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ISPSoft **User Manual**

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ISPSoft User Manual
Revision History

Version	Revision	Date
1st	The first version was published.	2013/01/18
2nd	Appendix D and Appendix E are added.	2015/03/18
3rd	1. New contents concerning AHxxEMC and AS300 series are added in Chapter 3. 2. New contents concerning Data Unit Type are added in Chapter 8. 3. New contents concerning Axis are added in Chapter 9. 4. New contents concerning Continuous Function Charts are added in Chapter 15. 5. New contents concerning G-Code Editor and E-CAM Editor are added in Chapter 21. 6. New contents concerning Wizard Tool are added in Chapter 22. 7. New contents concerning AHxxEMC and AS300 series are added in Appendix B. 8. Appendix D and Appendix E are removed. 9. Update all software images.	2016/05/13
4th	10. New contents concerning setting communication parameters for AS300 simulator are added in Chapter 2. 11. Update information concerning AHxxEMC and AS300 in Chapter 3. 12. New contents concerning axis are updated in Chapter 9. 13. Update new folding function in the action list for SFC. 14. New contents concerning change DVP series modules to AS series modules are updated in Chapter 16. 15. Update information concerning online monitoring in Chapter 17. 16. New contents concerning ECAM editor and polynomial are added in Chapter 21. 17. New contents concerning planning table, lists, data tracer, data logger and double vertical measurement lines are added in Chapter 22. 18. New contents concerning installing the USB driver in Windows XP with SP3, Windows 7, Window 8 and Window 10 are added in Appendix A. 19. The ranges of the S device for AS300 series are revised in Appendix B.	2017/06/15
5th	1. Add new contents regarding DVP15MC and information on ISPSoft for installing/removing in Chapter 1. 2. Update backup file number of auto save project and limitation on the number of AH/DV{/AS simulators; new contents on DVP15MC and edited routing mode information are added in Chapter 2. 3. Add new information containing HWCONFIG for AH500 redundancy system series and DVP15MC, redundant extension rack, new tab-IO input filter	2018/06/12

Version	Revision	Date
	content in HWCONFIG basic CPU parameter setting of AHxxEM series. Edit basic CPU parameter-Name and Comment boxes,parameters of AS series CPU modules in Chapter 3. 4. Update contents regarding task management for AH500 redundancy system and DVP15MC in Chapter 5. 5. Edit AS series data types and add information like S device supports by AH series CPU modules and data types of DVP15MC as well as symbol classes in Chapter 6. 6. Add data types not supported by the function blocks in AS series CPU modules, assigning memory blocks to function blocks in AH redundancy system series, edit basic specifications for function blocks and new contents regarding function blocks I/O and library for DVP15MC are included in Chapter 7. 7. Add contents regarding structure DUT and limitation on number of enumerations, change structure to enumeration and from enumeration to structure as well as information for DVP15MC in Chapter 8. 8. Updates on cycle time for axis in the project management section, introduce ‘Synchronize with ECAT Builder’ option and add information on axis parameter setting including node address, monitoring and test run functions for DVP15MC and AHxxEMC series in Chapter 9. 9. Add new contents including MPS instruction and information on DVP15MC; edit ladder diagram regarding activating or inactivating a network in Chapter 10. 10. Edit contents of putting labels in Chapter 11 11. Add ST instructions not supported by the AH/AS series CPU modules and ST instructions supported by the AS series CPU modules but with limitations in Chapter 13. 12. Edit contents of S device occupied by the STEP data type in the PLC and add AH500 redundancy system series in running the ‘Final Scan’ as well as SFC system structure contents in Chapter 14. 13. Correct the wording used in warning the operation that causes loss of data or task; add new contents of DVP15MC; edit device comment lists of AH/AS/DVP series and contents in used device report in Chapter 16. 14. Add new contents including DVP15MC, online editing and update function, DVP simulator information; edit debugging mode for DVP series, and system log functions for AH500 redundancy system series in Chapter 17. 15. Expand contents regarding DVP15MC in Chapter 18. 16. Edit contents of NWCONFIG in Chapter 19. 17. Add new information regarding CARD Utility for AH500 redundancy system series and edit backup source in card utility for AS series added in	

Version	Revision	Date
	Chapter 20. 18. Correct Chapter 21 of G-code editor to ‘not supported by the current ISPSoft version’ and edit E-CAM functions. 19. Edit contents regarding position planning table, data tracer, data logger and high speed counter in Chapter 22. 20. Add AH560EN2 module to the installation path in Appendix A 21. Add new contents regarding DVP15MC, AHCPU501-EN, AHCPU501-RS2, AHCPU521-RS2, AHCPU531-RS2, AS200 series; update data exchange setups and NWCONFGIC; edit the address range for AHCPU511-EN/ AHCPU511-RS2 and AHCPU531-EN modules and program compilation & time for uploading/downloading in Appendix B.	
6th	1. Modify chapter 1: add DVPxxMC description; information on installing ISPSoft and remove modified ISPSoft content; installing COMMGR and remove modified COMMGR content; add language supported by PLC types in ISPSoft and function support list. 2. Modify chapter 2: ISPSoft first step, window title; content, function toolbar and icon toolbar; project, message and edit work content section; project structure in ISPSoft, single project and group project; integrate motion module project content; system and environment setting; enable and close communication COMMGR as well as drive management; create connection channel, create ISPSoft and COMMGR connection as well as connection with host and communication port. 3. Modify chapter 3: DVPxxMC PLC host parameter setting; AH560 redundant system parameter setting and related content; HWCONFIG tools. 4. Modify chapter 4: add new project and hardware configuration and module allocation; host and module parameter setting and create program content; basic edit- select ladder diagram section and increase operation function; basic edit- insert API instructions, program check and editing; create connection between testing and debugging, download program and configuration parameter, connection testing examples. 5. Modify chapter 5: the POU structure and task management in ISPSoft; task in project section and POU execution order content in task; create POU and property setting as well as POU active state, delete and copy POU, POU password setting and canceling, export and import POU, export and import function block POU; task management operation and task property and condition for interrupt, POU allocation, POU order and content; programming examples of POU and task, interrupt program examples of DVP series, interrupt program examples of AH500 series. 6. Modify chapter 6: symbol variable category and	2019/06/14

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	data types as well as position allocation and initial value content; symbol variable table and add symbol variable as well as array and string symbols, modification on symbol variable and edit symbol table, download initial value of symbol variables, device resource allocation setting. 7. Modify chapter 7: symbol variable of function block, input and output of function block; the function block call or ‘nesting FBs’ and function block memory allocation and basic specification; create program example; add and refer to user library as well as Delta library. 8. Modify chapter 8: create Structure content 9. Modify chapter 9: create axis content in AHxxEMC; create axis and basic settings in DVPxxMC; the main symbol and axis symbol in global symbol table; AHxxEMC and DVPxxMC axis parameter setting; AHxxEMC and DVPxxMC monitoring and testing 10. Modify chapter 10: LD edit environment in ISPSoft; use device symbol variable and contatn in LD, insert API instruction and function block, edit section logic command, switching between symbol mode and position mode content. 11. Modify chapter 11: FBD edit environment in ISPSoft, FBD device symbol variable and constant; contacts of API comparison and function block content; switching between symbol mode and position mode content. 12. Modify chapter 12: edit IL command, insert API and function block content. 13. Modify chapter 13: ST edit environment in ISPSoft, edit ST description, insert API and function block, create program example. 14. Modify chapter 14: Step and Action, Transition, Jump, condition for Action modifiers, condition defined, initial Step; internal attribute, Step attribute parameter, Action and Transition attribute parameter; SFC edit environment in ISPSoft, create and manage Action & Transition, assign Step and Transition symbol, allocate Action/ folded Action list; create program example. 15. Modify chapter 15: instruction and function block content. 16. Modify chapter 16: add modified PLC types list, add project download and upload list, device note table and device use status for DVP series, content for program alignment. 17. Modify chapter 17: debugging mode in DVP series, AH500 simulator content; PLC system information, PLCY system log content. 18. Modify chapter 18: ISPSoft password structure, POU password, subroutine password, and other password protection function. 19. Modify chapter 19: NWCONFIG brief intro, basic introduction, communication parameters setting, task procedure modification; deploy node, connect internet, node and internet property setting,	

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	device or hide/show internet, legal internet structure, download routing table, routing table testing content; choose host device, communication parameter setting, data exchange table, section setting, synchronized data exchange for PLCs, management for data exchange table, PLC Link monitoring function, setup PLC Link notes; Ether Link brief intro, open Ether Link setting window, create and manage data exchange table, device list and icon operation, Ether Link operating mode, download Ether Link device, upload Ether Link device, delete non synchronized device, online start/stop Ether Link, system download, routing application in ISPSoft. 20. Modify chapter 20: information backup memory card operation, PLC permanent backup setting, memory card utility software intro and backup operation, restore operation content. 21. Modify chapter 21: delete G-Code editor; E-CAM editor, about E-CAM and its details as well as usage. 22. Modify chapter 22: setup position planning, position planning simulation, upload and download position planning table ; axis control mode- point to point single axis mode, single axis multiple section output mode, 2-axis linear interpolation mode, 2-axis arc interpolation mode; about and open data tracer, parameter sample setting, sample mode, measurement content; About and open data logger, setting sample parameters, monitoring and log mode, measurement content; About high-speed timer wizard. 23. Modify Appendix A: install USB driver in Windows 10. 24. Modify Appendix B: DVPxxMC device types and device address format as well as retain latched device.	
7th	1. Add a new Chapter 16; the chapter number of the chapters after chapter 16 have been modified accordingly. 2. Update List of Programming Languages supported by ISPSoft in Chapter 1. 3. Update the project display and add new initialization options for PLC in Chapter 2. 4. Add new introductions on HWCONFIG 4.0 in Chapter 3. 5. Update execution images of the EI instruction in section 5.3.2. 6. Update descriptions on Global Symbols which may have more sub-options for some series and update descriptions on the initial values in Chapter 6. 7. Update descriptions on bookmarks which can be inserted in a program in Chapter 10. 8. Add descriptions on the usage of multiple comments (using words between (* and *), (/* and */) and single line comment (using (/ /)) in a	2020/03/20

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	structured text in Chapter 13. When a program is compiled, the system automatically skips the words between (* and *) , (/* and */) and (/ /) in the program. 9. Update descriptions on Search for Device and Search for Symbols in Chapter 17. 10. Add descriptions of the function of Temporarily Store Password in Online Editing Function in Chapter 18. 11. Update descriptions of G-Code functions in Chapter 22.	
8th	1. Modify Chapter1 System Requirement, List of Programming Language, List of Functions and add the statement concerning the content of this manual is not applicable for model AS5xx series. 2. Modify Chapter2 Project Setting tab on Options window. Add the selections of Show Symbol Hint Configuration Editor-IL,ST and C. Add description concerning COMMGR button under Communication Setting. Add the new function of exporting programs to text. 3. Modify Chapter3 the order of sections concerning HWCONFIG 4.0, including interface update, function of HWCONFIG variables and IO-Link. 4. Add section 5.2.1 and 5.4.1 for introduction of Function(FC). 5. Add description of VAR_STATIC and VAR_STATIC_RETAIN in symbol variable table in section 6.1.2. Add the description of data types supported by Function(FC) in section 6.1.3. Add description relating to initialize retentive symbols. 6. Add description relating to Function Block in chapter 7. 7. Add description and figures relating to Union, Structure and Enumeration in chapter 8. 8. Add description relating to AxisParaForm, section of Back-up/Restore Servo Parameter and Auto Gain Tuning section. 9. Add description relating to programs PLCs using structured text supported by function blocks and pins of DVPxxMC/AS5xx in section 10.2.4. 10. Modify the content of section 15.2.10 Changing the Order in Which Objects are Executed. 11. Modify the content of section 17.1.1 Modify PLC Types. 12. Add the CARD Utility Backup and Restore table in section 21.3. 13. Add section 23.5 NTC Module Wizard. 14. Add description relating to AS5xx in appendix B.	2020/6/30

Version	Revision	Date
9^{th}	1.Update figures related to HWCONFIG3.0 of AH series and figures with password settings for adding or modifying POU in each chapter. 2.Add new description for ISPSoft installation instruction including installing USB drive, HWCONFIG and Visual C++. 3.Update the table content of Programming language list and function list in section 1.3.1 and1.3.2. 4.Add a new option of COM ports for RS232/422/485 connection setup type in section 2.4.3. 5.Add description relating to AH series supported by HWCONFIG 4.0 as well as EtherNetIP feature in chapter3.1. 6.Add description of EtherNetIP feature in section 3.1.5. 7.Add description of EtherCAT in section 3.1.6. 8.Add new content of section 5.4.9 “Edit Folder”. 9.Add LD and CFC to the languages used by ARRAY type variables in section 6.2.3. 10.Update the figures in section 7.5.1 “Creating the User-defined Library”. 11.Add the table of data types supported by different models in chapter 8.1. 12.Update the table of axis-related functions supported by each model in chapter 9.1.(Add DVP50MC-04S, DV50MC-16S, AS532EST, AS564EST models) 13.Add new OPCUA support to the table of download/ upload projects in section 17.1.3. 14.Add new content of switching LD monitoring value display position in section 18.1.2. 15.Update the content of online editing procedure as well as temporary saving passwords in section 18.1.6. 16.Update the table of password description and password length for model types in chapter 19.1. 17.Add AS5xx and DVP to the models supporting CARD Utility in chapter 21.3. 18.Add a new description table for E-CAM master slave axes setting in section 22.2.3. 19.Add a new section 23.2.6 “DIA Data Tracer”.	2021/03/29

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Chapter 1 Introduction to ISPSoft

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1

1.1 Introduction of ISPSoft and System Requirements

ISPSoft is a software development tool for Delta's new generation programmable logic controllers. IEC 61131-3, which supports seven programming languages and adopts a large number of applied instructions. In addition to basic programming functions, ISPSoft also contains many auxiliary tools. The multilingual environment and the friendly user interface provide users with a convenient and efficient development environment.

1.1.1 Characteristics

- It supports the international standard IEC 61131-3 and a large number of applied instructions.
- It supports six programming languages. They are ladder diagrams (LD), sequential function charts (SFC), function block diagrams (FBD), structured texts (ST), continuous function chart (CFC) and C language (C). Users can use more than one programming language in one project.
- It supports traditional Chinese, simplified Chinese, and English.
- The **Find** and **Replace** functions can be applied to a present window, or a whole project.
- It provides a user-defined operating environment.
- The project management adopts an interface which uses a hierarchical tree structure.
- Users can develop several models in a group of projects.
- It provides many convenient functions such as making comments, creating bookmarks, activating/inactivating networks, managing devices and symbols, simulation, and etc.
- It supports several types of online operation such as monitoring programs online, editing programs online, monitoring devices online, debugging programs online, operating/setting a PLC online, and etc.
- Users can import and export projects by means of the **Import** and **Export** functions.
- A file (*.dvp) created with WPLSoft can be opened directly, and can be converted into an ISPSoft format (*.isp).
- It provides several password setting mechanisms and data protection mechanisms.
- It supports COMMGR, a new generation communication manager.
- There are three built-in configurations.
  - HWCONFIG: It is used to configure hardware for a system, and manage parameters.
  - NWCONFIG: It is used to configure networks for a PLC system, and manage data exchanges.
  - CARD Utility: Users can backup and restore a system through a management wizard and a memory card.

- It provides various solutions for motion control including PLCopen MC function block, G-Code editor, E-CAM editor, positioning planning chart tool and many more.
- The software can be applied to DVPxxMC series including DVP15MC, DVP15MC-06, DVP50MC, DVP50MC-04S, DVP50MC-16S and DVP50MC-06.
- The content description concerning AS series is not applicable for model AS5XX.
- The content description concerning model AS5XX is only applicable for model AS516E, AS524C, AS532EST and AS564EST.

1.1.2 System Requirements

Before using ISPSoft, users have to make sure that an operating system meets the requirements below.

<table>
<tr><th>Item</th><th colspan="2">System requirement</th></tr>
<tr><td>Operating system</td><td colspan="2">Windows 7 / 8 / 10</td></tr>
<tr><td>CPU</td><td colspan="2">Pentium 1.5 G or above</td></tr>
<tr><td>Memory</td><td colspan="2">1024 MB or above (A memory with a capacity of 2048 MB or above is recommended.)</td></tr>
<tr><td>Hard disk drive</td><td colspan="2">Capacity : 5000 MB or above</td></tr>
<tr><td>CD-ROM drive</td><td colspan="2">For installing ISPSoft, it is optionally required.</td></tr>
<tr><td>Monitor</td><td colspan="2">Resolution: 1024×768 pixels or above
(Recommended setting: 1920x1080/96 DPI)</td></tr>
<tr><td>Keyboard/Mouse</td><td colspan="2">General keyboard/mouse, or device compatible with Windows</td></tr>
<tr><td>Printer</td><td colspan="2">Printer with a driver for Windows
(It is used to print projects, and is optionally required.)</td></tr>
<tr><td>RS-232 port</td><td>For connecting to a PLC</td><td rowspan="3">Users have to select one of them according to the communication interfaces provided by the PLC or the module used. (*1)</td></tr>
<tr><td>USB port</td><td>For connecting to a PLC</td></tr>
<tr><td>Ethernet port</td><td>For connecting to a PLC</td></tr>
<tr><td>Communication software</td><td colspan="2">COMMGR, a communication manager, must be installed on a computer. (*2)</td></tr>
</table>

Item	System requirement
Models which are supported	AH500 series PLCs/DVP series PLCs (exclusive of DVP-PM series PLCs)/VFD-C2000 series AC motor drives/VFD-C200 series AC motor drives/VFD-CP2000 series AC motor drives /VFD-E series AC motor drives (*3) PLC: all AH series, AS series and DVP series (except DVP-PM series) AC motor drive: VFD series with PLC built-in Text panel: TP series with PLC built-in

***1. ISPSoft supports several ways in which a computer is connected to a PLC. Users have to make sure of the ports and the modes supported by a PLC before a computer is connected to the PLC.**

***2. Please refer to section 1.2 for more information about COMMGR.**

***3. In addition to ISPSoft, users must use PMSoft version 2.05 or above to develop AH10PM-5A and AH20MC-5A.**

***4. The functions and specifications mentioned above are only applicable to ISPSoft version 2.00 or above. The older versions may not be equipped with complete functions.**

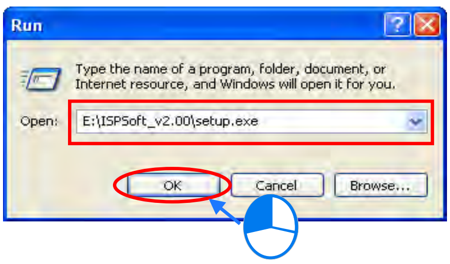
1.1.3 Installing ISPSoft

When the previous version of ISPSoft is detected in a computer, that version is advised to be uninstalled first before the latest ISPSoft can be installed.

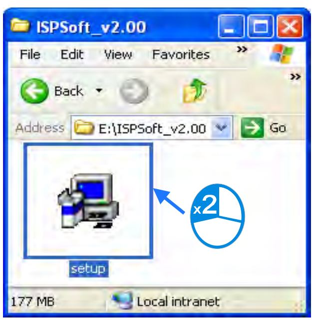
(1) Start a computer and enter the operating system. Users have to log on to the system as a system administrator before installing ISPSoft.

(2) Put an ISPSoft CD in the CD-ROM drive, or download the installation program from the official Delta website http://www.deltaww.com/ to download ISPSoft. (The installation programs need to be decompressed if downloaded from the internet.)

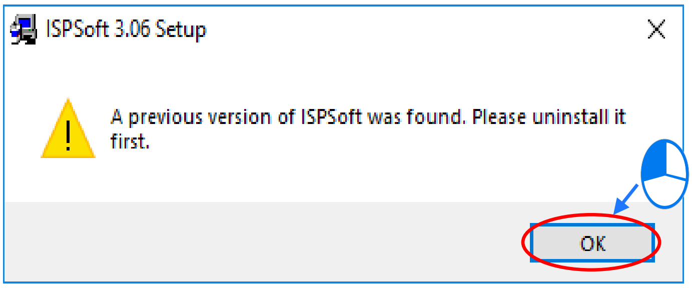
(3) Click **Start**, and **Run** to open the **Run** window. Specify the path denoting the executable file which is used to install COMMGR in the **Open** box, and then click **OK**. Alternatively, users can double-click the icon which is used to install ISPSoft to execute the installation program.

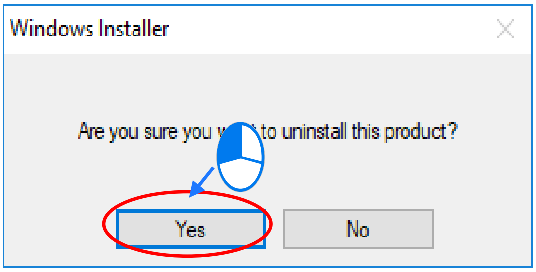


OR

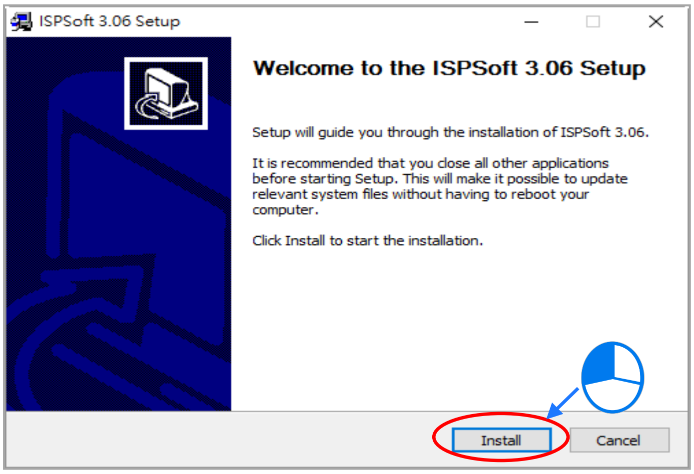


(4) When a previous version of the ISPSoft is found, click **OK** then **Yes t**o uninstall that version shown in the pop-up windows (see below).

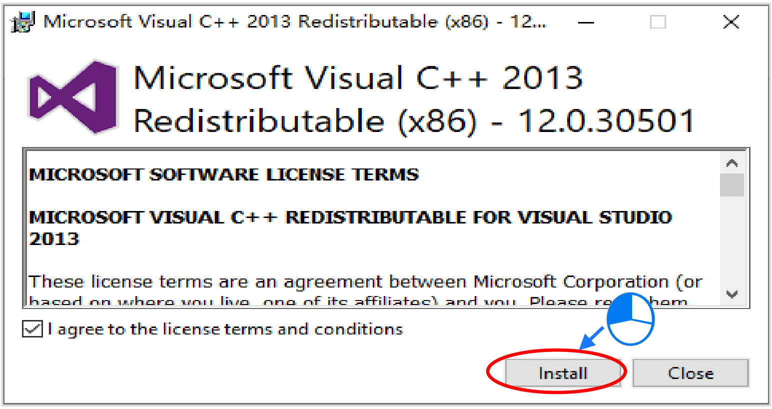


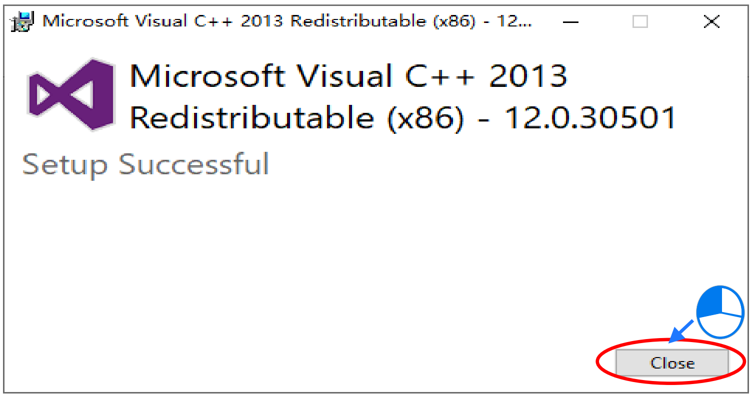


(5) Click **Install** once Shield Wizard window appears.

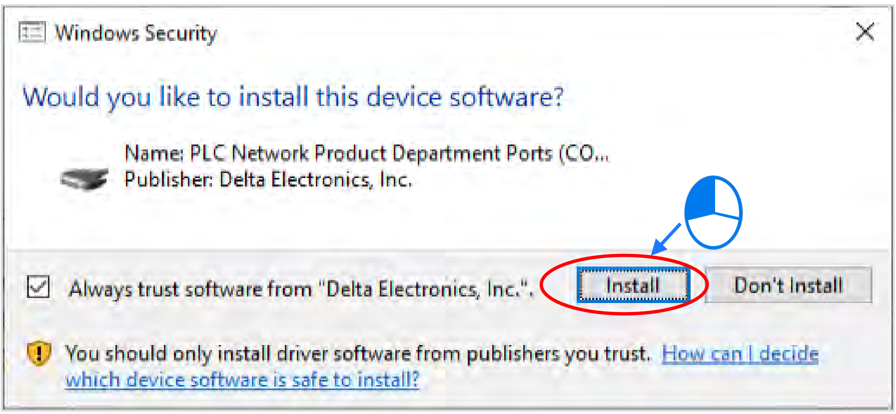


(6) The installation program would auto detect MicrosoftVisual C++ 2013 installed in your PC. If such compiler has not been installed, the following page would pop up for MicrosoftVisual C++ setup by choosing **Install** and clicking **Close** when completes.

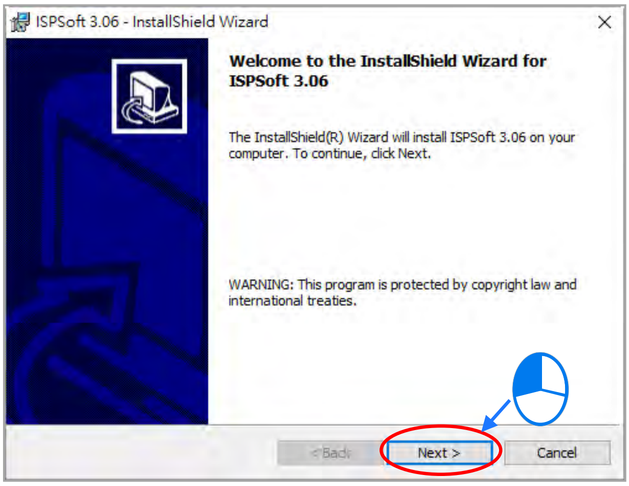




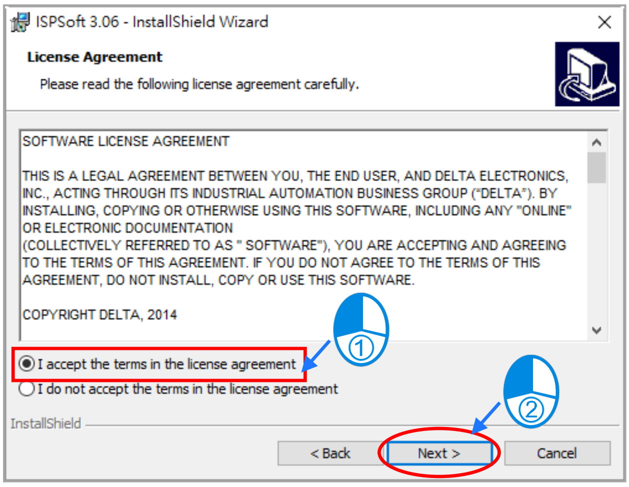
(7) If DELTA PLC USB drive has not been installed in your PC, the following window would pop up and help you on the installation after clicking **Install** on the window.



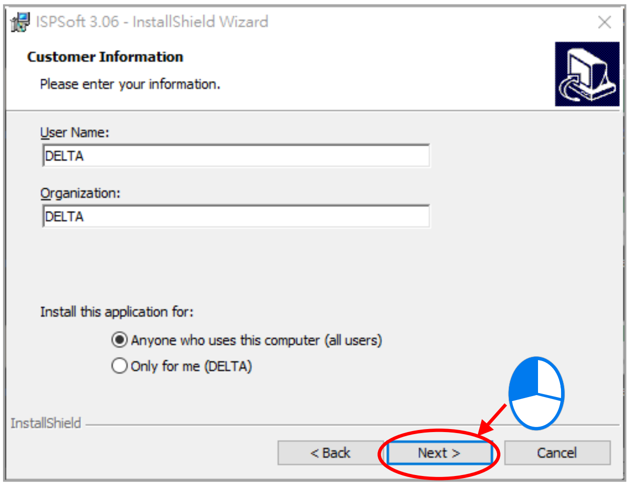
(8) Then, click **Next** for the next step.



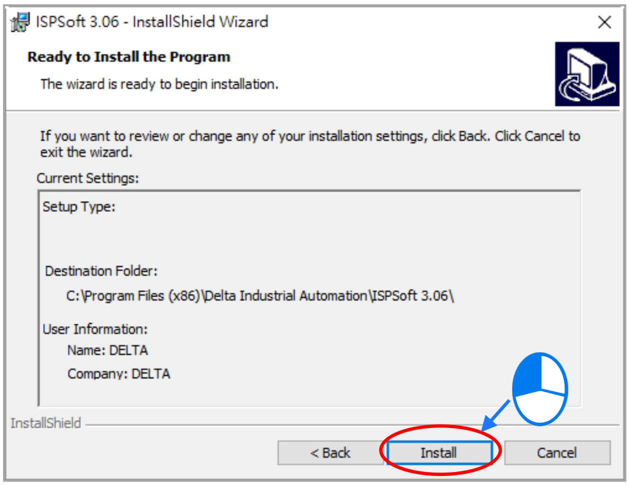
(9) Choose **I accept the terms in the license agreement**. Click **Next** to proceed to the next step.



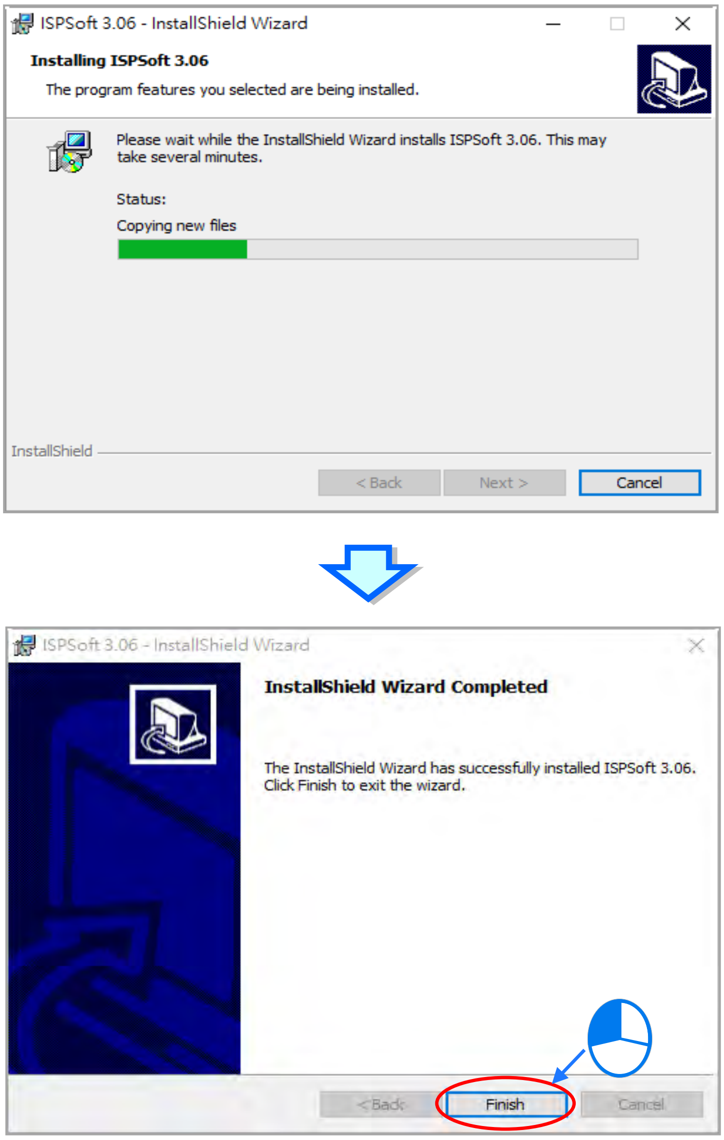
(10) After configuring customer information, click **Next** to start the installation process.



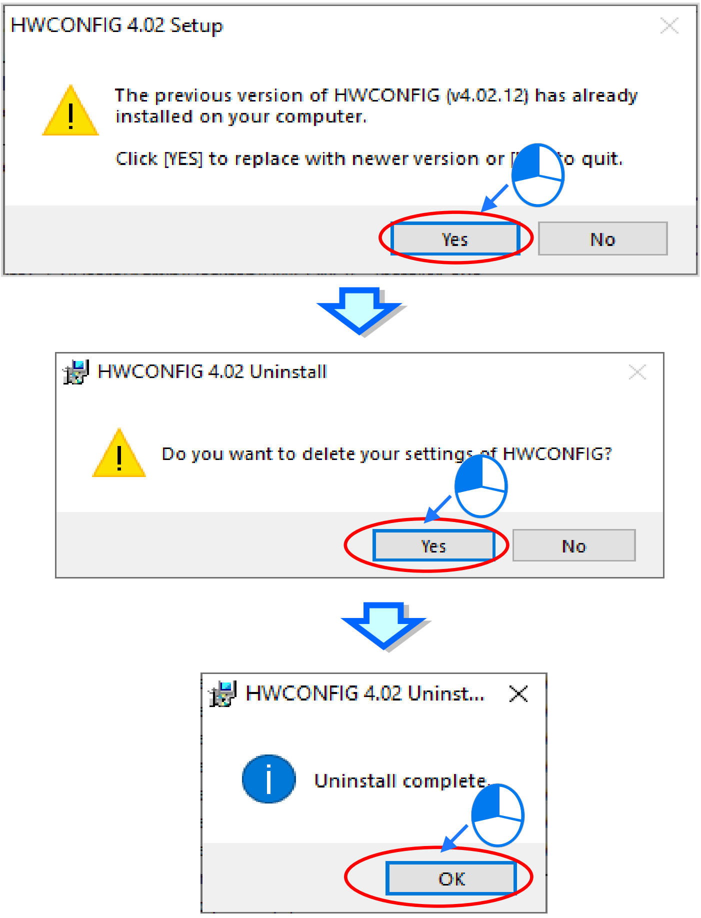
(11) Check the installation information, and then click **Install**.



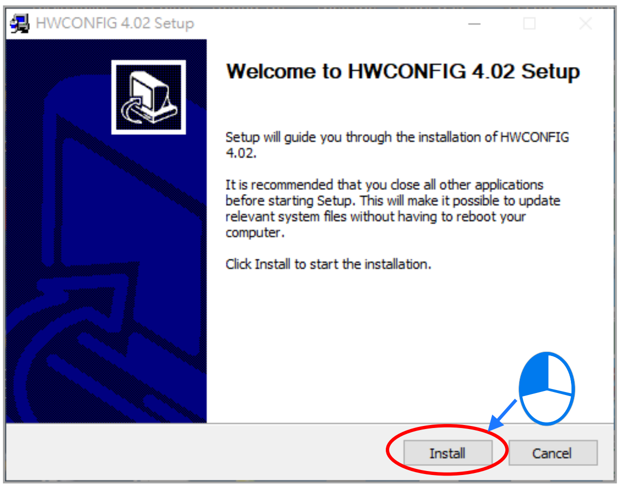
(12) After installation is completed, click **Finish** to continue the next step.



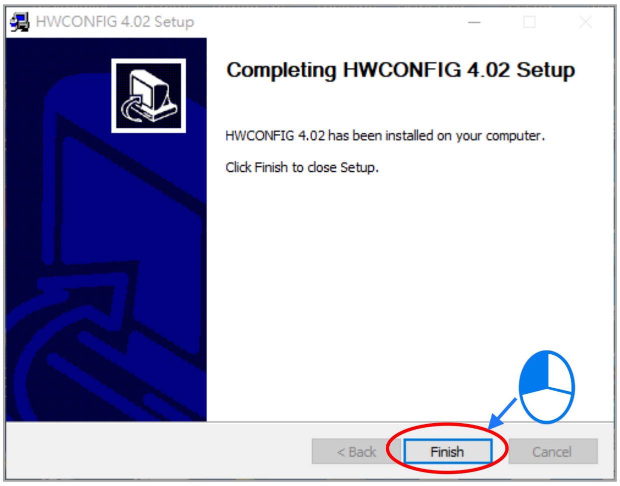
(13) Continue to install HWCONFIG. Whereas if there's an older version of HWCONFIG installed, the following window would be prompted for you to uninstall and replace it with a newer version by clicking **Yes** and **OK**.



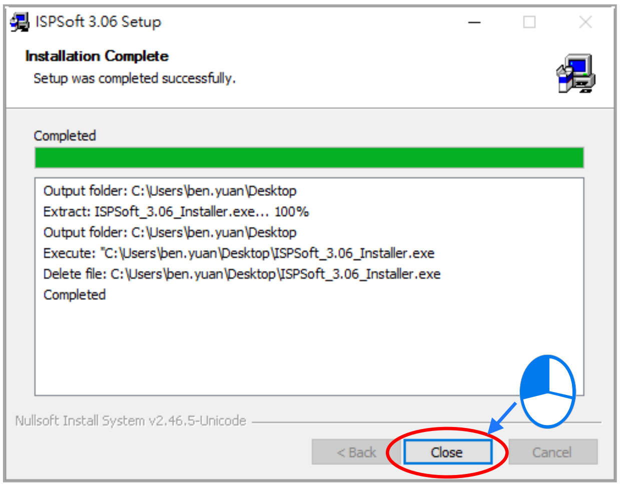
(14) After the setup page being displayed, click **Install** to start the setup process.



(15) Click **Finish** to continue.



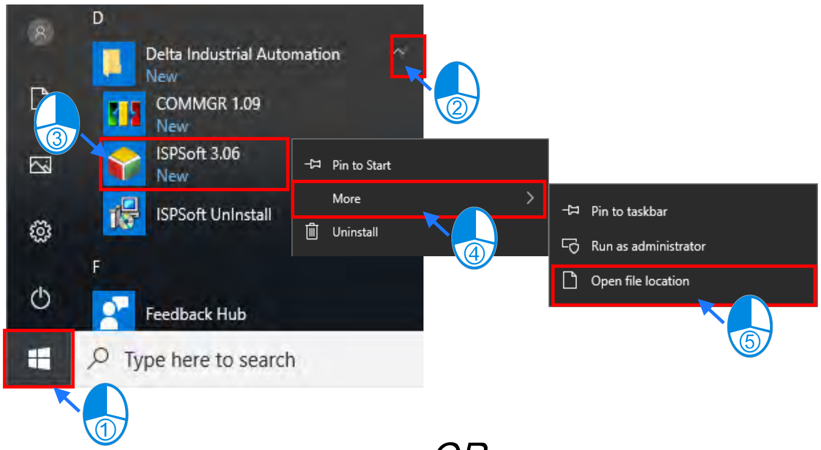
(16) When installation completes, shortcuts to the software is created on the desktop and Start menu. Click **Close** to exit the setup.



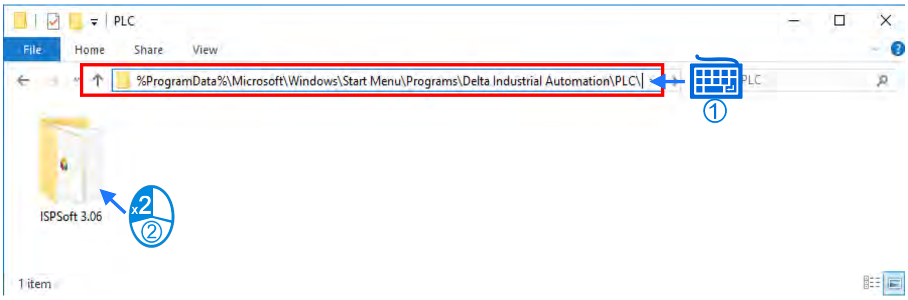
1.1.4 Uninstalling ISPSoft

(1) Generally, users can click **ISPSoft Uninstall** or choose **Programs** under **Control Panel** to remove the ISPSoft; when **ISPSoft Uninstall** is not found, there are two methods to uninstall the software:

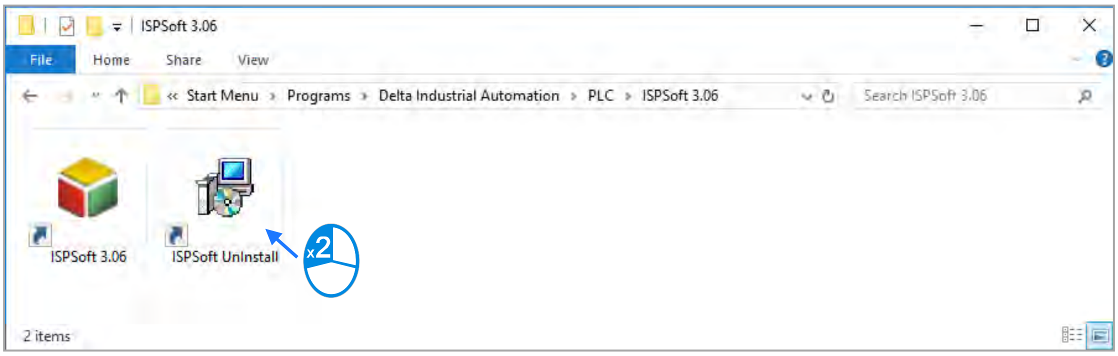
- Method 1: Choose **ISPSoft x.xx** from the Windows list, click **More** then select **Open file location.**
- Method 2: Place **%ProgramData%\Microsoft\Windows\Start Menu\Programs\Delta Industrial Automation\PLC** in the address box and press Enter. Then, double click ISPSoft x.xx file.



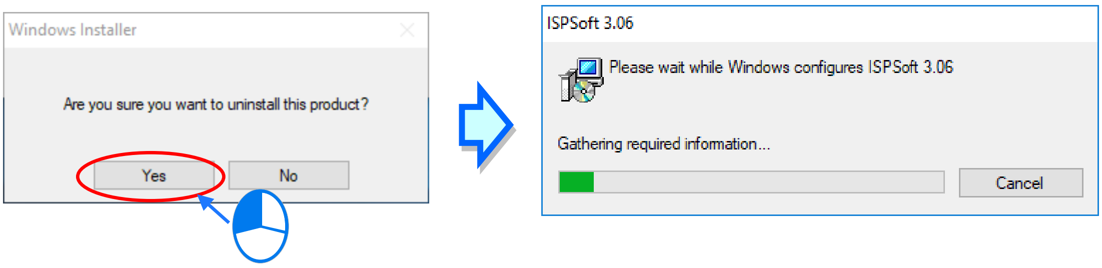
OR



(2) Remove the software by double-click the **ISPSoft UnInstall**.



(3) To uninstall ISPSoft, click **Yes** shown in the pop-up window. The window will automatically close once the software is removed.

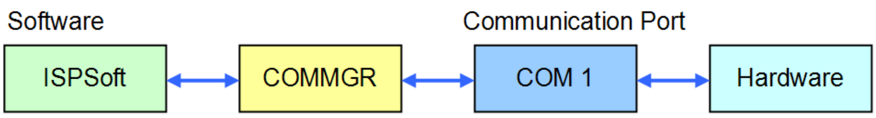


1.2 Introduction of COMMGR

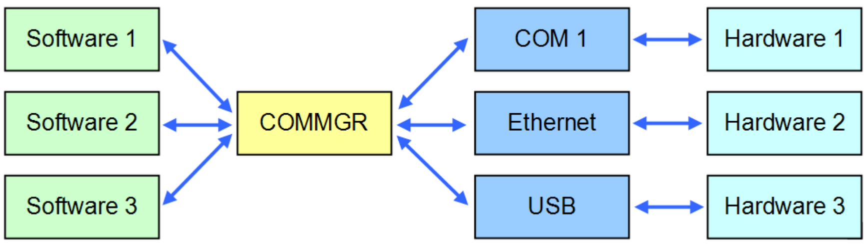
COMMGR is a new generation communication management tool developed by Delta Electronics, Inc. in 2011. It functions as a communication bridge between Delta software and hardware. Communication becomes more convenient and more efficient through the management of COMMGR.

1.2.1 Operating Mode of COMMGR

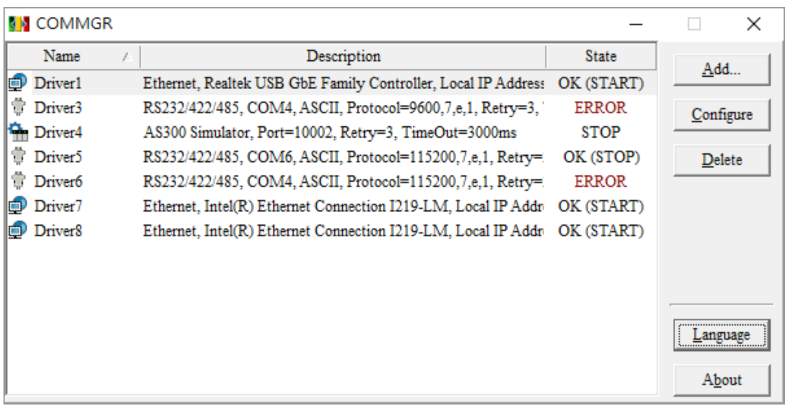
Users can create communication parameters which must be set on the management list in COMMGR in advance. The communication parameters which have been created in advance are called drivers. Users can start or stop a driver in COMMGR. If a driver is started, a connection will be created automatically. After the users specify a driver which is started in ISPSoft, a communication will be carried out.



In addition to ISPSoft, other software communicating with hardware through COMMGR can operate simultaneously. COMMGR automatically manages all communication commands, and makes software connect to hardware.



The **COMMGR** window and the management list in the **COMMGR** window are shown below. The drivers which are named by users are displayed in the **Name** column, parameters related to the drivers are displayed in the **Description** column, and the statuses of the drivers are displayed in the **Status** column.



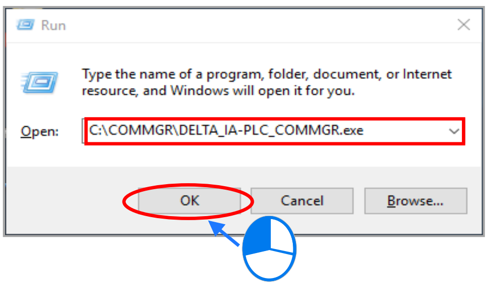
1.2.2 Installing COMMGR

COMMGR is a software independent of ISPSoft. It must be installed separately. When the previous version of COMMGR is detected in a computer, that version is advised to be uninstalled first before the latest COMMGR can be installed.

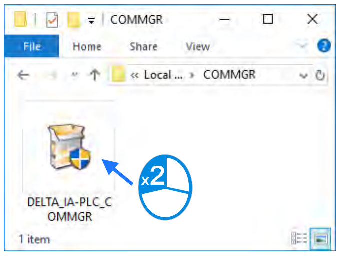
(1) Start a computer and enter the operating system. Users have to log on to the system as a system administrator before they install COMMGR.

(2) Put a COMMGR CD in the CD-ROM drive, or download the installation program from the official Delta website http://www.deltaww.com/. (The installation programs need to be decompressed if downloaded from the internet.)

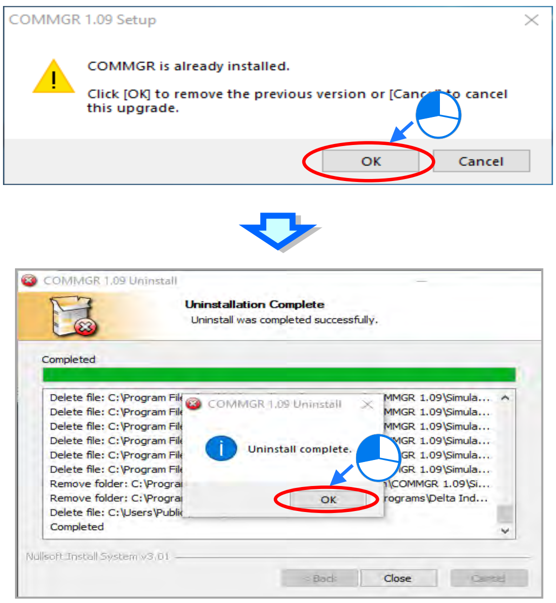
(3) Click **Start**, and then click **Run...** to open the **Run** window. Specify the path denoting the executable file which is used to install COMMGR in the **Open** box, and then click **OK**. Alternatively, users can double-click the icon which is used to install COMMGR to execute the installation program.



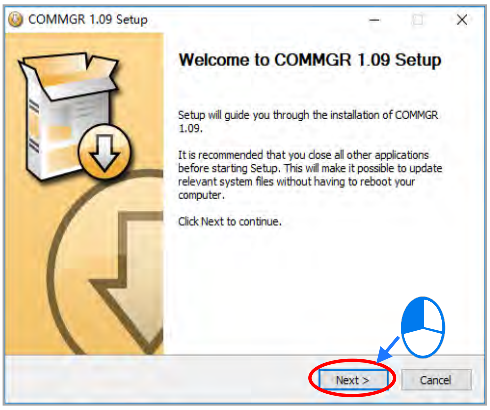
OR



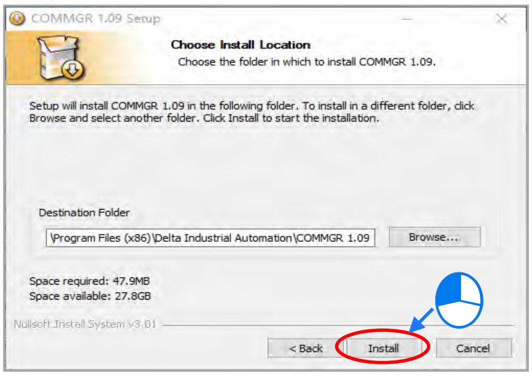
(4) When the previous version of COMMGR is installed, click **OK** to remove that version shown in the pop-up window (see below) and when uninstall is complete, click **OK** again.



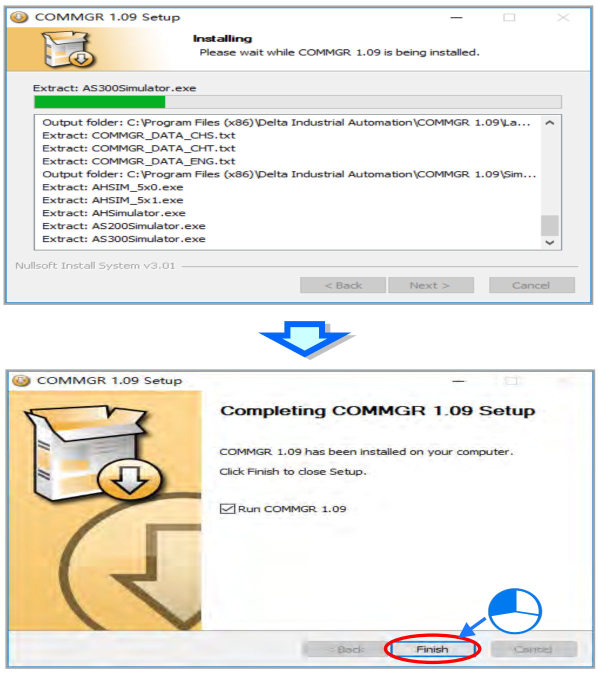
(5) Click **Next** after the Setup window appears.



(6) Use default setup in the destination folder. Click **Install** to start the installation.

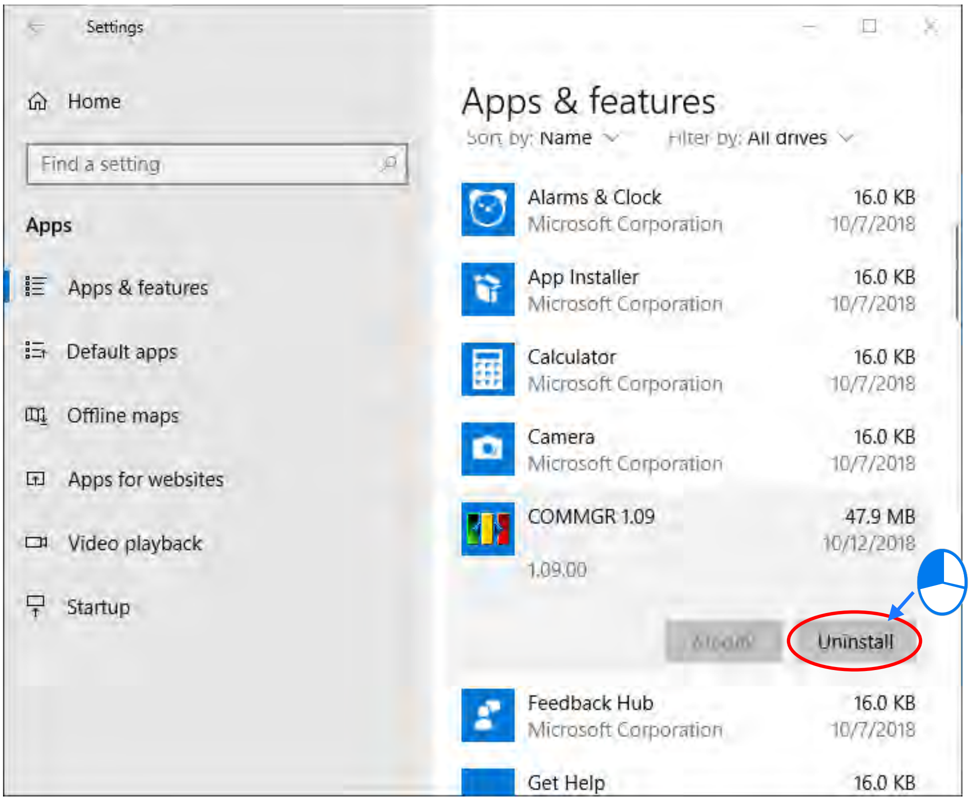


(7) When the installation is complete, the shortcut for COMMGR is created on the Start menu, click **Finish** to close the setup.

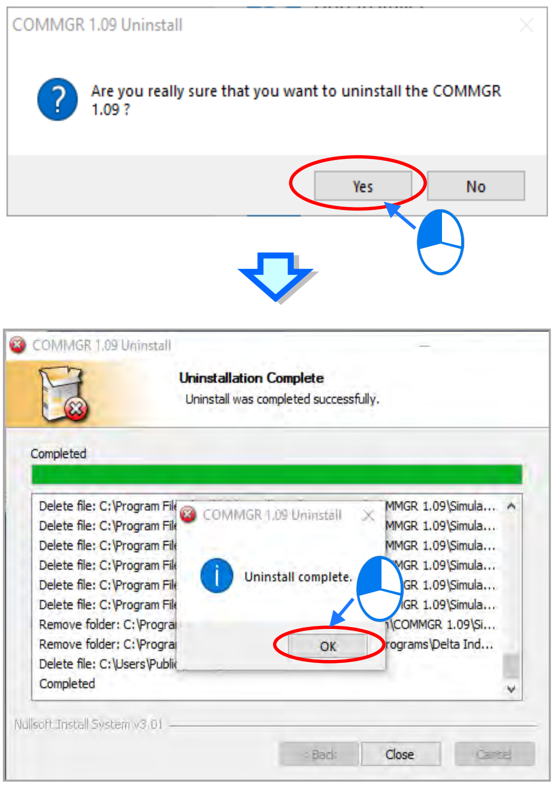


1.2.3 Uninstalling COMMGR

(1) Enter the settings of **Apps & features** in Windows, select **COMMGR x.xx** and click **Uninstall**.



(2) Click **Yes** then **OK** to complete COMMGR uninstallation.



1.3 ISPSoft for PLC Devices

The ISPSoft supports a variety of Delta PLC devices with many functions included. This chapter provides information regarding the ISPSoft that is applied in 8 PLC series: AS, AH5x0, AH5x1, AH560, AHxxEMC, DVP, DVPxxMC、AS5xx.

1.3.1 ISPSoft - List of Programming Languages

It supports six programming languages. They are ladder diagrams (LD), sequential function charts (SFC), function block diagrams (FBD),and structured texts (ST), continuous function chart (CFC) and C language (C). Users can use more than one programming language in one project.

	AS	AH5x0	AH5x1	AH560	AHxxEMC	DVP	AS5xx DVPxxMC
Ladder Diagram (LD)	V	V	V	V	V	V	V
Function Block Diagram (FBD)		V	V	V			
Structured Text (ST)	V	V	V	V	V	Only Supports ES3	V
Sequential Function Charts (SFC)	V	V	V	V	V	V	
Continuous Function Chart (CFC)	V				V	Only Supports ES3	
C Language (C)	V						

1

1.3.2 ISPSoft - List of Functions

The following table shows major functions of ISPSoft.

	AS	AH5x0	AH5x1	AH560	AHxxEMC	DVP	AS5xx DVPxxMC
Motion Module		V	V	V	V		
HWCONFIG	V	V	V	V	V	Supports ES3 ONLY	V
HWCONFIG Printing Function	V	V	V	V	V		
Ordered List	V	V	V	V	V		
Custom Library	V	V	V	V	V	V	
Delta Library	V	V	V	V	V	V	V
User-defined	V	V	V	V	V	V	V
Axis					V		V
PLC Modification	V	V	V	V	V	V	V
Device Comment List	V	V	V	V	V	V	
Status Bar	V	V	V	V	V	V	
Edit Register	V	V	V	V	V	V	
Status Editing	V	V	V	V	V	V	
File Registers	V					Supports SA/SX/SC/EH/EH2/SV/EH2-L/ES2/ES2-E/EX2/SX2/SA2/EH3/SV2/EH3-L/ES3	
Position-Step	V	V	V	V	V	V	
Alignment	V	V	V	V	V	V	
Online Editing	V	V	V	V	V	Supports EH3/EH3-L/SV2/ES2/ES2-E/EX2/SA2/SX2/MC/ SS2	
Troubleshooting	V	V	V	V	V	V	
System Log	V	V	V	V	V	Supports ES3 Only	V

	AS	AH5x0	AH5x1	AH560	AHxxEMC	DVP	AS5xx DVPxxMC
3D Coordinate					V		
Identifier	V	V	V	V	V	V	V
Password (case-sensitive)	V	V	V	V	V	V	V
POU Password	V	V	V	V	V	V	V
Subroutine Password						Do Not Support ES3	
NWCONFIG		V				Do Not Support ES3	
Data Backup Memory Card (Supplementary)						Supports EH3/EH2 Only	
PLC Permanent Backup Setting						Supports EH2/EH2-L/EH3/EH3-L/SV/SV2 Only	
CARD Utility	V	V	V	V	V	V	V
G-Code Editor							V
E-CAM Editor	V				V		V
Position Planning Table	V					Supports ES3 Only	
Oscilloscope	V		V		V	Supports ES3 Only	
Data Logger	V		V			Supports ES3 Only	
High-speed Counter Setting Wizard	V					Supports ES3 Only	
AIO Wizard Setting						Do Not Support ES3	
Temperature Control						Do Not Support ES3	
Weighing Module						Do Not Support ES3	
Extension Module Wizard						Do Not Support ES3	
Extension Module-Monitoring Wizard						Do Not Support ES3	

	AS	AH5x0	AH5x1	AH560	AHxxEMC	DVP	AS5xx DVPxxMC
NTC Wizard						Supports SX/ SE/ SS2/ SX2、 SA2/ SV2 Only	Supports DVPxxMC Only
Motion Parameter Simulation							V

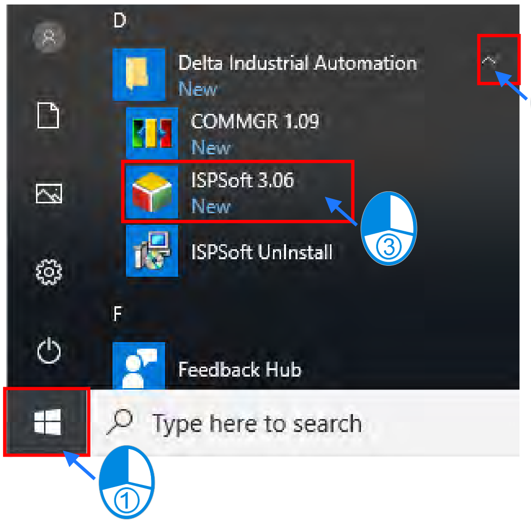
Chapter 2 Starting and Setting ISPSoft

Table of Contents

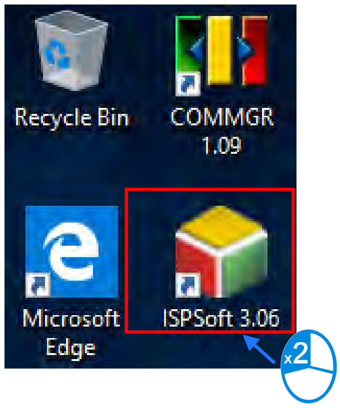
2.1 Guidelines and Environment

2.1.1 Getting Started

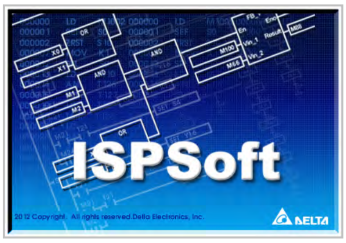
After installing ISPSoft, shortcuts is created on your desktop and **Start** menu for quick access of the software. In addition, users can install ISPSoft by taking the following steps below.

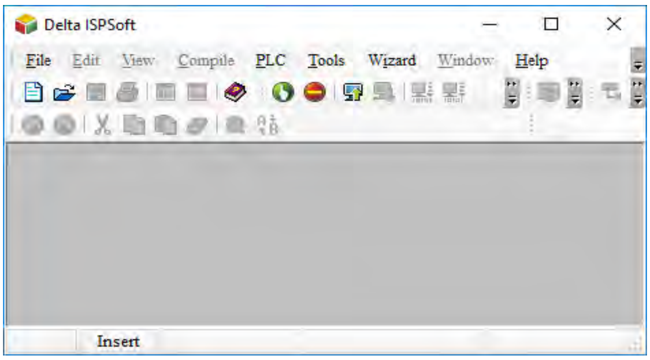


OR

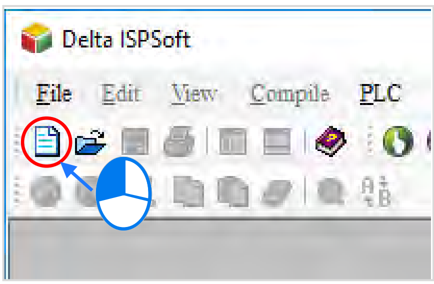


After the welcome screen image, the Delta ISPSoft window appears with basic functions provided.

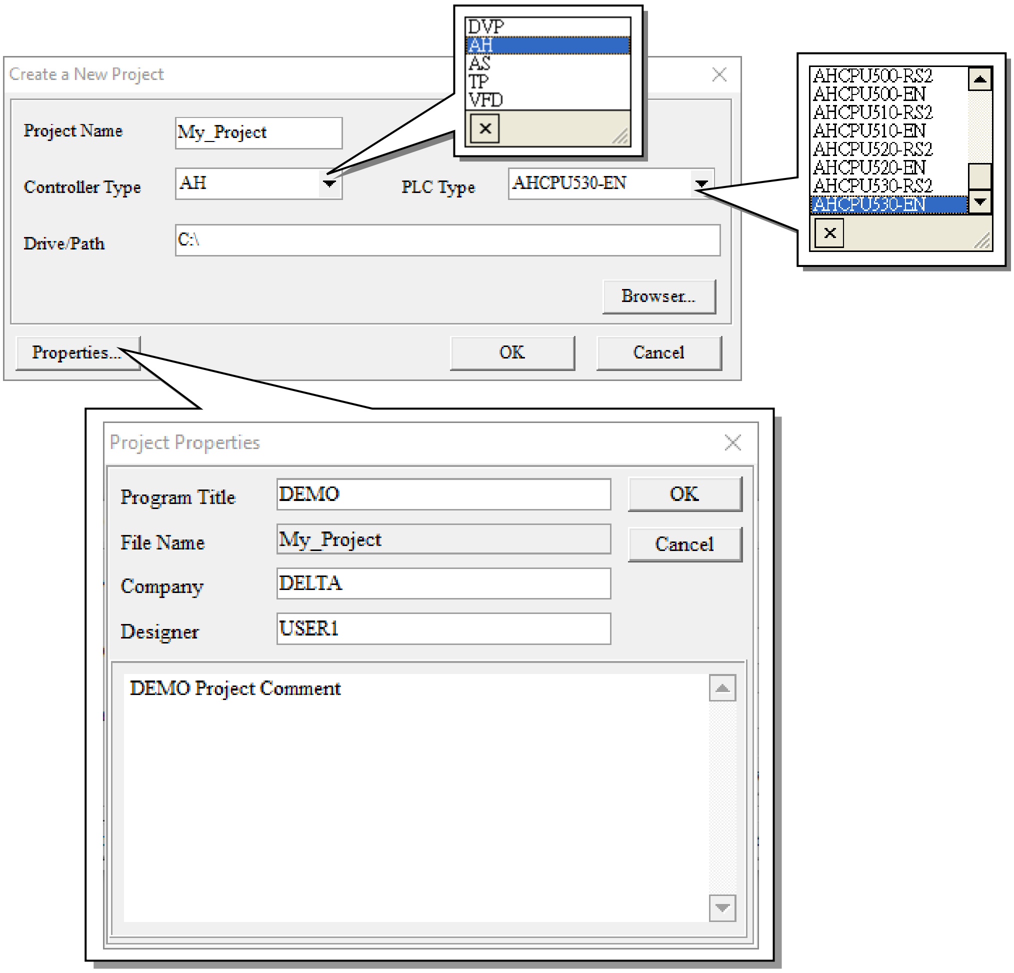




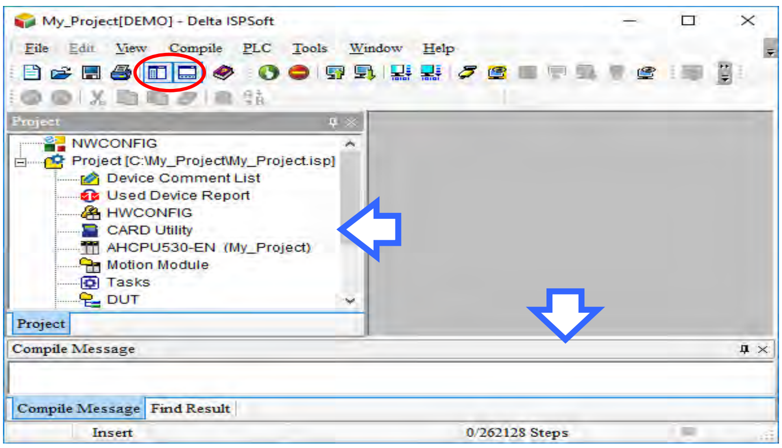
Click  on the toolbar to create a new project.



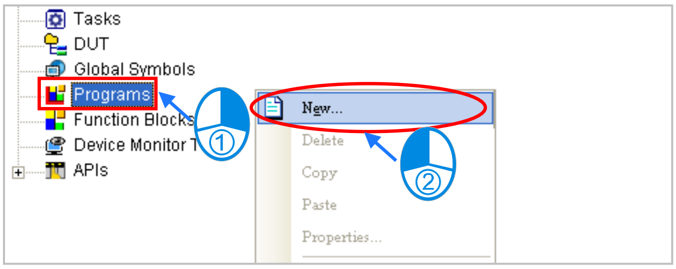
In the **Create a New Project** window, type a project name in the **Project Name** box and a path in the **Drive/Path** box. Also, select a **Controller Type** and **PLC Type** from the drop-down lists. After users click **Properties…**, they can give a description of this project and click **OK**.



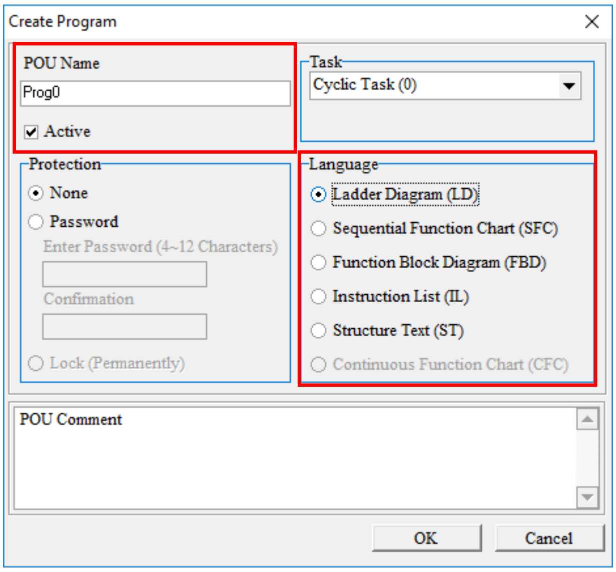
After the project is created successfully, a Project section appears on the left side of the dialog box with items listed in a hierarchical tree structure. If the section did not appear, users can click **View** on the toolbar, then choose **Workspace** or click  from the icon bar. To view Compile Message section, select **View** > **Output Window (M)** or click .



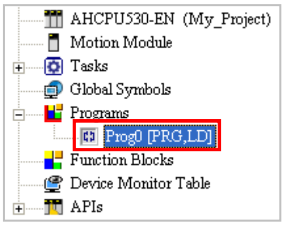
When a project is created, the main working area is blank with no editing. To start PLC programming, users can right-click **Programs** in the Project section and click **New…**.

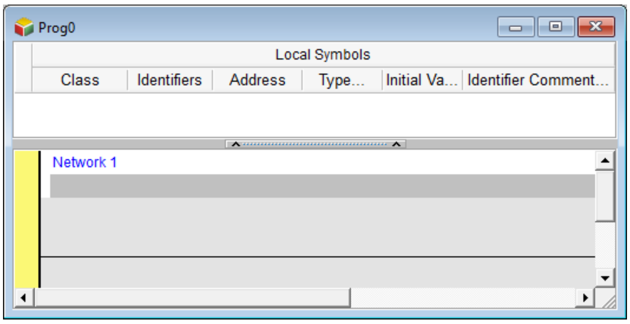


In the **Create Program** window, users can type a program name in the **POU Name,** and select a programming language in the **Language** section. Other parameters in the window use defaults and the description is provided in section 5.4.

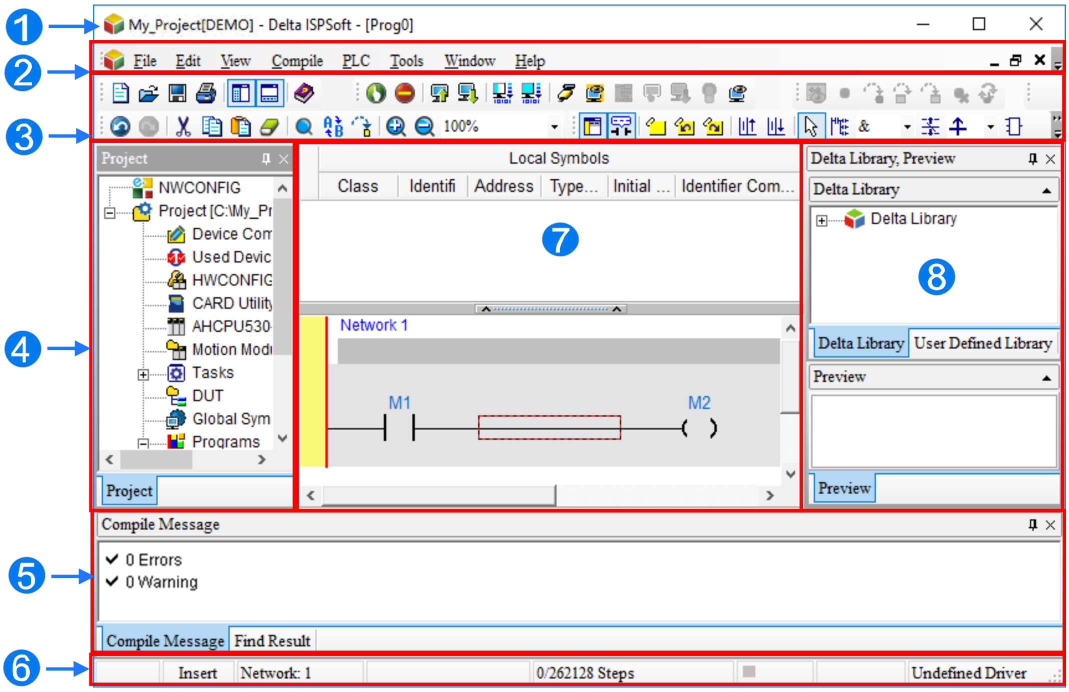


When a program is added under **Programs,** an editing area is formed in the new program window.





The ISPSoft main screen is shown below.



❶ Window title: It displays a project name and a program title.

❷ Menu bar: There are eight menus.

❸ Toolbar: There are five toolbars.

❹ Project: Uses hierarchical tree structure to manage the section.

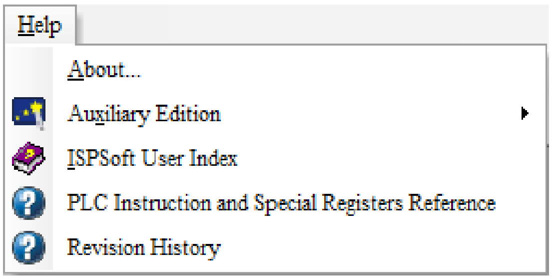
❺ Compile Message: Shows compiling result and project search.

❻ Status bar: Displays current edit or network status.

❼ Work Edit: Includes program edit section, local symbols, monitoring chart a device table, and etc. are displayed in this area.

❽ Delta Library: Lists out contents regarding Delta library and user-defined library.

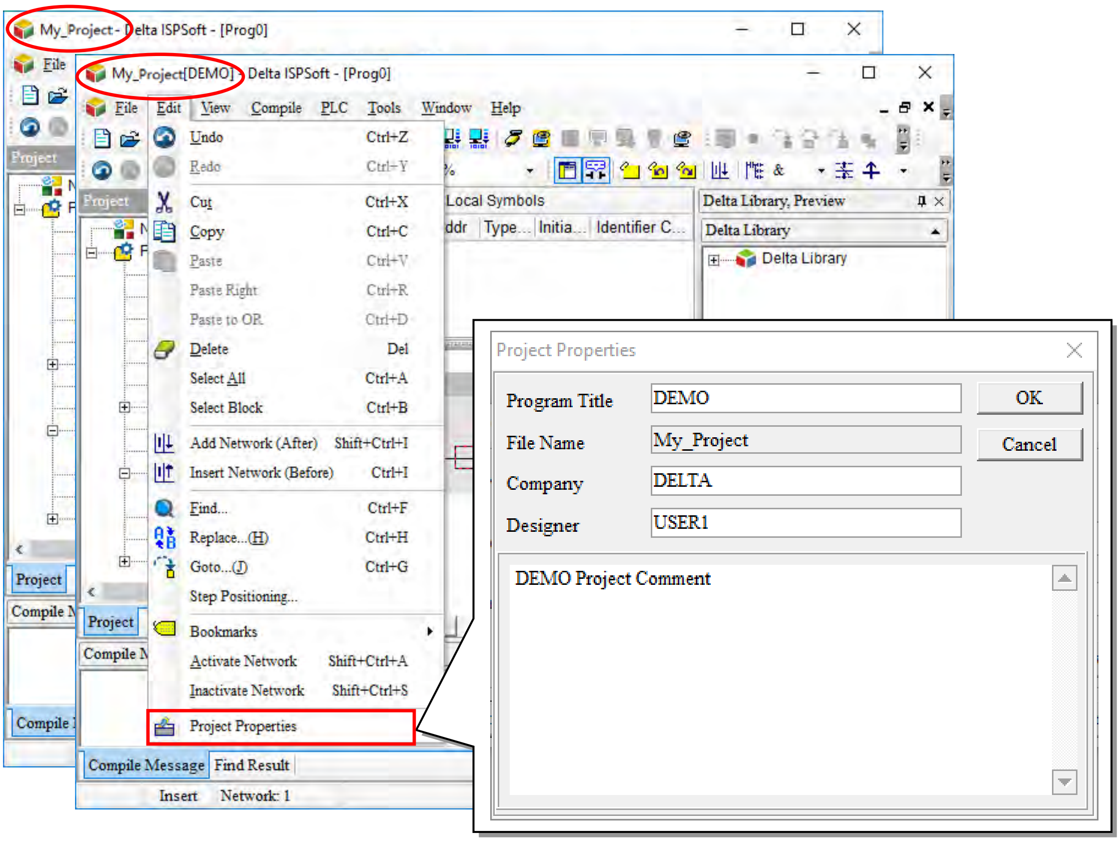
When using ISPSoft, users can click **Help** from the toolbar to get help.



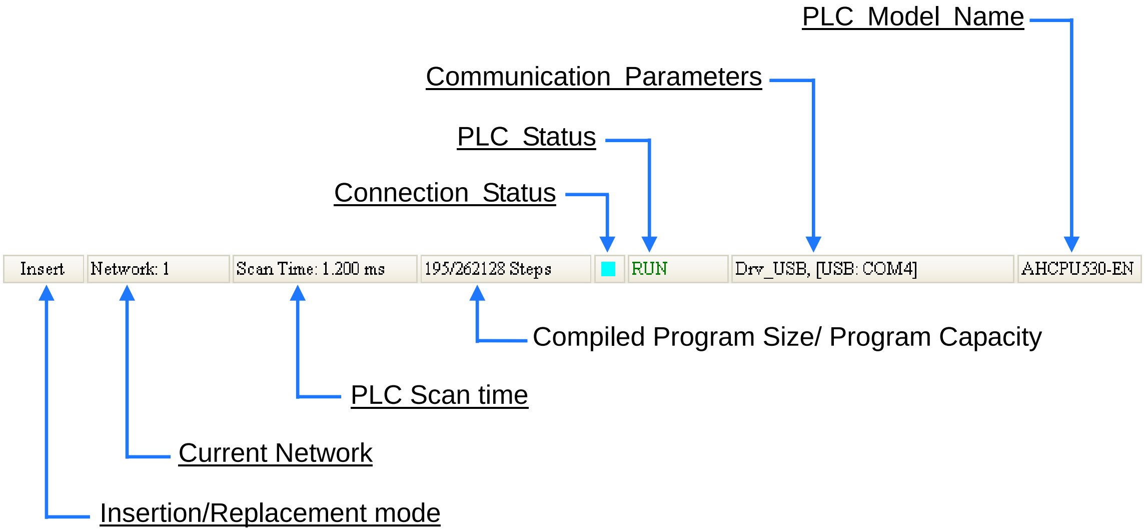
Item	Description
About…	Information about software version and date of release.
Auxiliary Edition	Auxiliary edit tools, e.g. communication format < = > parameter code.
ISPSoft User Index	Contains software usage information. (Alternatively, users can click  on the toolbar to view the information.)
PLC Instruction and Special Registers Reference	Information on instructions and registers. Users can click any instruction in the program edit section and press **F1** on the keyboard for explanations.
Revision History	Lists out the software version updates or modifications.

2.1.2 Window Title and Status Bar

After a project is created, the window title displays in the format of **project name [program title]**. If there is no program title, the project name is shown as the window title. Users can also click **Edit (E)** and select **Project Properties** to view the program title.



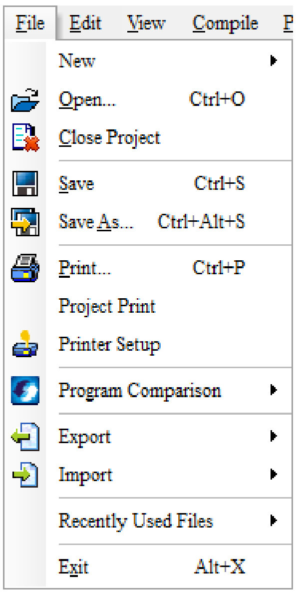
The status bar at the bottom of a window displays all kinds of working status. For example, edit mode (switch between insertion/replacement with the INSERT key on the keyboard), current network, PLC scan time, compiled program size or program capacity, connection status, PLC status, communication parameters, and PLC model name.

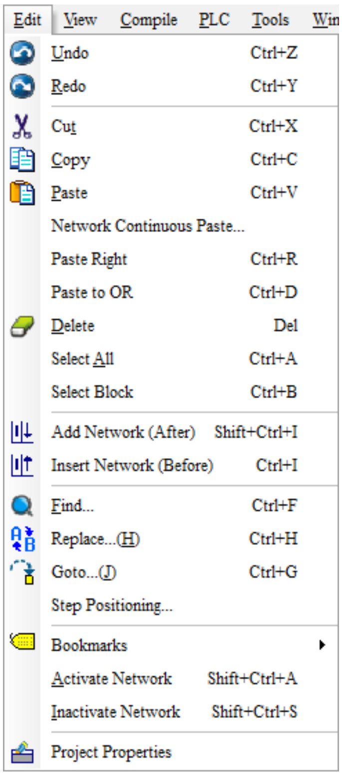


2.1.3 Toolbar - Functions

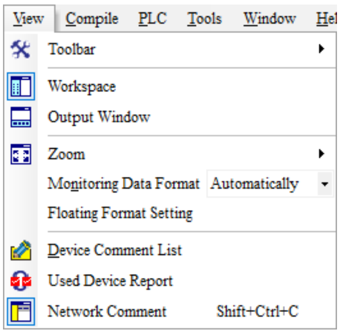
The ISPSoft toolbar contains eight functions. The contents of the functions may vary based on the editing and model selected. This chapter presents a brief introduction of the toolbar. For more explanation, please view the following chapters concerning the functions.

- **File:** To save a project as its main function.

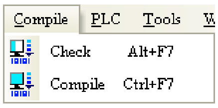




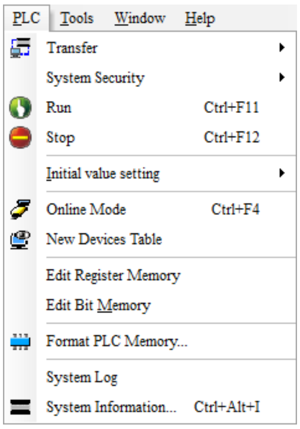
- **View:** Offers information regarding the project and workspace.



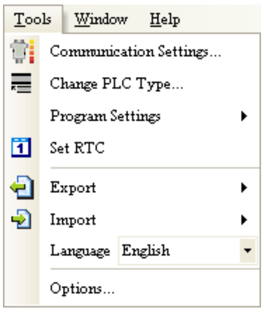
- **Compile**: Check programming syntax or compile programs into executable code.



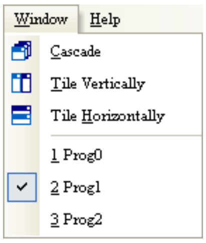
- **PLC**: Sets up a PLC connection and functions through ISPSoft.



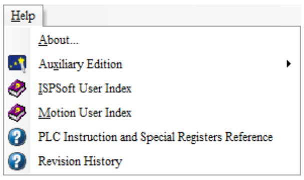
- **Tools**: Provides convenient functions to execute ISPSoft.



- **Window**: Manages the windows regarding the Edit section in workspace.

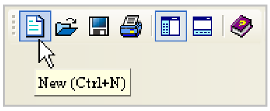


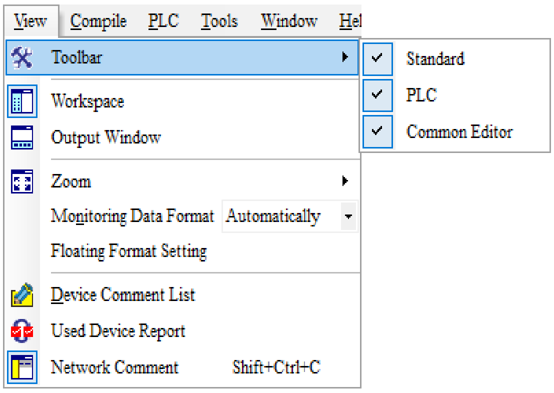
- **Help**: Provides auxiliary functions for ISPSoft.



2.1.4 Toolbar- Icons

There are five icon categories on the toolbar. The icons may also vary based on the editing and model selected. When a mouse cursor points at an icon for a short while, its function and keyboard shortcuts is shown; users can select their icons to show or hide under **Toolbar** by clicking **View**.





● **File toolbar**: Provides functions related to managing a project.

● **Editing toolbar**: Provides functions related to editing work.

● **Quick PLC toolbar**: Provides functions related to PLC operation.

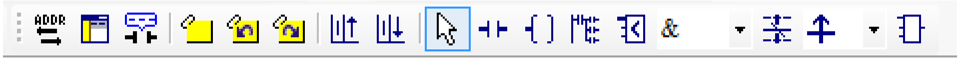
● **Troubleshooting toolbar**: Provides functions related to troubleshooting. The icons in the toolbar may vary based on the model selected.

***. Models DVPxxMC /AS5xx currently does not support this function.**

AH/AS series: 

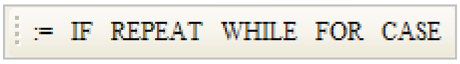
DVP series: 

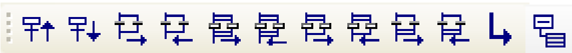
● **Programming toolbar**: Provides functions related to programming. Icons may vary based on the programming language used.

LD: 

FBD: 

IL: 

ST: 

SFC: 

CFC: 

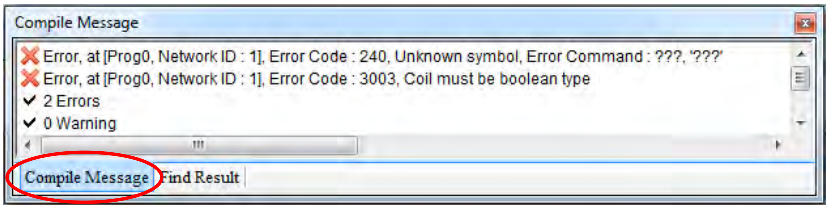
2.1.5 Project and Compile Message

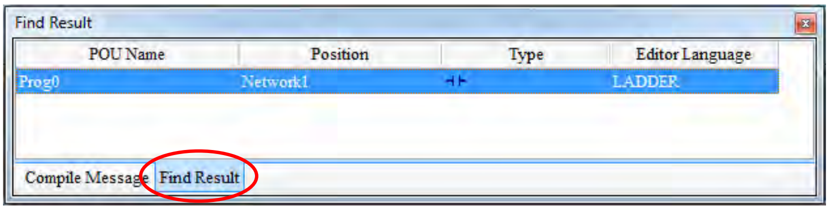
The Project section contains contents related to project development and uses hierarchical tree structure to manage its interface. The section includes tools for configuration, device information and instruction application, user-defined variables, program items and monitoring tables. In addition, the lists in the section may vary based on the model selected.

On the left of the ISPSoft screen is the default Project section and click ☒ on the upper right corner to close the section. Users can click the Workspace icon or select **Workspace** under **View** from the toolbar to open or close the Project window. When users right-click an item in the Project section, a corresponding quick menu offers items for selection.

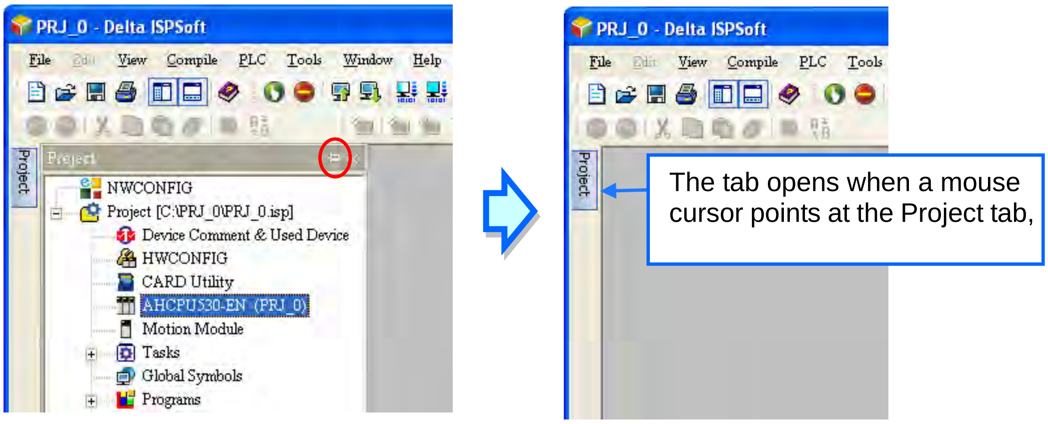
In **Compile Message** section, users can click the tabs referring to the **Compile Message** and the **Find Result**. The **Compile Message** page shows the results of compiled programs or messages when checking on the syntax. While the **Find Result** page lists out the results on the searched projects.

The default Compile Message section designed at the bottom of the ISPSoft main page, users can click the Output Window icon on the toolbar or select **Output Window** (M) under **View** from the toolbar to open or close the section. Click ☒ on the upper right corner of the window can also close the window.

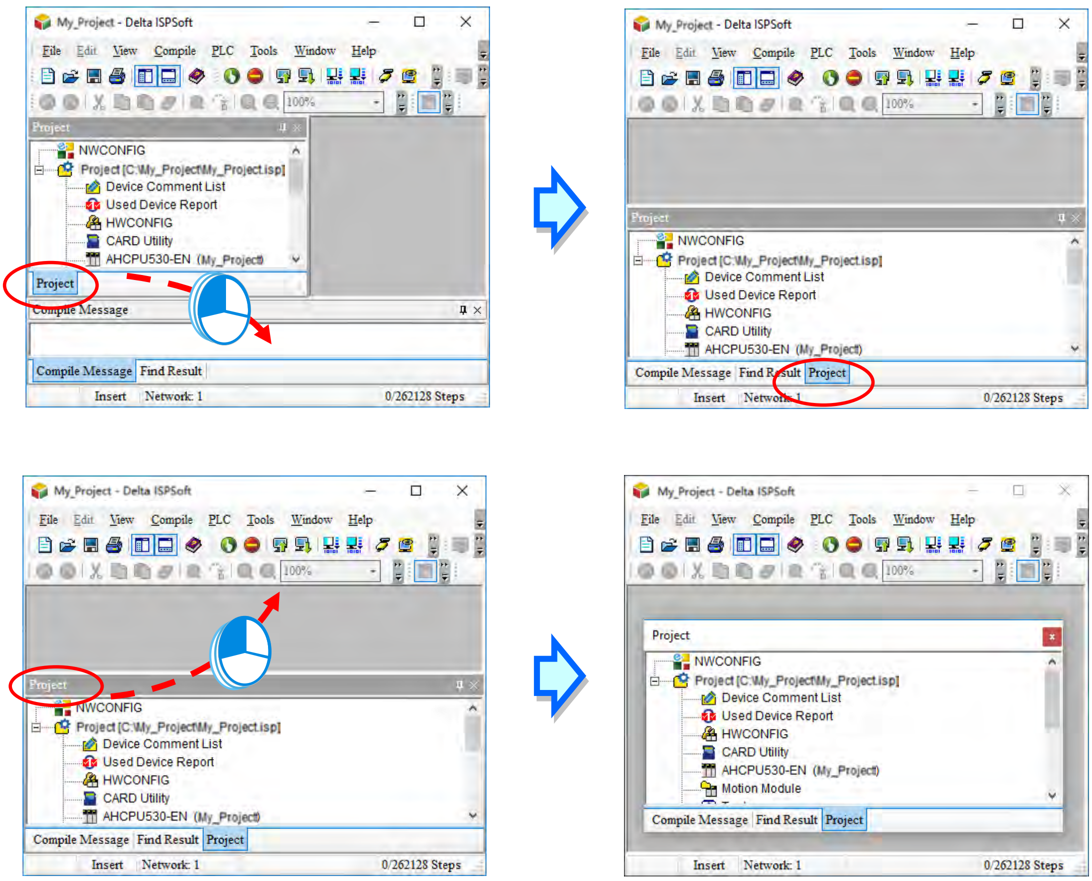




Users can click on the upper right corner of the window to change the display of the Project or Compile Message section. When the icon changes to , the section is hidden. When the mouse cursor moves away from the section for a while, the window of the section automatically turns into a tab on the page, but when the mouse cursor moves to the tab, the tab is opened.



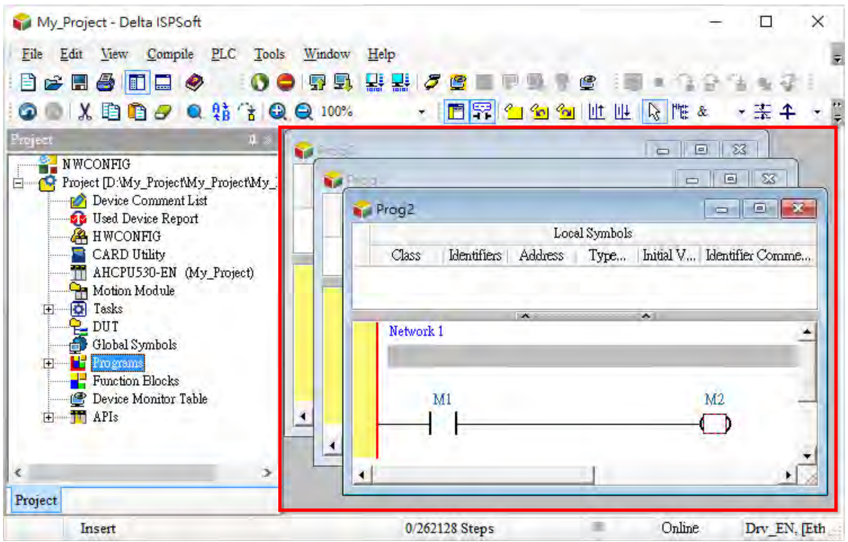
When the section is not hidden, users can drag the tab with a left click mouse button to any position or combine the tab to a different section. If users want to drag the whole section, they have to drag the title bar.



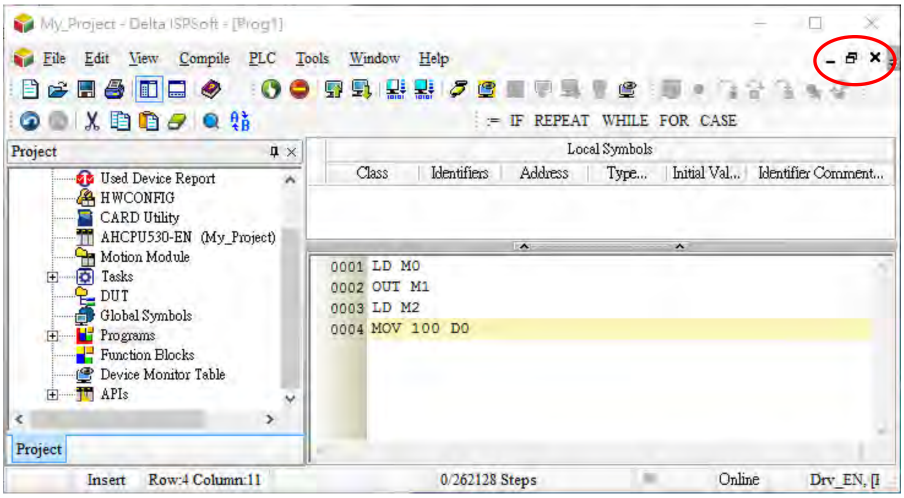
2.1.6 Workspace

Users can view maximized or minimized windows in this section. To maximize a window, the status buttons for the window appears on the right side of the toolbar.

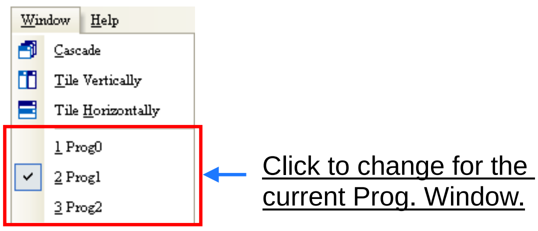
● **Display windows**



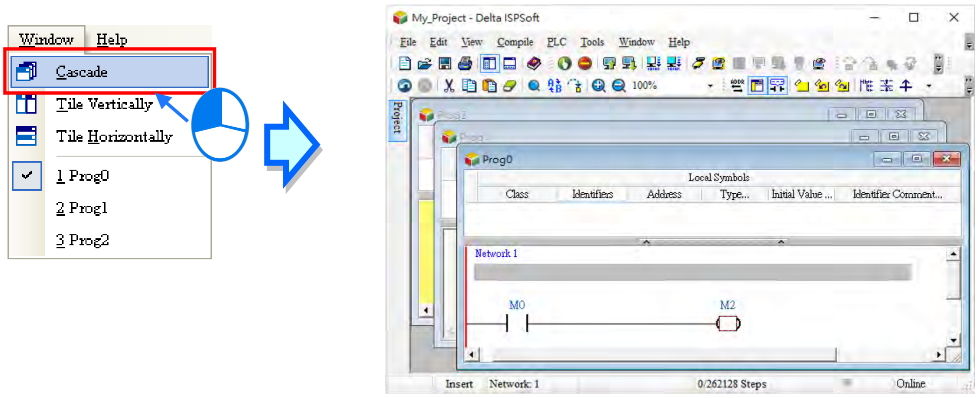
● **Maximize the window**



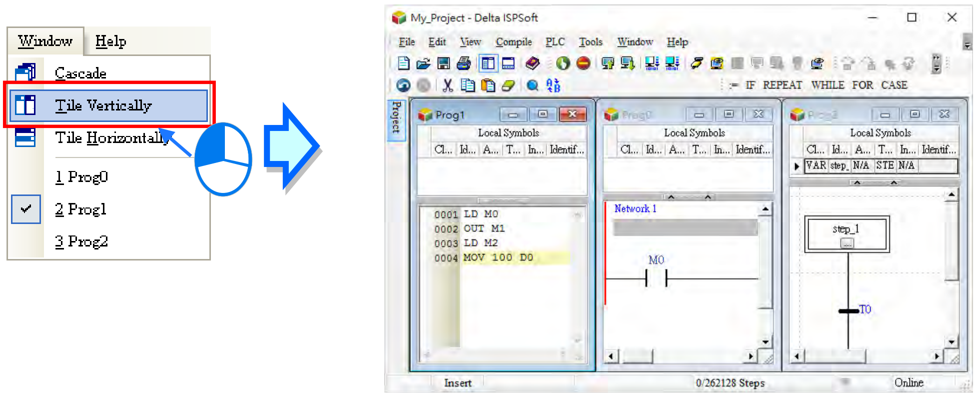
Select **Window** on the menu to change the Prog. windows.



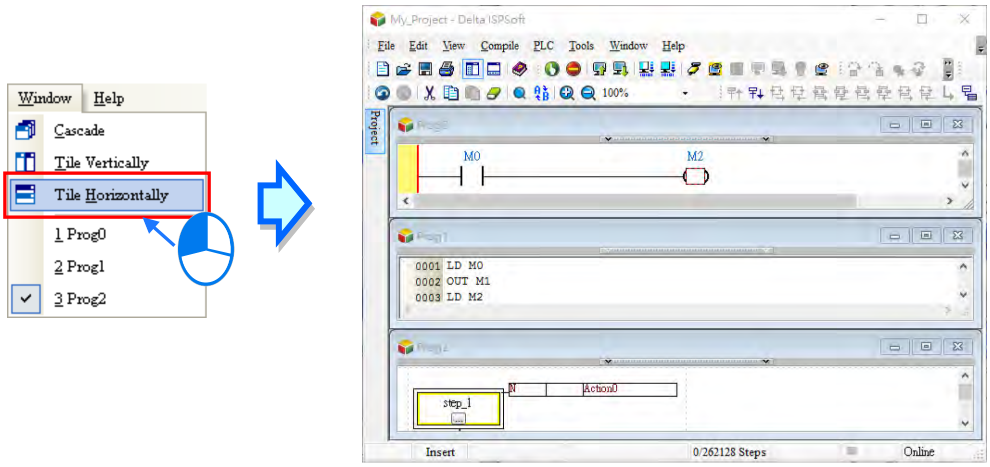
- **Cascade**: When selected, all windows will stack on top of each other, and the current window is the first one displayed.



- **Tile Vertically:** The windows are displayed like tiles in vertical alignment; the current window is at the leftmost side.



- **Tile Horizontally:** The windows are displayed like tiles in horizontal alignment; the current window is at the topmost.



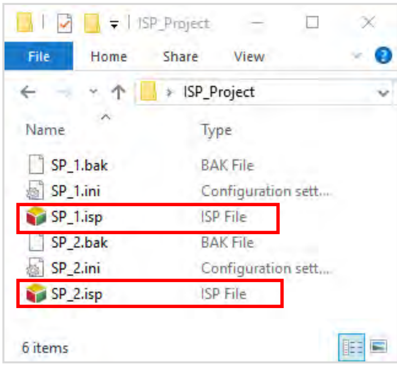
2.2 Project Framework

2.2.1 Single Project and Group Project

Two types of project frameworks are described below.

● **Single project**

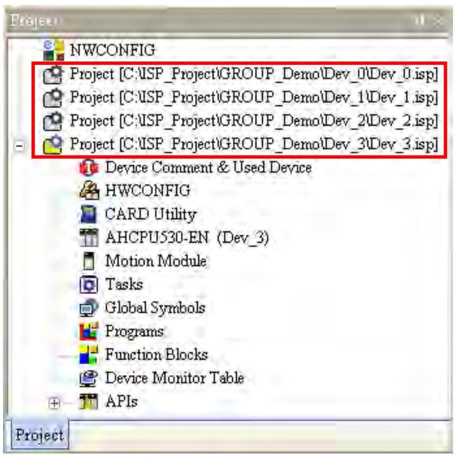
This is the basic project type. Each project can only execute one model. The file type of a single project is *.isp.

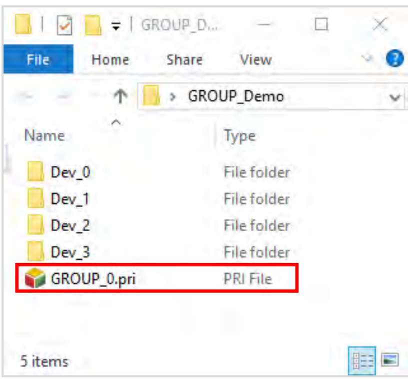


● **Group project**

If several devices are connected on a network, users can create a group of single projects for the devices without restriction. The number of projects which can be created is unlimited. Users can make projects according to practical application, and they can carry out network configuration for the devices in a group of projects through **NWCONFIG** rapidly and easily.

The filename extension for a group of projects is *.pri, and the filename extension for every project in the group is *..isp. The isp files are in the folders whose names are the same as the project names. Users can import a single project which was created previously to a group.



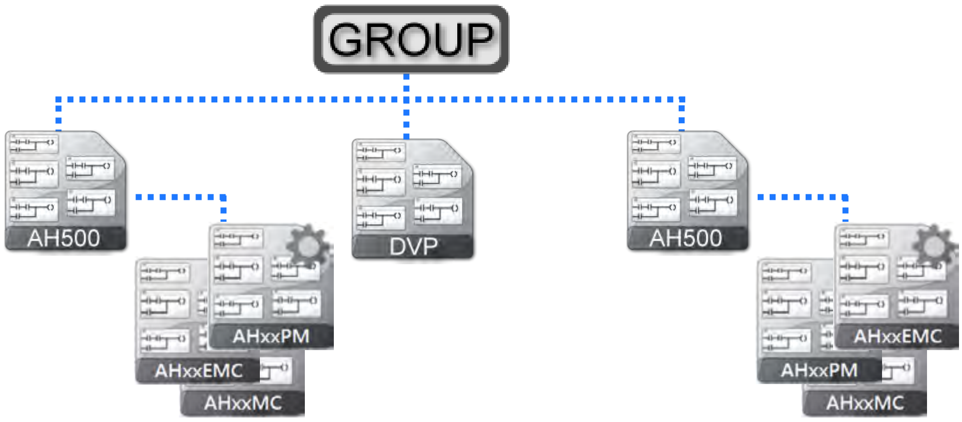


***. Please refer to chapter 20 for more information about NWCONFIG.**

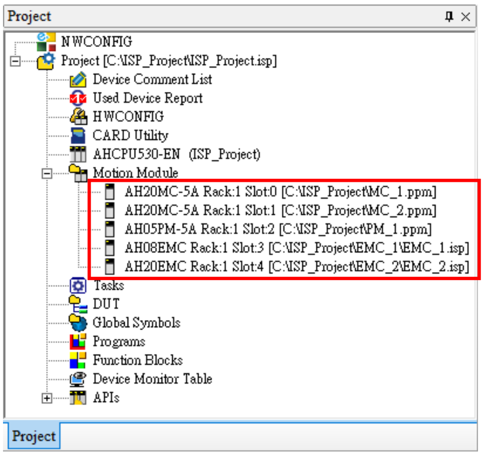
2.2.2 Integration of Motion Control Modules

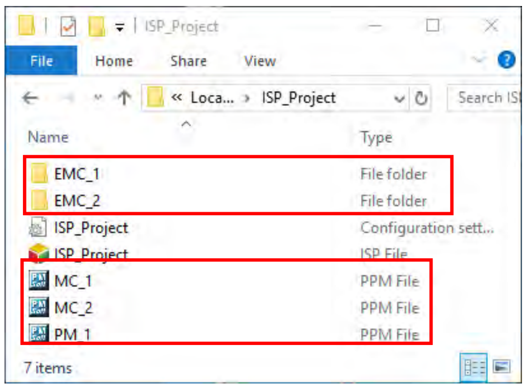
The AH series include motion control modules such as AH05PM-5A, AH10PM-5A, AH15PM-5A, AH20MC-5A, AH08EMC, AH10EMC, AH20EMC. Users can write a program regarding AHxxPM and AHxxMC motion control modules by means of PMSoft, a software developed by Delta Electronics, Inc. Please refer to PMSoft User Manual for more information about usage. The AHxxEMC can be used as host or motion control module in ISPSoft.

Users can create projects concerning motion control modules in ISPSoft and configure hardware as well as parameter settings through **HWCONFIG**. Each AH series can create more than one motion control module project whether the project framework is single or in a group, the corresponding motion control modules also need to be added for hardware configuration in HWCONFIG. Please refer to section 2.2.5 for more information.



The PMSoft projects include AHxxPM and AHxxMC modules, with filename as .ppm. While ISPSoft project contains AHxxEMC modules, the file name is .isp and is placed in the same path as of single projects for AH series. Regarding previously created PMSoft or ISPSoft projects, users can import those to an ISPSoft project.



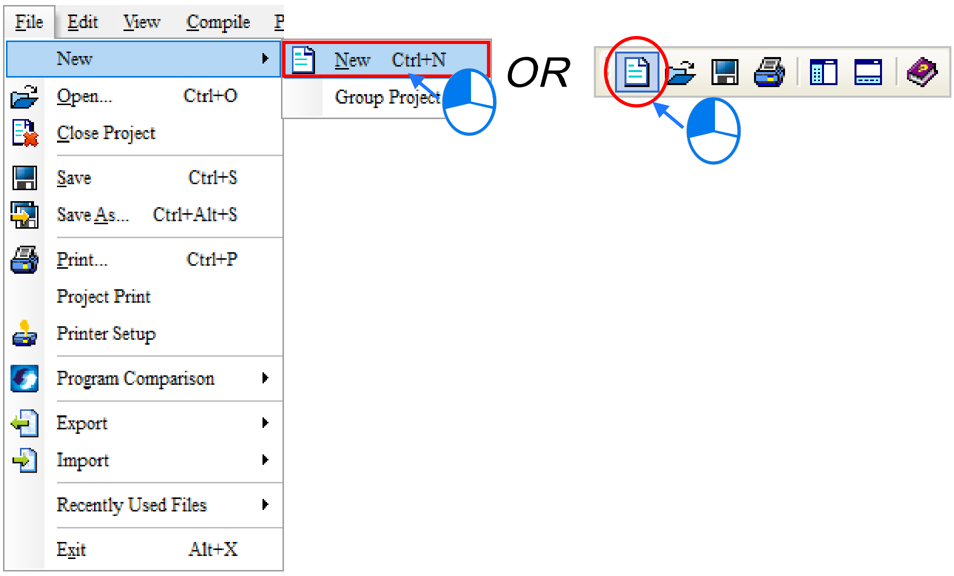


***1. An imported PM project must use file format that is avilable for PMSoft v2.05 or above, and do not support DVP-PM series projects.**

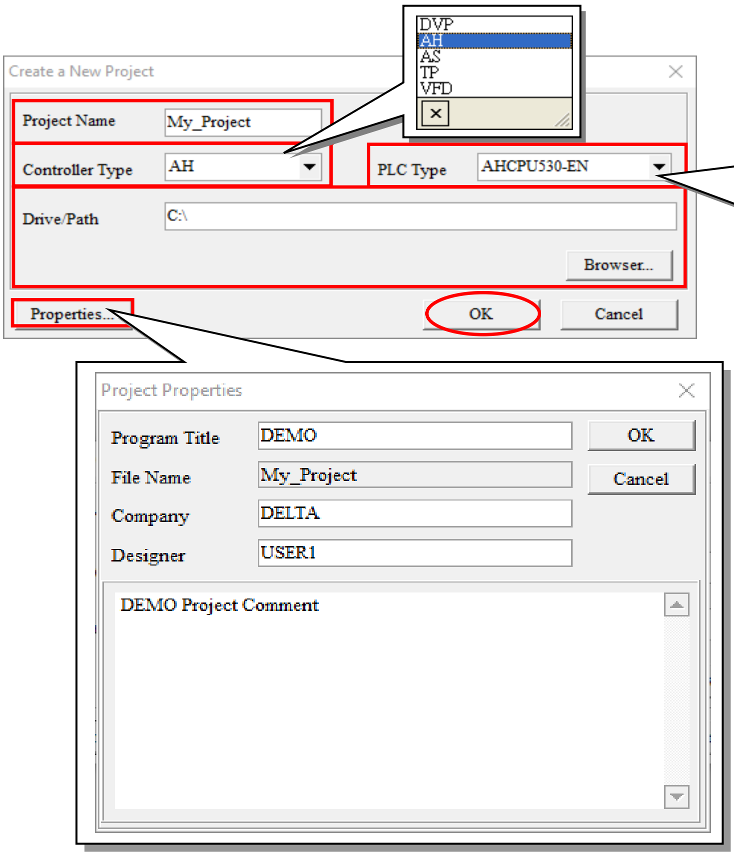
2.2.3 Managing a Single Project

- **Creating a single project**

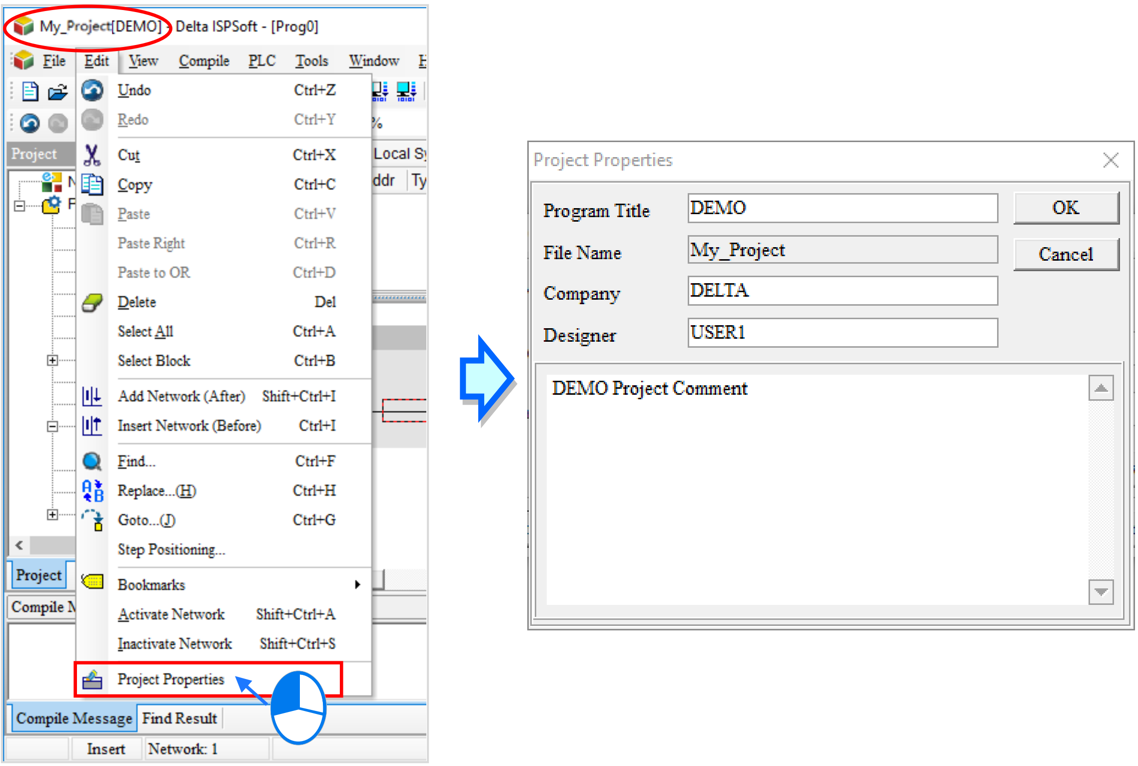
User can click the **File** menu, point to **New**, and click **New** to create a new project. They can also create a new project by clicking on the toolbar.



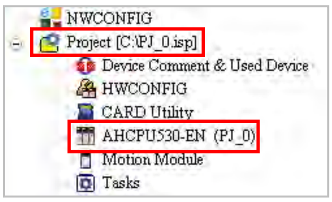
In the **Create a New Project** window, type a project name in the **Project Name** box and a path in the **Drive/Path** box, and select a **Controller Type** and **PLC Type** from the drop-down lists. After users click **Properties…**, users can add description of this project. Finally, click **OK**.



After a project is successfully created, the ISPSoft window title displays the project name, under the format of **project name [Program Title]**. When no program title is setup, the window will display only the **project name.** When users want to view or modify the program title, users can click **Edit** from the toolbar and select **Project Properties** to type in the information.



Under Project, users can view the path of the project file and selected model. For AH/AS series projects, the PLC label name is shown in parentheses next to the selected model, and the project name is set as default. However, the project name can be reset in **HWCONFIG**. Users can refer to section 3.3.2.1 for more information.

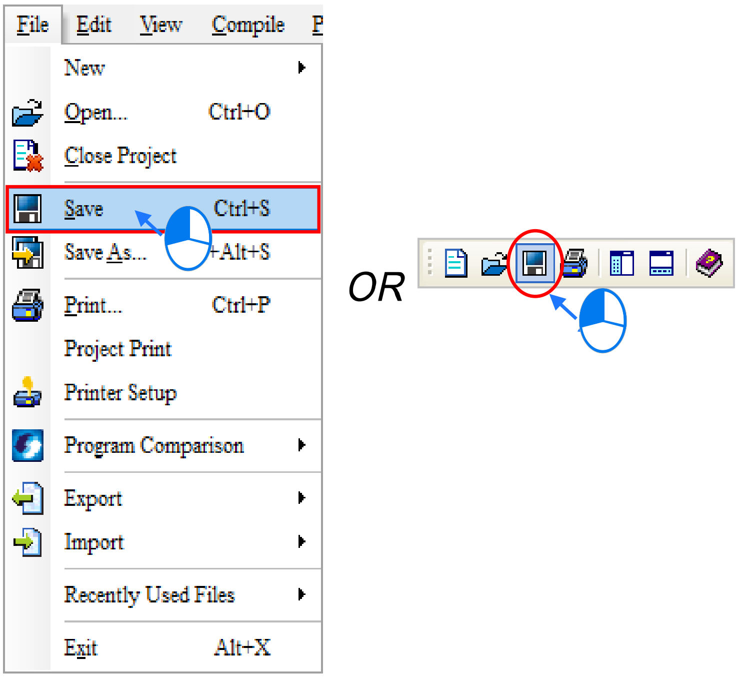


***. Only AH/AS and DVPxxMC/AS5xx series have PLC label names, but DVP series do not. The main function of the label name is to perform device identification, especially for network applications or other online operations. The gathered information can be used to check whether the object is operating as we expected.**

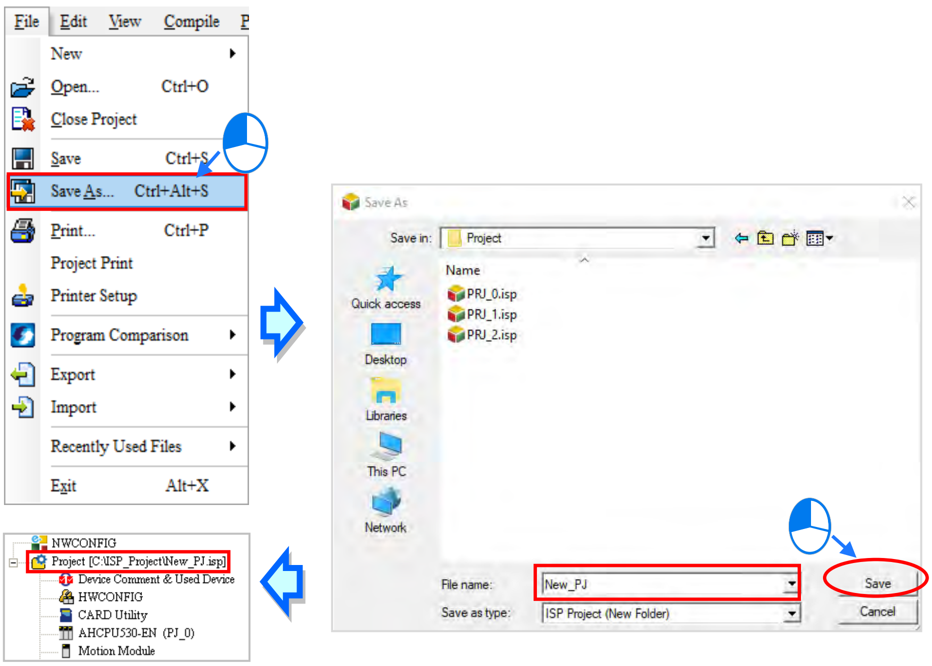
- **Save project**

When a project is created, the file denoted by a path is not established immediately. Users need to click ‘Save’ first for the file to exist. To ‘Save’ a project, please refer to the following description.

Select **File** from the toolbar and click **Save**. Or click  on the icon bar.



Make sure you’ve archived and disabled editing software such as HWCONFIG, EthernetIP, EtherCAT before save the file with a different file name or save the file denoted by a path in another location on your computer by selecting **Save As** from the **File** menu. After setting a new path and a new file name, click **Save**.



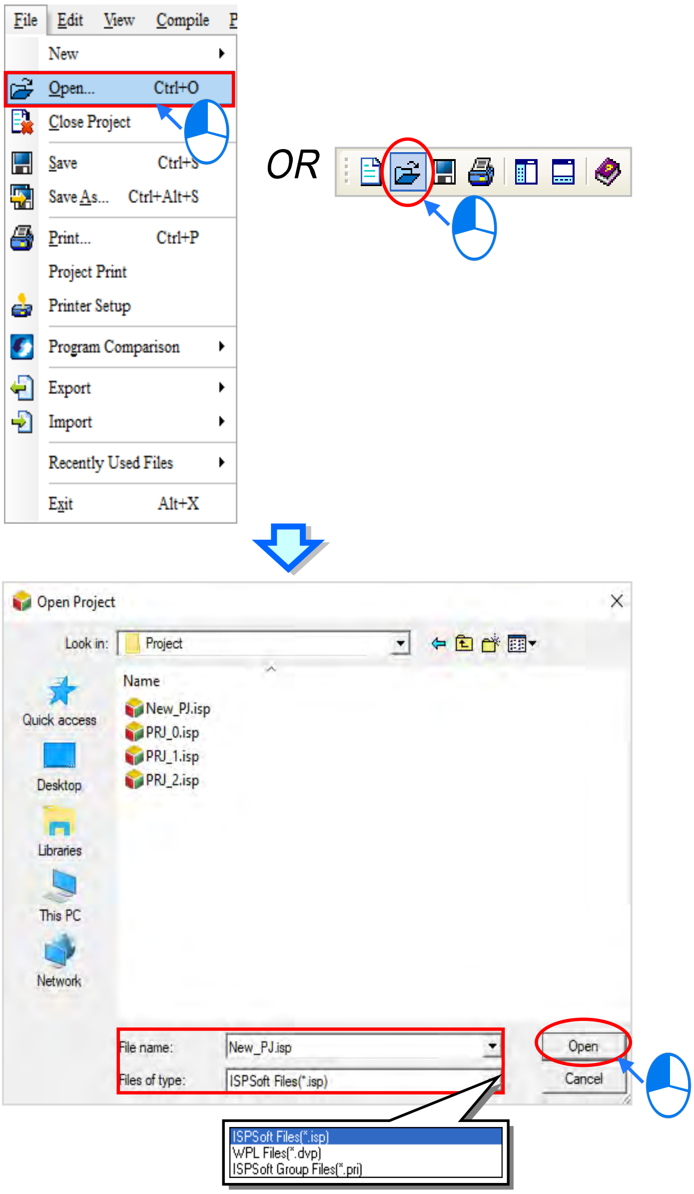
***. To ‘Save As’ a file will not change the PLC label name, the name adopts the created project name by default but can be modified in HWCONFIG.**

● **Open previous project**

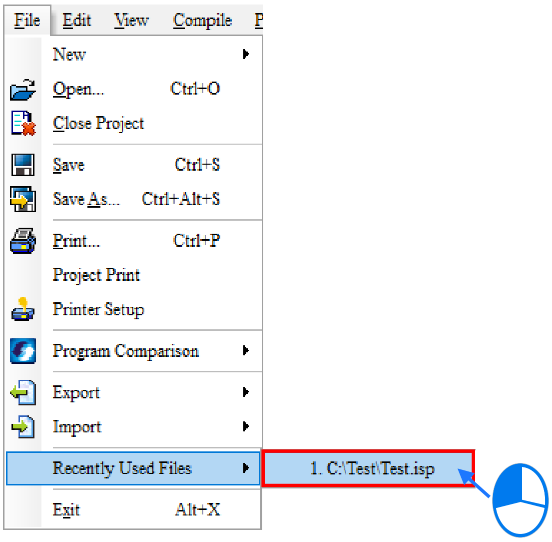
If users want to open a previous project, they can click **Open** on the **Fil**e menu, or click on the toolbar. Users can select from the **Files of type** for the previous file and click **Open**. The following table shows the file types that can be opened.

File type	Description
ISPSoft Files (*.isp)	This is a single project file. If old file format is opened, the ISPSoft will automatically change the file into the new format.
WPL Files (*.dvp)	This file is created be WPLSoft. When the file is opened and saved, it is automatically changed into an ISPSoft file (*.isp).
ISPSoft Group Files (*.pri)	It is a group of files in ISPSoft.

***. WPLSoft is a PLC programming software produced by Delta Electronics, Inc.. Please refer to WPLSoft User Manual for more information.**

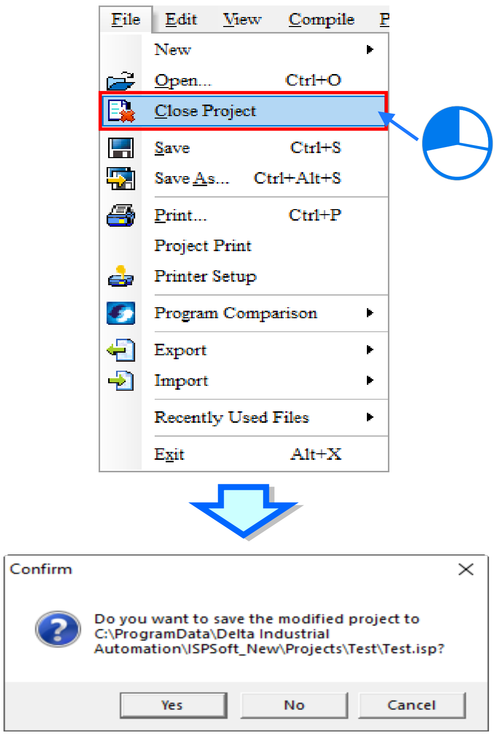


Users can select **File** from the menu to open Recently Used Files.



● **Close project**

Click **Close Project** from the **File** menu once the editing is complete. When the modified project is not saved, a pop-up window appears to confirm whether the project needs saving or not.



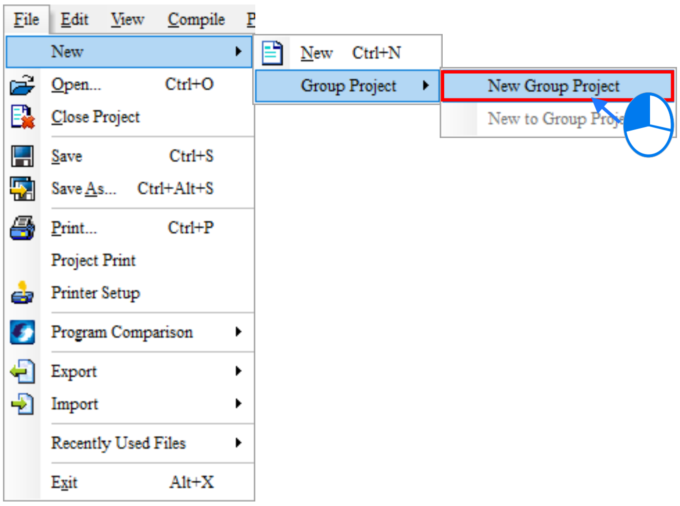
Additional remark

If users do not close the project before leaving ISPSoft and restart the software again next time, the system will automatically open the file edited from last time by default. (Users can set the function to enable or disable for opening previous projects. For more details, please refer to section 2.3.1.)

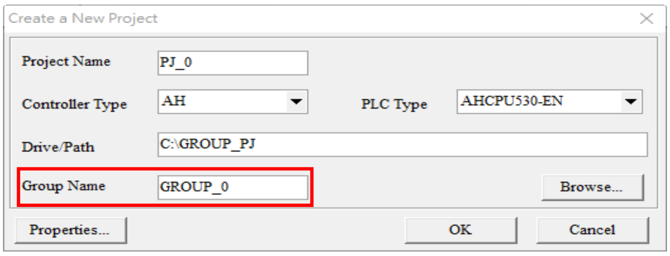
2.2.4 Managing Group Project

● **Creating group project**

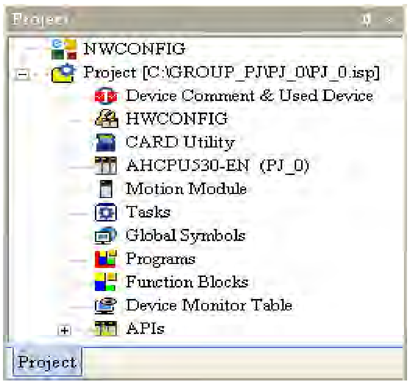
Click the **File** menu, choose **New** then move to **Group Project** and click on **New Group Project**.



When creating group project, users also need to create a single project from the group. In the **Create a New Project** window, type the **Project Name** and **Drive/Path**, select the **PLC Type** and **Controller Type** from the drop-down lists. Users can add information and description related to the project by clicking **Properties**; Nevertheless, type **Group Name** in the box then click **OK**.

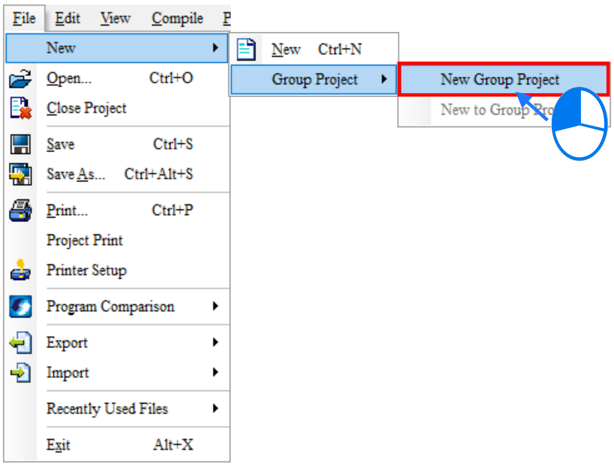


After a group project is created, information related to the first single project will be displayed in the Project section. Owing to the fact that there is only one single project in the group, so it is displayed and operated in the same way as creating a single project. The only difference is under the group project framework, users cannot execute the **Save As** function.

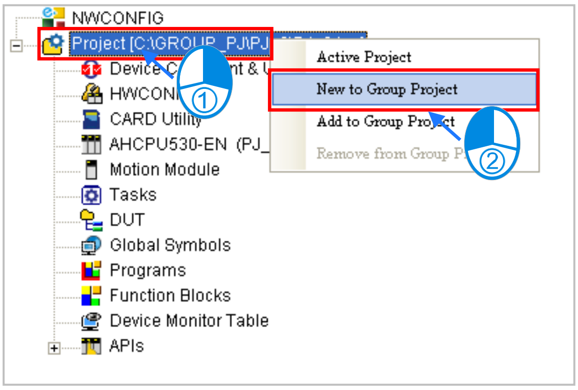


● **New to group project**

Click **File from the** menu, choose **New** move to **Group Project** and click **New to Group Project** to add new single project to the group. Or, you can also right-click a **Project** in the section and select **New to Group Project**.

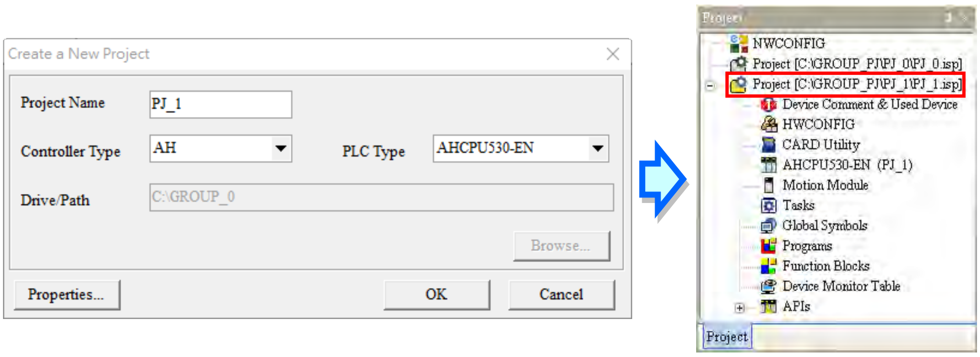


OR



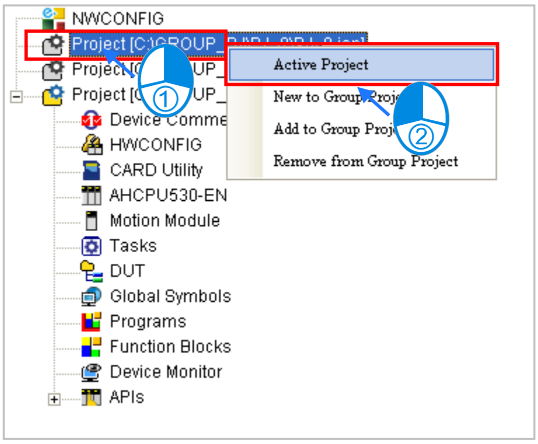
In Group Project, only one project is edited at a time. Therefore, when a new project is added to the group, the editing project needs to be closed. A window will appear to confirm if this editing project needs saving or not.

In the **Create a New Project** window, users can type a project name in the **Project Name** box, and select a PLC in the **PLC Type** drop-down list box. Besides, after users click **Properties…**, they can give a description of the project. However, users can not specify a path.

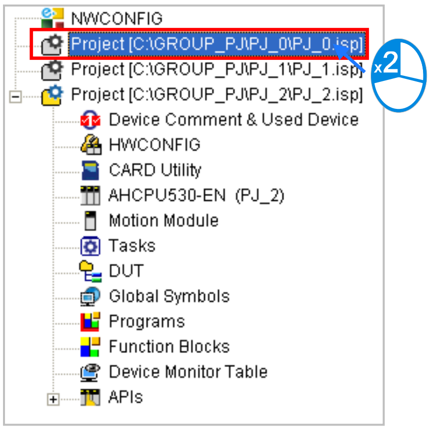


- **Active project**

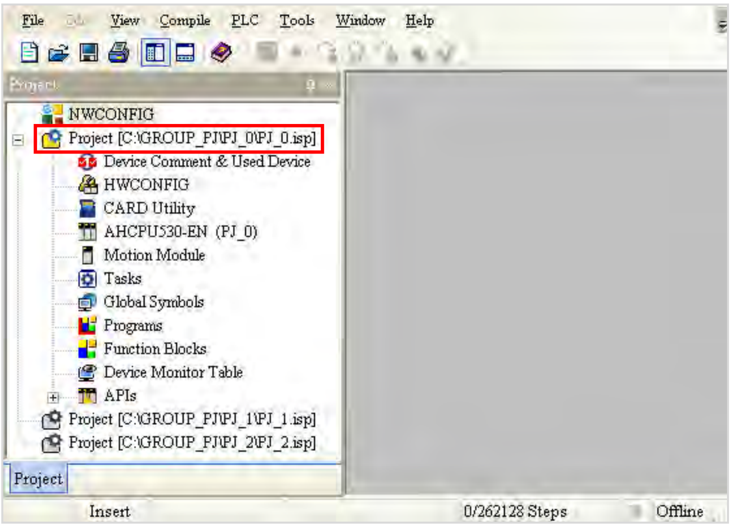
In Group Project, only one project is edited at a time. To edit another project, right-click on the selected project and choose **Active Project.** Or, double click to activate on the selected project.



OR

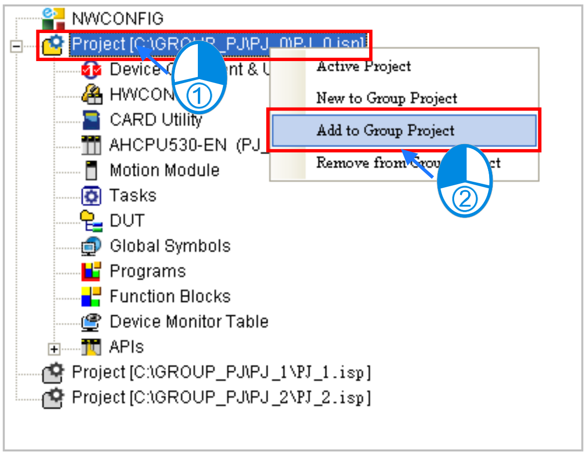


When switching to another project, the selected file can be edited in the Project section, while other files not activated are in gray colors.

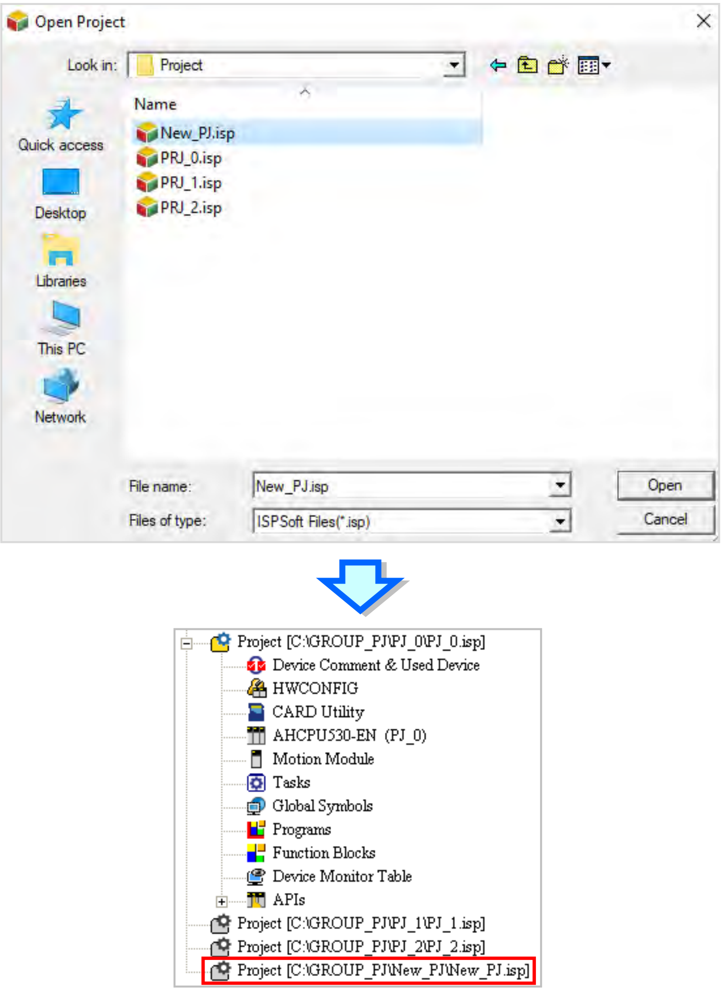


● **Importing single project to a group**

When a single project (*.isp) file is not created under a group, users can import it into the group. To import a single project, you can right-click a project in the Project section, then select **Add to Group Project** from the quick menu to select the import file.

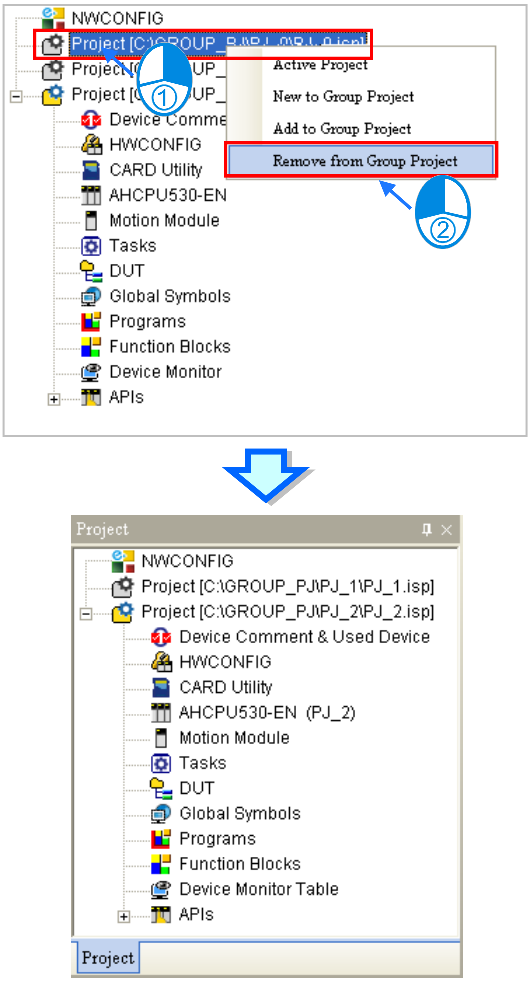


Only single project *.isp files are allowed to be imported. When importing a single project, the project will be copied to the group project file, and the single project is still saved in the original path of your computer.

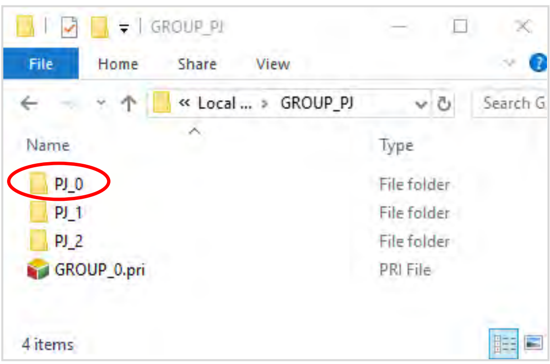


- **Remove from group project**

When removing a single project from a group, they can right-click the selected file in the Project section and click **Remove from Group Project** from the quick menu. However, if there is only one project in the group, that project cannot be removed.

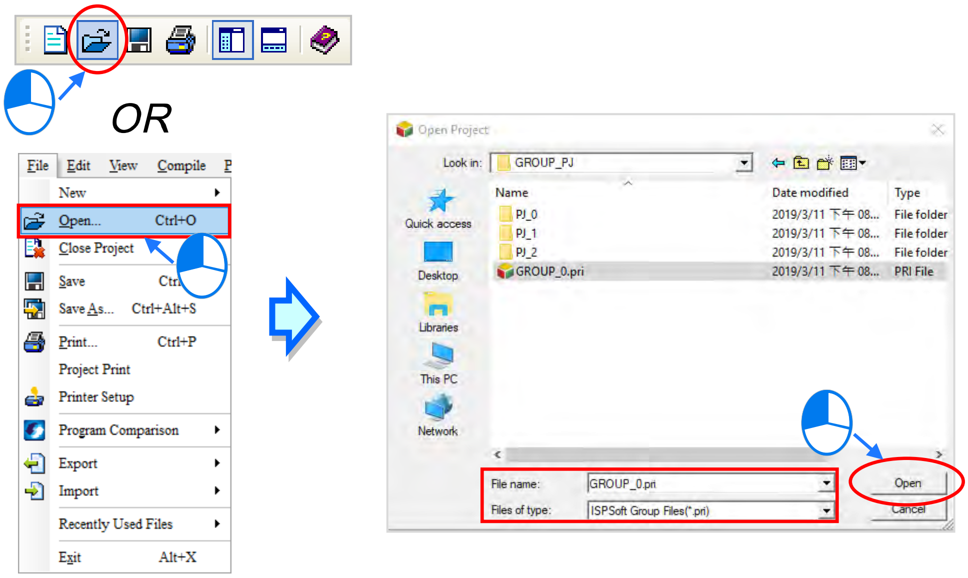


When removing, the file is removed only from the list of projects in the group project file, and not from its former path. Users can re-add the project into the group through importing the file.

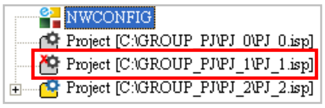


● **Open a group project**

To open previously created group projects, click **Open** from the **File** menu, or [toolbar icon] in the toolbar, then choose **Files of type** to select **ISPSoft Group Files (*.pri)** in the drop-down list box and click **Open**.

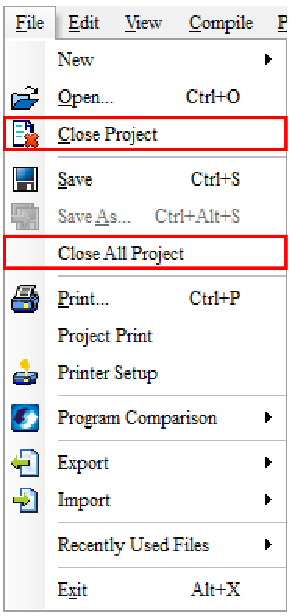


When the group file to be opened has a red cross icon on it, this means the single project saved in the path used to denote group project appears abnormal and may be either removed, saved in a new path or using a new file name.



● **Close project**

Click **Close Project** from the **File** menu to close editing projects, but other inactivated single projects can still be activated. Users can click **Close All Project** to close the entire project.

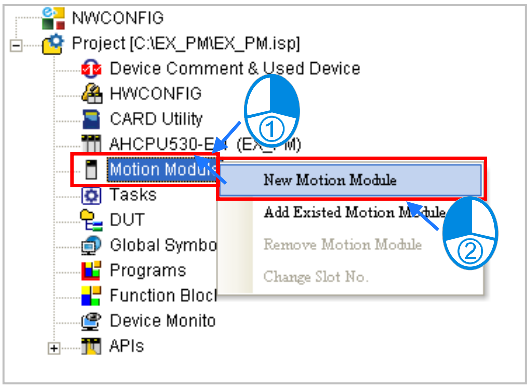


2.2.5 Managing Motion Control Modules

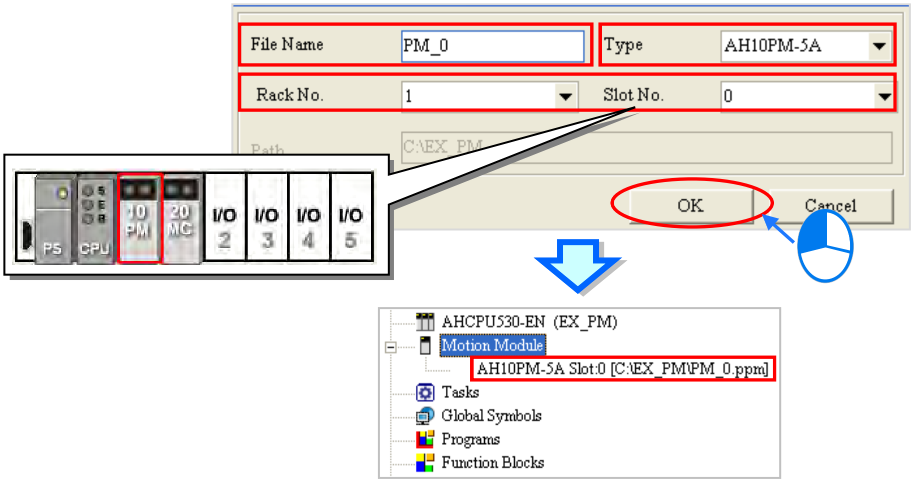
In the Project section of ISPSoft, the **Motion Module** option is added for AH series. To add AHxxPM and AHxxMC motion modules, users must install PMSoft version 2.05 or above.

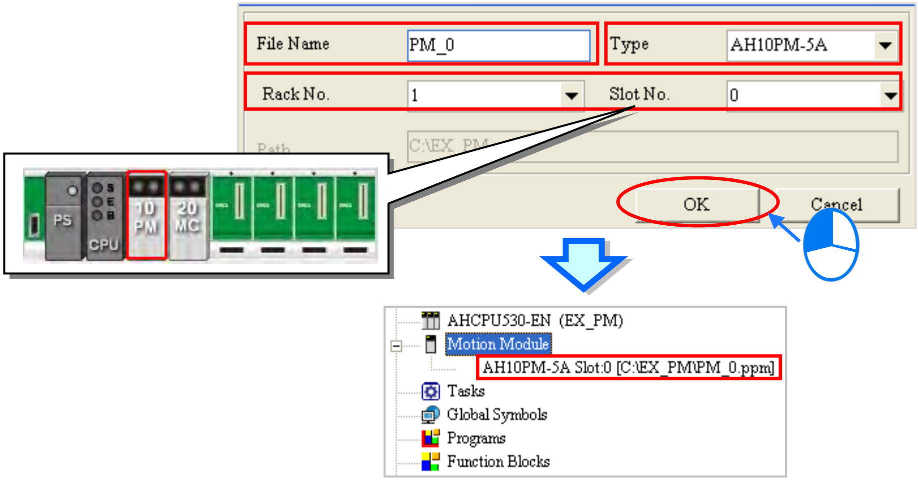
● **New Motion Module - AHxxPM and AHxxMC**

If users want to create a PMSoft project in ISPSoft, click **Motion Module** in the **Project section and** choose **New Motion Module** from the quick menu.



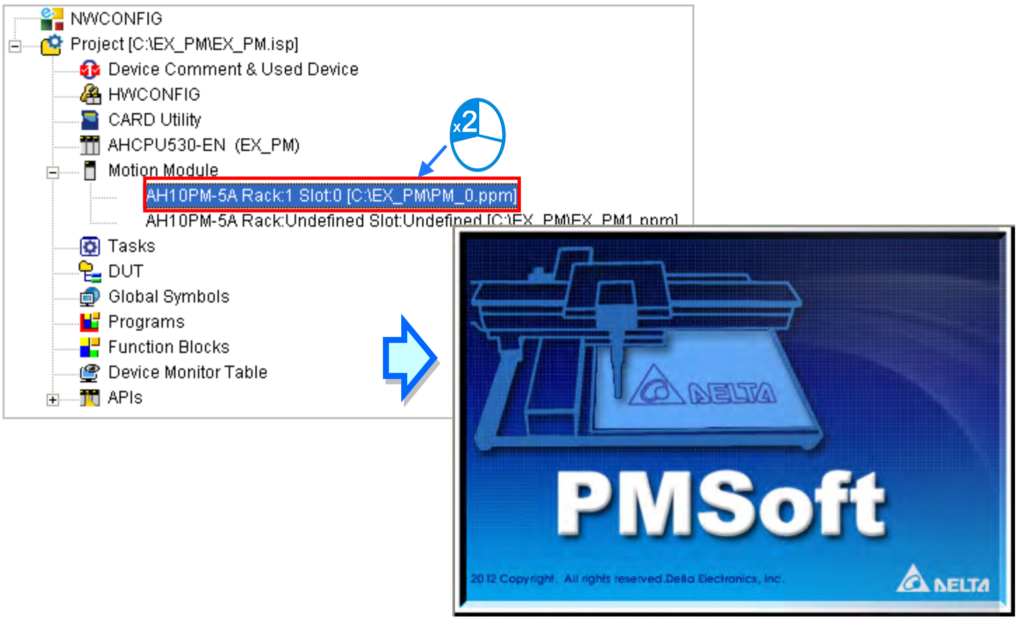
Then, type the **File Name** of the motion module project and select a model **Type** from the drop-down list. In addition, choose the **Rack No.** and **Slot No.** from the drop-down lists based on **HWCONFIG** configuration. Each slot also corresponds to a motion module. If users are uncertain of the mounting position or may rearrange the slots later, users can select **Undefined** from the **Slot No.** drop-down list. Click **OK** once the setting is complete.





● **Open AHxxPM and AHxxMC Motion Module Projects**

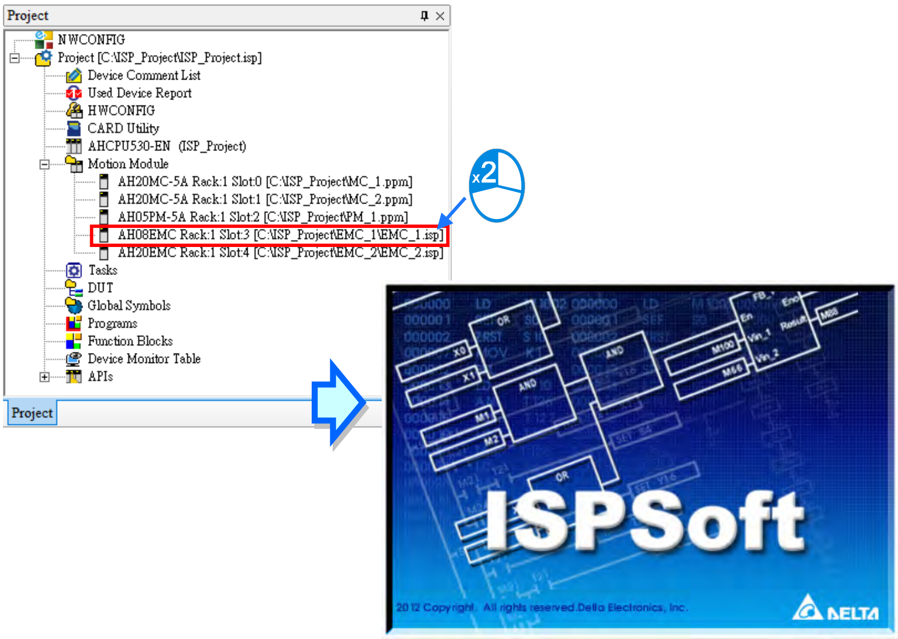
To edit AHxxPM and AHxxMC motion modules, please double-click the project file and PMSoft will automatically be opened for users to implement software development and programming on motion modules in PMSoft.



***. Please refer to PMSoft User Manual for more information on the usage. If PMSoft is opened through ISPSoft, users can only edit motion modules, but must save the edited content in PMSoft to complete the execution.**

● **Open AHxxEMC Motion Module Projects**

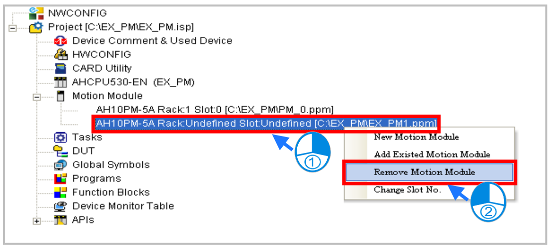
To edit an existed project concerning AHxxEMC motion module, please double-click on the file and ISPSoft will automatically be opened for users to implement software development and programming on motion modules in ISPSoft.



*. When ISPSoft is opened through the ISPSoft, users can only edit motion modules, but must save the edited content in ISPSoft to complete the execution.

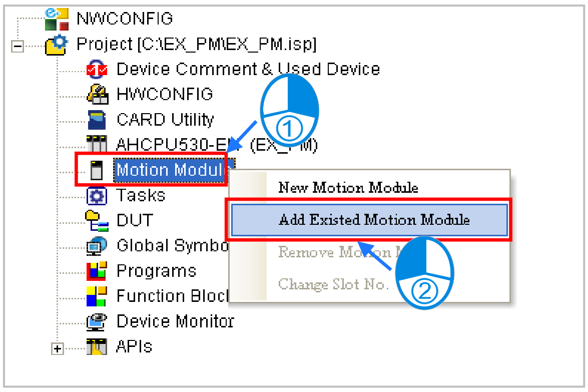
● **Remove Motion Module**

To delete an existed motion module project, users can right-click the selected project and choose **Remove Motion Module** from the quick menu; when removing, the module project files (*.ppm) or (*.isp) is removed only from the list under the Project section, but still saved in its original path.



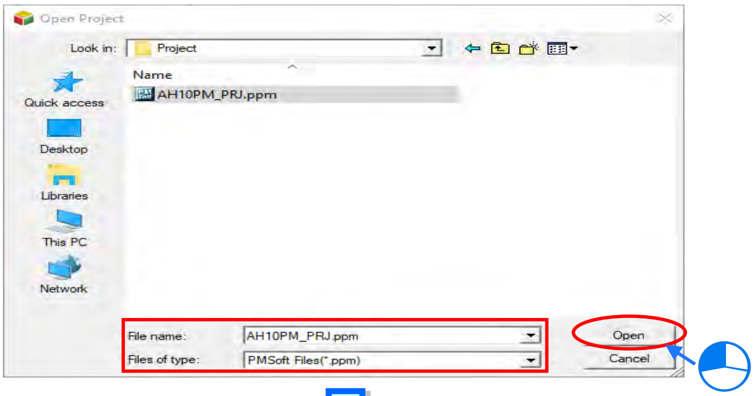
● **Add Existed Motion Module**

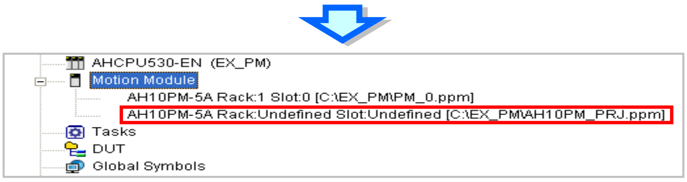
To add an existed motion module project file (*.ppm) or (*.isp), right-click **Motion Module** in the Project section and select **Add Existed Motion Module** from the quick menu.



2

Choose the added motion module project based on file name and type in the Open Project window, then click **Open**. The slot number is set as undefined.

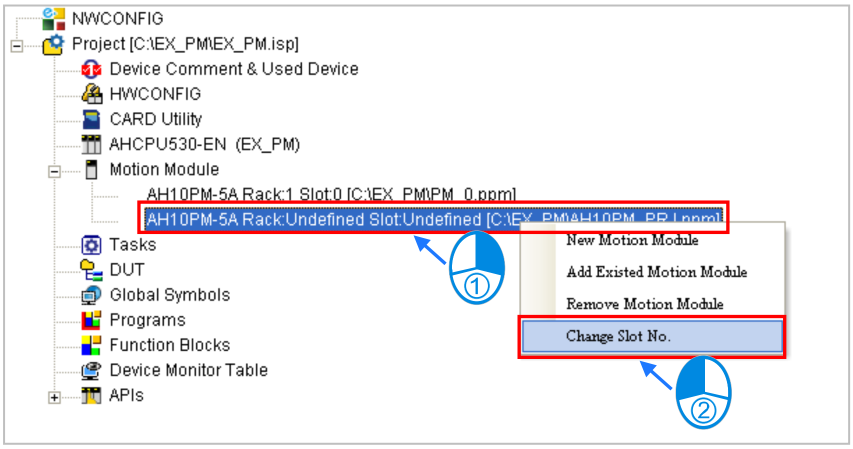




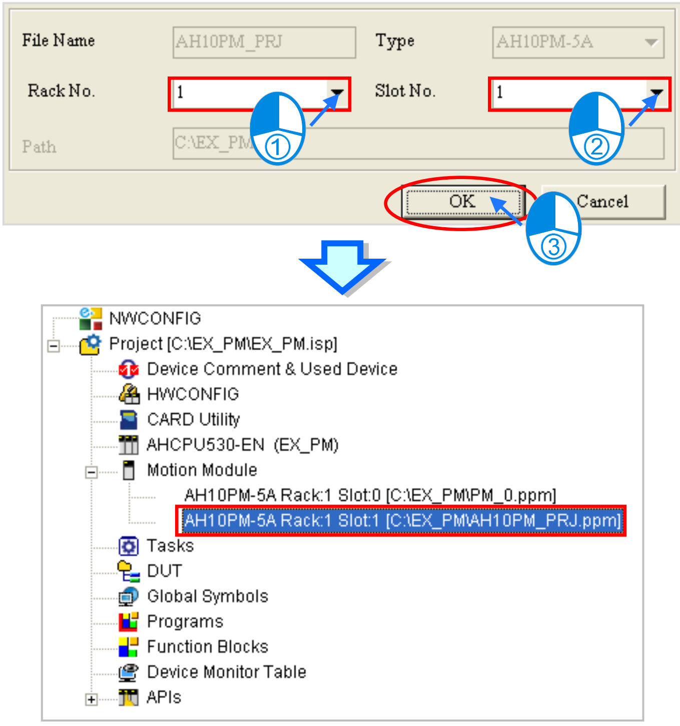
When adding a PMSoft project, the file is copied to the path concerning ISPSoft projects, while the original PMSoft project is saved in the former path. The file format used in PMSoft version 2.05 or above is applied to the added PMSoft project, but does not apply to DVP-PM projects; when adding an ISP project file, a file is created and copied to the path concerning ISPSoft projects.

- **Change Slot Number**

If users want to change the slot and rack number in a motion module project, right-click the selected project and choose **Change Slot No.** from the quick menu.



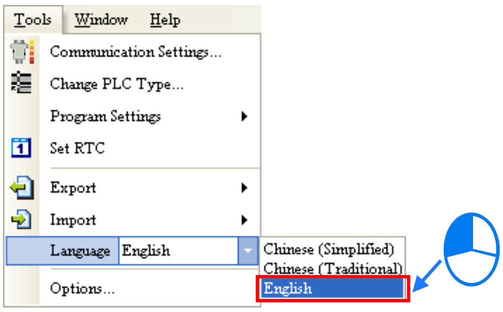
Select the **Rack No. and Slot No.** from the drop-down list. Please do not select a slot number which is already occupied, then click **OK.**



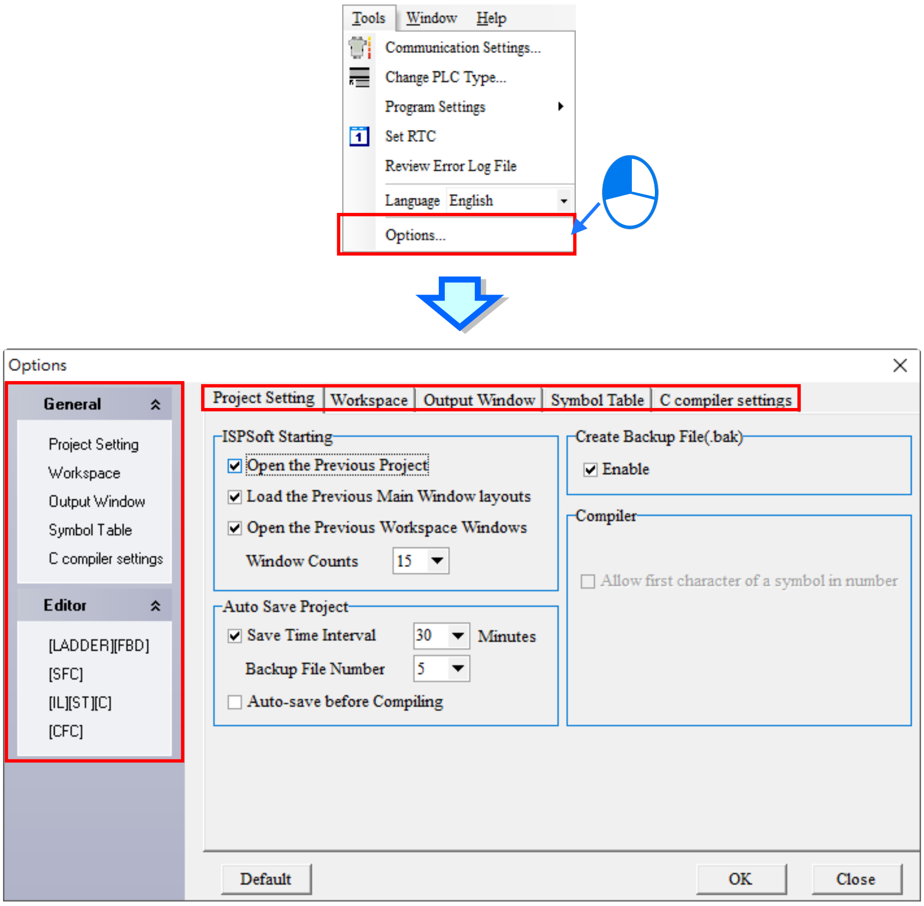
2.3 Basic Configuration

2.3.1 System and Environment

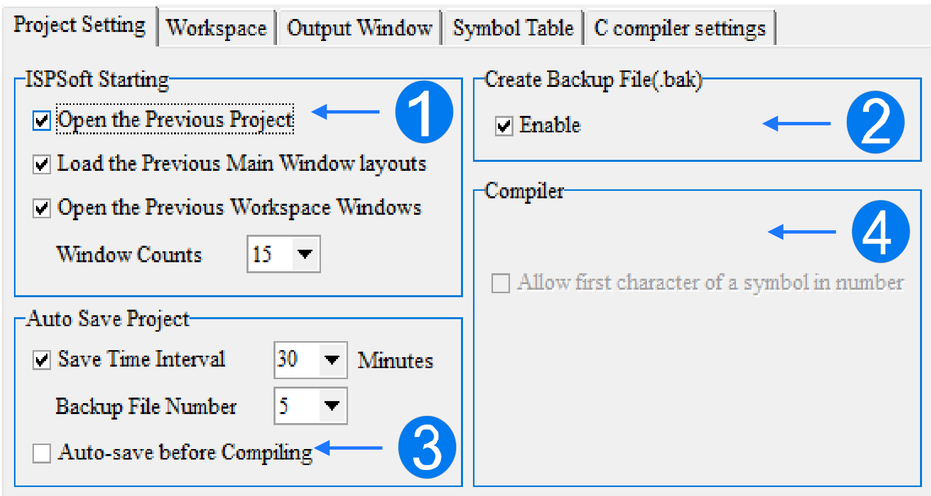
Select **Tools** and choose **Language** from the drop-down list.



Users can click **Options** in the **Tools** menu and choose desired settings from corresponding tabs at the top or listed on the left side of the window.



● **System Configuration - Project Setting**



❶ **Open the Previous Project:** When starting ISPSoft, the system will automatically open the last edited project.

Load the Previous Main Window layouts: Automatically memorize the size and position of the main window you last edited. You can choose not to enable this function while editing with dual screen, and the main window will only be positioned on the main screen even when the sub screen is missing.

Open the Previous Workspace Windows: When starting ISPSoft, the system will automatically open the workspace windows which you did not close in the last edit. Up to 15 windows can be displayed by choosing from the drop-down list of Window Counts.

❷ **Create Backup File & Enable:** Creates a backup file when saving.

❸ **Save Time Interval:** The system automatically saves the project files according to the selected **Minutes** from the drop-down list in the Auto Save Project section. Next, users can choose the maximum **Backup File Number.** If the auto-saved files exceeds the maximum backup number, the earliest saved files will be replaced by the backup files accordingly; if ISPSoft is not closed properly and a project file is opened, users will be asked if the last backup file of that project need to be loaded in or not.

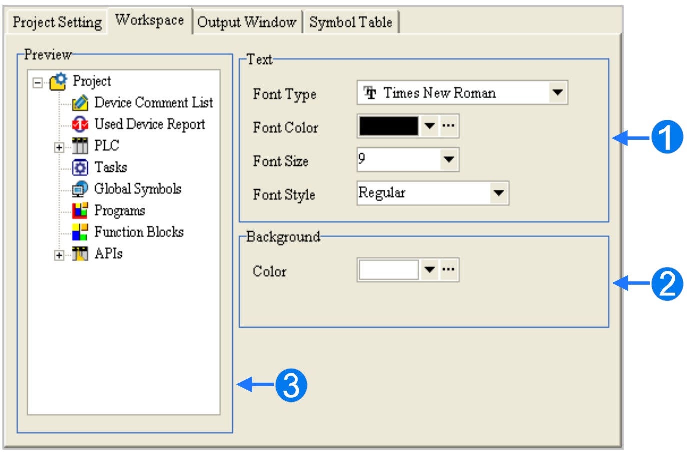
Auto-save before Compiling: Auto-save the edited project file before compiling.

❹ **Allow the same address in symbol table:** Allow different symbol variables to assign the same address.

Allow first character of a symbol in number: Allow the first character of a symbol variable to be a number.

Old Variable Array Compiling: Supports variable array compiling of previous version. *Functions may vary based on different PLC models.

● **System Configuration - Workspace**

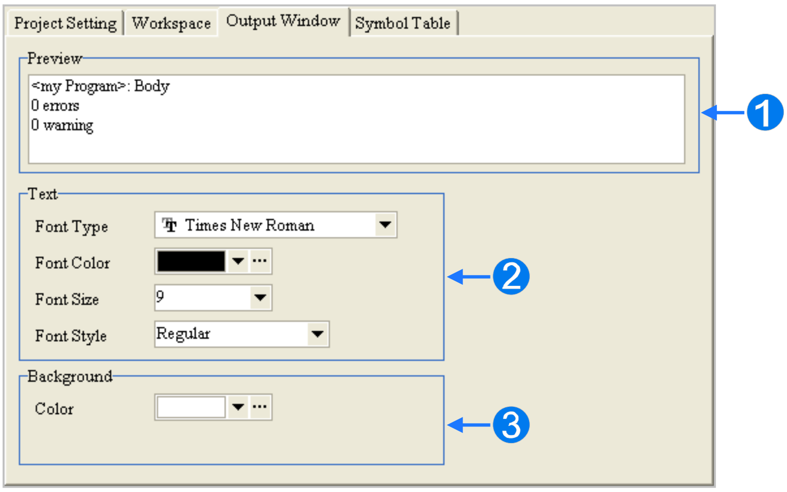


❶ Setup Text related contents i.e. font type, color, size and style.

❷ Setup a background color for Workspace.

❸ A preview of the modification.

- **System Configuration - Output Window**

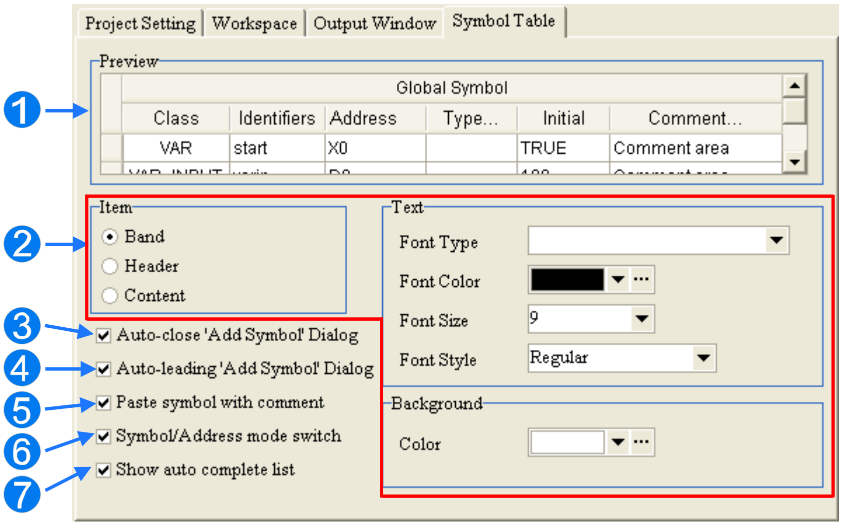


❶ A preview of the modification.

❷ Setup output text.

❸ Setup a background color for Output.

- **System Configuration - Symbol Table**



❶ A preview of the modification.

❷ Select an item in the left **Item** box, then choose the style of display in the right **Text** box.

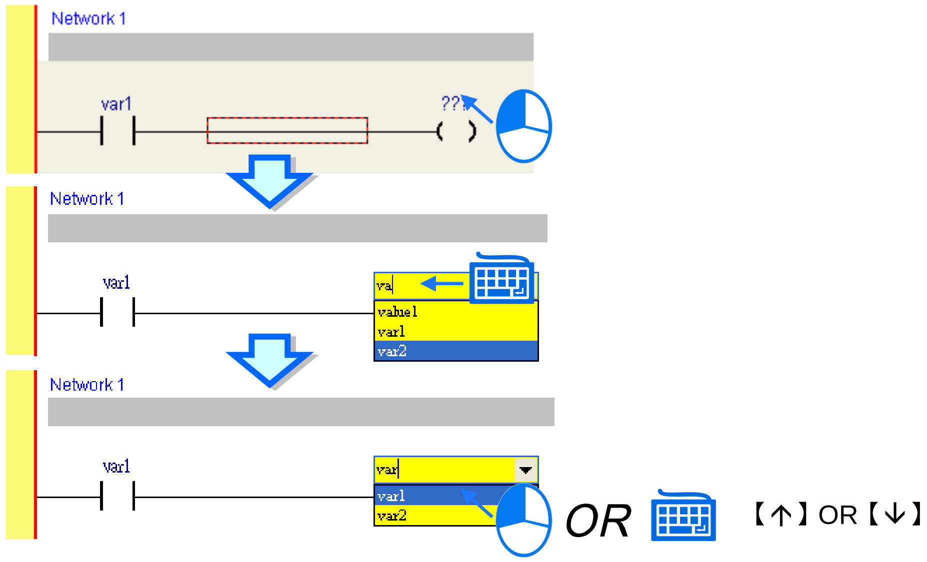
❸ The dialog **Add Symbol** configuration will close automatically once it is declared.

❹ Input undefined symbol variables in ladder diagram (LD), function block diagram (FBD), or a sequential function chart (SFC) environment, click [Enter] when complete and the dialog **Add Symbol** configuration appears.

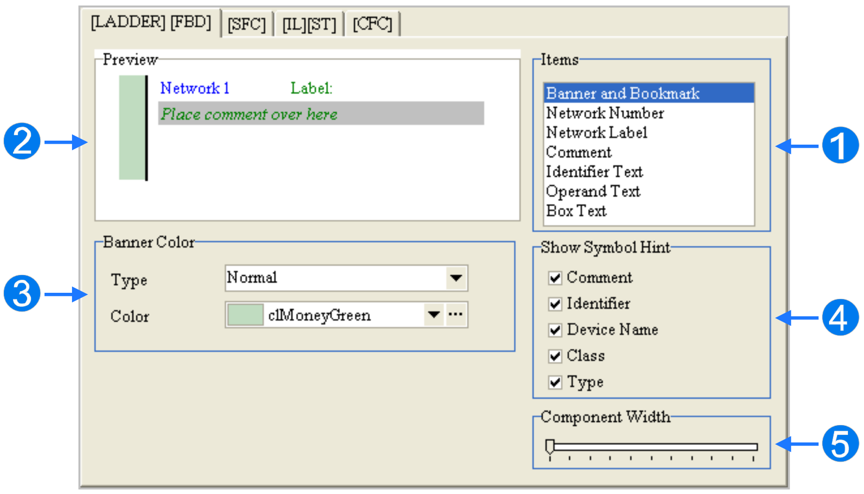
❺ When copy or paste from symbol tables, select to include comment.

6 Select [ADDR icon] from the icon toolbar to switch between Symbol or Address mode.

7 Input symbol variables in the program and a list of created variables are shown. To select, users can use the mouse or the up and down arrow keys on the keyboard. (See below)



● **Configuration Editor - LADDER and FBD**



1 Select an item for setup.

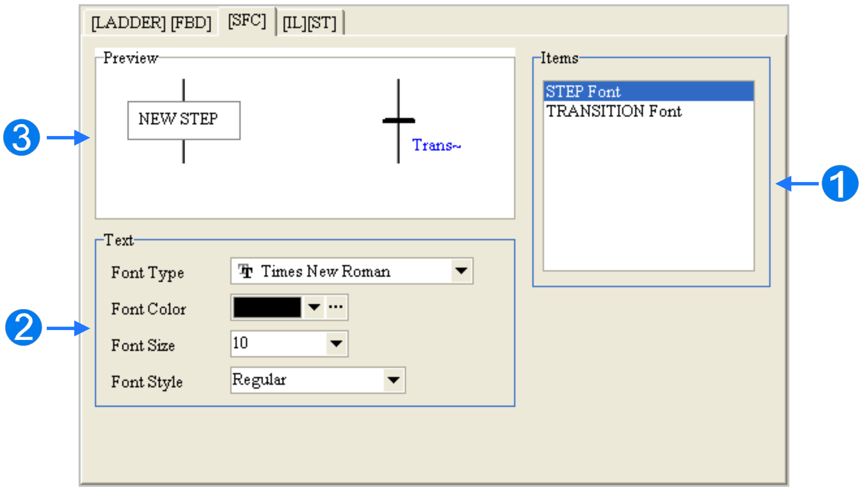
2 A preview of the modification.

3 Select a display type and color.

4 In Ladder and FBD programming editor section, users can choose from the 'Show Symbol Hint' box to display selected hints of the device or symbol variable pointed by the mouse cursor.

5 Set the Ladder and FBD component width in the box. The setup will affect the word length in FBD programming.

- **Configuration Editor - SFC**

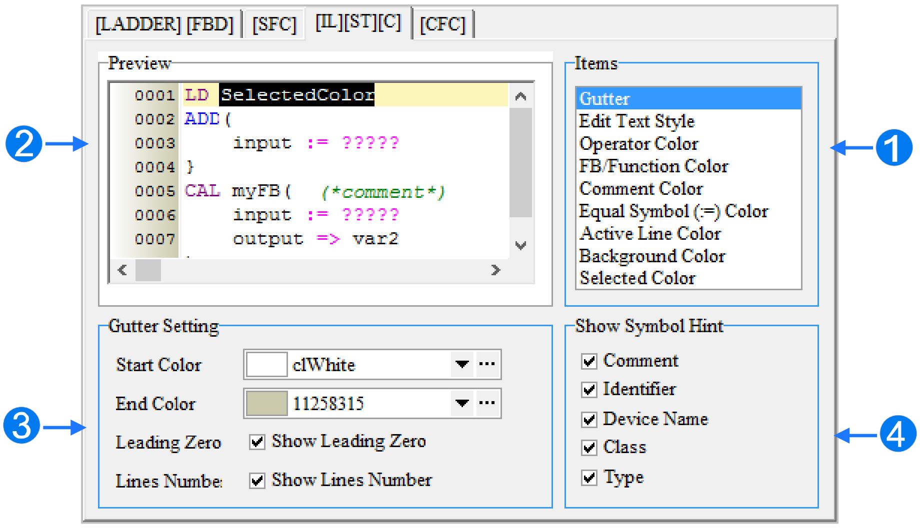


❶ Select an item for setup.

❷ Based on the selected item, select the Text box for display.

❸ A preview of the modification.

- **Configuration Editor – IL, ST and C**



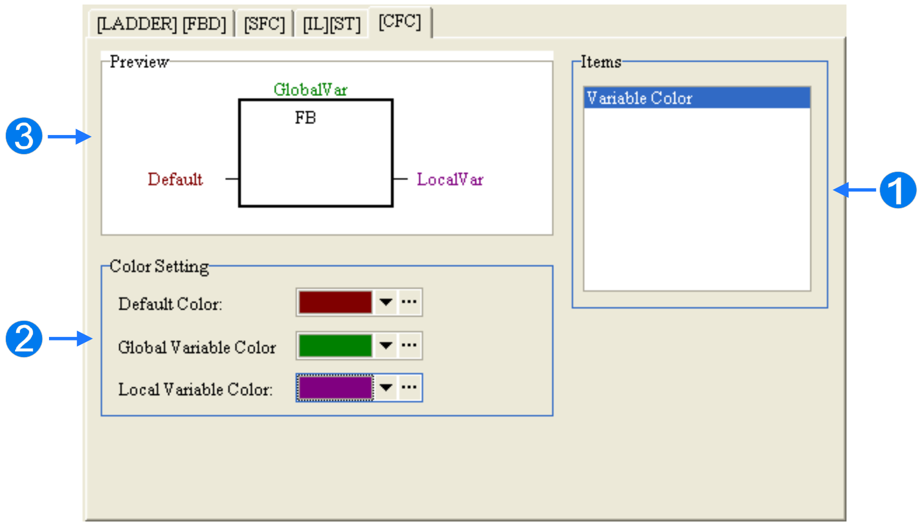
❶ Select an item for setup.

❷ A preview of the modification.

❸ Based on the selected item, select the Text box for display.

❹ When keep the mouse pointer on a device or symbol in the program area of [IL][ST][C], corresponding hints would be shown on the screen, which users can select symbol hints intended to be shown from this section based on their demand.

- **Configuration Editor - CFC**

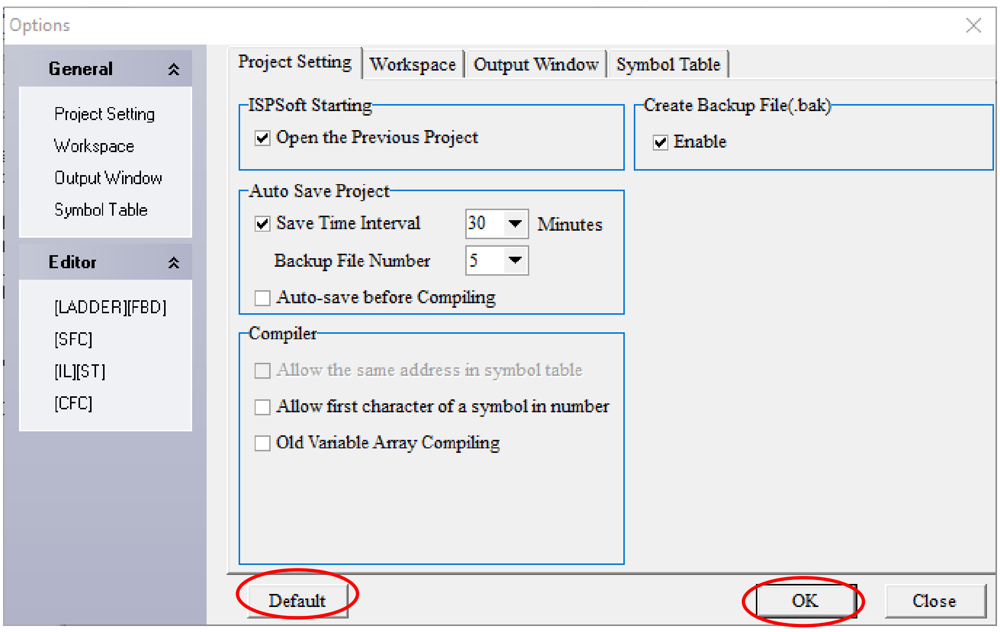


❶ Select an item for setup.

❷ Based on the selected item, select the Color Setting for display.

❸ A preview of the modification.

By clicking **Default**, all settings are restored to defaults. When modification for all setups are complete, click **OK**.



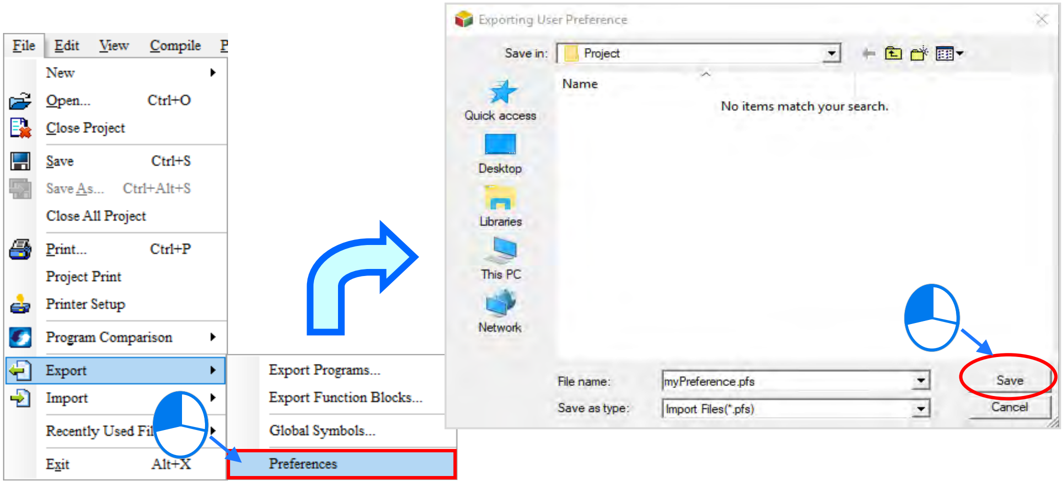
***. When several windows are opened in ISPSoft, each window provides a different setting. However, the software only remembers the environment setting of the last window closed, so it will automatically apply that setup once re-started.**

2.3.2 Importing and Exporting User Preference

Users can export and import their preference concerning environment settings through ISPSoft.

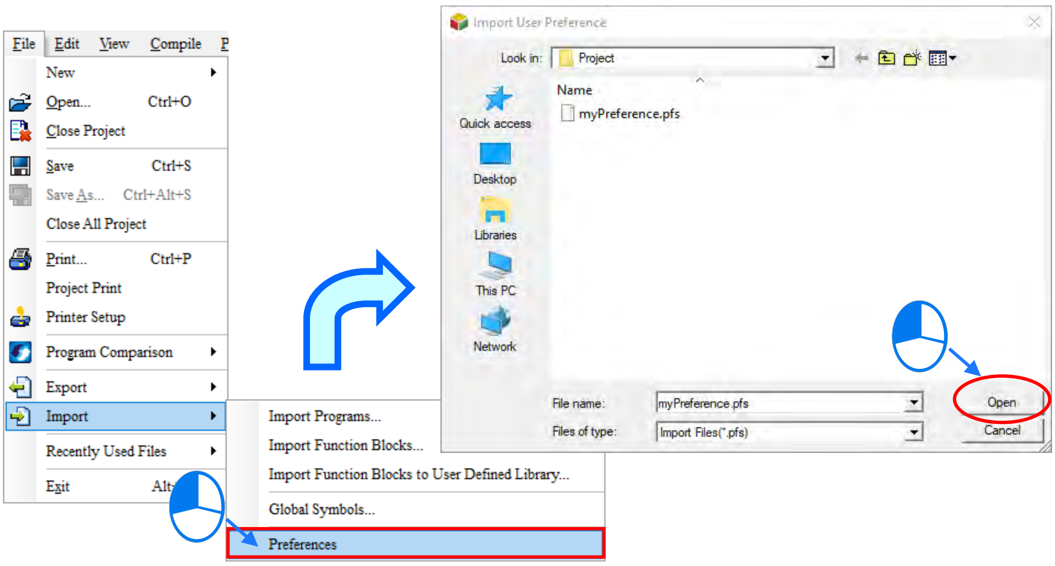
● **Export User Preference**

Choose **Export** from the **File** menu and select **Preferences**. Input file name to export from the pop-up window and click **Save**.



● **Import User Preference**

Choose **Import** from the **File** menu and click **Preferences.** Select a file for import from the pop-up window and click **Open**.

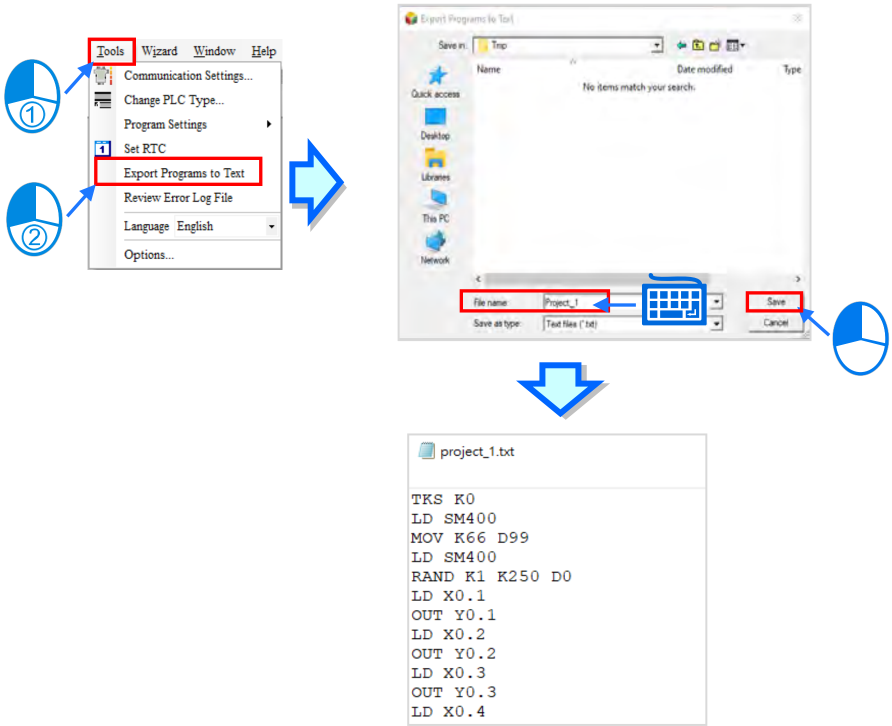


Additional remark

Since environment parameters may vary based on different ISPSoft versions, not all import preferences may be applicable. Users need to check the imported **Preference** file (*.pfs) to make sure the contents is desired if unsure which ISPSoft version it is exported from.

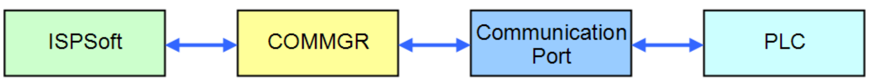
2.3.3 Export Programs to Text

With this feature, users can export programs into text files for patent application, which would not be able to revert back to programs. To export programs, click “Tools (T)” and choose “Export Programs to Text”, then input a file name for exported file and click on “Save”.



2.4 Communication Settings

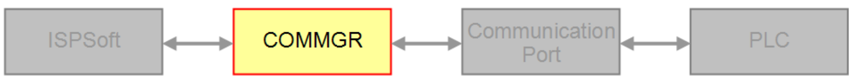
The following picture shows a communication structure between ISPSoft and a Delta PLC. Unlike previous ways of connection, the ISPSoft uses Communication Manager- **COMMGR** as the communication interface. The section explains how to build communication between ISPSoft and PLCs with basic tests completed.



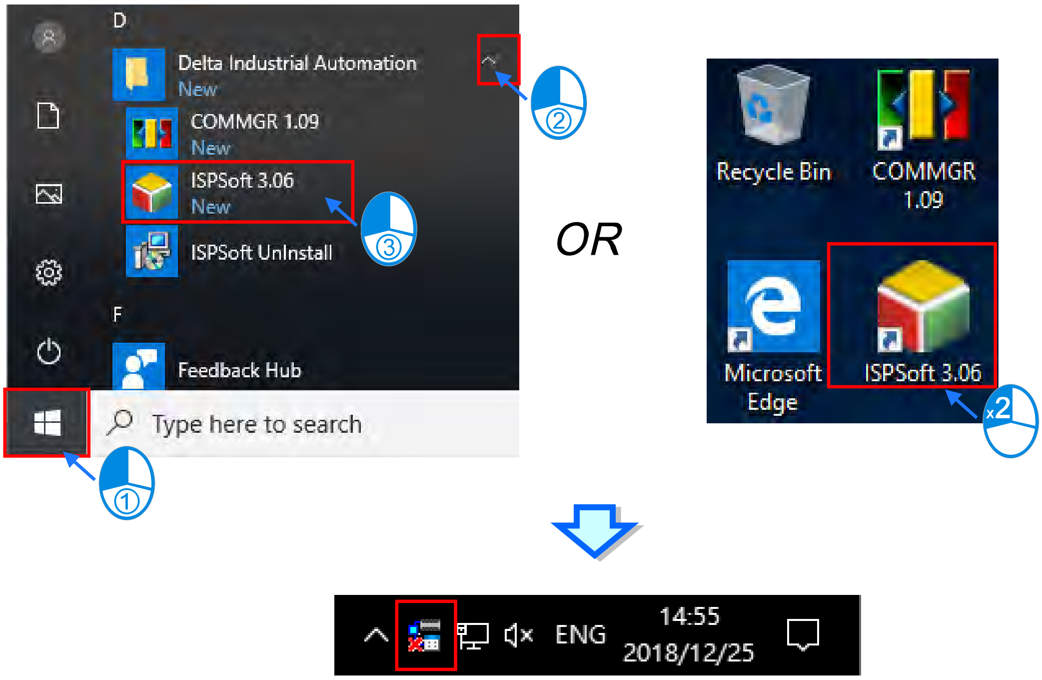
***1. Please refer to section 1.2 for information about COMMGR and installation guide.**

***2. For ISPSoft version 2.0 or above, COMMGR is used in the communication structure; while earlier versions adopts the traditional ways of connection.**

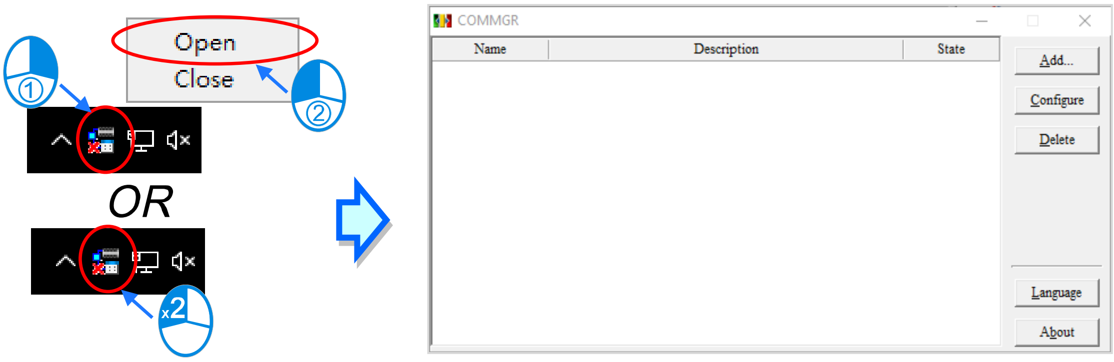
2.4.1 Start / Close COMMGR



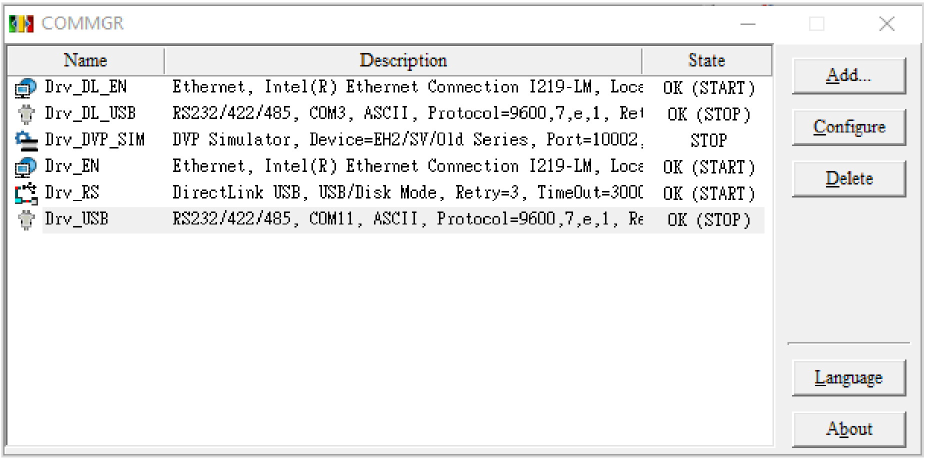
When **COMMGR** is installed, its shortcut can be found in the Programs of a PC **Start** menu. Users need to click the shortcut to start **COMMGR** only for first-time installation. Afterwards, when starting a computer, the **COMMGR** is automatically started and remains in the Windows system; however, when its icon is not shown, please click the shortcut of **COMMGR** listed in the Programs.



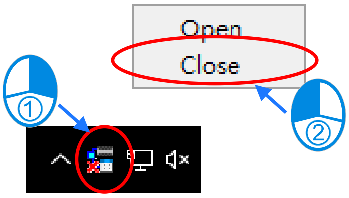
To start **COMMGR**, select its icon and double-click **Open** or right-click the icon to open the program on Windows PC.



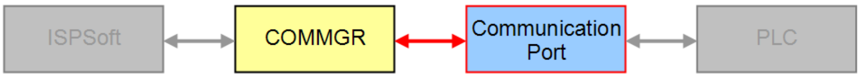
The following image is a display of the **COMMGR** status window. In the middle of the window contains description of drivers established for communication. The ISPSoft assigns a driver from the description box to form connection with PLCs; on the right are buttons for managing these drivers. For more information, please read the next section.



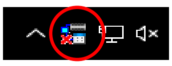
Users can close the **COMMGR** window by clicking ✕ or — in the upper right corner, but the program still exists in Windows; to close **COMMGR** completely, right-click the **COMMGR** icon displayed in the system and choose **Close**.

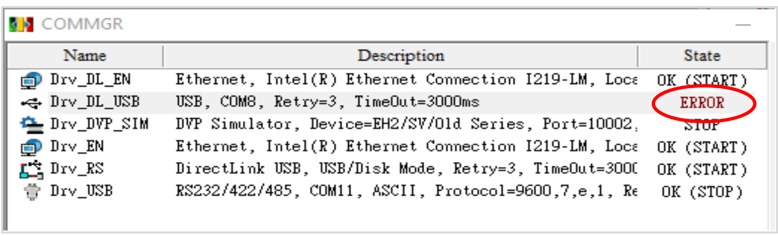


2.4.2 Driver Management for COMMGR



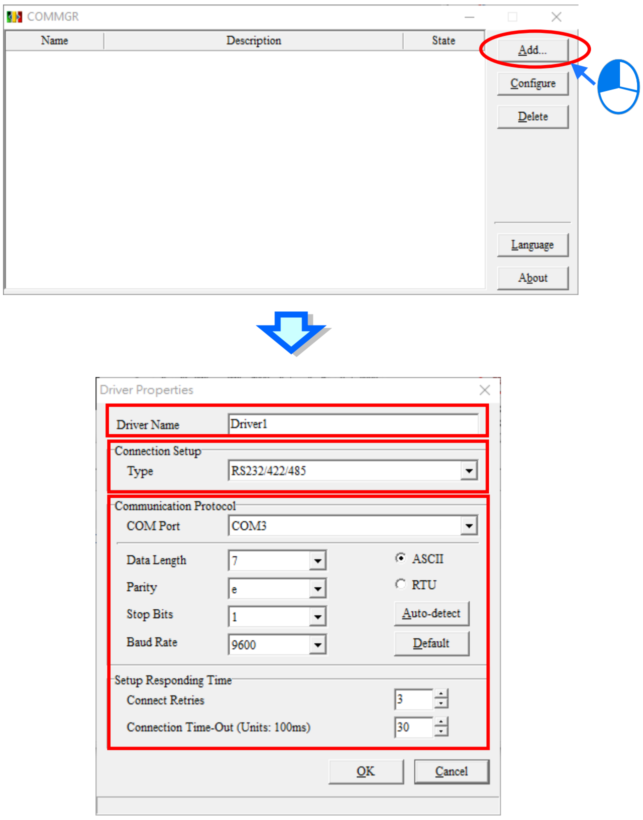
The driver in **COMMGR** act as a channel that connects the program and communication port. When users add a new driver and has setup the communication parameters, the COMMGR forms a channel connecting the assigned communication port in the driver and when the computer reboots, the **COMMGR** will automatically start the driver. However, when the channel for connecting the driver is not properly functioning, for instance, the existed network card or USB cable is removed, the **COMMGR** will automatically stop the driver and **ERROR** status is displayed. Meanwhile, a small red 'X' appears on the COMMGR icon of the Windows system tray. When connection restores, the status for the driver also returns to **OK**.





2.4.3 Creating Connection Channel - Add Driver

Click **Add** on the right side of the **COMMGR** window to start settings concerning communication parameters.



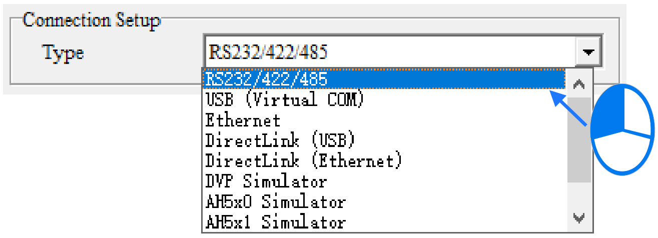
Quick steps to set up a driver:

(1) **Driver Name Setup**

Type the **Driver Name** in the box. Users can input maximum of 31 characters, and special marks such as "_" but not *, #, ?, \, %, @ in the name box.

(2) **Connection Setup**

Select a desired connection **Type** from the drop-down list. The following is a list of the connection types supported by COMMGR.



➢ **RS232/422/485**

Uses COM Port to communicate with PLC hosts.

➢ **USB (Virtual COM)**

Some PLC hosts provides USB port, so a PC and PLC host can directly connect through USB. However, before using this connection method, please make sure that the software for the USB driver is installed in the computer. For more information on methods of installation, please refer to appendix A or other PLC user manuals.

➢ **Ethernet**

Uses Ethernet to communicate with PLC hosts.

➢ **DirectLink (USB) & DirectLink (Ethernet)**

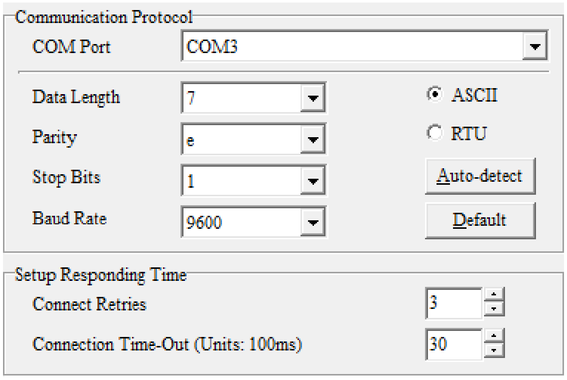
Used by Delta human-machine interfaces (HMI) for connection. Under normal connection of PLC and HMI, a computer uses an USB or Ethernet to connect with the HMI, and indirectly builds communication with PLC host. Please refer to Delta HMI user manuals for more information on connection and notifications.

➢ **DVP Simulator& AH5x0 Simulator & AH5x1 Simulator & AS300 Simulator & AS200 Simulator**

Serves as virtual channels for simulators regarding all PLC types, but must use corresponding devices for connection in the ISPSoft.

(3) **Communication Protocol Setup**

Setup the communication protocol based on the selected connection type. Each type of connection has its own communication protocol setting. The following section will introduce the different types of communication parameter settings.

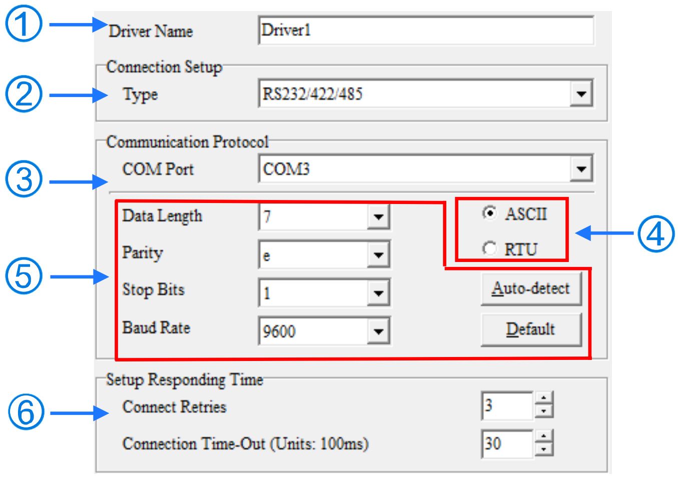


2.4.3.1 Communication Parameter Setting - RS232/422/485

Before starting the setup of RS232/422/485 driver, make sure:

(a) The software for driver installation can be found in the computer.

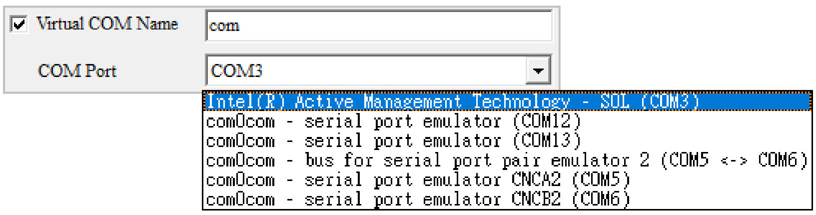
(b) The PC and PLC hosts has now established connection and is functioning.



(1) Type the **Driver Name.** To add special marks, only '_' can be used.

(2) For **Connection Setup,** select **RS232/422/485** from the drop-down list for **Type**.

(3) For **COM Port,** select the desired port for communication from the drop-down list. The list contains complete information regarding COM Port number and device name, which is the same as in **Windows Device Manager**. If (a) and (b) mentioned above is confirmed, users will be able to select the COM Port.



(4) The data format for communication is **ASCII** or **RTU**.

(5) The communication protocol setting of the COM Port is the same as its connected device. When **Default** is clicked, the communication protocol parameters returns to defaults.

If not sure about the communication protocol of the connected device, click **Auto-detect** to find out the parameter. When detection is successful, users can connect the device to a RS232 communication port selected with a RS232 cable, and click to automatically detect the communication protocol. If the communication protocol is successfully detected, its parameters will be automatically filled in the corresponding boxes in the section; however, the system will not auto-detect parameters for **COM Port** and **ASCII / RTU**, therefore, please confirm these two parameters before clicking auto-detect.

(6) To setup parameters concerning responding time. For **Connect Retries,** users need to setup the number of retry once connection error occurs, while for **Connection Time-Out** setting, the parameter concerns the time interval between retries.

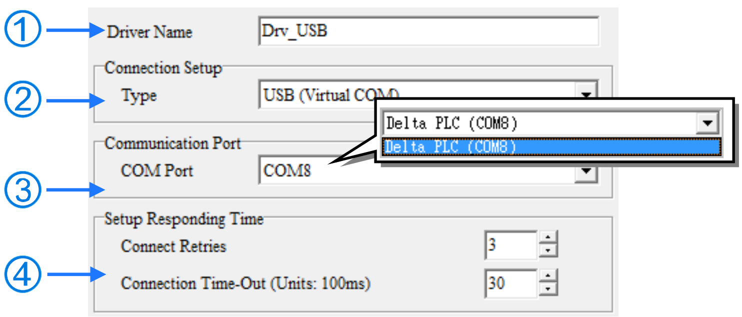
***. When changing a hardware device connected to a PC, users need to close the setting page concerning communication driver properties and re-start in order to obtain the new hardware communication device.**

2.4.3.2 Communication Parameter Setting - USB (Virtual COM)

Before starting the setup of USB type drivers, make sure:

(a) The software for driver installation can be found in the computer.

(b) The PC and PLC hosts has now established connection and is functioning.



(1) Type the **Driver Name**. To add special marks, only ‘_’ can be used.

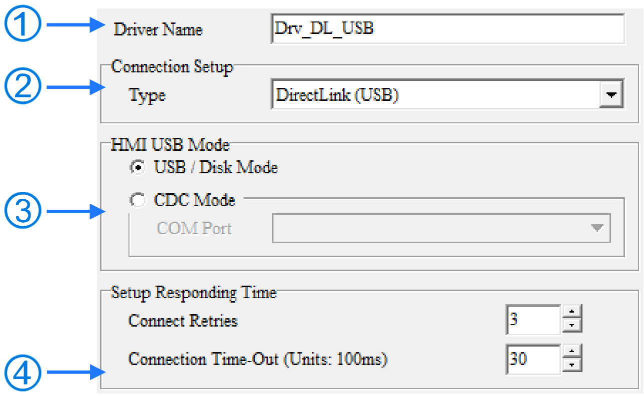
(2) For **Connection Setup**, select **USB (Virtual COM)** from the drop-down list for **Type**.

(3) For **COM Port**, select the desired port for communication from the drop-down list. If (a) and (b) mentioned above is confirmed, the list will display the host device name and COM Port number.

(4) To setup parameters concerning responding time. For **Connect Retries,** users need to setup the number of retry once connection error occurs, while for **Connection Time-Out** setting, the parameter concerns the time interval between retries.

***. For more information regarding USB drivers in PLC hosts, please refer to appendix A.**

2.4.3.3 Communication Parameter Setting - DirectLink (USB)



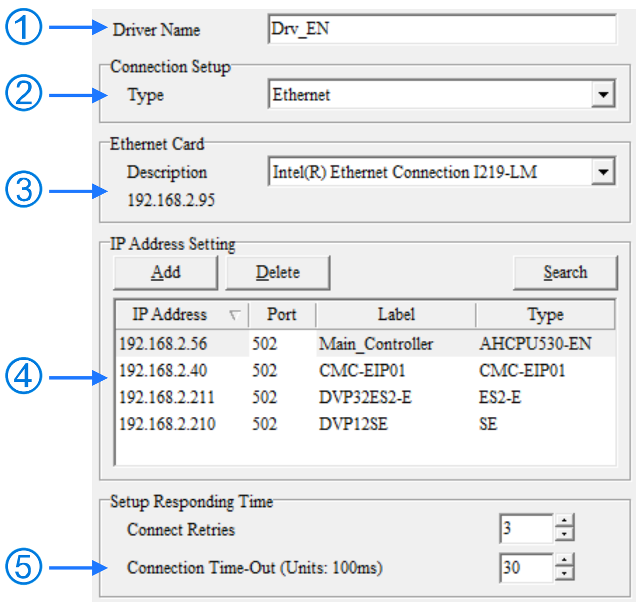
(1) Type the **Driver Name**. To add special marks, only '_' can be used.

(2) For **Connection Setup**, select **DirectLink (USB)** from the drop-down list for **Type**.

(3) Choose from the **HMI USB Mode**. When selecting **CDC Mode**, choose the desired COM Port from the drop-down list. For more methods regarding connection, please refer to Delta HMI user manuals.

(4) To setup parameters concerning responding time. For **Connect Retries,** users need to setup the number of retry once connection error occurs, while for **Connection Time-Out** setting, the parameter concerns the time interval between retries.

2.4.3.4 Communication Parameter Setting - Ethernet



(1) Type the **Driver Name**. To add special marks, only '_' can be used.

(2) For **Connection Setup**, select **Ethernet** from the drop-down list for **Type**.

(3) For **Ethernet Card**, select the desired network card from the drop-down list. The current IP address is shown below the description.

(4) In the **IP Address Setting**, setup the communication device IP address and name.

➢ Click **Search** and the result for devices in the same network are shown in the box.

➢ Click **Add** for a new IP address and input information regarding each cell.

❶ IP address: The device IP address.

❷ Port: Used during communication, default setting is 502.

❸ Label: The name of the device.

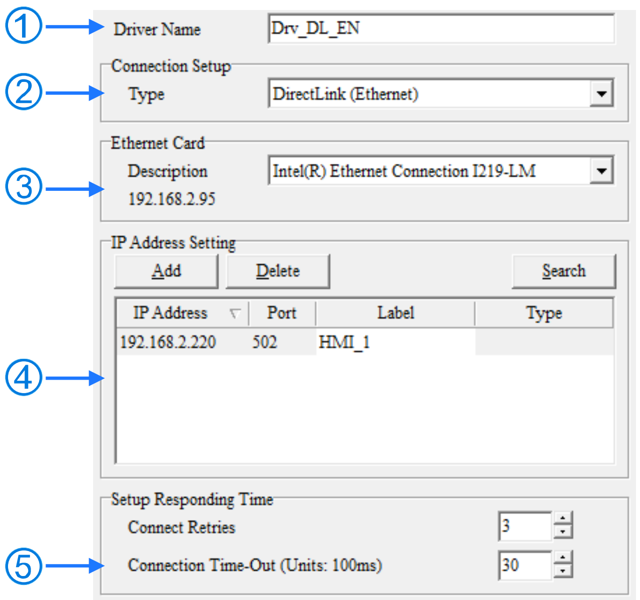
❹ Type: The device model type that can be found through clicking **Search**.

➢ Select an IP address and click **Del** or press Delete on the keyboard to remove it from the list.

(5) To setup parameters concerning responding time. For **Connect Retries,** users need to setup the number of retry once connection error occurs, while for **Connection Time-Out** setting, the parameter concerns the time interval between retries.

***. When changing an internet device connected to a PC, users need to close the setting page concerning communication driver properties and re-start in order to obtain the new internet device.**

2.4.3.5 Communication Parameter Setting - DirectLink (Ethernet)



(1) Type the **Driver Name**. To add special marks, only '_' can be used.

(2) For **Connection Setup**, select **DirectLink (Ethernet)** from the drop-down list for **Type**.

(3) For **Ethernet Card**, select the desired network card from the drop-down list. The current IP address is shown below the description.

(4) In the **IP Address Setting**, setup the communication device IP address and name.

- Click **Search** and the result for devices in the same network are shown in the box.
- Click **Add** for a new IP address and input information regarding each cell.

  ❶ IP address: The device IP address.

  ❷ Port: Used during communication, default setting is 502.

  ❸ Label: The name of the device.

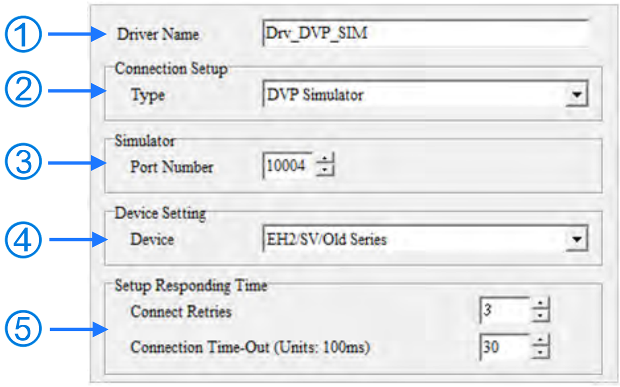
  ❹ Type: The device model type that can be found through clicking **Search**.

- Select an IP address and click Del or press Delete on the keyboard to remove it from the list.

(5) To setup parameters concerning responding time. For **Connect Retries,** users need to setup the number of retry once connection error occurs, while for **Connection Time-Out** setting, the parameter concerns the time interval between retries.

***. When changing an internet device connected to a PC, users need to close the setting page concerning communication driver properties and re-start in order to obtain the new internet device.**

2.4.3.6 Communication Parameter Setting - DVP Simulator



(1) Type the **Driver Name**. To add special marks, only '_' can be used.

(2) For **Connection Setup**, select **DVP Simulator** from the drop-down list for **Type**.

(3) Input assigned **Port Number**.

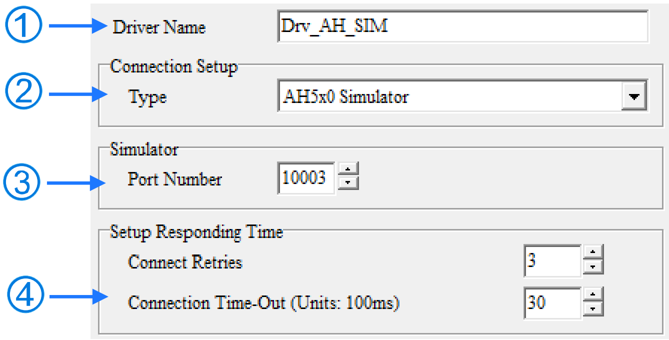
(4) For **Device Setting**, DVP simulators include **EH2/SV/Old Series, EH3/ EH3-L/SV2, ES2/ EX2/SA2/SX2/MC, SE and SS2**.

(5) To setup parameters concerning responding time. For **Connect Retries,** users need to setup the number of retry once connection error occurs, while for **Connection Time-Out** setting, the parameter concerns the time interval between retries.

***. When ES, SS, EX, VFD, EC devices download the DVP simulator, these devices will change to EH device once uploaded.**

***. Regarding TP devices, please select SS2 series as simulator.**

2.4.3.7 Communication Parameter Setting - AH5x0 & AH5x1 Simulator



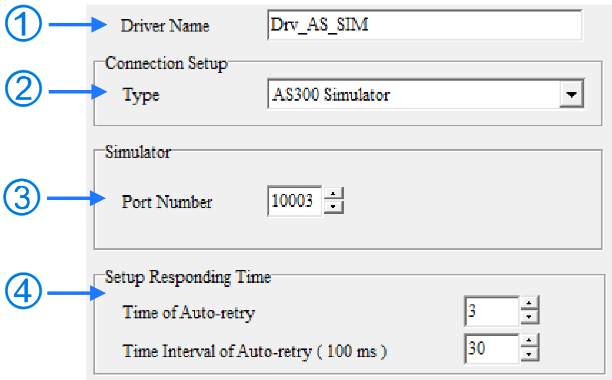
(1) Type the **Driver Name**. To add special marks, only '_' can be used.

(2) For **Connection Setup**, select **AH5x0 Simulator or AH5x1 Simulator** from the drop-down list for **Type**.

(3) Input assigned **Port Number**.

(4) To setup parameters concerning responding time. For **Connect Retries,** users need to setup the number of retry once connection error occurs, while for **Connection Time-Out** setting, the parameter concerns the time interval between retries.

2.4.3.8 Communication Parameter Setting - AS Simulator



(1) Type the **Driver Name**. To add special marks, only '_' can be used.

(2) For **Connection Setup**, select **AS200 Simulator or AS300 Simulator** from the drop-down list for **Type**.

(3) Input assigned **Port Number**.

(4) To setup parameters concerning responding time. For **Connect Retries,** users need to setup the number of

retry once connection error occurs, while for **Connection Time-Out** setting, the parameter concerns the time interval between retries.

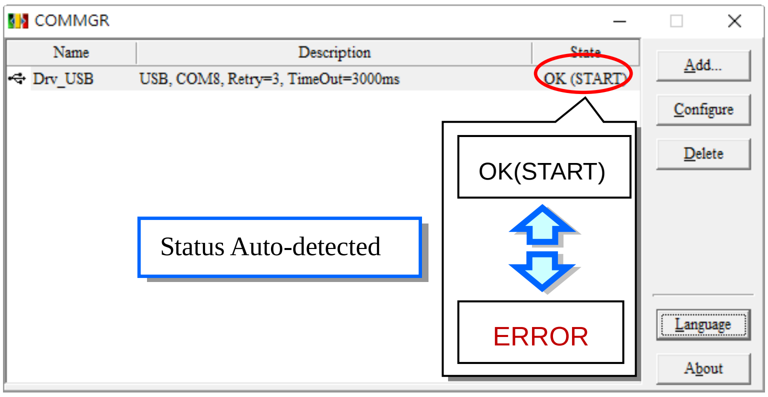
Additional remark

(a) To use simulator functions, we suggest using ISPSoft V3.05 or later versions.

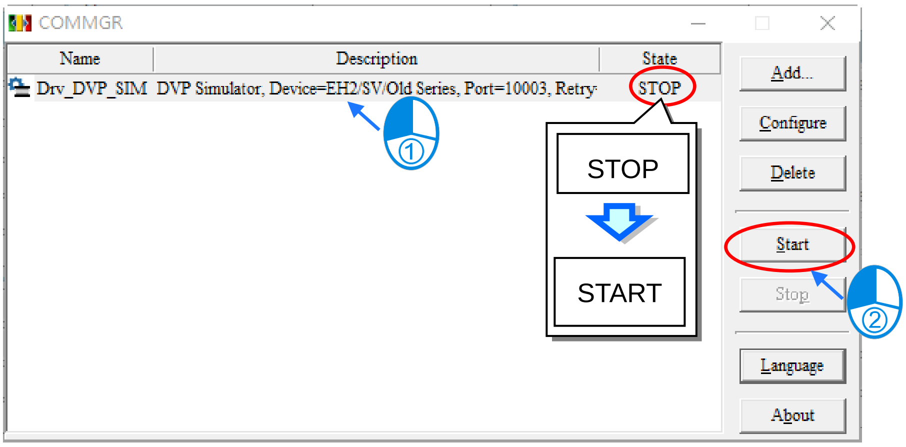
(b) When using simulators, users need to be aware that they do not support all functions and commands.

2.4.4 Creating Connection Channel - Start / Stop a Driver

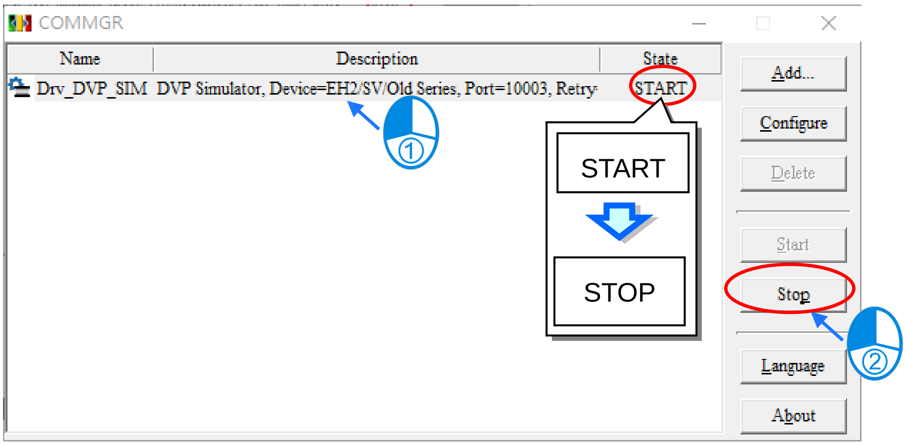
For USB driver, users do not need to operate because COMMGR will auto-detect for the connection when a device is properly connected to a PC.



Users must enable a simulator first to start execution. By choosing the desired simulator driver from the list in the COMMGR window and click **Start** button on the right, you will see **START** shown in the State column if the simulator driver is successfully enabled.

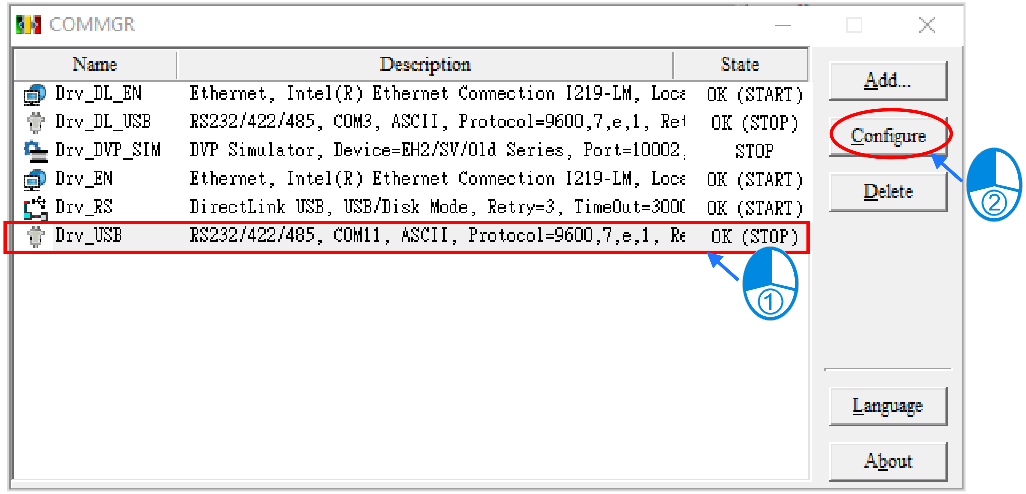


To stop a driver, select the desired driver on the list in **COMMGR** window and click **Stop** button on the right, you will see **STOP** shown in the State column if the simulator drive is stopped.

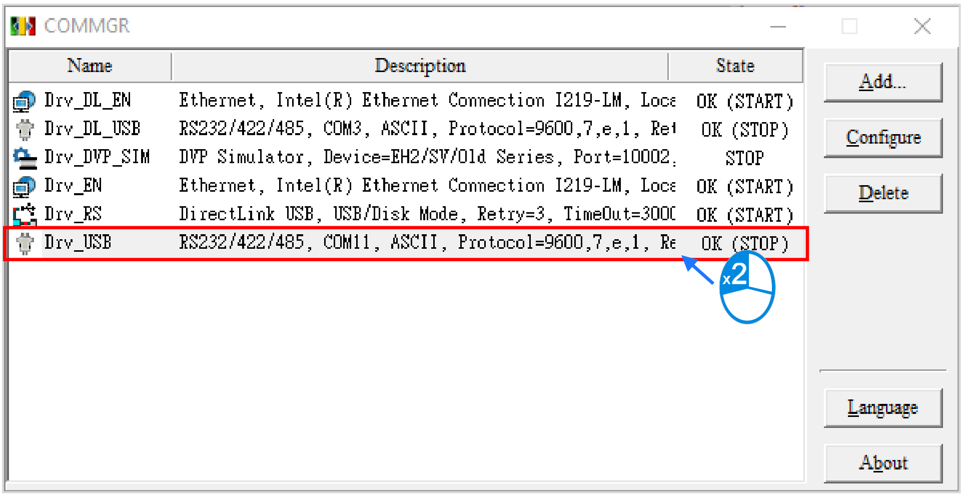


2.4.5 Creating Connection Channel - Configure / Delete a Driver

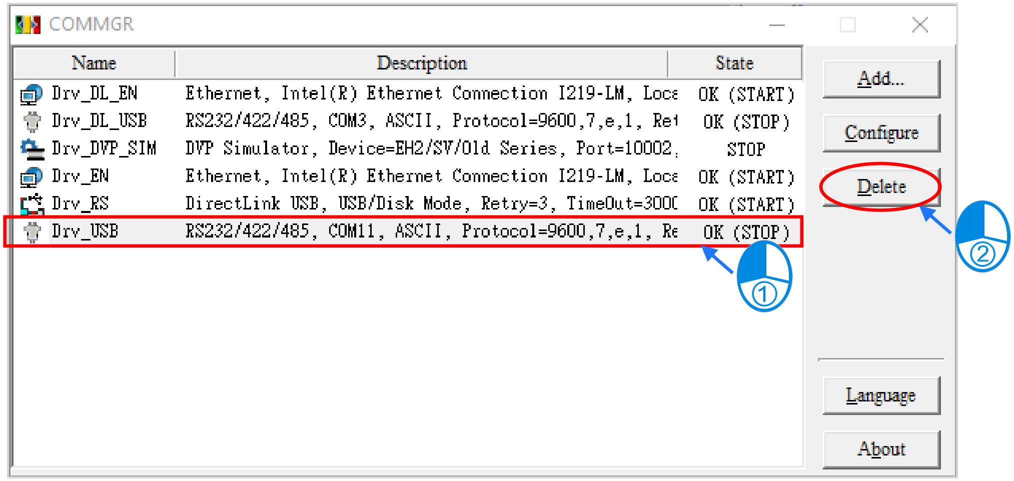
To modify the parameter of a particular driver, please click **Configure** button on the right or double-click the selected driver to open a setup window for modification.



OR

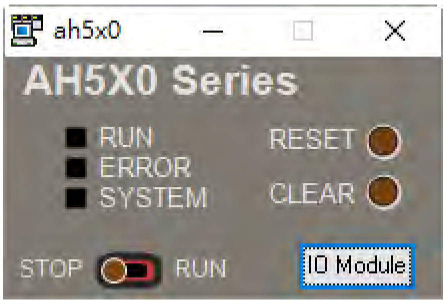


To delete a driver, select the desired driver and click **Delete** button on the right or press DEL on the keyboard for removal.

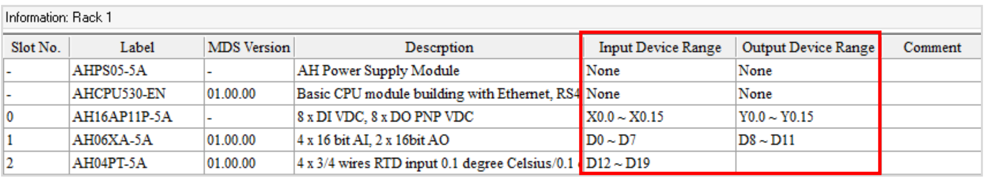


2.4.6 Creating Connection Channel - Simulator with Operating Panels

When the state of a simulator shows **START,** an operating panel (see below) pops-up to demonstrate the current states of AH5x0 and AH5x1 simulators and provide STOP or RUN mode for users to control.



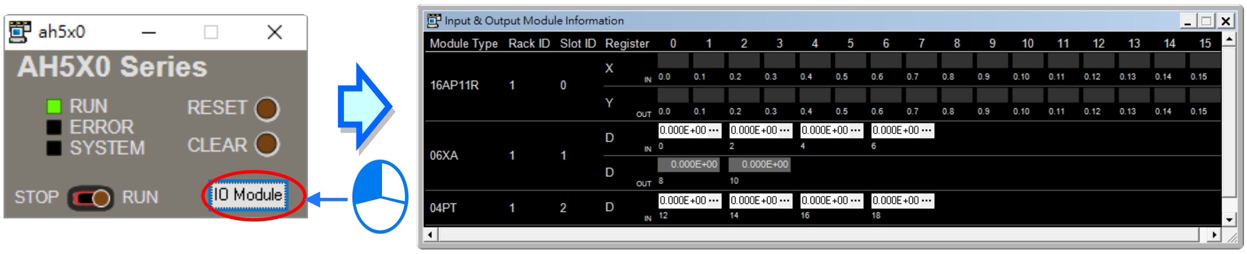
The **IO Module** button of a simulator can open an IO module panel. However, modules must be configured in HWCONFIG and please refer to section 3.8.4 for parameter download to hosts.



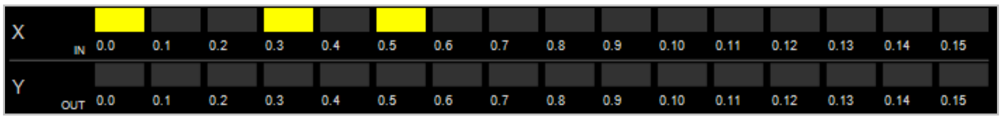
Information: Rack 1

Slot No.	Label	MDS Version	Description	Input Device Range	Output Device Range	Comment
-	AHPS05-5A	-	AH Power Supply Module	None	None	
-	AHCPU530-EN	01.00.00	Basic CPU module building with Ethernet, RS4	None	None	
0	AH16AP11P-5A	-	8 x DI VDC, 8 x DO PNP VDC	X0.0 ~ X0.15	Y0.0 ~ Y0.15	
1	AH06XA-5A	01.00.00	4 x 16 bit AI, 2 x 16bit AO	D0 ~ D7	D8 ~ D11	
2	AH04PT-5A	01.00.00	4 x 3/4 wires RTD input 0.1 degree Celsius/0.1	D12 ~ D19		

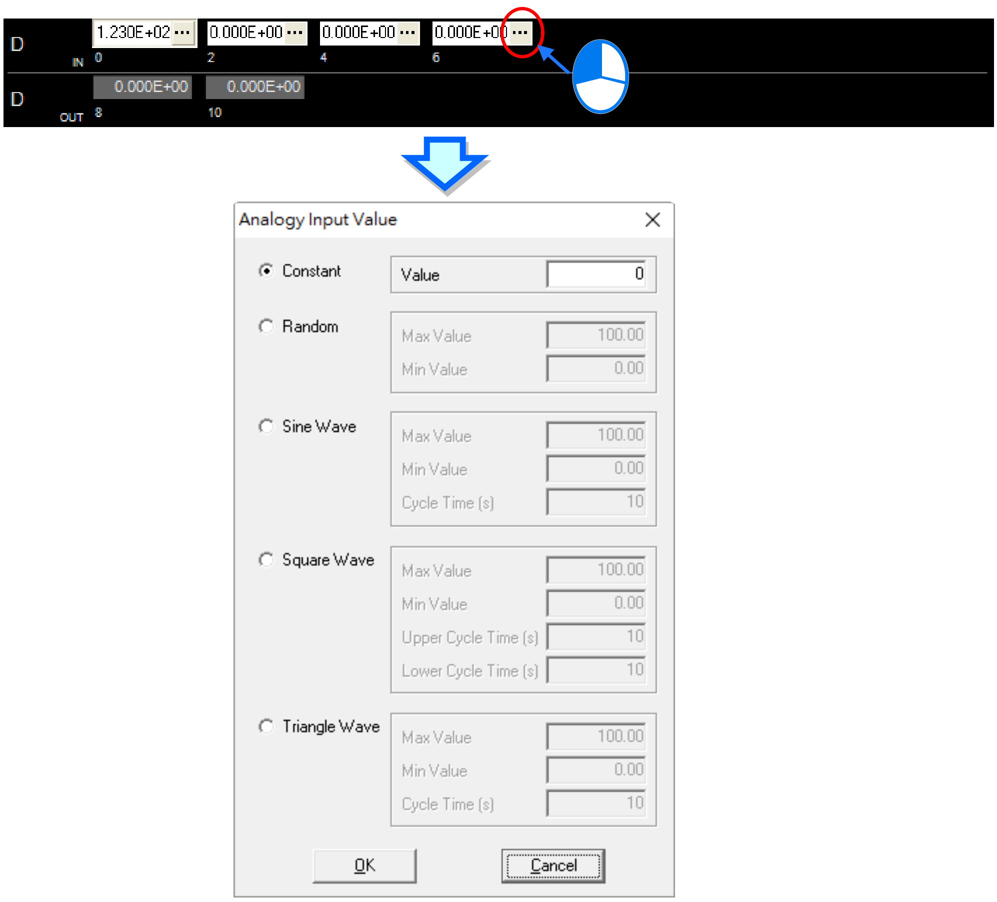
Users can switch to RUN mode and view the same HWCONFIG module configuration and state on IO module panel.



The following chart demonstrates the digital input and output registers area. The Y device offers only output status but cannot perform any operation; while X device offers users to click and change the ON/OFF status of each contact for external input simulation.

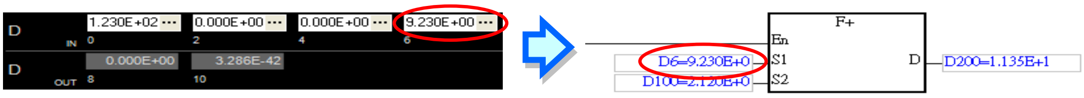


The following chart shows analog input and output registers area. Each column requires 32-bit floating- point format and corresponds to every channel of the actual module; for D8 and D10 (see below) corresponds to analog output channel - D device, the output are for viewing only; while D0, D2, D4 and D6 corresponds to analog input channel - D device. Users can click ··· to open the setup window (see below) for analog input value.

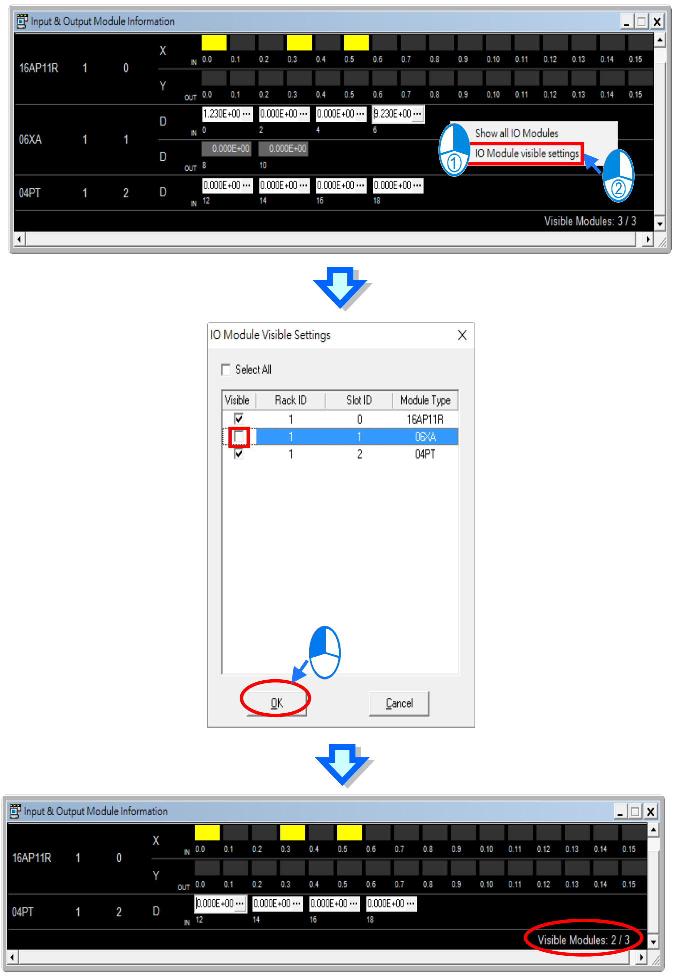


Signal Type	Description
Constant	A constant signal with fixed value.
Random	To assign the maximum and minimum value of random signal.
Sine Wave	To assign the maximum or minimum value and signal cycle of sine wave.
Square Wave	To assign the maximum or minimum value, ON and OFF times of cyclic square wave.
Triangle Wave	To assign the maximum or minimum value and signal cycle of triangle wave.

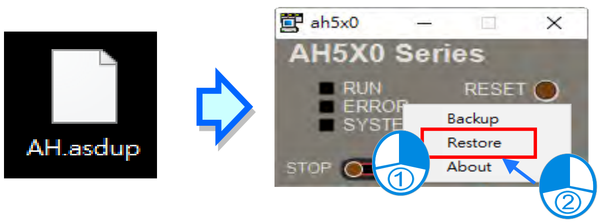
When setting is complete, the column (channel) will continue to send data to COMMGR based on the signal mode setup. While ISPSoft can conduct related tests when capturing simulator signals through COMMGR.



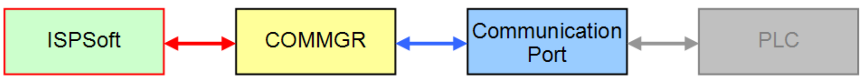
Users can right-click the IO module panel and select **Show All IO Module** to display all modules. To hide the modules, click **IO Module Visible Settings** and choose the module to hide from the list of module types then click **OK.** You will be able to view the current state on the right bottom corner of the window. (See below)



The AH5x0 and AH5x1 simulators also provides backup function which combines parameters and program backup into an *.asdup file then use this file and restore in other identical simulators. (See below)

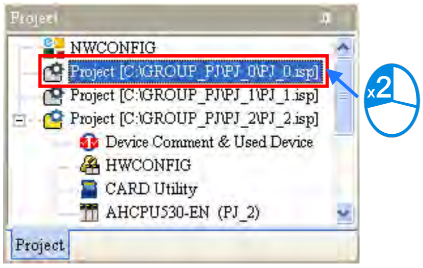


2.4.7 Creating Connection between ISPSoft and COMMGR

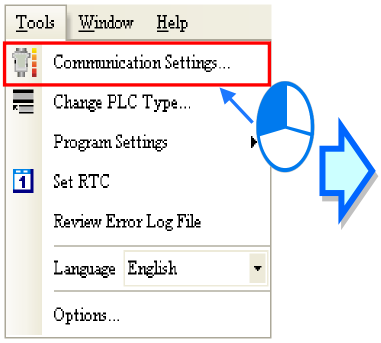


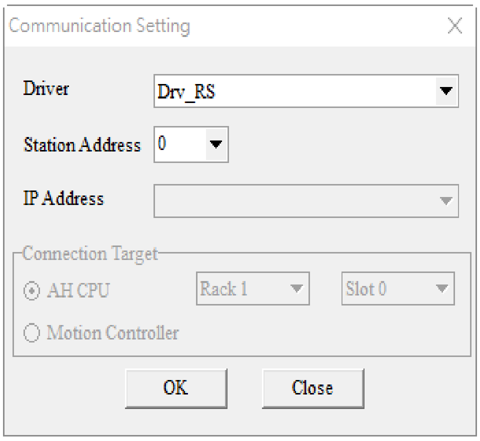
When a driver is created and also enabled in COMMGR, users can assign the driver and use it in ISPSoft. After the setting is complete, a connection between ISPSoft and COMMGR is formed. For single project setup, each requires an assigned communication, thus, under the structure of **group project,** users must open each single project and complete the setups.

(1) First, please enable the desired project for communication setup, but if under a single project structure, you can skip this step.

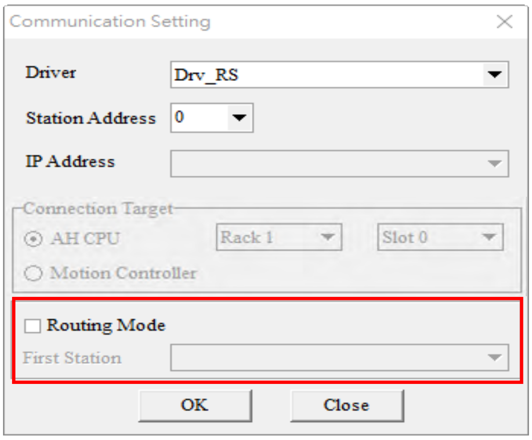


(2) Choose Communication Settings from Tools menu in ISPSoft and its setting window will appear.

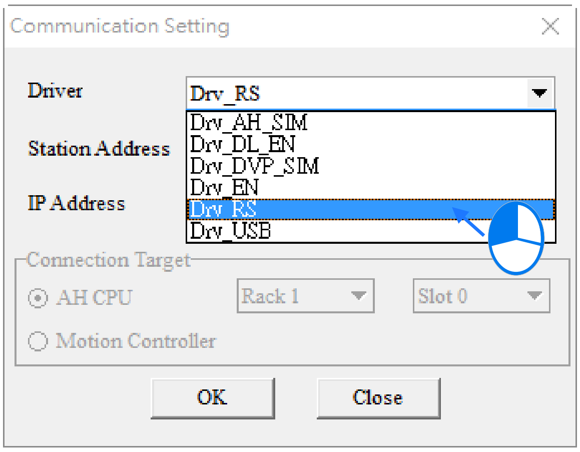




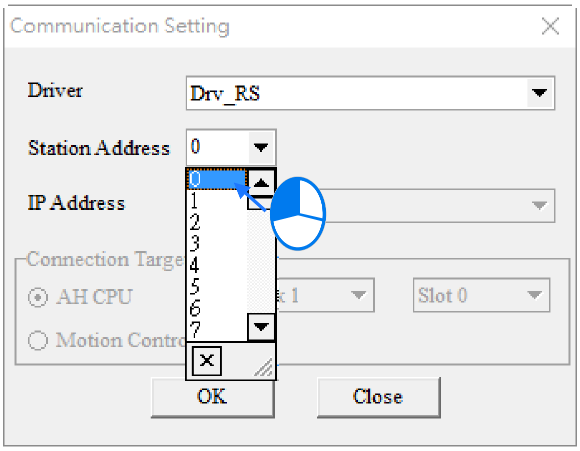
(3) When AH5x0 series is selected as the connection target for **group project**, the option **Routing Mode** is added and used together with **NWCONFIG**. Please refer to chapter 20 for more information.



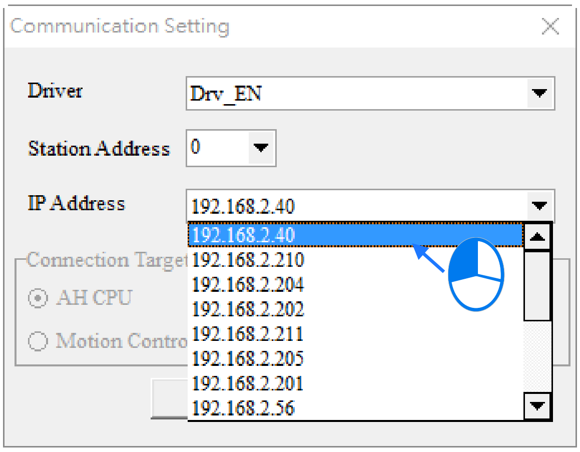
(4) Select the desired **Driver** from the drop-down list in **Communication Setting** window.



(5) Select the PLC station address from the drop-down list that is to connect with the PC or choose 0 for station address (broadcast).

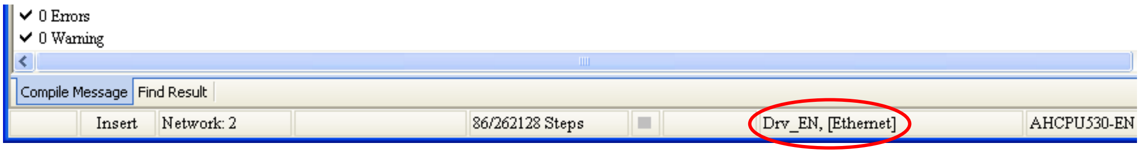


(6) When driver type is **Ethernet** or **DirectLink (Ethernet)**, users can select the desired **IP Address** to connect with PLC hosts from the drop-down list.



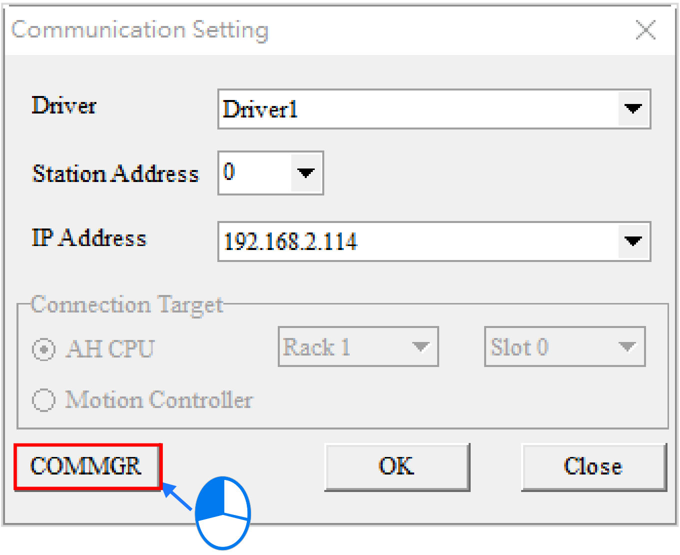
(7) Click **OK** once all settings are complete. Meanwhile, the current connected driver information will appear in the

ISPSoft status bar.

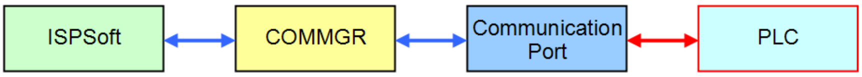


Additional remark

If COMMGR setting is modified, then communication settings in ISPSoft must be re-selected for proper connection. You can also call on the COMMGR settings window by clicking on the COMMGR button with the COMMGR version 1.09.05 or above.



2.4.8 Connecting PLC (Host) and Communication Port

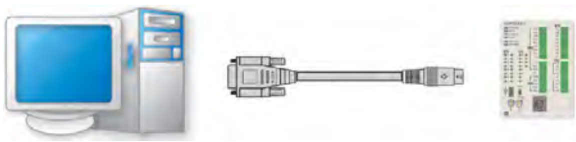


Users can use communication cables to connect PLC hosts and assigned communication ports. The following introduces most commonly used connections and useful notes. For more details, please refer to any types of PLC user manuals.

A. DVP series PLC (RS232)

Adopts **Delta communication cable** to connect a computer with a PLC host. Select RS232 for COMMGR driver type.

Note: Before connecting, please confirm that the setups in COMMGR drive concerning RS232 parameters is the same as in PLC hosts.



B. DVP-SX2 series PLC (USB)

A DVP-SX2 series PLC provides a type B mini USB interface. Users can use the USB cable to connect a PLC host with a computer. However, since the USB framework in SX2 series contains USB converting to RS232 (circuit built-in), therefore, the internal function adopts RS232 mode and is also selected as the COMMGR driver type.

Note:

(a) Please confirm that the USB driver is properly installed in SX2 series. For more details, please refer to Appendix A.

(b) Before connecting, please confirm that the setups in COMMGR drive concerning RS232 parameters is the same as in PLC hosts.

C. AH/AS series PLC (USB)

Adopts USB cable to connect a computer with a PLC host. The USB port of the host is a type B mini USB. Select USB (Virtual COM) for COMMGR driver type.

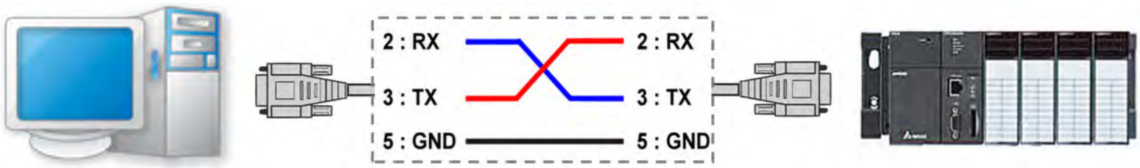
Note: Please confirm that the USB driver is properly installed in AH/AS series. For more information, please refer to Appendix A.

D. AH series PLC (RS232/422/485)

The COM port for AH series PLC host is a standard type, therefore, please use RS232 communication of RX and TX lines or an adapter that has jumper function to proceed the connection with a computer. Please select RS232/422/485 for COMMGR driver type.

Note: (a) Before connecting, please confirm that the setups in COMMGR drive concerning RS232 parameters is the same as in PLC hosts.

(b) The COM interface of AH series provides many modes including RS232/RS485/RS422. Before connecting, please confirm that current desired mode is correct. (Please refer to follow-up comments.)

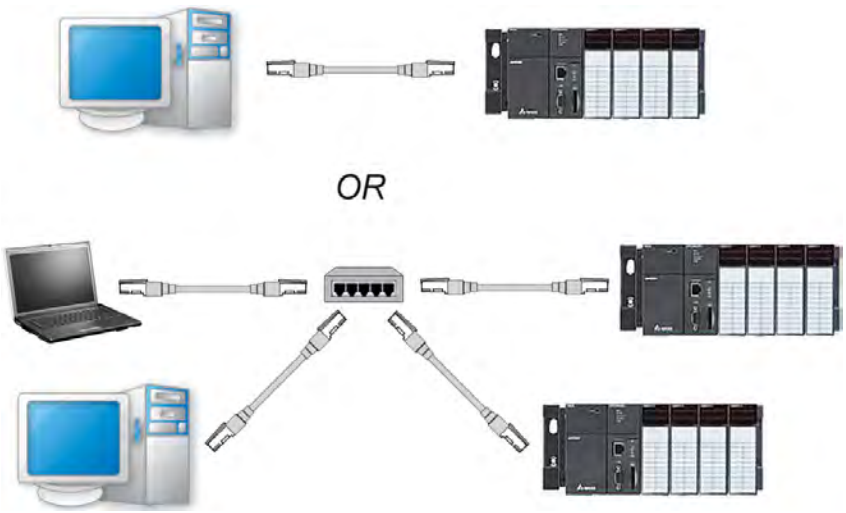


E. AH/AS series PLC, DVPxxMC, AS5xx and DVP-SE (Ethernet)

The AHCPU5xx-EN, AHxxEMC, AS series, DVPxxMC, AS5xx and DVP-SE series PLC hosts contain built-in RJ-45 port (Ethernet) and can connect with a PC through Ethernet. A PC can also connect with a PLC host to the same domain through the hub or uses direct network cable for connection. Please choose Ethernet for COMMGR driver type.

Note: (a) Before connecting, please check the structure of the internet is properly functioning.

(b) Check the accuracy of the Ethernet parameter in host CPU. Please refer to follow-up comments

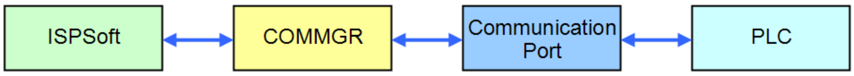


Additional remark

For communication parameter defaults regarding all PLC types, please refer to related user manuals.

2.4.9 Practical Connection Test

When all the steps mentioned above are completed, users can conduct a simple test to check on the connection with a PLC host is properly functioning.



Before connecting, please check on the following:

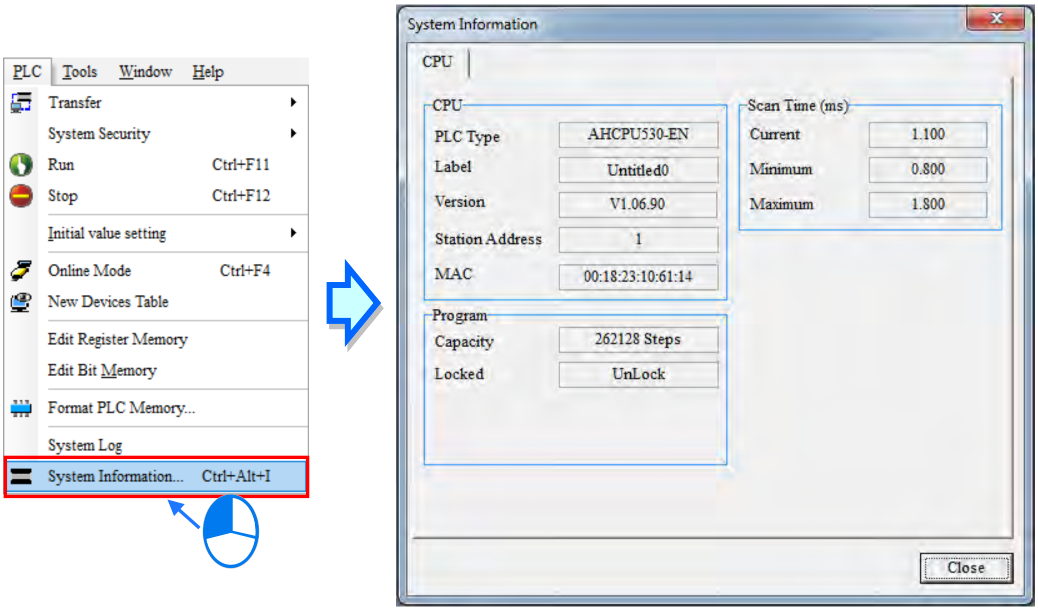
(a) A PLC host and PC is properly connected through communication cable, while the host power is turned on and well-functioning.

(b) Provides communication device including PC network cards, internet hub and serial port is properly functioning.

(c) To use the desired COMMGR driver, please check related parameters to be correct and the driver state is **OK**.

(d) Please check the assigned driver, station number and IP address in **Communication Setting** for ISPSoft is correct.

After confirming the list above, please select **System Information (I)** from **PLC** menu and a pop-up window will appear. However, if the pop-up window concerning system information did not appear, this means connection failure, users will need to check the above list (a) to (d) again.



MEMO

Chapter 3 PLC System Configuration & Settings

Table of Contents

You can use ISPSoft features and tools to set up configurations and parameters for DVP Series PLC and its entire system. For other series, you need to use HWCONFIG in ISPSoft to accomplish the same operation. The old HWCONFIGE does NOT have a unified interface for all the various PLC types but fortunately things are about to change. We have integrated the assorted interfaces and come up with a whole new version, HWCONFIG 4.0. Now the new HWCONFIG 4.0 is available for AS Series. We will continue to include all the other series in the near future. This chapter will introduce the steps and setups concerning configuration and parameter settings.

Series / Version	AS	AH5x0	AH5x1	AH560	AHxx EMC	DVP	AS5xx DVPxxMC
HWCONFIG 4.0	V						Only AS5xx
HWCONFIG 3.0		V	V	V	V	Only ES3	Only DVPxxMC

3.1 HWCONFIG 4.0 – Hardware Configuration Tool

HWCONFIG is one of the tools in ISPSoft for hardware configuration. Its functions include configuration of module racks, parameter settings for modules, download/upload hardware parameters and simple on-line detection and diagnosis function. HWCONFIG 4.0 provides you with different display theme styles, light and dark. Here we use light theme for display examples. Refer to section 3.1.2.6 for more details on theme style settings.

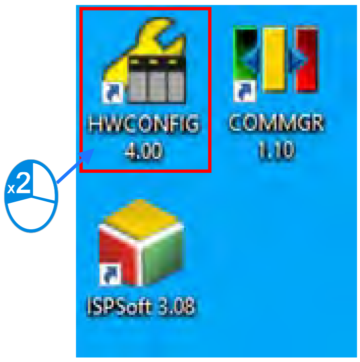
⚠ **The settings will only be effective when the parameters are downloaded to the PLC CPUs. Make sure you download the configuration parameters to the PLC CPU after the setups are complete.**

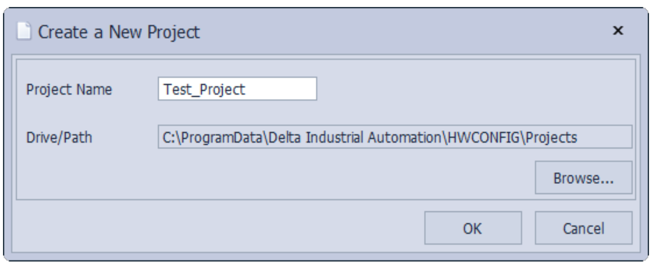
3.1.1 Open Your HWCONFIG 4.0

You can open HWCONFIG 4.0 either by clicking its shortcut icon as the image shown below or by clicking the setup option below Project in ISPSoft V3.10.

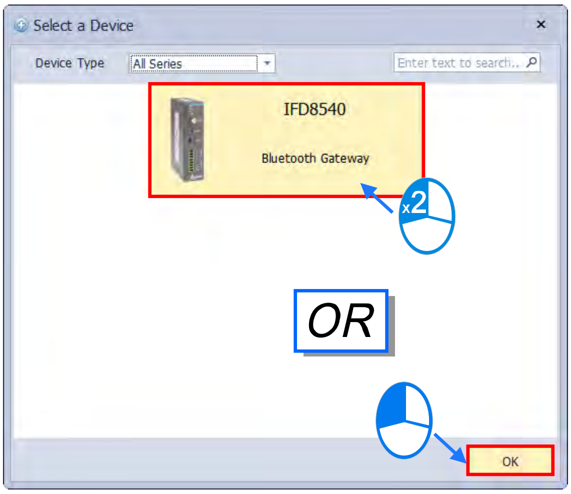
- **Open HWCONFIG 4.0 through its shortcut icon:**

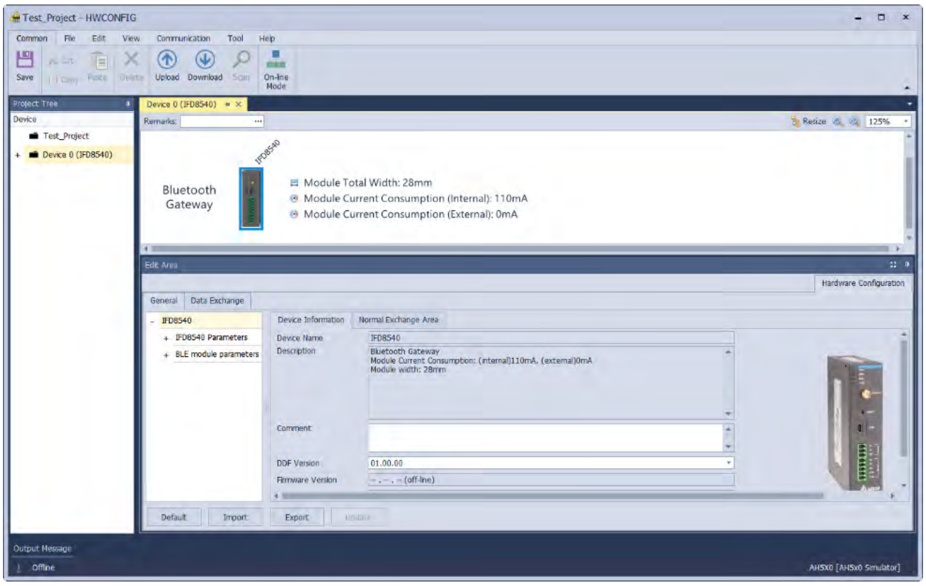
1. Double-click **HWCONFIG** icon to open HWCONFIG software.
2. In **Create a New Project** window, input a **Project Name** and choose a file saving path for the project.
3. Click **OK**.





4. Choose a device type from the drop-down list on the **Select a device** page and double click on the target PLC device or you can click on the **OK** button after selecting the PLC device to enter the operation page shown as below.



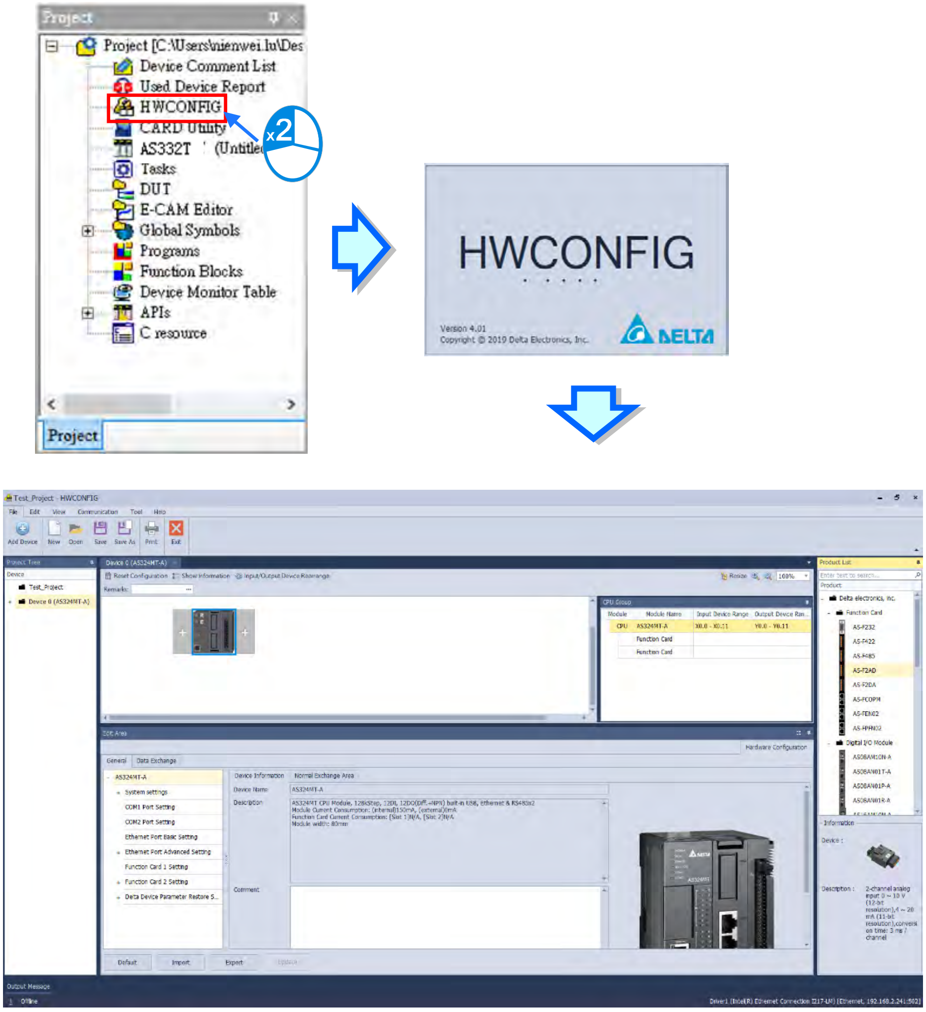


- **Open HWCONFIG 4.0 through ISPSoft V3.10:**

1. Double-click **ISPSoft** icon to open ISPSoft software.

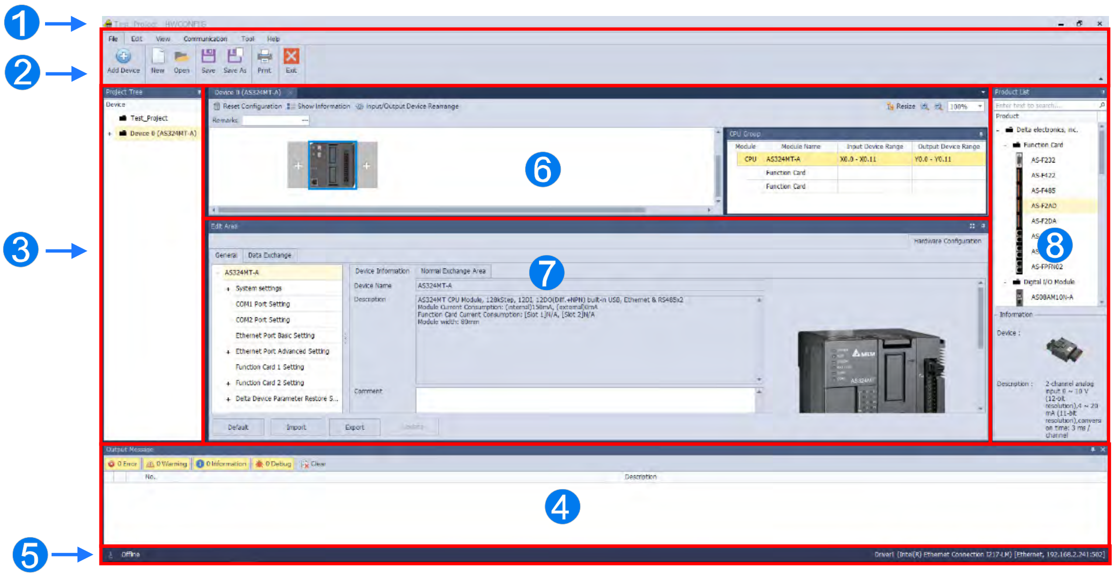
2. Open an existing project or create a new project in ISPSoft. Click *File->New* or click the icon  to open the **Create a New Project** window. Input a **Project Name**, select a **Controller Type** and **PLC Type** and then choose a file saving path for the project. Click **OK**.

3. Double-click **HWCONFIG** in the Project section to open HWCONFIG 4.0.



3.1.2 HWCONFIG 4.0 Environment

HWCONFIG 4.0 Environment is consist of Window Title, Tool Bar, Project Tree, Output Message Section, Status Bar, Hardware Configuration Area, Edit Area and Product List. The options under them may vary according to the device selected.



❶ **Window Title:** Here shows the current project name.

❷ **Tool Bar:** There are 6 tabs on the tool bar.

❸ **Project Tree:** Tree-structured projects for easier management

❹ **Output Message Section:** Here shows project related information.

❺ **Status Bar:** Here shows the connection status and the communication parameters.

❻ **Hardware Configuration Area:** You can set up hardware configuration here.

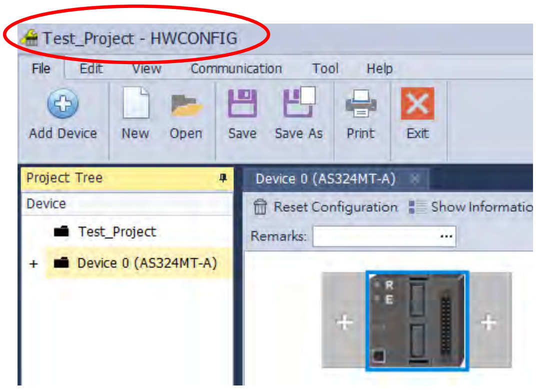
❼ **Edit Area:** You can set up parameters for PLC CPU and modules.

❽ **Product List:** You can find available hardware here.

3.1.2.1 Window Title and Status Bar

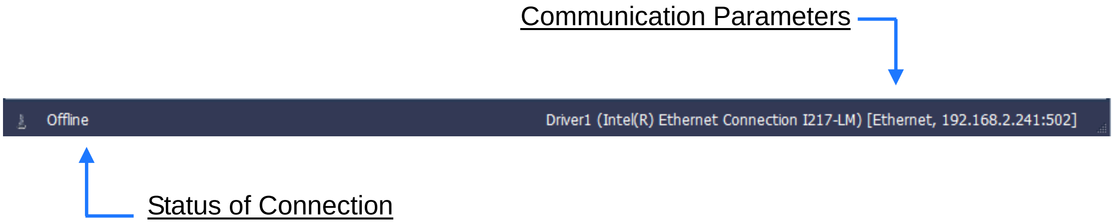
- **Window Title**

After you have created your project, the name of your created project shows in here.



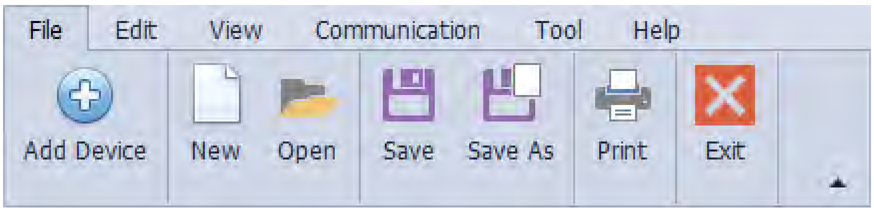
- **Status Bar**

From the Status Bar, you can find the connection status and the communication parameters.



3.1.2.2 File Tab

File Tab: Use options under this tab to create, save or print a project.

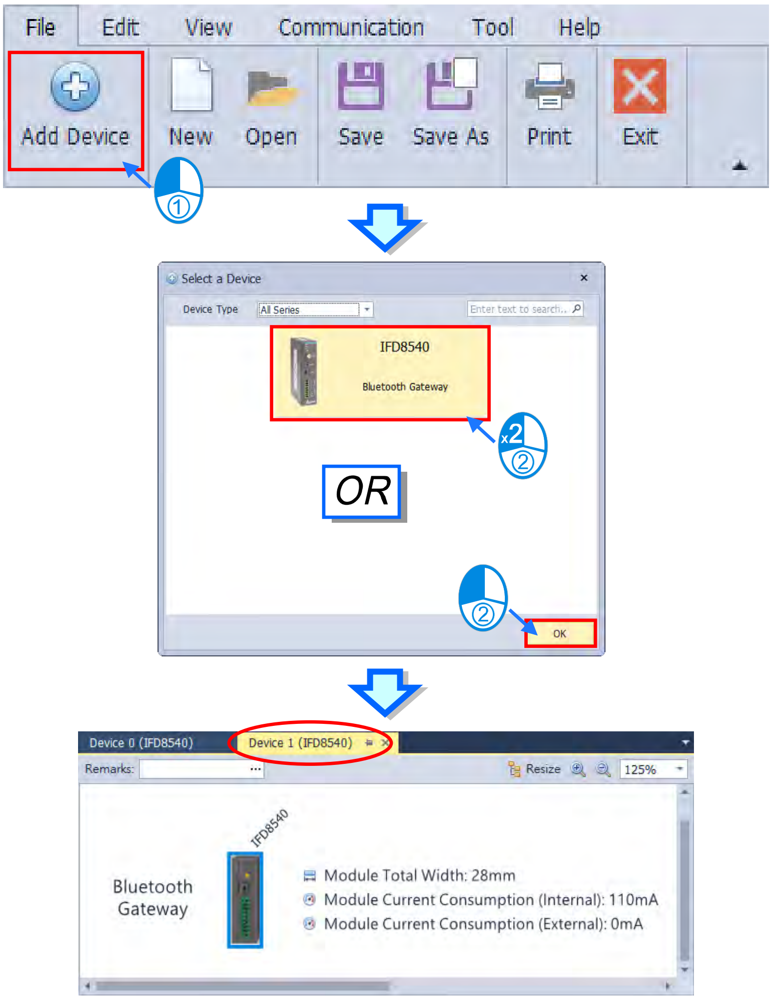


Item	Description
Add Device	Add a new PLC CPU to the current project. (only available for standalone HWCONFIG software)
New	Create a new project. (only available for standalone HWCONFIG software)
Open	Open an existing project. (only available for standalone HWCONFIG software)

Save	Save a project.
Save As	Save the project to another location or another project name.
Print	Print the hardware configuration.
Exit	Exit HWCONFIG 4.0

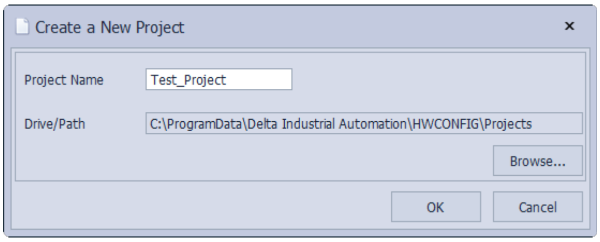
- **Add Device**

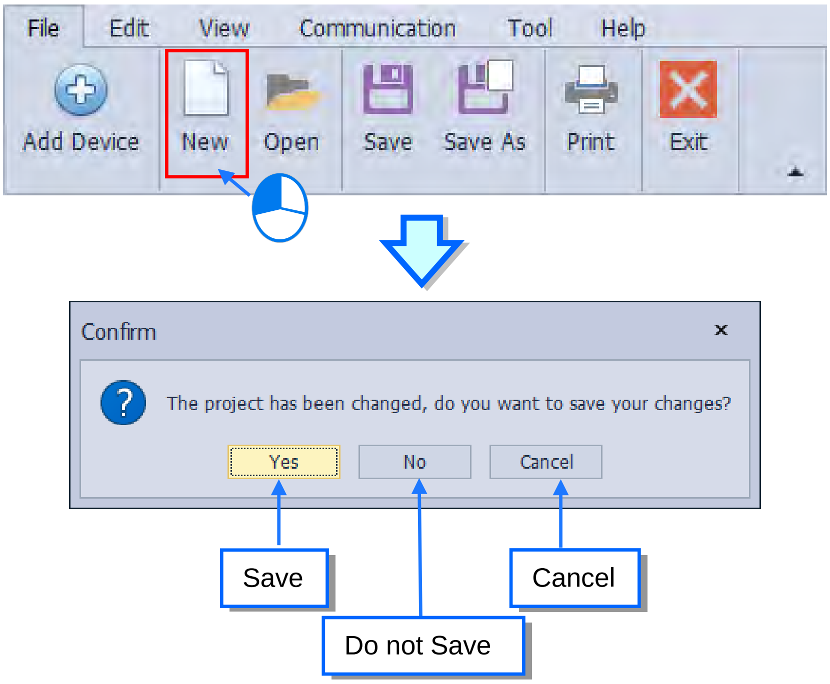
Only available for standalone HWCONFIG software. This feature allows users to add another device in a project. By clicking "**Add Device**" on the File tab, the "**Select a Device**" window will pop up. Double-click on the target PLC device or you can click on the "**OK**" button directly after selecting the PLC device, and a new device would be added in the project with a new tab created as shown below.



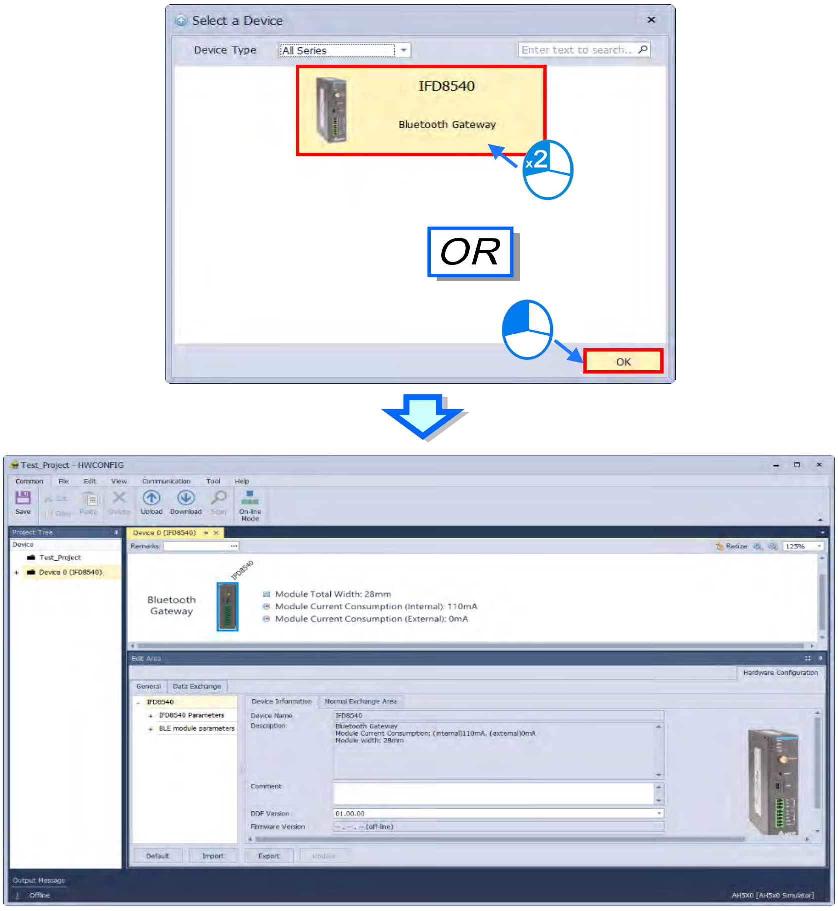
- **New**

Only available for standalone HWCONFIG software. To create a new project, click the "**New**" button on the File tab or use shortcut key **Ctrl+N**., then an enquiry about whether to save the current project will be shown with (Y) for yes, (N) for no, (Cancel) for cancelling the action of creating a new project. After the new window of Create a New Project pops up, input the project name and the Drive/ Path and click "**OK**".



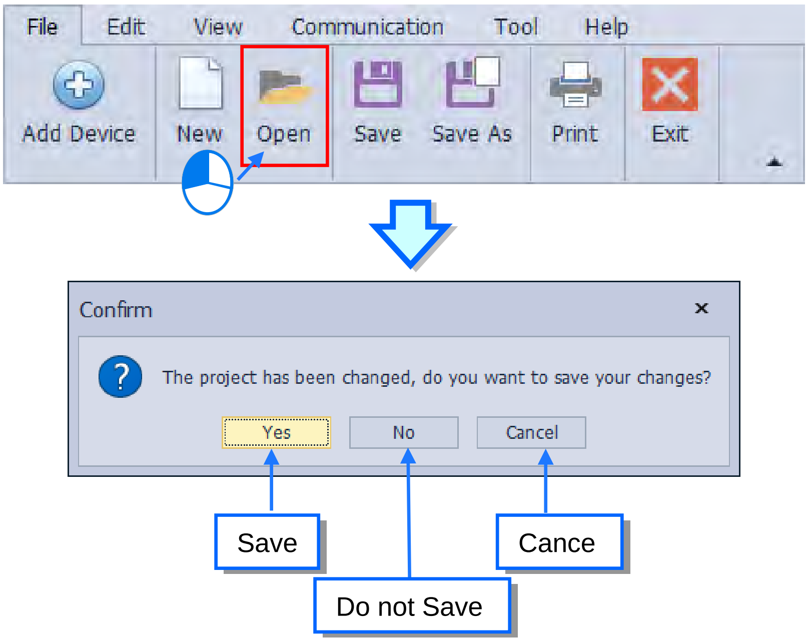


The window of "**Select a Device**" will be displayed afterwards. Choose a device type from the drop-down list on the page, then double- click on the target PLC device or you can click on the "**OK**" button after selecting the device to enter the operation page shown as below.

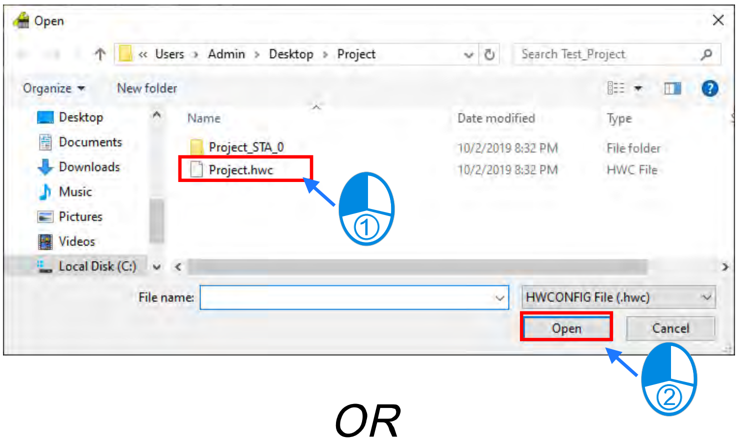


- **Open**

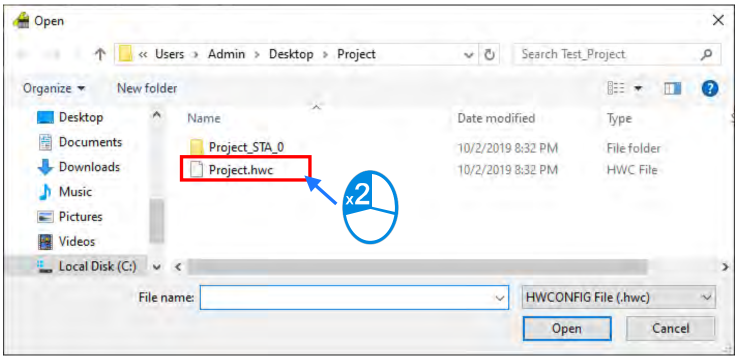
Only available for standalone HWCONFIG software. To open an existing project, click the "**Open**" button on the File tab or use shortcut key **Ctrl+O**., then an enquiry about whether to save the current project will be shown with (Y) for yes, (N) for no, (Cancel) for cancelling the action of opening a project.



Find the file and choose “**.hwc**” for the file type, then click “**Open(O)**” or double-click on the file to open the target file.

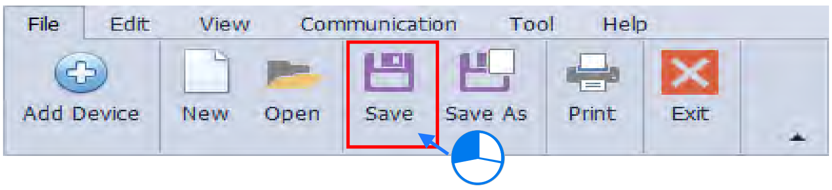


OR

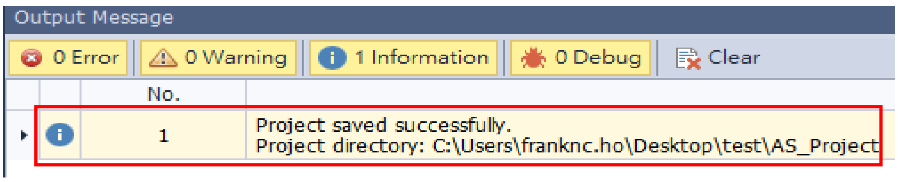


- **Save**

Click the “**Save**” button on the File tab or use shortcut key **Ctrl+S**.

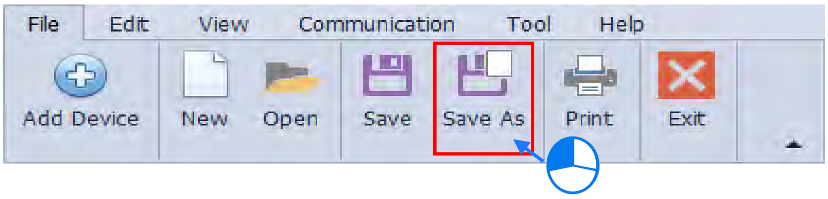


After save successfully, the output window will displays as below and shows the project directory.

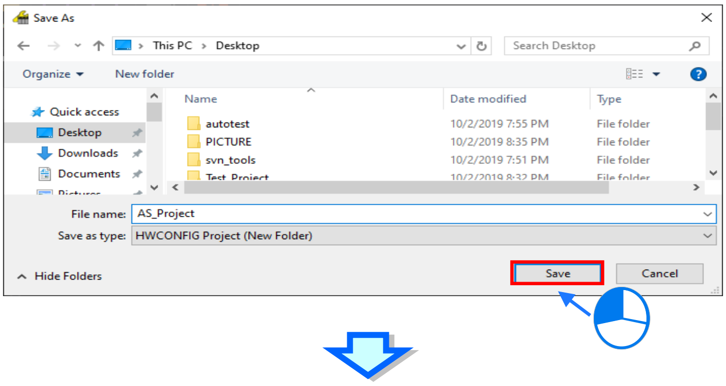


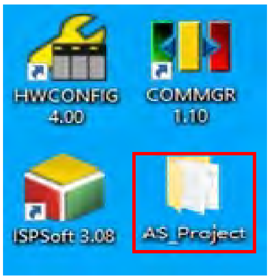
- **Save As**

Only available for standalone HWCONFIG software. Click the “**Save As**” button on the File tab or use shortcut key **Ctrl+Alt+S**.



Input the file name and click on “**Save(S)**”, then the file will be saved in the new folder.

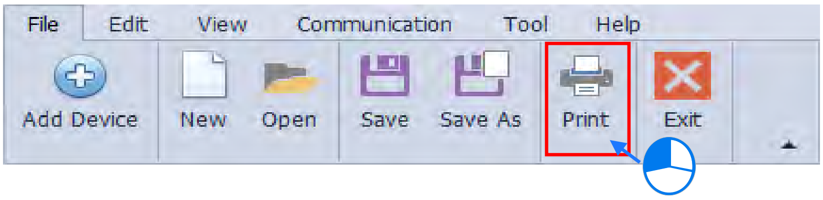


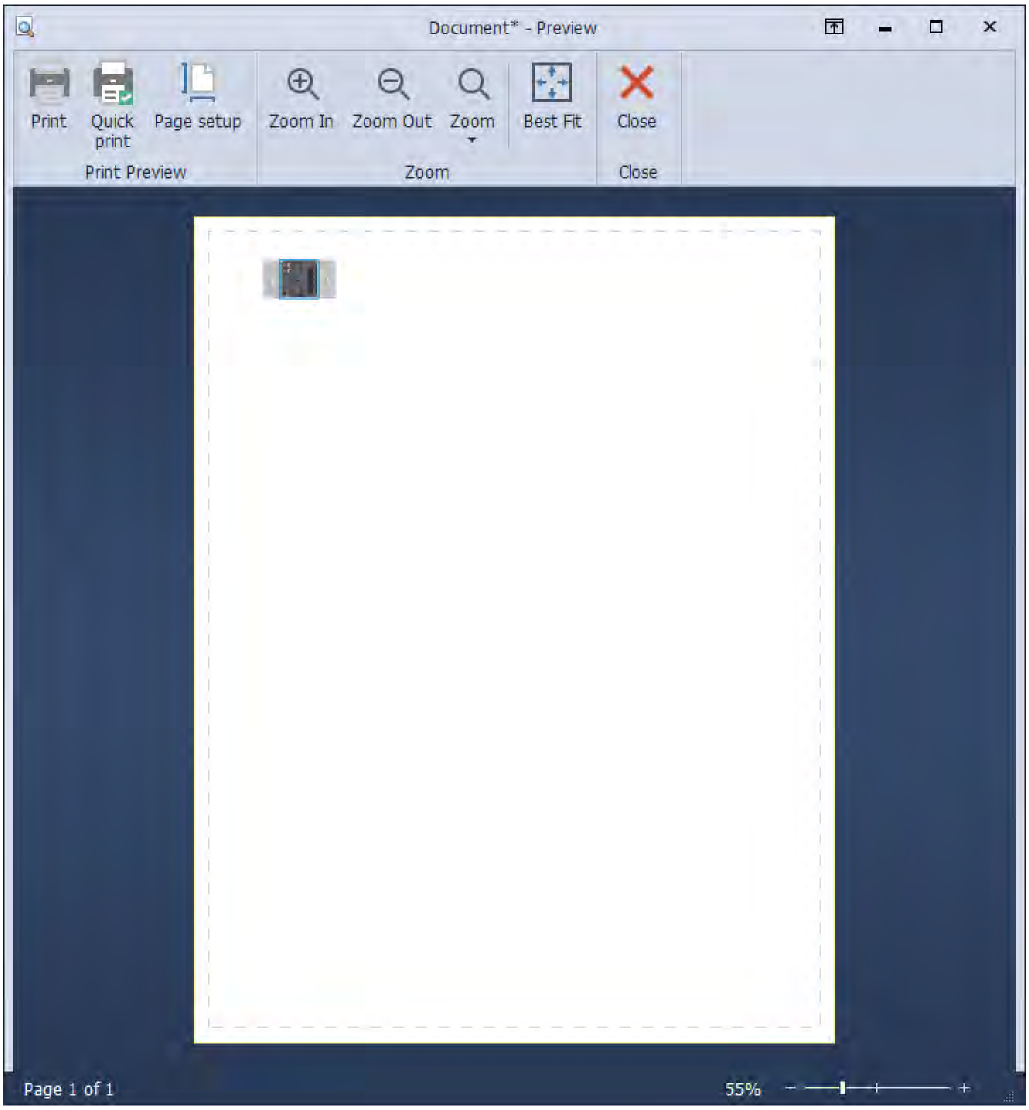


- **Print**

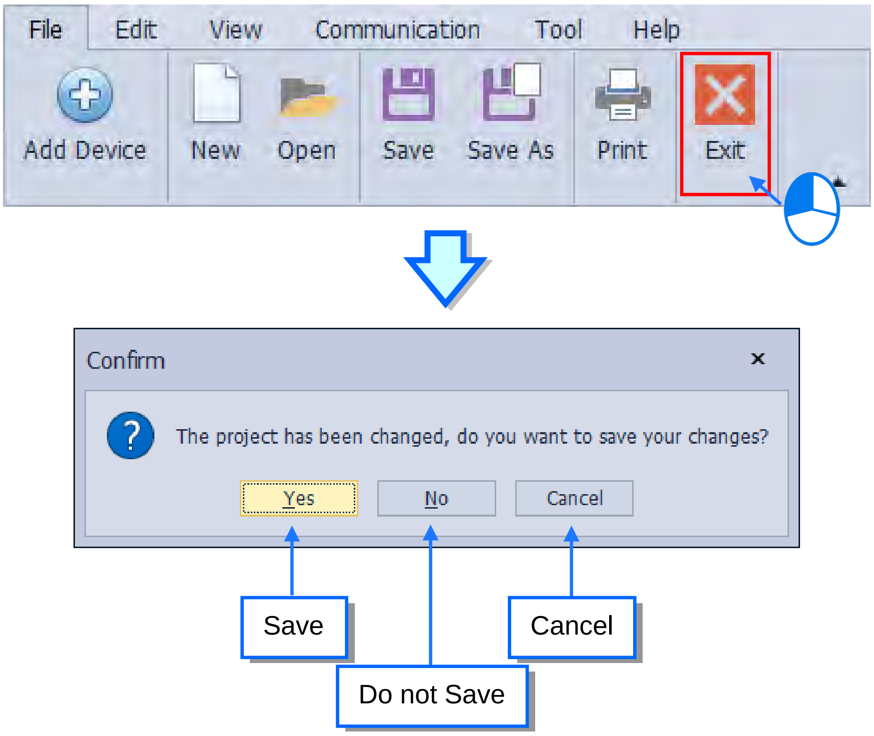
To print the hardware configuration:

Click the “**Print**” button on the File tab or use shortcut key **Ctrl+P t**o enter the printing setting window.



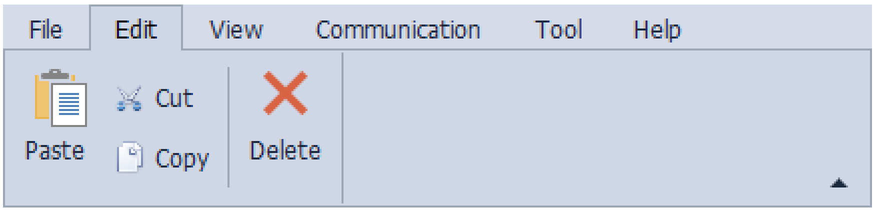


- **Print Preview**（**Printer setting**）
- **Print**：Change the printing properties.
- **Quick print**：Print out directly.
- **Page setup**：Adjust the page setup.
- **Zoom**（**Preview the image size**）
- **Zoom In**：Zoom in the image display.
- **Zoom Out**：Zoom out the image display.
- **Zoom**：Change the aspect ratio.
- **Best Fit**：Adjust the size of the preview image according to the window size.



3.1.2.3 Edit Tab

Edit Tab: Use options under this tab to paste, cut, copy or delete to add or remove devices from the hardware configuration area.

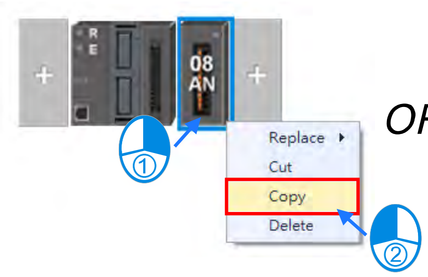


Item	Description
Paste	After selecting an added device in the hardware configuration area, click **CUT** or **COPY**, and then use **Paste** to move or add the selected device to a new positon.
Cut	After selecting an added device in the hardware configuration area, click **CUT** to remove the selected device.
Copy	After selecting an added device in the hardware configuration area, click **Copy** to add the selected device in the hardware configuration area.
Delete	After selecting an added device in the hardware configuration area, click **Delete** to remove the selected device.

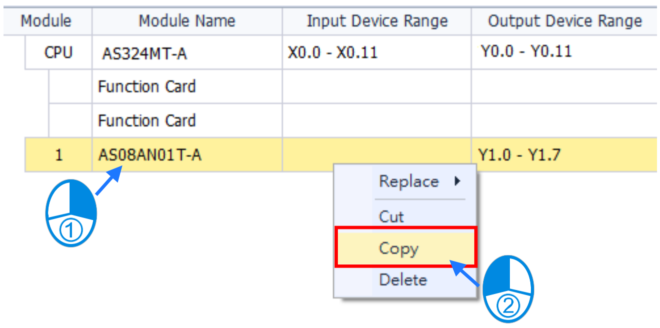
- **Copy**

-There're two ways to copy devices in the hardware configuration area.

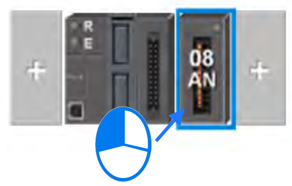
Ⓐ Right-click the selected device on the hardware configuration or the configuration list, then click "**Copy**" on the shortcut list.



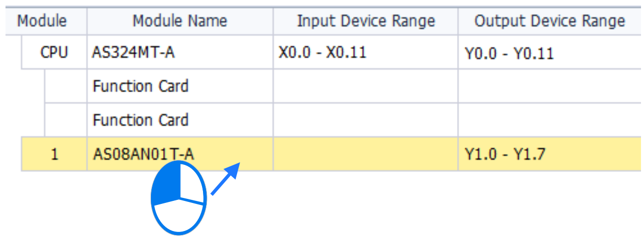
OR

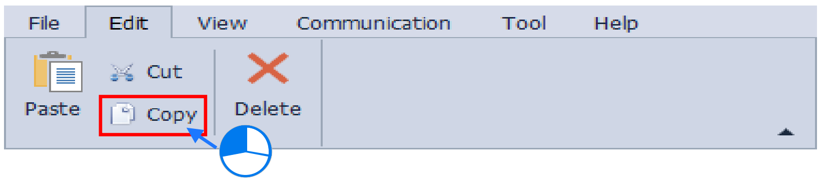


Ⓑ Select the target device on the hardware configuration or the configuration list. Then click "**Copy**" on HWCONFIG tool bar under the Edit tab or use shortcut key **Ctrl+C.**



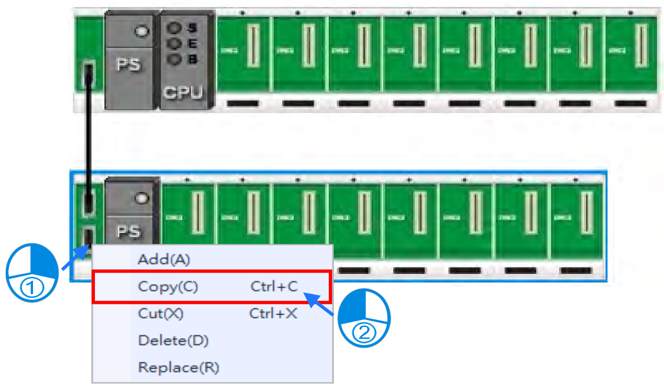
OR



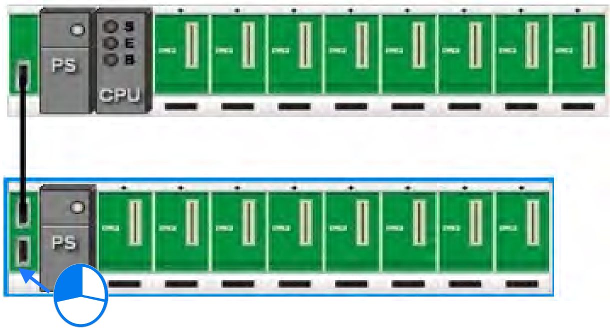


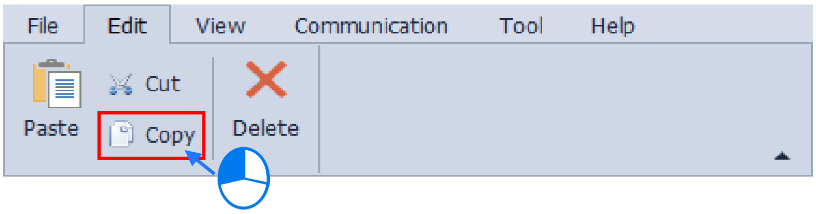
-There're two ways to copy extension backplanes in the hardware configuration area.

Ⓐ Right-click the selected extension backplane on the hardware configuration, then click "**Copy**" on shortcut list.

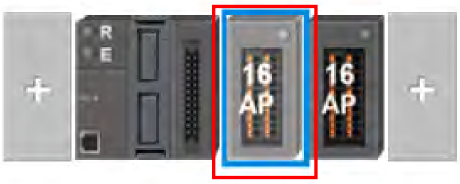


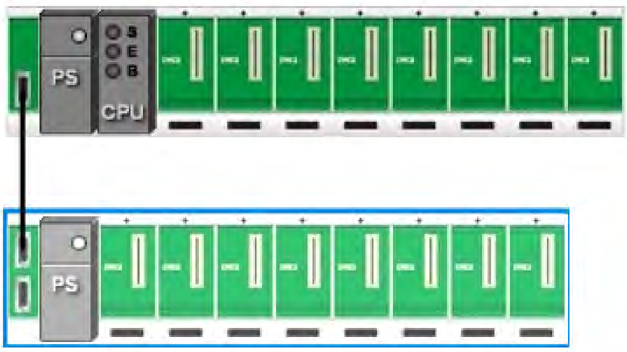
Ⓑ Select the target extension backplane on the hardware configuration. Then click “**Copy**” on HWCONFIG tool bar under the Edit tab or use shortcut key **Ctrl+C.**





The objects being cut will turn grey. To remove the grey shading, you would have to copy and paste the object, or simply delete it. Instead, you can also choose another object to perform cut or copy and then paste.

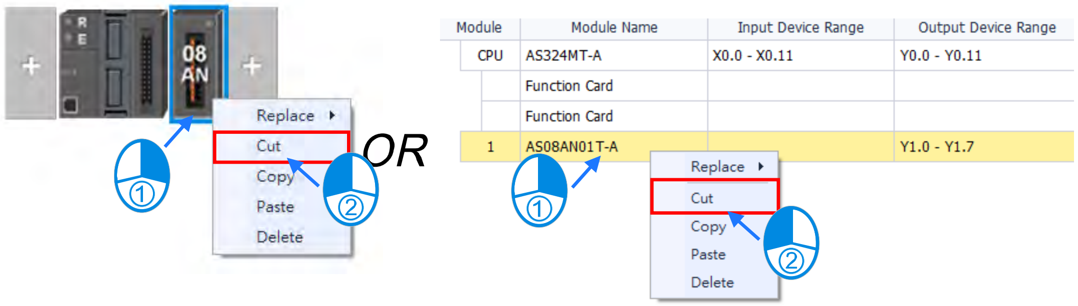




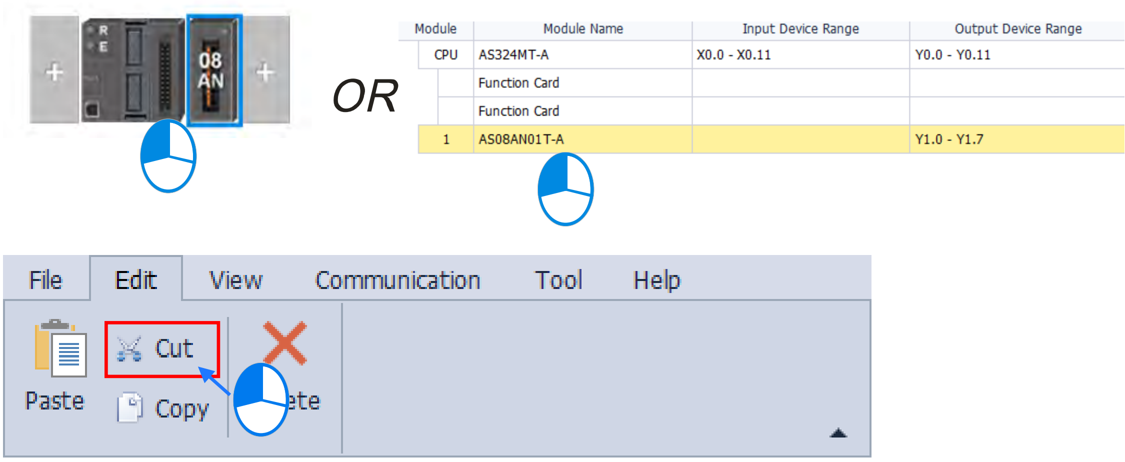
- **Cut**

-There’re two ways to remove devices.

Ⓐ Right-click the selected device on the hardware configuration or the configuration list, then click “**Cut**” on the shortcut list.



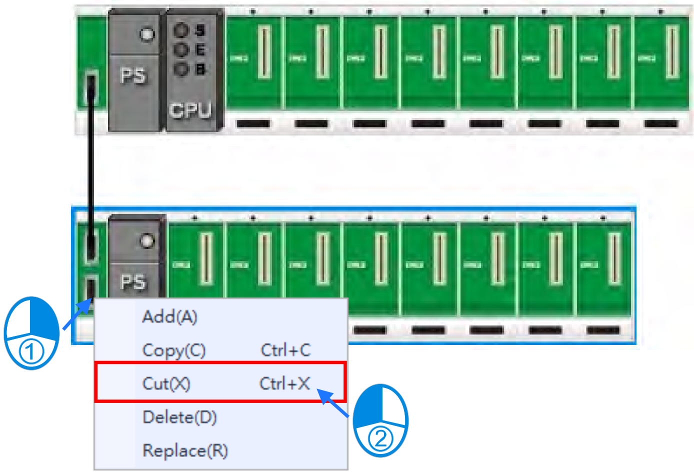
Ⓑ Select the target device on the hardware configuration or the configuration list. Then click “**Cut**” on HWCONFIG tool bar under the Edit tab or use shortcut key **Ctrl+X.**



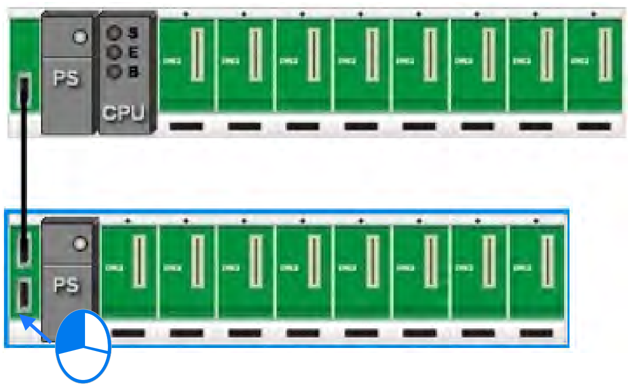
The removed device will be grayed-out on the hardware configuration. If intend to enable the device again, you must copy and paste the device, or delete the greyed device, then copy/cut other devices and paste.

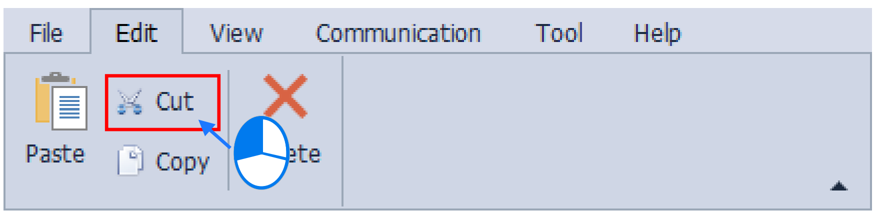
There’re two ways to remove extension backplanes.

Ⓐ Right-click on the left side of the selected backplane on hardware configuration, then click “**Cut**” on shortcut list.



Ⓑ Click on the left side of the target backplane on hardware configuration. Then click “**Cut**” on HWCONFIG tool bar under the Edit tab or use shortcut key **Ctrl+X.**

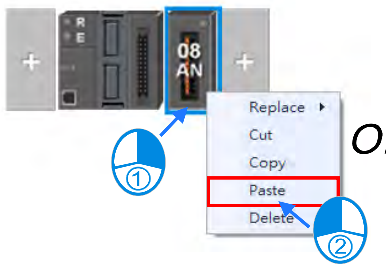




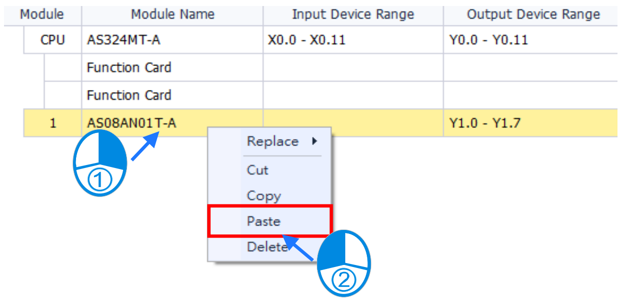
- **Paste**

-There're two ways to paste devices.

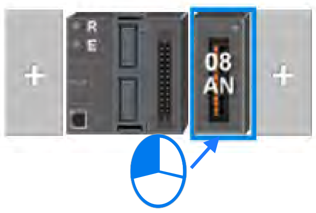
Ⓐ Right-click the selected slot or location either on the hardware configuration or the configuration list and choose "**Paste**" on the shortcut list.



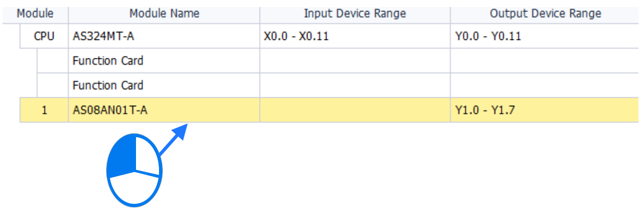
OR

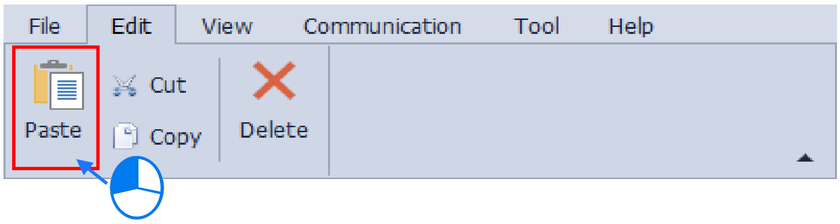


Ⓑ Select a slot or location either on the hardware configuration or the configuration list you intend to paste on. Then click "**Paste**" on HWCONFIG tool bar under the Edit tab or use shortcut key **Ctrl+V.**



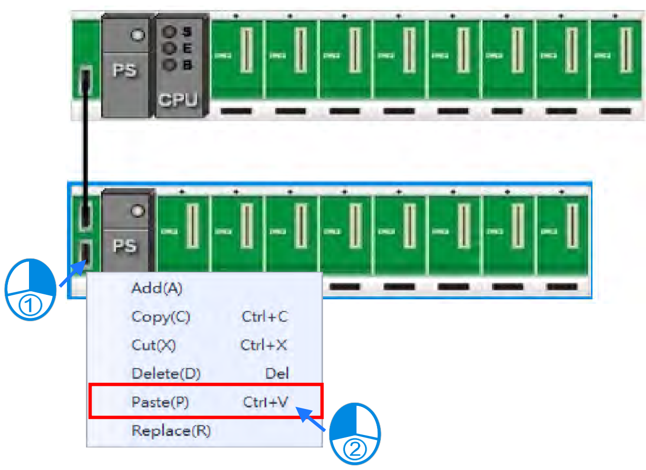
OR



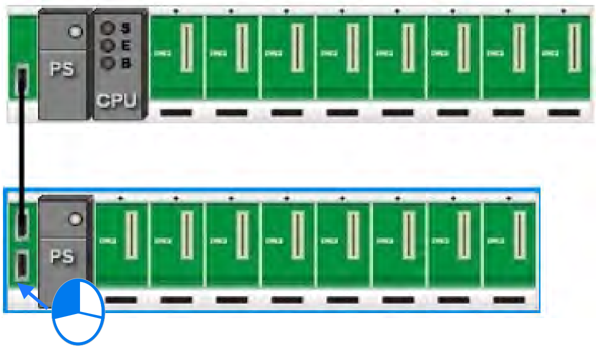


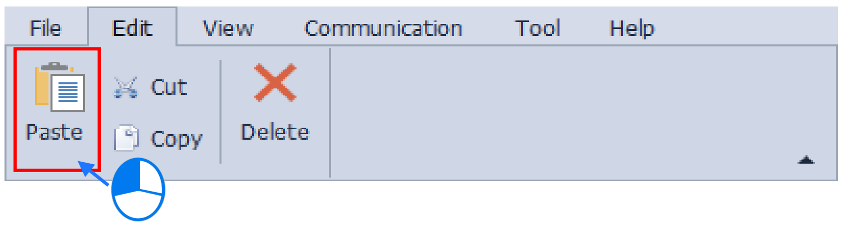
-There're two ways to paste extension backplane.

Ⓐ Right-click the selected location on the hardware configuration and choose "**Paste**" on the shortcut list.

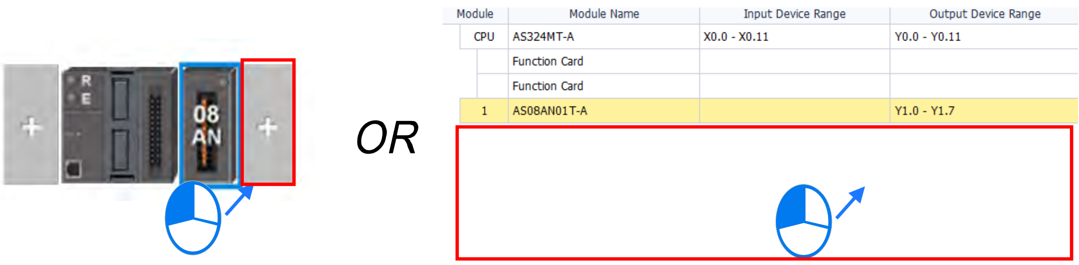


Ⓑ Select a location either on the hardware configuration you intend to paste on. Then click “**Paste**” on HWCONFIG tool bar under the Edit tab or use shortcut key **Ctrl+V.**

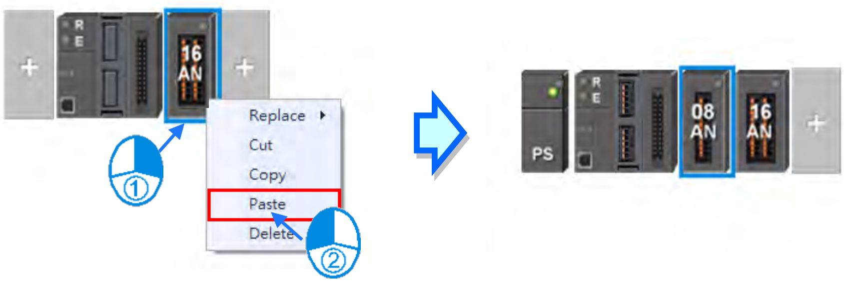




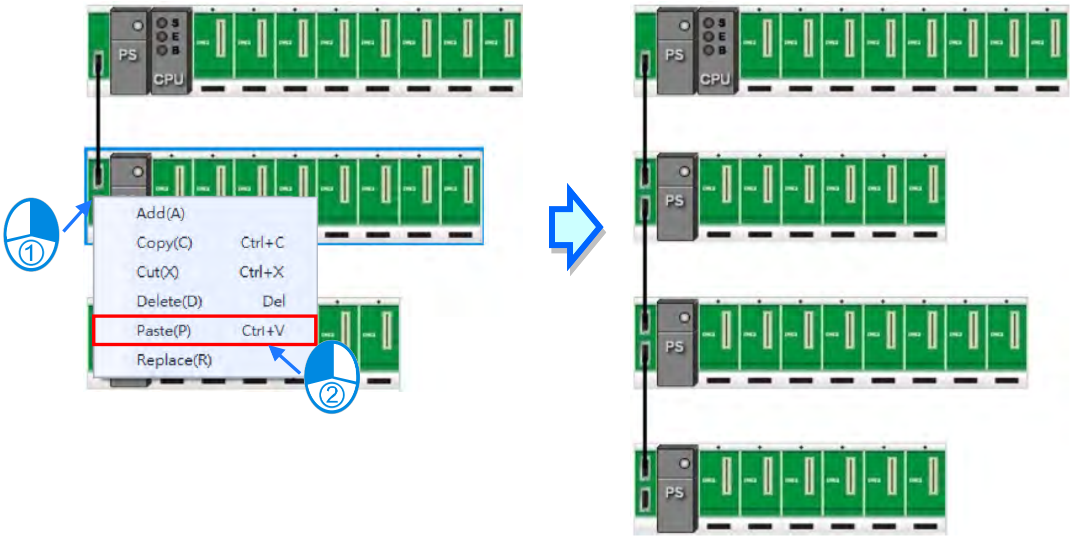
AS series devices are designed without rear panels. If not choosing a target location to paste, the device can only be pasted on the most right hand side and the blank row at the bottom of the configuration list.



If the target location has been occupied by another device, it will be pasted on the left side of the target location while others will move to the right as the following figure shows.



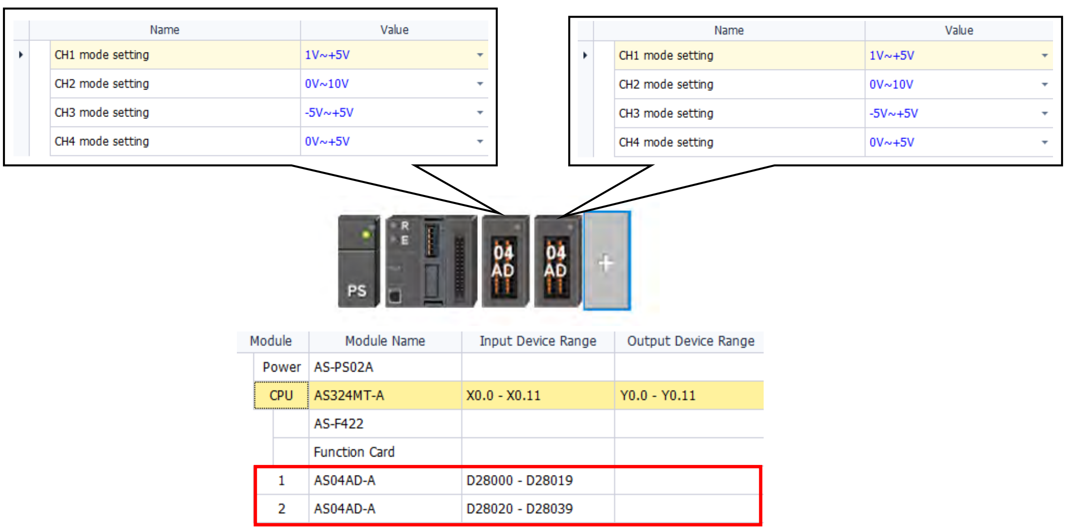
However if there has already been extension backplanes on the target location, the object would be pastes above on the selected location as the following shown, which the eight pieces of extension backplanes move to the underside of the pasted objects.



Note:

When perform “**Paste**” operation, the rules of parameters are as follows.

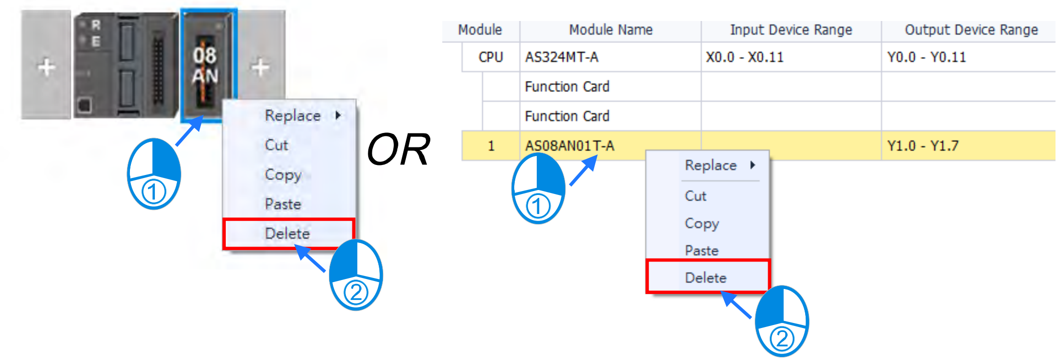
- **I/O range of devices:** Arrange the input/ output range data from the first module on the right side with no duplication. And the devices of pasted modules will be automatically redirected to applicable addresses.



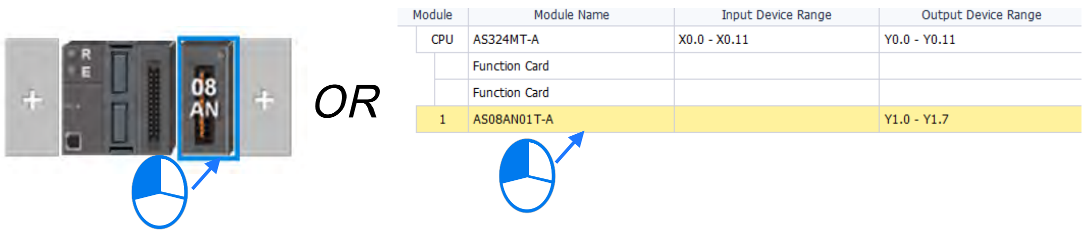
- **Delete**

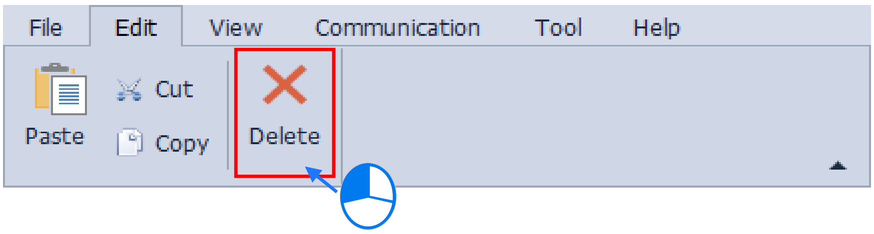
-There are two ways to delete modules.

Ⓐ Right-click the selected device either on the hardware configuration or the configuration list and choose "**Delete**" on the shortcut list.



Ⓑ Select the target module either on the hardware configuration or the configuration list you intend to delete. Then click "**Delete**" on HWCONFIG tool bar under the Edit tab or press DELETE key.

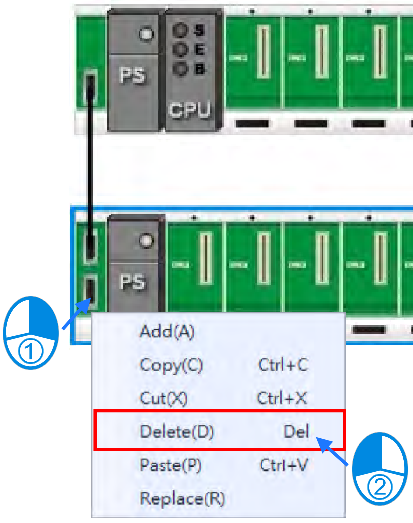




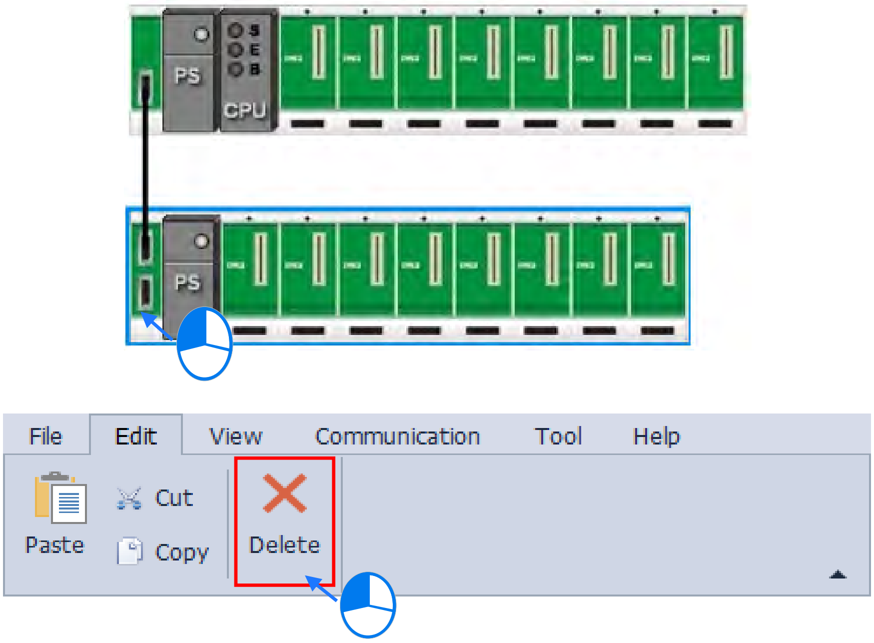
3

-There are two ways to delete extension backplanes.

Ⓐ Right-click the selected extension backplane on the hardware configuration and choose “**Delete**” on the shortcut list.

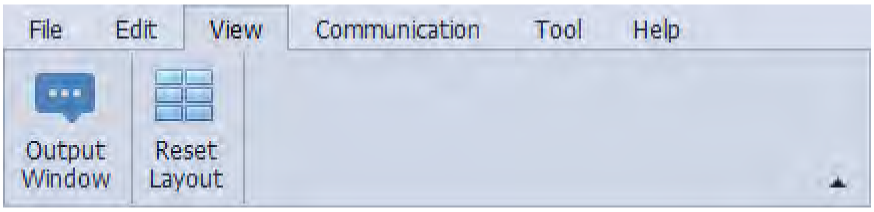


Ⓑ Select the target extension backplane on the hardware configuration you intend to delete. Then click “**Delete**” on HWCONFIG tool bar under the Edit tab or press DELETE key.



3.1.2.4 View Tab

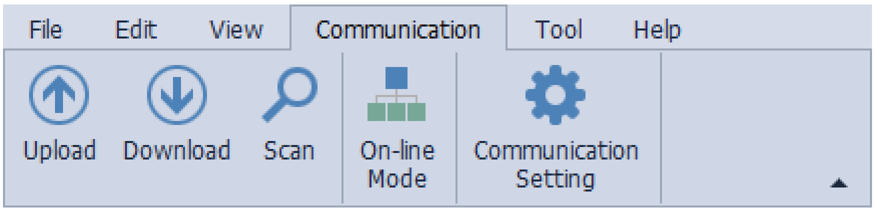
View Tab: Use options under this tab to view information of projects and organize the HWCONFIG display.



Operation button	Function description
Output Window	Open or close output window.
Reset Layout	Reset the page layout of HWCONFIG.

3.1.2.5 Communication Tab

Communication Tab: Perform operating tasks and configure the settings via connection between HWCONFIG and PLC device.



Item	Description
Upload	Upload PLC parameters and module configurations to HWCONFIG for further configuration.
Download	Download parameters and configuration in HWCONFIG to PLC.
Scan	Scan the current connected module configurations.
On-Line Mode	Monitor the module status and its information.
Communication Setting	Set up the communication for the PLC.

- **Upload/ Download**

  Configuration made with HWCONFIG must be downloaded to the CPU module so as to be activated.

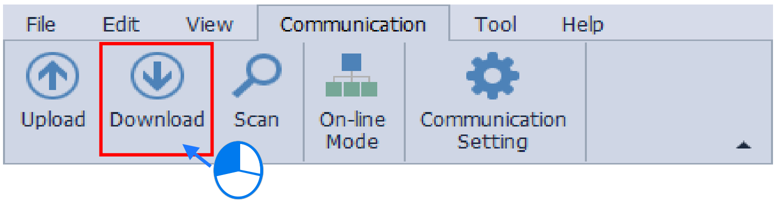
  ① Please make sure you've finished the communication settings before performing upload/ download operation.

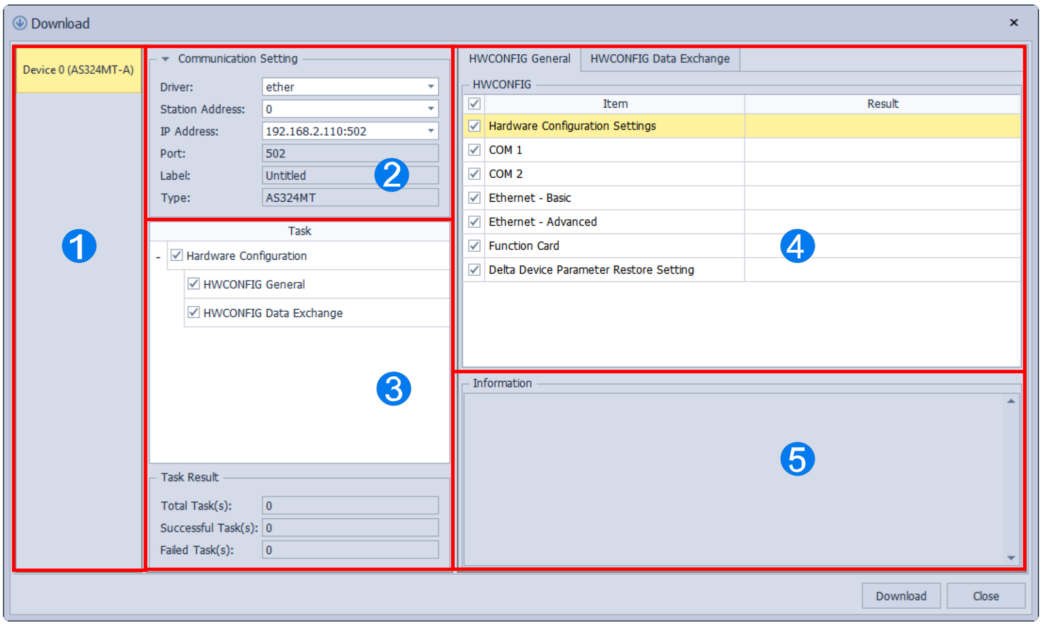
② If you open HWCONFIG via ISPSoft, the communication setting of ISPSoft would be adopted by HWCONFIG. Therefore, the connection between ISPSoft and the CPU module must functions properly. Also, if the label name of CPU module is not same as the one in parameter settings, an alert message will be shown on the display.

③ The upload and download of hardware configuration with HWCONFIG would not include EtherNet IP and EtherCAT. In case you want to configure EtherNet IP or EtherCAT, please open the corresponding page and click Upload or Download on the page, which is detailed in section 3.1.5 and 3.1.6.

- **Download hardware configuration parameters**

Click “**Download**” from the toolbar on “**Communication**” tab. or use shortcut key Ctrl+B, then the download window will pop up.





❶ **Device:** Display the device’s name and model you are currently editing.

❷ **Communication Setting:** Configure the communication settings and display the PLC device’s name and model you are currently using for communication.

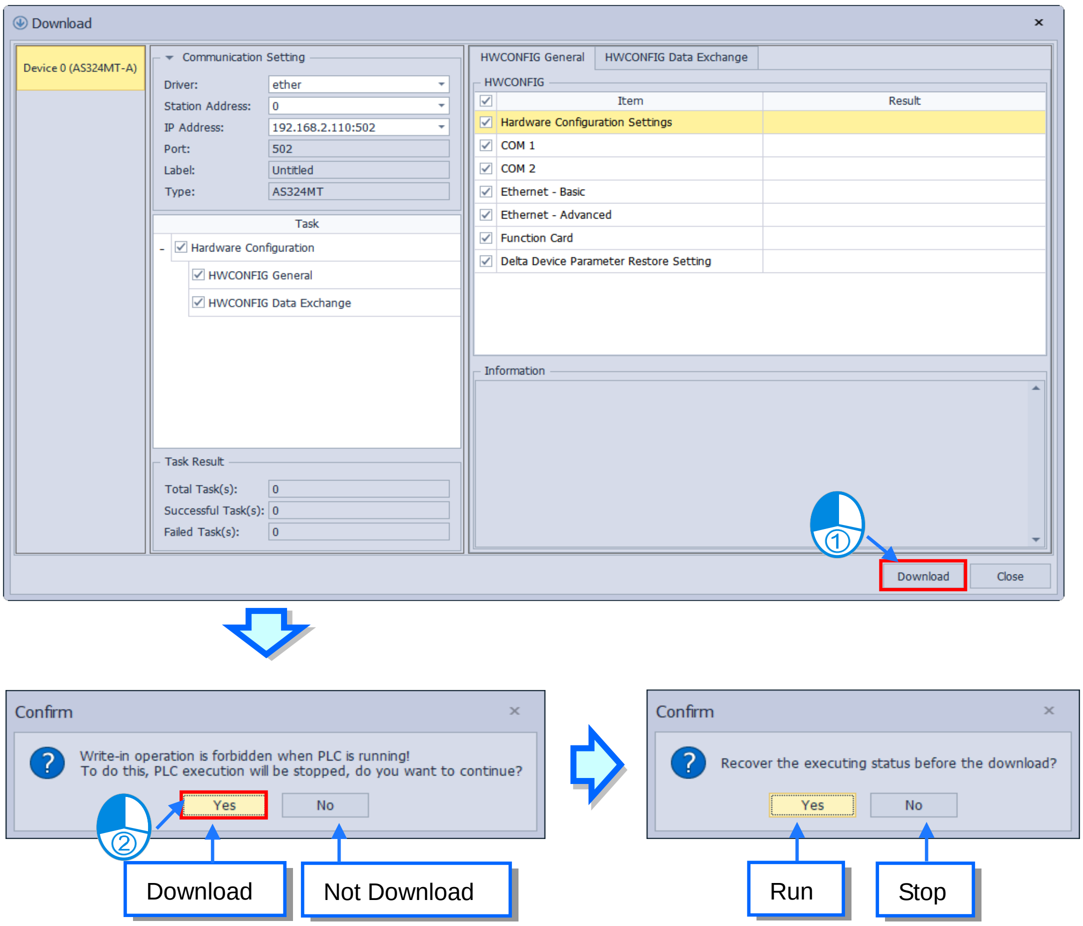
❸ **Download Task:** ☑ for selected items; ▣ for partially selected items; ☐ for not selected items.

❹**Downloading Details:** Select detail items of device settings and data exchange and relating information will be displayed in the area below.

❺ **Information:** Display download progess and status.

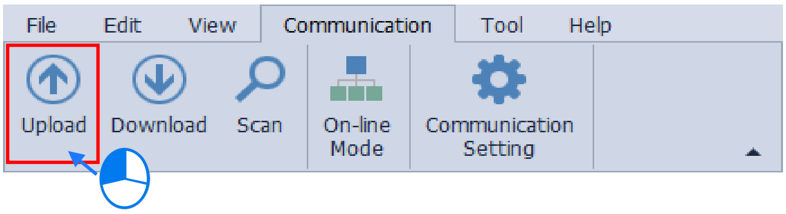
Note:

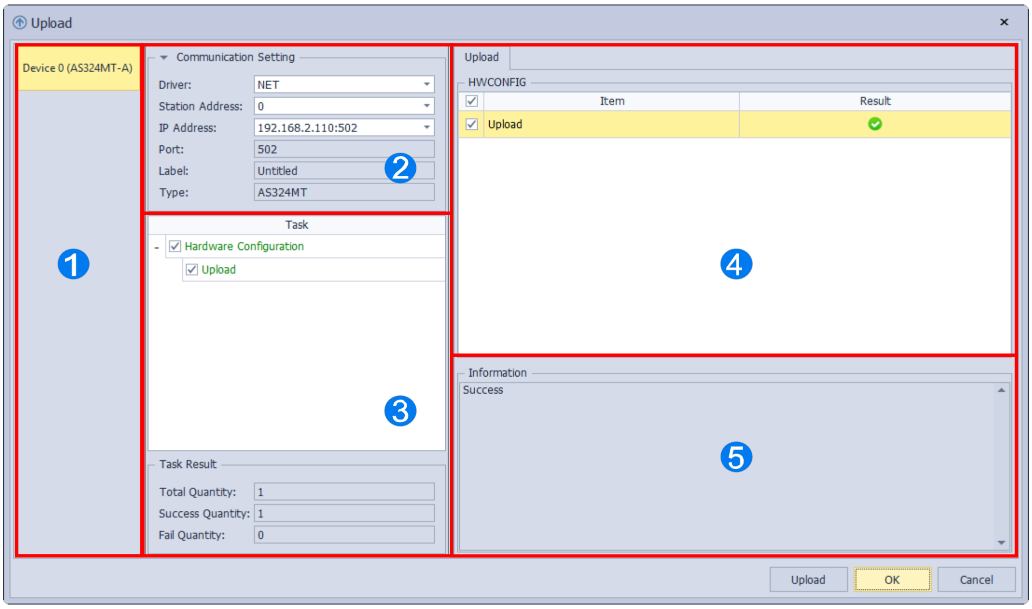
- Opened via ISPSoft, the communication setting of ISPSoft would be directly applied in HWCONFIG and cannot be modified. If you intend to change the settings, HWCONFIG must be saved and closed. Then, updates the communication settings in ISPSoft and reopen HWCONFIG.
- Configure the comminication setting after opening the download window, then select the desired items for downloading and click “**Download**”. After the processing window closed, parameters can be downloaded to the CPU module.
- Below is the download window, the CPU’s status must be “**STOP**” during downloading proccess. If the status shows “**RUN**”, an alert message will be displayed before the system starts performoing download task. Click “**YES**” and an enquiry about whether to recover the executing status will be shown.
- When the CPU module’s label name is not corresponding to the one in parameter settings, an alert message will be shown on the display before performing upload/ download task..
- A proper connection between ISPSoft and the CPU module must be checked before performing upload/ download task, since the communication setting of ISPSoft would be adopted by HWCONFIG.



- **Upload parameter**

While performing download task with HWCONFIG, click “**Upload**” from the toolbar on “**Communication**” tab or use shortcut key **Ctrl+F9**, then the upload window will pop up.





❶ **Device:** Display the device’s name and model you are currently editing.

❷ **Communication Setting:** Configure the communication settings and display the PLC device’s name and model you are currently using for communication.

❸ **Upload Task:** ☑ for selected items; ▣ for partially selected items; ☐ for not selected items.

❹**Uploading Details:** Select detail items of device settings and data exchange and relating information will be displayed in the area below.

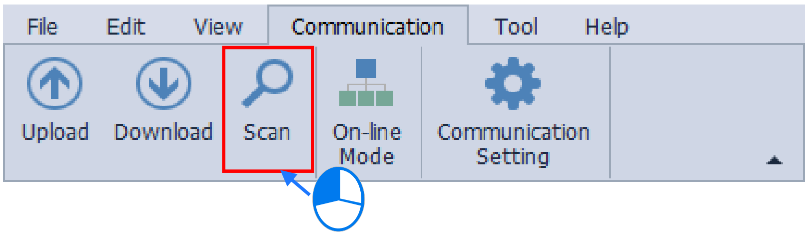
❺ **Information:** Display upload progess and status.

Note:

- Opened via ISPSoft, the communication setting of ISPSoft would be directly applied in HWCONFIG and cannot be modified. If you intend to change the settings, HWCONFIG must be saved and closed. Then, updates the communication settings in ISPSoft and reopen HWCONFIG.

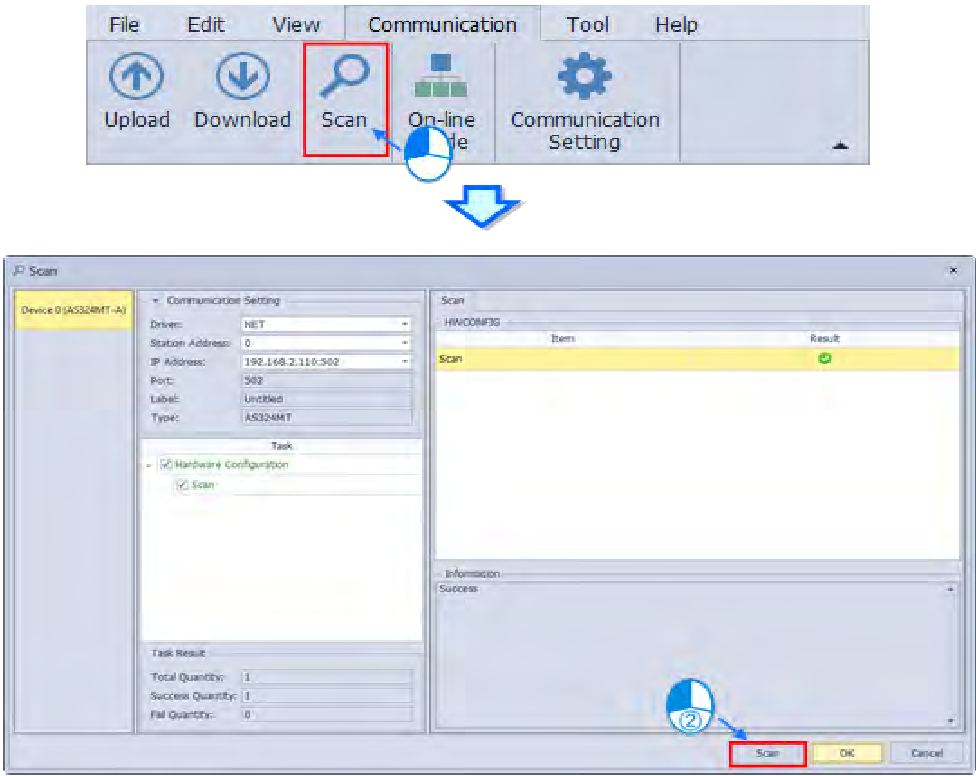
- Configure the comminication setting after opening the upload window, then select the desired items for uploading and click "**Upload**". After the processing window closed, parameters can be uploaded to CPU which include modules configuration, parameters of CPU PLC and PLC parameters.
- All the PLC parameters will be uploaded during upload operation. When perform download operation, the options window will be displayed first, then users can select the target parameter types without necessarily downloading all the configuration to the CPU module.

- **Scan**



After finished hardware configuration and confirmed the communication with the CPU module' is normal, users can use this function to scan the actual configuration for modules without spending time on adding modules individually. Make sure ISPSoft has been connected to the CPU module' successfully before operating.

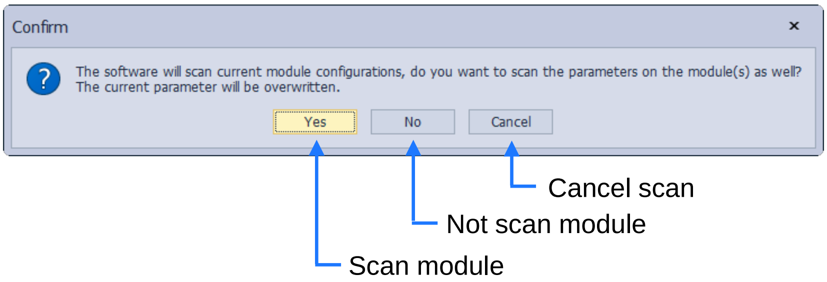
Click "**Scan**" from the toolbar on "**Communication**" tab or use shortcut key **Ctrl+F7** to scan the content which includes module models, configuration and firmware versions, not including parameters in the modules. After Scan completed, the original hardware configuration and the parameter setting will be cleared. However, the parameters in the CPU module will not be affected.



Not all the model types support module parameters scanning. Click “**Scan**” and a confirmation inquiry window about whether to perform parameter scanning will be shown. (Nothing shows up means this feature is not supported.) If choosing YES, the right-side modules of the CPU will be scanned (parameters of the CPU PLC excluded) and the current configurations will be overwritten.

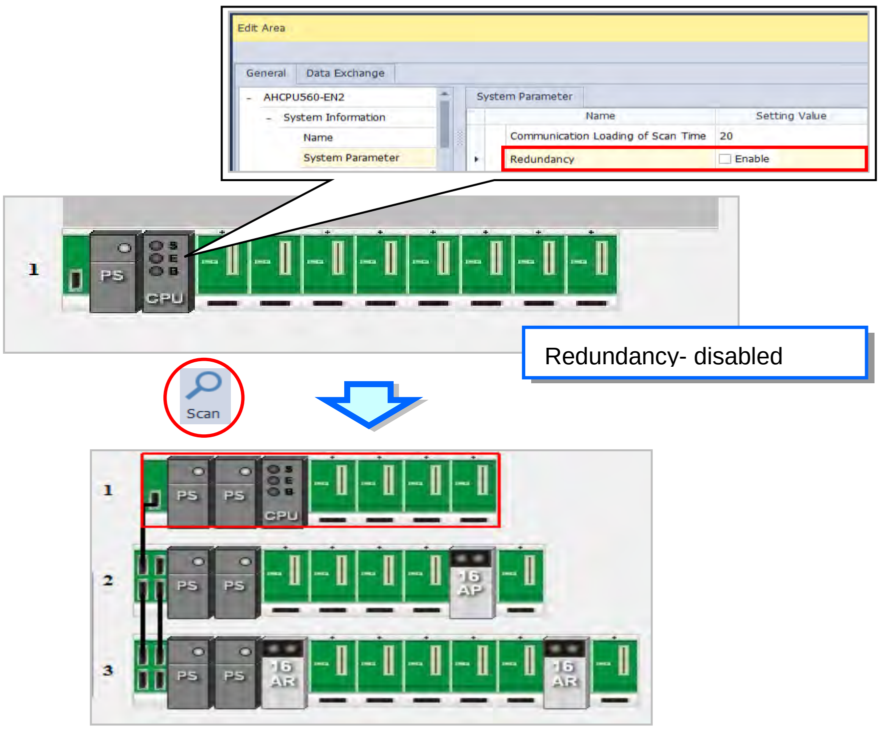
Besides that other information such as the model number, configurations of the I/O port, the firmware version, and extension card will also be scanned. After the scan is complete, the actual module configurations will be shown in the configuration area and the I/O Device Range will be rearranged. If No is clicked, the parameters of the module PLC (parameters of the CPU PLC excluded) will be set according to the default settings.

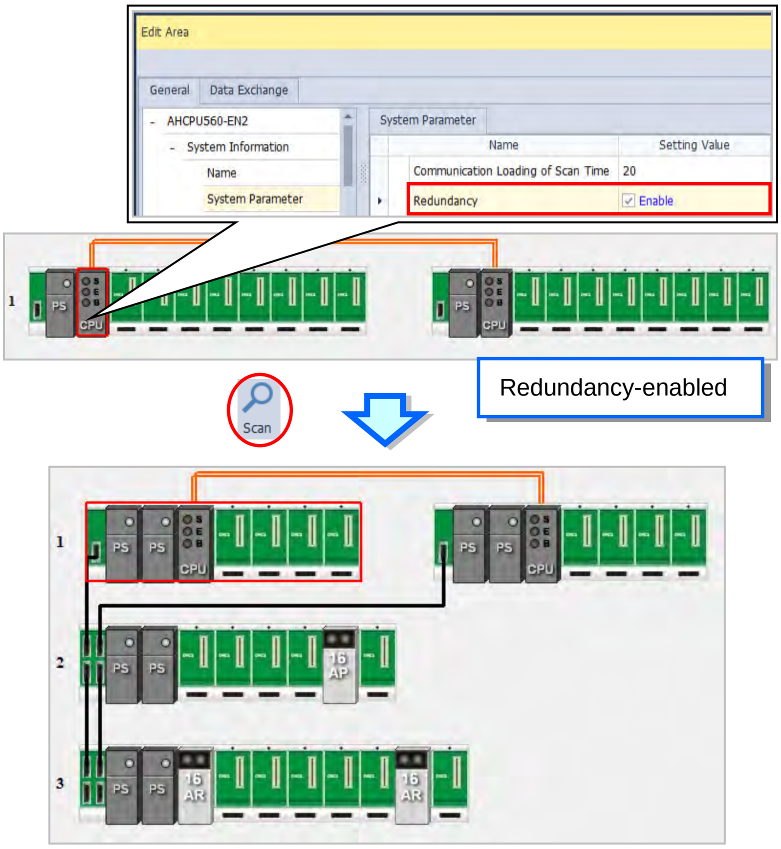
***Parameters of the CPU PLC include parameters of the function card.**



After scan complete, a success message will pop up. Click on “**OK**”, then the modules of the project will be updated. Clicking “**Cancel**” would not do any change on the modules.

If using AH560 Redundancy series, the scan result may be different with redundancy feature being enabled (Please find section 3.1.3.20 for more details of enabling redundancy feature), which you can refer to the example below. (The following demonstrations should not be considered as the actual result.)





	Upload	Scan
CPU Setting	V	
Function Card	O	V
Function Card Setting	O	
Modules Configuration	O	V
Modules Setting	O	Parameters of scan modules
Modules Firmware Version	O	V

***If the CPU PLC is not same as the actual configuration, the uploaded data would not match the actual configuration.**

Here we explain the difference between “**Scan**” and ‘**Upload**” with an example as follows. While Scan function is to scan the current configuration of modules and function card, “**Upload**” is to reread the CPU parameters and modules configuration stored in the CPU PLC, which may not be compatible with the actual hardware configuration under current connection.

For example:

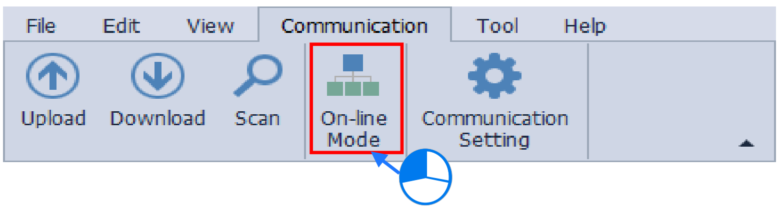
Download the following module configuration to the CPU.

Then remove the 16AN module and enable the “**Scan**” function. The result would be same as the actual configuration.

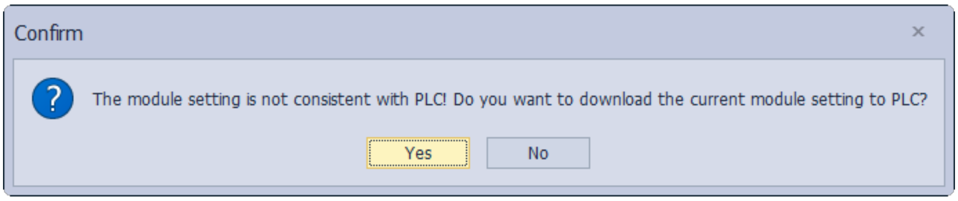
Continue to enable the “**Upload**” function. After operation complete, the result turns out to be same as the configuration we downloaded earlier.

- **On-line Mode**

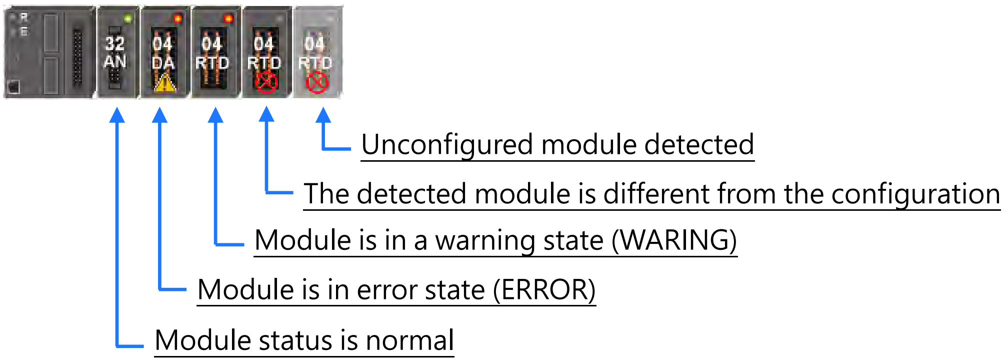
❶ Click “**On-line Mode**” from the toolbar on “**Communication**” tab or use shortcut key Ctrl+F4 to switch to on-line mode. To disable On-line mode, simply click “**On-line Mode**” from HWCONFIG tool bar again or use shortcut key Ctrl+F4.



❷ Before goes into On-line mode, the parameters of hardware configuration stored in the CPU PLC will be checked for the consistency with the module setting in module configuration area. If there’s any inconsistency, the system would request for re-downloading the configuration parameters.



❸ After goes into On-line mode, the display may change based on the actual configuration. And the indicators of the CPU PLC are "**Run**" and "**Error**" separately on the top and the bottom.

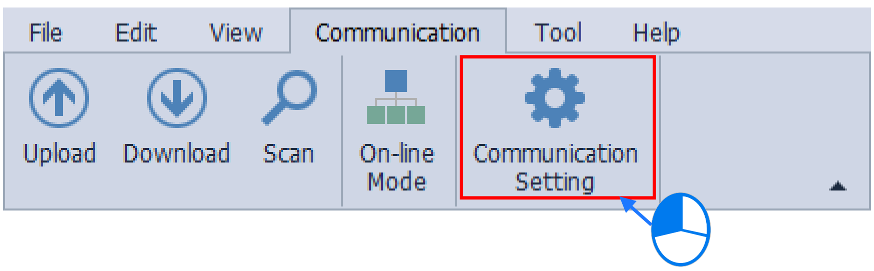


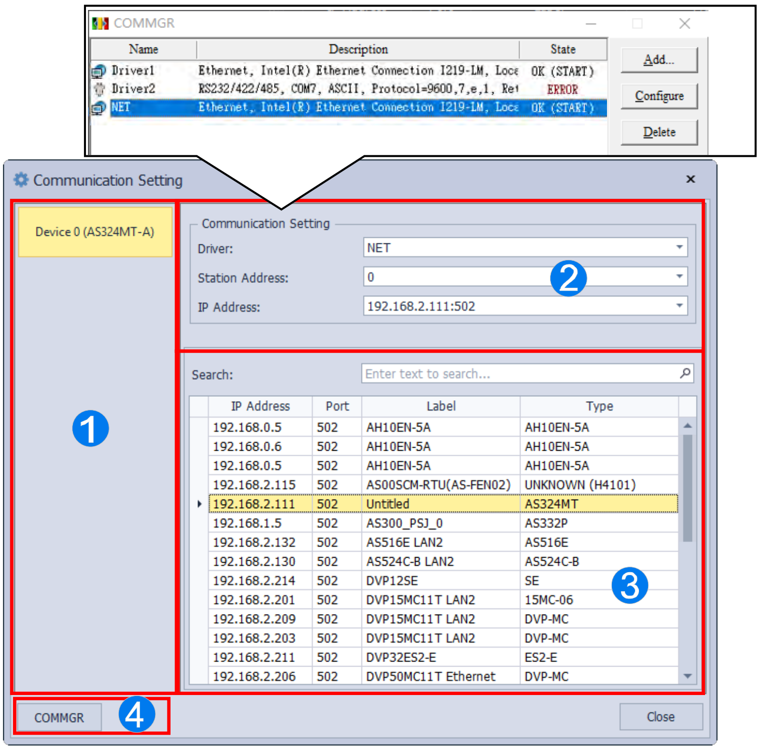
If using AH560 Redundancy Series, the status of Master and Standby would be shown after enabling the redundancy feature as well as the on-line mode.

- Communication Setting

This feature only supports standalone version to build the connection to the target device.

Click "**Communication Setting**" from the toolbar on "**Communication**" tab to open the Communication setting page.





❶ **Device:** Display the device's name and model you are currently editing.

❷**Comminication Setting:** Choose the driver set by COMMGR.

❸ **Choosing connected devices:** Search for the target device to connect by using Ethernet.

❹ **COMMGR:** Enable COMMGR to configure the communication settings.

After the window is opened, you can enable COMMGR to set up the communication, then choose the driver set by COMMGR in ❷ Communication Setting. While using Ethernet, devices included in the driver will be shown in ❸. Finaly, click "**Finish**" after the setting is completed.

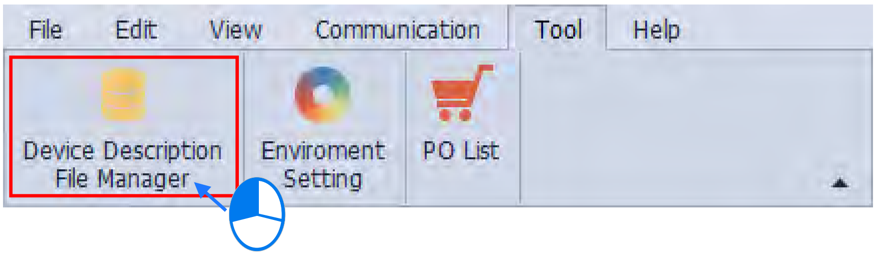
3.1.2.6 Tool Tab

Tool Tab: Use options under this tab to open **Device Description File Manager, Environment Setting** and **PO List** for further configuration.

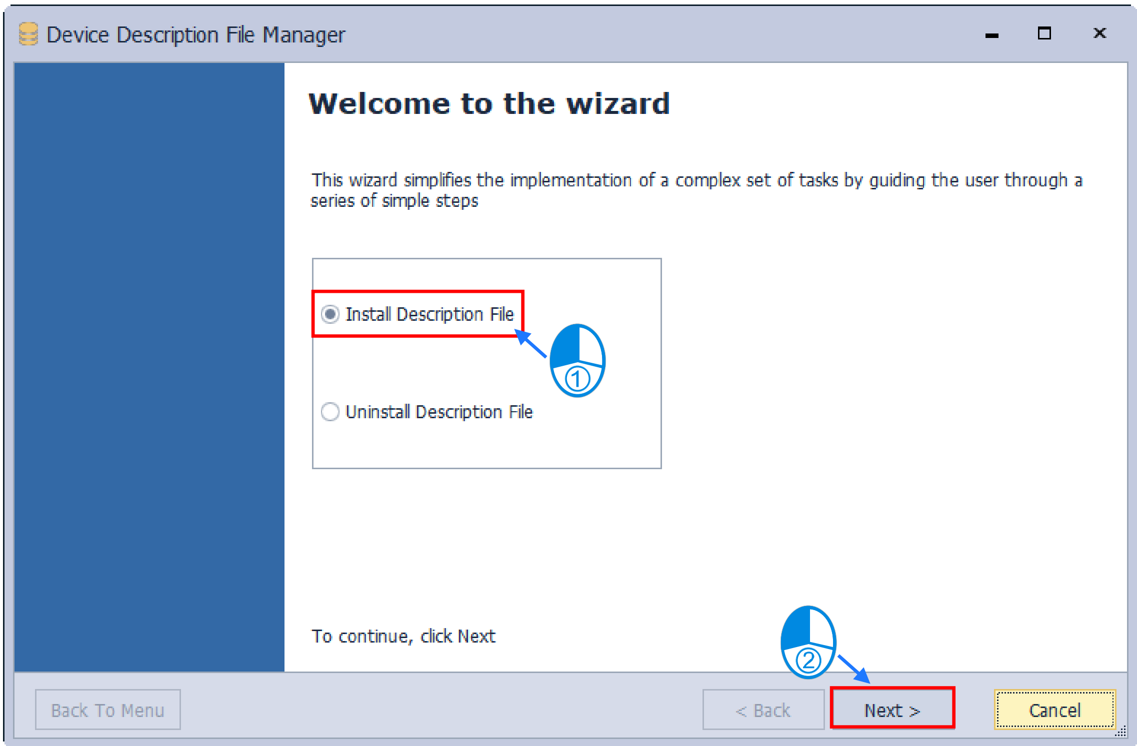
Item	Description
Device Description File Manager	Use the wizard to install / uninstall description files (IODD, DDF).
Environment Setting	General: Enable prompt confirmation, retain last layout setting and manage theme style.
PO List	List all the compatible devices and accessories that the created project may need for your reference.

- **Device Description File Manager**

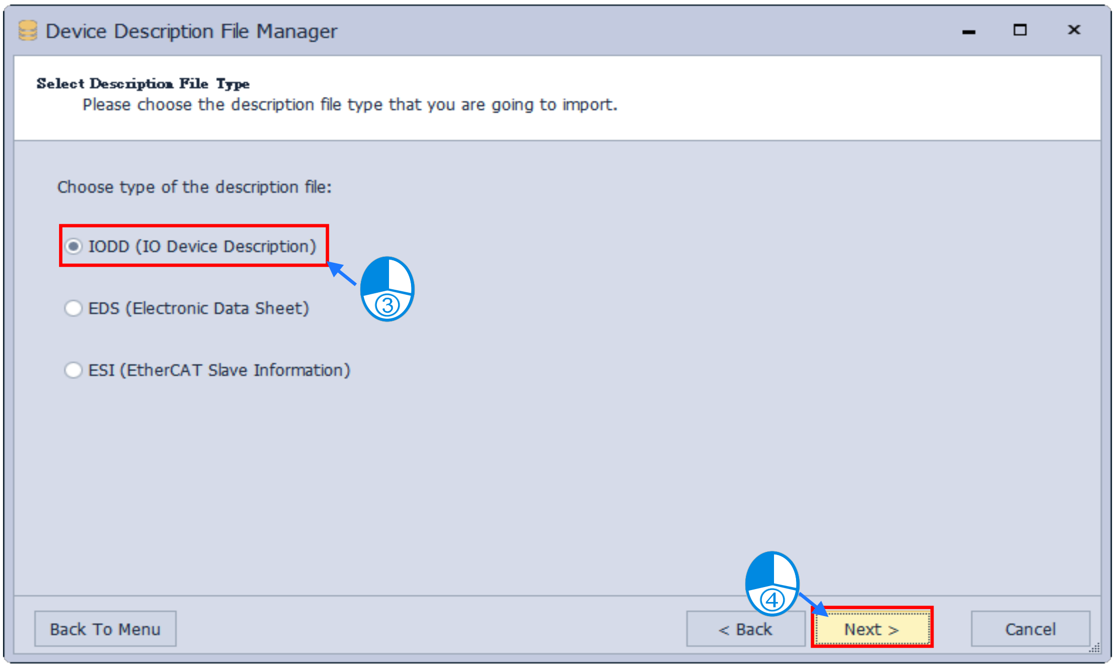
Use the wizard to install / uninstall description files (IODD, DDF) by clicking "**Device Description File Manager**" from the HWCONFIG toolbar on the Tool tab to open the Device Description File Manager page.



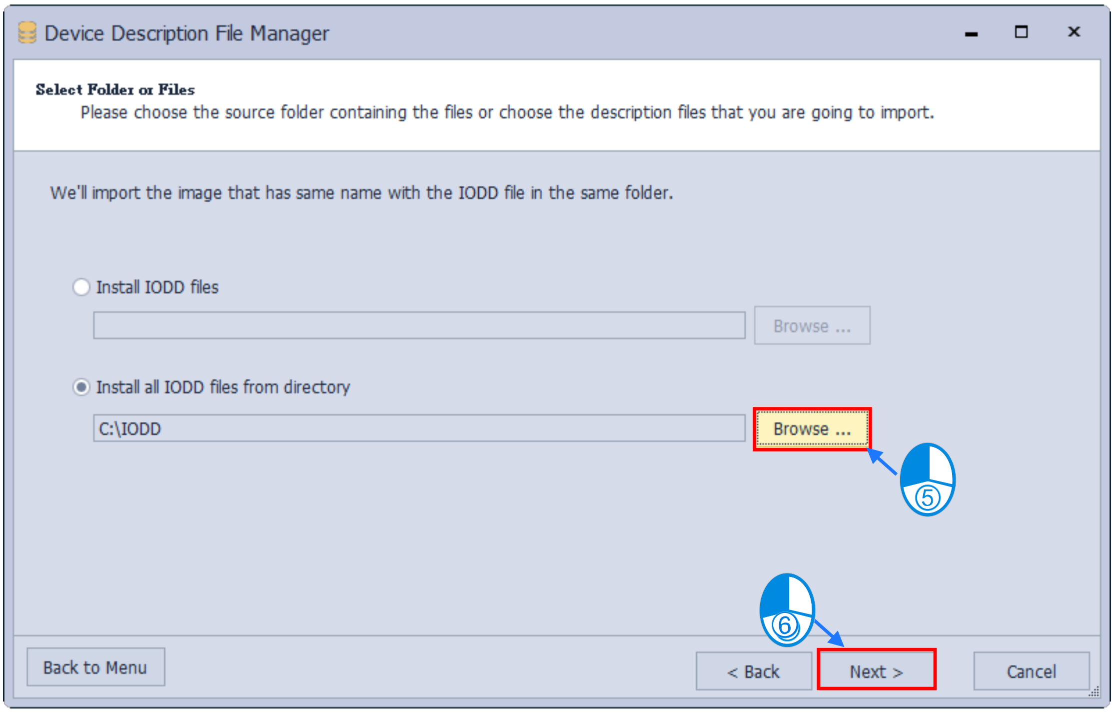
Choose to install or uninstall description file and click on "**Next**".



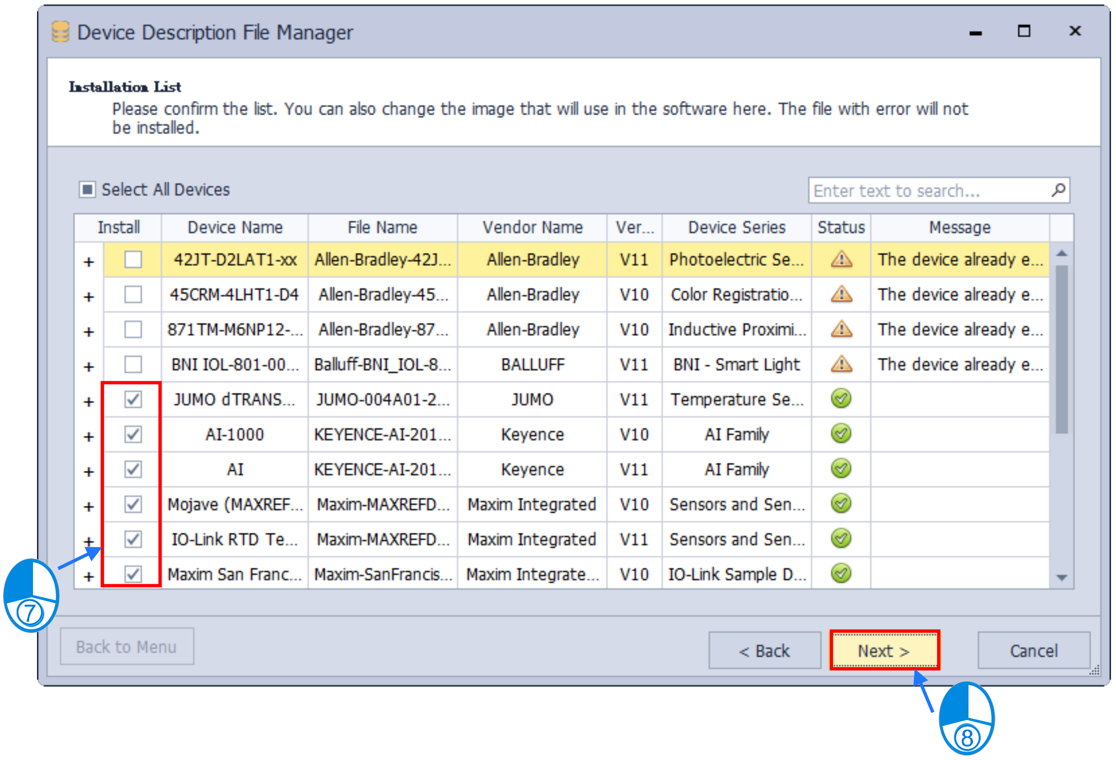
Then choose the description file type you intend to import.



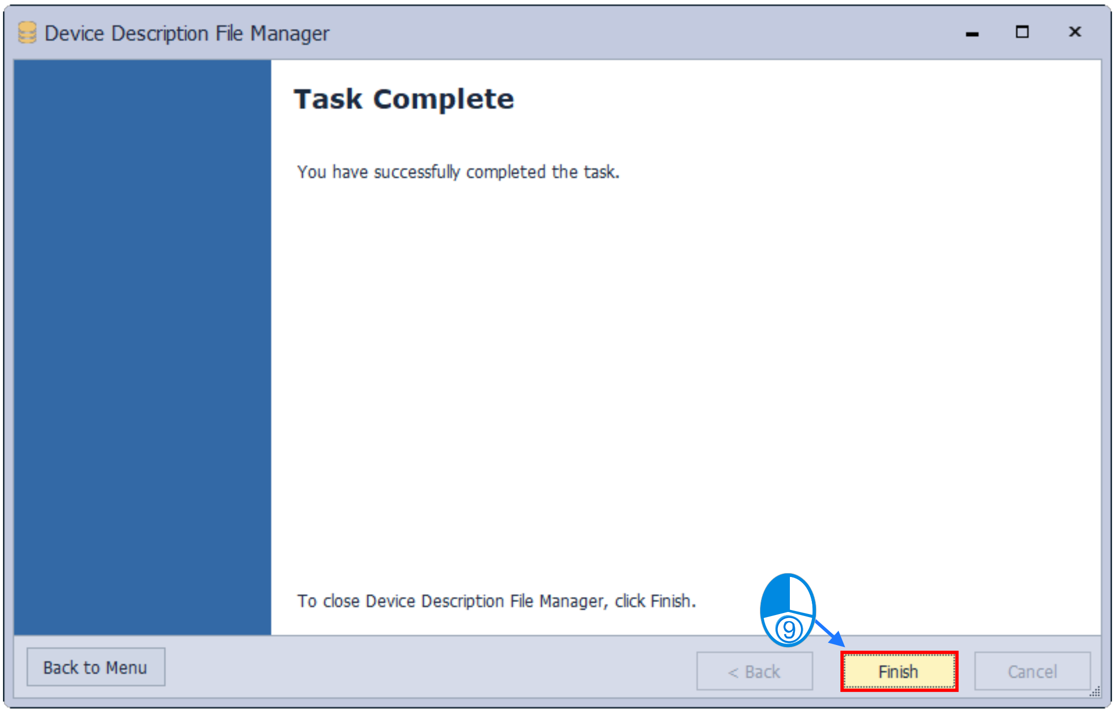
Continue to choose the path of the description file. If choosing "**Install IODD files**", only one file can be imported at a time. While mutiple files are allowed to be imported at a time if you choose to install all IODD files from directory



Finally, select the description files you intend to import and click “**Next**”, then the system will start to import files.

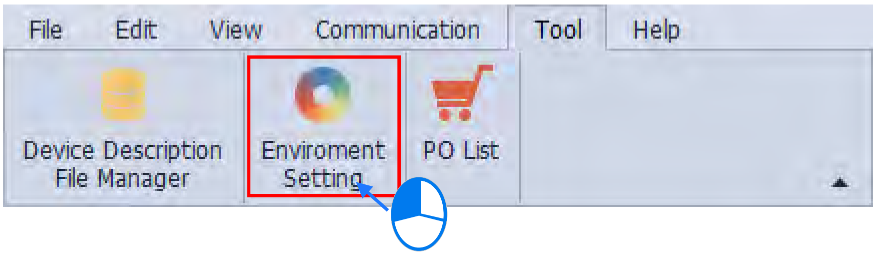


Click “**Finish**” to complete on installing the target files.

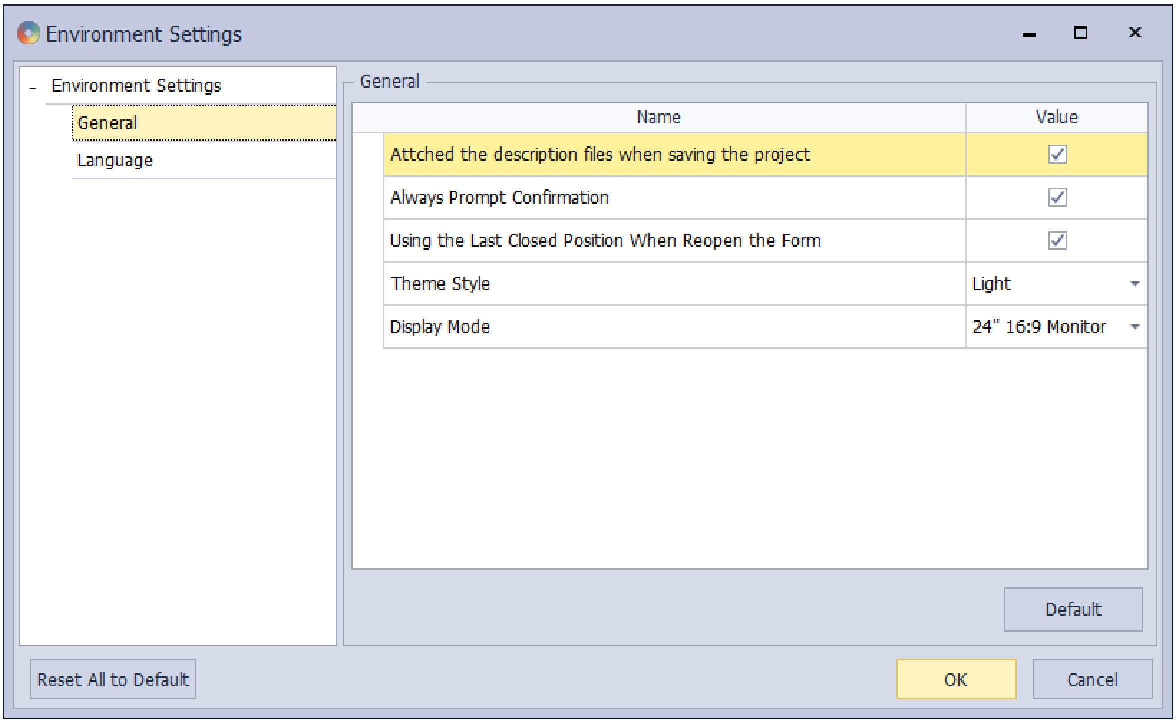


- **Environment Setting**

Click “**Environment Setting**” from the HWCONFIG toolbar on the Tool tab to open the environment setting page.



Environment settings include “**General setting**” and “**Language setting**”. Please find below for the detailed description.



***Settings and options on the general setting page.**

- **Attached the description files when saving the project**

Choose whether to save description files while saving projects. If yes, then check the box and the description file will be automatically imported when you open the project in HWCONFIG environment. If this feature is disabled, you will need to import the description file manually.

- **Always Prompt Confirmation**

Choose whether to prompt confirmation window every time operation changes. Check the box for “**YES**” or clear the checkbox for “**NO**”.

- **Using the Last Closed Position When Reopen the Form**

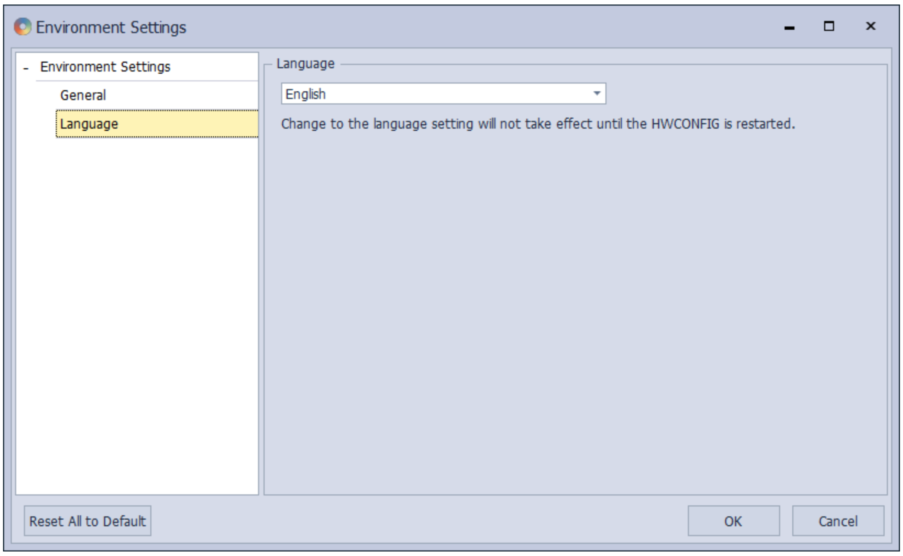
If this option is selected, the size and position of the form will be memorized when the software is turned off, or the window's size and position will be set as default the next time you turn on the software.

- **Theme Style**

The default setting would be the light color style, which can also be changed to the dark color style.

- **Display Mode**

According to the screen size, there are two options for the display mode. One is 13" 16:9 size suggested to be used for laptops or devices with a smaller screen; a settings window will prompt for users to configure parameters of devices and modules, please refer to the content of HWCONFIG 3.0 operation mode . Another option is 24" 16:9 size supporting new operation mode for HWCONFIG 4.0 to provide users a convenient way of viewing more information in a single screen.



*** Settings and options on the Language tab.**

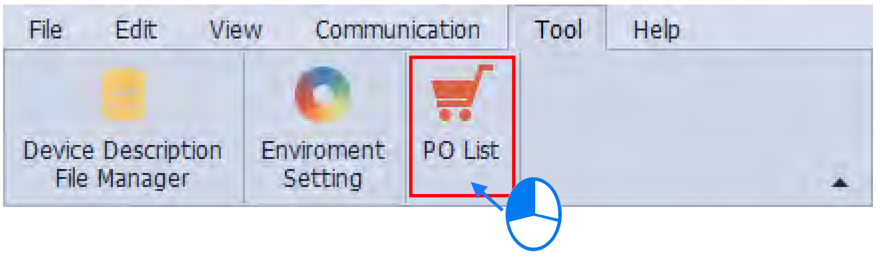
- **Language**

The display language can be modified in standalone version. When finish modifying, the change will be effective after a reboot. The display language in HWCONFIG opened by ISPSoft would be same as the one used in ISPSoft. If intend to change the language setting, you must turn off HWCONFIG and modify in ISPSoft, then reopen HWCONFIG.

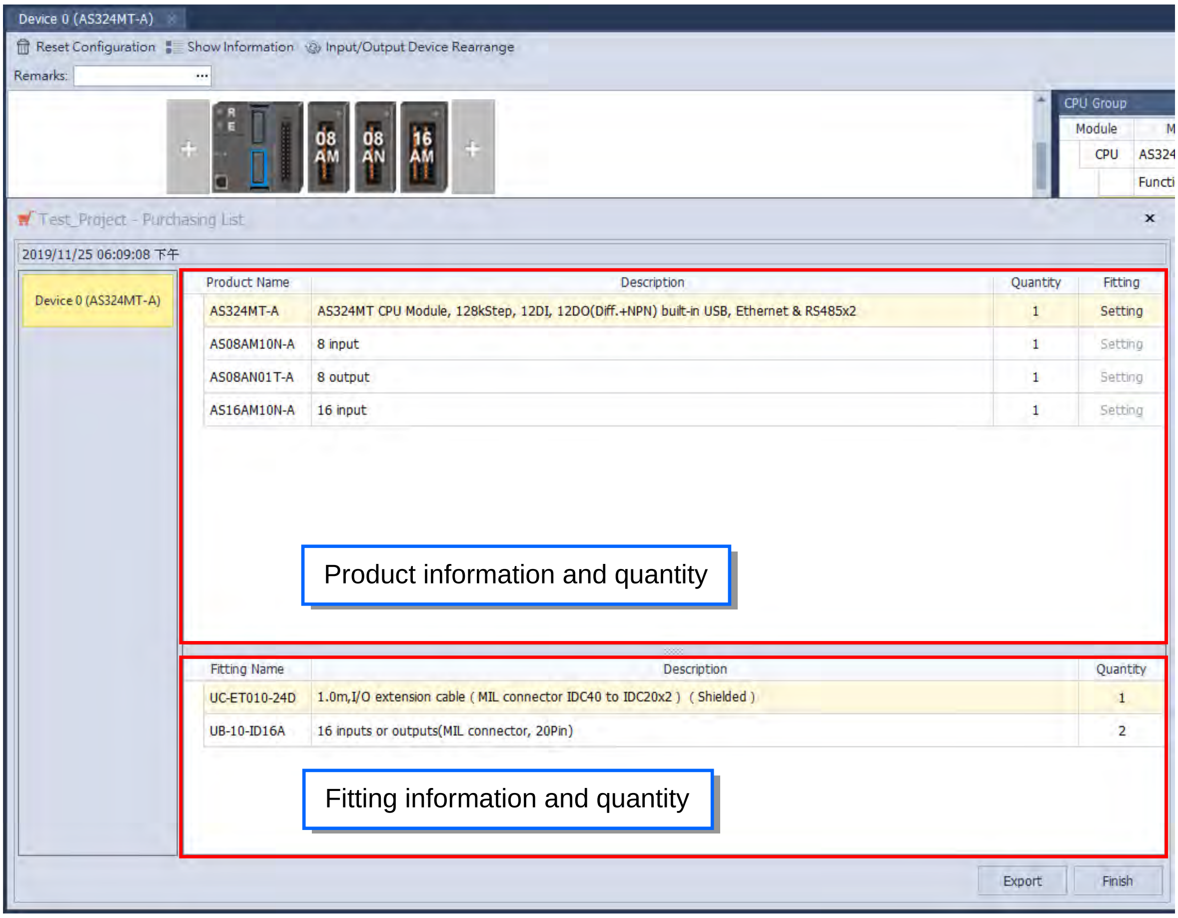
- **PO List**

Display the list of hardware and accessaries configured in the project.

