

DART-Studio User Manual

Version 1.0.0.4



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Preface

This User Manual introduces DART-Studio SW installation and operation methods.

The content of this manual refers to the latest product versions at the time of writing, and the product information provided in the manual is subject to change without prior notice to the user.

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This manual provides reliable information. However, we are not responsible for any loss or damage arising from errors, typos, or omissions in the manual. The information contained in this manual may change without prior notice due to product improvements.

For further information on the revision details, please visit the Doosan Robotics website (www.doosanrobotics.com).

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1 Getting Started

1.1 Setup

1.1.1 System Requirements

Before installing software, ensure that the computer meets the following hardware and software requirements.

Part	Minimum Specifications	Recommended Specifications
CPU	2.3GHz or higher	3.70GHz or faster processor Multiple cores recommended
RAM	4 GB	8 GB or more
Disk	1 GB of available space	2 GB or more of available space
Graphic Card	Intel HD Graphics 620 or similar	Intel UHD Graphics 620 or similar
Display Settings	at least 1280 x 1024	1920 x 1080 Full HD or higher
Mouse	Three-button mouse	Three-button mouse
Operating System	Microsoft Windows 7 SP1 (64-bit)	Microsoft Windows 10 (64-bit)



CAUTION

This software may have compatibility problems with a lower controller version than GF020400.

1.1.2 Installation

Install

- 1 Download and run the installer for DART-Studio.
- 2 On the **Select Destination Location** screen, accept or change the location for storing the DART-Studio program files, and then **Click**.
- 3 On the **Select Additional Tasks** screen, select or do not create a desktop shortcut, and then click **Next**.
- 4 On the **Ready to Install** screen, click **Install**.
- 5 On the **Completing the DART-Studio Setup Wizard** screen, select or do not launch DART-Studio, and then click **Finish**.

Uninstall

- 1 Depending on your device and version of Windows, access Uninstall or change a program screen from the Control Panel.
- 2 In the list view of programs, find and select your version of DART-Studio, and then click Uninstall.
- 3 On the Uninstallation Successful screen, click **OK**.

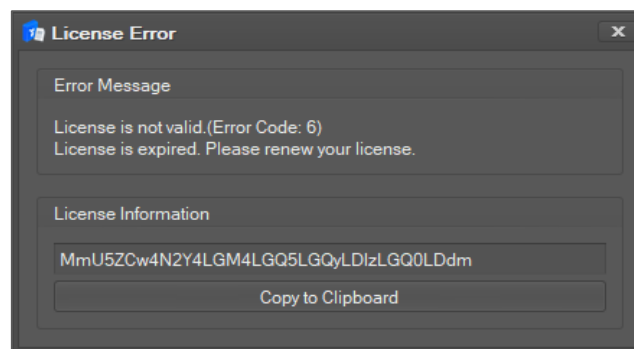
1.1.3 Licensing

The purpose of the license may vary depending on the user. In addition, the features available may vary depending on the intended use of the license. In addition, It is installed as a 30-day limited trial on the initial installation of the program and will no longer be available when the license expires.

Standalone License

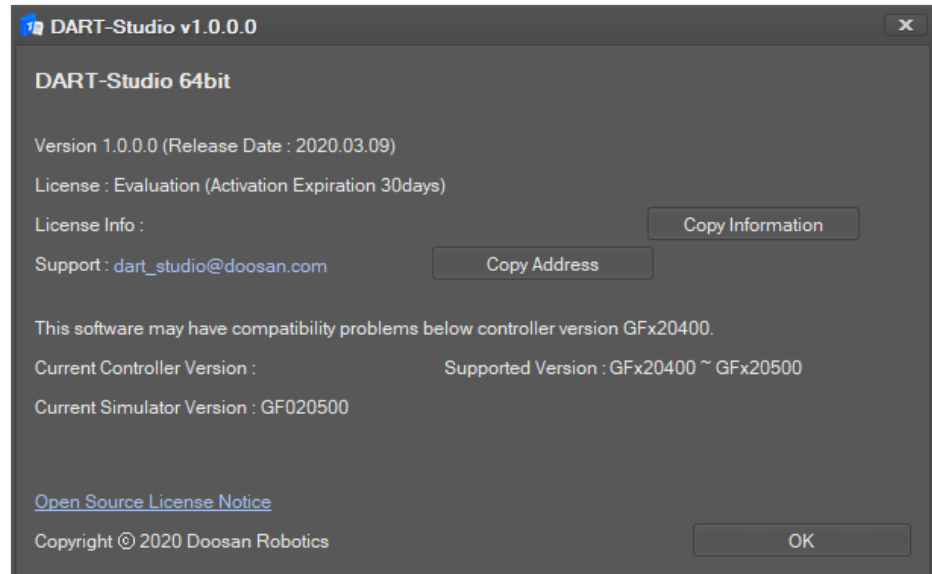
A standalone license is a product key that can be used to run DART-Studio on your device. The license must be validated and activated prior to its use.

- 1 Run the installed DART-Studio.
- 2 If the license file is not registered or the license is expired, DART-Studio will not run and you will see the **License Error** screen, as shown below.



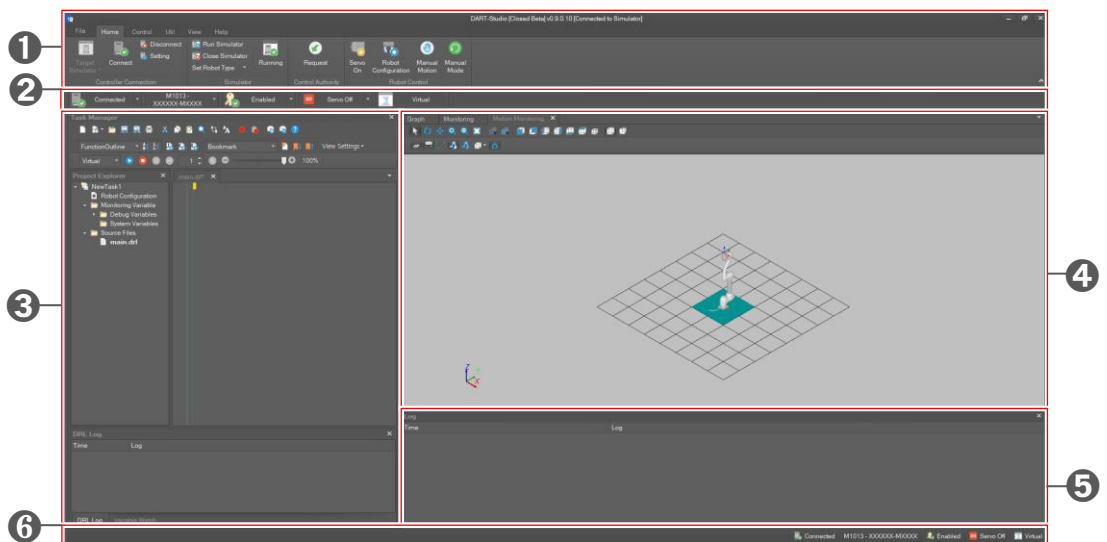
- 3 Click the **Copy to Clipboard** button of **License Information**. Inform your license provider about the generated license information key so you can obtain a license file.
- 4 Copy the license file to the installation path of DART-Studio to complete the license registration. (Generally, the installation path is C: \ Program Files \ Doosan Robotics \ DART-Studio.)
- 5 If you want to obtain a license file before the license error window appears, please inform the license provider about the generated the license information that you have copied by clicking the **Copy Information** button in the **License Info**. as shown below. The program information window pops up when you click the **Help-> Info-> Program Info** button on the top menu.

1 Getting Started



2 Software Overview

2.1 Layout Overview



- 1 Main menu

- 2 Monitoring bar

- 3 Task manager

- 4 Monitoring pane

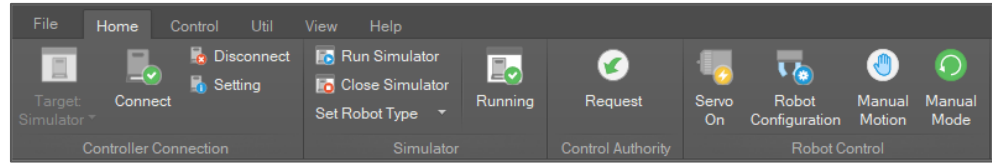
- 5 Message pane

- 6 Status bar


2.1.1 Main Menu

The main menu has 6 categories.

2 Software Overview

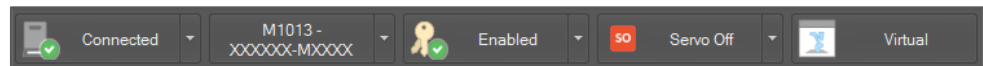


- **File:** Opens or saves project files, Language Setting, Exit Program.
- **Home:** Default menu for frequently used features.
- **Control:** Menu for robot control.
- **Util:** Menu for utility such as path generation.
- **View:** Menu for the view and layout setting.
- **Help:** Help menu for this software.

 **CAUTION** The **Util** menu may not be visible depending on the license you have or SW version.

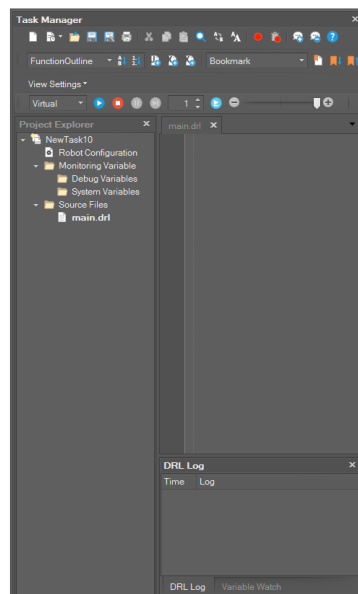
2.1.2 Monitoring Bar

The monitoring bar shows information on main system status. Detailed information is explained in **3.1 Monitoring Bar**.



2.1.3 Task Manager

Task Manager manages panes for robot control. There are three types of panes: **Project Explorer**, **DRL Editor** and **Variable Watch**. Detailed use is explained in **4 System Control**.



2.1.4 Monitoring Window

The **Monitoring** window manages panes for robot monitoring. There are three types of panes: **Monitoring**, **Graph** and **Motion Monitoring**. Detailed use is explained in **3 System Monitoring**.

Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Joint Space (5)																
Actual Angle	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Target Angle	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Actual Velocity	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Target Velocity	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Actual Angle (ABS)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Task Space (Base) (11)																
Actual TCP	0.000	-115.500	1487.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Target TCP	0.000	-115.500	1487.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Actual Velocity	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Target Velocity	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Actual Flange Pose	0.000	-150.000	35.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Actual TCP Speed	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Target TCP Speed	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Solution Space	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tool X-axis	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Tool Y-axis	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Tool Z-axis	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Task Space (World) (9)																
Actual TCP	0.000	-115.500	1487.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Target TCP	0.000	-115.500	1487.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Actual Velocity	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Target Velocity	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Actual Flange Pose	0.000	-150.000	35.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Tool X-axis	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Tool Y-axis	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Tool Z-axis	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
World to Base Relation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

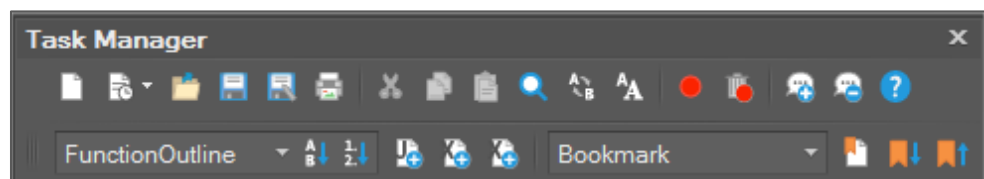
2.1.5 Message Window

The **Message** window shows log messages, which are mainly about communication with the controller and history of the system alarm from the robot.

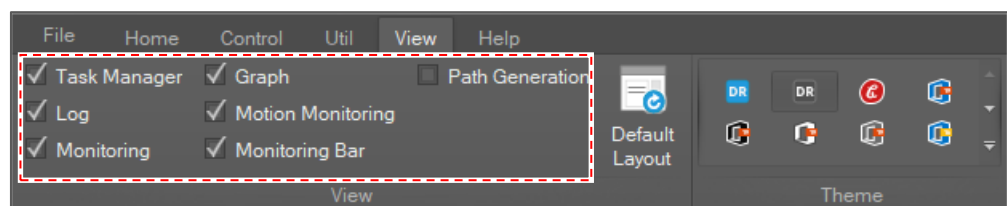
Time	Log
13:20:44.688	[2:32:15] Jog motion was stopped in order not to exceed Joint Limit (Null,Null,Null)
13:20:48.417	[2:32:15] Jog motion was stopped in order not to exceed Joint Limit (Null,Null,Null)
13:20:50.855	[2:32:15] Jog motion was stopped in order not to exceed Joint Limit (Null,Null,Null)
13:20:51.212	[2:32:15] Jog motion was stopped in order not to exceed Joint Limit (Null,Null,Null)

2.2 Show or Hide a Window

You can hide or show windows. To hide a window, click the button on the right top of the window.



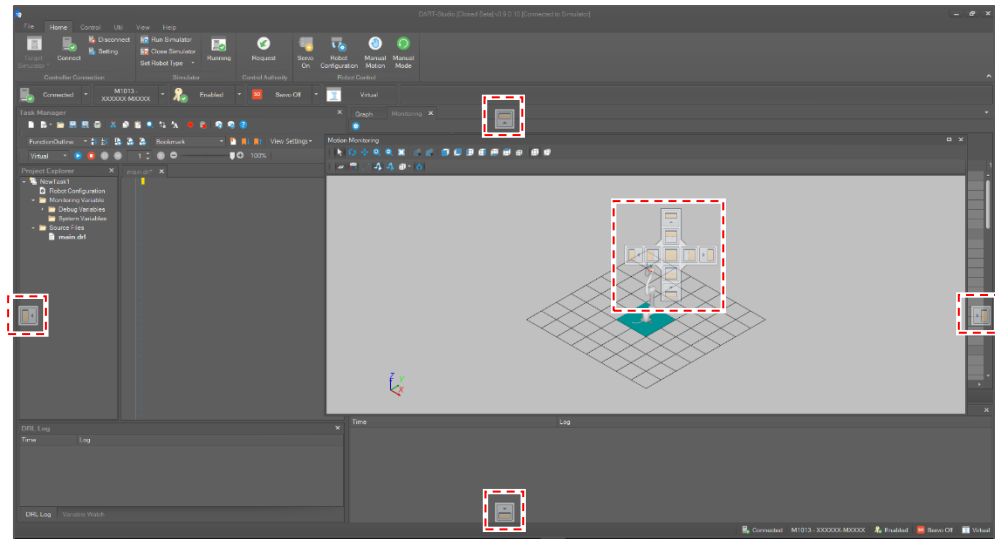
Or select **View** on the main menu and uncheck the checkbox for each window.



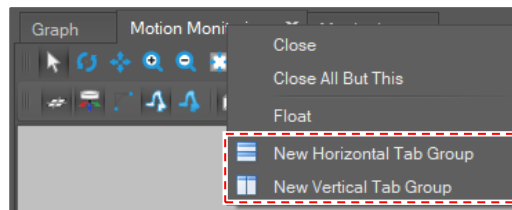
To show a window that is hidden, tick the checkbox for the window.

2.3 Change the Layout and Theme

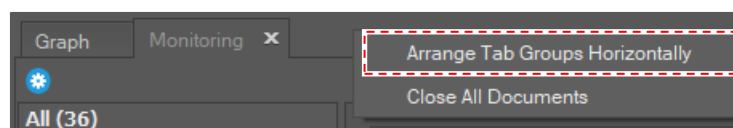
To change the layout, drag the pane and drop it in the desired location.



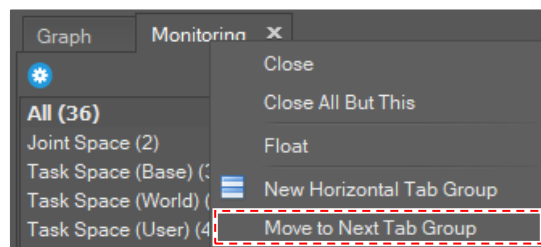
To add a tab group, right-click a tab and select **New Horizontal Tab Group** or **New Vertical Tab Group** on the context menu.



If you add a new horizontal (or vertical) tab group and select **Arrange Tab Groups Horizontally (Vertically)**, the tab group is added horizontally (or vertically).



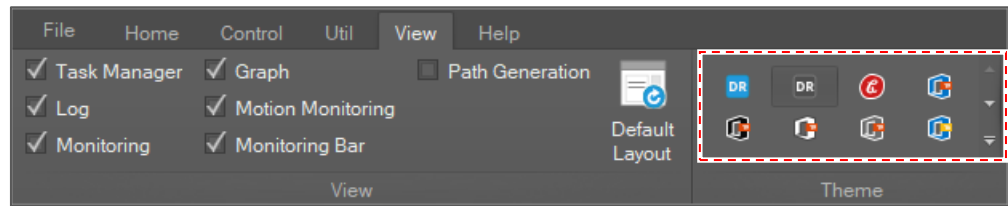
To move the tab to another tab group, select **Move to Next Tab Group**.



To initialize layout, select **View** on the main menu and click the **Default Layout** button.

2.4 Change the Software Theme

To change the software theme, select **View** on the main menu and choose a software theme in the **Theme** category.



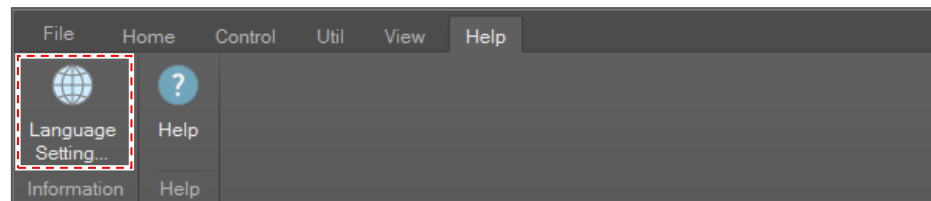
2.5 Change the Software Language

Two languages are provided: Korean and English.

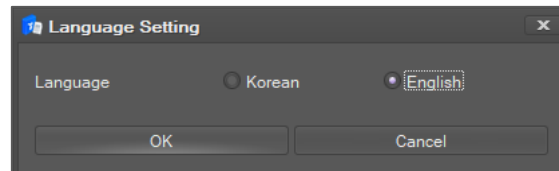
- The default language is English.

To change the UI language,

- 1 Go to **Help** on the main menu and click the **Language Setting...** button.



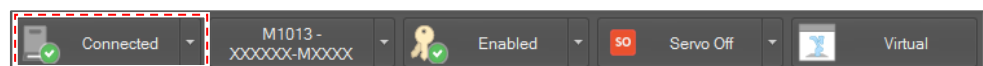
- 2 Select a language and click the **OK** button. The setting will be promptly applied.



2.6 Connect to the Controller

When the program starts, it automatically tries to connect to the controller.

If it is successfully connected to the controller, the connection state is updated on the **monitoring bar**.



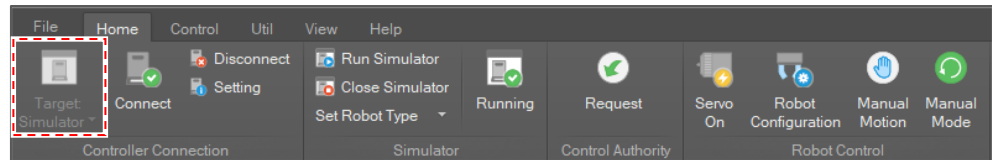
Select Connection Target

2 Software Overview

You can select the type of controller you want to connect between the actual robot controller and the simulator. At this time, IP is automatically set according to the selected connection target.

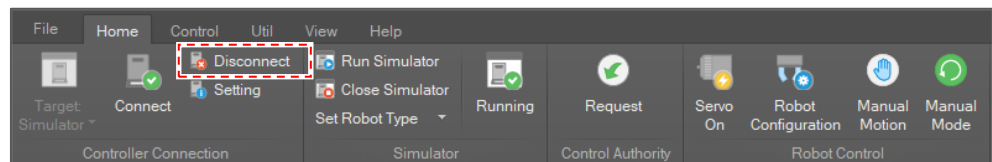
- Default robot controller IP : 192.168.137.100
- Simulator IP : 127.0.0.1

It can only be set when the controller (simulator) is not connected.

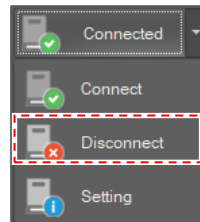


Disconnect from the controller

To disconnect from the controller, select **Home** on the main menu and click the **Disconnect** button.

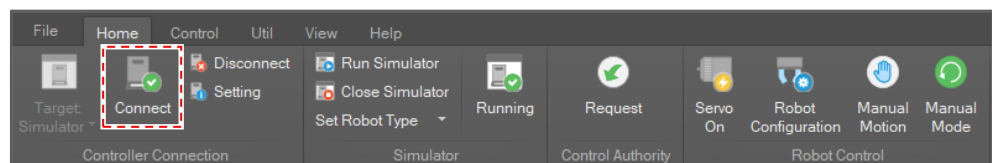


- It is also possible to disconnect from the controller by clicking the connection state and selecting **Disconnect** on the monitoring bar.

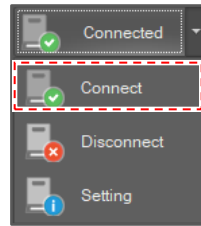


After the connection is disconnected from the controller, you must connect to the controller manually to connect to the controller.

To connect to the controller, select **Home** on the main menu and click the **Connect** button.



- It is also possible to connect to the controller by clicking the connection state and selecting **Connect** on the monitoring bar.



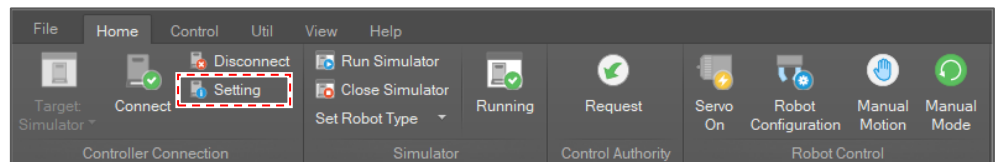
Change the connection configuration

The controller's default IP address is **192.168.137.100**, so this software's connection address is also set to 192.168.137.100 by default.

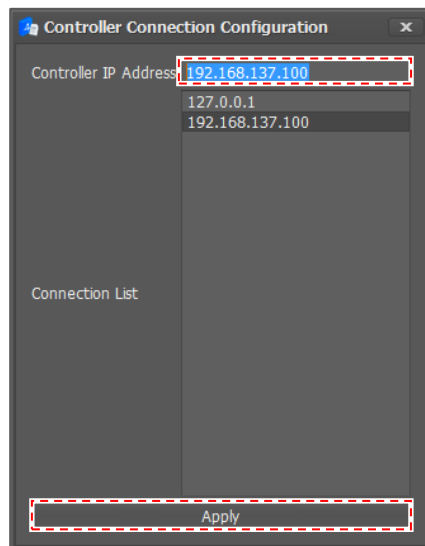
- Before changing the connection configuration, make sure that the connection is disconnected from the controller.

To change the connection address,

- 1 Select **Home** on the main menu and click the **Setting** button.



- 2 Type a new address in the **Controller IP Address** field and click the **Apply** button.



2.7 Use the Virtual Controller

You can simulate the robot motion by using the virtual controller.

2 Software Overview

Connect to the virtual controller

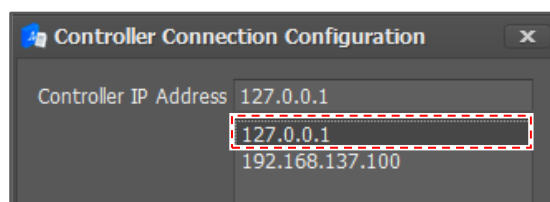
Before running the virtual controller, you must connect to the virtual controller.

To connect to the virtual controller, change the controller IP address to **127.0.0.1** and try connection.

Or, if you select the simulator in the connection target, it will be connected to the simulator automatically without any separate IP setting.

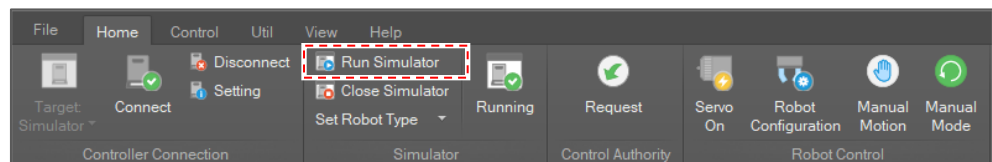
To change the controller IP address,

- 1 Select **Home** on the main menu and click the **Setting** button.
- 2 Select the address for the virtual controller in the connection list and click the **Apply** button.

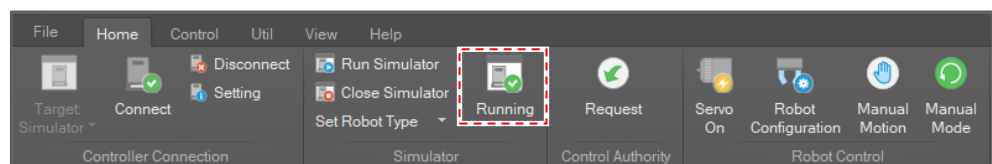


Run the virtual controller

To run the virtual controller, select **Home** on the main menu and click the **Run Simulator** button.



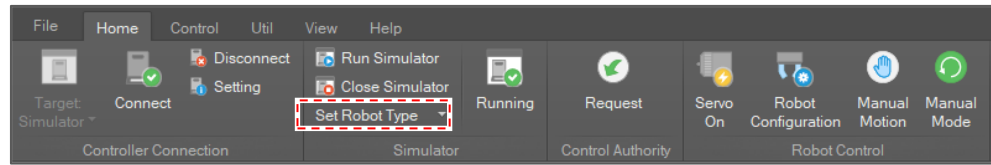
The virtual controller runs in the background. When the controller starts, the running status is updated.



Set the robot model type

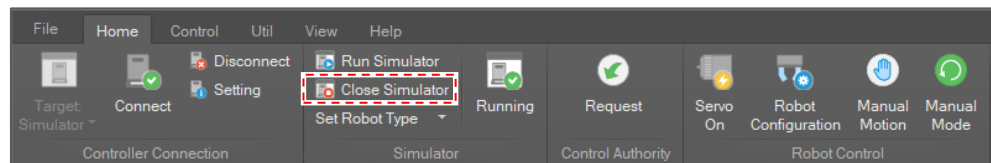
Virtual controller's robot model is set to M1013 by default.

To change the robot model type, select **Home** on the main menu and click the **Set Robot Type** menu, and then select a robot model.



Close the virtual controller

To close the virtual controller, select **Home** on the main menu and click the **Close Simulator** button.

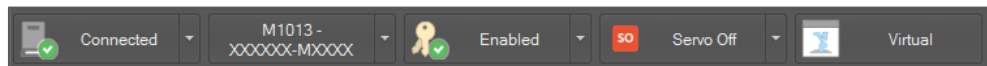


3 System Monitoring

If the program is connected to the controller, system status information is updated.

3.1 Monitoring Bar

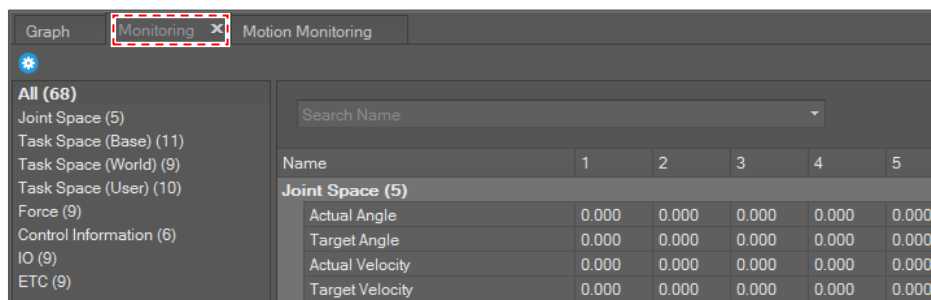
The **Monitoring Bar** window mainly shows the states needed for the user to control the robot.



- Connection State: It shows the connection state to the controller.
- Robot Model: It shows the currently connected robot’s model type and serial number.
- Control Authority: It shows whether control is enabled.
- Control State: It shows the current control state.
- System Mode: It shows the current system mode. The system mode can be either **Real** or **Virtual**. “Virtual” means that the robot motion is simulated without actually moving.

3.2 Monitoring Window

The **Monitoring** window shows the controller’s current control status in tabular form.



Each row shows a monitoring item and each row’s column size varies for each monitoring item dimension. For example, “Joint Angle” needs six columns to display values from joint axis 1 to 6 and Controller Digital Input needs 16 columns to display its state from port 1 to 16.

