Hyundai Robot

Hi6WB230427FMEN2

Hi6 Controller Function Manual

HRWorkBench

V1.0.0

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1 Overview

1. Overview

1.1. Introduction to HRWorkBench

HRWorkBench is a Windows PC software designed for supporting the teaching of the Hi6 controller of Hyundai Robotics.[1] HRWorkBench supports the following functions of the Hi6 controller when connected through Ethernet communication.

Category	Description
Back up and restore files	You can back up the entire project folder and the entire log folder to the PC and restore it back to the controller.
Manage the job files	You can check the list of jobs in the controller and copy or delete some job files in both the PC and controller.
Edit the job files	You can open and edit a job file in the controller by double-clicking it. Syntax coloring and smart indent functions are supported for readable editing.
Check the syntax of job files	You can remotely carry out a basic syntax check of job files before executing them.
Monitor the global variables, and edit their values	You can monitor the values of all global variables and modify the value of the targeted variables or delete targeted variables.
Execute the Robot Language	You can remotely execute an assignment statement of a job file. There is no support for the move statement or flow control statement.
Monitor logs in the controller	You can monitor the logs of errors, warnings, etc. that have occurred in the controller.

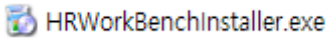
Warning

This program allows you to remotely change the job program or variable value, so it may affect the robot′ s operation. You are required to read this manual and use the program carefully while paying sufficient attention!

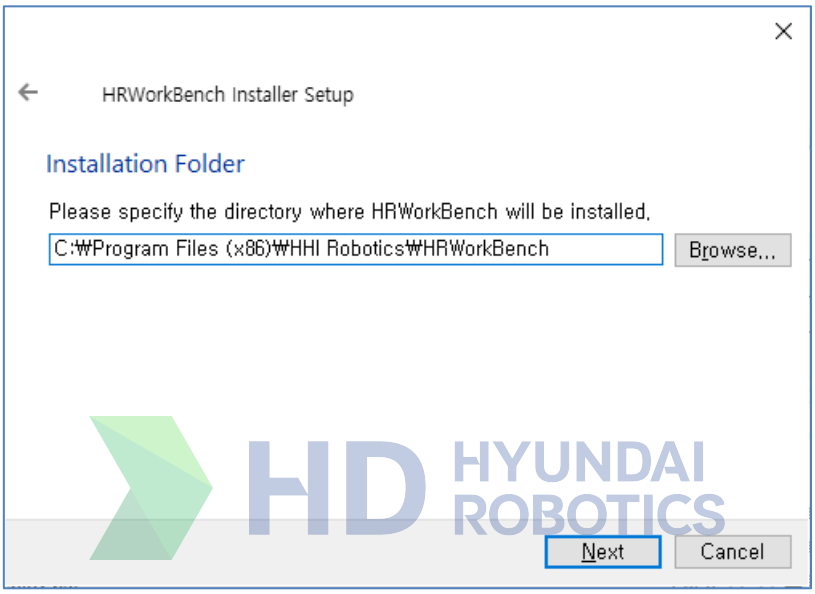
[1] This is the successor product of the HRView software used in the Hi5a controller.

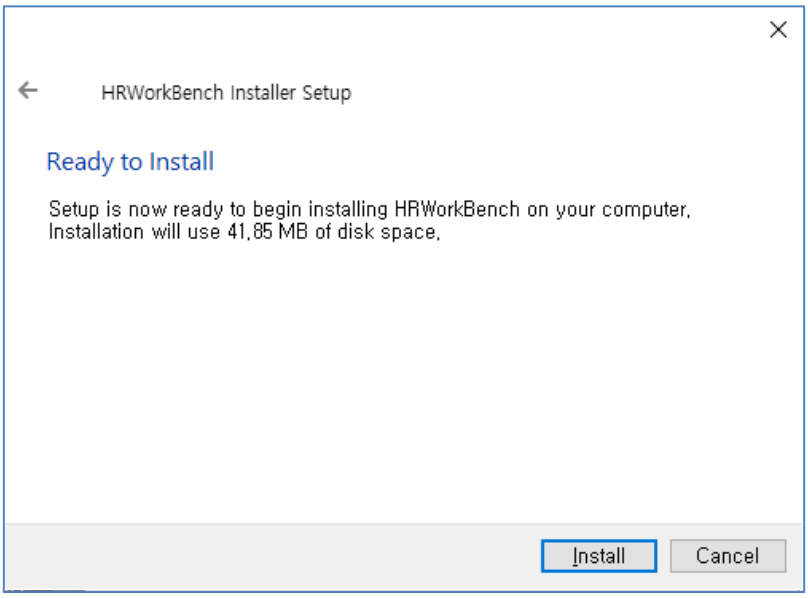
1.2. Install and Execute HRWorkBench

Run the installer.

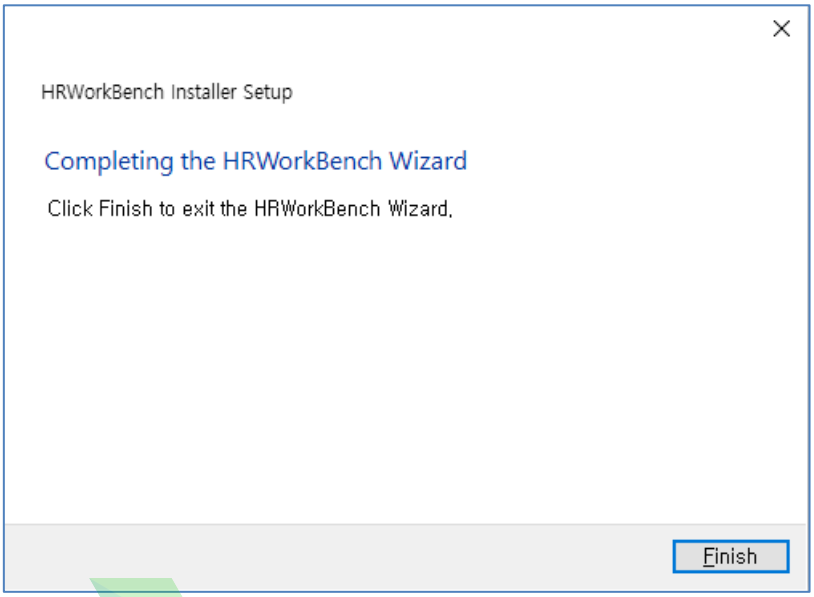


Proceed with selecting the installation details, such as the installation location, etc., and click Next. Finally, click the Install button when you agree to the license.

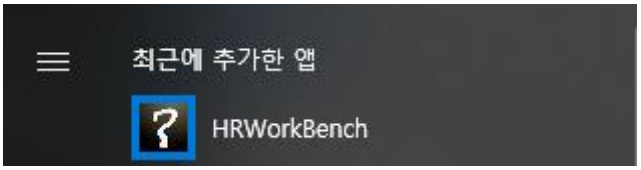




Click the Finish button to end the installer once the installation is completed.