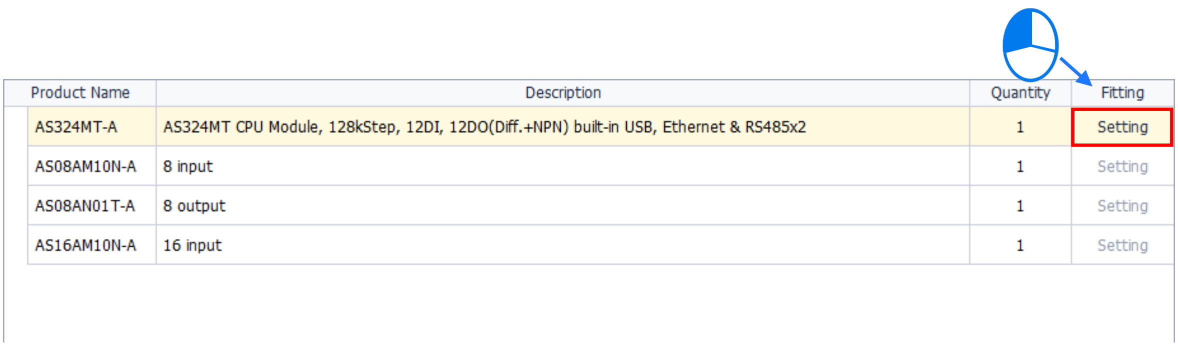
Click "**PO List**" from HWCONFIG tool bar on the Tool tab or use shortcut key Ctrl+F6.



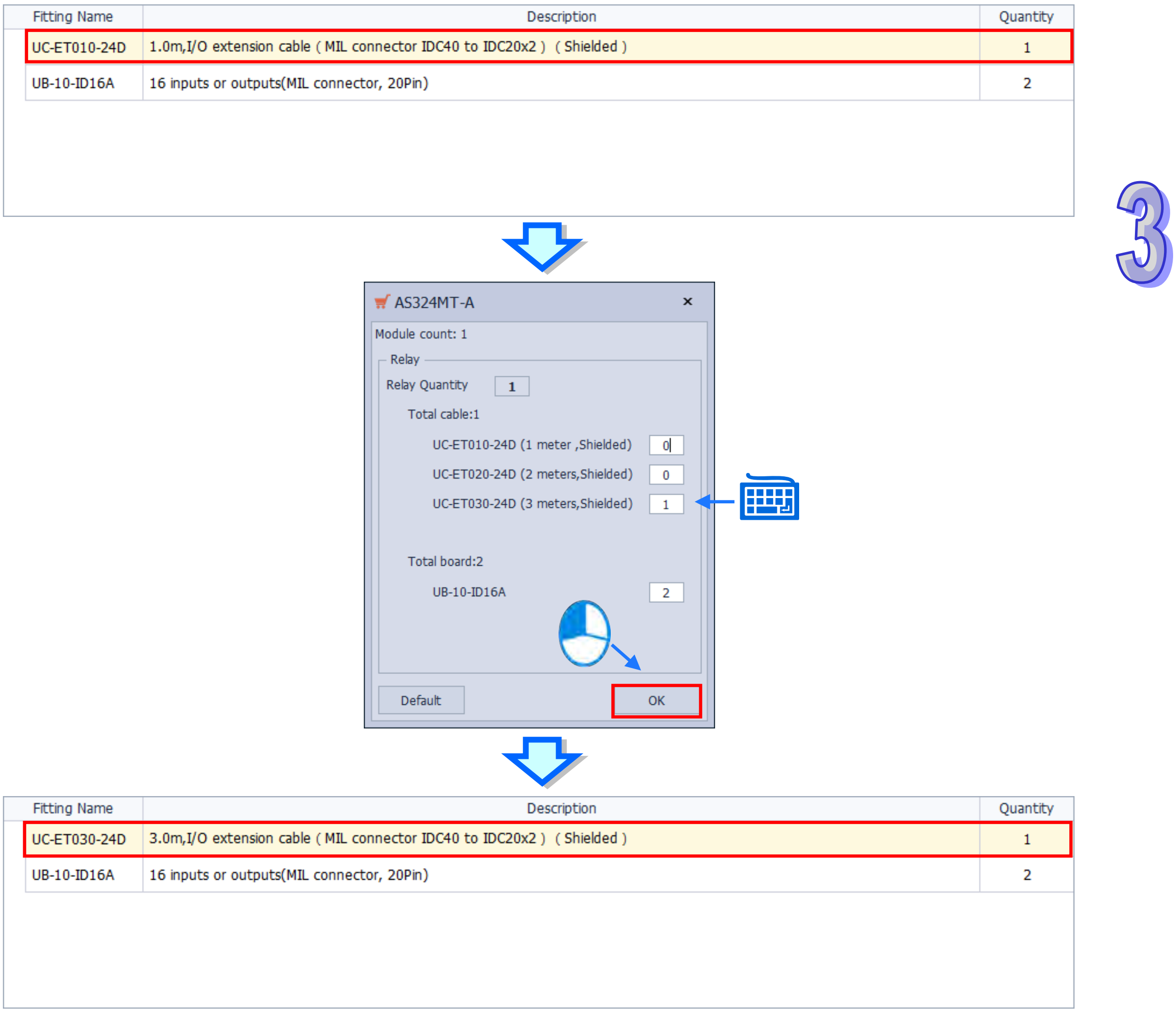
Display the PLC devices, function cards, modules quantity and information at the top of the PO List window, while the quantity and informatioin of accessaries would be displayed at the bottom.



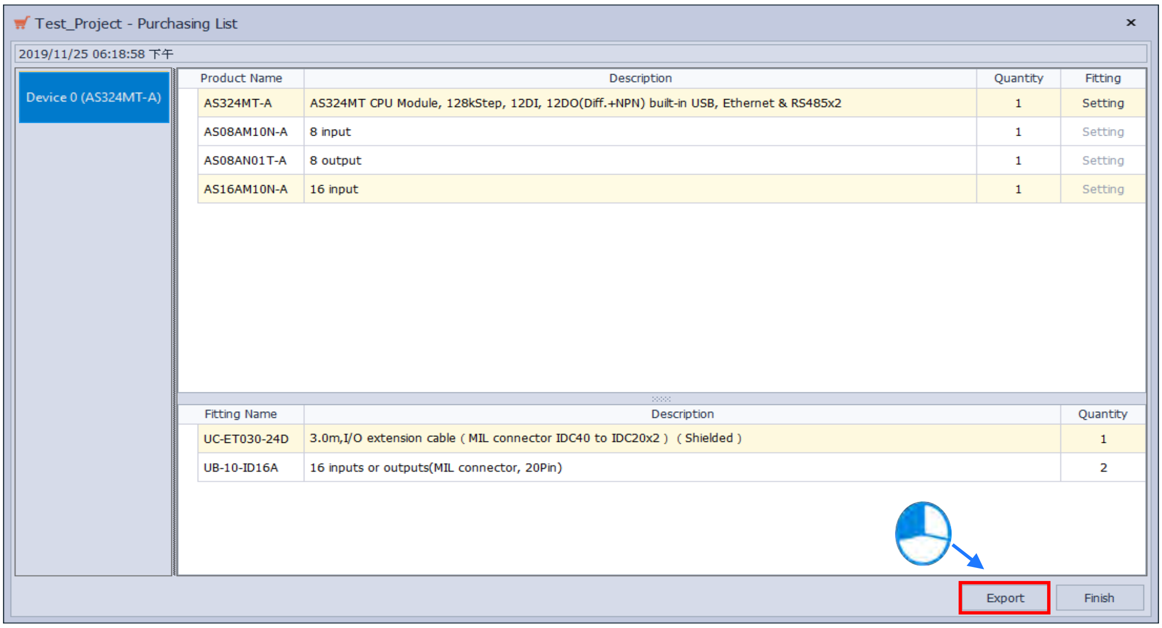
The specification and quantity of accessories can be configured by clicking “**Setting**” on the right side of device information table.

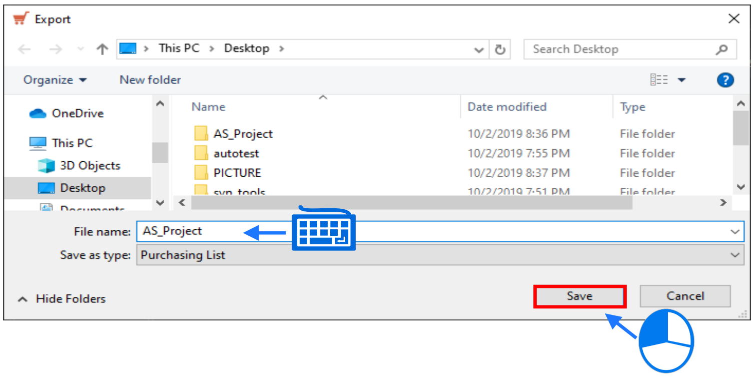


After the accessory setting window pops up, the required quantity of extension cable and MIL connector will be displayed, which can be modified by users and the quantity must not lower than the minimum number required. Click on “**Default**” to reset setting values as default. After the input action completes, click “**OK**” to revise the accessory information on the PO List.

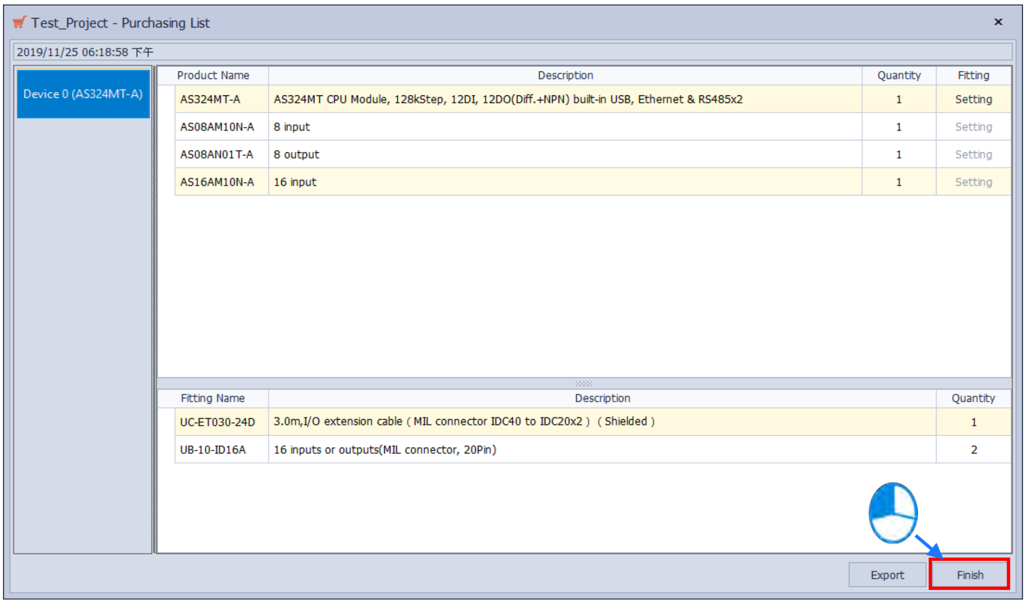


Click “**Export**” to export the PO list as an Excel XLSX file so as to manage and maintain the exported data via Excel in future.



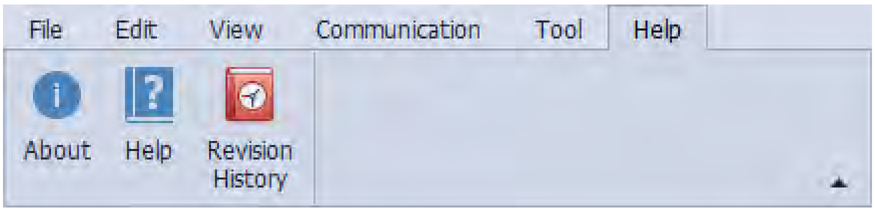


Then click "**Finish**" to close the PO List window.



3.1.2.7 Help Tab

Help Tab: Provide users of ancillary functions for HWCONFIG.



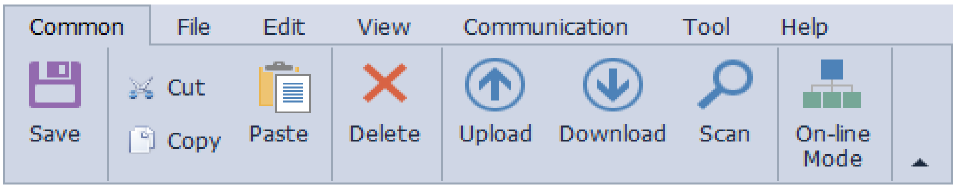
Item	Description
About	Click to see information of the version and the release date of this HWCONFIG.
Help	Click this button to see the user manual.
Revision History	Click to see the change history of HWCONFIG.

- **About**

Click "**About**" from the Help tab to view the current version, release date and other information of the software.

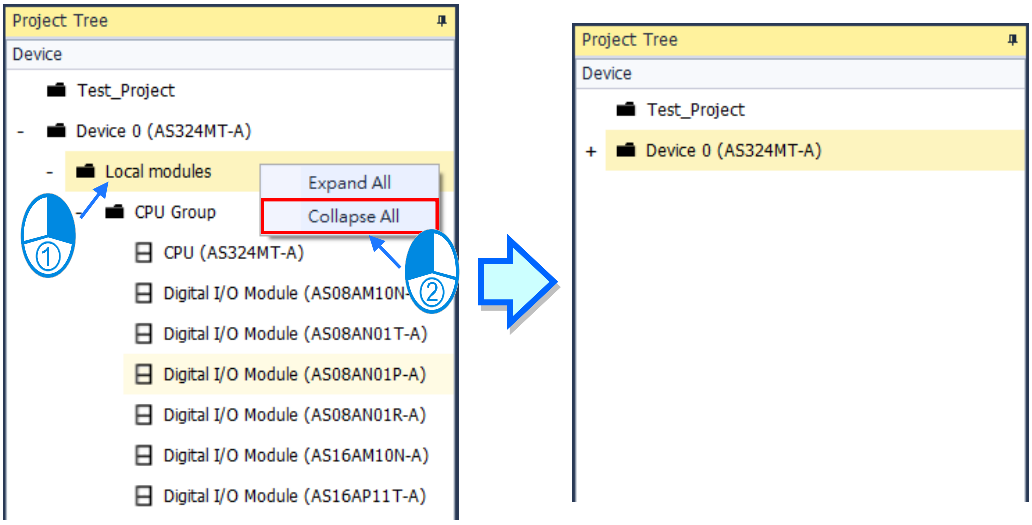
3.1.2.8 Common Tab

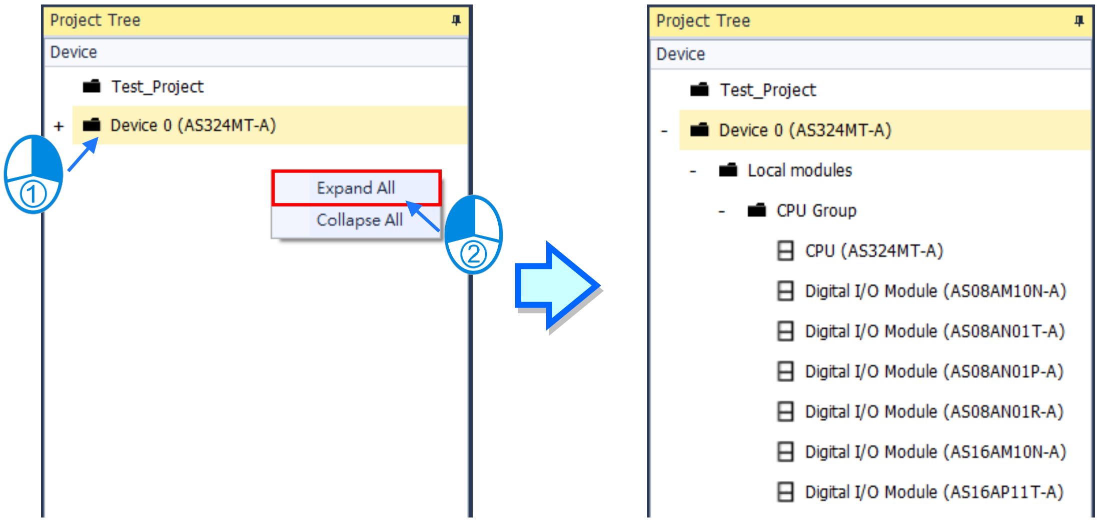
Provide common options for HWCONFIG.



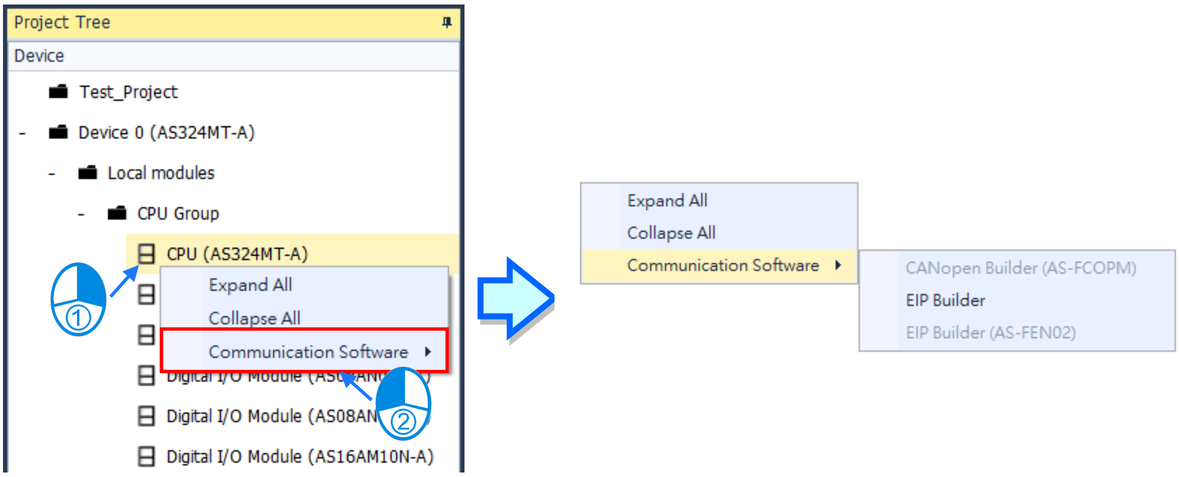
3.1.2.9 Project Tree

List the added devices of the project in a tree structure for easier management. The **Project Tree** is on the left side of the HWCONFIG by default. You can rearrange the layout; refer to section 3.1.3.12 for more details. You can right-click the item on the Project Tree to see options of **Expand All** or **Collapse All**, use these options to fold or unfold the devices under the item.



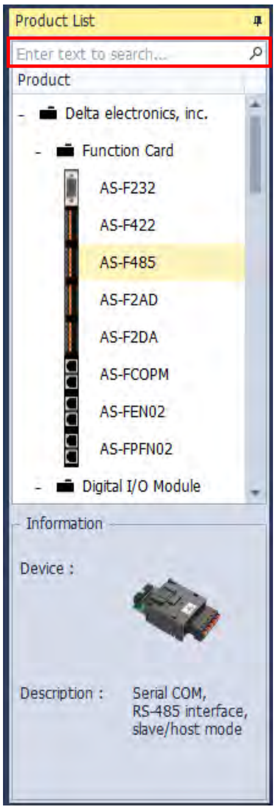


Right-click the **PLC CPU** on the **Project Tree**, you can see **Communication Software** on the context menu. Click **Communication Software** to see which software is available for this project. If the software option is grayed out, you may need applicable function cards to work along with the project.



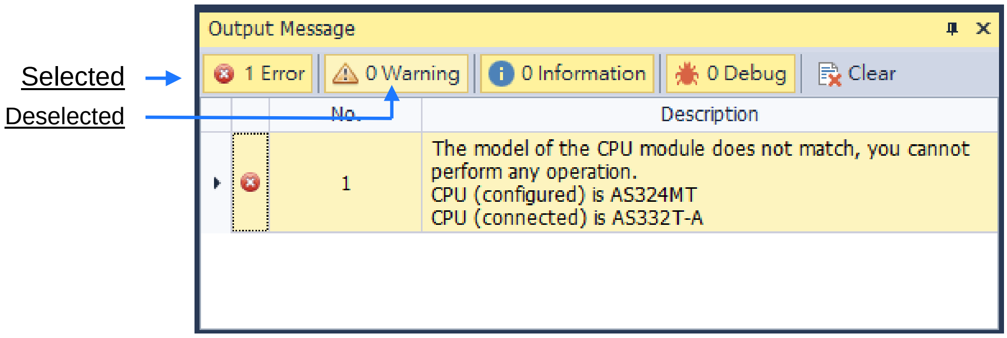
3.1.2.10 Product List

Applicable devices, including modules and function cards for the project, are listed in a tree structure for easier management. The **Project Tree** is on the right side of the HWCONFIG by default. You can rearrange the layout; refer to section 3.1.2.4 for more details. Click to select the device and you can see its information below. You can use the search function by entering a key work in the blank field to search for the device you need.



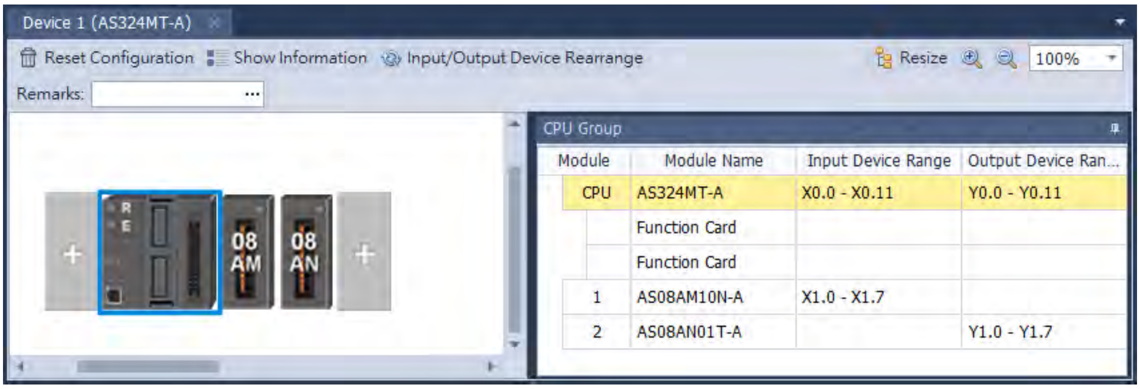
3.1.2.11 Output Message

The **Output Message** is on the bottom of the HWCONFIG by default. You can rearrange the layout; refer to section 3.1.2.4 for more details. You can see four types of messages, including **Error, Warning, Information, Debug** and one **Clear** button, in the **Output Message** section. Click to select the message type and you can see its information below. Use **Clear** button to clear all messages.



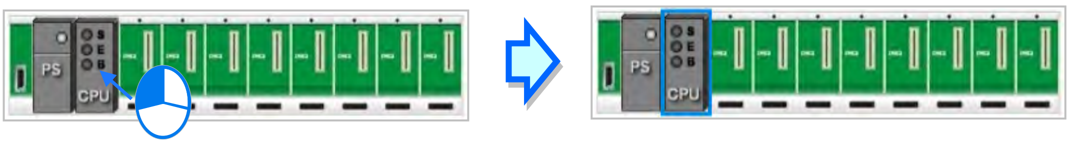
3.1.2.12 Hardware Configuration Area

The **Hardware Configuration Area** is on the right side of the HWCONFIG by default. You can rearrange the layout; refer to section 3.1.2.4 for more details. You can see the configurations of the modules and function card here. You can also use the functional tabs including **Reset Configuration** to set the configurations back to default values, **Show Information** to see the hardware configurations and **Input / Output Device Rearrange** to rearrange the device ranges.

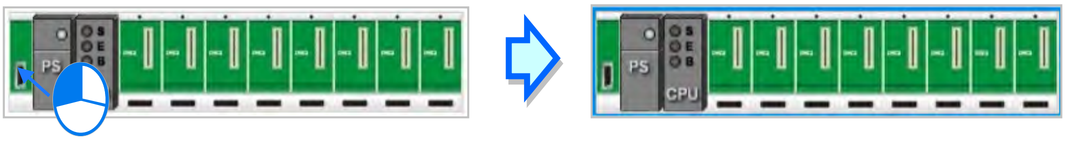


Item	Description
Reset Configuration	Use this button to set the configurations back to default values
Show Information	Use this button to see the hardware configurations
Input / Output Device Rearrange	Use this button to rearrange the device ranges.
Resize	Use this button to set the display of the configuration area back to its default values (shown at 100% and in the center).
+	Use this button to enlarge the display of the configuration area
-	Use this button to shrink the display of the configuration area
%	Enter a precise number for the display of the configuration area
Remark	Use this field to enter notes

While operating, select the target module by simply clicking in its figure.

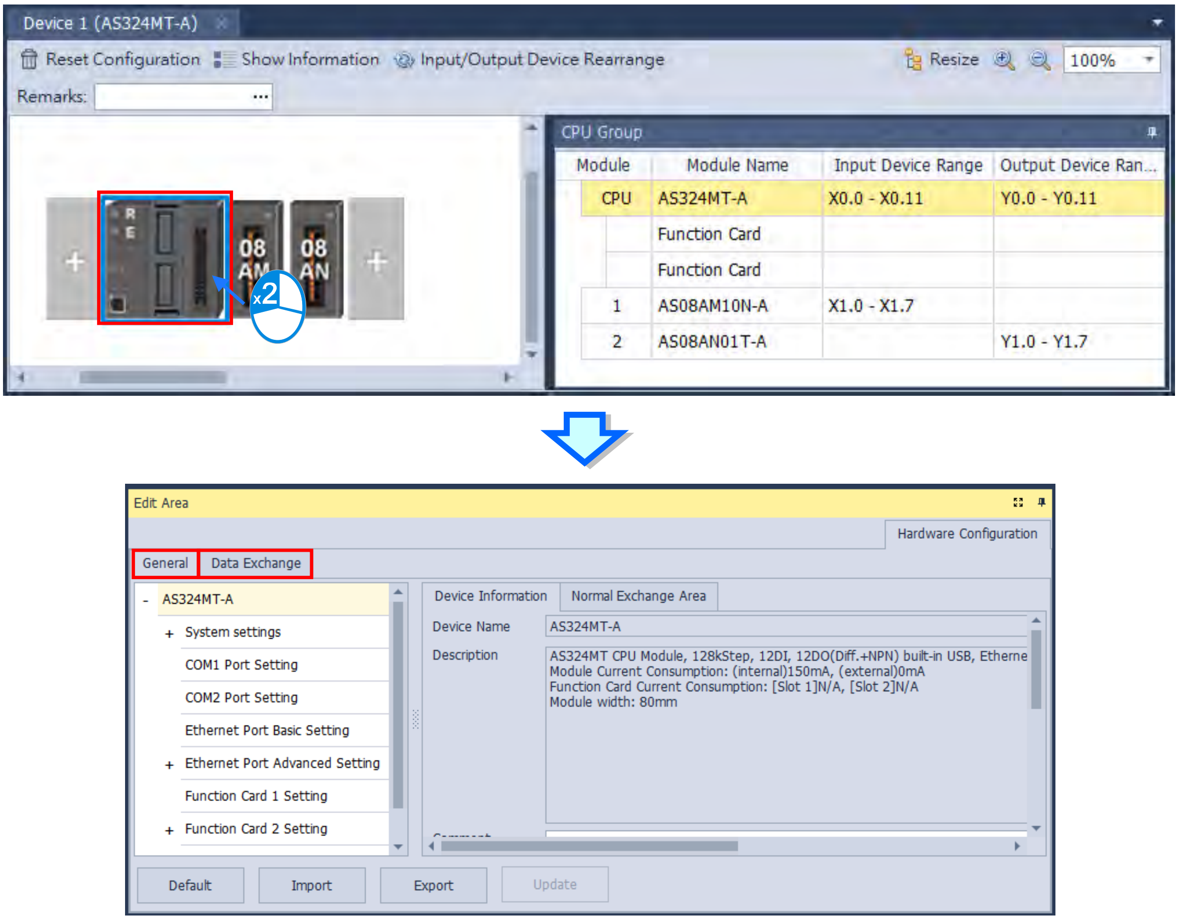


To select a target extension backplanes of AH series, move the cursor to the port position on the left side of the figure, then click on it.



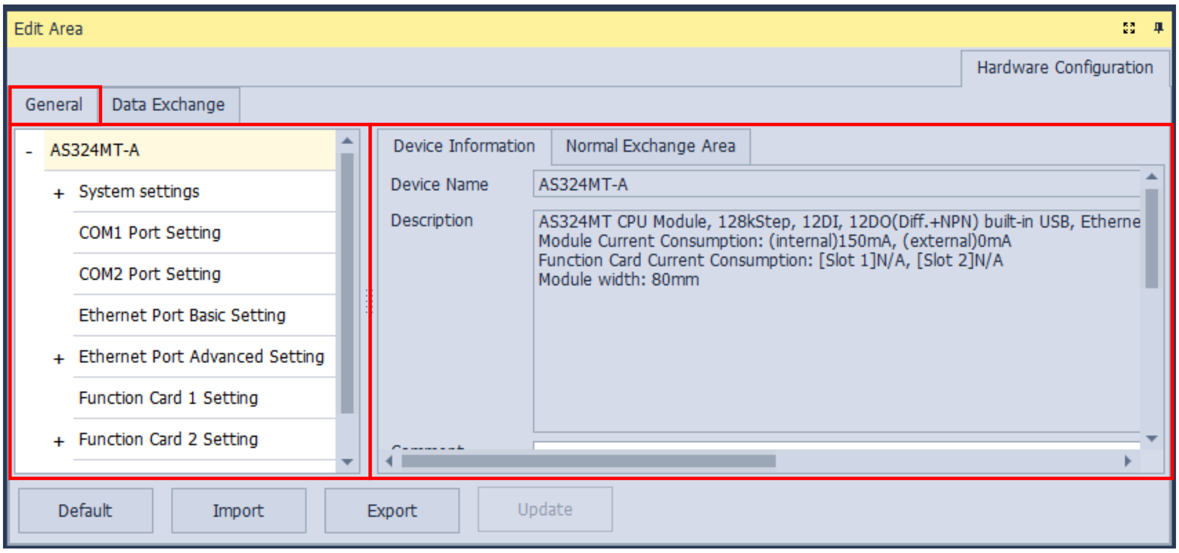
3.1.2.13 Edit Area

Edit Area features parameter settings for the PLC CPU, including system settings, communication port settings, Ethernet port settings, function cards and modules. For module's parameter settings, please refer to the related manual of each module. The edit area would not be displayed in the default of HWCONFIG. Instead, you should double-click on the CPU to open as the following shown.

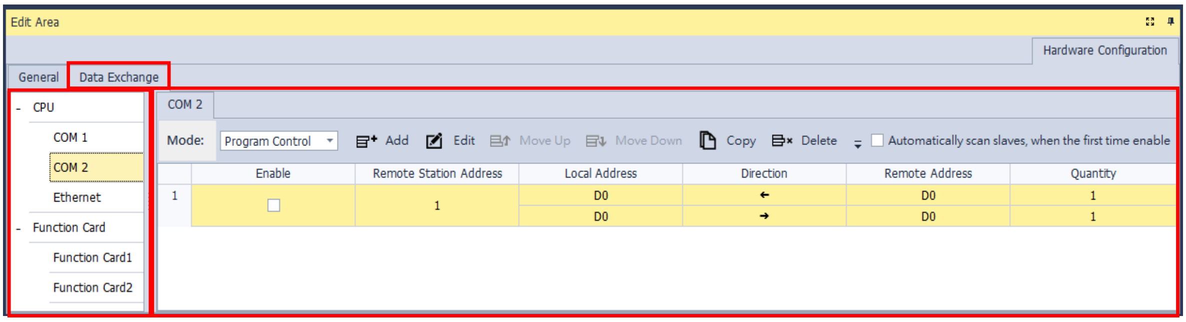


With Environment setting in section 3.1.2.6 and the feature detailed in section 3.1.3.13, you can also change the display mode and choose to show or hide the display area. After clicking  at the top right corner, the edit area window would be enlarged and the hardware configuration area would be covered. To bring the hardware configuration area back, click  again or select "Reset Layout" from the View tab.

The parameter settings of CPUs and function cards are displayed on the left hand side of the window, while device information and normal exchange area are displayed on the right. In addition, if you choose any module from the hardware configuration area, the parameter setting of the chosen module would be displayed.



You can set the data exchange related settings, including communication mode and the device settings on the **Data Exchange tab**.



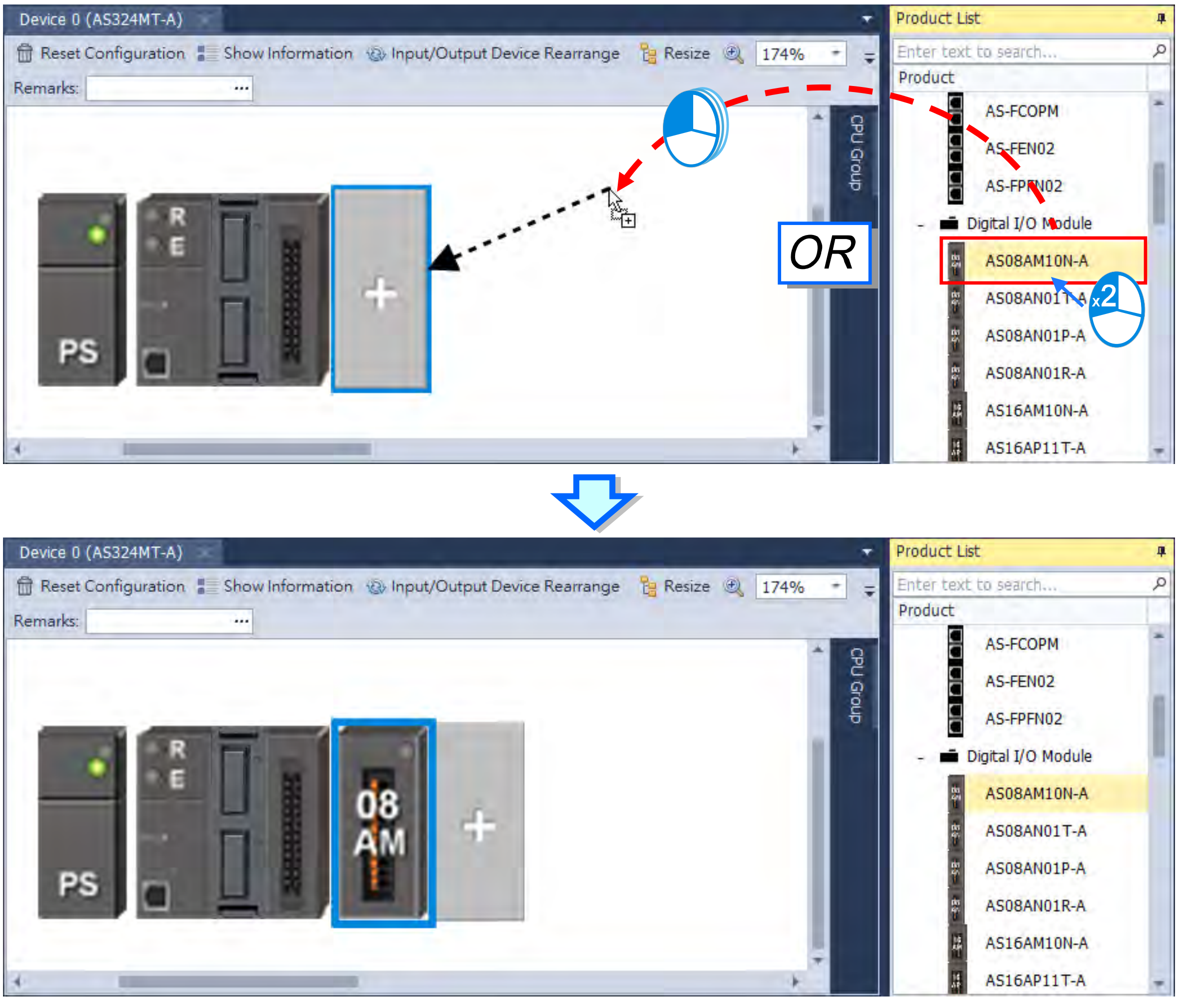
3.1.3 Module Configurations

3.1.3.1 Add One or More Modules/ Backplanes

Add a Module

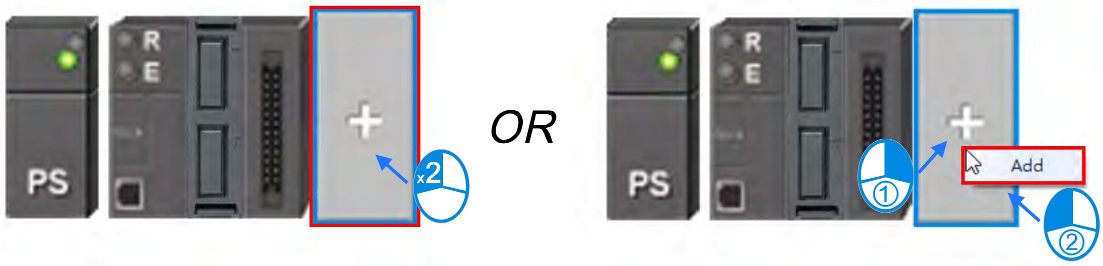
- **Method 1**

Double-click the module you want to add in the project or select it from the **Product List** and drag that module to the desired position. There will be a suggestive dotted line to indicate the legitimate position for the selected module.

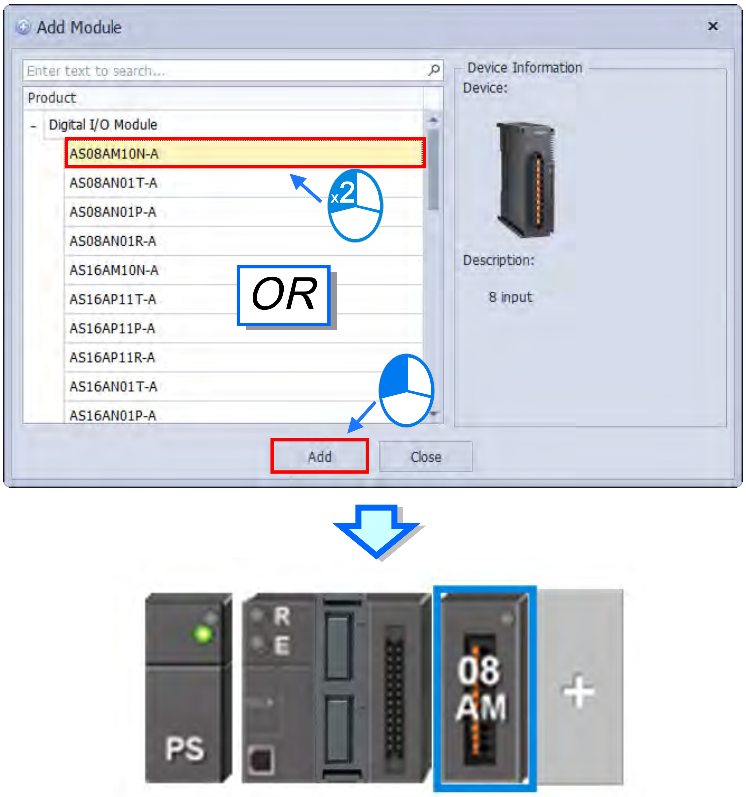


- **Method 2**

(1) Double-click a vacant slot or right-click the slot and choose **Add**.

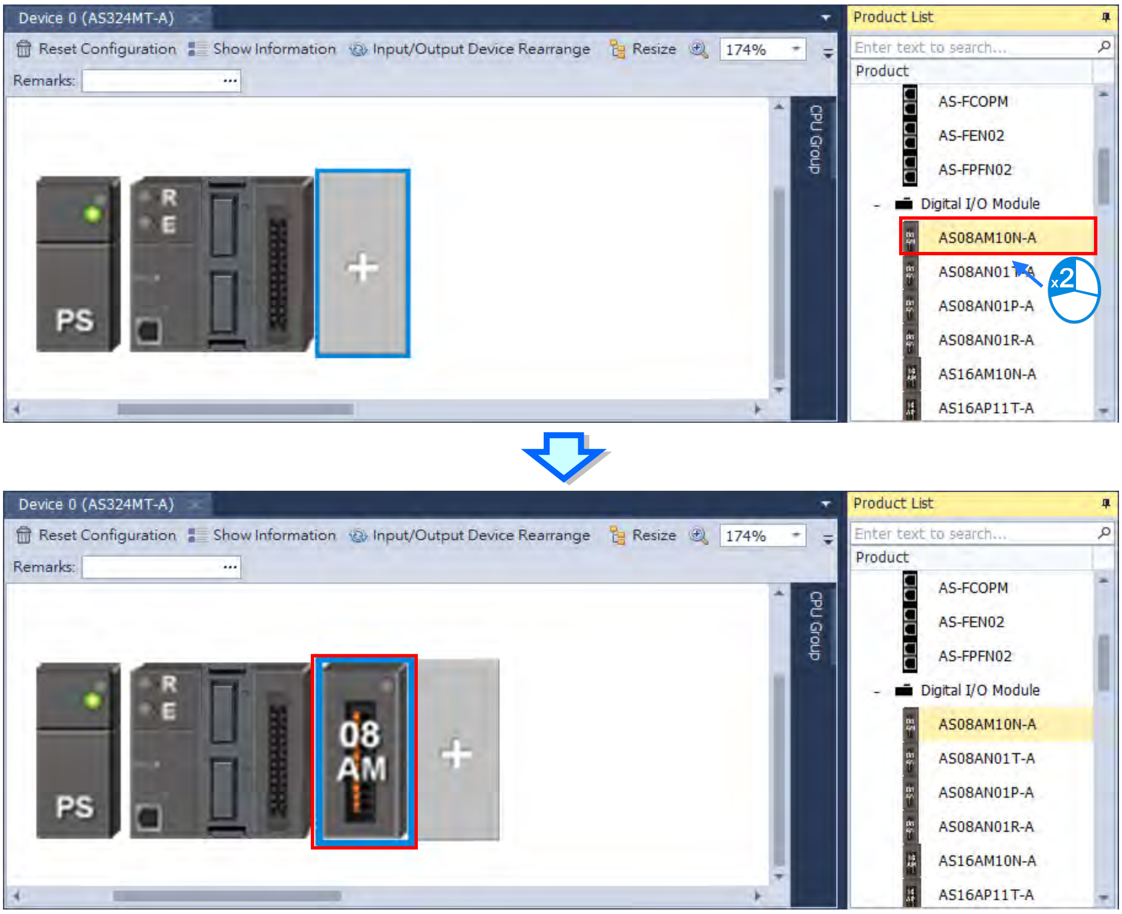


(2) Double-click the selected module to add. You can repeat these two steps to add more modules in.



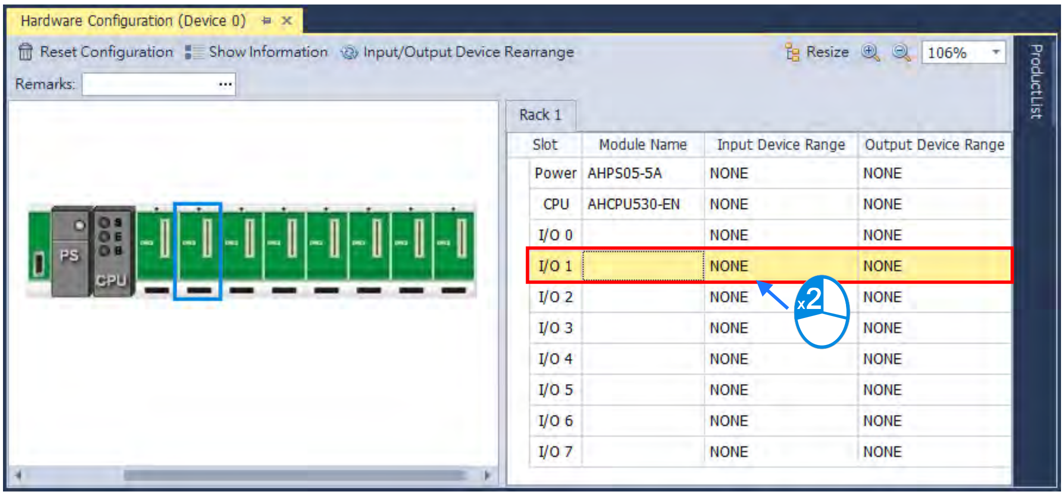
- **Method 3**

In the **Product List** section, double-click the selected module or select the desired module and press **Enter** on the keyboard to add the selected module in the hardware configuration area.

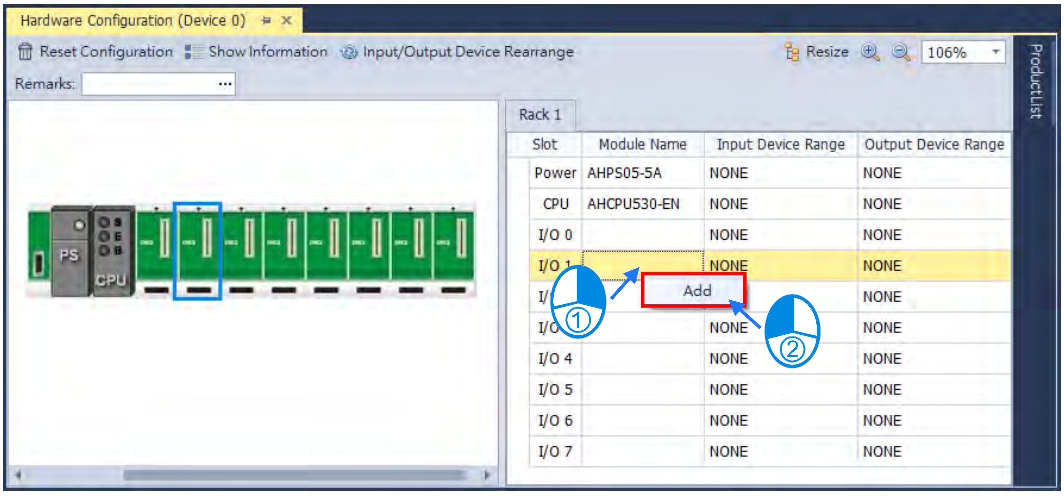


- **Method 4**

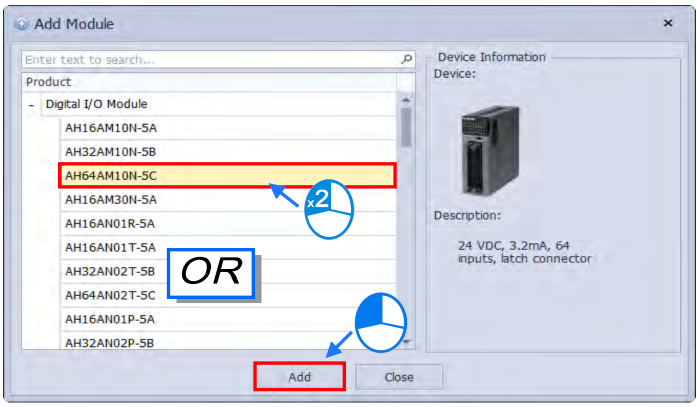
For AH series modules with extension backplanes, double click the desired slot position to add a module, or right click on it and select “Add” to display the add modules window.



OR

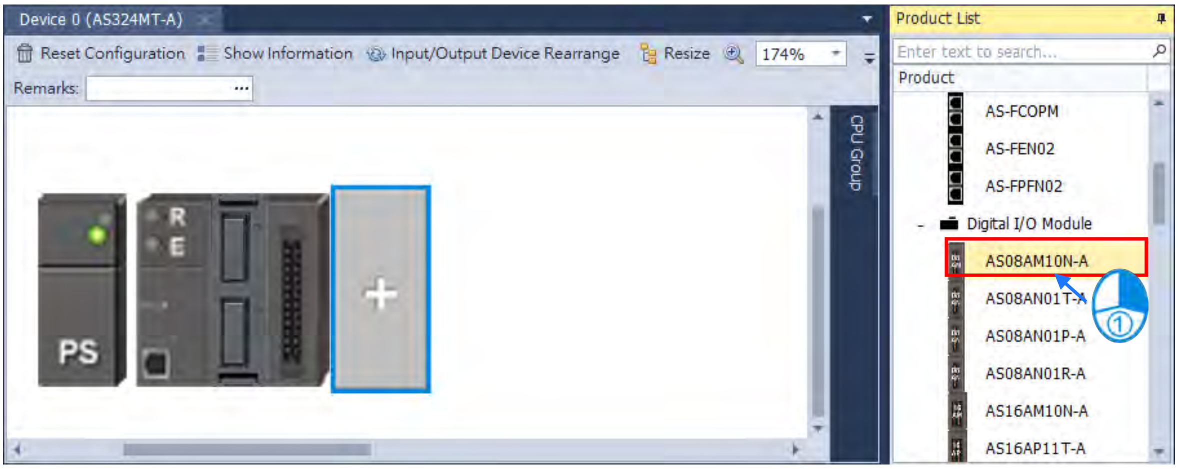


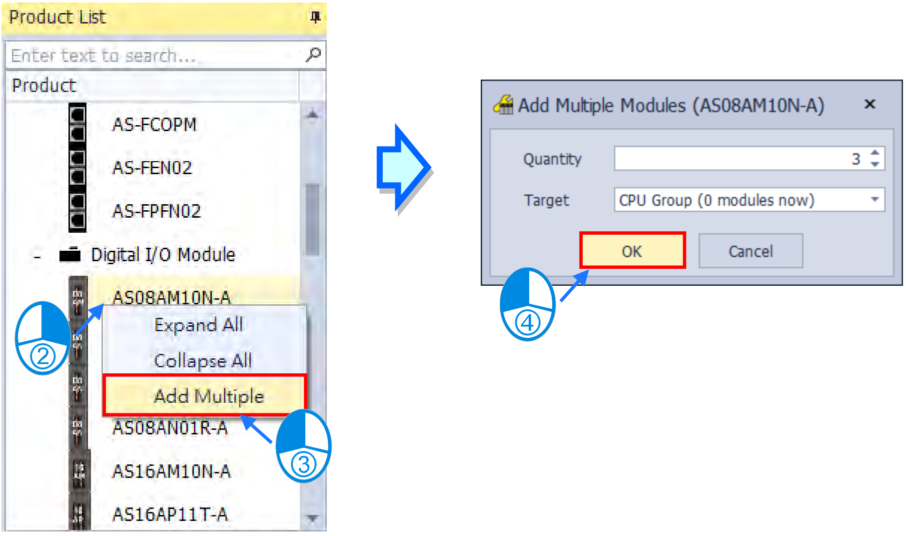
Then select the desired module and click "Add", or simply double click on it to complete.

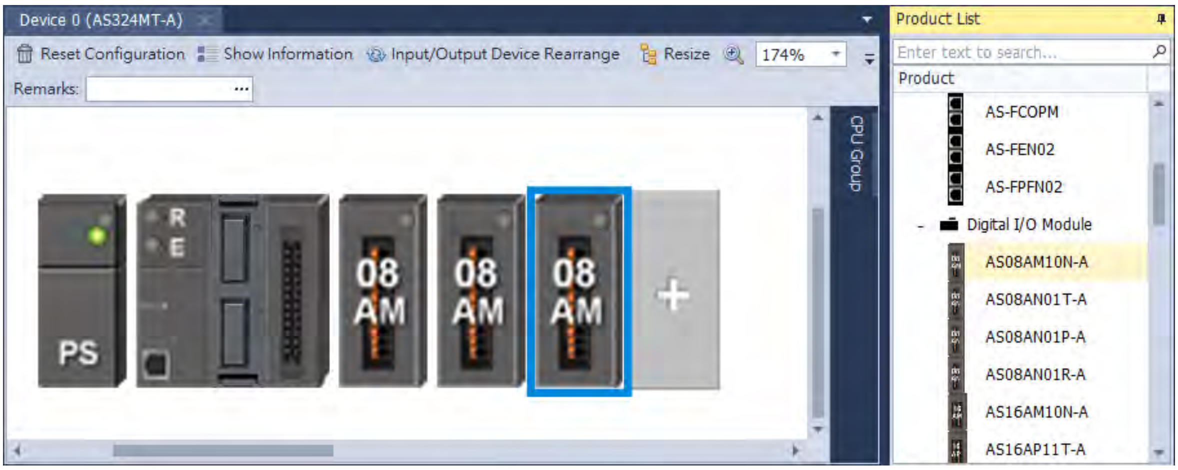


Add More Modules at a Time

In the **Product List** section, right-click the selected module that you need for more than one, and you will see the context menu showing three options **Expand All, Collapse All,** and **Add Multiple**. Click **Add Multiple**, and then an Add Multiple Modules (your desired module name) window appears, use the up and down arrows to increase or decrease the quantity number that you need and then click **OK** to confirm the setting.





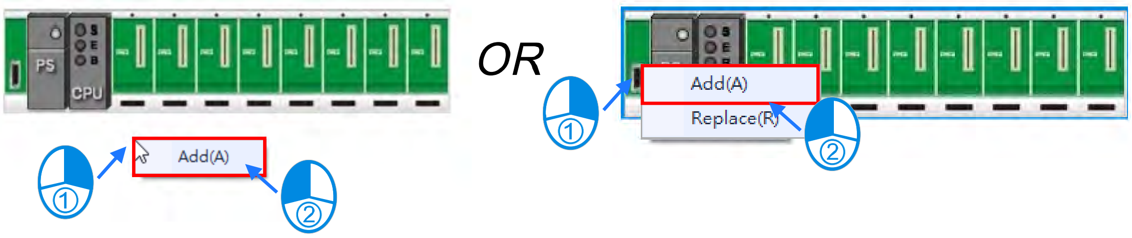


Add Extension backplanes (For models in AH series)

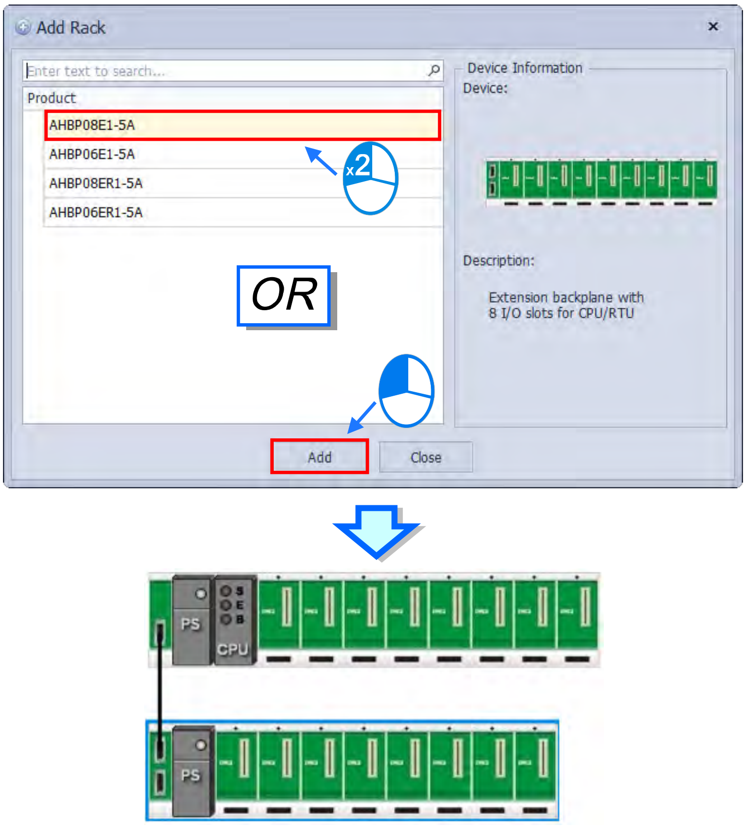
Extension backplanes are featured in AH series PLCs, which can be added to the hardware configuration area in various methods as described in the following information.

- **Method 1**

Right click on the blank field or the leftmost side of the extension backplane and select "Add (A)".

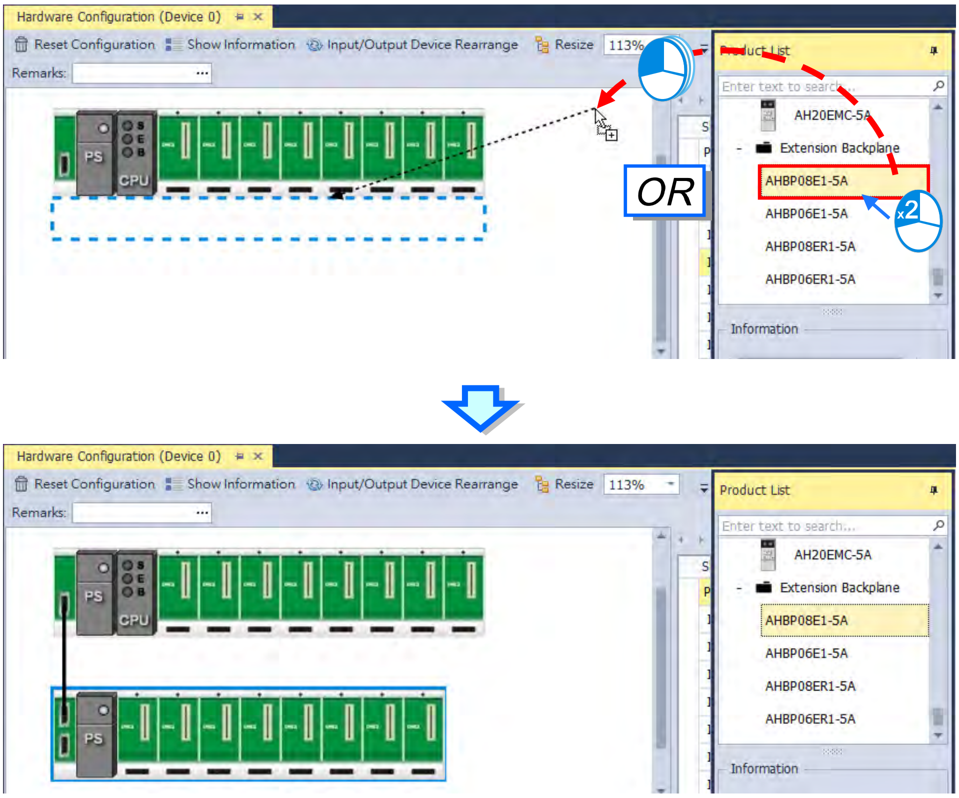


Then select the desired extension backplane and click "Add", or simply double click on it to complete.



● **Method 2**

Select the desired extension backplane to add and double click on it, or drag it directly to the blank space of the hardware configuration area which there will be dotted line to indicate the location of placement.

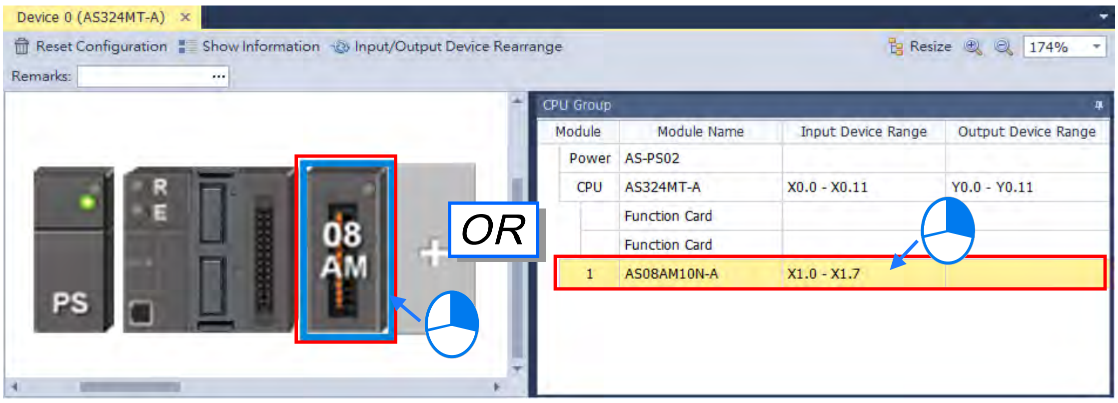


*Redundant type and the general type backplanes cannot exist at the same time, while the software would only save the most recent chosen type.

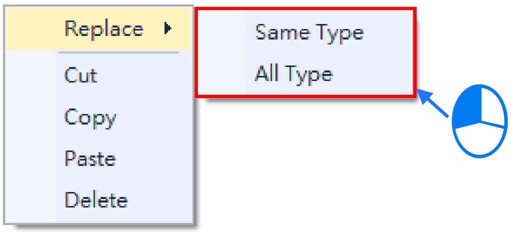
3.1.3.2 Replace the Module / Backplane

The following steps show you how to replace the module.

(1) Select and right-click the module for replacement in **Hardware Configuration** area or from **CPU Group Information** section.



(2) Choose **Replace** on the context menu. After that you can see two different types of replacements for selection, **Same Type** and **All Type**.



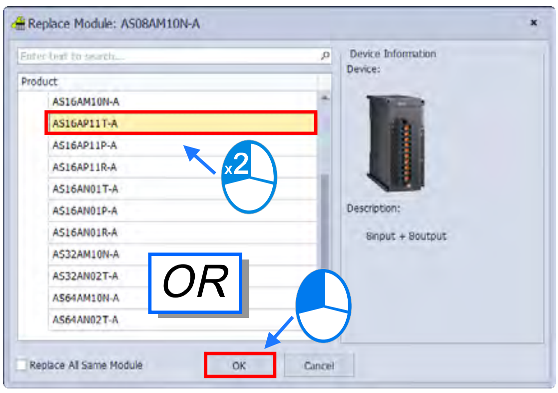
➢ **Same Type**

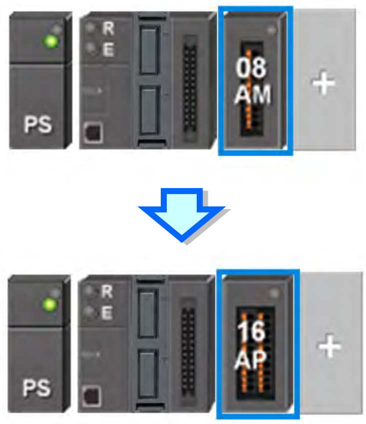
Replace only the selected module with the same type module. The new module **Input/Output Device Range** will be the same, while other parameters may return to system defaults if they cannot be matched.

➢ **All**

Replace selected module to be any type of module. The result is similar to deleting the original module by adding a new one, so the new module **Input/Output Device Range** will be re-configured and other parameter settings will also return to system defaults.

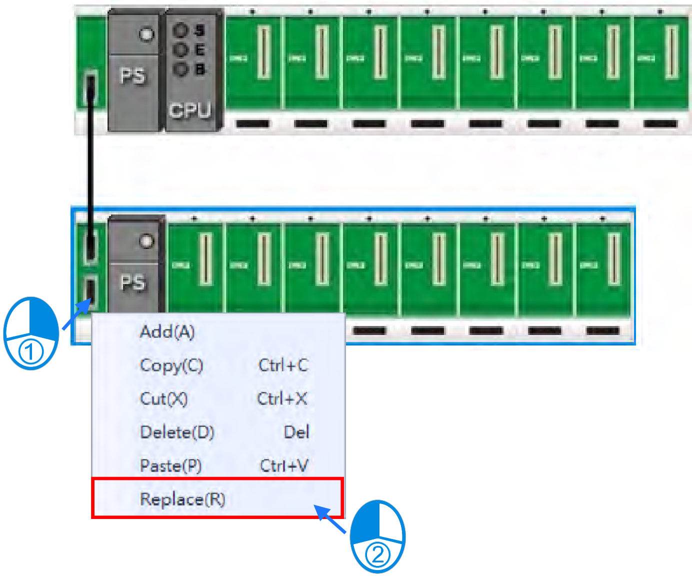
Once the replace type is selected, the Module Selection window appears with modules available for the selected replace type. Double click or select the module you want to replace with and click **OK**.



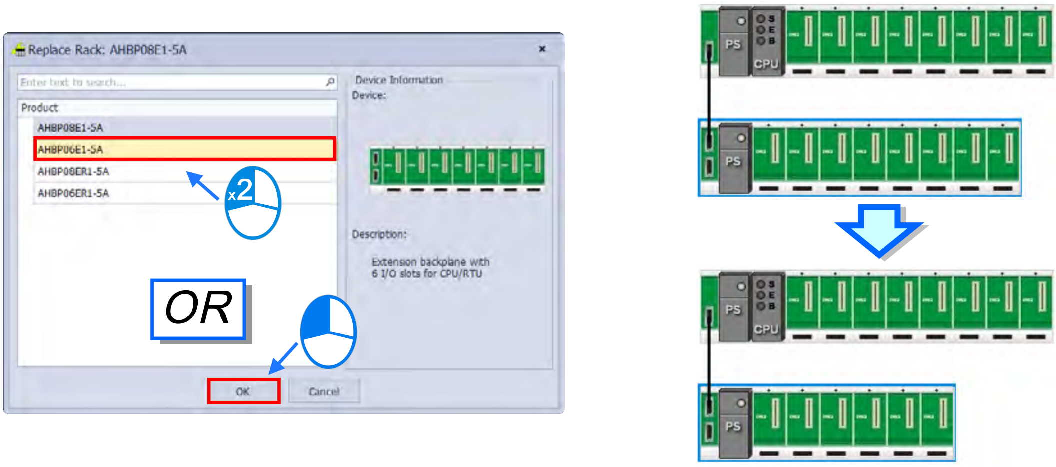


To replace backplanes in the hardware configuration area, please follow the step below.

(1) Right-click on the left side of the backplane you intend to replace in the hardware configuration area and click “Replace”.



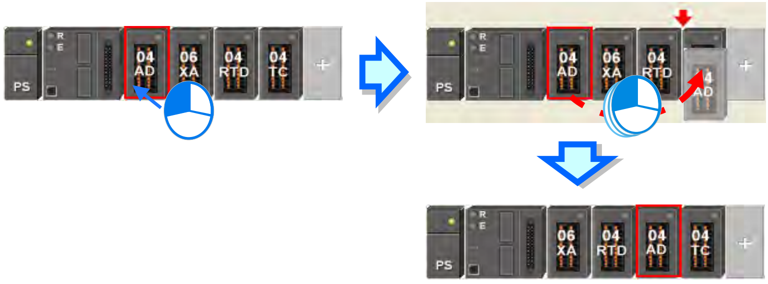
(2) Then the replace window would pop up with the title displaying the name of the selected backplane. You are able to choose the replacement backplane from the window by double clicking on it or clicking OK.



3.1.3.3 Rearrange Module / Backplane Position by Drag and Drop

Except CPU modules, you can drag and drop all module graphics in **Hardware Configuration** area to rearrange their positions.

AS Series PLC is non-backplane designed. When the module is dragged to a position between two modules, a red arrow mark appears indicating the position where the module will be after dropping.



* When rearranging the module position, the input/output device range, comment, internal parameters, corresponding device D and advanced parameters for intelligent modules are also rearranged with the module.

With extension backplanes featured in our AH series PLCs, you are allowed to rearrange the backplanes, except for Backplane 1(Main backplane), by dragging its figure directly in the hardware configuration area. If overlays one backplane on another, an exchange icon would be shown for exchanging the two backplanes. While an insert icon would be shown if dragging one backplane to the middle of the other two as shown below.

***Illustration of exchanging backplanes**

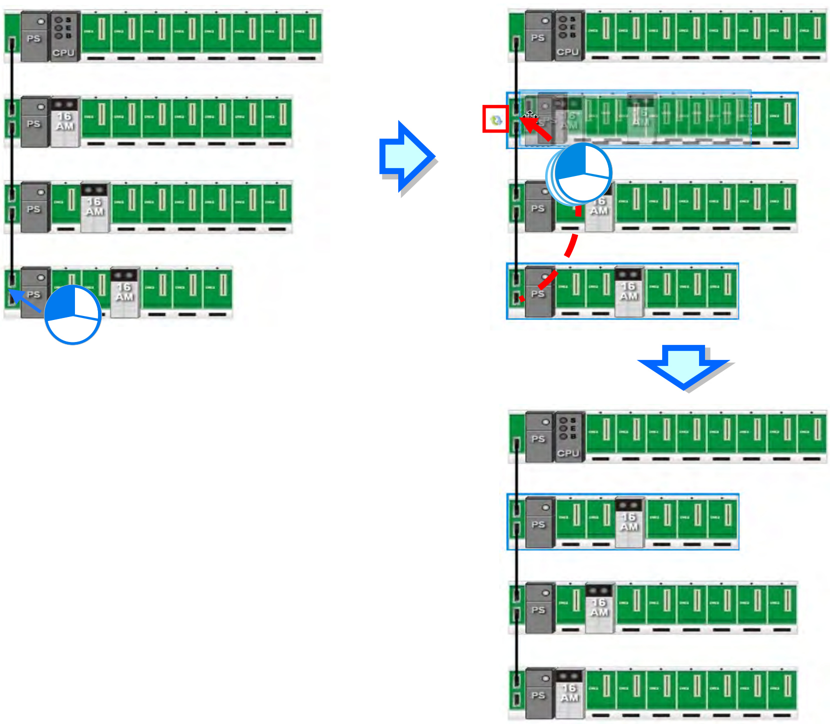
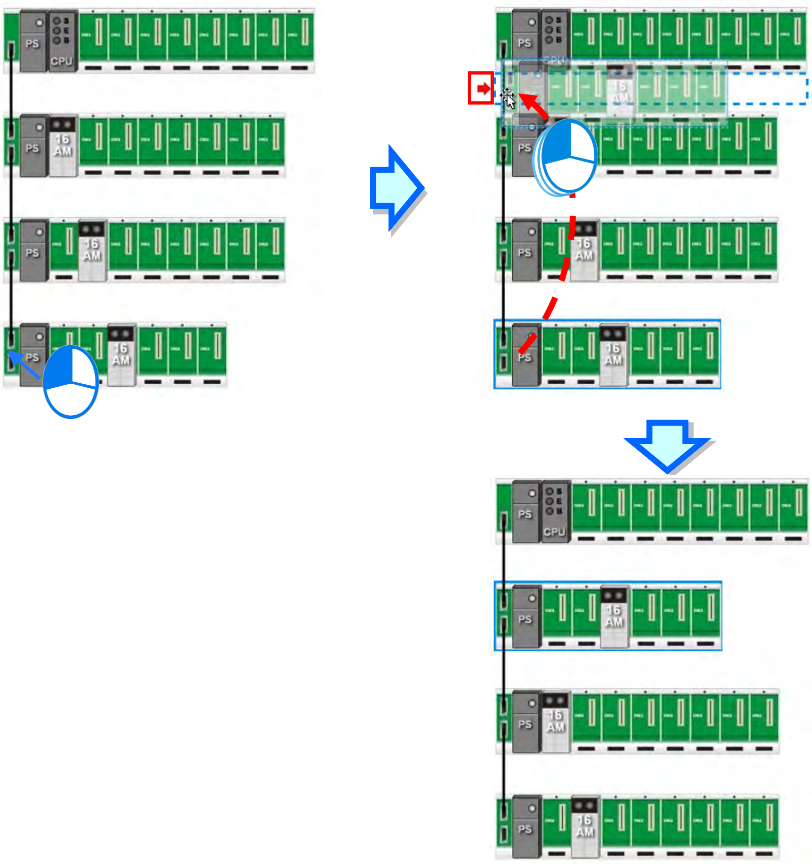


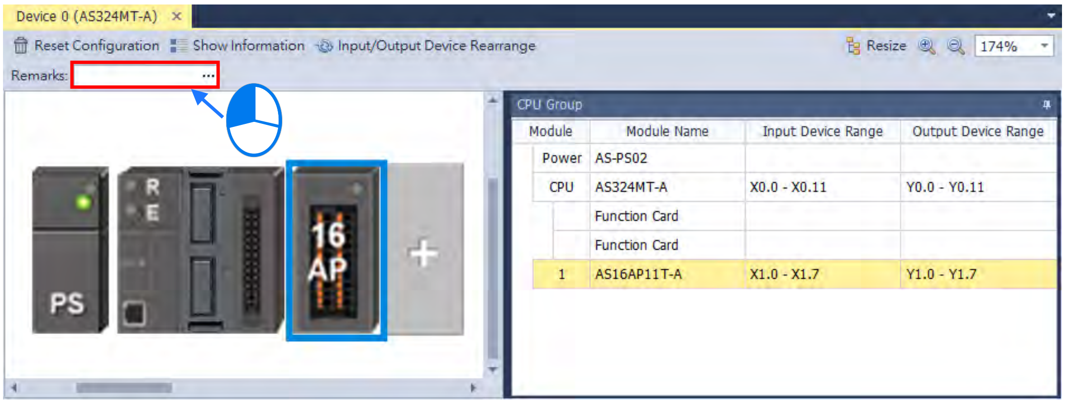
***Illustration of inserting backplanes**

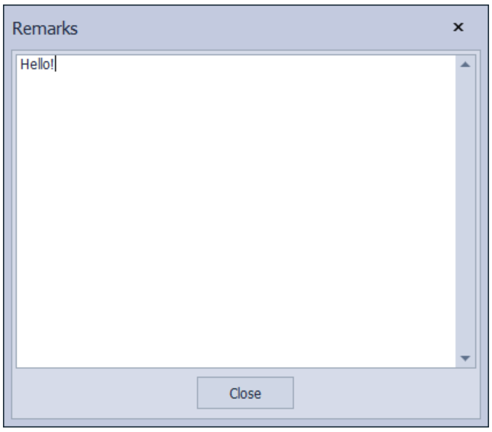


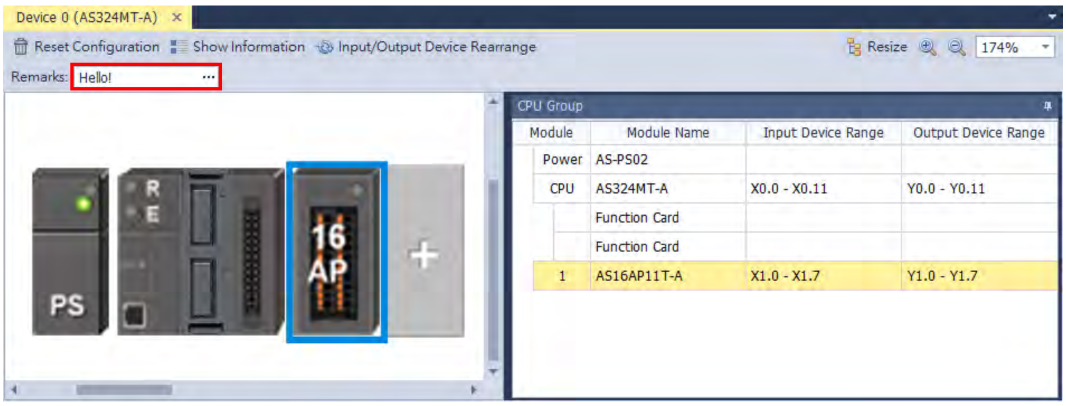
3.1.3.4 Remarks and Comments

- **Remarks for the project**

  Click **Remarks** field on the top of the **Hardware Configuration** area and a blank box appears for you to leave remarks for the project. After typing the remarks, press **Enter** on the keyboard or click **Close** to save the remarks.

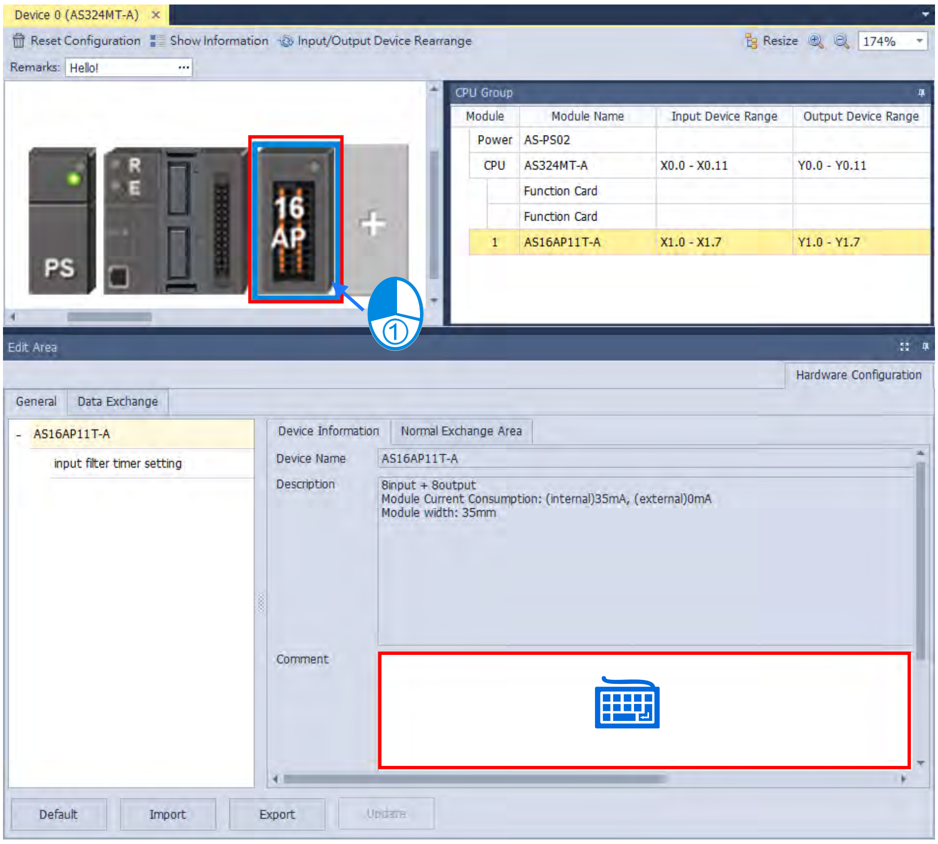






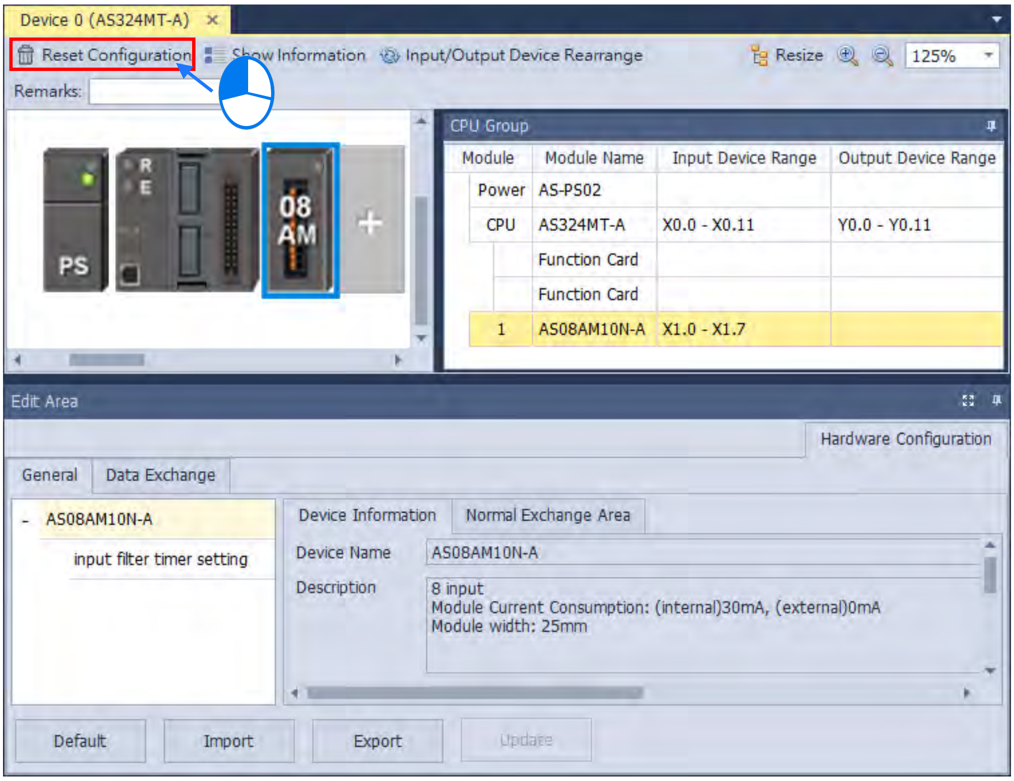
- **Comments for PLC CPU and Modules**

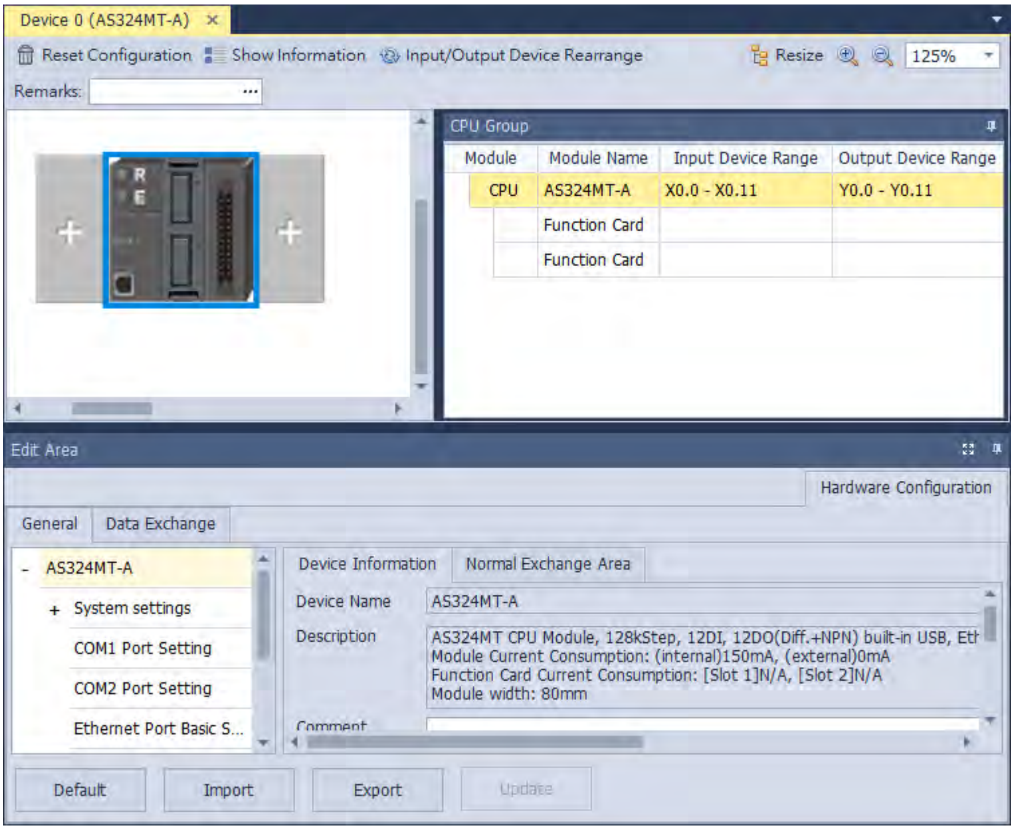
  Click the module graphic and you can see its details in the Edit Area. You can leave comments for the PLC CPU and Modules. After typing the comments, it saves the comments automatically.



3.1.3.5 Hardware Configuration Area - Reset Configuration

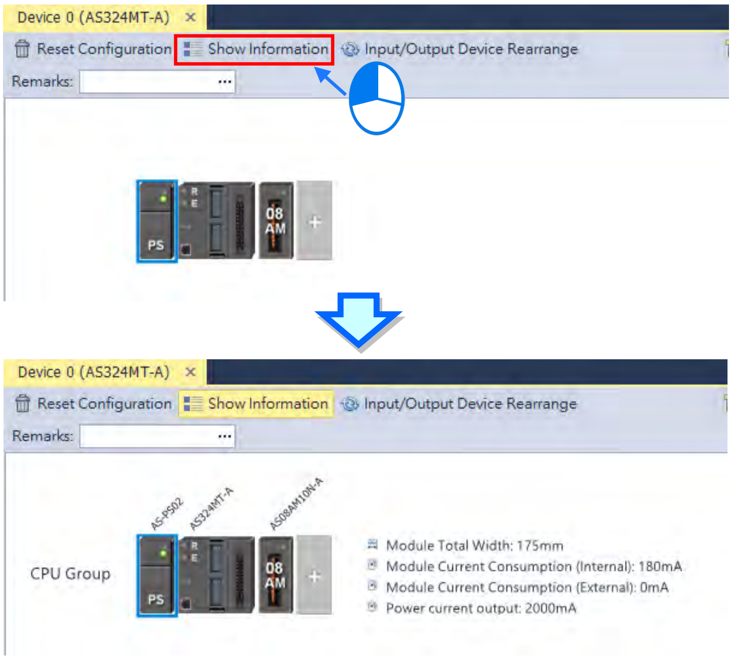
Use the functional button **Reset Configuration** to set the PLC configurations back to default values





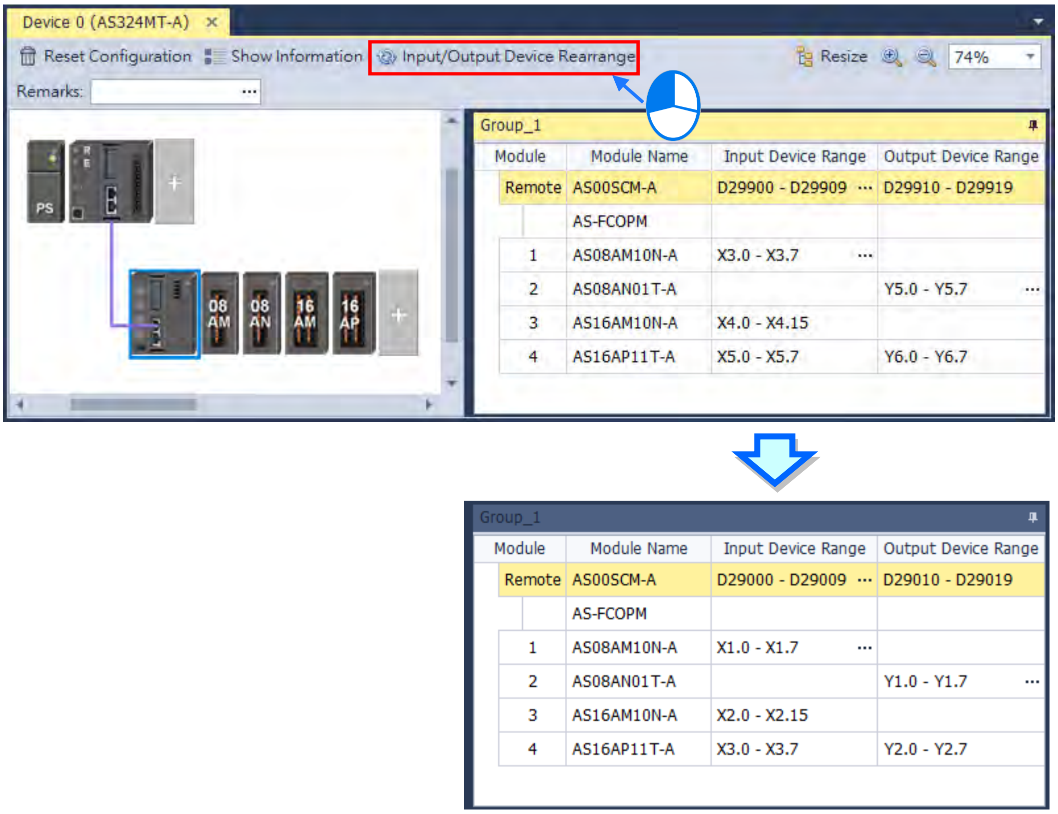
3.1.3.6 Hardware Configuration Area - Show Information

Use the functional button **Show Information** to see the hardware configurations



3.1.3.7 Hardware Configuration Area - Input / Output Device Rearrange

Use the functional button and **Input / Output Device Rearrange** to rearrange the device ranges.

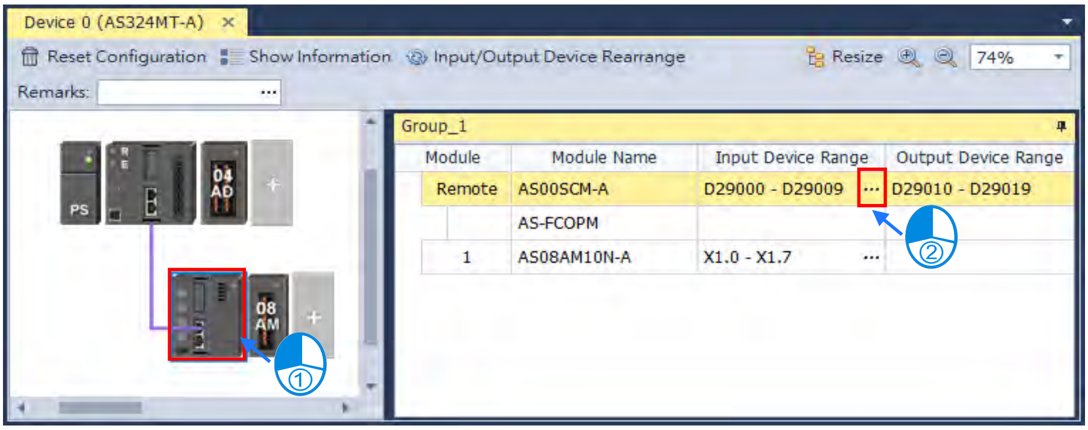


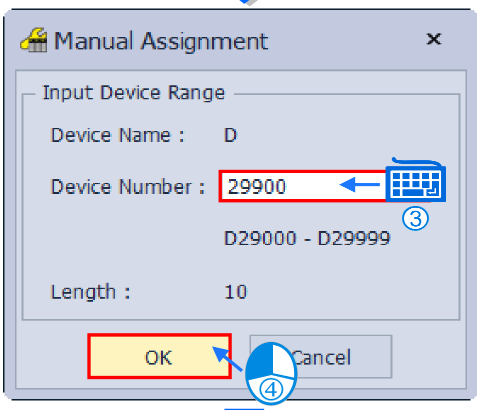
3.1.3.8 Hardware Configuration Area – Address Configuration of Modules

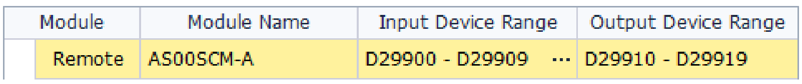
In case that there are regular queries for updating data, for example by continuously updating the received analog signals, the analog input module would transfer the signals to available data and store in corresponding device addresses automatically. The device addresses would be displayed in the columns of **Input/ Output Device Range** from the device list as shown in the figure in the next section. In addition, the manual IP address configuration feature is not supported by AS series models, but rather automatically configure a fixed address based on the module's location. While only the address of the first SCM module can be configured by RTU remote units, others would be configured sequentially. For more details concerning remote module configuration of AS series, please refer to the next section **3.1.3.9**.

3.1.3.9 Hardware Configuration Area - Change Input Device Range of the Remote Modules

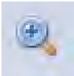
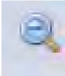
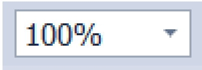
In case that you want to specify the IP address of the remote device while configuring modules, click the remote module and then you can see **···** in the column of **Input Device Range**. Double-click it to see the **Manual Assignment** window and start editing your desired input device range.





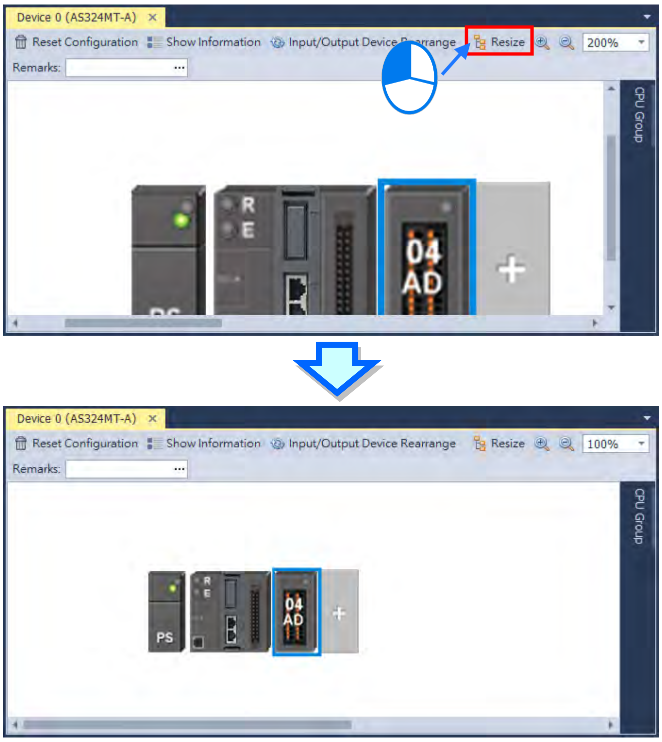


3.1.3.10 Hardware Configuration Area - Resize

Use the functional buttons ,  or 

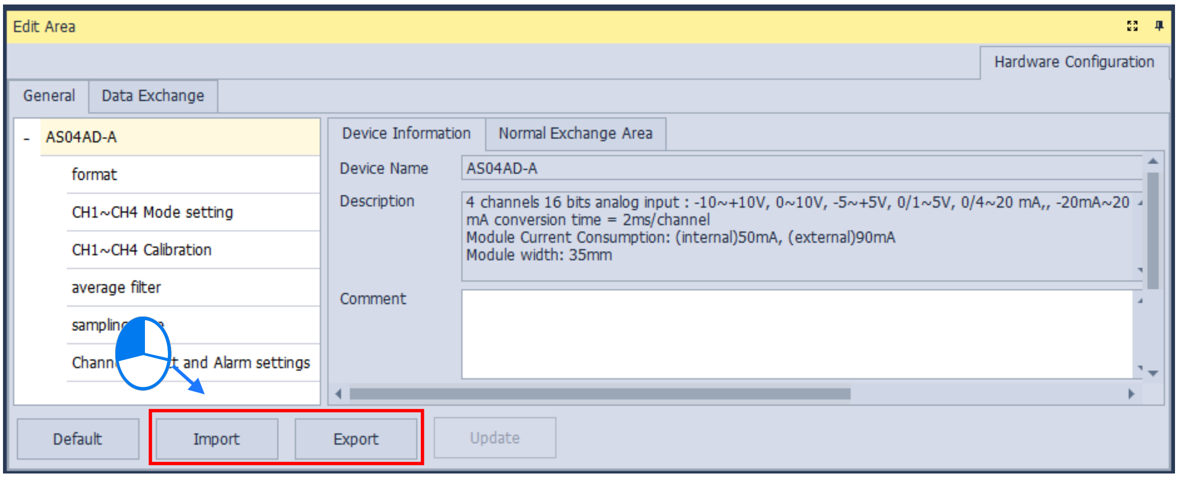
to rearrange the size of the device images in Hardware Configuration Area. Use 

to set the display of the configuration area back to its default values (shown at 100% and in the center).



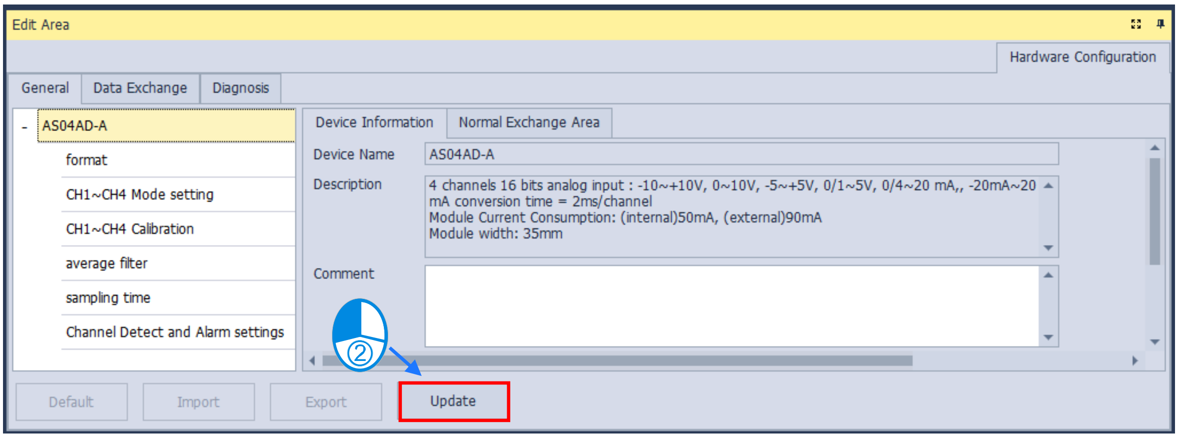
3.1.3.11 Edit Area – Import and Export

You can import/export the module parameters in .dep format. Click the **Import** button and then choose a file to import. Click the **Export** button and then choose a path and enter a file name for the exported file. When importing, the system checks if the file format and the module name are matched. If not, an error message shows up.



3.1.3.12 Edit Area – Update

To update the module parameters, first you need to be in the online mode. Please refer to section 3.1.2.5 for switching to online mode. Select the module that you want to update its parameters and then click the **Update** button. This functionality is only available for digital IO modules, analog IO modules and network modules.

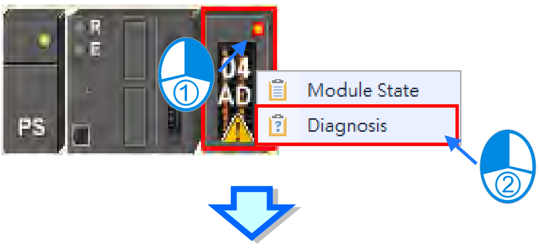


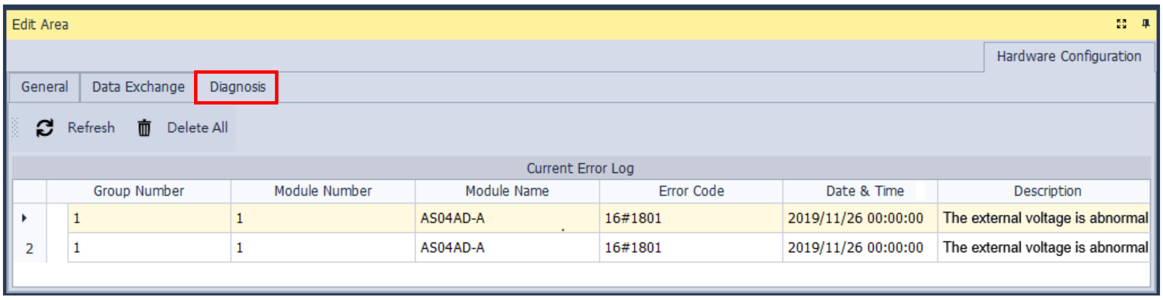
3.1.3.13 Show or Hide the Display

Click  or  to hide the display area and after that only its tab remains shown. Move your cursor to the tab to have the hidden display area shown. Click  to pin and lock the display area to keep it shown while the icon changes to .

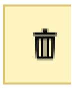
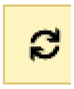
3.1.3.14 Module State and Diagnosis

To check the module state and diagnosis, first you need to be in the online mode. Right-click the module that you want to check its module state and diagnosis and then a context menu appears.





	Group Number	Module Number	Module Name	Error Code	Date & Time	Description
▸	1	1	AS04AD-A	16#1801	2019/11/26 00:00:00	The external voltage is abnormal
2	1	1	AS04AD-A	16#1801	2019/11/26 00:00:00	The external voltage is abnormal

After you click Diagnosis, you can see a table with three tabs. On the Diagnosis tab, you can see the Current Error Log table. When the error is cleared, you can use  to clear the error log stored in the module and the module state can be restored to normal. Use  to update the module state.

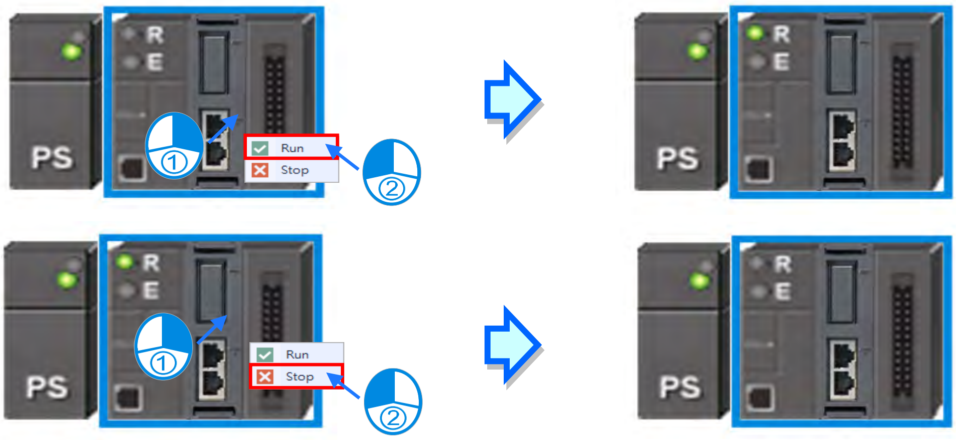
3.1.3.15 Change Module State in Online Mode

You can change the module state in online mode.

⚠ Before changing the module state, make sure no personnel or system will be affected.

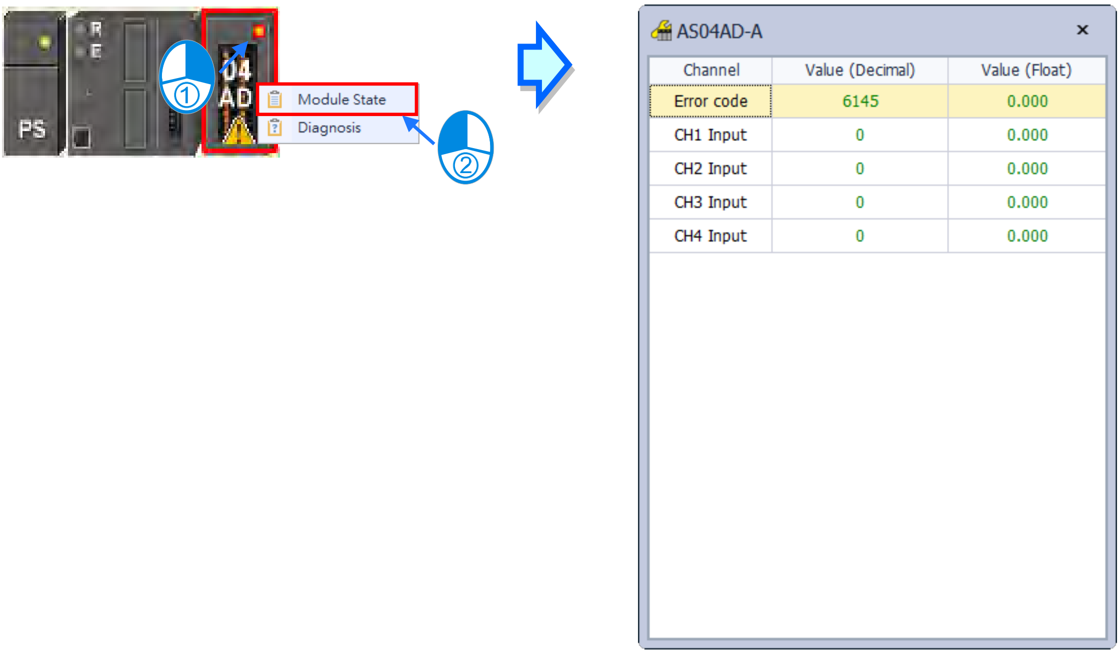
<u>**Change the module operation state**</u>

- Right-click the PLC CPU to see the context menu and click **Run** for the PLC CPU and module to start running (RUN LED ON) or click **Stop** for the PLC CPU and module to stop running.



Change the module I/O state

- This functionality is only available for digital IO modules, analog IO modules and temperature modules. Right-click the module to see the context menu and click **Module State** and then you can see an IO state table shows up. For digital IO modules, you can right-click to set the input/output channel to ON or OFF, when the PLC CPU and the module are on the RUN state.



➢ **Force to ON：Force to set the channel state to ON**

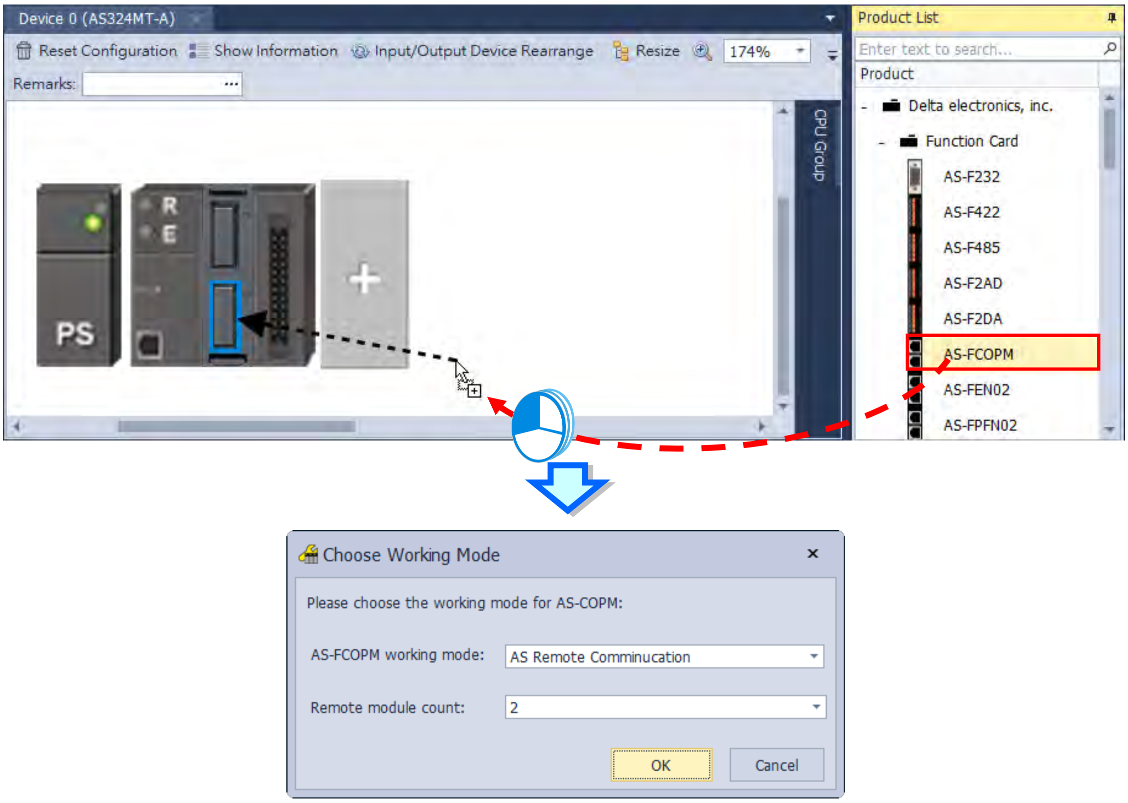
➢ **Force to OFF：Force to set the channel state to OFF**

➢ **Release：Release the selected channel from the force**

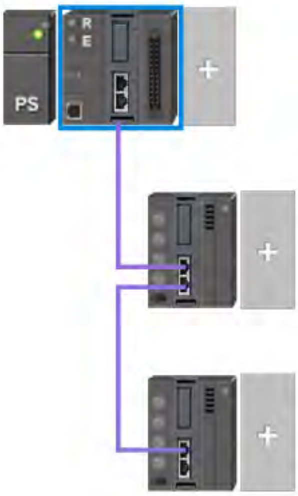
➢ **Release all：Release all channels from the force**

3.1.3.16 Configure a Remote Module

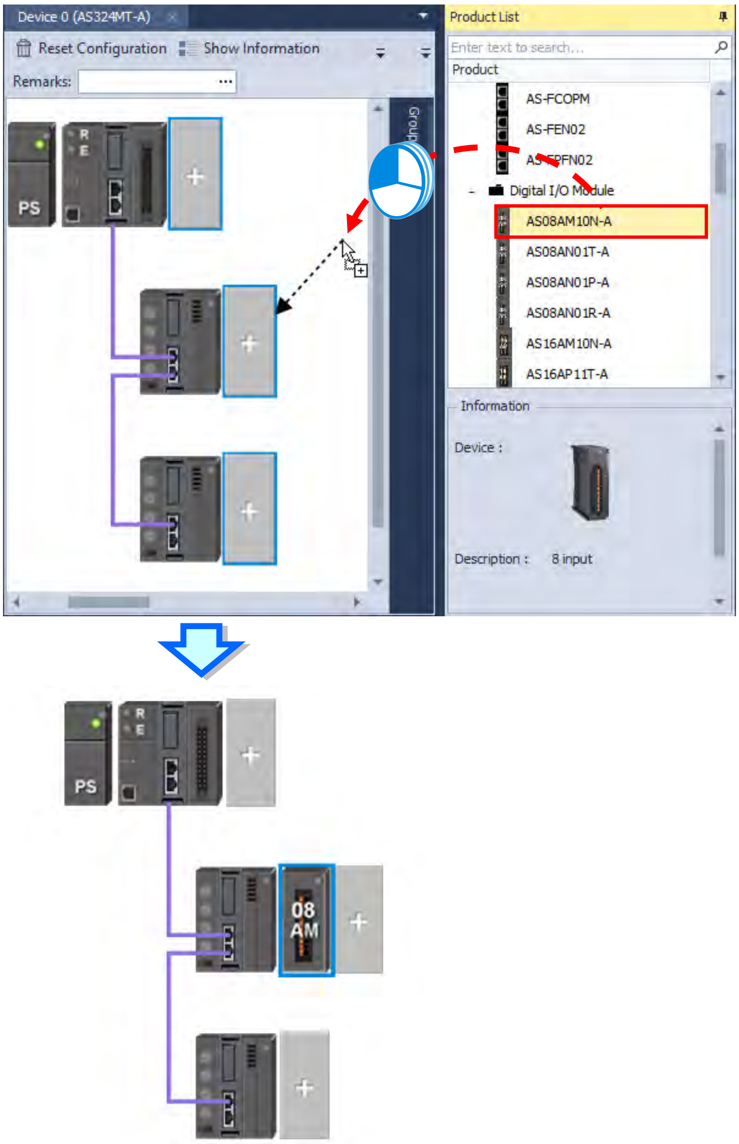
Drag AS-FCOPM from the Product List to the Function Card Slot 2 of the PLC CPU. After that you can set the Working Mode for the AS-FCOPM as AS Remote Communication and then you can set the quantity of the Remote Modules that you want to connect.



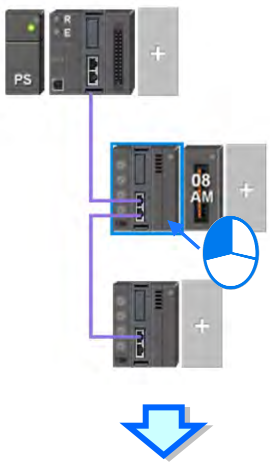
If you set the Remote module count to 2 and click OK, you can see two remote modules connected to the PLC CPU.

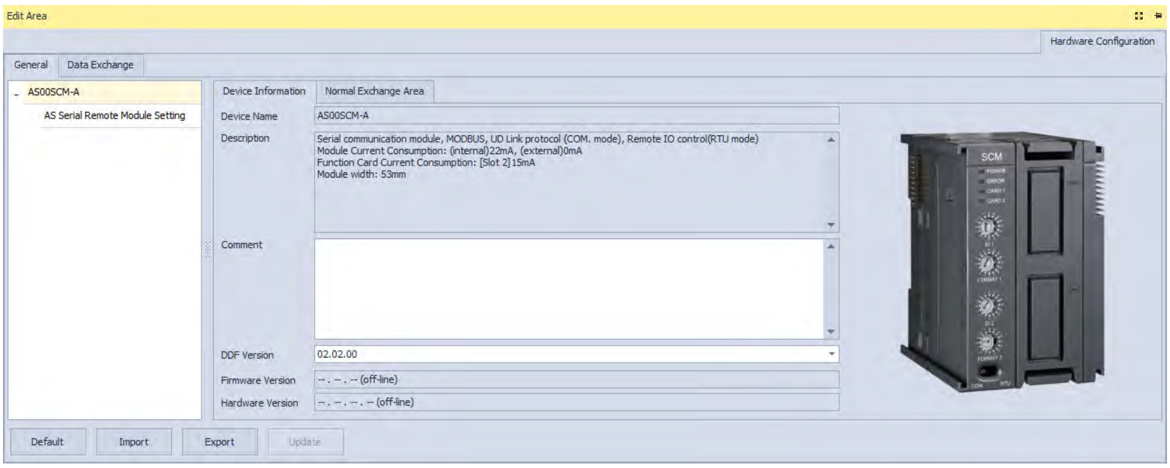


You can add more digital IO modules or analog modules to the remote module.



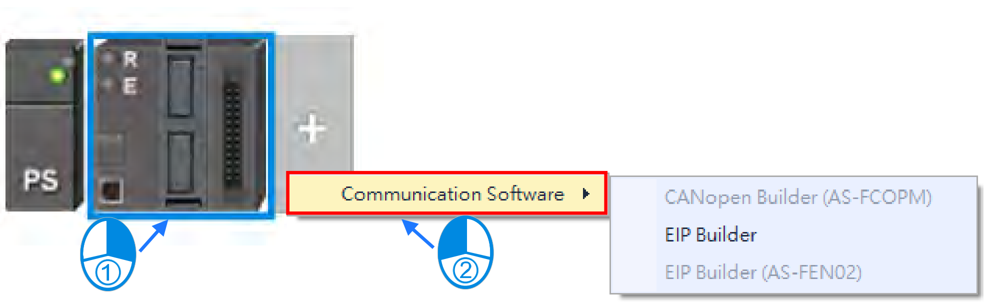
And then you can click the module to open its configuration page to configure.





3.1.3.17 Open Communication Software from HWCONFIG

Right-click the PLC CPU and click **Communication Software** to see which software is available for this PLC CPU. If the software option is grayed out, you may need applicable function cards to work along with the project.

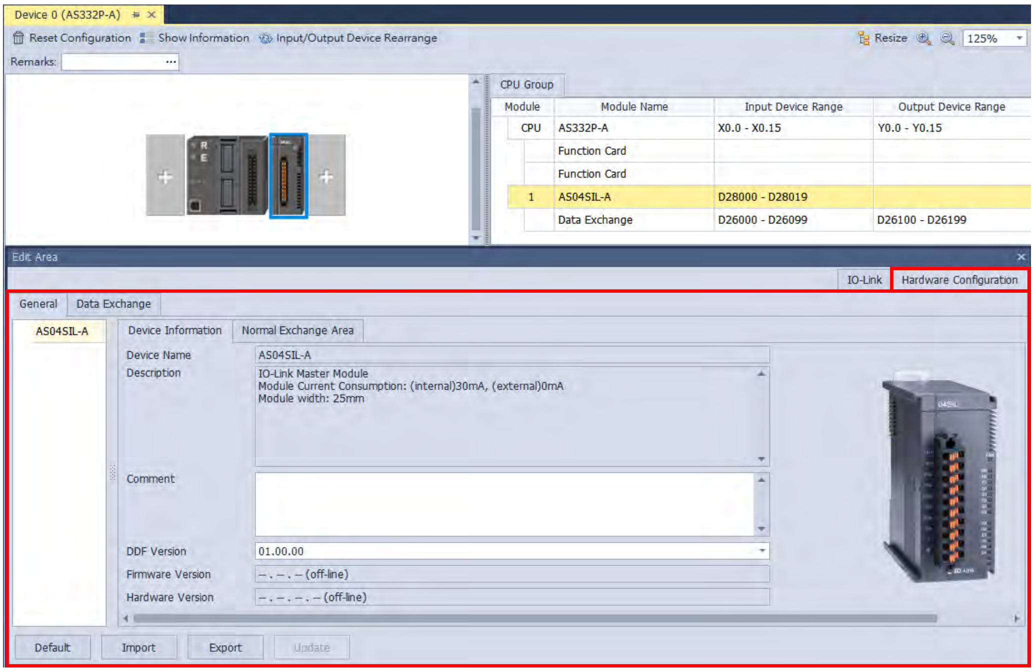


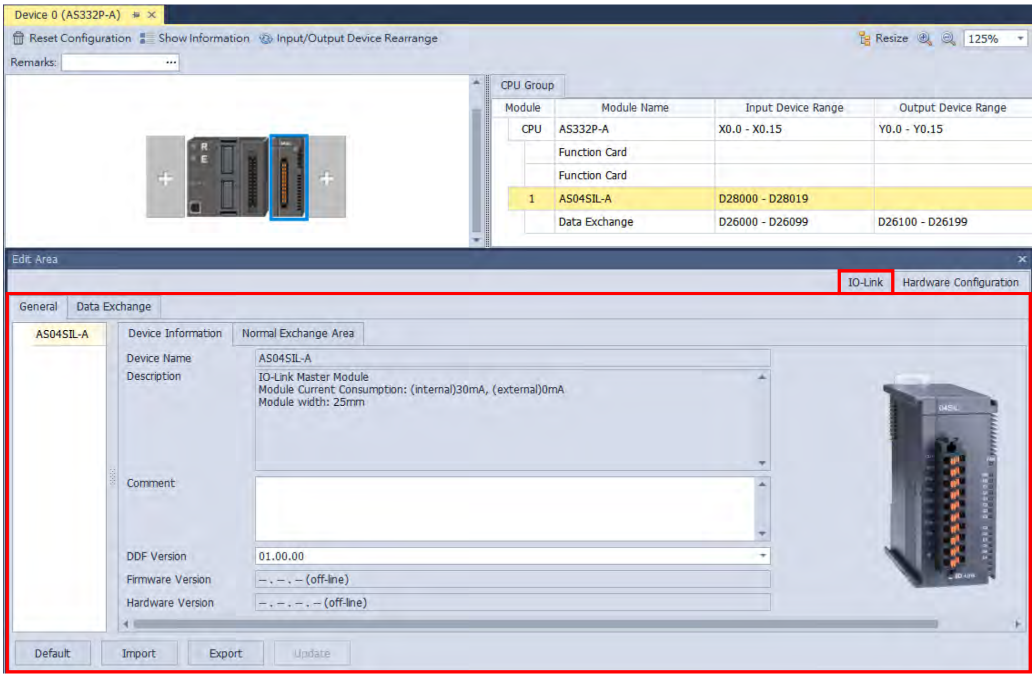
3.1.3.18 IO-Link

Please find the AS Series Module Manual for more details.

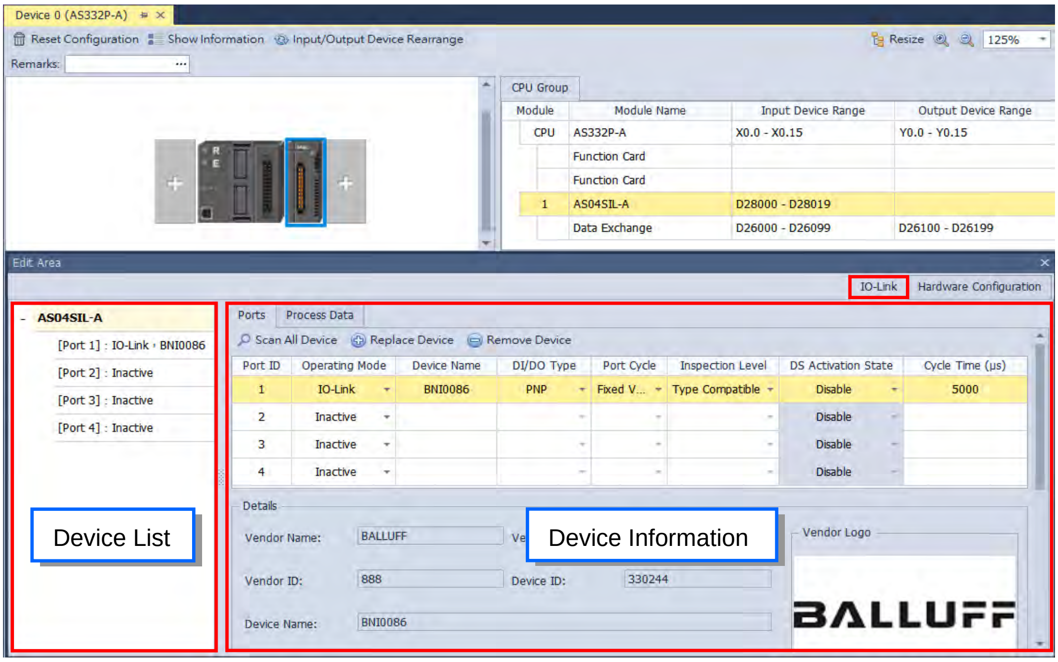
AS04SIL-A as the “**Master**” device communicates to the IO-Link devices, such as smart sensors and actuators, via a point-to-point connection with an unshielded standard cable adopting 3-wire technology. It is backwards compatible with traditional sensors and actuators. Circuits and communication channels are designed with reliable 24V DC power supply.

The “**Hardware Configuration**” tab on the interface of AS04SIL-A Edit area includes modules information and settings, while the “**IO-Link**” tab displays the information and settings of IO-Link as shown below.





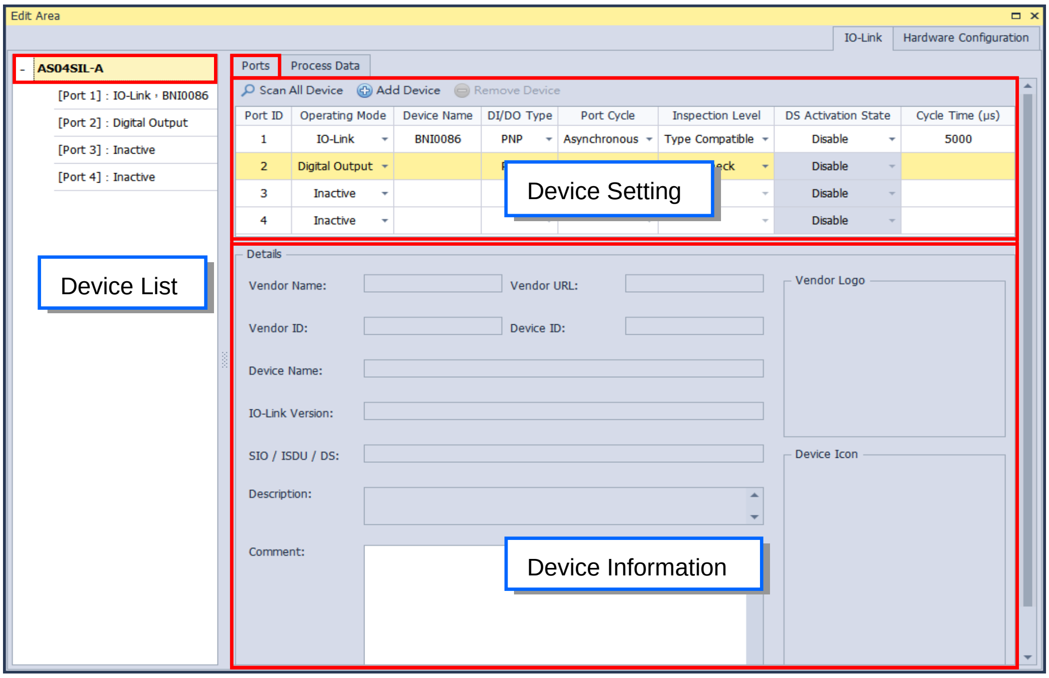
After entering the IO-Link tab, the Device List is shown on the left of the edit area and the Device Information is shown on the right.



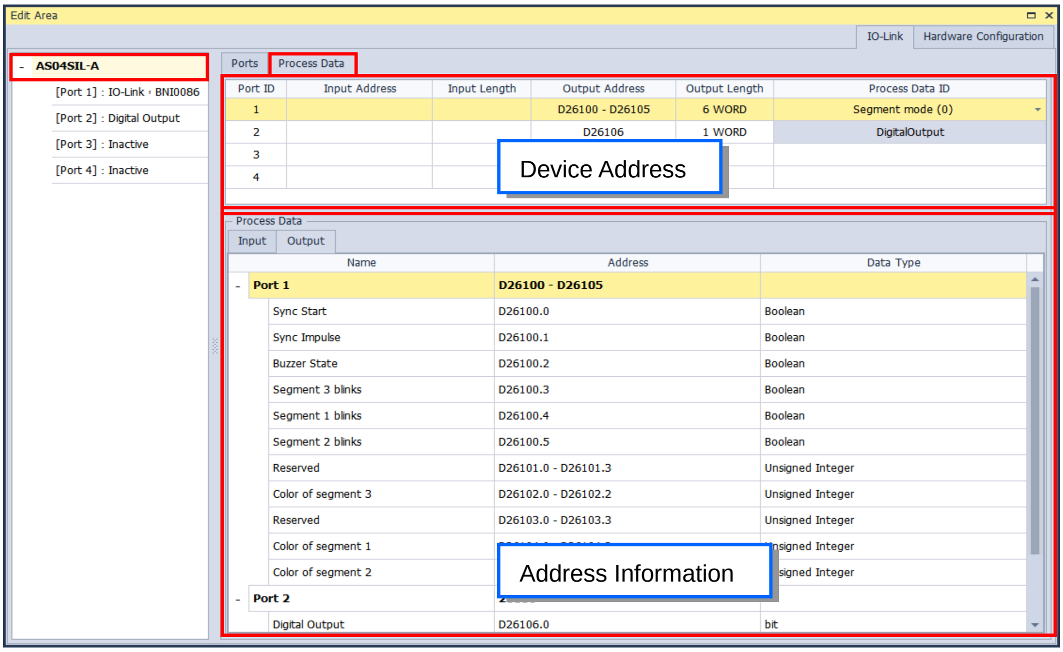
The display of Device Information would change to match different devices chosen on Device List. Please find below for the description.

- **AS04SIL-A (module)**

Two tabs "**Ports**" and "**Process Data**" will be displayed on the right when you choose **AS04SIL-A** on the device list. "**Device Setting**" on the upper side of the Port tab is to set the device configuration and communication settings. "**Process Data**" on the lower side of the Port tab is to display the information of the device chosen in Device Setting.



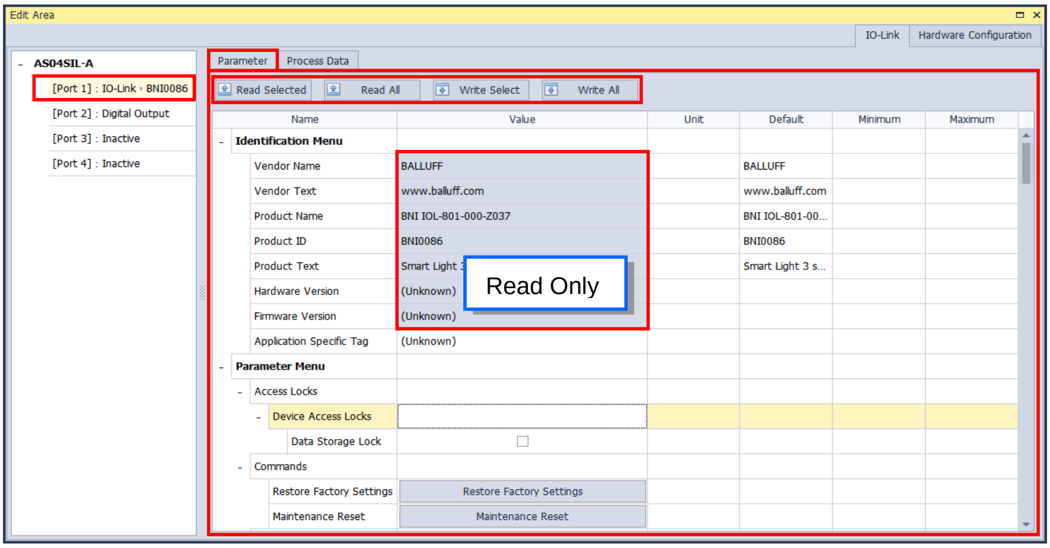
“**Device Address**” on the upper side of Process Data tab is to switch between different working modes (refer to section 12.3.2.2 in AS Series Module Manual) and display all the corresponding address ranges of CPU registers. “**Address Information**” displayed on the lower side is to provide all the detailed information of device addresses.



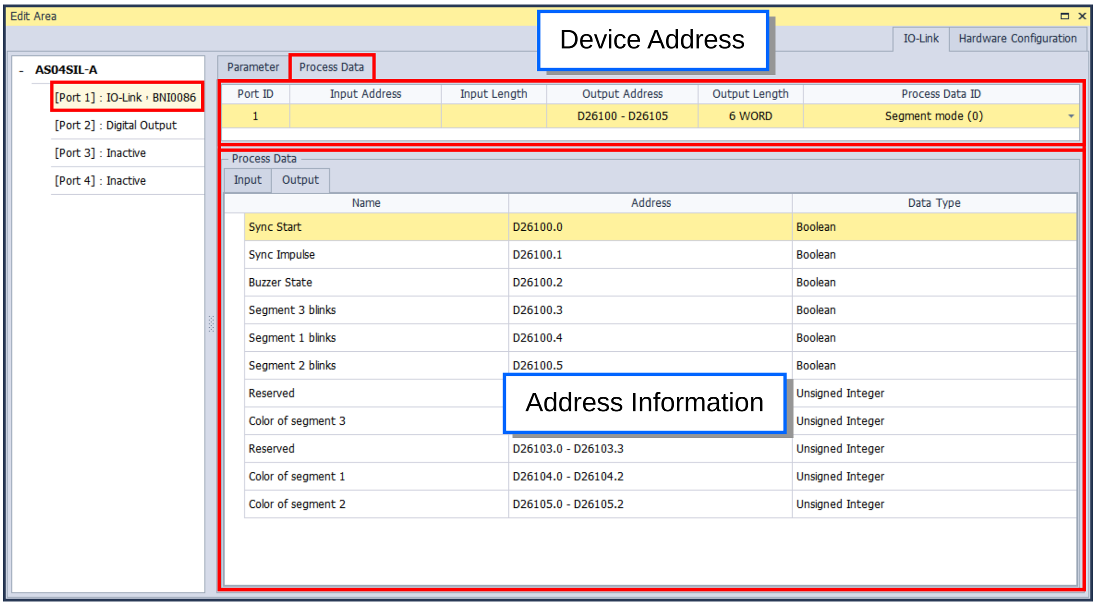
- Choosing the Device

  Take [Port 1] as an example, when this module is chosen, there’re two tabs displayed in the device information area on the right side.

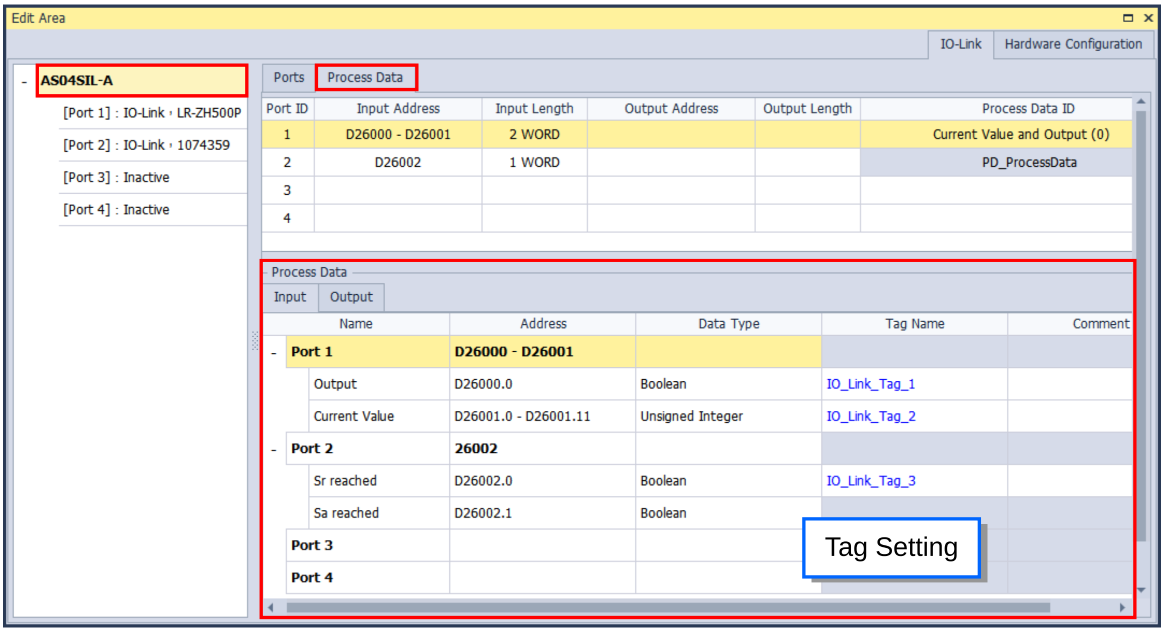
  The main function of “**Parameter**” tab is to set the parameters of devices. Users can read-write a single item or a group with the four buttons on the upper side of the window. Information of parameters including name, value, unit, default, minimum and maximum is displayed on the tab, while the greyed out field is read-only and the white field is editable.



The main functions of device address area on the upper side of Process Data tab are to switch among mutiple working modes with different devices (Refer to AS Series Module Manual section 12.3.2.2) and display the device address of [Port1]. Address Information area on the lower side of the tab is to display the detailed information of [Port 1] location.



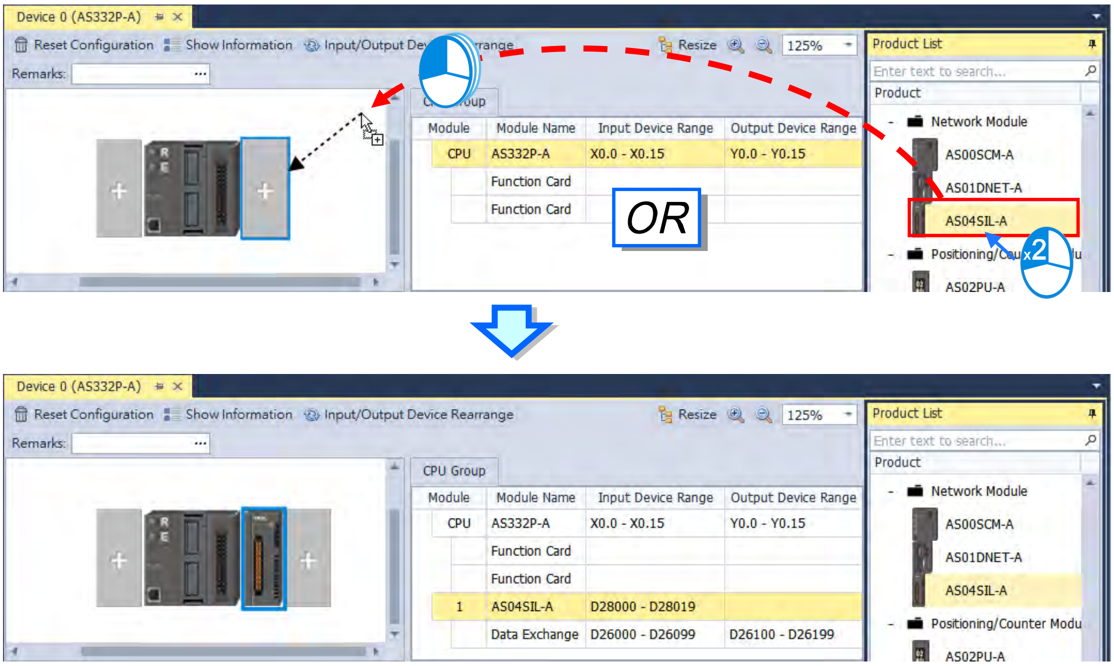
Tag configuration function would be featured on Process Data tab when open HWCONFIG in ISPSoft (refer to section 3.1.3.18), which can be functioned in Global HWCONFIG Variables under Global Symbols as well as accessing the corresponding IO-Link setting parameters.



IO-Link usage example:

- Step 1. Add AS04SIL-A module

Go to “**Network Module**” from “**Product List**” on the right side of the page, then add “**AS04SIL-A**” module to the hardware configuration area as below shown.



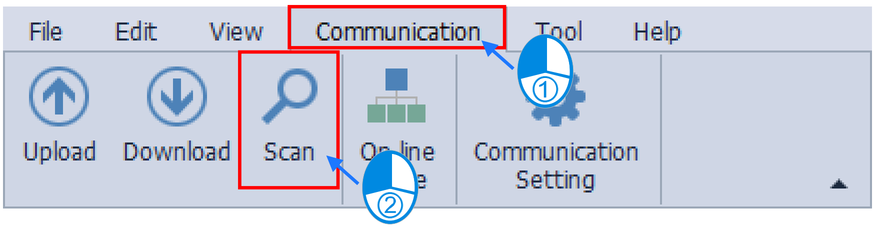
After click and choose the module, the “**Device Information**” and relating settings of module would be shown on the Hardware Configuration tab in the below Edit Area.

- Step 2. Add the IO-Link device

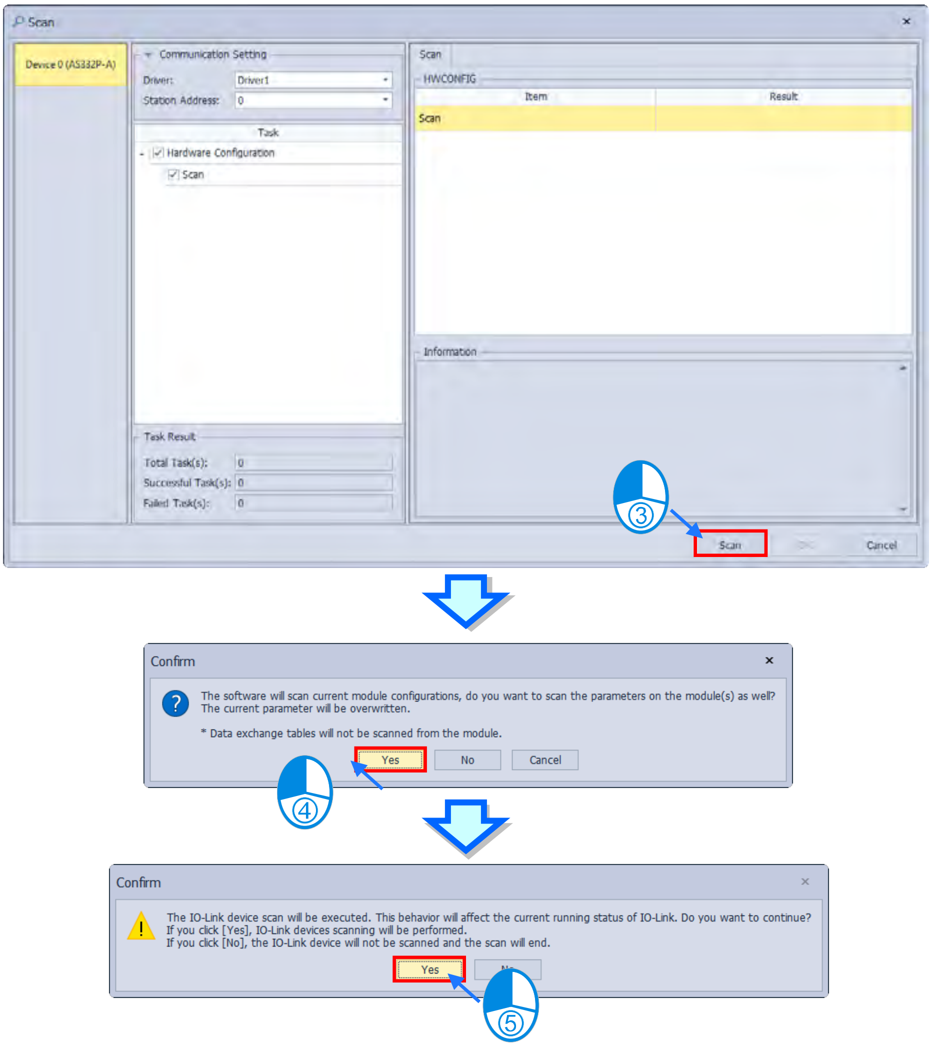
There’re three ways to add the IO-Link device.

➢ Method 1_Scan all the module configuration

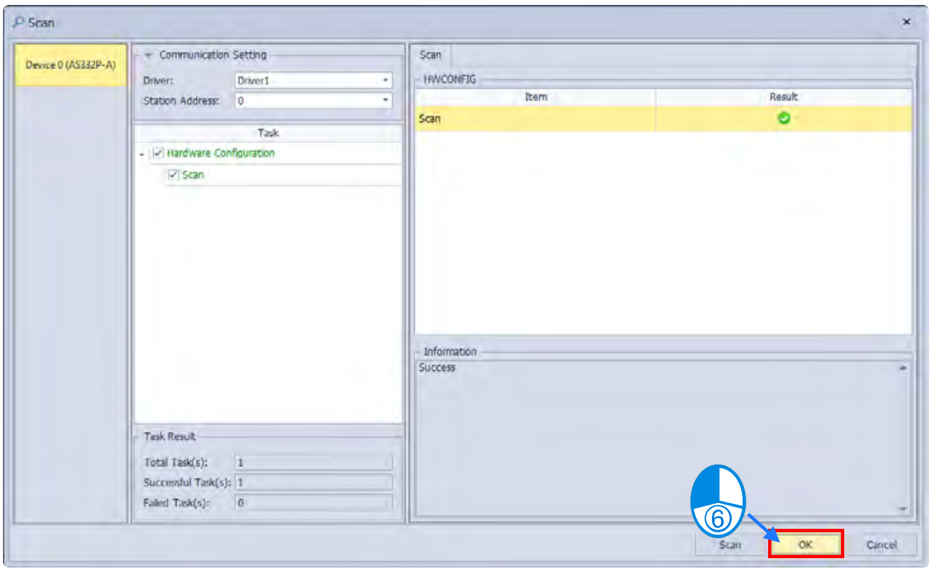
Make sure all the hardware devices are configured, then click “**Scan**” from the toolbar on “**Communication**” tab.



Click “**Scan**” after the Scan window appears, then click “**Yes**” in the confirm window to confirm the scan action. Continue to click “**Yes**” to start scanning.

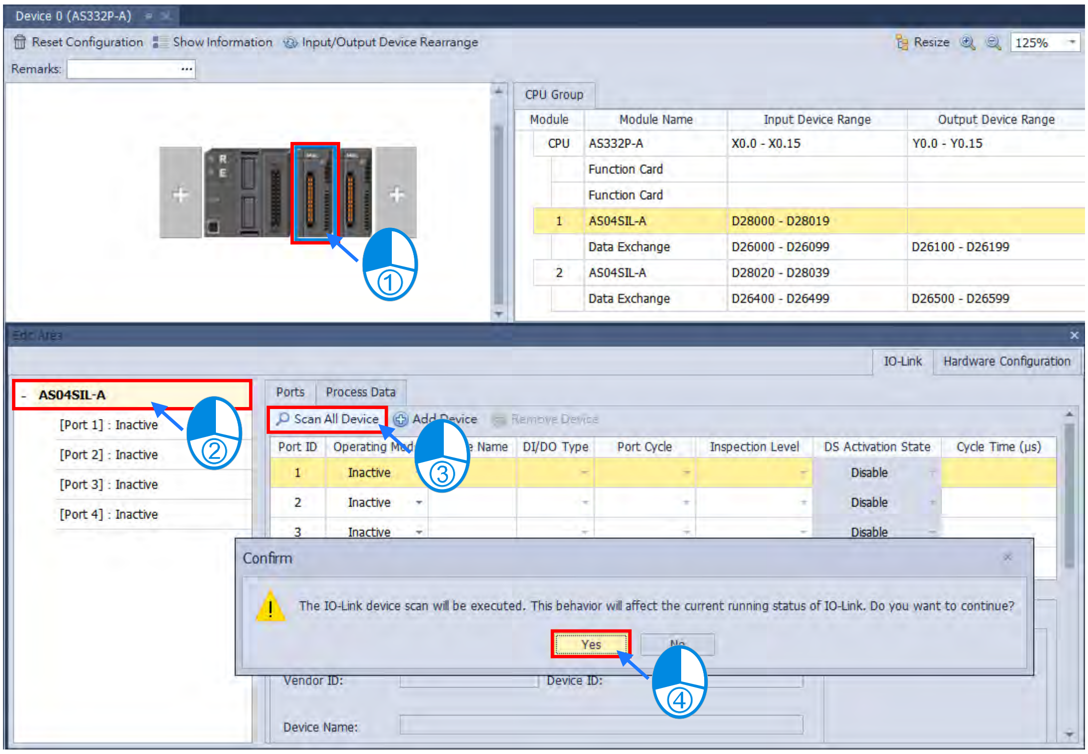


Click “**OK**” after the scan is complete. The IO-Link devices will be added automatically.

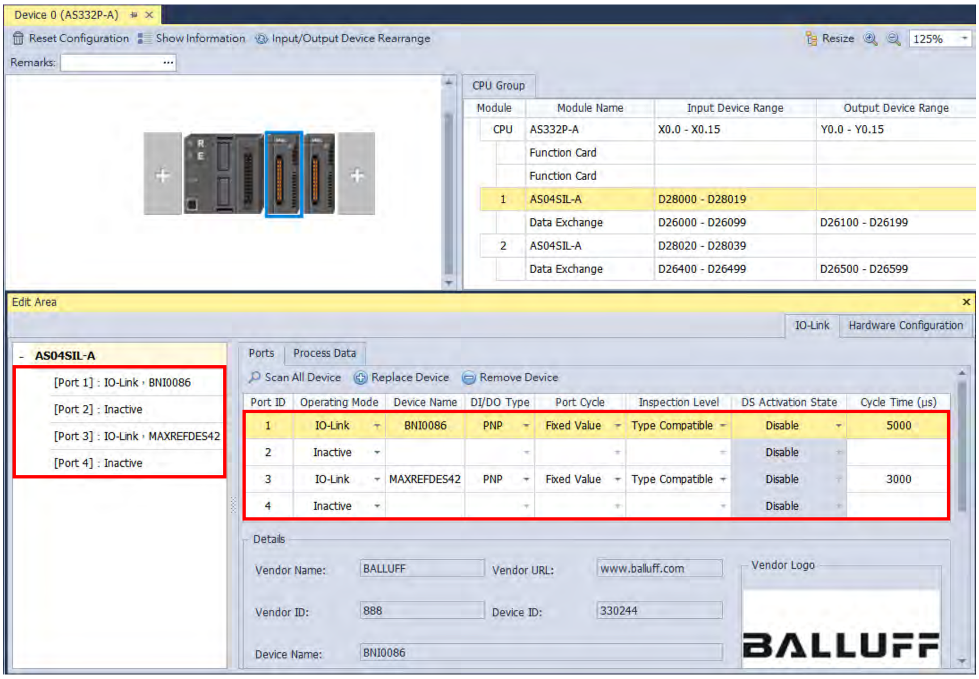


➢ Method 2_Scan the individual module configuration

Select the target module, then click the module name on the left side of Edit Area and continue to click on "**Scan All Device**". Click "**Yes**" on the confirm window to perform scanning.

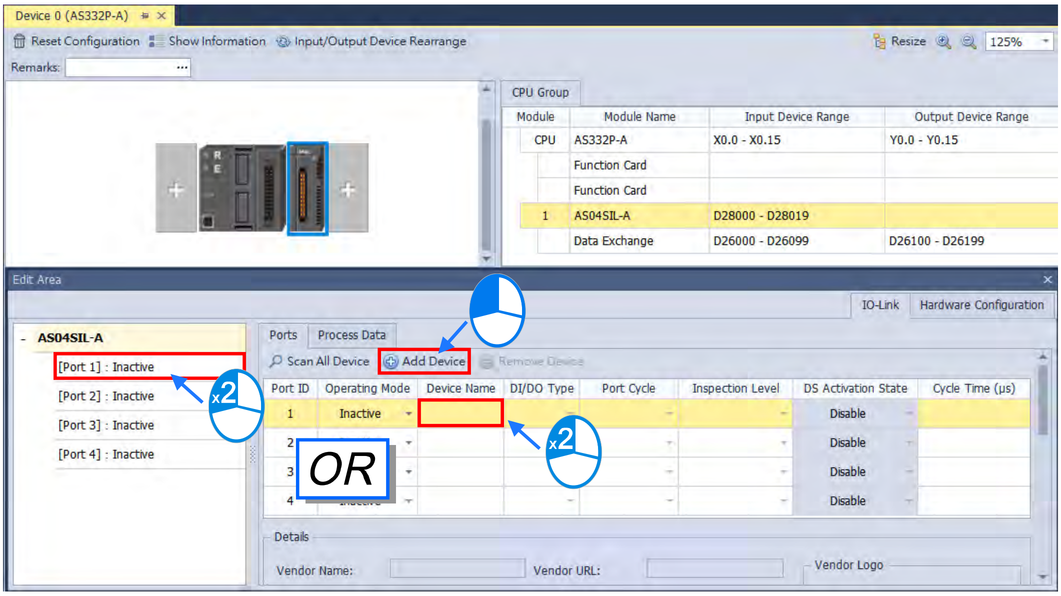


The IO-Link device will be added automatically.

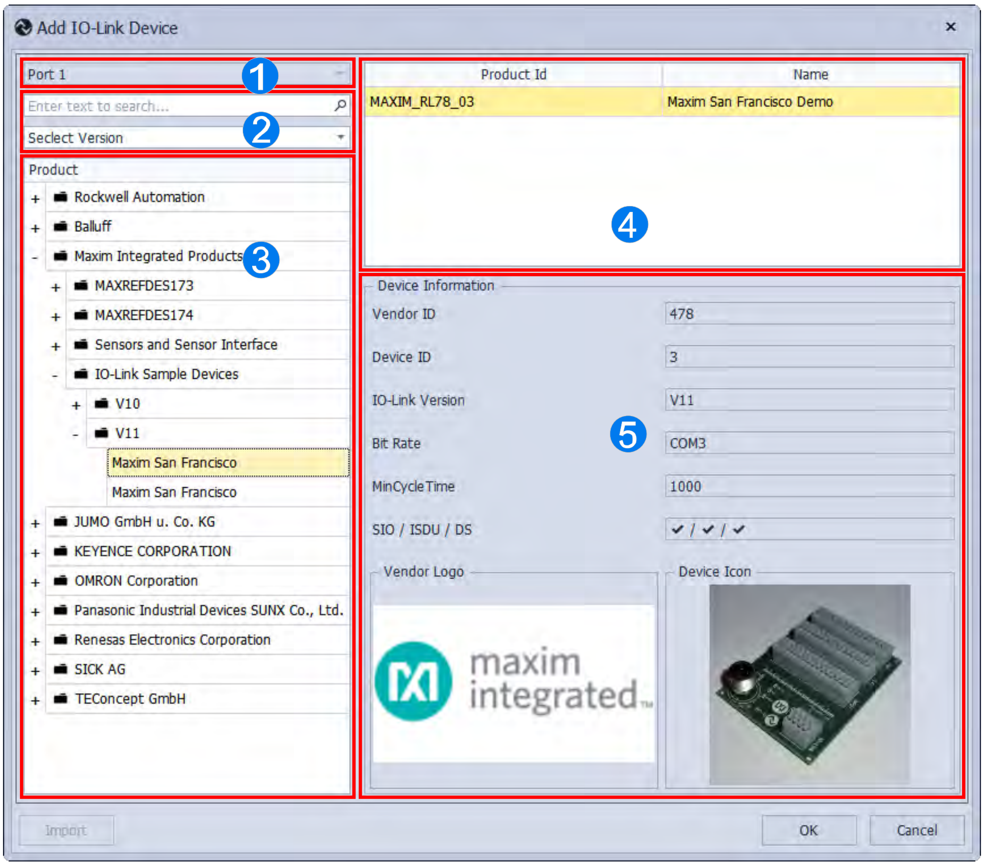


➢ Method 3_Manually add the IO-Link device

To manually add the device, please follow the instruction shown in the below figure.



Then the window of Add IO-Link Device will be displayed as following shows.



❶Location where the device is added

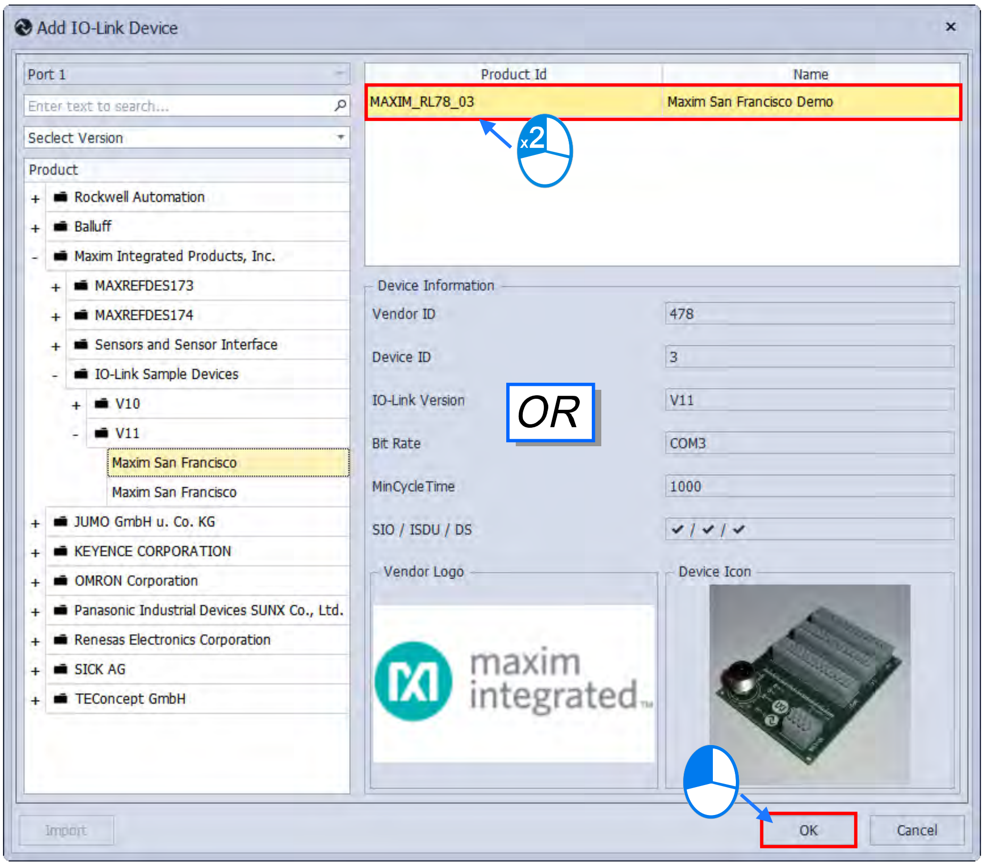
❷Quickly search with keywords via the filter

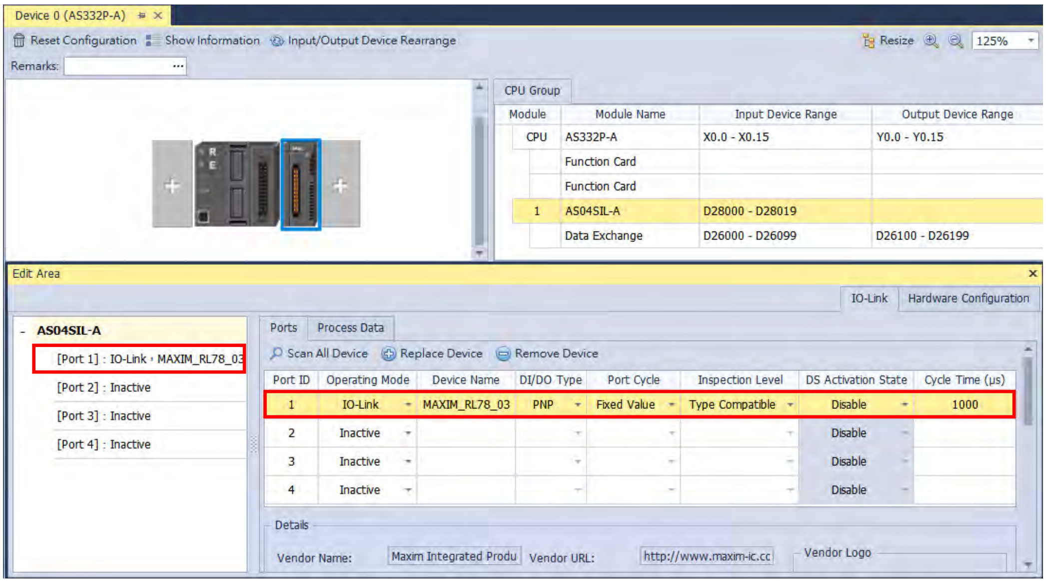
❸Product type and version

❹Device model type

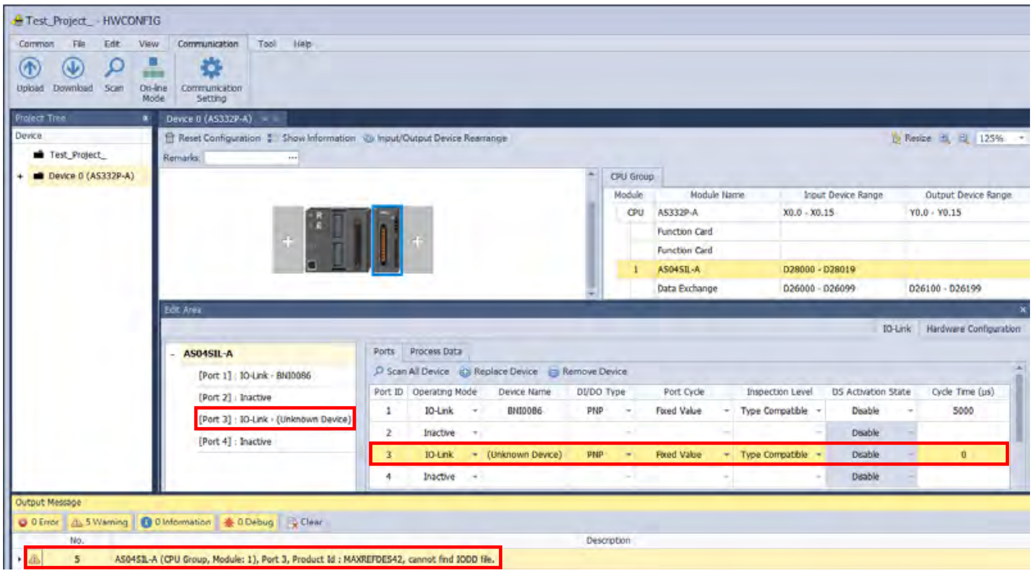
❺Device information

After choose the target device model and click "**OK**", the IO-Link device will be added automatically.





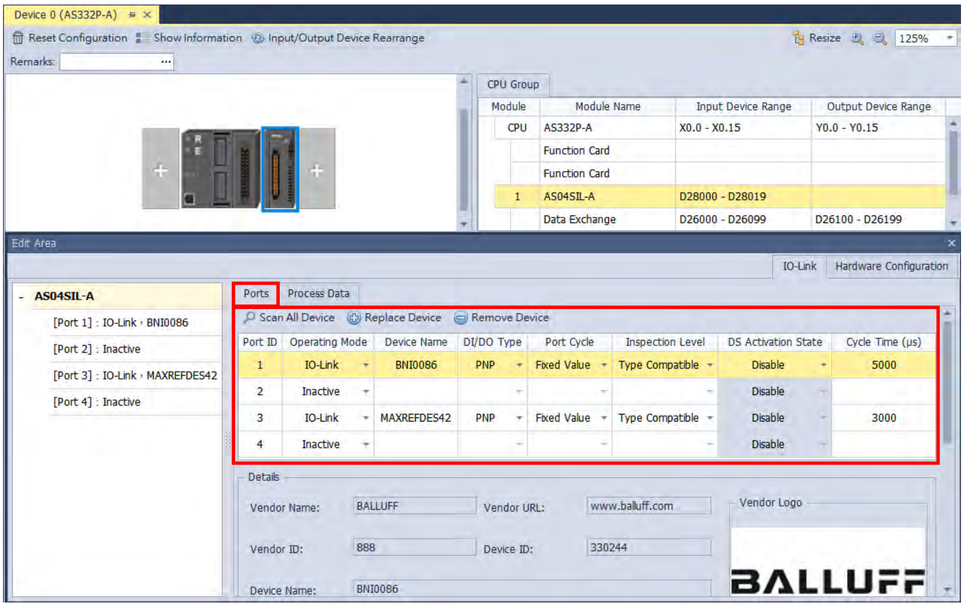
If an IODD file cannot be found in the IO-Link device after scanning is complete, the device would be presented as unknown. Please import the file before the rescan operation (Refer to section 3.1.2.6).

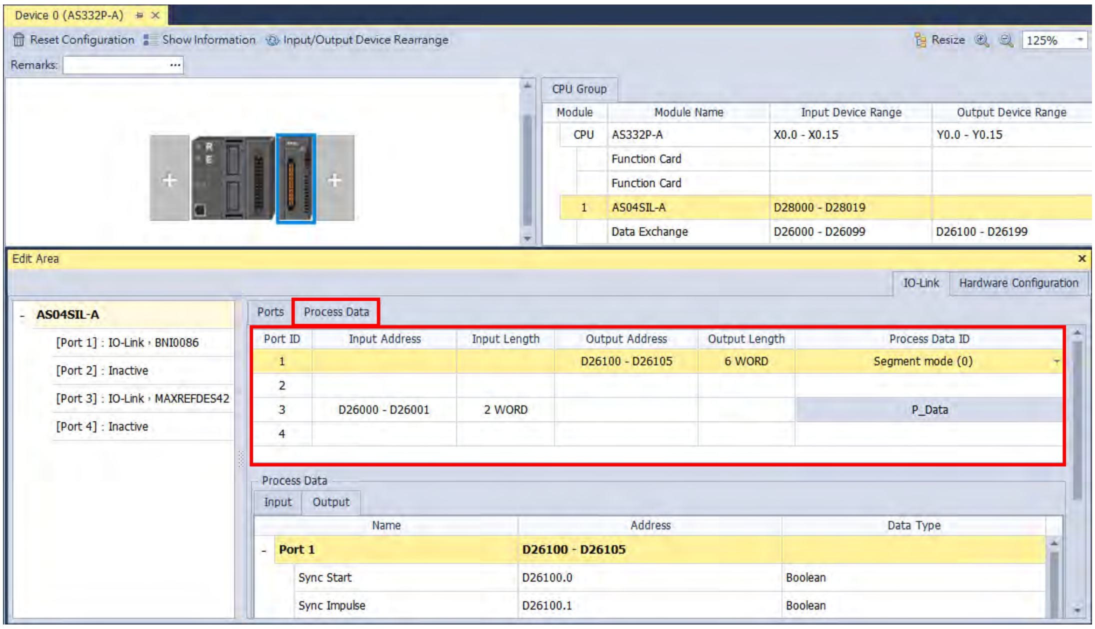


- Step 3. Configure device settings (download to PLC)

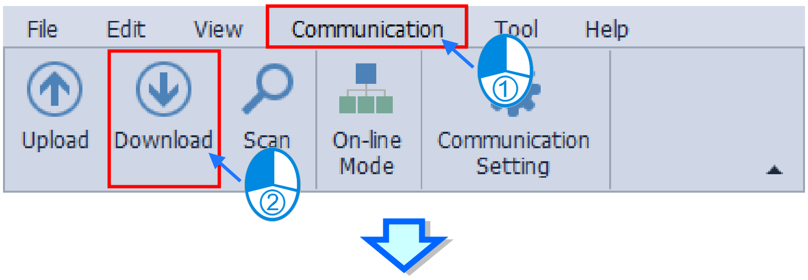
*Device parameters would not be downloaded to the IO-Link device.

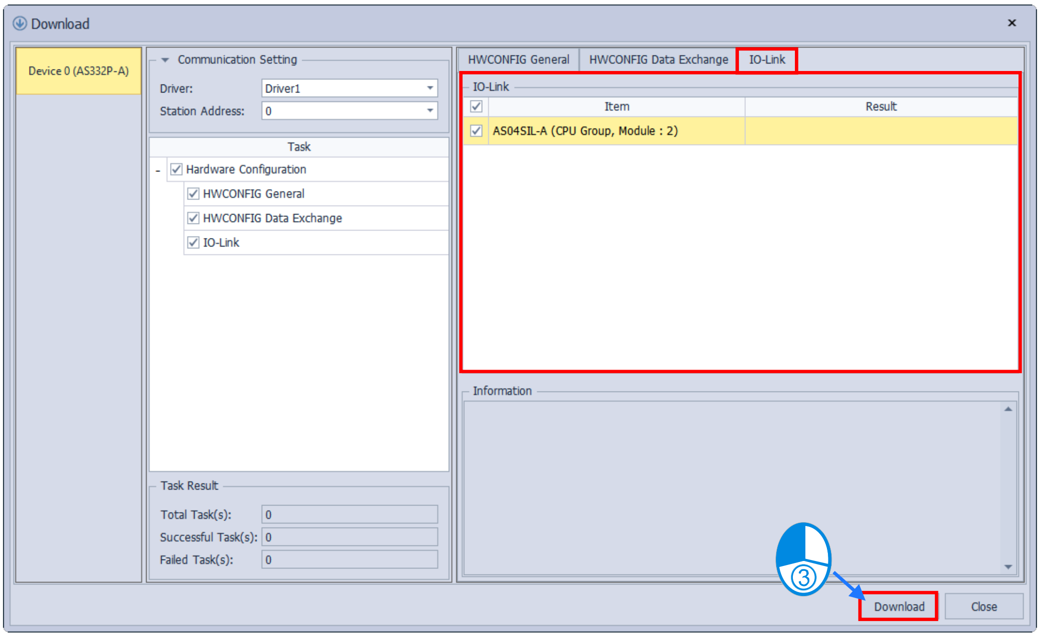
First, check the “**Ports**” setting of all modules as well as the working modalities of “**Process Data**”.





Click “**Download**” from the toolbar on “**Communication**” tab. Ensure options for IO-Link are selected after the download window appears, then click “Download” to download the IO-Link device configuration to the PLC.





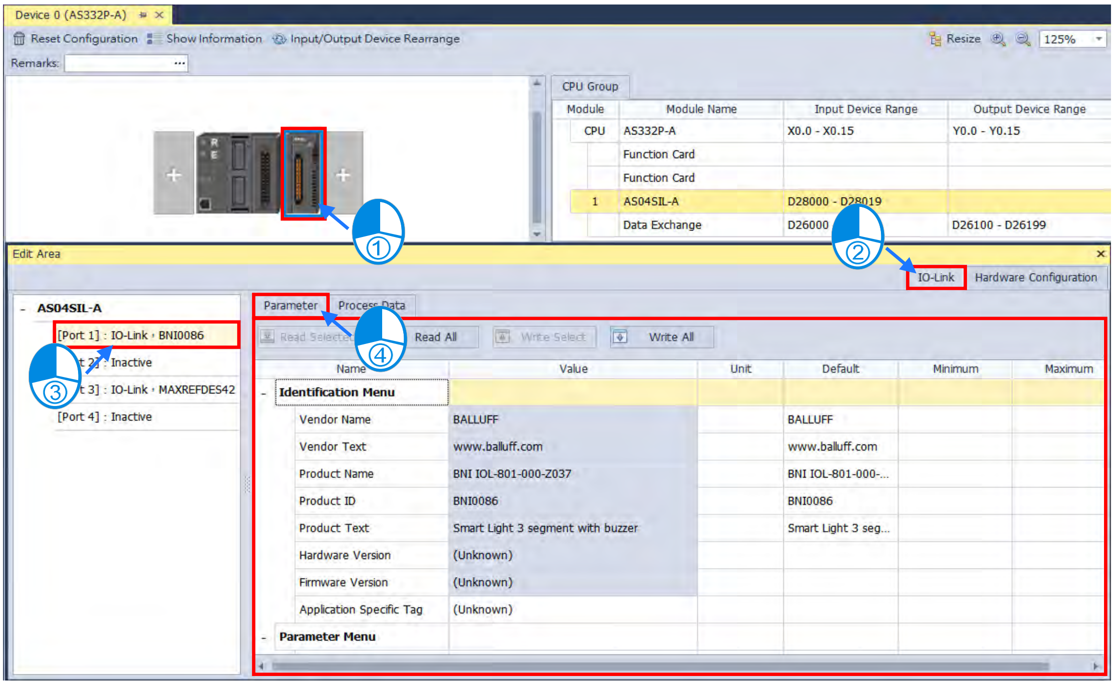
A success message should be displayed after download success.

- Step 4. Configure parameter settings

Two tabs for parameter settings are "**Parameter**" and "**Process Data**".

➢ Parameter

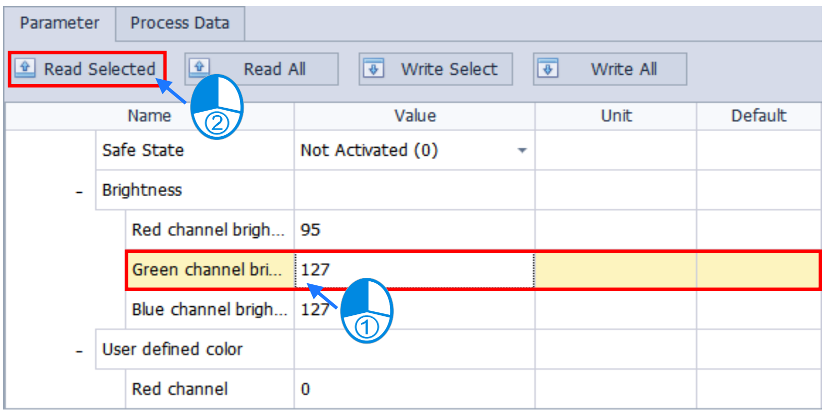
First, choose the target module and select the device from the device list on the IO-Link tab in Edit area. Then click the Parameter tab to configure the settings.



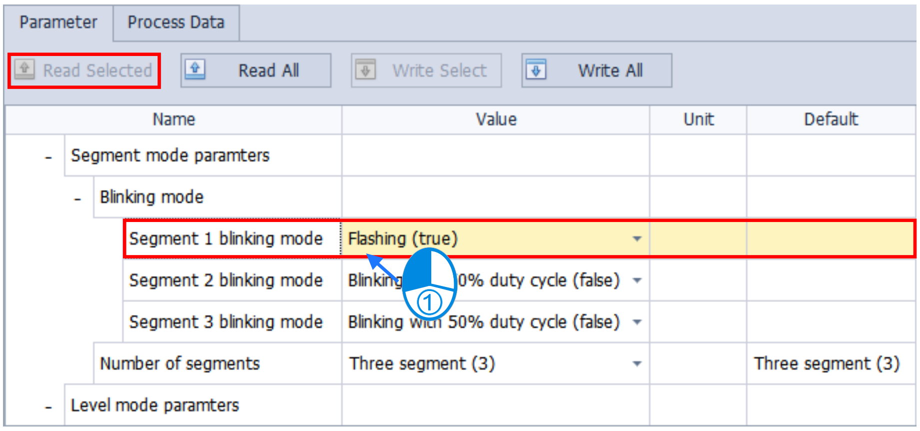
Options introduction (Parameters in greyed out fields are read-only)

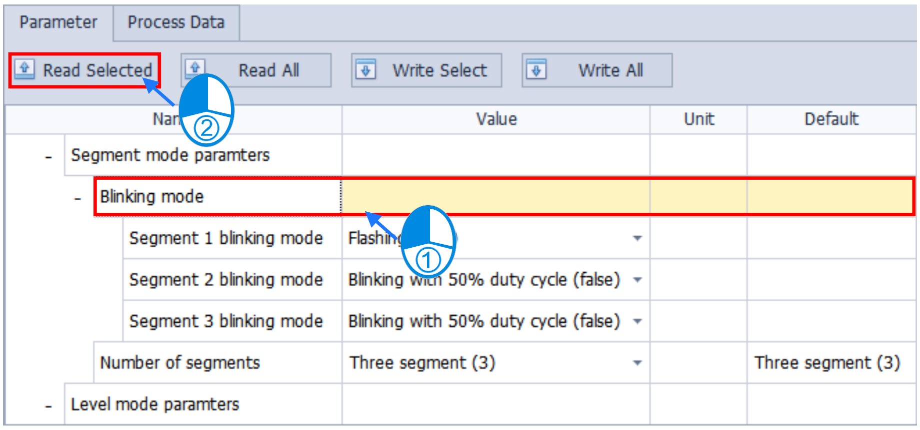
1. Read selected parameters for a single item (group)

➢ Choose the item you intend to read and click "**Read Selected**".



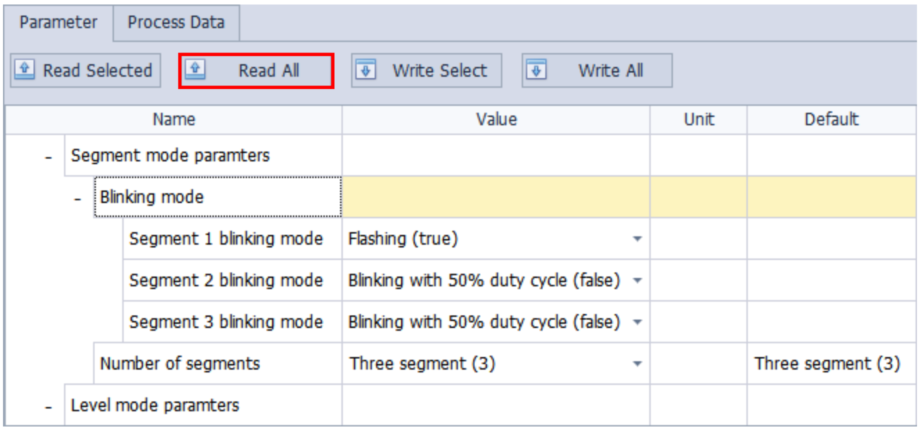
➢ Choose the target group and click “**Read Selected**”. (Some individual items are not readable.)





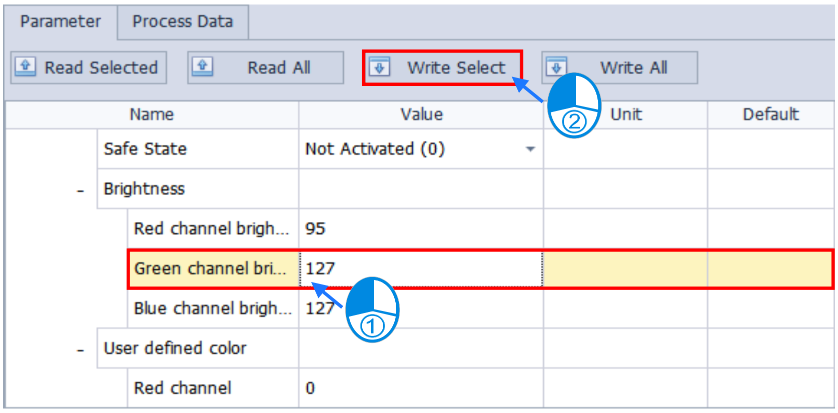
2. Read parameters for all items

Directly click on “**Read All**”.

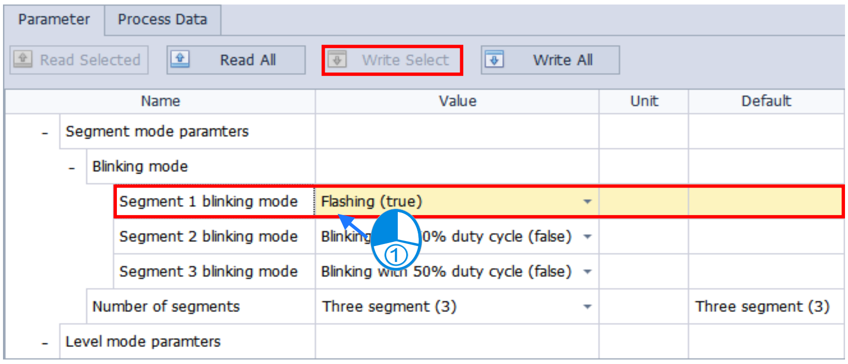


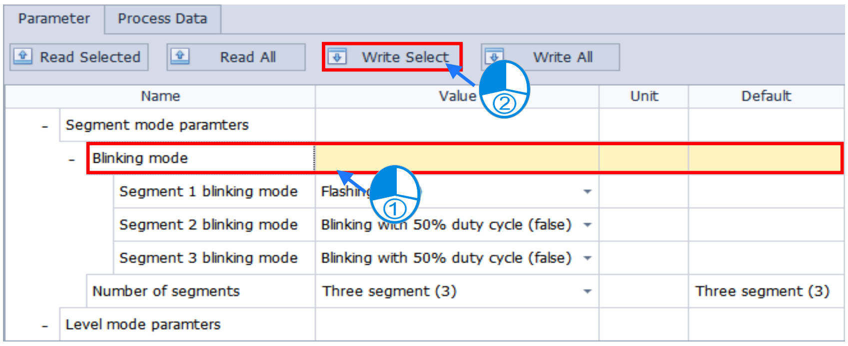
3. Input the specified parameters for a single item (group)

➢ Choose the target item to define with a specified parameter.



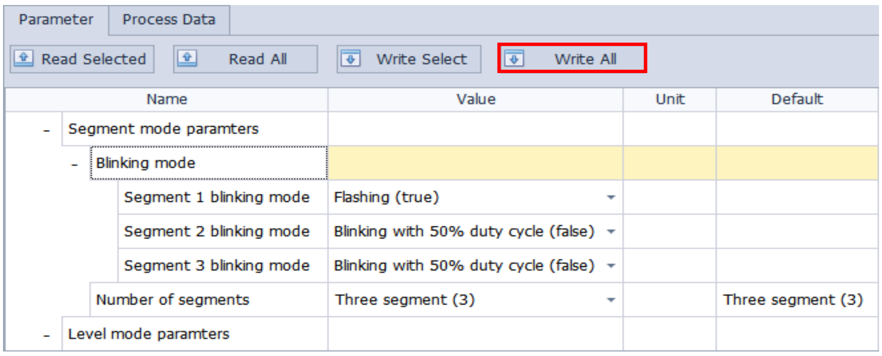
➢ Choose the target group to define with specified parameters. (Some individual items are not writable.)





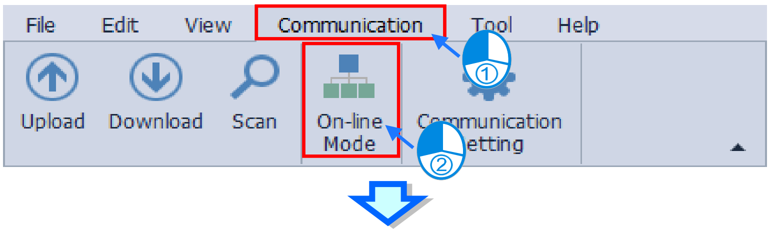
4. Input the specified parameters for all items

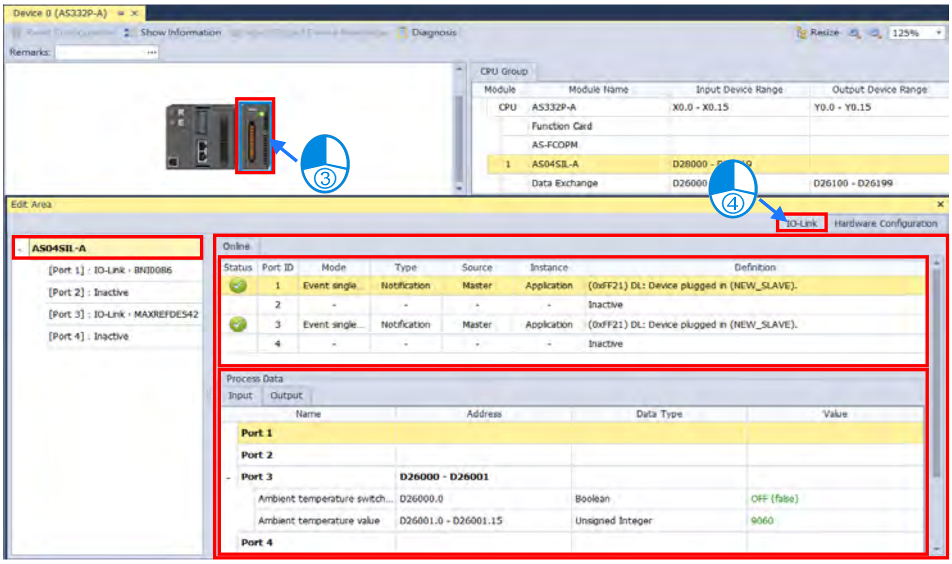
Directly click on “**Write All**”.



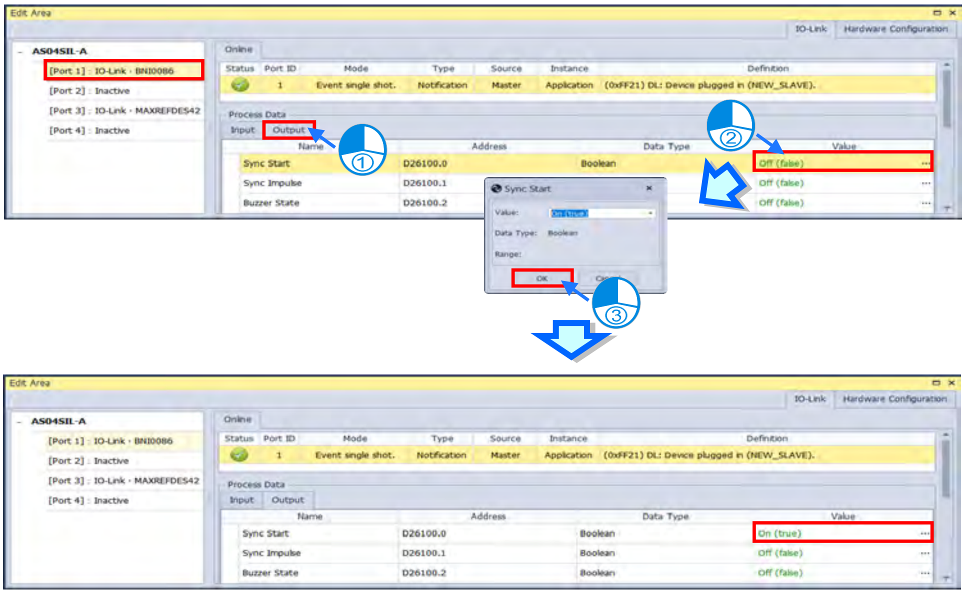
➢ Process Data: parameter settings

First, click "**On-line Mode**" from "**Communication**". Monitors and displays for connection status can be found on the upper half of the IO-Link tab page, while the lower half shows parameter values of Process Data.





Choose the output tab in Process Data, then click on the field of the value you intend to modify and the configuration window will pop up. Click "**OK**" after the modification is complete.



*Parameter values shown on the IO-Link tab in HWConfig are physical values transferred from voltage signals. As device addresses read by ISPSoft are voltage signals as well, users should verify before starting to use.

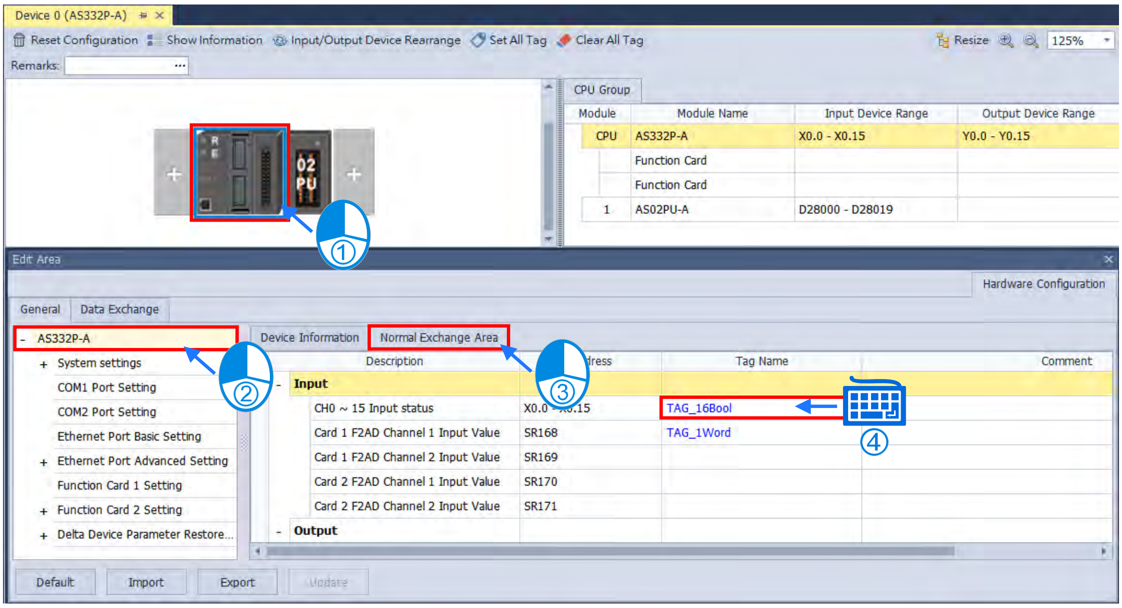
3.1.3.19 Tag Configuration

This function is only supported when HWConfig is opened via ISPSoft. HWConfig provides user-defined variables in Normal Exchange Area for PLC CPUs and modules, which would able to be functioned in Global HWCONFIG Variables under Global Symbols.

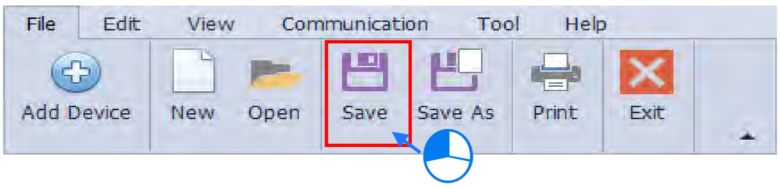
Create Tags

First, choose the target CPU or module and click on the CPU's name on the left side of Edit Area. Then open the "Normal Exchange Area" to specify the tag name and comment.

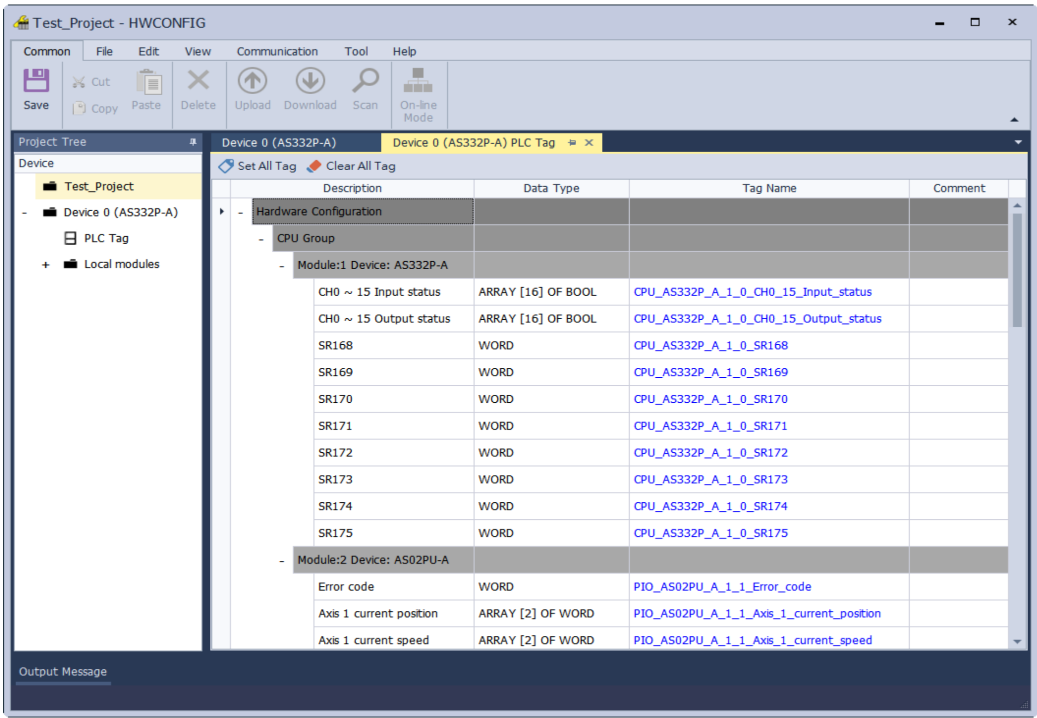
*Tag's naming rules: The maximum length is 40 characters./ Special characters are not allowed, such as *, #, ?, \, %, @, etc./ Numbers cannot be used in the beginning of the name./ Disallow duplicate names.



After the setting is done, click "**Save**".

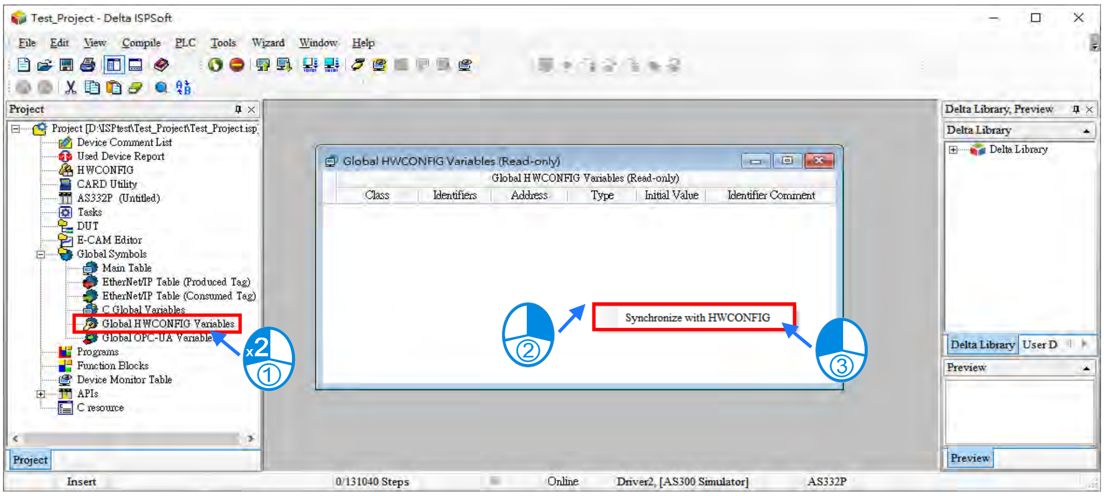


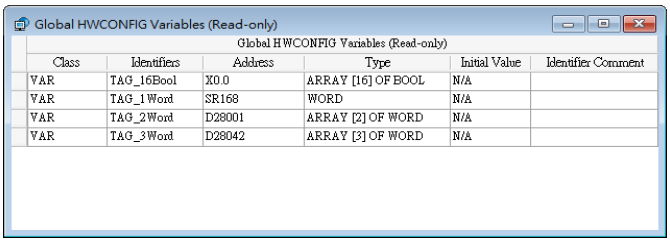
Click "**PLC Tag**" in Project Tree and the tags overview will be displayed while the function of editing tags is also supported as below shown.



Import HWConfig variables with ISPSoft

Choose “Global HWCONFIG Variables” under “Global symbols” in Project Tree, then right click “Synchronize with HWCONFIG” on Global HWCONFIG Variables page, so the variables would be updated which would able to be used in ISPSoft programming.

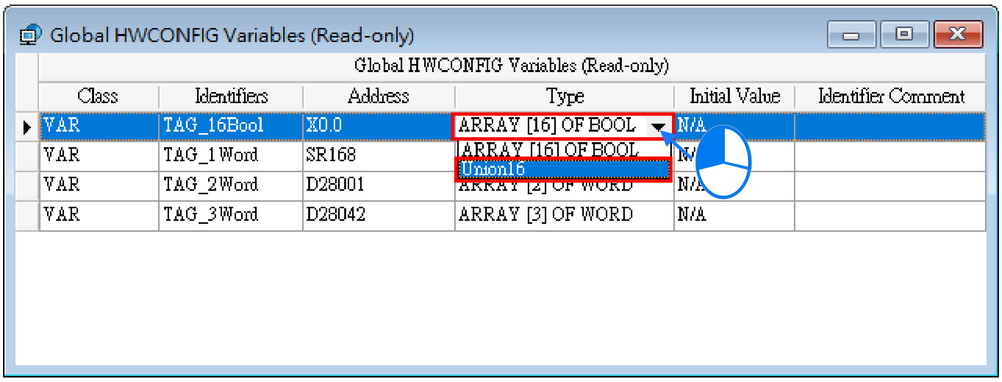


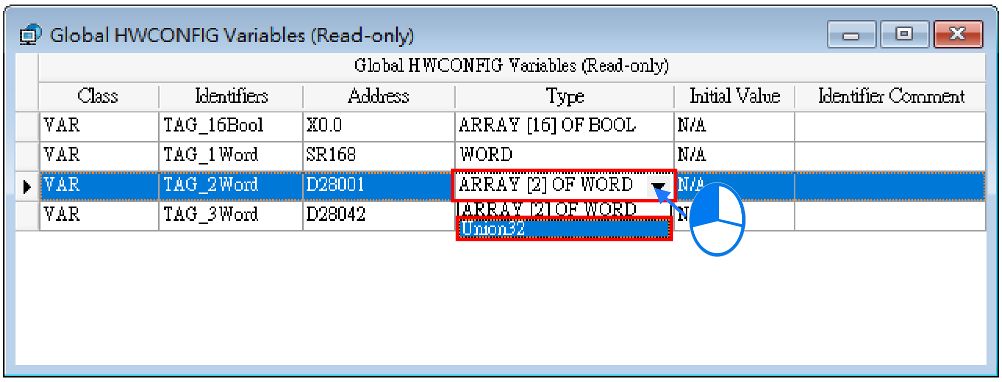

Global HWCONFIG Variables (Read-only)

Class	Identifiers	Address	Type	Initial Value	Identifier Comment
VAR	TAG_16Bool	X0.0	ARRAY [16] OF BOOL	N/A	
VAR	TAG_1Word	SR168	WORD	N/A	
VAR	TAG_2Word	D28001	ARRAY [2] OF WORD	N/A	
VAR	TAG_3Word	D28042	ARRAY [3] OF WORD	N/A	

The length of symbol would be 16 bits (ARRAY [16] OF BOOL or WORD) after synchronization. To provide a user-friendly usability for different data types, users may change the data type to Union16；32 Bits(ARRAY [2] OF WORD), Union32；64Bits(ARRAY[4] OF WORD) and Union 64 with the drop-down list in Type column.

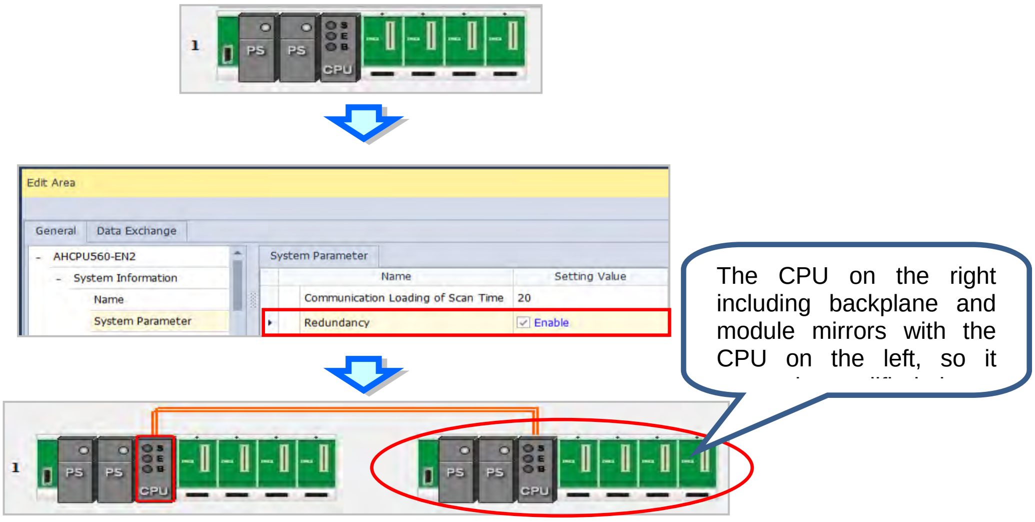
For detailed Union usage instruction, please refer to section 8.4.





3.1.3.20 Redundancy Feature

Go to “**System Information**” > “**System Parameter**” on Edit Area page and select “**Enable**” of the redundancy feature. Then two redundant backplanes, which are respectively on the left and right side, would be displayed in hardware configuration area as shown in the following figure. Since the right redundant backplane mirrors with the left one, you would not be allowed to add, remove or change modules on it. If such action is required, you have to perform the action on the left redundant backplane. After the redundancy feature is enabled, all extension backplanes in configuration area would be automatically changed to redundant type. For more details concerning the operation of configurable modules and redundancy feature, please refer to AH560 Redundancy System Operation Manual and other related manuals. (Currently only AH560 redundancy product series support redundancy feature.)

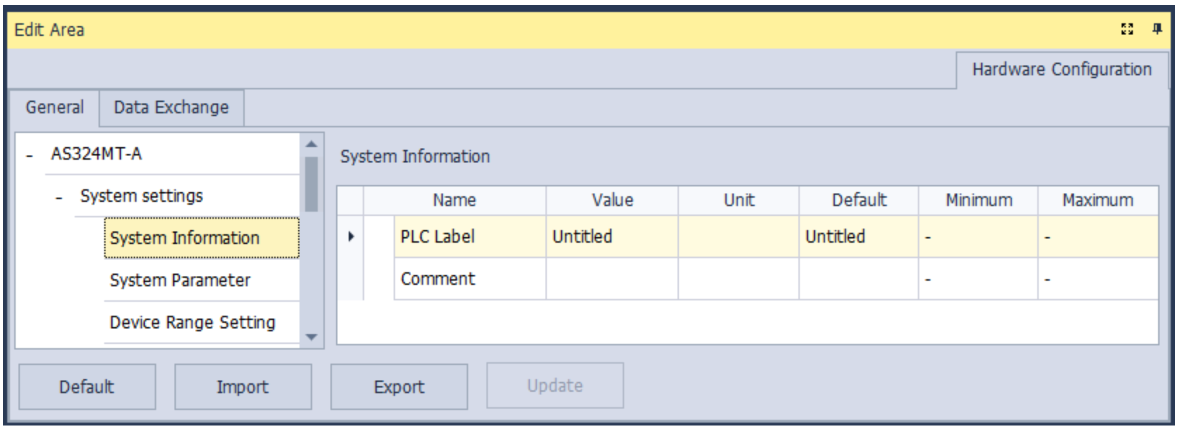


3.1.4 Parameter Settings for PLC CPU

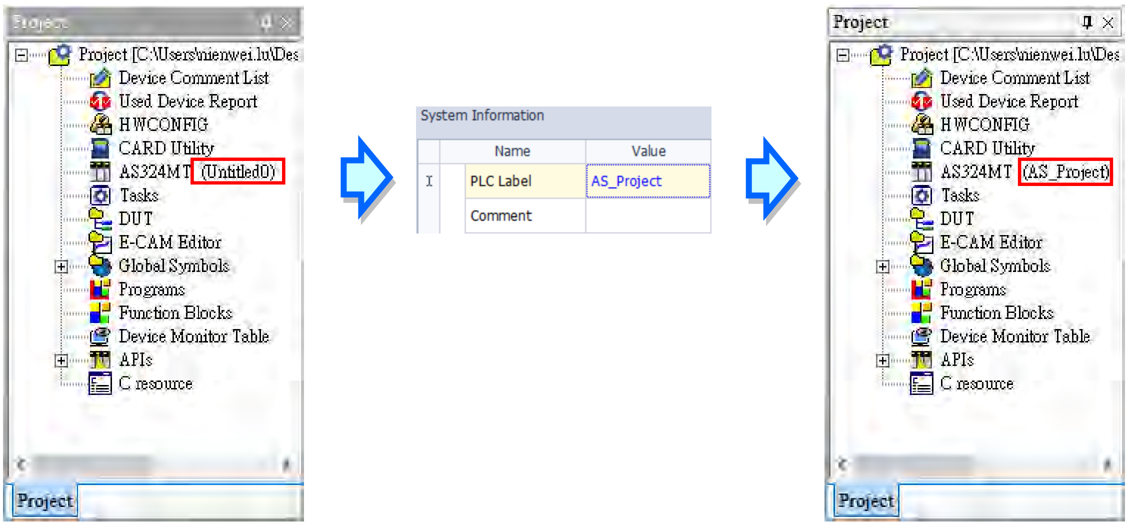
The functions and parameters of a module vary with different types of PLC CPU. This section gives you a roughly instruction on PCL CPU parameter settings; for more details, refer to the individual operation manual.

3.1.4.1 System Settings – System Information

In the Edit Area, select the option **System Settings** and you can find two items, **PLC Label** and **Comment** under this option. You can input up to 16 characters in the value field of **PLC Label** and 32 characters in the value field of **Comment**. You can use all characters in the fields, including special characters and spaces. Note: One Chinese character occupies two characters.

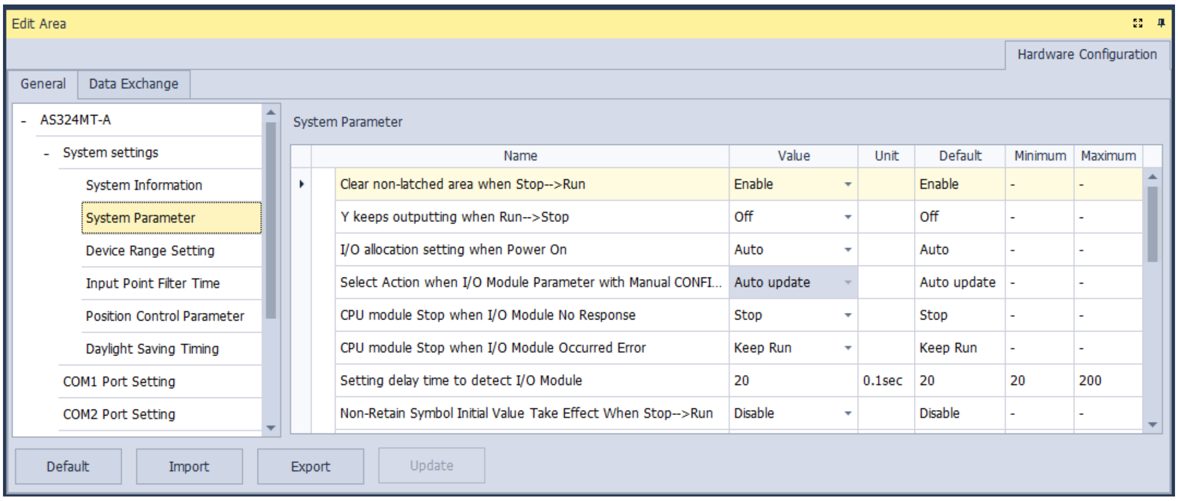


After the project is created, you can find the PLC label behind the product name in the project management area. You can change the PLC label in HWCONFIG as it is mentioned above. The PLC label is very useful when you have more than one PLC in the project. This label can be seen as the PLC identity. So that you will not change other PLC parameters by mistake. To prevent errors, when you download/upload the program, the system will remind you to check the name of the PLC CPU and the PLC label.



3.1.4.2 System Settings – System Parameter

The parameters on **System Parameter** table are shown in the following window. You can set appropriate values via a drop-down list or type the values in the box.



- **Clear non-latched area when STOP --> RUN**

If the state of the CPU module changes from **Stop** to **Run**, the states of the non-latched devices and the values in the non-latched devices are cleared.

➢ Enable: The current states and values of devices are retained.

➢ Disable: The states and values of devices are cleared to default value.

- **Y Keeps outputting when RUN --> STOP**

Set the state of Y device when the state of CPU is switched between RUN and STOP.

➢ Off：All Y devices are set to OFF.

➢ Retain Present State: The states of the Y devices are retained.

- **I/O allocation setting when Power On**

The actual I/O module configuration is read automatically when the CPU module is powered ON.

Or the CPU module operates based on the configuration set manually in HWCONFIG.

➢ Auto: Operates based on actual connected modules without any module and parameters set.

➢ Manual: Operates based on the configuration set in HWCONFIG.

➢ Manual + Flag: Select this option, you need to use it with flags SM230-SM261. For less module applications, you can simply use special flags to mark which I/O module will NOT be used to meet the actual I/O module placement. In this mode, you can use the same PLC program and download the I/O allocation table once for various I/O applications.

- **Select Action when I/O Module parameter with Manual CONFIG Different**

The parameter cannot be set unless the **Manual** option is selected in the above parameter **I/O module CONFIG by Auto/Manual when Power On**.

➢ Auto update: The CPU module will update its configurations based on the actual module configurations.

➢ CPU alarm: The CPU module shows a warning when an error occurs.

- **CPU module Stop when I/O Module No Response**

The parameter sets whether the CPU and other normal modules can operate constantly when there is a expansion module, which does not response when offline.

➢ Stop: The CPU module stops running and gives errors.

➢ Keep Run: The CPU module and other normal modules keep running.

- **CPU module Stop when I/O Module Occurred Error**

The parameter sets the method to deal with a tiny error in the expansion modules.

➢ Stop: The CPU stops running and sends an error.

➢ Keep Run: The CPU keeps running but records the warning message.

- **Setting delay time to detect I/O Module**

The parameter sets how long after the CPU is powered on, the I/O module and remote I/O module begin to be scanned.

- **Assign X Input Point Control Run/Stop**

The parameter sets whether one X input point controls the RUN or STOP state of the CPU.

➢ Disable: The function is closed. The state of the CPU can be changed with its DIP switch.

➢ Enable: Use the specified X input point to control and the DIP switch of the CPU can also be used.

- **Select X Input Point**

Select one X input point on the drop-down list to switch Run/Stop if the above parameter **Assign X Input Point Control Run/Stop** is enabled.

- **Constant Scan Cycle Time**

The parameter sets the shortest constant time to complete a cycle of scan.

➢ Disable: The function is closed.

➢ Enable: The CPU starts the next scan after the waiting time reaches the setting value if the actual scan time is less than the setting value. However, the CPU will operate based on actual scan time disregarding the setting value if the actual scan time is greater than the setting value.

- **Input Constant Time**

Type the cycle time value in the parameter box if the parameter **Constant Scan Cycle Time** is enabled. Please note if the setting value of scan time is greater than the setting value of **Setting Watchdog Time,** there will be a timeout error once the CPU operates**.**

- **Setting Watchdog Time**

The parameter sets a timeout during which the program is scanned. The CPU module will send an error if the program execution exceeds the time.

- **Show Battery Low Voltage Error**

The parameter sets whether the alarm is shown when the lithium battery for the real-time clock is of low voltage or is not installed in AS series.

➢ Disable: The function is closed.

➢ Enable: There is an alarm when the lithium battery is of low voltage or not installed.

- **Save Error history into**

The parameter sets the location to store error logs.

➢ PLC: The error logs are stored in PLC. Twenty error logs at most can be stored. If there are more than twenty error logs, the oldest error log will be overwritten by the latest error log.

➢ PLC & SD Card: The error logs are stored in PLC and SD card. There are more than twenty error logs, the oldest error log will be moved to the SD card before the oldest error log is overwritten.。

- **COM Communication Error Record**

The parameter sets whether to enable the **error record** when there is an error at COM port.

➢ Disable: The function is closed.

➢ Enable: The error record function is enabled.

- **Select Action When 24Vdc Input Unstable**

What to do when the 24Vdc power is unstable

➢ Continue Running when power stable: waits till the power is stable and then PLC begins to run.

➢ Into Error Status: Stops and go to the error mode。

- **Communication Module Refreshed Priority**

➢ Scan time first: only refresh the data that is different from the original ones to save scan time

➢ Synchronous Data first: scan and refresh all the data to ensure all data are synchronized.

- **AS remote module updated method**

➢ PLC Scan cycle first: update according to PLC program scan cycle

➢ Update one remote module by one scan time: update one remote module at one scan time

➢ Update all remote modules at one scan time: update all remote modules at one scan time

- **1601 Timer interrupt Setting Time Base**

Users can set the interval of triggering 1601 timer interrupt. The function is used with Timer Interrupt 0 in the work management together. Please refer to chapter 5 for more information.

- **1602 Timer interrupt Setting Time Base**

Users can set the interval of triggering 1602 timer interrupt. The function is used with Timer Interrupt 1 in the work management together. Please refer to chapter 5 for more information.

- **1603 Timer interrupt Setting Time Base**

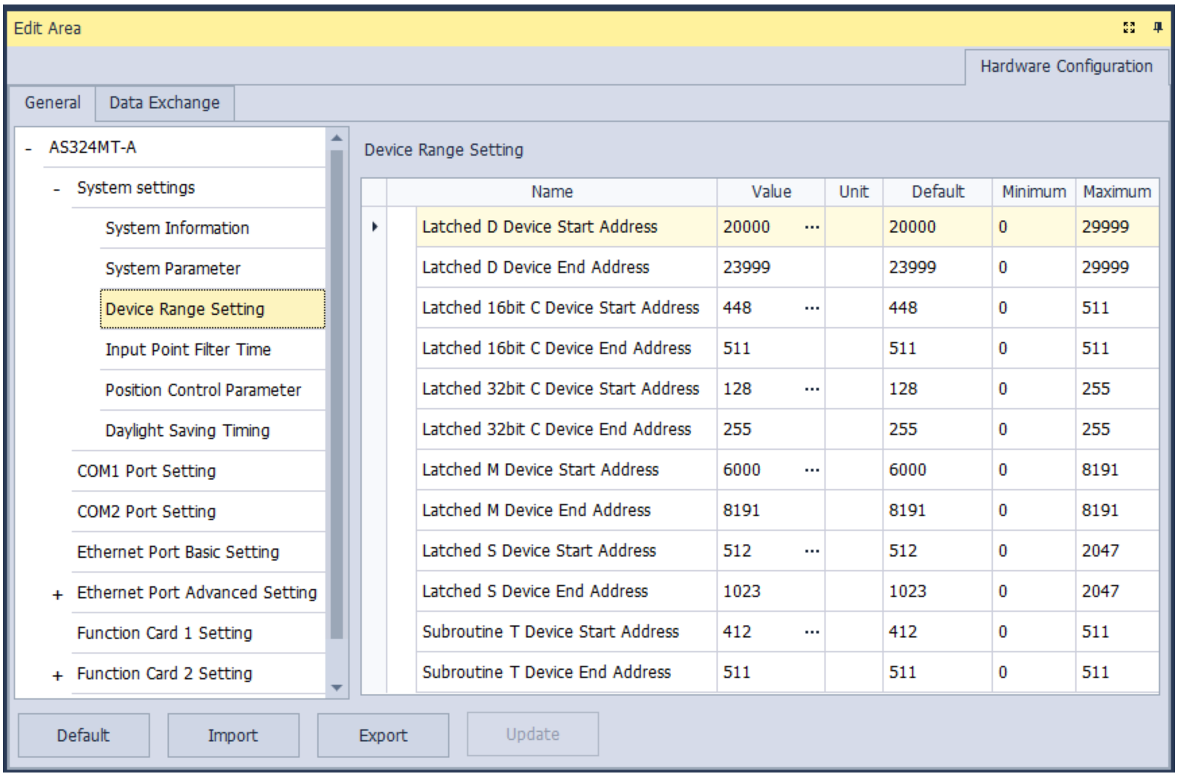
Users can set the interval of triggering 1603 timer interrupt. The function is used with Timer Interrupt 2 in the work management together. Please refer to chapter 5 for more information.

- **1604 Timer interrupt Setting Time Base**

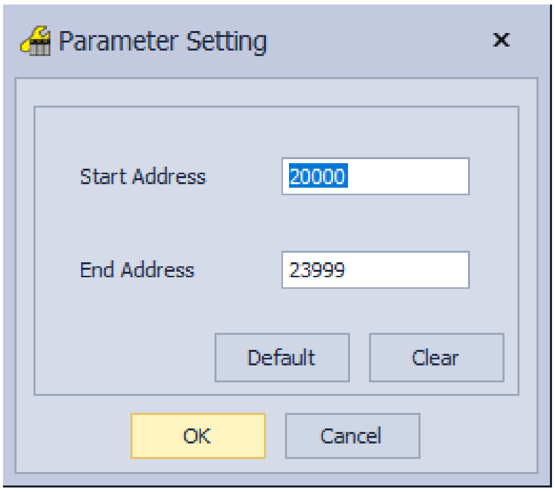
Users can set the interval of triggering 1604 timer interrupt. The function is used with Timer Interrupt 3 in the work management together. Please refer to chapter 5 for more information.

3.1.4.3 System Settings – Device Range Setting

The parameters on **Device Range Setting** table are shown in the following window.

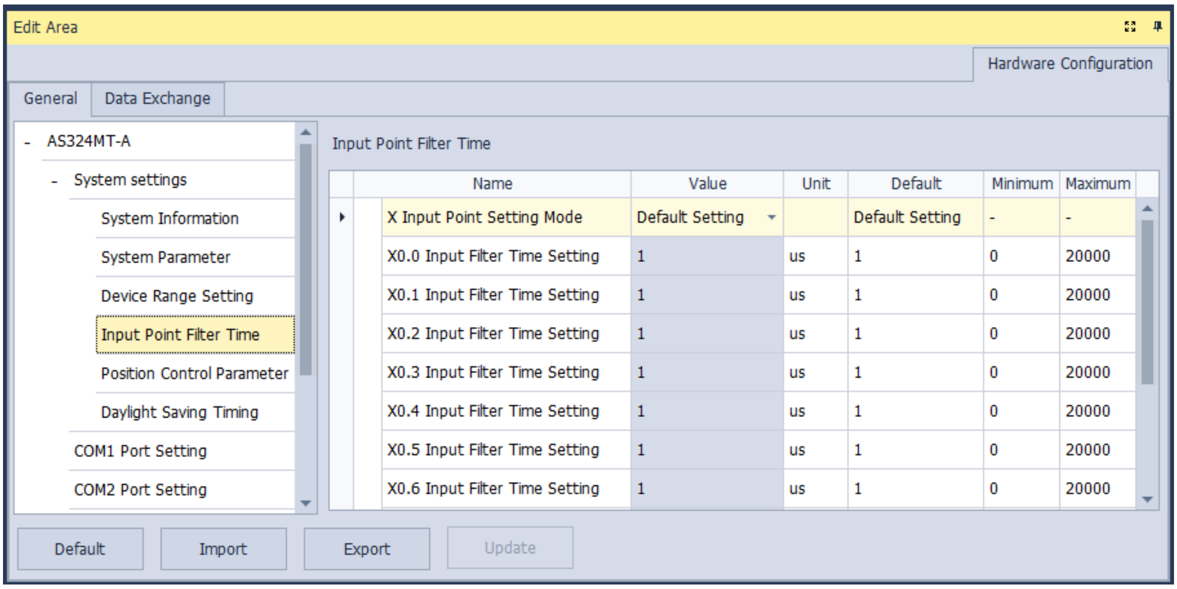


Set the start address and end address of this kind of devices by clicking ··· button. Click **Default** button to restore to the default value. Click **Clear** button to clear the box content to 0. Finally, click **OK** to save the settings or **Cancel** to give up the setting and leave the dialogue box.



3.1.4.4 System Settings – Input Point Filter Time

The filter time of every input point is set on the **Input Point Filter Time** table. The signal will be filtered as a noise if the period of time during which an input point receives a signal less than the filter time. And users could set an appropriate filter time according to the interference state of the field environment.



- **X Input Point Setting Mode**

The parameter sets whether to set the filter time of input points or to use default settings.

➢ Default Setting: Filter time is set to default value.

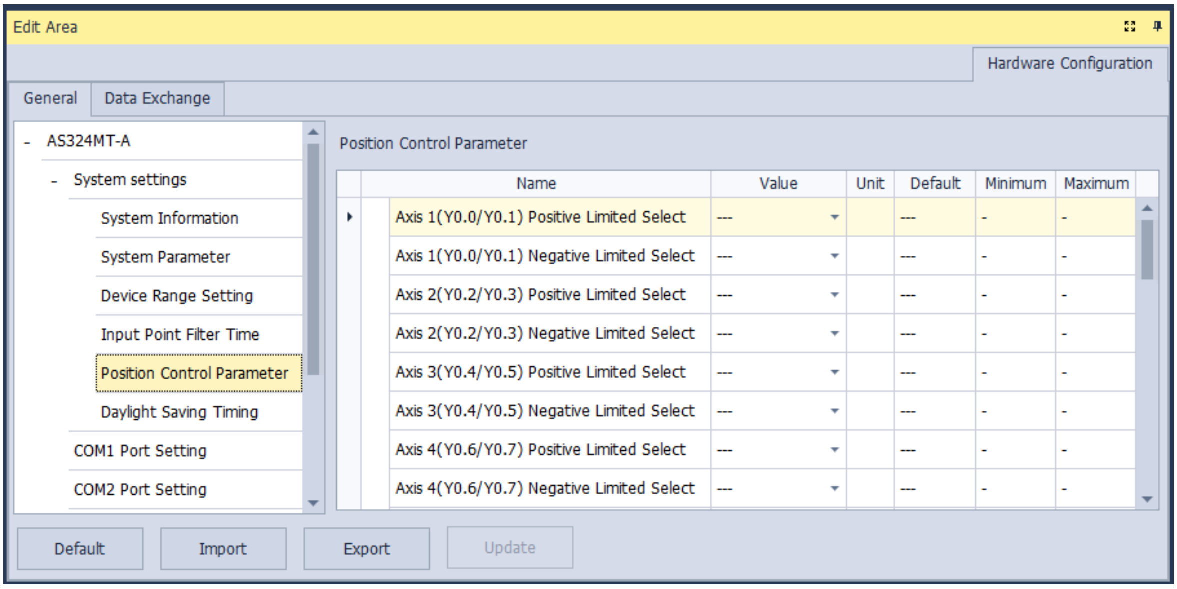
➢ Custom Setting: Users set the filter time of every X input point themselves.

- **X0.0~X0.15 Input Filter Time Setting**

  Users could type the respective filter time of X0.0~X0.15 if Custom Setting is selected as **X Input Point Setting Mode.**

3.1.4.5 System Settings – Position Control Parameter

The parameters on **Position Control Parameter** table set to specify input points as the positive and negative limits of axis 1~ axis 6 channels. 12 limit points can be set at most. Axis No. 1~6 can also be set as Z phase triggers, home function finish points and clear output selects or positive/negative limited position.



- **Axis1 (Y0.0/Y0.1) Positive/negative Limited Select ~ Axis 6 (Y0.10/Y0.11) Positive/negative Limited Select.**

  Select the rising or falling edge trigger and X input point on the drop-down list.

- **Axis1 (Y0.0/Y0.1) Z Phase Trigger ~ Axis6 (Y0.10/Y0.11) Z Phase Trigger**

  Select the rising or falling edge trigger and X input point on the drop-down list.

- **Axis1 (Y0.0/Y0.1) Home Function Finish and Clear Output Select ~ Axis6 (Y0.10/Y0.11) Home Function Finish and Clear Output Select**

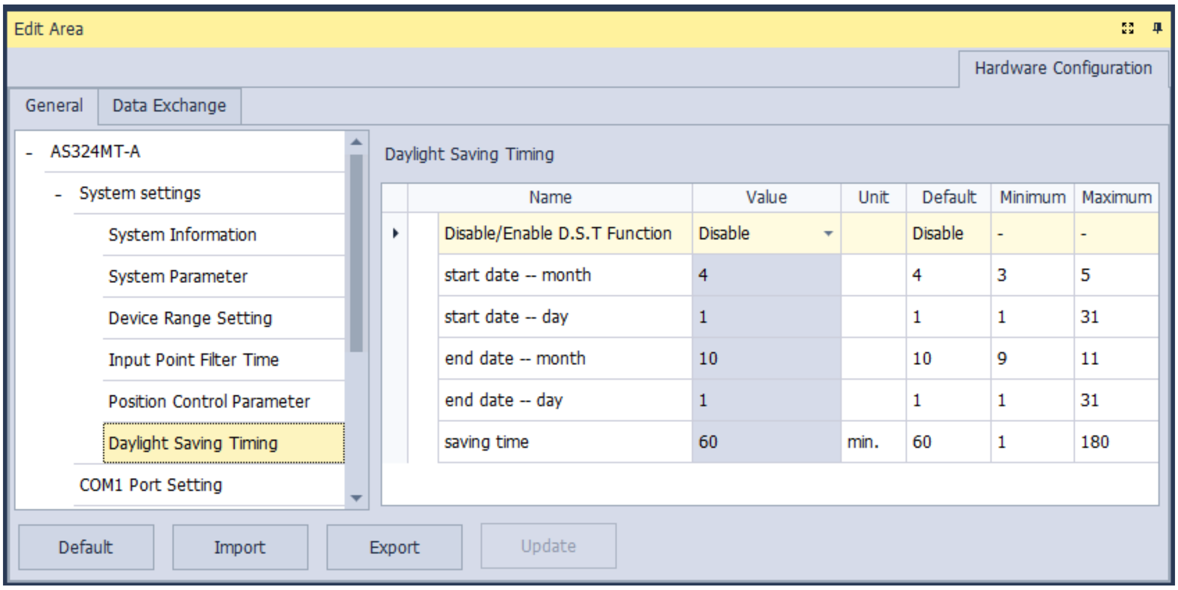
  Select the rising or falling edge trigger and X input point on the drop-down list.

- **Axis1 (Y0.0/Y0.1) Positive/negative Limited Position ~ Axis6 (Y0.10/Y0.11) Positive/negative Limited Position**

  Set up the number of pulses as the positive or negative limited position in axis 1~6; setting range is -2147483647 ~ 2147483647.

3.1.4.6 System Settings – Daylight Saving Timing

The parameters on **Daylight Saving Timing** table are used to enable or disable the function of daylight saving time and set the date when the daylight saving is conducted. The clock will automatically set the daylight saving time in advance based on the period of time set after the function is enabled.



- **Disable/Enable D.S.T Function**

The parameter sets to enable or disable daylight saving time.

- **Start date- month**

The parameter sets the month from which the daylight saving time starts.

- **Start date- day**

The parameter sets the date on which the daylight saving time starts.

- **End date- month**

The parameter sets the month in which the daylight saving time ends.

- **End date- day**

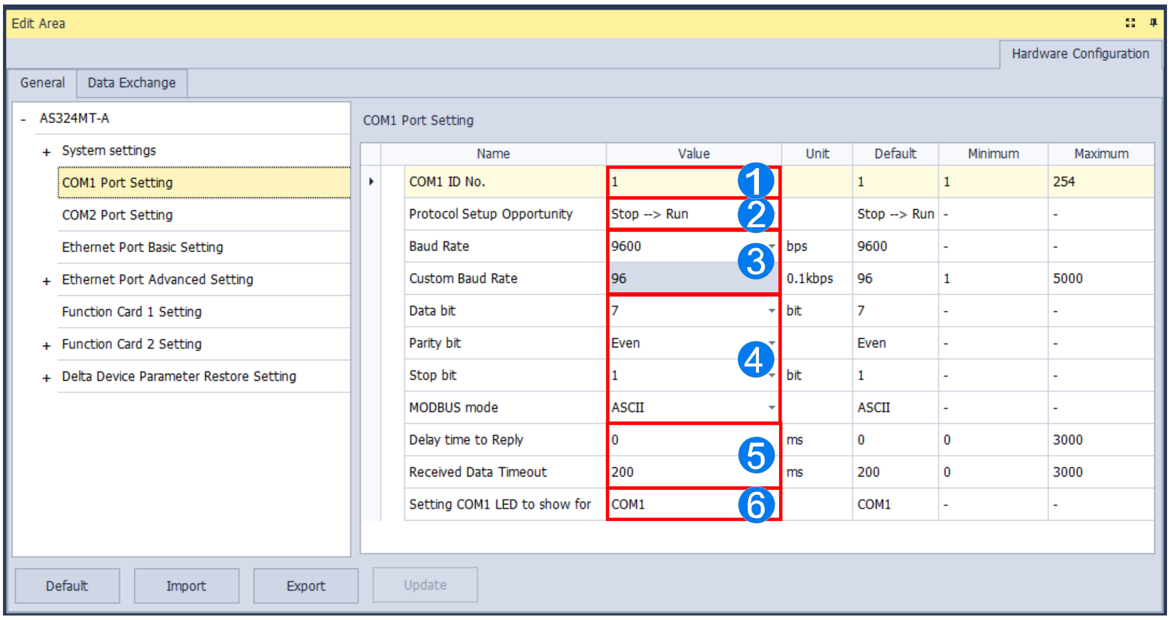
The parameter sets the date on which the daylight saving time ends.

- **Saving time**

The parameter is used to adjust to the earlier daylight saving time with the unit of minute.

3.1.4.7 Options - COM1 Port Setting & COM2 Port Setting

PLC modules are equipped with one or two COM ports based on different models. COM1 and COM2 parameters are set by clicking **COM1 Port Setting** and **COM2 Port Setting** in the list on the left-side of the following window. And the specific setting items are same for the two COM ports.



❶ Users can set a station address. A device on a network can be identified by means of the station address of the device. The station address of a device on a network can not be the same as the station address of another device on the same network.

❷ Users can set the timing of getting effective for the communication port. The communication port will take effect when the CPU module changes from STOP to RUN if users select **Stop --> Run.** The communication port will take effect when the CPU module is powered on if users select **Power on.**

❸ Users set the baud rate for the COM port. Users can select one of the preset baud rates on the drop-down menu or select **custom** to type a custom baud rate.

❹ Users set the communication protocol for the COM port.

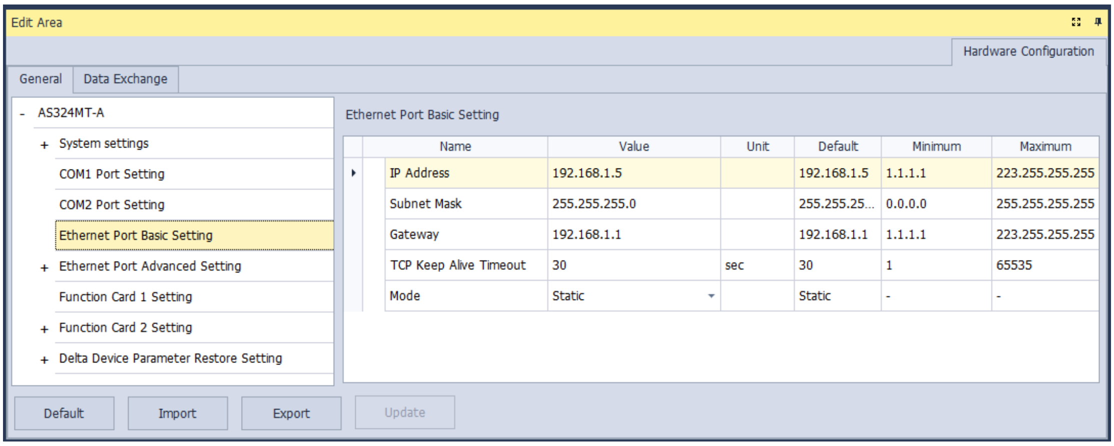
❺ Users set a value for **Delay time to Reply**. The AS CPU module waits for a period of time set and then gives a reply after receiving a communication command so as to match the time when the remote device switches the mode. Users set a value for **Received Data Timeout**. The AS CPU module sends a communication command as a master. But it cannot receive a reply within a period of time set and that will be regarded as a timeout.

❻ Setting COM1 to show for: when COM1 is selected from the drop-down list, it will show the RS485 communication status of the COM1; when Card1 is selected from the drop-down list, it will show the Card1 communication status.

Setting COM2 to show for: when COM2 is selected from the drop-down list, it will show the RS485 communication status of the COM2; when Card2 is selected from the drop-down list, it will show the Card2 communication status.

3.1.4.8 Options - Ethernet Port Basic Setting

The communication parameters can be set for the Ethernet port in the CPU module in this page. Refer to other related documents or manuals for more information about Ethernet.

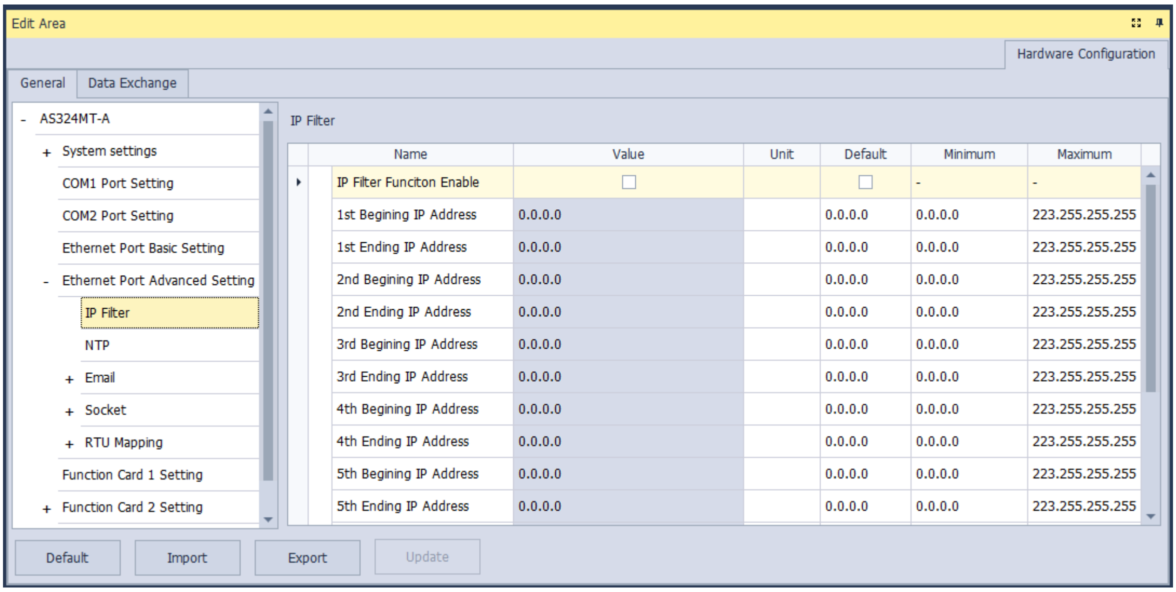


Mode sets the addressing mode of the IP of the CPU module.

If users select **Static**, they can specify an IP address directly. If **DHCP** or **BOOTP** is selected, the IP address is assigned dynamically by a DHCP/BOOTP server.

3.1.4.9 Ethernet Port Advance Setting – IP Filter

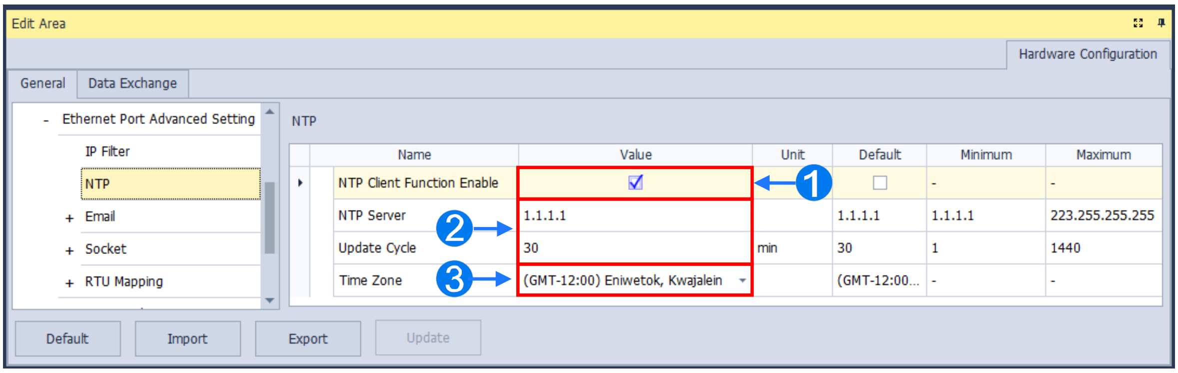
IP Filter sets the filter function of network devices. It is another acknowledgement mechanism to ensure the communication object is a device which is allowed by us. The function can limit the communication object. Only the devices in the IP address list are allowed to communicate with the CPU module after the IP filter function is enabled. The data packets sent from devices of other IP addresses will be discarded by the CPU module. The setting steps are shown below. Eighteen groups of IP address at most can be listed in the table.



Select **IP Filter Function Enable** checkbox to enable the IP filter function and type the start address and end address of group 1~8 IP.

3.1.4.10 Ethernet Port Advance Setting – NTP

Users can use **NTP** table to enable the CPU module and adjust time via NTP server. Relevant parameters are set here. For more information on NTP, refer to related literature and manuals.



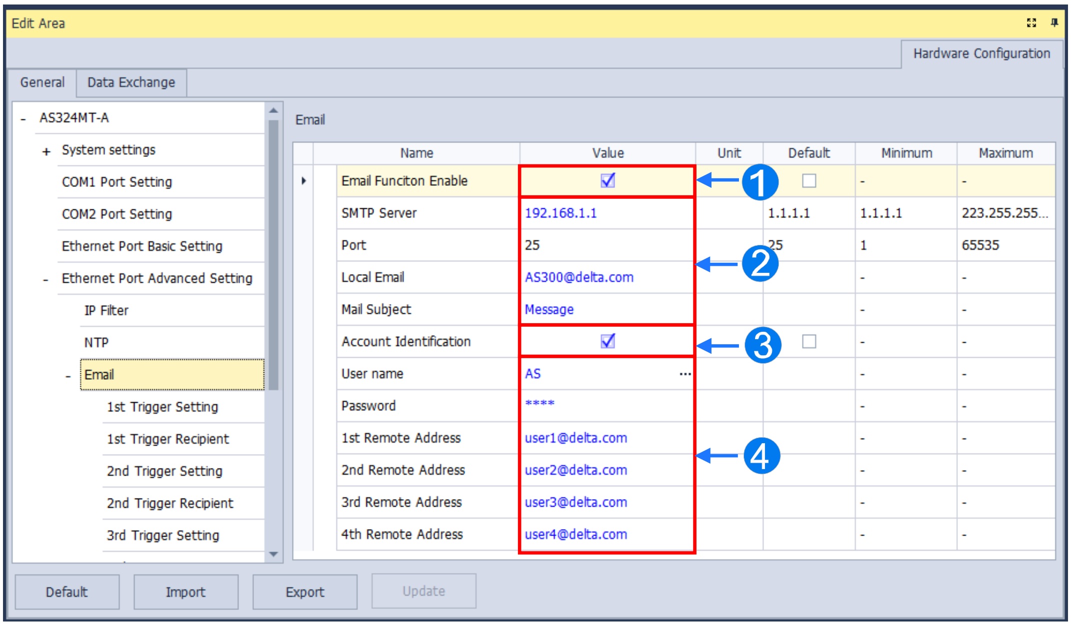
❶ Select **NTP Client Function Enable** checkbox to enable the function.

❷ Set the address of NTP server and cycle of constant update. Take the figure above as an example. The CPU module connects to the NTP server every 30 minutes.

❸ Set up the time zone for the daylight saving time area.

3.1.4.11 Ethernet Port Advance Setting – Email

Email table is for users to set the email-related functions. The email will be sent to the set email address after the email function is enabled. Total four groups of email sending conditions and four groups of email addresses can be set.



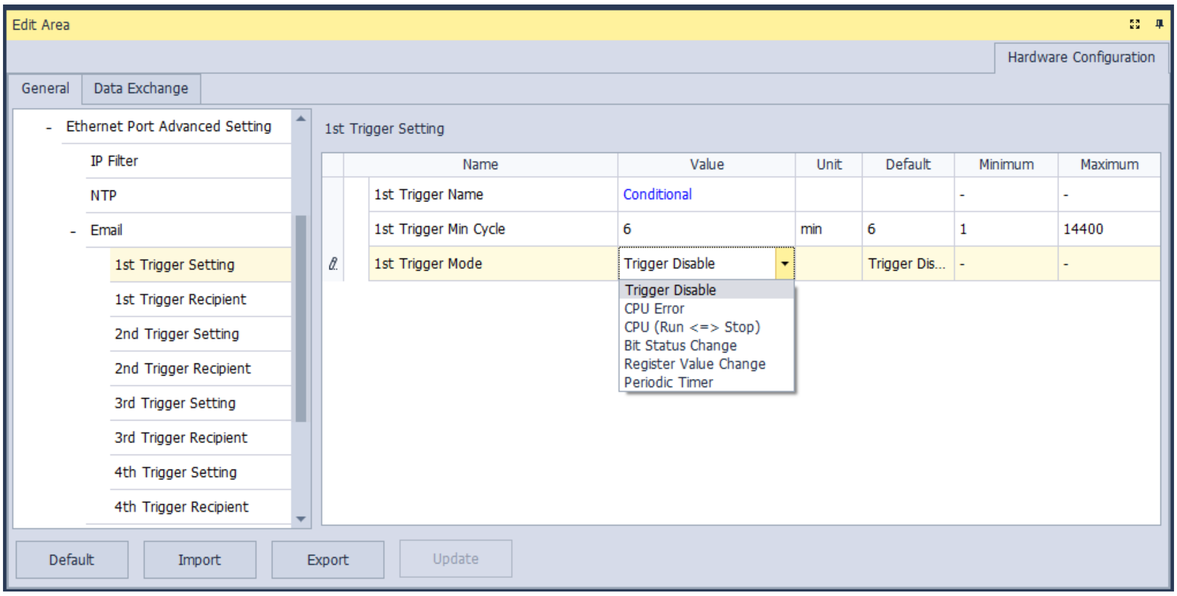
❶ Select **Email Function Enable** to enable the function and then start setting the following parameters.

❷ Set an IP address of SMTP server. Set the COM port of SMTP server at the COM port and set the sender's email box at local email address. Type a mail subject as the start of the subject of every email.

❸ Select **Account identification** checkbox to enable the function. Users can set to authenticate themselves with a user name and a password before logging in to an SMTP server.

❹ Type the target email address of a receiver.

Type a trigger name in **Trigger Name box** and a minimum interval in **Trigger Min Cycle** in the **Trigger Setting** table. And then select a trigger condition on the drop-down list. When the sending condition is met, the system will send an email every a period of time. But the same email will not be sent again within the set interval.



Trigger modes can be set as follows.

- **CPU Error**

If an error occurs in the CPU module, the condition of triggering the sending of an email is met. Please refer to operation manuals for more information about errors occurring in CPU modules. After users select the **CPU Error** option button, they have to select **Fatal Error Only** or **All Errors** in the drop-down list at the right side of the option button.

a) **Fatal Error Only**: If a fatal error occurs in the CPU module, the condition of triggering the sending of an email is met and an email will be sent.

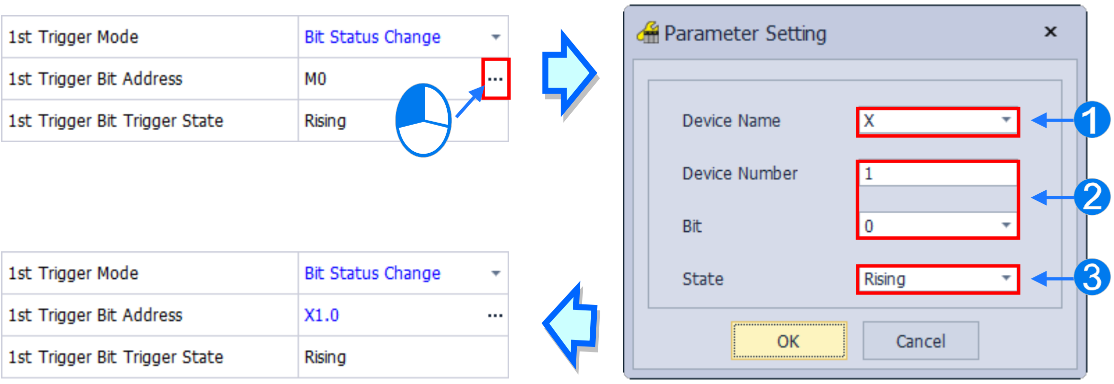
b) **All Errors**: If an error occurs in the CPU module, the condition of triggering the sending of an email is met and an email will be sent.

- **CPU (RUN<=>STOP)**

When the CPU module begins to run, or when the CPU module stops running, the condition of triggering the sending of an email is met and an email will be sent.

- **Bit Status Change**

If the state of a bit device specified meets a condition set, the sending of an email will be triggered and an email will be sent. For example, if X0.0 is turned from OFF to ON, the condition of triggering the sending of an email will be met. If users want to set a condition, they can click ··· button in the following window.



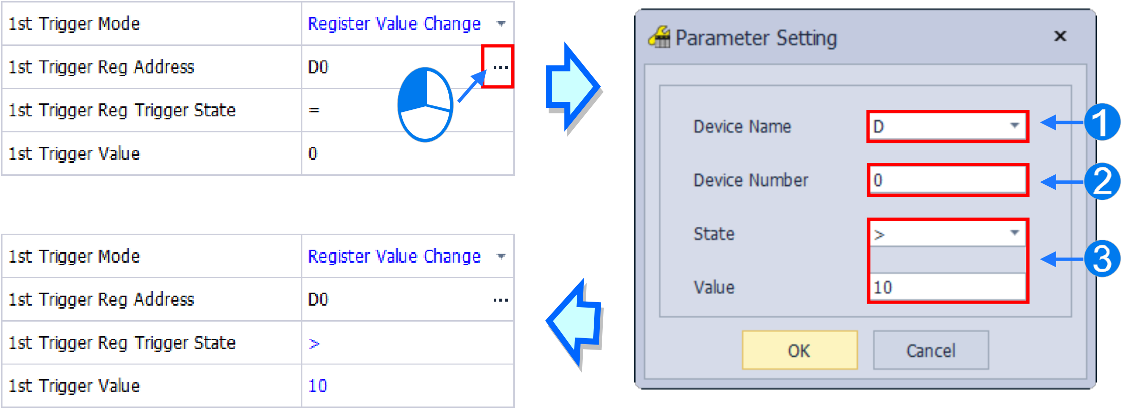
❶ **Device Name**: Users can select a device type in the **Device Name** drop-down list box.

❷ **Device Number & Bit**: Users can type a device address in the **Device Number** box. If the device type selected is X/Y, the users have to specify a bit number.

❸ **State**: Users can select **Rising** or **Falling** in the **State** drop-down list.

- **Register Value Change**

If the value in a device specified meets a set condition, the sending of an email will be triggered and an email will be sent. For example, if the value in D0 is larger than 10, the condition of triggering the sending of an email will be met and an email will be sent. If users want to set a condition, they can they can click ··· button in the following window.



❶ **Device Name**: Users can select a device type in the **Device Name** drop-down list.

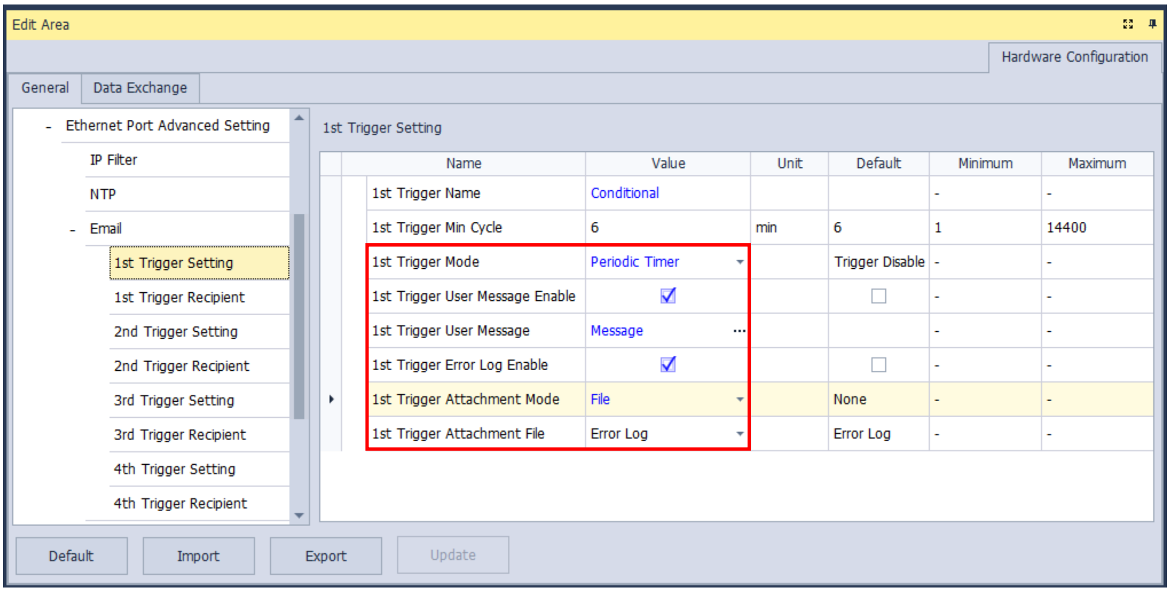
❷ **Device Number**: Users can type a device address in the **Device Number** field.

❸ **State & Value**: Users can set s condition of triggering the sending of an email here.

- **Periodic Timer**

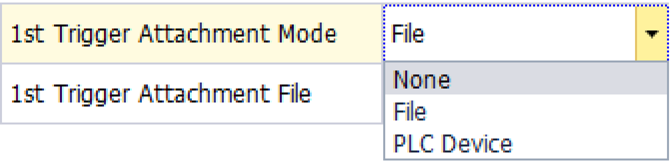
An email is sent periodically. How often an email is sent depends on the interval typed in the **Trigger Min Cycle** box in the **Trigger Setting** section.

Where any trigger mode is set, the user message and error log related parameters will show up.



Select the **Trigger User Message Enable** box and then click button to the right side of **Trigger User Message**. Type some content as the email text in the pop-up window.

If users select the **Error Log Enable** checkbox in the **Trigger Setting** table, the error log will be added to the email content automatically.



The options on the drop-down menu of **Trigger Attachment Mode** decide whether to add an attachment to the email. Please make sure the maximum size of the email file allowed before setting an attachment. For more information, refer to relevant operation manuals.

- **None**

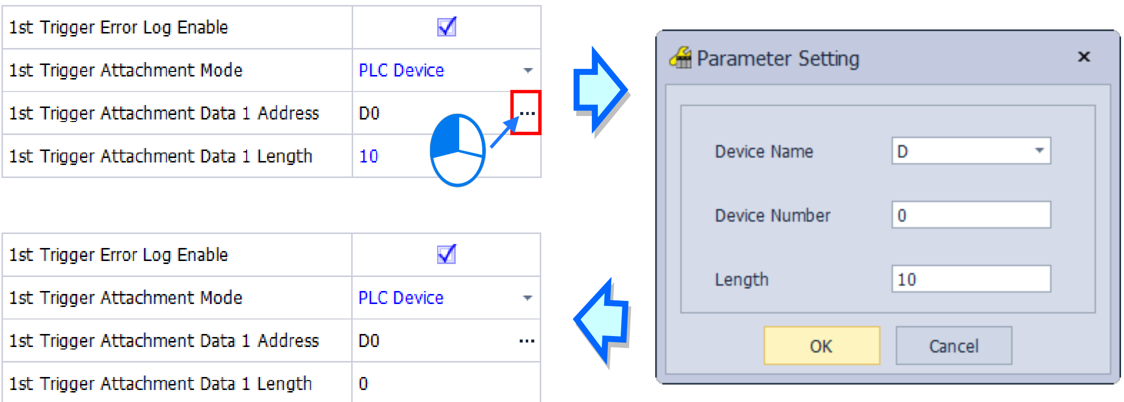
If this option button is selected, no attachment will be inserted.

- **File**

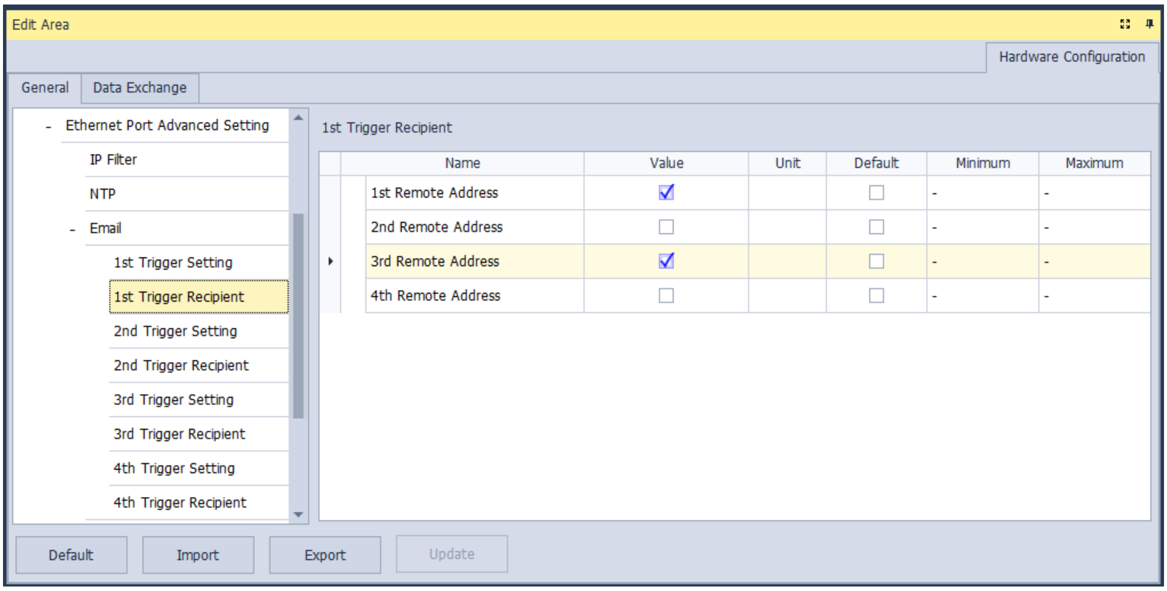
Users can select an error log in the memory card, or the system backup file in the memory card as the attachment of the email.

- **PLC Device**

If this option button is selected, the system automatically retrieves the states of the devices, or the values in the devices listed in the table as the attachment when the email is sent. After this option button is selected, users can click button in the following window to open the **Attachment** window. Two groups of devices at most can be set. For example, if the condition is met, the values in D0~D9 will be sent as an attachment.

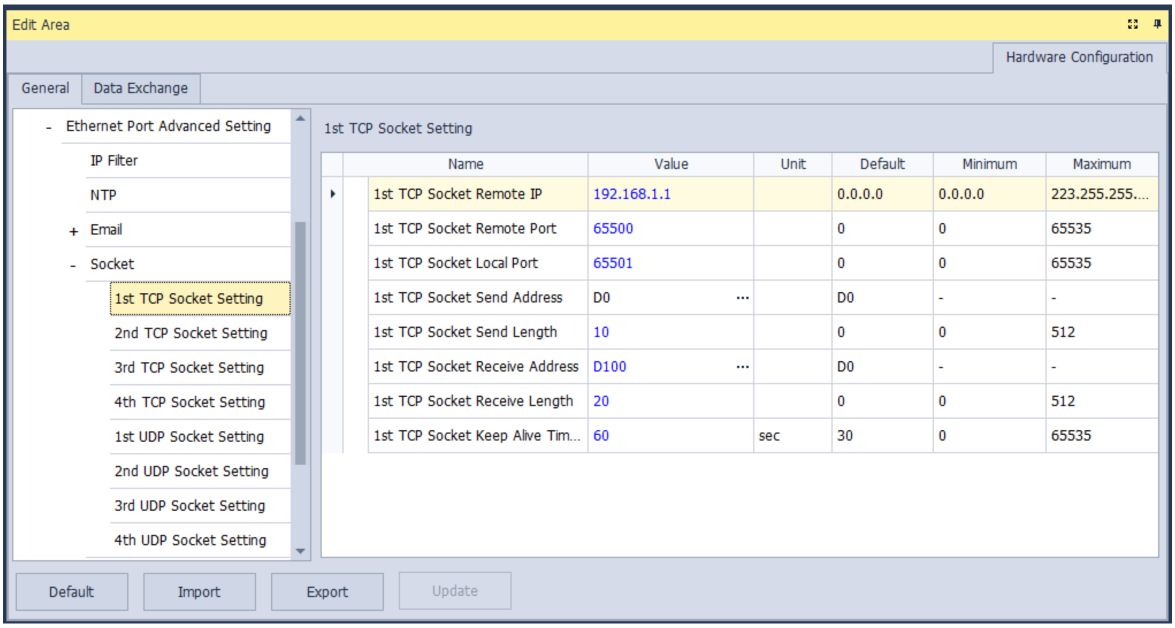


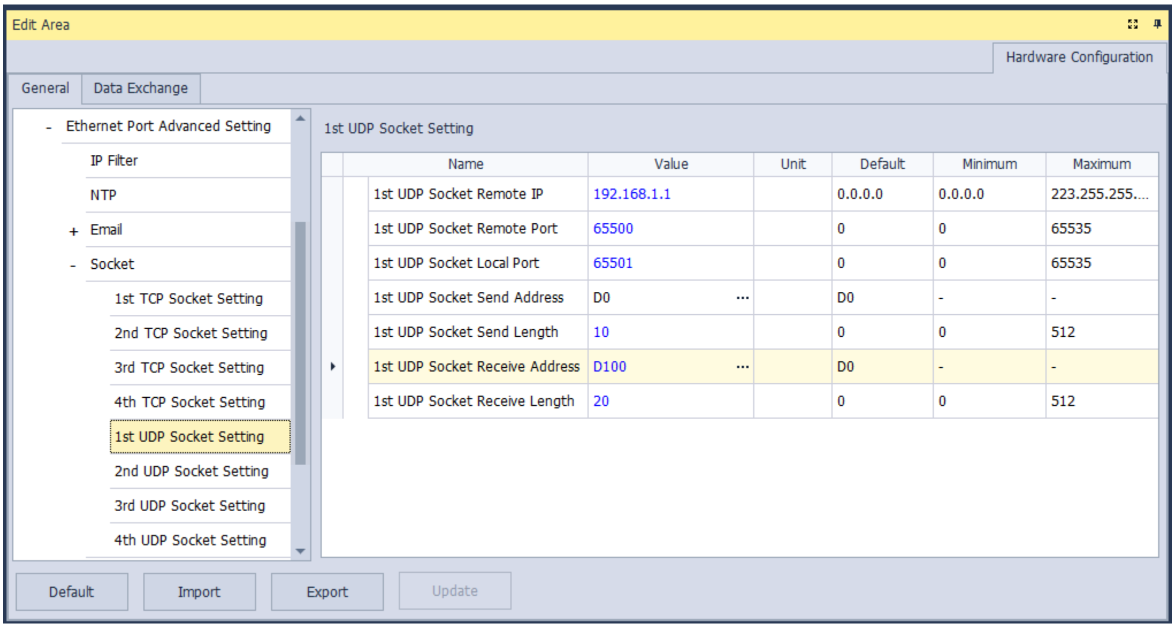
Select the target email address of a receiver when the condition of sending an email is met in **Trigger Receiving** table. And the specific email box is set in the **Email** section.



3.1.4.12 Ethernet Port Advance Setting – Socket

In the **Socket** table, users can set COM port parameters for data transmission via Ethernet. However, the function should be applied with specific API instructions. The system supports the data transmission between the CPU module and other CPU module or device via a socket as well as TCP and UDP protocols in each of which four groups of connections can be set.





The parameters in the **TCP Socket Setting** are the same as the parameters in the **UDP Socket Setting** except that there is no **Keep Alive Timer** parameter in the UDP Socket Setting. The parameters in the TCP and UDP Socket Setting are described below.

- **Remote IP**: Users can set a remote IP address.
- **Remote Port**: Users can set a communication port used by the remote device for this TCP connection. The port number must be within the range between 0 and 65535.
- **Local Port**: Users can set a communication port used by the local CPU module for this connection. The port number must be within the range between 0 and 65535.
- **Send Address**: Users can set the length of data which will be sent by the local CPU module. The length must be within the range between 0 words and 512 bytes.
- **Send Length**: Uses can set an initial device in the CPU module where data which will be sent is stored.
- **Receive Address**: Users can set the length of data which will be received by the local CPU module. The length must be within the range between 0 words and 512 bytes.
- **Receive Length**: Uses can set an initial device in the CPU module where data which will be received is stored.
- **Keep Alive Timer**: Users can set a maximum keep alive time for the connection. If no data is transmitted, and the keep alive period has elapsed, the CPU module will terminate the connection automatically.

The port number used by the local CPU module and the port number used by the remote device cannot be the same, and the devices where data which will be sent is stored cannot overlap the devices where data which will be received is stored. If the IP address of the remote device is 192.168.1.100, the port number used by the remote device is 65500, and the port number used by the local CPU module is 65501, the remote device and the local CPU module can transmit data through this TCP connection.

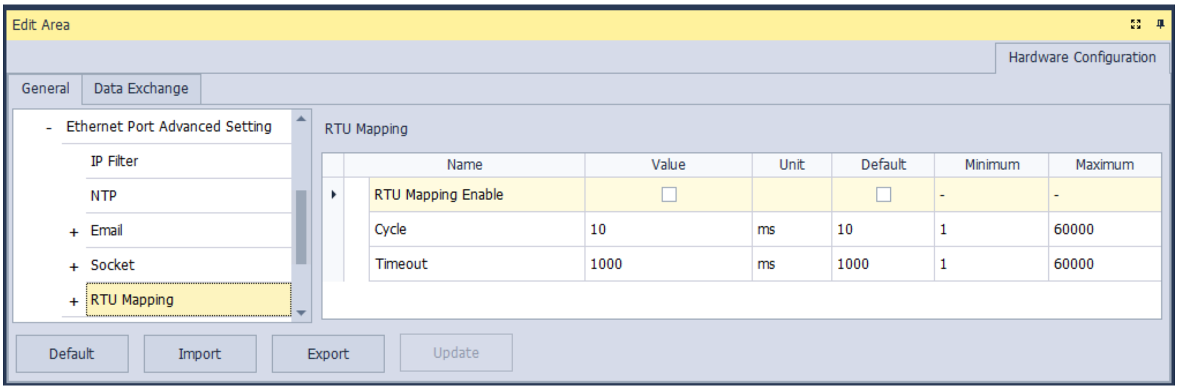
If the local CPU module wants to send 10-word data to the remote device, the data will be stored in D0~D9 before the data is sent. If the local CPU module receives 20-word data from the remote device, the data will be stored in D100~D119.

If the length of data received is larger than the length set, the first 20-word data will be stored in D100~D119, and the data after the first 20-word data will be discarded. Likewise, if the length of data received is less than the length set, the data will be stored in the devices starting from D100, and the values in devices where no new data is stored will be retained.

If no data is transmitted, and 60 seconds have elapsed, the CPU module will close the socket, and terminate the connection.

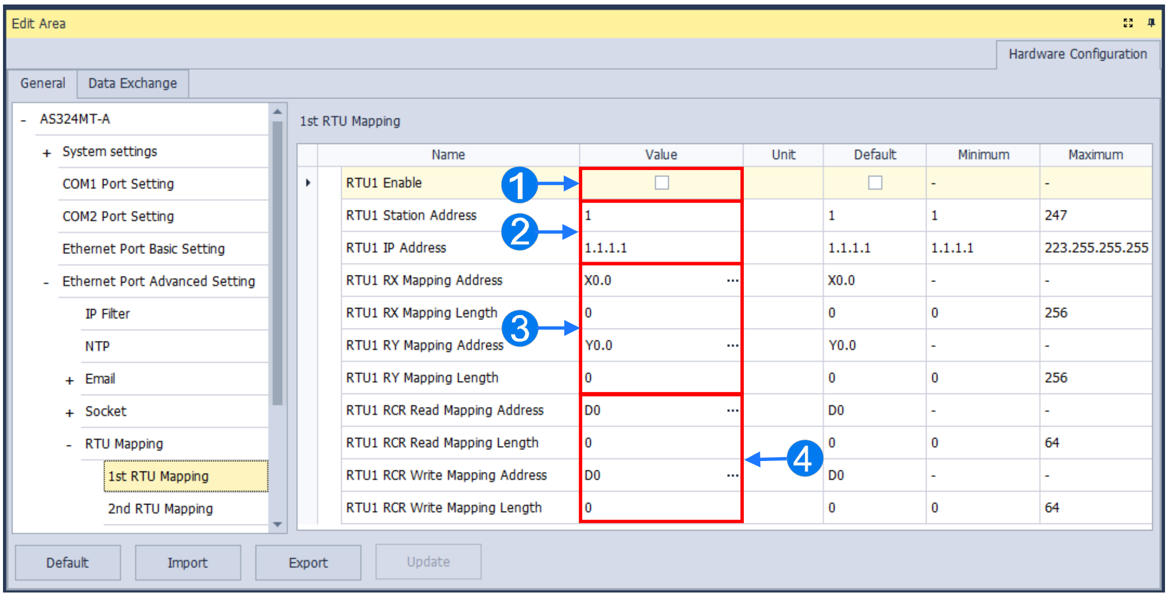
3.1.4.13 Ethernet Port Advance Setting – RTU Mapping

In the **RTU Mapping** table, users can set Delta RTU-EN01 slave in connection with PLC CPU. The remote device can be controlled via Ethernet. For the setting and operation of RTU-EN01, refer to the operation manual.



Select RTU Mapping Enable checkbox to enable the function of connection between RTU module and PLC CPU. Set the update cycle in **Cycle** box and a timeout in **Timeout** box. It means a timeout when RTU does not give a reply within the timeout set.

The data mapping between each group of RTU-EN01 and PLC CPU is set in the **RTU Mapping** section. RTU-EN01 and I/O module connected to it are set via DCISoft. For more information on DCISoft, refer to the operation manual.



❶ Users can select RTU1 Enable to enable this RTU function. Each RTU can be set individually.

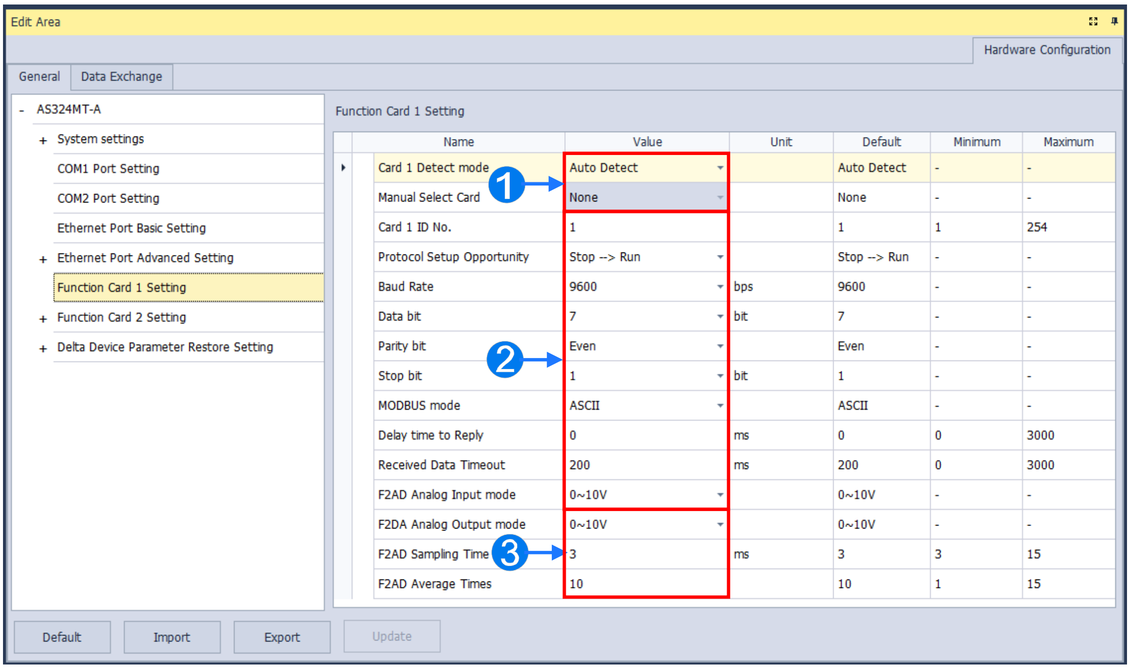
❷ Users can set a station address and IP address.

❸ Users can set RX mapping address and RX mapping length to make the digital input points of DI module connected to RTU mapped to X/M devices and length of PLC CPU. While, the RY mapping address and length set is used for making the digital output points of DO module mapped to Y/M devices and length of PLC CPU.

❹ Users can set RCR Read mapping address and RCR Read mapping length to make the analog input points of AI module connected to RTU mapped to D/SR devices and length of PLC CPU. While, the RCR Write mapping address and length set is used for making the analog output points of AO module mapped to D/SR devices and length of PLC CPU.

3.1.4.14 Function Card 1 Setting

The **Function Card 1 Setting** table is used for setting parameters of function card 1 in AS300 series CPU module, which is installed by inserting to the slot.



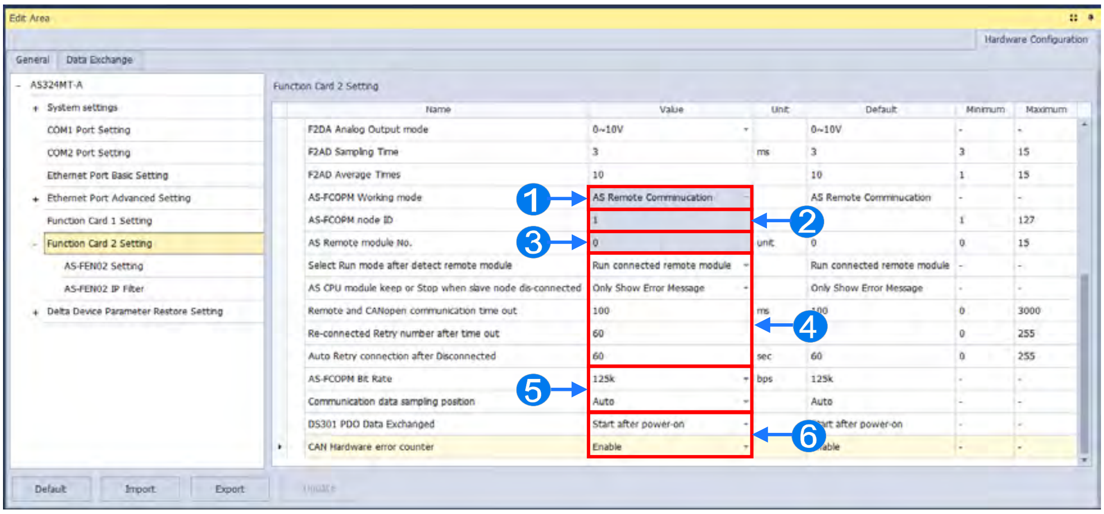
❶ Users can select **Auto** in **Card1 Detect mode** box to detect the actual card model and setting or **Manual** to select the AS--F232/ F422/ F485/F2AD/F2DA function card which need be configured in the **Manual Select Card** box.

❷ For the setting of parameters in AS--F232/ F422/ F485.

❸ Users can set **F2AD** to receive the signal of 0~10V or 4~20mA in **F2AD Analog Input Mode** box and set F2AD to send the signal of 0~10V or 4~20mA in **F2DA Analog Output Mode** box. The average times are set in **F2AD Sampling Time** and **Average Times** boxes respectively.

3.1.4.15 Function Card 2 Setting

The Function Card 2 Setting table is used for setting parameters of function card 2 in AS300 series CPU module, which is installed by inserting to the slot. Besides function card 2 settings, the option also include settings for AS-FEN02 and IP filter. For function card 2, AS-FCOPM and AS-FEN02 in **Manual Select Card** box are additional options that does not exist for function card 1. If users select AS-FCOPM card, the parameters can be set in the following window.



❶ Users can select AS Remote Control/Delta Servo Drives and AS Remote Module/CANopen DS301 from the **AS-FCOPM working mode** box. The AS Remote Module and Delta Servo Drives adopts communication protocols exclusive to Delta servo products and AC motor drives. In addition, the AS Remote Module and Delta Servo Drives are also applied in connecting remote I/O AS series as well as CANopen DS301 for the application of DS301 standard protocol.

❷ Users can set the address of the station when CANopen DS301 is selected from the **AS-FCOPM working mode** box.

❸ The remote I/O parameters can be set if AS Remote Mode is selected from the AS-FCOPM working mode box. The **AS Remote Module No.** sets the number of remote I/O modules and each one can connect an expansion module.

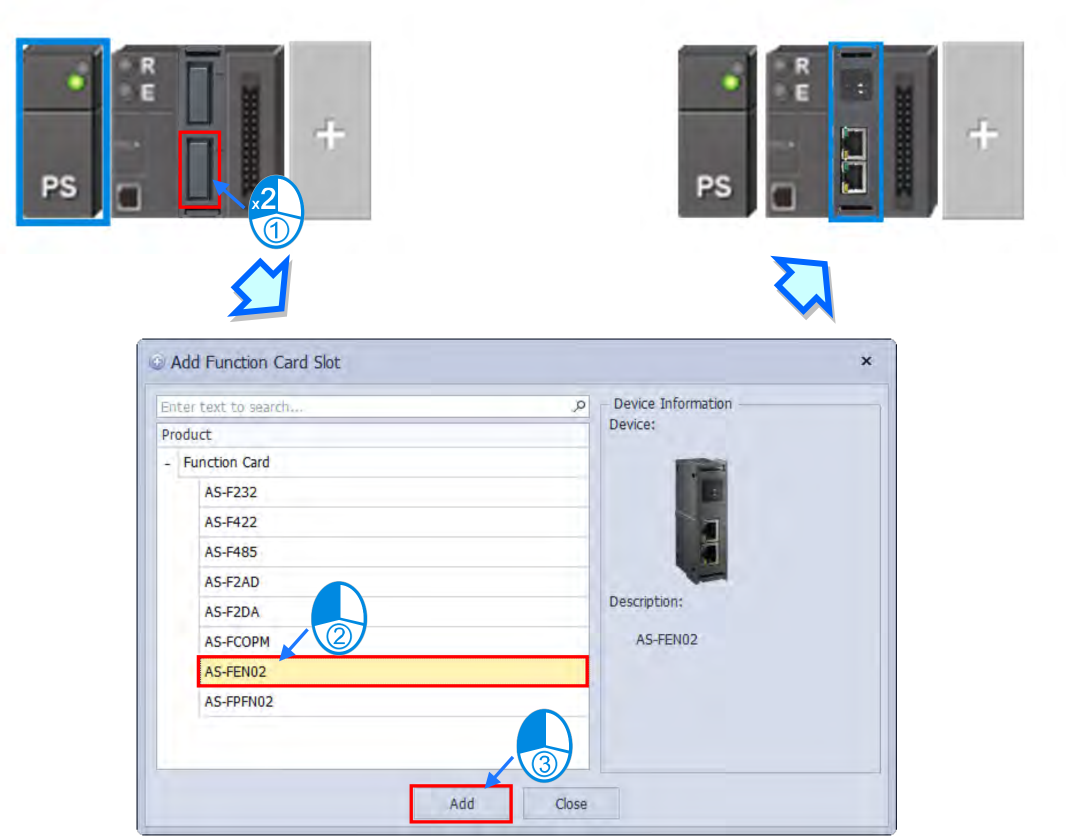
❹ If AS Remote Mode/Delta servo drives and AS Remote Mode is selected from the AS-FCOPM working mode box, users can **Select run mode after detect remote module** to run the number of actual connected modules inconsistent with the set number of modules, then the actual connected remote module operating or all remote modules will stop running; **AS CPU keep or Stop when slave node dis-connected** only shows errors or stops running and sends an alarm when the remote I/O module is disconnected during operation**; AS Remote and CANopen Communication Timeout** sets the timeout during which the remote I/O module does not give a reply**; Auto Retry connection after Disconnected** sets the times of retrying to make a connection after a timeout occurs.

❺ All three AS-FCOPM working modes can set the **AS-FCOPM Bit Rate**.

❻ The **DS301PDO Data Exchanged** parameter contains **Start after power** and **PLC RUN**

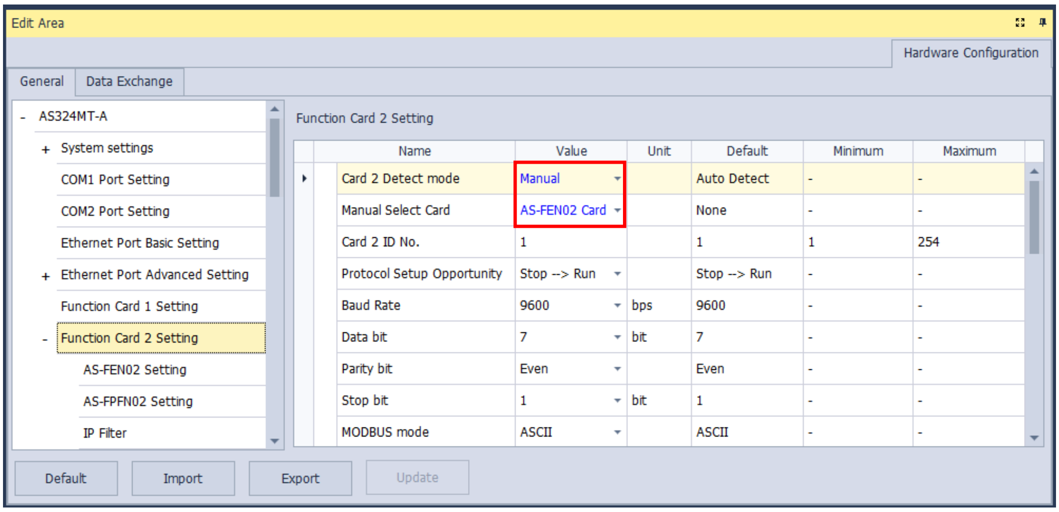
Will work when CANopen DS301 protocol is selected from the AS-FCOPM working mode box.

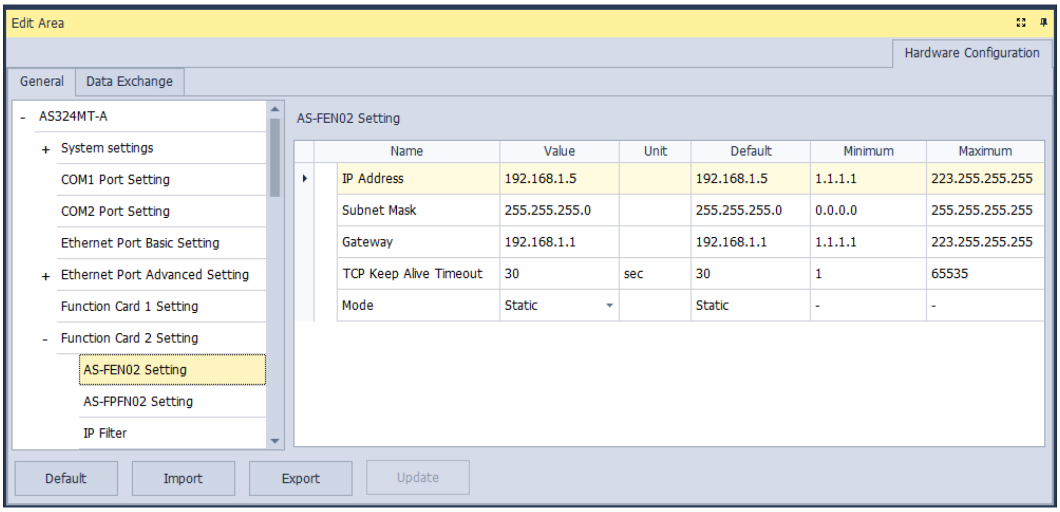
Insert AS-FEN02 by clicking the function card slot 2 and selecting AS-FEN02, as the image shown below.



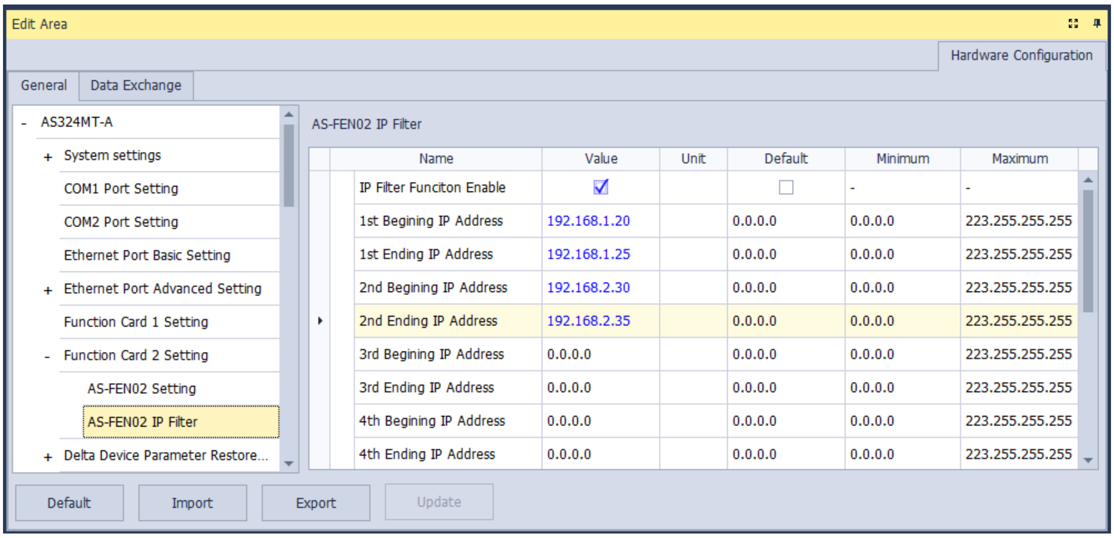
3

You can also set AS-FEN02 card in the Edit Area. Set AS-FEN02 as **Manual Select Card** (Note: If AS-FEN02 card is selected from **Manual Select Card,** then Function Card 1 cannot be set.) After that you can set up Ethernet communication parameters.





The IP filter adds another layer of confirmation to ensure the devices for communication are permitted. This function can also limit communication objects. When IP filter function enables, only the devices within the listed IP address from the IP filter table are allowed to communicate with AS-FEN02. By selecting **IP Filter Function Enable**, users can input the beginning and ending of 1-8 set of IP address.



3.1.4.16 Delta Device Parameters Backup and Restore

ISPSoft V3.10 supports Delta device parameters backup and restore. The firmware of your AS PLC CPU should be V1.08.10 or higher and you need to use EIP Builder V1.70 or later to backup / restore Delta device parameters. Now ISPSoft V3.10 only supports Delta C2000 invertor for parameters backup and restoration.

After you back up the parameters, with ISPSoft and EIP Builder, you can restore the parameters to your devices. Up to 32 Delta devices are supported. Refer to AS Series Operation Manual for further information.

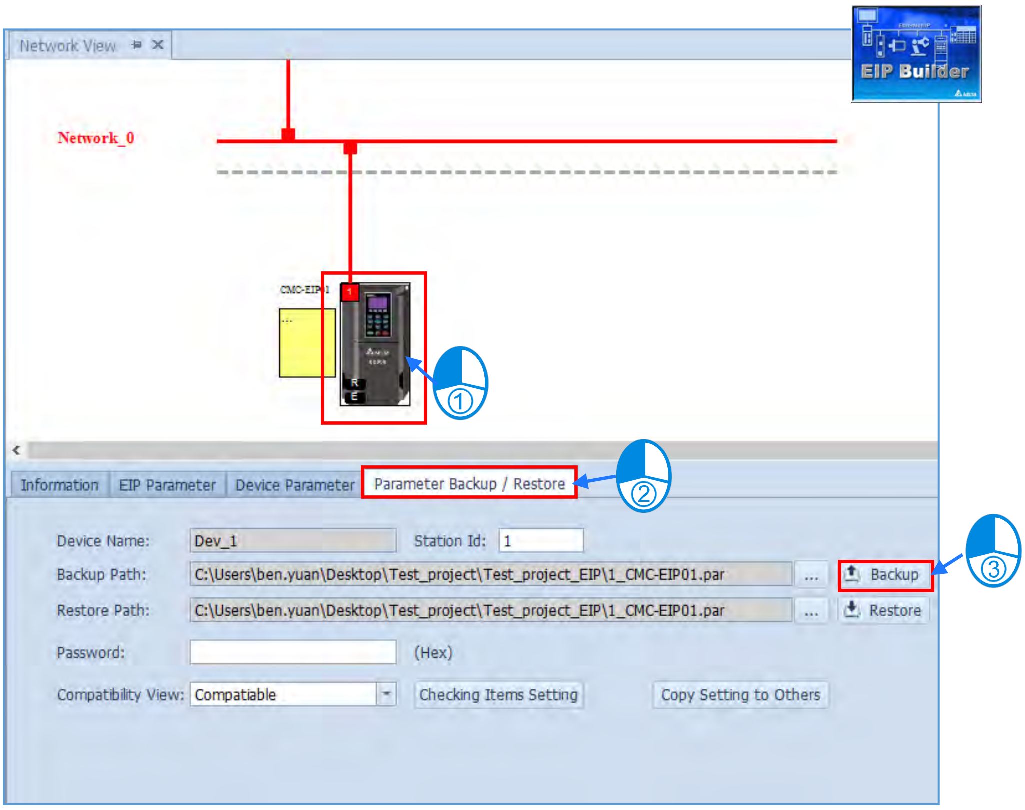
Steps to back up Delta device parameters to the SD card in the PLC device

1. Open EIP Builder (refer to section 3.1.3.16) and complete the network planning.

2. Click CMC-EIP01 (Delta C2000) and click **Parameter Backup / Restore** tab.

3. Select a backup path and click **Backup** button to back up Delta C2000 parameters.

The backup file is stored as the .par file. For multiple devices, the file name varies according to different station number for easier identification.



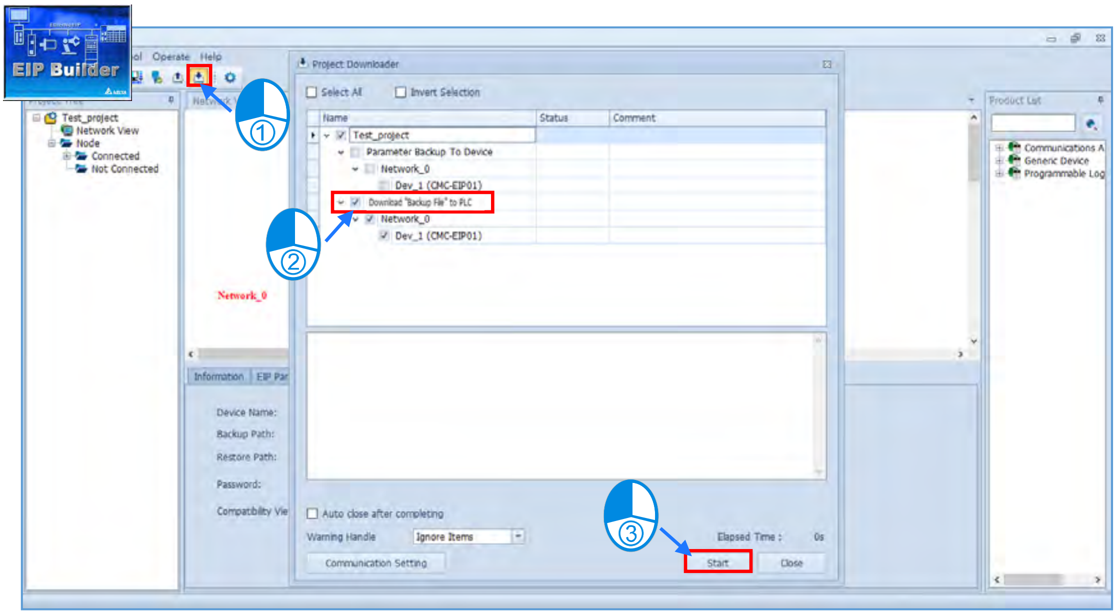
Steps to store Delta device parameters from your PC to the SD card on the PLC

1. Make sure the SD card is installed on the PLC.

2. Make sure that AS Series PLC CPU is at the state of STOP.

3. Click download on the tool bar and select the option **Download "Backup File" to PLC**.

3. Click **Start** button to store the Delta C2000 parameter backup file to the SD card.



Remarks:

- Default backup file path

  AS300: \SDCard\PLC CARD\AS300\DevPara

  AS200: \SDCard\PLC CARD\AS200\DevPara

- File naming: mmmm_nn_tt_pppppppppppppppp.par

  mmmm: device or module code (e.g. PLC CPU is 0000.)

  nn: communication port number (e.g. PLC Ethernet communication port is 03.)

  tt: communication protocol type (e.g. Ethernet communication is fixed to 01.)

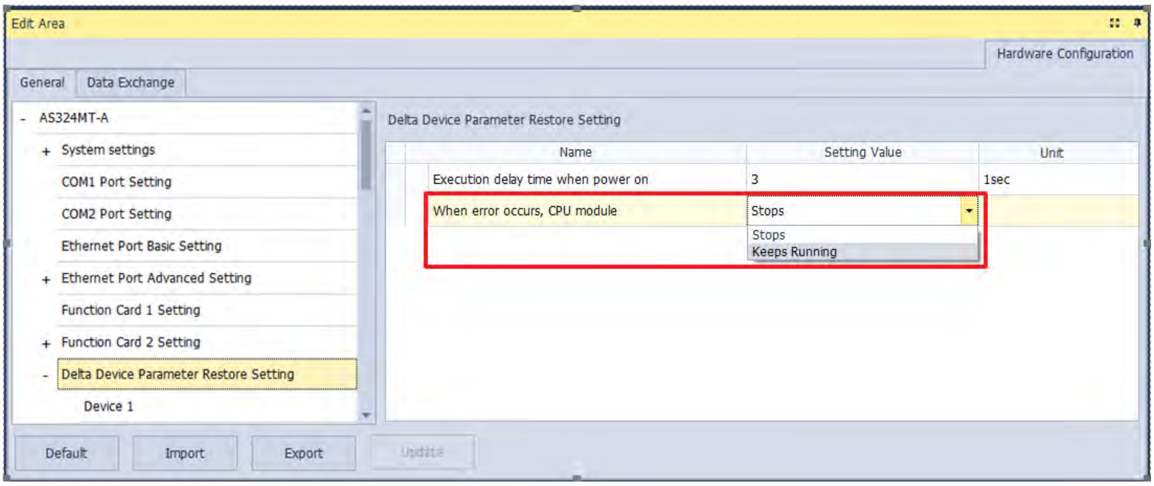
  pppppppppppppppp: device information (IP + ID + 000000 in the hexadecimal format)

  For example: If the device IP is 192.168.1.9 and its ID is 9, the device information is C0A80109 (IP) + 09 (ID) + 000000 = C0A8010909000000

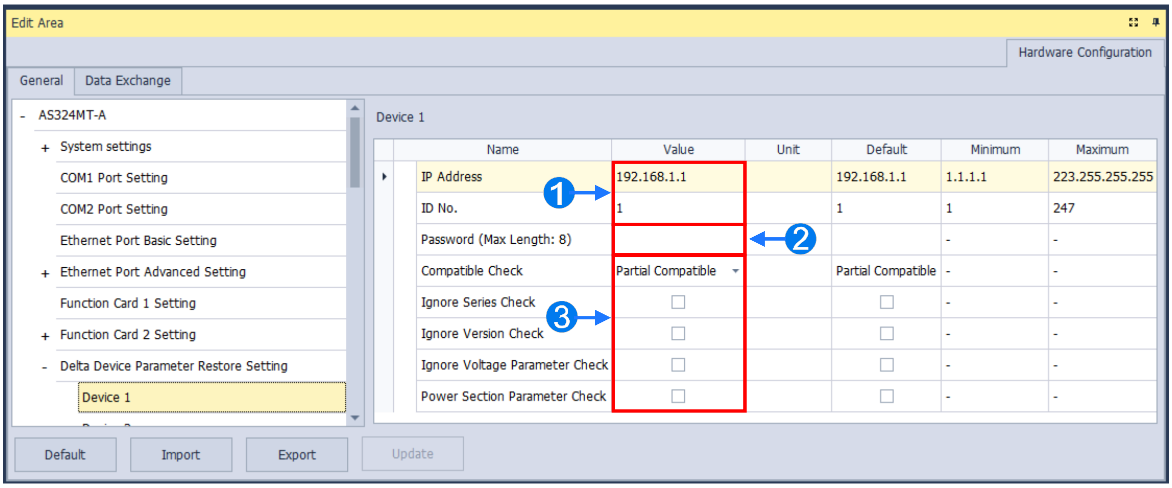
Delta Device Parameter Restore Setting

You can set up the handling method when an error occurs while restoring.

- Execution delay time when power on
- When error occurs, CPU module stops or keeps running.



You can set up further parameters for Delta devices 1 ~ 16.



❶ Set up the IP address and ID number for the device.

❷ Set up the password for the device; up to 8 characters can be used.

❸ Set up the compatible check. 3 different checks, **Partial Compatible, Full Compatible,** and **Force Write** can be set.

*** Partial Compatible:** you can set up which of the four following conditions can be ignored.

- Ignore Series Check if Possible: Even if the series in the backup file is different from the one on the list, the system still tries to restore the parameters.

- Ignore Version Check if Possible: Even if the version in the backup file is different from the one on the list, the system still tries to restore the parameters.

- Ignore Voltage Parameter Check if Possible: Even if the voltage parameter in the backup file is different from the one on the list, the system still tries to restore the parameters.

- Ignore Power Section Parameter Check if Possible: Even if the power parameter in the backup file is different from the one on the list, the system still tries to restore the parameters.

Note: If the target device does NOT support the partial compatibility, the restoration may not begin. Before restoration begins, you need to check which condition is supported by the target device by referring to the target device manual.

*** Full Compatible:** All the conditions should be met before the restoration begin.

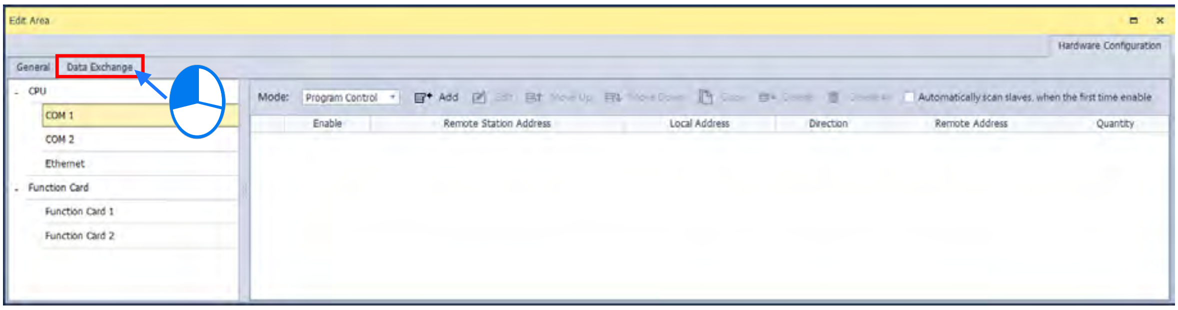
*** Force Write:** Ignore any difference between the backup file and the device on the list and force the system to restore the parameters.

Besides using ISPsoftand EIP Builder, or other PLC editing software, such as HMI or SCADA, you need to use SR devices to appoint which inverter needs to be restored. Refer to the table below. After you have set the configurations, the PLC executes the restorations according to your settings, when the PLC is Power-On or from Stop to Run.

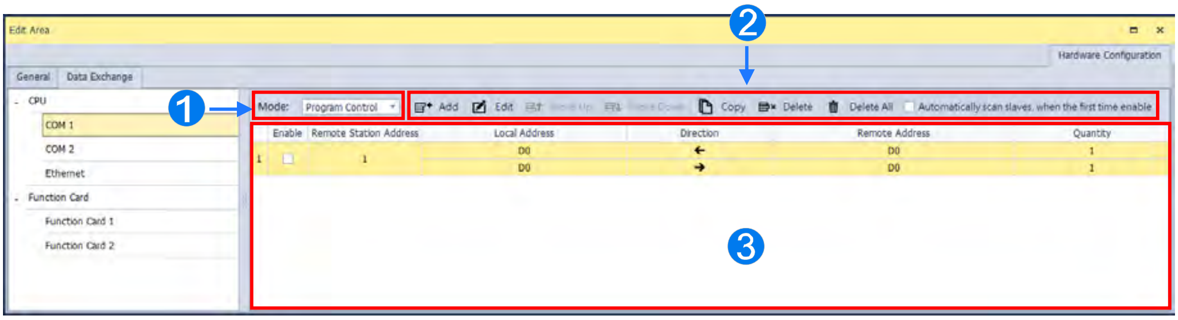
SR	Function	Description	Retain ability
SR1600	Parameter restoration code	0： Disable (default) 1： When PLC is Power-ON or Stop→Run, execute the restoration. Once the restoration is complete, clear the	Yes
SR1601.0~SR1601.15	Target device number	SR1601.0: refer to target device #1 SR1601.1: refer to target device #2 ⋮ SR1601.15: refer to target device #16 Off：Disable (default) On：Execute the restoration on the appointed target device	Yes

3.1.4.17 Data Exchange

With the feature of standard MODBUS TCP data exchanges built in the CPU module, you can configure the data exchange settings on Data Exchange Setting page from Edit Area shown as follows.



There're models of the CPU equipped with two COM ports or one each from COM and Ethernet, which the parameters can be configured via COM1, COM2, COM and Ethernet settings on Data Exchange page. To exchange data between Master and remote devices (slaves), COM1 and COM2 are used via MODBUS protocol, while Ethernet port is used via MODBUS TCP. The setting pages of these three communication ports are the same as shown in the following figure.



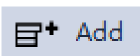
❶ Configure the start-up mode with the following options:

A. **Program Control:** The execution of data exchange flags is controlled by PLC program. For flags of each communication port, please refer to the description of special flags SM in the programming manual.

B. **PLC Run:** When PLC is in the RUN mode, the configured task of data exchange would be executed automatically. Once the PLC's status changes to Stop, the communication would be disconnected.

C. **Always Enable:** Once PLC is powered up, the task of data exchange would be continuously executed.

❷ The features of the toolbar are explained in the following table.

Icon	Description
	Add a row to the data exchange table in area ❸.

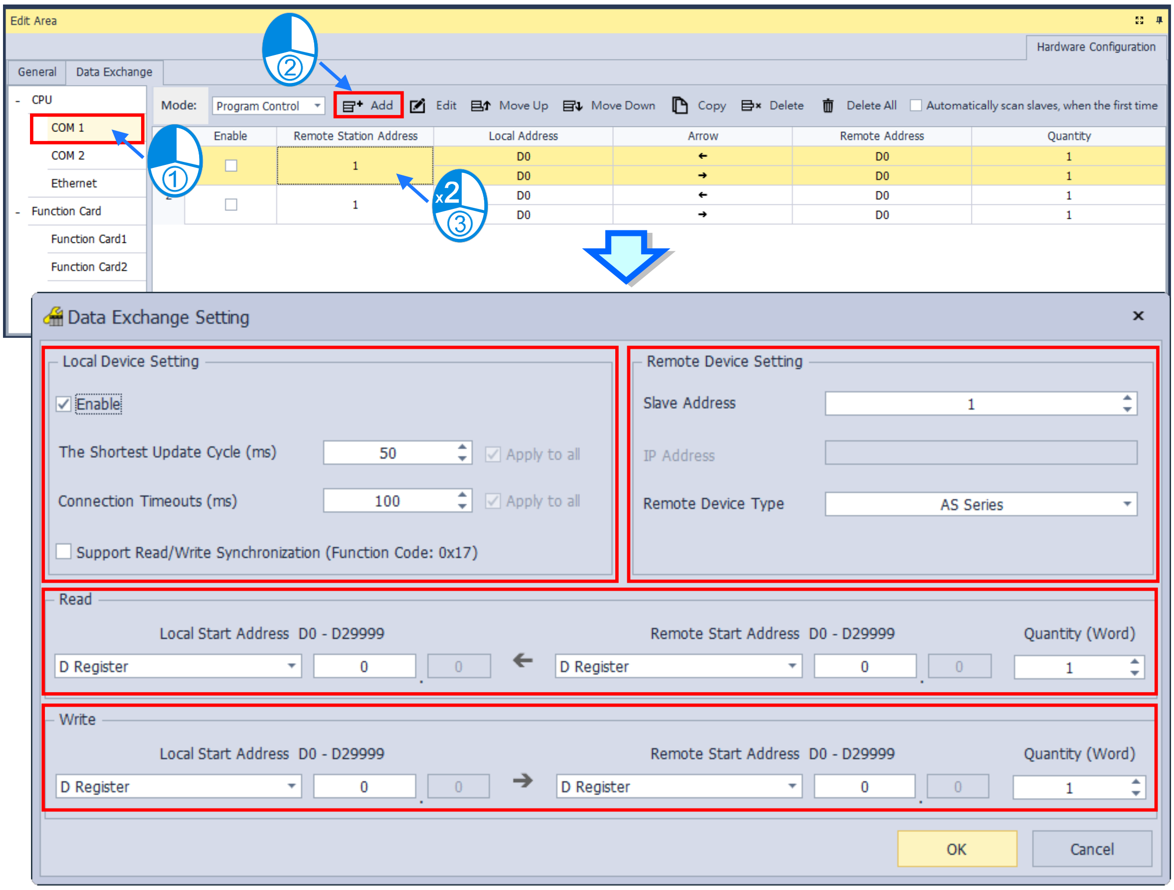
Icon	Description
Edit	Open the configuration page of the selected data exchange settings.
Move Up Move Down	Reorder groups in the data exchange table by moving the selected rows to the up or down of another row.
Copy	Copy the selected group to the bottom of the data exchange table.
Delete	Delete the selected groups in the data exchange table.
Delete All	Delete the entire data exchange table.
☑ Automatically scan slaves, when the first time enable	Before enabling data exchange for the first time, the designated slaves to activate would be scanned first for checking its existence. Slaves which do not exist will not be required to connect with the master so as to improve efficiency on communication. In addition, we suggest to enable this function only when slaves are powered up more quickly than master.

❸ The created data exchange table is described as follows.

Column	Description
Enable	Choose whether to enable the group of data exchange table, while performing data exchange.
Remote Station Address	Provide the slave address belonged to this group, which one address can be set to different groups in data exchange table.
Local Address	Provide the address of associated master device.
← →	← : Input, which means the data block displayed in this group is read by master from the slave. → : Output, which means the data block displayed in this group is written by master to the slave.

Column	Description
Remote Address	Provide the device address of associated slave. When the slave is a Modbus Custom Device, the address would be displayed in hexadecimal format.
Quantity	Provide the length of the group, which should be same as the calculated result of device range.

On the Data Exchange Tab, you can set up data exchange for COM communication, Ethernet communication and Function Card. Click **Add** and then **Edit** or double-click the data exchange table to open the editing page.



- **Local Device Setting**

Tick the option **Enable** for data exchange to start. You can set the shortest update cycle and connection timeout time in ms. If for a period of time that you have set, there is no response from the target device, this is considered as a timeout. If you tick the option **Support Read/Write Synchronization (Function Code: 0x17)**, the master PLC CPU can use MODBUS function code to complete read and write synchronization at one operation. However you need to make sure all the devices support MODBUS function codes; otherwise, the slaves devices may NOT recognize the function code and fail to complete read/write synchronization.

- **Remote Device Setting**

Slave Address: station number of the slave device for data exchange

IP Address: IP address of the slave device (only available for EtherNet)

Remote Device Type: slave device model type, such as Delta PLC or standard MODBUS devices

- **Read:** When PLC CPU reads data from the remote device: PLC CPU defines a device range to store data including the device type, starting address and quantity which are read from the remote device. Define the device type, starting address and quantity in the remote device that will be read by PLC CPU.

  Local Start Address: Device type and start address of devices where PLC CPU store data

  Remote Start Address: Device type and start address of the remote device to be read

  Quantity: Data length of input

- **Write:** PLC CPU writes data to a remote device; PLC CPU defines a device range for the remote device to read the following data, the device type, starting address and quantity. Define the device type, starting address and quantity in the remote device that will be written by the PLC CPU.
  Local Start Address: Device type and start address of the source data of PLC CPU

  Remote Start Address: Device type and start address of the remote device where data are to be written

  Quantity: Data length of output

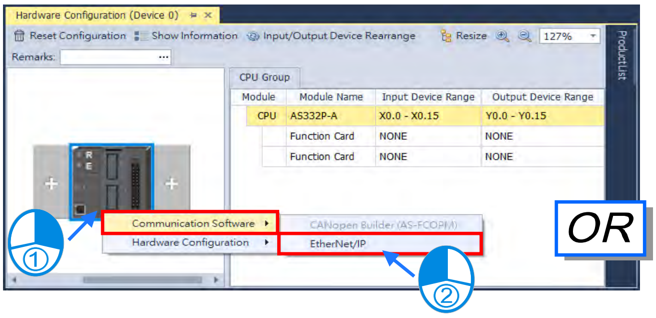
3.1.5 EtherNet/ IP

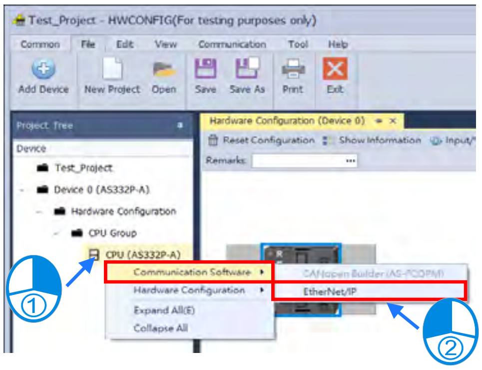
EtherNet/IP (EIP) is an industrial protocol managed by ODVA, Inc. (Open DeviceNet Vendors Association), which IP is an abbreviation of Industrial Protocol, working on a TCP/IP based Ethernet network and uses most widely deployed collections of Ethernet standards to provide a broad range of applications in different industries that require high-speed and stability including Factory Automation(FA), Building Automation(BA), Process Automation(PA) and more.

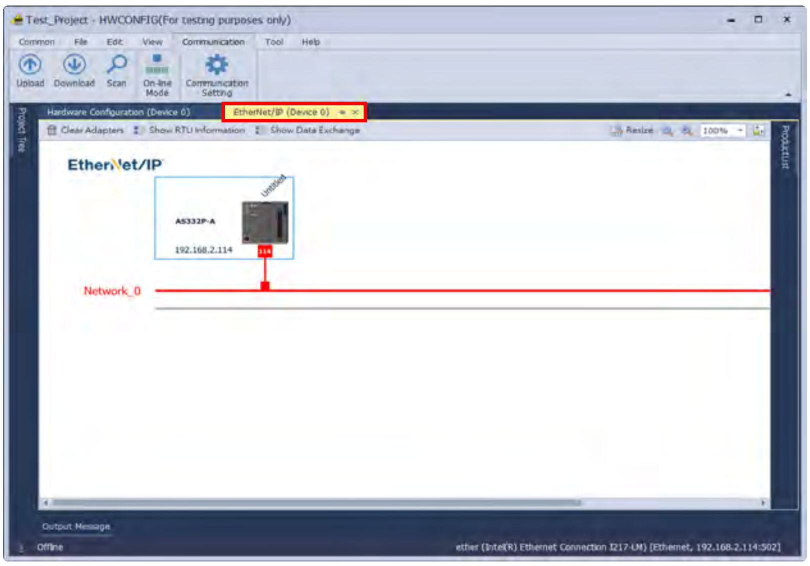
Delta covers a full range of controller and drive products supported by EtherNet/IP, including Programmable Logic Controllers (PLC), inverters, Human Machine Interfaces (HMI) and so on. Refer to chapter 9 for a full product list supported by EtherNet/IP. In addition, users can also use the EDS file to connect to the EtherNet/IP devices of other brands.

3.1.5.1 Open the EIP Setting Page

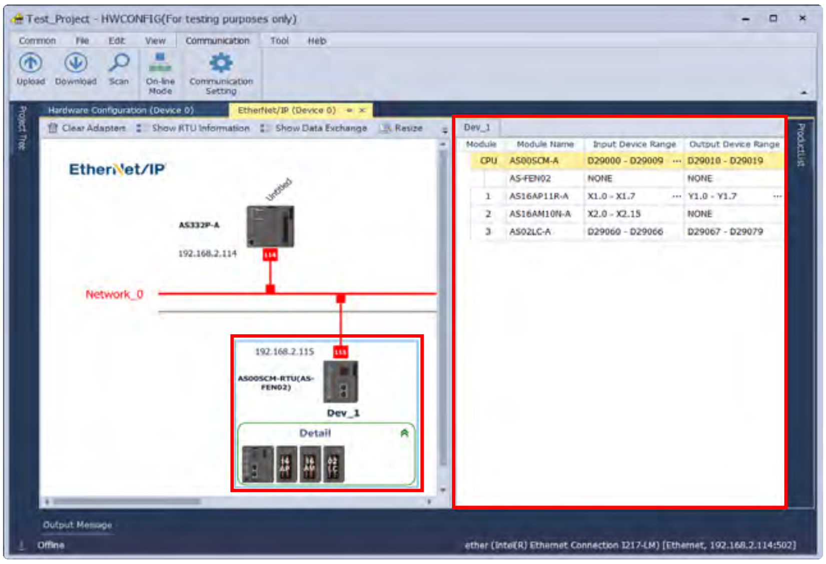
Right click the CPU on the hardware configuration page or in the project tree. And choose "**Communication Software**" then "**EtherNet/IP**" to open the EIP configuration page.





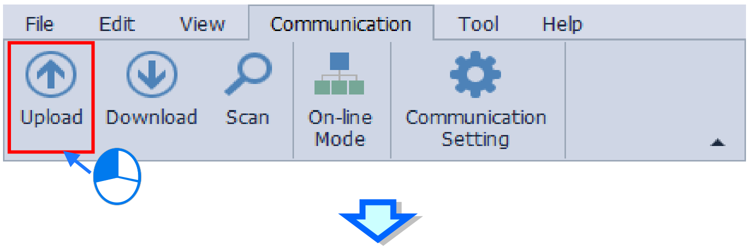


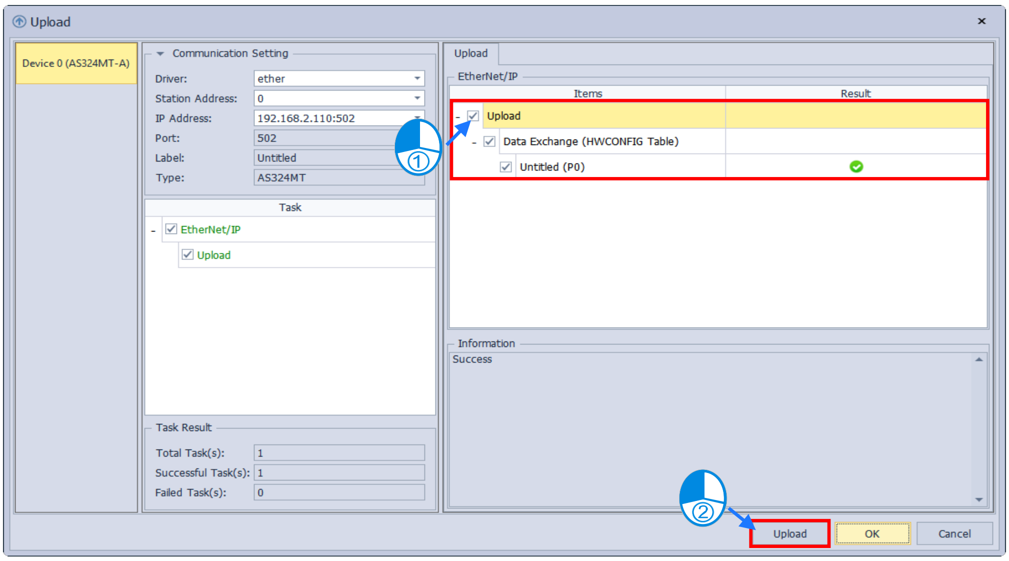
The configuration of EIP is shown on the left side of the page. If choosing RTU slave, the detailed configuration of modules inside RTU would be displayed on the right side of the page as the following shown.



3.1.5.2 Upload EtherNet/IP Settings

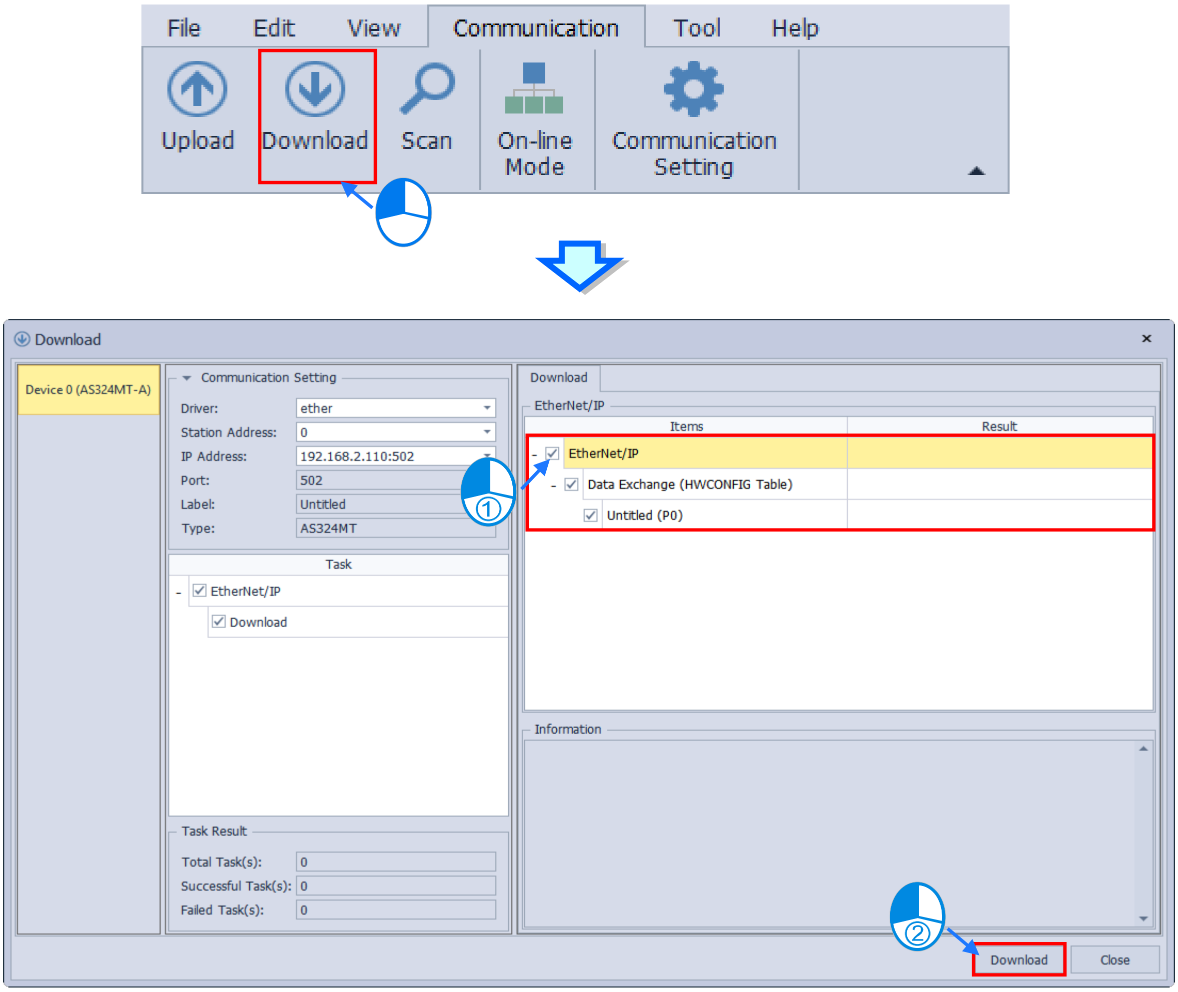
Enter the EIP page and click "**Upload**" from the toolbar on "**Communication**" tab, then the upload page would be displayed. A success message would pop up after clicking "**Upload**". Then click "**OK**" on the pop-up window to update the software's EIP settings, or click "**Cancel**" to cancel the update as the following shown.





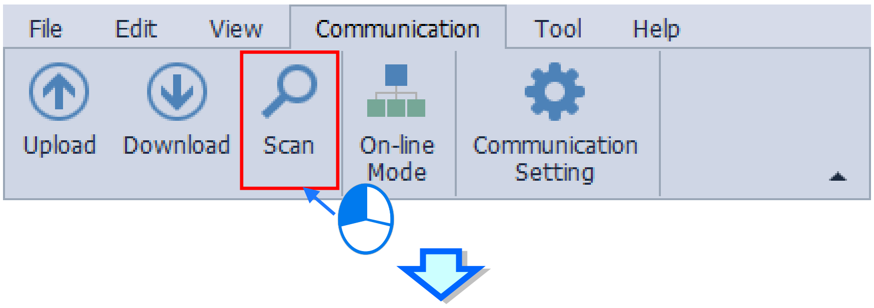
3.1.5.3 Download EtherNet/IP Settings

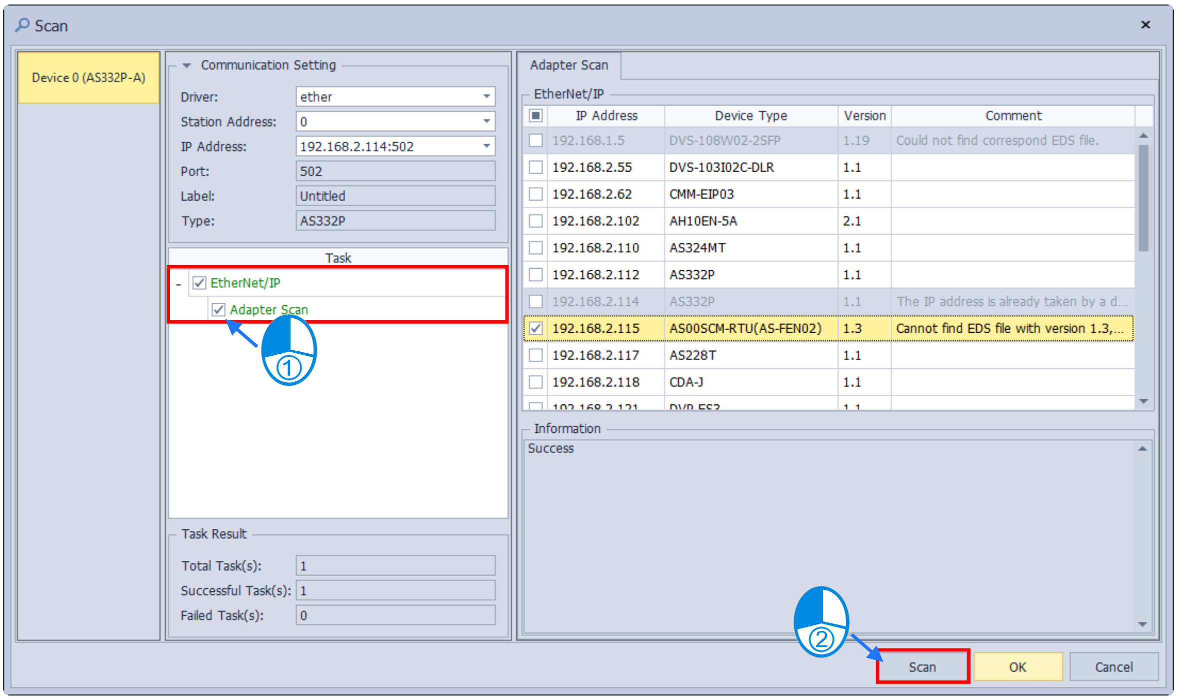
Enter the EIP page and click “**Download**” from the toolbar on “**Communication**” tab, then the upload page would be displayed. Then click “**Download**” after checking items to download so as to complete the download task as the following shown.



3.1.5.4 Scan EIP Adapters

Open the EIP page and click “**Scan**” from the toolbar on “**Communication**” tab, then the scan page would be displayed. After checking the checkbox of “**Adapter Scan**” and clicking “**Scan**”, adapters(slaves) available for communication would be shown on the right side of the page as the following shown.

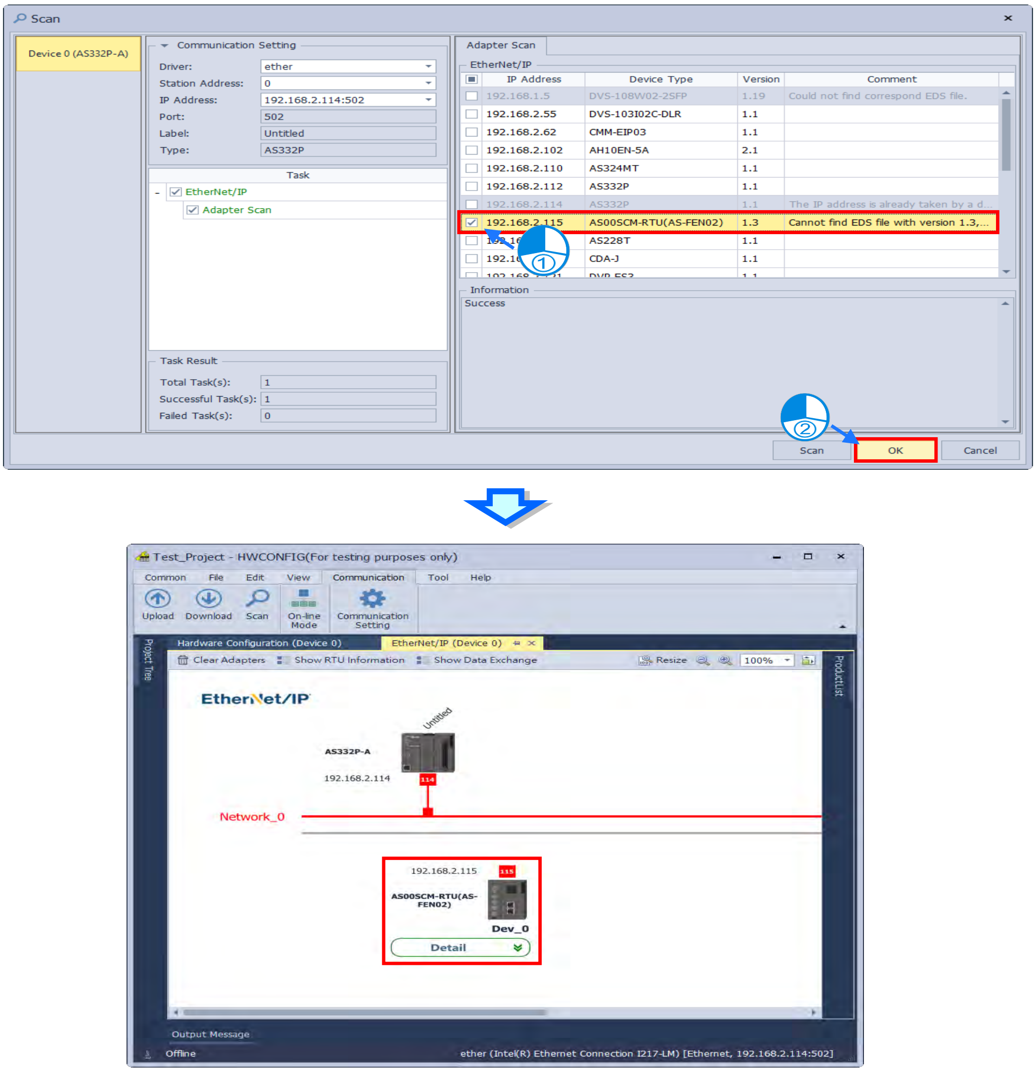




3.1.5.5 Add EIP Adapters

- **Method 1**

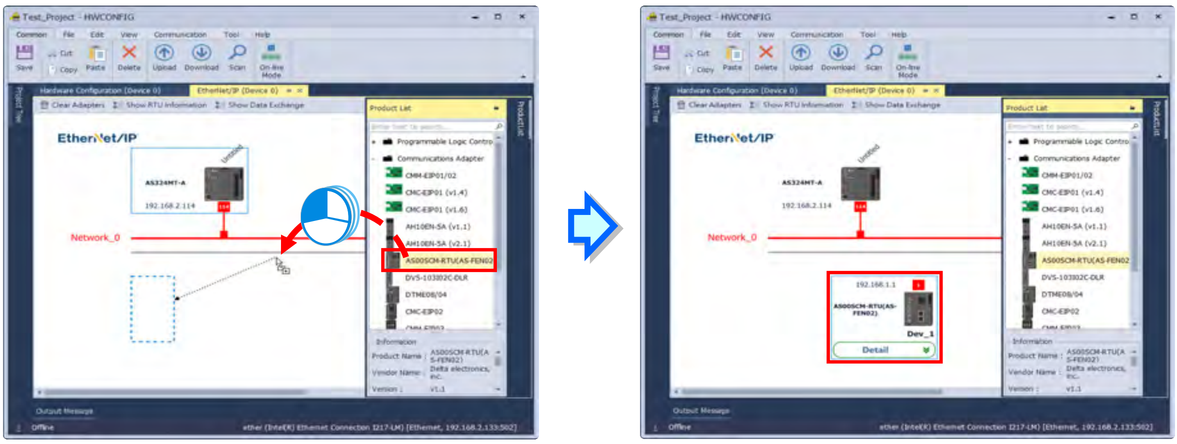
  Select the target slave from the Adapter Scan area on the right side of the page and click OK to add the slave to the EIP configuration as shown below.



***Slave information and RTU modules would also be added to the project along with the target slave.**

- **Method 2**

Drag the target slave from the product list to the configuration area.



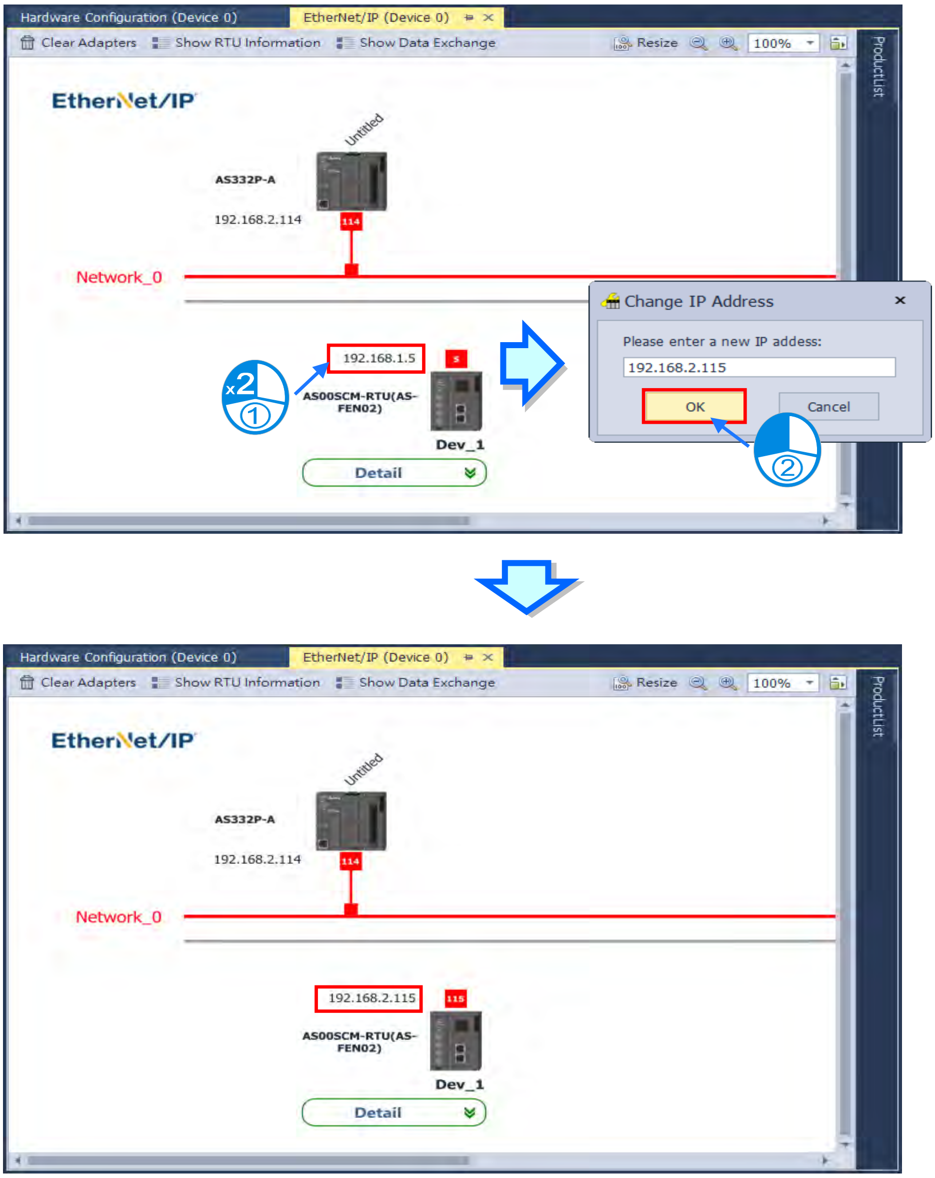
3.1.5.6 Setup Master / Slave IP

- **Set Master IP**

Since the master IP is the CPU's Ethernet IP address, you would not be able to modify the master IP on the EIP page. In case that you want to change the master IP, please refer to chapter 3.1.4.8 for more details.

- **Set Slave IP**

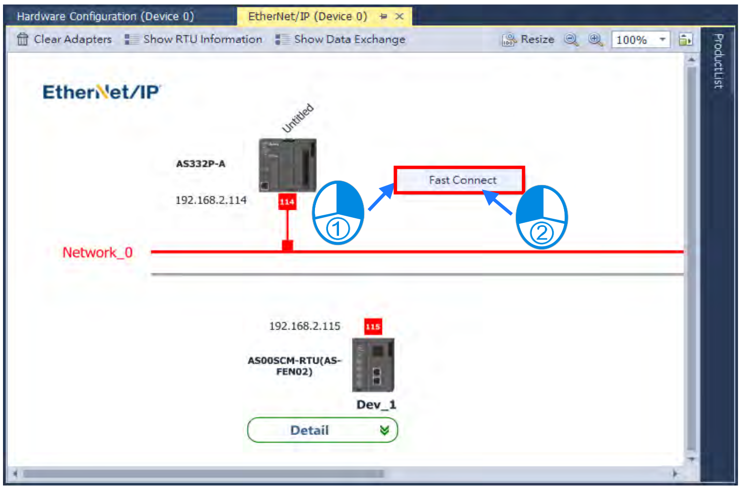
Double click the slave IP on the EIP page then the editing window would pop up. After finishing editing and closing the window, the configuration would be completed.



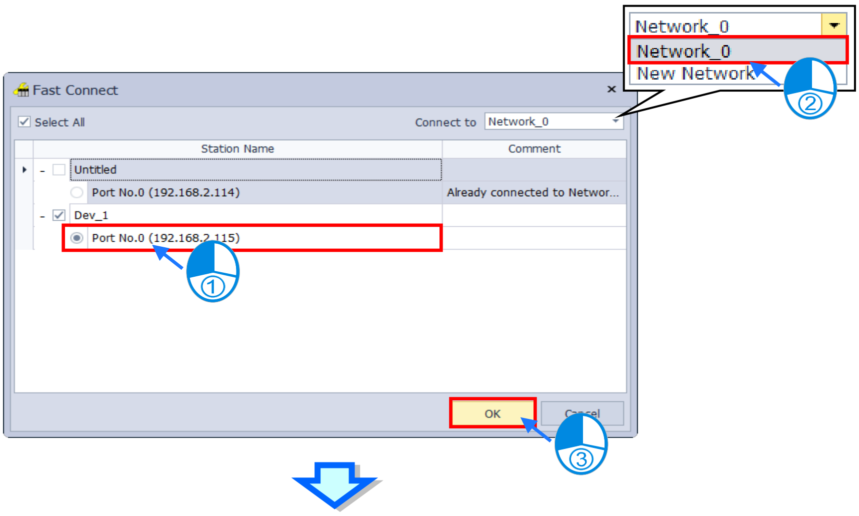
3.1.5.7 Setup Connections

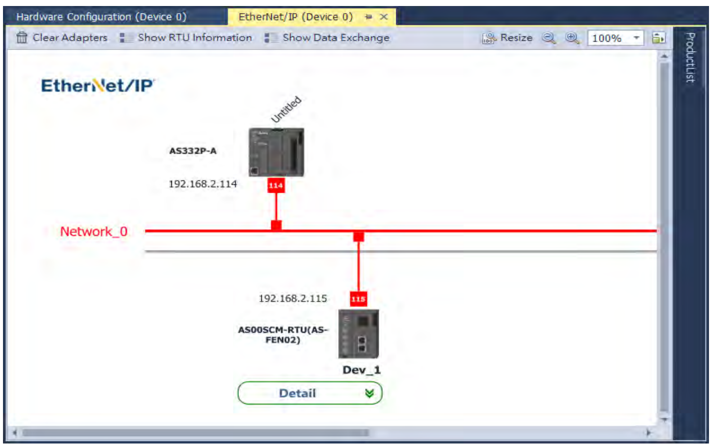
- **Method 1**

Right-click on any blank area of the page and select "**Fast Connect**".



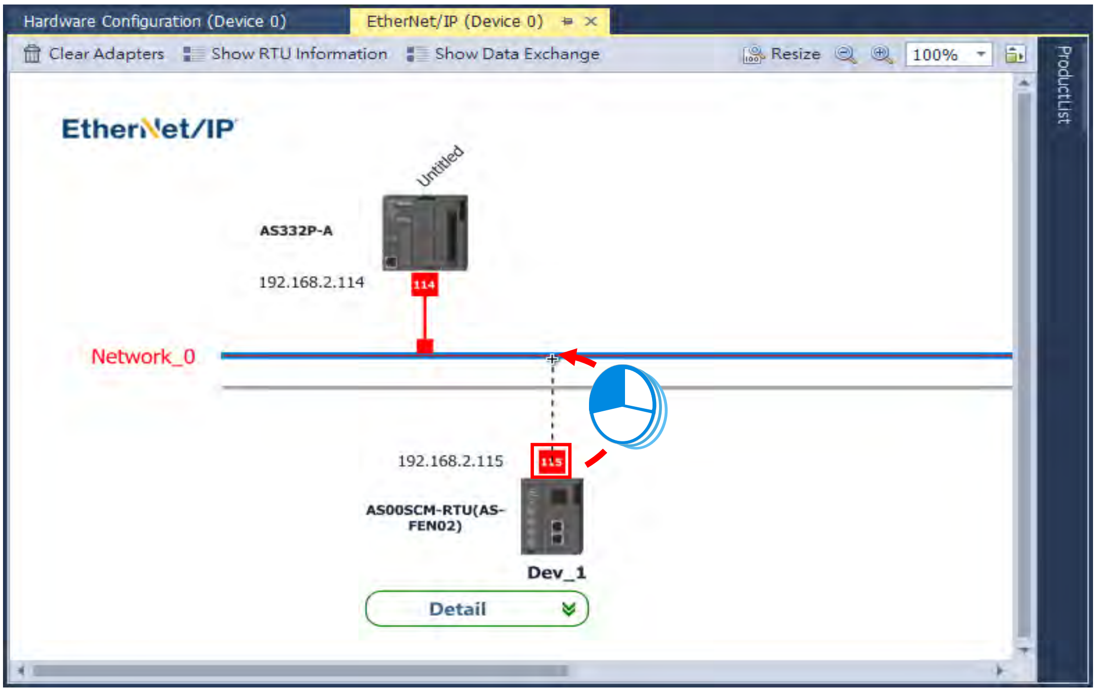
Select the slave station to connect on Fast Connect window, then choose the target network to connect at the top right corner of the window. Finally, click "**OK**" when finish setting the connection.

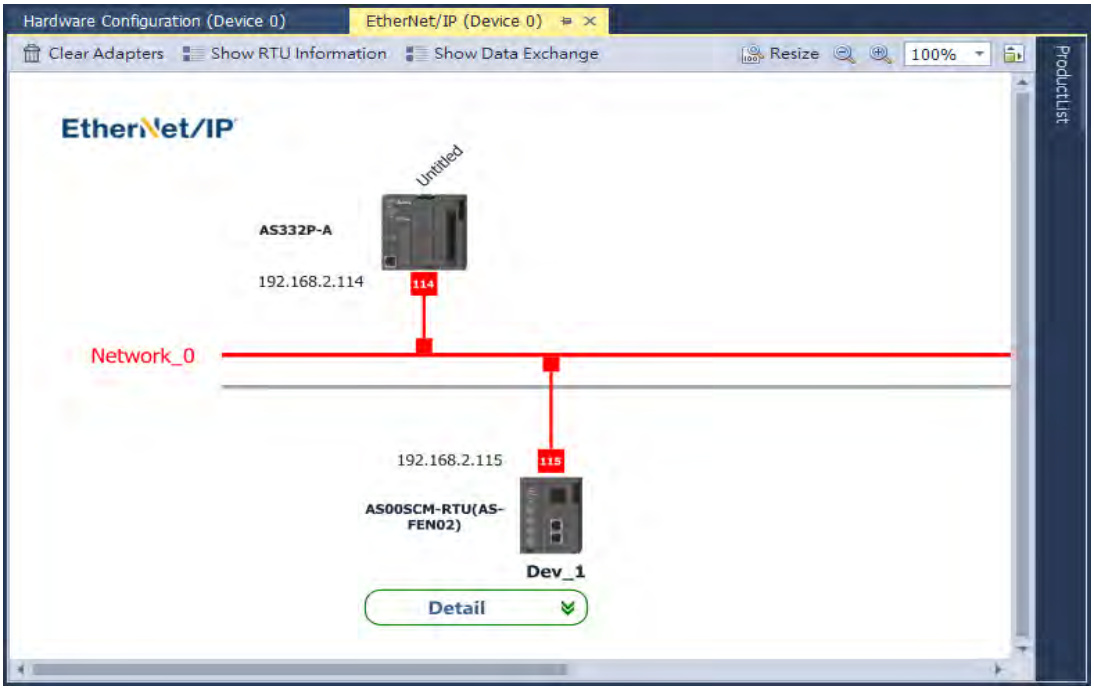




- **Method 2**

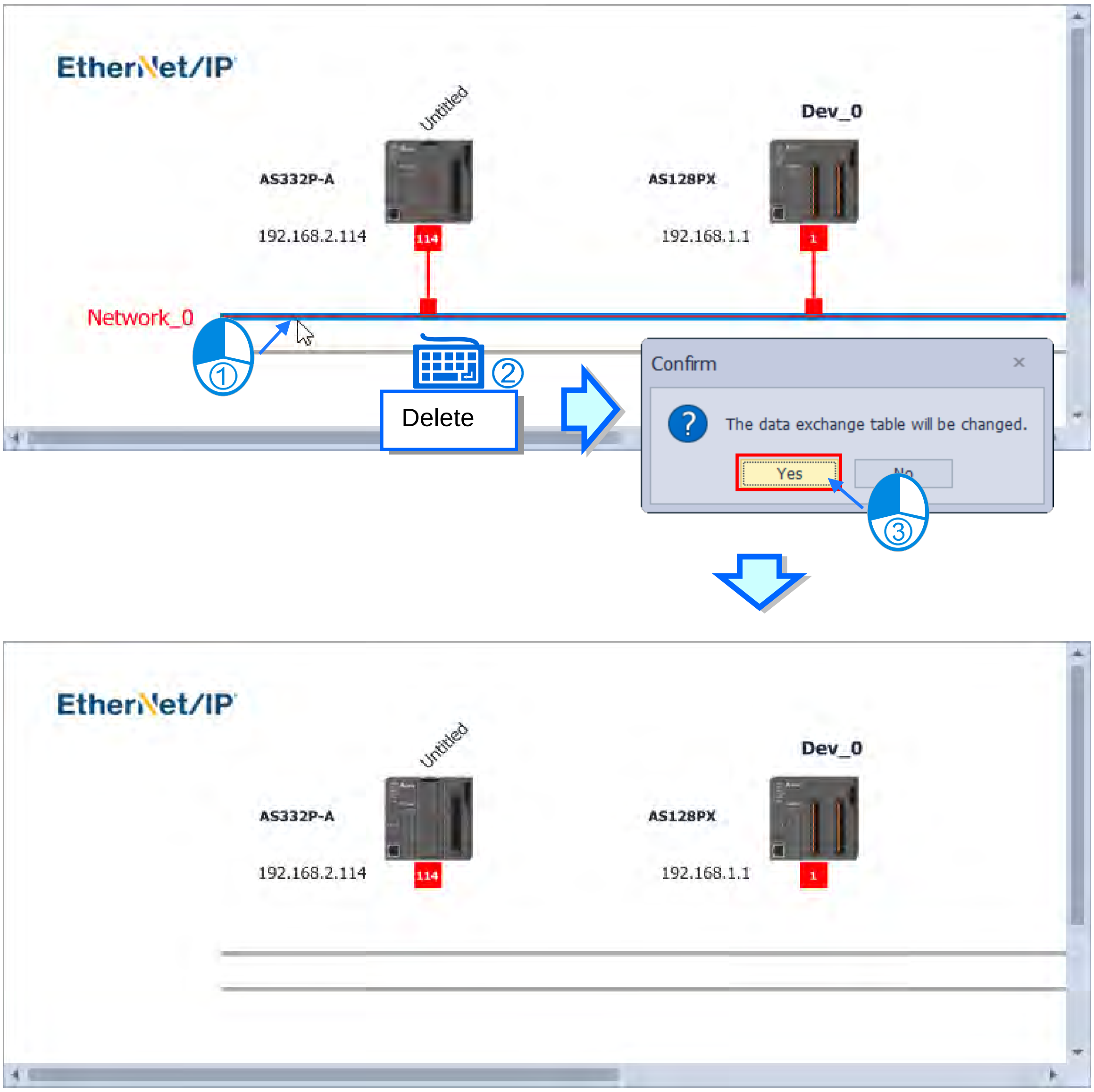
Click and hold the red box above the slave station while dragging it towards the network to connect. Then release the left mouse button to establish the connection.





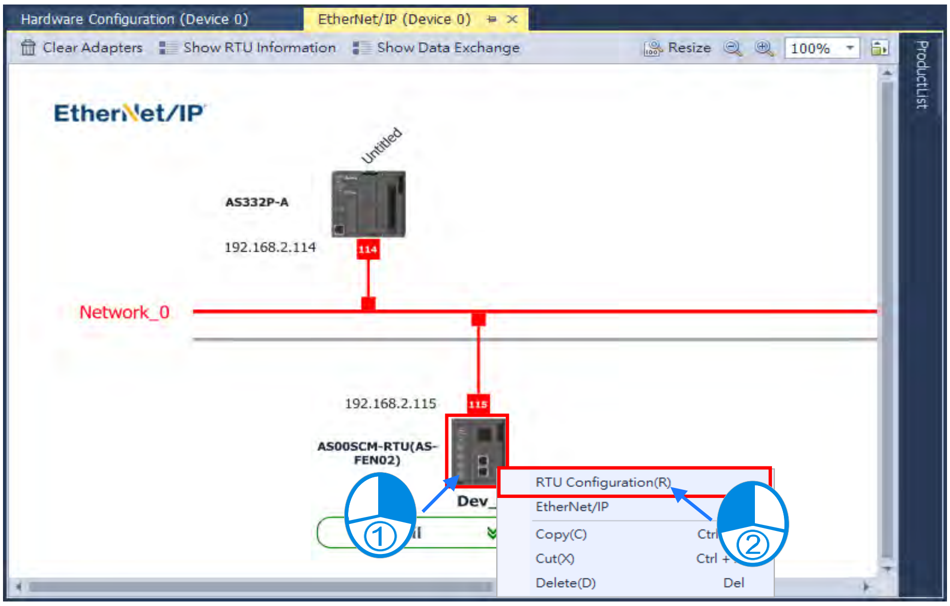
3.1.5.8 Delete Connections

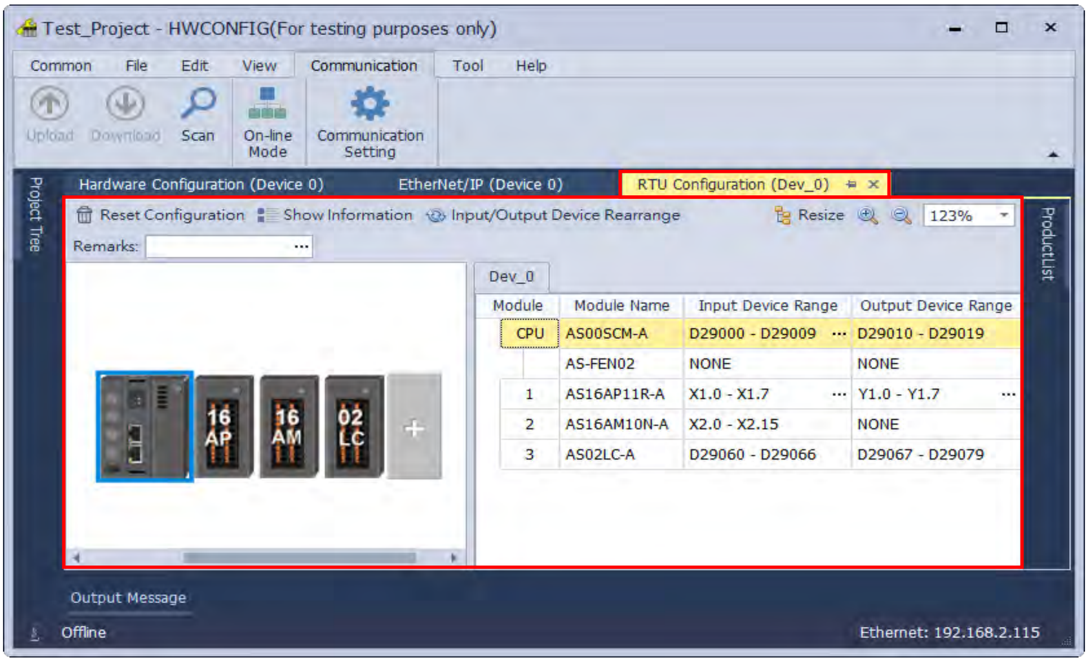
You are allowed to remove the whole network or a connection to an individual slave at a time. In case of the former, just click on the line of the target network and the line would change to blue, then press DELETE on your keyboard to delete the connection.



3.1.5.9 Configure RTU Module Setting

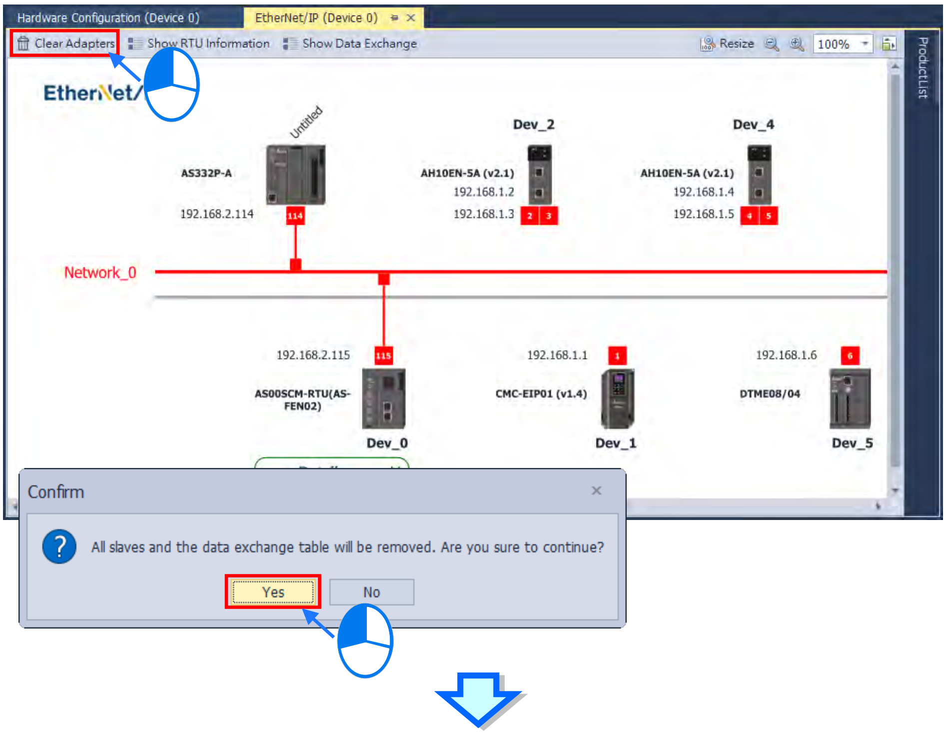
The connection to network must be established before you configure the RTU module settings. Continue to right click on the icon of RTU module, then choose “**RTU Configuration (R)**” to open the configuration page so as to add the target modules to the configuration from the product list. For more details of adding modules, please refer to chapter 3.1.3.1.

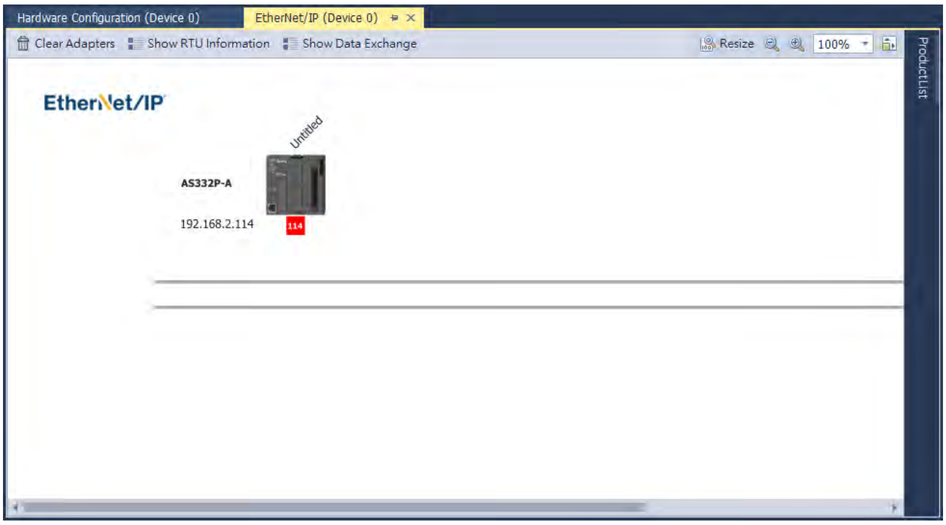




3.1.5.10 Clear All Slave Stations

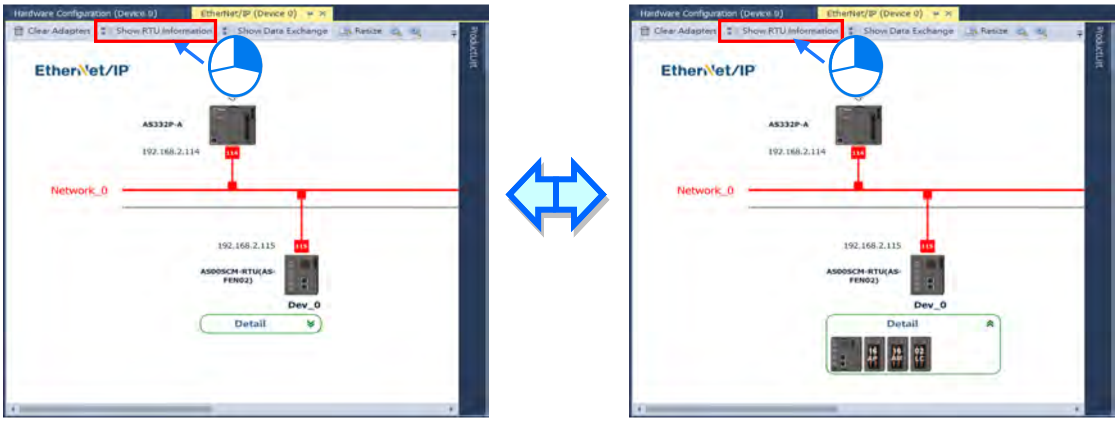
After click “**Clear Adapters**” on top of the page and “Yes” on the confirmation pop-up box, all the slaves would be removed as the following shown.





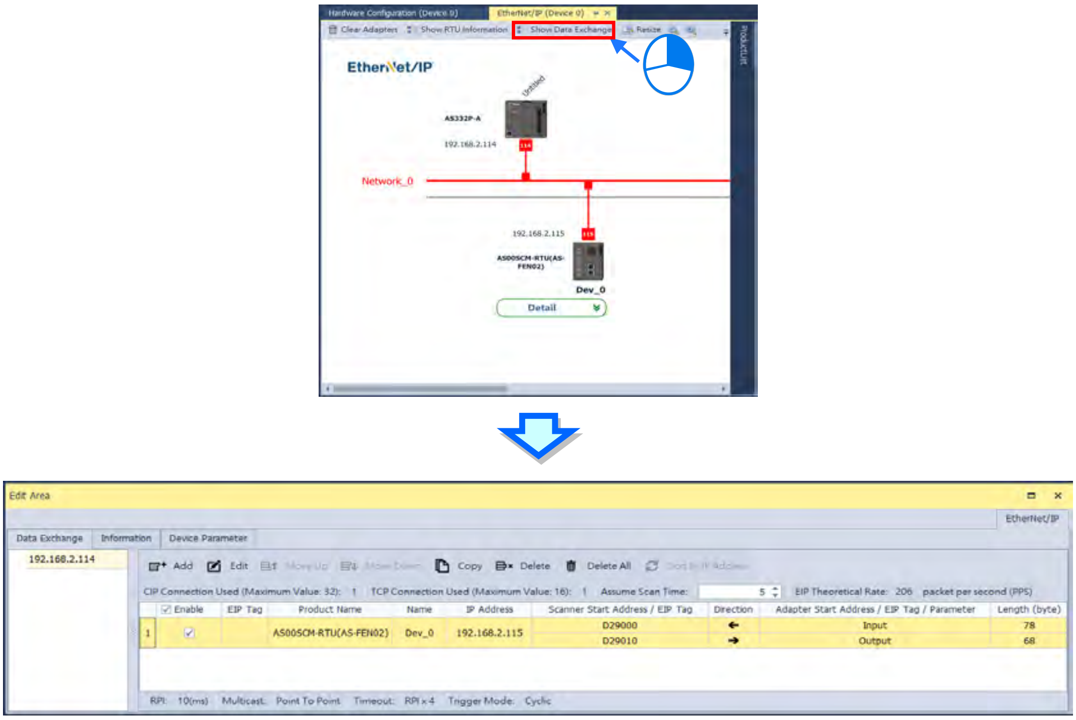
3.1.5.11 Display RTU Information

You control whether display or hide all the RTU information by clicking “**Show RTU Information**” on the top of the page.



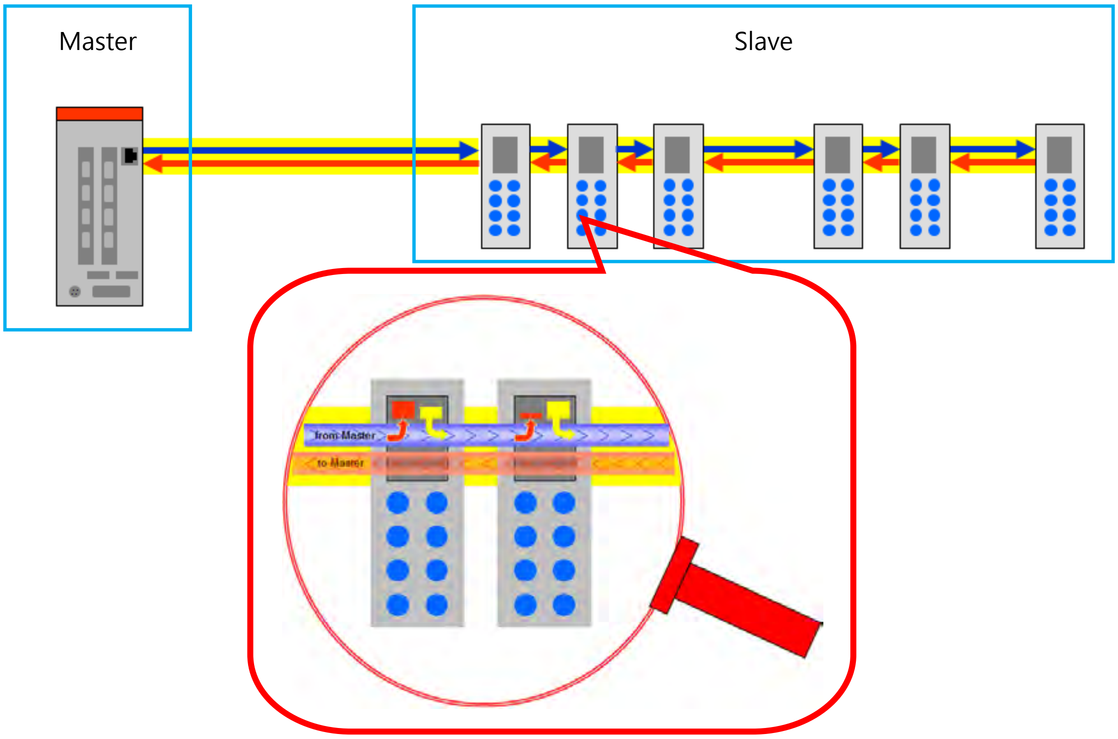
3.1.5.12 Display Data Exchange

After click “**Show Data Exchange**” on top of the page, the editing window of data exchange would be displayed as the following shown. For more details of data exchange settings, please refer to chapter 3.1.4.17.



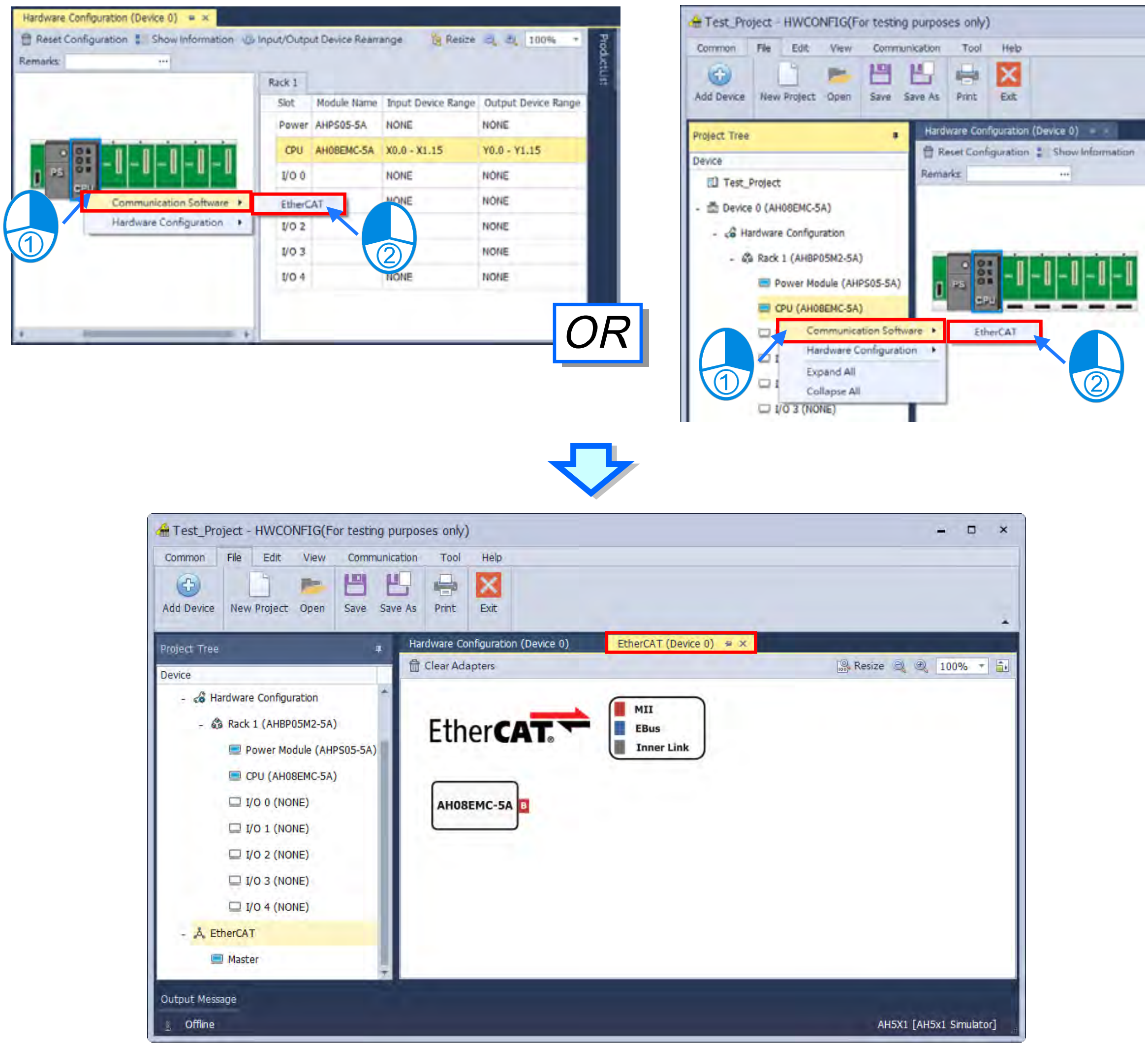
3.1.6 EtherCAT

EtherCAT is a new generation of industrial protocol, which has been widely applied in motion control applications. To perform data transmission with EtherCAT, the datagram forwarded by the master would pass through each slave station in sequence for slaves to read-write directly, then it would be forwarded back to the master eventually by the last slave station as shown.in the following figure. In addition, the received datagram would not need to be decoded, while the synchronization can also be performed between stations so as to achieve multi-axes-synchronous motion control by improving the synchronization of transmission. With CoE of application layer, PDO data exchange and all kinds of parameters as well as motion modes in CANopen are supported.



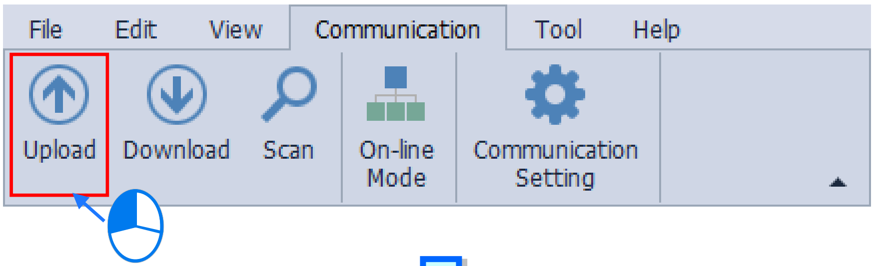
3.1.6.1 Open EtherCAT Topology

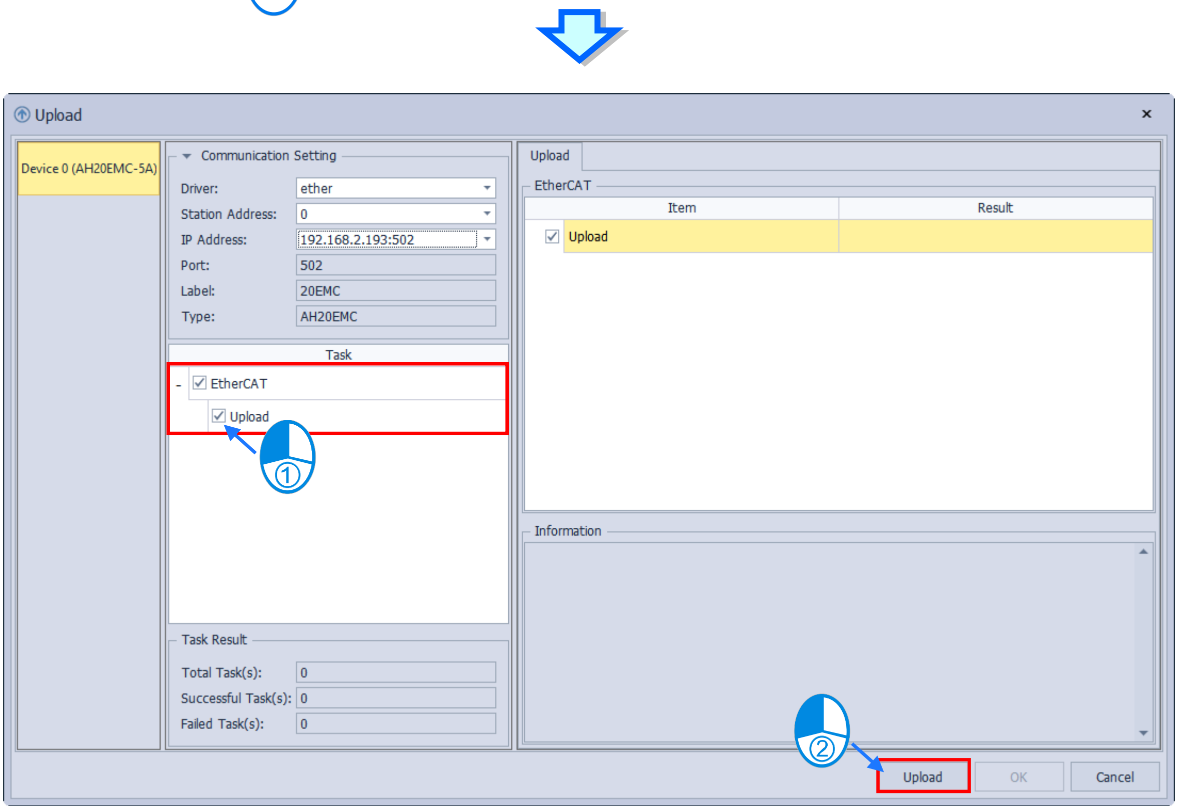
Right click the CPU on the hardware configuration page or in the project tree. And choose “**Communication Software**” then “**EtherCAT**” to open the EtherCAT network topology.



3.1.6.2 Upload EtherCAT Settings

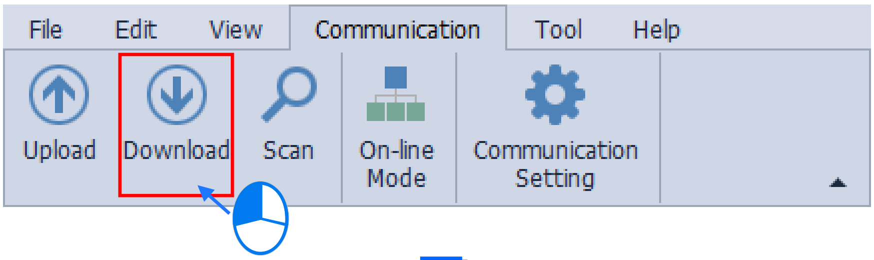
Open the EtherCAT page and click “**Upload**” from the toolbar on “**Communication**” tab, then the upload page would be displayed. A success message would pop up after clicking “**Upload**”. Then click “**OK**” on the pop-up window to update the software’s EtherCAT settings, or click “**Cancel**” to cancel the update as the following shown.

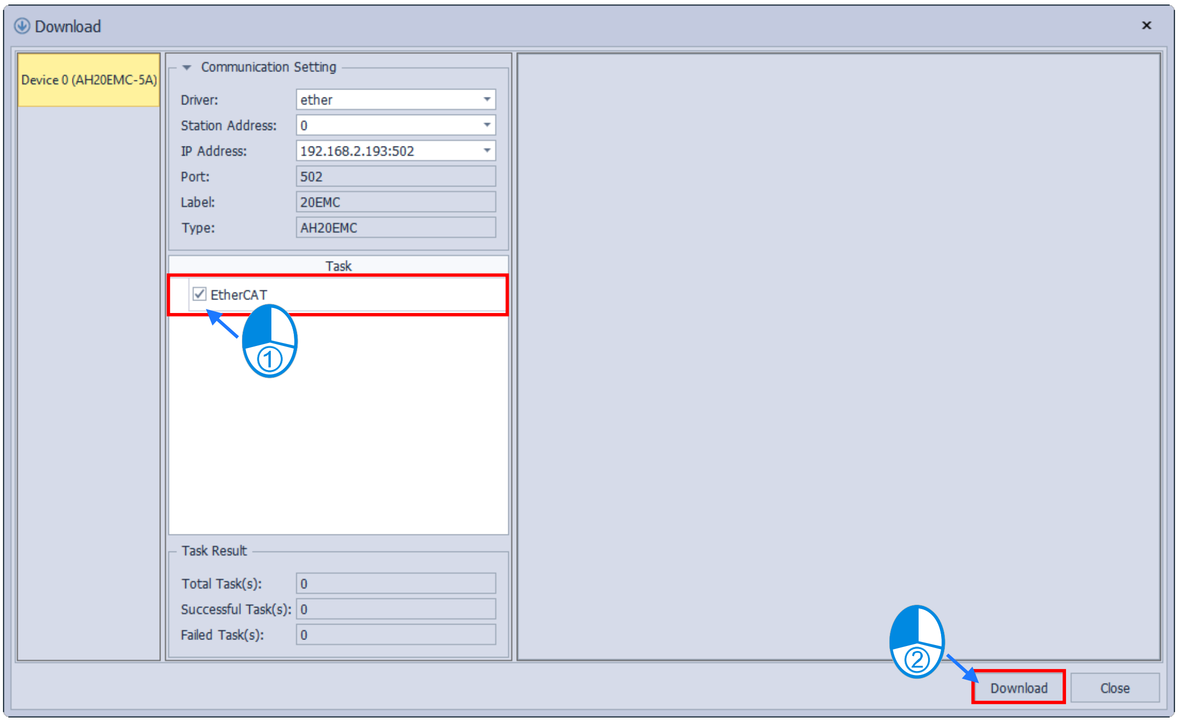




3.1.6.3 Download EtherCAT Settings

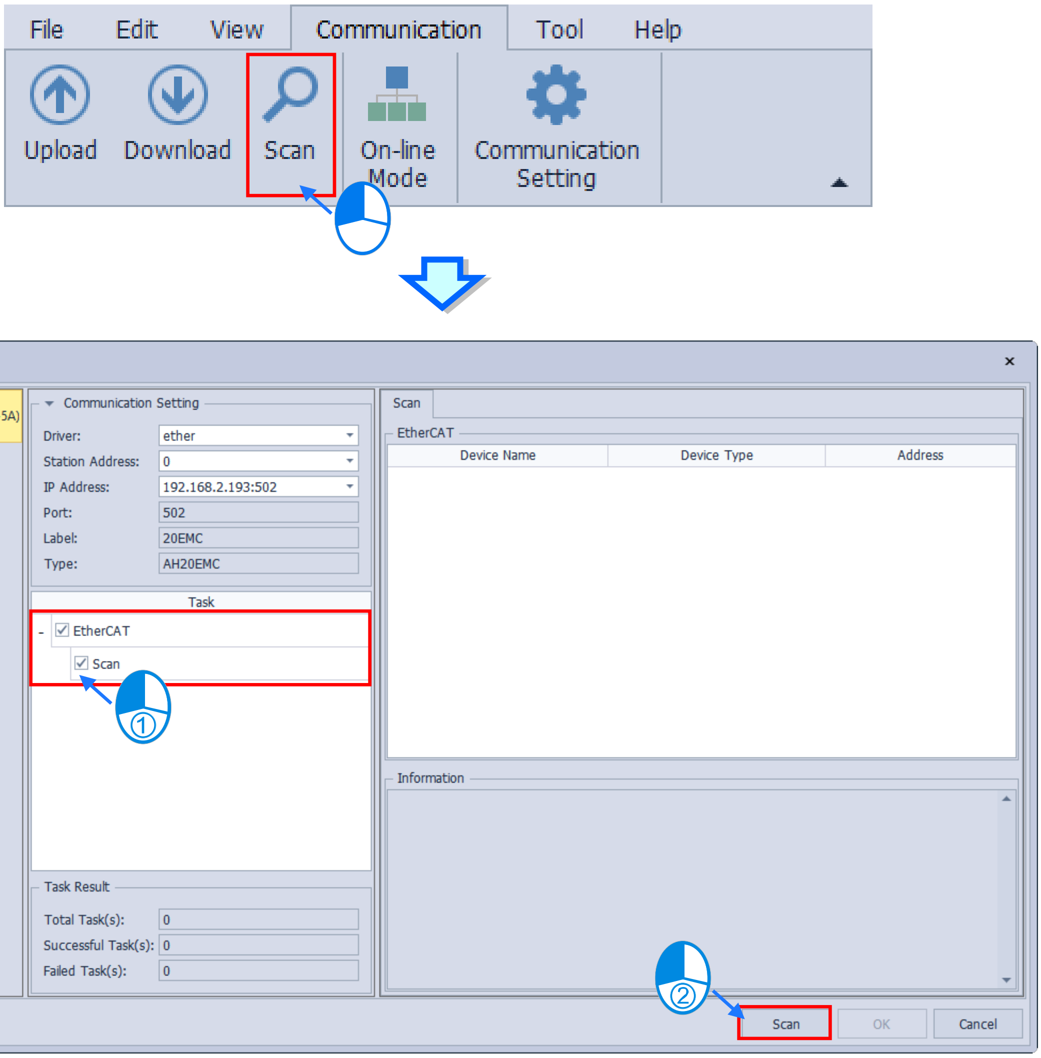
Enter the EtherCAT page and click "**Download**" from the toolbar on "**Communication**" tab, then the upload page would be displayed. Then click "**Download**" after checking items to download so as to complete the download task as the following shown.





3.1.6.4 Scan EtherCAT Slaves

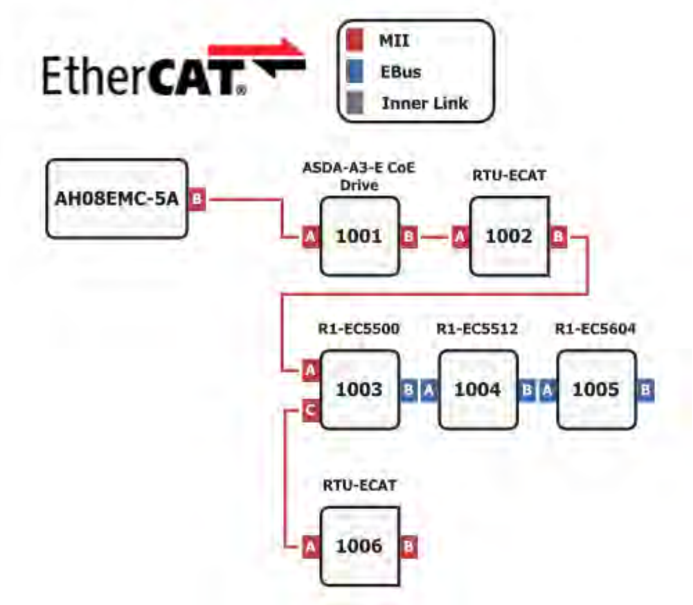
Open the EtherCAT page and click “**Scan**” from the toolbar on “**Communication**” tab, then the scan page would be displayed. After checking the checkbox of “**Scan**” in Task area and clicking “**Scan**”, slaves available for communication would be shown on the right side of the page as the following shown.



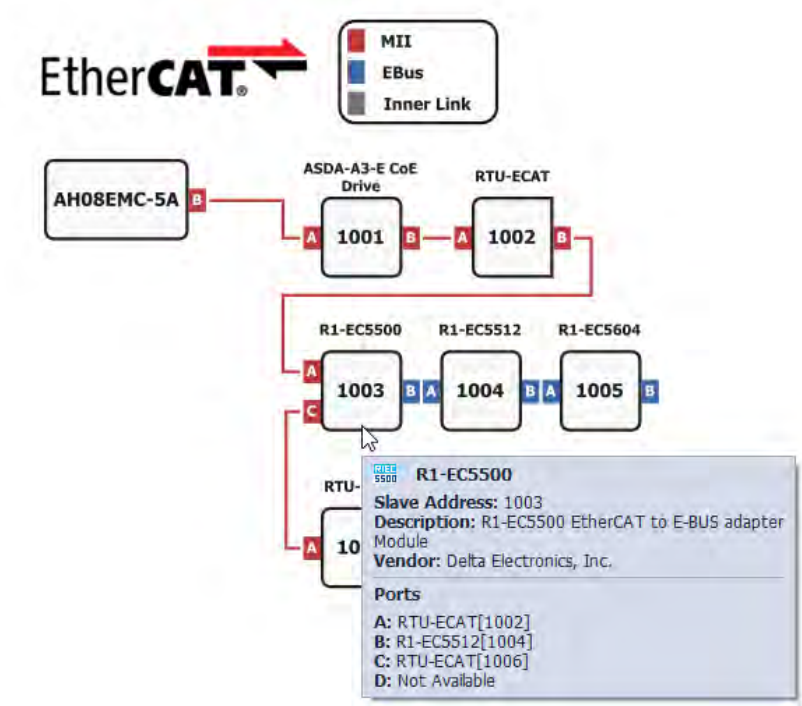
3.1.6.5 Operate with EtherCAT Topology

The illustrations of slaves would be briefly introduced before getting into the operation part.