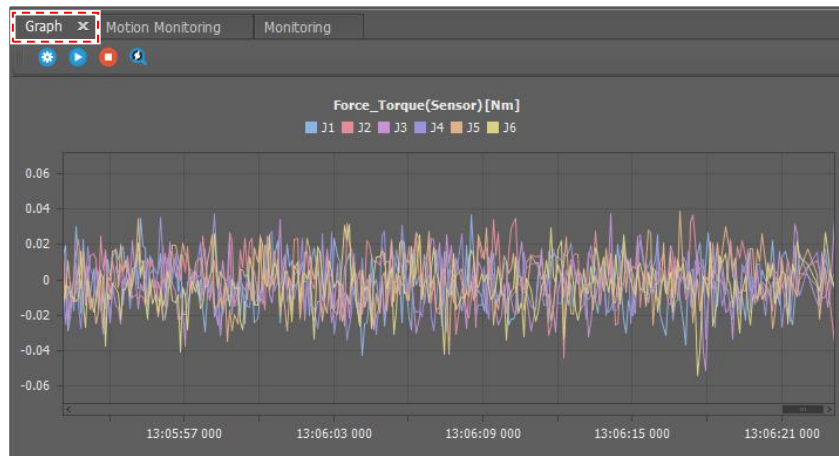
Most of the status values are updated every 100 milliseconds. In the case of IO status, the values are updated when its value is changed.

Status information is as in the table below.

Joint Space	<ul style="list-style-type: none"> Actual/Target angle [degree], Velocity [degree/sec] Actual Angle(ABS) [degree]
Task Space (Base)	<ul style="list-style-type: none"> Actual/Target TCP [mm], Velocity [mm/sec] Actual Flange Pose [mm] Actual/Target Speed [mm/sec] Solution Space Tool X,Y,Z-Axis
Task Space (World)	<ul style="list-style-type: none"> Actual/Target TCP [mm], Velocity [mm/sec] Actual Flange Pose [mm] Tool X,Y,Z-Axis World to Base Relation
Task Space (User)	<ul style="list-style-type: none"> Actual/Target TCP [mm], Velocity [mm/sec] Actual Flange Pose [mm] Tool X,Y,Z-Axis User Coordinate ID Parent Coordinate
Force	<ul style="list-style-type: none"> Joint Torque(Sensor) [Nm] Motor Torque [Nm] Force Torque Sensor [N], Acceleration Sensor [m/s²] Joint Torque (Gravity/Model), Joint External Torque [Nm] Task External Force (Base/World/User) [N]
Control Information	<ul style="list-style-type: none"> Operation Speed Mode Control State Current Tool Current TCP Collision Sensitivity Singularity
IO	<ul style="list-style-type: none"> Flange digital Input (6), digital output (6) Digital input (16), Digital output (16) Analog input (2), Analog output (2) Safety input (2) Encoder Strobe Count (2) Encoder Count (2)
ETC	<ul style="list-style-type: none"> Motor Current (A) Inverter Temperature (°C) Control Mode, Control Space DRCF, DRCL State Break State Arm Button State Switch State

3.3 Graph Window

Status monitoring information is provided as a graph in the **Graph** window.



In each data graph, the X axis is time in milliseconds and the Y axis is the value of the data. Data is updated every 100 milliseconds and as new data is added, the graph flows from right to left.

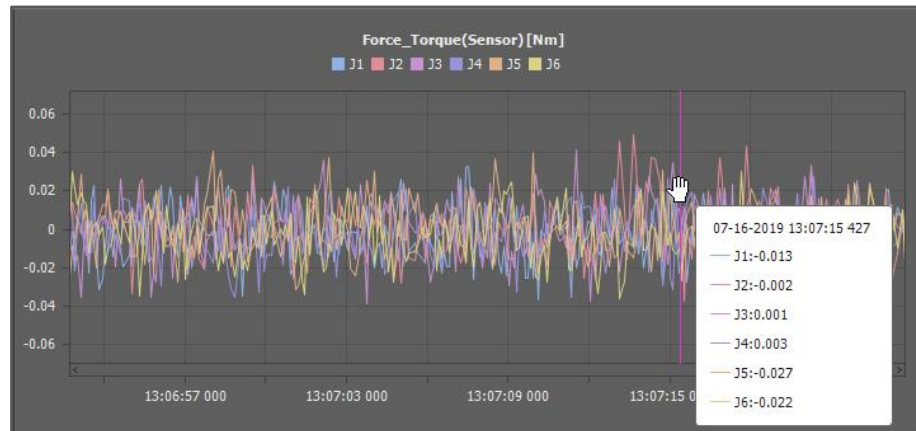
3.3.1 Supported Data Types

The supported data types are as in the following table.

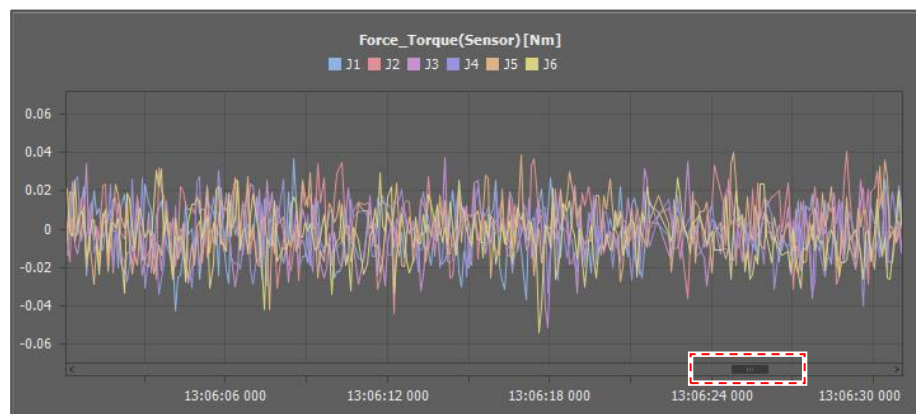
Joint Space	<ul style="list-style-type: none"> Actual/Target angle [degree], Velocity [degree/sec] Actual Angle(ABS) [degree]
Task Space (Base)	<ul style="list-style-type: none"> Actual/Target TCP [mm], Velocity [mm/sec] Actual Flange Pose [mm] Actual/Target TCP Speed [mm/sec] Solution Space
Task Space (World/User)	<ul style="list-style-type: none"> Actual/Target TCP [mm], Velocity [mm/sec] Actual Flange Pose [mm]
Force	<ul style="list-style-type: none"> Joint Torque(Sensor) [Nm] Motor Torque [Nm] Force Torque Sensor [N], Acceleration Sensor [m/s²] Joint Torque (Gravity/Model), Joint External Torque [Nm] Task External Force (Base/World/User) [N]
IO	<ul style="list-style-type: none"> Flange digital Input (6), digital output (6)
ETC	<ul style="list-style-type: none"> Motor Current (A) Inverter Temperature (°C)

3.3.2 Browse the Graph

- **Value Cursor:** If you move the mouse cursor over the graph, the value of the mouse cursor position is shown in the tooltip.



- **Zoom In:** Scroll the mouse wheel upward while the mouse cursor is over a graph.
- **Zoom Out:** Scroll the mouse wheel downward while the mouse cursor is over a graph.
- **Move:** Use the scroll to move the data window position. Or move the mouse cursor to the left or right while pushing the left mouse button.



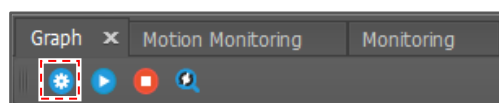
CAUTION If the data window doesn't include the new data position, the graph is fixed. If you move the data window so that it includes the new data position, it starts to flow.

3.3.3 Change the Graph Layout

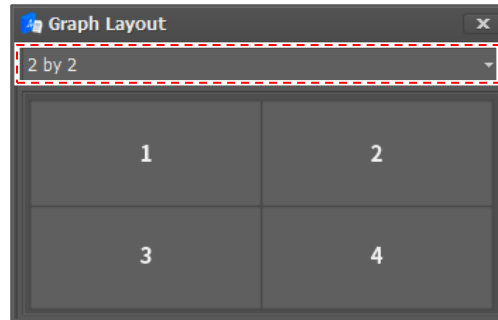
The layout and data type for each graph can be configured.

To change the graph layout and data type,

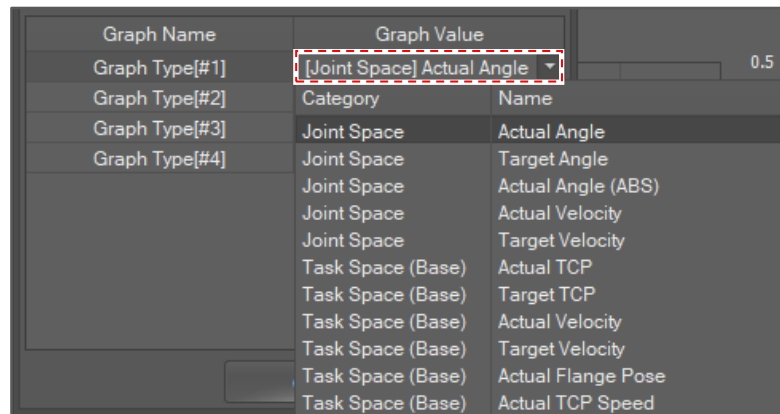
- 1 Click the **Set Graph Layout**  button on the toolbar.



- 2 Select a graph layout type.
 - It supports from **1 by 1** to **2 by 3**.




3 Assign a data type to each graph.

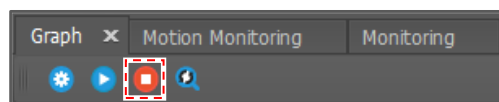


4 Click the **OK** button.

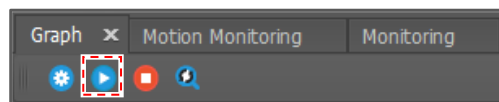


3.3.4 Control Monitoring

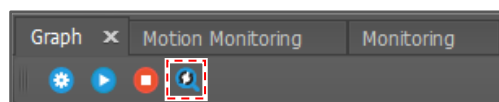
To stop real-time monitoring, click the **Stop**  button on the toolbar.



To resume monitoring, click the **Play**  button on the toolbar.

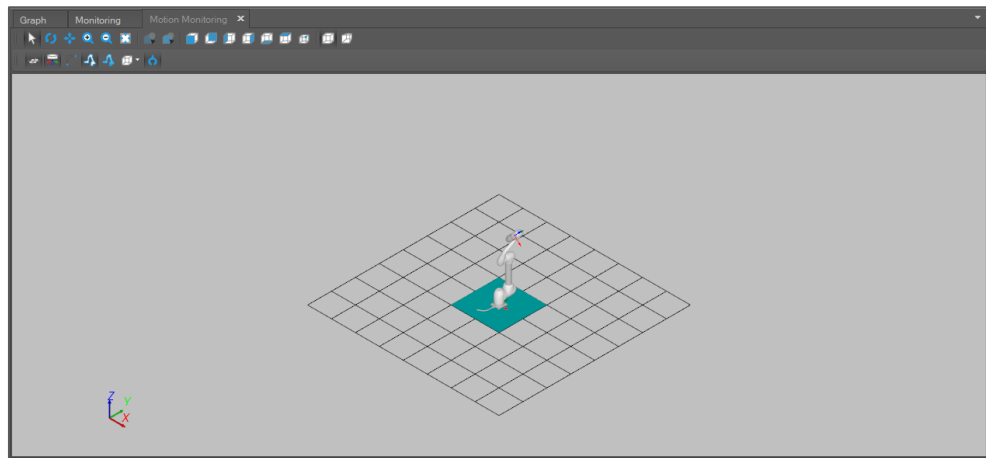


To initialize the zoom scale, click the **Init Zoom Level**  button on the toolbar.



3.4 Motion Monitoring Window

The **Motion Monitoring** window shows the current robot pose in the 3D viewer. The pose information is updated every 100 milliseconds.

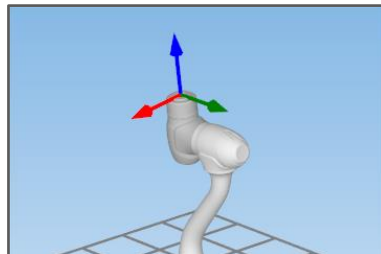


3.4.1 Visualized Objects

- Joint Angle and TCP position

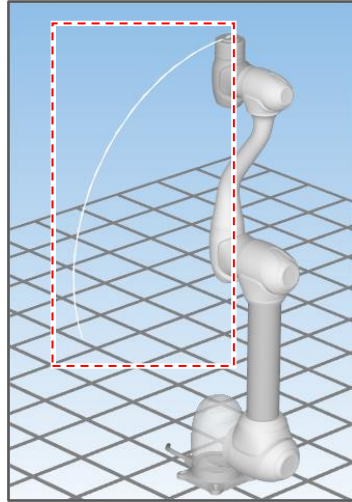
J1	J2	J3	J4	J5	J6
0.00	0.00	90.00	0.00	80.00	0.00
X	Y	Z	A	B	C
580.01	34.50	653.34	0.00	170.00	0.00

- Tool Coordination

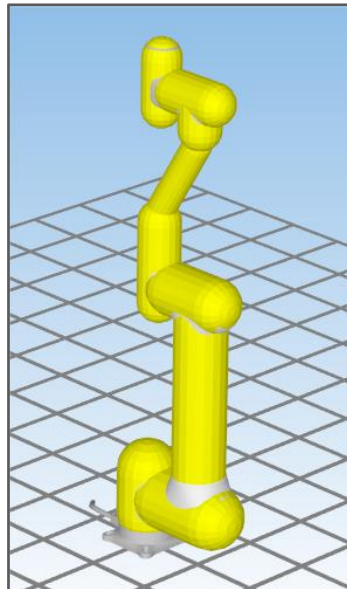


- Motion Trajectory

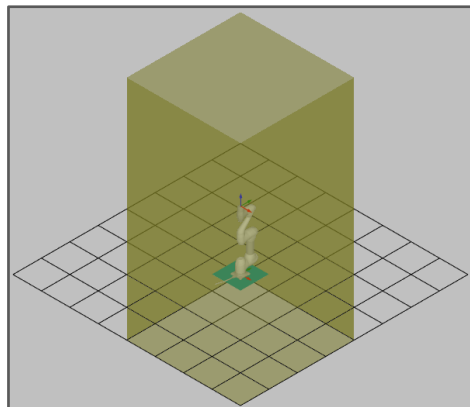
3 System Monitoring



- Robot Body Bounding Volume: Bounding Volume is a simplified body shape and is used to check collisions against the safety zone.



- Safety Zone















3.4.2 Use the 3D Viewer


Show or hide objects

To show or hide a scene object, click the buttons below for the object type.




	Show/Hide Grid Line	
	Show/Hide Tool Coordination	
	Show/Hide Motion Trajectory	
	Show/Hide Robot Shape	
	Show/Hide Robot Body Bounding Volume	
	Show/Hide Tool Shape	
	Show/Hide Local Zone, Show/Hide Space Limit Zone	Controller version GF020500 or later
	Show/Hide Operation Space	Controller version GF020400
	Show/Hide Collaborative Workspace	
	Show/Hide Protected Zone	
	Show/Hide Collision Detection Mute Zone	
	Show/Hide Tool Orientation Limit Zone	

Move

Click the **Move**  button or press the **F4** key and move the mouse cursor while clicking the left mouse button.

- It is also possible to move the mouse cursor while clicking the middle mouse button.



Rotate

Click the **Rotate**  button or press the **F2** key and then move the mouse cursor while clicking the left mouse button.


To fix the rotation axis, press the number key.

Key	Action
"1"	Rotation along X axis
"2"	Rotation along Y axis
"3"	Rotation along Z axis
"4"	Rotation along View Right direction
"5"	Rotation along View Up direction
"6"	Rotation along View Forward direction


Zoom





- Zoom In: Click the **Zoom In**  button on the menu or scroll the mouse wheel upward.
- Zoom Out: Click **Zoom Out**  button on the menu or scroll the mouse wheel downward.

Select

Click the **Select**  button on the menu or press the **F3** key, and then click the left mouse button over the object to select.

Fit scene

To reset the zoom ratio and rotation center, click the **Fit Scene**  button or press the **F5** key.

Menu Button	Shortcut	Function
	F2	Rotate
	F3	Select
	F4	Move
	F5	Fit scene

Change the viewpoint

To change the viewpoint, click one of the **View Direction** buttons. If you click the **To -X** button, the scene rotates so that the forwarding direction directs to the -X direction.

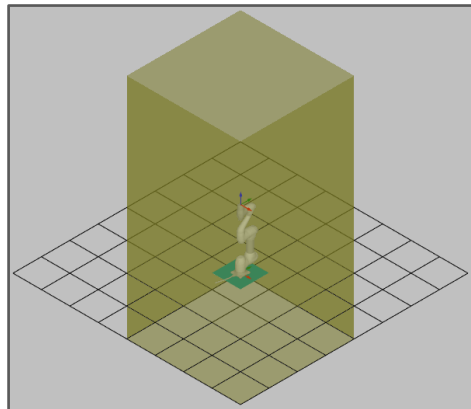


Projection Mode

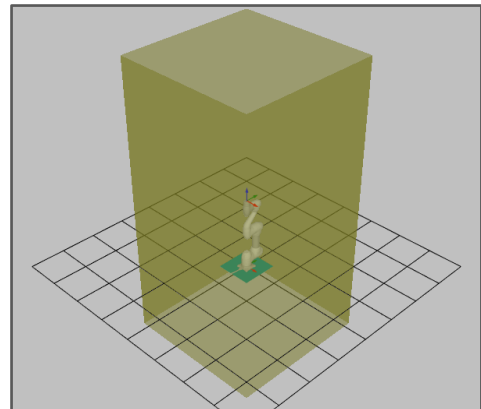
To change projection mode, click the **Orthogonal**  or **Perspective**  button.



The default projection mode is orthogonal projection.





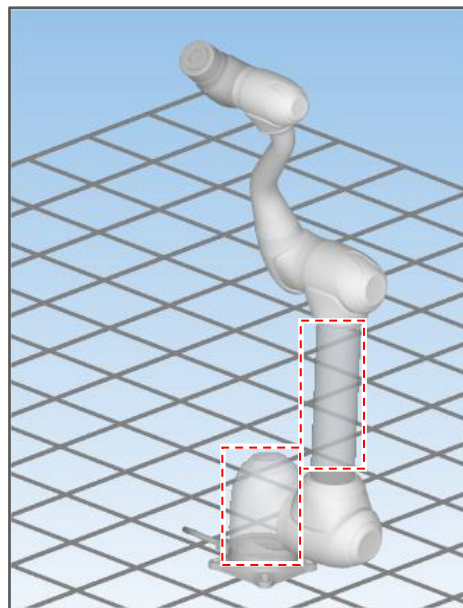
Orthogonal projection



Perspective projection

Change the object view property

- To make the selected object transparent, click the **Transparent**  button on the toolbar.
- To make the selected object opaque, click the **Opaque**  button on the toolbar.



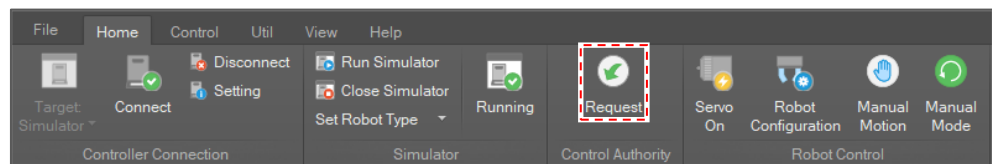
4 System Control

4.1 Control Authority

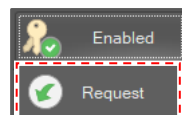
It is allowed for two or more clients to connect to a robot controller, for example a Teaching pendant and two or more DRFTs. If each client tries to manipulate the robot or change to a safety configuration, problems could occur, so robot control is only allowed for those who have control authority.

So, if you want to manipulate the robot with the Service Tool, you must first get control authority.

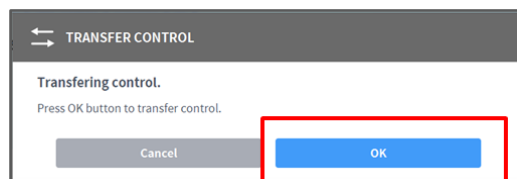
To acquire control authority, select **Home** on the main menu and click the **Request** button.



- It is also possible to acquire control authority by clicking the **Request** button on the status bar.



Then, in another client program that currently has control authority, a query window pops up.



If you want to yield the authority, click the **OK** button and the authority is given to the requesting client and the state UI is updated.

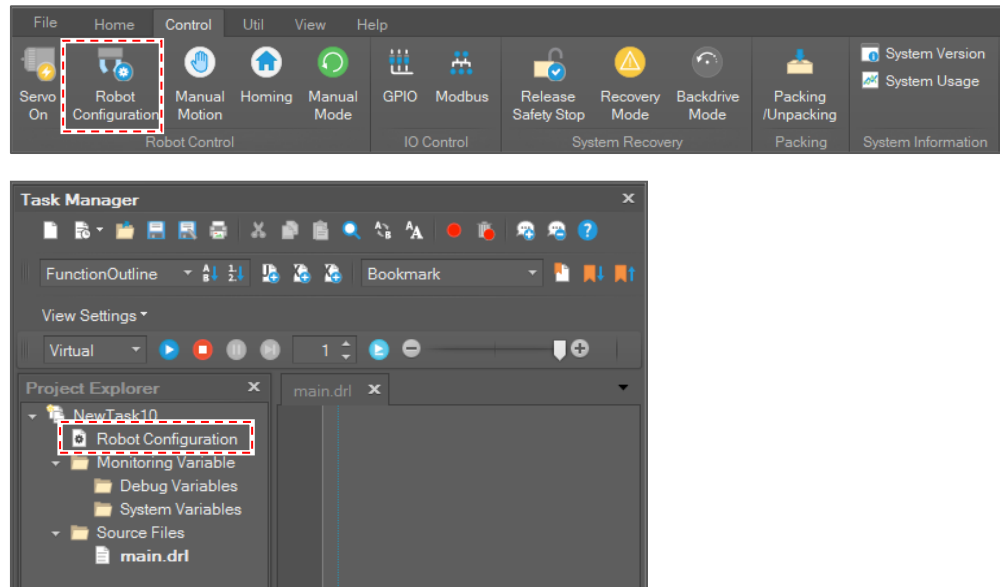


4.2 Robot Configuration

4.2.1 Open Robot Configuration Window

To open the Robot Configuration window, select **Control** on the main menu and click the **Robot Configuration** button or double click **Robot Configuration** in the **Task Manager** tree.

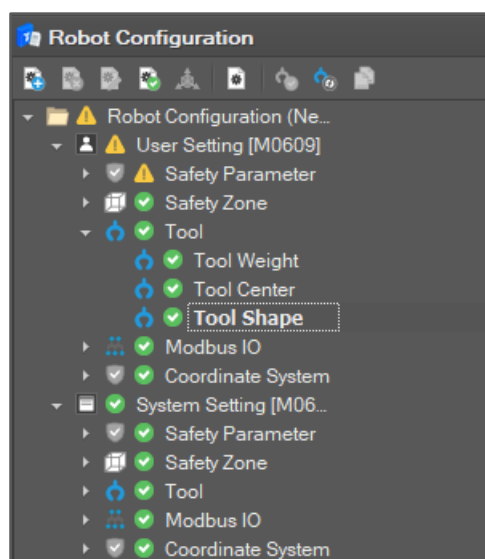
Note that the project must first be opened to open the **Robot Configuration** window.





4.2.2 Robot Configuration UI

The Safety Configuration UI is composed of a tree control and the tree has two main nodes, **User Setting** and **System Setting**.


Robot Configuration is composed of five categories: **Safety Parameter**, **Safety Zone**, **Tool**, **Modbus IO** and **Coordinate System**.

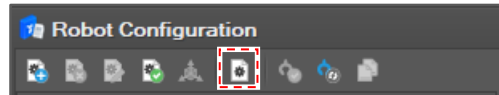


If **User Setting** and **System Setting** are different, the node icons for the **User Setting** items are displayed with .

And then if you apply the change by selecting **Apply Item**, the node icon changes to .

4.2.3 Get Current System Configuration


To get the current safety configuration, click the **Get Current Setting**  button on the toolbar.

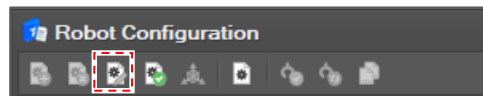


Then the current settings are updated to the **System Setting** tree.

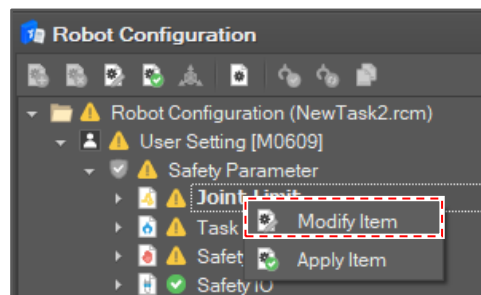
4.2.4 General Procedure to Set Robot Configuration

To set a robot configuration,

- 1 Select a configuration item in the tree and click the **Modify Item**  button on the toolbar.



- It is also possible to edit by right-clicking a configuration item in the tree and selecting **Modify Item** on the context menu.



- 2 After editing the settings, click the **Confirm** button. Then the edit window closes and the setting is applied to the system. If the setting is successfully set in the system, **System Setting** is updated.

Joint Axis	Setting Value Limit	Normal Speed Mode [Degree]		Reduced Speed Mode [Degree]	
		Min Limit	Max Limit	Min Limit	Max Limit
J1	[-360.0, 360.0]	-360.00	360.00	-360.00	360.00
J2	[-360.0, 360.0]	-90.00	90.00	-90.00	90.00
J3	[-160.0, 160.0]	-135.00	135.00	-135.00	135.00
J4	[-360.0, 360.0]	-360.00	360.00	-360.00	360.00
J5	[-360.0, 360.0]	-135.00	135.00	-135.00	135.00
J6	[-360.0, 360.0]	-360.00	360.00	-360.00	360.00

Joint Axis	Setting Value Limit	Normal Speed Mode [Degree/Sec]	Reduced Speed Mode [Degree/Sec]
		Min Limit	Max Limit
J1	(0, 120.0]		120.00
J2	(0, 120.0]		120.00
J3	(0, 180.0]		180.00
J4	(0, 225.0]		225.00
J5	(0, 225.0]		225.00
J6	(0, 225.0]		225.00

4.2.5 Safety Parameter

Joint Limit

- **Joint Angle Range:** This is a limit for joint angle by degree. If the angle of an axis exceeds the limit, a **JOINT_SLP** violation error is invoked.

Joint Axis	Setting Value Limit	Normal Speed Mode [Degree]		Reduced Speed Mode [Degree]	
		Min Limit	Max Limit	Min Limit	Max Limit
J1	[-360.0, 360.0]	-360.00	360.00	-360.00	360.00
J2	[-360.0, 360.0]	-90.00	90.00	-90.00	90.00
J3	[-160.0, 160.0]	-135.00	135.00	-135.00	135.00
J4	[-360.0, 360.0]	-360.00	360.00	-360.00	360.00
J5	[-360.0, 360.0]	-135.00	135.00	-135.00	135.00
J6	[-360.0, 360.0]	-360.00	360.00	-360.00	360.00

- **Joint Speed:** This is a limit for joint speed by degree/sec. If the speed of an axis exceeds the limit, a **JOINT_SLS** violation error is invoked.

Joint Axis	Setting Value Limit	Normal Speed Mode [Degree/Sec]	Reduced Speed Mode [Degree/Sec]
		Min Limit	Max Limit
J1	(0, 120.0]		120.00
J2	(0, 120.0]		120.00
J3	(0, 180.0]		180.00
J4	(0, 225.0]		225.00
J5	(0, 225.0]		225.00
J6	(0, 225.0]		225.00

You need to set the limits for **Normal Speed Mode** and **Reduced Speed Mode**. Normal speed mode limit is applied when the system is in a state of Manual operation, Hand-

guiding operation or Stand-alone autonomous operation. In contrast, **Reduced Speed Mode** limit is applied when the system is in a state of Collaborative autonomous operation.

Task Limit

- **Max Force:** It is a limit for force on TCP in N. If the force on TCP exceeds the limit, a **TCP_SLF** violation error is invoked.

Task Limit				Reset
Category	Setting Value Limit	Normal Speed Mode	Reduced Speed Mode	
Force [N]	(0, 240.0]		150.0	60.0
Power [W]	(0, 360.0]		250.0	30.0
Speed [mm/s]	(0, 8000.0]		2000.0	1500.0
Momentum [Kg·m/s]	(0, 165.0]		50.0	20.0
Collision Sensitivity [%]	(0, 100]			50.0

- **Max Power:** It is a limit for power on TCP in W. If the power exceeds the limit, **TCP_POWER** violation error is invoked.

Task Limit				Reset
Category	Setting Value Limit	Normal Speed Mode	Reduced Speed Mode	
Force [N]	(0, 240.0]		150.0	60.0
Power [W]	(0, 360.0]		250.0	30.0
Speed [mm/s]	(0, 8000.0]		2000.0	1500.0
Momentum [Kg·m/s]	(0, 165.0]		50.0	20.0
Collision Sensitivity [%]	(0, 100]			50.0

- **Max Speed:** It is a limit for TCP speed in mm/sec. If the TCP speed exceeds the limit, **TCP_SLS** violation error is invoked.

Task Limit				Reset
Category	Setting Value Limit	Normal Speed Mode	Reduced Speed Mode	
Force [N]	(0, 240.0]		150.0	60.0
Power [W]	(0, 360.0]		250.0	30.0
Speed [mm/s]	(0, 8000.0]		2000.0	1500.0
Momentum [Kg·m/s]	(0, 165.0]		50.0	20.0
Collision Sensitivity [%]	(0, 100]			50.0

- **Max Momentum:** It is a limit for TCP momentum in Kg·m/sec. If the momentum exceeds the limit, **TCP_MOMENTUM** violation error is invoked.