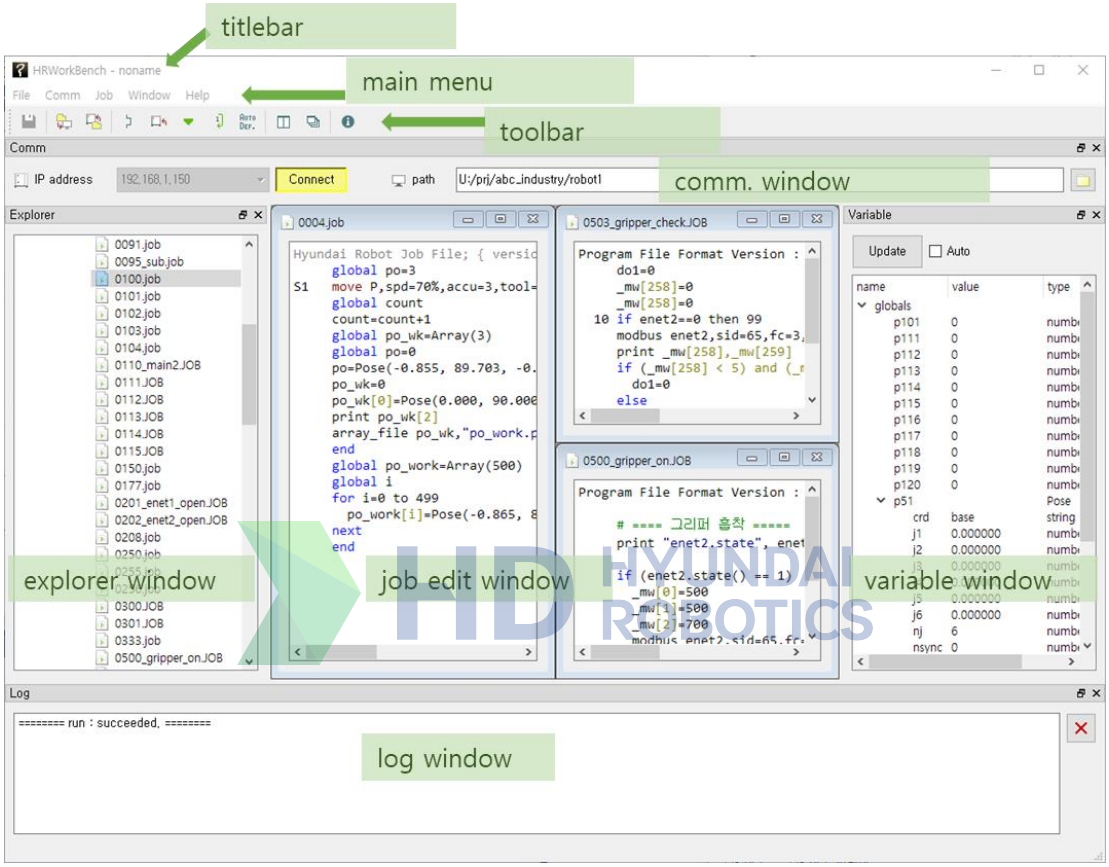
Execute the application by clicking the Windows Start button and then select HRWorkBench from the Recently Added App or the HHI Robotics Group.



1.3. Configuration of the User Interface for HRWorkBench

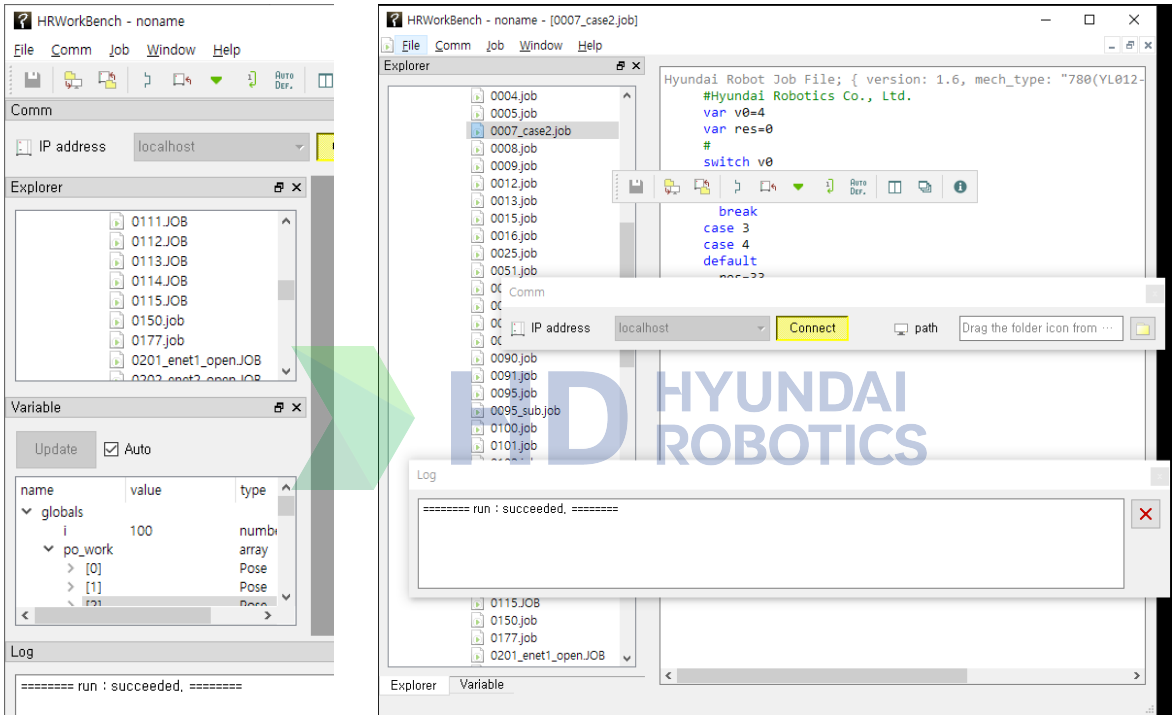
The figure below shows the names of the user interface elements of the HRWorkBench.

Each function will be described in the order according to the operation sequence.



The elements of the user interface can be rearranged into a layout convenient for the work.

Dragging the toolbar ' s left edge or dragging the title bar of each window will allow you to detach the toolbar or a window while it is in docking state or attach it back into the docking state. When in the docking state, the windows can be arranged side by side, or they can be stacked into a page from which you can select one using a tab.



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Basic Settings

2.1. Connect to Ethernet

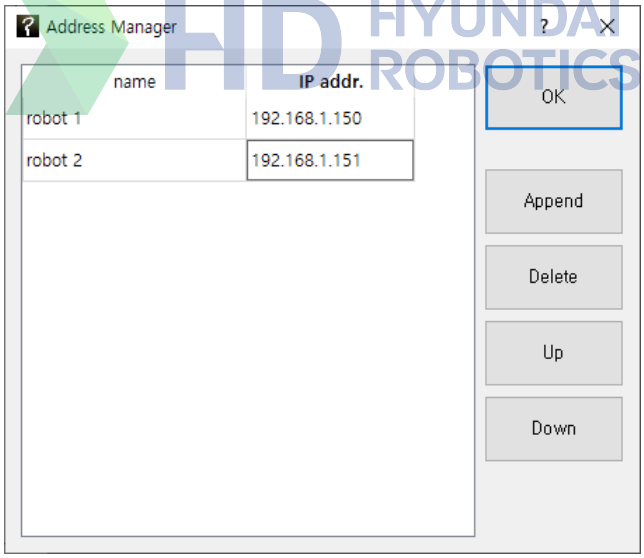
HRWorkBench and the Hi6 robot controller should be connected to the same Ethernet network.

Suppose there are two Hi6 controllers that need to be connected, and let us assume that their individual IP addresses are 192.168.1.150 and 192.168.1.151. Moreover, the IP address of the PC is 192.168.1.100. (The devices connected to each other through a hub should all be in the same subnetwork, 192.168.1.XXX.)

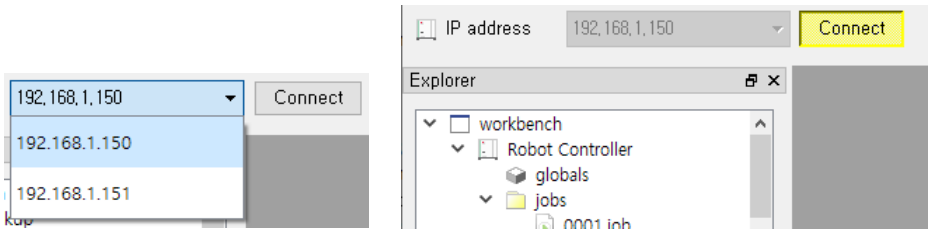
The IP Address Manager dialog box will be opened, as shown below, when you select Comm - Address Manager in the main menu of HRWorkBench or click the tool button.

A new input line will be added each time you click the Append button. After adding two lines, you need to input the name and IP address, as shown in the figure below.

You can also adjust the order of the current lines by moving them up and down using the Up and Down buttons.

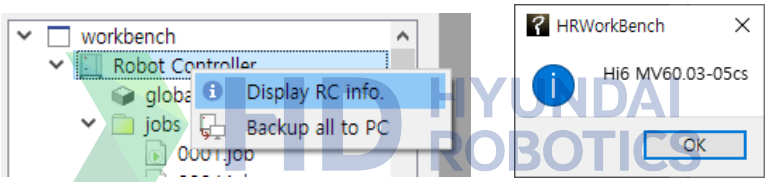


Now, when you open the IP address combo box in the Comm. window, you can select the two IP addresses that are already inputted.



When you press the Connect button, and the button turns yellow, you are now connected.