As the following shown, interface A of masters and slaves are the input ports, while the rest would be the output ports. With a total of three communication modes MII, EBus and Inner Link, the mode applied to the input and output port must be the same, or the connection would be failed.

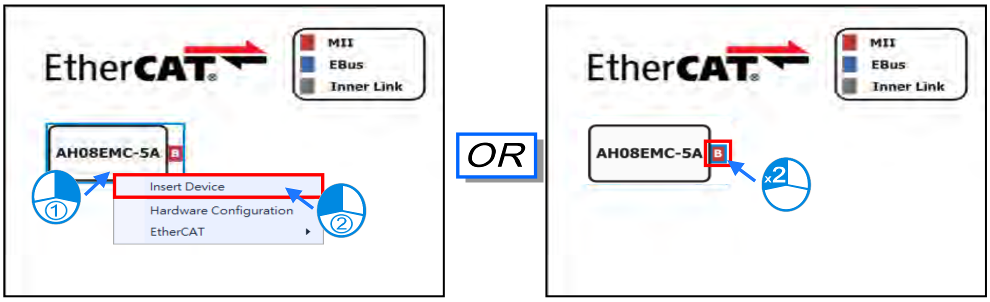


Move the cursor to the desired slave and the detailed information as well as the port connection status (up to 4 ports) would be displayed. If the display port is not working, it would be shown as Not Available.

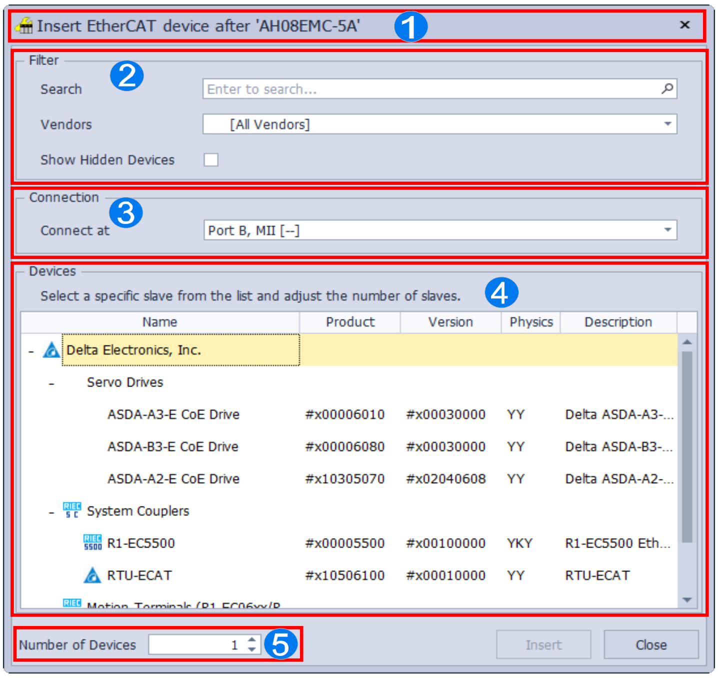


- **Add slaves**

Right click on the desired master or slave and choose “**Insert Device**” from the drop-down list. Instead, you can also double-click on the port of the desired master/ slave. Then the insert EtherCAT device window would be displayed.



Insert EtherCAT device window is shown below.



❶ **Window title:** Shows where the target slave would be added to.

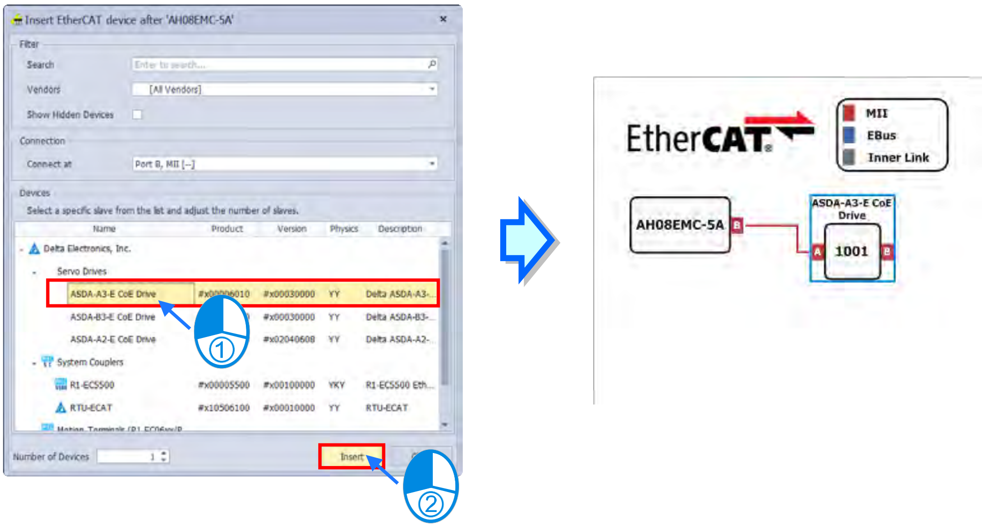
❷ **Filter:** Enables users to quickly filter more slaves, while the results would be displayed in the **Devices** area at the lower half of the window.

❸ **Connection:** Selects the desired port to connect, while the devices supported by the selected port would also be shown in the **Devices** area.

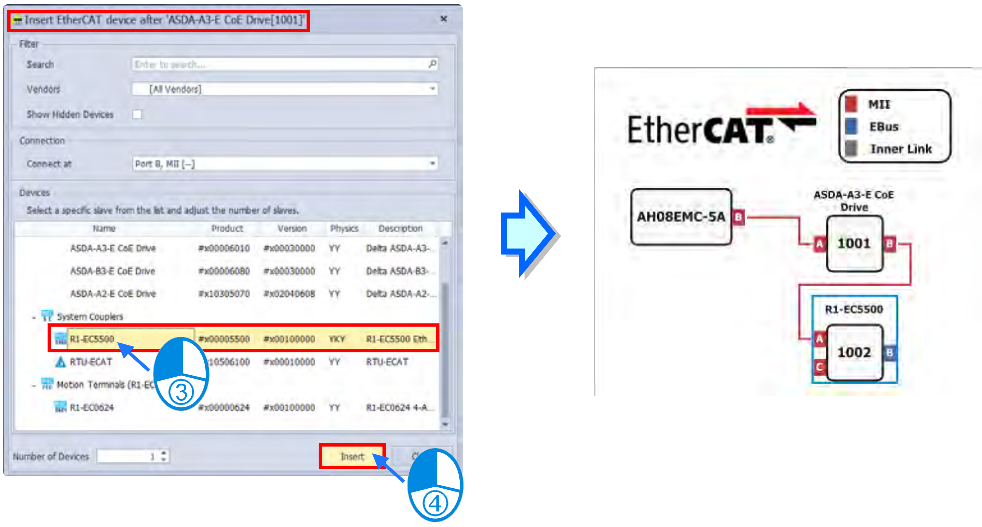
❹ **Devices:** Display the filtered slaves which are supported by the selected port.

❺ **Number of Devices:** Set the number of slave devices to add.

When the settings are completed, click “**Insert**” and the slave would be connected to the port as shown below.



If stays on the current window, you can see the location shown in the title changed to be the slave device you just added. In case that you continue to insert devices, the slave devices would be connected downstream as shown below. When finished inserting slave devices, close the insert EtherCAT device window.



- **Copy/ paste slaves**

To copy the desired slave, right click the device and choose “Copy” from the drop-down list or click the desired slave and use the shortcut key “**Ctrl+C**”. Then right click on the desired position to paste by choosing “Paste” from the drop-down list, or click to choose a slave device and use the shortcut key “**Ctrl+C**” to add the copied slave behind it.

***If the mode applied to the slave port A is not same as the previous slave output port, you would not be able to paste the copied slave device.**

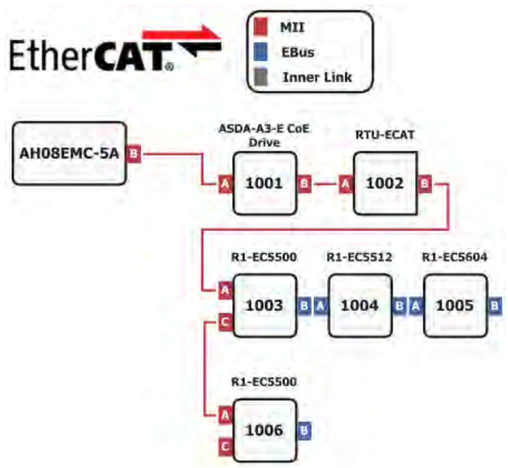
- **Delete slaves**

Right click the desired slave and choose “Delete (D)” from the drop-down list, or click the slave and simply hit the Delete key. Then all the related slaves to delete would be displayed. After confirmed by choosing “Yes (Y)”, the slave devices would be deleted.

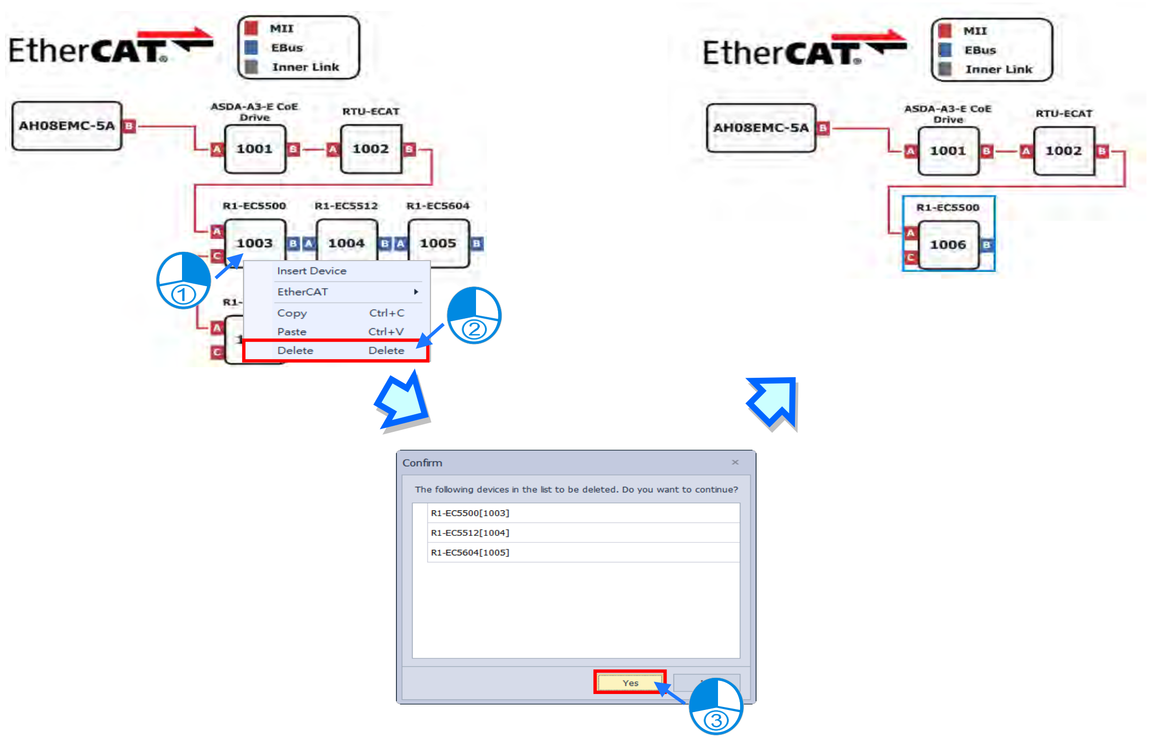
***In case that port A of the desired slave to delete and the one of the next slave operate in different modes, both slave devices would be deleted.**

***After slaves being deleted, the existing slaves would be connected sequentially.**

Take the following case as an example.



If you are removing slave 1003, slave 1002 would not be able to connect slave 1004 and 1005 as a result of different port modes. Therefore, slave 1004 and 1005 will also be deleted while removing slave 1003. And slave 1006 would be connected behind slave 1002 as shown below.

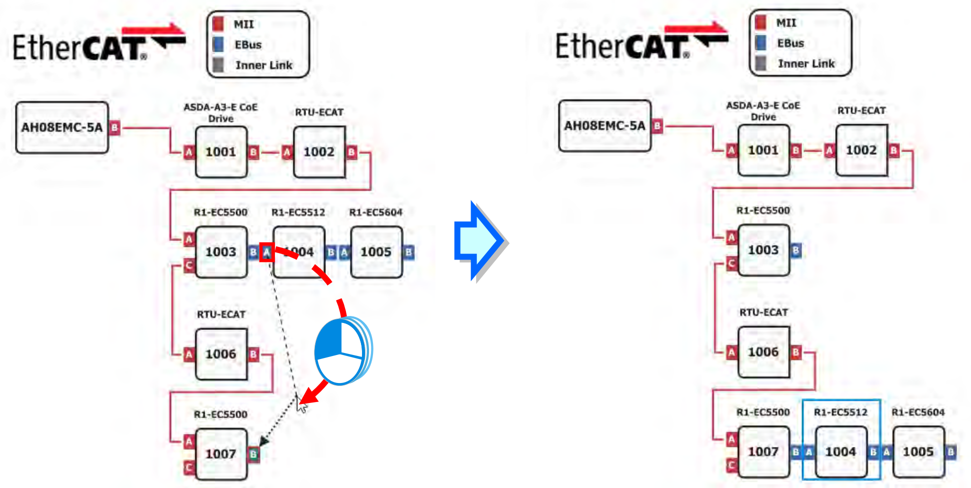


- **Delete connectors**

Right click the desired connector and choose "Delete (D)" from the drop-down list, or click it and simply hit the Delete key. Then all the related slaves to delete would be displayed. When confirmed by choosing "Yes (Y)", all the slave devices after the connector would be deleted.

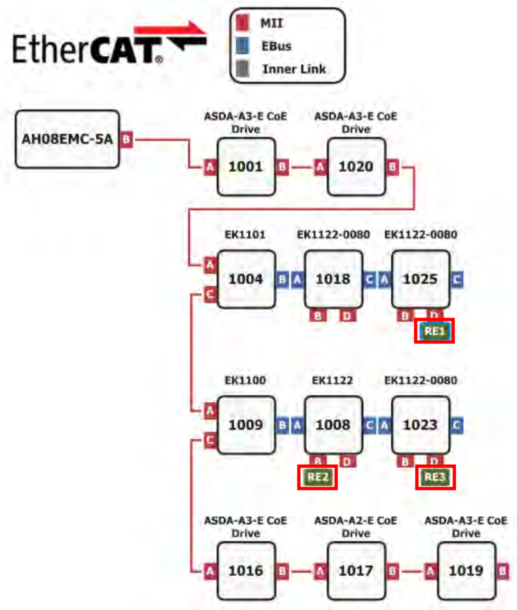
- **Move slaves**

Click on the port A of the desired slave to move and drag it to the target position. In addition, the slaves cannot be inserted between two connected devices, but only to the disconnected ports. Then release the mouse button when the drag operation is completed.

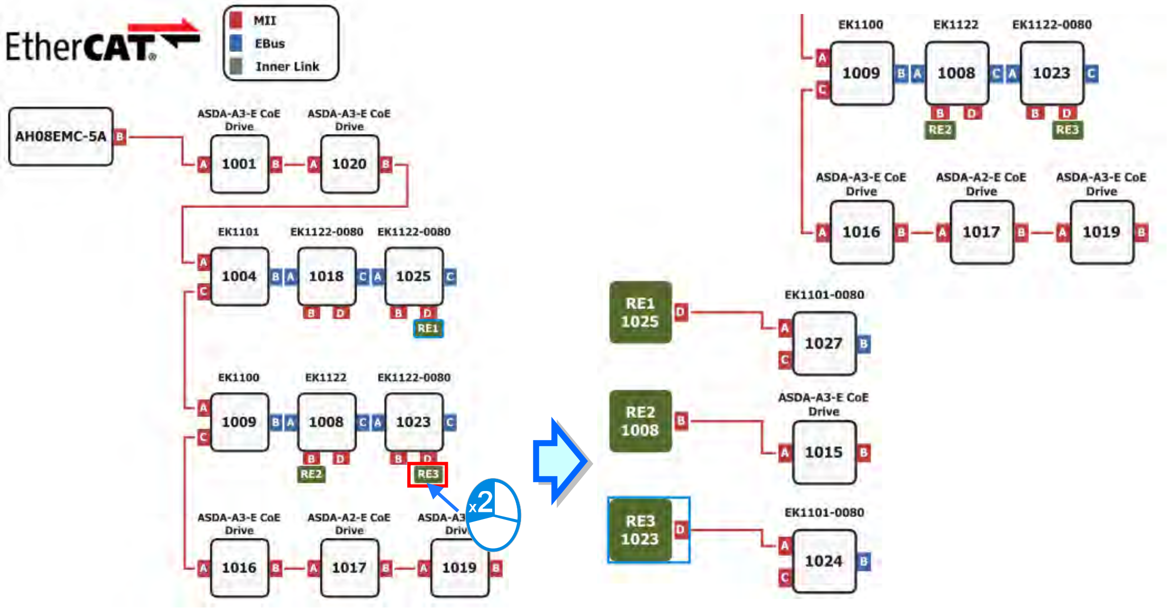


- **Quick jump**

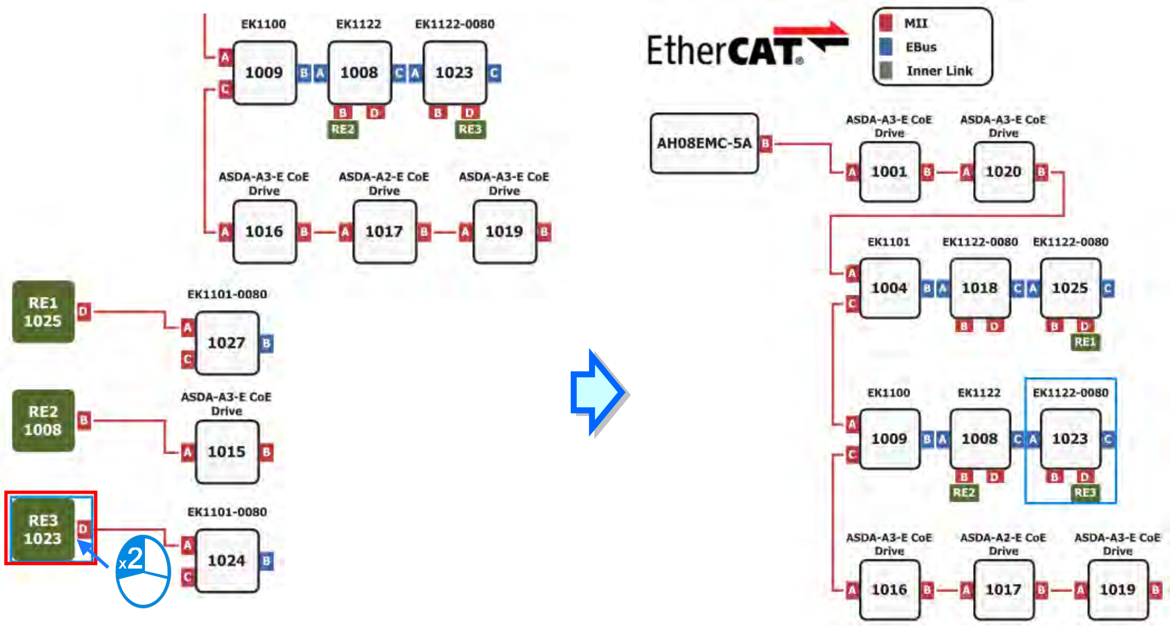
As the topology tends to be complicated, the software would automatically uses reference to assist you in editing as the following shown.



As shown below, simply double-click RE3 to quickly jump to the port D of station1023 and continue on editing.



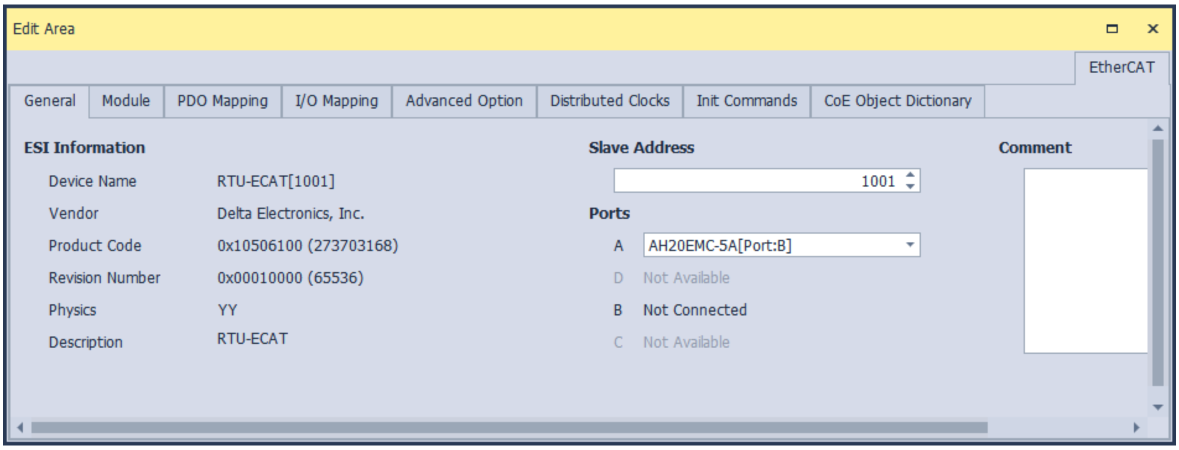
As shown below, you can double click RE3-1023 to quick jump to the slave under station1023.



3.1.6.6 Configure Slave Station Settings

Double click the slave you intend to configure, then the editing window would be displayed as shown below. The settings of slave are general, module, PDO mapping, I/O mapping, advanced option, distributed clock, Init commands and CoE object dictionary, which would be detailed in the following information. In addition, the options for settings may be different between slaves.

- **General**



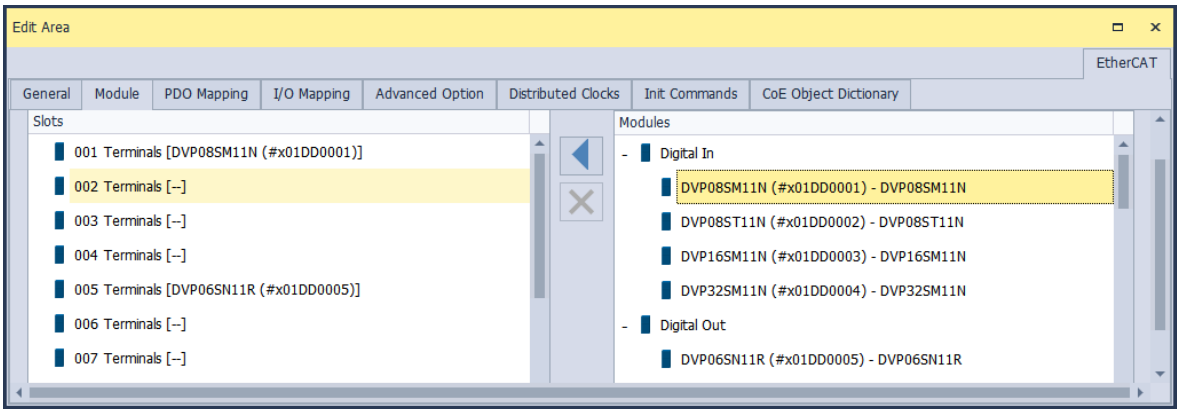
❶ **ESI information:** Device name, vendor, product code, revision number and description.

❷ **Slave address:** Set station number of slave. (Shall not duplicate)

❸ **Ports: Display the current connection status of each port.** (Port A is an input port, Port D, Port B, Port C are output ports)

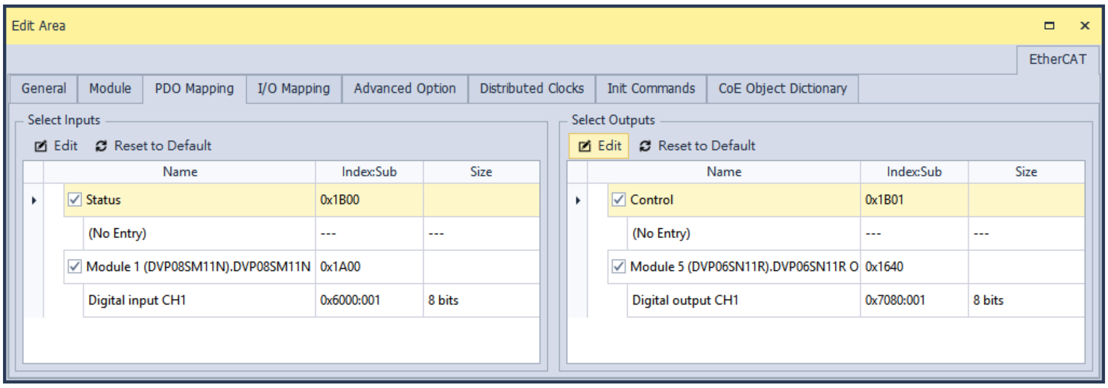
❹ **Comment:** Enter comments for slaves.

- **Module**



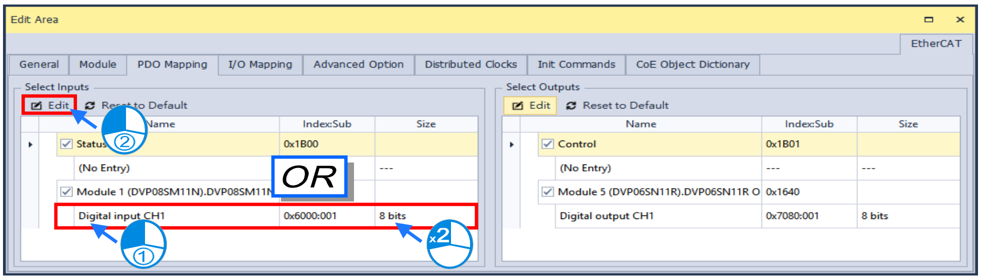
Module slots and supported modules are respectively shown on the left and right side of the window. Double click the target slot on the left or click to place the selected module into the slot, while double click on the desired module in the slot or click to remove the selected module.

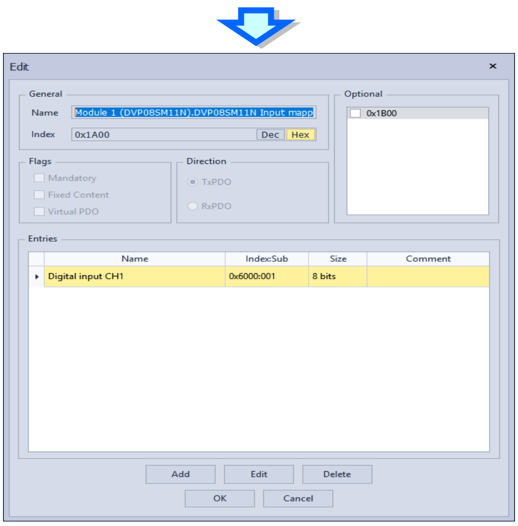
- **PDO mapping**



Periodic data exchange between the EtherCAT master and the EtherCAT slaves is performed via PDO mapping. PDOs can be reception PDOs (RxPDOs), which receive data from the EtherCAT master, or transmission PDOs (TxPDOs), which send the current value from the slaves to the master. Available PDOs for data exchange are listed in the Select Inputs and Select Outputs column, while users are allowed to modify the contents as well. In the ESI file, the default PDOs and the contents have been defined in advance with part of contents being editable.

You can check the checkboxes of the desired PDOs for data exchange directly. In case that you want to edit certain PDOs' content, click on the target PDO and click the **Edit** button, or simply double click on the PDO item. Then the edit window would be displayed. You can also click the **Reset to Default** button to reset all the settings to default.

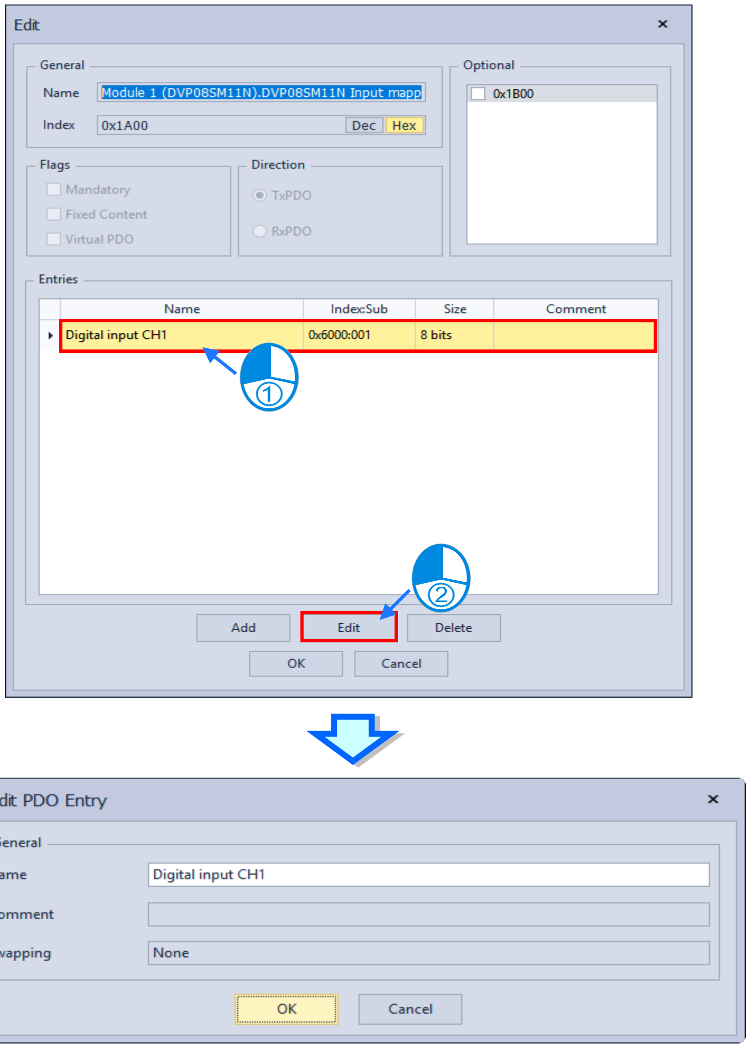




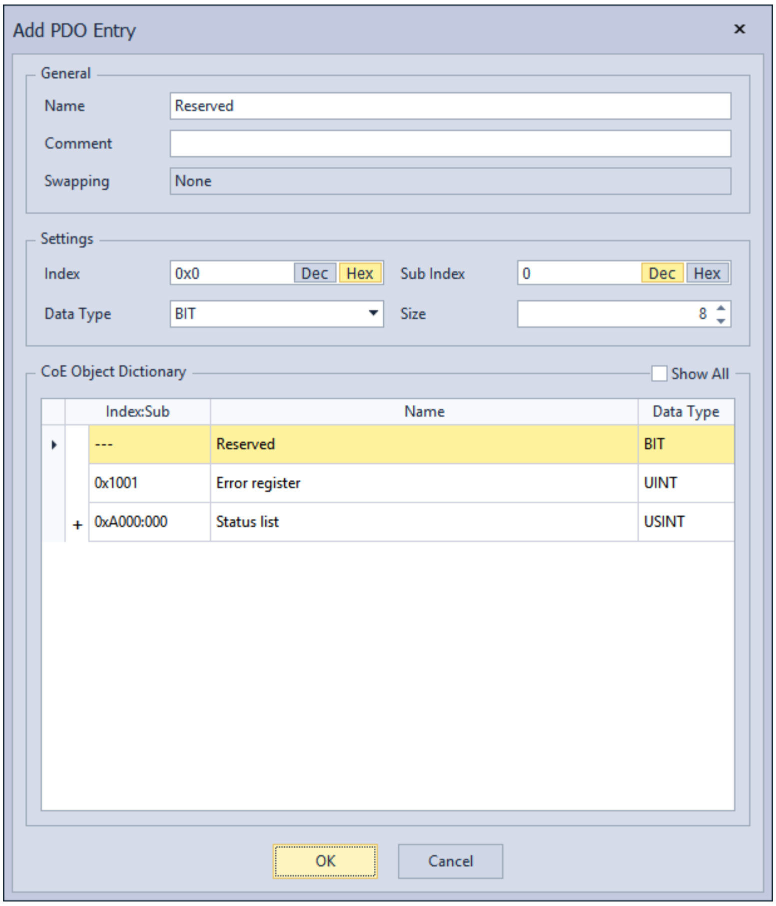
The content of PDO editing window is described as follows:

- **General:** Allows you to change the PDO's name as well as showing its index in whether decimal or hexadecimal format by switching between Dec and Hex.
- **Flags:** If selecting "Mandatory", you would not be able to delete the PDO. Select "Fixed Content" to make the content of the PDO fixed and unchangeable, while selecting "Virtual PDO" for PDOs with no contents.
- **Direction:** The PDO type, which would be either TxPDO or RxPDO.
- **Optional:** Set the PDO to be excluded by selecting its index in Optional area, which the PDO to exclude and the PDO you're editing cannot be selected on the PDO Mapping page at the same time.
- **Entries:** Shows the content in the PDO you're currently editing.

Select the desired item and click the "**Delete**" button at the bottom of the page to perform the delete action, or click the "**Edit**" button and the Edit PDO Entry window would be displayed for you to view the PDO content and modify the PDO name if required. When completed, click the "**OK**" button to finish as shown below.



If clicking the “Add” button, the Add PDO Entry window would be displayed as the following shows.

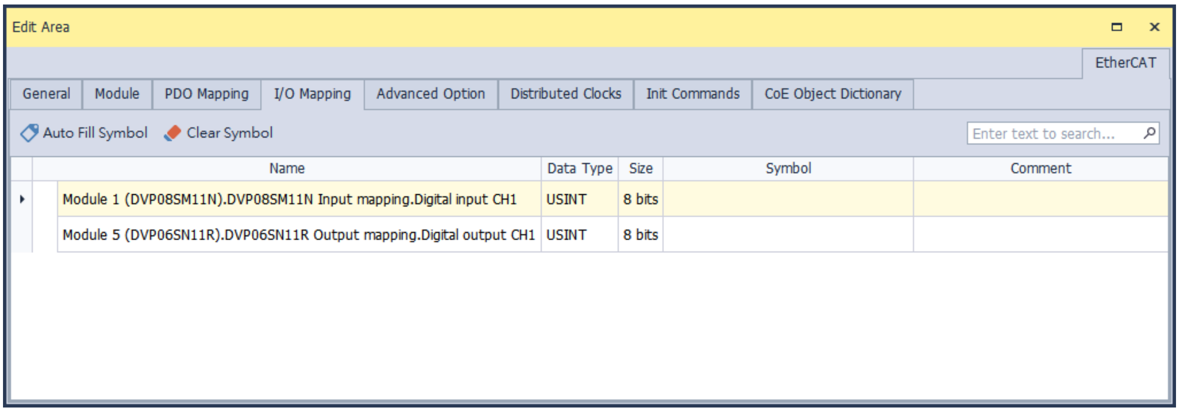


Choose the desired PDO to add from CoE Object Dictionary as well as being able to configure the settings of the PDO. The content of Add PDO Entry window is described as follows:

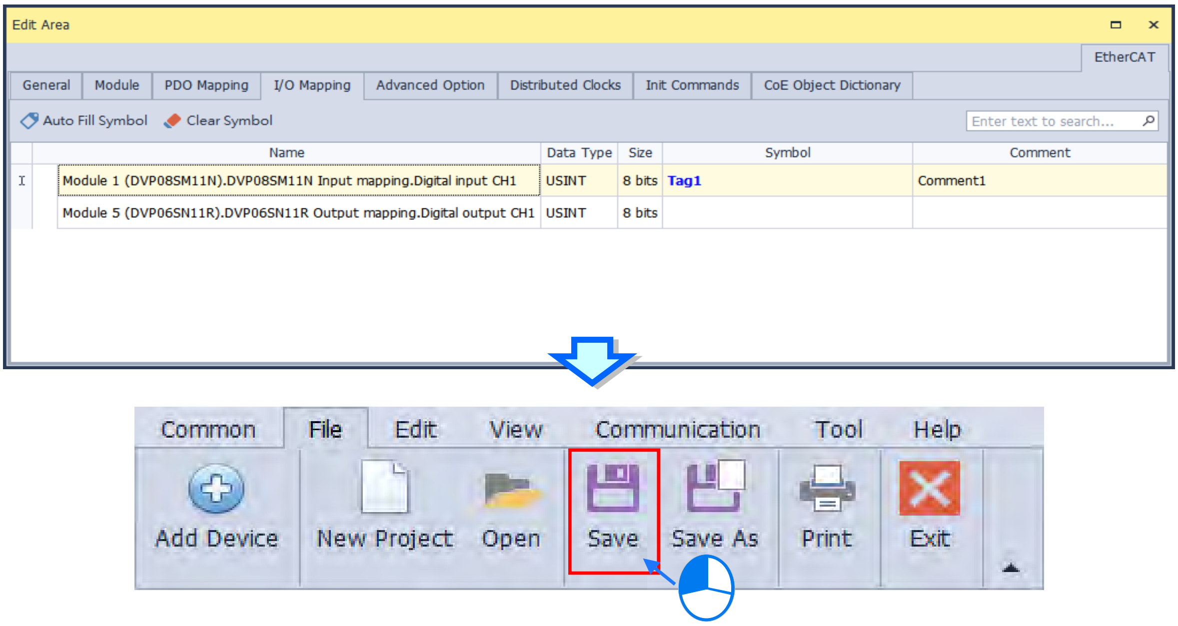
- **General:** Set the name and the comment of the PDO.
- **Settings:** Shows the information of index, sub index, data type and bit size.
- **CoE Object Dictionary:** Shows parameters in the dictionary**.**

The desired PDO would be added to the entries after clicking “**OK**” at the bottom of the window.

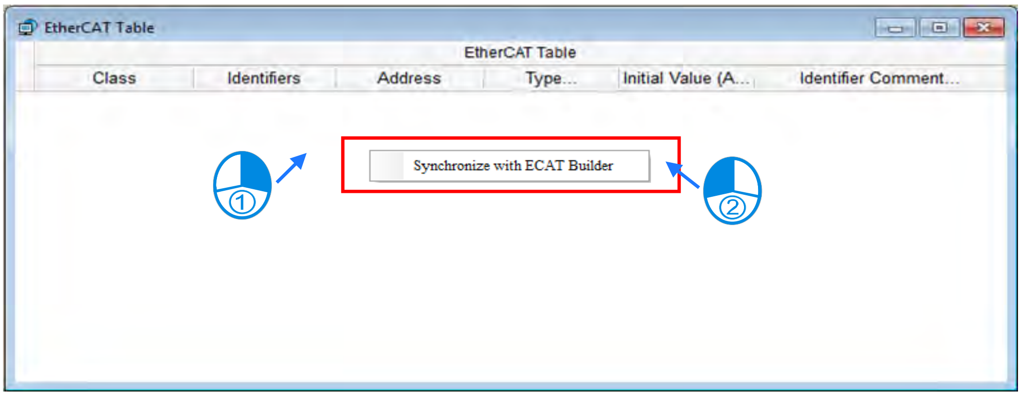
- **I/O mapping**

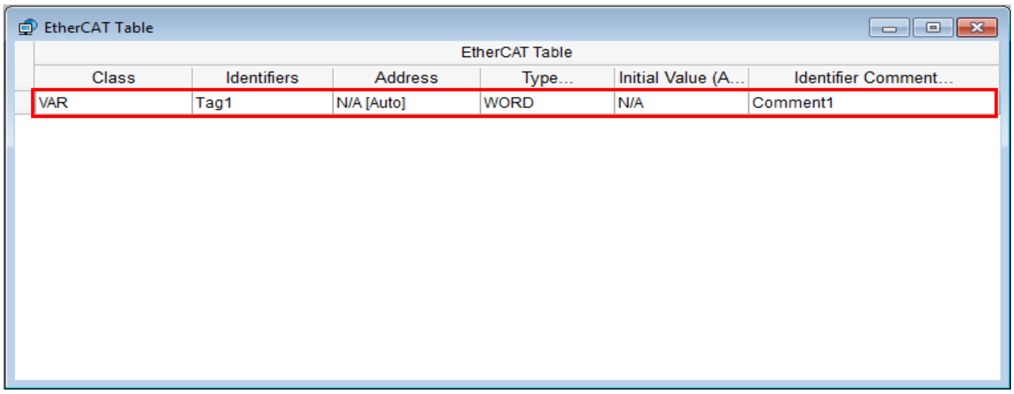


On the I/O mapping tab page, the PDO content, which has been configured on the PDO mapping page, would be listed as well as providing user-defined variables, or click **Auto Fill Symbol** to create symbols automatically by ISPSoft. Thereafter the symbolic variables defined on this page can be imported to ISPSoft so the relative EtherCAT slave parameters can be accessed in the program. Enter the symbol name and the comment in the corresponding columns of the desired variable, which the name must not start with a number and the maximum name length is 40. In addition, duplicate names and special symbols are not accepted, such as *, #, ?, \, %, @, etc. When finished, click **Save** from **File** in the tool bar so as to save the I/O mapping parameters in ISPSoft.

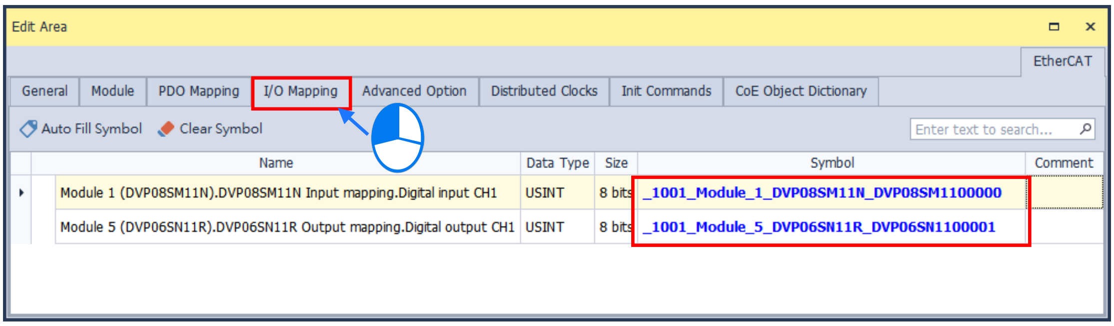


Then open “EtherCAT Table” from the project tree in ISPSoft. Right click on the EtherCAT Table window and select “**Synchronize with ECAT Builder**”, then the symbolic variables in ECAT Builder would be added to EtherCAT table. If HWCONFIG is closed, the EtherCAT table would be updated automatically. Thereafter the variables can be used by ISPSoft program.

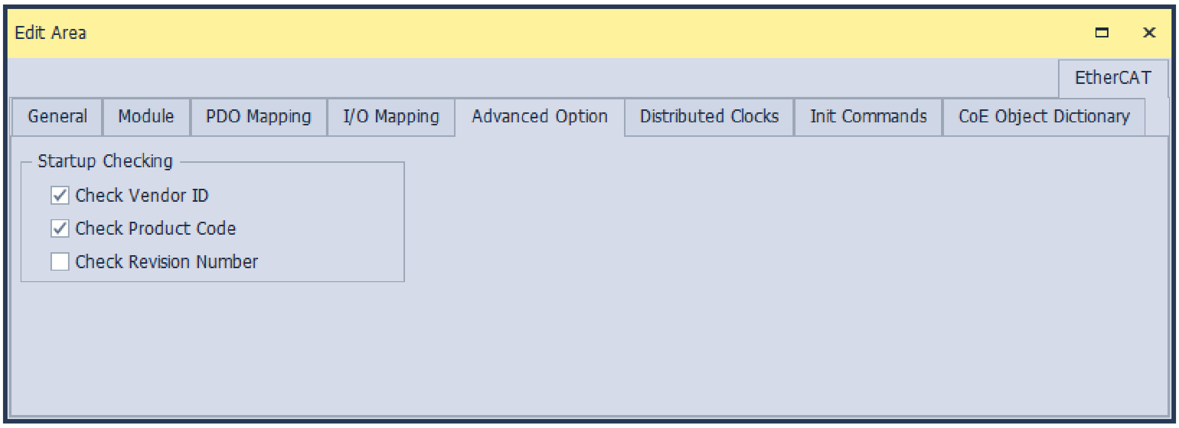




If click “**Auto Fill Symbol**” on I/O Mapping tab page, symbols will be generated automatically in the columns of the undefined symbols as shown in the following figure, which the symbol name would be the combination of station number and PDO content (The maximum name length is 40 characters. The texts that exceed the limit would be deleted automatically and the last three characters of the name would be displayed with serial numbers from 000 to 999.) If click “Clear Symbol”, all the symbols will be cleared.

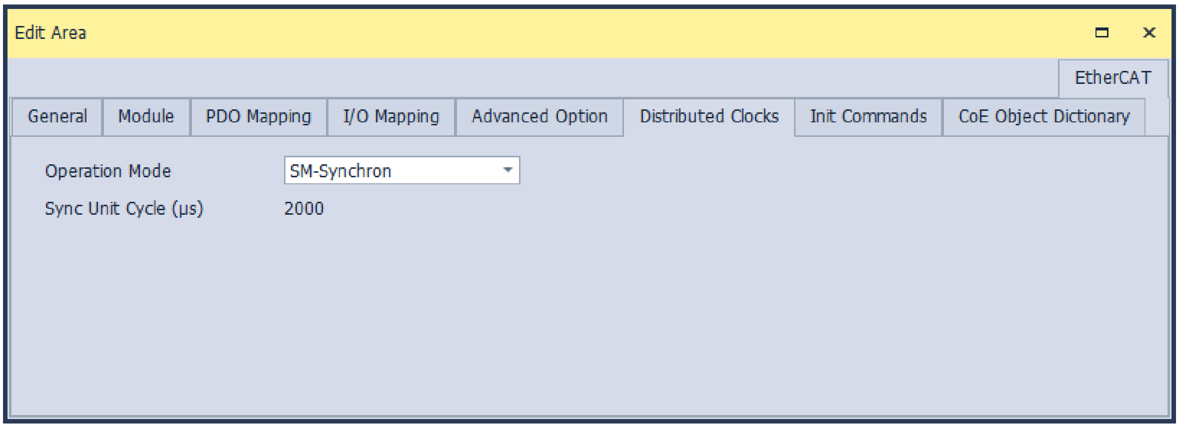


- **Advanced Option**



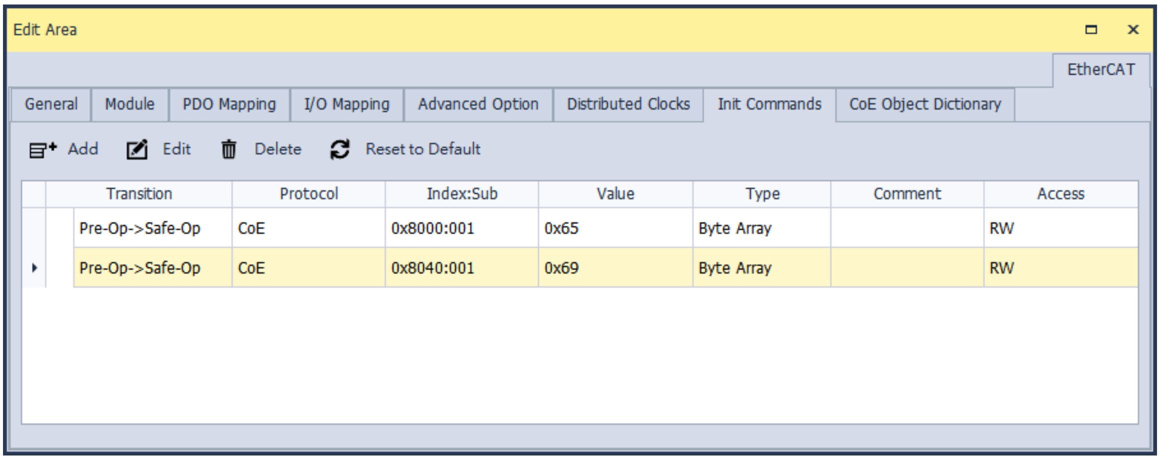
You can set the options for startup checking concerning EtherCAT slave information, which would be executed during the operation of PLC. If matches with a wrong PLC, the error would be reported and the PLC would stop runnung at the same time.

- **Distributed Clocks**



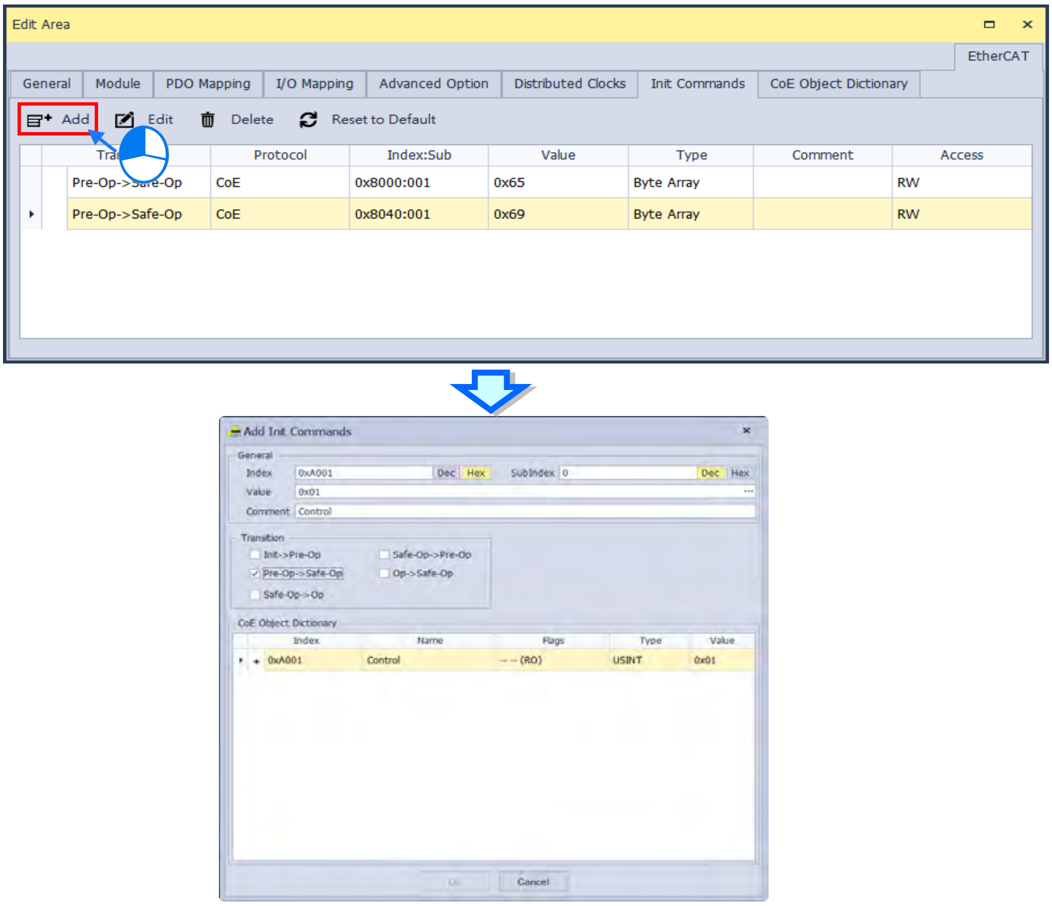
Synchronize the time in all EtherCAT devices so as to control the synchronous operation of each task between devices. With three operation modes (Free run, DC-Synchron and SM-Synchron), the options for mode setting would vary based on the sync mode supported by the slave station.

- **Init Commands**



This tab page displays the Init commands, which are predefined in the ESI file, sent by the master during specific state transition. You can add, edit or delete commands as needed.

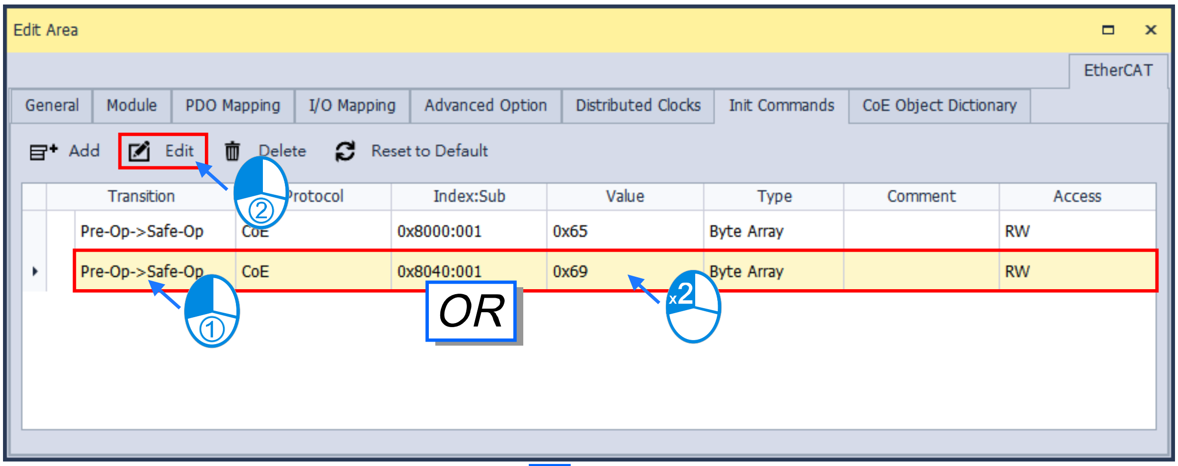
After clicking “Add”, Add Init Commands window would be displayed as shown below. Select the desired object to read-write from the CoE object dictionary and configure the parameter settings on the upper half of the page. When finished, click “OK: to add the new command to the command list, which the functions of Add Init Commands window are described as follows.

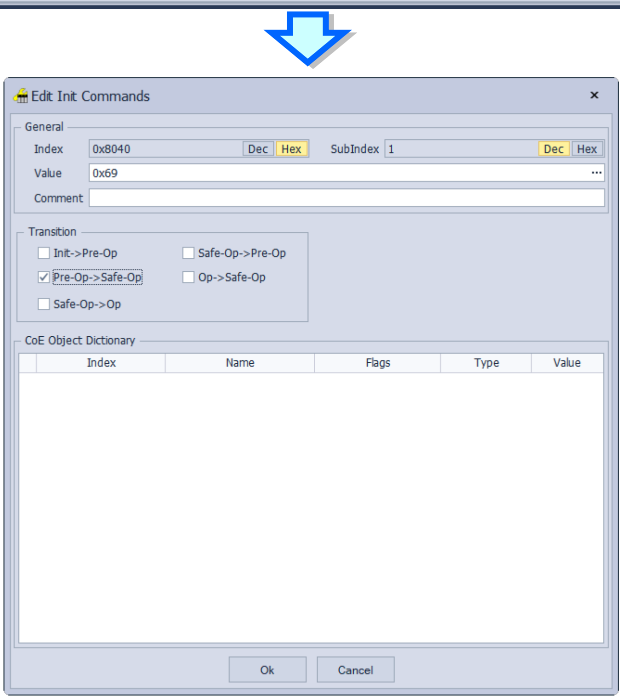


The functions of Edit Init Commands window are described as follows.

- **General:** Modify the value and the comment of the selected parameter, which the value can be shown in whether decimal or hexadecimal format.
- **Transition:** Depending upon the selected state transition, the specific command would be executed in the EtherCAT slave.
- **CoE Object Dictionary:** All the parameters in the slave station are listed.

To edit the content of a specific Init command, select the desired Init and click the "**Edit**" button, or simply double click on the desired Init to display the Edit Init Commands window. You can also click "**Cancel**" to remove the selected Init command, while all the settings would be returned to default by clicking on "**Reset to Default**".

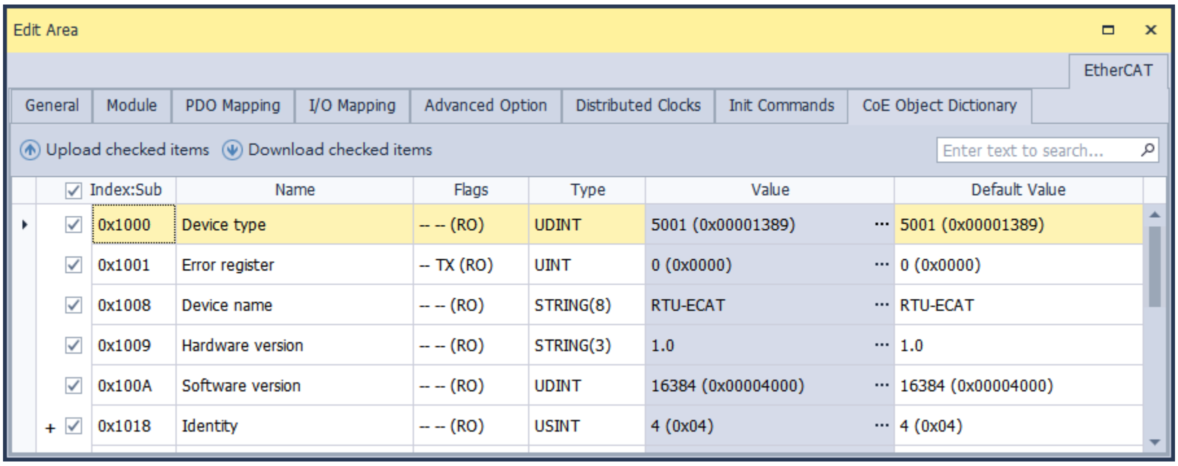




- **CoE Object Dictionary**

You are allowed to read-write values and types of slave parameters by selecting the desired CoE objects listed on this tab page. The access type of parameter is shown in the Flags column, which the values can be RO (read only) or RW (read-write). To update the data, please click “Upload checked items” at the top of the list. If you want to write parameters to the slave, click on “Download checked items”.

Before using this feature, you must ensure the same EtherCAT setting is set to the ISPSoft software and the PLC.



3.1.6.7 Configure Master Station Settings

Double click the master you intend to configure, then the editing window would be displayed as shown below.

- **General**

Provides information about the master station on this tab page.

❶ **Name:** Display the default name, which is fixed.

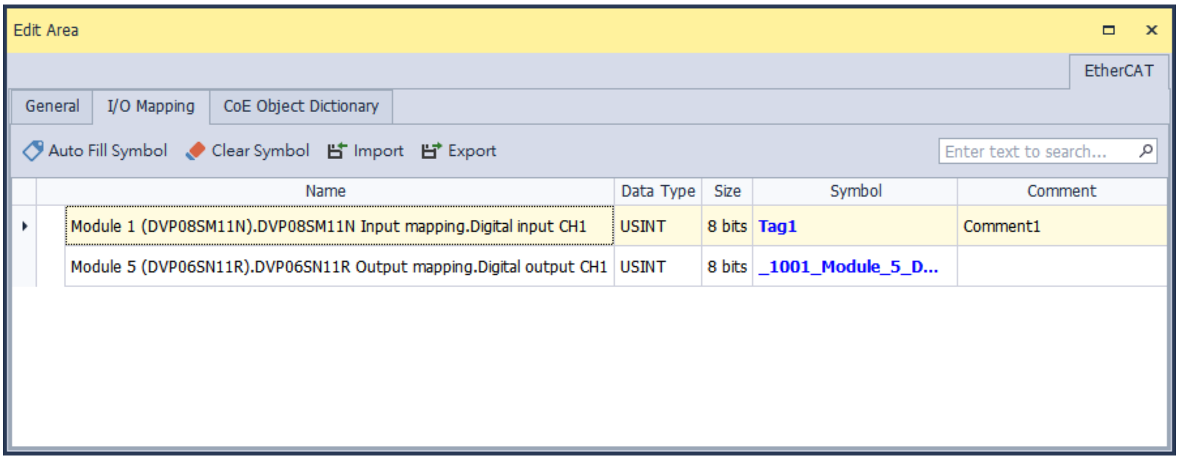
❷ **Cycle Time (ms):** Define the time base period for master to send the data exchange command.

❸ **Model Name:** Model number of the master station.

❹ **Disable all Slaves:** Disable all EtherCAT features.

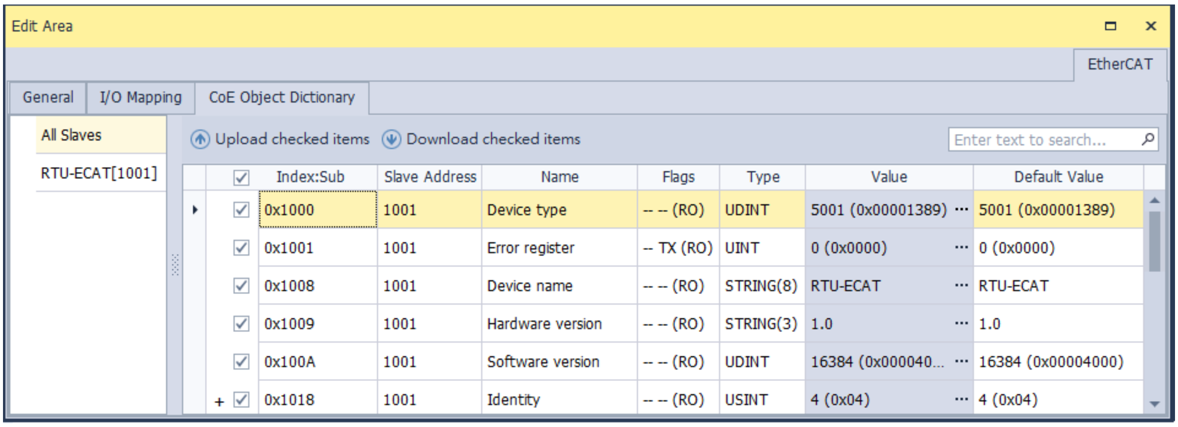
❺ **Comment:** Configure comments for master station.

- **I/O Mapping**



Lists all the I/O information of individual slaves on this tab page as references for the details concerning exchanged data and variable symbols. You are allowed to edit the symbol's name or comment on this page as well as importing and exporting symbols.

- **CoE Object Dictionary**



All the parameters in the slave station are listed on this tab page, as the description of CoE object dictionary in chapter 3.1.6.6, while the slave station ID listed in the Slave Address column is the source of each parameter. Click on "Upload checked items" and all the values of selected slave parameters would be read and displayed in the Value column. If click on "Download checked items" after finished editing values in Value column, the modified values would be written to the parameter. The downloaded parameter values would also be saved with the project. And when the project is opened once again, you can click on "Upload checked items" to download all the parameter values on CoE object dictionary page to corresponding devices.

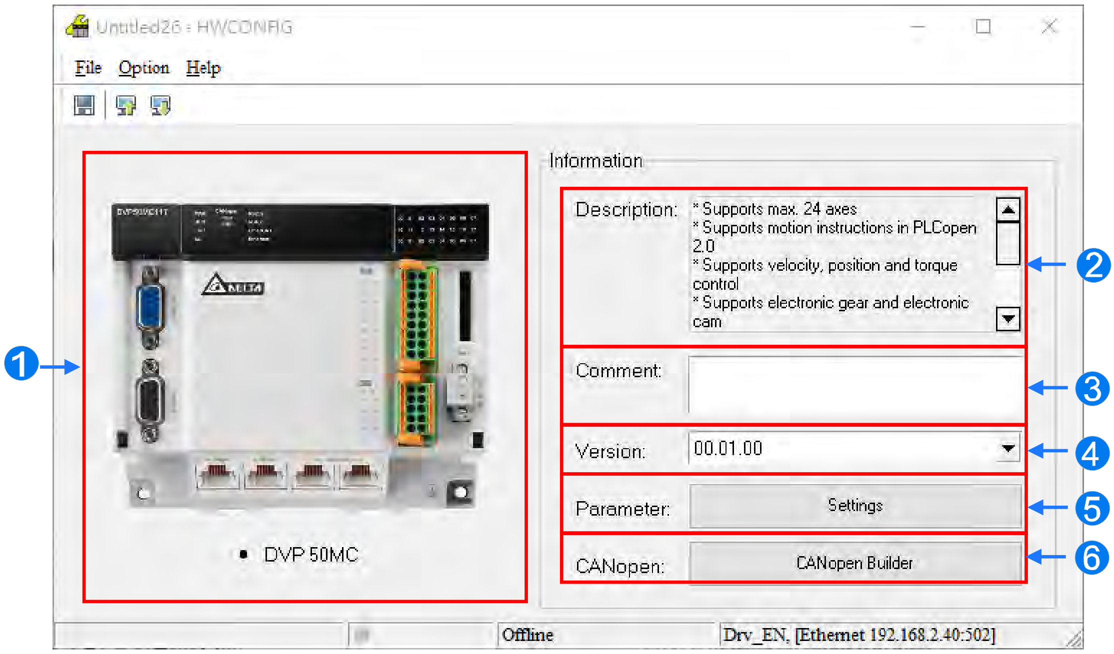
3.2 Hardware Configuration Tool – HWCONFIG 3.0

HWCONFIG is one of the tools in ISPSoft for hardware configuration. Its functions include configuration of module racks, parameter settings for modules, download/upload hardware parameters and simple on-line detection and diagnosis function. This section will introduce the functions mentioned above and point out some model types and its unique functions.

Attention! When parameter settings regarding hardware configuration are complete, the settings are effective once downloaded into PLC CPUs.

3.2.1 HWCONFIG Environment

When using DVPxxMC series, a HWCONFIG window is shown below.



❶ PLC CPU image.

❷ **Description:** Describes the PLC CPU functions.

❸ **Comment:** Comments concerning the PLC CPU.

❹ **Version:** DDF version.

❺ **Parameter:** Click **Settings** to enter PLC Parameter Settings

❻ **CANopen:** Click **CANopen Builder** to open the software.

3.2.2 Managing the Version of a Module

The functions of a module or the parameters in the module vary with the versions of the module. In HWCONFIG, the functions of the modules and the parameters in the modules are defined in a document called MDS. When ISPSoft is installed, the latest MDS document will be also installed.

An MDS document provides the information about the firmware versions of the modules. If users want to configure modules in HWCONFIG, they can select a suitable configuration according to the firmware versions of the actual modules. Besides, the parameters which can be set in the modules vary with the firmware versions of the modules which are set. If the firmware version of a module set in HWCONFIG is older than the firmware version of the actual module, the module will operate normally after the parameters are downloaded. If the firmware version of a module set in HWCONFIG is newer than the firmware version of the actual module, the module will not operate normally after the parameters are downloaded. Please refer to the descriptions in the table below for more information.

Difference	Compatibility
The firmware version set is older than the actual firmware version.	The module operates normally. Functions or parameters not defined in HWCONFIG are assigned with the default values.
The firmware version set is newer than the actual firmware version.	The module cannot operate, and is in an erroneous condition. Users have to select a firmware version which is the same as the firmware version of the actual module in HWCONFIG, check the parameters, and download the parameters again.

***. The compatibility mechanism described above only applies to modules whose firmware version is 1.0 or above. A firmware version below 1.0 is not compatible with firmware version 1.0 or above.**

***. The equipment description file can be in DDF or MDS format based on different models.**

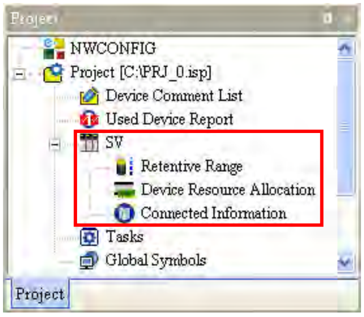
3.3 Parameter Setting for DVP Series PLC

***. The old DVP series do not support HWCONFIG; however, the new DVP-ES3 supports HWCONFIG. Regarding parameter setting for DVP-ES3, please refer to section 3.5.4.**

3.3.1 System Management Tools for DVP Series PLC

In the project for DVP series, users can find system management tools under the category of the PLC hosts name where some of the functions need to connect with the host for operation. The functions are described in the following:

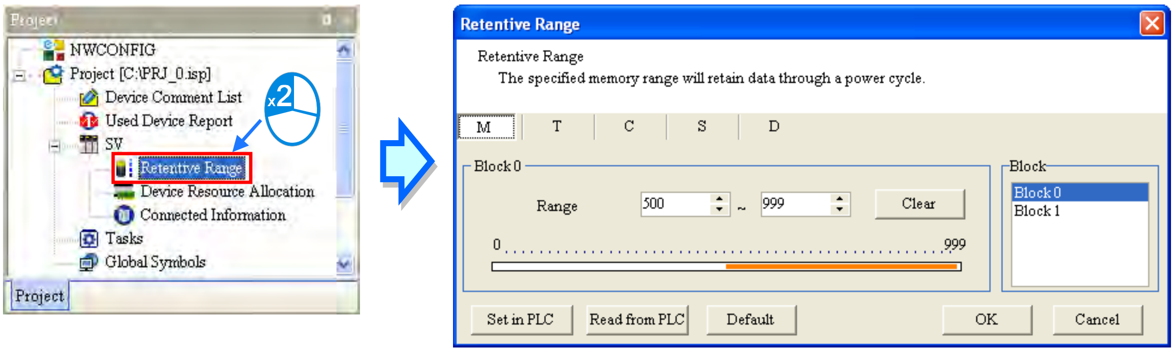
- **Retentive Range**: Set the PLC retentive device range.
- **Device Resource Allocation**: Set the device range for auto-configuring symbolic variables.
- **Connected Information**: View the current PLC host system setting and parameters.



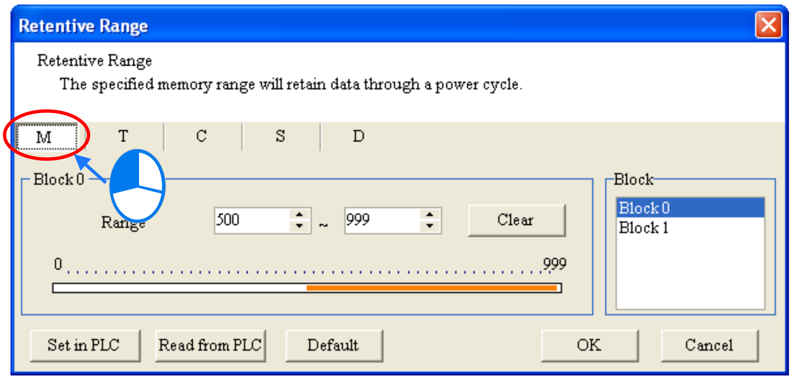
Apart from **Device Resource Allocation** function to be introduced in section 6.2.11, the **Retentive Range** and **Connected Information** function will be explained in the following sections.

3.3.2 Retentive Range

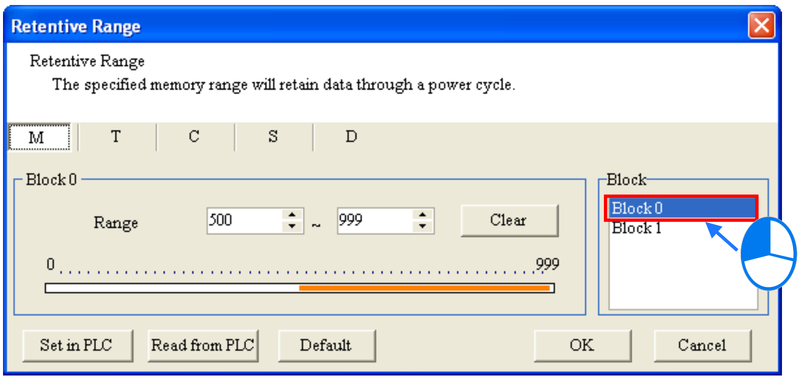
(1) Double-click the **Retentive Range** and its setting window will appear.



(2) Click on a desired device type for setup.

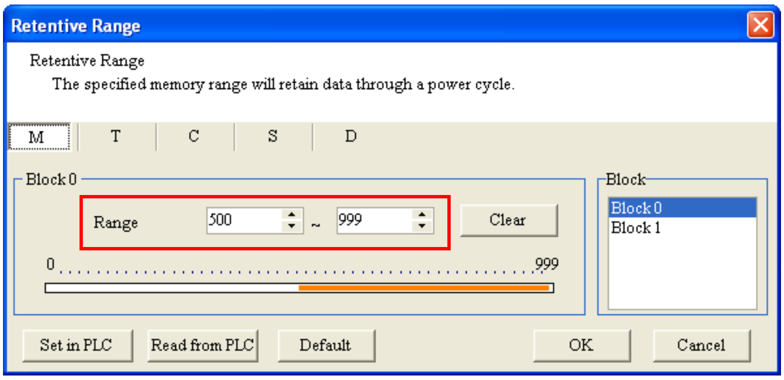


(3) Since the range for PLC retentive block may be discontinuous, therefore, please first select the desired setting section.

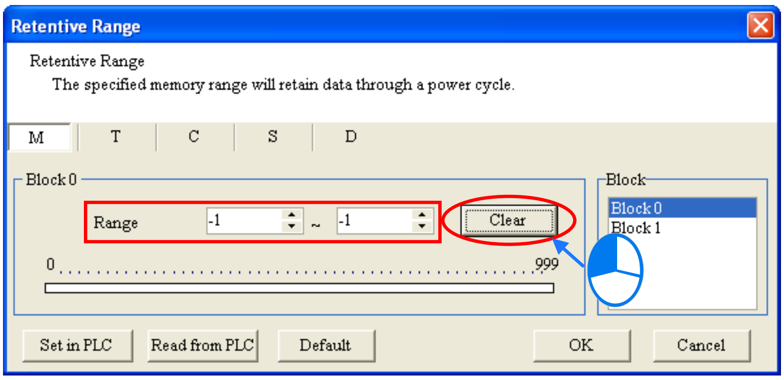


(4) Users will see a strip graph in the block section, with two values on both ends representing the setting range limit. The orange color in the strip graph refers to the existed retentive range; however, when the Block 0 section shows grey content, this means the current section cannot setup retentive range for the selected PLC model.

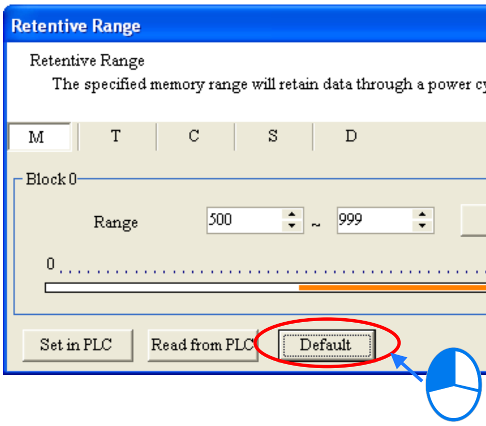
For the setup, users need to input values of the **Retentive Range,** where the beginning point is the value on the left box and the end point is the value on the right box. When input values, the beginning point on the left must be smaller than the end point on the right and cannot exceed the strip graph appearing as the range limit.



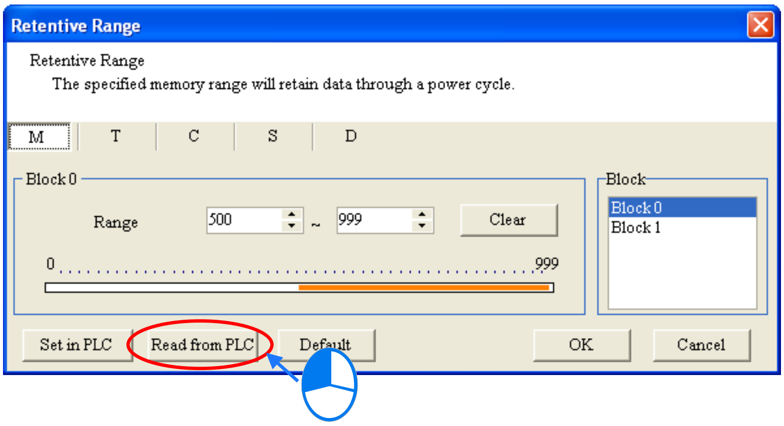
(5) Click **Clear** to remove the retentive function for the devices in that block and the range values will be from -1 to -1.



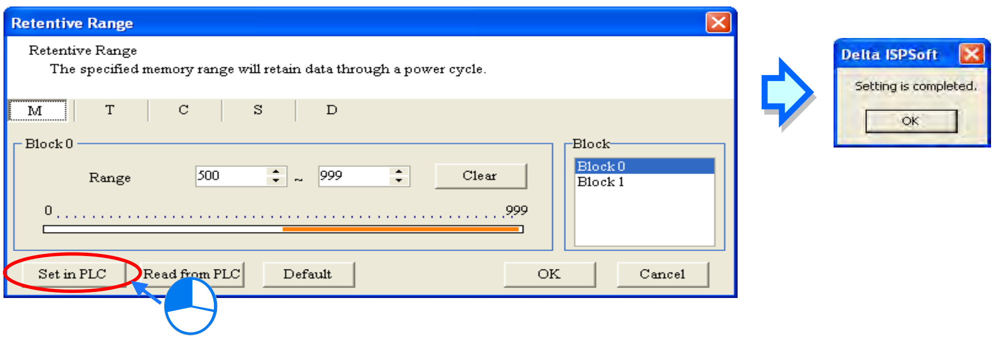
(6) Click **Default** for settings to return to default values and the retentive function for all devices will return to defaults.



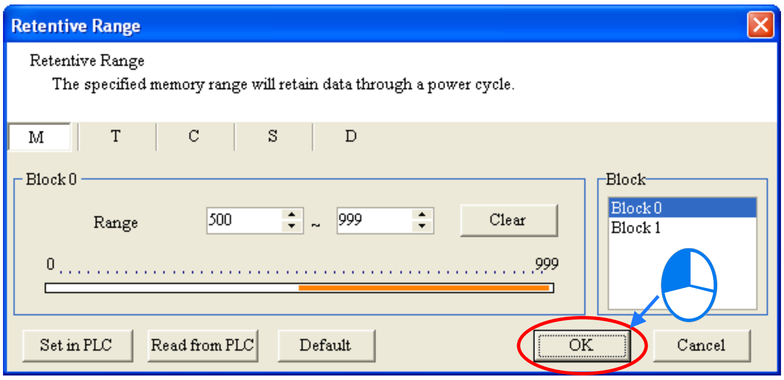
(7) When ISPSoft is connected to a PLC host, click **Read from PLC** to read the retentive setups on all devices from the PLC host.



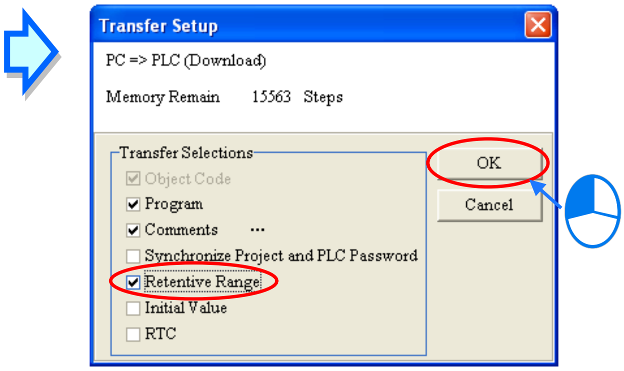
(8) When all setting is complete and ISPSoft is in connection with a PLC host, click **Set in PLC** to write the retentive settings for all devices into PLC hosts. Meanwhile, the system will automatically close the setting window and the setups are stored, but it will be saved once an ISPSoft project is saved.



(9) When setting values are not required temporarily, click **OK** to apply the setting. The setup is saved once an ISPSoft project is saved.

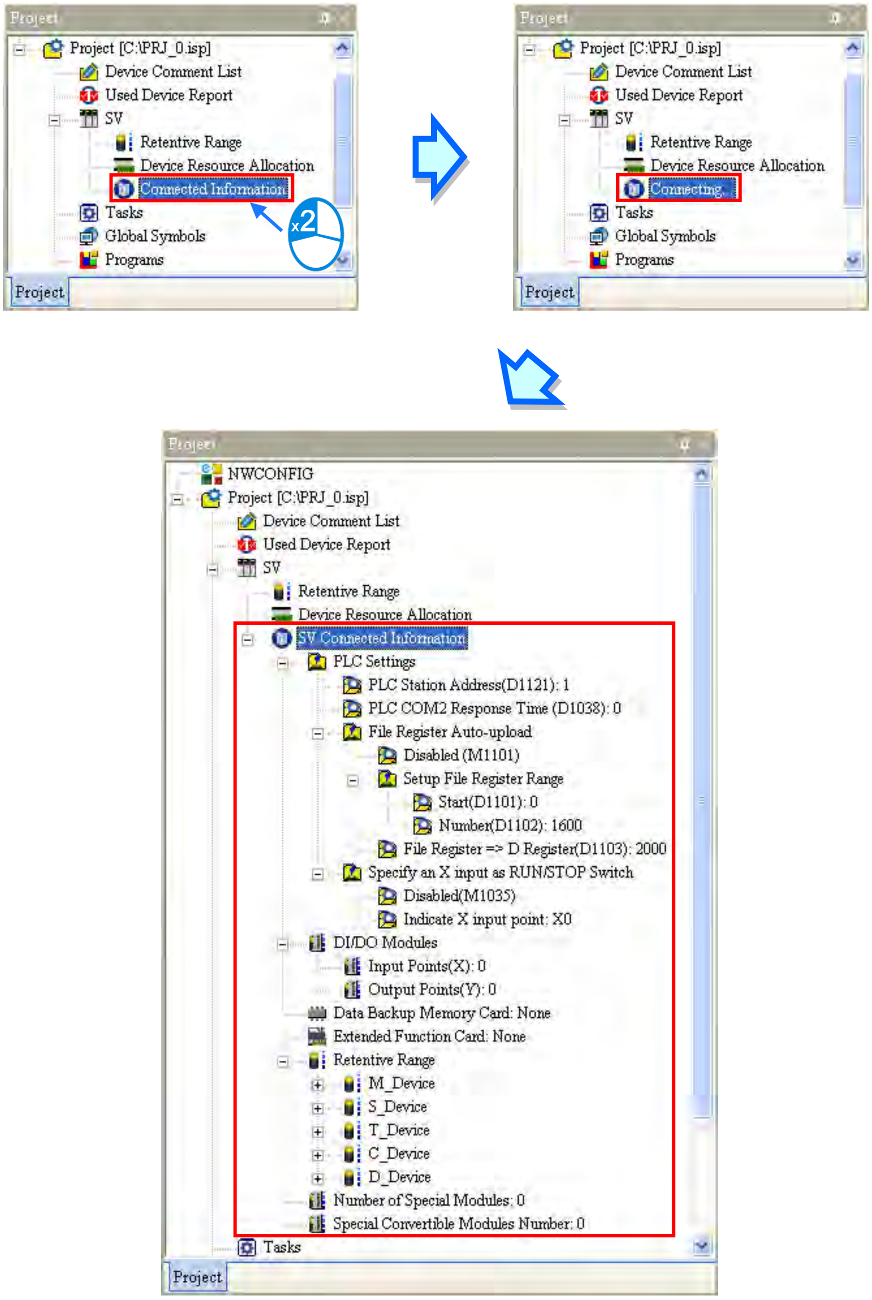


(10) Besides using the setting window to write the setting values of functions into PLC hosts, the retentive range in a project setting can also be written into PLC hosts when project program is downloaded. Users only need to select **Retentive Range from the Transfer Setup** window and click **OK** to download data to PLC hosts. For more details on download, please refer to section 17.1.3.



3.3.3 Connected Information

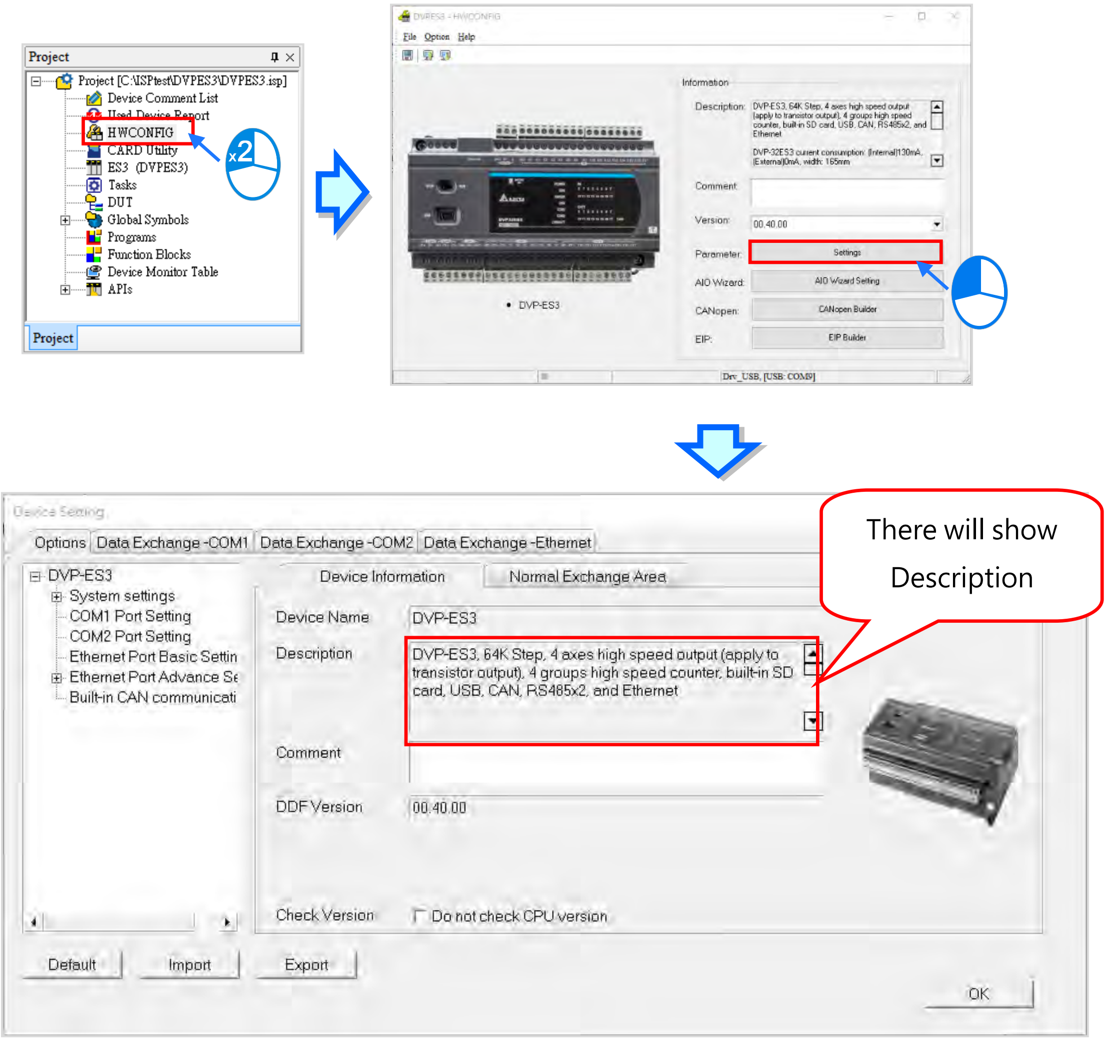
When ISPSoft is in connection with a PLC host, users can double-click **Connected Information** from the Project section, with PLC system parameters been captured and placed under Connected Information file for viewing only.



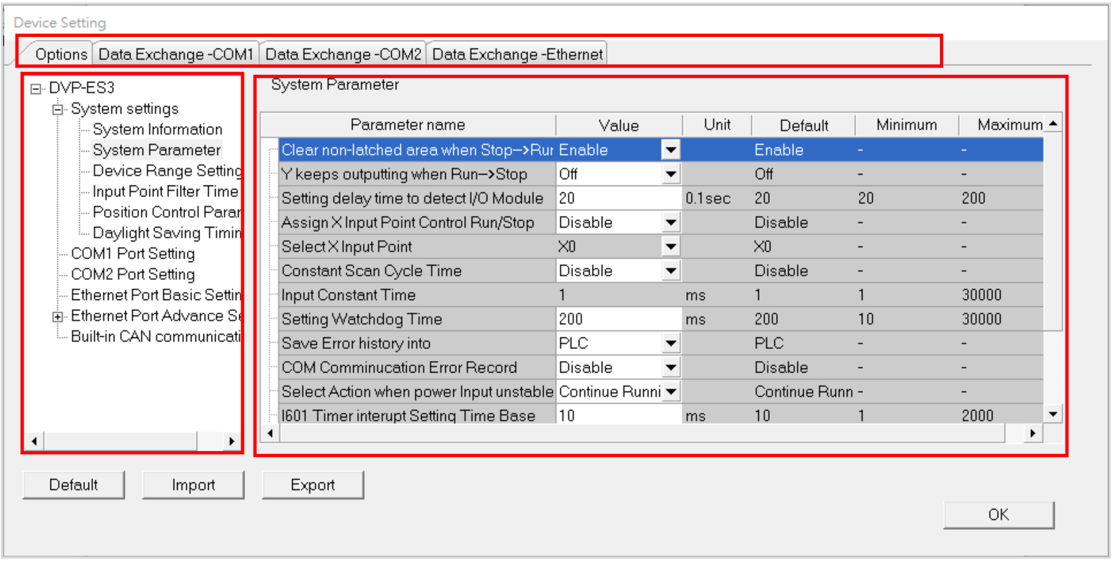
3.3.4 Parameter Setting for DVP-ES3 Series PLC

Double-click **HWCONFIG** in the Project section and choose **Parameter Setting** to open the setting page of the host CPU.

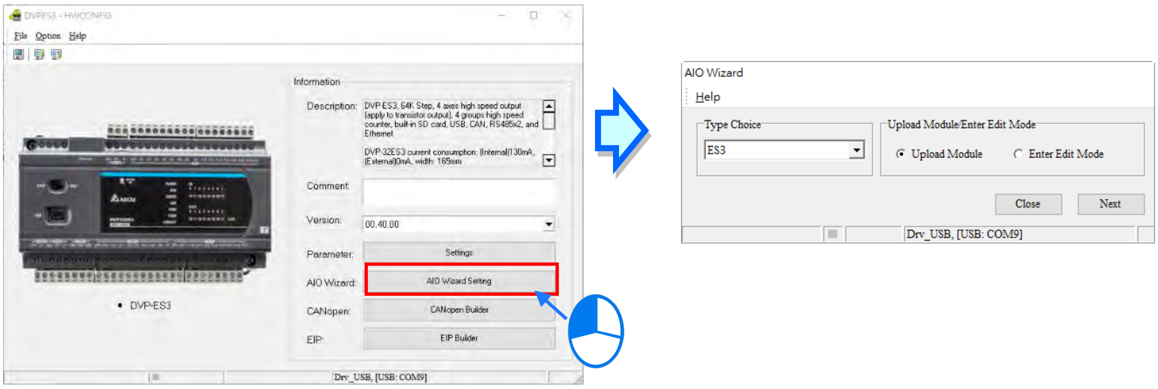
⚠ Before setting PLC parameters, please check the user manuals for all types of PLCs to avoid any personal loss or system damages due to the effects of the parameter setting for PLCs and the whole system.



In the **Device Setting** window, parameters are categorized into many pages and users can use the **main category labels** on the top of the window or select from the list of items in hierarchy on the left. On the right, the titles on the page (from left to right) are **Parameter Name, Value** for user input, **Unit** of the setting value as well as **Default, Minimum** and **Maximum** value. For more details, please refer to section 3.5.2.



DVP-ES3 series requires AIO wizard setting for configuring modules on the right. These parameters also determines the actual function and characteristics of each modules. For module parameter settings, please click **AIO Wizard Setting** to open its setup window and select **Upload Module** to upload back the configuration through PLC or select **Enter Edit Mode** to create modules manually as shown below.



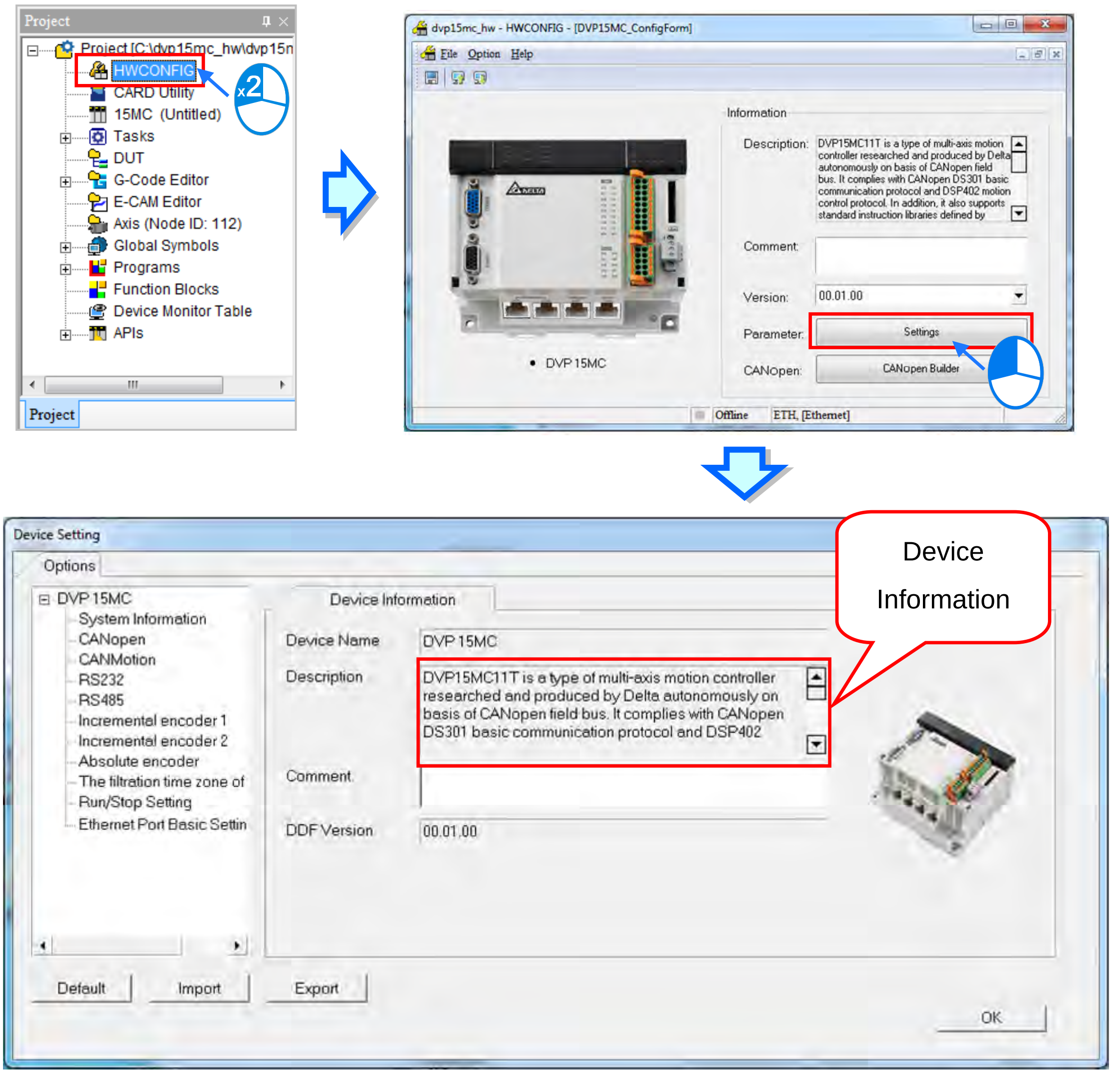
3.4 Parameter Settings for DVPxxMC Series PLC

3.4.1 Opening the PLC Parameter Setting Window

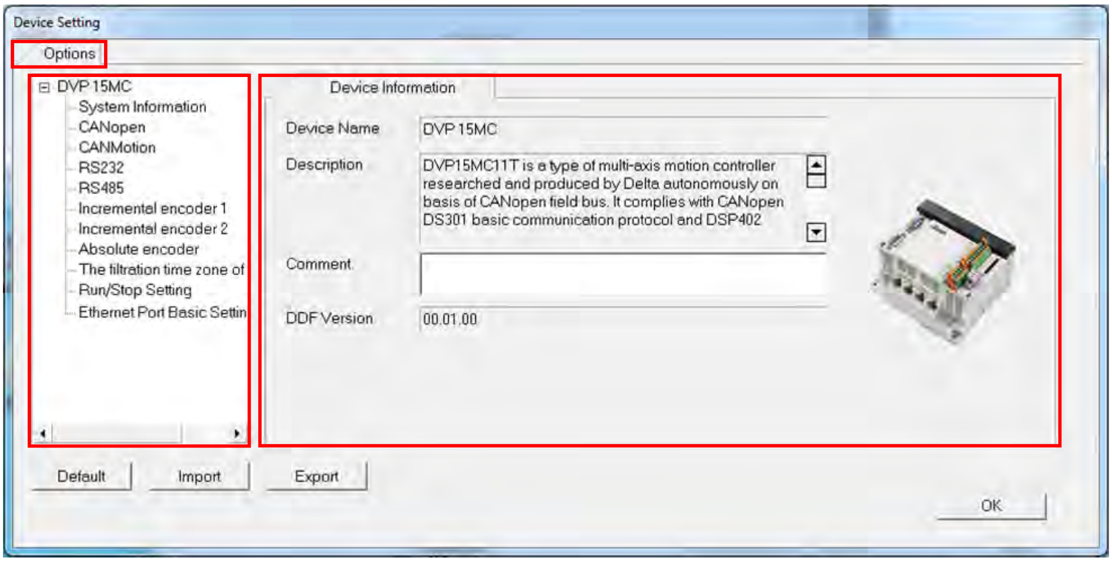
After double-clicking HWCONFIG in the system configuration area, users can select Setting from the Parameter field and the **Device Setting** window will appear. The parameters which can be set vary with the models or hardware of the CPU modules.

Before setting the parameters in a CPU module, users have to refer to the operation manual for the CPU module and to make sure the effect of the setting parameters have on the CPU module and the whole system is safe, so as to avoid system damage or staff injuries.

***.** The parameter settings are not effective until they are downloaded to the CPU module. Refer to section 3.8.4 for the download method.



The parameters are classified into several tabs on the setting page. Users can click the primary tabs on the top of the window and can switch to other setting pages base on different levels of settings. On the right, a table regarding parameter name as well as corresponding value is provided for users to set its unit, default, maximum and minimum.

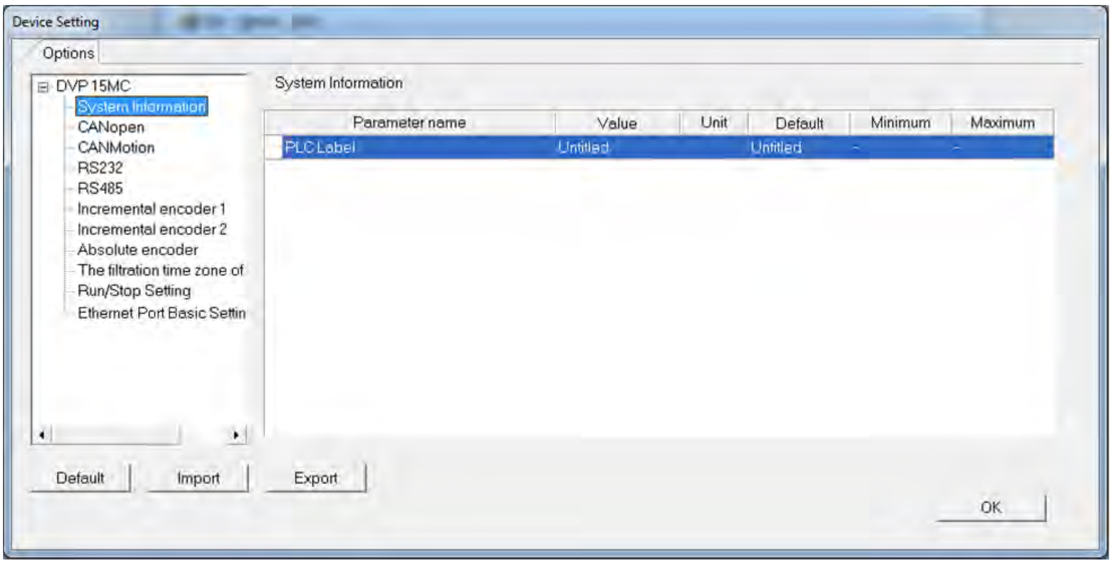


3.4.2 Options

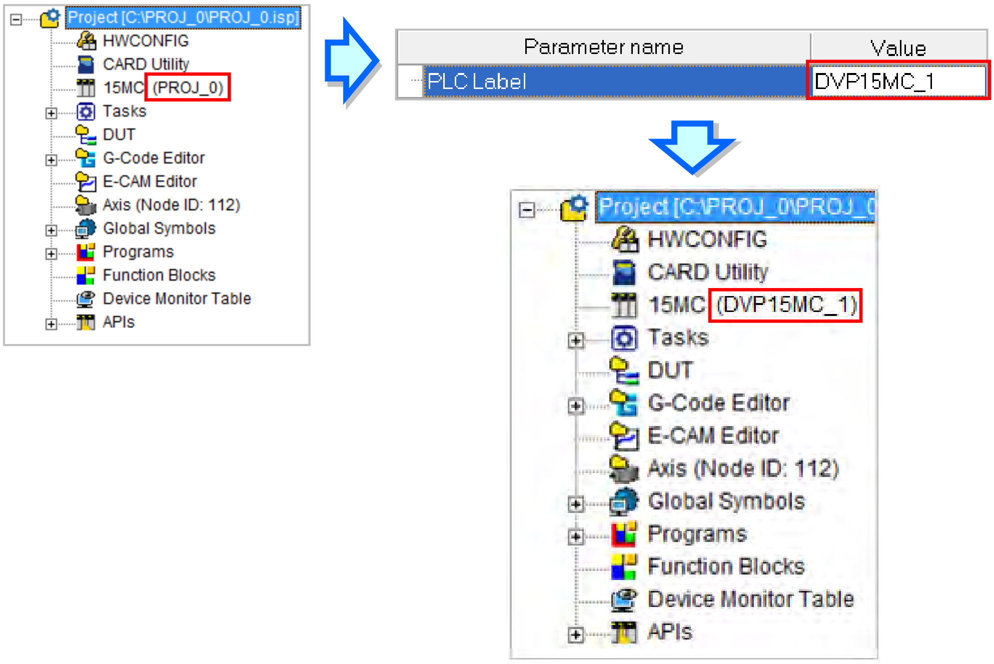
3.4.2.1 Options - System Settings

The **System Information** page under **Device Settings** appear after users click the **Options** tab.

There are only **PLC Label** box where maximum 15 characters can be input on the page. There is no special restriction on the input characters; special marks and spaces are all allowed to use here. However, the users have to note that a Chinese character occupies two characters.



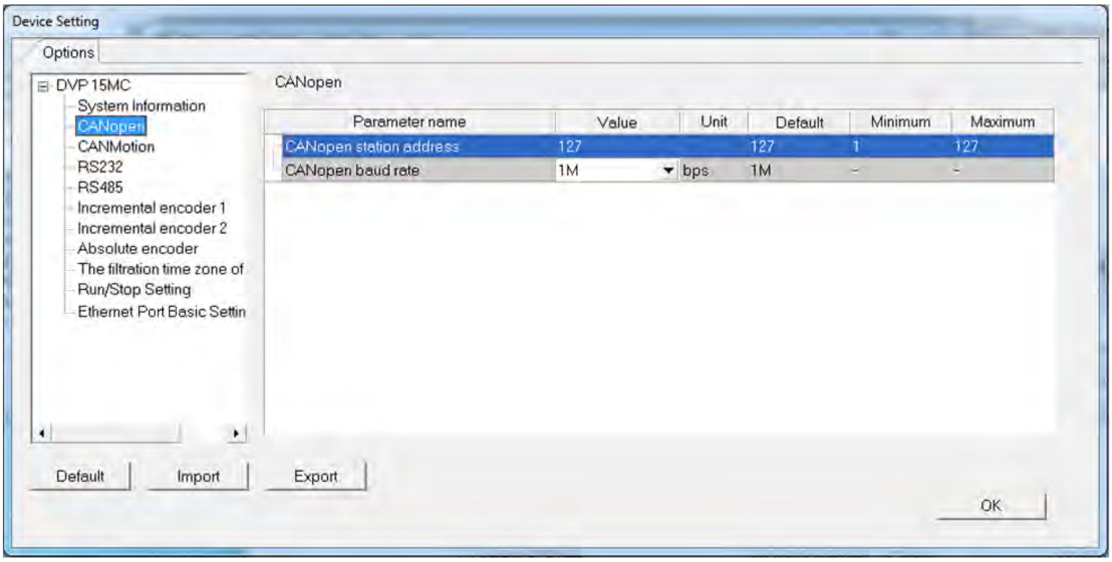
After an ISPSoft project is created, the project name will be taken as the default name of the CPU module, and the default name of the CPU module will be attached to the model in the project management area. Users can change the default name of the CPU module in the **Name** box later.



Users can identify a device by means of the name of the device. When several devices are connected to one network, users can check whether a device connected to the computer is the device they expect by checking the device name. To prevent errors, if users want to download/upload the program, the system will remind the users to check the name of the CPU module and the name attached to the model in the project management area, when the name of the CPU module is different from the name attached to the model in the project management area.

3.4.2.2 Options - CANopen

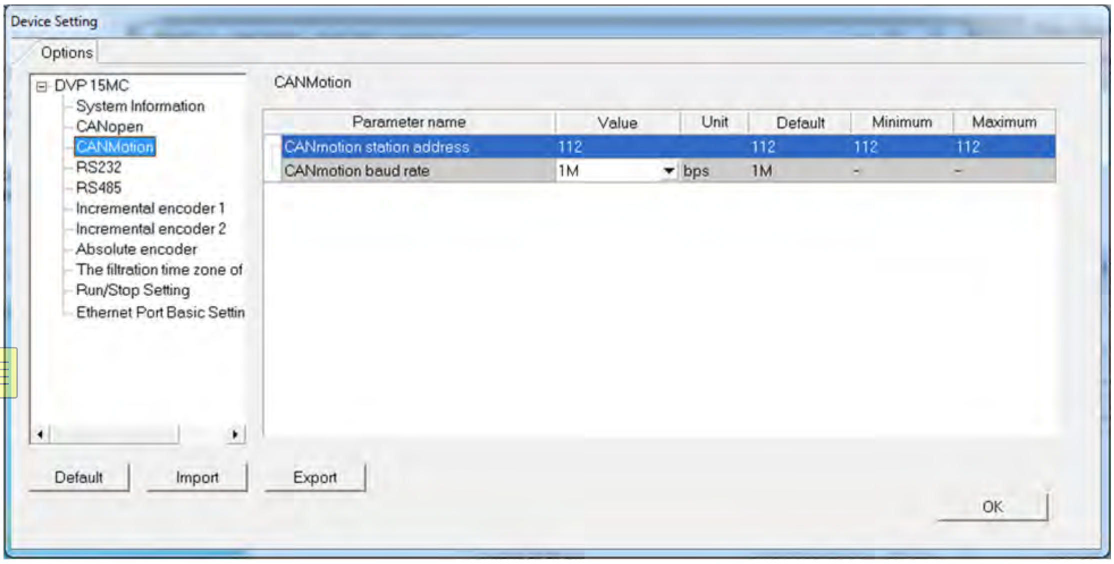
The parameters for CANopen are listed in the setting window below and users can set these values in the input box or via the drop-down menu.



Parameters for setting include CANopen station address and CANopen baud rate. Users can select CANopen baud rate value such as 20k bps, 50k bps, 125k bps, 250k bps, 500k bps, 800k bps and 1Mbps.

3.4.2.3 Options - CANmotion

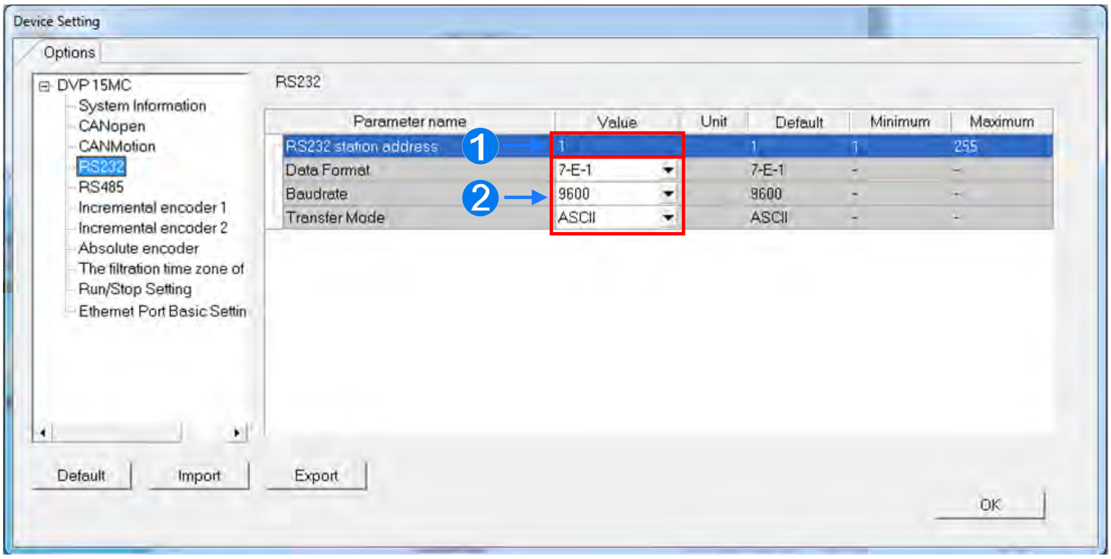
The parameters for CANmotion are listed in the setting window below and users can set these values in the input box or via the drop-down menu.



Parameters like CANmotion station address is set up with a default value of 112 and cannot be changed; users can select either 1Mbps or 500kbps for CANmotion baud rate.

3.4.2.4 Options - RS232

The settings of RS232 station are listed in the window below.

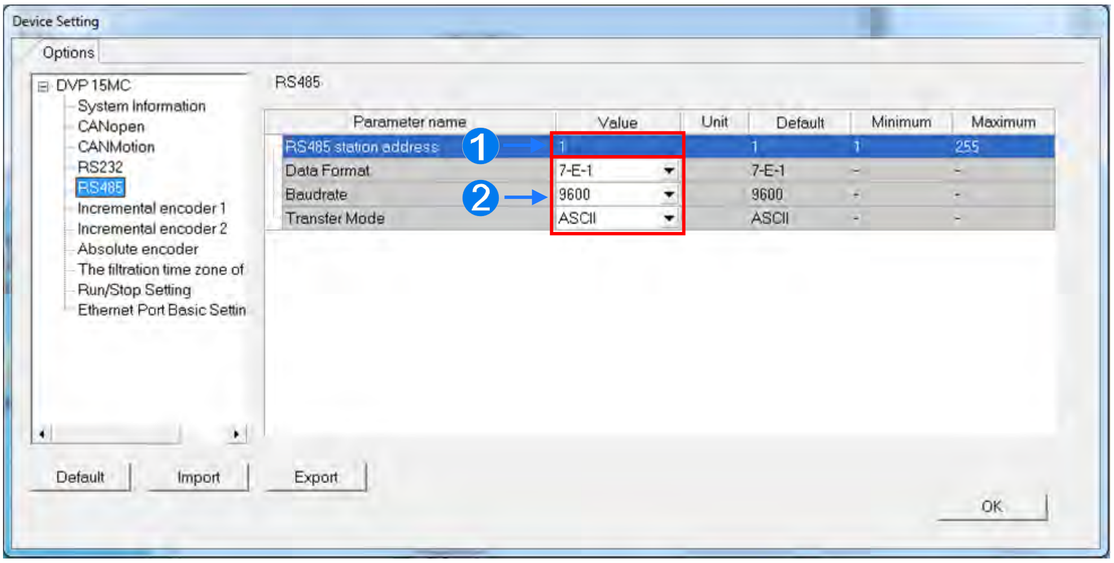


❶ Users can set up RS232 station address

❷ Select values of RS232 data format, baud rate and transfer mode. Users can select baud rate including 9600, 19200, 38400, 57600 and 115200.

3.4.2.5 Options - RS485

The settings of RS485 station are listed in the window below.

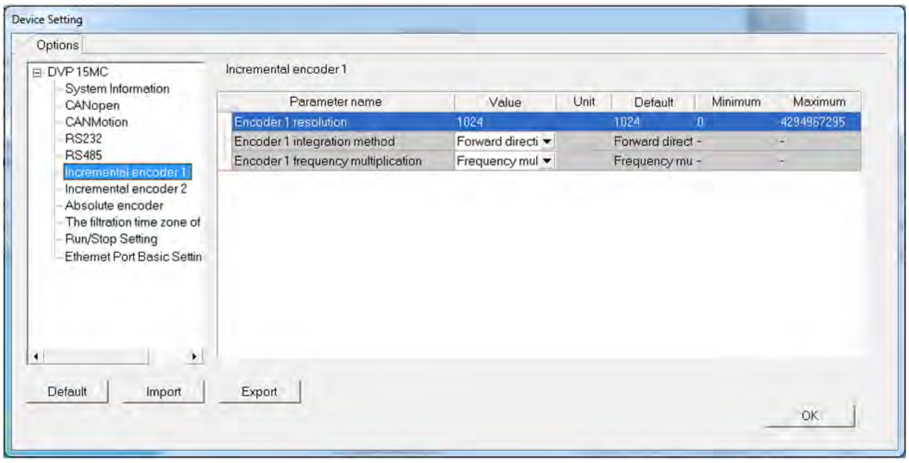


❶ Users can set up RS485 station address

❷ Select values of RS485 data format, baud rate and transfer mode. Users can select baud rate including 9600, 19200, 38400, 57600 and 115200.

3.4.2.6 Options - Incremental Encoder 1

The page below is for the first set of device settings.



Parameters settings include resolution, integration method and frequency multiplication.

- **Incremental Encoder 1 Resolution**

The default value of incremental encoder 1 resolution is 1024.

- **Incremental Encoder 1 Integration Method**

The settings include forward and reverse direction.

- **Incremental Encoder 1 Frequency Multiplication**

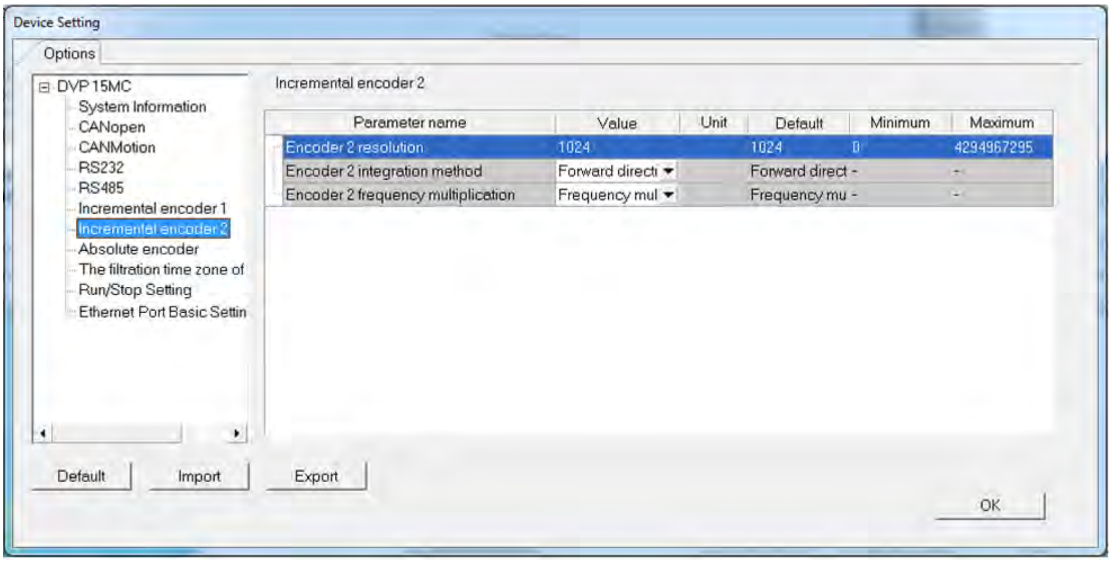
The settings include one/ two/ four times frequency multiplication.

The integration method and frequency multiplication is explained in the following table.

Integration Method	Meaning	Counting Method
One time frequency multiplication in forward direction	The counting starts when phase B rising edge is detected.	Increase the count
Two times frequency multiplication in forward direction	The counting starts when phase B rising and falling edge is detected.	Increase the count
Four times frequency multiplication in forward direction	The counting starts when the rising and falling edge of phase A and B are both detected.	Increase the count
One time frequency multiplication in reverse direction	The counting starts when phase B rising edge is detected.	Decrease the count
Two times frequency multiplication in reverse direction	The counting starts when phase B rising and falling edge is detected.	Decrease the count
Four times frequency multiplication in reverse direction	The counting starts when the rising and falling edge of phase A and B are both detected.	Decrease the count

3.4.2.7 Options - Incremental Encoder 2

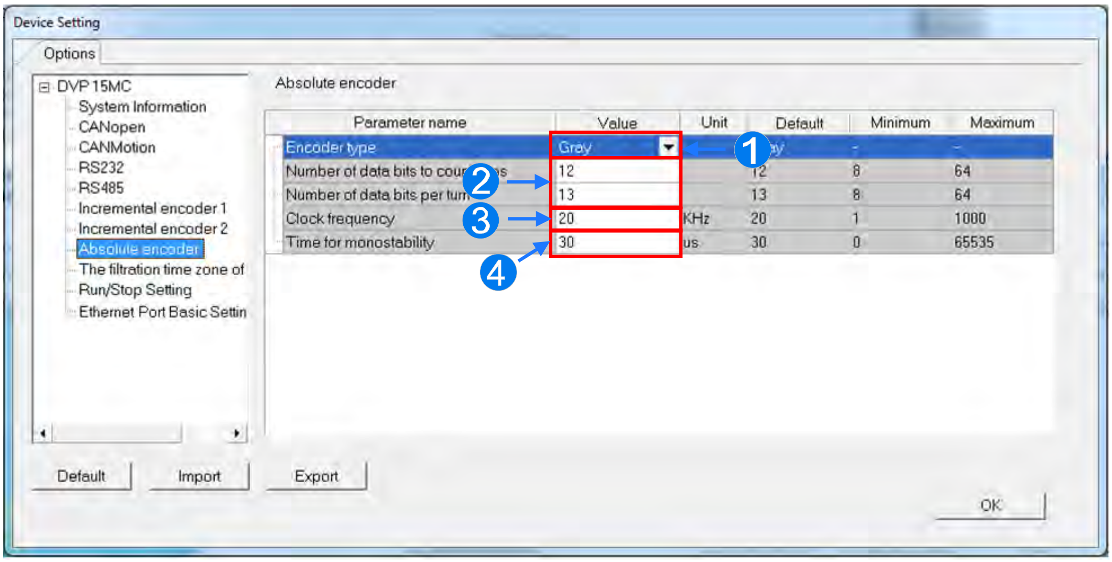
The page below is for the second set of device settings.



Parameters settings including resolution, integration method and frequency multiplication is the same as explained in incremental encoder 1 page. Please refer to section 3.6.2.6 for more information.

3.4.2.8 Options - Absolute Encoder

The page below is for setting the absolute encoder.



❶ The output value for absolute encoder include Gray or Binary. This parameter is set according to the encoder type.

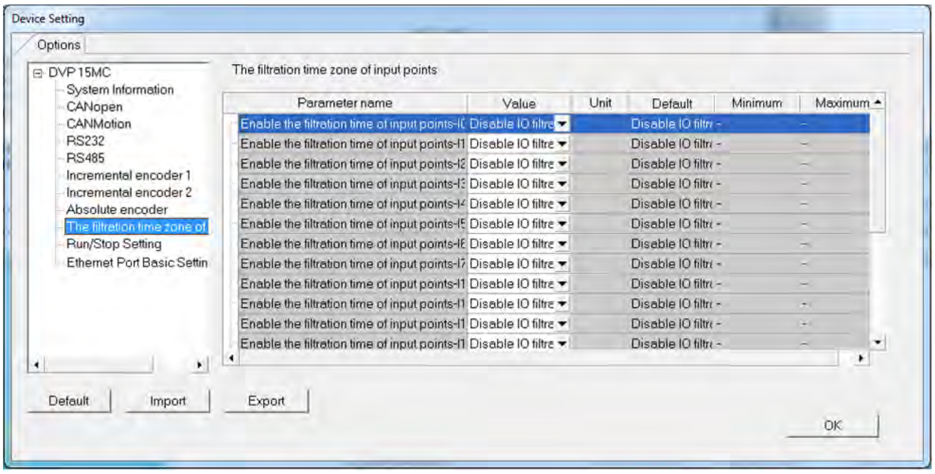
❷ The parameter **Number of data bits to count turns** item sets resolution for multi-turn. A recount will take place if the number of pulses exceeds the valid maximum turn count. The number of turns (N) equals to 2 ^{N}. This parameter is set according to the encoder type; the **Number of data bits per turn** item sets resolution for a single turn. The number of turns (N) equals to 2 ^{N}. An encoder turns to create the number of pulses. This parameter is set according to the encoder type.

❸ The item sets data transfer speed.

❹ The item determines the minimum transfer speed that counts from the falling edge of the last pulse in clockwise direction.

3.4.2.9 Options - Filtration Time Zone of Input Points

The setting page for DVPxxMC **Filtration Time Zone of Input Points** and updates IO along.



- **Enable the filtration time of input points -I0~I7**

The input points to filter the short pulse signals via filtration is set between -I0~I7. This can increase filtration rate and reduce signal interference, input signal tremble or external interference. Users can select enable or disable IO filter via the drop-down menu.

- **Enable the filtration time of input points -I10~I17**

The input points to filter the short pulse signals via filtration is set between-I10~I17. This can increase filtration rate and reduce signal interference, input signal tremble or external interference. Users can select enable or disable IO filter via the drop-down menu.

- **Filtration Time Factor of I0~I7**

The I0~I7 time factor of filtration is set between 0~255. The filtration time: t=31us * (time factor of filtration), the filtration time is a multiple of 31us and the default value of time factor is set to 0.

- **Filtration Time Factor I10~I13**

The I10~I13 time factor of filtration is set between 0~255. The filtration time: t=31us * (time factor of filtration), the filtration time is a multiple of 31us and the default value of time factor is set to 0.

- **Filtration Time Factor I14~I17**

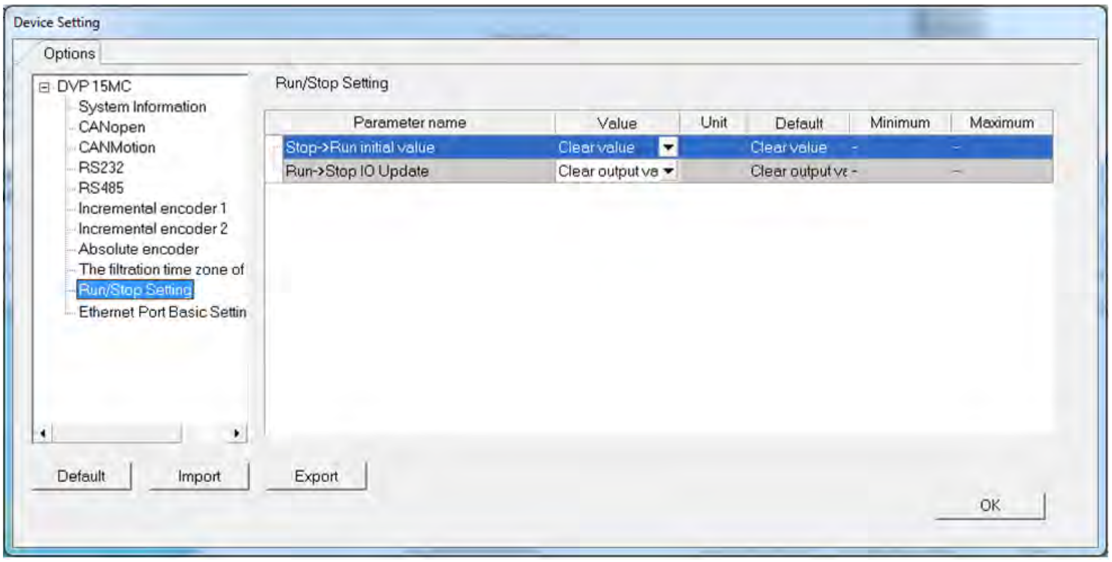
The I14~I17 time factor of filtration is set between 0~255. The filtration time: t=31us * (time factor of filtration), the filtration time is a multiple of 31us and the default value of time factor is set to 0.

- **IO Update with Task**

The I/O includes DVPxxMC I/O points, left and right expansion modules and CANopen data. Select **FF** and IO data is updated in the system; select other assigned Task and the IO data will be updated before executing the assigned Task.

3.4.2.10 Options - Run / Stop Setting

The page below is set to refresh IO and initial value of parameters.



- **Stop -> Run Initial Value**

Users can select Clear value or Keep value

(1) When Clear Value is selected and the device operates from Stop to Run, non-retentive variables and devices will return to initial value or default value, while the retentive variables (VAR_RETAIN type) and devices will not return to initial value.

When the non-retentive variables are bound to retentive devices, the variable will return to initial value if operates from Stop to Run or powering up; If the initial value is not set, the variable will be set as the value stored in the retentive device operates from Stop to Run or powering up.

(2) When Keep Value is selected and the device operates from Stop to Run, the variables and devices will keep the value before Stop. When the software starts download again and operates from Stop to Run, the, non-retentive variables and devices will return to initial value or default value; while the retentive variables (VAR_RETAIN type) and devices will not return to initial value.

- **Run -> Stop IO Update**

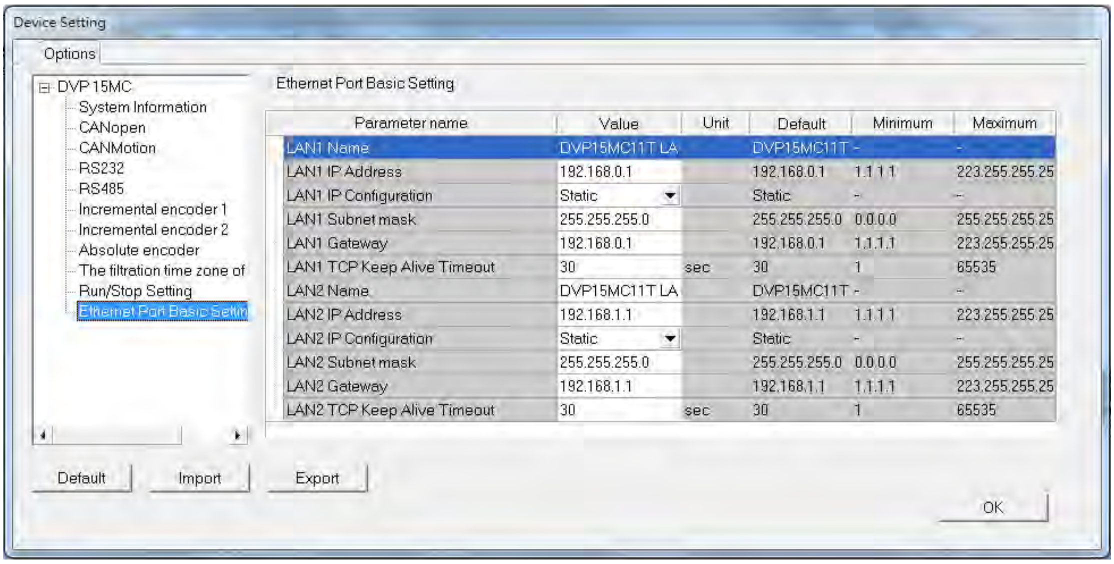
Users can select Clear Output Value or Keep Output Value for IO refresh setting when the device operates from Run to Stop.

(1) When Clear Output Value is selected and the device is under Stop, the current IO data is deleted not updated.

(2) When Keep Output Value is selected and the device is under Stop, the current IO data is not deleted and will continue to update while under Stop.

3.4.2.11 Options - Ethernet Port Basic Setting

Users can select **Ethernet Port Basic Setting** under the Option menu to setup the two Ethernet port communication parameters. 15MC supports LAN1/ LAN2; 50MC only supports LAN1 and EtherCAT.

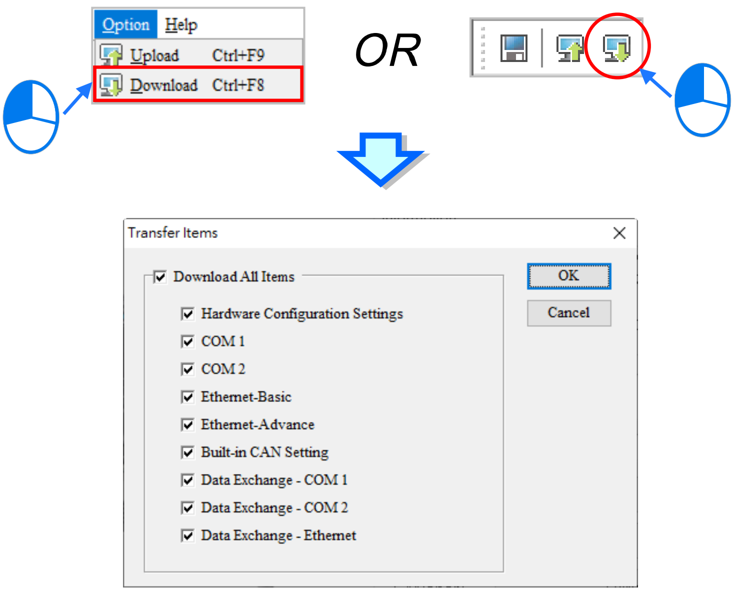


3.4.3 Upload / Download

The settings configured in HWCONFIG would be affective after being downloaded to the CPU. In addition, HWCONFIG would directly use the communication settings of ISPSoft, hence you must ensure a successful connection between ISPSoft and the CPU before upload and download parameters. A reminder message would pop up when the name of the CPU does not match to the name configured in parameter setting.

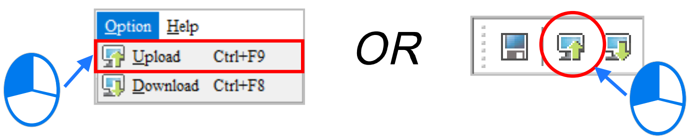
- **Download hardware parameters**

Choose "**Download**" from "**Option**", or click the download button in the toolbar, then a confirmation window of Transfer Items would be displayed. After selecting the desired items, click "**OK**" and the parameters of the selected items would be downloaded to the CPU.



- **Upload hardware parameters**

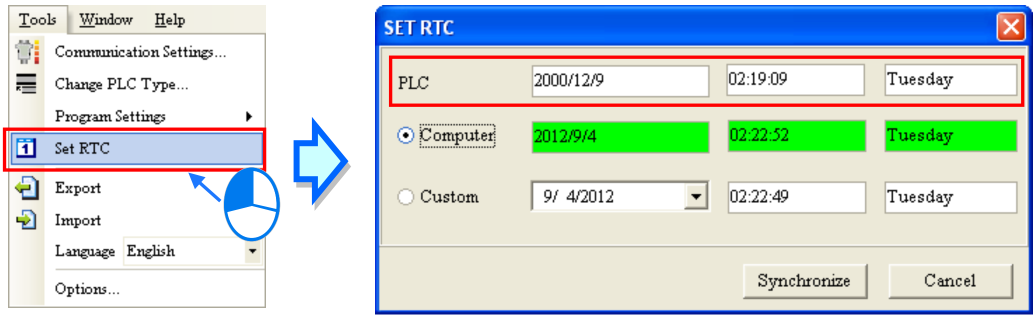
Choose "**Upload**" from "**Option**", or click the upload button in the toolbar, then the parameters of PLC CPU would be uploaded to the HWCONFIG configuration page.



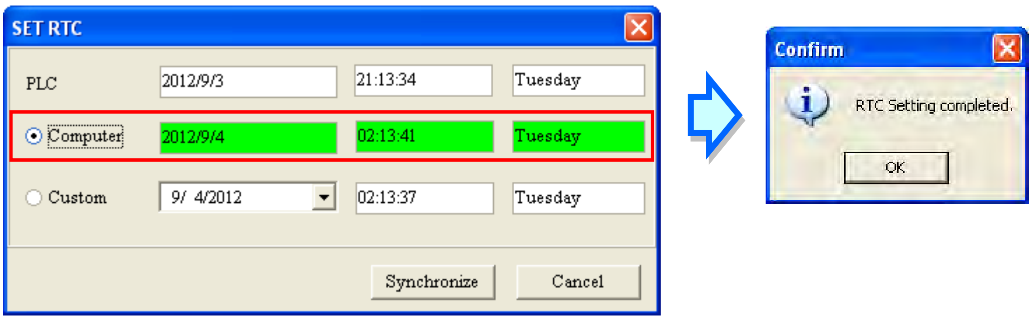
3.5 Setting a RTC

The RTC in a PLC can be set by a tool provided by ISPSoft. Before the real-time clock in a PLC is set, users have to make sure that ISPSoft is connected to the PLC normally. Please refer to section 2.4 for more information about communication setting.

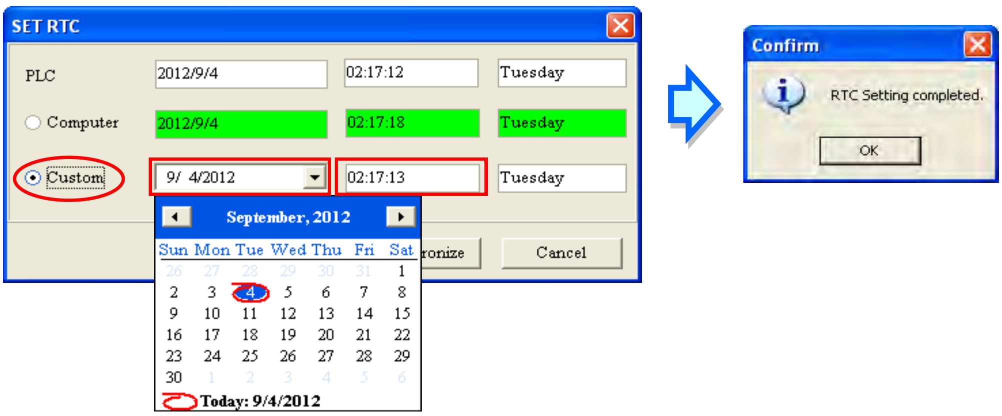
After users click **Set RTC** on the **Tools** menu, the **SET RTC** window will appear. The date displayed on the top of the window is the date retrieved from the PLC when the window is opened, and the time displayed on the top of the window is the time retrieved from the PLC when the window is opened.



If the time on the computer's clock is the time on the real-time clock, users can select the **Computer** option button, and click **OK**.



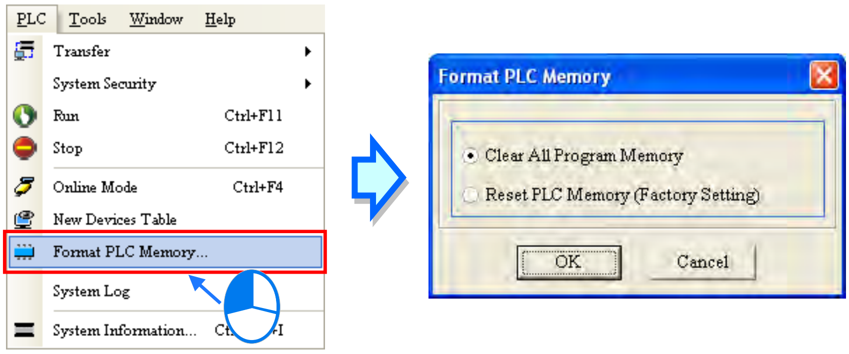
If users want to set the real-time clock by themselves, they can select the **Custom** option button, and type a date and a time in the boxes. If users click ▼ in the box, an auxiliary tool will appear. Click **OK** after the setting of the real-time clock is complete



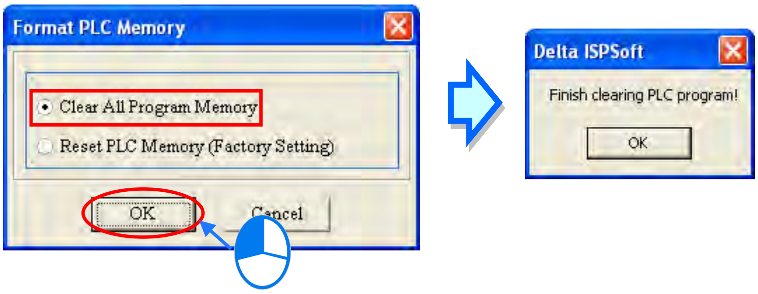
3.6 Setting the Memory in a PLC

By means of ISPSoft, users can clear the memory, or restore the setting in the PLC to the factory setting. Users have to make sure that ISPSoft has connected to the CPU module normally before they carry out the operation. Please refer to section 2.4 for more information about communication setting.

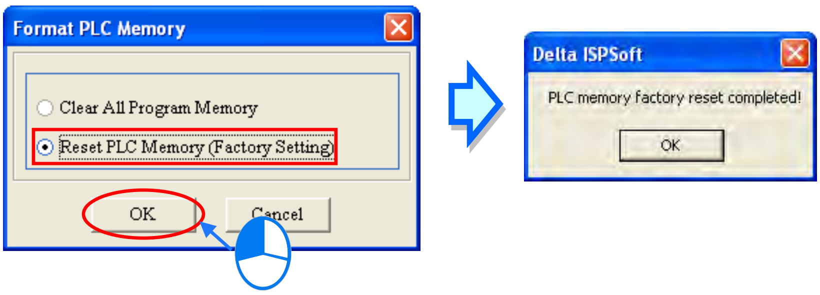
After users click **Format PLC Memory…** on the **PLC** menu, the **Format PLC Memory** will appear.



Select the **Clear All Program Memory** option button, and then click **OK**. The system will clear the memory in the PLC.



If the **Reset PLC Memory (Factory Setting)** option button is selected, the setting in the PLC will be restored to the factory setting after **OK** is clicked. On account of the design of the PLC, after the setting in the PLC is restored to the factory setting, users may need to repower the PLC so that they can proceed with the operation.



If ISPSoft is connected to an AH series CPU module, the setting in the CPU module is not allowed to be restored to the factory setting until the **Enable Remote Run** checkbox in the **PLC Parameter Setting** window is selected and the parameters are downloaded. Please refer to section 3.3 and 3.4 for more information.

Chapter 4 Quick Start

Table of Contents

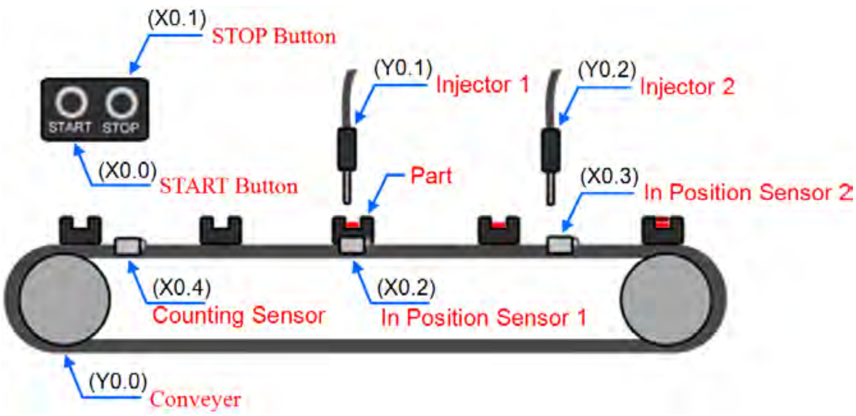
4.1 Quick Start

The chapter provides a simple example, and leads users to create a traditional ladder diagram in ISPSoft in a short time. However, in order to help users who are not familiar with IEC 61131-3 understand the functions provided by ISPSoft, and create a traditional ladder diagram, programming concepts related to IEC 61131-3 are not introduced in this chapter. For example, POUs, function blocks, variables, and etc. are not introduced. The concepts related to IEC 61131-3 will be introduced in the following chapters.

4.1.1 Example

When the equipment operates, the parts on the conveyer are conveyed from left to right. If a sensor senses that a part is under an injector, the PLC will send a trigger signal to the injector, and the injector will injects the glue. How long the part will be injected is set externally, and is not controlled by the program in the PLC. However, the program in the PLC must be able to turn the trigger signal OFF so that the trigger signal can be sent next time. There are two injectors above the conveyer, and the two injectors inject glue in the same way.

Besides, there is a sensor at the left side of the conveyer. When a part passes the sensor, the sensor value increases by one increment. If the sensor value is 100, the internal completion flag will be set to ON. The state of the flag can be used by other procedures later. However, the use of the state of the flag is not introduced in this example.



4.1.2 Hardware

In this example, we use AH5x0 series host CPU- **AHCPU530-EN**, the **AH16AP11R-5A** with 8-point digital I/O module, and **AHBP04M1-5A** with 4 slots as the main backplane. The following is an example of I/O allocation table.

Type	ID	Description
Digital input	X0.0	START button
Digital input	X0.1	STOP button
Digital input	X0.2	In position sensor 1
Digital input	X0.3	In position sensor 2
Digital input	X0.4	Counting sensor
Digital output	Y0.0	Conveyer
Digital output	Y0.1	Trigger signal for injector 1
Digital output	Y0.2	Trigger signal for injector 2

4.1.3 Program

(1) When the START button (X0.0) is turned from OFF to ON, the internal operation flag is set to ON, and the conveyer (Y0.0) starts to run. When the STOP button (X0.1) is turned from OFF to ON, an error occurs (the error flag is ON), the operation flag is reset to OFF, and the conveyer stops running.

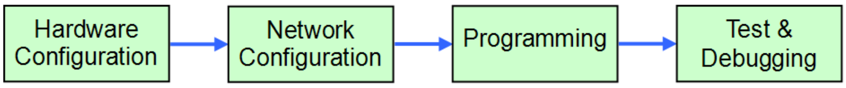
(2) When in position sensor 1 (X0.2) is ON, the trigger signal for injector 1 (Y0.1) is set to ON. When in position sensor 1 is OFF, the trigger signal for injector 1 is reset to OFF.

(3) When in position sensor 2 (X0.3) is ON, the trigger signal for injector 2 (Y0.2) is set to ON. When in position sensor 2 is OFF, the trigger signal for injector 2 is reset to OFF.

(4) When the counting sensor (X0.4) is turned from OFF to ON, the sensor value increases by one increment. If the sensor value is larger than or equal to 100, the internal completion flag will be set to ON.

4.2 Procedure for Creating a Project in ISPSoft

The procedure for creating a project in ISPSoft is as follow. Users can adjust the procedure according to the practical application and their habits.



- **Hardware configuration**

  Users can set the parameters such as a range of latched devices and a port number in a PLC. Besides, the users have to configure modules used with an AH500 series CPU module, and set the parameters in these modules.

- **Network configuration**

  If a system used adopts network architecture, or devices need to exchange data, users can configure a network, a PLC Link, or an Ether Link easily through the network configuration tool **NWCONFIG** in ISPSoft.

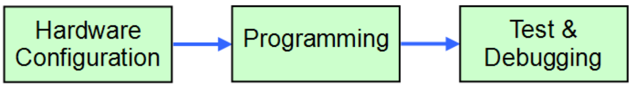
- **Programming**

  After users write a program in ISPSoft, they can compile the program. If the compiling of a program is unsuccessful, the messages in the **Compile Message** page can lead users to the places where errors occur to check the program code.

- **Test and debugging**

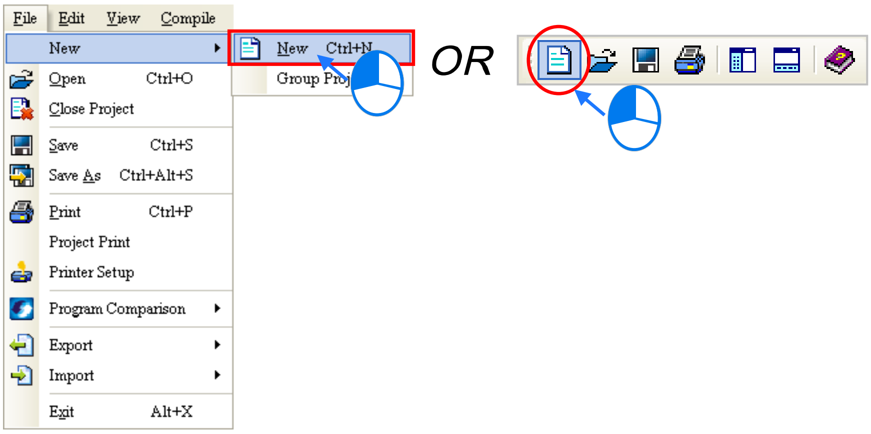
  Users can download a program which is compiled, a hardware configuration, and a network configuration to a PLC. Besides, the users can test and debug the program online by means of the functions provided by ISPSoft.

Owing to the fact that the example introduced in this chapter does not discuss a network configuration, only the following procedure is carried out. The procedure will be introduced in the following section.

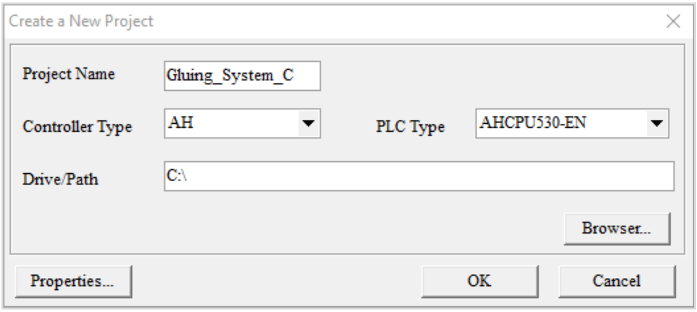


4.3 Creating a Project

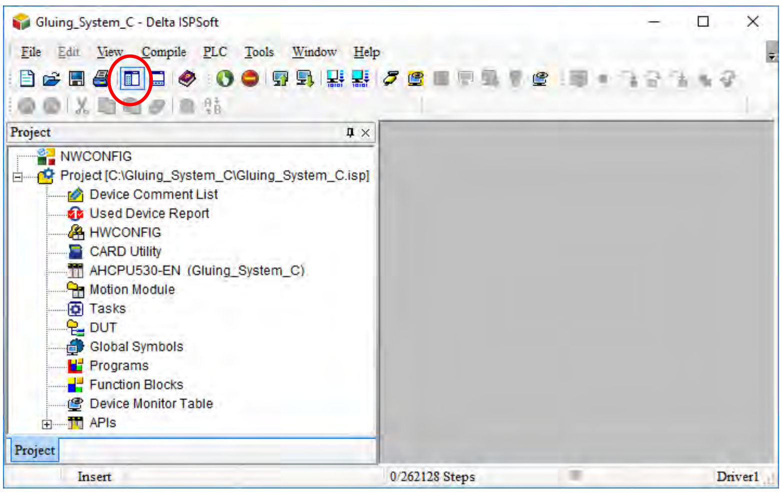
After ISPSoft is started, users can click the **File** menu, point to **New**, and click **New** to create a new project. They can also create a new project by clicking  on the toolbar after ISPSoft is started.



In the **Create a New Project** window, type a project name in the **Project Name** box and a path in the **Drive/Path** box, select a PLC in the drop-down list boxes of **Controller Type** and **PLC Type**, and click **OK**. (The PLC used in this example is AHCPU530-EN.)



After the project is created successfully, a project management area will appear at the left side of the main screen. The relation between the items listed in the project management area is represented by a hierarchical tree structure. If the project management area does not appear, the users can click **Workspace** on the **View** menu, or click  on the toolbar.



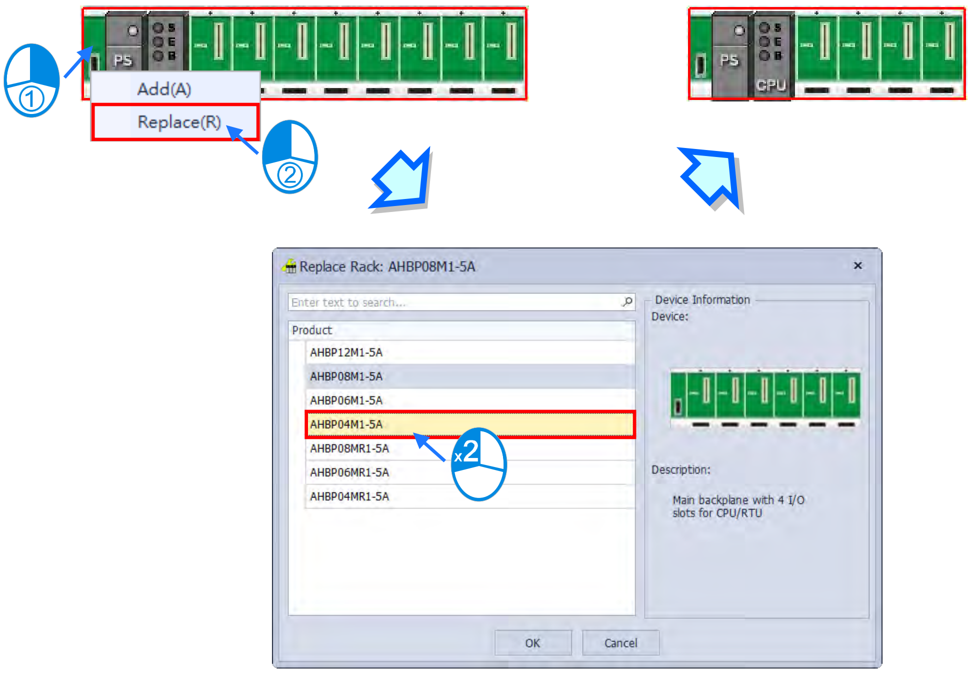
4.4 Hardware Configuration

After users double-click **HWCONFIG** in the project management area, the **HWCONFIG** window will appear.

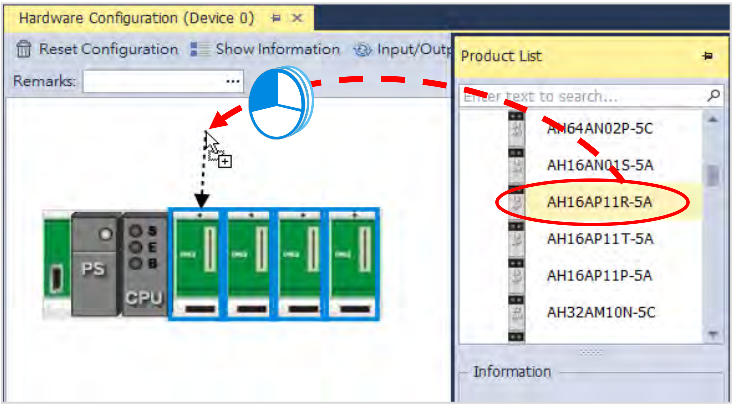
4.4.1 Configuring a Module

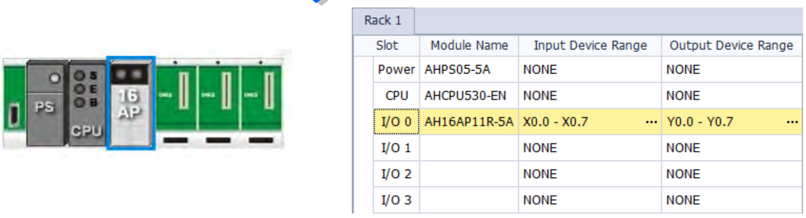
In the **HWCONFIG** window, there is an eight-slot backplane on which a CPU module and a power supply module are installed. However, the backplane used in this example is the four-slot backplane **AHBP04M1-5A** on which the digital I/O module **AH16AP11R-5A** is installed.

If users want to replace the backplane, they can right-click the left side of the rack in the system configuration area, click **Replace** on the context menu, and double-click **AHBP04M1-5A** in the Rack Selection window.

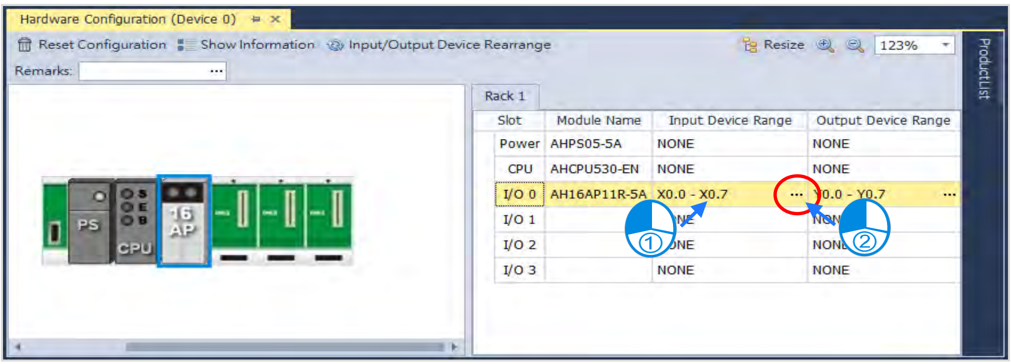


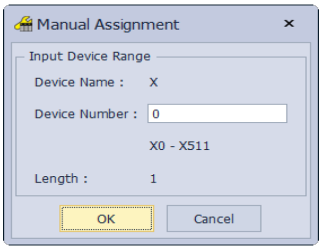
Unfold the **Digital I/O Module** section on the product list, find **AH16AP11R-5A**, and drag the module to a vacant slot on the backplane in the system configuration area. After the module is added successfully, the related information and the devices assigned to the module will be listed in the table at the bottom of the window.





The system automatically assigns devices to a module which is added. If the devices assigned to a module do no conform to what is expected, users can click the **Input/Output Device Range** cell for the module, click **···** in the cell, and type a device address in the **Manual Assignment** window.



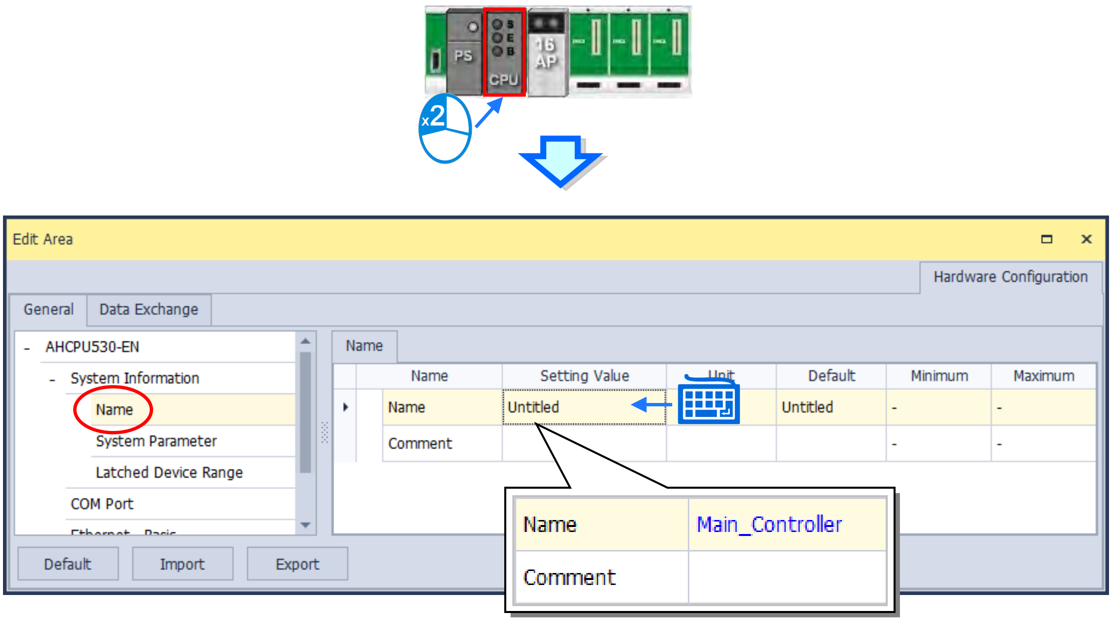


4.4.2 Parameter Setting for PLCs and Modules

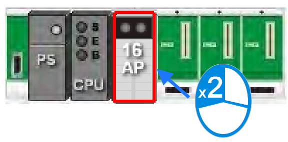
After **AH16AP11R-5A** is configured, users can set the parameters in the CPU module and the parameters in the extension module. After the users double-click the CPU module or the extension module, a corresponding window will appear.

After the CPU module is double-clicked, the **PLC Parameter Setting** window will appear. The users can click the tool tabs on the left side of the window, and the secondary tables at the bottom of the window to set the parameters. In this example, the users only need to define the name of the CPU module.

After you click the **System Information** tab and enter the **Name** tab, you can find the default name in the **Name** box is the same as the project name. Delete the default name, change the name to “Main_Controller” and click **OK**.

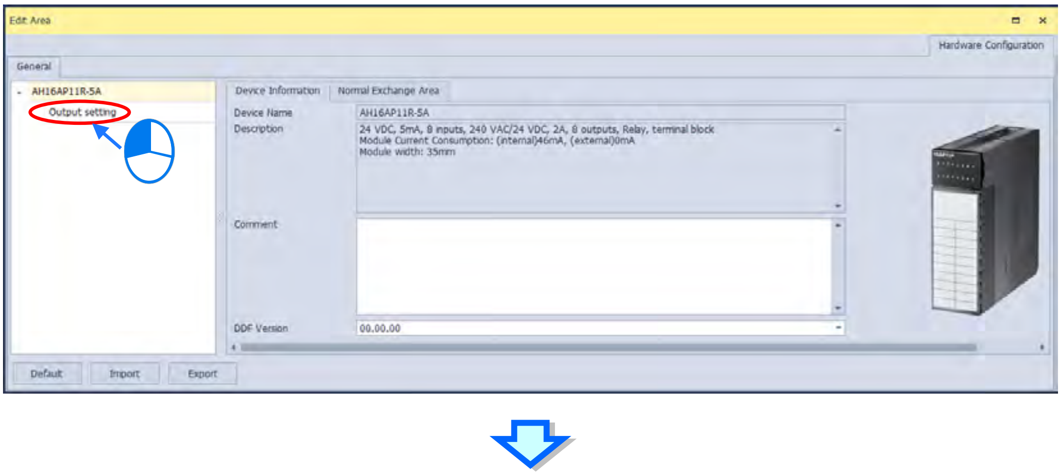


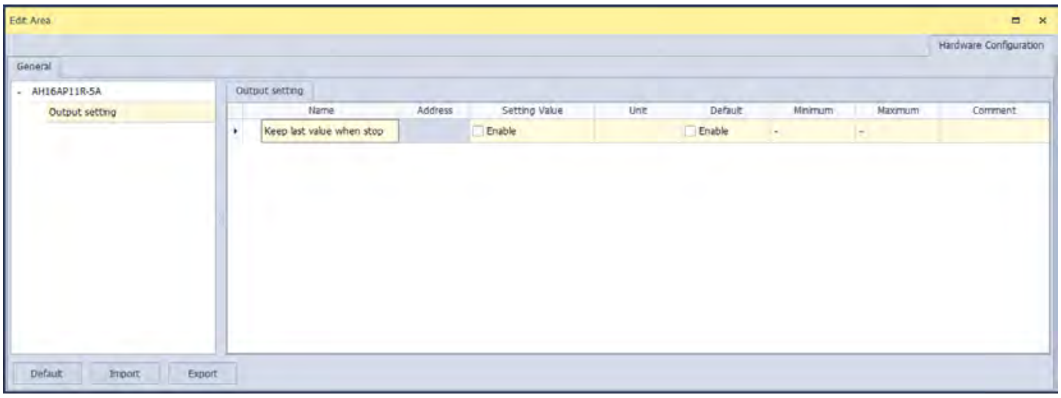
After the users double-click AH16AP11R-5A, the **Parameter Setting** window will appear.



After the **Parameter Setting** window is opened, the users can view the information related to the module. The users can select the parameter type at the left side of the window, and then set the parameter in the table at the right side of the window.

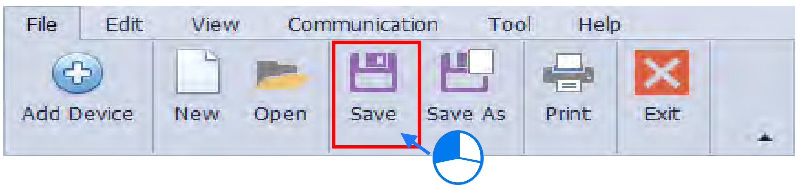
In this example, the default values are retained. Therefore, the step of setting the parameter in AH16AP11R-5A is skipped.





The hardware configuration is not complete until the parameters in the CPU module and AH16AP11R-5A are set. However, the configuration and the setting must be downloaded to the CPU module so that they can take effect. The configuration and the setting are saved here, and will be downloaded with the program in the project later.

To save the configuration and the setting, you can click **Save** on the **File** menu, or use the Ctrl+S shortcut key. After the configuration and the setting are saved, you can close the **HWCONFIG** window.



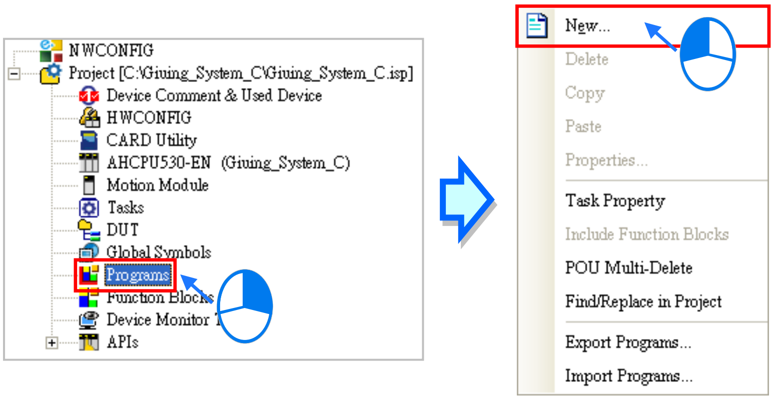
***. Please refer to chapter 3 for more information about HWCONFIG.**

4.5 Creating a Program

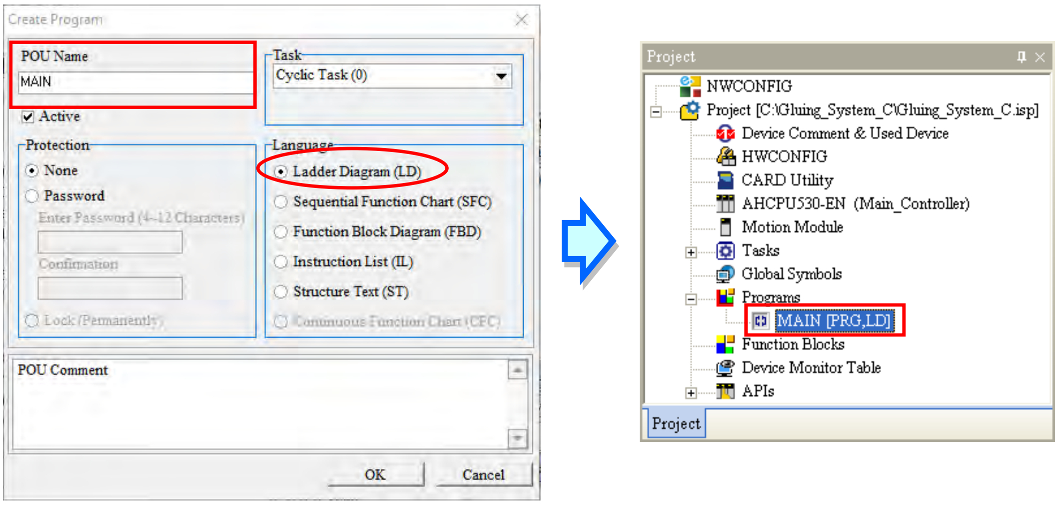
The following sections will lead you to create a traditional ladder diagram in ISPSoft. The contents of the following sections include creating a POU, editing a traditional diagram, and compiling a program. Users are expected to equip themselves with the basic abilities to create a traditional ladder diagram in a short time.

4.5.1 Adding a Ladder Diagram

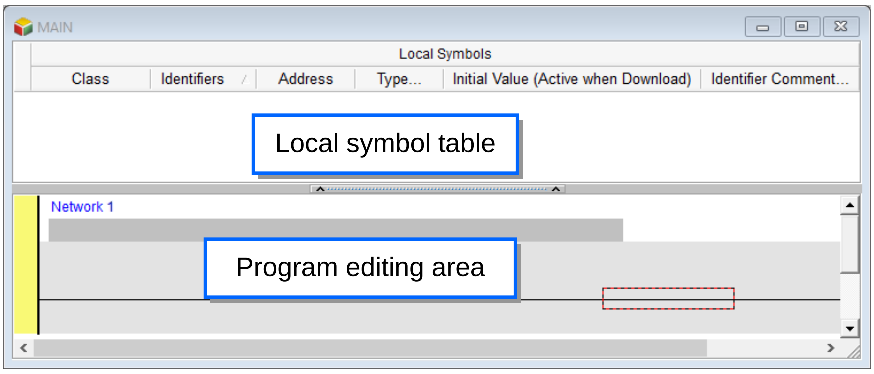
(1) Right-click **Programs** in the project management area and click **New…**.



(2) Type a program name in the **POU Name** box, select the **Ladder Diagram (LD)** option button in the **Language** section, and retain the other default values. Click **OK** after the setting is complete. An item will be under **Programs** in the project management area. The item is a program organization unit (POU).



(3) After the POU is added, a program editing window will appear in the main working area.



After the program editing window is opened, the corresponding toolbar will appear in the window. The functions are described below.

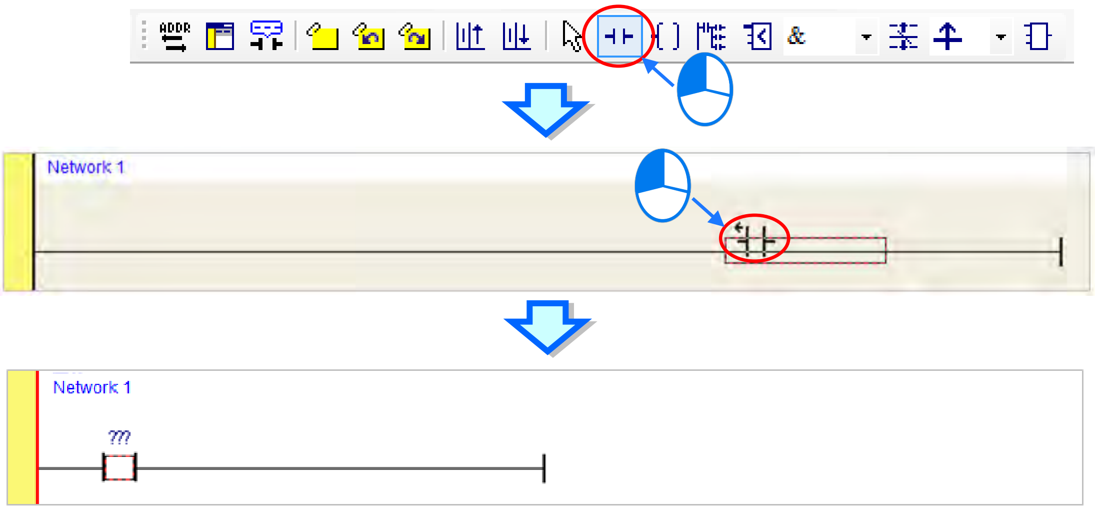
Icon	Keyboard shortcut	Function
	None	Switch to the Address mode
	Shift+Ctrl+C	Displaying/Hiding the comments on the networks
	None	Displaying/Hiding the commands on the devices
	Shift+Ctrl+B	Adding a bookmark to the network selected or deleting a bookmark from the network selected
	Shift+Ctrl+P	Going to the previous bookmarked position
	Shift+Ctrl+N	Going to the next bookmarked position
	Ctrl+I	Putting a network above the network selected
	Shift+Ctrl+I	Putting a network under the network selected
	ESC	Selection
	Typing an instruction	Inserting a contact
	Typing an instruction	Inserting a coil
	Typing an instruction	Inserting a comparison contact
&	Typing an instruction	Selecting a type of comparison contact
	Typing an instruction	Inserting a block logic instruction (NP/PN/INV/FB_NP/FB_PN)
	Typing an instruction	Selecting a type of block logic instruction (NP/PN/INV/FB_NP/FB_PN)
	Shift+Ctrl+U	Inserting an instruction or a function block

***. Please refer to section 4.5.3 for more information about typing an instruction.**

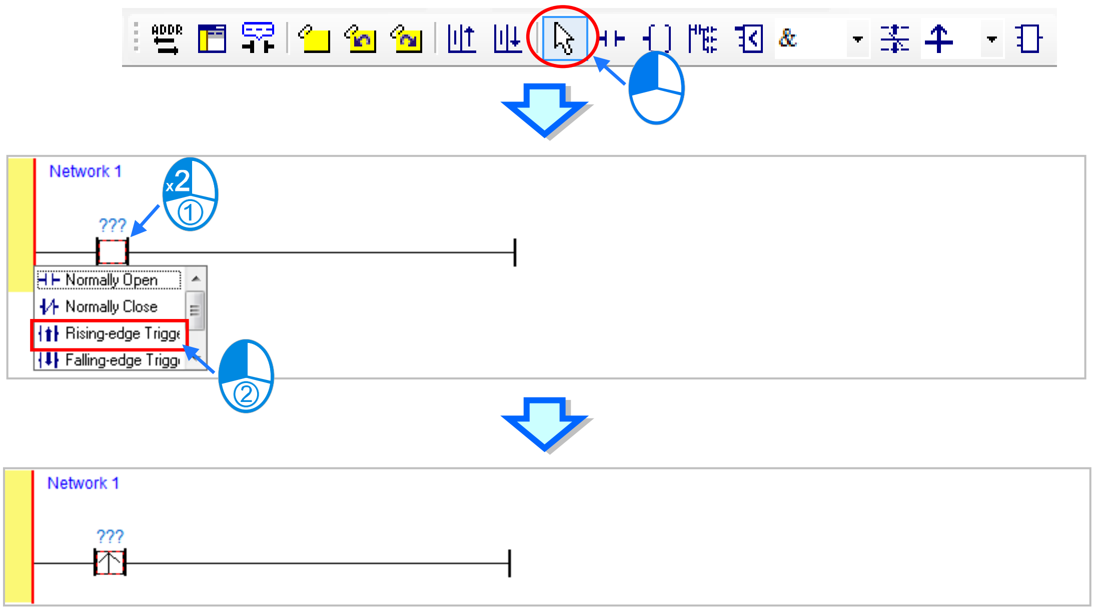
4.5.2 Basic Editing - Creating a Contact and a Coil

(1) Click on the toolbar, and then move the mouse cursor to the red frame in network 1. The mouse cursor appears as a contact when the mouse cursor is moved to the left side of the red frame, the right side of the red frame, or the bottom of the red frame. You can decide where to insert a contact. If a ladder diagram is edited, the mouse cursor must be near a position which is edited. Besides, an object inserted is arranged by the system automatically. You cannot move the object at will.

In this example, users do not need to decide where to insert the contact. Just move the mouse cursor near the red frame and click the left mouse button.

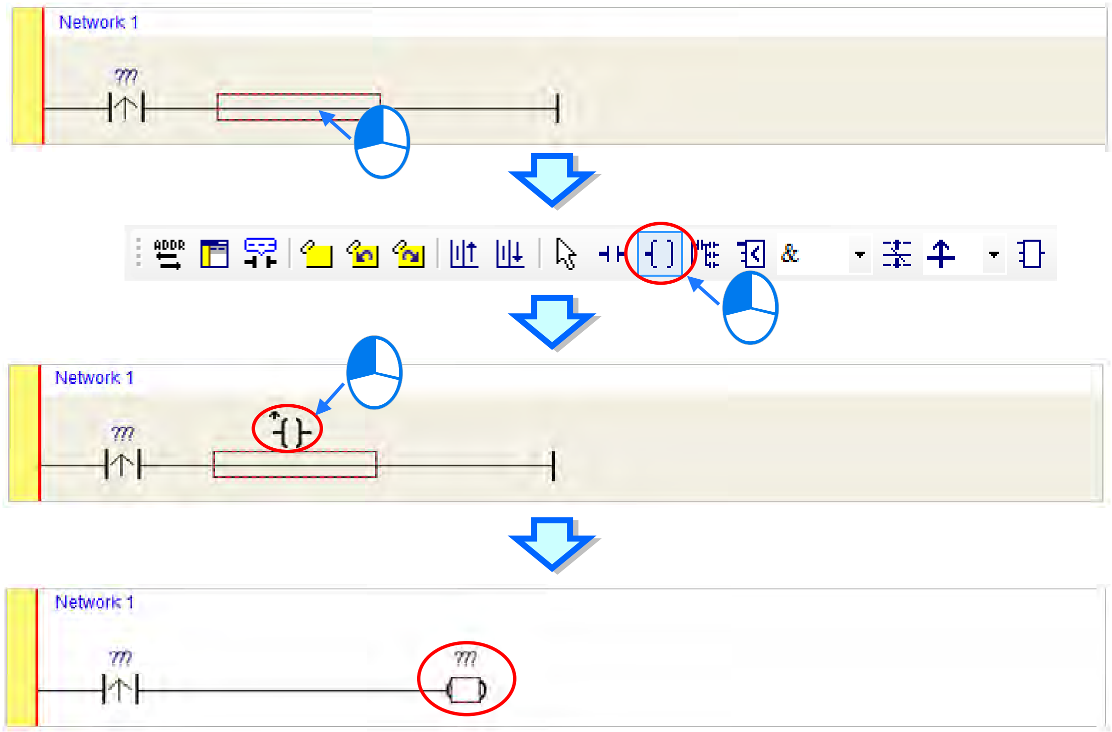


(2) Click on the toolbar, or press Esc on the keyboard. After the contact is double-clicked, a drop-down list will appear. The items on the drop-down list are **Normally Open**, **Normally Close**, **Rising-edge Trigger**, and **Falling-edge Trigger**. In this example, **Rising-edge Trigger** is selected.

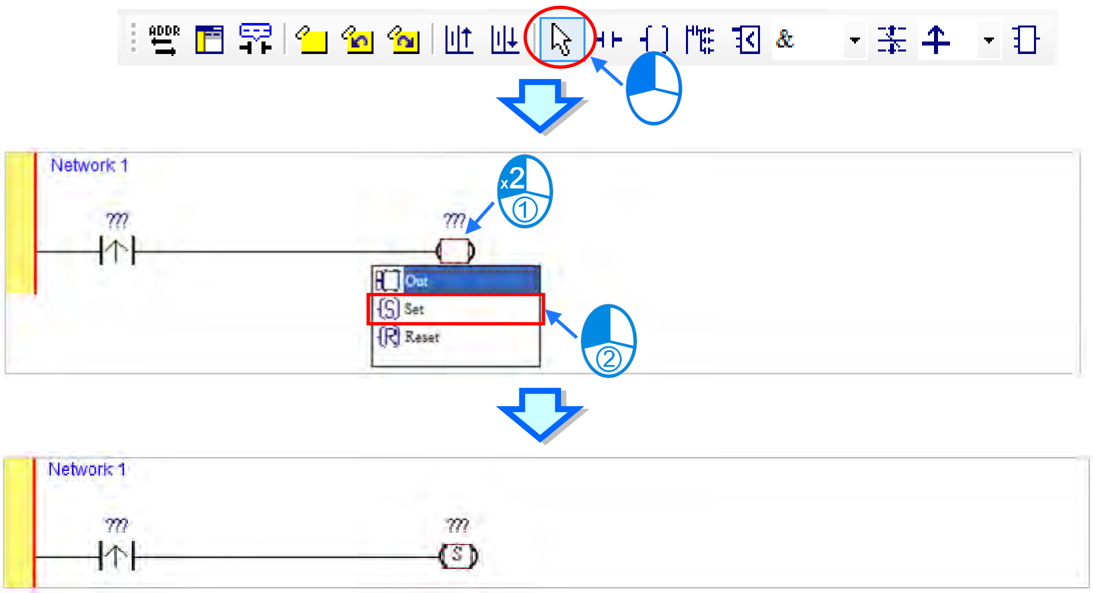


(3) Click the line at the right side of the contact, click  on the toolbar, and move the mouse cursor to the red frame. Likewise, the mouse cursor appears as a coil when the mouse cursor is above or under the red frame. You can decide where to insert the coil.

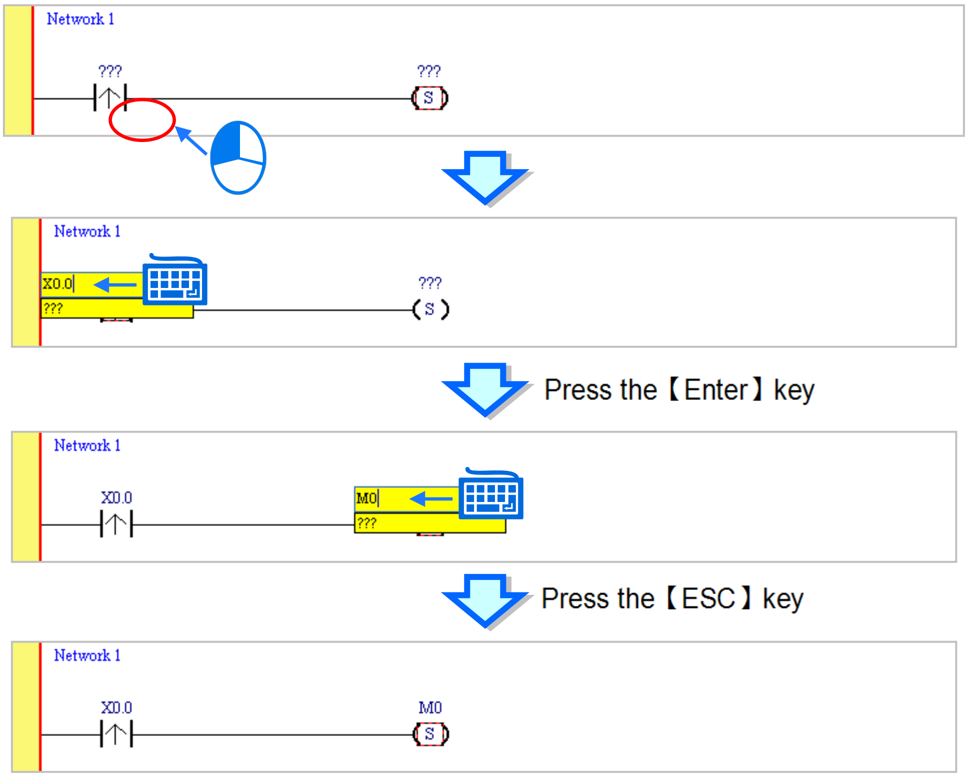
In this example, you do not need to decide where to insert the coil. Just move the mouse cursor near the red frame and click the left mouse button.



(4) Click  on the toolbar, or press **Esc** on the keyboard. After the coil is double-clicked, a drop-down list will appear. The items on the drop-down list are **Out**, **Set**, and **Reset**. In this example, **Set** is selected.



(5) Click ??? above the contact, type a device address in the box, and press Enter on the keyboard to jump to the next box in the network. After a device address is typed in the box, the users can press Esc on the keyboard to complete the editing. In this example, X0.0 is typed in the box for the contact, and M0 is typed in the box for the coil.

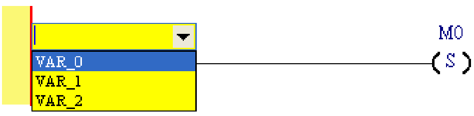


Additional remark

After users click a network and press Enter on the keyboard, they can edit a box. The users can edit the next box in the network after they press Enter on the keyboard. Besides, the next network is selected after the users press Tab on the keyboard. The users can edit a box with the keyboard. After the editing is complete, the users can press Enter on the keyboard to jump to the next box. If the users want to end the editing, they can press Esc on the keyboard.

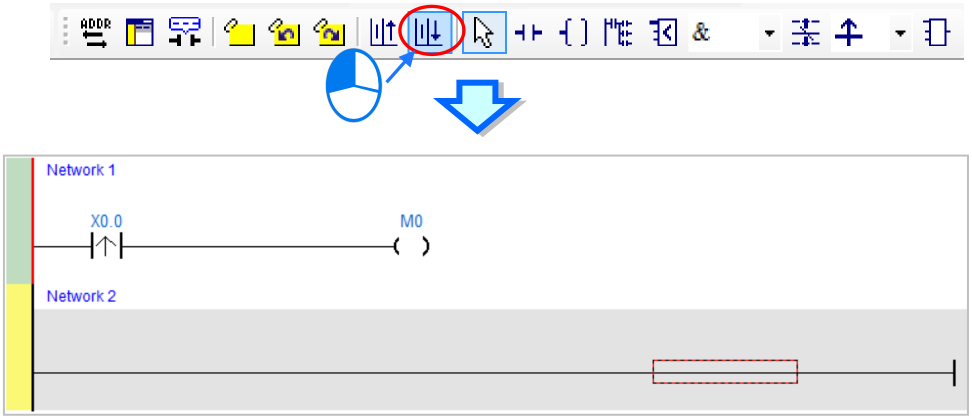
If the users have declared symbols, users can type the symbols or clear the field and use the drop-down list to select the symbols which can be assigned to the object.

The users can select a symbol by the mouse or the up/down key on the keyboard. Please refer to chapter 6 for more information about symbols.



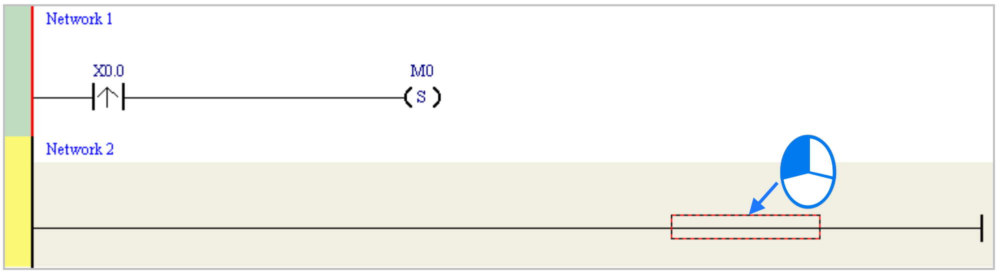
4.5.3 Basic Editing - Inserting a Network and Typing an Instruction

After [icon] on the toolbar is clicked, a network will be under the network selected. After [icon] on the toolbar is clicked, a network will be put above the network selected. In this example, a network is under network 1.

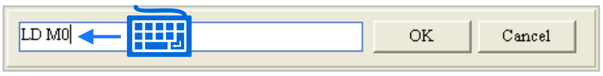


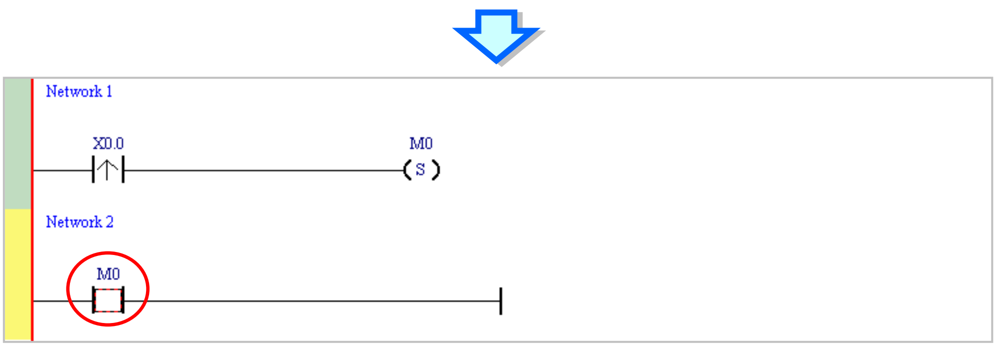
A contact and a coil can be created not only by clicking [icon] and [icon] on the toolbar, but also by typing instructions.

(1) Click the line in network 2.

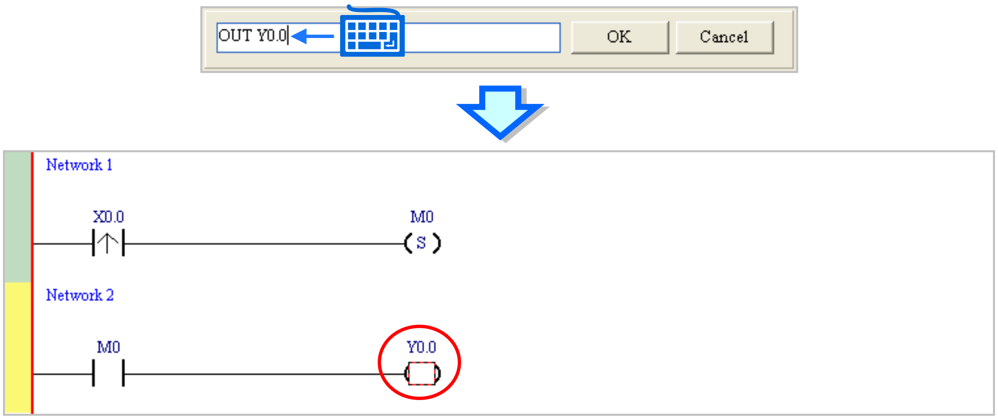


(2) Type the IL instruction “LD M0”. (The instruction is case-insensitive.) As soon as the IL instruction is typed, a box which can be edited appears. After the typing of the IL instruction is complete, users can press Enter on the keyboard or click **OK** at the right side of the box.





(3) Type the IL instruction “OUT Y0.0”, and write the program shown below.

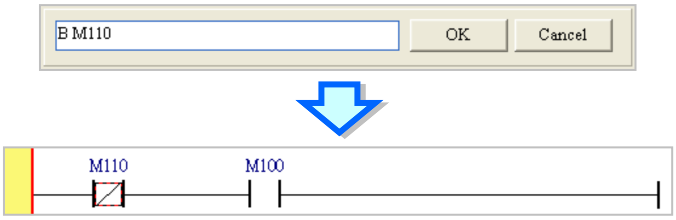


<u>Additional remark</u>

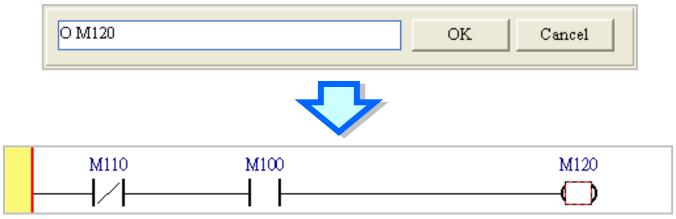
A contact and a coil can be created by typing simple instructions. Please refer to the description below. (The instructions typed are case-insensitive.)

- Inserting a normally-open contact (contact A): “A Device address”

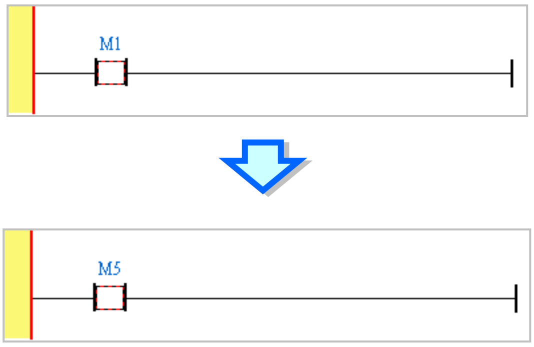
- Inserting a normally-closed contact (contact B): “B Device address”



- Inserting an output coil (OUT): “O Device address”

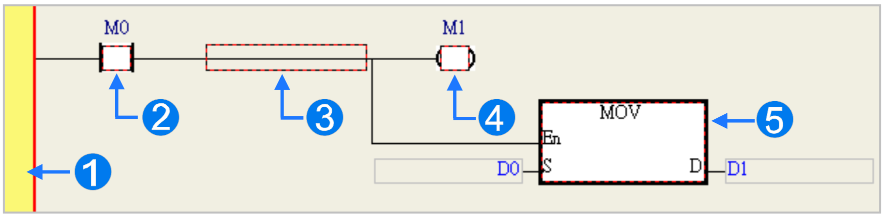


When adding devices, press [Insert] on the keyboard to choose **Insert** or **Replace** mode. Use [Insert] on the keyboard to input LD M5 on M1 position and M1 is replaced by M5 (see below).



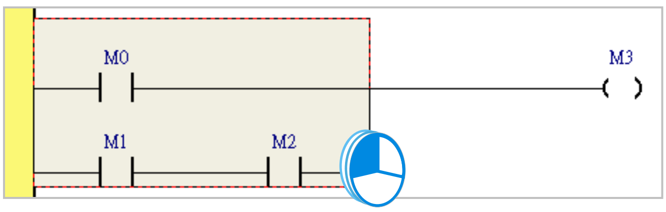
4.5.4 Basic Editing - Selection of a Network and Operation

When selecting in the ladder diagram, users can press [Esc] on the keyboard, or click  from the toolbar. After the mouse cursor appears in select mode, click the selected item. Basic operating steps are shown below.

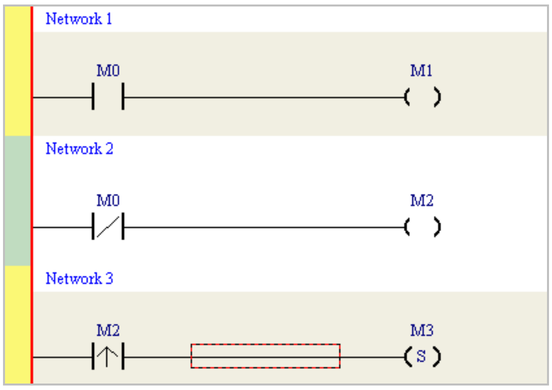


❶ Select the entire network
❷ Select an input
❸ Select the section
❹ Select the output coil
❺ Select the block

If users want to select a group of devices, they can click a device, and drag it to draw a frame round the group of devices. The users can also select the group of devices by clicking the first device, pressing Ctrl+B on the keyboard, clicking the last device, and pressing Ctrl+B on the keyboard. Users must draw a frame round devices which are in the same network, and the devices must be adjacent to one another. Besides, input devices and output devices cannot be in the same frame.



If users want to select several networks, they can press Ctrl on the keyboard, and click the networks. The users can also select a range of networks by pressing Shift on the keyboard, clicking the first network within the range, and the last network within the range.

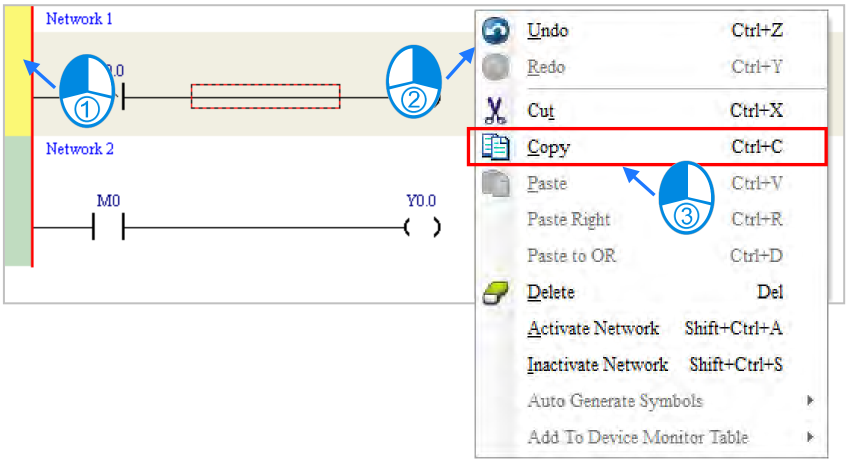


Right-click the selected item and execute basic operations from the quick start menu.

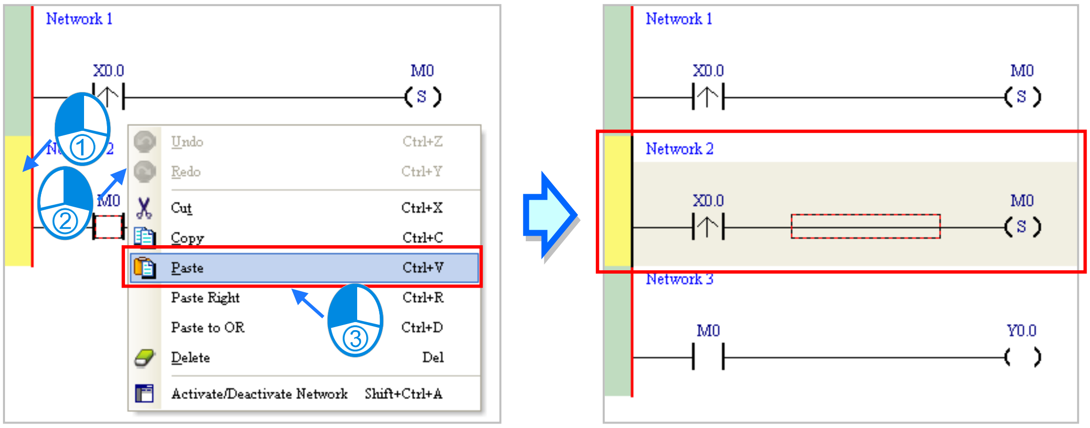
Item	Function
Undo	Undoing the last action (The number of previous actions that can be undone is 20.)
Redo	Redoing an action which has been undone
Cut	Cutting a device, a block, or a network
Copy	Copying a device, a block, or a network
Paste	Paste an object which has been copied or cut on the present position
Paste right	Pasting an object at the right side of the position selected (The object will be connected to the position selected in series.)
Paste under	Pasting an object under the position selected (The object will be connected to the position selected in parallel.)
Delete	Deleting a device, a block, or a network
Activate Network	Set the selected network to activate
Inactivate Network	Set the selected network to Inactivate
Variable Generated	To generate variable automatically and use on pins for function blocks
Add to Device Monitoring Table	Use on the selected pins to quickly add the device in the monitoring table

Users can proceed with the operation in the example.

(1) Select network 1, right-click network 1, and click **Copy** on the context menu.

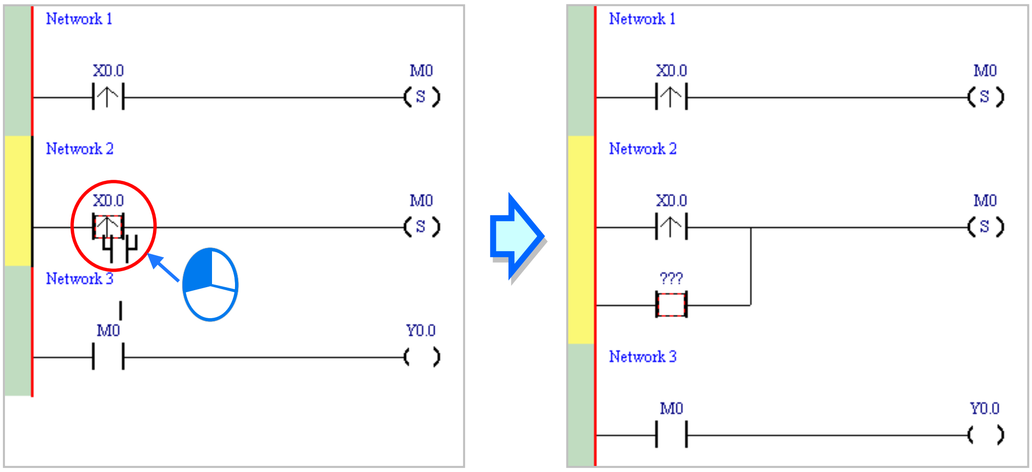


(2) Select network 2, right-click network 2, and click **Paste** on the context menu. A copy of network 1 will be put above network 2, and network 2 will become network 3.

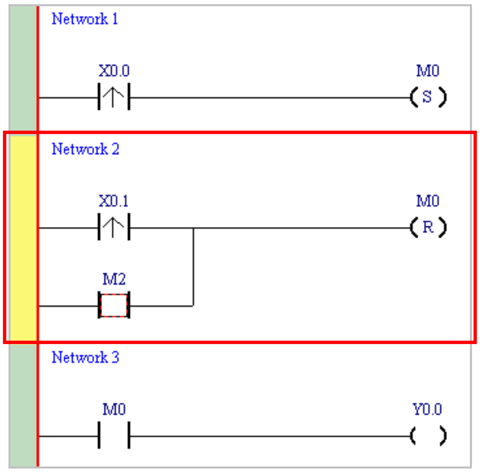


4.5.5 Basic Editing - Connecting a Contact in Parallel

(1) Click on the toolbar, and then move the mouse cursor to the input contact in network 2. The mouse cursor will appear as a contact. Move the mouse cursor to the button of the input contact in network 2. After the mouse cursor appears as , users can click the left mouse button. A contact will be connected to the input contact in network 2 in parallel.

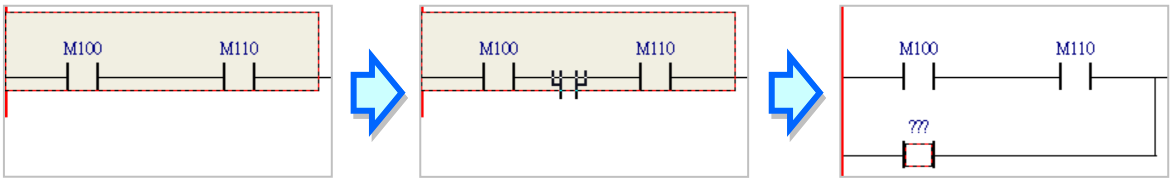


(2) Write the program in network 2 shown below in the way described above.



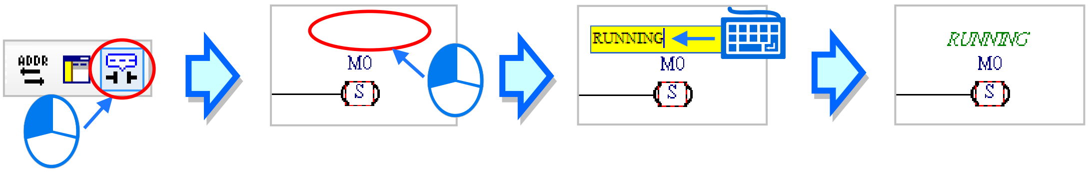
Additional remark

After users select a group of contacts, they can connect a contact to the group of contacts in the way described above.

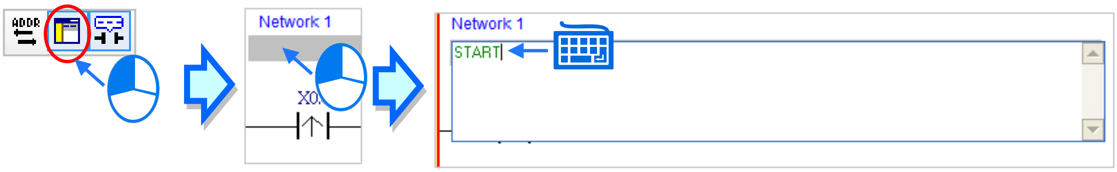


4.5.6 Basic Editing - Editing a Comment

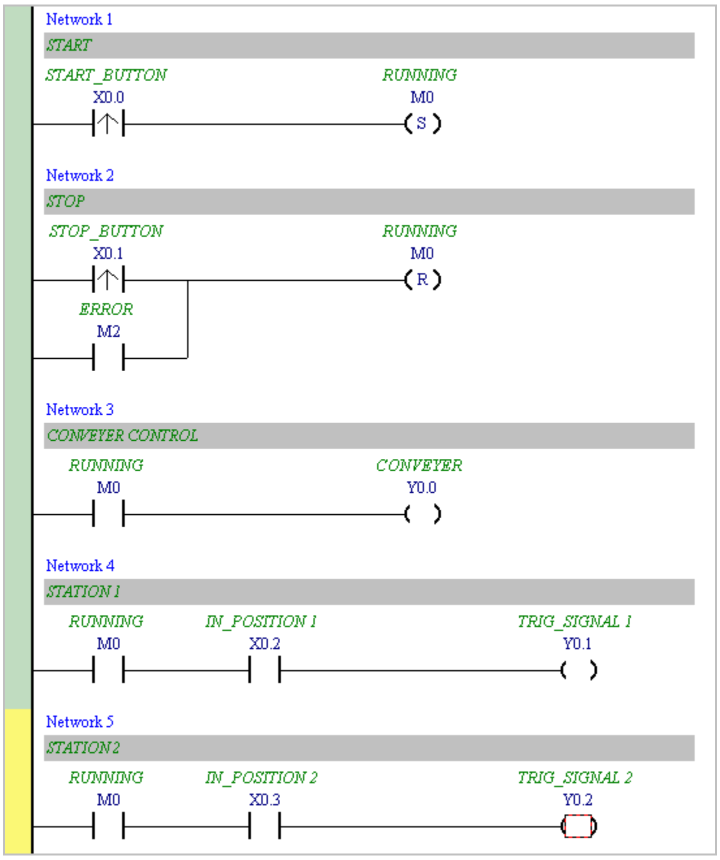
(1) Make sure that  on the toolbar is pressed. Click the position above a device name, type a comment in the box, and press Enter on the keyboard.



(2) Make sure that  on the toolbar is pressed. Click the position under a network number, and then type a comment in the box. If users want to start a new line of text at a specific point, they can press Shift+Enter on the keyboard. Press Enter on the keyboard after the editing is complete.

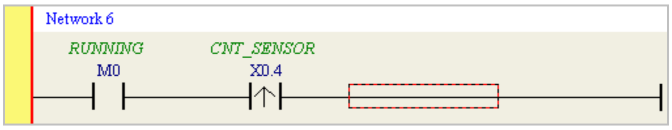


(3) Write the program shown below in the way described above.



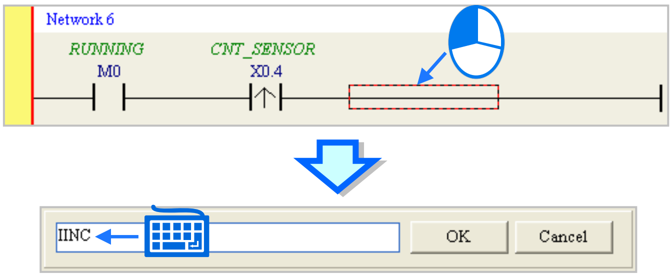
4.5.7 Basic Editing - Inserting an Applied Instruction

Put network 6 under network 5, and then write the program shown below. Users can insert an applied instruction in one of the three ways described below.



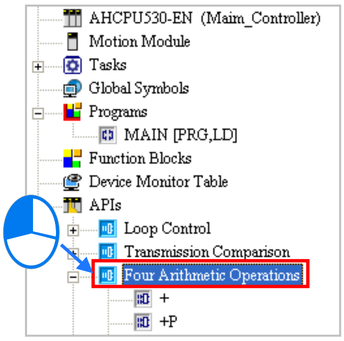
- Method 1

Click the position where an instruction will be inserted, type the instruction (INC in this example), and press Enter on the keyboard.

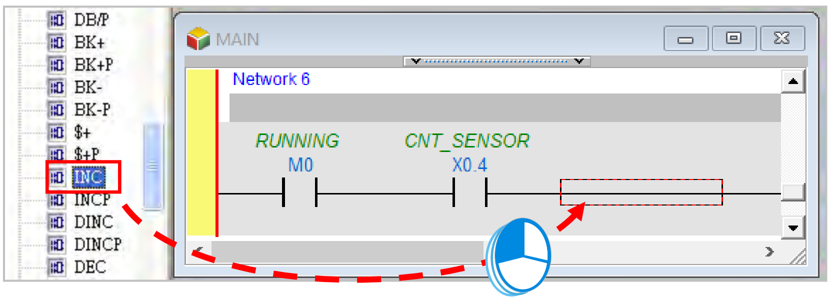


- Method 2

Unfold the **APIs** section in the project management area, find the instruction type, and unfold the instruction type section.

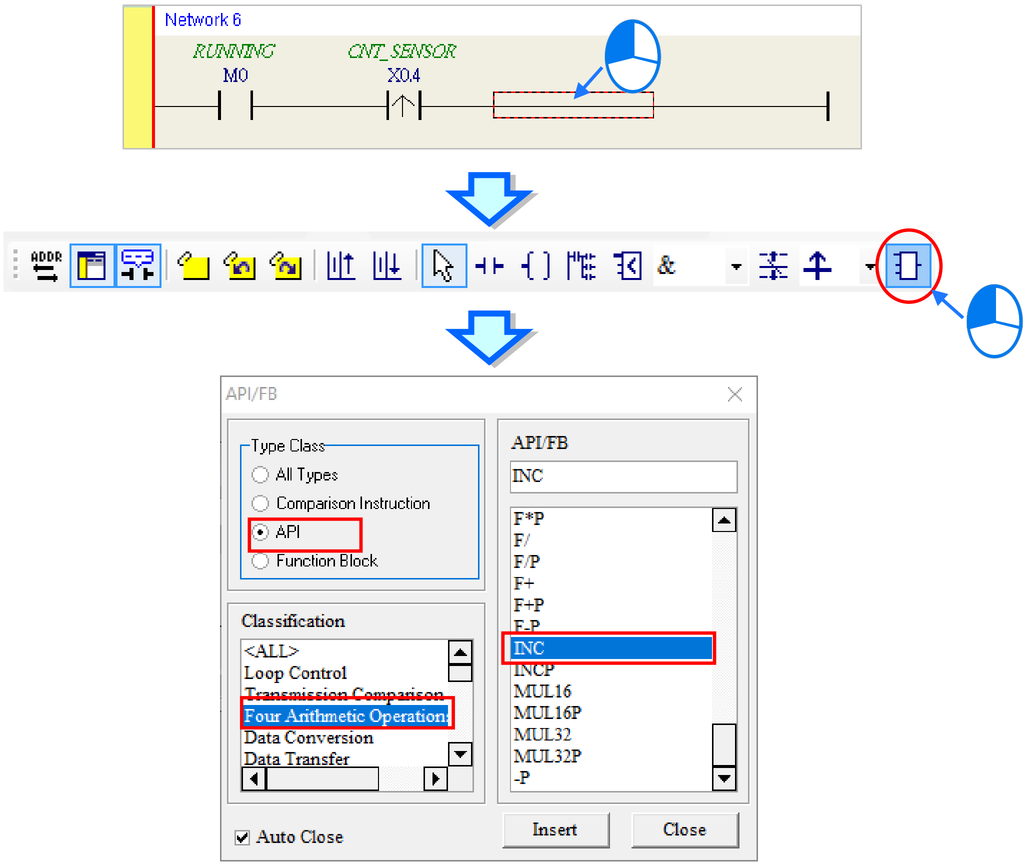


Select the instruction (INC in this example) which will be inserted, and then drag it to the position where it will be inserted.

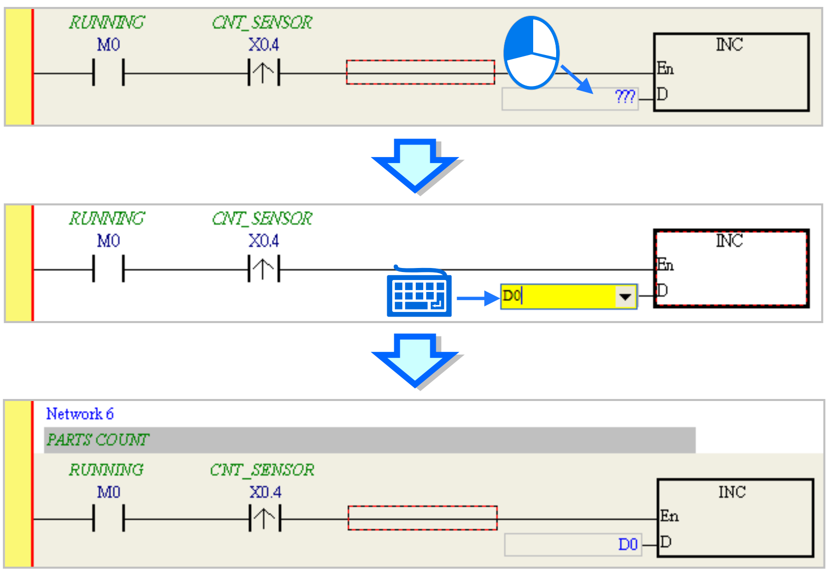


● Method 3

Click the position where an instruction will be inserted, click on the toolbar, select the instruction (INC in this example) which will be inserted in the **API/FB** window, and click **Insert**.

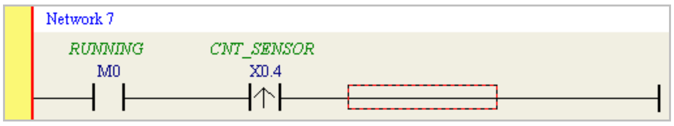


After the instruction is inserted successfully, the users can assign a device address to the operand, and write the program shown below.



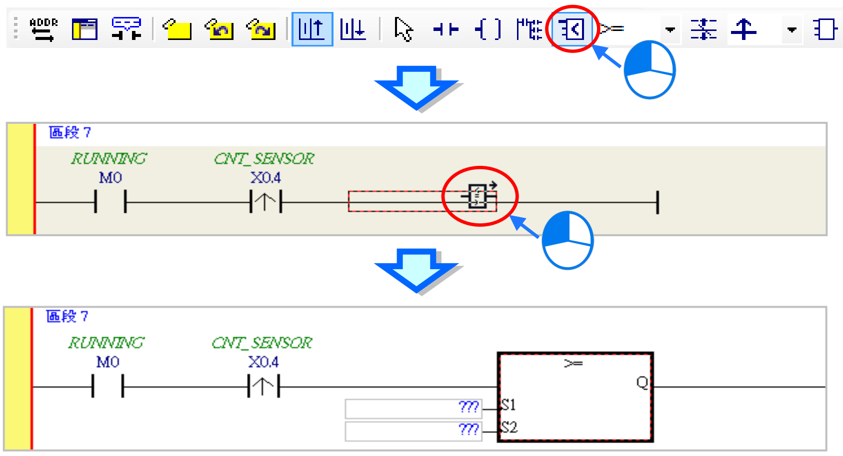
4.5.8 Basic Editing - Creating a Comparison Contact and Typing a Constant

A comparison contact can be inserted not only in one of the three ways described in section 4.5.7, but also by means of the following steps. Users need to put network 7 under network 6, and write the program shown below.

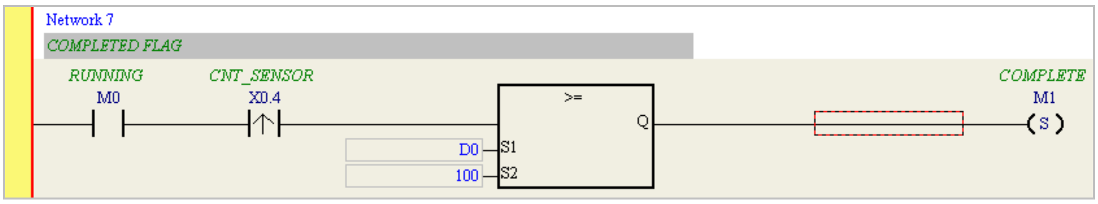


(1) Click  on the toolbar, and then select a type (>= in this example).

(2) Click  on the toolbar, and then move the mouse cursor to the position where the comparison contact will be inserted. The mouse cursor appears as a comparison contact when the mosue is moved to the left side of the red frame, the right side of the red frame, or the bottom of the red frame. The users can decide where to insert the comparison contact. After the users decided on a position, they can click the left mouse button to insert the comparison contact.

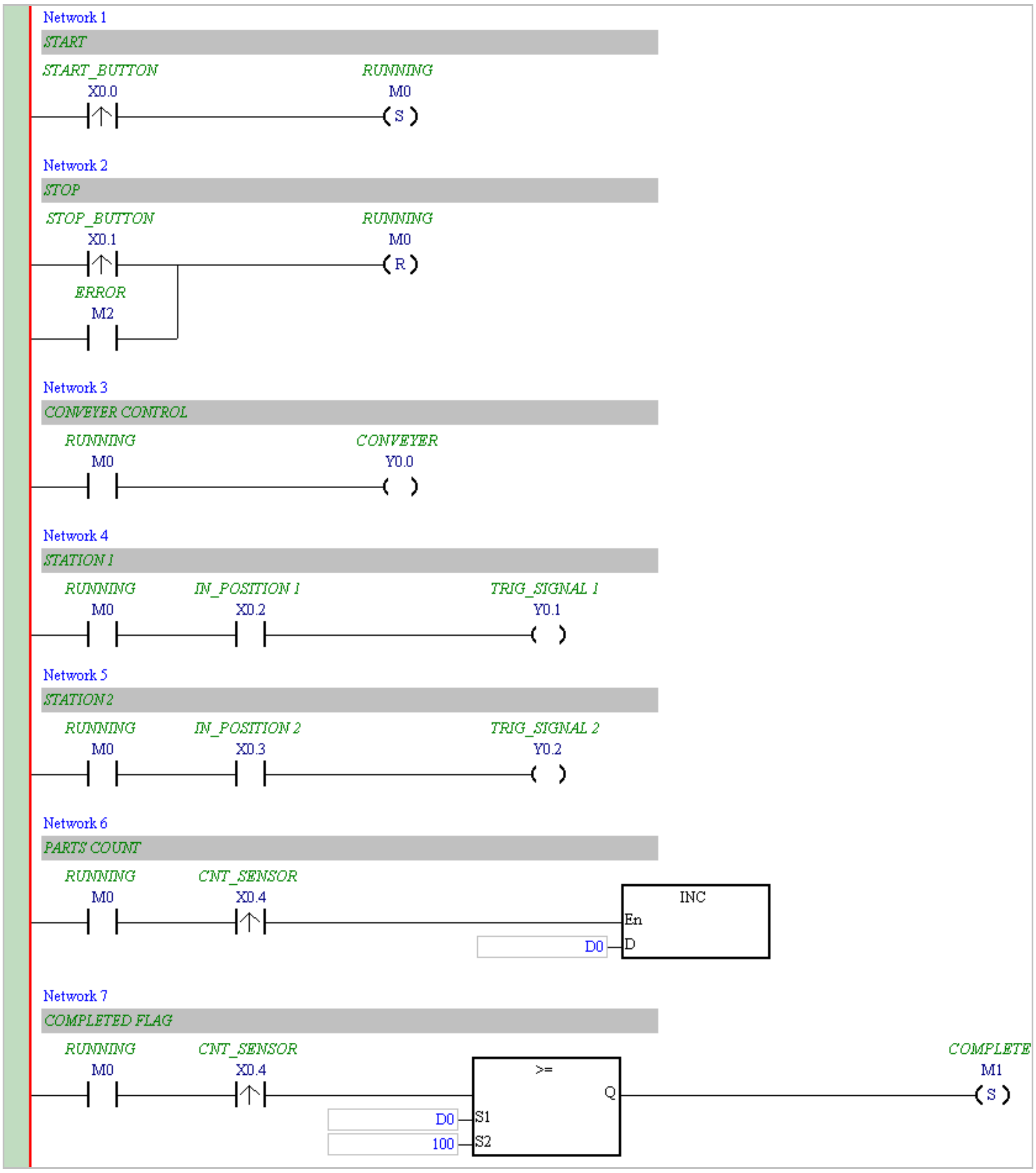


Write the program shown below in the way described above. In WPLSoft, a decimal value is preceded by K, and a hexadecimal value is preceded by H. If users want to type a decimal value in ISPSoft, they can type it directly. If users wan to type a hexadeicmal value in ISPSoft, they have to type “16#” and the hexadecimal value, e.g. 16#7FFF. In ISPSoft, an octal value is preceded by 8#, and a binary value is preceded by 2#.



4.5.9 Writing a Program

The creation of a traditional ladder diagram in ISPSoft has been introduced. Users can write the program shown below in the way described in the previous sections. Owning to the fact that the program has not been compiled, the mother line at the left side of the ladder diagram is red during the writing of the program. The following sections will introduce how to compile the program, and how to download the program which has been compiled to the CPU module to test the program.



***1. The program above is saved in the folder denoted by ...\ISPSoft x.xx\Project\Example\Gluing_System_C.**

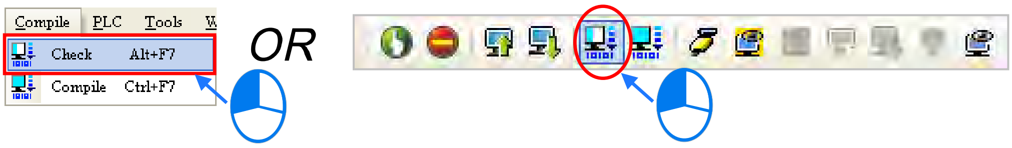
***2. Please refer to chapter 10 for more information about creating a ladder diagram.**

4.5.10 Checking and Compiling a Program

After users write a program, they can check the syntax of the programming language or compile the program. The syntax and the structure in the present window will be checked after the **Check** function is enabled. The whole project will be checked after the **Compile** function is enabled. If there is no error in the project, an execution code will be generated automatically. After the program is compiled successfully, the mother line at the left side of the ladder diagram will become black.

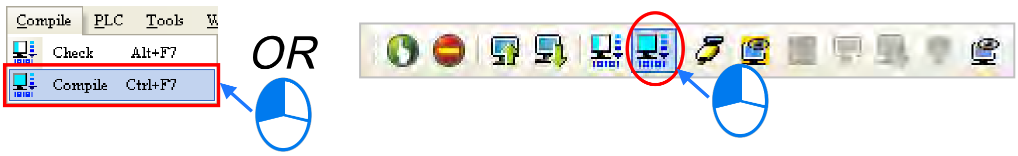
● **Check**

Click **Check** on the **Compile** menu, or  on the toolbar.

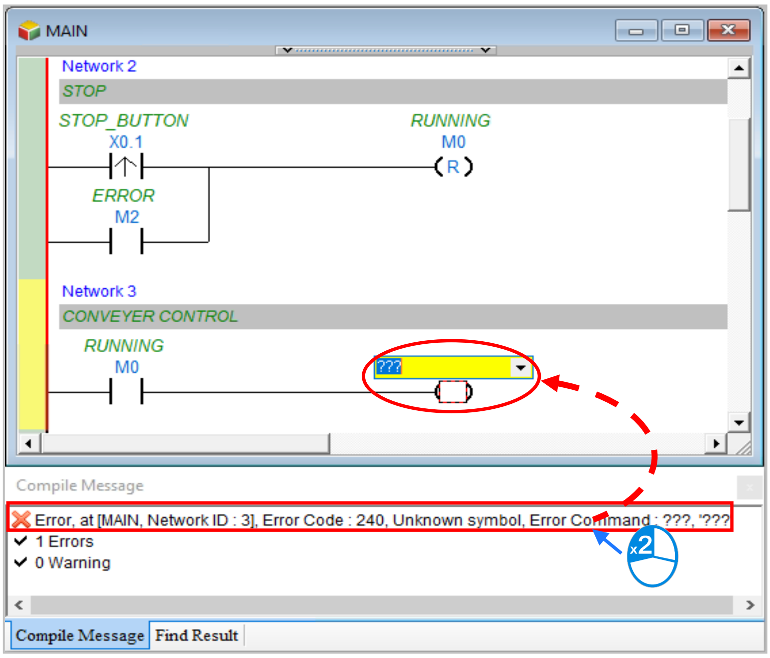


● **Compile**

Click **Compile** on the **Compile** menu, or  on the toolbar.



After the check is complete, the **Compile Message** page shows the result related to the check. If there is any error in the project, the **Compile Message** page will show the related message. After the message is clicked, the system will automatically lead users to the place where the error occurs. The users can enable the **Check** function or the **Compile** function after the error is eliminated.



4.6 Testing and Debugging a Program

4.6.1 Creating a Connection

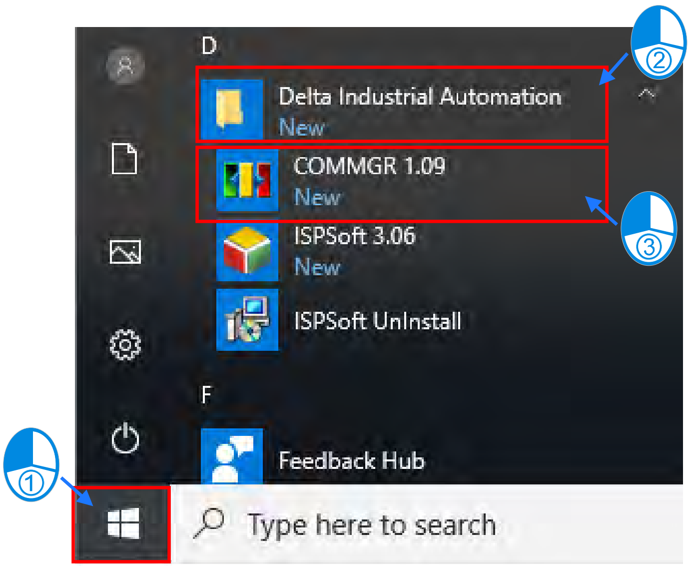
Before a program and parameters are downloaded to a PLC or monitored online, ISPSoft must be connected to the PLC. In this example, ISPSoft is connected to AHCPU530-EN host CPU through a USB cable.

For those already connected to the host, please skip to section 4.6.2 on details regarding download program and configuration parameters.

(1) Install the modules on the main backplane in accordance with the hardware configuration in HWCONFIG. Make sure that the wiring is correct, and then power the CPU module.

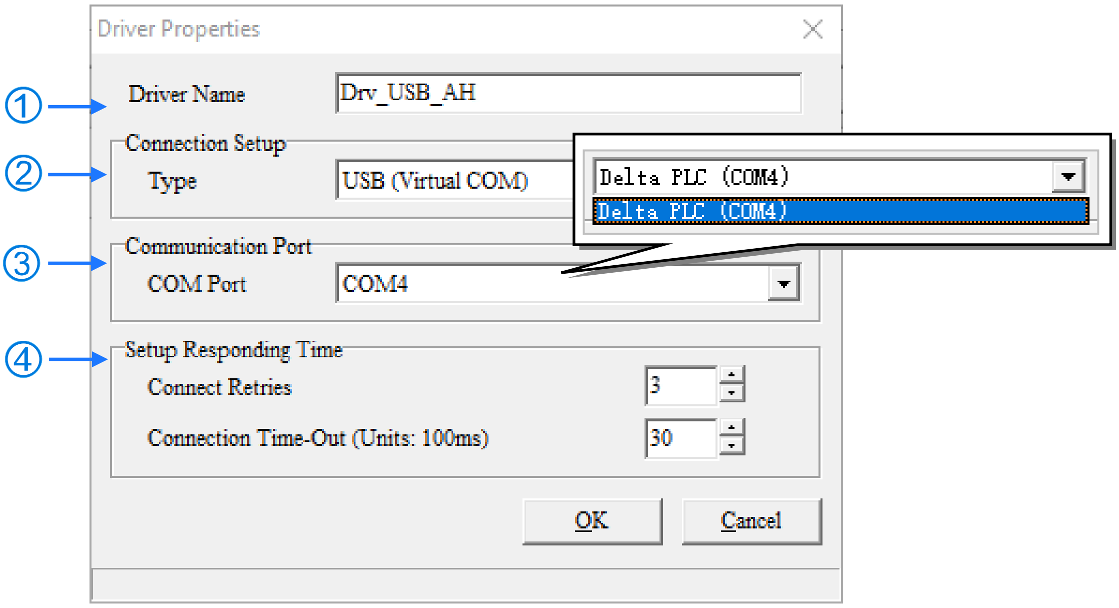
(2) Connect the CPU module to the computer through a USB cable. If the USB driver for the AH500 series CPU module has been installed on the computer, **Delta PLC** will appear in the **Device Manager** Window, and a port number will be assigned to **Delta PLC**. Please refer to appendix A for more information about installing a USB driver.

(3) Make sure that COMMGR is started, and the icon representing COMMGR is displayed on the system tray. If the icon representing COMMGR is not displayed on the system tray, users can start COMMGR by clicking the shortcut on the **Start** menu (**Start**>**Programs**>**Delta Industrial Automation**>**Communication**>**COMMGR)**.



(4) Double-click the icon representing COMMGR on the system tray to open the **COMMGR** window. Click **Add** in the **COMMGR** window to create a driver.

(5) Set the parameters in the **Driver Properties** window, and then click **OK**.



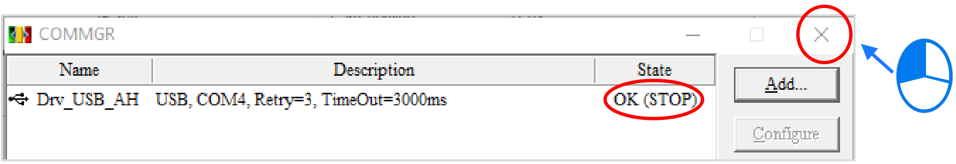
① Type a driver name in the **Driver Name** box.

② Select **USB (Virtual COM)** in the **Type** drop-down list box in the **Connection Setup** section.

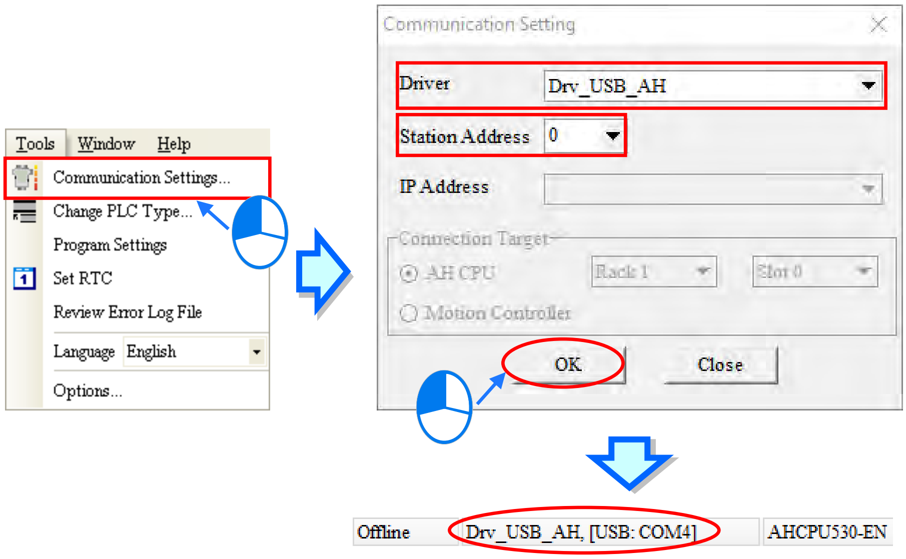
③ Select a communication port in the **COM Port** drop-down list box. If the first two steps are complete, the PLC which is connected and its communication port will be displayed in the **COM Port** drop-down list box.

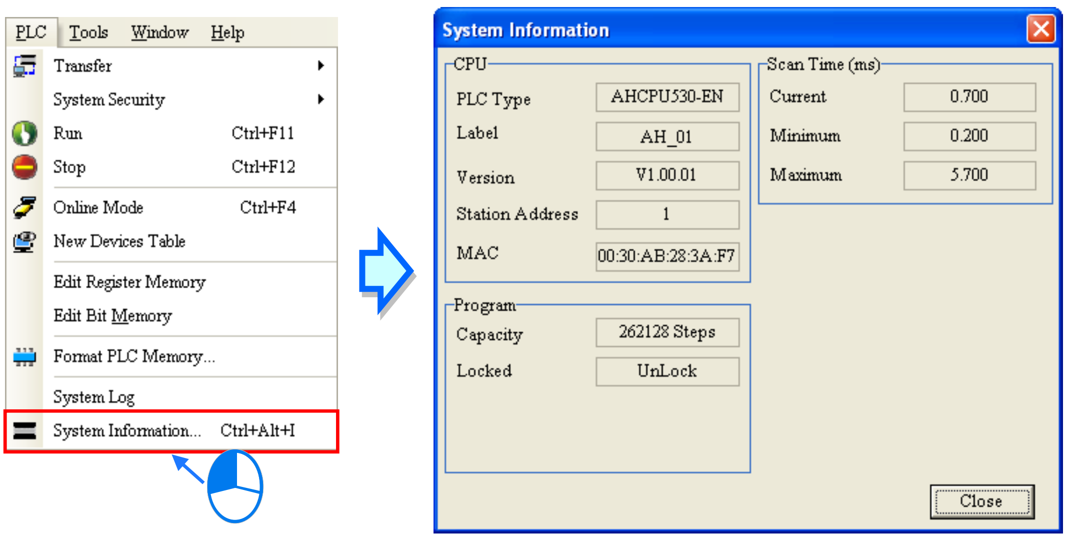
④ Users can select the number of times the sending of a command is retried if a connection error occurs in the **Time of Auto-retry** box, and select an interval of retrying the sending of a command in the **Time Interval of Auto-retry** box.

(6) After the status of the driver displayed in the window becomes **OK**, the window can be closed. The icon representing COMMGR will still be displayed on the system tray.

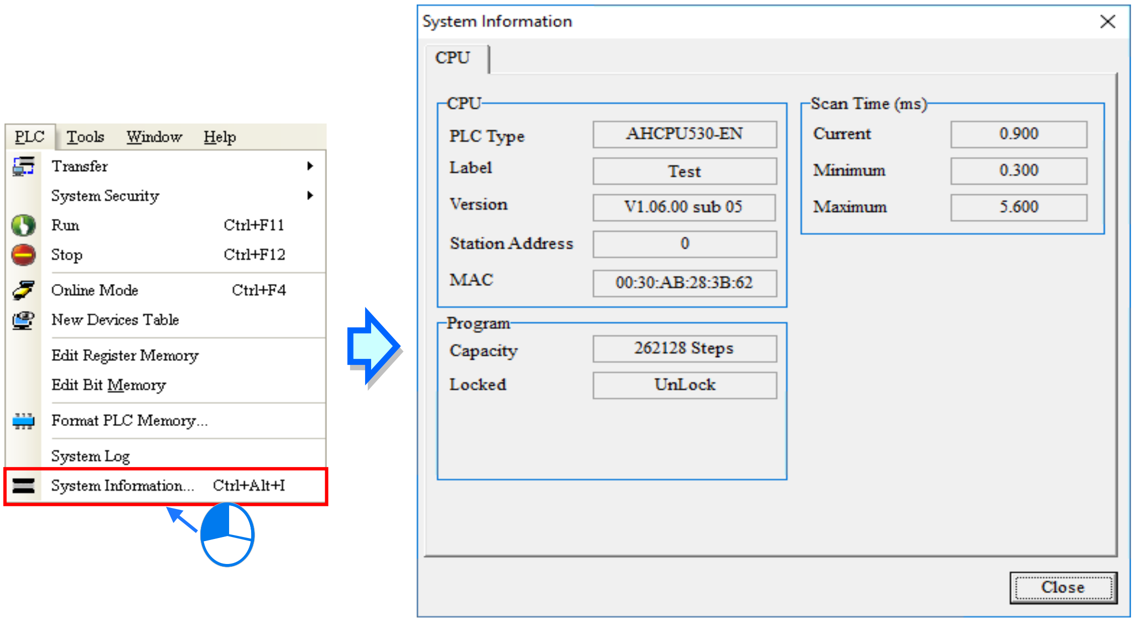


Start ISPSoft, and then click **Communication Settings…** on the **Tools** menu. In the **Communication Setting** window, select the driver which has been created in the **Driver** drop-down list box, appear, and select 0 in the **Station Address** drop-down list box, and click **OK**. The information about the driver will be displayed in the status bar in ISPSoft.





(7) Click **System Information** on the **PLC** menu. ISPSoft will retrieve related information from the PLC. If the computer communicates with the CPU module normally, the related information retrieved from the PLC will be displayed in the **System Information** window.

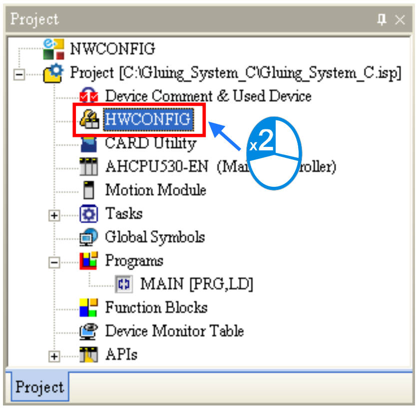


4.6.2 Downloading a Program and Parameters

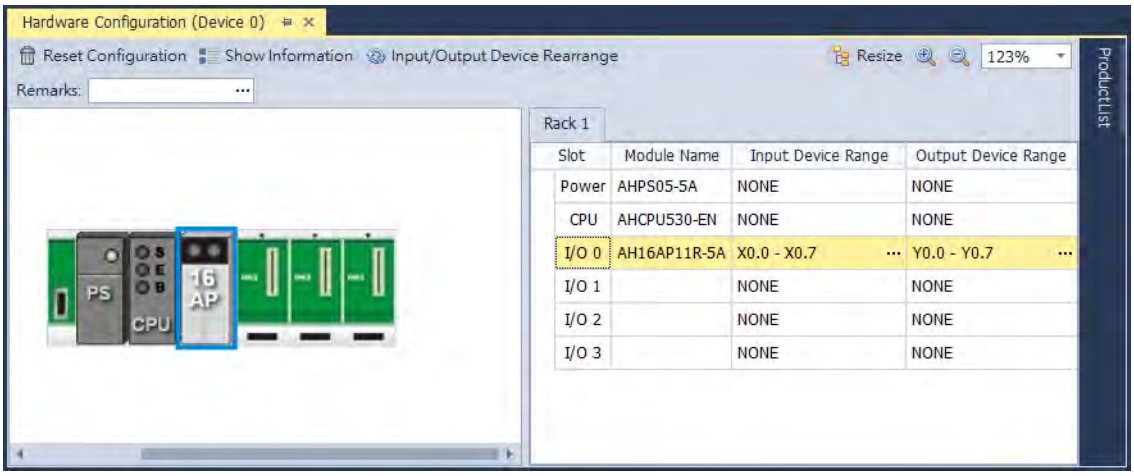
If ISPSoft is connected to a PLC normally, the parameters and the program in the project can be downloaded to the PLC. First, start ISPSoft and open the project created in the previous sections. In this example, two types of parameters are downloaded to the CPU module. They are the hardware configuration and the program.

- **Downloading the hardware configuration**

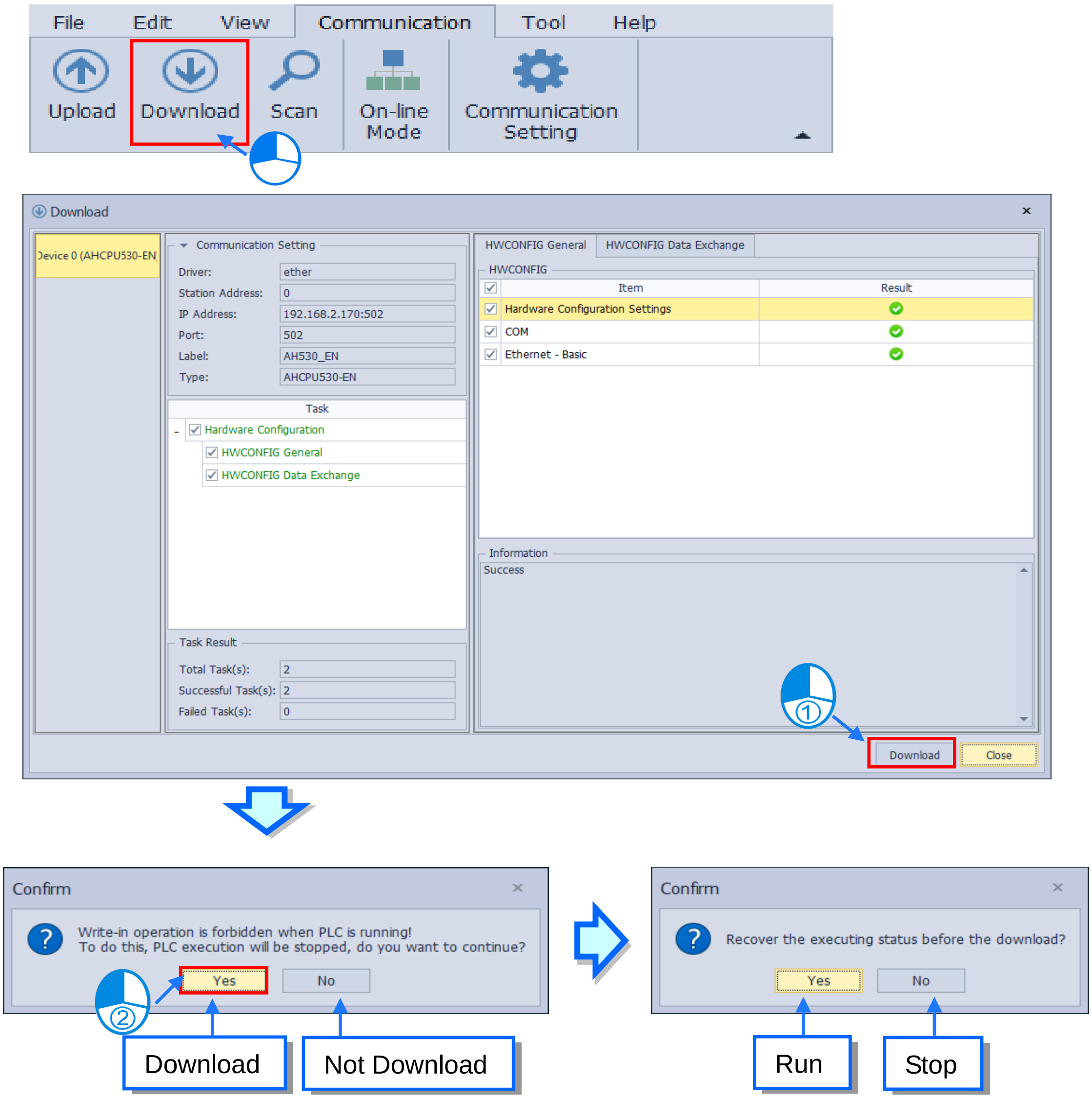
(1) Double-click **HWCONFIG** in the project management area to open the **HWCONFIG** window.



(2) The hardware configuration is displayed in the window. Before the hardware configuration is downloaded to the CPU module, users have to make sure that the actual hardware configuration is the same as the hardware configuration in the window.



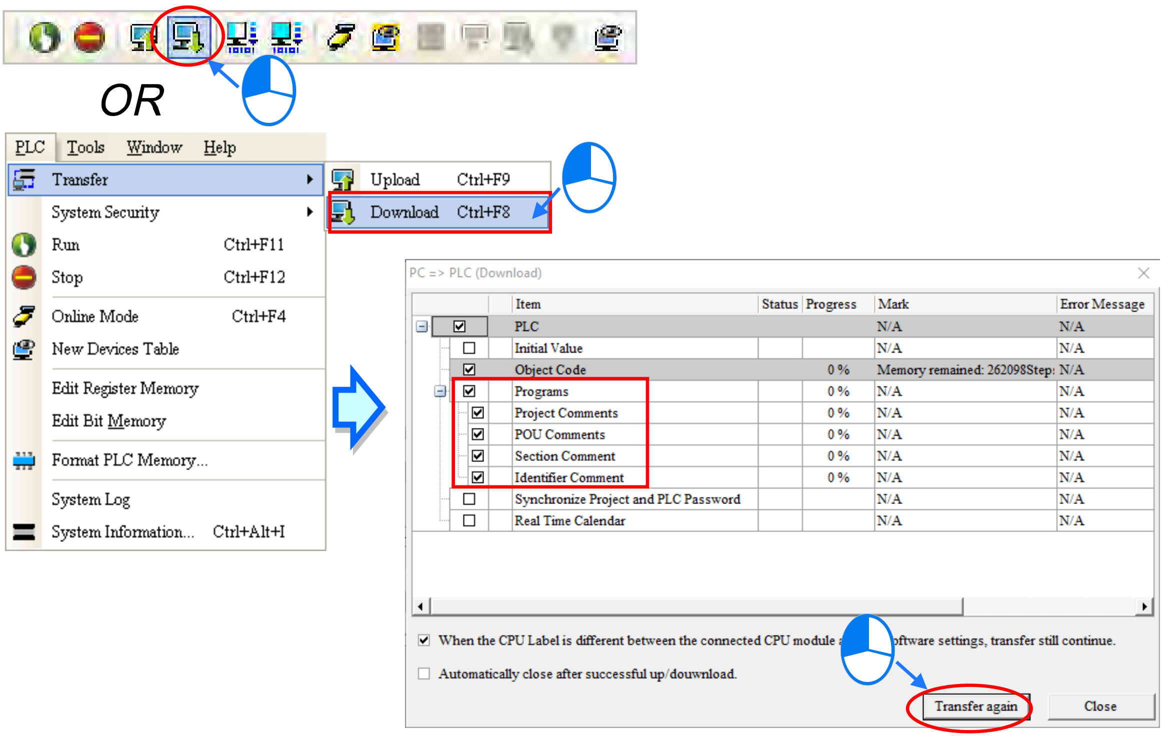
(3) After clicking **Download** on the tool bar, check the checkbox of the target item to download and click the download button at the bottom of the page.



(4) After the hardware configuration is downloaded to the CPU module successfully, the BUS FAULT LED indicator on the CPU module will be OFF. The users can close the **HWCONFIG** window. If the BUS FAULT LED indicator on the CPU module is still ON or blinking, the CPU module is in an abnormal state. Please make sure that the actual hardware configuration is the same as the hardware configuration in the **HWCONFIG** window again, or refer to the operation manual for more information about eliminating the error. Please refer to chapter 3 for more information about HWCONFIG.

● **Downloading the program**

After the program is compiled successfully, the users can click the **PLC** menu, point to **Transfer**, and click **Download**. The users can also click [toolbar icon] on the toolbar after the program is compiled successfully. Select the **Program** and related **Comments** checkboxes in the **Transfer Setup** window so that the program in the CPU module can be uploaded later, and then click **OK**.



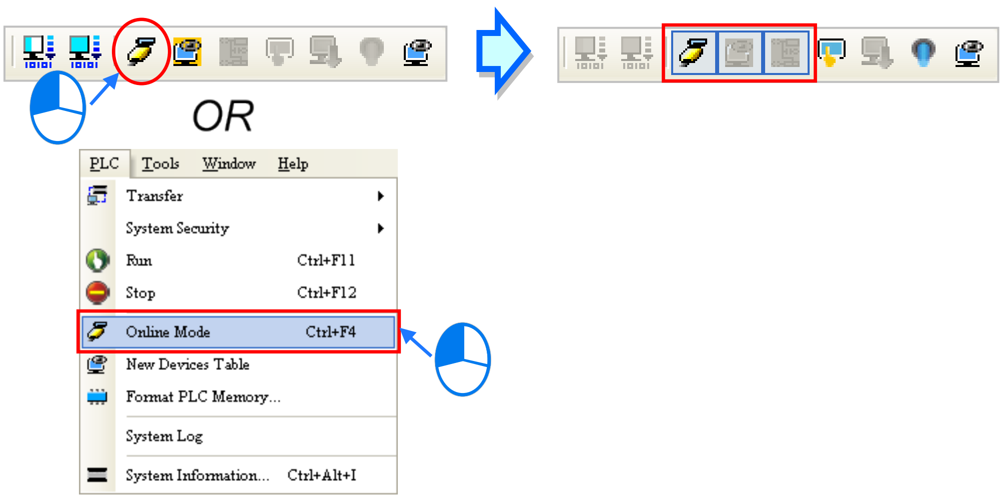
4.6.3 Connection Test

After a program is downloaded to a PLC, users can monitor the execution status of the PLC through ISPSoft. There are two monitoring modes that ISPSoft provide. One is the device monitoring mode, and the other is the program monitoring mode.

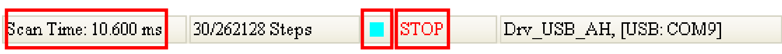
Monitoring mode	Description
 Device monitoring mode	Users can monitor the statuses of the devices in the PLC through the monitoring table. In this mode, ISPSoft only needs to update the statuses of the devices. The present program in ISPSoft does not need to be the same as the program in the PLC.
 Program monitoring mode	In this mode, the operating status of the program is displayed in the program editing window. As a result, the present program in ISPSoft must be the same as the program in the PLC.

***. The device monitoring function can be enabled independently. However, if the program monitoring function is enabled, the device monitoring function is also enabled.**

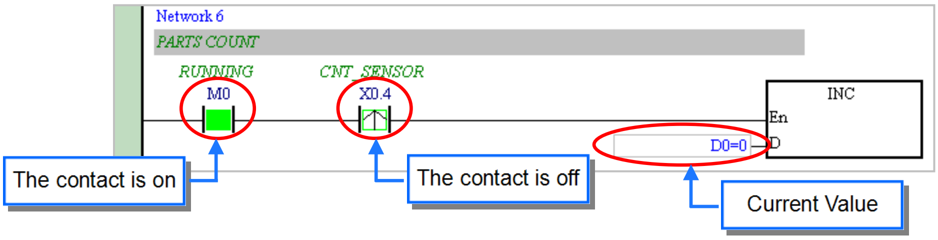
After users click **Online Mode** on the **PLC** menu, or  on the toolbar, the online monitoring function will be enabled. The system will also enable the device monitoring mode and the program monitoring mode.



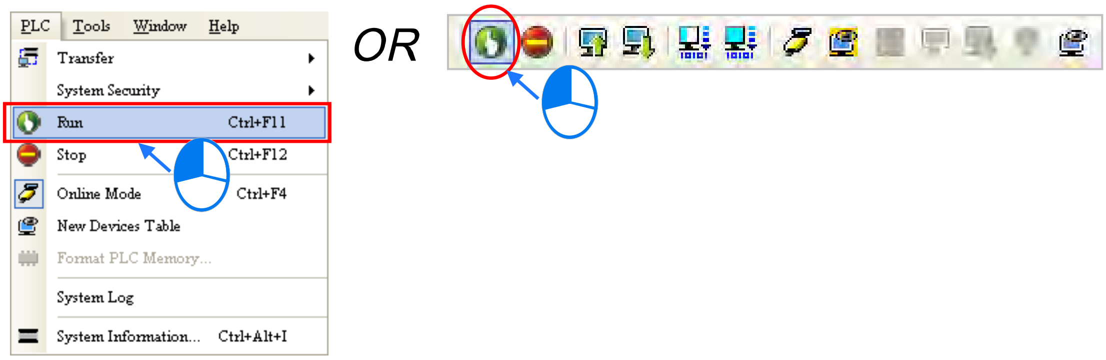
In the online monitoring mode, users can view the present scan time, the communication status, and the status of the PLC in the status bar in ISPSoft.



Besides, the present statuses of the devices will be displayed in the original program editing window after the program monitoring function is enabled.

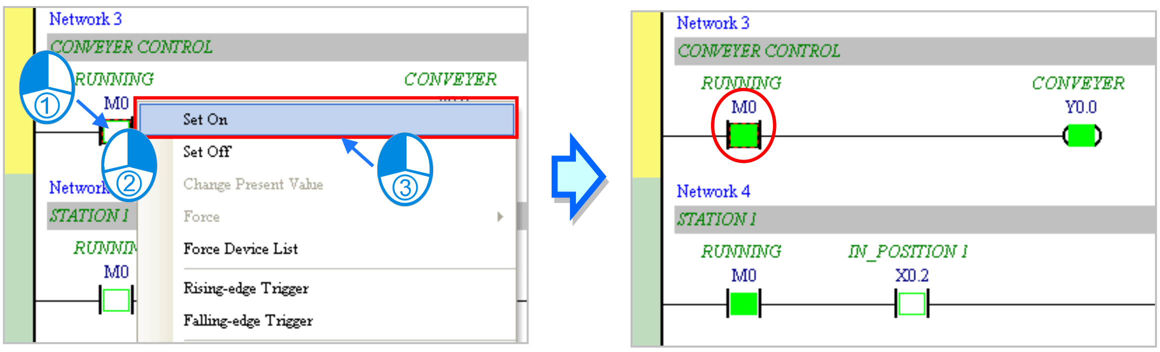


Users can change the operating status of a PLC by the RUN/STOP switch on the PLC. They can also change the operating status of the PLC through the functions provided by ISPSoft. After users click **Run** on the **PLC** menu or on the toolbar, the PLC will begin to run. The PLC will stop running after **Stop** on the **PLC** menu or on the toolbar is clicked.



In the online monitoring mode, users can select a device, right-click the device, and click an item on the context menu. During a test, users can change the status of a device or the value in a device by clicking an item on the context menu.

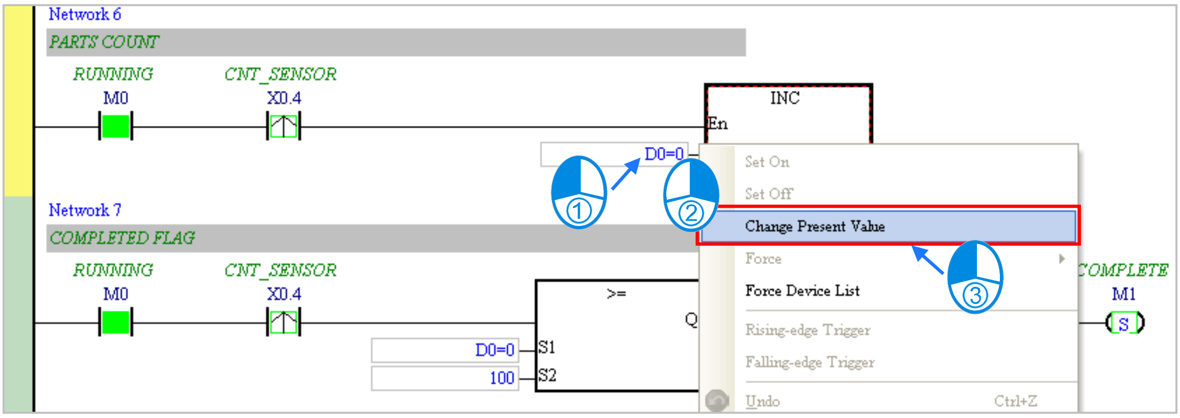
Before the status of a device is changed, users have to make sure that the operation does not cause damage to the system or staff.



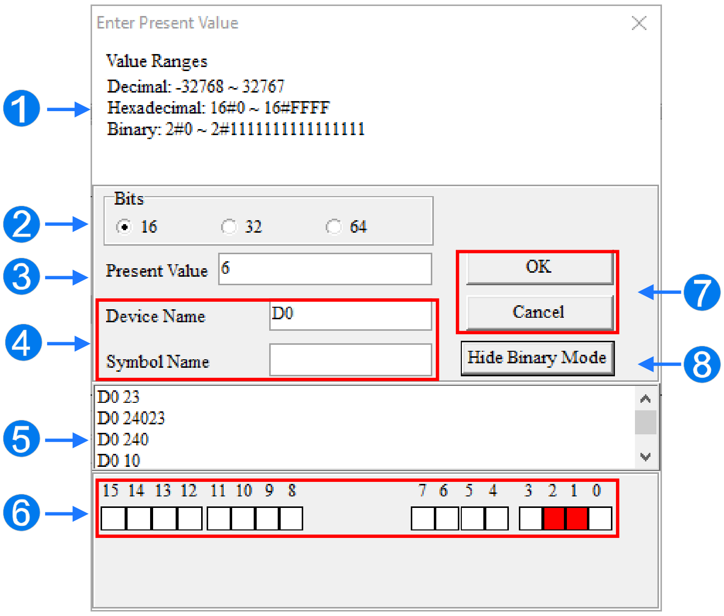
The items on the context menu are described below. **Force** on the context menu only applies to input contacts and output contacts.

Item	Description
Set On	Setting the contact selected to ON
Set Off	Setting the contact selected to OFF
Rising-edge Trigger	No matter what the state of the contact selected is, the system set the contact to OFF, and then set it to ON.
Falling-edge Trigger	No matter what the state of the contact selected is, the system set the contact to ON, and then set it to OFF.
Force	Forcing an input contact or output contact ON or OFF
Force Device List	Forcing several input contacts or output contacts in the tables ON or OFF

If users want to change the value in a device, they can click the device, right-click the device, click **Change Present Value** on the context menu, and set a present value in the **Enter Present Value** window.



The **Enter Present Value** window is described below.



❶ Message text.

❷ Select input number format: 16 bits/32 bits/64 bits.

❸ Input present value for modification.

❹ To modify present device name or symbol name.

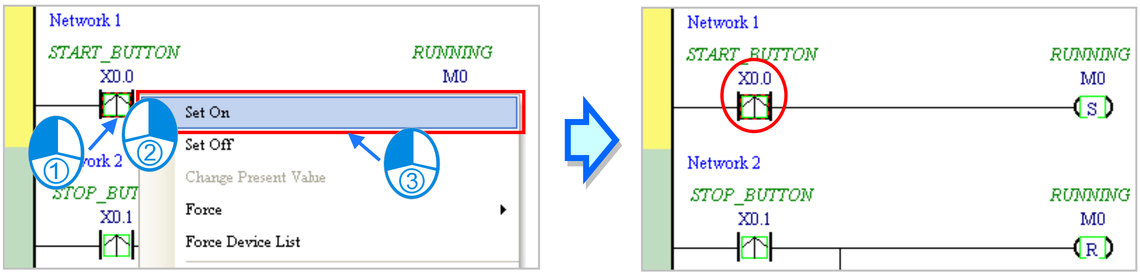
❺ Log for modified number (Format shown: Device name+ modified value)

❻ When binary mode is enabled, use the mouse to set ON/OFF state for each bit.

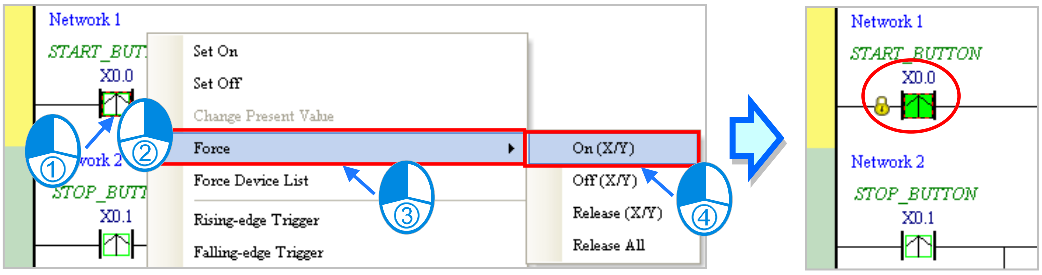
❼ Click **OK** to apply the setting value, and click **Cancel** to close the setting window.

❽ Click to open or hide binary mode.

In this example, X0.0~X0.15 and Y0.0~Y0.15 are input devices and output devices assigned to the digital I/O module AH16AP11R-5A. After the parameters in the hardware are downloaded to the CPU module, the states of X0.0~X0.15 will be the same as the states of the inputs on the actual module. Even if users set X0.0~X0.15 to ON or OFF in the program editing window, the states of X0.0~X0.15 will be updated by the actual input signals.



However, an input contact can be forced ON or OFF during a test. Users can click an input contact or output contact which will be set, right-click the contact, point to **Force** on the context menu, and select **On (X/Y)**, **Off (X/Y)**, **Release (X/Y)**, or **Release All**. If an input contact or output contact is forced ON or OFF, a lock symbol will appear at the left side of the contact.



Force	Description
On (X/Y)	Forcing the input contact or output contact selected ON
Off (X/Y)	Forcing the input contact or output contact selected OFF
Release (X/Y)	Releasing the contact from the locked state
Release All	Releasing all the contacts from the locked states

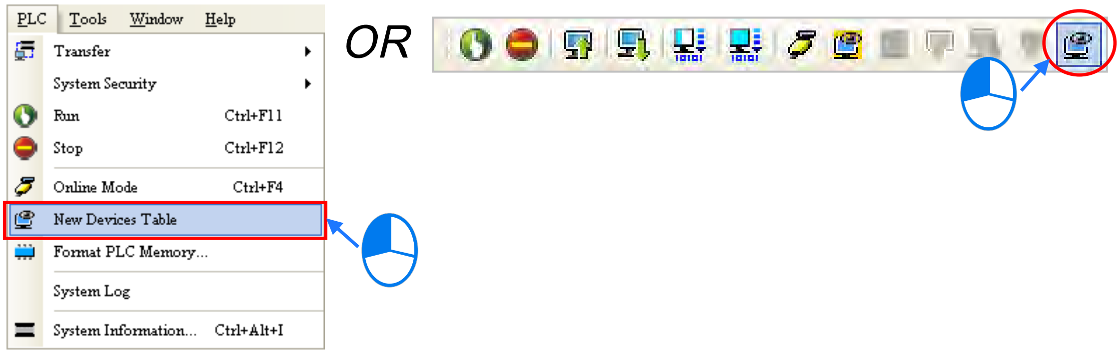
If an output contact in the program is forced ON or OFF, the output state of this contact will not be affected by the program execution result.

***. If the online monitoring function is disabled, the contacts will not be automatically released from the locked states. As a result, users have to check whether the contacts need to be released from the locked states after the test is complete.**

There are two ways to create a monitoring table. Users can create a monitoring table online or offline.

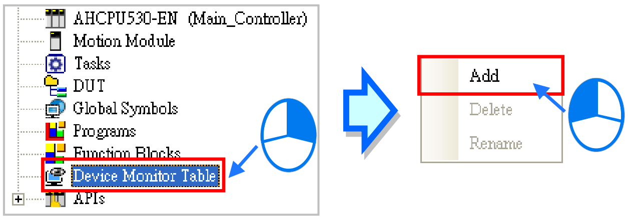
● **Method 1**

Click **New Devices Table** on the **PLC** menu, or on the toolbar.

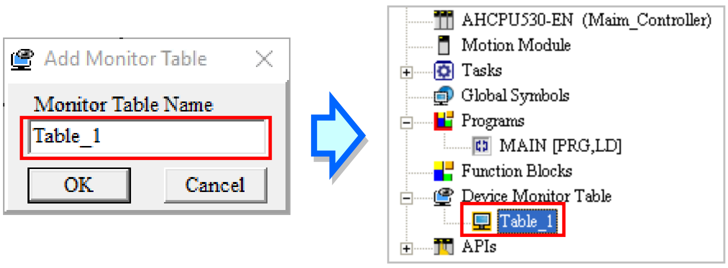


● **Method 2**

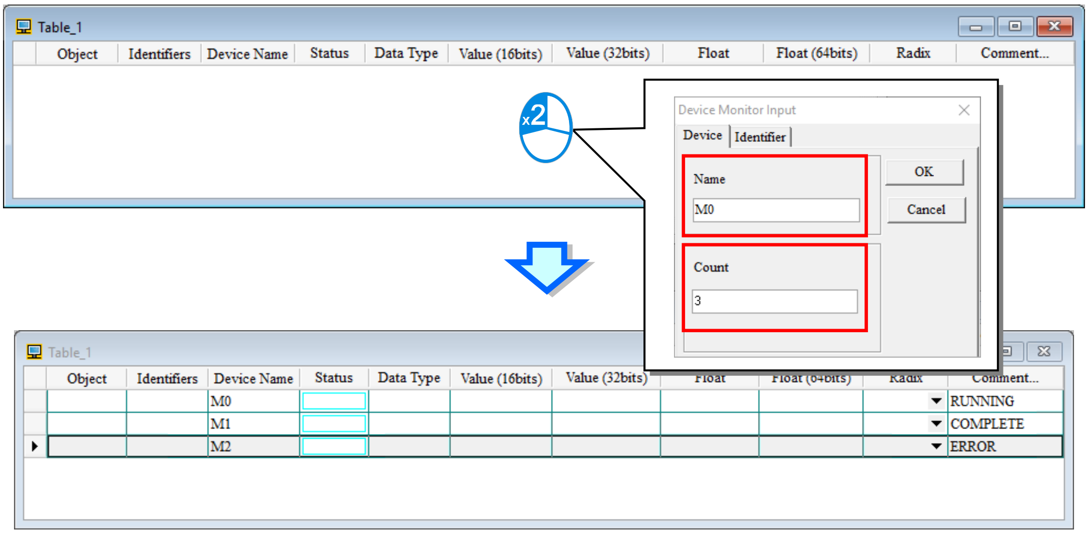
Right-click **Device Monitoring Table** in the project management area and click **Add**.



Type a table name in the **Add Monitor Table** window, and then click **OK**. An item will be under **Device Monitor Table** in the project management area. If users want to open the monitoring table, they can double-click the item. Users can create several monitoring tables in the project, and the monitoring tables created will be saved with the project.



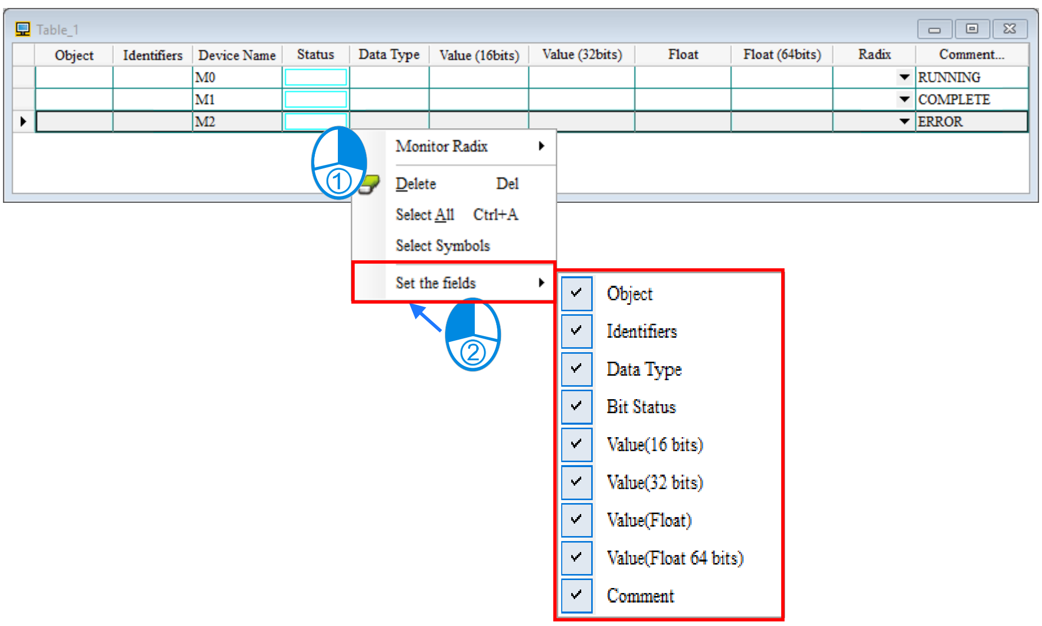
After the item is double-clicked, a window will appear. The users can add items which will be monitored to the window. If the users want to add an item to the window, they have to double-click the blank in the monitoring table, or type a device name directly, and type a start address and the number of devices which will be monitored in the **Device Monitor Input** window. Please notice that 100 items at most can be added to a monitoring table.



When adding a device item, press [Insert] on the keyboard to select **Insert** or **Replace** mode; users can find the current selected state in the ISPSoft status column.

When choosing **Insertion** mode, the item added will be on top of the selected item in the monitoring table; when choosing **Replace** mode, the item added will overwrite the selected item in the monitoring table.

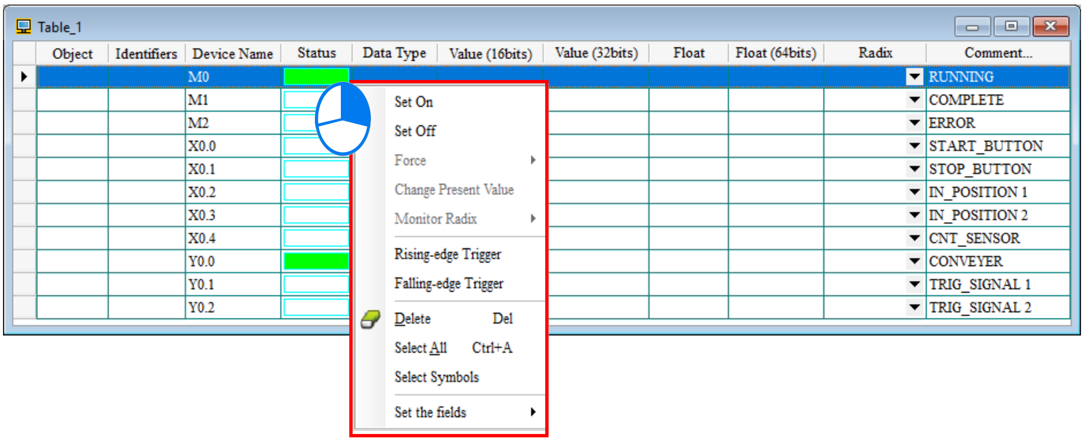
If the users want to hide certain columns in the monitoring table, they can right-click the monitoring table, point to **Set the Fields**, and unselect certain items. After an item is unselected, the corresponding column will disappear.



Description on the columns of the monitoring table.

Column	Description
Source	The source of a symbol
Identifier	The identifier of a symbol
Device name	The name of a device monitored
Status	If a bit device or a contact is monitored, the state will be ON or OFF.
Data type	If a symbol is monitored, the data type of the symbol will be displayed.
Value (16 bits)	In the online mode, a 16-bit value is displayed.
Value (32 bits)	In the online mode, a 32-bit value is displayed.
Float (32-bit floating-point)	In the online mode, a 32-bit floating-point number is displayed.
Float(64-bit floating-point)	In the online mode, a 64-bit floating-point number is displayed.
Radix	Users can select a format in which a value is represented.
Comment	The comments on a device or the comment on a symbol is displayed.

After the monitoring table is created, the users can monitor the items in the monitoring table in the online mode. Besides, after the users right-click an item in the monitoring table in the online mode, a context menu which is the same as the context menu which will after a device in the program editing window is clicked will appear. The users can change the state of the item or the value in the item by clicking an item on this context menu.



The program created in this chapter can be tested and debugged through the monitoring table created in this section. Please refer to chapter 18 for more information about testing and debugging a program.

Chapter 5 POU and Task

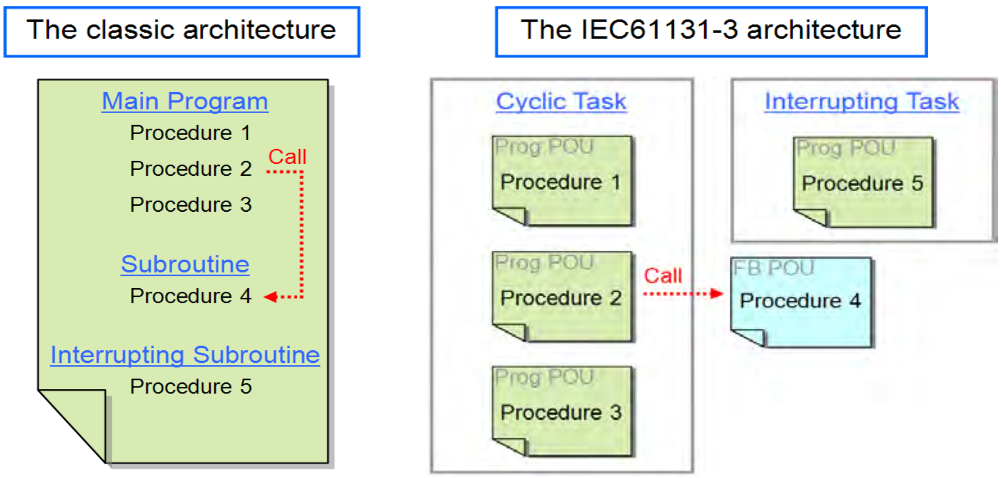
Table of Contents

5.1 Program Organization Units and Tasks

Program Organization Units (POUs) and tasks are important programming concepts related to IEC 61131-3. They upgrade programming from traditional program writing to project management. The difference between traditional ladder diagrams and IEC 61131-3 is described below.

Traditional ladder diagram	IEC 61131-3
Main program	1. A single program is divided into several independent program organization units. 2. A program organization unit which has been created is assigned to a cyclic task.
General Subroutine	1. A subroutine is a function block. 2. A function block which has been created can be called by a program organization unit.
Interrupt subroutine	1. Different interrupt subroutines are independent program organization units. 2. A program organization unit which has been created is assigned to an interrupt task.

Traditional ladder diagrams and IEC 61131-3 are represented by the following architectures. In the classic architecture, users write a source code. In the IEC 61131-3 architecture, a program is divided into several program organization units. Every program organization unit can be developed independently, and can be assigned a task.



If a control system reaches a certain scale, the internal control procedures will be quite complex, and the relation between the procedures will be closer. If the classic architecture is adopted, a lot of time and manpower must be invaded in developing and maintaining a program. However, in the IEC 61131-3 architecture, the program organization units are reusable and modular. Besides, the program organization units can be integrated easily by means of the management of the tasks. The concepts related to program organization units and tasks will be introduced in the following section.

5.2 Program Organization Units

5.2.1 Program Architecture and Types

Program organization units are basic elements of a program in a PLC. They are different from a traditional program in a PLC. The characteristic of the program architecture introduced by IEC 61131-3 is that a program is divided into several units. These units are called program organization units.

In the classic architecture, a source code for a PLC is composed of all procedures, including subroutines. If the size of a program becomes larger, the maintenance of the program and the debugging of the program will be a burden. In the IEC 61131-3 architecture, a program is divided into several units according to the functions or characteristics. It is convenient to develop and maintain a program. Besides, owing to the fact that program organization units are modular, different program organization units can be developed by different designers. It benefits the distribution of manpower and the execution of the project.

There are two types of POUs in ISPSoft. They are programs (PROGs), function blocks (FBs) and Function (FC).

- **Program (PROG)**

A POU of the program type plays a role according to the task to which it is assigned. If a program POU is assigned to a cyclic task, the POU of the program type acts as a main program. If the POU of the program type is assigned to an interrupt task, the POU of the program type acts as a subroutine. Besides, a POU of the program type can call a function block (FB).

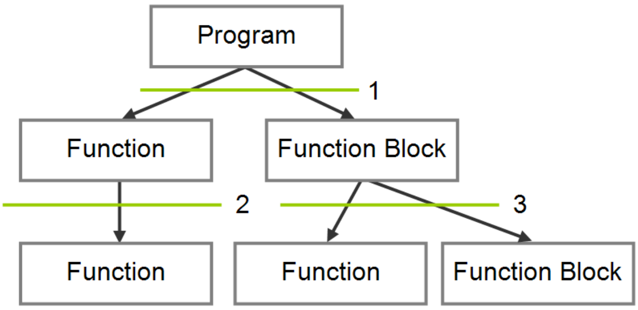
- **Function block (FB)**

A static symbol can be declared in a function block (FB). As a result, the value of the symbol after an operation can be retained. Owing to the fact that the operation is performed on the value memorized in the function block and an input value, the output values may be different even if the input values are the same. Besides, a function block can call another function block.

- **Function (FC)**

Each function is an individual program unit assigned with actual parameters (numerical values) based on its definition. Contrary to Programs and Function Blocks, Functions (FC) have no memory and the previous function result cannot be stored, resulting in a same outcome from a function with same input values, such as performing arithmetic operation. This feature currently only supports AS5xx and DVPxxMC models.

The relation among POUs is shown below.

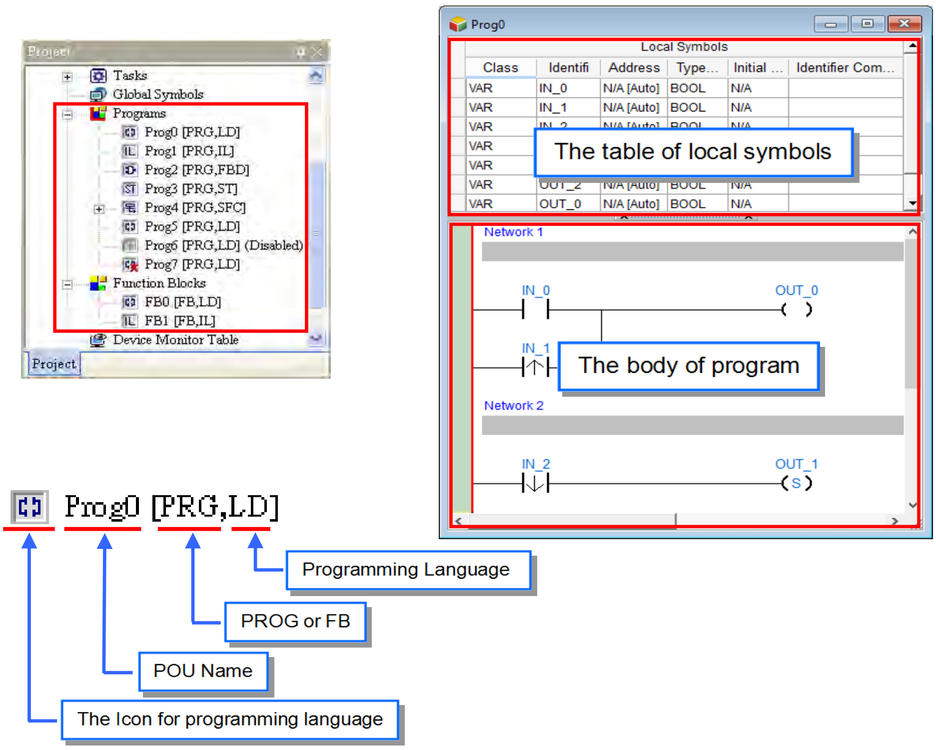


1. PROG calls FB or FC
2. FC calls FC
3. FB calls FC or FB

5.2.2 POUs in ISPSoft

All POUs created by users are listed in the program management area. The POUs of the program type and the POUs of the function block type are managed separately. Besides, the programming language in which a POU is written determines the icon representing the POU, and the information about the POU is put at the end of the POU name.

After a POU in the project management area is double-clicked, a POU editing window will appear. The POU editing window is composed of two parts. A table of local symbols is at the upper part of the window, and the body of a program is at the lower part of the window. Besides, the editing environment at the lower part of the window varies with the programming language used. Please refer to the following sections for more information about symbol tables and program editing.



The icons representing POUs are described below.

Icon	Description
	The POU is a ladder diagram (LD).
	The POU is an instruction list (IL).
	The POU is a function block diagram (FBD).
	The POU is a structured text (ST).
	The POU is a sequential function chart (SFC).
	The POU is a continuous function chart (CFC).
	The object is a POU created in C language.
	If the icon representing a POU is gray, the POU is disabled. A POU which is disabled is skipped when the program is compiled, and is not executed.
	If the icon representing a POU is marked with a red cross, the POU is not assigned to any task. A POU which is not assigned to any task is skipped when the program is compiled, and is not

***. Please refer to section 5.4.2 for more information about enabling a POU. Please refer to the following section for more information about tasks.**

5.3 Tasks

Every POU of the program type is assigned to a specific task. The tasks determine the order in which the POUs of the program type are executed or enabled. The Task is like a mission. In other words, every POU of the program type is like a basketball player, and the tasks are the roles that the POUs play.

5.3.1 Managing the Tasks in ISPSoft

In ISPSoft, not all the POUs of the program type in the project are executed. A POU of the program type will be executed after it is assigned to a task, and the task determined how the POU is executed. When a POU is not assigned to a task, the POU is refer to as a source code saved in a project, but not to be translated into an execution code. Only POUs of the program type need to be assigned to tasks, and function blocks are called by POUs.

The characteristic of the IEC 61131-3 architecture is that a program is divided into several independent POUs. All POUs are rearranged to scan as execution code for compiling and the combination is based on the TASK allocation status.

5

In ISPSoft, a POU is assigned to one TASK, however, only DVPxxMC and AS5xx series can assign a POU to multiple tasks, but the same task can allocate to more than one POU and the allocated POU can also assign the execute order in task; when users add a POU, a task has to be assigned by default.

Applicable	AS/AH/DVP	AS5xx/DVPxxMC
Work Management	A POU is assigned to one task	A POU is assigned to multiple tasks
Operation	Periodic, Timer Interrupt and Condition for Interrupt	Freewheeling ,Cyclic and Triggered by Event

For AS, AH and DVP series, the TASK operation can be categorized into three types: **Periodic, Timer Interrupt** and **Condition for Interrupt.**

(1) **Periodic**

For POU assigned to periodic task, the execution is simply to scan back and forth. Since there is only one periodic task in DVP series, therefore, all POUs been periodically scanned are assigned to this task; while AH/ AS series provides 32 periodic tasks for selection with number from 0 ~31. The scanning starts with small number as number one priority and AH/ AS series supports API command (**TKON** and **TKOFF**) to control task. Users can adopt the command to activate or stop a task during PLC operation.

The POU is created in SFC language and can only be allocated in periodic task and not task with interrupts.

(2) **Timer Interrupt**

For POU assigned to a task with timer interrupt, the function is similar to the subroutine of timer interrupt. When the timer interrupt has reached its time, all the POUs assigned to this task is executed according to the combination order. The task number with timer interrupt depends on the type of PLC used. In addition, the selected PLC type also determines the number of task group with timer interrupt based on the support of interrupt source groups.

(3) **Condition for Interrupt**

There are several types of condition for interrupt. For example, external interrupt, I/O interrupts, count interrupt and etc. Since different types of PLCs provides different interrupt service and amount. Thus, users have to make sure which interrupt modes are supported by the selected PLC type. When POU is allocated to task with condition for interrupt, the function is similar to subroutine interrupt. When the condition for interrupt is formed, for example the count has reached setting value, then all the POU assigned to that task will execute in order.

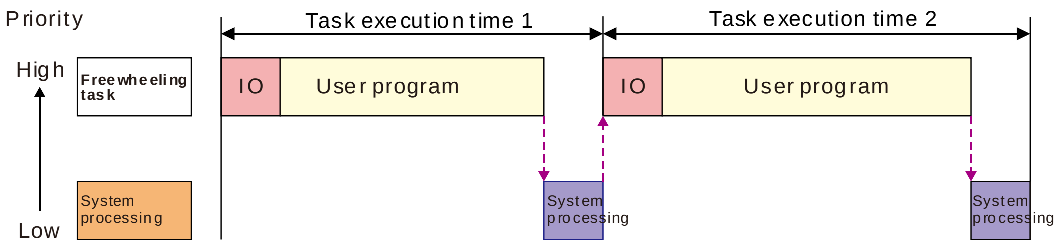
For AS5xx and DVPxxMC series, a POU can assign to multiple tasks and the same POU can repeatedly assign to the same task. While one task can assign to more than one POU and the allocated POU can also assign the execution order in the task. Three ways regarding AS5xx/ DVPxxMC series task operation include **freewheeling, cyclic** and **triggered by event.** The following introduces ways of task operation and execution according to priority.

- **Task Operation**

(1) Freewheeling

The task is handled as soon as the program running starts. The task will be restarted automatically in the next cycle after one execution cycle ends.

➢ Executing freewheeling task:

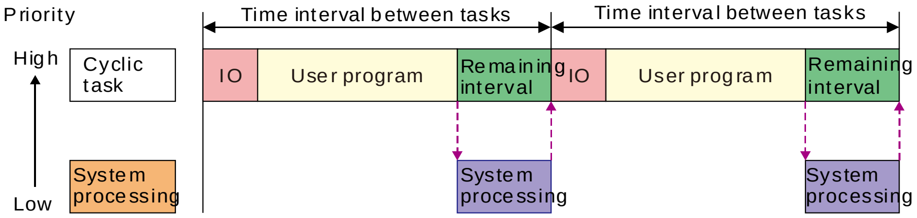


Note: There is no fixed execution time for the freewheeling task. So the values of task execution time 1 and task execution time 2 may not be equal in the above figure

(2) Cyclic

The cyclic task executes base on the setting of time interval in TASK Manager.

➢ Executing cyclic task:



***IO*: IO** means I/O refresh. I/O includes local I/O points and left-side and right-side extension module data and CANopen data. The data can be specified to refresh before the set task is executed. If not specified, the data will be refreshed during the system processing.

User Program: User Program stands for user program execution which is based on the execution sequences of programs assigned in a task.

Remaining interval: When the controller is to perform system processing, the low-priority task is executed first if any and then the system processing is performed.

System processing: The controller will perform the system processing which includes Ethernet, RS232 and RS485 communication processing after all task requests are completed.

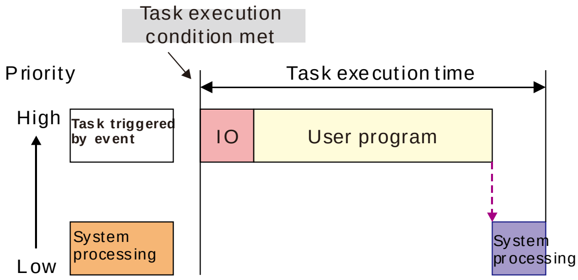
The four terms mentioned above have the same meanings as those in the following sections.

Note: If the cycle defined in the cyclic task is too short, the task will immediately repeat execution once finishing the user program but will not execute other low priority task or work on the system, and this may affect the execution on all tasks. If the task has setup watchdog timer for program scan, this will cause response timeout by the timer and the controller will be in Error state and stops executing the user program; if the task did not setup watchdog timer for program scan, the controller will not be able to execute the system, causing problems like communication timeout.

(3) Task triggered by event

An event task is executed once just when the specified event happens. The timing for execution of an event task depends on the timing for occurring of the event and the priority level of the event task.

➢ Executing an event task:



➢ **Events that are triggered in the following ways:**

- Motion event (Motion control task)
- Rising edge or falling edge of local input points (I0~I7 and I10~I17)
- CANopen SYNC signal
- Z pulse rising edge of incremental encoder 1 or encoder 2

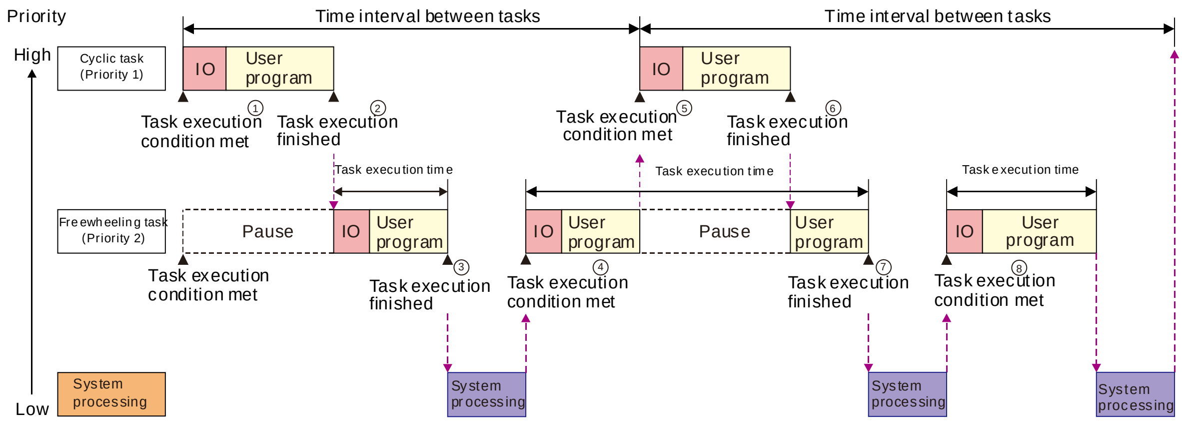
The condition for the second-time execution is ignored when the condition required for execution of the event task is met again before the event task is completed. The period before an event task is completed is the course while the event task is being executed or is waiting to be executed.

➢ **Executing Task According to Priority**

The controller cannot perform multiple tasks simultaneously. Every task must be given a priority level and they are executed according to preset priorities. Priority level can be set within the range of 1 to 24. (1 is the highest priority and 24 is the lowest priority.) The priority level of each task must be unique. The task with higher priority takes priority to perform. The high-priority task can interrupt the low-priority task.

We recommend that the task which has a high requirement of real time should be given a high priority and the task which has a low requirement of real time should be given a low priority. The priority of the default motion control task built in ISPSoft is 1 by default.

➢ **Executing two tasks at the same time (Cyclic and freewheeling)**



① The execution conditions for the cyclic task and freewheeling task are met at the same time. The cyclic task is executed first because of its higher priority.

② When the cyclic task execution is finished, the freewheeling task execution starts.

③ The controller will execute the system processing if there is no other task after the execution of the freewheeling task is completed.

④ The execution of the freewheeling task continues since the high-priority cyclic task request has not arrived.

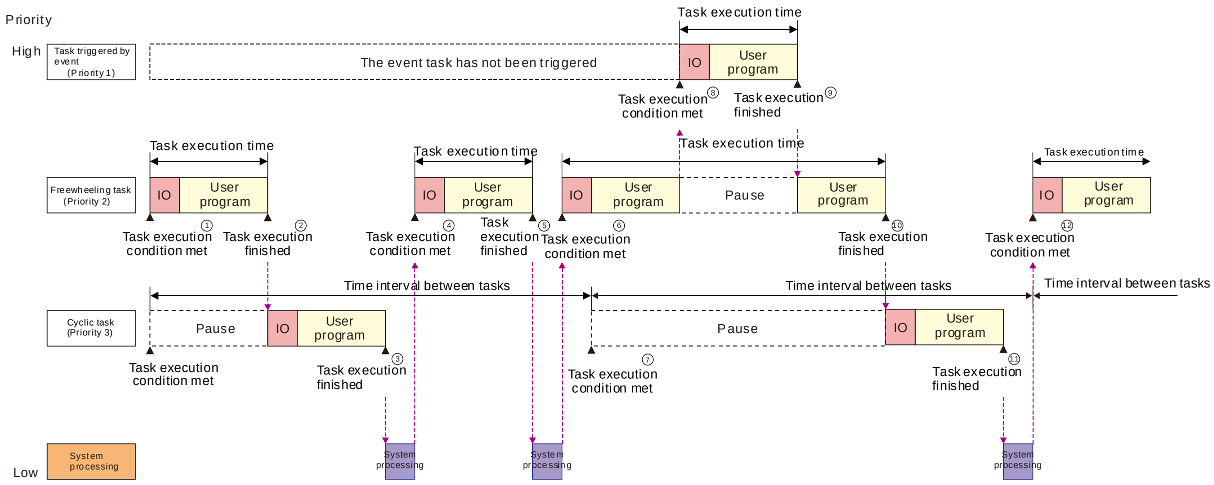
⑤ The cyclic task interrupts the freewheeling task execution and the controller executes the cyclic task because of the arrival of the high-priority cyclic task request during the execution of the freewheeling task.

⑥ The controller continues to execute the part of the low-priority freewheeling task, which has not been executed yet when the execution of the cyclic task is completed.

⑦ When the execution of the freewheeling task is completed, the controller executes the system processing due to no other task request.

⑧ When the system processing is completed, the execution of the freewheeling task continues due to no high-priority cyclic task request.

➢ **Executing mixture of three tasks (Event, Cyclic and Freewheeling task)**



① When the conditions for execution of the freewheeling task and cyclic task are both met, the freewheeling task is executed first because the priority of the freewheeling task is higher.

② The cyclic task execution starts when the freewheeling task execution is completed.

③ When the cyclic task execution is completed, the controller executes the system processing due to no other task request.

④ The freewheeling task is executed when the system processing is completed.

⑤ When the freewheeling task execution is completed, the controller executes the system processing due to no other task request.

⑥ The freewheeling task is executed when the system processing is completed.

⑦ The freewheeling task execution continues because the freewheeling task has a higher priority than the cyclic task although the execution condition for the cyclic task is met. And the cyclic task waits to execute.

⑧ The event task interrupts the freewheeling task execution because the event task has the highest priority and the execution condition for the event task is met.

⑨ The controller continues to execute the part of the low-priority freewheeling task, which has not been executed yet when the event task execution is completed.

⑩ The freewheeling task execution is completed. The controller executes the cyclic task since the cyclic task request in ⑦ is not responded yet.

⑪ The cyclic task execution is completed. The controller executes the system processing due to no other task request.

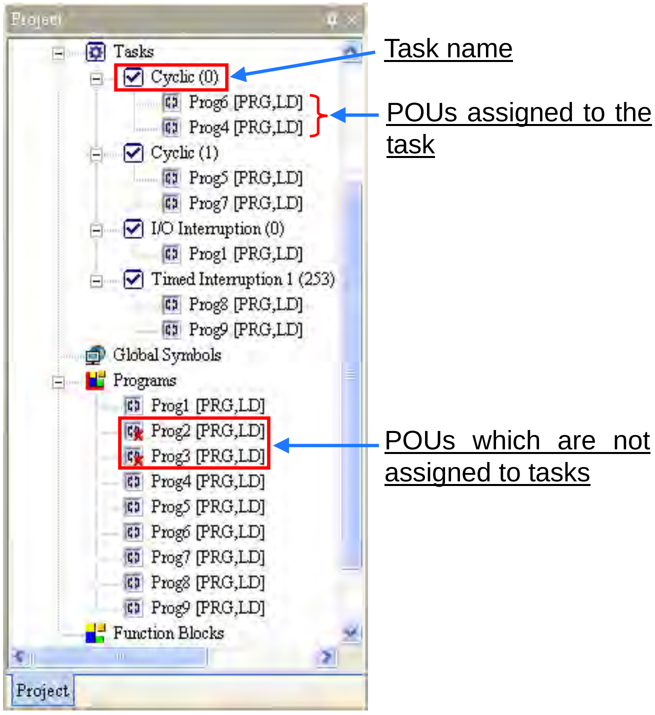
5.3.2 Tasks in the Project Management Area

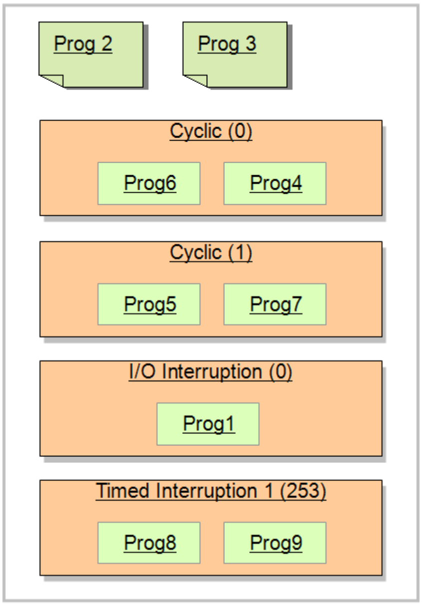
The POUs which are assigned to tasks are listed in the **Tasks** section in the project management area, and the POUs which are not assigned to tasks are not listed in the **Tasks** section. The order in which the POUs listed in a task section are arranged is the order in which the POUs are executed.

Take the project for an AH500 series CPU module below for example. There are 9 POUs of the program type. The assignment of the POUs of the program type to tasks is as follows.

Task name	POU	Execution
Not assigned	Prog2 and Prog3	Owning to the fact that Prog2 and Prog3 are not assigned to tasks, Prog2 and Prog3 are not executed.
Cyclic (0)	Prog6 and Prog4	The smaller the task number is, the earlier the task is executed. As a result, the order in which Prog6, Prog4, Prog5, and Prog7 are scanned is Prog6→Prog4→Prog5→ Prog7.
Cyclic (1)	Prog5 and Prog7	
I/O interrupt (0)	Prog1	If the condition of the interrupt is met, Prog1 will be executed once.
Timed interrupt 1 (253)	Prog8 and Prog9	Timed interrupt 1 is triggered every specific period of time. The order in which Pog8 and Prog9 are executed is Prog8→Prog9.

***. The setting of the condition for an interrupt will be introduced in section 5.5. Please refer to instructions for PLCs for more information.**

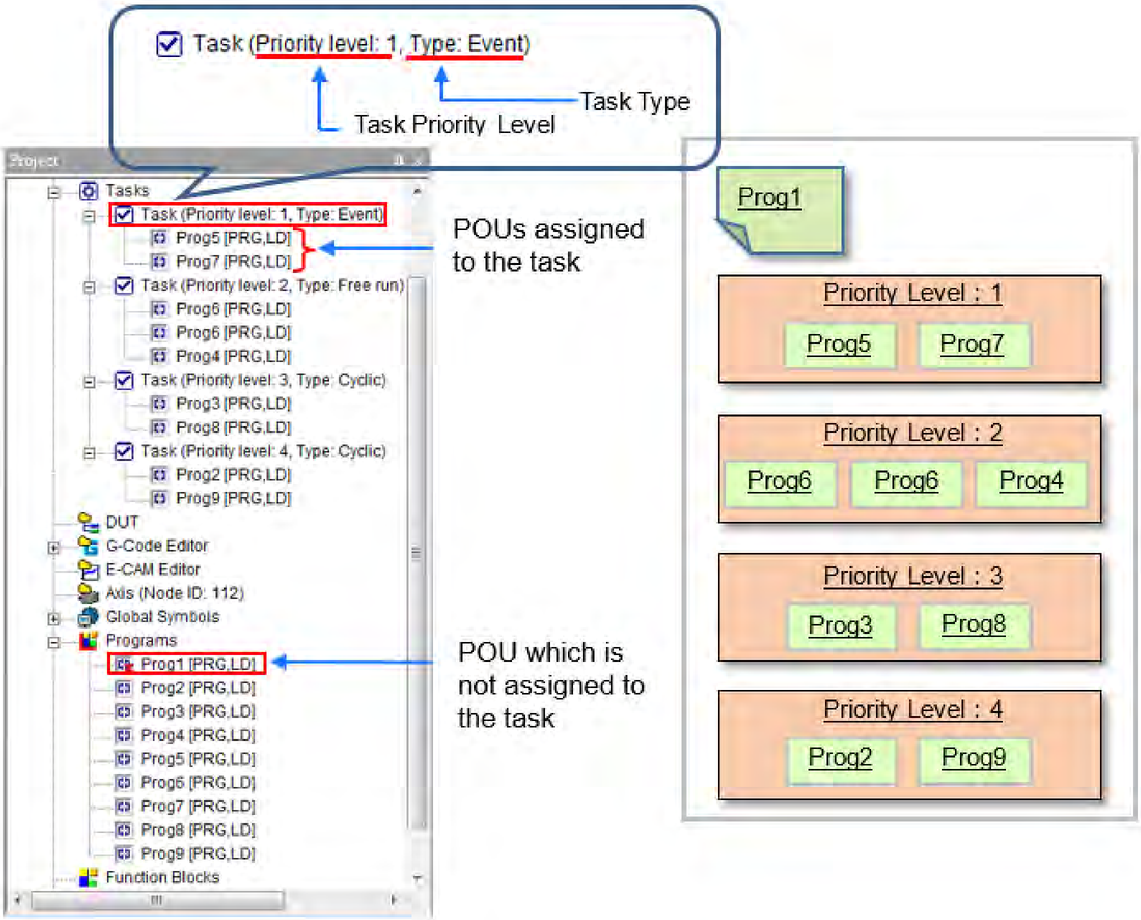




For AS5xx and DVPxxMC series, the task name appears to be a bit different with priority and type added. The following projects has established 9 POUs in total and the task allocation are described below.

The priority order and task type determine the task execution order.

TASK Priority Level	TASK Type	POU	Execution
Not allocated		Prog1	The POU is not executed, because the Task is not assigned.
Priority: 1	Triggered by Event	Prog5, Prog7	When executing, the program scans from Prog5 → Prog7 (back and forth)
Priority: 2	Freewheeling	Prog6, Prog6, Prog4	When executing, the program scans from Prog6 → Prog6 → Prog4 (back and forth)
Priority: 3	Cyclic	Prog3, Prog8	When executing, the program scans from Prog3 → Prog8 (back and forth)
Priority: 4	Cyclic	Prog2, Prog9	When executing, the program scans from Prog2 → Prog9 (back and forth)

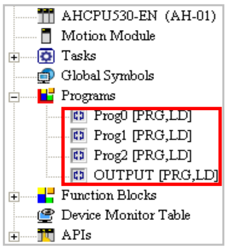


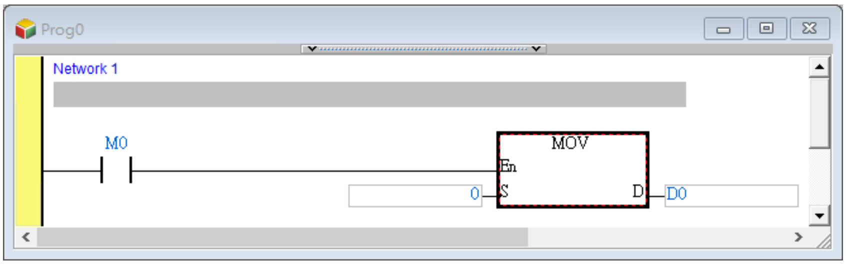
5.3.3 Executing the POUs Assigned to a Task

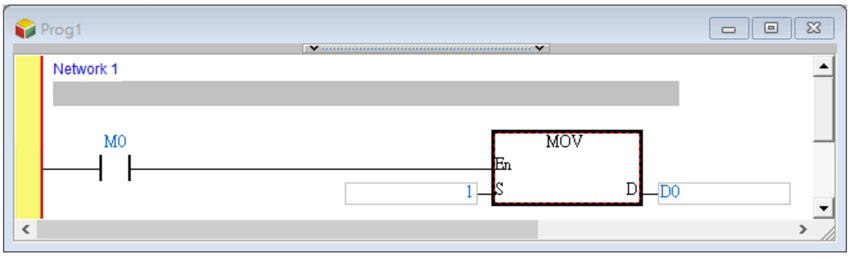
More one POU can be assigned to the same task, and the order in which the POUs listed in a task section in the project management area are arranged is the order in which the POUs are executed. Please refer to the following example. There are four POUs in the project. These POUs are described below.

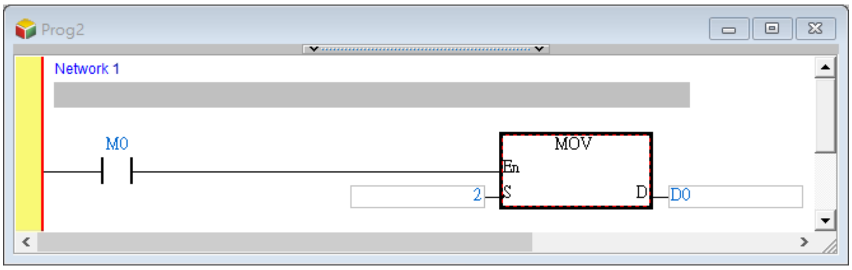
POU name	Description
Prog0	When M0 is ON, the value in D0 is 0.
Prog1	When M0 is ON, the value in D0 is 1.
Prog2	When M0 is ON, the value in D0 is 2.
OUTPUT	When M0 is ON, the value in Y0 is the value in D0.

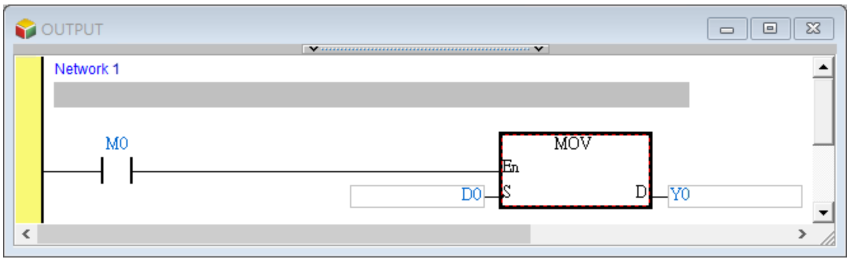
The programs in the POUs are as follows.



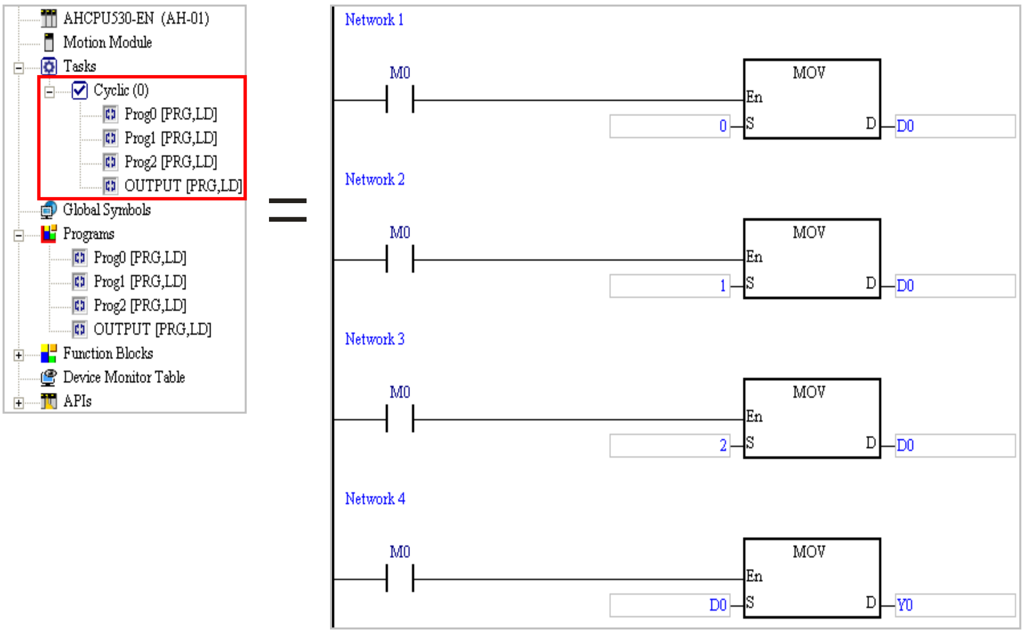




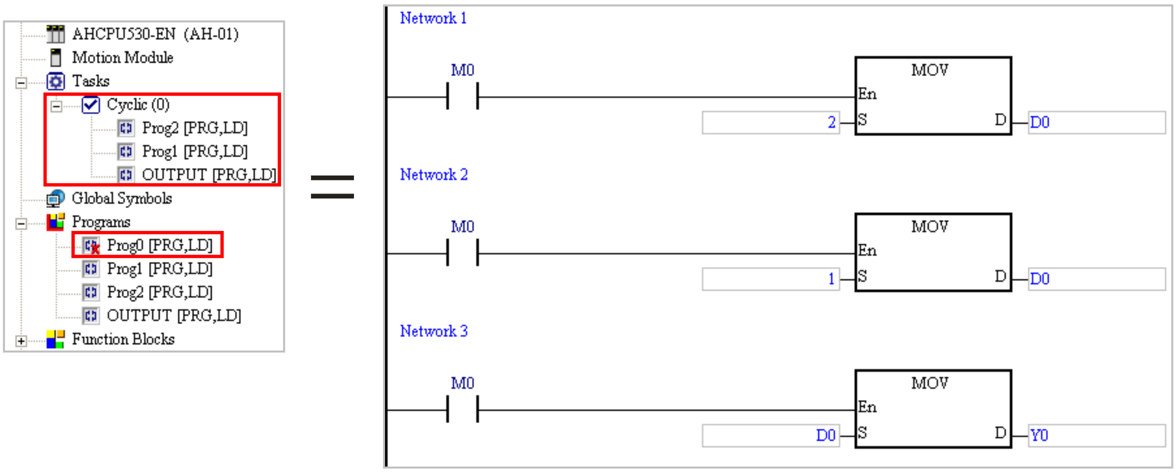




Suppose the four POUs of the program type are assigned to cyclic task (0). The arrangement of the POUs is shown below. The order in which these POUs are executed is Prog0→Prog1→Prog2→OUTPUT. The value in D0 in OUTPUT depends on the program in Prog2. When M0 is ON, the value in D0 in OUTPUT is 2. After the value in D0 is transferred to Y0, the value in Y0 will be 2. In other words, Y0.1 will be ON after a scan cycle is complete. The equivalent program is shown below.



If Prog2 is moved above Prog1, and Prog0 is removed from the **Cyclic (0)** section, the program in Prog0 will not be translated into an execution code, and the order in which the POUs are listed in the **Cyclic (0)** section will be Prog2→Prog1→OUTPUT. The value in D0 in OUTPUT depends on the program in Prog1. When M0 is ON, the value in Y0 is 1. In other words, Y0.0 will be ON after a scan cycle is complete.



5.4 Managing a POU

There are three types of POU supported by ISPSoft, including Programs (PROGs), Function blocks (FBs) and Function (FC), which Function block and Function are used in the same way, with reference in relevant introduction of Function Blocks (FBs).

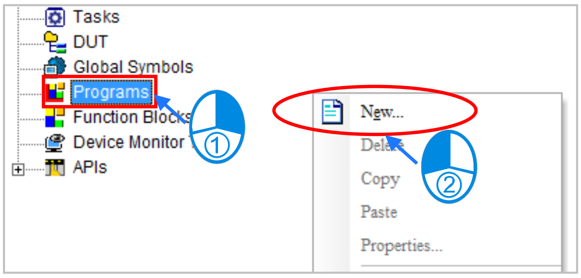
The information of POU types supported by different models is shown below:

	AS	AH5x0	AH5x1	AH560	AHxxEMC	DVP	AS5xx/DVPxxMC
Programs (PROGs)	V	V	V	V	V	V	V
Function blocks (FBs)	V	V	V	V	V	V	V
Function (FC)							V

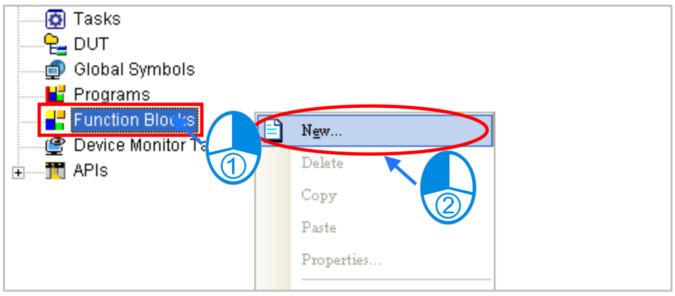
5.4.1 Creating and Setting a POU

(1) If users want to create a POU of the program type, they have to right-click **Programs** in the project management area and click **New**. If users want to create a POU of the function block type, they have to right-click **Function Blocks** in the project management area and click **New**.

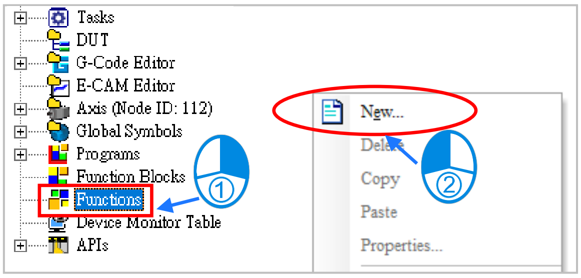
● Adding a POU of the program type



● Adding a POU of the function block type

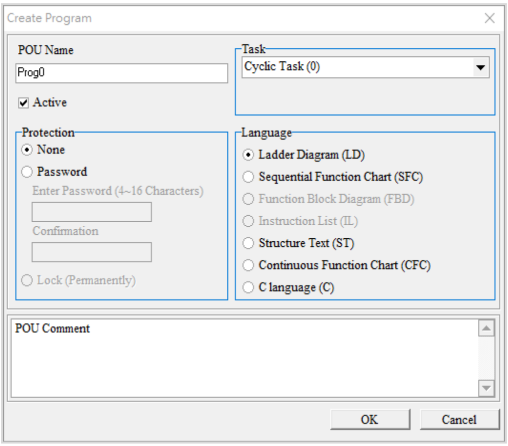


● Adding a POU of the function type

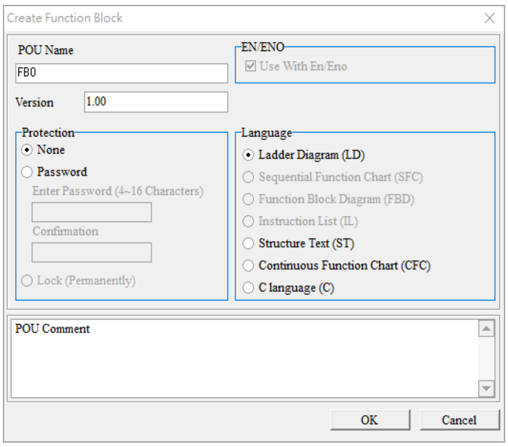


(2) The users have to set the attributes of the POU added in the window which appears. The attributes of the POU of the program type are slightly different from those of the POU of the function block type, and they are described below. Users can choose the task types from the drop-down menu base on the selected PLC series.

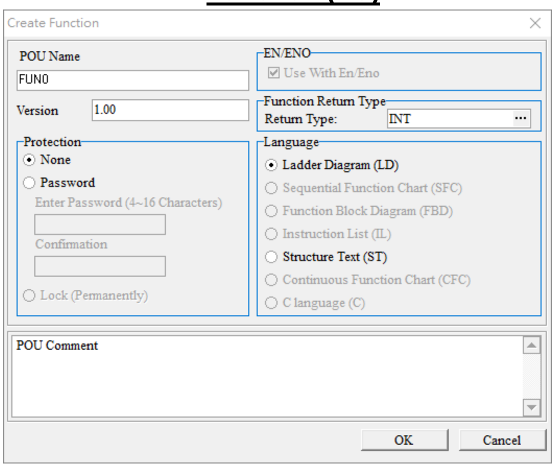
● Program（PROG）



● Function Block（FB）



● Function (FC)

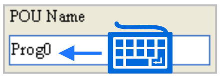


- **POU Name**: Users can type a POU name in this box.

  (a) Special marks and spaces can not be used. For example, *, #, ?, \, %, @, and etc. can not be used.

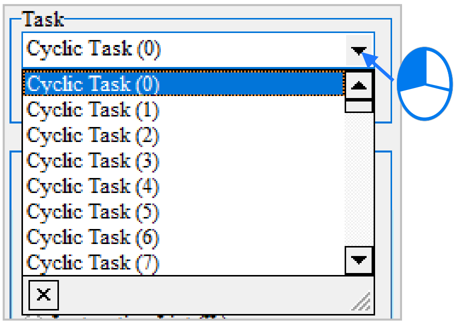
  (b) A POU name is composed of thirty characters at most. Users have to notice that a Chinese character occupies two characters.

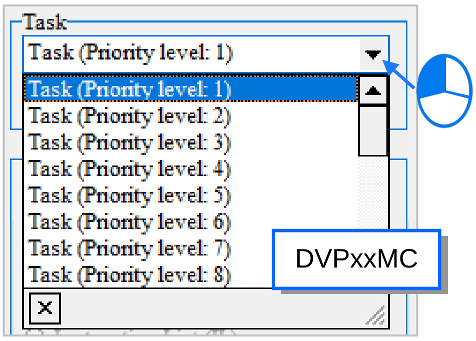
  (c) Underlines can be used, but they cannot be used continuously or put at the end of a POU name. For example, “POU_1” is a legal name, but “POU__1” and “POU_1_” are illegal names.



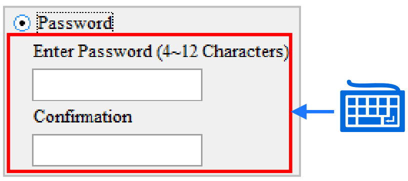
- **Function Return Type:** Choose the data type of return values for Function-type POUs via ··· button. If the setting is VOID, there will be no return values, which also means no output parameters.

- **Task**: POU is created and can assign a task type. For DVPxxMC and AS5xx series, the content appears to be different (as shown on the right).

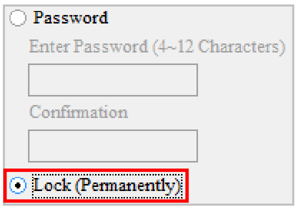




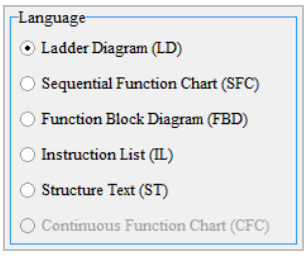
- **Password**: If users want to set a password, they have to type the same passwords in the two boxes. English letters, numerical digits, and special marks can be typed in the boxes.



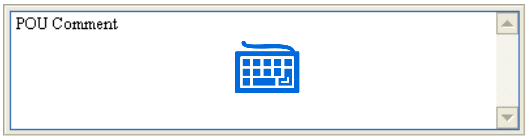
- **Lock (Permanently)**: This function can lock the function block permanently. A copy of the project is required if Lock (Permanently) is selected. Users can right-click Attributes on the POU item after adding a function block (FB POU).



- **Language**: Users have to select a programming language in which the POU is written. (The language may vary according to the selected PLC series)

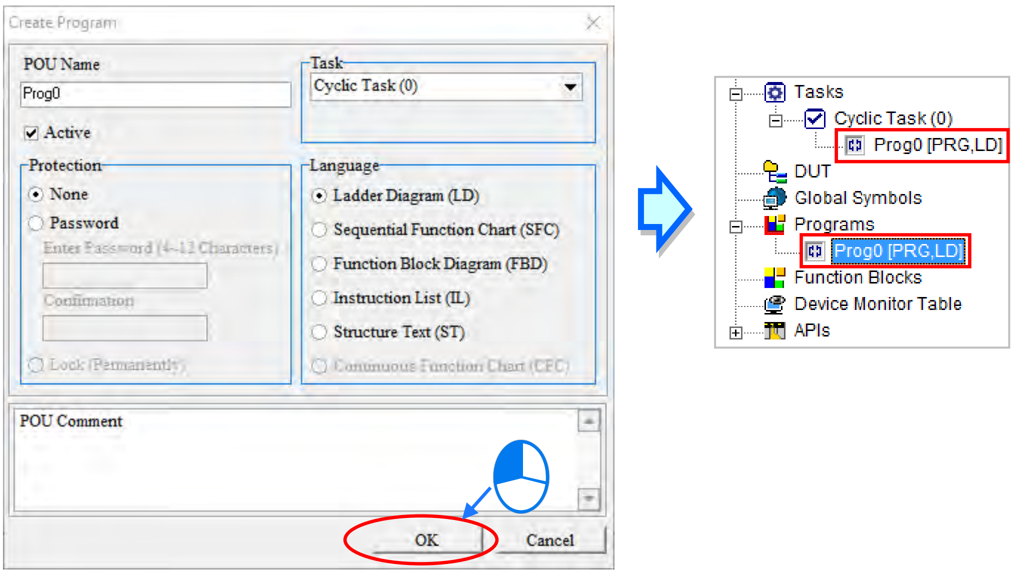


- **Comment**: Users can type a comment on the POU in this box.

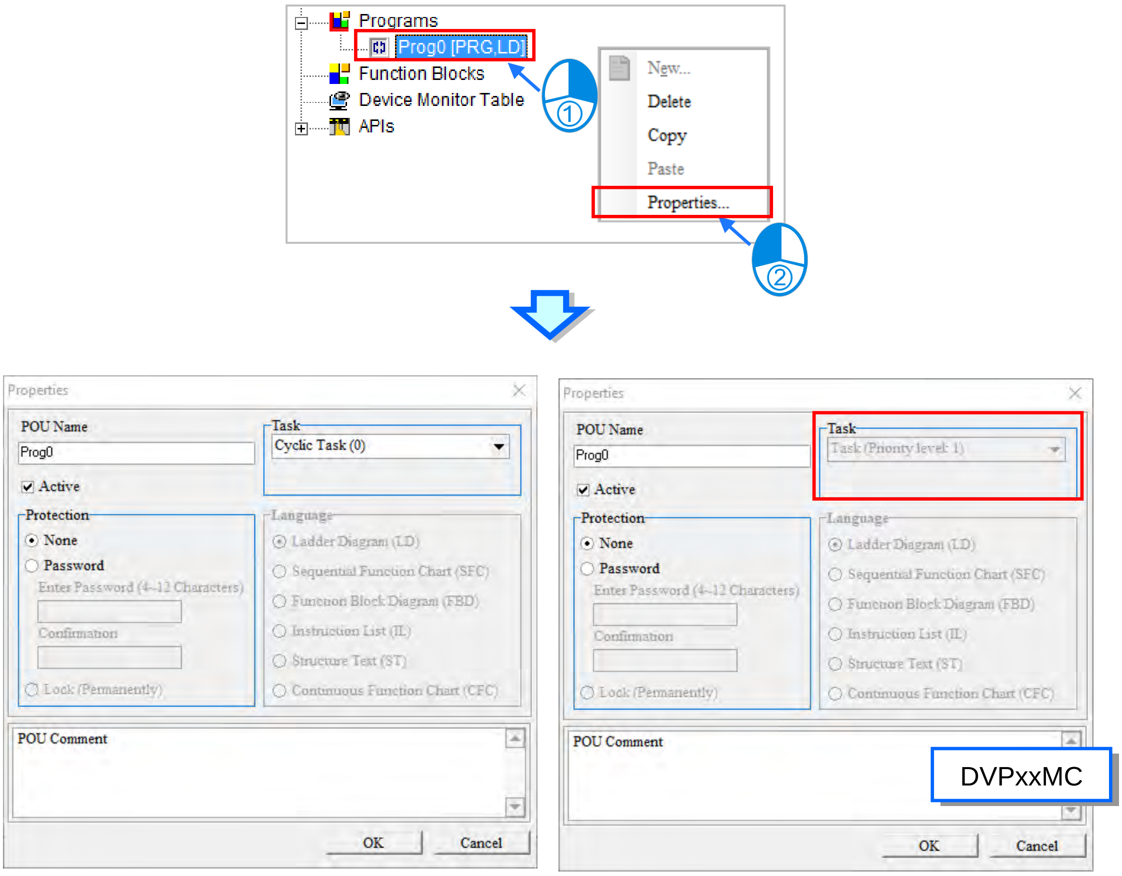


***. If the POU created is a POU of the program type, the Active checkbox will be in the window. The function of the Active checkbox will be introduced in section 5.4.2.**

(3) After the setting is complete, the users can click **OK**. If the POU created is a POU of the program type, the POU will be listed in the **Programs** section and the default task section. If the POU created is a POU of the function block type, the POU will be listed in the **Function Blocks** section.



(4) If users want to modify the properties of a created POU, right-click **Properties** from the POU item and refer to pervious description for setup. The programming language cannot be changed when using edit on Properties. For DVPxxMC/ AS5xx series, editing Properties cannot change the task setting.

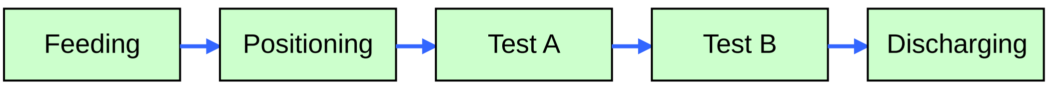


5.4.2 POU Active State

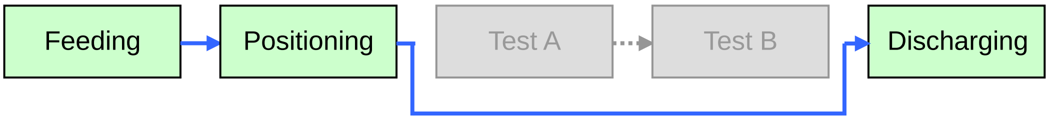
ISPSoft provides the function to temporarily close POUs. When POU is closed, the POU will be skipped for compiling and the internal process will also not be executed. However, this function only supports in program type POUs.

This function is used for testing or debugging. To skip some process beforehand, users can set POU as ineffective and restore to active testing is complete.

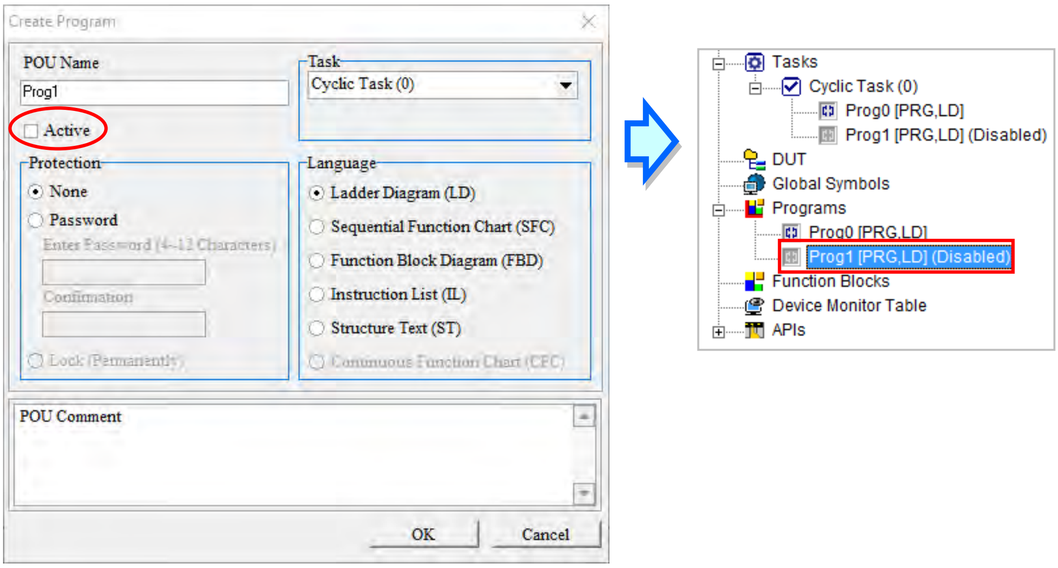
The following example shows the equipment has five workstations and the task process is categorized into 5 POUs for development.



When equipment assembly is complete, but test instrument are not, users can disable both POUs- test A and test B. Then, users can skip the two station to focus on other parts for adjusting and testing.



To set POU in active state, click **Active** in the Create Program window. If Active is not selected, the POU function is closed. A different icon is shown in the Project section to represent POU function closed.

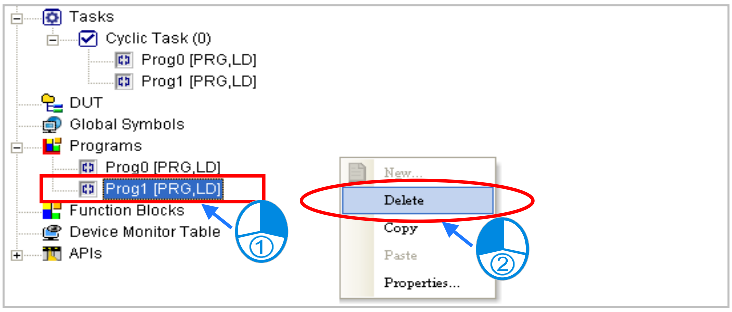


***1. Users can disable a POU by removing it from the original task section. However, if the users want to execute the POU later, they have to assign the POU to the original task again, and rearrange the POUs in the task section. As a result, it is more convenient for the users to disable the POU temporarily by unselecting the Active box in the window.**

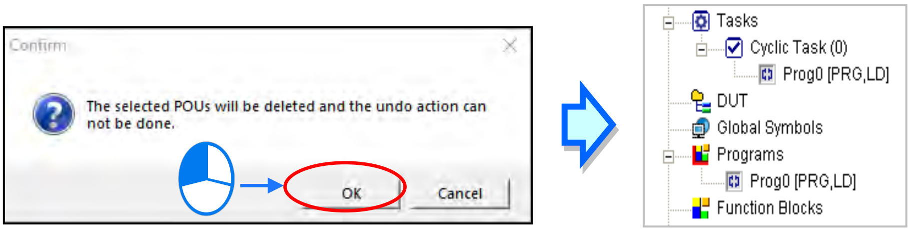
***2. A POU can be enabled not only by selecting the Active box, but also from Task Manager. Please refer to section 5.5.3 for more information.**

5.4.3 Delete and Copy POU

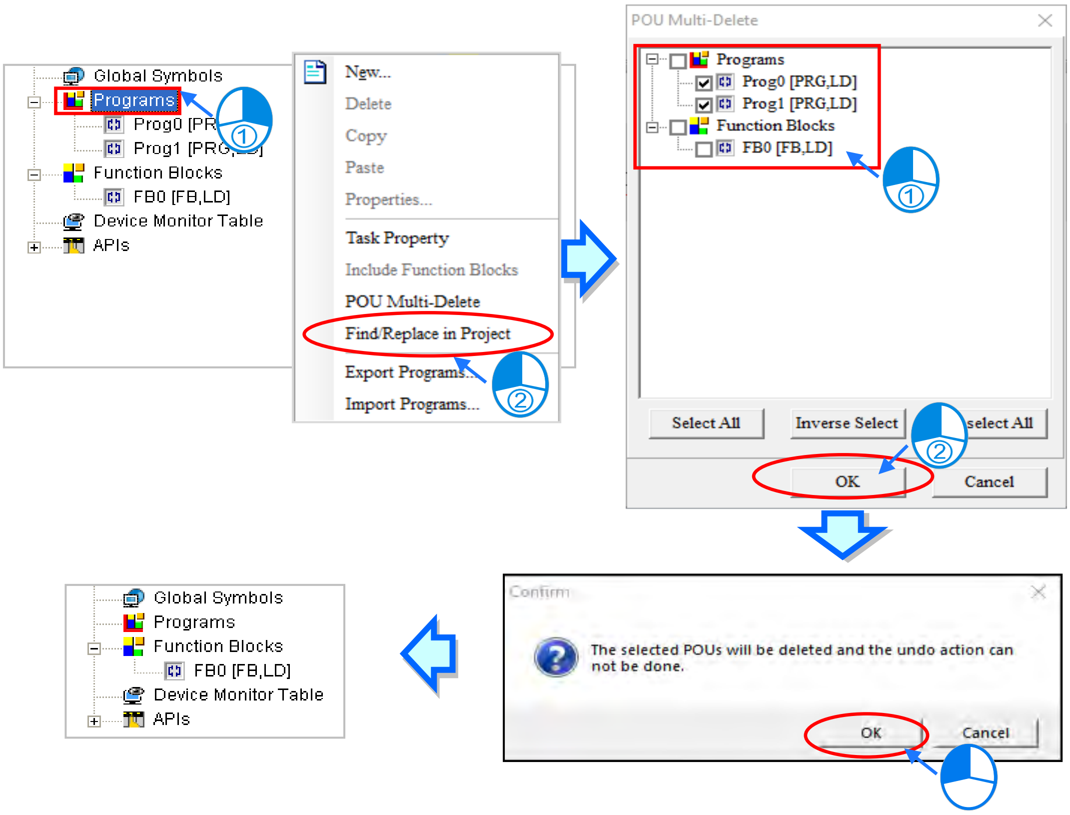
To delete a POU, right click on the selected item and click **Delete**.



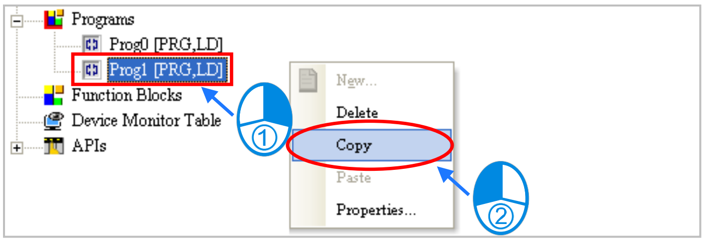
The POU cannot be recovered after it is deleted. The POU will be deleted from the project after **OK** is clicked. If the POU deleted is a POU of the program type, they system will also delete it from the task section.



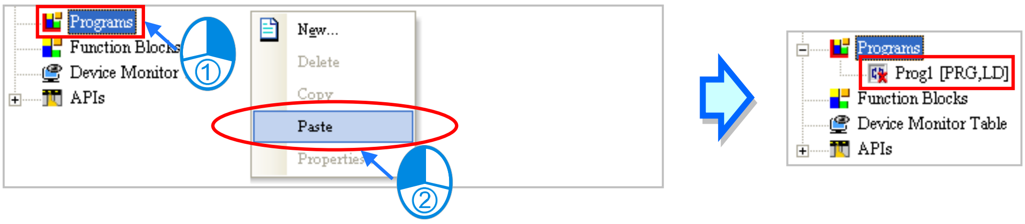
POU Multi-deletions are also supported. Right-click “Programs” or “Function Blocks” to see and select the option “POU Multi-Delete”. And then users will see the POU Multi_Delete window, use the “Select All”, “Inverse Select” and “Deselect All” buttons to select and delete more than 1 POU at the same time.



To copy a POU, right-click on the selected item and click **Copy**.



The POU can be copied into the same project or another project. If the POU copied is a POU of the program type, it can not be copied into the **Function Blocks** section. If the POU copied is POU of the function block type, it can not be copied into the **Programs** section. If the users want to paste the POU, they have to right-click **Programs** or **Function Blocks** and click **Paste**. Besides, if the POU copied is a POU of the program type, the POU pasted will not be assigned to any task.

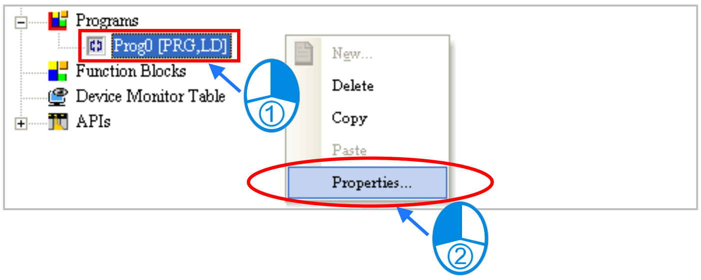


***. If a POU is pasted on a position where the same POU name exists, the system will put CopyOf_n at the end of the POU which is pasted. (n in CopyOf_n is a serial number.)**

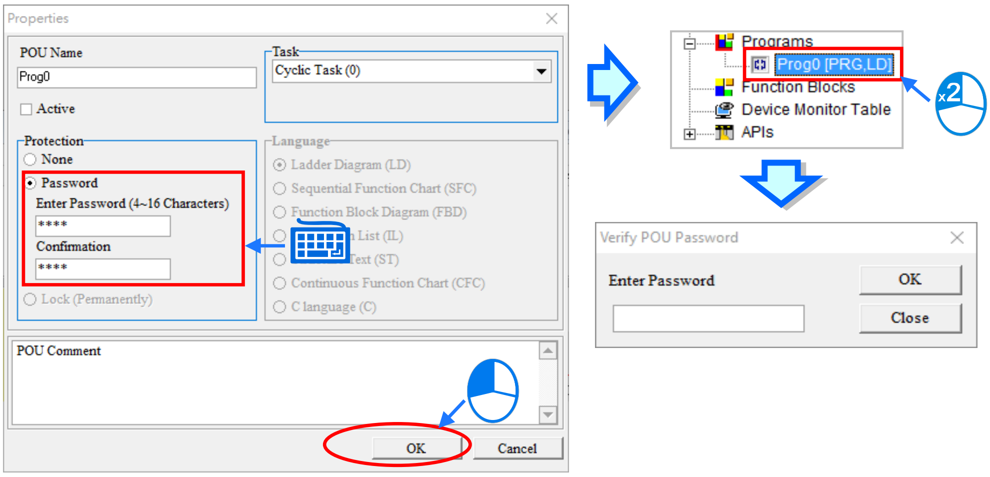
5.4.4 Set and Remove POU Password

Users can set a password for a POU in ISPSoft. The setting of a password, and the unlocking of the password are described below.

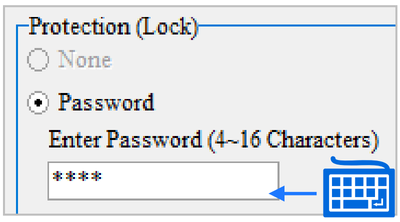
(1) When users create a POU, they can set a password for the POU. If users do not set a password a POU when the POU is created, but want to protect the POU with a password later, they have to right-click the POU in the project management area and click **Properties…** to open the **Properties** window.



(2) Type the same passwords in the **Enter Password** box and the **Confirmation** box, and then click **OK**. English letters, numerical digits, and special marks can be typed in the boxes. Once the POU is protected with the password, the system asks the users to type the password whenever the window for the POU is opened.



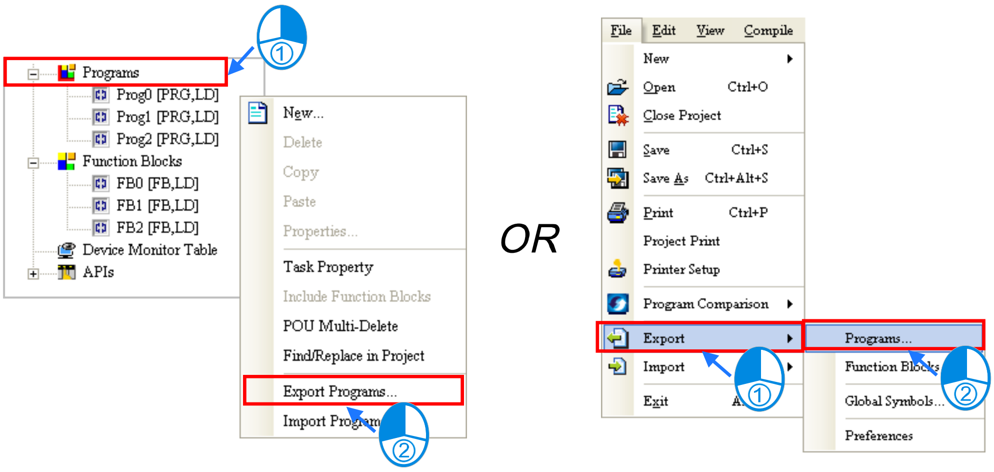
(3) If the users want to unlock the password, they have to open the **Properties** window again, type the password in the **Enter Password** box, and click **OK**.



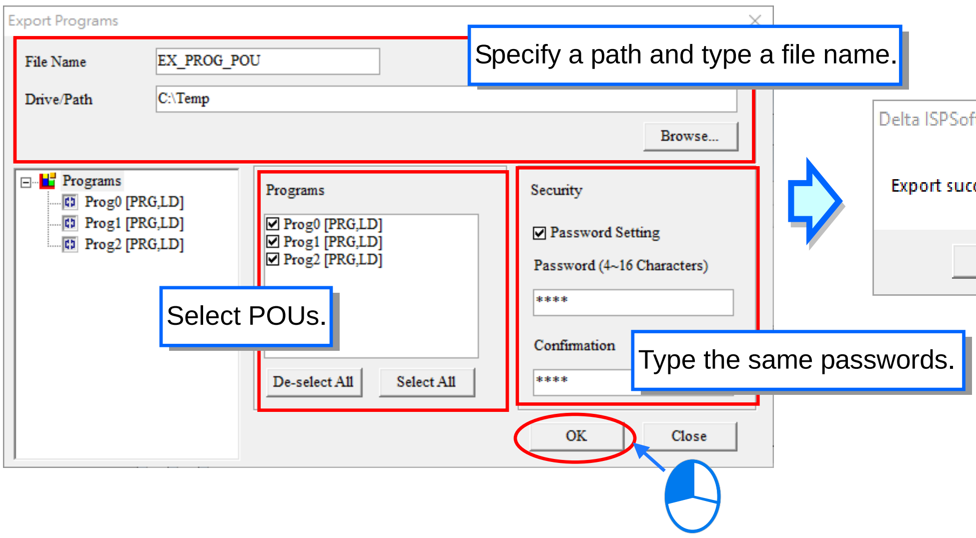
5.4.5 Exporting POU Program

ISPSoft supports exporting and importing POUs. But, under group project structure, users can only operate on the current editing project.

Choose **Programs** from **Export** in the **File** menu to directly operate on the current editing project for export; or, right-click **Programs** to select **Export Programs** from the quick menu.



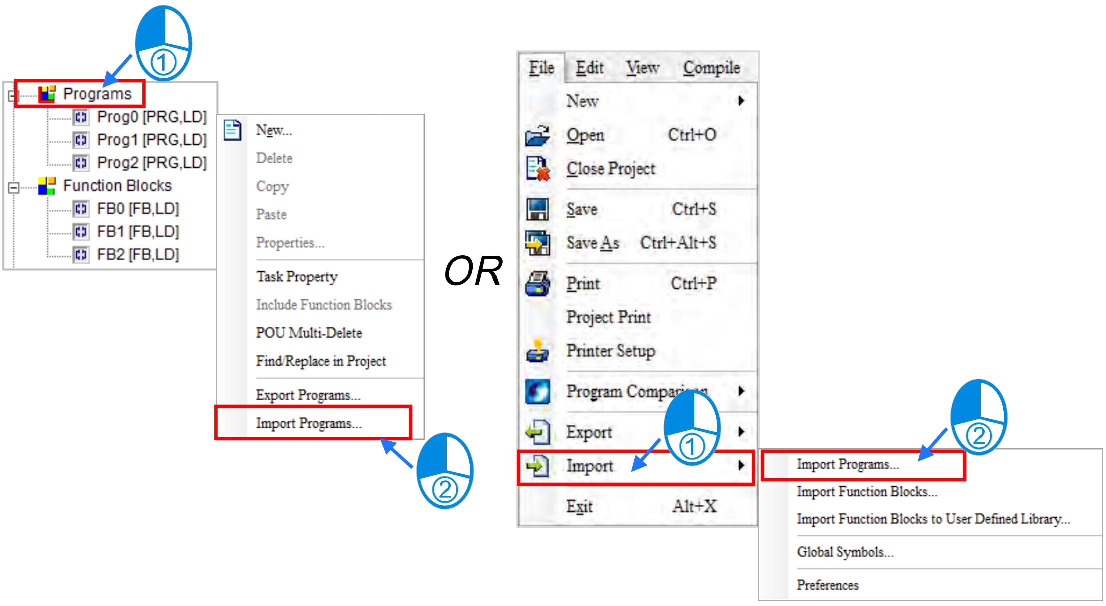
In the **Export Programs** window, specify a path in the **Drive/Path** box, type a file name in the **File Name** box, and select POUs of the program type which will be exported in the **Program** section. If the users want to protect the file which will be exported with a password, they have to select the **Password Setting** checkbox, type the same passwords in the **Password** box and the **Confirmation** box. English letters, numerical digits, and spaces can be typed in the boxes. Finally, click **OK**.



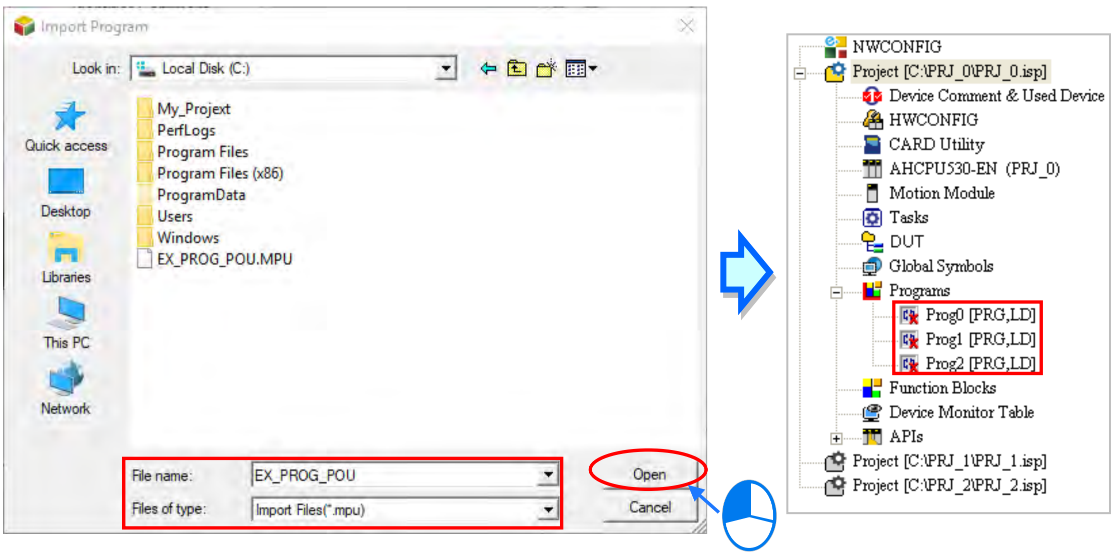
5.4.6 Importing POU Program

Similar to **Exporting**, users can only operate on the current editing project for **Import**. When importing, exported function block POU cannot import in **Programs**.

Choose **Import Programs** from **Import** in the **File** menu to directly operate on the current editing project for import; or, right-click **Programs** to select **Import Programs** from the quick menu.



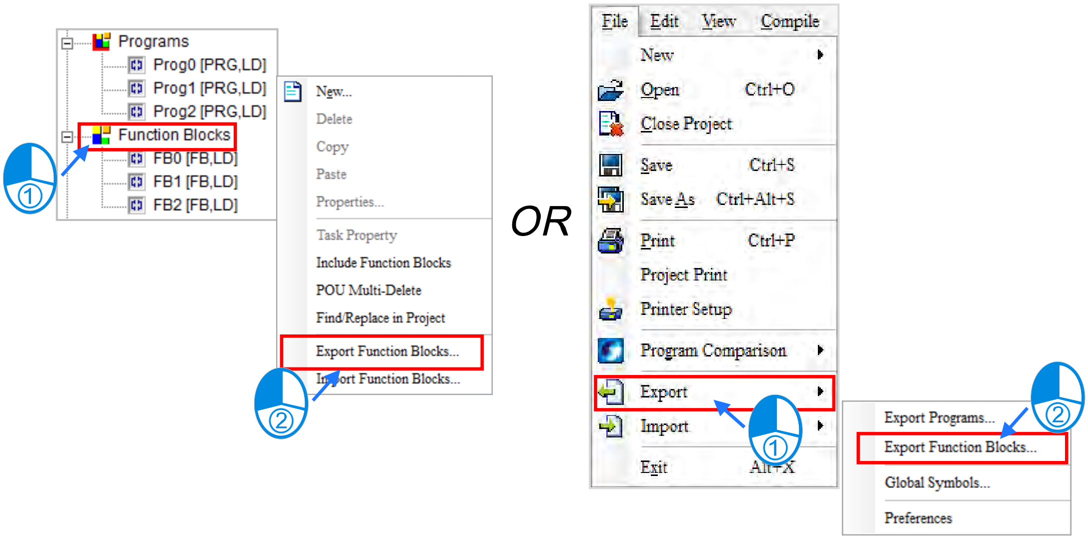
Select a file which will be imported, and then click **Open**. If the file is protected with a password, the users have to type the password in the **Password for Decrypting** window, and click **OK**. The POUs which are imported will not be assigned to any tasks. Besides, if the name of a POU which will be imported is the same as the name of a POU in the project, the system will not allow the POU to be imported, but the other POUs will be imported normally.



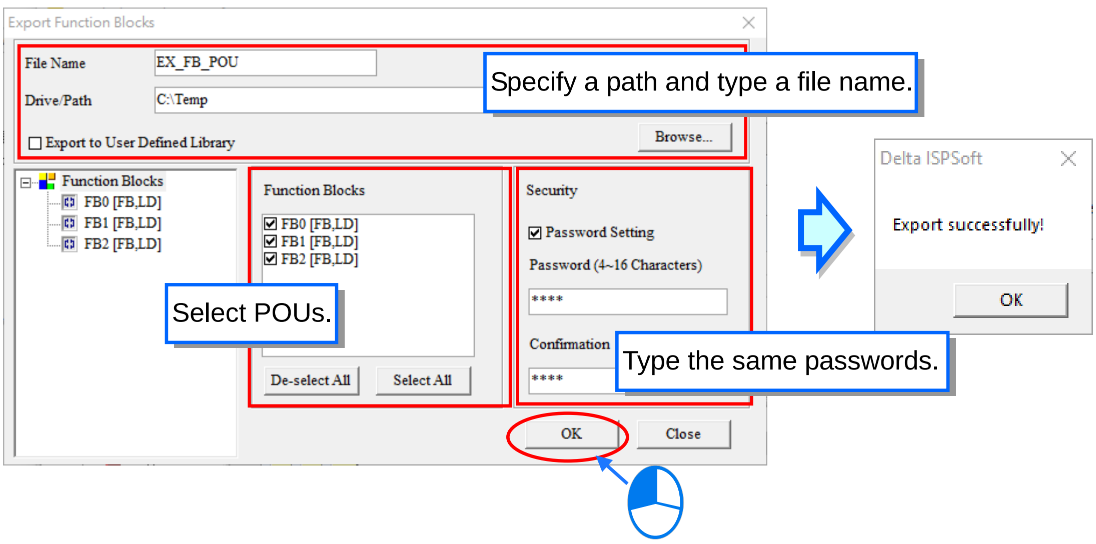
5.4.7 Exporting Function Block POU

ISPSoft supports exporting and importing POU. But, under group project structure, users can only operate on the current editing project.

Choose **Export Function Blocks** from **Export** in the **File** menu to directly operate on the current editing project for export; or, click **Function Blocks** to select **Export Function Blocks** from the quick menu.



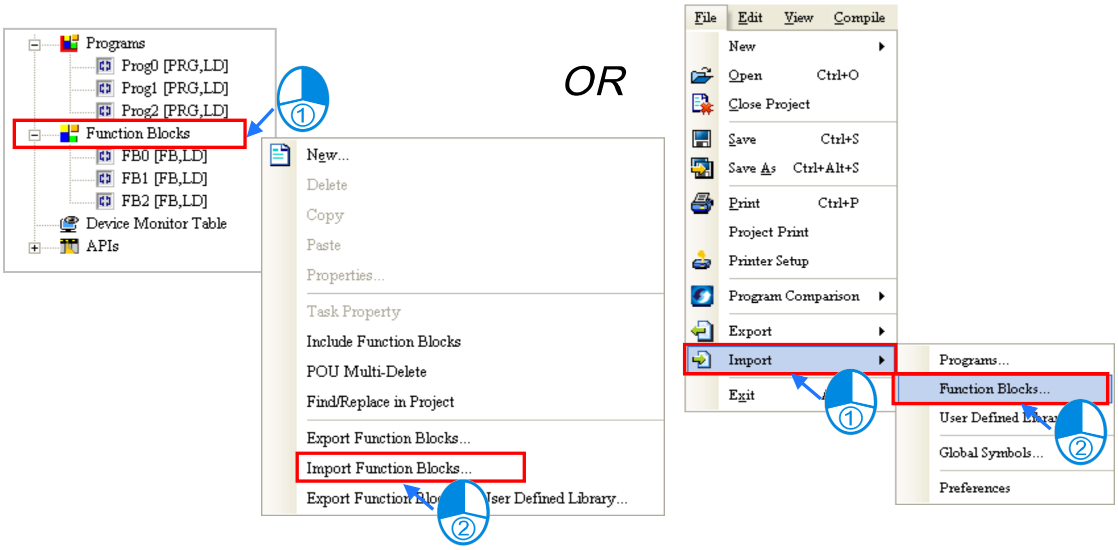
First set the name and the store path of the file to export, then select the desired function block POUs from the list of function blocks. If you want to encrypt the exported file with a password, please select "**Password Setting**" and set the same password in the following two columns, which the input value could be digits or blanks. If you'd like the exported file to be locked permanently and not editable, just click "**OK**" after finished the settings, which the decision would not have impact on the original FBs in this project.



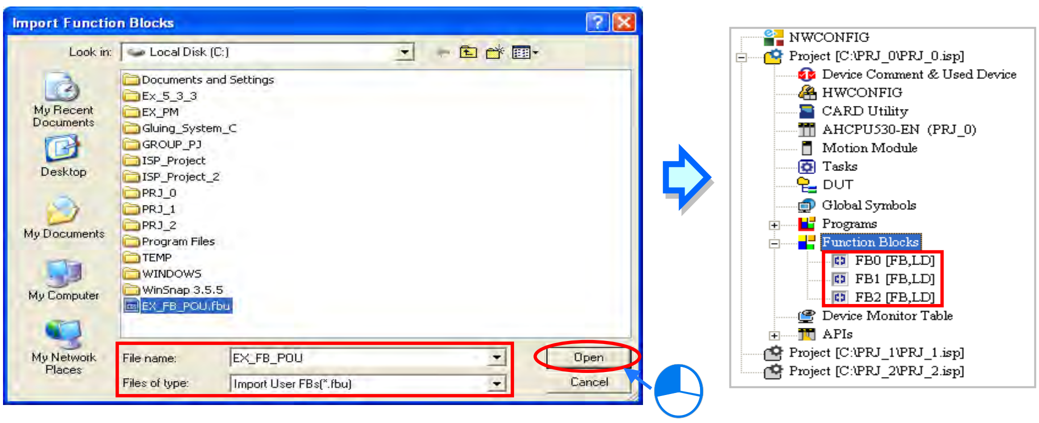
5.4.8 Importing Function Block POU

Similar to **Exporting**, users can only operate on the current editing project for **Import**. When importing, exported POU cannot import back under **Function Blocks**.

Choose **Function Blocks** from **Import** in the **File** menu to directly operate on the current editing project for import; or, click **Function Blocks** to select **Import Function Blocks** from the quick menu.

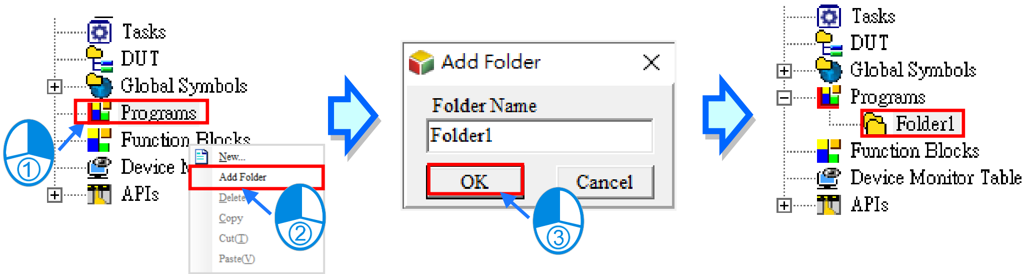


Select a file which will be imported, and then click **Open**. If the file is protected with a password, the users have to type the password in the **Password for Decrypting** window, and click **OK**. Besides, if the name of a POU which will be imported is the same as the name of a POU in the project, the system will not allow the POU to be imported, but the other POUs will be imported normally.



5.4.9 Edit Folder

Right click on "**Programs**", "**Function Blocks**" or "**Functions**" in the project tree and choose "**Add Folder**", then enter the folder name and click **OK** to complete the task.



The naming rules of folders are listed as follows.

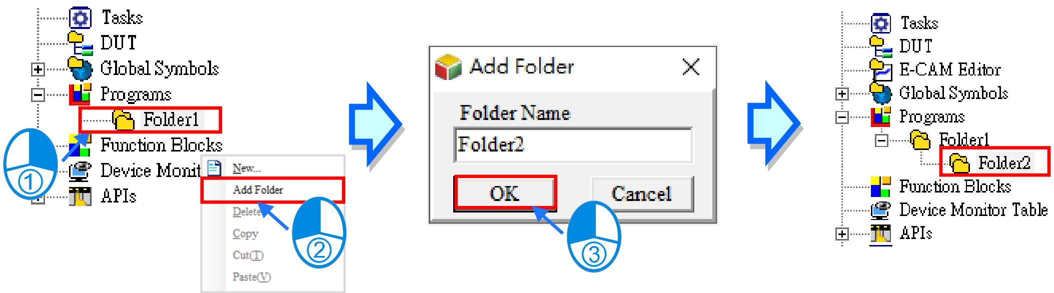
(a) Do not use special characters and blank spaces in folder names, such as *, #, ?, \, %, @, and so on.

(b) The maximum folder name length is 40 characters, while two spaces would be required for one Chinese character.

(c) The start bit should not be numbers.

(d) It is allowed to use underlines in a folder name, but you cannot continuously use it or put an underline at the end of the folder name. For example, "POU_1" is accepted, while "POU_1_" is not.

You can create folder groupings for layers as the following shown, which any folder can also be dragged into another layer so as to provide an easier way to manage POUs.



5.5 Task Management

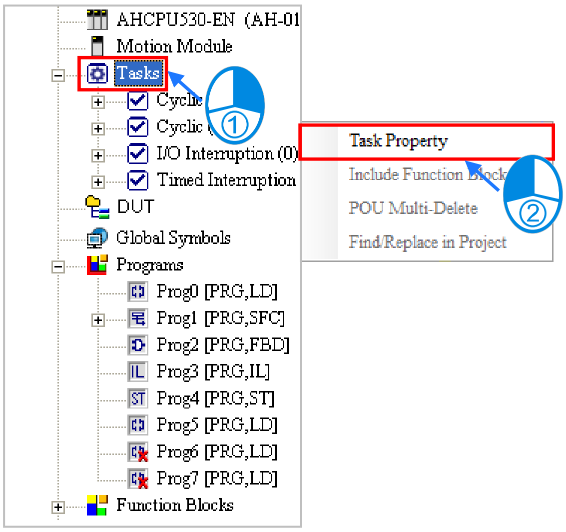
The steps of managing the tasks in ISPSoft are shown below. Please refer to the following sections for more information about the management of the tasks in ISPSoft.

Setting a task property → Assigning POUs to the task → Arranging the POUs

Before managing the tasks in ISPSoft, users have to start the Task Manager. There are three ways to start the tasks management tool.

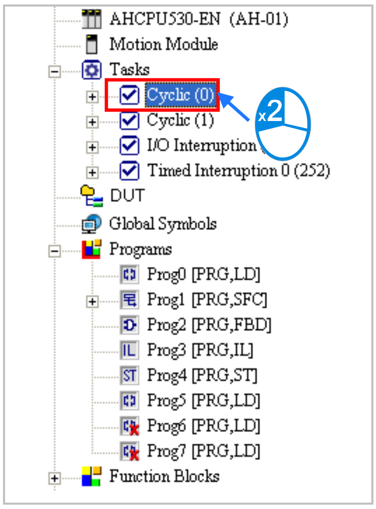
● **Method 1**

Right-click **Tasks** in the project management area, and then click **Task Property** on the context menu to open the **Task Manager** window.



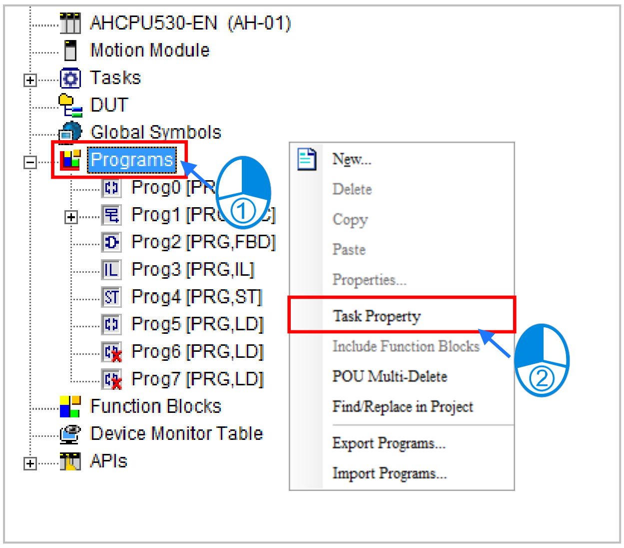
● **Method 2**

Unfold the **Tasks** section in the project management area, and then double-click a task which will be set to open the **Task Manager** window.

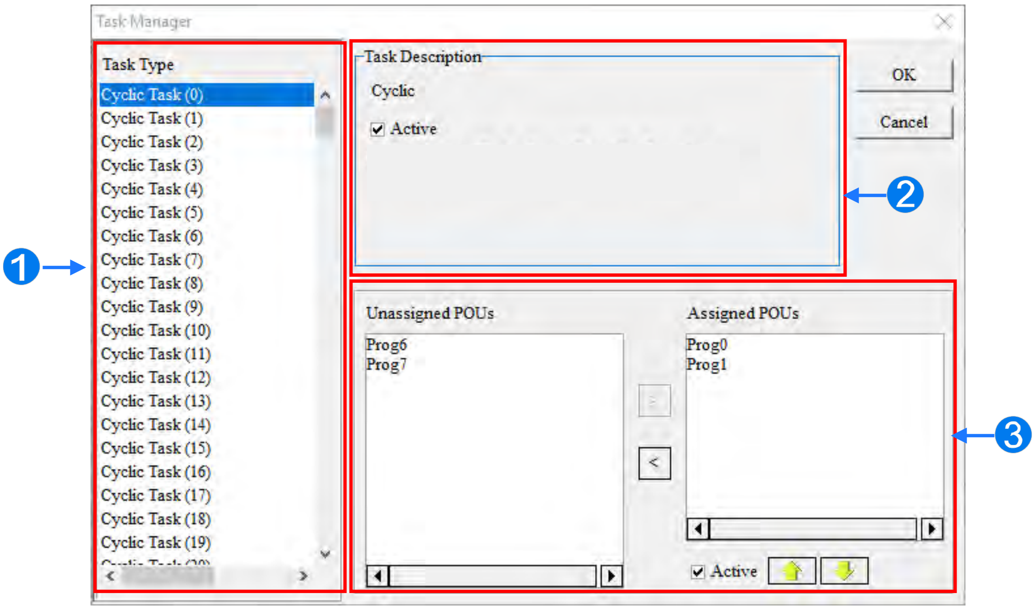


● **Method 3**

Right-click the **Programs** section in the project management area, and then click **Task Property** on the context menu to open the **Task Manager** window.



Below is the **Task Manager** setting page.



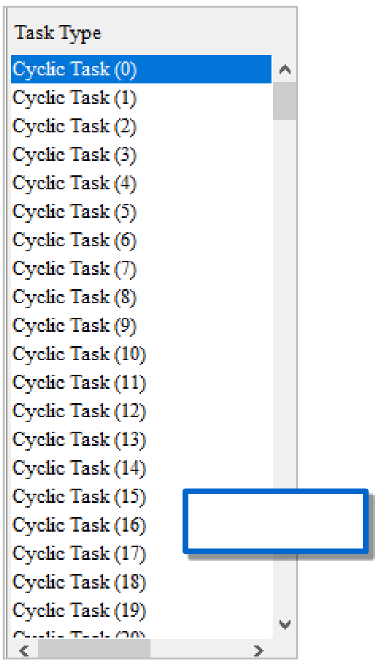
❶ Task type: The tasks available are listed here.

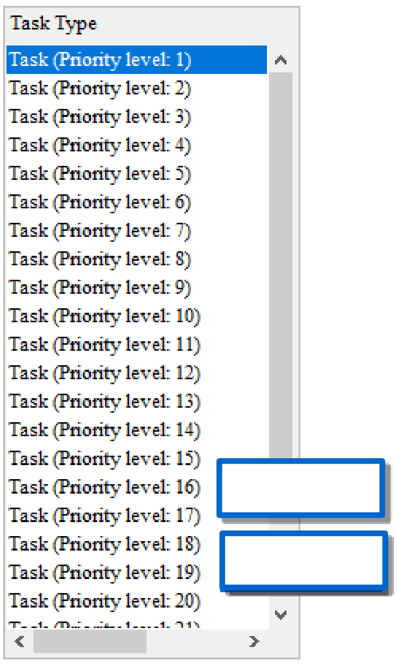
❷ Task description: The description of a task selected is displayed here.

❸ Task management area: Users can assign POUs to tasks, and arrange POUs.

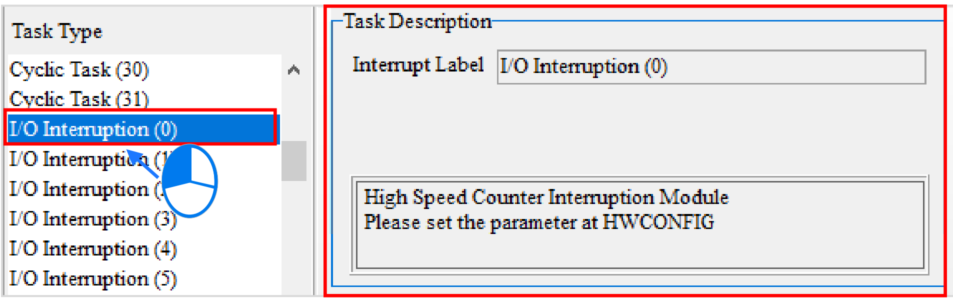
5.5.1 Setting Task Description and Condition for Interruption

The following TASK listed in **Task Type** differs according to the different types of PLC.

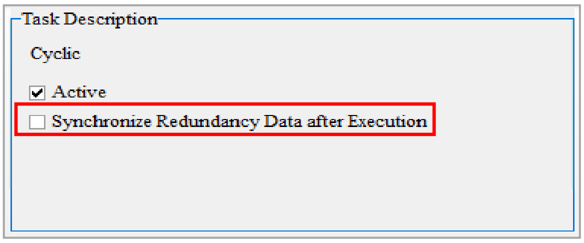




After a task in the **Task Type** section is selected, the description of the task will be displayed in the **Task Description** section. Users can set the condition of executing the task in the **Task Description** section. The tasks provided by projects are related to the functions of selected PLCs. Thus, each task property content is different, but basic settings are the same.



The content in Task Description also differs depending on the types of PLC. For instance, when using AH560 redundant system series, specific option like **Synchronize Redundancy Data after Execution** appears. For more information regarding the function, please refer to related product user manual.

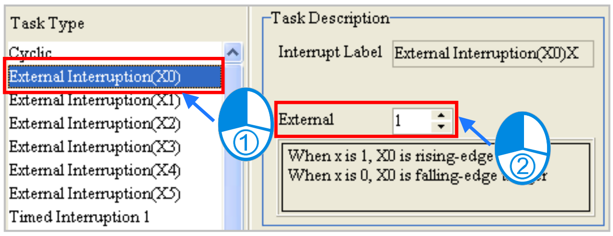


The setting of the properties of tasks can be illustrated with some simple examples. Users can refer to the examples and the operation manual for a PLC for more information about setting the properties of tasks.

Example 1: To set the interrupt task property of SV series, please check on the interrupt indicators provided by SV series. The following table demonstrates interrupt indicators in SV series from the DVP-PLC Application Manual (Programming).

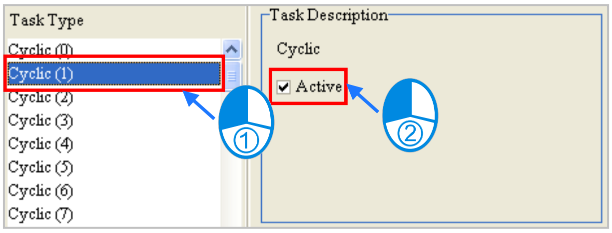
External interrupt	I00□(X0), I10□(X1), I20□(X2), I30□(X3), I40□(X4), and I50□(X5) (□=1: Rising edge-triggered ; □=0: Falling edge-triggered)
Timed interrupt	I6□□ and I7□□ (□□=1~99; Time unit=1 ms) I8□□ (□□=1~99; Time unit=0.1 ms)
High-speed counter interrupt	I010, I020, I030, I040, I050, and I060
Pulse interrupt	I110, I120, I130, and I140
Communication interrupt	I150, I160, and I170
Frequency measurement card interrupt	I180

The **Task Type** section for a DVP-SV series PLC is shown below. If users want to set a task corresponding to the interrupt I001, they have to select **External Interruption (X0)** in the **Task Type** section first. (I001 is triggered when the signal passing through X0 goes from low to high.) The description of **External Interruption (X0)** will be displayed in the **Task Description** section. According to the message in the **Task Description** section, I001 is rising edge-triggered if the value in the **External** box is 1. As a result, the users have to select 1 in the **External** box.

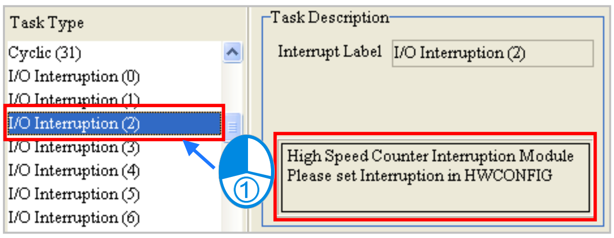


Example 2: The figure below is the **Task Manager** window for AHCPU530-EN. The task selected is

Cyclic (1). Owing to the fact that users can enable and disable a cyclic task in an AH500 series CPU module through the applied instructions TKON and TKOFF, they can set the initial state of the cyclic task. If the **Active** checkbox is unselected, **Cyclic (1)** is disabled when the program is executed. **Cyclic (1)** is not enabled until a POU assigned to another task uses the instruction TKON to enable **Cyclic (1)**. Please refer to AH500 Programming Manual for more information about TKON and TKOFF.

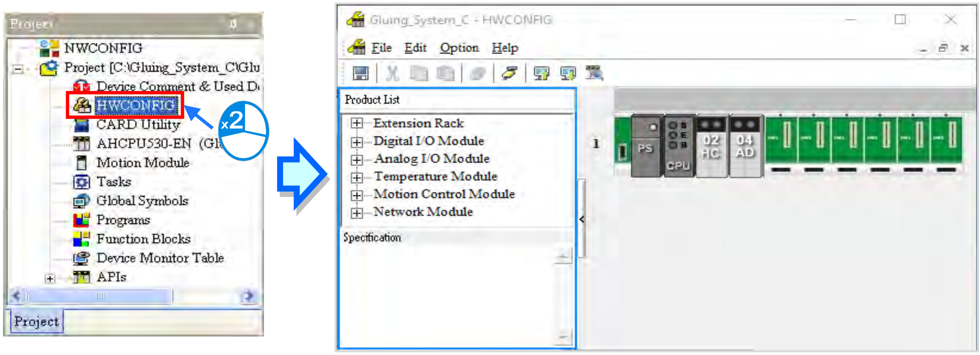


Example 3: The figure below is the **Task Manager** window for AHCPU530-EN. The task selected is **I/O Interruption (2)**. Owing to the fact that users can set the condition of an I/O interrupt by themselves, the message in the **Task Description** section indicates that the condition of **I/O Interruption (2)** can be set in HWCONFIG. The setting of the condition of **I/O Interruption (2)** in HWCONFIG is described below.

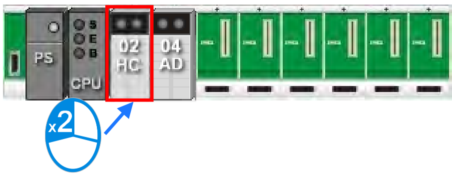


Suppose **I/O Interruption (2)** will be triggered after channel 1 on AH02HC-5A receives a certain number of pulses. The setting of **I/O Interruption (2)** in HWCONFIG is described below. Users can refer to chapter 3 for more information about setting the parameters in a module, and refer to AH500 Operation Manual for more information about the interrupts in an AH500 series CPU module.

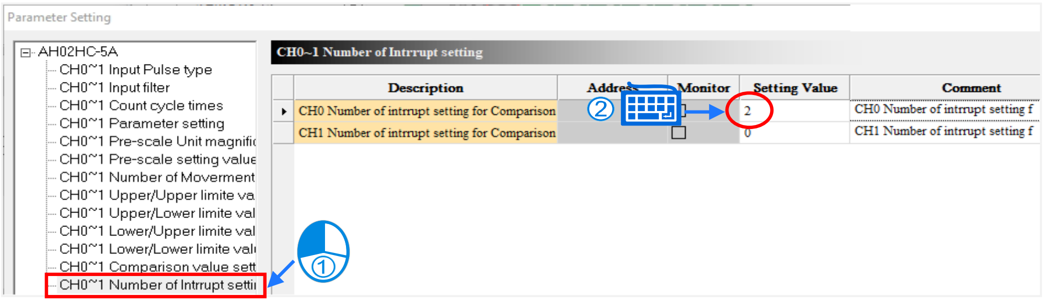
(1) Double-click **HWCONFIG** in ISPSOft.



(2) Double-click AH02HC-5A to open the **Parameter Setting** window.

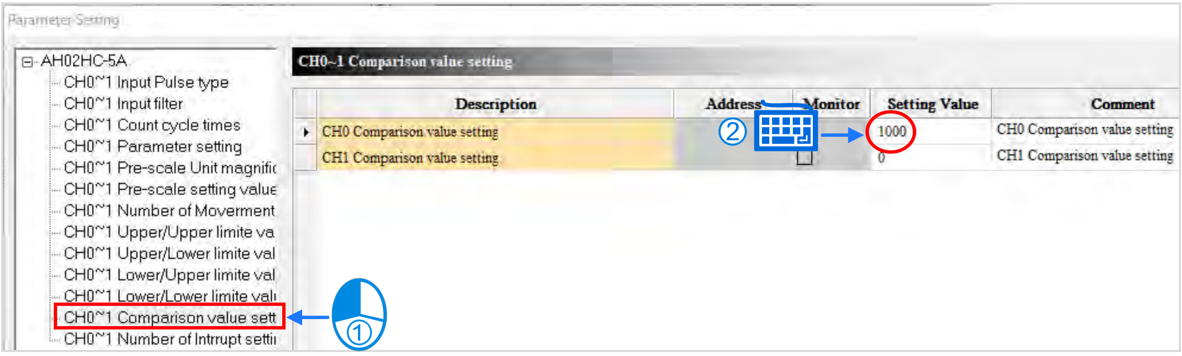


(3) Select **CH1~2 Number of Interrupt Setting**, and type 2 in the **Initial** cell for **CH1 Number of Interrupt Setting for Comparison**.

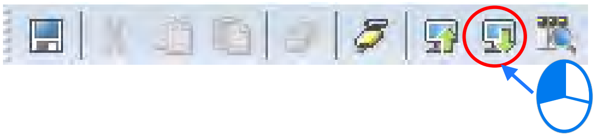


***. The number of interrupt setting for channel 0 and 1 can be the same. This setting means when the condition of any channel is set, it will trigger the same I/O interrupt.**

(4) Switch to comparison value setting page and input the Setting Value for triggering interrupt in **CH0 Comparison Value Setting**.



(5) Be sure to save the file after the setting is complete. The parameters set in HWCONFIG must be downloaded to the CPU module so that they can take effect.

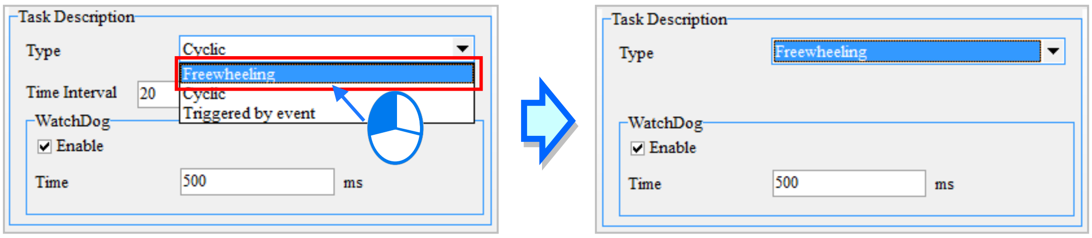


When using DVPxxMC/AS5xx series, the work list has options containing priority level 1~24 (1 refer to the highest priority level, 24 is the lowest priority level). After choosing the priority level, users can select the appropriate **Type** and setup **Watchdog** for program scan from Task Description. The following section introduces **Task Type** and **Watchdog** function.

- **Type**

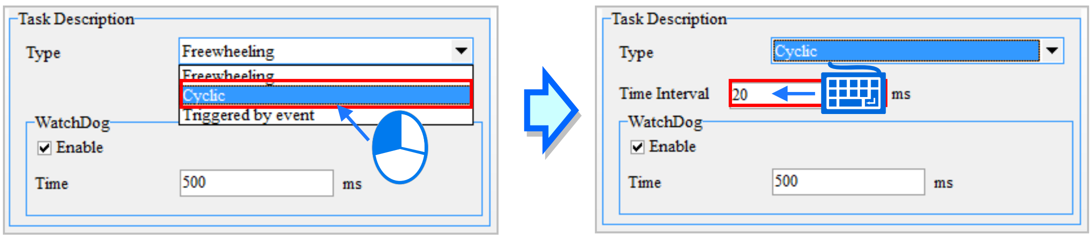
The three task types are **freewheeling, cyclic and triggered by event**.

(1) Freewheeling



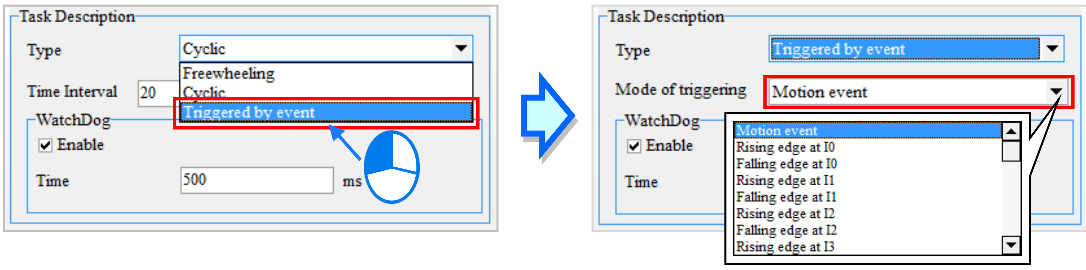
Choose **Freewheeling** from the **Type** drop-down list. This is the first task to choose when start operating. After operating for a cycle, the task is activated in the next cycle.

(2) Cyclic



Choose **Cyclic** from the **Type** drop-down list and setup the **Time Interval**; The cyclic task is operated according to the time interval setting from Task Manager.

(3) Triggered by Event



Choose **Triggered by Event** from the **Type** drop-down list and select from **Mode of Triggering** drop-down list.