Task Limit				Reset
Category	Setting Value Limit	Normal Speed Mode	Reduced Speed Mode	
Force [N]	(0, 240.0]	150.0	60.0	
Power [W]	(0, 360.0]	250.0	30.0	
Speed [mm/s]	(0, 8000.0]	2000.0	1500.0	
Momentum [Kg•m/s]	(0, 165.0]	50.0	20.0	
Collision Sensitivity [%]	(0, 100]		50.0	

- **Collision sensitivity:** It is a criterion for collision detection in percent units. The higher the value, the smaller the external force the robot stops with. If a collision is detected, a COLLISION violation error is invoked.

Task Limit				Reset
Category	Setting Value Limit	Normal Speed Mode	Reduced Speed Mode	
Force [N]	(0, 240.0]	150.0	60.0	
Power [W]	(0, 360.0]	250.0	30.0	
Speed [mm/s]	(0, 8000.0]	2000.0	1500.0	
Momentum [Kg•m/s]	(0, 165.0]	50.0	20.0	
Collision Sensitivity [%]	(0, 100]		50.0	

If the Collision detection mute zone is configured and TCP is inside a collision detection mute zone, the collision sensitivity for the zone is applied.

You need to set the limits for **Normal speed mode** and **Reduced Speed Mode**. Normal speed mode limit is applied when the system is in a state of Manual operation, Hand-guiding operation or Stand-alone autonomous operation. In contrast, **Reduced Speed Mode** limit is applied when the system is in a state of Collaborative autonomous operation.

Safety Stop Mode

You can assign a stop mode for each safety violation.

Safety Stop Mode		Reset
Safety Function	Stop Mode	
Emergency Stop	SS1	
Protective Stop	SS2	
Joint SLP	STO	
Joint SLS	SS2	
Joint SLT	SS1	
Collision (SWS)	SS2	
Collision (CWS)	SS1	
TCP SLP	STO	
TCP SLO	STO	
TCP SLS	SS2	
TCP SLF (SWS)	SS2	
TCP SLF (CWS)	SS1	
Momentum	SS1	
Power	SS1	

4 System Control

There are four kinds of stop modes.

- **STO**: Cuts off the motor power immediately.
- **SS1**: Cuts off the motor power after motion stop.
- **SS2**: Holds position after motion stop
- **RS1**: Reactive stop after collision. It can only be applied for a Collision violation.



CAUTION

From Controller GF020500 version, Safety stop mode for Collision and TCP SLF does not distinguish workspace type.

Safety Function	Stop Mode
Emergency Stop	SS1
Protective Stop	SS2
Joint SLP	STO
Joint SLS	SS2
Joint SLT	SS1
Collision	SS1
TCP SLP	STO
TCP SLO	STO
TCP SLS	SS2
TCP SLF	SS1
Momentum	SS1
Power	SS1

Safety IO - Safety Input

Safety Input defines robot action when the corresponding signal is invoked.

Safety IO	Safety Input	Safety Output
Port 01~02	Not Used	Not Used
Port 03~04	Not Used	Not Used
Port 05~06	Not Used	Not Used
Port 07~08	Not Used	Not Used
Port 09~10	Not Used	Not Used
Port 11~12	Not Used	Not Used
Port 13~14	Not Used	Not Used
Port 15~16	Not Used	Not Used

Possible options are as below.

Not Used

STO (Safe Torque Off) stop	Act like STO stop is invoked.
Emergency stop (ESTOP)	Act like Emergency stop is invoked.
Protective stop (PRS)	Act like Protective stop is invoked
Reduced speed mode	Act like robot operates in reduced speed mode.
3-Pos enable switch	Act like 3-pos mode is activated.

Direct teaching switch	Act like teaching button pushed.
Manual Guiding Stop	Notify that manual guiding operation finishes. It is only valid when the robot state changed from Autonomous Operation Mode to Manual Guiding Mode .
PRS (Protective Stop) auto resume	Safety stop auto resumed.
Safety Zone Dynamic Enable	A safety zone which enables 'Enabled by safety input' property is enabled.
Remote Control Mode Enable	Control by remote system is allowed.
Remote Emergency Stop	Act like Emergency stop is invoked. If the robot stops by 'Remote Emergency Stop', the safety output channel which set as 'Remote Emergency Stop' IS NOT invoked. On the other hand, if the robot stops by 'Emergency Stop', the safety output channel IS invoked. It is for preventing emergency stop signal loop between the robot and the remote system.

Safety IO - Safety Output

A signal is invoked for the corresponding safety output channel when the configured safety output action occurs.

Safety IO		
Port Number	Safety Input	Safety Output
Port 01~02	Not Used	Not Used
Port 03~04	Not Used	Not Used
Port 05~06	Not Used	Not Used
Port 07~08	Not Used	Not Used
Port 09~10	Not Used	Not Used
Port 11~12	Not Used	Not Used
Port 13~14	Not Used	Not Used
Port 15~16	Not Used	Not Used

Possible options are as below.

Not Used	
STO (Safe Torque Off)	Robot STO stopped.
SOS (Safe Operating Stop)	Robot in SOS state.
SS1/SS2 deceleration Status	Robot in SS1/SS2 deceleration state.

4 System Control

Normal speed mode Status	Robot in normal speed mode.
Reduced speed mode Status	Robot in reduced speed mode.
Auto mode Status	Robot in autonomous operation mode.
Manual mode Status	Robot in manual operation mode.
Standalone workspace Status	Robot in stand-alone mode.
Collaborative workspace Status	Robot in collaborative mode.
TCP Inside Collision detection mute zone Status	Robot TCP in a collision detection mute zone.
TCP Inside Tool orientation limit zone Status	Robot TCP in a tool orientation limit zone.
Emergency Stop Status	Robot in emergency stop state.
Remote Emergency Stop Status	<p>Robot in emergency stop state.</p> <p>If the robot stops by 'Remote Emergency Stop', the safety output channel IS NOT invoked. On the other hand, if the robot stops by 'Emergency Stop', the safety output channel IS invoked.</p> <p>It is for preventing emergency stop signal loop between the robot and the remote system.</p>

Installation Pose

When the robot is mounted on a side wall or ceiling, you must set the install pose.

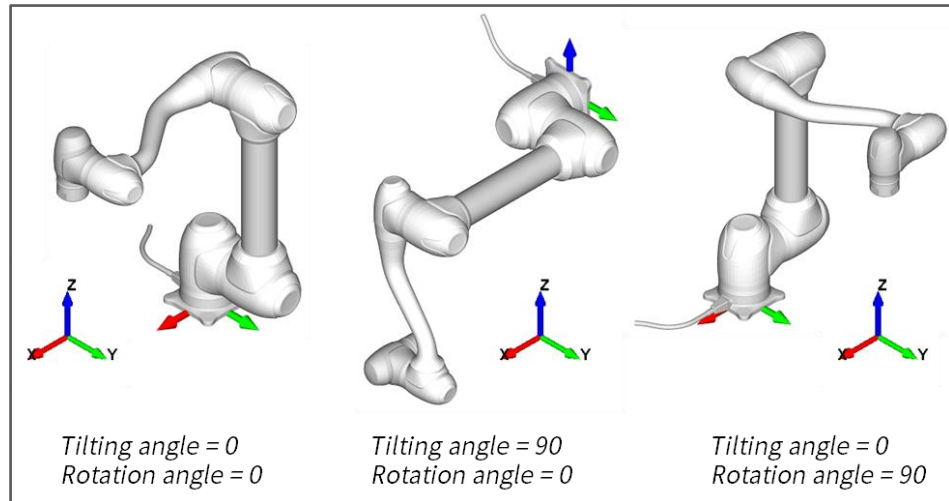


Installation Pose Measure Reset

Tilting Angle [Degree] 0 ↕

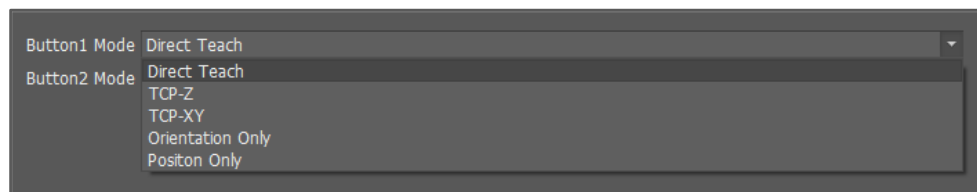
Rotating Angle [Degree] 0 ↕

- **Tilting Angle:** Tilting angle in degrees between the ground and the robot base frame.
- **Rotation Angle:** Rotation angle along vertical axis.



Cockpit Button

Set the teaching mode for the cockpit button.



Speed Reduction Rate

It provides the editing function to set the following property items.

Item	Range	Unit
CWS Speed Reduction Rate	1~100	%
IO Speed Reduction Rate	1 ~100	%

Nudge

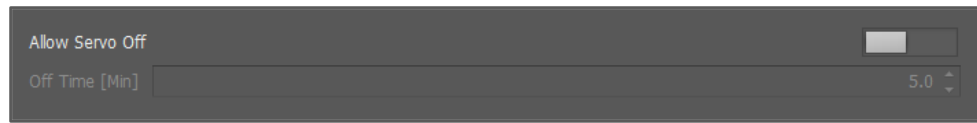
It provides the editing function to set the following property items for Nudge.

Item	Range	Unit
Input Force	10~50	N
Delay Time	0 ~30	Sec

Idle Servo Off

Idle Servo Off is one of our system's safety policies. If the robot is not used for more than 5 minutes, it will cut off the servo power. If not, turn off the **Allow Servo Off** button.

To only change the servo off time, set the **Off Time** value.

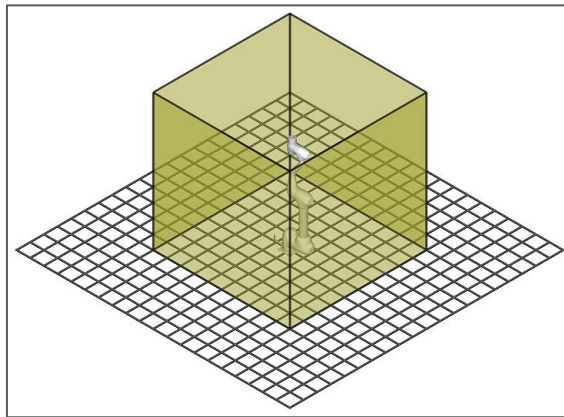


4.2.6 Safety Zone Overview (Valid for GF020400)

There are five types of Safety Zones.

Operating Space

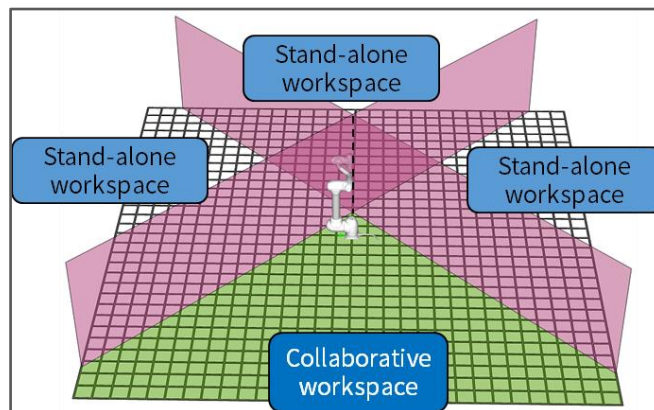
Operating Space is a safety zone where robot operation is limited.



If any part of the robot including tool goes beyond the zone, a TCP_SLP violation error is invoked. It is geometrically defined as one of Cuboid, Circular Prism, and Planar Prism.

Collaborative Workspace

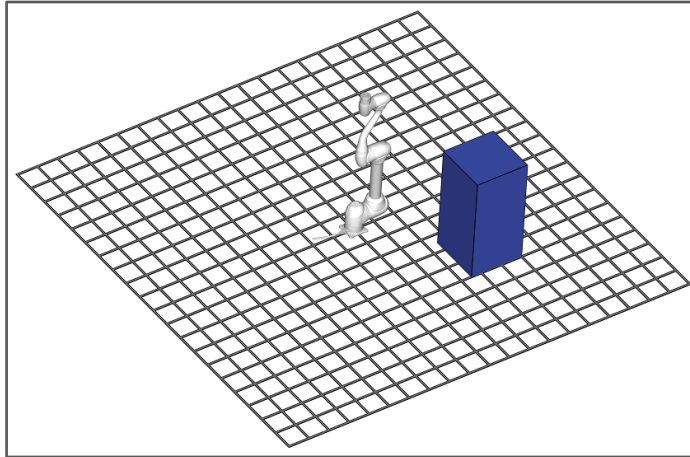
Collaborative Workspace is a safety zone where the user cooperates with the robot. Its complement is called Standalone Workspace, which is a space where the robot operates autonomously.



When the robot is moving in the autonomous mode and TCP is in Collaborative Workspace, the operation speed mode is changed to **Reduced Speed Mode**.

Protected Zone

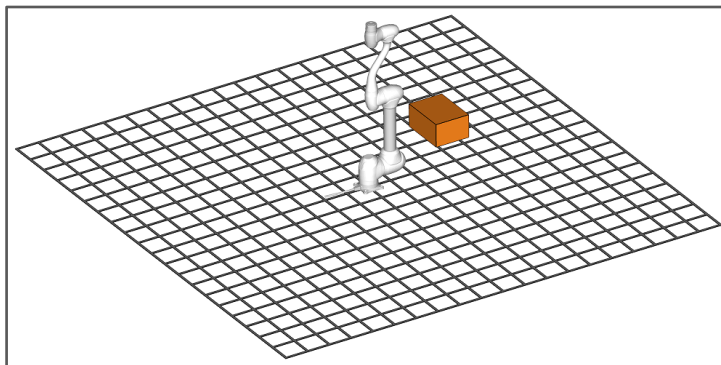
Protected Zone is a safety zone to protect environmental objects near the robot.



If any part of the robot including tool collides with the shape the zone defines, a TCP_SLP violation error is invoked. It is geometrically defined as one of Cuboid, Sphere, and Polygonal Prism.

Collision Detection Mute Zone

Collision Detection Mute Zone is a safety zone where collision detection is temporarily disabled, or local collision sensitivity is applied when TCP is inside the zone.



It is geometrically defined as one of Cuboid, Sphere, Cylinder, Tilted Cuboid and Polygonal Prism.

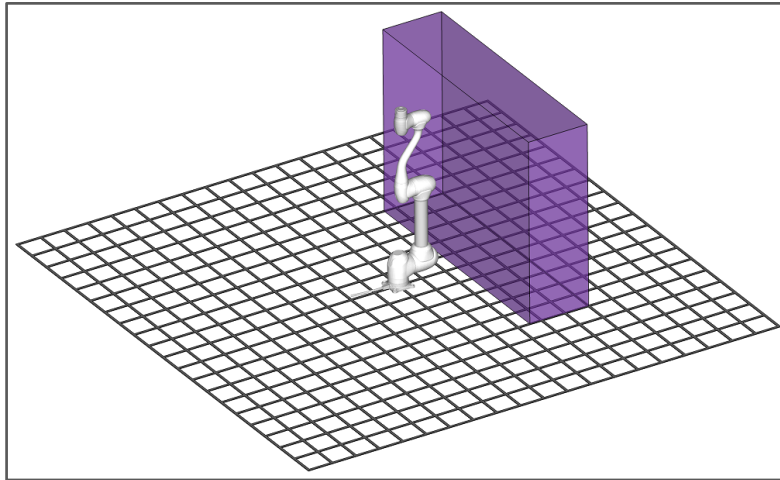
It has three zone properties.

- **Collision Detection On/Off:** If the property is OFF, Collision detection is disabled when TCP is inside the zone. If the property is ON, the local **Collision Sensitivity** property is applied to collision detection.
- **Collision Sensitivity:** Local collision sensitivity is applied to collision detection.

- **Dynamic Zone Enable:** If the property is set, the collision mute zone is only enabled when the corresponding safety input channel is enabled.

Tool Orientation Limit Zone

The tool orientation limit zone is a safety zone where tool direction is constrained when TCP is inside the zone. If the tool direction violates the limit condition, a TCP_SLO violation error is invoked.

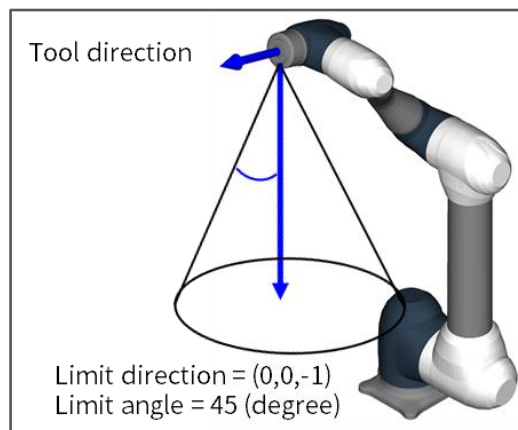


It is geometrically defined as one of Cuboid, Sphere, Cylinder, Tilted Cuboid and Polygonal Prism.

It has two zone properties.

- **Limit Direction:** Violation Limit Direction based on global coordination.
- **Limit Angle:** Violation Limit Angle along **Limit Direction**.

Limit Direction and Angle comprise a cone shape. If the tool direction goes beyond the limit range, a TCP_SLO violation error is invoked.

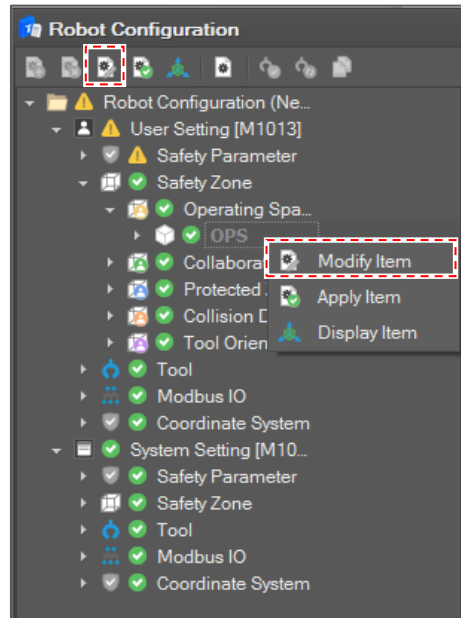


4.2.7 Safety Zone Setting (Valid for GF020400)

Modify a safety zone

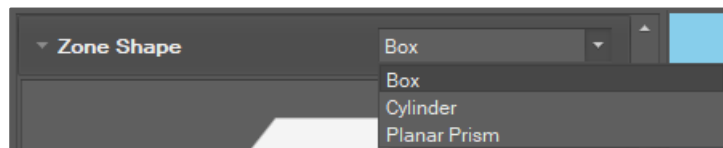
To modify a safety zone, click the **Modify Item**  button on the toolbar

- It is also possible to modify it by selecting **Modify Item** on the context menu.



Define Zone Shape

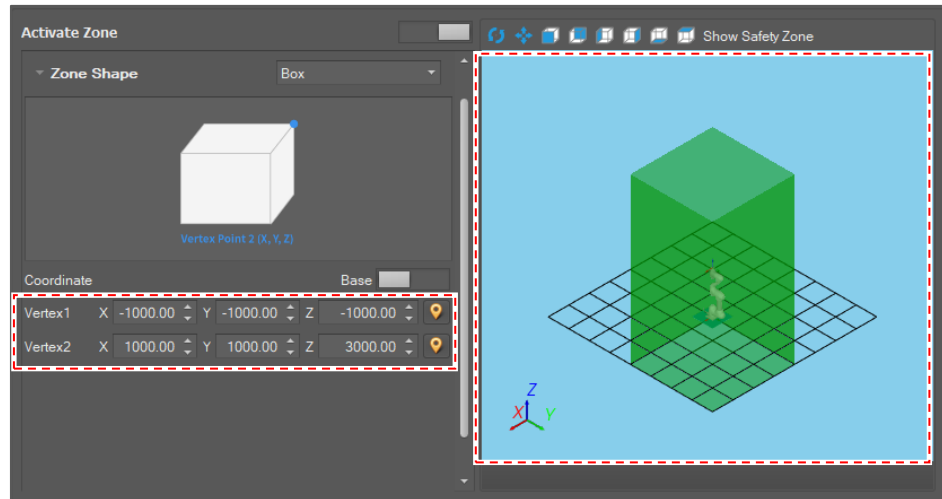
Define a zone shape type in the **Shape Type** list.



If the **Shape Type** is selected, the **Shape Property** field is updated for the type.

Display Zone Shape

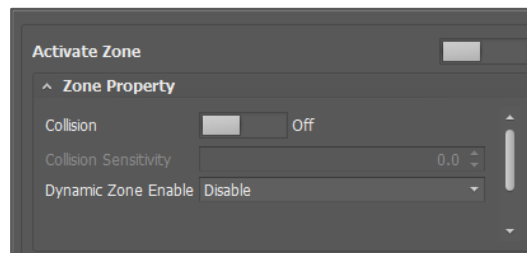
If all shape properties are filled and the shape is valid, the shape is displayed in the viewer.



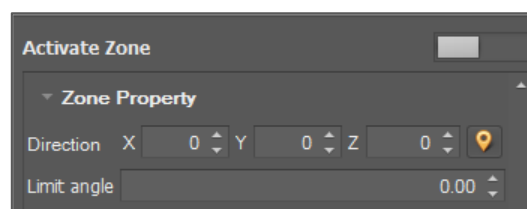
Define Zone Property

For **Collision Detection Mute Zone** and **Tool Orientation Limit Zone**, defining the **Zone property** is necessary.

- Collision Detection Mute Zone



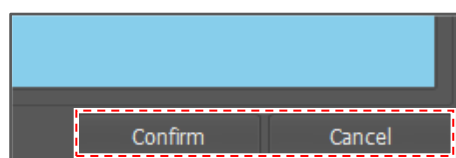
- Tool Orientation Limit Zone



Confirm the Zone

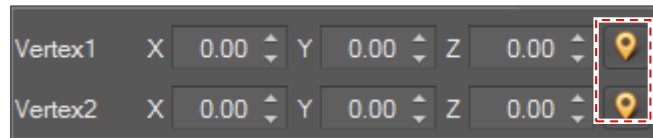
If editing is done, click the **Confirm** button.

If you want to cancel the editing result, click the **Cancel** button.

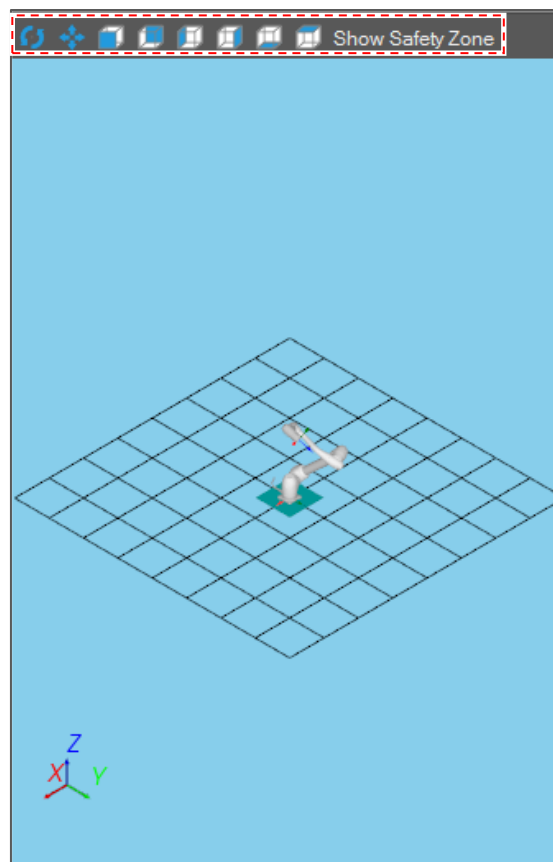





Get Pose

For position properties like XYZ, XY, Z coordinates, there is a Get Current Coordinates button as shown. Clicking the button sets the position field to Current TCP.



Use the zone shape viewer



- Move: Click the **Move**  button or press the **F4** key and move the mouse cursor while clicking left mouse button..
- Rotate: Click the **Rotate**  button or press the **F2** key and then move the mouse cursor while clicking the left mouse button.
- View Direction: To change the viewpoint, click one of the **View Direction** buttons. If you click the **To -X** button, the scene rotates so that the forwarding direction directs to the - X direction.
- Show Safety Zone: Select the zone type to show on the screen in the Context menu that appears when the **Show Safety Zone** button is clicked.
- Select: Click the **Select**  button on the menu or press the **F3** key, and then click the left mouse button over the object to select.

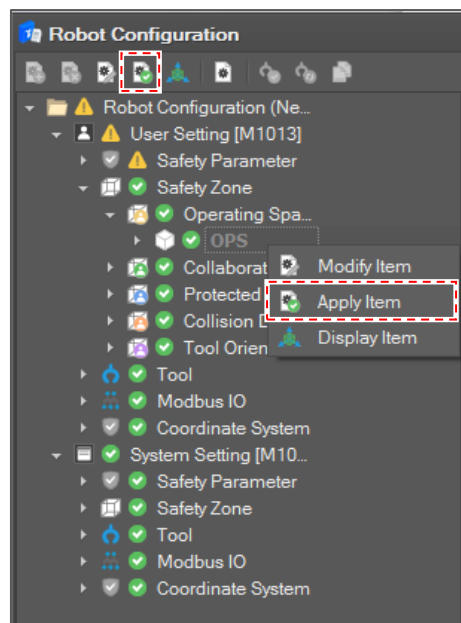
4 System Control

- Zoom: Scroll the mouse wheel upward to zoom in. Scroll the mouse wheel downward to zoom out.
- Scene Fitting: Press the F5 key.

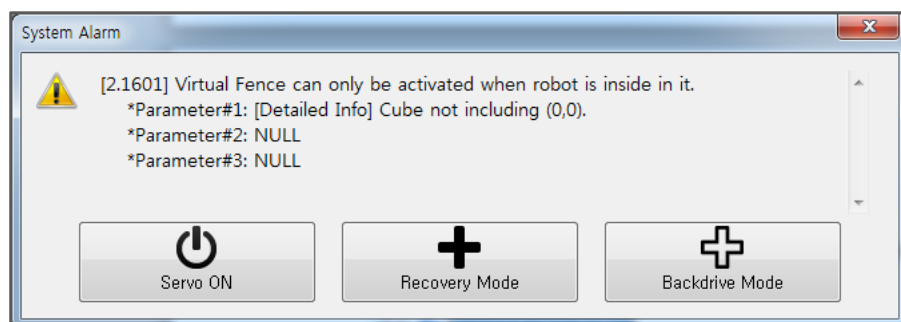
Apply an Item

If a zone is confirmed, the zone is applied to the system.

If the setting is successfully applied to the controller, the current system setting is updated.




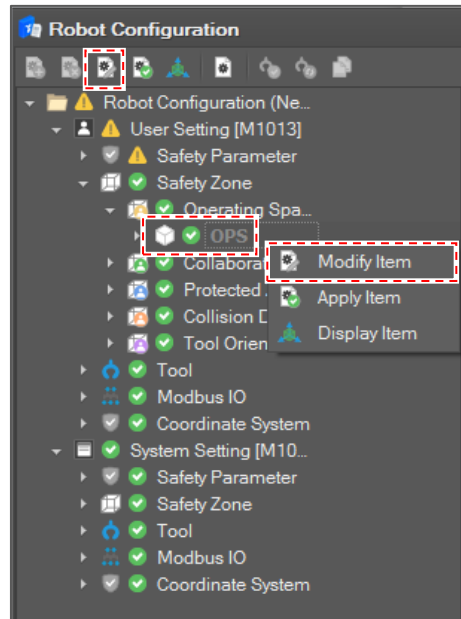
If the setting fails, a system alarm message that explains why the setting failed pops up.



Enable /Disable a Safety Zone

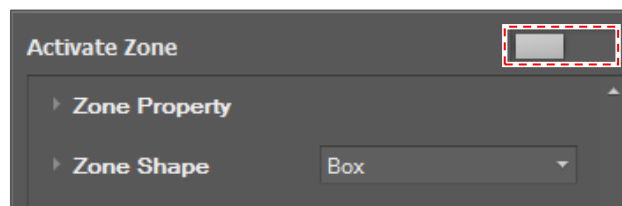
A disabled safety zone appears as disabled text on the tree node.

To enable a safety zone, select a disabled zone and select **Modify Item** on the context menu or click the **Modify Item**  button on the toolbar.



Then, the **Item Edit** window for the safety zone appears on the right side.

To change the safety zone activation, turn on the **Activate Zone** button.



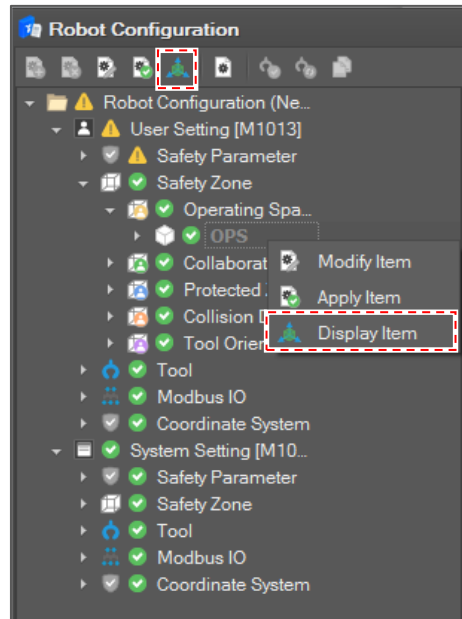
If the zone is enabled without a problem, the zone setting is applied to the system and the Current System Setting is updated.

