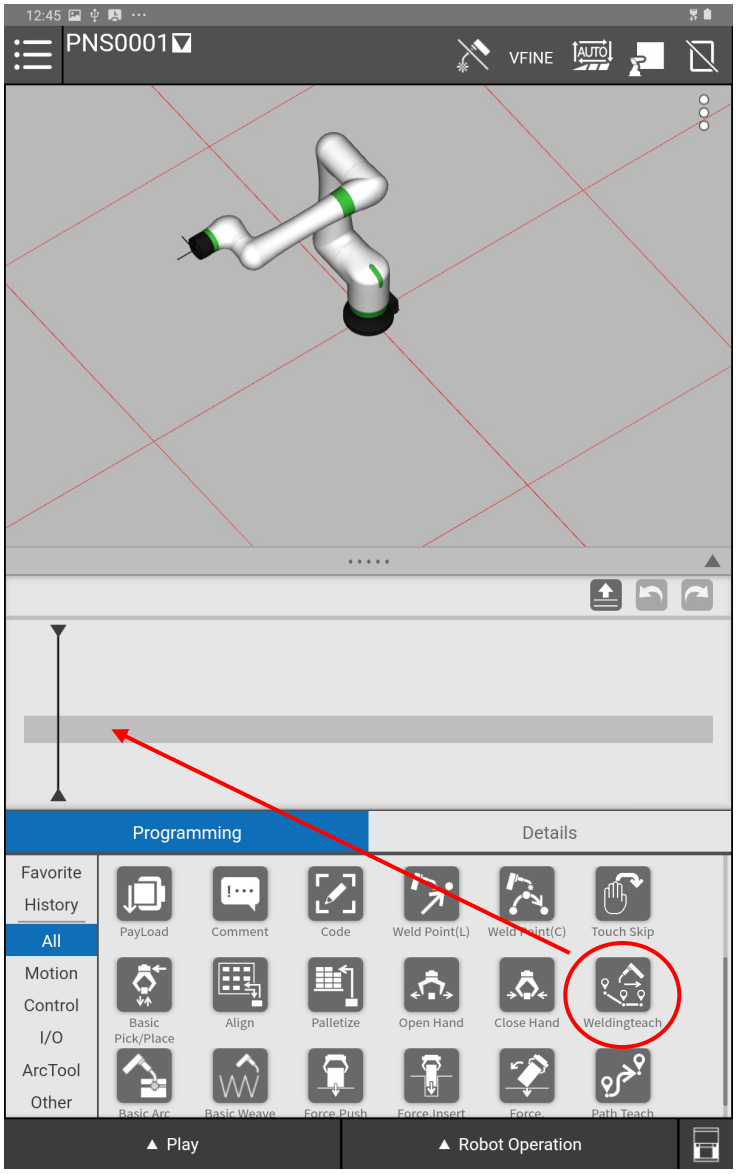


Fig. 9.6.5(a) Drag & Drop Handle Teaching icon

Following screen is displayed when the icon is dropped to the program line.

- The Teaching button is enabled.
- Program line is move to top of the screen. And “Handle Teach” icon with “!“ mark is displayed in the program line
- A detail screen of “Handle Teaching” instruction is displayed.
- Manuel Guided Teaching Panel appears automatically.

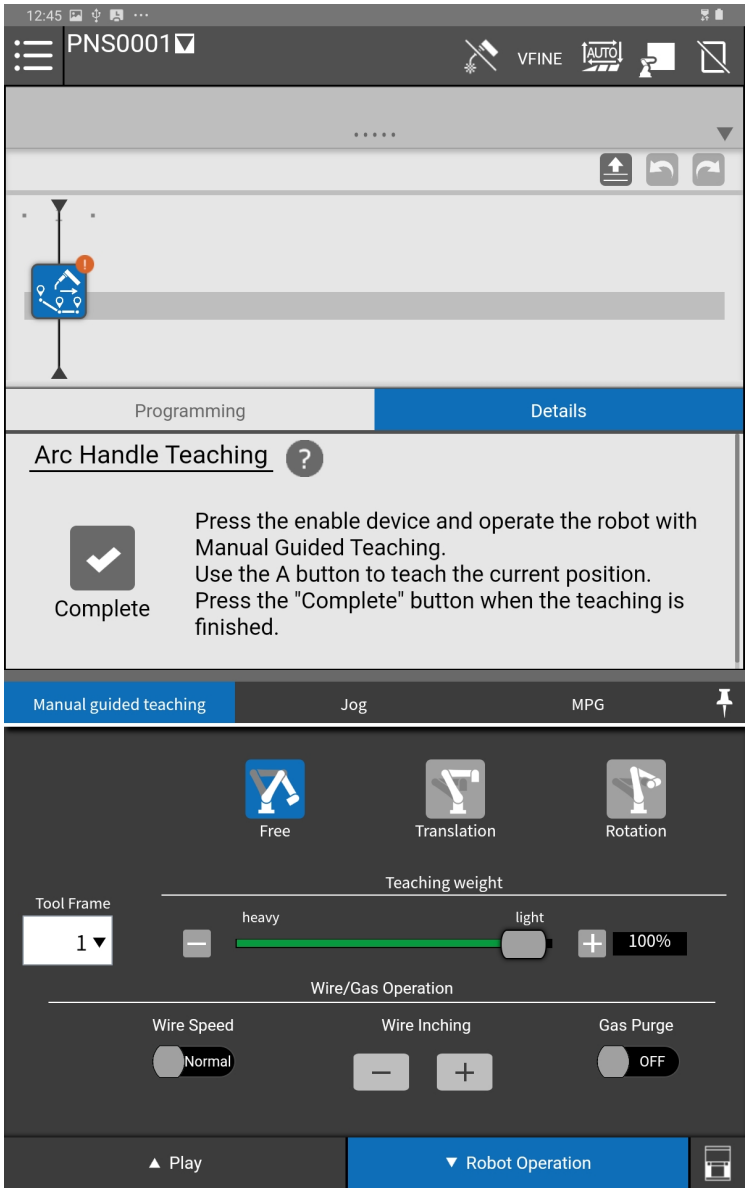


Fig. 9.6.5(b) Handle Teaching Mode

The Teaching Button is enabled while the “Handle Teach” instruction icon exists on the program line.

Instructions are added by pushing the teaching button. There are two operations, SHORT-press and LONG-press. If user pushes the button for longer than 1 second, it performs as LONG-press. If the user releases the button within 1 second, it performs as SHORT-press.
The instructions are inserted to the position of “Handle Teach” icon on the program line by pushing teaching button.

If the “Handle Teach” icon is NOT in “Basic Arc” instruction when the teaching button is pushed by SHORT-press, “Line Move” instruction is taught to the selected programs and current position is recorded. When the button is pushed by LONG-press, the “Basic Arc” instruction is taught to the selected programs and current position is recorded as the start position of the instruction. When the LONG-press is completed, LED of the teaching button will be turned on.

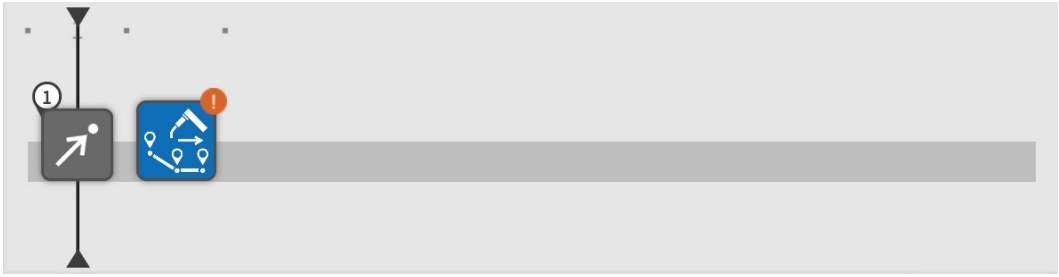


Fig. 9.6.5(c) Teach Line instruction

Fig. 9.6.5(d) Teach Basic Arc instruction

While handle teaching, other teaching operation such as teaching, delete and copy & paste of instruction can be also performed.
However, instruction including “Handle Teach” cannot be operated, neither moving an icon on the program line, copy & paste nor undo/redo.