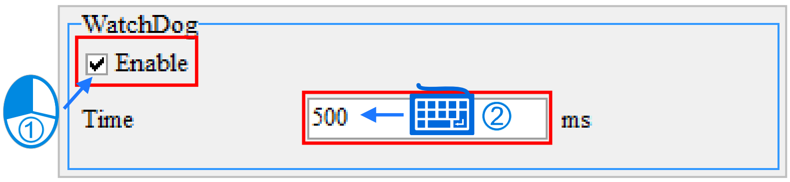
➢ The mode of triggering contains the following events:

- Motion event (Motion control task)
- Rising edge or falling edge of local input points (I0~I7 and I10~I17)
- CANopen SYNC signal
- Z pulse rising edge of incremental encoder 1 or encoder 2

An event task is only executed once to the assigned event. The executing time for event task is determined by the time of event and event task according to priority.

● **Watchdog**

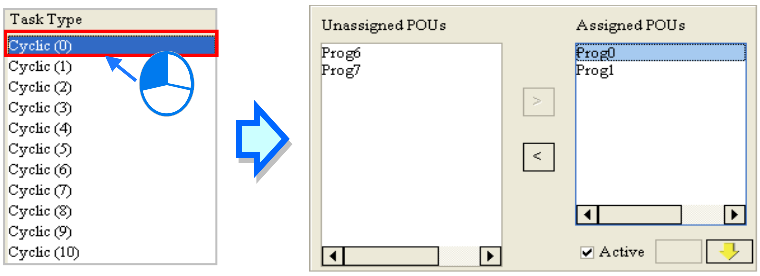
The Watchdog is used to monitor every task. When the task execution time exceeds the set watchdog time, the controller will enter Error state and the user program execution will stop. Every task can set its exceeding time and click the Watchdog function if needed.



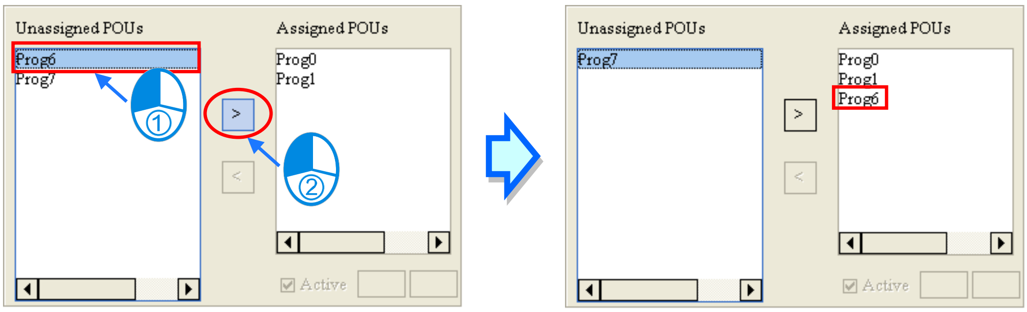
5.5.2 Configuration of POU

When Task Description setting is complete, the POUs will be configured in the TASK list. Please pay attention that one POU is assigned to one task, while POU that uses SFC for editing can only be configured to cyclic task.

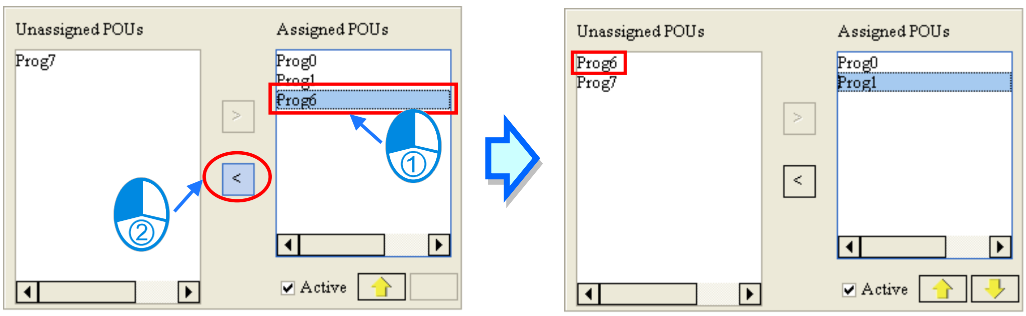
(1) After a task in the **Task Type** section is selected, the assignment of the POUs will be displayed in the task management area. The POUs which have not been assigned to the task are in the **Unassigned POUs** section, and the POUs which have been assigned to the task are in the **Assigned POUs** section.



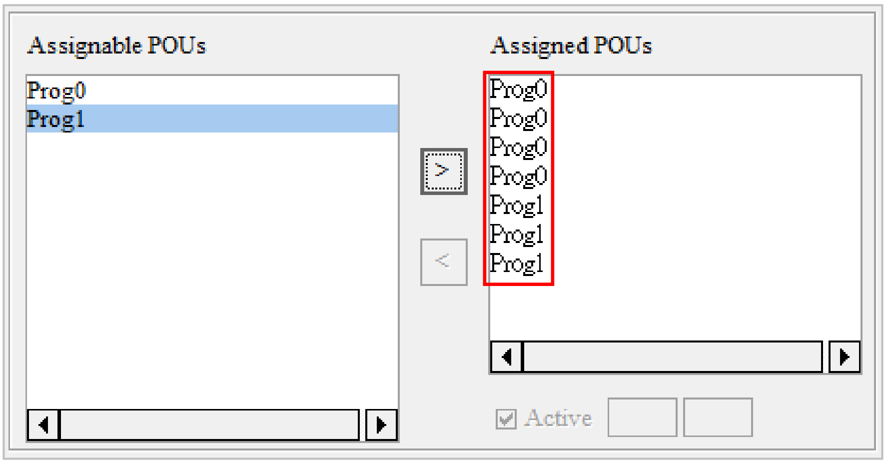
(2) If users want to assign a POU in the **Unassigned POUs** section to the task, they can select the POU in the **Unassigned POUs** section, and click >.



(3) If the users want to remove a POU from the **Assigned POUs** section, they can select the POU in the **Assigned POUs** section, and click <.



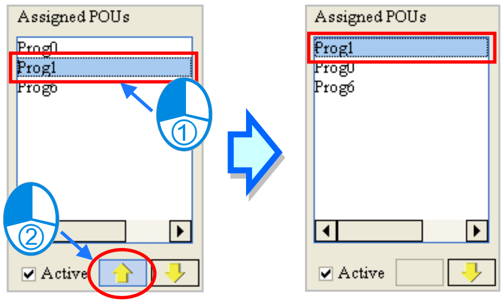
When using DVPxxMC/ AS5xx series in project, the same POY can be reassigned to multiple tasks and be reassigned in the same task too (see below).

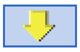


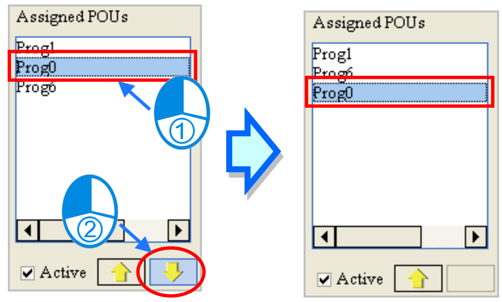
5.5.3 POU Order

When POU configuration is complete under the Task list, these POUs need to be arranged in execution order.

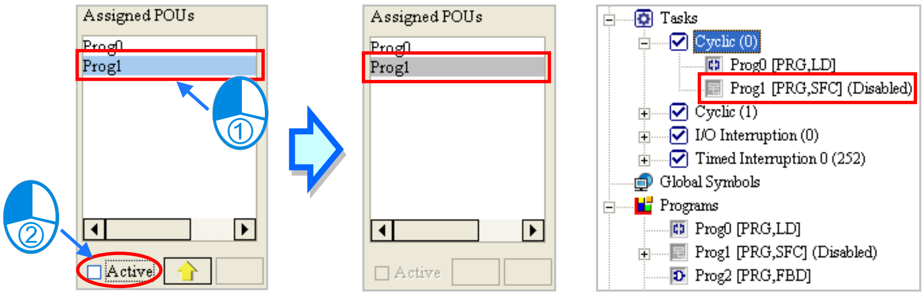
(1) If users want to execute a POU in the **Assigned POUs** section earlier, they can select the POU in the **Assigned POUs** section, and click  to move the POU upward.



(2) If users want to execute a POU in the **Assigned POUs** section later, they can select the POU in the **Assigned POUs** section, and click  to move the POU downward.



(3) After a POU in the **Assigned POUs** section is selected, users can select the **Active** checkbox if they want to enable the POU, or unselect the **Active** checkbox if they want to disable the POU. A POU which is disabled is represented by a gray icon in the project management area.



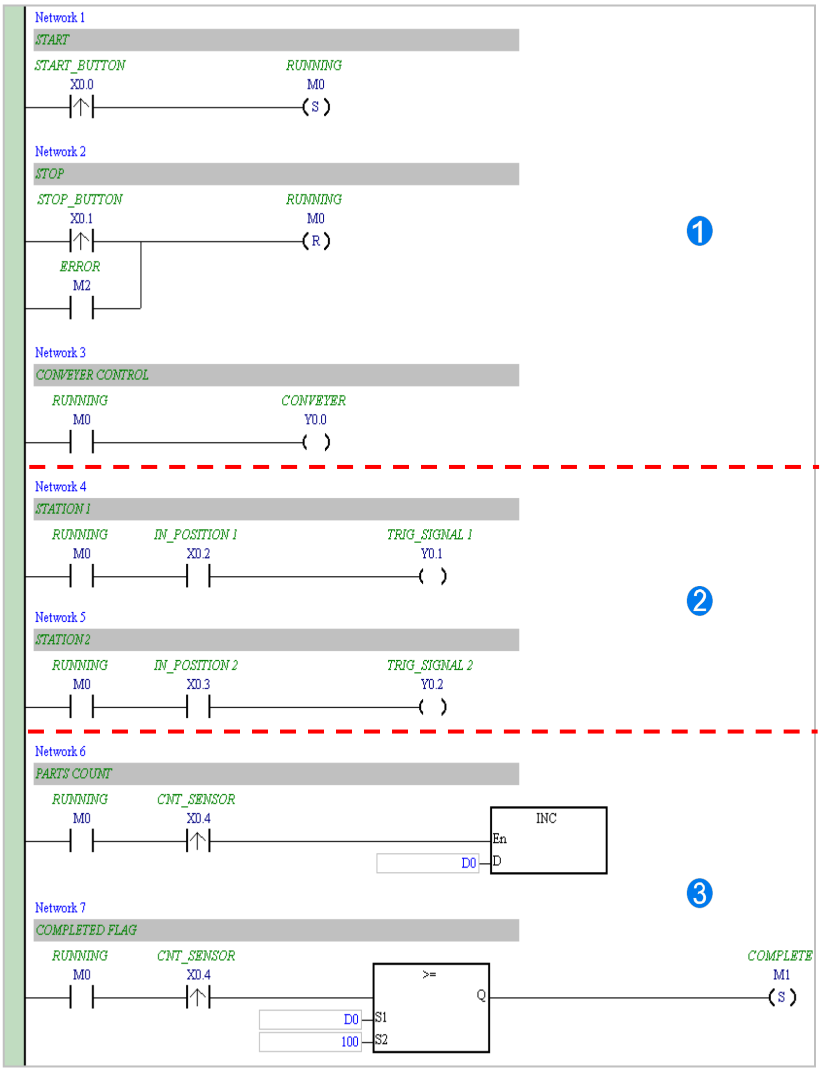
***.Please refer to section 5.4.2 for more information about enabling a POU.**

(4) Click **OK** in the **Task Manager** window after the setting of the task is complete.

5.6 Example

5.6.1 Programming TASK and POU

The examples created in chapter 4 will be rewritten in TASK and POU program. The program created in chapter 4 is shown below. It will be divided into three parts according to the functions listed below.



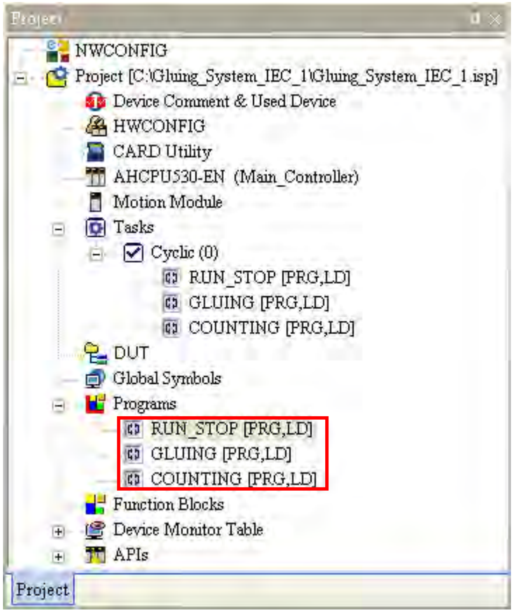
❶ This part of the program functions to start or stop the system.

❷ This part of the program functions to inject the glue.

❸ This part of the program functions to count the parts which are conveyed.

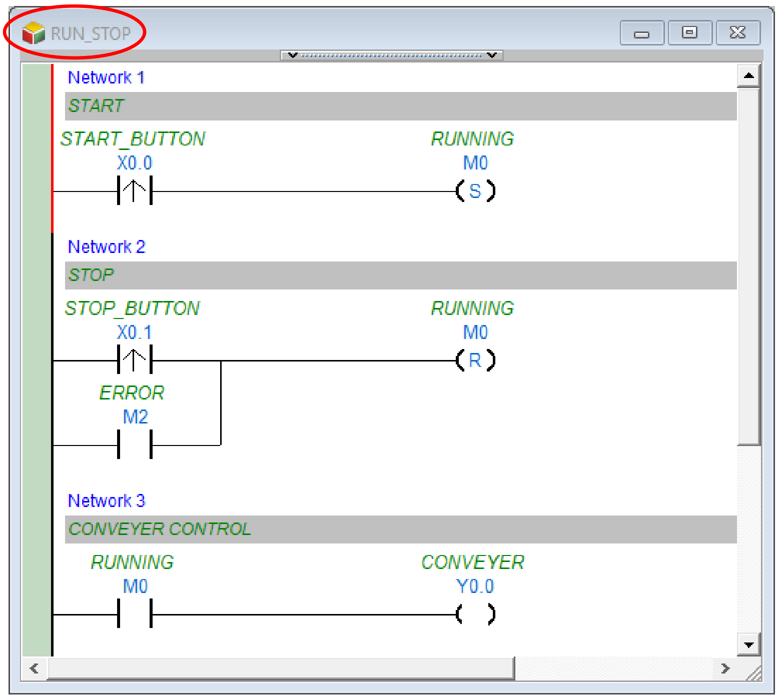
This section aims at the architecture of a program. The contents related to configuring hardware, setting parameters, testing a program, and debugging a program are the same as the contents of chapter 4. Users can try to complete the related setting by themselves.

First, create a new project. Then, refer to chapter 4, and complete the hardware configuration. Finally, refer to section 5.4.1, and create three POUs in the **Programs** section in accordance with the three points listed above. These three POUs are assigned to **Cyclic (0)**.

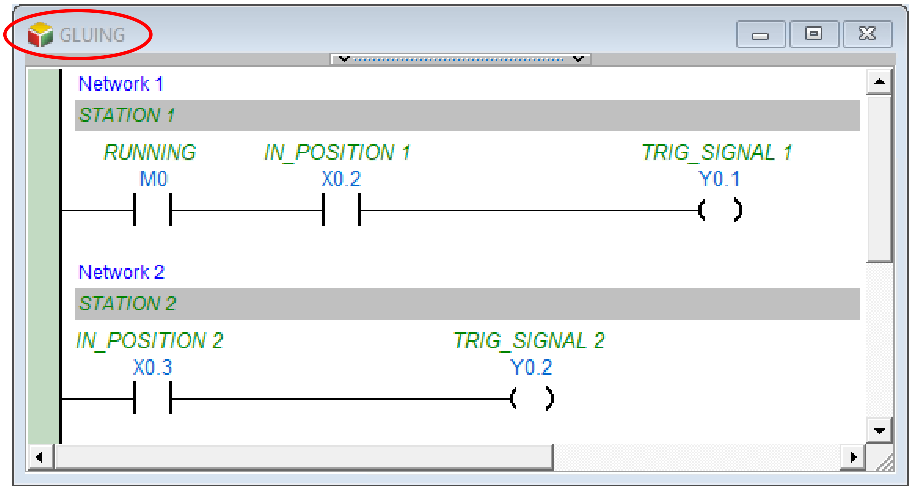


Please refer to chapter 4, and write the programs in the POUs shown below.

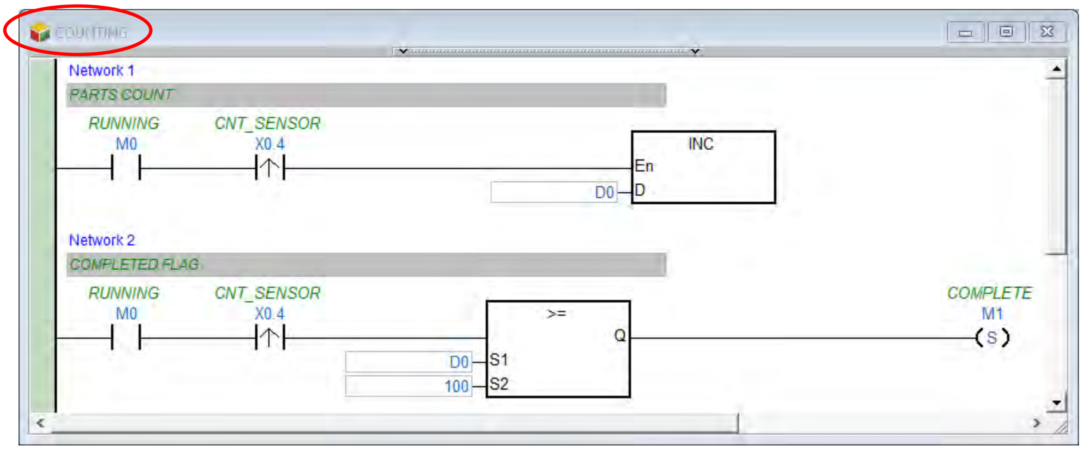
The program in **RUN_STOP** functions to start or stop the system.



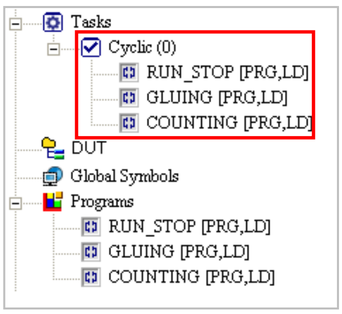
POU- **GLUING** to control gluing.



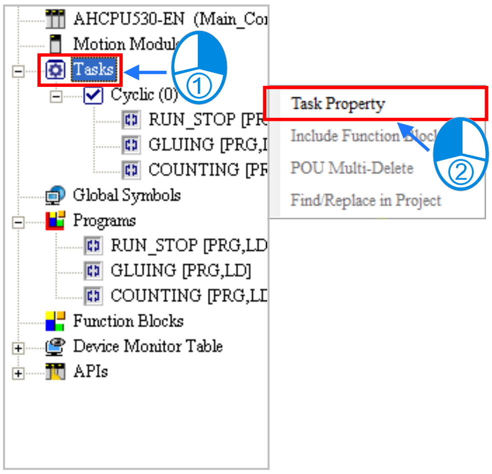
POU- **COUNTING** to finish the final counting.

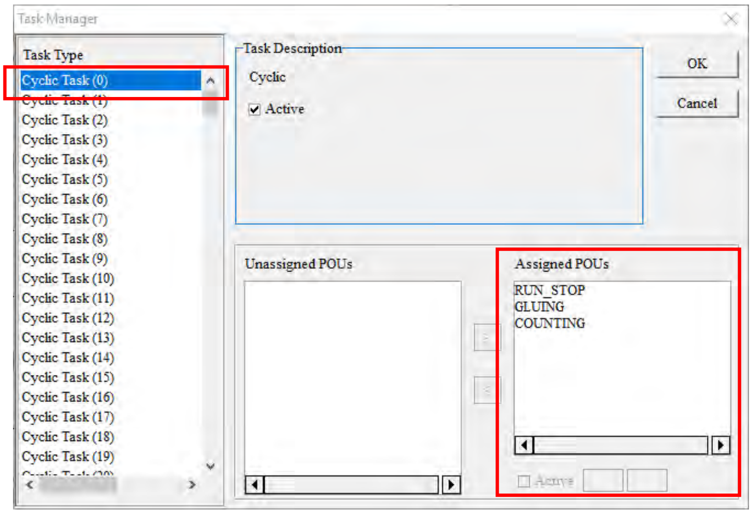


When programming is complete, please check the POU order under Tasks is the same as the diagram shown below.

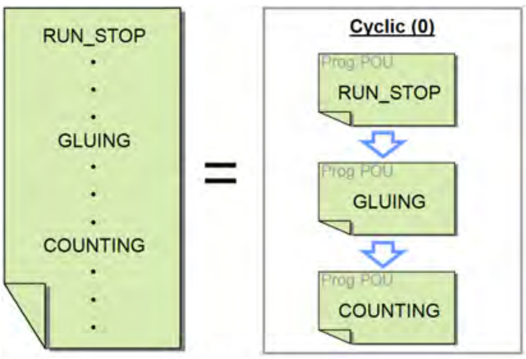


When re-planning the task configuration for each POU, right-click **Tasks** in Project section and choose **Task Property** from the quick menu to open **Task Manager** setting page and add POU to the assigned POUs in Cyclic (0).





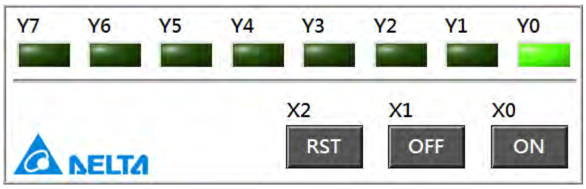
If the creation of the POUs is complete, the result of executing the program will be the same as the result of executing the ladder diagram in chapter 4. Please refer to chapter 4, and compile the program. The program can be tested after it is downloaded to the CPU module.



5.6.2 Example of an Interrupt Subroutine in a DVP Series PLC

- **Example**

If the ON button is pressed (X0 is turned ON), Y0~Y7 will scanned in order. If the OFF button is pressed (X1 is turned ON), the output will stop, and the present output state will be retained. If the RST button is pressed (X2 is turned ON), the output will be reset, and Y0~Y7 will be scanned again.



- **Planning a program**

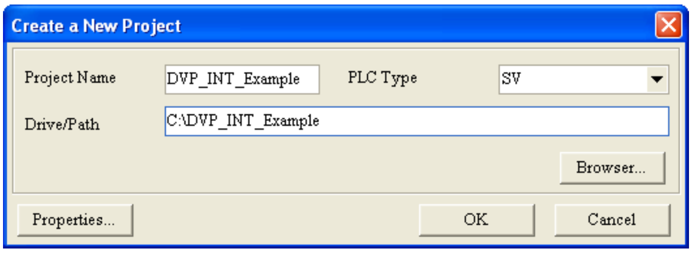
The model used in this example is a DVP-SV PLC, and four POUs are created. The functions of the POUs are described below.

POU name	Function
Run_Stop	1. Reset the operation flag M0, transfer the value 1 to the output data register D0, and enable the interrupt. 2. When X0 is turned from OFF to ON, the operation flag M0 is set to ON. 3. When X1 is turned from OFF to ON, the operation flag M0 is set to OFF.
LED	The states of Y0~Y7 are updated according to the value in the output data register D0.
Shift	The values of the bits in the output data register D0 is shifted by one bit to the left every 0.5 seconds. If the value in D0 is larger than 128, the value 1 will be transferred to D0.
Reset	Transfer the value 1 to the output data register D0, that is, set bit 0 in D0 to ON. The POU will be executed after the external interrupt I201 is triggered. (I201 is triggered when the signal passing through X2 goes from low to high.)

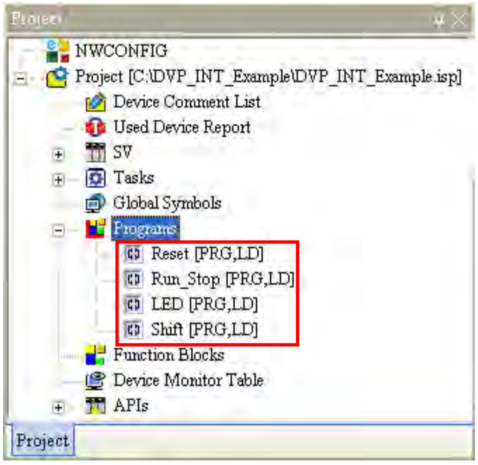
***. Please refer to DVP-PLC Application Manual—Programming for more information about the interrupts in a DVP-SV series PLC and the related applied instructions.**

- **Creating A New Project**

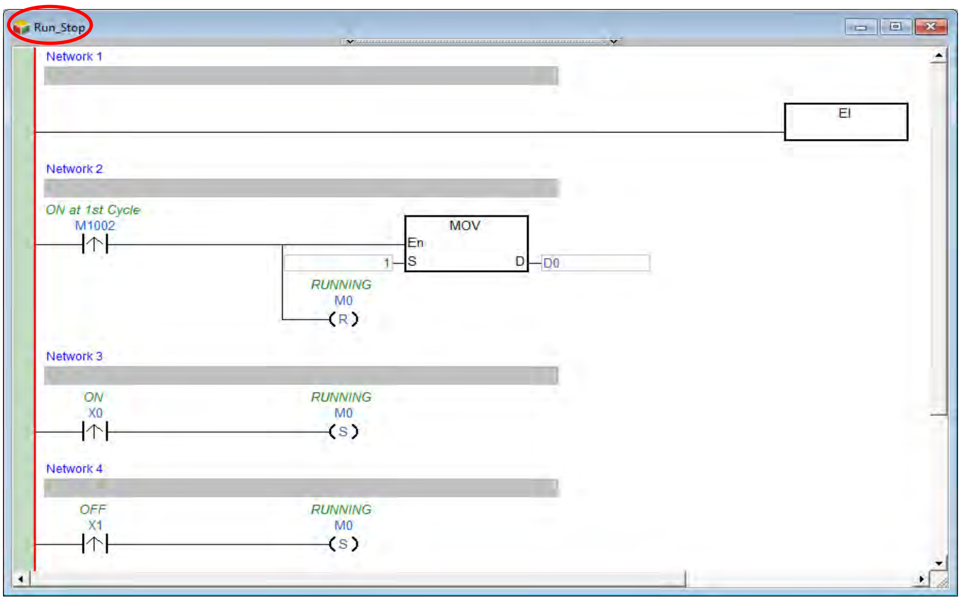
First, create a SV series project.



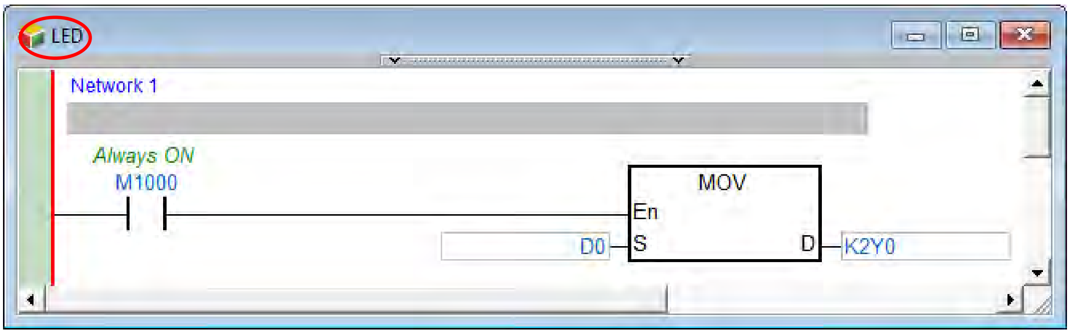
Under **Programs** in Project section, create for instance 4 POUs and **Task** column in POU Property can remain as **Cyclic** by default.



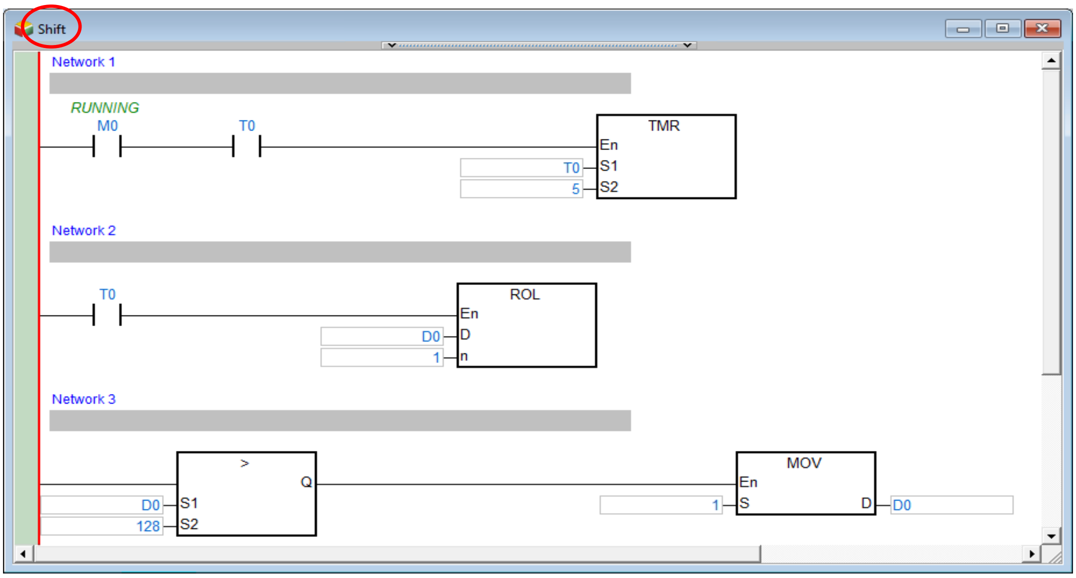
Write the programs in the POUs shown below.



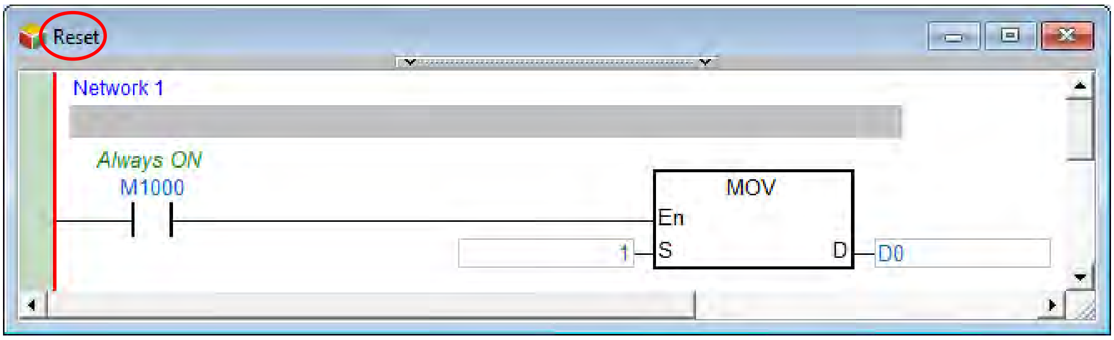
***. The applied instruction MOV is in the Transmission Comparison section, and the applied instruction EI is in the Loop Control section.**



*. The applied instruction MOV is in the Transmission Comparison section.

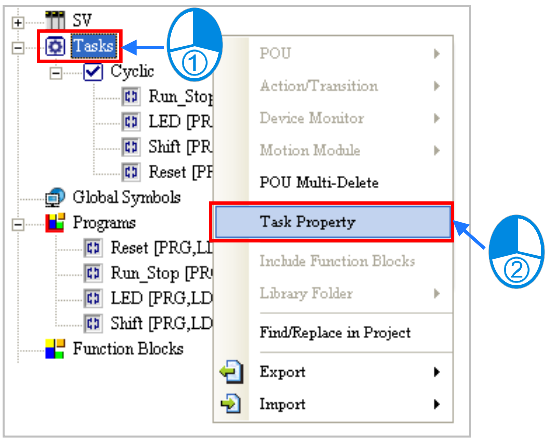


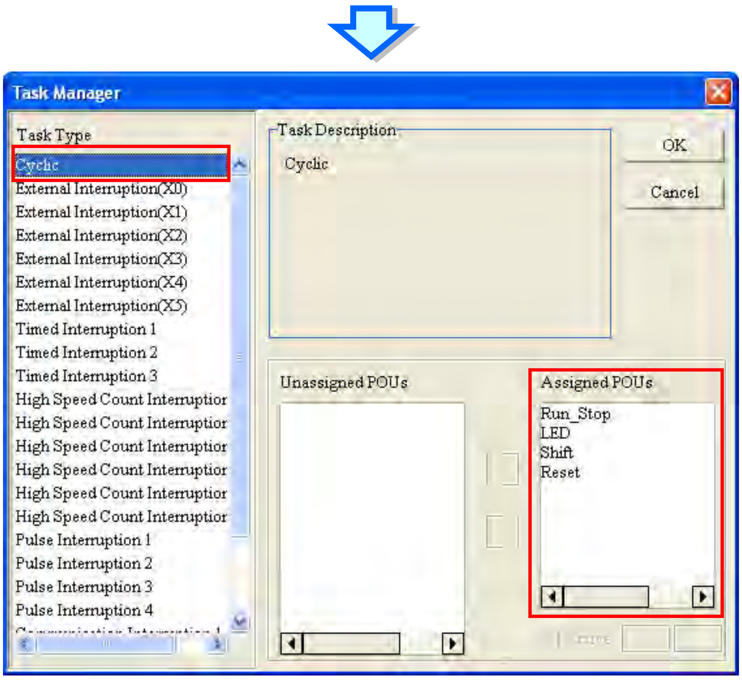
*. The applied instruction TMR is in the Basic Instructions section, the applied instruction ROL is in the Rotation and Displacement section, the applied instruction MOV is in the Transmission Comparison section, and the comparison contacts are in the Contact Type Logic Operation section.



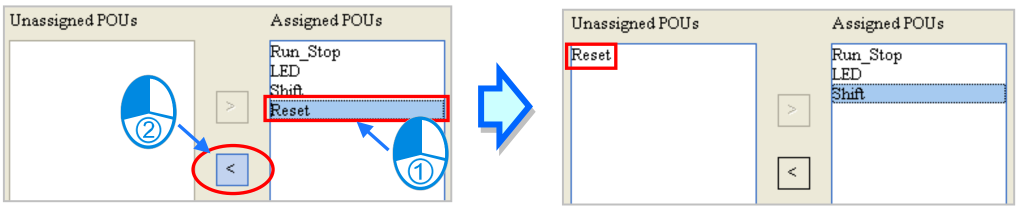
*. The applied instruction MOV is in the Transmission Comparison section.

Open the **Task Manager** window after the writing of the program is complete. Owing to the fact that the four POUs are assigned to **Cyclic** when they are created, the four POUs are in the **Assigned POUs** section for **Cyclic**.

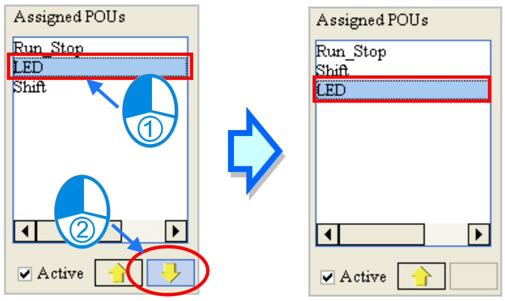




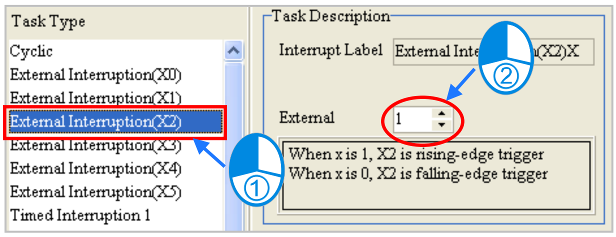
However, since **Reset** function is triggered by external interrupt, therefore, please remove **Reset** from the TASK list.



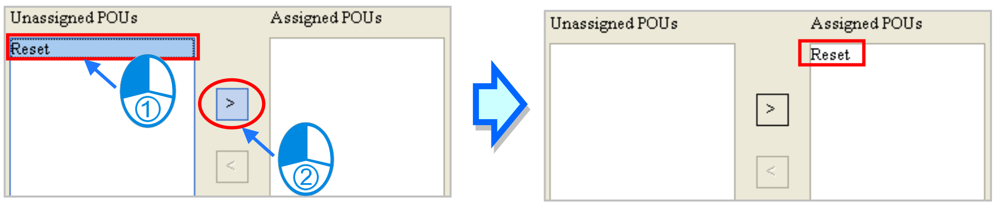
After the assignment of the POUs to **Cyclic** is complete, users can arrange the POUs in the **Assigned POUs** section. Owing to the fact that **Run_Stop** and **Shift** must be executed earlier than **LED**, the order in which **Run_Stop**, **Shift**, and **LED** are listed in the **Assigned POUs** section is **Run_Stop→Shift→LED**.



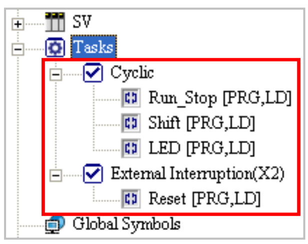
Select **External Interruption (X2)** in the **Task Type** section, and select 1 in the **External** box in the **Task Description** section. **External Interruption (X2)** is triggered when the signal passing through X2 goes from low to high.



Assign **Reset** to **External Interruption (X2)**. Owing to the fact that there is only one POU in the **Assigned POUs** section, the users do not need to arrange the POU.



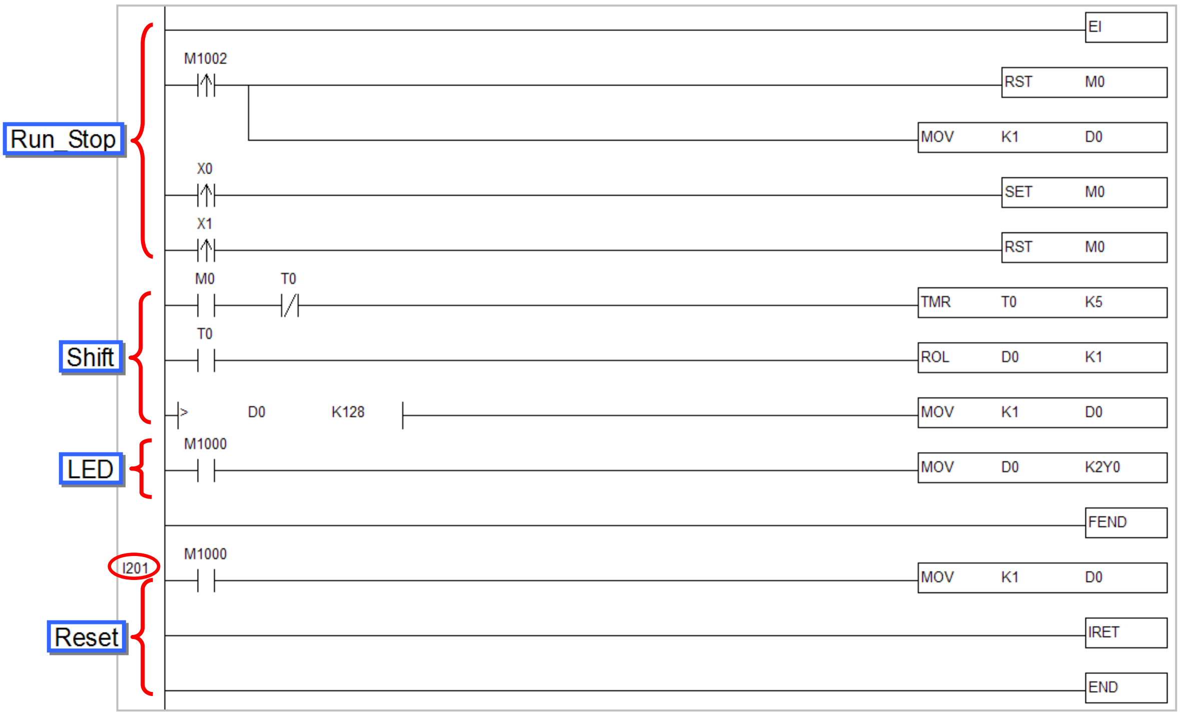
After **OK** is clicked, the assignment and the setting in the **Task Manager** window will be applied. The assignment is shown below. The writing of the program has been completed so far. The users can try to compile the program, download the program to the PLC, and test the program by themselves.



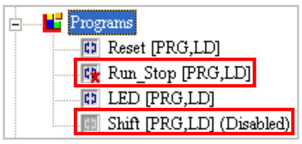
Additional remark

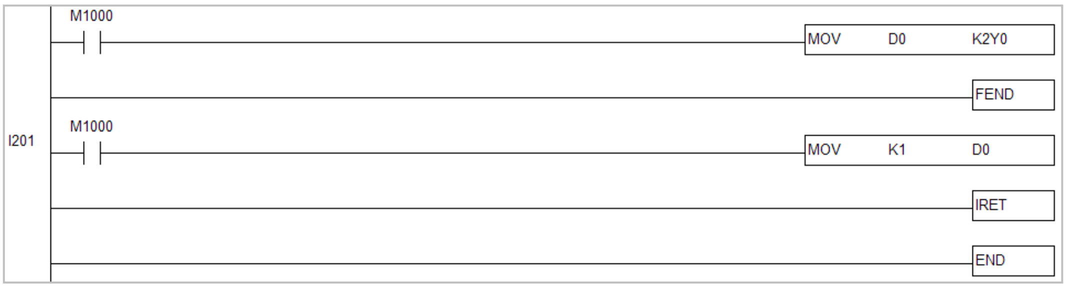
After the program above is compiled successfully and downloaded to the PLC, the users can upload the program in the PLC to WPLSoft. The program uploaded to WPSoft is shown below.

The main program is composed of the three POUs which are assigned to the cyclic task. The order in which the the POUs are executed is **Run_Stop→Shift→LED**. The contents of the interrupt subroutine I201 are the same as the contents of the POU **Reset**.



The users can remove **Run_Stop** from the **Tasks** section, and disable **Shift**. After the program is compiled and downloaded to the PLC, the users can upload the program in the PLC to WPLSoft. The main program will not include the two POUs **Run_Stop** and **Shift**.



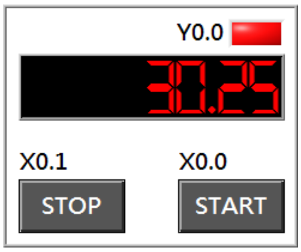


***. WPLSoft is programming software for Delta PLCs. The programming architecture adopted by WPLSoft is traditional programming architecture. Please refer to WPLSoft User Manual for more information.**

5.6.3 Task Management

- **Example**

If the START button is pressed (X0.0 is turned ON), the system will begin to count. The STOP button must be pressed (X0.1 must be turned ON) within 30 seconds. Otherwise, the alarm will ring (Y0.0 will be turned ON).



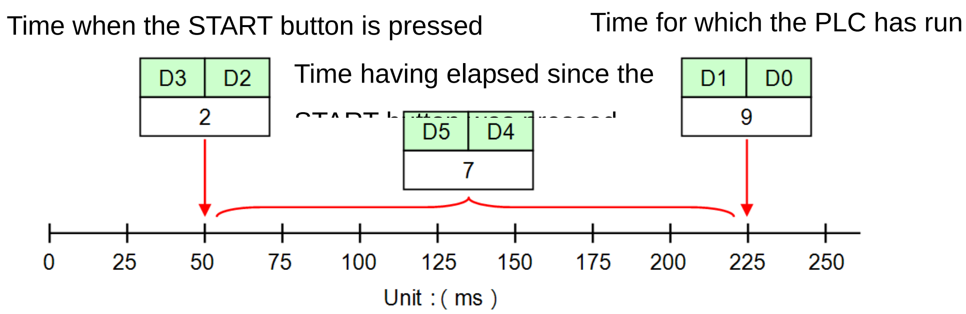
- **Hardware configuration**

In this example, the CPU module AHCPU530-EN, the digital I/O module AH16AP11R-5A, and the four-slot main backplane AHBP04M1-5A are used. (The hardware configuration here is the same as the hardware configuration in chapter 4.)

- **Planning a program**

In this example, a timed interrupt is triggered every 25 milliseconds, and time intervals are measured through a program. In the figure below, **Timed Interruption (0)** is triggered every 25 milliseconds, and the value in the 32-bit register (D1, D0) increases by one whenever **Timed Interruption (0)** is triggered. As long as the PLC keeps running, **Timed Interruption (0)** is triggered every 25 milliseconds, and the value in the 32-bit register (D1, D0) increases by one whenever **Timed Interruption (0)** is triggered. Users can calculate the time for which the PLC has run by reading the value in (D1, D0). For example, if the value in (D1, D0) is 10, the time for which the PLC has run is 250 milliseconds (10x25 ms).

After the START button is pressed, the present value in (D1, D0) will be transferred to (D3, D2), and the value in (D1, D0) will increase. After the present value in (D1, D0) is transferred to (D3, D2), the value in (D3, D2) will remain unchanged. Users can calculate the time which has elapsed since the START button was pressed by subtracting the value in (D3, D2) from the value in (D1, D0). The value gotten is stored in (D5, D4).



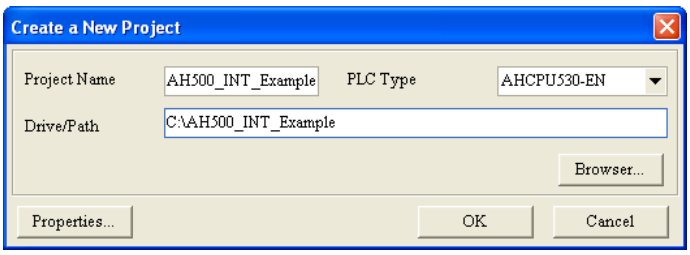
Examples in this section include timed interrupt in an AH5x0 series timed interrupt and the two control instructions concerning TKON and TKOFF. The following chart briefly describes the 5 POUs of a program.

POU name	Function
INT_Timer	The value in the 32-bit register (D1, D0) increases by one every 25 milliseconds. (The POU is assigned to **Timed Interruption (0)**.)
Initialize	Reset the flags M0 and M1, transfer the value 0 to the 32-bit registers (D1, D0), (D3, D2), (D5, D4), and (D7, D6), and enable the interrupt. During the first scan cycle, **Cyclic (0)** to which the POUs are assigned is enabled, and **Cyclic (1)** to which **Initialize** is assigned is disabled. As a result, **Initialize** is only executed during the first cycle.
Control	When X0.0 is turned form OFF to ON, the operation flag M0 is set to ON, and the value in (D1, D0) is transferred to (D3, D2). When X0.1 is turned from OFF to ON, or when an overflow occurs, the operation flag M0 is reset.
Time_CHK	Users can calculate the time which has elapsed since the START button was pressed by subtracting the value in (D3, D2) from the value in (D1, D0). The value gotten is stored in (D5, D4). If the value gotten is less than 0, the overflow flag M1 is set to ON.
Signal	If the time which has elapsed is more than 30 seconds (25 ms x1200), or the overflow flag M1 is ON, the alarm Y0.0 will be set to ON.

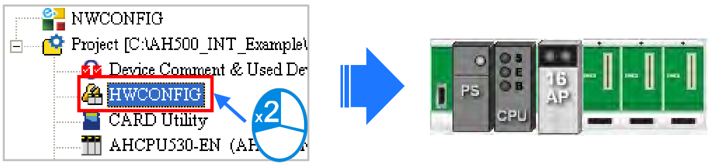
***. For more information on AH5xo series interrupt indicator and related API instructions, please refer to AH500 operation manual and AH500 programming manual.**

- **Creating New project**

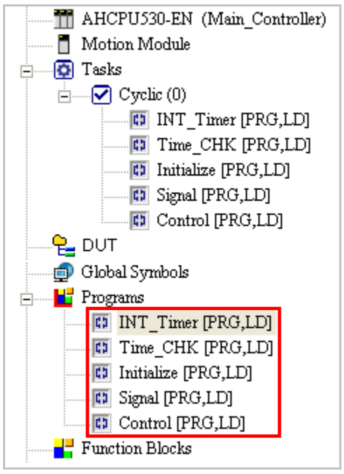
First, create an AHCPU530-EN series project.



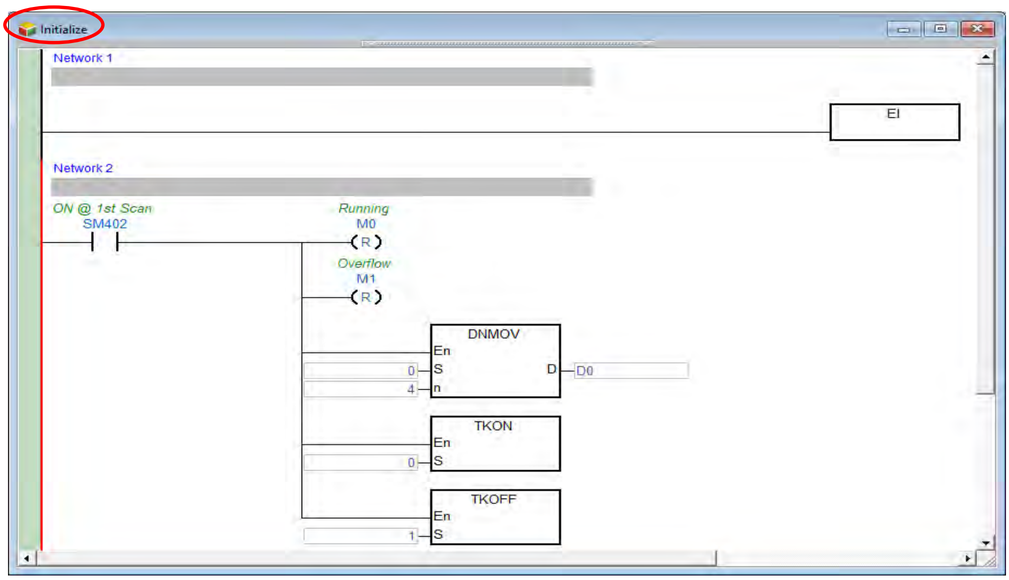
Click HWCONFIG to add a 16AP module and download hardware configuration and the parameter setting into the hosts.



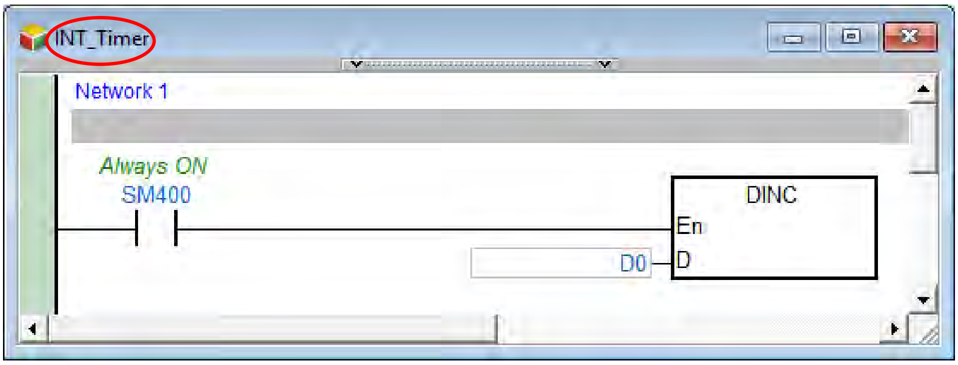
Create the 5 POUs in the **Programs** section in the project management area shown below. When these POU are created, they are assigned to **Cyclic (0)**.



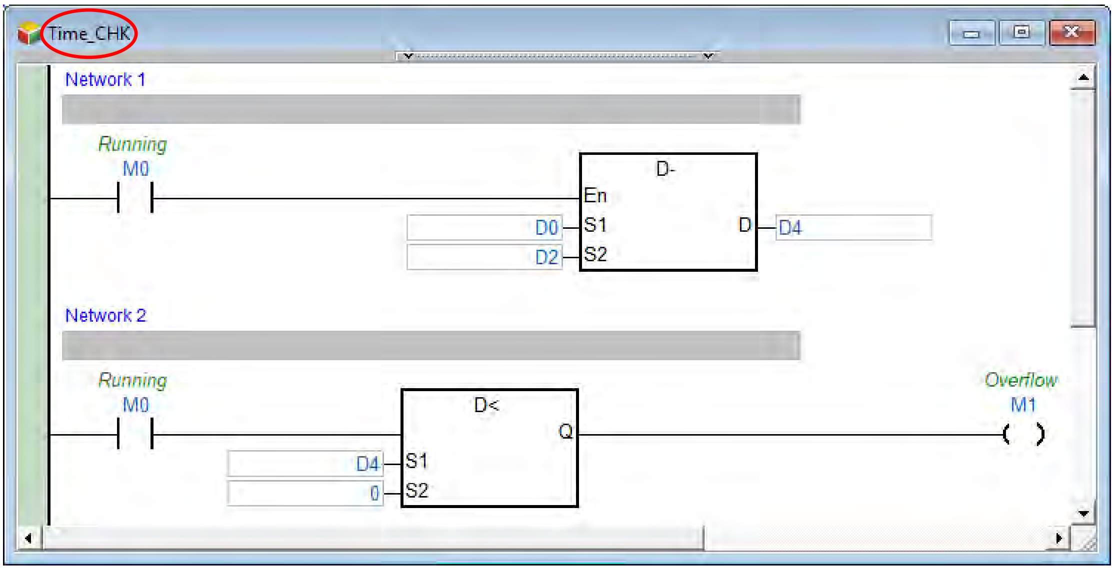
Please complete the following programming in each POU window.



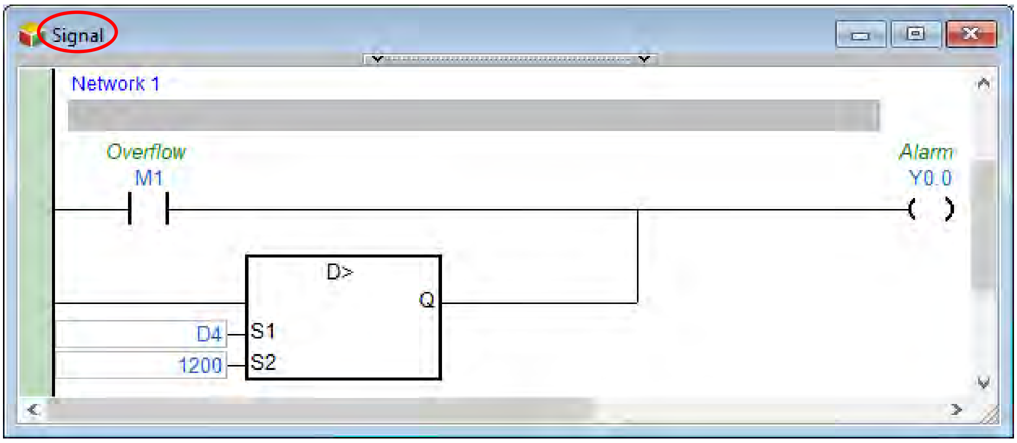
***. The applied instruction EI is in the Loop Control section, the applied instruction DNMOV is in the Data Transfer section, and the applied instructions TKON and TKOFF are in the Task Control section.**



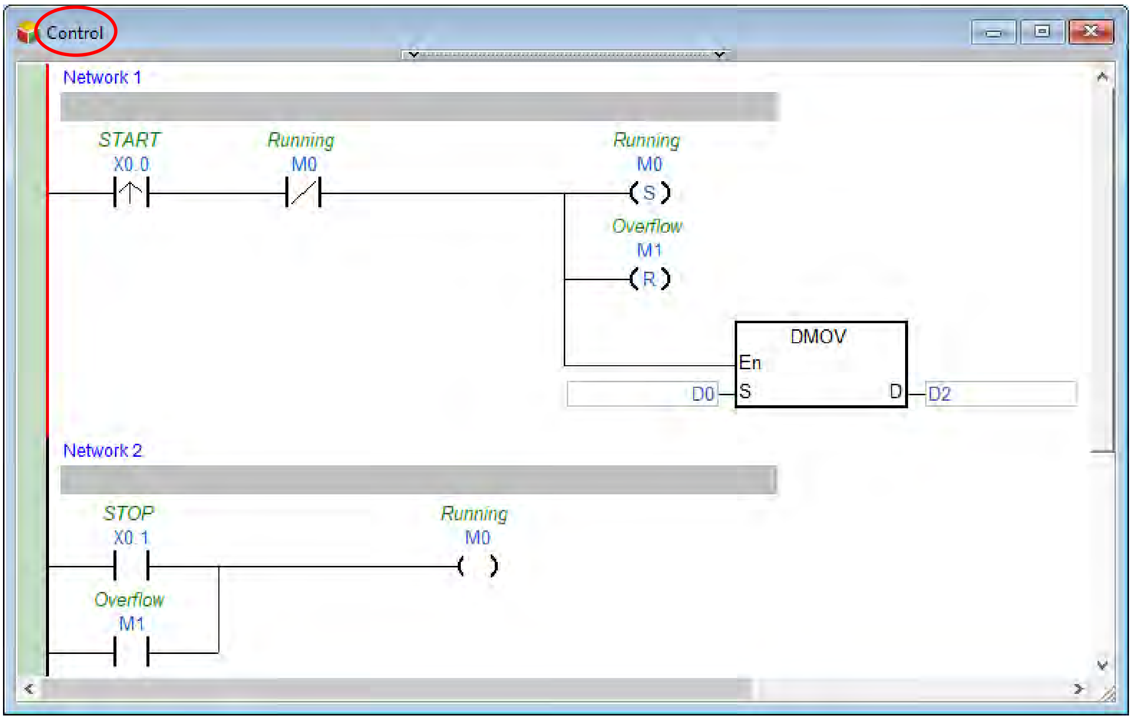
*. The applied instruction EI is in the Four Arithmetic Operations section.



*. The applied instruction D- is in the Four Arithmetic Operations section, and the comparison contact D< is in the Contact Type Logic Operation section.

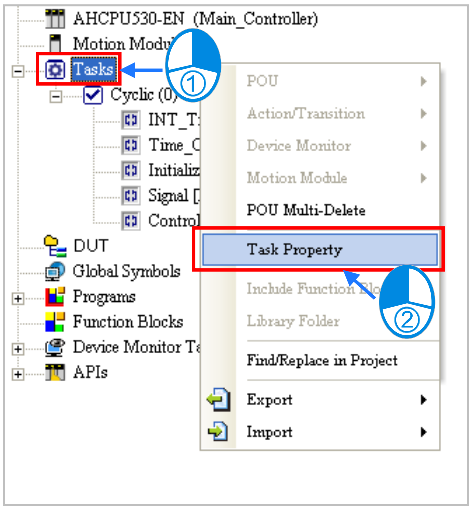


*. The comparison contact D> is in the Contact Type Logic Operation section.

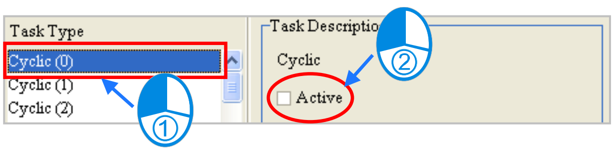


***. The applied instruction DMOV is in the Data Transfer section.**

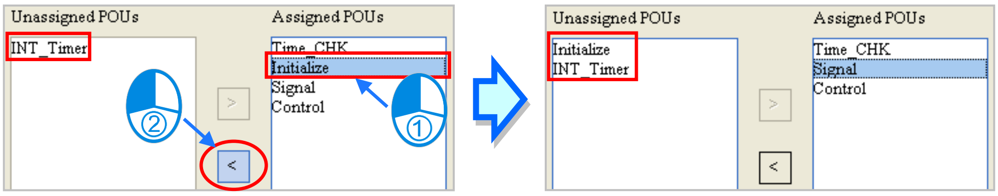
When programming is complete, double-click **Task Property**.



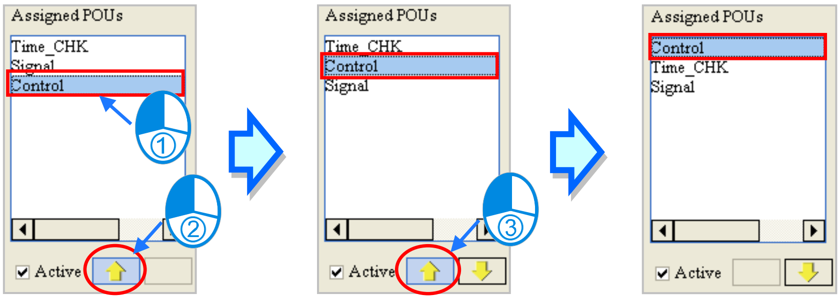
Set the property of **Cyclic (0)** first. Owing to the fact that **Cyclic (0)** is enabled by **Initialize**, the **Active** checkbox is unselected.



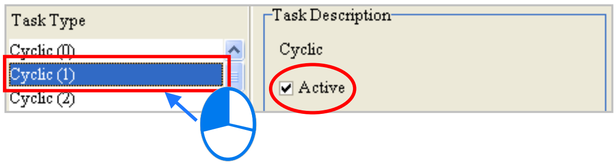
INT_Timer must be assigned to **Timed Interruption (0)**, and **Initialize** must be assigned to **Cyclic (1)**. As a result, **INT_Timer** and **Initialize** are removed from the **Assigned POUs** section for **Cyclic (0)**.



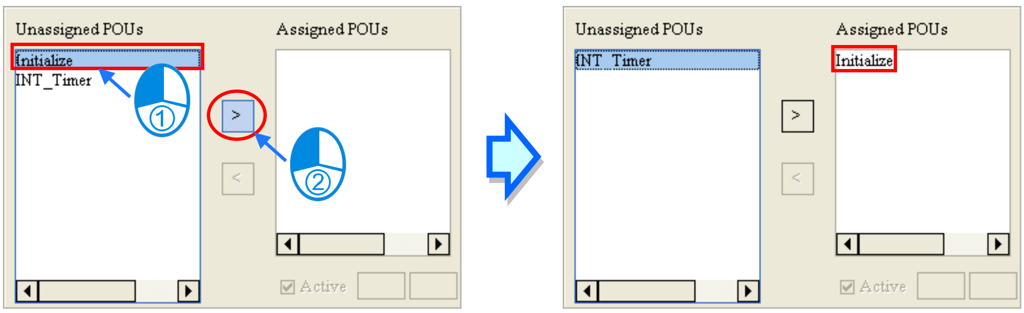
After the assignment of the POUs to **Cyclic (0)** is complete, users can arrange the POUs in the **Assigned POUs** section. Owing to the fact that **Control** and **Time_CHK** must be executed earlier than **Signal**, the order in which **Control**, **Time_CHK**, and **Signal** are listed in the **Assigned POUs** section is **Control→Time_CHK→Signal**.



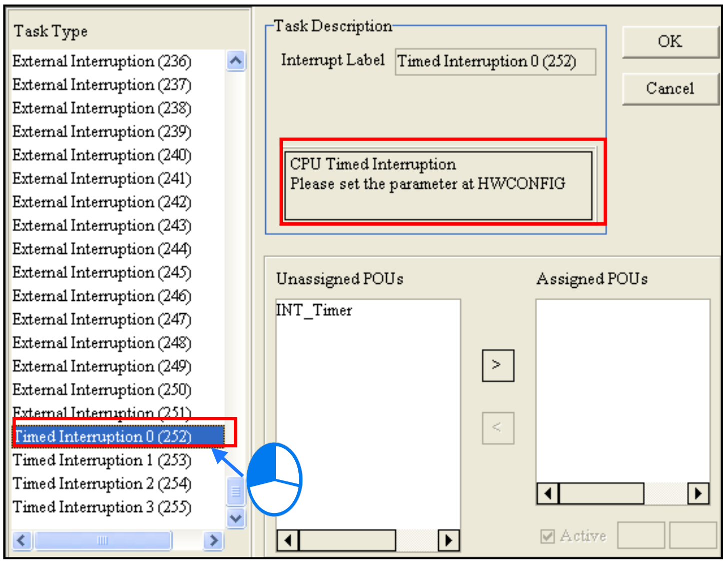
Select **Cyclic (1)** in the **Task Type** section. Owing to the fact that **Cyclic (1)** will be disabled after the first scan cycle is complete, the **Active** checkbox is selected.



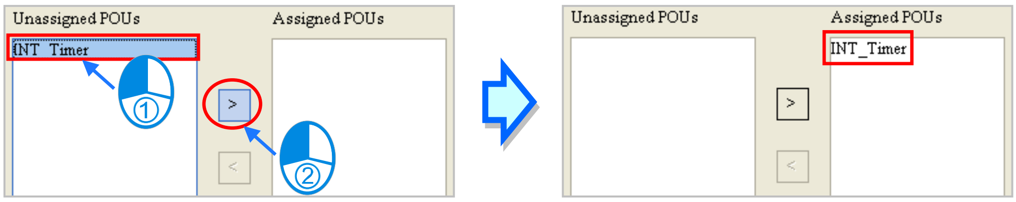
Assign **Initialize** to **Cyclic (1)**. Owing to the fact that there is only one POU in the **Assigned POUs** section, the users do not need to arrange the POU.



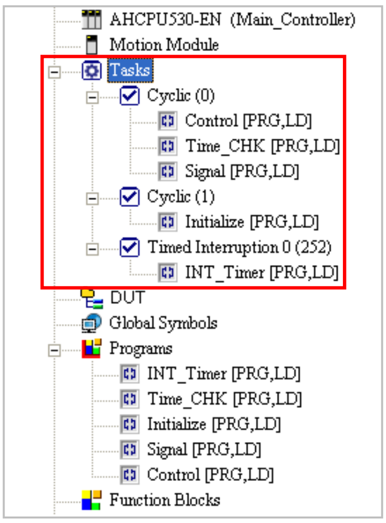
Select **Timed Interruption 0 (252)** in the **Task Type** section. The message in the **Task Description** section indicates that the condition of **Timed Interruption 0 (252)** can be set in HWCONFIG. The users have to assign a POU to this task, and set the property of this task.



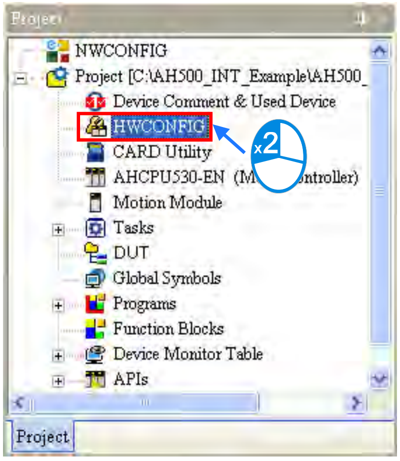
Assign **INT_Timer** to **Timed Interruption 0 (252)**.



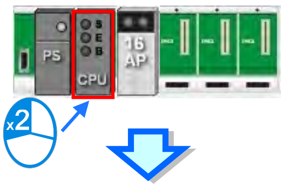
After **OK** is clicked, the assignment and the setting in the **Task Manager** window will be applied. The assignment is shown below.

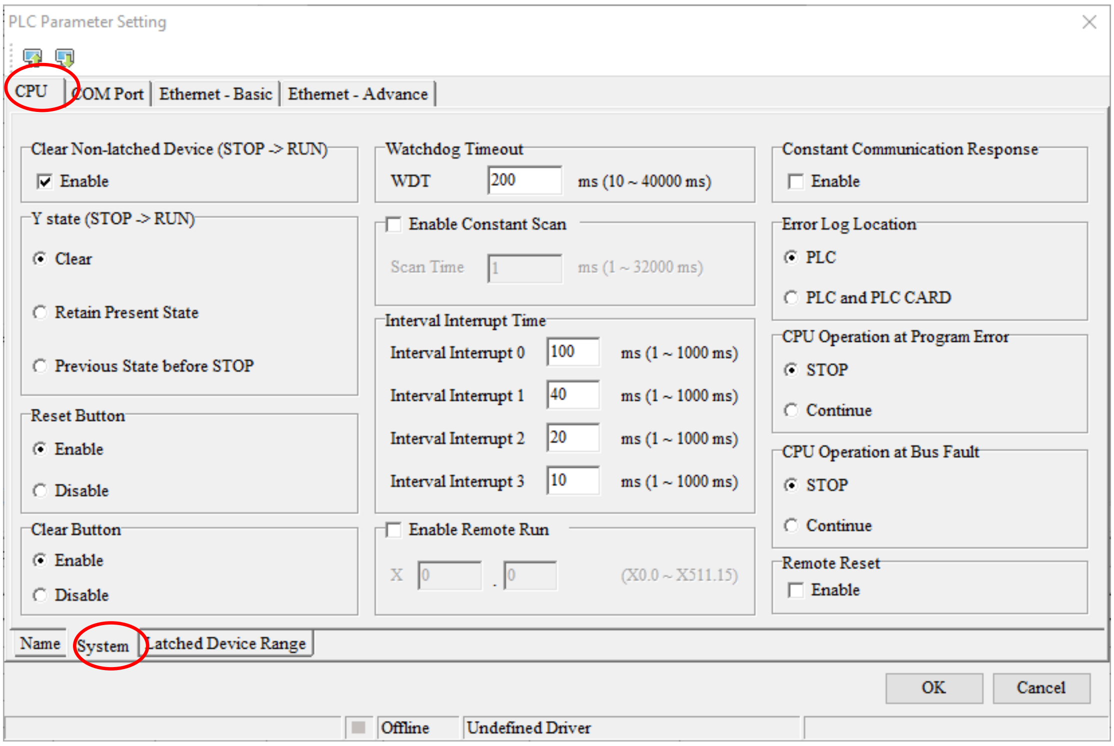


In order to set the property of **Timed Interruption 0 (252)**, HWCONFIG is started.

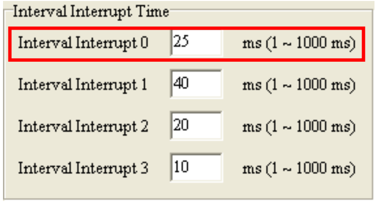


After HWCONFIG is started, the users can double-click the CPU module to open the **PLC Parameter Setting** window. Click the **CPU** tab at the top of the window, and the **System** tab at the bottom of the window.





Find the **Interval Interrupt Time** section. Type 25 ms in the **Interval Interrupt 0** box, and then click **OK**.



When complete, save the settings in HWCONFIG and download the setting value to the hosts to come into effect. Then, please compile the program and download to the host for testing.

MEMO

Chapter 6 Symbol Variables

Table of Contents

6.1 Introduction of Symbols

During the process of developing a traditional program for a PLC, it generally takes much time to manage device addresses. Besides, managing or debugging the program in a big project is a burden on users. As a result, the concept of symbols in a high-level programming language is introduced into IEC 61131-3. A device in a PLC can be represented by a symbol, and a device can be automatically assigned to a symbol. The time of assigning devices is saved, a program is more readable, and the efficiency of developing a program increases.

***. Variables in ISPSoft are called symbols. As a result, variables are the same as symbols in terms of meaning in this manual.**

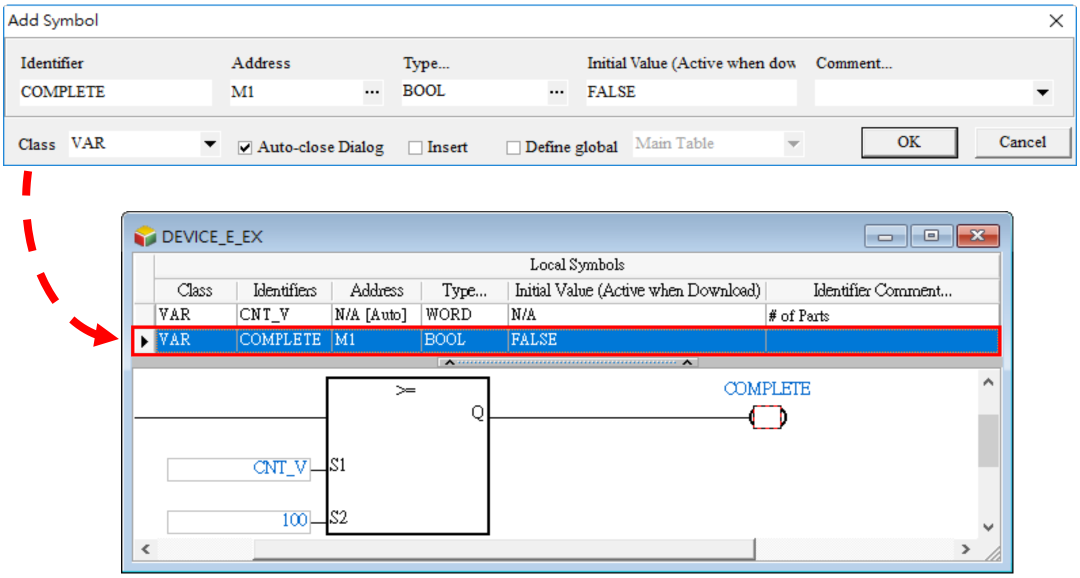
6.1.1 Application of Symbols and Creation of Identifiers

A symbol has to be declared before it is used, as shown below. There are two types of symbols. They are global symbols and local symbols. The global symbols can be used in all the POUs in a project, and the local symbols can only be used in the POU in which the local symbols are declared. Besides, the identifier of a local symbol in a POU can be the same as the identifier of a local symbol in another POU. However, if the identifier of a local symbol declared is the same as the identifier of a global symbol, the system will automatically regard the local symbol declared in a POU as a local symbol.

The regulations of creating the identifier of a symbol are as follows.

6

- An identifier is composed of 30 characters at most, and a Chinese character occupies two characters.
- The identifier of a symbol cannot be a name reserved by the system, e.g. an instruction code, a device name, or a name given a special significance. However, if a name reserved by the system is a part of the identifier of a symbol, the identifier is a legal name. For example, “M0” is an illegal name, but “_M0” is a legal name.
- The name of a symbol and the name of an enumeration cannot be the same. Refer to chapter 8 for the enumeration usage.
- Spaces cannot be used. For example, “INPUT CH0” is an illegal name.
- Underlines can be used, but they cannot be used continuously or put at the end of an identifier. For example, “INPUT_CH0” is a legal identifier, but “INPUT__CH0” and “INPUT_CH0_” are illegal identifiers.
- Special marks cannot be used. For example, *, #, ?, \, %, @, and etc. cannot be used.



*** When naming for the variable symbols, do not use digits or DFB_(initials of the function keys by default).**

To achieve optimization, it is recommended to use what the system assigns for the variable address.

6.1.2 Symbol Variable Classification

Symbol variables can be categorized into five types based on functions. The symbol category supported by global variable and program (local variable) are the same. The following table depicts the characteristics and details of the program (local variable), function block (local variable).and function (local variable).

Symbol Variable Classification	Local Variable						
	Program			Function Block			Function
	AH/AS	DVP	AS5xx/ DVPxxMC	AH/AS	DVP	AS5xx/ DVPxxMC	AS5xx/ DVPxxMC
VAR	✓	✓	✓	Position cannot be Assigned	Supports ONLY ES3 & Position cannot be Assigned	Position cannot be Assigned	Position cannot be Assigned

Symbol Variable Classification	Local Variable						
	Program			Function Block			Function
	AH/AS	DVP	AS5xx/ DVPxxMC	AH/AS	DVP	AS5xx/ DVPxxMC	AS5xx/ DVPxxMC
VAR_ RETAIN	Position cannot be Assigned (*1)	Supports ONLY ES3 & Position cannot be Assigned (*1)	✓			Position cannot be Assigned	Position cannot be Assigned
VAR_ STATIC			✓			Position cannot be Assigned	Position cannot be Assigned
VAR_ STATIC_ RETAIN			✓			Position cannot be Assigned	Position cannot be Assigned
VAR_INPUT				Position cannot be Assigned	Position cannot be Assigned	Position cannot be Assigned	Position cannot be Assigned
VAR_ OUTPUT				Position cannot be Assigned	Position cannot be Assigned	Position cannot be Assigned	
VAR_IN_ OUT				Position cannot be Assigned	Position cannot be Assigned		

***1. Data type cannot be TIMER, COUNTER or STEP.**

- **VAR - General symbol**

The symbols of this class are for general operations only. The significance of a symbol of this class depends on the data type of the symbol or the corresponding device.

- **VAR_RETAIN - Latched symbol**

When symbol variable is declared as VAR_RETAIN, it will automatically be configured in retain latched area. Therefore, when PLC host is latched, the symbol variables retains its value.

- **VAR_STATIC - Static symbol**

With static attributes, a symbol of this class is used only when defining the variables in POU (Program organization units). A static variable will be given a fixed address so as to share the same value across different instances.

- **VAR_STATIC RETAIN - Static-retained symbol**

Variables declared as static and retained would still keep the latest values after a power failure of PLC device.

- **VAR_INPUT - Symbol variable for function block input terminal point**

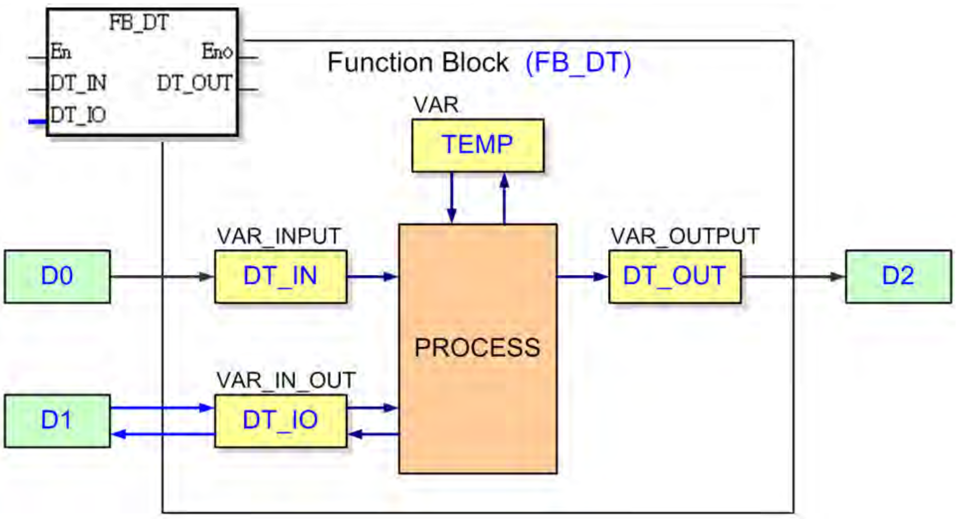
A symbol of this class is used as an input terminal point in a function block. If a function block is called, the symbol of this class can receive the input value from the caller. In ladder or function block editing environment, the VAR_INPUT is arranged on the left side of the function block diagram and will configure one terminal point to receive the input value of the caller.

- **VAR_OUTPUT - Symbol variable for function block input terminal point**

A symbol of this class is used as an output terminal point in a function block. After the execution of a function block is complete, the operation result will be sent to the caller through the symbol of this class. In ladder or function block editing environment, the VAR_OUTPUT is arranged on the right side of the function block diagram and will configure one terminal point to receive the input value of the caller.

- **VAR_IN_OUT - Symbol variable for feedback terminal point**

A symbol of this class is used as a feedback terminal point in a function block. Please refer to the following example. When the function block is called, the caller sends the value in D1 to DT_IO, which is a symbol of the VAR_IN_OUT class. After the operation comes to an end, the final value of DT_IO is sent to D1. In ladder or function block editing environment, the VAR_IN_OUT is arranged on the left side of the function block diagram and the terminal point is in blue bold lines used to connect with the caller.



6.1.3 Data Types

The data type of a symbol determines the significance of the value of symbol. Suppose there are two symbols VAR_1 and VAR_2. The data type of VAR_1 is BOOL, and the data type of VAR_2 is WORD. When VAR_1 and VAR_2 are used in a program, VAR_1 represents a contact, and VAR_1 represents a 16-bit device which can be involved in arithmetic or data transfer.

The data types supported by ISPSoft are listed below. Different PLC types supports different data types. However, global variable and program (local variable) are mainly the same, but symbol variables declared by function block (local variable) are different (see below).

Data type	Description	AH/AS		DVP		AS5xx/ DVPxxMC		
		Program	FB	Program	FB	Program	FB	FC
BOOL	Boolean data type, use 0, 1, or TRUE or FALSE to represent a pin device status; DVPxxMC only supports TRUE or FALSE, default setting is FALSE.	✓	✓	✓	✓	✓	✓	✓
BYTE	8-bit value, the effective range is 16#00~FF and can store 8-bit data size, default setting is 16#00.					✓	✓	✓

Data type	Description	AH/AS		DVP		AS5xx/ DVPxxMC		
		Program	FB	Program	FB	Program	FB	FC
WORD	16-bit value, the effective range is 16#00~FFFF and can store 16-bit data size, default	✓	✓	✓	✓	✓	✓	✓
DWORD	32-bit value, the effective range is 16#00000000~ FFFFFFFF and can store 32-bit data size, default setting	✓	✓	✓	✓	✓	✓	✓
LWORD	64-bit value, the effective range is 16#0000000000000000 ~ FFFFFFFFFFFFFFFF can store 64-bit data size, default	Only support AH	Only support AH			✓	✓	✓
SINT	8-bit signed integer, effective range is -128 ~ 127 and using positive/negative sign to represent the highest bit.					✓	✓	✓
INT	16-bit signed integer, effective range is -32768 ~ 32767 and using positive/negative sign to represent the highest bit. Default value is 0.	✓	✓	Only support AH	Only support AH	✓	✓	✓
DINT	32-bit signed integer, effective range is -2147483648 ~ 2147483647 and using positive/negative sign to represent the highest bit. Default value is 0.	✓	✓	Only support AH	Only support AH	✓	✓	✓

Data type	Description	AH/AS		DVP		AS5xx/ DVPxxMC		
		Program	FB	Program	FB	Program	FB	FC
LINT	64-bit signed integer, effective range is -9223372036854775808 ~ 9223372036854775807 and using positive/negative sign to represent the highest bit. Default value is 0.	Only support AH	Only support AH			✓	✓	✓
USINT	8-bit unsigned integer, effective range is 0 ~ 255, default value is 0.					✓	✓	✓
UINT	16-bit unsigned integer, effective range is 0 ~ 65535, default value is 0.					✓	✓	✓
UDINT	32-bit unsigned integer, effective range is 0 ~ 4294967295, default value is 0.					✓	✓	✓
ULINT	64-bit unsigned integer, effective range is 0 ~ 18446744073709551615, default value is 0.					✓	✓	✓
REAL	32-bit floating-point value, effective range is -3.402823e+38 ~ -1.175495e-38, 0 and 1.175495e-38 ~ 3.402823e+38, contains 32-bit to represent a decimal value. Default value is 0.	✓	✓	✓	✓	✓	✓	✓

Data type	Description	AH/AS		DVP		AS5xx/ DVPxxMC		
		Program	FB	Program	FB	Program	FB	FC
LREAL	64-bit floating-point value, effective range is -1.79769313486231e+308 ~-2.22507385850721e-308, 0 and 2.22507385850721e−308 ~ 1.79769313486231e+308, contains 64-bit to represent a decimal value. Default value is 0.	Only support AH	Only support AH			✓	✓	✓
ARRAY	Array data type When a symbol is declared, the length of an array and the data type which to be stored are specified. (The max. length of array is 512.)	✓	✓	✓	✓	✓	✓	✓
STRING	String data type, use 8-bit to represent one ASCII character. AH/AS series has to declare assigned string length, maximum 128 characters; the string format of DVPxxMC series uses apostrophe, e.g. ‘abcd’, the initial biggest length is 32000 characters; the initial character length by default is 80 characters.	✓	✓	Only support ES3	Only support ES3	✓	✓	✓
STEP	It is used as a recognition flag for step. (*1) (*2)	✓		✓	Do NOT support ES3			

Data type	Description	AH/AS		DVP		AS5xx/ DVPxxMC		
		Program	FB	Program	FB	Program	FB	FC
Function Block	Represents a named function block. (*2)	✓	✓	✓	Only support ES3	✓	✓	✓
COUNTER	Timer format use to represent timer device.	✓		✓	Do NOT support ES3			
TIMER	Timer format use to represent timer device.	✓		✓	Do NOT support ES3			
POINTER	Select VAR_IN_OUT in using WORD device as index indication. (*2)		✓		Only support ES3			
T_POINTER	Select VAR_IN_OUT in using timer as index indication. (*2)		✓		Only support ES3			
C_POINTER	Select VAR_IN_OUT in using timer variables as index indicator. (*2)		✓		Only support ES3			
HC_ POINTER	Select VAR_IN_OUT in using high-speed timer variables as index indicator. (*2)		✓		Only support ES3			

Data type	Description	AH/AS		DVP		AS5xx/ DVPxxMC		
		Program	FB	Program	FB	Program	FB	FC
TIME	Time format, using TIME#XXXXXXdXXhXXmXXs XXX.XXXms or T#XXXXXXdXXhXXmXXsXXX .XXXms for input, unit is ms. Effective range: T#0ms~T#213503d23h34m33 s709 .551ms, the value can be decimal (number) but not negative number; the number can exceed the effective range of TIME, e.g. T#25h and T#1d1h ; d, h, m, s, ms unit can be dropped, but one unit should remain and cannot arrange randomly; numbers must be decimal, default value is T#0ms.					✓	✓	✓
DATE	Time format, using DATE# Y-M-D or D#Y-M-D. Effective range : Display range:D#1970-01-01~D#2106-02-07. Unit is day. The Y, M,D cannot be dropped nor exceed the effective range; additional number 0 can be added before the number, the number must be decimal, default value is D#1970-01-01.					✓	✓	✓

Data type	Description	AH/AS		DVP		AS5xx/ DVPxxMC		
		Program	FB	Program	FB	Program	FB	FC
TOD	Time format. Using TIME_OF_DAY# hr: min: sec. ms or TOD# hr: min: sec. ms. Effective range: TOD#00:00:00~23:59:59.999. Unit is ms. When value is 0, TOD#00:00:00 is displayed; when value is 1, TOD#00:00:00.001 is displayed; when value is 86399999, TOD#23:59:59.999 is displayed; when value is 86400000, TOD#00:00:00 is displayed; when value is 4294967295, TOD#17:2:47.295 is displayed. Default value is TOD#00:00:00.					✓	✓	✓
DT	Time format. Using DT#Y-M-D-hr-min-sec for input. Effective range: DT#1970-01-01-0:0:0~ DT#2106-02-07-6:28:15. Unit: s. Default value is DT#1970-01-01-0:0:0.					✓	✓	✓
Pointer	A pointer is a variable that stores a memory address. You can use the address operator ADR in order to assign the address of a variable to a pointer.					✓	✓	✓

Data type	Description	AH/AS		DVP		AS5xx/ DVPxxMC		
		Program	FB	Program	FB	Program	FB	FC
	^ symbol is used to access the value at the address available in the pointer variable. Please notice that you must assign values to the pointer before using it, or an abnormal operation may be caused.							
Reference	A reference variable is an alias for another existing variable with same data type, which setting initial values is needed. For example, suppose you make mydata a reference (alias) to myref, you can input the initial values as either mydata or myref.					✓	✓	✓

***1. For more information on STEP, please refer to chapter 14.**

***2. The symbol variables for function block types and index types has special meanings. For more details, please refer to chapter 7- Function Block (FB) and library.**

6.1.4 Symbol Variable Address Allocation and Initial Value

Every symbol variable is allocated to a corresponding device address based on data types and can setup an **initial value**. When downloading the project, users can select to write initial value in the corresponding device address of the symbol variable. Please refer to section 6.2.6 for more operation details relating to initial values.

The following chart provides a description on the symbol variable address allocation principle. The allocation principle differs based on different PLC types.

Model	Allocation Principle
AH/AS	● Users can assign devices to the global symbols and the local symbols declared in the POUs of the program type. The system can also automatically assign devices to the global symbols and the local symbols declared in the POUs of the program type. ● The system automatically allocates the local symbols of function blocks, but does not provide allocation by users. ● The auto-allocated address is configures to the reserved memory section in the hosts, and do not occupy D or M device; for STEP, TIMER, or COUNTER types, the system still automatically allocate S, T and C device.
DVP	● Users can allocate devices to all the global symbols and the local symbols. The system can also automatically allocate devices to all the global symbols and the local symbols. ● The devices allocate by the system are usable devices. (Users can set a range of devices which can be allocate automatically.)
AS5xx/ DVPxxMC	● Users can assign devices to the global symbols and the local symbols declared in the POUs of the program type. The system can also automatically assign devices to the global symbols and the local symbols declared in the POUs of the program type. ● The system automatically allocates the local symbols of function blocks, but does not provide allocation by users. ● The auto-allocated address is configures to the reserved memory section in the hosts, and do not occupy I/Q/ M device.

The relation between the data types and the device types which can be allocate is described below.

Data type	AH/AS		DVP	
	Device allocate by users	Device allocate by the system	Device allocate by users	Device allocate by the system
BOOL	Contact M/SM or bit in the device D/L/X/Y	Internal memory	Contact M/X/Y	Contact M
WORD	D/L/X/Y/E/SR	Internal memory	D/E/F	D
DWORD	D/L/X/Y/E/SR	Internal memory	D/E/F	D
LWORD	D/L/X/Y/E/SR (Only support AH)	Internal memory	None	
INT	D/L/X/Y	Internal memory	None	
DINT	D/L/X/Y	Internal memory	None	
LINT	D/L/X/Y (Only support AH)	Internal memory	None	
REAL	D/L/X/Y	Internal memory	D	D
LREAL	D/L/X/Y (Only support AH)	Internal memory	None	
STRING	D/L/X/Y	Internal memory	None	
STEP	S (Only support AH5x0)	S	S	S
COUNTER	C/HC	C	C	C
TIMER	T	T	T	T
ARRAY	The devices assigned to a symbol whose data type is ARRAY depend on the array type specified. The array is composed of the devices starting from the device assigned by users or the system, and the number of devices in the array conforms to the size of the array. The devices assigned to a symbol whose data type is ARRAY cannot be SR/SM/E/F devices.			

Data type	AS5xx/DVPxxMC	
	Device assigned by users	Device assigned by the system
BOOL	I/Q/M of B and X	Internal memory
BYTE	I/Q/M of B device	Internal memory
WORD	I/Q/M of W device	Internal memory
DWORD	I/Q/M of D device	Internal memory
LWORD	I/Q/M of L device	Internal memory
USINT	I/Q/M of B device	Internal memory
SINT	I/Q/M of B device	Internal memory
UINT	I/Q/M of W device	Internal memory
INT	I/Q/M of W device	Internal memory
UDINT	I/Q/M of D device	Internal memory
DINT	I/Q/M of D device	Internal memory
LINT	I/Q/M of L device	Internal memory
ULINT	I/Q/M of L device	Internal memory
REAL	I/Q/M of D device	Internal memory
LREAL	I/Q/M of L device	Internal memory
STRING	I/Q/M of B device	Internal memory
TIME	I/Q/M of L device	Internal memory
DATE	I/Q/M of D device	Internal memory
TOD	I/Q/M of D device	Internal memory
DT	I/Q/M of D device	Internal memory
ARRAY	I/Q/M device and base on types to determine devices (B,W,D,L), WORD Array does not support the assigned address writing for WORD[ArrayIndex].Bit	Internal memory

***1. If the device assigned to a symbol is an internal memory in an AH/AS series CPU module, users cannot know the actual device address.**

***2. Please refer to section 6.2.3 for more information about ARRAY and STRING.**

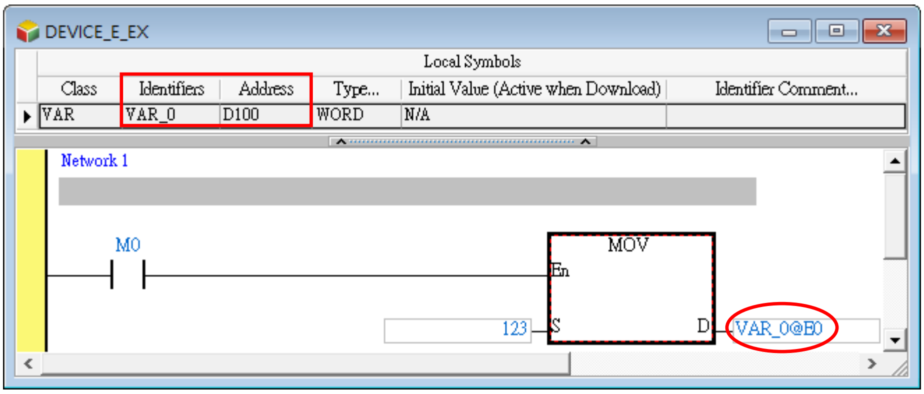
***3. Please refer to section 6.2.11 for more information about setting a range of devices which can be assigned automatically in a DVP series PLC.**

***4. A symbol in a function block has a special significance. Please refer to chapter 7- Function Block and Library for more information.**

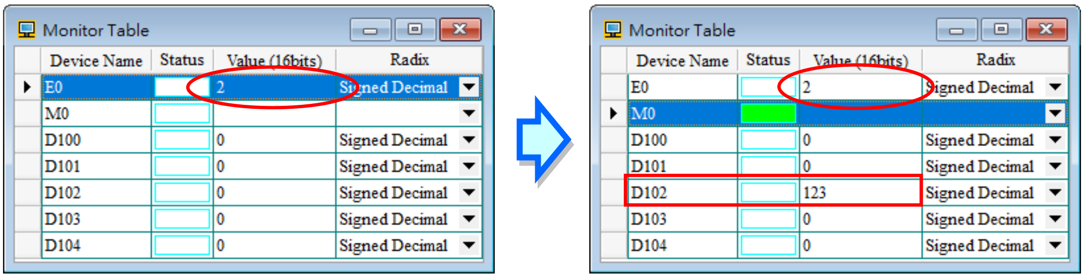
***5. For example, X0.0 and Y0.1 are bits in the word devices X and Y. Please refer to appendix B for more information.**

6.1.5 Indirect Assignment and Modification for Register Symbol Variable

In ISPSoft, a symbol can be modified by an index register. The format is **Identifier@Index register**. An index register can be an E device, an F device, or a symbol to which an E device or an F device is assigned.

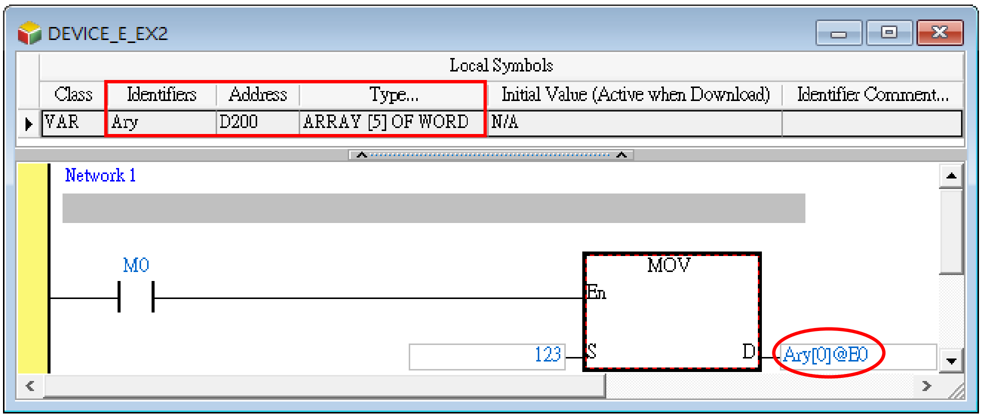


The data stored in an index register indicates the offset for an object modified. Take the figure above for example. If the value in the index register E0 is 2, VAR_0@E0 indicates that 2 is added to the device address (D100) assigned to VAR_0, that is, VAR_0@E0 represents D102. When M0 is ON, the value 123 is transferred to the data register D102.



The same rule applies to a symbol whose data type is ARRAY. The format is **Identifier[Index]@Index register**. The index must be a constant. If the index is a symbol, the symbol whose data type is ARRAY cannot be modified by the index register.

In the figure below, Ary is an array composed of five elements, and the start device address is D200. When the system compiles the program, D200~D204 are assigned Ary. If the value in the index register E0 is 2, Ary[0]@E0 indicates that 2 is added to the device address (D200) assigned to Ary[0], that is, Ary[0]@E0 represents D202, the device address assigned to Ary[2]. If the value in the index register E0 is 6, Ary[0]@E0 represents D206. D206 is not within the range of devices assigned to the array, but this usage is legal. Owing to the fact that the data stored in an index register indicates the offset for an object modified, users have to be more careful when they modify a symbol whose data type is ARRAY with an index register. Please refer to section 6.2.3 for more information about the usage of arrays.



An AH500 series CPU module differs from a DVP series PLC in the use of an index register to modify an operand. Please refer to the following table.

Application	Example	AH/AS	DVP	DVPxxMC
Modifying operands	MOV 100 VWD@E0	According to instruction	According to instruction	Do NOT Support
Modifying contact or coil	LD VBL_0@E0 OUT VBL_1@E1	Support	According to model types	Do NOT Support
Modifying symbol variable of ARRAY	ARY[0]@E0	Support	Support	Do NOT Support

***1. In an AH/AS series CPU module, only the E devices are index registers. In a DVP series PLC, the E devices and the F devices are index registers. Please refer to the operation manual for a model for more information.**

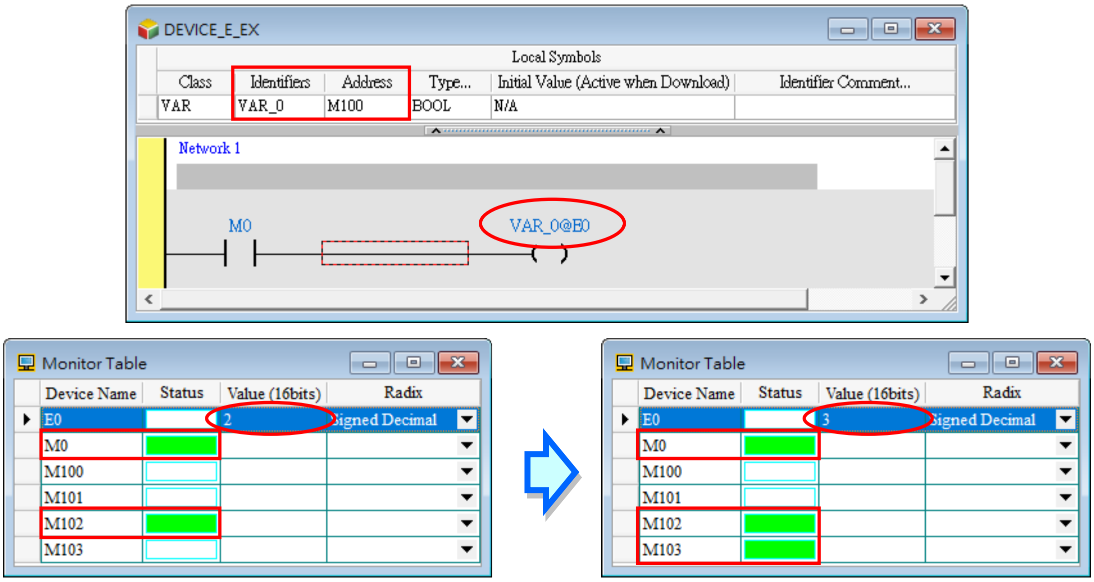
***2. An index register cannot be modified by another index register. For example, E0@E1 is not allowed. As a result, before a symbol is modified by an index register, users have to make sure that the device assigned to the symbol is not an E device or an F device.**

<u>Additional remark</u>

(a) The data stored in an index register indicates the offset for a device modified. If the system automatically assigns a device to a symbol modified, the use of an index register will cause the program to be executed incorrectly because users do not know which device is assigned to the symbol.

(b) If the addition of the value in an index register to a device address produces a device address which is not within the range, the PLC will operate incorrectly. As a result, users have to be more careful when they modify a symbol with an index register. Take AHCPU530-EN for example. If the value in E0 is larger than 35, the operand D65500@E0 represents a device which is not within the range of data registers, and an error occurs in the CPU module.

(c) If the value in an index register is changed, the device which actually operates differs from the original device. As a result, if the original device is not used in the program, the final value in the original device is retained. Take AHCPU530-EN for example. In the figure below, if the value in E0 is 2. M102 is ON when M0 is ON. If the value in E0 is changed from 2 to 3, the device which actually operates becomes M103. M103 is ON when M0 is ON. Owing to the fact that M102 is not used in the program, M102 remains ON.

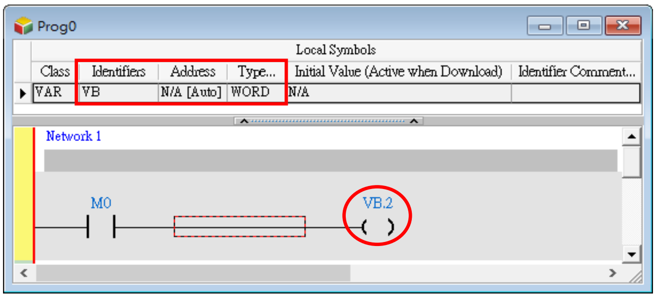


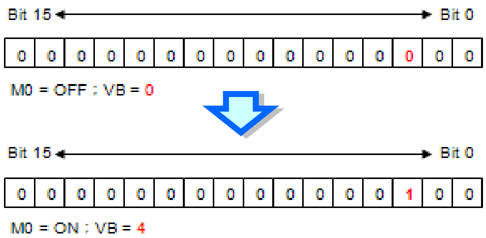
6.1.6 Bit Operation of Symbol Variable (Only AH / AS Series)

An AH/AS series CPU module supports the manipulation of the bits in a word device. The format is **Word device.Bit number**. For example, D0.2 indicates that bit 2 in D0 is manipulated. The same rule applies to the symbols. The format is **Identifier.Bit number**, e.g. VB.2. The rule also applies to the symbols whose data type is ARRAY. The format is **Identifier[Index].Bit number**, e.g. Ary[0].1.

The bit number must be a decimal constant. No matter what the data type of a symbol modified is, the bit number must be within the range between 0 and 15. Besides, the bits in a device represented by a symbol whose data type is BOOL, STEP, COUNTER, TIMER, a function block, HC_POINTER, C_POINTER, or T_POINTER cannot be manipulated.

In the figure below, the data type of VB is WORD. Suppose the present value of VB is 0. When M0 is ON, the value of bit 2 in the device represented by VB is 1, that is, the value of VB is 4.





In an AH/AS series CPU module, an index register can be used with the manipulation of the bits in a device. If an index register is used with the manipulation of the bits in a device, the mark @ has high priority. Please refer to the following example. The data type of VB is WORD.

Example 1: VB.1@E0 (VB represents D100. The value in E0 is 3.)

1@E0 is interpreted first. As a result, VB.1@E0 is equivalent to VB.4. The bit which is actually manipulated is bit 4 in D100.

The following modifying ways are also available for AH Series CPU modules.

Example 1: VB@E0.1 (VB represents D100. The value in E0 is 3.)

VB@E0 is interpreted first. As a result, VB@E0.1 represents D103.1. The bit which is actually manipulated is bit 1 in D103.

Example 2: VB@E0.1@E1 (VB represents D100. The value in E0 is 3, and the value in E1 is 2.)

VB@E0 and 1@E1 are interpreted separately. As a result, VB@E0 represents D103, and 1@E1 represents 3. VB@E0.1@E1 represents D103.3. The bit which is actually manipulated is bit 3 in D103.

***1. If a bit in a device is manipulated, the system will faithfully get the state of the bit. Users have to judge whether the state of the bit is significant by themselves.**

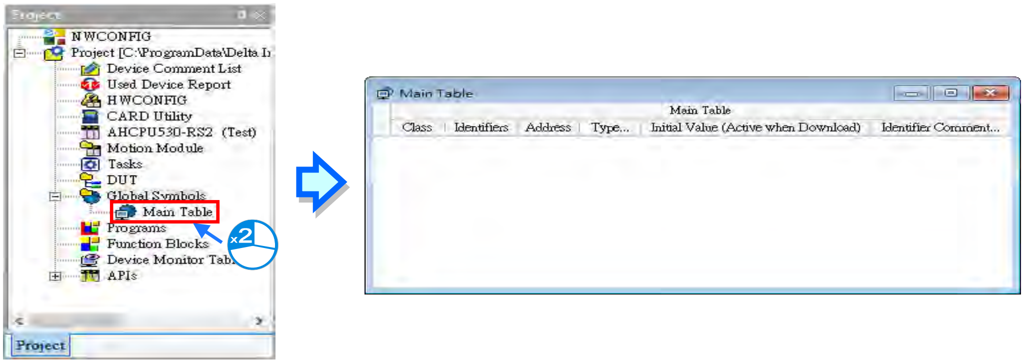
***2. In the present version of ISPSoft, a bit number must be within the range between 0 and 15. However, in the future version of ISPSoft, the data length of a symbol will allow the bit number to be within the range between 0 and 31, or between 0 and 63.**

6.2 Symbol Variable Management in ISPSoft

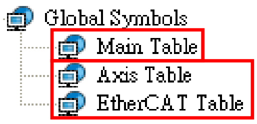
6.2.1 Symbol Variable Table

● **Global symbol table**

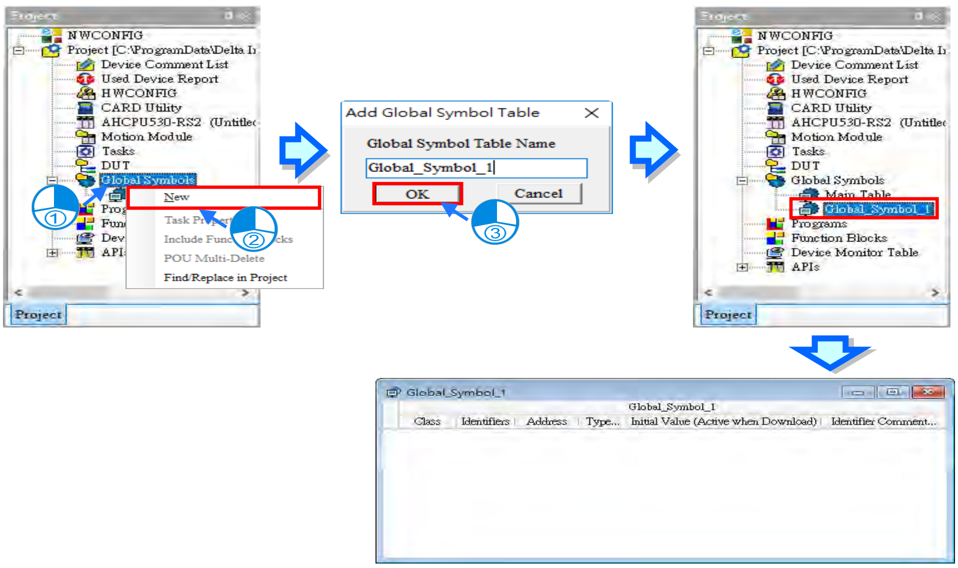
Double-click the option **Main Table** under the **Global Symbols** in the project management area to open the **Main Table** window.



The option Global Symbols may have more sub-options for some series. For example the AHxxEMC series has more sub-options, including Main Table, Axis Table, and EtherCAT Table. Please refer to the related chapters for more information on how to use these symbols.

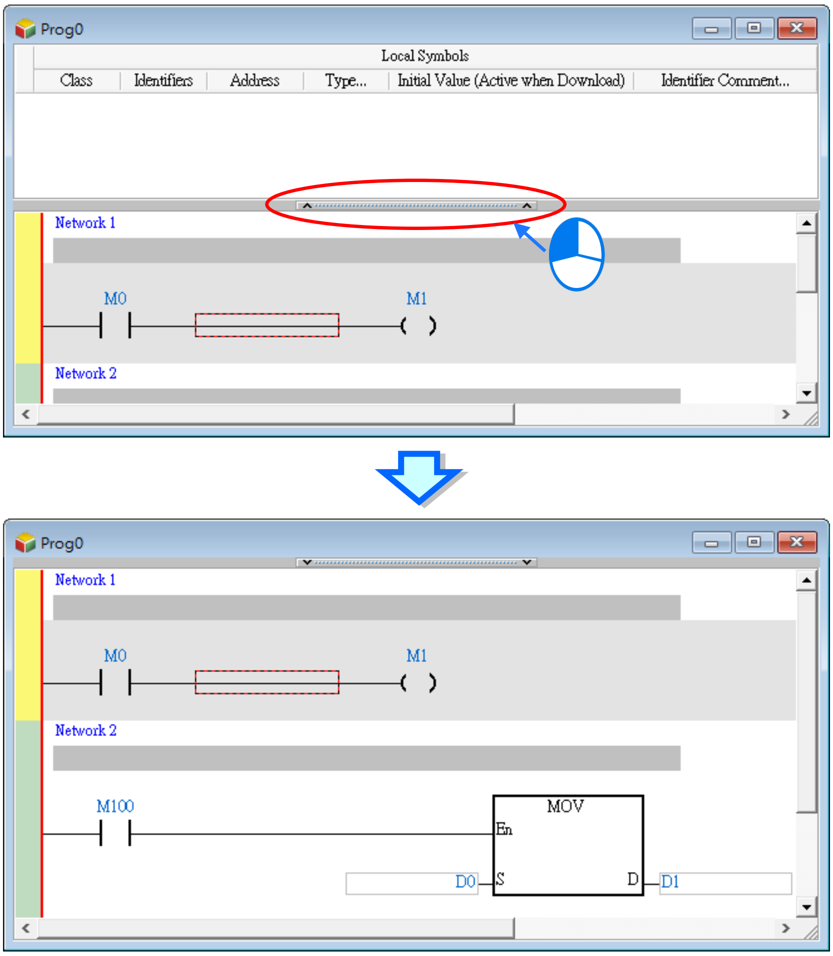


Right-click **Global Symbols** in the project management area and click **NEW** to open Add Global Symbol Table and click **OK** to create a Global Symbol node. Click the **Global Symbol node** to open the Global Symbol Table. To delete the newly created node, you can right-click the newly created node and click **Delete**, the node will be deleted.



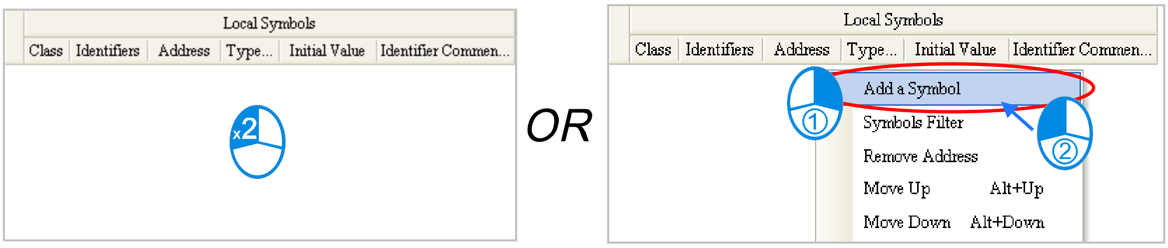
- **Local symbol table**

In ISPSoft, the local symbol table in a POU is at the top of the window for the POU. If users click the button under a local symbol table, the local symbol table will be hidden. After the users click the button again, the local symbol table will be displayed.

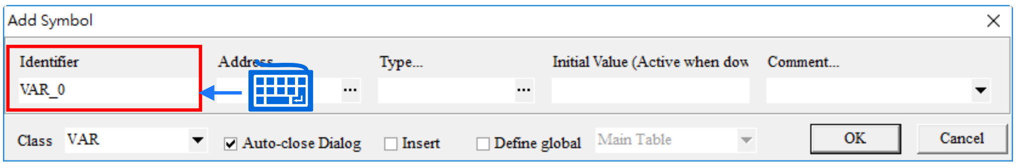


6.2.2 Adding Symbol Variable

(1) After users double-click or right-click the blank in a symbol table, they can click **Add a Symbol** on the context menu.



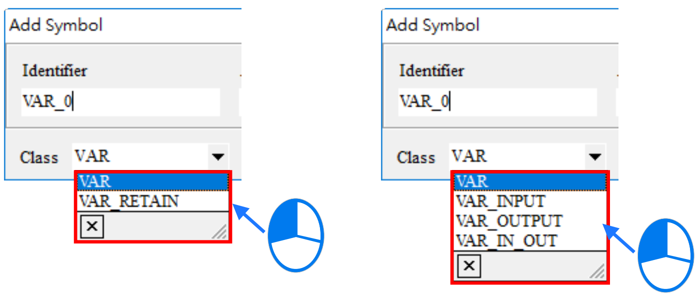
(2) After **Add a Symbol** is clicked, the **Add Symbol** window will appear. Type an identifier in the **Identifier** box. Please refer to section 6.1.1 for more information about the regulations of creating the identifier of a symbol.



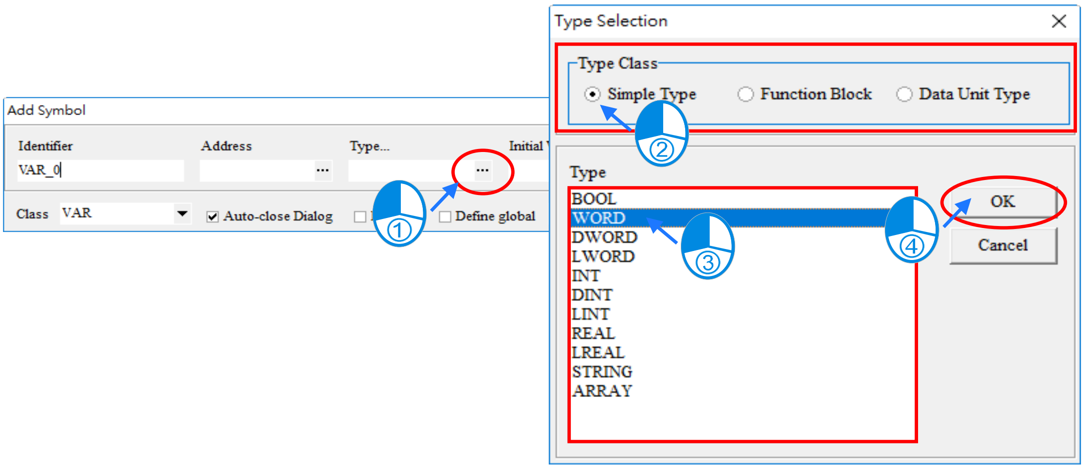
***1. The window which appears varies with the model selected, and the symbol table created (the global/local symbol table). However, the setting does not vary.**

***2. There is a way to open a declaration window in every programming environment. Please refer to chapter 8~chapter 12 for more information.**

(3) Select a class in the **Class** drop-down list box. The items in the **Class** drop-down list box vary with the symbol table created (the global/local symbol table). Please refer to section 6.1.2 for more information.



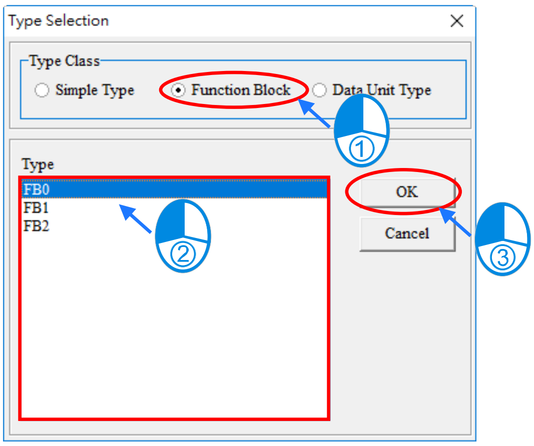
(4) Click the button at the right side of the **Type…** box, set the data type of the symbol in the **Type Selection** window, and click **OK**. Please refer to section 6.1.3 for more information about the data types.



The setting of **Function Block, Data Unit Type, STRING, and ARRAY** are described below.

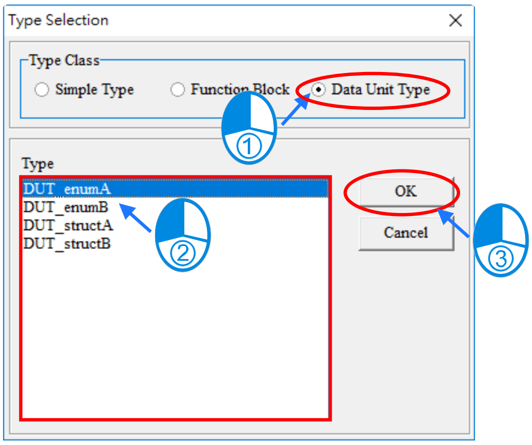
● **Function Block**

Select the **Function Block** option button in the **Type Class** section, and then select a function block definition in the **Type** box. If the data type of a symbol is a function block, a function block instance is declared. Please refer to chapter 7 for more information.



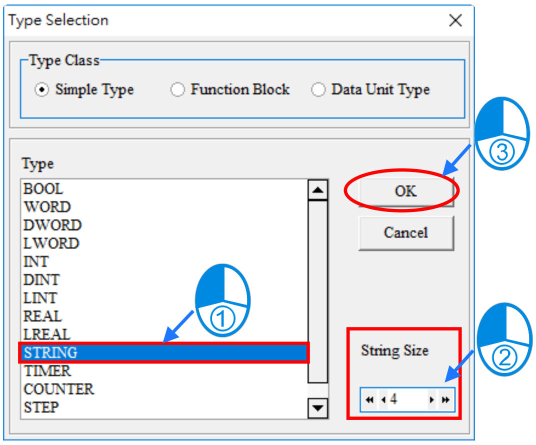
● **Data Unit Type**

Select the **Data Unit Type** option button in the **Type Class** section, and then select a DUT_enumA in the **Type** box, indicating the symbol is declared here. Please refer to chapter 8 for more information.



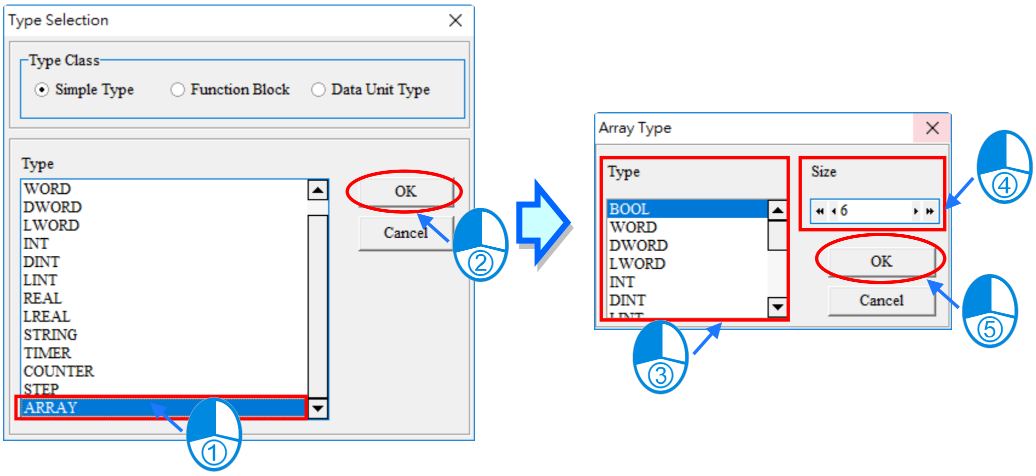
● **STRING**

If the data type of a symbol is STRING, users have to set the size of the string. The size of a string is within the range between 1 character and 128 characters. The size of a string that users set is the maximum number of characters in the string. Users can click or to decrease or increase the digit in the ones place of the setting value, and they can click or to decrease or increase the digit in the tens place of the setting value.

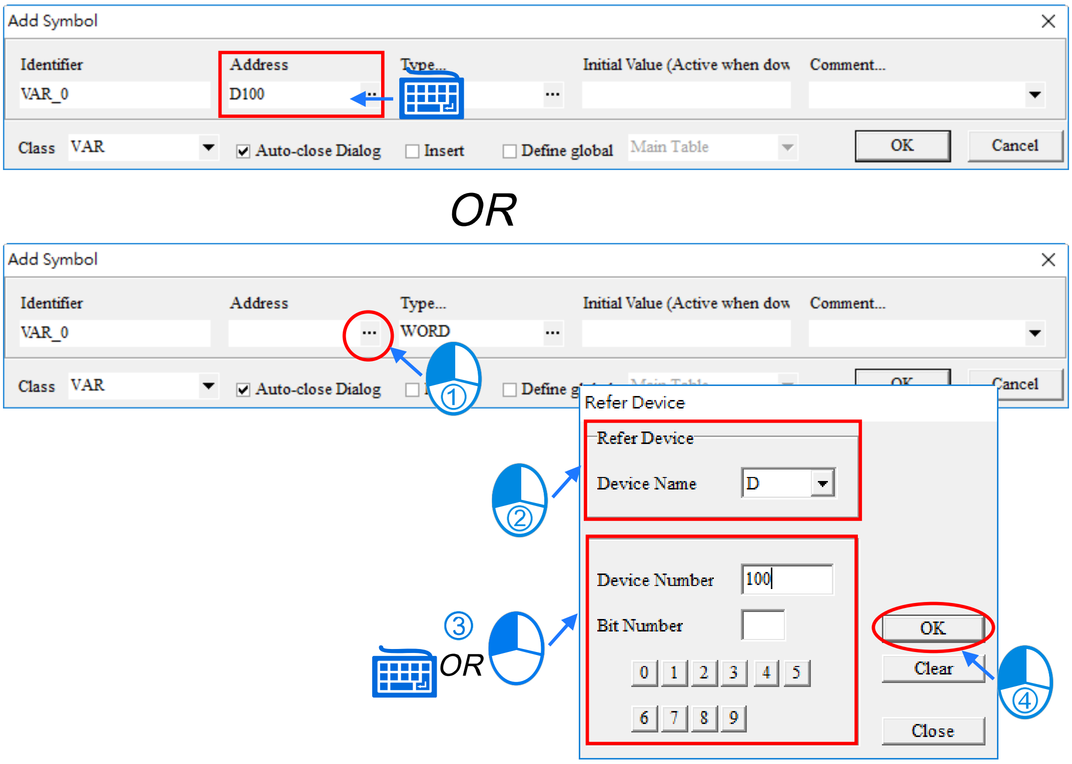


● **ARRAY**

If the data type of a symbol is ARRAY, the **Array Type** window will appear after **OK** in the **Type Selection** window is clicked. Users have to select an array type and set the size of the array in the **Array Type** window. The size of an array is within the range between 1 element and 512 elements. Users can click or to decrease or increase the digit in the ones place of the setting value, and they can click or to decrease or increase the digit in the tens place of the setting value.



(5) If the **Address** box is blank, the system will automatically assign a device address to the symbol. If users want to specify a device address, they can type the device address in the **Address** box, or specify the device address in the **Refer Device** window after they click the button at the right side of the **Address** box. Please refer to section 6.1.4 for more information.

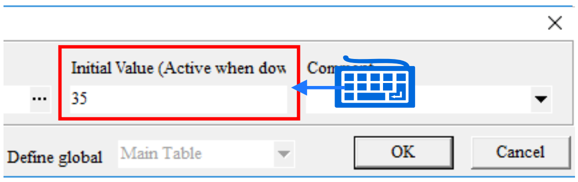


***1. When function block is selected for Type, the address column cannot be setup.**

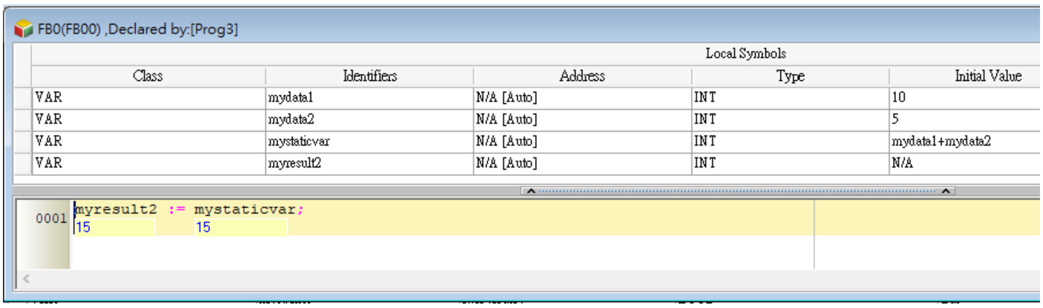
***2. For bit operation supported model types, the device setting window has Bit Number column to input e.g. X0.0, D0.1.**

(6) If users want to set the initial value of the symbol, they can type the initial value in the **Initial** box. If the data type of the symbol is ARRAY, the **Array Initial Values** window will appear after the **Initial** box is clicked. In the **Array Initial Values** window, users can set the initial values of the elements in the array.

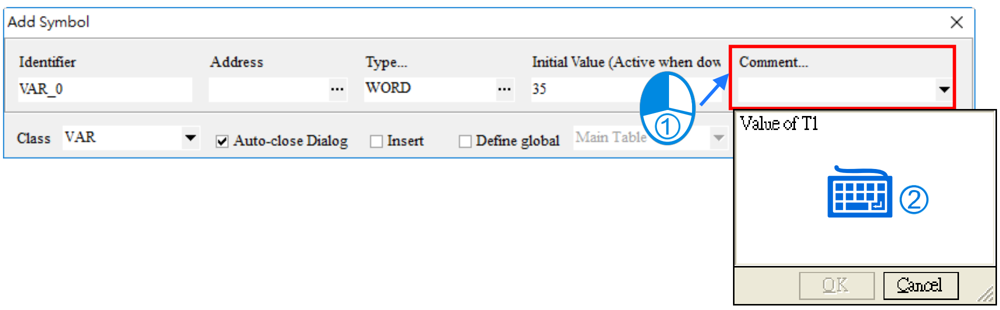
If the data type of the symbol is BOOL, the initial value is either TRUE (abbreviated to T) or FALSE (abbreviated to F). If users type 1 or 0 in the **Initial** box, the system will automatically convert it into TRUE or FALSE. If the data type of the symbol is STRING, the number of characters in the **Initial** box cannot be larger than the maximum number of characters in the string which has been set. The characters cannot be put in double quotes. Otherwise, the double quotes will be regarded as a part of the string. For DVPxxMC/ AS5xx, users can add apostrophe to the first and last character in a string. When the data type of the symbol is function block or user-defined, the **Initial** column cannot be setup.



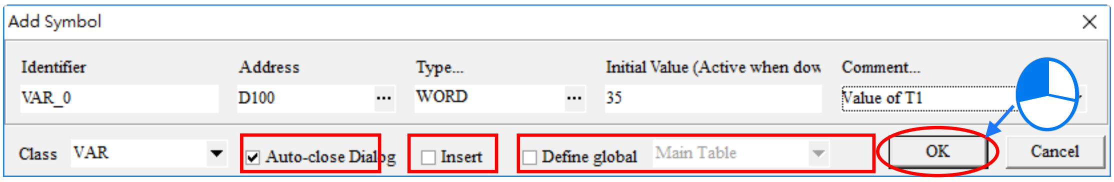
Supporting structure text language, the expression for initial values of DVPxxMC and AS5xx series is shown as follows:



(7) If After users click the **Comment** box, they can type a comment about the symbol in the drop-down box that appears.



(8) There are three checkboxes in the **Add Symbol** window. Please refer to the descriptions below for more information. After users make sure of the setting, they can click **OK** to add the symbol.



- **Auto-close Dialog**

  If users unselected the **Auto-close Dialog** checkbox, the **Add Symbol** window will not be closed automatically after OK is clicked. Please refer to section 2.3.1 for more information.

- **Insert**

  When selected, the symbol variable declared here will be added on top of the symbol variables for selection in the symbol table; when not selected, it is added to the last row in the symbol table.

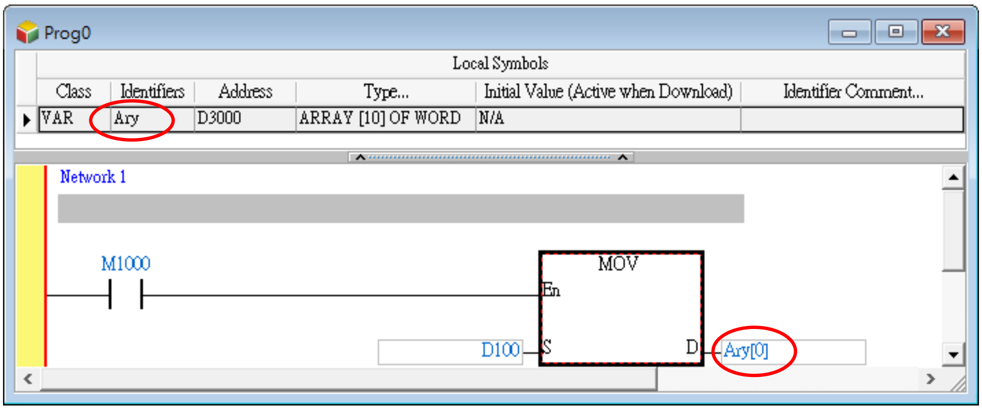
- **Declared in Global Symbol Table**

  If users select the **Define Global** checkbox, you can click the drop-down list to find the Main Table and self-defined Global Symbol Table with the declared symbols in them. However, if you are on the Main Table and self-defined Global Symbol Table, this option will not appear.

6.2.3 Principles of ARRAY or STRING Symbol

- **Symbol Variable - ARRAY**

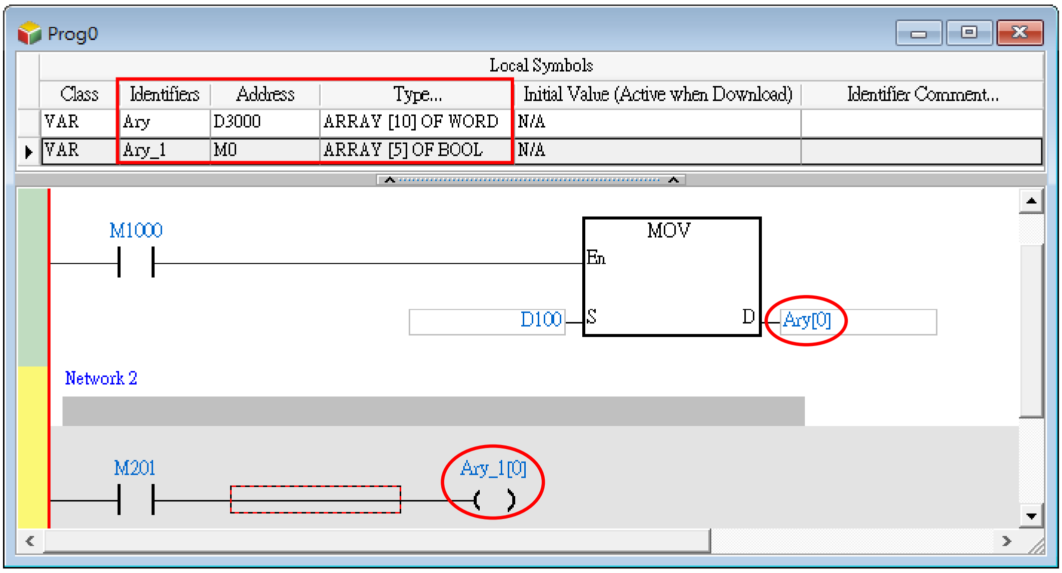
  If users want to use a symbol whose data type is ARRAY in a program, the expression format is **Identifier[Index]**. Generally speaking, the index is a decimal constant. If the project for an AH/AS series CPU module is set to be in the languages ST (Structured Text), LD (Ladder Diagrams) or CFC (Continuous Function Chart), the index can be a symbol. The minimum index value must be 0, whether the index is a constant or a symbol. The maximum index value cannot be larger than or equal to the number of elements in the array. For example, if the number of elements in an array is 10, the index value must be within the range between 0 and 9. If the index is a symbol, the value of the symbol cannot be larger than the number of elements in the array. Otherwise, an error will occur during the operation.



If users declare a symbol whose data type is ARRAY, they have to select an array type, and set the size of the array. The number of elements in an array must be within the range between 1 and 512. A start device address is assigned to a symbol whose data type is ARRAY according to the array type. Please notice that the start device address is assigned to a symbol whose data type is ARRAY cannot be an SR device, an SM device, an E device, or an F device. Please refer to section 6.1.4 for more information. Besides, an array is composed of the devices starting from the device assigned by users or the system, and the number of devices in the array conforms to the size of the array.

In the figure below, **ARRAY[3] OF DWOED** in the **Type…** cell for **Ary_0** indicates that the array is composed of 3 elements, and the array type is DWORD. The device address in the **Address** cell for **Ary_0** indicates that the start device address is D0. As a result, the array is composed of D0~D5 (6 word devices).

ARRAY[5] OF BOOL in the **Type…**cell for **Ary_1** indicates that the array is composed of 5 elements, and the array type is BOOL. The device address in the **Address** cell for **Ary_1** indicates that the start device address is M0. As a result, the array is composed of M0~M4. For DVPxxMC and AS5xx, if **ARRAY[10] OF BOOL** in the Type, the assigned address is%IB0, this means the array will occupy %IB0 ~ %IB9 device, a total of 10% IB devices.



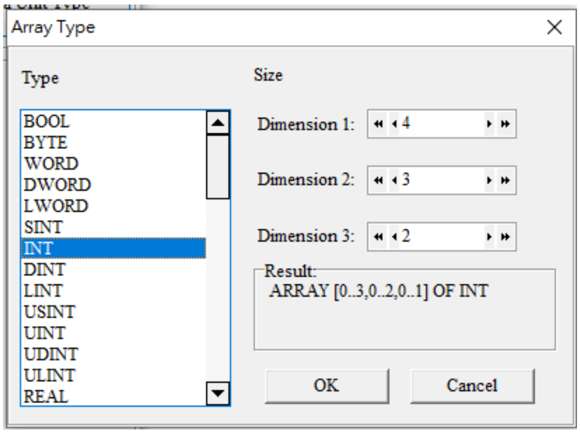
When users declare a symbol whose data type is ARRAY, they can set the initial value of the symbol. Please refer to the following example.

[1,2,3,4,5] in the **Initial Value** cell for **A_Ary** indicates that the initial value of A_Ary[0] is 1, the initial value of A_Ary[1] is 2, the initial value of A_Ary[2] is 3, the initial value of A_Ary[3] is 4, and the initial value of A_Ary[4] is 5. **[1,3(0),5]** in the **Initial Value** cell for **B_Ary** indicates that the initial value of B_Ary[0] is 1, the initial value of B_Ary[1] is 0, the initial value of B_Ary[2] is 0, the initial value of B_Ary[3] is 0, and the initial value of B_Ary[4] is 5.

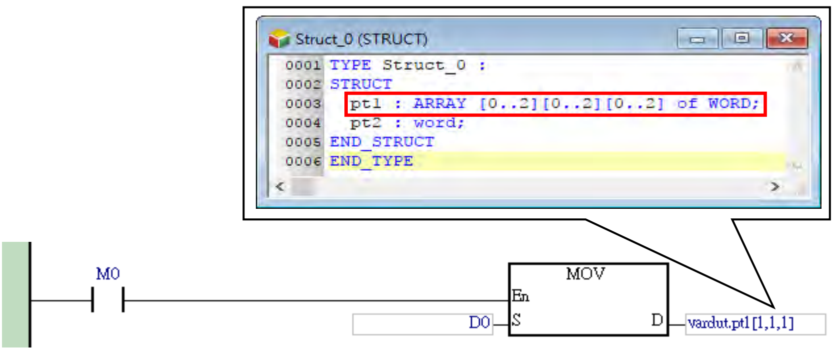
Local Symbols					
Class	Identifiers	Address	Type...	Initial Value	Identifier Comment...
VAR	A_Ary	D7000	ARRAY [5] OF WORD	[1,2,3,4,5]	
VAR	B_Ary	D7005	ARRAY [5] OF WORD	[1,3(0),5]	

A_Ary		B_Ary	
Element	**Initial value**	**Element**	**Initial value**
A_Ary[0]	1	B_Ary[0]	1
A_Ary[1]	2	B_Ary[1]	0
A_Ary[2]	3	B_Ary[2]	0
A_Ary[3]	4	B_Ary[3]	0
A_Ary[4]	5	B_Ary[4]	5

With a maximum array size of three dimension supported by DVPxxMC and AS5xx series, users can determine the array size during declaration via the Array Type window as shown below.



When the element is with a two-dimensional array or three-dimensional array in the data unit type, the symbol can use [n,n] or [n,n,n]. As the image shown below, the element pt1 is with a three-dimensional array, the data unit type of the variable can be vardut.pt1[1,1,1] to assign the element [1,1,1] from the array.



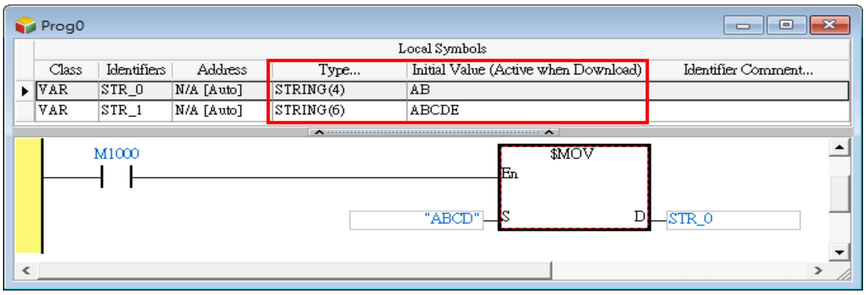
- **Symbol Variable - STRING**

In ISPSoft, a string is composed of ASCII codes, and the ASCII codes are surrounded by double apostrophe, e.g. “ABCD”, while for DVPxxMC and AS5xx series, the single apostrophe is used, e.g. ‘ABCD’. A symbol whose data type is STRING is generally used with an applied instruction. Please refer to the programming manual for a model for more information.

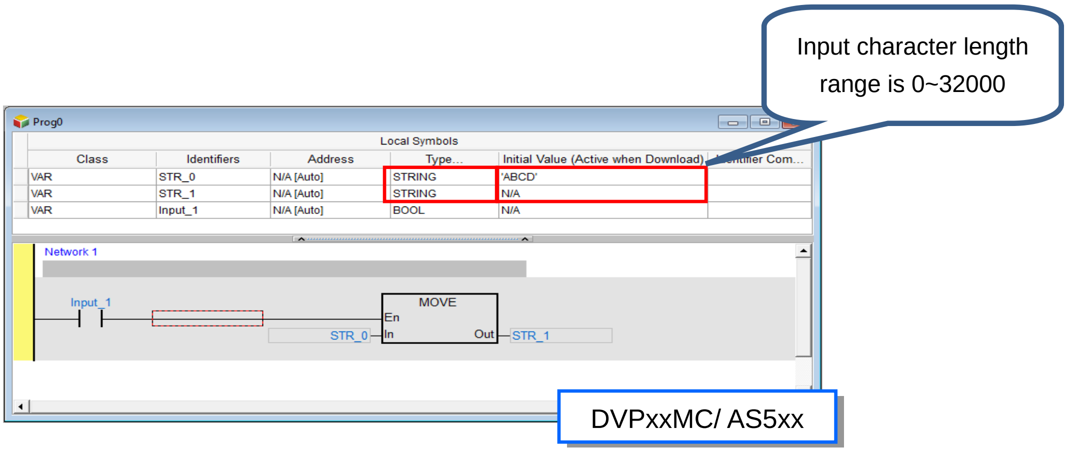
When users declare a symbol whose data type is STRING, they can specify the maximum size of the string. The number of characters in a string is within the range between 1 and 128, and one character occupies 1 byte. The number of devices assigned to the characters in a string must conform to the size of the string, and one extra byte must be assigned to the ending character in the string. If the last character and the ending character in a string does not occupy the two bytes in a word device, the ending character will be assigned another device.

For example, two word devices (four bytes) will be assigned to a string which is composed of three characters, and three word devices (six bytes) will be assigned to a string which is composed of four or five characters.

Please refer to the following figure. The number in the parentheses in the **Type…** cell for a symbol whose data type is STRING indicates the maximum size of the string. The characters in the **Initial Value** cell for a symbol whose data type is STRING cannot be put in double quotes, and the number of characters in the **Initial Value** cell for the symbol whose data type is STRING must be less than or equal to the maximum number of characters in the string.

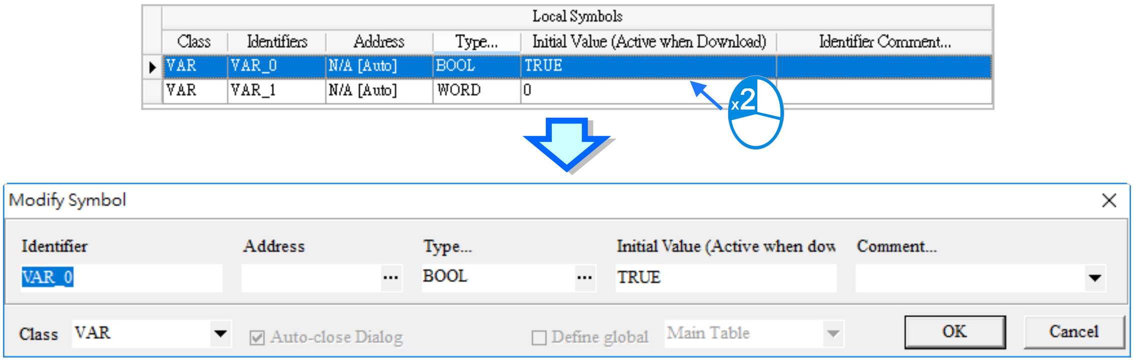


When using DVPxxMC and AS5xx, users do not need to adjust because the string length declared is allocated by software. For initial value assigned, the character length of an initial value is 0~32000 characters. After declaring, the maximum length of characters is not shown in the brackets beside STRING type.

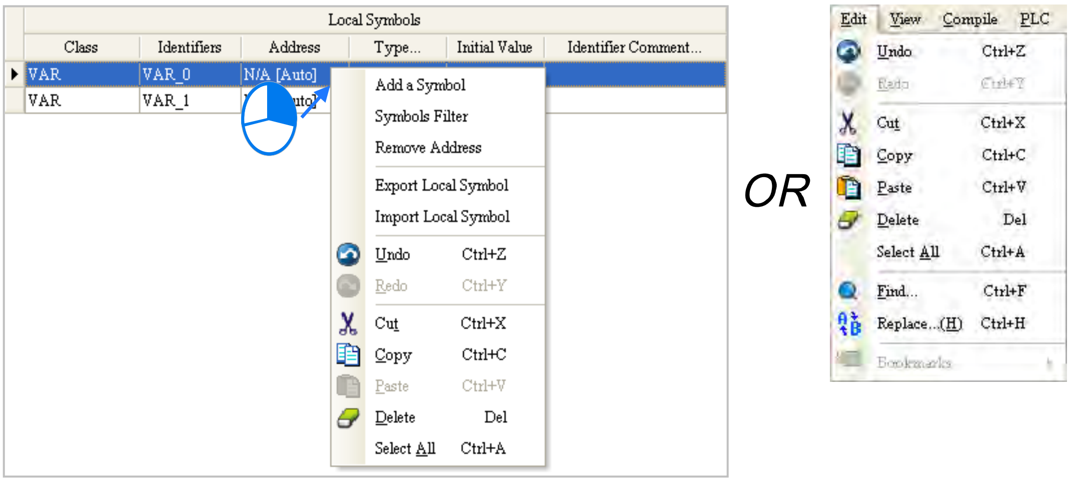


6.2.4 Modify Symbol Variables and Edit Symbol Table

If users want to modify the attributes of a symbol, they can double-click the symbol to open the declaration window, and modify the setting values in the boxes according to the description in section 6.2.2.



When editing an item in the symbol table, users can click **Edit** in the toolbar, or right-click on the symbol table to operate from the quick menu. Please refer to the following table for basic operations.



Item	Function
Undo	Undoing the last action (*The number of previous actions that can be undone is 20.)
Redo	Redoing an action which has been undone
Cut	Cutting the symbol selected
Copy	Copying the symbol selected
Paste	Pasting an object which has been copied or cut on the present symbol table
Delete	Deleting the symbol selected
Select All	Selecting all the symbols in the symbol table

***1. To copy/cut/paste symbol variables in different PLC types or POUs, please check the pasted symbol variable attributes are correct.**

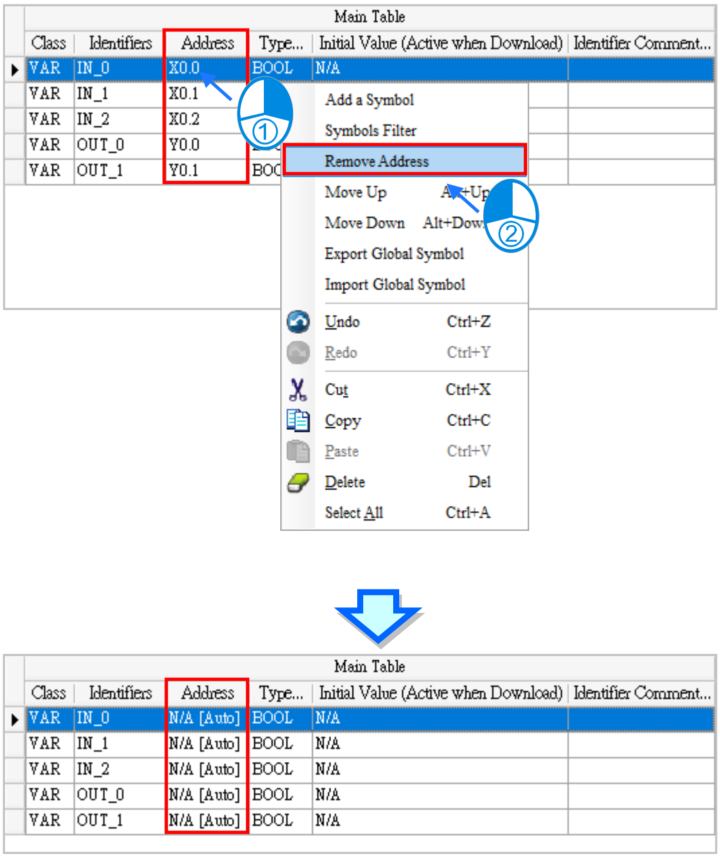
***2. The AH/AS series, DVP series and DVPxxMC/ AS5xx series, users cannot copy/ paste/ cut the symbol variables amongst the three types .**

***3. When the pasted symbol table contains the same symbol name, the system will automatically add CopyOf_n (n is a serial number) after the pasted symbol.**

6.2.5 Remove Symbol Variable Allocated Address

Users can clear all the devices addresses assigned to the symbols in a symbol table, whether the devices are assigned by the users or by the system. After the program is compiled again, the system will automatically assign device addresses to these symbols. Besides, only the device addresses in the symbol table selected are cleared, the device addresses in the other symbol tables are not cleared.

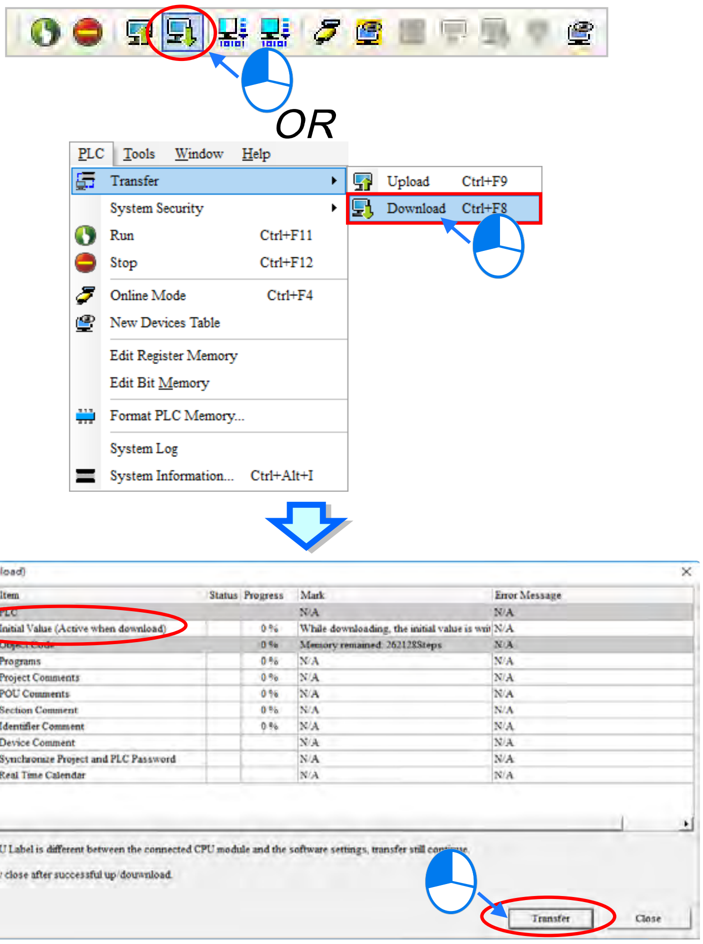
Right-click a symbol table, and click **Remove Address** on the context menu.



6.2.6 Downloading the Initial Values of the Symbols

Users can set the initial value of a symbol when they declare the symbol. If a project is downloaded, the initial values of the symbols can be written into the devices assigned to the symbols. However, the initial values of the symbols in a project are written into the devices assigned to the symbol only when the project is downloaded. If a PLC is disconnected or stops running, and runs again, the values of the symbols in the program in the PLC will not be the initial values. In order to ensure that the values of the symbols in the program in a PLC are the initial values whenever the PLC begins to run, it is suggested that users download the initial values of the symbols. When executing online updates, the system does not download the initial values of the symbol variables.

Users can click the **PLC** menu, point to **Transfer**, and click **Download** to open the **Transfer Setup** window. The can also click on the toolbar to open the **Transfer Setup** window. After the users select the **Initial Value (Active when download)** checkbox in the **Transfer Selections** section, and click **OK**, the initial values will be written into the PLC.

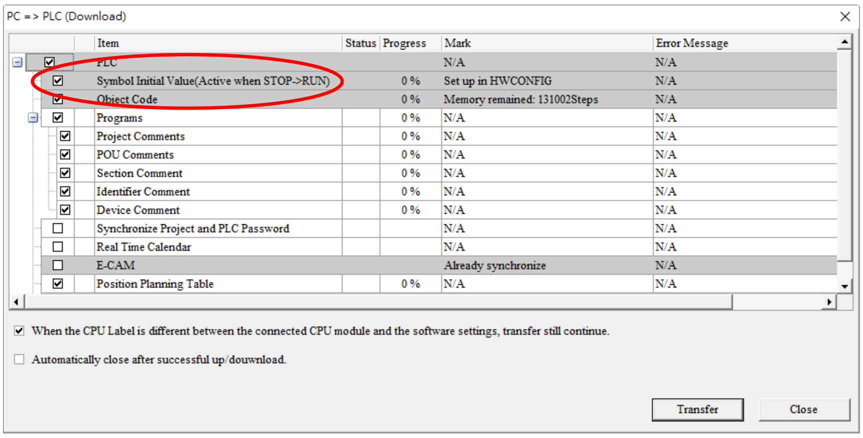


***. Before the initial values are downloaded, users have to make sure that ISPSoft is connected to the PLC normally.**

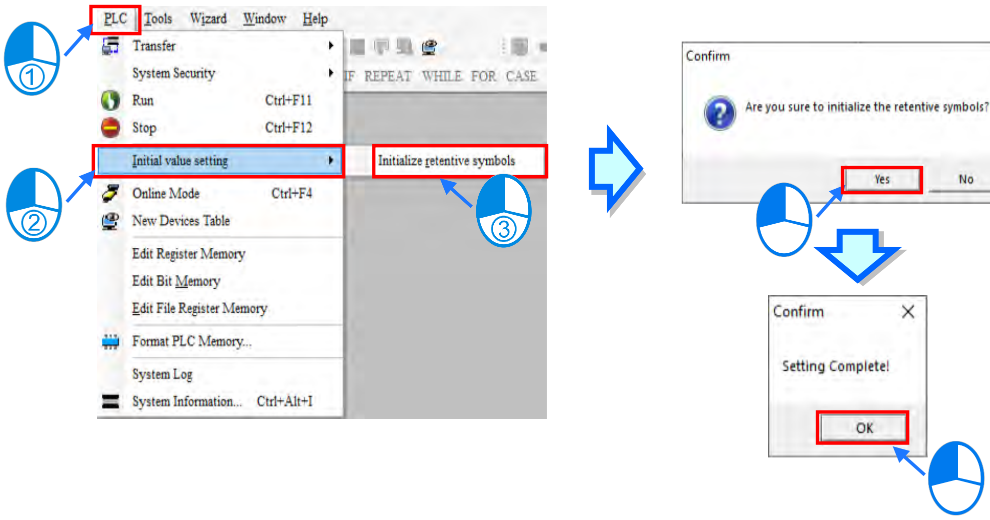
Specific models with the latest hardware versions support three new initialization processes, Stop ➔ Run initializing retentive symbols, Stop ➔ Run initializing non-retentive symbols and Initializing retentive symbols. Please refer to section 3.1.5 and download the configured initialization setting to the PLC device before downloading the project.

Model Types	Hardware Ver.	Max. Capacity of Initial Values Table
AH5x1-RS2	**1.05.00**	**80K Bytes**
AH5x1-EN	**2.03.00**	**80K Bytes**
AH560-EN2	**1.02.00**	**80K Bytes**
AS	**1.06.60**	**20K Bytes**
ES3	**0.40.10**	**20K Bytes**
AHxxEMC	**2.03**	**80K Bytes**
MH/MP	**1.00.00**	**80K Bytes**
AS Simulator	**1.06.60**	**20K Bytes**

ISPSoft would detect automatically whether the connected device supports the new initialization processes. If yes, the option “Symbol Initial Value(Active when STOP ➔ RUN)” would not able to be unselected as shown below.



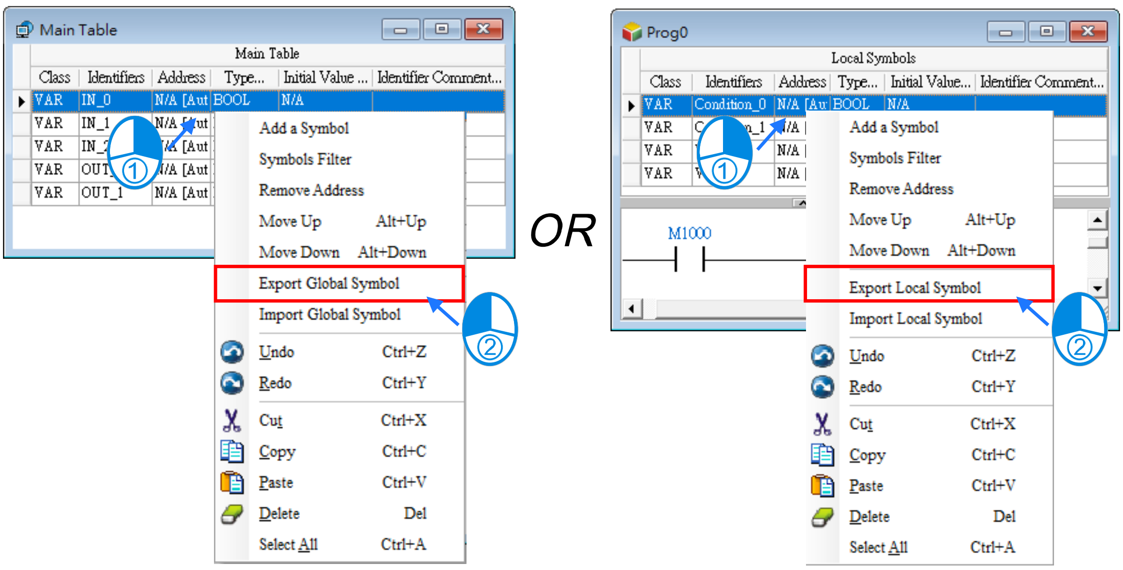
After the initial values download is complete, go to PLC (P) > Initial value setting (I) > Initial retentive symbols (R), then confirm on the initialization action, as well as the normal connection between ISPSoft and the CPU must be checked



6.2.7 Export Symbol Table

The symbols created in a project can be exported as a CSV file. The data which is exported can be edited and managed through Microsoft Excel. Instead, you can also save the exported file in DIATAG file type, which the content would include the information of user-defined data.

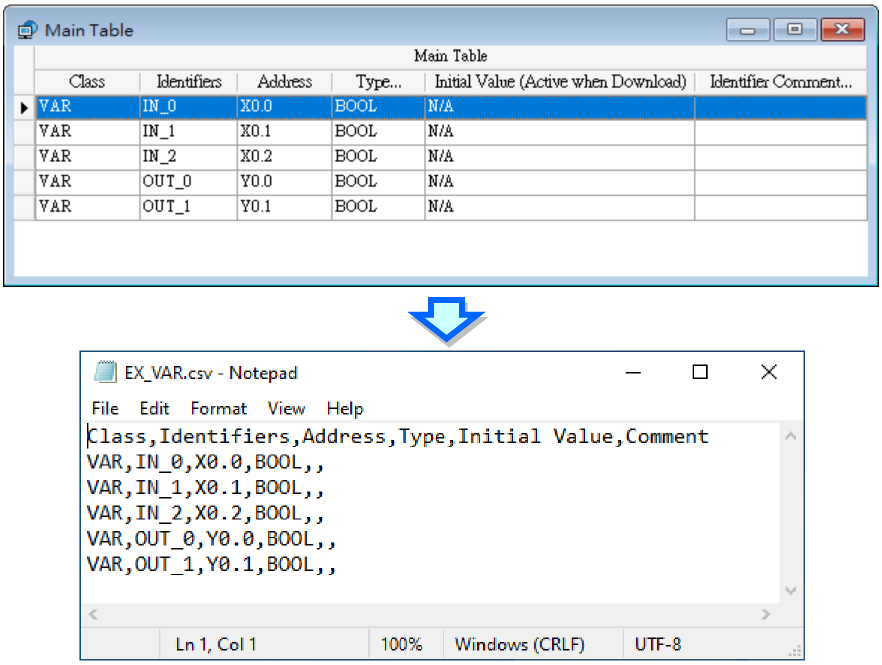
If users want to export a symbol table, they can right-click the symbol table, and click **Export Global Symbol** or **Export Local Symbol** on the context menu.



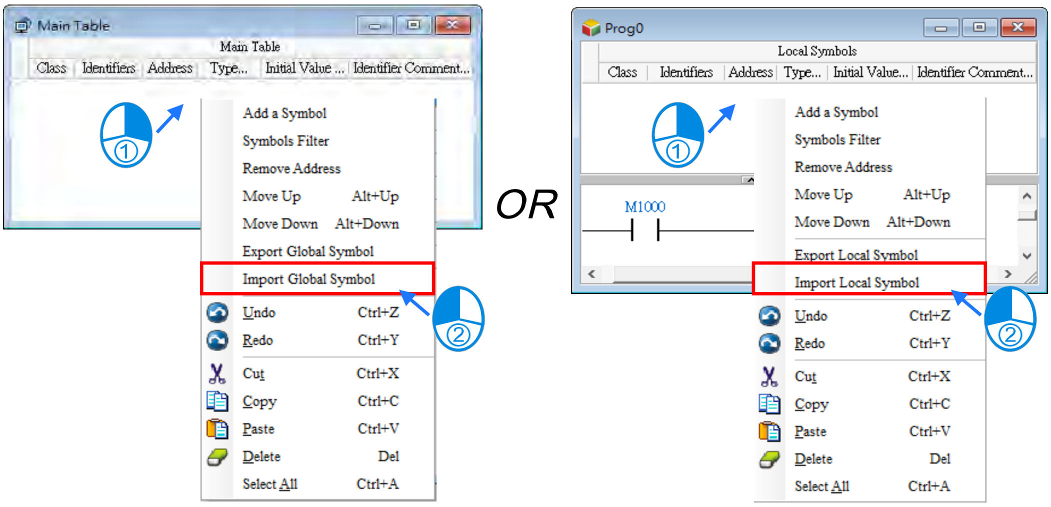
The users can also export the global symbol table in a project through the toolbar **File -> Export -> Global Symbols** or right-click the global symbol table and select **Export Global Symbol** from the context menu to export the global symbols which is being edited presently. If there is a group of projects in ISPSoft, the users can only export the global symbol table in the project which is being edited presently.

6.2.8 Importing a Symbol Table

If users want to create symbols, they can add the symbols to a symbol table. If the users want to create a large number of symbols easily, they can export a symbol table as a CSV file, edit the CSV file through Microsoft Excel, and import the new CSV file into ISPSoft.

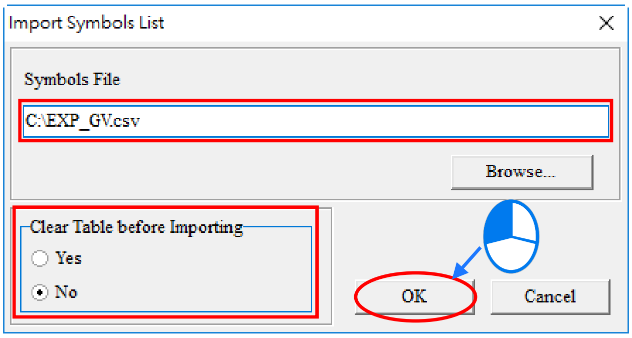


If users want to import a symbol table, they can right-click a symbol table, and click **Import Global Symbol** or **Import Local Symbol** on the context menu.



The users can also import the global symbol table in a project through the toolbar **File -> Export -> Global Symbols** or right-click the global symbol table and select **Import Global Symbol** from the context menu to import the global symbols which is being edited presently. If there is a group of projects in ISPSoft, the users can only import the global symbol table in the project which is being edited presently.

Select a file which will be imported in the **Import Symbol List** window, select an option button in the **Clear Table before Importing** section, and click **OK**.



<u>**Additional remark**</u>

A symbol table exported from a project for a model or a POU can be imported into a project for another model or another POU. Currently, the DVPxxMC and AS5xx series do not support export and import symbol variables with other model types. However, if a symbol in a file which will be imported is in one of the situations listed below, the symbol will be automatically eliminated or converted. Besides, if an error occurs when a symbol table is imported, the error log will be saved as a file whose primary filename is "**Project name_ErrorLog**" in a folder in which the project (*.isp) is saved. Users can know the error occurring when the symbol is imported by viewing the file.

(a) If a symbol in a file is imported into a symbol table where the same identifier exists, the symbol will be automatically eliminated from the file. If the contents of a symbol table are cleared before a symbol table is imported, no such problem will occur.

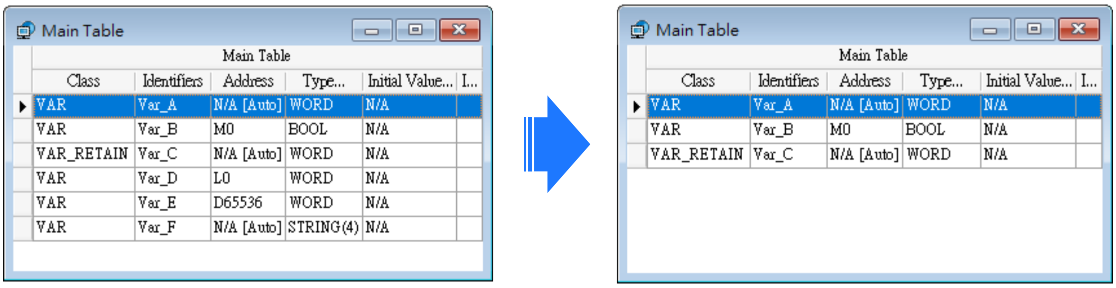
(b) If the data type of a symbol in a file is not supported by a project for a model, the symbol is eliminated from the file when the file is imported into the project.

(c) If the device assigned to a symbol in a file is not supported by a project for a model, or the device is not within the range of devices in the model, the symbol is eliminated from the file when the file is imported into the project.

(d) If the class of a symbol in a file is incompatible with the symbol table in a POU or a global symbol table, the symbol is eliminated from the file when the file is imported into the symbol table in the POU or the global table.

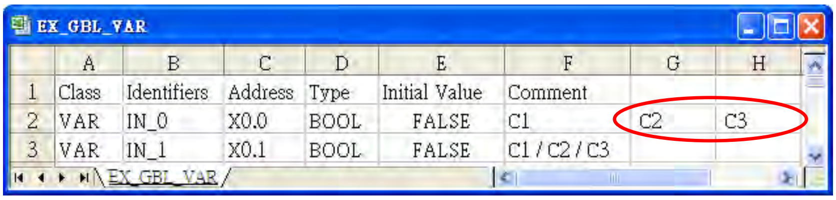
(e) If a symbol in a project for an AH/AS series CPU module is a symbol of the VAR_RETAIN class, the symbol will become a symbol of the VAR class after the symbol is imported into a project for a DVP series PLC.

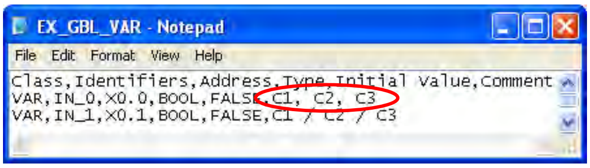
An example of importing the global symbol in a project for AHCPU530-EN into a project for a DVP-SV series PLC is shown below. Var_A, Var_B, and Var_C in the project for AHCPU530-EN can be imported into the project for a DVP-SV series PLC. Var_C in the project for AHCPU530-EN is a symbol of the VAR_RETAIN class. After Var_C in the project for AHCPU530-EN is imported into the project for the DVP-SV series PLC, Var_C becomes a symbol of the VAR class. Owing to the fact L0 is not supported by the DVP-SV series PLC, Var_D is eliminated. D65535 is not within the range of devices in the DVP-SV series PLC, and therefore Var_E is eliminated. Var_F is eliminated because the DVP-SV series PLC does not support the symbols whose data types are STRING.



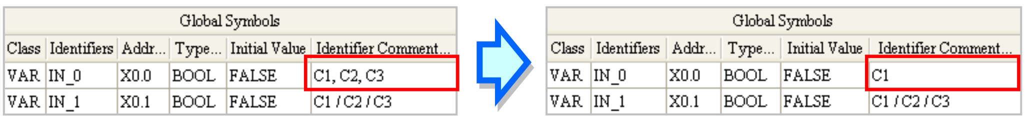
Users not only have to pay attention to the data formats in symbol tables, but also have to pay attention to the comments on the symbols in a symbol table.

A CSV file can be opened in Microsoft Excel and Notepad, as shown below. In a CSV file, the cells are divided by the commas. As a result, if there are commas in the **Identifier Comment…** cell for a symbol in a symbol table, the system will automatically regard the contents after the first comma as the contents of other cells, as shown by C2 and C3 which are in the red circle below. After the symbol table is imported again, the contents after the first comma will be lost.



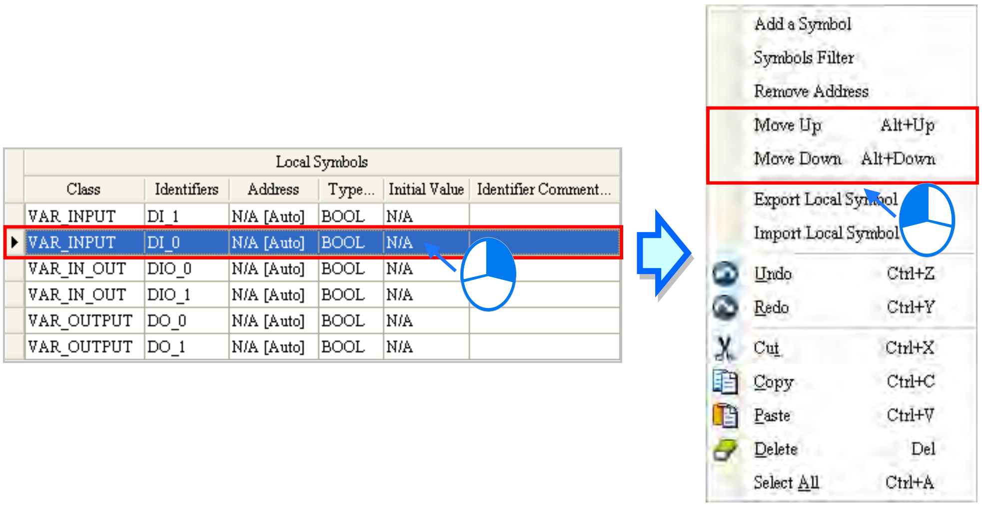


● Before the symbol table is exported ● After the symbol table is imported

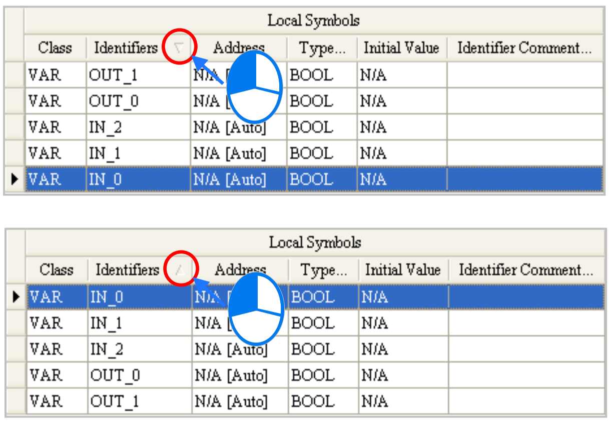


6.2.9 Arranging the symbols

In the local symbol table in a function block, the order in which the symbols of the VAR_INPUT class, the symbols of the VAR_IN_OUT class, and the symbols of the VAR_OUTPUT class are arranged affects the order in which the operands in the function block are arranged. If users want to arrange the symbols in the local symbol table in a function block, they can right-click a symbol which will be moved upward or moved downward, and press Alt + ↑ or Alt + ↓ on the keyboard.



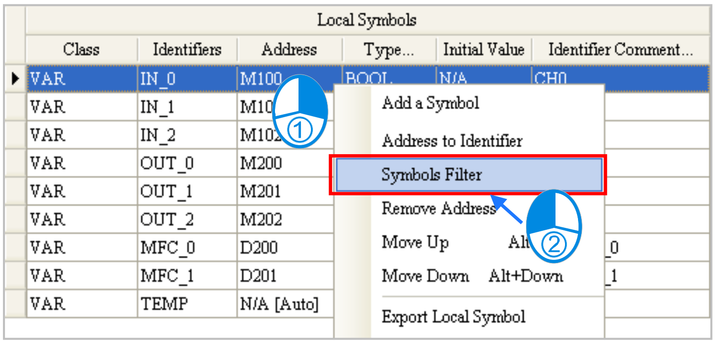
In global symbol table and local symbol table of POU, users can click the **Identifier** or **Address** the data in the table will be sorted according to the contents of the **Identifier** column or the **Address** column, and a mark indicating the sort direction will appear in at the right side of the heading **Identifier** or **Address**. Owing to the fact that the order in which the symbols in the local symbol table in a function block are arranged affects the order in which the operands in the function block are arranged, the data in the local symbol table in a function block cannot be sorted in this way.



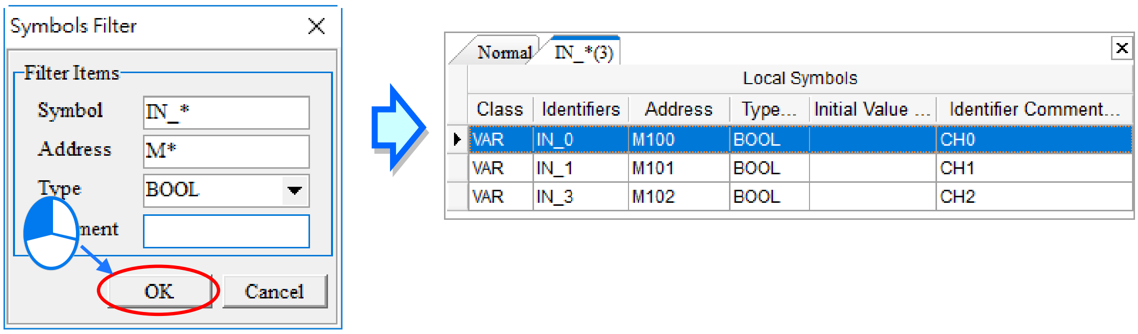
6.2.10 Filtering the Symbols

Users can view the symbols which meet the same conditions.

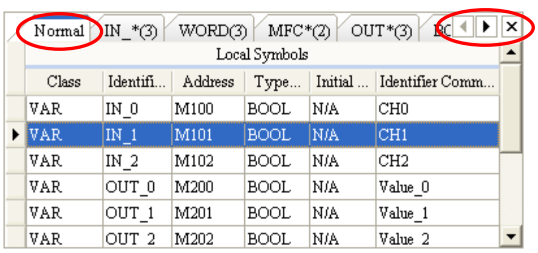
(1) Right-click a symbol table, and click **Symbols Filter** on the context menu.



(2) Users can set the conditions in the **Symbols Filter** window. The wildcard character " * " can be used to substitute for any character or characters in a string. The symbols which satisfy the conditions set are sieved out. If the users want to ignore a certain condition, they can leave the box for the condition blank. Click **OK** after the setting is complete.



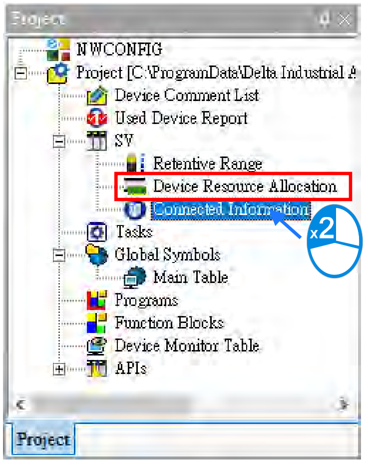
(3) The symbols which are sieved out are displayed in the additional page. The users can switch between the pages by clicking the tabs at the top of the table. If several groups of symbols are sieved out, the users can switch among the tabs by clicking ◀ or ▶ in the upper right corner of the window. If users click ✕ in the upper right corner of a page, the page will be closed. Besides, these additional pages are for view only. Users cannot edit the tables in the pages. After the users click the **Normal** tab, they can edit the original symbol table.



6.2.11 Device Resource Allocation Setting

The devices automatically assigned to the symbols in a project for a DVP series PLC are devices available to users. Users set a range of devices which can be automatically assigned to the symbols in a project so that they can manage the devices conveniently. They can set a range of devices for a project created. When the program in a project is compiled, devices within the range which is set are assigned to the symbols. If the number of symbols is larger than the devices within the range, an error message showing that the devices are insufficient will appear after the program in a project is compiled. Please refer to section 6.1.4 for more information about assigning devices to the symbols in a project.

Unfold the PLC section in the project management area in a project for a DVP series PLC, double-click **Device Resource Allocation**.



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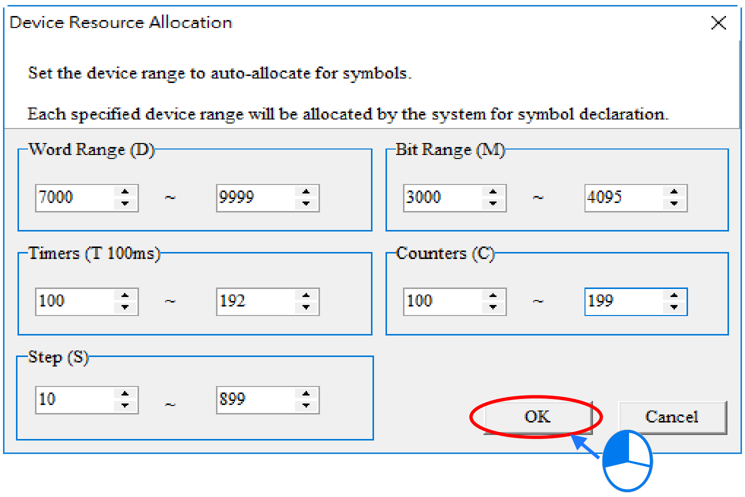
Users can set a device range in the **Device Resource Allocation** window. Every type of device has its limitations. For example, the data registers in a DVP-SV series PLC start from D2000, the auxiliary relays start from M2000, the counters are 16-bit counters, and the timers take 100 milliseconds as the timing unit. If users select a device address which is not allowed, the system will modify it automatically.

Click **OK** after the setting is complete. The setting here will be saved with the project.



6.3 Example

An example of creating a ladder diagram is shown in chapter 4. In section 5.6.1, the program created in chapter 4 is rewritten by means of reorganizing the structure of the POU and TASK. In the following sections, the device names in the program created in section 5.6.1 will be replaced by symbols.

6.3.1 Planning a Symbol Table

The symbols which correspond to the device names in the program created in section 5.6.1 are listed in the following table. Please refer to the descriptions below for more information.

Original device name	Identifier	Address specified	Declaration position	Function
X0.0	START_BT	X0.0	Global symbol table	START button
X0.1	STOP_BT	X0.1	Global symbol table	STOP button
X0.2	InP_SNR_1	X0.2	Global symbol table	In position sensor 1
X0.3	InP_SNR_2	X0.3	Global symbol table	In position sensor 2
X0.4	CNT_SNR	X0.4	Global symbol table	Counting sensor
Y0.0	CONVEYER	Y0.0	Global symbol table	Conveyer
Y0.1	TRIG_1	Y0.1	Global symbol table	Trigger signal for injector 1
Y0.2	TRIG_2	Y0.2	Global symbol table	Trigger signal for injector 2
M0	RUNNING	A device address is assigned automatically.	Global symbol table	Operation flag
M1	COMPLETE	A device address is assigned automatically.	Global symbol table	Completion flag
M2	ERROR	A device address is assigned automatically.	Global symbol table	Error flag

Original device name	Identifier	Address specified	Declaration position	Function
D0	CNT_DT	A device address is assigned automatically.	Local symbol table	Number of parts which are conveyed

- The X devices and the Y devices in the PLC are contacts connected to the equipment. The X device addresses and the Y device addresses are related to the wiring of the equipment. Users have to specify the device addresses by themselves. Besides, it is suggested that the X devices and the Y devices should be created in the global symbol table although some X devices and Y devices are only used in a certain POU. After the X devices and the Y device are created in the global symbol table, the subsequent maintenance such as changing the wiring and accessing the contacts in the additional program will be more convenient to users. However, it is not necessary for users to create the X devices and the Y devices in the global symbol table. The users can decide by themselves.

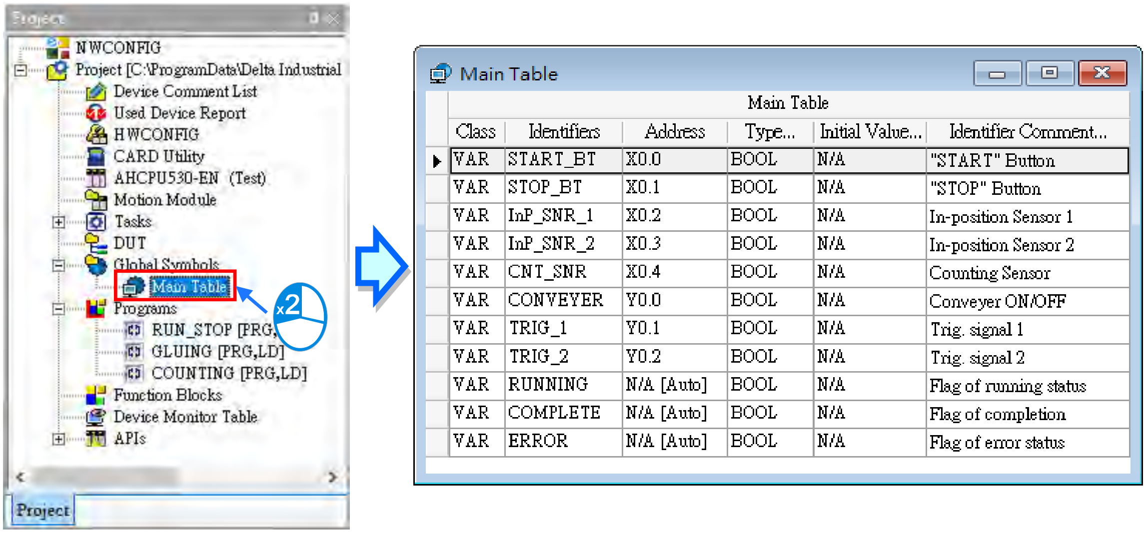
- Owing to the fact that M0, M1, and M3 are used in the different POUs, the symbols correspond to the three flags are declared in the global symbol table. Users do not need to assign device addresses to the symbols, and therefore the system assigns device addresses to them.

- The number of parts which are conveyed is stored in D0, and D0 is only used in the **COUNTING**. As a result, the symbol corresponding to D0 is declared in the local symbol table in the **COUNTING**, and the system assigns a device address to D0.

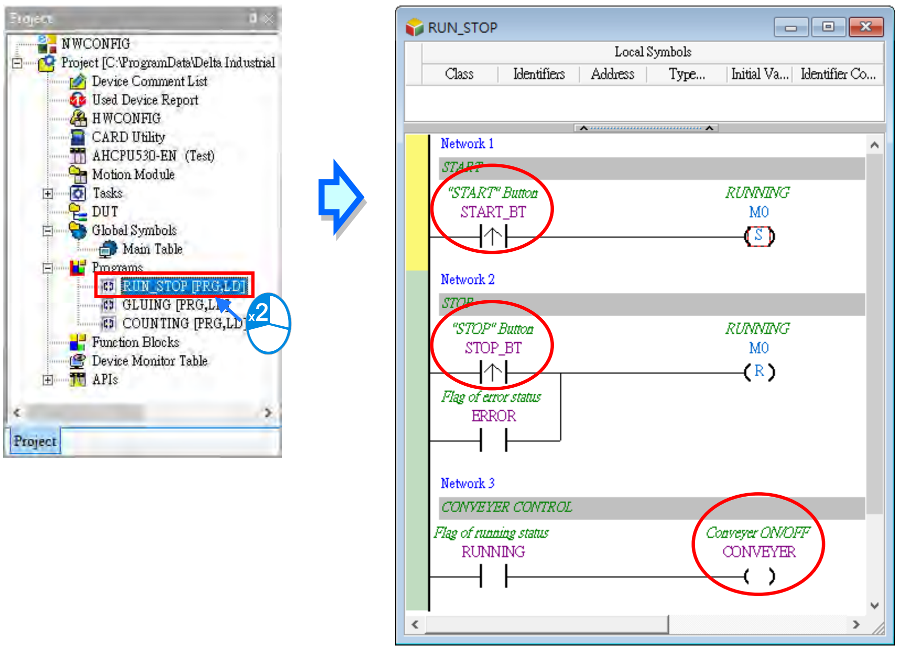
6.3.2 Writing a Program

Users can directly modify the program created in section 5.6.1, or write the program shown in section 5.6.1 again. If the users want to write the program again, they have to create a new project, and refer to chapter 4 and section 5.6.1 for more information.

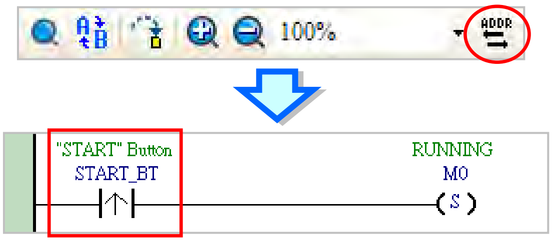
First, open the **Main Table** window. Then, refer to section 6.2, and create the symbols shown below in the global symbol table.



Double-click **RUN_STOP** in the project management area after the creation of the symbols in the global symbol table is complete. If users directly modify the program created in section 5.6.1, they will find that the symbols to which they assign the device addresses replace the corresponding device names, and the comments on the symbols replace the original comments on the devices. Please refer to the contents below if the program displayed in **RUN_STOP** is not the same as that shown in the figure below.

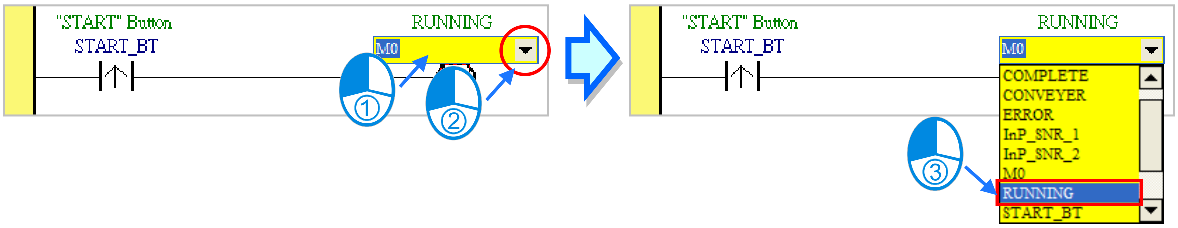


The users can choose whether to display the symbols to which they assign devices in the ladder diagram. If  on the toolbar is pressed, the device names and the comments on the devices will be displayed in the program. If  is not pressed, the identifiers and the comments on the symbols will be displayed in the program.

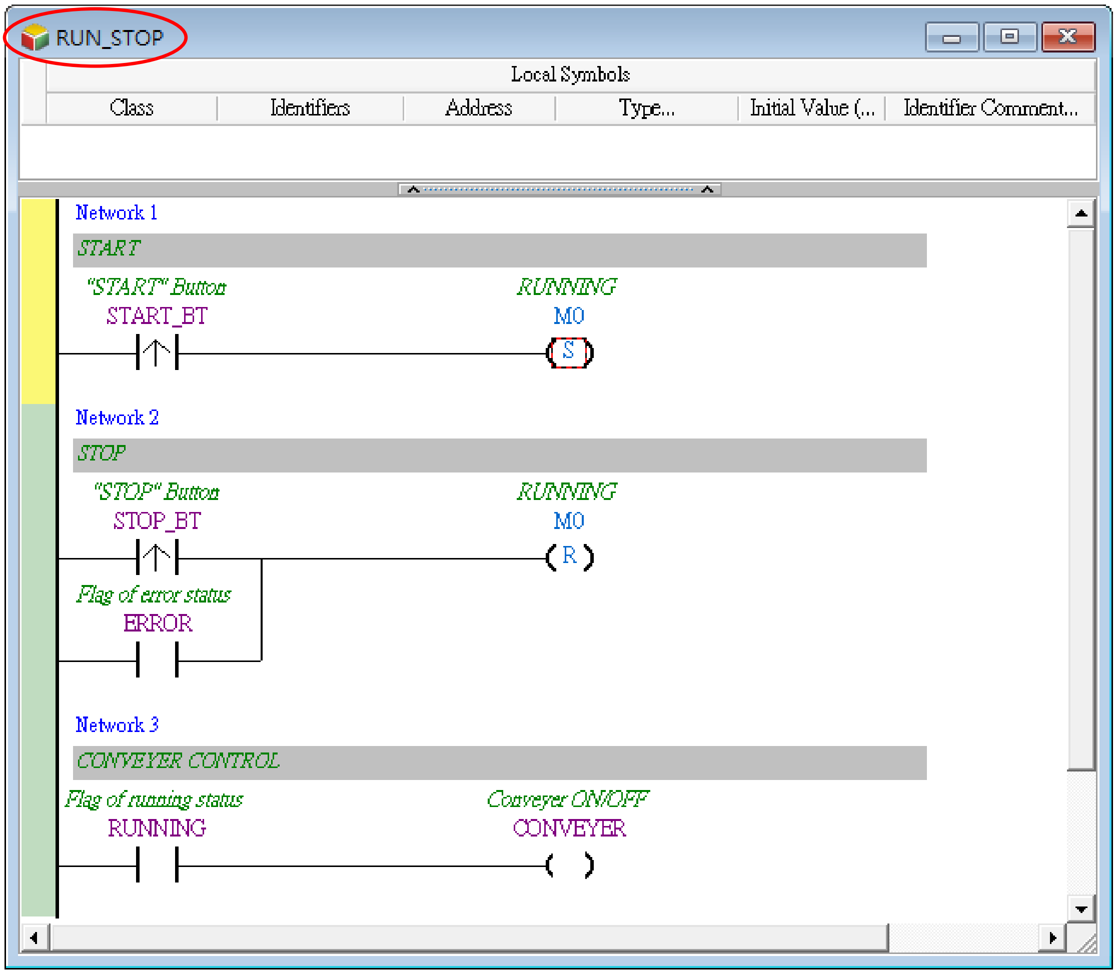


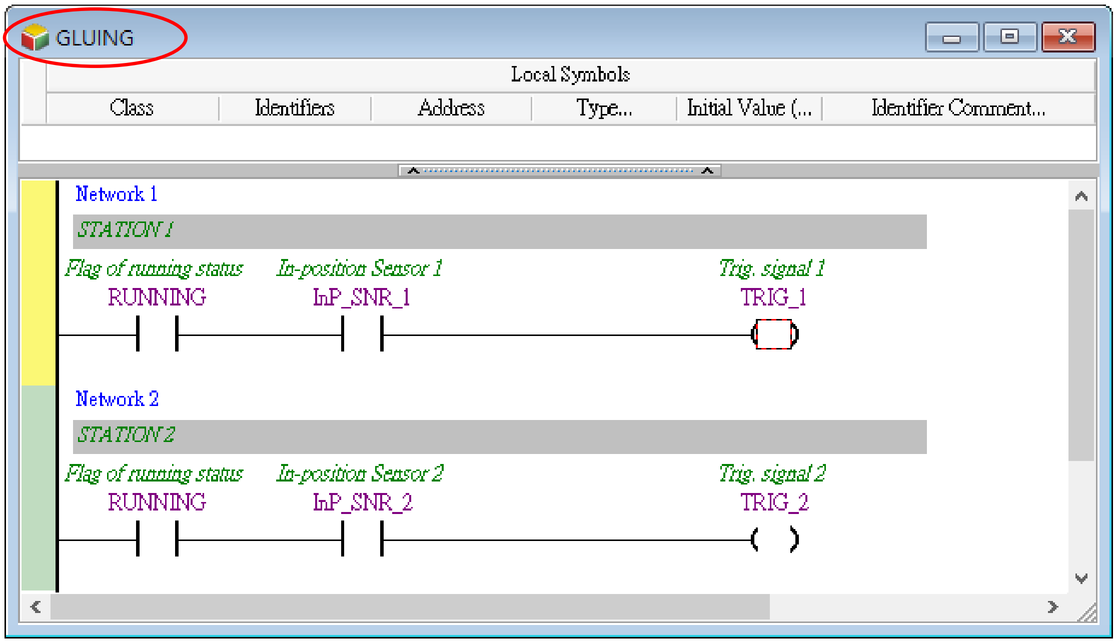
***. M0 is not assigned to any symbol, and therefore it remains unchanged if  is not pressed. Likewise, if users do not assign a device address to a symbol, or the system automatically assigns an internal memory to a symbol, the symbol will remain unchanged after  is pressed.**

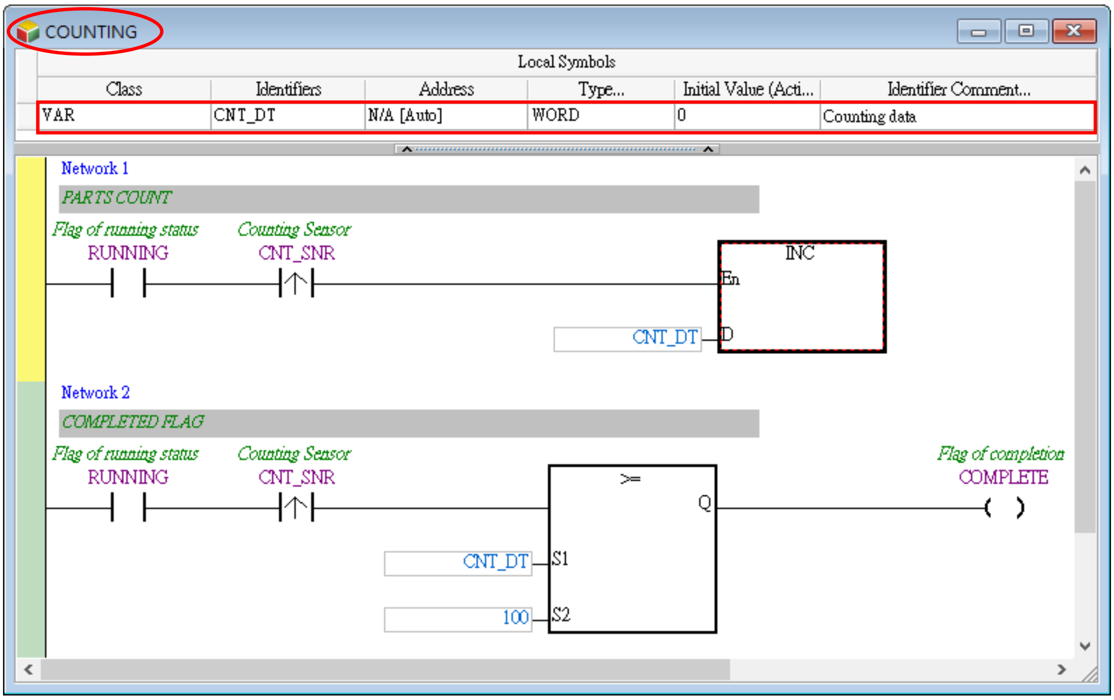
The operation flag M0 can be replaced by the identifier RUNNING. The users can refer to chapter 4, and type RUNNING directly. They can also click M0, click  in the box, and select an identifier on the drop-down list. Besides, the users can press Page Down on the keyboard when they edit the box. The users can select an identifier on the drop-down list by ↑ or ↓ on the keyboard. Press Enter on the keyboard after the selection is complete.



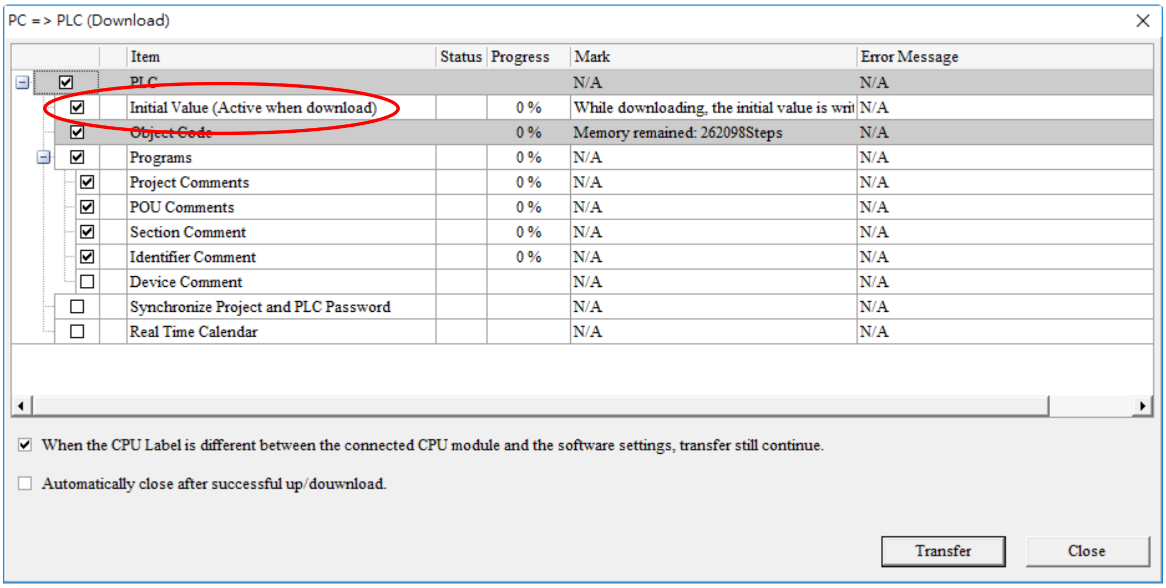
Refer to the description above, and write the program in the POU shown below.







If users want to write the program shown in section 5.6.1 again, they have to refer to chapter 4 and section 5.6.1, and complete the hardware configuration, the parameter setting, and the task management. After the writing of the program is complete, the users have to compile the program, and download the parameters and the program to the CPU module. Before the program is downloaded to the CPU module, the users have to select the **Initial Value** checkbox in the **Transfer Setup** window. Once the **Initial Value** checkbox in the **Transfer Setup** window is selected, the initial value of CNT_DT in **COUNTING** will be written into the CPU module.



Chapter 7 Function Block and Library

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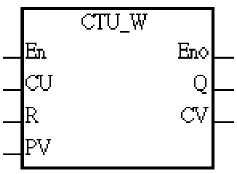
7.1 Knowing Function Blocks

Function blocks (FB) and Function (FC) play important roles in the PLC programming. They are also supported by IEC 61131-3. Owing to the characteristics and advantages of function blocks, ISPSoft also supports and offer many functionalities related to function blocks, for instance user-defined FB POU and system-defined FB POU. Though self-defined FC POU is only supported by DVPxxMC and AS5xx series, ISPSoft provides API instructions for users to use as system-defined FC POU.

7.1.1 Introduction of Function Blocks

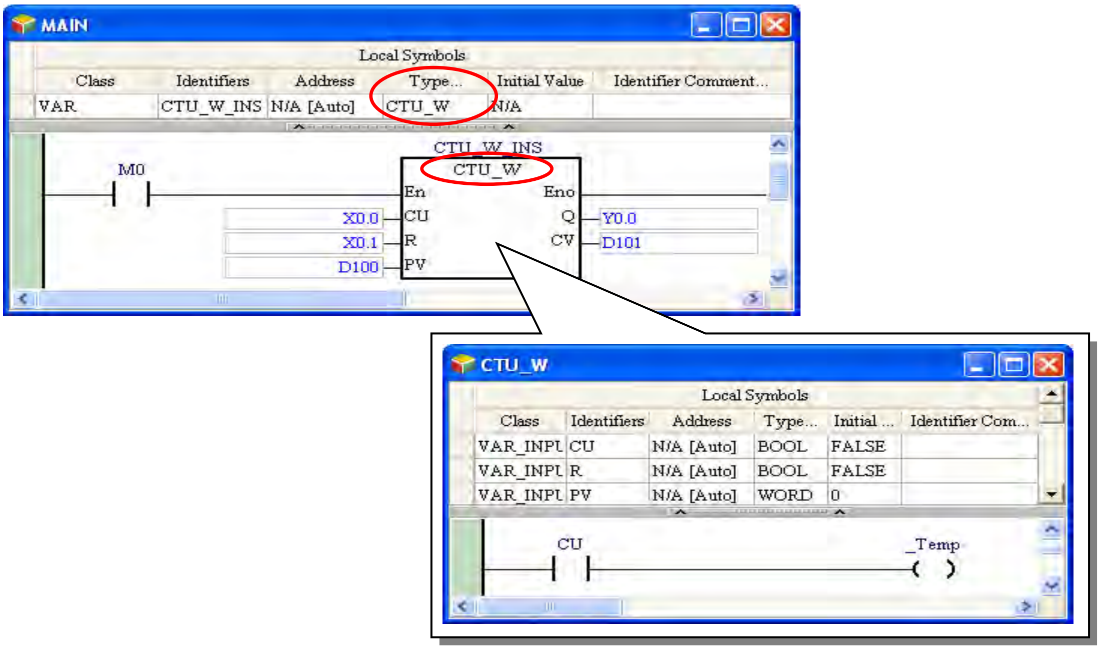
A function block is a component in a program which performs an operation. It is a type of POU, but it can not operate by itself. After a POU of the program type calls a function block, and sends the related parameters, the function of the function block can be executed. After the execution of the function block is complete, the internal operation result will be sent to the device or symbol specified by the superior POU (caller).

A function block is shown below. The appearance of a function block is similar to that of an applied instruction in that there are input pins and output pins. The usage of a function block is also similar to that of an applied instruction. A function block is different from an applied instruction in that users have to declare a symbol whose data type is a function block in the superior POU (caller) which calls the function block. Besides, a function block can call another function block.



A function block is a memory unit. Every function block is assigned a substantial memory block where the values of the internal symbols are stored. Owing to the fact that the value of the symbol in a function block will be retained after the function block is executed, every execution result is affected by the last execution result. In other words, the output values may be different even if the input values are the same.

An application instance of a function block is shown in the figure below. There is a symbol whose data type is a function block in the local symbol table in the superior POU (caller). The name in the **Type…** cell is the same as the name of the function block. Please refer to the following sections for more information about the usage of a function block.



7.1.2 Characteristics and Advantages of Function Blocks

Owing to the fact that function blocks present characteristics and advantages that traditional programming of a PLC does not have, function blocks are supported by IEC 61131-3, and are widely used by users.

● **Modular design**

A large program is divided into several subroutines, and the subroutines are created as function blocks. The function blocks are arranged and called by POUs of the program type.

● **Highly independent**

Different function blocks can be created by means of different programming languages such as a ladder diagram, an instruction list, a structured text, and a function block diagram according to the characteristics of the function blocks or a programmer’s habit. Besides, when a POU calls a function block, the programming language by which the program in the function block is written does not need to be considered. For example, if a complex operation has to be performed in a part of a ladder diagram, users can create the part of the ladder diagram as a function block by means of a structured text, and the function block can be called by the original ladder diagram.

● **Reusable**

Once a function block is created, it can be used repeatedly as long as users conform to the rule of using the function block.

● **Highly portable**

After a function block is created, it can be used in the original project. Besides, after the function block is exported, it can be imported into another project. As a result, users can gradually create their own function blocks.

- **Function blocks can be maintained conveniently.**

The program in a function block is an independent module. If an error occurs in a function block, or the function of a function block does not meet the actual requirement, users can just modify the program in the function block, and do not need to debug or modify the whole program,

- **The readability of a program is increased.**

Users can write a complex program or a program which will be used repeatedly in a function block, and the function block can be called by the original program. The structure of the original program becomes more simplified, and the program becomes more readable.

- **Highly confidential**

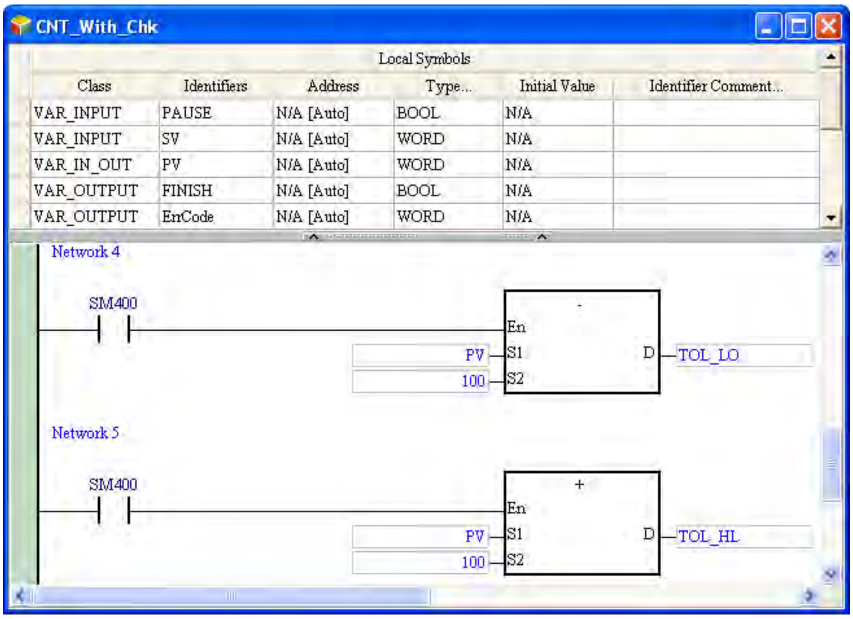
After users set a password for a function block created, they can create their own core technology in the function block without care, and provide the function block for other users. Besides, system suppliers or software developers can provide function blocks which have specific functions for customers.

- **Highly efficient**

The application of function blocks provides a highly efficient development environment in terms of project development. Owing to the fact that function block are modular, developers and manufacturers can take part in the development of a project together, and the use of human resources are more flexible.

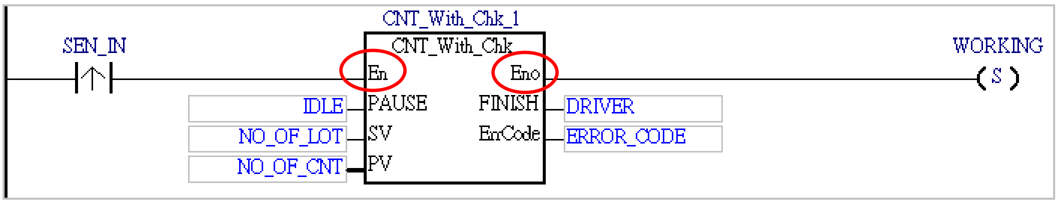
7.2 Structure of the Function Blocks in ISPSoft

Please refer to the following figure. The internal structure of a function block and function is similar to that of a POU of the program type. It is composed of a local symbol table and a program. A function block is edited in a way in which a POU of the program type is edited. The programming languages that users can make use of to create the function blocks in ISPSoft are ladder diagrams, instruction lists, structured texts, and function block diagrams, but are not sequential function charts. Besides, a function block can call another function block. When a function block is called, the programming language by which program in the function block is written does not need to be considered.



7.2.1 En Pin of Function Block

A superior POU (caller) calls a function block in a way similar to the way in which an applied instruction is executed. Whether a function block is executed depends on the logic state sent to the En pin of the function block. If the logic state sent to the En pin of a function block is ON, the function block will be executed. If the logic state sent to the En pin of a function block is OFF, the function block will not be executed. The Eno pin of a function block functions to send the logic state sent to the En pin of the function block. Besides, if a function block is used in a structured text, the function block does not have an En pin. Please refer to chapter 11 for more information.



7.2.2 Symbol Variables in Function Block

Function blocks are similar to POUs of the program type in that users can create local symbols in the function blocks. Local symbols can also be used in a function block. However, if local symbols are used in a function block in a project, the function block may not portable. If the function block is imported into another project, the project may not have the same global symbols.

The following table describes the symbol variables related to function blocks and different categories of symbol variables supported by each PLC types.

● The category of symbol variables for function block:

Category	Description	AH/AS	DVP	AS5xx/ DVPxxMC
VAR	Only for function block arithmetic purpose internally. After executing, the symbol variable status is retained.	✓	✓	✓
VAR_INPUT	Used as input point of function block. The variable receives the assigned operand from the upper level POU (caller). When executing the function block, the operand value is copied into the function block.	✓	✓	✓
VAR_OUTPUT	Used as output point of function block. When finish executing the function block, the variable outputs the arithmetic result to the assigned operand by the upper level POU (caller)	✓	✓	✓
VAR_IN_OUT	Feedback points of a function block. When executing function blocks, use the point to send in the assigned operand content by the upper level POU (caller) to the function block. When finish executing the function block, arithmetic result feedback is output to the assigned operand by the upper level POU (caller).	✓	✓	
VAR_RETAIN	The retain variables can retain their value after power failure and the variable can be defined up to 15999 in total.			✓
VAR_STATIC	A static variable will be given a fixed address so as to share the same value across different instances using the same function block.			✓
VAR_STATIC_ RETAIN	Variables are declared as static and retained.			✓

● Data types supported by internal function block local symbols :

Model Types	Description
AH/AS	BOOL, WORD, DWORD, LWORD(*2), INT, DINT, LINT(*2), REAL, LREAL(*2), ARRAY, STRING, POINTER(*1), T_POINTER(*1), C_POINTER(*1), HC_POINTER(*1), function block(FB) types, user-defined types
DVP	BOOL, WORD, DWORD, , REAL, ARRAY, STEP, TIMER, and COUNTER
AS5xx/ DVPxxMC	BOOL, BYTE, WORD, DWORD,LWORD, SINT, INT, DINT, LINT, USINT, UINT, UDINT, ULINT, REAL, LREAL, ARRAY, STRING, TIME, DATE, TOD,DT, function block (FB) types, user-defined types

*1. Please refer to section 7.2.4 for more information about POINTER, T_POINTER, C_POINTER, and HC_POINTER.

*2. The LWORD, LINT and LREAL data types are not supported by the function blocks in AS series CPU modules.

● Memory configuration of a function block

Model Types	Description
AH/AS	When the symbols whose data type is a function block, and the local symbols created in a function block are declared, users can not assign device addresses to them. The system will automatically assign memories reserved by the CPU module.
DVP	Every symbol whose data type is a function block is assigned a P device. Besides, the system automatically assigns devices in the PLC to the local symbols in a function block instance according to the data types of the local symbols.
AS5xx/ DVPxxMC	When declaring symbol variables as function block types (FB instance)as well as local symbols created in function blocks, both cannot assign device address by themselves, the system will auto-configure a reserved memory section in the host.

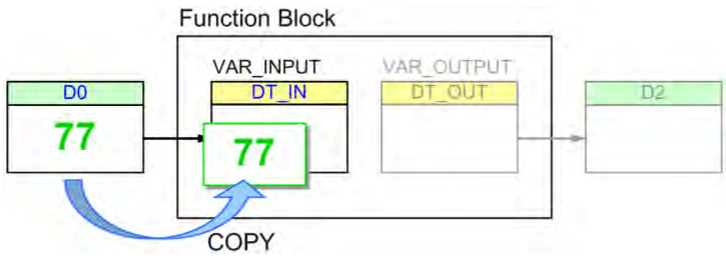
*. Please refer to sections 7.2.5~7.2.7 for more information about function block instances and the assignment of memories.

7.2.3 Input / Output Pins of a Function Block

When a POU calls a function block, it sends the value in a device to the input pin of the function block. After the function block is executed, the operation result is sent to the device in the POU through the output pin of the function block. A single function block can accept multiple inputs and return multiple outputs, while function only has an output parameter (return value). Please refer to the following figures.

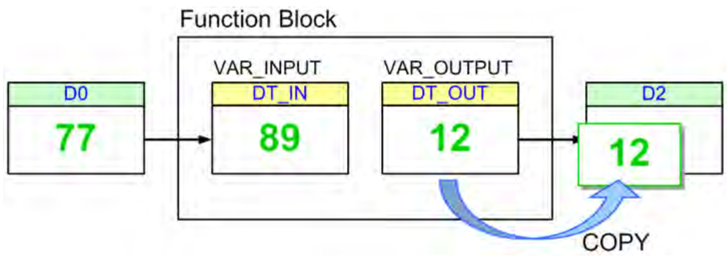
● **Before a function block is executed**

The caller assigns D0 to DT_IN, the input pin of the function block. When the function block is called, the system sends the present value in D0 to DT_IN. (DT_IN is a symbol of the VAR_INPUT type.)

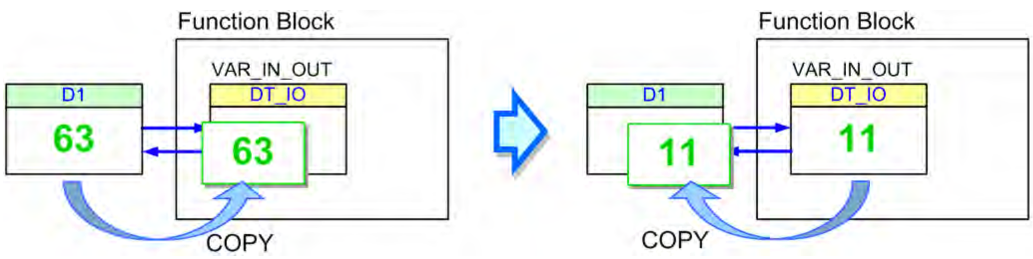


● **After a function block is executed**

After the function block is executed, the value of DT_IN becomes 89. The value in D0 is unchanged. Besides, DT_OUT sends the final operation result to D2, the device specified by the caller. Even if the value in D2 is overwritten during the execution of the program, the value of DT_OUT will remain unchanged. (DT_ OUT is a symbol of the VAR_OUTPUT class.)

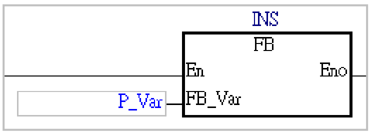


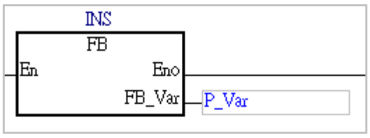
Although the value of the symbol of the VAR_IN_OUT class will be sent to the device that the caller assigns to the symbol after the function block is executed, the present value in the device specified by the caller is sent to the symbol before the symbol sends the final operation result to the device.



*. The data type of the symbol of the VAR_IN_OUT class in a function block in a project for an AH/AS series PUC module can be POINTER. The caller can send the device address to the function block through the symbol whose data type is POINTER. Please refer to the following section for more information.

Please refer to the function blocks below. FB_Var is the pin of the function block, and P_Var is the operand that the superior POU (caller) assigns to FB_Var. The data type of P_Var and that of FB_Var must conform to the basic principle described below. However, in order to make the writing of a program more convenient, ISPSoft provides some special principles. As long as the data type of P_Var and that of FB_Var conform to one of the special principles, the system will regard the data types as legal data types even if the data types does not conform to the basic principle. The basic principles below is supported by DVPxxMC and AS5xx series.





● **Basic principle for the general data types**

The data type of P_Var must be the same as the data type of FB_Var.

● **Special principles for the general data types (Please refer to the following table.)**

1. If either the data type of P_Var or the data type of FB_Var is WORD, DWORD, or LWORD, the data type of the other symbol can be WORD, DWORD, LWORD, INT, DINT, LINT, REAL, or LREAL. If this condition is met, the data length of P_Var can be larger than or equal to the data length of FB_VAR.

2. If the data type of P_Var is STEP, the data type of FB_Var can be BOOL. The state of the step in the caller will be used in the function block.

Model Types		AS/AH/DVP								
Data type		FB_Var (function block)								
		WORD	DWORD	LWORD	INT	DINT	LINT	REAL	LREAL	BOOL
P_VAR (caller)	WORD	✓			✓					
	DWORD	✓	✓		✓	✓		✓		
	LWORD	✓	✓	✓	✓	✓	✓	✓	✓	
	INT	✓			✓					
	DINT	✓	✓			✓				
	LINT	✓	✓	✓			✓			
P_VAR (caller)	REAL	✓	✓					✓		
	LREAL	✓	✓	✓					✓	
	BOOL									✓
	STEP									✓

In addition to the principles for the general data types described above, there are principles for the symbols whose data type is ARRAY.

● **Basic principles for the symbols whose data types are ARRAY**

1. The array type of P_Var must be the same as the array type of FB_Var.

2. If the array type of P_Var is the same as the array type of FB_Var, the size of the array for P_Var can be larger than the size of the array for FB_VAR.

● **Special principles for the symbols whose data types are ARRAY**

1. When the array types are compared, the first special principle for the general data types applies.

2. If either the data type of P_Var or the data type of FB_Var is ARRAY, the system will regard the other symbol whose data type is not AARAY as a symbol whose data type is ARRAY, and the size of the array for the symbol will be one element.

3. If the array type of P_Var or the array type of FB_Var is WORD,INT, REAL or any other types, users can compare bothdata lengths by means of summation. For example, a symbol whose array type is DWORD is compatible with a symbol whose array type is INT and contains the length of two elements and for a symbol whose array type WORD and has a length of four elements is compatible with a symbol whose array type is LINT. However, a symbol whose array type is INT and has a length of four elements is not compatible with a symbol whose array type is LINT, because both data types do not contain the array type of WORD and do not fit the principle. The following examples are:

✓ Example 1: The data type of P_Var (in the caller) is INT, and the data type of FB_Var (in the function block) is INT.

➔ The basic principle for the general data types is satisfied. As a result, the data types are legal.

✓ Example 2: The data type of P_Var (in the caller) is WORD, and the data type of FB_Var (in the function block) is INT.

➔ The first special principle for the general data types is satisfied. As a result, the data types are legal.

✓ Example 3: The data type of P_Var (in the caller) is LWORD, and the data type of FB_Var (in the function block) is DINT。

➔ The first special principle for the general data types is satisfied. As a result, the data types are legal.

✕ Example 4: The data type of P_Var (in the caller) is WORD, and the data type of FB_Var (in the function block) is LINT.

➔ Although the data type of P_Var is WORD, the data length of P_Var is less than that of FB_Var. As a result, the data types are illegal.

✗ Example 5: The data type of P_Var (in the caller) is LINT, and the data type of FB_Var (in the function block) is DINT.

➔ The data type of P_Var is not the same as the data type of FB_Var. As a result, the data types are illegal.

✓ Example 6: The array type of P_Var (in the caller) is INT, and the size of the array for P_Var (in the caller) is four elements. The array type of FB_Var (in the function block) is INT, and the size of the array for FB_Var (in the function block) is three elements.

➔ The basic principles for the symbols whose data types are ARRAY are satisfied. As a result, the array types are legal.

✓ Example 7: The array type of P_Var is WORD, and the size of the array for P_Var is two elements. The data type of FB_Var is WORD (not ARRAY).

➔ The second special principle for the symbols whose data types are ARRAY is satisfied. As a result, the array type and the data type are legal.

✓ Example 8: The array type of P_Var is WORD, and the size of the array for P_Var is four elements. The data type of FB_Var is DWORD (not ARRAY).

➔ The third special principle for the symbols whose data types are ARRAY is satisfied. As a result, the array type and the data type are legal.

✗ Example 9: The array type of P_Var is DINT, and the size of the array for P_Var is four elements. The array type of FB_Var is INT, and the size of the array for FB_Var is two elements.

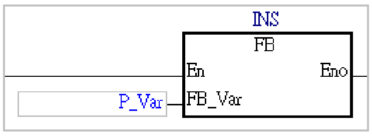
➔ The array type of P_Var is not the same as the array type of FB_Var. As a result, the array types are illegal.

✓ Example 10: The data type of P_Var is DWORD (not ARRAY). The array type of FB_Var is WORD, and the size of the array for FB_Var is two elements.

➔ The third special principle for the symbols whose data types are ARRAY is satisfied. As a result, the data type and the array type are legal.

Principles of Data Types for DVPxxMC/ AS5xx

Example 1



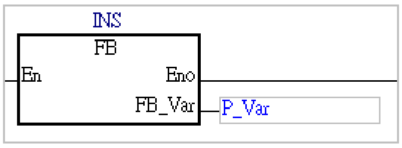
Generally, the data type of P_Var (in the caller) and the data type of FB_Var (in the function block) is the same. But for some situations, the ISPSoft allows the length of the data type of P_Var (in the caller) to be shorter or equal to the length of FB_Var (in the function block).

If the data type of FB_Var (in the function block) is ARRAY, then the data type of P_Var (in the caller) has to be ARRAY and the content as well as length has to be the same as FB_Var (in the function block).

Model Type		DVPxxMC/AS5xx														
Data Type		FB_Var (Function Block)														
		BOOL	BYTE	WORD	DWORD	LWORD	USINT	UINT	UDINT	ULINT	SINT	INT	DINT	LINT	REAL	LREAL
P_VAR (Caller)	BOOL	✓														
	BYTE		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	WORD			✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓
	DWORD				✓	✓			✓	✓			✓	✓	✓	✓
	LWORD					✓				✓				✓	✓	✓
	USINT		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	UINT			✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓
	UDINT				✓	✓			✓	✓			✓	✓	✓	✓
	ULINT					✓				✓				✓	✓	✓
	SINT		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	INT			✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓
	DINT				✓	✓			✓	✓			✓	✓	✓	✓
	LINT					✓				✓				✓	✓	✓
	REAL														✓	✓
	LREAL														✓	✓

Model Types		DVPxxMC/ AS5xx				
Data Type		FB_Var (Function Block)				
		TIME	DATE	TOD	DT	STRING
P_VAR (Caller)	TIME	✓				
	DATE		✓			
	TOD			✓		
	DT				✓	
	STRING					✓

Example below:



Generally, the data type of P_Var (in the caller) and the data type of FB_Var (in the function block) is the same. But for some situations, the ISPSoft allows the length of the data type of P_Var (in the caller) to be longer or equal to the length of FB_Var (in the function block).

If the data type of FB_Var (in the function block) is ARRAY, then the data type of P_Var (in the caller) has to be ARRAY and the content as well as length has to be the same as FB_Var (in the function block).

Model Type		**DVPxxMC/AS5xx**														
Data Type		**FB_Var（Function Block）**														
		BOOL	**BYTE**	**WORD**	**DWORD**	**LWORD**	**USINT**	**UINT**	**UDINT**	**ULINT**	**SINT**	**INT**	**DINT**	**LINT**	**REAL**	**LREAL**
P_VAR（Caller）	**BOOL**	✓														
	BYTE		✓	✓	✓	✓✓	✓	✓	✓	✓✓	✓	✓	✓	✓	✓	✓
	WORD			✓	✓	✓✓		✓	✓	✓✓		✓	✓	✓	✓	✓
	DWORD				✓	✓✓			✓	✓✓			✓	✓	✓	✓
	LWORD					✓				✓				✓	✓	✓
	USINT		✓	✓	✓	✓✓	✓	✓	✓	✓✓	✓	✓	✓	✓	✓	✓
	UINT			✓	✓	✓✓		✓	✓	✓✓		✓	✓	✓	✓	✓
	UDINT				✓	✓✓			✓	✓✓			✓	✓	✓	✓
	ULINT					✓				✓				✓	✓	✓
	SINT		✓	✓	✓	✓✓	✓	✓	✓	✓✓	✓	✓	✓	✓	✓	✓
	INT			✓	✓	✓✓		✓	✓	✓✓		✓	✓	✓	✓	✓
	DINT				✓	✓✓			✓	✓✓			✓	✓	✓	✓
	LINT					✓				✓				✓	✓	✓
	REAL														✓	✓
	LREAL														✓	✓

Model Type		DVPxxMC				
Data Type		FB_Var (Function Block)				
		TIME	DATE	TOD	DT	STRING
P_VAR (Caller)	TIME	✓				
	DATE		✓			
	TOD			✓		
	DT				✓	
	STRING					✓

Additional remark

(a) According to the above principle, the data length of P_Var (in the caller) is larger than that of FB_Var (in function block), and the value of P_Var is sent to FB_Var, the values of the bits starting from the lowest bit in P_Var are retrieved, and the number of values retrieved conforms to the data length of FB_Var. If the value of FB_Var is sent to P_Var, the values of the bits starting from the lowest bit in P_Var are overwritten, the number of values overwritten conforms to the data length of FB_Var, and the values which are not overwritten remains unchanged. Users have to be careful about the correctness of the data.

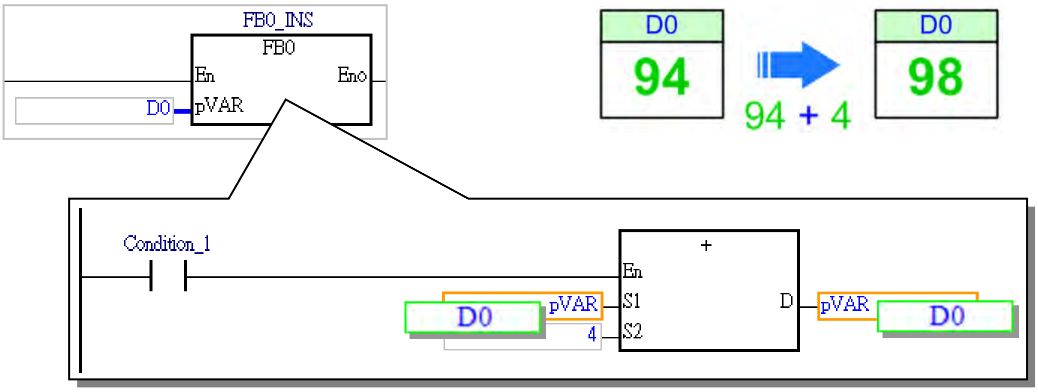
(b) The data type of a symbol in a function block in a project for an AH series CPU module can be POINTER. Please refer to section 7.2.4 for more information.

(c) For AS5xx and DVPxxMC series, if the data length of P_Var (in the caller) is shorter than that of FB_Var (in function block), and the value of P_Var is sent to FB_Var, the values of the bits starting from the lowest bit in P_Var are retrieved, and the number of values retrieved conforms to the data length of FB_Var. If the value of FB_Var is sent to P_Var, the values of the bits starting from the lowest bit in P_Var are overwritten, the number of values overwritten conforms to the data length of FB_Var, and the highest bits which exceeds the length of FB_Var is overwritten as 0. Users have to be more careful about the correctness of the data.

7.2.4 Index Type Symbol Variables

A symbol whose data type is POINTER, T_POINTER, C_POINTER, or HC_POINTER functions to send the symbol or the device address specified by the caller to the function block. The use of a symbol whose data type is POINTER, T_POINTER, C_POINTER, or HC_POINTER is quite different from the use of a symbol whose data type is a general data type. A symbol whose data type is a general data type in a function block either receives the value from the device specified by the caller or sends the operation result to the device specified by the caller. If the data type of a pin of a function block is POINTER, T_POINTER, C_POINTER, or HC_POINTER, the data sent to the function block will be the symbol or the device address assigned to the pin. As a result, the object processed in a function block is the object which is specified.

The caller assigns D0 to pVAR in the function block, and the data type of pVAR in the function block is POINTER, T_POINTER, C_POINTER, or HC_POINTER, as shown in the figure below. If the function block is called and executed, pVAR in the function block will be regarded as D0.



The principles of using a symbol whose data type is POINTER, T_POINTER, C_POINTER, or HC_POINTER are as follows.

1. Only AH/AS and DVP-ES3 series CPU modules support a symbol whose data type is POINTER, T_POINTER, C_POINTER, or HC_POINTER.

2. The symbols whose data types are POINTER can only be declared in the function blocks in a project, and they must be symbols of VAR_IN_OUT class.

3. The pointers and the restrictions are described below.

Pointer	Restriction	
General pointer POINTER	Maximum number	16 symbols whose data types are POINTER can be declared in a function block.
	Reference	Symbol whose data type is WORD/DWORD/LWORD/INT/DINT/LINT, data register, link register, or X/Y device (e.g. X0/Y0)
Pointer for a timer T_POINTER	Maximum number	8 symbols whose data types are T_POINTER can be declared in a function block.
	Reference	Timer or symbol whose data type is TIMER
Pointer for a counter C_POINTER	Maximum number	8 symbols whose data types are C_POINTER can be declared in a function block.
	Reference	Counter or symbol whose data type is COUNTER
Pointer for a high-speed counter HC_POINTER	Maximum	8 symbols whose data types are HC_POINTER can be declared in a
	Reference	32-bit counter or symbol whose data type is COUNTER and to which a 32-bit counter is assigned

● Example of using a symbol whose data type is POINTER

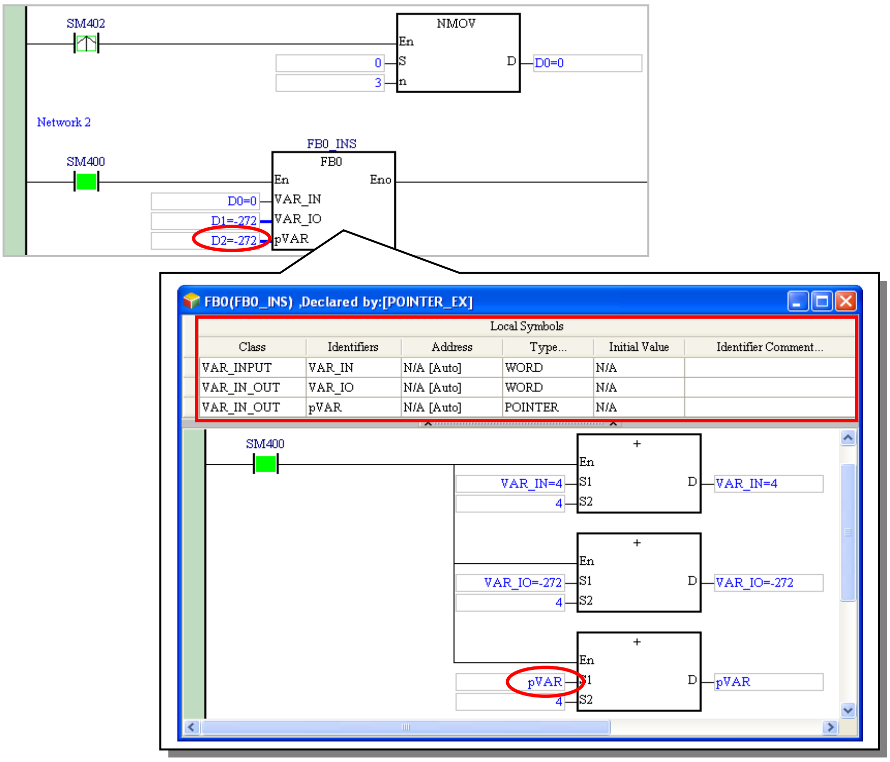
The function block FB0 has three input pins. The data types and the classes are in the red frame in the local symbol table below. D0, D1, and D2 in the POU (caller) are assigned to the three pins. (The initial values in D0, D1, and D2 are 0.) The execution of the program is as follows.

➢ D0 is assigned to VAR_IN. VAR_IN is a symbol of the VAR_INPUT class, and the data type of VAR_IN is WORD. When the function block is called, the present value in D0 is copied into VAR_IN. After the operation inside the function block is performed, 4 will be added to the value of VAE_IN. The operation result does not affect D0, and therefore the value in D0 is always 0.

➢ D1 is assigned to VAR_IO. VAR_IO is a symbol of the VAR_IN_OUT class, and the data type of VAR_IO is WORD. When the function block is called, the present value in D1 is copied into VAR_IO. After the operation inside the function block is performed, 4 is added to the value of VAR_IO. Owing to the fact that VAR_IO is a symbol of the VAR_IN_OUT class, the value of VAR_IO is copied into D1 after the function block is executed. The value sent from D1 to VAR_IO is an accumulated value. The value in D1 accumulates during the execution of the function block.

➢ D2 is assigned to pVAR. Owing to the fact that the data type of pVAR is POINTER, the sum will be written into D2 after 4 is added to D2. The value in D2 accumulates during the execution of the function block.

Although D1 and D2 get the same execution results, they have different execution processes. Besides, owing to the fact that pVAR is regarded as D2, the present value of pVAR is not displayed in a way in which the present value of VAR_IO is displayed when the online monitoring function is enabled.



*. SM400 is a special auxiliary relay in AH/AS series. It is ON when the CPU module is powered. SM402 initializes forward (an instant RUN is ON).

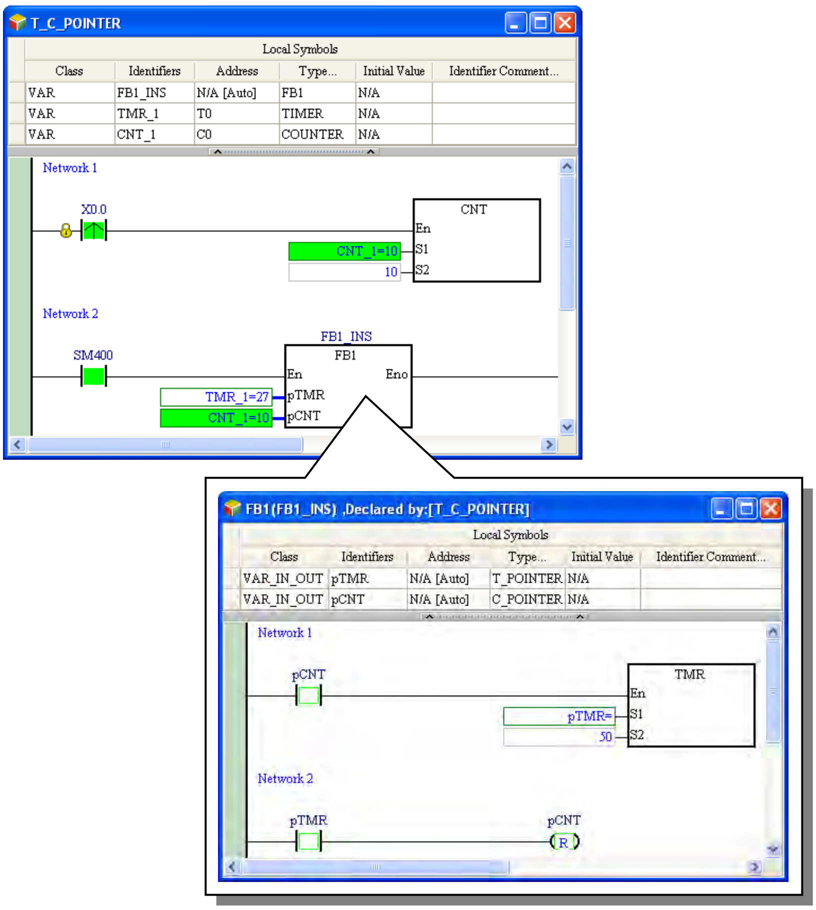
● Example of using a symbol whose data type is T_POINTER and a symbol whose data type is C_POINTER

Owing to the fact that users can not declare a symbol whose data type is TIMER and a symbol whose data type is COUNTER in a function block in a project for an AH/AS series CPU module, they can send a timer, and a counter to a function block by means of declaring a symbol whose data type is T_POINTER, and a symbol whose data type is C_POINTER in the function block.

The function block FB1 has two input pins. pTMR is a symbol whose data type is T_POINTER, and pCNT is a symbol whose data type is C_POINTER. The caller assigns TMR_1 and CNT_1 to the two pins. (The data type of TMR_1 is TIMER, and the data type of CNT_1 is COUNTER.)

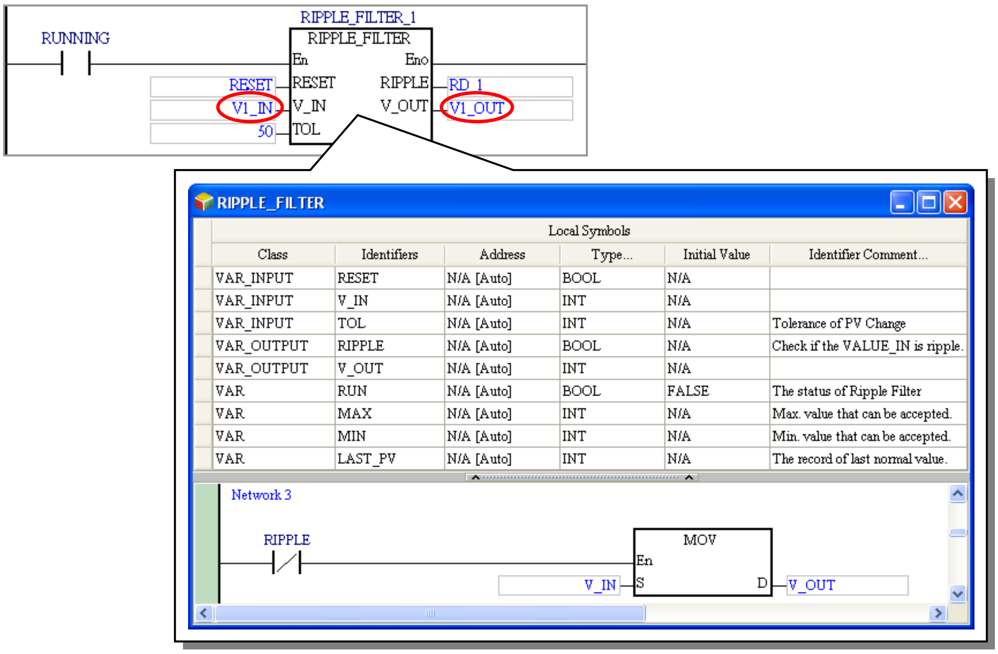
In the superior POU, the value of CNT_1 increases by one when X0.0 is turned from OFF to ON. CNT_1 will not be ON until the value of CNT_1 is 10. Owing to the fact that TMR_1 and CNT_1 are assigned to the function block, the state of CNT_1 (pCNT) is judged when the function block is executed. When CNT_1 (pCNT) is ON, TMR_1 (pTMR) measures the time interval. When the value of pTMR is 50, CNT_1 (pCNT) is reset.

Likewise, the present value of pTMR and that of pCNT are not displayed when the online monitoring function is enabled.

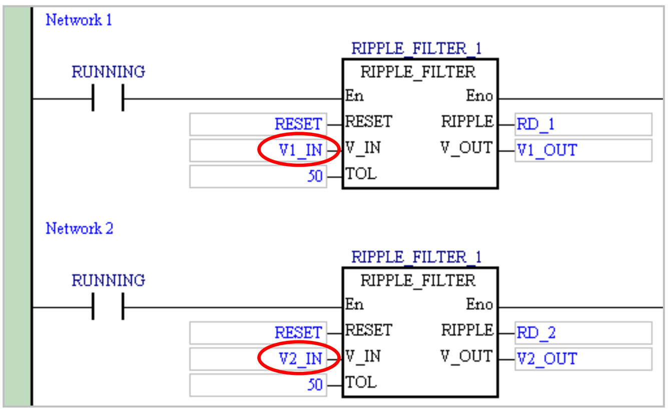


7.2.5 Function Block Definition and Function Block Instance

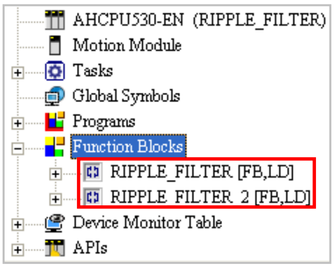
The definition of a function block and an example of a function block are important concepts. Please refer to the following example. Whenever the superior POU (caller) is executed, the value of V1_IN is sent to the function block RIPPLE_FILTER. After the value sent to the function block this time is compared with the value recorded last time, the final operation result will be sent to V1_OUT in the superior POU. In order to record the operation result, a local symbol in which the operation result can be stored is declared in the function block. When the program is compiled, the system assigns a substantial memory block to this local symbol.

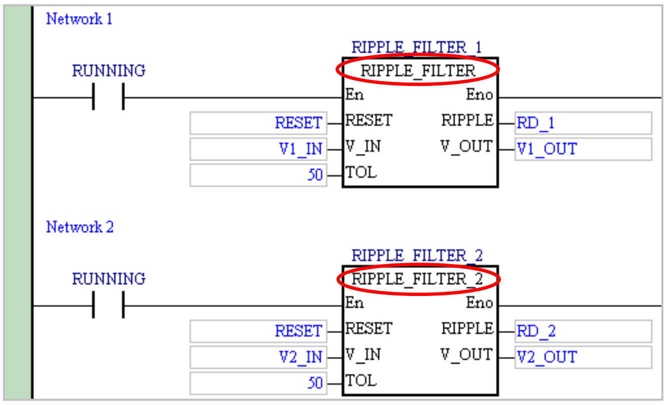


If several pieces of data in the superior POU are processed in the same way, and theses pieces of data are independent of one another, the execution result may be incorrect, as shown in the figure below. After the value of V2_IN is sent to the function block, it will be compared with the value gotten from the operation performed on V1_IN last time. As a result, V1_IN and V2_IN interfere with each other.



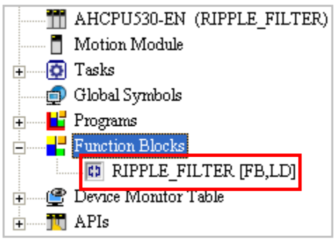
If the same POU of the function block type is created a gain, the execution result is correct although different memory blocks are assigned to the local symbols in the two POUs of the function block type when the program is compiled. However, the same work is repeated when users write the program.





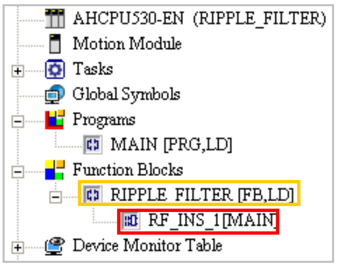
In view of this, the concept related to function block instances is introduced into IEC 61131-3.

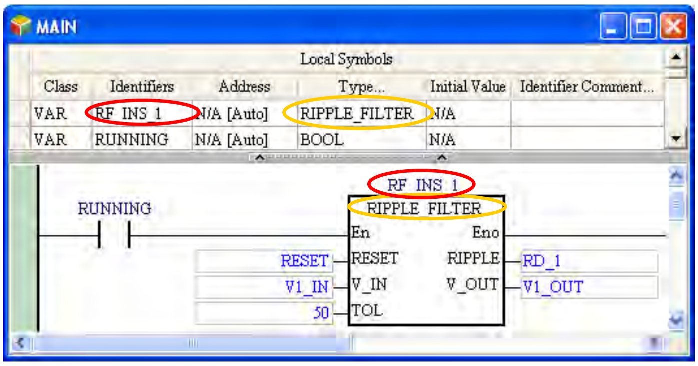
After users add a POU of the function block type, declare local symbols in the POU, and write a program in the POU, they will get a function block definition. The function block definition is like a document. It does not participate in any operation, and does not appropriate any resources that the PLC uses.



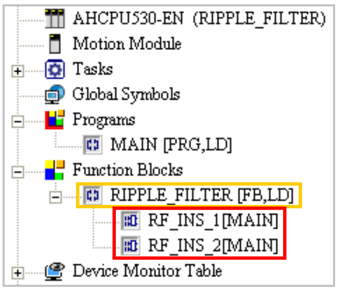
If a POU of the program type wants to call this function block, the users must declare a symbol whose data type is a function block in advance. In other words, the users have to produce an object which takes part in an operation according to the function block definition. The object produced is a function block instance.

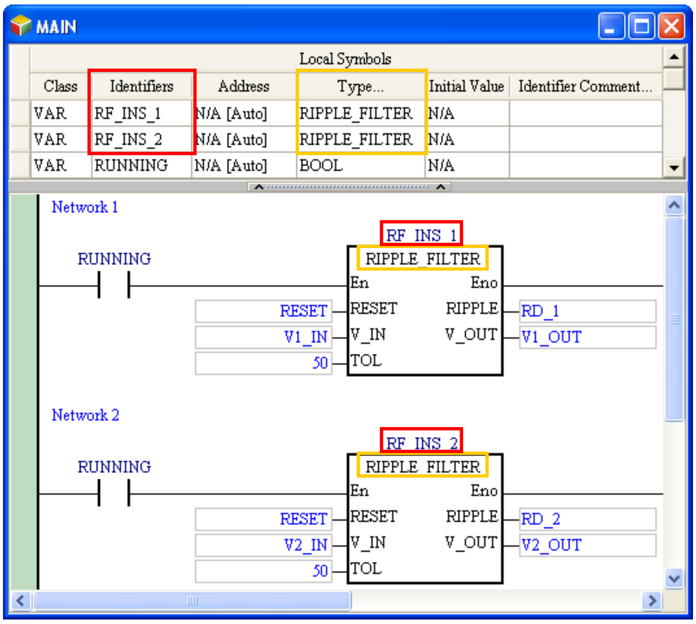
When the program is compiled, the system assigns a substantial memory block to the function block instance and the local symbols in the function block instance according to the definition.



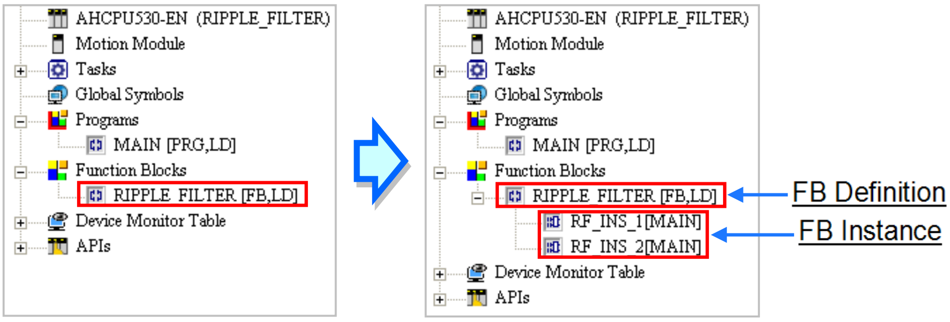


If the same operation is required, and a different memory block is also required, users can make use of the characteristic of a function block instance. After a different symbol is declared for a function block which requires a different memory block, the system will regard the different symbol as a different function block instance. When the program is compiled, a different memory block is assigned to the different function block instance.





As shown in the figure below, only the function block definition is under **Function Blocks** in the project management area before the program in the project is compiled. After the program is compiled, the function block instances will be under the function block definition. The format of a function block instance is **Instance name[POU name]**.



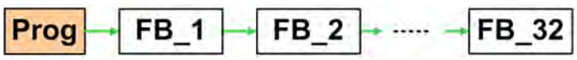
If a symbol whose data type is general data type is declared, a device is assigned to the symbol when the program is compiled. Likewise, if a symbol whose data type is a function block is declared, a corresponding function block instance is produced when the program is compiled. Besides, the number of function block definitions which produce the instances in a project for an AH5X0 series CPU module can not be larger than 1024. (The function block definitions which do not produce the instances are not included.)

If a symbol with a general data type is declared, a device will be assigned to the symbol when the program is compiled. Likewise, whether it will be used or not, if a symbol with a function block data type is declared, a corresponding function block instance will be produced, whenever a program is compiled. However for an AH5X0 series CPU module, the number of function block instances as POUs in a project cannot exceed 1024. (The function block definitions which do not produce instances are not included.) This limitation only applies to AH5X0 series; for other series, the number of function block definitions can be as large as the size of the PLC internal memory.

In sum, the operation of a function block involves a definition and an instance. Function block definitions are related to planning, and function block instances are related to execution. Take products for example. A function block definition is the same as the product specifications developed by engineers, and a function block instance is the same as the product produced according to the specifications.

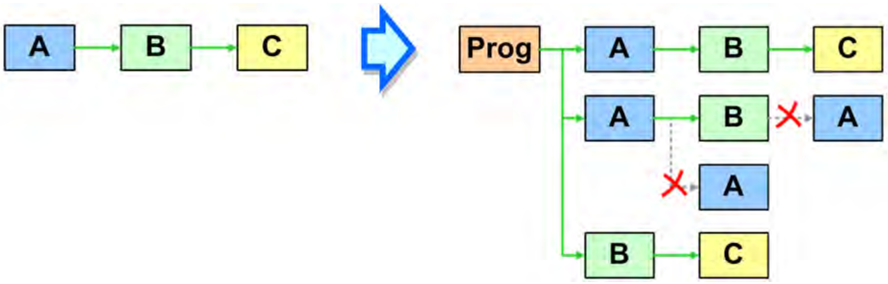
7.2.6 Calling Relation Between Function Blocks

In ISPSoft function block specification, a function block can call another function block. For AH series, maximum of 32 layers can be called; AS/DVP series, a maximum of 16 layers can be called; DVPxxMC/ AS5xx series, there are no limits on calls. To identify, the function block example called by POU is defined as the first layer.



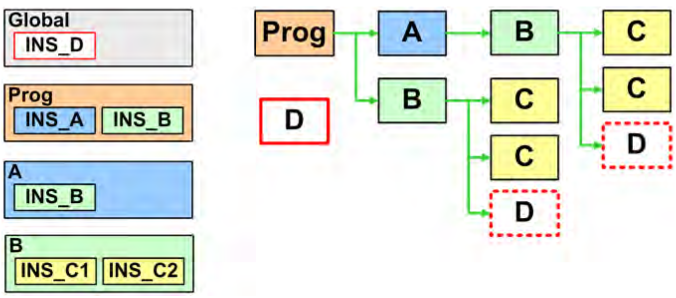
The program in function block A calls function block B, and the program in function block B calls function block C. In other words, function block A is superior to function block B and function block C, and function block B is superior to function block C. In ISPSoft, a function block is not allowed to call itself. As a result, if function block

A is superior to function block B, function block B and function block C can not call function block A, but the POU of the program type can call function block A, function block B, or function block C.



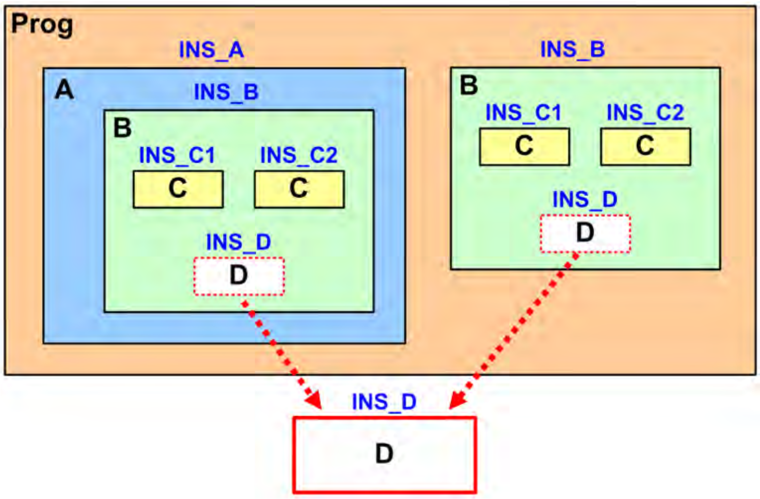
If function block A, function block C, and function B are not called by any POUs of the program type, they do not participate in the execution of the program, and the corresponding function block instances are not produced when the program is compiled. After function block A is declared in a certain POU of the program type or in a the global symbol table in a project, the corresponding function block instances will be produced according to the relation among the three function blocks during the compiling of the program.

Please refer to the declaration of the function block instances and the relation among the function blocks below. Function block D is declared in the global symbol table while the other function block instances are declared in the local symbol tables in the superior POUs (callers).

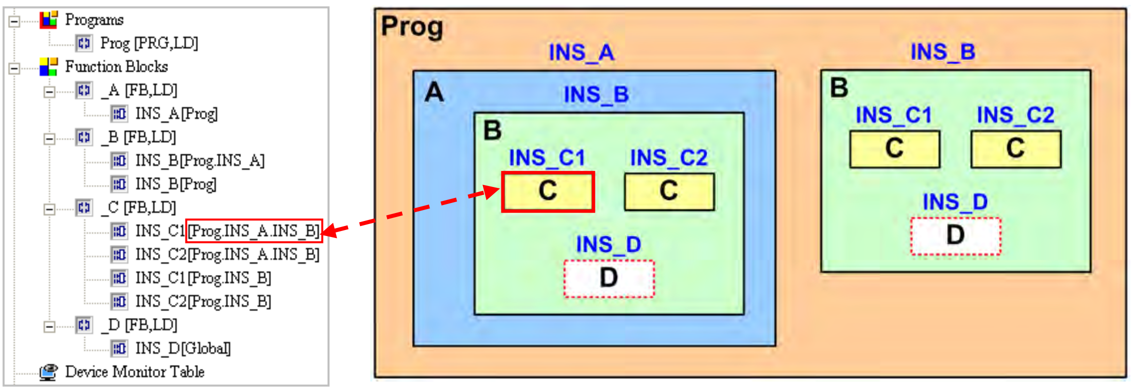


Declaration position		Function block which is declared
Global symbol table		One instance of function block D: INS_D
Local symbol table	POU of the program type	One instance of function block A: INS_A One instance of function block B: INS_B
	Function block A	One instance of function block B: INS_B
	Function block B	Two instances of function block C: INS_C1 and INS_C2

The function block instances produced when the program is compiled according to the relation described above are as follows. Owing to the fact two instances of function block C are declared in the local symbol table in function block B, two instances of function block C are produced when another instance of function block B is produced. Since function block D is declared in the global symbol table, the function of the function block instance and the data stored in the function block instance can be used by all the POUs. In other words, the system only produces one instance of function block D. Although function block D is called by the two POUs, the same instance of function block D is executed in the two POUs.



The items which will appear in the project management area after the program is compiled are shown in the figure below. The superior POU of the program type and the inferior POUs are in the brackets at the end of a function block instance.



Users can not declare function block instances in the local symbol table in a function block in a project for a DVP series PLC. If a function block wants to call another function block, the inferior function block instance must be declared in the global symbol table. As a result, users have to be more careful about the correctness of the data when a function block calls another function block. If an independent memory block is required, users have to declare another instance of a function block in the global symbol table.

Users are allowed to declare function block instances in the local symbol table in a function block in a project for an AH/AS series CPU module. If an inferior function block instance which is called by a function block is not called by another POU, the inferior block instance can be declared in the local symbol table in the function block. Besides, in a project for an AH/AS series CPU module, the memory block the system assigns to a function block instance depends on the position where the function block instance is declared.

7.2.7 Memory Configuration of Function Block

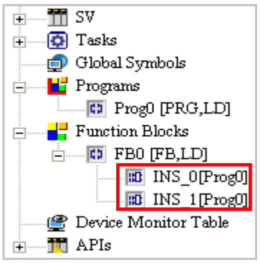
When internal function blocks has local symbols declared to auto-configure address, the system will configure an independent memory section for these local symbols during the process of compiling and creating the instance; if the internal function block declare that the local symbol has assigned device address by themselves, then the symbol variable is referred as an absolute address and a memory section is not configured to the variable during compiling. Even in different function block instances, as long as the process is related to this variable, the system will view as user-defined device content to operate.

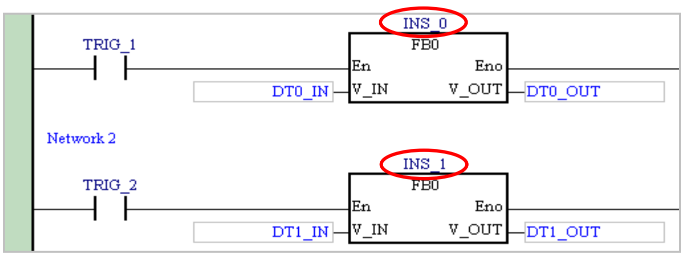
When the system is configuring resources, DVP series, DVPxxMC series, AS5xx series, AH5X0 series, AH5X1 series, AH560 redundant system, AHxxEMC and AS series all have different mechanisms. Please refer to the following explanations.

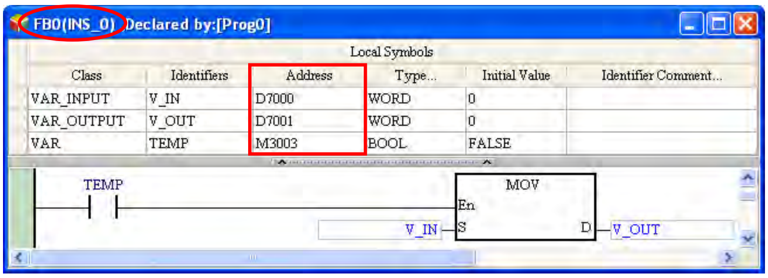
● **DVP series PLC**

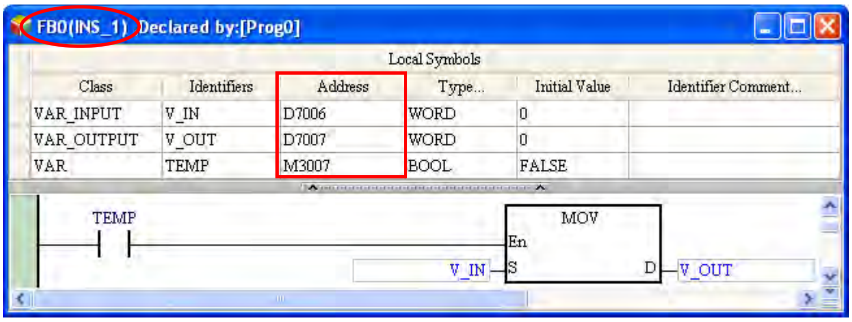
When a DVP series PLC assigns memory blocks, every function block instance is automatically assigned a P device. If the POU name of a function block begins with “P0_” or “P1_”, P0 or P1 will be assigned to the function block instance after the program is compiled. If more than one instance of the function block is declared, an error occurs when the program is compiled. The error occurs because the same P device is used repeatedly.

The system assigns corresponding devices to the local symbols declared in a function block according to the data types of the local symbols. For example, the system assigns a data register to a local symbol whose data type is WORD, and an auxiliary relay to a local symbol whose data type is BOOL. As a result, the size of function block instance in a DVP series PLC depends on the local symbols declared, and different instances occupy different devices. Two function block instances produced in a DVP series PLC are shown in the figure below. After the windows for the two function block instances are opened, users can see in the local symbol tables that the system assigns different devices to the two instances.





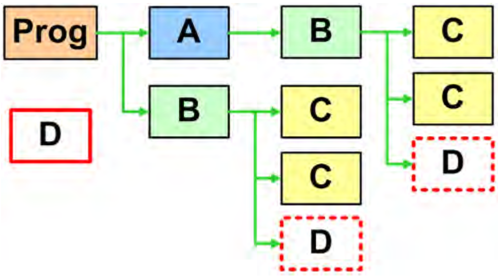


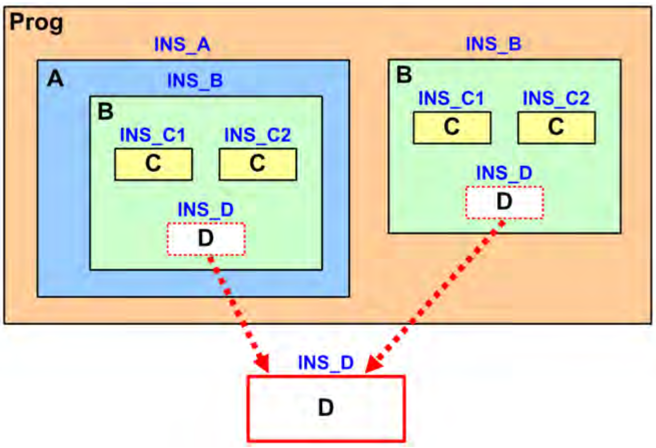


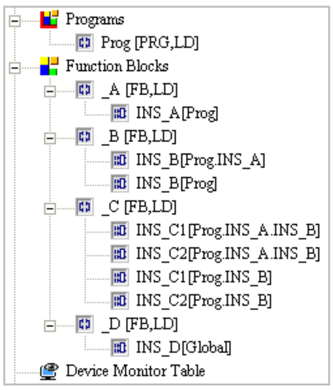
● **AH5X0 series CPU module**

The system in an AH5X0 series CPU module reserves a fixed number of memory blocks for function block instances. The number of memory blocks varies with the model selected and every instance produced will occupy one P device. The size of every memory block is 4096 words. Owing to the fact that the memory blocks assigned to the function blocks in a project for an AH5X0 series CPU module are memories reserved by the CPU module, users can not view the assignment result in the windows for the function blocks.

The following diagram is the call structure of function block for section 7.2.6 example.

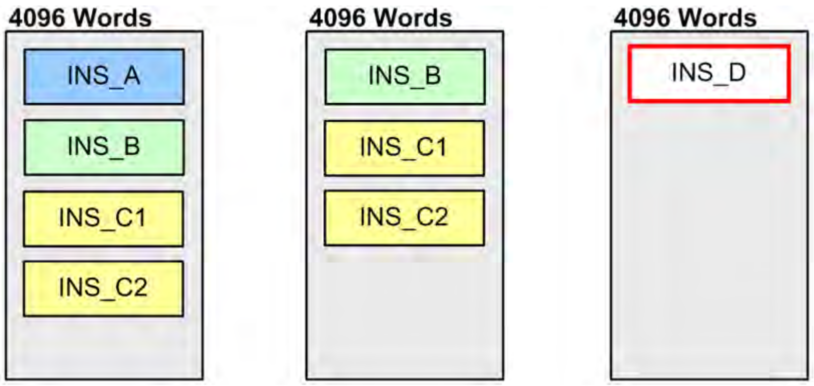






The system assigns a 4096-word memory block to the function block instance declared in a POU of the program type in a project for an AH5X0 series CPU module. The function block instance declared in the POU of the program type and the inferior function blocks are assigned the same memory block. Besides, the system assigns another 4096-word memory block to a function block instance declared in the global symbol table.

In the example above, the system assigns three 4096-word memory blocks.

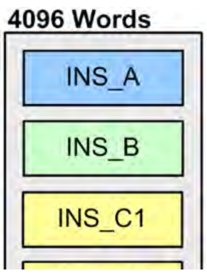


The memory blocks that an AH5X0 series CPU module reserves for function block instances are stored in the internal memory. The memory blocks assigned to the function blocks in a project for an AH5X0 series CPU module are not devices available to users. No matter what the size of the memory that a function block instance occupies is, the size of the memory block assigned to the function block instance is 4096 words. As a result, users have to be careful when they program a CPU module. The calculation of the size of a function block instance is as follows.

The size of the memory that a function block instance occupies is 2 words.

The size of the memory that a local symbol in a function block instance occupies is calculated by the word. The size which is less than one word is calculated as one word. The size of the memory that a symbol whose data type is a function block (inferior function block instance) occupies is calculated by means of (1).

Please refer to the following example. The local symbols declared in the function block definitions are listed in the table below.



Function block definition	Number of local symbols
Function block A	Two symbols whose data types are DWORD. One symbol whose data type is LREAL. One inferior function block instance.

	Function block B	One symbol whose data type is WORD. Two symbols whose data type is REAL. Two inferior function block instances.
	Function block C	Two symbols whose data type is BOOL. One symbol whose array type is BOOL and whose array size is 22 elements.

The calculation for the example is as follows.

The size of the memory that a function block instance occupies is 2 words. There are four function block instances in the example, and therefore the size is 8 words.

The size of the memory that a local symbol whose data type is not a function block in a function block instance occupies is calculated as follows.

➢ Function block instance INS_A

➔ Two words (DWROD x 1) + Four words (LREAL x 1)

The sum is 2+4=6 (words).

➢ Function block instance INS_B

➔ One word (WORD x 1) + Four words (REAL x 2)

The sum is 1+4=5 (words).

➢ Function block instance INS_C1/INS_C2

The size of the memory that a local symbol occupies is calculated by the word. The size which is less than one word is calculated as one word. As a result, the size of the memory that a local symbol whose data type is BOOL occupies is calculated as one word. The size of the memory that a local symbol whose array type is BOOL and whose array size is 22 elements occupies is larger than one word, but is less than two words. The size is calculated as two words. The calculation is as follows.

➔ Two words (BOOL x 2) + Two words (Boolean array which is composed of twenty-two elements x 1)

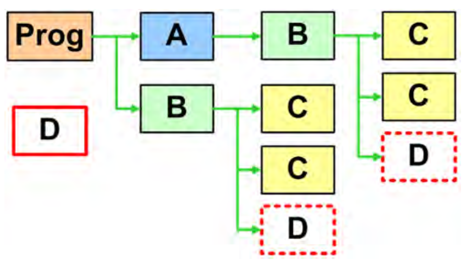
The sum is 2+2=4. There are two instances of function block C, and therefore the size of the memory that the two function block instances occupy is 2x4=8 (words).

The size of the memory that the function block instances and the local symbols occupy is 8+6+5+8=27 (words).

● **AH5X1, AH560 Redundant System, AHxxEMC, and AS Series**

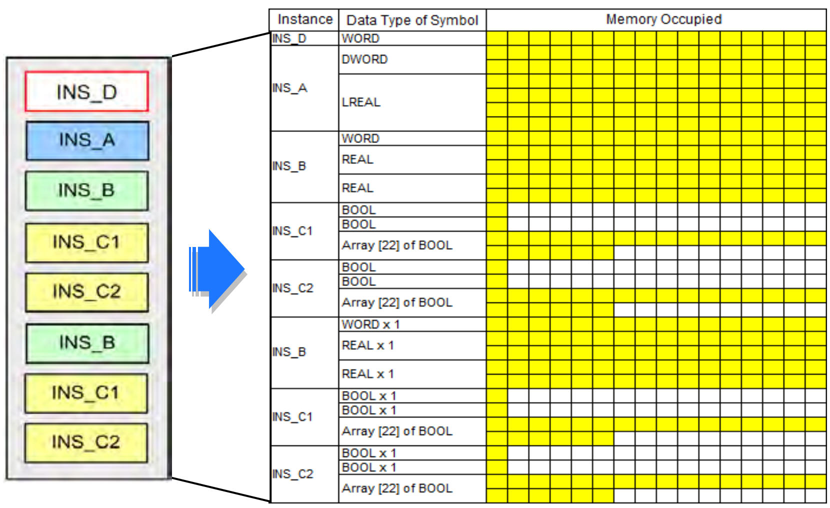
The memory blocks that an AH5X1, **AH560 Redundant System,** AHxxEMC, or ASseries CPU module reserves for function block instances are stored in the internal memory. That means it will not take up the device resources while allocating. The difference is for AH5X1, AHxxEMC, AS series, the number of memory blocks assigned to the function block instances can be as large as the size of the PLC internal memory, but for AH5X0, the limitation is 4096 words. And one function block instance occupies one P device.

The following diagram adopts section 7.2.6 example, including an estimated amount of local and global symbol data types declared in the function block definition.



Function block definition	Number of local/global symbols
Function block A	One symbol whose data type is DWORD. One symbol whose data type is LREAL. One inferior function block instance.
Function block B	One symbol whose data type is WORD. Two symbols whose data type is REAL. Two inferior function block instances.
Function block C	Two symbols whose data type is BOOL. One symbol whose array type is BOOL and whose array size is 22 elements.
Function block D	One symbol whose data type is WORD.

Following figure illustrates how the internal memory occupies in the instances.



The calculation for the example is as follows.

All the instances will occupy the internal memory by the order of their declarations. The first declared one is the function block instance INS_D.

➢ Function block instance INS_D

➔ One word (WORD x 1)

The sum is 1 (word).

The size of the memory that a local/global symbol whose data type is not a function block in a function block instance occupies is calculated as follows.

➢ Function block instance INS_A

➔ Two words (DWROD x 1) + Four words (LREAL x 1)

The sum is 2+4=6 (words).

➢ Function block instance INS_B

➔ One word (WROD x 1) + Four words (REAL x 2)

The sum is 1+4=5 (words).

➢ Function block instance INS_C1 / INS_C2

The size of the memory that a local/global symbol occupies is calculated by the word. The size which is less than one word is calculated as one word. As a result, the size of the memory that a local symbol whose data type is BOOL occupies is calculated as one word. The size of the memory that a local symbol whose array type is BOOL and whose array size is 22 elements occupies is larger than one word, but is less than two words. The size is calculated as two words. The calculation is as follows.

➔ Two words (BOOL x 2) + Two words (Boolean array which is composed of twenty-two elements x 1)

The sum is 2+2=4. There are two instances of function block C, and therefore the size of the memory that the two function block instances occupy is 2x4=8 (words).

➢ Function block instance INS_B / INS_C1 / INS_C2

➔ As the previous example shown INS_B occupies 5 (Words)；INS_C1 / INS_C2 occupies 8 (Words); and therefore the size of the memory that two function block occupy is 5 + 8 = 13 (Words).

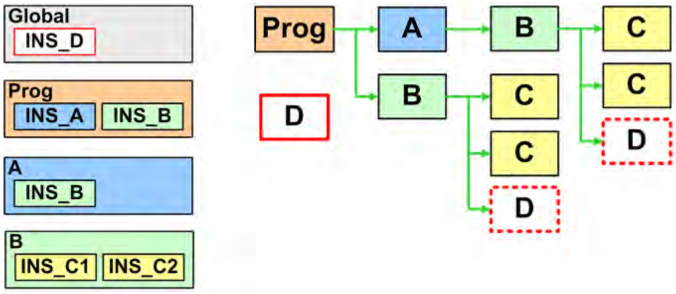
The size of the memory that the function block instances and the local/global symbols occupy is 1 + 6 + 5 + 8 + 13 = 33 (words).

● **DVPxxMC/ AS5xx series PLC**

When DVPxxMC/ AS5xx series is configured in memory section, the instance is assigned to a particular section of the memory and till the memory space reaches 2x10^{13}Byte. Users need to take not that the memory section is still affected by the number of POU, therefore, the more number of FB defined by users, there will be limits in corresponds to the number of instances referred by each function block definition.

For local symbols in each instance, when byte number for each symbol variable based on data size does not reach 1 byte, it is calculated as 1 byte (no device attached); if symbol variable data type is BOOL and has device attached, the device type is calculated in Bit if device type is Bit, if the device type is Byte, then it is calculated in Byte.

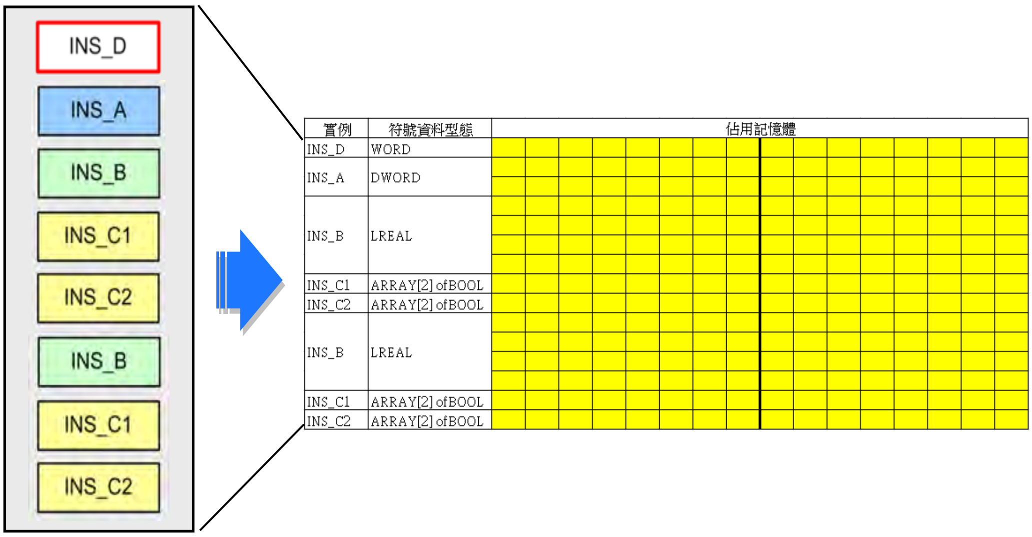
The following diagram is the section 7.2.6 instance regarding call structure of function block, please refer to the section for more details. In addition, the diagram includes an estimated amount of local and global symbol data types declared by each function block definition.



Function Block Definition	Amount of Local / Global Symbols
Function Block A	DWORD x 1, lower level function instance, function block instance x 1
Function Block B	LREAL x 1, lower level function instance x 2
Function Block C	BOOL array x 1 (length is 2)
Function Block D	WORD x 1

Following figure illustrates how the internal memory occupies in the instances.

$2x10^{13}$Bytes



The calculation for the example is as follows.

➢ Function block instance INS_A

➔ 4 Bytes (DWORD x 1), total 5 (Bytes)

➢ Function block instance INS_B

➔ 8 Bytes (LREAL x 1), total 8 (Bytes)

➢ Function block instance INS_C1/INS_C2

In BOOL array. The BOOL element in each array is fixed to occupy 1 Byte. Calculation are as followed.

➔ 2 Bytes (BOOL array x 1, length is 2), total is 2; function block C produces 2 instances in total. So, the two function block instances total is 2x2=4 (Bytes) i.

In short, the total memory size of the occupied section that corresponds to the function block is 5+8+4=17 (Bytes).

7.3 Using a Function Block

7.3.1 Basic Specifications for Function Blocks

The specifications for the function blocks in ISPSoft are shown below. When users use function blocks, they have to make sure that the operation conforms to the specifications in the table. Otherwise, an error occurs when the program is compiled or executed.

● Specifications for the function blocks

Number of function block definitions	All series: no limitation
Number of function block instances	AH5X1/ AH560 Redundancy System / AHxxEMC/AS: Depends on the controller devices available. AH5X0: The maximum number of memory block instances varies according to the series (Please refer to appendix B).Depends on the controller devices available. DVP: Depends on the controller devices available.
Size of a function block	AH5X1/ AH560 Redundancy System/AS: Without limit, until the internal memory is used up. AH5X0: The size of a memory block instance is 4096 words. DVP: Depends on the devices assigned to the function block.
Number of layers	For AH series, the nest structure of function block calling function block, maximum layer is 32 ; AS/DVP series, maximum layer is 16; DVPxxMC/ AS5xx series does not have limit.

● **Note**

➢ The pins of a function block must be assigned operands. The operands can be device addresses or symbols. If the class of a symbol is VAR_INPUT, the operand assigned to the symbol can be a constant.

➢ An inferior function block can not call the superior function block, and a function block can not call itself.

➢ If a function block is exported, the definition of the function block is exported, but the definitions of the inferior function blocks and the global symbols used are not exported.

➢ The En pins of the function blocks in ladder diagrams, sequential function charts, function block diagrams, and instruction lists must be connected to contacts. However, the En pins of the function blocks in structured texts do not have to be connected to contacts.

➢ The programming languages which support the creation of function blocks include ladder diagrams, instruction lists, structured texts, function block diagrams and continuous function charts. Sequential function charts do not support the creation of function blocks.

➢ The programming languages which support the calling of function blocks include ladder diagrams, instruction lists, structured texts, function block diagrams and continuous function charts. Users can also use function blocks in the actions in sequential function charts.

➢ Users can modify function block definitions, but they can not modify function block instances. (Please refer to section 7.3.4.)

➢ If the modification of a function block definition in the online mode results in the abnormal representation of the function block in the superior POU, users have to disable the online editing function, delete the abnormal representation of the function block, and add the normal representation of the function block. After the normal representation of the function block is added, the program can be compiled and downloaded. (Please refer to section 7.3.4 for more information.)

➢ If a jump instruction is used in a function block, the jump destination must be in the same function block, and can not be outside the function block or in the inferior function block.

➢ Users can not declare symbols whose data types are TIMER and symbols whose data types are COUNTER in the function blocks in a project for an AH/AS series CPU module, but they can declare symbols whose data types are POINTER, symbols whose data types are T_POINTER, symbols whose data types are C_POINTER, and symbols whose data types are HC_POINTER.

➢ Pulse instructions such as MOVP and CML can not be used in the function blocks in a project for an AH/AS series CPU module. LDP/ANDP/ORP, LDF/ANDF/ORF, PLS, PLF, NP, PN, MC, MCR, and GOEND can not be used.

➢ AH/AS series CPU modules provide special pulse instructions which can be used in function blocks. Please refer to the following section for more information.

*1. Please refer to section 5.4.1 for more information about creating a POU of the function block type, and section 6.2.2 for more information about declaring a function block instance.

*2. Please refer to chapter 10~chapter 15 for more information about calling function blocks.

7.3.2 Pulse Instructions for Function Blocks (AH/AS Series ONLY)

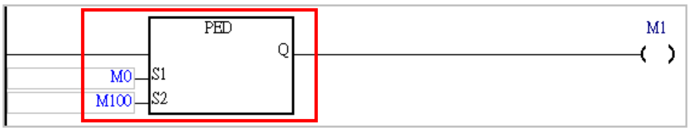
Pulse instructions such as LDP, LDF, NP, and PN can not be used in the function blocks in a project for an AH/AS series CPU module, and therefore users can consider using the following instructions. Please refer to AH/AS Programming Manual for more information about the instructions.

● **PED and NED**

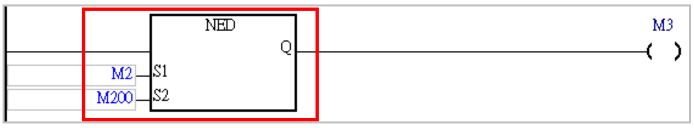
PED and NED are similar to LDP and LDF in functions. PED and NED differ from LDP and LDF in that users have to specify Boolean devices. The Boolean devices that users specify when they use PED and NED in a project can not be used in other places in the project. Otherwise, an error will occur.

➢ LDP (rising-edge detection) and LDF (falling-edge detection) can be used in a POU of the program type.

➢ Users can use PED in place of LDP in a function block, but they have to specify a device, e.g. M100 in the figure below.



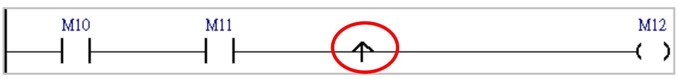
➢ Users can use NED in place of LDF in a function block, but they have to specify a device, e.g. M200 in the figure below.



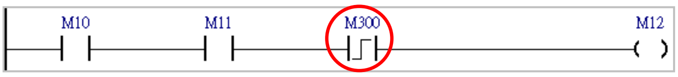
● **FB_NP and FB_PN**

FB_NP and FB_PN are similar to NP and PN in functions. FB_NP and FB_PN differ from NP and PN in that users have to specify Boolean devices. The Boolean devices that users specify when they use NED and PED in a project can not be used in other places in the project. Otherwise, an error will occur.

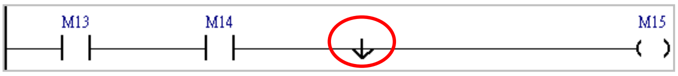
➢ NP can be used in a POU of the program type.



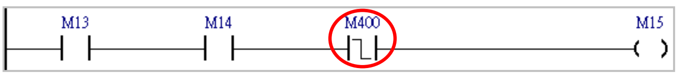
➢ Users can use FB_NP in place of NP in a function block, but they have to specify a device, e.g. M300 in the figure below.



➢ PN can be used in a POU of the program type.



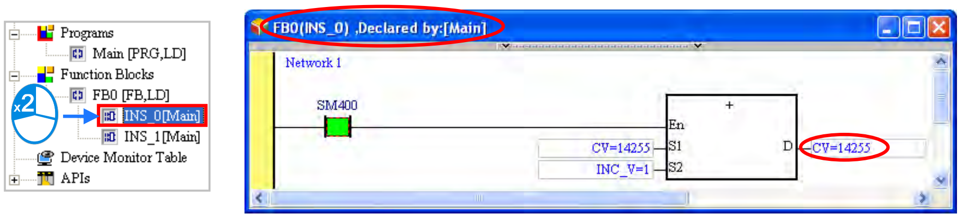
➢ Users can use FB_PN in place of PN in a function block, but they have to specify a device, e.g. M400 in the figure below.

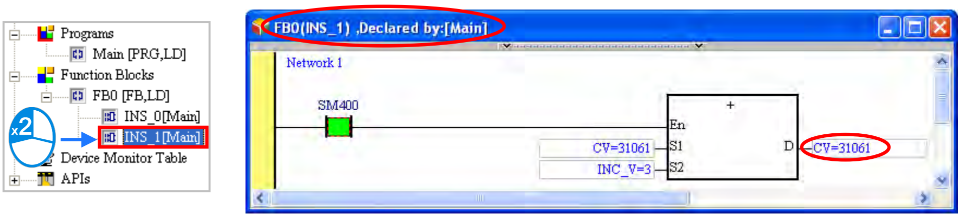


7.3.3 Monitoring the Program in a Function Block

It is the functions block instances in a project that participate in the execution of the program in the project. If users want to monitor the program in a function block online, they have to open the window for the function block instance.

If users want to monitor the program in a function block online, they have to open the window for the function block instance, as shown below. The function block instances below operate independently.





If users open the window for a function block definition, no values will be displayed in the window, and users can not monitor the program in the function block.

*. If users want to modify the program in a function block, they have to open the window for the function block definition. Please refer to section 7.3.4 for more information.

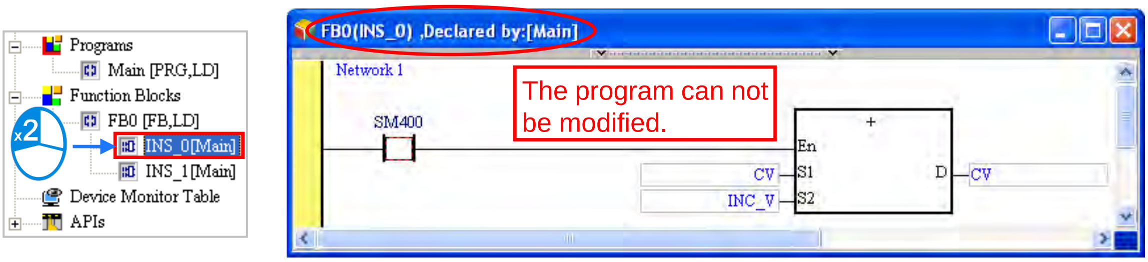
7.3.4 Modifying the Program in a Function Block

The object produced from a function block definition is a function block instance. The program in a function block instance can not be modified, but the program in a function block definition can be modified. After the program in a function block definition is modified, the modification result will be applied to the new instances produced from the function block definition. The new function block instances will not be produced until the program is compiled. Likewise, if users want to modify the program in a function block online, they have to open the window for the function block.

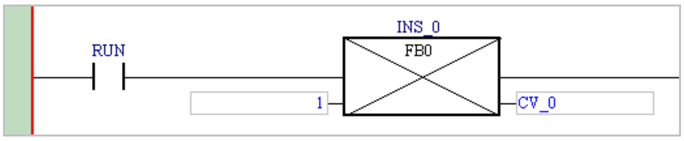
After users double-click a function block definition in the project management, they can modify the program in the window which appears, as shown below.

7

If users open the window for a function block instance, they can not modify the program in the window.



If a function block is called by another POU, the modification of the function block will result in the abnormal representation of the function block in the superior POU, as shown below. Users have to delete the abnormal representation of the function block.



7.4 Instance

An instance of creating a ladder diagram is shown in chapter 4. In section 5.6.1, the program created in chapter 4 is rewritten by means of POU and TASK. In section 6.3, the device names in the program created in section 5.6.1 are replaced by symbols. In the following sections, function blocks will be used in the program created in section 6.3.

7.4.1 Planning a Program

The POUs created in section 6.3 are described below.

POU name	Function
RUN_STOP	If the START button is pressed, the equipment begins to operate. If the STOP button is pressed, or an error is detected, the equipment stops operating.
GLUING	There are two injectors above the conveyer, and the two injectors inject glue in the same way. When in position sensor 1 is ON, the trigger signal for injector 1 is set to ON. When in position sensor 1 is OFF, the trigger signal for injector 1 is reset to OFF. When in position sensor 2 is ON, the trigger signal for injector 2 is set to ON. When in position sensor 2 is OFF, the trigger signal for injector 2 is reset to OFF.
COUNTING	The parts which are conveyed are counted. If the number of parts which are conveyed is 100, the completion flag is set to ON.

Two function blocks will be created according to the characteristics of the POUs.

● The two networks in the **GLUING** are the same, and therefore they can be created in a function block which can be used repeatedly. The function block will be called by the **GLUING**. Owing to the fact the two injectors operate independently, two independent function block instances will be declared for them.

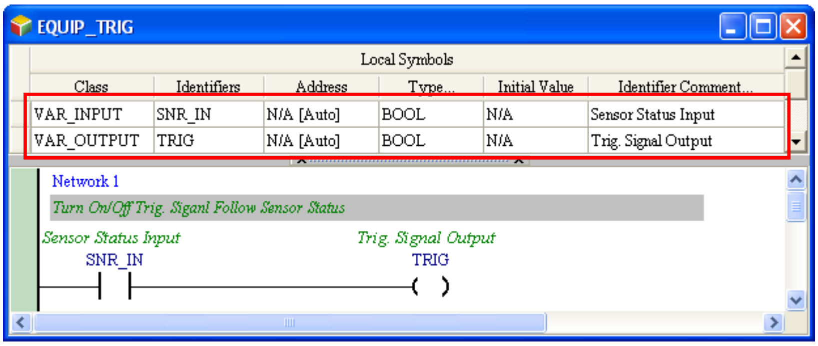
● The program in the **COUNTING** is not related to the other programs except that the operation flag and the completion flag are related to the other programs. In other words, the **COUNTING** is quite independent. In order to make the program in the **COUNTING** more readable, the program is created in a function block.

7.4.2 Creating the Program

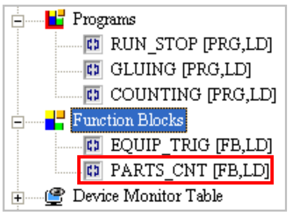
Users can directly modify the program created in section 6.3, or write the program shown in section 6.3 again. If the users want to write the program again, they have to create a new project, and refer to chapter 4~chapter 6 for more information.

Please refer to section 5.4.1, and create **EQUIP_TRIG** in the **Function Blocks** section in the project management area.

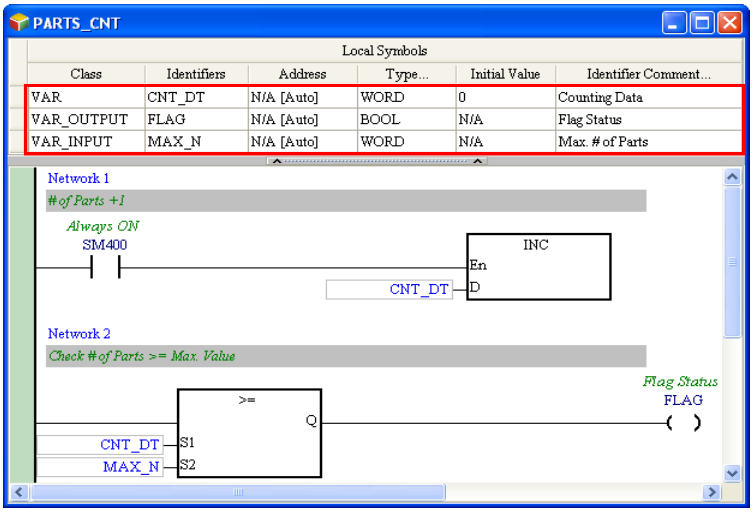
The program in **EQUIP_TRIG** functions to inject the glue. Please refer to section 6.2.2, and create the two symbols shown below in the local symbol table in the **EQUIP_TRIG** window. Please refer to chapter 4~chapter 6, and write the program shown below.



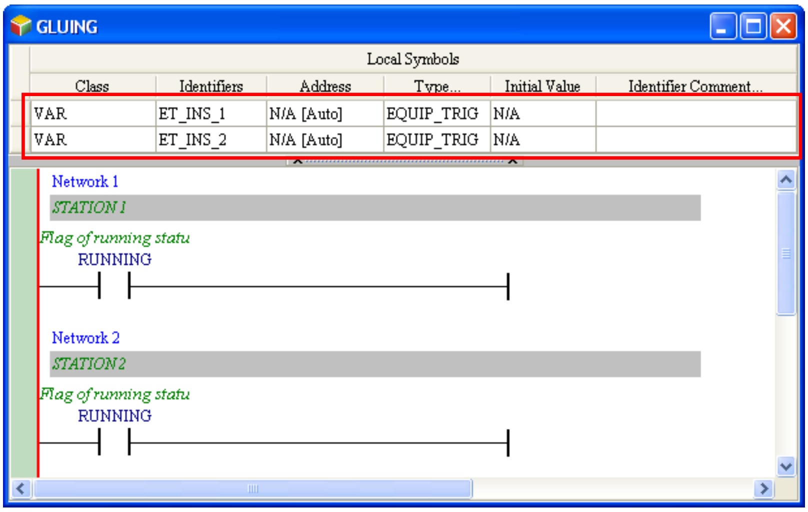
Create **PARTS_CNT** in the **Function Blocks** section in the project management area.



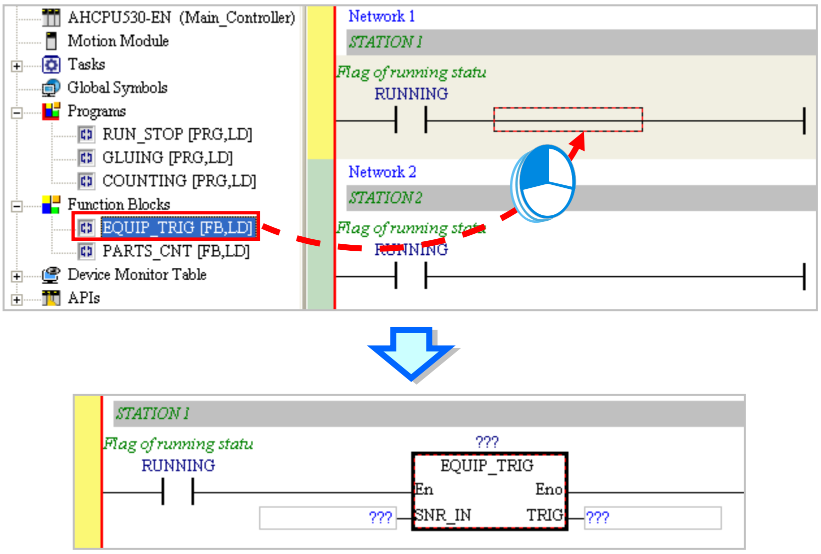
The program in **PARTS_CNT** functions to count the parts which are conveyed. Please refer to section 6.2.2, and create the three symbols shown below in the local symbol table in the **PARTS_CNT** window. The initial value of CNT_DT is 0. Please refer to chapter 4~chapter 6, and write the program shown below.



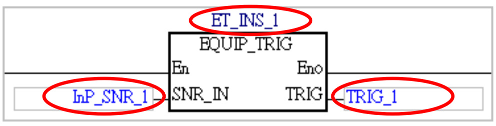
The function block **EQUIP_TRIG** is called by the POU **GLUING**. Please refer to section 6.2.2, and declare the two function block instances shown below in the local symbol table in the **GLUING** window. Write the program shown below.



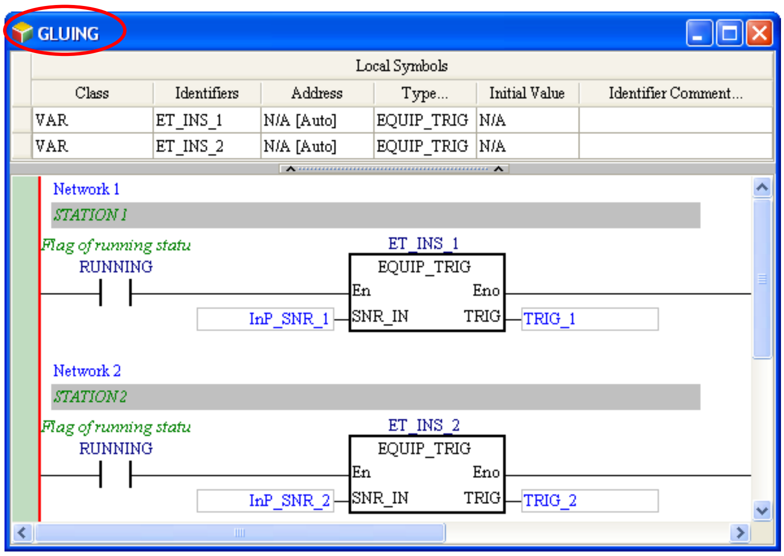
A function block is inserted into a program in a way in which an applied instruction is inserted into a program. Drag the function block **EQUIP_TRIG** in the project management area to the position where it will be inserted. If there is a function block instance under **EQUIP_TRIG** in the porject management area, users have to drag the function block definition rather than the function block instance.



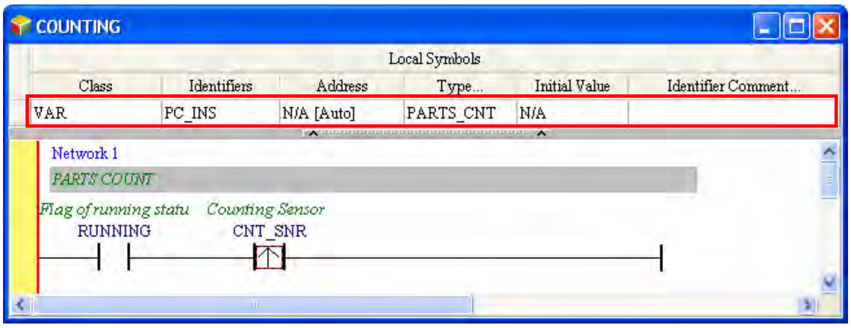
Specify a function block instance and two operands after the function block is inserted.



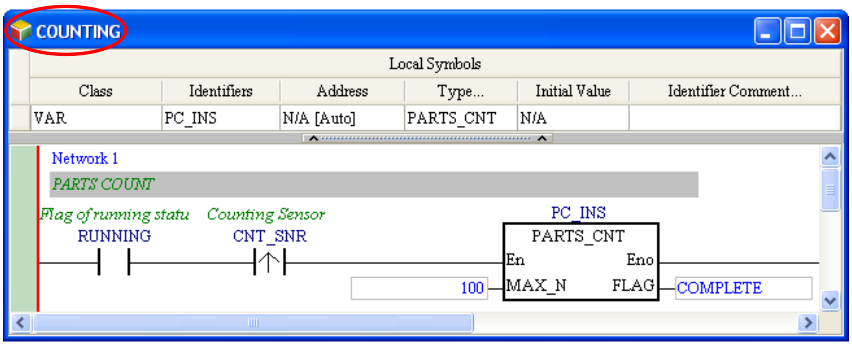
Write the program shown below.



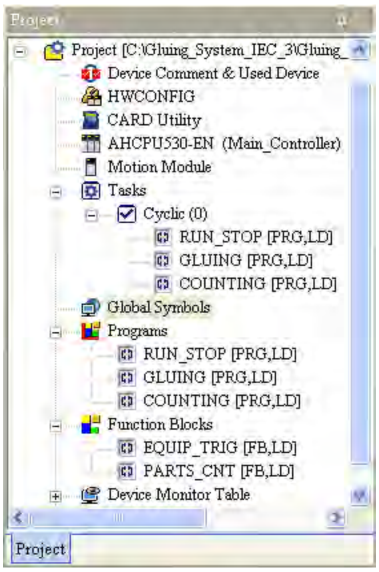
The function block **PARTS_CNT** is called by the POU **COUNTING**. Please declare the function block instance shown below in the local symbol table in the **COUNTING** window. The local symbol **CNT_DT** does not have any effect, and therefore it is deleted. Write the program shown below.

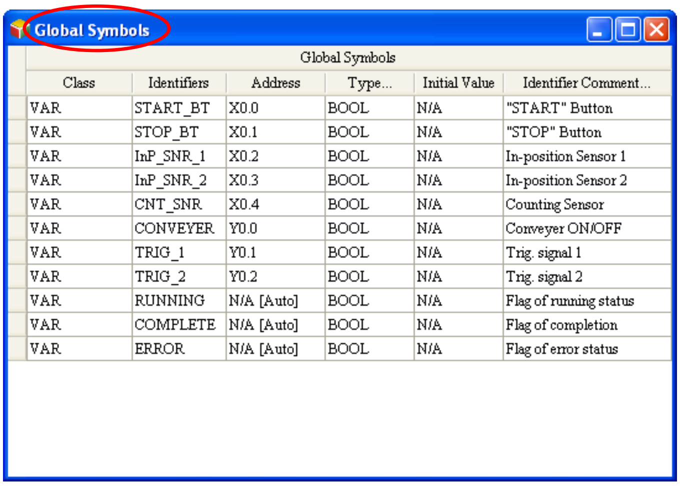


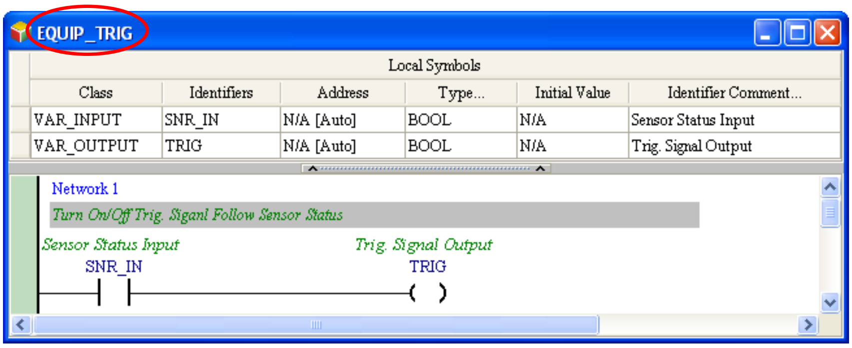
Please refer to the description above, and insert the function block **PARTS_CNT**. Write the program shown below.

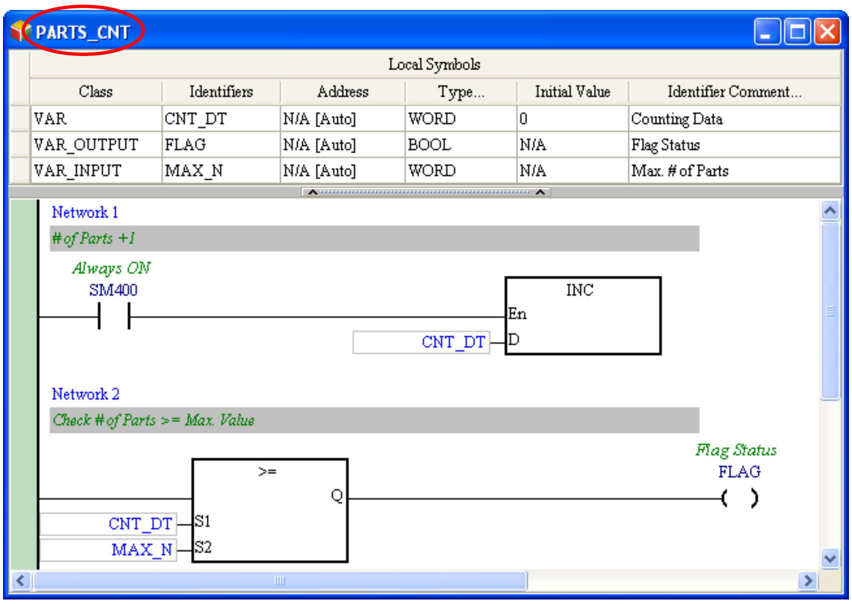


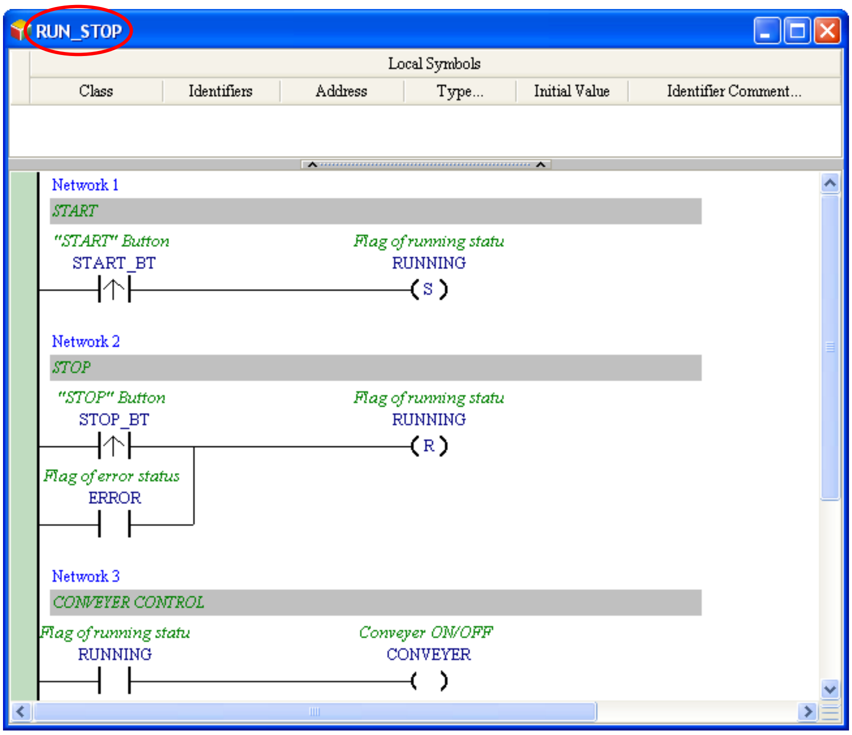
The editing of the program in this section has been completed so far. Users have to make sure that the program they write is the same as the program shown below.

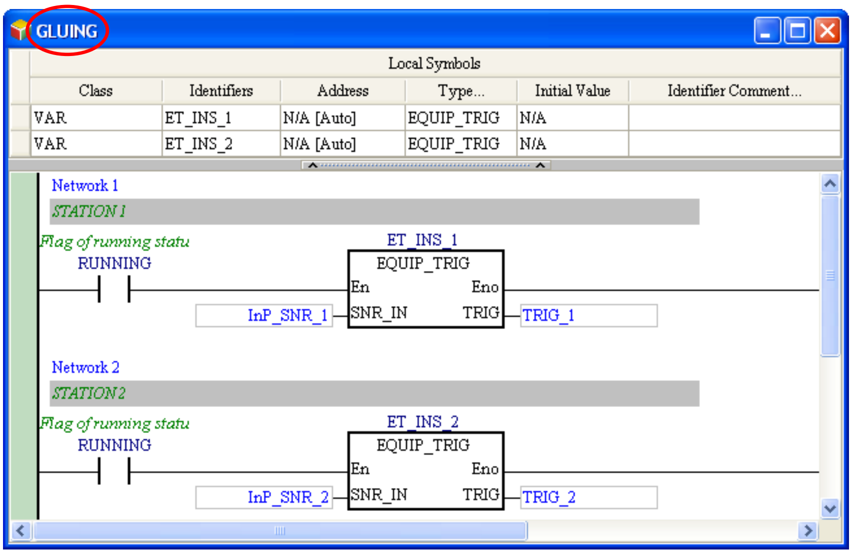


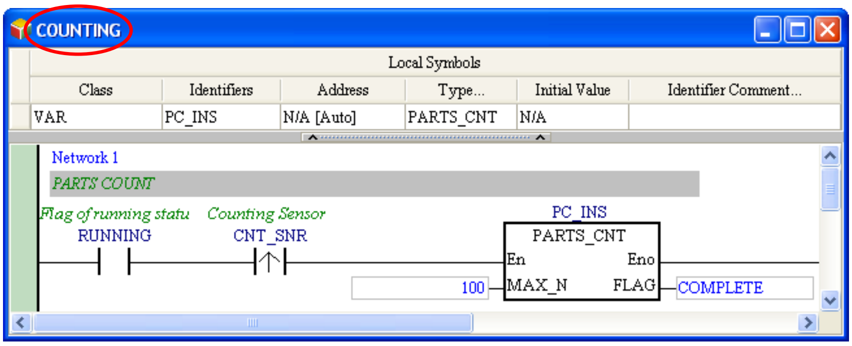



EQUIP_TRIG
Local Symbols
Class | Identifiers | Address | Type... | Initial Value | Identifier Comment...
VAR_INPUT | SNR_IN | N/A [Auto] | BOOL | N/A | Sensor Status Input
VAR_OUTPUT | TRIG | N/A [Auto] | BOOL | N/A | Trig. Signal Output
Network 1
Turn On/Off Trig. Siganl Follow Sensor Status
Sensor Status Input
SNR_IN
Trig. Signal Output
TRIG

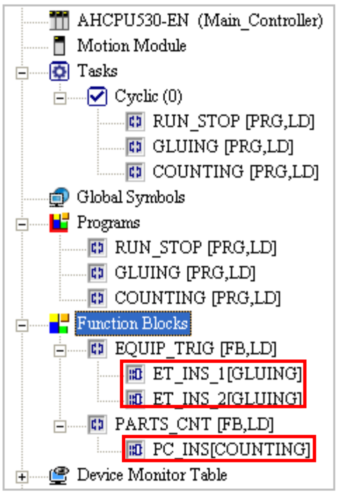

PARTS_CNT
Local Symbols
Class | Identifiers | Address | Type... | Initial Value | Identifier Comment...
VAR | CNT_DT | N/A [Auto] | WORD | 0 | Counting Data
VAR_OUTPUT | FLAG | N/A [Auto] | BOOL | N/A | Flag Status
VAR_INPUT | MAX_N | N/A [Auto] | WORD | N/A | Max. # of Parts
Network 1
# of Parts +1
Always ON
SM400
INC
En
CNT_DT
D
Network 2
Check # of Parts >= Max. Value
>=
Q
CNT_DT
S1
MAX_N
S2
Flag Status
FLAG


RUN_STOP
Local Symbols
Class | Identifiers | Address | Type... | Initial Value | Identifier Comment...
Network 1
START
"START" Button
START_BT
Flag of running statu
RUNNING
S
Network 2
STOP
"STOP" Button
STOP_BT
Flag of running statu
RUNNING
R
Flag of error status
ERROR
Network 3
CONVEYER CONTROL
Flag of running statu
RUNNING
Conveyer ON/OFF
CONVEYER

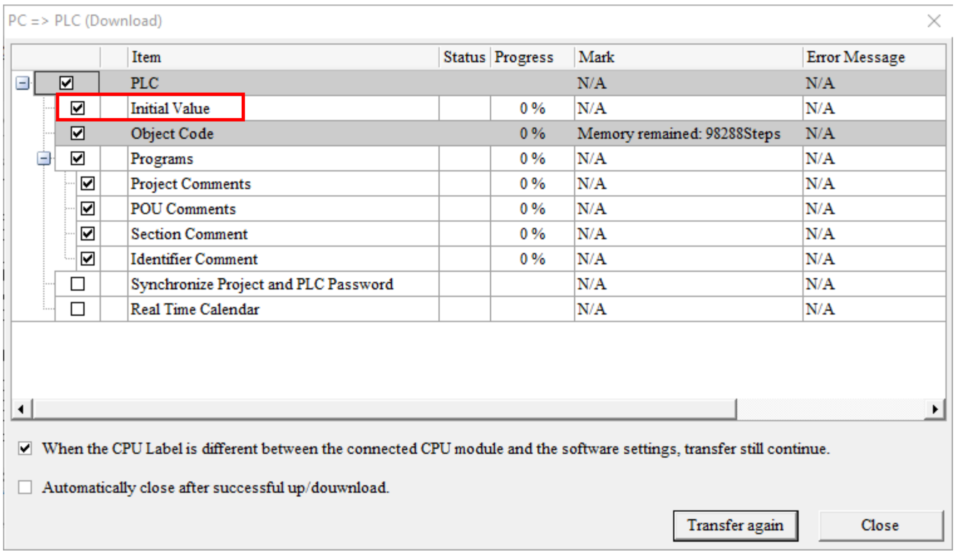




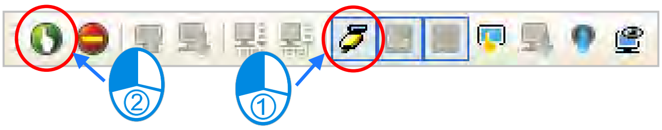
After the users make sure that the program they write is the same as program shown above, they can try to compile the program. After the program is compiled, the function block instances declared will appear in the project management area.



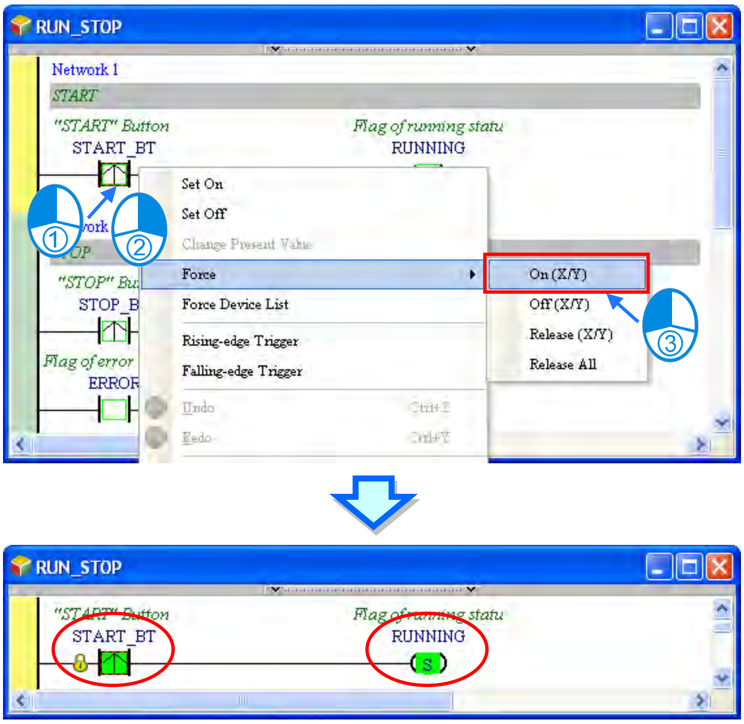
Please make sure that the hardware configuration, the parameter setting, and the task management are completed. If the hardware configuration, the parameter setting, and the task management are not completed, the users have to refer to chapter 4~chapter 6, and complete the hardware configuration, the parameter setting, and the task management. After the hardware configuration, the parameter setting, and the task management are completed, the users can compile the program again, and download the parameters and the program to the CPU module. Before the program is downloaded to the CPU module, the users have to select the **Initial Value** checkbox in the **Transfer Setup** window. Once the **Initial Value** checkbox in the **Transfer Setup** window is selected, the initial value of CNT_DT in **PARTS_CNT** will be written into the CPU module.



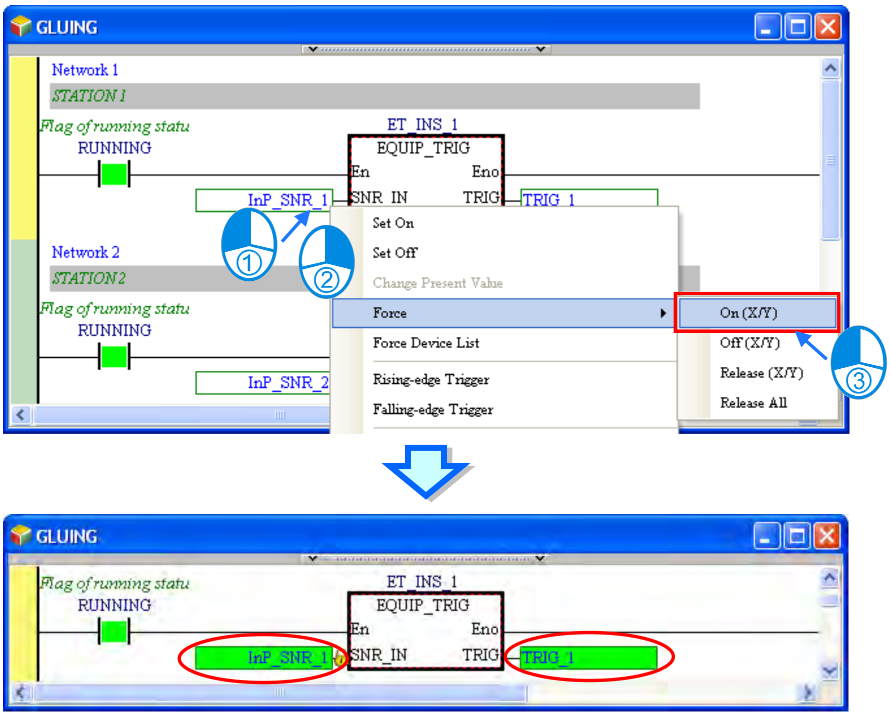
When the program is downloaded, the users can click and on the toolbar. Please follow the steps below, and test the characteristics of the function blocks.



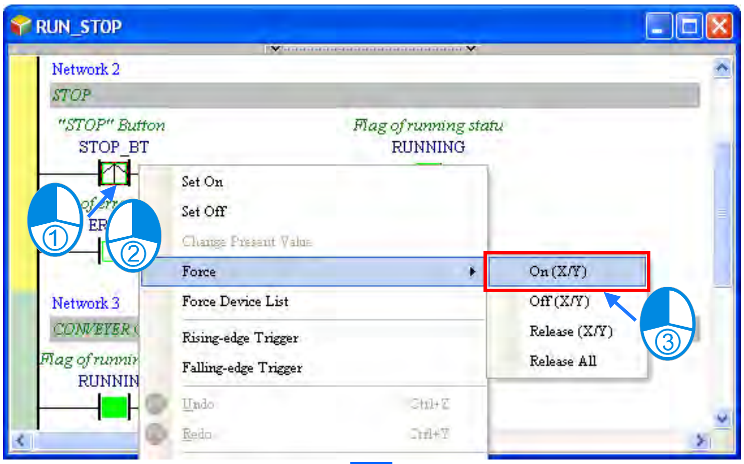
Open the window for **RUN_STOP**, and force **START_BT** ON. **RUNNING** is ON. The equipment begins to run.

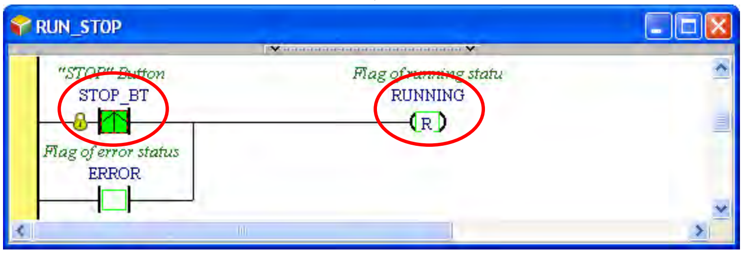


Open the window for **GLUING**, and force **InP_SNR_1** ON. **TRIG_1** is ON. The sensor senses a part, and a trigger signal is sent.

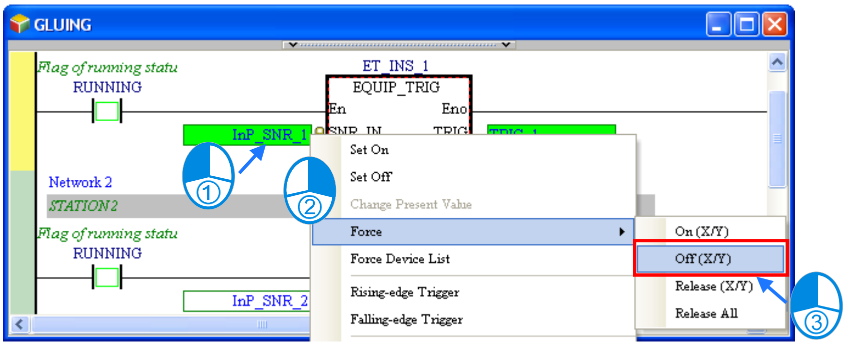


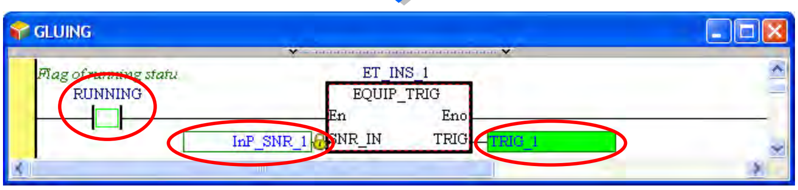
Open the window for **RUN_STOP**, and force **STOP_BT** ON. **RUNNING** is reset to OFF. The equipment stops running.



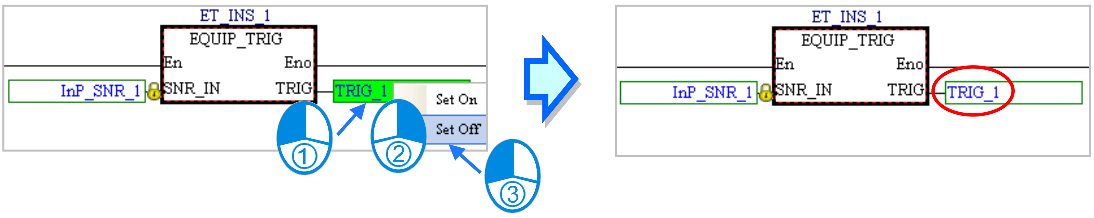


Open the window for **GLUING**, and force **InP_SNR_1** OFF. **TRIG_1** is still ON. The situation is correct. **RUNNING** is a flag connected to the En pin of the function block. **RUNNING** is OFF, and therefore the function block is not executed. The value of **TRIG**, a pin of the function block, is not sent to the symbol **TRIG_1**, and therefore the state of **TRIG_1** remains unchanged.

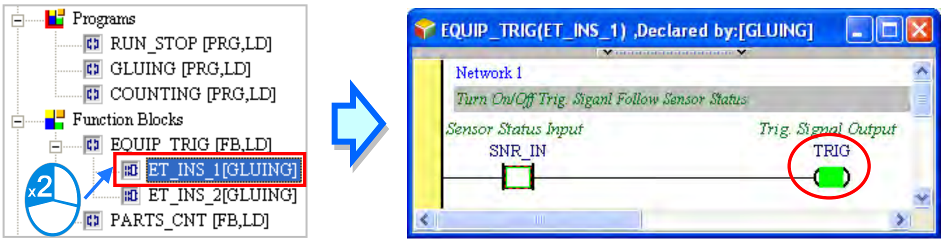




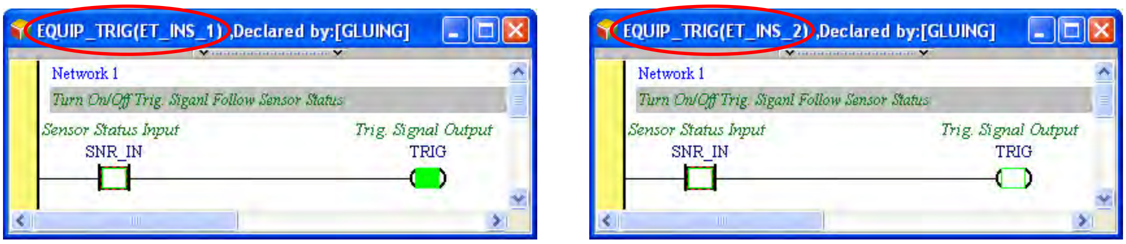
Set **TRIG_1** to OFF.



Open the window for **ET_INS_1**. **TRIG** in the window remains ON. This indicates that the states of the symbols in a function block will be retained after the function block is executed.



Open the window for **ET_INS_2**. **TRIG** in the window is OFF. The state of **TRIG** in the window for **ET_INS_2** is different the state of **TRIG** in the window for **ET_INS_1**. This indicates that the function block instances operate independently.



After the users follow the steps above, they can draw the following conclusions.

1. If the flag connected to the En pin of a function block is OFF, the program in the function block will not be executed.

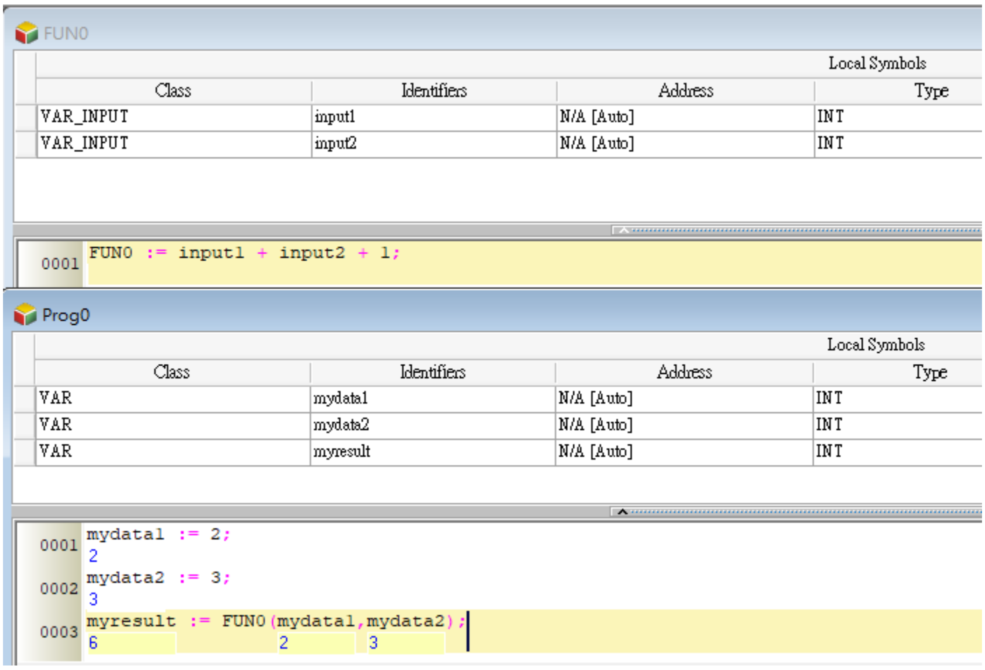
2. The states of the symbols in a function block will be retained after the function block is executed.

3. The function block instances in a project operate independently.

Obviously, the execution of the program in this section is different from the execution of the program in section 6.3. In the program in section 6.3, **TRIG_1** is OFF when the flag **RUNNING** is OFF. In the program in this section, **TRIG_1** is ON when the flag **RUNNING** is OFF. This is an expectable and acceptable situation. In the plan for the equipment, **TRIG_1** is set to OFF so that it can be set to ON next time. As a result, the function of the equipment will not be affected even if the state of **TRIG_1** remains unchanged when the equipment stops running. Please refer to section 4.1 for more information about the plan for the equipment.

7.4.3 Sample Program for Function (FC)

Declare a function (FUN0) and the return value type as INT with definition of two input symbols (INT) added together and plus 1, as shown by the sample program below.

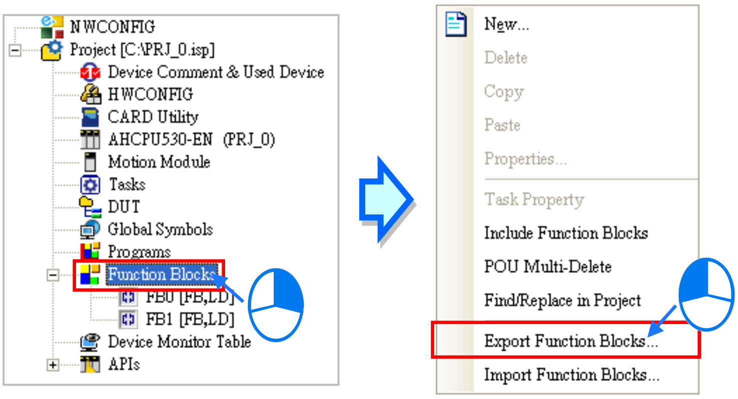


7.5 Knowing the Library

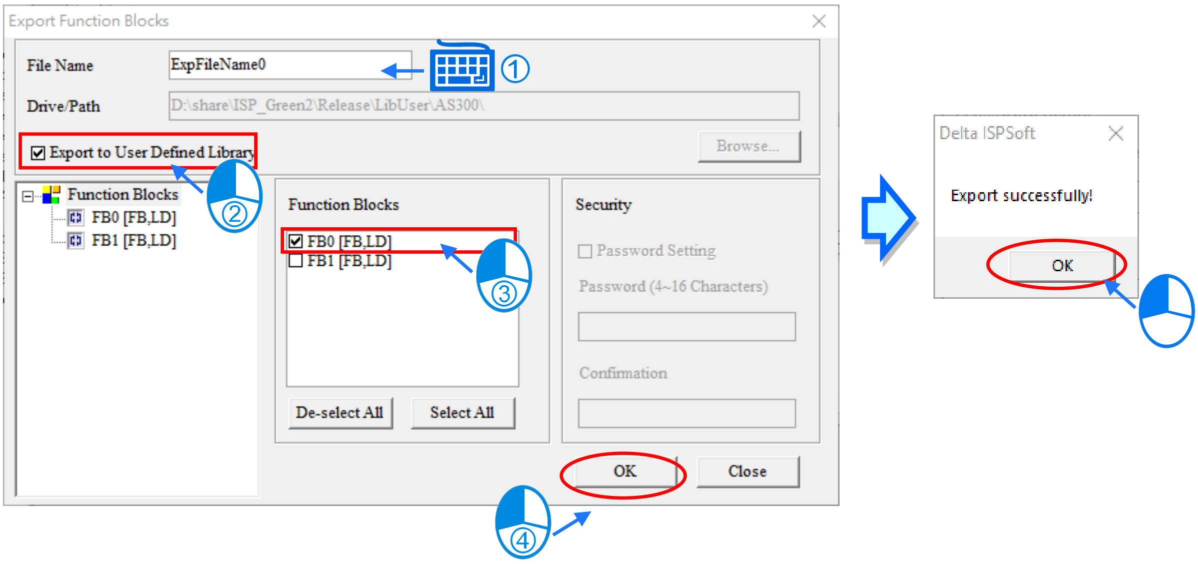
Library contains User Defined Library and Delta Library. A function block can be exported to the User Defined Library and can be used in other projects. There are several function blocks for various applications stored in the Delta Library for users to apply.

7.5.1 Creating the User-defined Library

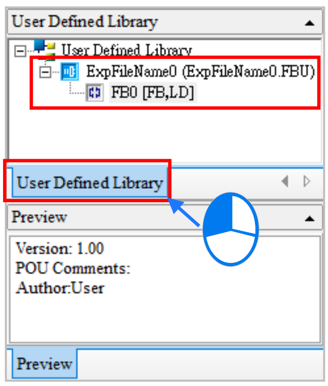
When there is a function block created in a project, the function block can be exported to the user-defined library and by doing so, the function block can be used in other projects. Right click the **Function Blocks** under the Project node and click **Export Function Blocks**.



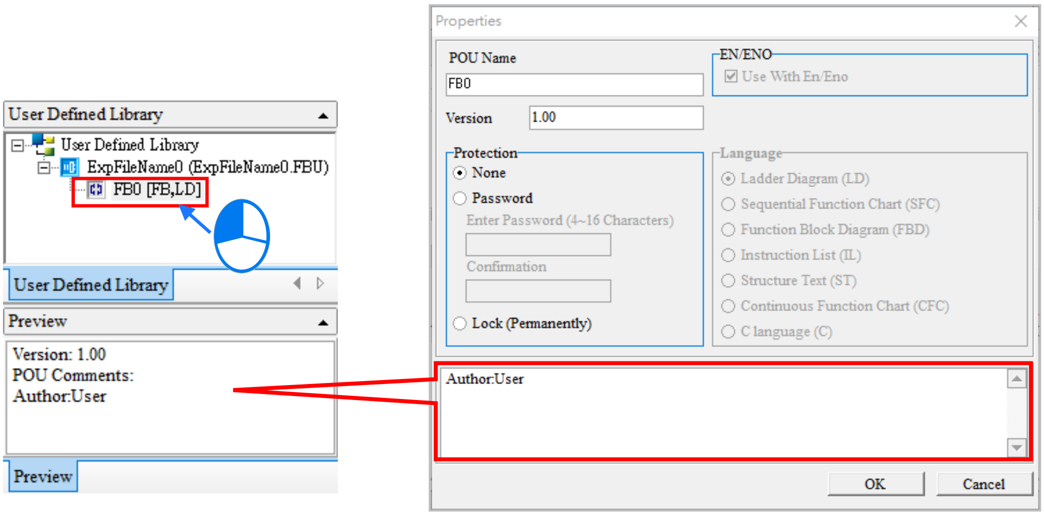
After that you will see the Export Function Blocks window, type the file name, select the option **Export to User Defined Library** and click to select the function blocks you'd like to export. File name is used for categorization; one file can contain more than 1 function block. After the setup is done, click **OK** to confirm the setting. Click **OK** again once the Export Successfully window show up.



Click the User Defined Library tab and you will see the exported function blocks in this section.



Click on the Function Block, its properties will be shown in the Preview section.

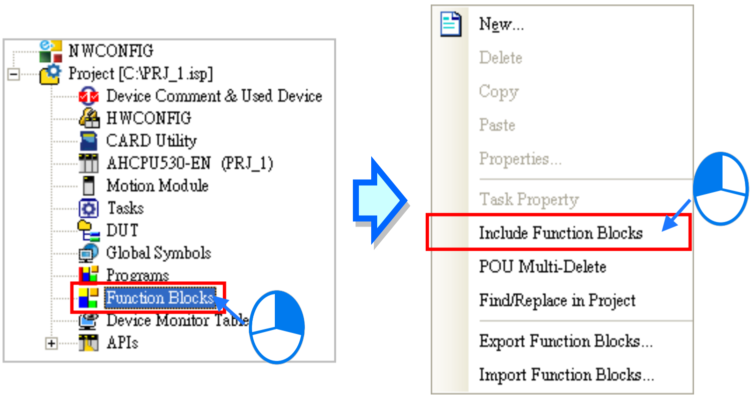


7.5.2 Including the Function Blocks in the User Defined Library

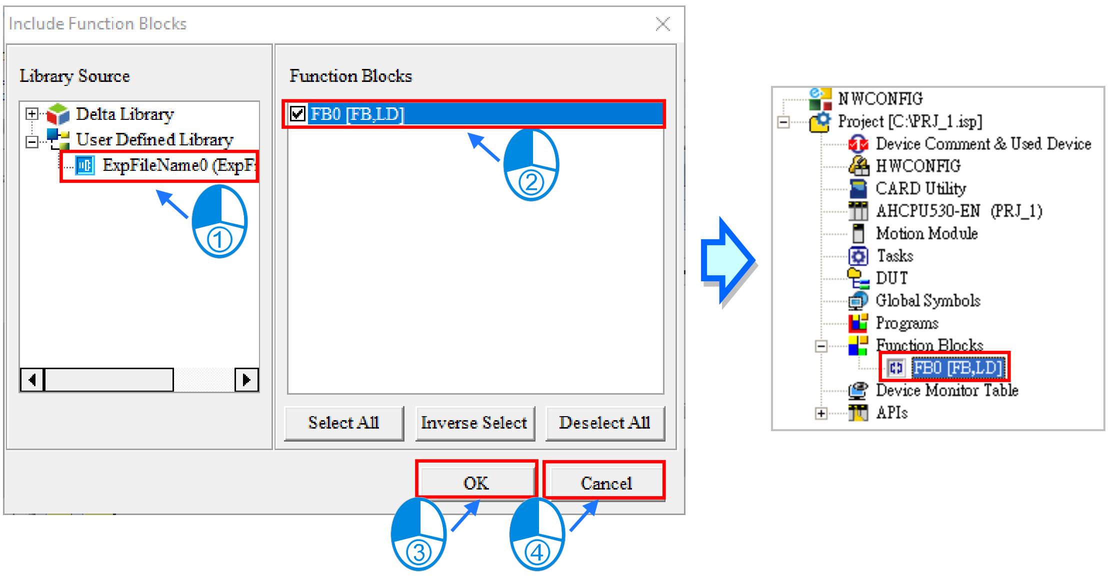
Aforementioned, once a function block is exported to the User Defined Library, users can find the exported function block in the User Defined Library when opening a new project in the same computer. Through the following methods, users can include the function to the function block.

Method 1:

Right click the **Function Blocks** under the Project node and click **Include Function Blocks**.

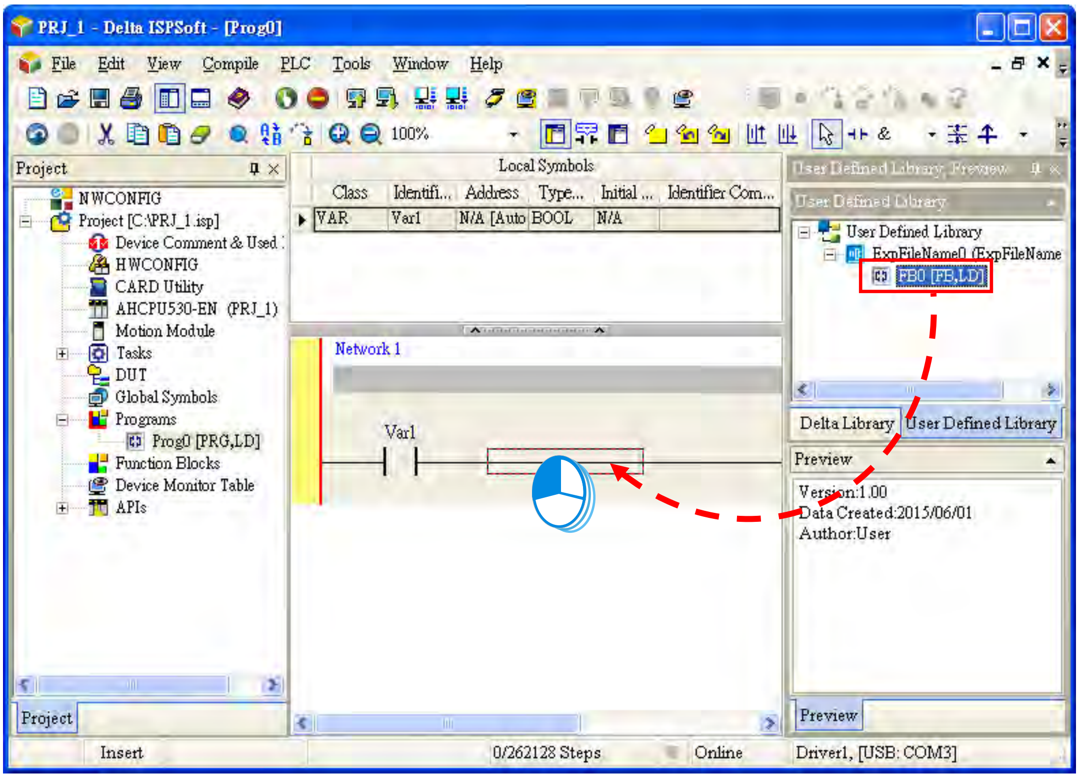


After that you will see the Include Function Blocks window, select the function that you'd like to include and click **OK**. Click **Cancel** to close the window. After that you will see the newly included function under the Function Blocks node.

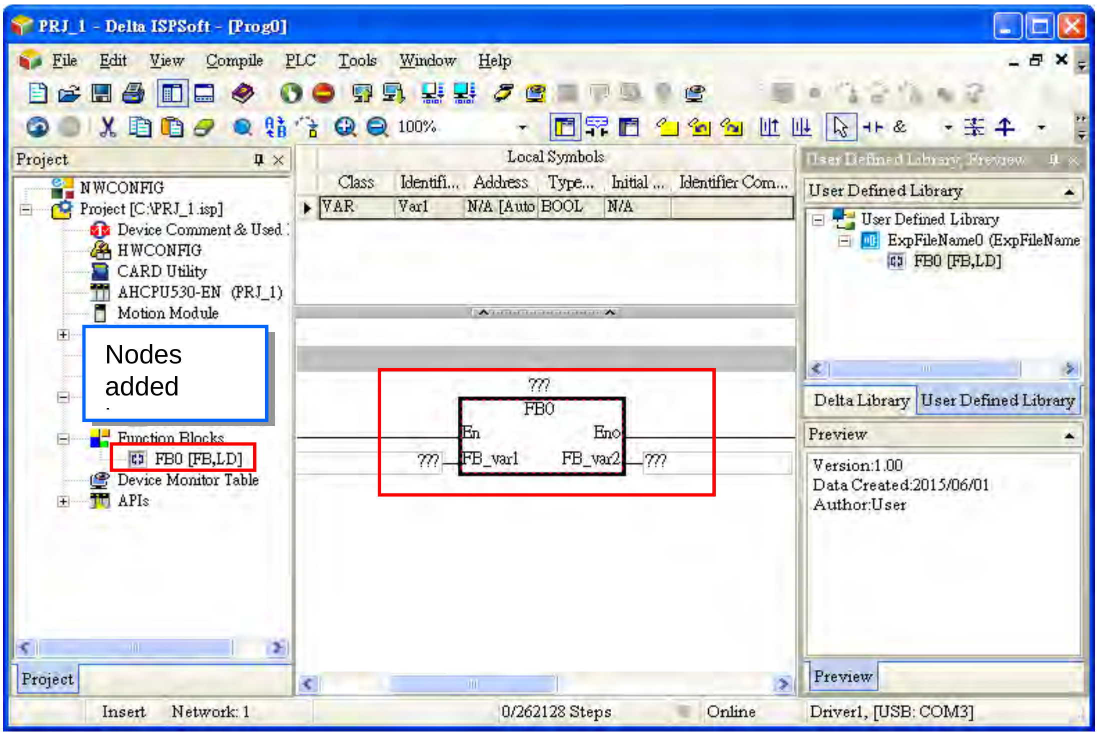


Method 2:

In the User Defined Library click and drag the function you'd like to use to the position where you'd like to add in the POU and it will be added in the POU.

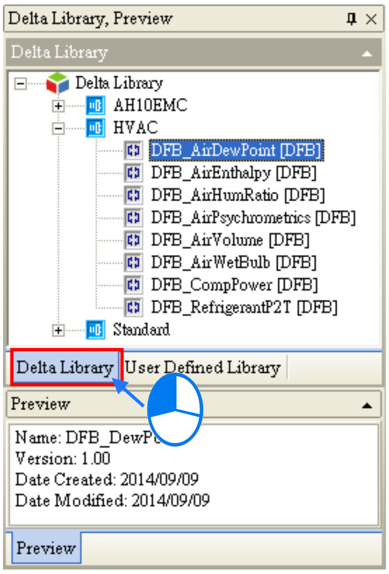


After that you will see the newly added function under the Function Blocks node.



7.5.3 Using Delta Library

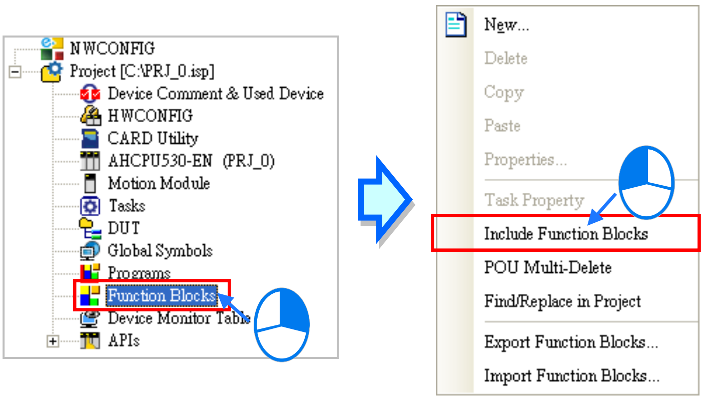
For various applications, Delta provides several function blocks stored in the Delta Library for users to apply. Click the Delta Library tab to see the provided function blocks.



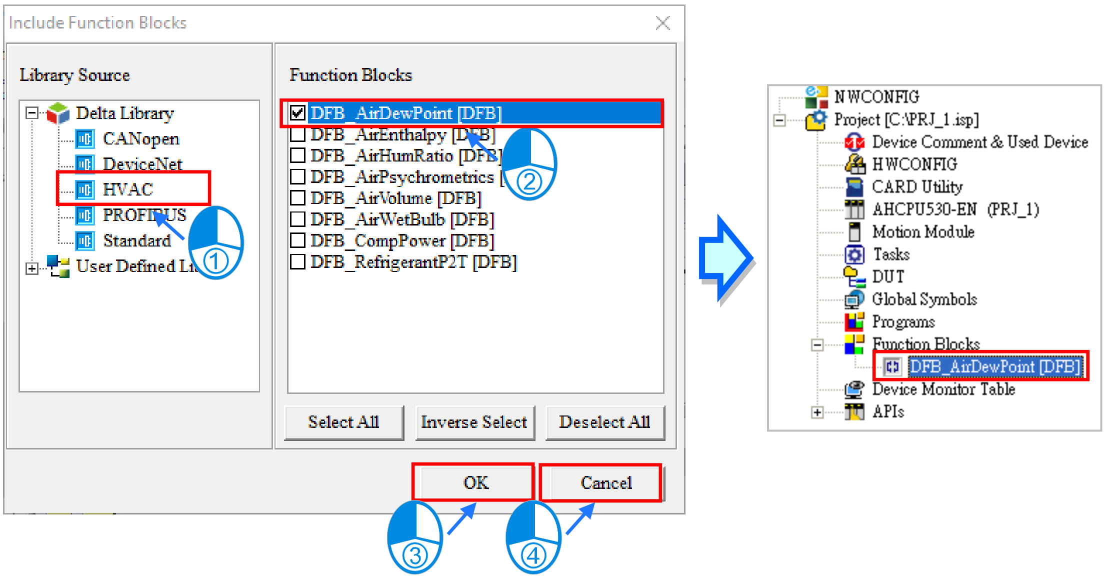
Through the following methods, users can include the function to the function block.

Method 1:

Right click the **Function Blocks** under the Project node and click **Include Function Blocks**.

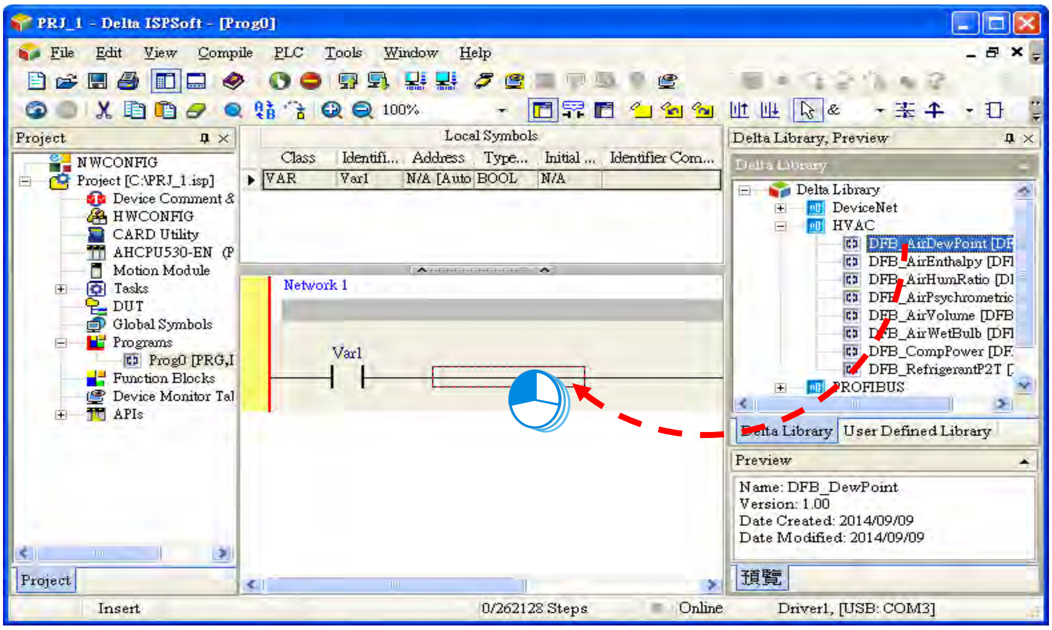


After that you will see the Include Function Blocks window, select the function that you'd like to include and click **OK**. Click **Cancel** to close the window. After that you will see the newly included function under the Function Blocks node.

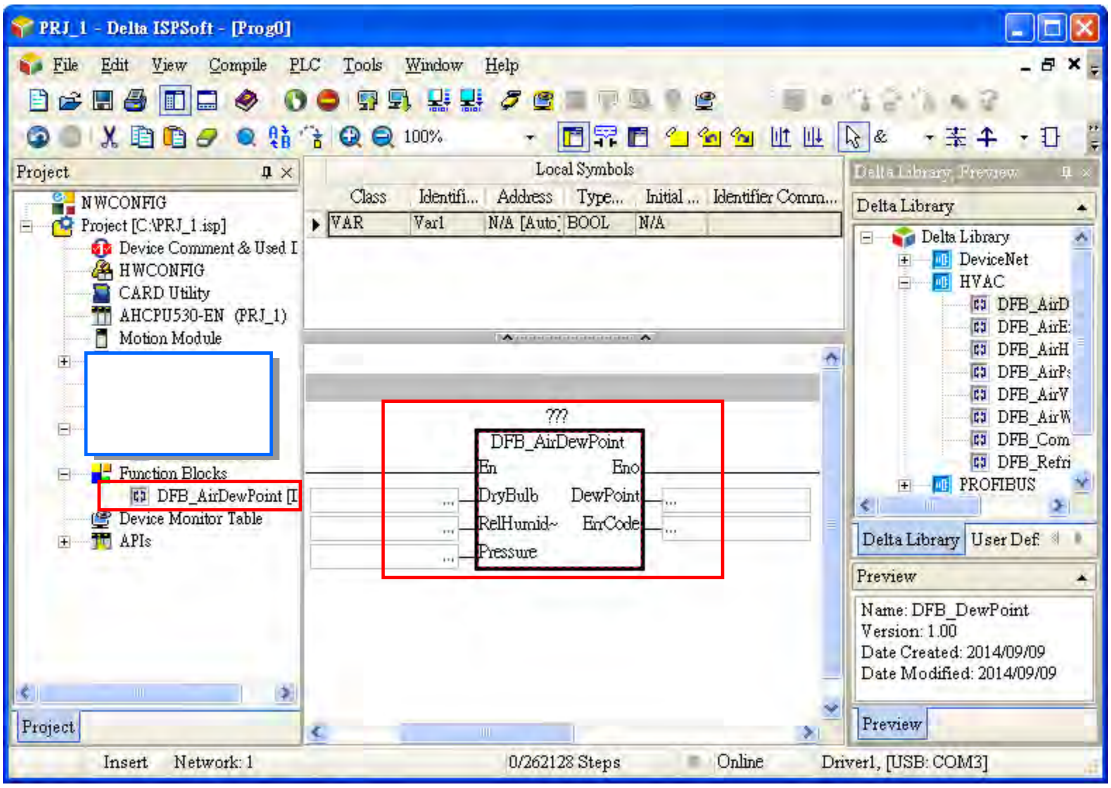


Method 2:

In the Delta Library click and drag the function you'd like to use to the position where you'd like to add in the POU and it will be added in the POU.



After that you will see the newly added function under the Function Blocks node.



*1. For the function blocks in the Delta Library, the contents are not for users to open to view or edit.

MEMO

Chapter 8 Data Unit Type

Table of Contents

8.1 User-defined Data Type / Data Unit Type

Sometimes basic data types are not sufficient for users to write their own programs for the PLC. In the IEC 61131-3 standard, a high-level language such as the user-defined data type is adopted to create a new data type as users desired, supporting the following three self-defined data types with ISPSoft and improving the readability and the efficiency of developing a program.

Data Type	Description
Structured	Composed of multiple data types as members.
Enum	Composed of multiple enumeration values, which correspond to a constant of INT type individually.
Union	Similar with structured type, the difference is that all the members of Union share the same memory location. Thus, any changes to a single member's value will change all other members' values.

Data types supported by different models are presented in the following table.

Data types	AH/AS	AS5xx/DVPxxMC	DVP
BOOL	✓	✓	Only supports ES3
BYTE		✓	
WORD	✓	✓	Only supports ES3
DWORD	✓	✓	Only supports ES3
LWORD	Only supports AH	✓	
SINT		✓	
INT	✓	✓	Only supports ES3
DINT	✓	✓	Only supports ES3
LINT	Only supports AH	✓	
USINT		✓	
UINT		✓	
UDINT		✓	
ULINT		✓	
REAL	✓	✓	Only supports ES3
LREAL	Only supports AH	✓	
STRING	Does not support ARRAY	✓	
STEP			
COUNTER			
TIMER			
TIME		✓	
DATE		✓	
TOD		✓	
DT		✓	

8

8.2 Structure

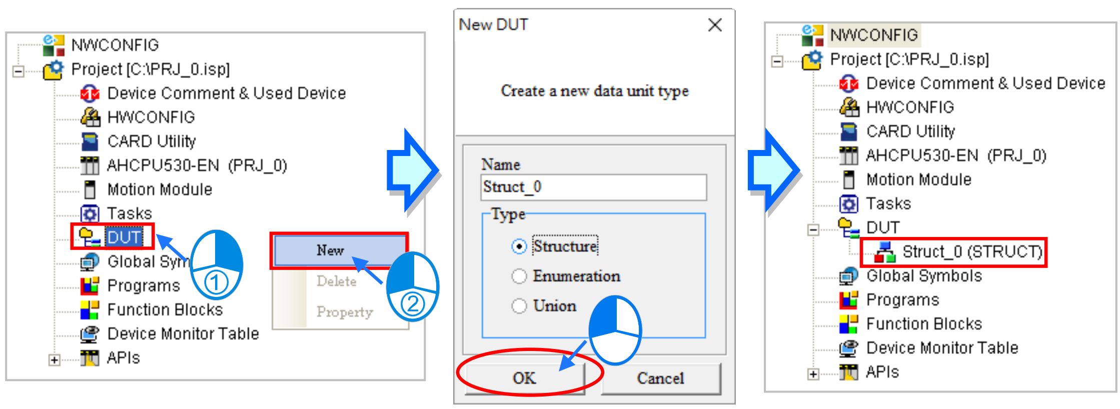
8.2.1 Definition of a Structure

A structure is the collection of data, consisting of members with various data types, which can also be used as a member for other structures as well as used for grouping data and can be seen as a data unit to transfer values.

STRUCTURE																																	
Member Name	Data Type	Values																															
		WORD 1																WORD 0															
		Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Str1	**ARRAY**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**
Str2	**WORD**																	**12,039 (16#2F07)**															
Str3	**ARRAY**	**32,769(16#8001)**																**12,039 (16#2F07)**															
Str4	**DWORD**	**2,147,561,223(16#80012F07)**																															

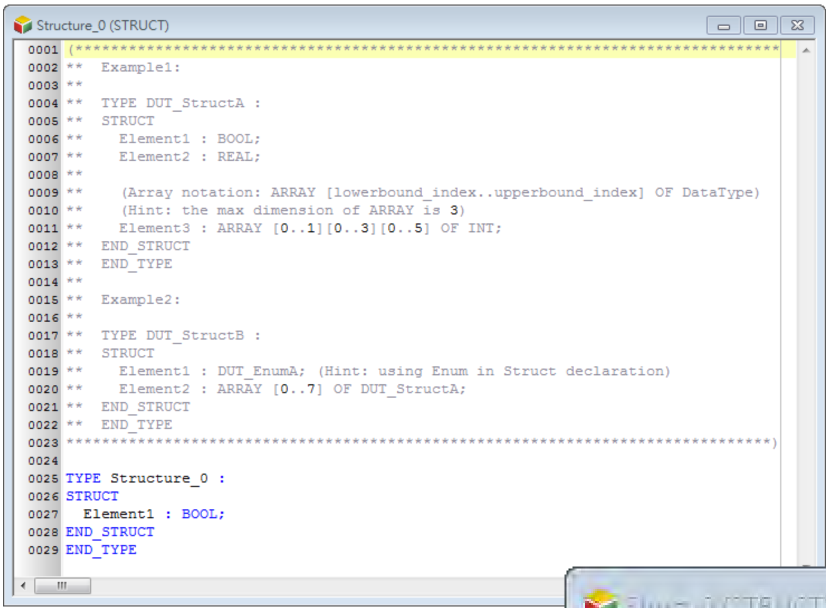
8.2.2 Creating a Structure

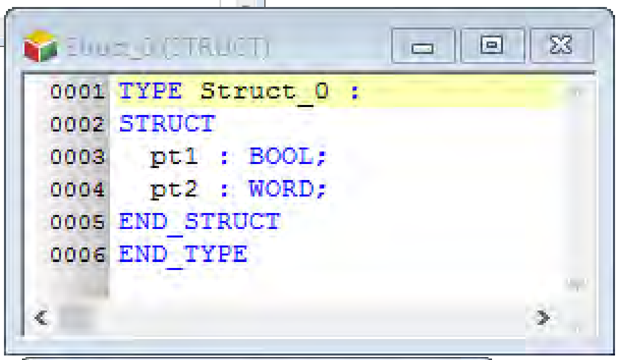
Right-click **DUT (Data Unit Type)** in the project management area to see the option **New**. Click **New** to bring out a **New DUT** window. Input a name, select the type as **Structure** and then click **OK** to confirm the setting. After that, a new DUT will appear under the DUT option.



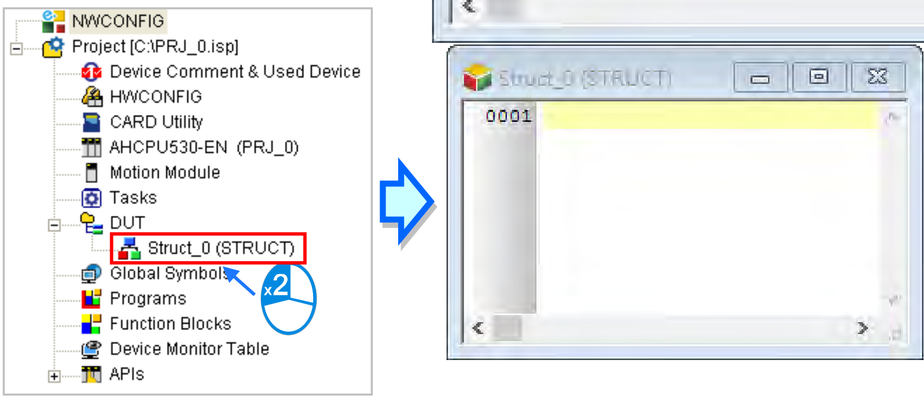
***. The naming rules of a structure and an element can be found below.**

After a structure DUT is created, an editing window will be presented with examples and definitions for reference. Users can edit the examples to make them as their own structures.





Users can also find it under the DUT option in the project management area. Double click the new DUT to open it and start to edit the contents of the newly added DUT.



The structure format is stated as below: wordings in blue are the system keywords; wordings in black are the user-defined names and member names.

TYPE < User-defined Name>:

STRUCT

<Member 1 Name>: <Data Type>;

<Member 2 Name>: <Data Type>;

...

<Member N Name>: <Data Type>;

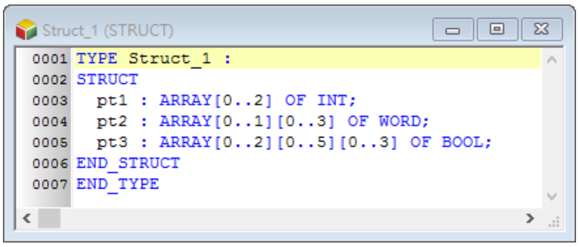
END_STRUCT

END_TYPE

● **User-defined Name:** Set as the default name, which cannot be modified. Otherwise, an error will be reported.

● **Member Name:** Define the member name.

● **Data Type**：Define the data type for members, such as BOOL, WORD, DWORD, LWORD, INT, DINT, LINT, REAL, LREAL, STRING, ARRAY, or another STRUCTURE or,ENUMERATION. (For DVPxxMC/ AS5xx series, more data types include BYTE, SINT, USINT, UINT, UDINT, ULINT, TIME, DATE, TOD, DT, STRING.) As the image shown below, when the member data type is ARRAY, the format will be **ARRAY [0..n] OF <data type>;** the maximum for n value is 65535. (For DVPxxMC/ AS5xx series, the maximum for n value is2147483647.) If the member data type is Structure, write another structure name. But if the data type is ARRAY, users cannot import ARRAY again. The system supports multi-dimensional array, up to three-dimension. The format of a two-dimensional array is **ARRAY [0..n] [0..n] OF <data type>** and the three-dimensional array is **ARRAY [0..n] [0..n] [0..n] OF < data type>.** As the image shown below:



The naming rules of user-defined names and member names are stated as below.

● A user-defined name cannot be the same as names of other user-defined data types.

● The repetition of a member name based on the same user-defined is not allowed.

● User-defined names and member names can be composed of 30 characters at most, and a Chinese character takes two characters.

● It is not allowed to use a name reserved by the system, e.g. an instruction code, a device name, or a name given a special significance. However, if a name reserved by the system is a part of the names of a structure or an element, it is then a legal name. For example, “M0” is an illegal name, but “_M0” is a legal name.

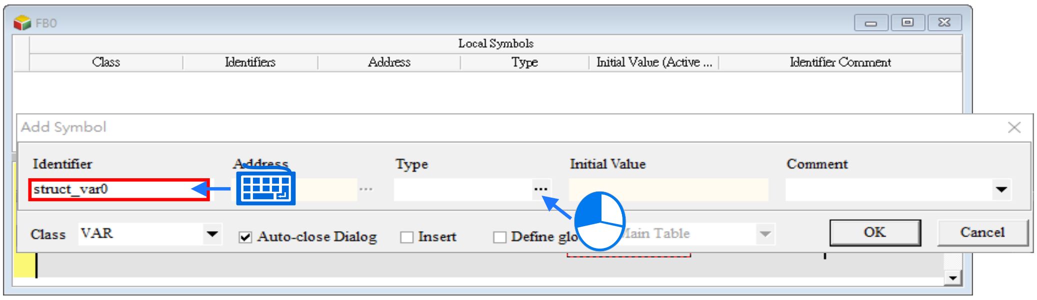
● User-defined names and member names cannot contain space. For example, “INPUT CH0” is an illegal name.

● User-defined names and member names can contain underline but it is not allowed to use 2 underlines in a row or put it in the end. For example, “INPUT_CH0”is acceptable, but “INPUT__CH0” and “INPUT_CH0_” are illegal.

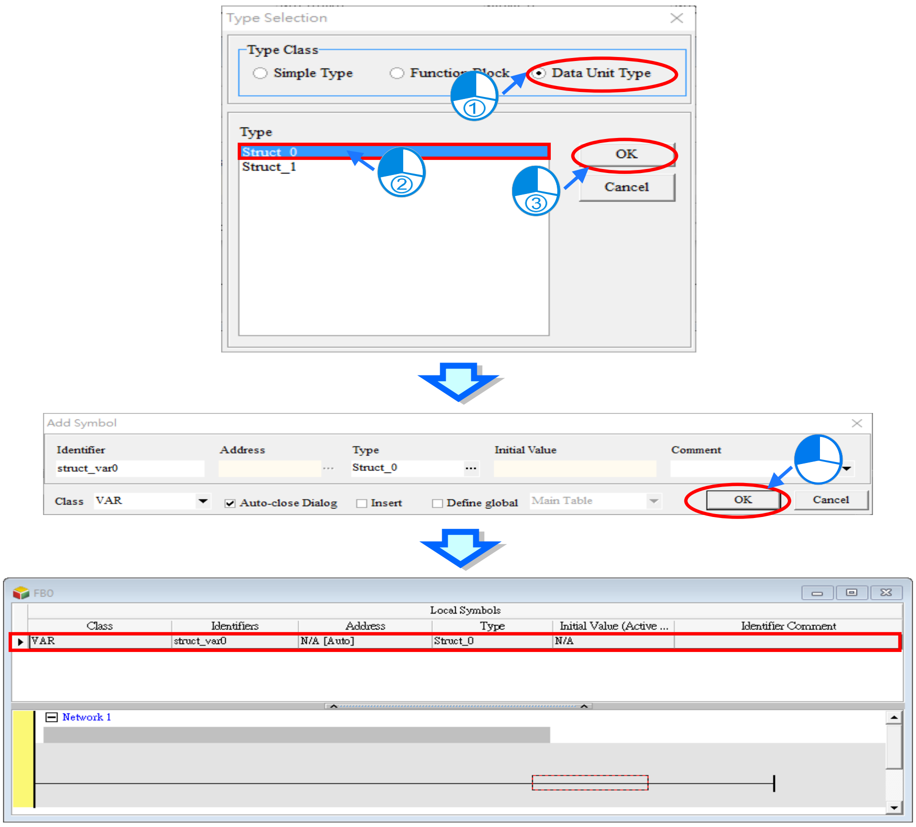
● User-defined names and member names cannot contain special characters, including *, #, ?, \, %, @ and more.

8.2.3 Using a Structure Variable

After the creation of the structure type is done, users can declare the variable symbol in the Local Symbols page. Open the Add Symbol window from the Global and local symbol table and input the identifier and then click on the right as the image shown below.

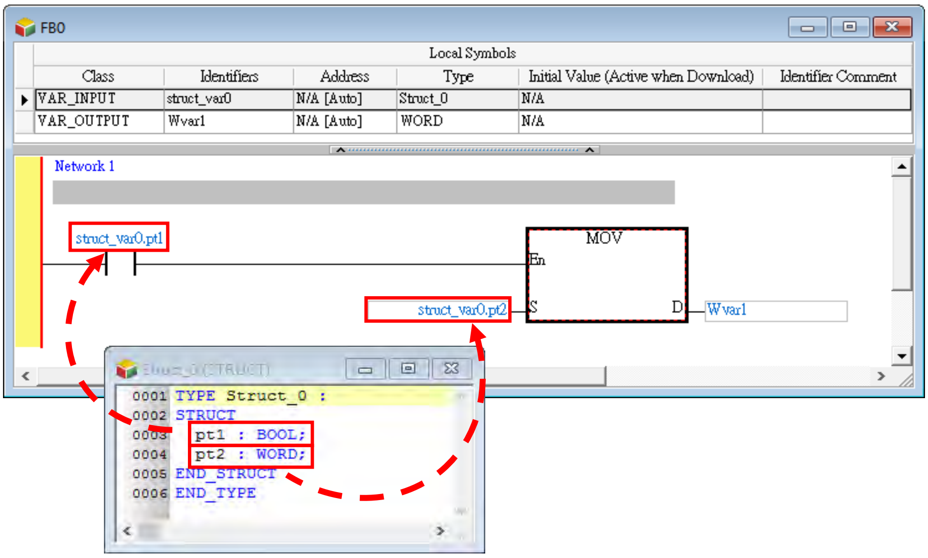


Select the Data Unit Type, and the declared structure data type, then click OK to add a new symbol.

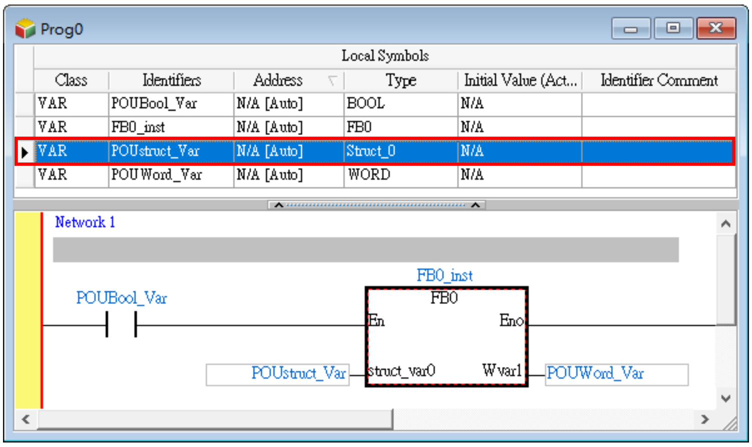


8.2.4 Applications of Structures

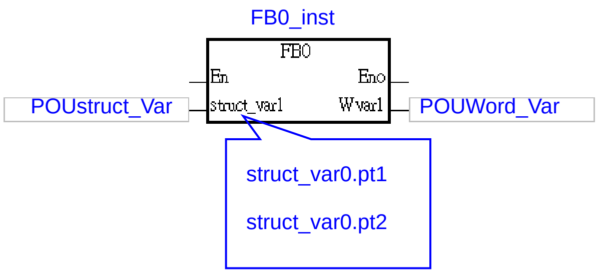
After the structure and symbol are declared, they can be used in the POU. The data type of the symbol **struct_var0** is **Struct_0** in the function block as the image shown below. Users can use "." to assign the member for the structure symbols, for example **struct_var0.pt1** means the first member pt1 is assigned as a contact to the data type BOOL operand and **struct_var0.pt2** means the second member pt2 is assigned as a pin to the data type WORD operand as the image shown below.



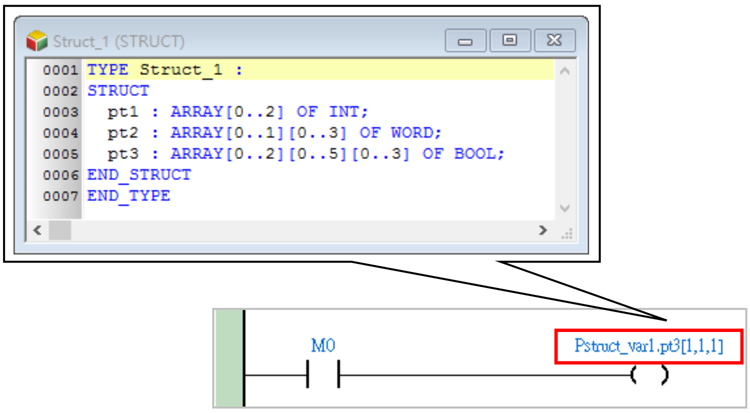
When using the aforementioned function block, Struct_0 data type symbol should be declared in the POU, so that Struct_0 data type input pin and output pin can be consistent. The elements with the same structure can use "." to assign the member for the structure type symbols, for example POUstruct_var.



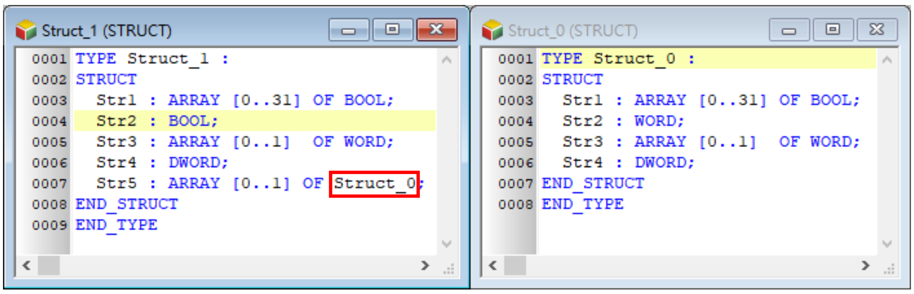
From the description above, we know that when the structure type symbol **POUstruct_Var** is used in the FB0, it also delivers all the members from the symbol for **struct_var0.pt1** and **struct_var0.pt2** to operate. Thus users can define the structure type symbols as the input/output pin for the function block to deliver all the members from the symbol. So that the pin defining time can be saved and the program can be simpler.



When the structure is constructed with an array member, the symbols in the structure can be written as the example shown below: the status of M0 can be written in the [1,1,1] of the appointed member pt3 in the symbol Pstruct_var1.



Another example is that one structure can be used as a member of another structure. As shown below, Struct_0 is a member under Struct_1.



The Struct_1 memory size is shown as follows.

User-defined Name	Member Name	Data Type	Memory(Bit)
Struct_1	Str1	ARRAY [0..31] OF BOOL	
	Str2	BOOL	
	Str3	ARRAY [0..1] OF	

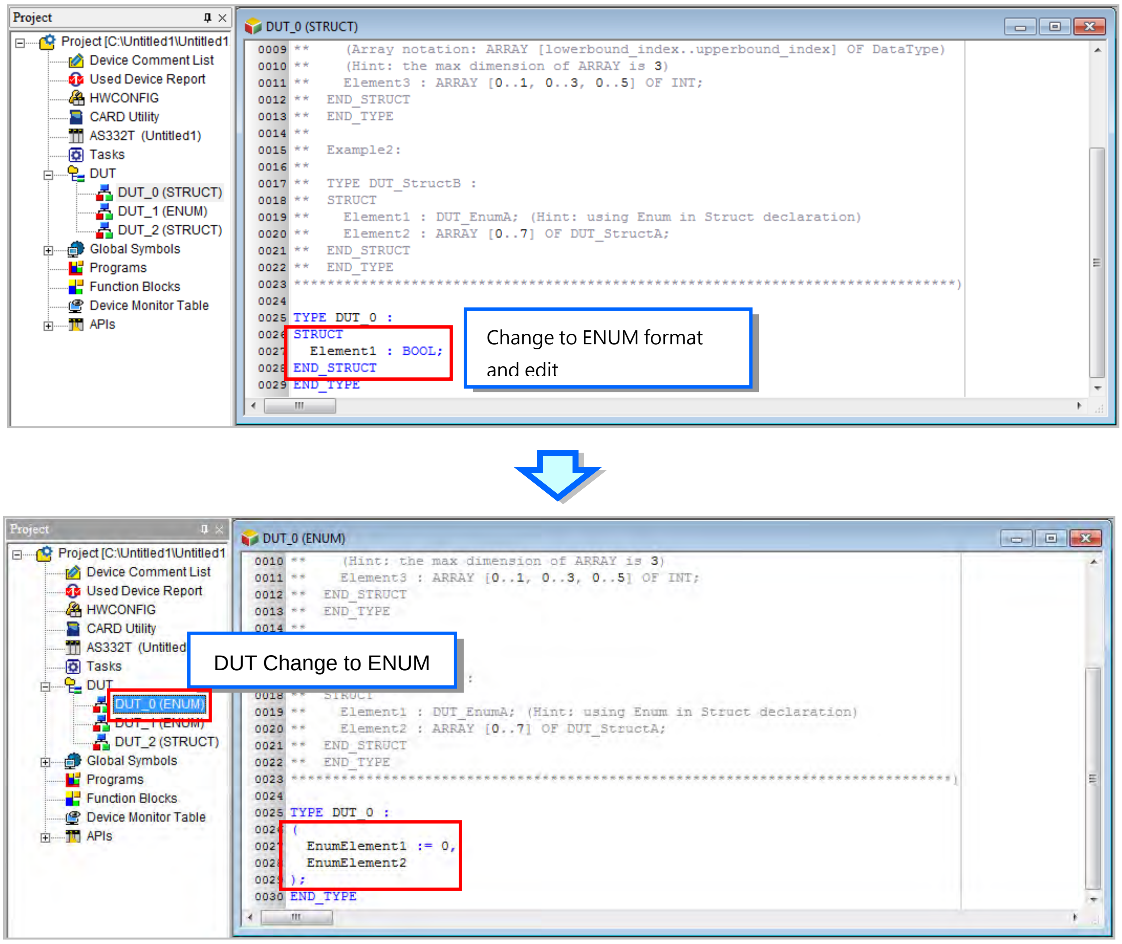
		WORD	
	Str4	DWORD	
	Str5	ARRAY [0..1] OF Struct_0	

The above area marked by the red circle is the memory size of Struct_0 as a member, which occupies 7 words.

Struct_0																																	
Member Name	**Data Type**	**Values**																															
		WORD 1																WORD 0															
		Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Str1	**ARRAY**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**
Str2	**WORD**																	**12,039 (16#2F07)**															
Str3	**ARRAY**	**32,769(16#8001)**																**12,039 (16#2F07)**															
Str4	**DWORD**	**2,147,561,223(16#80012F07)**																															

8.2.5 Change Structure to Enumeration

Users can change a DUT from **Structure** to **Enumeration** by editing the structure names of STRUCT and END STRUCT to **“ (”** and **“) ; ”** as well as the member names from STRUCT to ENUM format, please refer to section 8.3 for more information.


Project
Project [C:\Untitled1\Untitled1
Device Comment List
Used Device Report
HWCONFIG
CARD Utility
AS332T (Untitled1)
Tasks
DUT
DUT_0 (STRUCT)
DUT_1 (ENUM)
DUT_2 (STRUCT)
Global Symbols
Programs
Function Blocks
Device Monitor Table
APIs
DUT_0 (STRUCT)
TYPE DUT_0 :
STRUCT
Element1 : BOOL;
END_STRUCT
END_TYPE
Change to ENUM format and edit
DUT Change to ENUM
DUT_0 (ENUM)
TYPE DUT_0 :
(
EnumElement1 := 0,
EnumElement2
);
END_TYPE

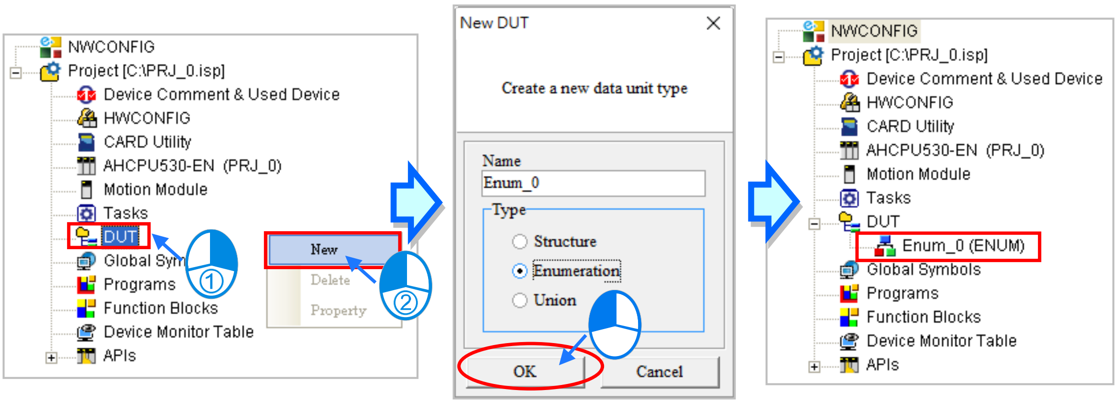
8.3 Enumeration

8.3.1 Definition of Enumeration

Users can enumerate (obtain one at a time) the elements in a collection of objects, providing an efficient way to define a set of named integral constants that may be assigned to a variable and values that the enumeration represents.

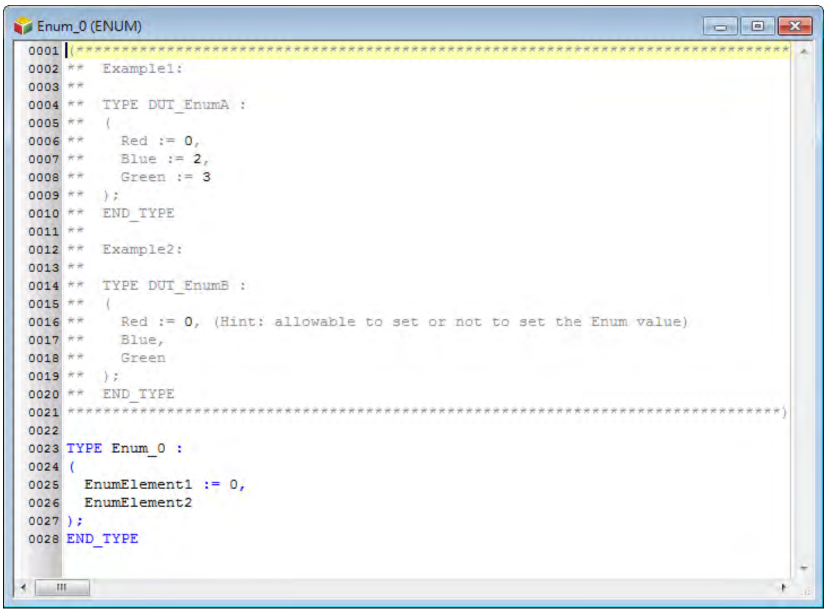
8.3.2 Creating an Enumeration

Right-click DUT (Data Unit Type) in the project management area to see the option New. Click New to bring out a New DUT window. Input an enumeration name, select the type as Enumeration and then click OK to confirm the setting. After that, a new DUT will appear under the DUT option.