To disable a safety zone, turn off the **Activate Zone** button.

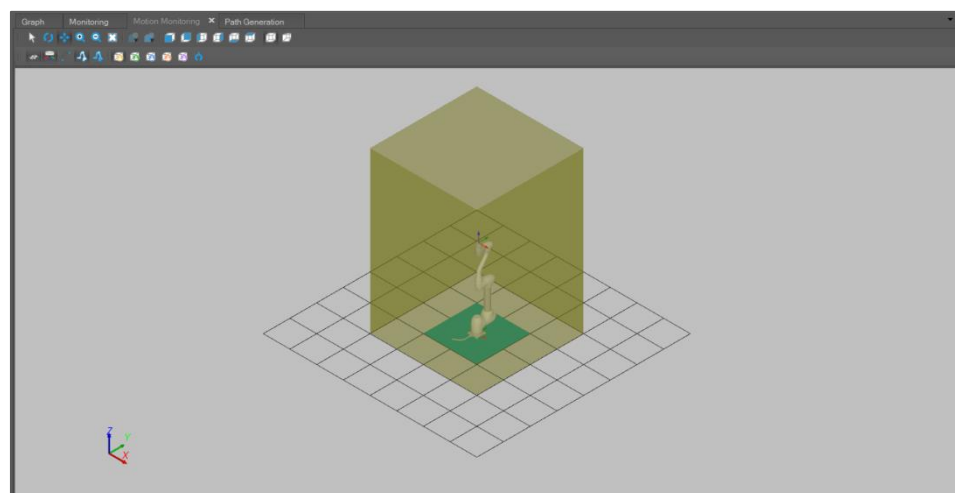
If a zone is disabled, the zone setting is applied to the system, which means the setting is removed from the system.

Display Safety Zone

To display the safety zone settings, select **Safety Zone** and click the **Display Item**  button on the toolbar or select **Display Item** on the context menu.



Then, the selected safety zone is displayed in the 3D viewer of the **Motion Monitoring** tab.



4.2.8 Safety Zone Overview (Valid from GF020500)

Safety zone is unified as two types of zone, Space limit zone and Local zone.

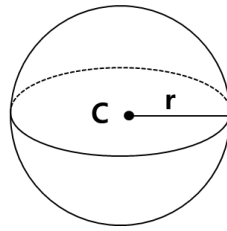
Space Limit Zone

Space limit zone is a safety zone which limits operation of the robot. It unified the Operating space and the Protection zone of the previous version.

The shape of a zone is geometrically defined as one of Sphere, Cylinder, Cuboid, Tilted Cuboid and Multi Plane. The properties of each shape is as below.

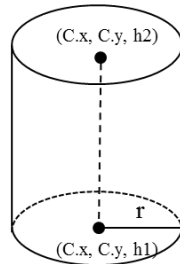
Type	Image	Property
------	-------	----------

Sphere



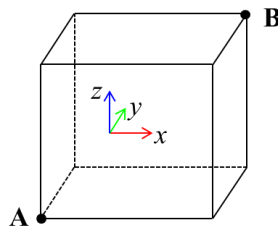
C: Center Point (X, Y, Z)
r: Radius

Cylinder



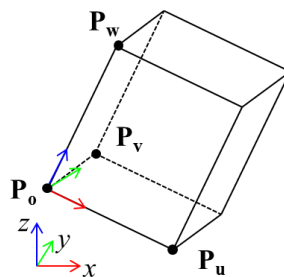
C: Center Point (X, Y)
r: Radius
h₁: Lower Height (Z)
h₂: Upper Height (Z)

Cuboid



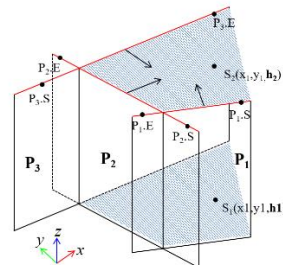
A: Vertex Point 1 (X, Y, Z)
B: Diagonal Vertex Point of A (X, Y, Z)

Tilted Cuboid



Tilted cuboid is defined as an origin point and three orthogonal vertex points.
P₀: Origin Point (X, Y, Z)
P_u: Vertex point along U axis (X, Y, Z)
P_v: Vertex point along V axis (X, Y, Z)
P_w: Vertex point along W axis (X, Y, Z)

Multi Plane



P₁~P₆: A plane orthogonal to XY plane.
Defined as start and end points on XY plane.
h₁: Lower Height (Z)
h₂: Upper Height (Z)
S: Space point(X, Y). The Space point decides a valid space among spaces divided by planes.

Shapes have common properties as below.

Property	Description
----------	-------------

4 System Control

Coordinate	If defines the coordinate system of the position of the shape. It is one of Base coordinate system or World coordinate system.
Valid space	A shape divide the space into inner space and outer space. The user can select which space is valid. If the outer space is valid, the robot cannot reside inside the shape which means that it defines a protection zone.
Margin	Margin means an offset value to expand or shrink the shape. If it is positive value, the shape is expanded. Or if it is negative value, the shape is shrunk.

The properties of a zone is as below:

Property	Description
Inspection Type	If defines space limit violation inspection type. Body: Robot shape volumes are used to decide whether the robot reside inside space limit. TCP: Robot TCP is used to decide whether the robot reside inside space limit.
Joint Angle Limit Override	It defines whether to override joint angle limit inside the zone.
Dynamic Enable By Safety Input	It defines whether to dynamically enable the zone based on the safety input signal. If the option is enabled, the safety zone is enabled when the assigned safety input channel is invoked
Dynamic Enable By Safety Output	It defines whether to dynamically enable the zone based on the safety output signal. If the option is enabled, the safety zone is enabled when the assigned safety output channel is invoked

Local Zone

Local zone is a safety zone which overrides safety parameters when TCP is inside the zone.

The shape of a zone is geometrically defined as one of Sphere, Cylinder, Cuboid, Tilted Cuboid and Multi Plane. The properties of each shape are as described in Space Limit Zone.

The properties of a zone is as below:

Property	Description
Prior to other zones	It decides the priority of zones when local zones are overlapped. If this flag is enabled, the zone is prior to other zones.
Prior to Reduced mode	If the reduced speed mode safety input is invoked while the robot is operating in Auto mode, the safer limit between global reduced speed mode limit and the local safety limit is applied. If this flag is enabled, the local safety limit is applied.
Joint Angle Limit Override	It defines whether to override joint angle limit inside the zone.
Joint Speed Limit Override	It defines whether to override joint speed limit inside the zone.
TCP Speed Limit Override	It defines whether to override TCP speed limit inside the zone.
Power Limit Override	It defines whether to override Power limit inside the zone.

Momentum Override	Limit		It defines whether to override Momentum limit inside the zone.
TCP Force Override	Limit		It defines whether to override Force limit inside the zone.
Collision Override	Sensitivity		It defines whether to override Collision sensitivity inside the zone.
TCP SLF Stop Mode Override	Violation		It defines whether to override TCP SLF Violation Stop Mode inside the zone.
COLLISION Stop Mode Override	Violation		It defines whether to override COLLISION Violation Stop Mode inside the zone.
Speed Rate Override			It defines the operation speed rate inside the zone.
Tool Orientation	Limit		It defines whether to limit the tool orientation inside the zone. To limit the tool orientation, the limit axis and the angle should be defined.
Collaborative Enable	Zone		It defines whether to collaborative zone enable.
Dynamic Safety Input	Enable	By	It defines whether to dynamically enable the zone based on the safety input signal. If the option is enabled, the safety zone is enabled when the assigned safety input channel is invoked
Dynamic Safety Output	Enable	By	It defines whether to dynamically enable the zone based on the safety output signal. If the option is enabled, the safety zone is enabled when the assigned safety output channel is invoked

**CAUTION**

The safety violation inspection criterion is decided based on rules below.

1) Manual mode or hand-guiding mode:

The global reduced speed mode limit is applied. The safety limit of the local zone is ignored.

2) Normal speed Auto mode:

If the TCP is inside the zone, the safety limit of the local zone is applied.


3) Reduced speed Auto mode:

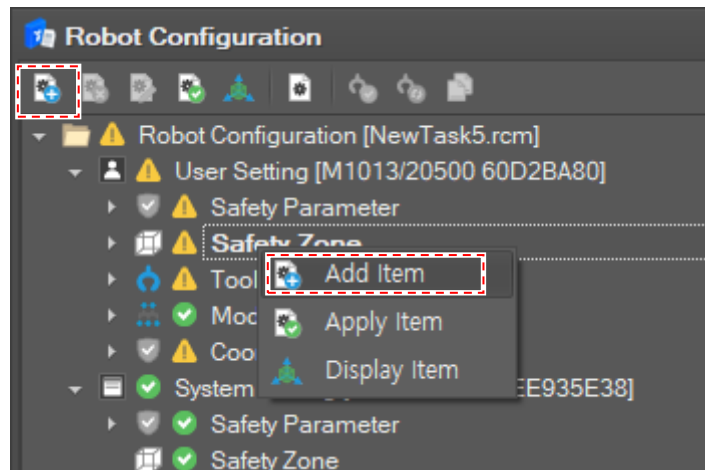
If the reduced speed mode safety input is invoked while the robot is operating in Auto mode, the safer limit between global reduced speed mode limit and the local safety limit is applied.

If the 'Prior to reduced mode' is enabled, the local safety limit is applied.

4.2.9 Safety Zone Setting (Valid from GF020500)

Add a safety zone

To add a safety zone click **Add Item**  button on the toolbar or select the **Add Item** menu on the context menu.

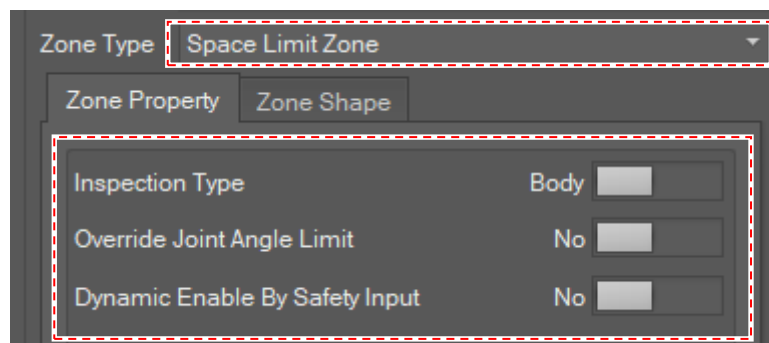


Define properties of the safety zone

Set the name of the zone. It should be unique.

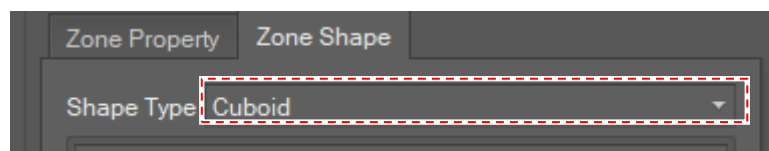


Select the type of the zone and set the properties.

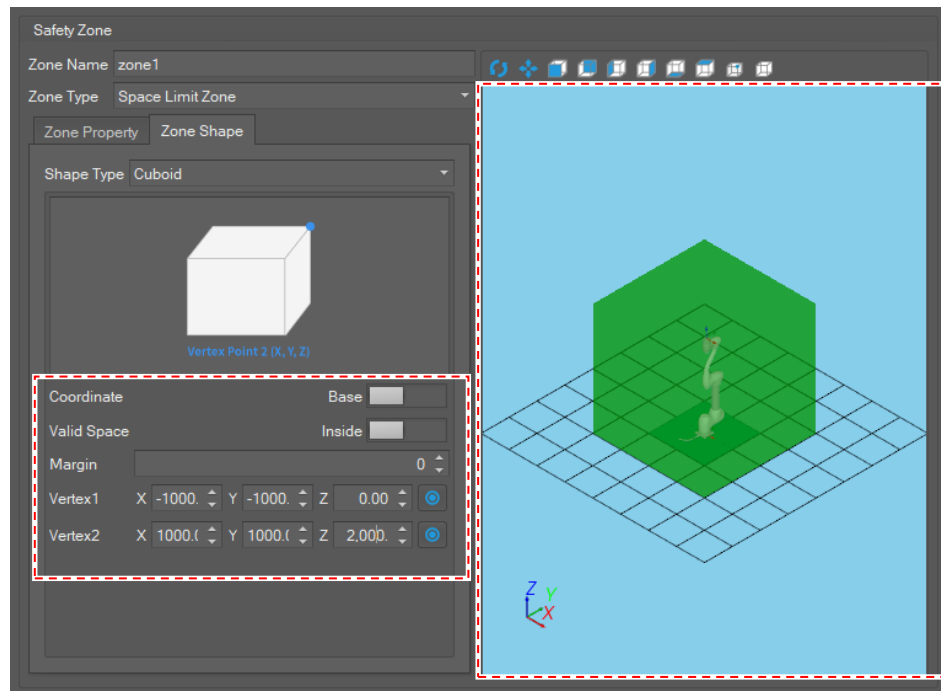


Define the shape of the safety zone.

Select the **Zone Shape** tab, and select the shape type.






Set properties of the shape. If the shape is properly set, the shape is displayed in the shape view.



The user can manipulate the 3d shape view by using the functions below.

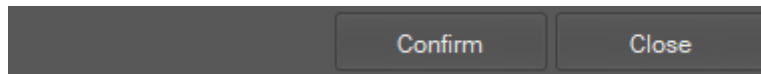


- Move: Click the **Move**  button or press the **F4** key and move the mouse cursor while clicking left mouse button..
- Rotate: Click the **Rotate**  button or press the **F2** key and then move the mouse cursor while clicking the left mouse button.
- View Direction: To change the viewpoint, click one of the **View Direction** buttons. If you click the **To -X** button, the scene rotates so that the forwarding direction directs to the - X direction.
- Show Safety Zone: Select the zone type to show on the screen in the Context menu that appears when the **Show Safety Zone** button is clicked.
- Select: Click the **Select**  button on the menu or press the **F3** key, and then click the left mouse button over the object to select.
- Zoom: Scroll the mouse wheel upward to zoom in. Scroll the mouse wheel downward to zoom out.
- Scene Fitting: Press the F5 key.

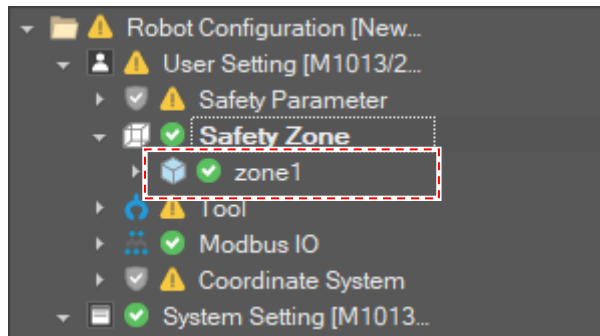
Confirm the safety zone

4 System Control

If editing is done, click the **Confirm** button. Or the user can discard the setting by clicking the **Close** button.




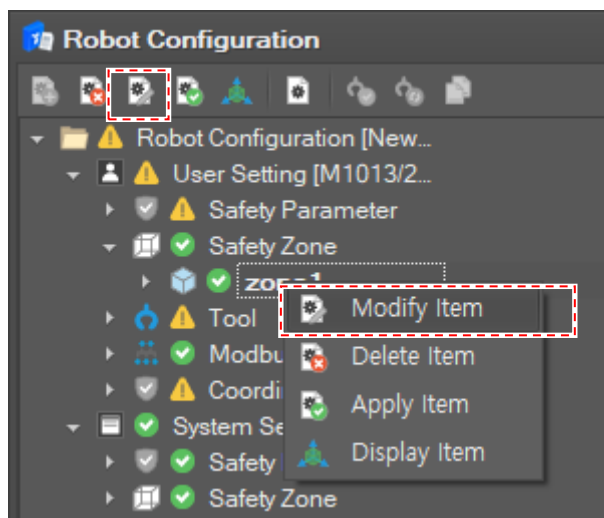
If the user confirm the setting, a new safety zone item is added to the configuration tree.



If the DART Studio is connected to the controller, the setting is applied to the system. Or if it is not connected to the controller, the setting is just saved to the configuration file.

Modify a safety zone

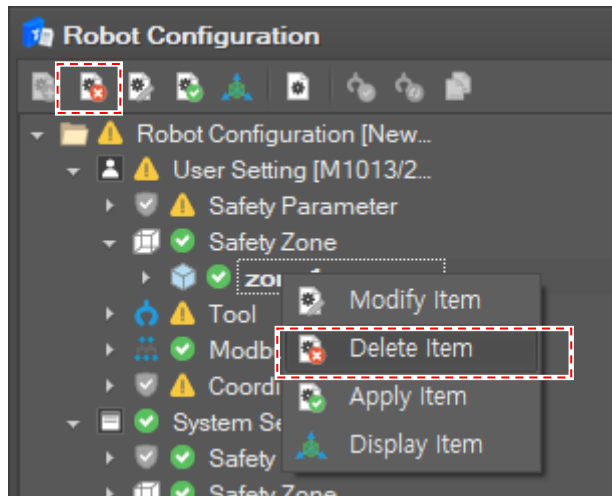
To modify setting of a safety zone click **Modify Item**  button on the toolbar or select the **Modify Item** menu on the context menu.



If the button is clicked, the editing window is displayed. After editing the setting click the **Confirm** button to confirm the setting.

Delete a safety zone

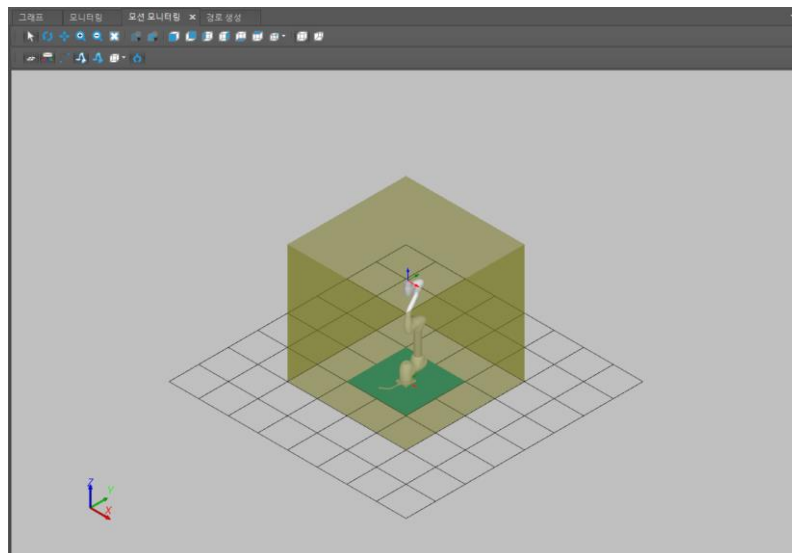
To delete a safety zone click **Remove Item**  button on the toolbar or select the **Remove Item** menu on the context menu.



Display a safety zone

To display a safety zone click **Display Item**  button on the toolbar or select the **Display Item** menu on the context menu.


Then the safety zone is display in the **Motion Monitoring** view.



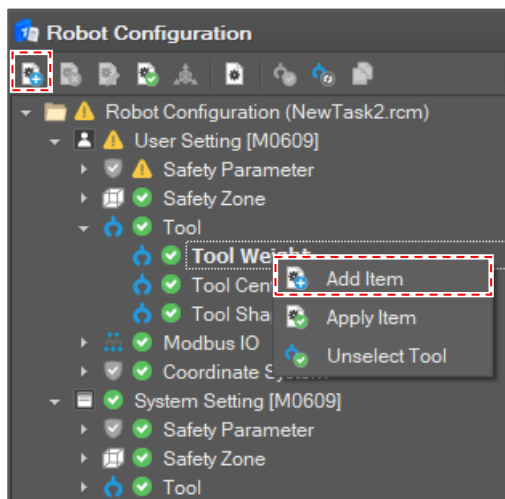
4.2.10 Tool

Add an item to set a tool

4 System Control




To register a tool setting, select **Tool Weight**, **Tool Center** or **Tool Shape** and click the **Add Item**  button on the toolbar.

- It is also possible to add an item by selecting **Add Item** on the context menu.



Edit a tool setting

Fill the tool properties.

Tool Name	<input type="text"/>					
Tool Weight	<input type="text"/>					0.00  
Center of Gravity	X	<input type="text" value="0.00"/>	Y	<input type="text" value="0.00"/>	Z	<input type="text" value="0.00"/>
						
Inertia	X	<input type="text" value="0"/>	Y	<input type="text" value="0"/>	Z	<input type="text" value="0"/>
	A	<input type="text" value="0"/>	B	<input type="text" value="0"/>	C	<input type="text" value="0"/>

Tool Name	<input type="text"/>					
TCP	X	<input type="text" value="0"/>	Y	<input type="text" value="0"/>	Z	<input type="text" value="0"/>
	A	<input type="text" value="0"/>	B	<input type="text" value="0"/>	C	<input type="text" value="0"/>

You can automatically measure the tool weight by clicking the **Measure** button.

If measurement is done, the measure result is filled in the tool weight fields.


You can automatically calculate the TCP by clicking the **Calculate** button. If you click it, the TCP Calculating window opens. After filling in the four reference values required for TCP calculation, press the **measure** button to start the measurement motion. During motion, the **measure** button changes to a **stop** button, and the measurement motion stops when the **stop** button is pressed.

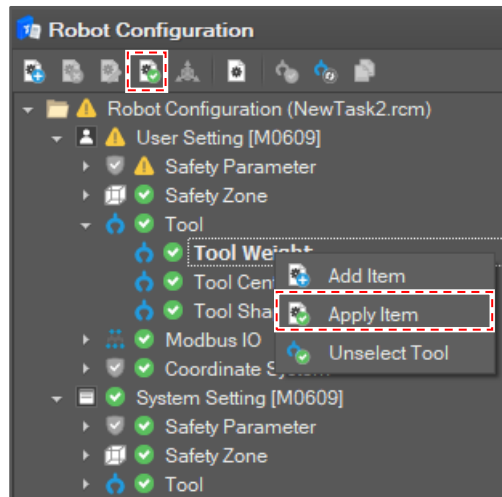
If calculation is done, the result is filled in TCP fields.

If editing is done, click the **Confirm** button.

Then, the setting is registered in the system.


Activate a tool

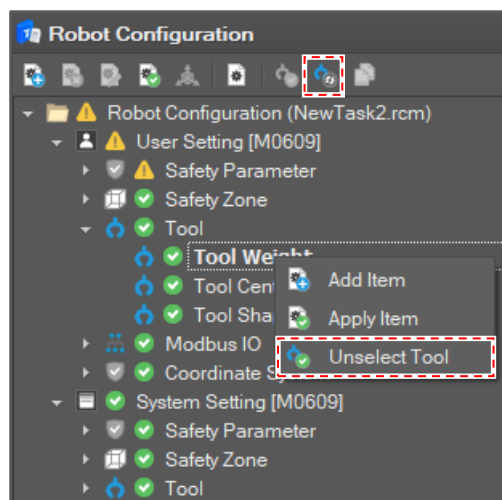
To activate a tool, select a tool item and click the **Apply Item**  button on the toolbar, or select **Apply Item** on the context menu.



Then, the selected tool is set as an active tool.


Unselect a tool

Click the **Unselect Tool**  button on the toolbar or select **Unselect Tool** on the context menu.



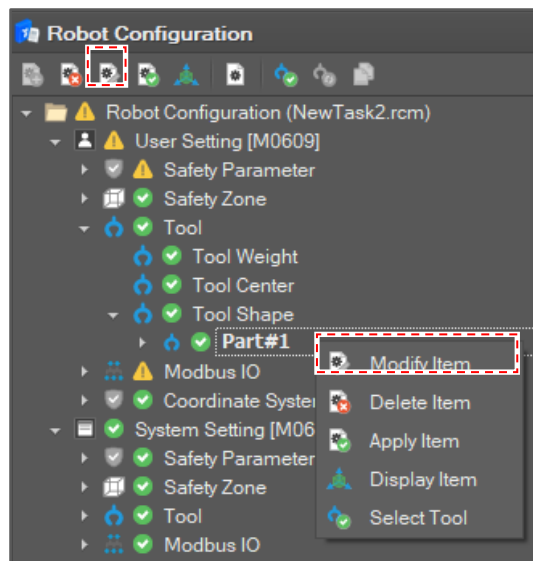
Then, the active tool is reset.

Modify a tool shape Item

To set tool shape setting, select an added item and click the **Modify Item**  button on the toolbar.

4 System Control

- It is also possible to modify it by selecting **Modify Item** on the context menu.



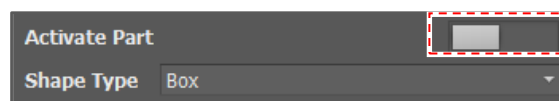
Then, the edit window appears on the right side.

Tool shape is composed of at most five parts, and each part's shape is one of **Box**, **Sphere** or **Capsule**. To configure the shape of a part, you must set its validity flag and shape.

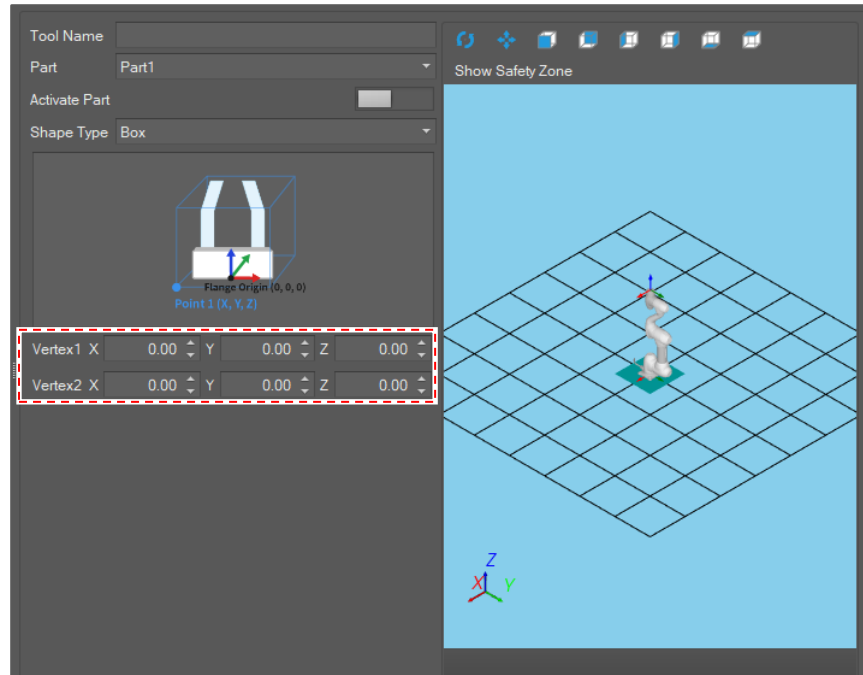
- 1 Select the part in the **Tool Shape** list.
- 2 Click the **Modify Item** button on the toolbar or select **Modify Item** on the context menu.
- 3 Select **Shape Type**.



- 4 Turn on the **Activate Part** button if you want to enable a part.



- 5 Define shape
 - It is assumed that the origin of the tool shape is in the "Tool Flange Center" and its X, Y, Z direction is the same as the **Base** coordinate system X, Y, Z direction.
 - If every field is filled and the shape is valid, it is displayed in the **Tool Shape Display Window**.



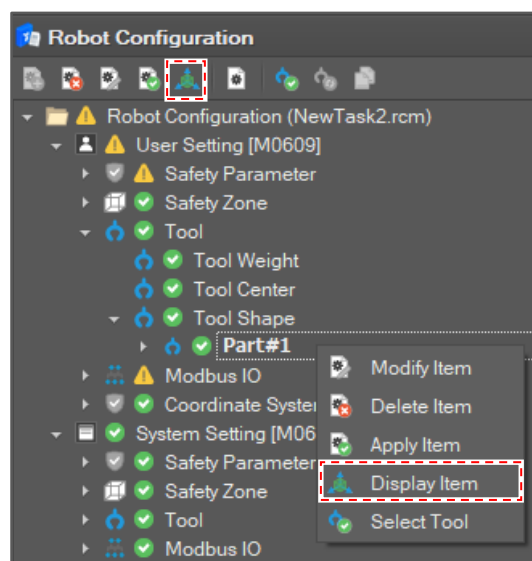
6 Click the **Confirm** button.

The setting display is updated and applied to the system.

Display the tool shape item

To display the tool shape in the **Motion Monitoring** window, select a tool shape item and click the **Display Item** button.

- It is also possible to display the tool shape by selecting **Display Item** on the context menu.