When a complete button in the instruction screen is touched, teaching by the handle finishes. “Handle Teach” instruction disappears and the teaching button turns disabled.

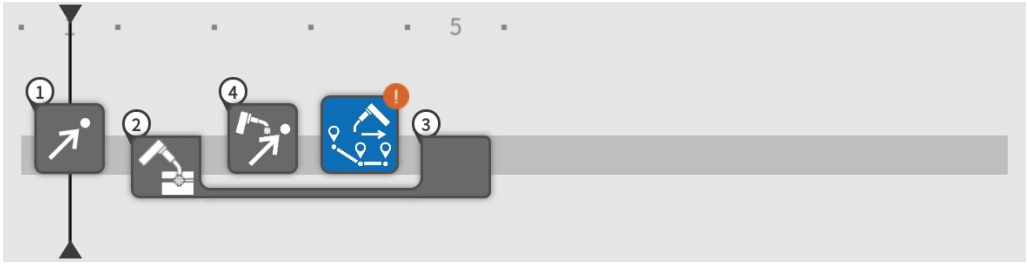


Fig. 9.6.5(e) Teach Weld Point (L) instruction

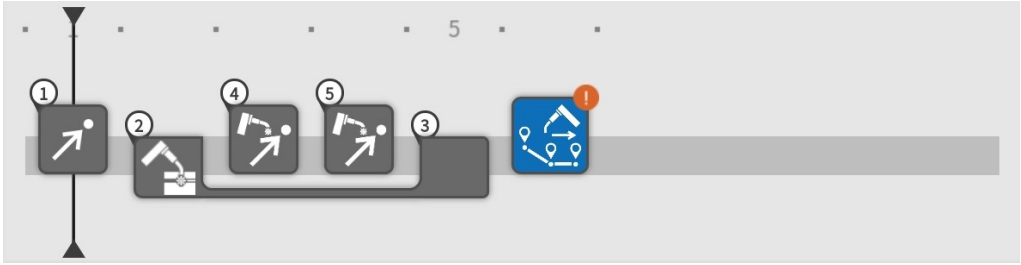


Fig. 9.6.5(f) Teach End point of Basic Arc instruction

While handle teaching, other teaching operation can be also performed, teaching, delete and copy & paste instruction.
User cannot operate “Handle Teach” instruction, move on the program line, copy & paste and undo/redo operation.

When a complete button in the detail screen of the instruction is touched, teaching by the handle is finished “Handle Teach” instruction disappear and the teaching bottom is disabled.

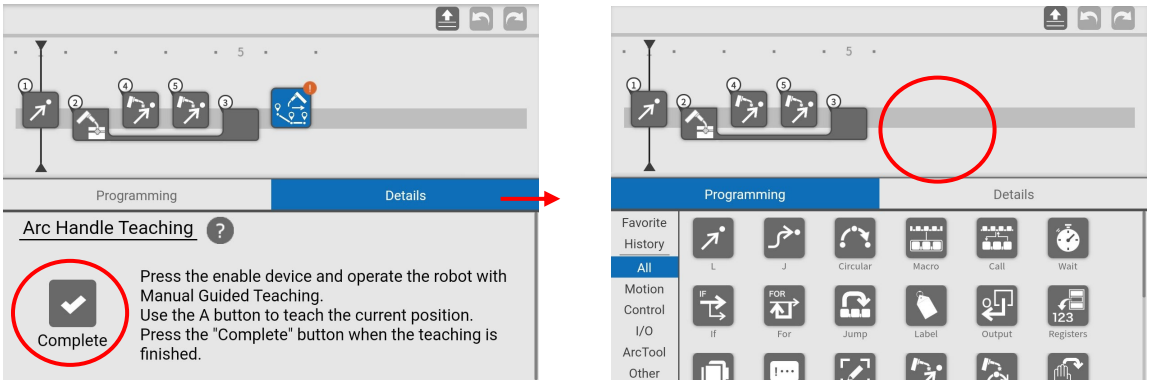


Fig. 9.6.5(g) Complete Handle Teaching

To execute the arc welding program, please refer to Chapter 9.5 “EXECUTING THE ARC WELDING PROGRAM”.

9.6.6 Teaching Manual Guided Teaching Handle by User

The FANUC Manual Guided Teaching Handle is certificated by the certification body. It consists following components.

Manual Guided Teaching Handle device

- The device mount to wrist flange of CRX series robot. Fig. 9.6.6 (a) shows the CRX wrist flange interface.

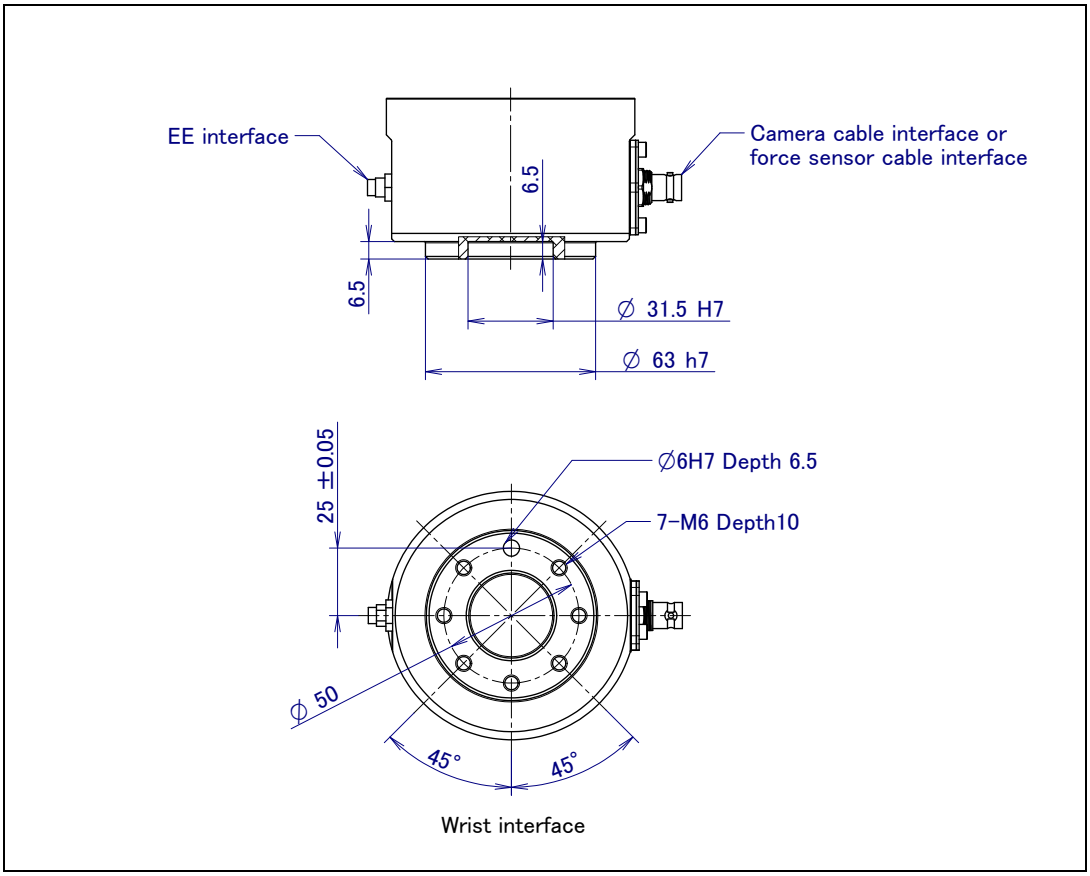


Fig. 9.6.6 (a) CEX wrist flange interface

Enabling device

- The switch is a certificated three position switch and it has dual channel safety signal,
- The switch is wired to safety input SFDI1 in CMRC15 of R-30iB Mini Plus controller. Table 9.6.6(a) shows the connector specification. Fig. 9.6.6(b) shows the circuit diagram of controller main board and pin layout of Safety inputs (CRMC15)
- While the switch is middle position, SFDI1 is ON, and in other situation it is OFF.
- The switch and peripheral circuit is protected as IP-56
- When the enabling device is ON, it performs to enable Manual Guided Teaching function. The contact stop function is disabled during the Manual Guided Teaching operation.
- The safety function meets EN ISO 13849-1:2015 (PL d, Cat. 3) and IEC 61508 2nd Ed SIL3. It is certificated by the certification body.