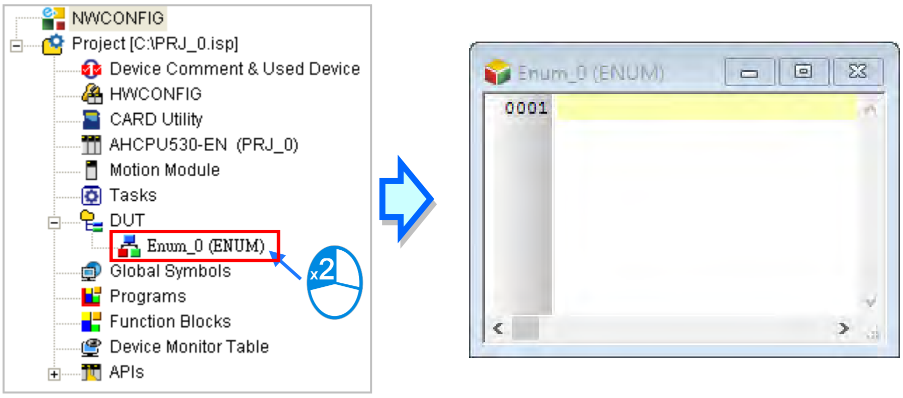


***. The naming rules of an enumeration can be found below.**

After an enumeration DUT is created, an editing window will be presented with examples and definitions for reference. Users can edit the examples to make them as their own enumerations.



Users can find it under the DUT option in the project management area. Double click the new DUT to open it and start to add the contents of the newly added DUT.



The enumeration format is stated as below: wordings in blue are the system keywords; wordings in black are the user-defined enumeration names, element names and values.

TYPE <User-defined Name>:

(

< Member 1 Name > := <Value 1>,

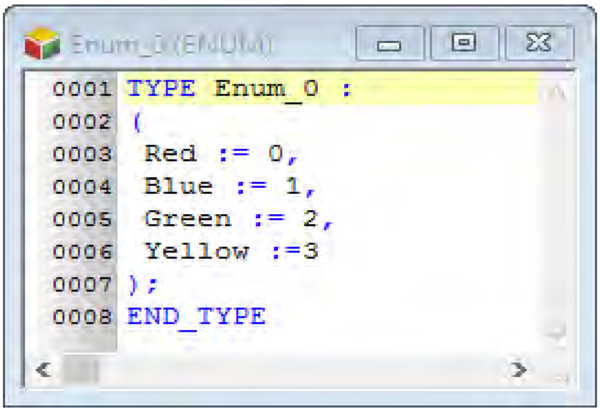
< Member 2 Name > := <Value 2>,

...

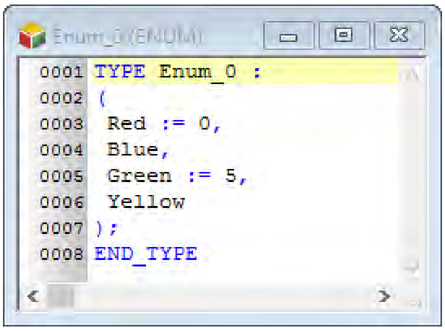
< Member Name > := <Value n>

);

END_TYPE



- **Self-defined Name:** Set as the default name, which cannot be modified. Otherwise, an error will be reported.
- **Member Name:** Define the member name.
- **Value:** Define values for every member, ranging -32768~32767. It is acceptable to leave this field blank. The system will use defaults according to the previous member value and avoid duplications. The system will set the value of the member Blue to 1 and Yellow to 6 as the image shown below.

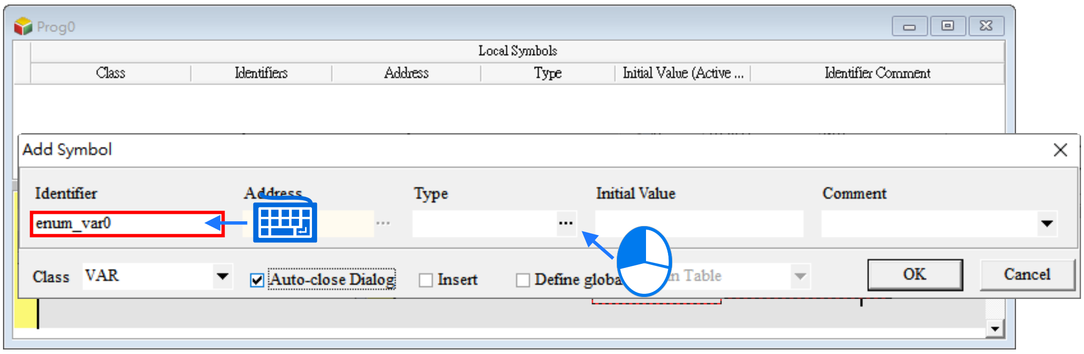


The naming rules of user-defined names and member names are stated as below.

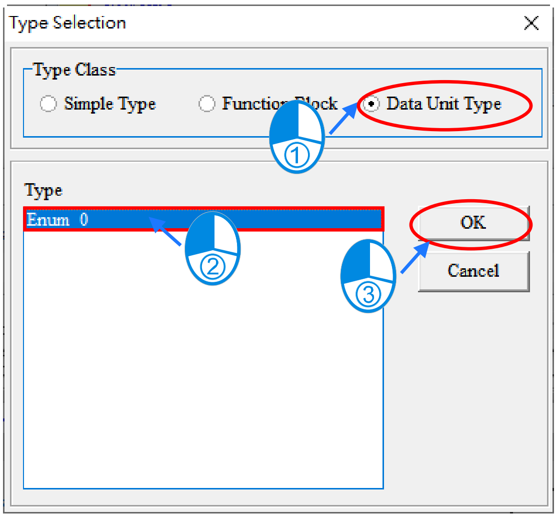
- A user-defined name cannot be the same as other names of user-defined data type.
- The repetition of a member identifier under the same user-defined type is not allowed.
- User-defined names and member names can be composed of 30 characters at most, and a Chinese character takes two characters.
- It is not allowed to use a name reserved by the system, e.g. an instruction code, a device name, or a name given a special significance. However, if a name reserved by the system is a part of the names of a structure or an element, it is then a legal name. For example, “M0” is an illegal name, but “_M0” is a legal name.
- The identifiers of user-defined type and a member cannot contain space. For example, “INPUT CH0” is an illegal name.
- The identifiers of user-defined type and a member can contain underline but it is not allowed to use 2 underlines in a row or put it in the end. For example, “INPUT_CH0”is acceptable, but “INPUT__CH0” and “INPUT_CH0_” are illegal.
- The identifier of user-defined type and a member cannot contain special characters, including *, #, ?, \, %, @ and more.
- Enumeration values are INT data type.

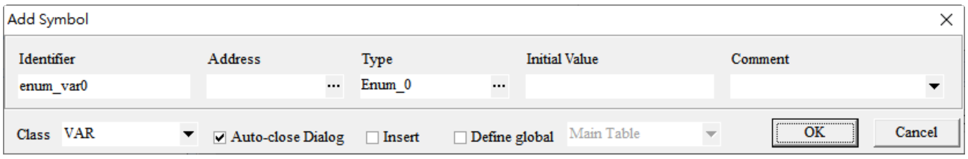
8.3.3 Using an Enumeration Variable

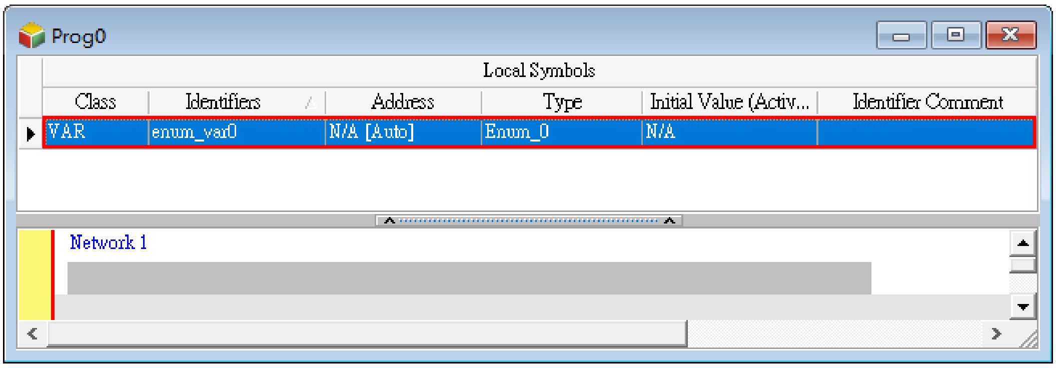
After the creation of the enumeration type is done, users can declare the symbol in the Local Symbols page. Open the Add Symbol window from the Global and local symbol table and input the identifier and then click on the right as the image shown below.



Select the Data Unit Type, and the declared enumerated data type and then click OK to add a new symbol.



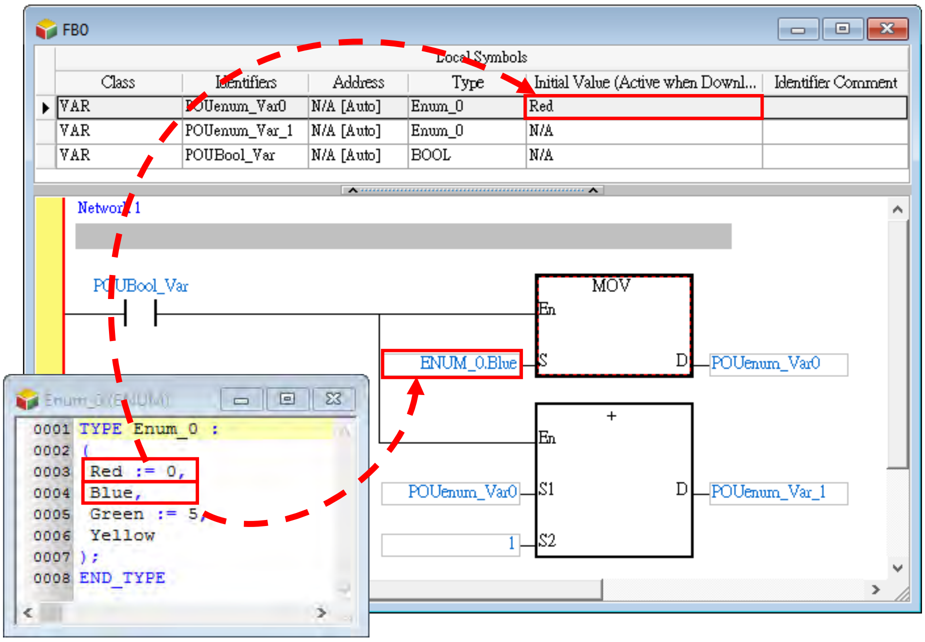




8.3.4 Applications of Enumerations

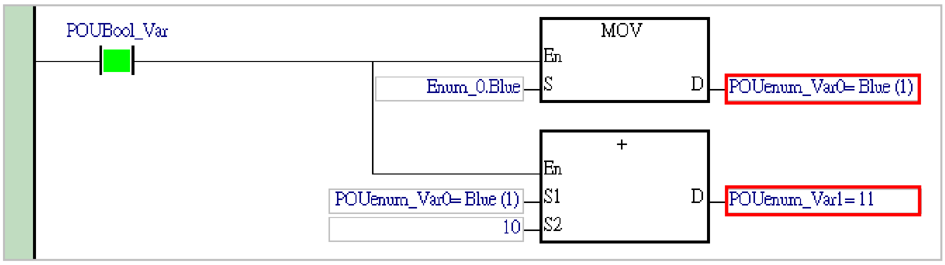
After the enumeration and symbol are declared, they can be used in the POU. The data type of the symbol **POUenum_Var0** is Enum_0. The Initial Value can be set by the member name or values. The image below shows the element name, Red.

Users can use "." to assign the member for the enumeration symbols, for instance, users can assign **Enum_0.Blue** to **POUenum_Var0**, the symbol Enum_0, and execute the instruction MOV; the defined member or value will be the enumeration value and after the execution of MOV, the value of POUenum_Var0 will be 1.



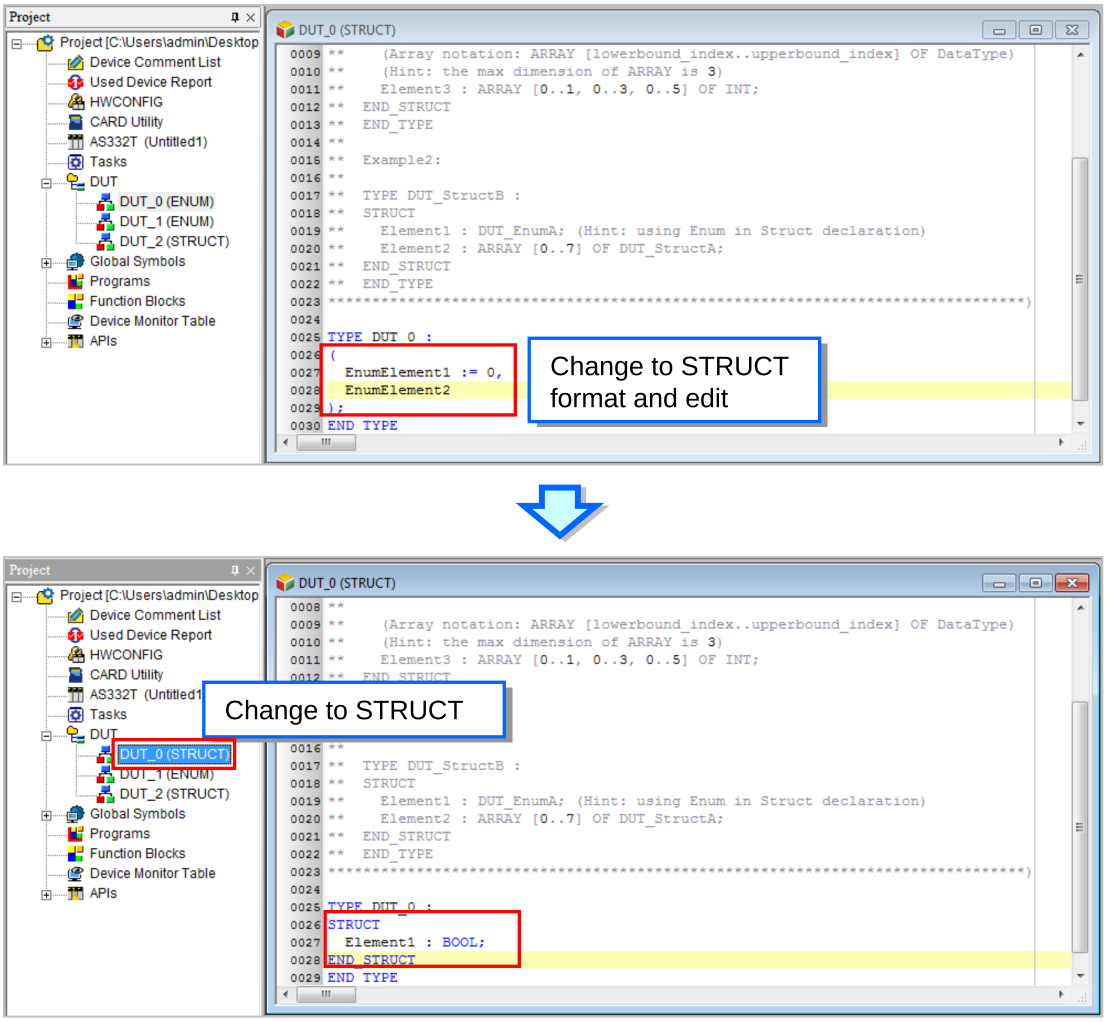
Users can also perform numerical operations; using the instruction + and set the value to 1, POUenum_Var0 will be incremented by 1 as the example shown above. When the value of POUenum_Var0 is 1, after executing the instruction +, the value result will be 2 and its member will be Green as defined.

When running and monitoring the program, the enumeration symbols will show their current defined member names. For example when the value is 1, the POUenum_Var0 will be seen as POUenum_Var0=Blue(1) as they are defined in the following image. But if the value of the enumeration symbol is not in the defined member range, the value will be shown as it is; as the following example shows when the value is 11 but 11 is not in the defined range, POUenum_Var1=11 will be stated as the image shown below.



8.3.5 Change Enumeration to Structure

Users can change a DUT from **Enumeration** to **Structure** by editing **“ (”** and **“) ; ”** to structure names of STRUCT and END STRUCT as well as the member names from ENUM to STRUCT format, please refer to section 8.2 for more information.



8.4 Union

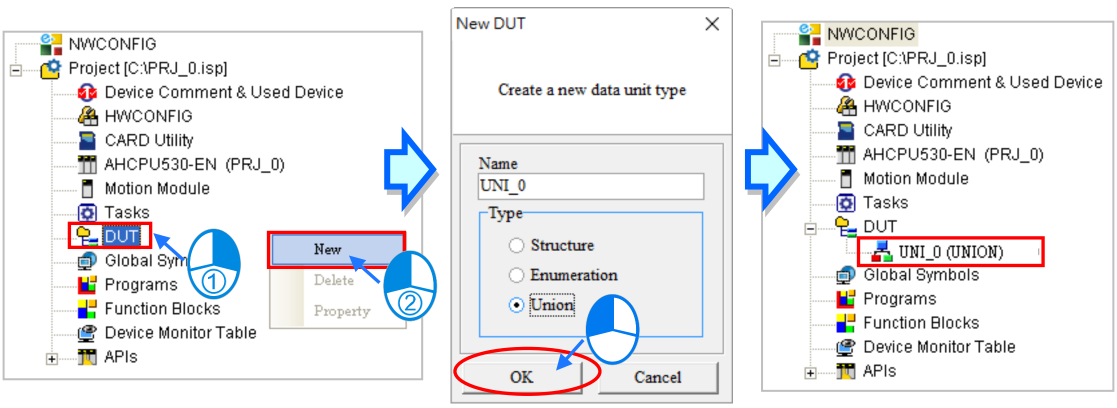
8.4.1 Definition of Union

Similar with structured type, the difference is that all the members of Union share the same memory location and the memory space allocated for a union is the storage required for the largest member of the union. Thus, any changes to a single member's value will change all other members' values as the following table shows, which displays a total memory of 32 bits (2 words) occupied by 4 members under a union.

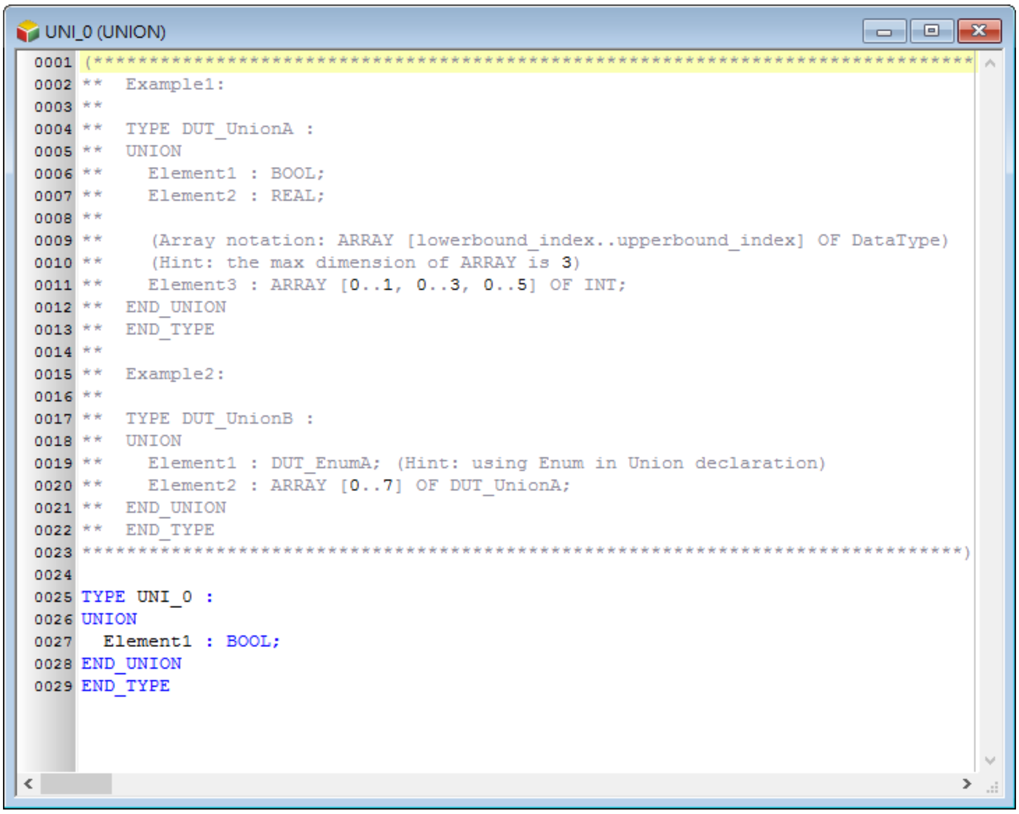
UNION																																	
Member Name	Data Type	Values																															
		WORD 1																WORD 0															
		Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
uni1	**ARRAY**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**
uni2	**WORD**																	**12,039 (16#2F07)**															
uni3	**ARRAY**	**32,769(16#8001)**																**12,039 (16#2F07)**															
uni4	**DWORD**	**2,147,561,223(16#80012F07)**																															

8.4.2 Creating an Union

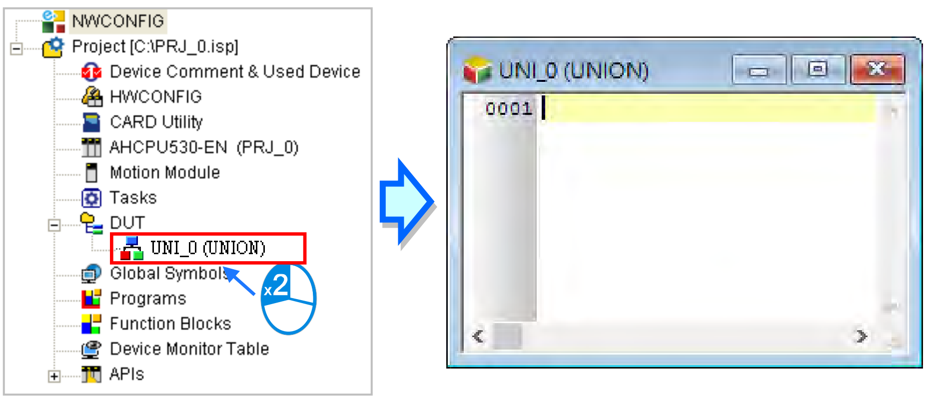
Right-click DUT (Data Unit Type) in the project management area to see the option New. Click New to bring out a New DUT window. Input a name, select the type as Structure and then click OK to confirm the setting. After that, a new DUT will appear under the DUT option.



After a union DUT is created, an editing window will be presented with examples and definitions for reference. Users can edit the examples to make them as their own unions.



Users can also find it under the DUT option in the project management area. Double click the new DUT to open it and start to edit the contents of the newly added DUT.



The structure format is stated as below: wordings in blue are the system keywords; wordings in black are the user-defined names and member names.

TYPE < User-defined Name>:

UNION

<Member 1 Name>: <Data Type>;

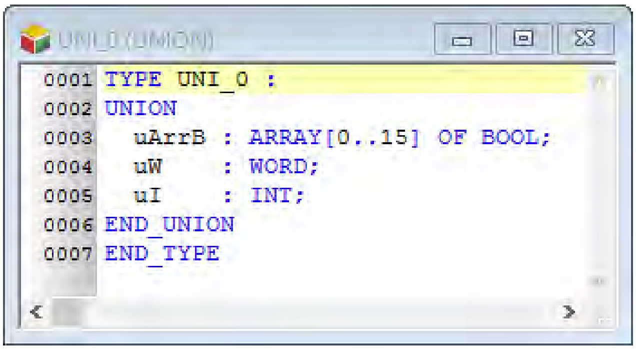
<Member 2 Name>: <Data Type>;

...

<Member N Name>: <Data Type>;

END_UNION

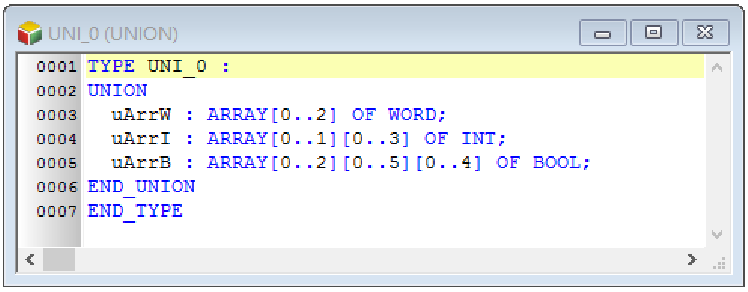
END_TYPE



● **User-defined Name:** Set as the default name, which cannot be modified. Otherwise, an error will be reported.

● **Member Name:** Define the member name.

● **Data Type：** Define the data type for members, such as BOOL, WORD, DWORD, LWORD, INT, DINT, LINT, REAL, LREAL, ARRAY, or another STRUCTURE or,ENUMERATION. (For DVPxxMC/ AS5xx series, more data types include BYTE, SINT, USINT, UINT, UDINT, ULINT, TIME, DATE, TOD, DT, STRING.) As the image shown below, when the member data type is ARRAY, the format will be **ARRAY [0..n] OF <data type>;** the maximum for n value is 65535. (For DVPxxMC/ AS5xx series, the maximum for n value is2147483647.) If the member data type is Structure, write another structure name. But if the data type is ARRAY, users cannot import ARRAY again. The system supports multi-dimensional array, up to three-dimension. The format of a two-dimensional array is **ARRAY [0..n] [0..n] OF <data type>** and the three-dimensional array is **ARRAY [0..n] [0..n] [0..n] OF < data type>.** As the image shown below:



The naming rules of user-defined names and member names are stated as below.

● A user-defined name cannot be the same as names of other user-defined data types.

● The repetition of a member name based on the same user-defined is not allowed.

● User-defined names and member names can be composed of 30 characters at most, and a Chinese character takes two characters.

● It is not allowed to use a name reserved by the system, e.g. an instruction code, a device name, or a name given a special significance. However, if a name reserved by the system is a part of the names of a structure or an element, it is then a legal name. For example, "M0" is an illegal name, but "_M0" is a legal name.

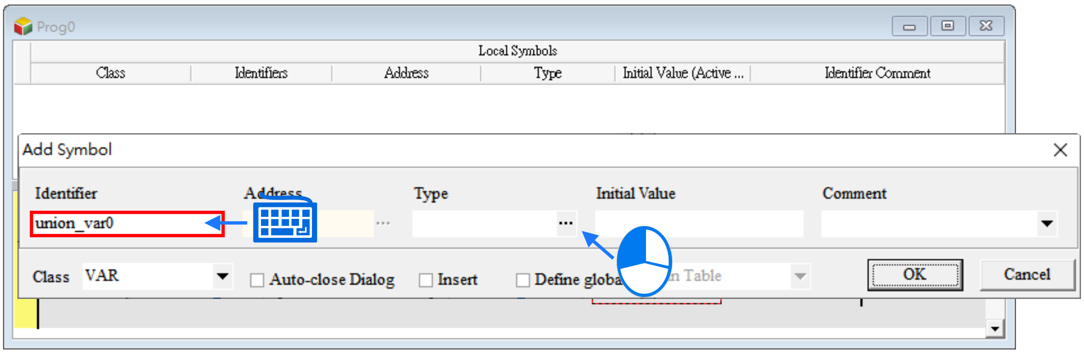
● User-defined names and member names cannot contain space. For example, "INPUT CH0" is an illegal name.

● User-defined names and member names can contain underline but it is not allowed to use 2 underlines in a row or put it in the end. For example, "INPUT_CH0"is acceptable, but "INPUT__CH0" and "INPUT_CH0_" are illegal.

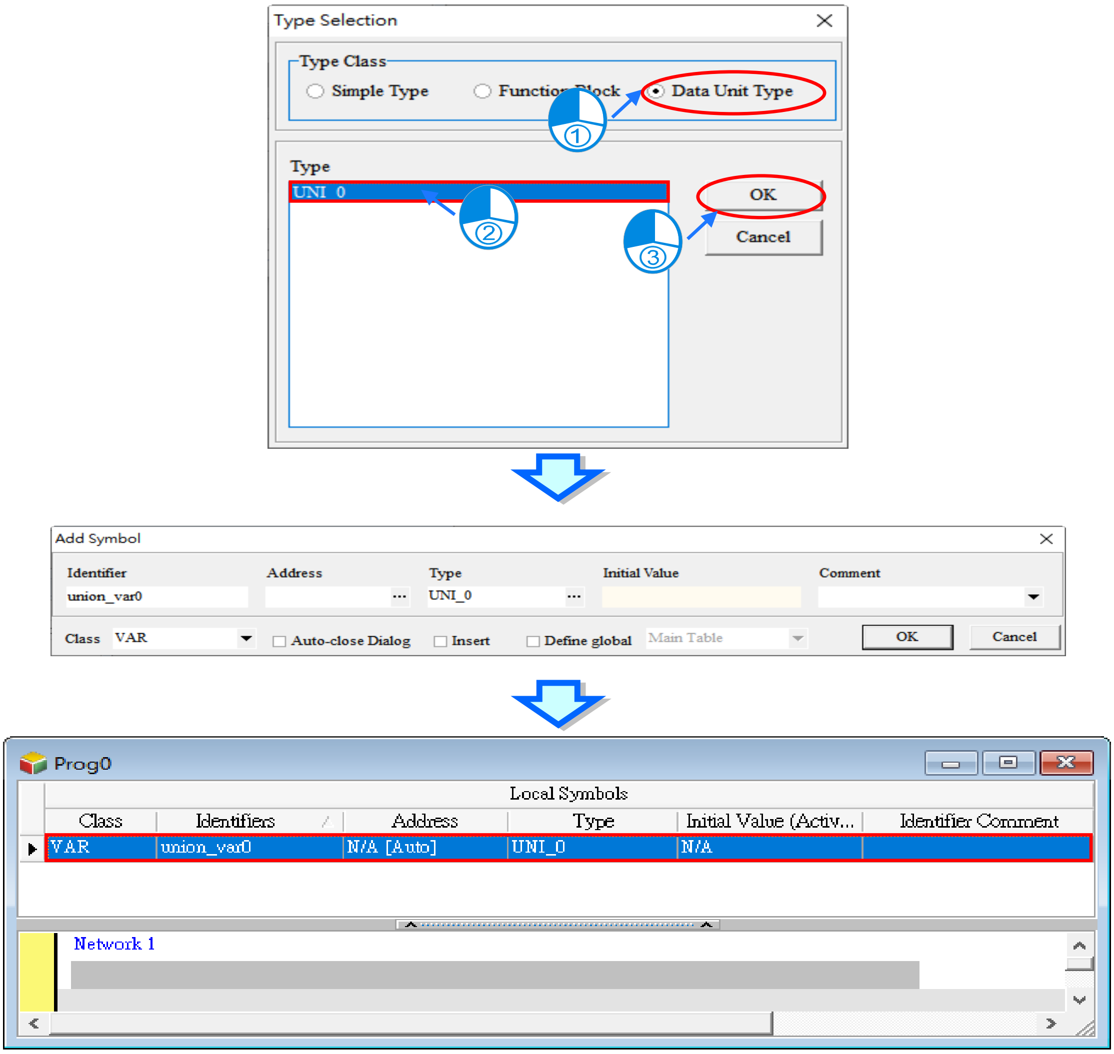
● User-defined names and member names cannot contain special characters, including *, #, ?, \, %, @ and more.

8.4.3 Using an Union Variables

After the creation of the structure type is done, users can declare the variable symbol in the Local Symbols page. Open the Add Symbol window from the Global and local symbol table and input the identifier and then click on the right as the image shown below.

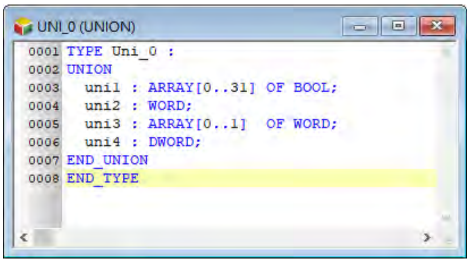


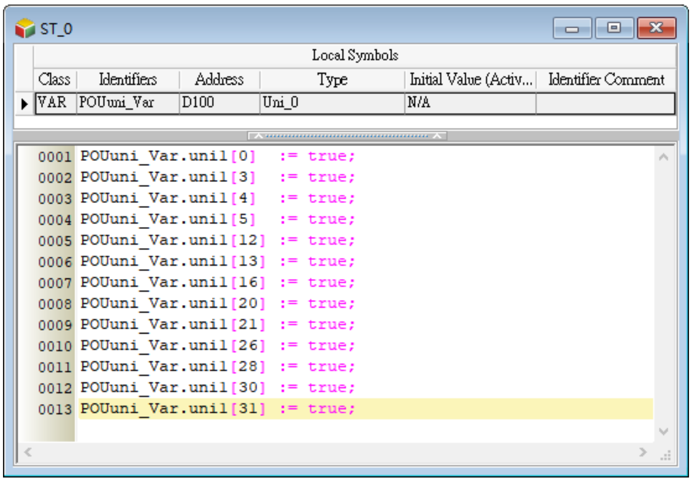
Select the Data Unit Type, and the declared union data type, then click OK to add a new symbol.



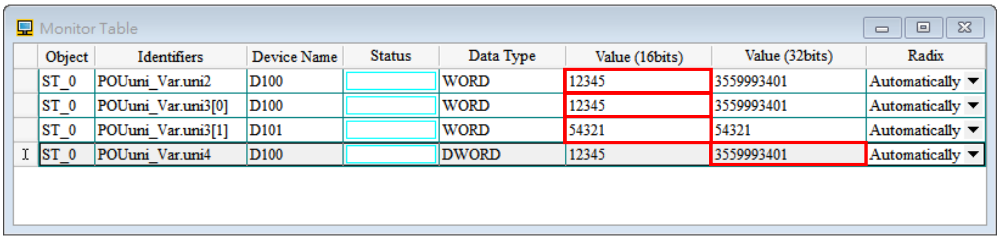
8.4.4 Application of Union

The following example shows that there are four member (uni1~uni4) included in a union. The data type of the symbol **POUuni_Var** is Uni_0. Then change the value of **POUuni_Var.uni1** with the program as below shown.





And see if the values of **POUuni_Var.uni2** and other members are changed via Monitor Table.



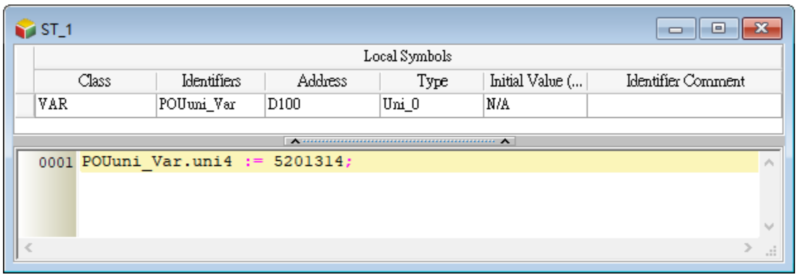
Monitor Table

Object	Identifiers	Device Name	Status	Data Type	Value (16bits)	Value (32bits)	Radix
ST_0	POUuni_Var.uni2	D100		WORD	12345	3559993401	Automatically
ST_0	POUuni_Var.uni3[0]	D100		WORD	12345	3559993401	Automatically
ST_0	POUuni_Var.uni3[1]	D101		WORD	54321	54321	Automatically
ST_0	POUuni_Var.uni4	D100		DWORD	12345	3559993401	Automatically

You can find the corresponding values of each member (uni1~uni4) from the table below.

POUuni_Var																																	
Member Name	Data Type	Values																															
		WORD 1																WORD 0															
		Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
uni1	**ARRAY**	**1**	**1**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**1**
uni2	**WORD**																	**12,345**															
uni3	**ARRAY**	**54,321**																**12,345**															
uni4	**DWORD**	**3,559,993,401**																															

The second example to change the value of **POUuni_Var.uni4** is shown as follows.



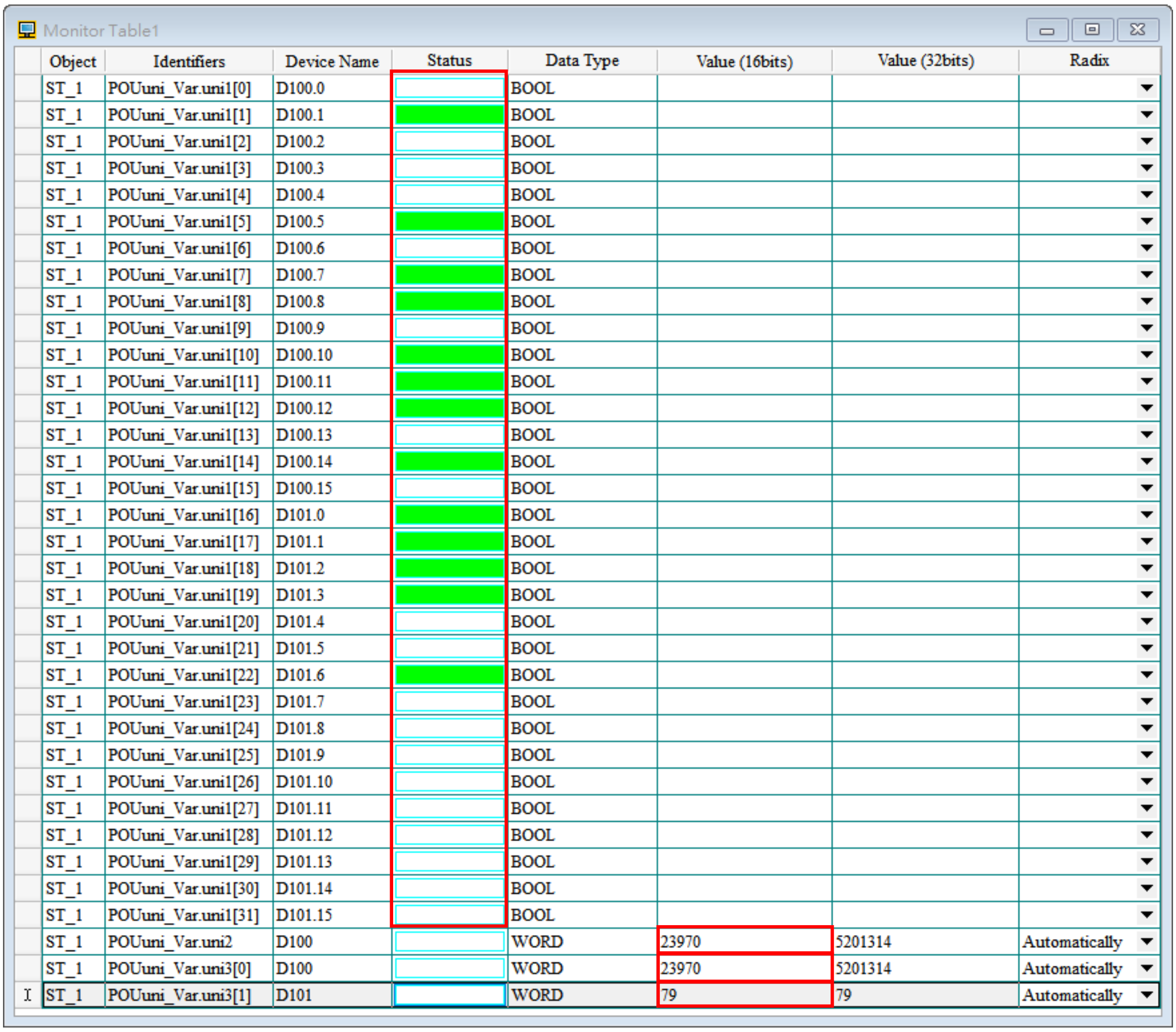
ST_1

Local Symbols

Class	Identifiers	Address	Type	Initial Value (...	Identifier Comment
VAR	POUuni_Var	D100	Uni_0	N/A	

```
0001 POUuni_Var.uni4 := 5201314;
```

Observing values via the monitor table, you'll notice all values changed because of the change on a member's value.



Monitor Table1

Object	Identifiers	Device Name	Status	Data Type	Value (16bits)	Value (32bits)	Radix
ST_1	POUuni_Var.uni1[0]	D100.0		BOOL			
ST_1	POUuni_Var.uni1[1]	D100.1		BOOL			
ST_1	POUuni_Var.uni1[2]	D100.2		BOOL			
ST_1	POUuni_Var.uni1[3]	D100.3		BOOL			
ST_1	POUuni_Var.uni1[4]	D100.4		BOOL			
ST_1	POUuni_Var.uni1[5]	D100.5		BOOL			
ST_1	POUuni_Var.uni1[6]	D100.6		BOOL			
ST_1	POUuni_Var.uni1[7]	D100.7		BOOL			
ST_1	POUuni_Var.uni1[8]	D100.8		BOOL			
ST_1	POUuni_Var.uni1[9]	D100.9		BOOL			
ST_1	POUuni_Var.uni1[10]	D100.10		BOOL			
ST_1	POUuni_Var.uni1[11]	D100.11		BOOL			
ST_1	POUuni_Var.uni1[12]	D100.12		BOOL			
ST_1	POUuni_Var.uni1[13]	D100.13		BOOL			
ST_1	POUuni_Var.uni1[14]	D100.14		BOOL			
ST_1	POUuni_Var.uni1[15]	D100.15		BOOL			
ST_1	POUuni_Var.uni1[16]	D101.0		BOOL			
ST_1	POUuni_Var.uni1[17]	D101.1		BOOL			
ST_1	POUuni_Var.uni1[18]	D101.2		BOOL			
ST_1	POUuni_Var.uni1[19]	D101.3		BOOL			
ST_1	POUuni_Var.uni1[20]	D101.4		BOOL			
ST_1	POUuni_Var.uni1[21]	D101.5		BOOL			
ST_1	POUuni_Var.uni1[22]	D101.6		BOOL			
ST_1	POUuni_Var.uni1[23]	D101.7		BOOL			
ST_1	POUuni_Var.uni1[24]	D101.8		BOOL			
ST_1	POUuni_Var.uni1[25]	D101.9		BOOL			
ST_1	POUuni_Var.uni1[26]	D101.10		BOOL			
ST_1	POUuni_Var.uni1[27]	D101.11		BOOL			
ST_1	POUuni_Var.uni1[28]	D101.12		BOOL			
ST_1	POUuni_Var.uni1[29]	D101.13		BOOL			
ST_1	POUuni_Var.uni1[30]	D101.14		BOOL			
ST_1	POUuni_Var.uni1[31]	D101.15		BOOL			
ST_1	POUuni_Var.uni2	D100		WORD	23970	5201314	Automatically
ST_1	POUuni_Var.uni3[0]	D100		WORD	23970	5201314	Automatically
ST_1	POUuni_Var.uni3[1]	D101		WORD	79	79	Automatically

You can find the corresponding values of each member (uni1~uni4) from the table below.

POUuni_Var																																	
Member Name	Data Type	Values																															
		WORD 1																WORD 0															
		Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
uni1	ARRAY	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	0	1	0	1	1	1	0	1	1	0	1	0	0	0	1	0
uni2	WORD																	23,970															
uni3	ARRAY	79																23,970															
uni4	DWORD	5,201,314																															

8.4.5 Built-in Members and Data Type

Partial models support built-in union data type available to users, please find the table below.

MODELS / UNION	AS	AH5x0	AH5x1	AH560	AHxxEMC	DVP	AS5xx DVPxxMC
Union16	V	V	V	V	V		
Union32	V	V	V	V	V		
Union64		V	V	V	V		

The inbuilt union includes members and data types. Users can make choices under user-defined type while declaring symbols.

Union / Member	Union16	Union32	Union64
uArrB	ARRAY [0..15] OF BOOL	ARRAY [0..31] OF BOOL	ARRAY [0..63] OF BOOL
uW	WORD		
uI	INT		
uArrW		ARRAY [0..1] OF WORD	ARRAY [0..3] OF WORD
uArrI		ARRAY [0..1] OF INT	ARRAY [0..3] OF INT
uDW		DWORD	
uDI		DINT	
uR		REAL	
uArrDW			ARRAY [0..1] OF DWORD
uArrDI			ARRAY [0..1] OF DINT
uArrR			ARRAY [0..1] OF REAL
uLW			LWORD
uLI			LINT
uLR			LREAL

MEMO

Chapter 9. Axis

Table of Content

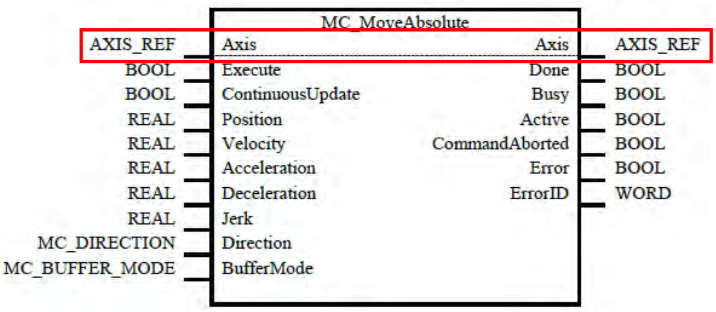
9.1 Axis

Please find below table for models supporting axis-related functions.

Models / Functions	AHxxEMC	DVPxxMC/AS5xx
Axis Parameter	**V**	**V**
Monitor & Test Run	**V**	**V**
Backup/ Restore Servo Parameter	**V**	
Auto Gain Tuning	**V**	**Only supported by DVP50MC/DVP50MC-06/ DVP50MC-04S/DV50MC-16S/ AS516E-B/AS532EST/ AS564EST**

9.1.1 The Meaning of Axis

As defined in the PLCopen MC standard, **Axis** on the software is the VAR_IN_OUT parameter of the STRUCTURE data type used in motion control function blocks. **Axis** provides a connection between the motion control in the program and the physical output device. Axis stores various motion control information such as position, velocity and so on. Below is an example of one function block defined in the PLCopen MC standard and AXIS_REF being the axis defined in the standard.



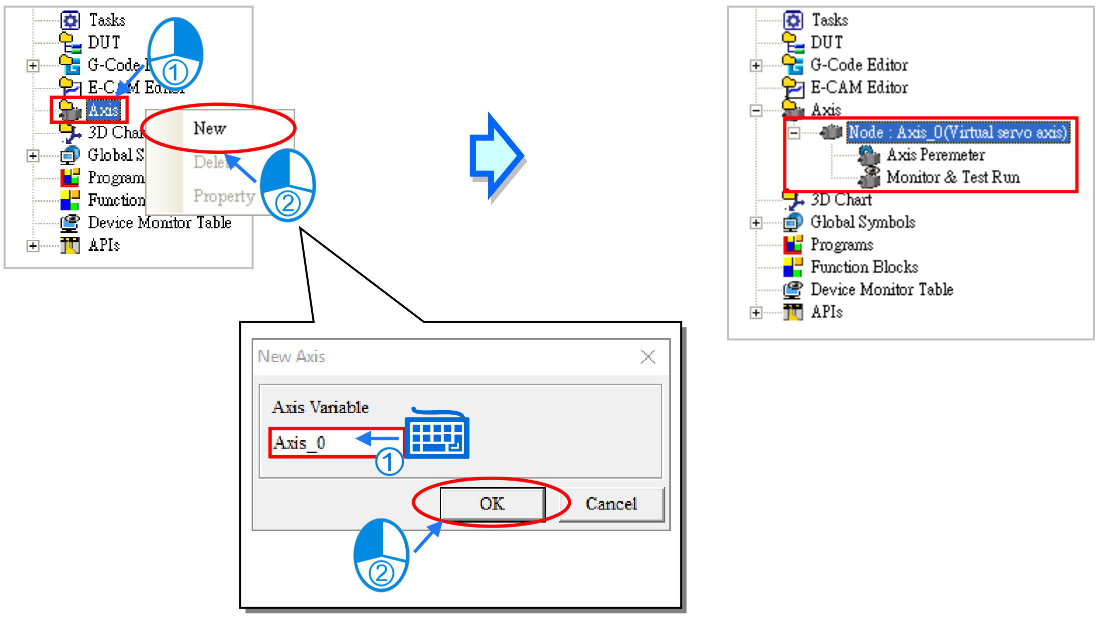
In the actual application, different motion function blocks are used to control an axis and then the target servo motor receives the output to achieve the motion control.

***. Currently the DVPxxMC/AS5xx series does not follow the principle for VAR_IN_OUT parameter of the STRUCTURE data type used in the Axis, but uses the VAR_INPUT of the STRUCTURE data type instead.**

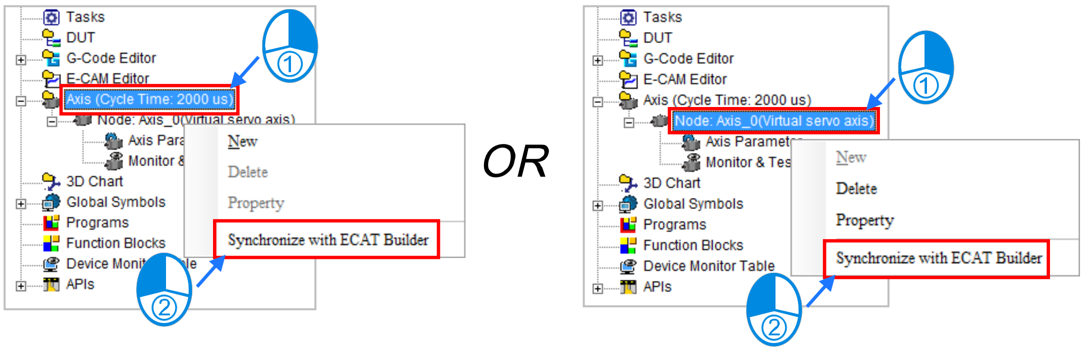
9.1.2 Creating a New Axis

9.1.2.1 AHxxEMC Series PLC - New Axis Settings

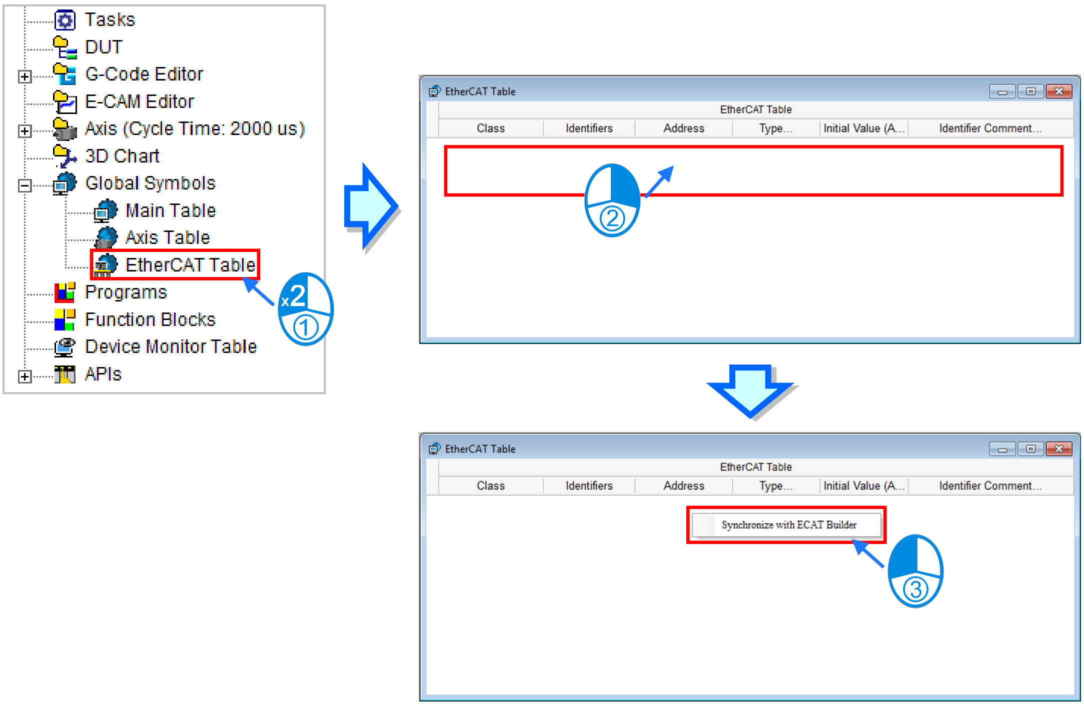
Right-click **New** from the context menu in Project area. The **New Axis** window will appear. Type an axis variable name under **Axis Variable** and click **OK** button in the following window to add the node item under **Axis** in the project management area. Make sure that the axis variable name should not be the same as other global symbol names or local symbol names. The **Cycle Time** shown next to the Axis in the project management is the cycle time of ECAT Builder master station, please refer to section **3.2 Master Setting** of the ECAT Builder User Manual for more information.



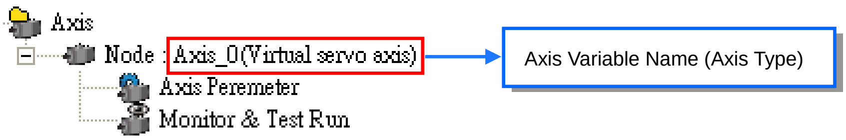
Users can synchronize the **Axis** information (including axis parameter, node information) which is saved in the ECAT Builder, then right-click the Axis in the project management area and select **Synchronize with ECAT Builder** on the context menu to display the synchronized information.



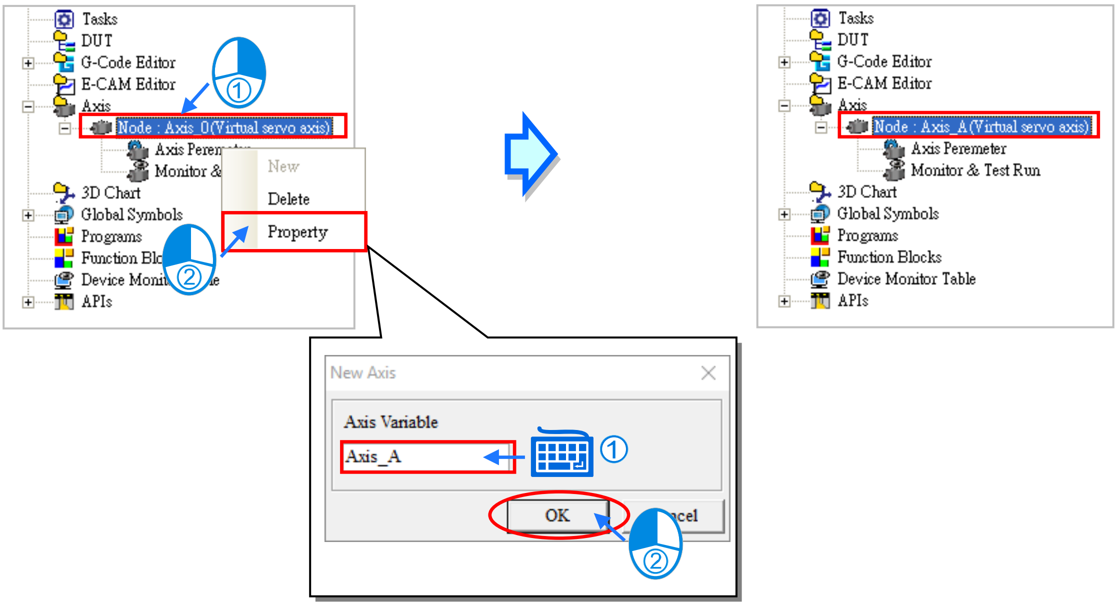
Users can also right-click the EtherCAT Table and select **Synchronize with ECAT Builder** on the context menu to view synchronized information of the ECAT Builder, Axis and EtherCAT Table.



The full name of the node item under **Axis** contains the axis variable name and axis type mentioned above. The axis type here which is the same as that in the parameter setting can be the EtherCAT slave name and the station address of a virtual or real axis. There are two sub-items, **Axis Parameter** and **Monitor & Test Run** under every node. Refer to the following sections for more information.

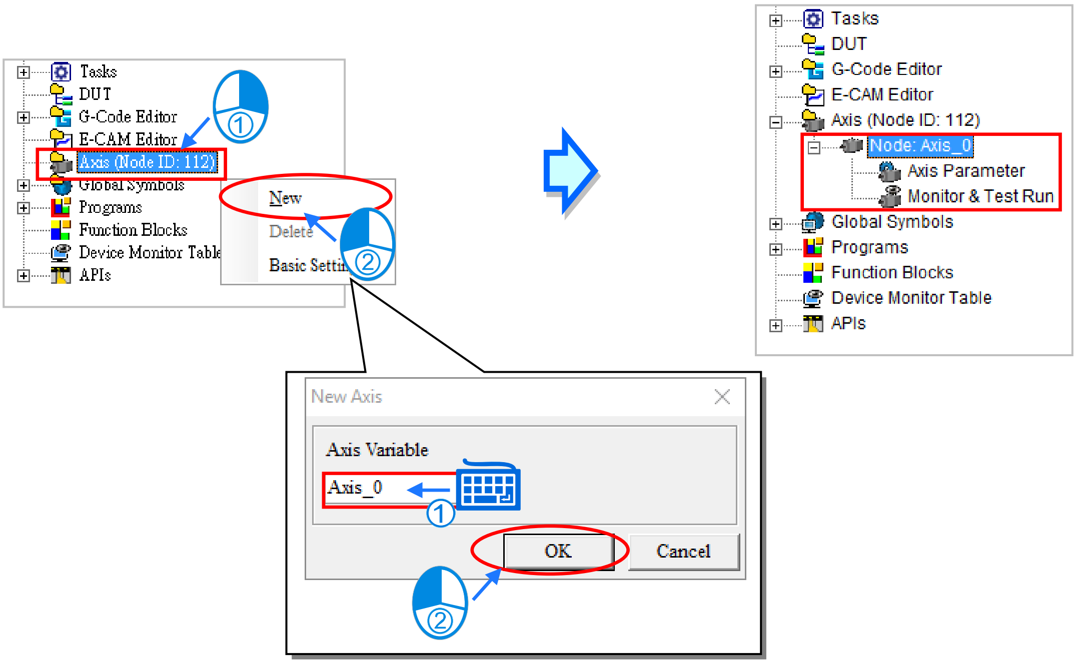


Right-click the axis which has been built and then select **Delete** button on the context menu to delete the axis or select **Property** button to reset the axis variable name.

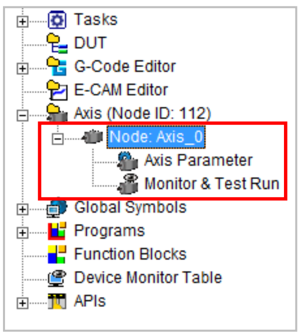


9.1.2.2 DVPxxMC / AS5xx – Create Axis & Basic Settings

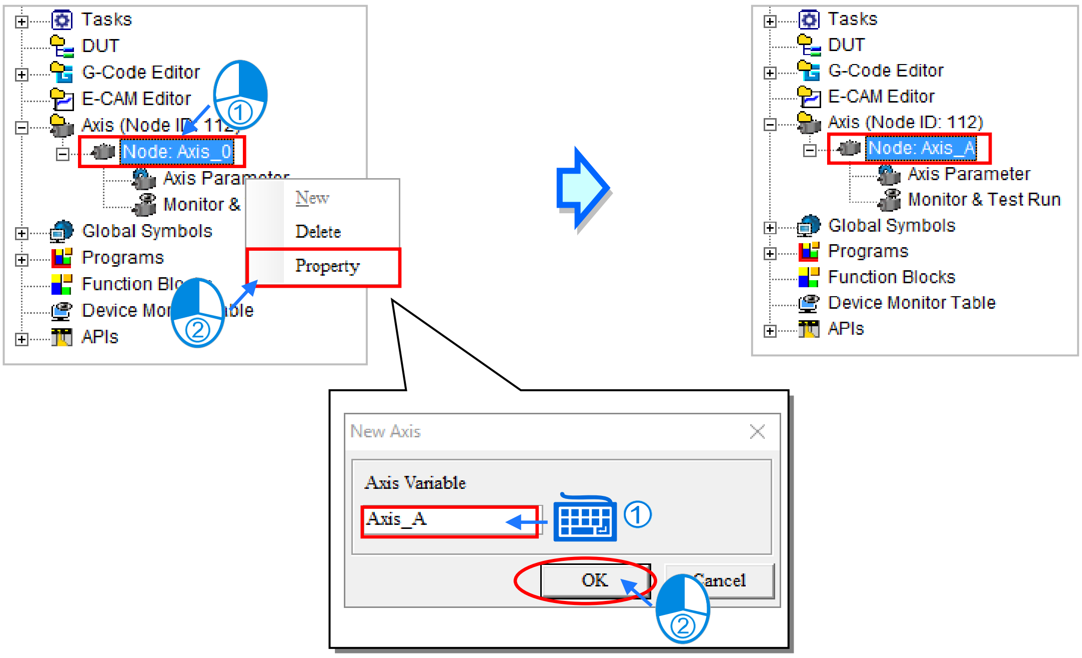
Right-click **Axis** in the Project area and then click **New** on the context menu. The **New Axis** window will appear. Type an axis variable name under **Axis Variable** and click **OK** button in the following window to add the node item under **Axis** in the project management area. Currently, the DVPxxMC and AS5xx series provide maximum number of 32 axes and supports up to 24 real axes. For settings on real axis and virtual axis, please refer to section 9.2.1.2. Make sure that the axis variable name should not be the same as other global symbol names or local symbol names. On the right side of the Axis items is **Node ID:112**, it is the station number of motion controller, default setting is 112 and cannot be changed.



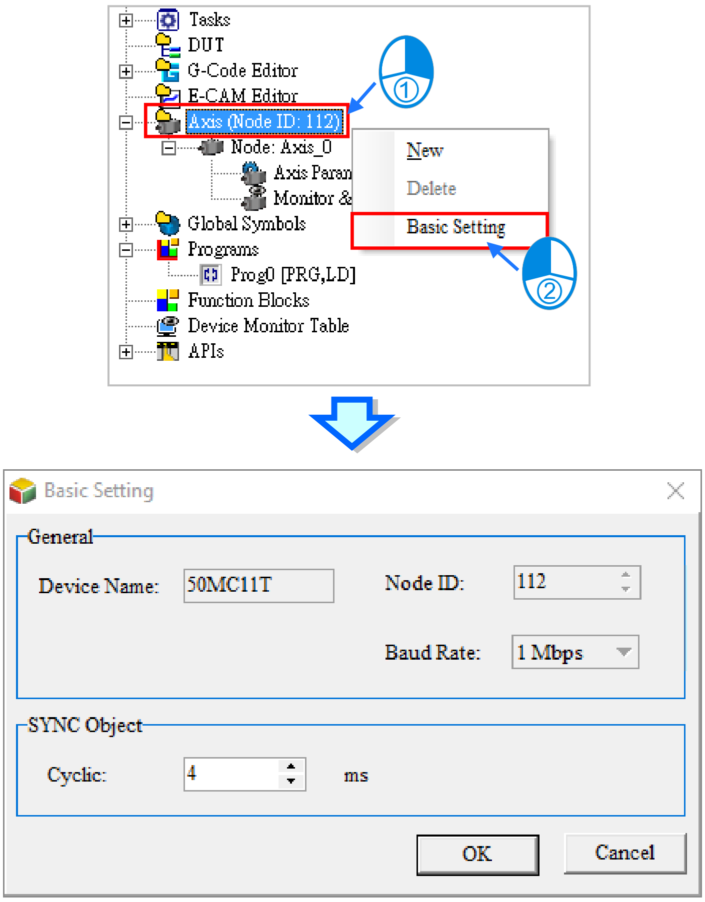
The Axis name is shown next to the Node item and contains two sub-items- **Axis Parameter** and **Monitor &Test Run.** Please view the following chapters for more details.



Right-click the axis which has been built and then select **Delete** button on the context menu to delete the axis or select **Property** button to reset the axis variable name.

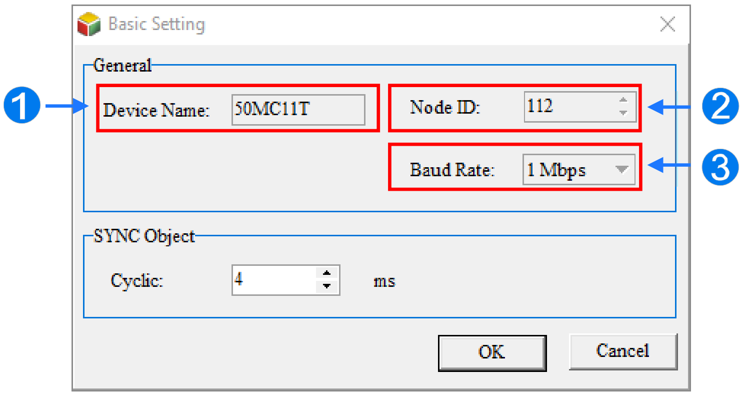


Right-click the Axis to select **Basic Setting** for adjusting axis parameter settings.



The Basic Setting window contains two items- **General** and **SYNC Object** and descriptions are introduced below.

- **General**

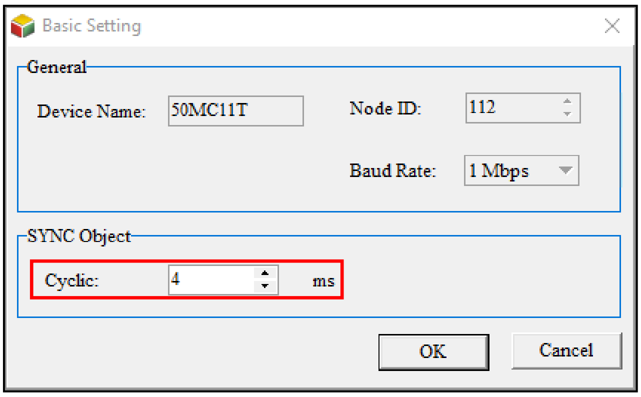


❶ Device Name: Device name for project by default and cannot change.

❷ Node ID: Default is 112 and cannot change.

❸ Baud Rate: The baud rate of CANMotion in HWCONFIG. For more information on CANMotion baud rate setting, please refer to section 3.4.2.

- **SYNC Object**



Cyclic: Represents setting the synchronous cycle time for the master to transmit a new datagram. This is an important motion control parameter. If the cycle time is set wrong, it will cause alarm AL303/AL302/ AL301 or errors in servo drives during the network communication cycle.

The Cyclic starts by scanning the motion control program and use algorithm to calculate the motion data and send the information to all axes. It can be identified as a total time for motion programming and communication between DVPxxMC and all servo drives.

The maximum execution time for motion programming is set as the execution time for motion programming time (unit: ms). Since 1000 microseconds equals to 1 millisecond. It is suggested to round up the unit (ms) for applications. For example, the maximum execution time for motion programming is 2567 microseconds and equals to 2.5 milliseconds. Thus, the execution time is rounded to 3 milliseconds.

The estimated communication time between DVPxxMC and servo drives is 0.5 milliseconds per axis. It is suggested to round up the unit (ms) for applications. For example, the communication time for five servo drives is 5*0.5 milliseconds and equals to 2.5 milliseconds. Thus, the execution time is rounded to 3 milliseconds.

Calculation formula: Cyclic (ms) = round the max. execution time (ms) + communication time between DVPxxMC and servo drives (ms) + 1 (reserved time for program change) (ms).

For program change, the reserved time is set between 1 to 2 milliseconds so that the synchronous time setting is not affected by increased programming time.

Example:

The maximum execution time for five servo drives is 1634 microseconds. The reserved time for program change is 1 millisecond.

Cyclic = 2 milliseconds (round the max. execution time of 1634 microseconds to an integer) + 3 milliseconds (round 5*0.5 to an integer) + 1 millisecond (reserved time to program) = 6 milliseconds.

For DVPxxMC and AS5xx series, the following table provides axis related system structure:

Member Variable	Data Type	Function Description
CmdPos	LREAL	Command position (unit: unit)
CmdVel	LREAL	Command velocity (unit: unit/sec)
CmdAcc	LREAL	Command acceleration (unit: unit/sec)
CmdTrq	INT	Command torque (per thousand (1‰) of rated torque)
ActPos	LREAL	Actual position (unit: unit)
ActVel	LREAL	Actual velocity(unit: unit/sec)
ActTrq	INT	Actual torque (per thousand (1‰) of rated torque)
ActCur	INT	Actual current

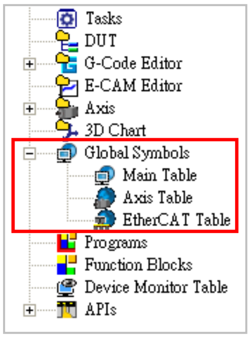
9.1.3 Main Table and Axis Table under Global Symbols

For management of the symbols by classification, there are different sub-items including **Main Table**, **Axis Table** and other network symbol table under **Global Symbols**.

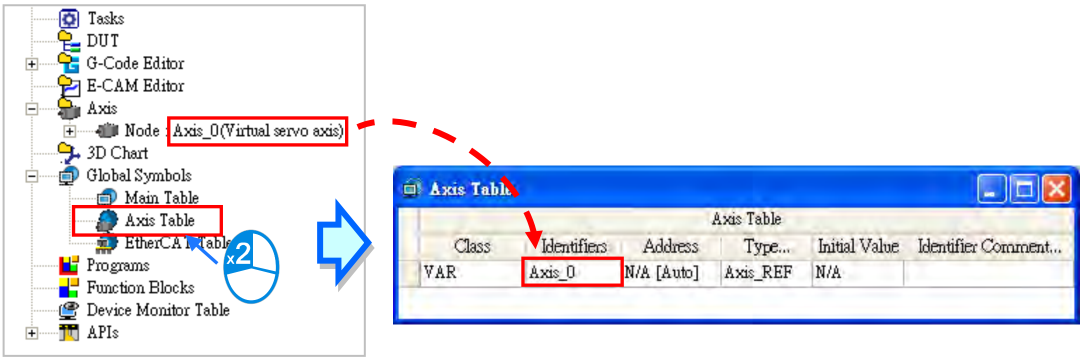
Main Table, the global symbols of other models, is used for editing the global symbols.

Axis Table lists all axis variable names which have already been created.

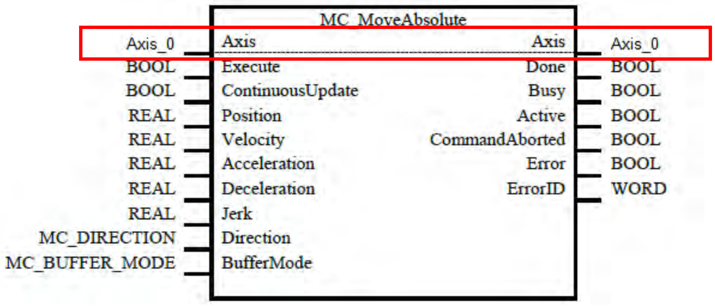
Other network symbol table contains the symbols in other network configuration software such as ECAT Builder supported by the model. For details on other network configuration software, refer to operation manuals of the software.



After the axis is created, the identifier of the axis variable name will appear automatically in **Axis Table** under **Global Symbols** and the axis symbol table cannot be edited. Double-click **Axis Table** to open the **Axis Table** window.



The axis variable symbol can be used for the pins of PLCopen MC function blocks and Delta function blocks as the example shown below.



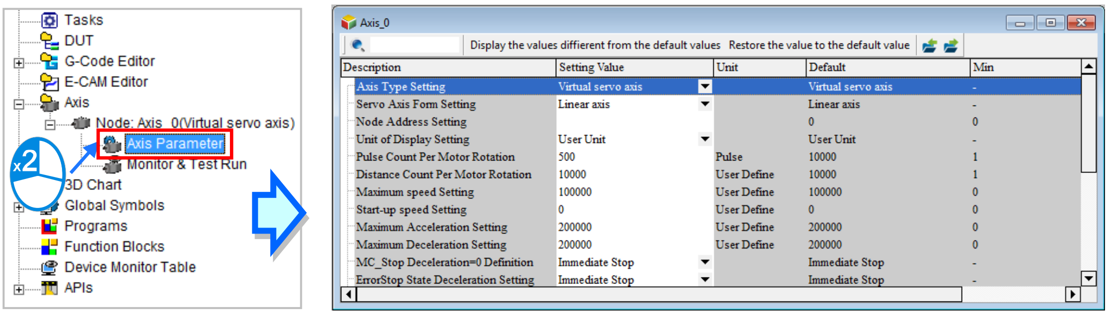
9.2 Axis Parameter and Monitor & Test Run

9.2.1 Axis Parameter

9.2.1.1 AHxxEMC Series Parameter Settings

The parameter setting pop-up window **AxisParaForm** appears after the node item is created. Users can double-click **Axis Parameter** under the axis node item to open the **AxisParaForm** window once more after the window is closed. All settings on motion control of the axis are listed in the window as below. For details, refer to the user manuals of modules.

The set values can be downloaded to the PLC with the project together after the setting is done.



- **Axis Type Setting**

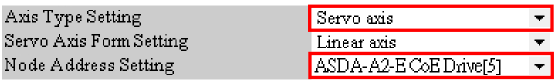
Users can set the real axis which produces actual output to the drive assembly or the virtual servo axis on which the operation is done in the controller.

- **Servo Axis Form Setting**

The axis can be set as **Linear axis** or **Rotary axis**. The position value will be constantly increased (or decreased) when the linear axis rotates toward the positive direction (or negative direction). The position value will be calculated again from minimum (maximum) value after the axis which rotates toward the positive direction (or negative direction) reaches the limit value.

- **Node Address Setting**

If **Real axis** is selected in the **Axis Type Setting** box, the content in **Node Address Setting** must be chosen by the servo names and station addresses in ECAT Builder. It means that the axis is the set EtherCAT servo drive to which the actual output is delivered. The node address is selected as the EtherCAT slave, ASDA-A2-E CoE Drive [5] (the station address) as below. The drop-down menu of the **Node Address Setting** is updated when the setting information is saved in the ECAT Builder and then close both ECAT Builder and HWCONFIG; Or the updated setting will take place when the **axis** information synchronizes with the ECAT Builder, please refer to **section 9.1.2** in this chapter for more detail.



- **Unit of Display Setting**

Users can select a system unit. The default unit is user unit.

- **Pulse Count Per Motor Rotation**

Users can set how many pulses the controller outputs for a motor to rotate.

- **Distance Count Per Motor Rotation**

Users can set the distance in an actual mechanism move whenever a motor rotates.

- **Maximum speed setting**

Users can set the upper limit of the speed of the axis.

- **Start-up speed setting**

Users can set the start-up speed for the axis to start running.

- **Maximum Acceleration Setting**

Users can set the upper limit of the acceleration of the axis.

- **Maximum Deceleration Setting**

Users can set the upper limit of the deceleration of the axis.

- **MC_Stop deceleration = 0 Setting**

Users can set the axis stopping method, when an error occurs or an instruction is executed. The option **Immediate Sto**p or **Deceleration Stop** can be selected.

- **Error Stop Deceleration Setting**

Users can set the axis stopping method, when the axis runs beyond the software limit set. The option **Immediate Stop** or **Deceleration Stop** can be selected.

- **Software Limit Enable Setting**

Users can set whether to enable or disable the software limit control and the limit values depend on the following two parameters.

- **Axis software positive limit Setting**

Users can set the positive software limit value of the axis, which is only applied to the linear axis.

- **Axis software negative limit Setting**

Users can set the negative software limit value of the axis, which is only applied to the linear axis.

- **Rotary Maximum Position Setting**

Users can set the maximum position of the rotary axis which moves toward the positive direction. The position value will be calculated again from the minimum value after the axis reaches the limit value.

- **Rotary Minimum Position Setting**

Users can set the minimum position of the rotary axis which moves toward the negative direction. The position value will be calculated again from the maximum value after the axis reaches the limit value.

- **Gear Ratio Numerator**

Users can set the numerator value of the electronic gear ratio.

- **Gear Ratio Denominator**

Users can set the denominator value of the electronic gear ratio.

- **Homing Acceleration**

The acceleration speed while homing is performed.

- **Homing Velocity**

The parameter is the speed while the homing is performed

- **Homing Closed Velocity**

While the homing is performed, the motor moves at the homing velocity at first. Then the motor starts to decelerate to this velocity and moves at this velocity when the trigger is close to the home signal.

- **Permitted Deviation**

The permitted deviation between the actual position and the command position

The axis parameter setting window provides the following tool bar for editing the axis parameter table.

- **Single Axis Start Immediately**

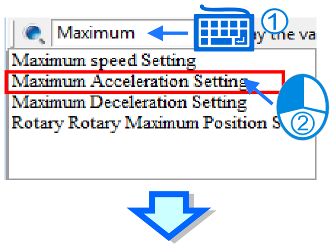
Users can select **Disable** or **Enable.** When single axis is enabled, it will enable motion immediately and not be affected by the CPU cycle time. Please refer to AHxxEMC Series PLC manuals for more information.

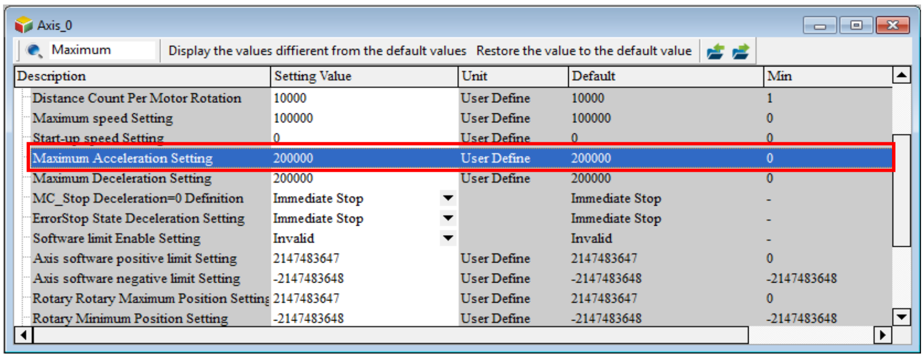
- **MC_CamIn Master Direction**

Users can select **Positive Direction** or **No Direction.** Under **Positive Direction,** the main axis moves backwards and this will halt the slave; Under No Direction, the slave is not affected by the main axis moving forward or backwards.

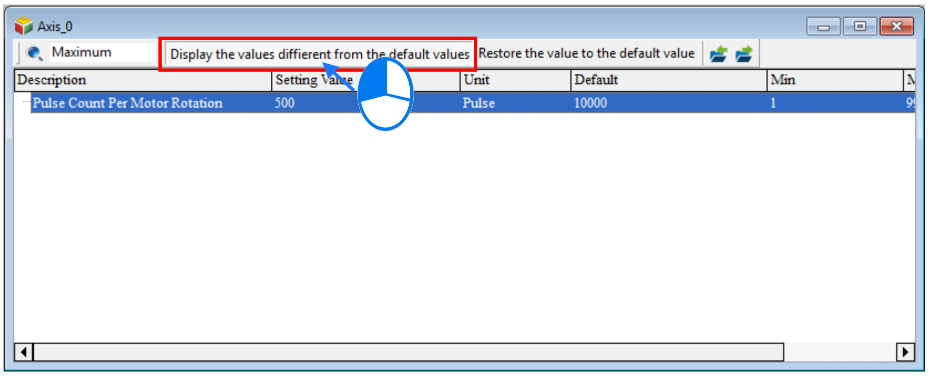
- **Search Tool**

  After a character string is typed, relevant character strings will be listed automatically. If one item in the list of relevant character strings is selected, the corresponding line in the table will be selected accordingly.





After the button Display the values diffierent from the default values is clicked, the parameter values different from the default values will be filtered out.



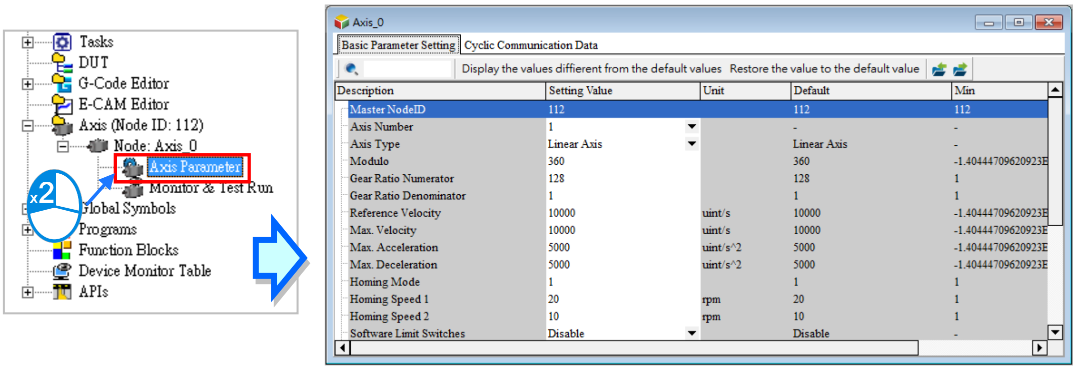
After the button Restore the value to the default value is clicked, all setting values will be restored to the default values.

If the button is clicked, current parameters can be exported to the specified path in the file format of .CSV.

If the button is clicked, the file at the specified path can be imported.

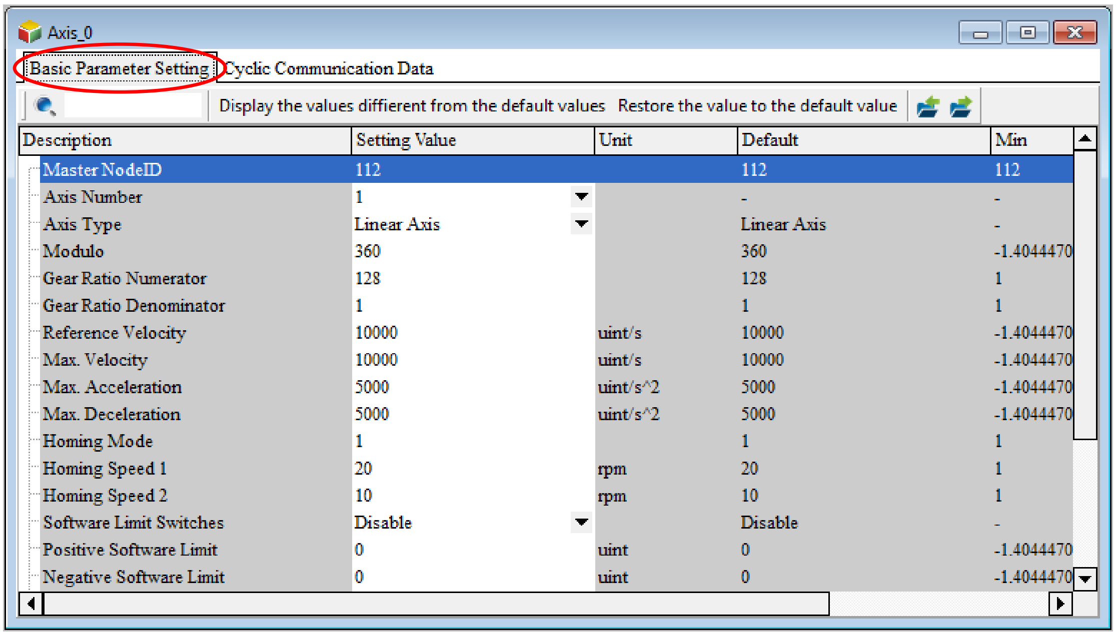
9.2.1.2 DVPxxMC/AS5xx Parameter Settings

For DVPxxMC/AS5xx series, the **Basic Parameter Setting** pop-up window of the axis appears once the node item is created. Users can double-click **Axis Parameter** under the node item to open the window once more when closed.



The basic parameter setting window contains two items - **Basic Parameter Setting** and **Cyclic Communication Data**, please refer to PLC series manuals for more information. The parameter settings for projects can be downloaded to the CPU.

- **Parameter Setting**



Description of the Parameter Settings:

Master Node ID

The master node ID set as 112 is permanent.

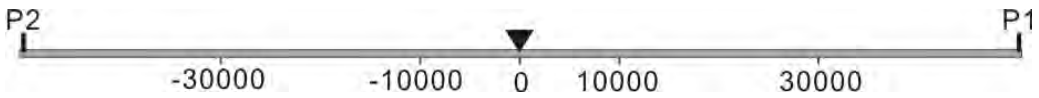
Axis Number

The setting value range is from 1~32.

Axis Type

The axis type include Linear Axis and Rotary Axis.

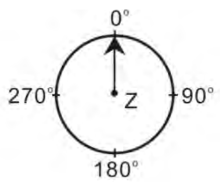
➢ Linear Axis Model

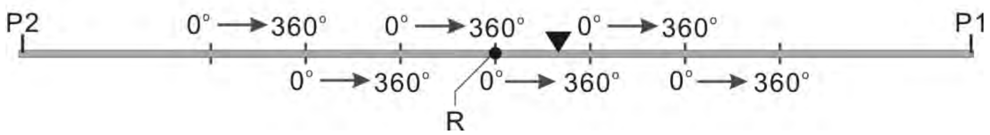


Note:

P1	Positive Limit
P2	Negative Limit
▼	Servo Position

➢ Rotary Axis Model (“modulo”: 360)





Note:

P1	Positive Limit
P2	Negative Limit
▼	Servo Position
R	Homing Position
Z	Servo Motor Shaft

Modulo

The cycle is used for equally dividing the actual position of the actuator.

E-gear Ratio Numerator

This parameter and gear ratio denominator sets the motor pulse number per round.

E-gear Ratio Denominator

This parameter and gear ratio numerator sets the motor pulse number per round.

Reference Velocity

A temporary parameter that does not affect the functions of the controller.

Max. Velocity

It sets the max. velocity of axis connection to a device

Max. Acceleration

A temporary parameter that does not affect the functions of the controller.

Max. Deceleration

A temporary parameter that does not affect the functions of the controller.

Homing Mode

Users can set the homing mode range from 1~35. Please refer to DVP15MC manuals for more detail.

Homing Speed 1

The speed from homing to finding the homing switch

Homing Speed 2

The speed after finding the homing switch to machine homing.

Software Limit Switches

Users can select **Enable** or **Disable**. If software limit switch is enabled and the axis actuator position reaches positive limit or negative limit setting, motion instruction is wrong and stops

Positive Software Limit

It refers to the positive direction of an axis

Negative Software Limit

It refers to the negative direction of an axis

Deviation Switch

It sets the deviation detected between command position and feedback position. When the deviation switch is enabled, the controller detects the deviation between command position and feedback position; if deviation switch is disabled, the controller will not detect for deviation between command and feedback positions.

Permitted Deviation

It refers to the deviation between the command position and feedback position

Gearbox Input Rotation

This parameter and gearbox output rotation decides the mechanical gear ratio.

Gearbox Output Rotation

This parameter and gearbox input rotation decides the mechanical gear ratio.

Units Per Rotation

The number of units which the actuator moves while gearbox output rotates for one circle.

Axis Mode

This parameter sets the **real axis** to read the actual position of servo components, the **virtual axis** to calculate by a controller and the **encoder axis** to perform with an encoder.

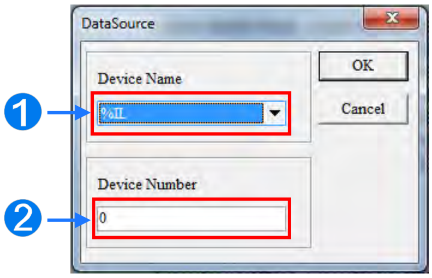
Encoder Axis Mode

Users can select **Encoder Axis** from the **Axis mode** and mode options include incremental encoder 1, incremental encoder 2, absolute encoder and data source.

Mode	Function
Incremental Encoder 1	The data source is derived from incremental encoder 1
Incremental Encoder 2	The data source is derived from incremental encoder 2
Absolute Encoder	The data source is derived from absolute encoder
DataSource	The data source is derived from assigned device data

Encoder Axis Data Source

Users can select **DataSource** from the **Encoder Axis Mode** and left-click ... icon for DataSource setting window to appear as below.



❶ The drop-down list of Device Name include %IL, %QL and %ML.

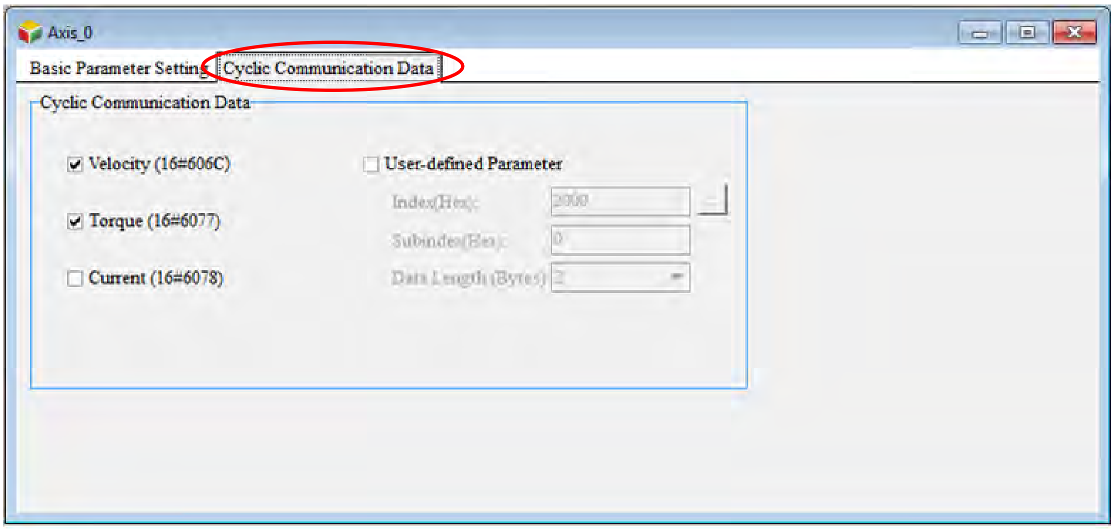
❷ This section is for Device Number settings

Under **DataSource**, the variation amount of the encoder axis position is the same as that of the variation amount for each scanning cycle of the assigned device value.

EtherCAT Node

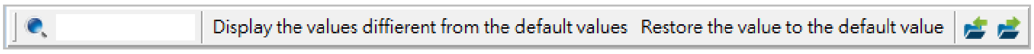
DVP50MC, DVP50MC-06 and AS516E-B support this item. The node number begins from 1001 to 1024.

- **Cyclic Communication Data**

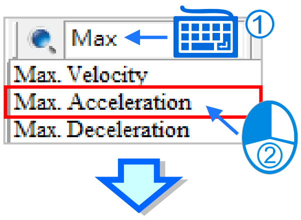


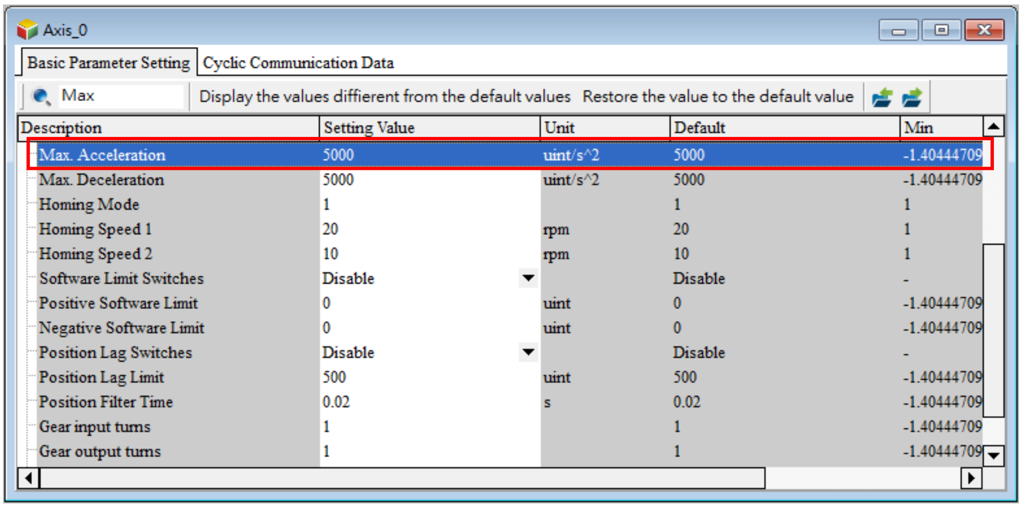
After users select Velocity, Torque, Current or User-defined Parameter, the servo drives operates in cyclic synchronous velocity and can transmit data length of up to 8 bytes regarding information data and cyclic communication data to the bus network. When the corresponding data are selected, users can monitor corresponding parameters from the Axis status.

The axis parameter settings window provided the following toolbar for editing the axis parameter table.

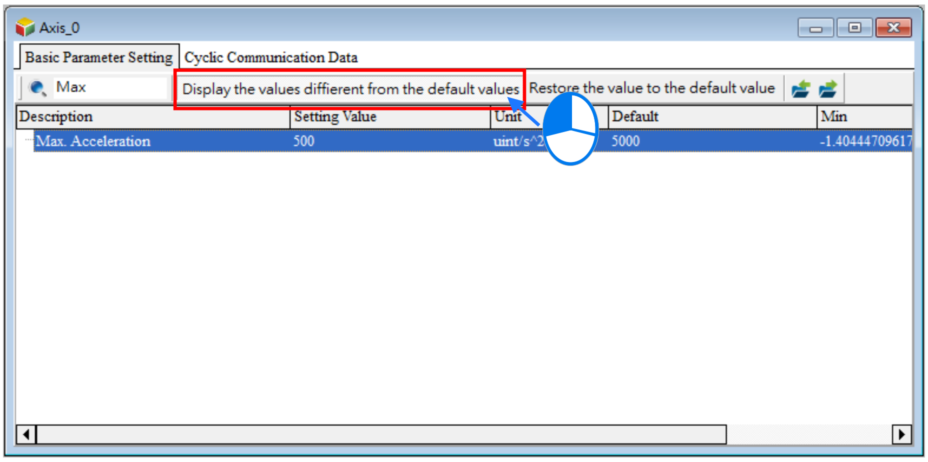


Search Tool: After a character string is typed, relevant character strings will be listed automatically. If one item in the list of relevant character strings is selected, the corresponding line in the table will be selected accordingly.





After the button Display the values diffierent from the default values is clicked, the parameter values different from the default values will be filtered out.



After the button Restore the value to the default value is clicked, all setting values will be restored to the default values.

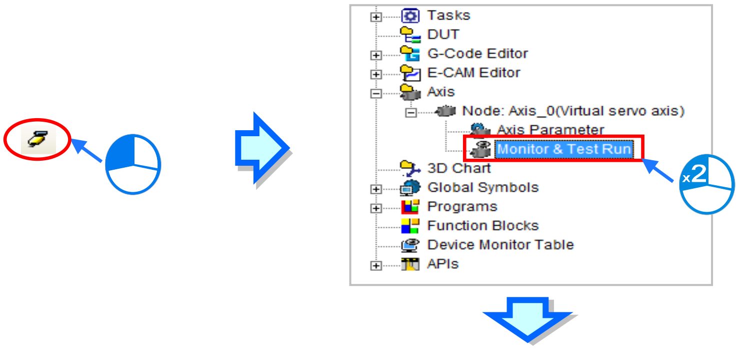
If the button  is clicked, current parameters can be exported to the specified path in the file format of .CSV.

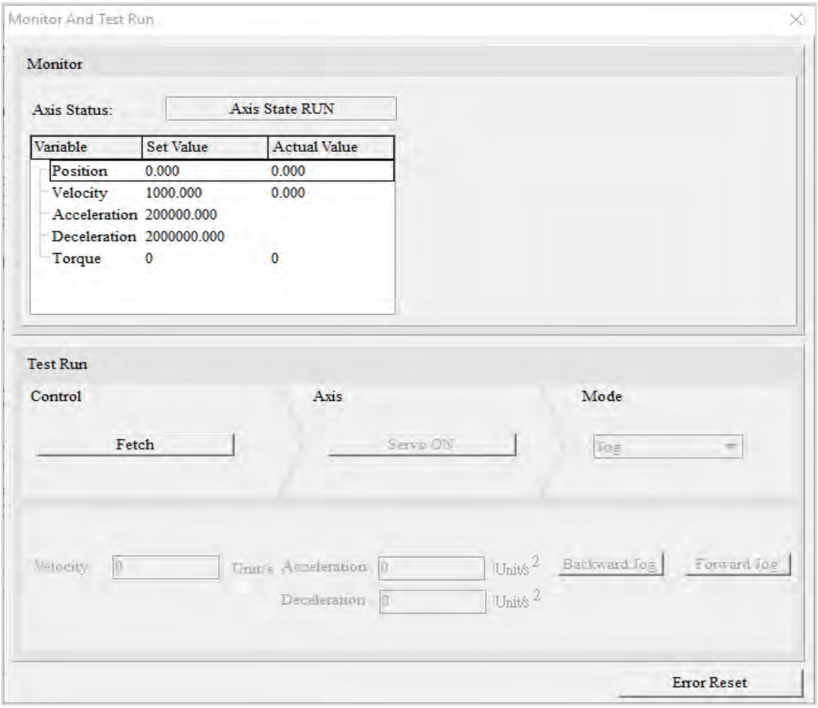
If the button  is clicked, the file at the specified path can be imported.

9.2.2 Monitor & Test Run

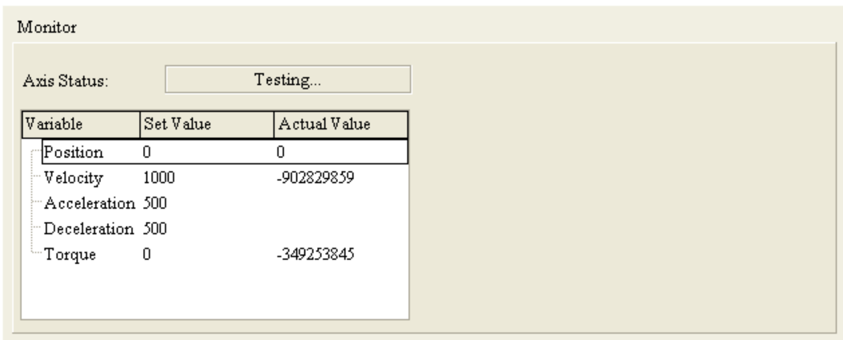
9.2.2.1 AHxxEMC Series Monitoring & Test Run

When ISPSoft is in online mode, double-click **Monitor &Test Run** to open the setting window.





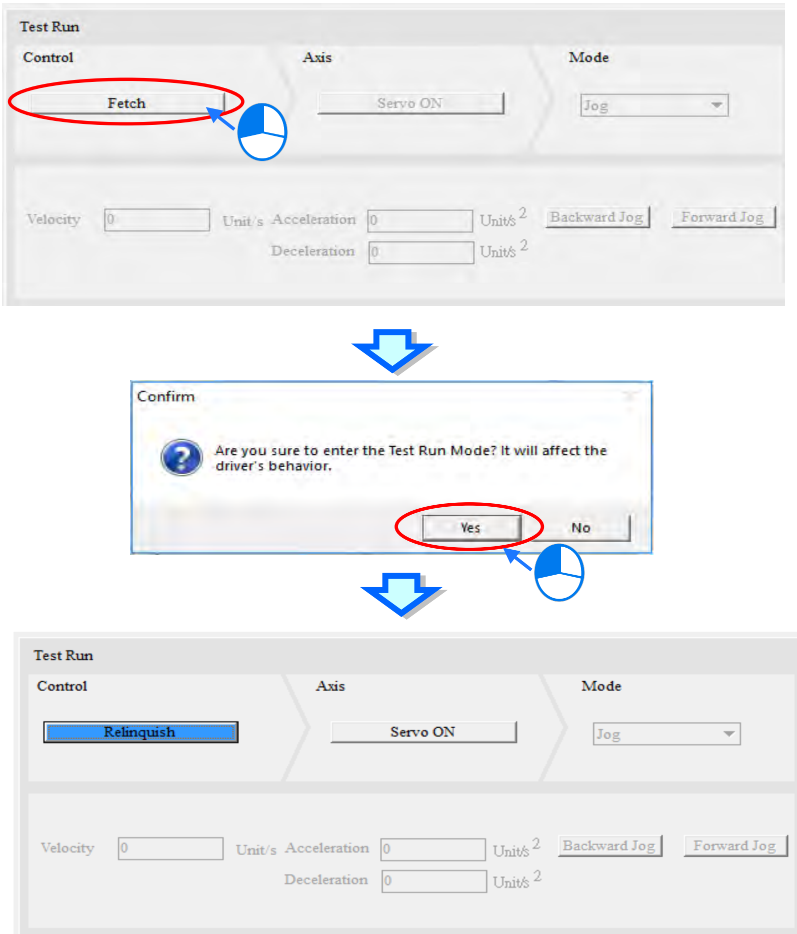
The upper part of the window above is a monitor window for displaying the axis state, the set value and the actual value of a variable such as positions and velocities.



The bottom part of the window is a test-run window for giving a test-run command to the axis after hardware connection is made in the period of the test.

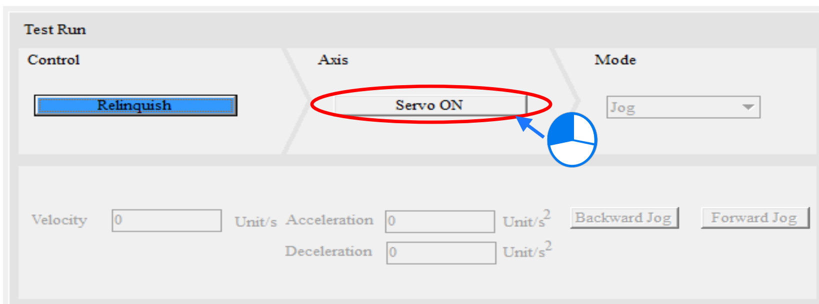
After the **Fetch** button is clicked, the **Confirm** window will appear for confirmation of the control over the axis.

Please note that the field configuration and personnel's positions must be confirmed in order to make sure that no injury to personnel and no damage to devices when the motor works before the test run of the axis is started.



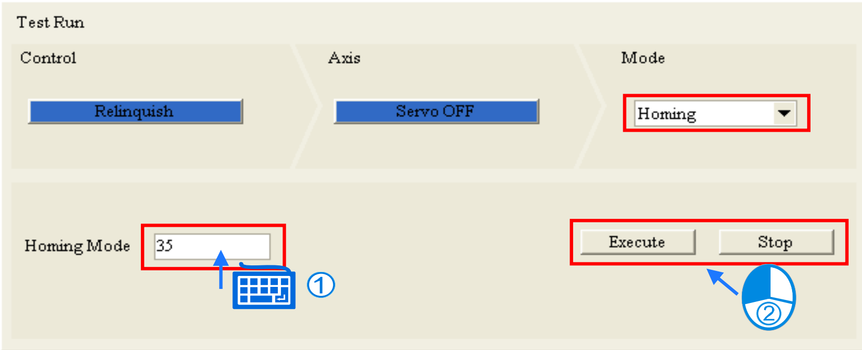
To exit the test-run mode, click the **Relinquish** button to stop having the control over the axis.

Click **Servo ON** button to turn on or **Servo OFF** button to turn off the servo drive after having the control over the axis.

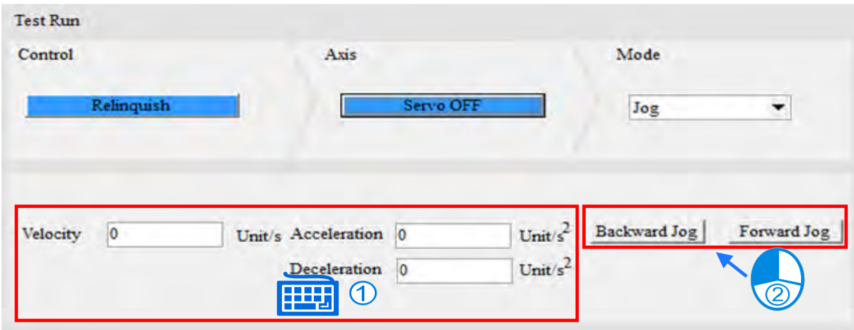


When **Servo ON** is clicked, various test-run modes in the **Mode** field are optional. There are different execution functions for users to type under various modes. The corresponding functions are explained as below.

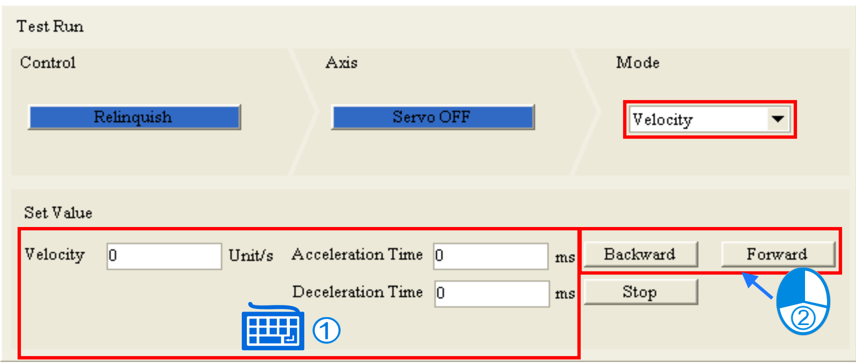
Homing Mode: Perform the homing according to the axis parameter setting and type the homing mode number in the **Homing Mode** field based on the 35 homing modes in CANopen standard. Click the **Execute** button to start the homing. Click **Stop** to abort the homing action.



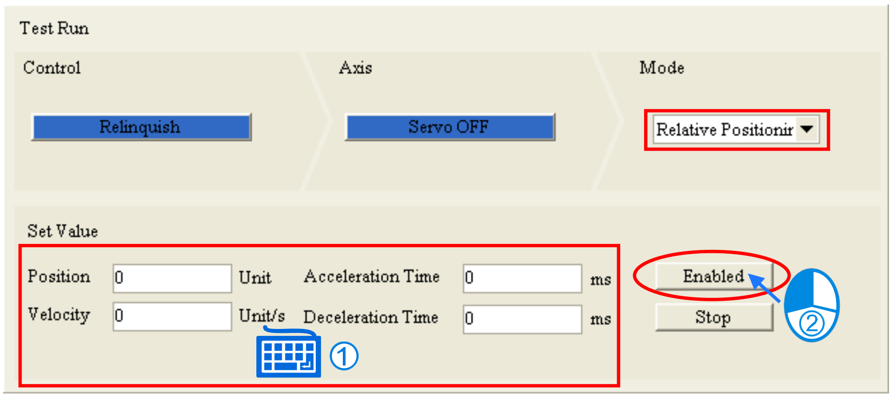
Jog: Execute the jog action according to the jog velocity in the axis parameter setting. After typing the jog velocity in the **Velocity** field, the acceleration unit and the deceleration unit, execute the backward jog or forward jog by clicking the **Backward Jog** or **Forward Jog** button.



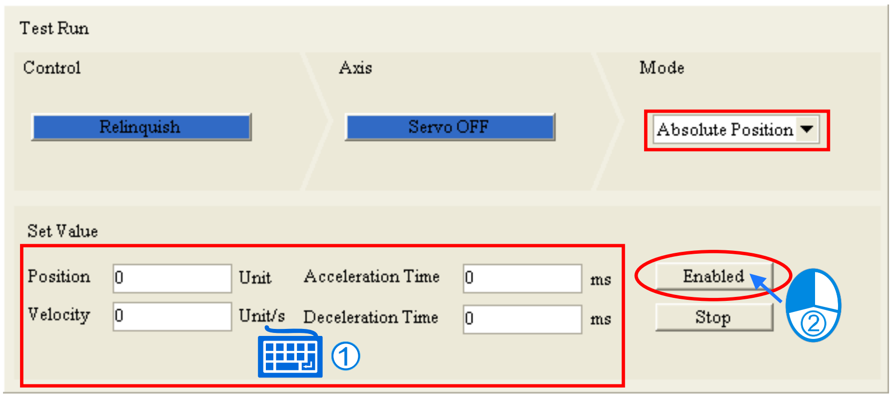
Velocity: Type the values in the **Velocity**, **Acceleration Time** and **Deceleration Time** fields. If the **Forward** or **Negative** button is clicked, the drive will accelerate till the set velocity is reached according to the set acceleration time and then keep moving in the forward or backward direction. By clicking **Stop,** the axis will decelerate to stop according to the set acceleration time.



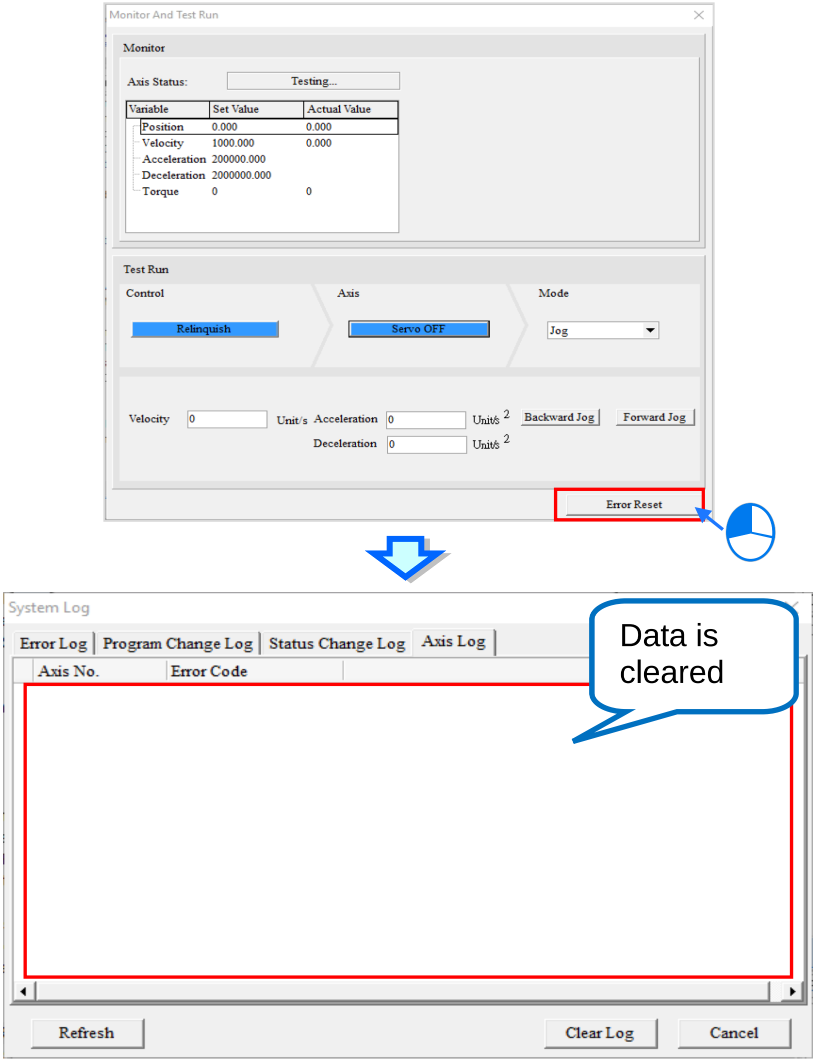
Relative Positioning: Type values in the **Position** (adding + or -), **Velocity**, **Acceleration Time** and **Deceleration Time** fields. After the **Enabled** button is clicked, the drive will accelerate till the set velocity is reached and keep moving according to the set acceleration time. And then the drive decelerates to stop and finally reaches the relative position according to the set deceleration time. Clicking **Stop** will abort the action during the motion.



Absolute Positioning: Type values in the **Position**, **Velocity**, **Acceleration Time** and **Deceleration Time** fields. After the **Enabled** button is clicked, the drive will accelerate till the set velocity is reached and keep moving according to the set acceleration time. And then the drive decelerates to stop and finally reaches the absolute position according to the set deceleration time. Clicking **Stop** will abort the action during the motion.

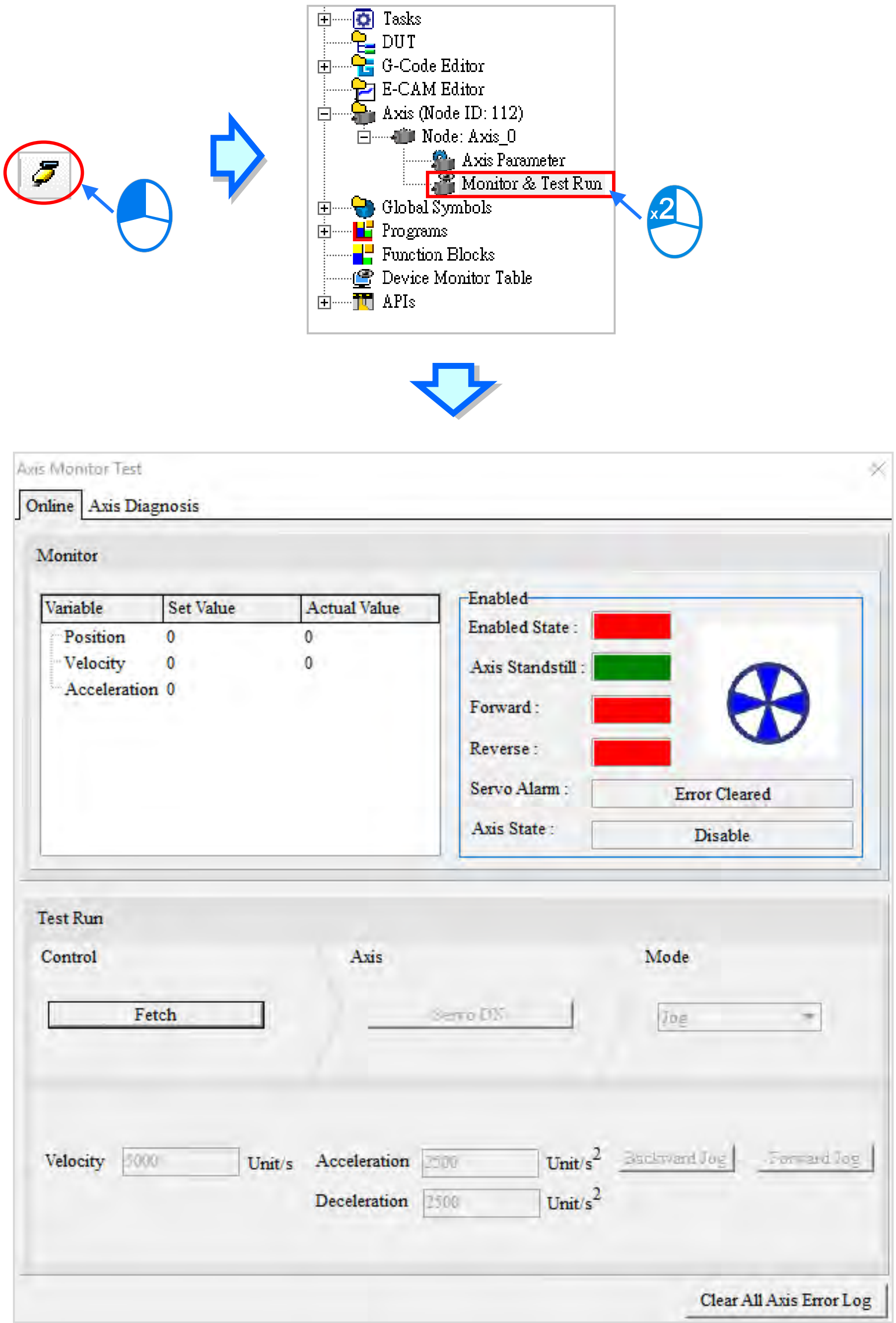


Click Error Reset and all the data in the System Log is cleared.

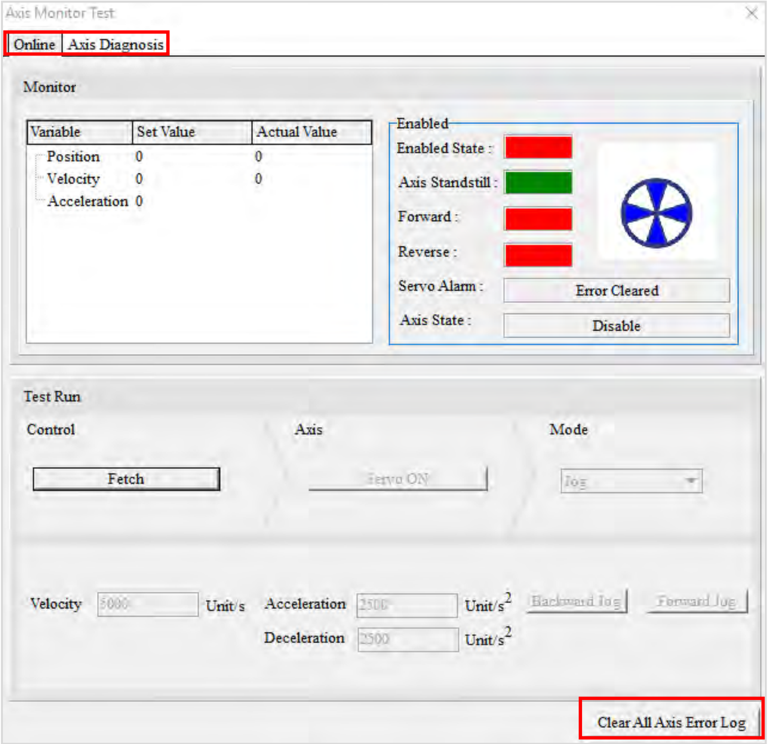

Monitor And Test Run
Monitor
Axis Status:
Testing...
Variable
Set Value
Actual Value
Position 0.000 0.000
Velocity 1000.000 0.000
Acceleration 200000.000
Deceleration 2000000.000
Torque 0 0
Test Run
Control
Axis
Mode
Relinquish
Servo OFF
Jog
Velocity
Unit/s
Acceleration
Units²
Backward Jog
Forward Jog
Deceleration
Units²
Error Reset
System Log
Error Log
Program Change Log
Status Change Log
Axis Log
Axis No.
Error Code
Data is cleared
Refresh
Clear Log
Cancel

9.2.2.2 DVPxxMC/AS5xx Series Monitoring &Test Run

For DVPxxMC/AS5xx series, double-click **Monitor &Test Run** under **Axis** to open the Monitor & Test Run window after ISPSoft enters the online mode.

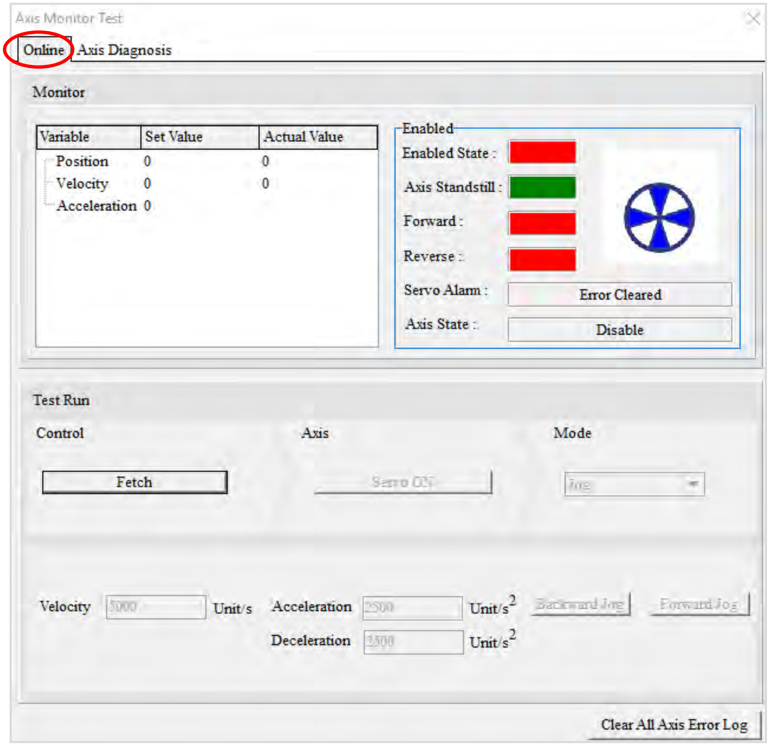


The Monitor & Test Run window contains **Online** and **Axis Diagnosis** tabs. The **Clear All Axis Error Log** button at the bottom of the page can clear all the axis error records from the project management area.

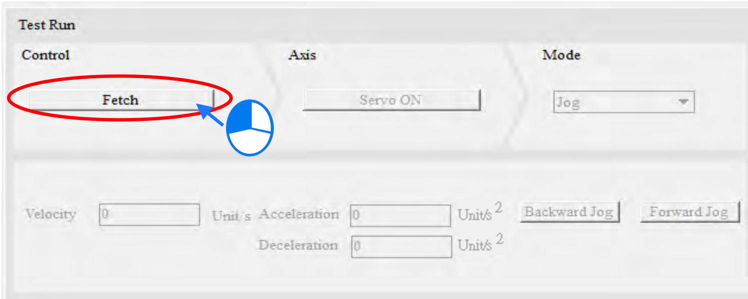


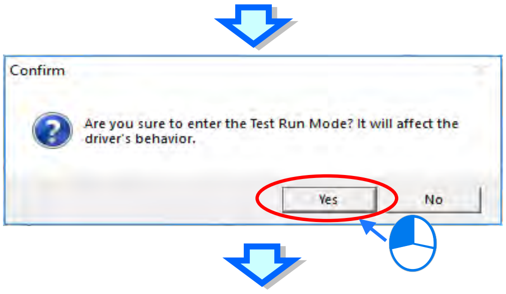
- **Online**

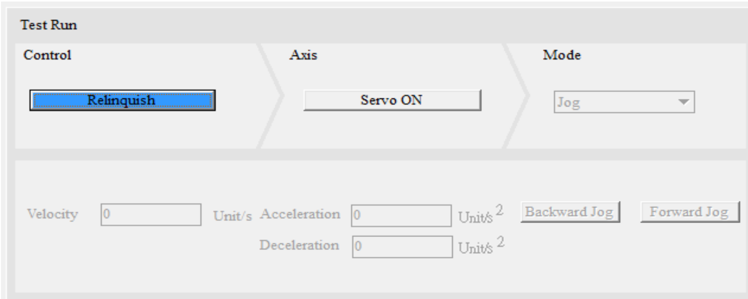
The upper part of **Online** is the **Monitor** section. On the left are items regarding real-time set value as well as actual value of the axis state and the physical quantity with the following variables, e.g. position and velocity. On the right is the **Enabled** section that displays the axis state and servo alarm. This section can be used jointly with the Test Run section at the lower part of the window.



The **Test Run** section is for testing the axis state after connecting to the hardware. Users can click Fetch and a window will appear for confirmation of the control over the axis. When motors are running, please make sure that field configuration and personnel's positions will not cause personnel injury or object damage before doing the Test Run.



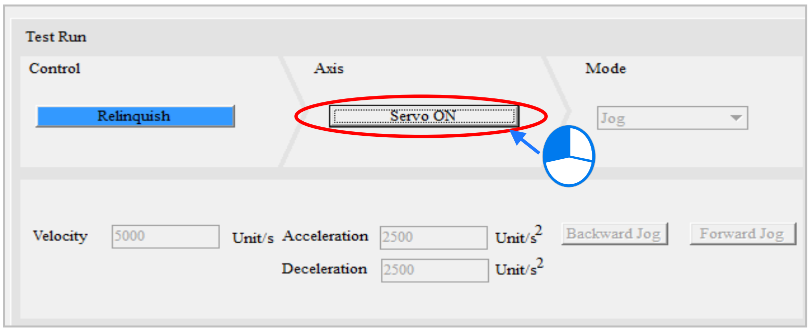




To exit the test-run mode, click the **Relinquish** button to stop having the control over the axis.

Click **Servo ON** button to turn on or **Servo OFF** button to turn off the servo drive after having the control over the axis.

***. If users select Virtual Axis for mode, the axis will automatically switch to Servo ON, please refer to section 9.2.1.2 for more information on axis mode.**



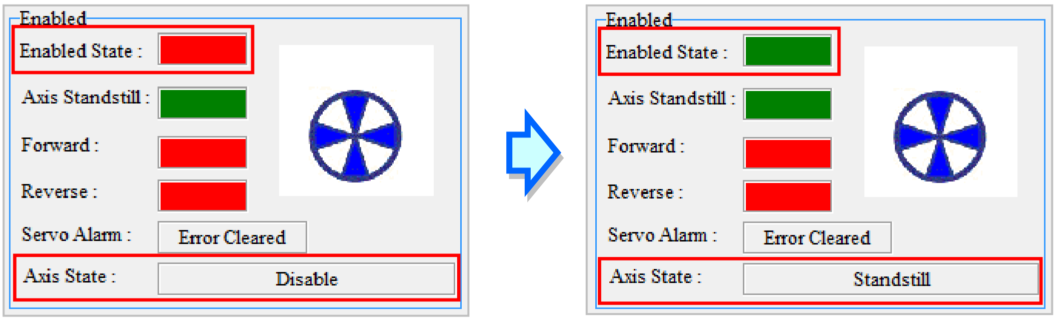
By connecting servo drives and motion controllers via communication ports, users can click **Servo ON** and the system will point out the following remarks in Jog mode.

(a) Velocity selected under cyclic data exchange.

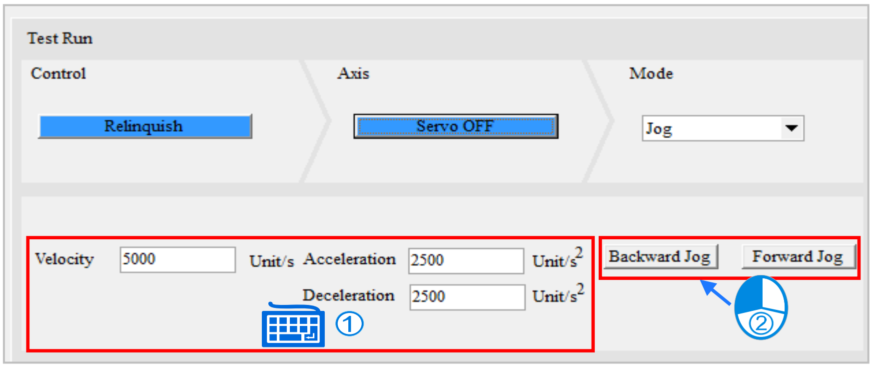
(b) Do NOT use MC_Power instruction for axis programming

(c) If communication disconnects during jog mode, the servo axis will automatically stop after 1 sec.

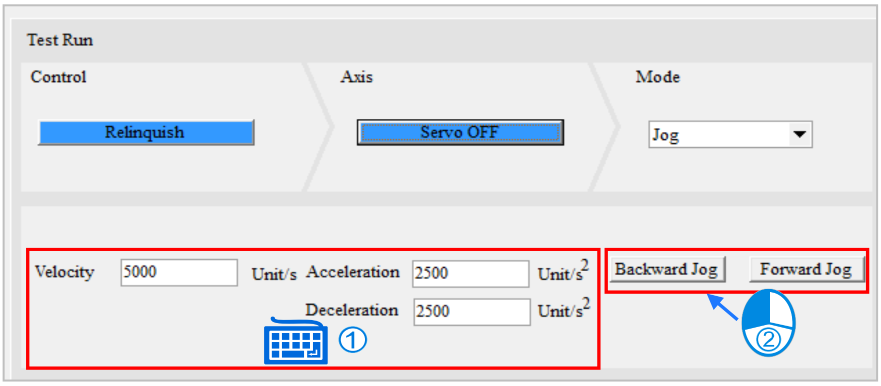
When Servo OFF change to ON, the red light will change to green in the **Enabled State** field and the **Axis State** changes from Disable to Standstill under Enabled section.



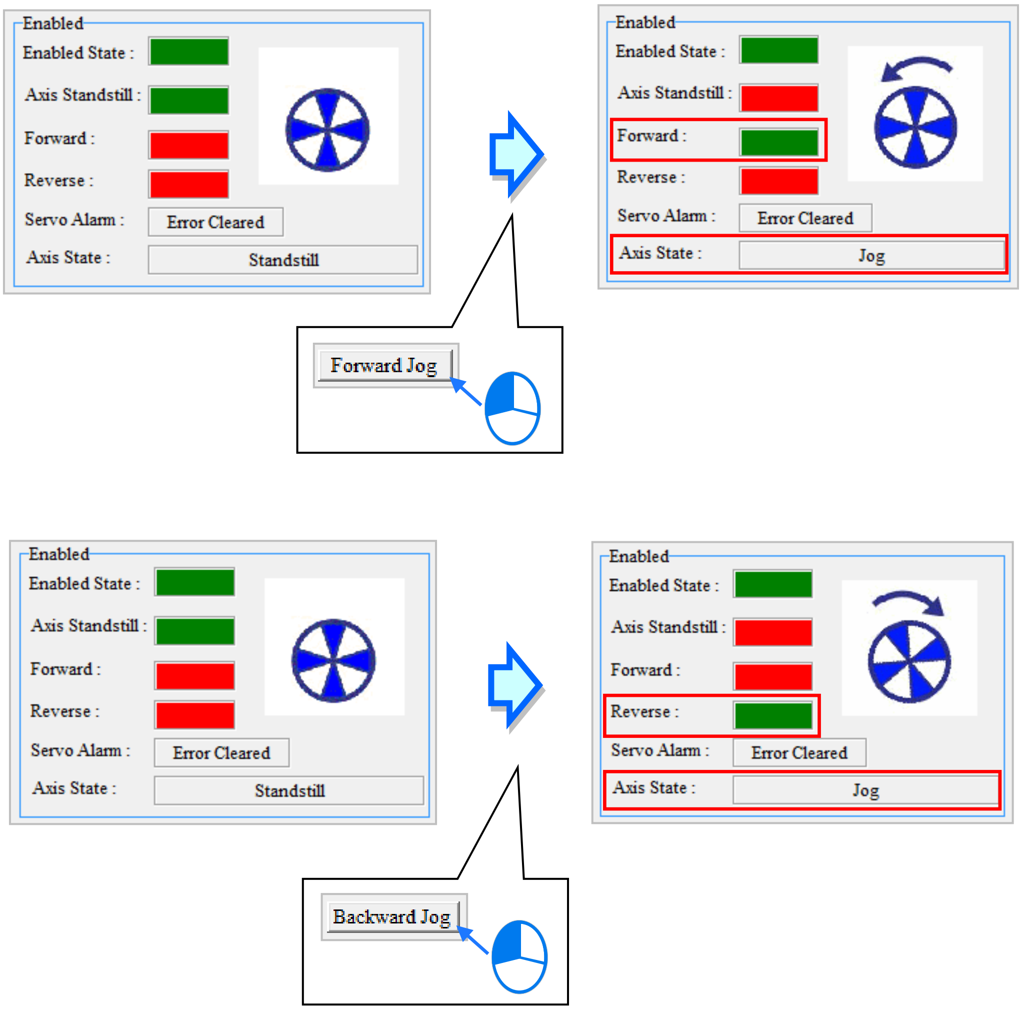
Under Servo is ON, currently only Jog mode can be selected for test run and functions are explained as below.



Jog: Users can input parameter settings including **Velocity, Acceleration, Deceleration** and press **Forward Jog** or **Backward Jog** for execution.



When **Forward Jog / Backward Jog** button is clicked, the red light will turn to green in Forward /Reverse field and the **Axis State** changes from Standstill to **Jog** under Enabled section. (This function is used when controllers are in operating mode.)

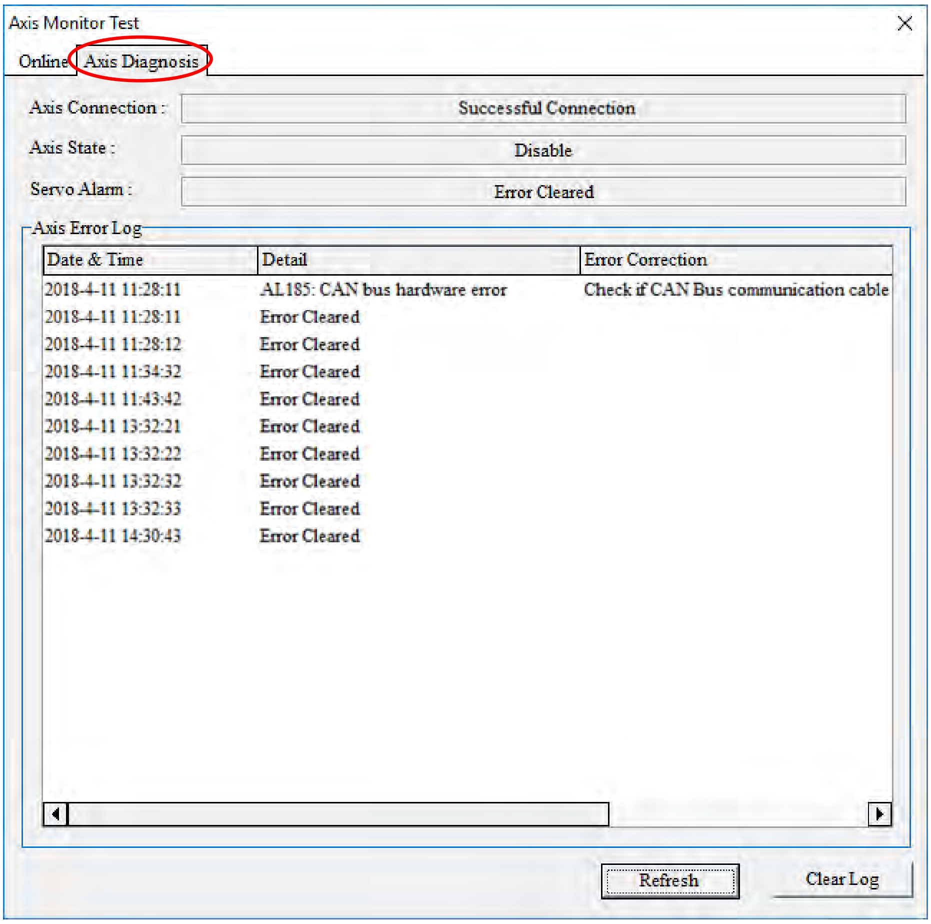


Relevant parameters in Enabled section are described below.

Parameter	Description
Enabled State	Color : Green - Enabled; Red - Disabled
Axis Standstill	Color : Green - Standstill; Red - Jog
Forward	Color : Green – Forward; Red – Reverse/Standstill
Reverse	Color : Green – Backward; Red – Reverse/Standstill
Servo Alarm	Display error message
Axis State	Include Disable, Standstill, ErrorStop, Stopping, Homing, Discrete Motion, Continuous Motion, Synchronized Motion and Jog

- Axis Diagnosis

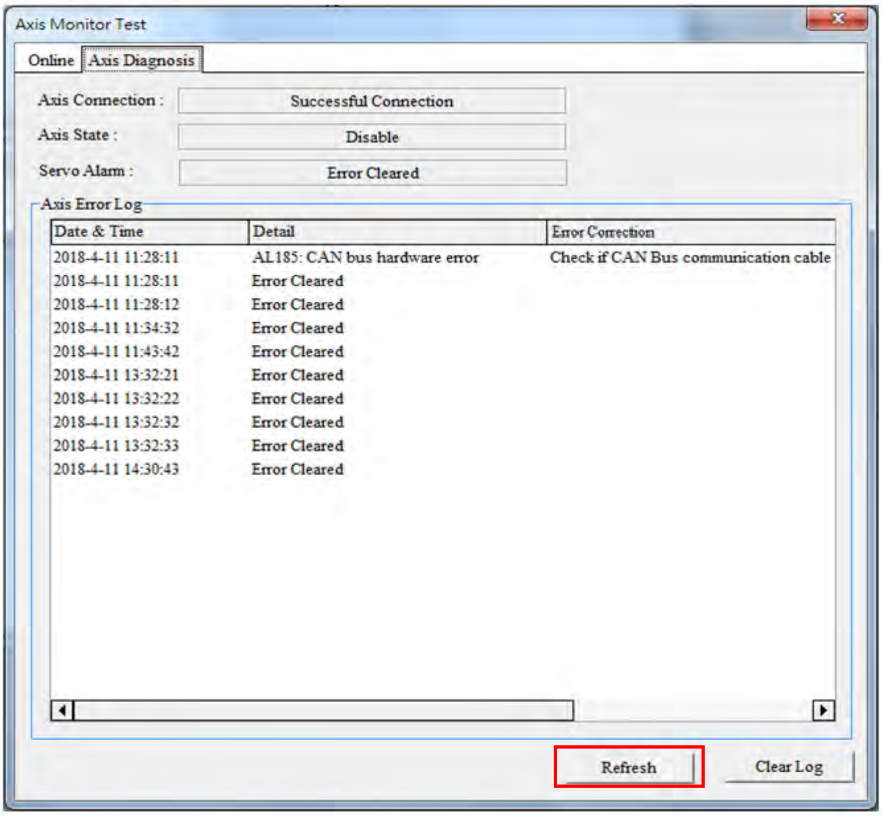
The function provides diagnosis for axis connection, state and servo alarm, while error detail and correction are displayed in the **Axis Error Log** section.



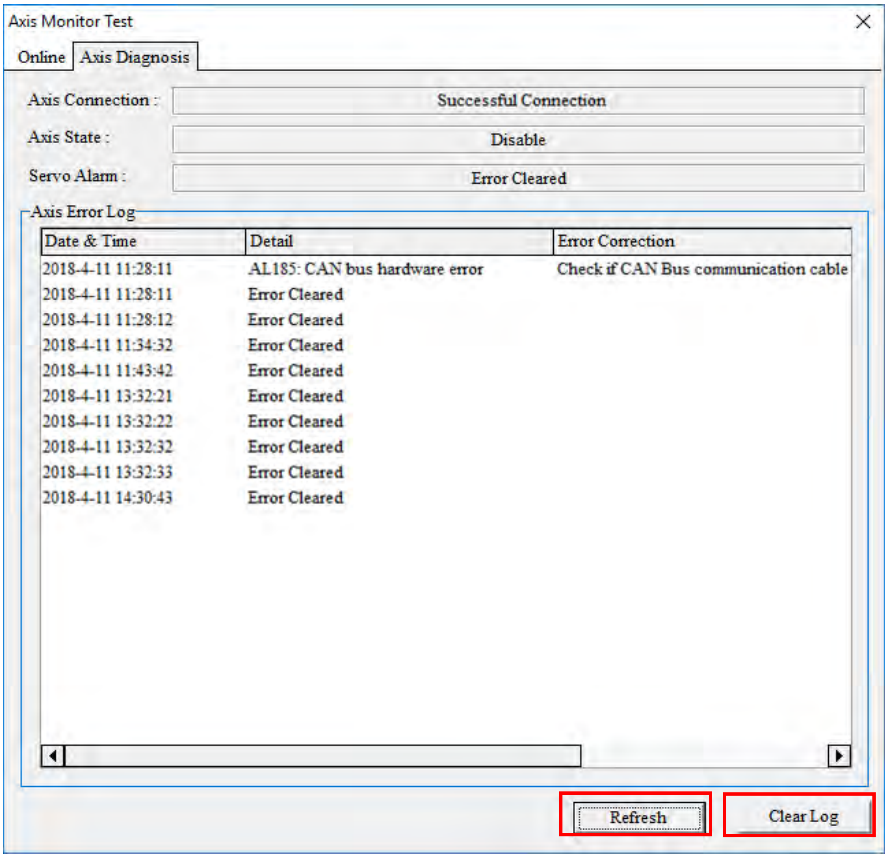
Relevant parameters of Axis Diagnosis are described below.

Parameter	Description
Axis Connection	Successful connection or disconnection between servo drives and controllers
Axis State	Corresponds to the state machine（Please refer to related product manuals for more details）
Servo Alarm	Display error message
Axis Error Log	Records error data including the date & time, detail and correction.

Click **Refresh** to update the Axis Diagnosis page.

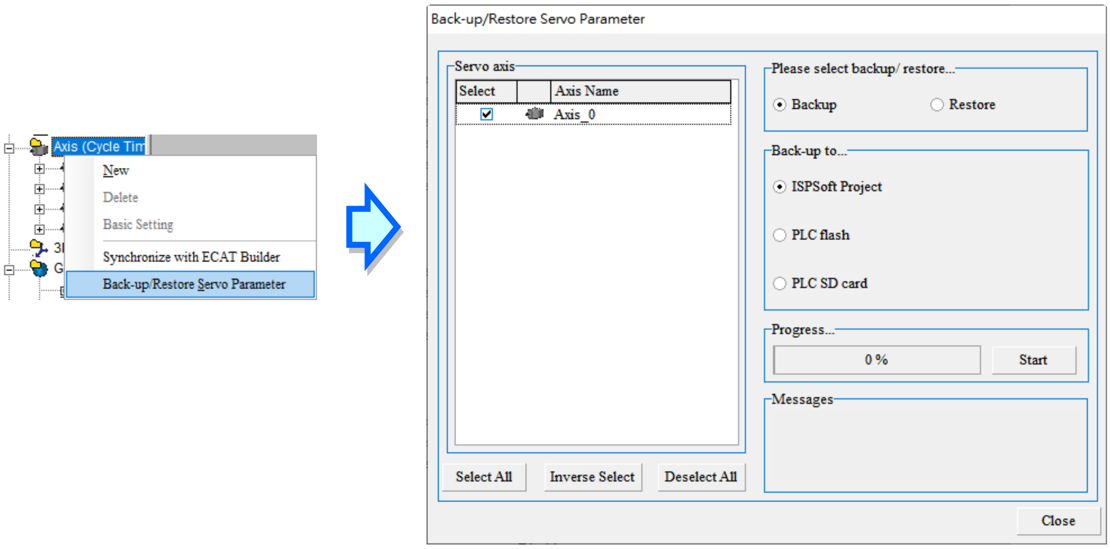


Click **Clear Log** button to delete the current axis error log data.



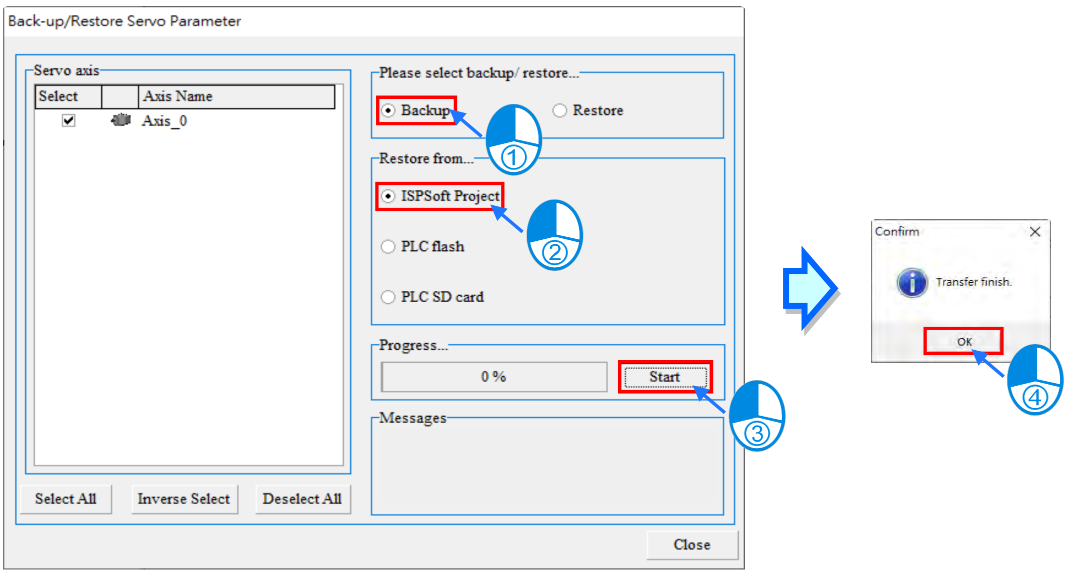
9.2.3 Back-up/Restore Servo Parameter

Right click on the “Axis” node, then click “Back-up/Restore Servo Parameter” to backup real axis settings to ISPSoft, PLC Flash or PLC SD Card, at the same time, users can also restore settings from the backup to these three locations by selecting the intended action and clicking “Start”.

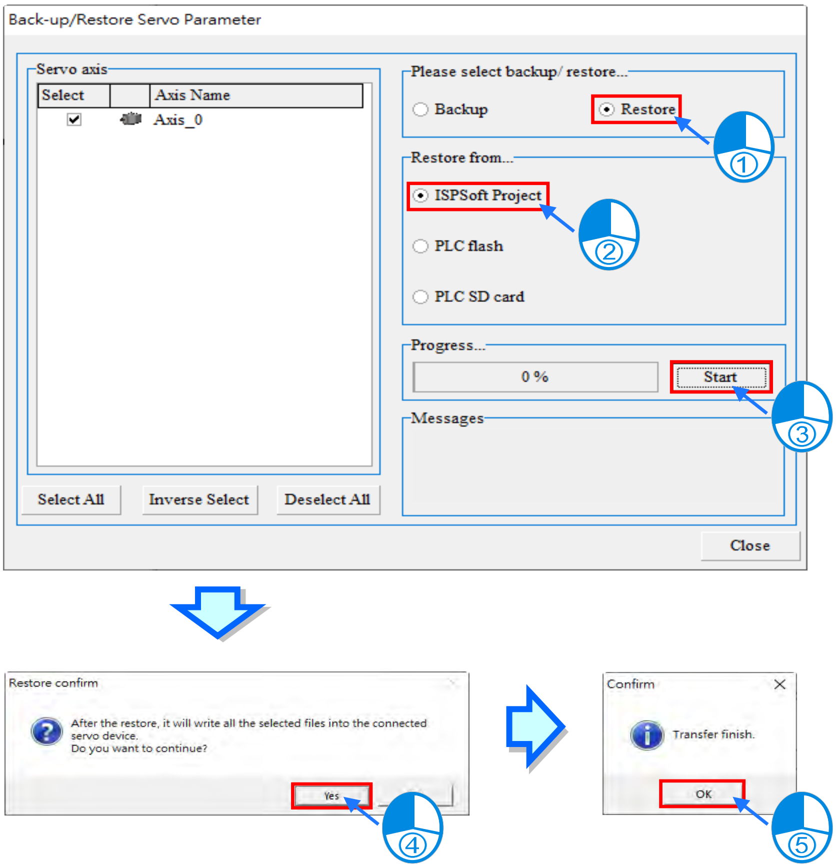


The following example presents backup and restore operations.

Select “Back-up” on the Back-up/Restore Servo Parameter window and choose ISPSoft Project as the backup destination, then click “Start” to proceed. After completion, click “OK” in the pop up confirmation box.

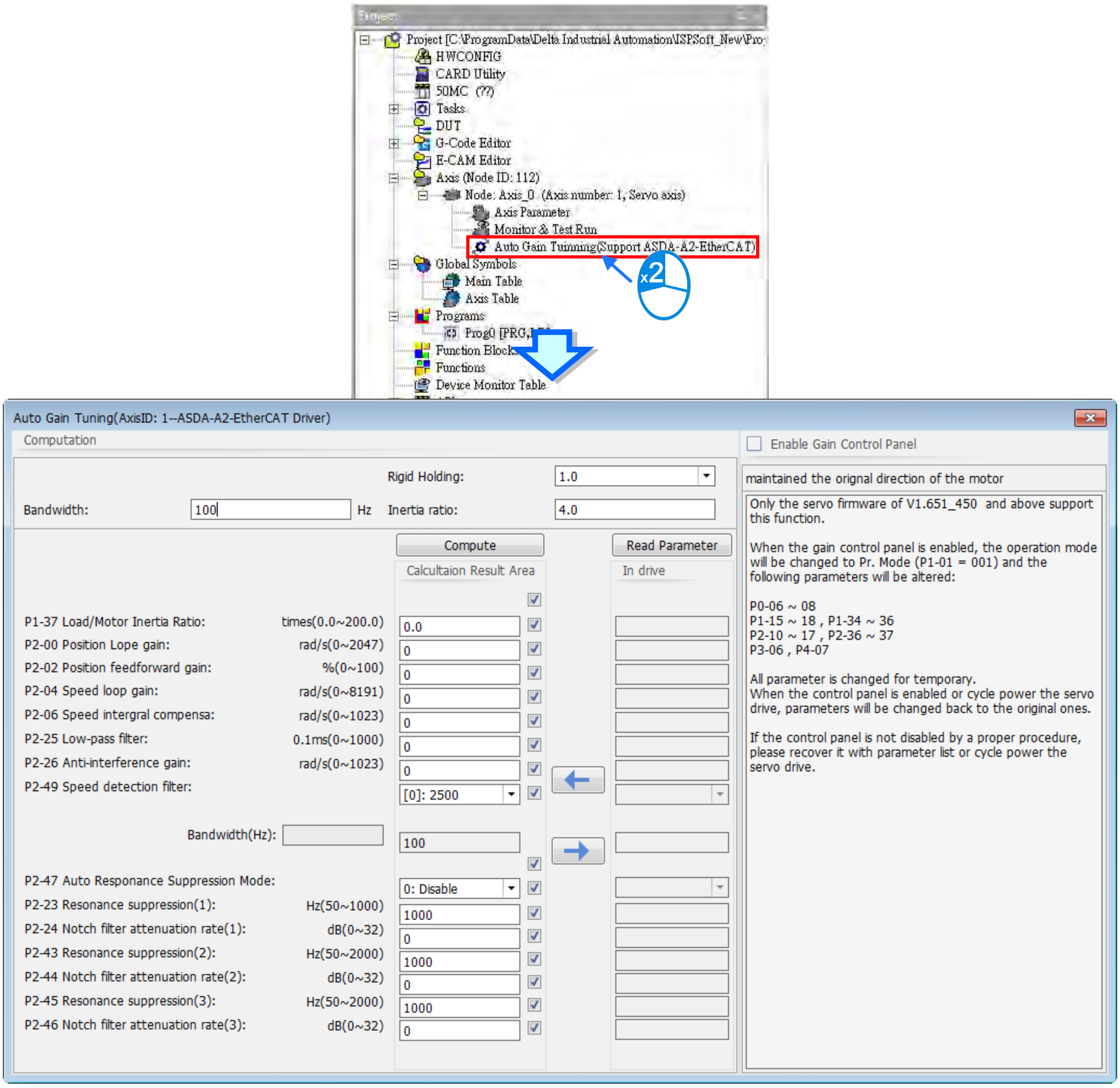


Select “Restore” on the Back-up/Restore Servo Parameter window and choose to restore from ISPSoft Project, then click “Start”. A restore confirm dialogue box would pop up to remind you that all the selected files will be written to the connected servo device. Click “Yes” and wait for backup completed with the progress bar displayed. After completion, click “OK” in the pop up confirmation box.

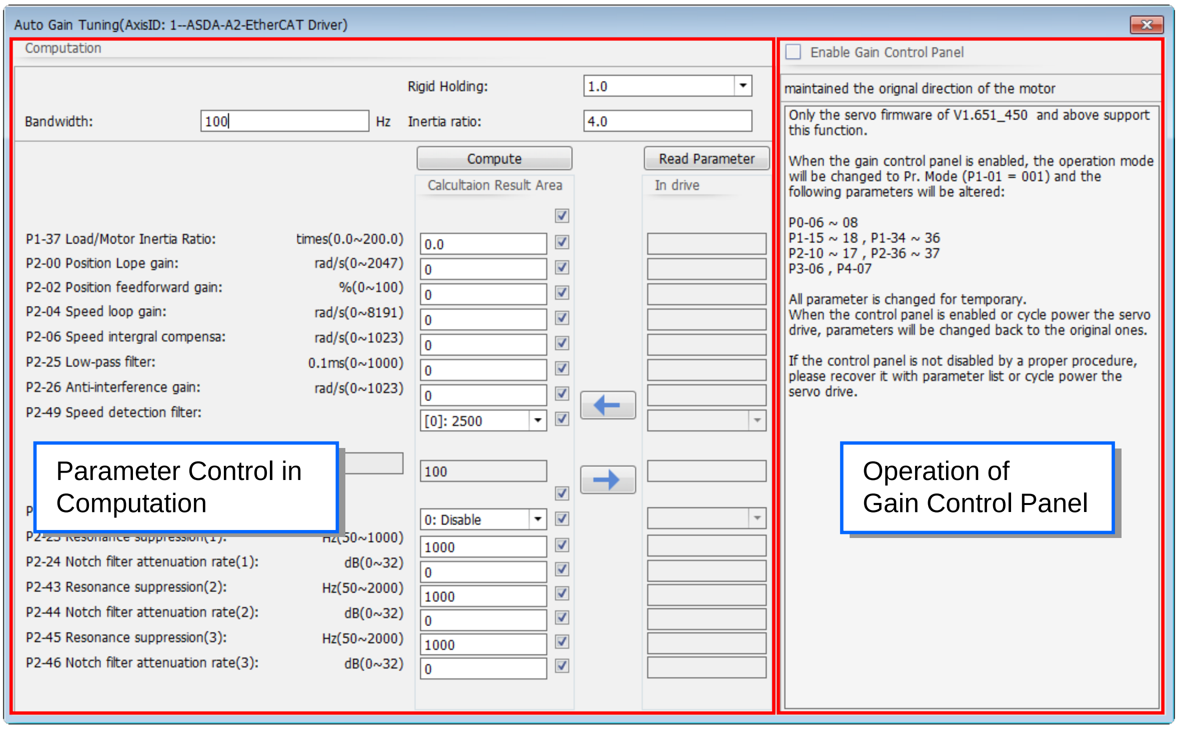


9.2.4 Auto Gain Tuning

Click “Auto Gain Tuning” under the “Axis” node from the drop-down list in Project to open Auto Gain Tuning page.

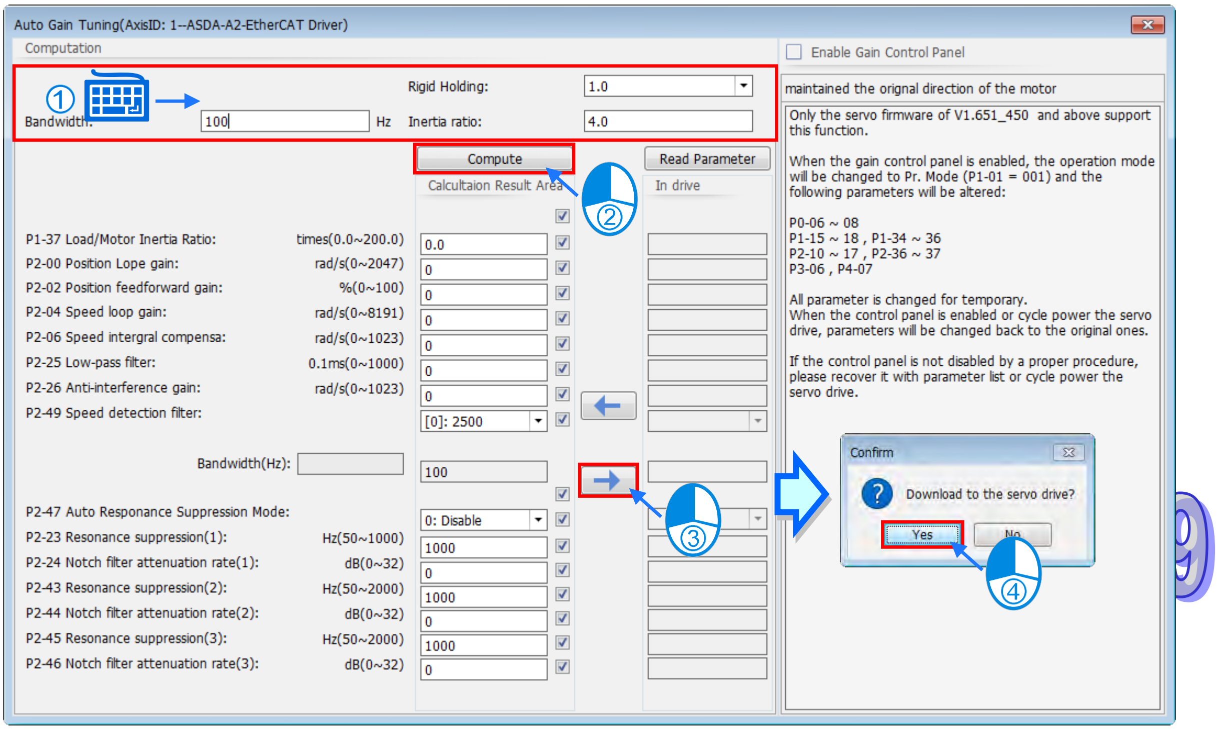


On the left side of the page is Parameter Control in Computation window, while the right side is operation of Gain Control Panel.

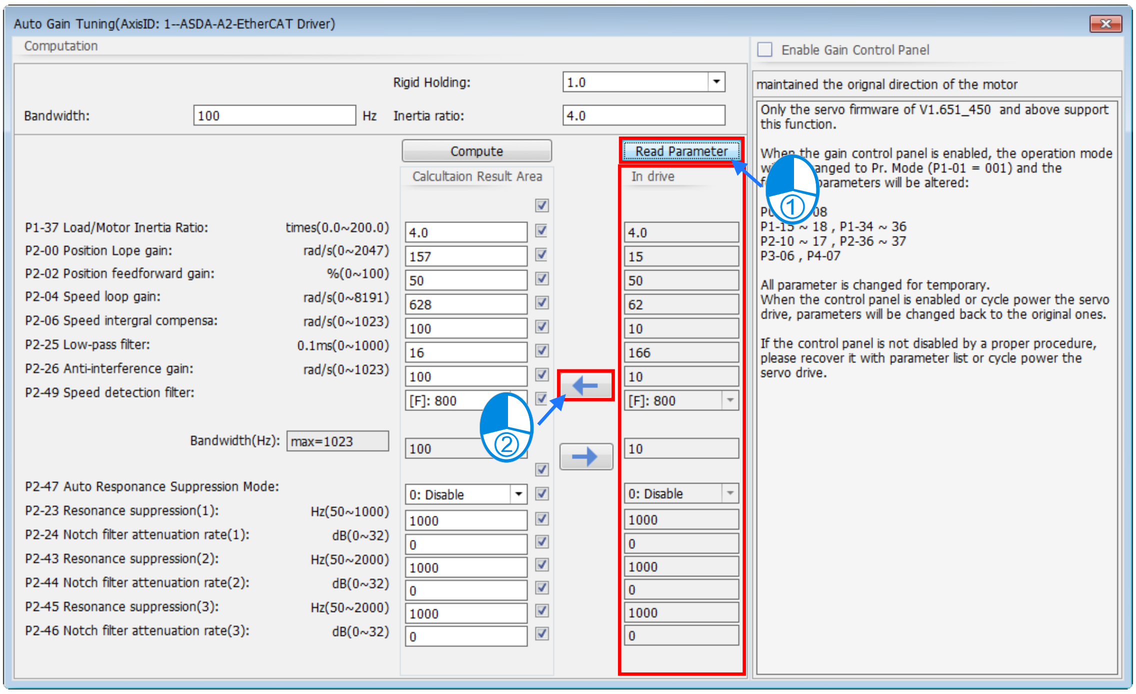


- **Parameter Control in Computation**

Compute: Users can input the appropriate values for Bandwidth, Rigid Holding and Inertia Ratio, then click the Compute button to calculate the relating parameter values. Continue to click on "→" and the calculation results can be written into the servo , at the same time, users can choose to download the parameters by selecting the action.



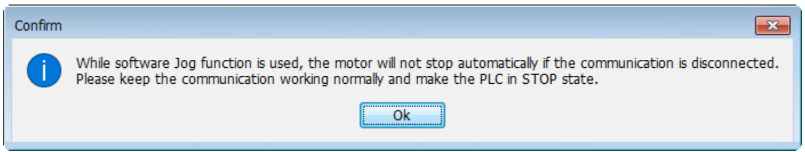
Read Parameter: Click "Read Parameter" and the current values in drive will be displayed in the below area for users' inspection. After successful reading of parameters, users can copy the values to the Calculation Result Area with a click of "", then modify the parameters before written into the servo.



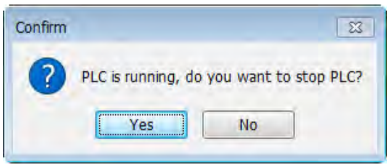
- **Operation of Gain Control Panel**

Before using the gain control panel, users must select the checkbox of Enable Gain Control Panel on the upper right side of the window.

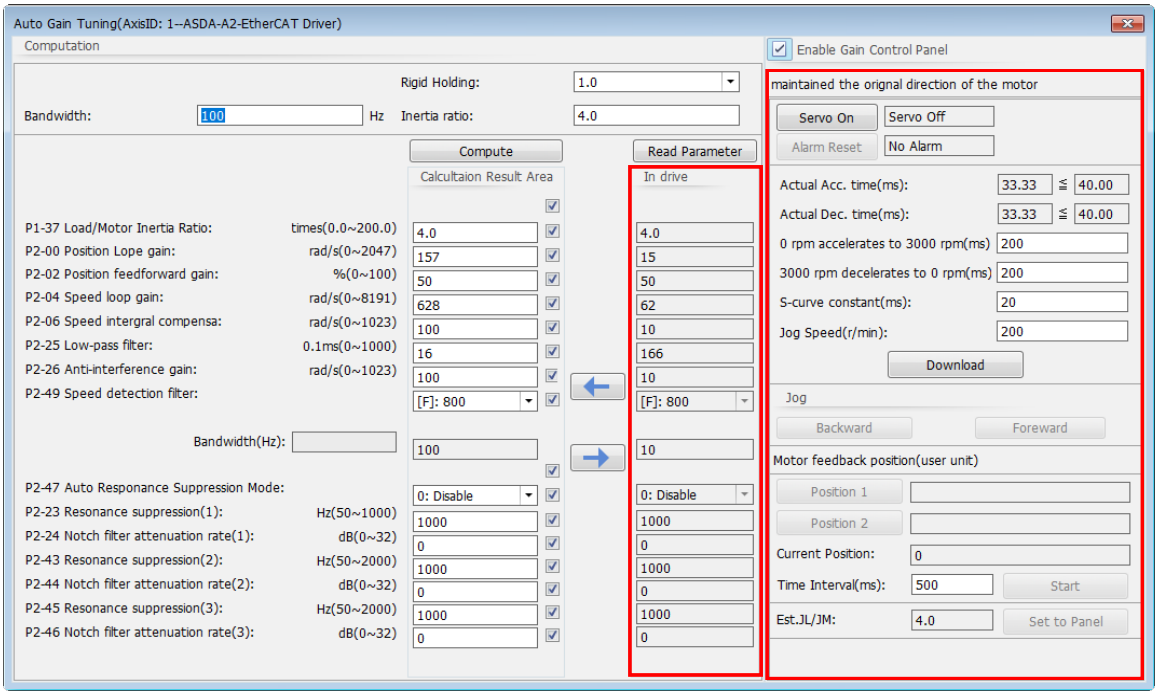
After selected, a pop-up confirm box would display information as below shown, to remind users should keep communication connected and working normally while software Jog function is used.



After clicking "OK" in the above confirm box, if the PLC still operates under RUN status, a pop-up window will be displayed and ask users to put controllers in "STOP" state by clicking on "YES" as below shown.



The Auto Gain Tuning window will be opened after clicking "YES" in the above confirm box, with parameters read and displayed automatically at the same time. While enabling control panel, the servo is put into PR state and parameters, such as P1-01, P0-10~12, P0-18~20, P1-15~18, P5-20~21, P1-36, P2-10~17, P5-60, P5-61, P3-06 and P4-07, is modified temporarily.(except for the output direction of P1-01) Once the control panel is disabled, the original parameters will be restored.



- **Explanation of relating functions on Gain Control Panel**

For detailed description of configuration, please refer to the user manual of the specific model.

1. **Servo On:** Click on ":Servo On" to activate. If an alarm or warning occurs, the activation would not be able to proceed unless the alarm is removed.

2. **Set Jog-related parameters:** After complete actual accelerate/ decelerate time, S-curve constant and Jog speed settings, click either the Download button or buttons for Jog function can perform the action of writing settings into the servo.

3. **Jog:** Click the forward or backward button according to the direction in different situations. Press and hold the button to make the motor run; release the button to stop the motor, and the current position will be returned and displayed in the column of Current Position. Users can click "Position 1" button after Jog Forward operation complete and the feedback position would be display in the column of position 1. Click "Position 2" button after Jog Backward operation complete to display the feedback position in the column of position 2.

4. **Position:** Click on "Position 1" or "Position 2" and the returned values of motor's current position would be read and displayed in the columns of "Position 1" and "Position 2" separately.

5. **Time Interval:** The waiting time after position1 and 2 operation complete. For example, you'll need to wait for the duration of time interval after the operation of position 1 complete so as to operate position2.

6. **Start:** Click "Start" to perform debugging task; click "Start" again to stop. Alternating operation will be performed with Position1 and 2 during debugging process. Users can click on the "Start" button again to stop the motor when notice that there's not much change on JL/JM (has been stabilized)

7. **Est. JL/JM:** Please refer to the point (6) above.

8. **Set to Panel:** Click "Set to Panel" to input the estimated inertia values to Calculation Result Area on the left side of the window, then users can modify the related parameters before clicking  to write the parameters into the servo.

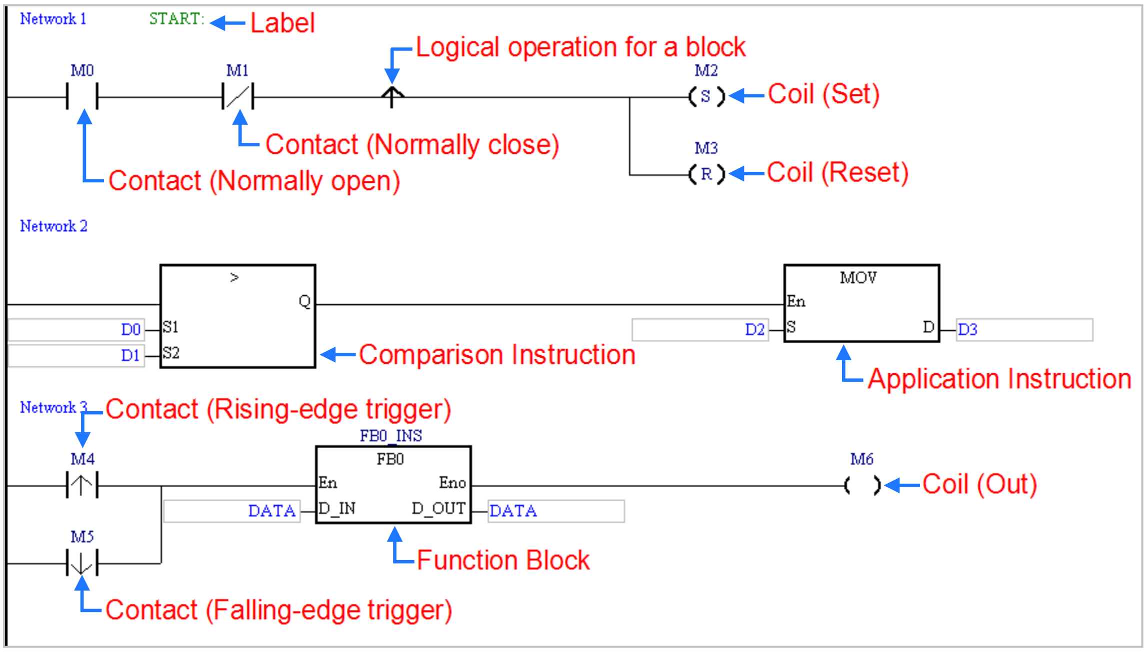
9. **Disable Gain Control Panel:** After finish dynamic calculating, users should click the "Servo On" button to put servo in "Servo Off" state and then clear the checkbox of "Enable Gain Control Panel".

Chapter 10 Ladder Diagram

Table of Contents

10.1 Introduction of a Ladder Diagram

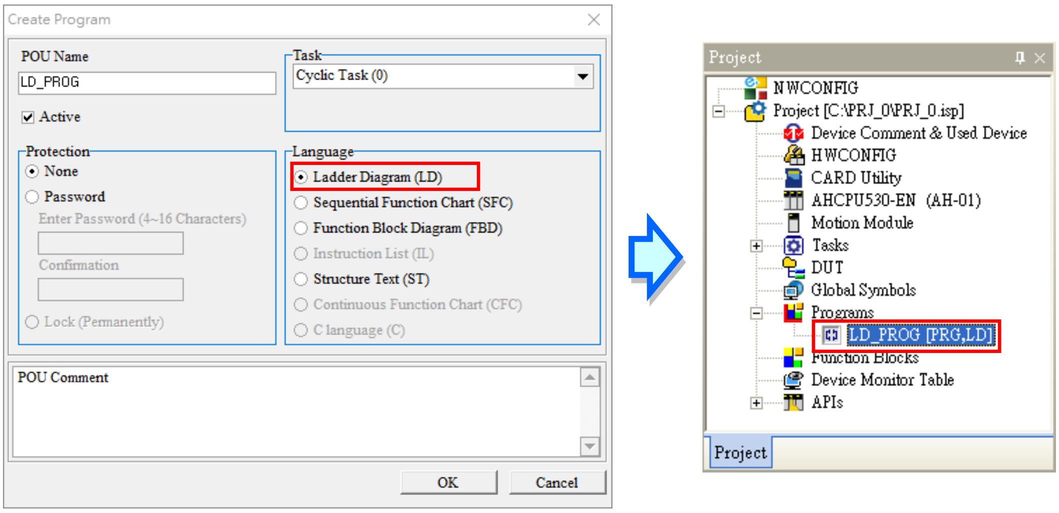
A ladder diagram is one of the programming languages defined by IEC 61131-3, and is widely used to create a PLC program. A ladder diagram is a programming language that represents a program by a graphical diagram based on the circuit diagrams of relay logic hardware. A ladder diagram in ISPSoft is shown below.



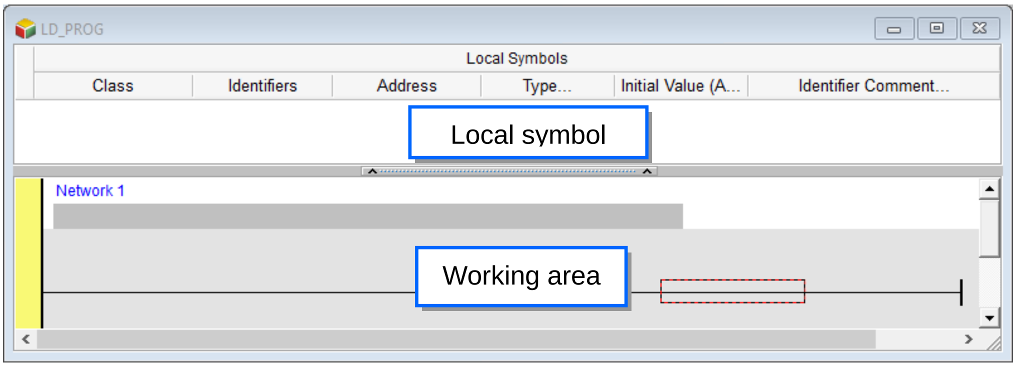
***. Please refer to DVP-PLC Application Manual─Programming for more information about ladder diagrams.**

10.1.1 Editing Environment

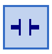
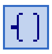
Select the **Ladder Diagram (LD)** option button in the **Language** section in the **Create Program** window. Please refer to section 5.4.1 for more information.



The environment in which a ladder diagram can be edited is shown below. The table at the upper part of the window is a local symbol table, and the area at the lower part of the window is a working area.



After a program editing window in which a ladder diagram can be created is opened, the corresponding toolbar will appear in the ISPSoft window. The functions are described below.

Icon	Keyboard shortcut	Function
	None	Display/Hiding symbol or address
	Shift+Ctrl+C	Displaying/Hiding the comments on the networks
	None	Displaying/Hiding the commands on the devices
	Shift+Ctrl+B	Adding a bookmark to the network selected or deleting the bookmark from the network selected
	Shift+Ctrl+P	Going to the previous bookmarked position
	Shift+Ctrl+N	Going to the next bookmarked position
	Ctrl+I	Inserting a network above the network selected
	Shift+Ctrl+I	Inserting a network under the network selected
	ESC	Selection
	Typing an instruction	Inserting a contact
	Typing an instruction	Inserting a coil
	Typing an instruction	Add MPS
	Typing an instruction	Inserting a comparison contact
	Typing an instruction	Selecting a type of comparison contact
	Typing an instruction	Inserting a block logic instruction (NP/PN/INV/FB_NP/FB_PN)

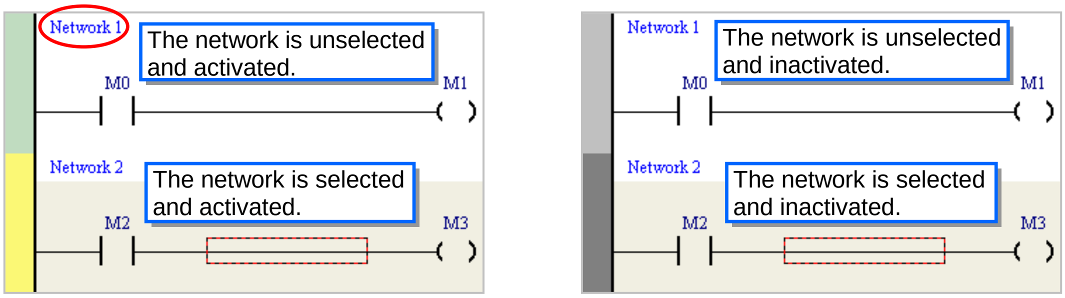
Icon	Keyboard shortcut	Function
	Typing an instruction	Selecting a type of block logic instruction
	Shift+Ctrl+U	Inserting an instruction or a function block

***. Please refer to section 8.2.3 for more information about typing an instruction.**

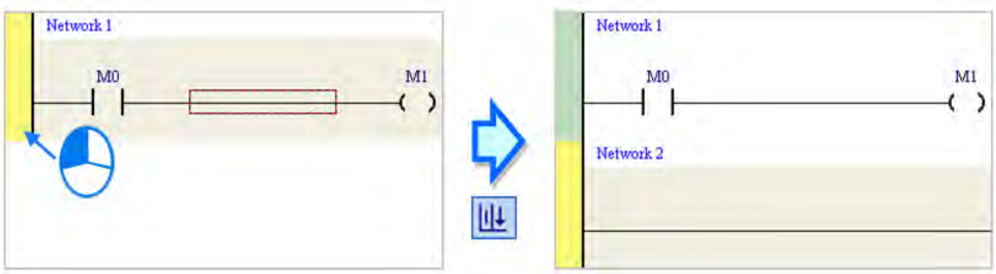
10.1.2 Networks in a Ladder Diagram

A ladder diagram consists of networks. Every network is an independent program. Besides, there is no limit on the number of objects which can be inserted in a network in ISPSoft, and therefore there is no mark which is used to connect two networks.

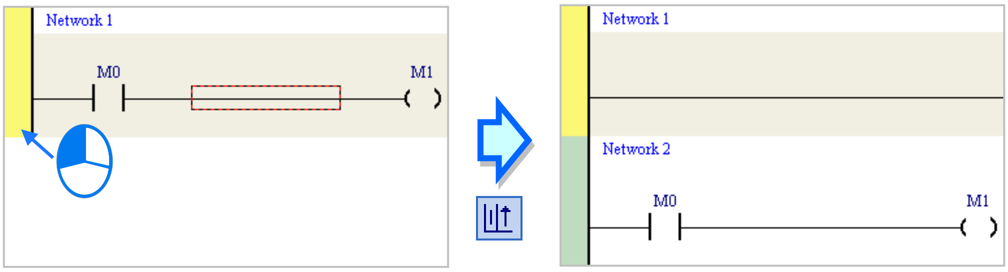
Network numbers are marked on the networks in a ladder diagram. The color at the left side of a network indicates the state of the network. A network can be activated or inactivated, and a network can be selected or unselected. Users can select colors which will be shown at the left sides of the networks in a ladder diagram in the **Options** window in ISPSoft. Please refer to section 2.3.1 for more information.



After a new window in which a ladder diagram will be created is opened, the system will insert a blank network in the window. If users want to add a network, they can select a network, and click on the toolbar. The network added will be under the network selected.

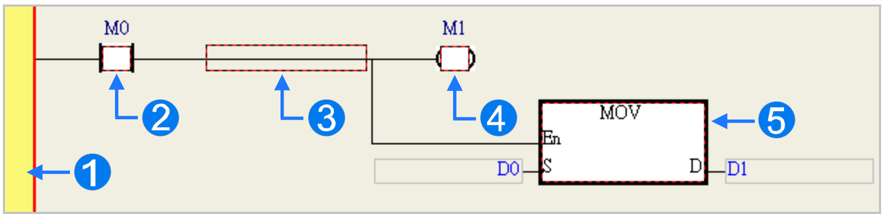


If users click  on the toolbar, a blank network will be put above the network selected.



10.1.3 Selecting Objects

Before an object in a network in a ladder diagram is selected, users have to press Esc on the keyboard, or click  on the toolbar. After the cursor appears as a small arrow, the users can click the object in the network. The basic selection is shown below.



❶ Selecting the network

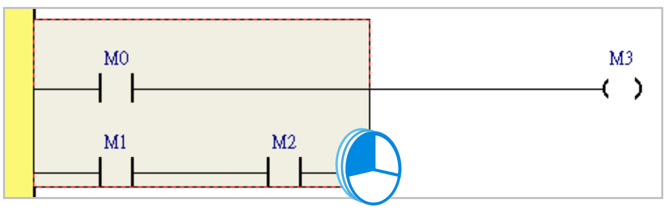
❷ Selecting the input contact

❸ Selecting the network

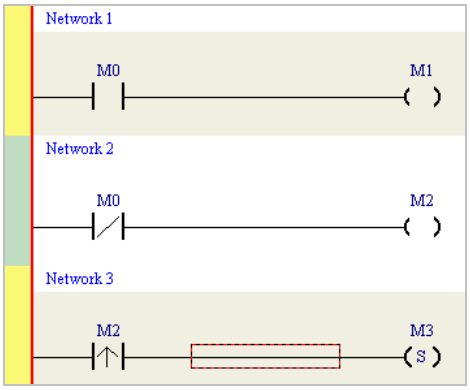
❹ Selecting the output coil

❺ Selecting the block

If users want to select a group of devices, they can click a device, and drag it to draw a frame round the group of devices. The users can also select the group of devices by clicking the first device, pressing Ctrl+B on the keyboard, clicking the last device, and pressing Ctrl+B on the keyboard. Users must draw a frame round devices which are in the same network, and the devices must be adjacent to one another. Besides, input devices and output devices can not be in the same frame.



If users want to select several networks, they can hold down Ctrl on the keyboard while they click the networks. The users can also select a range of networks by pressing Shift on the keyboard, clicking the first network within the range, and the last network within the range.



10.2 Creating a Ladder Diagram in ISPSoft

10.2.1 Creating a Contact, Coil & MPS

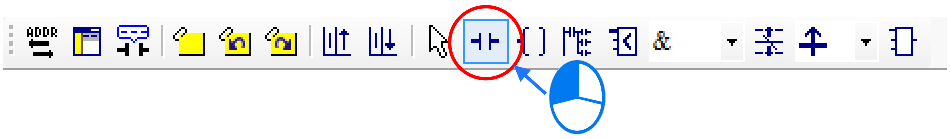
The representations of contacts and the representations of coils in ISPSoft are listed below.

Contact	**Normally-open contact**	M0 ┤ ├
	Normally-closed contact	M0 ┤/├
	Rising edge-triggered contact	M0 ┤↑├
	Falling edge-triggered contact	M0 ┤↓├
Coil	**OUT**	M1 ( )
	SET	M1 (S)
Coil	**RESET**	M1 (R)

10.2.1.1 Inserting a Contact and Changing a Contact Type

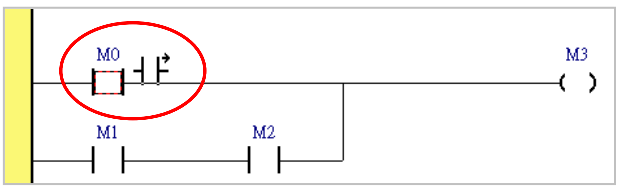
(1) Select a line, a contact, or a group of devices. Before users connect a contact to a group of devices in parallel or in series, they have to draw a frame round the group of devices.

After users make sure of the position in which a contact will be inserted, they can click on the toolbar.

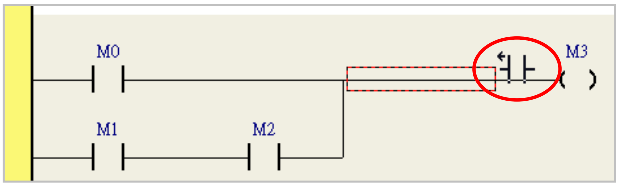


(2) The mouse cursor appears as a contact when the mouse cursor is near the position in which a contact will be inserted.

- If the mouse cursor is near a contact, a contact will be connected to the contact in parallel or in series.

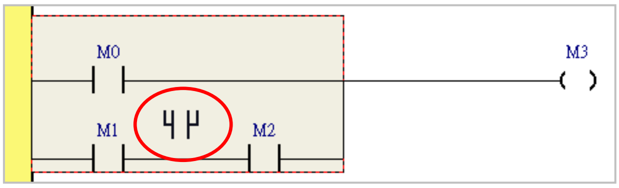


- If the mouse cursor is near a line, a contact will be inserted in the line.

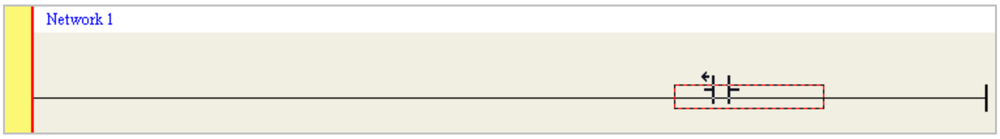


-

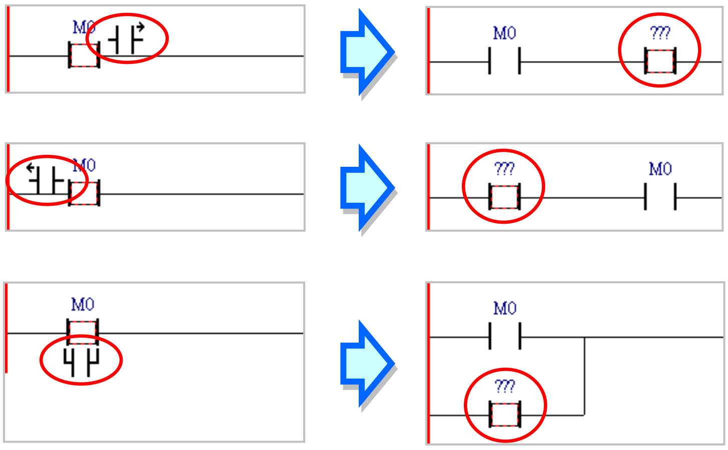
- If the mouse cursor is near a group of devices, a contact will be connected to the group of devices in parallel or in series.



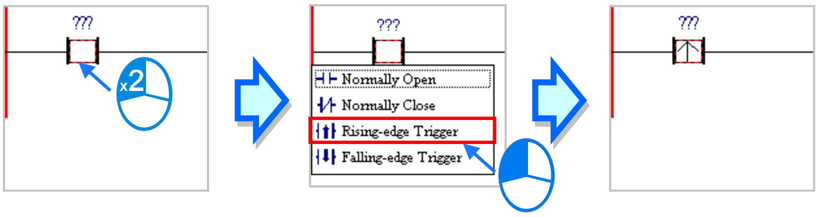
- If users want to insert a contact in a new network, they can move the mouse cursor to the red frame in the new network.



(3) The mouse cursor appears as a contact when the mouse cursor is at the right side of a contact, at the left side of a contact, or at the bottom of a contact. Users can decide where to insert a contact. After users click the position in which a contact will be inserted, the system will insert the contact.

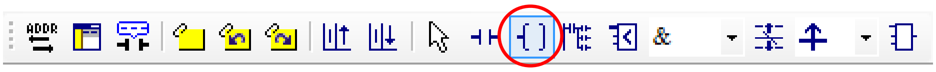


(4) After a contact is inserted, users can click on the toolbar or press Esc on the keyboard. After the contact is double-clicked, users can select a contact type on the drop-down list.



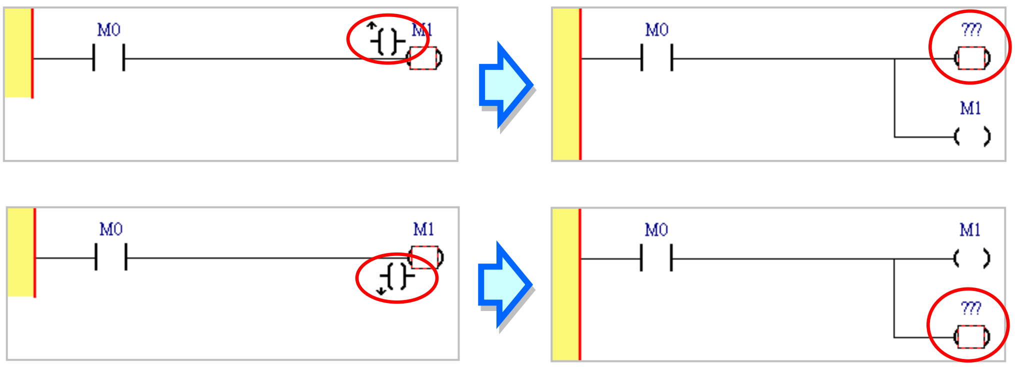
10.2.1.2 Inserting a Coil and Changing a Coil Type

(1) Select a line, a contact, a coil, or an applied instruction. After users make sure of the position in which a coil will be inserted, they can click on the toolbar.

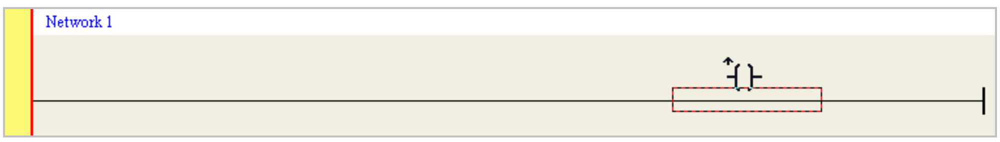


(2) The mouse cursor appears as a coil when the mouse cursor is near the position in which a coil will be inserted. If the mouse cursor is at the top of a coil or at the top of an applied instruction, a coil will be put above the coil or the applied instruction. If the mouse cursor is at the bottom of a coil or at the bottom of an applied instruction, a coil will be put under the coil or the applied instruction. If the mouse cursor is near the line in a network, a coil will put above all the output devices in the network.

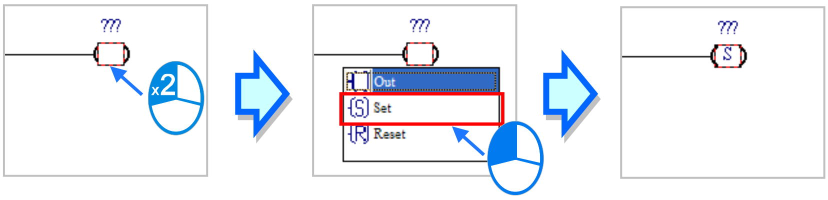
After users click the position in which a coil will be inserted, the system will insert the coil.



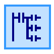
If users want to insert a coil in a network where there is no output device, the mouse cursor must be near the line selected.



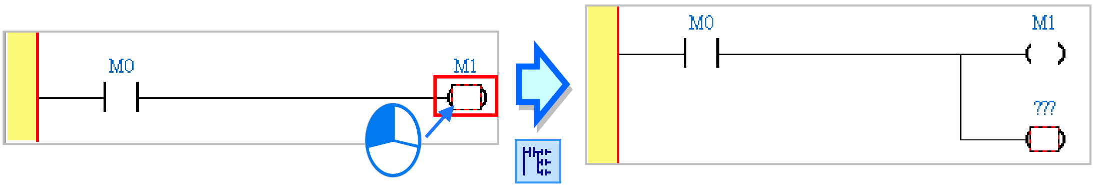
(3) After a coil is inserted, users can click  on the toolbar or press Esc on the keyboard. After the coil is double-clicked, users can select a coil type on the drop-down list.

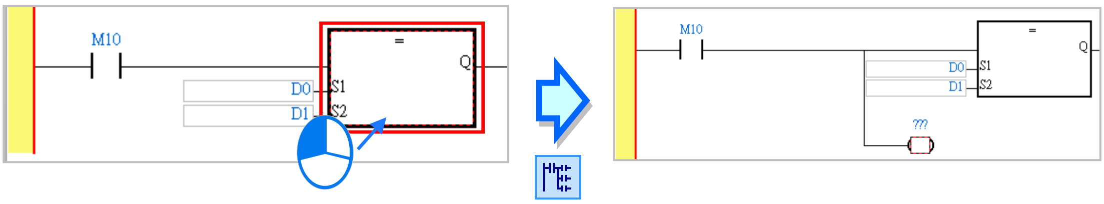


10.2.1.3 Add MPS

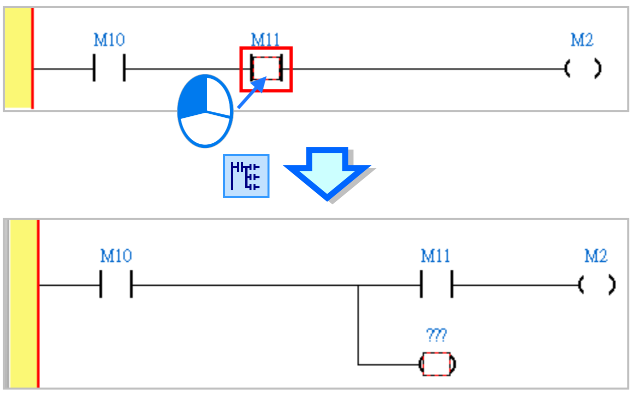
Choose a line, coil, comparison or API position to confirm and add the MPS by clicking  on the toolbar which will create a bifurcation point.

Users can select the line or comparison instruction, then click the add MPS icon to create a bifurcation point.

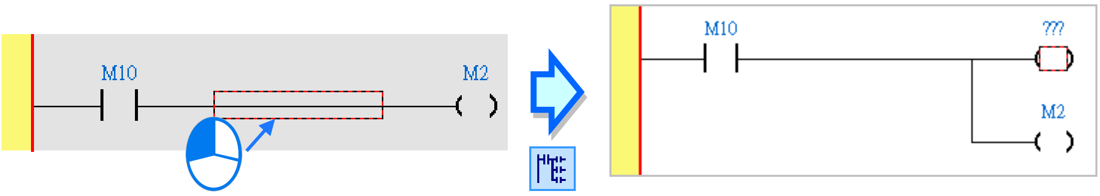




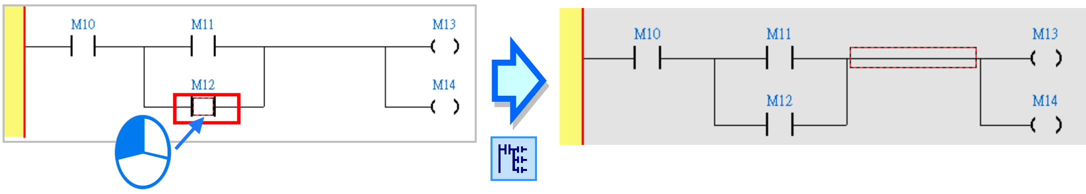
Users can select a contact, then click the add MPS icon to create a bifurcation point.



Users can select a line, then click the add MPS icon to create a bifurcation point.

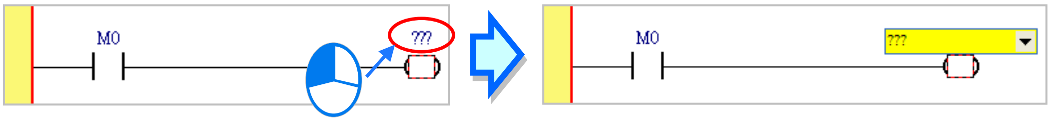


Some positions cannot add MPS, so when users click add MPS icon, the diagram will show the position to insert MPS.

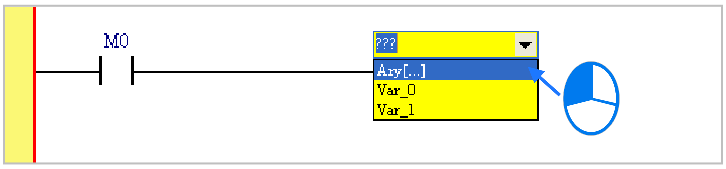


10.2.2 Use Device, Symbols and Constants in LD

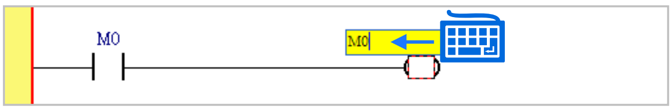
After users click ??? above an object inserted in a network, they can type an operand.



The users can click in the box, and select a declared symbol on the drop-down list. Select an ARRAY data type symbol from the drop-down list and type an element in the […]. See below for ARRAY element descriptions.



The users can type a device name or a symbol in the box. If they type a symbol which is not declared, the **Add Symbol** window will appear after they press Enter on the keyboard. (Please refer to section 2.3.1 for more information about declaring a symbol.)



After users click a network and press Enter on the keyboard, they can edit a box. The users can edit the next box in the network after they press Enter on the keyboard. Besides, the next network will be selected after the users press Tab on the keyboard. The users can edit a box with the keyboard. If the users have declared symbols, they can press Page Down on the keyboard when they edit a box. The symbols on the drop-down list are symbols which can be assigned to the operands. The users can select a symbol by the mouse or the up/down key on the keyboard. After the editing is complete, the users can press Enter on the keyboard to jump to the next box. If the users want to end the editing, they can press Esc on the keyboard.

Additional remark

(a) If users want to use constants in a ladder diagram in ISPSoft, the constants must be represented in the following ways.

- Decimal value: 23456 (A value which is not preceded by any mark will be regarded as a decimal value.)
- Hexadecimal value: 16#5BA0 (A value is preceded by 16#.)
- Octal value: 8#55640 (A value is preceded by 8#.)
- Binary value: 2#101101110100000 (A value is preceded by 2#.)
- String: “XYZ” (Characters are put in double apostrophes); use single apostrophe for DVPxxMC/AS5xx series.
- BOOL:

  AH/AS: SM400 (The flag is always ON when CPU runs), or SM401 (The flag is always OFF when CPU runs) is used.

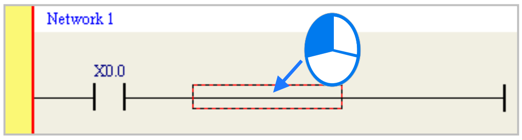
  DVP: M1000 or M1001 is used.

(b) If users want to use a symbol whose data type is ARRAY, the expression format is as the image shown above Ary[…] (Identifier[Index]). An index should be a decimal constant, less than the size of the ARRAY and should start from 0, supporting up to three-dimensional array and separating by a comma, for example Ary[1,2,3], please refer to chapter 8.

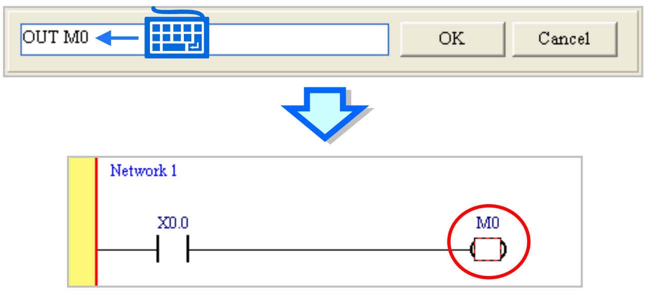
10.2.3 Typing Instructions

Users can add devices, applied instructions and function blocks to a ladder diagram in ISPSoft by typing instructions.

(1) Select a position in which an object will be inserted in a working area.

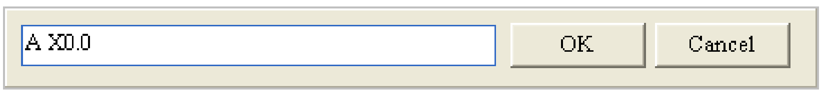


(2) Type an instruction. As soon as the instruction is typed, a box which can be edited appears. After the typing of the instruction is complete, users can press Enter on the keyboard or click **OK** at the right side of the box. (The instruction is case-insensitive.)

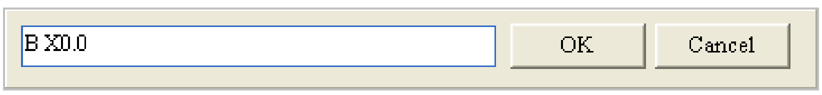


Besides, contacts and coils can be created by typing simple instructions. Please refer to the following figures. (The instructions typed are case-insensitive.)

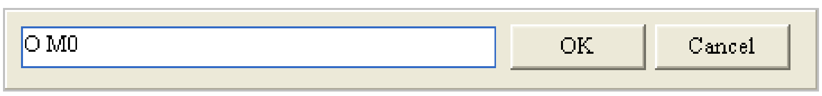
- Inserting a normally-open contact (contact A): "A Device address"



- Inserting a normally-closed contact (contact B): "B Device address"



- Inserting an output coil (OUT): "O Device address"

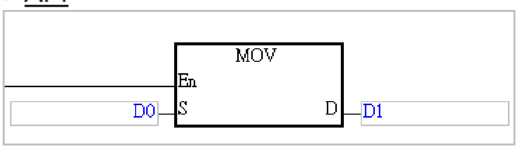


10.2.4 Inserting Applied Instructions and Function Blocks

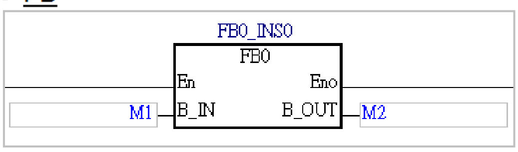
The applied instructions and function blocks in a ladder diagram in ISPSoft are represented by blocks. The pins of a block representing an applied instruction include the pins corresponding to the operands specified in the applied instruction and an En pin. The pins of a block representing a function block include the pins corresponding to the symbols declared in the function block and an En pin. The En pin of a block representing an applied instruction or a function block is connected to the logic state preceding the En pin. If the logic state connected to the En pin of a block representing an applied instruction or a function block is ON, the applied instruction or the function block will be executed.

The pins of a block representing a function block include an Eno pin whereas the pins of a block representing an applied instruction do not include an Eno pin. An applied instruction can only be put at the end of a network in a ladder diagram, and can not be followed by any object. Besides, users can type a function block instance in the box above a function block. Please refer to chapter 7 for more information.

● API



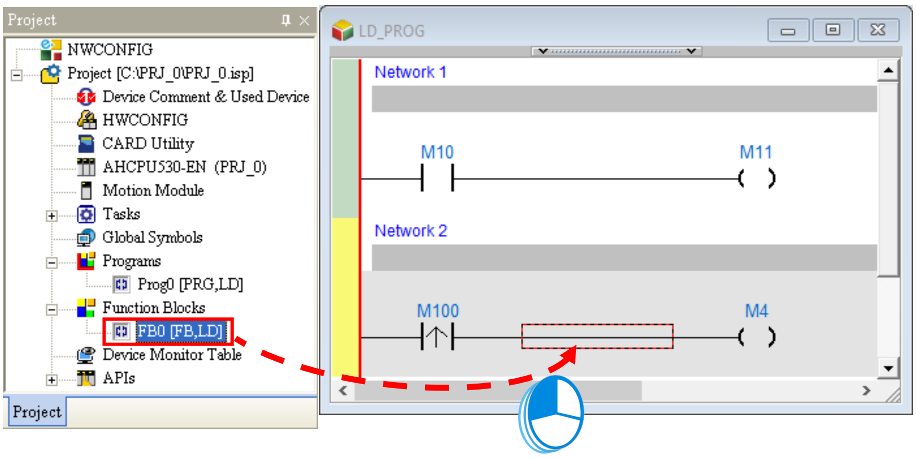
● FB



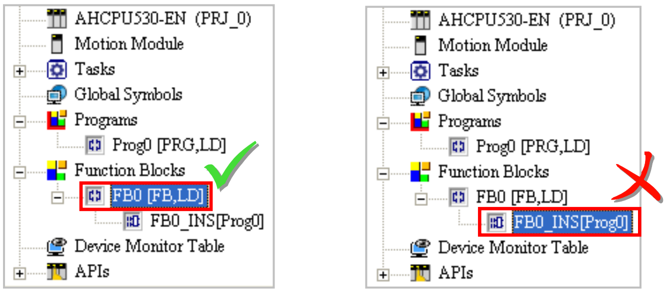
Users can insert an applied instruction or a function block in a ladder diagram in ISPSoft in one of the three ways described below.

● **Method 1**

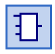
Unfold the **APIs** section or the **Function Blocks** section in the project management area, and find the item which will be inserted. Select the item, and drag it to the position in which it will be inserted.

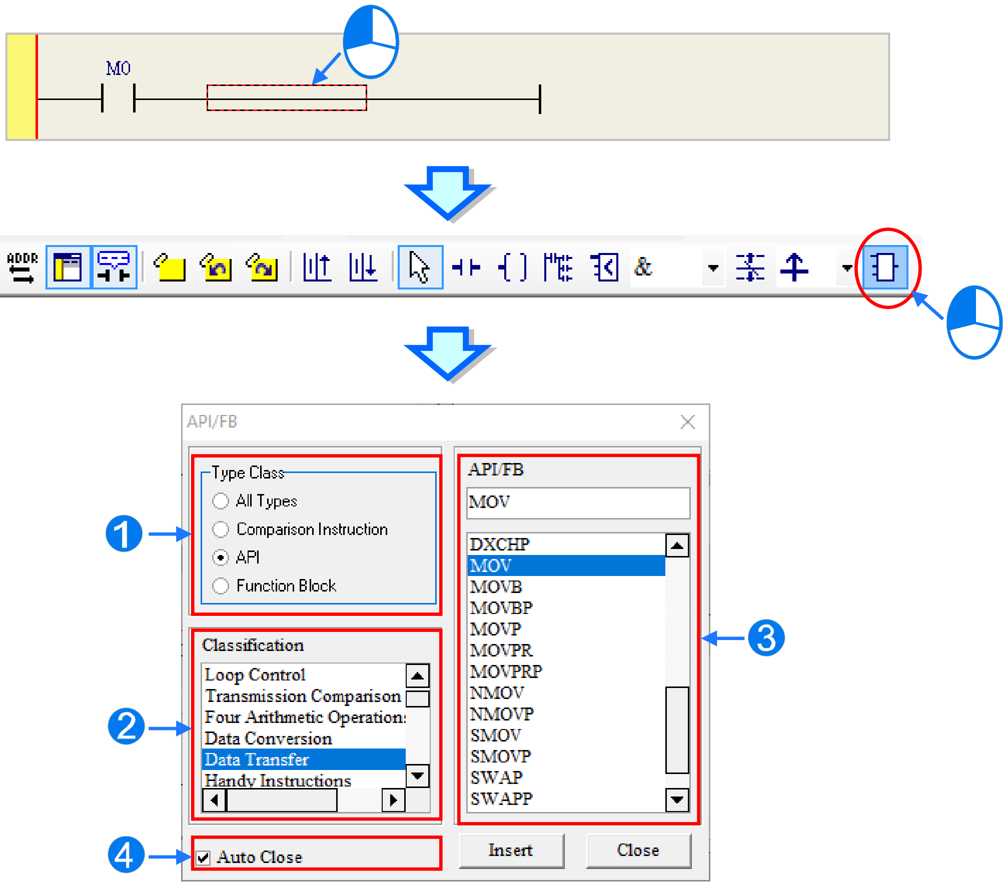


Function block definitions can be dragged, but function block instances cannot be dragged.



- **Method 2**

Click the position in which an applied instruction or a function block will be inserted, click  on the toolbar, select the item which will be inserted in the **API/FB** window, and click **Insert**.



❶ Users can select the **All Types** option button, the **Comparison Instruction** option button, the **API** option button, or the **Function Block** option button.

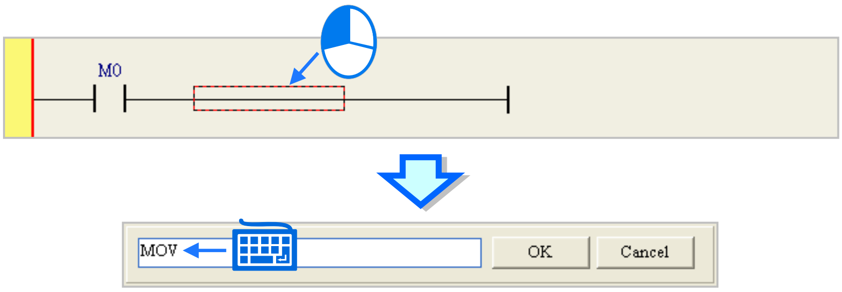
❷ If users select the **API** option button in the **Type Class** section, they have to select an instruction type in the **Classification** box.

❸ Users can select an applied instruction, a comparison contact, or a function block here.

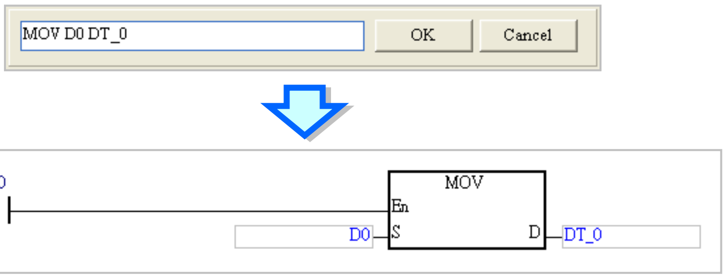
❹ If users unselect the **Auto Close** checkbox, they can insert instructions or function blocks continuously.

● **Method 3**

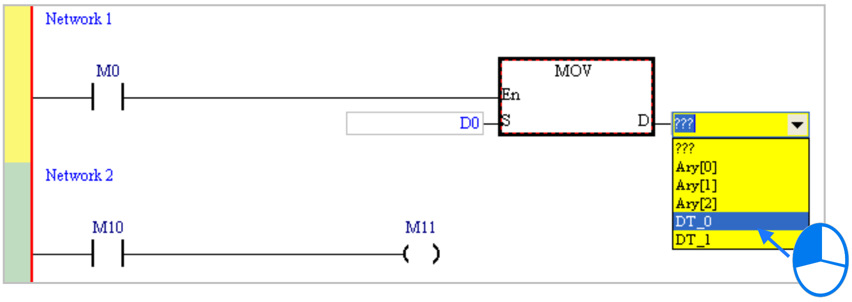
Click the position in which an instruction or a function block will be inserted, and type the applied instruction or the function block definition. As soon as the applied instruction or the function block definition is typed, a box which can be edited appears. After the typing of the applied instruction or the function block definition is complete, users can press Enter on the keyboard or click **OK** at the right side of the box. (The applied instruction and the function block definition are case-insensitive.)



If users want to insert a function block, they have to type the function block definition, and they can not type the operands specifed in the function block. If users want to insert an applied instruction, they have to type the applied instruction, and they can type the operands specified in the applied instruction. The users do not have to type all the operands specified in the applied instruction. The system will assign the operands typed to the corresponding boxes, and ??? will appear in the boxes where there are no operands. Besides, if the operands typed include a symbol which is not declared, the **Add Symbol** window will appear after the users press Enter on the keyboard. Please refer to programming manuals for more information about instructions.

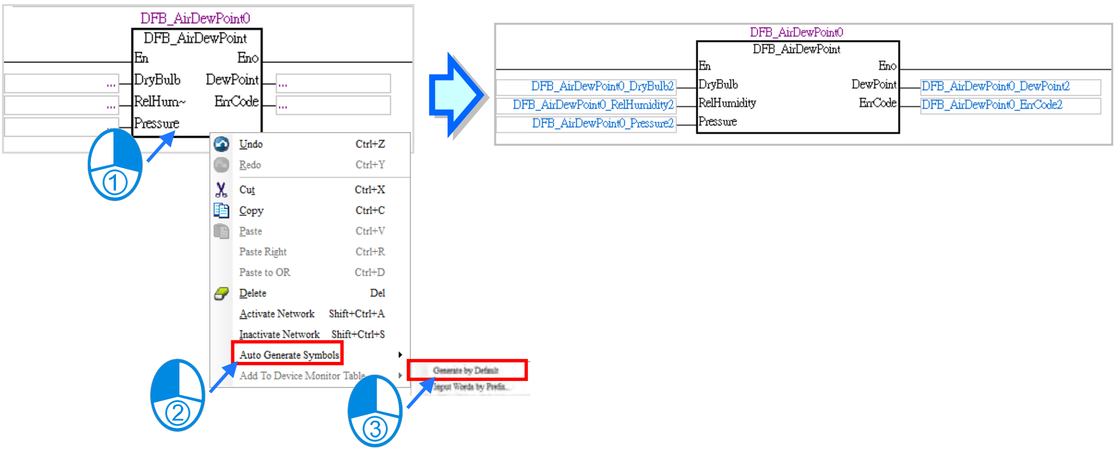


After an applied instruction or a function block is inserted successfully, users have to refer to section 10.2.2, and type operands.

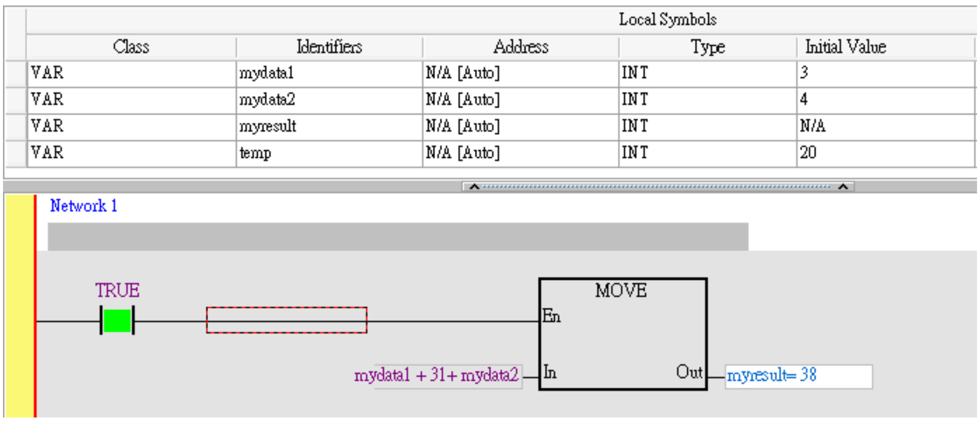


***. If the Auto-leading 'Add Symbol' Dialog checkbox in the Options window is selected, the Add Symbol window will appear automatically after users type a symbol which is not declared. Please refer to section 2.3.1 for more information.**

Right-click on top of the function block, select Auto Generate Symbols and choose to generate by default. The default name usually adopts function block name + pin name and once symbols are generated type in pin position (see below); type in the spelling or words to generate symbols and type in pin position.



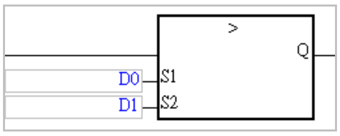
Programs PLCs using structured text supported by function blocks and pins of DVPxxMC/AS5xx series as below shown.



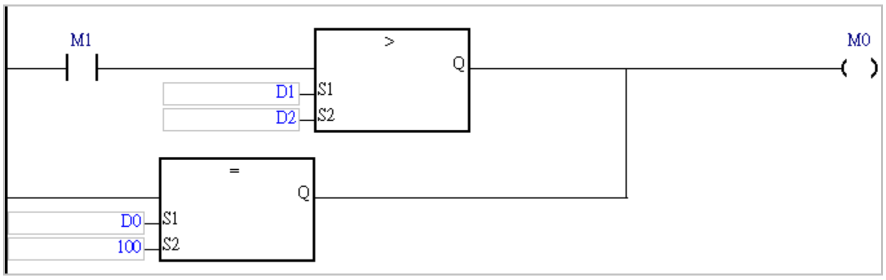
Local Symbols				
Class	Identifiers	Address	Type	Initial Value
VAR	mydata1	N/A [Auto]	INT	3
VAR	mydata2	N/A [Auto]	INT	4
VAR	myresult	N/A [Auto]	INT	N/A
VAR	temp	N/A [Auto]	INT	20

10.2.5 Creating a Comparison Contact

An example of a comparison contact in ISPSoft is shown below. **>** in the block represents a comparison type. **S1** and **S2** are objects which are compared. The data format which is accepted depends on the comparison type. **Q** can drive a coil or connect to a contact in series.

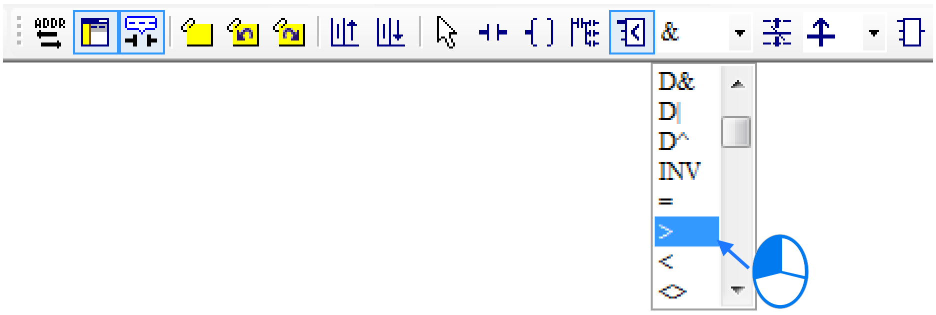


The comparison contacts in a ladder diagram are similar to general contacts in that they can connect to other contacts in parallel or in series.



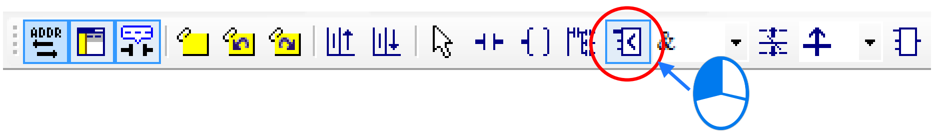
A comparison contact can be inserted not only in one of the three ways described in section 10.2.4, but also by means of the following steps.

(1) Click  on the toolbar, and then select a type.

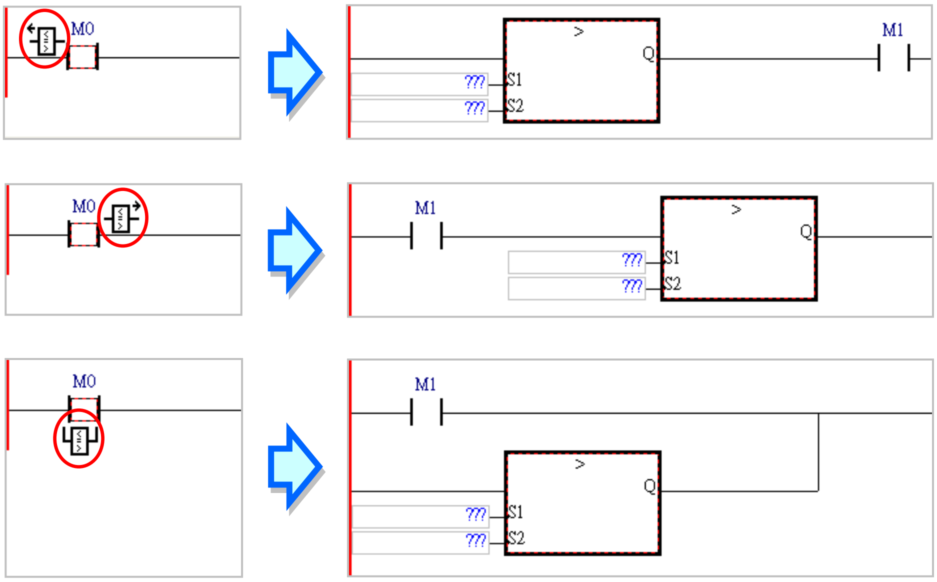


(2) Select a line, a contact, or a group of devices. Before users connect a comparison contact to a group of devices in parallel or in series, they have to draw a frame round the group of devices.

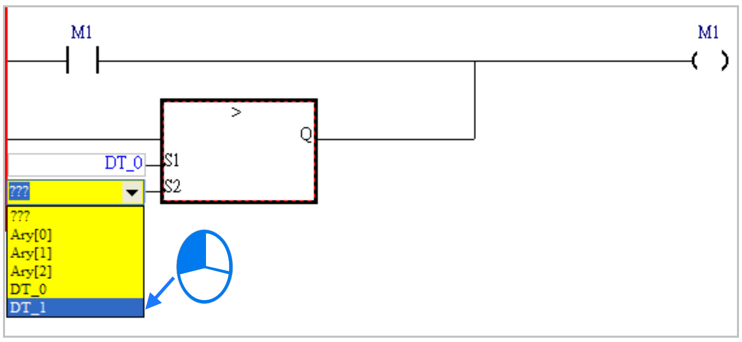
After users make sure of the position in which a comparison contact will be inserted, they can click  on the toolbar.



(3) The mouse cursor appears as a comparison contact when the mouse cursor is near the position in which a comparison contact will be inserted. Please refer to the figures below. The mouse cursor appears as a contact when the mouse cursor is at the right side of the contact selected, at the left side of the contact selected, or at the bottom of the contact selected. Users can decide where to insert a comparison contact. After users click the position in which a contact will be inserted, the system will insert the contact.

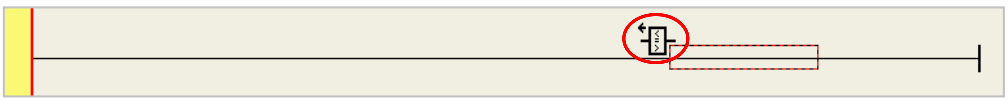


(4) After an comparison contact is inserted successfully, users have to refer to section 10.2.2, and type operands.



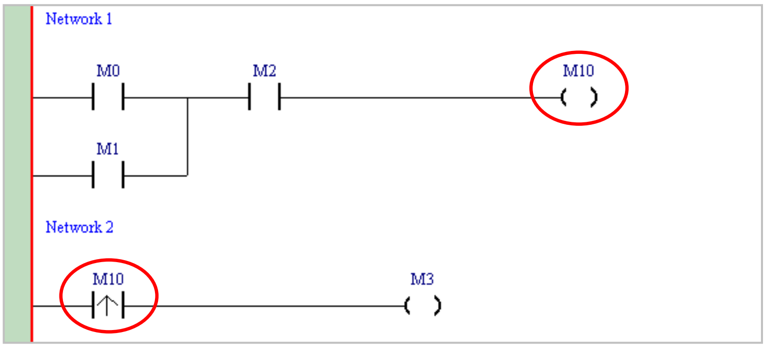
Additional remark

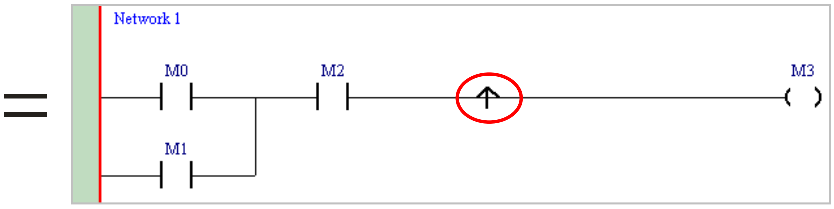
If users want to insert a comparison contact in a new network, the mouse cursor must be near the line selected.



10.2.6 Inserting a Block Logic Instruction

If users want to take the operation result of a block as a condition of a rising edge-triggered circuit, they traditionally have to create two networks in a ladder diagram. However, the users can combine the two networks by means of using a block logic instruction.



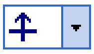


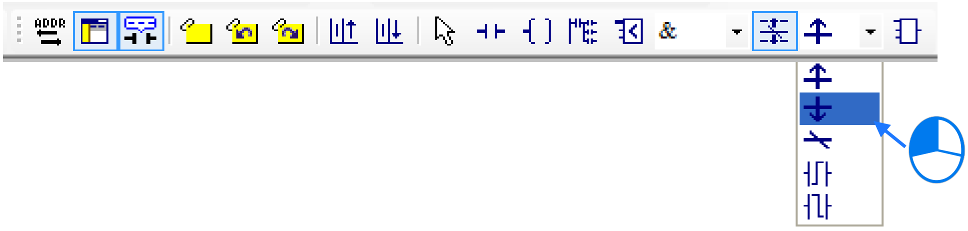
Icon	Instruction	Function	AH/AS		DVP		AS5xx/ DVPxxMC	
			POU	FB	PO	FB	POU	FB
	NP	When the block preceding this block logic instruction is tuned from OFF to ON, the	✓	✓	✓	✓		
	PN	When the block preceding this block logic instruction is turned form ON to OFF, the	✓	✓	✓	✓		
	INV	Invert the preceding block logic status and output.	✓	✓	✓	✓	✓	✓
	FB_NP	The function is similar to NP, users need to specify a register device or variables.		✓		Support ES3		
	FB_PN	The function is similar to PN, users need to specify a register device or variables.		✓		Support ES3		

*** Please refer to AH/AS Programming Manual or section 7.3.2 for more information about FB_NP and FB_PN.**

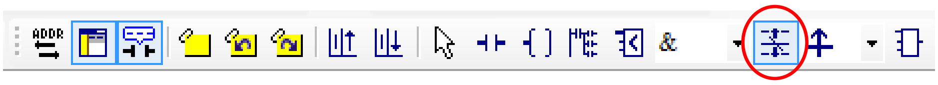
Users can insert a block logic instruction in one of the two ways described below.

● **Method 1**

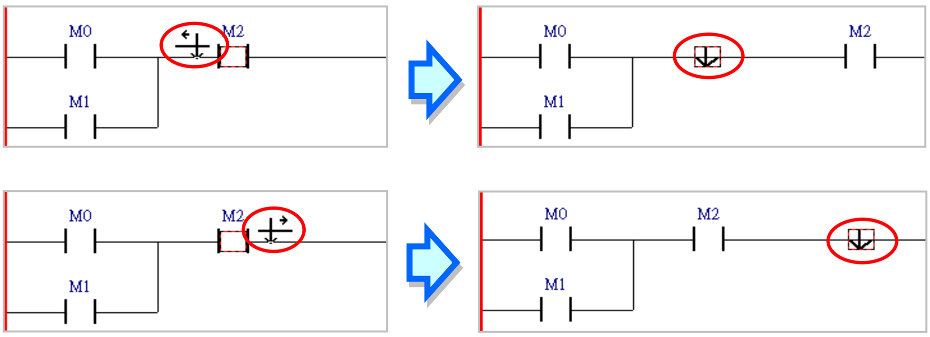
(1) Click  on the toolbar, and then select a type.



(2) Click  on the toolbar.

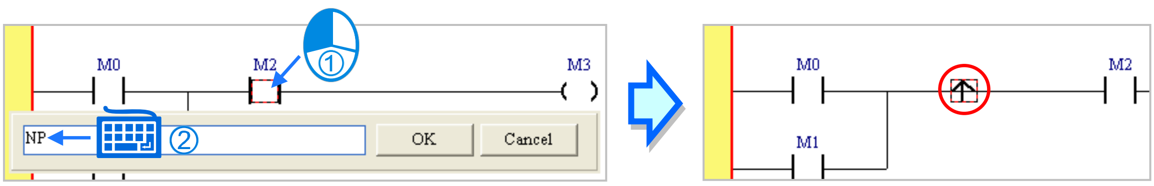


(3) The mouse cursor appears as the representation of a block logic instruction when the mouse cursor is near the position in which a block logic instruction will be inserted. Please refer to the figures below. The mouse cursor appears as the representation of a block logic instruction when the mouse cursor is at the right side of the contact selected, or at the left side of the contact selected. Users can decide where to insert a block logic instruction. After users click the position in which a block logic instruction will be inserted, the system will insert the block logic instruction.



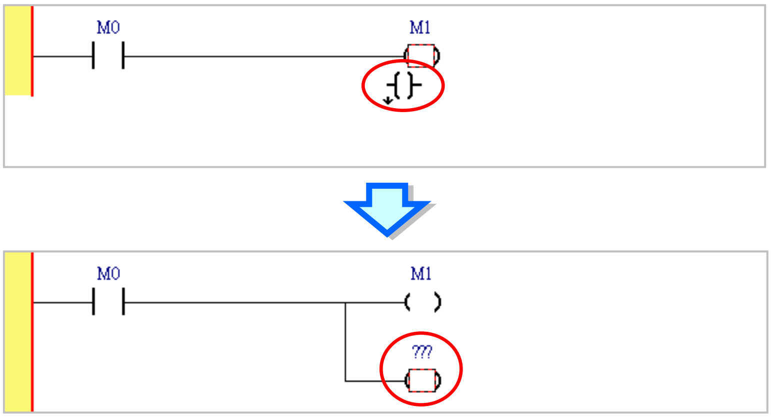
● **Method 2**

Click the position in which a block logic instruction will be inserted, and type the block logic instruction. As soon as the block logic instruction is typed, a box which can be edited appears. After the typing of the block logic instruction is complete, users can press Enter on the keyboard or click **OK** at the right side of the box. The representation of the block logic instruction typed will be put in front of the position selected. (The instruction typed is case-insensitive.)

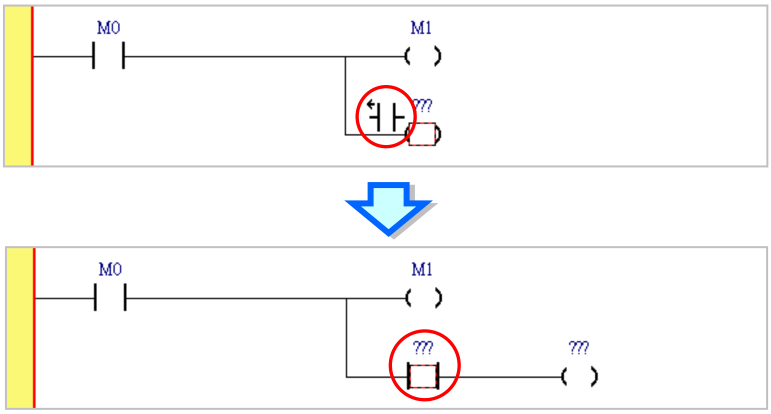


10.2.7 Creating Multiple Outputs

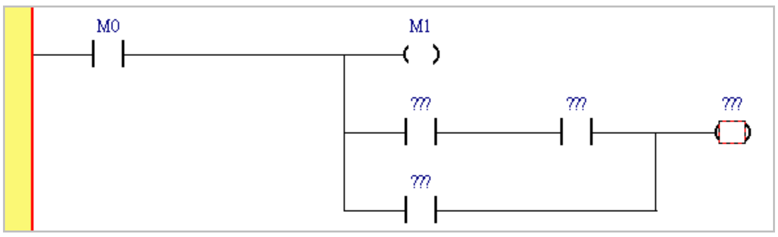
(1) If users want to create multiple outputs, they have to insert a coil or an applied instruction first.



(2) Click  or  on the toolbar, move the mouse cursor to a position near the output object, and then click the left mouse button.



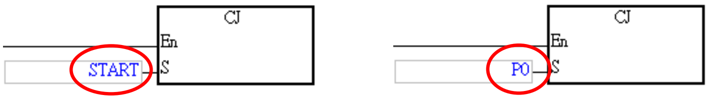
(3) Create multiple outputs according to the description above.



10.2.8 Putting a Label

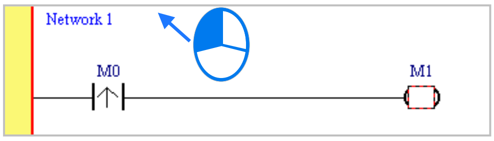
If users want to use a jump instruction, they have to put a label on the network to which the execution of the program jumps. A label is put at the right side of a network number.

If users want to specify a label in an instruction, they do not have to type a colon in front of the label.

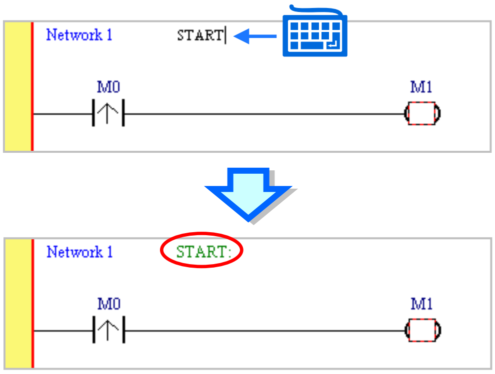


The steps of putting a label are as follows.

(1) Click the right side of the network number at which a label will be put.



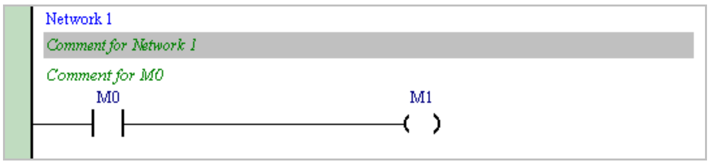
(2) Users have to type a label symbol. Press Enter on the keyboard after a P device number or a label symbol is typed. The system will automatically put a colon at the right side of the label.



10

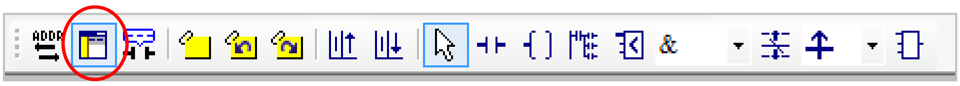
10.2.9 Editing a Comment

In a ladder diagram in ISPSoft, users not only can make comments on the devices, but can make comments on the networks. Users can type comments under the network numbers in a ladder diagram in ISPSoft.

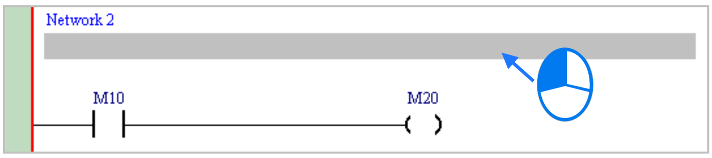


● **Editing the comment on a network**

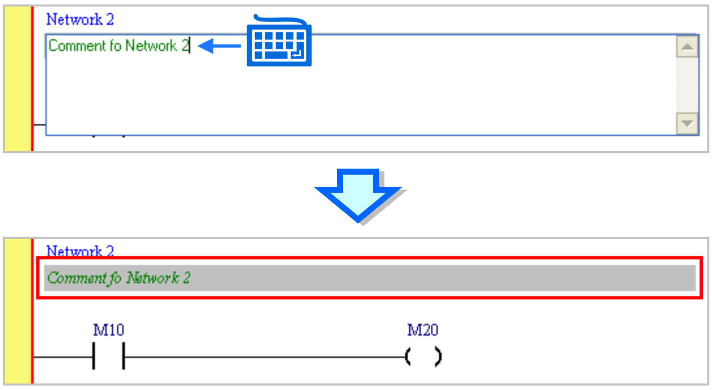
(1) After users click on the toolbar, the comments on the networks will be displayed. If the users click on the toolbar again, the comments on the networks will be hidden.



(2) After the users click the position under a network number, a box will appear.

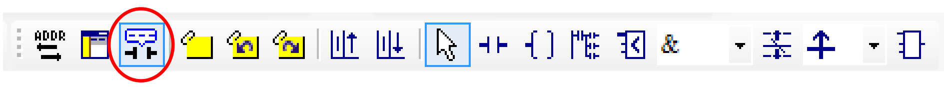


(3) Type a comment in the box. If the users want to start a new line of text at a specific point, they can press Shift+Enter on the keyboard. Press Enter on the keyboard after the editing is complete.

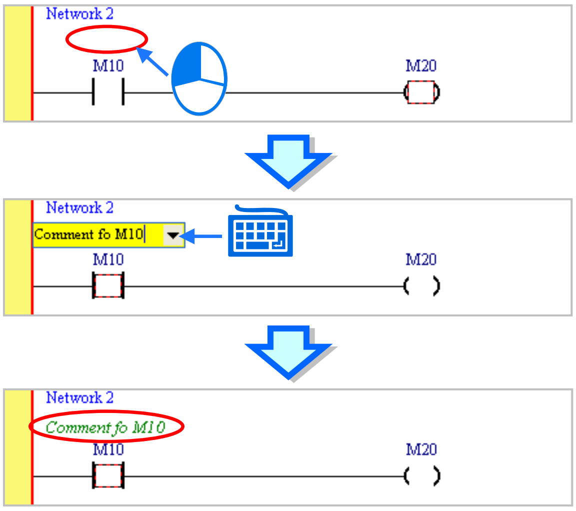


● **Editing the comment on a device**

(1) After users click on the toolbar, the comments on the devices will be displayed. If the users click on the toolbar again, the comments on the devices will be hidden.



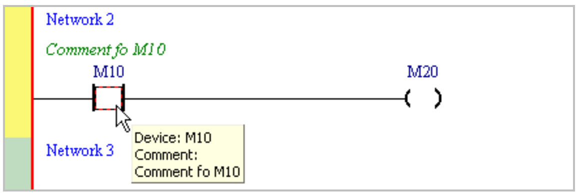
(2) After the users click the position above a device name, they can type a comment in the box and also edit pin content of API. Press Enter on the keyboard after the editing is complete.



Additional remark

If a symbol is assigned to a contact or a coil in the program, the comment users make on the symbol will appear after  on the toolbar is clicked. The comments on the devices are different from the comments on the symbols. Users can not edit the comments on the symbols directly. If users want to edit the comment on a symbol, they have to open the **Modify Symbol** window for the symbol. Please refer to section 6.2.4 for more information.

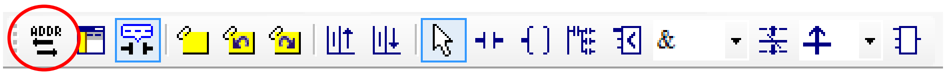
Besides, if  on the toolbar is clicked, the hints related to a device will appear after the mouse cursor stays at the device for a while. Users can select hints in the **Options** window in ISPSoft. Please refer to section 2.3.1 for more information.

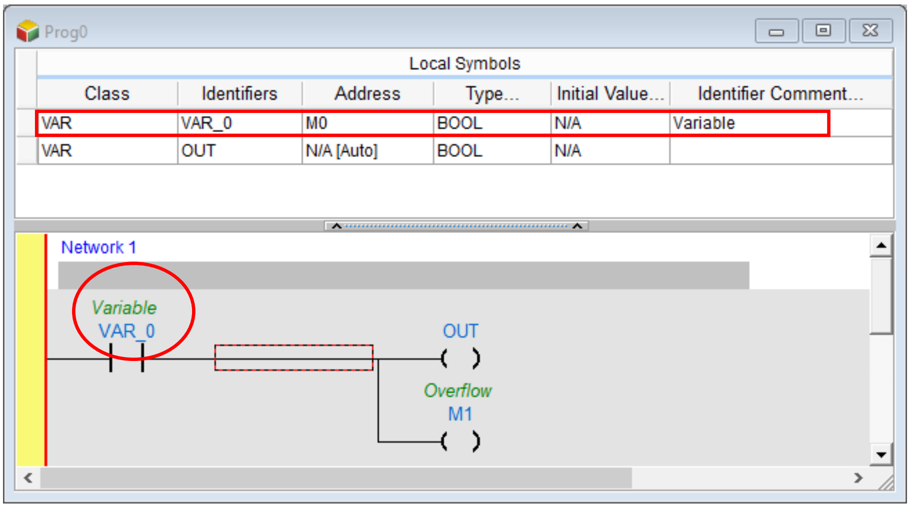


10.2.10 Symbol Mode and Address Mode

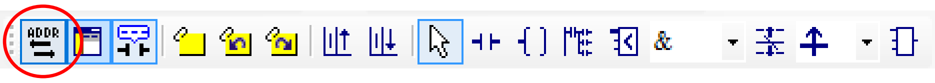
If a device address is assigned to a symbol declared in a ladder diagram, users can change the mode in which the symbol is displayed by means of clicking  on the toolbar. However, the symbols to which no devices are assigned and the devices to which no symbols are assigned will remain unchanged after  on the toolbar is clicked.

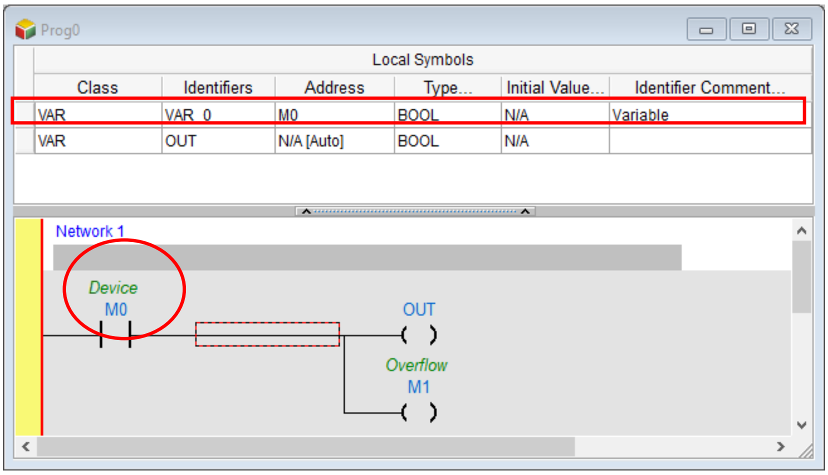
If  on the toolbar is not clicked, the identifiers of the symbols to which devices are assigned will be displayed, and the comments on the symbols will be displayed.





If  on the toolbar is clicked, the devices to which symbols are assigned will be displayed, and the comments on the devices will be displayed.

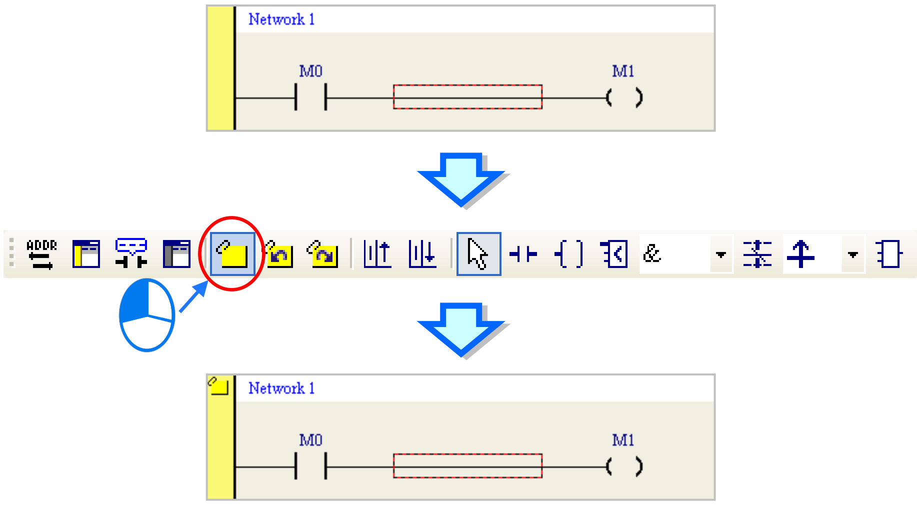




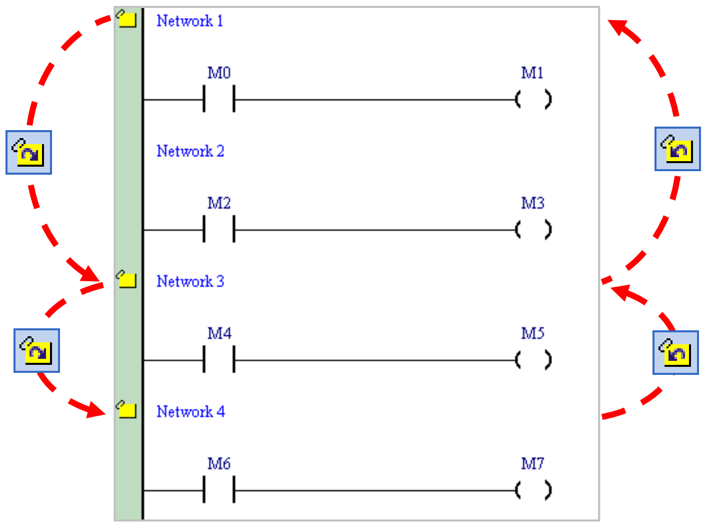
10.2.11 Bookmark

After networks are bookmarked, users can find or go to the networks easily.

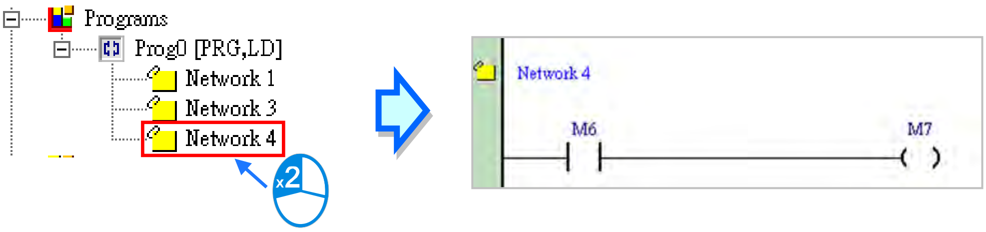
(1) After users click  on the toolbar, a bookmark will be inserted in the network selected. If the users want to delete the bookmark, they can select the network, and click  on the toolbar again.



(2) If there are bookmarks in a program, users can go to the next network which is bookmarked by clicking  on the toolbar, and go to the previous network which is bookmarked by clicking  on the toolbar.



(3) You can also go to where the bookmarked is by clicking twice on the bookmarked network in the Project area.



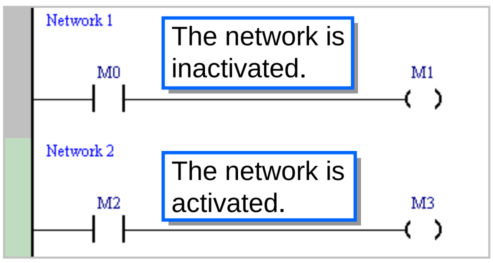
Additional remark

After users point to **Bookmarks** on the **Edit** menu, they can select **Toggle Bookmark**, **Goto the Next Bookmark**, **Goto the Previous Bookmark**, or **Remove All Bookmarks**. If the users click **Remove All Bookmarks**, all the bookmarks in the present program editing window will be deleted.

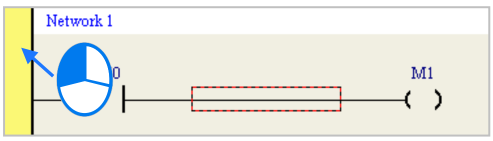
10.2.12 Activating / Inactivating a Network

If a network is inactivated, the compiling of the program will skip the network. When users test or debug a program, they can inactivate some part of the program temporarily by means of this function.

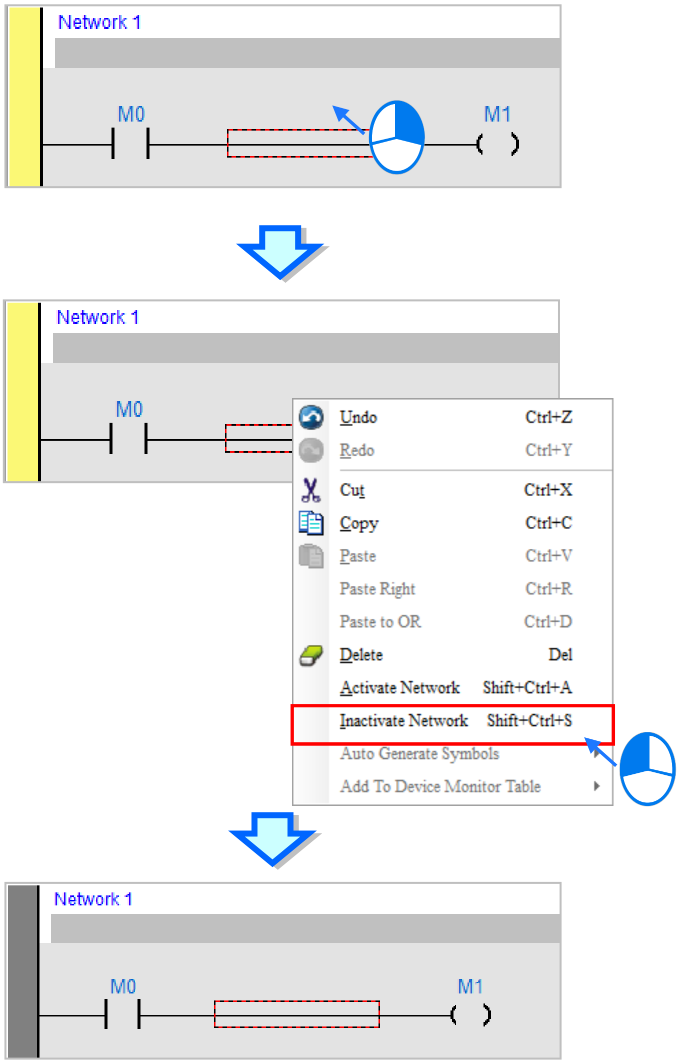
The color at the left side of a network indicates whether the network is activated or inactivated. Users can select colors which will be shown at the left sides of the networks in a ladder diagram in the **Options** window in ISPSoft. Please refer to section 2.3.1 for more information.



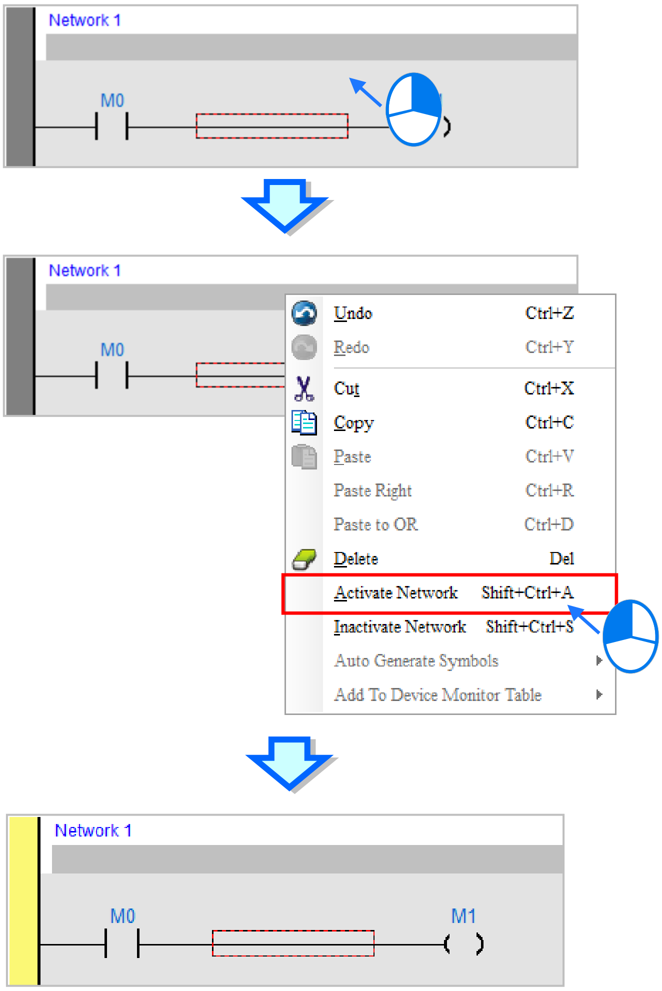
If users want to activate or inactivate a network, they have to select the network first. Users can select several networks simultaneously.



Click **Inactivate Network** on the **Edit** menu or right-click the network selected and click **Inactivate Network** on the context menu. The network selected will be inactivated.



If users want the inactivated network selected to be activated, they can click **Activate Network** on the **Edit** menu or right-click the network selected and click **Activate Network** on the context menu.


Network 1
M0
Network 1
M0
Undo Ctrl+Z
Redo Ctrl+Y
Cut Ctrl+X
Copy Ctrl+C
Paste Ctrl+V
Paste Right Ctrl+R
Paste to OR Ctrl+D
Delete Del
Activate Network Shift+Ctrl+A
Inactivate Network Shift+Ctrl+S
Auto Generate Symbols
Add To Device Monitor Table
Network 1
M0
M1

Chapter 11 McFunction Block Diagram

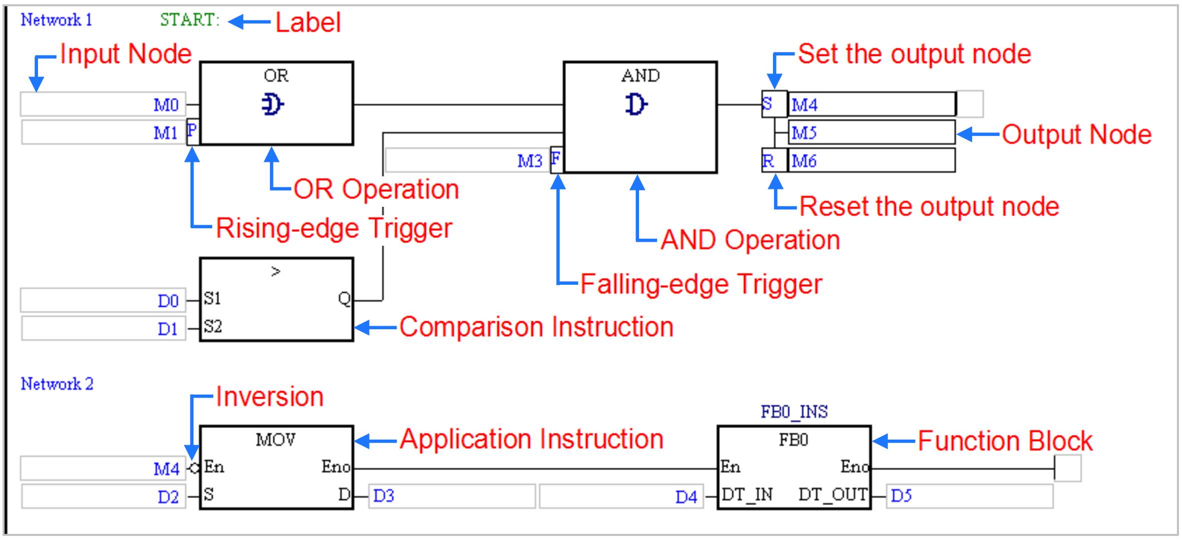
Table of Contents

11.1 Introduction of Function Block Diagrams

11.1.1 Knowing Function Block Diagrams

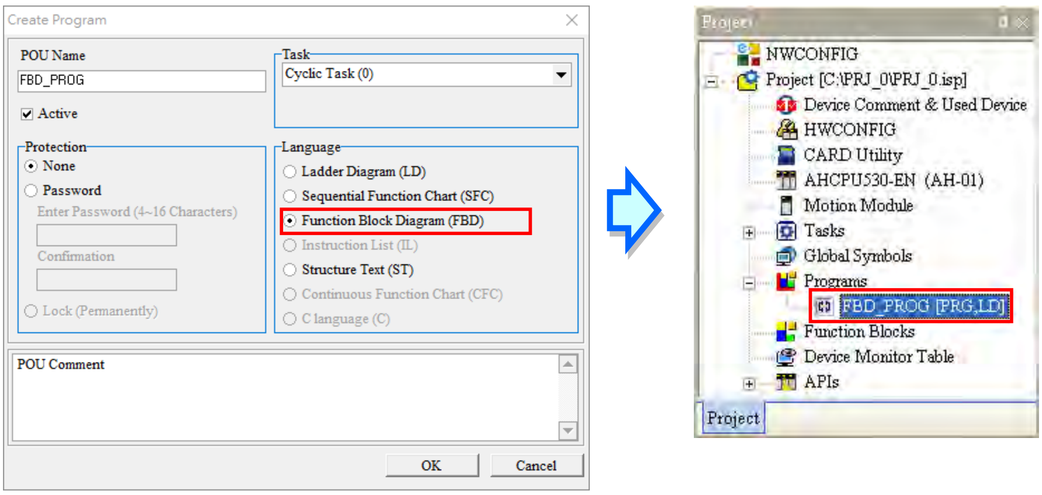
A function block diagram is one of the five languages defined by IEC 61131-3 standard. A function block diagram and a ladder diagram are graphical programming languages. A ladder diagram is a programming language that represents a program by a graphical diagram based on the circuit diagrams of relay logic hardware. A function block diagram is a block diagram that describes a function between input variables and output variables. A program is systematically divided into several function blocks, and these function blocks are arranged in a function block diagram.

A function block diagram in ISPSoft is shown below.

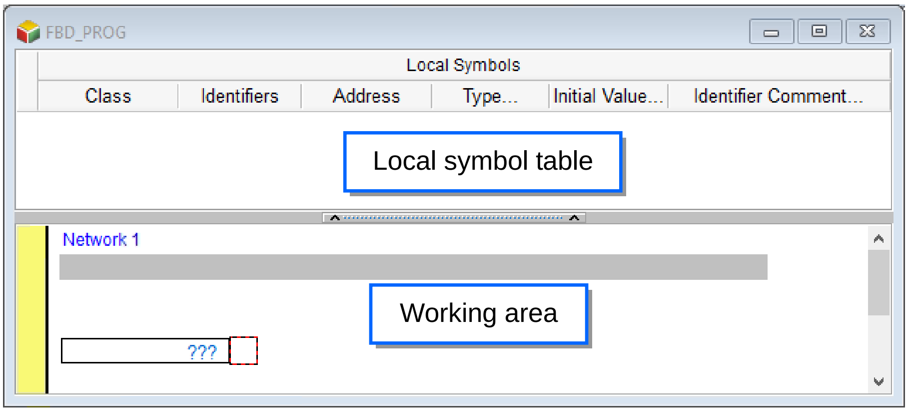


11.1.2 Editing Environment

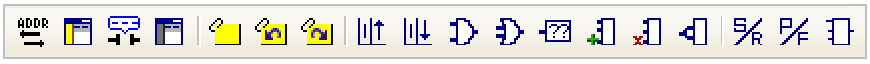
Select the **Function Block Diagram (FBD)** option button in the **Language** section in the **Create Program** window. Please refer to section 5.4.1 for more information.

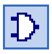
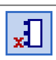
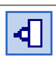


The environment in which a function block diagram can be edited is shown below. The table at the upper part of the window is a local symbol table, and the area at the lower part of the window is a working area.



After a program editing window in which a function block diagram can be created is opened, the corresponding toolbar will appear in the ISPSoft window. The functions are described below.



Icon	Keyboard shortcut	Function
	None	Displaying/Hiding the symbol or address
	Shift+Ctrl+C	Displaying/Hiding the comments on the networks
	None	Displaying/Hiding the commands on the devices
	Shift+Ctrl+A	Activating/Inactivating the network selected
	Shift+Ctrl+B	Adding a bookmark to the network selected or deleting the bookmark from the network selected
	Shift+Ctrl+P	Going to the previous bookmarked position
	Shift+Ctrl+N	Going to the next bookmarked position
	Ctrl+I	Inserting a network above the network selected
	Shift+Ctrl+I	Inserting a network under the network selected
	Shift+F1	Inserting an AND block
	Shift+F2	Inserting an OR block
	Shift+F3	Inserting an output node
	Shift+F4	Adding an input node to the AND/OR block
	Shift+F5	Deleting the input node from the AND/OR block
	Shift+F6	Inserting inverse logic

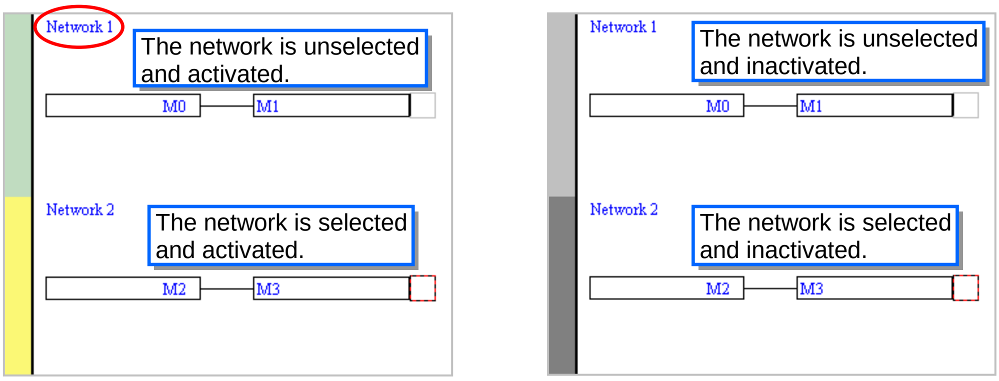
Icon	Keyboard shortcut	Function
	Shift+F7	Setting/Resetting the input
	Shift+F8	The input is rising edge-triggered/falling edge-triggered.
	Shift+Ctrl+U	Inserting an instruction or a function block

***. Instructions and function blocks can be inserted by means of a keyboard. Please refer to section 11.2.7 for more information.**

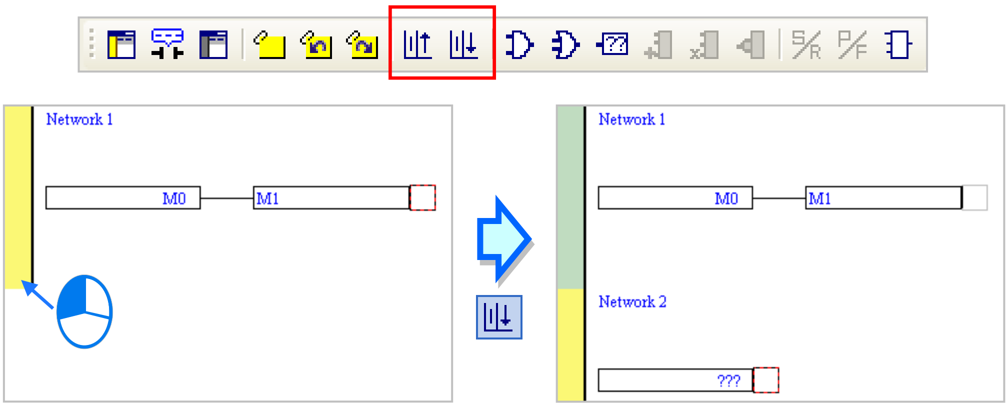
11.1.3 Networks in a Function Block Diagram

A function block diagram consists of networks. Every network is an independent program. Besides, there is no limit on the number of objects which can be inserted in a network in ISPSoft.

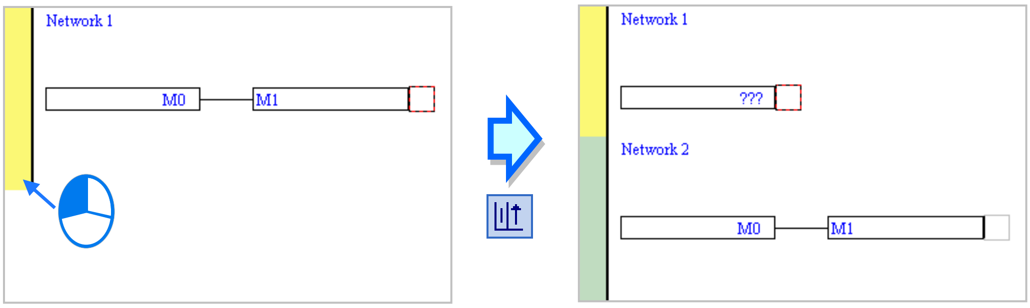
Network numbers are marked on the networks in a ladder diagram. The color at the left side of a network indicates the state of the network. A network can be activated or inactivated, and a network can be selected or unselected. Users can select colors which will be shown at the left sides of the networks in a ladder diagram in the **Options** window in ISPSoft. Please refer to section 2.3.1 for more information.



After a new window in which a ladder diagram will be created is opened, the system will insert a blank network in the window. If users want to add a network, they can select a network, and click  on the toolbar. The network added will be under the network selected.

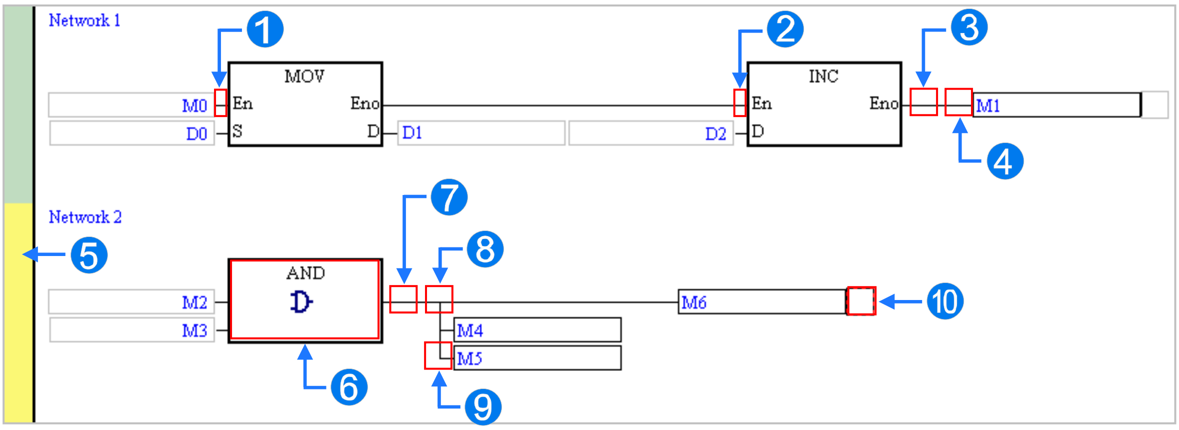


If users click  on the toolbar, a blank network will be put above the network selected.



11.1.4 Selecting Objects

The red frame in the working area indicates the objects which are edited. It also indicates the objects which are selected. If users want to edit he program in the figure below, they can only select the positions marked with red frames. Besides, the functions which can be used vary with the position selected. The objects which are copied/cut/pasted/deleted depend on the position selected. The positions which are marked with red frames in the figure are described below.



❶ The input node at the right side of this position is selected. M0 in the figure is selected.

❷ The block before this position is selected.

❸ All the blocks before this position are selected.

❹ The output node at the right side of this position is selected. M1 in the figure is selected.

❺ The whole network is selected.

❻ The block is selected.

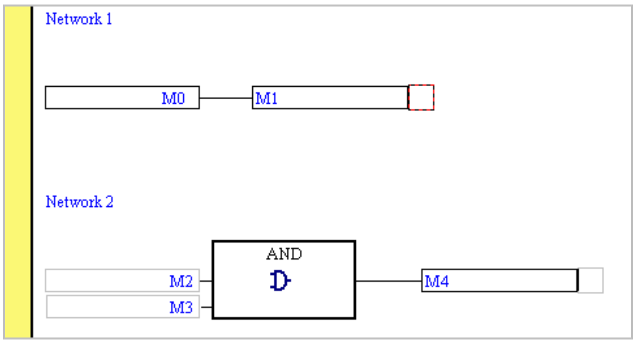
❼ The block before this position is selected.

❽ The output nodes under this position are selected.

❾ The output node at the right side of this position is selected.

❿ The block before this position is selected.

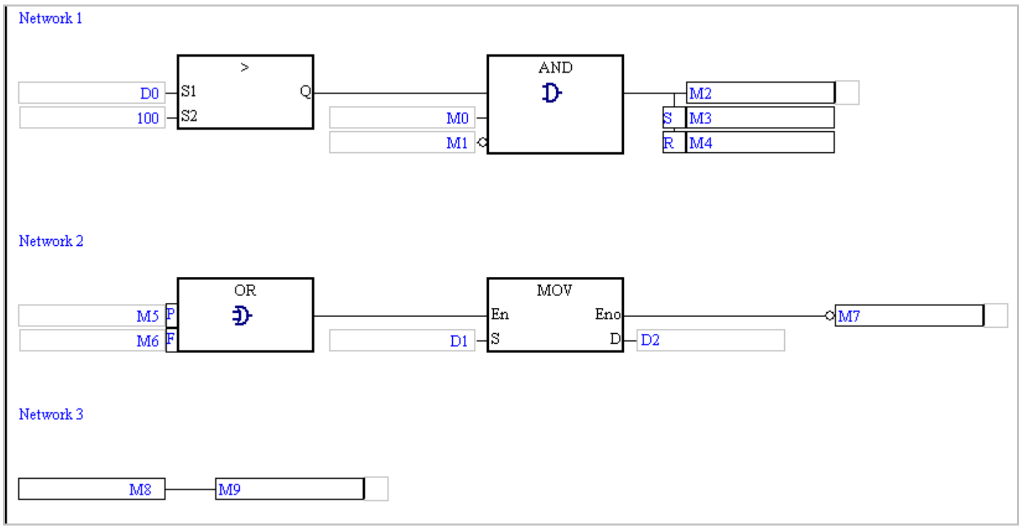
If users want to select several networks, they can hold down Ctrl on the keyboard while they click the networks. The users can also select a range of networks by pressing Shift on the keyboard, clicking the first network within the range, and the last network within the range.



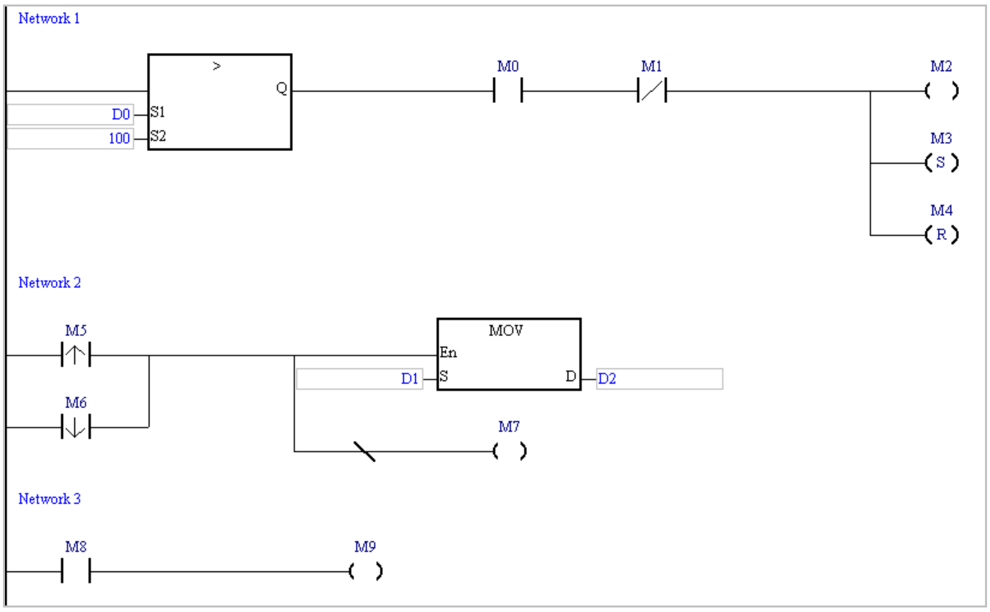
11.2 Creating a Function Block Diagram in ISPSoft

A basic function block diagram and its equivalent ladder diagram are shown below. The graphical representations in a function block diagram will be described in the following sections.

- **Function block diagram**



- **Equivalent ladder diagram**



11.2.1 Input Nodes and Output Nodes

The devices and the symbols in a function block diagram are represented by nodes. An input node and the corresponding output node must conform to the rules listed below.

(a) One node represents an M/S/T/C/HC device, and the other node represents a symbol whose data type is BOOL/STEP/TIMER/COUNTER. (The device assigned to the node which represents a symbol is a bit device.)

(b) One node represents a D/L device, and the other node represents a symbol whose data type is not BOOL/STEP/REAL/STRING.

(c) One node represents a T/C device, and the other node represents a D/L device or a symbol whose data type is WORD/INT/TIMER/COUNTER.

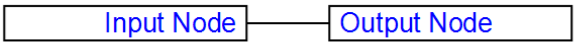
(d) One node represents a D/L/HC device, or a symbol whose data type is COUNTER, and to which a HC device is assigned. The other node represents a symbol whose data type is DWORD/DINT.

(e) One node represents a symbol whose data type is WORD/DWORD/LWORD, and the other node represents a symbol whose data type is INT/DINT/LINT. The data length of the output node must be larger than or equal to the data length of the input node.

(f) Both nodes represent symbols whose data types are REAL/LREAL/STRING. The data lengths of the nodes must be the same.

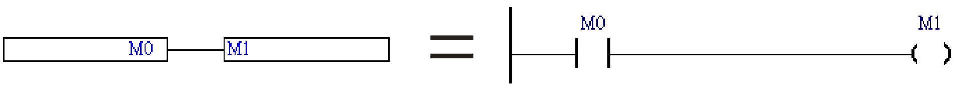
(g) If an input node has multiple output nodes, the output nodes must conform to the rules listed above. 32 output nodes at most form a group. After users add an output node rightward, they can create another group of output nodes.

- **Graphical representation**

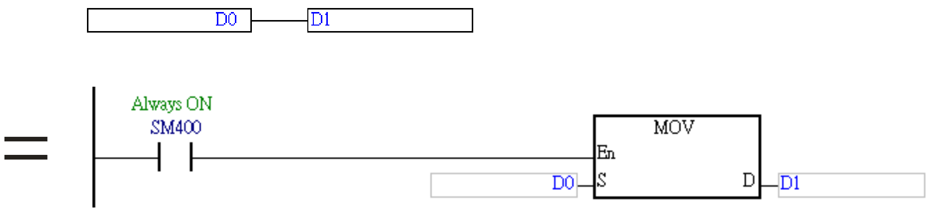


- **Example**

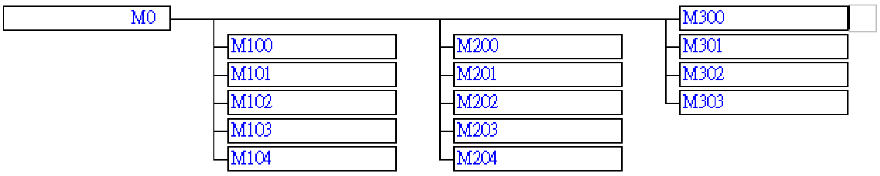
Example 1: The state of the contact M0 is sent to M1.



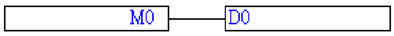
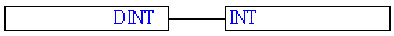
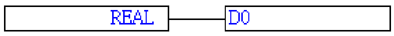
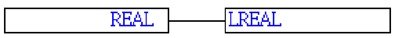
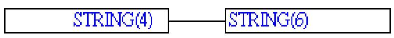
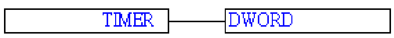
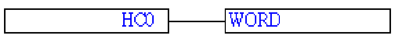
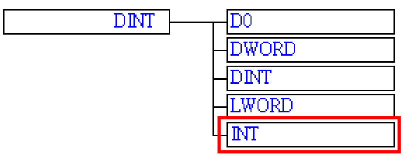
Example 2: The data in D0 is sent to D1.



Example 3: There are three groups of output nodes. The first group begins with M100, the second group begins with M200, and the third group begins with M300. 32 output nodes at most form a group. After users add an output node rightward, they can create another group of output nodes. There is no limit on the number of output nodes which can be added rightward.

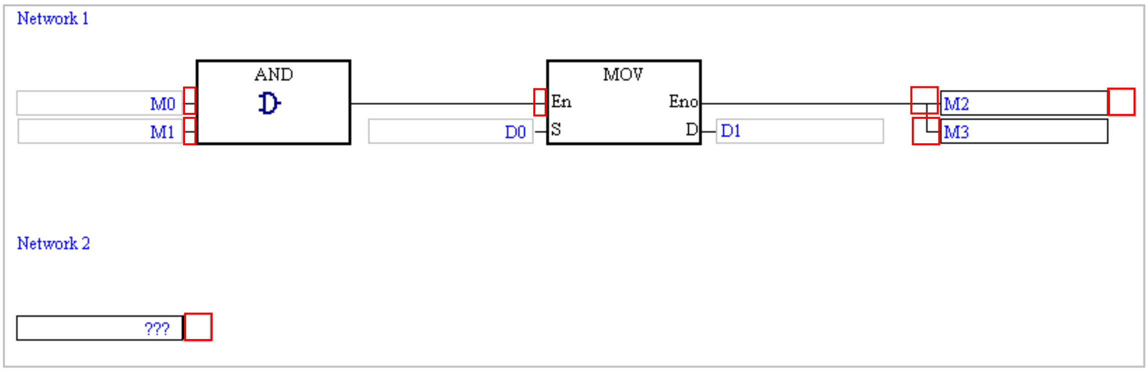


Example 4: Some incorrect examples are listed below.

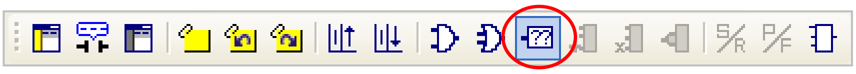
Incorrect example	Description
	The data type of the input node must not be different from the data type of the output node.
	The data length of the output node must not be less than the data length of the input node.
	The value of a symbol whose data type is REAL can not be sent to a D device.
	If the input node represents a symbol whose data type is REAL, the output node must represent a symbol whose data type is REAL. If the input node represents a symbol whose data type is LREAL, the output node must represent a symbol whose data type is LREAL.
	The data length of the input node representing a symbol whose data type is STRING and the data length of the output node representing a symbol whose data type is STRING must be the same.
	The value of a symbol whose data type is TIMER can not be sent to a symbol whose data type is DWORD, but can be sent to a symbol whose data type is WORD.
	The value in a HC device can not be sent to a symbol whose data type is WORD, but can be sent to a symbol whose data type is DWORD.
	The multiple output nodes must conform to the rules listed above. The example is incorrect because the data length of the output node representing a symbol whose data type is INT is less than the data length of the input node.

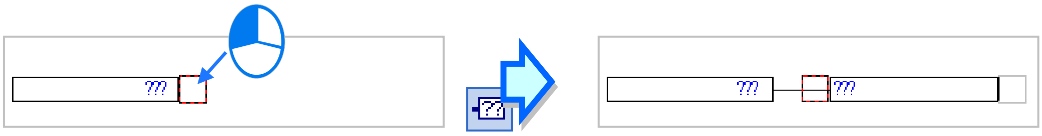
- **Inserting an output node**

(1) Select a position into which an output node will be inserted in the working area. Users are allowed to insert output nodes into the positions marked with red frames in the figure below.

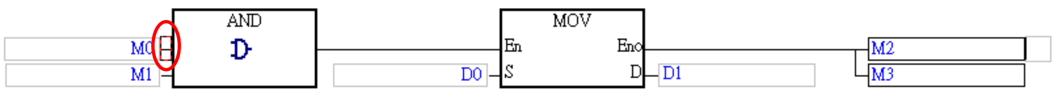
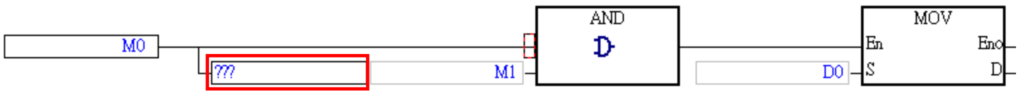
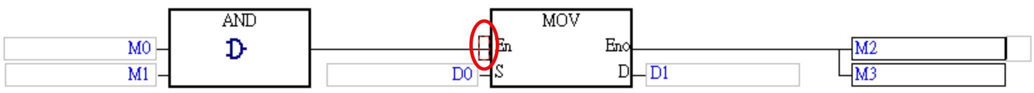
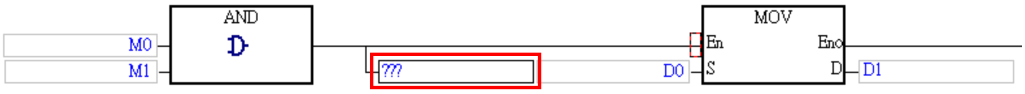
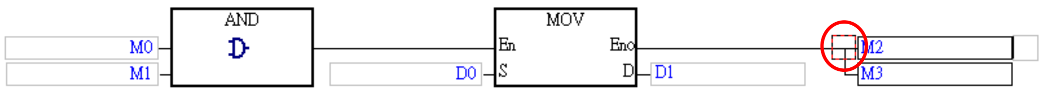
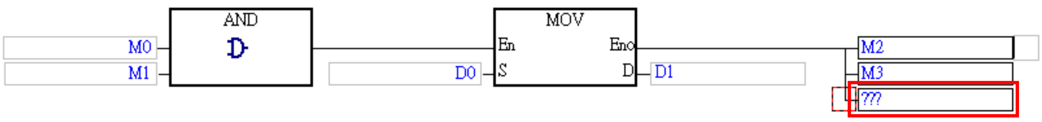
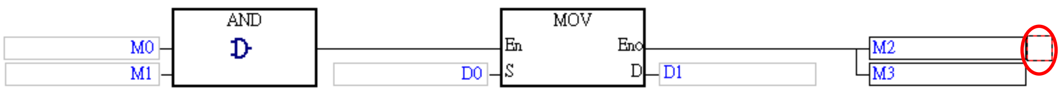


(2) In addition to the structure in the figure above, users may be allowed to insert an output node into another structure. If users are allowed to insert an output node into the position selected,  on the toolbar can be clicked. After  is clicked, an output node will be inserted.





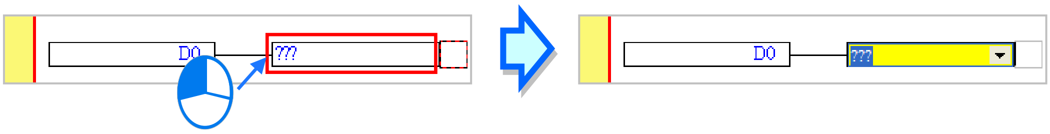
An output node can be inserted in the following structures.

<table>
<tr><th colspan="2">Inserting an output node into an input pin of an AND/OR block</th></tr>
<tr><td>Before</td><td>
</td></tr>
<tr><td>After</td><td>
</td></tr>
<tr><th colspan="2">Inserting an output node into the output pin of an AND/OR block</th></tr>
<tr><td>Before</td><td>
</td></tr>
<tr><td>After</td><td>
</td></tr>
<tr><th colspan="2">Adding an output node downward</th></tr>
<tr><td>Before</td><td>
</td></tr>
<tr><td>After</td><td>
</td></tr>
<tr><th colspan="2">Adding an output node rightward</th></tr>
<tr><td>Before</td><td>
</td></tr>
<tr><td>After</td><td>
</td></tr>
</table>

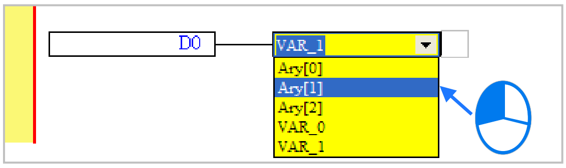
***. Users are not allowed to insert output nodes into the output pins of a function block/an applied instruction to which operands are assigned.**

11.2.2 Use Devices, Symbols Constants in FB Diagram

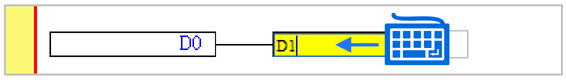
Before users edit a node or an operand of an instruction, they have to click the node or the operand.



Click ▼ in the box, and then select a symbol on the drop-down list. If a symbol whose data type is ARRAY is declared, the elements in the array will be on the drop-down list. Ary[…] in the figure below are elements.



The users can type a device name or a symbol in the box. If they type a symbol which is not declared, the **Add Symbol** window will appear after they press Enter on the keyboard. (Please refer to section 2.3.1 for more information about declaring a symbol.)



After users click a network and press Enter on the keyboard, they can edit a box. The users can edit the next box in the network after they press Enter on the keyboard. Besides, the next network will be selected after the users press Tab on the keyboard. The users can edit a box with the keyboard. If the users have declared symbols, they can press Page Down on the keyboard when they edit a box. The users can select a symbol by the up/down key on the keyboard. After the editing is complete, the users can press Enter on the keyboard to jump to the next box. If the users want to end the editing, they can press Esc on the keyboard.

<u>Additional remark</u>

(a) If users want to use constants in a function block diagram in ISPSoft, the constants must be represented in the following ways.

- Decimal value: 23456 (A value which is not preceded by any mark will be regarded as a decimal value.)
- Hexadecimal value: 16#5BA0 (A value is preceded by 16#.)
- Octal value: 8#55640 (A value is preceded by 8#.)
- Binary value: 2#101101110100000 (A value is preceded by 2#.)
- String: “XYZ” (Characters are put in double quotes.)
- BOOL: Need to use normally-open or normally-closed contact

  AH/AS Series: Use SM400/ SM401 .

DVP Series: M1000/ M1001.

If users want to use a symbol whose data type is ARRAY, the expression format is **Identifier[Index]**, for example Ary [1] from the drop-down list of the above diagram.

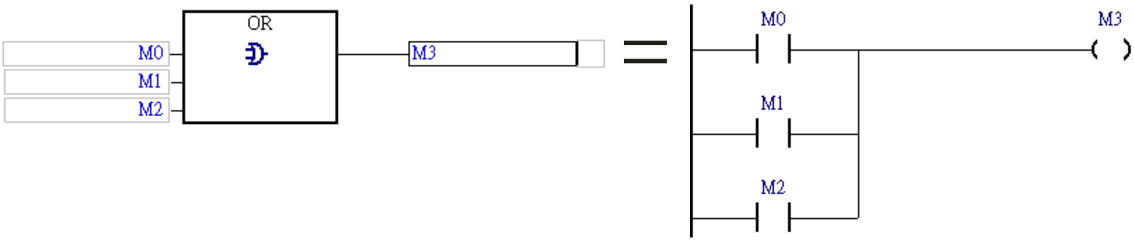
11.2.3 And and OR Block

Contacts in a function block diagram can be connected in series/parallel by means of an AND/OR block. The input nodes and the output nodes of an AND/OR block must represent Boolean devices or symbols whose data types are BOOL. An AND/OR block have 32 input nodes and 32 output nodes at most. Besides, an AND/OR block has at least one output node, or is connected to the next object.

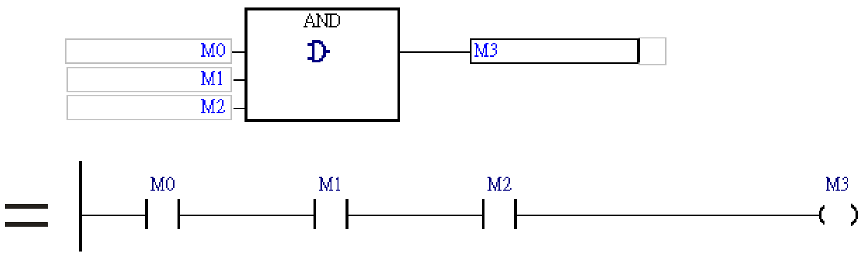
- **Graphic representation**

- **Example**

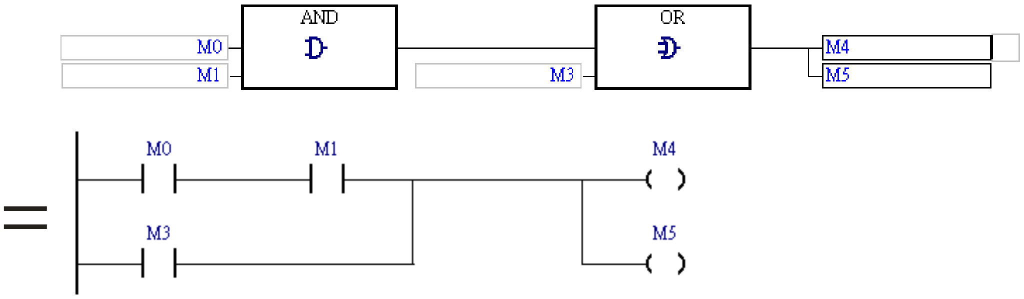
Example 1: The contacts M0, M1, and M2 are assigned to the OR block, and the result of the operation is sent to M3. In other words, after M0, M1, and M2 are connected in parallel, the coil M3 will be driven if M0, M1, or M2 is ON.



Example 2: The contacts M0, M1, and M2 are assigned to the AND block, and the result of the operation is sent to M3. In other words, after M0, M1, and M2 are connected in series, the coil M3 will be driven if M0, M1, and M2 are ON.

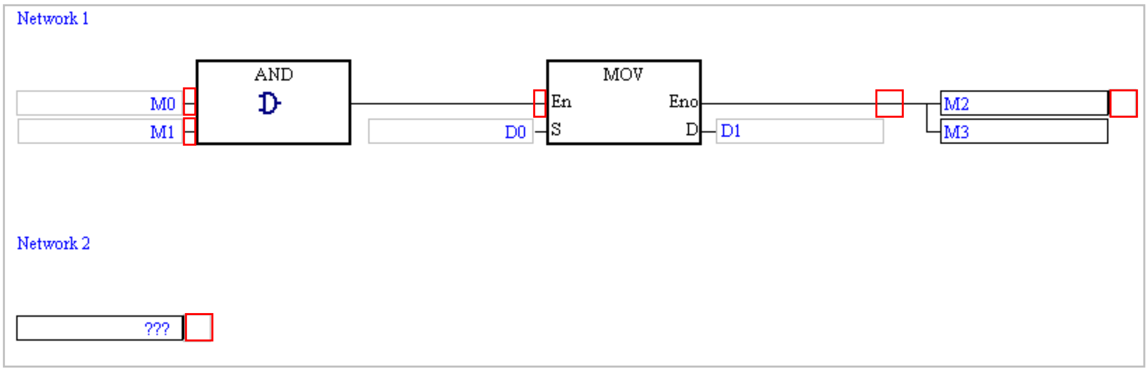


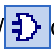
Example 3: The use of an AND block and an OR block in a function block diagram is equivalent to the use of a serial connection and a parallel connection in a ladder diagram.

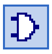


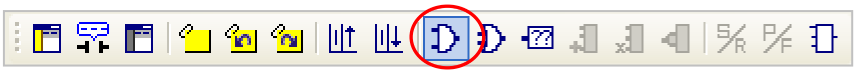
- **Inserting an AND/OR block**

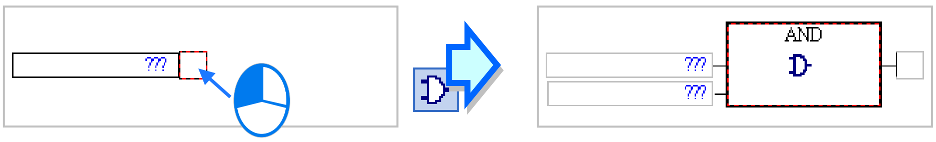
(1) Select a position into which an AND/OR block will be inserted in the working area. Users are allowed to insert AND/OR blocks into the positions marked with red frames in the figure below.



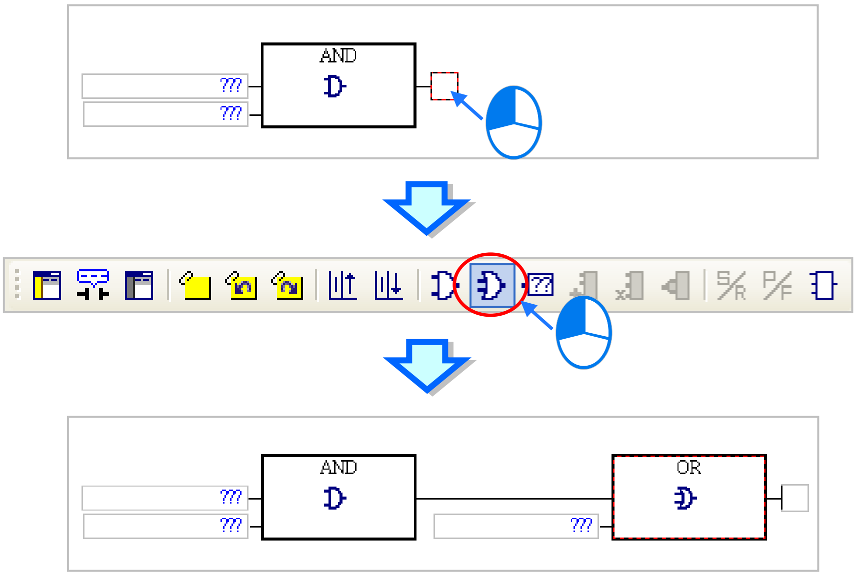
(2) In addition to the structure in the figure above, users may be allowed to insert an AND/OR block into another structure. If users are allowed to insert an AND/OR block into the position selected, / on the toolbar can be clicked.

After  is clicked, an AND block will be inserted.



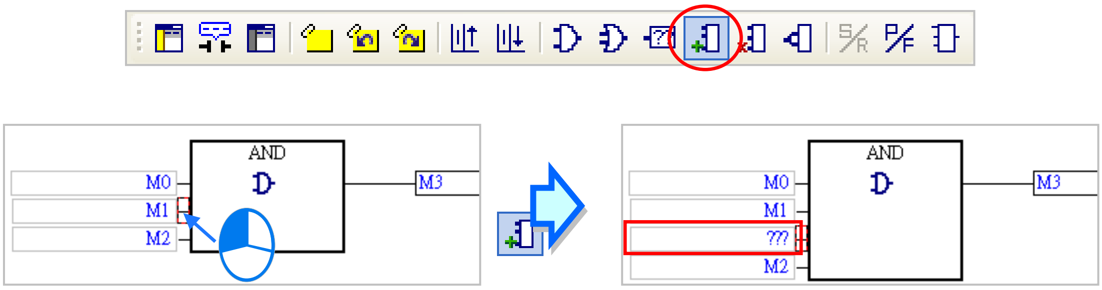


After  is clicked, an OR block will be inserted.

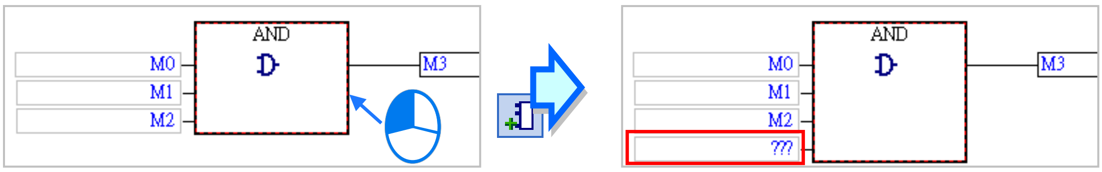


- **Adding an input node to an AND/OR block**

Select an input node of an AND/OR block, and then click on the toolbar. After is clicked, a node will be added to the bottom of the input node selected. If the input node selected is the topmost input node of an AND/OR block, e.g. M0 in the figure below, users can not add an input node.



If an AND/OR block is selected, an input node will be added to the bottom of the bottommost input node of the block after is clicked.

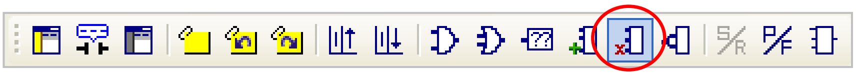


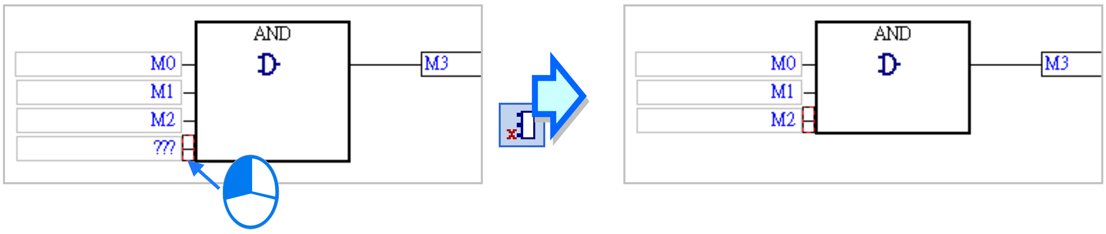
- **Deleting an input node from an AND/OR block**

Select an input node which will be deleted from an AND/OR block, and then click on the toolbar. After is clicked, the input node will be deleted. Users have to pay attention to the following two points when they delete an input node.

(a) The topmost input node of an AND/OR block, e.g. M0 in the figure below, can not be deleted.

(b) If an AND/OR block has only two input nodes, neither of the input nodes can not be deleted.

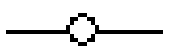




11.2.4 Inverse Logic

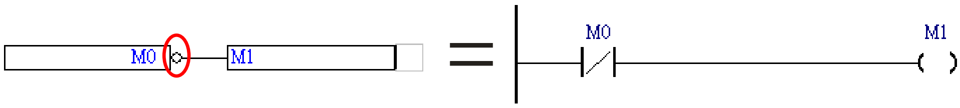
Users can insert inverse logic into a Boolean position in a function block diagram, e.g. an input node which represents a Boolean device or a symbol whose data type is BOOL, an output node which represents a Boolean device or a symbol whose data type is BOOL, the En pin of a function block, or the En pint of an applied instruction. However, users have to notice that they are not allowed to insert inverse logic into the pins of a function block/an applied instruction to which operands are assigned.

- **Graphical representation**

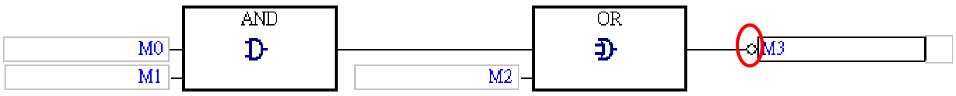


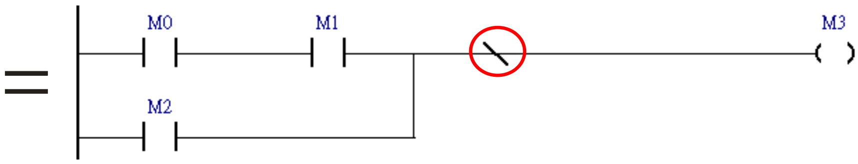
- **Example**

Example 1: The state of M0 is inverted, and the inversion result is sent to M1. Likewise, the coil M1 will be driven if the normally-closed M0 is OFF.



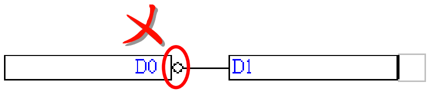
Example 2: The inverse logic inserted into the output node indicates that the result of the operation is inverted. The inversion result is sent to M3.





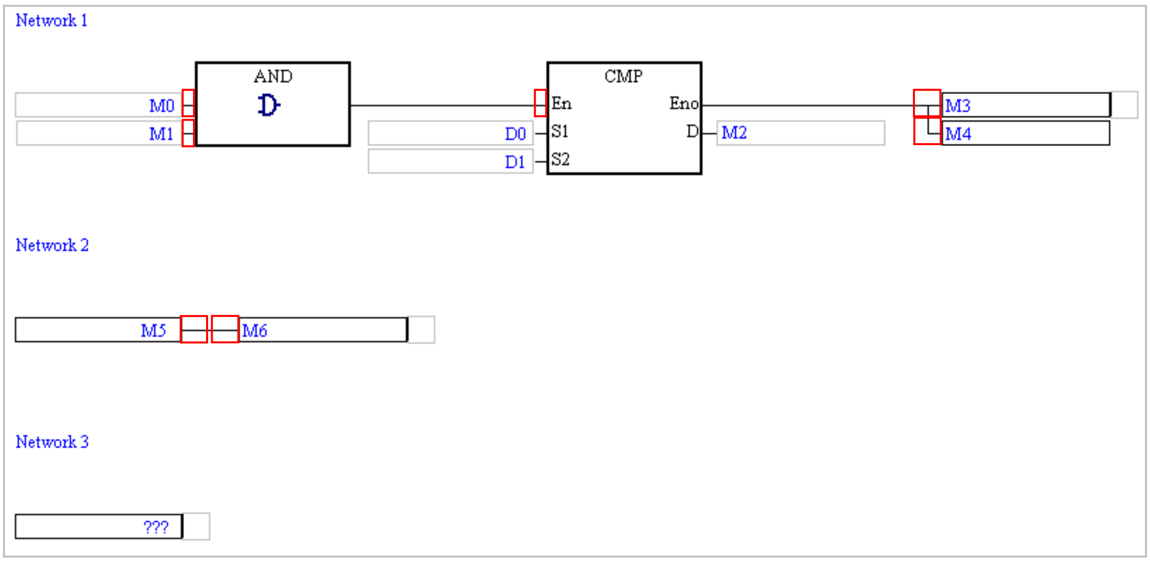
Example 3: If M0 is ON, the function block BLACK will be executed. If M0 is OFF, the function block WHITE will be executed.

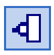
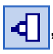
Example 4: The figure below is an incorrect example. Inverse logic can not be inserted into a node which does not represent a Boolean device or a symbol whose data type is BOOL.

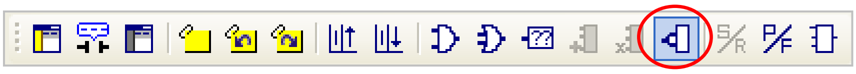


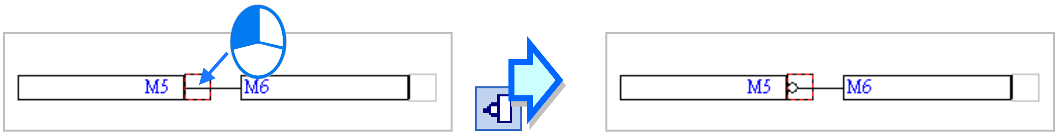
- **Inserting inverse logic**

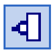
(1) Select a position into which inverse logic will be inserted in the working area. Users are allowed to insert inverse logic into the positions marked with red frames in the figure below. Although the operand assigned to the output pin of the instruction CMP is a Boolean operand, inverse logic can not be inserted into the output pin of CMP. Besides, inverse logic can not be inserted into a position which does not have an output node, and a position which is not connected to an object. For example, inverse logic can not be inserted into the input node in network 3.

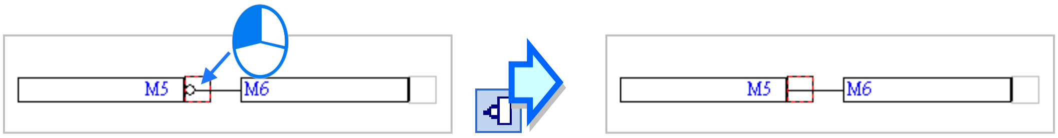


(2) In addition to the structure in the figure above, users may be allowed to insert inverse logic into another structure. If users are allowed to insert inverse logic into the position selected,  on the toolbar can be clicked. After users click , inverse logic will be inserted.





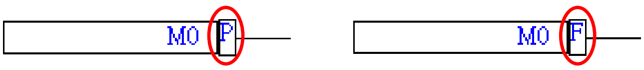
If the users want to cancel the inverse logic, they can click  again.



11.2.5 Rising and Falling edge-triggered Input

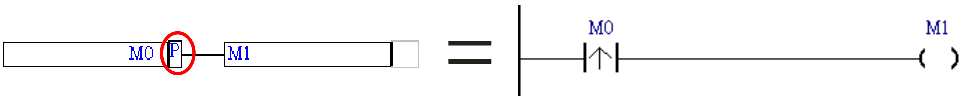
In a function block diagram in ISPSoft, the mark P on an input node indicates that the input node is rising edge-triggered, and the mark F on an input node indicates that the input node is falling edge-triggered. The mark P/F can only be inserted into an input node which represents a Boolean device or a symbol whose data type is BOOL, or an input node of an AND/OR block. Users are not allowed to insert P/F into the operands of a function block/an applied instruction, and the En pin of a function block/an applied instruction.

- **Graphical representation**

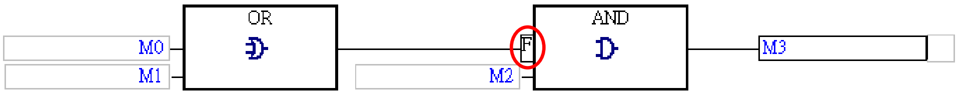


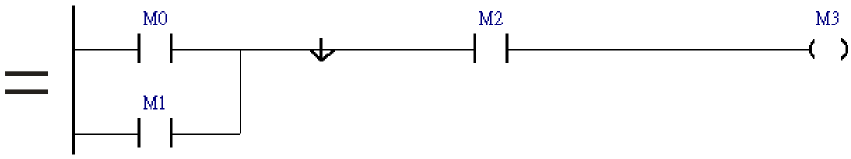
- **Example**

Example 1: When M0 is turned from OFF to ON, M1 is ON. When M0 is turned form ON to OFF, M1 is OFF.

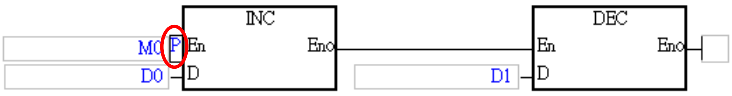


Example 2: The mark F is inserted into an input pin of the AND block.

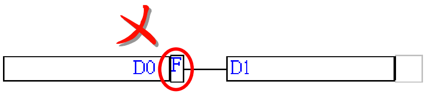




Example 3: The En pin of the first applied instruction is connected to the input node representing M0, and therefore the mark P can be inserted into in the input node representing M0. However, the mark P/F can not be inserted into the En pin of the second applied instruction.

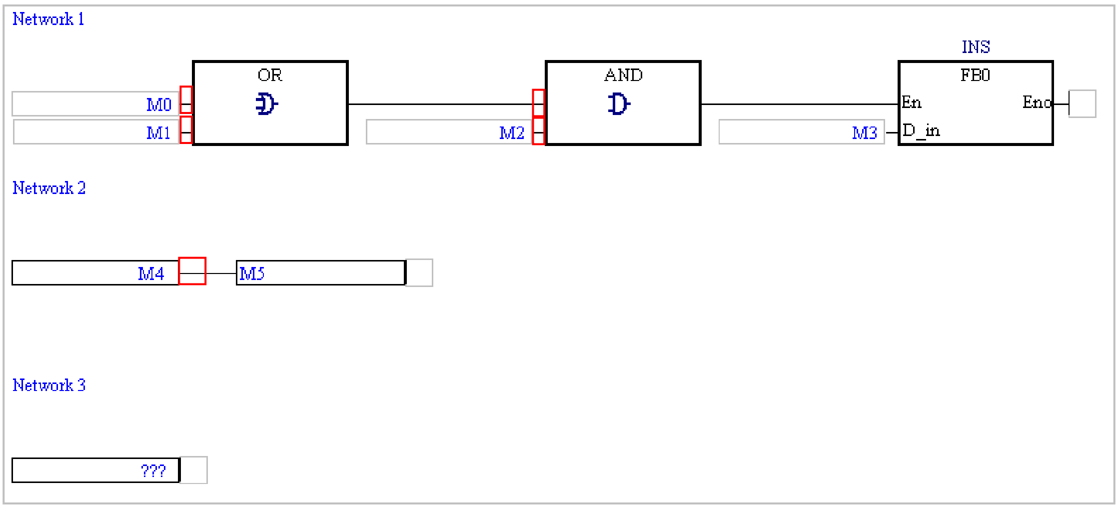


Example 4: The figure below is an incorrect example. The mark F can not be inserted into an input node which does not represent a Boolean device or a symbol whose data type is BOOL.

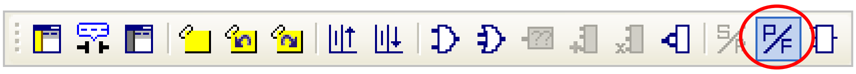


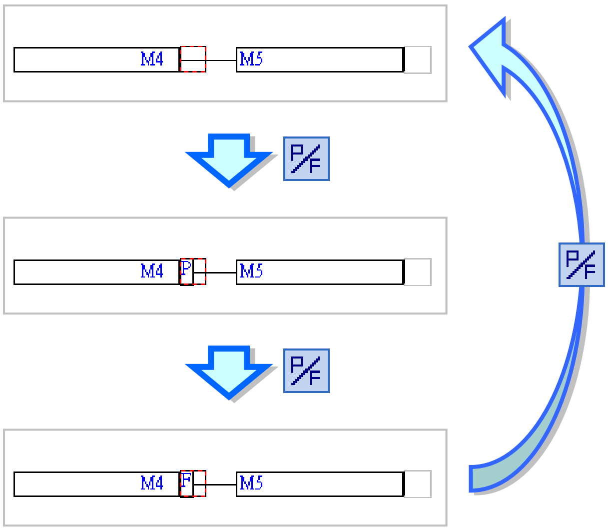
- **Inserting the mark P/F**

(1) Select a position into which the mark P/F will be inserted in the working area. Users are allowed to insert the mark P/F into the positions marked with red frames in the figure below. Although the operand assigned to the input pin of the function block FB0 is a Boolean operand, the mark P/F can not be inserted into the input pin of FB0. Besides, P/F can not be inserted into a position which does not have an output node, and a position which is not connected to an object. For example, the mark P/F can not be inserted into the input node in network 3.



(2) In addition to the structure in the figure above, users may be allowed to insert the mark P/F into another structure. If users are allowed to insert the mark P/F into the position selected, on the toolbar can be clicked. After users click , the mark P will be inserted. If the users click again, the mark F will be inserted.

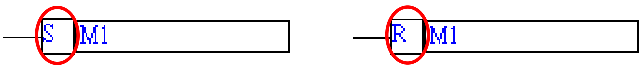




11.2.6 Setting an Output and Resetting an Output

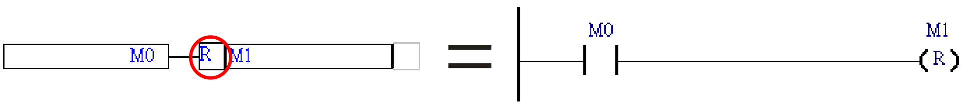
In a function block diagram in ISPSoft, the mark S on an output node indicates that the output node is set to ON, and the mark R on an input node indicates that the output node is reset to OFF. Users are not allowed to insert S/R into the operands of a function block/an applied instruction.

- **Graphical representation**

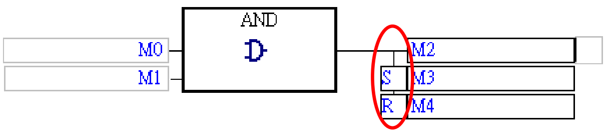


- **Example**

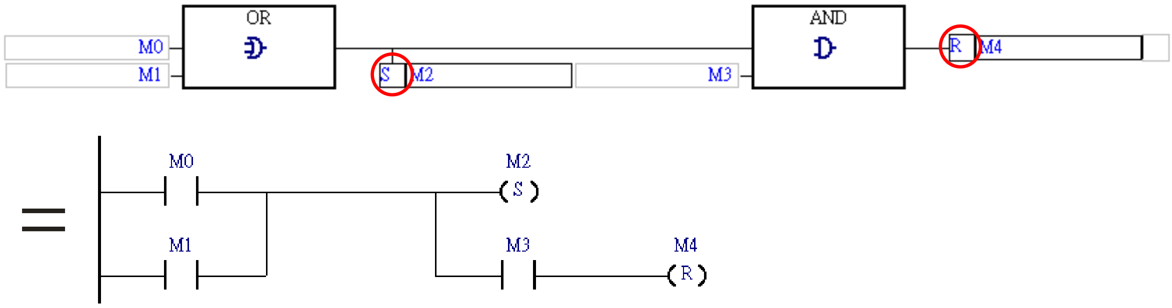
Example 1: If M0 is ON, M1 will be reset to OFF.



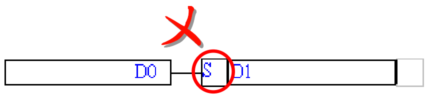
Example 2: In the figure below, the mark S is inserted into the output node representing M3, and the mark R is inserted into the output node representing M4.



Example 3: If M0 or M1 is ON, M2 will be set to ON. If M0 or M1 is ON, and M3 is ON, M4 will be reset to OFF.

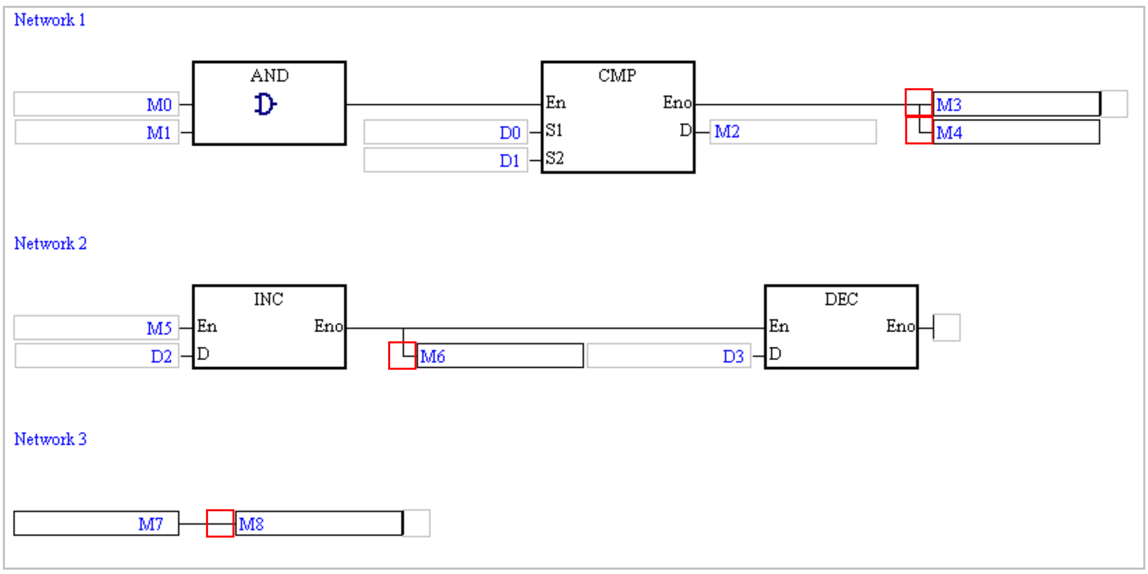


Example 4: The figure below is an incorrect example. The mark S can not be inserted into an output node which does not represent a Boolean device or a symbol whose data type is BOOL.

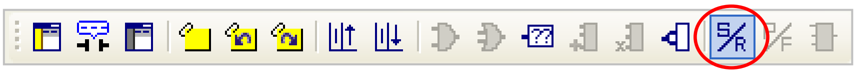


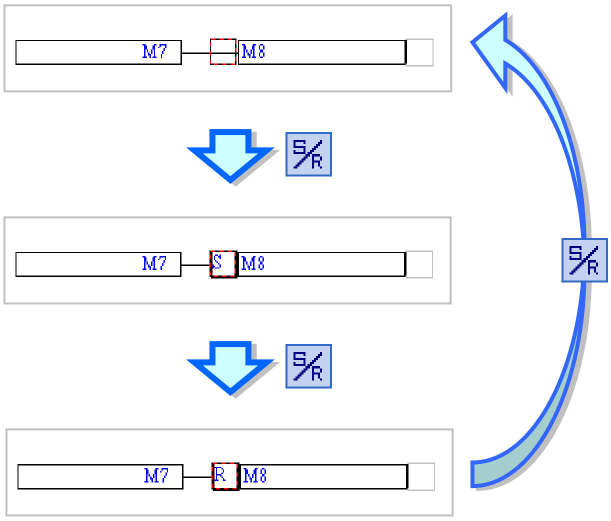
- **Inserting the mark S/R**

(1) Select a position into which the mark S/R will be inserted in the working area. Users are allowed to insert the mark S/R into the positions marked with red frames in the figure below. Although the operand assigned to the output pin of the applied instruction CMP is a Boolean operand, the mark S/R can not be inserted into the output pin of CMP.



(2) In addition to the structure in the figure above, users may be allowed to insert the mark S/R into another structure. If users are allowed to insert the mark S/R into the position selected, on the toolbar can be clicked. After users click , the mark S will be inserted. If the users click again, the mark R will be inserted.



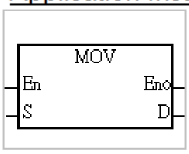


11.2.7 API, Comparison Contact and Function Block

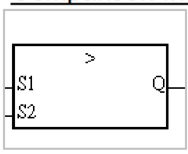
In a function block diagram in ISPSoft, the applied instructions, the comparison contacts, and the function blocks are represented by blocks. Besides, users can type function block instances in the boxes above the function blocks.

If the logic state connected to the En pin of a block representing an applied instruction or a function block is ON, the applied instruction or the function block will be executed. A function block diagram is flexible in that users can put a logical operation, e.g. inverse logic or an AND/OR block, between two function blocks, between two applied instructions, or between a function block and an applied instruction in a network.

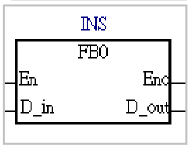
- **Graphic representation**
  - Application Instruction



  - Comparison Instruction

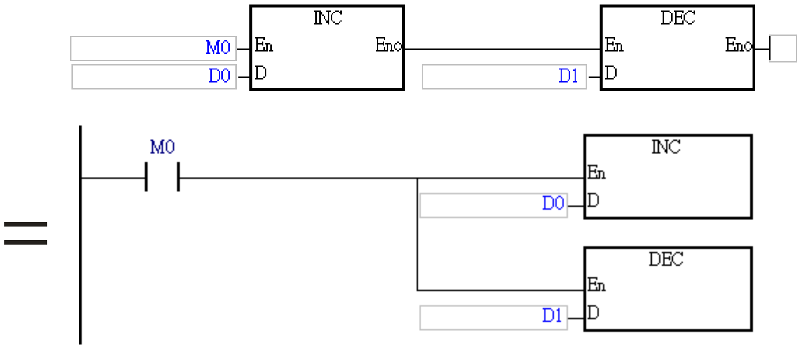


  - Function Block

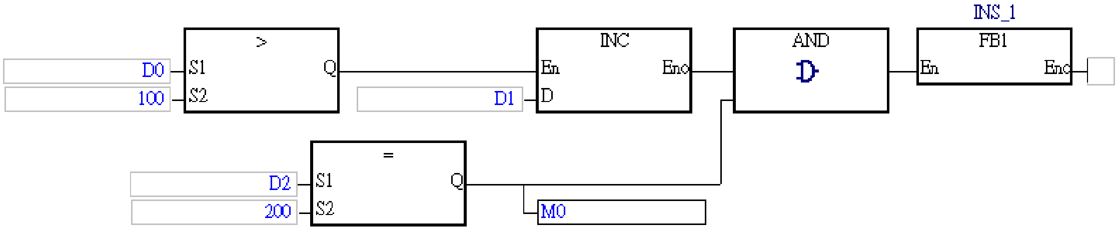


- **Example**

Example 1: The En pin of a block representing an applied instruction in a function block diagram can be connected to anther instruction or object.



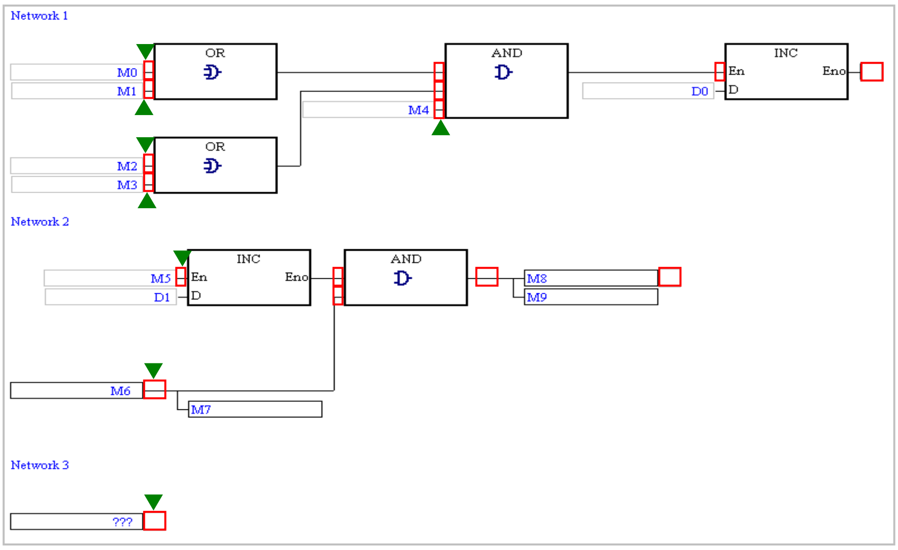
Example 2: In a function block diagram, no object can precede a comparison contact, but the output pin of the comparison contact can connect to an input pin of an AND/OR block, an output node, the En pin of a block representing a function block, or the En pin of a block representing an applied instruction.



***. Please refer to chapter 7 for more information about function blocks.**

- **Inserting an applied instruction, a comparison contact, or a function block**

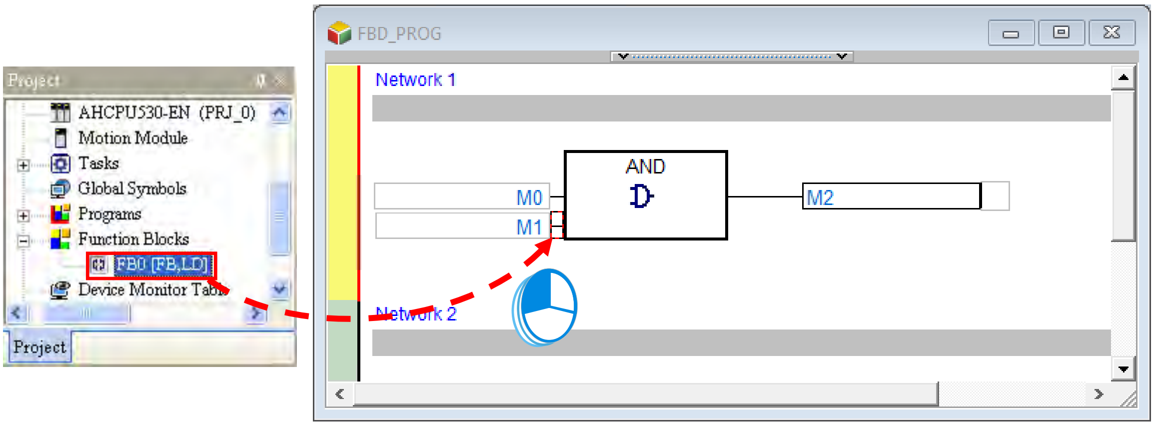
(1) Select a position into which an applied instruction, a comparison contact, or a function block will be inserted in the working area. In the figure below, users are allowed to insert applied instructions and function blocks into the positions marked with red frames, and comparison contacts into the positions marked with green triangles.



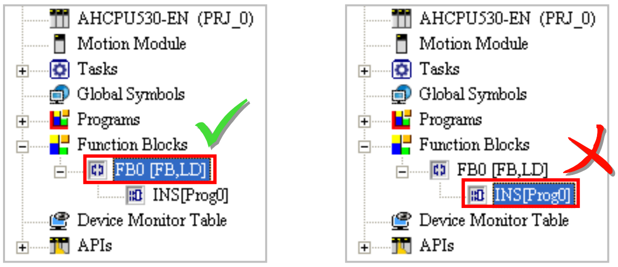
(2) There are three ways to insert an applied instruction, a comparison contact, or a function block in a function block diagram.

➢ **Method 1**

Unfold the **APIs** section or the **Function Blocks** section in the project management area, and find the item which will be inserted. Select the item, and drag it to the position in which it will be inserted.

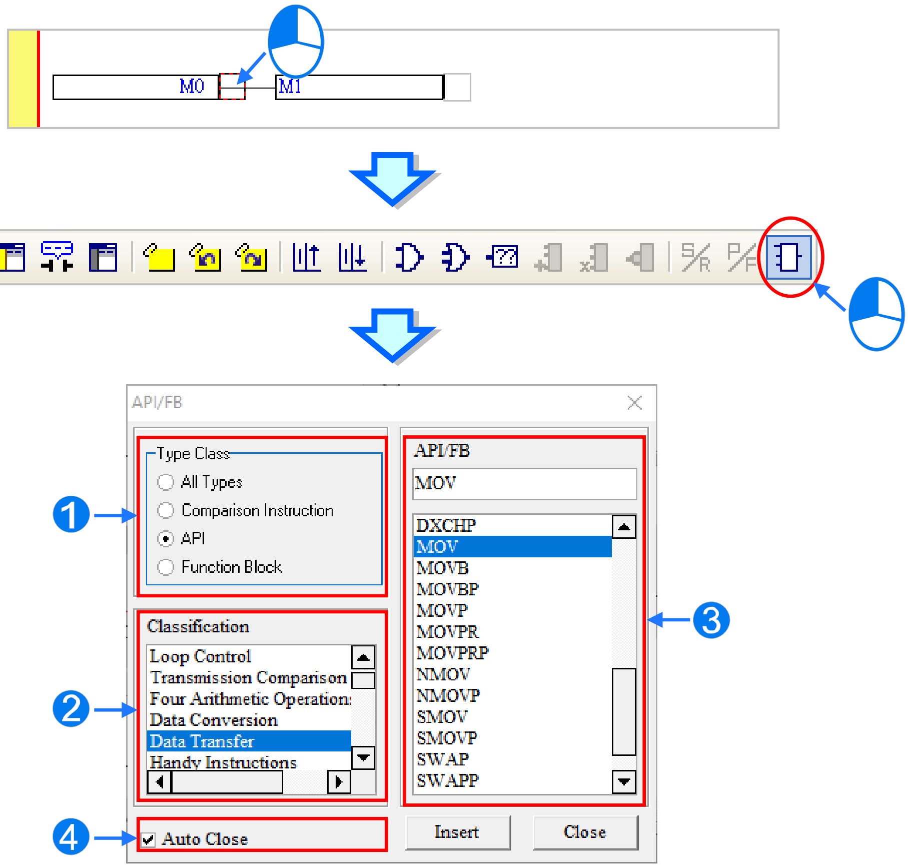


Function block definitions can be dragged, but function block instances can not be dragged.



➢ **Method 2**

Click the position into which an applied instruction, a comparison contact, or a function block will be inserted, click on the toolbar, select the item which will be inserted in the **API/FB** window, and click **Insert**.



❶ Users can select the **All Types** option button, the **Comparison Instruction** option button, the **API** option button, or the **Function Block** option button.

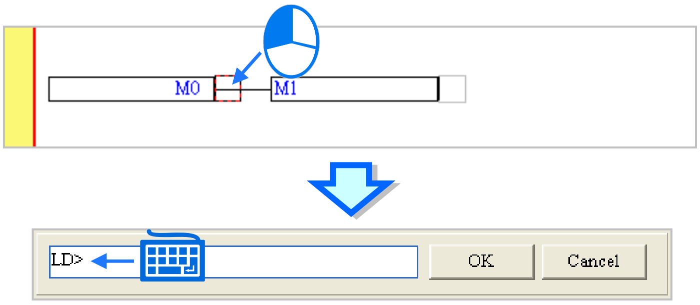
❷ If users select the **API** option button in the **Type Class** section, they have to select an instruction type in the **Classification** box.

❸ Users can select an applied instruction, a comparison contact, or a function block here.

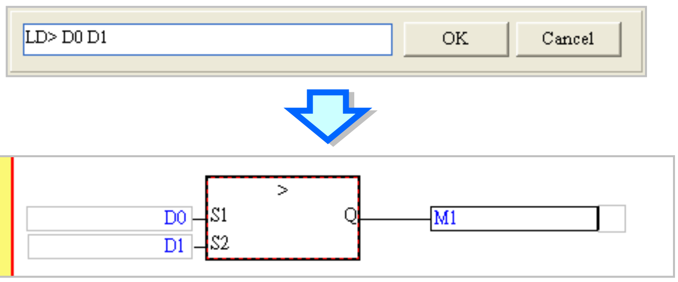
❹ If users unselect the **Auto Close** checkbox, they can insert instructions or function blocks continuously.

- **Method 3**

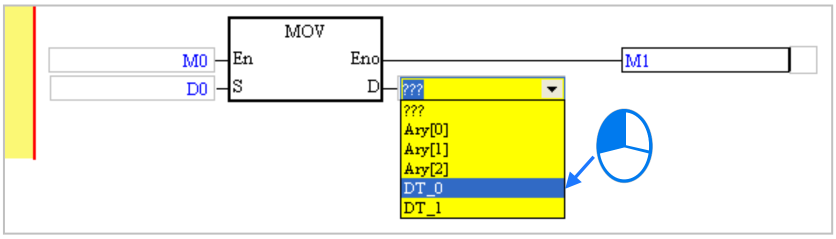
Click the position into which an applied instruction, a comparison contact, or a function block will be inserted, and type the applied instruction, the comparison contact instruction, or the function block definition. As soon as the applied instruction, the comparison contact instruction, or the function block definition is typed, a box which can be edited appears. After the typing of the applied instruction, the comparison contact instruction, or the function block definition is complete, users can press Enter on the keyboard or click **OK** at the right side of the box. (The applied instruction, the comparison contact instruction, and the function block definition are case-insensitive.)



If users want to insert a function block, they have to type the function block definition, and they can not type the operands specifed in the function block. If users want to insert a comparison contact or an applied instruction, they have to type the comparison contact instruciton or the applied instruction, and they can type the operands specified in the comparison contact instruciton or the applied instruction. The users do not have to type all the operands specified in the comparison contact instruciton or the applied instruction. The system will assign the operands typed to the corresponding boxes, and ??? will appear in the boxes where there are no operands. Besides, if the operands typed include a symbol which is not declared, the **Add Symbol** window will appear after the users press Enter on the keyboard. Please refer to programming manuals for more information about instructions.



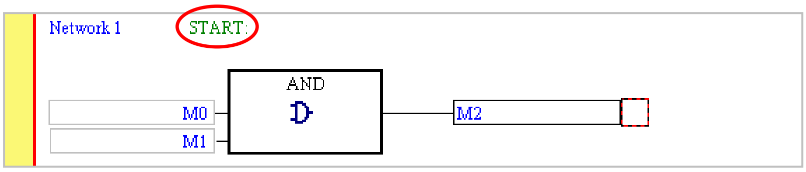
(3) After an applied instruction, a comparison contact, or a function block is inserted successfully, users have to type operands.



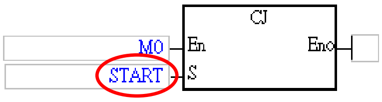
***. If the Auto-leading 'Add Symbol' Dialog checkbox in the Options window is selected, the Add Symbol window will appear automatically after users type a symbol which is not declared. Please refer to section 2.3.1 for more information.**

11.2.8 Setting Label

If users want to use a jump instruction, they have to put a label on the network to which the execution of the program jumps. A label is put at the right side of a network number. When choosing DVP series or AH/AS series, since the P device is automatically assigned by the system and cannot be directly used by users, input label name must not be repeated and the label symbols do not need to be declared in the symbol table. For more information on using P device and limitations, please refer to user manuals of PLC types.

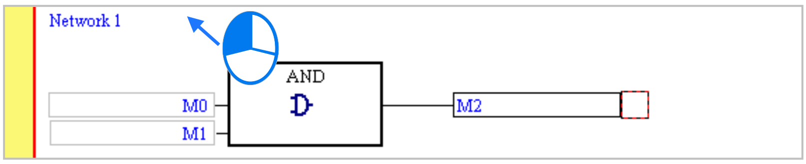


If users want to specify a label in an instruction, they do not have to type a colon in front of the label.

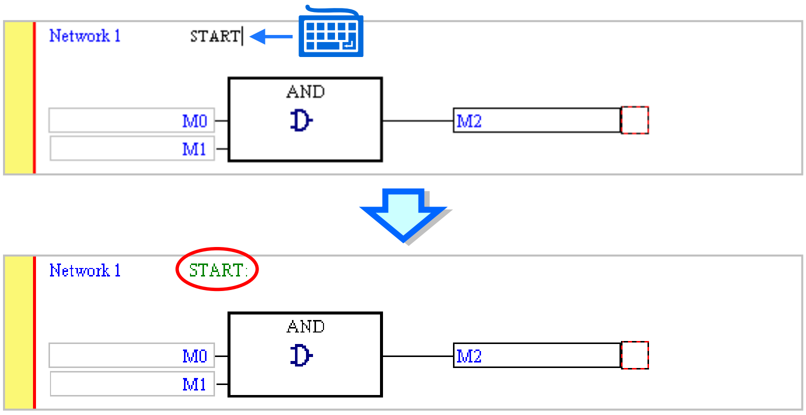


The steps of putting a label are as follows.

(1) Click the right side of the network number at which a label will be put.

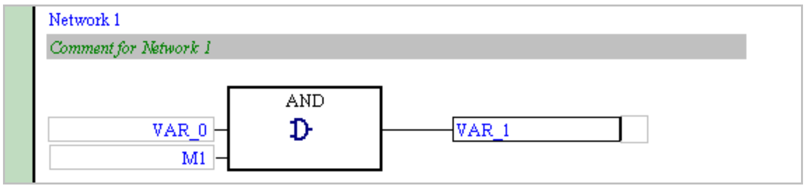


(2) If the project created is a project for a DVP or AH/AS series CPU module, users have to type a label symbol. Press Enter on the keyboard after a P device number or a label symbol is typed. The system will automatically put a colon at the right side of the label.



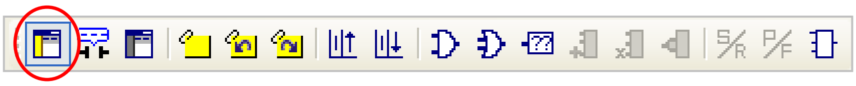
11.2.9 Comments and Hints

Users can make comments on the networks in a function block diagram in ISPSoft. They can type comments under the network numbers in a function block diagram in ISPSoft.

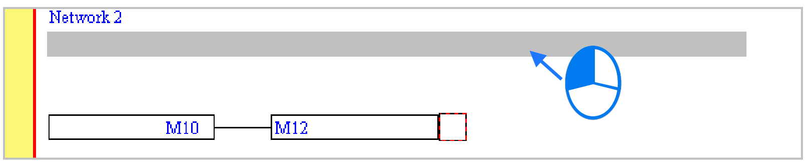


- **Editing the comment on a network**

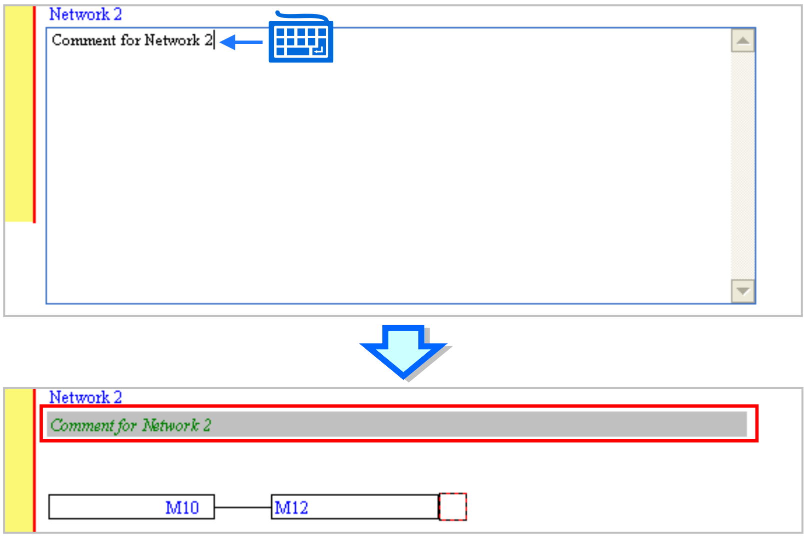
(1) After users click on the toolbar, the comments on the networks will be displayed. If the users click on the toolbar again, the comments on the networks will be hidden.



(2) After the users click the position under a network number, a box will appear.

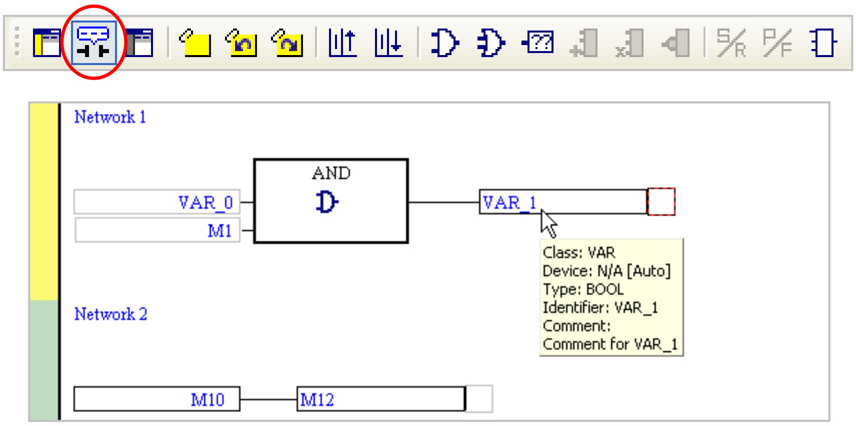


(3) Type a comment in the box. If the users want to start a new line of text at a specific point, they can press Shift+Enter on the keyboard. Press Enter on the keyboard after the editing is complete.

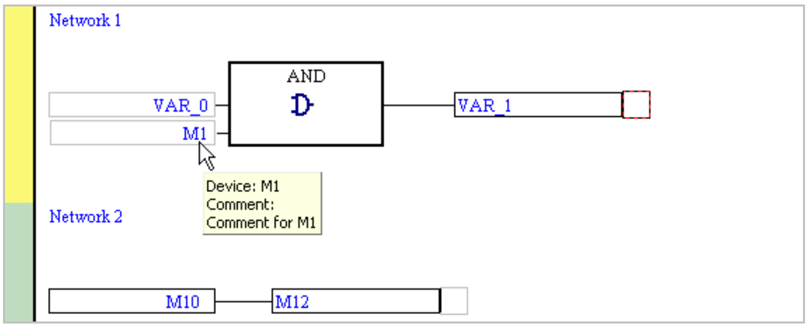


- **Hints related to the devices and the symbols in a function block diagram**

  In a function block diagram, the comments on the devices and the comments on the symbols are not displayed. If users want to view the comment on a device or a symbol, they have to make sure that  on the toolbar is clicked, and move the mouse cursor to the device or the symbol. After the mouse cursor stays at the device or the symbol for a while, the hints related to the device or the symbol will appear. The users can select hints in the **Options** window in ISPSoft. Please refer to section 2.3.1 for more information. If the users want to hide the hints, they can click  again.



Besides, owing to fact that the devices and the symbols are different objects in ISPSoft, the hints related to the devices are different from the hints related to the symbols.



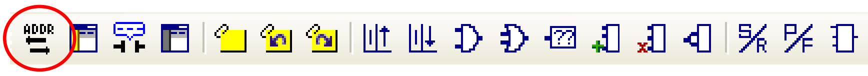
Additional remark

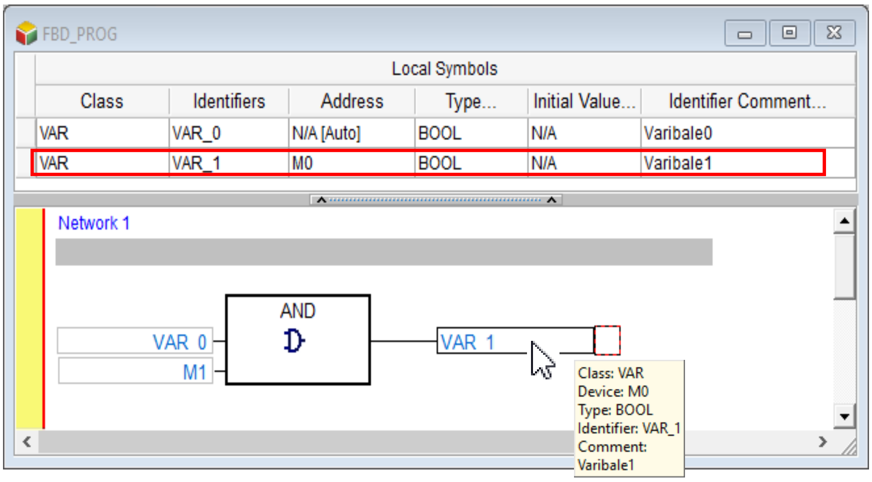
Users can make a comment on a device by means of the comment management tool provided by ISPSoft. Please refer to section 17.2 for more information.

11.2.10 Symbol Mode and Address Mode

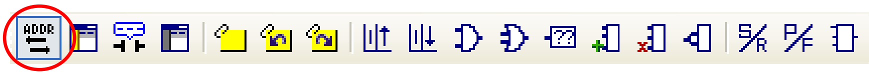
If a device address is assigned to a symbol declared in a function block diagram, users can change the mode in which the symbol is displayed by means of clicking ADDR on the toolbar. However, the symbols to which no devices are assigned and the devices to which no symbols are assigned will remain unchanged after ADDR on the toolbar is clicked.

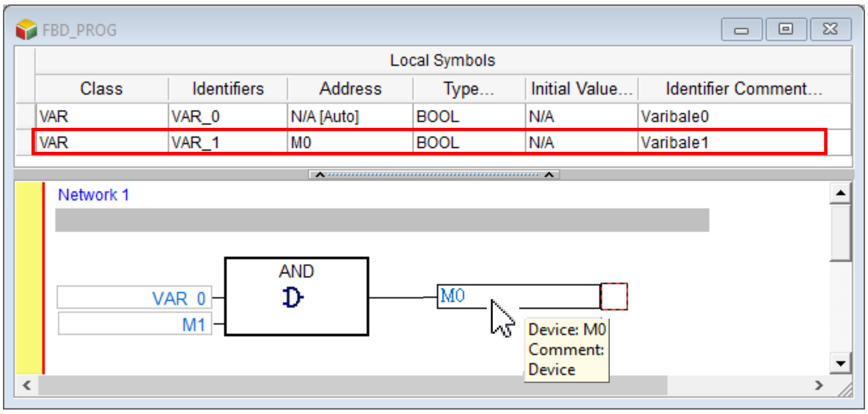
If ADDR on the toolbar is not clicked, the identifiers of the symbols to which devices are assigned will be displayed, and the hints which appear will be the hints related to the symbols.





If on the toolbar is clicked, the devices to which symbols are assigned will be displayed, and the hints which appear will be the hints related to the devices.

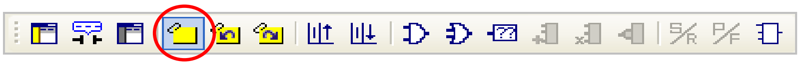


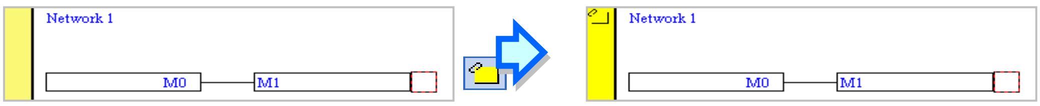


11.2.11 Bookmark

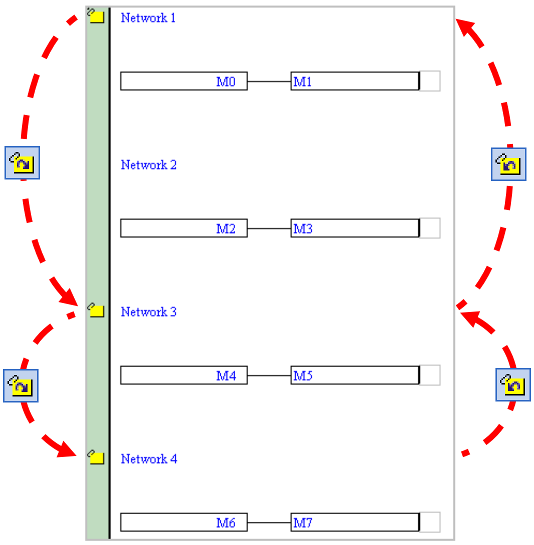
After networks are bookmarked, users can find or go to the networks easily.

(1) After users click on the toolbar, a bookmark will be inserted in the network selected. If the users want to delete the bookmark, they can select the network, and click on the toolbar again.





(2) If there are bookmarks in a program, users can go to the next network which is bookmarked by clicking on the toolbar, and go to the previous network which is bookmarked by clicking on the toolbar.



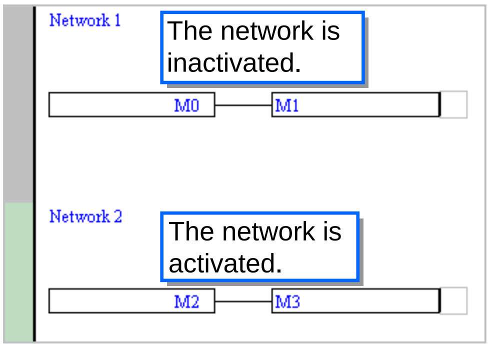
<u>Additional remark</u>

After users point to **Bookmarks** on the **Edit** menu, they can select **Toggle Bookmark**, **Goto the Next Bookmark**, **Goto the Previous Bookmark**, or **Remove All Bookmarks**. If the users click **Remove All Bookmarks**, all the bookmarks in the present program editing window will be deleted.

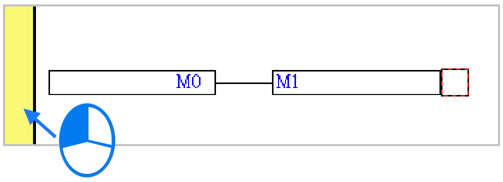
11.2.12 Activating / Inactivating a Network

If a network is inactivated, the compiling of the program will skip the network. When users test or debug a program, they can inactivate some part of the program temporarily by means of this function.

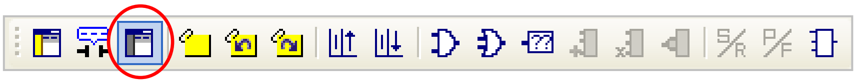
The color at the left side of a network indicates whether the network is activated or inactivated. Users can select colors which will be shown at the left sides of the networks in a ladder diagram in the **Options** window in ISPSoft. Please refer to section 2.3.1 for more information.

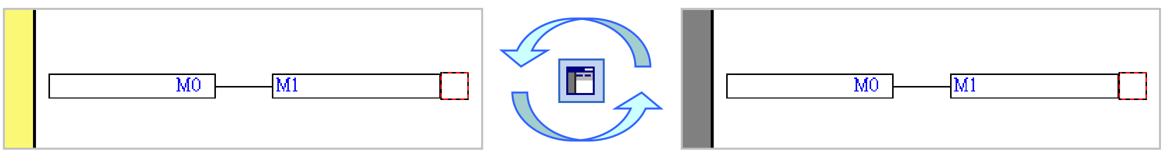


If users want to activate or inactivate a network, they have to select the network first. Users can select several networks simultaneously.



Right-click the network selected, and click **Activate/InactivateNetwork** on the context menu. The network selected will be activated/inactivated. Users can also activate/inactivate the network selected by clicking **Activate/InactivateNetwork** on the **Edit** menu, or by clicking  on the toolbar.





If users want to activate all the networks which are inactivated in the present program editing window, they can click **Activate All Networks** on the **Edit** menu.

MEMO

11

Chapter 12 Instruction List

Table of Contents

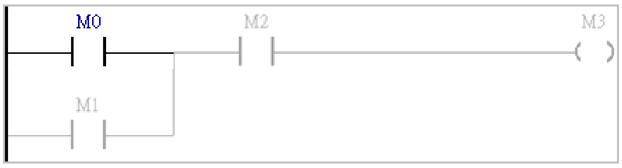
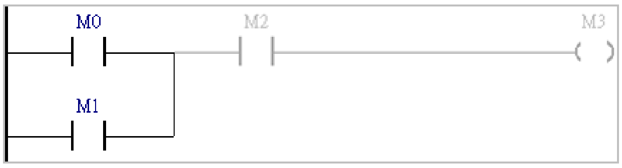
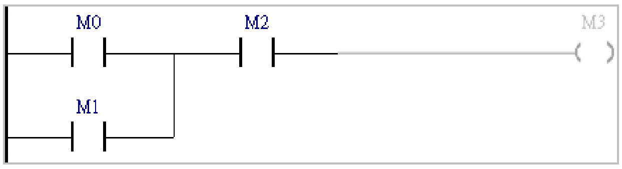
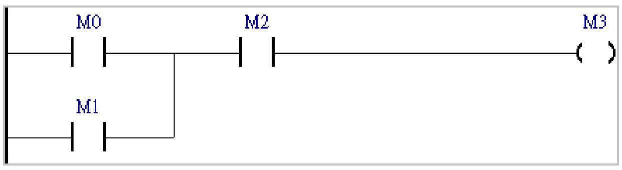
12.1 Introduction of Instruction Lists

An instruction list is one of the five languages supported by the IEC 61131-3 standard. It is a low level language and resembles an assembly language. In earlier times, users entered control instructions into a PLC through a programming panel, and the programming language used was an instruction list.

12.1.1 Structure of an Instruction List

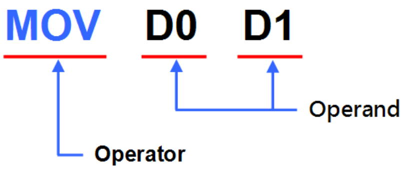
An instruction list is composed of statements. Every statement represents an action. A task which can be accomplished by a complete ladder diagram can be accomplished by an instruction list composed of many instructions.

An example of an instruction list is shown below. There are five lines of program code. The ladder diagram corresponding to the instruction list is shown at the right side of the instruction list.

LD M0: Loading the state of M0	
0001 LD M0 0002 OR M1 0003 AND M2 0004 OUT M3 0005 (*Note*)	
OR M1: The logical OR operation is performed on M1.	
0001 LD M0 0002 OR M1 0003 AND M2 0004 OUT M3 0005 (*Note*)	
AND M2: The logical AND operation is performed on M2.	
0001 LD M0 0002 OR M1 0003 AND M2 0004 OUT M3 0005 (*Note*)	
OUT M3: M3 The result of the operation is sent to M3.	
0001 LD M0 0002 OR M1 0003 AND M2 0004 OUT M3 0005 (*Note*)	
(*Note*): It is a comment on the program. When the program is compiled, this line is skipped automatically.	
0001 LD M0 0002 OR M1 0003 AND M2 0004 OUT M3 0005 (*Note*)	No action

Every statement on an instruction list is composed of an operator and operands. An operator is a function representing an operation, and an operand is the object of an operation. An operand can be a device, a symbol, or a constant. Besides, the operands for an operator are separated by spaces.

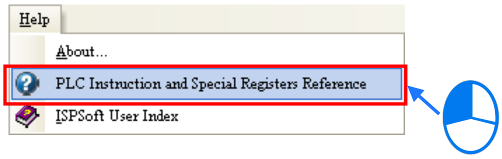
The operator MOV in the example below denotes that an action of transferring data will be executed. The operands D0 and D1 are the source device and the destination device which take part in the transfer.



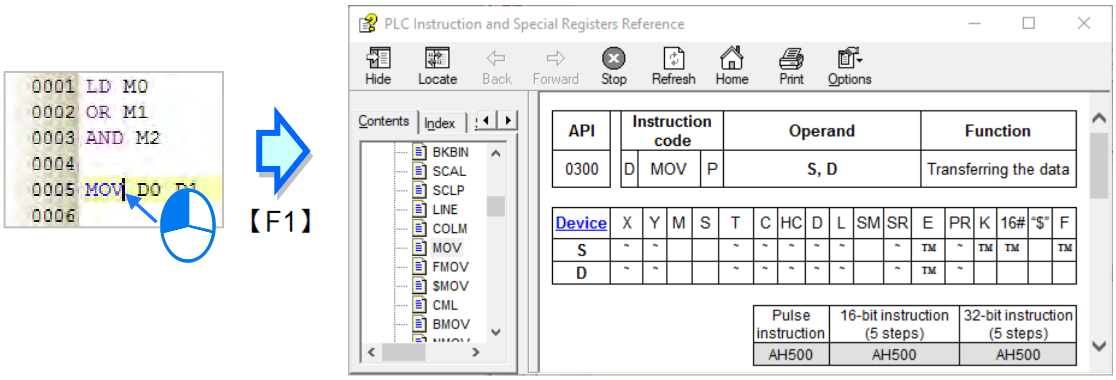
On an instruction list, the words between **(*** and ***)** are regarded as comments. When a program is compiled, the system automatically skips the words between **(*** and ***)**. Besides, as long as the structure of an instruction list is not destroyed, comments can be put anywhere on the instruction list. However, users have to be careful about the readability of the instruction list. The comments in the example below are legal.

```
0001 LD M0 (*Note*)
0002 (*Note*)  OR M1
0003 AND    (*Note*)  M2
0004 OUT M3
0005 (*Note 1
0006   NOte 2
0007   Note 3*)
```

Instructions are divided into basic instructions and advanced instructions. Please refer to programming manuals for more information about the usage of instructions. If users want to check the usage of an instruction, they can click **PLC Instruction and Special Registers Reference** on the **Help** menu.



Besides, if users press F1 after they click an instruction, the usage of the instruction will be displayed in the window which appears.

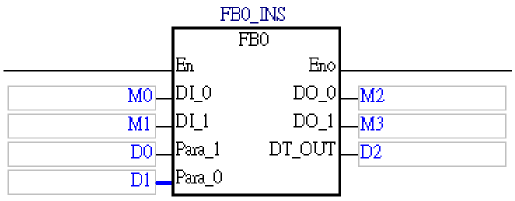


12.1.2 Calling a Function Block

The important points about calling a function block on an instruction list are listed below.

```
CAL  Name of FB instance  (  Input pin 1  :=  Input operand 1  ,
                             Input pin 2  :=  Input operand 2  ,
                             .........
                             Output pin1  =>  Output operand 1  ,
                             Output pin 2  =>  Output operand 2  ,
                             .........
                             Output pin n  =>  Output operand n  )
```

- CAL, the function block instance and the left parenthesis must be in the same line while the other parts can be in different lines.
- The input/output pins of the function block and the corresponding operands must be put in parentheses. A pin and the corresponding operand form a group. The groups are separated by commas. The data types of the operands are specified in the function block definition.
- The function block after CAL is a function block instance rather than a function block definition, that is, the symbol after CAL is a symbol whose data type is a function block. Please refer to chapter 7 for more information about function block definitions and function block instances.
- The assignment mark for an input pin is :=, and the assignment mark for an output pin is =>.
- The pins and the operands are arranged according to the definition of the function block. The arrangement can not be changed. The En pin and the Eno pin are excluded. The input pins are listed above all the output pins. A pin of the VAR_IN_OUT class is an input pin. Please refer to the ladder diagram and the instruction list below for more information.

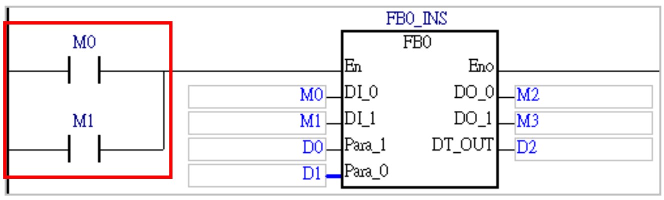



```
CAL  FB0_INS  (  DI_0  :=  M0 ,
                 DI_1  :=  M1 ,
                 Para_1  :=  D0 ,
                 Para_0  :=  D1 ,
                 DO_0  =>  M2 ,
                 DO_1  =>  M3 ,
                 DT_OUT  =>  D2   )
```

- The state of the En pin of the function block is not specified in the instruction CAL. When the instruction is executed, the result of the logical operation before the instruction determines whether the function block will be enabled.

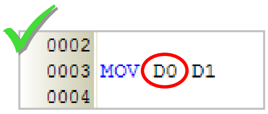
```
LD  M0
OR  M1

CAL  FB0_INS  (  DI_0  :=  M0 ,
                 DI_1  :=  M1 ,
                 Para_1  :=  D0 ,
                 Para_0  :=  D1 ,
                 DO_0  =>  M2 ,
                 DO_1  =>  M3 ,
                 DT_OUT  =>  D2   )
```

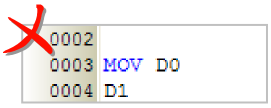
=

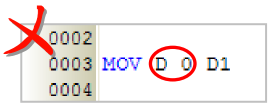


12.1.3 Important Points About Instruction Lists

- Every line on an instruction list is regarded as an instruction except the instruction CAL, and therefore an operator and the operands for the operator can not be in different lines. If an operator and the operands for the operator are in two lines, these two lines will be regarded as two incomplete instructions. Besides, no spaces can be inserted into the instruction names, the function block names, and the operand names on an instruction list. Otherwise, the instructions, the function blocks, and the operands will not be recognized if the program is compiled.



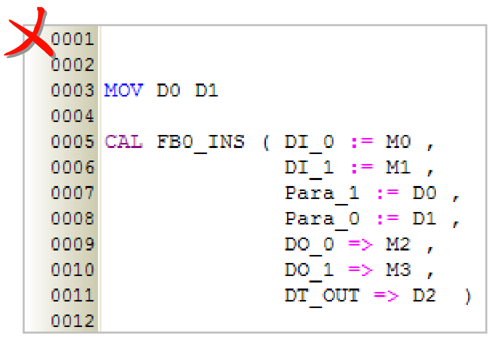


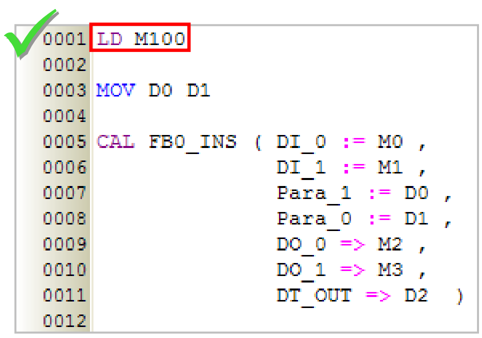


- As long as the format of an instruction is not destroyed, leaving blank spaces and starting new lines are allowed.
- Fullwidth characters and halfwidth characters in ISPSoft are regarded as different characters. Please avoid using fullwidth characters lest they should be identified incorrectly.
- Instruction lists are case-insensitive. “OUT” and “Out” are considered to be the equivalents of “out”.
- If users want to use constants in a program created by means of an instruction list in ISPSoft, the constants must be represented in the following ways.
  - Decimal value: 23456 (A value which is not preceded by any mark will be regarded as a decimal value.)
  - Hexadecimal value: 16#5BA0 (A value is preceded by 16#.)
  - Octal value: 8#55640 (A value is preceded by 8#.)
  - Binary value: 2#101101110100000 (A value is preceded by 2#.)
  - String: “XYZ” (Characters are put in double quotes.)
  - BOOL: Need to use normally-open contact / normally-closed contact

    AH/AS Series: SM400/ SM401

    DVP Series: M1000/ M1001
- When using ARRAY, the input format is **Identifier[Index]** and since IL currently does not support index value, therefore, users can use decimal-constant smaller than array, but must begin with 0.
- When using function blocks or APIs, if there is no LD commands or logic calculation area before giving an instruction, an error will occur during compiling.



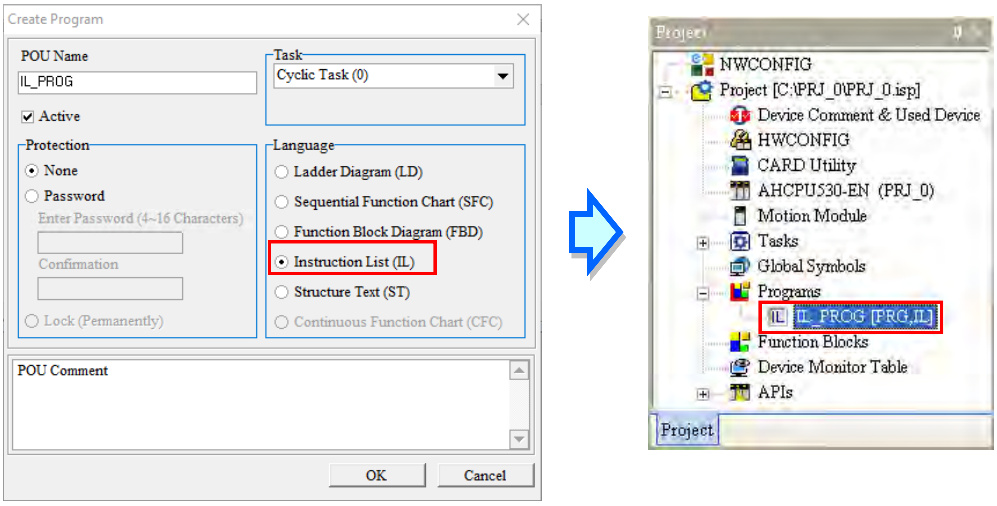


- Although there is no limit on the number of lines, users still have to consider the capacity of the memory in the PLC.
- The sections of an instruction list in ISPSoft can be copied/cut/pasted. Users can copy the text in a file edited with a text editor into an instruction list in ISPSoft.

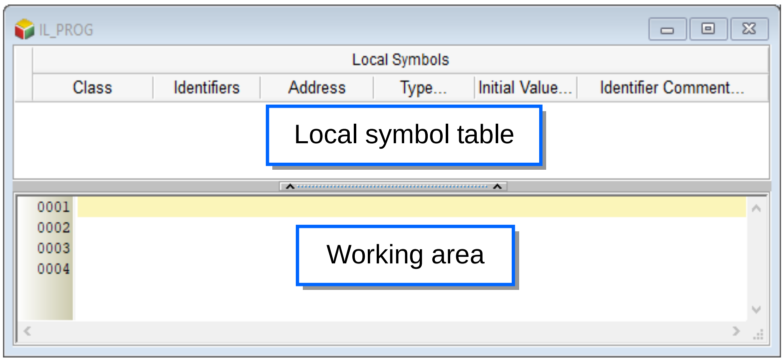
12.2 Create Instruction List in ISPSoft

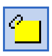
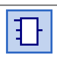
12.2.1 Editing Environment

Select the **Instruction List (IL)** option button in the **Language** section in the **Create Program** window. Please refer to section 5.4.1 for more information.



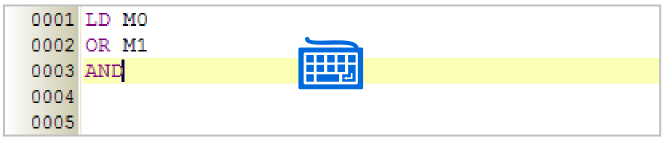
The environment in which an instruction list can be edited is shown below. The table at the upper part of the window is a local symbol table, and the area at the lower part of the window is a working area. There are line numbers at the left side of the working area. Users can set the way in which the line numbers are displayed. Please refer to section 2.3.1 for more information. After a program editing window in which an instruction list can be created is opened, the corresponding toolbar will appear in the ISPSoft window. The functions are described below.



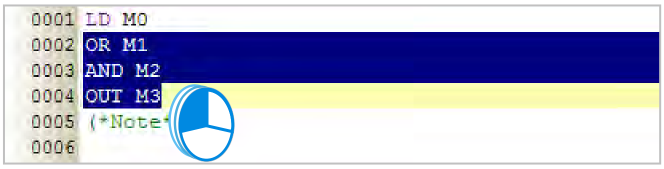
Icon	Keyboard shortcut	Function
	Shift+Ctrl+B	Adding a bookmark to the network selected or deleting the bookmark from the network selected
	Shift+Ctrl+P	Going to the previous bookmarked position
	Shift+Ctrl+N	Going to the next bookmarked position
	Shift+Ctrl+U	Inserting an instruction or a function block

12.2.2 Edit IL instruction

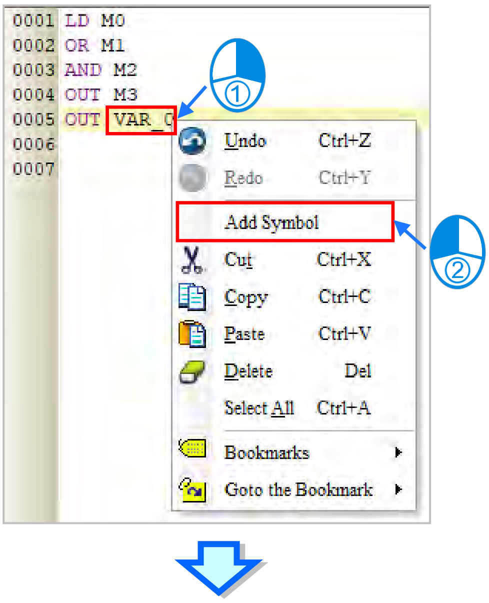
The way in which an instruction list file is edited is similar to the way in which a text file is edited with a general text editor. If users want to create an instruction list, they can type or modify text in the working area. If the users want to start a new line of text at a specific point, they can press Enter on the keyboard.

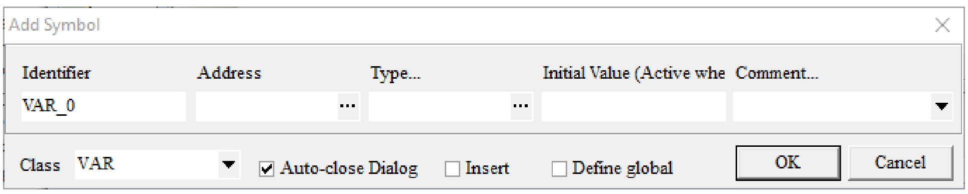


If users want to select any amount of text, they can click where they want to begin the selection, hold down the left mouse button, and drag the pointer over the text that they want to select. The users can also click at the start of the selection, scroll to the end of the selection, and hold down Shift on the keyboard while they click where they want the selection to end.



If users type a symbol which has not been declared, they can click the symbol, click the right mouse button, and click **Add Symbol** on the context menu to open the **Add Symbol** window.



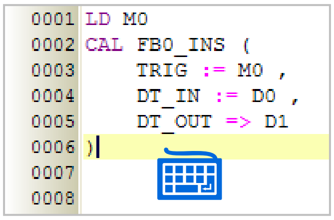


12.2.3 Insert API and Function Blocks

Users can insert an applied instruction or a function block in an instruction list in ISPSoft in one of the three ways described below.

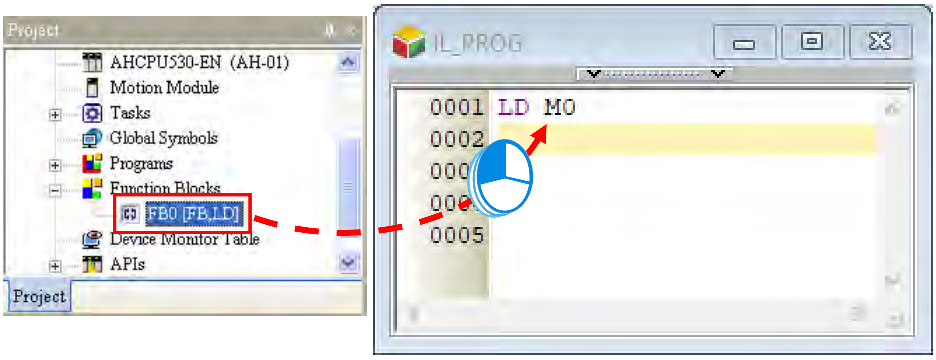
- **Method 1**

  An applied instruction or a function block is inserted according to the format of the applied instruction or the format of the function block.

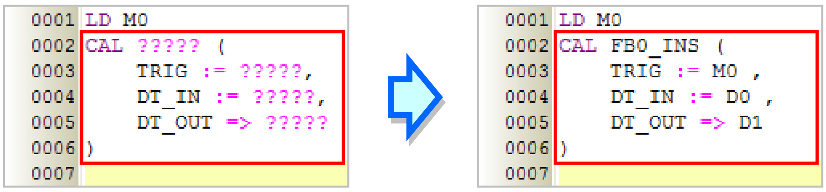


- **Method 2**

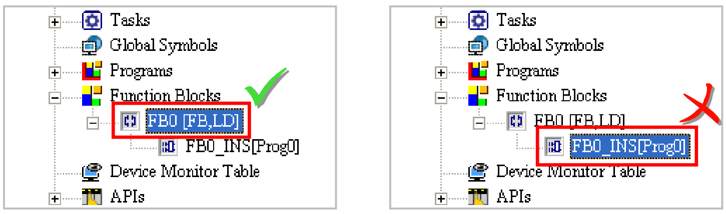
  Unfold the **APIs** section or the **Function Blocks** section in the project management area, and find the item which will be inserted. Select the item, and drag it to the position in which it will be inserted.



After the applied instruction or the function block is inserted, users have to type the corresponding operands according to the format of the applied instruction or the format of the function block.



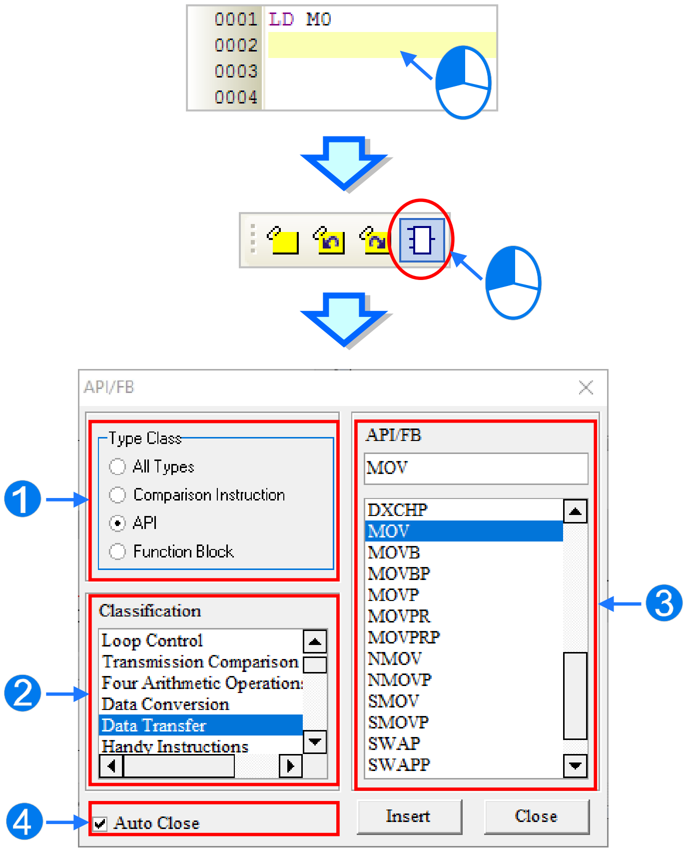
Function block definitions can be dragged, but function block instances can not be dragged.



12

- **Method 3**

Click the position in which an applied instruction or a function block will be inserted, click  on the toolbar, select the item which will be inserted in the **API/FB** window, and click **Insert**.



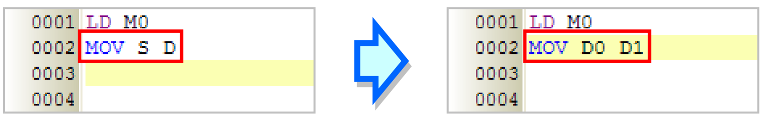
❶ Users can select the **All Types** option button, the **Comparison Instruction** option button, the **API** option button, or the **Function Block** option button.

❷ If users select the **API** option button in the **Type Class** section, they have to select an instruction type in the **Classification** box.

❸ Users can select an applied instruction, a comparison contact, or a function block here.

❹ If users unselect the **Auto Close** checkbox, they can insert instructions or function blocks continuously.

After the applied instruction or the function block is inserted, users have to type the corresponding operands according to the format of the applied instruction or the format of the function block.



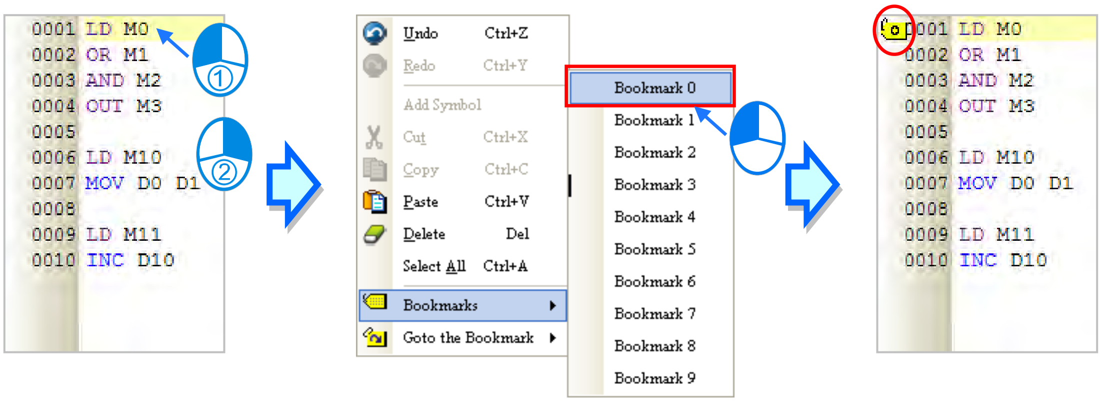
12.2.4 Bookmark

After lines are bookmarked, users can find or go to the lines easily. Users can add ten bookmarks at most to an instruction list.

12.2.4.1 Adding Bookmarks

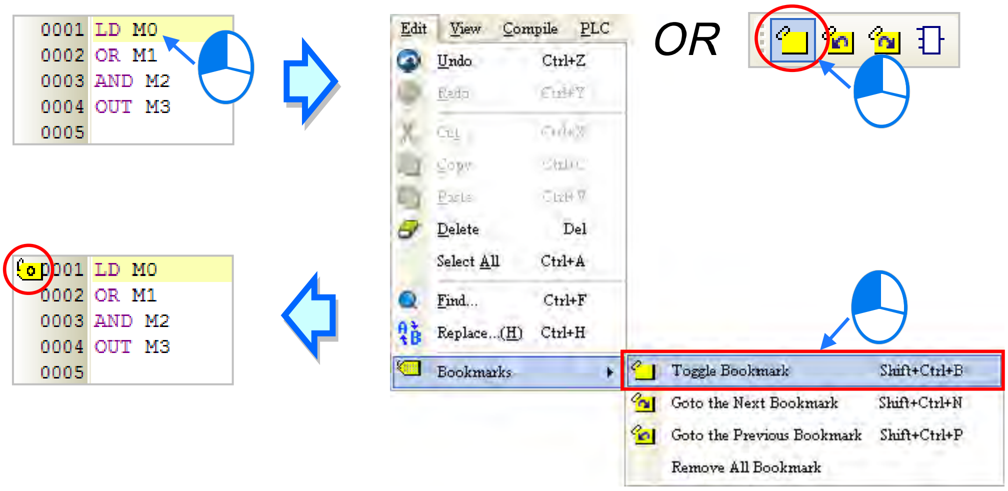
- **Method 1**

If users want to add a bookmark to a line, they can select the line, click the right mouse button, click **Bookmarks** on the context menu, and select a bookmark number. If the bookmark number selected has been added to another line, the bookmark number will be moved to the line selected presently.



- **Method 2**

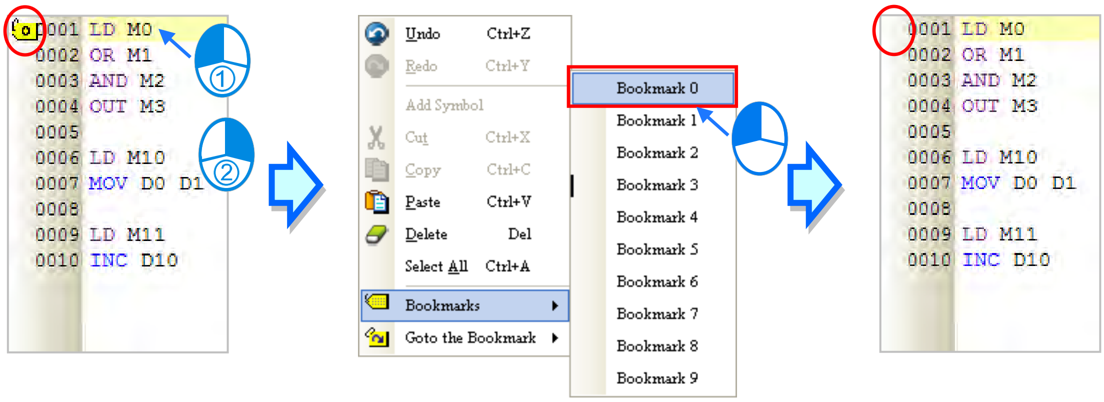
If users want to add a bookmark to a line, they can click the line, and click on the toolbar. The users can also add a bookmark to a line by clicking the line, clicking the **Edit** menu, pointing to **Bookmarks**, and clicking **Toggle Bookmark**. The bookmarks added in this way are numbered in sequence. The users can not specify bookmark numbers.