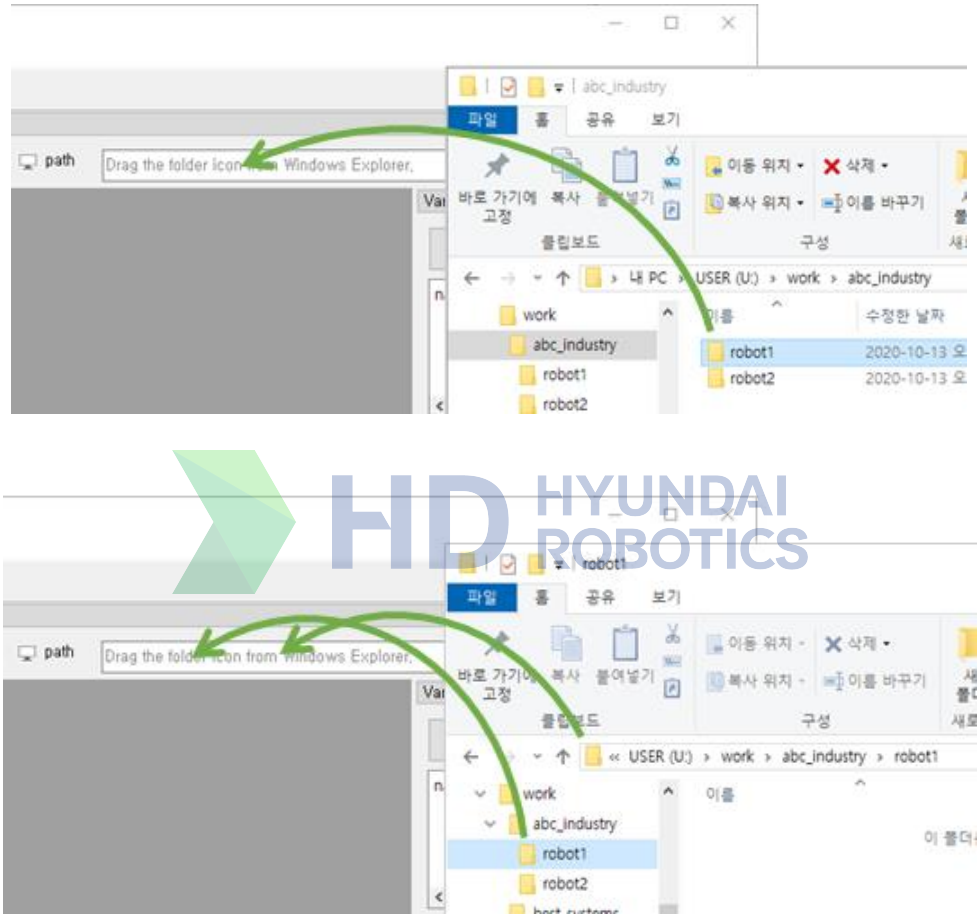
If you are successfully connected, the Robot Controller node will appear in the Explore window on the left. Right-click the node and then click Display RC Info. in the pop-up menu. The software version of the Hi6 controller will be received and displayed, as shown below.



2.2. Select the PC Path

When backing up or editing the files of the robot controller, you need to copy the files to the PC. To do this, you should designate the path of the folder on the PC side. This path is called the “current PC home path” or “PC path” when shortened.

In Windows Explorer, you need to drag and drop the folder icon toward the Comm. window.



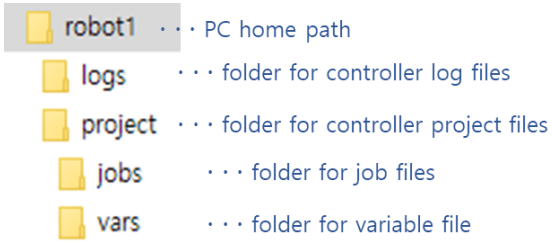
The designated PC path will be displayed in the Comm. window. Then, the files copied to the PC will be saved in this folder.

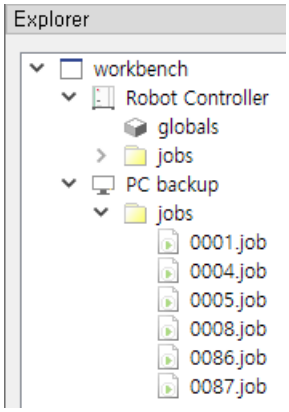
When you manage multiple robot controllers in different PC folders, you can perform tasks by changing between folders and dragging and dropping them.

If you click the  button on the right side of the displayed path, the path will be opened in Windows Explorer.

The folders in the PC path is structured, as shown in the figure below.

Jobs that have been backed up before in the PC path will be displayed under the PC node of the Explore window, as shown in the figure below.





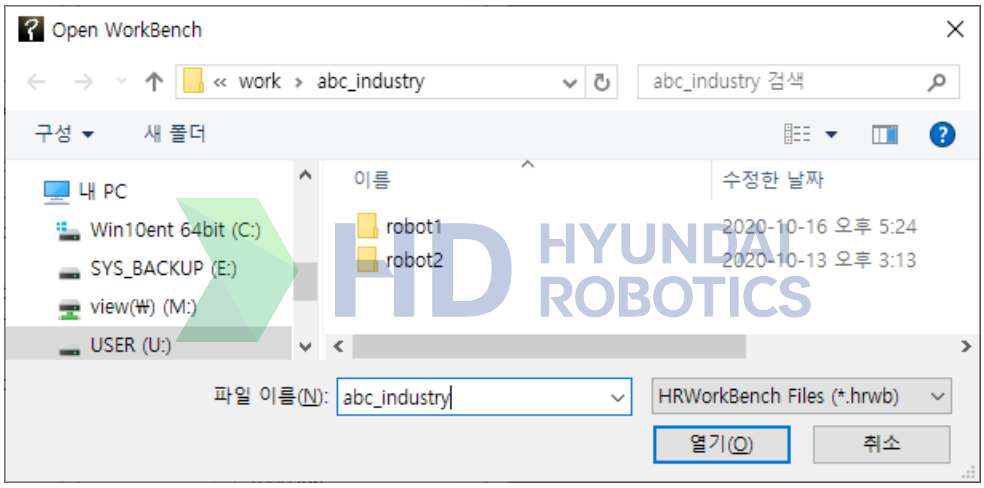
2.3. Save and Load WorkBench Files

You can save and load working environment settings as a WorkBench file with the extension .hrwb.

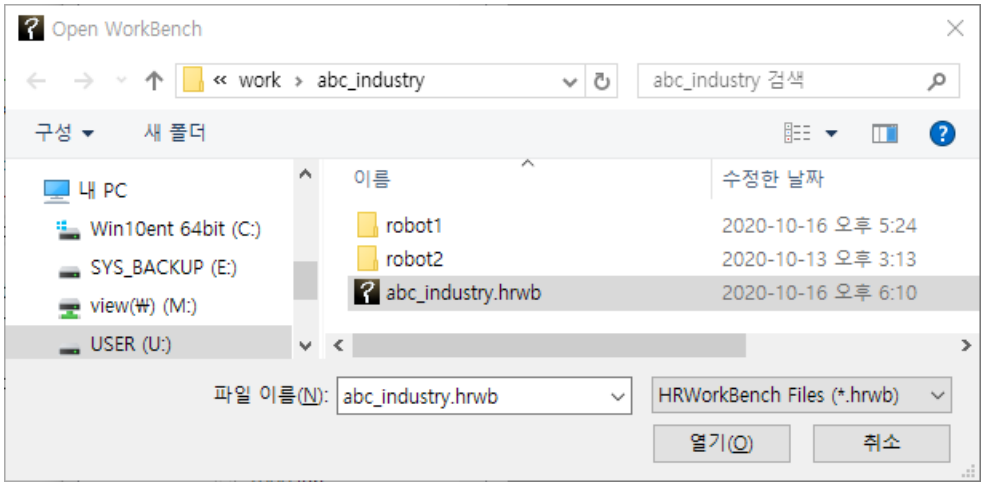
The following items will be saved.

- List created in the IP address manager
- PC path setting

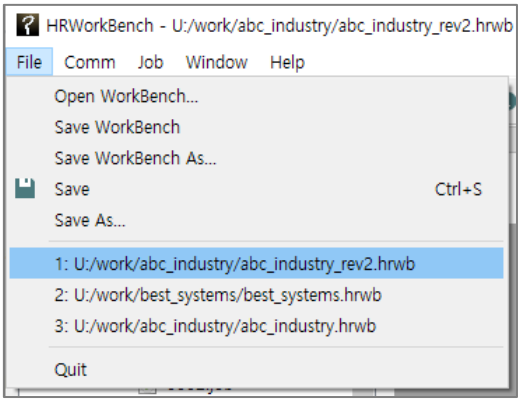
Let us save a WorkBench file. After performing the basic settings, select File - Save Workbench in the main menu. Select the desired path, input the file name, and then click the Save button.