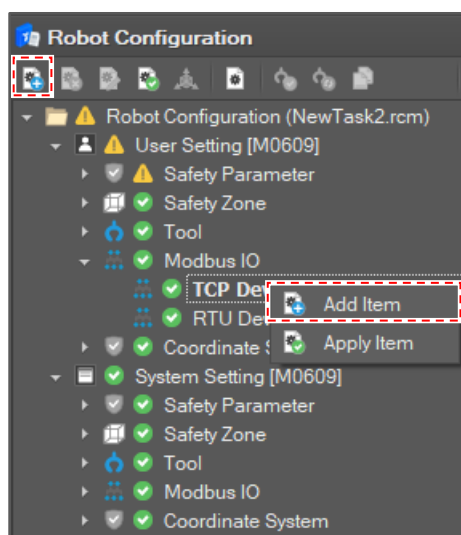
Then, the tool shape is displayed in the **Motion Monitoring** window.

4.2.11 Modbus IO

Modbus IO has two types, TCP device and RTU Device.

Add a Modbus Monitoring Item

To add a Modbus monitoring item, select a tool item (TCP device or RTU Device) and click the **Add Item**  button on the toolbar or select **Add Item** on the context menu.



Then, the **Modbus Setting** window appears on the right side.


Modbus Device information includes:

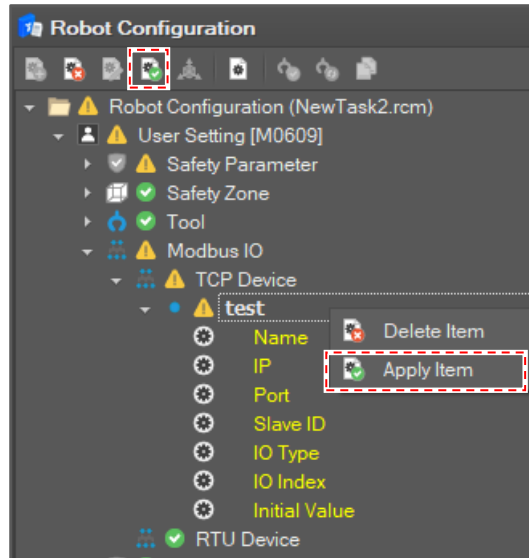
- Device IP Address and Port
- I/O Type

IO Type	Read/Write Property	Value Range
Discrete Input	Read Only	0~1 (1 Bit)
Coil	Read / Write	0~1 (1 Bit)
Input Register	Read Only	0~65535 (2 Bytes)
Holding Register	Read /Write	0~65535 (2 Bytes)

- I/O Index


If setting is done, click the **Confirm** button.

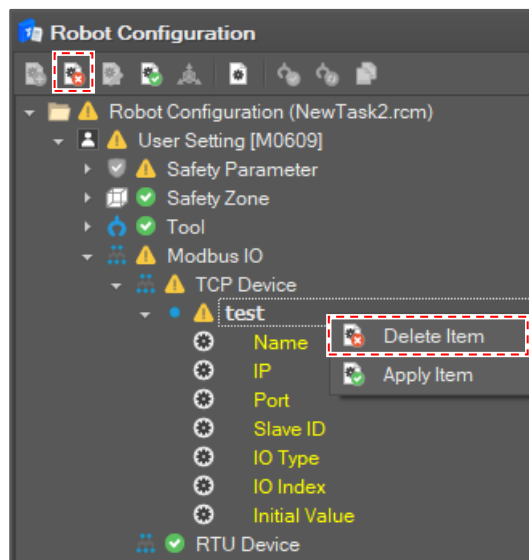
When a new item is added to the tree, select the item and click the **Apply Item**  button on the toolbar or select **Apply Item** on the context menu.



If the setting item is successfully applied, the value of the item is displayed in the **Input Value** field in the tree.

Remove a Modbus Monitoring Item

To remove monitoring items, select an item node in the tree and click the **Delete Item**  button on the toolbar or select **Delete Item** on the context menu.




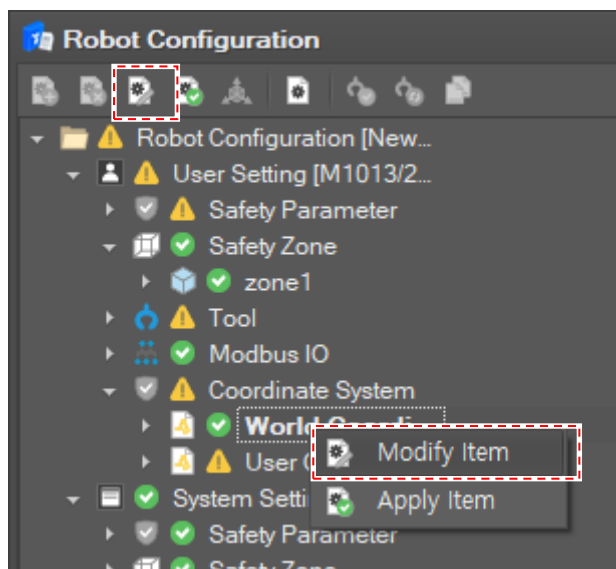
Then, the selected items are removed from the tree and controller.

4.2.12 Coordinate System

World Coordinate

4 System Control

To configure the world coordinate, click **Modify Item**  button on the toolbar or select the **Modify Item** menu on the context menu after selecting the **World Coordinate** item.



Configure the world-base relation in the editing window. World-Base relation means the position and the orientation of the robot based on the world coordinate system.

Item	Description
X	Coordinates of the relative position of the robot base in the X axis direction of the world coordinate system
Y	Coordinates of the relative position of the robot base in the Y axis direction of the world coordinate system
Z	Coordinates of the relative position of the robot base in the Z axis direction of the world coordinate system
A	Angle of the XY coordinate axis of the robot base rotated with the Z axis of the world coordinate system as the rotation axis
B	Angle of ZX coordinate axis of robot base rotated with Y axis rotated above
C	Angle of XY coordinate axis of robot base rotated with Z axis rotated above

Add a user coordinate


To add a user coordinate, click **Add Item**  button on the toolbar or select the **Add Item** menu on the context menu after selecting the **User Coordinate** item.

Set the properties of the user coordinate and click the **Confirm** button.

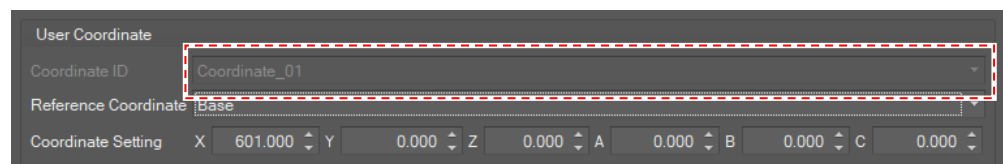
Property	Description
ID	At most 20 user coordinates can be defined. The id of the coordinate is pre-assigned. So select the id of the coordinate. It cannot be duplicated with other coordinate setting.
Basis Coordinate System.	Set the basis coordinate system among the World coordinate system and the Base coordinate system.
Coordinate Setting	Set the origin position and the orientation of the user coordinate system based on the basis coordinate system.

X, Y, Z: the origin position based on the basis coordinate system.
 A, B, C: the orientation of the coordinate based on the basis coordinate system.

Modify the user coordinate


To modify a user coordinate, click **Modify Item**  button on the toolbar or select the **Modify Item** menu on the context menu after selecting the item to modify.

The coordinate ID cannot be modified.



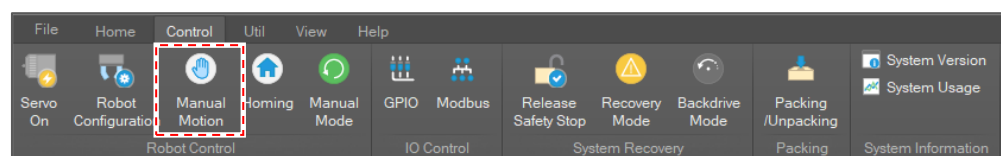
After setting properties, click the **Confirm** button.

Delete a user coordinate

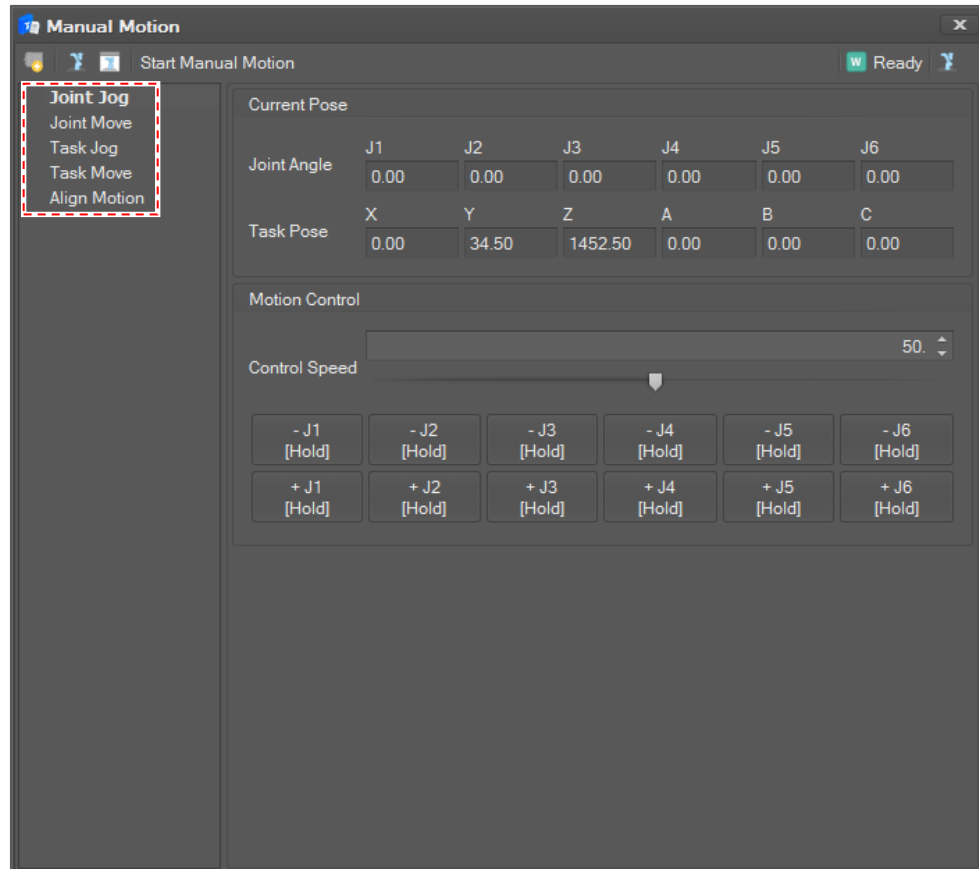
To delete a user coordinate, click **Delete Item**  button on the toolbar or select the **Delete Item** menu on the context menu after selecting the item to delete.

4.3 Manual Motion

To control the robot motion manually, select **Control** on the main menu and click the **Manual Motion** button.



Joint Jog, Joint Move (MoveJ), Task Jog, Task Move (MoveL) and **Align Motion** are available in the **Manual Motion** window.



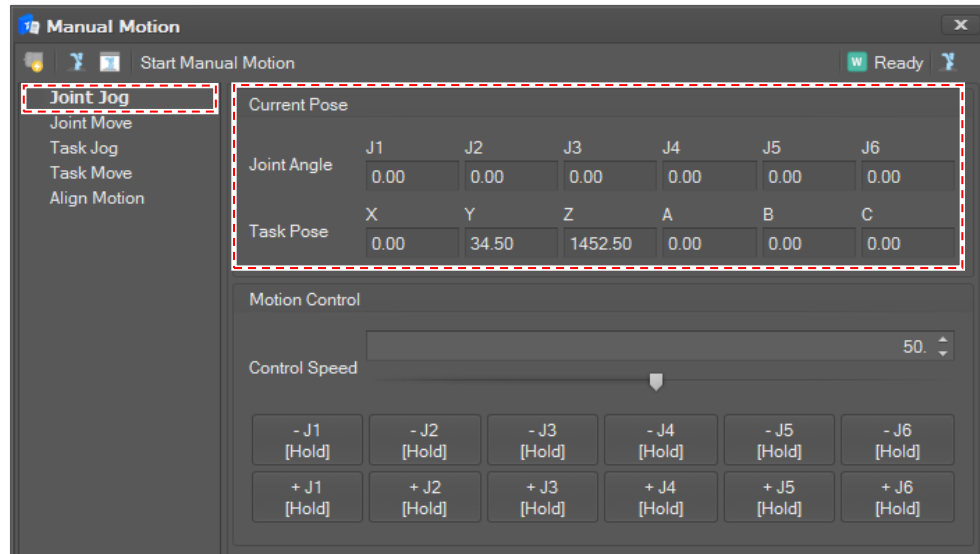
And then you can perform the servo on, change real / virtual mode using the button on the left upper side. It is also possible to see the current control state and system mode in the right upper side.

All manual motions are run by the user's **Hold To Run** operation. **Hold To Run** means that the robot moves only when the operation button is pushed. If the button is released, the robot stops immediately.

In motion control, every joint angle value is displayed in degree units and its speed is displayed in degree/second units. For task pose, the translation part (X, Y, Z position) is displayed in mm units and orientation part (RZ, RY, RZ orientation) is displayed in degree units. For task speed, the speed of the translation part is displayed in mm/second units and speed of the orientation part is displayed in degree/second units.

4.3.1 Joint Jog

Select **Joint Jog** in the **Manual Motion** list. Then, the current joint angle and TCP position are displayed and updated in 100 milliseconds.



Set Jog Speed

Jog speed is set in percent units. The joint angle speed for 100% is 30 degrees/seconds. To set the speed, click the spin button or move the slide bar.



Jog the joint angles

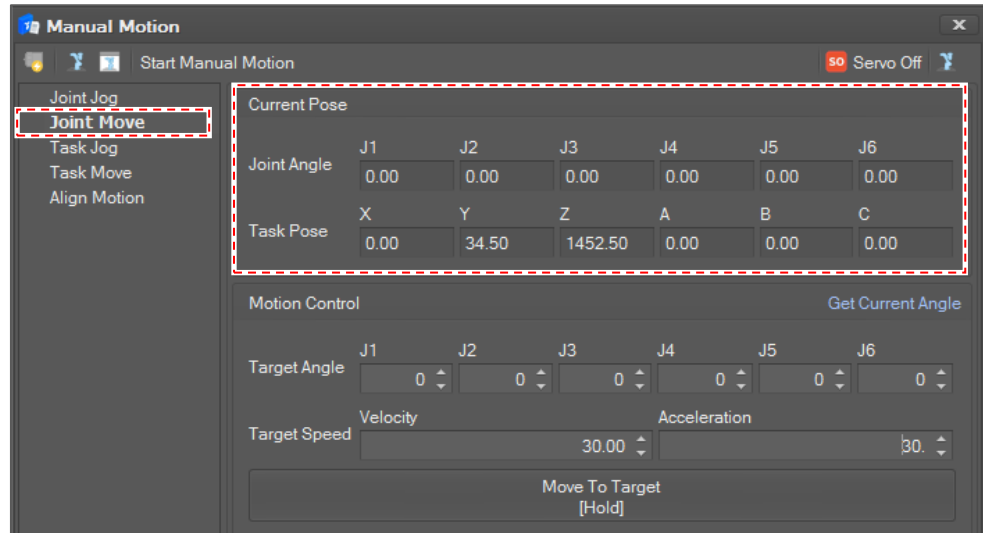
Use the **+** (plus) or **-** (minus) buttons to adjust the joint angles. If the button is released, the motion stops.

- To decrease the joint angle, click the **- (minus)** button.
- To increase the joint angle, click the **+** (plus) button.



4.3.2 Joint Move

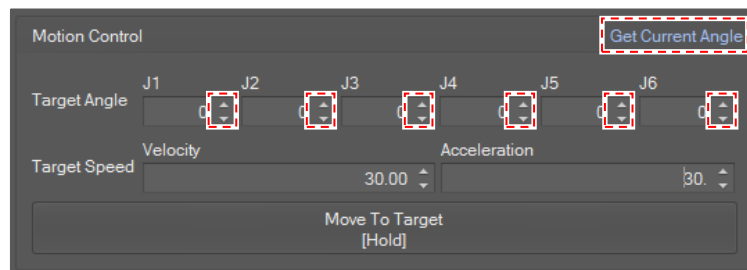
Select **Joint Move** in the **Manual Motion** list. Then, the current joint angles and TCP position are displayed and updated in 100 milliseconds.



Set the target joint angles

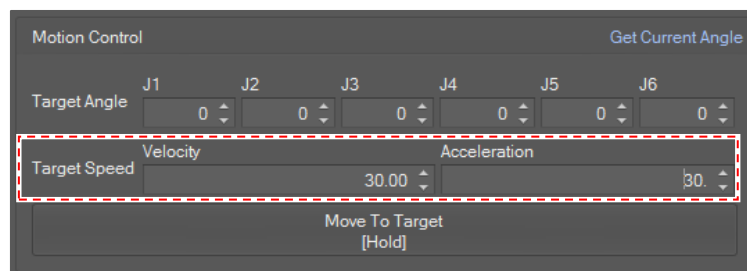
To set the target angles, type the value or click the spin button.

- To load the current angle in the **Target Angle** field, click the **Get Current Angle** button.



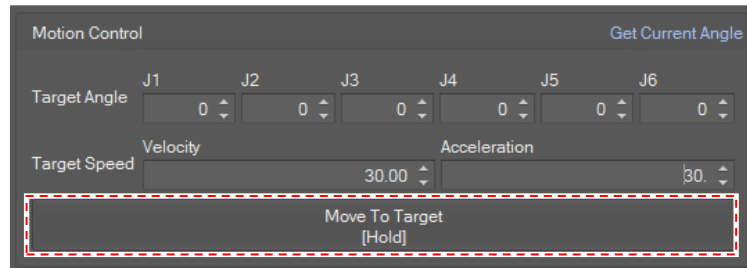
Set the speed and acceleration

To set the speed and acceleration, type the value or click the spin button.



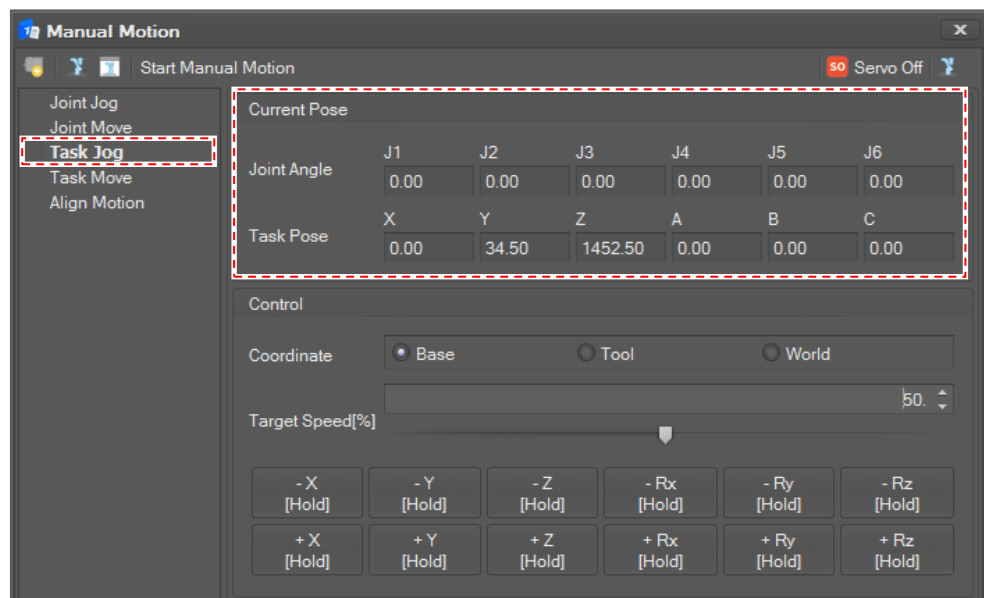
Start motion

Click and hold the **Move To Target** button to move the robot to the target angles in the way of “MoveJ.” If the button is released, the robot will stop.



4.3.3 Task Jog

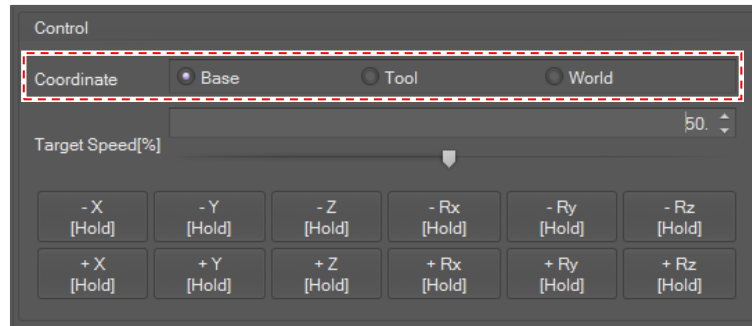
Select **Task Jog** in the **Manual Motion** list. Then, the current joint angles and TCP position are displayed and updated in 100 milliseconds.



Set Jog Mode

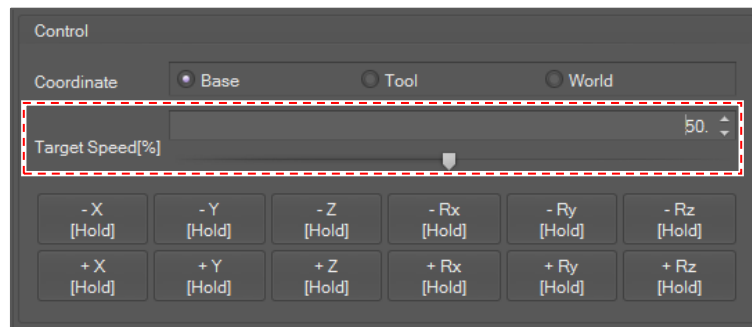
There are three jog modes: **Base**, **Tool** and **World**.

- **Base**: The TCP of robot will move along the corresponding axis of base coordination.
- **Tool**: The TCP of robot will move along the corresponding axis of tool coordination.
- **World** : The TCP of robot will move along the corresponding axis of world coordination.



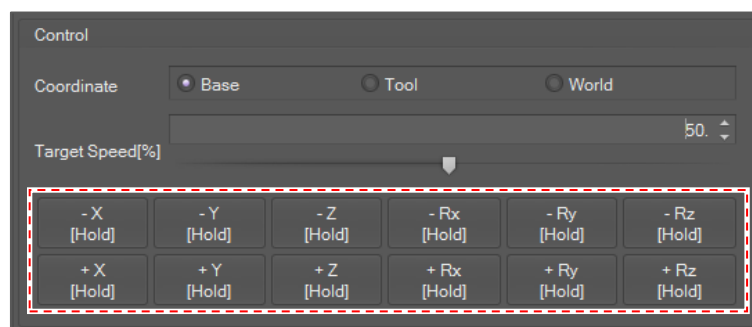
Set Jog Speed

Jog speed is set in percent units. The task jog speed for 100% is 250 mm/second. To set the jog speed, click the spin button or move the slide bar.



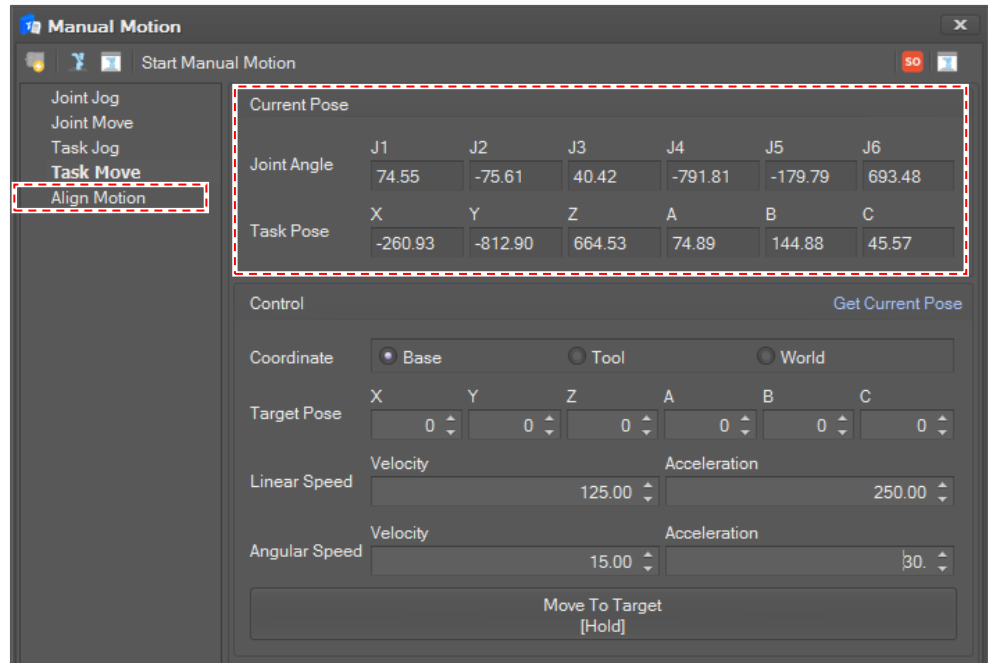
Start Motion

Click and hold the **Plus(+)** or **Minus(-)** button for the axes and direction to move. If you release the button, the motion stops.



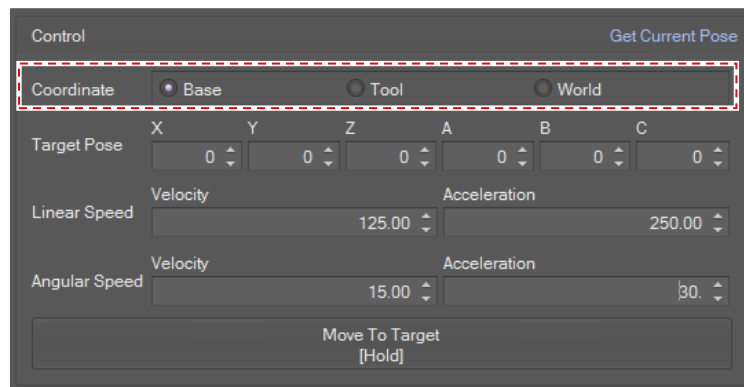
4.3.4 Task Move

Select **Task Move** in the **Manual Motion** list. Then, the current joint angles and TCP position are displayed and updated in 100 milliseconds.



Set Coordination Mode

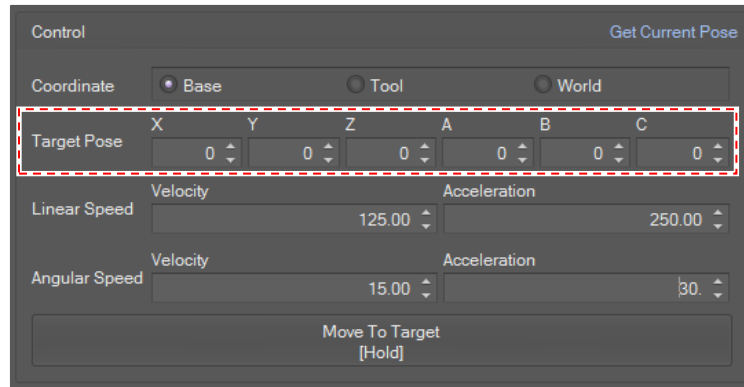
- **Base:** The target position is interpreted as a position in the base coordination.
- **Tool:** The target position is interpreted as in the tool coordination.
- **World :** The target position is interpreted as in the world coordination.



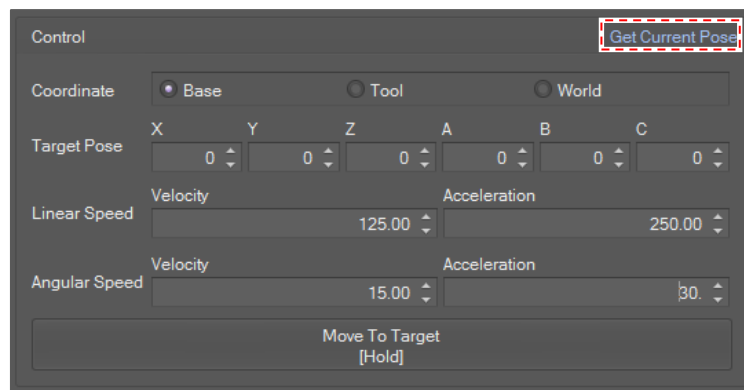
Set Target Coordinates

Type the value or click the spin button to set the **Target coordinates**.

4 System Control

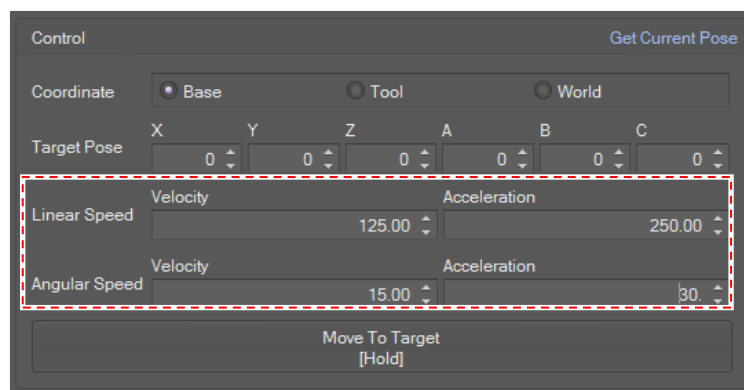


To load the current target coordinates in the **Target coordinates** field, click the **Get Pose** button.