12.2.4.2 Removing Bookmarks

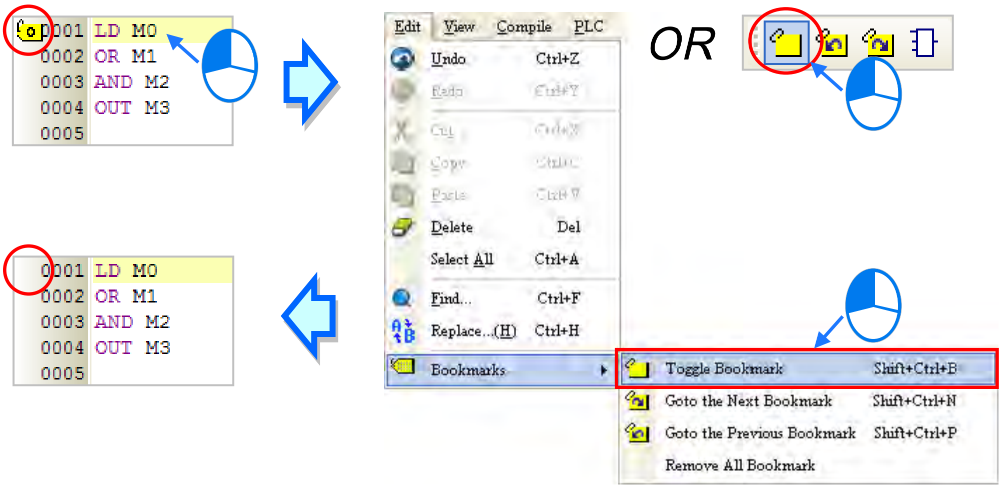
- **Method 1**

If users want to remove the bookmark from a line, they can select the line, click the right mouse button, click **Bookmarks** on the context menu, and click the bookmark number corresponding to the bookmark added to the line. If the bookmark number clicked does not correspond to the bookmark added to the line, the bookmark number added to the line will become the bookmark number clicked. Besides, if the bookmark number clicked has been added to another line, the bookmark number will be moved to the line selected presently.



- **Method 2**

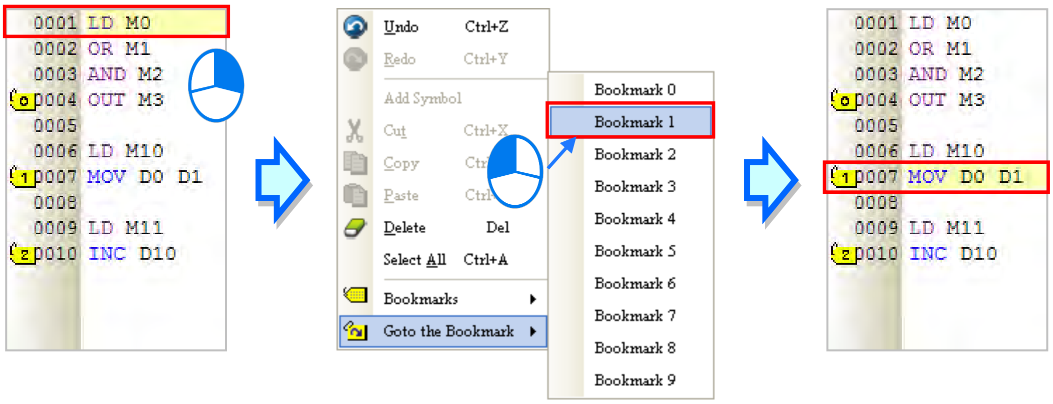
If users want to remove the bookmark from a line, they can click the line, and click  on the toolbar. The users can also remove the bookmark from a line by clicking the line, clicking the **Edit** menu, pointing to **Bookmarks**, and clicking **Toggle Bookmark**. If the users click the **Edit** menu, point to **Bookmarks**, and click **Remove All Bookmarks**, all the bookmarks in the present program editing window will be deleted.



12.2.4.3 Going to a Bookmark

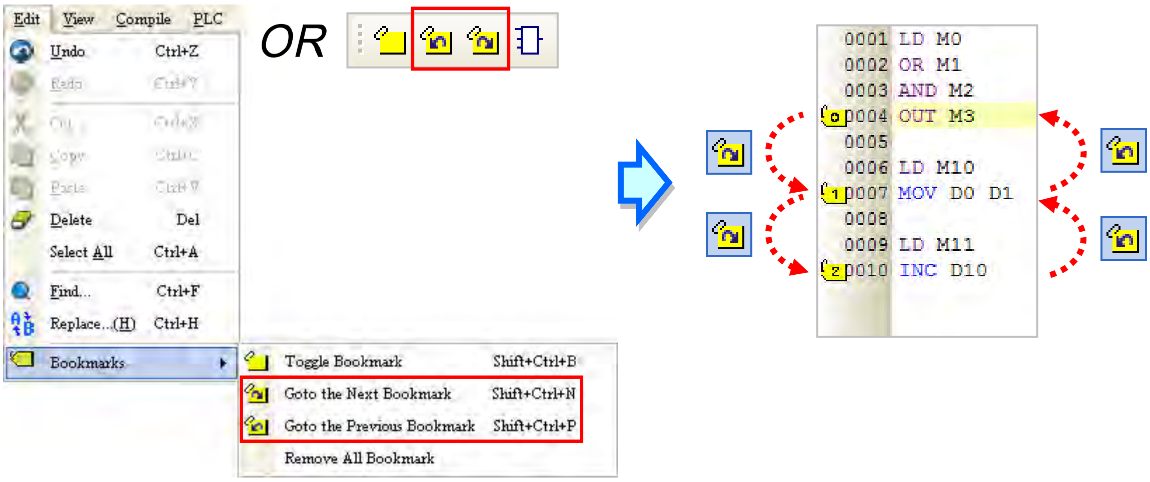
- **Method 1**

Right-click the working area, point to **Goto the Bookmark** on the context menu, and click a bookmark number.



- **Method 2**

If there are bookmarks in a program, users can go to the next line which is bookmarked by clicking on the toolbar, and go to the previous line which is bookmarked by clicking on the toolbar. The users can also go to the next/previous line which is bookmarked by clicking the **Edit** menu, pointing to **Bookmarks**, and clicking **Goto the Next Bookmark**/**Goto the previous Bookmark**.



Chapter 13 Structured Texts

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13.1 Introducing Structured Texts

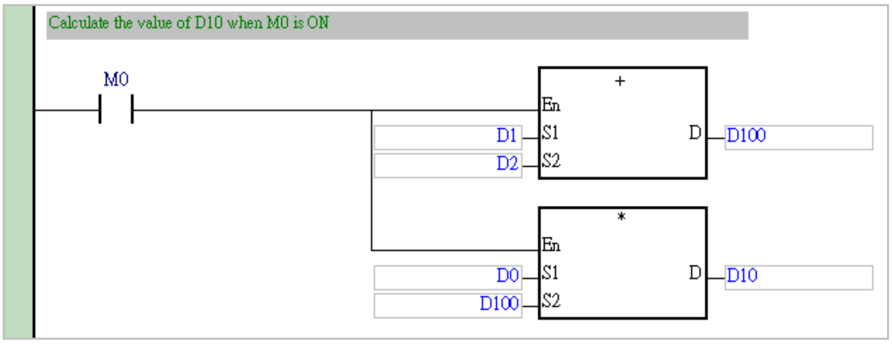
A structured text is a high level language that is syntactically resembles C or Pascal. It is composed of text. Compared with instruction lists, structured texts are more readable. A structured text is very flexible and intuitive for writing control algorithms. People who are trained in programming languages often find it the easiest language to use for programming control logic. Besides, structured texts provide a familiar programming environment for programmers who are familiar with the C language.

13.1.1 Basic Structure of a Structured Texts

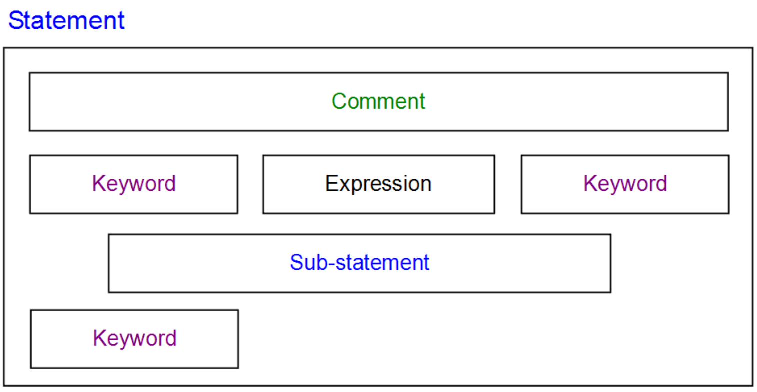
The structured text shown below is a basic structured text. It has the same function as the ladder diagram under it. The structure of the structured text is similar to the syntax of human language. A structured text is composed of statements.

```
(*Calculate the value of D10 when M0 is ON*)
IF M0 THEN
   D10 := D0*(D1+D2) ;
END_IF ;

```

=



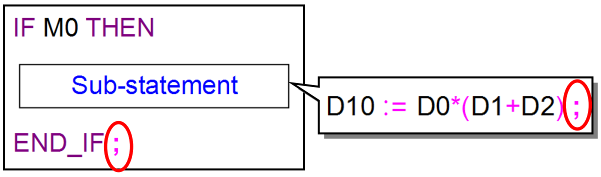
The structure of the structured text above is shown below.



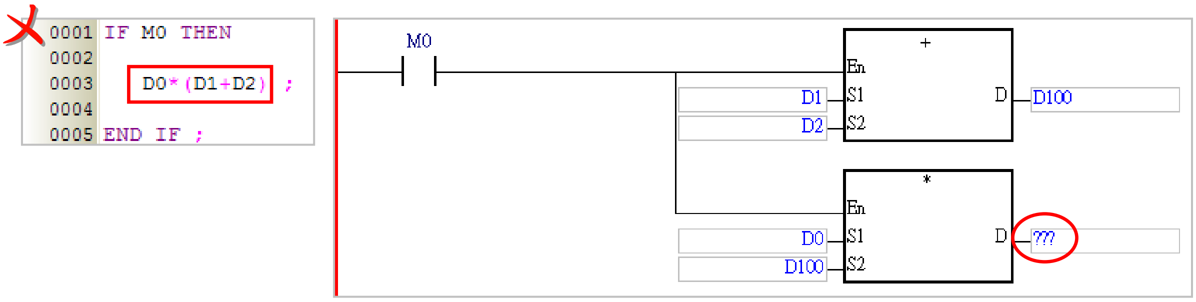
*** In a structured text, ":=" means "to assign", and "=" means "to be equal to".**

13.1.2 Statement

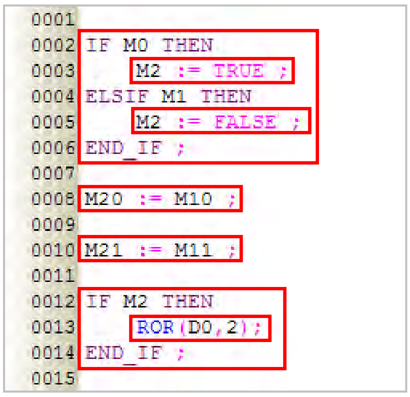
The statement is a basic unit. It represents a complete task which can be executed. A complete statement may not be represented by a single line, but it always ends with a semicolon.



A complete statement corresponds to a network in a ladder diagram. It represents a task. Take the sub-statement shown above for example. The value of the arithmetic expression D0* (D1+D2) is calculated, and the result of the operation is stored in D10. The arithmetic expression in the red frame in the figure below is not a legal statement. It is an expression. It is not a concrete task. It is like the ladder diagram shown below. The ladder diagram lacks an output operand. It is not a complete program which can be executed.



A structured text is composed of statements, and a statement is composed of elements. An example of a structured text is shown below. The complete statements in the structured text are in the red frames.



*** In a structured text, ": = " means "to assign", and " = " means "to be equal to".**

13.1.3 Expression

An expression is an important element of a statement. It represents a value. An expression can be an arithmetic expression, a constant, a symbol, or a device. Examples are listed below.

- M0 & M1 (Boolean value)

  The logical operator **&** takes **M0** and **M1**, and performs the logical **&** operation on **M0** and **M1**. The result of the operation is a Boolean value.

- M0 = FALSE (Boolean value)

  The expression is a conditional expression. If M0 is ON, the Boolean value is TRUE. If M0 is OFF, the Boolean value is TRUE.

- M0 (Boolean value)

  If M0 is ON, the Boolean value is TRUE. If M0 is OFF, the Boolean value is FALSE.

- D1 + D2 (Value)

  The value of the arithmetic expression D1+D2 is calculated.

- D0 (Value)

  The value represented by the expression if the value stored in D0.

- D2 = D0 + D1 (Boolean value)

  If the value of the arithmetic expression D0+D1 is equal to the value stored in D2, the Boolean value is TRUE. If the value of the arithmetic expression D0+D1 is not equal to the value stored in D2, the Boolean value is FALSE.

- D2 := D0 + D1; (Statement)

  This is a statement rather than an expression. The value of the arithmetic expression D0+D1 is calculated, and the result of the operation is stored in D2. This statement is composed of the expression **D2** and the expression **D0+D1**.

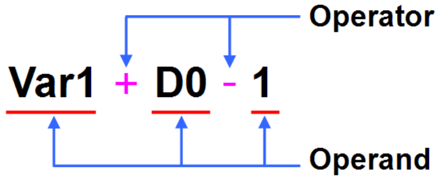
Please refer to the following example. The program is mainly composed of two IF statements. When the first IF statement is executed, the system evaluates the expression M0. If M0 is ON, the value of the arithmetic expression D21+D22 will be calculated, and the result of the operation will be stored in D20. When the second IF statement is executed, the system judges whether the value of the arithmetic expression D0* (D1+D2) is equal to the value stored in D20. If the value of the arithmetic expression D0* (D1+D2) is equal to the value stored in D20, the Boolean value is TRUE, and the value of M1 is TRUE. If the value of the arithmetic expression D0* (D1+D2) is not equal to the value stored in D20, the value of M1 is FALSE.

```
IF M0 THEN
    D20 := D21 + D22 ;
END_IF;

IF D20 = D0*(D1+D2) THEN
    M1 := TRUE ;
ELSE
    M1 := FALSE ;
END_IF;
```

13.1.4 Operand and Operator

Operands and operators are basic elements of an expression. An operand is the object of an operation, and an operator is a symbol or function representing an operation. For example, in the expression D0 + D1, D0 and D1 are operands, and + is an operator.

An expression can be composed of operands and operators. It can also be composed of a single operand. The operands in an expression can be devices, symbols, or constants.



Rules of precedence affect which values form operands for which operators. If the operators in an expression share the same precedence, the order of the operation is carried out from left to right. The operands which can be used in a structured text in ISPSoft are listed below.

Symbol	Function	Data format		Example of an expression		Precedence
		Operand	Result of an operation (Value of an expression)	Expression	Value	
( )	The parenthetical part of an expression is calculated first.	Unspecified	Unspecified	(D0 + 6)* 3	33	Highest
**	Exponentiation	Floating-point number	Floating-point number	2.0 ** 5.0	3.2E+1	
-	Negative sign	Signed number	Signed number	-(D0 + 3)	-8	
NOT	Logical negation	Boolean value	Boolean value	NOT M0	TRUE	
*	Multiplication	Any value	Any value	D0 * 3	15	
/	Division	Any value	Any value	15 / D0	3	
MOD	Remainder	Integer	Integer	D0 MOD 3	2	
+ , -	Addition, subtraction	Any value	Any value	D0 + 3	8	
< , >,<=, >=	Comparison	Any value	Boolean value	D0 > 2	TRUE	

Symbol	Function	Data format		Example of an expression		Precedence
		Operand	Result of an operation (Value of an expression)	Expression	Value	
=, <>	Equal to, not equal to	Any value	Boolean value	D0 <> 2	TRUE	
		Boolean value		M0 = TRUE	FALSE	
AND, &	Logical AND operation	Boolean value	Boolean value	M0 & M1	FALSE	
XOR	Logical exclusive OR operation	Boolean value	Boolean value	M0 XOR M1	TRUE	
OR	Logical inclusive OR operation	Boolean value	Boolean value	M0 OR M1	TRUE	Lowest

***1. In the table above, the default value of M0 is FALSE, the default value of M1 is TRUE, and the default value of D0 is 5.**

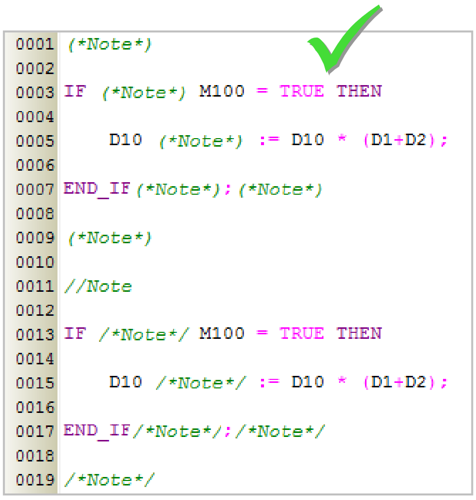
***2. The operands for an exponentiation operator must be constants or floating-point symbols, and must not be devices.**

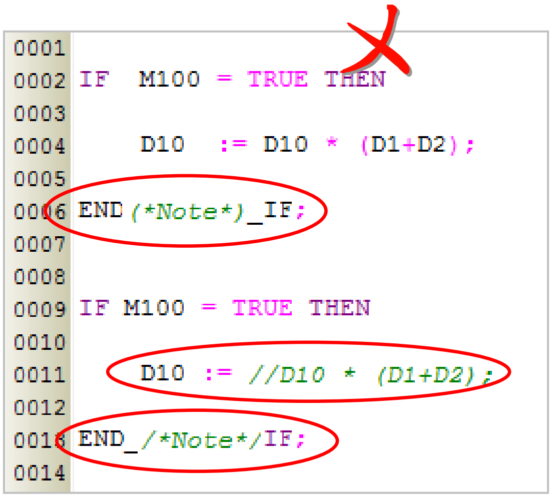
13.1.5 Keyword and Comment

In computer programming, a keyword is a word which has a special meaning to the programming language. For example, TRUE and FALSE in a program represent Boolean values, and the IF statements in the example above represent tasks which will be executed. Besides, applied instructions are regarded as keywords. In order to prevent a program from being compiled incorrectly, the words which are regarded as keywords in the program cannot be declared to be symbols. However, the words which are regarded as keywords in a program can be parts of the symbols in the program. For example, “**FIFO**” and “**_IF**” are allowed.

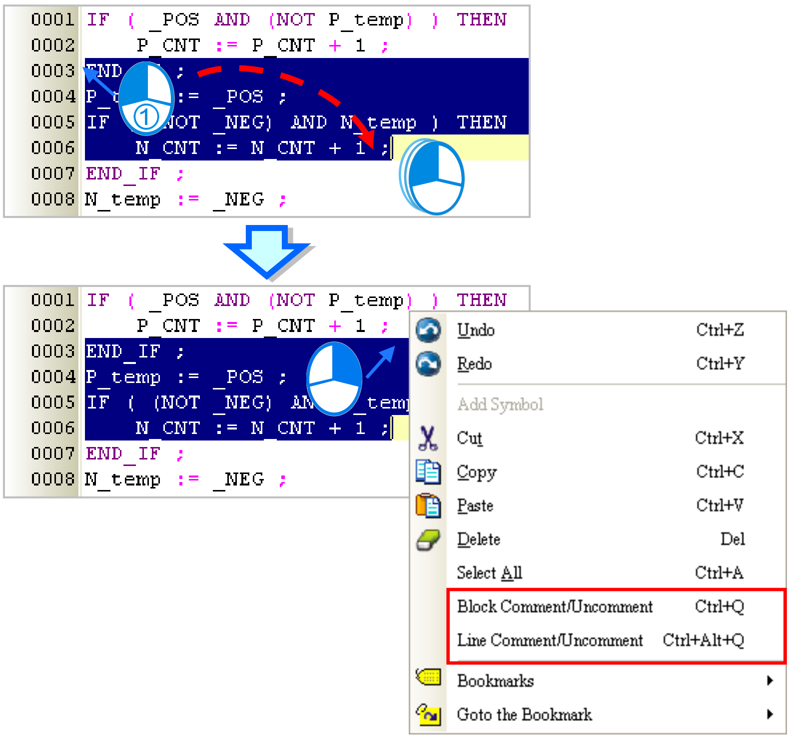
In a structured text, you can use multiple comments (using words between **(*** and ***)**, **(/* and */)** and single line comment (using **(/ /)**). When a program is compiled, the system automatically skips the words between **(*** and ***)** , **(/* and */)** and **(/ /)** in the program. As long as the structure of a structured text is not destroyed, comments can be put anywhere in the structured text. However, users have to be careful about the readability of the structured text.

Please refer to the examples below. The comments in the left example are legal. The comment in the right example divides the keyword “END_IF” into two parts by using /*and*/, and therefore an error will occur after the program is compiled.

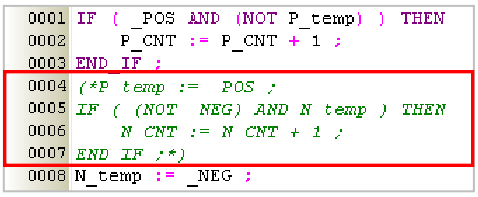




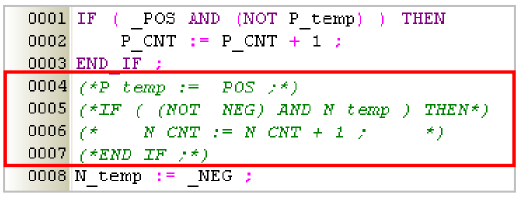
ISPSoft provides a quick way to change the programs to Block Comment/Line comment. Click and drag the ST block that you'd like to edit and then right click the selected area to open the quick menu.



After selecting the Block Comment/Line Comment, the comments will be added. Click again if you'd like to remove the comments.



Block Comment



Line Comment

13.1.6 Using Array Symbols in ST

If users want to use a symbol whose data type is ARRAY in a structured text, the expression format is **Identifier[Index]**. The index is a constant or a symbol. However, only the indexes in a project for an AH/AS series CPU module can be symbols. The minimum index value must be 0, whether the index is a constant or a symbol. The maximum index value cannot be larger than or equal to the number of elements in the array. For example, if the number of elements in an array is 10, the index value must be within the range between 0 and 9. Please refer to section 6.2.3 for more information.

```
IF M0 THEN

Ary_A[0] := Ary_B[IDX] ;

END_IF ;
```

Besides, users have to pay attention to the following points when they use a symbol whose data type is ARRAY.

- Users can only manipulate a single element in an array. A symbol which represents an array can not be used as an operand.
- The arrays that ISPSoft supports are one-dimensional arrays but the structure from the Data Unit Type can support up to three-dimensional arrays. This type of variables can be written as the image shown below. DO value is written in the pt1 [1,1,1] of the vardut. Refer to chapter 8 for more information.

```
IF M0 THEN

vardut.pt1[1,1,1]:=D0;

END_IF;

```

- If an index is a symbol, and the value of the symbol is not within a legal range, the PLC will continue running and no error will occur. However, the data taking part in the operation may be incorrect.
- If the index for a symbol is constant, the symbol can be modified by an index register. If the index for a symbol is a symbol, the symbol can not be modified by an index register. Please refer to section 6.1.5 for more information.

13.1.7 Notes on ST Programming

- If the structure of the keywords or the statements in a structured text is not destroyed, starting new lines and leaving blank spaces is allowed.
- In principle, full width characters and half width characters in ISPSoft are regarded as different characters. Please avoid using full width characters lest they should be identified incorrectly.
- Structured texts are case-insensitive. “IF” and “If” are considered to be the equivalents of “if”. (The C language is case-sensitive.)
- If users want to use constants in a structured text in ISPSoft, the constants must be represented in the following ways.
  - Decimal value: 23456 (A value which is not preceded by any mark will be regarded as a decimal value.)
  - Hexadecimal value: 16#5BA0 (A value is preceded by 16#.)

- ➢ Octal value: 8#55640 (A value is preceded by 8#.)
- ➢ Binary value: 2#101101110100000 (A value is preceded by 2#.)
- ➢ String: “XYZ” (Characters are put in double quotes.)
- ➢ Boolean value (BOOL): TRUE or FALSE

- In a structured text in ISPSoft, the data types of the operands in an expression must be the same. However, if the data type of one operand is INT and the data type of the other operand is WORD, both operands can take part in the operation. Likewise, if the data type of one operand is DINT and the data type of the other operand is DWORD, the two operands can take part in the operation as well. If the data lengths of the operands in an expression are different, the operands cannot take part in the operation.

```
Var_0 := Var_INT + Var_WORD ;

Var_1 := Var_DINT + Var_DWORD ;

Var_2 := Var_INT + Var_DINT ;
```

- If the data type of a symbol is WORD, DWORD, the system regards it as a signed integer during the operation.
- Although there is no limit to the number of lines, users still have to consider the capacity of the memory in the PLC.
- The sections of a structured text in ISPSoft can be copied/cut/pasted. Users can copy the edited text into a structured text in ISPSoft.

- The following instructions are not supported in a structured text:

AH/AS series CPU modules
All the IL instructions are not supported. For example, LD, LDI, OUT, SET, RST, LD&, LDP are not supported.
All the pulse type API instructions are not supported. For example, ROLP, RORP, BCDP, TRDP are not supported.
The Four Arithmetic Operations instructions, the Logical Operation instructions, the Contact Type Logic Operation instructions, and the Structure Creation instructions are not supported. In addition, instructions including PLS, PLF, MOV, DMOV, DFMOV, $MOV, MC, MCR, CJ, JMP, GOEND are not supported. Also, instructions such as CNT, DCNT used in counter values and TMR instruction used by counters in subroutine program are not supported.

13

- The following instructions are supported in a structured text but with limitation:

AS series CPU module
All the high speed output instructions (API 27xx) for example, DPLSY and DDRVI are supported. Please refer to DDRVI instruction for application.
The use of DCNT instructions for high speed counters is supported. But, statements need to be executed so that values can be updated.
Communication instructions are supported but only after flag instruction setup is completed. The instructions used in the program procedures can be scanned for execution.

13.2 Structure of a Statement

13.2.1 Assignment Structure—:=

● **Format**

Device or Symbol	:=	Expression	;

● **Description**

The value represented by the expression at the right side of := is assigned (transmitted) to the device or the symbol at the left side of :=.

● **Rules and limits**

➢ The expression at the right side of := can be a constant, a device, a symbol, or an arithmetic expression. Only a device or a symbol can be at the left side of :=.

➢ For the assignment / transmission, the operands at both sides of := must conform to the rules listed below.

(a) One operand is an M/S/T/C/HC device, and the other operand is a symbol whose data type is BOOL/STEP/TIMER/COUNTER. (The device assigned to the operand which is a symbol is a bit device.)

(b) One operand is a D/L device, and the other operand is a symbol whose data type is not BOOL/STEP/REAL/STRING.

(c) One operand is a T/C device, and the other operand is a D/L device or a symbol whose data type is WORD/INT/TIMER/COUNTER.

(d) One operand is a D/L/HC device, or a symbol whose data type is COUNTER, and to which a HC device is assigned. The other operand is a symbol whose data type is DWORD/DINT.

(e) One operand is a symbol whose data type is WORD and the other operand is a symbol whose data type is INT.

(f) Both operands are symbols whose data types are REAL/STRING. The data lengths of the operands must be the same.

(g) One operand is a symbol whose data type is WORD, and the other operand is a symbol whose data type is DWORD. The transmission direction can only be from WORD to DWORD but not the other way around or the data might be lost.

(h) One operand is a symbol whose data type is INT, and the other operand is a symbol whose data type is DINT. The transmission direction can only be from INT to DINT but not the other way around or the data might be lost.

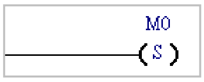
- **Example**

Example 1: The value of M0 is assigned to the symbol OUT_0.

```
OUT_0 := M0 ;
```

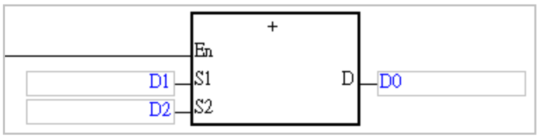
Example 2: M0 is set to ON.

```
M0 := TRUE ;
```



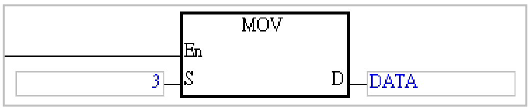
Example 3: The value in D2 is added to the value in D1. The sum is stored in D0.

```
D0 := D1 + D2 ;
```



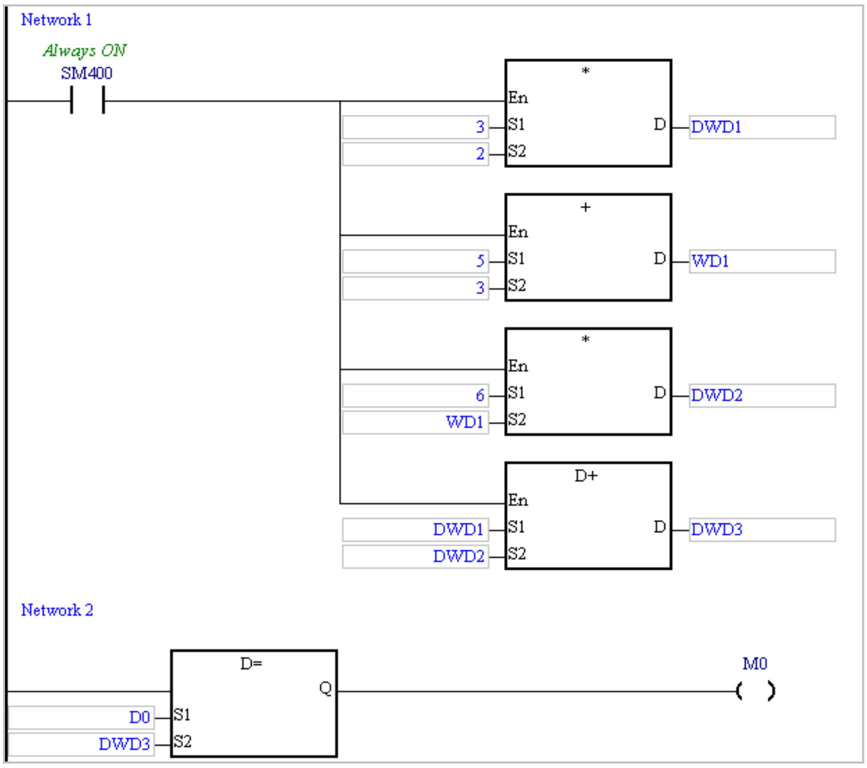
Example 4: 3 is assigned to the symbol DATA.

```
DATA := 3 ;
```



Example 5: The system judges whether the value of the arithmetic expression 3*2+6* (5+3) is equal to the value stored in D0. The judgement result is sent to M0.

```
M0 := (D0=3*2+6*(5+3)) ;
```



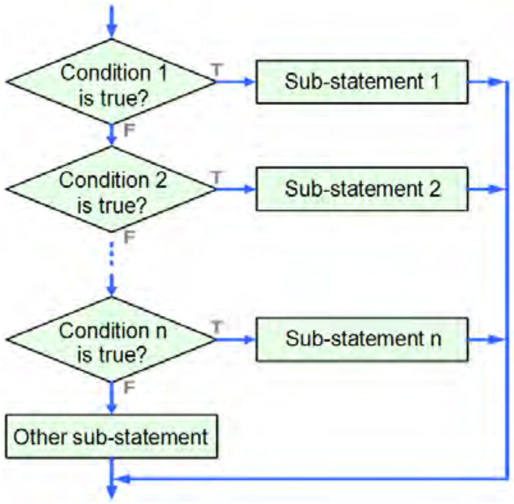
Example 6: Examples of incorrect use of the assignment structure are as follows.

Statement	Description
D0 := M0 ;	The data type of one operand must not be different from the data type of the other operand.
D0 := V_REAL ;	The value of a symbol whose data type is REAL can not be assigned to a D device.
V_LREAL := V_REAL ;	If one operand is a symbol whose data type is REAL, the other operand must be a symbol whose data type is REAL. If one operand is a symbol whose data type is LREAL, the other operand must be a symbol whose data type is LREAL.
V_DWORD := V_TIMER ;	The value of a symbol whose data type is TIMER can not be assigned to a symbol whose data type is DWORD, but can be assigned to a symbol whose data type is WORD.
V_WORD := HC0 ;	The value in a HC device can not be assigned to a symbol whose data type is WORD, but can be assigned to a symbol whose data type is DWORD.

13.2.2 Conditional Structure - IF

● **Format**

```
IF    Bool expression 1   THEN
      Sub-statement 1  ;
ELSIF    BooL expression 2   THEN
         Sub-statement 2  ;
              :
ELSIF    BooL expression n   THEN
         Sub-statement n  ;
ELSE
         Other sub-statement  ;
END_IF ;
```



● **Description**

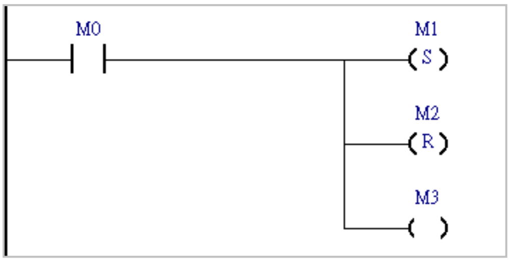
If the value of **Boolean expression 1** is TRUE, **Sub-statement 1** will be executed. If the value of **Boolean expression 1** is FALSE, **Boolean expression 2** will be evaluated. If the values of all the Boolean expressions are FALSE, **Other sub-statement** will be executed.

- **Rules and limits**
  - A Boolean expression can be a device, a symbol, or an arithmetic expression. It can not be a constant.
  - A sub-statement can be a legal statement, or an IF statement.
  - There is no limit on the number of sub-statements following **THEN** or **ELSE**.
  - The **ELSIF** sections and the **ELSE** section can be omitted. If the **ELSE** section is omitted, and the values of all the Boolean expressions are FALSE, no sub-statement will be executed.
  - Users can add **ELSIF** sections to a conditional structure at will. There is only one **ELSE** section in a conditional structure. The **ELSE** section in a conditional structure is at the last section of the conditional structure.
- **Example**

Example 1: If M0 is ON, M1 will be set to ON, and M2 will be set to OFF. If M0 is not ON, the step will end. No matter what the value of M0 is, the value of M0 will be assigned to M0.

```
IF M0 THEN
    M1 := TRUE ;
    M2 := FALSE ;
END_IF;

M3 := M0 ;
```

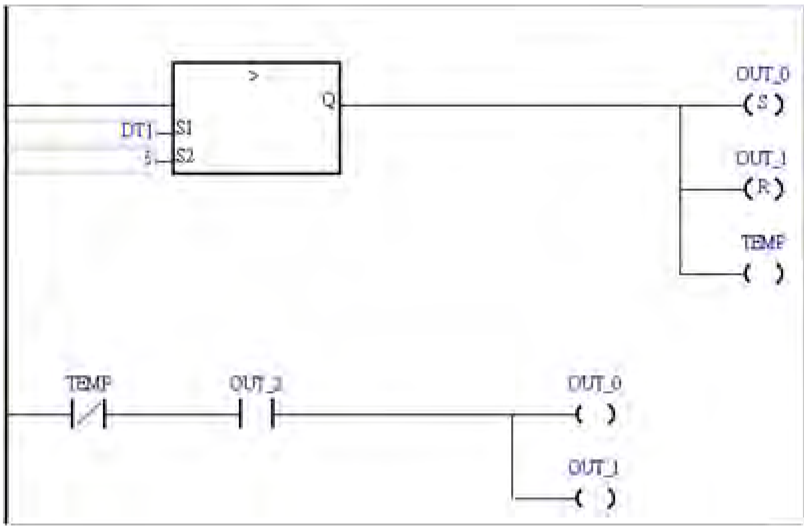
=



Example 2: If the value of DT1 is larger than 5, OUT_0 will be set to ON, and OUT_1 will be reset to OFF. If the value of DT is not larger than 5, the value of OUT_2 will be assigned to OUT_0 and OUT_1.

```
IF DT1>5 THEN
    OUT_0 := TRUE ;
    OUT_1 := FALSE ;
ELSE
    OUT_0 := OUT_2 ;
    OUT_1 := OUT_2 ;
END_IF;
```

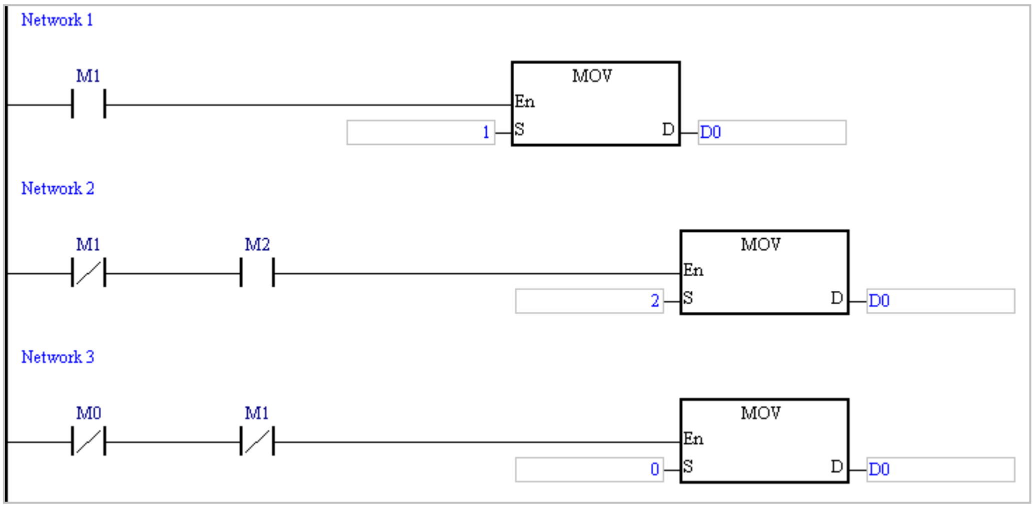
=



Example 3: If M1 is ON, the value in D0 will be 1. If M1 is not ON, the PLC will evaluate M2. If M2 is ON, the value in D0 is 2. If M2 is not ON, the value in D0 will be 0.

```
IF M1 THEN
    D0 := 1 ;
ELSIF M2 THEN
    D0 := 2 ;
ELSE
    D0 := 0 ;
END_IF;
```

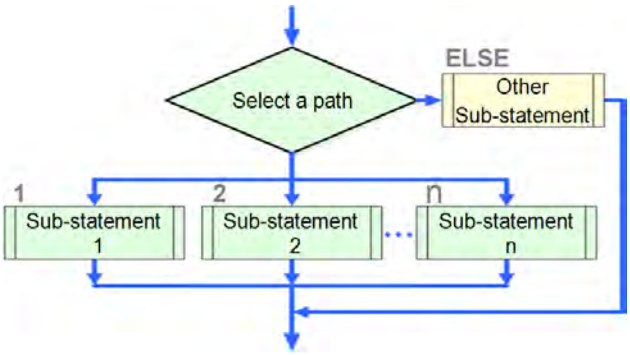
=



13.2.3 Conditional Structure–CASE

- **Format**

```
CASE  Integer expression  OF
    Conditional value 1 : Sub-statement 1 ;
    Conditional value 2 : Sub-statement 2 ;
             :
    Conditional value n : Sub-statement n ;
ELSE
    Other sub-statement ;
END_CASE ;
```



- **Description**

The PLC judges whether the value of **Integer expression** is on the list of condition values. If the value of **Integer expression** is the same as a condition value on the list, the sub-statement following the condition value will be executed. If the value of **Integer expression** is not on the list of condition values, **Other sub-statement** under the keyword **ELSE** will be executed.

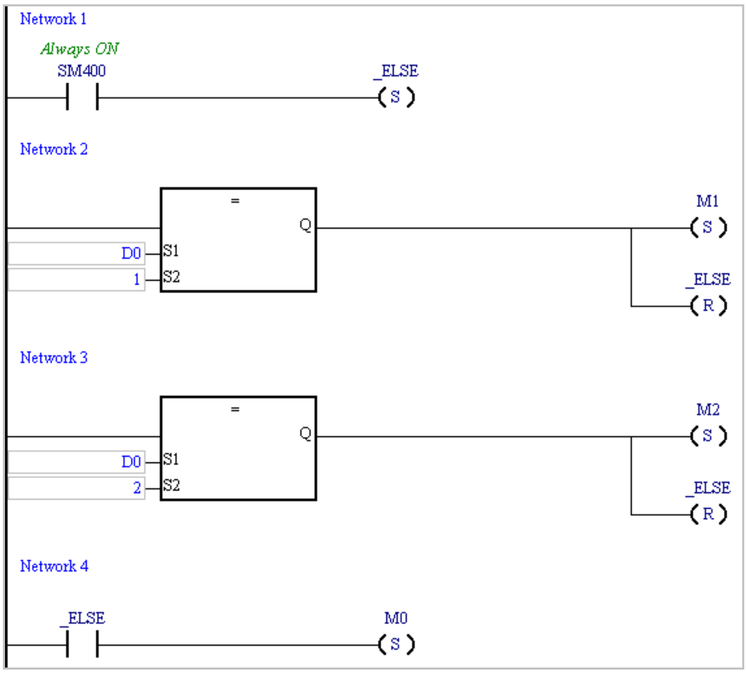
- **Rules and limits**

  - **Integer expression** in the figure above can be a device, a symbol, or an arithmetic expression. It can not be a constant. The data type of **Integer expression** must be INT (-32768~32767) or DINT (-2147483648~2147483647). If a device is used as **Integer expression**, the system will automatically regard the value in the device as an integer. Besides, if an arithmetic expression is used as **Integer expression**, and the result of the operation is not an integer, the result will be rounded down to the nearest whole digit.
  - A condition value on the list can not be the same as another condition value on the list, and the condition values on the list must be integers. The range of condition values depends on the data type of **Integer expression**. If the data type is INT, the condition values must be in the range of -32768 to 32767. If the data type is DINT, the condition values must be in the range of -2147483648 to 2147483647.
  - If the sub-statements following some condition values are the same, users can combine them.
    (a) If the condition values are not continuous values, they are separated by commas. For example, **1, 3, 5: Sub-statement** means that the sub-statement will be executed if the value of **Integer expression** is 1, 3, or 5.
    (b) If the condition values are continuous values, the range of condition values can be indicated by the mark "**..**". For example, **3..6: Sub-statement** means that the sub-statement will be executed if the value of **Integer expression** is in the range of 3 to 6 (including 3 and 6). If the mark "**..**" is used, the value at the left side of "**..**" must be less than the value at the right side of "**..**". For example, **6..3 :** is an illegal range.
  - A sub-statement can be a legal statement, or another structure.
  - There is no limit on the number of sub-statements following a condition value.
  - The **ELSE** section can be omitted. If the **ELSE** section is omitted, and the value of **Integer expression** is not on the list of condition values, no sub-statement will be executed.
  - After a sub-statement is executed, the execution of the program will jump out of the CASE structure. No jump instruction is needed.

● **Example**

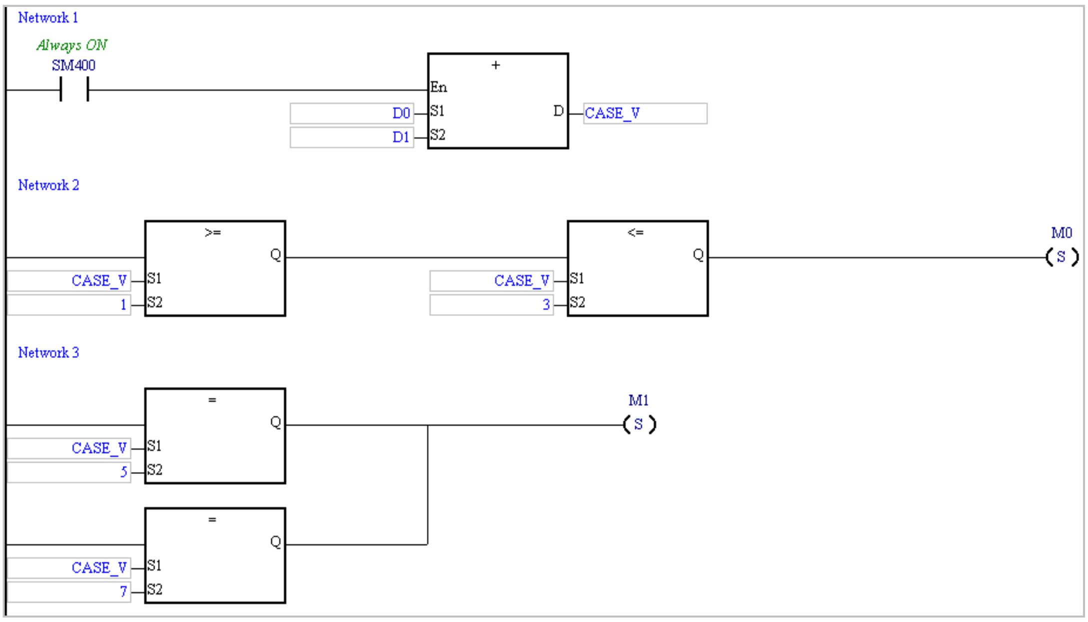
Example 1: If the value in D0 is 1, M1 will be ON. If the value in D0 is 2, M2 will be ON. If the value in D0 is neither 1 nor 2, M0 will be ON.

```
CASE D0 OF
  1: M1 := TRUE ;
  2: M2 := TRUE ;
ELSE
  M0 :=TRUE ;
END_CASE;
```



Example 2: The value of the arithmetic expression D0+D1 is calculated first. If the result of the operation is in the range of 1 to 3, M0 will be ON. If the result of the operation is 5 or 7, M1 will be ON. If the result of the operation is not on the list of condition values, no sub-statement will be executed, and the execution of the program will jump out of this structure.

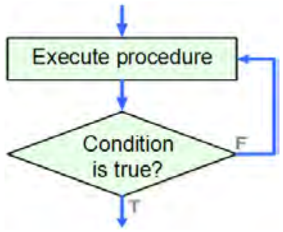
```
CASE D0+D1 OF
  1..3: M0 := TRUE ;
  5,7 : M1 := TRUE ;
END_CASE;
```



13.2.4 Loop Structure - REPEAT

- **Format**

```
REPEAT
  Sub-statement ;
UNTIL  Bool expression
END_REPEAT ;
```



- **Description**

The sub-statement is executed, and then the Boolean expression is evaluated. If the Boolean expression is evaluated as TRUE, the loop will be terminated. If the value of the Boolean expression is FALSE, the program in the structure will be executed repeatedly until the value of the Boolean expression is TRUE.

- **Rules and limits**

  - The Boolean expression can be a device, a symbol, or an arithmetic expression. It can not be a constant.
  - The sub-statement is executed before the Boolean expression is evaluated, and therefore the sub-statement is executed at least once.
  - The sub-statement can be a legal statement, or another structure. There is no limit on the number of sub-statements in a **REPEAT** structure. One loop structure can be embedded in another loop structure. There are at most 64 loop structures.
  - If the value of the Boolean expression following **UNTIL** is TRUE, the loop will be terminated. To prevent an infinite loop, the operand in the Boolean expression following **UNTIL** can not be a device or a symbol which cannot be updated.
  - The X devices in a program are updated after the program is scanned. If users want to use an X device as the operand of the Boolean expression, they have to add an I/O update instruction to the structure, or update the X through an interrupt subroutine.

- **Example**

Example 1: The initial value of DT1 is 0. In the loop structure, the value of DT1 increases progressively by 2. The loop will not be terminated until the value of DT1 is larger than 100.

```
DT1 := 0 ;
REPEAT
   DT1 := DT1 + 2 ;
UNTIL DT1 > 100
END_REPEAT;
```

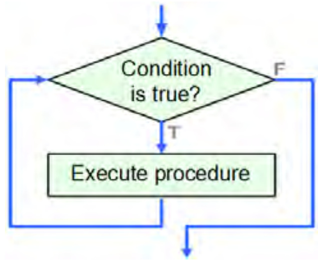
Example 2: The initial value in D0 is 1, and the initial value in D10 is 5. After the loop is terminated, the value in D0 will become 5*4*3*2*1.

```
D10 := 5 ;

D0 := 1 ;
REPEAT
  D0 := D0 * D10 ;
  D10 := D10 - 1 ;
UNTIL  D10 = 0
END_REPEAT ;
```

13.2.5 Loop Structure - WHILE

● **Format**

```
WHILE [Bool Expression] DO
    [Sub-statement] ;
END_ WHILE ;
```



● **Description**

The Boolean expression is evaluated. If the value of the Boolean expression is TRUE, the sub-statement will be executed. This repeats until the value of the Boolean expression becomes FALSE.

● **Rules and limits**

➢ The Boolean expression can be a device, a symbol, or an arithmetic expression. It can not be a constant.

➢ The sub-statement will be executed if the value of the Boolean expression is TRUE, and therefore the sub-statement may not be executed.

➢ The sub-statement can be a legal statement, or another structure. There is no limit on the number of sub-statements in a **WHILE** structure. One loop structure can be embedded in another loop structure. There are at most 64 loop structures.

➢ If the value of the Boolean expression following **WHILE** is FALSE, the loop will be terminated. To prevent an infinite loop, the operand in the Boolean expression following **WHILE** cannot be a device or a symbol which cannot be updated.

➢ The X devices in a program are updated after the program is scanned. If users want to use an X device as the operand of the Boolean expression, they have to add an I/O update instruction to the structure, or update the X through an interrupt subroutine.

● **Example**

Example 1: The initial value of DT1 is 0. In the loop structure, the value of DT1 increases progressively by 2. The loop will not be terminated until the value of DT1 is larger than 100.

```
DT1 := 0 ;

WHILE DT1 <= 100 DO
   DT1 := DT1 + 2 ;
END_WHILE;
```

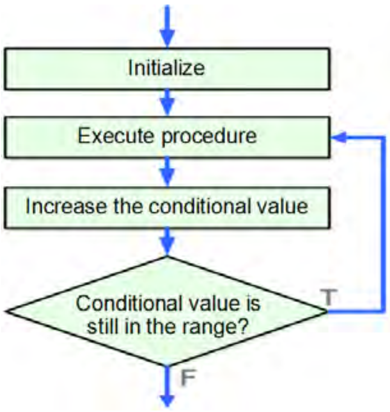
Example 2: The REPEAT loop checks the Boolean expression after the sub-statement is executed. The sub-statement in the REPEAT structure is executed once. After the REPEAT loop is terminated, the value in D0 will become 1. The WHILE loop checks the Boolean expression before the sub-statement is executed. The Boolean expression in the WHILE structure is evaluated as FALSE, and therefore the sub-statement in the WHILE structure is not executed. After the WHILE loop is terminated, the value in D1 will still be 0.

```
M0 := TRUE ;
D0 := 0 ;
D1 := 0 ;

REPEAT
 D0 := D0 + 1 ;
UNTIL  M0
END_REPEAT ;

WHILE (NOT M0) DO
   D1 := D1 + 1 ;
END_WHILE ;
```

13.2.6 Loop Structure - FOR

● **Format**

FOR [Device or Symbol] := [Start value] TO [End value] BY [Increment] DO
    [Sub-statement] ;
END_ FOR ;



- **Description**

The initial value of the symbol or the initial value in the device is the start value. Whenever the loop body is executed, the value of the symbol or the value in the device increases by the increment. If the value of the symbol or the value in the device is in the range of the start value to the end value, the loop body will be executed. If the value of the symbol or the value in the device is not in the range of the start value to the end value, the loop will be terminated.

- **Rules and limits**

  - The start value/end value/increment can be a device, a symbol, an arithmetic expression, or a constant. The data type of the start value/end value/increment must be INT (-32768~32767) or DINT (-2147483648~2147483647). If a device is used as the start value/end value/increment, the system will automatically regard the value in the device as an integer. Besides, if an arithmetic expression is used as the start value/end value/increment, and the result of the operation is not an integer, the result will be rounded down to the nearest whole digit.
  - If the end value is less than the start value, the increment must be a negative number. Otherwise, there will be an infinite loop.
  - The data type of the symbol must be INT or DINT. If the symbol or the device takes part in the operation, please prevent the value of the symbol or the value in the device from resulting in an infinite loop.
  - The sub-statement can be a legal statement, or another structure. There is no limit on the number of sub-statements in a **FOR** structure. One loop structure can be embedded in another loop structure. There are at most 64 loop structures.
  - After the value of the symbol or the value in the device increases by the increment, the system will check whether the value of the symbol or the value in the device is in the range of the start value to the end value. If an overflow occurs after the value of the symbol or the value in the device increases by the increment, there will be an infinite loop.

- **Example**

The initial value of the symbol INDEX is 1. Whenever the loop body is executed, the value of INDEX increases by 2. After the loop body is executed for the fifth time, the value of INDEX will increase by 2, and the value of INDEX will become 11. Owing to the fact that the value INDEX is not in the range of 1 to 9, the loop is terminated. The initial value of the symbol SU is 0. After the loop is terminated, the value of SU will become $1^2+3^2+5^2+7^2+9^2$.

```
SU := 0 ;

FOR  INDEX := 1  TO  9  BY  2  DO
     SU :=  INDEX * INDEX + SU ;
END_FOR ;

```

13.2.7 Applied Instruction Structure

- **Format**

Name of API	(	Operand 1	,	Operand 2	, ... ,	Operand n	) ;

- **Description**

The applied instruction is executed.

- **Rules and limits**

➢ The state of the En pin does not need to be specified in the applied instruction. When the statement is executed, the applied instruction is executed. An IF statement functioning as an En pin can be used with the applied instruction.

➢ As long as the structure of the operands and the structure of the keywords are not destroyed, starting new lines is allowed.

➢ The applied instruction is a statement, and therefore it ends with a semicolon.

➢ The operands specified in the applied instruction must be put in parentheses.

➢ The order in which the operands are arranged can not be changed. Please refer to instruction manuals for more information.

➢ The applied instructions in ISPSoft do not support the assignment of values, and therefore M0 := CMP (D0, D10, M0) ; is an illegal statement.

➢ As long as the structure of the applied instruction is unchanged, starting new lines is allowed.

```
CMP (
      D0,
      D10,
      M0
      ) ;
```

```
CMP
( D0, D10, M0 ) ;
```

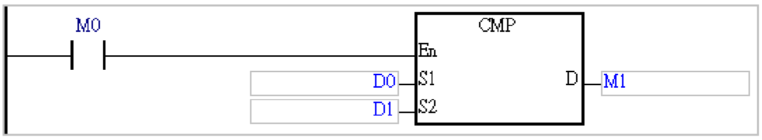
```
CM
P( D0, D10, M0 ) ;
```

- **Example**

Example 1: The instruction CMP is used with an IF statement.

```
IF M0 THEN
   CMP(D0, D1, M1);
END_IF;
```

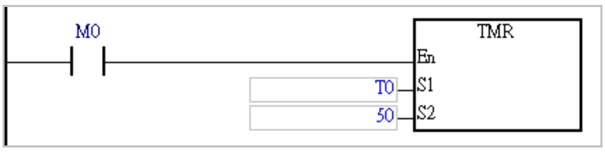
=



Example 2: The state of the En pin does not need to be specified in an applied instruction. If the instruction TMR is used, a statement about resetting the timer is required. Otherwise, the value of the counter will not become zero. For example, line 0004 in the figure below is a statement about resetting the timer.

```
0001 IF M0 THEN
0002   TMR (T0, 50);
0003 ELSE
0004   T0 := FALSE ;
0005 END_IF ;
```

=



13.2.8 Function Block Structure

● **Format**

```
Name of FB instance ( Input pin 1 := Input operand 1 ,
                      Input pin 2 := Input operand 2 ,
                      .........
                      Output pin1 => Output operand 1 ,
                      Output pin 2 => Output operand 2 ,
                      .........
                      Output pin n => Output operand n ) ;
```

● **Description**

The function block is executed.

● **Rules and limits**

➢ The state of the En pin of the function block does not need to be specified in the function block. When the statement is executed, the function block is executed. An IF statement functioning as an En pin can be used with the applied instruction.

➢ As long as the structure of the operands and the structure of the keywords are not destroyed, starting new lines is allowed.

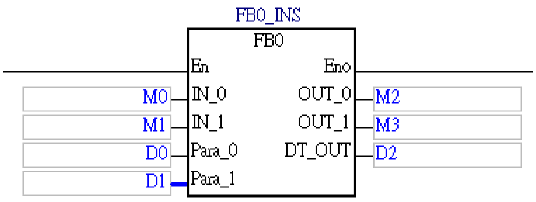
➢ The function block is a statement, and therefore it ends with a semicolon.

➢ The input/output pins of the function block and the corresponding operands must be put in parentheses. A pin and the corresponding operand form a group. The groups are separated by commas. The data types of the operands are specified in the function block definition.

➢ The function block before the parentheses is a function block instance rather than a function block definition, that is, the symbol before the parentheses is a symbol whose data type is a function block. Please refer to chapter 7 for more information about function block definitions and function block instances.

➢ The assignment mark for an input pin is :=, and the assignment mark for an output pin is =>.

➢ The pins and the operands are arranged according to the definition of the function block. The arrangement can not be changed. The En pin and the Eno pin are excluded. The input pins are listed above all the output pins. A pin of the VAR_IN_OUT class is an input pin. Please refer to the ladder diagram and the structured text below for more information.



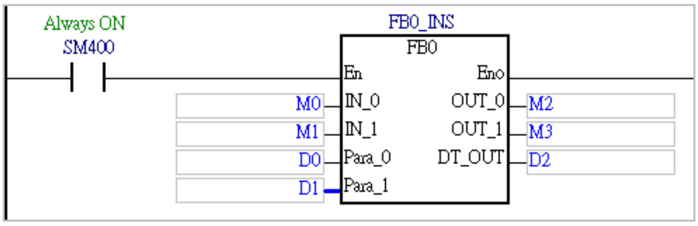

```
FB0_INS ( IN_0 := M0 ,
          IN_1 := M1 ,
          Para_0 := D0 ,
          Para_1 := D1 ,
          OUT_0 => M2 ,
          OUT_1 => M3 ,
          DT_OUT => D2 );
```

● **Example**

Example 1: When a statement which calls a function block is executed, the function block is executed.

```
FB0_INS ( IN_0 := M0 ,
          IN_1 := M1 ,
          Para_0 := D0 ,
          Para_1 := D1 ,
          OUT_0 => M2 ,
          OUT_1 => M3 ,
          DT_OUT => D2 );
```

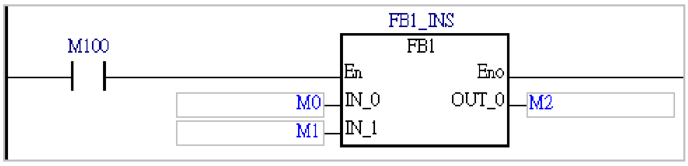
=



Example 2: A function block is used with an IF statement.

```
IF M100 THEN
FB1_INS ( IN_0 := M0 ,
          IN_1 := M1 ,
          OUT_0 => M2 );
END_IF;
```

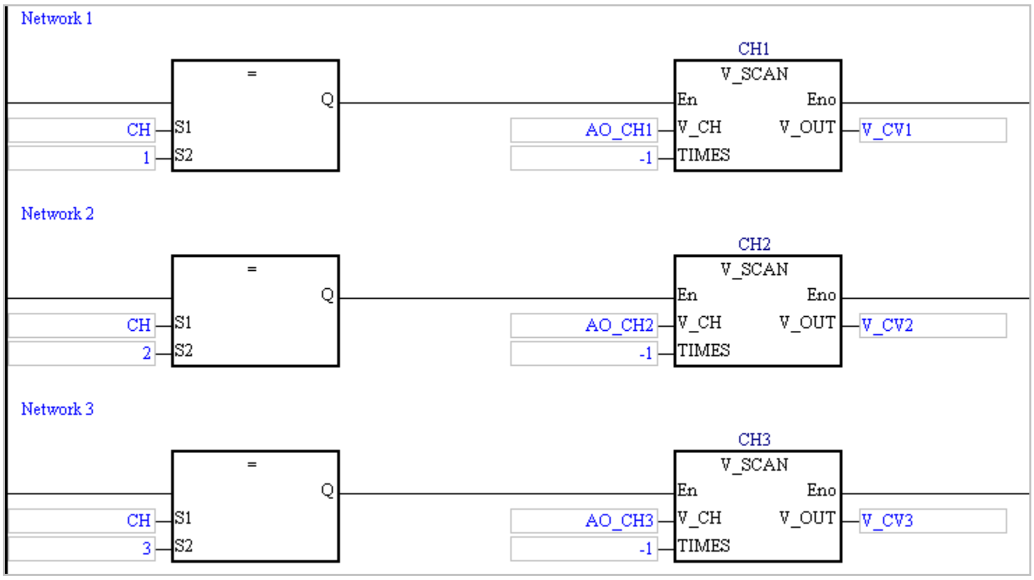
=



Example 3: The value of the symbol CH determined which function block will be executed.

```
CASE CH OF
  1: CH1 ( V_CH := AO_CH1,
           TIMES := -1 ,
           V_OUT => V_CV1 );

  2: CH2 ( V_CH := AO_CH2,
           TIMES := -1 ,
           V_OUT => V_CV2 );

  3: CH3 ( V_CH := AO_CH3,
           TIMES := -1 ,
           V_OUT => V_CV3 );
END_CASE;
```

=



13.2.9 Blank Statement

● **Format**

```
;
```

● **Description**

If a statement is needed, but no action needs to be executed, a blank statement is used.

● **Example**

The For loop below shows that no action is executed. Owing to the blank statement, the execution of the program is delayed. Users can adjust the time for which the execution of the program is delayed by adjusting the number of times the loop body is executed.

```
FOR D100:=1 TO 3000 BY 1 DO
    ;
END_FOR;
```

13.2.10 RETURN Statement

● **Format**

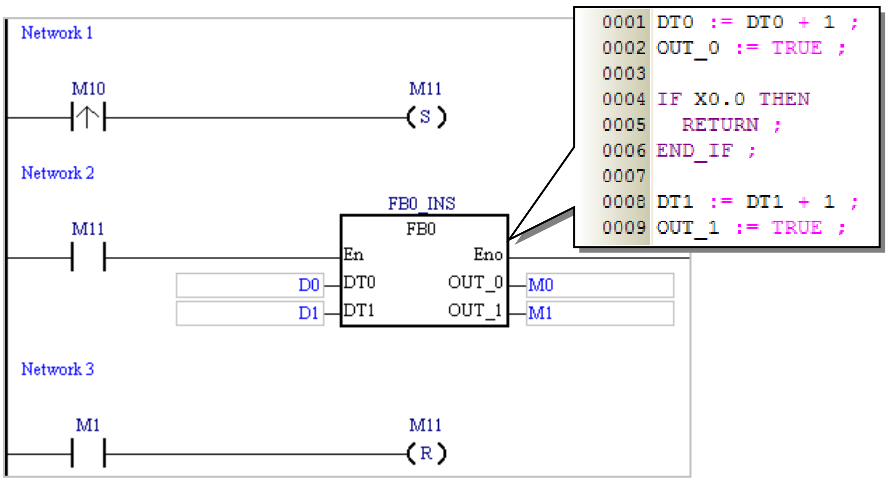
```
RETURN ;
```

● **Description**

A RETRUN statement is used in a function block in a structured text. It ends the program in the function block.

● **Example**

The programming language used to create the program in the function block FB0 is a structured text. After the upper part of the program is executed, the state of X0.0 will be judged. If X0.0 is ON, the execution will leave the current program. If X0.0 is OFF, the whole program in the function block will be executed.



13.2.11 EXIT Statement

● **Format**

```
EXIT ;
```

● **Description**

An EXIT statement is used in a REPEAT loop, a WHILE loop, or a FOR loop. It is used to exit the loop.

● **Example**

Example 1: The loop below is a REPEAT loop. The loop will not be terminated until the value of DT1 is 0. The IF structure in the loop is used with an EXIT statement. The initial value in D0 is 0. It increases by 1. The loop will not be terminated until the value in D0 is 100. As a result, the loop body will be executed 100 times at most. In the example below, the initial value of DT1 is 110. After the loop body is executed for the 100th time, the value of DT1 will become 10. In other words, the final value of DT1 will be 10. The value of DT1 will not decrease to 0.

```
DT1:= 110 ;
D0 := 0 ;

REPEAT

   DT1  :=  DT1- 1 ;
   D0   :=  D0 + 1 ;

   IF  D0=100  THEN
     EXIT ;
   END_IF ;

UNTIL  DT1= 0
END_REPEAT ;
```

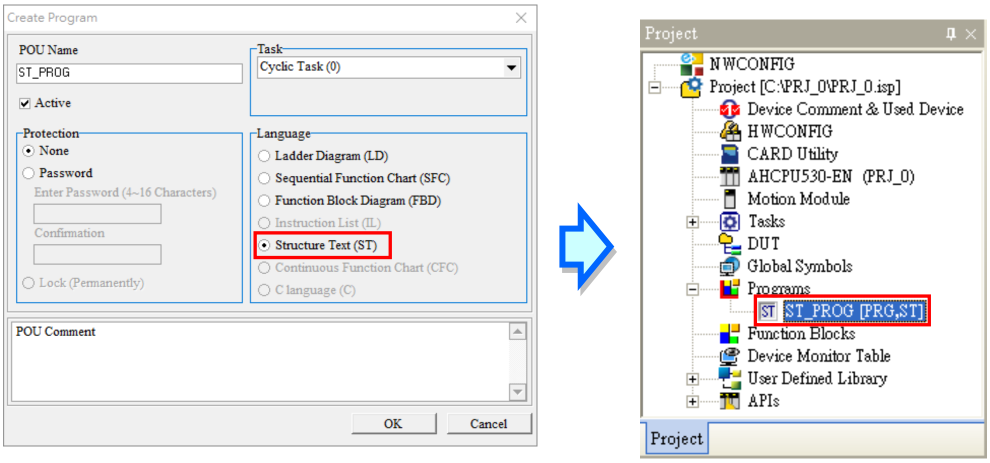
Example 2: The loop below is a FOR loop. Originally, the arithmetic hierarchy is DT1 value (initial value is10) and the result of the operation is stored in D0. The IF structure in the loop is used with an EXIT statement. The loop will not be terminated until the value in D0 is larger than 100. When the value in D10 increases to 5, the value in D0 is 1*2*3*4*5=120, and the loop is terminated.

```
DT1:= 10 ;
D0 := 1 ;

FOR D10 := 1 TO DT BY 1 DO

    D0 := D0 * D10 ;

    IF  D0>100  THEN
      EXIT ;
    END_IF ;

END_FOR ;
```

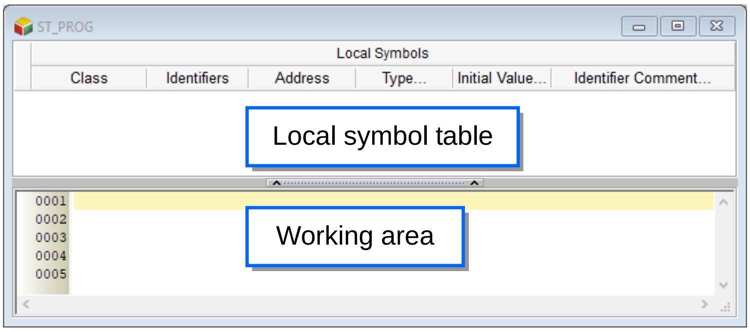
13.3 Create a Structured Text in ISPSoft

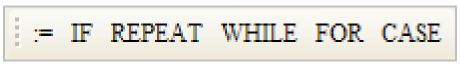
13.3.1 ST Editing Environment

Select the **Structured Text (ST)** option button in the **Language** section in the **Create Program** window. Please refer to section 5.4.1 for more information.



The environment in which a structured text can be edited is shown below. The table at the upper part of the window is a local symbol table, and the area at the lower part of the window is a working area. There are line numbers at the left side of the working area. Users can set the way in which the line numbers are displayed. Please refer to section 2.3.1 for more information. After a program editing window in which a structured text can be created is opened, the corresponding toolbar will appear in the ISPSoft window. The functions are described below.



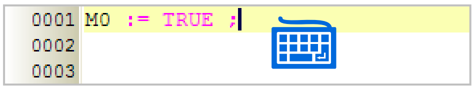


Icon	Function
:=	Inserting an example of an assignment structure
IF	Inserting an example of an if statement
REPEAT	Inserting an example of a repeat loop
WHILE	Inserting an example of a while loop

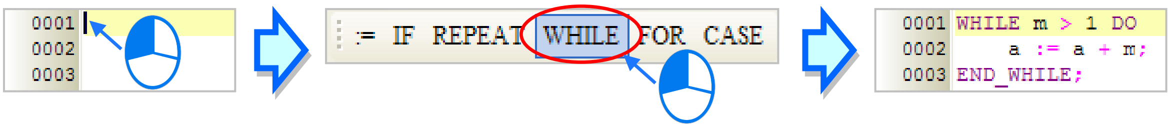
Icon	Function
FOR	Inserting an example of a for loop
CASE	Inserting an example of a case statement

13.3.2 Edit Structured Text

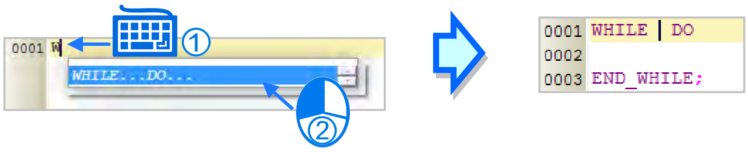
The way in which a structured text file is edited is similar to the way in which a text file is edited with a general text editor. If users want to create a structured text, they can type or modify text in the working area. If the users want to start a new line of text at a specific point, they can press Enter on the keyboard.



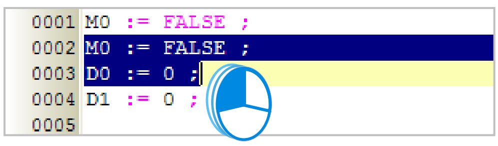
Besides, the users can click a line which will be edited, insert an example of a structure, and modify the structure.



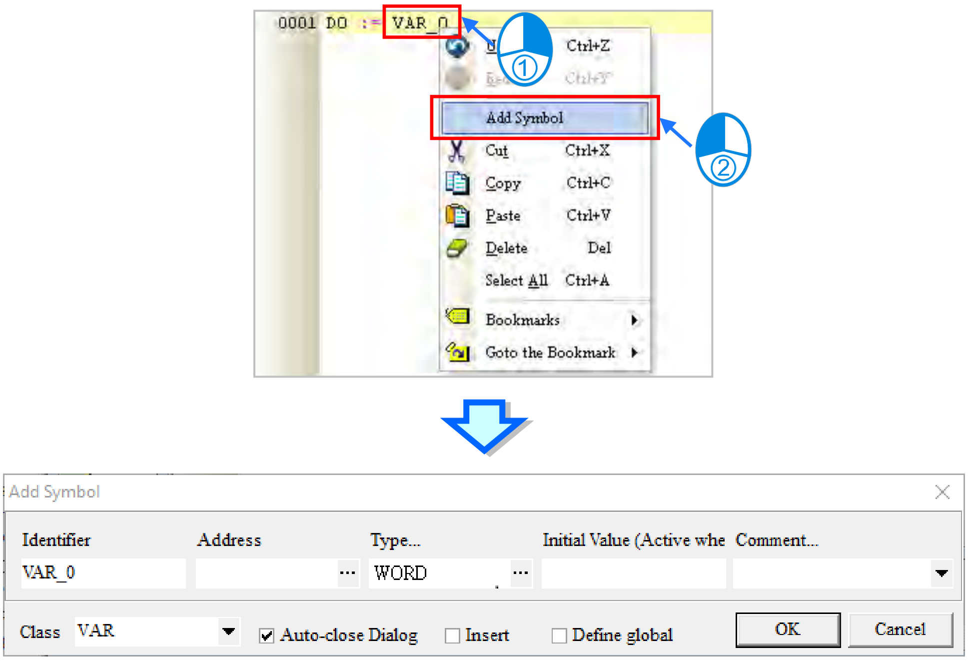
Or you can also type the first letter of the structured text and then the suggested structured text appears. Double-click it and the cursor moves to where the text is and then you can start editing.



If users want to select any amount of text, they can click where they want to begin the selection, hold down the left mouse button, and drag the pointer over the text that they want to select. The users can also click at the start of the selection, scroll to the end of the selection, and hold down **Shift** on the keyboard while they click where they want the selection to end.



If users type a symbol which has not been declared, they can click the symbol, click the right mouse button, and click **Add Symbol** on the context menu to open the **Add Symbol** window.



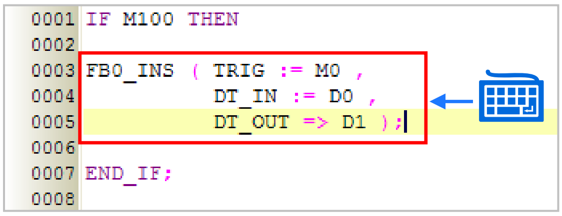
While typing in the symbol, the system will autofill and show a list with variable symbols for users to choose from. Users can use " ↑ " and " ↓ " on the keyboard to select or simply click on the variable symbol you'd like to use.

13.3.3 Insert API and Function Blocks

Users can insert an applied instruction or a function block in a structured text in ISPSoft in one of the two ways described below.

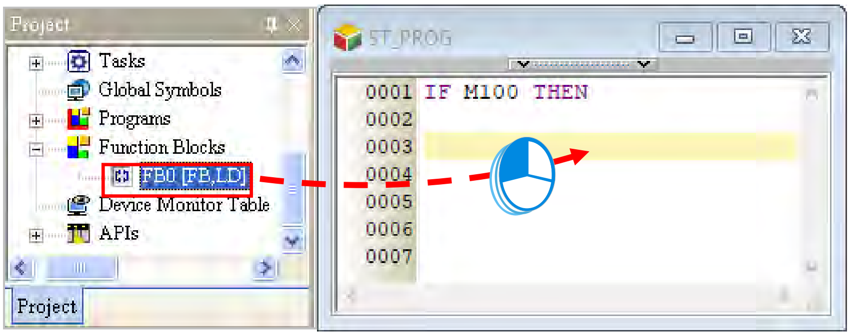
- **Method 1**

  An applied instruction or a function block is inserted according to the format of the applied instruction or the format of the function block.

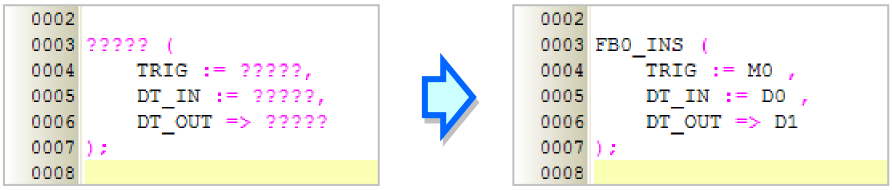


- **Method 2**

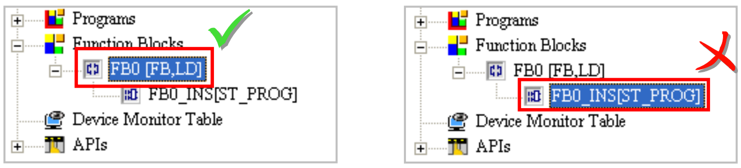
  Unfold the **APIs** section or the **Function Blocks** section in the project management area, and find the item which will be inserted. Select the item, and drag it to the position in which it will be inserted.



After the applied instruction or the function block is inserted, users have to type the corresponding operands according to the format of the applied instruction or the format of the function block.



Function block definitions can be dragged, but function block instances can not be dragged.



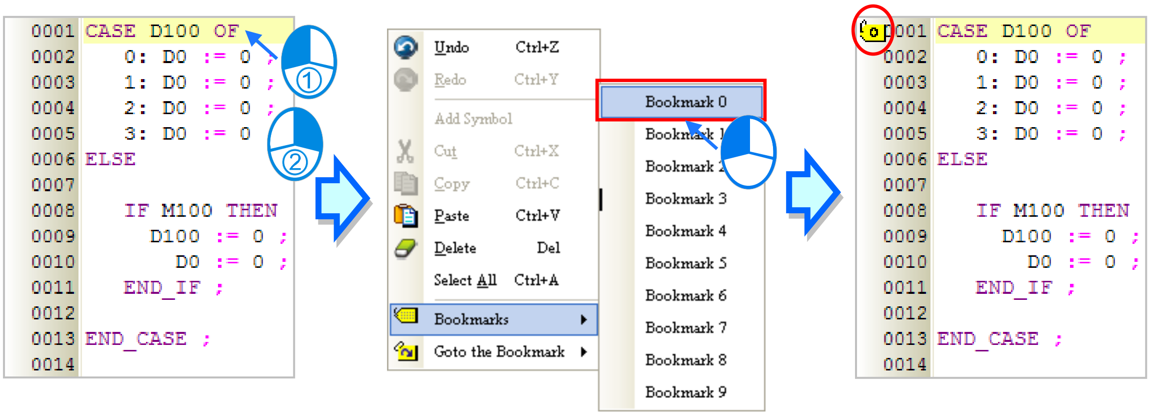
13.3.4 Bookmark

After lines are bookmarked, users can find or go to the lines easily.

● **Adding/Removing bookmarks**

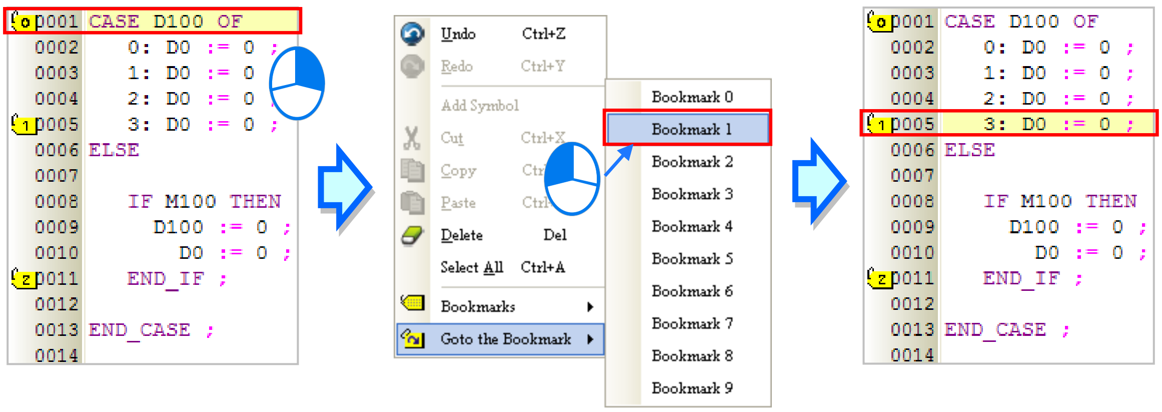
If users want to add a bookmark to a line, they can select the line, click the right mouse button, click **Bookmarks** on the context menu, and select a bookmark number. If users want to remove the bookmark from a line, they can select the line, click the right mouse button, click **Bookmarks** on the context menu, and click the bookmark number corresponding to the bookmark added to the line. If the bookmark number clicked does not correspond to the bookmark added to the line, the bookmark number added to the line will become the bookmark number clicked. Besides, if users click the **Edit** menu, point to **Bookmarks**, and click **Remove All Bookmarks**, all the bookmarks in the working area will be removed.

If users click a bookmark number which has been added to another line, the bookmark number will be moved to the line selected presently.



● **Going to a bookmark**

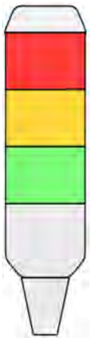
Right-click the working area, point to **Goto the Bookmark** on the context menu, and click a bookmark number.



13.4 Example of a Structured Text

13.4.1 Explanation

The example is about the control of a tower light. A tricolor light and a buzzer are used. The control mechanisms for various device statuses are listed below. If more than one device status appears, the device status which is given precedence over the others is displayed.



State code	Device status	Light				Precedence
		Red light	Yellow light	Green light	Buzzer	
4	The device is malfunctions.	ON	OFF	OFF	Flash	Highest
3	The device malfunctions. (The buzzer is turned off.)	Flash	OFF	OFF	OFF	↑
2	The device is operating.	OFF	OFF	ON	OFF	
1	The work is done.	OFF	Flash	OFF	OFF	
0	The device is idling.	OFF	ON	OFF	OFF	Lowest

13.4.2 Planning Hardware

In this example, the AH500 series CPU module **AHCPU530-EN**, the digital I/O module **AH16AP11R-5A**, and the four-slot main backplane **AHBP04M1-5A** are used. The table below is an I/O allocation table.

Type	ID	Description
Digital output	Y0.0	Red light
Digital output	Y0.1	Yellow light
Digital output	Y0.2	Green light
Digital output	Y0.3	Buzzer

13.4.3 Planning a Program

(1) If the flag ERROR is ON, and the flag BUZZER_OFF is OFF, the state code will be 4.

(2) If the flag ERROR is ON, and the flag BUZZER_OFF is ON, the state code will be 3.

(3) If the flag ERROR is OFF, and the flag RUNNING is ON, the state code will be 2.

(4) If the flags ERROR and RUNNING are OFF, and the flag COMPLETE is ON, the state code will be 1.

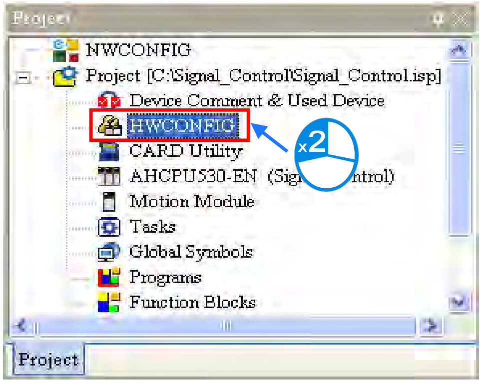
(5) If the flags ERROR, RUNNING, and COMPLETE are OFF, the state code will be 0.

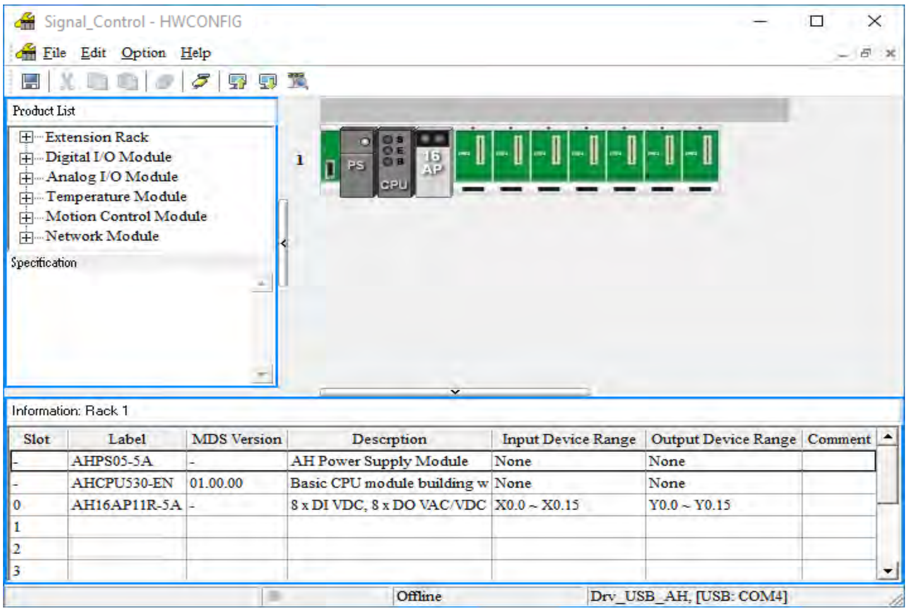
(6) Every state code corresponds to a light. The control of the tricolor light has many practical applications, and the tricolor light can be displayed in various ways. Considering that a program can be expanded and reused, a function block is created.

13.4.4 Creating a Program

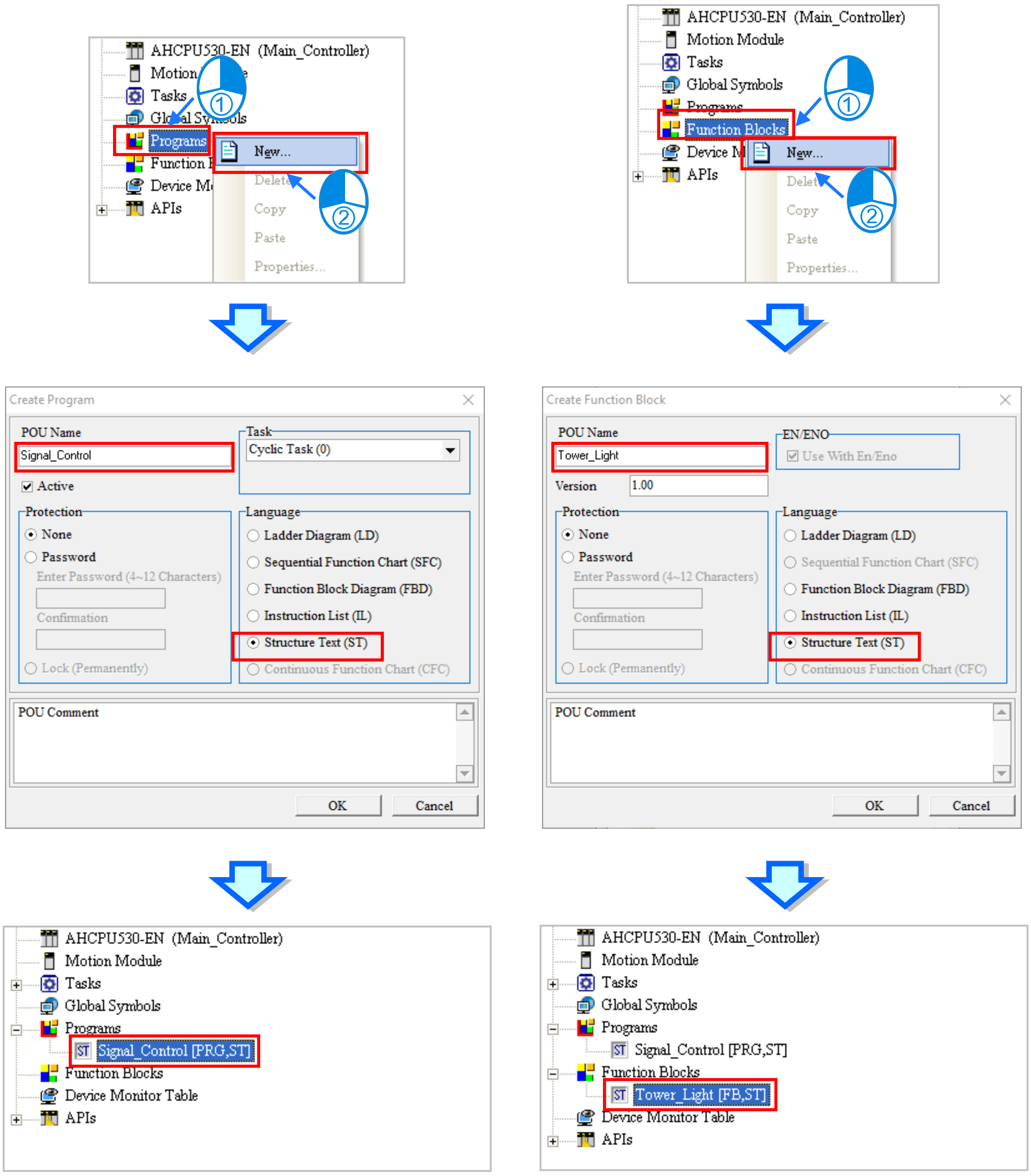
Start ISPSoft, and then create a new project.

The hardware configuration in this example is the same as the hardware configuration in chapter 4. Please refer to chapter 4, and complete the hardware configuration.





Create a POU of the program type and a POU of the function block type in the project management area. The programming language used to create the POU of the program type and the POU of the function block type are structured texts.



Create the flags and the digital outputs in the global symbol table.

Global Symbols

Class	Identifiers	Address	Type...	Initial Valu...	Identifier Comment...
VAR	ERROR	N/A [Auto]	BOOL	FALSE	
VAR	RUNNING	N/A [Auto]	BOOL	FALSE	
VAR	COMPLETE	N/A [Auto]	BOOL	FALSE	
VAR	BUZZER_OFF	N/A [Auto]	BOOL	FALSE	
VAR	RED	Y0.0	BOOL	FALSE	
VAR	YELLOW	Y0.1	BOOL	FALSE	
VAR	GREEN	Y0.2	BOOL	FALSE	
VAR	BUZZER	Y0.3	BOOL	FALSE	

When users edit the POU of the function block type, they have to create an input pin which receives the state code specified by the main program, and output pins which correspond to the three lights and the buzzer.

Owing to the fact that the corresponding light will be displayed after the function block receives the state code specified by the main program, a CASE statement can be used in the function block. If there is another display mode, the users can add a state code, and insert a condition in the function block.

The users can insert an example of a CASE statement in the working area, and modify the statement. They can also type the structured text shown below in the working area.

Tower_Light

Local Symbols

Class	Identifiers	Address	Type...	Initial Value...	Identifier Comment...
VAR_INPUT	MODE	N/A [Auto]	INT	N/A	
VAR_OUTPUT	RL	N/A [Auto]	BOOL	FALSE	
VAR_OUTPUT	YL	N/A [Auto]	BOOL	FALSE	
VAR_OUTPUT	GL	N/A [Auto]	BOOL	FALSE	
VAR_OUTPUT	BR	N/A [Auto]	BOOL	FALSE	

```
CASE MODE OF

(* SM407:0.5S on/ o.5S off *)

    0: RL:=FALSE ;
       YL:=TRUE  ;
       GL:=FALSE ;
       BR:=FALSE ;

    1: RL:=FALSE ;
       YL:=SM407 ;
       GL:=FALSE ;
       BR:=FALSE ;

    2: RL:=FALSE ;
       YL:=FALSE ;
       GL:=TRUE  ;
       BR:=FALSE ;

    3: RL:=SM407 ;
       YL:=FALSE ;
       GL:=FALSE ;
       BR:=FALSE ;

    4: RL:=TRUE  ;
       YL:=FALSE ;
       GL:=FALSE ;
       BR:=SM407 ;

END_CASE;
```

When the users edit the POU of the program type, they have to declare the symbol SC, which represents a state code, and the function block instance in the local symbol table. Owing to the fact that there is a precedence mechanism for the control of the tricolor light, an IF statement can be used in the main program. After a state code is specified, the function block must be called. The state code is sent to the function block, and the result of the operation is sent to the digital output which is specified.

The main program is shown below.

Signal_Control

		Local Symbols			
Class	Identifiers	Address	Type...	Initial Value ...	Identifier Comment...
VAR	SC	N/A [Auto]	INT	N/A	
VAR	TL_INS	N/A [Auto]	Tower_Light	N/A	
VAR	Tower_Light0	N/A [Auto]	Tower_Light	N/A	

```
IF ERROR THEN (*Alarm*)

   IF BUZZER_OFF THEN
      SC :=3 ; (*Buzzer OFF*)
   ELSE
      SC :=4 ; (*Buzzer ON*)
   END_IF;

ELSIF RUNNING THEN
   SC :=2 ; (*Running*)

ELSIF COMPLETE THEN
   SC :=1 ; (*Finish*)

ELSE
   SC :=0 ; (*Idle*)

END_IF;

TL_INS (MODE := SC ,
        RL => RED ,
        YL => YELLOW ,
        GL => GREEN ,
        BR => BUZZER );

```

After the POU of the program type and the POU of the function block type are edited, the users can compile the program, download the parameters and the program to the CPU module, and test the program.

MEMO

Chapter 14 Sequential Function Charts

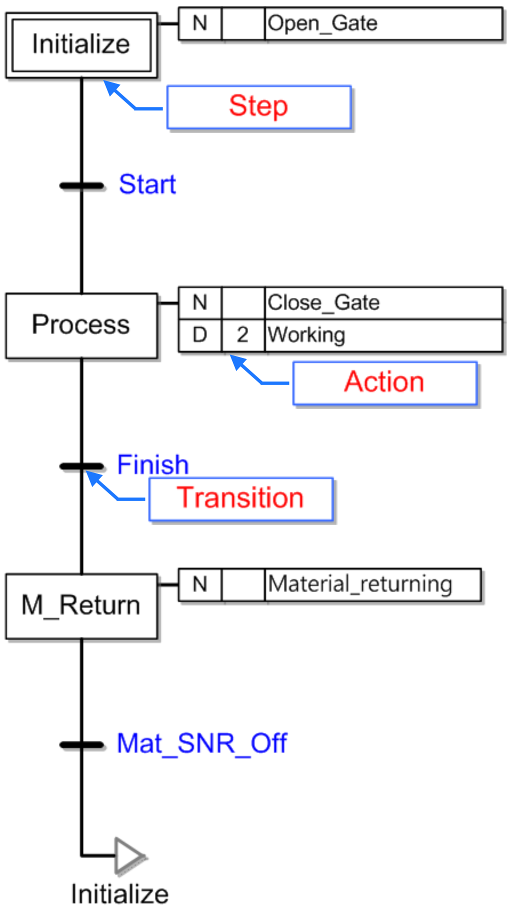
Table of Contents

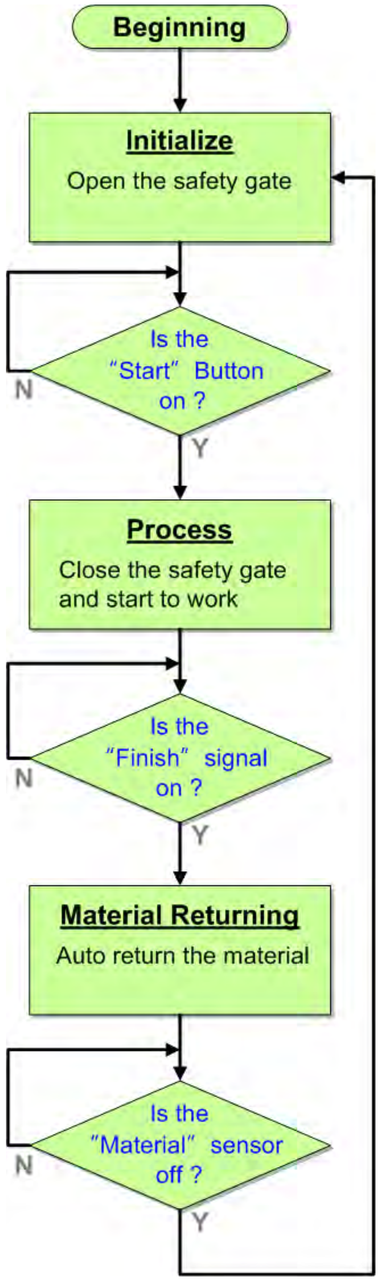
14.1 Knowing Sequential Function Charts

14.1.1 Structure of a Sequential Function Chart

A sequential function chart is one of the five languages defined by IEC 61131-3 standard. It is a powerful graphical technique for describing the sequential behavior of a control program.

A sequential function chart and its corresponding flowchart are shown below. The main components of a sequential function chart are steps with associated actions, transitions with associated logic conditions, and directed links between steps and transitions.



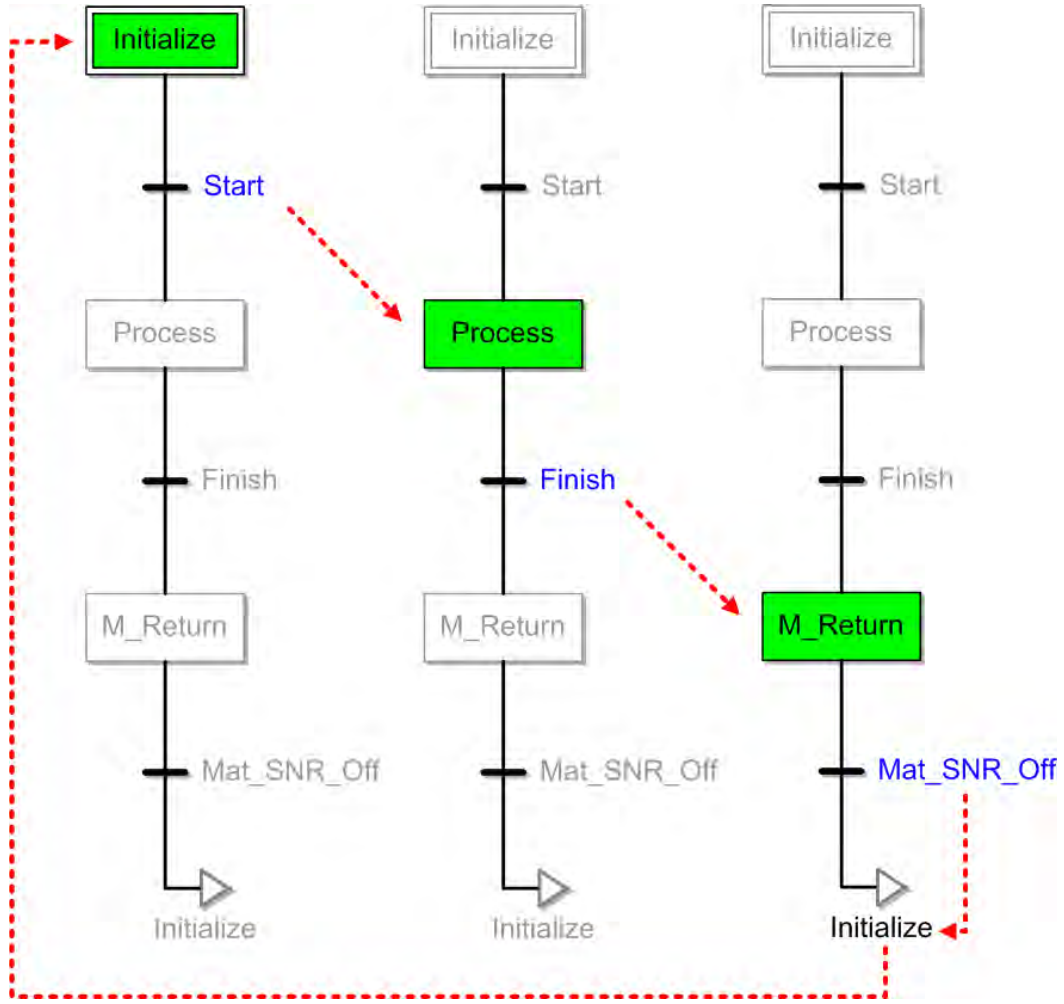


14.1.2 Principle of a Sequential Function Chart

A sequence in a sequential function chart is depicted as a series of steps shown as rectangular boxes connected by vertical lines. Each step represents a particular state of the system being controlled. A transition is associated with a condition which, when true, causes the step before the transition to be deactivated and the step that follows the transition to be activated.

Steps in a sequential function chart can be active or inactive. Actions are only executed for active steps. If a step is inactive, the transition follows it will not affect the execution of the program, and the actions associated with the step will not be executed.

In a sequential function chart in ISPSoft, the steps must alternate with the transitions. If there are two continuous steps or transitions in a sequential function chart, the program can not be compiled.



The example above is the structure of a simple sequential function chart. ISPSoft also provides other flexible programming functions, such as the use of divergent and convergent paths, the use of modular actions and transitions, and the qualification of actions. These programming functions will be introduced in the sections below.

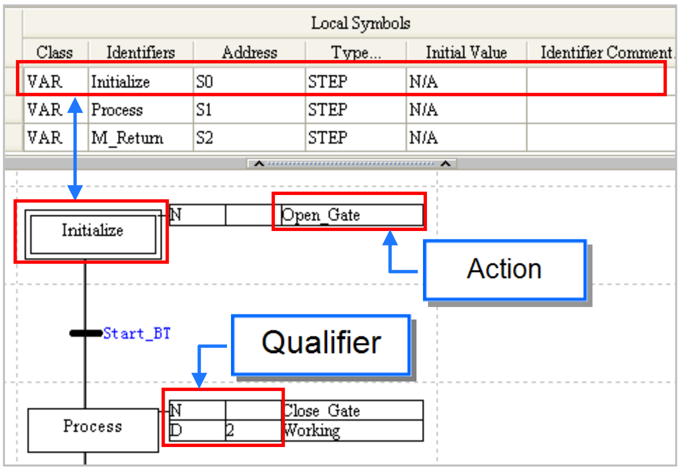
14.2 Sequential Function Chart in ISPSoft

If users use sequential function chart (SFC) for programming, the content of this program format may vary according to the PLC series. This chapter contains introduction of the SFC structure.

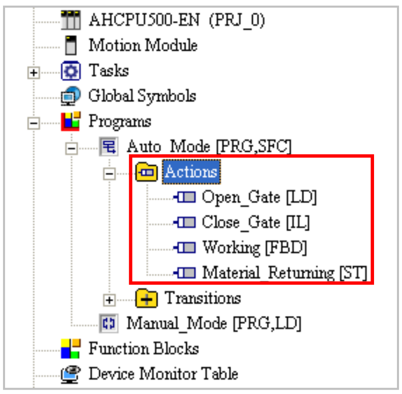
14.2.1 Steps and Actions

Every step in ISPSoft must be assigned a variable whose data type is STEP, and functions as a state flag. If the flag correspond to a step is ON, the step is active. Every symbol in AH5x0 and DVP series whose data type is STEP occupies an S device in the PLC. Please refer to operation manuals for more information about the S devices.

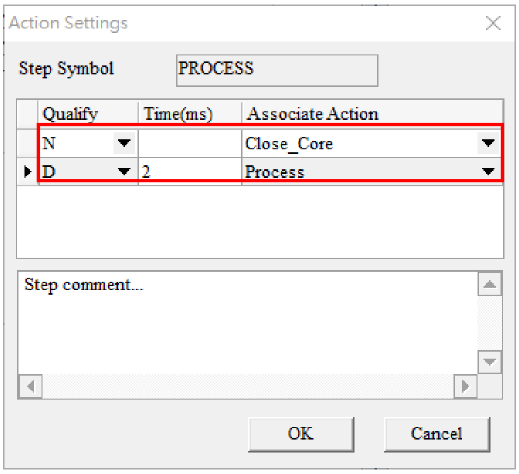
After a step is activated, the actions associated with the step will be executed according to the qualifiers. In ISPSoft, the actions can be modularized, and can be associated with different steps. A step can be associated with more than one action. Besides, every action has a qualifier that determines when the action is executed.

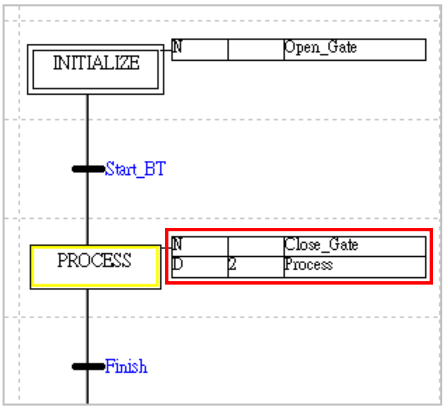


In ISPSoft, an action is a program code, and can be developed by means of a ladder diagram, an instruction list, a function block diagram, or a structured text. The actions which are created are listed in the project management area. The program editing window in which an action can be created differs from the window for a programming language in that there is no local symbol table in the program editing window in which an action can be created. In ISPSoft, the actions and the transitions in a sequential function chart share the same local symbol table.



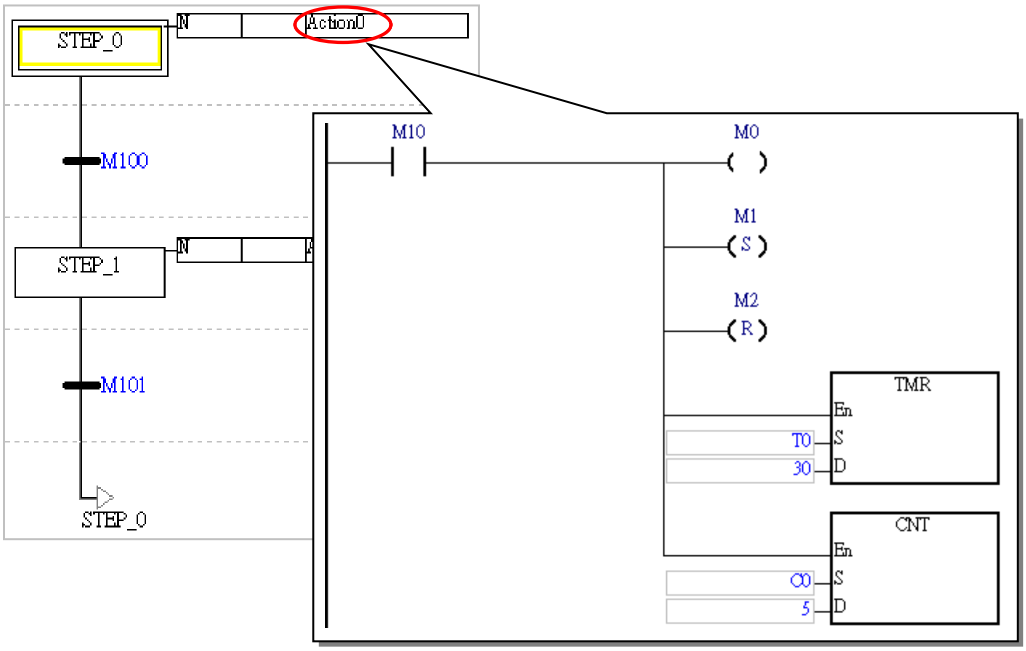
If users want to edit a sequential function chart, they have to create actions, assign the actions to the steps, and assign qualifiers to the actions. The **Action Settings** window and the corresponding action list are shown below.



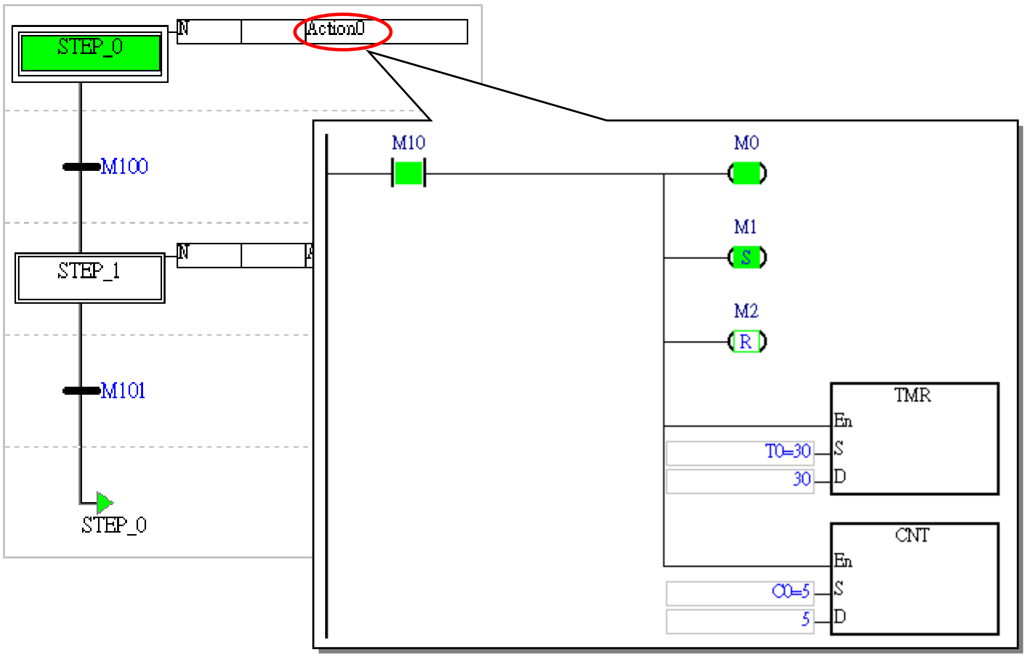


Final scans are important procedures during the execution of a sequential function chart. After the execution of an action stops, the system will automatically execute a procedure to disable all the outputs in the action. If a final scan is executed, the coils driven by the instruction OUT will be OFF, the application instructions and the function blocks will not executed, the timers will be reset, the states of the coils driven by the instruction SET or RESET will remain unchanged, the counters will stop counting, the states of the contacts of the counters will remain unchanged, and the values in the counters will remain unchanged.

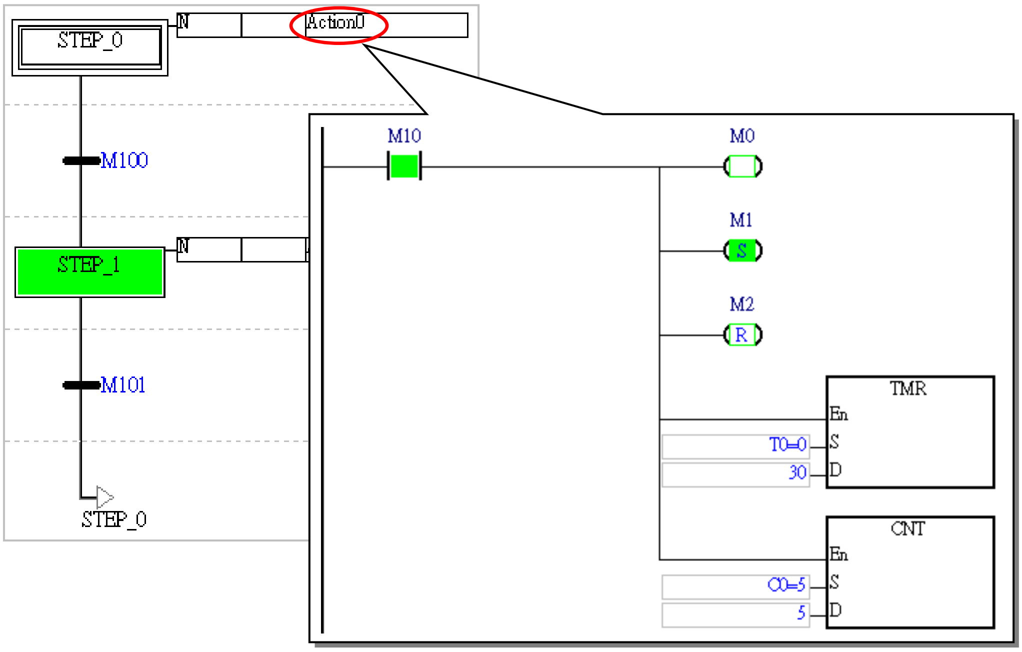
Action0 in the figure below is an action associated with STEP_0, and is an N action. When STEP_0 is deactivated and STEP_1 is activated, the system executes a final scan.



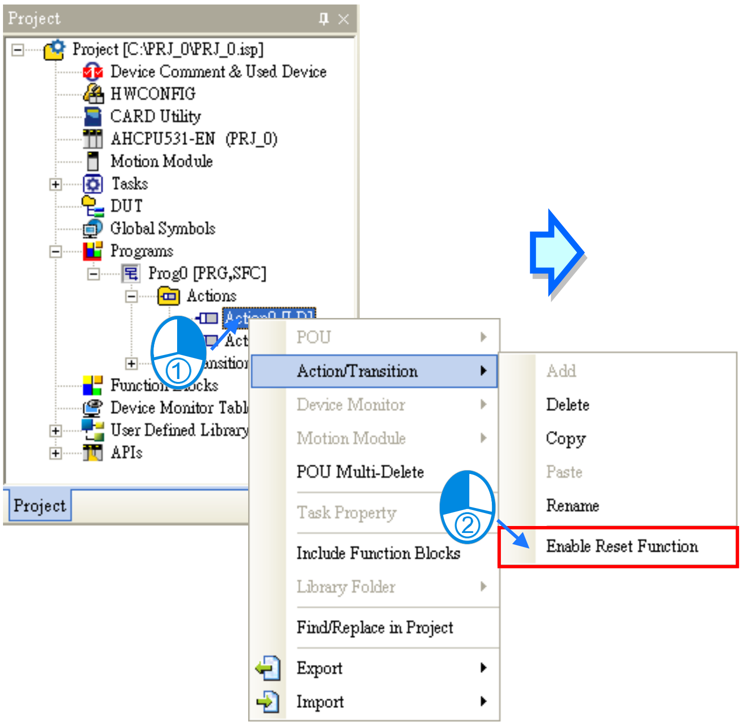
STEP_0 in the figure below is activated. M10 in Action0 is ON, and therefore M0 is ON, M1 is set to ON, M2 is reset to OFF, the value in T0 is 30, and the value in C0 is 5.



STEP_1 in the figure below is activated. Although M10 is ON, M0 is OFF, and T0 is reset. The state of M1, the state of M2, and the value in C0 remain unchanged.



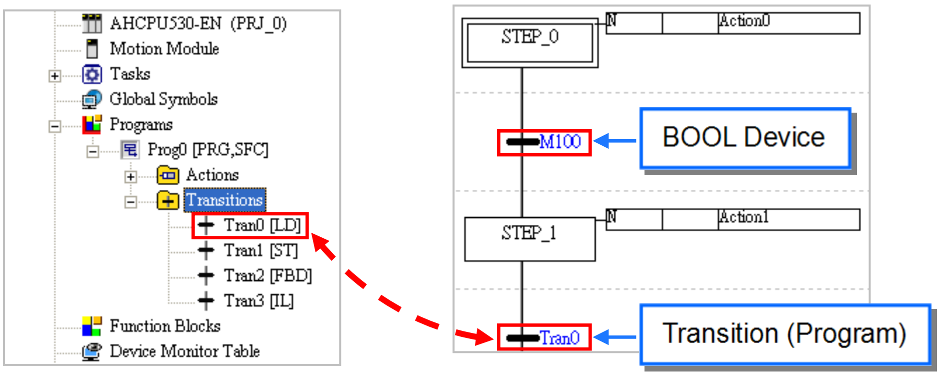
For the AH5x1, AH560 redundant system, AHxxEMC and AS series, users can set the Final Scan to run or not for every Action. The default is to run the Final Scan in the ISPSoft. To disable this function, users can right-click the Action that does not require a Final Scan to see a context menu and then deselect the Action/Transition > Enable Reset Function. After that users will see a red indicator situated in front of the Action that does not require a Final Scan. The state of an Action that does not run a Final Scan will stay the same as the previous state does, while the state of an Action that runs a Final Scan will be cleared.



14.2.2 Transitions

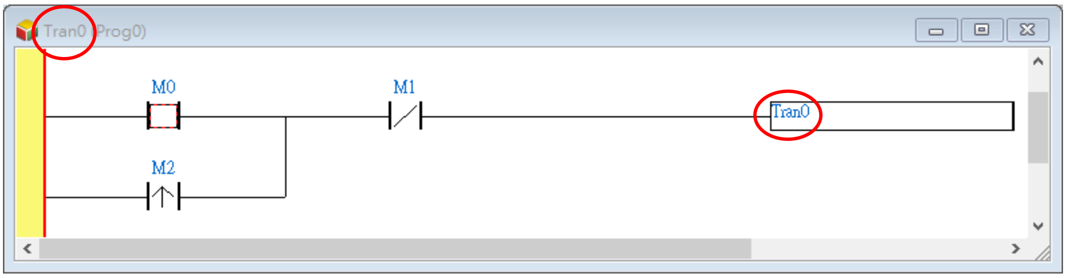
When a transition is true, the active step immediately before the transition becomes inactive and the step immediately after the transition becomes active. A transition can be true anytime, but for a transition to activate the step following it, the step preceding it must be active when the transition is true.

In ISPSoft, a transition can be a Boolean device or symbol, or a program code. If a transition is a logical operation, users can create a transition program, and assign the program to the transition. The transition programs which are created are listed in the project management area.

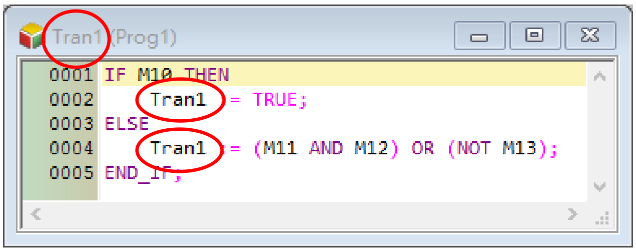


The programming languages which can be used to create transition programs include ladder diagrams, instruction lists, function block diagrams, and structured texts. The Boolean state in a transition program must be sent to a symbol name which is the same as the transition program name, whether the programming language used to create the transition program is a ladder diagram, an instruction list, a function block diagram, or a structured text. The symbol does not need to be declared. However, if there is a symbol name in a symbol table which is the same as a transition program name, an error occurs when the program is compiled. Besides, applied instructions and function blocks can not be used in a transition program, but comparison contacts and block logic instructions (NP, PN, and INV) can be used in a transition program.

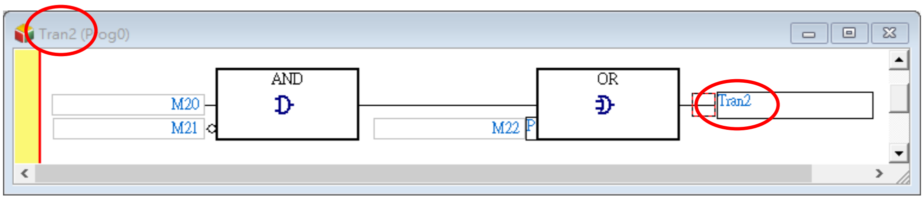
If the programming language used to create a transition program is a ladder diagram, the program code of the transition program must be composed of one network, and the output contact must be assigned a symbol name which is the same as the transition program name. Besides, multiple outputs are not allowed in a transition program created by means of a ladder diagram.



If the programming language used to create a transition program is a structured text, there is no limit on the number of lines of program code. However, a Boolean state in a transition program must be assigned to a symbol name which is the same as the transition program name.



If the programming language used to create a transition program is a function block diagram, the program code of the transition program must be composed of one network, and the output contact must be assigned a symbol name which is the same as the transition program name. Besides, multiple outputs are not allowed in a transition program created by means of a function block diagram.



If the programming language used to create a transition program is an instruction list, there is no limit on the number of lines of program code. OUT, SET, RST, and applied instructions can not be used in a transition program created by means of an instruction list. Besides, the output instruction in a transition program created by means of an instruction list must be TRANS, and the operand for TRANS must be assigned a symbol name which is the same as the transition program name.

```
LD    M0
OR    M3 1
AND   M3 2
TRANS Tran3
```

When users create a transition program, a symbol name which is the same as the transition program name is added to the program code of the transition program. The users only have to create a conditional operation. Owing to the fact that the actions and the transitions in a sequential function chart share the same local symbol table, there are not local symbol tables in the program editing windows for the transitions.

Users can not create a complex transition program. If a transition condition must undergo a complex operation, users can create the complex operation in an action associated with a step, create a condition flag in the action, and assign the flag to the transition following the step.

Although users do not need to declare the symbols in the transition programs, the system assigns memories which function as flags to the symbols. As a result, users have to make sure that the symbols in the transition programs can be assigned a specific logic state. Otherwise, an error will occur if the program is executed.

Take the transition program which is created by means of a structured text below for example. During the execution of the transition program for the first time, Tran4 will be ON if the result of (M0 AND M1) is ON. Since Tran4 is ON, it passes control to the next step. After the control is passed to the step preceding the transition program again, the transition program will be executed again. If the result of (M0 AND M1) is OFF, the statement following **THEN** will not be executed. Tran4 will still be ON because it is not updated. The system will evaluate the transition condition as TRUE, and the control will be passed to the next step.

Adding an **ELSE** section to the transition program below is a better way to ensure that the symbol Tran4 is assigned a specific logic state. Users also have to pay attention to the same problem in a CASE sttructure.

```
IF (M0 AND M1) THEN
    Tran4 := TRUE;
END_IF;
```

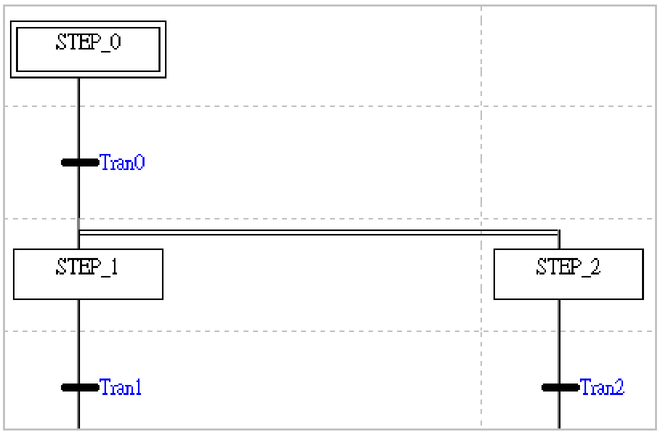
14.2.3 Simultaneous Divergence and Divergence of Sequence Selection

Users can create divergent paths in a sequential function chart. There are two types of divergences. One is a simultaneous divergence, and the other is a divergence of sequence selection

- **Simultaneous divergence**

  A simultaneous divergence is shown below. The divergent steps are connected by a double line. The characteristic of a simultaneous divergence is that the divergent steps share the same transition. When the transition is true, the steps are active.

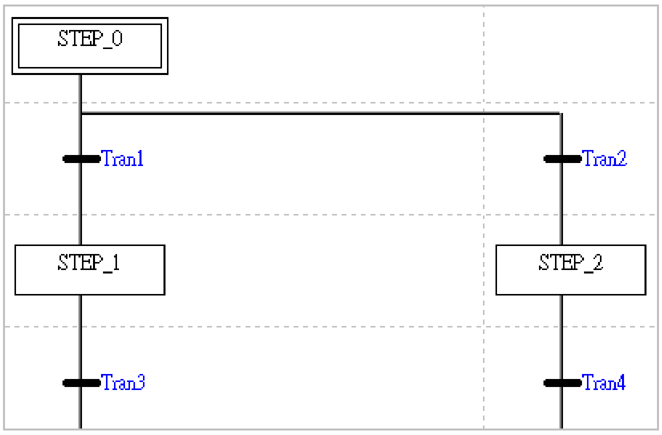
  When Tran0 is true, STEP_0 becomes inactive, and STEP_2 and STEP_2 become active.



- **Divergence of sequence selection**

  A divergence of sequence selection is shown below. The characteristic of a divergence of sequence selection is that the divergent steps have their own transitions. When one transition is true, the step following the transition becomes active, and the other transitions are not evaluated. Consequently, if there are divergent paths, only one path is taken at a time. Besides, the transitions are evaluated from left to right. If several transitions are true simultaneously, only the step following the leftmost transition will be activated.

  When Tran2 is true, STEP_0 becomes inactive, and STEP_2 becomes active. Tran1 is not evaluated, and STEP_1 remains inactive.



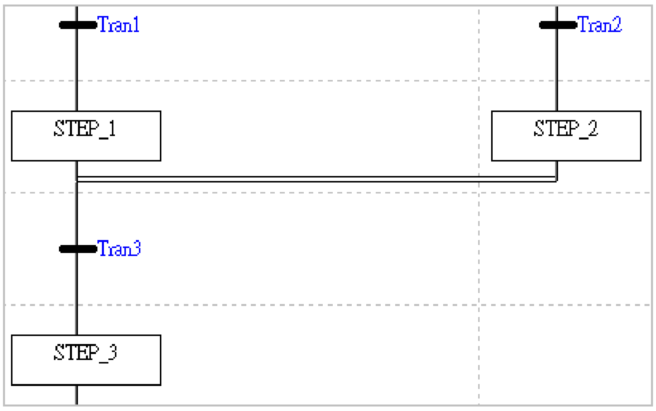
14.2.4 Simultaneous Convergence and Convergence of Sequence Selection

The divergent paths in a sequential function chart must be converged. There are two types of convergences. One is a simultaneous convergence, and the other is a convergence of sequence selection.

- **Simultaneous convergence**

  A simultaneous convergence is shown below. The convergent steps are connected by a double line. The characteristic of a simultaneous convergence is that the convergent steps are connected to the same transition. The transition will not be evaluated until the convergent steps preceding the transition are activated.

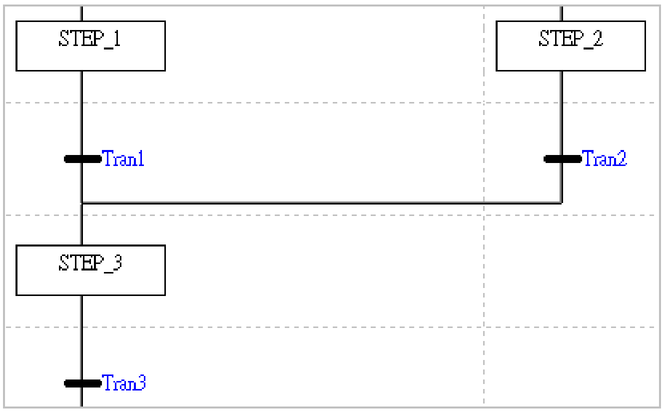
After STEP_1 and STEP_2 are activated, Tran3 will be evaluated. When Tran3 is true, STEP_1 and STEP_2 become inactive, and STEP_3 becomes active.



- **Convergence of sequence selection**

A convergence of sequence selection is shown below. The characteristic of a convergence of sequence selection is that the convergent steps have their own transitions. When one transition is true, the next step becomes active. If there is another convergent step which is activated, the step will be active until the transition following the step is true. When the transition is true, the step following the transition becomes active. Consequently, if a convergence of sequence selection is used in a sequential function chart, several steps following the convergence may be activated. If users use a convergence of sequence selection in a sequential function chart, they have to make sure that the program is not confused.

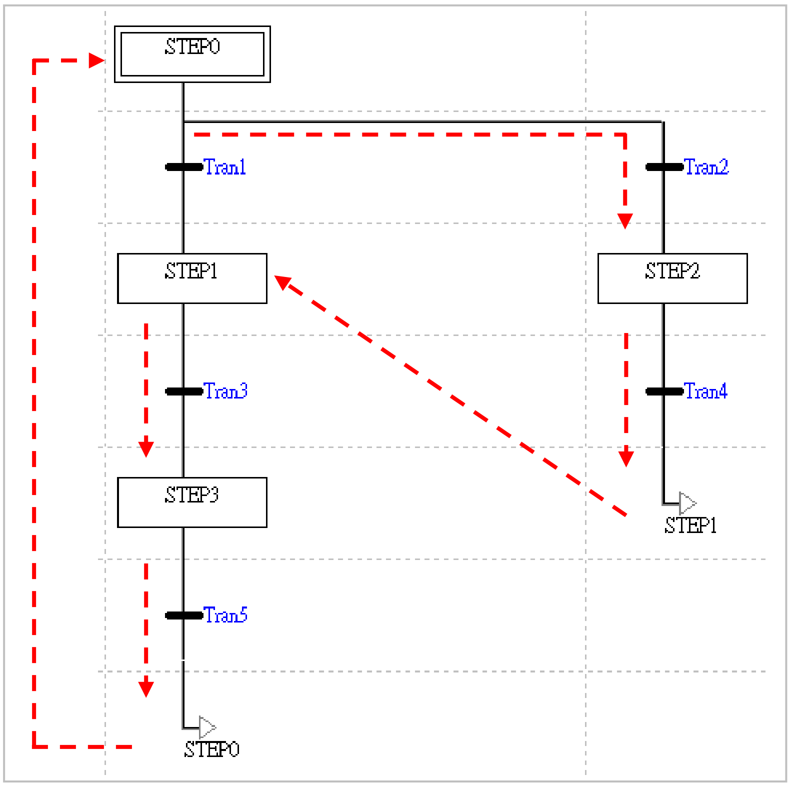
When Tran1 is true, STEP_1 becomes inactive, and STEP_3 becomes active. If Tran2 is true, STEP_2 will be inactivated, and STEP_3 will be activated again.



14.2.5 Jump

The use of a jump structure in a sequential function chart results in the passing of control to a step which is specified. There is at least one jump point indicating that the passing of control will occur once the transition preceding the jump point is true in a sequential function chart. Users can use jump structures quite freely. If they use a jump structure in a sequential function chart, they have to make sure that the program is not confused.

The program below is a sequential function chart where there is a divergence of sequence selection. If Tran2 is true, control will be passed to STEP2. When Tran4 is true, it passes control to STEP1 through a jump. When Tran5 is true, it passes control to STEP0.



If users use a jump structure in a sequential function chart, the step specified must be a step in the same sequential function chart. If the step specified is not in the same sequential function chart, and is declared in a local symbol table or the global symbol table, an error occurs when the program is compiled

If control needs to be passed from a step in a sequential function chart to a step in another sequential function, users can make use of the characteristics of steps and the characteristics of transitions. Users can declare the step or the transition which is the destination of a jump in the global symbol table. When the condition of the jump is met, the step or the transition declared is set to ON. The condition of the jump can be created in an action.

The figure below shows that **SFC_A** is executed first. **SFC_B** will be executed after **SFC_A** is executed, and **SFC_A** will be executed after **SFC_B** is executed. User can achieve the jumps by means of the characteristics of transitions.

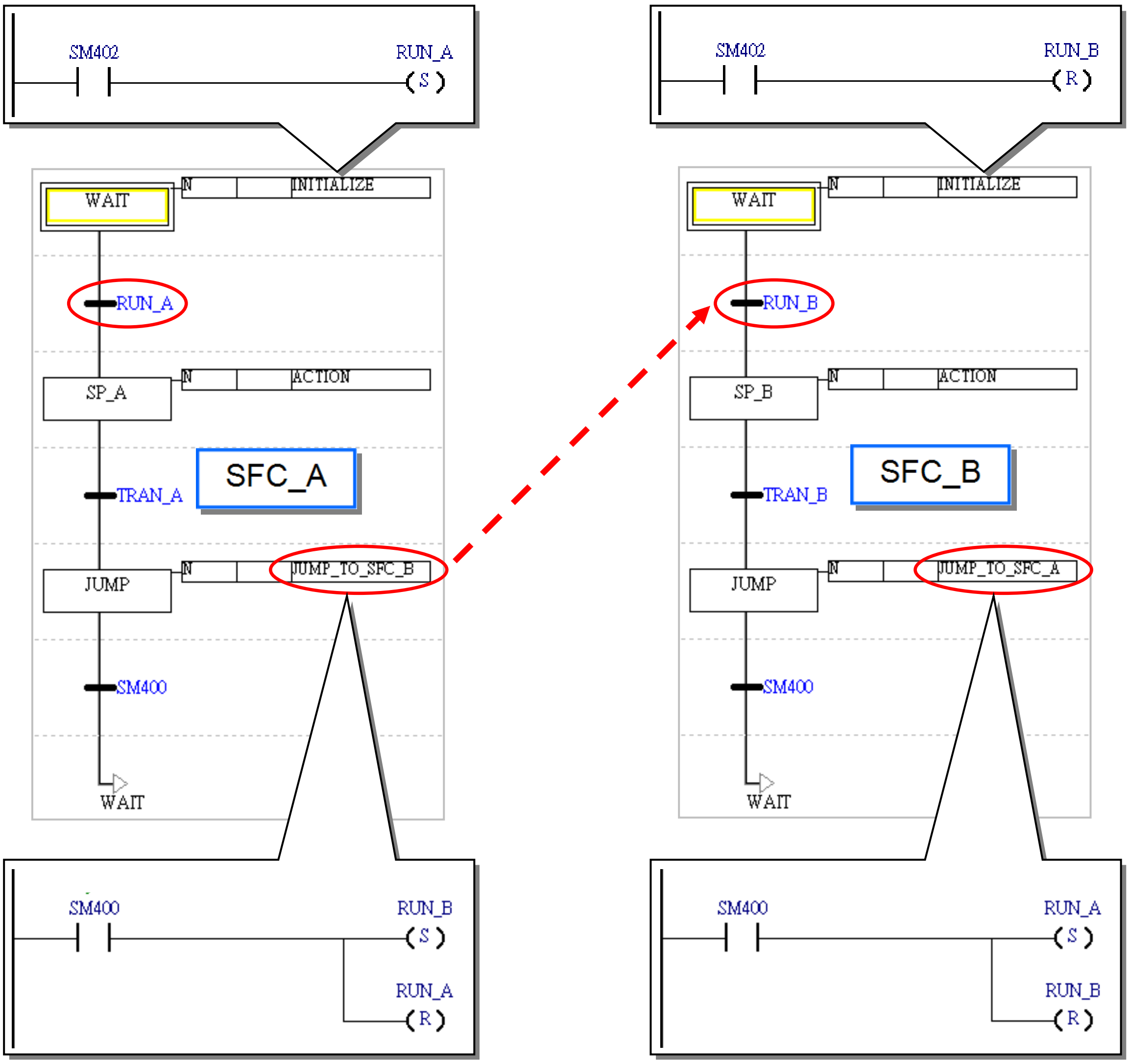
SFC_A → SFC_B → SFC_A → SFC_B → • • •

The steps **SP_A** and **SP_B** in the example below are used to express the sequential function chart which will be executed. They are preceded and followed by steps. Besides, the transitions **RUN_A** and **RUN_B** are declared in the global symbol table.

When the program is executed, the step **WAIT** in SFC_A and the step **WAIT** in SFC_B are activated, and the action **INITIALIZE** associated with **WAIT** in SFC_A and the action **INITIALIZE** associated with **WAIT** in SFC_B are executed. **INITIALIZE** in SFC_A sets the transition **RUN_A** to ON during the first scan cycle, and therefore control is passed to **SP_A**. **INITIALIZE** in SFC_B sets the transition **RUN_ B** to OFF during the first scan cycle, and therefore control is not passed to **SP_B**.

When the step **JUMP** in SFC_A is activated, the action associated with **JUMP** sets the transition **RUN_B** to ON, and resets **RUN_A** to OFF. When **RUN_B** is set to ON, control is passed to the step **SP_B**. Besides, the transition following **JUMP** in SFC_A is a special relay which is always ON, and therefore control is passed to the step **WAIT**. Owing to the fact that **RUN_A** is set to OFF, control is not passed to **SP_A**. **RUN_A** will not be set to ON until the action associated with **JUMP** in SFC_B is executed.

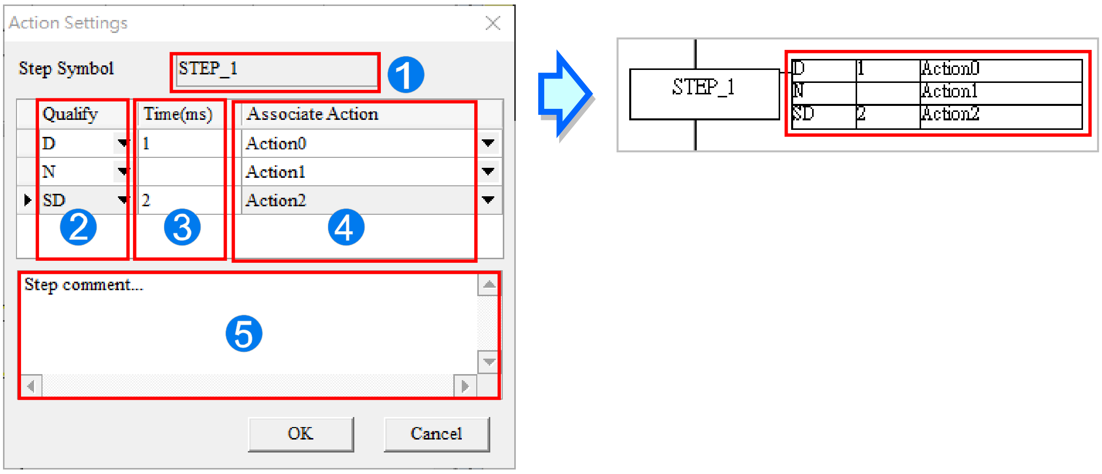
The use of **WAIT** and **JUMP** in SFC_A serves to set **RUN_B** to ON, and the use of **WAIT** and **JUMP** in SFC_B serves to set **RUN_A** to ON. **WAIT** and **JUMP** in SFC_A and **WAIT** and **JUMP** in SFC_B actually have little significance. If the program is applied to an AH/AS series CPU module, users can assign the qualifier **P** or **P1** to the actions associated these steps. Please refer to section 14.2.6 for more information.


SM402
RUN_A
S
WAIT
N
INITIALIZE
RUN_A
SP_A
N
ACTION
TRAN_A
SFC_A
JUMP
N
JUMP_TO_SFC_B
SM400
WAIT
SM400
RUN_B
S
RUN_A
R
SM402
RUN_B
R
WAIT
N
INITIALIZE
RUN_B
SP_B
N
ACTION
TRAN_B
SFC_B
JUMP
N
JUMP_TO_SFC_A
SM400
WAIT
SM400
RUN_A
S
RUN_B
R

14

14.2.6 Qualifier of an Action

In ISPSoft, users can define the execution of an action by qualifying the action. However, users can not qualify the actions in the program in a DVP series PLC. Consequently, the actions in the program in a DVP series PLC are N actions.



❶ The step name is displayed here.

❷ Users can select qualifiers for the actions associated with the step.

❸ Users can specify qualifiers related to time.

❹ Users can select actions which are qualified.

❺ Users can make comments on the step.

14.2.6.1 Qualifier Types

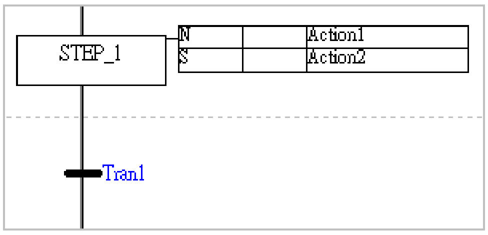
- **N (Normal)**

  When a step is activated, the N action associated with the step is executed. When the step is inactivated, the system executes a final scan to disable all the outputs in the N action. However, the outputs which use the instructions similar SET are not disabled. The actions in the program in a DVP series PLC are N actions.

- **S (Set)**

  When a step is activated, the S action associated with the step is executed. Even if the step is inactivated, the S action will still be executed.

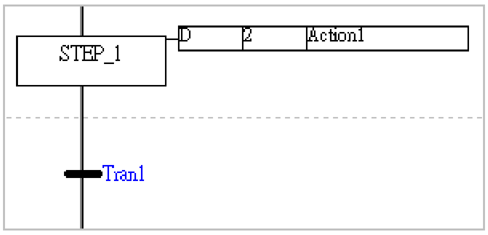
  When STEP_1 in the figure below is activated, Action1 and Action2 are executed. When Tran1 is true, STEP_1 becomes inactive. Once STEP_1 is inactivated, the execution of Action1 will stop, the system will execute a final scan, and Action2 will still be executed.



- **D (Delay)**

The D action associated with a step is not executed at the time when the step is activated. The execution of the D action is delayed for a certain amount of time. If the transition following the step becomes true before the D action is executed, the step will be inactivated, control will be passed to the next step, and the D action will not be executed. When the step is activated again, the delay is measured again.

Action1 in the figure below is not executed at the time when STEP_1 is executed. The execution of Action1 is delayed for two seconds. If STEP_1 is inactivated before Action1 is executed, Action1 will not be executed.



- **SD (Set Delay)**

The SD action associated with a step is not executed at the time when the step is activated. The execution of the SD action is delayed for a certain amount of time. If the SD action is executed, it will still be executed after the step is inactivated. Besides, if the transition following the step becomes true before the SD action is executed, control will be passed to the next step, and the delay will still be measured. A certain amount of time has elapsed before the SD action is executed.

- **DS (Delay Set)**

A DS action is similar to a SD action. However, if the transition following a step becomes true before the SD action associated with the step is executed, the delay will not be measured, and the SD action will not be executed. When the step is activated again, the delay is measured again. If the DS action is executed, it will still be executed after the step is inactivated.

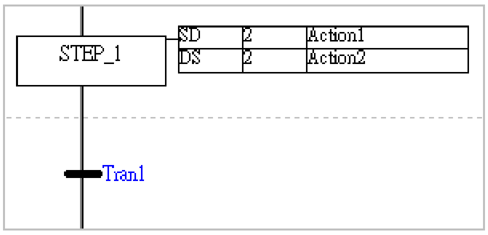
Action1 and Action2 are not executed at the time when STEP_1 is activated. The execution of Action1 and the execution of Action2 are delayed for two seconds. There are two situations which need to be considered.

(a) STEP_1 is activated for more than two seconds.

Action1 and Action2 will be executed after STEP_1 has been executed for two seconds. Even if STEP_1 is inactivated, Action1 and Action2 will still be executed.

(b) STEP_1 is activated for less than two seconds.

After control is passed to the next step, the delay of Action1 will still be measured. Two seconds has elapsed before Action1 is executed. However, after the control is passed to the next step, the delay of Action2 will not be measured, and Action2 will not be executed.



- **L (Limit)**

When a step is activated, the L action associated with the step is executed. If the L action has been executed for a certain amount of time before control is passed to the next step, the execution of the L action will stop automatically, and the system will execute a final scan. If the control is passed to the next step before the time specified has elapsed, the execution of the L action will stop.

- **SL (Set Limit)**

When a step is activated, the SL action associated with the step is executed. If the SL action has been executed for a certain amount of time before control is passed to the next step, the execution of the SL action will stop automatically, and the system will execute a final scan. If the control is passed to the next step before the time specified has elapsed, the execution of the SL action will stop after the time specified has elapsed.

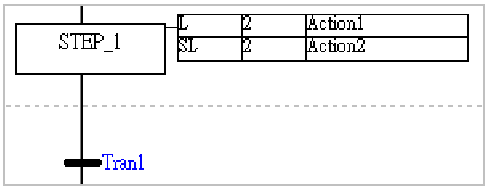
When STEP_1 is activated, Action1 and Action2 are executed. There are two situations which need to be considered.

(a) STEP_1 is activated for more than two seconds.

After Action1 and Action2 have been executed for two seconds, the execution of Action1 and the execution of Action2 will stop, and the system will execute final scans.

(b) STEP_1 is activated for less than two seconds.

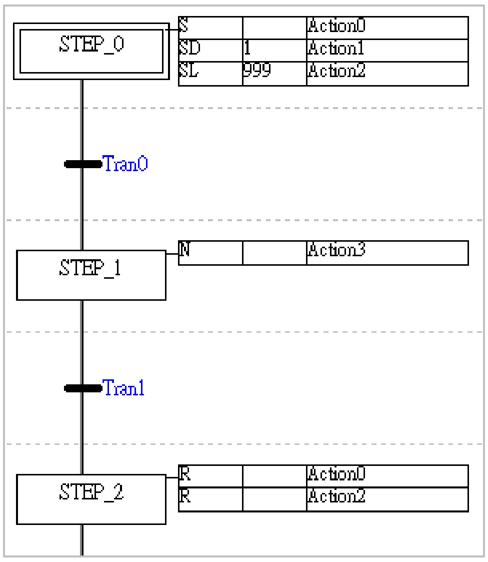
After control is passed to the next step, the execution of Action1 will stop, and the system will execute a final scan. The execution of Action2 will stop after two seconds have elapsed.



- **R (Reset)**

When a step is activated, the R action related to the step is not executed, and the system executes a final scan. An action qualified by S, SD, DS, or SL will not be executed if it is qualified by R.

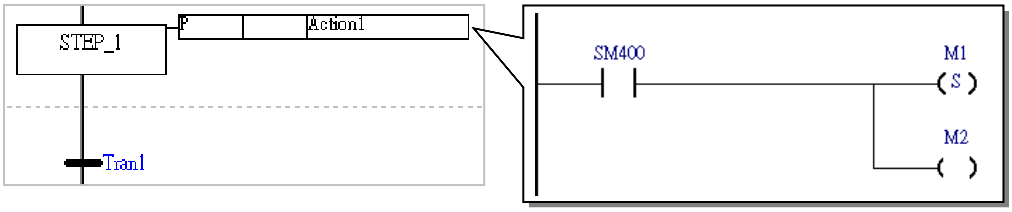
Suppose that Action0, Action1, and Action2 are executed during the activation of STEP_0, and will be executed until control is passed to STEP_2. After the control is passed to STEP_2, the execution of Action0 and the execution of Action2 will stop, and the system will execute final scans. Owing to the fact that Action1 is not qualified by R, it will still be executed after the control is passed to STEP_2.



- **P (Pulse)**

During the first scan cycle, the P action associated with a step is executed when the step is activated. During the second scan cycle, even if the step is activated, the outputs will be disabled, and the system will execute a final scan.

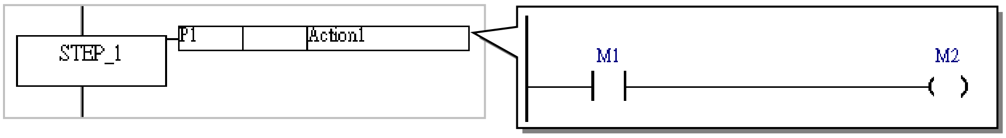
During the first scan cycle, Action1 is executed when STEP_1 is activated. Owing to the fact that SM400 is ON, M1 and M2 are ON. During the second scan cycle, the system inactivates Action1. Although SM400 is still ON, M2 becomes OFF. M1 is driven by the instruction SET, and therefore it remains ON.



- **P1 (Raising Pulse)**

The P1 action associated with a step is executed only when the step is activated during the first scan cycle. Besides, the system will not execute a final scan after the execution of the P1 action stops. Consequently, although an action where the instruction OUT or TMR is used is allowed to be qualified by P1, a warning appears when the program is compiled.

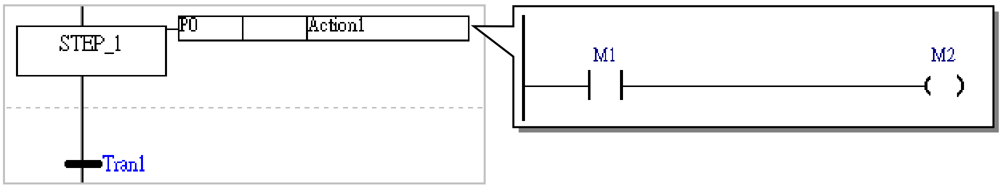
During the first scan cycle, Action1 is executed when STEP_1 is activated. If M1 is ON, M2 will be ON. Action1 is executed only when STEP_1 is activated during the first scan cycle. Besides, the system will not execute a final scan after the execution of Action1 stops. Consequently, the state of M2 will not change even if the state of M1 changes.



- **P0 (Falling Pulse)**

The P0 action associated with a step is executed only when the step is inactivated during the first scan cycle. Besides, the system will not execute a final scan after the execution of the P0 action stops. Consequently, although an action where the instruction OUT or TMR is used is allowed to be qualified by P1, a warning appears when the program is compiled.

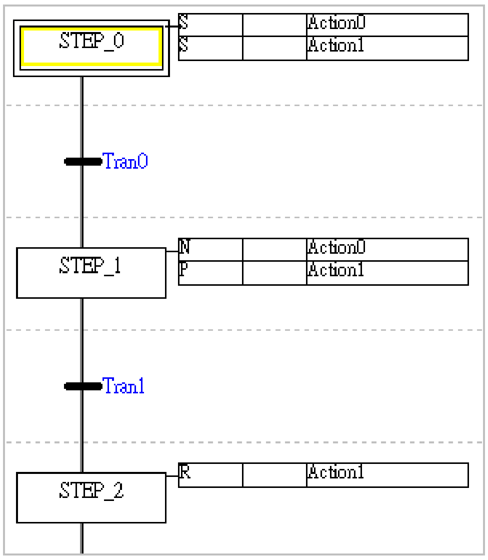
When STEP_1 is activated, Action1 is not executed. Action1 will not be executed until Tran1 is true. If M1 is ON, M2 will be ON. Action1 is executed only when STEP_1 is inactivated during the first scan cycle. Besides, the system will not execute a final scan after the execution of Action1 stops. Consequently, the state of M2 will not change even if the state of M1 changes.



14.2.6.2 Important Points About Qualifying an Action

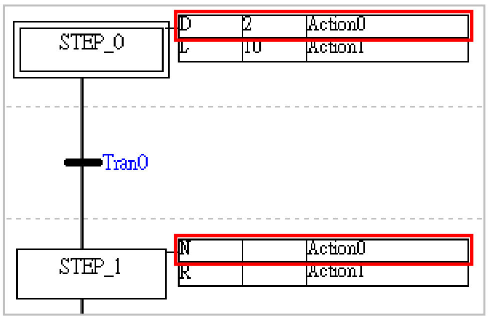
- Once an action qualified by S is executed, it will still be executed even if it is qualified by N or P. The execution of the action stops only when the action is qualified by R. If there is an action which is qualified by S, users have to check whether they have to assign R to the action to stop the execution of the action.

  When STEP_0 is activated, Action0 and Action1 are executed. After control is passed to STEP_1, Action0 and Action1 will still be executed even if they are qualified by N and P respectively. The execution of Action1 will stop after control is passed to STEP_2. Action0 is never qualified by R, and therefore it will be executed all the time.



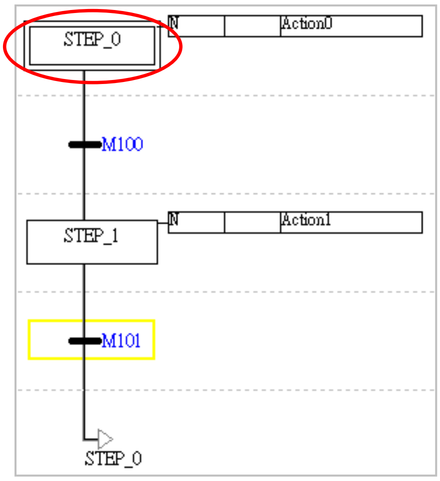
- Except the R qualifier, when assigning a time-related qualifier for an Action, the qualifier can only be used in the SFC instruction once. In other words, if an action is qualified by D, SD, DS, L, or SL, no other qualifiers can be used for the action, except the R qualifier.

  From the example shown below, we can see that in the STEP_0, the Action0 and Action1 are qualified by D and L respectively. And in the STEP_1, the Action0 and Action1 are qualified by N and R. The usage of Action 0 being assigned with D in the STEP_0 and N in the STEP_1 is wrong and will cause error to occur. The usage of Action 1 being assigned with Lin the STEP_0 and R in the STEP_1 is correct, since R can be added to an Action with more than 1 qualifier.



14.2.7 Initial Step

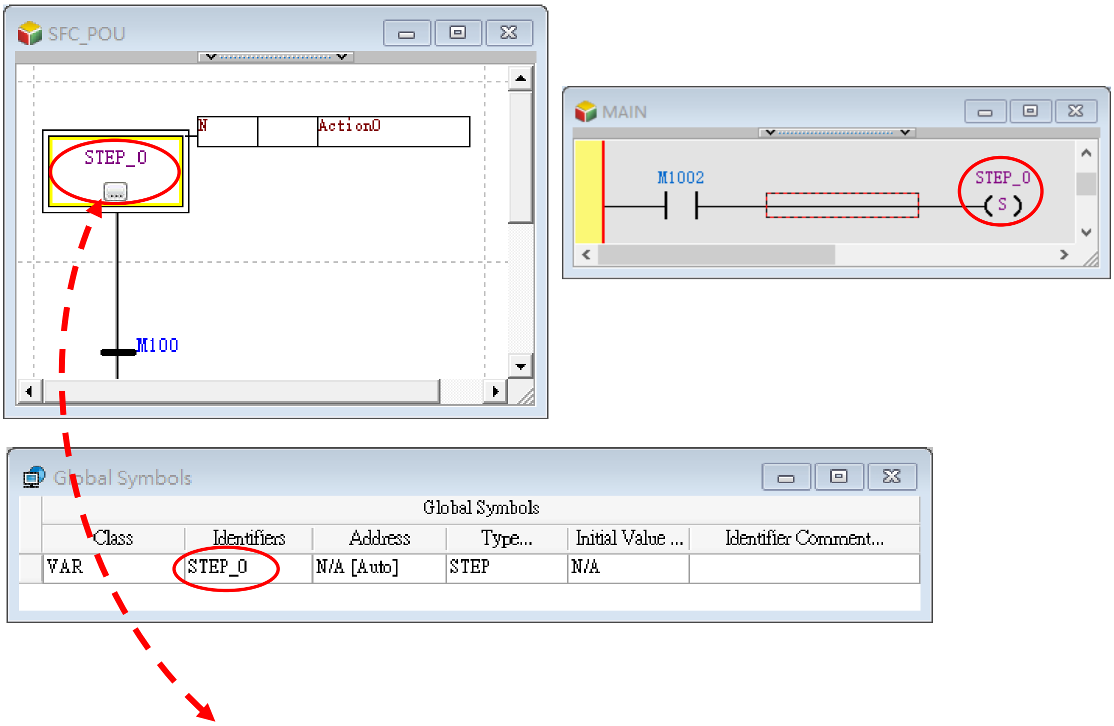
During the execution of a sequential function chart, every step is activated in turn and cyclically. It is necessary to define a step as an initial step which is activated when the program is executed for the first time. In ISPSoft, the initial step in a sequential function chart is drawn as a box with a double line. Besides, there is only one initial step in a sequential function chart.



Any step in a sequential function chart in an AH/AS series CPU module can be defined as the initial step in the sequential function chart. When a sequential function chart in an AH/AS series CPU module is executed for the first time during the operation of the CPU module, the initial step in the sequential function chart is the step which is activated first.

If there is a sequential function chart in a DVP series PLC, the sequential function chart will not be executed until the instruction SET used in another POU activate a step in the sequential function chart. Users can not define a step in a sequential function chart in a DVP series PLC as the initial step in the sequential function chart, and the first step in a sequential function chart in a DVP series PLC is always the initial step in the sequential function chart. The real initial step in a sequential function chart in a DVP series PLC is the device or the symbol driven by the instruction SET used in another POU. An example of executing a sequential function chart in DVP series PLC is shown below.

Users have to determine which step in a sequential function chart is the initial step in the sequential function chart, declare the step in the global symbol table, and apply the instruction SET to the step in another POU. In the program code where the instruction SET is applied to the step, the condition contact or the logical output preceding the step must be prevented from becoming ON again during the execution of the program. Otherwise, the step will be ON, and the sequential function chart will be executed incorrectly. The special relay M1002 is highly recommended. The characteristic of M1002 is that M1002 is ON during the first scan cycle.



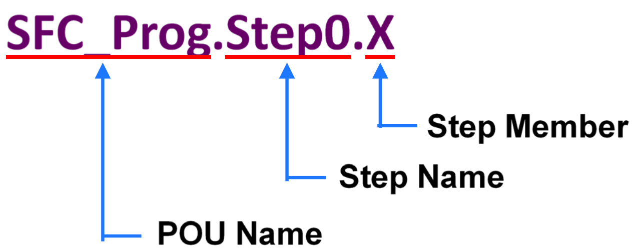
14.2.8 Internal Property

The internal property provides users to use in POUs and particular parameter properties in SFC programming. The parameter properties are categorized into Step, Action and Transition. The following content introduce the properties accordingly.

14.2.8.1 Step Property

To use SFC in POU, the step property adopts STRUCTURE framework to display.

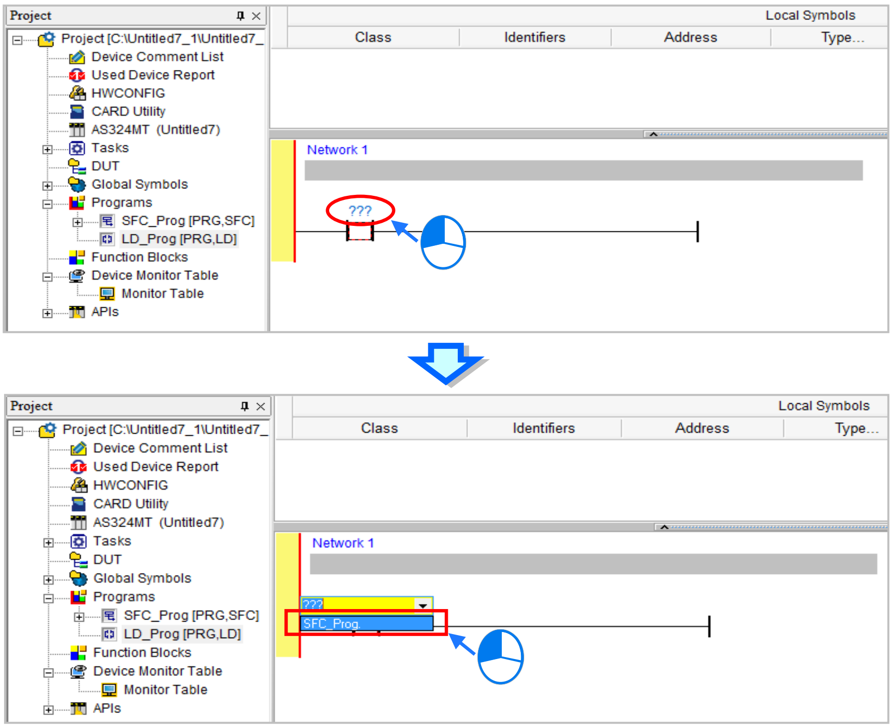
The structure consists of POU Name, Step Name and Step Member. Users can select the appropriate POU and Step name then decide on the step member.



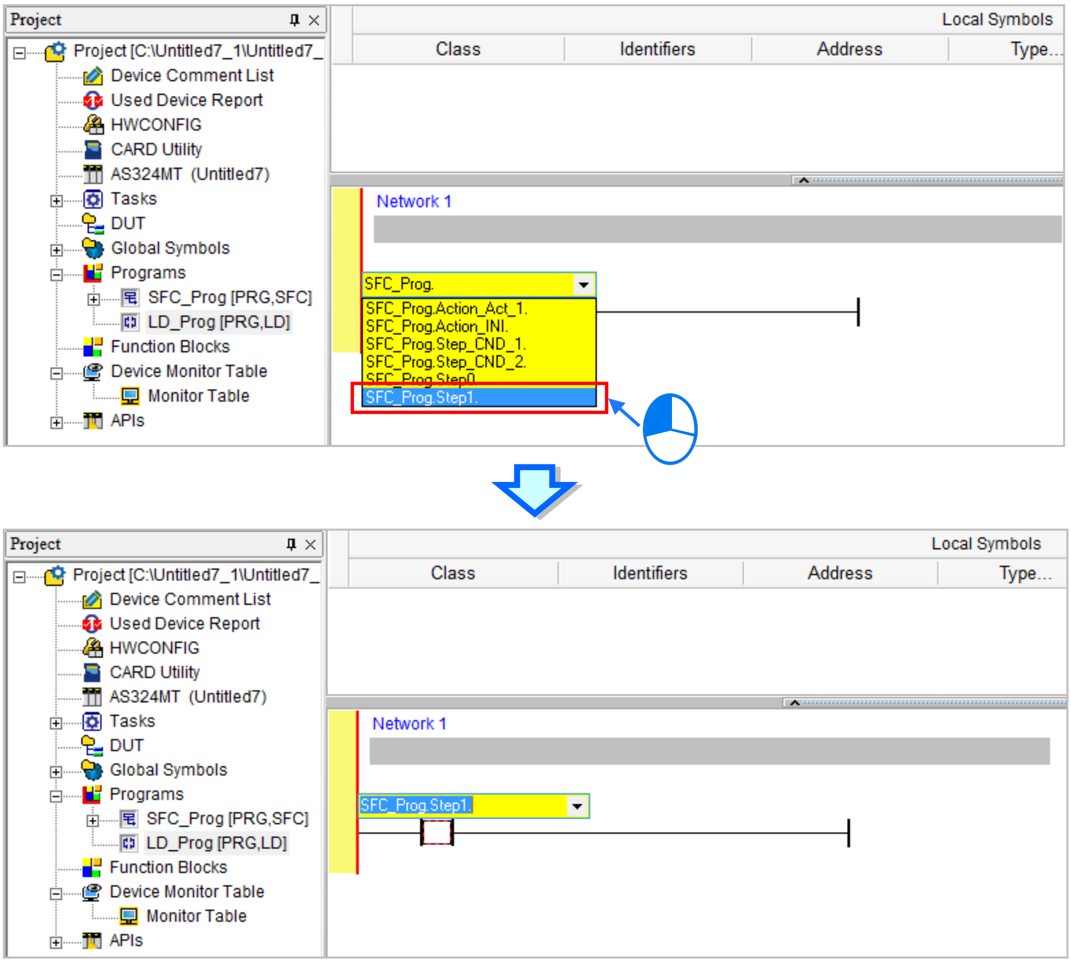
The following table provides Step member categorization.

Category	Member	Description	Read	Write
Step	X	When executing Step, the SFC parameter property is ON ; this parameter property can replace previous S device.	V	X
	done	When Step Property **T** (the **current time spent executing Step) >=** Step property **timePreset** and the value is ON	V	X
	counter	When Step property **X** changes from OFF to ON, parameter property count adds 1	V	X
	timePreset	Determines the time for Step property **done** changes from OFF to ON (unit: **ms**, data length: **DWORD)**	V	X
	maxTime	Record the maximum time of Step property **T** (unit: **ms**, data length: **DWORD)**	V	X
	T	The time spent executing Step (unit: **ms**, data length: **DWORD)**	V	X

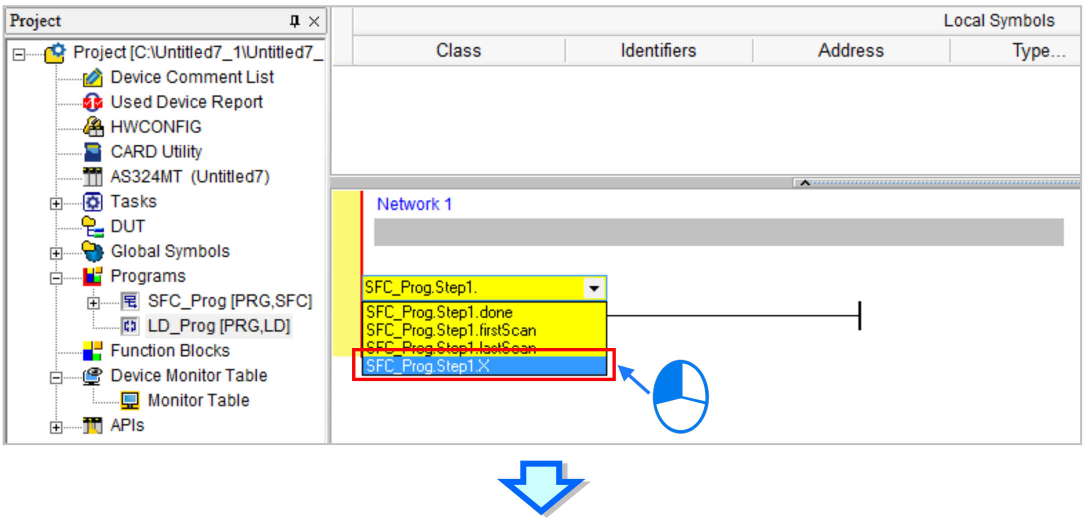
Take executing Step member X in SFC for example, when users want to trigger the contact to ON for POU in ladder programming once Step execution starts, the programs are written in the following ways. By using normally-open contact of POU in ladder program, click on top of the normally-open contact, a drop-down list appears and provides POU name options for SFC program then click the name.

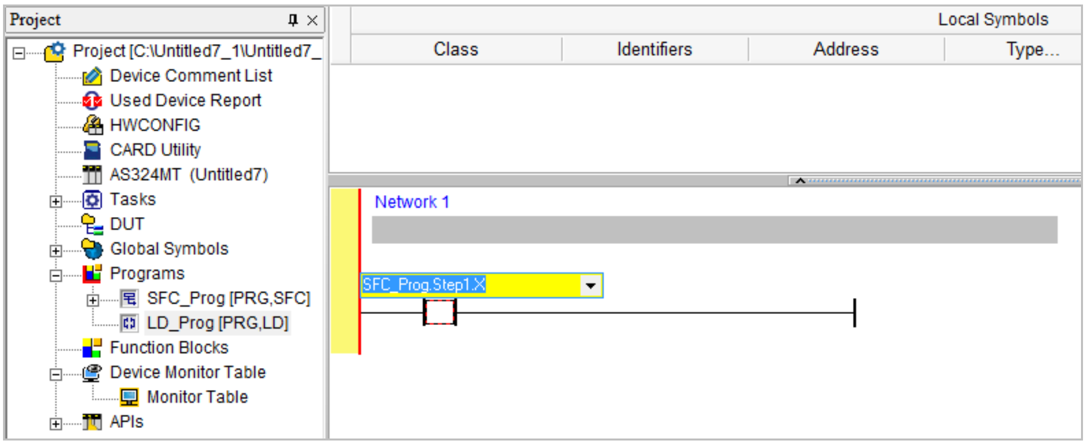


After clicking the POU name for SFC program, right-click the mouse and a drop-down list with POU Step name appears, then select the name.

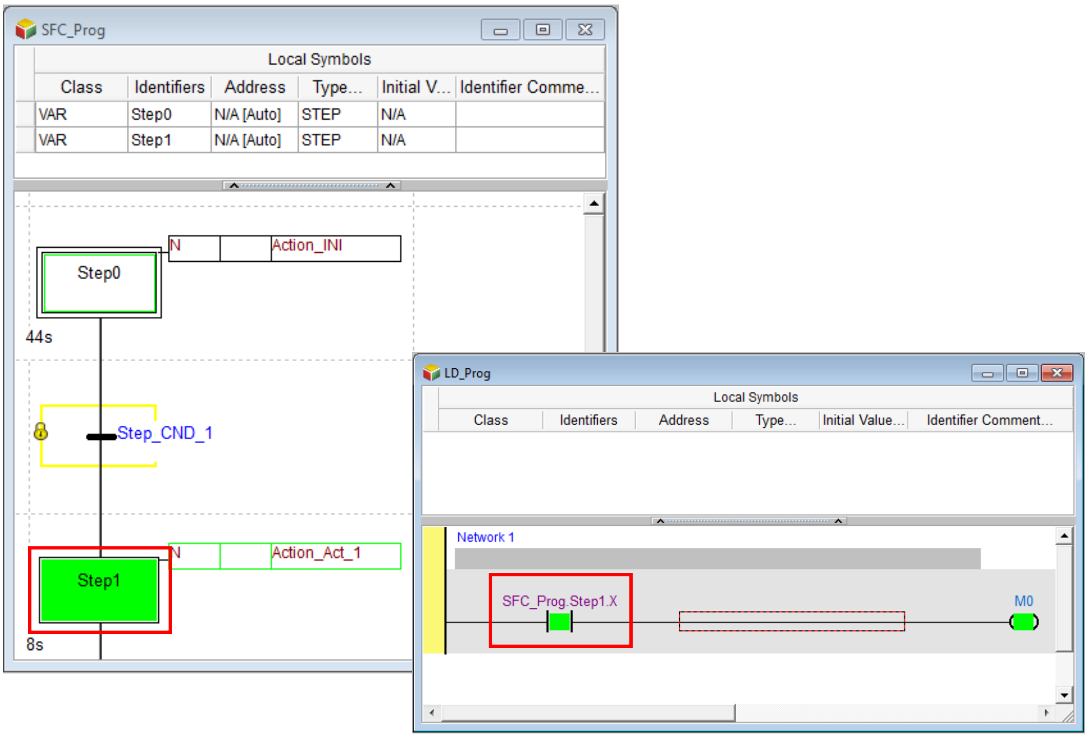


After clicking the POU Step name for SFC program, right-click the mouse and a drop-down list with POU Step Member name appears, then select the name.





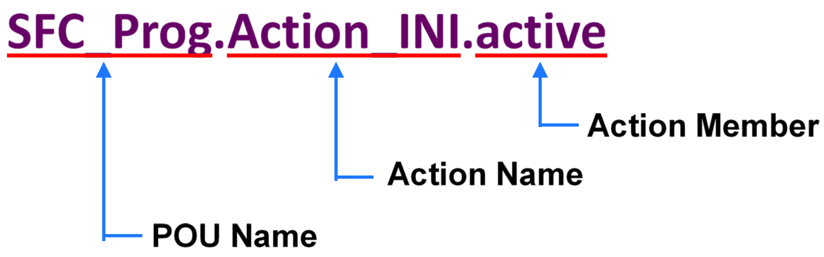
When executing POU Step in SFC program, the normally-open contact of SFC_Prog.Step1.X is ON.



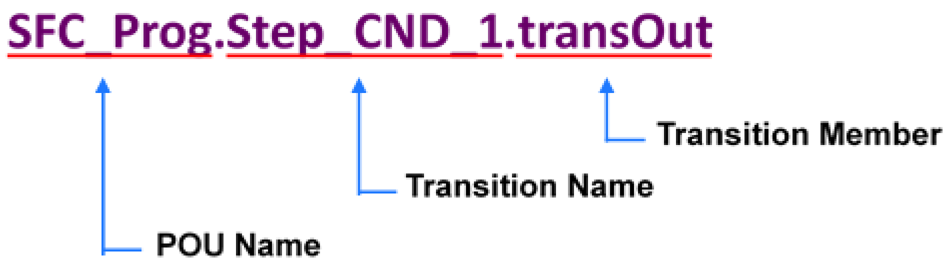
14.2.8.2 Action and Transition Property

To use SFC in POU, the Action and Transition property adopts STRUCTURE framework to display.

For Action property structure consists of POU Name, Action Name and Action Member. Users can select the appropriate POU and Action name then decide on the Action member.



For Transition property structure consists of POU Name, Transition Name and Transition Member. Users can select the appropriate POU and Transition name then decide on the Transition member.

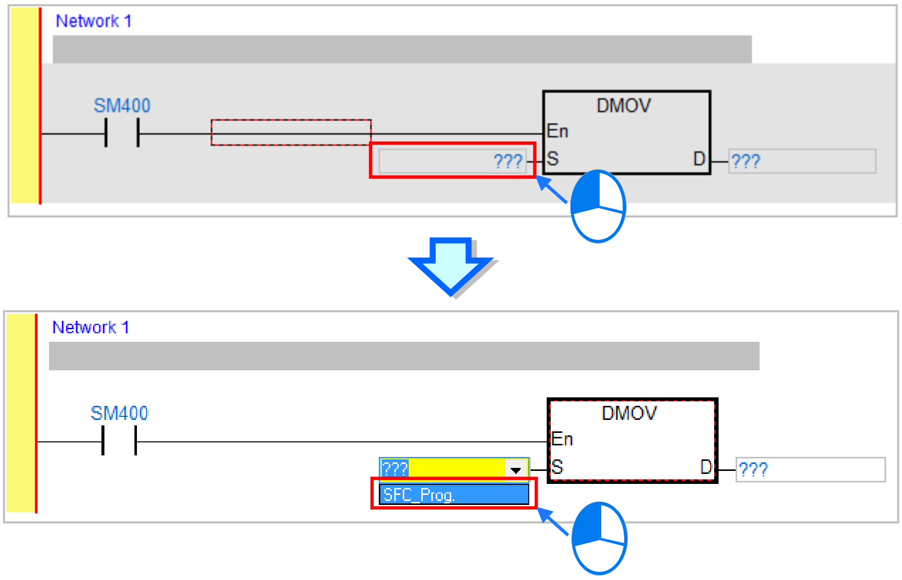


The following table provides Action and Transition member categorization.

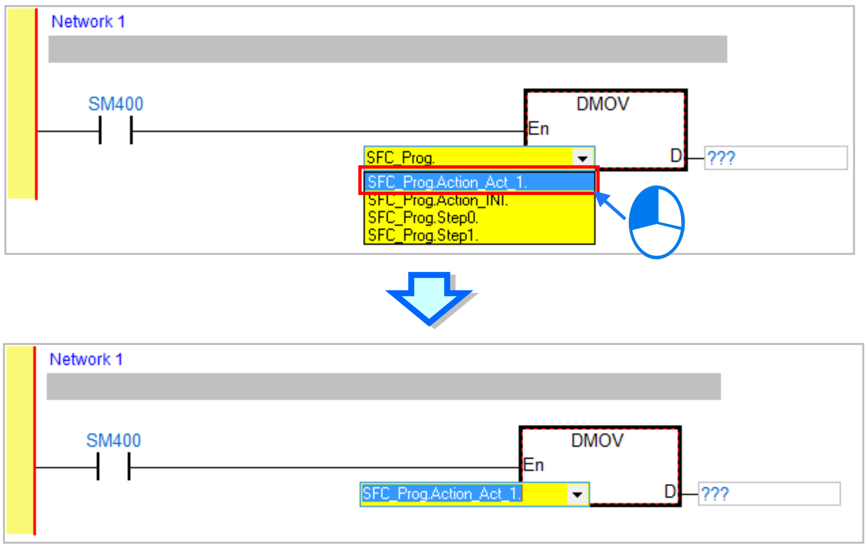
Category	Member	Description	Read	Write
Action	enabled	When qualifier condition of Action is set, the SFC parameter property is ON and checks if Action is enabled or not.	V	X
	active	When finish Action program for the first time, the SF parameter property is ON.	V	X
	rstDisable	When Final scan is enabled, its value is OFF; when Final scan is not enabled, its value is ON.	V	X
	counter	When Active property **active** changes from OFF to ON, parameter property count adds 1.	V	X
	setTimer	Shows time for time related qualifier (unit: **ms**, data length: **DWORD**)	V	X
Transition	transOut	When Transition condition set is ON, or Transition is forced to start is ON.	V	X

Take Action member counter for example, if users want to monitor Action property active number change from 0 to 1and transmit the parameter value to D100 register, the programs are written in the following ways.

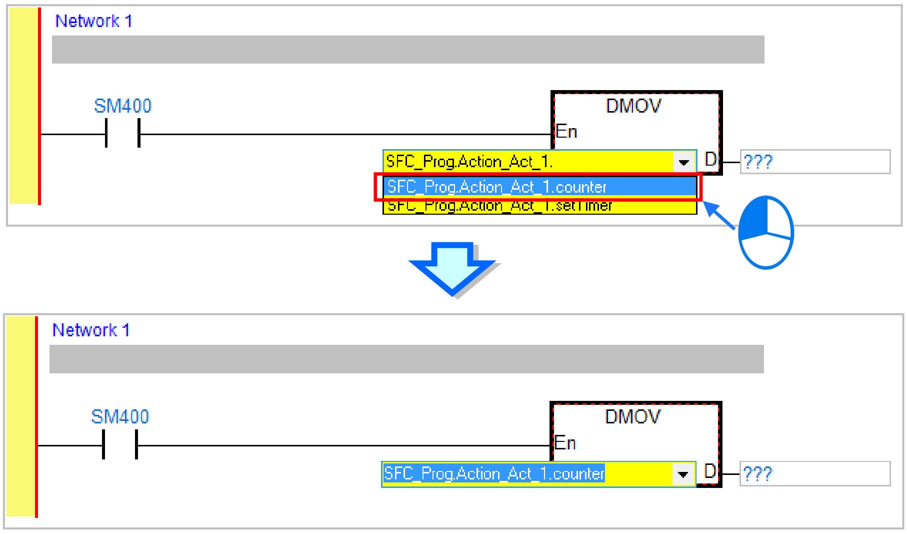
Use SM400 (The flag is always ON when CPU runs) and DMOV command in ladder program, click the S contact of DMOV command and choose the POU name for SFC program from the drop-down list and click the name.



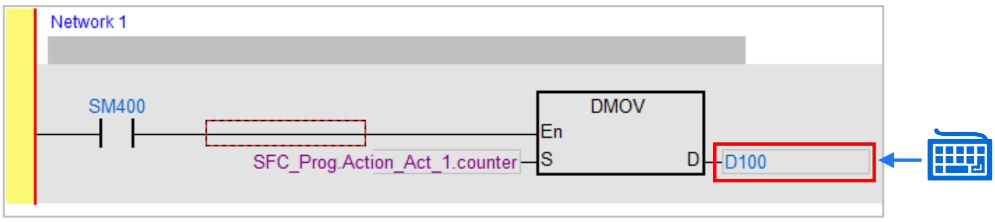
After clicking the POU name for SFC program, right-click the mouse and a drop-down list with POU Action name appears, then select the name.



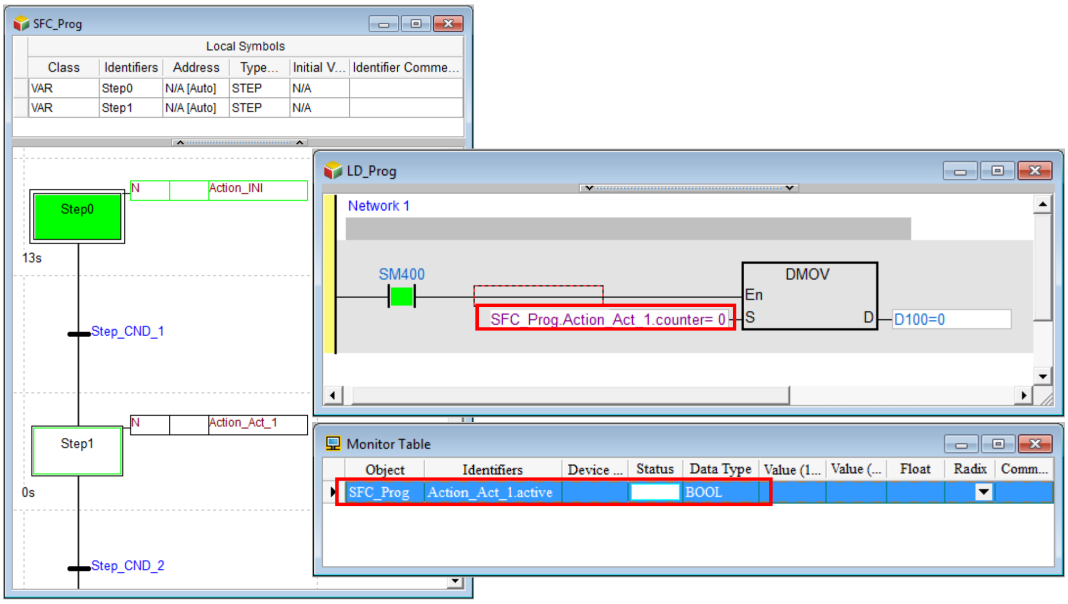
After clicking the POU Action name for SFC program, right-click the mouse and a drop-down list with POU Action Member name appears, then select the name.

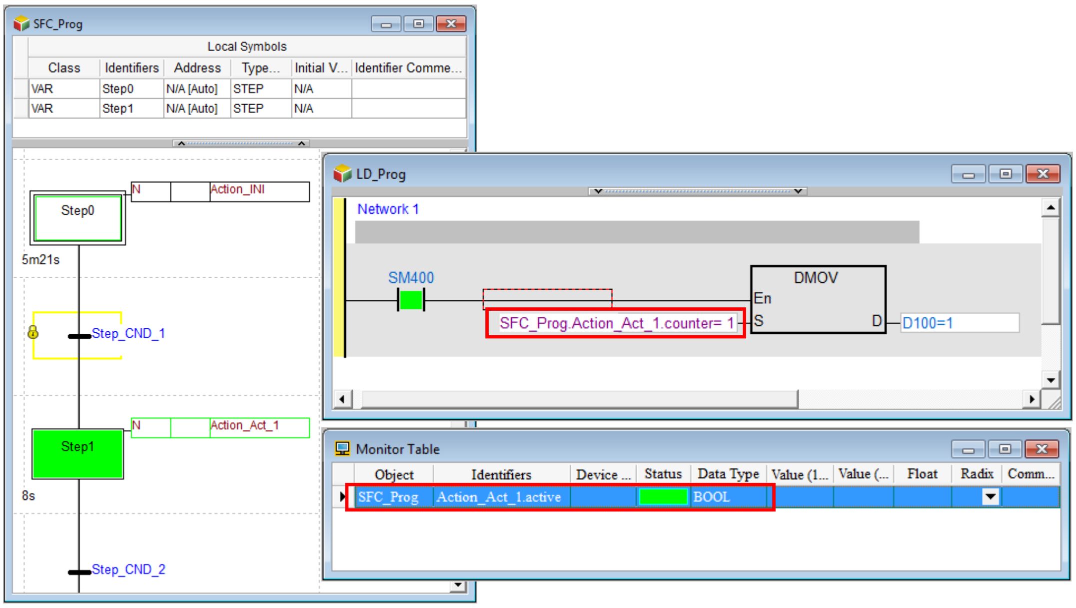


For D contact of DMOV command, input D100.



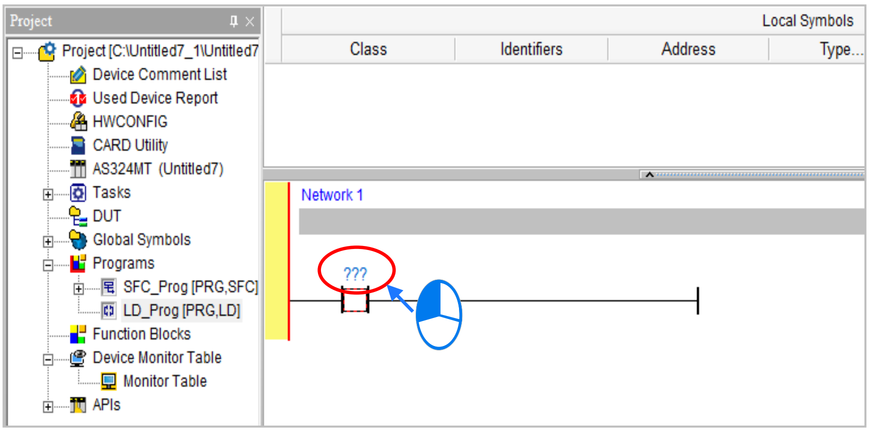
When SFC_Prog.Action.Act_1.Active changes from 0 to 1, the SFC_Prog.Action.Act_1.counter adds 1.

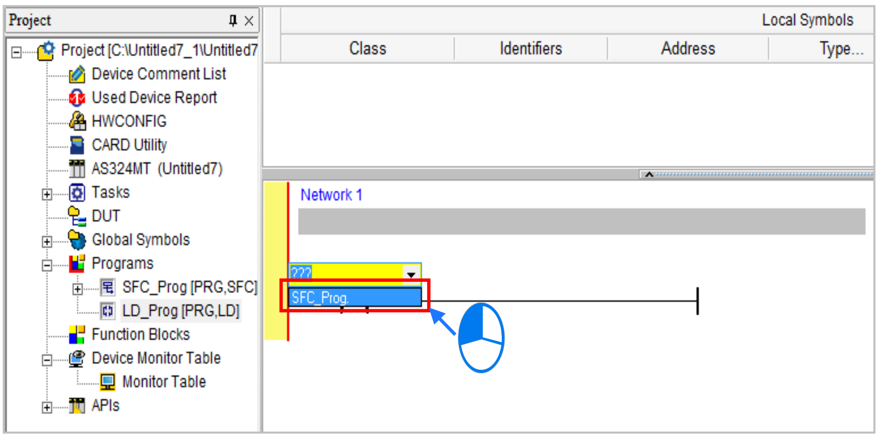




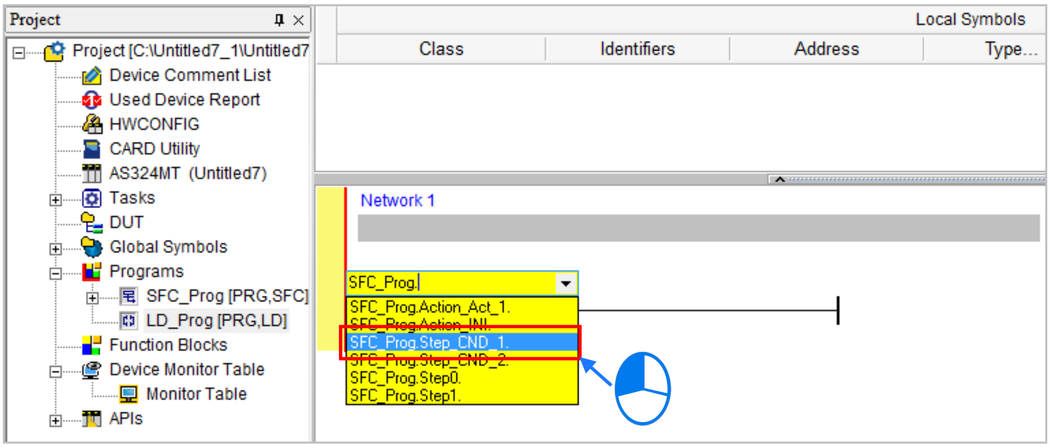
Take Transition member transOut for example, if users want Transition condition set in POU, trigger the normally-open contact in POU for ladder program to ON, the programs are written in the following ways.

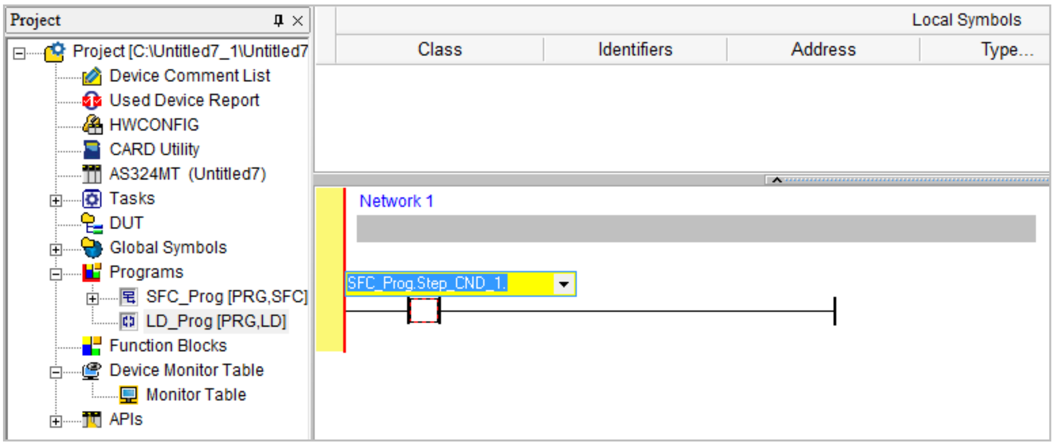
Use a normally-open contact and click on top of the contact and choose the POU name for SFC program from the drop-down list and click the name.



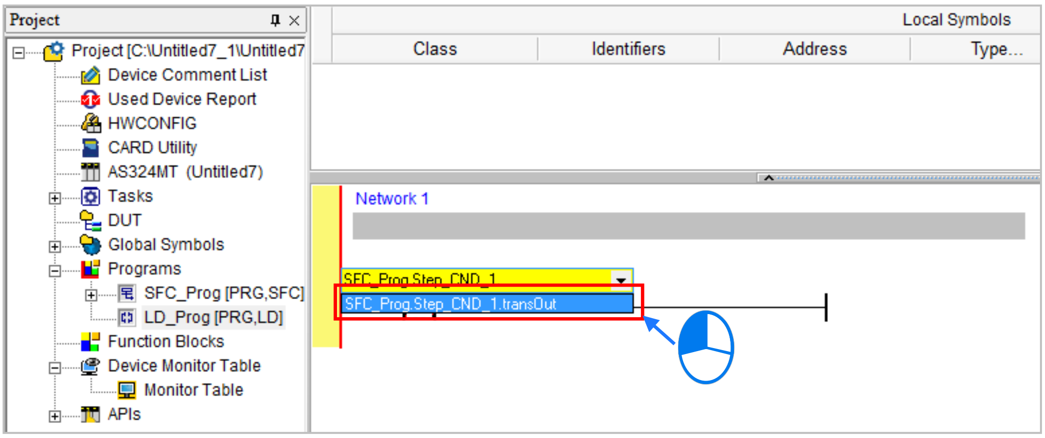


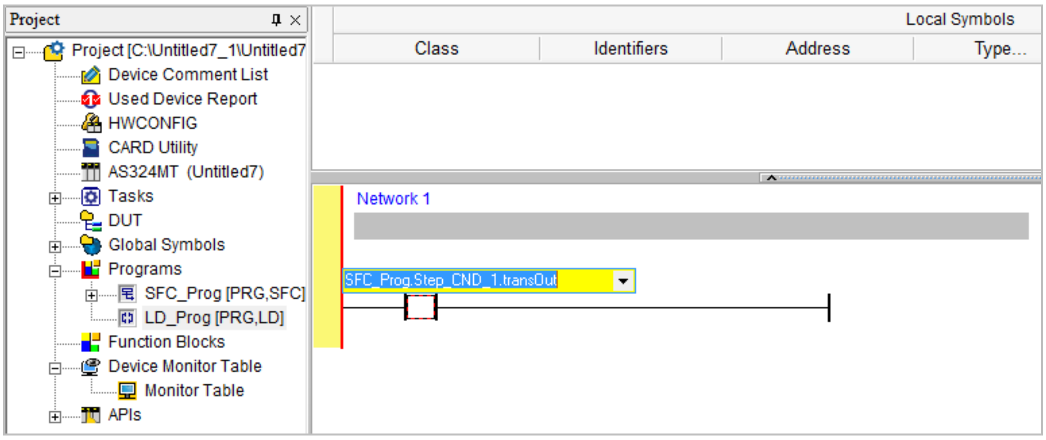
After clicking the POU name for SFC program, right-click the mouse and a drop-down list with POU Transition name appears, then select the name.



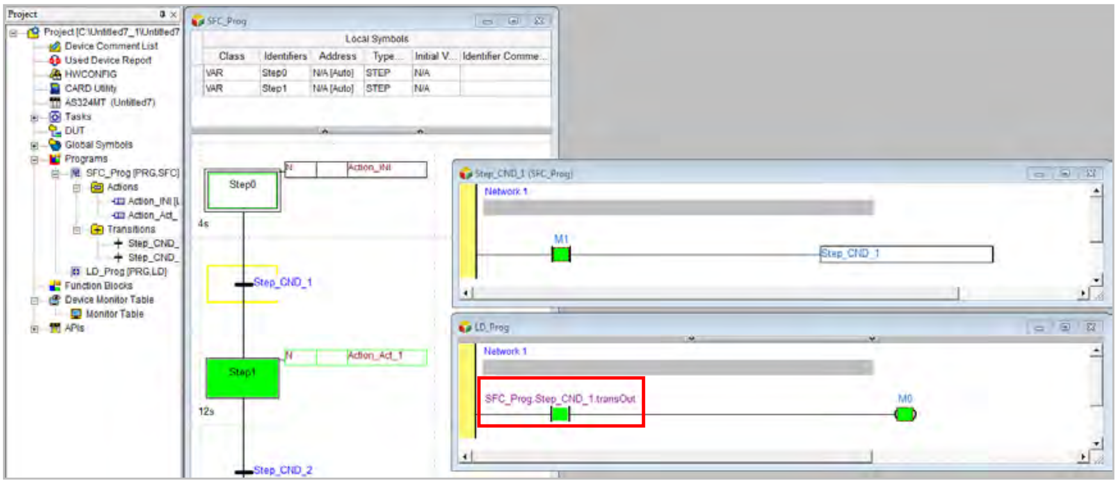


After clicking the POU Transition name for SFC program, right-click the mouse and a drop-down list with POU Transition Member name appears, then select the name.





When Transition condition Step_CND_1 in POU for SFC program is set, the normally-open contact of SFC_Prog. Step_CND_1.transOut is ON.



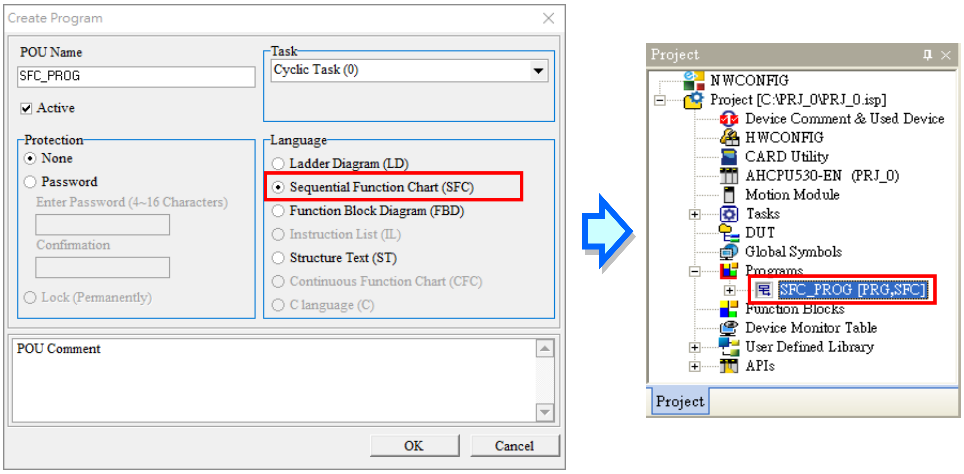
14.3 Create SFC in ISPSoft

14.3.1 Editing Environment

Select the **Sequential Function Chart (SFC)** option button in the **Language** section in the **Create Program** window. Please refer to section 5.4.1 for more information about creating a sequential function chart. In addition, users have to pay attention to the following two points when they create a sequential function chart.

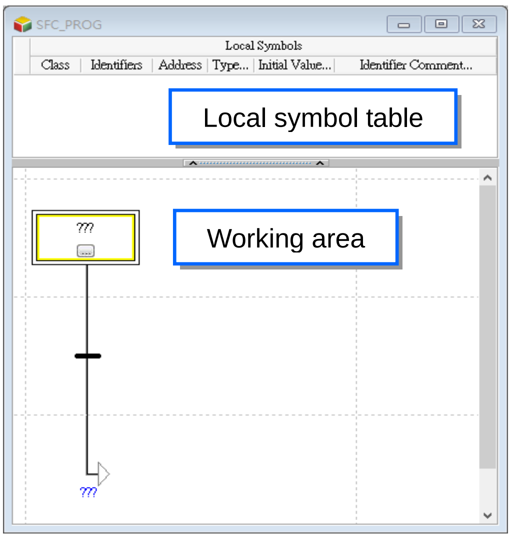
(a) The programming language used to create a POU of the function block type can not be a sequential function chart.

(b) If the programming language used to create a POU of the program type is a sequential function chart, the POU of the program type can only be assigned to a cyclic task.

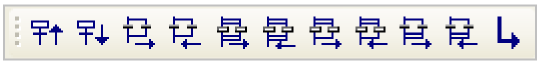


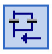
The environment in which a sequential function chart can be edited is shown below. The table at the upper part of the window is a local symbol table, and the area at the lower part of the window is a working area. The working area is like a checkerboard.

The steps and the transitions are put in squares. If users click an object or the square where the object is put, the object will be selected, and a yellow frame will appear.

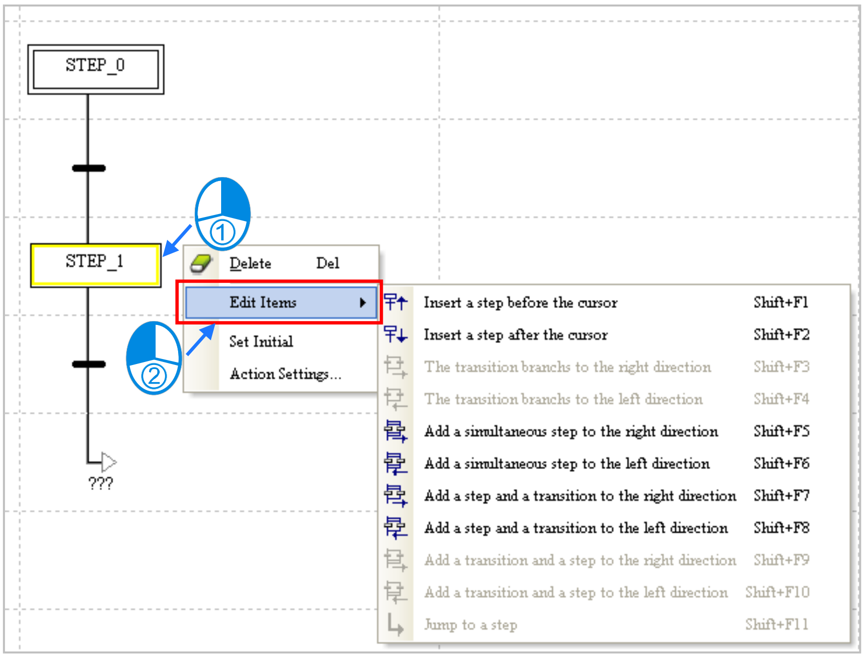


After a program editing window in which a sequential function chart can be created is opened, the corresponding toolbar will appear in the ISPSoft window. The functions are described below.



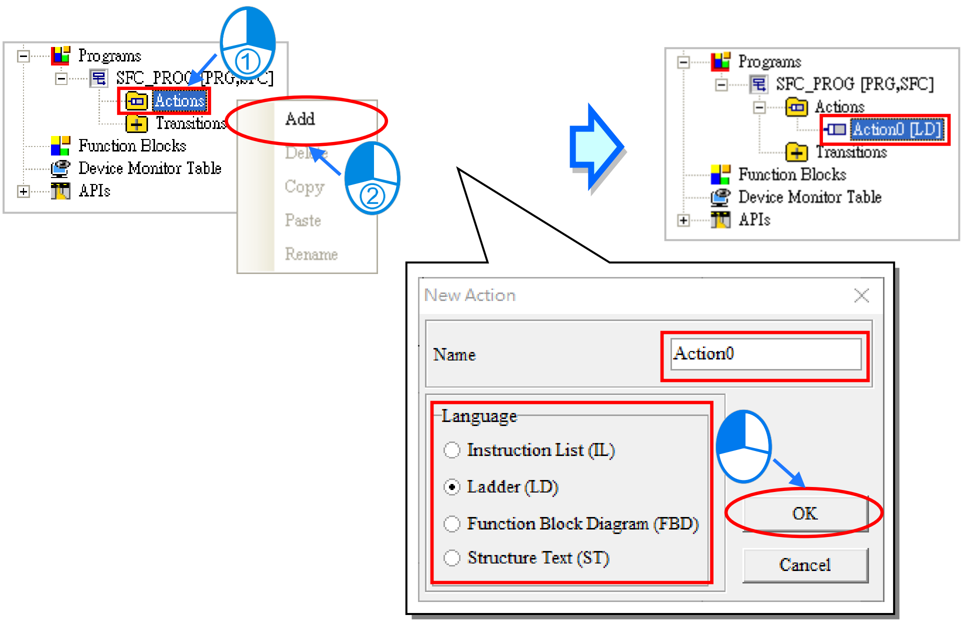
Icon	Keyboard shortcut	Function
	Shift+F1	Adding a step to the top of the object selected.
	Shift+F2	Adding a step to the bottom of the object selected
	Shift+F3	Connecting a transition to the transition selected in parallel, and putting the transition at the right side of the transition selected
	Shift+F4	Connecting a transition to the transition selected in parallel, and putting the transition at the left side of the transition selected
	Shift+F5	Connecting a step to the step selected in parallel, and putting the step at the right side of the step selected
	Shift+F6	Connecting a step to the step selected in parallel, and putting the step at the left side of the step selected
	Shift+F7	Creating a simultaneous divergence and a convergence of sequence selection at the right side of the step selected
	Shift+F8	Creating a simultaneous divergence and a convergence of sequence selection at the left side of the step selected
	Shift+F9	Creating a divergence of sequence selection and a simultaneous convergence at the right side of the transition selected
	Shift+F10	Creating a divergence of sequence selection and a simultaneous convergence at the left side of the transition selected
	Shift+F11	Inserting a jump point

Users can edit the sequential function chart by means of the toolbar. They can also edit the sequential function chart by clicking an object in the working area, and clicking an item on the context menu. To ensure that the sequential function chart is a complete and legal sequential function chart, the editing function which can be used varies with the object selected.

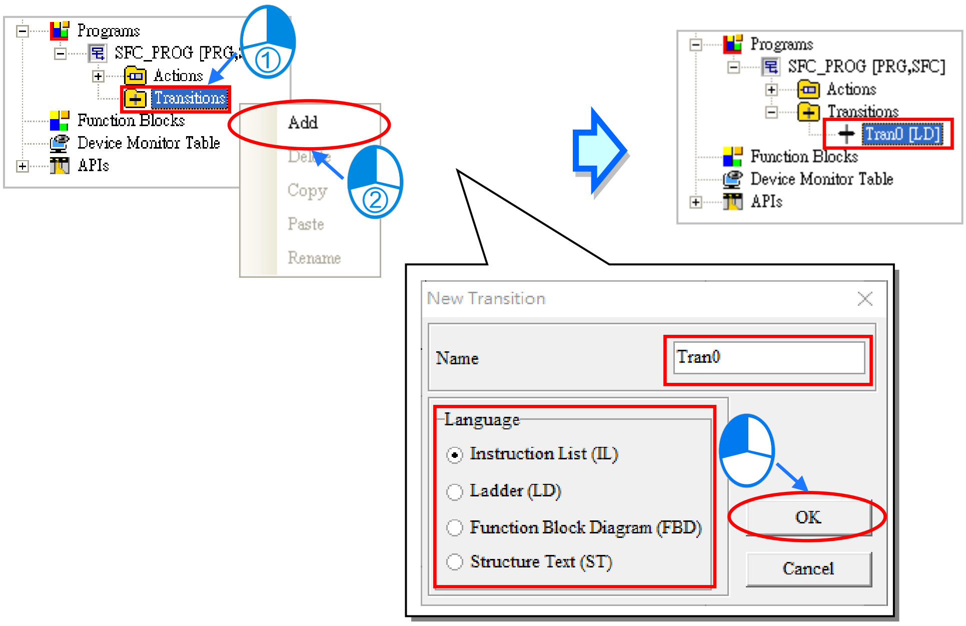


14.3.2 Creating and Managing Actions and Transitions

If users want to create an action, they have to unfold the sequential function chart section in the project management area, select **Actions**, right-click **Actions**, and then click **Add.** Type an action name in the **New Action** window, and select a programming language in the **New Action** window.

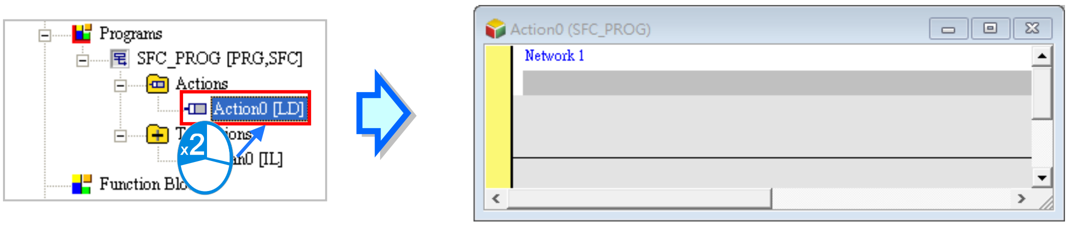


If the users want to create a transition, they have to unfold the sequential function chart section, selection Transitions, right-click Transitions and then click **Add**, type a transition name in the **New Transition** window, and select a programming language in the **New Transition** window.



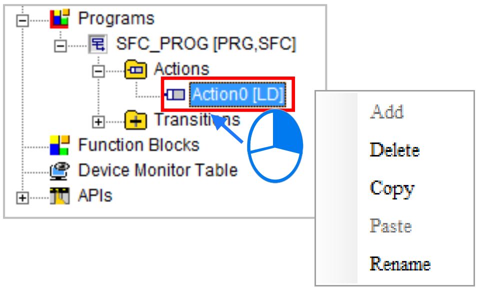
After the users double-click the action or the transition created in the project management area, the corresponding program editing window will appear. In the window for the transition, there is a symbol name which is the same as the transition program name.

The action and the transition are edited in much the same way as a general POU is. However, there are no local symbol tables in the window for the action and the window for the transition. If users want to declare a local symbol table, they have to declare it in the window for the sequential function chart. Besides, the actions and the transitions in a sequential function chart share the same local symbol table.



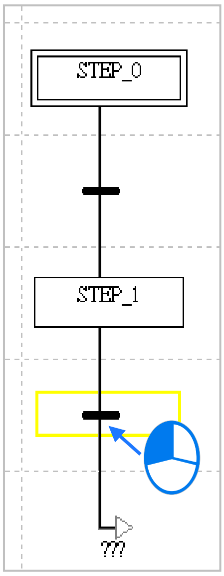
***. If the transition create is assigned to a transition in the sequential function chart, the window for the transition will be opened after users double-click the transition in the sequential function chart.**

If the users want to manage the action or the transition created in the project management area, they can right-click the action or the transition and then click **Add**. The users have to notice that the action can not be copied into the **Transitio**n section, and the transition can not be copied into the **Action** section.

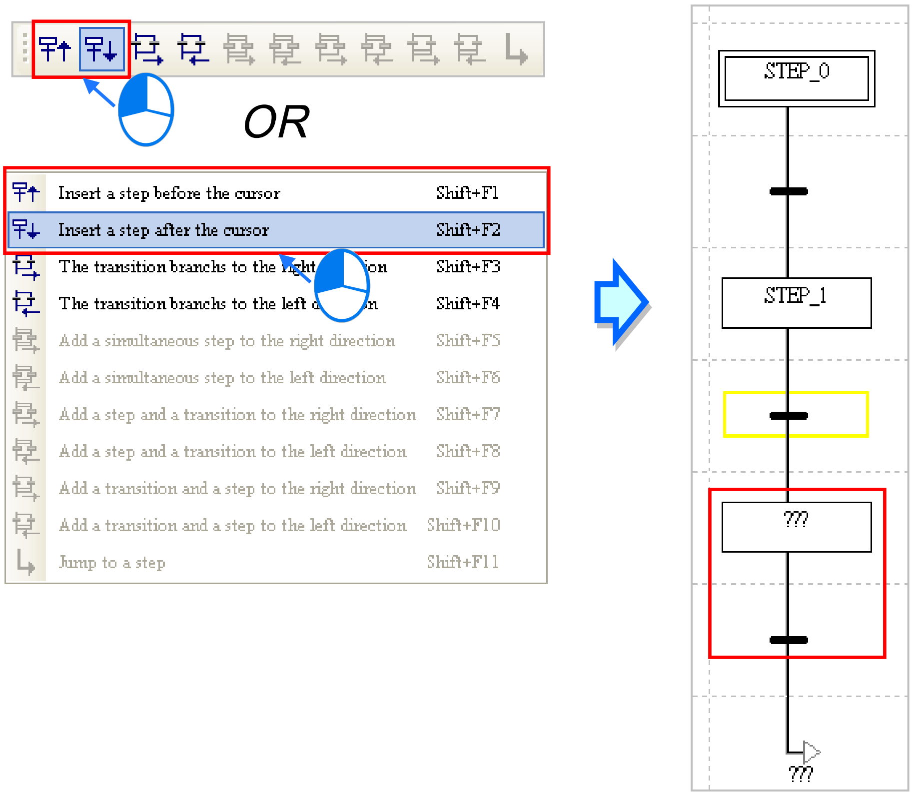


14.3.3 Adding a Step

(1) Select a step in the working area.

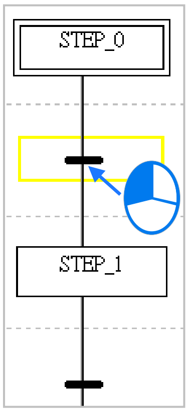


(2) If users want to put a step to the top or the bottom of the step selected, they can click for the top or for the bottom direction on the toolbar. Or users can also right-click the step selected and click the suitable option, for the step to be added to the before or after the cursor.

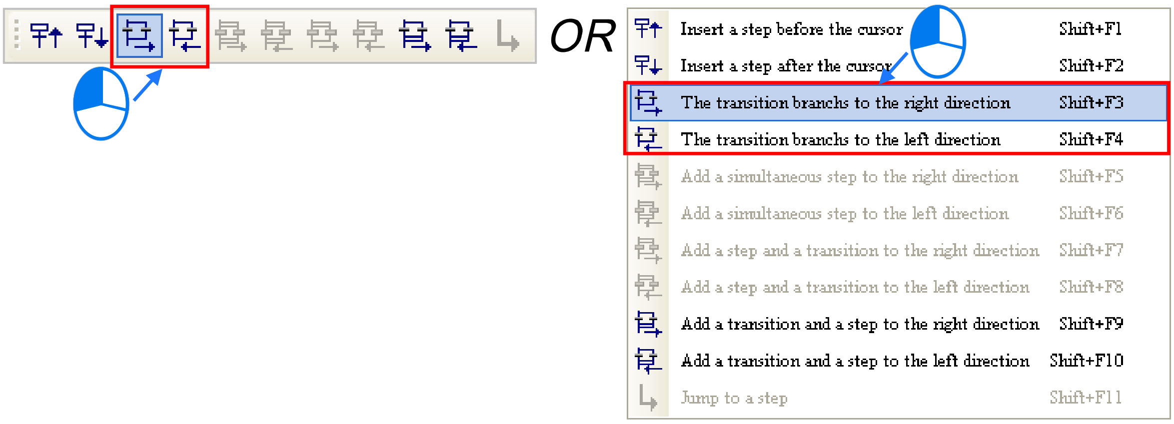


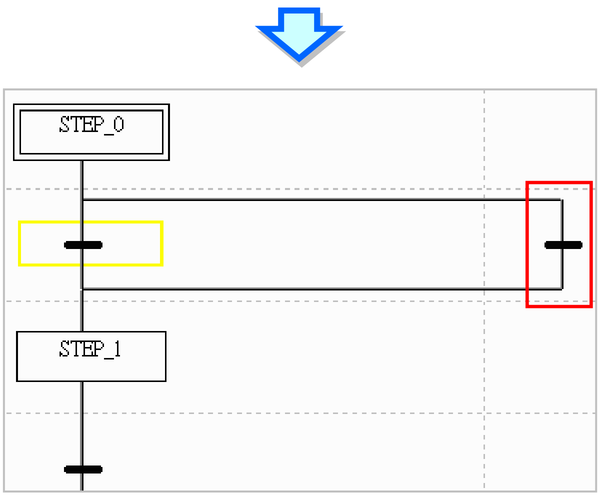
14.3.4 Connecting a Transition in Parallel

(1) Select a transition in the working area.



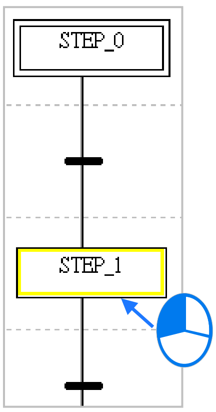
(2) If users want to put a transition at the right/left side of the transition selected, they can click on the toolbar for the right direction or for the left direction. Or users can also right-click the transition selected and click the suitable option, for the transition to be branched to the right or left direction.



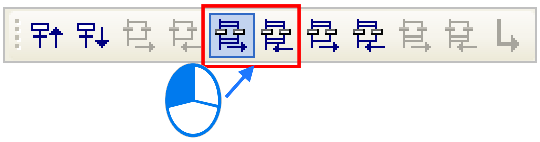


14.3.5 Connecting a Step in Parallel

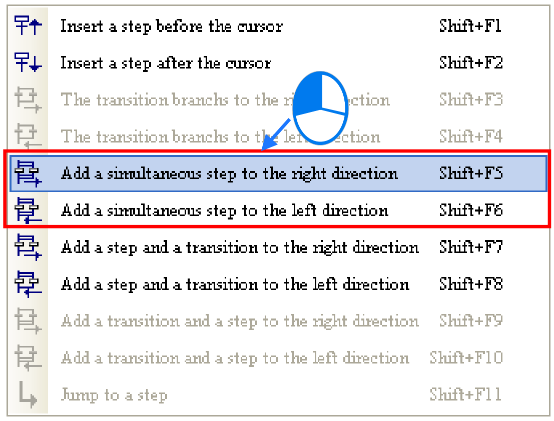
(1) Select a step in the working area. (The topmost step in the working area can not be connected to another step in parallel.)

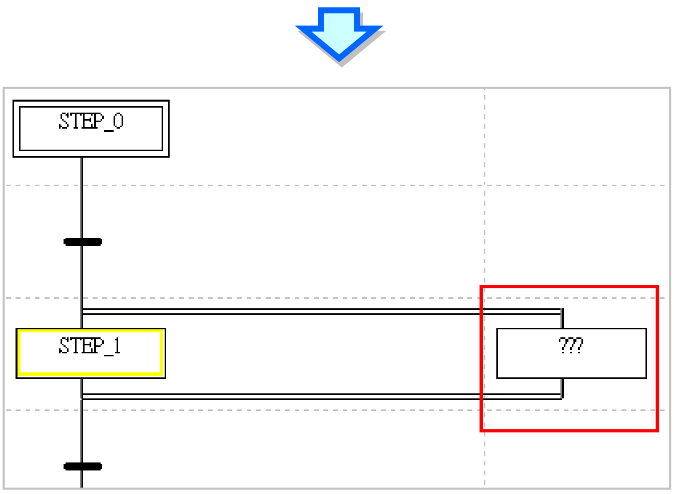


(2) If users want to put a step at the right/left side of the step selected, they can click the icon on the toolbar for the right direction or the icon for the left direction. Or users can also right-click the simultaneous step selected and click the suitable option, for the simultaneous step to be added to the right or left direction.



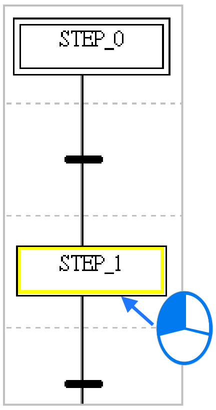
OR



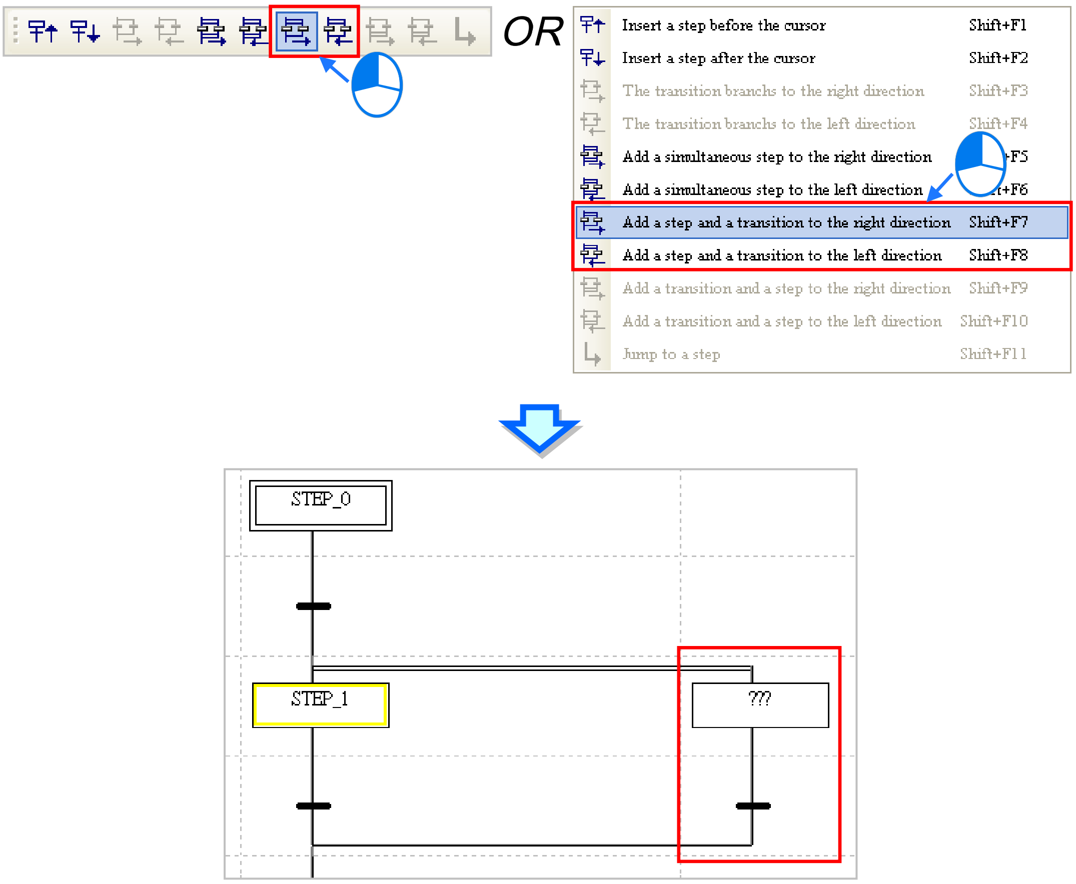


14.3.6 Step Structure - Simultaneous Divergence & Select Convergence

(1) Select a step in the working area. The step selected can not be the topmost step in the sequential function chart.

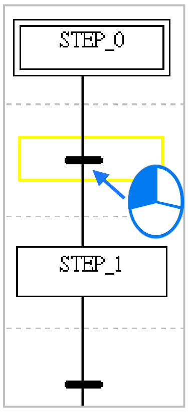


(2) If users want to create a simultaneous divergence and a convergence of sequence selection at the right/left side of the step selected, click  on the toolbar for the right direction or  for the left direction. Or users can also right-click the step selected and click the suitable option, for the step and a transition to be added to the right or left direction.

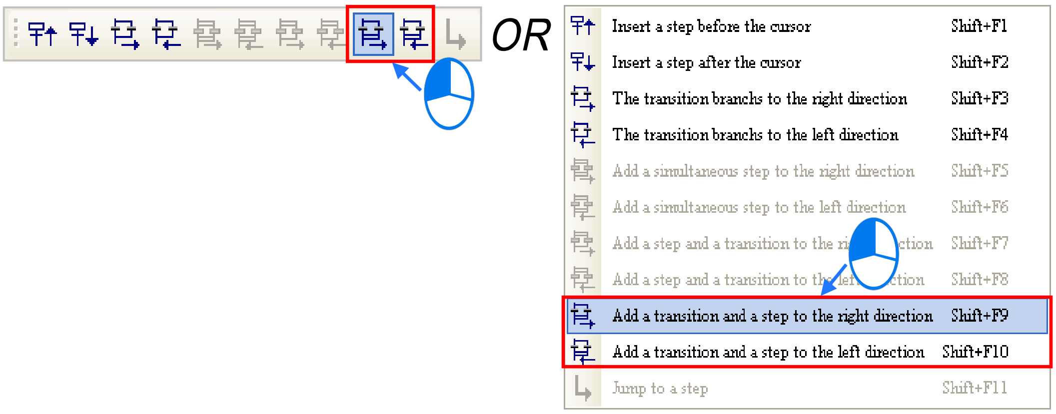


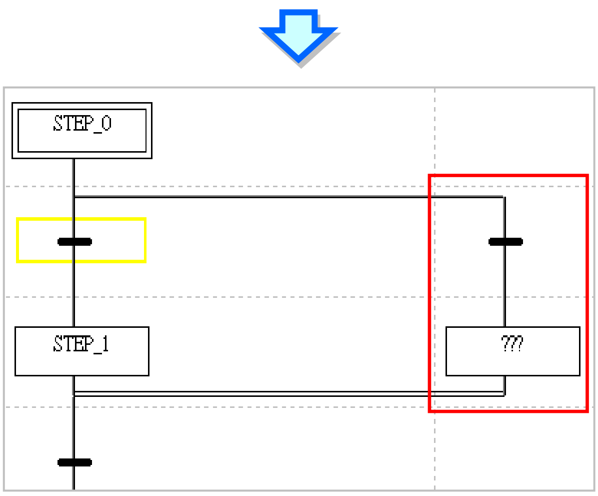
14.3.7 Step Structure – Select Divergence & Simultaneous Convergence

(1) Select a transition in the working area. The transition selected can not be the bottommost transition in the sequential function chart.



(2) If users want to create a divergence of sequence selection and a simultaneous convergence at the right/left side of the step selected, click on the toolbar for the right direction or for the left direction. Or users can also right-click the step selected and click the suitable option, for the transition and a step to be added to the right or left direction.

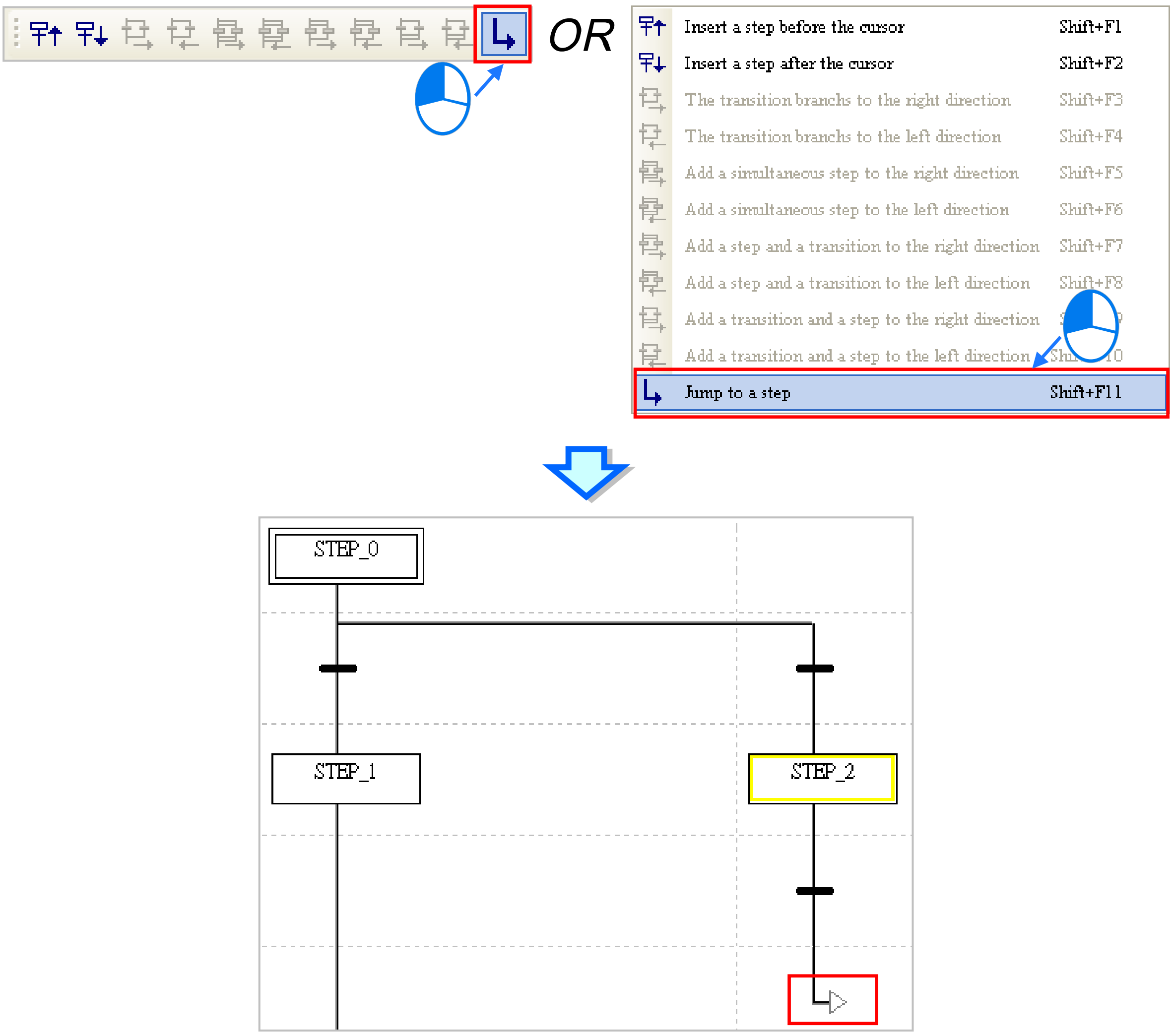




14.3.8 Inserting a Jump Point

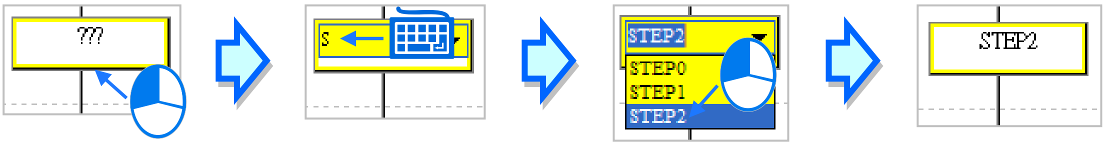
(1) Select the bottommost step or the bottommost transition on a divergent path in the working area.

(2) After users click on the toolbar, a jump point will be inserted. The users can also insert a jump point by right-clicking the step or the transition selected and click **Jump to a Step**.

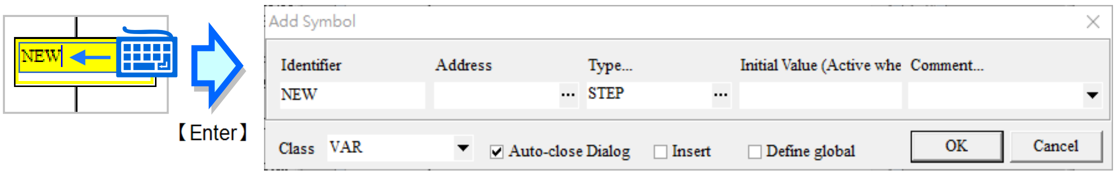


14.3.9 Assign Steps and the Transitions

After the editing of a sequential function chart is complete, users must assign symbols to the steps and the transitions in the sequential function chart. Click a step or a transition first. After a yellow frame appears, users can type partial step name to see a dropdown list and then click to select the step or the transition. Click the button at the right side of the box which appears, and select an item created.



The users can also assign a symbol to a step or a transition by means of the keyboard. They can move the yellow frame by pressing the up/down key on the keyboard. After the users select a step or a transition, they can press Enter on the keyboard. The users can type characters in the box which appears and a drop-down list will appear. The users can select a symbol on the drop-down list by the up/down key on the keyboard. After the editing of the box is complete, the users can press Enter on the keyboard to jump to the next box. If the users want to end the editing, they can press Esc on the keyboard. Besides, if the step name the users type in the box for a step is symbol which is not declared, the **Add Symbol** window will appear after the users press Enter on the keyboard. However, if the transition name the users type in the box for a transition is a symbol which is not declared, the **Add Symbol** will not appear.

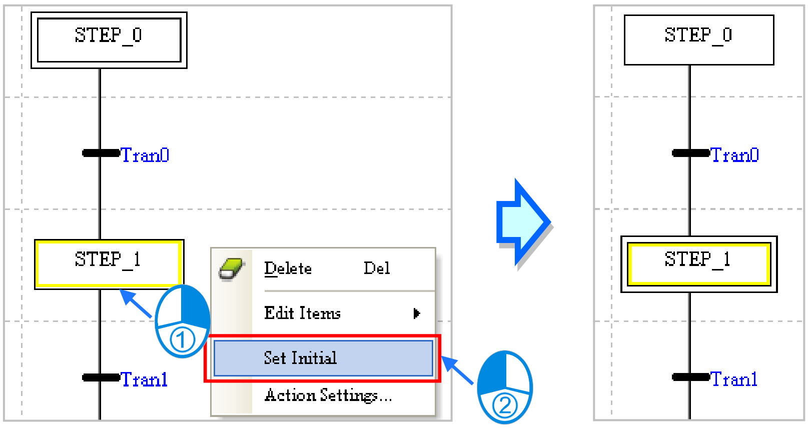


***.Transitions can be assigned as the element BOOL for the structure variable. Please refer to chapter 8, for more information about structure.**

***. Users can decide whether to allow the system to open the Add Symbol window automatically or not. Please refer to section 2.3.1 for more information about the setting.**

14.3.10 Specifying an Initial Step

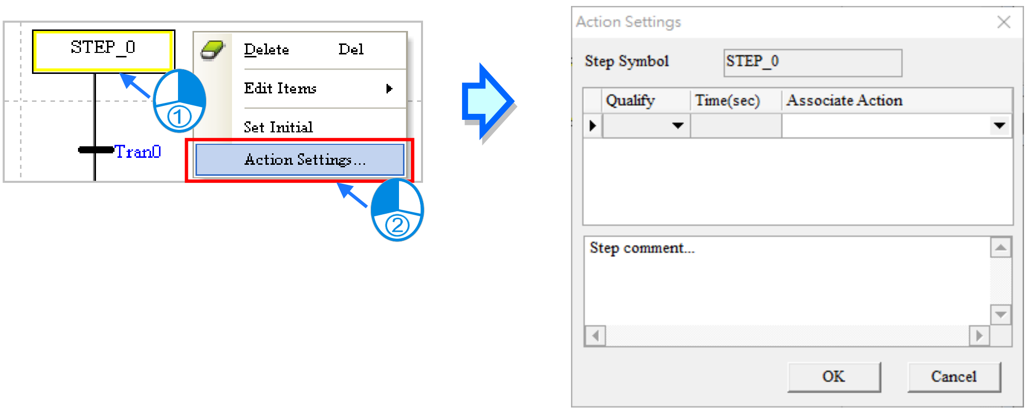
Users can define a step in a sequential function chart in an AH/AS series CPU module as the initial step in the sequential function chart whereas they can not define a step in a sequential function chart in a DVP series PLC as the initial step in the sequential function chart. If users want to define a step in a sequential function chart as the initial step in the sequential function chart, they have to select the step in the working area, right-click the step, and click **Set Initial** on the context menu.



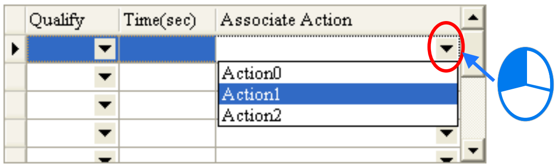
***. Please refer to section 14.2.7 for more information about activating the steps in a DVP series PLC.**

14.3.11 Assigning Actions / Fold the Action Table

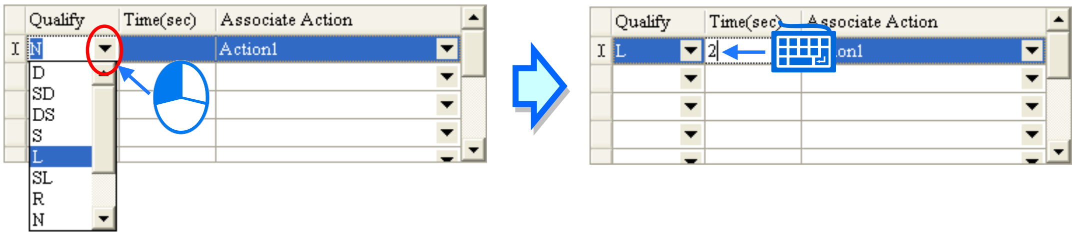
(1) Select the step to which an action will be assigned, right-click the step, and click **Action Settings…** on the context menu to open the **Action Setting**s window. If the step is not declared, the system will not allow the assignment of an action to the step.



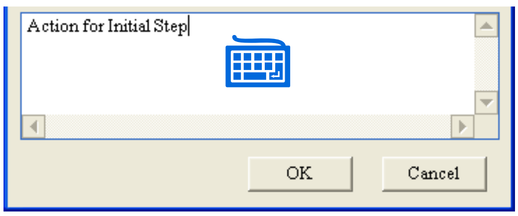
(2) Select an action in an **Associate Action** drop-down list cell in the **Action Setting**s window.



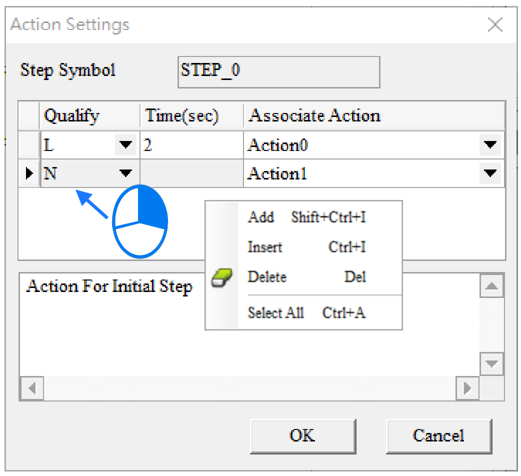
(3) After an action is selected, users have to select a qualifier in the **Qualify** drop-down list cell for the action. If the qualifier selected is related to time, the users have to type a time interval in the **Time (sec)** cell for the qualifier. A second is a measurement unit of a time interval. Besides, the users can only type an integer. (The users can not qualify the actions in the program in a DVP series PLC.)



(4) If the users want to make comments on the step, they can type the comments in the box at the lower part of the window.



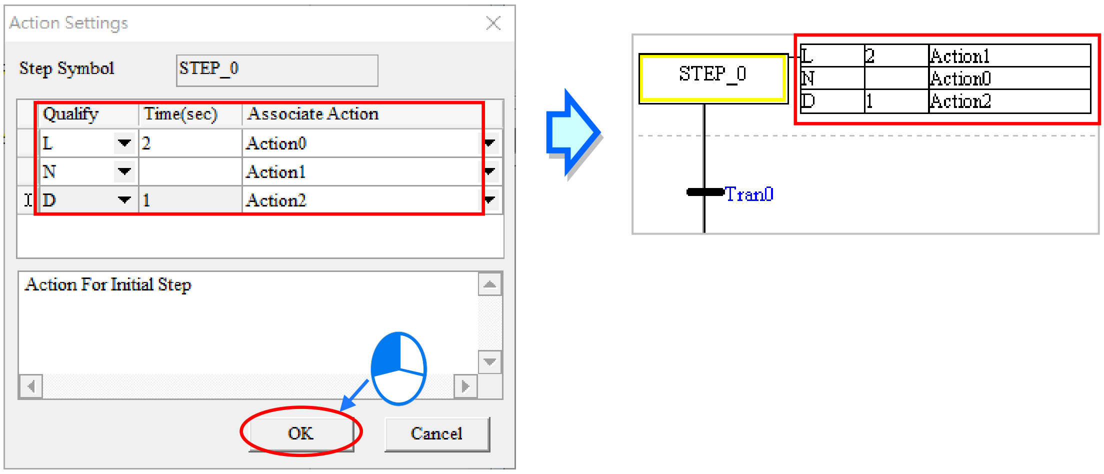
(5) After the users right-click an item on the list, they can click **Add**, **Insert**, **Delete**, or **Select All** on the context menu. When there are more than one action that needed to be selected, users can hold the Control button on the keyboard and simultaneously use the mouse to click and select the actions. Users can also hold the Shift button on the keyboard and simultaneously use the mouse to click the first action needed and the last action needed to set the selection range.



Item	Function

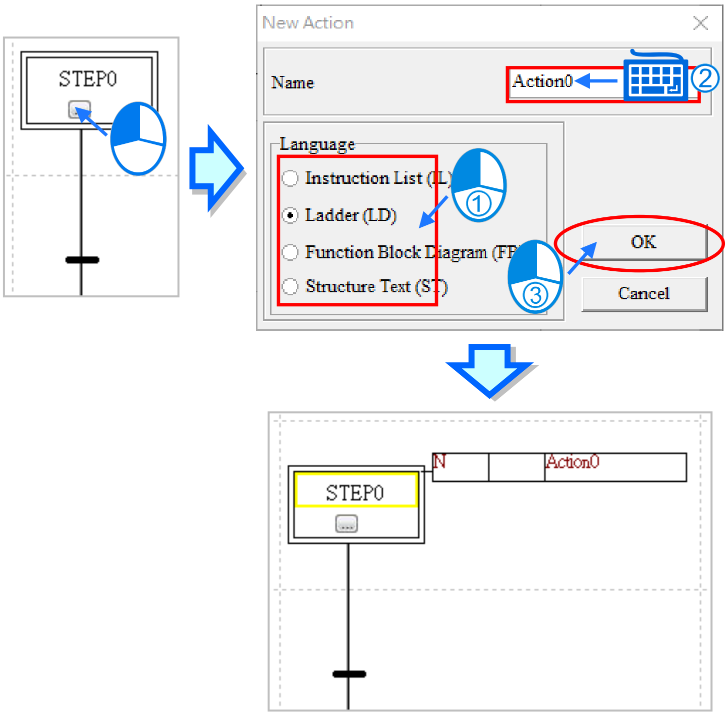
Item	Function
Add	Adding a row to the bottom of the cell selected.
Insert	Inserting a row above the cell selected
Delete	Deleting the row selected
Select All	Selecting all the items

(6) After the assignment of actions is complete, users can click **OK**. A list of the actions will appear at the right side of the step.

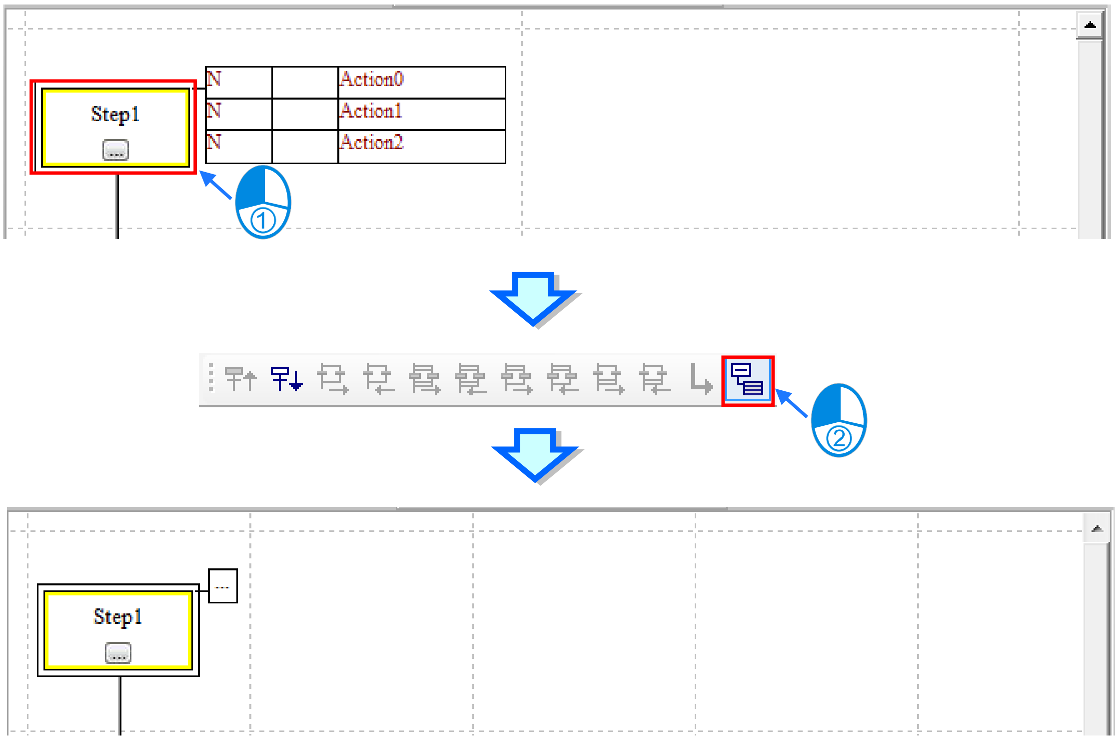


Additional remark

ISPSoft has a new button for quickly adding and set up actions. Users can click the button in the STEP to open a New Action window to add and set up actions. Once the creation is done, click the OK button to have the action added to the step you have selected.



Users can use the icon  to fold the Action table to save some space.



14.4 Sequential Function Chart Examples

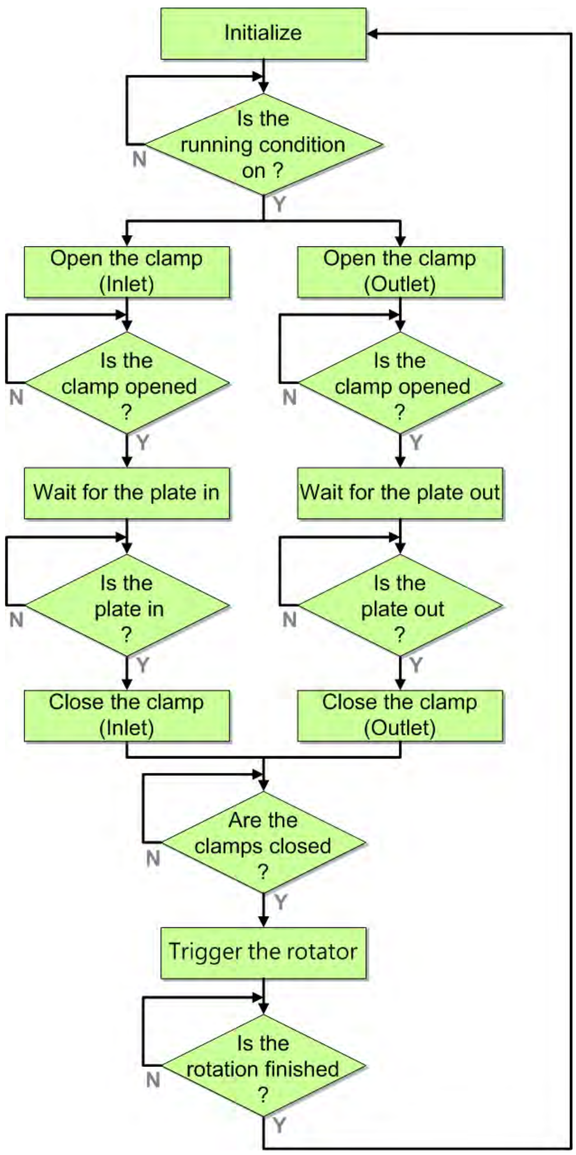
14.4.1 Example Descriptions

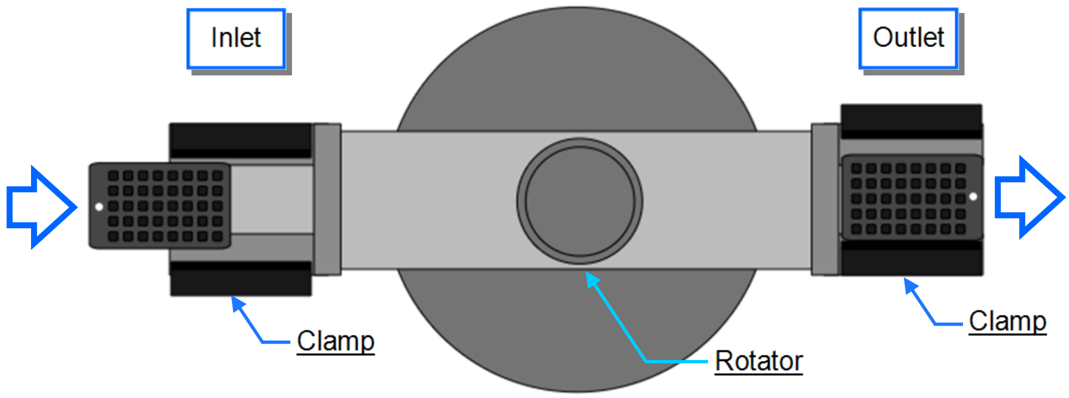
The example is about the rotation of two plates. The figure below is a flow chart. The actual equipment is also diagramed below.

The inlet is at the right side of the platform, and the outlet is at the left side of the platform. After a plate enters the inlet, and the plate in the outlet makes its exit from the outlet, the rotator in the middle of the platform will rotate 180 degrees. After the rotator rotates, the plate which entered the inlet will be in the outlet, and the clamp from which the plate made its exit will receive another plate. During the whole process, a plate enters the inlet independently, and the plate in the outlet makes its exit from the outlet independently. However, the rotator does not rotate independently.

When the system begins to operate, the cylinders under the clamps open the clamps. After the clamps are opened, the system will send readiness signals. After the readiness signals are sent, a plate will enter the inlet, and the plate in the outlet will make its exit from the outlet.

After a plate enters the inlet, and the plate in the outlet makes its exit from the outlet, the system will receive completion signals, the corresponding readiness signals will be set to OFF, and the clamps will be closed. After the system makes sure that the clamps are closed, the system will send a trigger signal. After the rotator rotates 180 degrees, and the system receives a completion signal, the next cycle will begin.


Initialize
Is the running condition on ?
N
Y
Open the clamp (Inlet)
Open the clamp (Outlet)
Is the clamp opened ?
N
Y
Is the clamp opened ?
N
Y
Wait for the plate in
Wait for the plate out
Is the plate in ?
N
Y
Is the plate out ?
N
Y
Close the clamp (Inlet)
Close the clamp (Outlet)
Are the clamps closed ?
N
Y
Trigger the rotator
Is the rotation finished ?
N
Y


Inlet
Outlet
Clamp
Rotator
Clamp

14.4.2 Planning Hardware

In this example, the AH5x0 series **AHCPU530-EN**, the digital I/O module **AH16AP11R-5A**, and the four-slot main backplane **AHBP04M1-5A** are used. The table below is an I/O allocation table.

Type	ID	Description
Digital input	X0.0	Completion signal
Digital input	X0.1	Completion signal
Digital input	X0.2	Completion signal
Digital input	X0.3	(Inlet) Cylinder─Opening sensor
Digital input	X0.4	(Inlet) Cylinder─Closing sensor
Digital input	X0.5	(Outlet) Cylinder─Opening Sensor
Digital input	X0.6	(Outlet) Cylinder─Closing Sensor
Digital output	Y0.0	Readiness signal
Digital output	Y0.1	Readiness signal
Digital output	Y0.2	Trigger signal
Digital output	Y0.3	(Inlet) Clamp
Digital output	Y0.4	(Outlet) Clamp

14.4.3 Planning a Program

(1) The procedure for initializing the system is to reset the trigger signal and the readiness signals to OFF until the condition for the operation of the system is met. In this example, when the operation flag is ON, and the error flag is OFF, the condition for the operation of the system is met.

(2) Once the system begins to operate, the cylinders under the clamps will open the clamps **(Y0.3 and Y0.4)**, and the system will make sure that the opening sensors **(X0.3 and X0.5)** are ON.

(3) After the system makes sure that the clamps are opened, the system will send readiness signals **(Y0.0 and Y0.1)** to inform the work stations connecting to the system.

(4) After a plate enters the inlet, the system will receive a completion signal **(X0.0)**, and delay the closing of the clamp in the inlet **(Y0.3)** for one second.

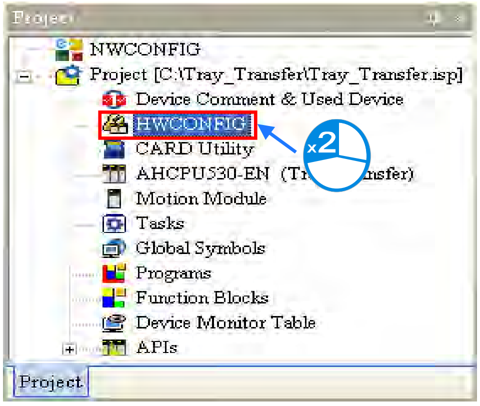
(5) After the plate in the outlet makes its exit from the outlet, the system will receive a completion signal **(X0.1)**, and delay the closing of the clamp in the outlet **(Y0.4)** for one second.

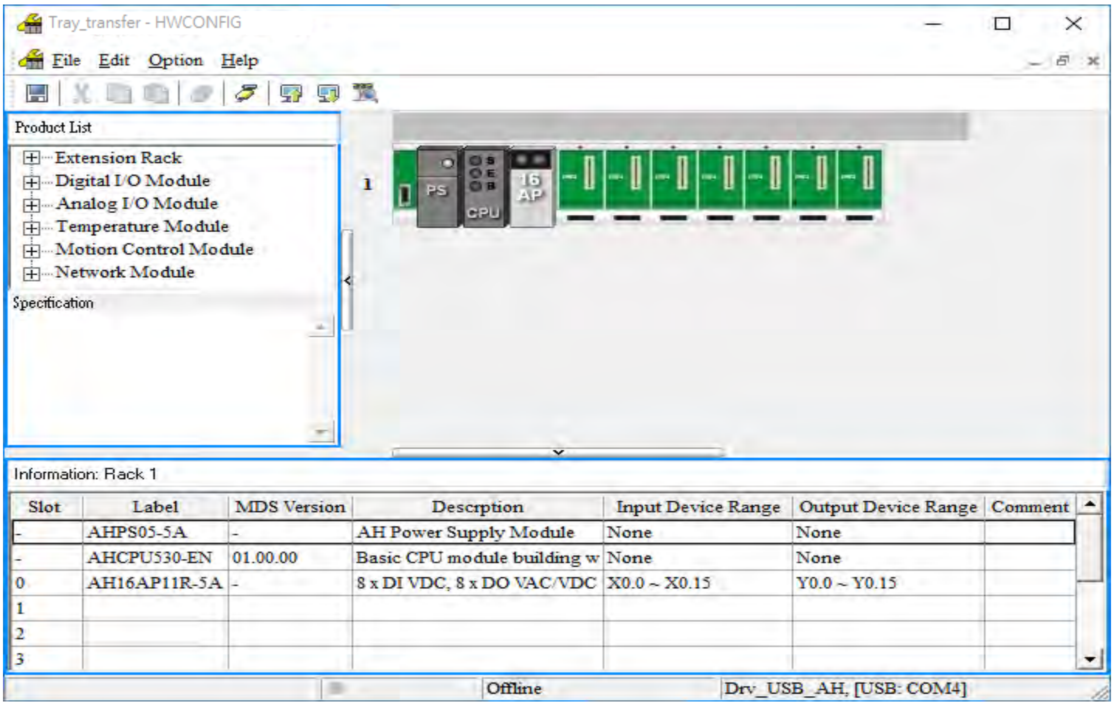
(6) After the system makes sure that the closing sensors **(X0.4 and X0.6)** are ON, the system will send a trigger signal **(Y0.2)**. After the rotator rotates 180 degrees, the system will receive a completion signal **(X0.2)**, and the procedure for initializing the system is carried out again.

14.4.4 Creating a Program

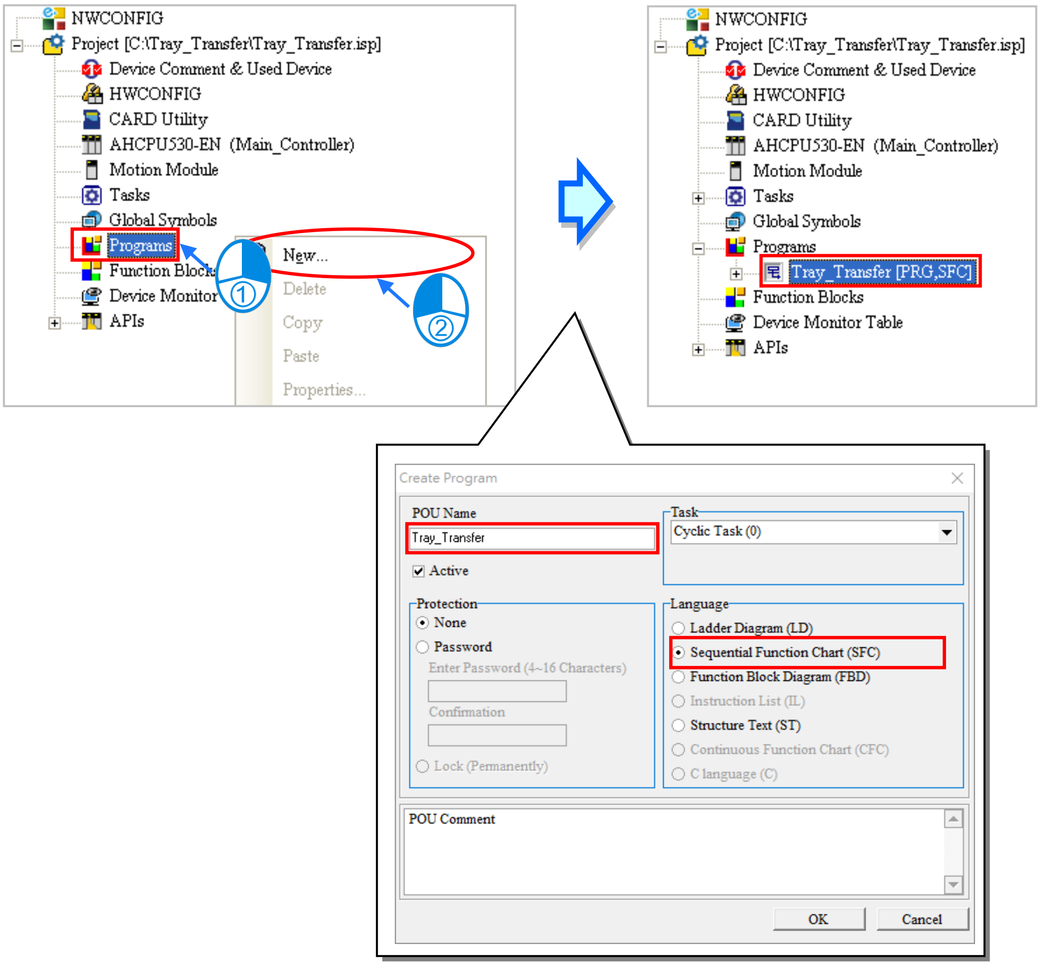
Start ISPSoft, and then create a new project.

The hardware configuration in this example is the same as the hardware configuration in chapter 4. Please refer to chapter 4, and complete the hardware configuration.





Create a POU of the program type in the project management area. The programming language used to create the POU of the program type is a structured text.



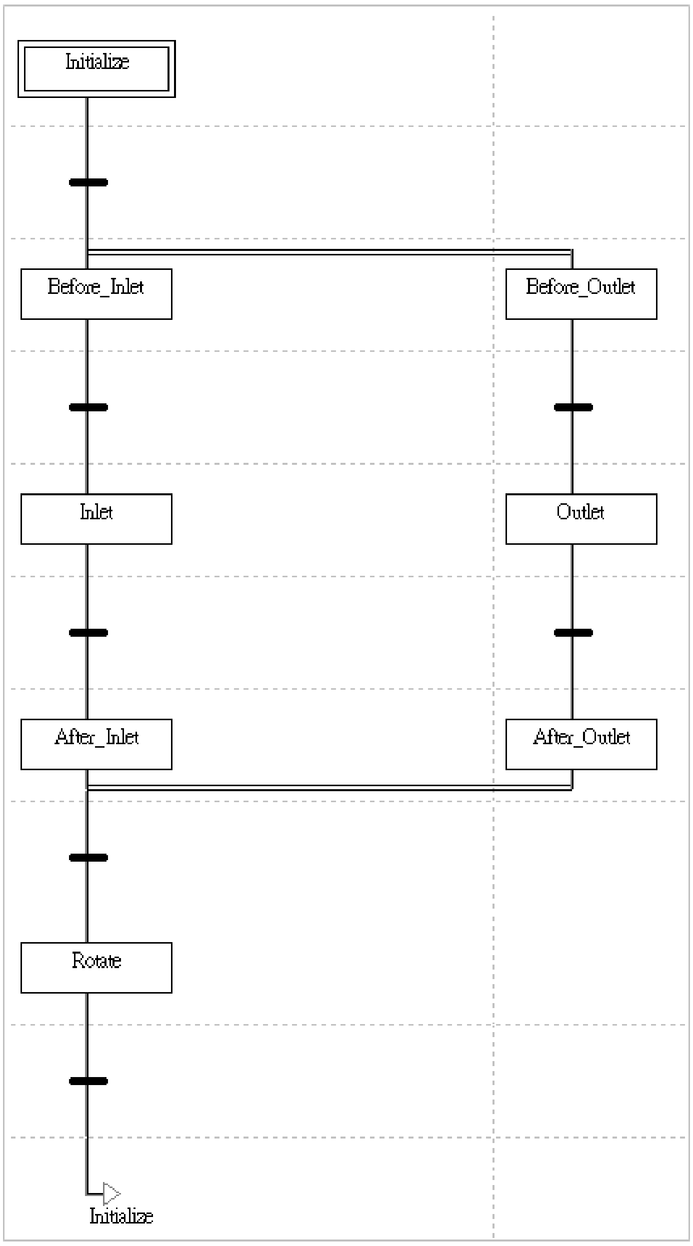
Create the flags, the digital input, and the digital outputs in the global symbol table.

Class	Identifiers	Address	Type...	Initial Value	Identifier Comment...
VAR	IN_Done	X0.0	BOOL	FALSE	
VAR	OUT_Done	X0.1	BOOL	FALSE	
VAR	R_Done	X0.2	BOOL	FALSE	
VAR	Clip_1_OS	X0.3	BOOL	FALSE	
VAR	Clip_1_CS	X0.4	BOOL	FALSE	
VAR	Clip_2_OS	X0.5	BOOL	FALSE	
VAR	Clip_2_CS	X0.6	BOOL	FALSE	
VAR	Inlet_Rdy	Y0.0	BOOL	FALSE	
VAR	Outlet_Rdy	Y0.1	BOOL	FALSE	
VAR	Rotator_Trig	Y0.2	BOOL	FALSE	
VAR	Clip_1	Y0.3	BOOL	FALSE	
VAR	Clip_2	Y0.4	BOOL	FALSE	
VAR	RUN	N/A [Auto]	BOOL	FALSE	
VAR	ERROR	N/A [Auto]	BOOL	FALSE	

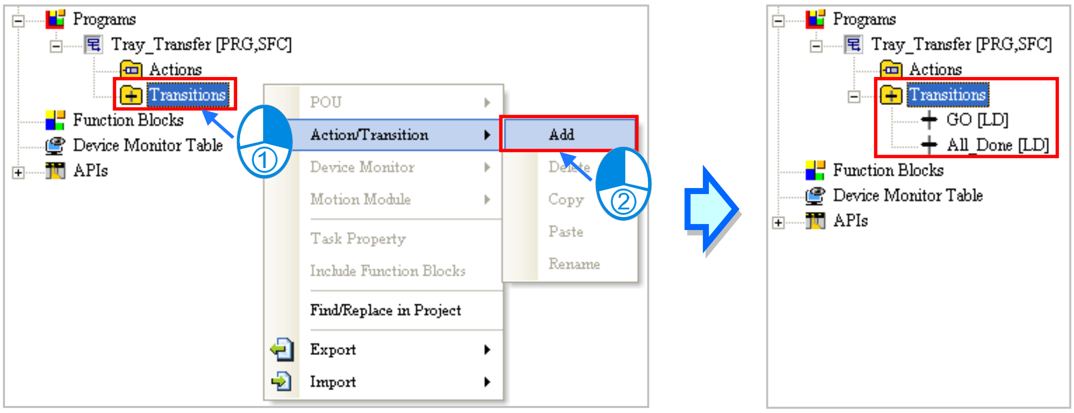
Declare the steps shown below in the local symbol table in the POU of the program type.

Local Symbols					
Class	Identifiers	Address	Type...	Initial Value	Identifier Comment...
VAR	Initialize	N/A [Auto]	STEP	FALSE	
VAR	Before_Inlet	N/A [Auto]	STEP	FALSE	
VAR	After_Inlet	N/A [Auto]	STEP	FALSE	
VAR	Before_Outlet	N/A [Auto]	STEP	FALSE	
VAR	After_Outlet	N/A [Auto]	STEP	FALSE	
VAR	Inlet	N/A [Auto]	STEP	FALSE	
VAR	Outlet	N/A [Auto]	STEP	FALSE	
VAR	Rotate	N/A [Auto]	STEP	FALSE	

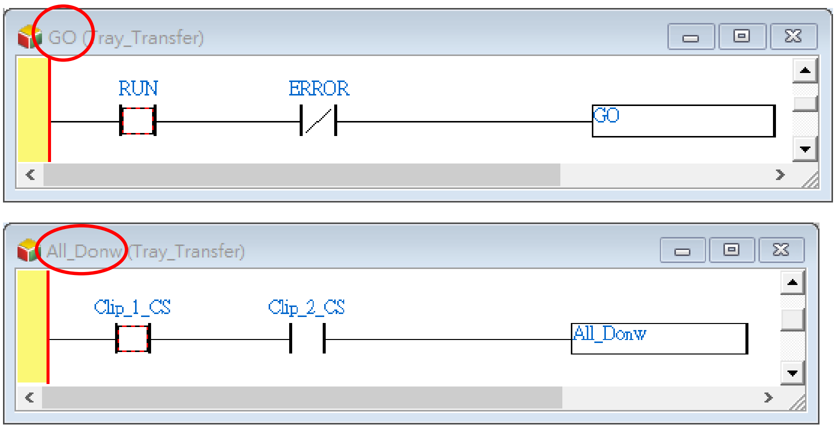
Base on the sequential function chart shown below, use the first step by default for initial step.



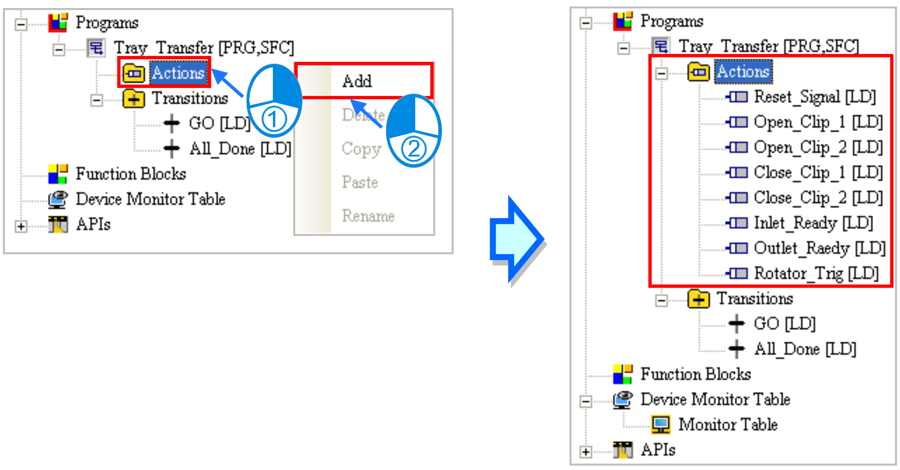
Create a transition called **Go** and a transition called **All_Done** under the **Transitions** section in the project management area.



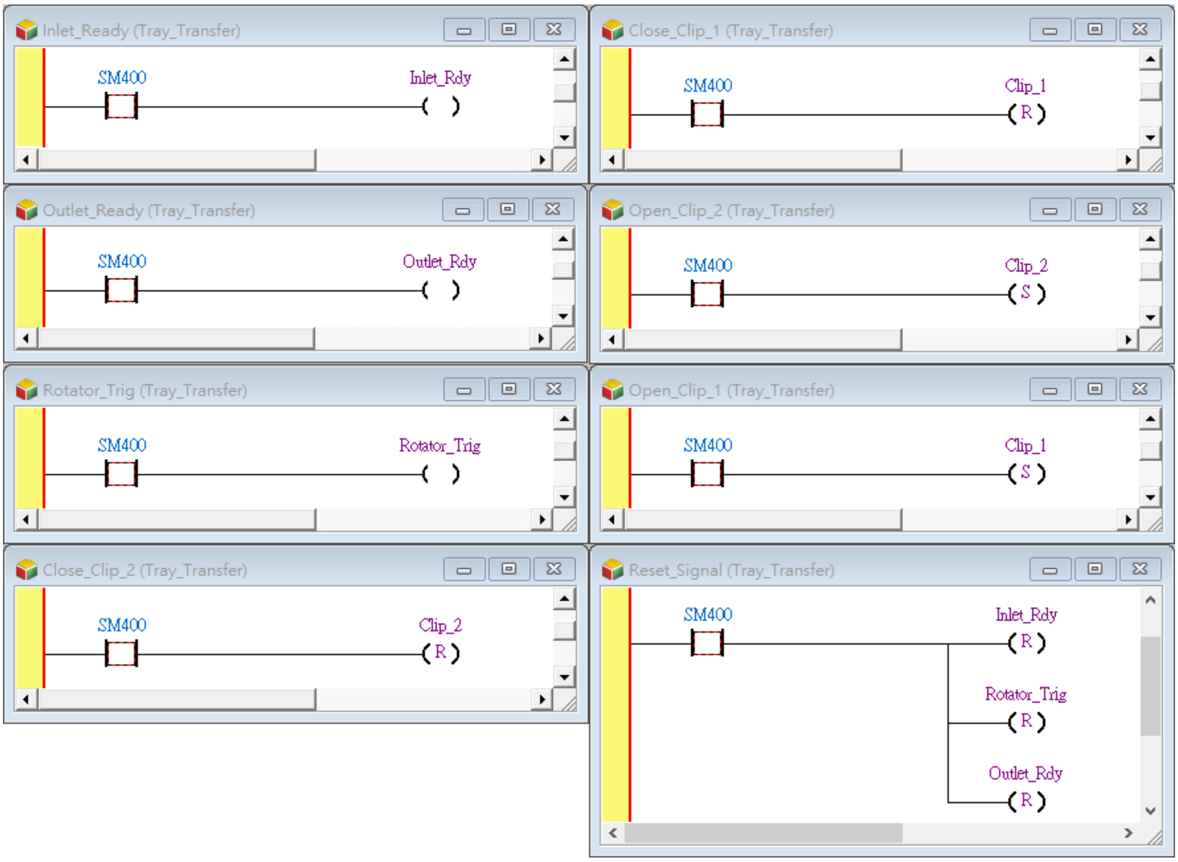
After a transition called **Go** and a transition called **All_Done** are created under the **Transitions** section in the project management area, users have to write the programs shown below.



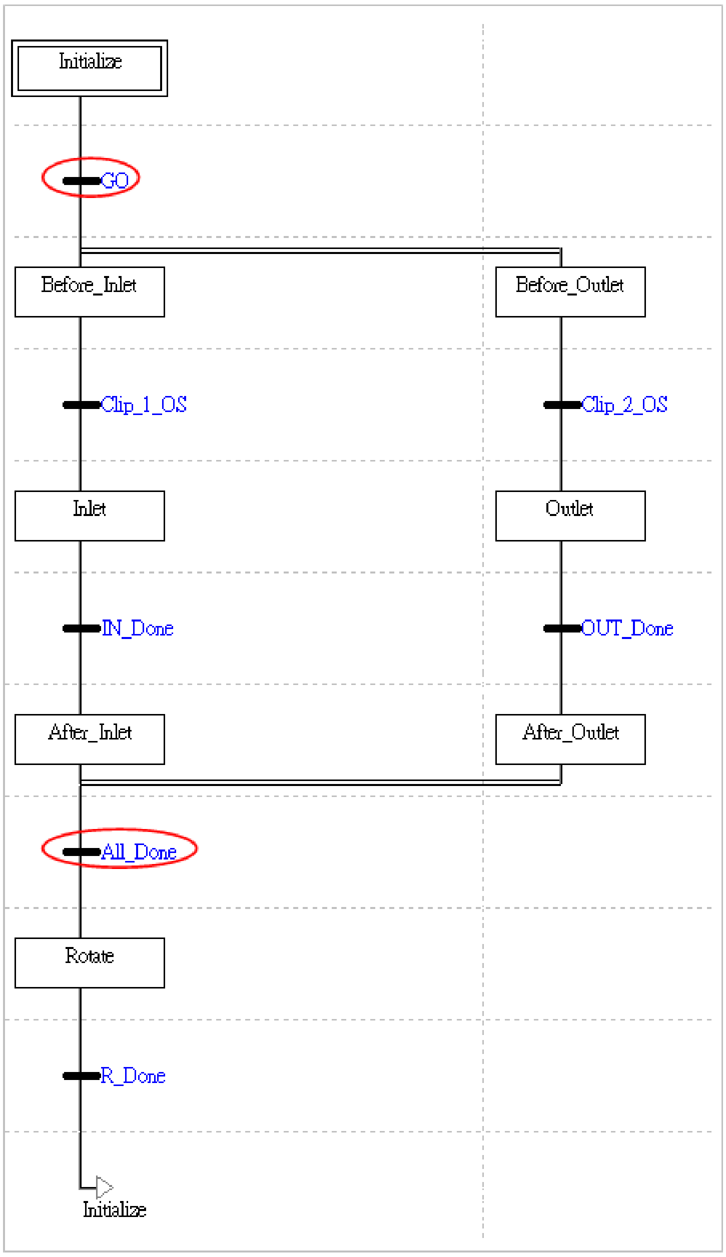
Create the actions which are shown below under the **Actions** section in the project management area.



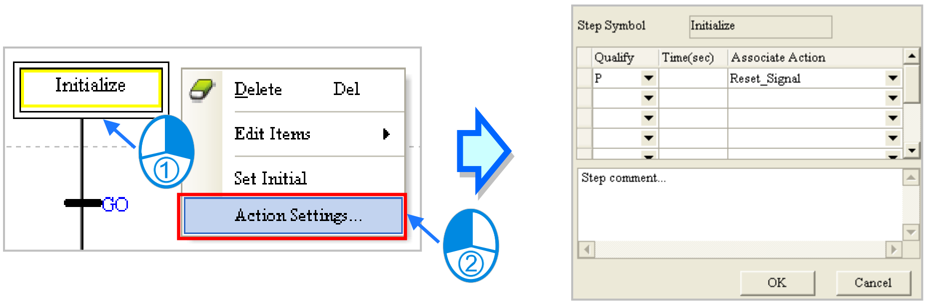
After the actions are created under the **Actions** section in the project management area, the users have to write the programs shown below.



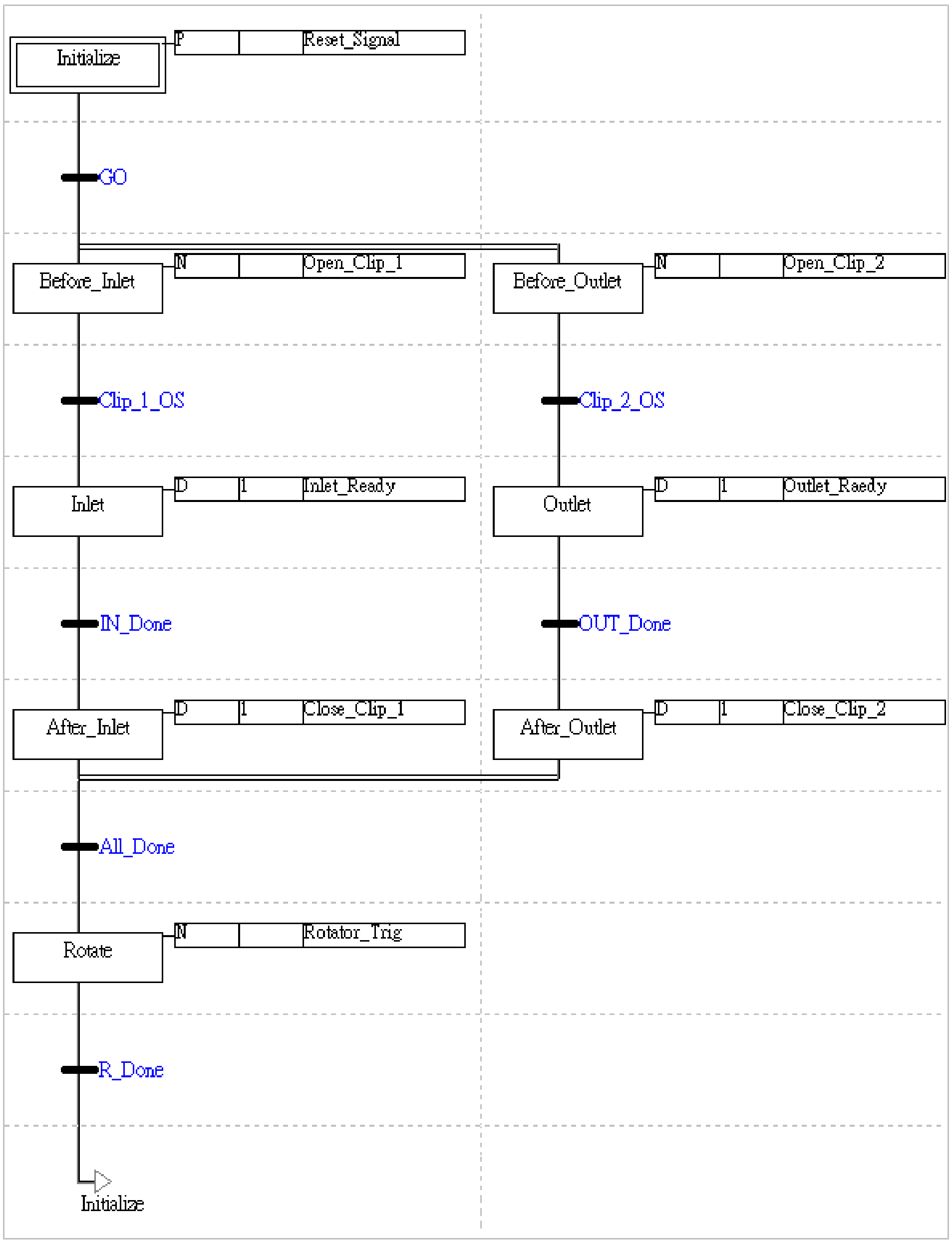
After the users write the action programs and the transition programs, they have to assign symbols to the transitions in the sequential function chart. All the symbols assigned to the transitions in the sequential function chart are symbols in the global symbol except **GO** and **All_Done**.



The users have to assign the actions to the steps in the sequential function chart, and assign qualifiers to the actions.



The writing of the program has been completed so far. The users can try to compile the program, download the parameters and the program to the CPU module, and test the program by themselves.



Chapter 15 Continuous Function Charts

Table of Contents

15.1 Continuous Function Charts (CFC)

15.1.1 About Continuous Function Charts

Continuous Function Chart (CFC) is a PLC programming language in extension to the IEC 61131-3 standard. CFC is often used in the area of motion control. The most significant feature is its graphical programming language basing on the function block diagram language. Comparing to other PLC programming languages, CFC can provide a more logical relation between input and output and a more clear execution order of the program. The operation principle of CFC will not be covered in this chapter; this chapter will only focus on the creation and operation of CFC in ISPSoft.

15.1.2 Things to Note When Using CFC

- It supports keyboards but does not support the instructions of LD, LDI, LDP, and LDF. Users can type the register or the name of the variable, and the system will add input node in the back.

- Inputted data is not case-sensitive, any uppercase or lowercase character can be entered. For example, OUT, Out and out are all correct. Common positional numeral systems:

  - Decimal range: 2345
  - Hexadecimal range: 16#5BA0
  - Floating point number: 4.123

*. The K and H notations are supported.

- There is no limit on the number of the loops for CFC to edit. But the size of a edited programs should not be larger than the memory size.

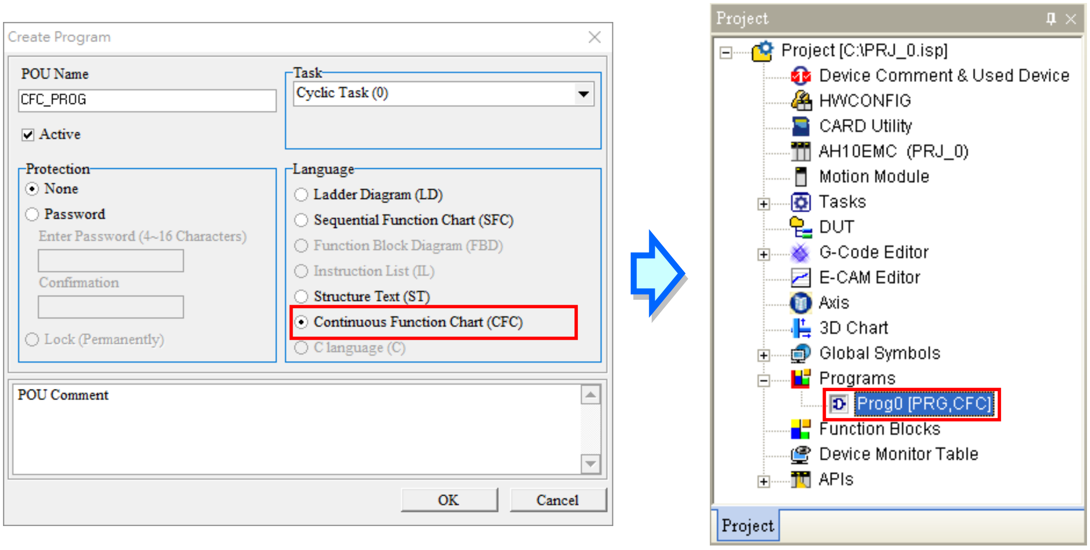
  The input pin of nodes, logic gates, instructions, and function blocks can only be from one origin. But the targets of the output pin can be multiple.

15.1.3 CFC Programming in ISPSoft

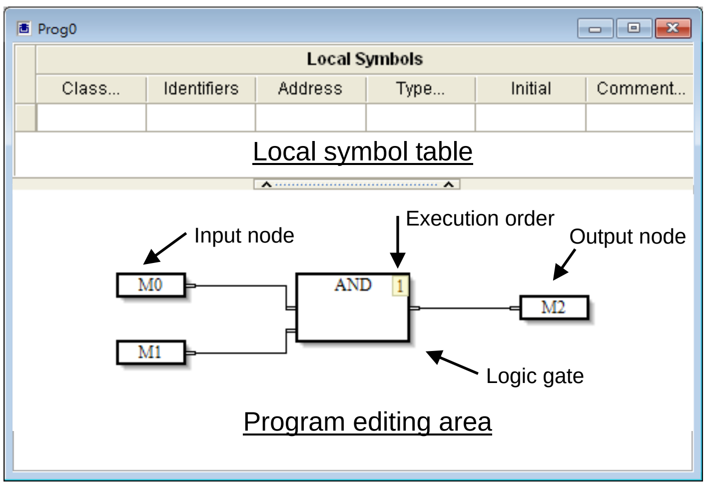
When creating a POU, select **Continuous Function Chart (CFC)** in the Language selection section

, then users can see the created program in the project management area. Refer to section 5.4.1

for more information.

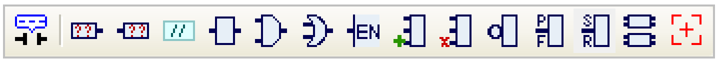


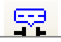
Below is the editing area for CFC in the ISPSoft. The upper section is for Local Symbols to be declared. And the lower section is for CFC program editing, including the input/export nodes and logic gate. The number on the upper right corner of the object is the execution order.



15.1.4 CFC Editing Toolbar

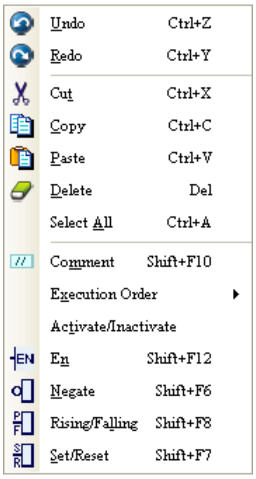
After a program editing window in which a CFC diagram can be created is opened, the corresponding toolbar will appear in the ISPSoft window. The functions are described below.



Icon	Keyboard Shortcut	Function
	None	Displaying/Hiding the commands on the devices
	Shift + F9	Inserting an input node
	Shift + F3	Inserting an output node
	Shift + F10	Comment
	Shift + F11	OUT gate
	Shift + F1	Inserting an AND block
	Shift + F2	Inserting an OR block
	Shift + F12	Enable/Disable function blocks or the EN pin of the
	Shift + F4	Adding an input node to the AND/OR block
	Shift + F5	Deleting the input node from the AND/OR block
	Shift + F6	Inserting inverse logic
	Shift + F7	Setting/Resetting the input
	Shift + F8	The input is rising edge-triggered/falling
	None	Auto arrange All the objects will be sorted according to the data flow
	None	Auto resize to fit the screen to see all the objects

15.1.5 Shortcuts for CFC Programing

Right-click in the editing area, users will see the following shortcuts. The functions are described below.



Item	Description
Undo	It erases the last editing done to the document reverting it to an older state.
Redo	It reverses the undo.
Cut	Cut the selected object.
Copy	Copy the selected object.
Paste	Paste the lately cut/copied object to the editing position.
Delete	Delete the selected object.
Select All	Select all objects in the editing area.
Comment	Insert a comment at the cursor position.
Execution Order	Set up the execution order of the logic gates, instructions and function blocks. Data flow: all objects will be run according to the original set order. Topology: all the objects will be sorted and executed in an order of top-to-bottom and left-to-right.
Activate/Inactivate	Activate/inactivate the selected object
EN	Enable/Disable function blocks or the EN pin of the instructions
Negate	Inserting inverse logic
Rising/Falling	The input is rising edge-triggered/falling edge-triggered.
Set/Reset	Setting/Resetting the input

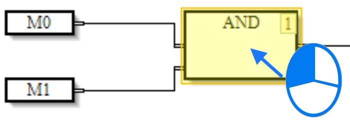
15.2 Creating a CFC in ISPSoft

15.2.1 Selecting Objects

Objects in the CFC can be selected by clicking the mouse. After selected, users can start to edit, copy, paste and so on.

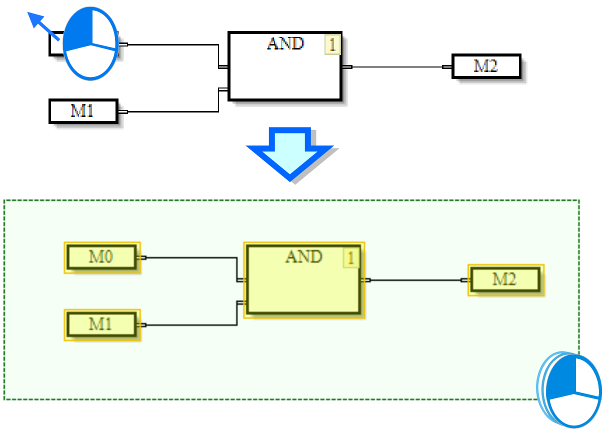
- Select an object

  Move the cursor to the object you'd like to select and click the mouse or use the directional buttons on the keyboard to select objects. The selected object will be in orange; as for unselected objects, they are in white as the image shown below.



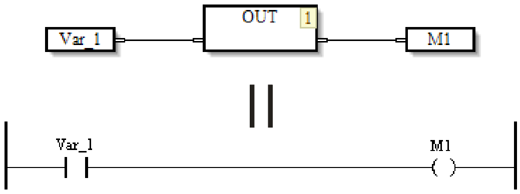
- Select multiple objects

  Click and drag the mouse to select the area of objects you'd like to select.

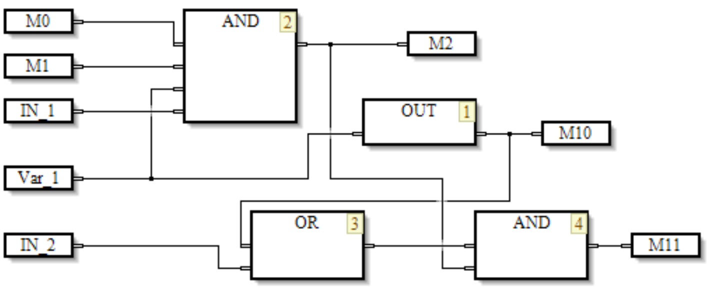


15.2.2 Input/Output Nodes and Logic Gates

Nodes and logic gates are factors to construct a CFC. Input nodes can be the variable status of the input origin or the status of the register. The output nodes are the results from the operation of logic gates. The following example illustrates the same program in 2 programming languages, the CFC and LD. Input nodes and output nodes cannot be linked directly; that is why logic gates are needed.



Use logic gates such as AND gate and OR gate to link the objects to create various complicated loops, as the following example shown.

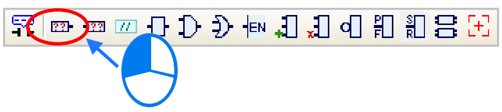


15.2.2.1 Inserting Nodes or Gates

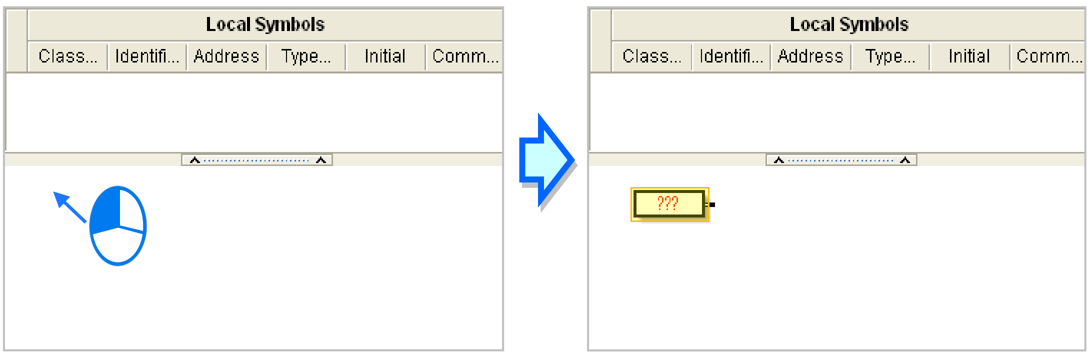
There are 2 methods to insert a node, choose one for insertions.

● Method I: use the icons from the toolbar

(1) Click the icon from the toolbar, as the image shown below.

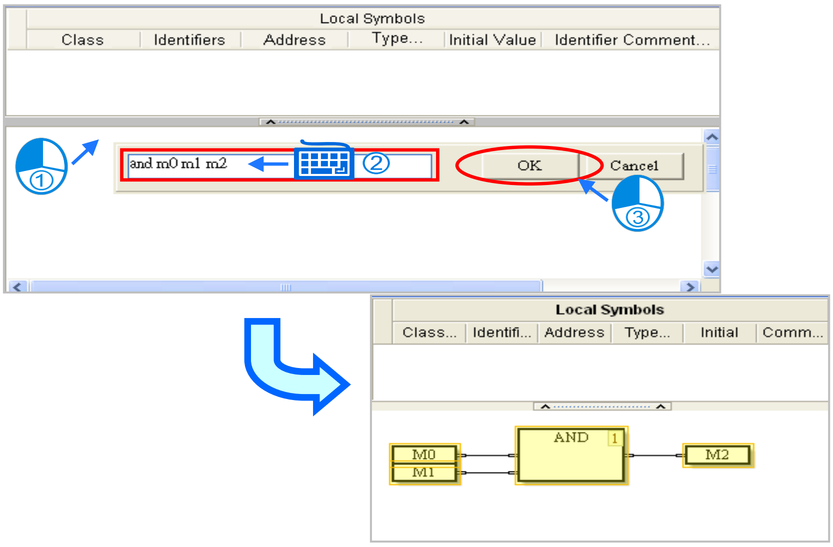


(2) Click the mouse on where you'd like to put the nodes/gates in the editing area, as the image shown below.



● Method II: use a keyboard

(1) Click the mouse in the editing area and type the name of the instruction. After pressing Enter on the keyboard or click the OK button on the screen, the instruction will appear. Click where you'd like to use the instruction and then the instruction creation is done. (The instructions you type are not case-sensitive. But if the instruction name is wrong, an error message will appear.)



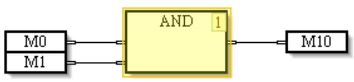
Instructions can be created via a keyboard:

Instruction	Description
OUT	Creating an OUT gate
AND	Creating an AND gate
OR	Creating an OR gate
Name of a register	Creating an input nodes for the register
Name of a instruction	Creating an instruction block
Name of a function block	Creating a function block

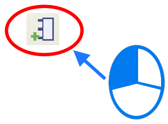
15.2.2.2 Add / Delete a Pin

AND and Or gates can be used for adding and deleting a pin, suitable for programs with multiple conditions.

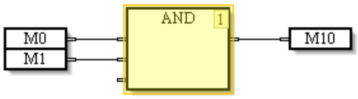
(1) Click to select the logic gate as the image shown below.



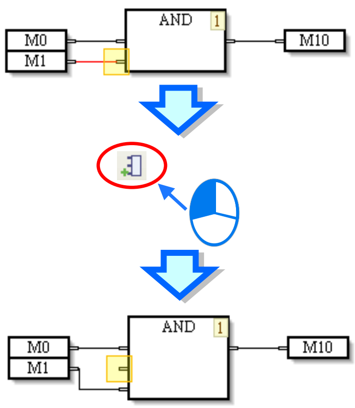
(2) Click the icon  to add an input node to the AND/OR gates as the image shown below.



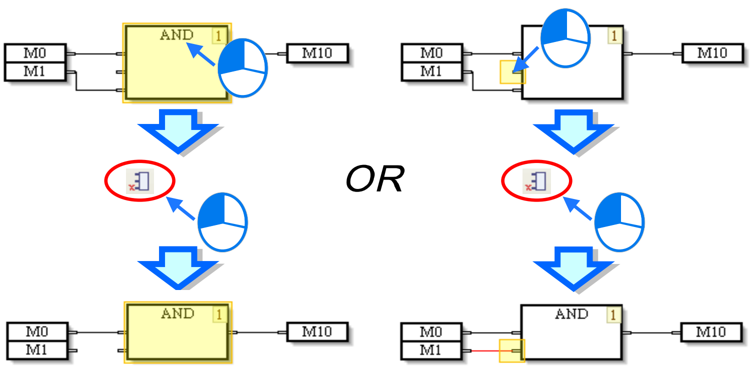
(3) Then there will be a pin added to the logic gate as the image shown below.



(4) If a pin needs to be added before a specific pin, click to select the pin you'd like to add a new pin before it and click the icon . A newly added pin will appear right before the pin you have selected as the image shown below.



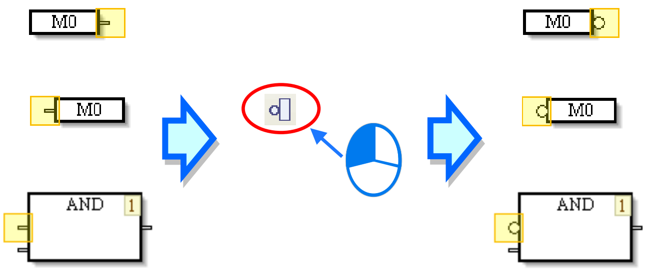
(5) Click the icon  to delete an input node from the AND/OR gates. Users can also click and select a specific pin and click the icon  to delete as the image shown below.



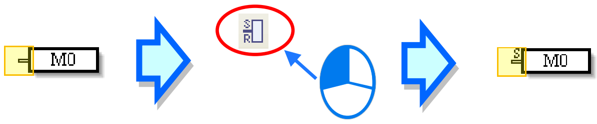
15.2.3 Changing a Pin Type

Users can change a pin type in a way described below, and design a complex continuous function chart.

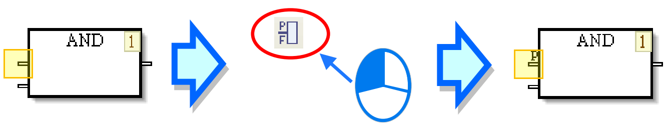
(1) For negating, users can select the pin of a node, a pin of a logic gate, a pin of a function block, or a pin of an instruction, and then click on the toolbar or on the context menu which will appear after the users right-click the pin, the state of the pin will be negated. If users select a pin whose state is negated, and then click , the state of the pin will not be negated.



(2) For setting a pin, users can select the pin of an output node, and then click on the toolbar or on the context menu which will appear after the users right-click the pin, the pin will be set. For resetting a pin, if users select a pin which is set, and then click , the pin will be reset. If users select a pin which is reset, and then click , the pin will not be reset.

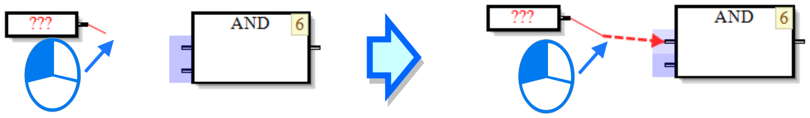


(3) For rising, users can select a pin of a logic gate, a pin of a function block, or a pin of an instruction, and then click on the toolbar or on the context menu which will appear after the users right-click the pin, the pin will be rising-edge triggered. For falling, when users select a pin which is rising edge-triggered, and then click , the pin will be falling edge-triggered. If the users select a pin which is falling edge-triggered, and then click , the pin will not be falling edge-triggered.



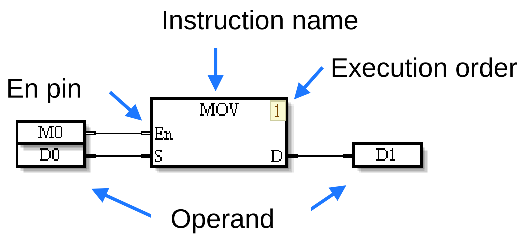
15.2.4 Connecting objects and Canceling Connections

When users click a pin of an object, and hold down the left mouse button, the target pins to which the pin can be connected are indicated by gray. When the users drag the mouse cursor to a target pin of an object, an arrow appears. After users release the left mouse button, the two pins will be connected. If users want to change the connection or cancel the connection, they can drag the line to a new target pin or to the blank.

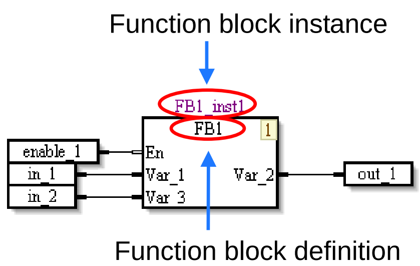


15.2.5 Instructions and Function Blocks

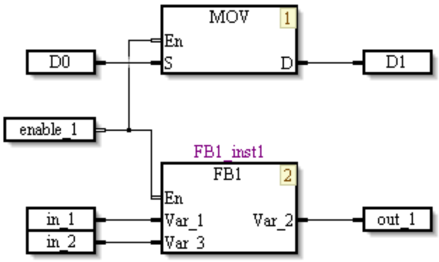
An instruction name and operands are shown in a block. The orders in which the instructions in a continuous function chart are executed are indicated by the numbers in the right corners of the blocks representing the instructions. An instruction is executed only when the logic state connected to the En pin of the block representing the instruction is ON.



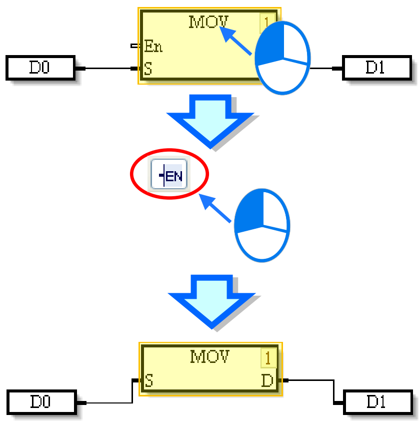
A function block in a continuous function chart is shown below. It is executed only when the logic state connected to the En pin is ON. Besides, the text on the top of the function block is the name given to the function block, i.e. a function block instance. Please refer to chapter 7 for more information about function blocks.



If users need to enable an instruction and a function block by a condition, they can connect the input node of the condition to the En pin of the block representing the instruction and the En pin of the function block. When the input node is ON, the instruction and the function block is executed in order. From the image shown below, enable_1 controls the instruction and the function block.



If an instruction or a function block does not need to be controlled by a condition, users can select the block representing the instruction or the function block, and then click EN on the toolbar or on the context menu which will appear after the users right-click the block representing the instruction or the function block. After the En pin of a block representing the instruction or the En pin of a function block is disabled, the instruction or the function block will be executed if it is the instruction's turn or the function block's turn to be executed. If users select an instruction or a function block whose En pin is disabled, and then click EN, the En pin of the instruction or the En pin of the function block will be enabled.

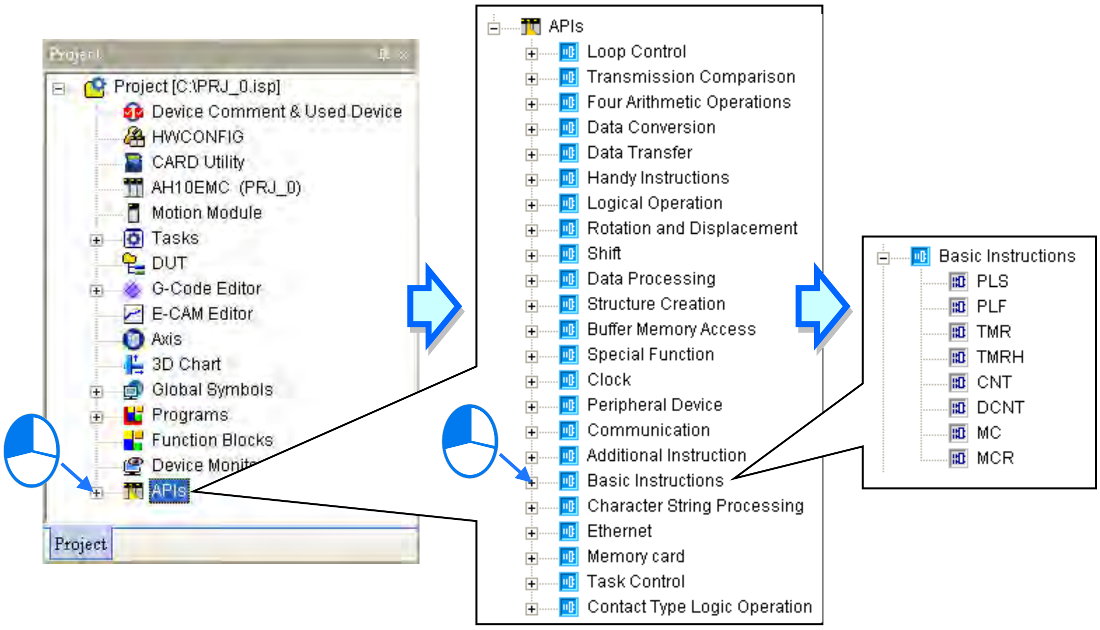


15.2.5.1 Inserting an Instruction

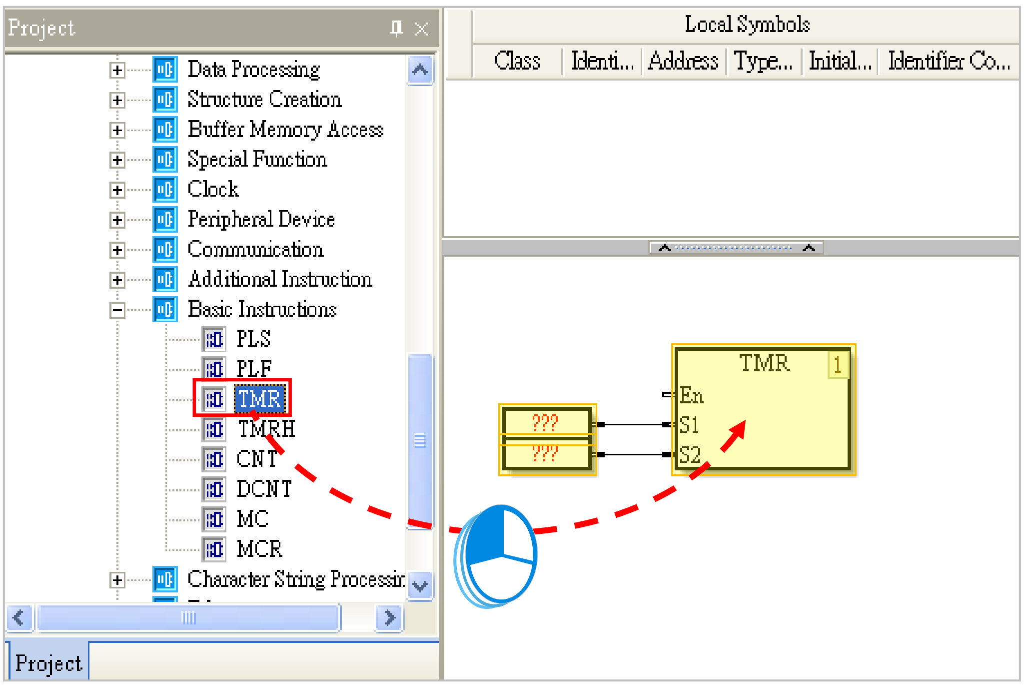
There are two methods to insert an instruction.

● Method 1: Drag the instruction

(1) Open the API to seek for the instruction you'd like to use, as the image shown below.

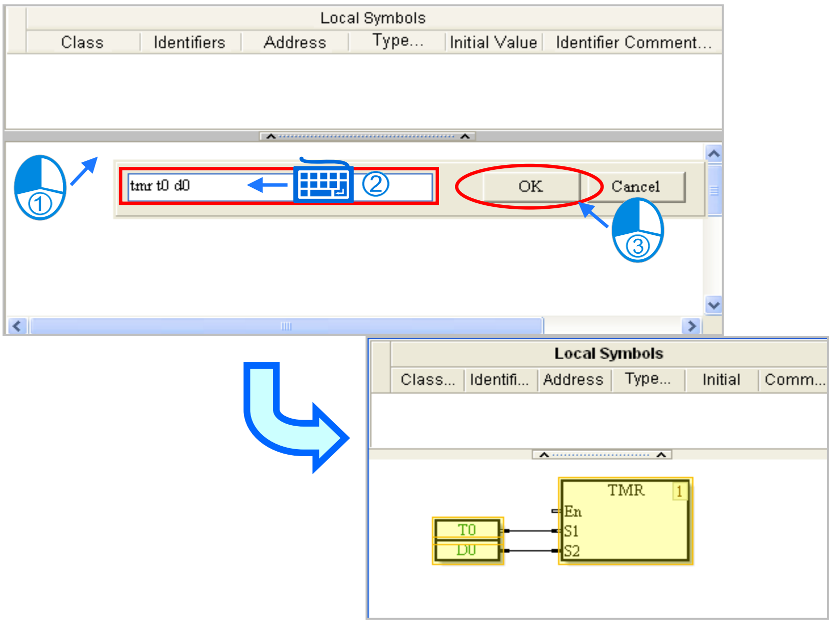


(2) Click on the instruction you'd like to add and drag it to where you'd like to add in the editing area. And then the instruction is added.



- Method 2: Keyboard

Type an instruction in the **Instruction** box, and press Enter on the keyboard, or click **OK**. If users move the mouse cursor and click where you'd like to add the instruction in the program editing area, the instruction will be inserted. (The instruction that users type in is not case-insensitive. If the users type an incorrect applied instruction, or an incorrect device name, an error message will appear after they click **OK**.), as the image shown below.

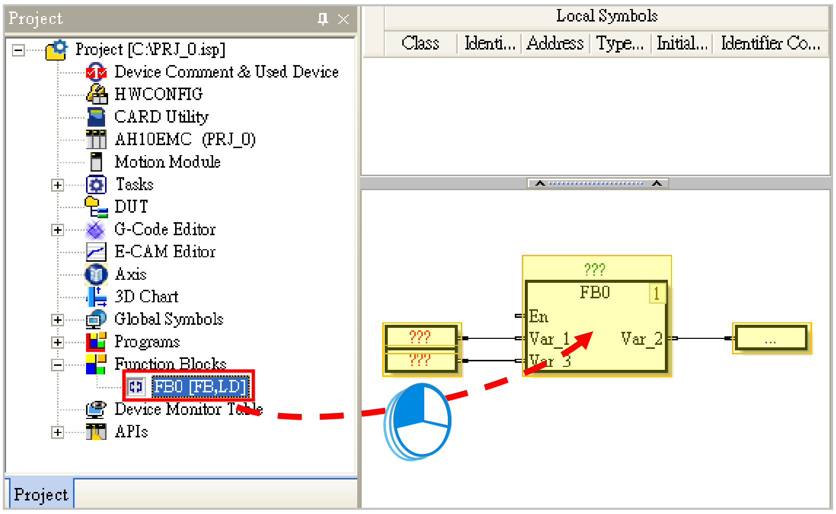


15.2.5.2 Inserting a Function Block

There are two methods of inserting a function block.

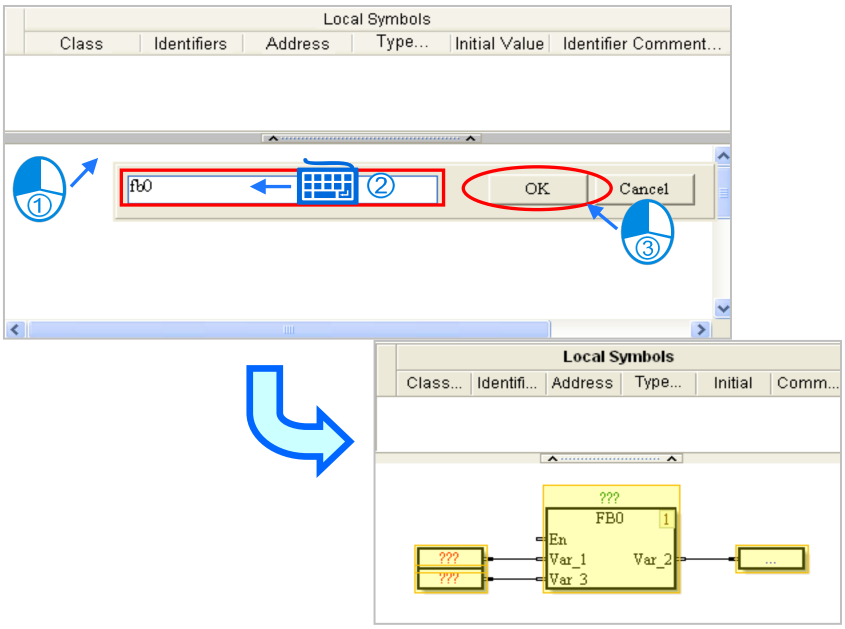
- Method 1: Dragging a function block definition

Click on the function block definition you'd like to add and drag it to where you'd like to add in the editing area. And then the funciton block is added.



● Method 2: Keyboard

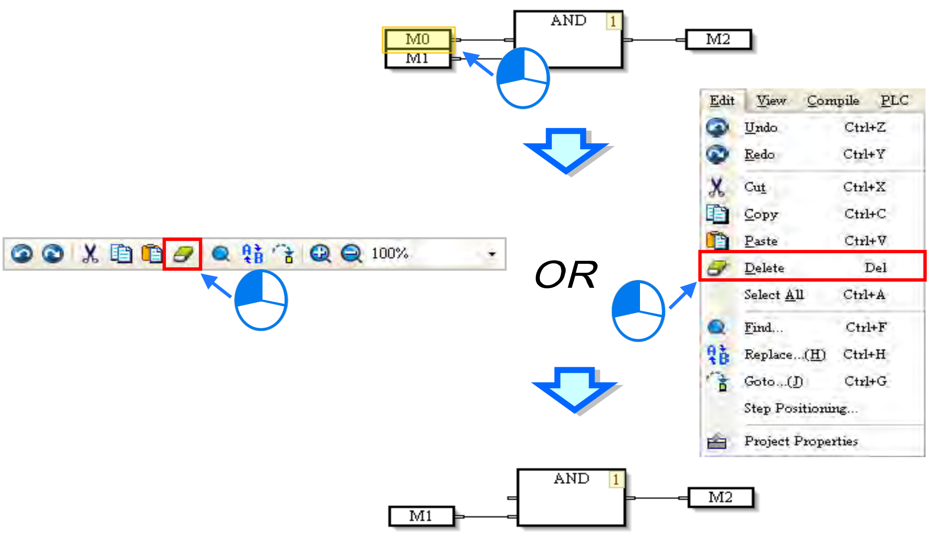
Type an instruction in the **function block definition** box, and press Enter on the keyboard, or click **OK**. If users move the mouse cursor and click where you'd like to add the function block, the function block will be inserted. (The function block that users type in is not case-insensitive. If the users type an incorrect function block, or an incorrect device name, an error message will appear after they click **OK**.), as the image shown below.



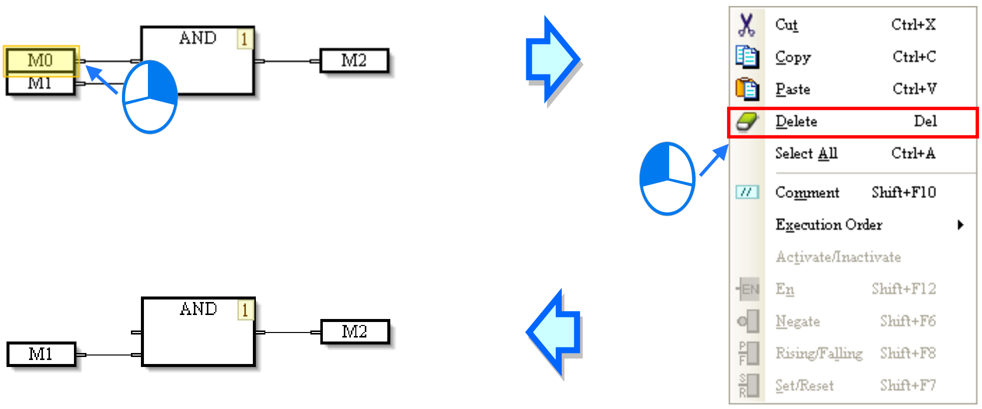
15.2.6 Deleting objects

If users want to delete a single object or several objects in a continuous function chart, they can use one of the methods below.

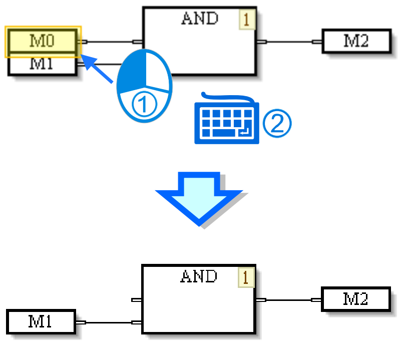
(1) The users have to click an object, and click **Delete** on the **Edit** menu, or on the standard toolbar, as the image shown below.



(2) The users have to click to select the object and right-click on the object, and then click **Delete** on the context menu which appears

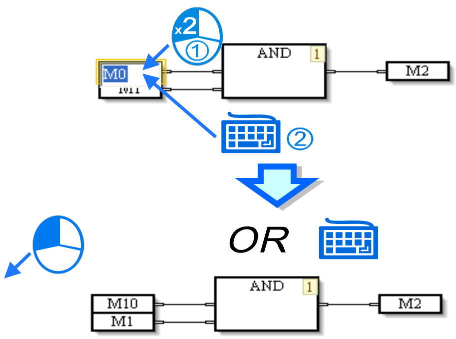


(3) The users have to click an object, and press Delete on the keyboard, as the image shown below.

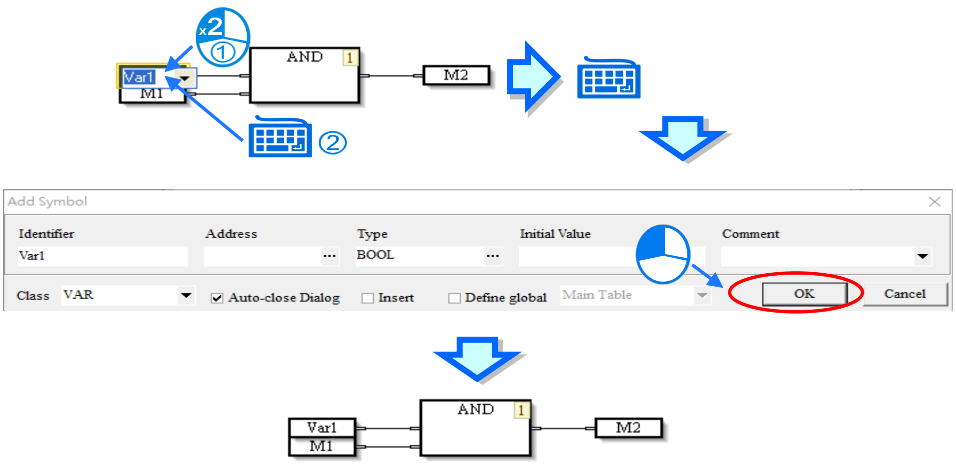


15.2.7 Editing Devices or Symbols

If users want to edit a node, they have to double-click the node, type a device name, and click the blank in the program editing area or press Enter on the keyboard.



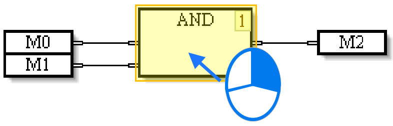
If the users type a symbol in a node, the **Add Symbol** window will appear after they press Enter on the keyboard. After the users set a symbol and click **OK** in the **Add symbol** window, they will finish declaring the symbol, as the image shown below. Please refer to chapter 6 for more information about symbols.



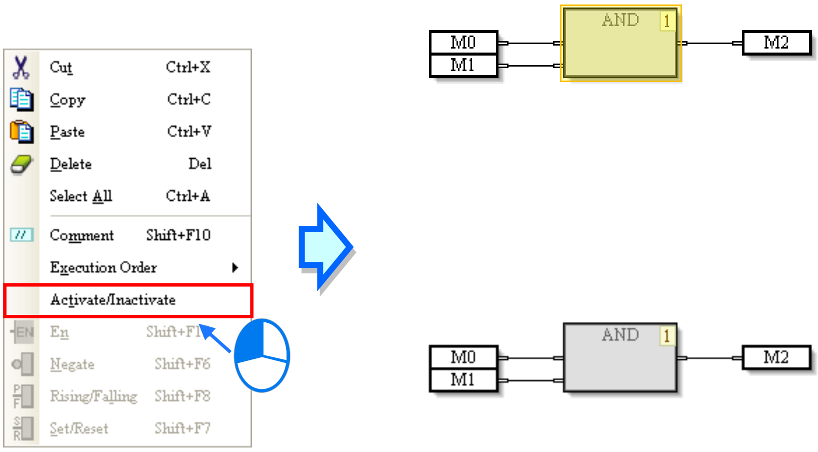
15.2.8 Activating / Inactivating an Object

If an object in a continuous function chart inactivated, the compiling of the continuous function chart will skip the object. Users can temporarily inactivate some parts of a program.

(1) The users have to right-click on an object, as the image shown below.



(2) After the users click **Activate/Inactivate** on the context menu which appears, the object will be in a dark color, as the image shown below.



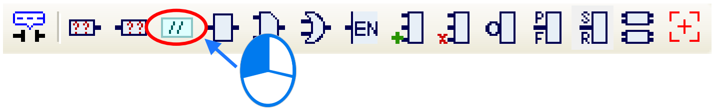
(3) If the users want to activate the object, they have to right-click the object, and click **Activate/Inactivate** on the context menu which appears.

15.2.9 Inserting a Comment

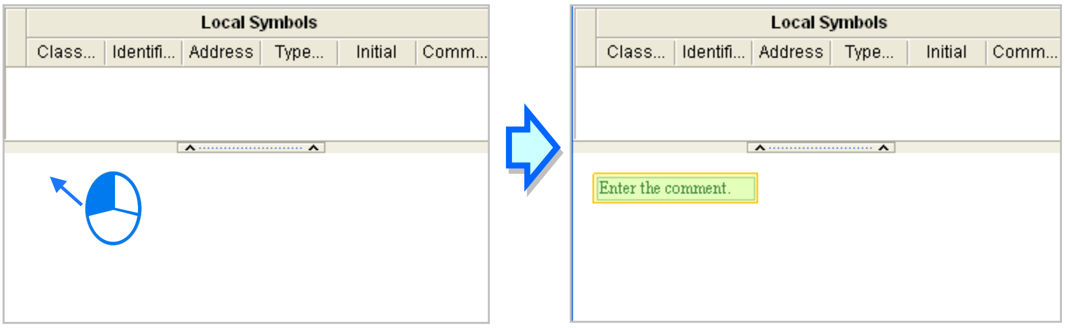
Users can insert comments in a continuous function chart. There are two methods of inserting a comment.

- Method 1: Inserting a comment in any position

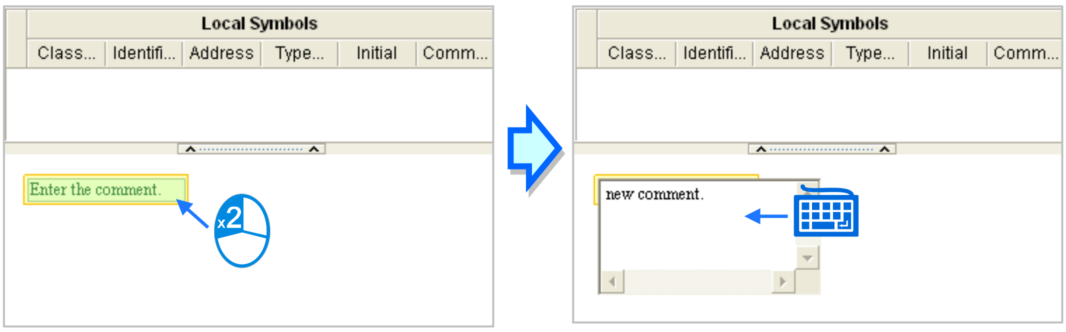
(1) The users have to click **Comment** on the toolbar, as the image shown below.



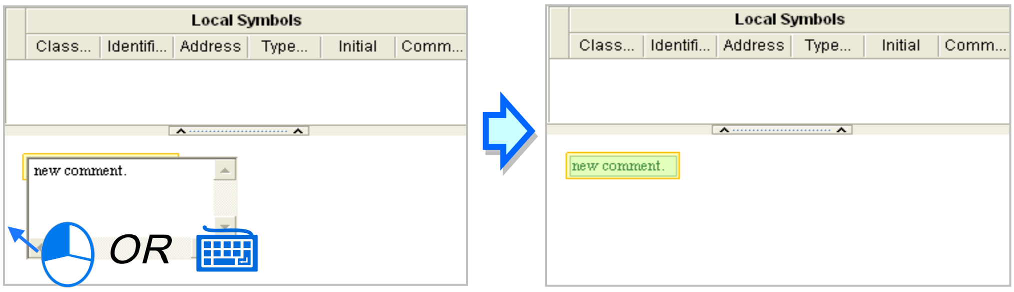
(2) After the users click a position in the program editing area, an object will be inserted, as the image shown below.



(3) After the users double-click the object inserted, a box will appear. The users can type a comment in the box. If the users want to start a new line of text at a specific point, they can press Shift+Enter on the keyboard.

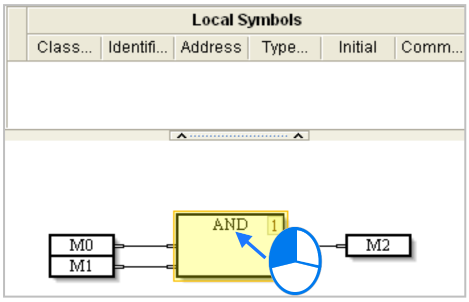


(4) After the users type a comment, they have to click the blank in the program editing window, or press Enter on the keyboard. This type of comment is independent of the other types of objects in the program editing area. It does not vary with the deletion or the movement of another type of object.

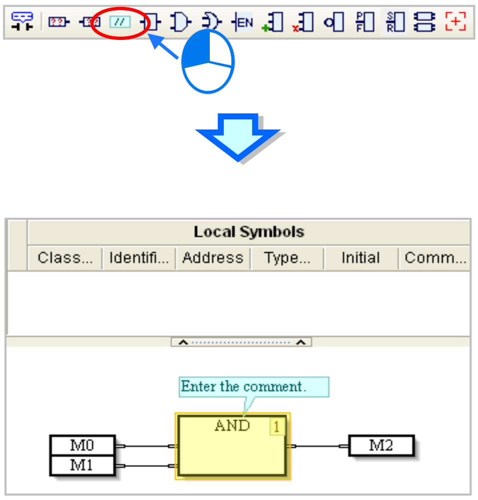


- Method 2: Inserting a comment binding with an object

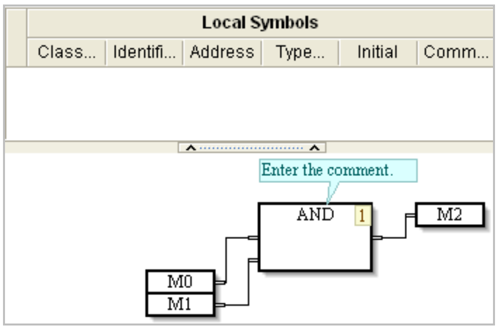
(1) The users have to click the object in which a comment will be inserted, as the image shown below.



(2) After the users click **Comment** on the toolbar, the comment binding with the object will appear. The users can edit the comment.

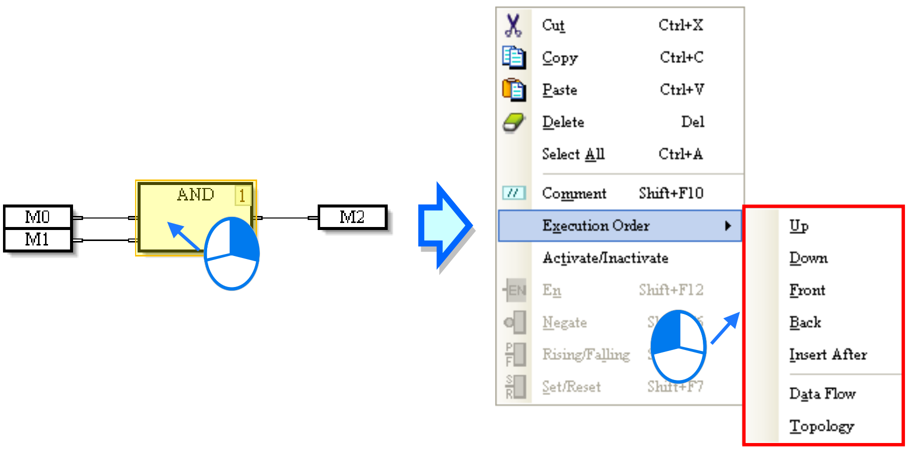


(3) The position of the comment varies with the movement of the object. When the users move the object, the comment moves, as the image shown below.



15.2.10 Changing the Order in Which Objects are Executed

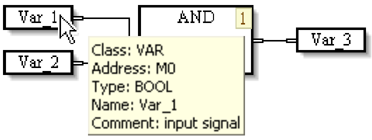
The numbers in the upper right corners of the objects in a continuous function chart indicate the order in which the objects are executed. If users want to change the number in the upper right corner of an object, they can right-click the object, point to **Execution Order** on the context menu which appears, and click **Up**, **Down**, **Front**, **Back**, **Insert After**, **Data Flow**, or **Topology**. If **Data Flow** is clicked, the order in which the objects in a continuous function chart are executed will be determined by the data flow of the objects. If **Topology** is clicked, the order in which the objects in a continuous function chart are executed will be determined by the relative positions of the objects.



⚠ If the execution order is changed, the result would also be different. The auto-arrange button on the tool bar is suggested to use for users who are not familiar with the order.

15.2.11 Displaying/Hiding Information

If users move the mouse cursor to a device or a symbol after they click  on the toolbar, the information about the device or the symbol will appear. The information related to a device or a symbol includes a device address and a comment



Chapter 16 C the Programming Language

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16.1 C Programming Language (C)

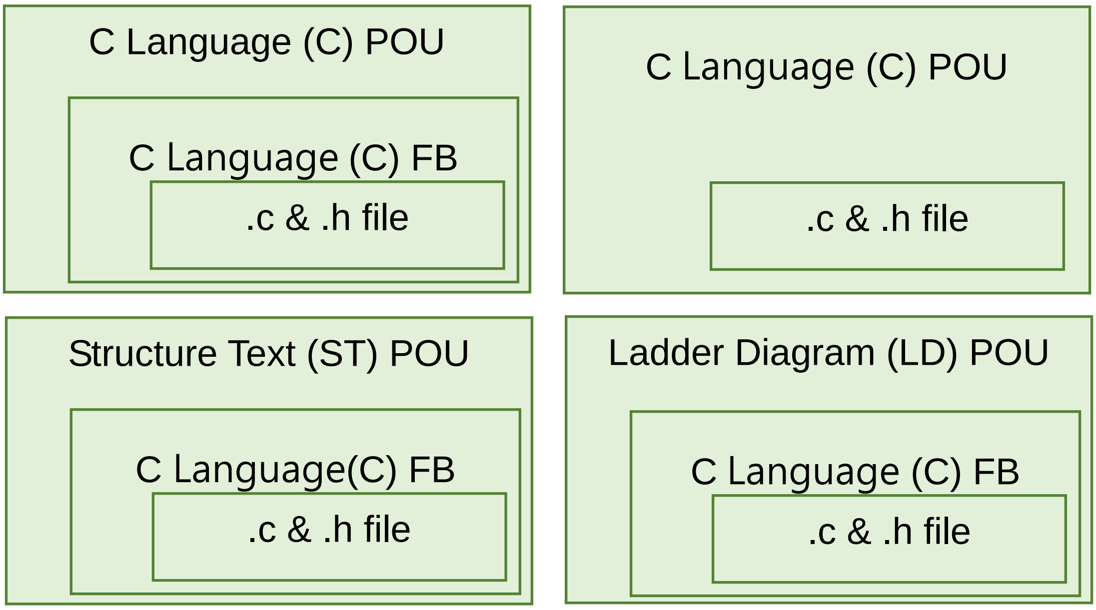
One characteristic of the C language is that the entire C program consists of statements. Compared with instruction lists (IL), C language has a higher readability. Complex expressions can be expressed in the syntax like mathematical equations. Therefore, C is the programming language more suitable for the programming applications where complex operations are required.

* Before downloading a C program to the PLC, do confirm that the version of the AS series PLC firmware is V1.06.00 or later.

16.1.1 C Structures

The programming language C is a fit for the programmers who have already been familiarized with the programming in C language. Please refer to the following programming language structures supported by C language before starting the C programming.

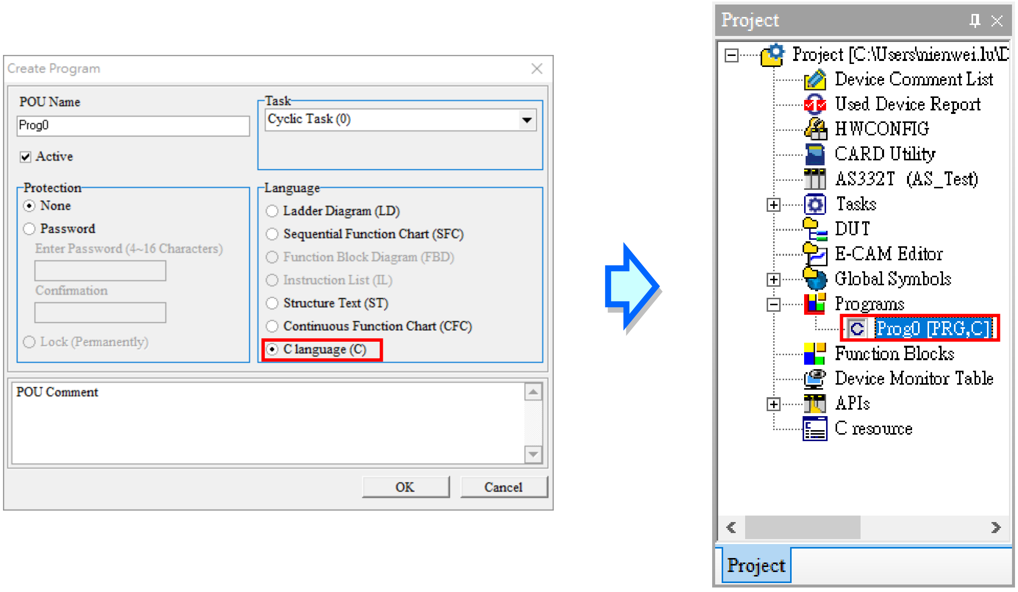
In the first place, use one of the most common editors on the market, such as DEV-C, TurboC and Visual Studio for writing, compiling and debugging. Then import the generated "**.c**" and "**.h**" files through the **Import** function of ISPSoft and use them in the C Language (C) FB or (C) POU. (C) FB can be cited in Structure Text (ST) POU and Ladder Diagram (LD) POU as shown below.



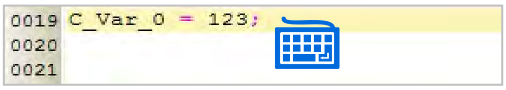
16.1.2 C Environment

In AS series PLC, the storage space for C execution codes (ROM) is 64K Bytes, and the available space for variable declaration (RAM) is 8K Bytes. The two storage spaces mentioned above and the space for storing the existing PLC programs are independent with each other. We suggest you pay attention to the remaining space in the **Compile Message** area once compiling is completed.

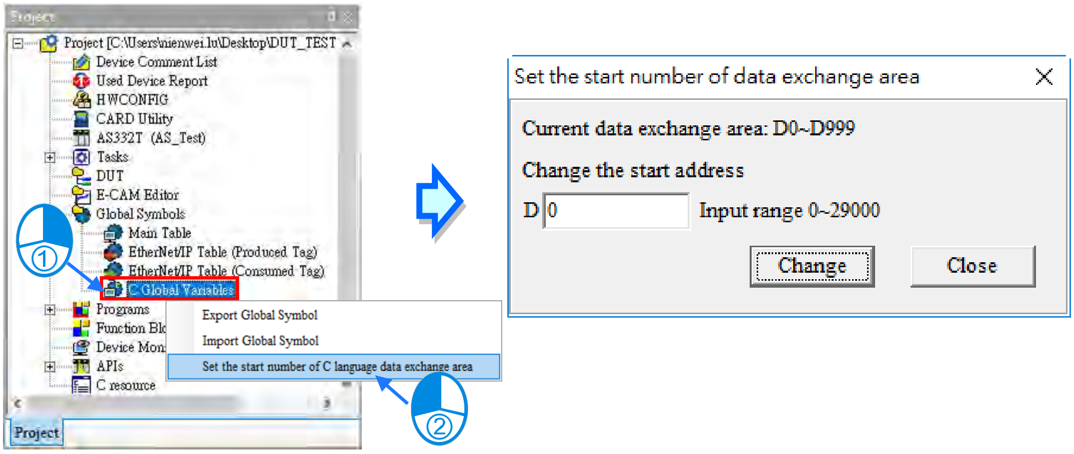
C programs are written in the C editing workplace of ISPSoft. A C program can be built just by choosing the **C language (C)** option in the field of **Language** during the creation of a POU.



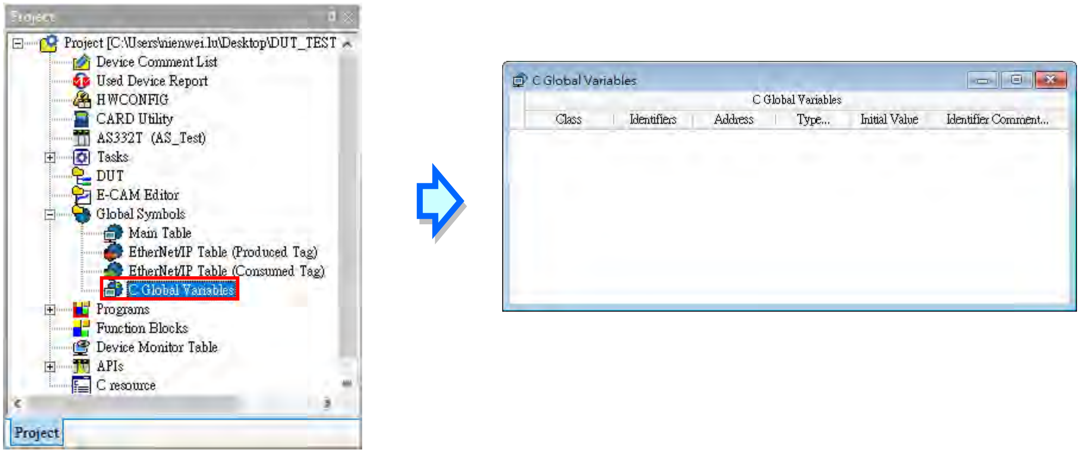
In the C editing workspace, only the standard C writing is supported and other high-level syntax like PLC instructions, C++ or Visual C is not supported. The operation in the C editing workspace is similar to that in a common text editor. When editing a C program, directly type characters or modify them following the format of C syntax in the workspace and switch to the next line when you press **Enter** key of the keyboard.



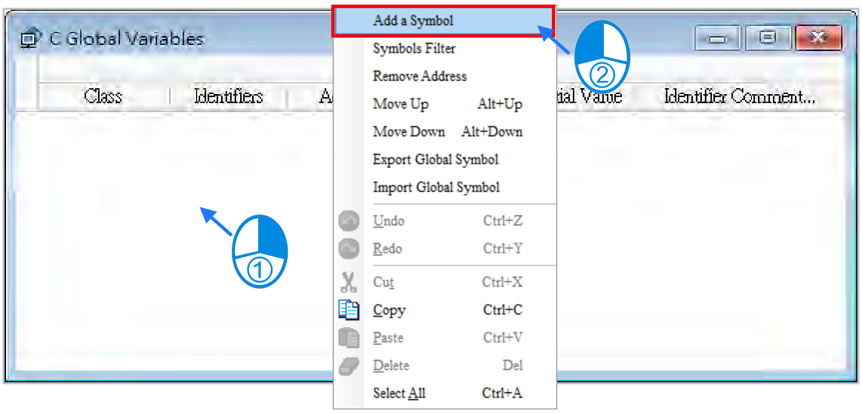
Array can be used to make a variable declaration. Please note that the memory for variable declarations is limited. So variable declarations should be made within the memory-allowed range in case of the PLC crash. A new variable symbol should be added in the **C Global Variables** table. There are 1000 D devices for the C variables to use. The start address for C variables is set in the **C Global Variables** table. Right-click **C Global Variables** and select the **Set the start number of C language data exchange area** option from the context menu to set the start position of the data exchange area. One of D0~D29000 can be filled as the start address and then the system automatically assigns 1000 consecutive D devices. The device range of the current data exchange area is displayed once the setting is done.

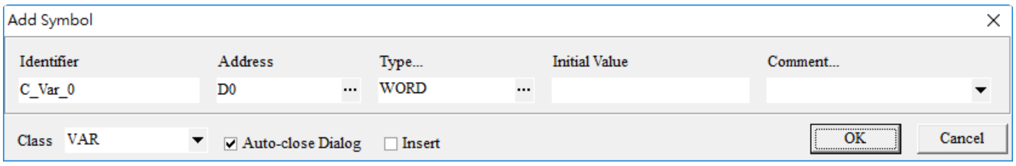


Then double-click **C Global Variables** below. The **C Global Variables** window appears right away.

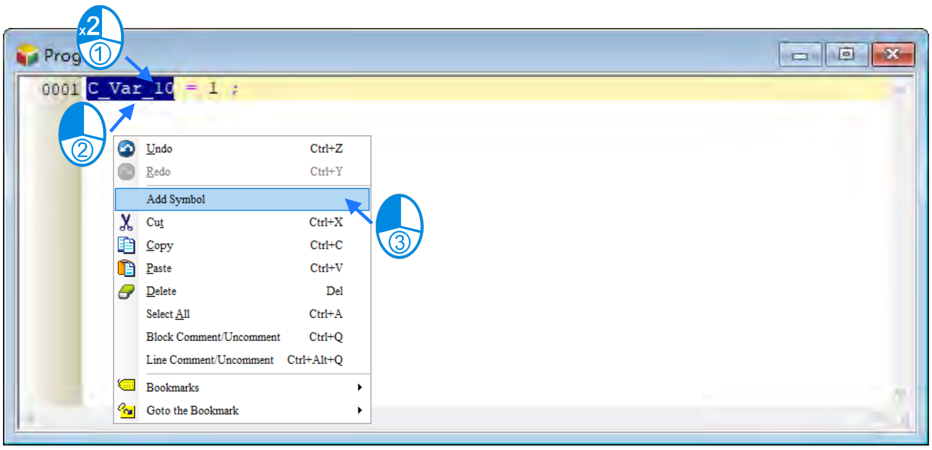


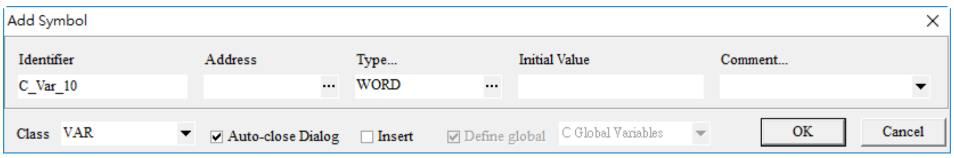
Right-click the blank space of the **C Global Variables** table and select the **Add a Symbol** item from the context menu. Then the variable symbol declaration window appears. C variable symbols only support the four data types BOOL, WORD, DWORD and REAL, the start address within the range configured in **C Global Variables.** In the following figure, the variable symbol can be used directly in C programming after D0 being declared, which can also be used in other programming languages as a global variable.



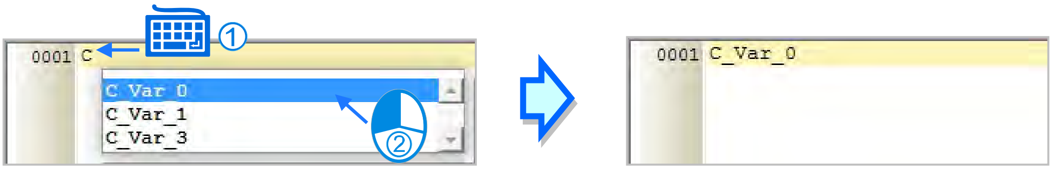


After an undeclared variable symbol is entered during the editing, double-click the text, press the right button of the mouse and select **Add Symbol** from the context menu. And then the variable symbol declaration window pops out.

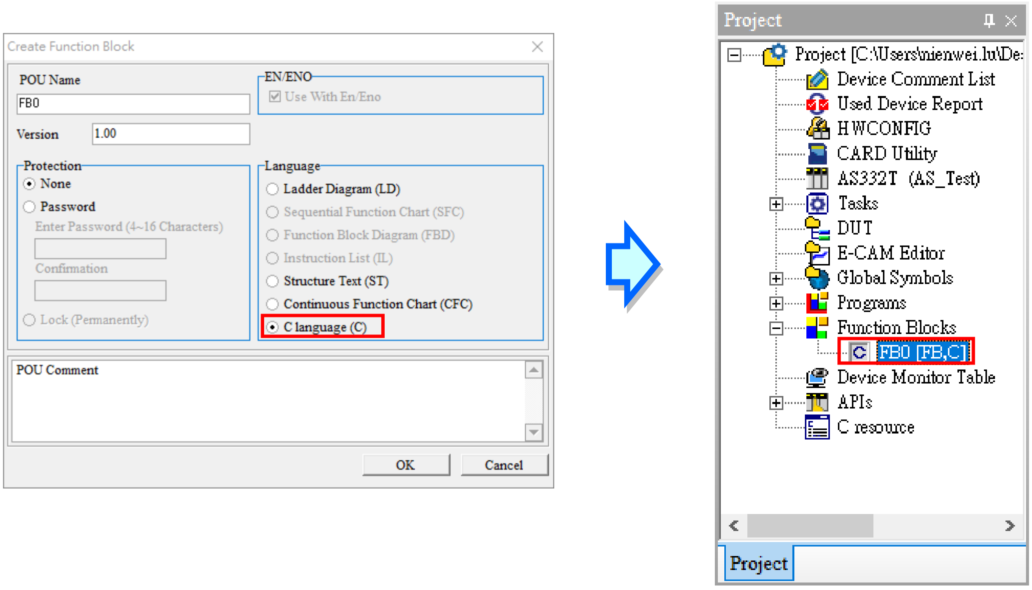




During the program writing, the software automatically provides suitable variable symbols which have been created for option. Use the up 「↑」 and down 「↓」 keys of the keyboard or simply select the desired one from the list by pressing the left button of the mouse.

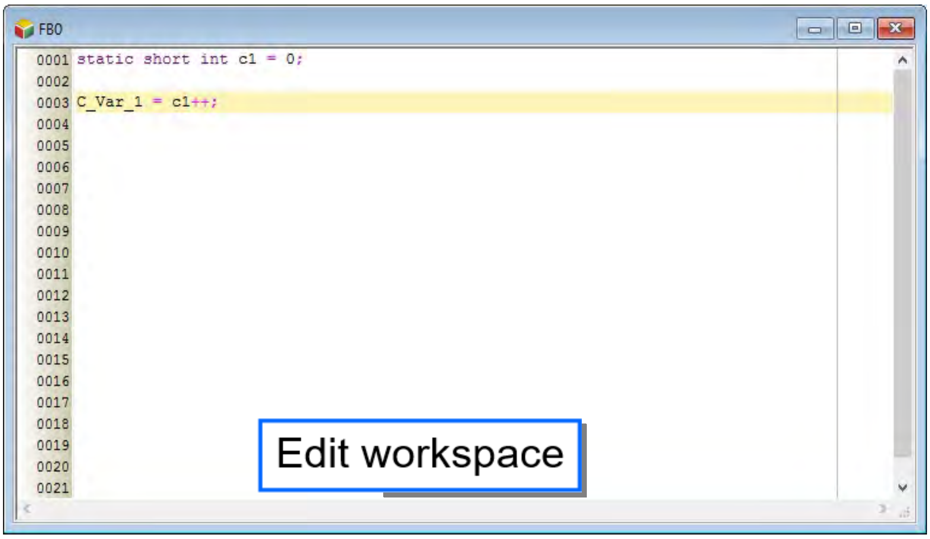


A function block is created by selecting the **C language** option for the **Language** field as below.



16

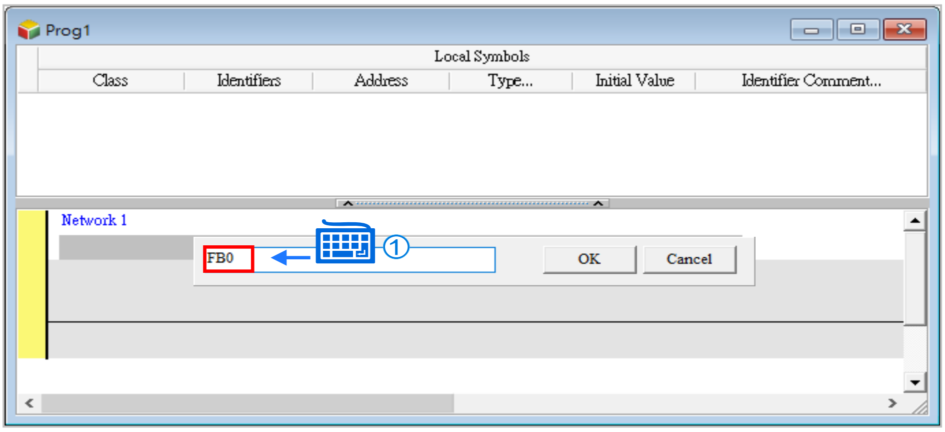
The editing of a C function block is the same as that of a C program. Type or modify the expression following the C syntax format in the following Edit workspace through your keyboard.



There are two methods to insert a C function block to a LD program.

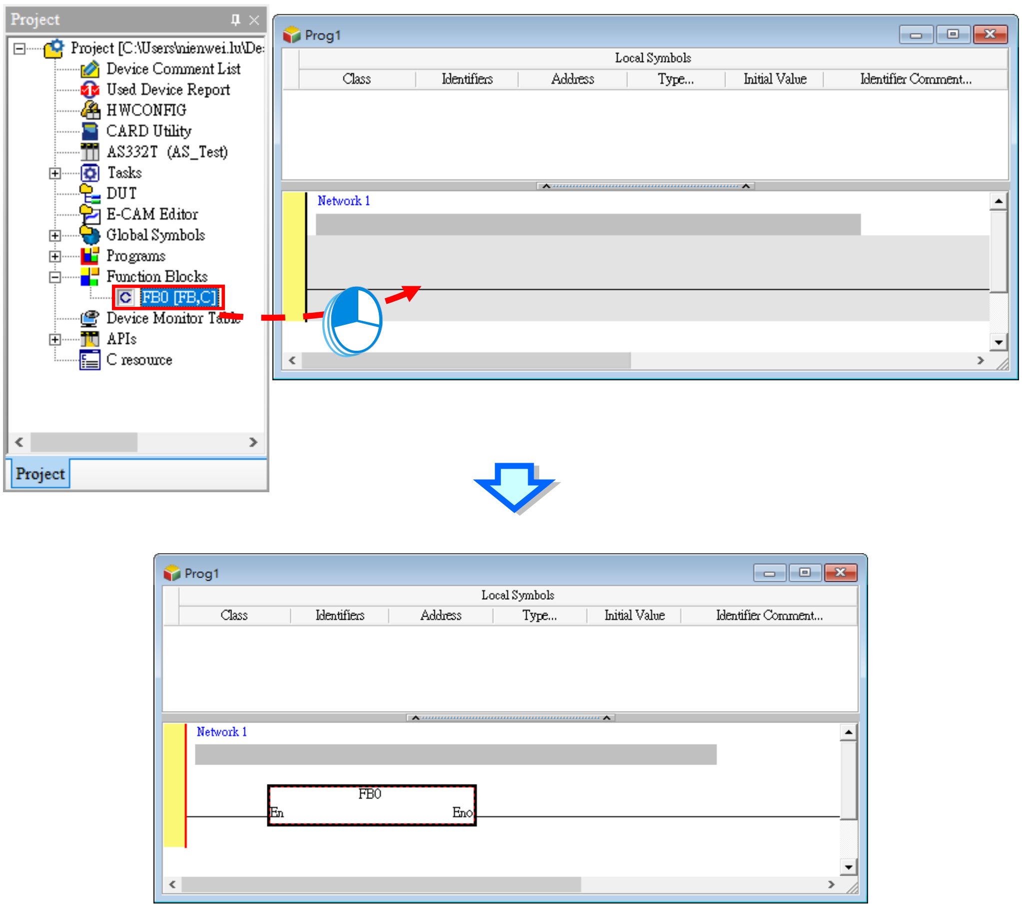
Method 1

Type the function block name through the keyboard to insert the function block to the LD editing workplace.

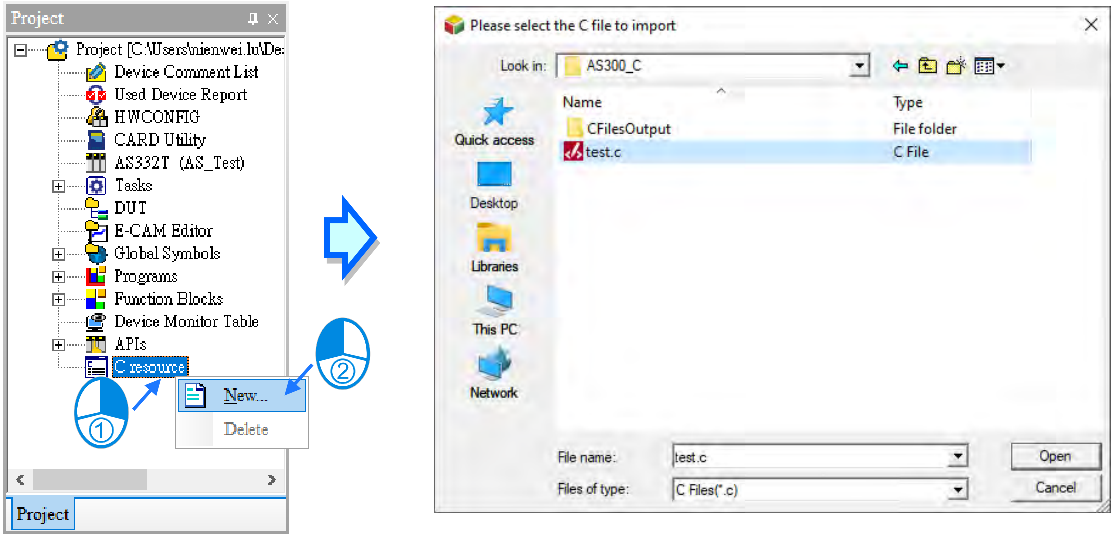


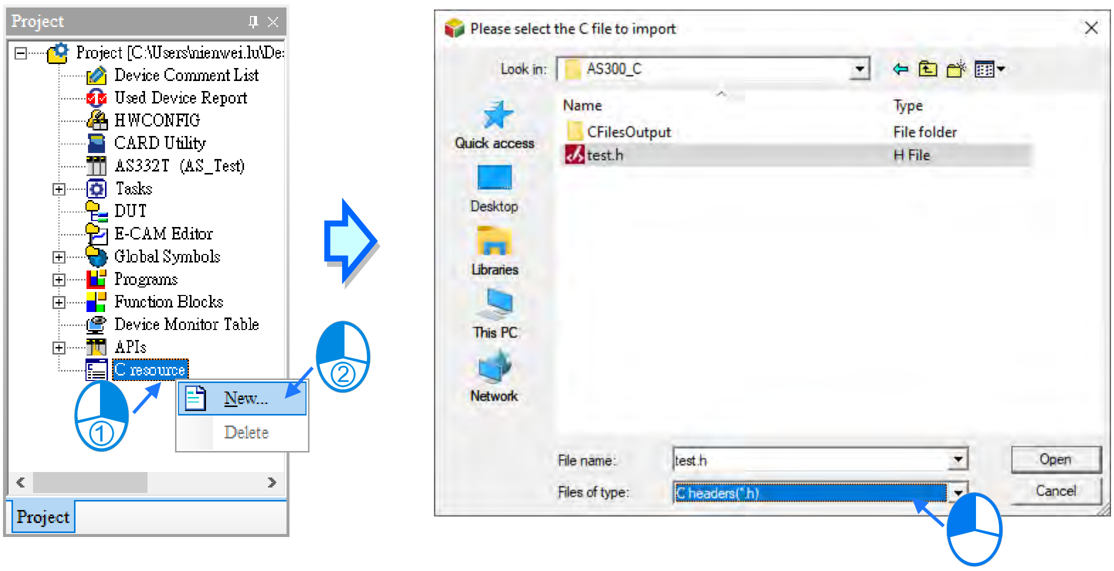
Method 2

Unfold **Function Blocks** in the **Project** area, find the item to be inserted and drag it to the position where it should be inserted as below.



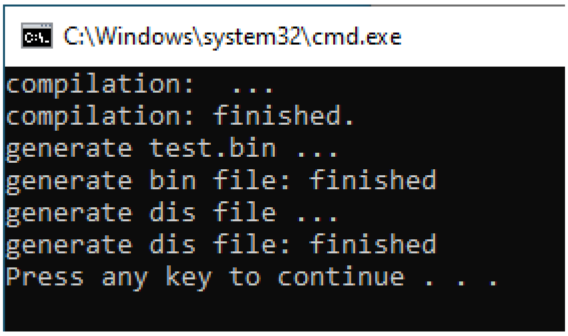
To import the generated “.c” and “.h” files, right-click **C resource**, select **New** from the context menu and then choose the C file to be imported in the pop-up window as follows. To import the “.h” file, choose C headers (*.h) for the **Files of Type** field.

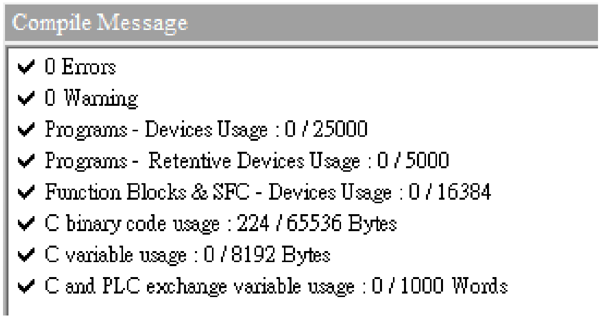




16.1.3 C Compiling and Debugging

ISPSoft provides the standard GCC compiler as well as triangular function and exponential function libraries which have been built in the PLC. They can be used without being declared. But ISPSoft does not provide other standard C function libraries (e.g. math.h) on the market, in order to save the storage space for C codes in the PLC.





ISPSoft only shows the error messages which emerge after the GCC compiling is done. But it does not support the function of jumping to the location where the error occurs to make a modification by clicking an error statement.

The online monitoring of existing PLC programs and function blocks can be conducted. But ISPSoft does not support the line-by-line monitoring of the C codes in C programs.

16.1.4 Internal Function Library Instructions

The common four mathematical operations of integers or floating-point numbers, "addition, subtraction, multiplication and division" have already been built in ISPSoft. So they can be used directly without being declared additionally.

The names of built-in triangular functions:

C function name	ISPSoft-edited name	Format	Description
sinf	DELTA_SINF	Float DELTA_SINF (float radian)	Sin operation
cosf	DELTA_COSF	Float DELTA_COSF F (float radian)	Cos operation
tanf	DELTA_TANF	Float DELTA_TANF (float radian)	Tan operation
asinf	DELTA_ASINF	Float DELTA_ASINF (float arg)	Sin^{-1} operation
acosf	DELTA_ACOSF	Float DELTA_ACOSF (float arg)	Cos^{-1} operation
atanf	DELTA_ATANF	Float DELTA_ATANF (float arg)	Tan^{-1} operation
sinhf	DELTA_SINHF	Float DELTA_SINHF (float arg)	Sinh operation
coshf	DELTA_COSHF	Float DELTA_COSHF (float arg)	Cosh operation
tanhf	DELTA_TANHF	Float DELTA_TANHF (float arg)	Tanh operation

The names of built-in exponential functions:

C function name	ISPSoft-edited name	Format	Description
sqrf	DELTA_SQRF	Float DELTA_SQRF (float value)	Square root operation
logf	DELTA_LOGF	Float DELTA_LOGF (float base, float value)	Log operation
lnf	DELTA_LNF	Float DELTA_LNF (float arg)	Ln operation
powf	DELTA_POWF	Float DELTA_POWF (float base, float power)	Exponential operation

16.1.5 Bookmark and Comment

The **Bookmarks** function is a convenience tool used for a search for or moving to a specific editing location.

- **Add/ Remove a bookmark**

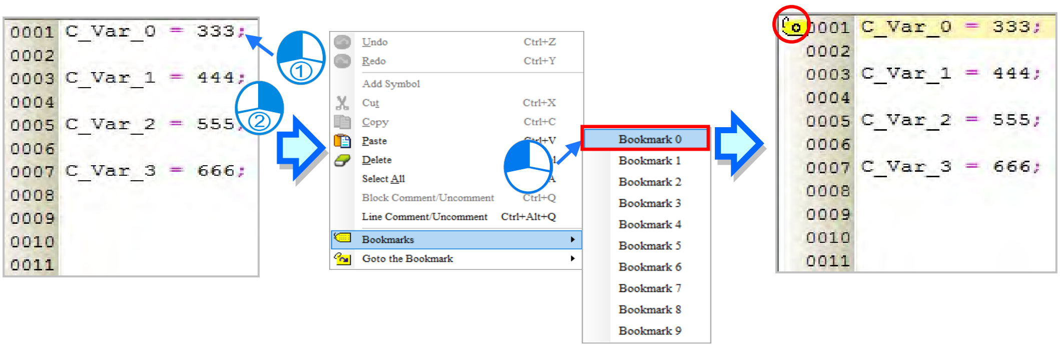
Select the line to which a bookmark is added and right-click the selected line. Then select the **Bookmarks** option from the context menu and pick the desired bookmark number.

To remove a bookmark, in the same way select the line of which a bookmark is to be removed, right-click the selected line and then select the **Bookmarks** option from the context menu as well as pick the bookmark number which is the same as that of the selected line.

However, the original bookmark of the selected line will be replaced by the currently picked one if they are different.

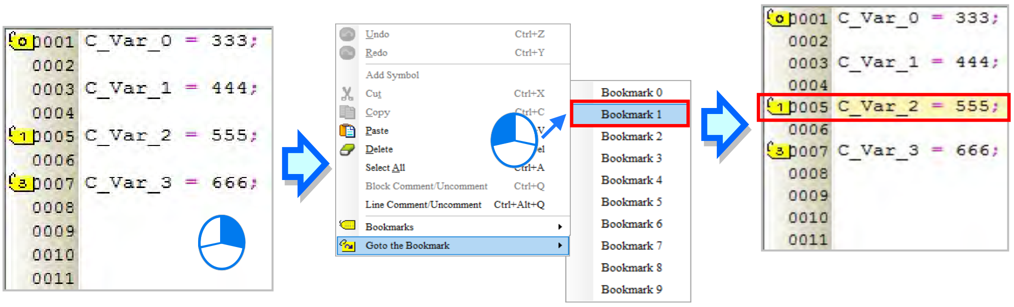
In addition, if you select **Edit** menu > **Bookmarks** > **Remove All Bookmark**, all bookmarks will be cancelled in the editing window.

If you select one bookmark number which has been used for other line, the picked bookmark number will be moved to the currently selected line.



- **Go to the bookmark**

Right-click the workplace, select the **Goto the Bookmark** option from the context menu and then pick the bookmark number from the dropdown list to come to the target bookmark location.

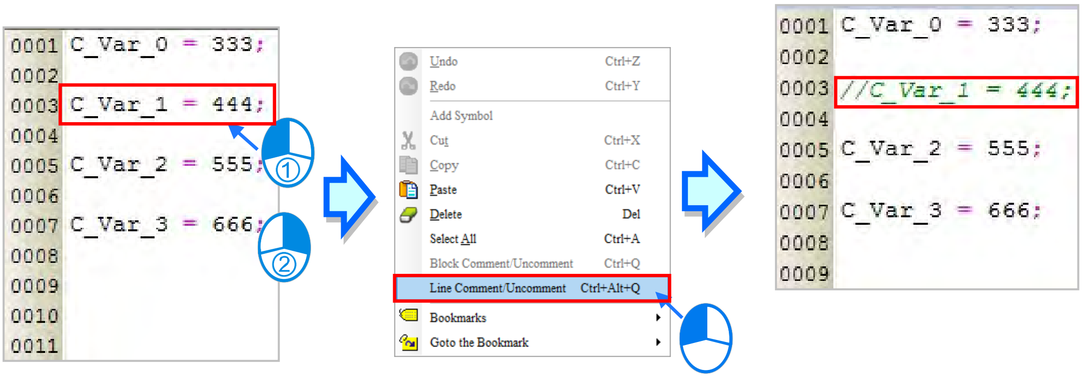


The **Comment** function is a convenience tool used to comment the selected block or lines.

- **Comment/Uncomment a line**

Right-click the line to be commented and select the **Line Comment/Uncomment** option from the context menu. Then the two slashes / / are automatically added to the start of the selected line.

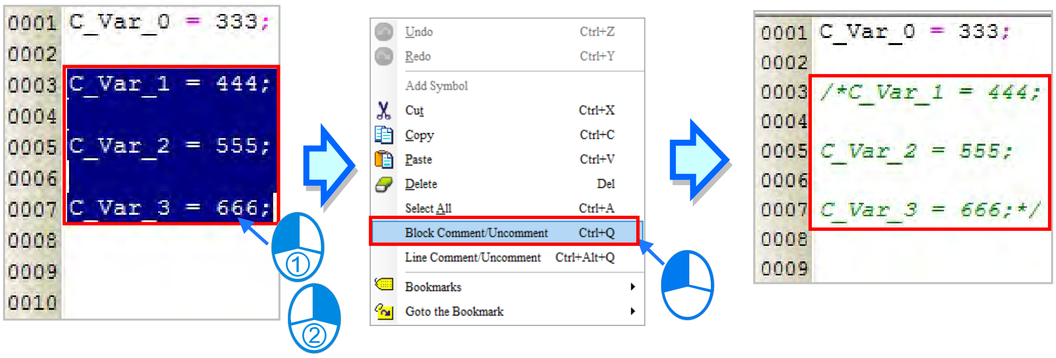
To uncomment a line, in the same way right-click the line to be uncommented and select the **Line Comment/Uncomment** option from the context menu. Then the two slashes / / are automatically removed from the start of the selected line.



- **Comment/Uncomment a block**

Right-click the block to be commented and select the **Block Comment/Uncomment** option from the context menu. Then the marks **/*** and ***/** are automatically added to the start and end of the selected block respectively.

To uncomment a block, in the same way right-click the block to be uncommented and select the **Block Comment/Uncomment** option from the context menu. Then the marks **/*** and ***/** are automatically removed from the start and end of the selected block.

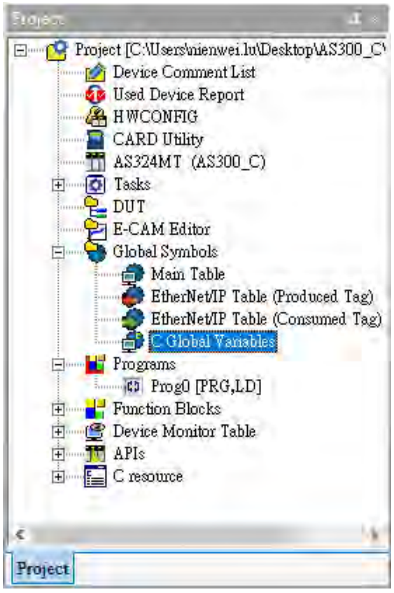


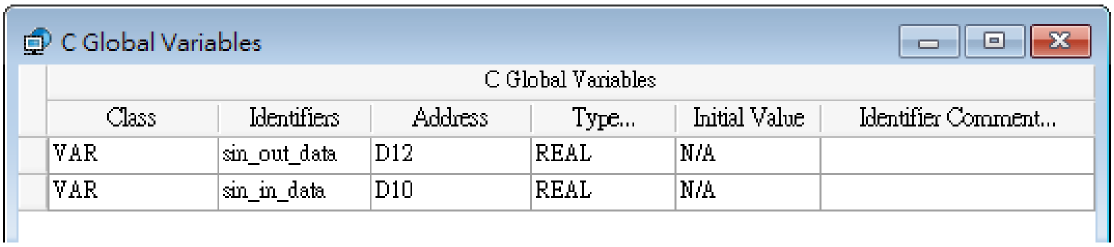
16.1.6 Operation Example

Example:

One value for the Sin function is output by a change of 5° every 10ms and the output values for the Sin function of 0~ 355° are recorded via the data tracer function

Step 1: Create C global variable symbols necessary for PLC and C program. See Section 16.1.2 for details.

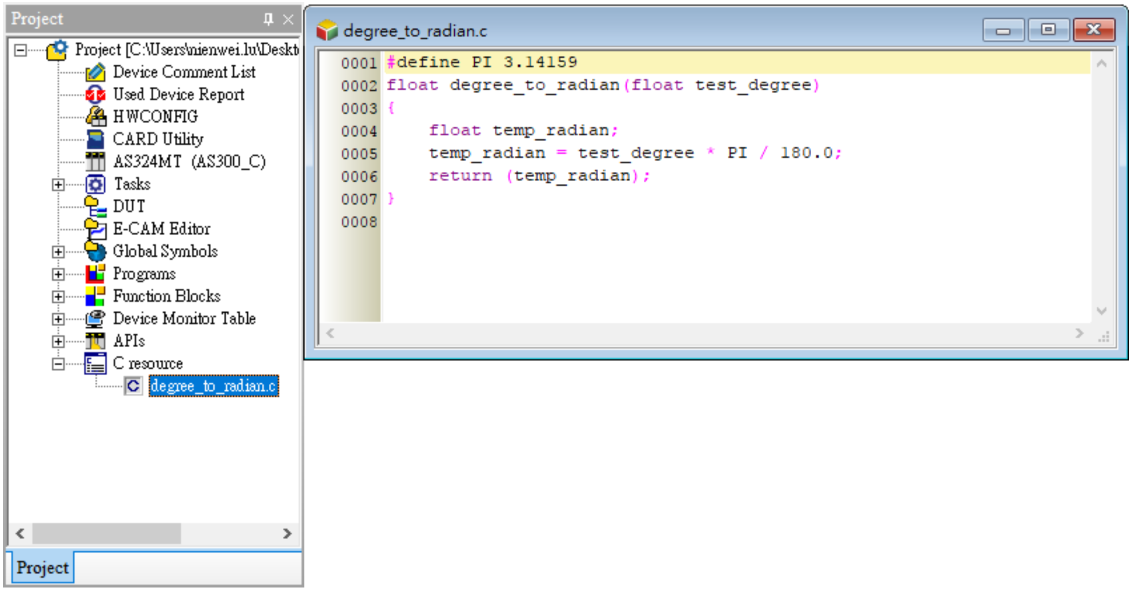




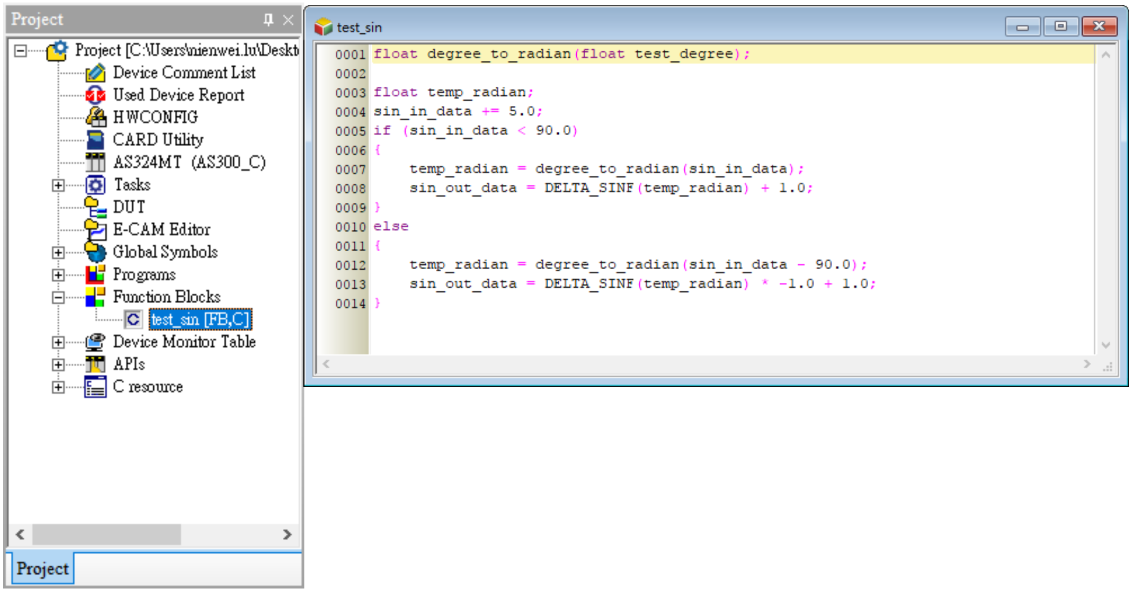
C Global Variables

Class	Identifiers	Address	Type...	Initial Value	Identifier Comment...
VAR	sin_out_data	D12	REAL	N/A	
VAR	sin_in_data	D10	REAL	N/A	

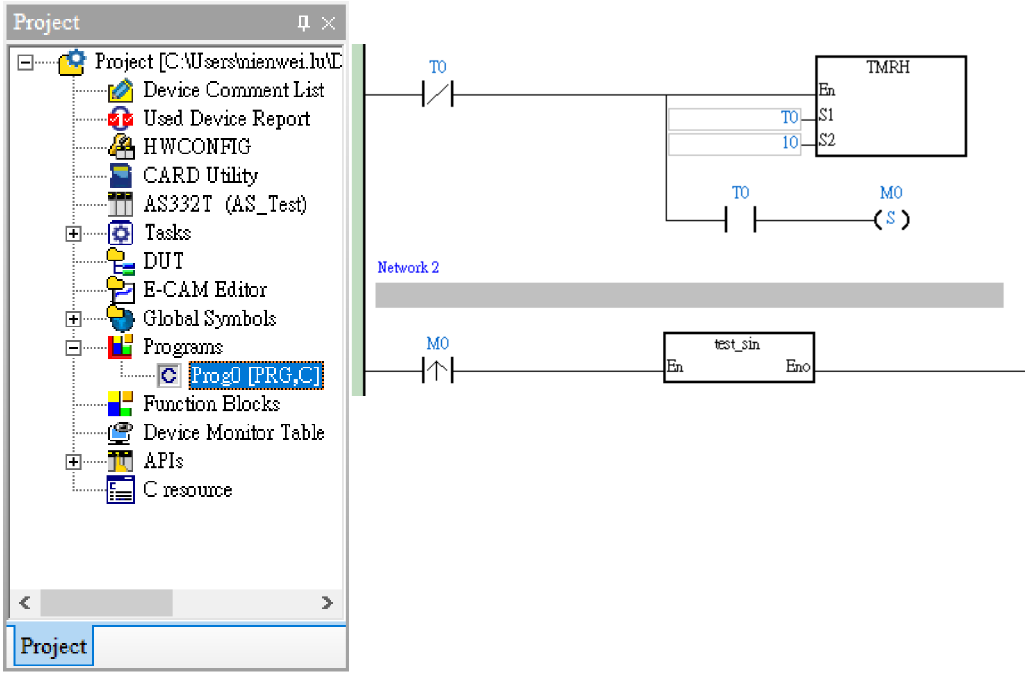
Step 2: Import the degree_to_radian.c function which has been edited and debugged. See Section 16.1.2 for details. This step can be skipped according to actual need.



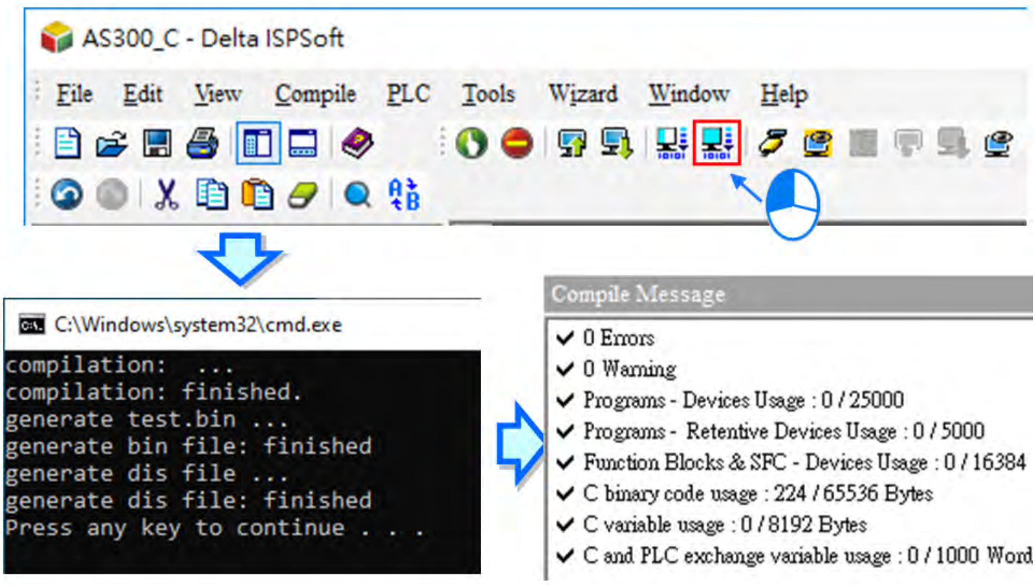
Step 3: Edit a new function block **test_sin** and write the computing process in it where the degree_to_radian library function is called.



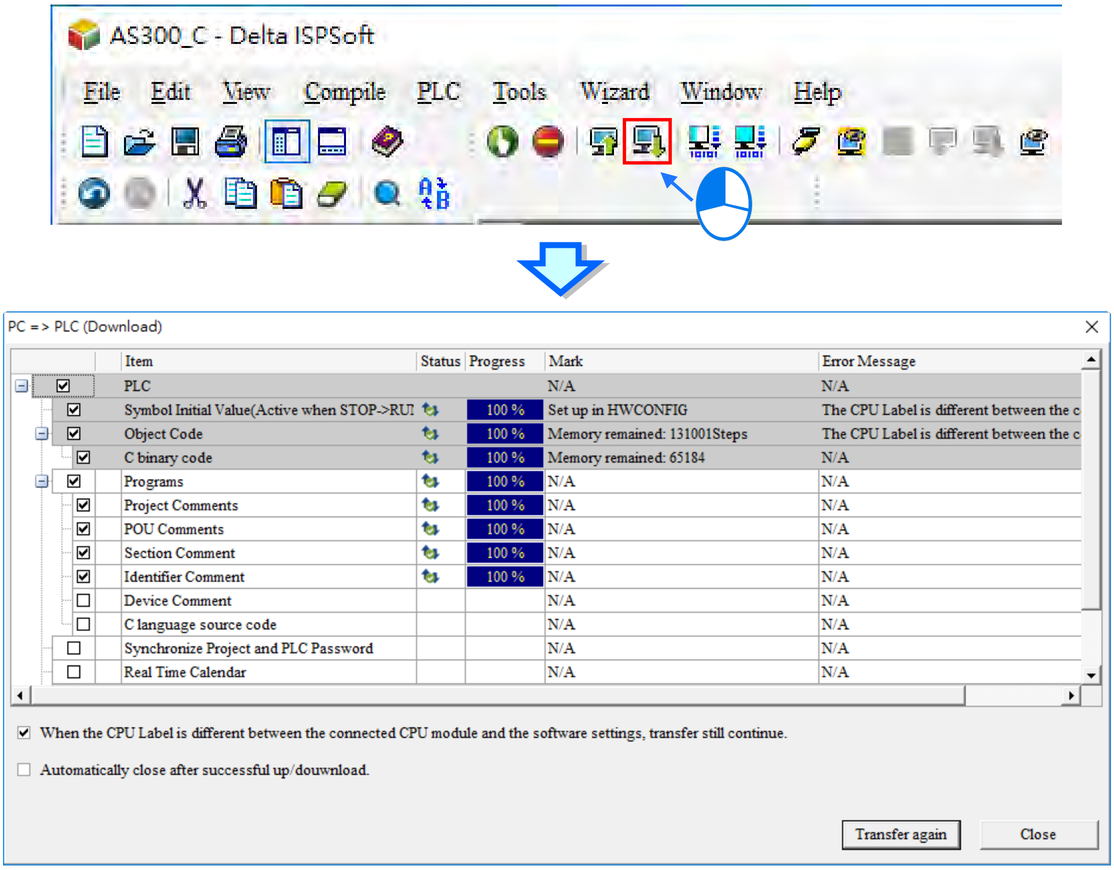
Step 4: Create a POU and write a segment where the **test_sin** FB is called every 10ms .



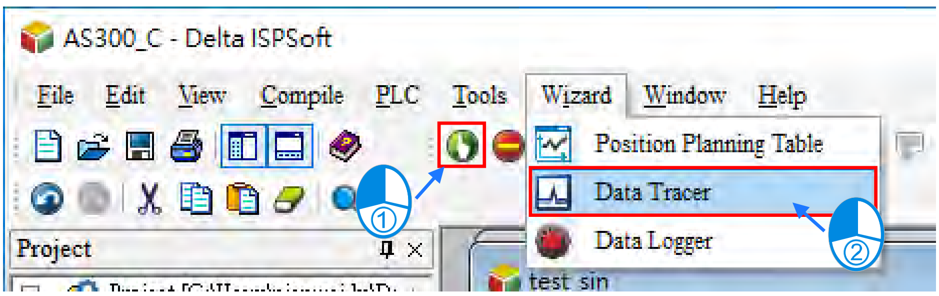
Step 5: Press the **Compile the Project** button. Suppose no error occurs, the process is seen as below.