A1	24V-2	B1	0V
A2	24V-2	B2	0V
A3	SFDI11	B3	SFDI21
A4	SFDI12	B4	SFDI22

Connector pin layout

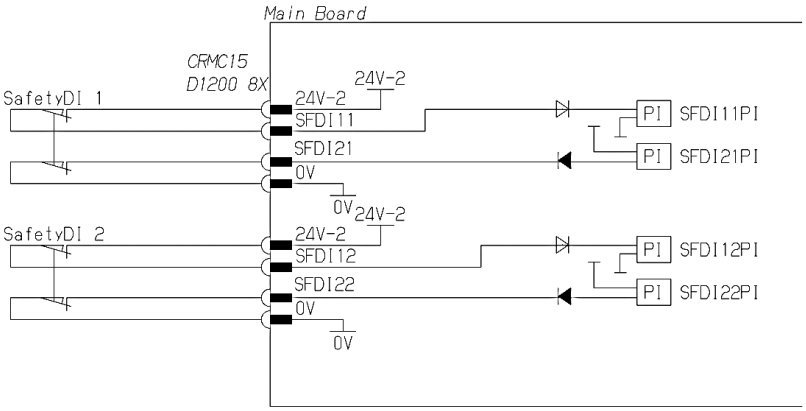


Fig. 9.6.6(b) Safety DI connection diagram

Table 9.6.6(a) Connector specification

Parts name	Manufacturer	Manufacturer specification	Fanuc specification
Connector	TYCO ELECTRONICS AMP CO LTD.	1-1827864-4	A63L-0002-0066#R08DX

Teaching button

- The “Teaching” button is connected Digital input 1 in CRX EE interface. Fig. 9.6.6 (c) shows the Pin layout for CRX EE interface. Table 9.6.6(b) shows the EE connector specification
- When the button is changed OFF to ON while the Handle Teach instruction is displayed on the program line, an instruction is taught to selected robot program and current position is recorded. Please refer “1.2.5 Teaching” in this manual.

“Manual Guided Teaching Mode” button

- The “Manual Guided Teaching Mode” button is connected Digital input 2 in CRX EE interface. Fig. 9.6.6(c) shows the Pin layout for CRX EE interface. Table 9.6.6(b) shows the EE connector specification
- When the button is changed to ON, selected Manual Guided Teaching mode is change. Please refer “1.2.4 Robot Operation” in this manual.

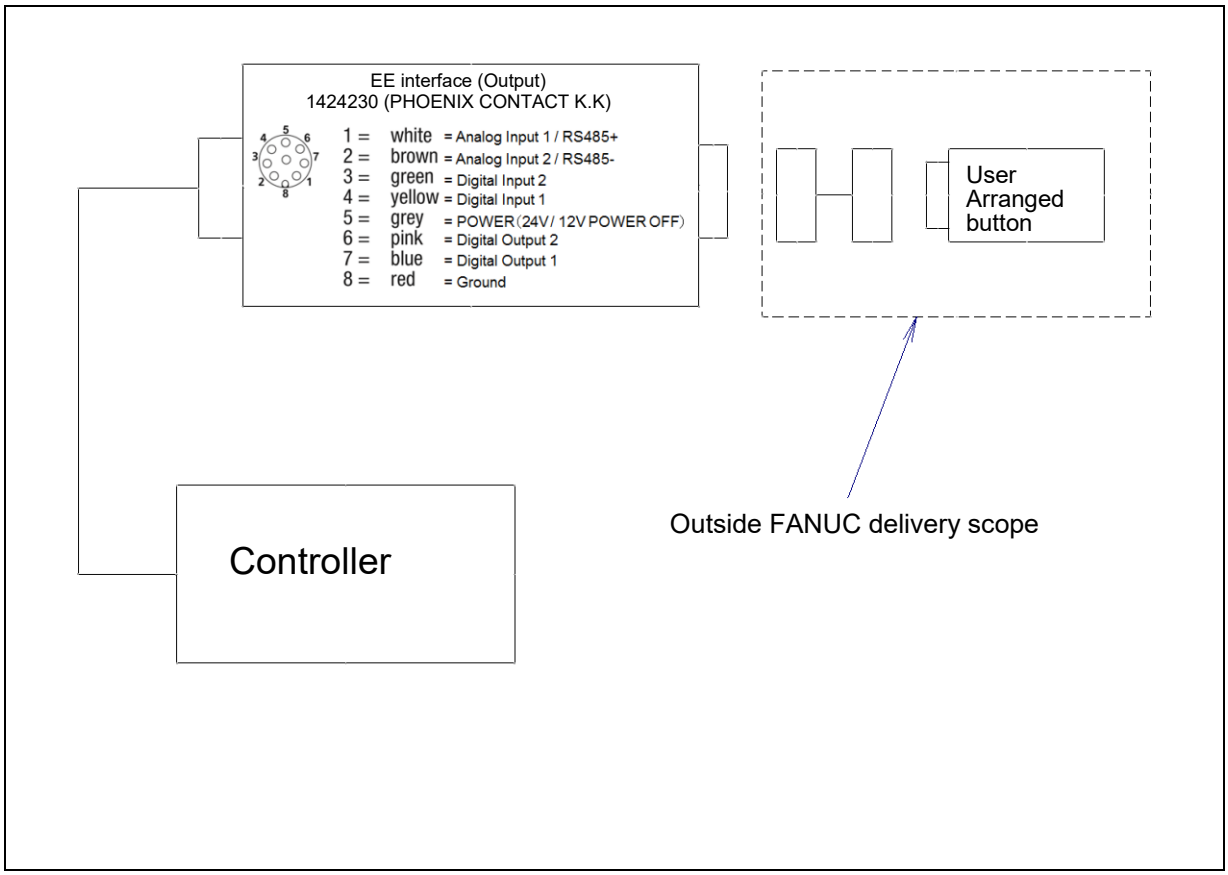


Fig. 9.6.6(c) Pin layout for CRX EE interface

Table 9.6.6(b) Connector specifications (User side)

Parts name	Manufacturer	Manufacturer specification
EE	PHOENIX CONTACT K.K	1404190 Straight plug 1404194 Angle plug

Software
- 7DF5/10 or later software version supports this function.
- S530 software option must be ordered to use the Manual Guided Teaching Handle. When S530 is ordered safety input SFDI1 is used for the enabling device. RI[1] is used for “Teaching” button. RI[2] is used for “Manual Guided Teaching Mode” buttons. These signals cannot be used for other purpose.

User must follow the same approach and implementation as above description to develop the Manual Guided Teaching Handle for FANUC CRX series robot.

> ⚠ **WARNING**
> The robot system including the manual guided teaching device must comply with ISO 10218-1 and ISO 10218-2. It is recommended to get a certificate from a certification body.