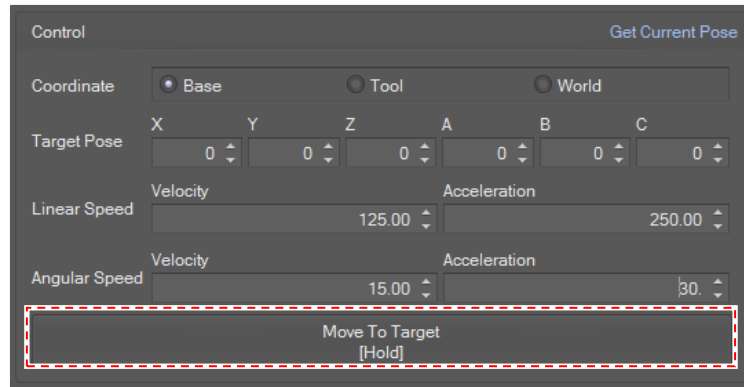
Set speed and acceleration

Type the value or use the spin button to set the speed and acceleration. The speed for translation part (mm/second) and orientation part (degree/second) must be set separately.



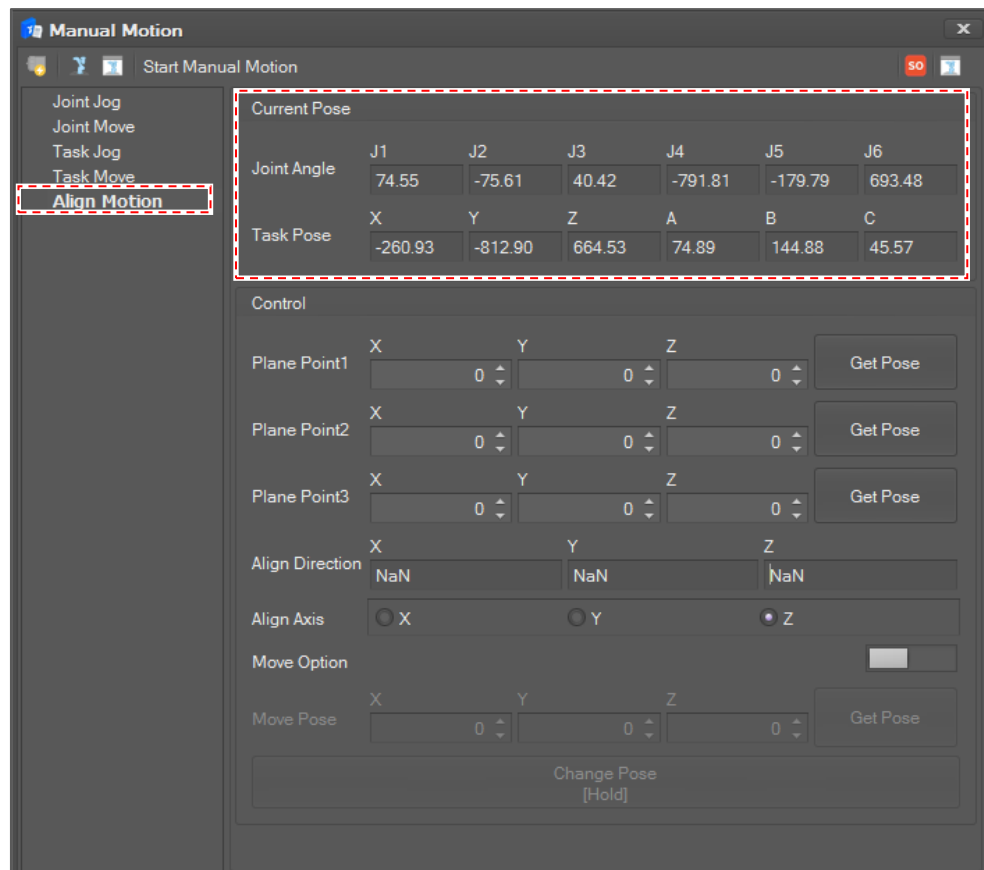
Start Motion

If you click and hold the **Move To Target** button, the robot will move to the target position in the way of "MoveL". If you release the button, robot will stop.



4.3.5 Align Motion

Select **Align Motion** in the **Manual Motion** list. Then, the current joint angles and TCP position are displayed and updated in 100 milliseconds.

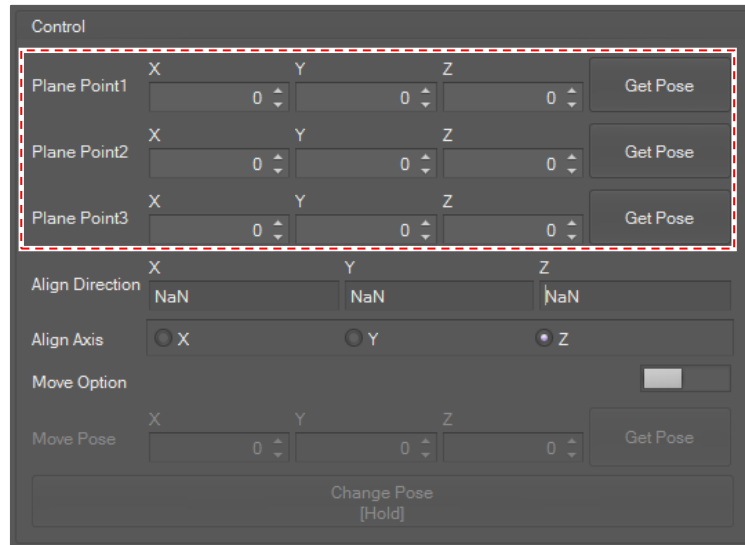


Set Plane Points

Set three plane points to decide the alignment direction. The alignment direction is the normal vector of the plane that the three plane points define.

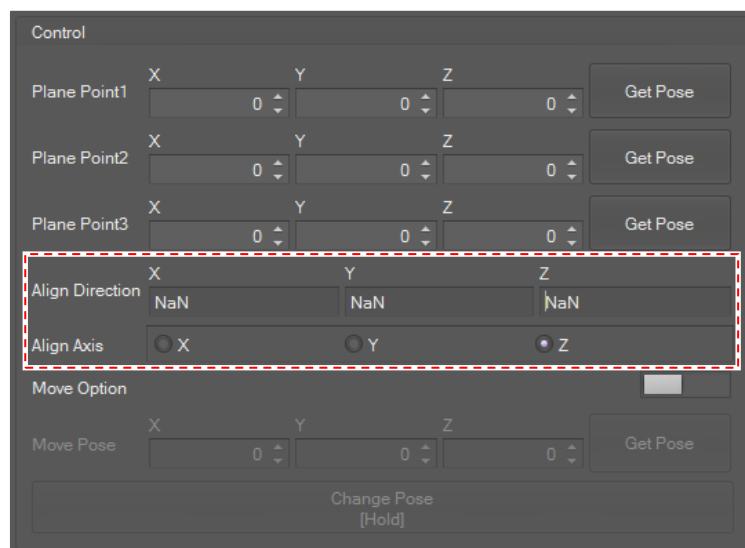
To get the current pose, click the corresponding **Get Pose** button.

4 System Control



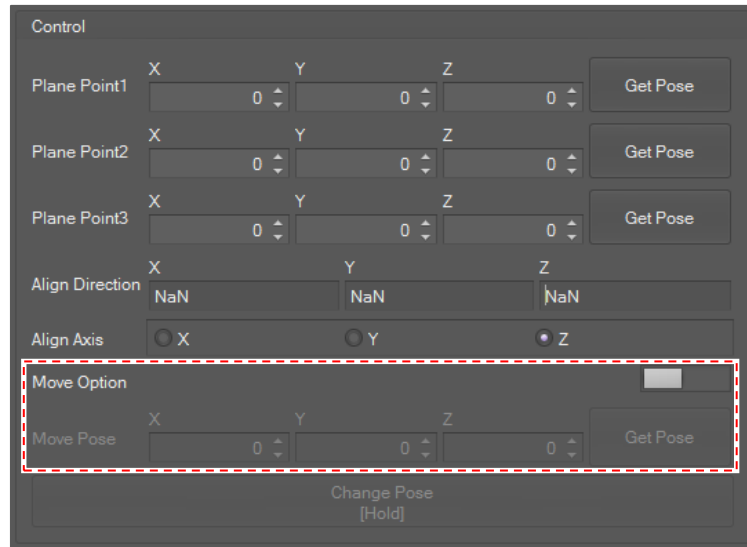
Select Alignment axis

Select the tool axis to align. If you select **Z Axis**, the tool's z axis will align to the alignment direction. If you select **X Axis**, the tool's x axis will align to the alignment direction.



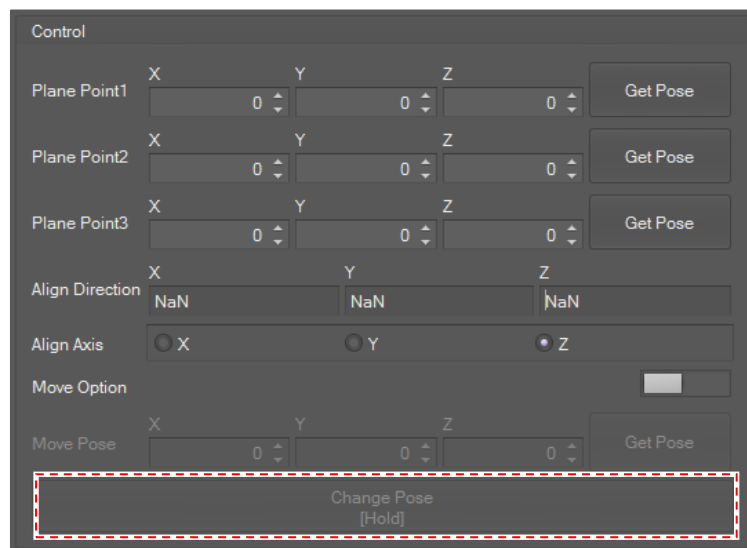
Select Target Coordinate Movement (Optional)

If the **Target Coordinate Movement** switch is on, the robot will move to the target position while changing the orientation of the tool. If the **Target Coordinate Movement** switch is off, the robot will change the orientation of the tool without changing the position.



Start Motion

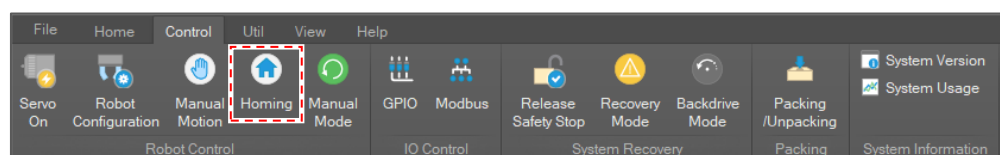
If you click and hold the **Move To Align** button, the robot will change its tool direction until you release the button.



4.3.6 Homing

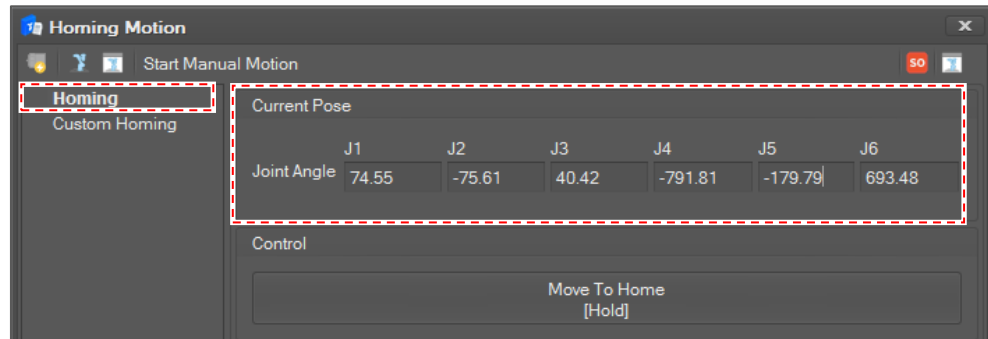
Though the homing motion is one of the manual motions, it has its own menu because it is used frequently.

Select **Control** on the main menu and click the **Homing** button.

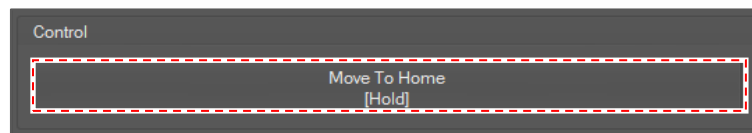


Homing

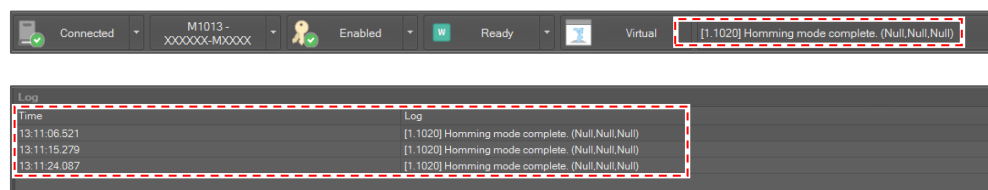
Select **Homing** in the **Homing Motion** list. Then, the current joint angles are displayed and updated in 100 milliseconds.



If you click and hold the **Move To Home** button, the robot will move to the home position until you release the button.

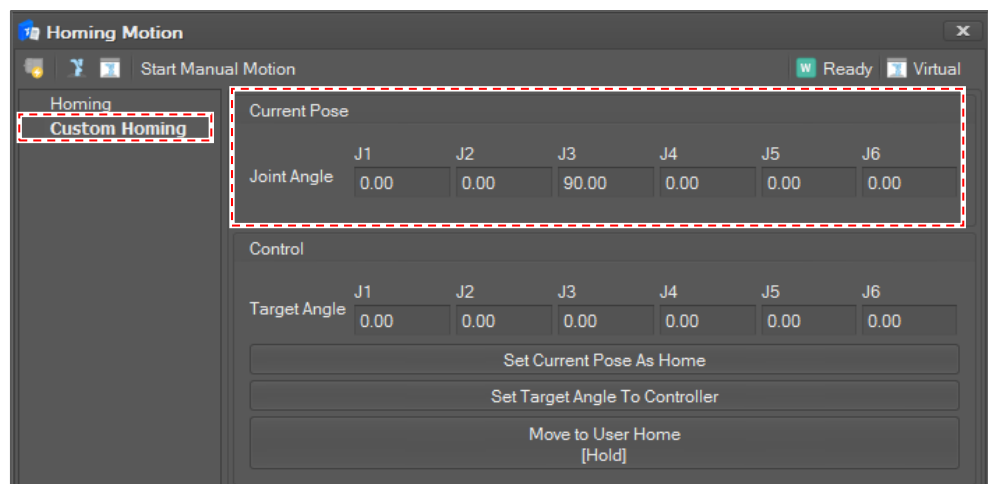


If homing is completed, you can see the “**Homing mode complete**” message on the Monitoring bar or message pane.



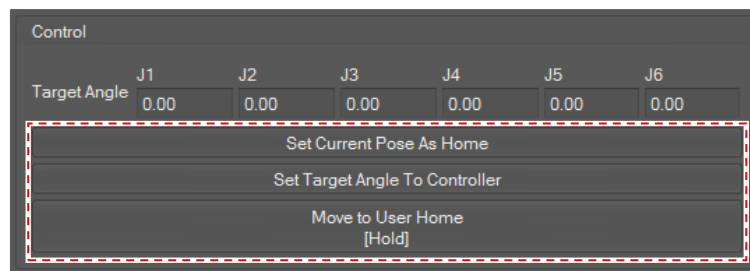
Custom Homing

Select **Custom Homing** in the **Homing Motion** list. Then, the current joint angles are displayed and updated in 100 milliseconds.



To set the current joint angle of the robot to the user's home, do the following.

- 1 Click the **Set Current Pose as Home** button to set the current pose to the custom home position.
- 2 Click the **Set Target Angle to Controller** button to apply to the controller.
- 3 If you click and hold the **Move to user Home** button, the robot will move to the custom home position until you release the button.
- 4 If homing is completed, you can see the “**Homing mode complete**” message on the Monitoring bar or message pane like **Homing**.

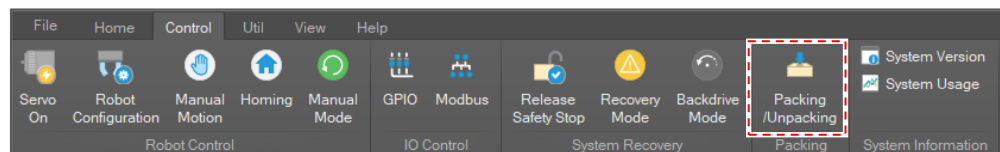


4.4 Packing

4.4.1 Packing or Unpacking

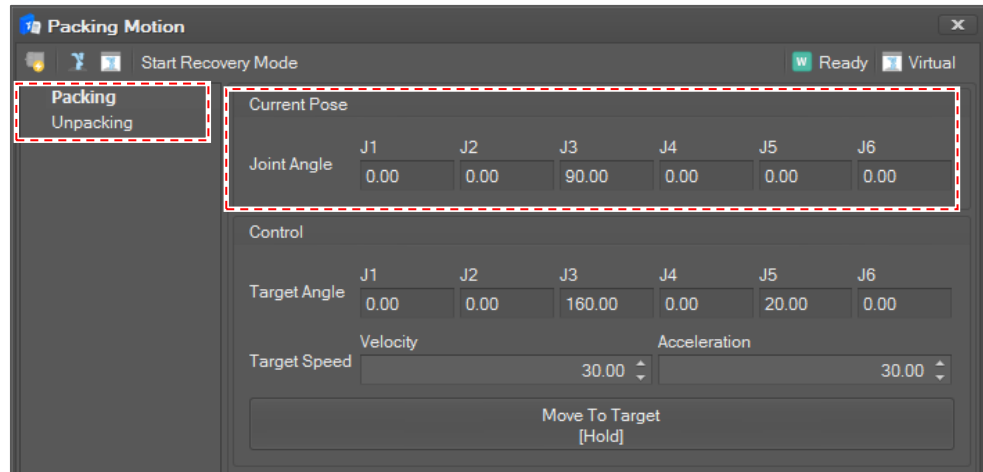
To control the robot packing mode, select **Control** on the main menu and click the **Packing/Unpacking** button.

CAUTION Control is available when entering recovery mode and the window is activated when control is available.

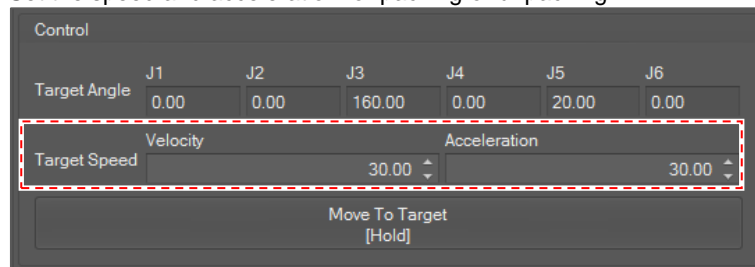


Packing/Unpacking

Select **Packing** or **Unpacking** in the **Packing Motion** list. Then, the current joint angles are displayed and updated in 100 milliseconds.

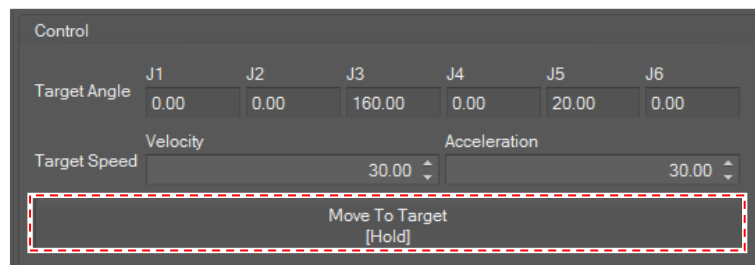


Set the speed and acceleration for packing or unpacking.



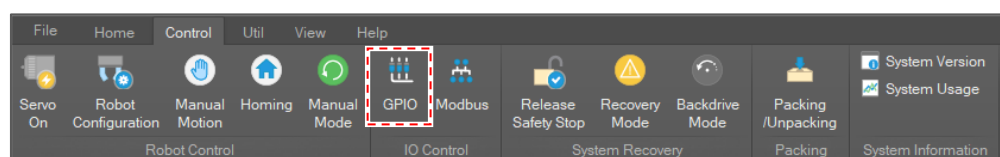
To pack or unpack the robot into the set specified packaging pose, Click and hold the **Move To Target** button.

If you release the button, the robot motion stops.

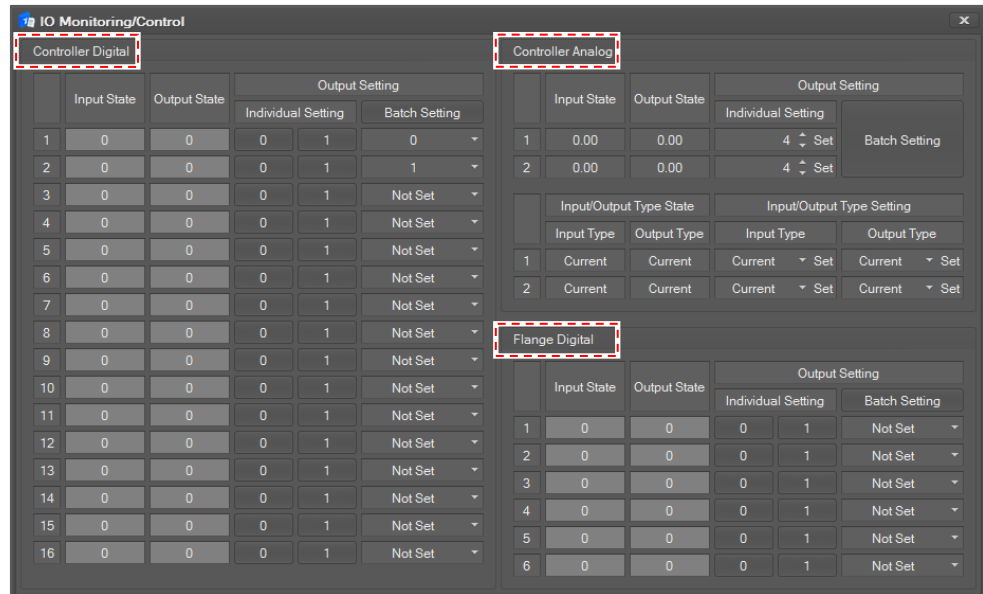


4.5 IO Control

To monitor or set the IO of the controller and the robot arm flange, select **Control** on the main menu and click the **GPIO** button.



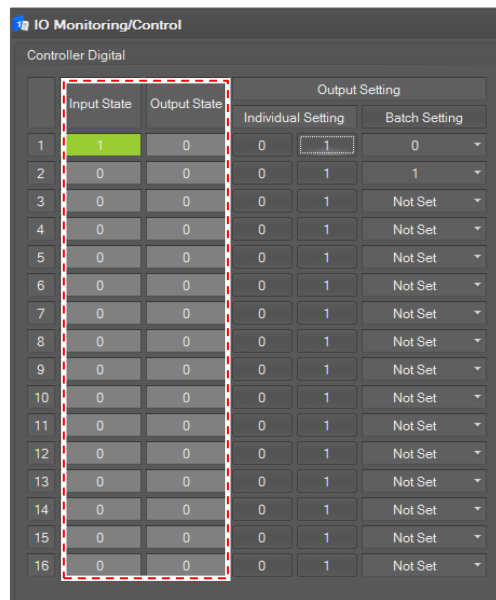
The **IO Monitoring / Control** window is composed of three parts: **Controller Digital** setting, **Controller Analog** setting and **Flange Digital** Setting.



Controller Digital

The Digital IO state of the controller is displayed in the **Input State/Output State** field.

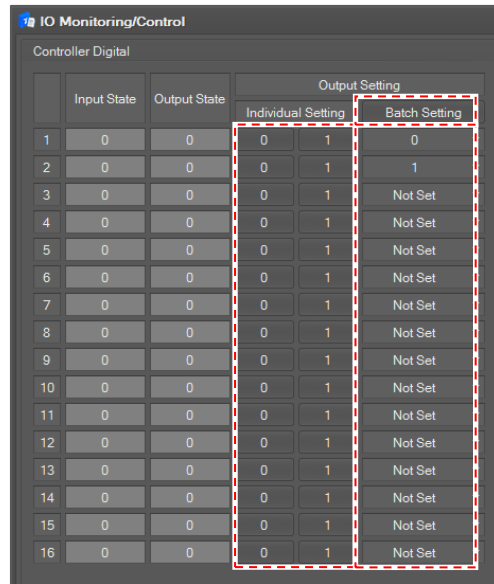
- If the signal is high, the IO state color is displayed in green.
- If the signal is low, the IO state color is displayed in gray.



To set output, click the 0 or 1 button for each channel in **Individual Setting**.

To set all outputs at once, set the desired value in each channel at the bottom of the **Batch Setting** button and click the **Batch Setting** button.

4 System Control

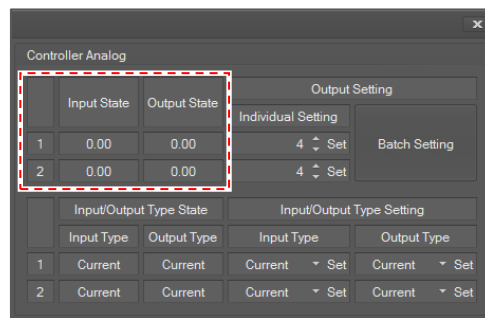


The screenshot shows the 'IO Monitoring/Control' window for a digital controller. It features a table with columns for 'Input State', 'Output State', and 'Output Setting'. The 'Output Setting' column is further divided into 'Individual Setting' and 'Batch Setting'. A red dashed box highlights the 'Individual Setting' and 'Batch Setting' columns for all 16 channels.

	Input State	Output State	Output Setting		
			Individual Setting	Batch Setting	
1	0	0	0	1	0
2	0	0	0	1	1
3	0	0	0	1	Not Set
4	0	0	0	1	Not Set
5	0	0	0	1	Not Set
6	0	0	0	1	Not Set
7	0	0	0	1	Not Set
8	0	0	0	1	Not Set
9	0	0	0	1	Not Set
10	0	0	0	1	Not Set
11	0	0	0	1	Not Set
12	0	0	0	1	Not Set
13	0	0	0	1	Not Set
14	0	0	0	1	Not Set
15	0	0	0	1	Not Set
16	0	0	0	1	Not Set

Controller Analog

The Analog IO state of the controller is displayed in the **Input State/Output State** field.



The screenshot shows the 'Controller Analog' window. It has a table for 'Input State' and 'Output State' with values of 0.00. Below this is an 'Output Setting' section with 'Individual Setting' (4) and 'Batch Setting' buttons. At the bottom, there is an 'Input/Output Type Setting' section with dropdown menus for 'Input Type' and 'Output Type'.

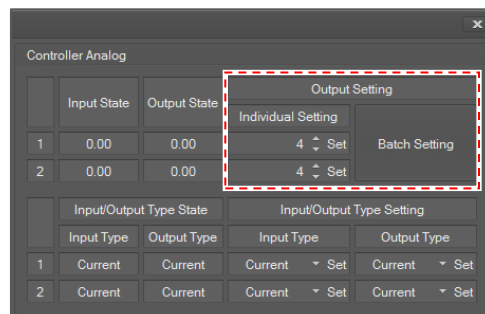
	Input State		Output State	
	Input State	Output State	Input State	Output State
1	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00

	Output Setting	
	Individual Setting	Batch Setting
1	4 <input type="text"/> Set	Batch Setting
2	4 <input type="text"/> Set	Batch Setting

	Input/Output Type State		Input/Output Type Setting	
	Input Type	Output Type	Input Type	Output Type
1	Current	Current	Current <input type="text"/> Set	Current <input type="text"/> Set
2	Current	Current	Current <input type="text"/> Set	Current <input type="text"/> Set

To set output, set **Output Setting** and click the corresponding **Set** button.

To set all output values at once, set the analog output fields and click the **Batch Setting** button.



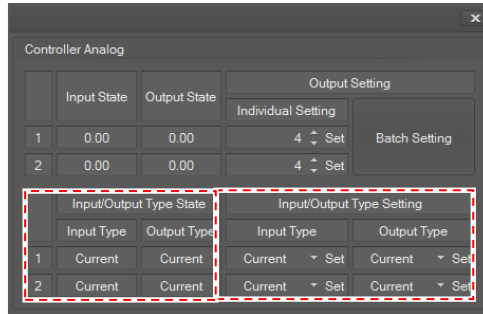
This screenshot is identical to the previous one, but a red dashed box highlights the 'Output Setting' section, specifically the 'Individual Setting' and 'Batch Setting' buttons.

Controller Analog Value Type Setting

The analog input/output type state of the controller is displayed in the **Input/Output Type State** field.

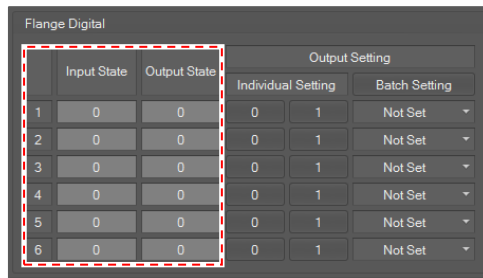
You can set the value type of analog input and output. It can be current or voltage.

To set the value type, select the type and click the **Set** button for the input/output type that you want to set in **Input/Output Type Setting**.