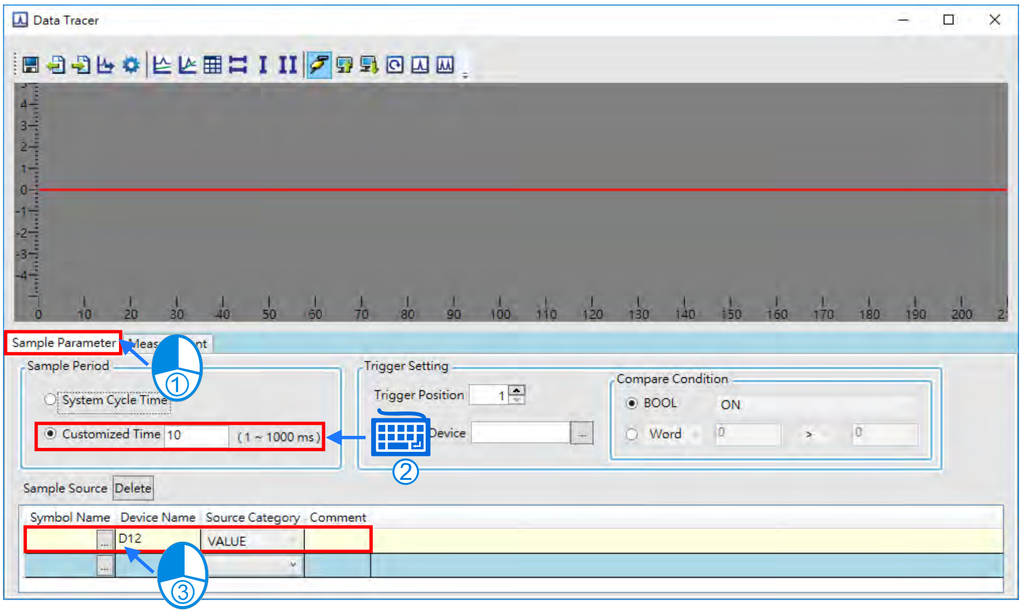
Step 6: Press **Download to PLC** button to download the program to the PLC after compiling is done.

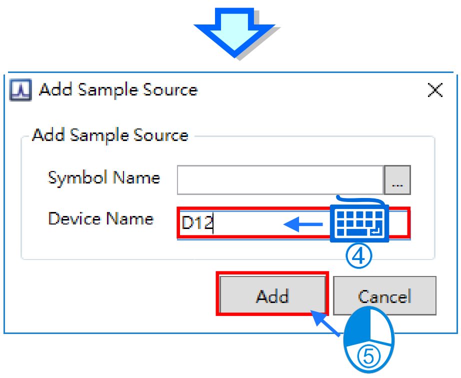


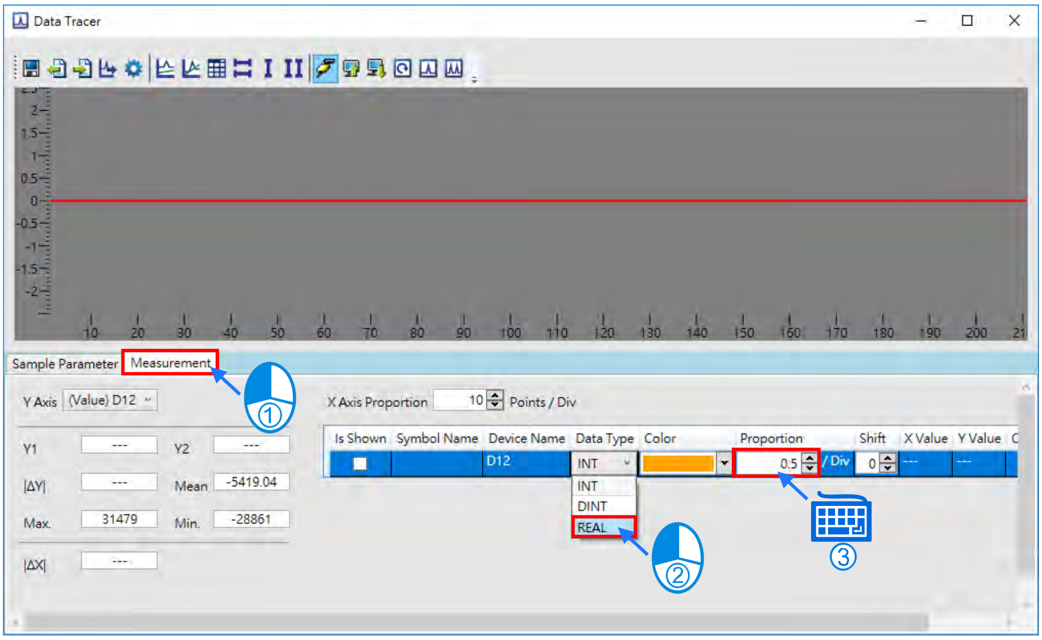
Step 7: Press the **Run** button and then start the **Data Tracer** function.



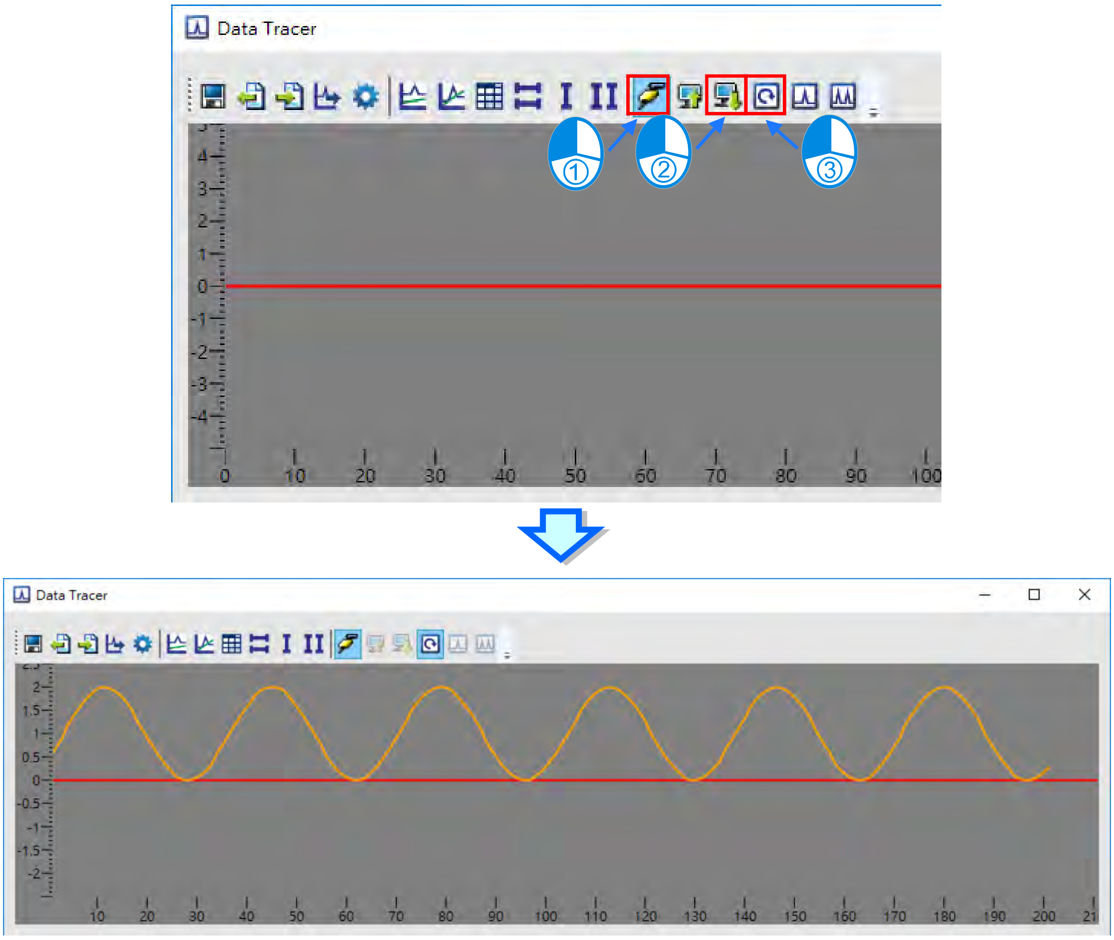
Step 8: Set sample parameters and measurement for Data Tracer.







Step 9: Set the online, download and monitor for Data Tracer as follows.



Chapter 17 Auxiliary Editing Tools

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17.1 ISPSoft Editing Tools and Auxiliary Functions

17.1.1 Modify PLC Types

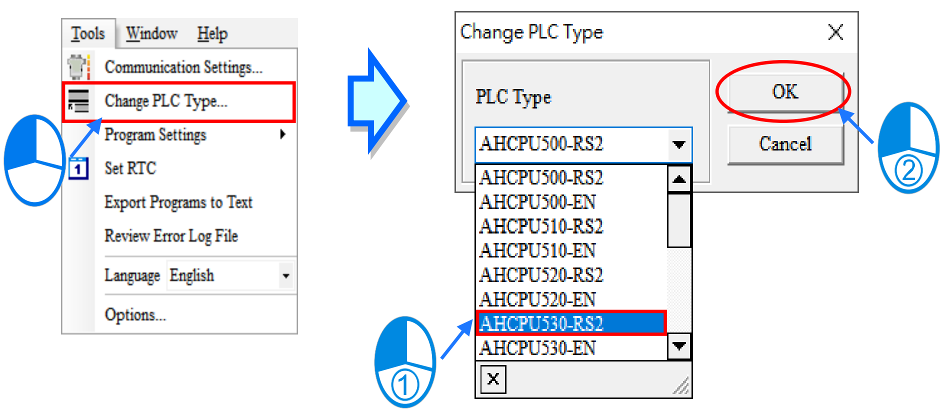
In ISPSoft, users can change PLC types, most series offers two-way but some series only offer one-way modification. For example, DVP Series can change to AS Series, but not vice versa; AH5xo Series can change to AH560 Series but not vice versa. Please refer to the following table.

Purpose / Source	AS	AH5x0	AH5x1	AH560	AHxxEMC	DVP	AS5xx DVPxxMC
AS	V	V	V	V	V	Support ES3	
AH5x0		V	V	V	V		
AH5x1			V	V	V		
AH560			V	V	V		
AHxxEMC					V		
DVP	V					V (*1)	
AS5xx DVPxxMC							V

***1. DVP-ES3 Series cannot change other DVP Series, but other DVP Series can change to DVP-ES3 Series.**

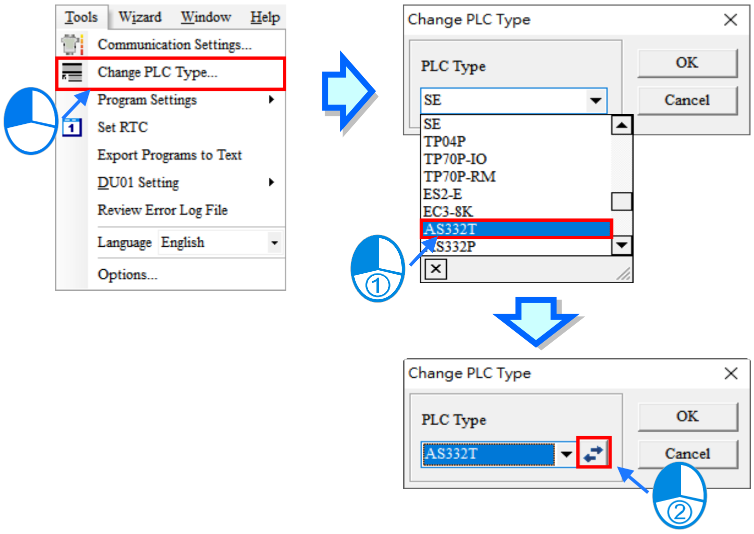
The modified PLC types will change the content of current project. Thus, the project should be saved first before modify the PLC. Since PLC functions, device range or support command can vary before or after the modification, please make sure the original program, parameter setting, hardware and network planning is functioning properly.

If users want to change the PLC type, they can click **Change PLC Type…** on the **Tools** menu, select a PLC type in the **Change PLC Type** window, and click **OK**.

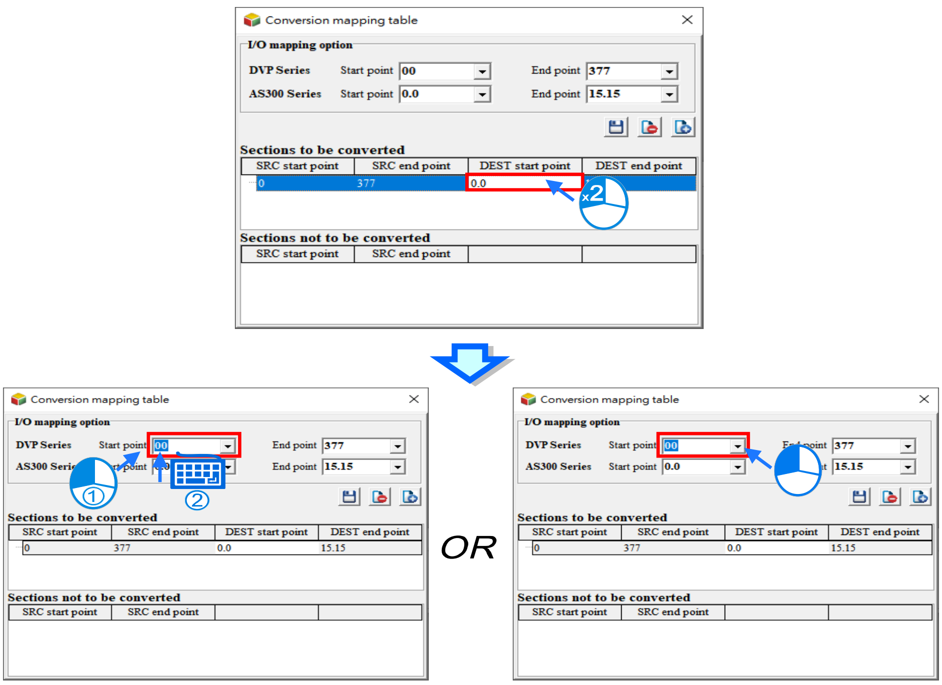


17.1.2 Change DVP Series Modules to AS Series Modules

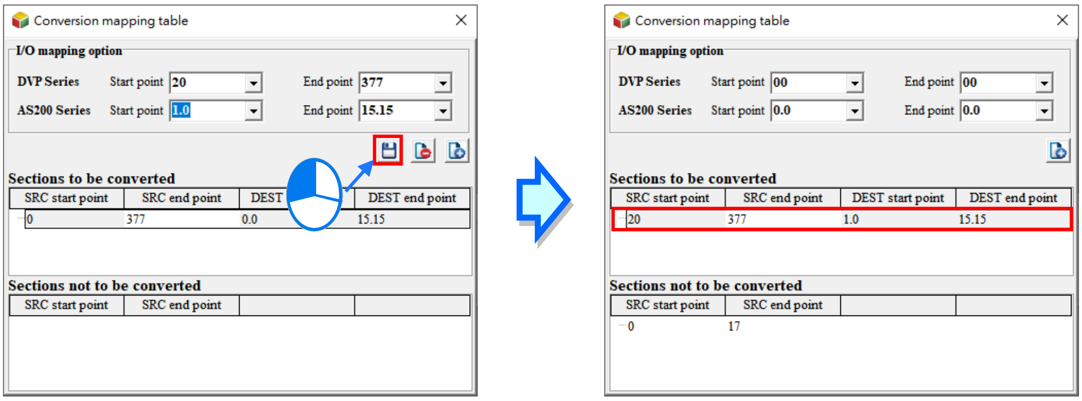
For the change of a DVP series module to an AS series module, user can click Tools tab and then Change PLC Type to see a change PLC Type window. Select the PLC type you'd like to change from the drop-down list and then click the exchange icon  to complete the conversion I/O mapping change.



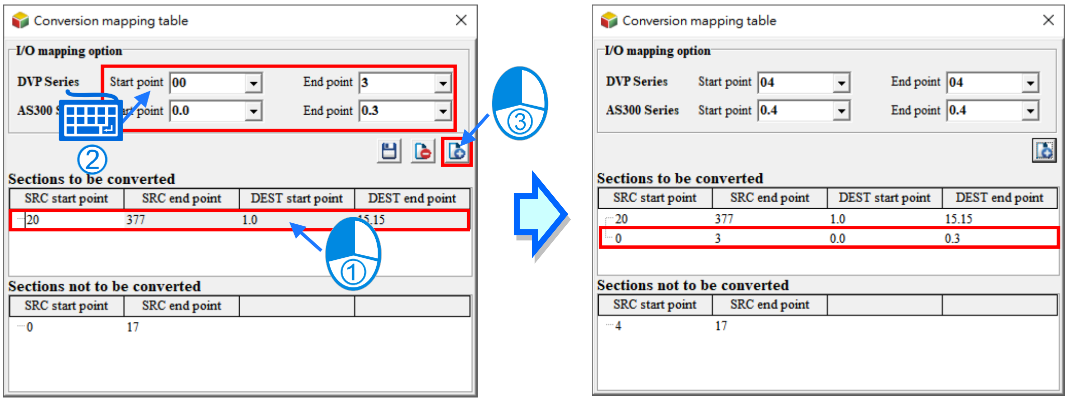
Input the start/end point of the DVP series module to be changed with the AS series module and click save . After that users can see the start/end points of the DVP series and AS series in the list of sections to be converted. The SRC start point and end point correspond to the start and end point of the input points X and Y of a DVP series module. DEST start and end points correspond to the input points X and Y of an AS series module. Please note if the I/O conversion range of a DVP series module and an AS series module cannot be matched, a warning will appear; Double click the mouse on the selected box(See below), the save or delete icon will appear for users to directly change the value in the box or select it from the drop-down menu.



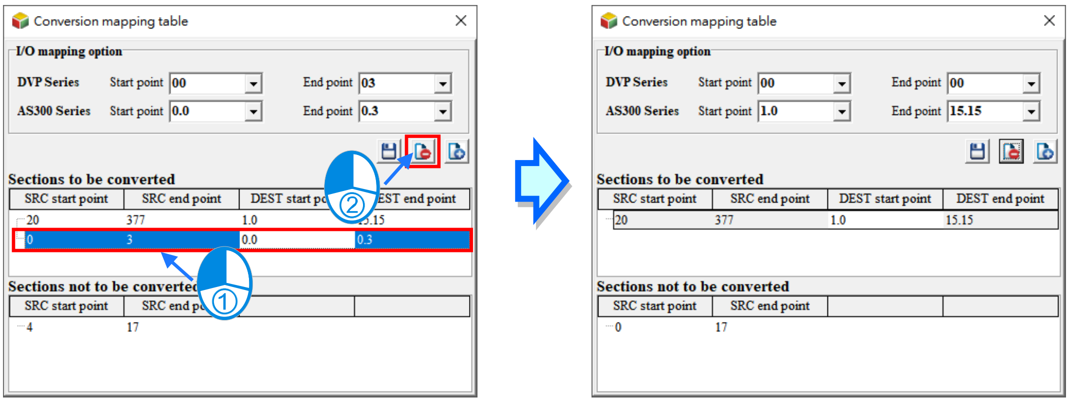
When start/end points are set, click save to complete the setting. Then, **Sections to be converted** and **Sections not to be converted** will appear.



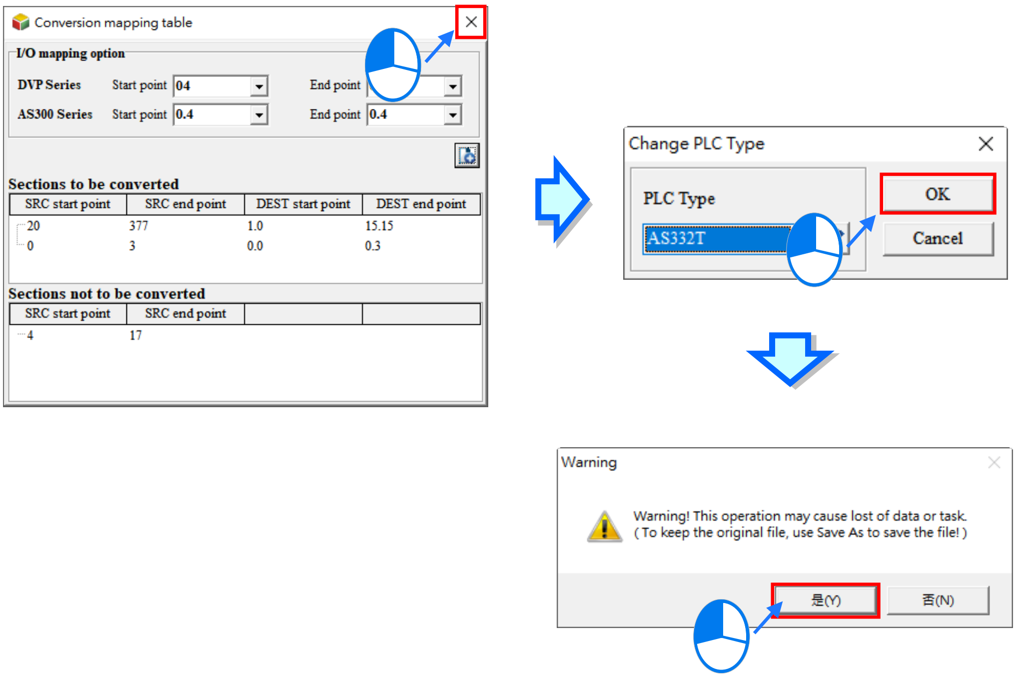
To add a new conversion, users can click on the sections to be converted list and then input new start/end points and then click Plus after that a new conversion will be added.



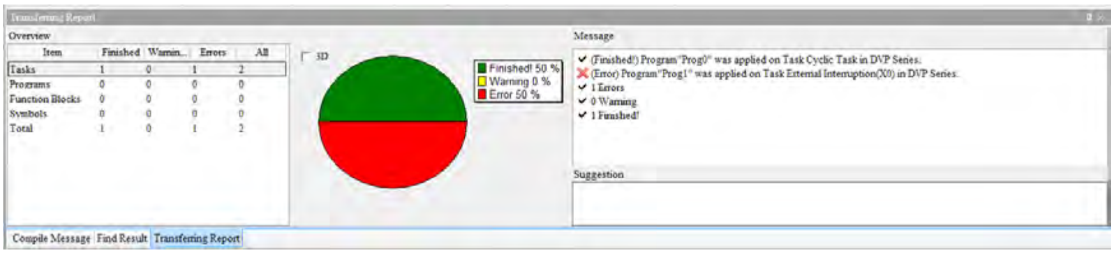
To delete a conversion item from the list, users can double click to select the item to be deleted on the list and then click the delete icon after that the selected item will be deleted.



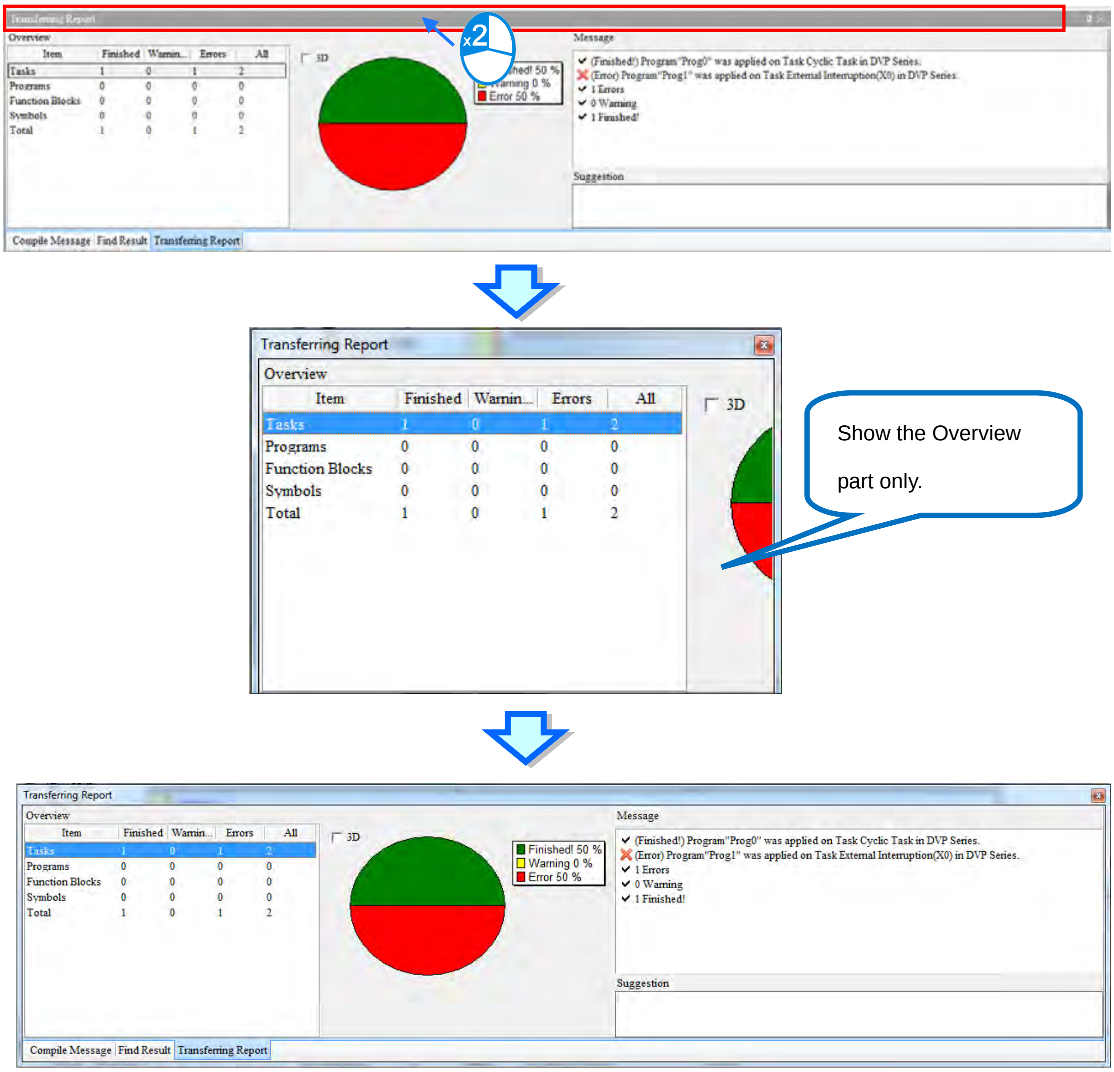
After the conversion mapping table is set, users can close the window. A Change PLC Type window will then appear. Click OK to confirm the change and a warning window stating “Warning! This operation may cause loss of data or task.” will appear. (If users want to keep the original file, click “No” to cancel the conversion, then use Save As to save the file for conversion). Click Yes to double confirm the change for conversion.



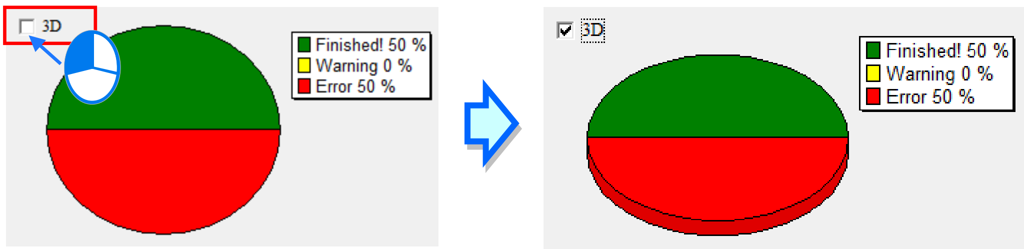
After the conversion is done, a Transferring Report will show up.



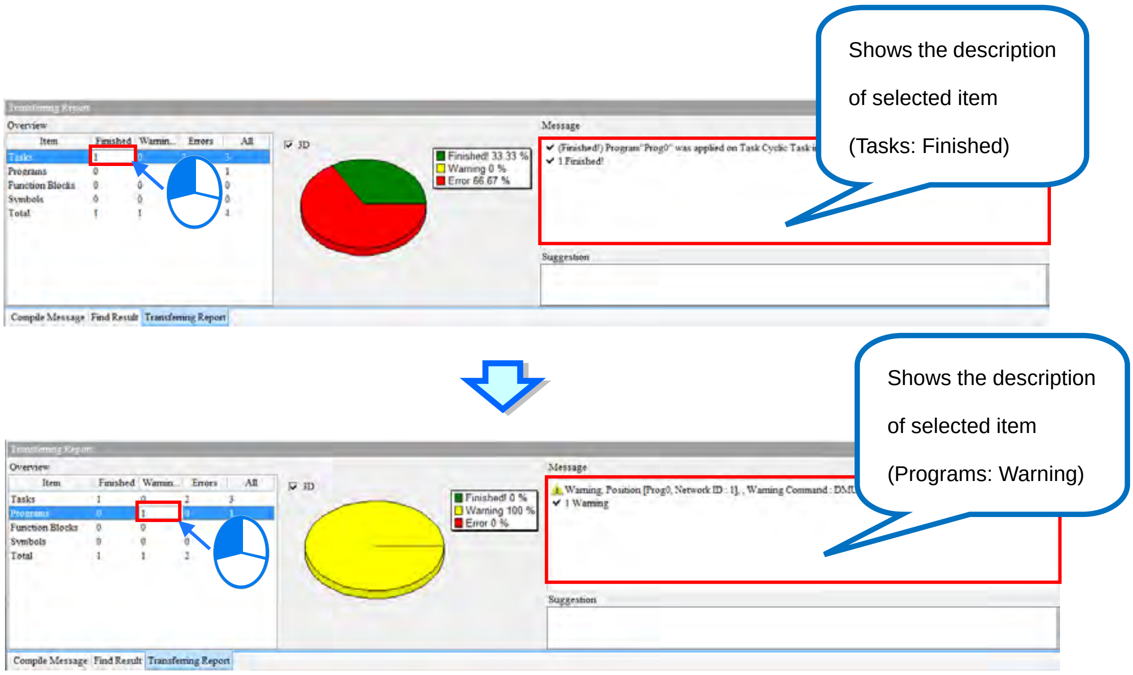
Click and drag the header of the Transferring Report to move the window. Double click the header to have it shown the Overview part only and double click the header again to have a complete window back.



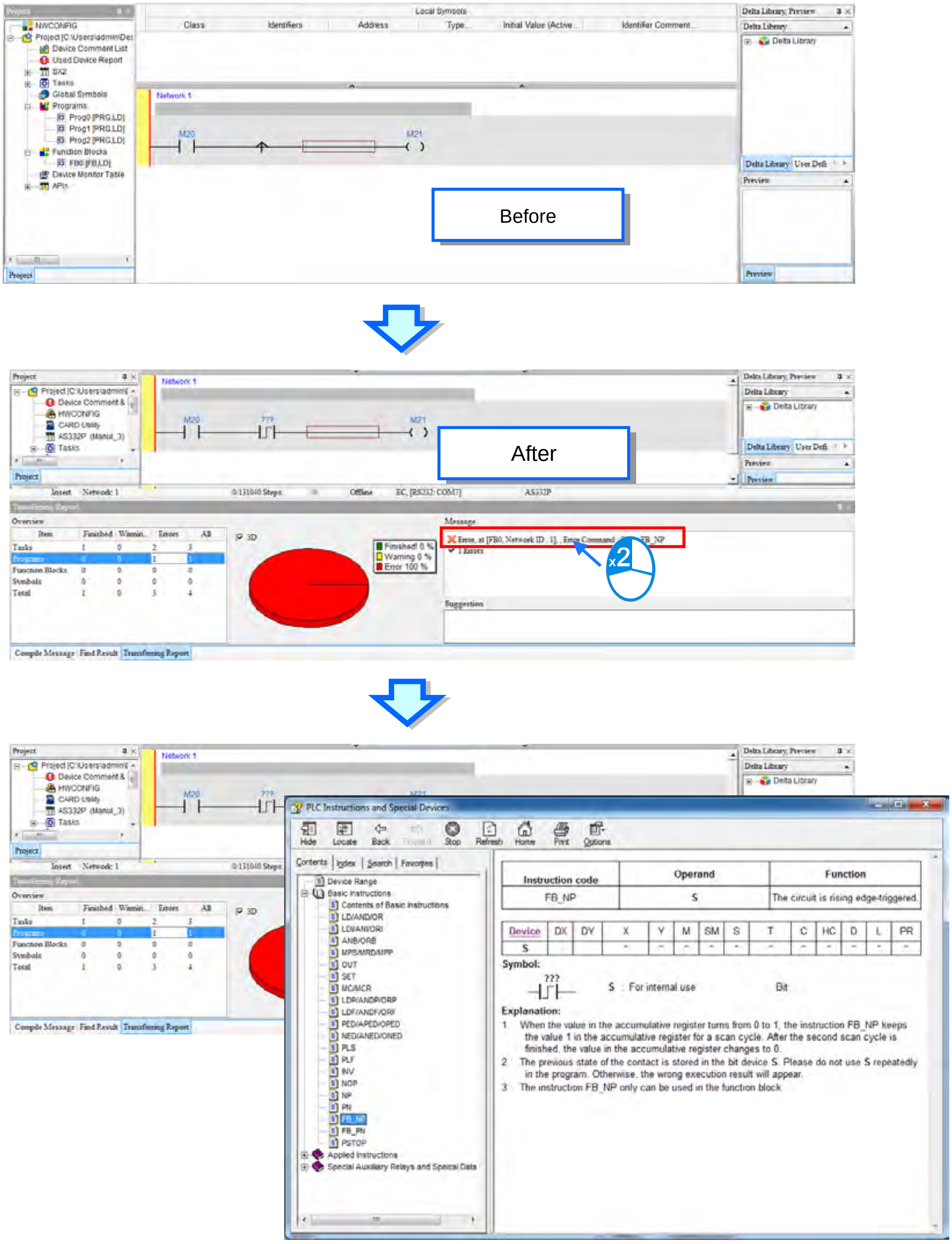
On the left side of the Transferring Report, there is an overview of the conversion, including tasks, programs, function blocks, symbols and total. A pie chart will show the corresponding result of the selected item in the middle of the transferring report. Green indicates the percentage of the finished part, yellow shows the percentage of the warning part, and red represents the percentage of the error part. When the 3D option is selected, the pie chart will be shown in 3D.



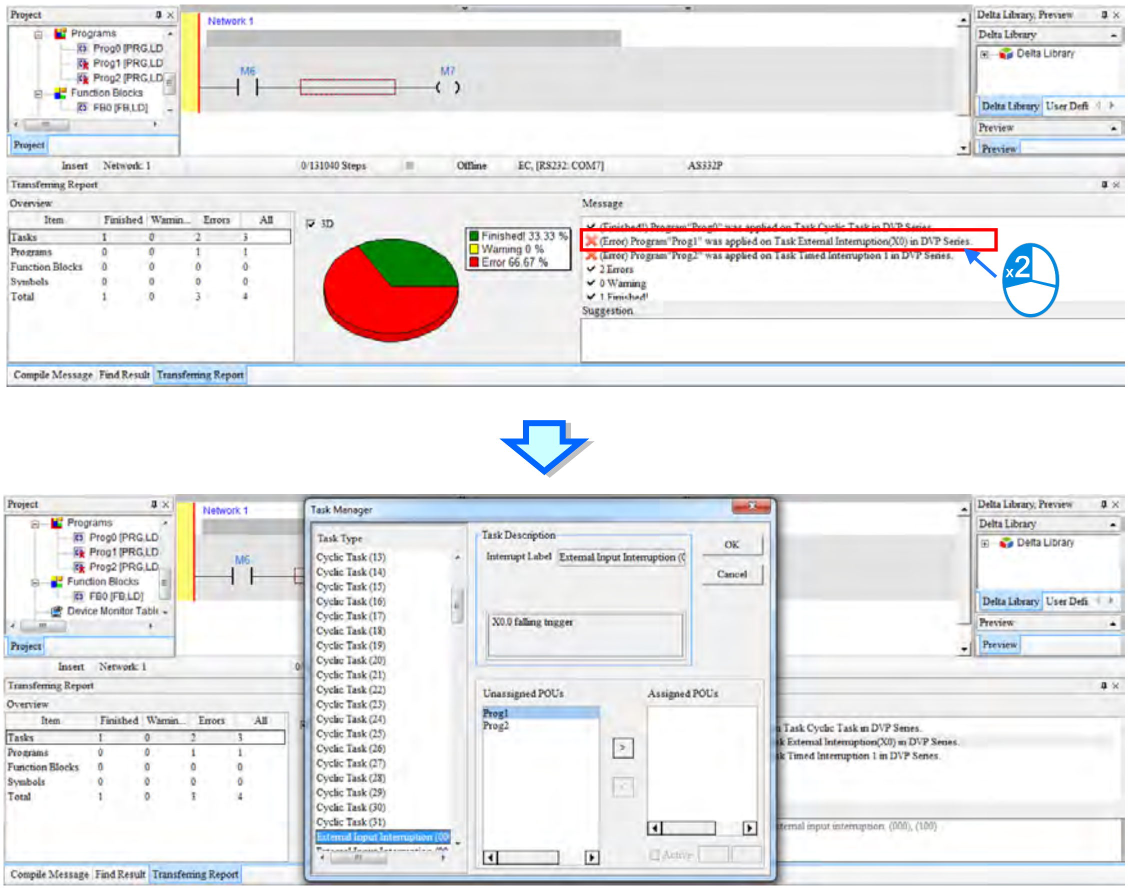
On the right side of the transferring report, a message section shows the description of the selected item from the overview section. Users can click any number shown in the overview to see the detailed descriptions of the selected item.



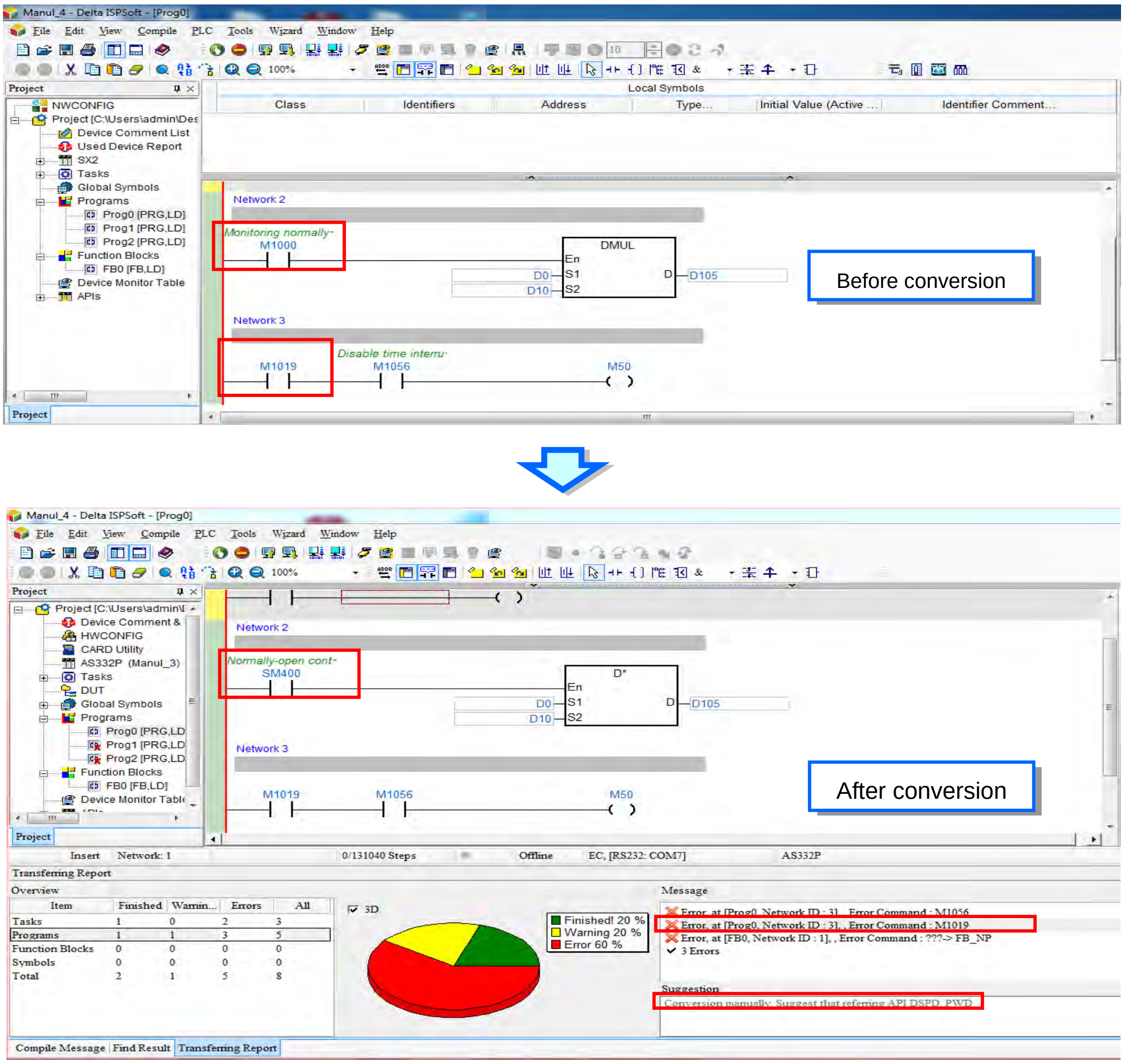
On the right side of the transferring report, a suggestion section targeting on “warning” or “error” messages in the selected item will be shown in the section. After transferring, users can use the corresponding index files to edit the instructions.



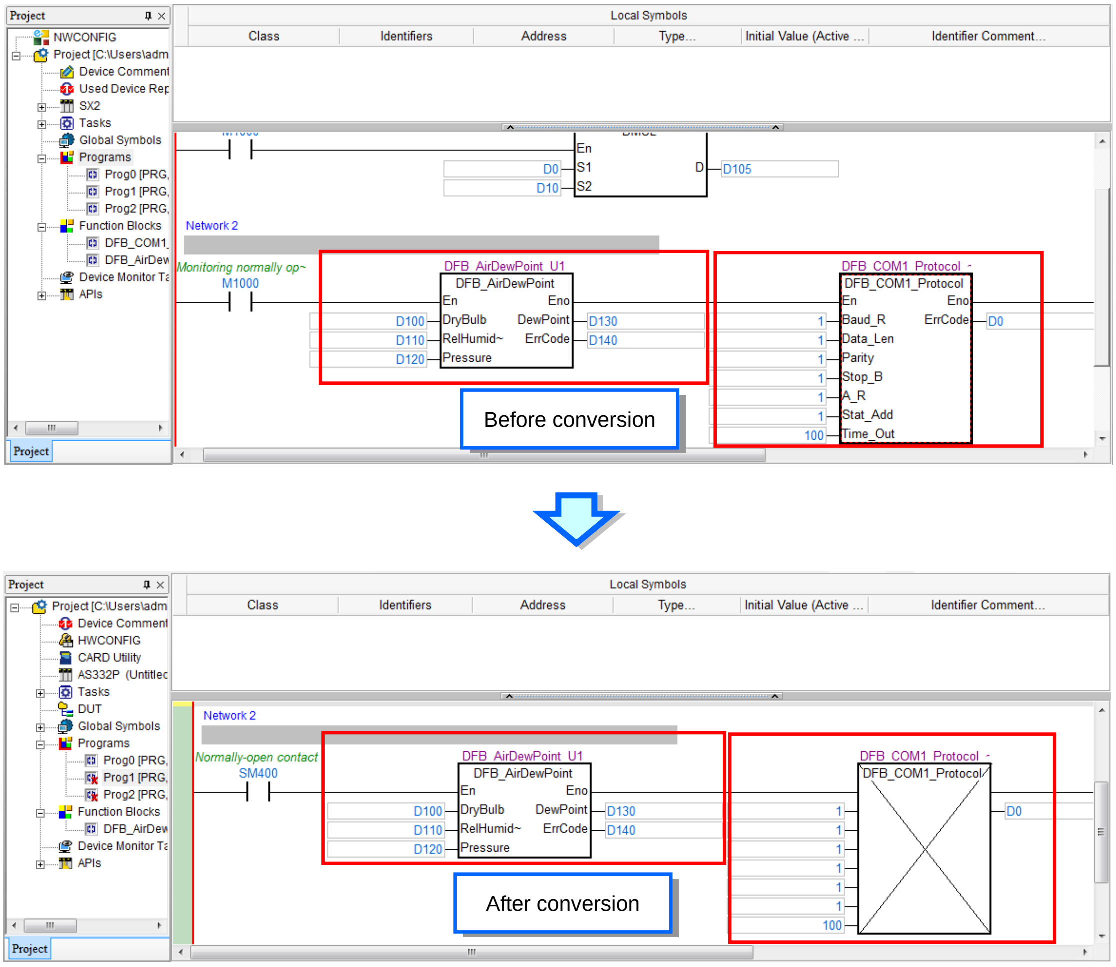
After the conversion is done, if there is any change in the Task Manager, suggestions will be shown in the suggestion section. Users can click the detailed message in the message section to open the Task Manager to edit the setting.



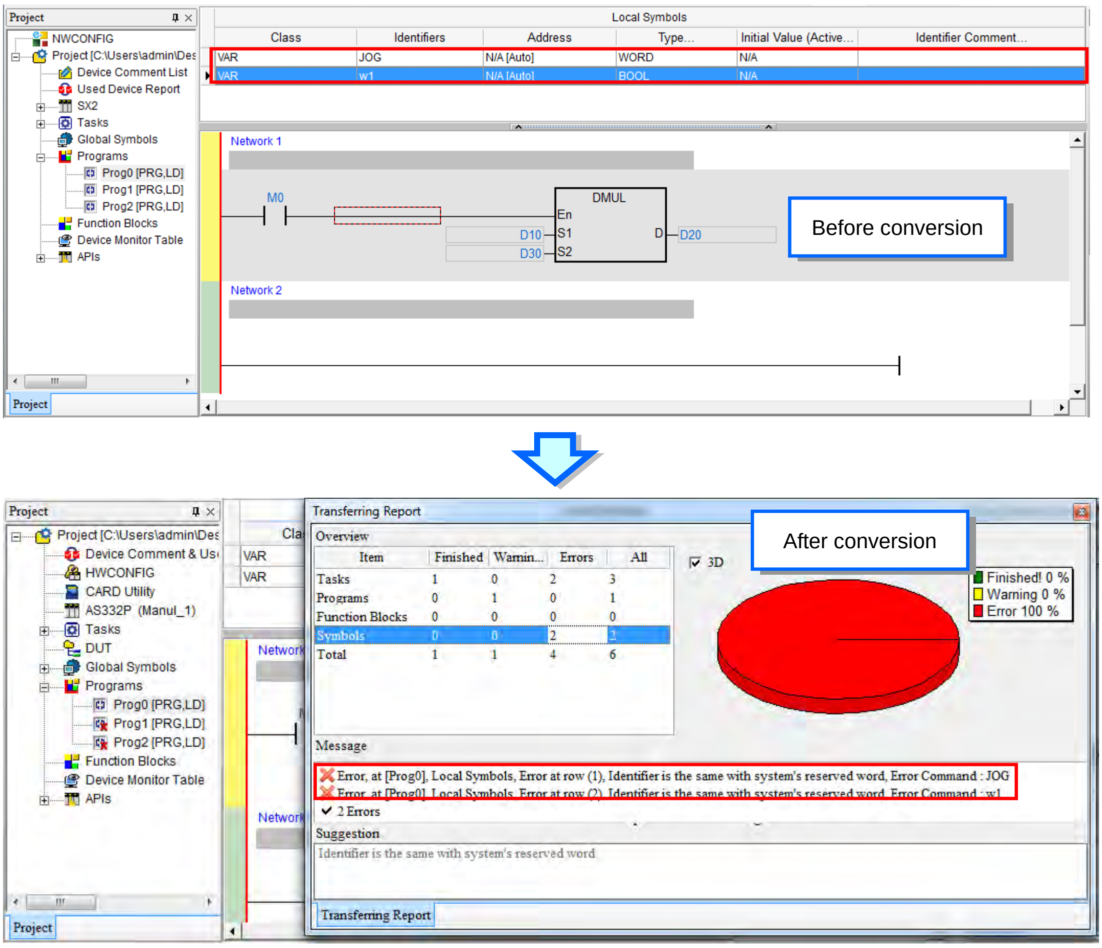
If the special M or special D of the DVP series can correspond to the ones in AS series, the system will generate the relays and registers automatically during the conversion. If not, users can find suggestions in the suggestion section after the conversion. Suggestion section is used for providing suggestions for users when warnings or errors occur.



When executing program conversion, if both DVP series and AS series support Delta Function Blocks then it will automatically convert to support once execution is complete; after conversion, however, when AS series does not have any corresponding Delta Function Blocks, an error cross mark appears in the function block (see below).



If the symbols used in the DVP series and the symbols, instructions names, device names used in AS series are contradicted, after the conversion, errors will occur.



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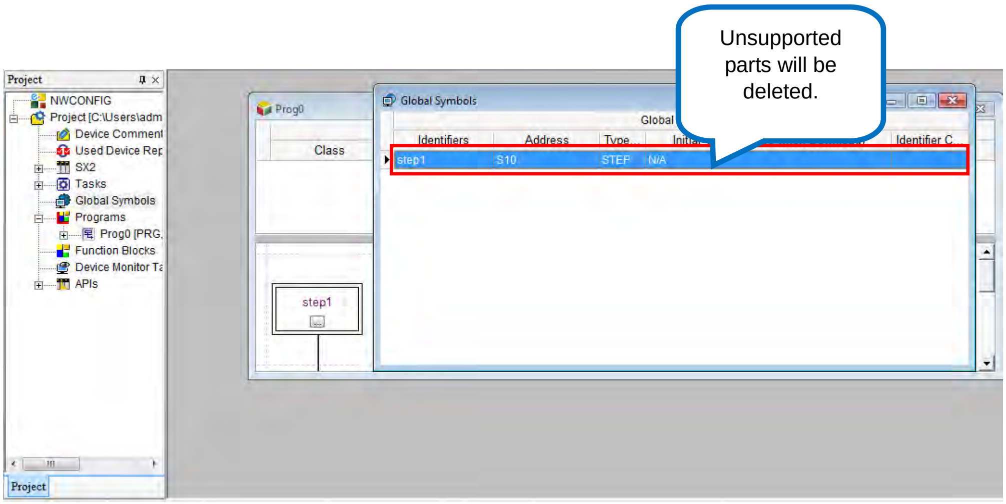
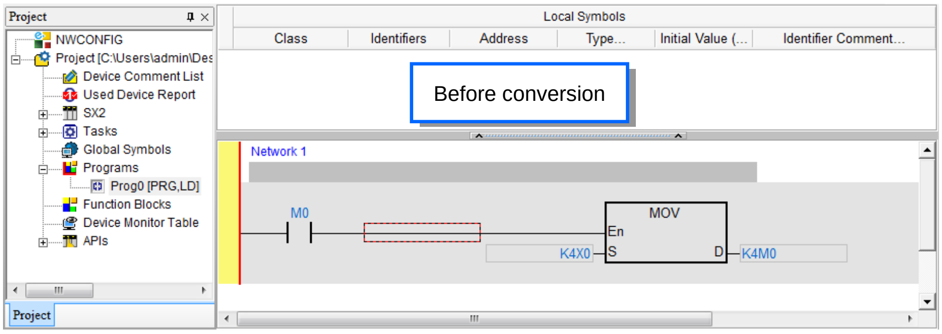
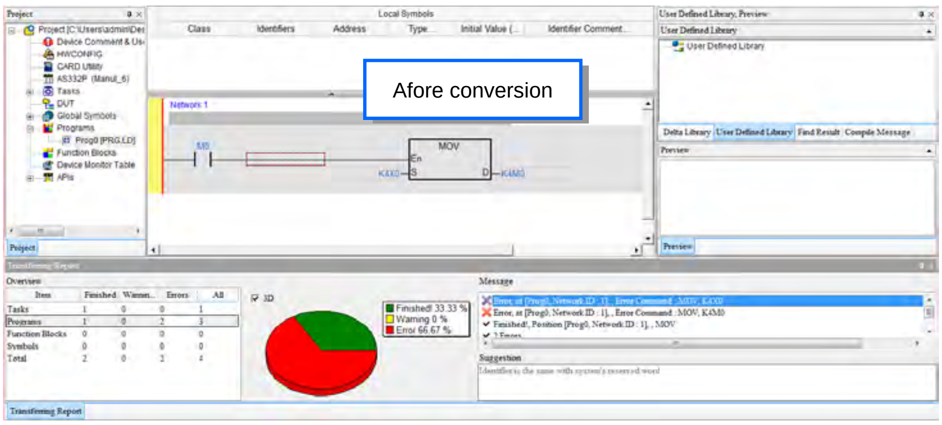
The programming languages such as LD and SFC are supported by the conversion of DVP series and AS series. Thus these two programming languages can be used without problem during conversion. When any unsupported programming language is used, the unsupported part will be deleted, after the conversion is done. For instance, a STEP symbol is declared in DVP series but this symbol will be deleted after the conversion, since AS series does not support this variable. If Kn is used in devices for DVP series, after the conversion, an error will occur, since AS series does not support Kn.



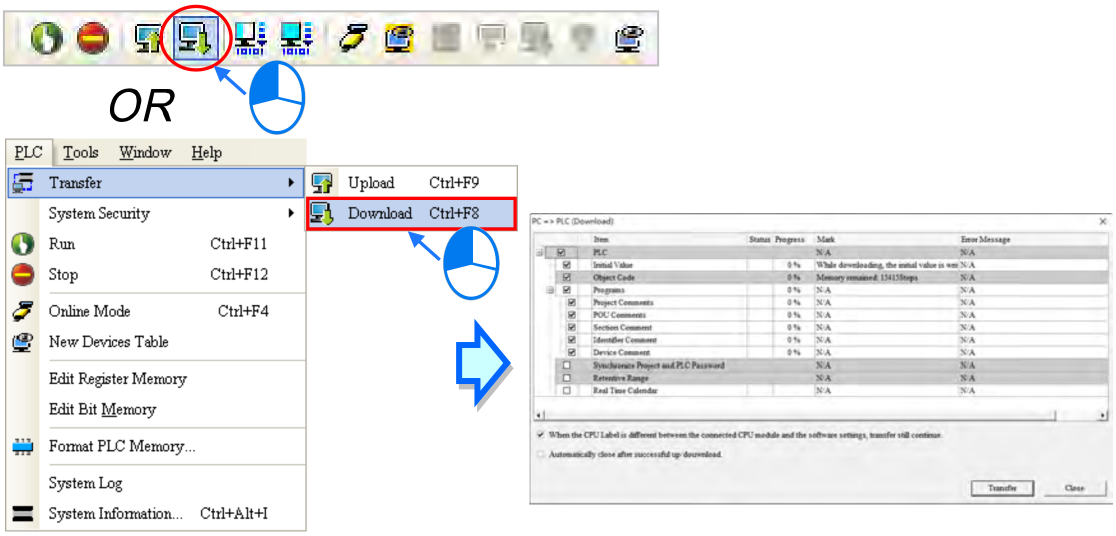




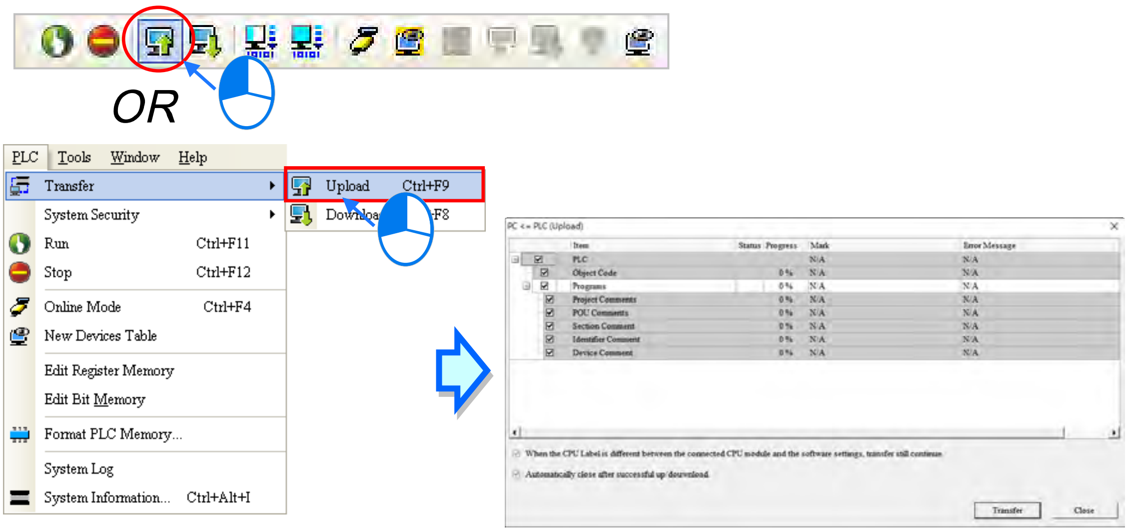
17.1.3 Download / Upload a Project

Users can download/upload not only the program in a project, but also the functions or the parameters in the project.

If users want to download the project, they can click the **PLC** menu, point to Transfer, and click **Download**. Or click  on the toolbar. After that users will see a PC=>PLC (Download) window, select the items you'd like to download and then click **Transfer**.



If users want to download the project, they can click the **PLC** menu, point to Transfer, and click **Upload**. Or click  on the toolbar. After that users will see a PC=>PLC (Upload) window, select the items you'd like to upload and then click **Transfer**.



The items in the upload and download windows vary according to different series. The descriptions of the items in the upload/download window are as follows.

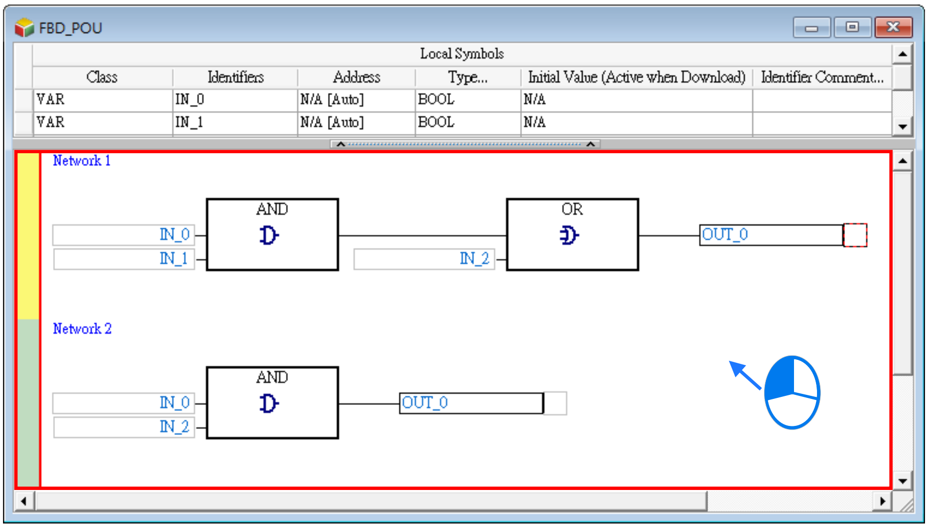
Transmit Item	Description	AH/AS		DVP		AS5xx DVPxxMC	
		Upload	Download	Upload	Download	Upload	Download
Execution code	Program compiled PLC execution code	V	V	V	V	V	V
Program	Users create project program	V	V	V	V	V	V
Project Comment	Comments for projects	V	V	V	V	V	V
POU Comment	POU and FB comments	V	V	V	V	V	V
Segment Comment	POU and FB program Segment Comment	V	V	V	V	V	V
Symbol Comment	Comments regarding global and local symbols	V	V	V	V	V	V
Synchronize project and PLC passwords	Synchronize project password to PLC host password		V		V		V
Task Parameter	Setting task parameters					V	V
Retention Range (power failure)	Setting value for retention range (power failure)				Do Not Support ES3		
Retention Symbol Table (power failure)	Retention symbol for power failure listed in the table					V	V

Transmit Item	Description	AH/AS		DVP		AS5xx DVPxxMC	
		Upload	**Download**	**Upload**	**Download**	**Upload**	**Download**
CANopen Parameter	Setting CANopen Builder Value					V	V
Symbol Initial Value	Write the symbol initial value in the corresponding hosts memory		V		V		
Calendar	Write in the Date/Time settings in PLC		V		V		V
Position planning Table	Content of position planning table	Support AS	Support AS	Support ES3	Support ES3		
Axis Parameter	Axis parameter content	Support AHxxEMC	Support AHxxEMC			V	V
Ethernet/IP Symbol Table	Ethernet/IP symbol table content		Support AS		Support ES3		
E-CAM	E-CAM content	Support AS &AHxxEMC	Support AS &AHxxEMC	Support ES3		V	V
OPCUA symbol table	OPCUA symbols content			Support AS300			

17.1.4 Find / Replace in LD / FBD / CFC

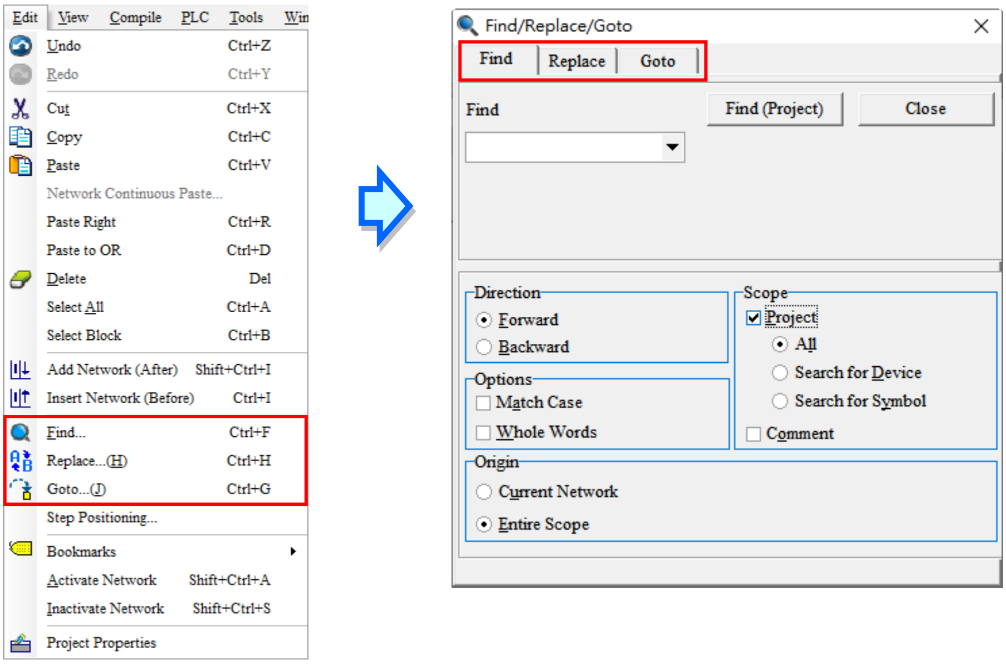
The **Find**/**Replace** function that ISPSoft provides varies with the program editing window. This section aims at describing the functions used in the window in which a ladder diagram / function block diagram / continuous function chart can be created.

1. Open a program editing window, and click anywhere in the working area.

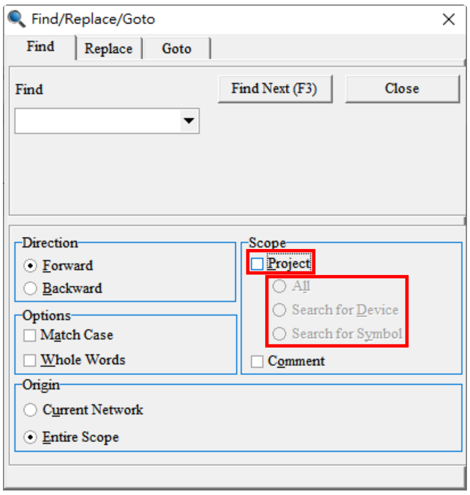


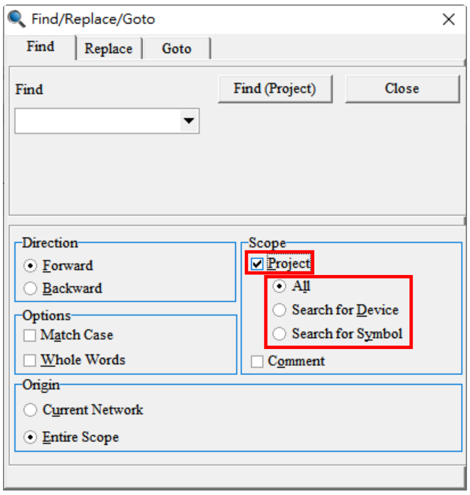
2. Find **Edit** on the toolbar and after clicking **Edit**, you can see the options **Find, Replace** and **Goto**. You can either select **Find, Replace** and **Goto**, the system directs you to the same setting page as the image shown below. You can also use the icons on the toolbar for the functions of **Find, Replace** and **Goto**.

OR



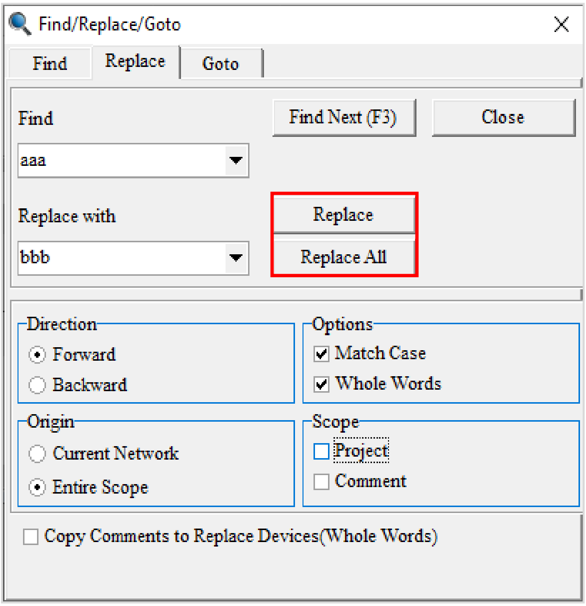
Type the object you'd like to search for and select search conditions. The users can do a search on the object typed in the **Find** box by clicking **Find Next (F3)** or pressing F3 on the keyboard. The users can still do a search even when the **Find/Replace/Goto** window is closed. When not defining the Scope, the search will only focus on the current editing. When **Project** is selected in the Scope section, you can search all or choose to search for the device or the symbol.





Item	Description
Find	Users can type the object which will be searched for, or select an object which has been searched for after they click in the box. Search for device: searching for all devices which are matched Search for symbol: searching for all symbols which are matched
Direction	Users can search down or search up.
Options	**Match Case**: ISPSoft searches only for words that match the case of the word which users type in the **Find** box. **Whole Words**: **Whole Words** instructs ISPSoft to find complete words only, and not to find words that only contain what users type. If the option is selected, users can further select the "**Copy Comments to Replace Devices (Whole Words)**" to copy the source device comments to the target device comments.
Origin	**Current Network**: The search starts at the position selected. **Entire Scope**: The search starts at the beginning of the program or the end of the program. This is the only option for CFC.
Scope	Users can define the searching ranges (When **All, Project** or **Comment** is selected, you can search for devices or symbols.) **All:** Search all the devices and symbols for the qualified targets. **Search for Device:** Search all the devices for the qualified targets. **Search for Symbol:** Search all the symbols for the qualified targets.

Type the object you'd like to be replaced with in the field of **Find** and type the new object you'd like to use in the field of **Replace With**. And that select **Replace** to replace the next matched object or select **Replace all** to replace all the matched objects.

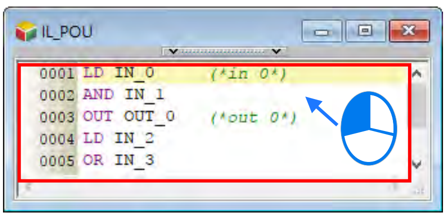


If the users want to go to a specific position in the LD and FBD program, they can click the **Goto** tab in the **Find/Replace/Goto** window, select **Network Label** or **Bookmark** in the **Location Type** drop-down list box, select an item in the **Index** drop-down list box, and click **Goto**.

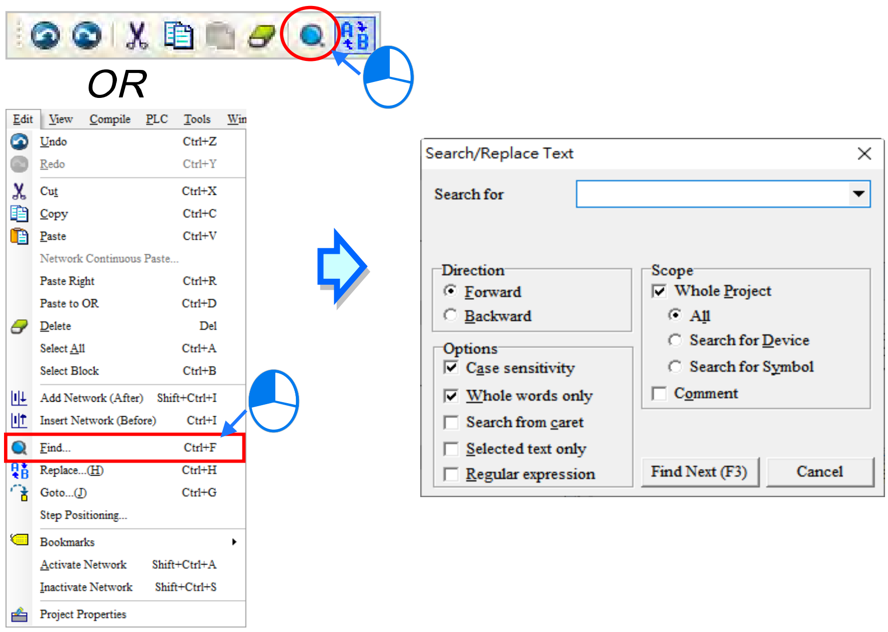
17.1.5 Find / Replace in IL / ST

Use the **Find** and the **Replace** functions in IL/ST.

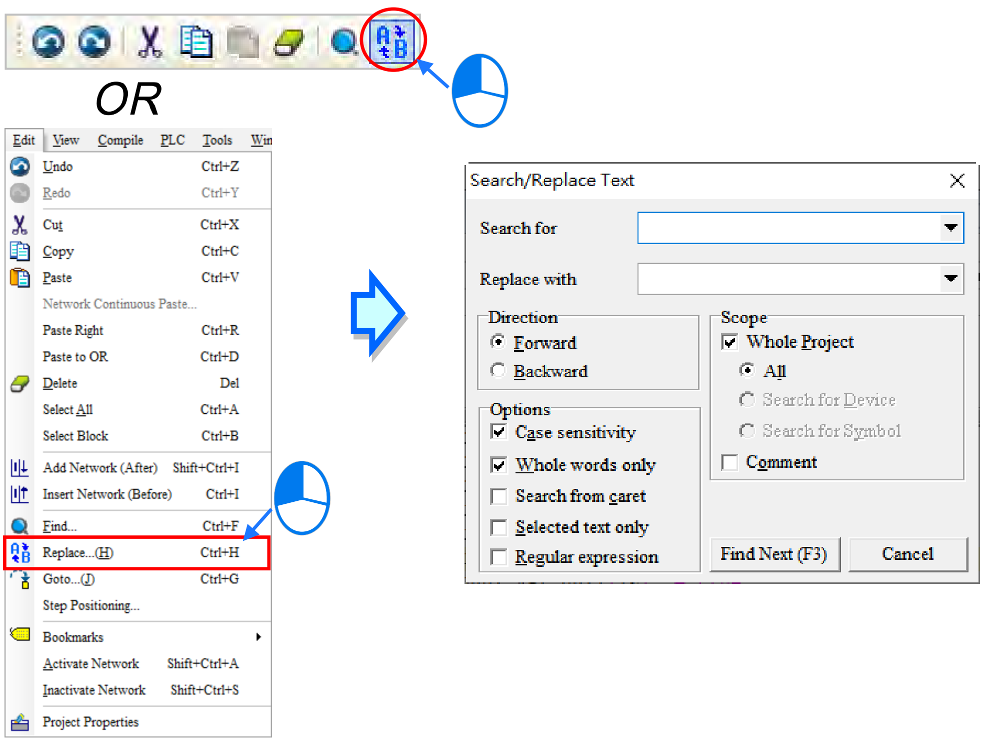
1. Open a program editing window, and click anywhere in the working area.



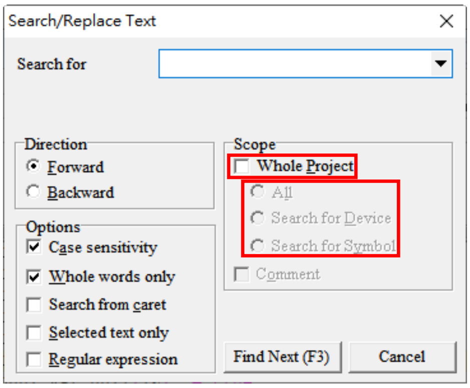
2. You can use the icon  on the toolbar for the functions of **Find.** Or you can click **Edit** on the toolbar to see the option **Find.** And after clicking the mentioned icon or option, the **Search/Replace Text** window appears.

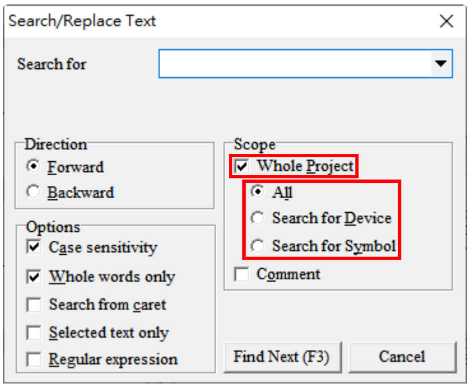


3. After the users click **Replace** on the **Edit** menu, or  on the toolbar, the **Search/Replace Text** window will appear.



The below operation page is for search function. Users must set the search targets and conditions in the below fields. After the setting is completed, click “Find Next” button or press the “F3” key to perform the searching task even when the search page is closed. If “Whole Project” is not selected in the Scope field, the scope of text search would be limited to the window you are currently editing. Instead, users can search in different categories by choosing “All”, “Search for Device” or “Search for Symbol” when the option “Whole Project” is selected , with the search results displayed in the message area.

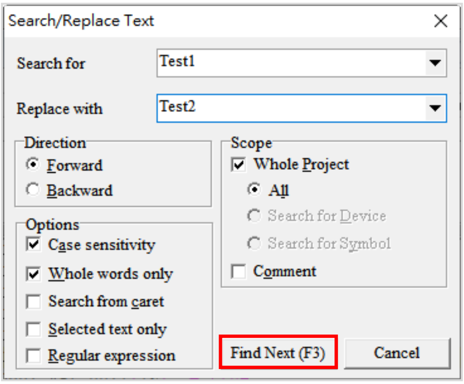




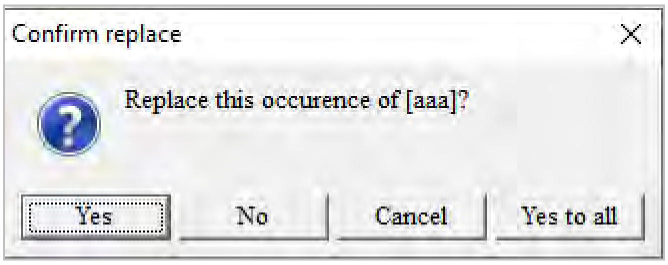
Search Condition	Description
Search for	Users can type the object which will be searched for, or select an object which has been searched for after they click ▼ in the box.
Direction	Users can search down or search up.
Options	**Match Case:** ISPSoft searches only for words that match the case of the word which users type in the Find box. **Whole Words:** Whole Words instructs ISPSoft to find complete words only, and not to find words that only contain what users type. If the option is selected, users can further select the “Copy Comments to Replace Devices (Whole Words)” to copy the source device comments to the target device comments. **Search from caret：** Only search from the current cursor location. (If this option is not selected, system will search the whole program.) **Selected text only :** The searching starts from the selected area of texts. (If this option is not selected, system will search the whole program.) **Regular Expression:** Select this option to use Regular Expression in “Search For” field.
Scope	Specify the area you want to search. (Options “All”, “Search for Device” and “Search for Symbol” are available when “Whole Project” is selected.) **All:** Search all the Strings for the qualified targets. **Search for Device:** Search all the devices for the qualified targets. **Search for Symbol:** Search all the symbols for the qualified targets. **Comment:** Search all the comments for the qualified targets.

*** A regular expression is a type of standard syntax which uses * a wildcard. Please refer to related technical documents for more information.**

The below operation page is for replace function. Type the object you'd like to be replaced with in the field of **Search for** and type the new object you'd like to use in the field of **Replace With**. You can also select options as the searching conditions. And then click **Find Next (F3)** to replace the next matched object. In addition, only option "All" would be available when "Whole Project" is selected.



If the users use the **Replace** function, the **Confirm replace** window appears after a matched object is found.

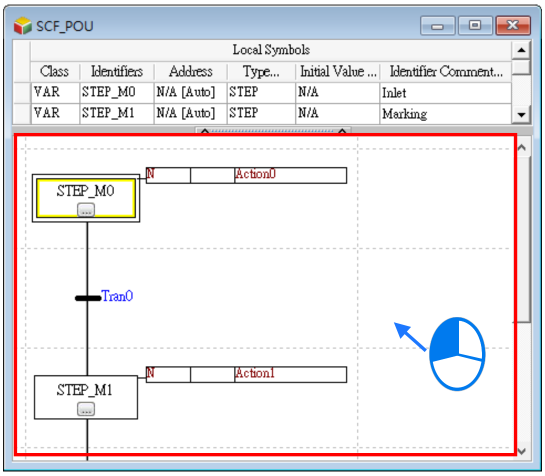


Button	Function
Yes	The object found is replaced by the replacement object, and the system searches for the next occurrence of the object typed in the **Search for** box.
No	The object found is not replaced by the replacement object, and the system searches for the next occurrence of the object typed in the **Search for** box.
Cancel	The search is canceled, and the **Confirm replace** window is closed,
Yes to all	All the objects meeting the search conditions selected are replaced by the replacement object.

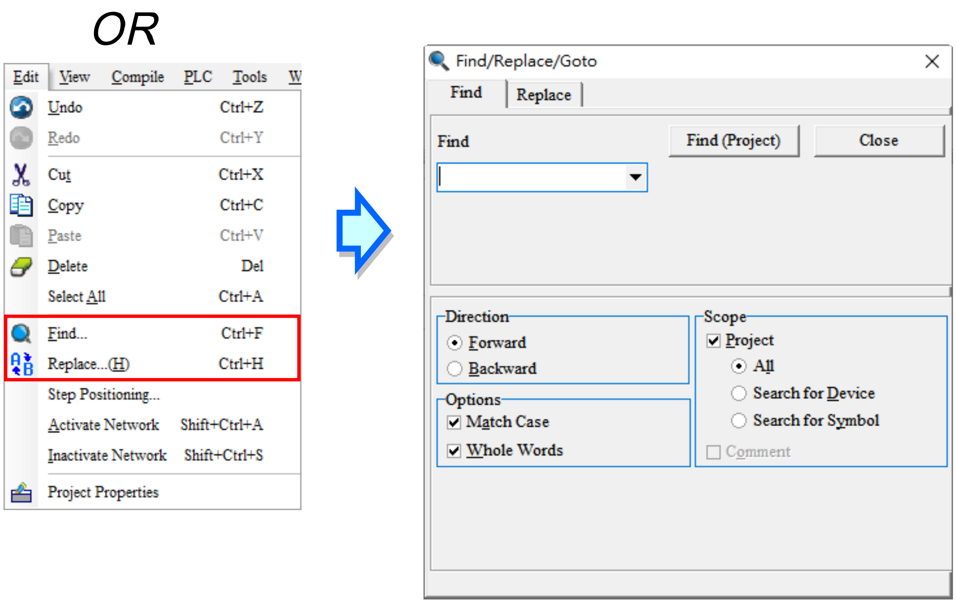
17.1.6 Find / Replace in SFC

Use the **Find** and the **Replace** functions in a sequential function chart (SFC).

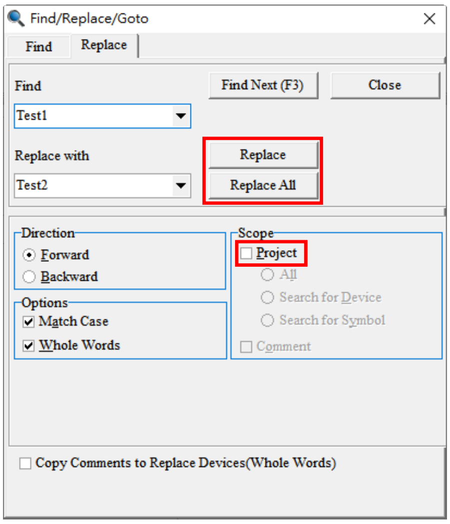
1. Open a program editing window, and click anywhere in the working area.

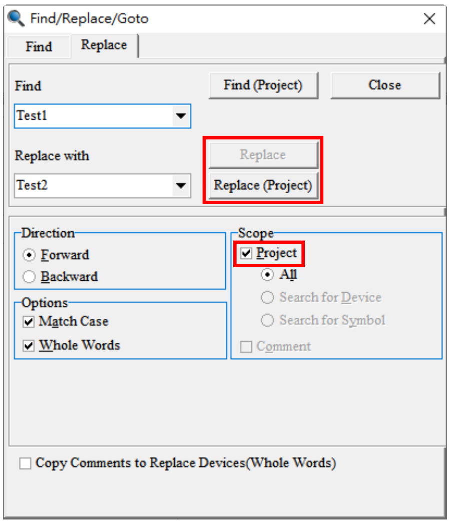


2. You can use the icons or on the toolbar for the functions of **Find** and **Replace.** Or you can click **Edit** on the toolbar to see the options **Find** and **Replace** and after clicking the mentioned icon or option, the **Find/Replace/Goto** window appears.



Below is the operation page for replace function. Type the object you'd like to be replaced with in the field of **Find** and type the new object you'd like to use in the field of **Replace With**. After that select **Replace** to replace the next matched object or select **Replace all** to replace all the matched objects. If the "Project" in Scope field is selected and click on "Replace (Project)", all the strings in the project will be replaced.



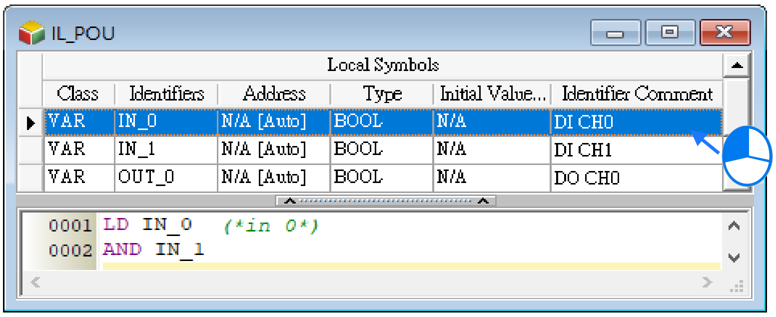


Search condition	Description
Find	Users can type the object which will be searched for, or select an object which has been searched for after they click ▼ in the box. Search for device: searching for all devices which are matched Search for symbol: searching for all symbols which are matched
Direction	Users can search down or search up.
Options	**Match Case**: ISPSoft searches only for words that match the case of the word that users type in the **Find** box. **Whole Words**: **Whole Words** instructs ISPSoft to find complete words only, and not to find words that only contain what users type. If the option is selected, users can further select the "**Copy Comments to Replace Devices (Whole Words)**" to copy the source device comments to the target device comments.
Scope	Specify the area you want to search. (Options "All", "Search for Device" and "Search for Symbol" are available only when "Whole Project" is selected.) **All:** Search all the Strings for the qualified targets. **Search for Device:** Search all the devices for the qualified targets. **Search for Symbol:** Search all the symbols for the qualified targets. **Comment:** Search all the comments for the qualified targets.

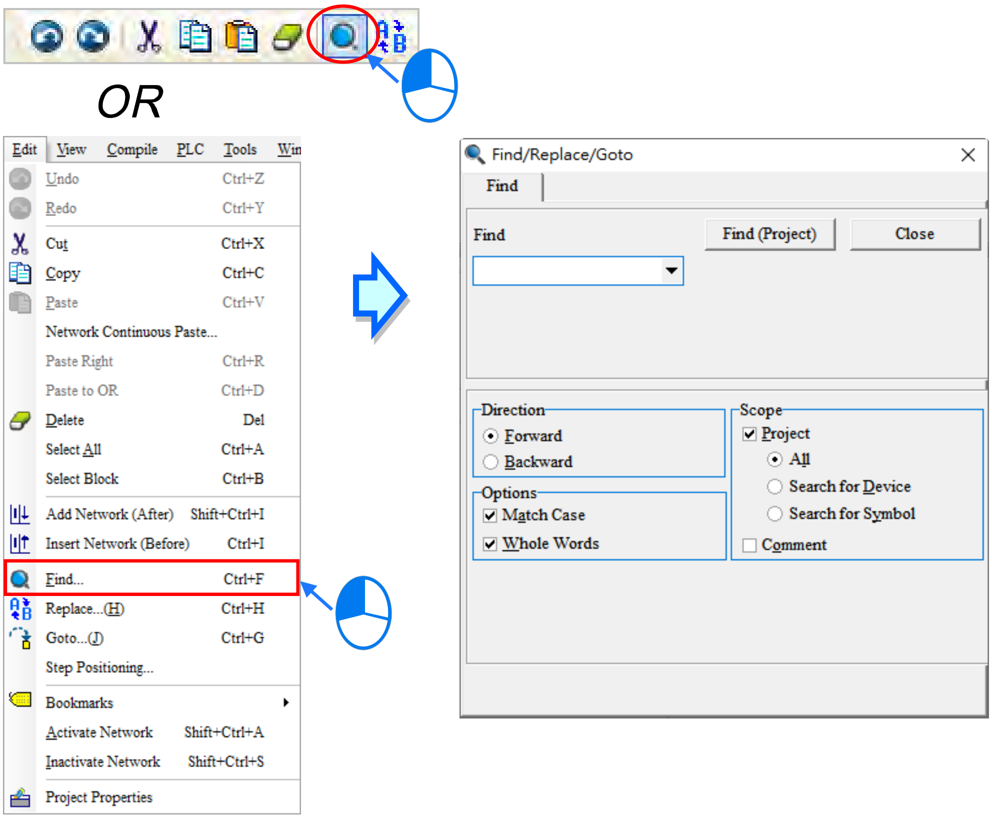
17.1.7 Find Function in Symbol Table

Use the **Find** function in a local symbol table/global symbol table.

1. Open a program editing window, and click anywhere in the working area.



2. You can use the icons  on the toolbar for the functions of **Find.** Or you can click **Edit** on the toolbar to see the option **Find** and after clicking the mentioned icon or option, the **Find/Replace/Goto** window appears.

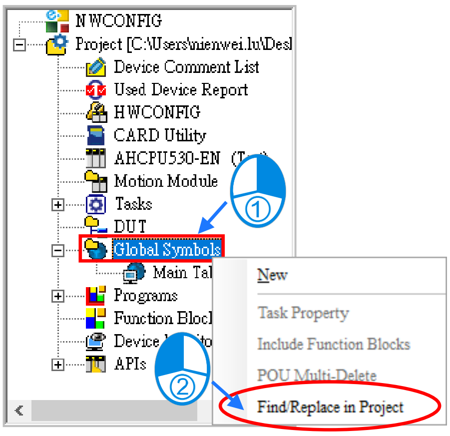


3. Type the object you'd like to search for and select search conditions. The users can do a search on the object typed in the **Find** box by clicking **Find Next (F3)** or pressing F3 on the keyboard. The users can still do a search even when the **Find/Replace/Goto** window is closed.

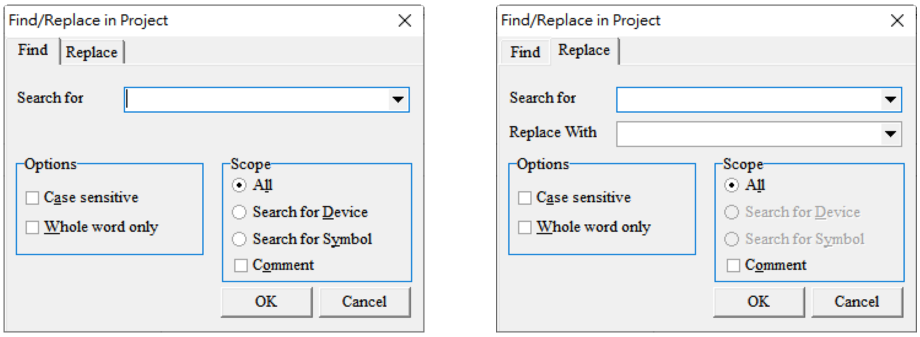
Search condition	Description
Find	Users can type the object which will be searched for, or select an object which has been searched for after they click in the box. Search for device: searching for all devices which are matched Search for symbol: searching for all symbols which are matched
Direction	Users can search down or search up.
Options	**Match Case**: ISPSoft searches only for words that match the case of the word that users type in the **Find** box. **Whole Words**: **Whole Words** instructs ISPSoft to find complete words only, and not to find words that only contain what users type. If the option is selected, users can further select the "**Copy Comments to Replace Devices (Whole Words)**" to copy the source device comments to the target device comments.
Scope	Specify the area you want to search. (Options "All", "Search for Device" and "Search for Symbol" are available only when "Whole Project" is selected.) **All:** Search all the Strings for the qualified targets. **Search for Device:** Search all the devices for the qualified targets. **Search for Symbol:** Search all the symbols for the qualified targets. **Comment:** Search all the comments for the qualified targets.

17.1.8 Find / Replace in Project

1. Right-click the Global Symbols/Programs/Function Blocks in the project management area, and then click **Find/Replace in Project** on the context menu to find device or symbol in a project.

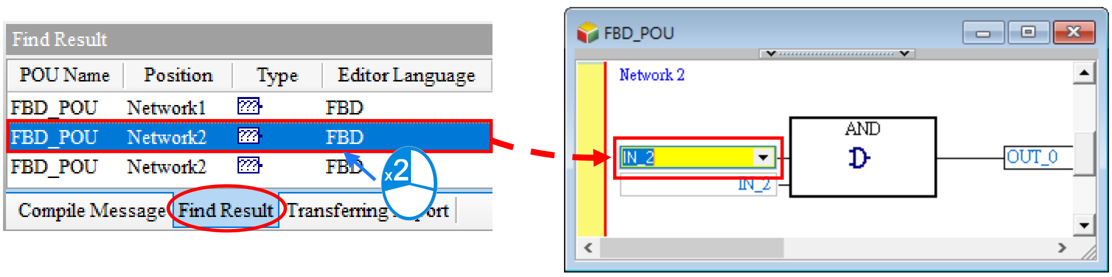


2. The **Find** page and the **Replace** page are shown below. There are two tabs in the **Find/Replace in Project** window. Type the object you'd like to search for in the field of **Search for** on the Find tab page and select search conditions. Click **OK** to start searching. Type the object you'd like to be replaced with in the field of **Search for** and a new object you'd like to use in the field of **Replace With**. After that click **OK** to replace the next matched object. Note this act (replacement) can NOT be undone.



Search condition	Description
Scope	Search for device: searching for all devices which are matched Search for symbol: searching for all symbols which are matched Comment: searching for all the comments which are matched
Options	**Case sensitive**: ISPSoft searches only for words that match the case of the word that users type in the **Find** box. **Whole word only**: **Whole Words** instructs ISPSoft to find complete words only, and not to find words that only contain what users type.

After using the **Find/Replace** function, the search results will be displayed in the message display area at the bottom of the ISPSoft window. If the users double-click a search result, the system will direct the users to the position of the object corresponding to the search result.

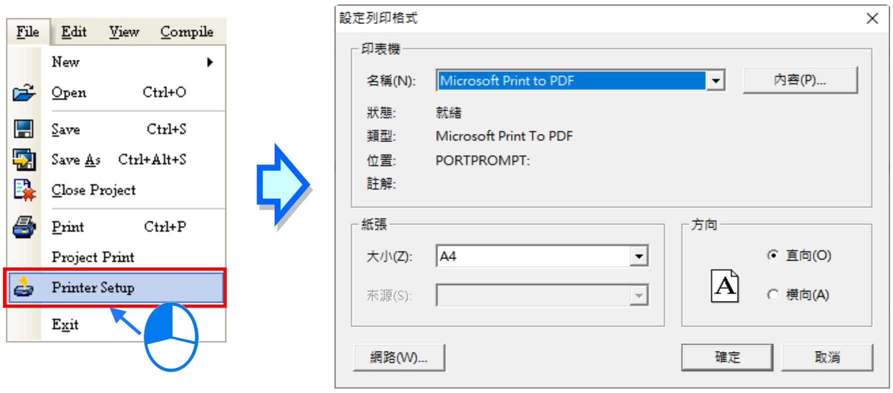


17.1.9 Print Function

ISPSoft provides a printing function.

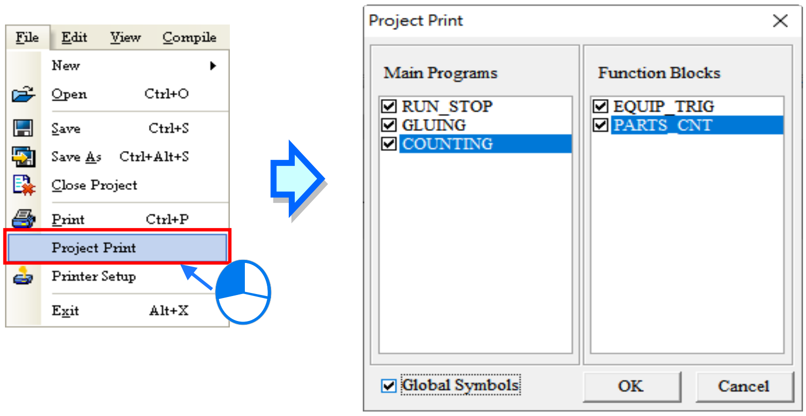
- **Printer Setup**

After users click **Printer Setup** on the **File** menu, the **Print Setup** window will be opened. Before a document is printed, the users can select a printer, and set a print format.

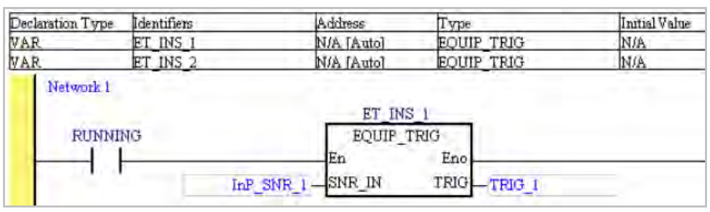


- **Project Print**

After users click **Project Print** on the **File** menu, users can select items which will be printed in the **Project Print** window. The items which can be selected are the main programs, the function blocks, and the global symbols.

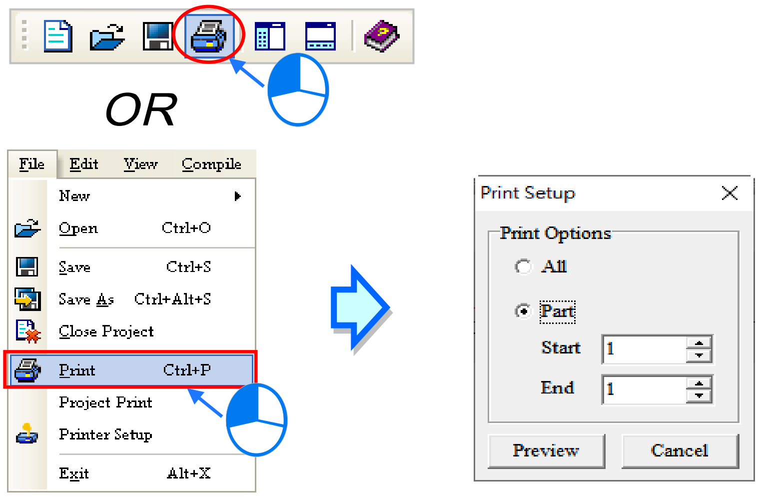


An example of a print result is shown below. The contents which are printed include a local symbol table. If there are comments in the window whose contents are printed, the comments will be printed.



- **Print**

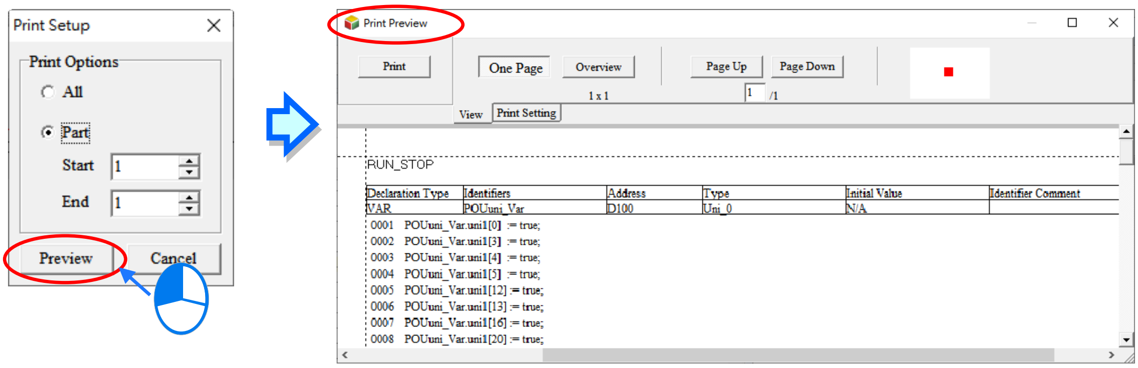
If users want to print the contents of the present window, they can click **Print** on the **File** menu or  on the toolbar. The users can set a print range in the **Print Setup** window. The print result varies with the contents of the present window. Please refer to the table below for more information.



Window	All	Part
Global symbol table	The complete global symbol table is printed.	Users can not print a part of the global symbol table.
Ladder diagram/Function block diagram	The complete program and local symbol table are printed.	The complete local symbol table and a part of the program are printed. (The start number and the end number are network numbers.)
Instruction list/Structured text	The complete program and local symbol table are printed.	The complete local symbol table and a part of the program are printed. (The start number and the end number are network numbers.)
Sequential function chart	The complete local symbol table and sequential function chart are printed. (The actions and the transitions are not printed.)	Users can not print a part of the sequential function chart.
Continuous function chart	The complete program and local symbol table are printed.	Users can not print a part of the continuous function chart.

***.After users open the window for an action/transition, they can print the action/transition.**

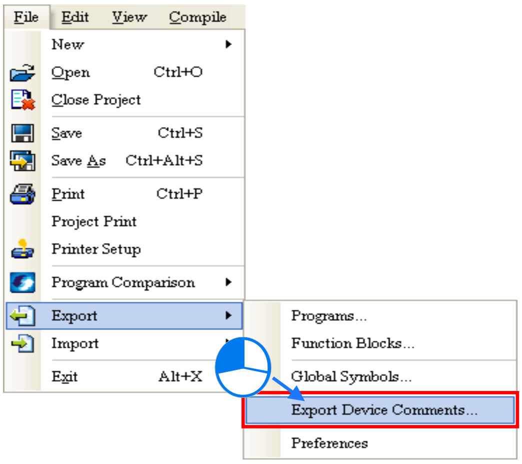
After the users click **Preview** in the **Print Setup** window, the **Print Preview** window will be opened. Please refer to appendix C for more information about the print management tool that ISPSoft provides.

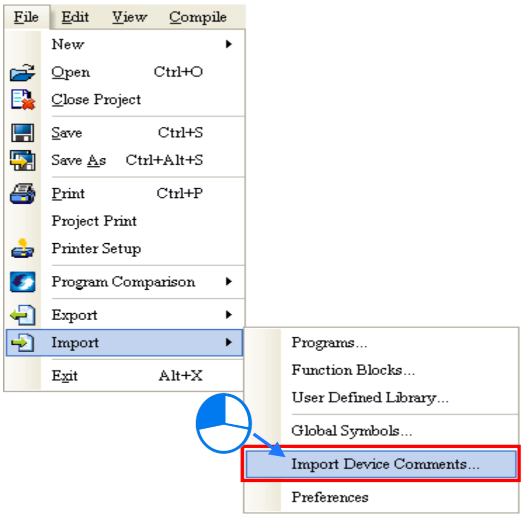


17.2 Devices and Registers

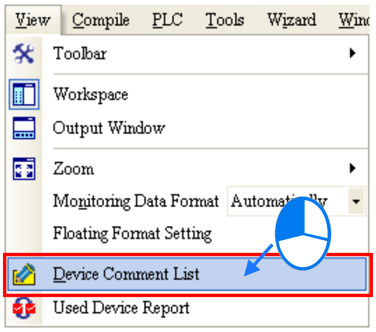
17.2.1 Device Comment List for a DVP Series PLC

If users want to export the device comment list from a project for a DVP series PLC, they can click the **File** menu, point to **Export**, and click **Export Device Comments…**. If the users want to import the device comment list, they can click the **File** menu, point to **Import**, and click **Import Device Comments…**.

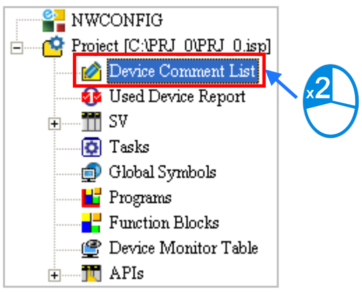




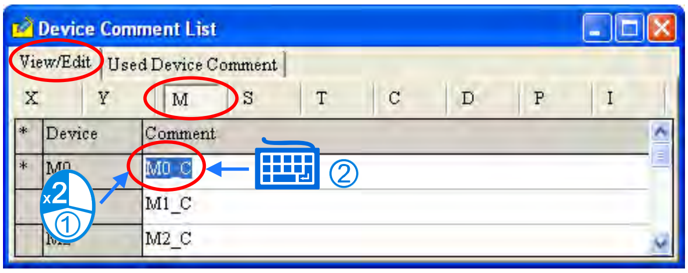
If the users want to manage the comments on devices, they can click **Device Comment List** on the **View** menu, or double-click **Device Comment List** in the project management area. After the users click **Device Comment List** on the **View** menu, or double-click **Device Comment List** in the project management area, the system will open the **Device Comment List** window.



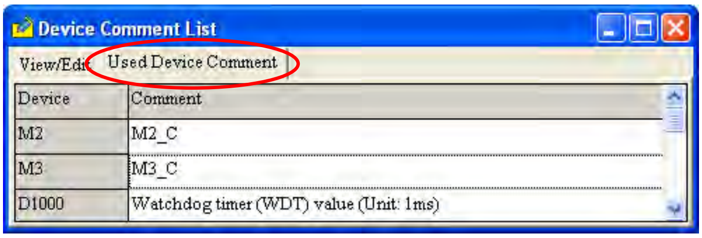
OR



The comments on devices are on a **View/Edit** page. After the users click a tab which indicates a device type in the window, the comments on devices are displayed. The mark "*" at the left side of a device indicates that the device is used in the program. If the users want to make a comment on a device, they can double-click the **Comment** cell for the device, and type the comment.



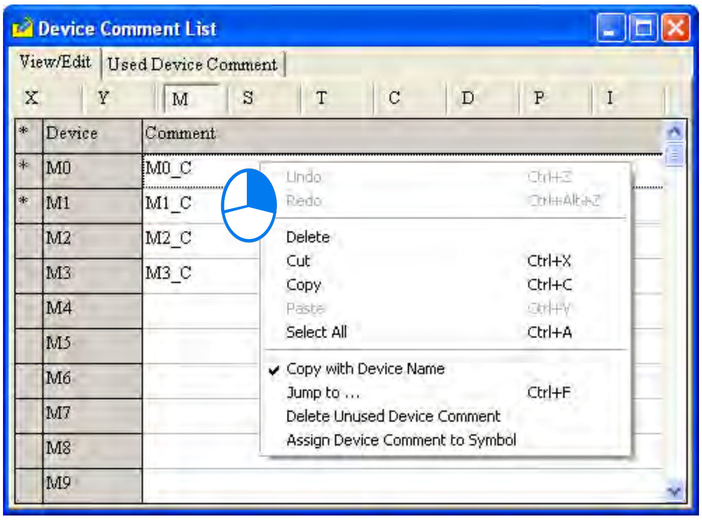
The devices on which comments are made and all the comments on the devices are on the **Used Device Comment** page. After the users double-click the **Comment** cell for a device, they can edit the comment on the device.



***1. The comments on devices are separate from the comments on symbols. The comments on devices appear in the Device Comment List window, while the comments on symbols do not appear in the Device Comment List window.**

***2. Users can edit the default comments on the special relays and the special registers in a project. However, the new comments are valid only in this project.**

After the uses right-click the table in the **Device Comment List** window, a context menu will appear. The context menu comprises basic items and special items.



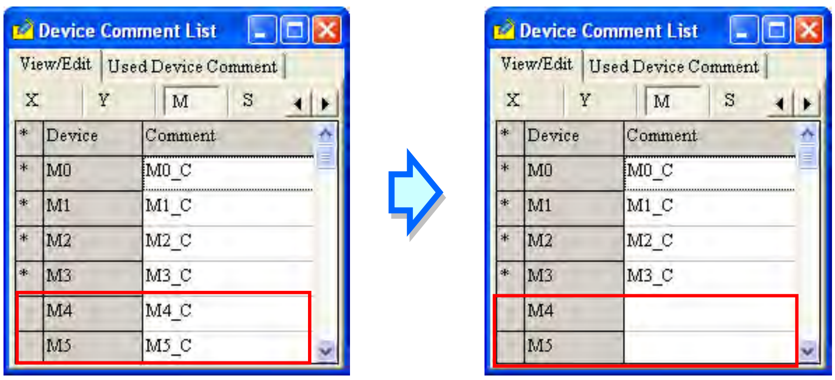
- **Jump to…**

After the users click **Jump to…** on the context menu, the **Jump to…** window will appear. The users can type a device name in the **Device Name** box. After the users click **OK** in the **Jump to…** window, they can easily view the device name and the comment on the device on a **View/Edit** page.

The device name typed must be matched with the device type clicked, otherwise, the device name will not be found. If the users click **Jump to…** on the context menu which appears after they right-click the **Used Device Comment** page, the device name typed in the **Device Name** box in the **Jump to…** window must be on the **Used Device Comment** page.

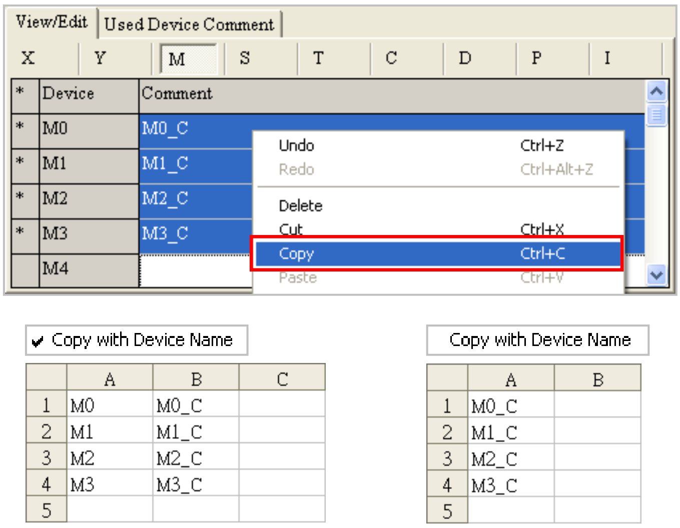
- **Delete Unused Device Comment**

After the users click **Delete Unused Device Comment** on the context menu, the system will delete the comments on the devices which are not used in the program.



- **Copy with Device Name**

If the users click **Cut/Copy** on the context menu, the items selected in the **Device Comment List** window will be cut/copied to the Windows Clipboard. The items cut/copied can be pasted into a document in Microsoft Excel. If **Copy with Device Name** on the context menu is clicked before **Cut/Copy** on the context menu is clicked, the contents which will be cut/copied will include device names. Please compare the two Excel tables below.

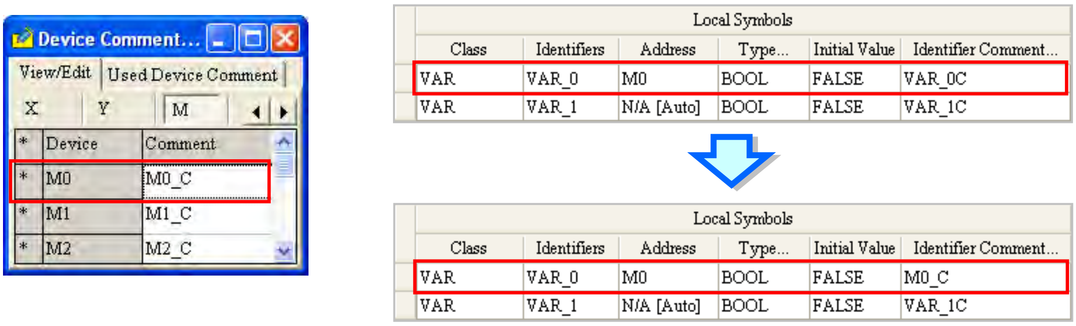


	A	B	C
1	M0	M0_C	
2	M1	M1_C	
3	M2	M2_C	
4	M3	M3_C	
5			

	A	B
1	M0_C	
2	M1_C	
3	M2_C	
4	M3_C	
5		

- **Assign Device Comment to Symbol**

If symbols are assigned devices, the comments on the devices will be assigned to the symbols after the users click **Assign Device Comment to Symbol** on the context menu.



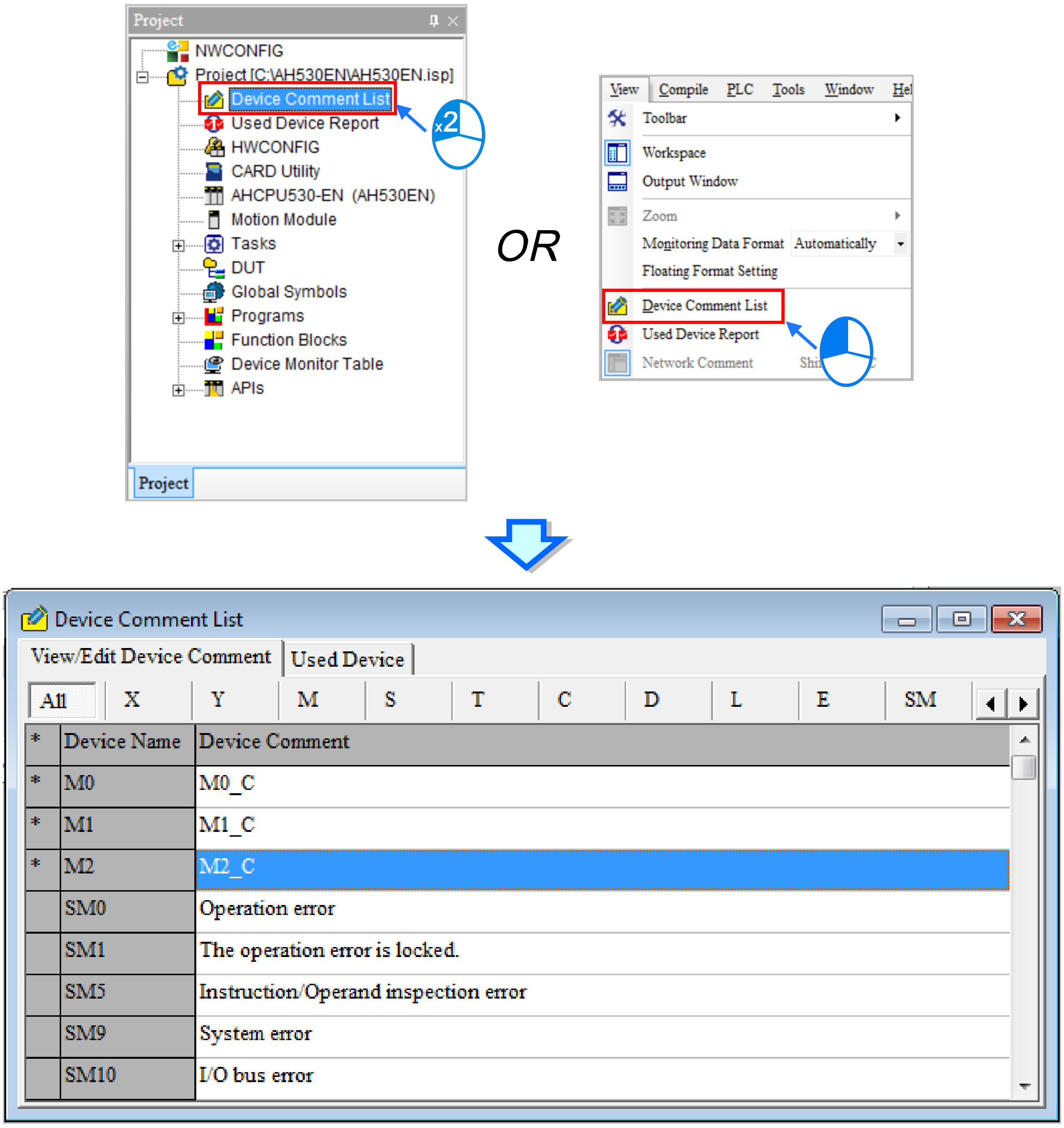
Class	Identifiers	Address	Type...	Initial Value	Identifier Comment...
VAR	VAR_0	M0	BOOL	FALSE	VAR_0C
VAR	VAR_1	N/A [Auto]	BOOL	FALSE	VAR_1C

Class	Identifiers	Address	Type...	Initial Value	Identifier Comment...
VAR	VAR_0	M0	BOOL	FALSE	M0_C
VAR	VAR_1	N/A [Auto]	BOOL	FALSE	VAR_1C

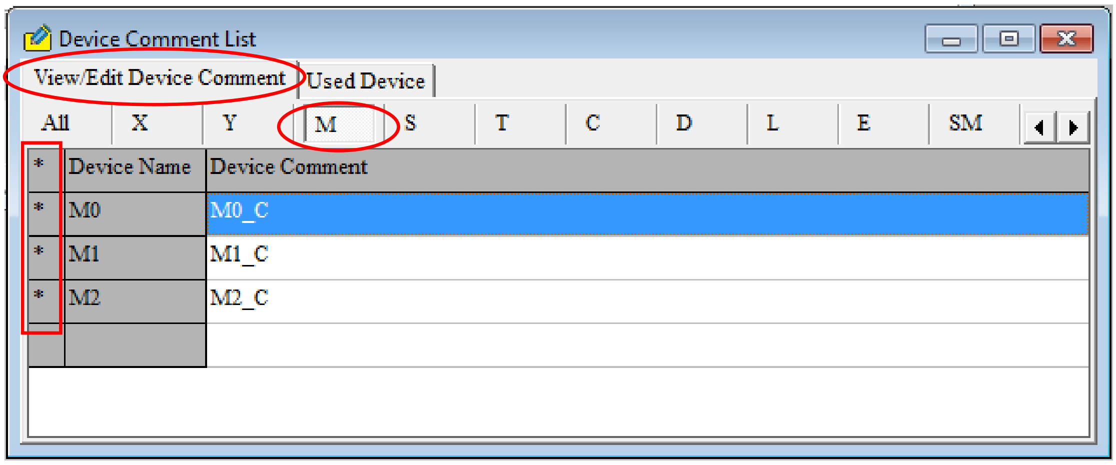
17.2.2 AH / AS Series Device Comment List

Users can manage the devices in an AH/AS series CPU module. After users click **Device Comment List** on the **View** menu, or double-click **Device Comment List** in the project management area, the **Device Comment List** window will be opened.

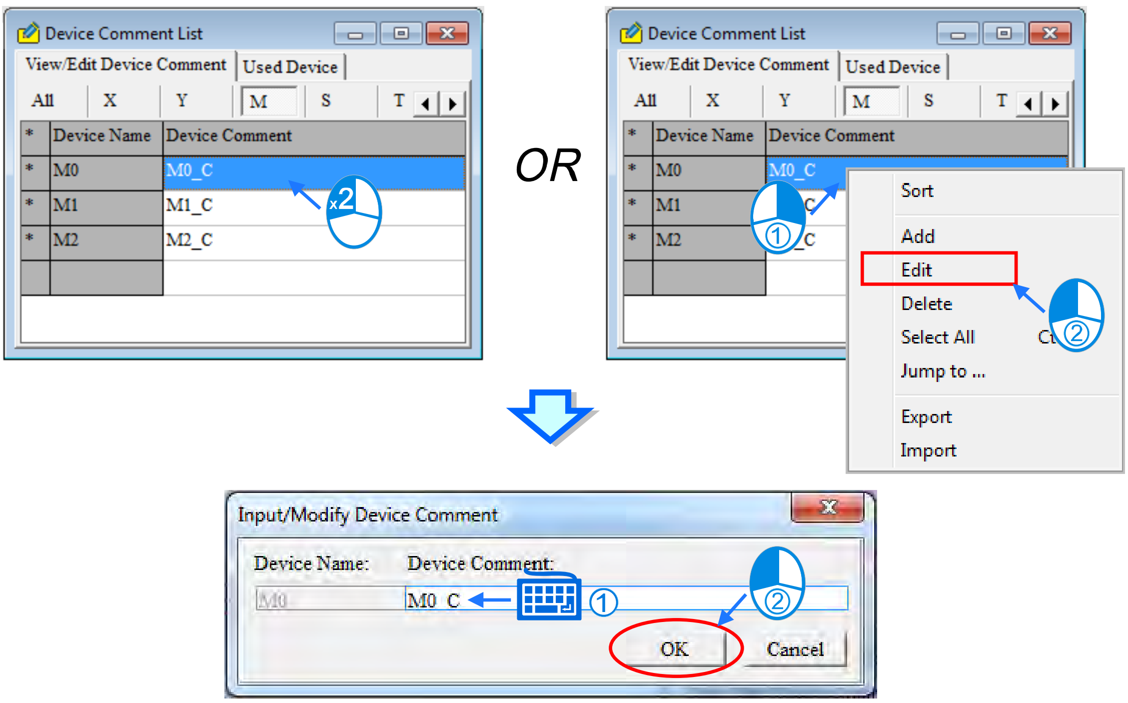
There are two tabs at the top of the **Device Comment & List** window. If the users modify the program or comments after the window is opened, they have to close the window, compile the new program, and open the window again to get the latest information.



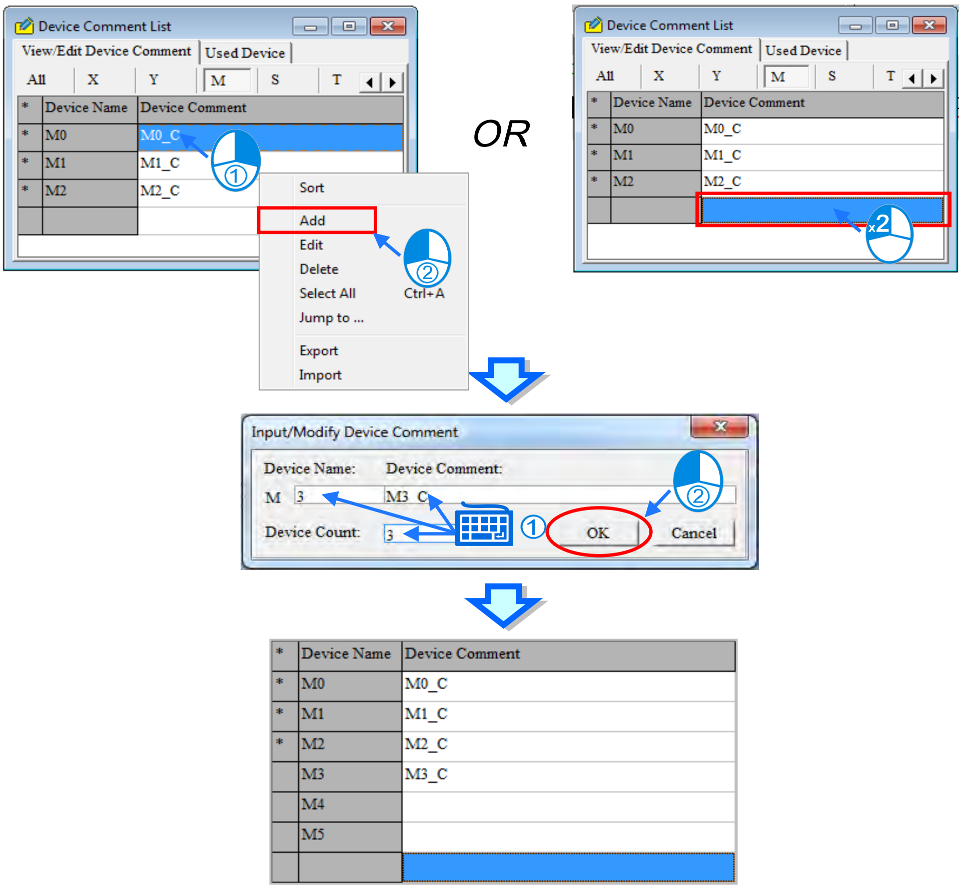
The **View/Edit Device Comment** page displays the device names with corresponding comments on the list. The tabs below the Comment indicate the device types. After the users click **All**, the devices on which comments are made are displayed. Besides, the mark “*” at the left side of a device indicates that the device is used in the program.



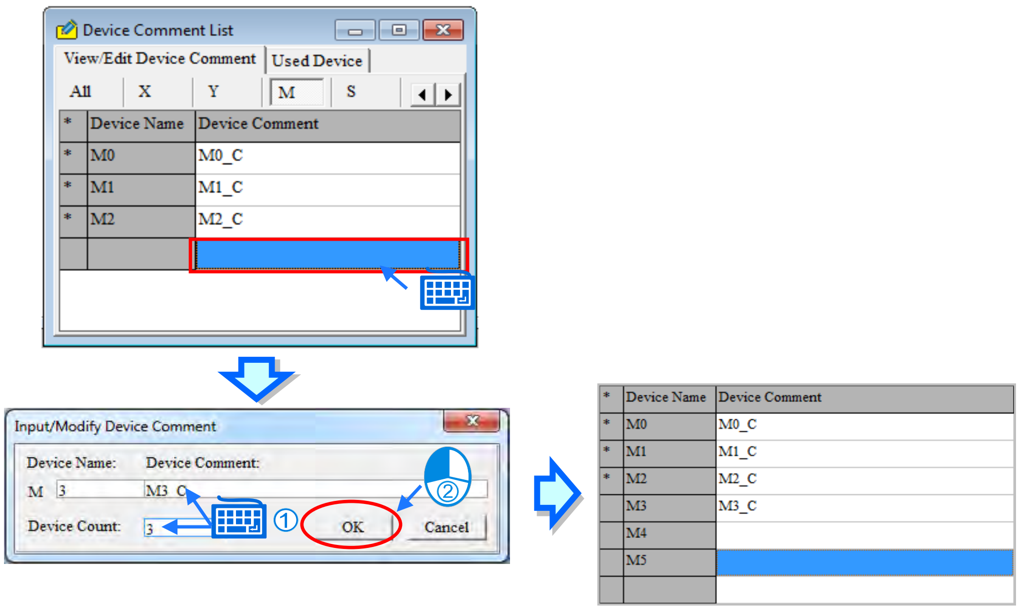
The users can modify the comments on the **View/Edit Device Comment** page, and add comments to a **View/Edit Device Commen**t page. If the users want to modify the comment on a device, they can double-click the comment, and modify the comment in the **Input/Modify Device Comment** window. The users can also modify the comment on a device by right-clicking the comment or clicking **Edit** on the context menu, and modifying the comment in the **Input/Modify Device Comment** window. The users can edit the default comments on the SR devices and the SM devices in a project. However, the new comments are valid only in this project.



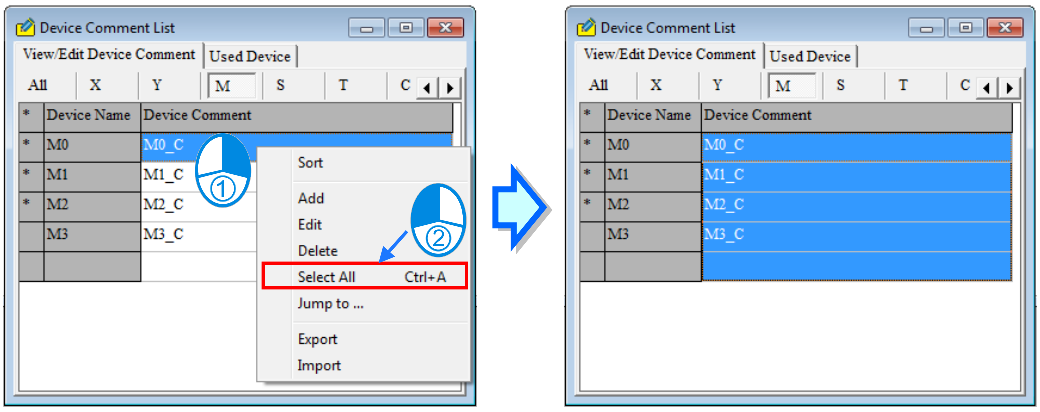
Right-click **Add** on the selected Device Comment from the Device Comment List window or double left-click the list and users can modify the comments shown in the Input/Modify Device Comment window. Users can input a value in the Device Count box to indicate the number of devices and corresponding comments as the image shown below.



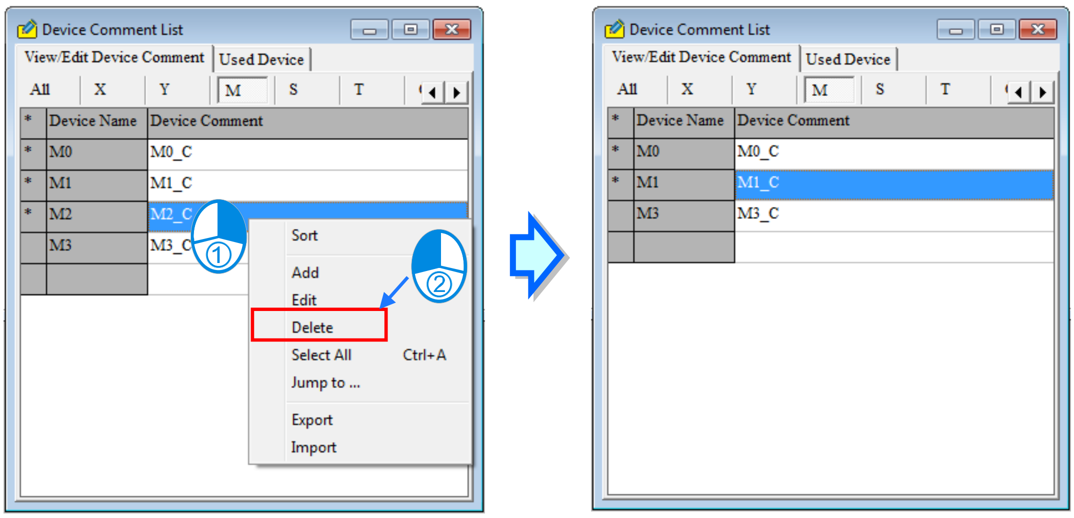
Users can also input the device location and then the Input/Modify Device Comment window will appear. Input the comment and the Device Count to complete the setting.



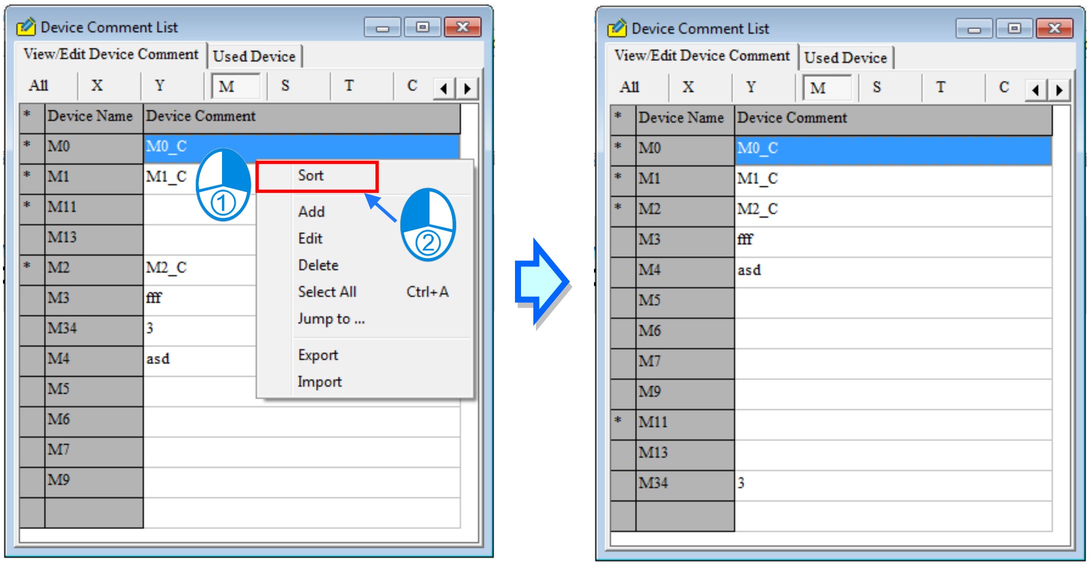
If the users want to delete the comment on a device on a **View/Edit Device Comment** page, they can select the comment, right-click the comment, and click **Delete** on the context menu. If the users want to delete a range of comments on a **View/Edit Device Comment** page, they can select the first comment and the last comment while they press Shift on the keyboard, right-click a comment selected, and click **Delete** on the context menu. If the users want to delete all the comments on a **View/Edit Device Comment** page, they can right-click the page, select **Select All** on the context menu, right-click a comment selected, and click **Delete** on the context menu.



The users can also delete the device selected or the devices selected by pressing Delete on the keyboard. If the comments deleted include the comments on SM devices or the comments on SR devices, the comments on the SR devices or the comments on the SR devices is recovered to default value.

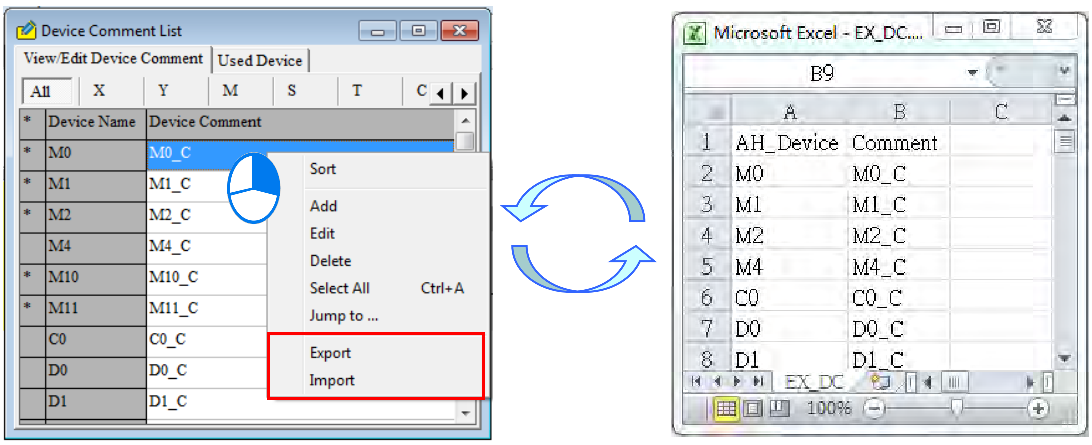


If the users want to rearrange the devices on a **View/Edit Device Comment** page, they can right-click the page, and click **Sort** on the context menu.

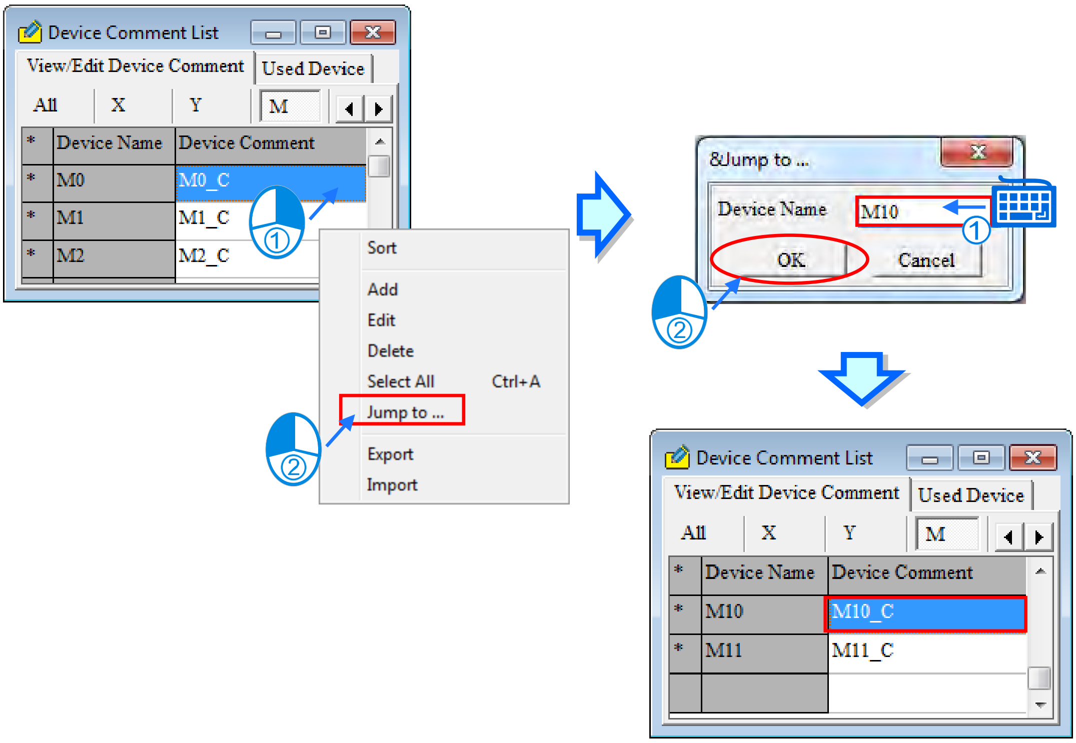


The users can export the comments on devices as a CSV file, edit the CSV file through Microsoft Excel, and import the new CSV file into ISPSoft. If the default comments on SM/SR devices are modified, the comments exported will include the new comments on theses SM/SR devices. The comments exported do not include the default comments on all the SM/SR devices. If the comments imported include the comments on SM/SR devices, the default comments on these SM/SR devices will be modified after the comments are imported, and the default comments on the remaining SM/SR devices will not be changed after the comments are imported.

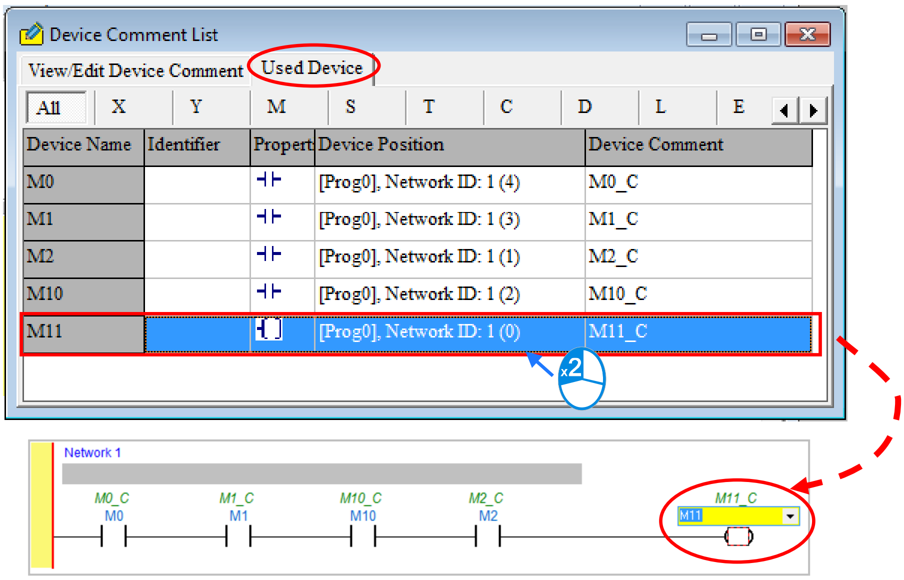
If the users want to export the comments on devices, they can right-click a **View/Edit Device Comment** page, click **Export** on the context menu, select a folder in the **Save in** drop-down list box in the **Export Device Comments** window, type a filename in the **File name** box, and click **Save**. If the users want to import a CSV file, they can right-click a **View/Edit Device Comment** page, click **Import** on the context menu, select the CSV file in the **Import Device Comments** window, and click **Open**.



For a quick way to go to the specific device range, right-click on the Device Comment area to see the context menu and select “Jump to”. After that a Jump to window will show up. Type the device name and press OK. The table will display the required device range. Before typing the device name, you will need to make sure the device name you are going to type exists in the table. You can also use Jump to function in the Used Device tab.



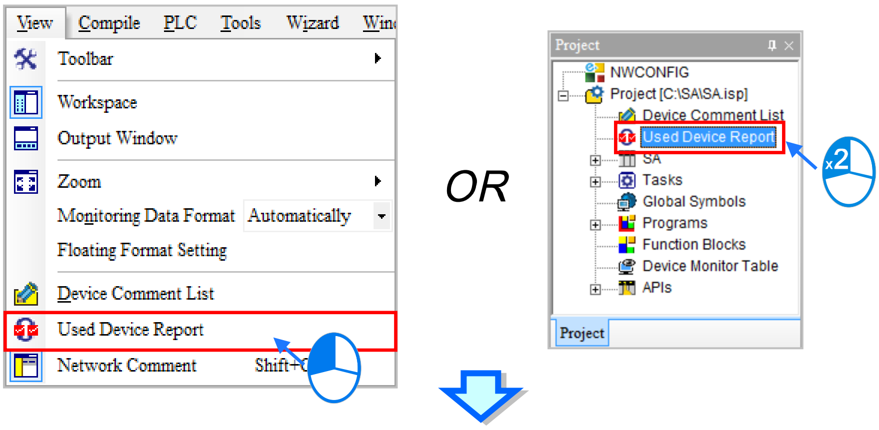
The devices used in the program and the information about the devices are listed in the **Used Device** page. The tabs below this page indicate device types. Besides, after the users double-click a row on the **Used Device** page, the system will lead the users to the corresponding device position of that row.

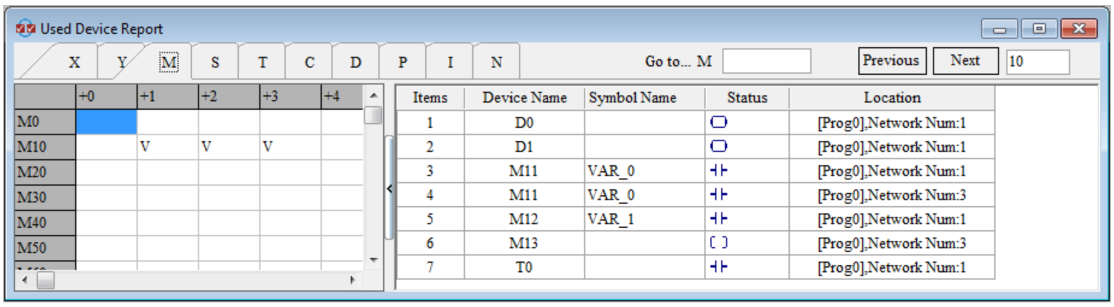


17.2.3 Using Device Report

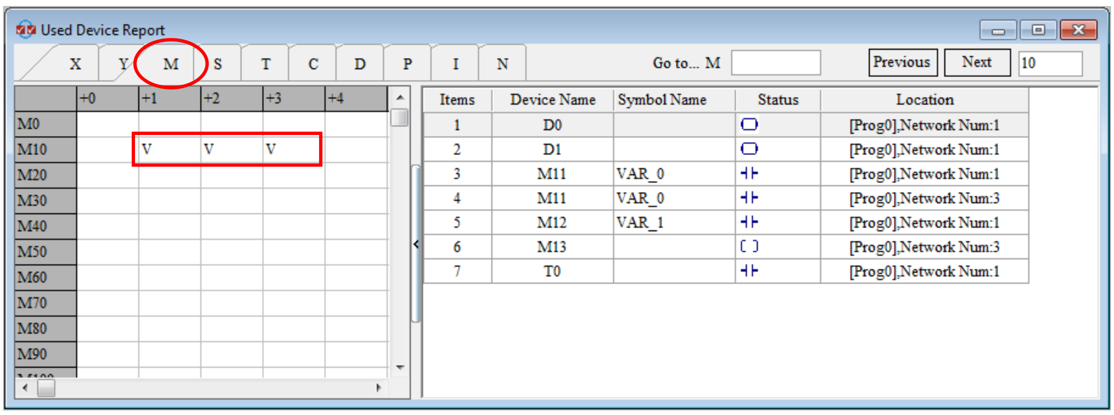
When users edit a project, they can refer to the report on the devices used in the project. However, the users have to compile the program in the project before they refer to the report on the devices used in the project for a DVP series PLC. Besides, if the users modify the program after the window for the report is opened, they have to close the window, compile the new program, and open the window again to get the latest information.

If users click **Used Device Report** on the **View** menu, or double-click **Used Device Report** in the project management area, the **Used Device Report** window will be opened.

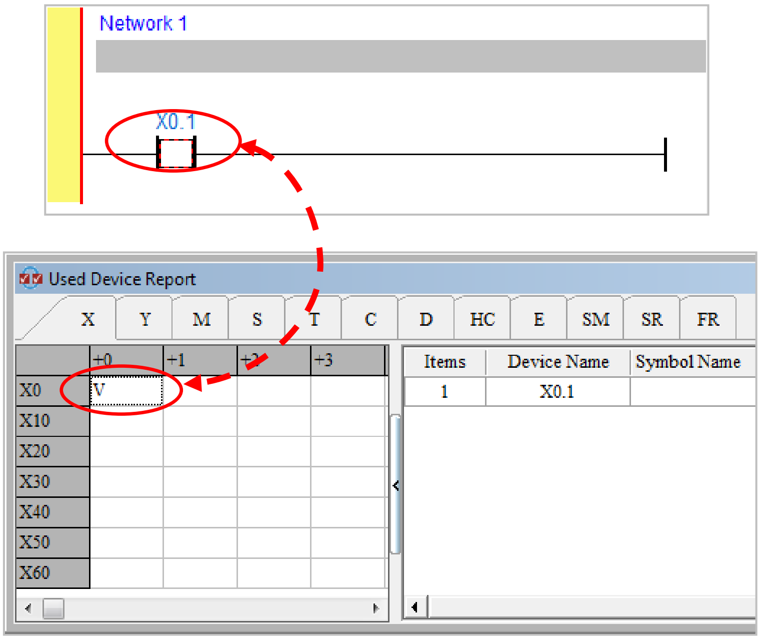


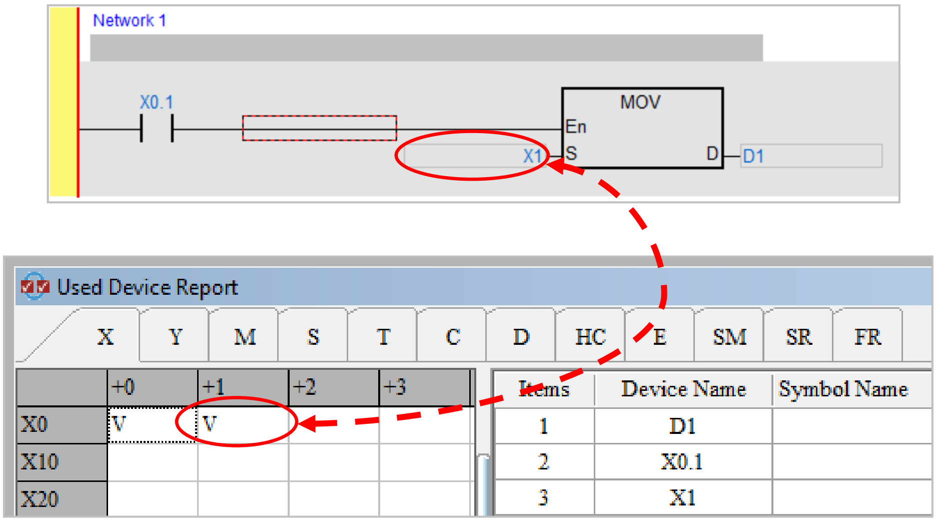


The **Used Device Report** window is composed of two parts. A table of devices is in the left part of the window. The users can click the tabs at the top of the window. The checks in the cells of devices indicate that the devices are used in the program. For example, there are checks in the cells for M11 M12 and M13.

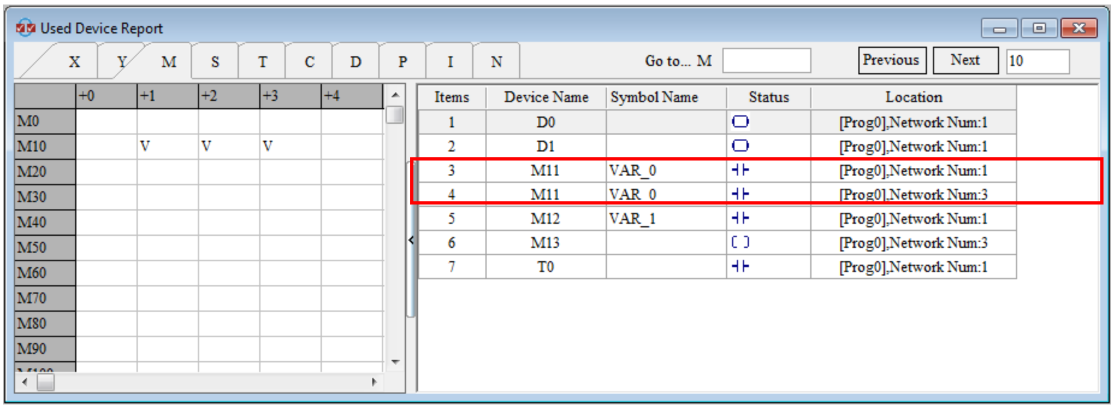


If users select AH/AS Series CPU modules and use any bits of the device or the device itself, that device box will be checked.

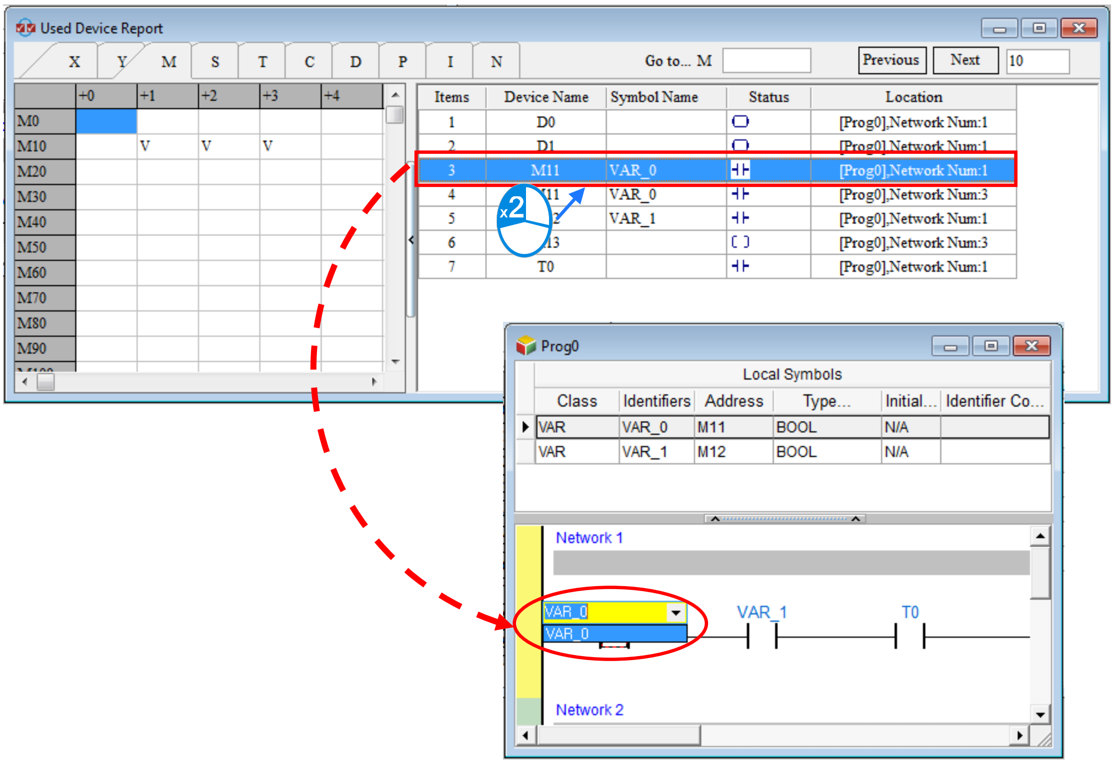




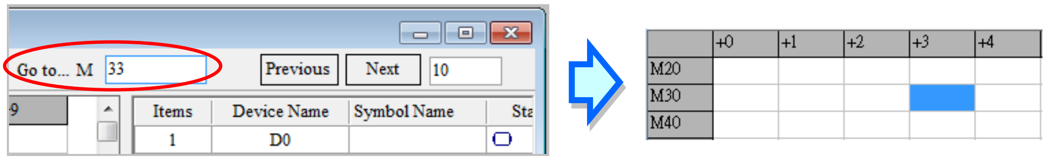
A table of devices used in the program is in the right part of the window. The devices listed are not classified. If a certain device is used in different positions in the program, the information about the positions will be listed. For example, M11 in the figure below is used in two positions in the program.



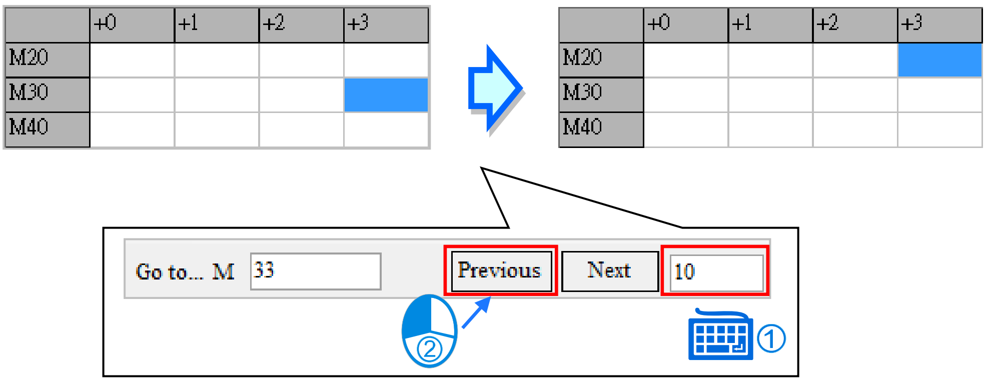
After the users double-click a row on the right part of the window, the system will lead the users to the corresponding device location.

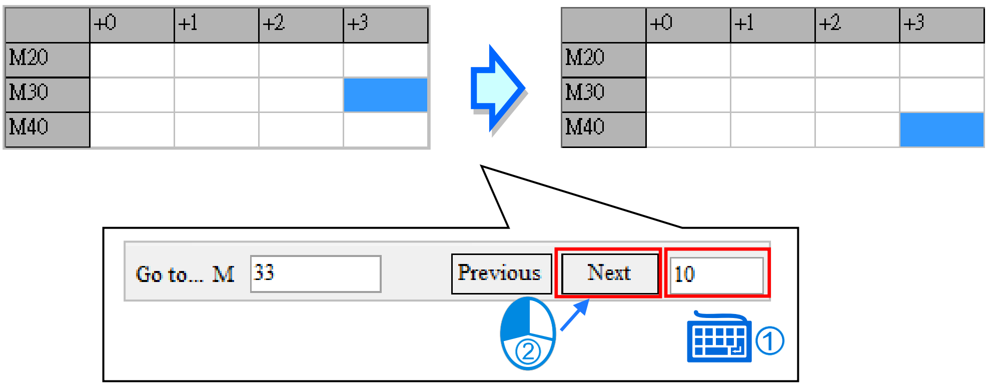


If the users press Enter on the keyboard after they type a device number in the **Go to…** box, the blue cursor in the table in the left part of the window will move to the corresponding device position.



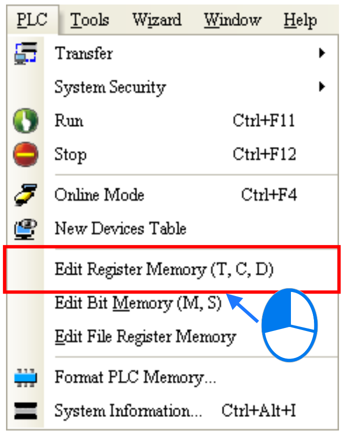
By executing the input number next to the **Previous/ Next** button for forward or backward movement, the blue cursor can move to the assigned device number.





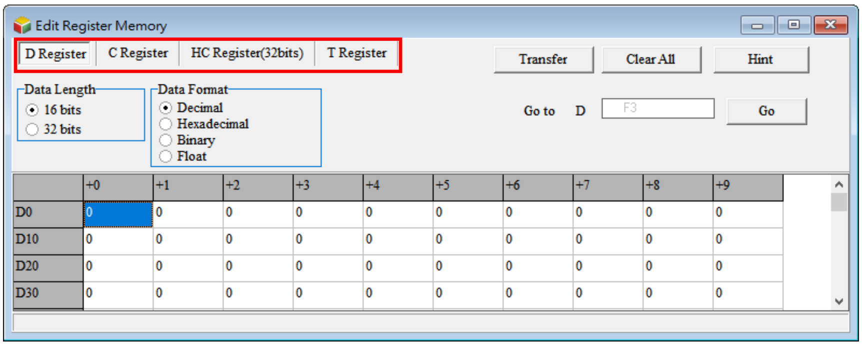
17.2.4 Edit Register Memory

Users can edit the values in the T/C/D/L devices in a batch. And the new values in these T/C/D/L devices can be saved and downloaded. After users create a project, they can click **Edit Register Memory** on the **PLC** menu to open the **Edit Register Memory** window.

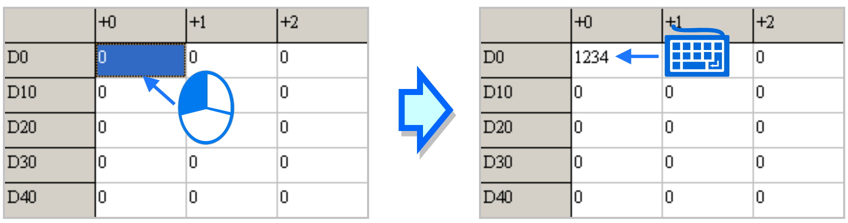


The values in the tables in the **Edit Register Memory** window are not the values uploaded form the PLC. They are the values saved last time. If the **Edit Register Memory** window in the project is opened for the first time, the default values in the tables are 0.

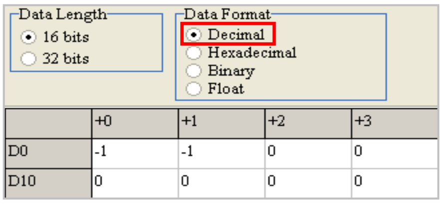
The tabs at the top of the **Edit Register Memory** window indicate device types.

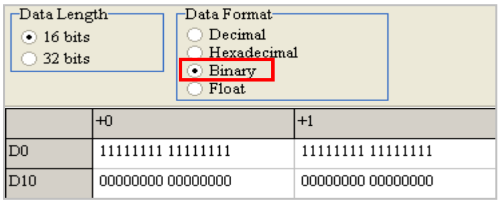


If the users want to edit the value in the cell for a device, they can click the cell for the device, and type a value.



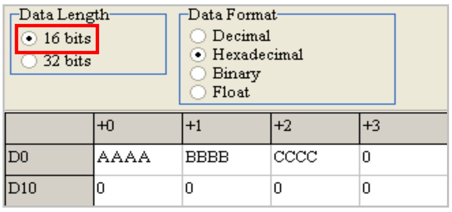
The users can select a data format in the **Data Format** section.

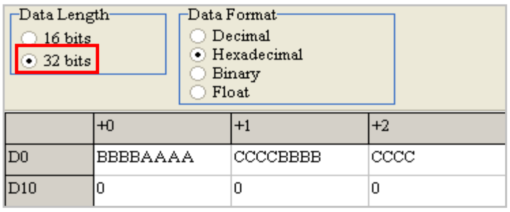




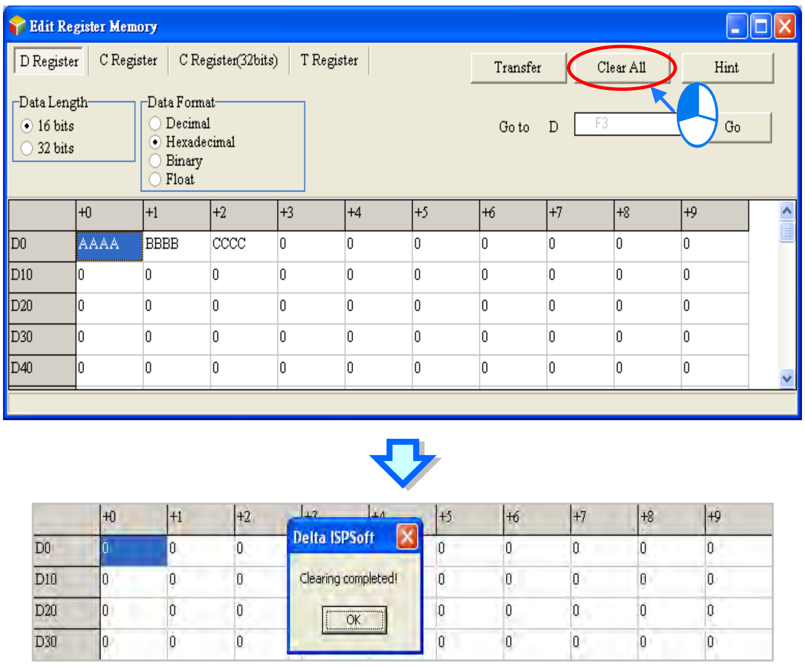
The users can select the **16 bits** option button or the **32 bits** option button in the **Data Length** section. If the **32 bits** option button is selected, the value in the cell for a device includes the value in the next device.

Take the figures below for example. The hexadecimal value in D0 is AAAA, the hexadecimal value in D1 is BBBB, and the hexadecimal value in D2 is CCCC. If the **32 bits** option button in the **Data Length** section is selected, the value in the cell for D0 will include the value in D1, the value in the cell for D1 will include the value in D2, and the value in the cell for D2 will include the value in D3. In other words, if the **32 bits** option button is selected, the value in the cell for D0 will become BBBBAAAA, the value in the cell for D1 will become CCCCBBBB, and the value in the cell for D2 will become CCCC.

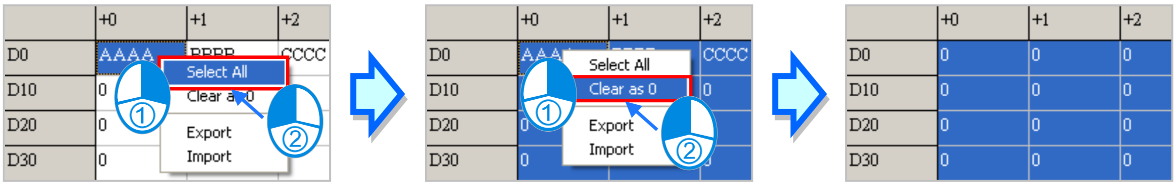




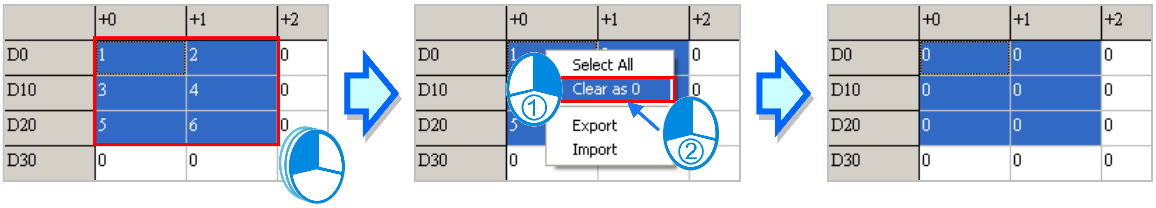
If the users click **Clear All**, the values on the present page will be cleared to 0, and the values on the other pages will remain unchanged.



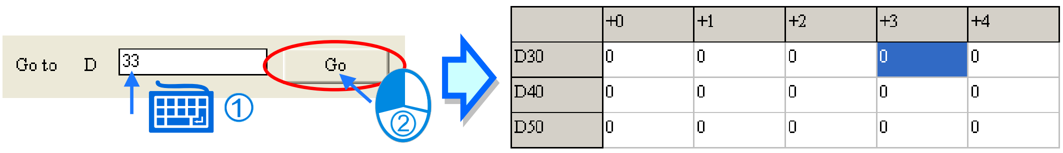
Besides, the users can clear the values on the present page by right-clicking the present page, clicking **Select All** on the context menu, right-clicking the present page again, clicking **Clear as 0** on the context menu.



If the users want to clear the values in the cells for a range of devices on the present page, they can drag across the cells, right-click the present page, and click **Clear as 0** on the context menu.

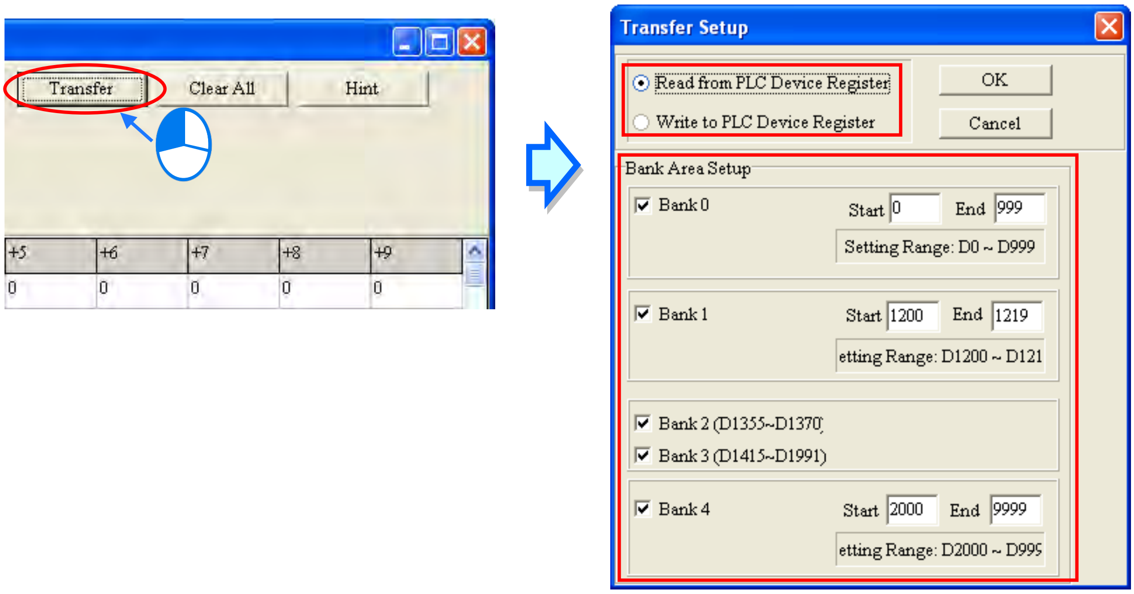


After type the device number in the **Go to** field, click **Go**. The blue cursor will move to the number you have typed.



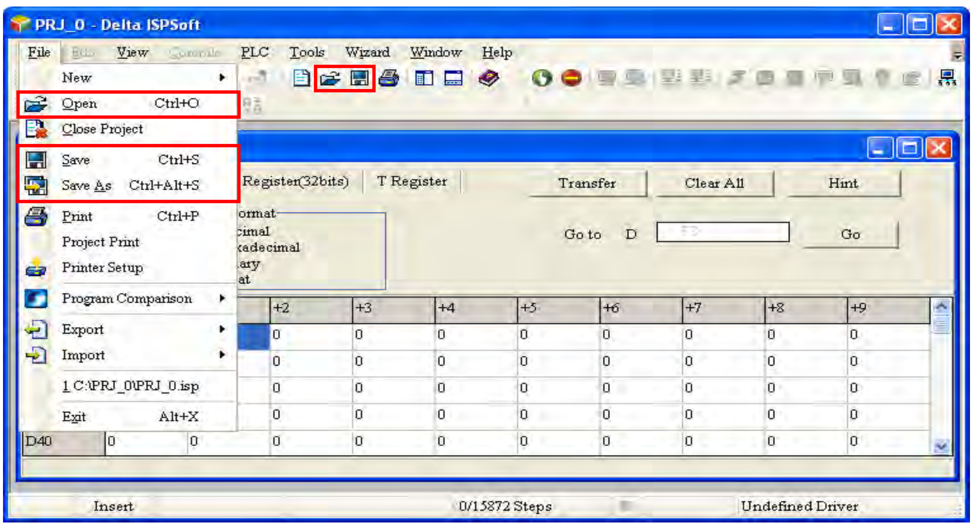
After the users click **Transfer**, the **Transfer Setup** window will appear. The users can download the values in the tables to the PLC, or upload the values in the T/C/D devices from the PLC through the window. Before **Transfer** is clicked, the users have to make sure that ISPSoft is connected to the PLC normally. Please refer to section 2.4 for more information.

The users can select the **Read from PLC Device Register** option button or the **Write to PLC Device Register** option button. Besides, the users can select device ranges. The values in the devices which are not in the device ranges will remain unchanged after **OK** is clicked. After the setting is complete, the users can click **OK**. After **OK** is clicked, the values in the T devices, the values in the C devices, and the values in the D devices which are in the device ranges set will be transferred.

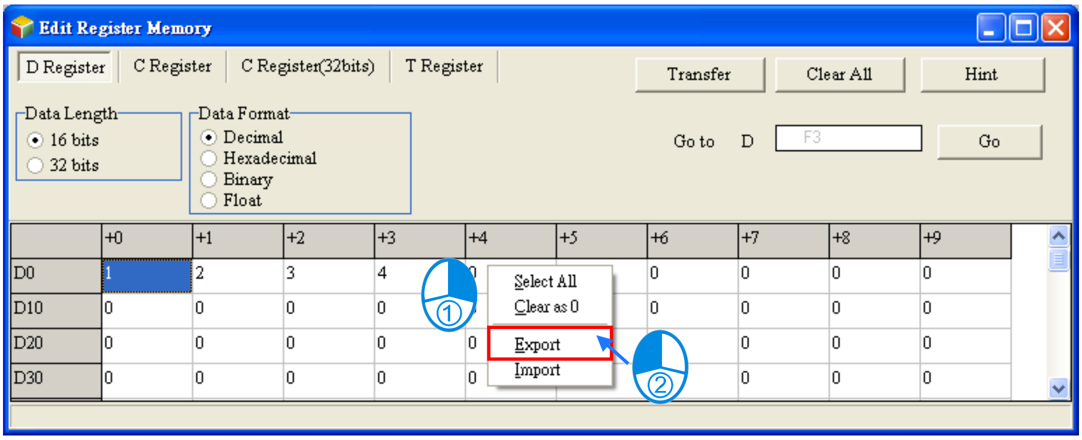


⚠ **Before the values are written into the registers, users have to make sure that the operation does not affect the system, or cause damage to the system and staff.**

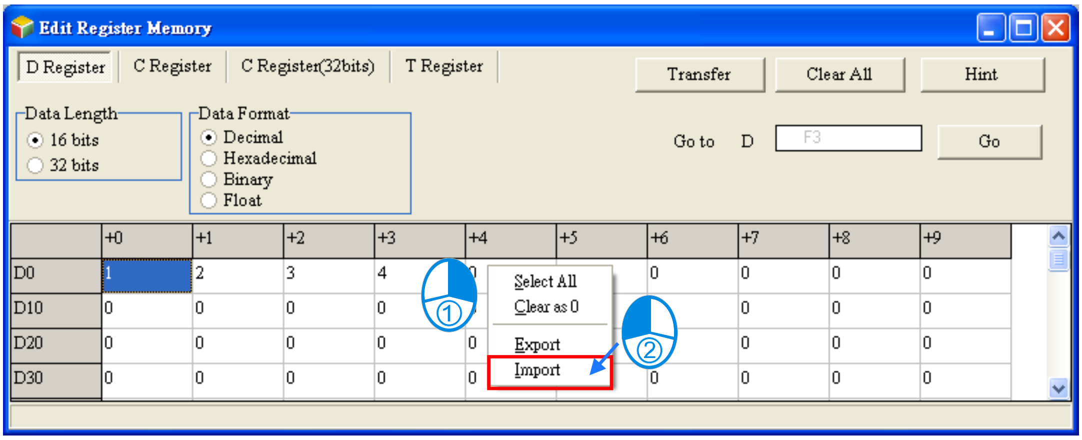
The values in the **Edit Register Memory** window can be saved with the project. If the present window is the **Edit Register Memory** window, the values in the **Edit Register Memory** window will be saved as a .dvl file whose primary filename is the project name in the folder in which the project (*.isp) is saved after the users click **Save** on the **File** menu or the toolbar. If the users want to open the **Edit Register Memory** window in the project again, the system will open the dvl file in the folder in which the project (*.isp) is saved. If no dvl is in the folder in which the project is saved, the values in the **Edit Register Memory** window will be 0. Besides, the users can save the values in the **Edit Register Memory** window as a dvl file in another folder after they click **Save As** on the **File** menu. If the users want to open the dvl file which was saved previously, they can click **Open** on the **File** menu or the toolbar.



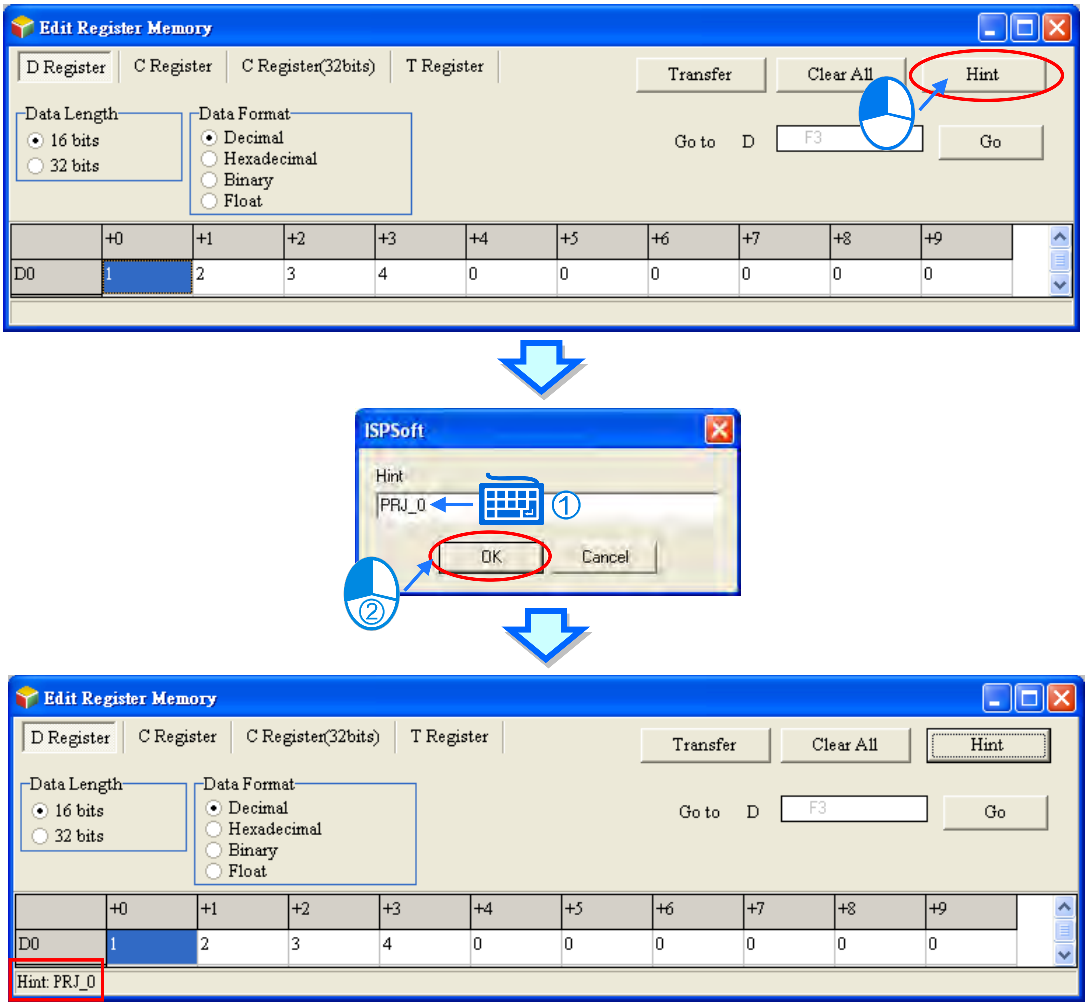
The users can export the values on the present page as a CSV file, and edit the CSV file through Microsoft Excel. If the users want to export the values on the present page, they can right-click the present page, select the range you'd like to export and then click **Export** on the context menu. Select a folder in the **Save in** drop-down list box in the **Save As** window, type a filename in the **File name** box, and click **Save**. The contents exported are the contents of the page selected.



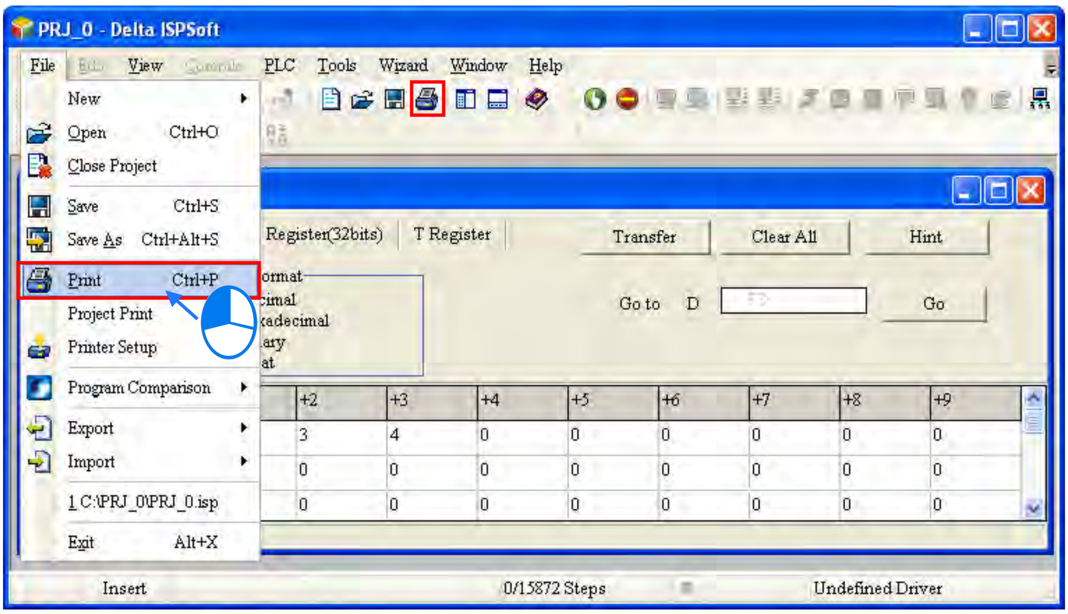
If the users want to import a CSV file into a page, they can right-click the page, click **Import** on the context menu, select the CSV file in the **Open** window, and click **Open**. The file imported must be matched with the device type clicked.



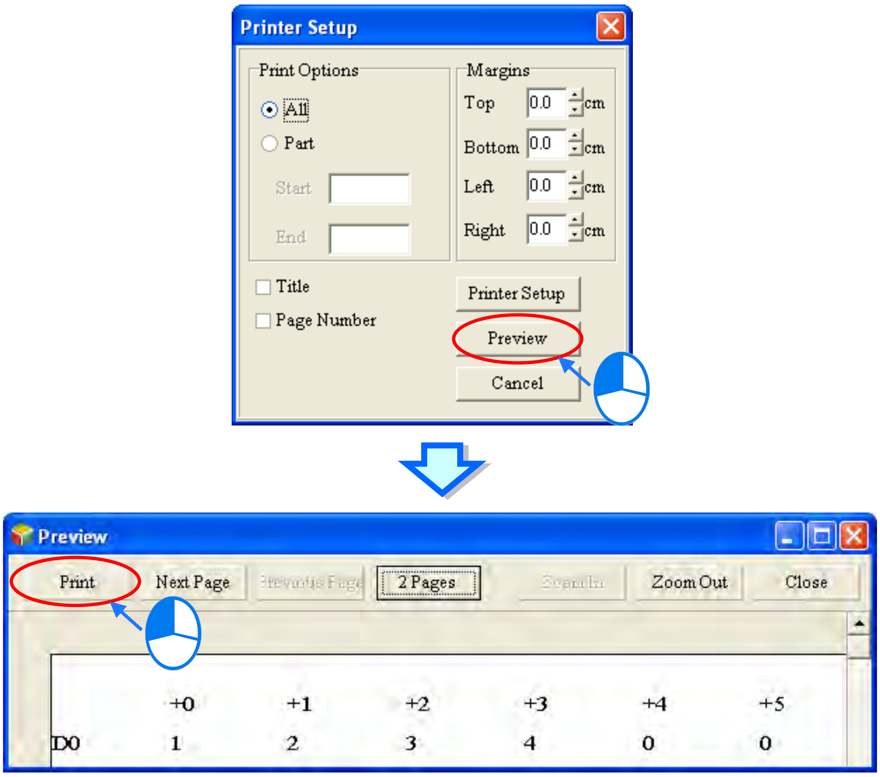
After the users click **Hint** in the **Edit Register Memory** window, the **ISPSoft** window will appear. After a hint is typed in the **ISPSoft** window, the hint will appear at the bottom of the **Edit Register Memory** window. The hint is saved with the values in the **Edit Register Memory** window. After the users open a dvl file, they can identify the tables in the file through the hint in the file.



If the present window is the **Edit Register Memory** window, the users can print the present page in the **Edit Register Memory** window by clicking **Print** on the **File** menu or on the toolbar.

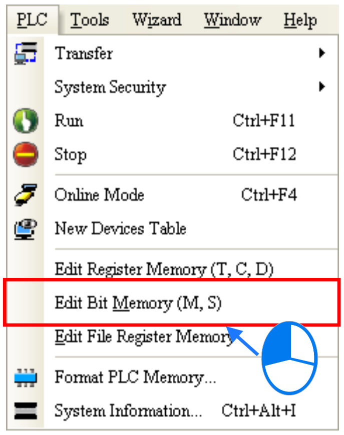


Select the **All** option button or the **Part** option button in the **Print Options** section, set margins, and select items which will be added. After the users click **Printer Setup**, they can select a printer, and set a print format. After the users click **Preview**, they can preview the document which will be printed. After the setting is complete, the users can click **Print** in the **Preview** window.



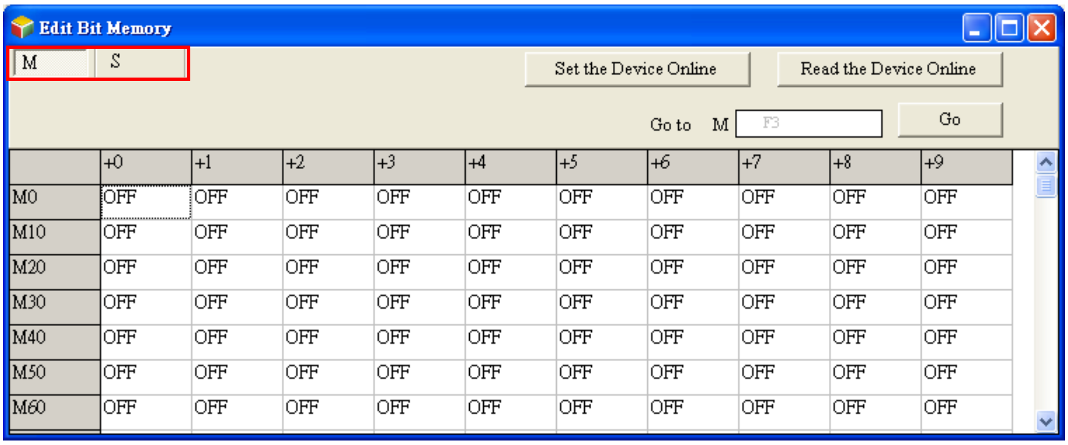
17.2.5 Edit Bit Memory

Users can edit the states of several M/S devices in a batch. The new states of these M/S devices can be saved and downloaded. After users create a project, they can click **Edit Bit Memory (M, S)** on the **PLC** menu to open the **Edit Bit Memory** window.

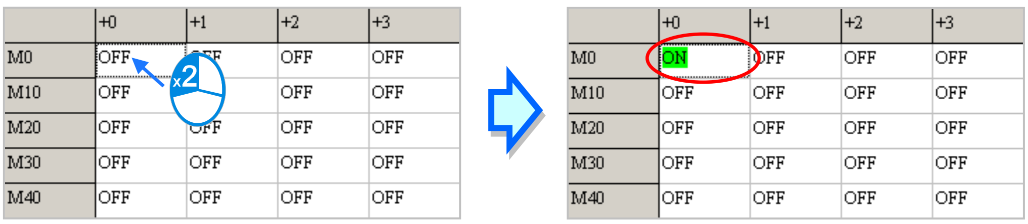


The states in the tables in the **Edit Bit Memory** window are not the states uploaded form the PLC. They are the states saved last time. If the **Edit Bit Memory** window in the project is opened for the first time, the default states in the tables are OFF.

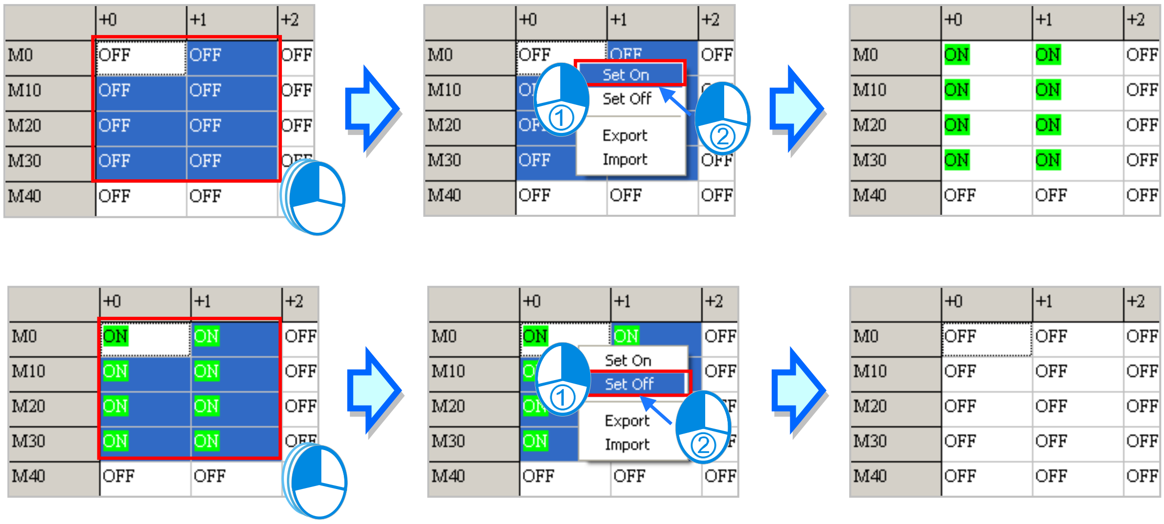
The tabs at the top of the **Edit Bit Memory** window indicate device types.



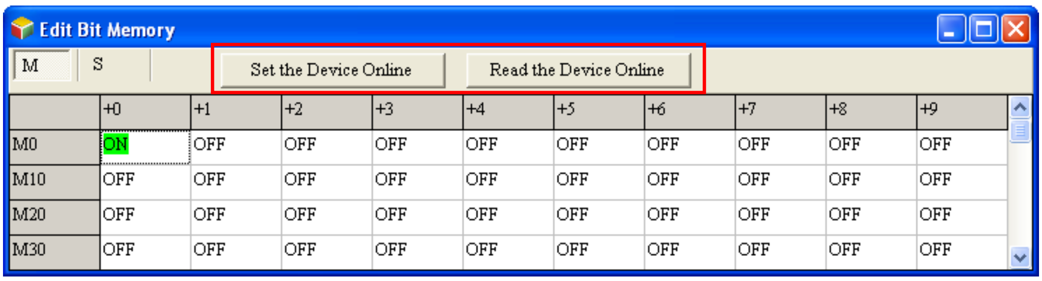
If the users want to change the state in the cell for a device, they can double-click the cell.



If the users want to set the states in the cells for a range of devices on the present page simultaneously, they can drag across the cells, right-click the present page, and click **Set On** or **Set Off** on the context menu.

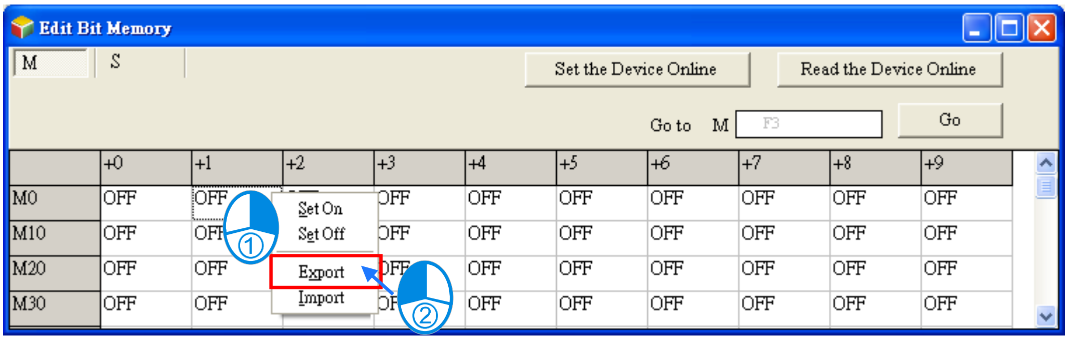


If the users click **Set the Device Online**, the states in the **Edit Bit Memory** window will be written into the PLC. If the users click **Read the Device Online**, the states of the M devices, and the states of the S devices will be read from the PLC. Before **Set the Device Online**/**Read the Device Online** is clicked, the users have to make sure that ISPSoft is connected to the PLC normally. Please refer to section 2.4 for more information.

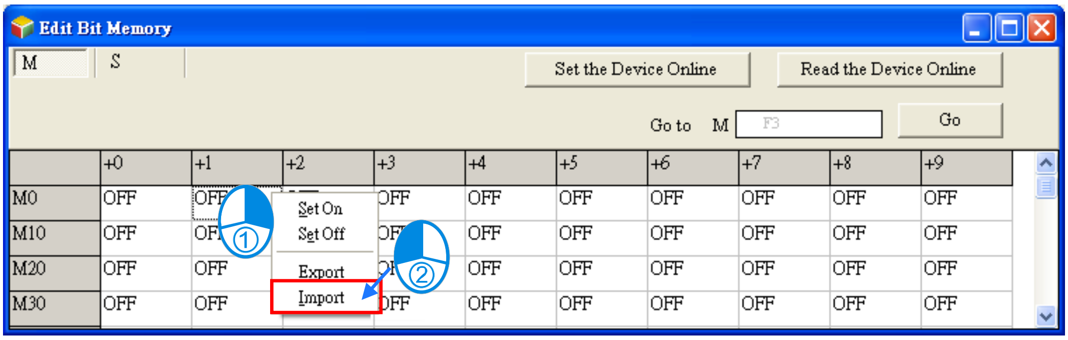


Before the states are written into the PLC, users have to make sure that the operation does not affect the system, or cause damage to the system and staff.

The users can export the states on the present page as a CSV file, and edit the CSV file through Microsoft Excel. If the users want to export the states on the present page, they can right-click the present page, select the range you'd like to export and then click **Export** on the context menu. Select a folder in the **Save in** drop-down list box in the **Save As** window, type a filename in the **File name** box, and click **Save**. The contents exported are the contents of the page selected.

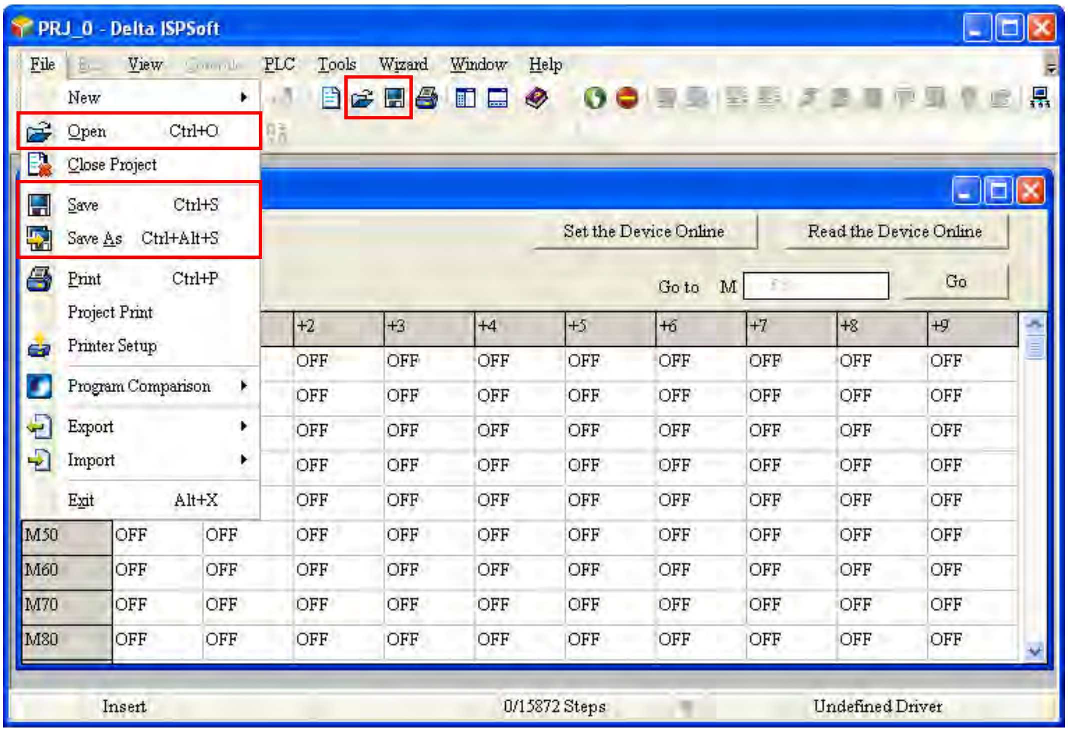


If the users want to import a CSV file into a page, they can right-click the page, click **Import** on the context menu, select the CSV file in the **Open** window, and click **Open**. The file imported must be matched with the device type clicked.

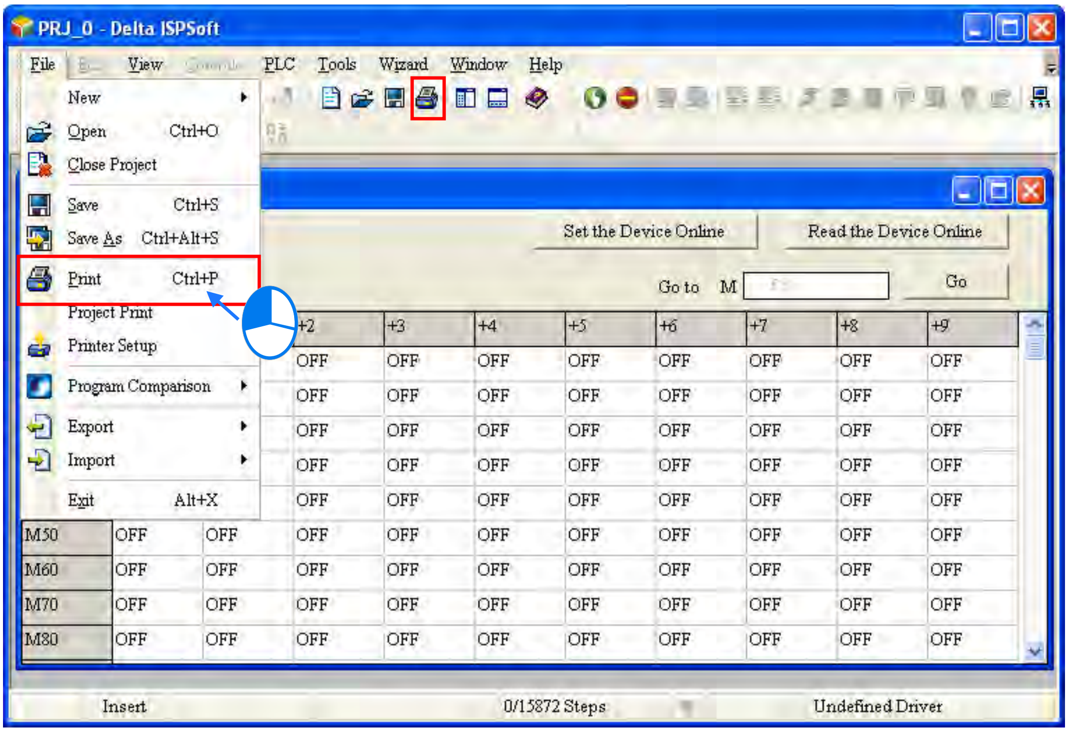


The states in the **Edit Bit Memory** window can be saved with the project. If the present window is the **Edit Bit Memory** window, the states in the **Edit Bit Memory** window will be saved as a dvb file whose primary filename is the project name in the folder in which the project (*.isp) is saved after the users click **Save** on the **File** menu or the toolbar. If the users want to open the **Edit bit Memory** window in the project again, the system will open the dvb file in the folder in which the project (*.isp) is saved. If no dvb is in the folder in which the project is saved, the states of the devices in the **Edit Bit Memory** window will be OFF

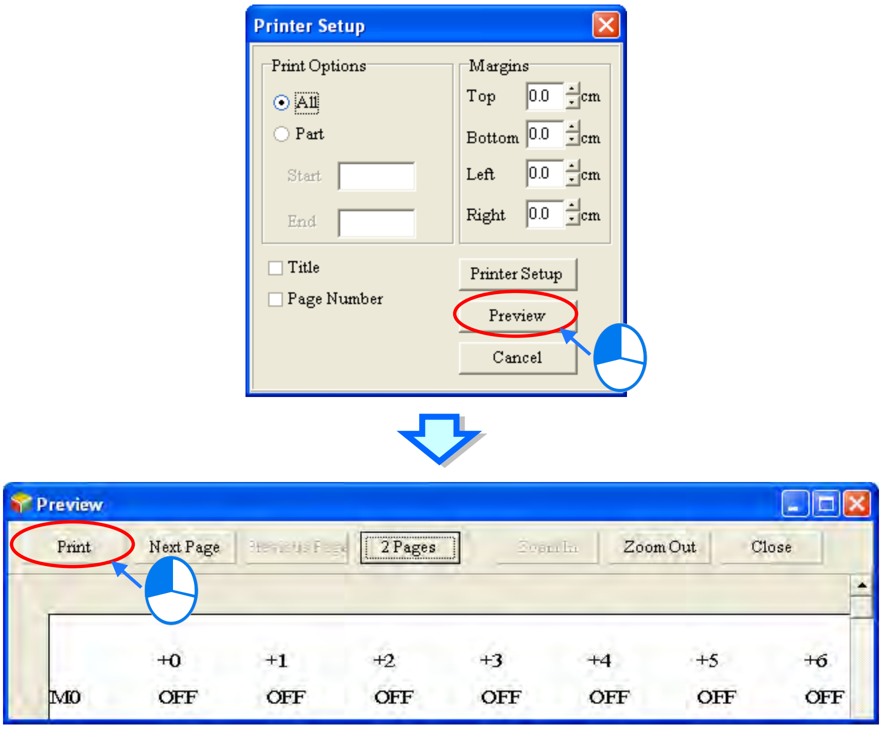
Besides, the users can save the states in the **Edit Bit Memory** window as a dvb file in another folder after they click **Save As** on the **File** menu. If the users want to open the dvb file which was saved previously, they can click **Open** on the **Fil**e menu or the toolbar.



If the present window is the **Edit Bit Memory** window, the users can print the present page in the **Edit Bit Memory** window by clicking **Print** on the **File** menu or on the toolbar.



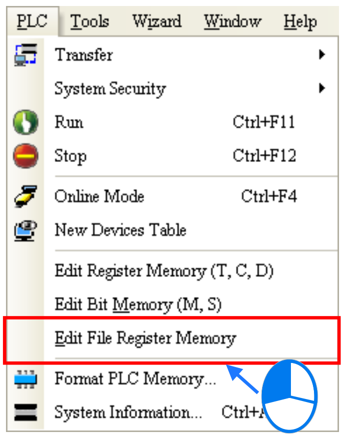
Select the **All** option button or the **Part** option button in the **Print Options** section, set margins, and select items which will be added. After the users click **Printer Setup**, they can select a printer, and set a print format. After the users click **Preview**, they can preview the document which will be printed. After the setting is complete, the users can click **Print** in the **Preview** window.



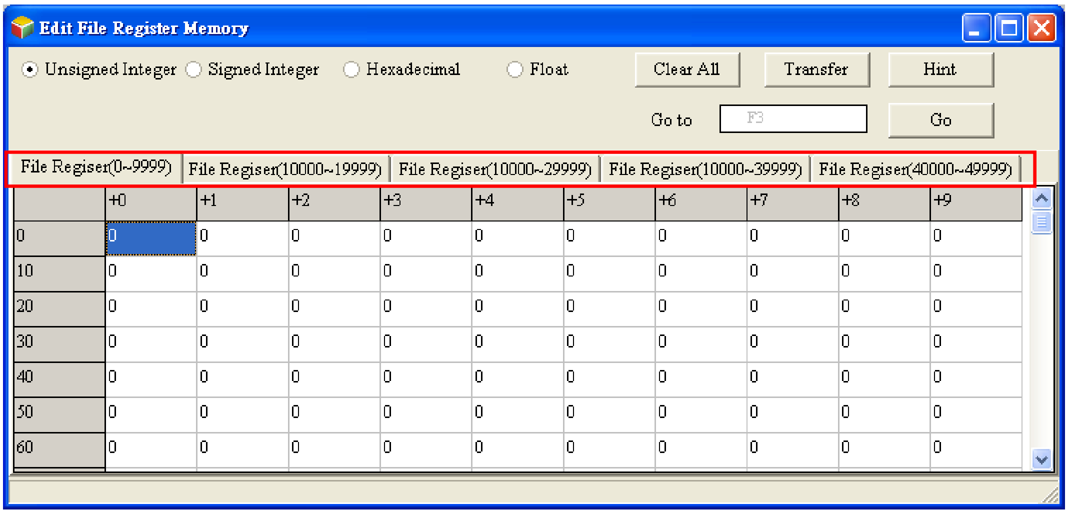
17.2.6 Edit DVP Series File Register

Users can edit the values in several file registers in a DVP series PLC at a time. The new values in these file registers can be saved and downloaded.

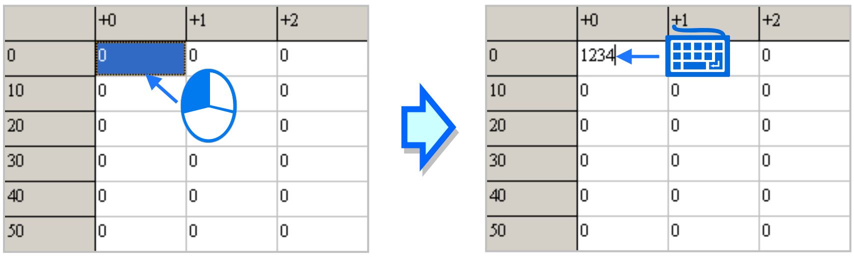
After users create a project for a DVP series PLC, they can click **Edit File Register Memory** on the **PLC** menu to open the **Edit File Register Memory** window.



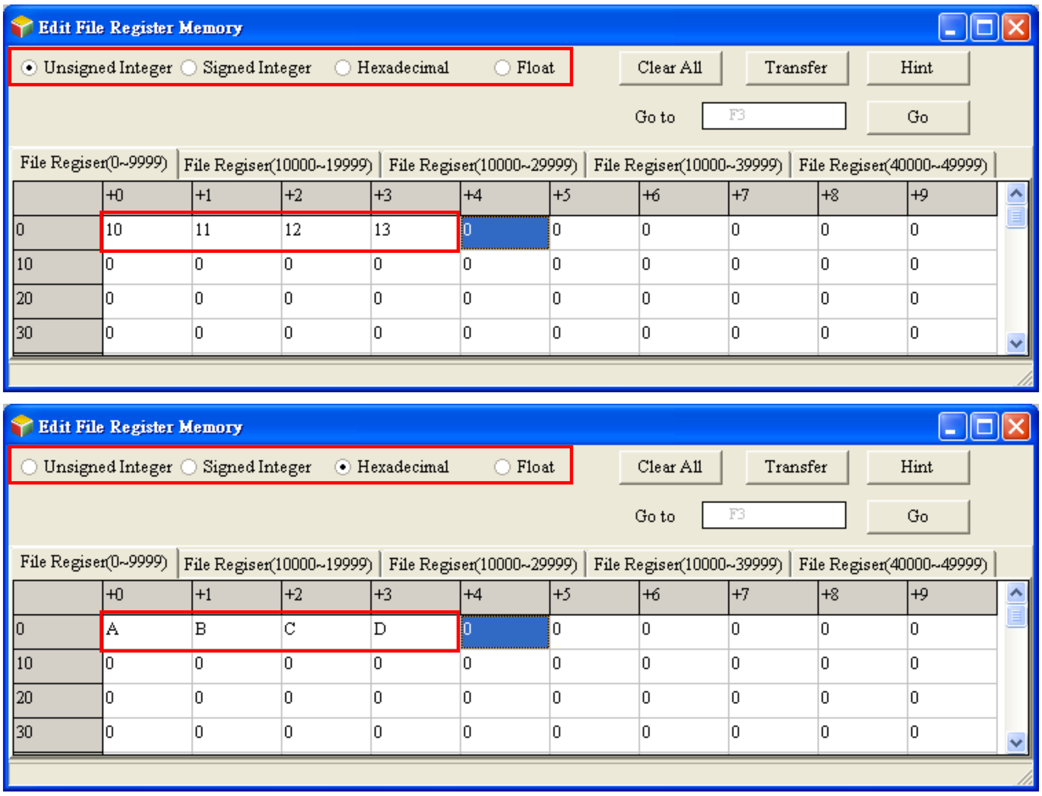
The values in the table in the **Edit File Register Memory** window are not the values uploaded form the PLC. They are the values saved last time. If the **Edit File Register Memory** window in the project is opened for the first time, the default values in the table are 0. Users can select different tap for different register ranges.



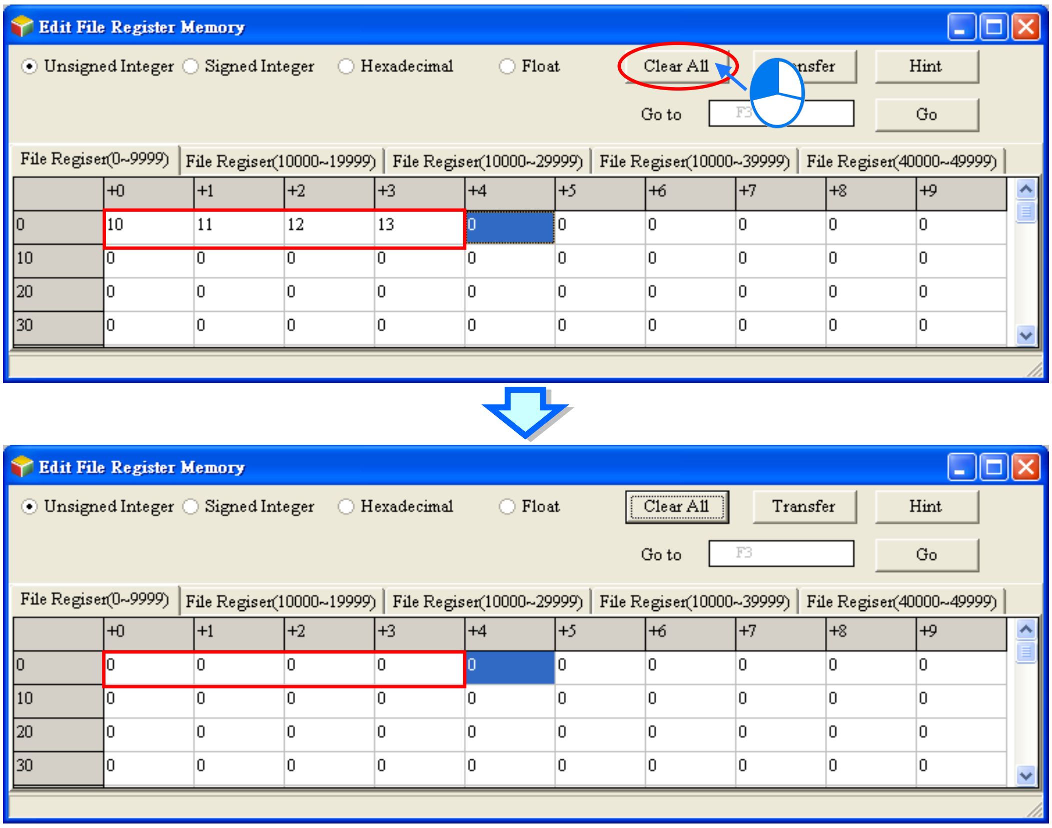
If the users want to edit the value in the cell for a file register, they can click the cell for the file register, and type a value.



The users can select a data format at the top of the **Edit File Register Memory** window.

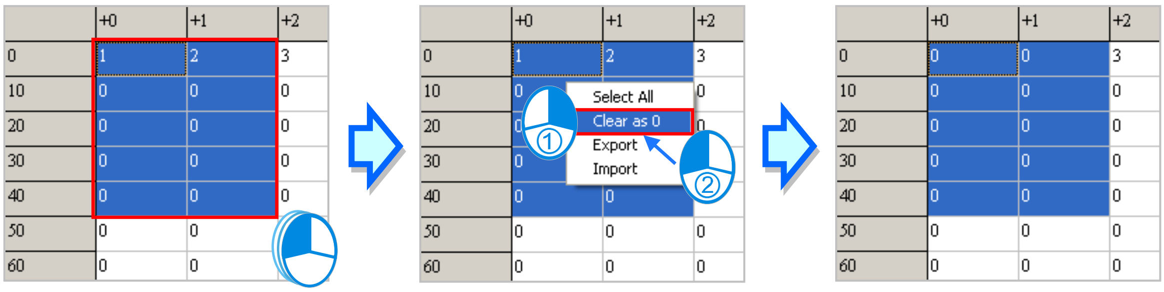


If the users click **Clear All**, the values in the **Edit File Register Memory** window will be cleared to 0.



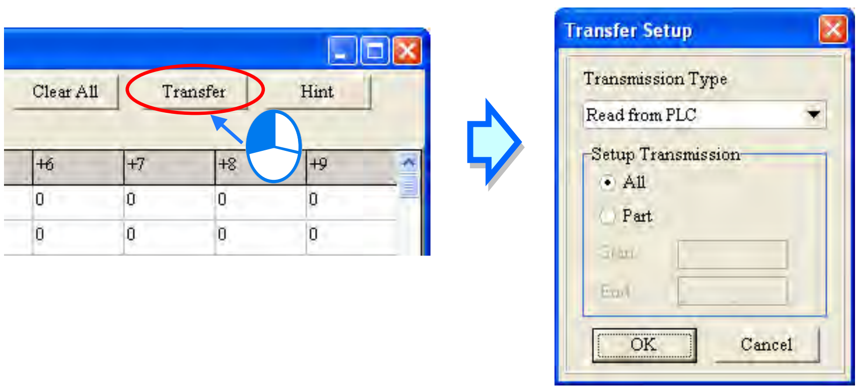
Besides, the users can clear the values on the present page by right-clicking the present page, clicking **Select All** on the context menu, right-clicking the present page again, clicking **Clear as 0** on the context menu.

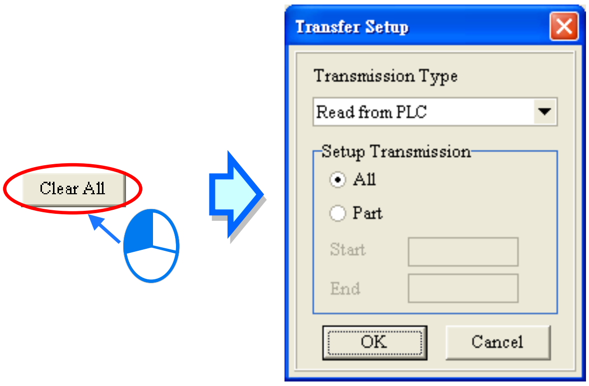
If the users want to clear the values in the cells for a range of file registers on the present page, they can drag across the cells, right-click the present page, and click **Clear as 0** on the context menu.



After the users click **Transfer**, the **Transfer Setup** window will appear. The users can download the values in the table to the PLC, or upload the values in the file registers from the PLC through the window. Before **Transfer** is clicked, the users have to make sure that ISPSoft is connected to the PLC normally. Please refer to section 2.4 for more information.

Select **Read form PLC** or **Write to PLC** in the **Transmission Type** drop-down list box, and then select the **All** option button or the **Part** option button. After the setting is complete, the users can click **OK**.

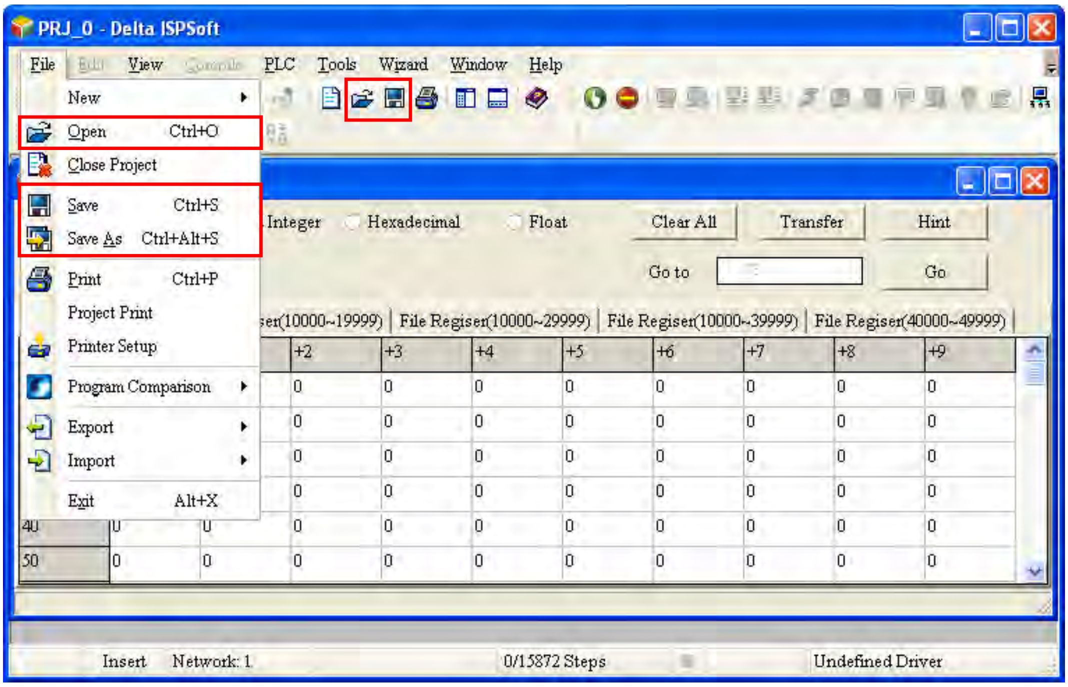




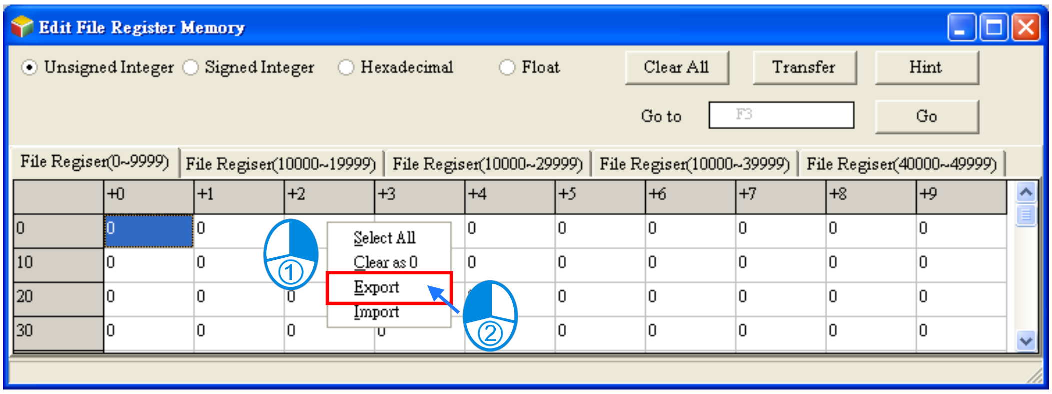
Before the values are written into the registers, users have to make sure that the operation does not affect the system, or cause damage to the system and staff.

The values in the **Edit File Register Memory** window can be saved with the project. If the present window is the **Edit File Register Memory** window, the values in the **Edit Register Memory** window will be saved as a wft file whose primary filename is the project name in the folder in which the project (*.isp) is saved after the users click **Save** on the **File** menu or the toolbar. If the users want to open the **Edit File Register Memory** window in the project again, the system will open the wft file in the folder in which the project (*.isp) is saved. If no wft is in the folder in which the project is saved, the values in the **Edit File Register Memory** window will be 0.

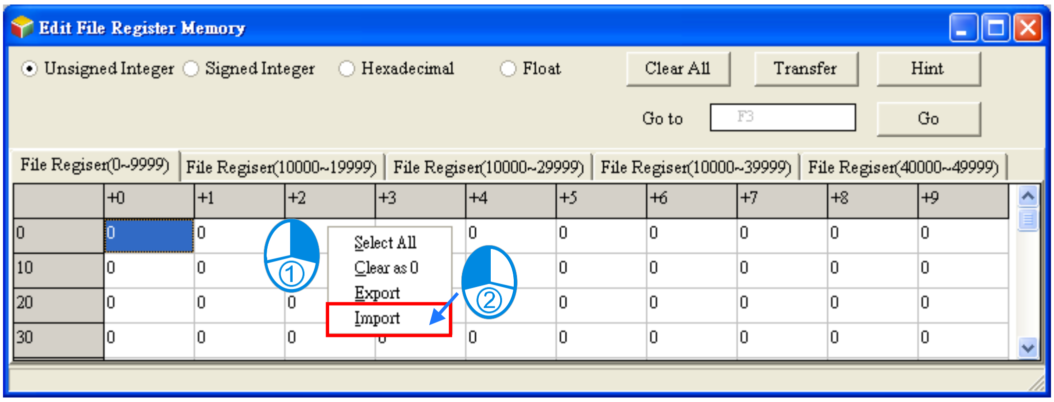
Besides, the users can save the values in the **Edit File Register Memory** window as a wft file in another folder after they click **Save As** on the **File** menu. If the users want to open the wft file which was saved previously, they can click **Open** on the **Fil**e menu or the toolbar.



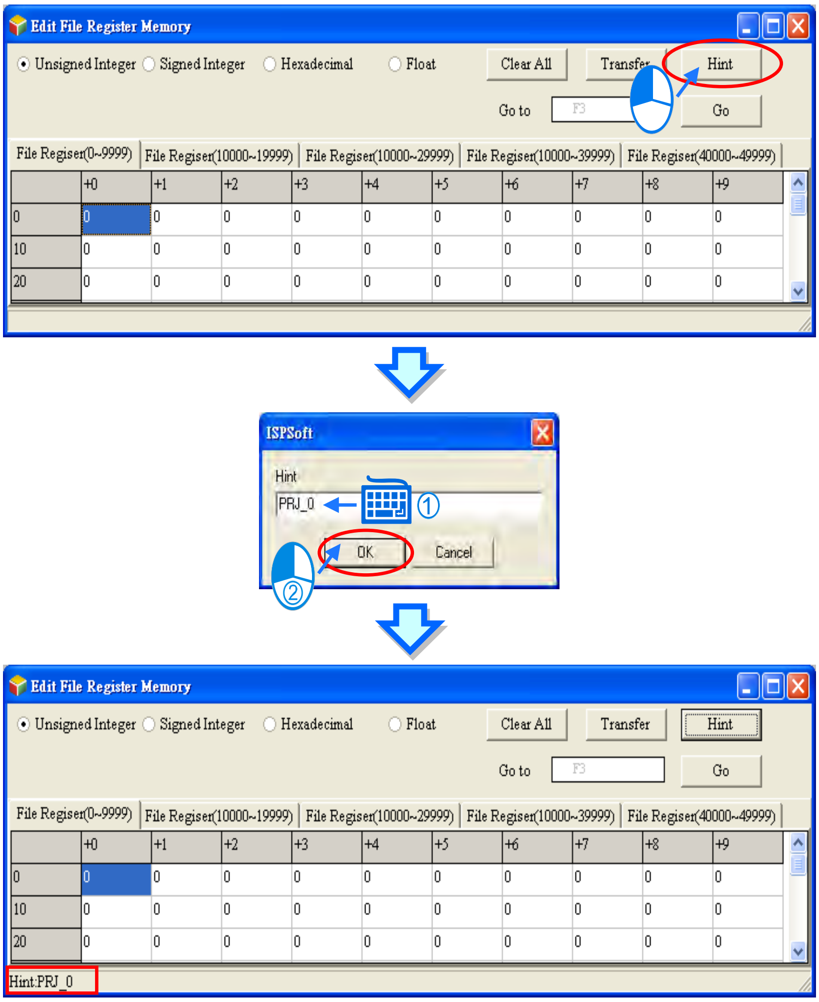
The users can export the values on the present page as a CSV file, and edit the CSV file through Microsoft Excel. If the users want to export the values on the present page, they can right-click the present page, click **Export** on the context menu, select a folder in the **Save in** drop-down list box in the **Save As** window, type a filename in the **File name** box, and click **Save**.



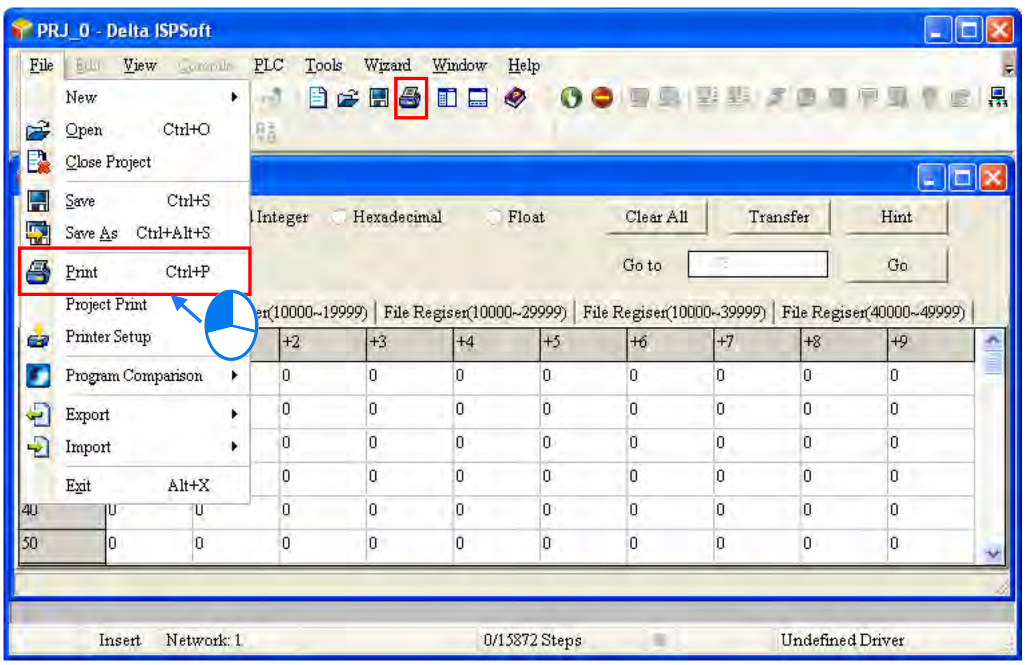
If the users want to import a CSV file into the page, they can right-click the page, click **Import** on the context menu, select the CSV file in the **Open** window, and click **Open**.



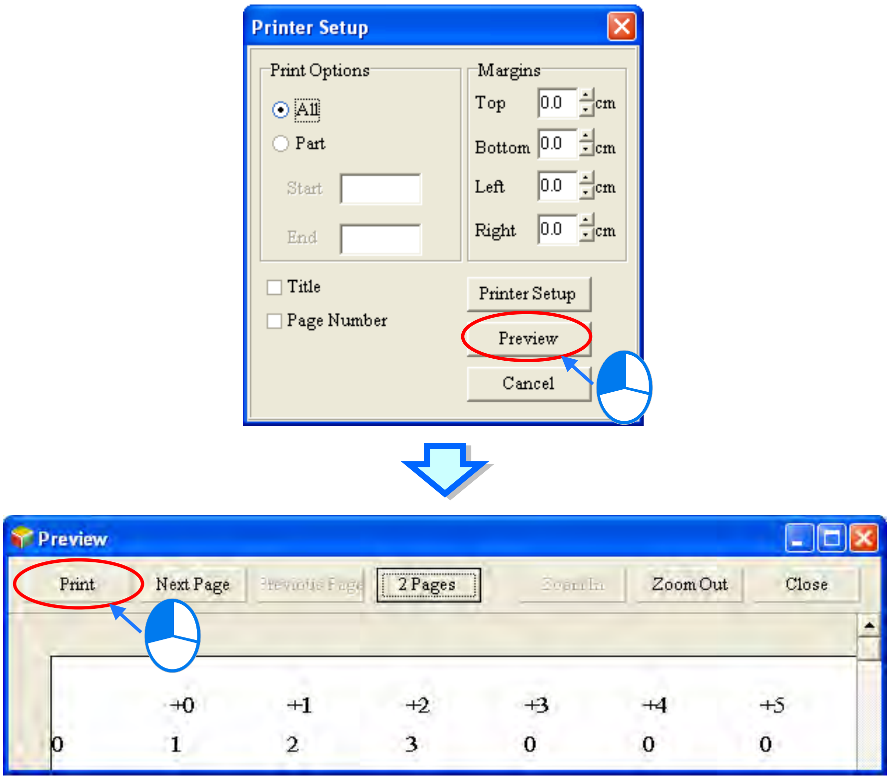
After the users click **Hint** in the **Edit File Register Memory** window, the **ISPSoft** window will appear. After a hint is typed in the **ISPSoft** window, the hint will appear at the bottom of the **Edit File Register Memory** window. The hint is saved with the values in the **Edit File Register Memory** window. After the users open a wft file, they can identify the table in the file through the hint in the file.



If the present window is the **Edit File Register Memory** window, the users can print the present page in the **Edit File Register Memory** window by clicking **Print** on the **File** menu or  on the toolbar.



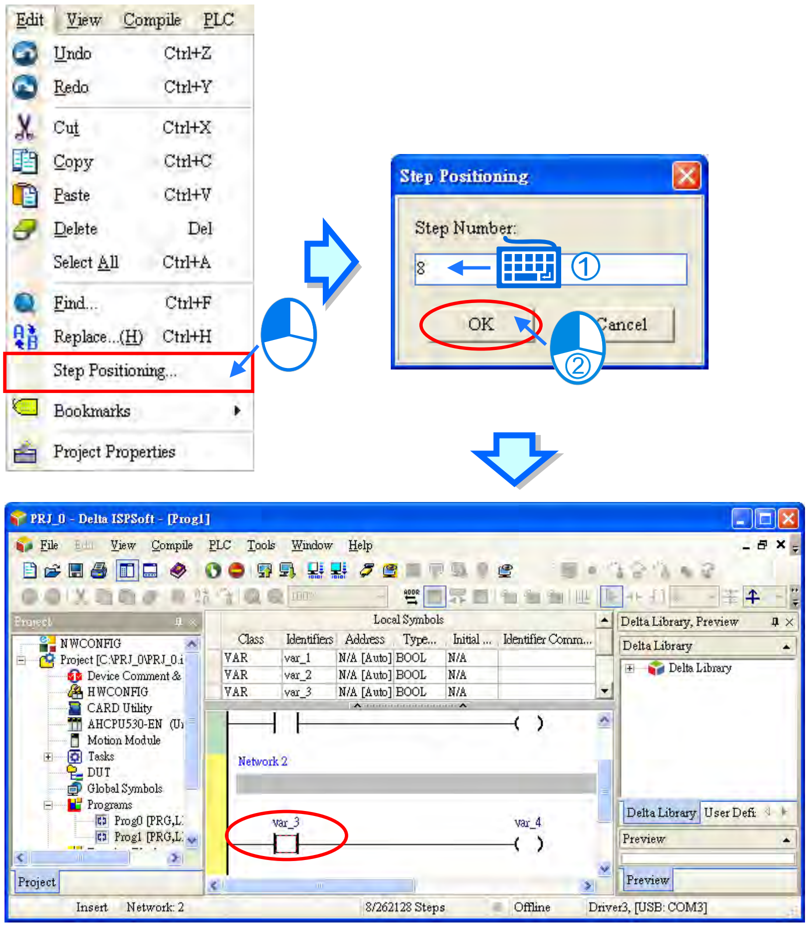
Select the **All** option button or the **Part** option button in the **Print Options** section, set margins, and select items which will be added. After the users click **Printer Setup**, they can select a printer, and set a print format. After the users click **Preview**, they can preview the document which will be printed. After the setting is complete, the users can click **Print** in the **Preview** window.



17.3 Step Positioning

17.3.1 Using Step Positioning

When an error occurred during operation, users can use special registers (e.g. SR1, SR2, the 32 bit registers for storing wrong addresses in the AH series) to know which step went wrong and then go to the specific program to check and fix it. Go to Edit > Step Positioning to open the Step Positioning window. Type the step number you'd like to inquire and press OK. The system will direct you to the corresponding POU and the position of the step in the program, as the image shown below. Be sure to program the project before using the step positioning function.



17.4 Program Comparison

17.4.1 Introduction to Program Comparison

ISPSoft provides a program comparison tool for users to compare 2 ISPSoft projects, or to compare an ISPSoft project and the PLC internal programs. Here are the comparison rules.

● Comparison items include product series, models, POUs, global symbols, local symbols and programs.

● For a POU comparison, the name of a POU will be checked first. Different POU name will be seen as different, even for those with the same contents.

● For a variable symbol comparison, the order of a variable symbol will be checked first. Different variable symbol order will be seen as different, even for those with the same contents. As the image shown below, the var_a and var_b from the left and right are with different order; thus they will be seen as different.

Class	Identifiers	Address	Type...	Initial Value
VAR	var_a	N/A [Auto]	BOOL	N/A
VAR	var_b	N/A [Auto]	BOOL	N/A
VAR	var_c	N/A [Auto]	BOOL	N/A
VAR	var_d	N/A [Auto]	BOOL	N/A

Class	Identifiers	Address	Type...	Initial Value
VAR	var_b	N/A [Auto]	BOOL	N/A
VAR	var_a	N/A [Auto]	BOOL	N/A
VAR	var_c	N/A [Auto]	BOOL	N/A
VAR	var_d	N/A [Auto]	BOOL	N/A

● The comparison of variable symbols will include the step skipping in the program. As the image shown below the var_c only appears on the left and that does not exist on the right.

Class	Identifiers	Address	Type...	Initial Value
VAR	var_a	N/A [Auto]	BOOL	N/A
VAR	var_b	N/A [Auto]	BOOL	N/A
VAR	var_c	N/A [Auto]	BOOL	N/A
VAR	var_d	N/A [Auto]	BOOL	N/A
VAR	var_e	N/A [Auto]	BOOL	N/A

Class	Identifiers	Address	Type...	Initial Value
VAR	var_a	N/A [Auto]	BOOL	N/A
VAR	var_b	N/A [Auto]	BOOL	N/A
VAR	var_d	N/A [Auto]	BOOL	N/A
VAR	var_e	N/A [Auto]	BOOL	N/A

● The comparison of POUs in the languages of LD, FBD, IL, ST will include the step skipping in the program. As the image shown below, the second line on the left does not exist on the right.

```
0001 ld var1
0002 and var3
0003 out var2
0004 ld m0
0005 out var3
```

```
0001 ld var1
0002 out var2
0003 ld m0
0004 out var3
```

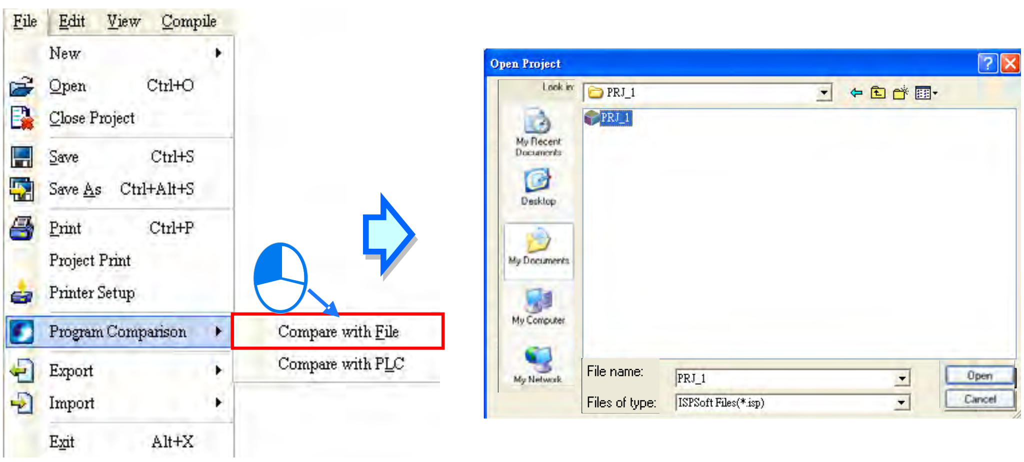
● Once there is a difference in the SFC, the comparison of POUs in the language of SFC will be seen as different. When the Action and Transition are different in the SFC, the system will identify which sections or lines of action/transition are different.

● Projects should be saved before running the program comparison tool.

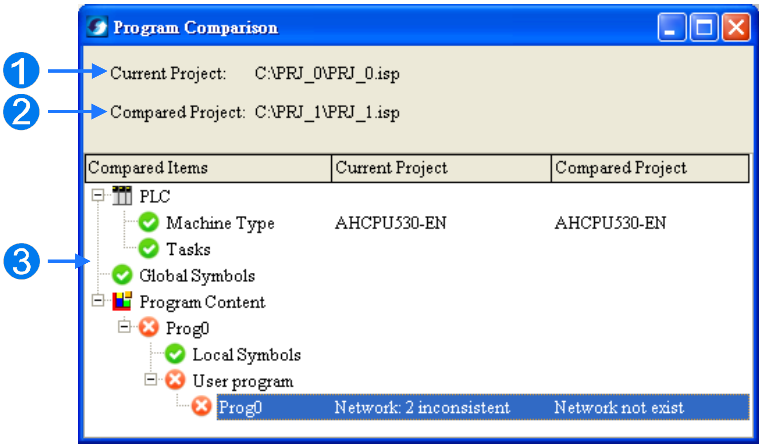
● Be sure to select the program items while downloading the CPU module; so that the programs in the CPU module can be compared.

17.4.2 Compare with File

It is used to compare different projects in the computer. Select File > Program Comparison > Compare with File, and then the Open Project window will appear. Select the project you'd like to compare with and click Open.



After that you will see a program comparison table, listing the sameness and the differences.

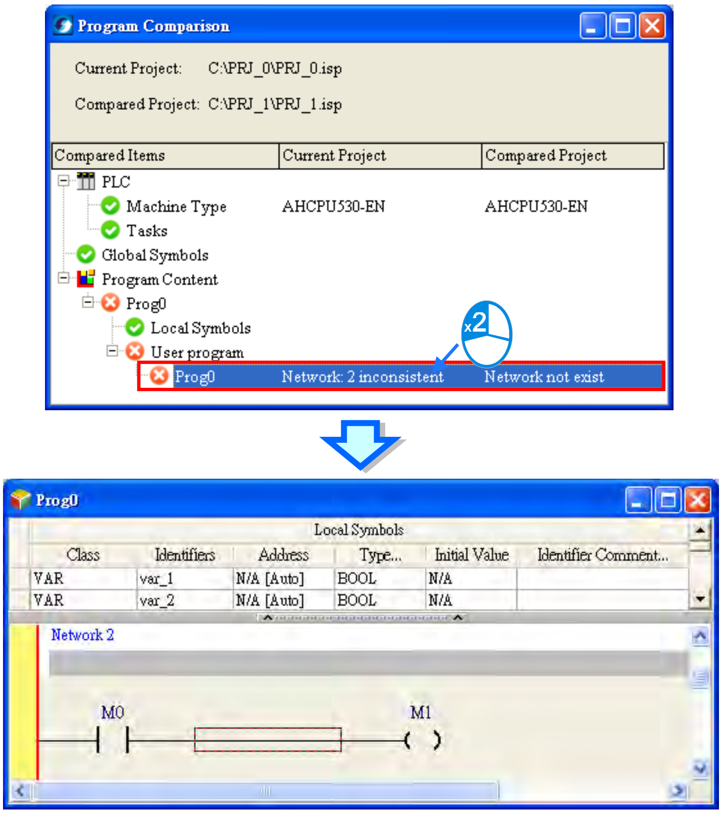


❶ The location of the current project

❷ The location of the compared project

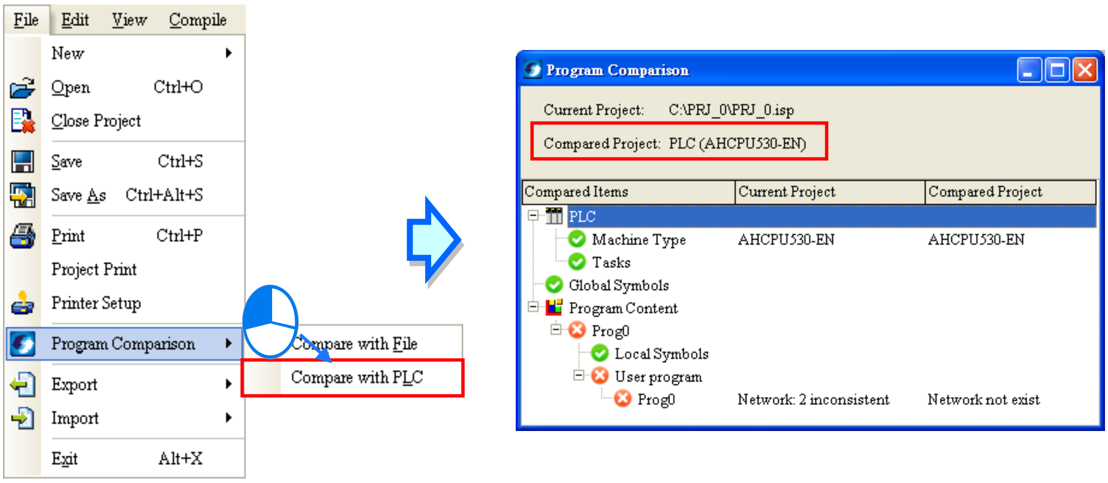
❸ The comparison results, including models, global symbols and program contents.

Double click the items with different comparison results; the system will open the contents for users to review. As the image shown below, click Prog0, the item with a different comparison result, to show its contents.

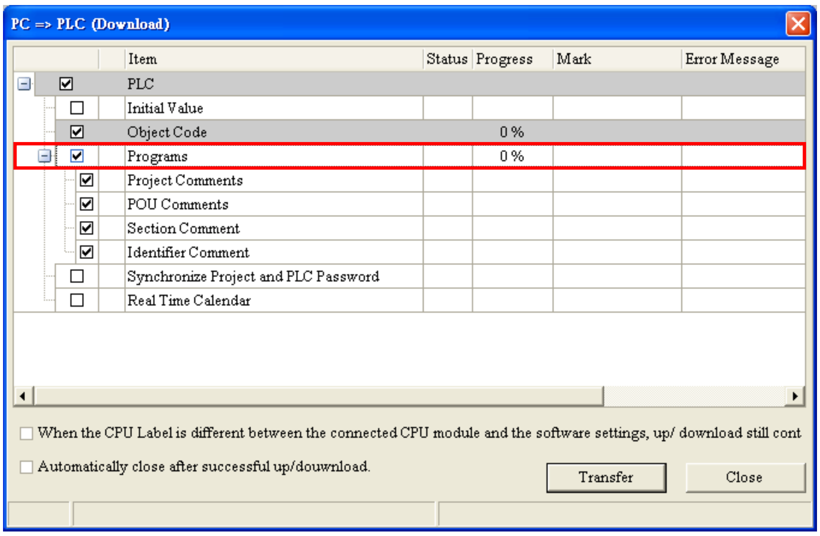


17.4.3 Compare with PLC

It is used to compare the CPU module contents and the projects in the computer. Make sure the connection between ISPSoft and the CPU module has been established. Select File > Program Comparison > Compare with PC=LC, and then the Program Comparison window will appear. Open the Program Comparison window and view the compared items (see below). PLC type used in connection with the compared project is also shown.



Select the items from the PC => PLC (Download) you'd like to compare with the CPU module. If not selecting any item to compare, an error message will appear and no comparison can be made. Refer to section 17.1.3 for more information on Downloading.



MEMO

Chapter 18 Testing and Debugging Tools

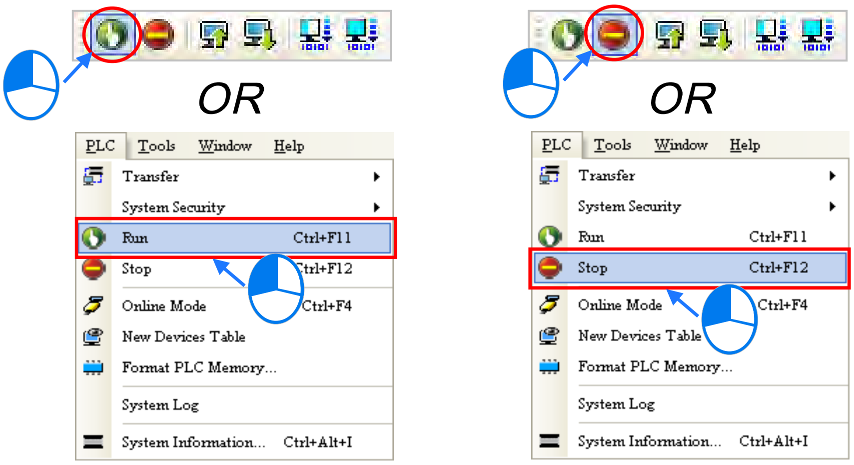
Table of Contents

18.1 Online Monitoring Function

18.1.1 Changing the Operating Status of a PLC

Users need to constantly change the operating status of a PLC when they test and debug the program in the PLC. They can easily change the status of the PLC by means of ISPSoft. Before the operation status of a PLC is changed by means of ISPSoft, users have to make sure that ISPSoft is connected to the PLC normally. Please refer to section 2.4 for more information.

After users click **Run** on the **PLC** menu or  on the toolbar, the PLC will begin to run. The PLC will stop running after **Stop** on the **PLC** menu or  on the toolbar is clicked.



If the operating status of a PLC is changed by means of ISPSoft, users do not have to consider the state of the RUN/STOP switch on the PLC. After the operating status of a PLC is changed by means of ISPSoft, users still can change the operating status of the PLC again by means of the RUN/STOP switch on the PLC.

18.1.2 Online Monitoring Function and Environment

If ISPSoft is connected to the PLC normally, users can monitor the execution status of the PLC through the online monitoring modes. Please refer to section 2.4 for more information about setting the connection between ISPSoft and a PLC.

In ISPSoft, there are two monitoring modes. One is the device monitoring mode, and the other is the program monitoring mode.

Monitoring mode	Description
 Device monitoring mode	Users can monitor the statuses of the devices in the PLC through the monitoring table. In this mode, ISPSoft only needs to update the statuses of the devices. The present program in ISPSoft does not need to be the same as the program in the PLC.
 Program monitoring mode	In this mode, the operating status of the program is displayed in the program editing window. As a result, the present program in ISPSoft must be the same as the program in the PLC.

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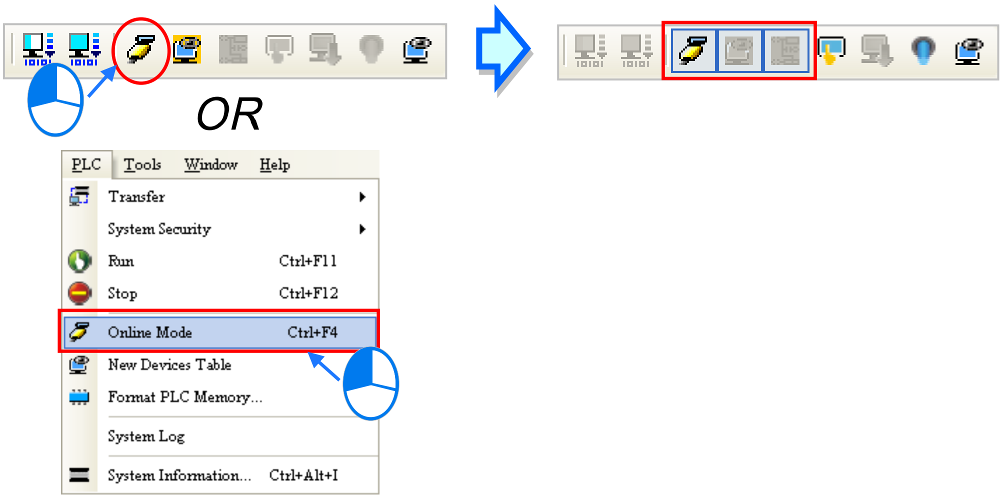
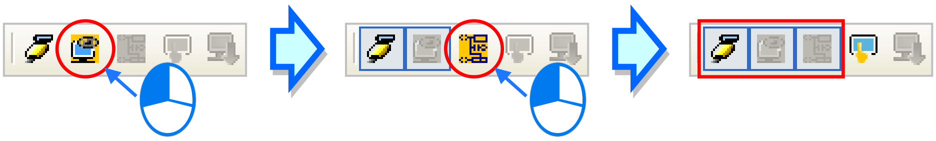
***. The device monitoring function can be enabled independently. However, if the program monitoring function is enabled, the device monitoring function is also enabled.**

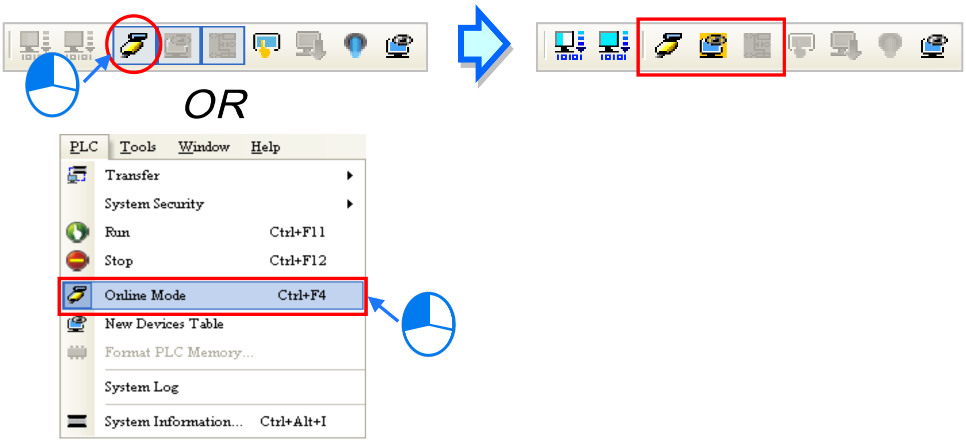
After users click **Online Mode** on the **PLC** menu, or on the toolbar, the online monitoring function will be enabled. The system will also enable the device monitoring mode and the program monitoring mode.



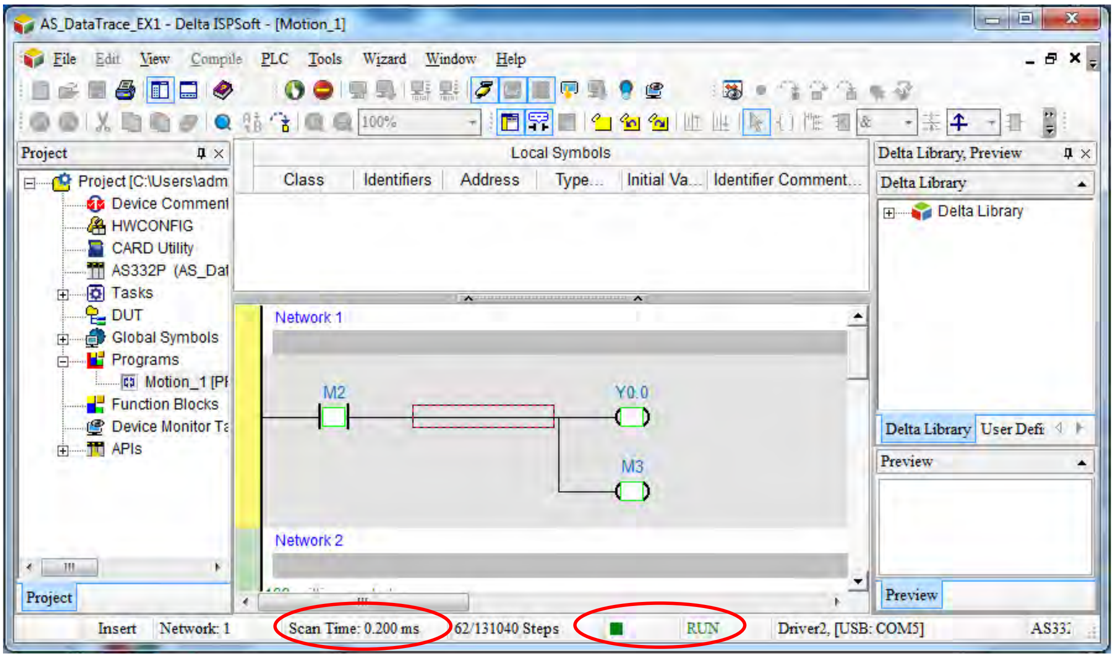
If the users only want to monitor the statuses of the devices in the PLC, they can click on the toolbar. When on the toolbar is clicked, on the toolbar is also clicked. If the users want to monitor the program, they can click on the toolbar.



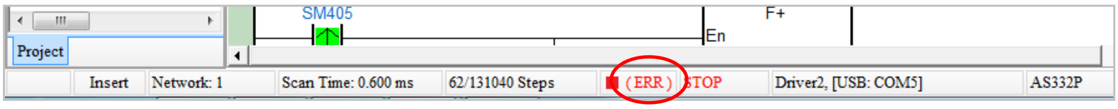
If the users want to disable the online monitoring function, they can click **Online Mode** on the **PLC** menu, or on the toolbar.



In the online monitoring mode, users can view the present scan time and the status of the PLC in the status bar in ISPSoft. The light at the left side of the status of the PLC indicates the communication status. When ISPSoft communicates with the PLC, the green light blinks.

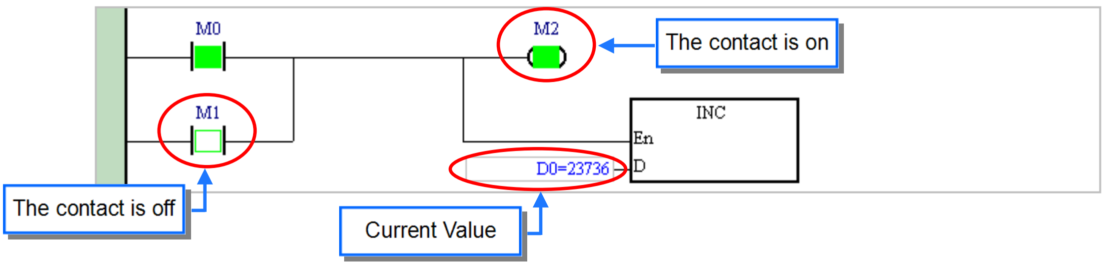


If an error occurs in the PLC, users may not be able to operate the PLC, e.g. the PLC can not run. Please refer to the manual for the model used for more information about troubleshooting.

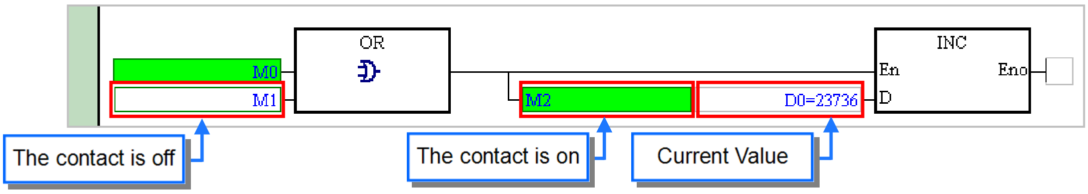


The present statuses of the devices will be displayed in the program editing window after the program monitoring function is enabled. Users can debug and test the program in the program monitoring mode. The way in which the statuses of the devices in a program are displayed depends on the programming language used to create the program.

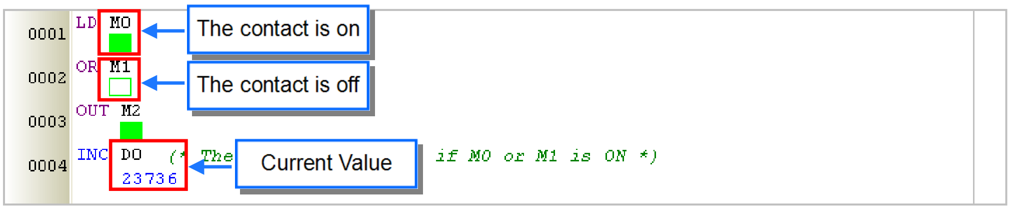
A ladder diagram in the program monitoring mode is shown below.



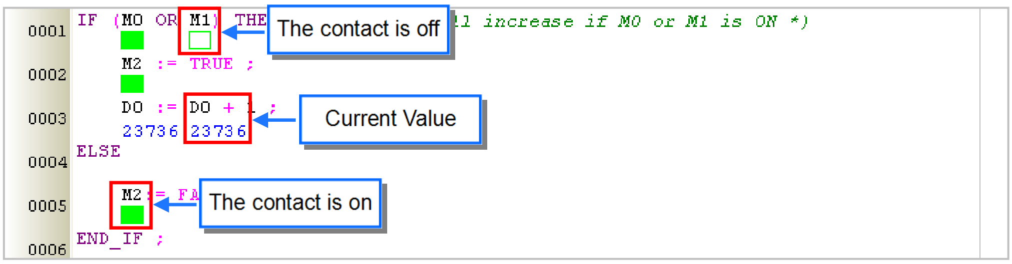
A function block diagram in the program monitoring mode is shown below.



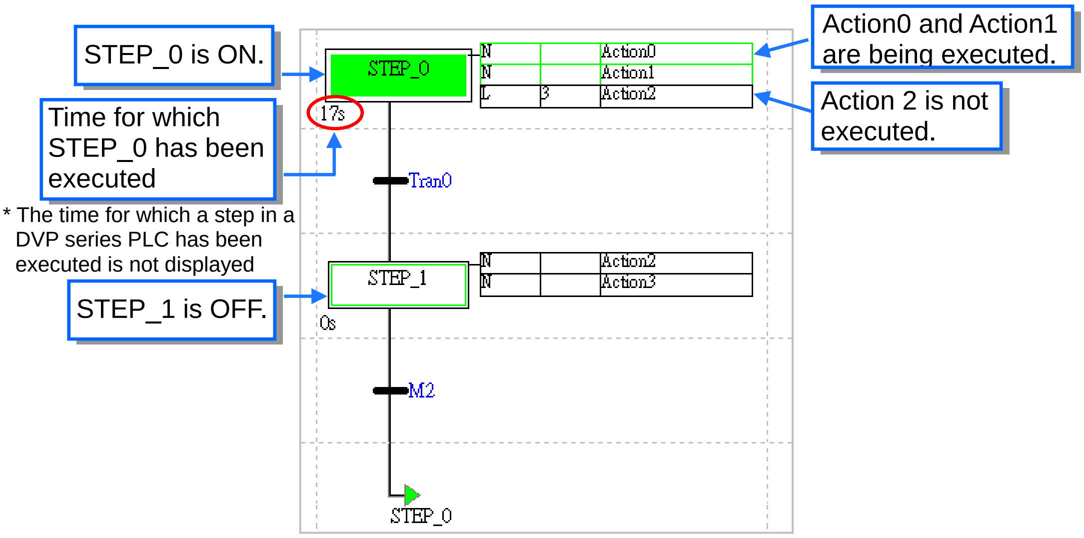
An instruction list in the program monitoring mode is shown below.



A structured text in the program monitoring mode is shown below.



A sequential function chart in the program monitoring mode is shown below. Not only the sequential function chart itself is monitored, but also the actions and the transitions are monitored.



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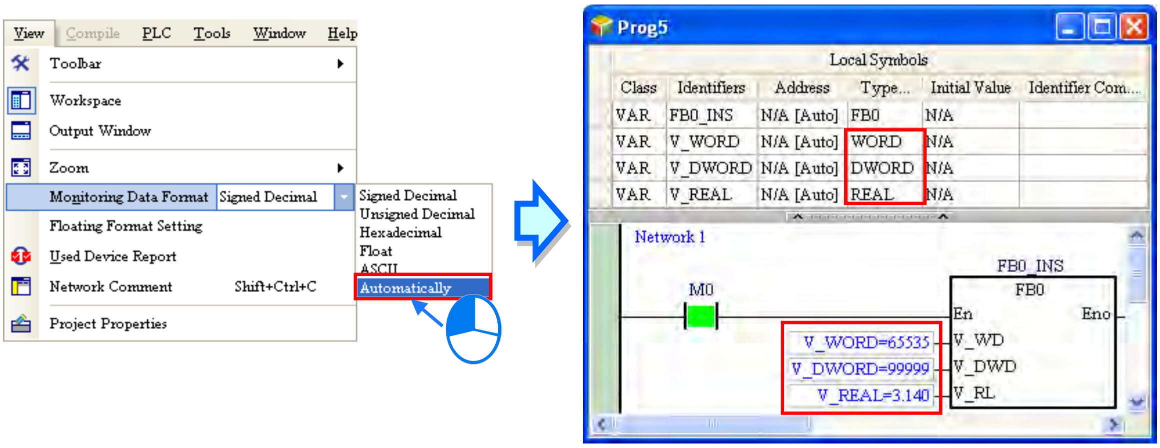
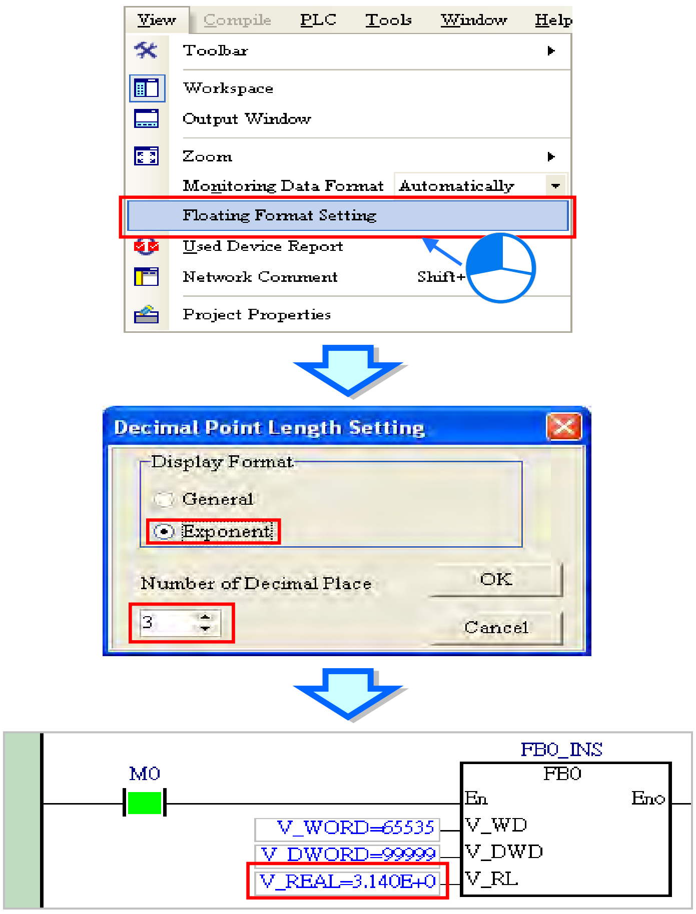
In the program monitoring mode, users can monitor not only the states of the contacts, but also the values in the registers. Besides, users can set the formats of the values monitored.

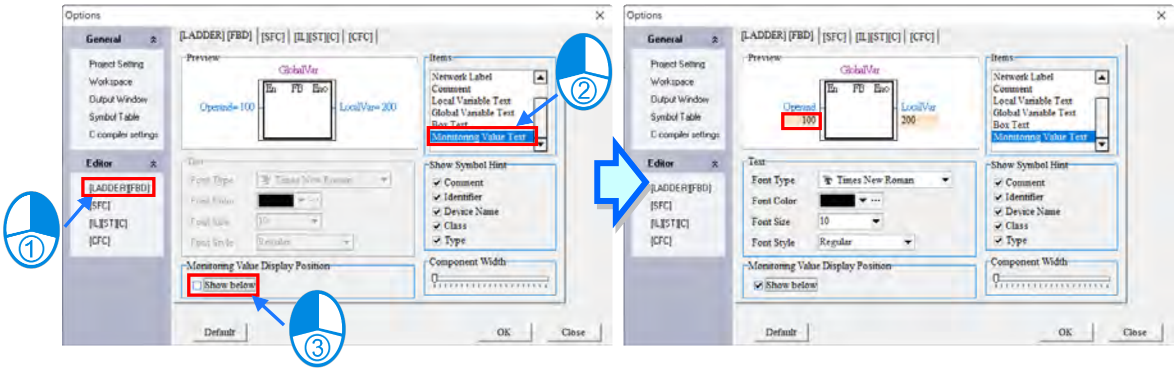
Click **Monitoring Data Format** on the **View** menu, and then select a data format on the drop-down list. If **Automatically** is selected, the formats of the values monitored depend on the data types of the symbols declared.



After users click **Floating Format Setting** on the **View** menu, they can set the formats of the floating-point numbers.

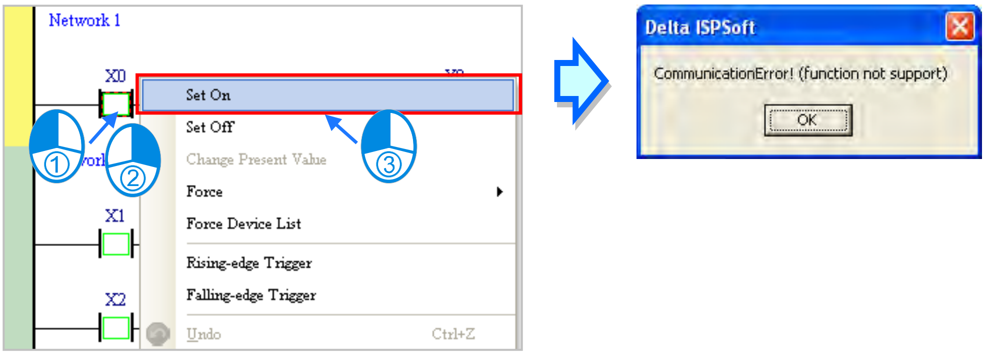


Select “**Option (O)**” from the “Toolbar” and click on **[LADDER][FBD]**, then click “**Monitoring Value Text**”. After checking the checkbox of “**Show below**” in Monitoring Value Display Position, the monitored values would be displayed under the pins.

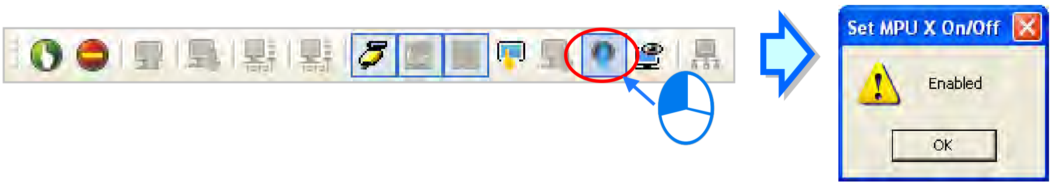


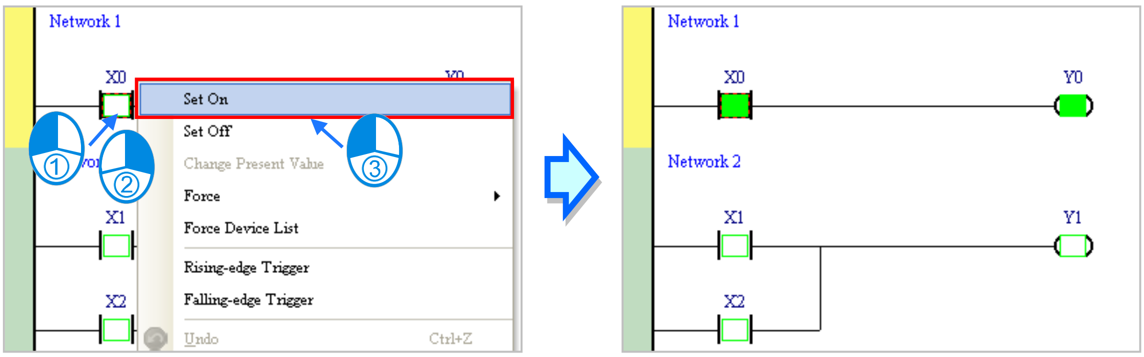
18.1.3 Changing the States of the X Devices in the Online Mode

In the online mode, users can change the states of the contacts in the program editing window. Users may not be allowed to change the states of the X devices in some PLCs in the online modes owing to the design of these PLCs. If users want to change the state of an X device, an error message will appear. Please refer to the manual for the model selected for more information.



If an X device needs to be operated when the program is tested, users can click  on the toolbar to enable the function of setting the X device. However, the state of the X device will not be updated after the function is enabled.



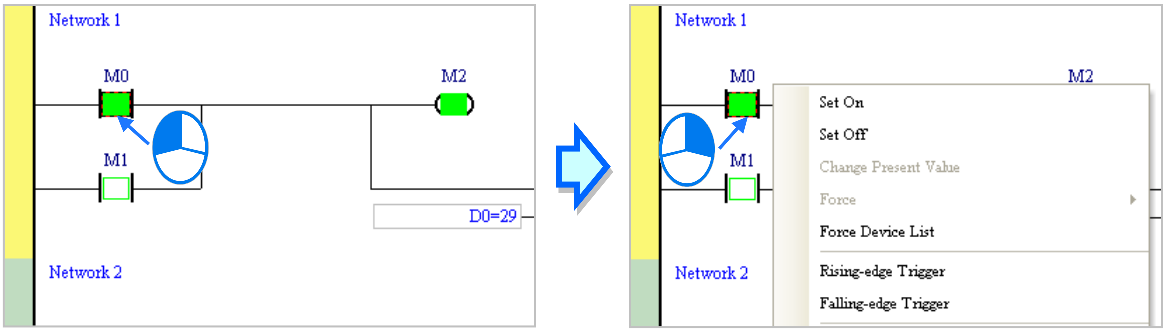


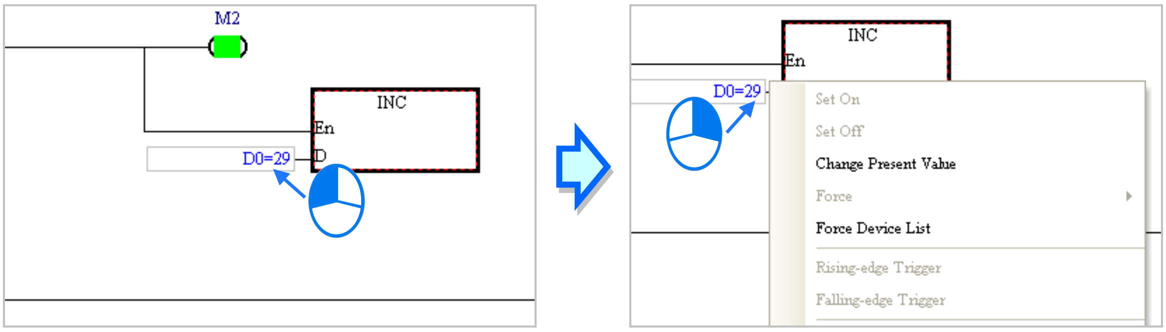
After the online monitoring function is disabled, the function of setting the X device will not be disabled automatically. As a result, be sure to disable the function of setting the X device before the online monitoring function is disabled lest the state of the X device should not be updated during the operation of the PLC.

⚠ **<u>Before the state of a contact is changed, users have to make sure that the operation performed does not affect the operation of the system, or cause damage to the system or the staff.</u>**

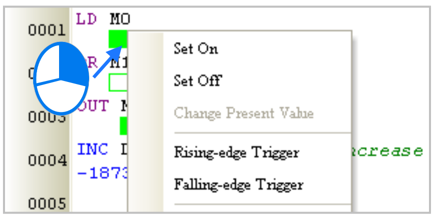
18.1.4 Monitoring a Program Online

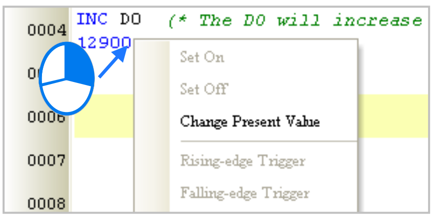
In the program monitoring mode, users can change the state of a contact or the value in a register in the program editing window. By means of changing the state of a contact or the value in a register, users can debug or test the program. If users want to manipulate a device or an operand in a ladder diagram or a function block diagram, they can click the device or the operand, right-click the device or the operand, and select an item on the context menu. The items on the context menu vary with the programming language used.



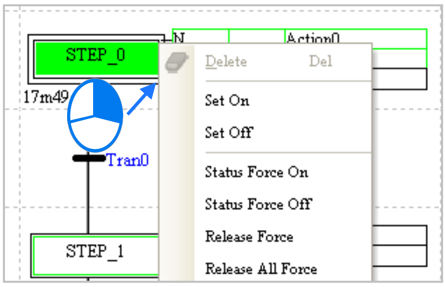


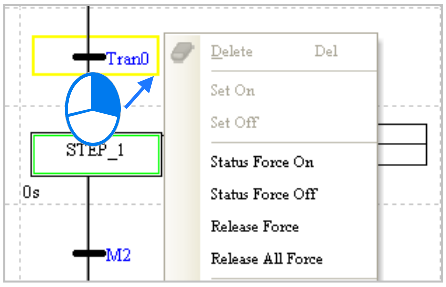
If users want to manipulate an operand on an instruction list or in a structured text, they can right-click the operand, and select an item on the context menu.



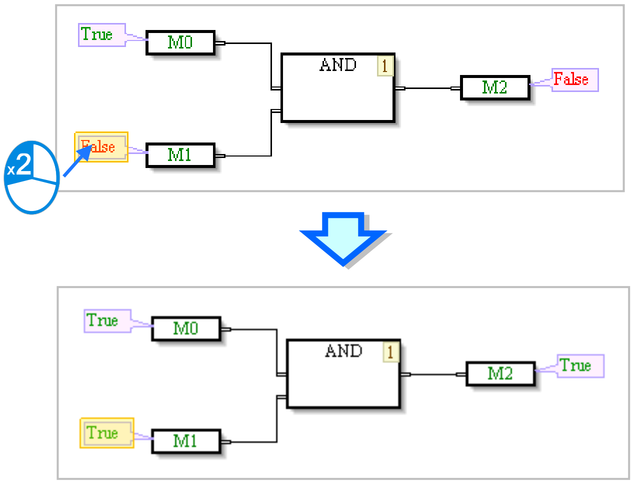


If users want to manipulate a step or a transition in a sequential function chart, they can right-click the step or the transition, and select an item on the context menu.





If users want to manipulate a step or a transition in a continuous function chart, they can double click the shown status to switch from True to False or vice versa.



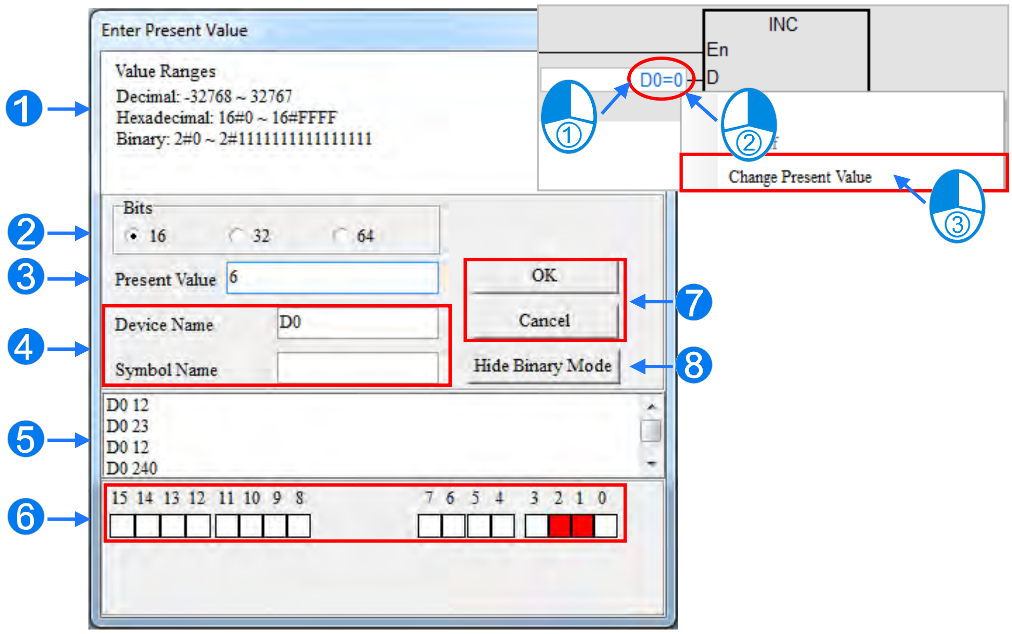
The items on the context menu are described below.

Item	Description
Set On	Setting the contact selected to ON
Set Off	Setting the contact selected to OFF
Rising-edge Trigger	No matter what the state of the contact selected is, the system set the contact to OFF, and then set it to ON.
Falling-edge Trigger	No matter what the state of the contact selected is, the system set the contact to ON, and then set it to OFF.
Change Present Value	Users can set the value of the operand selected.
Force	Forcing an input contact or output contact ON or OFF
Force Device List	Forcing several input contacts or output contacts in the tables ON or OFF

⚠ **Before the status of a device is changed, users have to make sure that the operation does not affect the operation of the system, or cause damage to the system or the staff.**

● **Change Present Value**

First, select an operand, and right-click the operand. Next, select **Change Present Value** on the context menu. Finally, set the value of the operand in the **Enter Present Value** window.



❶ Message.

❷ Users can select 16 bits/ 32 bits/ 64bits. (The content changes according to the selected PLC series.)

❸ Input the present value to be changed.

❹ Users can type a Device Name or Symbol Name for the change present value.

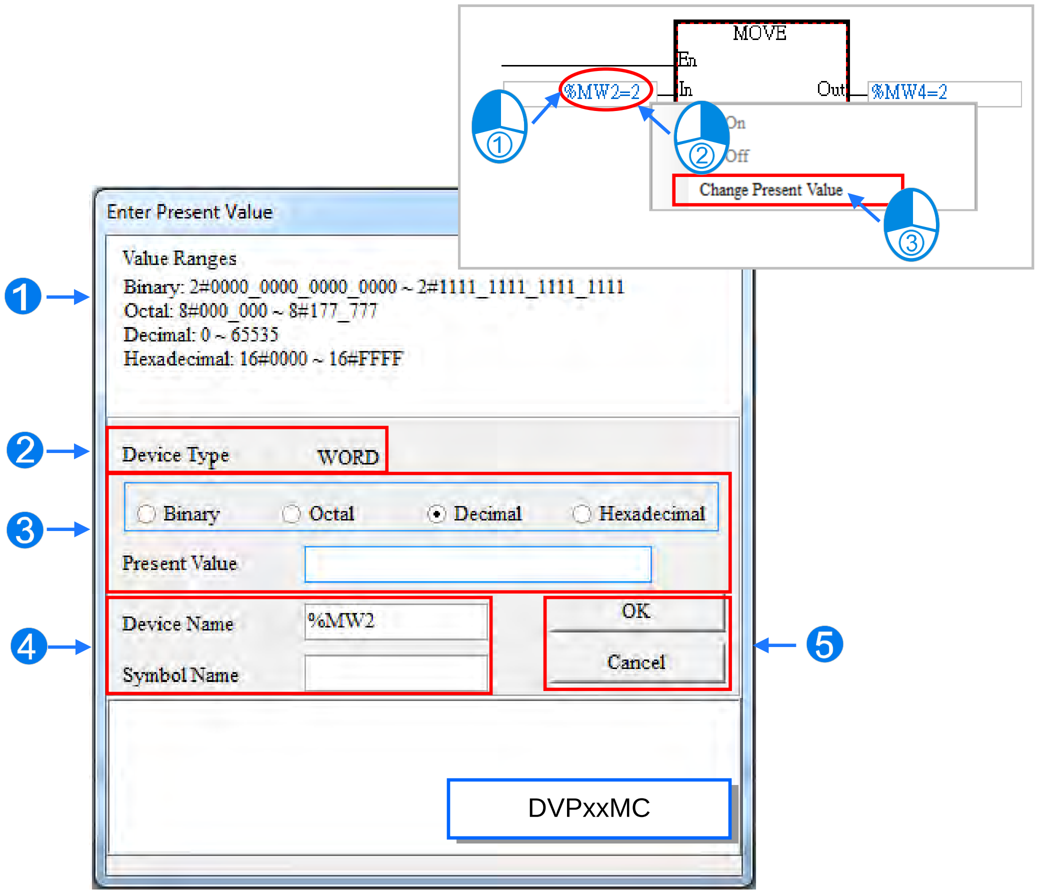
❺ Value change history (Format: Device name Value).

❻ In the binary mode, users can set the states of the bits through the mouse.

❼ The setting values will be applied after **OK** is clicked. The window will be closed after **Cancel** is clicked.

❽ Users can display or hide the binary mode.

Users can select DVPxxMC series and the following image appears.



❶ Message.

❷ Users can select 16 bits/ 32 bits/ 64bits. (The content changes according to the selected PLC series)

❸ Input the present value and select format including Binary/ Octal/ Decimal/ Hexadecimal.

❹ Users can type a Device Name or Symbol Name for the change present value.

❺ Press Enter to apply the setting values; press Cancel to close the setting window.

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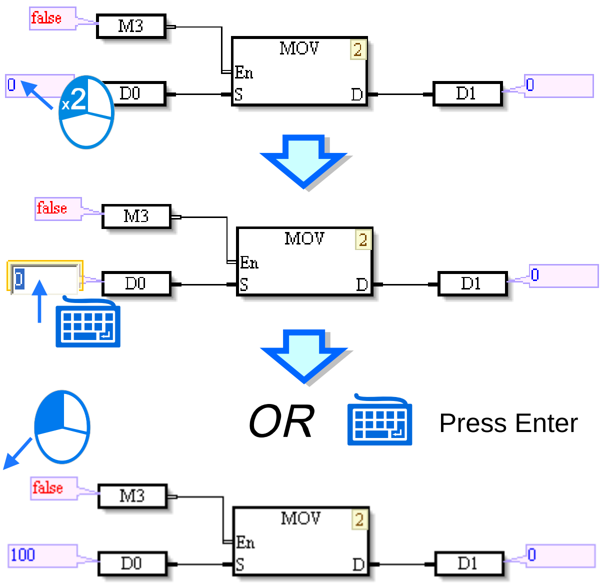
In the continuous function charts, double click the value that you'd like to change, the field will become editable. Type the value in and click on the blank area or press Enter on the keyboard to complete the editing.

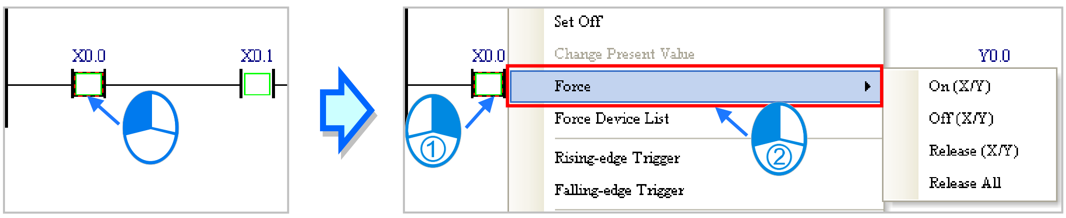


● **Force**

Only X contact and Y contacts and be forced ON or OFF. If an X contact is forced ON or OFF, the state of the contact will not be affected by the actual input. Likewise, if a Y contact is forced ON or OFF, the state of the contact will be affected by the program execution result.

Y0.0 in the figure below is forced ON. It will be ON even if M0 is OFF. Besides, if a contact is forced ON or OFF, a lock symbol will appear at the left side of the contact.

Click an X contact or a Y contact which will be manipulated, right-click the X contact or the Y contact, point to Force on the context menu, and select **On (X/Y)**, **Off (X/Y)**, **Release (X/Y)**, or **Release All**.



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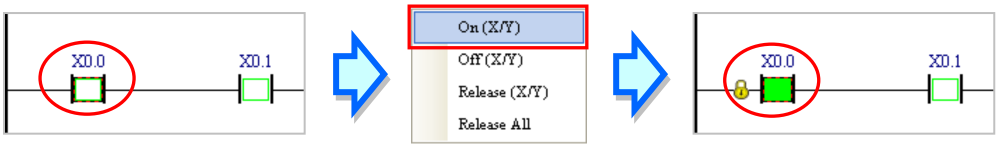
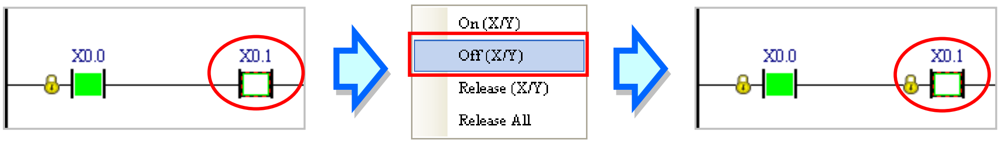
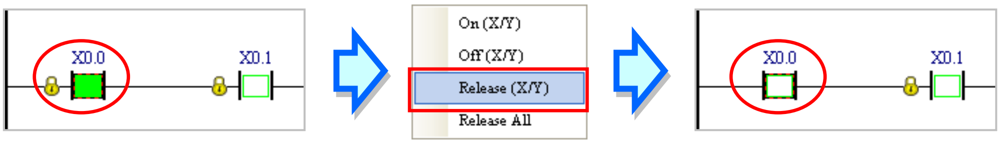
➢ **On (X/Y)**: Forcing the X contact or the Y contact selected ON



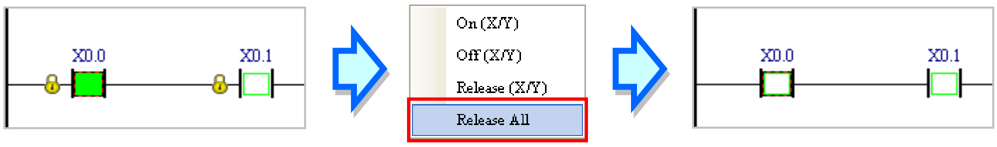
➢ **Off (X/Y)**: Forcing the X contact or the Y contact selected OFF



➢ **Release (X/Y)**: Releasing the contact from the locked state



➢ **Release All**: Releasing all the contacts from the locked states



***1. The mechanism for forcing contacts ON/OFF, and the limit on the number of contacts which can be forced ON/OFF vary from model to model. Please refer to the manual for the model selected for more information.**

***2. If the online monitoring function is disabled, the contacts will not be automatically released from the locked states. Please check whether the present state will cause any problem.**

- **Force Device List**

Right-click the program editing window, and then select **Force Device List** on the context menu. Click the **Device X** tab or the **Device Y** tab in the **Forced Devices List** window. Select a contact in the table, right click the contact, and select an item on the context menu.

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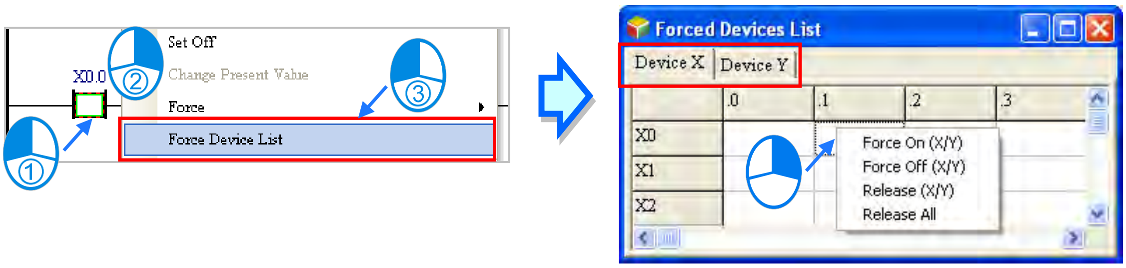
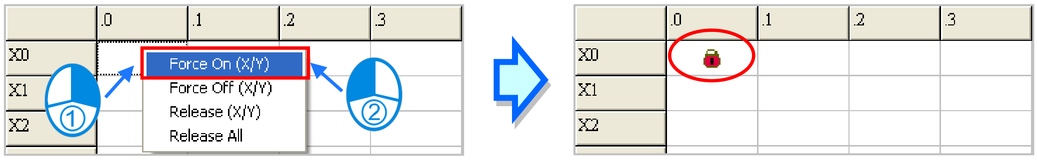
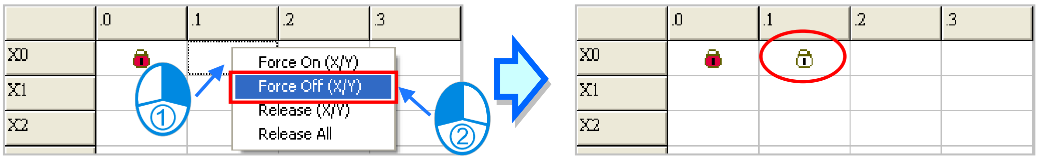


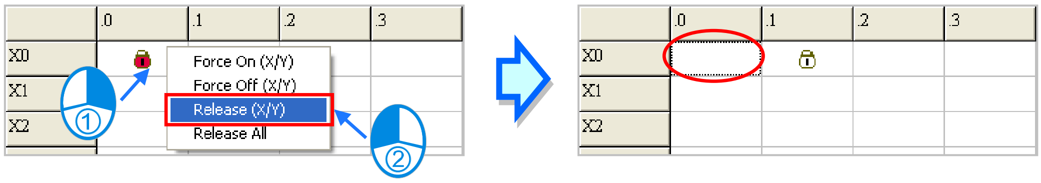
➢ **Force On (X/Y)**: Setting the contact selected to ON



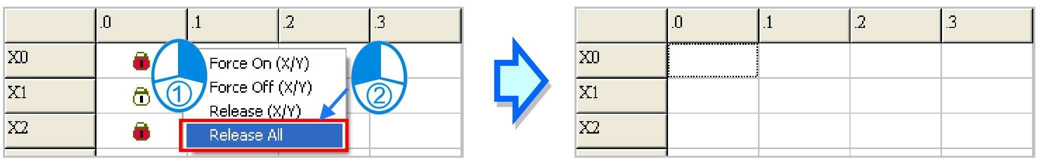
➢ **Force Off (X/Y)**: Setting the contact selected to OFF



➢ **Release (X/Y)**: Releasing the contact from the locked state



➢ **Release All**: Releasing all the contacts from the locked states



***1. The mechanism for forcing contacts ON/OFF, and the limit on the number of contacts which can be forced ON/OFF vary from model to model. Please refer to the manual for the model selected for more information.**

***2. If the online monitoring function is disabled, the contacts will not be automatically released from the locked states. Please check whether the present state will cause any problem.**

18

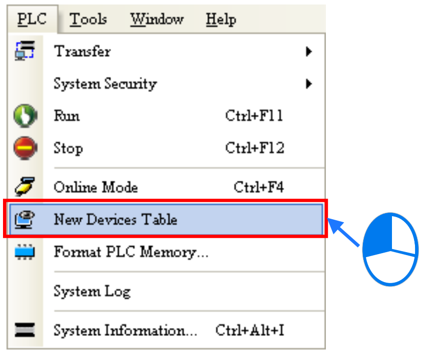
18.1.5 Device Monitoring Table

After users create monitoring tables, they can monitor the devices or the symbols in the tables online. Users are allowed to create more than one device monitoring table in a project in ISPSoft. 100 items at most can be added to a device monitoring table. Users can classify and manage the items which are monitored by themselves. Besides, device monitoring tables can be created online or offline. The device monitoring tables which are created in a project will be saved with the project, and users

There are three ways to create a device monitoring table.

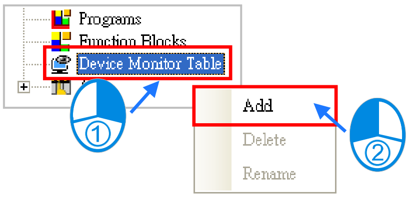
- **Method 1**

Click **New Devices Table** on the **PLC** menu.



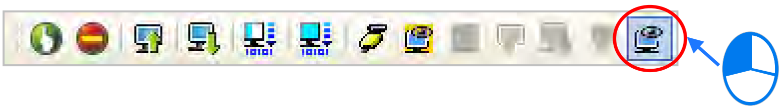
- **Method 2**

Right-click **Device Monitoring Table** in the project management area and click **Add**.

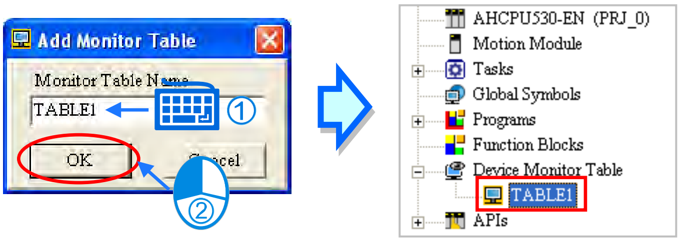


- **Method 3**

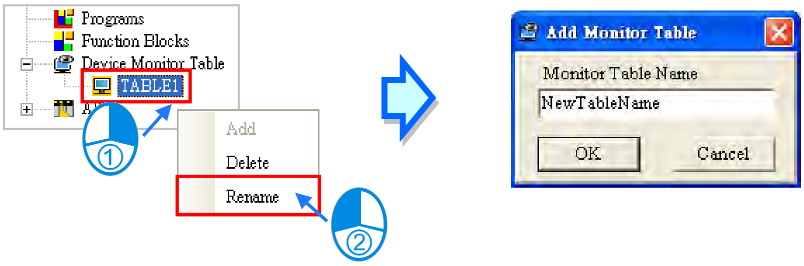
Click  on the toolbar.



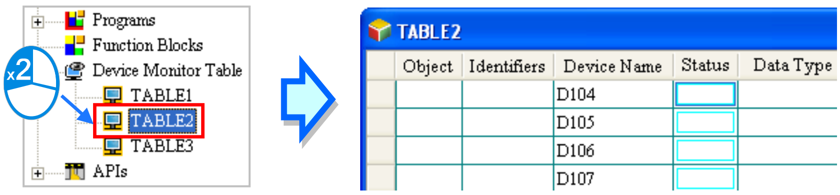
Type a table name in the **Add Monitor Table** window, and then click **OK**. An item will be under **Device Monitor Table** in the project management area, and a device monitoring window will appear in the working area. Users can manage the items in the window.



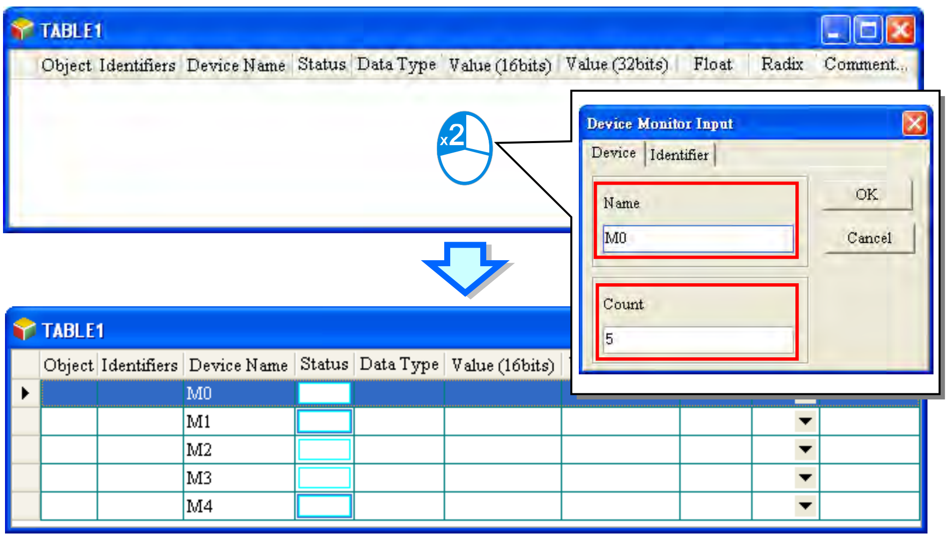
If users want to rename a device monitoring table created, they can click the device monitoring table in the project management area, right-click the device monitoring table click **Delete**. As for renaming a device, click **Rename** and type a new table name in the **Add Monitor Table** window.



Users are allowed to open several device monitoring windows in ISPSoft. If users want to open a device monitoring window, they can double-click the device monitoring table in the project management area.

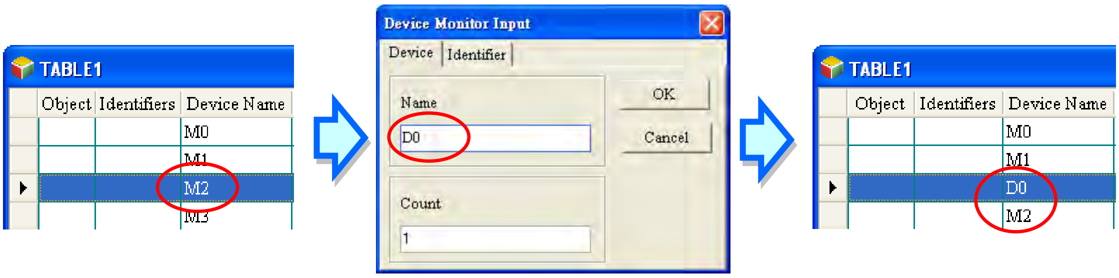


If users want to add an item to a device monitoring table, they have to double-click any blank area in the device monitoring table, or type a start address and the number of devices which be monitored in the **Device Monitor Input** window. Please notice that 100 items at most can be added to a monitoring table.

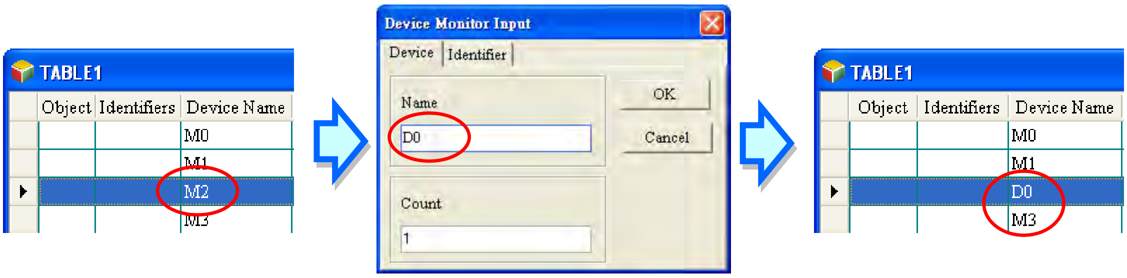


Users can press Insert on the keyboard to switch between inserting an item in the present device monitoring table and replacing an item in the present device monitoring table. The mode which is selected is displayed in the status bar in ISPSoft.

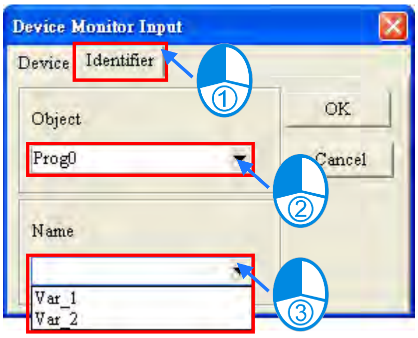
If the insertion mode is selected, the item added will be inserted above the item selected in the device monitoring table.



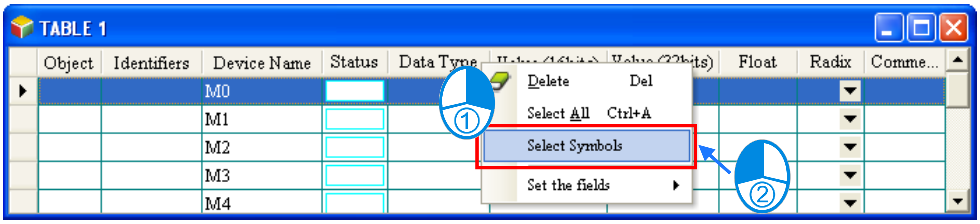
If the replacement mode is selected, the item added will overwrite the item selected in the device monitoring table.



Users can click the Identifier tab and add identifiers in this Device Monitor Input window.

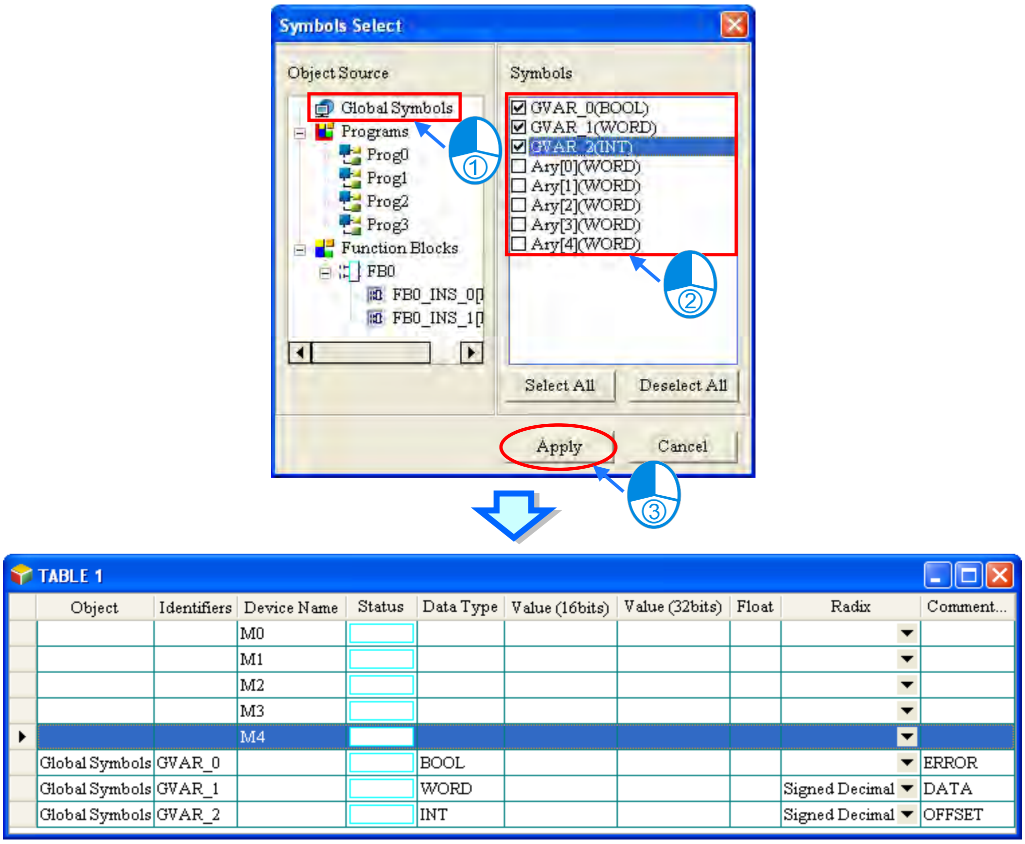


Users can add symbols as well as devices to a device monitoring table. After they right-click a device monitoring table, and select **Select Symbols** on the context menu, they can add symbols to the device monitoring table.



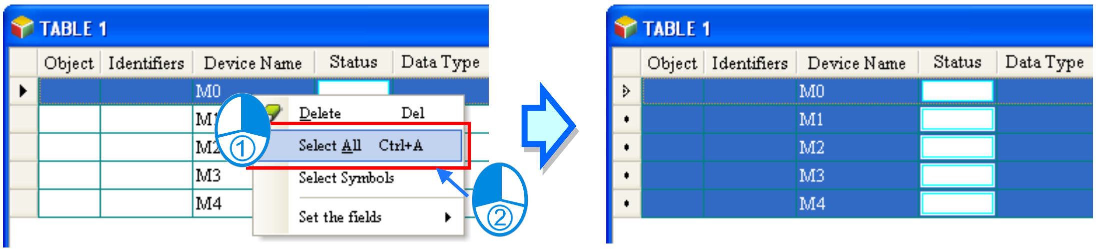
The users can select global symbols or local symbols in the POUs in the **Symbols Select** window. Before they select local symbols in a function block, the program must be compiled. After the function block instances declared in the superior POU are produced, they will be assigned substantial memory blocks. The users can monitor the local symbols in the function block instances. Different function block instances are assigned different memory blocks. If users want to monitor local symbols in a function block, they must select the local symbols in the instances of the function block.

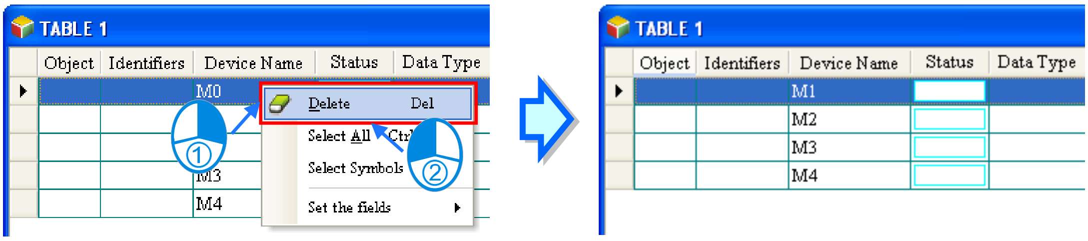
After the users select an item in the **Object Source** section, they can select symbols in the **Symbols** section. If a symbol whose data type is ARRAY is declared, the elements will be listed in the **Symbols** section. After symbols in the **Symbols** section are selected, the user can click **Apply** to add the symbols to the device monitoring table. The users can continue to select other symbols. After the users finish adding symbols to the device monitoring table, they can click **Cancel** to close the window.



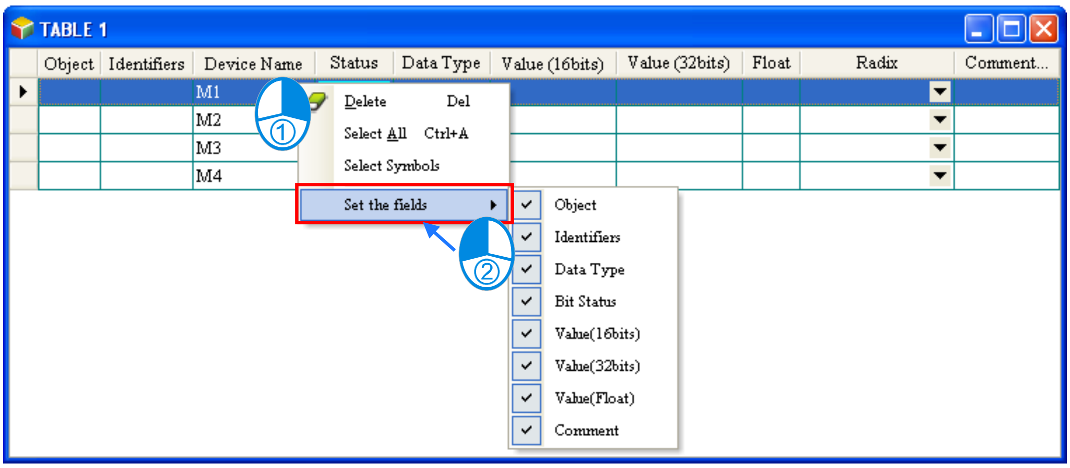
***. The symbols whose data types are POINTER, the symbols whose data types are T_POINTER, the symbols whose data types are C_POINTER, and the symbols whose data types are HC_POINTER can not be monitored.**

If the users want to delete an item in a device monitoring table, they can select the item, right-click the item, and click **Delete** on the context menu. If the users want to delete several items in a device monitoring table, they can select the items while they press Ctrl on the keyboard, right-click an item selected, and click **Delete** on the context menu. If the users want to delete a range of items in a device monitoring table, they can select the first item and the last item while they press Shift on the keyboard, right-click an item selected, and click **Delete** on the context menu. If the users want to delete all the items in a device monitoring table, they can right-click the device monitoring table, select **Select All** on the context menu, right-click an item selected, and select **Delete** on the context menu. The users can also delete the item selected or the items selected by pressing Delete on the keyboard.





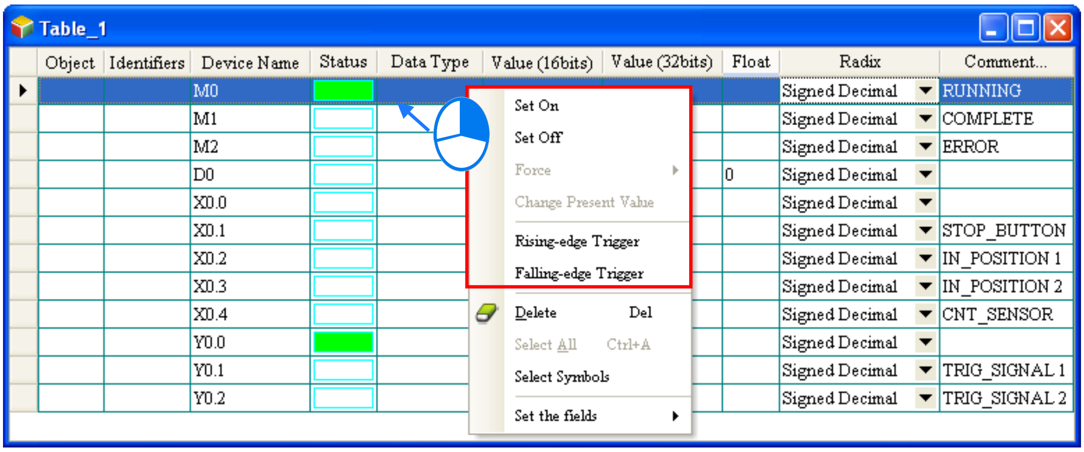
The users can hide some columns in a device monitoring table. If the users want to hide some columns in a device monitoring table, thy can right-click the device monitoring table, point to **Set the Fields**, and unselect items which correspond to the columns they want to hide. Please refer to the description of the columns below for more information.



The description of the columns in a device monitoring table is as follows.

Column	Description
Object	The sources of the symbols are displayed.
Identifier	The identifiers of the symbols are displayed.
Device Name	The names of the devices monitored are displayed.
Status	If the objects monitored are bit devices or contacts, the states of the bit devices or the states of the contacts will be displayed in this column.
Data Type	If the objects monitored are symbols, the data types of the symbols will be displayed in this column.
Value (8 bits)	When the devices and the symbols are monitored, the 8-bit values are displayed in this column.
Value (16 bits)	When the devices and the symbols are monitored, the 16-bit values are displayed in this column.
Value (32 bits)	When the devices and the symbols are monitored, the 32-bit values are displayed in this column.
Value (64 bits)	When the devices and the symbols are monitored, the 64-bit values are displayed in this column.
Float (32-bit floating-point)	When the devices and the symbols are monitored, the 32-bit floating-point numbers are displayed in this column.
Float (64-bit floating-point)	When the devices and the symbols are monitored, the 64-bit floating-point numbers are displayed in this column.
Radix	Users can select the formats of the values monitored.
Comment...	The comments on the devices monitored, and the comments on the symbols monitored are displayed in this column.

After a device monitoring table is created, the users can monitor the items in the device monitoring table online. After the users right-click an item in a device monitoring table in the online mode, they can select an item on the context menu to change the state of the item monitored, or the value of the item monitored. Please refer to section 18.1.4 for more information.



Additional remark

If the comment on a device which is monitored is changed, users have to close the device monitoring table in which the device is added, and open the window again to get the new comment on the device. If the properties of a symbol in a device monitoring table are changed, or a symbol in a device monitoring table is removed from the symbol table, the symbol in the device monitoring table will not be updated, and will not have any effect in the online mode. Please delete the symbol from the device monitoring table, and add it again.

18.1.6 Online Editing Function and Online Update Function

***. Currently, NOT supported by DVPxxMC**

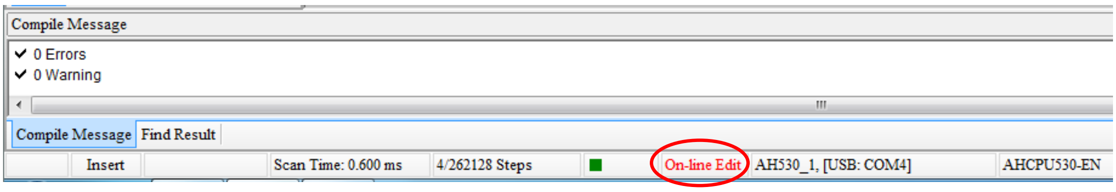
When the system is in the online mode and the PLC is running, users can modify the program monitored through the online editing function and the online update function. Please refer to the following table for more information about the limits set on the editing of programs.

Programming language	Description
Ladder diagram	One network is edited at a time. Users are allowed to add new networks. After a new network is added, the network which can be edited will be the new network, that is, the previous networks can not be edited.
Function block diagram	One network is edited at a time. Users are allowed to add new networks. After a new network is added, the network which can be edited will be the new network, that is, the previous networks can not be edited.
Instruction list	There is no limit on the number of lines which can be edited.
Structured text	There is no limit on the number of lines which can be edited.
Sequential function chart	A sequential function chart can not be modified online, but actions and transitions can be modified. The limit set on the editing of an action or a transition depends on the language used to create the action or the transition.

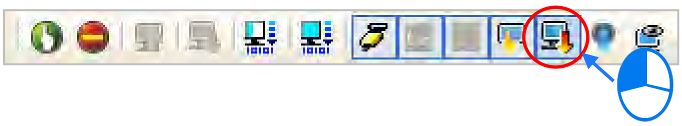
Programming language	Description
Continuous function chart	No limit on the editing.
Common limit	After the program is edited, users can only edit one POU. In the online editing mode, users can not modify or add a symbol.

If users want to edit the program online, they must enable the program monitoring function, make sure that the PLC runs, and click  on the toolbar.

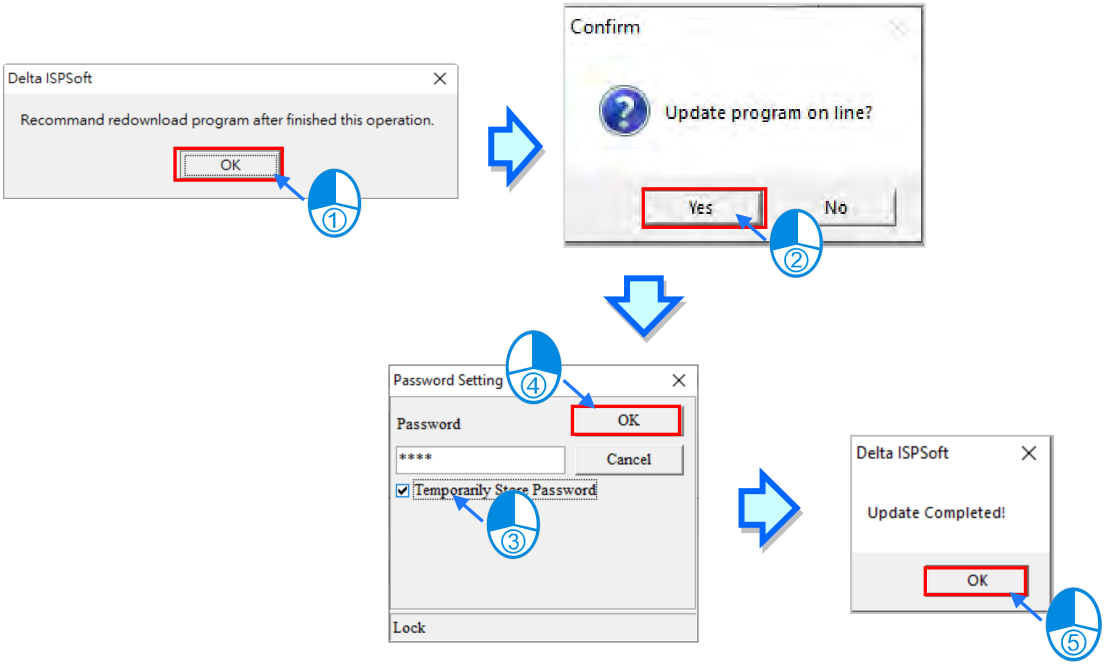
If the online editing function is enabled, **On-line Edit** will be displayed in the status bar in ISPSoft.



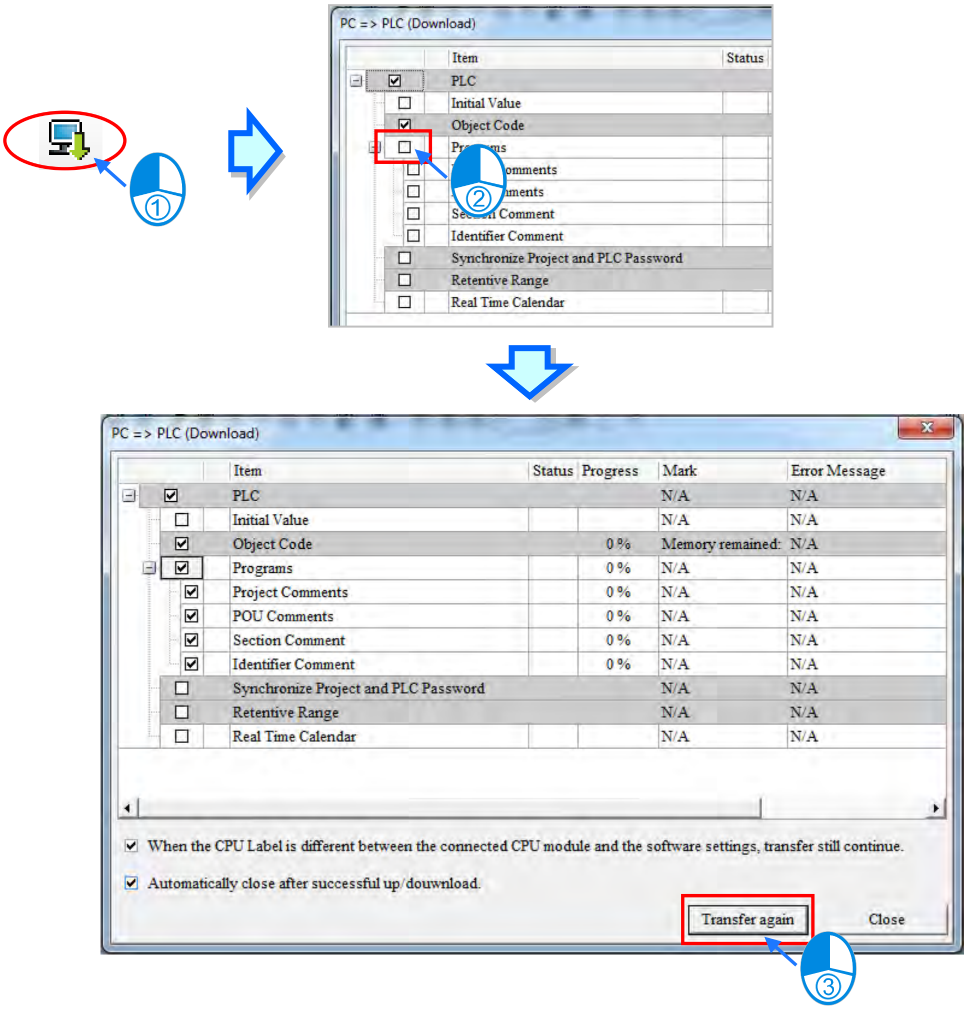
If the editing of the program is complete and the program is compiled successfully, the program will be downloaded to the PLC after users click  on the toolbar. If the program is not compiled, the system will ask users to compile the program.



When users select DVP series and click  on the toolbar, the screen will appear **Recommand redownload program after finished this operation** window. Click **OK** and a confirmation shows up, asking you to **Update program on line**, click **Yes** and a **Password Setting** window appears. If tick the option **Temporarily Store Password**, the password would not be requested again for online update until the project is reopened. Then click **OK**, after that a comfirmation shows up to inform you the update is complete, click **OK**.



Click and select **Programs** to download the PLC source code for synchronization.



18.2 Debugging Mode for DVP Series

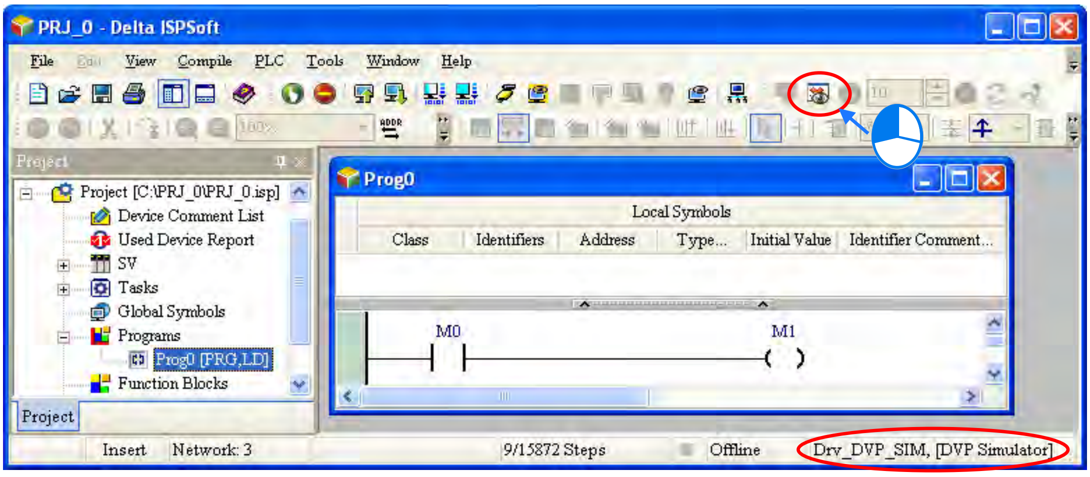
ISPSoft provides debugging functions for DVP series PLCs. Users can debug and test the program in a DVP series PLC by means of the debugging tools. Before the debugging mode is enabled, users have to pay attention to two points below.

(a) The debugging mode for a DVP series PLC can be executed only if the connection type is a simulator.

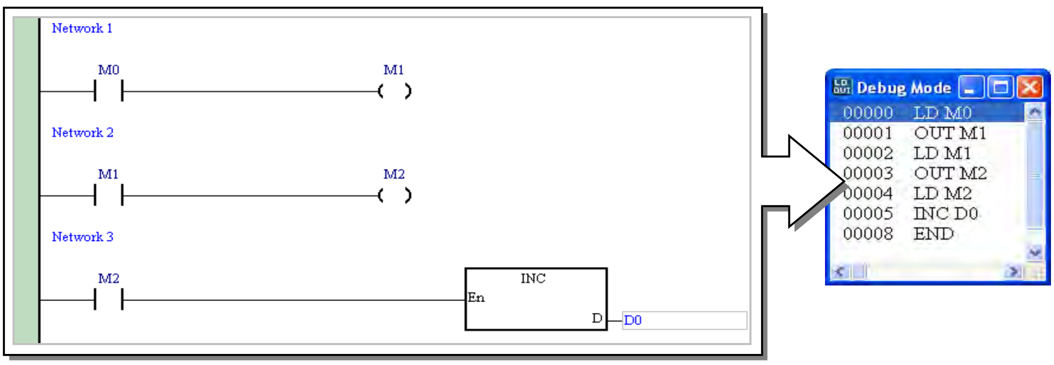
(b) If the online mode is enabled, the debugging mode can not be enabled. However, the device monitoring function can be enabled after the debugging mode is enabled.

18.2.1 Enabling the Debugging Mode for DVP Series

The connection type must be a DVP simulator. Please refer to section 2.4 for more information. After users click on the toolbar, a window will appear. If the users want to disable the debugging mode, they can click again.

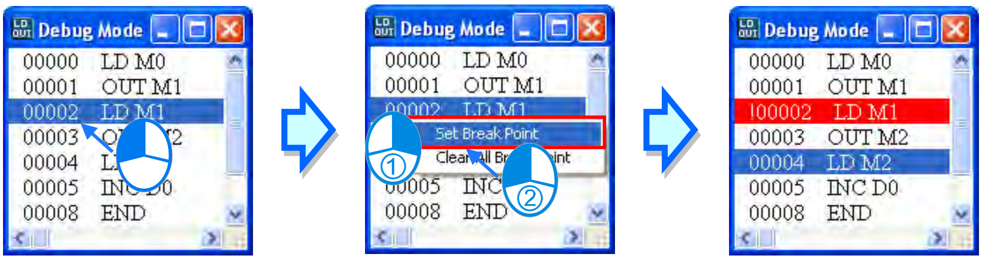


After the program in a DVP series PLC is translated into an instruction list, the instruction list will appear in the debugging window for the DVP series PLC. The part of the instruction list which is on a blue ground in the debugging window is the position where the execution of the program stops. The position where the execution of the program stops is the part of the program which has not been executed.

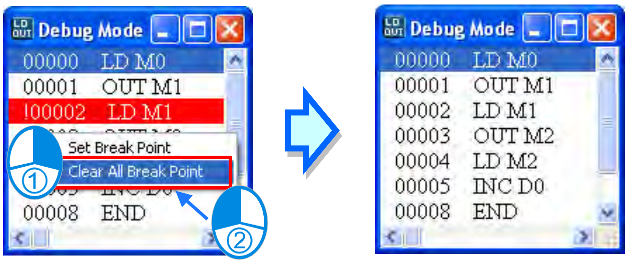


18.2.2 Adding and Clearing Breakpoints

After users right-click a line in the debugging window and select **Set Break Point** on the context menu, a breakpoint will be added to the line. If the users right-click the line again and select **Set Break Point** on the context menu, the breakpoint will be canceled. In the debugging window, an exclamation appears at the beginning of the line to which a breakpoint is added, and the line is on a red ground.



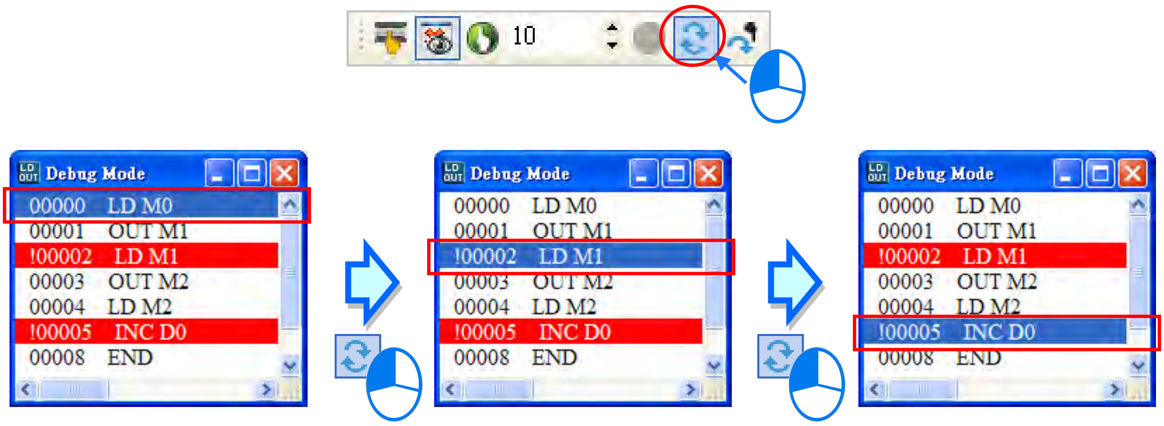
If users want to clear the breakpoints in the debugging window, they can right-click a line, and select **Clear All Break Points** on the context menu.



18.2.3 Execution of the Program in the Debugging Mode

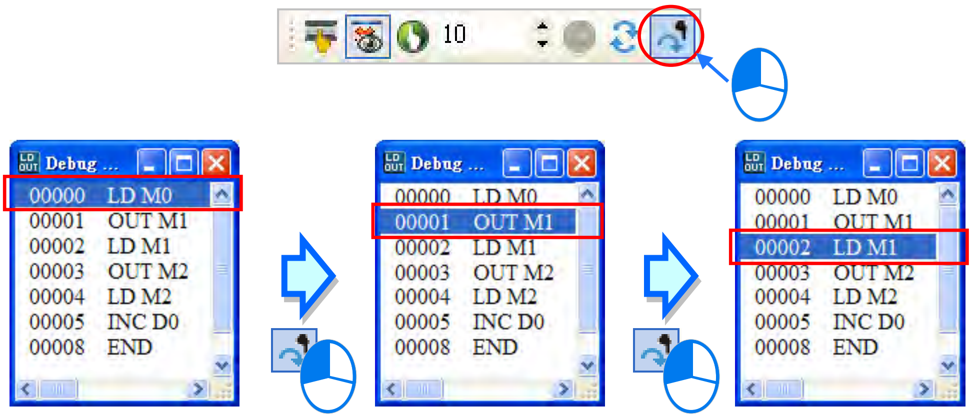
- **Continuous execution**

After  on the toolbar is clicked, the execution of the program will stop at a breakpoint. If users click  again, the execution of the program will continue, and will stop at the next breakpoint. If there are no breakpoints, the program will be scanned repeatedly after  clicked.



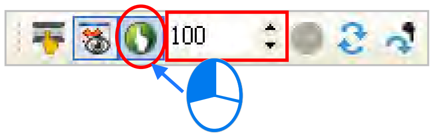
● **Single-step execution**

If the execution of the program stops, single-step execution will be performed after on the toolbar is clicked.



● **Setting the number of times the program is executed**

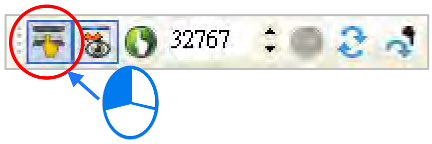
If the number of times the program is scanned reaches the number specified, the scan will stop. Besides, the scan of the program is not affected by the breakpoints in the program. Users have to set a number in 100 on the toolbar. The maximum number which can be set is 32767. Click on the toolbar after the setting is complete.



● **Stopping the execution of the program and resetting the execution order**

After users click on the toolbar, the execution of the program stops.

After on the toolbar is clicked, the execution order and the values will be reset. The execution of the program will start form the beginning of the program next time the program is executed.



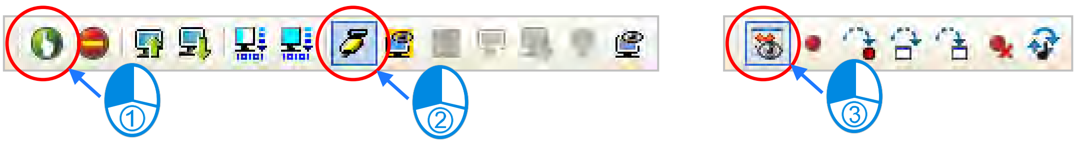
***. After the debugging mode for a DVP series PLC is enabled, the devices in the device monitoring table still can be monitored.**

18.3 Debugging Mode for AH / AS Series

18.3.1 Enter Debugging Mode

The debugging mode which ISPSoft provides for AH/AS series CPU modules supports all the programming languages. (Currently, when the AH560 Redundant System series synchronizes, it does NOT provide debugging mode.) However, the debugging functions can only be executed in the actions in a sequential function chart, and the steps to which the actions belong must be ON. Besides, if the state of a transition in a sequential function chart does not make the transition from one step to another step, users must change the state of the transition.

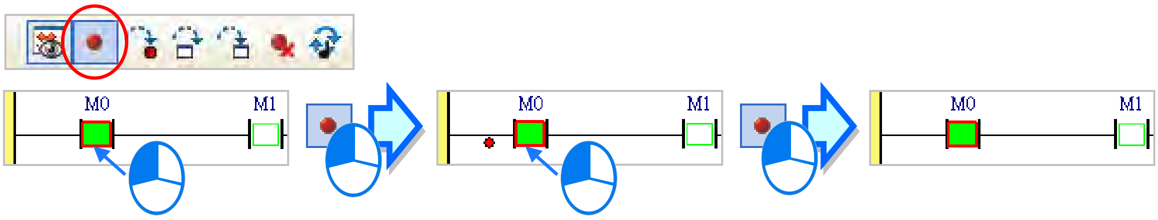
Click on the toolbar, click on the toolbar, and click on the toolbar.



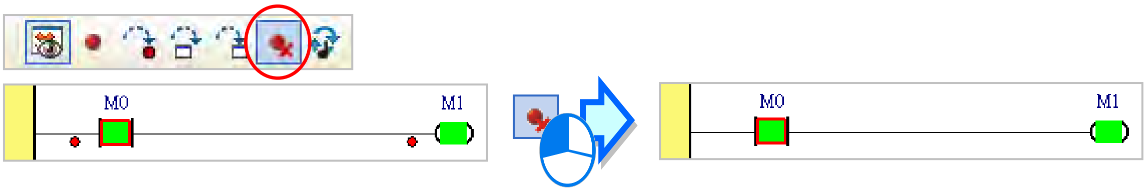
If the debugging mode is not enabled, but the CPU module is in the debugging mode, the debugging mode can not be enabled. (When the CPU module is in the debugging mode, **Debug** is displayed in the status bar in ISPSoft.) The reason is that the debugging mode was not disabled normally last time or another user on the network is debugging the program in the CPU module. If users want to reset the debugging mode, they must stop the CPU module, start the CPU module again, and enable the debugging mode.

18.3.2 Adding and Clearing Breakpoints

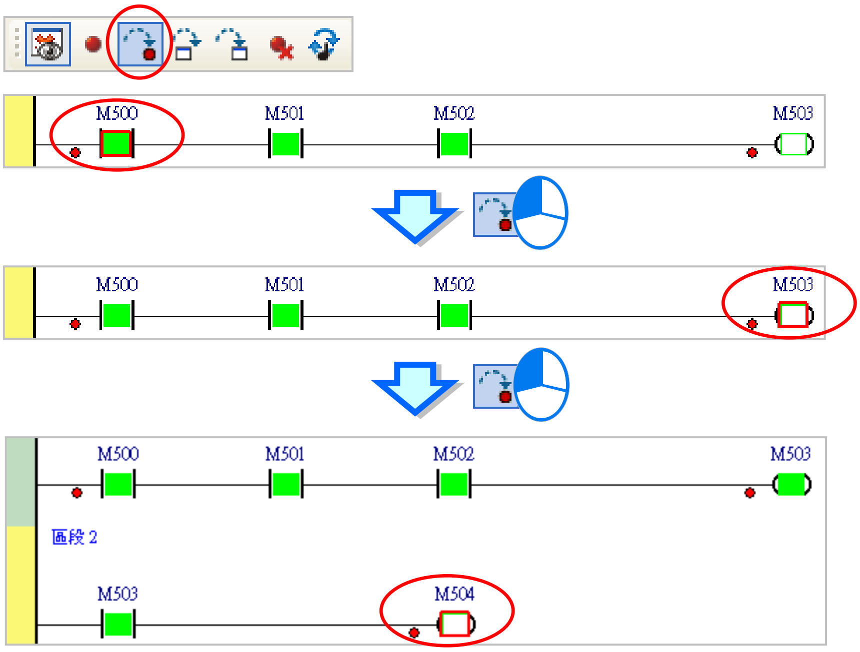
Ten breakpoints at most can be added to the program in a project for an AH500 series CPU module. After users click a position in a program editing window and click on the toolbar, a breakpoint will be added to the position. If the users click the position again and click on the toolbar, the breakpoint will be canceled.



If users want to clear all the breakpoints in the program in an AH500 series CPU module, they can click  on the toolbar.

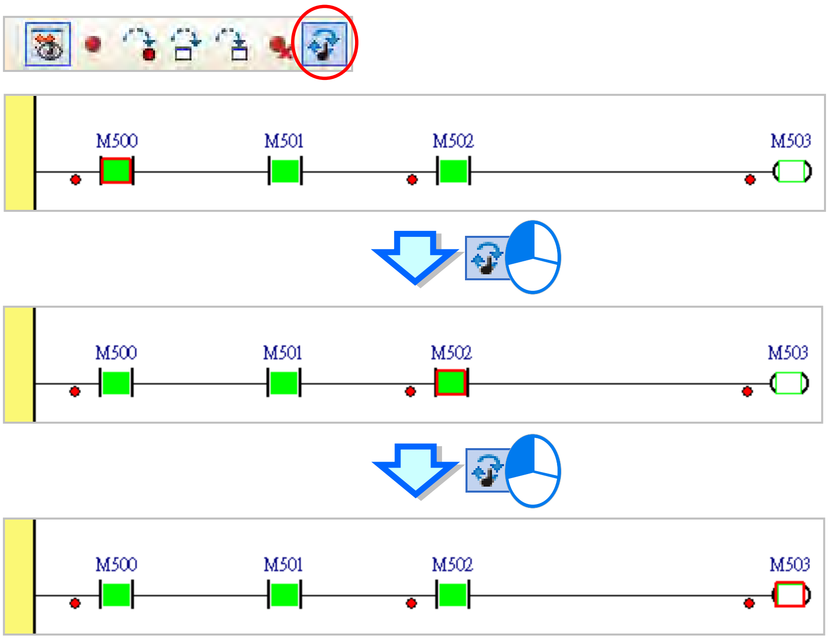


After  on the toolbar is clicked, the execution of the program will stop at a breakpoint. If users click  again, the execution of the program will continue, and will stop at the next breakpoint. The position where the execution of the program stops is the part of the program which has not been executed.



18.3.3 Continuous Execution

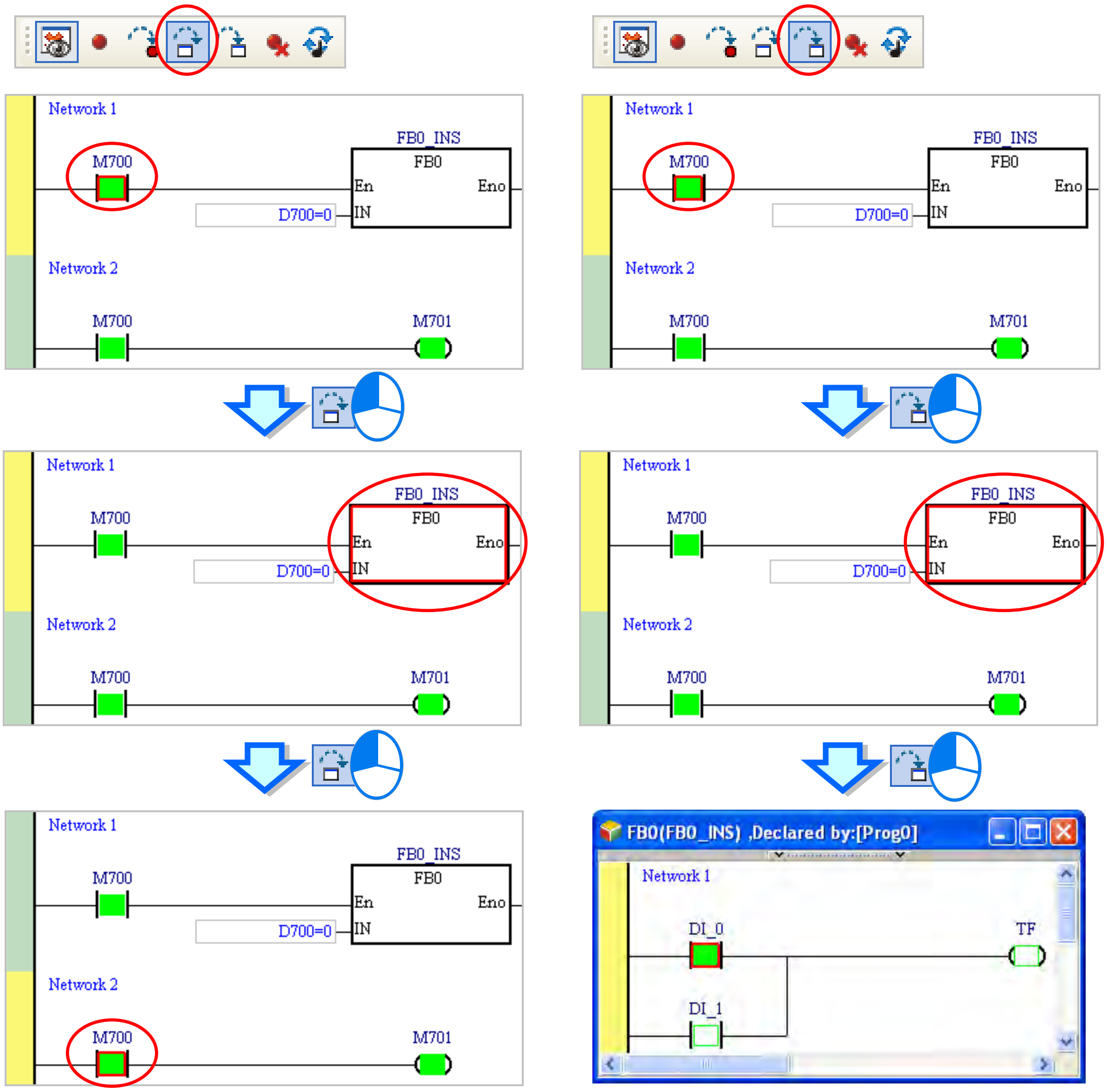
If on the toolbar is clicked, the execution of the program will stop at a breakpoint. If users click again, the execution of the program will continue, and will stop at the next breakpoint. If there are no breakpoints, the program will be scanned repeatedly after is clicked.



18.3.4 Single-Step Execution

After or on the toolbar is clicked, the part of the program selected will be executed. If a function block is selected, the function block will be executed after is clicked, and the first step in the function block will be executed after is clicked. However, if the function block selected is protected with a password, or the state of the En pin of the function block selected is OFF, the first step in the function block will not be executed whether or is clicked. Besides, if users want to perform single-step execution in a structured text, they must add breakpoints to the structured text. If users want to perform single-step execution in the POUs following a sequential function chart, they must add breakpoints to the POUs.

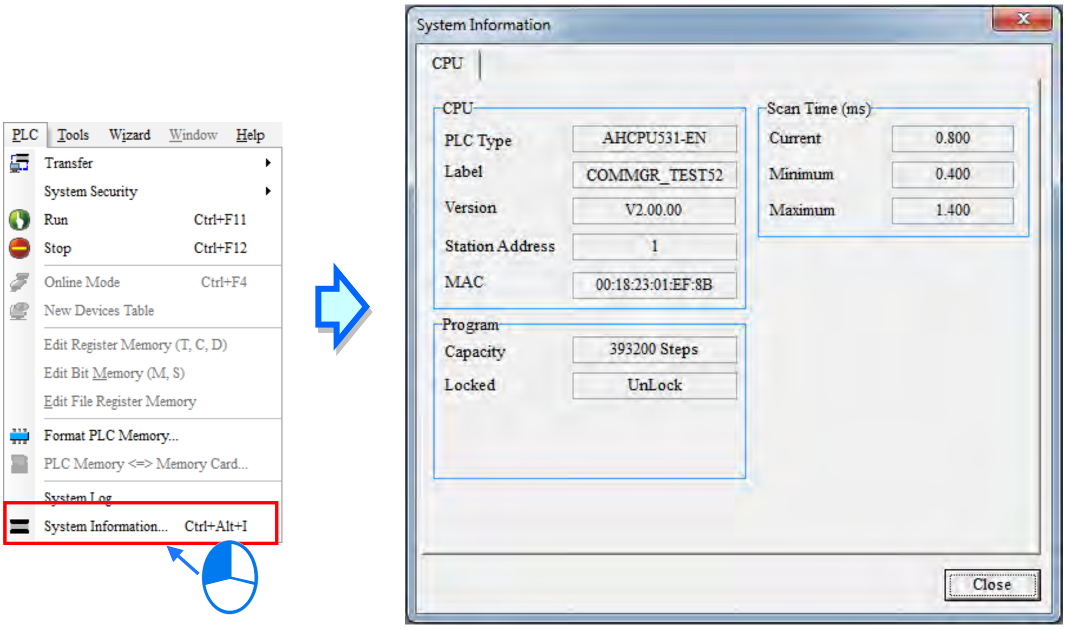
The different between and is shown below.

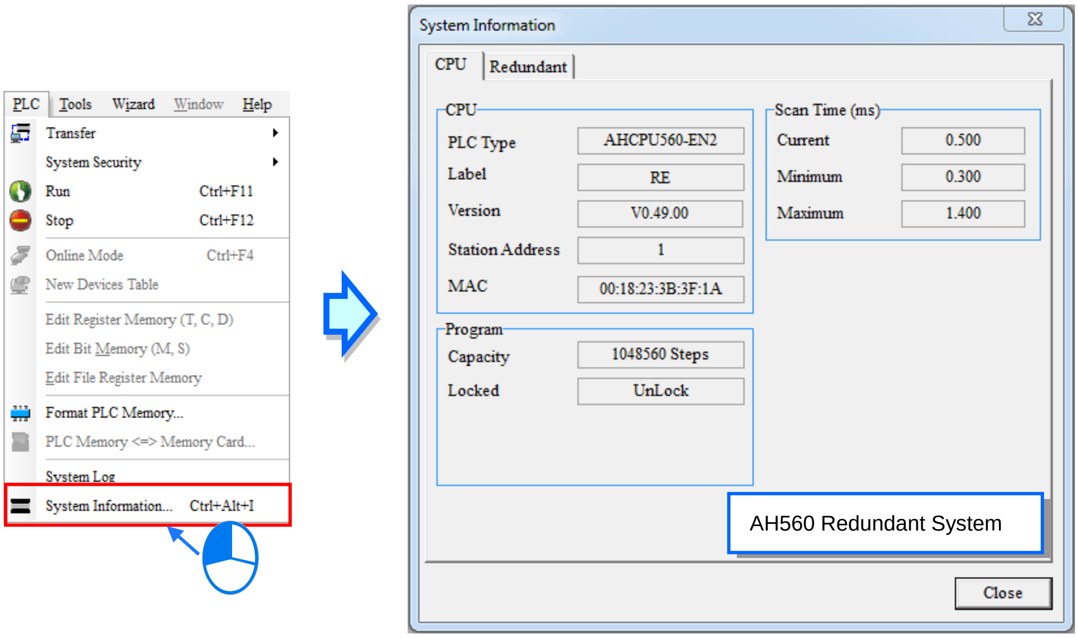

Network 1
FB0_INS
FB0
M700
En
Eno
D700=0
IN
Network 2
M700
M701
FB0(FB0_INS) ,Declared by:[Prog0]
Network 1
DI_0
TF
DI_1

18.4 Checking the Status of a PLC

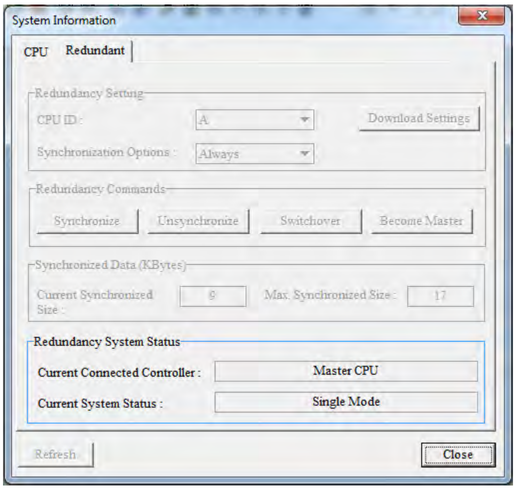
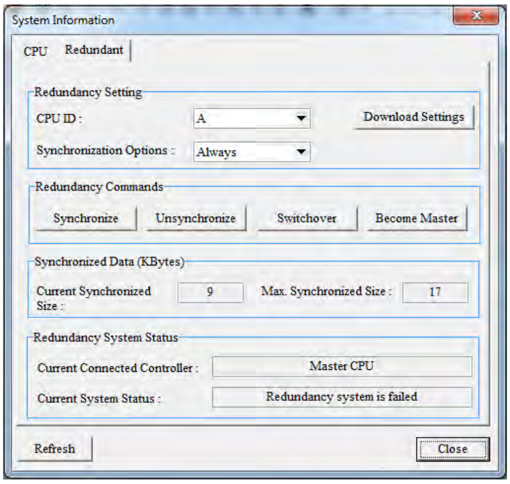
18.4.1 System Information

If ISPSoft is connected to the PLC normally, the system will retrieve information from the PLC after users click **System Information…** on the PLC menu. For AH560 redundant system series, a **Redundant** page is added.

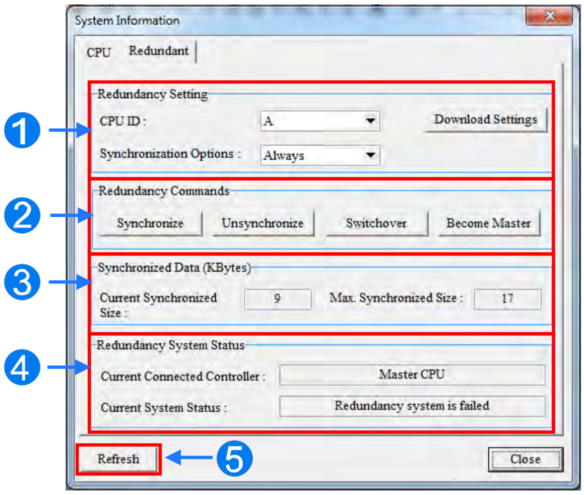




In **Redundant** page provides current redundant system status or related settings. The current system can only operate under **standby mode CPU;** only redundancy system status appears in **Control Mode** CPU (see below).

Control Mode CPU	Standby Mode CPU
	

Introducing Redundant page content:



❶ CPU ID: an id for A and B controller to check whether the controller is switched in the redundant system and uses API2901 RCS command for setting or reading.

Synchronization Options: contains ‘Always’ and ‘Condition’ which also allows users to check the redundant system and synchronization settings, please refer to related product manuals.

Download Settings: Finish setting CPU ID and Synchronization Options, users need to click this button to download to PLC hosts.

❷ **Synchronize**: triggers the master CPU to check the standby CPU and will only initiate synchronization under qualified standby CPU.

Unsynchronize: cancelling the standby CPU

Switchover: refers to switching controllers under qualified standby CPU.

Become Master: allows the standby CPU to become the master CPU when the master CPU does not exist.

❸ The section displays synchronized data in Current Synchronized Size and **Max. Synchronized Size (Kbytes)**, using special registers ‘SR18’ ~ ‘SR21’ for confirmation.

❹ **Current Connected Controller:** can connect to either a master CPU or a standby CPU

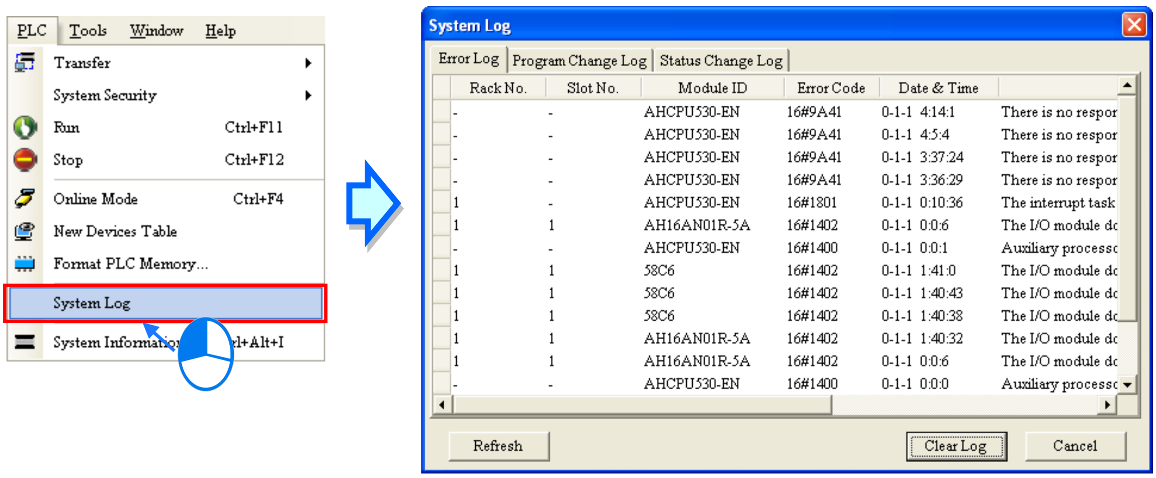
Current System Status: contains **Checking the redundancy system’, ‘Redundancy system is ready’, ‘Control mode CPU’, ‘Redundancy system is failed’ and ‘Disconnected with synchronous optical network’**.

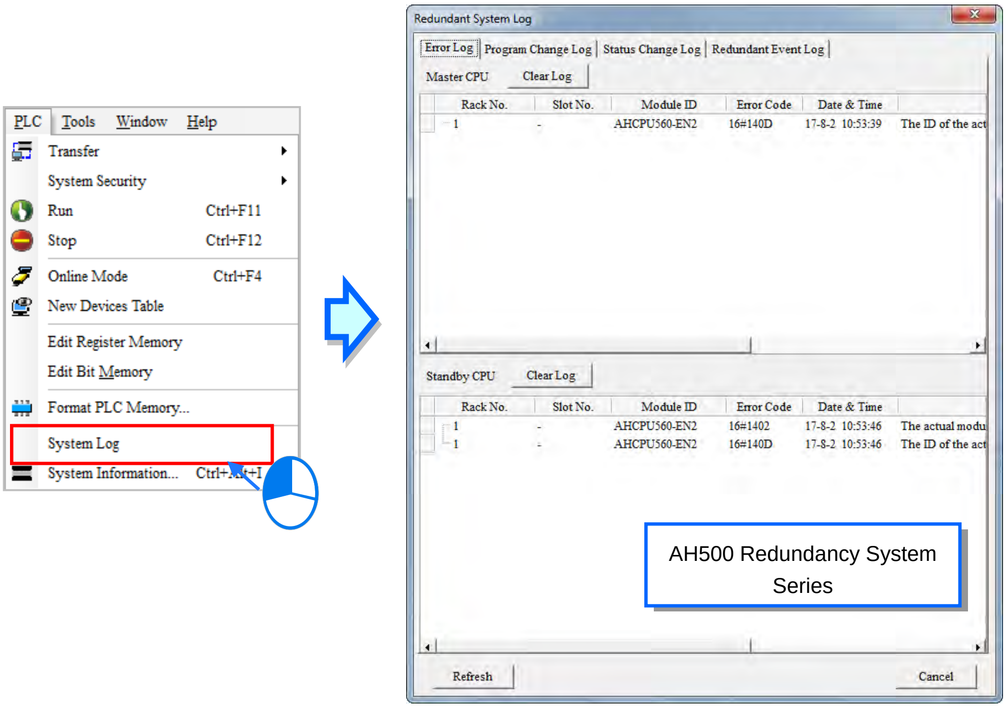
❺ **Refresh**: used to update all information in the Redundant page.

*. For more information containing AH560 redundant system series and **Redundant** page, please refer to related product manuals.

18.4.2 PLC System Log

Under normal connection with hosts, users can select **System Log** from the **PLC** menu to view logs regarding modification and errors; For AH560 redundant system, users can check the logs of both master and standby controllers, if no master or standby controller is detected, the display areas are in gray color. The **System Log** page contains several pages and can use the labels on top to switch to different functions. The data in system log is not updated in real-time, but users can click **Refresh** to update.

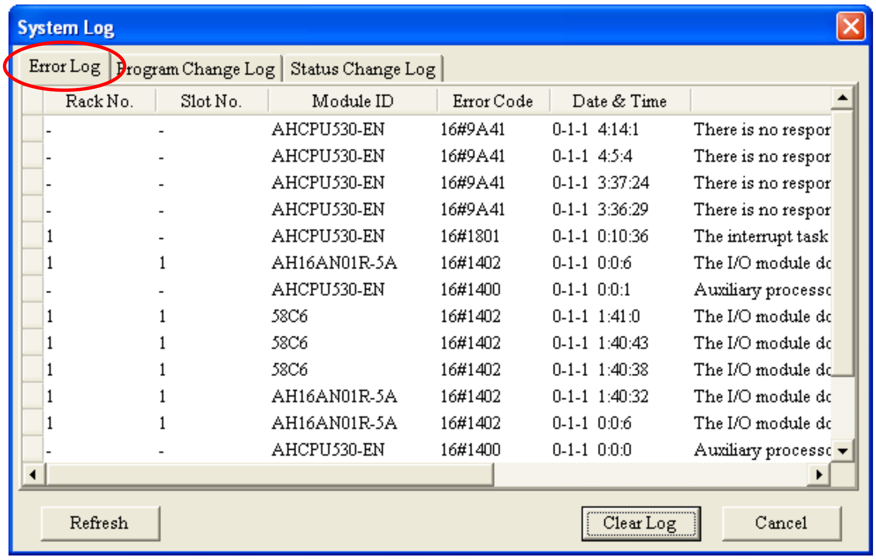


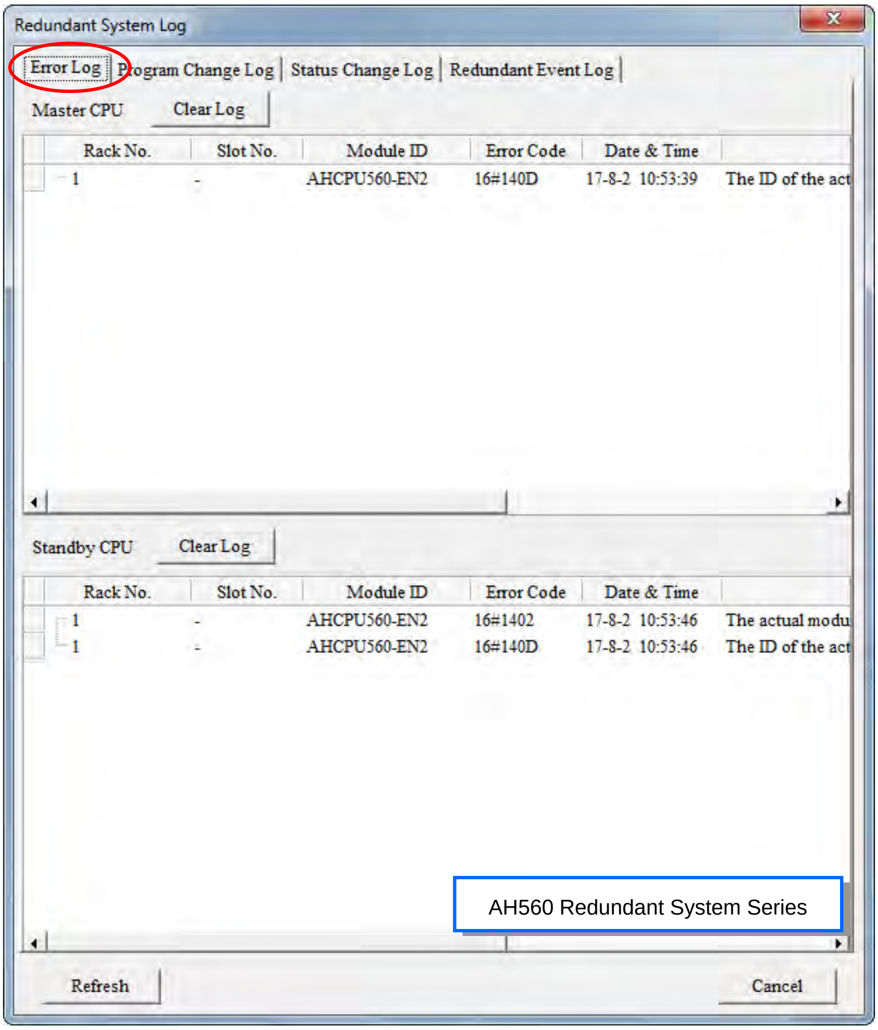


● **Error Log**

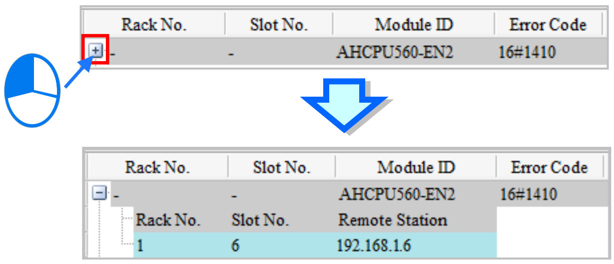
Users can view hosts and all modules error codes, date & time as well as error description. In addition, it will also contain the error module ID and backplane no. as well as slot no.

When users click **Refresh**, the system will retrieve data from the host and update the data in the log; click **Clear Log,** to clear the table and internal host error log as well as reset the host error status. But, when the error reason still exists, the host remains in error status and new error log is formed.

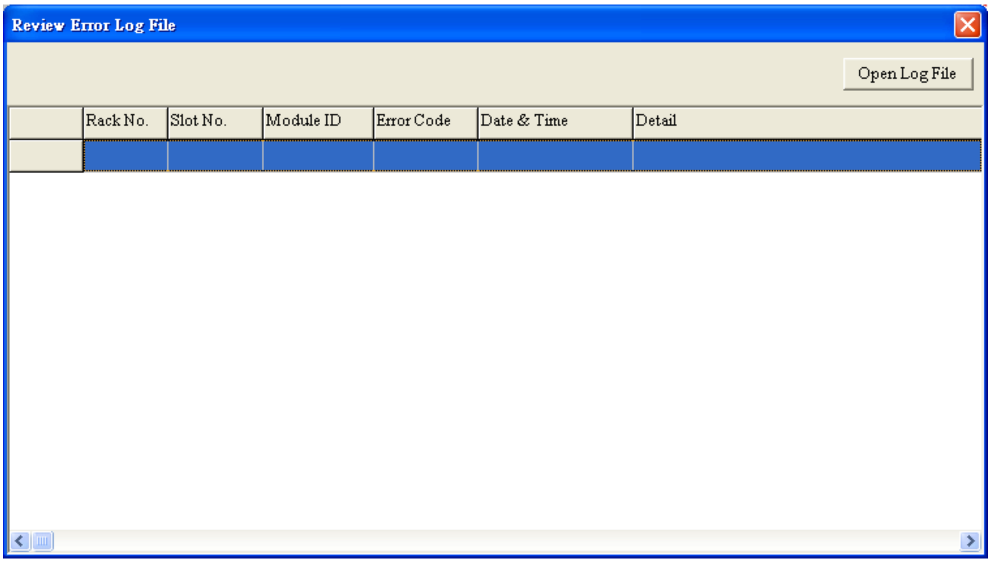




When the CPU module is connected to a remote module, users can click ⊞ to view the remote module's rack no., slot no. and RTU remote IP address from the error logs.

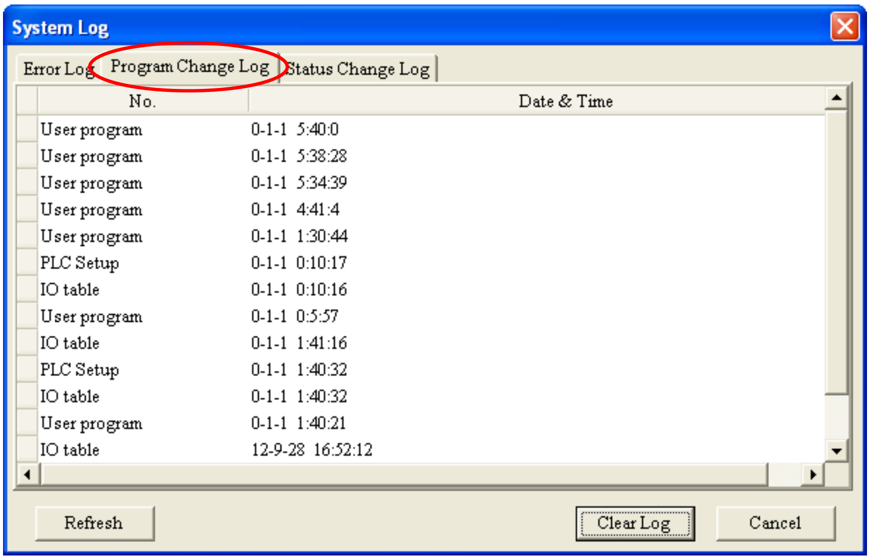


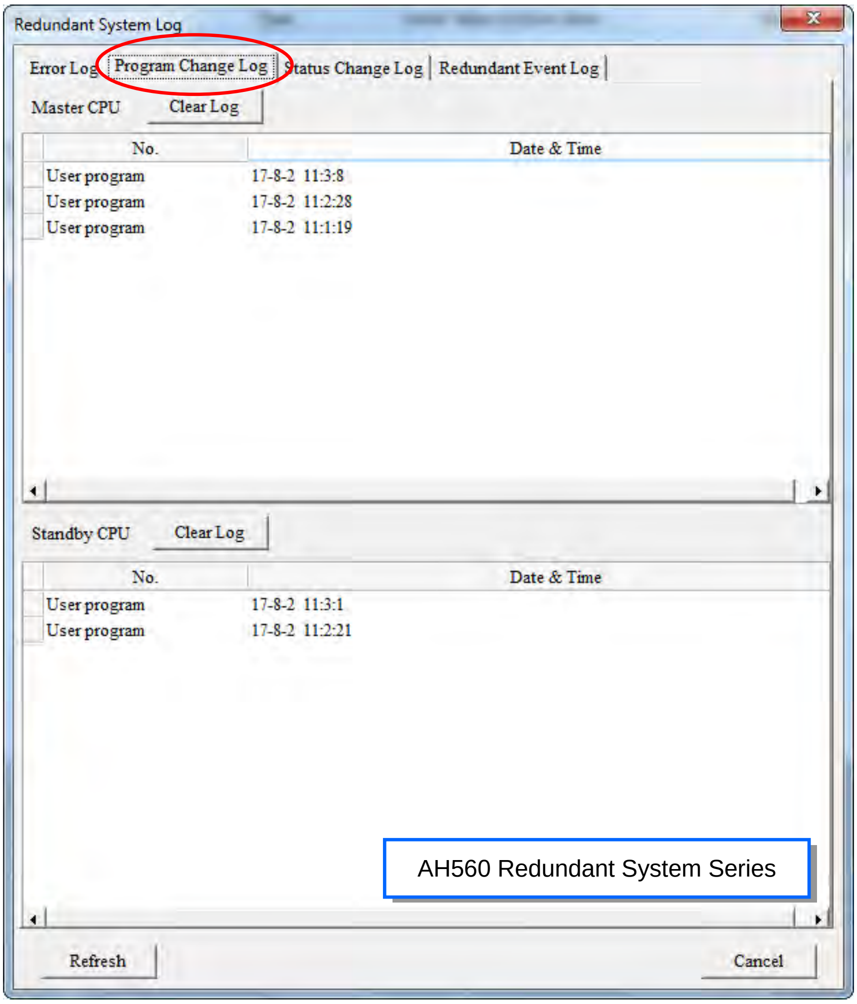
Error logs can be stored in the SD card and then the logs can be moved to the PC for better management. Refer to character 3 for more information on how to save error logs to the SD card. After that users can go to Tools > Review Error Log File and press **Open Log File** to select the path where the error log saved to see the contents of the error log.



● **Program Change Log**

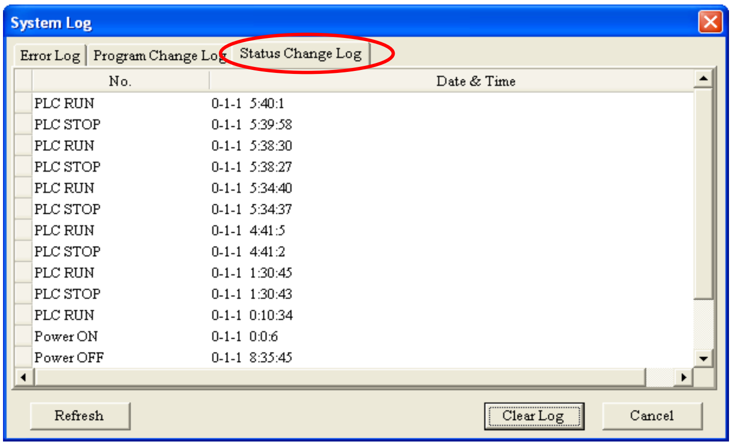
After users click the **Program Change Log** tab, they can view the log related to the downloading/uploading of programs and parameters. After users click **Refresh**, the system will retrieve data from the CPU module, and the data displayed in the window is updated. After users click **Clear Log**, the program change log in the pop-up window and the program change log in the CPU module is cleared.

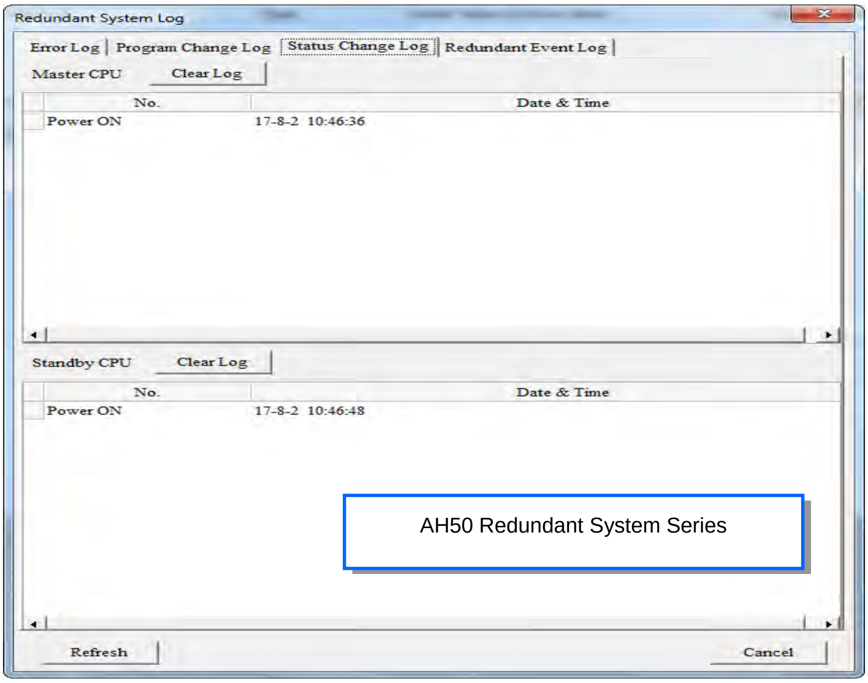




- **Status Change Log**

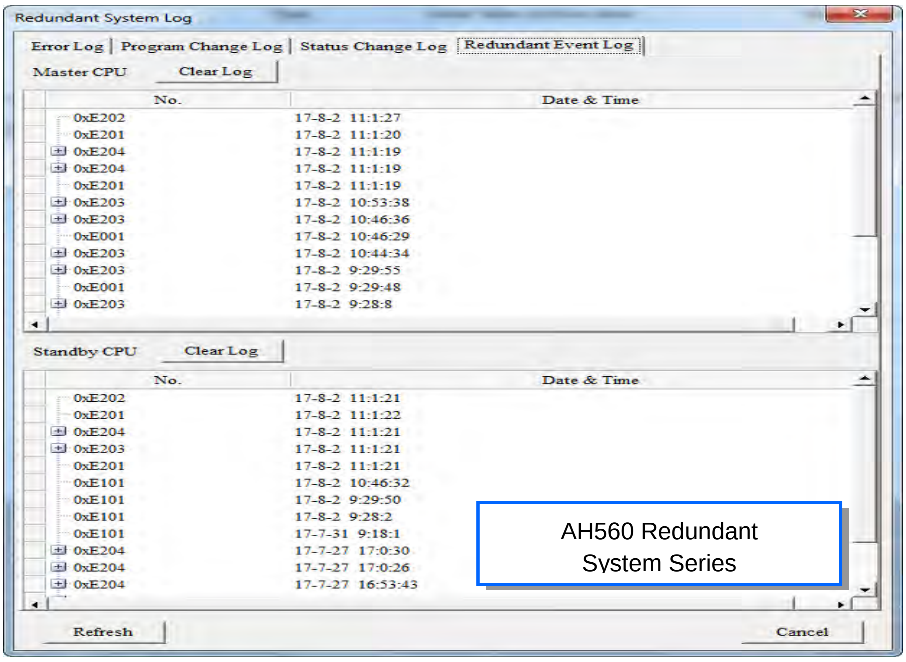
After users click the Status Change Log tab, they can view the log related to the change of the status of the CPU module. After users click **Refresh**, the system will retrieve data from the CPU module, and the data displayed in the pop-up window isupdated. After users click **Clear Log**, the status change log in the pop-up window and the status change log in the CPU module is cleared.





● **Redundant Event Log**

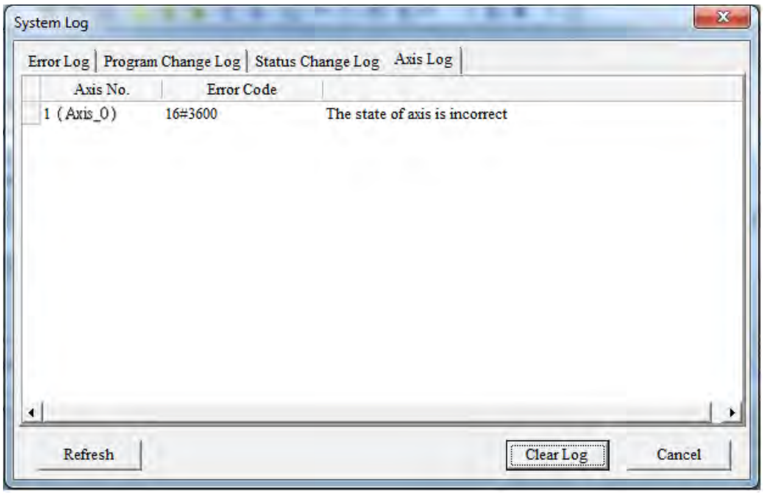
The tab displays redundant event logs of the master and standby CPU. After users click **Refresh**, the system will retrieve data from the master and standby CPUs, and the data displayed in the pop-up window is updated. After users click **Clear Log** in the master CPU, the redundant event log in the pop-up window and the redundant event log in the master CPU is cleared; if users click Clear Log in the standby CPU, the redundant event log in the pop-up window and the redundant event log in the standby CPU is cleared.



*. The redundant event log only supports the AH560 redundant system series.

● **Axis Log**

After users click the Axis Log tab (the axis number and the axis name inside the bracket are shown in the Axis. No column), they can view the log related to the axis. After users click **Refresh**, the system will retrieve data from the CPU module, and the data displayed in the window is updated. After users click **Clear Log**, the axis log in the window and the axis log in the CPU module is cleared.



***.Axis log is only available for AHxxEMC.**

18.5 3D Chart

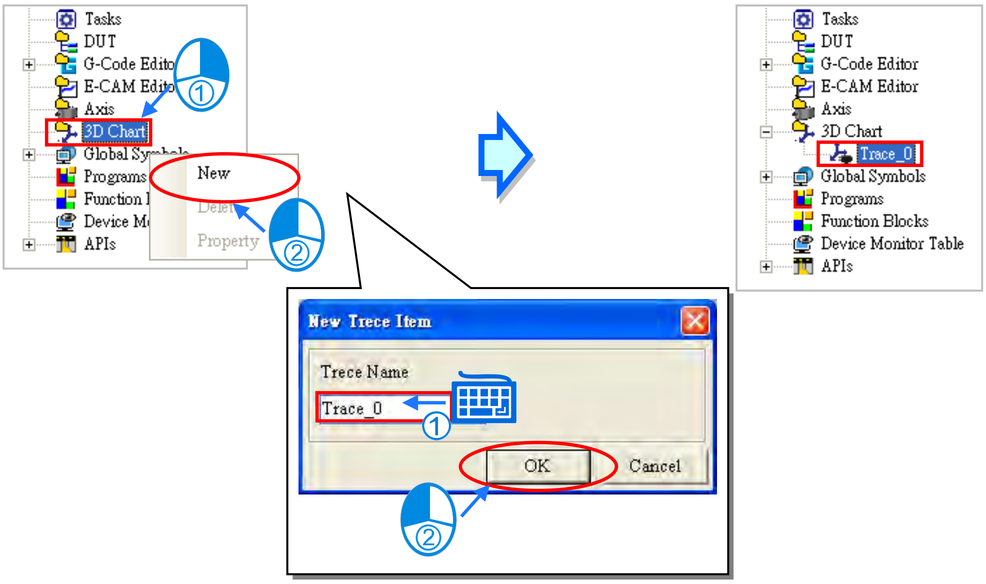
18.5.1 Features

During the operation of the multi-axis interpolation in the monitoring mode, users can use the 3D chart to see the motion traces, variables and devices, providing a way to check the accuracy of the motion and a way to analyze the value trend.

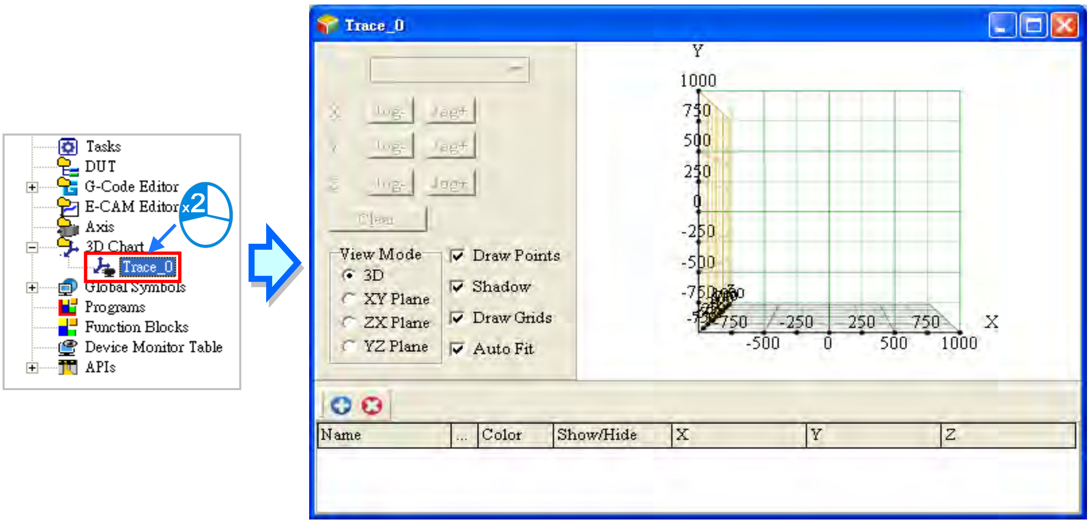
***. This function is only available for AHxxEMC.**

18.5.2 Creating a 3D Chart

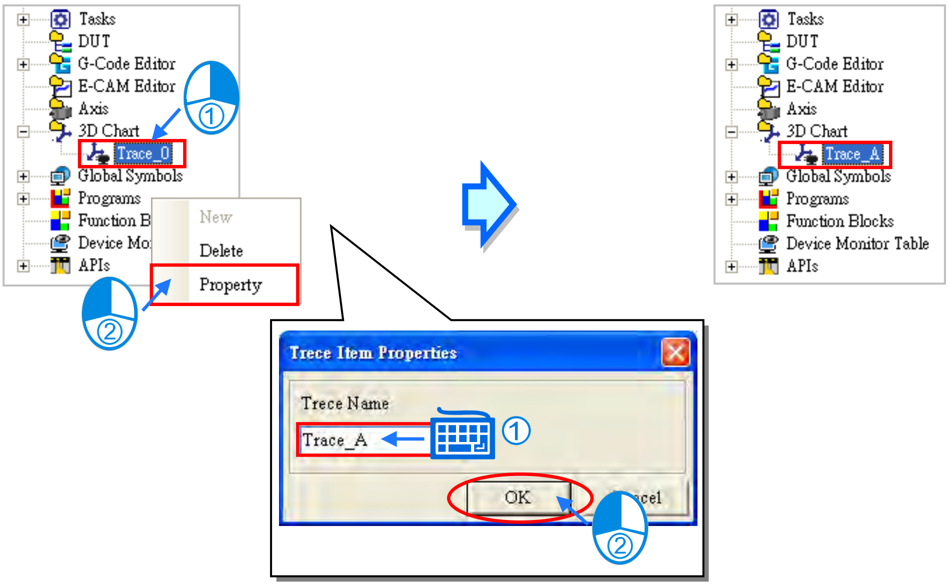
Right-click the **3D Chart** in the project management area and then click **Add** to bring out a New Trace Item window, type the trace name in the field to create a trace. One project can add up to 10 sets of 10 traces.