10 TOOL INTERFACE

This chapter describes the tool interface specification which is available on the EE connector mounted on the wrist of FANUC Robot CRX series.

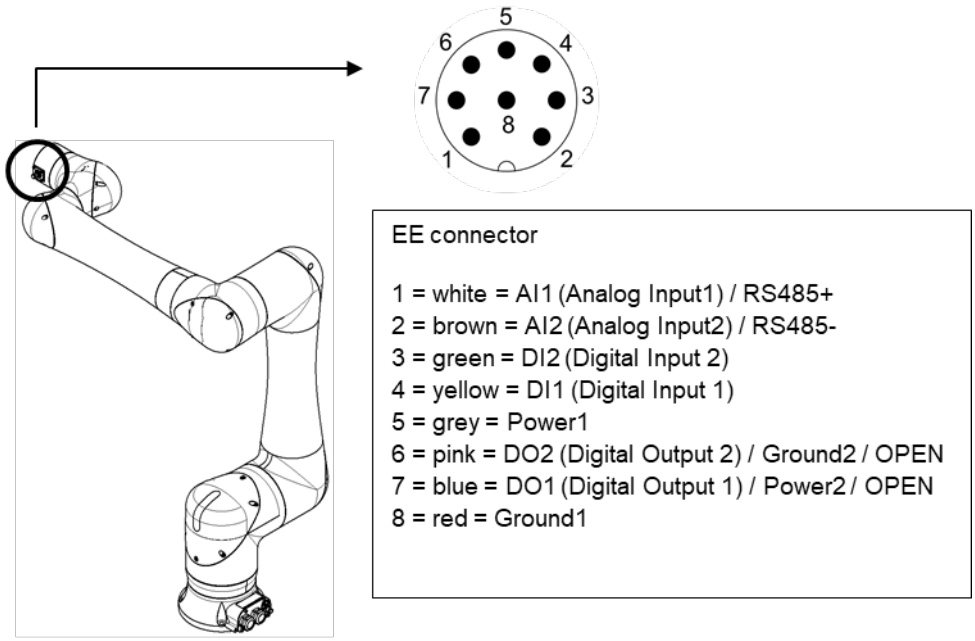


Fig. 10 (a) EE connector

10.1 EE INTERFACE SETUP SCREEN

EE Interface setup screen allows to configure the tool interface (EE Interface) according to the electrical specification of the peripheral device. This screen is available as a standard feature of FANUC Robot CRX series with Tablet TP. Tap the menu icon on the Tablet TP, and then select “Setup” -> “EE Interface Setup” to show EE Interface Setup screen similar to the following.

⚠ CAUTION

1 When EE Interface configuration is changed, the robot controller must be re-started to take effect.
2 Be sure to complete the EE Interface configuration and turn off the robot controller before connecting the device to EE connector. If you connect the device before configuration is complete, the device may be damaged, for example, due to incorrect power supply voltage.
3 The EE Interface Setup screen is available only on V9.40P/05 or later software version. If V9.40P/04 or older software version is used, please update the robot software to the latest version (V9.40P/05 or later).