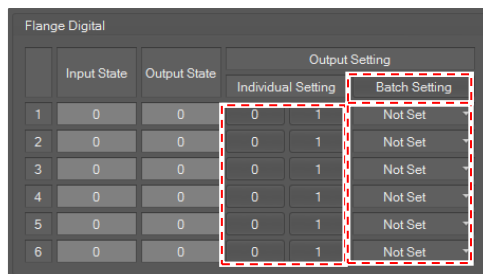
Flange Digital

The Digital IO state of the flange is displayed in the **Input State**, **Output State** field. As with the **Controller Digital**, the IO state color is green if the signal is high and gray if the signal is low.



To set output, click the 0 or 1 button in **Individual Setting**.

To set all outputs at once, select value for the flange digital and click the **Batch Setting** button.

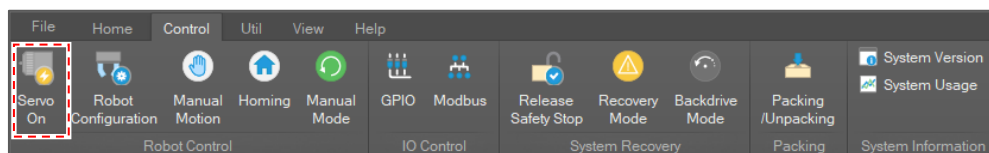


4.6 Fault Recovery

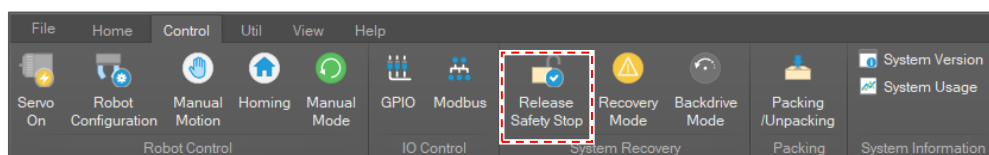
When an error occurs, the robot stops by its stop mode option. Stop mode and its action when an error occurs are as in the table below.

Stop Mode	Action	Controller State
STO	Motor power is cut off immediately.	Servo Off
SS1	Motor power is cut off after the robot motion stops completely.	Servo Off
SS2	The robot motion stops without motor power off.	Safety Stop

To recover the controller state from “Servo Off,” select **Control** on the main menu and click the **Servo On** button.



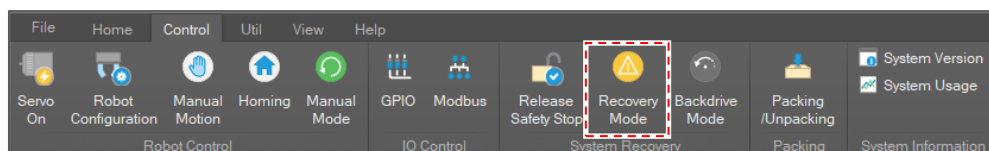
To recover the controller state from “Safety Stop,” select **Control** on the main menu and click the **Release Safety Stop** button.



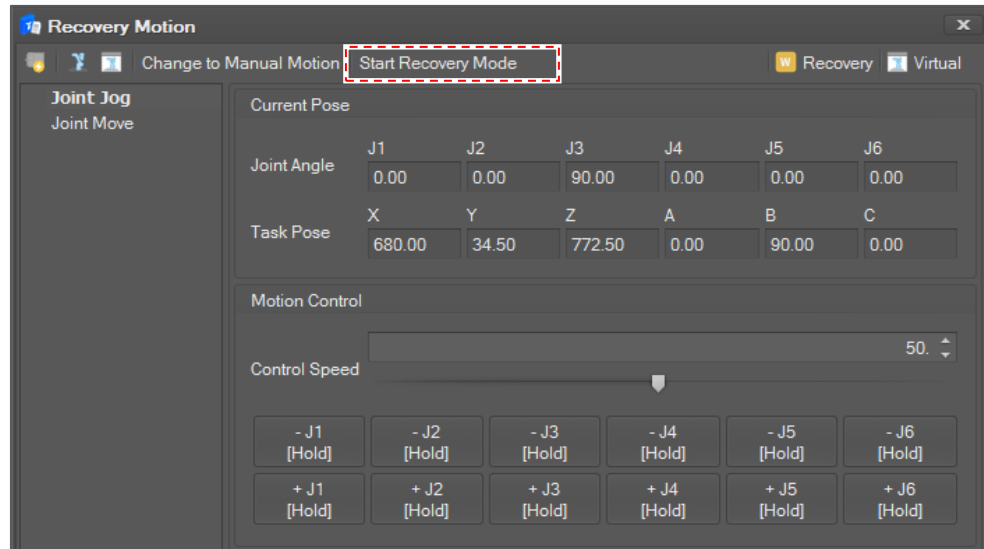
When a position-related error such as JOINT_SLP, TCP_SLP or TCP_SLO occurs, even if you click the **Servo On** or **Release Safety Stop** button, the same fault occurs again and the state goes back to the fault state. In that case, you must change the robot pose to avoid the violation.

4.6.1 Recovery Motion

To change the robot pose in the fault situation, select **Control** on the main menu and click the **Recovery Mode** button.



If the button is clicked, the **Recovery Motion** window pops up. And then click the **Start Recovery Mode** button, servo on and the controller state changes to **Recovery** mode. And each control becomes active and can be controlled.

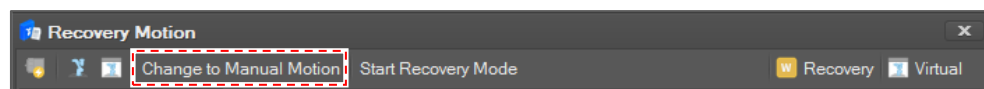


Recovery motion supports two types of manual motion, **Joint Jog** and **Joint Move**. Their use is the same as **Manual Motion**. For information about **Joint Jog** and **Joint Move**, refer to [“Joint Jog”](#) and [“Joint Move.”](#)

CAUTION In recovery mode, no position violation inspection is performed. So, you can move the robot joint to its hardware limit.

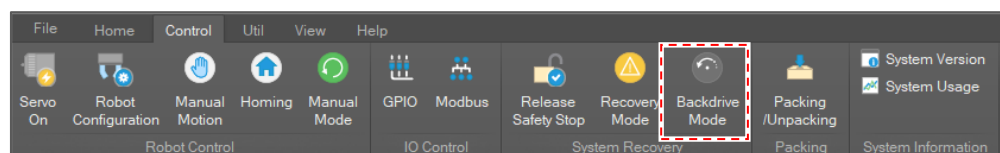
You can visually check whether there is a position violation in the 3D viewer. If you ensure that there is no position violation, click the **Change to Manual Motion** button or just close the **Recovery Motion** window to go back to the manual mode.

Then, the system goes to the “Manual Standby” state.



4.6.2 Backdrive Mode

When a fault occurs and you need to move the robot by releasing the brake, select **Control** on the main menu and click the **Backdrive Mode** button.



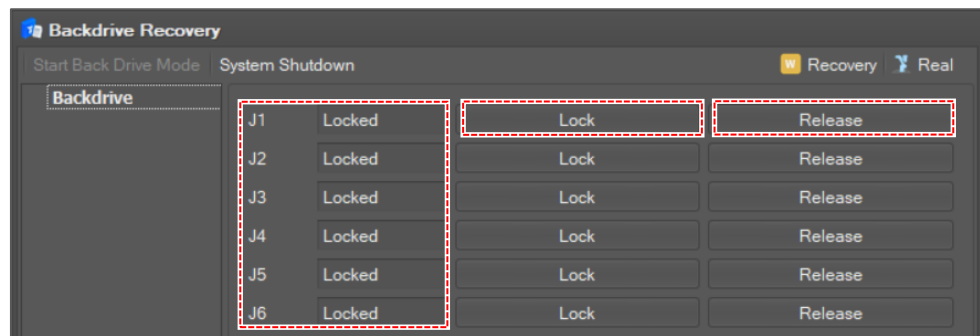
If the **Backdrive Mode** button is clicked, the **Backdrive Recovery** window pops up. And then click the **Start Back Drive Mode** button, and the controller state goes to **Backdrive** mode.

CAUTION You must restart the system to release backdrive mode. Other functions of the SW cannot be operated until the system is restarted.

You can see the current brake status for each axis on the left side of the window.

4 System Control

And then to release the brake so that you can move the robot joint manually, click the **Release** button. To set the brake, click the **Lock** button.



If recovery is done, click the **System Shutdown** button to shut down the system.









5 Task Manager

5.1 Project Explorer

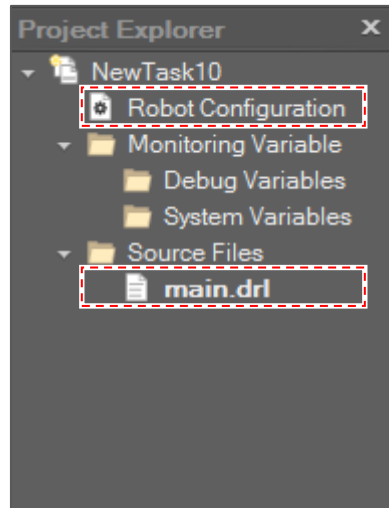
To edit and run, the DRL program must create a new project or open a saved project.



Menu Button	Shortcut	Function
	Ctrl+N	Create new project
		Open recent project list
	Ctrl+O	Open project
	Ctrl+S	Save project (include all DRL files)
		Save as project (include all DRL files)
	Ctrl+P	Print current active DRL file

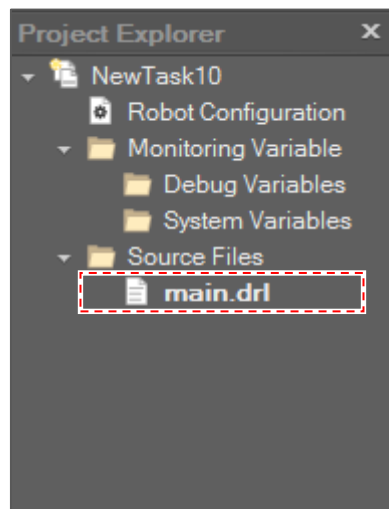
The **Project Explorer**, a tree-like viewer, manages projects.

If you make a new project, **main.drl** file and **Robot Configuration** item are created automatically. Also, robot setting and DRL programs including safety zones are stored and managed on a project basis.

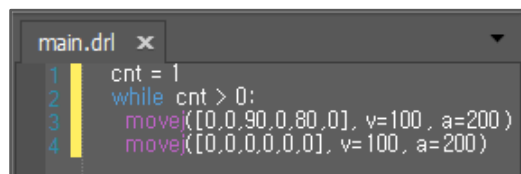


5.2 DRL Program Running

To open a DRL program, double click a DRL file that you want to open in the **Source Files** list of **Project Explorer**.



Then, the file is opened in **DRL Editor**.



```
main.drl x
1 cnt = 1
2 while cnt > 0:
3   move([0,0,90,0,80,0], v=100, a=200)
4   move([0,0,0,0,0,0], v=100, a=200)
```

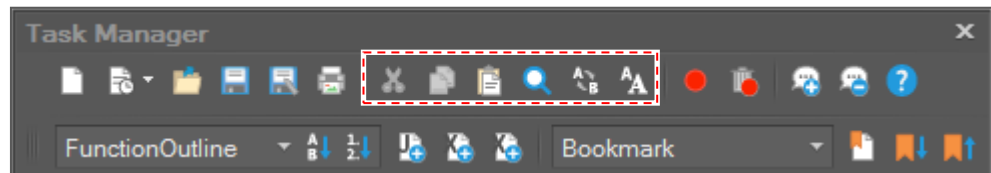
The screenshot shows the 'DRL Editor' window with the file 'main.drl' open. The code is as follows:

5.3 Use DRL Editor

DRL Editor is a simple text editor for DRL programming. Its basic use is just like “Notepad”.

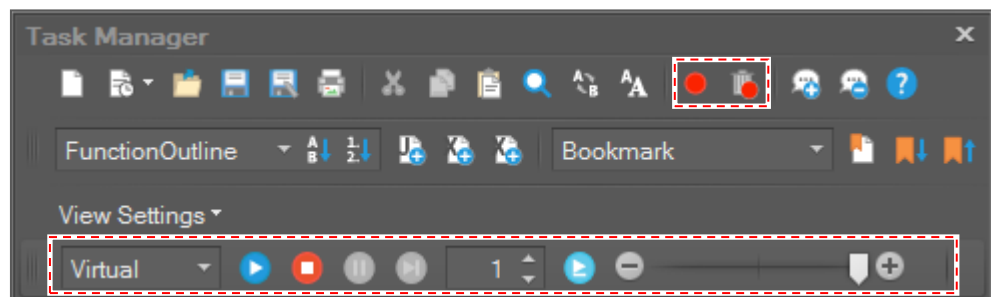
5.3.1 DRL Editor Overview

Text editing






Menu Button	Shortcut	Function
	Ctrl + X	Cut Text
	Ctrl + C	Copy Text
	Ctrl + V	Paste Text
	Ctrl + F	Find Text
	Ctrl + H	Replace Text
		Change Font (all opened windows only)

Running a program

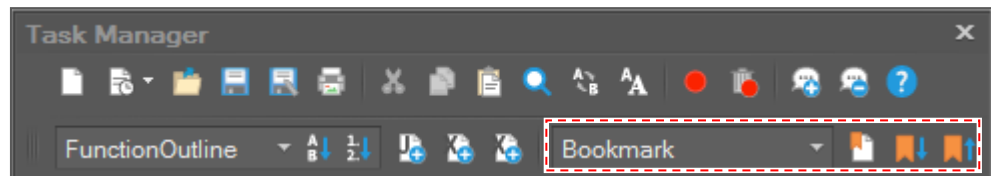






Menu Button	Shortcut	Function
	F9	Set or clear a breakpoint on DRL file
	Ctrl+Shift+F9	Delete all breakpoints set on the DRL file
		Choose whether to run the program in real mode or in virtual mode
	F5	Play DRL Program
	Shift+F5	Stop DRL Program
	Ctrl+Alt+Break	Pause DRL Program
	F5	Continue running on DRL program

5 Task Manager

		Set line spacing on next line run
	F10	Execute the next line
		Set the program execution speed

Bookmark



Menu Button	Shortcut	Function
		You can check the list of bookmarks and move to the bookmark selected in the list
	F2	Add or delete bookmarks on selected rows
	Ctrl+F2	Move to the next bookmark in the currently selected row
	Shift+F2	Moves from the currently selected row to where the previous bookmark is located

Edit window

```

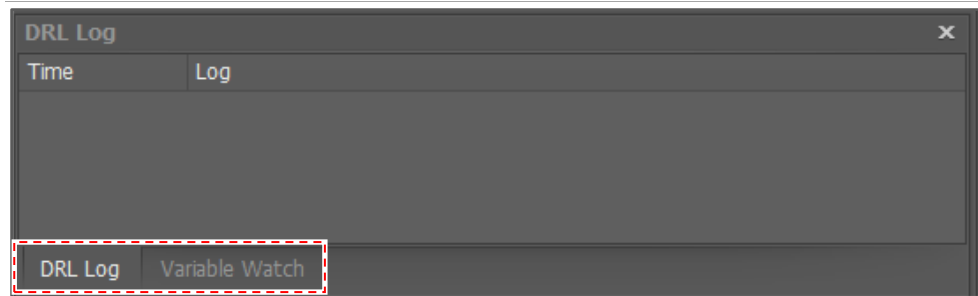
1 ##### SI TEST for ColDetection and Motion #####
2 ##### (M1310) #####
3 ## Motion Included (moveJ-J, L-L, SJ, SX, C-C, L-C, C-L, J-L, L-J, J-C, C~J) #####
4
5 ##### [1] Comment 1st Line, Pause/Resume TEST for Each Motion (w/o Coll.Detec) #####
6 ##### [2] Uncomment 1st Line, Collision Detection Test for Each Motion #####
7 #####
8
9
10
11 #watch_collision_on()
12
13 q99 = pos(0, 0, 0, 0, 0)
14 movej (q99, vel=10, acc=20)
15
16

```

- 1
- 2
- 3

- 1 Show bookmarks or break points. If you want to add a break point, just click the position to add.
- 2 Indicates the line numbers.
- 3 Text editor for DRL program.

Message window



You can see the log messages that occur when the DRL program is running in the **DRL Log** tab. If necessary, you can delete the entire log by using the **Clear All** menu that appears when you right-click on the added row.

If you select the **Variable Watch** tab, you can see the variable value that is added in **Project Explorer**.

5.3.2 Syntax Highlighting

DRL Syntax Keyword

```

9
10 if mode == 1|
11 #watch_collision_on()
12
13 q99 = pos(0, 0, 0, 0, 0, 0)
14 movej (q99, vel=10, acc=20)
15
  
```

Comment

```

9
10 if mode == 1|
11 #watch_collision_on()
12
13 q99 = pos(0, 0, 0, 0, 0, 0)
14 movej (q99, vel=10, acc=20)
15
  
```

DRL function

```

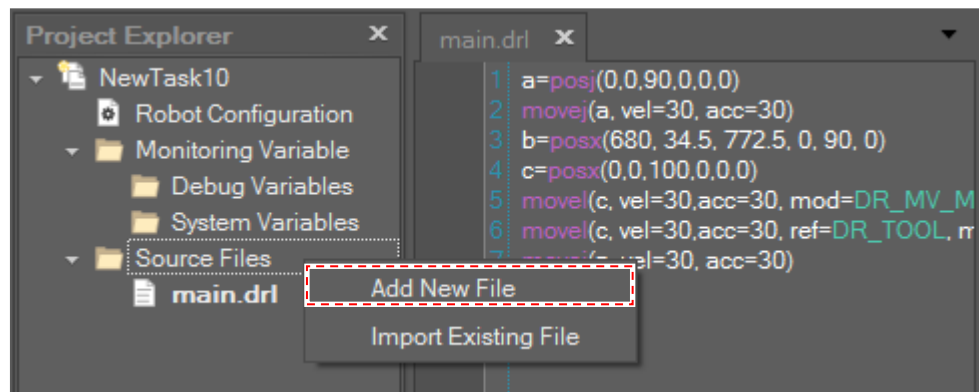
9
10 if mode == 1|
11 #watch_collision_on()
12
13 q99 = pos(0, 0, 0, 0, 0, 0)
14 movej (q99, vel=10, acc=20)
15
  
```

DRL constant

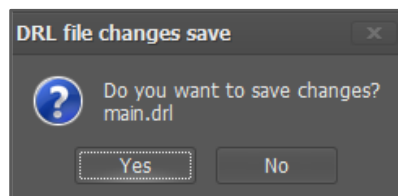
```
76  
77 movesx(xlist, vel=[100, 30], acc=[200, 60], vel_opt=DR_MVS_VEL_NONE)  
78 # #####  
79
```

5.3.3 Create a New Program

To create a new program, select **Source Files** in the tree node of **Project Explorer** and right-click, and then select **Add New File**.



If you were editing a program, the **Save Query Window** pops up before clearing the contents.



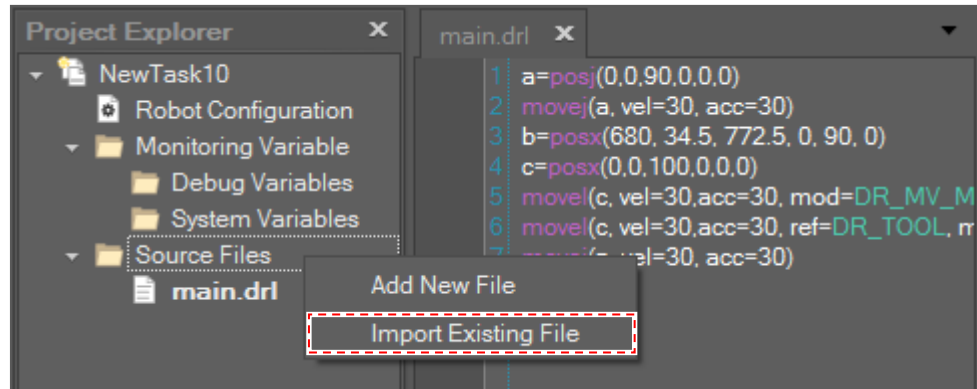
5.3.4 Save and Load a Program

To save a program, click the **Save**  button or **Save As**  button.

If you want to open a program, first you must open a project.

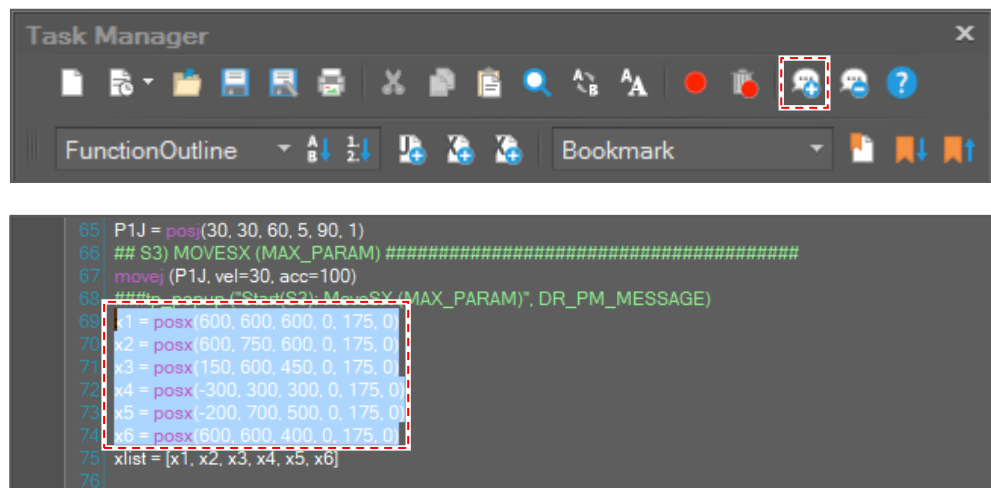
Please refer to [Project Explorer](#).

To import a program file from another project, select **Source Files** in the tree node of **Project Explorer** and right-click, and then select **Import Existing File** on the context menu.

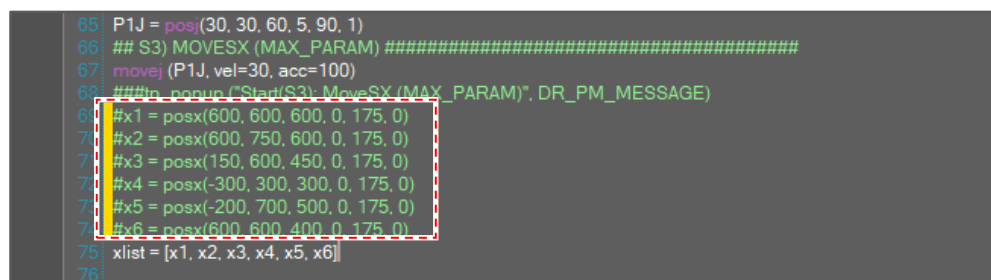


5.3.5 Comment

After selecting text, click the **Comment**  button on the toolbar or press **Ctrl + J**.



Then, the selected text is commented.



If no text is selected, only the line at the cursor is commented.

Uncomment

After selecting commented text, click the **Uncomment**  button on the menu or press **Ctrl + L**.



If no text is selected, only the line at the cursor is uncommented.


Toggle Comment

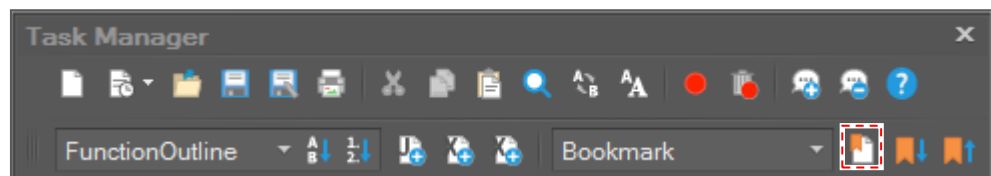
To toggle comment, press **Ctrl + K** after selecting text.

- If the selected text is plain text, the text is commented.
- If the selected text is commented text, the text is uncommented.
- If the selected text includes the plain text line and the commented text line, the text is commented.

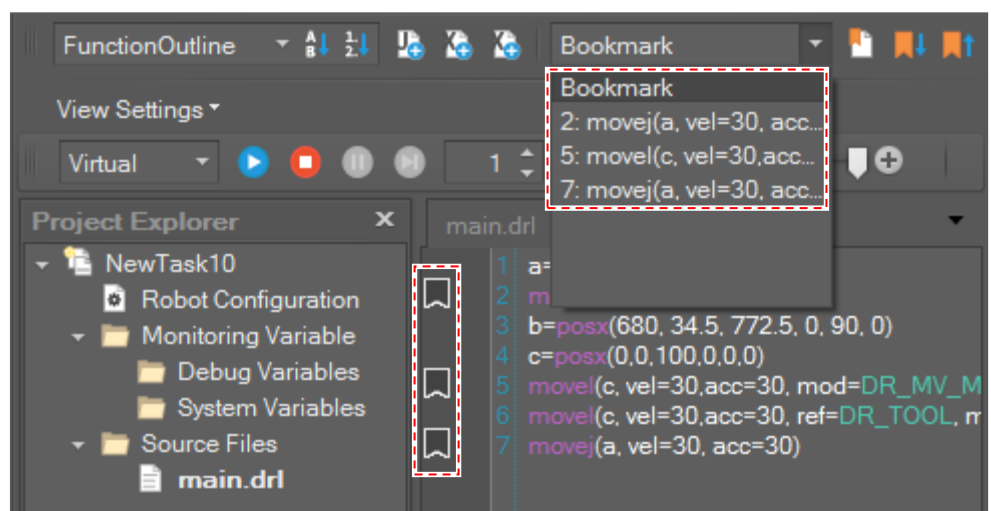
5.3.6 Bookmark

Toggle Bookmark

To add or remove a bookmark, set the cursor at the text line and click the **Toggle Bookmark**  button on the toolbar or press the **F2** key.




If the cursor line has no bookmark, a new bookmark is added and the **Bookmark List** is updated.

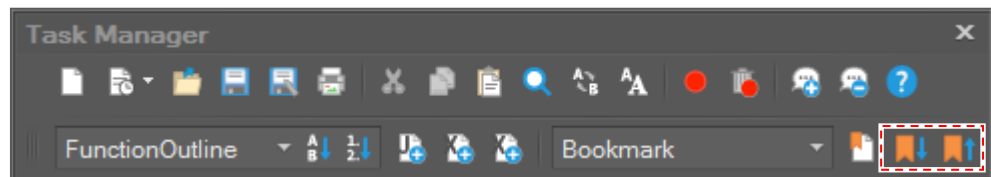


If the cursor line has a bookmark, the bookmark is removed and the **Bookmark List** is updated.

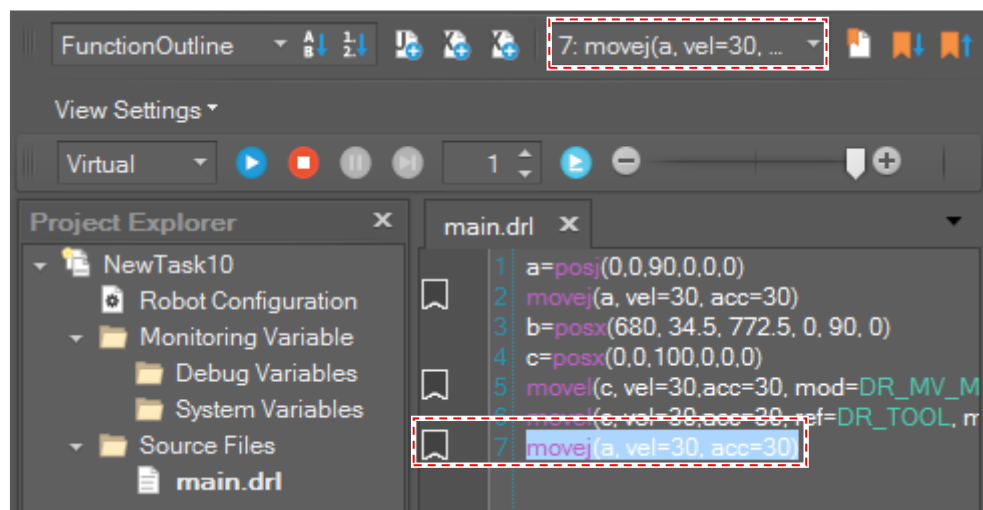
Go to Bookmark

If you click the **Go to Next Bookmark**  button on the toolbar or press **Ctrl + F2**, the cursor goes to the nearest next bookmark from the current cursor position.

If you click the **Go to Previous Bookmark**  button on the toolbar or press **Shift + F2**, the cursor goes to the nearest previous bookmark from the current cursor position.




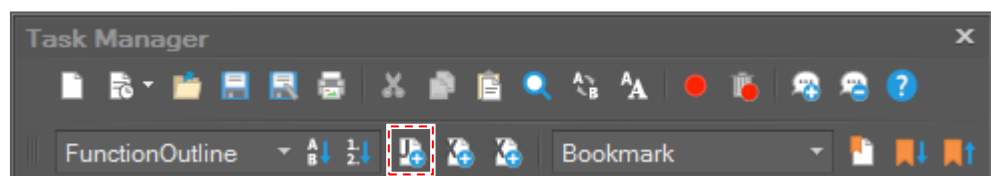
If you select a bookmark from the **Bookmark List**, the cursor goes to the bookmark.