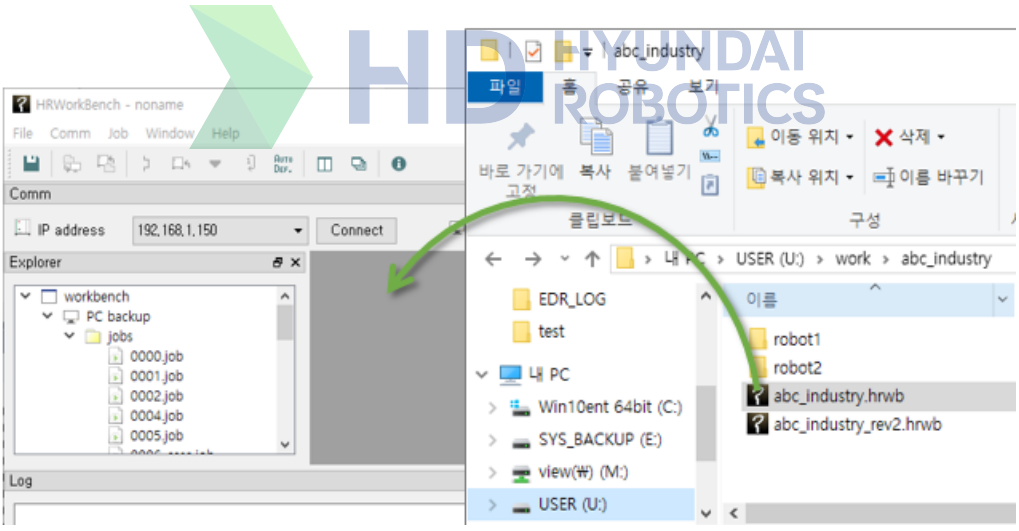
Let us load a WorkBench file. Exit the HRWorkBench application and execute it again. Select File - Open WorkBench in the main menu. If you select the saved file, you can see that the existing settings are restored.



The recently loaded paths and file names will be listed in File in the main menu, so you can quickly open a file by clicking it.



Another way to load WorkBench files is by opening an .hrwb file by dragging and dropping its icon from Windows Explorer.



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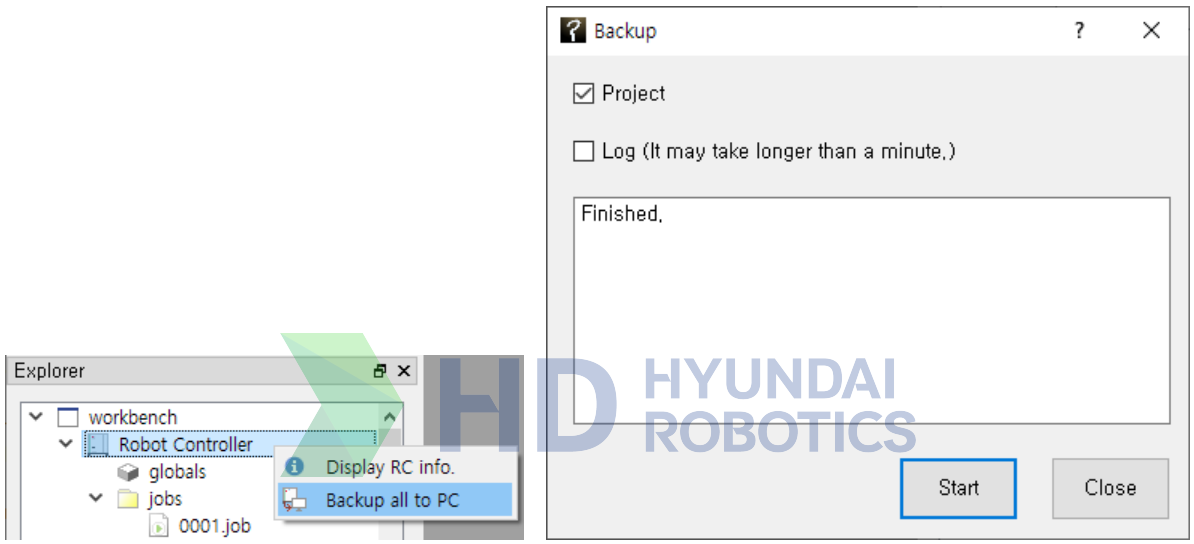
How to Use

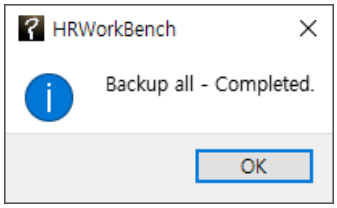
3.1. Back Up and Restore Job Files

You can back up or restore the files in the Hi6 controller.

First, press the Connect button to remotely connect to the controller. In the Explore window, open a pop-up menu for the Robot Controller node by right-clicking it, and then select “Backup all to PC.” The Backup dialog box will appear.

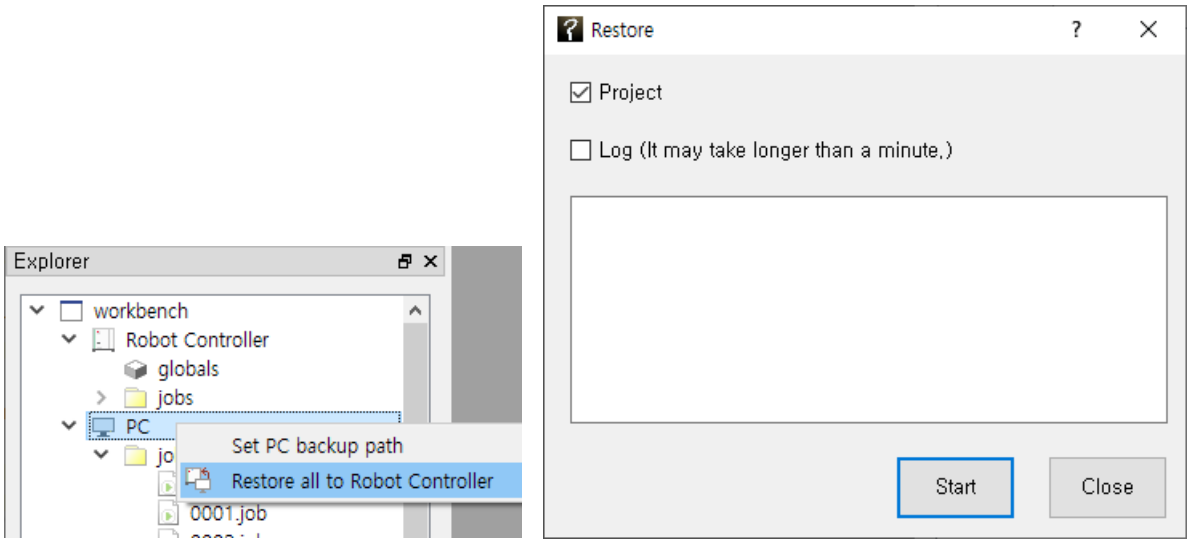


Press the Start button after checking the target that needs to be backed up. The files in the controller will be backed up to the PC path. The Completed dialog box will be displayed once the backup is finished, and the file list under the PC node in the Explore window will be updated.



The method for restoration is similar to this.

In the Explore window, open a pop-up menu for the Robot Controller node by right-clicking it, and then select “Restore all to Robot Controller.” The Restore dialog box will appear.



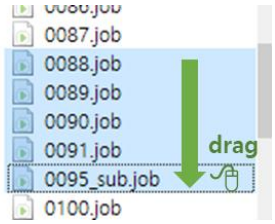
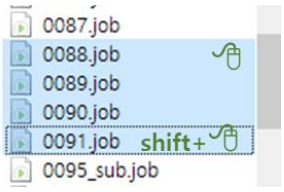
Press the Start button after checking the target that needs to be restored. The files in the controller will be restored to the PC path, and the Completed dialog box will be displayed.

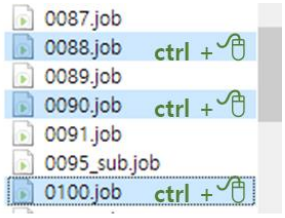
3.2. Copy and Delete Job Files

You can only copy some of the controller's job files.