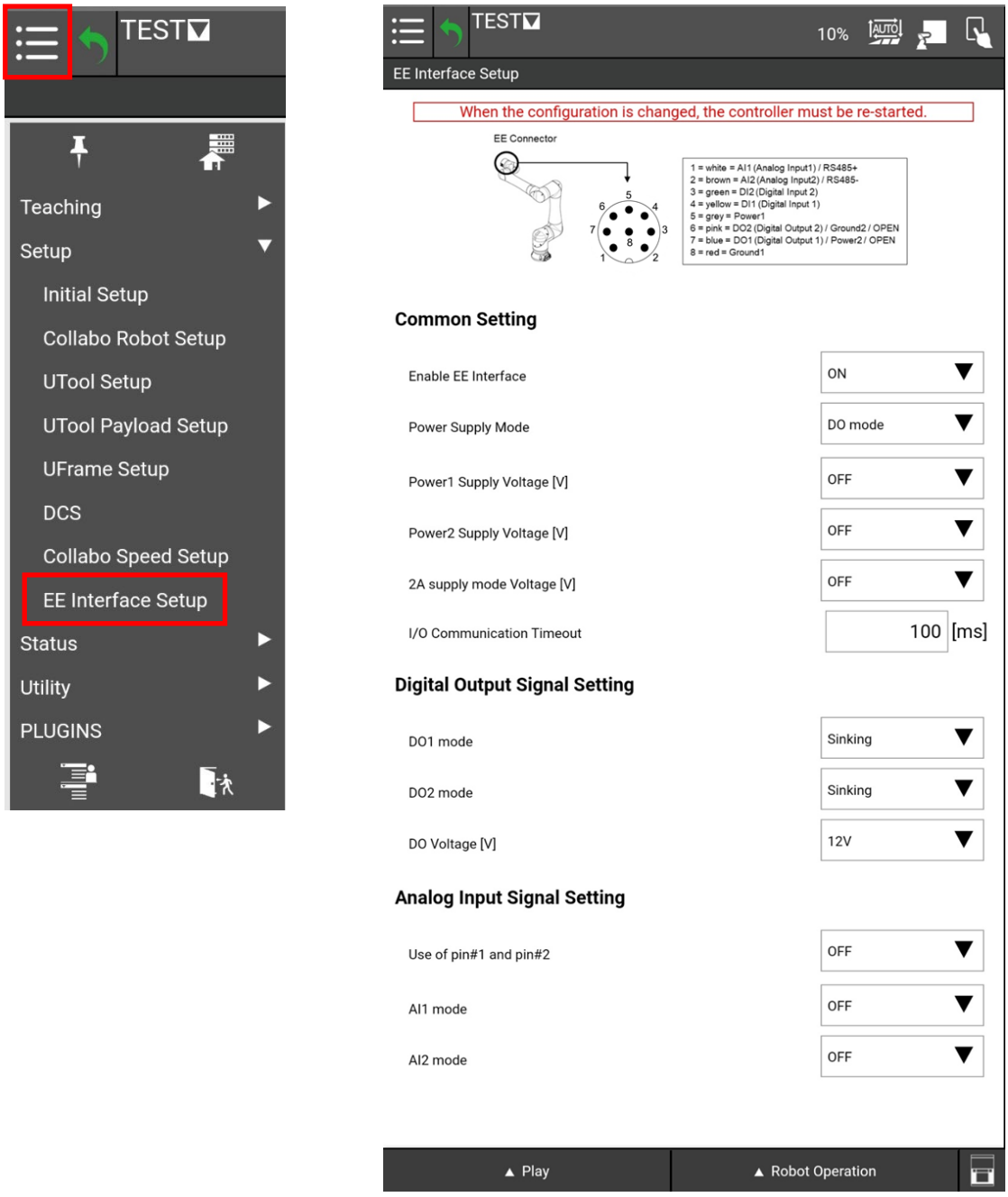


Fig. 10.1 (a) EE Interface Setup screen

Table 10.1 (a) EE Interface Setup Items

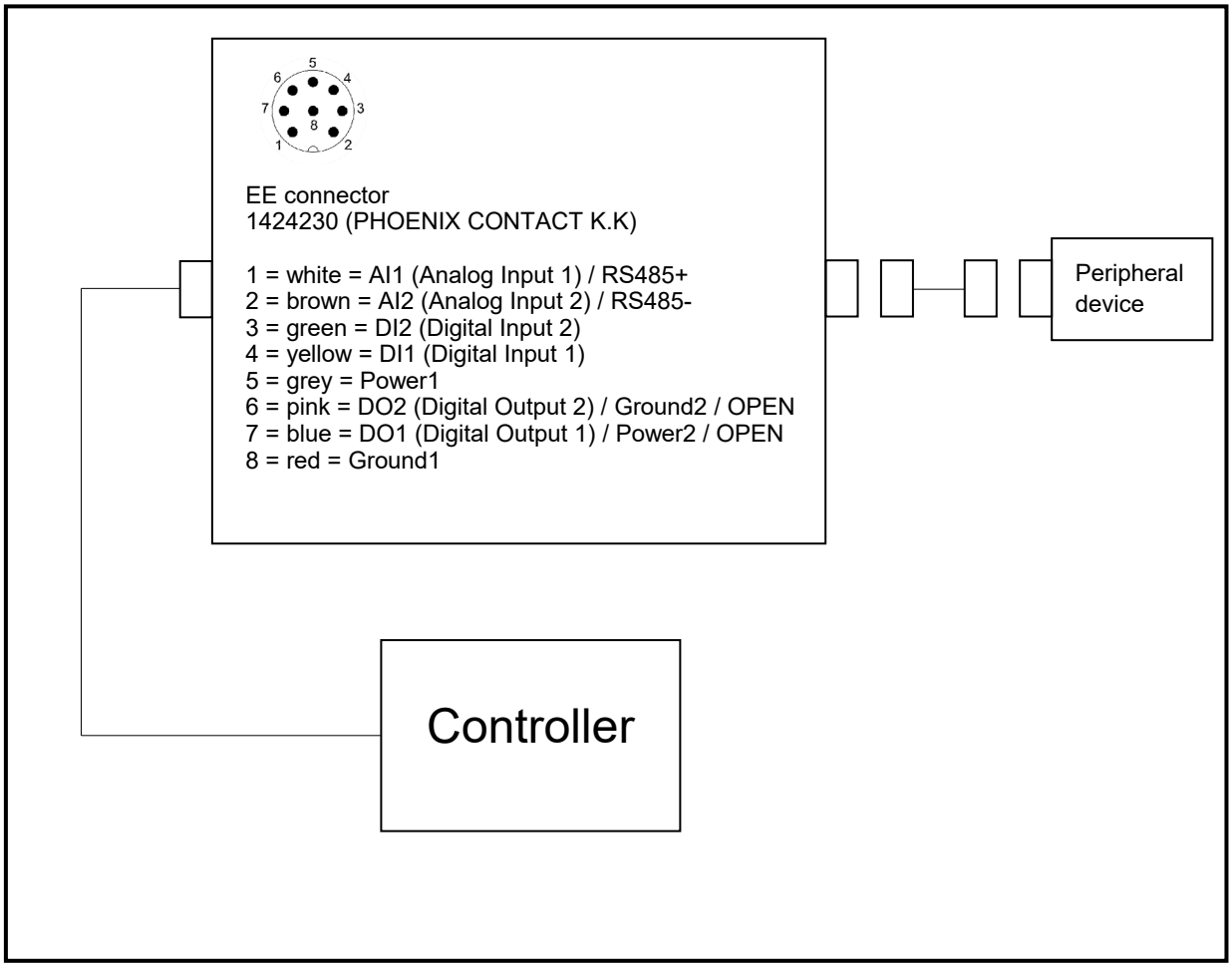
Item	Description
Enable EE Interface	Enable/disable EE Interface. • OFF • ON (default)
Power Supply Mode	Set power supply mode of EE Interface. • Digital output mode (default) • 2A supply mode • 2 pin supply mode
Power1 Supply Voltage [V]	Set power supply voltage for Power1 (pin #5). • OFF (No power supply) (default) • 12V • 24V

Item	Description
Power2 Supply Voltage [V]	Set power supply voltage for Power2 (pin #7). • OFF (No power supply) (default) • 12V • 24V
2A supply mode Voltage [V]	Set voltage when “2A supply mode” is selected for “Power Supply Mode”. • OFF (No power supply) (default) • 12V • 24V
I/O Communication Timeout	Specify the I/O time-out value [ms]. The system posts an alarm “HOST-424 IO is not updated during $TLIF.$IO_TIMEOUT[ms] for Tool I/F function” with STOP severity if I/O was not updated for the specified time. The default value is 100 [ms].
DO1 mode	Specify the digital output mode for DO1 (pin #7). • DO is not used • Sinking (default) • Sourcing • Push / Pull
DO2 mode	Specify the digital output mode for DO2 (pin #6). • DO is not used • Sinking (default) • Sourcing • Push / Pull
DO Voltage [V]	Set the voltage of DO1 (pin #7) and DO2 (pin #6). Either “12V” or “24V” must be selected if “Sourcing” or “Push / Pull” is specified for the item “DO1 mode” or “DO2 mode”. • OFF • 12V (default) • 24V
Use of pin #1 and pin #2	Select the use of the pin #1 and #2 on the EE Interface. • OFF • RS485 (default) • Analog Input
AI1 mode	Specify the analog input mode for AI1 (pin #1). • OFF (default) • 0-10V (Voltage) • 4-20mA (Current)
AI2 mode	Specify the analog input mode for AI2 (pin #2). • OFF (default) • 0-10V (Voltage) • 4-20mA (Current)

⚠ CAUTION

1 When 2A supply mode or 2 pin power supply mode is used, DO1 (Power2) and DO2 (Ground2) are not available.
2 When RS485 serial communication is used, analog input signal is not available.
3 When using the analog input, the item “Use of pin #1 and pin #2” must be set “Analog Input”, and the AI mode of corresponding analog input pin must be set “0-10V (Voltage)” or “4-20mA (Current)”.

10.2 CONNECTION BETWEEN THE TOOL INTERFACE AND PERIPHERAL DEVICES



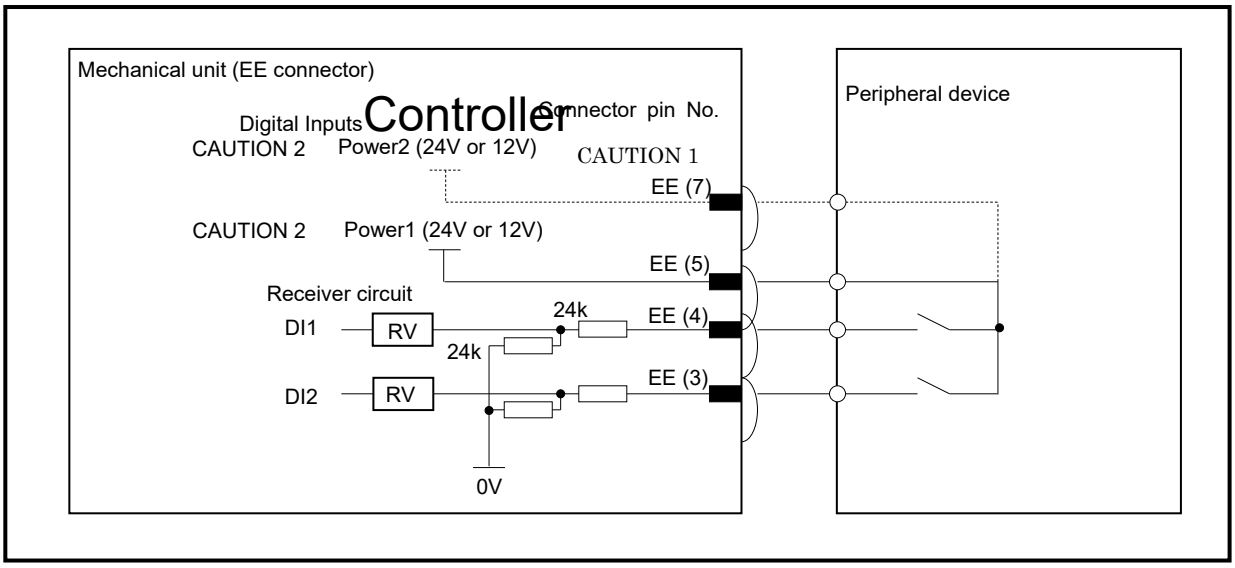
⚠ CAUTION
For setup of each pin, refer to the Section 10.1 EE Interface Setup screen.