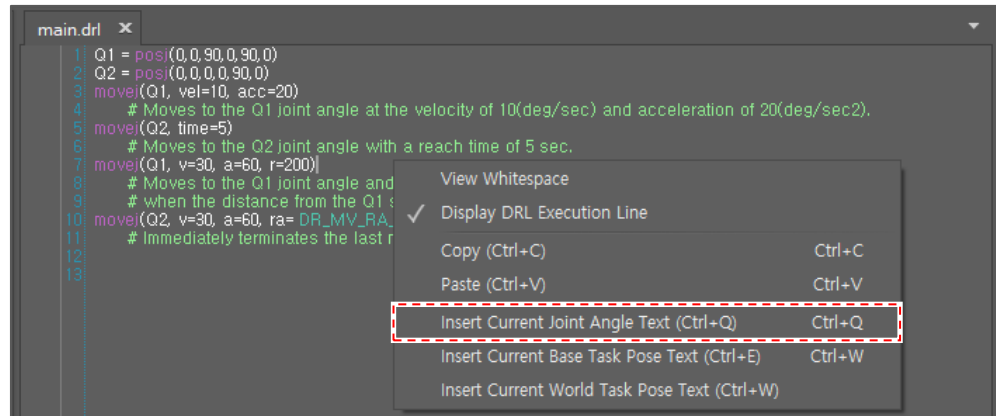
5.3.7 Get Current Position as Text

Get the Posj Position

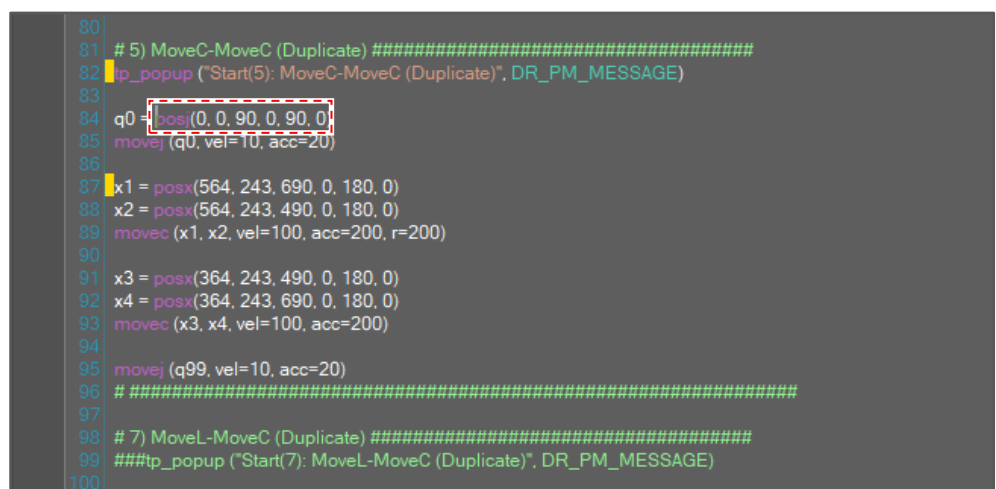
To insert the current joint position, click the **Insert Current Joint Angle Text**  button on the toolbar or press the **Ctrl+Q** keys. Or select **Insert Current Joint Angle Text** on the context menu.



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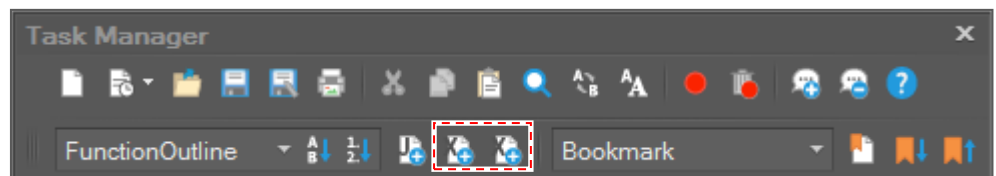


The current joint angle value is then inserted into the current cursor position.



Get Posx Position

To insert the current task position, click the **Insert Current Base Task Pose Text**  or **Insert Current World Task Pose Text**  button on the toolbar or select **Insert Current Base Task Pose Text (Ctrl+E)** or **Insert Current World Task Pose Text (Ctrl+W)** on the context menu.



The screenshot shows a code editor window titled 'main.drl'. The code contains several lines of DRL (Direct Robot Language) commands for moving joints and a table. A context menu is open over the code, listing several actions. The option 'Insert Current Base Task Pose Text (Ctrl+E) Ctrl+W' is highlighted with a red dashed border.

```

1 Q1 = posj(0,0,90,0,90,0)
2 Q2 = posj(0,0,0,0,90,0)
3 movej(Q1, vel=10, acc=20)
4 # Moves to the Q1 joint angle at the velocity of 10(deg/sec) and acceleration of 20(deg/sec2).
5 movej(Q2, time=5)
6 # Moves to the Q2 joint angle with a reach time of 5 sec.
7 movej(Q1, v=30, a=60, r=200)
8 # Moves to the Q1 joint angle and
9 # when the distance from the Q1 s
10 movej(Q2, v=30, a=60, ra= DR_LMV_RA,
11 # Immediately terminates the last r
12
13

```

Context Menu Options:

- View Whitespace
- Display DRL Execution Line
- Copy (Ctrl+C) Ctrl+C
- Paste (Ctrl+V) Ctrl+V
- Insert Current Joint Angle Text (Ctrl+O) Ctrl+O
- Insert Current Base Task Pose Text (Ctrl+E) Ctrl+W
- Insert Current World Task Pose Text (Ctrl+W)

Then, the current task position value is inserted into the current cursor position.

The screenshot shows the same code editor window after the insertion. The line 'x1 = posx(564, 243, 690, 0, 180, 0)' is highlighted with a red dashed border, indicating that the current task position values have been inserted into the code.

```

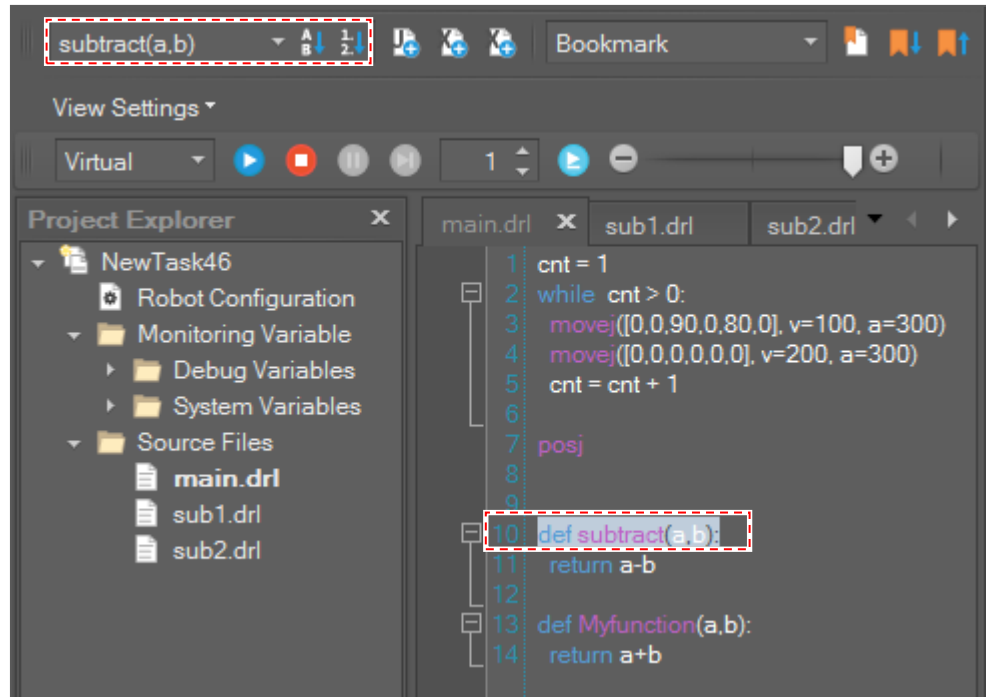
80
81 # 5) MoveC-MoveC (Duplicate) #####
82 tp_popup ("Start(5): MoveC-MoveC (Duplicate)", DR_PM_MESSAGE)
83
84 q0 = posj(0, 0, 90, 0, 90, 0)
85 movej (q0, vel=10, acc=20)
86
87 x1 = posx(564, 243, 690, 0, 180, 0)
88 x2 = posx(564, 243, 490, 0, 180, 0)
89 movec (x1, x2, vel=100, acc=200, r=200)
90
91 x3 = posx(364, 243, 490, 0, 180, 0)
92 x4 = posx(364, 243, 690, 0, 180, 0)
93 movec (x3, x4, vel=100, acc=200)
94
95 movej (q99, vel=10, acc=20)
96 #####
97
98 # 7) MoveL-MoveC (Duplicate) #####
99 ###tp_popup ("Start(7): MoveL-MoveC (Duplicate)", DR_PM_MESSAGE)
100


```

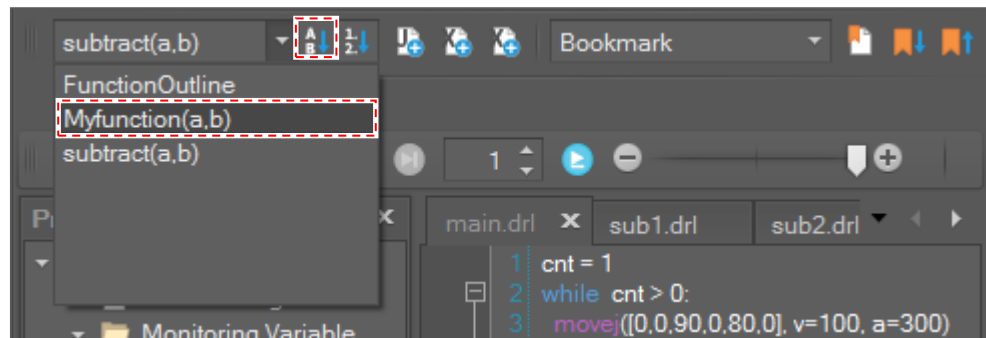
5.3.8 Function Outline


If you define a function and save the file, the **Function Outline** list is updated.

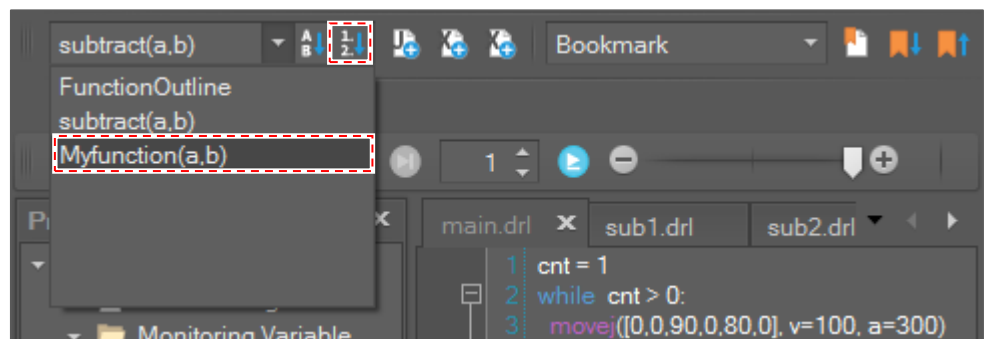
And if you select a function in the **Function Outline** list, the cursor goes to the line where the function is defined.



To sort the Function Outline list in alphabetical order, click the **Sort Function List By Name**  button.



To sort the Function Outline list in order of line numbers, click the **Sort Function List By Line No**  button.



5.3.9 Code Completion

Code completion completes the rest of a command, variable, or function name after you have entered enough characters to disambiguate the term. You can use Code completion by pressing **Ctrl + Space key** or **alphabet key**.

5.3.10 Go to definition

You can go to the definition of the selected symbol by pressing the **F12 key**.

5.3.11 Find References


You can find references to the selected symbol by pressing **Shift + F12 key**. A list of references appears in the **Find All References window**.

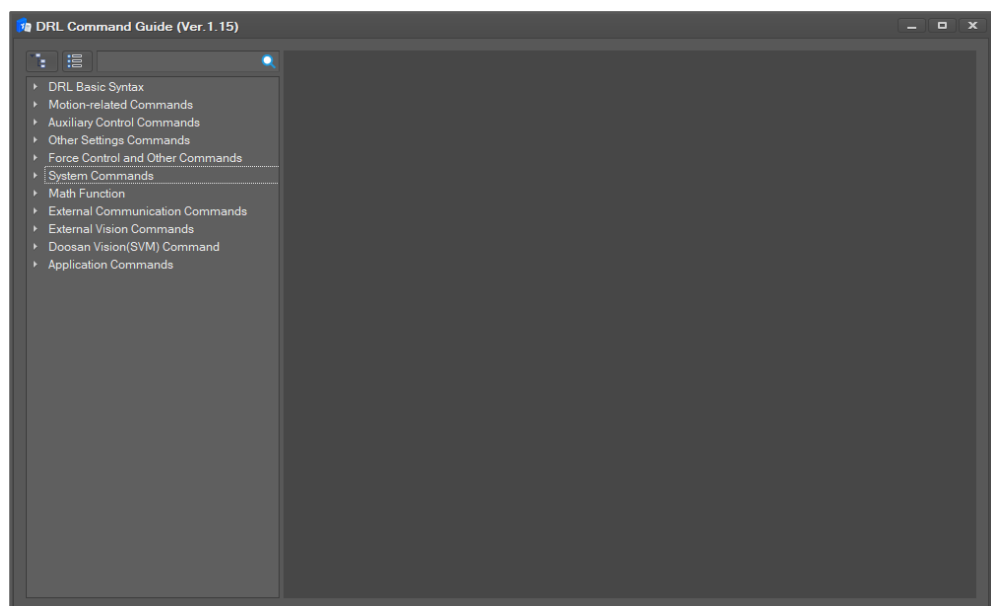
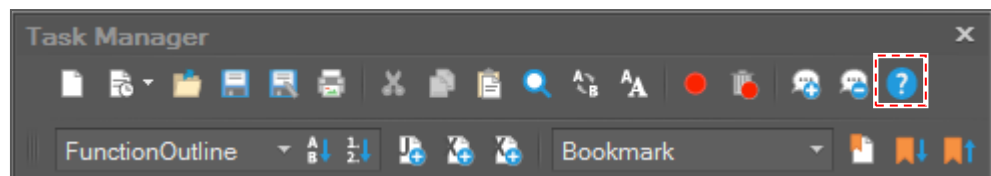
5.3.12 Upload scripts to smart TP

If you click the **Upload to Smart TP** button on the toolbar, all DRL scripts in the project will be uploaded to the Smart TP. (You can import and run the DRL scripts in smart tp.)


5.4 DRL Guide

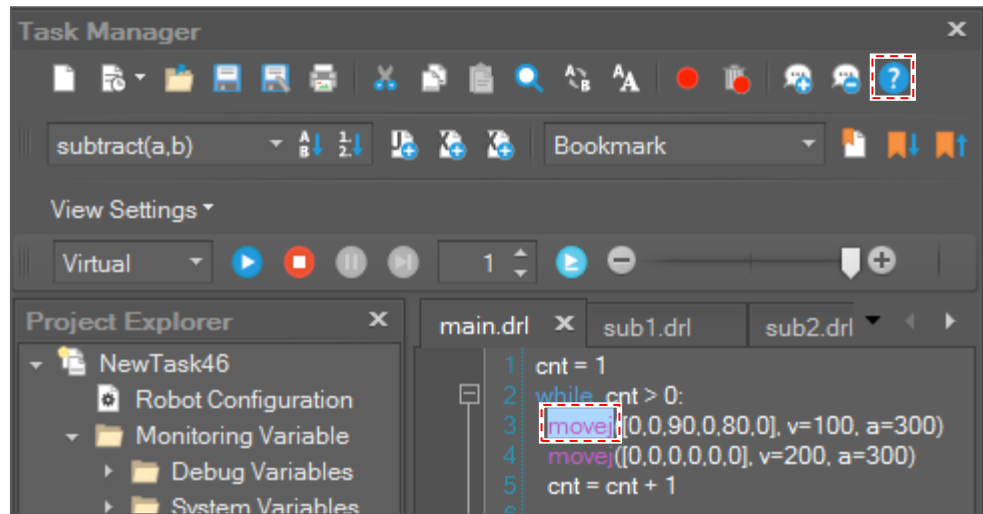
5.4.1 Open DRL Guide

If you click the **DRL Help**  button on the toolbar or press the **F1 key**, the **DRL Guide** window appears.




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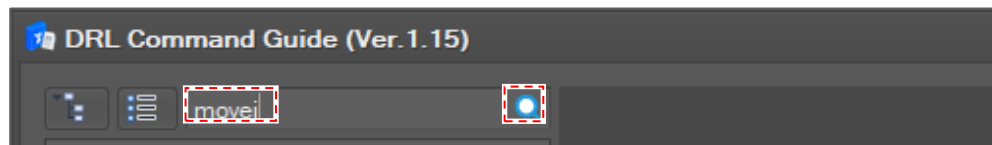
If you select text and click the **DRL Help**  button or press the **F1** key, the **DRL Guide** window appears and shows the search results.



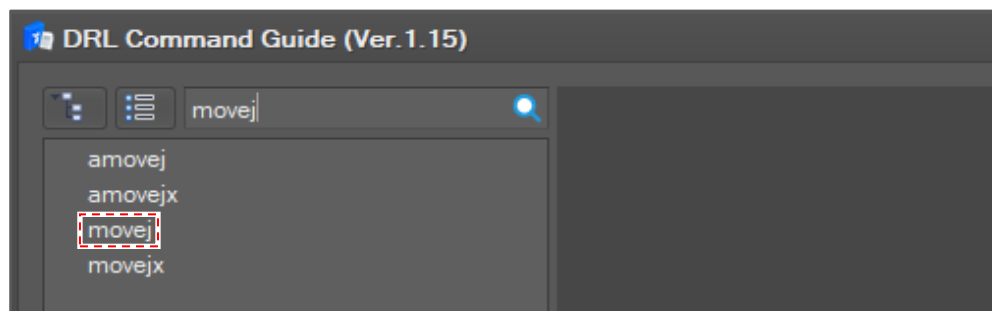
5.4.2 Search DRL Command

To search the DRL command,

Type a keyword and click the **Search**  button.



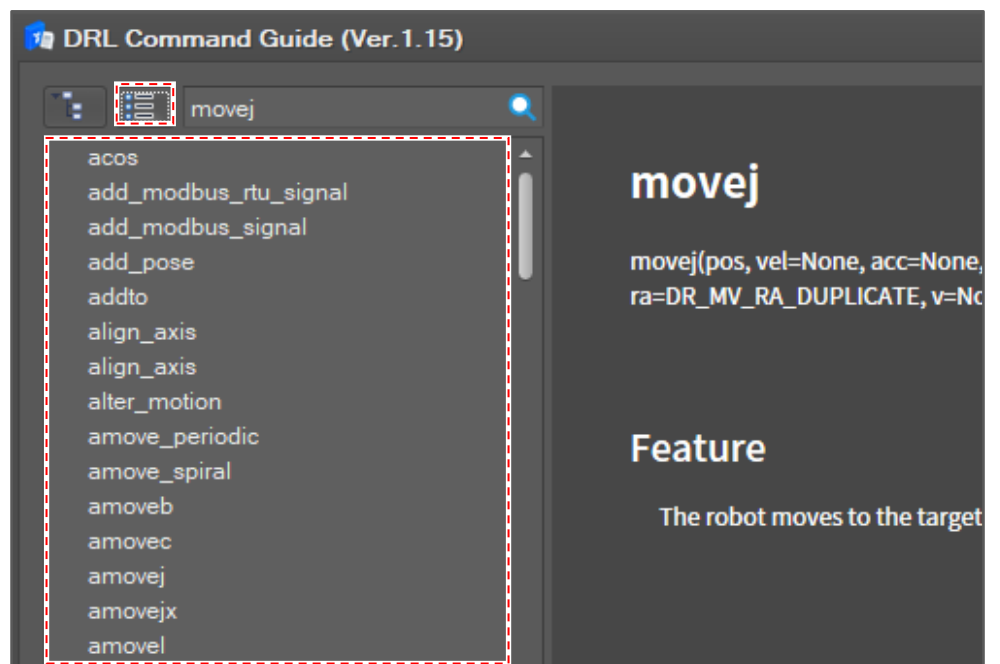
Click a command from the list, and then the guide for the command is shown in the right pane.



To go back to the command tree, click the **Command Tree**  button.



To set the command list in alphabetical order, click the **Command List**  button.



5.5 Shortcut List

Ctrl + X	Cut Text
Ctrl + C	Copy Text
Ctrl + V	Paste Text
Ctrl + F	Find Text
Ctrl + H	Replace Text
Ctrl + J	Comment Text
Ctrl + K	Toggle Comment
Ctrl + L	Uncomment Text
Ctrl + Q	Insert Current Joint Angle Text
Ctrl + E	Insert Current Base Task Pose Text (Posx)
Ctrl + W	Insert Current World Task Pose Text (Posx)
Ctrl + N	Create a New Project

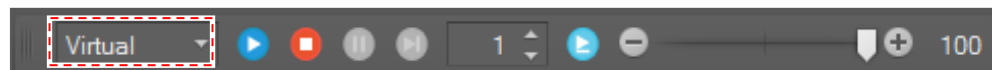
Ctrl + S	Save a Project
Ctrl + O	Open a Project
F1	Open DRL Guide
F2	Add / Remove Bookmark
Ctrl + F2	Go to Next Bookmark
Shift + F2	Go to Previous Bookmark
Ctrl + P	Print
F5	Run / Continue Run Program
Shift + F5	Stop
Ctrl + Alt + Break	Pause
F10	Run Next Program Line
F9	Toggle Breakpoint
Ctrl+Shift+F9	Remove All Breakpoints


5.6 Run a Program

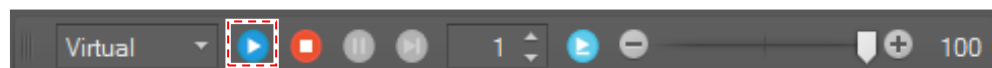
To run a program,

Set **Running Target** on the toolbar.

- **Virtual**: the program runs in the **Virtual** mode.
- **Real**: the program runs in the **Real** mode.



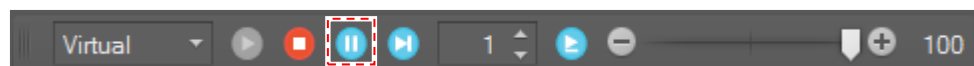
Click the **Play**  (**F5**) button on the toolbar.



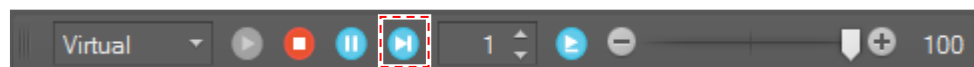
If the program starts without error, the current execution line is displayed in the editor.

Pause and Resume a running program


To pause the program, click the **Pause Program Run**  (**Ctrl+Alt+Break**) button.

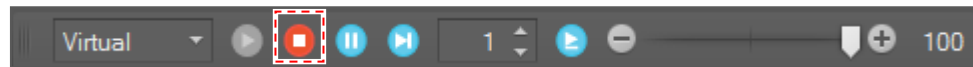


To resume the program, click the **Continue to Run Program**  (**F5**) button.




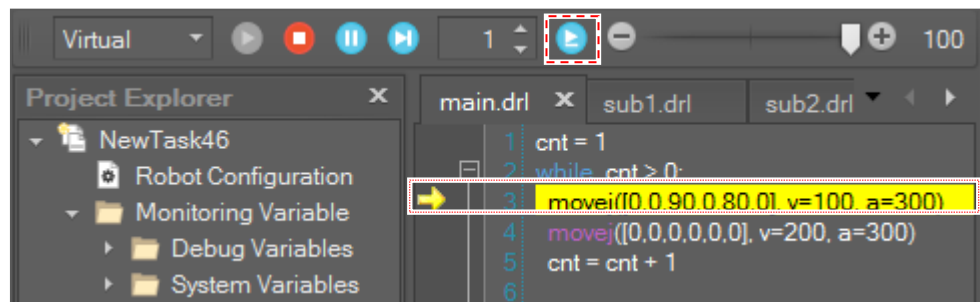
Stop Program Running

If you click the **Stop Program Run**  (**Shift+F5**) button while the program is running, the program is stopped.



5.6.1 Run a Program Line by Line

When the program running is paused, if you click the **Run Next Program Line**  (**F10**) button, the program running is paused again when it reaches the next program line.

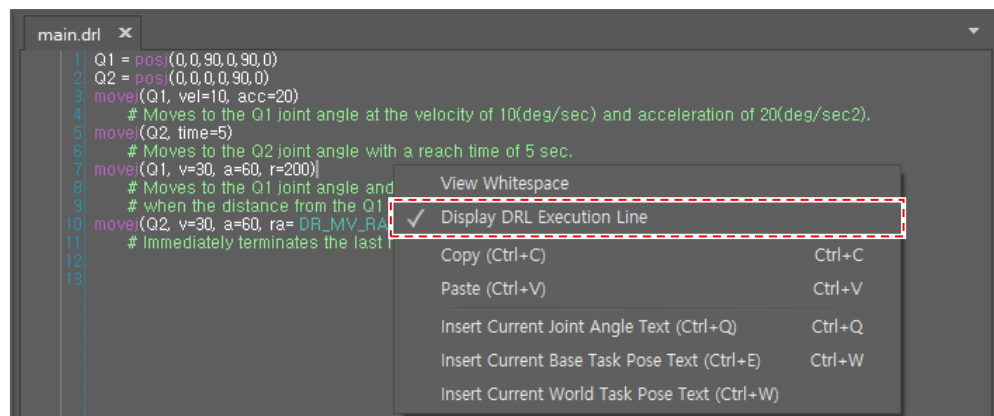


When the program running is paused, the selected line means the next running line, which means it is not executed yet.

To run multiple lines, change the line number.



When the program runs, the yellow trace moves along the execution line as shown above. If you do not want to use this function, uncheck the **Display DRL Execution Line** as shown below.




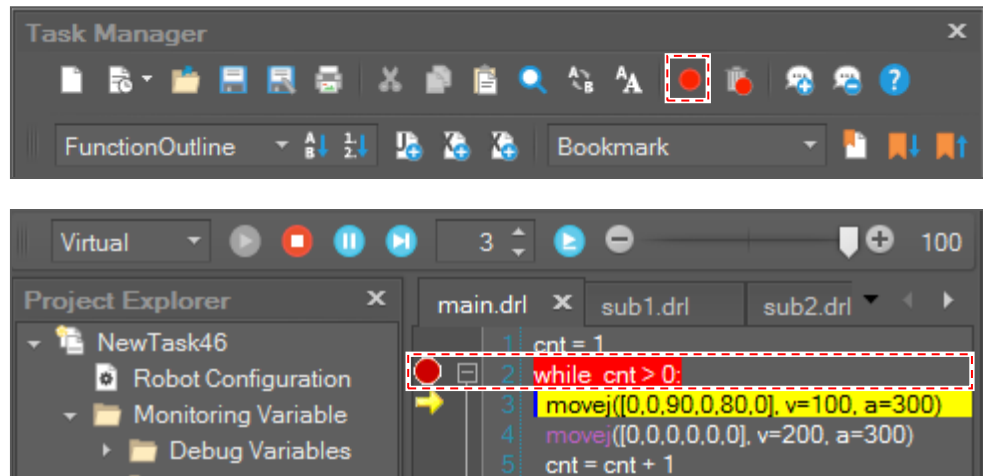
5.6.2 Set Break Point

If a break point is set to a program line, the program running is paused when the running cursor reaches the line.

Add Break Point


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When the cursor is at a line with no break point, if you click the **Toggle Break Point**  button or press the **F9** key, a break point is added to the line.

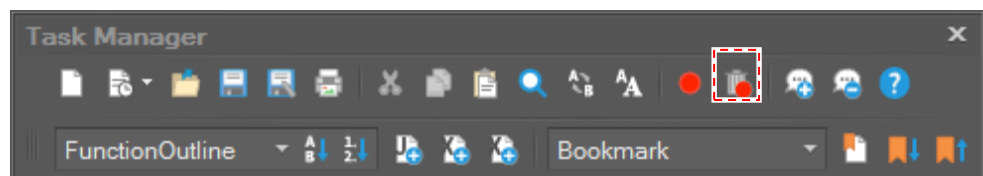


When there is no break point in that marker line, if you click the marker area, a break point is added to the line.

Remove Break Point

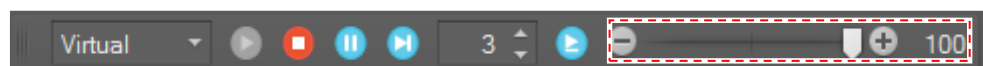
When the cursor is at the line with a break point, click the **Toggle Break Point**  button or press the **F9** key to remove the break point from the line.

- The break point can be also removed by clicking a break point in the marker area.
- To remove all break points at once, click the **Remove All Break Points**  button or press the **Ctrl + Shift + F9** keys.



5.6.3 Change Running Speed

Change the **Speed Slide Bar** while the program is running.



If you change the speed ratio, the program running speed will decrease by that ratio. If the speed ratio is set to 40 (%), the robot moves with 40% of its original speed.