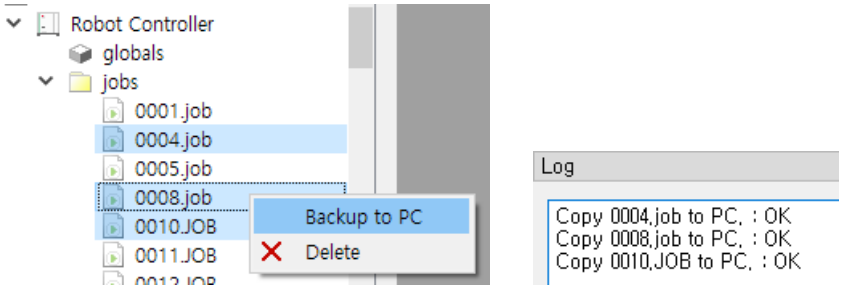
When copying files from the robot controller to the PC, click and select the targeted job files under the Robot Controller/ jobs / path in the Explore window.

To select multiple files, you use the following methods.

	Drag and select multiple files while pressing the left button.
	Select one file, hold the Shift key, then click another file to select files in between.

	Select multiple files individually while pressing the ctrl key.

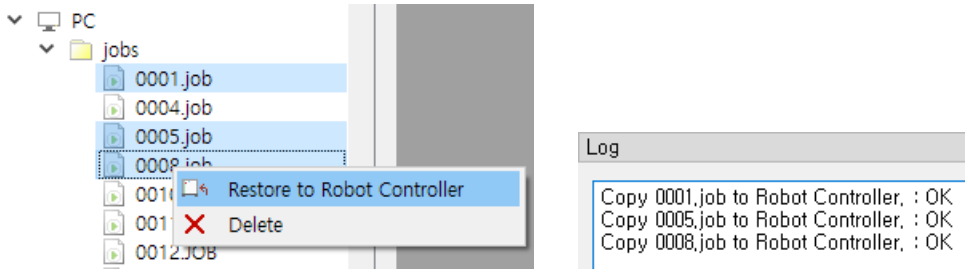
Right-click the selected job files and then select “Backup to PC” in the pop-up menu. The copy result will be displayed in the Log window, and the names of copied files will be displayed on the PC/jobs node.



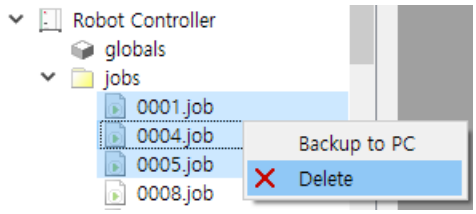
The method is similar when copying files from the PC to the robot controller.

Click and select the desired job files under the PC/jobs/ path in the Explore window.

Right-click the selected job files and select “Restore to Robot Controller” in the pop-up menu.



You can delete job files in the robot controller or the job files in the PC using the Delete pop-up menu.

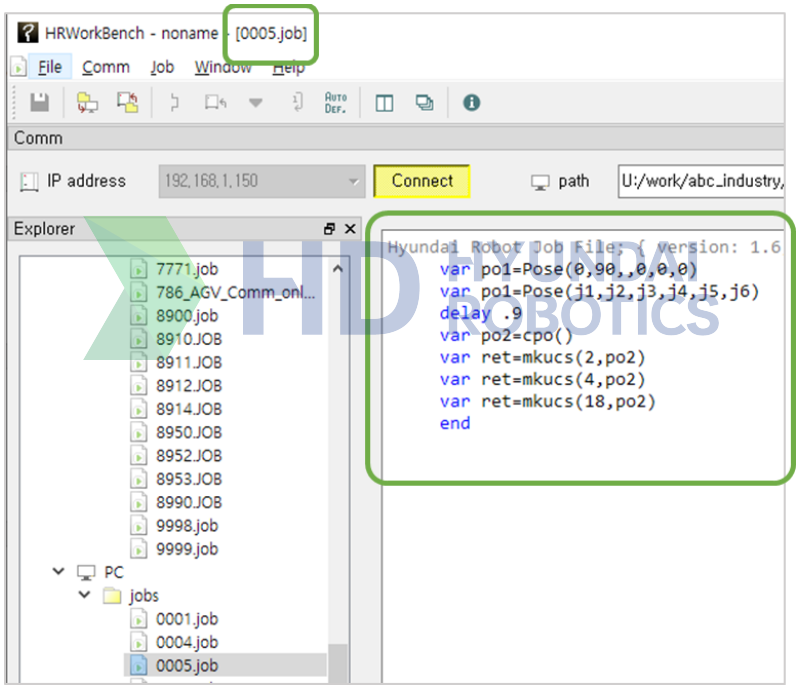

Robot Controller
globals
jobs
0001.job
0004.job
0005.job
0008.job
Backup to PC
Delete

3.3. Edit Job Files

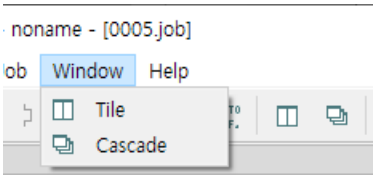
You can edit the job files copied to the PC with your preferred text editor, but HRWorkBench also provides an editor.

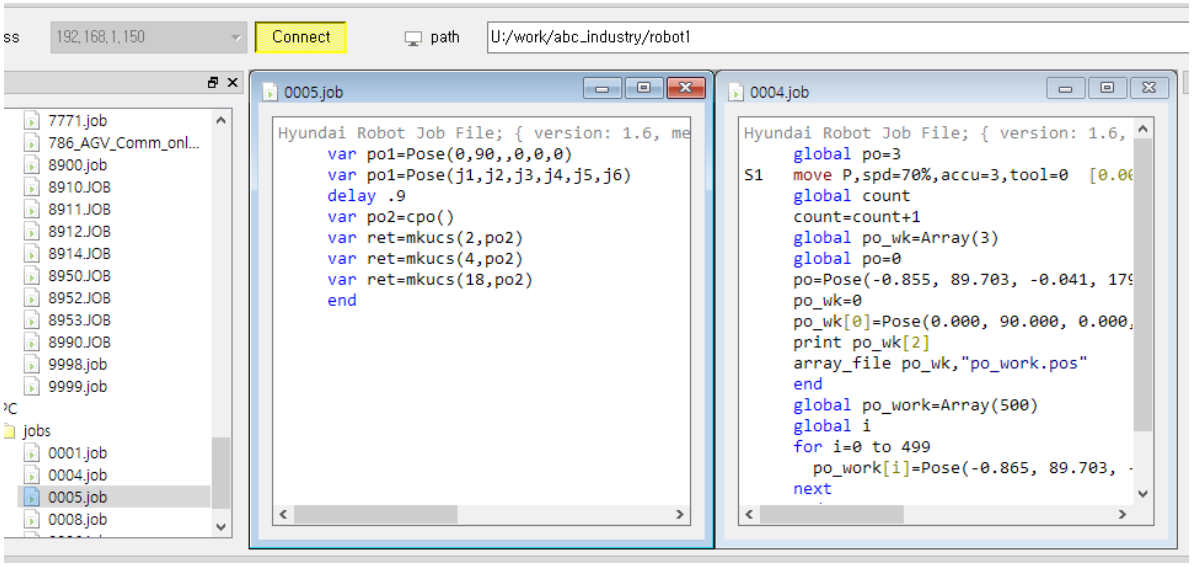
3.3.1. Open and Arrange Edit Windows

To open and edit a job file copied to the PC, double-click a job file on the PC side in the Explore window. This will open the editor. In the succeeding examples, two job files will be opened: 0004.job and 0005.job. As shown below, the Edit window of the last opened 0005.job will fill the space, and the file name will be displayed on the upper title bar.



You can arrange multiple Job Edit windows side by side by selecting Tile or Cascade from the main menu Window or from the toolbar. The file name will be displayed in the title bar of each child window.



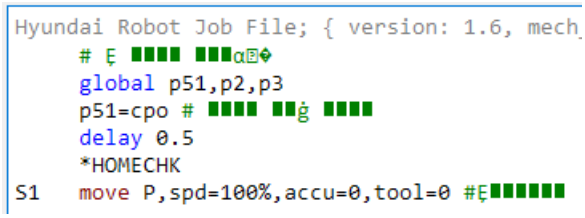


You can minimize the Edit window with the  button and maximize it with the  button. Clicking the  button or pressing ctrl+F4 will close the Edit window.

When the window is maximized, operate the buttons on the right side of the main menu.