Table 10.2 (a) Connector specifications (User side)

Cable name	Input side (J1 base)	Output side (Wrist flange)		Maker/dealer
EE	————	1404190 1404194	Straight plug (Attached) Angle plug	PHOENIX CONTACT K.K

Table 10.2 (b) Connector specifications (Mechanical unit side・reference)

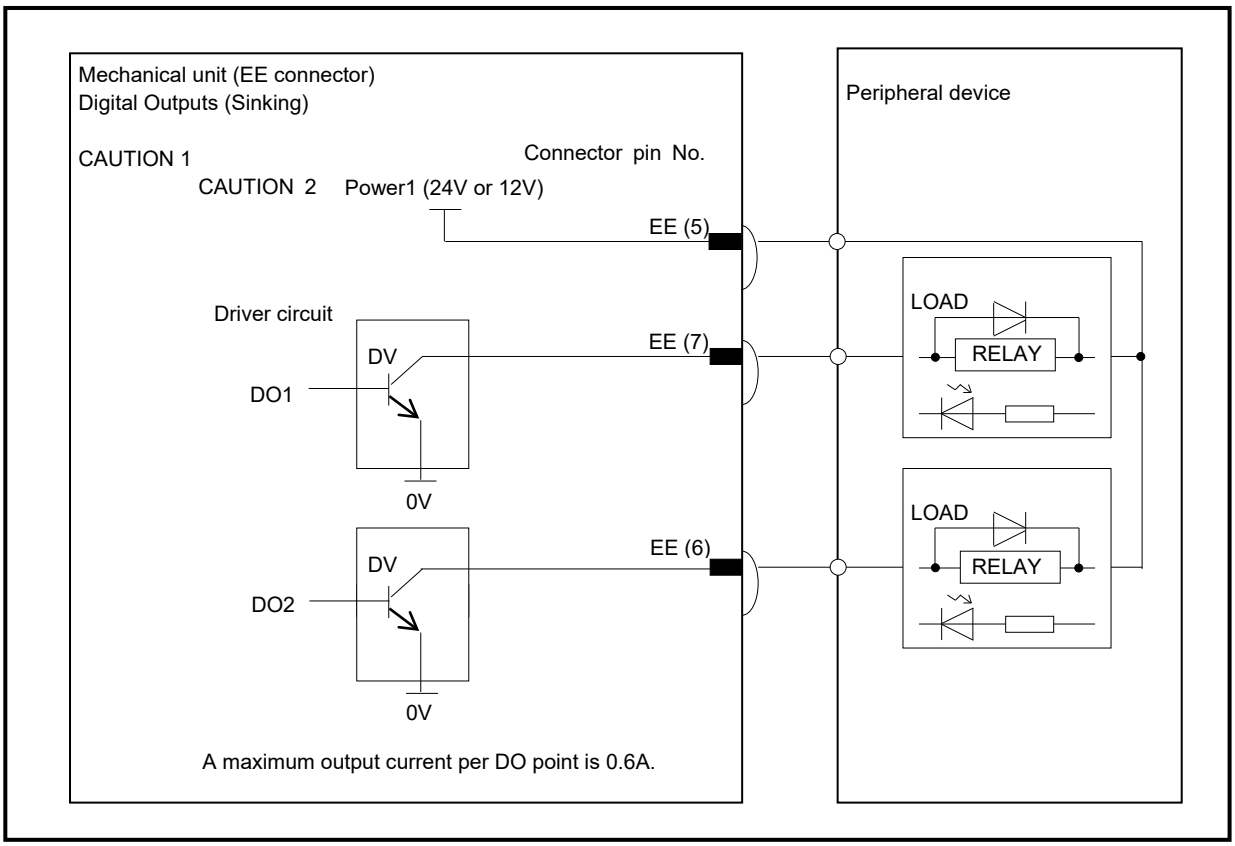
Cable name	Input side (J1 base)	Output side (Wrist flange)	Maker/dealer
EE	————	1424230	PHOENIX CONTACT K.K



⚠ CAUTION

1 Power can be supplied by pin #5 or pin #7.
For setup power supply, refer to the Section 10.1 EE Interface Setup screen.
When pin #7 as power supply is used, DO1 and DO2 are not available.
Pin #5 and pin #7 are independent power supply. Pin #5 and pin #7 must not be connected.

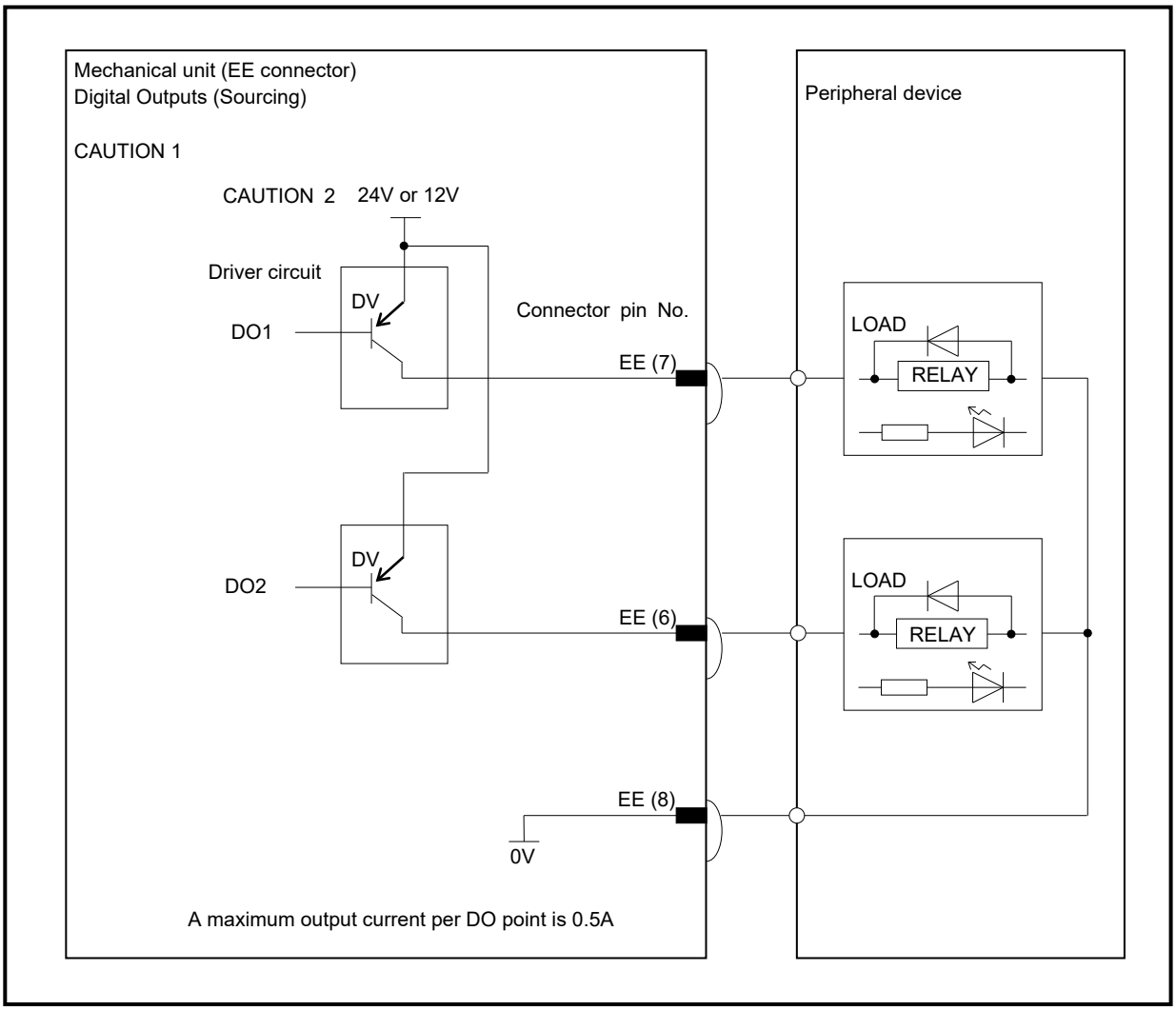
2 Supply voltage can be selected from 24V and 12V.
For setup Supply voltage, refer to the Section 10.1 EE Interface Setup screen.