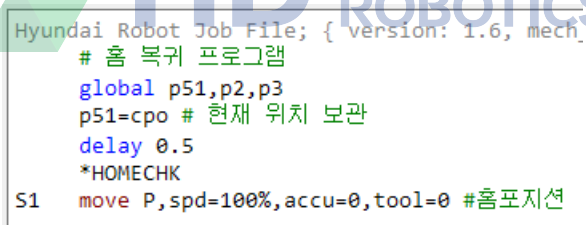
3.3.2. Reloading after Converting Encoded Job Files

When a job file is opened, non-English characters (Korean, Chinese, etc.), comments, or strings may appear broken. The job file of the Hi6 controller should be saved in utf-8 encoding, but the file will not be displayed properly in HRWorkBench and teach pendant if the file is saved with a different type of encoding (e.g. EUC-KR, GB2312).



For example, if the job file is encoded in an extended complete type, select Job - Encoding: Reload from - Korean in the main menu. The job file will be converted to a utf-8 encoding and opened in the Edit window, and the text will now be displayed correctly. When saved in this state, the file will be saved as a utf-8 encoding file.

(The ascii file and utf-8 file are the same for a file only written in English, so this operation will not be necessary.)

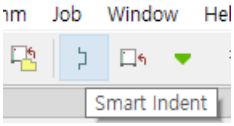


3.3.3. Syntax Coloring and Automatic Multi Stage Indentation (Smart Indent)

The Edit window provides basic syntax coloring for readability, where main commands and strings, hidden poses, comments, and job headers are displayed in unique colors.

```
Hyundai Robot Job File; { version: 1.6, mech_type: "780(YL012-0D)", to
     global po=3
S1   move P,spd=70%,accu=3,tool=0  [0.000, 90.000, 0.000, 179.200, 179
     global count
     count=count+1 # 사이클 횟수 카운터
     global po_wk=Array(3)
     global po=0
     po=Pose(-0.855, 89.703, -0.041, 179.181, 179.198, -0.001)
     po_wk=0
     po_wk[0]=Pose(0.000, 90.000, 0.000, 179.200, 179.200, 0.000)
     print "po_wk="+po_wk[2]
```

An automatic multi stage indentation function (smart indent) is also used for a more easy-to-read structure of the flow control statement. All of the current job programs in the Edit window will be automatically indented if you click Smart Indent under the Job main menu or toolbar.



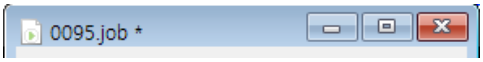

```
Hyundai Robot Job File; { version: 1.6,
     var v0=3
     switch v0
     case "xx"
       break
     case 3
       print "ok"
       break
     default
       break
       wait v0==2,5,99
       var myvar=0
     end_switch
S1   move P,spd=70%,accu=3,tool=0  [-0.
  99 if myvar==1
       delay 1.5
     endif
```

3.3.4. Undo, Redo, and Save

The Edit window provides Undo and Redo functions with the shortcut keys Ctrl+Z and Ctrl+Y.

An asterisk (*) mark in the file name in the title bar, as shown below, means that some edited content have not been saved.

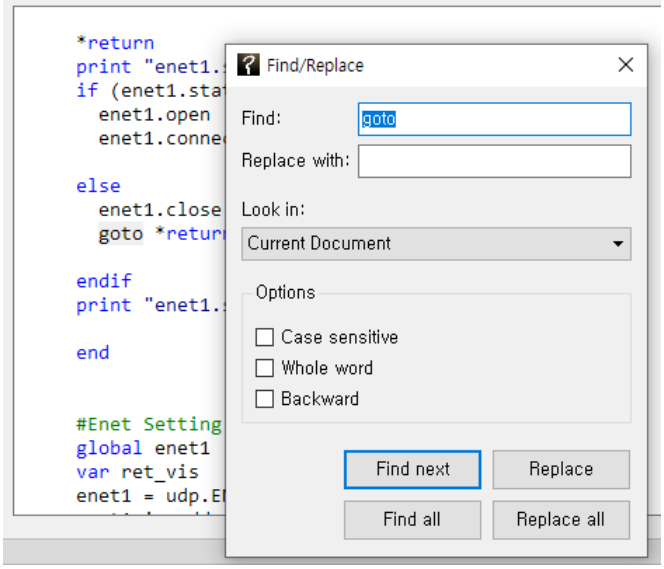
You can save the edited contents to a file by selecting File - Save or File - Save As in the main menu. You can also use the shortcut Ctrl+S or click the button in the toolbar.



The file will be saved and copied to and immediately reflected in the robot controller if you select Job - Save & Copy to RC in the main menu or click the button on the toolbar.

3.3.5. Find, Replace, and Go To Lines

You can open the Find/Replace dialog box by selecting Job - Find and Replace in the main menu or by pressing the shortcut key Ctrl+F. If a specific text has been selected, the text will be automatically inputted into Find.



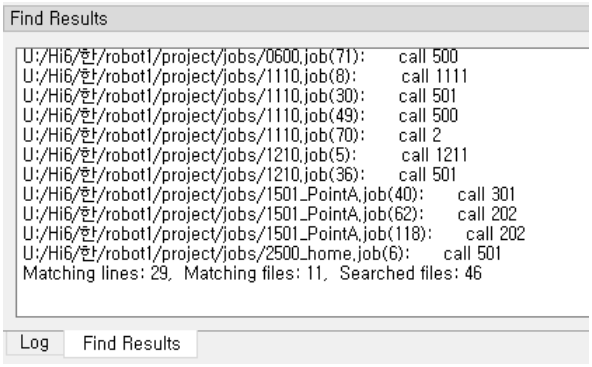
The functions of the individual options in the dialog box are shown below.

Name	Function	
Look In	Current Document	The function will be performed within the currently selected window.
	Current Project	The function will be performed for all jobs under the PC node of a project.
Case Sensitive	Selecting this function makes it possible to distinguish between upper and lower cases.	
Whole Word	Selecting this makes it possible to perform searches only for a complete word.	
Backward	Selecting this makes it possible to perform searches from the current cursor position toward the earlier parts of the document. This setting will be ignored in the case of the Find all or Replace all options.	

Clicking the Find next button allows the cursor to move to the next matching string. Clicking the Replace button allows the currently selected string to be replaced with the string inputted under Replace with and then allows the cursor to move to the next matching string.

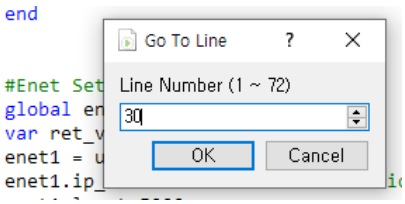
Clicking the Find all button searches for the entire range designated under Look In, and lists the searched

items in the Find Results window at the bottom in the form of its path file name (line number): string. When you double-click on a specific item, the relevant file will be opened, and the cursor will move to the matching position.



Clicking the Replace all button searches the entire range designated in Look In and replaces the matching string with the string inputted in Replace with. Moreover, this function will list the searched items in the Find Results window at the bottom.

You can select Job - Go To in the main menu or press the shortcut key Ctrl+G to open the Go To Line dialogue box. When you input a line number, the cursor will move to line number.

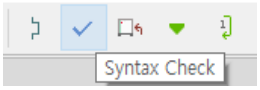


3.4. Check the Robot Language Syntax

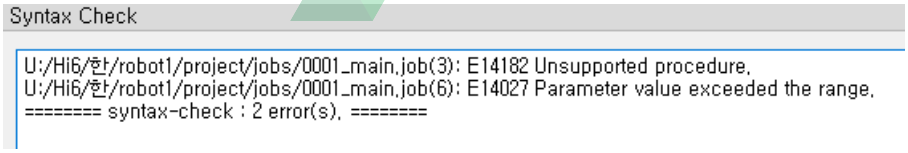
You can remotely carry out a basic syntax check on the job file currently being edited.

While the job file to be checked is open, as shown below, click “Syntax Check” on the main menu or on the toolbar.

```
Hyundai Robot Job File; { version: 1.6, mech_ty
     # main
     val arr=Array(4,5,2) # misspell of var
     global tno=0

S1   move P,spd=60%,accu=8,tool=0  [45.717, 96.
     wait DO31 # misspell of do31
     tn=2 # misspell of tno
```



The path file name and line number, where there is a syntax error, and the relevant error message will be displayed on the Syntax Check window. Double-clicking an error will move the cursor to the corresponding position.



Because this syntax check is executed without the actual execution of a job, it cannot detect all errors that may occur when a job is executed. In the job file shown in the figure above, it was detected that “var” was incorrectly marked as “val” and that the move statement accuracy exceeded the range of 0–7. However, it could not detect that the I/O variable do31 of the wait statement was incorrectly marked as “DO31” and that “tno=2” was incorrectly marked as “tn=2.” They are not considered errors because the variables DO31 and tn may possibly have been created during execution.

3.5. Execute Robot Language Statements

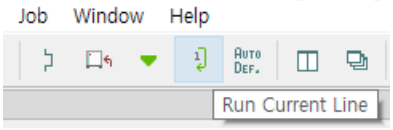
You can remotely execute robot language statements in job files. A move statement or flow control statement is not supported, and only some commands that can be executed individually, such as an assignment statement, are supported.

The global variables window in the teach pendant of the connected Hi6 controller should be left open to check the result.

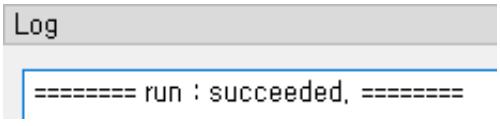
The following program was created as a demonstration in the Job Edit window.

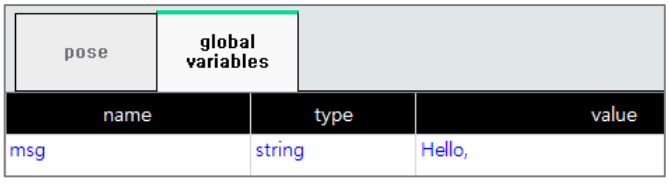
```
Hyundai Robot Job File; { version
    global onoff=true
    global pi=3.141
    global msg="Hello, "

    global values
    values=Array(10)
    global po_cur=cpo()

    print msg+"HRWorkBench!"
    end
```

Place the cursor on global msg="Hello," and click on Job in the main menu, or Run Current Line in the toolbar.

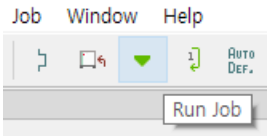


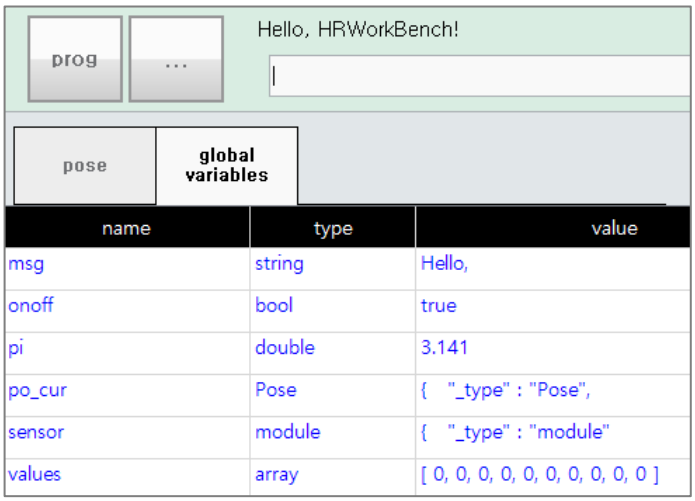
A success message will be displayed in the Log window if the remote execution is successful. In the global variables of the teach pendant, you can also see that the msg variable has been created.





Clicking on Job in the main menu or Run Current Line in the toolbar will execute all of the currently selected jobs, including the print statement.



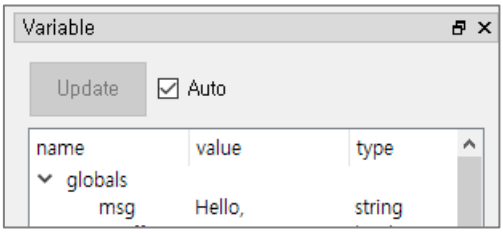


name	type	value
msg	string	Hello,
onoff	bool	true
pi	double	3.141
po_cur	Pose	{ "_type" : "Pose",
sensor	module	{ "_type" : "module"
values	array	[0, 0, 0, 0, 0, 0, 0, 0, 0, 0]

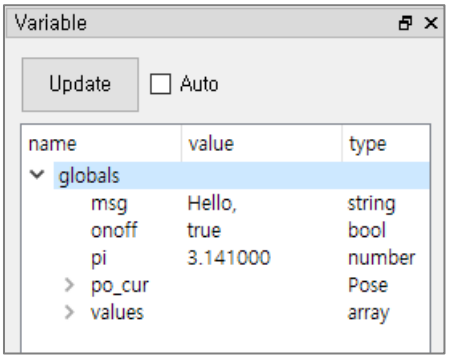
3.6. Monitor Global Variables and Set Their Values

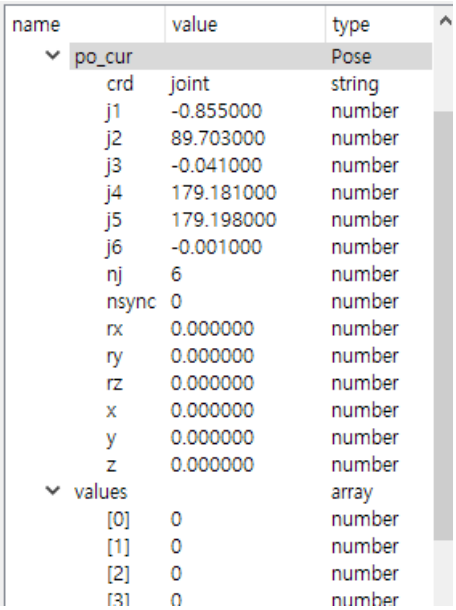
Clicking the Update button in the Variable window will display the current global variable values. The Variable window will display variables in three columns: name, value, and type of the variables, as shown in the figure.

If you check the Auto checkbox, the update will be automatically performed repeatedly, allowing you to check the change of the variable value in real time. (Please note that if the robot controller has global variables on a large scale, the update may be very slow.)

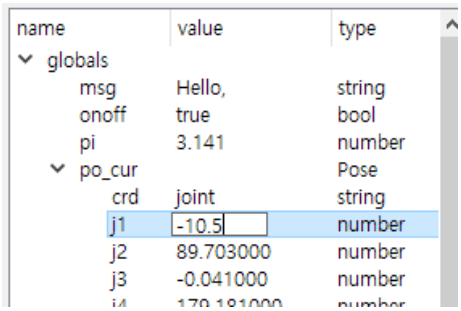


In the case of the array type or object type, such as pose, the value column is empty. Clicking › on the left of the variable value will expand the node to display sub-nodes, and clicking it again will hide them. (You can also press the left/right arrow keys to do it.)

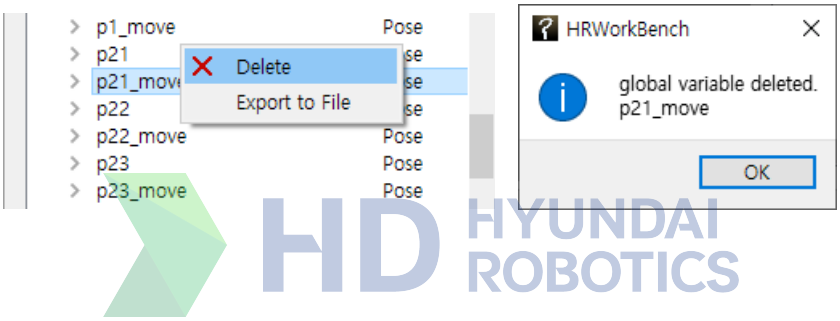




For primitive types such as bool, number, and string, the value will be displayed. You can set it remotely by double-clicking it and input a new value and then press the enter key.



Remotely delete a selected variable by right-clicking it to expose the pop-up menu and select Delete.