⚠ CAUTION

1 Digital output mode can be selected from Sinking, Sourcing and Push / Pull. DO1 and DO2 can be set independently.
For setup digital output mode, refer to the Section 10.1 EE Interface Setup screen.

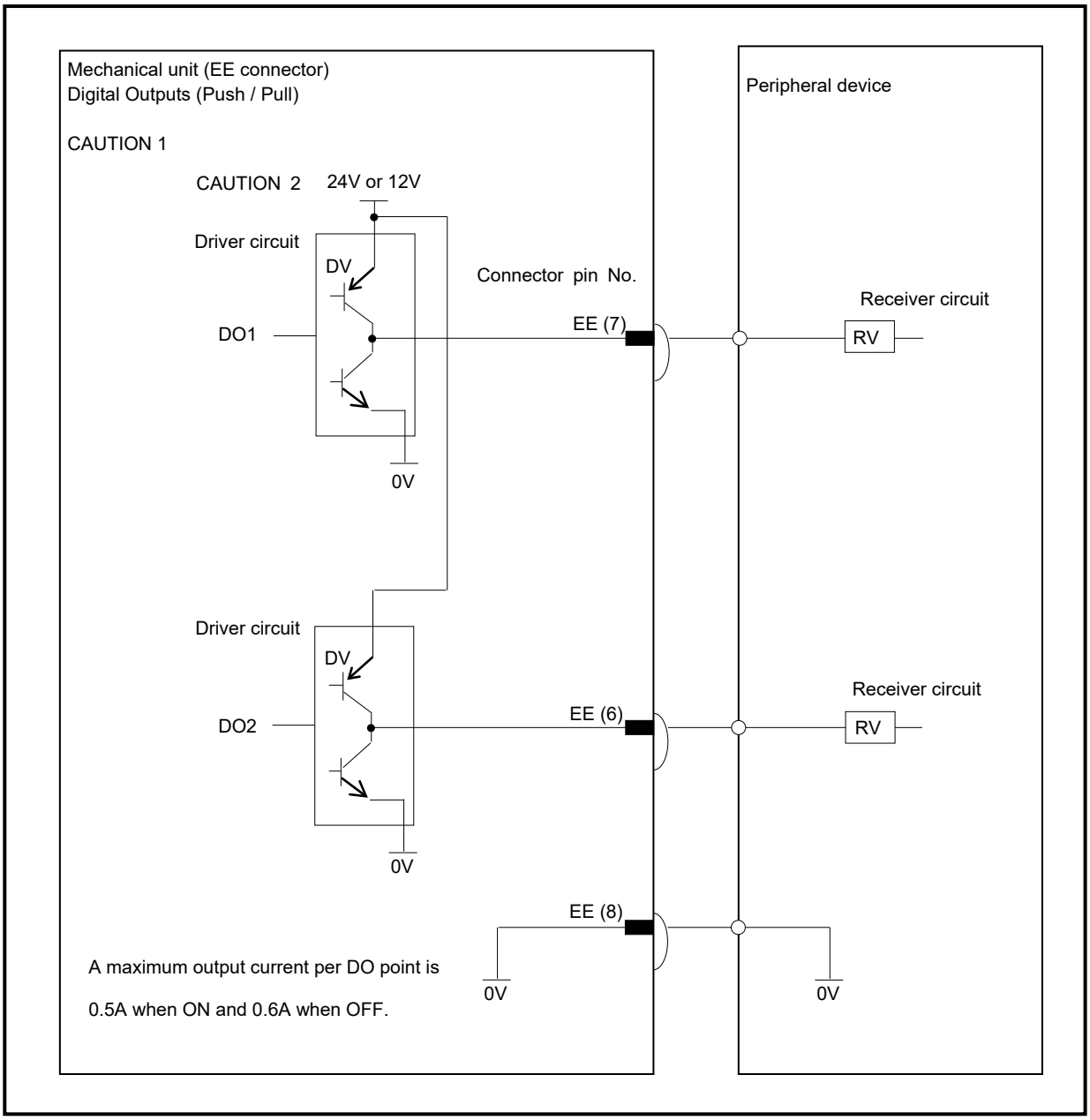
2 Supply voltage can be selected from 24V and 12V.
For setup Supply voltage, refer to the Section 10.1 EE Interface Setup screen.



⚠ CAUTION

1 Digital output mode can be selected from Sinking, Sourcing and Push / Pull. DO1 and DO2 can be set independently.
For setup digital output mode, refer to the Section 10.1 EE Interface Setup screen.

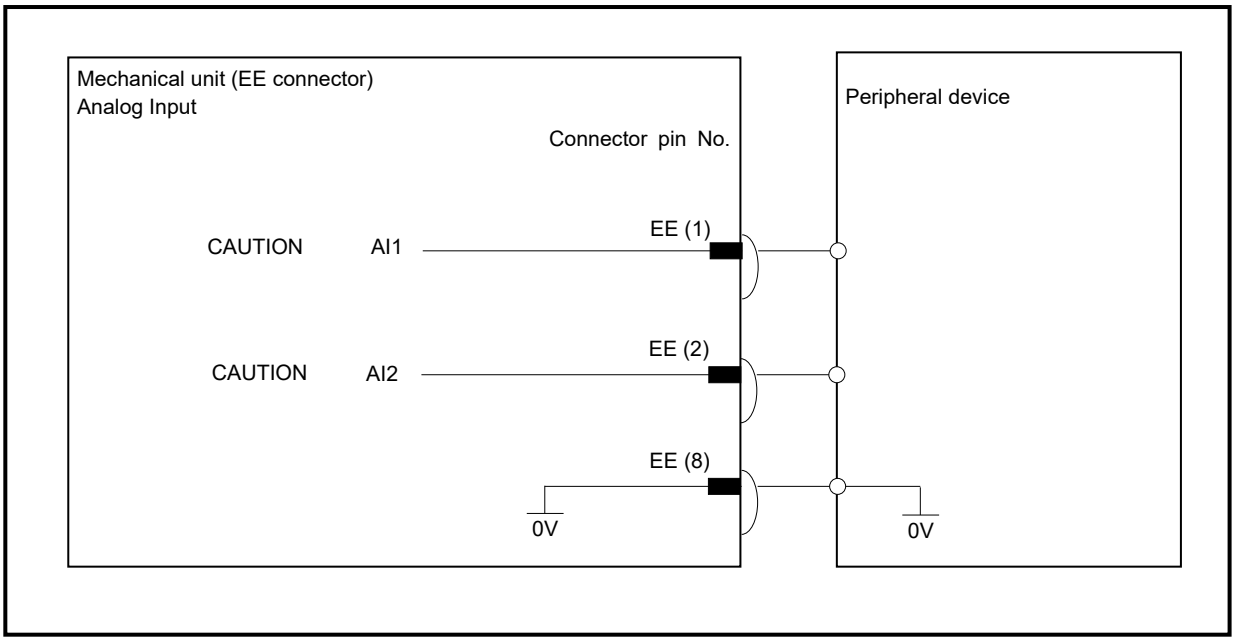
2 Voltage of digital output (Sourcing) can be selected from 24V and 12V.
For setup voltage of digital output, refer to the Section 10.1 EE Interface Setup screen.



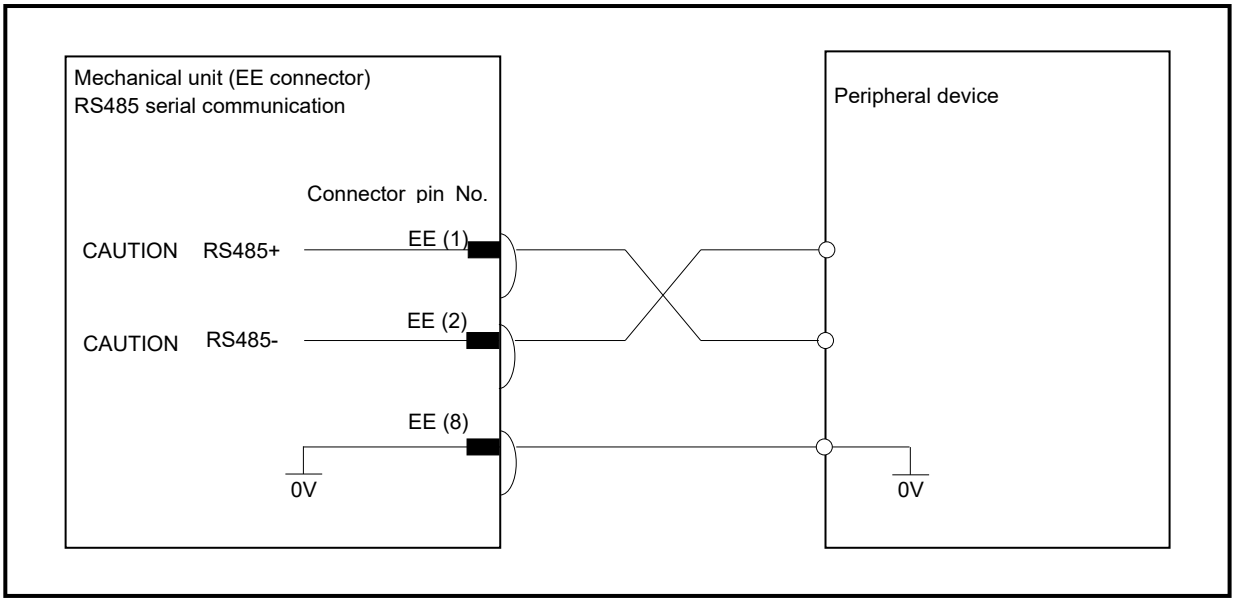
⚠ CAUTION

1 Digital output mode can be selected from Sinking, Sourcing and Push / Pull. DO1 and DO2 can be set independently.
For setup digital output mode, refer to the Section 10.1 EE Interface Setup screen.

2 Voltage of digital output (Push / Pull) can be selected from 24V and 12V.
For setup voltage of digital output, refer to the Section 10.1 EE Interface Setup screen.



⚠ CAUTION
When analog input signal is used, RS485 communication is not available.
AI1 and AI2 can be set independently.
For setup analog input mode, refer to the Section 10.1 EE Interface Setup screen.



⚠ CAUTION
When RS485 serial communication is used, analog input signal is not available.

10.3 INTERNAL POWER SUPPLY AND INPUT/OUTPUT SIGNAL SPECIFICATIONS

Following are the specifications of internal power supply and input/output signal from Tool Interface to peripheral devices.

10.3.1 INTERNAL POWER SUPPLY SPECIFICATIONS

Following are the specifications of internal power supply from Tool Interface to peripheral devices.

Set the internal power supply (Power1, Power2) to OFF (No power supply), 12V or 24V.
Power1 and Power2 are independent power supply and can be set different power supply voltage respectively.
The electrical specifications are shown below.

Table 10.3.1 (a) : Electrical specifications of internal power supply

Parameter	Min	Typ	Max	Unit
Supply voltage in 24V	21.6	24	26.4	V
Supply voltage in 12V	10.8	12	13.2	V
Supply current in both modes (*2)	--	1000	2000 (*1)	mA
Supply current in 2A supply mode (*2)	--	2000	2000	mA

(*1) When 2A supply mode is not used, 2000 mA is for max 1 second. Duty cycle max: 10%. Average current must not exceed 1000 mA. When Power2 is used, total current of Power1 and Power2 must not exceed 2000 mA.
(*2) When connecting inductive loads, please use a protective diode.

> ⚠ **CAUTION**
> When 2A supply mode is used, DO1 (Power2) and DO2 (Ground2) are not available.
> Power1 and Power2 are independent power supply. Power1 and Power2 must not be connected.

10.3.2 DIGITAL OUTPUT SIGNAL SPECIFICATIONS

Following are the specifications of digital output signals from Tool Interface to peripheral devices.

Digital output signals support three different modes.

Table 10.3.2 (a) : Digital output signal modes

Mode	Active	Inactive
Sinking	Low	Open
Sourcing	High	Open
Push / Pull	High	Low

The electrical specifications are shown below.

Table 10.3.2 (b) : Electrical specifications of digital output signals

Parameter	Min	Typ	Max	Unit
Voltage when open	-0.5	-	26	V
Current when sinking / pin	0	600	3000 (*1)	mA
Current when sourcing / pin	-	-	500 (*2)	mA

(*1) 3000 mA for max 1 second. Duty cycle max: 10%. Average current must not exceed 1000 mA.
(*2) Total current of power1 and source current of digital output signals must not exceed 2000 mA.

⚠ CAUTION
When 2A supply mode is used, DO1 (Power2) and DO2 (Ground2) are not available.

10.3.3 DIGITAL INPUT SIGNAL SPECIFICATIONS

Following are the specifications of digital input signals from peripheral devices to Tool Interface.

Table 10.3.3 (a) : Electrical specifications of digital input signals

Parameter	Min	Typ	Max	Unit
Input voltage	-0.5	-	26	V
Logical low voltage	-	-	2.0	V
logical high voltage	5.5	-	-	V
Input resistance	-	48k		Ω

10.3.4 ANALOG INPUT SIGNAL SPECIFICATIONS

Following are the specifications of analog input signals from peripheral devices to Tool Interface.

Analog input signals are nondifferential and can be set to either voltage (0-10V) or current (4-20mA)
The electrical specifications are shown below.

Table 10.3.4 (a) : Electrical specifications of analog input signals

Parameter	Min	Typ	Max	Unit
Input voltage in voltage mode	-0.5	-	12.5	V
Input resistance range 0V to 10V	-	10.6k		Ω
Resolution	-	12	-	bit
Input voltage in current mode	-0.45	-	4.5	V
Input current in current mode	-2.5	-	24	mA
Input resistance range 4mA to 20mA	-	183	187	Ω
Resolution	-	12	-	bit

⚠ CAUTION
When analog input signal is used, RS485 communication is not available.

11 SOFTWARE UPDATE

In the CRX series, you can download the latest software and update the software of your CRX series robot.
You can confirm whether the latest software exists in the FANUC membership site.
Fanuc membership site Japan https://store.member.fanuc.co.jp/fanuc/store/
In the case of regions other than the above, please contact the service base of the neighborhood.

For more information about the installation method of the software, please confirm the attached software update procedure for the CRX series robot.

INDEX

REVISION RECORD

Edition	Date	Contents
03	Aug.,2021	For 7DF5/06 to 15 Applied to R-30*i*B Plus/R-30*i*B Mate Plus controller
02	Dec.,2020	For 7DF5/05
01	Sep., 2020	

B-84274EN/03