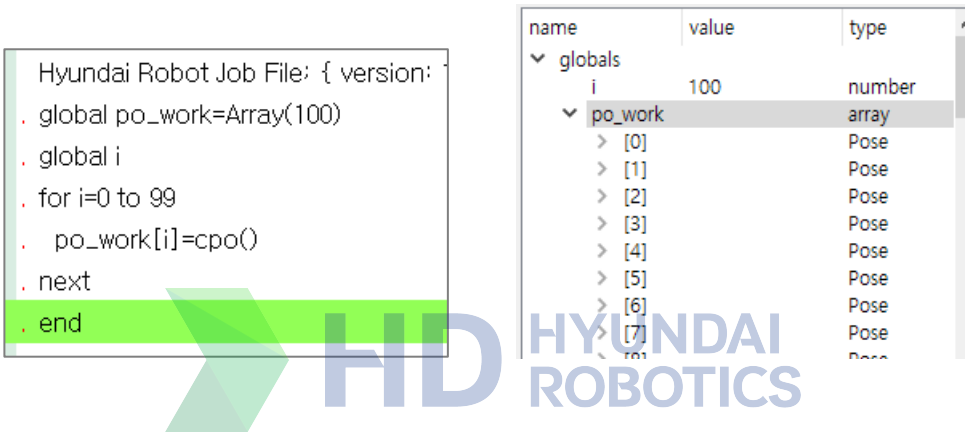


3.7. Export the Global Variables

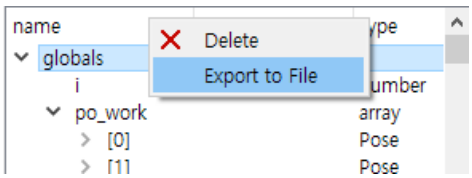
You can monitor global variables and set their values in the Variable window. However, there is a limit to editing a list of a large number of variables.

HRWorkBench provides a function that allows you to export the names and values of global variables in the form of a .job program that lists the assignment statements. The job program created for editing variables can be easily edited using the Job Edit window or your favorite text editor. [2]

For a demonstration, the following job program is executed in the robot controller to create a pose array. When you monitor in the Variable window, you can see an array of 100 pose type elements.

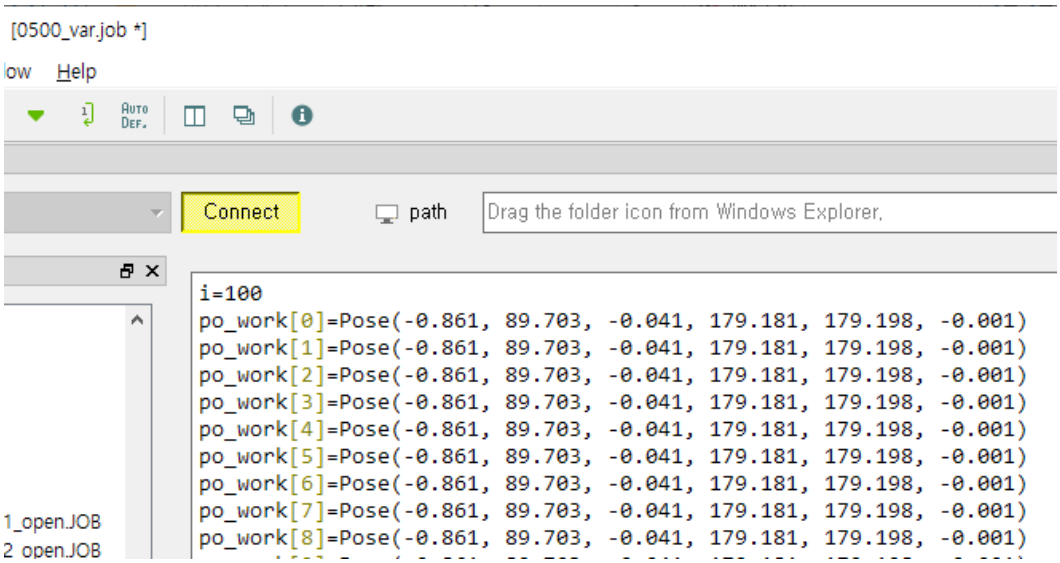


Right-click the globals node and select “Export to File” in the pop-up menu.

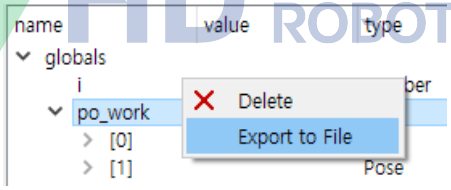


As the Job Edit window opens, all global variables will be listed in the form of assignment statements. Arrays and objects are broken down and listed continuously until the child properties of the primitive type (number, string, etc.) are displayed. As you can see from the title bar, the file name of this Edit window is set to 0500_var.job by default, and it has not been saved as an actual file yet. Save it as is using the File - Save menu, or save it with the desired name using the File - Save As menu.

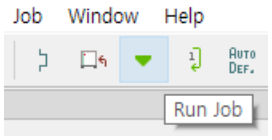
[2] Global variables are saved as a file inside the robot controller. However, caution is required, as modification of the file may cause damage to the structure, leading to malfunction.



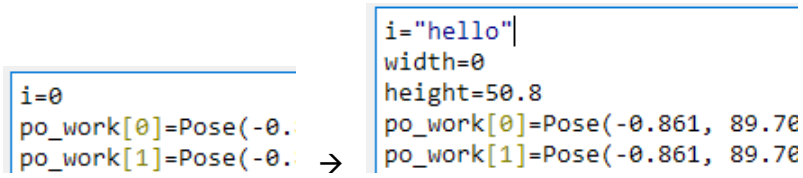
If you want to export only one specific variable and its child properties and not all of its global variables, you can perform Export to File on the specific variable.

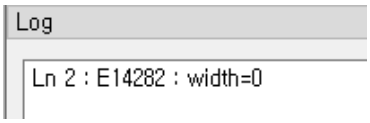


After checking or editing the listed pose values, you need to perform remote execution using the Run Job command if you want to apply them back to the controller.



Let us suppose that you add a new variable to the global variables that do not exist in the robot controller. It doesn't matter to change the type of variable i from number type to string type as shown below (because an i variable exists anyway). However, because the newly typed width and height do not exist in the robot controller, an error stating that"E14282 Invalid left-side of assignment statement" will be displayed when these assignment statements are executed.





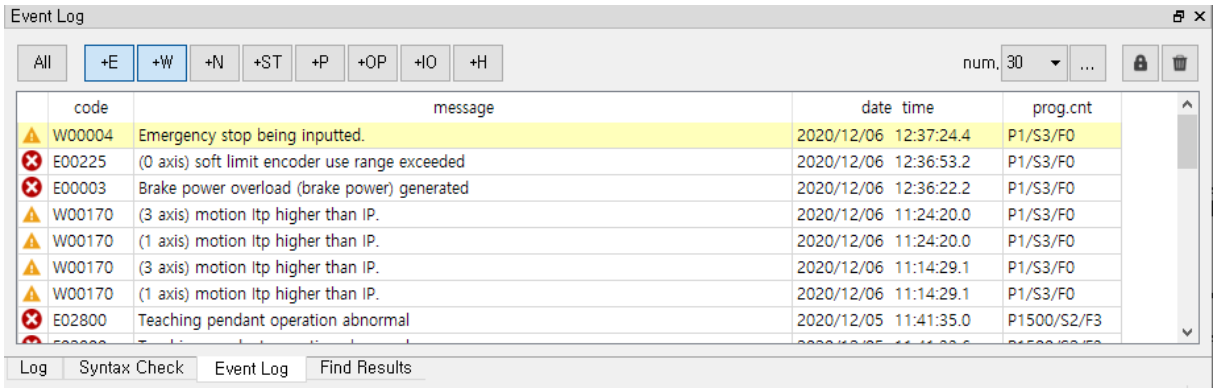
Therefore, you have to attach the global statement one by one, as shown below.

```
i="hello"
global width=0
global height=50.8
po_work[0]=Pose(-0.861, 89.70
po_work[1]=Pose(-0.861, 89.70
```

If you think that this is cumbersome, select Job - Auto-def as a global variable in the main menu or click the AUTO DEF. button in the toolbar. If you execute Run while the Auto-Def function is checked, global variables will be automatically created for nonexistent variables and assigned accordingly, so there is no need to attach the global statement.

3.8. Monitor Logs in the Controller

In the Event Log window, logs generated from the Hi6 controller will be displayed. This window provides the same functions as those of the U/I provided by Hi6's teach pendant. New logs will be highlighted in yellow.



Category	U/I	Description
Filter	All	Turn (toggle) on or off all types of logs.
	E (Error)	Display the error log.
	W (Warning)	Display the warning log.
	N (Notice)	Display the notice log.
	ST (Start/Stop)	Display the start/stop logs.
	P (Periodic)	Display the periodic status log.
	OP (Operation)	Display the operation log.
	IO (I/O)	Display the I/O logs.
	H (History)	Display the execution history.
	num. 30	Select the number of logs to be displayed on the window and refresh the screen.
... (Pop-up menu)	Save to log files	Save the logs that have been accumulated in the controller's memory as log files in the controller.
	Clear log files	Clear all the logs both in the controller's memory and in the log files.
		Stop monitoring a new log.
		Clear the items in the Event Log window.

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