Once a trace is created, the 3D chart window will show up automatically. Users can also find it under the option 3D Chart and double click it to open its editing window.

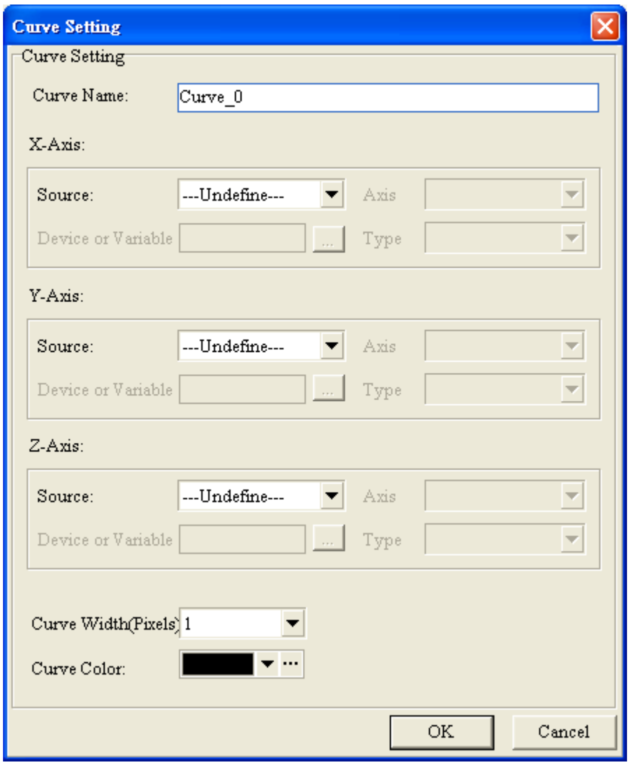


Right-click the created trace, users can use the options to delete or click Property to rename the selected trace.

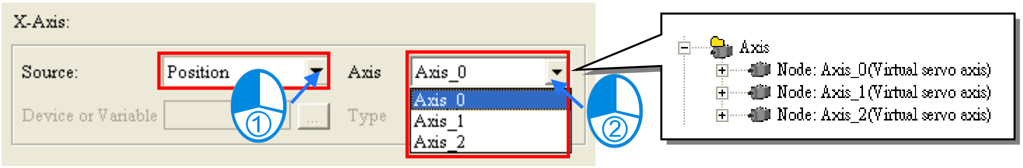


18.5.3 Creating a Curve

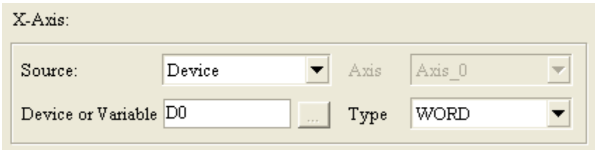
Click the button on the 3D chart editing page to bring out a Curve Setting page.



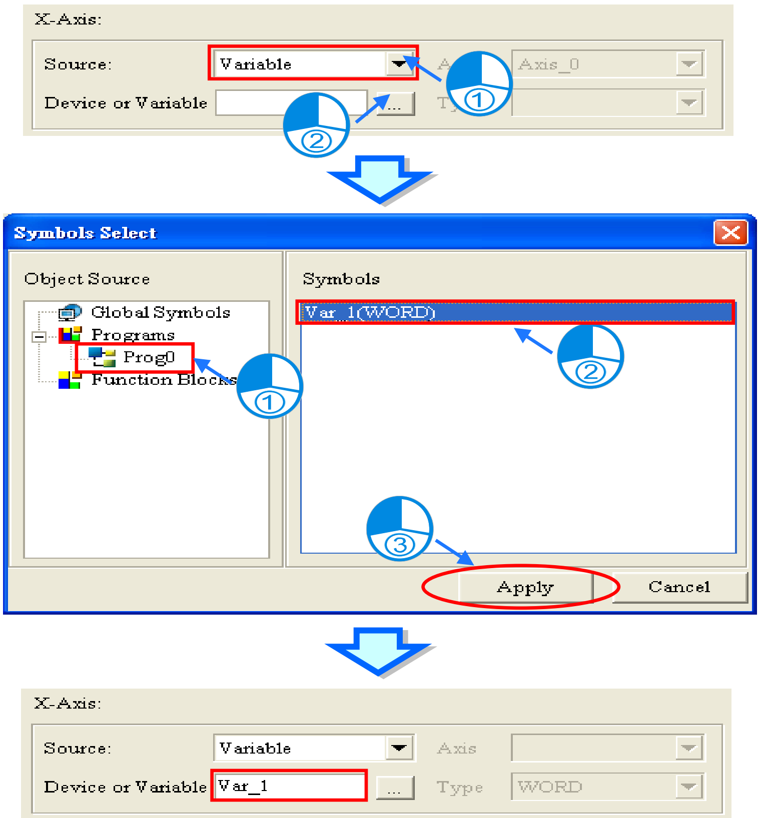
Type a name for the new curve and define the sources and other related settings for the X-, Y-, Z- axes. Setting the source to Position or Speed for the axes means the data of the 3D chart is from the positon or speed of the axes. Users can use the drop-down list to select the created axes. When the PLC runs the motion control program, the positon or speed of the set axis can be monitored in real time.



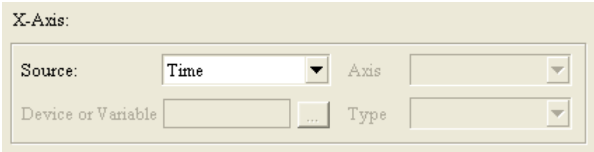
Setting the source to Device for the axes means the data of the 3D chart is from the device of the axes. Users can use the drop-down list to select the created device address and select the type. When the PLC runs the program, the address and type of the device of the set axis can be monitored.



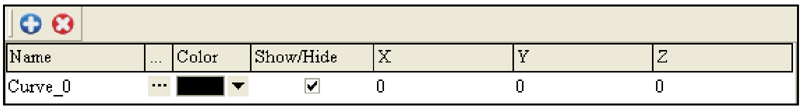
Setting the source to Variable for the axes means the data of the 3D chart is from the variable of the axes. Users can use the … to open a Symbol Select page and select the created variable from the Symbols section. The system will bring in the suitable type automatically.



Setting the source to Time for the axes means the data of the 3D chart is from the time of the axes and the value of axes will be increased by 1 every second.

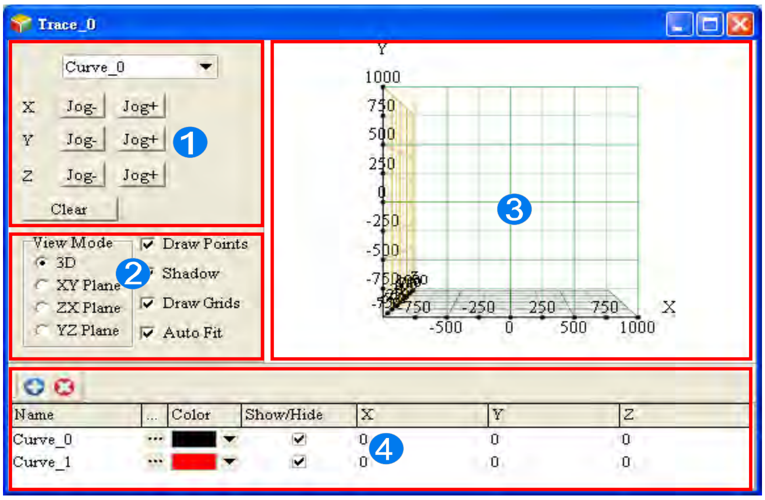


Set up the width and the color for the curve and then click **OK** on Curve Setting page to complete the creation of a curve. After that the created curve will be listed below the 3D chart. Click to select a curve you'd ike to edit. Click to delect the selected or click … to open the curve set up page and set up again. Use the drop-down list to change the color of the selected curve and select or deselect the checkbox to show or hide the curve on the 3D chart. Up to 10 curves can be added on one 3D chart.



18.5.4 Display a 3D Chart

Follow the procedures aforementioned to download program and complete the monitoring setups. After a 3D chart is created, make sure the motion control CPU is connected to your computer and then the 3D chart will be displayed.



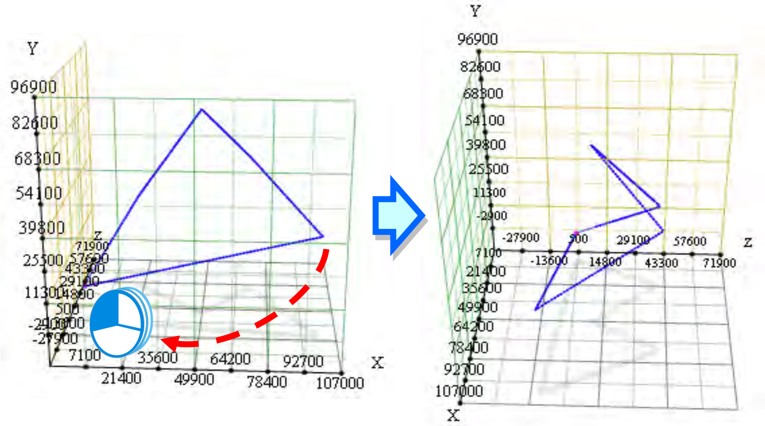
1. To edit a created curve, users can use the drop-down list on the area 1 or click to select a curve from the list4. After selection, click Jog- and Jog+ to edit the curve or click Clear to delete the selected curve.

❷ Use options in the View Mode section to change the view of the chart; selections are 3D, XY Plane, ZX Plane and YZ Plane. Other view options include to show or not to show the Draw Points, Shadow, Draw Grids and Auto Fit. When Auto Fit is selected, the display area will auto adjust the X, Y, Z axes according to the traces to fit the screen.

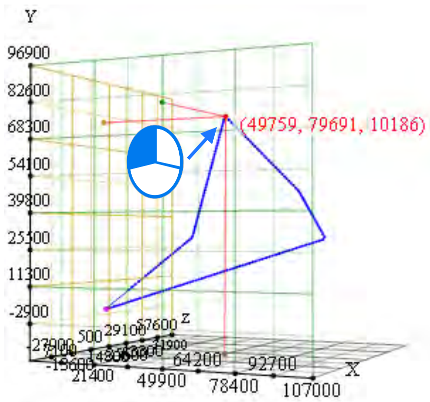
❸ 3D chart display area.

❹ List of the curves created.

Users can use click and drag the trace on the 3D chart to see the chart from different angles. Use the mouse wheel to scroll and adjust the scale of the chart.



Move the cursor pointer to the trace on the 3D chart and it will show its coordinates, as the image shown below.



18

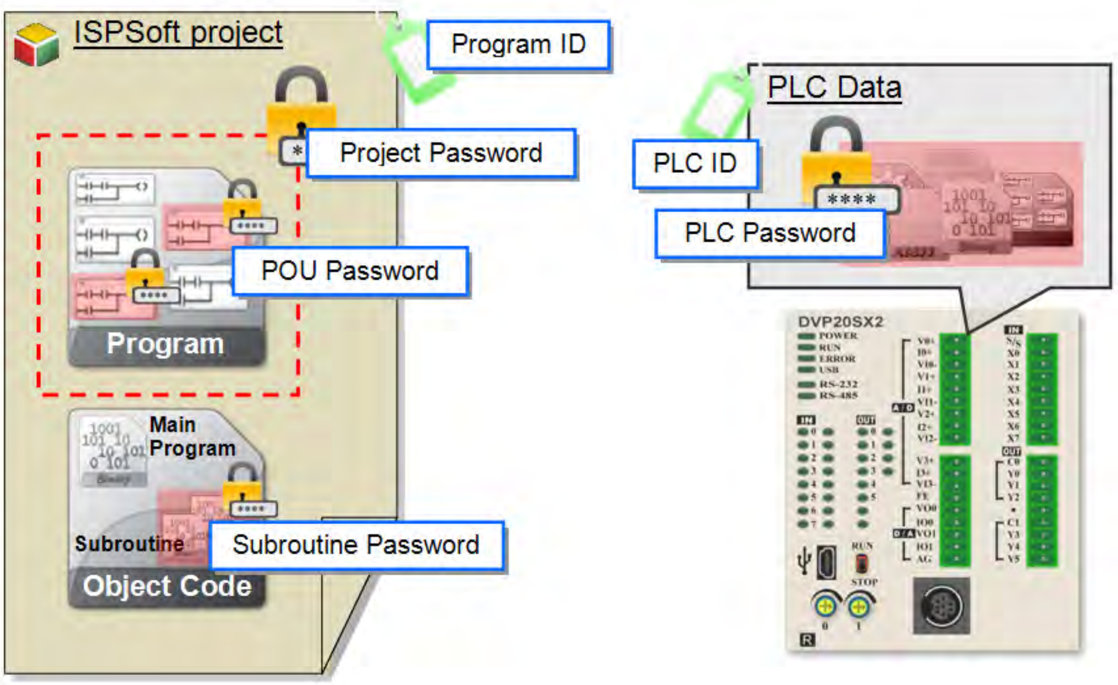
MEMO

Chapter 19 Password Management and Data Protection

Table of Contents

19.1 Password Protection Mechanisms Provided by ISPSoft

To protect the programs or the core techniques developed by users, ISPSoft provides multiple protection mechanisms for the projects developed by the users. The password protection mechanisms provided by ISPSoft are shown below. Users can set or unlock the passwords, and adopt different data protection mechanisms according to their needs.



Password type		Description	AS/AH AS5xx DVPxxMC	DVP
ISPSoft project	Program ID	This is the first authentication information which needs to be checked on. If users want to download a project to a PLC, the program ID set in the project must be the same as the PLC ID set in the PLC. A specific project can only be downloaded to a specific PLC.	4~16 characters	4~8 characters
	Project password	The project password set in a project is used to protect the program in the project. If users want to open the POUs in a project protected by a project password, the system will require the users to type the correct password.	4~16 characters	4 characters

Password type		Description	AS/AH AS5xx DVPxxMC	DVP
	POU password	The POU password set in a POU is used to protect the POU. Users can set a password in a POU to protect the source code or the core technique in the POU.	4~16 characters	4~16 characters
	Subroutine password	A subroutine password set in a subroutine is used to protect the subroutine. It prevents the programs in the function blocks from being analyzed after the programs are uploaded.		4~8 characters
	Settings Password	The password is used to protect all design data. Different PLC types provides design tools and password protection, including E-CAM and Position Planning Table password introduced in each chapter.	4~16 characters	
PLC	PLC ID	This is the first authentication information which needs to be checked on. If users want to download a project to a PLC, the program ID set in the project must be the same as the PLC ID set in the PLC. A specific project can only be downloaded to a specific PLC.	4~16 characters	4~8 characters
	PLC password	The PLC password set in a PLC is used to protect the data in the PLC. If users want to download the data protected by a PLC password to a PLC, or upload the data protected by a PLC password from a PLC, they have to type the correct password.	4~16 characters	4 characters

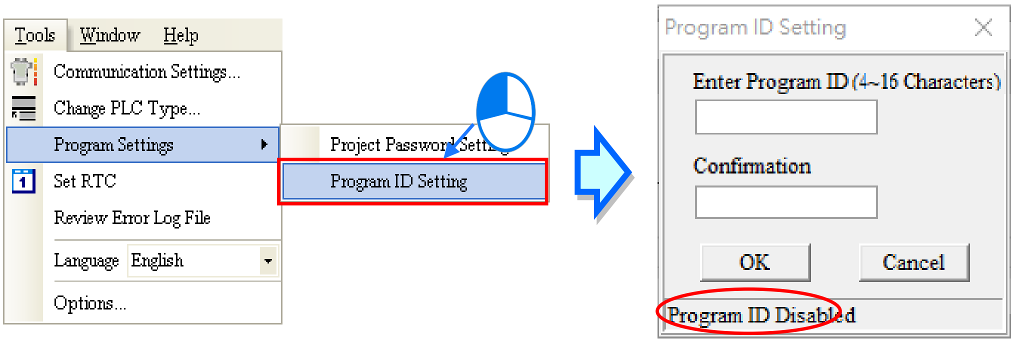
19.2 Program ID and PLC ID

An ID is the first authentication information which needs to be checked on. If users want to download a project to a PLC, the program ID set in the project must be the same as the PLC ID set in the PLC. The project which is protected by a program ID can only be downloaded to a specific PLC, and the PLC ID set in the PLC must be the same as the program ID.A specific project can only be downloaded to a specific PLC.

If users want to upload a project to a PLC protected by a PLC ID, the system will ask the users to type the correct ID before the project is uploaded. If users want to open a project protected by a program ID, the system will ask the users to type the correct ID before the project is opened. As a result, an ID is used for access approval to gain access to data.

19.2.1 Setting and Unlocking a Program ID

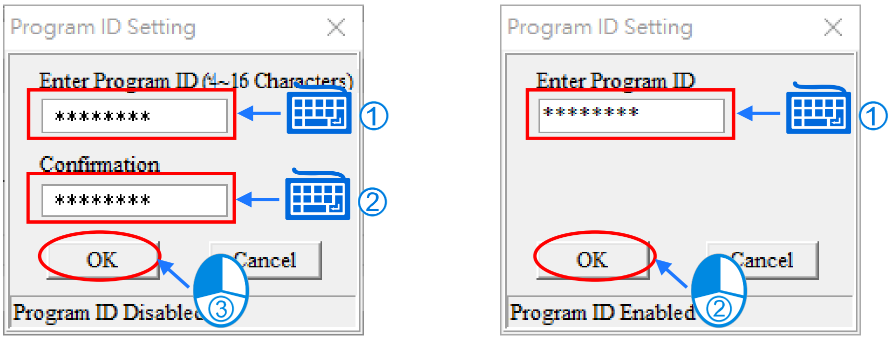
After users click the **Tools** menu, point to **Program Settings**, and click **Program ID Setting**, the **Program ID Setting** window will appear. The message at the bottom of the window indicates whether the project is protected by a program ID.



If the project is not protected by a program ID, there will be two boxes used to set a program ID in the **Program ID Setting** window. If the users want to set a program ID, they have to type the same password in the two boxes, and click **OK**.

If the project is protected by a program ID, there will be one box used to unlock the program ID in the **Program ID Setting** window. If the users want to unlock the program ID, they can type the correct ID in the box, and click **OK**.

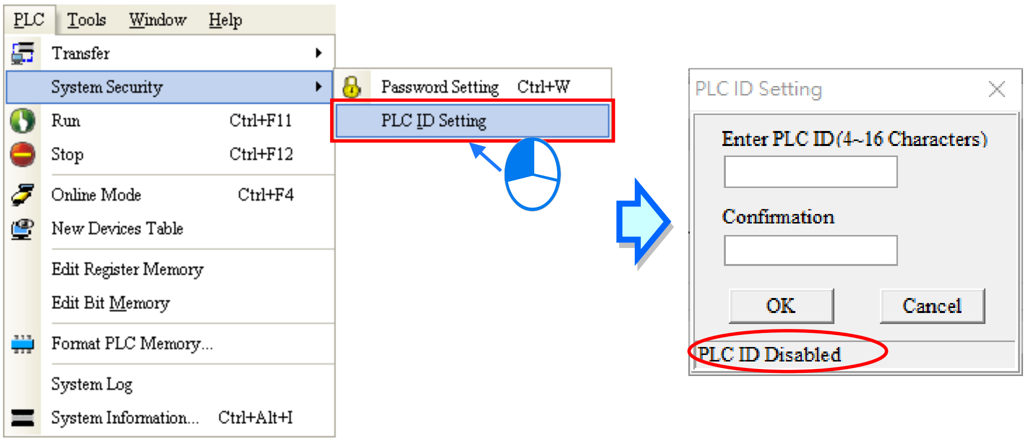
If the users want to set a program ID, they can only type English letters, numerical digits, and spaces in the window. A program ID is case-sensitive. Besides, the limit on the number of characters which can be typed depends on the model selected. The users have to type a program ID according to the hint in the window. After the users set a program ID, the project will be protected by the program ID. The window will be closed after the users click **Cancel**.



19.2.2 Setting and Unlocking a PLC ID

To set a PLC ID, please make sure that ISPSoft and PLC host is connected.

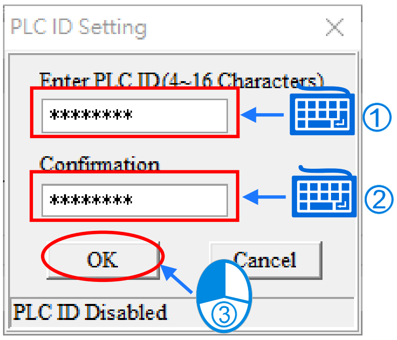
After users click the **PLC** menu, point to **System Security**, and click **PLC ID Setting**, ISPSoft will connect to the PLC, and read the information from the PLC. If the reading of the information from the PLC is successful, ISPSoft will open the **PLC ID Setting** window. The message at the bottom of the window indicates whether the PLC is protected by a program ID.

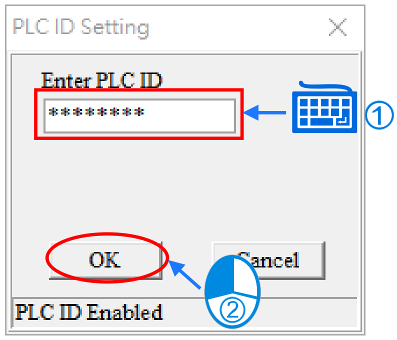


If the PLC is not protected by a PLC ID, there will be two boxes used to set a PLC ID in the **PLC ID Setting** window. If the users want to set a PLC ID, they have to type the same password in the two boxes, and click **OK**.

If the PLC is protected by a PLC ID, there will be one box used to unlock the PLC ID in the **PLC ID Setting** window. If the users want to unlock the PLC ID, they can type the correct ID in the box, and click **OK**.

If the users want to set a PLC ID, they can only type English letters, numerical digits, and spaces in the window. A PLC ID is case-sensitive. Besides, the limit on the number of characters which can be typed depends on the model selected. The users have to type a PLC ID according to the hint in the window. After the users set a PLC ID, the PLC will be protected by the PLC ID. The window will be closed after the users click **Cancel**.





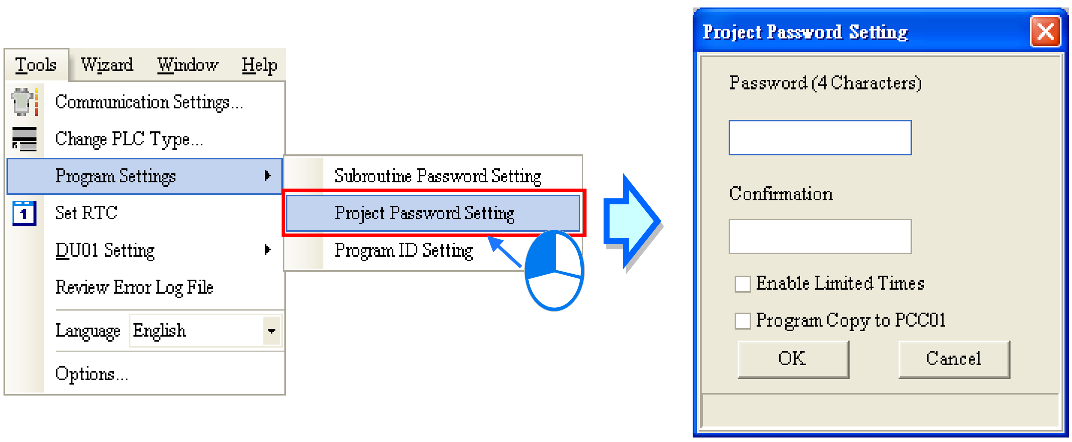
19.3 Project Password and PLC Password

The project password set in a project is used to protect the program in the project. If users want to open the POUs in a project protected by a project password, the system will require the users to type the correct password. Besides, the users can limit the total number of password guesses that can be made. If the number of password guesses that is made is larger than the total number of password guesses that can be made, the project will be closed automatically.

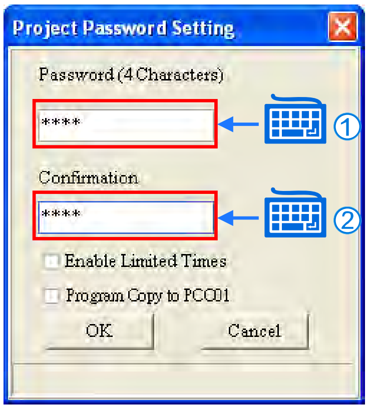
The PLC password set in a PLC is used to protect the data in the PLC. If users want to download or upload a project, the system will ask the users to type the correct password. Besides, the users can limit the total number of password guesses that can be made. If the number of password guesses that is made is larger than the total number of password guesses that can be made, the PLC will be locked, and the data can not be downloaded/uploaded. To unlock the PLC, the users have to restore the PLC to the default setting.

19.3.1 Setting and Unlocking a Project Password

After users click the **Tools** menu, point to **Program Settings**, and click **Project Password Setting**, the **Project Password Setting** window will appear. The message at the bottom of the window indicates whether the project is protected by a project password. If the project opened is a project for a DVP series PLC, the **Program Copy to PCC01** checkbox will appear in the **Project Password Setting** window.

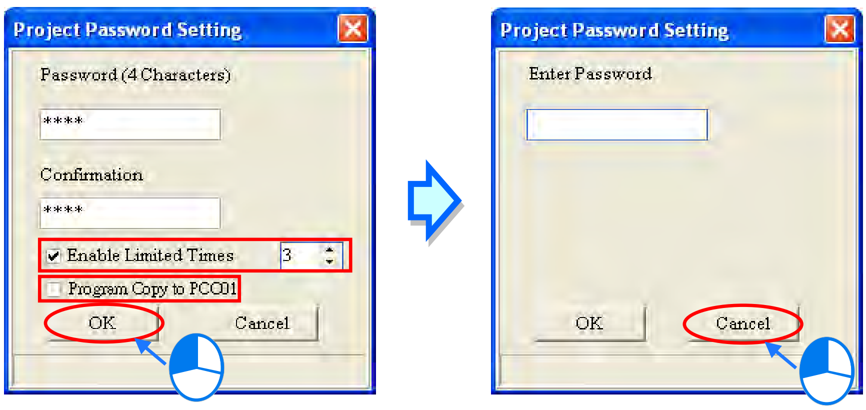


If the project is not protected by a project password, there will be two boxes used to set a project password in the **Project Password Setting** window. If the users want to set a project password, they have to type the same password in the two boxes, and click **OK**. The users can only type English letters, numerical digits, and spaces in the window. A project password is case-sensitive. The limit on the number of characters which can be typed depends on the model selected. The users have to type a project password according to the hint in the window.

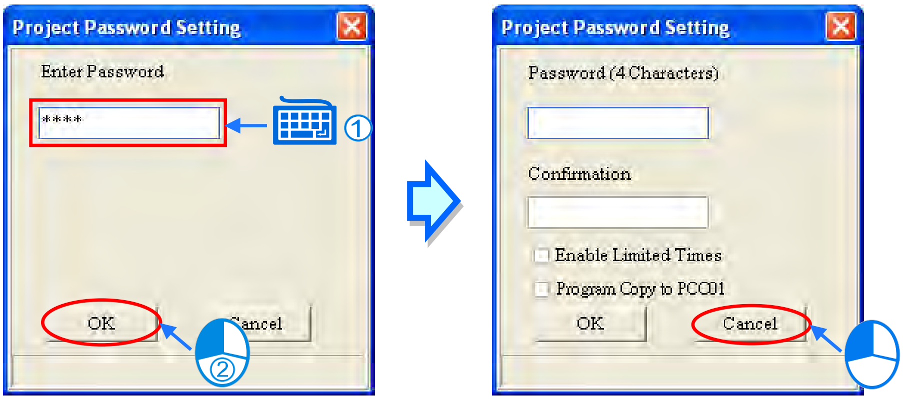


If the users want to limit the total number of password guesses that can be made, they can select the **Enable Limited Times** checkbox, and select a number in the box at the right side of the checkbox. If users want to copy the program into DVPPCC01, they can select the **Program Copy to PCC01** checkbox. (Please refer the additional remark below for more information.)

After the users set a project password, the project will be protected by the project password. The window will be closed after the users click **Cancel**.



If the project is protected by a project password, there will be one box used to unlock the project password in the **Project Password Setting** window. If the users want to unlock the project password, they can type the correct password in the box, and click **OK**. After the project password is unlocked successfully, the project will not protected by the project password. The window will be closed after the users click **Cancel**.

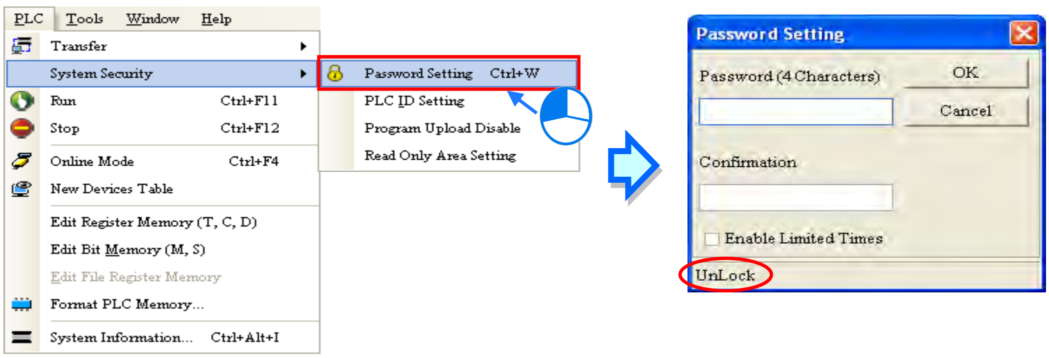


Additional remark

DVPPCC01 is a data backup memory card for DVP series PLCs. If the **Program Copy to PCC01** checkbox in the **Project Password Setting** window is selected, the PLC connected to ISPSoft will be in a status after the project is downloaded to the PLC. If DVPPCC01 is inserted into the PLC when the PLC is in that status, the project downloaded to the PLC will be backed up onto DVPPCC01. However, if the PLC receives another communication command before DVPPCC01 is inserted, the program will not be copied into DVPPCC01. This function supports DVP-ES2 series PLCs. Please refer to the related user manuals or technical documents for more information about the firmware versions which support this function and the usage of DVPPCC01.

19.3.2 Setting and Unlocking a PLC Password

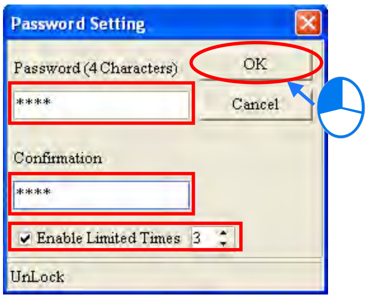
Before users set a PLC password, they have to make sure that ISPSoft is connected to the PLC normally. After users click the **PLC** menu, point to **System Security**, and click **Password Setting**, ISPSoft will connect to the PLC, and read the information from the PLC. If the reading of the information from the PLC is successful, ISPSoft will open the **Password Setting** window. The message at the bottom of the window indicates whether the data in the PLC is protected by a PLC password.

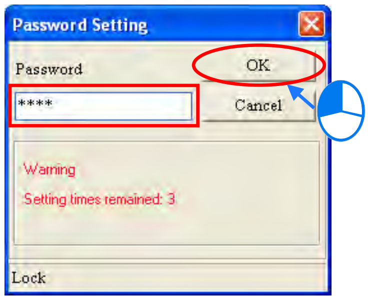


If the data in the PLC is not protected by a PLC password, there will be two boxes used to set a PLC password in the **Password Setting** window. If the users want to set a PLC password, they have to type the same password in the two boxes, and click **OK**. If the users want to limit the total number of password guesses that can be made, they can select the **Enable Limited Times** checkbox, select a number in the box at the right side of the checkbox, and click **OK**.

If the data in the PLC is protected by a PLC password, there will be one box used to unlock the PLC password in the **Password Setting** window. If the users want to unlock the PLC password, they can type the correct password in the box, and click **OK**.

The users can only type English letters, numerical digits, and spaces in the window. A PLC password is case-sensitive. The limit on the number of characters which can be typed depends on the model selected. The users have to type a project password according to the hint in the window. After the users set a PLC password, the data in the PLC will be protected by the PLC password. The window will be closed after the users click **Cancel**.



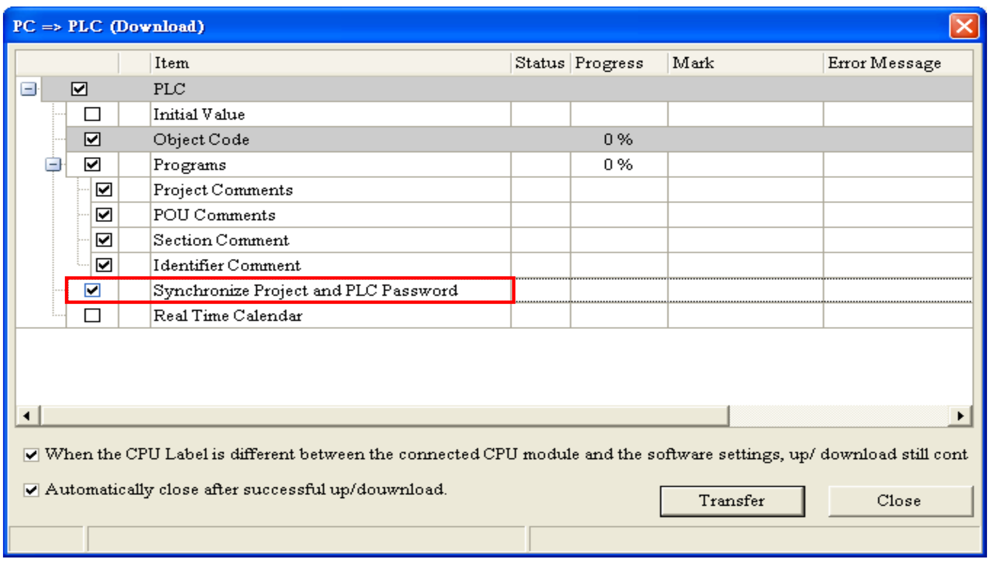


19.3.3 Synchronize Project and PLC Password

ISPSoft provides a convenient function for users. During the downloading/uploading of a project, users can make the project password and the PLC password become the same.

If users select the **Synchronize Project and PLC Password** checkbox in the **Transfer Setup** window, the PLC password will become the same as the project password after the project is downloaded.

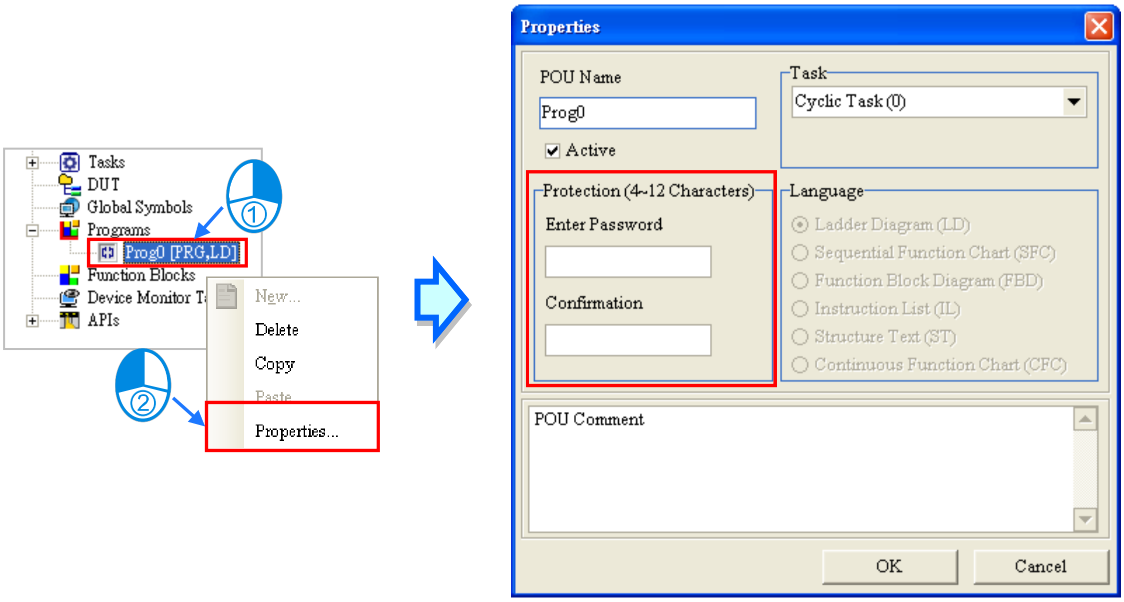
If the users do not set a project password, the system will ask the users to set a project password after the users select the **Synchronize Project and PLC Password** checkbox in the **Transfer Setup** window. When users open a project like an old file and the file is protected by project password, the **Synchronize Project and PLC Password** option is forced to select.



19.4 POU Password

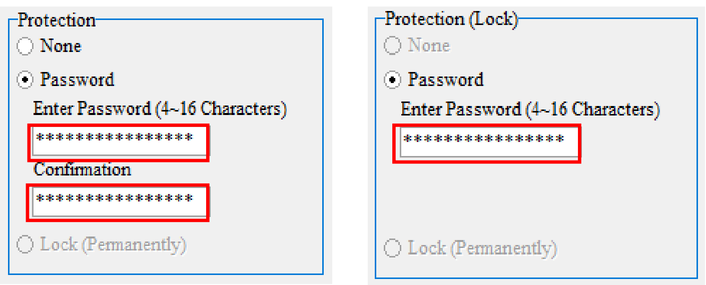
ISPSoft allows users to set a password in a POU. If users want to open a POU protected by a password, the system will ask the users to type the correct password. The password set in a POU protects the source code or the core technique in the POU. The setting of a POU password and the unlocking of a POU password are described below.

Right-click a POU in the project management area and click **Properties…**. The **Protection** section in the **Properties** window indicates whether the POU is protected by a POU password.



If the POU is not protected by a POU password, there will be two boxes used to set a POU password in the **Protection** section. If the users want to set a POU password, they have to type the same password in the two boxes. The users can only type English letters, numerical digits, and marks in the window. A POU password is case-sensitive. After the setting of a POU password is complete, the users can click **O**K.

If the POU is protected by a POU password, there will be one box used to unlock the POU password in the **Protection** section. If the users want to unlock the POU password, they can type the correct password in the box, and click **OK**.

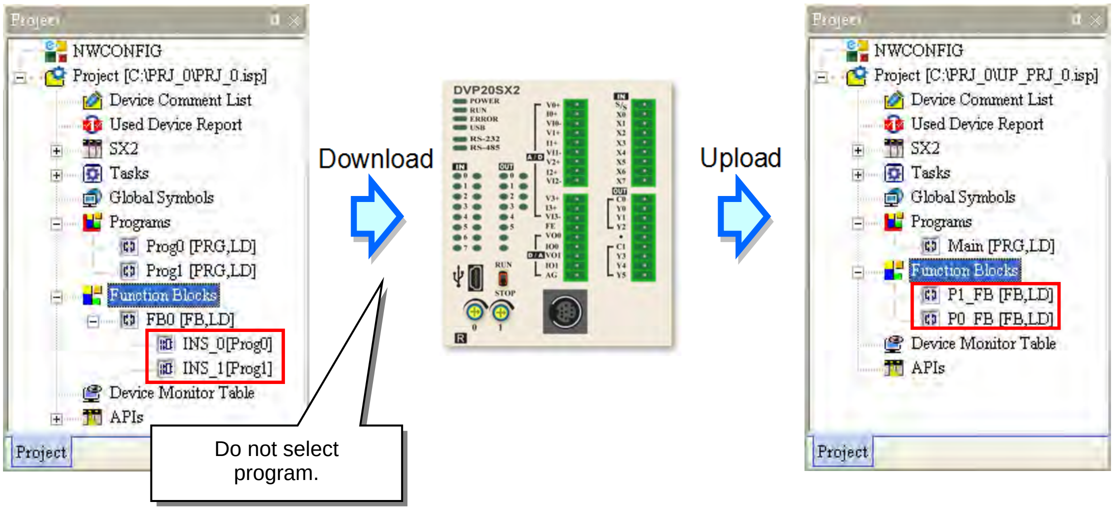


19.5 Subroutine Password

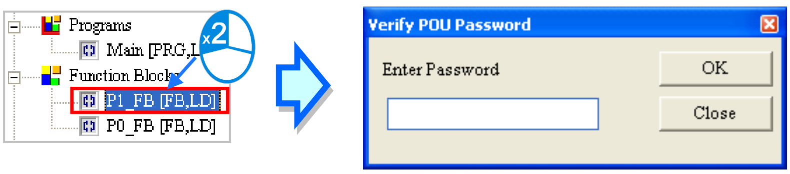
*** Currently. DVPxxMC series does not support subroutine password .**

19.5.1 Introduction of a Subroutine Passwords

After the program in a project for a DVP series PLC is compiled, the object code produced by the system may include a main program, a general subroutine, and an interrupt subroutine. The subroutine is transformed from the source code in the POUs of the function block type in the project. If the **Program** checkbox in the **Transfer Setup** window is not selected, and the **Object Code** checkbox in the **Transfer Setup** window is selected, the general subroutine which is a part of the object code will be transformed into POUs of the function blocks type in ISPSoft after the object code is uploaded. Owing to the fact that a POU password protects the source code in a POU, the POUs transformed from the object code are not protected by POU passwords. Users can open the POUs of the function block type at will, and analyze the contents of the POUs.

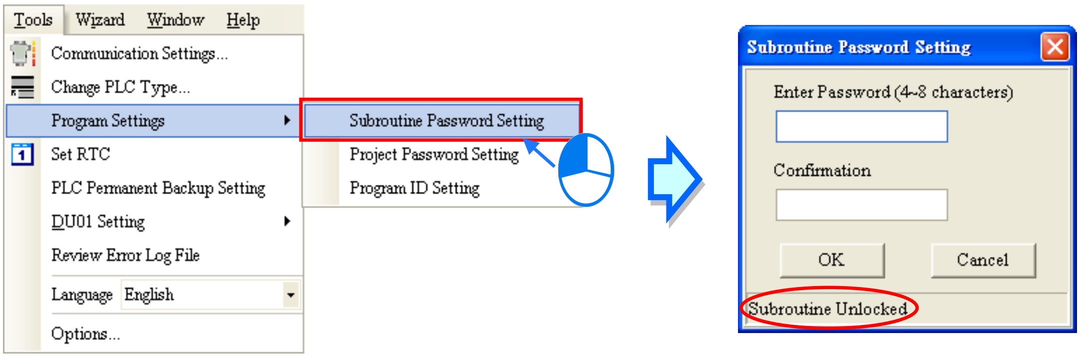


Generally speaking, developers pack core techniques or low-level programs in function blocks. If object code is gotten in the way described above, all the techniques may be analyzed. To prevent this situation, the users can set a subroutine password before the project is downloaded. If the users set a subroutine password, the subroutine password will become the POU passwords which protect the POUs of the function block type transformed from the object code which is uploaded. As a result, if the users want to open the POUs of the function block type, the system will ask the users to type the correct passwords.



19.5.2 Setting and Unlocking a Subroutine Password

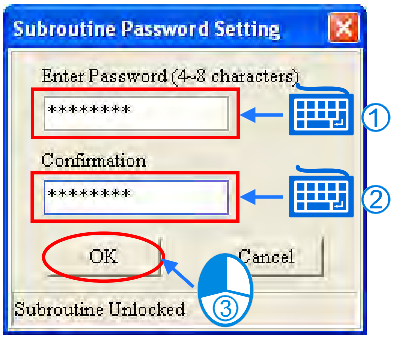
After users click the **Tools** menu, point to **Program Settings**, and click **Subroutine Password Setting**, the **Subroutine Password Setting** window will appear. The message at the bottom of the window indicates whether the subroutine is protected by a subroutine password.

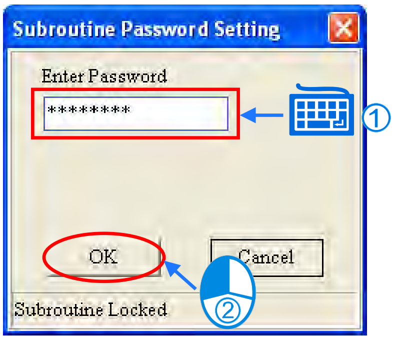


If the subroutine is not protected by a subroutine password, there will be two boxes used to set a subroutine password in the **Subroutine Password Setting** window. If the users want to set a subroutine password, they have to type the same password in the two boxes, and click **OK**.

If the subroutine is protected by a subroutine password, there will be one box used to unlock the subroutine password in the **Subroutine Password Setting** window. If the users want to unlock the subroutine password, they can type the correct password in the box, and click **OK**.

The users can only type English letters, numerical digits, and spaces in the window. A subroutine password is case-sensitive. After the users set a subroutine password, the subroutine will be protected by the subroutine password. The window will be closed after the users click **Cancel**.



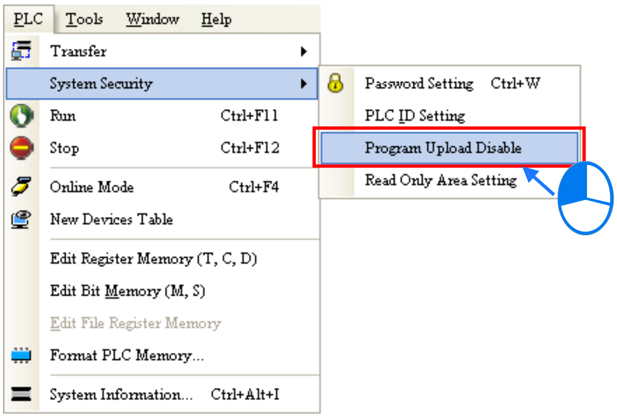


19.6 Other Password and Data Protection Functions

19.6.1 Disable Program Upload

Users can inactivate the uploading of the program from a DVP series PLC. If this function is used, the uploading of the program from the DVP series PLC will be prohibited. The uploading of the program from the DVP series PLC will be allowed only after the PLC is restored to the default setting. Besides, if a PLC password is set in the PLC, it has to be unlocked before this function is used. The data in the PLC does not need to be protected by a PLC password after the uploading of the program from the PLC is inactivated, and therefore the users can not set a PLC password.

If the users want to inactivate the uploading of the program from the DVP series PLC, they can click the **PLC** menu, point to **System Security**, and click **Program Upload Disable**. After the uploading of the program from the PLC is inactivated, the data in the PLC can not be uploaded. As a result, the users have to decide whether they need to back the data in the PLC up in advance.

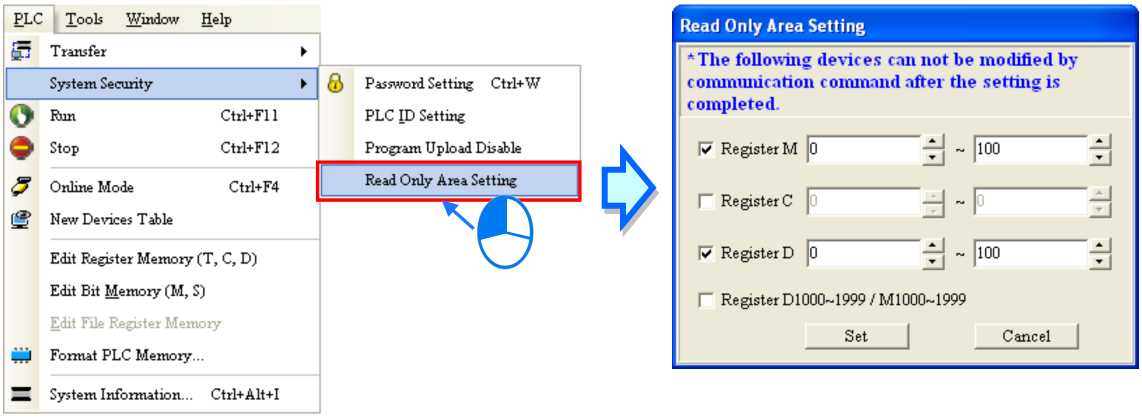


***. Before the function is used, users have to check whether the model selected and the firmware version of the model support this function. Please refer to operation manuals or technical documents for more information.**

19.6.2 Setting Read-only Area

The values stored in the read-only devices in a PLC can not be altered at will. After users set read-only device ranges in a DVP series PLC, they can not alter the values in the devices in these ranges through communication. If the users want to alter the values in the devices in these ranges, they have to restore the PLC to the default setting.

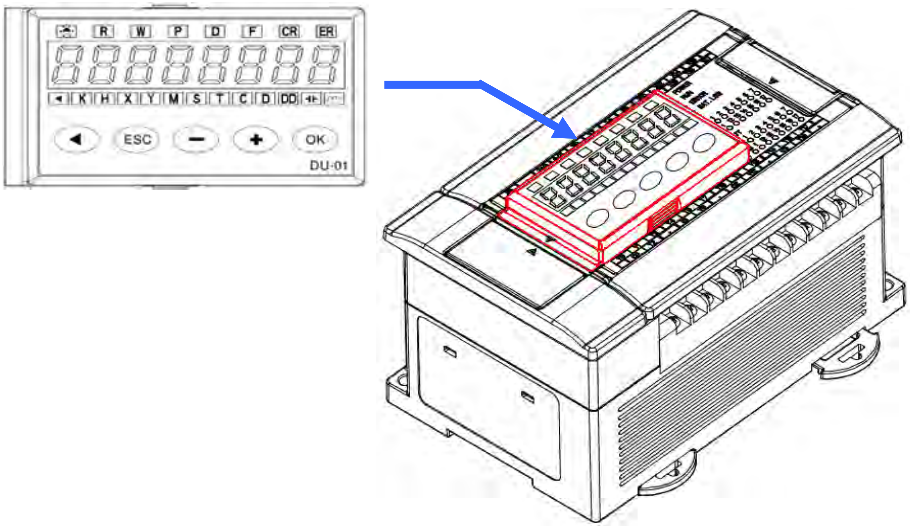
If the users want to set read-only device ranges in the DVP series PLC, they can click the **PLC** menu, point to **System Security**, click **Read Only Area Setting**. In the **Read Only Area Setting** window, the users have to select device types, and set read-only device ranges. After the setting is complete, the users can click **Set** in the **Read Only Area Setting** window.



***. Before the function is used, users have to check whether the model selected and the firmware version of the model supports this function. Please refer to operation manuals or technical documents for more information.**

19.6.3 Setting TC-01 Password Key

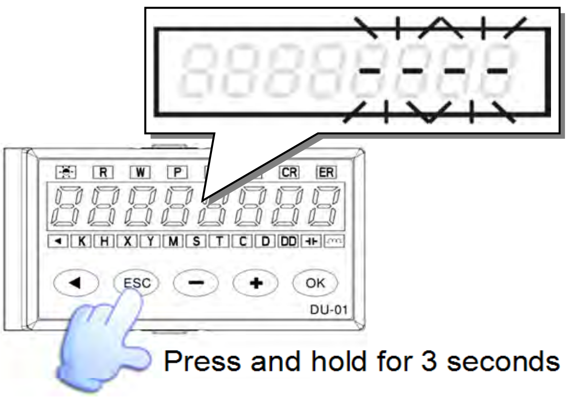
Users can set a TC-01 password key in DVPDU-01, a digital setup display. A drawing of DVPDU-01 is shown below. DVPDU-01 provides a simple operation interface for a DVP series PLC.



If users want to monitor the devices in a DVP series PLC through DVPDU-01, they can select the TS-01 mode in DVPDU-01. If users want to read data from a DVP series PLC through DVPDU-01, or write data into a DVP series PLC through DVPDU-01, they can select the TC-01 mode in DVPDU-01. If users want to read data from a DVP series PLC in which a PLC password is set through DVPDU-01, or write data into a DVP series PLC in which a PLC password is set through DVPDU-01, they can set a TC-01 password key which is the same as the PLC password in DVPDU-01. After the system makes sure that the TC-01 password key set in DVPDU-01 is the same as the PLC password, the data will be read from the DVP series PLC, or the data will be written into the DVP series PLC. Besides, when users read data from a DVP series PLC in which no PLC password is set through DVPDU-01, or write data into a DVP series PLC in which no PLC password is set through DVPDU-01, the system sets a PLC password in the DVP series PLC. The PLC password set in the DVP series PLC is the same as the TC-01 password key set in DVPDU-01.

The setting of a TC-01 password key and the unlocking of a TC-01 password key are described below. Users have to make sure that DVPDU-01 is on standby before they set a TC-01 password. If an error occurs in DVPDU-01, or DVPDU-01 is in a process, the users have to eliminate the error, or complete the process. Please refer to DVPDU-01 User Manual for more information.

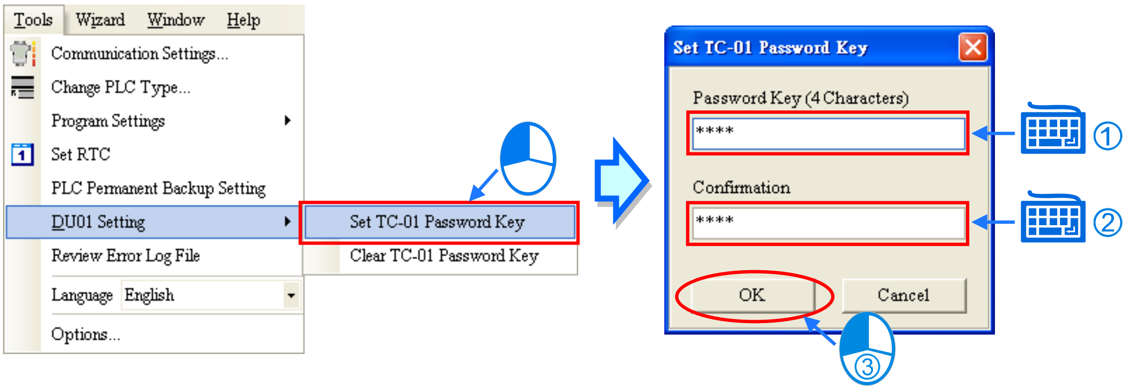
(1) After the users press **ESC** on DVPDU-01 for three seconds, the password setting screen will appear.



(2) Set a TC-01 password key by means of ISPSoft, or unlock the TC-01 password key by means of ISPSoft.

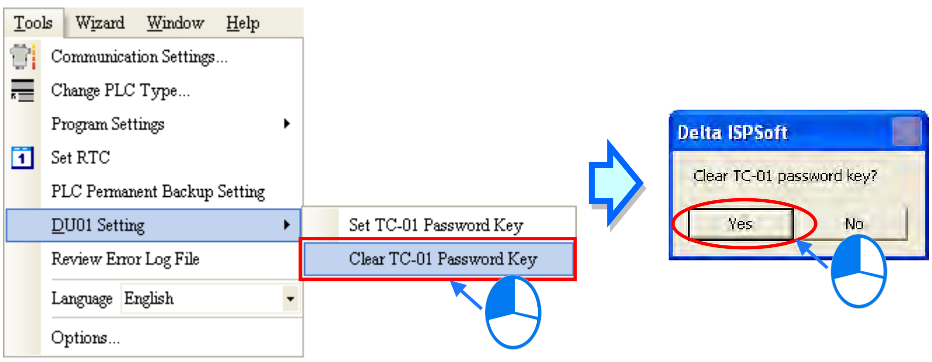
- **Setting a TC-01 password key**

  After the users click the **Tools** menu, point to **DU01 Setting**, and click **Set TC-01 Password Key**, the **Set TC-01 Password Key** window will appear. The users have to type the same password in the two boxes in the window. After the setting of a TC-01 password key is complete, the users can click **OK** in the window.

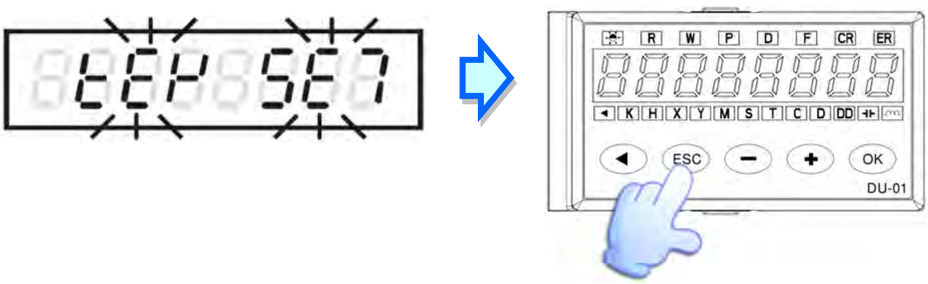


- **Unlocking the TC-01 password key**

  Click the **Tools** menu, point to **DU01 Setting**, click **Clear TC-01 Password Key**, and click **Yes** in the **Delta ISPSoft** window.



(3) After the users set a TC-01 password key, or unlock the TC-01 password key, **KEY SET** will be displayed on DVPDU-01. Press **ESC** on DVPDU-01.



Chapter 20 Network Configuration and Data Exchange

Table of Contents

20.1 Network Configuration Tool - NWCONFIG

20.1.1 Introduction of NWCONFIG

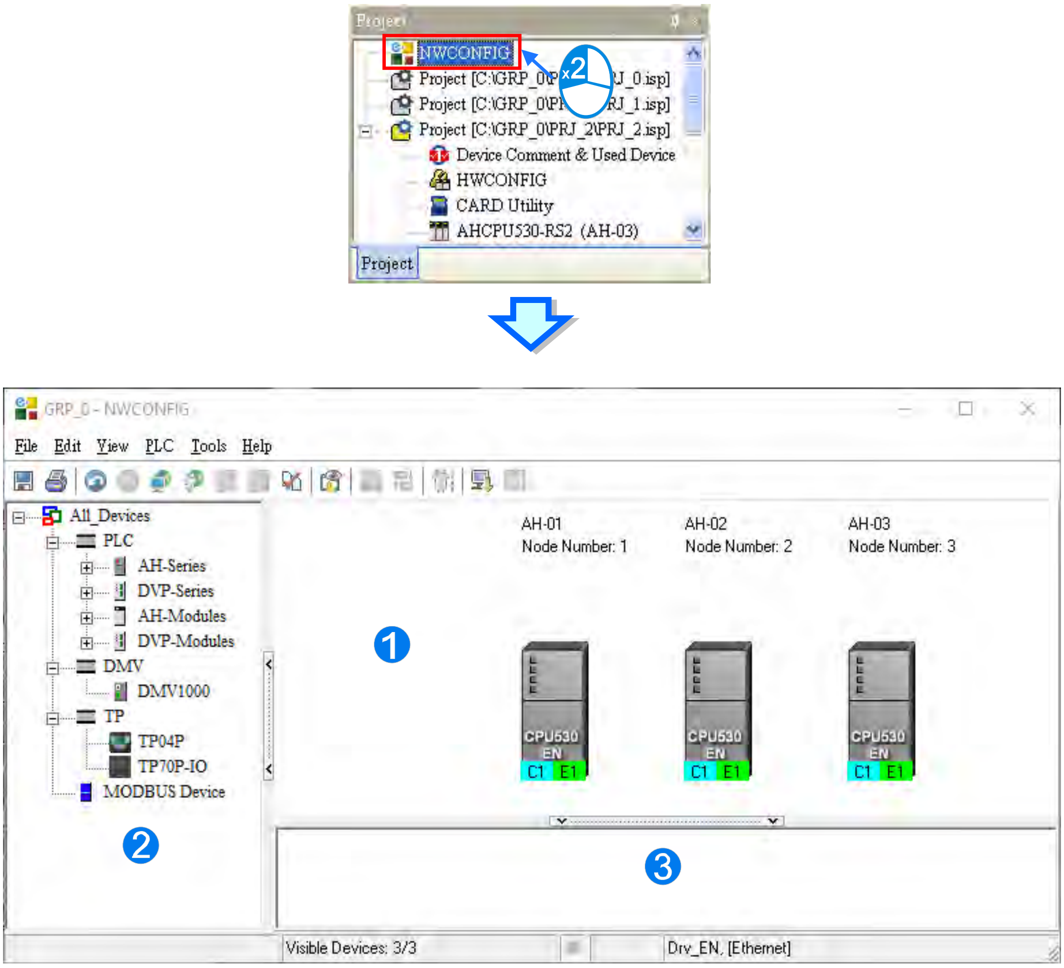
NWCONFIG is the network configuration tool provided by ISPSoft. Users can configure the network in a project and set up a mechanism for data exchange through NWCONGIF. The functions of NWCONFIG are listed below. They will be described in the following sections.

(a) Creating networks in a project, and selecting paths along which data is sent

(b) Performing data exchange through an RS-485 cable─PLC Link

(c) Performing data exchange through Ethernet─Ether Link

NWCONFIG is used to create a network framework for projects, and therefore it is at the top of the project management area. If users want to start NWCONGIF, they can double-click **NWCONFIG** in the project management area.



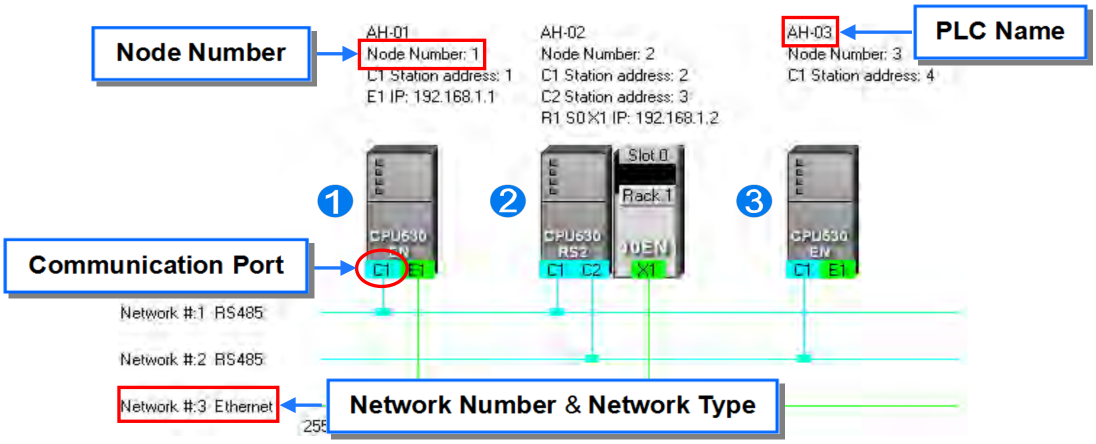
❶ **Working area**: It is a main working area. Users can create a network framework in this area.

❷ **Device list**: All the devices which can be used are listed in a catalog.

❸ **Message display area**: The messages related to operation are displayed in this area.

20.1.2 Basic Knowledge

Before creating networks, some basic knowledge is required, which is introduced in this section.



- **Device and network**

  A device is the most basic element in a network. It is a PLC, a module, or equipment defined by users. A network is a collection of devices which are interconnected. Every network is assigned a network number. There are RS-485 networks and Ethernet networks. Besides, a physical interface that a device uses to connect to a network is a port of the device. If there are more than two ports on a device, the device can connect to networks which are assigned different network numbers. Please refer to section 20.2.2 for more information about the marking of a port in NWCONFIG.

- **PLC name**

  "**AH-01**", "**AH-02**", and "**AH-03**" in the figure above are PLC names. The PLC name of an AH5x0 series CPU module depends on the setting in HWCONFIG. Users can identify a device in a network by means of the PLC name of the device. Please refer to section 3.1.4 for more information. However, the PLC name of a device which is not an AH5x0 series CPU module is like a comment on the device. It has little significance.

- **Node and node number**

  A node is a basic unit which can operate independently in a network. ❶ ~ ❸ in the figure above are nodes. ❷ consists of a CPU module and a network module. The network module cannot operate by itself, and therefore the CPU module and the network module are regarded as one node.

  Besides, AH5x0 series CPU modules can forward packets and perform routing. For example, ❸ in the figure above can be monitored through ❶. Before routing is performed, users have to create paths along which data is sent, and assign node numbers to the nodes which forward the data along the paths. Only AH5x0 series CPU modules can be assigned node numbers, and the node number of a node in a network cannot be the same as the node number of another node in the network. After the paths created are downloaded to the PLCs which forward the data along the paths, every PLC has its own routing table. The forwarding of the data is directed on the basis of the routing tables produced.

- **Station address**

This is to identify RS-485 stations on the internet. The station address is configured base on communication port. Basically, a communication port represents a station, and the workstation address that has the same internet no. cannot be repeated. Therefore, when a node contains several COM ports and is connected, a station address has to be assigned.

- **IP address and DHCP mode**

IP address is the address for communication ports on the internet. Basically, a communication port represents a internet point. Therefore, when several communication ports are included and connected to the internet, an IP address has to be assigned and cannot be repeated.

DHCP is the mechanism for dynamic allocation of IP addresses. A host allocated by the DHCP has to exist in the internet. When a communication port adopts DHCP mode, the port automatically obtains an IP address from DHCP host.

- **Subnet mask**

A subnet mask is used to differentiate the subnework parameter values.

- **PLC Link**

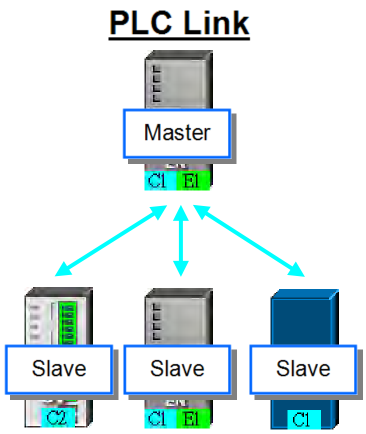
A network mechanism for data exchange performed through an RS-485 cable. If there are several nodes in an RS-485 network, users can create a mechanism for data exchange in the network. If the parameters which are set are downloaded to the PLC which functions as a master station, the system of the PLC will perform data exchange through special relays and special registers when the PLC runs.

A PLC Link is a master/slave model. There is only one master station in an RS-485 network, and the other stations which are slave stations passively receive reading/writing commands from the master station. The slave stations cannot exchange data. They have to exchange data through the master station.

- **Ether Link**

A network mechanism for data exchange performed through an Ethernet connection. If there are several nodes in an Ethernet network, users can create a mechanism for data exchange in the network, and select a start mode. If the parameters which are set are downloaded to the PLCs in the network, the systems of the PLCs perform data exchange according to the start mode selected when the PLCs run.

An Ether Link is not a master/slave model. It allows a node to send reading commands which ask for data to other nodes. The nodes will send the data to the node after they receive the reading commands. Owing to the fact that a node cannot send writing commands to other nodes, the use of an Ether Link is safer than the use of a PLC Link. Besides, the system automatically manages the transmission of packets through TCP/IP. Compared with a PLC Link, an Ether Link is more efficient.



***. Please refer to related books or technical documents for more information about RS-485 and Ethernet.**

20.1.3 Communication Setting in NWCONFIG

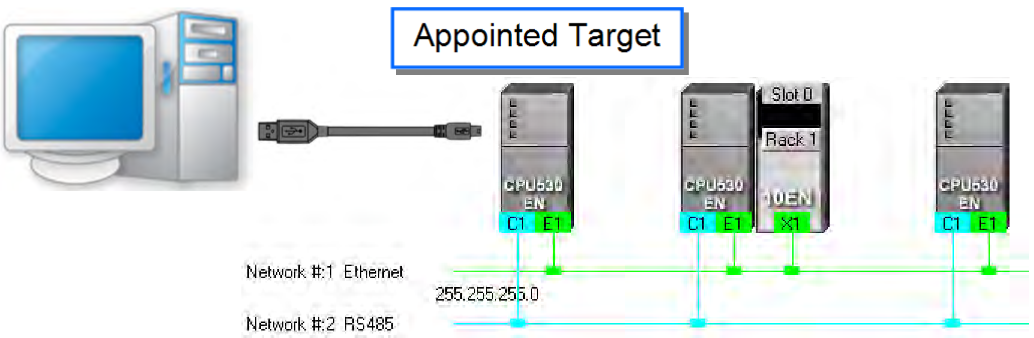
NWCONFIG is used to configure a network. When users configure a network, they have to download parameters to the nodes in the network, upload parameters from the nodes in the network, or monitor nodes in the network. The nodes in the networks created in NWCONFIG may include a device which is not the device for which the ISPSoft project is created, and therefore users have to set the communication parameters in the device. In order to help people select appropriate parameters, the communication mechanism in NWCONFIG is introduced before communication setting is described.

20.1.3.1 Connection Mechanism in NWCONFIG

In the networks created in NWCONFIG, users can download parameters to a single node or multiple nodes, upload parameters from a single node or multiple nodes, and monitor a single node or multiple nodes. Before users download parameters to a single node or multiple nodes, upload parameters from a single node or multiple nodes, or monitor a single node or multiple nodes, they have to select appropriate parameters.

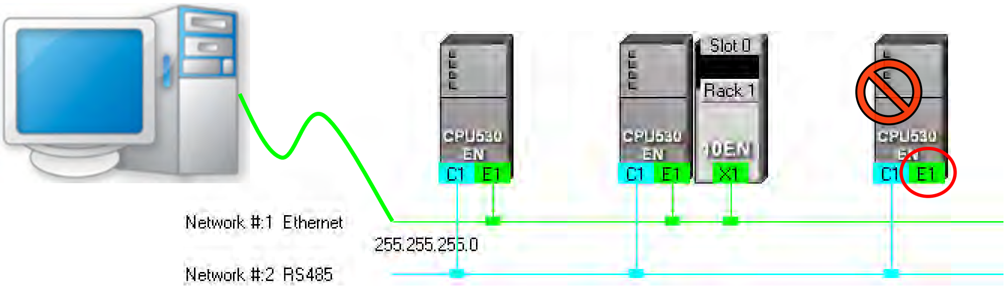
- **Single node**

  Users can download parameters to a single device, upload parameters from a single device, and monitor a single device. Before users download parameters to a single device, upload parameters from a single device, or monitor a single device, they have to make sure that the device specified is the same as the device which is actually connected to the computer.

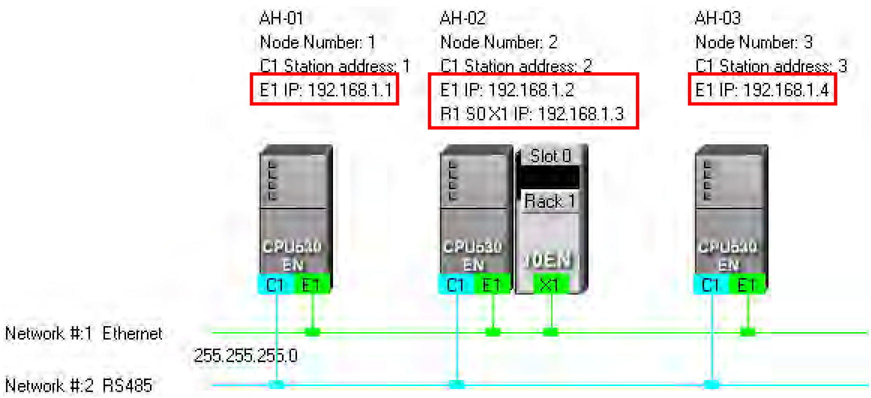


- **Multiple nodes**

In a network, users can download parameters to multiple devices, upload parameters from multiple devices, and monitor multiple devices. Before users download parameters to multiple devices, upload parameters from multiple devices, or monitor multiple devices, they have to make sure that the devices are connected to an Ethernet network, the devices are assigned IP addresses, and the connection type that the driver uses is Ethernet.

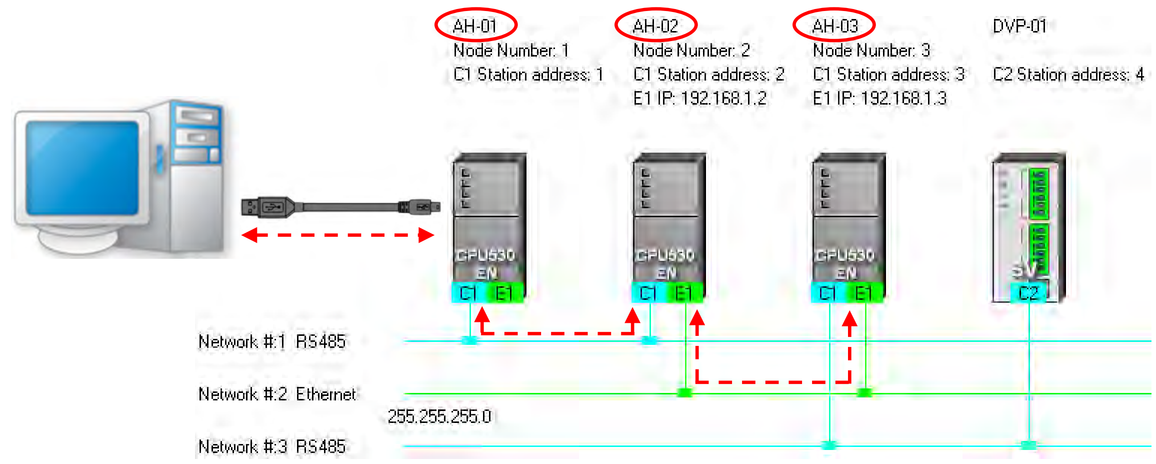


If the connection type that the driver selected uses is Ethernet, the system will carry out communication according to the IP addresses assigned to the devices in NWCONFIG. Before the communication is carried out, users have to make sure that the IP addresses actually assigned to the devices are the same as the IP addresses set in NWCONFIG, and the networks actually created are the same as the networks created in NWCONFIG. Otherwise, an error will occur if the communication is carried out.



NWCONFIG can also carries out communication through routing.

Routing is a function provided by AH5x0 series CPU modules. It directs packet forwarding. Packet forwarding is the relaying of packets from their source toward their destination through intermediate nodes. In the figure below, the device which actually connects to the computer is AH-01. If the computer wants to connect to AH-03, it can communicate with it through routing, and designates AH-01 as the first station. After the computer sends a command, the command is transmitted to AH-03 through AH-01 and AH-02.



The important points about routing are listed below.

(a) Users have to create networks in NWCONFIG, and download the routing tables produced to nodes in the networks. Please refer to section 20.2 for more information.

(b) AH5x0 series CPU modules support routing whereas DVP series PLCs and other devices do not support routing. Although DVP series PLCs and other devices cannot function as intermediate nodes through which packets pass, they can function as destinations to which packets are transmitted.

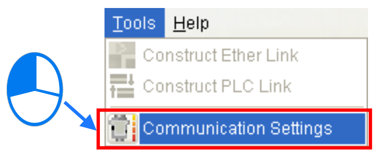
20.1.3.2 Setting Communication Parameters

The steps of setting the communication parameters in NWCONFIG are as follows. Please follow the steps to ensure normal connection.

(1) Start the communication manager COMMGR, and check the status of the driver as OK.

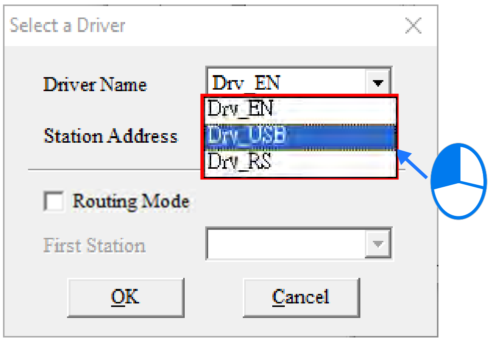
(2) When using **Single node**, please check the object for operation is the same as the actual device for connection; When operating in **Multiple node**, please check that all operating devices are linked to the Ethernet and as planned in NWCONFIG.

(3) Click **Communication Setting** on the **Tools** menu or  on the toolbar in the NWCONFIG window. After the users complete the setting described below, they can click **OK** in the **Select a Driver** window.

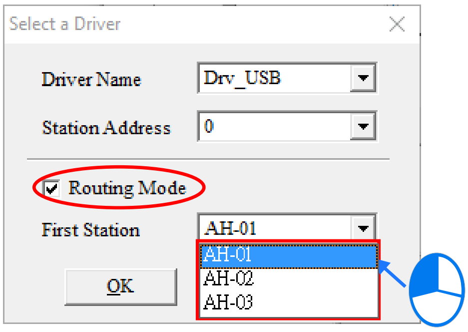


OR

(4) Select a driver in the **Driver Name** drop-down list box.



(5) Select the **Routing Mode** and select a device in the **First Station** from the drop-down list box that is the actual device connected to the PC.

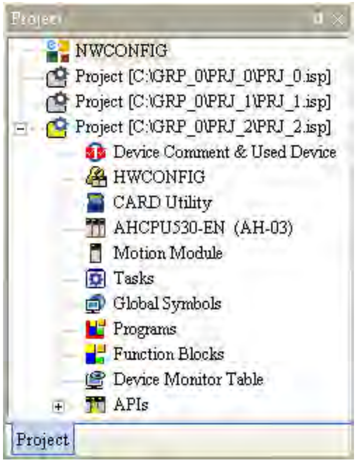


20.1.4 Workflow

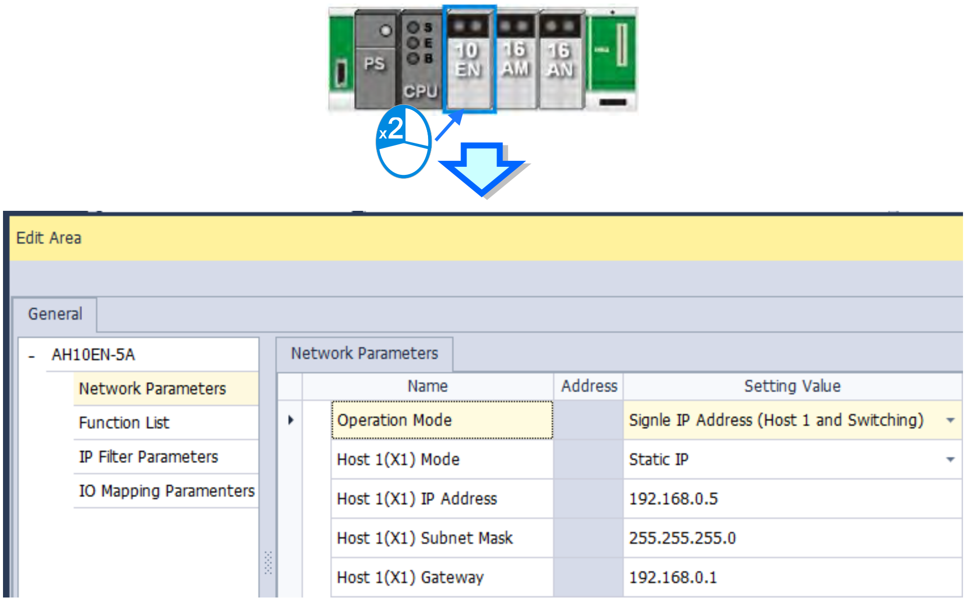
The creation of networks involves the operation of a system, and therefore the workflow needed must consist of a sequence of connected steps. The workflow needed to create networks is introduced briefly in this section, and will be described in length in the following sections. The workflow introduced in this section is a method which can be used to efficiently complete work in a general condition. It is not necessarily applicable to all conditions. Users can adjust the workflow according to the actual situations or their habits.

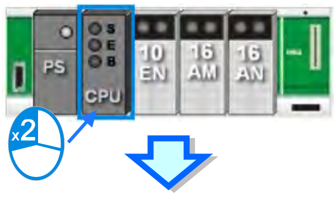
(1) Before users create a system by means of ISPSoft, they have to design networks. The users have to decide what PLCs or devices are used in the networks, whether a PLC needs to be connected to a network module, how the nodes in the networks are connected, what IP address or RS-485 station address are assigned to the ports connected, and what the values of RS-485 communication parameters are. Besides, the users have to decide what devices perform data exchange. The data exchange is related to the programs in the PLCs used in the networks. After the users design networks, they can create the networks in ISPSoft.

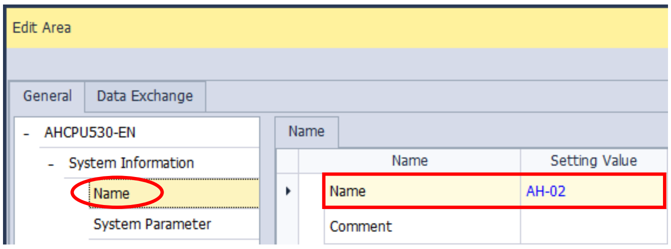
(2) Create a project in ISPSoft. If there are more than two Delta PLCs in a system, it is recommended that the users should create a group of projects in ISPSoft. Please refer to section 2.2 for more information.

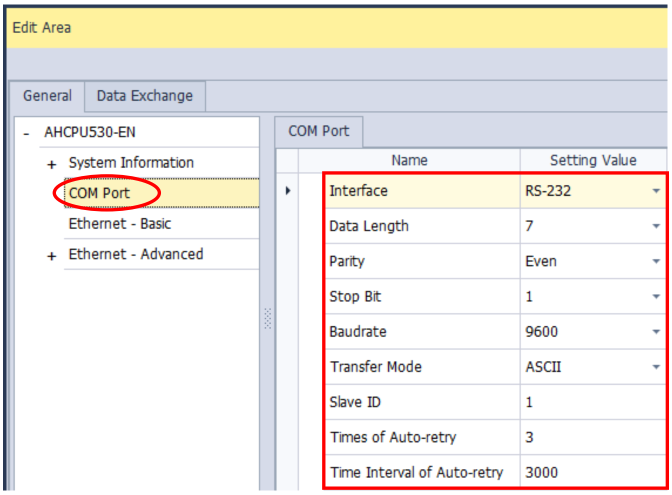


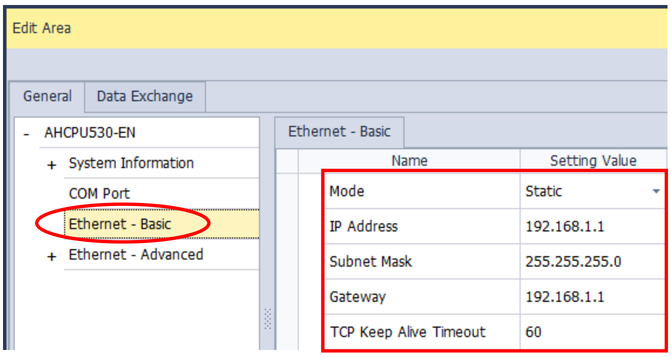
(3) If there are projects for AH5x0 series CPU modules, the users have to open the HWCONFIG windows in the projects, and complete hardware configurations. The users have to configure modules, set the parameters in network modules, gives names to the CPU modules, set ports, and set Ethernet ports. Please refer to chapter 3 for more information.



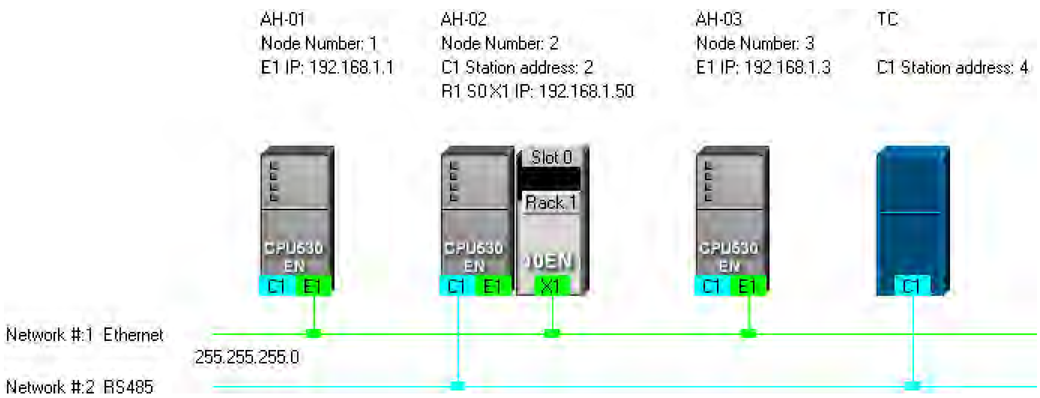

PS
CPU
10
EN
16
AM
16
AN
x2


Edit Area
General
Data Exchange
AHCPU530-EN
System Information
Name
System Parameter
Name
Name
Setting Value
Name
AH-02
Comment


Edit Area
General
Data Exchange
AHCPU530-EN
System Information
COM Port
Ethernet - Basic
Ethernet - Advanced
COM Port
Name
Setting Value
Interface
RS-232
Data Length
7
Parity
Even
Stop Bit
1
Baudrate
9600
Transfer Mode
ASCII
Slave ID
1
Times of Auto-retry
3
Time Interval of Auto-retry
3000

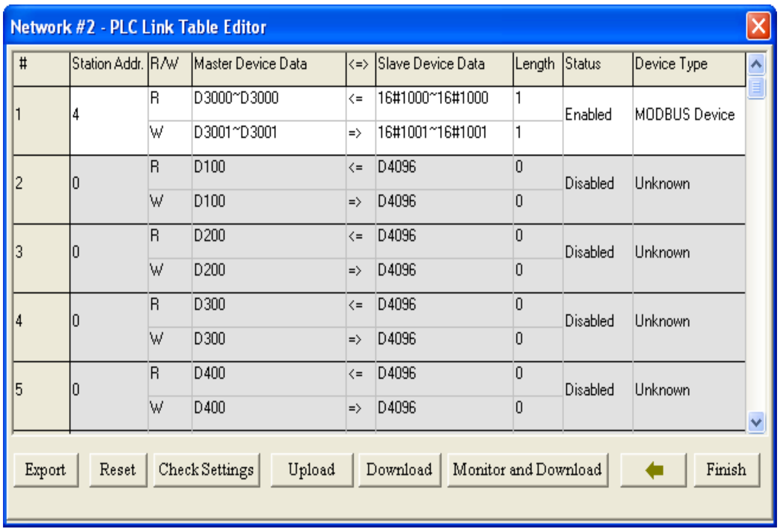

Edit Area
General
Data Exchange
AHCPU530-EN
System Information
COM Port
Ethernet - Basic
Ethernet - Advanced
Ethernet - Basic
Name
Setting Value
Mode
Static
IP Address
192.168.1.1
Subnet Mask
255.255.255.0
Gateway
192.168.1.1
TCP Keep Alive Timeout
60

(4) Complete a network configuration in NWCONFIG.



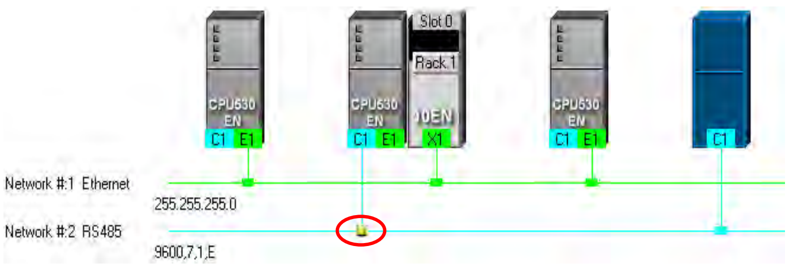
(5) Create a mechanism for data exchange performed by means of a PLC Link or an Ether Link. A PLC Link and an Ether Link operate independently. The users can create them in any order. The addresses involved in data exchange cannot overlap, otherwise an error will occur after the data exchange is performed. It is recommended that the users should set addresses which are involved in data exchange according to the programs in the projects created.

The figure below is a table related to data exchange performed by means of a PLC Link. After the users complete the setting in the table, the master station in NWCONFIG will be marked.

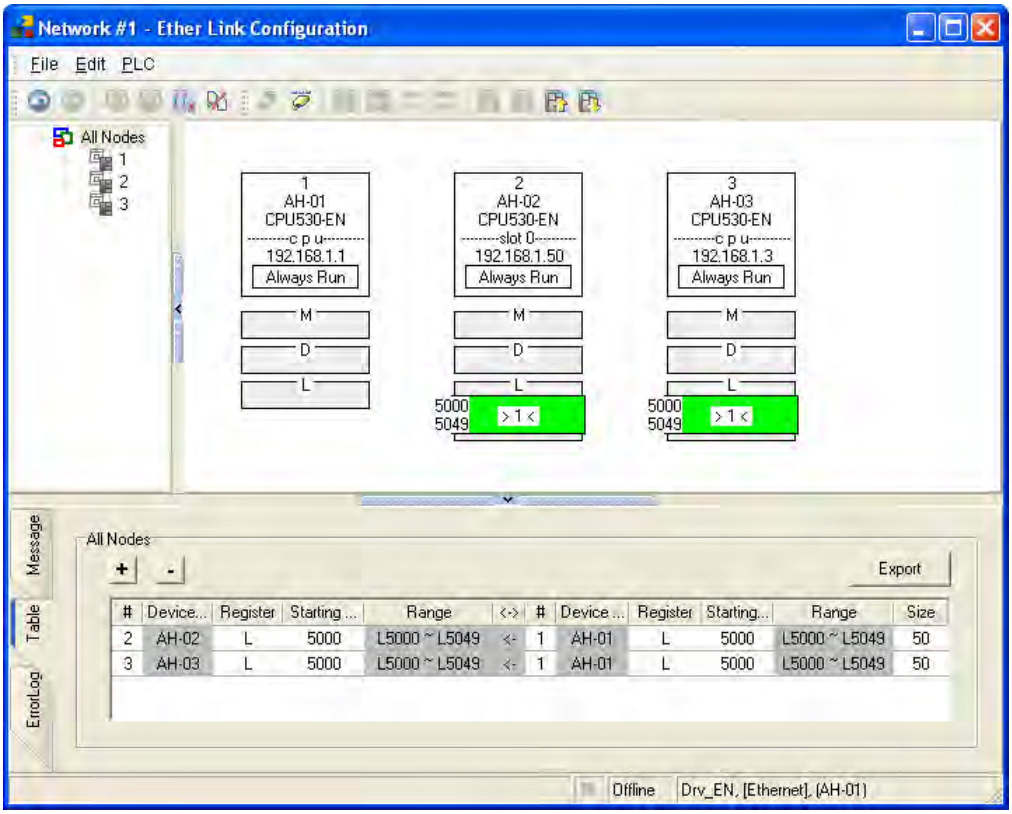

Network #2 - PLC Link Table Editor

#	Station Addr.	R/W	Master Device Data	<=>	Slave Device Data	Length	Status	Device Type
1	4	R	D3000~D3000	<=	16#1000~16#1000	1	Enabled	MODBUS Device
		W	D3001~D3001	=>	16#1001~16#1001	1		
2	0	R	D100	<=	D4096	0	Disabled	Unknown
		W	D100	=>	D4096	0		
3	0	R	D200	<=	D4096	0	Disabled	Unknown
		W	D200	=>	D4096	0		
4	0	R	D300	<=	D4096	0	Disabled	Unknown
		W	D300	=>	D4096	0		
5	0	R	D400	<=	D4096	0	Disabled	Unknown
		W	D400	=>	D4096	0		

Export | Reset | Check Settings | Upload | Download | Monitor and Download | Finish

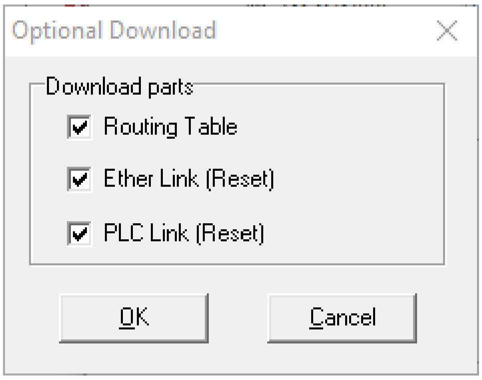


The figure below is a table related to data exchange performed by means of an Ether Link.



(6) Download the programs in the projects, the parameters set in HWCONIFG, and the parameters set in NWCONFIG to the PLCs. If the devices in the networks designed include DVP series PLCs or devices which are not AH5x0 series CPU modules, the users have to set the communication parameters in these DVP series PLCs or devices which are not AH500 series CPU modules.

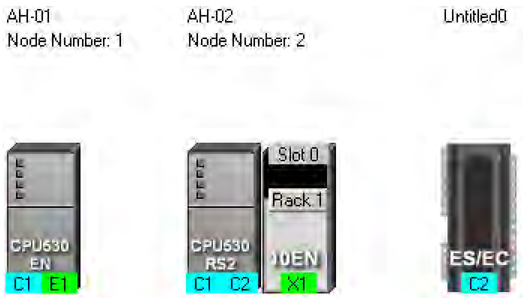
The **Optional Download** window in NWCONFIG is shown below. The items which can be downloaded vary with the node selected.



20.2 Creating a Network Architecture

20.2.1 Deploying Nodes

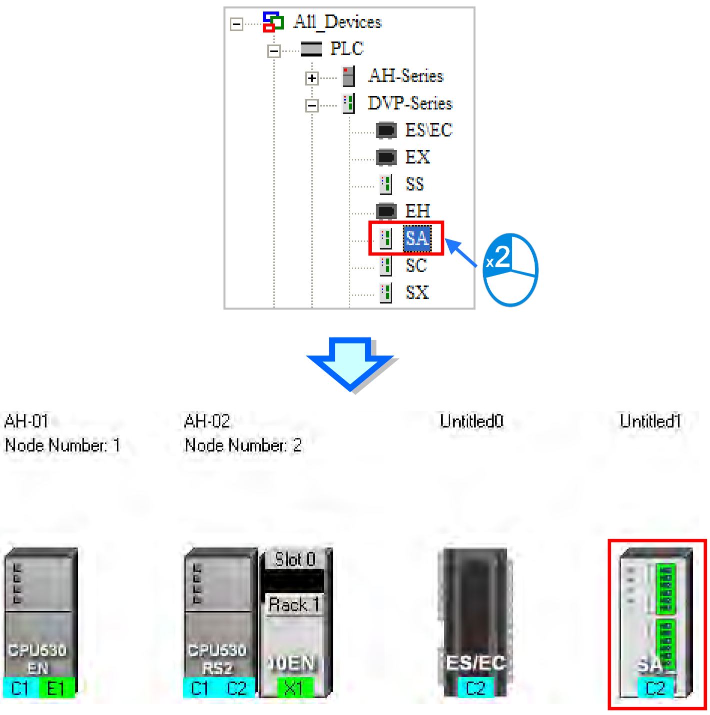
After users open the NWCONFIG window for projects for the first time, the devices for which the projects are created will be deployed in the working area in the NWCONFIG window. If the devices deployed in the working area include AH5x0 series CPU modules, the modules connected to the CPU modules, the parameters in the CPU modules, and the parameters in the modules connected to the CPU modules will be displayed according to the setting in HWCONFIG. The devices deployed in the working area cannot be changed or deleted.



The users can add other PLCs or devices to the working area. There are two ways to add a new device to the working area.

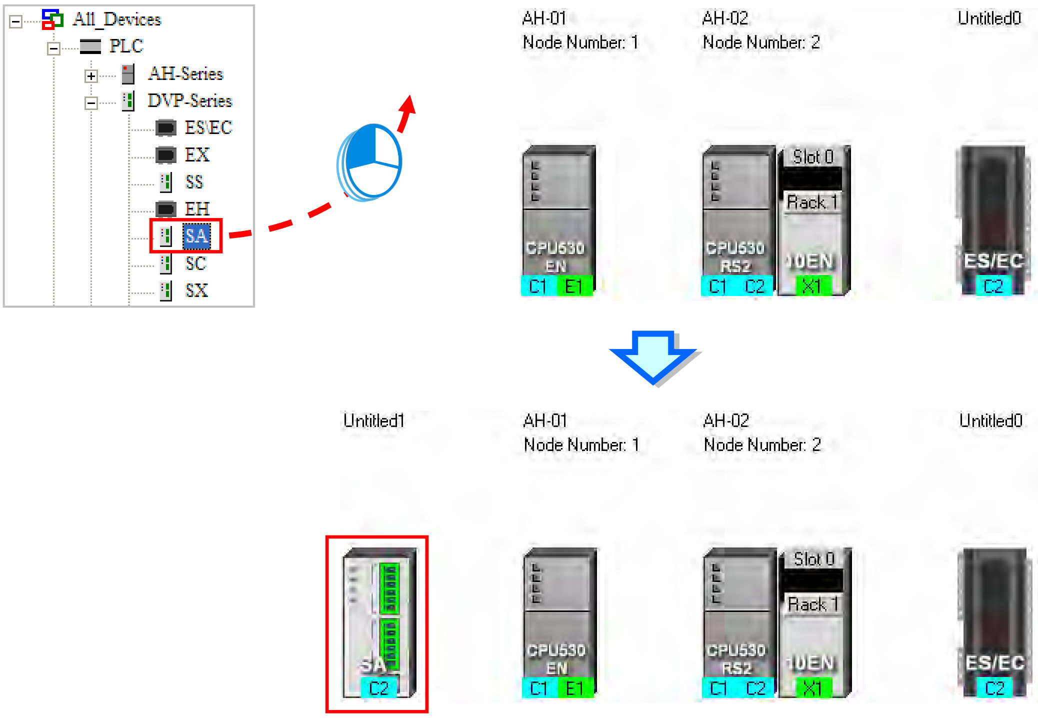
- **Method 1**

  Select a PLC or a device on the device list. After the users double-click the PLC or the device, the PLC or the device will be put at the right side of the rightmost device in the working area.

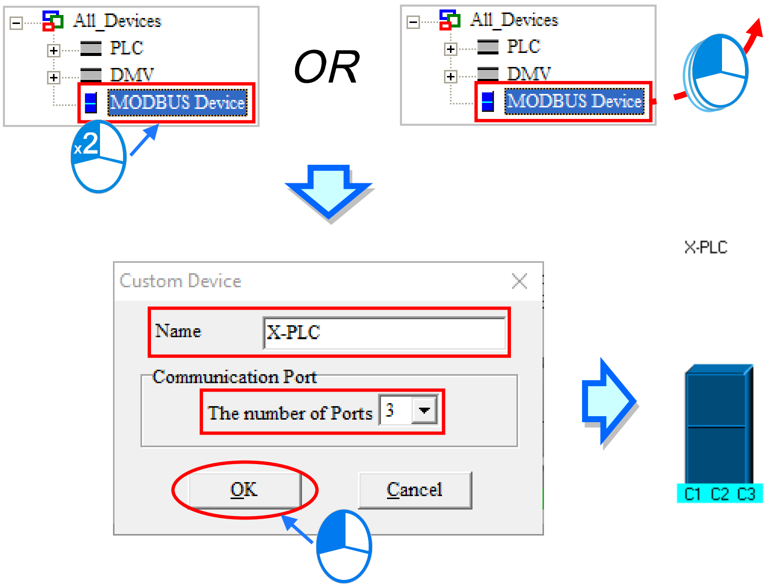


- **Method 2**

Select a PLC or a device on the device list, and then drag it to a position in the working area.



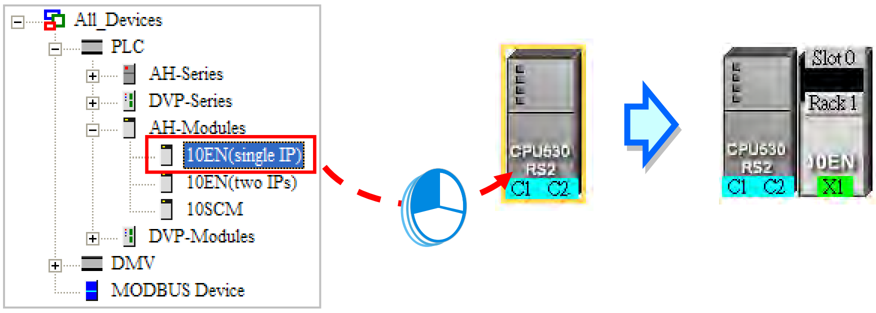
The users can add a user-defined Modbus device to the working area. After the users select **MODBUS Device** on the device list, and add it to the working area in one of the two ways described below, the **Custom Device** window will appear. The users have to type a name in the **Name** box, select a number in the **The number of ports** from drop-down list box, with maximum of three ports and click **OK**.



Base on the project content, the first AH5xo host is auto-selected with module configuration in sync with HWCONFIG. Therefore, it is not possible to add modules in NWCONFIG, but configuration changes can be made in HWCONFIG settings.

- **Method 1**

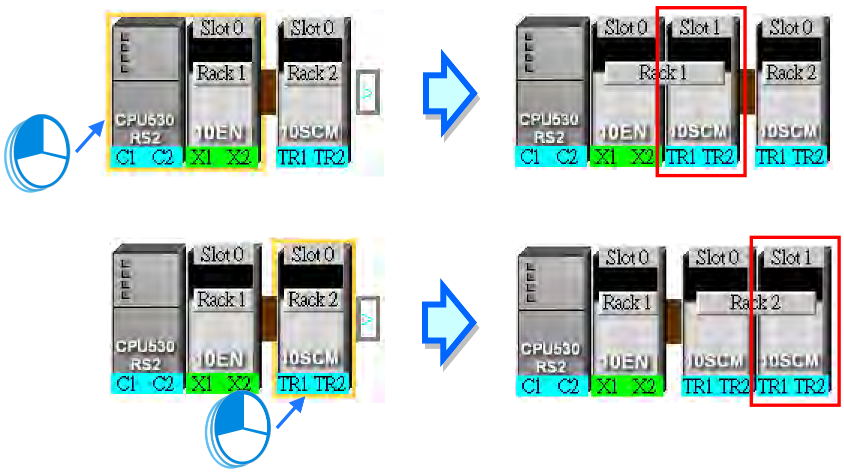
Select a network module on the device list, and then drag it to a PLC in the working area.



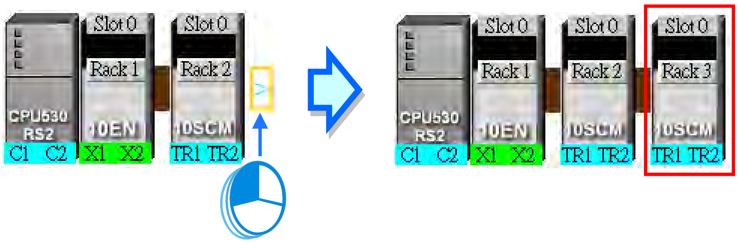
If the PLC does not support the network module selected, the mouse cursor becomes .

For AH5x0 series, 10EN module can be placed on the main backplane, with a maximum of at least 8 modules. The SCM module can be put on the extension backplane and the number is limited according to the slot number of each backplane. .

When choosing to drag added SCM modules, users can decide the backplane position to drag and drop.

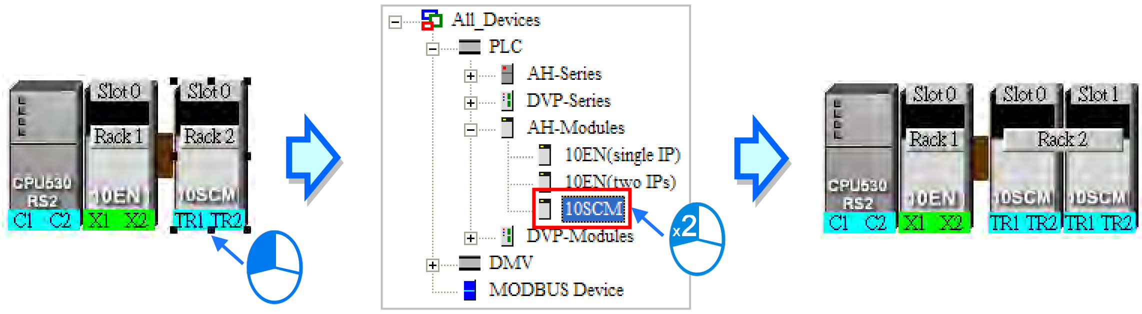


After the users drag an AH10SCM series module to at the right side of a node, an extension rack will be added to the node.

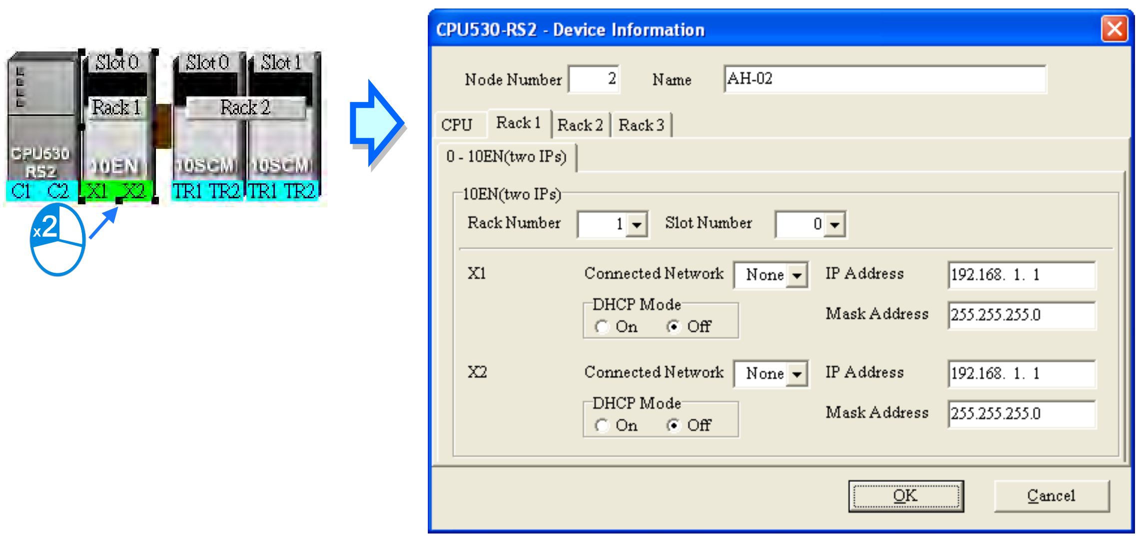


- **Method 2**

Select a PLC or a rack in the working area, and then double-click a network module on the device list.



After the users add a network module to a node, the slot in which the network module is installed, and the backplane on which the network module is installed may be different from the actual slot in which the network module is installed, and the actual backplane on which the network module is installed. The users have to adjust the properties of the node.

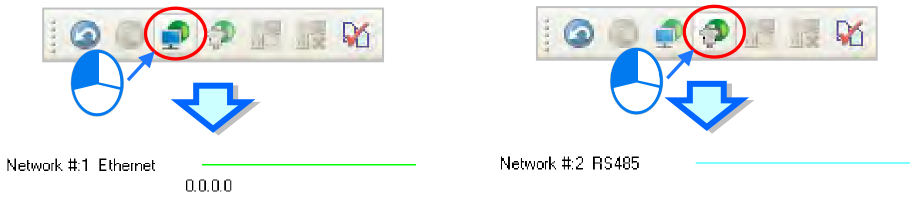


20.2.2 Connecting to a Network

After users deploy the nodes in the NWCONFIG window, they can connect the nodes to the networks designed. There are three ways to add a network to the working area. There are Ethernet networks and RS-485 networks.

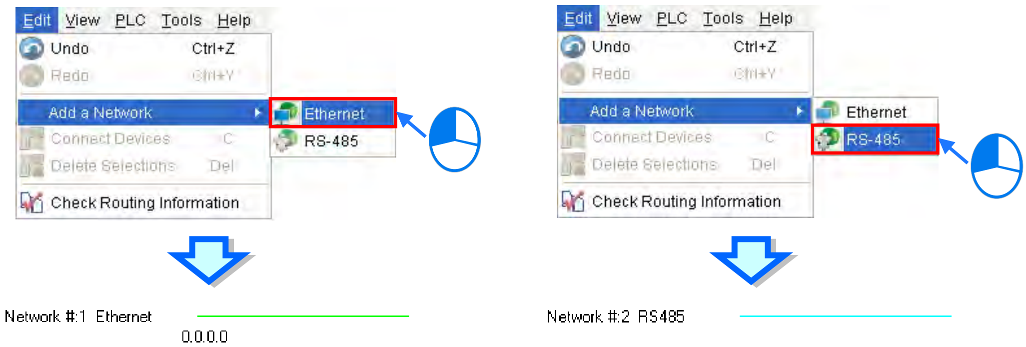
- **Method 1**

  After users click on the toolbar, an Ethernet network is added. After the users click on the toolbar, an RS-485 network is added.



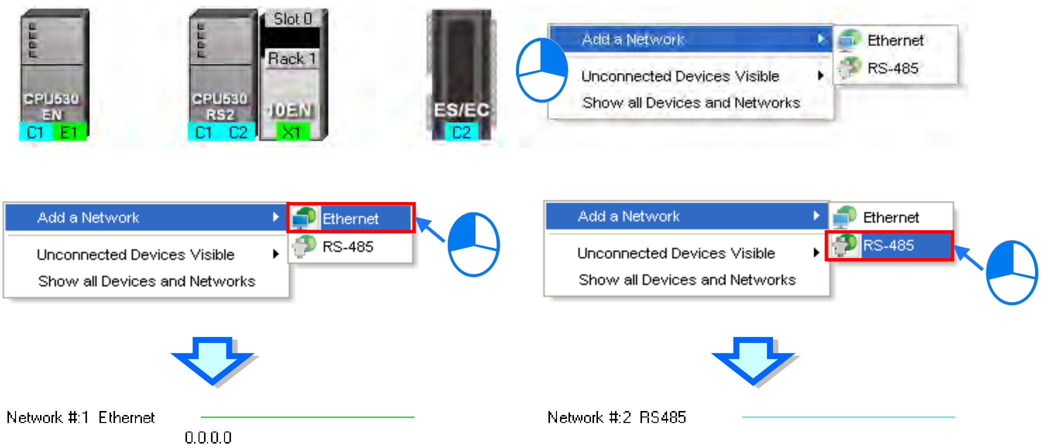
- **Method 2**

  Click the **Edit** menu, point to **Add a Network**, and click **Ethernet** or **RS-485**.



- **Method 3**

  Right-click the blank in the working area, point to **Add a Network** on the context menu, and click **Ethernet** or **RS-485**.

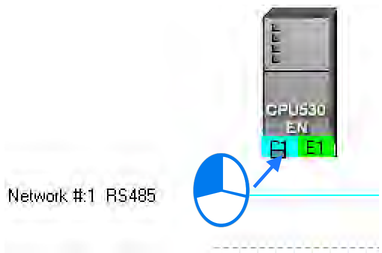


The ports of a device are displayed at the bottom of the device. If a port is blue, it is an RS-485 port. If a port is green, it is an Ethernet port. The port number assigned to a port of a device is consistent with the definition of the port. For example, E1 represents the first Ethernet port, C1 represents COM1, and C2 represents COM2. The ports of an AH10SCM series module are marked with TR1 and TR2, and the ports of an AH10EN series module are marked with X1 and X2. Besides, if the IP address assigned to an Ethernet port is a dynamic IP address, or a port of an AH10SCM series module is not a Modbus port, the Ethernet port or the port of the AH10SCN series module will be gray, and cannot connect to any network.

There are several ways to connect the nodes in the working area to networks.

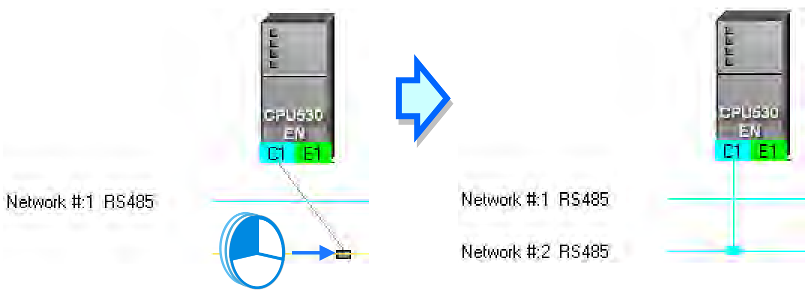
- **Connecting a port to a network by means of dragging the port**

  The users press the left mouse button while the mouse cursor hovers over a port. A dotted line is under the existing network.



  The users move the mouse cursor to the existing network while holding the left mouse button down. If the network matches the port, the port will connect to the network after the users release the left mouse button.

  If the users move the mouse cursor to the dotted line while holding the left mouse button down, the port will connect to a network which matches the port.



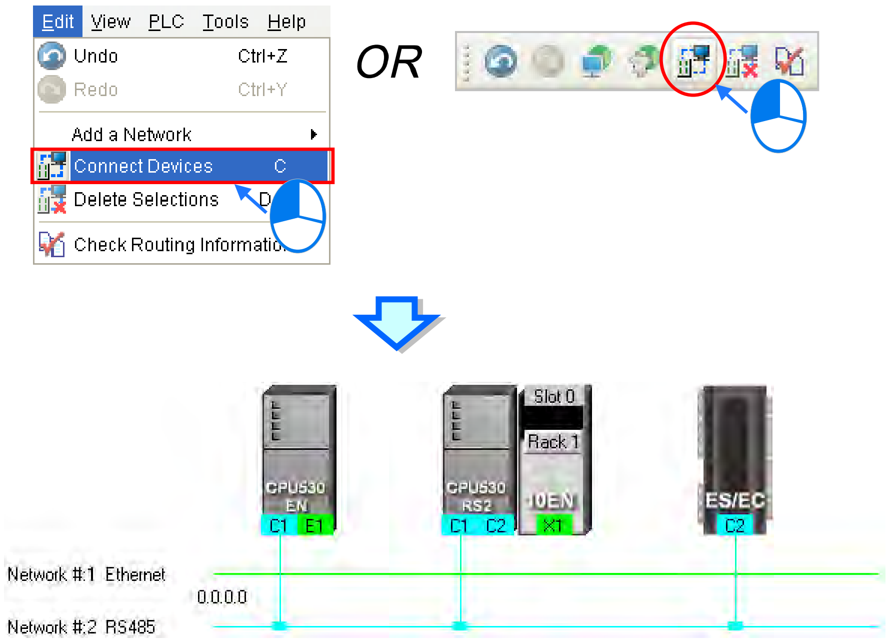
- **Connecting a single device or several devices to an existing network**

(1) The users hold down Shift on the keyboard while they click devices and a network. They have to conform to the two principles below.

(a) PLCs and modules are independent devices. A device that the users click must have at least one port which is not connected to any network, and matches the network clicked.

(b) The users can click several devices, but they can only click one network.

(2) After the users click **Connect Devices** on the **Edit** menu, or on the toolbar, the system will connect the devices clicked to the network clicked.



Additional remark

(a) If the objects selected do not conform to the two principles listed above, the system will not connect the devices selected to the network selected, and a warning message will appear.

(b) If a device selected has more than one port which is not connected to any network and matches the network selected, the system will connect the port whose port number is smaller to the network selected.

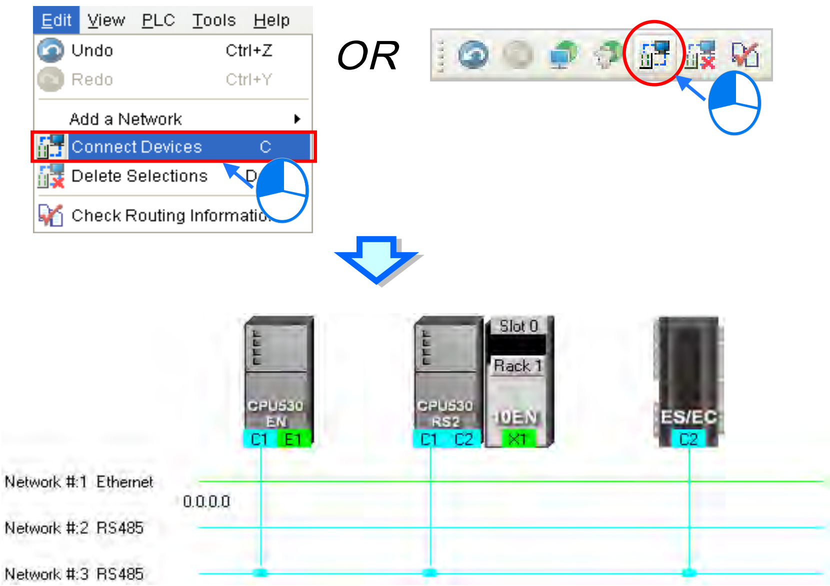
(c) Users can select multiple devices by dragging a selection net around them. If the users press Ctrl+A on the keyboard, all the devices and networks in the working area are selected.

(d) If users select a node which consists of a PLC and a module, and the PLC and the module conform to the principles listed above, the system will connect a port of the PLC and a port of the module to the network selected.

● **Automatically connecting a single device or several devices to a new network**

(1) The users hold down Shift on the keyboard while they click devices. PLCs and modules are independent devices. A device that the users click must have at least one port which is not connected to any network, and matches the new network added.

(2) After the users click **Connect Devices** on the **Edit** menu, or  on the toolbar, the system will connect the devices clicked to the new network added.



Additional remark

(a) If the devices selected do not conform to the principle described in (1), the system will not connect the devices selected to a new network, and a warning message will appear.

(b) If a device selected has more than one port which is not connected to any network and matches the new network added, the system will connect the port whose port number is smaller to the new network added.

(c) Users can select multiple devices by dragging a selection net around them. If the users press Ctrl+A on the keyboard, all the devices and networks in the working area are selected.

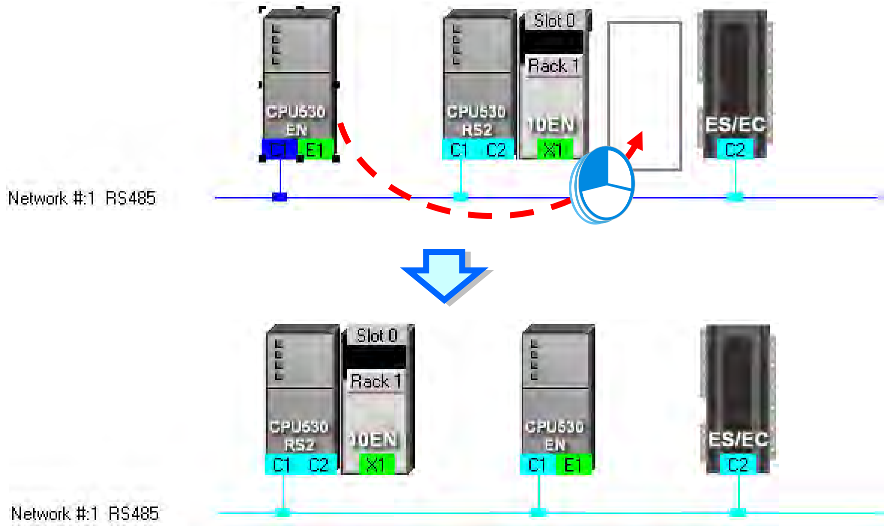
(d) If users select a node which consists of a PLC and a module, and the PLC and the module conform to the principle described in (1), the system will connect a port of the PLC and a port of the module to a new network added.

(e) If the devices that users select have ports which are not connected to any networks, and can be connected to an RS-485 network or an Ethernet network, the system will connect the ports to an Ethernet network.

20.2.3 Adjusting or Deleting Devices or Networks

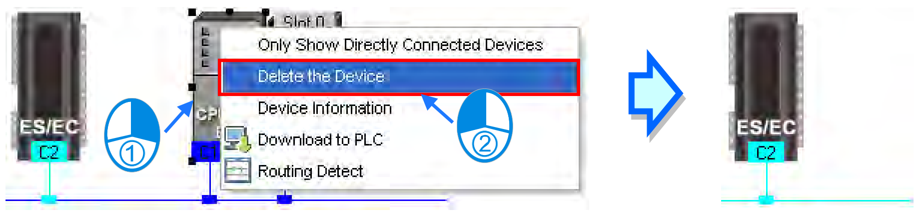
- **Adjusting the order in which the nodes in the working area are arranged**

Users can change the order in which the nodes in the working area are arranged by dragging a node to a different position. The nodes in the working area can only be at the same level, and increase rightwards. The users cannot drag a node to a position above or under another node.

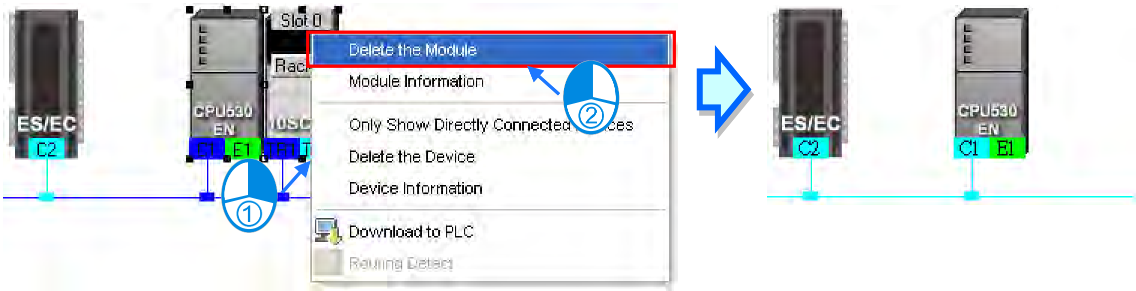


- **Deleting a single device by means of a context menu**

After users right-click a PLC, and click **Delete the Device** on the context menu, the PLC and the modules connected to the PLC will be deleted. However, the PLC for which a project is created and the modules connected to the PLC cannot be deleted.

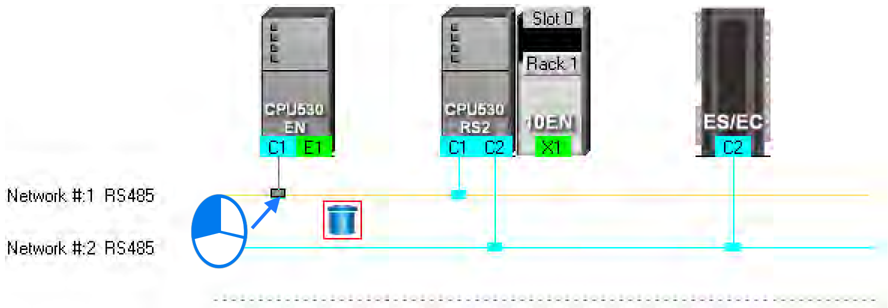


After the users right-click a module, and click **Delete the Module** on the context menu, the module will be deleted.

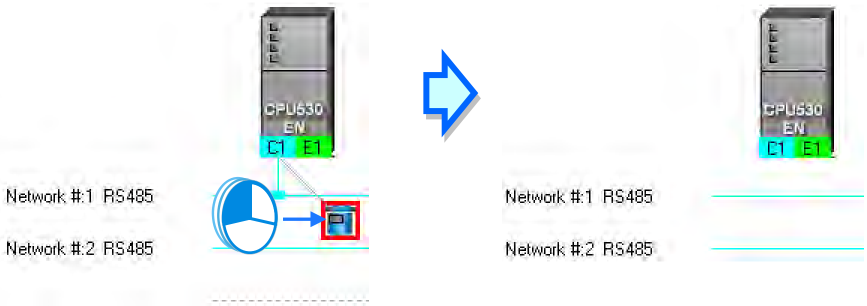


● **Adjusting a connection**

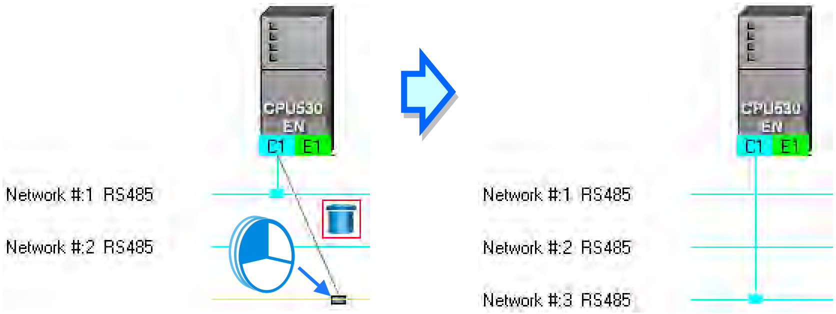
If users press the left mouse button while the mouse cursor hovers over a connection point which connects a network and a port, a small picture representing a trash can and a dotted line will appear.



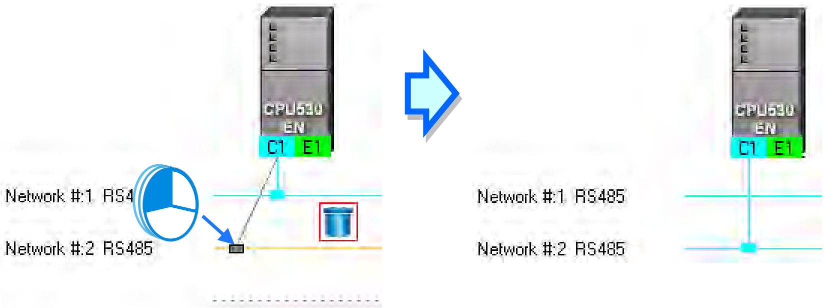
If the users release the left mouse button after they drag the connection point to the small picture representing a trash, the connection between the network and the port will be canceled.



If the users drag the connection point to the dotted line, the system will connect the port to the new network added.

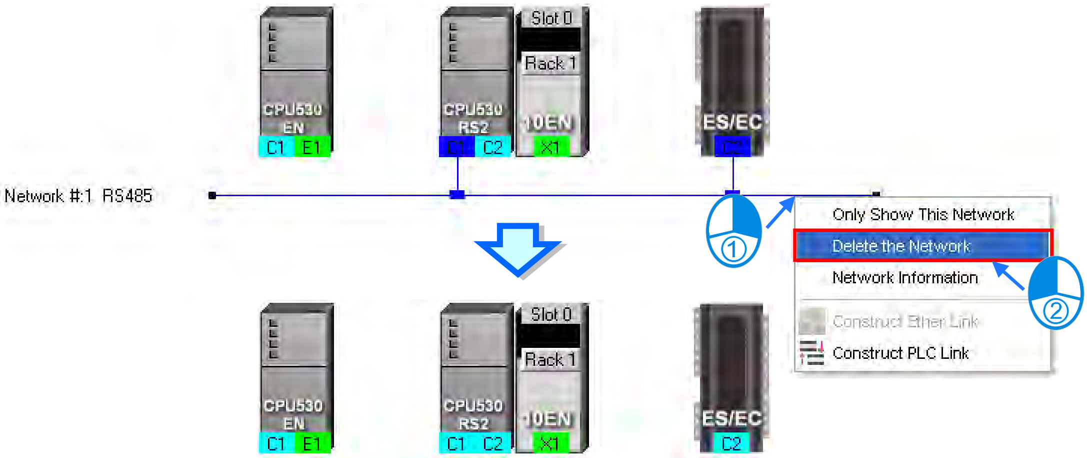


If the users release the left mouse button after they drag the connection point to another network which matches the port, the port will be connected to the network.



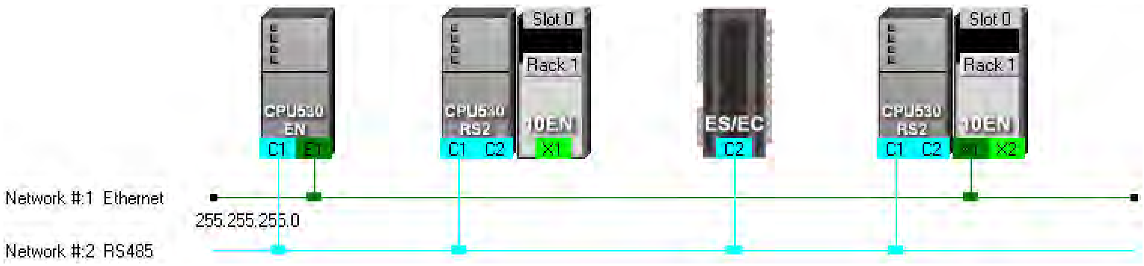
- **Deleting a single network by means of a context menu**

After users right-click a network, and click **Delete the Network** on the context menu, the network and the lines connected to the network will disappear.

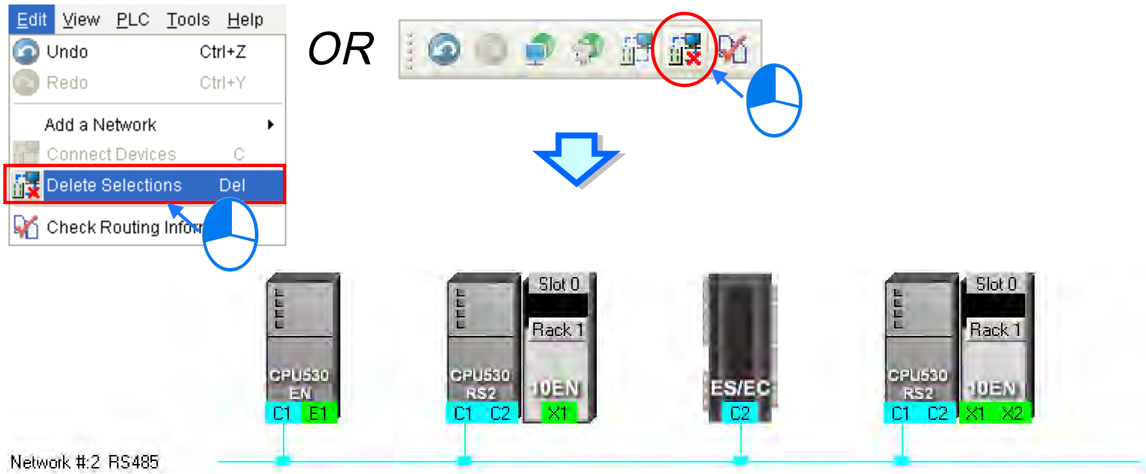


- **Deleting several devices or several networks**

Users can select several objects by holding down Shift on the keyboard. Besides, the users can select multiple devices by dragging a selection net around them, or selecting all the objects in the working area by pressing Ctrl+A on the keyboard.

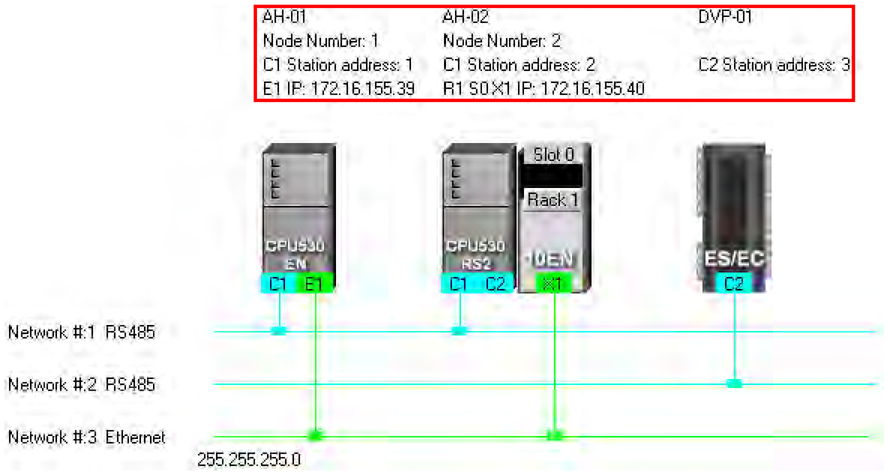


After the users click **Delete Selections** on the **Edit** menu, click on the toolbar, or press Delete on the keyboard, the objects selected will be deleted. However, the PLC for which a project is created and the modules connected to the PLC cannot be deleted. Besides, if a PLC is deleted, the modules connected to the PLC will also be deleted.

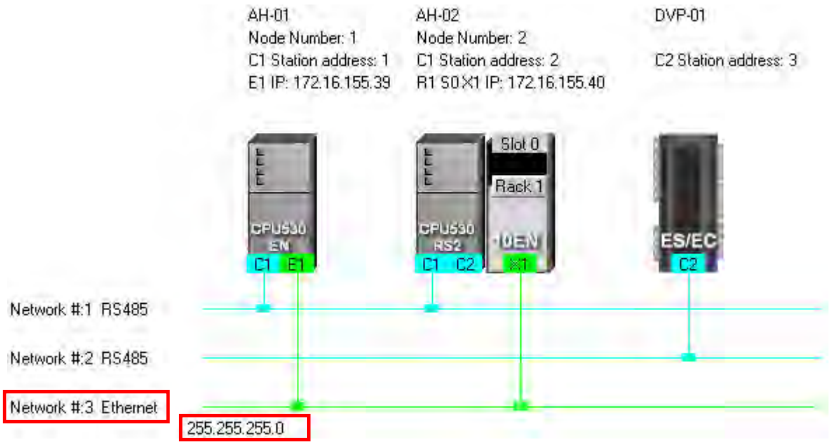


20.2.4 Setting the Attributes of a Node / Network

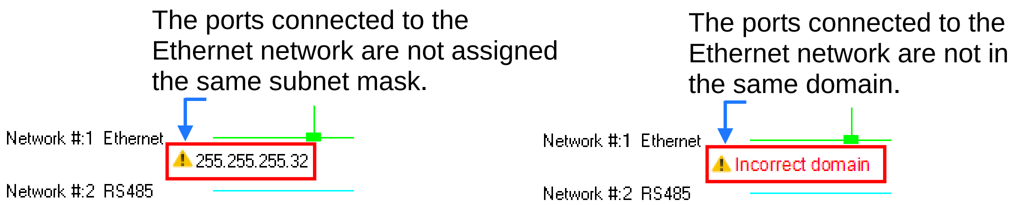
After users deploy the nodes in the NWCONFIG window, the information about the nodes will put above the nodes. The information includes PLC names and node numbers. The attributes of the ports connected to networks are also displayed. If a port is an RS-485 port, a station address will be displayed. If a port is an Ethernet port, an IP address will be displayed. The information about a port will be shown if the port is connected to a network. If a port is not connected to any network, no information about the port will be shown. Besides, if a port of a network module is connected to a network, the information about the slot in which the network module is installed, and the information about the backplane on which the network module is installed will be shown.



In addition to the information about the nodes, the network numbers assigned to the networks and the network types of the networks are shown. If a network is an Ethernet network, the subnet mask assigned to the ports connected to the network will be shown.



If the ports connected to an Ethernet network are not in the same domain, or are not assigned the same subnet mask, a warning sign will appear. If the ports connected to an Ethernet network are not assigned the same subnet mask, the strictest subnet mask will be shown.



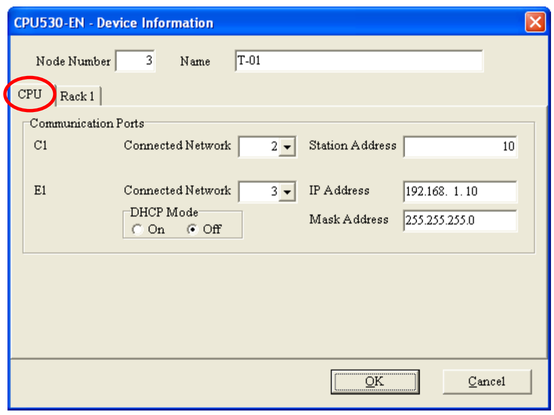
- **Setting the attributes of a node**

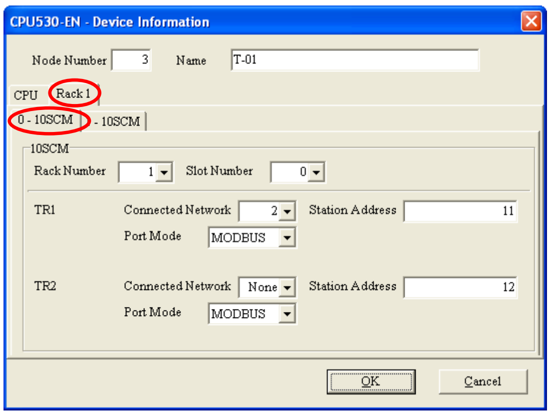
  There are two ways to open the **Device Information** window.

  (a) After users double-click a PLC, the **Device Information** window will appear. The users can also open the **Device Information** window by right-clicking the PLC, and clicking **Device Information** on the context menu.

  (b) After users double click a module, the **Device Information** window will appear. The users can also open the **Device Information** window by right-clicking the module, and clicking **Module Information** on the context menu.

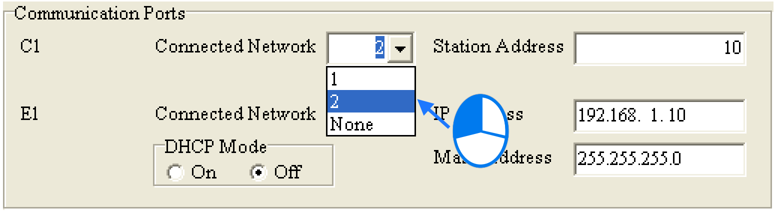
In the **Device Information** window, there are two tabs. The page displayed in the window depends on the device selected.



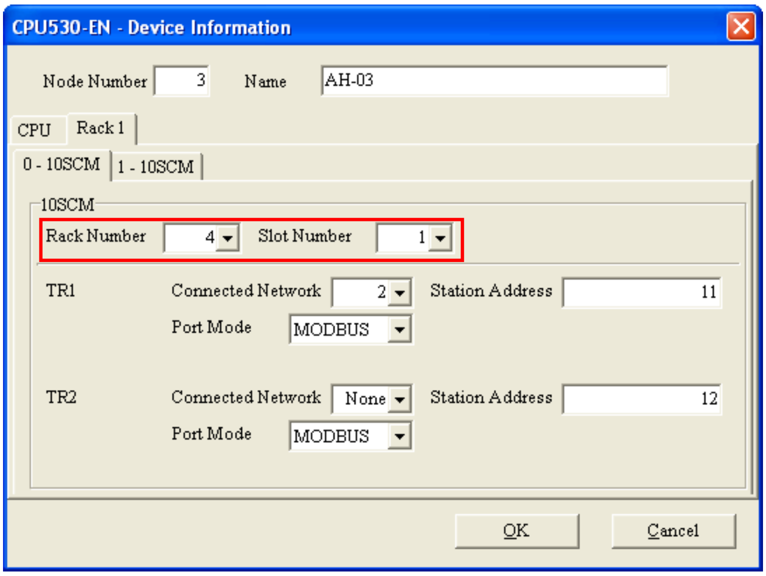


When the device selected based on project setting is AH5x0 series, most of the columns in the property window is greyed, so property settings can only be completed through HWCONFIG.

In the setting page, every communication port has a corresponding **Connected Network number** to choose from the drop-down list box. When **None** is selected, the port connection is deleted.



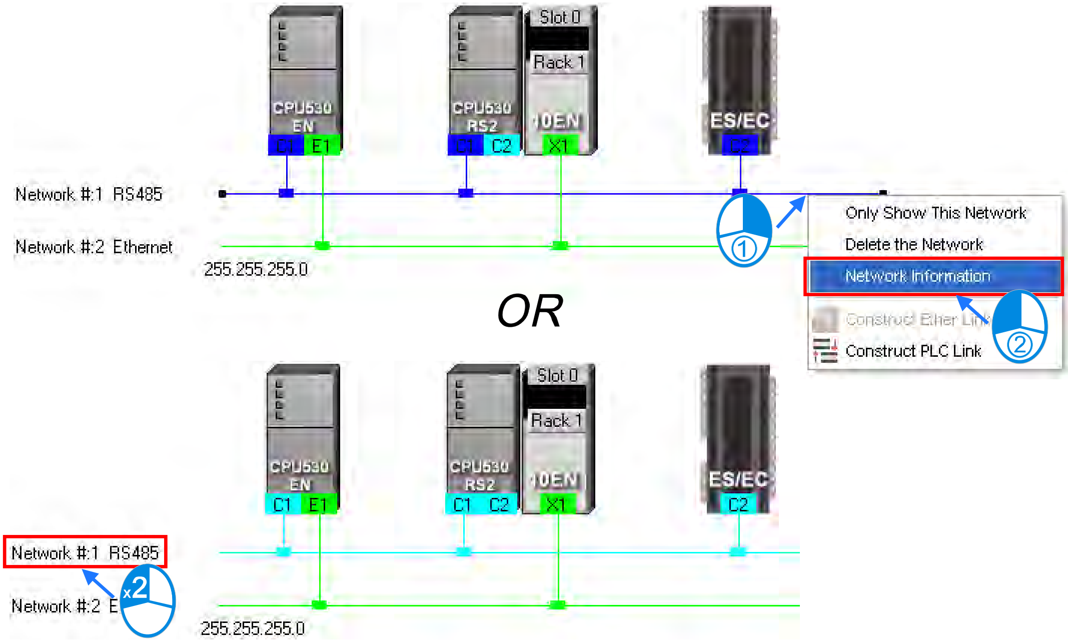
In the page for a module, the users can select a rack number in the **Rack Number** drop-down list box, and a slot number in the **Slot Number** drop-down list box.



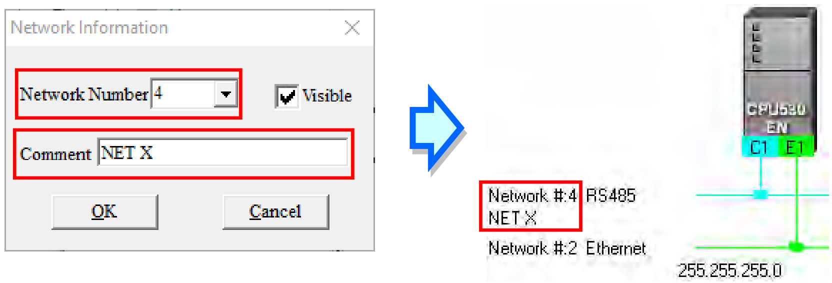
After the users complete the setting of the attributes of a node, and click **OK** in the **Device Information** window, the attributes of the node will be updated immediately.

- **Setting the attributes of a network**

After users double-click a network, the **Network Information** window will appear. The users can also open the **Network Information** window by right-clicking the network, and clicking **Network Information** on the context menu.



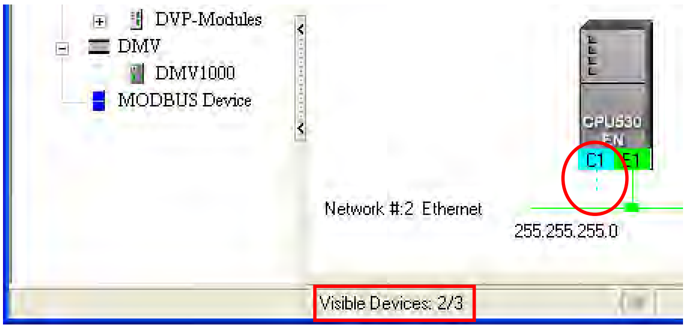
In the **Network Information** window, the users can select a network number which is not assigned to any network in the **Network Number** drop-down list box. Besides, the users can type a comment in the **Comment** box. After the users complete the setting of the attributes of the network, and click **OK** in the **Network Information** window, the attributes of the network will be updated immediately.



Un-click **Visible** in the **Network Information** window, the network will be hidden and connected communication ports are displayed in dotted lines.

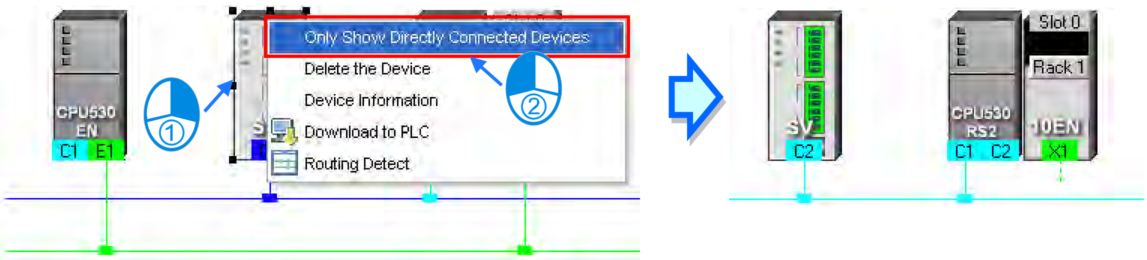
20.2.5 Hiding / Displaying Devices or Networks

Users can hide/display devices or networks in the working area. The number of devices visible and the total number of devices are displayed in the status bar. Besides, if a dotted line is connected to a port of a device, the port is connected to an invisible network.



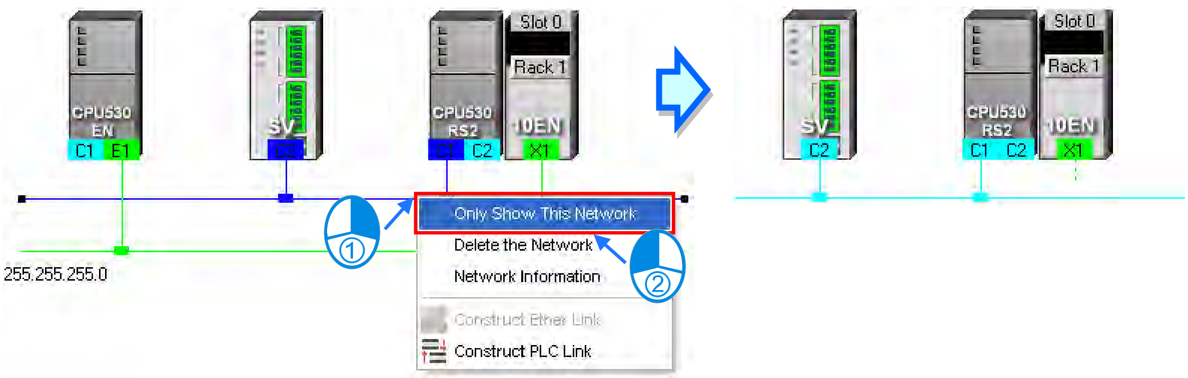
- **Only displaying the objects connected to a device**

  After users right-click a node, and click **Only Show Directly Connected Devices** on the context menu, only the network and the devices which are connected to the node will be displayed.



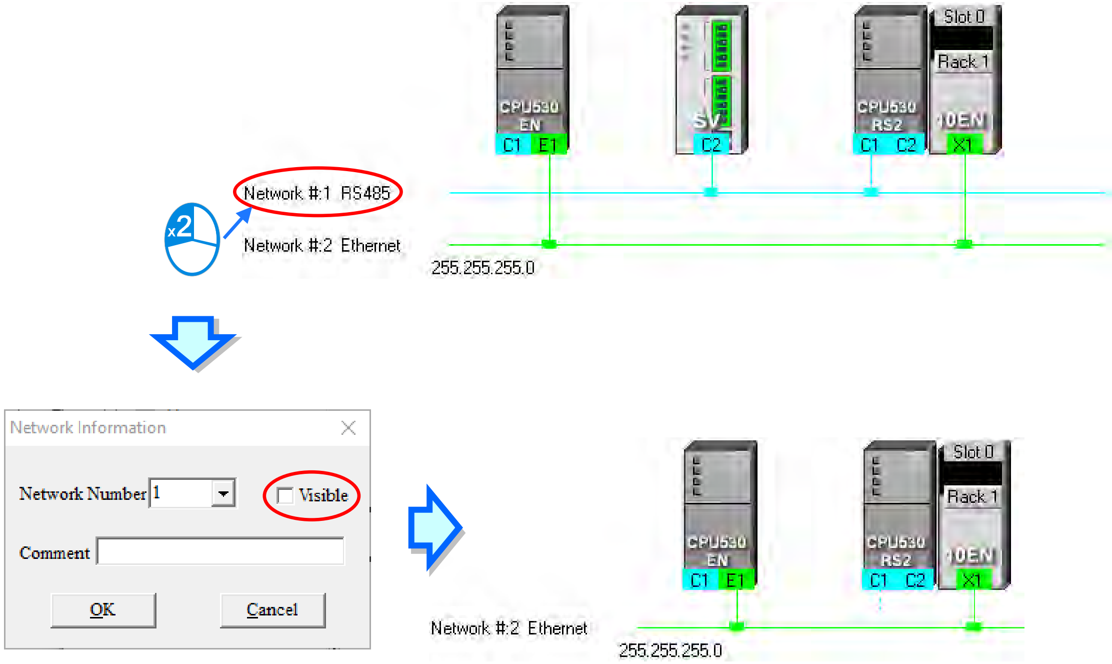
- **Only displaying the devices connected to a network**

  After users right-click a network, and click **Only Show This Network** on the context menu, only the devices connected to the network will be displayed.



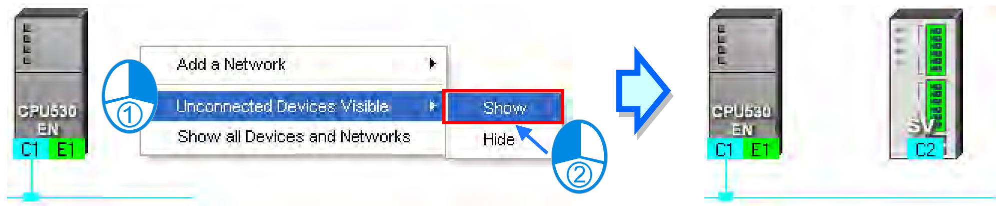
- **Hiding a network and the devices connected to the network**

Unclick **Visible** in the **Network Information** window, the network is hidden and connected communication ports are displayed in dotted lines.



- **Hiding/Displaying the devices which are not connected to any networks**

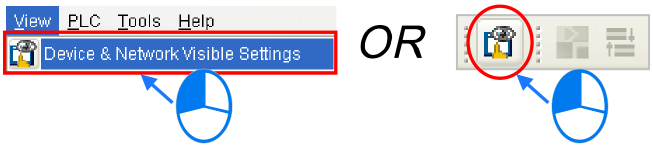
If users want to hide/display the devices which are not connected to any networks, they can right-click the working area, point to **Unconnected Devices Visible** on the context menu, and click **Hide**/**Show**. This operation affects the devices in the present working area. It does not affect the devices which will be added latter.



- **Setting the display states of all the objects at the same time**

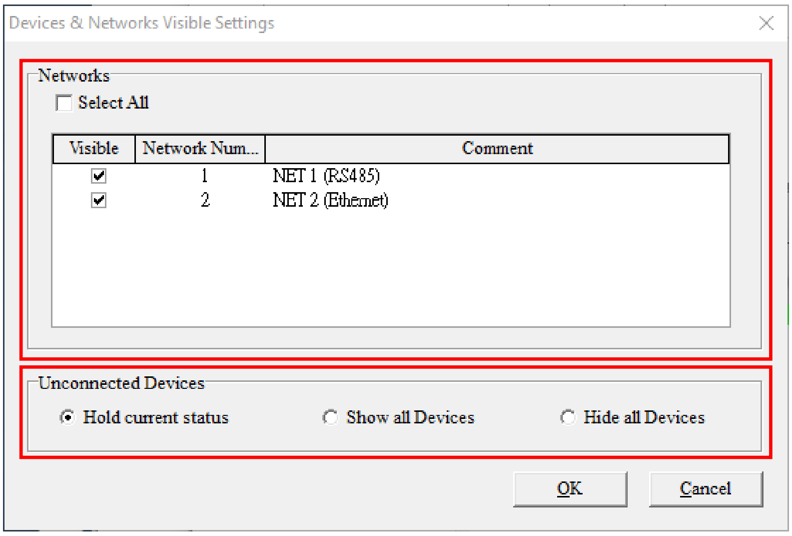
Users can set the display states of all the devices at the same time.

Click **Device & Network Visible Settings** on the **View** Menu, or  on the toolbar.



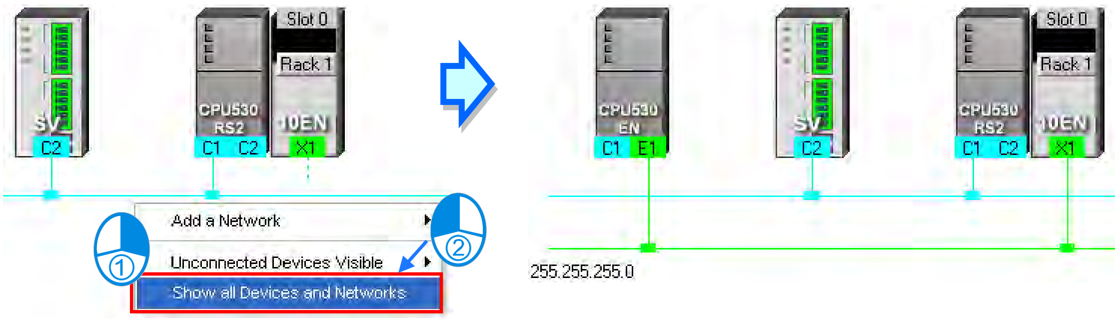
Select networks which will be displayed in the **Networks** section in the **Devices & Networks Visible Settings** window. The networks which are not selected will not be displayed in the working area. If the users select the **Select All** checkbox, all the networks in the **Networks** section will be selected. If the users unselect the **Select All** checkbox, all the networks in the **Networks** section will be unselected.

In the **Unconnected Devices** section, the users can set the display states of the devices which are not connected to any networks. This operation affects the devices in the present working area. It does not affect the devices which will be added latter.



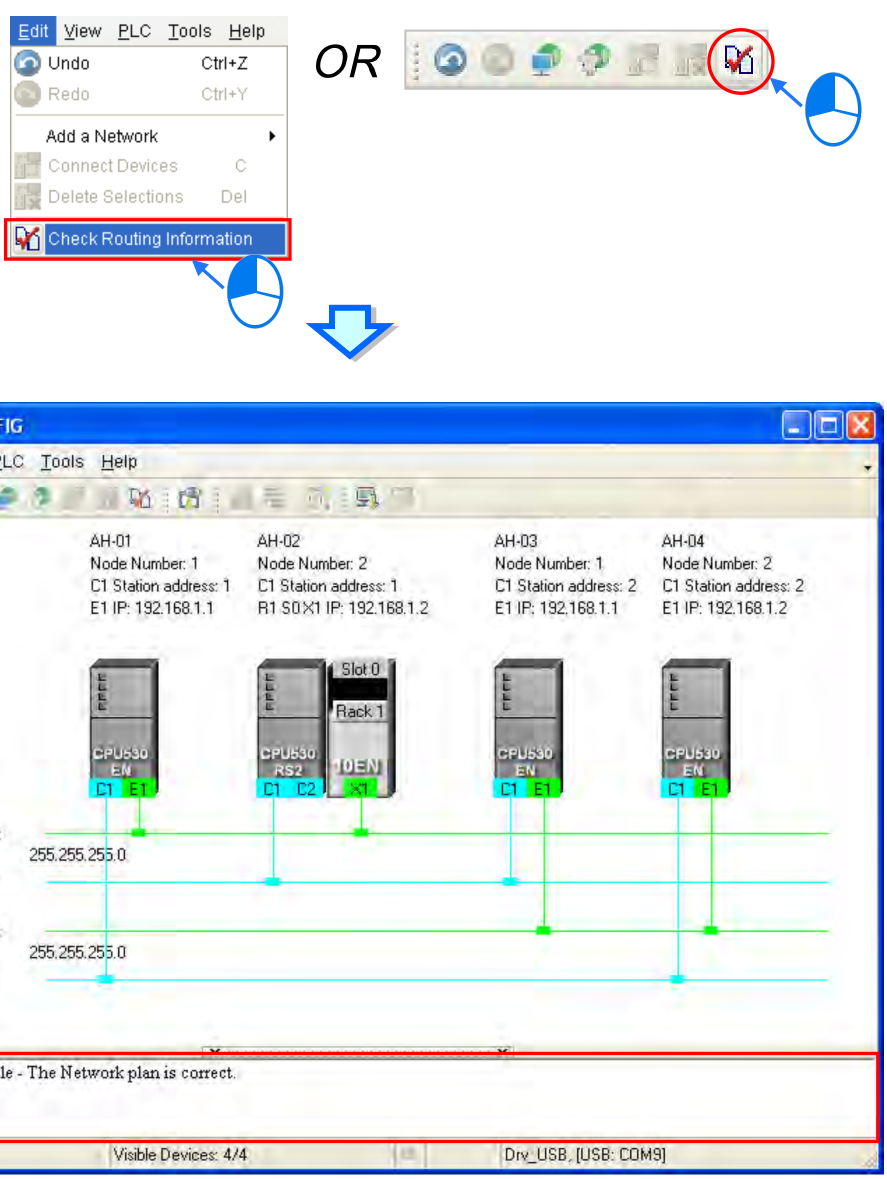
- **Displaying all the objects**

After users right-click the blank in the working area, click **Show All Devices and Networks** on the context menu, the devices and the networks which are hidden will be displayed.



20.2.6 Correct Network Architecture

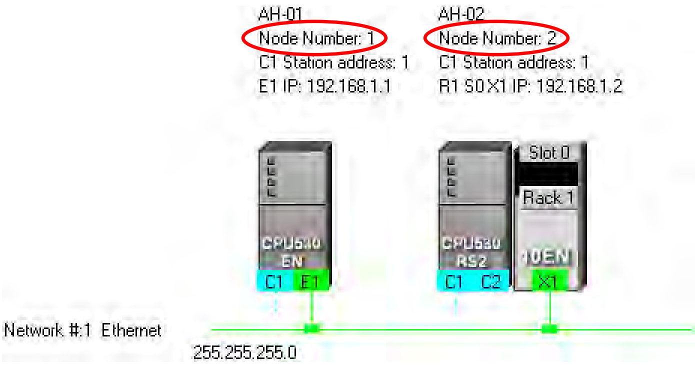
After users click **Check Routing Information** on the **Edit** menu, or on the toolbar, the system will check whether the network architecture the users create is correct, and the check result will be displayed in the message display area.

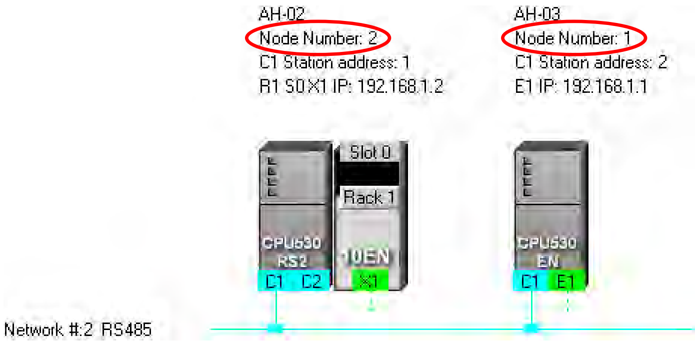


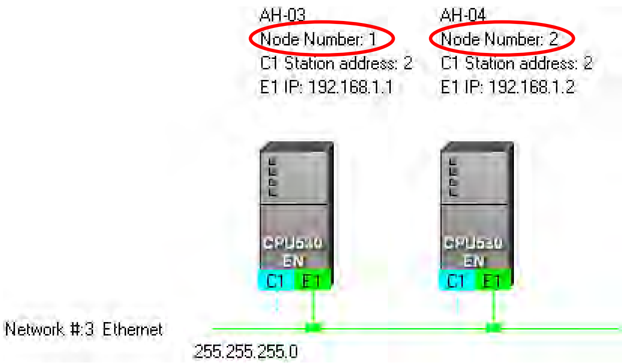
When checking, the system only focuses on the connected ports or the nodes and internet information in the Graphic Workspace for confirmation. The items to check include **nodes number, RS485 station address and IP address.** From the above image, the issue of repetition in nodes number, RS485 station address and IP address appears, therefore, we can check an internet one at a time to make sure that it is connected to the same node on the internet and the **nodes number, RS485 station address and IP address** are not repeated.

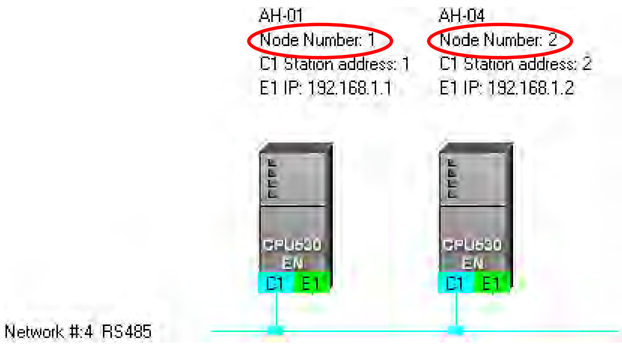
- **Node number**

In principle, the node number assigned to a node in a network cannot be the same as the node number assigned to another node in the network. If users view a network at a time, they can check whether the node number assigned to a node connected to a network is the same as the node number assigned to another node connected to the network.



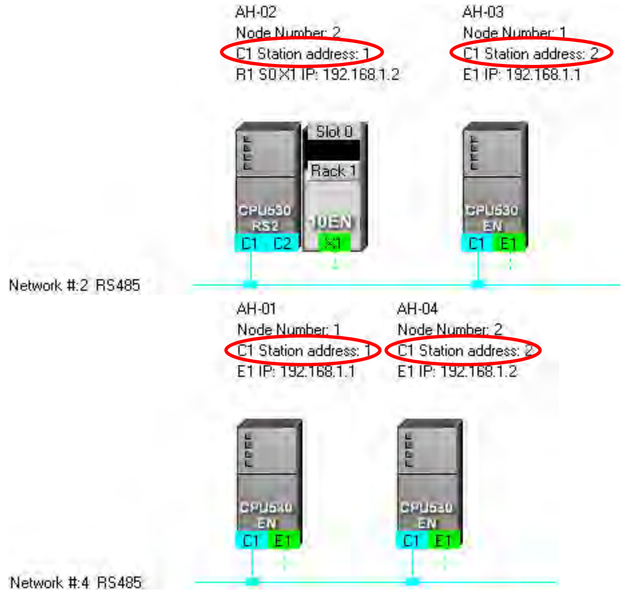






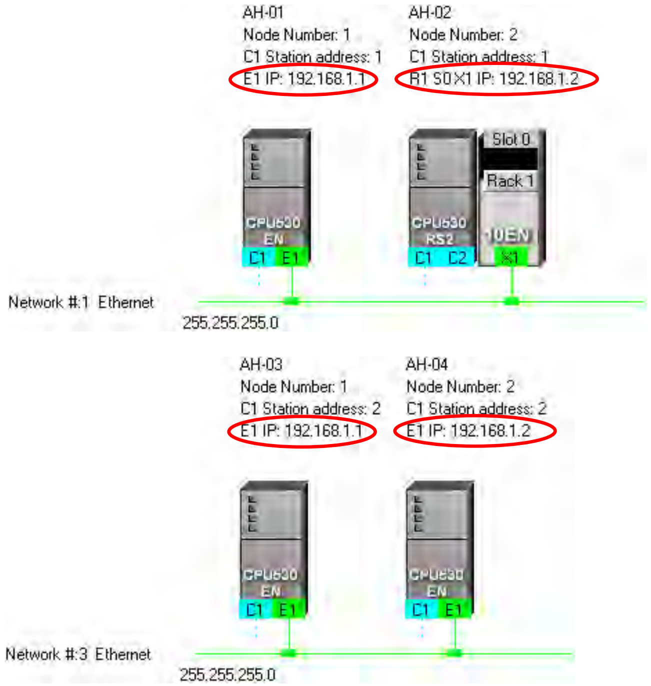
- **RS-485 station address**

In principle, the RS-485 station address of a port in a network cannot be the same as the RS-485 station address of another port in the network. If users view an RS-485 network at a time, they can check whether the RS-485 station address of a port in a network is the same as the RS-485 station address of another port in the network.



- **IP address**

The IP address of a port in a network cannot be the same as the IP address of another port in the network. If users view an Ethernet network at a time, they can check whether the IP address of a port in a network is the same as the IP address of another port in the network.



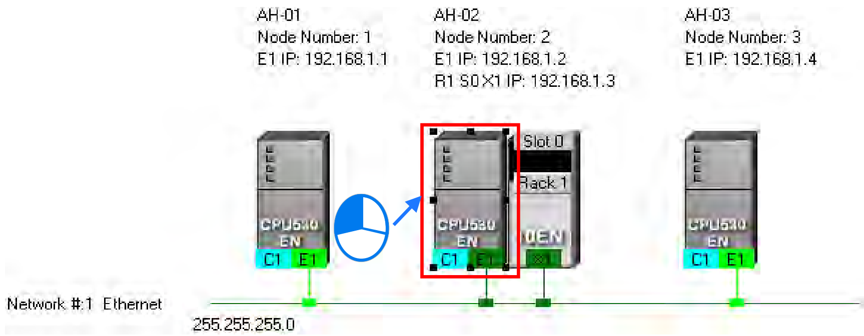
20.2.7 Downloading Routing Tables

After users make sure that the network architecture they create is correct, they can download the routing tables produced to PLCs. The routing data stored in a PLC is data related to the PLC itself, and therefore the routing tables downloaded to nodes are different. The users have to download the routing tables produced to nodes in the working area.

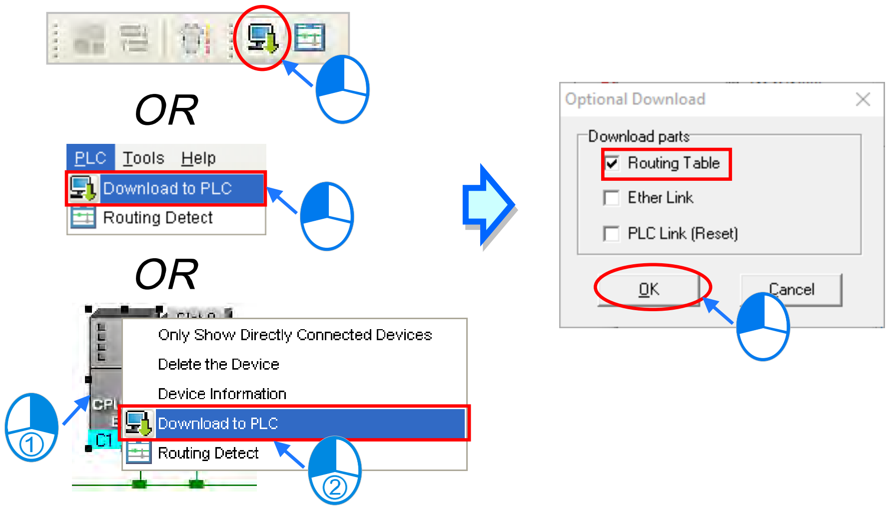
The users can download the routing tables produced to nodes one by one, or download the routing tables produced to nodes at the same time. If the users want to download the routing tables produced to nodes, the **Routing Mode** checkbox in the **Select a Driver** window must be unselected.

- **Single node**

  First, select a node to download and click on the node in the host part from the graphic workspace. Since the routing function only supports AH5x0 series, therefore, selecting other PLC types or devices will be unable to download the **Routing Table**.

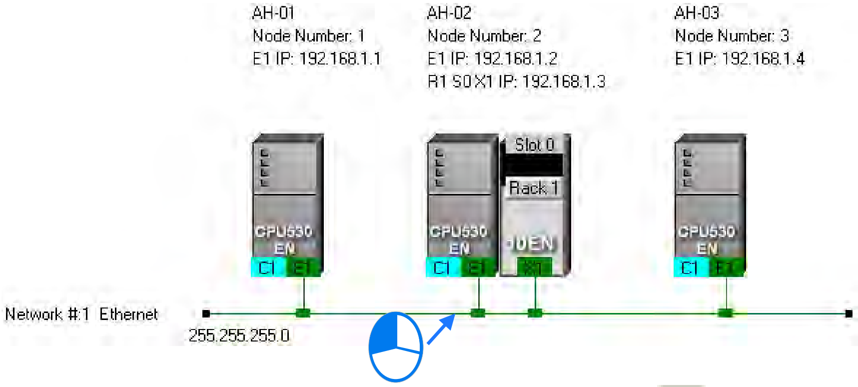


  After the users click **Download to PLC** on the **PLC** menu, or on the toolbar, the **Optional Download** window will appear. The users can also open the **Optional Download** window by right-clicking the device they select, and clicking **Download to PLC** on the context menu. After the users select the **Routing Table** checkbox in the **Optional Download** window, and click **OK**, a routing table will be downloaded to the device.

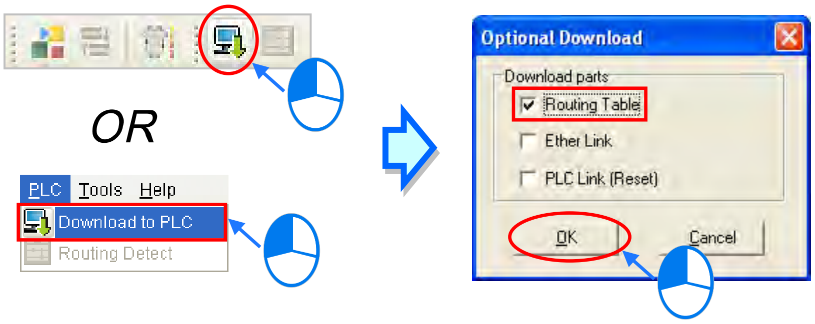


- **Multiple nodes**

The COMMGR Driver has to be under Ethernet structure in the communication setting. Then, choose an Ethernet network from the graphic area and parameters can download to connected nodes.



After the users click **Download to PLC** on the **PLC** menu, or on the toolbar, the **Optional Download** window will appear. Select the **Routing Table** checkbox in the **Optional Download** window, and click **OK**, the routing tables produced will be downloaded to the nodes connected to the Ethernet network.



Additional remark

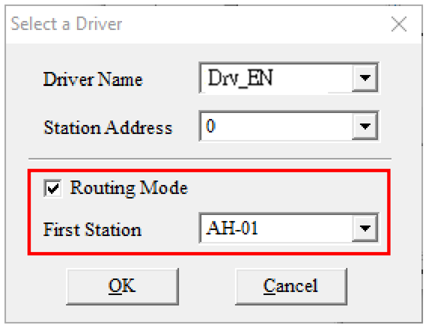
If the parameters related to an Ether Link or a PLC Link can be downloaded to the object selected, users can select the **Ether Link** checkbox or the **PLC Link (Reset)** checkbox in the **Optional Download** window. If a checkbox in the **Optional Download** window is gray, the checkbox cannot be selected. Please refer to the following sections for more information about Ether Links and PLC Links.

Besides, the routing data stored in a PLC is data related to the PLC itself. The users cannot upload the routing data stored in a PLC. The system does not provide the function of uploading routing data.

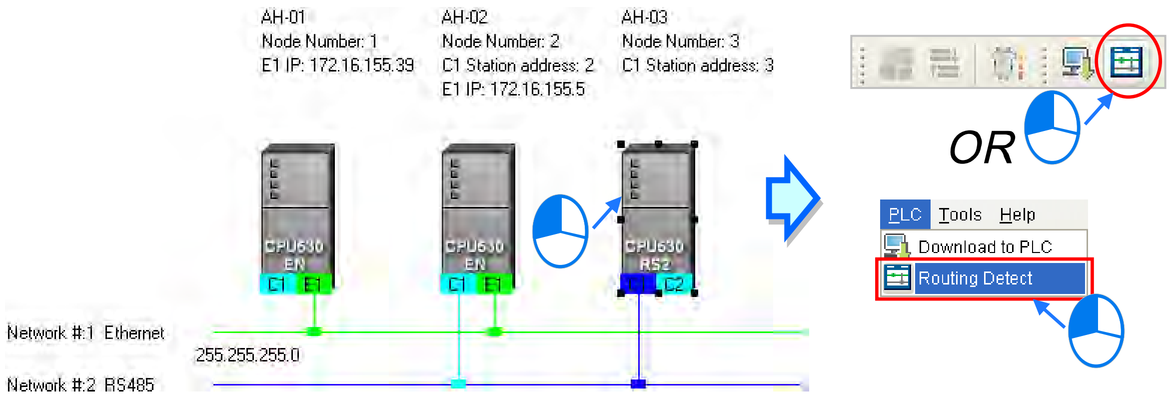
20.2.8 Testing Routing

After the routing tables produced are downloaded, users can test routing by means of a function provided by NWCONFIG. The steps of testing routing are as follows.

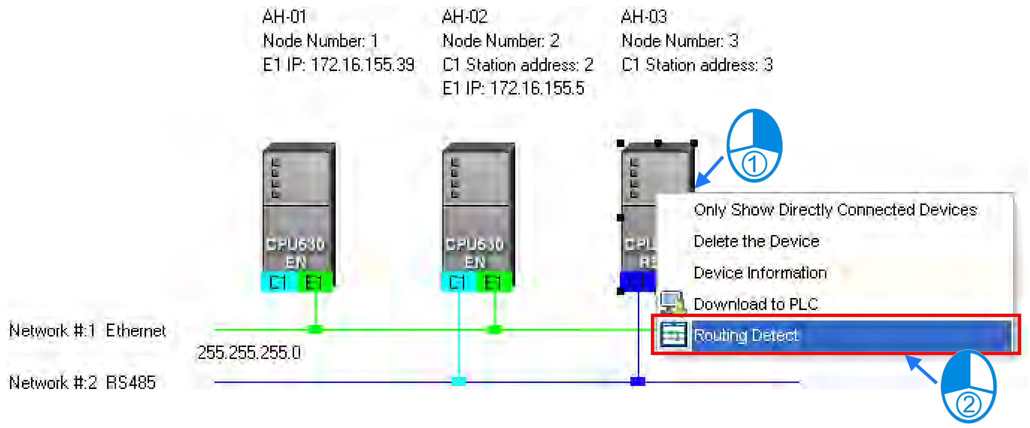
(1) The users have to make sure that all the nodes are wired according to the configuration in NWCONFIG, and operate normally. The setting of the devices has to be consistent with the setting in NWOCNIFG. In the **Select a Driver** window, the users have to select the **Routing Mode** checkbox, and select a device in the **First Station** drop-down list box.



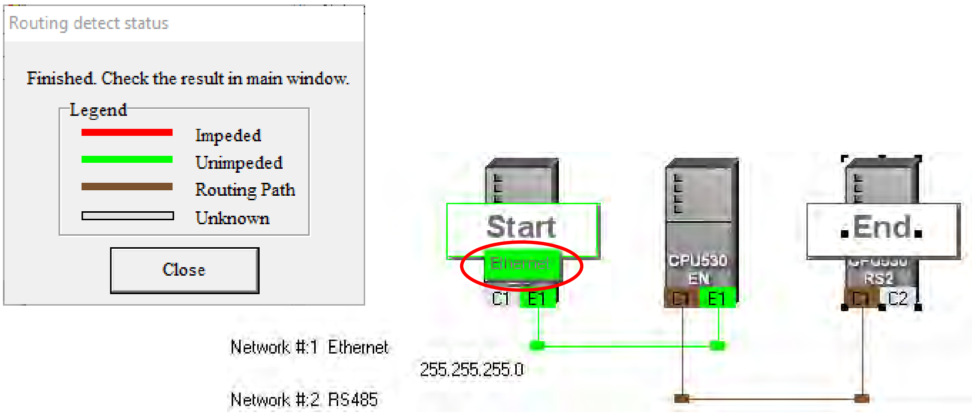
(2) After the users select the destination device toward which packets are relayed, they have to click on the toolbar, or **Routing Detect** on the **PLC** menu.



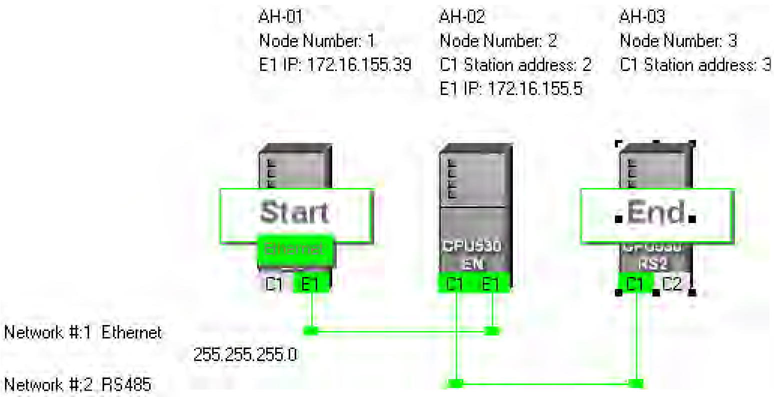
The users can also right-click the destination device, and then click **Routing Detect** on the context menu.



(3) After **Routing Detect** is clicked, the display of the network architecture in the working area will change, and the **Routing detect status** window will appear. Please see the red circle in the figure below.



(4) After the detection is complete, the detection result will be shown in the working area.



Additional remark

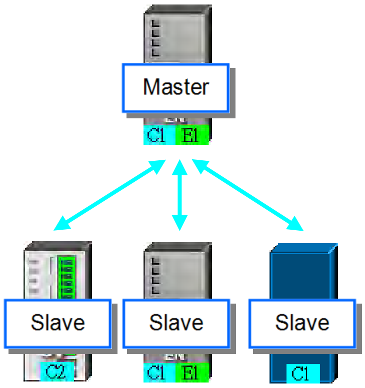
If the detection fails, the users have to make sure of the following points.

(a) Please confirm hardware configuration is the same as NWCONFIG configuration and every node is correctly connected to the internet and functioning.

20.3 Constructing a PLC Link

A PLC Link is a network mechanism for data exchange performed through an RS-485 cable. If there are several nodes in an RS-485 network, users can create a mechanism for data exchange in the network. If the parameters which are set are downloaded to the PLC which functions as a master station, the system of the PLC will perform data exchange through special relays and special registers when the PLC runs.

A PLC Link is a master/slave model. There is only one master station in an RS-485 network, and the other stations which are slave stations passively receive reading/writing commands from the master station. The slave stations cannot exchange data. They have to exchange data through the master.

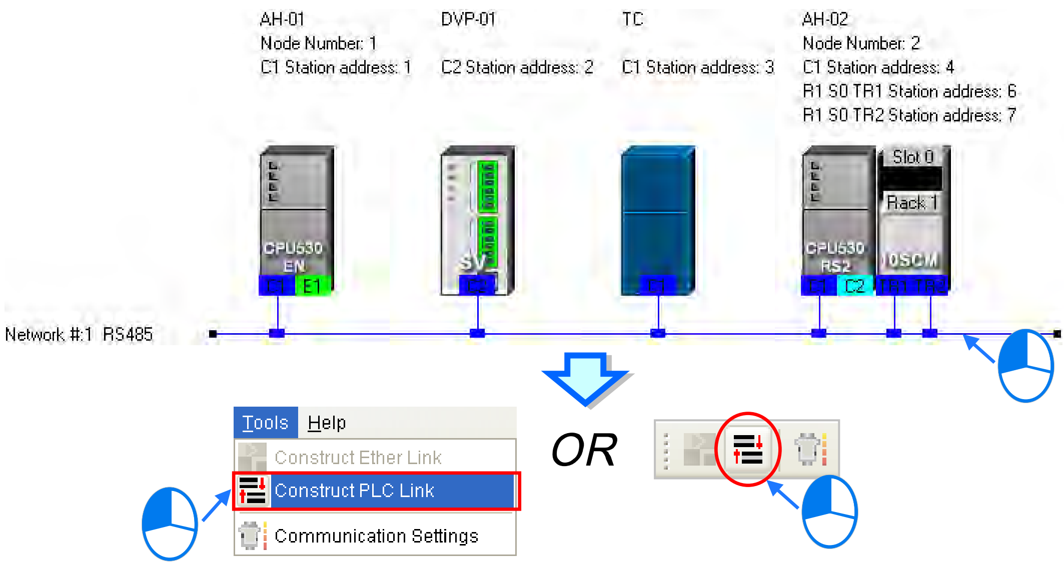


20.3.1 Opening the PLC Link Table Editor Window

Before creating a PLC Link, users have to make sure that all the network setting is correct. Please use one of the methods described below.

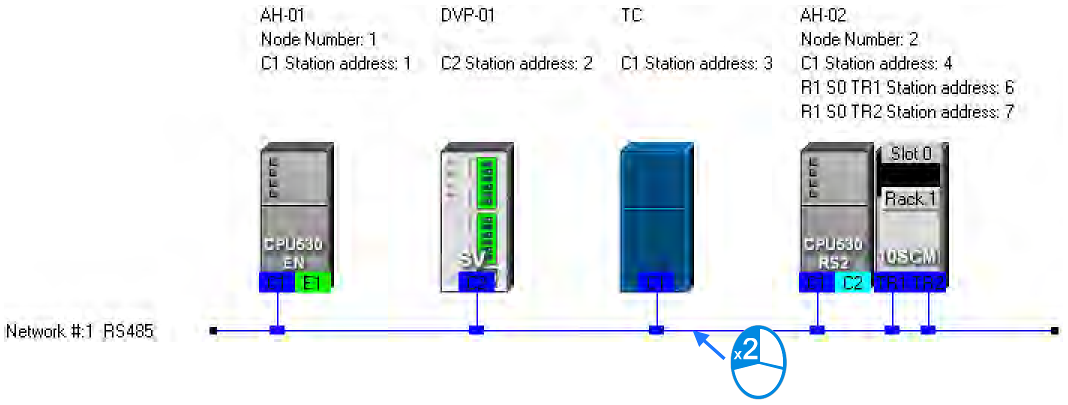
- **Method 1**

  After the users select a network, they have to click **Construct PLC Link** on the **Tools** menu, or on the toolbar.



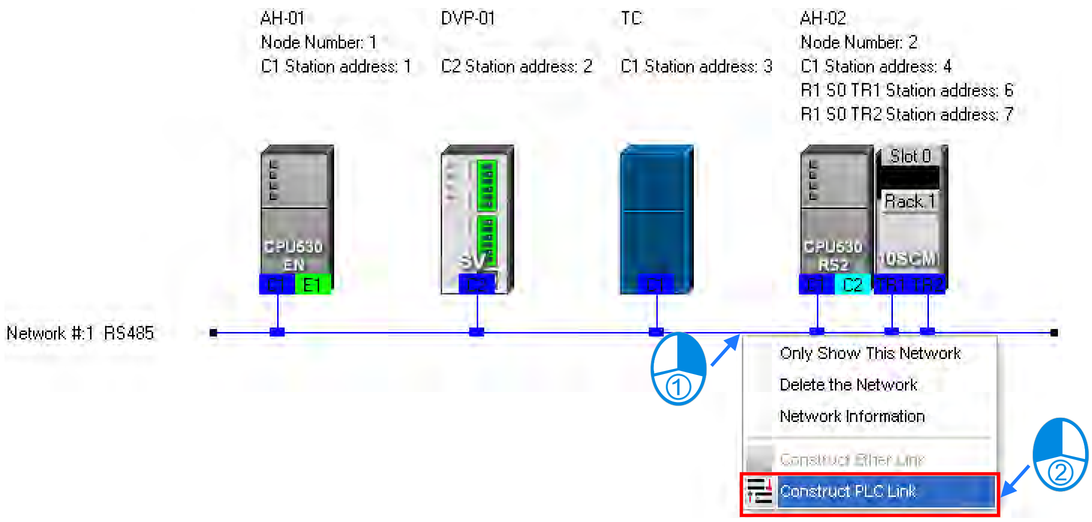
- **Method 2**

Double-click a network.



- **Method 3**

Right-click a network, and then click **Construct PLC Link** on the context menu.

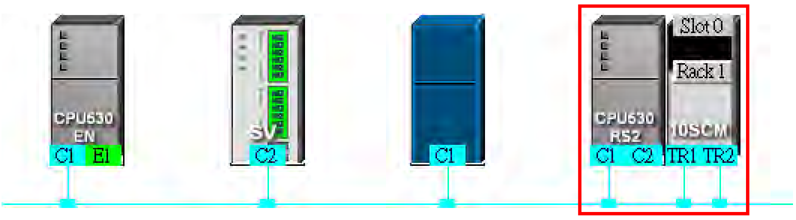


After the users use one of the methods described above, the **PLC Link Table Editor** window will be opened. The **PLC Link Table Editor** window leads the users to construct a PLC Link step by step. The steps of constructing a PLC Link are designating a port as a master station, setting communication parameters, and creating a data exchange table. The system leads the users to the operation screen displayed last time as soon as the **PLC Link Table Editor** window is opened. As a result, if the users construct a PLC Link for the first time, the screen displayed will lead the users to accomplish the first step.

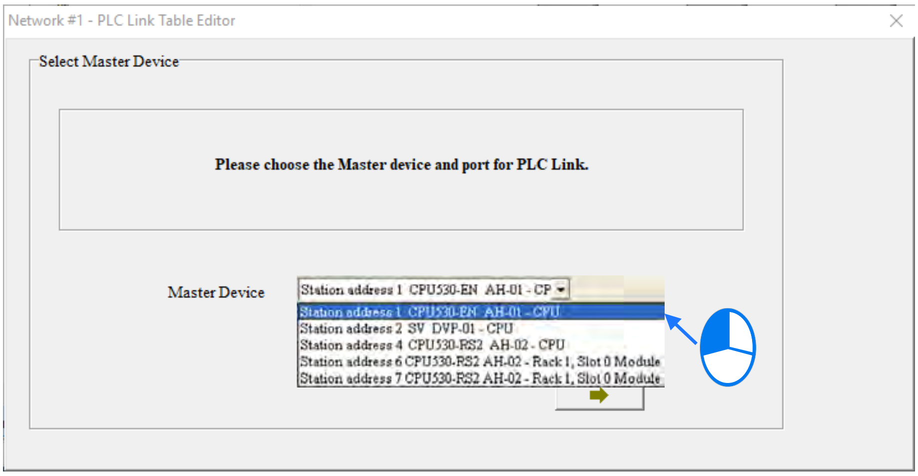
Besides, a PLC Link is executed through special relays and special registers. The construction tool introduced here is just a friendly user interface which helps users download the parameters related to a PLC Link to the related special relays and the related special registers. The exact execution of a PLC Link depends on the special relays and the special registers in a PLC. To ensure that the PLC Link constructed can operate normally, users have to make sure of the functions of the PLCs and the limitations of the PLCs with regard to the PLC Link.

20.3.2 Select Master Station Device (Step 1)

Only an AH5x0 series CPU module, an AH500 series module, a DVP series PLC, or a DVP series module can be designated as the master station. Not all ports of a PLC or a module can be designated as the master station, and therefore users have to read the usage of the PLC or the module before they designate a port as the master station. Besides, if some of the ports of a node can be designated as masters, the PLC which is a part of the node will execute the PLC Link no matter what port is designated as a master station.



(1) Select a port of a node in the **Master Device** drop-down list box. Only the ports which can be designated as master stations are listed.

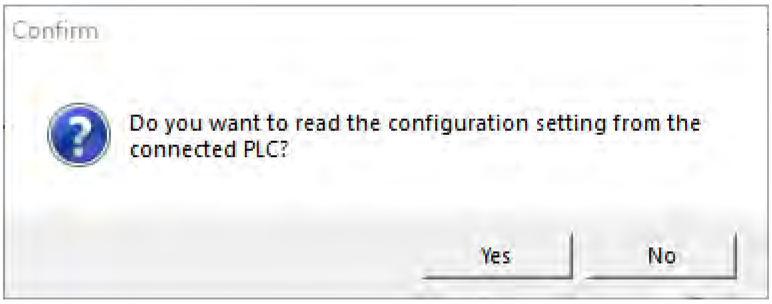


(2) After users click [➡], the system will ask the users whether they want to upload the setting related to a PLC Link through the master station. If the users click **No**, they will be led to the second step. If the users click **Yes**, the setting related to a PLC Link in the PLC which is a part of the node will be uploaded through the master station, and the data uploaded will be displayed on the screen after the users are led to the third step. Before the users upload the data, they have to make sure of the following points.

(a) The users have to make sure that the computer and the port designated as a master station are connected by means of a communication cable.

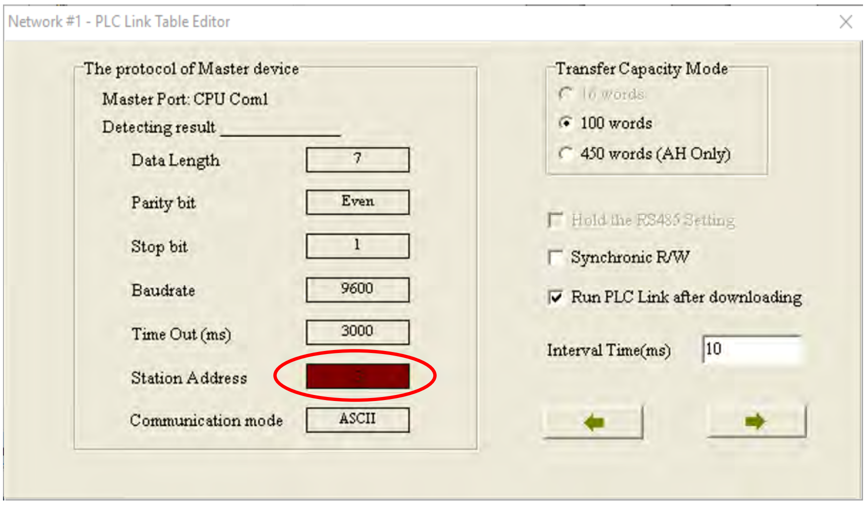
(b) The users have to make sure that a driver has been created correctly, and the driver status is OK.

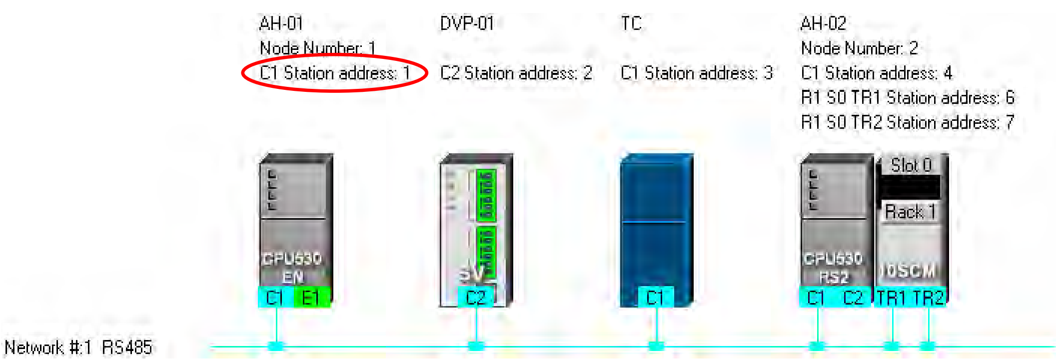
(c) The users have to make sure that they have completed the communication setting in NWCONFIG.



20.3.3 Communication Parameter Settings (Step 2)

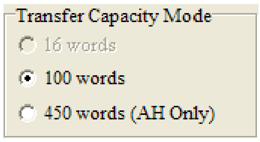
After the system leads users to the second step, the users have to set the communication parameters in the **PLC Link Table Editor** window. The parameters uploaded through the master station are displayed at the left part of the window. The setting of the communication parameters of all the slave stations in the same network must be the same as the setting of the communication parameters of the master station. If no parameters are uploaded, “Unknown” will be shown in the boxes at the left part of the window. If the station address uploaded is different form the station address assigned o the master station, the **Station Address** box will become red.





- **Transfer Capacity Mode**

The users can set 16 data exchange groups or 32 data exchange groups, depending on the model selected. The users can select a maximum data length in the **Transfer Capacity Mode** section. Besides, the maximum data length which can be set varies with the PLC which is designated as a master station. Please refer to manuals for more information.



Setting	Description	DVP	AH5x0
16 Words	A single data exchange transfer capacity length is 16 Words. Use only Device D.	V	V
100 Words	A single data exchange transfer capacity length is 100 Words. Use only Device D.	V	V
450 Words	A single data exchange transfer capacity length is 450 Words and can use Device M, D or L. The device type for master and slave station can be different.		V

- **Hold the RS485 Setting**

The communication parameters in a DVP series PLC will be restored to the default values if the DVP series PLC is turned on after a power failure. However, if the **Hold the RS485 Setting** checkbox is selected, the host will switch from STOP to RUN and re-download the saved communication parameters; for more information on DVP COM port communication parameters, please refer to manuals regarding PLC types.

- **Synchronic R/W**

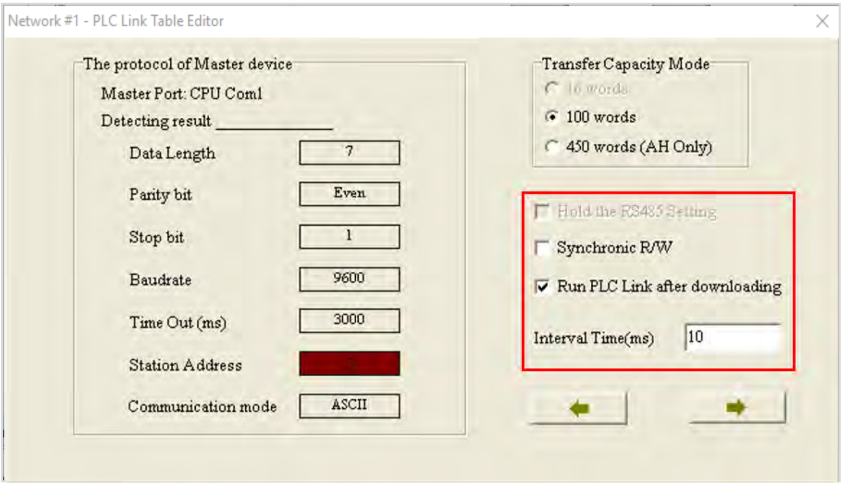
A master station sends a writing command and a reading command to a slave station separately. If the **Synchronic R/W** checkbox is selected, the master station can complete reading and writing simultaneously by means of a specific Modbus function code (the hexadecimal code 17), and the efficiency of data exchange is increased. However, the users have to make sure that the devices involved in data exchange support the Modbus function code before they select the **Synchronic R/W** checkbox. If the devices do not support the Modbus function code, the Modbus code cannot be identified, and the reading/writing of data will fail after they receive the commands from the master station. For mode, choose 450 Words or users can only select Device D to enable **Synchronic R/W.**

- **Run PLC Link after downloading**

Select **Run PLC Link after downloading**. When finish planning PLC Link, download to hosts will also enable PLC Link.

- **Interval Time (ms)**

The users can specify how often the master station sends a command.

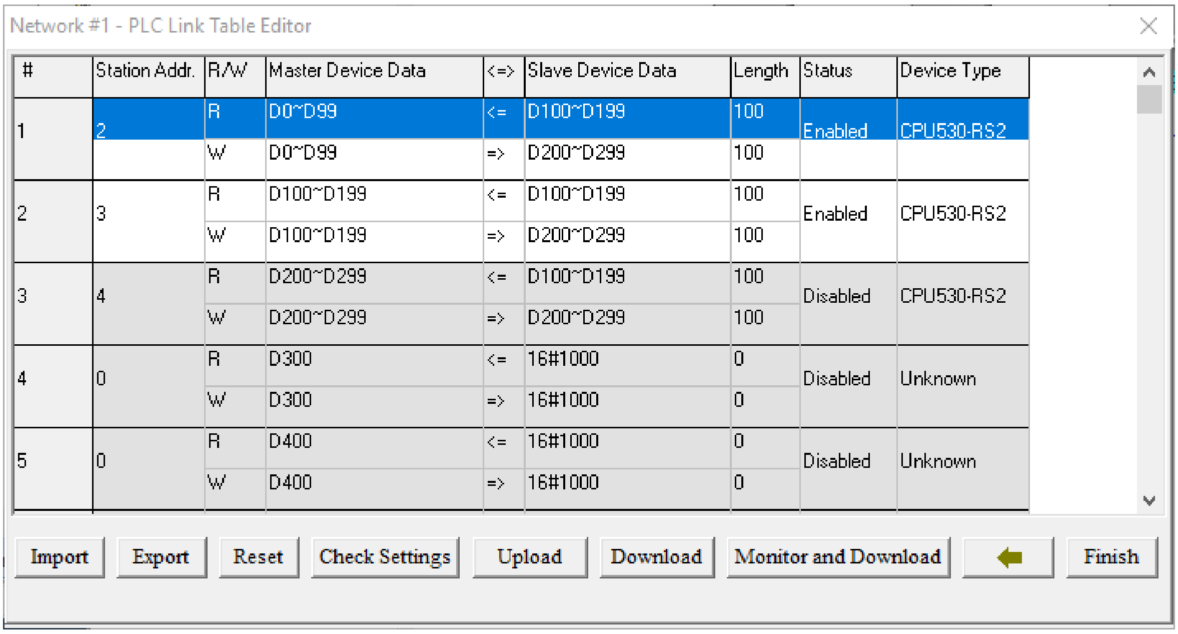


After the users click [→], the system will lead the users to the next step. If the users click [←], the system will lead the users to the previous step.

20.3.4 Create Data Exchange Table (Step 3)

20.3.4.1 Introduction of a Data Exchange Table

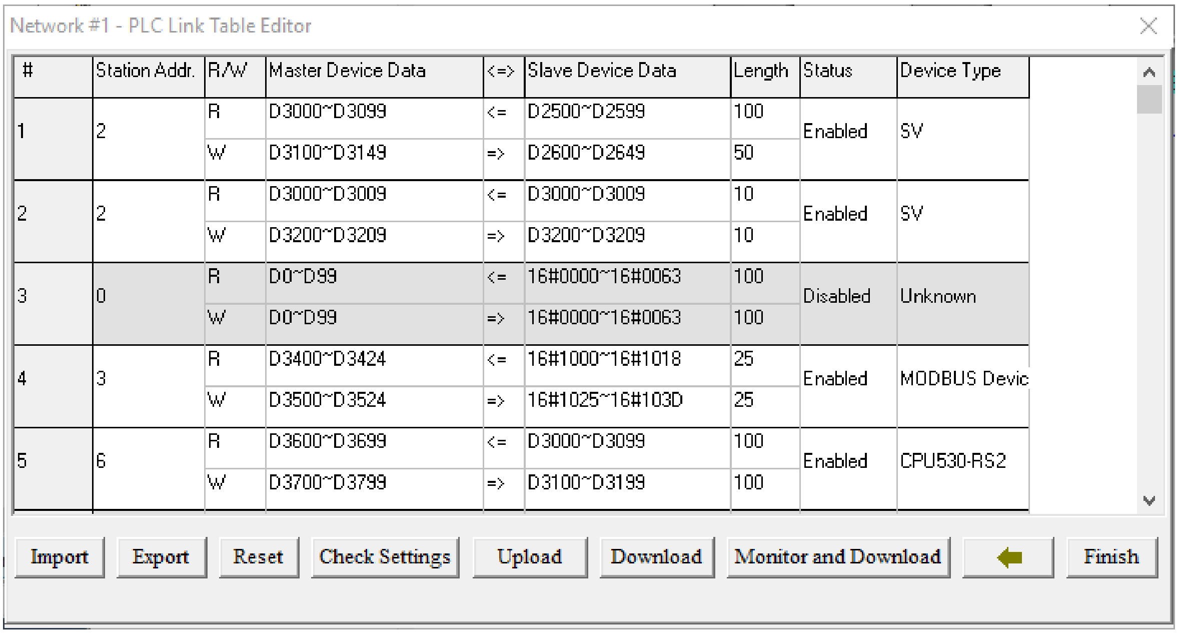
The table below is a data exchange table. When a PLC Link is executed, the master station sends reading/writing commands to the slave stations according to the data exchange table created.



#	Station Addr.	R/W	Master Device Data	<=>	Slave Device Data	Length	Status	Device Type
1	2	R	D0~D99	<=	D100~D199	100	Enabled	CPU530-RS2
		W	D0~D99	=>	D200~D299	100		
2	3	R	D100~D199	<=	D100~D199	100	Enabled	CPU530-RS2
		W	D100~D199	=>	D200~D299	100		
3	4	R	D200~D299	<=	D100~D199	100	Disabled	CPU530-RS2
		W	D200~D299	=>	D200~D299	100		
4	0	R	D300	<=	16#1000	0	Disabled	Unknown
		W	D300	=>	16#1000	0		
5	0	R	D400	<=	16#1000	0	Disabled	Unknown
		W	D400	=>	16#1000	0		

Column	Description
Serial Number (#)	The data exchange groups in the data exchange table in the **PLC Link Table Editor** window are numbered. Users can set 16 data exchange groups or 32 data exchange groups, depending on the model selected.
Station Addr.	Indicate the station address for data exchange group. The same station address can contain multiple sets of slave station from different sections. Besides, the station address 0 represents an undefined slave station, and is not a broadcast station address.
R/W	R: The master station reads the data in devices in a slave station. W: The master station writes data into devices in a slave station.
Master Device Data	The range of devices which are used in the master station is indicated.
<=>	<=: The master station reads the data in devices in a slave station. =>: The master station writes data into devices in a slave station.
Slave Device Data	The devices which are used in a slave station are indicated. If a slave station is a user-defined Modbus device, the devices used will be represented by hexadecimal addresses.
Length	A data length is indicated. A length indicates the number of devices used.
Status	Users can decide whether to involve a data exchange group in data exchange. If a data exchange group is set incorrectly, the data exchange group will not be involved in data exchange. If a data exchange group is not involved in data exchange, the related data will be on a gray ground.
Device Type	The device types shown are consistent with the device names shown in the working area in NWCONFIG. If a slave station address is assigned to a network module, the name of the PLC to which the network module is connected will be shown. Besides, if a slave station is undefined, it is unknown.

The figure below is an example of a data exchange table. Group #1, group #2, group #4, and group #5 are involved in data exchange. Please refer to the table below for more information.

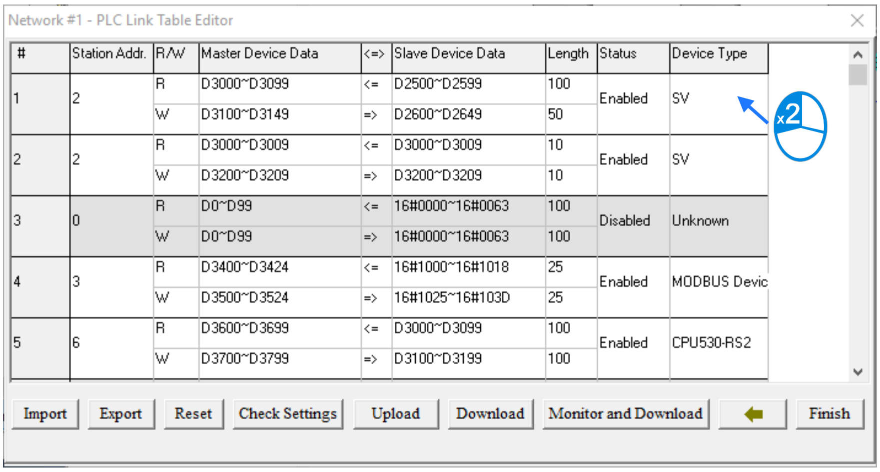


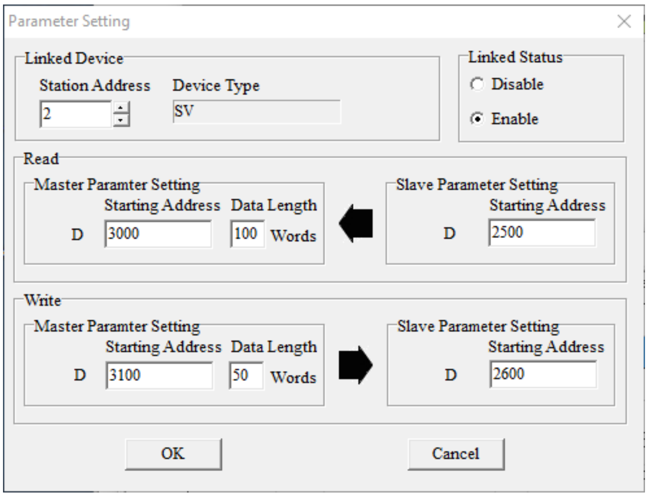
#	Station Addr.	R/W	Master Device Data	<=>	Slave Device Data	Length	Status	Device Type
1	2	R	D3000~D3099	<=	D2500~D2599	100	Enabled	SV
		W	D3100~D3149	=>	D2600~D2649	50		
2	2	R	D3000~D3009	<=	D3000~D3009	10	Enabled	SV
		W	D3200~D3209	=>	D3200~D3209	10		
3	0	R	D0~D99	<=	16#0000~16#0063	100	Disabled	Unknown
		W	D0~D99	=>	16#0000~16#0063	100		
4	3	R	D3400~D3424	<=	16#1000~16#1018	25	Enabled	MODBUS Devic
		W	D3500~D3524	=>	16#1025~16#103D	25		
5	6	R	D3600~D3699	<=	D3000~D3099	100	Enabled	CPU530-RS2
		W	D3700~D3799	=>	D3100~D3199	100		

Serial number	Description
#1	The master station reads the data in D2500~D2599 in the slave station whose station number is 2, and stores the data in D3000~D3099 in itself. Meanwhile, the data in D3100~D3149 in the master station is written into D2600~D2649 in the slave station.
#2	The master station reads data from slave station no.2 (SV series) in D3000~D3009, a total of 10 words and stores the data in D3000~D3009. Meanwhile, the mast station data in D3200~D3209, a total of 10 words is written in slave station D3200~D3209.
#4	The master station reads the data in 16#1000~16#1018 in the slave station whose station number is 3, and stores the data in D3400~D3424 in itself. Meanwhile, the data in D3500~D3524 in the master station is written into 16#1025~16#103D in the slave station.
#5	The master station reads the data in D3000~D3099 in the slave station whose station number is 6, and stores the data in D3600~D3699 in itself. Meanwhile, the data in D3700~D3799 in the master station is written into D3100~D3199 in the slave station.

20.3.4.2 Setting a Data Exchange Group

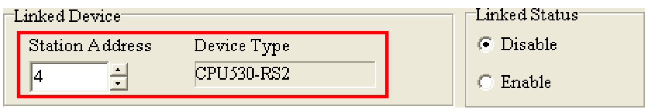
Double-click on the data exchange group for setup to open the setting window.





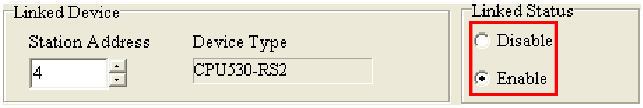
- **Linked Device**

  The **Station Address** is the slave station for data exchange group. Do not select the master station address but slave station address used in other data exchange group can be selected. When choosing 0, Unknown appears in the Device Type column meaning not defined. Otherwise, a hardware device name will appear in corresponds to the slave station address.



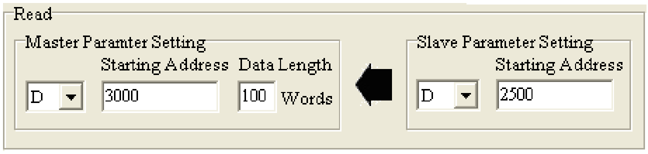
- **Linked Status**

To set on the linked status to enable data exchange for data exchange groups.



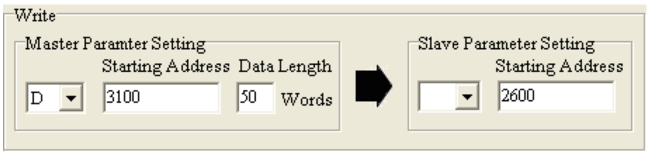
- **Read**

The device type on both sides should be the same. The data length is the number for exchange. To read from the device starting address of Slave Parameter Setting the device starting address of Master Parameter Setting.



- **Write**

The device type on both sides should be the same. The data length is the number for exchange. To read from the device starting address of Master Parameter Setting the device starting address of Slave Parameter Setting.

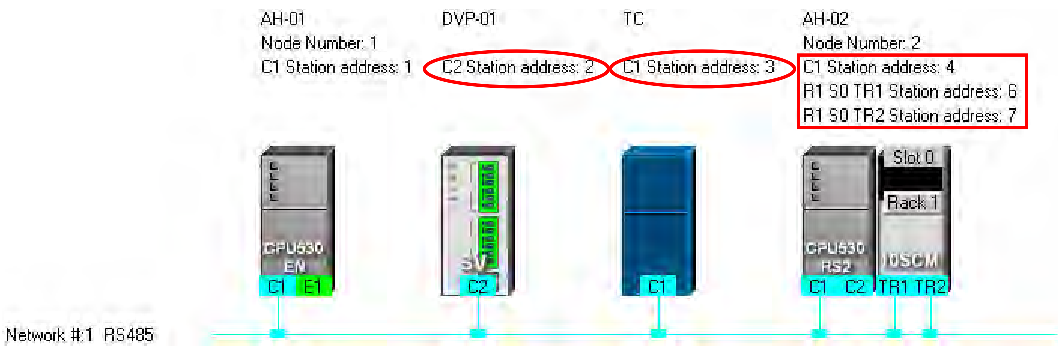


For section planning, the same section data can write into multiple different positions but does not allow different section data to store in the same position. Base on the image above, the content data in master station D3100~D3149 can repeat and write in different slave station, but section in master station D3000~D3099 cannot receive data from other slave stations.

20.3.4.3 Device Synchronization in Data Exchange Table

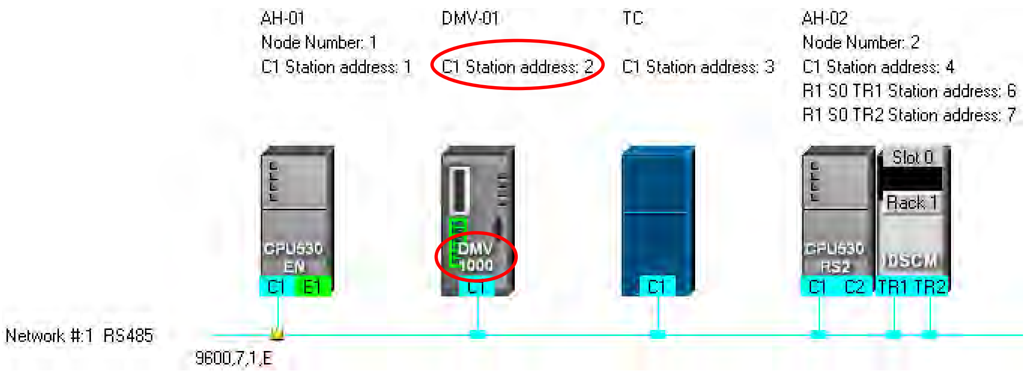
In **Device Type** column of the data exchange table, the appearing content is based on the host model type of each station address as well as according to the current configuration in the **NWCONFIG** Graphic Work space; when a host has multiple station address, the host type is shown in the **Device Type** column.

#	Station Addr.	R/W	Master Device Data	<=>	Slave Device Data	Length	Status	Device Type
1	2	R	D0~D99	<=	D100~D199	100	Enabled	SV
		W	D0~D99	=>	D200~D299	100		
2	3	R	D100~D199	<=	16#1000~16#1063	100	Enabled	MODBUS Device
		W	D100~D199	=>	16#1000~16#1063	100		
3	4	R	D200~D299	<=	D100~D199	100	Enabled	CPU530-RS2
		W	D200~D299	=>	D200~D299	100		
4	6	R	D300~D399	<=	D100~D199	100	Enabled	CPU530-RS2
		W	D300~D399	=>	D200~D299	100		
5	7	R	D400~D499	<=	D100~D199	100	Enabled	CPU530-RS2
		W	D400~D499	=>	D200~D299	100		



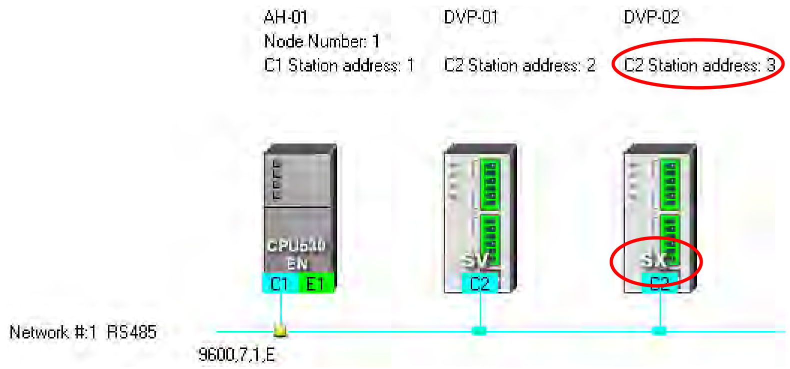
When finish planning and data setting is saved, the modified host type is marked in red to remind users and the status is auto-switched to **Disabled**.

#	Station Addr.	R/W	Master Device Data	<=>	Slave Device Data	Length	Status	Device Type
1	2	R	D3000~D3099	<=	D2500~D2599	100	Disabled	DMV1000
		W	D3100~D3149	=>	D2600~D2649	50		



When the master station device is AH5x0 series and executing upload but finds the current NWCONFIG not matched, the modified PLC type is marked in red to remind users and the status is auto-switched to **Disabled**.

#	Station Addr.	R/W	Master Device Data	<=>	Slave Device Data	Length	Status	Device Type
2	3	R	D100~D115	<=	D100~D115	16	Disabled	SX
		W	D100~D115	=>	D200~D215	16		



When the master station device is DVP series, since the host of DVP series cannot save the device type in data exchange table, it is not possible to check on the PLC type base on the data uploaded. Therefore, the Device Type column shows the name of the PLC type base on the Graphic Workspace. For unreasonable settings, the status is auto-switched to **Disabled**.

20.3.4.4 Managing Data Exchange Table

There are buttons under the data exchange table in the **PLC Link Table Editor** window. Please refer to the table below for more information about the buttons. If users click , the system will lead the users to the previous step.

Network #1 - PLC Link Table Editor

#	Station Addr.	R/W	Master Device Data	<=>	Slave Device Data	Length	Status	Device Type
1	2	R	D3000~D3099	<=	D2500~D2599	100	Enabled	SV
		W	D3100~D3149	=>	D2600~D2649	50		
2	2	R	M3000~M3159	<=	M3000~M3159	10	Enabled	SV
		W	M3200~M3359	=>	M3200~M3359	10		
3	0	R	D1000	<=	16#1000	0	Disabled	Unknown
		W	D1000	=>	16#1000	0		
4	3	R	D3400~D3424	<=	16#1000~16#1018	25	Enabled	MODBUS Device
		W	D3500~D3524	=>	16#1025~16#103D	25		
5	6	R	D3600~D3699	<=	D3000~D3099	100	Enabled	CPU530-RS2
		W	D3700~D3799	=>	D3100~D3199	100		

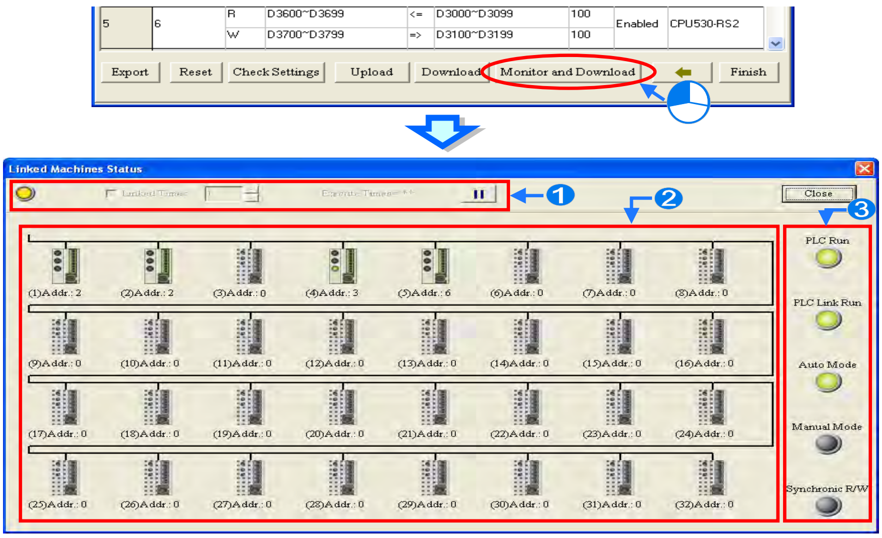
Export | Reset | Check Settings | Upload | Download | Monitor and Download | Finish

Item	Description
Export	Exports the data exchange table in CSV file format.
Reset	Set the data exchange table content to initial state.
Check Settings	Check the data exchange table to be correct.
Upload	Upload the data exchange table in master station.
Download	Download data exchange table to master station.
Download & Monitor	Download data exchange table to master station and automatically opens monitoring window once downloading is complete.
Finish	The system will ask to save the modifications before closing the window.

Before executing uploading & downloading or monitoring in PLC Link, please make sure the actual device is well-connected.

20.3.5 Monitoring a PLC Link

Before monitoring, please make sure the system and host is well-connected. Then, click **Monitor and Download** to open the monitoring window in PLC Link; the host of the master station must be in RUN state, so that PLC Link operation can execute.



❶ **Function Operation area**: To operate PLC Link data exchange function.

❷ **Monitoring area**: Displays the read or write status of master to slave station and execute online data read or write in this area.

❸ **Lighting Status area**: The lighting indicates current PLC Link status. Please refer to the following table for each lighting description.

Lighting	Description
PLC Run	When lighting is ON means PLC host is RUN.
PLC Link Run	When lighting is ON means PLC Link enabled.
Auto Mode	When lighting is ON means PLC Link execution in Auto Mode.
Manual mode	When lighting is ON means PLC Link execution in Manual Mode. When executing number reaches the polling number, the lighting is OFF.
Synchronic R/W	When lighting is ON means Synchronic R/W enabled.

- **Setting area**

To execute setting or operating PLC Link data exchange function, the values in the related special registers in the master station and the states of the related special relays in the master station will be changed. When leaving PLC Link monitoring function, the PLC Link will remain in its last operating status, therefore, please make sure the current PLC Link status is correct before leaving the monitoring page.

❶ When lighting is ON means the computer and PLC host remains connected.

❷ Select the item and the setting bases on ❸ polling number to execute. Maximum number is 65535.

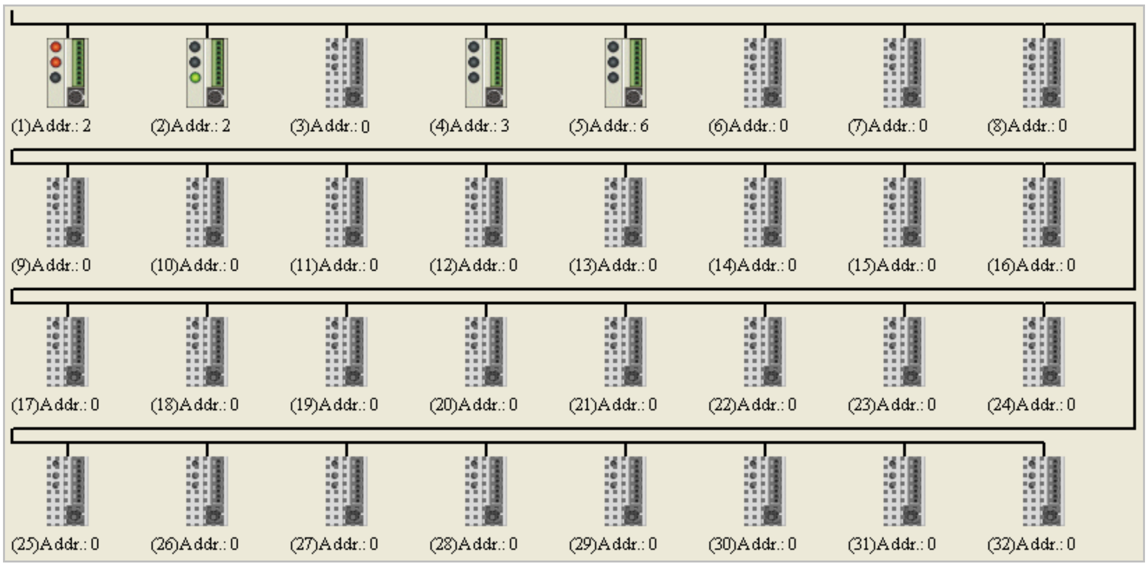
❹ When ❷is selected and execution starts, the number of Execution Times is shown; the calculation is to complete one round of data read and write in slave station.

❺ To start or stop monitoring.

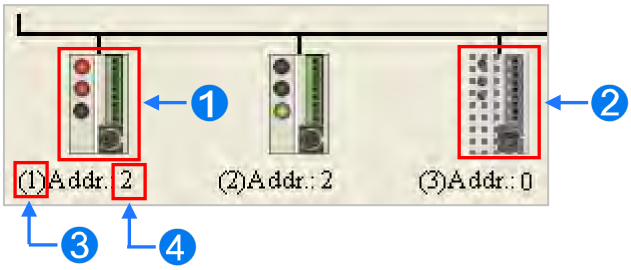
When disconnection occurs during monitoring process, **Continue to Monitor** button appears on the right upper corner of the window; when resolved, click the button to restart the connection.

- **Monitoring area**

When the PLC Link constructed is executed, the master station exchanges data with the slave stations. The status of the data exchange between the master station and the slave stations are displayed in this area.



The small pictures in the monitoring area indicate the status of the main station rather than the statuses of the slave stations. The small pictures in the monitoring area are described below.



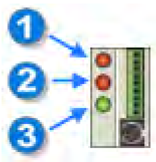
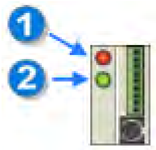
❶ The indicators on the small picture indicate the status of the data exchange group represented by the small picture.

❷ The data exchange group represented by the small picture is not involved in data exchange.

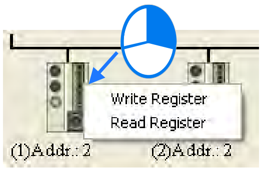
❸ The number corresponds to a serial number in the data exchange table. It represents the serial number of the data exchange group represented by the small picture.

❹ The number corresponds to a slave station address in the data exchange table. It represents the slave station address which belongs to the data exchange group represented by the small picture.

Since PLC Link error flags for AH5x0 series and DVP series differs slightly, therefore it is displayed differently. Please refer to the following table.

Master station PLC Type	Small picture	Description
AH5x0 series		❶ When lighting is ON means read slave station data is in error. ❷ When lighting is ON means writing data in slave station data is in error. ❸ When lighting is ON means data is exchanging.
DVP series		❶ When lighting is ON means read or write slave station data is in error. ❷ When lighting is ON means data is exchanging.

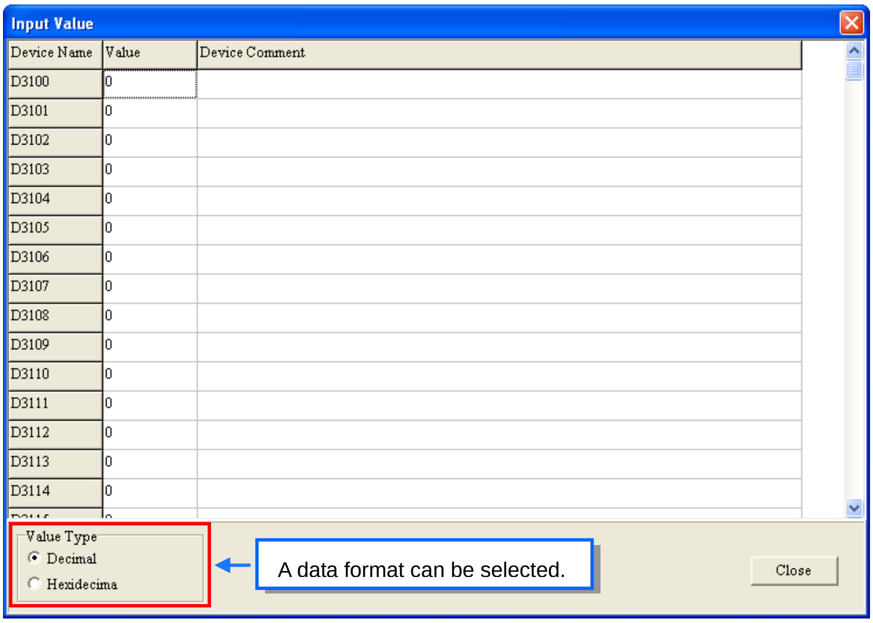
After the users select a small picture, and right-click the small picture, they can click **Write Register** or **Read Register** on the context menu.



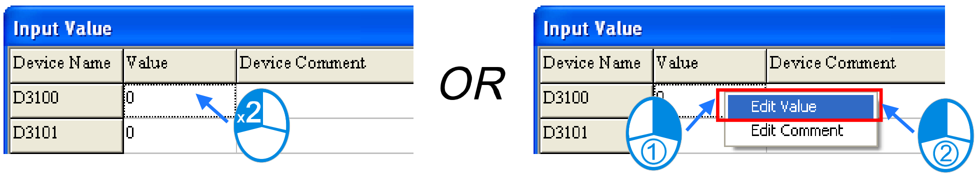
- **Write Register**: To write in the device position data of slave to master station, for example D3100~D3149 (see image below).
- **Read Register**: To read the device position data of slave from master station, for example D3000~D3099 (see image below).

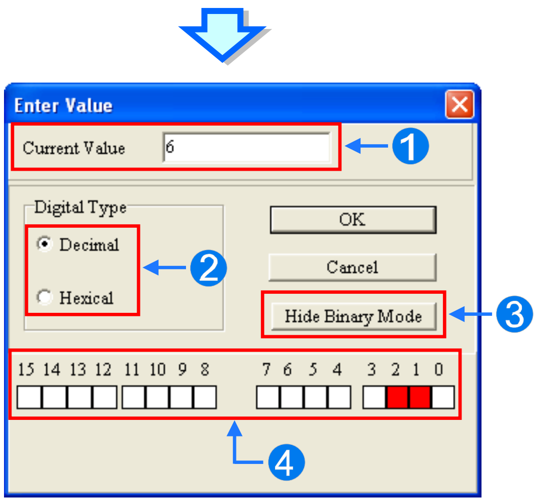
#	Station Addr.	R/W	Master Device Data	<=>	Slave Device Data	Length	Status	Device Type
1	2	R	D3000~D3099	<=	D2500~D2599	100	Enabled	SV
		W	D3100~D3149	=>	D2600~D2649	50		

After the users click **Write Register** or **Read Register** on the context menu, a correponding register monitoring table will appear.



If the users double-click the **Value** cell for a device, or click **Edit Value** on the context menu after they right-click the **Value** cell, they can type a value in the **Enter Value** window. If the users double-click the **Device Comment** cell for a device, or click **Edit Comment** on the context menu after they right-click the **Device Comment** cell, they can make a comment on the device. The comments made are for the PLC Link constructed. They are not related to the comments on the devices in the program created in ISPSoft.

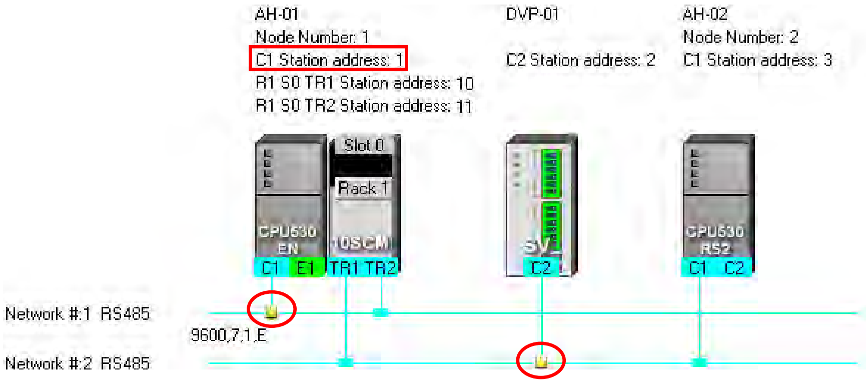




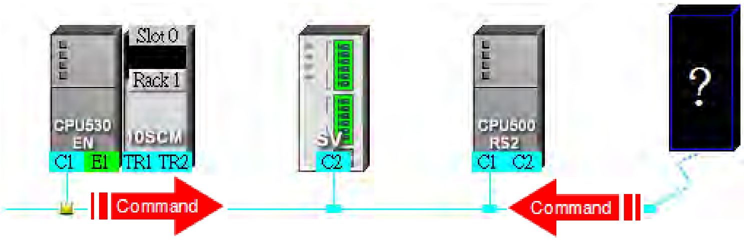
1. Users can type a value in the box.
2. Users can select a data format.
3. Users can display or hide the binary mode.
4. In the binary mode, users can set the states of the bits through the mouse.

20.3.6 Notifications on PLC Link

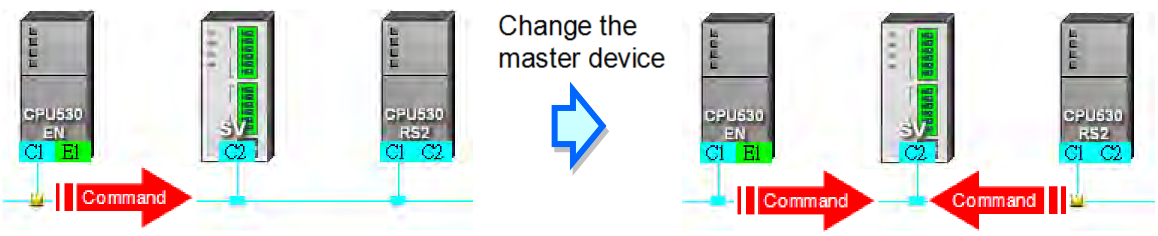
When planning PLC Link, the same RS-485 network can only have one master station. When the nodes set as the master station has many COM ports, the nodes cannot be used as master station in other RS-485 network, but only as slave station. For example (see below), AH-01 shows that node in communication port C1 is the master station for Network #1 and cannot be the master station assigned to Network #2 but only as slave station. While, C1 and TR1 port in AH-01 are connected to Network#1 and both port station addresses are independent, therefore, TR2 assigned as slave station is allowed for Network#1 in PLC Link planning.



One network can only have one master station to send command at the same time. Therefore, when finish network planning, please make sure the actual network is the same as in NWCONFIG to avoid similar error (see below).



Besides, if the users do not set the parameters related to a PLC Link in the original master station again before they designate another device as a master station, an error occurs when more than one device sends reading/writing commands. As a result, if the users want to designate another device as a master station, they have to make sure that the original master station does not execute the original PLC Link.



*** In addition to the conditions mentioned above, users have to prevent two devices or more than two devices from sending reading/writing commands simultaneously in any conditions.**

20.4 Constructing an Ether Link

20.4.1 Introduction of an Ether Link

An Ether Link is a network mechanism for data exchange performed through an Ethernet connection. If there are several nodes in an Ethernet network, users can create a mechanism for data exchange in the network, and select a start mode. If the parameters which are set are downloaded to the PL

Cs in the network, the systems of the PLCs perform data exchange according to the start mode selected when the PLCs run. The users do not have to write a redundant program.

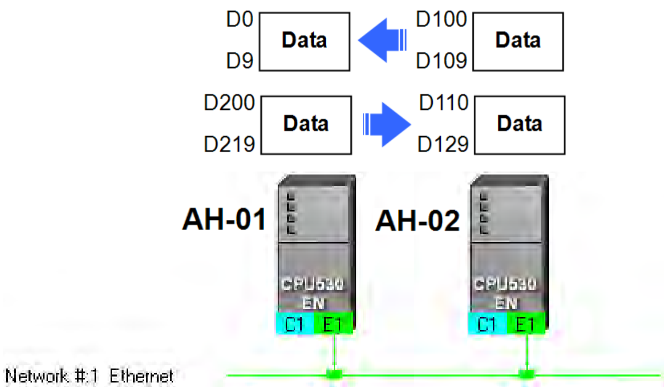
A PLC Link is a master/slave model. There is only one master station in an RS-485 network, and the other stations which are slave stations passively receive reading/writing commands from the master station. Compared with a PLC Link, an Ether Link adopts a safer data request mechanism. It is the data demanding nodes in an Ethernet network that execute an Ether Link.

An Ether Link is not a master/slave model. It allows a node to send reading commands which ask for data to other nodes. The nodes will send the data to the node after they receive the reading commands. Owing to the fact that a node cannot send writing commands to other nodes, the use of an Ether Link is safer than the use of a PLC Link. Besides, all the nodes in an Ethernet network can send reading commands through TCP/IP, and the system automatically manages the transmission of packets through TCP/IP. Compared with a PLC Link, an Ether Link is more efficient.

Please refer to the example below for more information. If users want to create an Ether Link shown below, they have to create a data exchange table for the two data request nodes AH-01 and AH-02.

(a) AH-01 reads the data in D100~D109 in AH-02, and stores the data in D0~D9 in itself.

(b) AH-02 reads the data in D200~D219 in AH-01, and stores the data in D110~D129 in itself.



#	Device Name	Register	Starting Address	Range	<->	#	Device Na...	Register	Starting Address	Range	Size
1	AH-01	D	0	D0 ~ D9	<-	2	AH-02	D	100	D100 ~ D109	10
2	AH-02	D	110	D110 ~ D129	<-	1	AH-01	D	200	D200 ~ D219	20

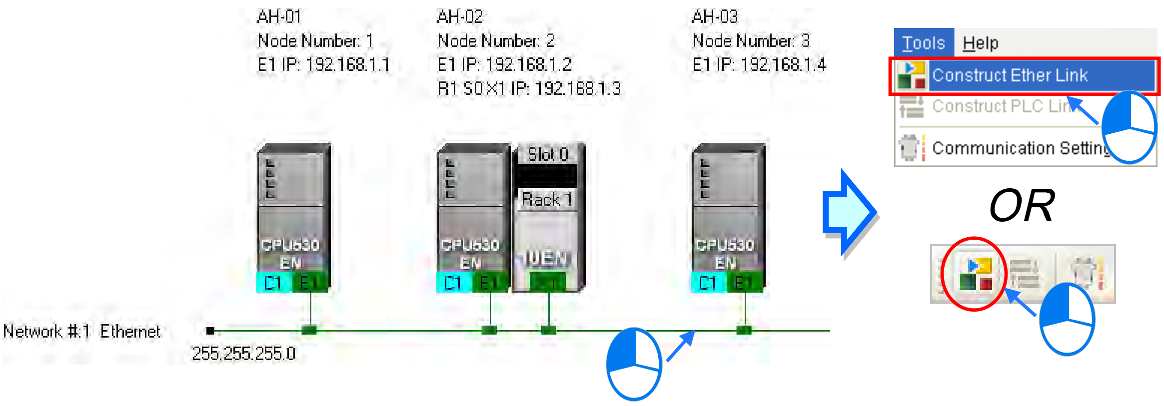
An Ether Link is based on a network. If a node is connected to several networks, users can set several groups of parameters related to Ether Links for the networks. As a result, there may be several groups of parameters related to Ether Links in a PLC. Owing to the fact that an Ether Link is not a master/slave model, each node in a network can be a data demanding node and a data supply node at the same time. In the first piece of data in the table above, AH-01 is a data requiring node, and AH-02 is a data providing node. In the second piece of data in the table above, AH-01 is a data providing node, and AH-02 is a data requiring node.

20.4.2 Open Ether Link Configuration

To construct an Ether Link, they have to make sure that a network is set correctly. There are three ways to open the Ether Link Configuration window.

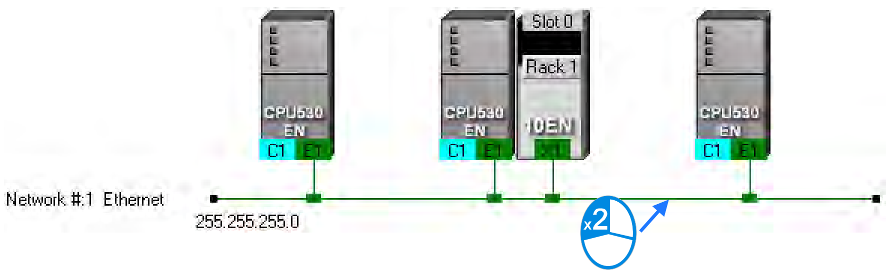
- **Method 1**

After the users select a network, they have to click **Construct Ether Link** on the **Tools** menu, or on the toolbar.



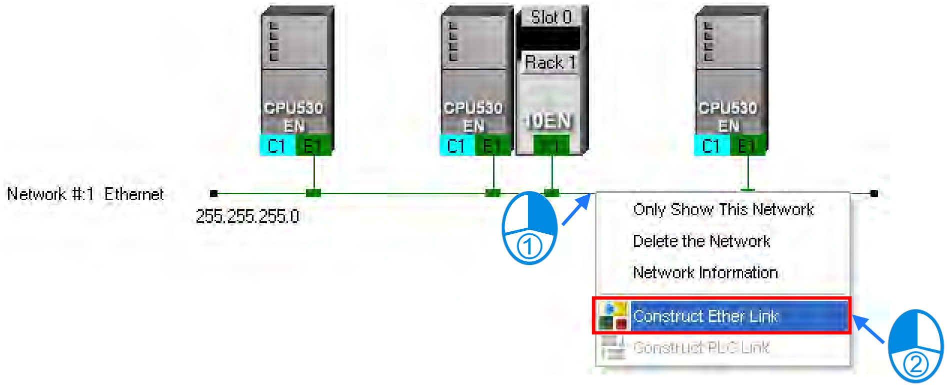
- **Method 2**

Double-click a network.

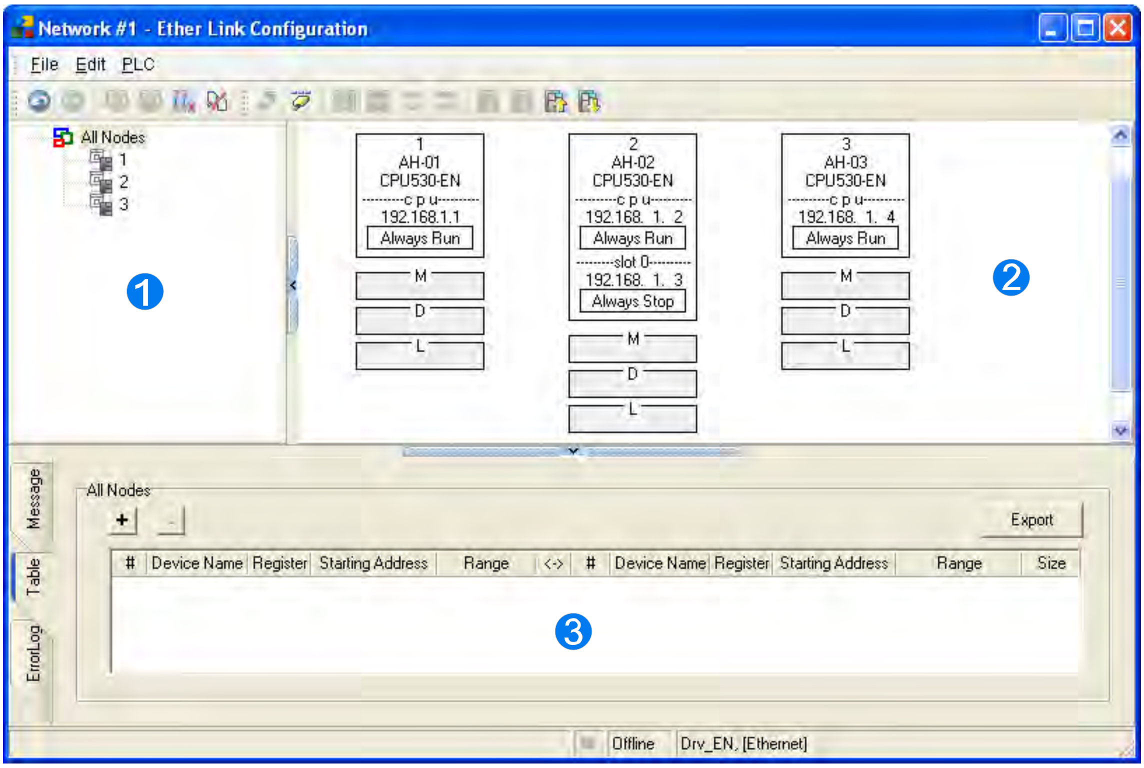


- **Method 3**

Right-click a network, and then click **Construct Ether Link** on the context menu.



The **Ether Link Configuration** window is shown below.

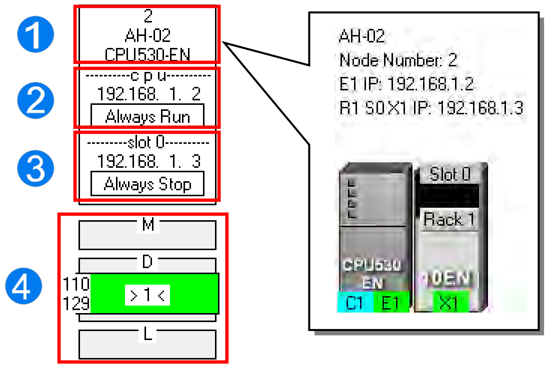


❶ **Node list**: Displays the node list.

❷ **Graphic area**: Use graphics to demonstrate node settings.

❸ **Information window**: Display three pages each contains information on data exchange table, message and device error logs.

A node shown in the display area in the figure above is described below.



❶ The information is composed of a node number, a PLC name, and a model name.

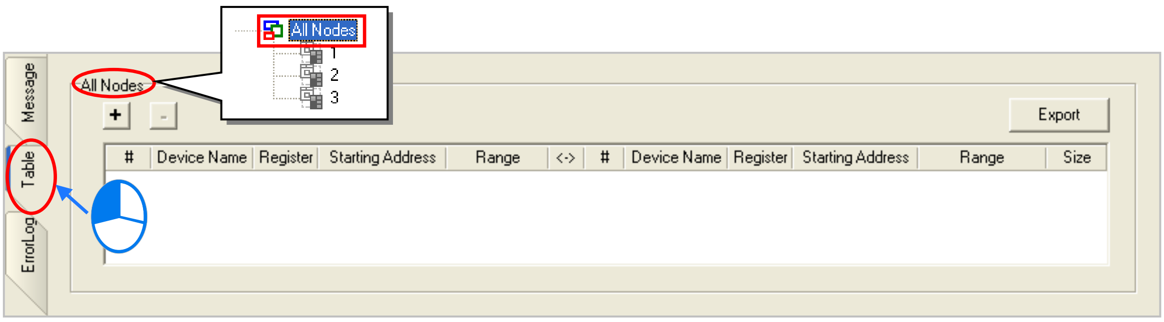
❷ The IP address assigned to AH500 series CPU module is 192.168.1.2. The start mode of the Ether Link constructed is **Always Run**.

❸ The IP address assigned to the module installed in slot 0 is 192.168.1.3. The start mode of the Ether Link constructed is **Always Stop**.

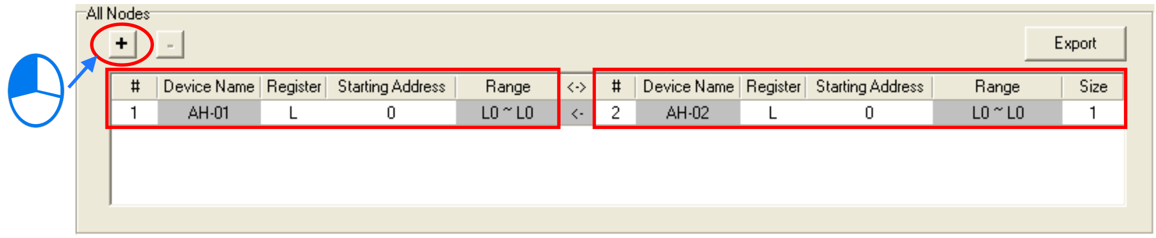
❹ >1< in the D block indicates that the D block demands data of node 1. The numbers at the left side of the D block indicate that the data demanded of node 1 will be stored in D110~D119 in node 2. The color assigned to the D block depends on the node number in the D block. Owing to the fact that there is not any information in the M block and the L block, the M block and the L block does not demand any data of other devices.

20.4.3 Create and Manage Data Exchange Table

If users want to create a data exchange table, they have to click the **Table** tab in the information area. The node which is selected on the node list is shown in the upper left corner of the information area. The data in the table is related to the node selected.

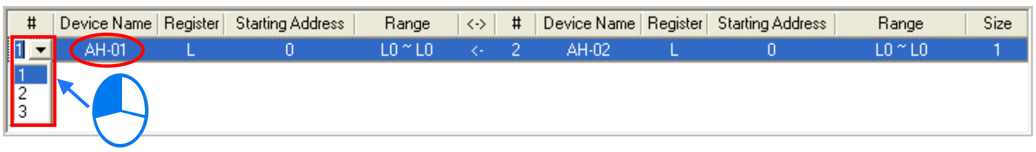


If the users click +, a new piece of data will be added to the table. A piece of data is composed of two parts. The left part of the data in the figure below indicates that the data demanding node AH-01 will store the data demanded in L0 in itself, and the right part of the data in the figure below indicates that the data supply node AH-02 will supply the data in L0 in itself.

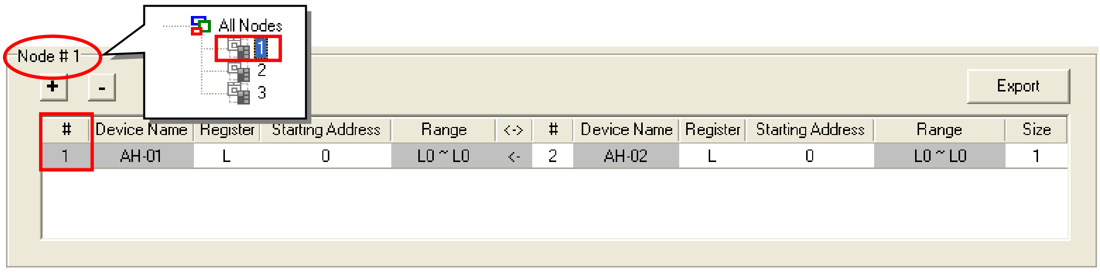


The steps of setting a data exchange group are as follows.

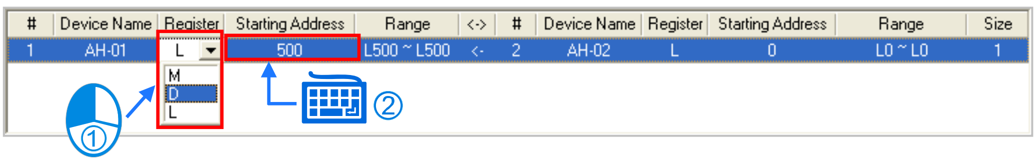
(1) Select a node number in the # cell for the data demanding node. After the users select a node number, the PLC name corresponds to the node number will be appear in the **Device Name** cell for the node number.



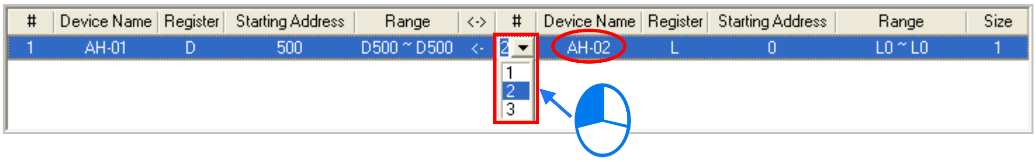
If the users select a specific node number rather than **All Nodes** on the node list, the data in the table will be related to the specific node number selected, and the fixed node number in the # cell for the data demanding node will be the specific node number selected on the node list.



(2) Select a device type in the **Register** cell for the data demanding node, and type an address in the **Starting Address** cell for the data demanding node.

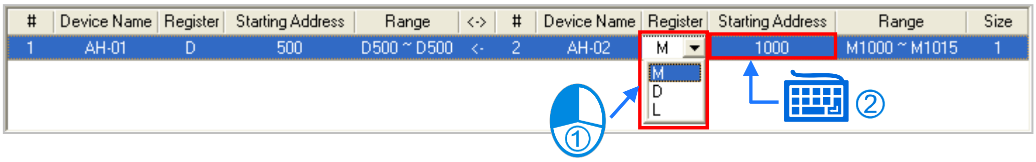


(3) Select a node number in the # cell for the data supply node. The node number in the # cell for the data demanding node cannot be the same as the node number in the # cell for the data supply node. After the users select a node number, the PLC name corresponds to the node number will be appear in the **Device Name** cell for the node number.



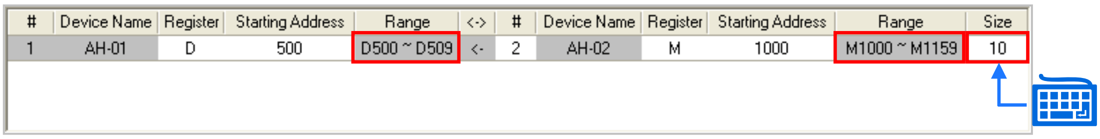
#	Device Name	Register	Starting Address	Range	<->	#	Device Name	Register	Starting Address	Range	Size
1	AH-01	D	500	D500 ~ D500	<-	2	AH-02	L	0	L0 ~ L0	1

(4) Select a device type in the **Register** cell for the data supply node, and type an address in the **Starting Address** cell for the data supply node. The device type selected in the **Register** cell for the data supply node does not have to be the same as the device type selected in the **Register** cell for the data demanding node.



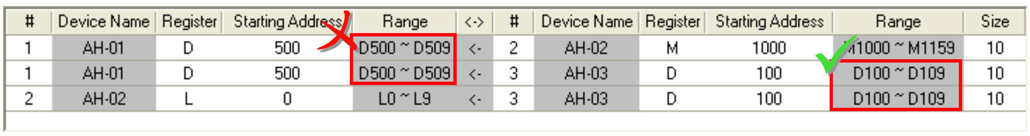
#	Device Name	Register	Starting Address	Range	<->	#	Device Name	Register	Starting Address	Range	Size
1	AH-01	D	500	D500 ~ D500	<-	2	AH-02	M	1000	M1000 ~ M1015	1

(5) Type a data length in the **Size** cell. A word is a unit. The maximum data length is 1900 words. After the users type a data length, the device ranges in the **Range** cells will change according to the data length typed.



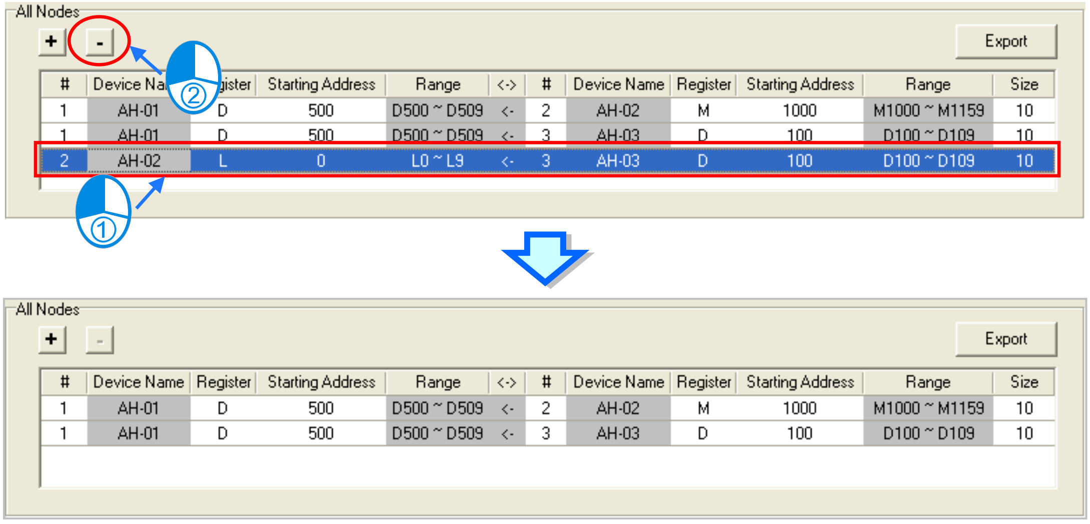
#	Device Name	Register	Starting Address	Range	<->	#	Device Name	Register	Starting Address	Range	Size
1	AH-01	D	500	D500 ~ D509	<-	2	AH-02	M	1000	M1000 ~ M1159	10

The users can create data exchange groups by following the steps described above. The device range in the **Range** cell for a data demanding node cannot overlap the device range in the **Range** cell for another data demanding node whereas the device range in the **Range** cell for a data supply node can overlap the device range in the **Range** cell for another data supply node. In other words, different demanders can ask for the same data, but different data cannot be store in the same block.

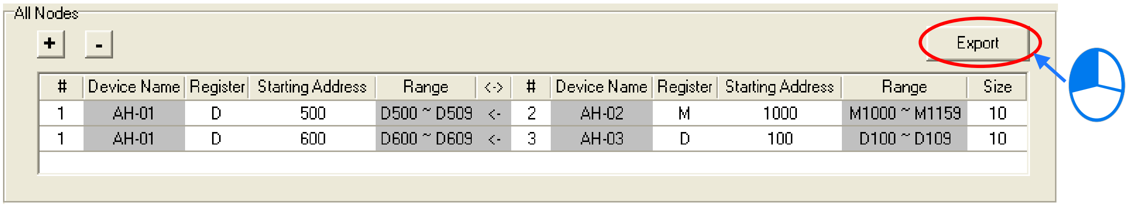


#	Device Name	Register	Starting Address	Range	<->	#	Device Name	Register	Starting Address	Range	Size
1	AH-01	D	500	D500 ~ D509	<-	2	AH-02	M	1000	M1000 ~ M1159	10
1	AH-01	D	500	D500 ~ D509	<-	3	AH-03	D	100	D100 ~ D109	10
2	AH-02	L	0	L0 ~ L9	<-	3	AH-03	D	100	D100 ~ D109	10

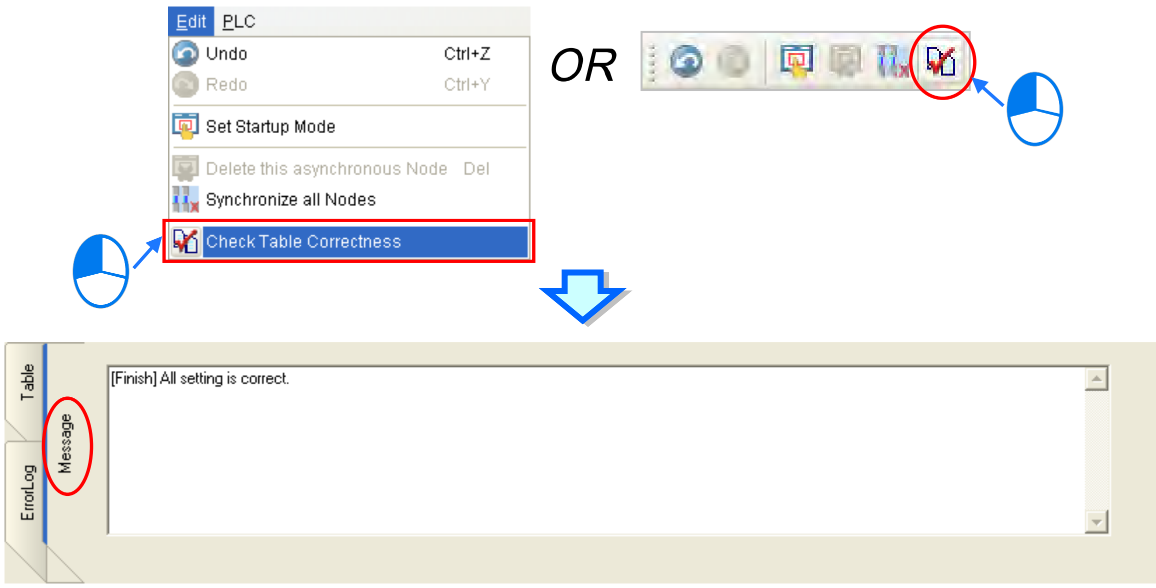
If the users want to delete a piece of data, they can click the piece of data, and click **-**.



After the users click **Export**, the data in the data exchange table can be exported as a CSV file.



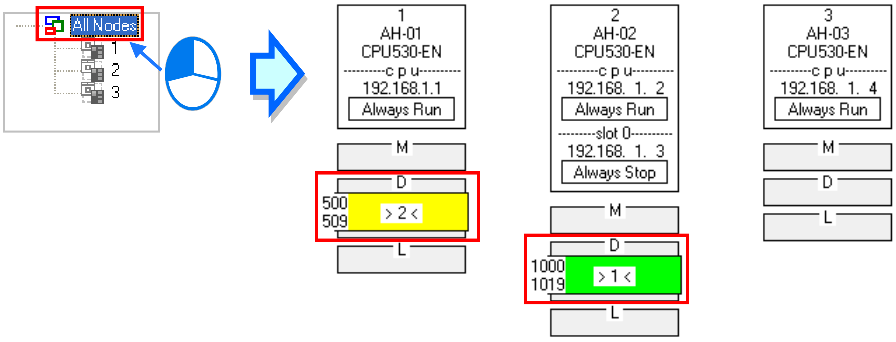
After the users create a data exchange table, they can click **Check Table Correctness** on the **Edit** menu or on the toolbar if they wan to check the data set in the table. The check result will be displayed in the **Message** page.



20.4.4 Node List and Display Area

If users click **All Node**s on the node list, all the nodes will be displayed in the display area, and all the data exchange groups set will be in the data exchange table under the display area. Besides, the devices in which the data demanded will be stored, and the data supply nodes are indicated in device blocks of the nodes in the display area.

>2< in the D block in node 1 indicates that the D block demands data of node 2, and the numbers at the left side of the D block indicate that the data demanded of node 2 will be stored in D500~D509 in node 1. Likewise, >1< in the D block in node 2 indicates that the D block demands data of node 1, and the numbers at the left side of the D block indicate that the data demanded of node 1 will be stored in D1000~D1019 in node 1.

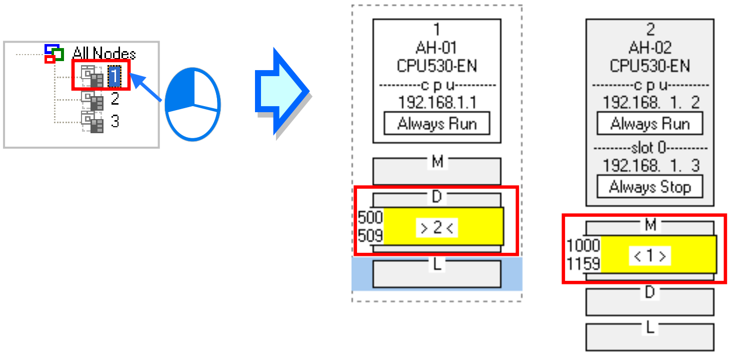


#	Device Name	Register	Starting Address	Range	<->	#	Device Name	Register	Starting Address	Range	Size
1	AH-01	D	500	D500 ~ D509	<-	2	AH-02	M	1000	M1000 ~ M1159	10
2	AH-02	D	1000	D1000 ~ D1019	<-	1	AH-01	L	0	L0 ~ L19	20

If the users click a specific node on the node list, the node and the nodes of which the node demands data will be shown in the display area, and the data in the data exchange table under the display will be related to the specific node selected.

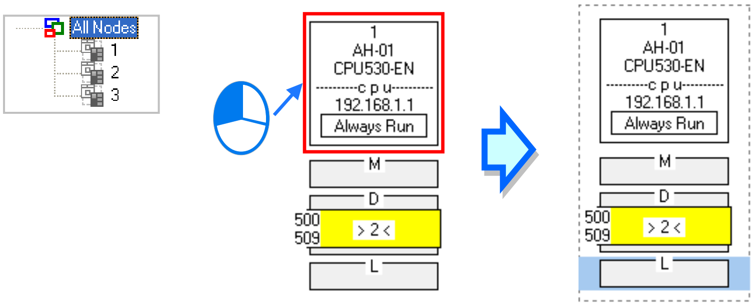
In the figure below, the dotted frame indicates that node 1 on the node list is selected, and the gray ground indicates that node 2 is a data supply node. Node 2 cannot be selected, and the information in the M block in node 2 indicates the data which will be supplied to node 1. Owing to the fact that node 3 does not supply any data to node 1, node 3 is not displayed in the display area.

The numbers at the left side of the D block in node 1 indicates that the data demanded of node 2 will be stored in D500~D509 in node 1. <1> in the M block in node 2 indicates that the data in M1000~M1129 in node 2 will be supplied to 1.

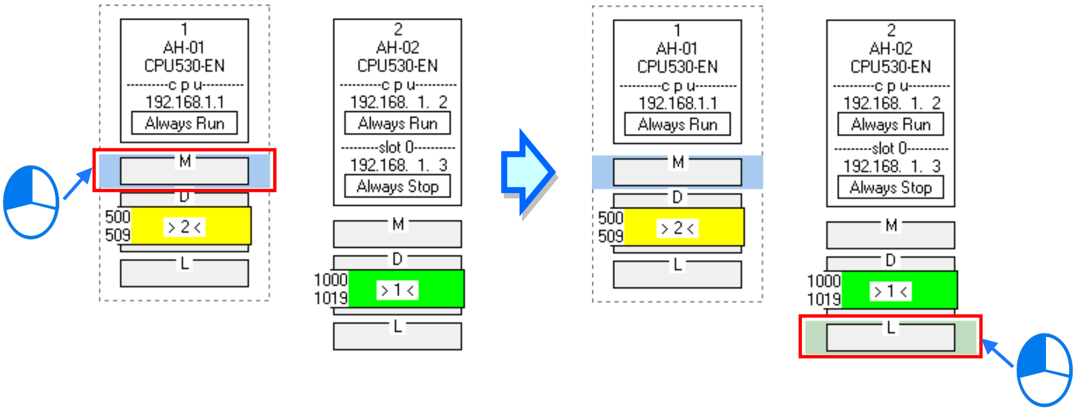


#	Device Name	Register	Starting Address	Range	<->	#	Device Name	Register	Starting Address	Range	Size
1	AH-01	D	500	D500 ~ D509	<-	2	AH-02	M	1000	M1000 ~ M1159	10

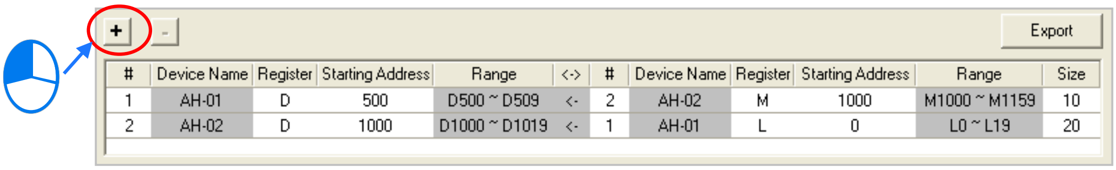
If a specific node on the node list is selected, the node in the display area will be selected. After the users select **All Nodes** on the node list, they can click the information about a node in the display area if they want to select the node. If the users click a device block in a node, the node will not be selected. After a node is selected, a dotted frame will appear.



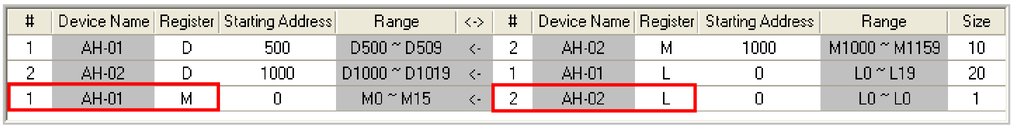
Once a node is selected, the node will be designated as a data demanding node. After the users click a device block in the node selected, a blue cursor will appear. After the users click a device block in another node (a data supply node), a green cursor will appear. The users can only click a device block in a data supply node. They cannot select the node, otherwise the node will be designated as a data demanding node.



The users can click **+** to add a new piece of data to the data exchange table. The data includes the data demanding node, the node number assigned to the data demanding node, the data supply node, the node number assigned to the data supply node, and the device types selected.



#	Device Name	Register	Starting Address	Range	<->	#	Device Name	Register	Starting Address	Range	Size
1	AH-01	D	500	D500 ~ D509	<-	2	AH-02	M	1000	M1000 ~ M1159	10
2	AH-02	D	1000	D1000 ~ D1019	<-	1	AH-01	L	0	L0 ~ L19	20



#	Device Name	Register	Starting Address	Range	<->	#	Device Name	Register	Starting Address	Range	Size
1	AH-01	D	500	D500 ~ D509	<-	2	AH-02	M	1000	M1000 ~ M1159	10
2	AH-02	D	1000	D1000 ~ D1019	<-	1	AH-01	L	0	L0 ~ L19	20
1	AH-01	M	0	M0 ~ M15	<-	2	AH-02	L	0	L0 ~ L0	1

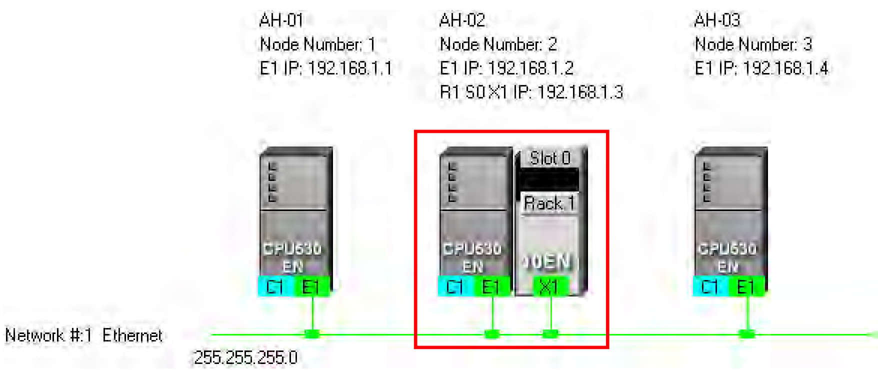
20.4.5 Start Mode of an Ether Link

There are three start modes. Please refer to the table below for more information.

Start mode	Description
Always Stop	During the operation of the PLC, no data exchange is performed.
Always Run	When the PLC runs, data exchange is performed.
SM Flag	The performance of data exchange depends on a special relay in the PLC. After users select **SM Flag**, they can set the initial state of the related special relay.

***. Please refer to manuals or technical documents for more information about special relays related to Ether Links.**

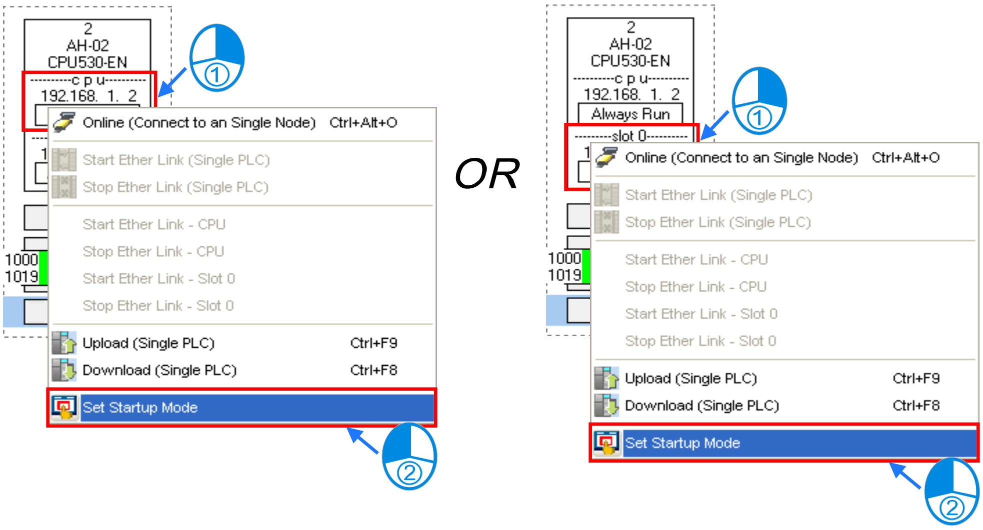
The execution of an Ether Link is based on the nodes in a network. If some of the ports that a node has are connected to a network, users can set the start modes of the ports separately. When the Ether Link constructed is executed, the system automatically distributes reading/writing work to the ports according to the start modes of the ports. If a port is disconnected, the system will pass the work belonging to the port to another port.



There are three ways to set the start mode of a node.

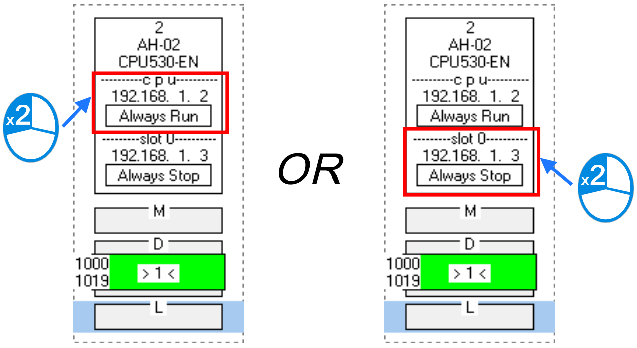
- **Method 1**

Right-click CPU information or module information, and then click **Set Startup Mode** on the context menu.



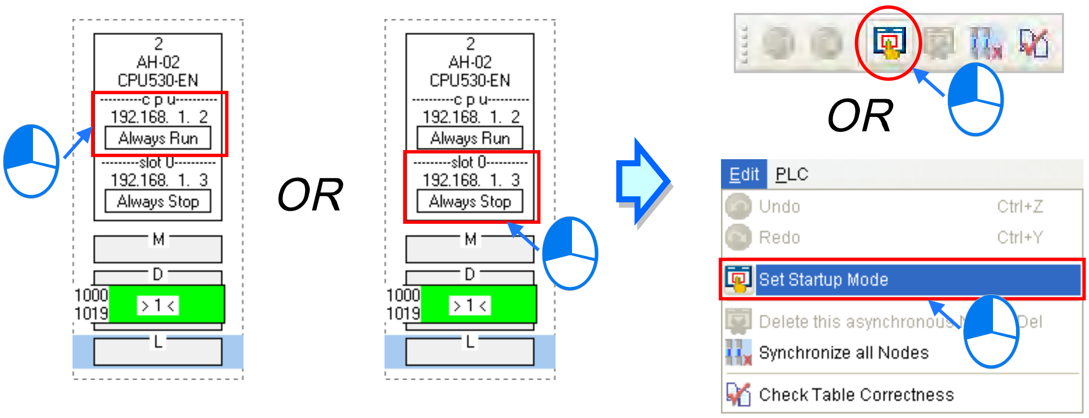
- **Method 2**

Double-click CPU information or module information.

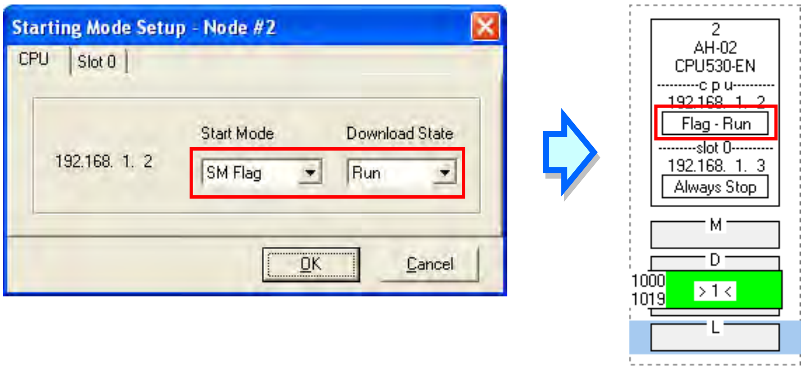


- **Method 3**

After the users click CPU information or module information, they have to click  on the toolbar, or **Set Startup Mode** on the **Edit** menu.



After the users use one of the methods described above, the Starting Mode Setup window will appear. The page displayed in the window varies with the information selected. The users can click the tabs in the window. Select a mode in the **Start Mode** drop-down list box. If **SM Flag** is selected, the users can select an initial state in the **Download State** drop-down list box. After an initial state is selected, the users can click **OK**.



20.4.6 Download Ether Link Configuration

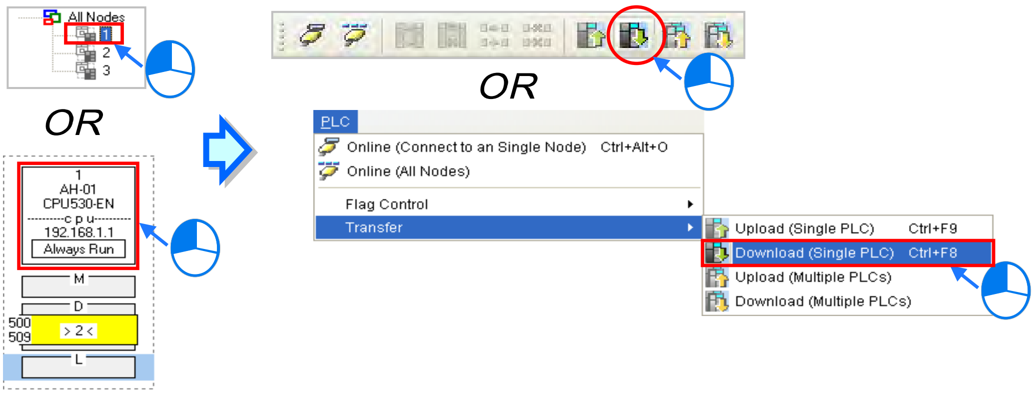
After the parameters related to an Ether Link are set, users have to download the parameters to PLCs. The PLCs can perform data exchange after the parameters are downloaded.

- **Single node**

  Only the data demanding setting related to the PLC selected, the start mode of the PLC selected, and the start modes of the modules connected to the PLC are downloaded. Before downloading the related parameters, please make sure the system is well-connected to hosts or modules.

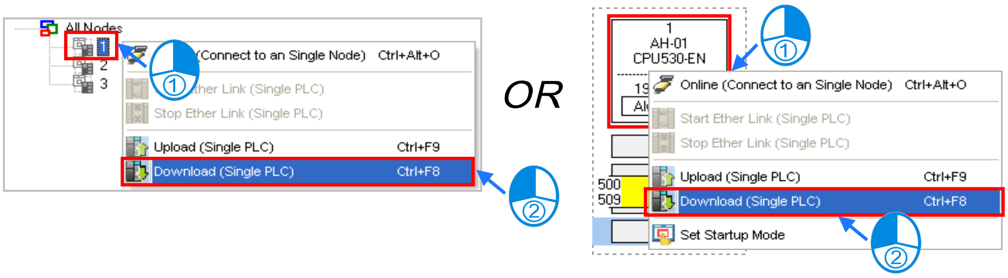
  ➢ **Method 1**

  Select a data demanding node to download parameters, click  on the toolbar. The users can also download the related parameters by selecting a data demanding node, clicking the **PLC** menu, pointing to **Transfer**, and clicking **Download (Single PLC)**.



➢ **Method 2**

Select a data demanding node, right-click the data demanding node, and click **Download (Single PLC)** on the context menu.

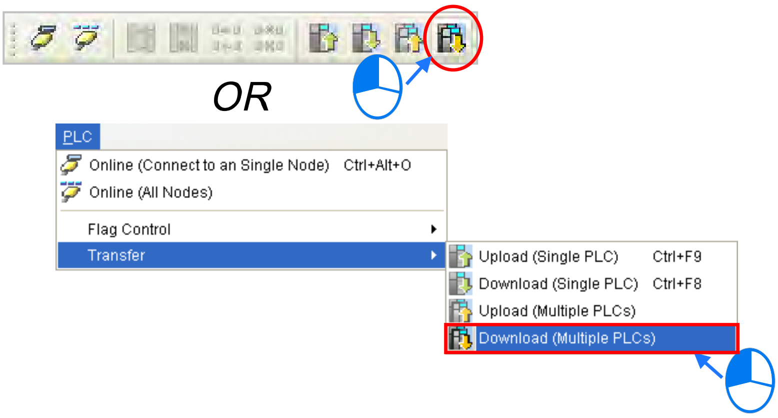


- **Multiple nodes**

Download all settings and enabling mode for data demanding nodes; before downloading, please check the system and hosts or modules are well-connected.

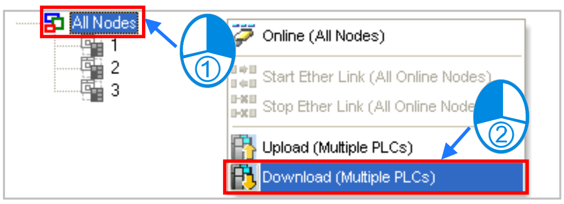
➢ **Method 1**

Click the **PLC** menu, point to **Transfer**, and click **Download (Multiple PLCs)**. The users can also download the related parameters by clicking on the toolbar.



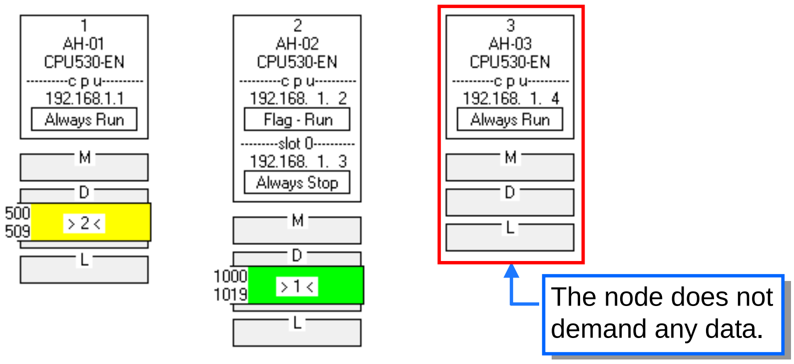
➢ **Method 2**

Select **All Nodes** on the node list, right-click **All Nodes**, and click **Download (Multiple PLCs)** on the context menu.



<u>**Additional remark**</u>

If the parameters set include a node which does not demand any data, the node will not demand any data through the network specified after the parameters are downloaded to multiple nodes.



20.4.7 Upload Ether Link Configuration

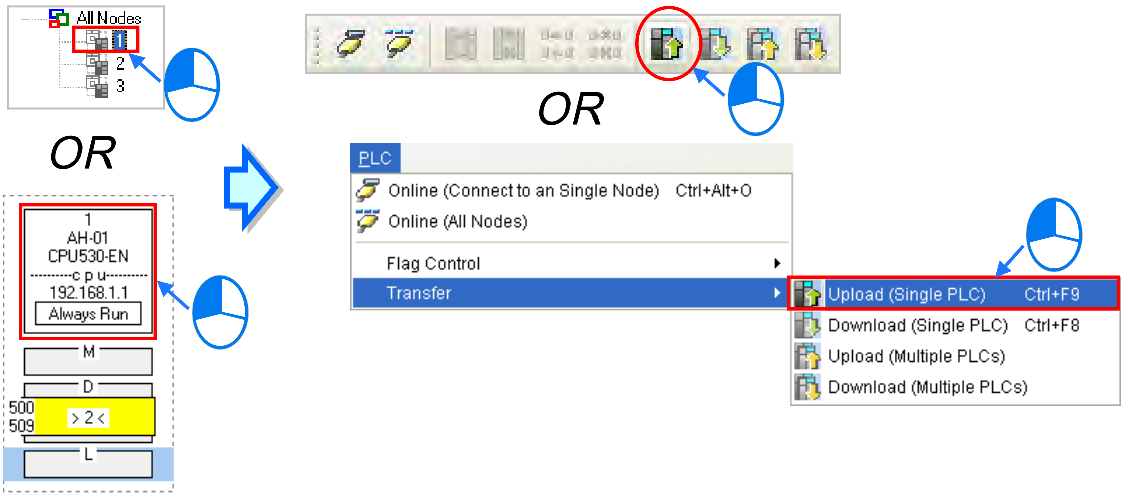
Users can upload the parameters related to an Ether Link in a PLC.

- **Single node**

  Upload only the Ether Link setting parameter of single node; before uploading, please check the system and hosts or modules are well-connected.

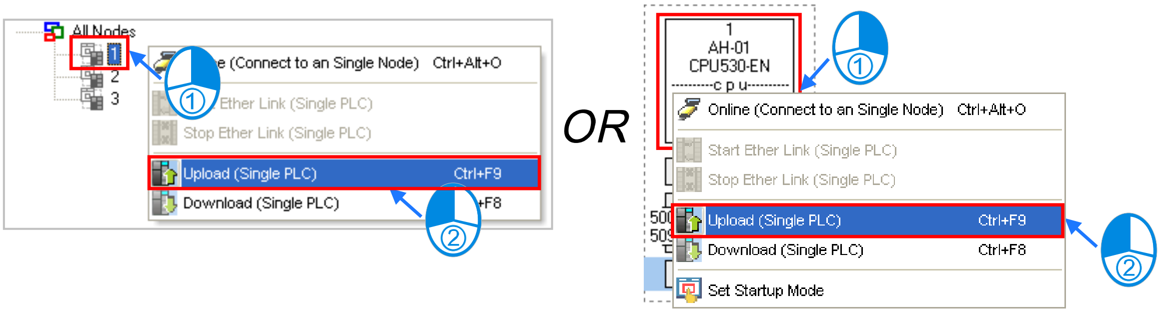
➢ **Method 1**

Select a data demanding node, and then click [icon] on the toolbar. The users can also download the related parameters by selecting a data demanding node, clicking the **PLC** menu, pointing to **Transfer**, and clicking **Upload (Single PLC)**.



➢ **Method 2**

Select a data demanding node, right-click the data demanding node, and click **Upload (Single PLC)** on the context menu.

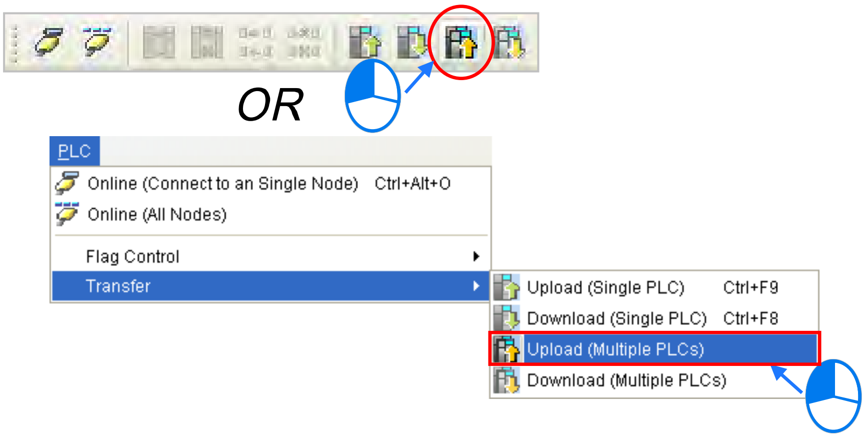


- **Multiple nodes**

  Upload all Ether Link setting parameters on nodes; before uploading, please check the system and hosts or modules are well-connected.

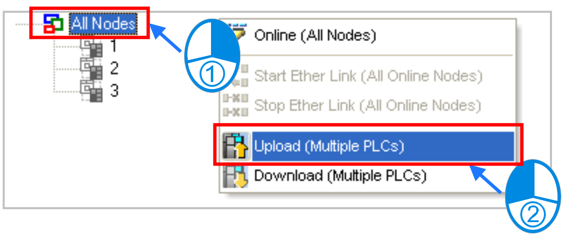
  - **Method 1**

    Click the **PLC** menu, point to **Transfer**, and click **Upload (Multiple PLCs)**. The users can also download the related parameters by clicking on the toolbar.



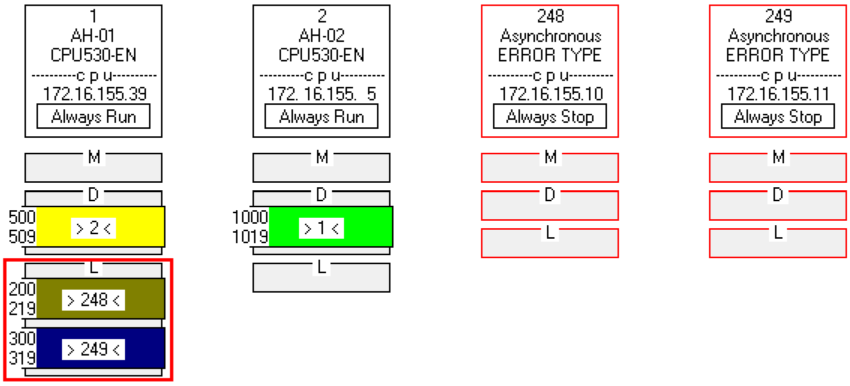
  - **Method 2**

    Select **All Nodes** on the node list, right-click **All Nodes**, and click **Upload (Multiple PLCs)** on the context menu.



<u>**Additional remark**</u>

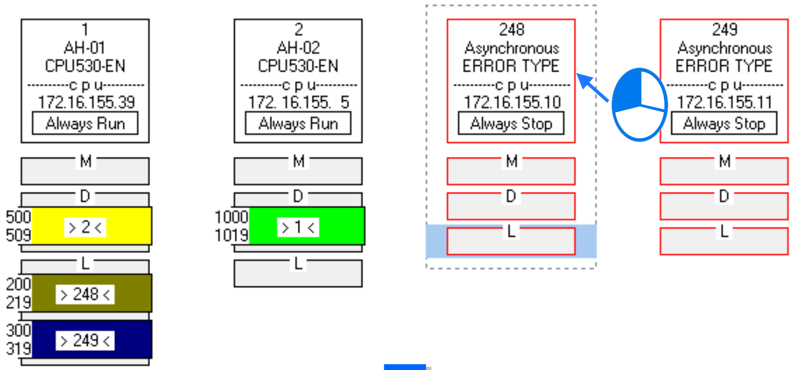
After re-uploading Ether Link parameters, if nodes that are not assigned in NWCONFIG, the node will be framed in red to display as **Asynchronous Device**. When Ether Link setting contains asynchronous device, monitoring or down loading are not allowed.

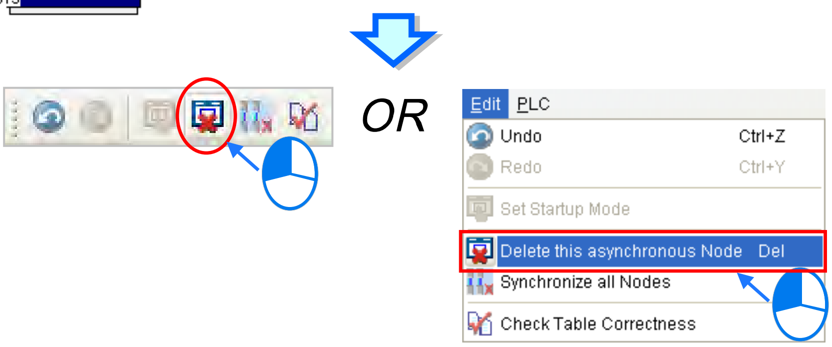


20.4.8 Deleting Asynchronous Device

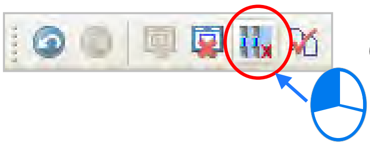
If the setting of an Ether Link includes asynchronous devices, the system does not allow the Ether Link to be monitored, and it does not allow the parameters related to the Ether Link to be downloaded. Users have to find out the reason for the existence of the asynchronous devices. If the network configuration in NWCONFIG is incorrect, the users have to modify the network configuration, and upload the parameters related to the Ether Link again. If the parameters uploaded are not applicable to the current network configuration, the users can delete the asynchronous devices.

Select an asynchronous device which will be deleted, and then click **Delete This Asynchronous Node** on the **Edit** menu, or  on the toolbar.

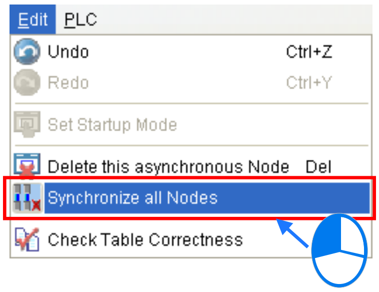




If the users want to delete all the asynchronous devices at the same time, they can click **Synchronize All Nodes** on the **Edit** menu, or  on the toolbar.



OR



20.4.9 Enable / Disable Online Monitoring Function

In the **Ether Link Configuration** window, users can execute or test the Ether Link constructed by means of the online monitoring functions provided by NWCONFIG. The users can enable/disable the function of monitoring a single node/multiple nodes online.

Enabling/Disabling	Description	
Single node	Function	Enabling or disabling the function of monitoring the node selected online
	Condition	The users have to make sure that ISPSoft can connect to the PLC selected normally, and they have completed the communication setting in NWCONFIG.
Multiple nodes	Function	Enabling or disabling the function of monitoring all the nodes online
	Condition	The users have to make sure that all the nodes are connected to a network, and can connect to ISPSoft through Ethernet. The connection type that the driver selected in the **Driver Name** drop-down list box in the **Select a Driver** window uses must be Ethernet.

Before the users enable the online monitoring function, they have to make sure that all the nodes are connected according to the network framework created in NWCONFIG, and can operate normally.

(a) Every node has been connected to a network according to the network framework created in NWCONIFG.

(b) The users have set the parameters for Ethernet ports of the nodes by means of HWCOFNIG, and the parameters have been downloaded to the PLCs and the modules. The setting of the parameters must be consistent with the setting in NWCONFIG.

(c) The parameters related to an Ether Link have been downloaded to the PLC selected.

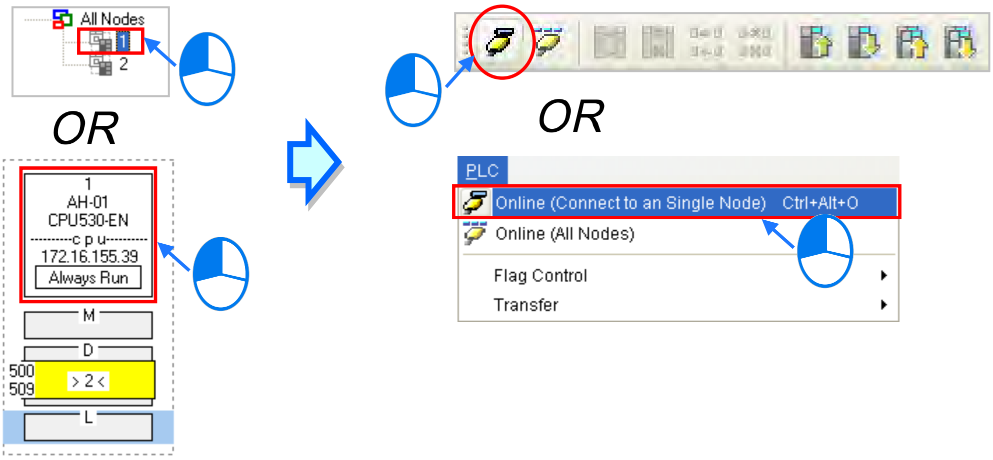
(d) Every node is powered up, and can operate normally.

20.4.9.1 Enabling a Monitoring Function

- **Enabling the function of monitoring a single node**

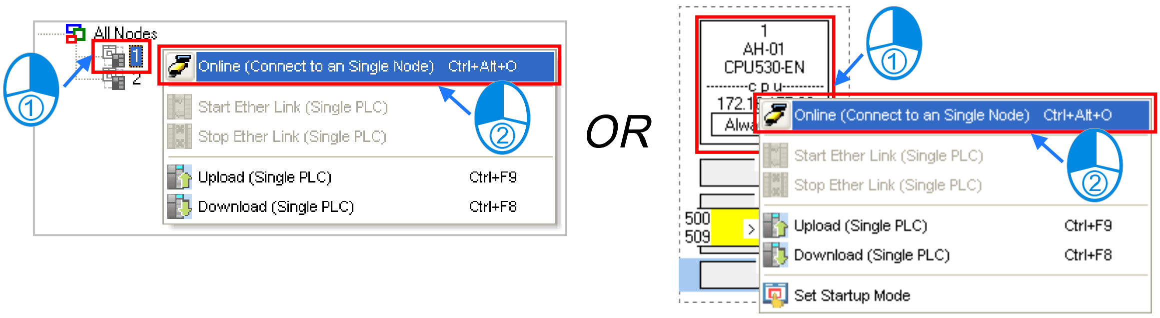
  - **Method 1**

Select a data demanding node, and then click  on the toolbar, or **Online (Connect to a Single node)** on the **PLC** menu. When the data demanding node is monitored,  on the toolbar is pressed.



  - **Method 2**

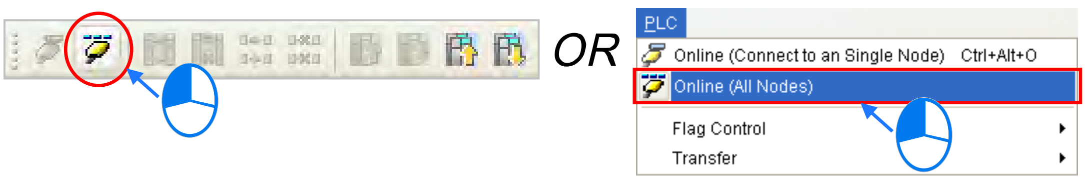
Select a data demanding node, right-click the data demanding node, and click **Online (Connect to a Single Node)** on the context menu. When the data demanding node is monitored,  on the toolbar is pressed.



- **Enabling the function of monitoring multiple nodes**

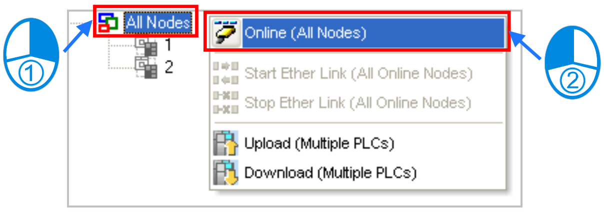
  - **Method 1**

Click **Online (All Nodes)** on the **PLC** menu, or  on the toolbar.



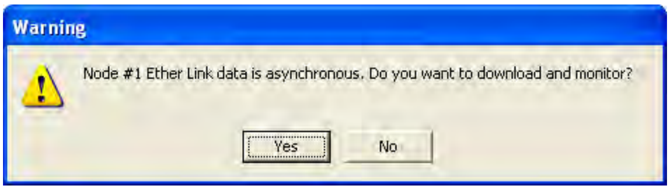
➢ **Method 2**

Select **All Nodes** on the node list, right-click **All Nodes**, and click **Online (All Nodes)** on the context menu.



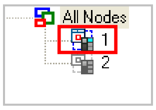
<u>**Additional remark**</u>

Before the system enters a monitoring mode, it checks whether the Ether Link constructed in the **Ether Link Configuration** window is consistent with the setting in the PLCs. If the Ether Link constructed in the **Ether Link Configuration** window is not consistent with the setting in the PLCs, the system will ask the users to download the related parameters again.

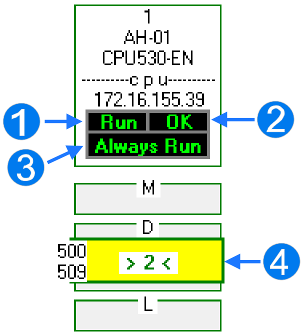


20.4.9.2 Monitoring Status

After the system enters a monitoring mode, the node which is monitored will be colored on the node list.



Besides, the words and the pictures in the display area will indicate the execution status of the current Ether Link after the system enters a monitoring mode.

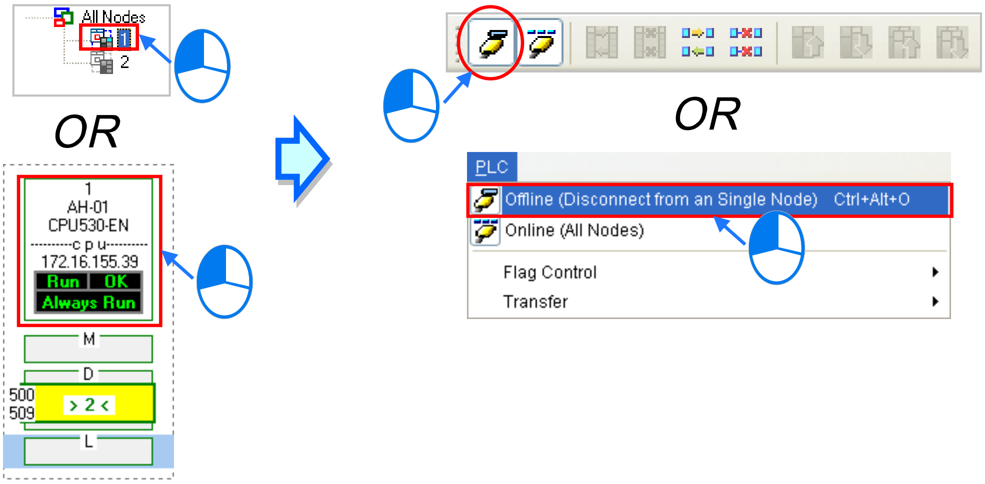


Status	Description
❶ Running/Stopping	Run: The Ether Link constructed is executed.
	Stop: The Ether Link is not executed.
❷ Operating status	OK: The Ether Link constructed is executed normally.
	Error: The Ether Link constructed is not executed normally.
❸ Start mode	Always Stop: **Always Stop**
	Always Run: **Always Run**
	Flag Mode: **SM Flag**
❹ Data block	500 509 > 2 <: The data exchange is being performed.
	500 509 ≠ 2 ≠: The performance of the data exchange stops.

20.4.9.3 Disabling a Monitoring Function

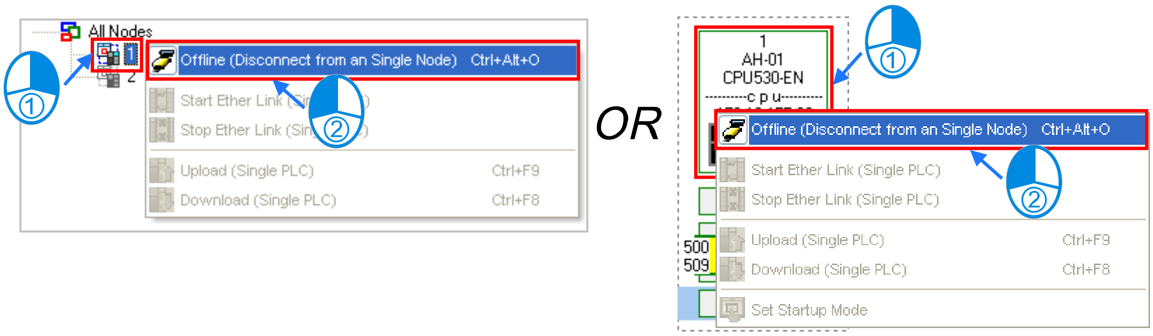
- **Disabling the function of monitoring a single node**
  - **Method 1**

    Select a data demanding node, and then click  on the toolbar, or **Offline (Disconnect from a Single node)** on the **PLC** menu.

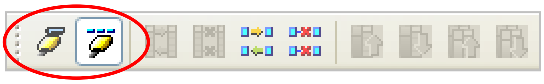


➢ **Method 2**

Select a data demanding node, right-click the data demanding node, and click **Offline (Disconnect from a Single Node)** on the context menu.



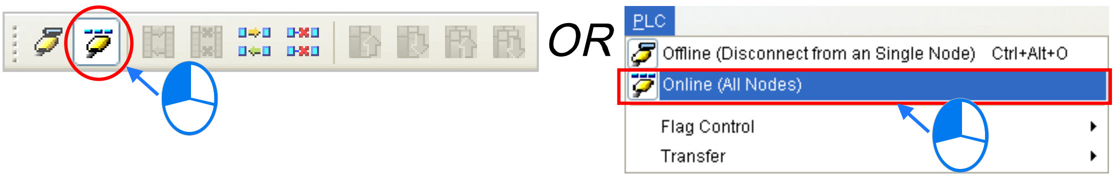
When the data demanding node selected is not monitored,  on the toolbar is not pressed. If another node is monitored,  will be pressed.



- **Disabling the function of monitoring multiple nodes**

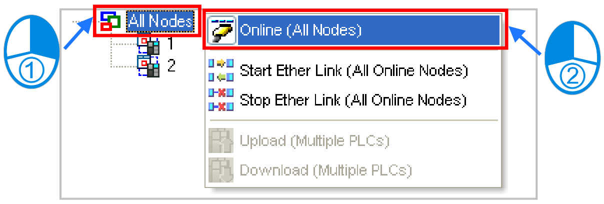
➢ **Method 1**

Click **Online (All Nodes)** on the **PLC** menu, or  on the toolbar.



➢ **Method 2**

Select **All Nodes** on the node list, right-click **All Nodes**, and click **Online (All Nodes)** on the context menu.



20.4.10 Online Start / Stop Ether Link (SM Flag)

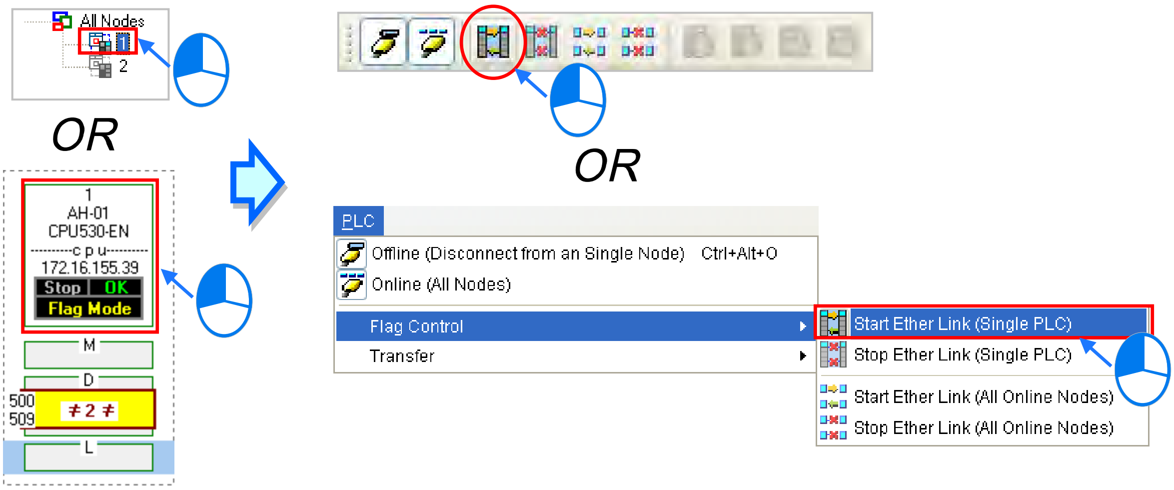
When the start mode of a node is in **SM Flag**, users can directly operate the flags under online monitoring state and start or stop a node under Ether Link operation; however, it is limited to nodes in monitoring.

20.4.10.1 Starting the Execution of an Ether Link

● **Making a single node start the execution of an Ether Link**

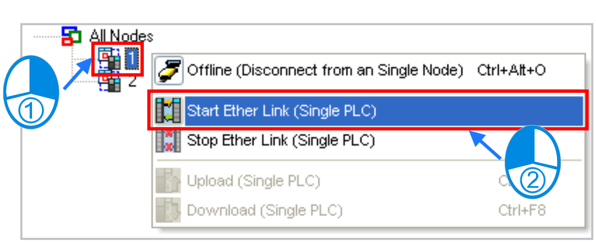
➢ **Method 1**

If users want to make a node start the execution of the Ether Link constructed, they have to select the node, and click on the toolbar. They can also make the node start the execution of the Ether Link constructed by selecting the node, clicking the **PLC** menu, pointing to **Flag Control**, and clicking **Start Ether Link (Single PLC)**.

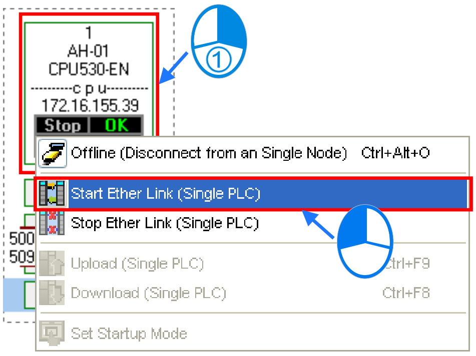


➢ **Method 2**

Select a node, right-click the node, and click **Start Ether Link (Single PLC)** on the context menu.



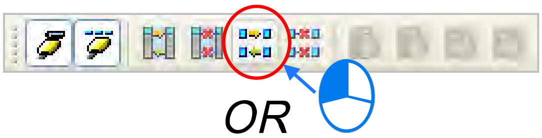
OR



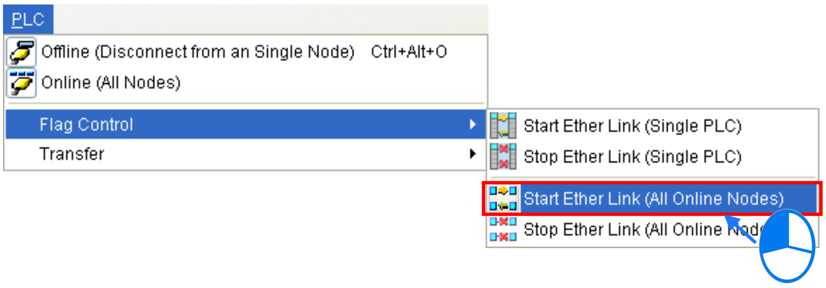
- **Making multiple nodes start the execution of an Ether Link**

  - **Method 1**

    If users want to make all the nodes start the execution of the Ether Link constructed, they have to click the **PLC** menu, point to **Flag Control**, and click **Start Ether Link (All Online Nodes)**. The users can also make all the nodes start the execution of the Ether Link constructed by clicking  on the toolbar.

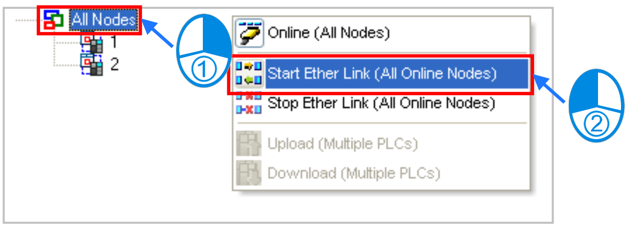


OR



  - **Method 2**

    Select **All Nodes** on the node list, right-click **All Nodes**, and click **Start Ether Link (All Online Nodes)** on the context menu.

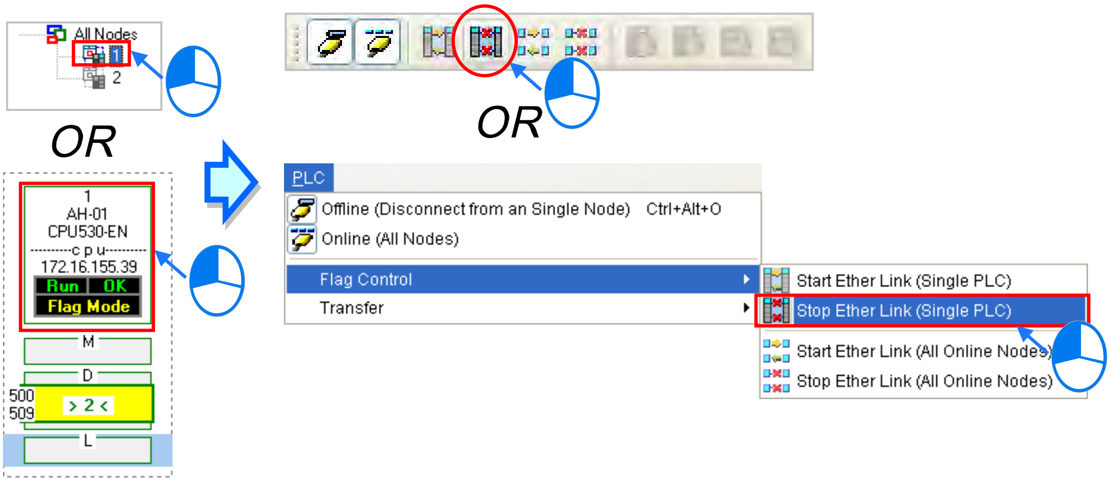


20.4.10.2 Stopping the Execution of an Ether Link

- **Making a single node stop the execution of an Ether Link**

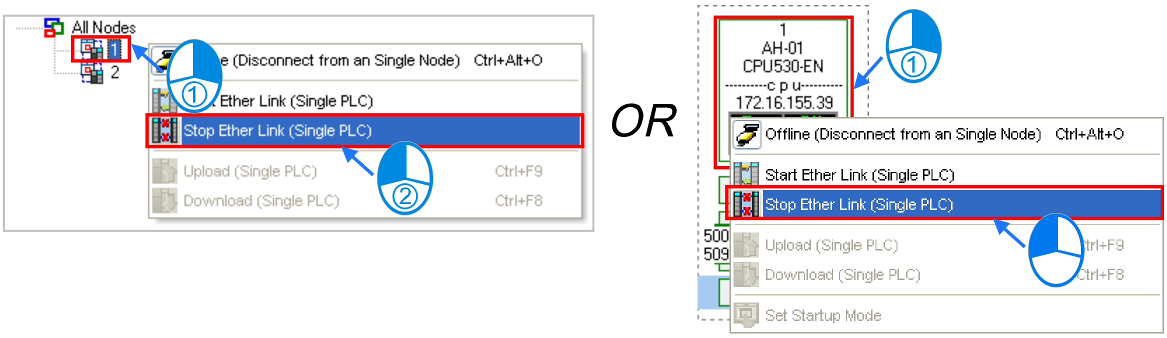
  ➢ **Method 1**

  If users want to make a node stop the execution of the Ether Link constructed, they have to select the node, and click  on the toolbar. They can also make the node stop the execution of the Ether Link constructed by selecting the node, clicking the **PLC** menu, pointing to **Flag Control**, and clicking **Stop Ether Link (Single PLC)**.



  ➢ **Method 2**

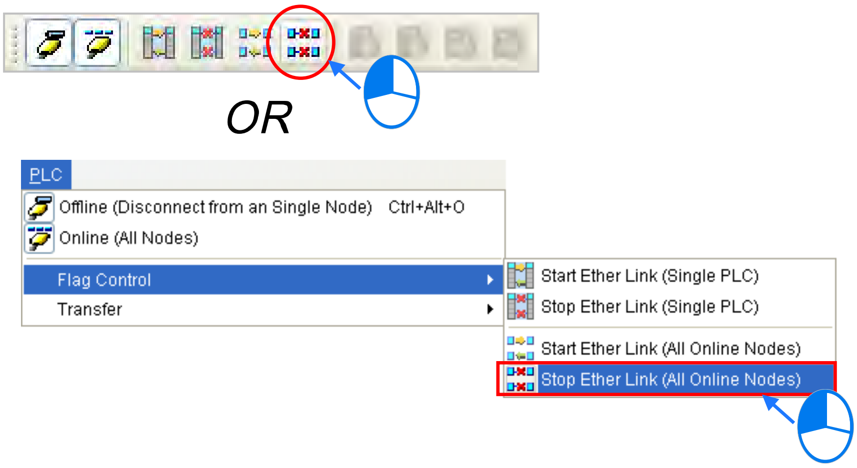
  Select a node, right-click the node, and click **Stop Ether Link (Single PLC)** on the context menu.



- **Making multiple nodes stop the execution of an Ether Link**

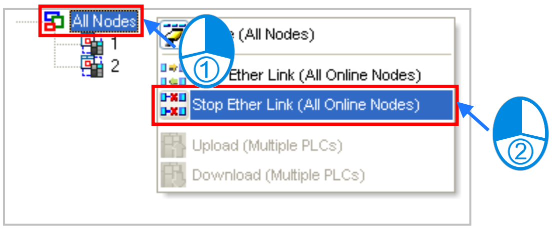
  ➢ **Method 1**

  If users want to make all the nodes stop the execution of the Ether Link constructed, they have to click the **PLC** menu, point to **Flag Control**, and click **Stop Ether Link (All Online Nodes)**. The users can also make all the nodes stop the execution of the Ether Link constructed by clicking  on the toolbar.



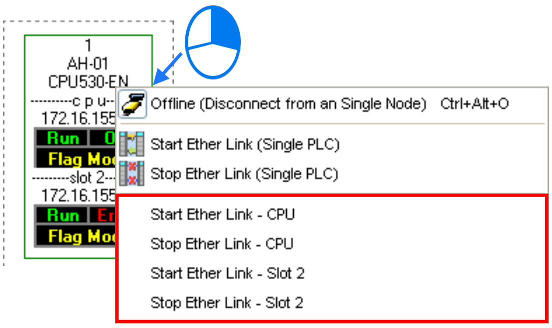
- **Method 2**

  Select **All Nodes** on the node list, right-click **All Nodes**, and click **Stop Ether Link (All Online Nodes)** on the context menu.



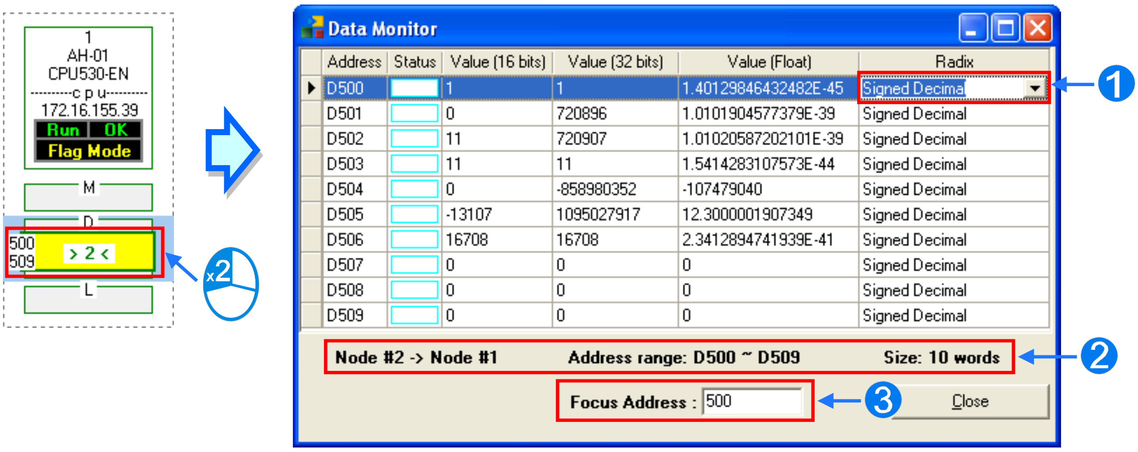
<u>Additional remark</u>

If a node in the display area has several Ethernet ports, users can make a port start/stop the execution of the Ether Link constructed by means of clicking an item on the context menu which appears after they right-click the node. The execution of an Ether Link is based on the nodes in a network. If users make a port that a node has stop the execution of the Ether Link constructed, another node that the node has can still execute the Ether Link constructed.



20.4.11 Monitoring Table and Error Log

After users double-click a data block, the **Data Monitor** window will appear. The users can view the values in the window. They cannot change the values in the window.

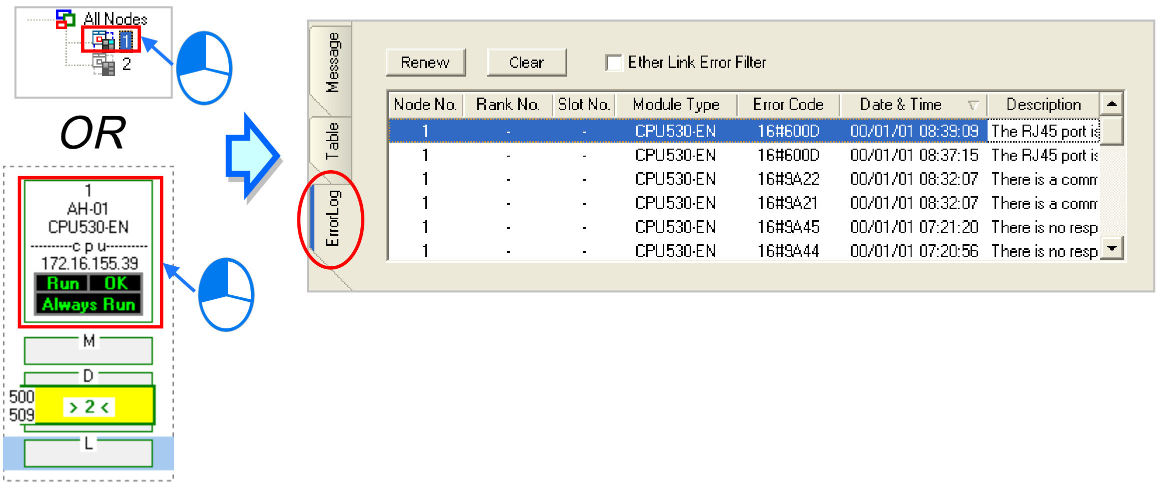


❶ After users click the **Radix** cell for a device, they can select a method of representing the value in the device on the drop-down list.

❷ The information about the data block which is monitored is displayed.

❸ Users can type a device address in this box. After the users press **Enter** on the keyboard, they can easily view the device address in the window.

After a node is selected, the error log in the node will be displayed in the **Error Log** page. If the users select the **Ether Link Error Filter** checkbox, only the error log related to the Ether Link constructed will be listed. Besides, after the users click **Renew**, the error log in the node will be retrieved, and the error log retrieved will be displayed in the **Error Log** page. After the users click **Clear**, the error log in the **Error Log** page and the error log in the node will be cleared.

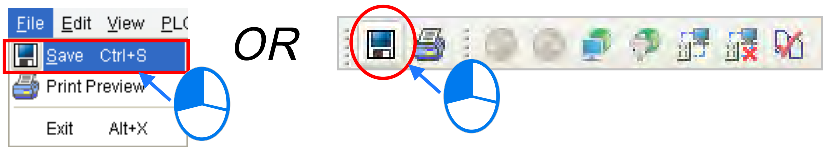


The **Error Log** page contains error records from hosts and modules. When an error log is formed by modules, the PLC model type is known in the **Device Type** column and the module position can be found in **Rack No.** and **Slot No.** columns. However, when error occurs by CPU, no numbers are shown in **Rack No.** and **Slot No.** columns.

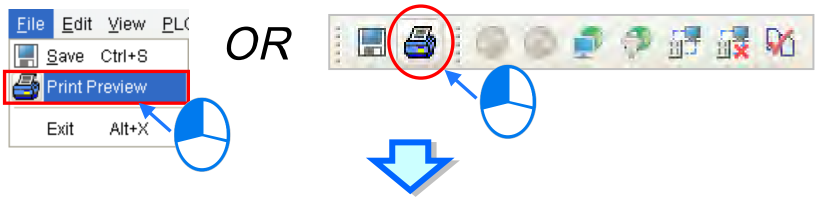
20.5 NWCONFIG Management and Application

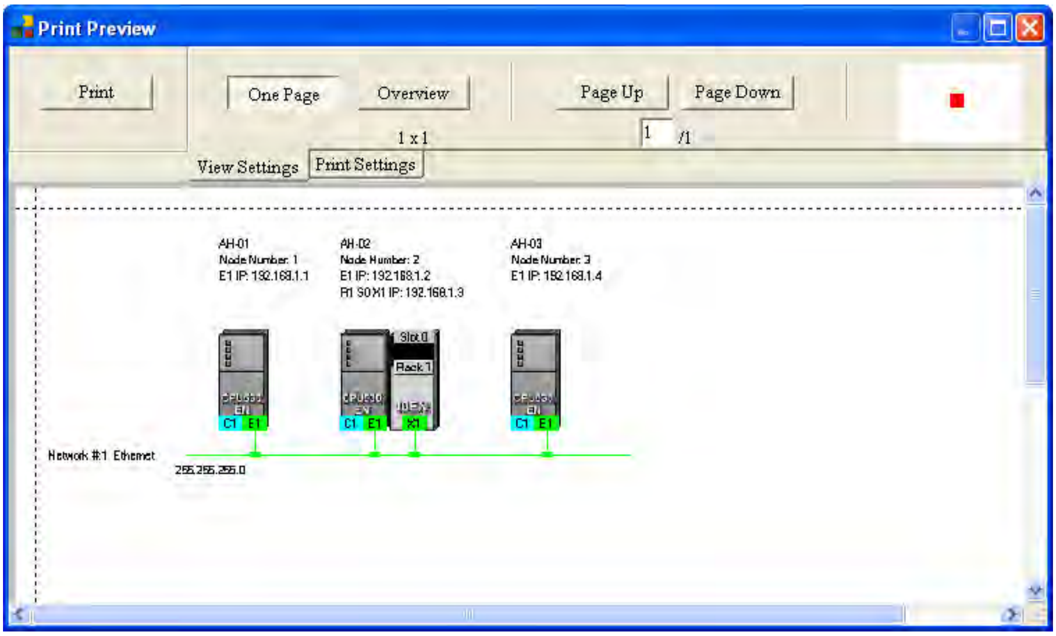
20.5.1 Save and Print

If users want to save the parameters set in NWCONFIG, they can click **Save** on the **File** menu, or  on the toolbar. The parameters which can be saved are the network framework created in NWCONFIG, the parameters related to the PLC Links constructed, and the parameters related to the Ether Links constructed. After the saving of the parameters set in NWCONFIG is complete, an nw file whose primary filename is the project name/group name, and an nwsd file whose primary filename is the project name/group name will appear in the folder in which the project/group of projects is/are saved.



After the users click **Print Preview** on the **File** menu, or  on the toolbar, the system will automatically open the **Print Preview** window, and the network framework that the users create in NWCONFIG will be displayed in the **Print Preview** window. Please refer to appendix C for more information.





Before the users print the data related to a PLC Link or an Ether Link, they have to export the data as a CSV file. After the CSV file is opened in Microsoft Excel, they can print the data in the CSV file.

20.5.2 Downloading

In NWCONFIG Graphic Workspace, download the routing tables produced to PLCs, the parameters related to the PLC Links constructed, the parameters related to the Ether Links constructed to the nodes.

20.5.2.1 Downloading Parameters

- **Routing table**

  The routing data stored in a PLC is data related to the PLC itself, and therefore the routing tables downloaded to nodes are different. Users have to download the routing tables produced to nodes in the working area.

- **Parameters related to a PLC Link**

  The parameters related to a PLC Link can only be downloaded to the PLC designated as a master station. If the parameters related to a PLC Link are downloaded to a slave station, the related special relays and the related special registers in the slave station will be restored to the default setting. There is only one master station in a network. If users are not sure whether a device was designated as a master station, and whether the parameters related to a PLC Link was downloaded to the device, they have to download the parameters related to a PLC Link to the device.

- **Parameters related to an Ether Link**

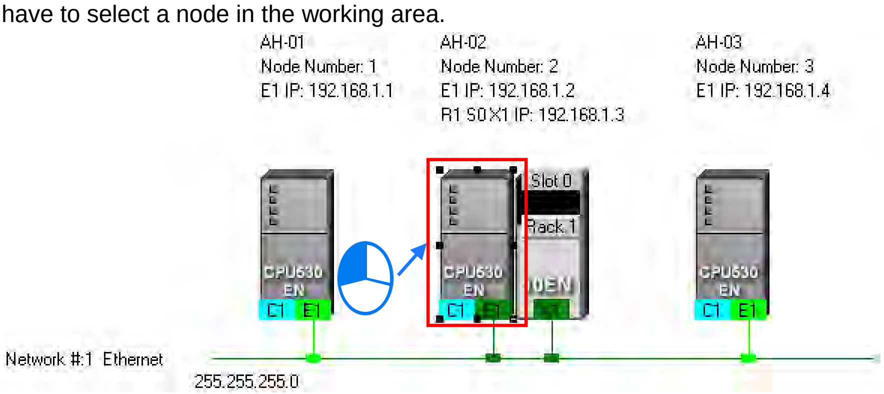
  The parameters related to an Ether Link must be downloaded to the data demanding nodes. However, the data exchange table stored in a PLC is a table related to the PLC itself. Besides, if the parameters set include a node which does not demand any data, the data in the node will be cleared after the parameter are downloaded to the node, and the start mode of the node will depend on the parameters after the parameters are downloaded to the node.

20.5.2.2 Description of Downloading

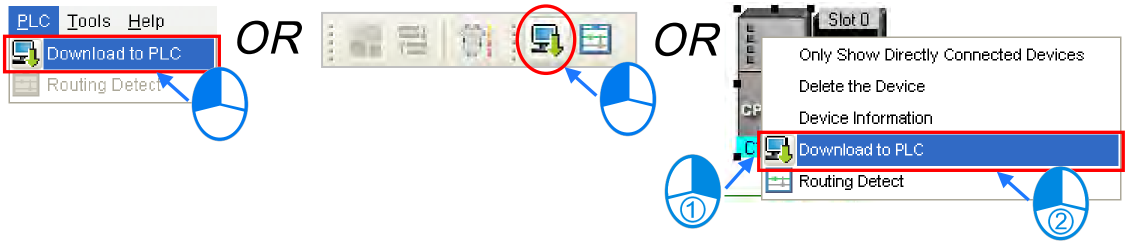
There are two ways to download. One is **Single node**, the other is **Multiple node**. When downloading communication settings, do not use **Routing Mode**.

- **Single node**

  The users have to select a node in the working area.

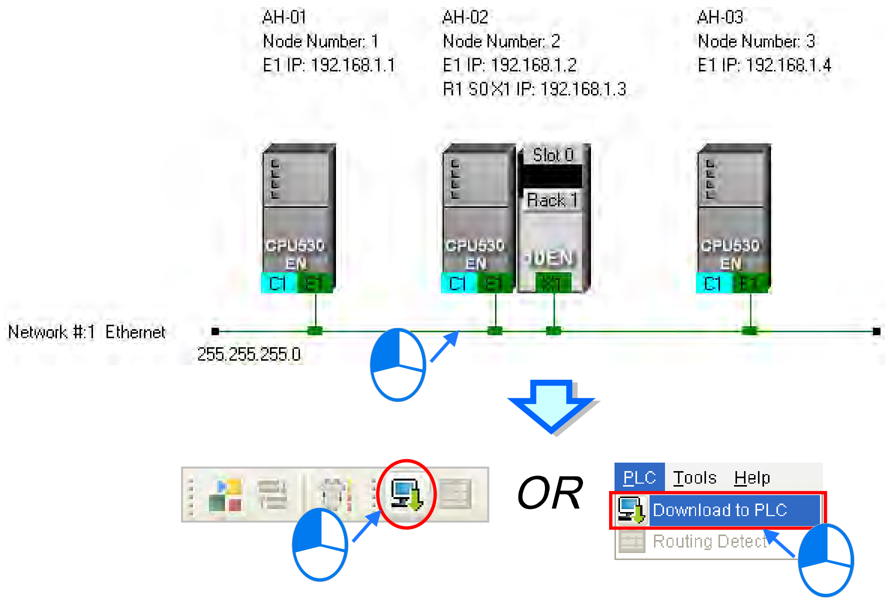


After the users click **Download to PLC** on the **PLC** menu, or on the toolbar, the **Optional Download** window will appear. The users can also open the **Optional Download** window by right-clicking the device they select, and clicking **Download to PLC** on the context menu.

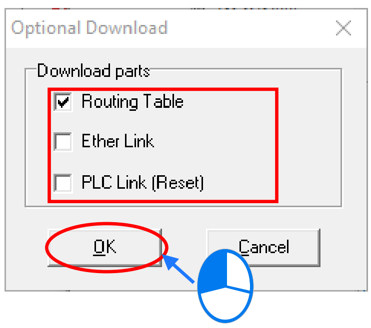


- **Multiple nodes**

The users have to select an Ethernet network in the working area. After the users click **Download to PLC** on the **PLC** menu, or on the toolbar, the **Optional Download** window will appear. If the actual connection is consistent with the setting in NWCONFIG, parameters can be downloaded to the nodes connected to the Ethernet network.



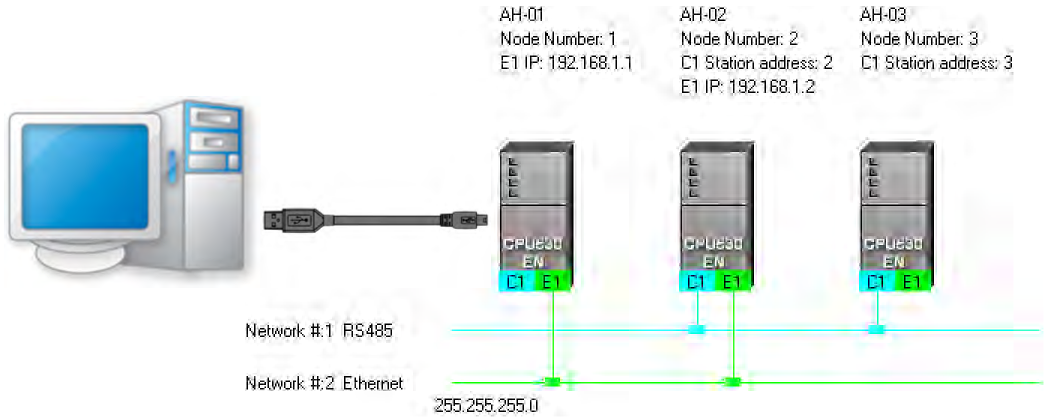
Base on the steps above, the screen will appear Optional Download window. When certain items are in grey, the function is not supported; select the time to download and click **OK**.



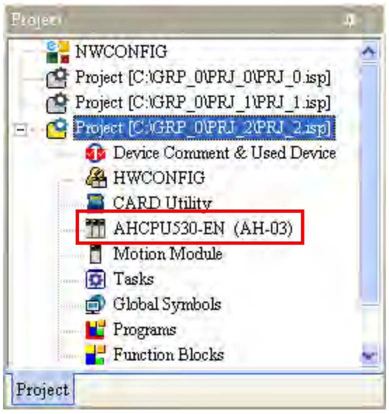
20.5.3 ISPSoft Routing Application

When completing the network structure in NWCONFIG and successfully downloaded Routing Table for each node, users can download and upload or monitor hosts (non-directly connected) through routing function in ISPSoft; but, to use the function in ISPSoft, the objective needs to be AH5xo series.

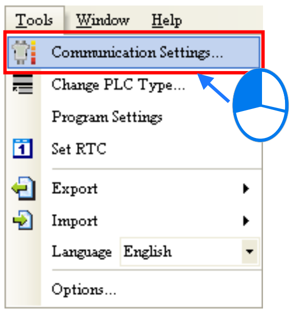
In the figure below, the actual connected host is AH-01. But, it is possible to monitor AH-03 through routing function.



(1) Users have to activate the project for AH-03.



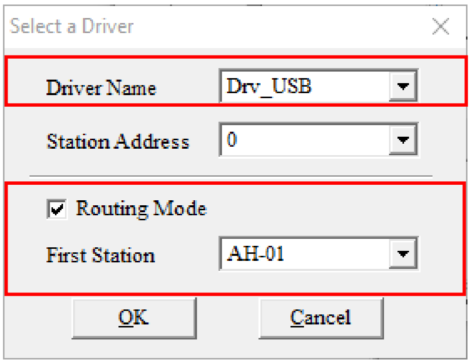
(2) Click the **Tools** menu, and then click **Communication Settings…**.



(3) In the **Communication Setting** window, the users have to select the **Routing Mode** checkbox, and select a device in the **First Station** drop-down list box.

Generally speaking, the device which actually connects to the computer is the first station. If the computer connects to several devices, or connect to devices through Ethernet, the users have to designate a device as the first station according to the network framework created in NWCONFIG. Besides, if the **Routing Mode** checkbox is selected, the driver selected in the **Driver** drop-down list box must be a driver which can connect to the first station.

After the users click **OK** in the **Communication Setting** window, AH-03 can be monitored through AH-01.



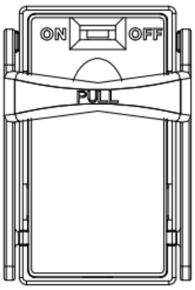
Chapter 21 Data Backup and Data Restoration

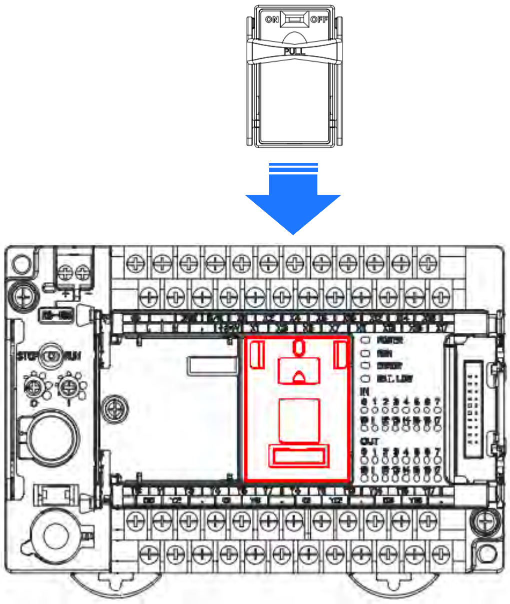
Table of Contents

21.1 Data Backup Memory Cards

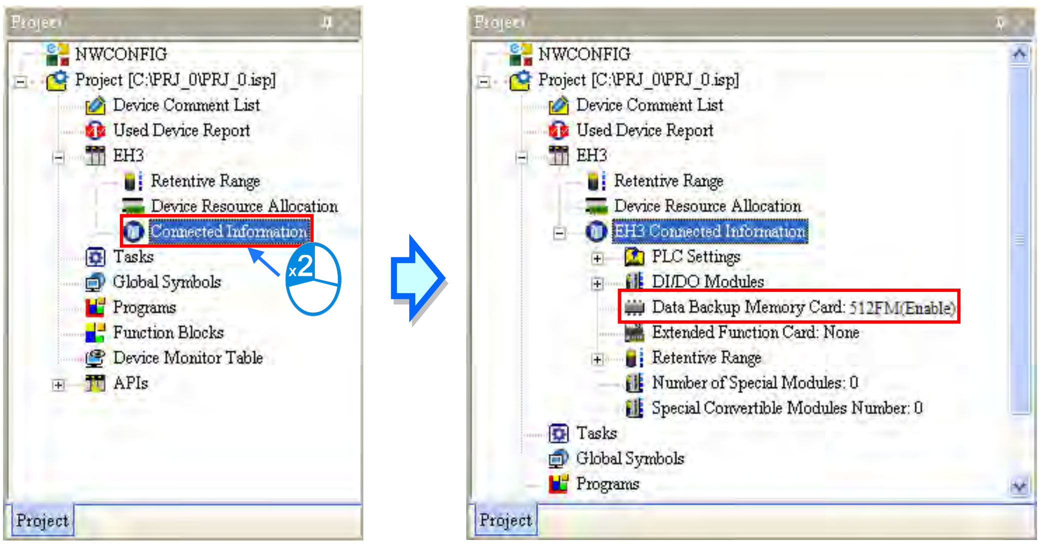
21.1.1 Introduction of Data Backup Memory Cards

A DVP-EH2 series PLC can be used with DVP-256FM, a data backup memory card with a milky cover. A DVP-EH3 series PLC can be used with DVP-512FM, a data backup memory card with a black cover.



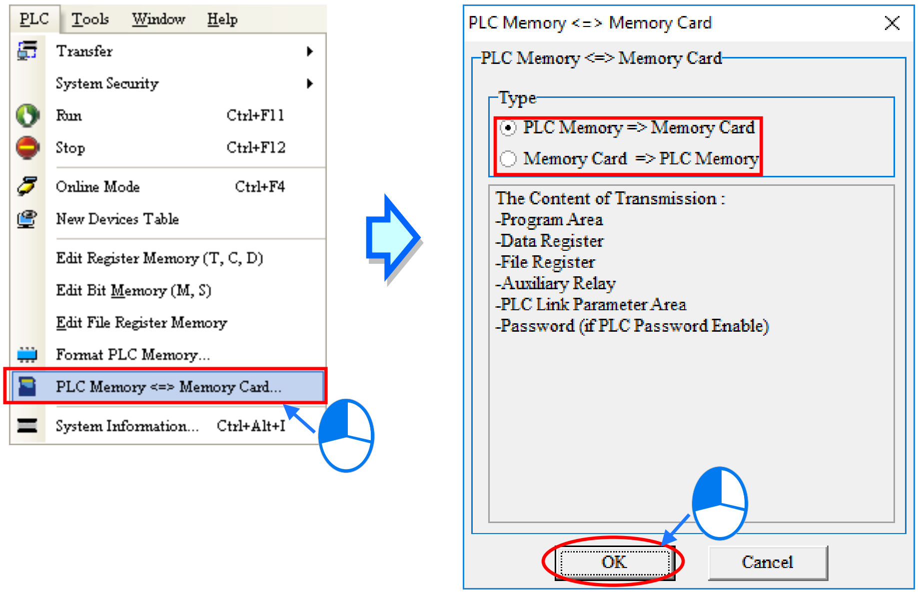


Install a memory card in a PLC, power the PLC up, unfold the PLC section in the project management area in ISPSoft, and double-click **Connected Information**. If ISPSoft is connected to the PLC normally, the system information about the PLC will be under the **Connected Information** section. The **Data Backup Memory Card** item indicates whether the memory card is enabled.



21.1.2 Operating Data Backup by Memory Card

Before executing data backup by memory card, please make sure that ISPSoft and PLC hosts are connected. Click **PLC Memory<=>Memory Card…** on the **PLC** menu, select the **PLC Memory=>Memory Card** option button or the **Memory Card=>PLC Memory** in the **Type** section in the **PLC Memory<=>Memory Card** window, and click **O**K.

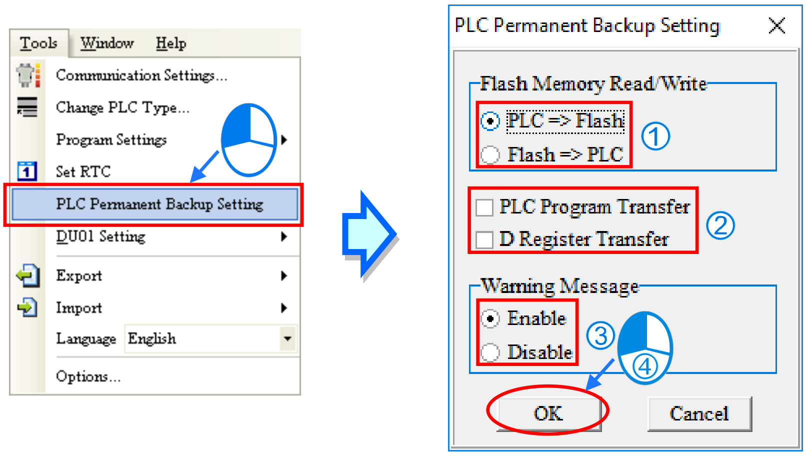


***. Please refer to the related user manuals or technical documents for more information about data backup memory cards, the models which are supported, and the firmware versions which are supported.**

21.2 Permanent Data Backup

There is flash memory in a DVP-EH2/DVP-EH2-L/DVP-EH3/DVP-EH3-L/DVP-SV/DVP-SV2 series PLC. The flash memory in a PLC is used to back up the data in the PLC. Please refer to manuals or documents for more information about the functions of flash memory.

Users have to make sure that ISPSoft is connected to a PLC before they perform a data backup or a data restoration through ISPSoft. Click **PLC Permanent Backup Setting** on the **Tools** menu. In the **PLC Permanent Backup Setting** window, the users have to select the **PLC=>Flash** option button or the **Flash=>PLC** option button in the **Flash Memory Read/Write section**, select contents which will be transferred, select the **Enable** option button or the **Disable** option button in the **Warning Message** section. (A data restoration is automatically performed when the flat battery in a PLC causes a data loss. If the **Enable** option button in the **Warning Message** section is selected, a warning message appears when a data restoration is automatically performed.) After the setting in the **PLC Permanent Backup Setting** window is complete, the users can click **OK**.



21.3 CARD Utility

Before you start, please refer to the CARD Utility Backup and Restore table below to check if the certain backup/restore item is supported by your model type.

	AS DVP-ES3	AH5x0	AH5x1RS	AH5x1EN AH560	AHxxEMC	AS5xx DVPxxMC	DVP
Source Code (Note 1)	V	V	V	V	V	V	
Actuating Code	V	V	V	V	V	V	V

	AS DVP-ES3	AH5x0	AH5x1RS	AH5x1EN AH560	AHxxEMC	AS5xx DVPxxMC	DVP
Project Password/ Program ID	V	V	V	V	V	V	V
HWCONFIG Configuration	V	V	V	V	V	V	
CPU Modules Configuration / Modules Parameter settings	V	V	V	V	V	Only support AS5xx	
Devices (Note 2)	M, D, C, HC, FR	X, Y , M, SM, SR, D, B, W, L, S, TB, T, CB, C, HCB, HC, E	X, Y , M, SM, SR, D, W, L, S, TB, T, CB, C, HCB, HC, E	X, Y , M, SM, SR, D, W, L, S, TB, T, CB, C, HCB, HC, E	X, Y , M, SM, SR, D, W, L, S, TB, T, CB, C, HCB, HC, E	(Note 3)	D, C, HC, T, FR
Data Communication Exchange Table	COM1/ COM2/ Ethernet/ FEN02/ Function Card1/ Function Card2	RS485/ Ethernet	COM1 COM2	COM1/ Ethernet/ RTU IO Table/ EIP I/O Connection table	COM2 Ethernet EtherCAT	CANopen	
Positioning	V						
Default Values			V	V	V		
ECAM					V	V	
Gcode						V	
Axis Parameters					V	V	
							V

	AS DVP-ES3	AH5x0	AH5x1RS	AH5x1EN AH560	AHxxEMC	AS5xx DVPxxMC	DVP
C code	V						
Data logger sampling setting	V						
EIP TAG	V						
	V						
HW TAG	V						
	V						
Webpage setting	V (Note 4)						

Note (1): Users may choose whether or not to backup source code when the project data is exported as a backup file (DUP). If there's no backup files and source code originally stored on PC, users would not be able to restore backup files without source code.

Note (2): Device backup and restore mechanism.

Note (3): For DVPxxMC and AS5xx series, the current values of retain variables can be backed up in DMD files.

Note (4): CANopen DS301 and webpage setting only support backup and restore between CPU and SD cards.

<table>
<tr><th rowspan="2"></th><th colspan="3">Backup</th><th colspan="3">Restore</th></tr>
<tr><th>From ISPSoft to PC</th><th>From CPU to PC</th><th>From CPU to PLC card</th><th>From PC to ISPSoft</th><th>From PC to CPU</th><th>From PLC card To CPU</th></tr>
<tr><td>AS
DVP-ES3</td><td>Perform device backup when device file (dvl, dvb, wft) exists.</td><td rowspan="5">Optional for device backup</td><td rowspan="5">Optional for device backup</td><td>Restore device files (dvl, dvb, wft) when device data is in backup files.</td><td rowspan="5">Restore device files when device data is in backup files.</td><td rowspan="5">Restore device files when device data is in backup files.</td></tr>
<tr><td>AH5x0</td><td rowspan="4">Would not perform device backup</td><td rowspan="4">Would not perform a device restore</td></tr>
<tr><td>AH5x1RS</td></tr>
<tr><td>AH5x1EN
AH560</td></tr>
<tr><td>AHxxEMC</td></tr>
<tr><td>AS5xx
DVPxxMC</td><td>Would not perform device backup</td><td>Not supported</td><td>Not supported</td><td>Not supported</td><td>Would not perform a device restore</td><td>Not supported</td></tr>
<tr><td>DVP</td><td>Optional for device data backup (dvl, wft)</td><td>Optional for device backup</td><td>Not supported</td><td>Not supported</td><td>Restore device files (dvl, dvb, wft) when device data is in backup files.</td><td>Not supported</td></tr>
</table>

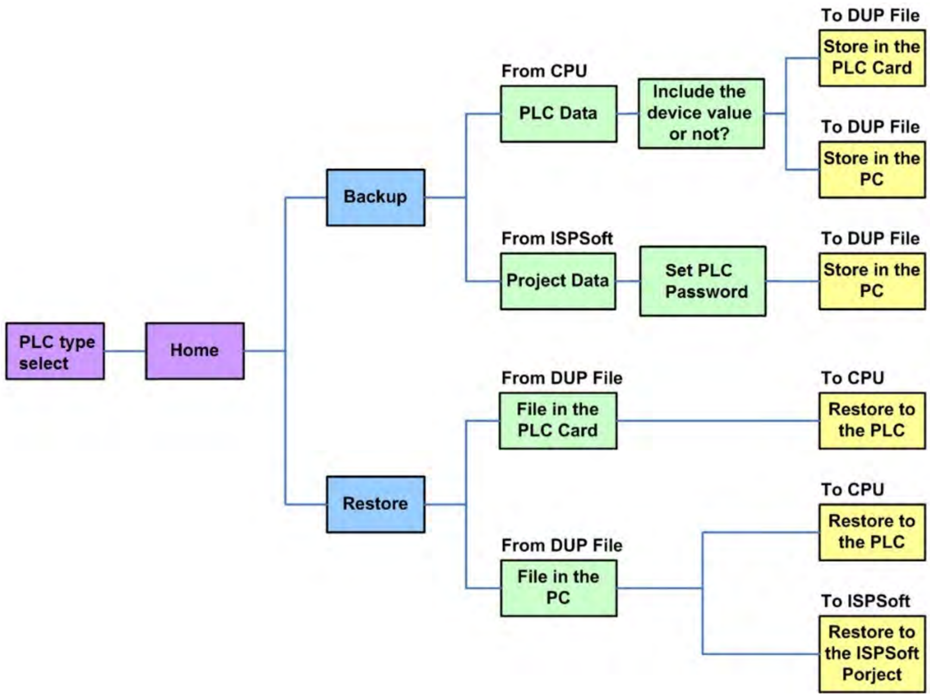
21.3.1 Introduction of CARD Utility

There are SD slots on AH/AS series CPU modules. Users can back up/restore data in an AH/AS series CPU module through a memory card. Besides, ISPSoft provides CARD Utility for users to back up/restore data or an ISPSoft project on AH/AS series CPU modules. The program codes, the parameter settings, the hardware configurations, and the network configurations in an AH/AS series CPU module or an ISPSoft project can be backed up. The values in the devices in an AH/AS series CPU module can also be backed up. For the module software in the HWCONFIG, only ECAT Builder supports data backup and restoration. Please refer to operation manuals or technical documents for more information about the SD card specifications.

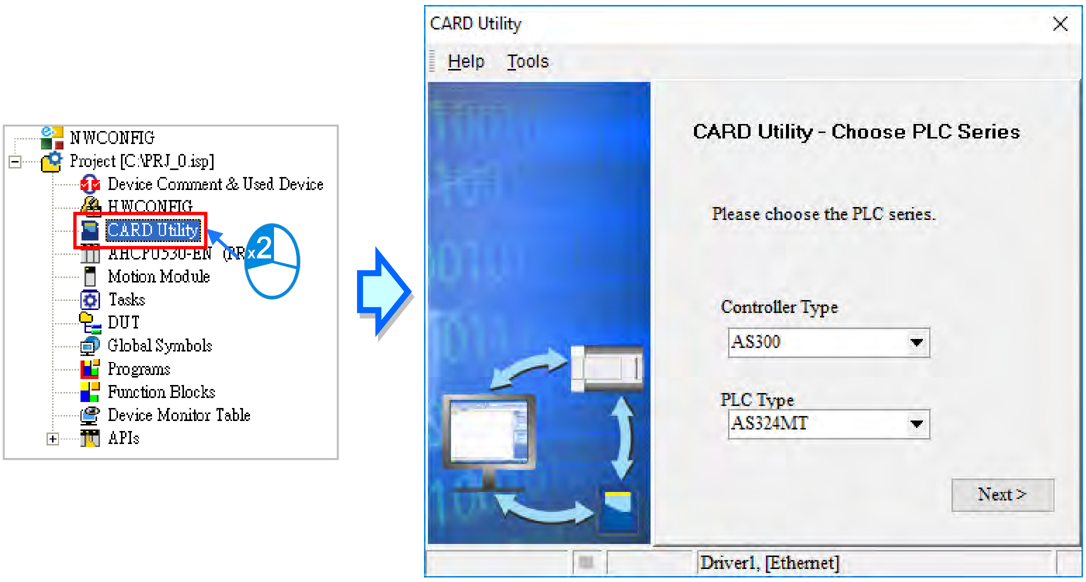
As for the network configurations, the AH5x0 series will only back up data that is related to their own modules and ISPSoft CPU projects, such as Routing Table and Ether Link. Likewise, not all network configurations can be restored back to the ISPSoft project. Please refer to chapter 20 for more information about network configurations.

The functions supported by CARD Utility are described below. The diagram below is a flowchart.

- If users export data from an AH series CPU module as a backup file (*.dup), the data exported can be saved in the memory card or in the computer. Users can also export the values in the devices in the AH/AS series CPU module.
- If users export an ISPSoft project as a backup file (*.dup) can only be saved in the computer. Data such as register editing (*.dvl), device status editing (*.dvb), file register editing (*.wft) of AS series can be seen as values in the device and can be exported and saved as backup files.
- Users can download the backup file saved in the inserted memory card back to the CPU module.
- Users can import a backup file (*.dup) saved in a computer back to the AH series CPU module or restore the backup file to an ISPSoft project. For AS series, if the users choose to restore the backup file to an ISPSoft project, the system will automatically skip the values in the devices and the hardware configuration in the backup file. Data such as register editing (*.dvl), device status editing (*.dvb), file register editing (*.wft) of AS series and AHxxEMC can be seen as values in the device and can be imported back to restore the ISPSoft project.



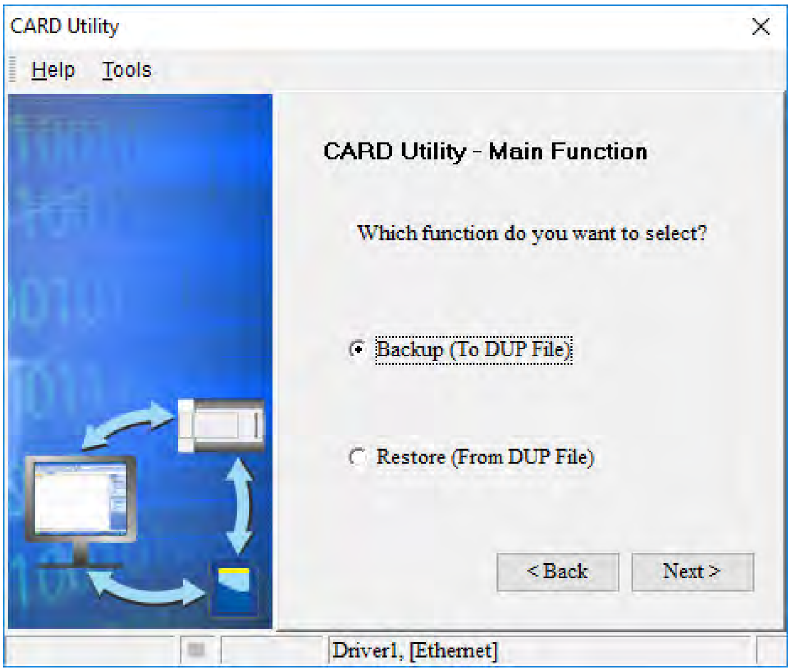
After users double-click **CARD Utility** in the project management area, the system will open the **CARD Utility** window. Select the controller and PLC type from the drop-down list and then click **Next** to start.



21.3.2 Backup

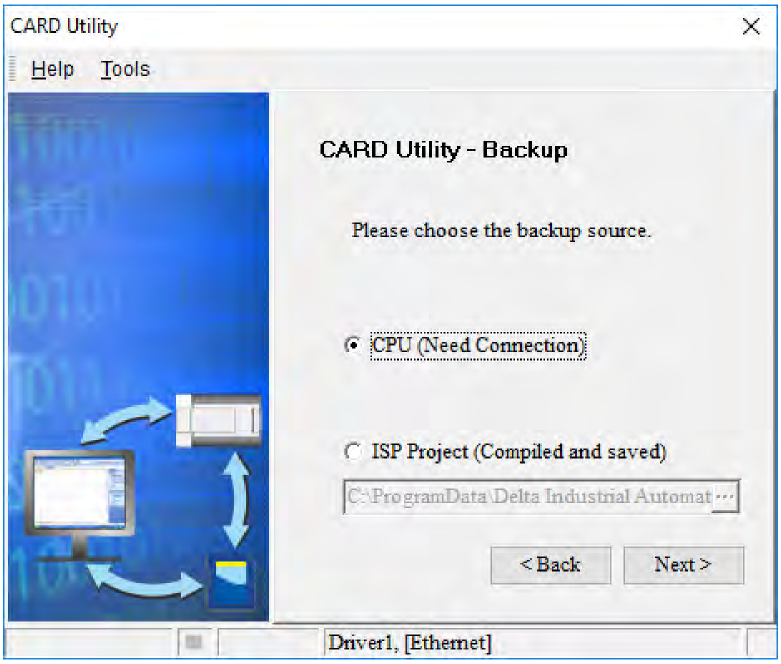
When the backup source/backup destination contains a host CPU or memory card, please check that ISPSoft and the hosts is connected.

(1) Select **Backup (To DUP File)** option button in the **CARD Utility** window, then click **Next**.

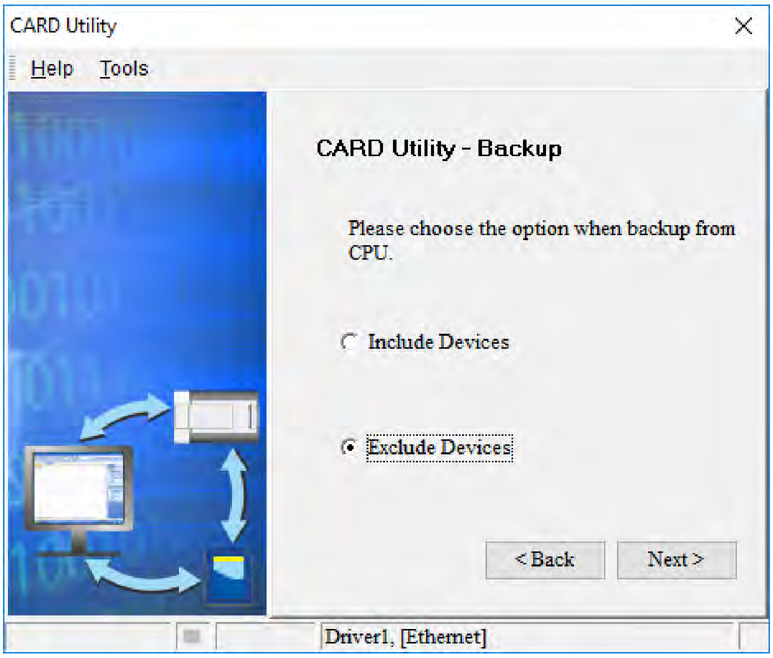


(2) Select a backup source, and then click **Next**.

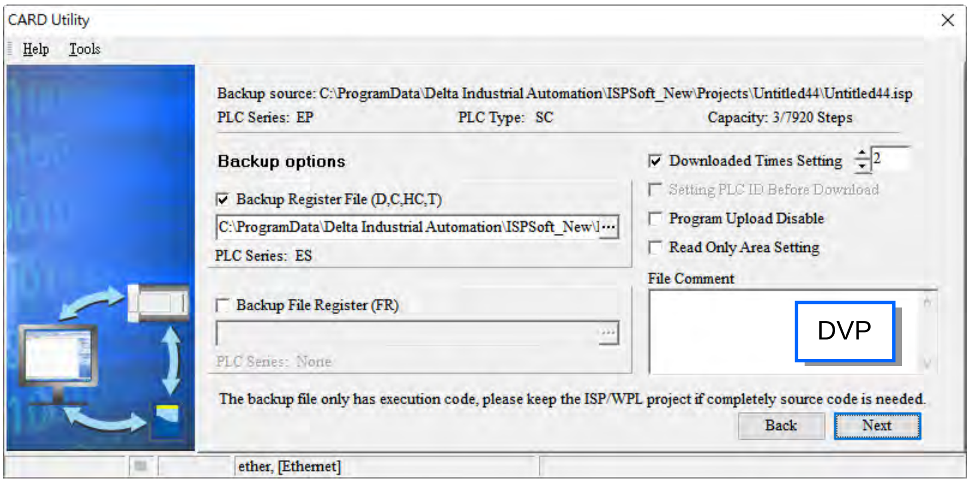
After the users select the **ISP Project (Compiled and saved)** option button, they have to click ···, and select an isp file in the **Open** window. If the program in the isp file selected is not compiled, a message appears when the isp file is backed up; meanwhile, please re-compile and save to re- execute data backup.



(3) When backup source is **CPU**, a window appears to choose whether the backup should include or exclude device content.



When using DVP series with “ISP project” as the backup source, the backup settings would pop up for you to configure the desired items to backup.



(4) Select a backup destination. If the backup source is an ISPSoft project, the backup destination must be a computer.

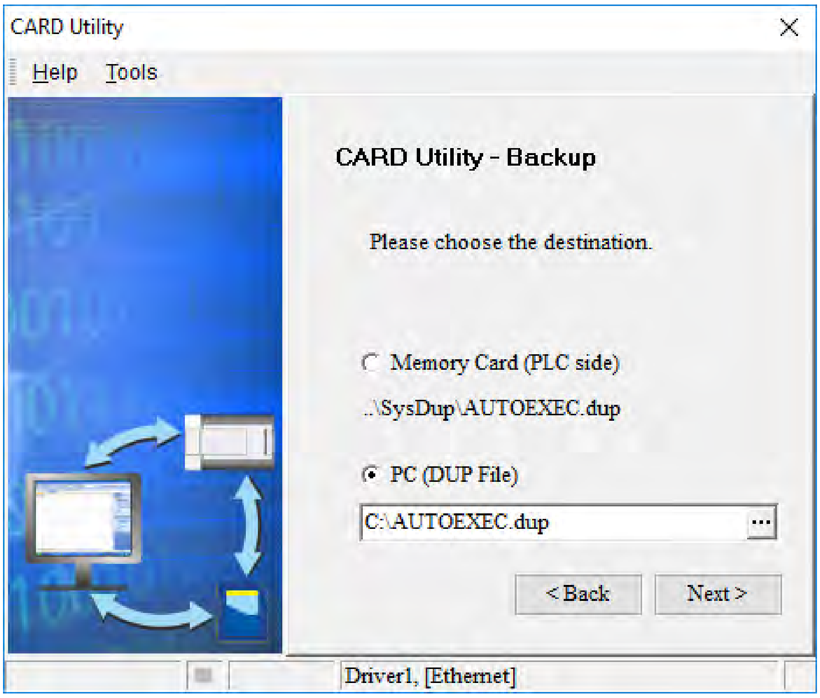
α. If the **Memory Card (PLC Side)** option button is selected, the filename of the backup file which will be produced will be **AUTOEXEC.dup**, and the path which points to the backup file is **Root directory of the memory card\\PLC CARD\AH500\SysDup\AUTOEXEC.dup** for AH series.

For AS300 series, it is **Root directory of the memory card\ SDCard \PLC CARD\AS300\SysDup\AUTOEXEC.dup**

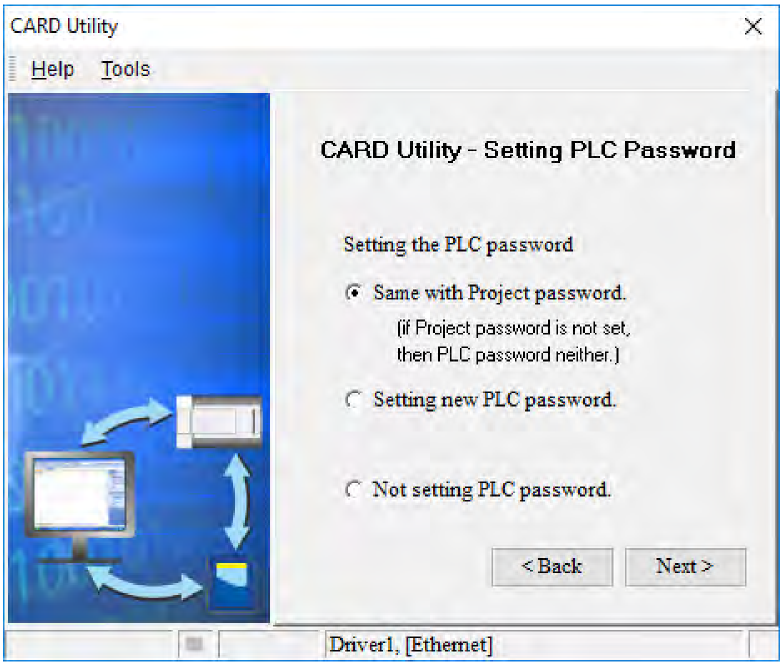
For AS200 series, it is **Root directory of the memory card\ SDCard \PLC CARD\AS200\SysDup\AUTOEXEC.dup**

For DVP-ES3 series, it is **Root directory of the memory card\ SDCard \PLC CARD\ES3\SysDup\AUTOEXEC.dup**

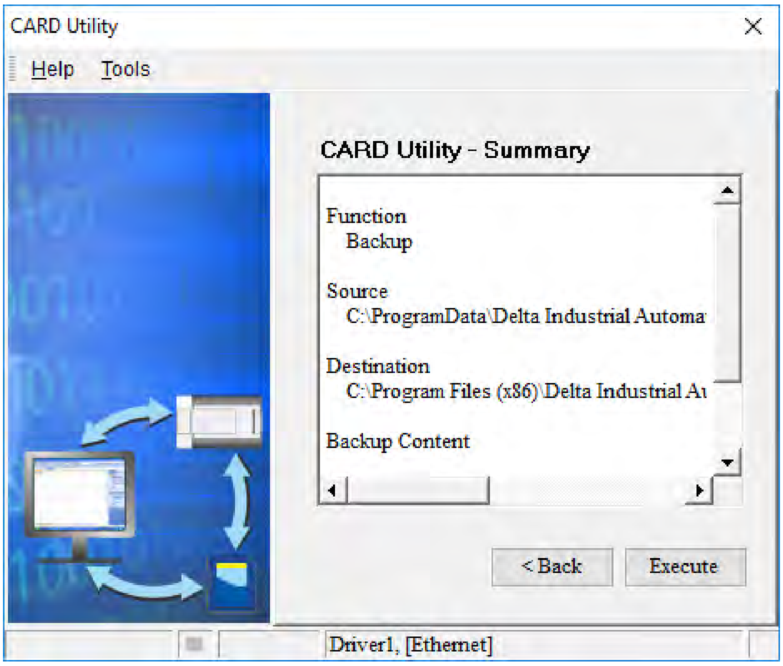
β. If the **PC (DUP File)** option button is selected, the users have to click ..., select a folder in the **Save in** drop-down list box in the **Save As** window, and type a filename in the **File name** box.



(5) When the backup source is selected to the ISPSoft Project, users can set up the PLC password. The options are to set the password the same as the Project (If the password for the Project is not set, the same goes to the PLC password.), set a new PLC password, and do not set a PLC password. When the option “Setting new PLC password” is selected, the setup window will show up.

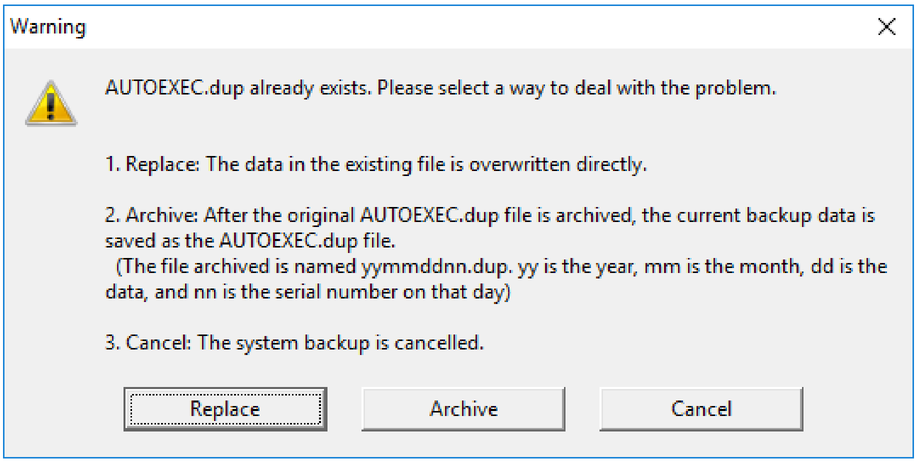


(6) After the users make sure that the summary in the **CARD Utility** window is consistent with the data backup which will be performed, they can click **Execute**.



Even if the users click **Cancel** to stop ISPSoft from performing the data backup in the process of backing up data in the CPU module onto the memory card inserted in the CPU module, the CPU module will still performs the data backup. The users can turn off the CPU module to stop the data backup from being performed. However, the backup file produced is not a complete backup file. As a result, the users have to delete the backup file from the memory card.

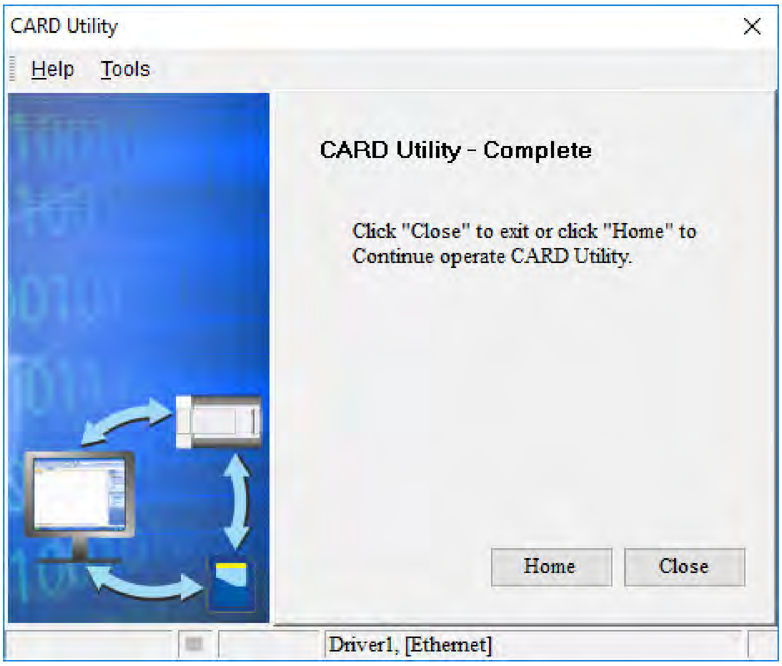
If the **Memory Card (PLC Side)** option button is selected, the filename of the backup file which will be produced will be **AUTOEXEC.dup**, and the path which points to the backup file will be **Root directory of the memory card\AH500\SysDup\AUTOEXEC.dup**. If there is an old backup file in the memory card inserted in the CPU module which is connected to ISPSoft, the **Warning** window will appear. The users have to click **Replace**, Archive, or **Cancel** in the Warning window according to the message in the window.



If the data backed up is protected by passwords, these passwords will also be backed up.

Data backup	Description
CPU module ➔ Memory card	The data backed up includes the PLC ID and the PLC password set in the CPU module.
CPU module ➔ Computer	The system asks users to type a PLC ID and a PLC password. If the PLC ID and the PLC password typed are correct, the data backup will be performed. The data backed up includes the PLC ID and the PLC password.
ISPSoft project ➔ Computer	The data backed up includes the program ID, the project password and the PLC password set while setting up the backup.

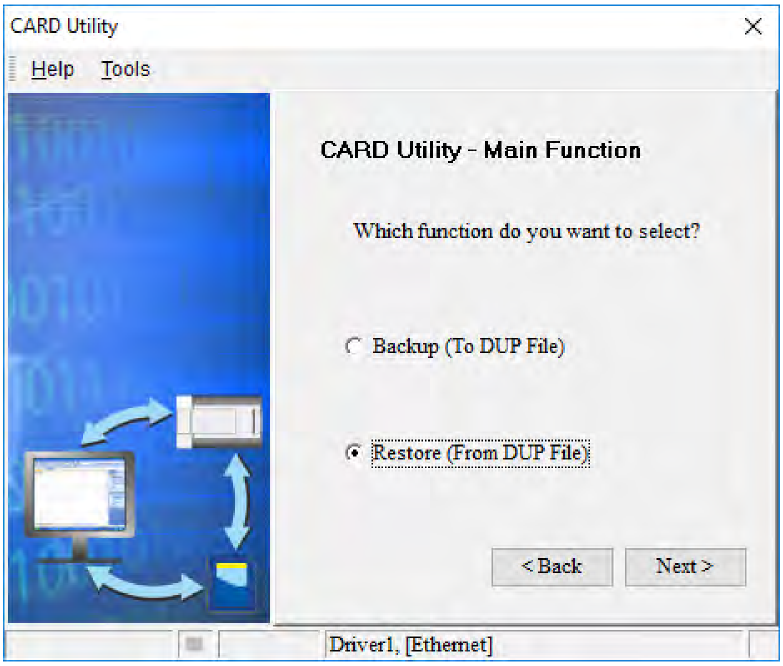
(7) After the data backup is performed, the users can click **Home** or **Close** in the **CARD Utility** window.



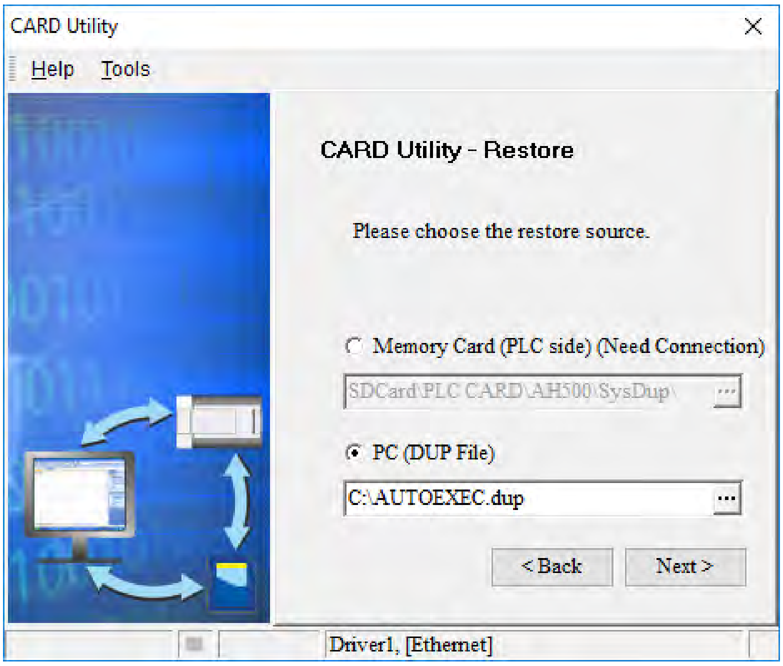
21.3.3 Restoration

When restoration source/restoration destination has a host CPU or memory card, please make sure that ISPSoft and the host is connected

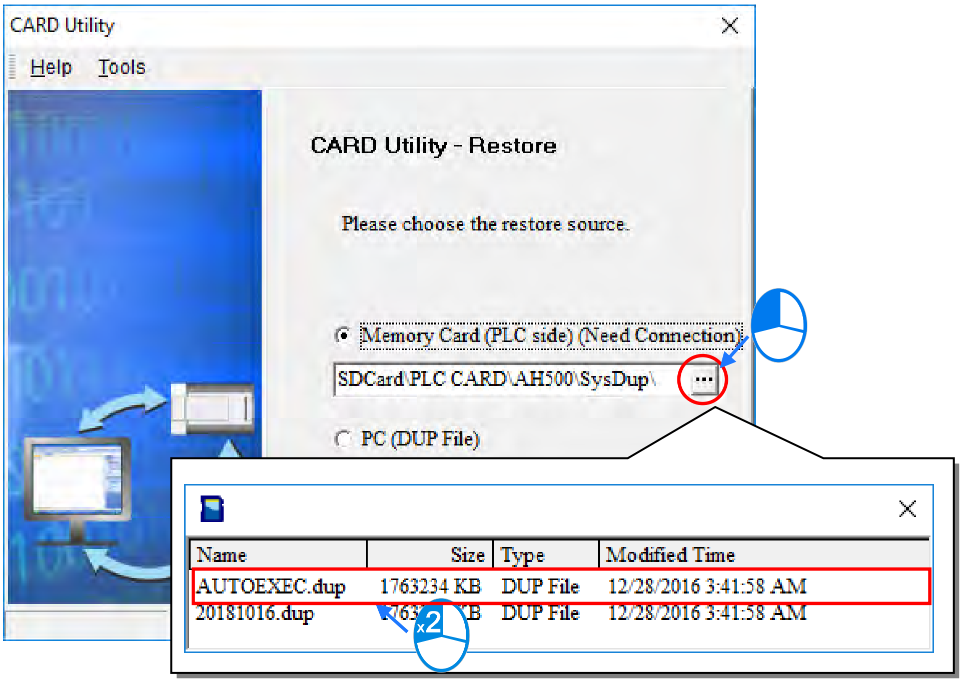
(1) Select **Restore (From DUP File)** option button in the **CARD Utility** window, and then click **Next**.



(2) Click ··· at the right of the path column and select a backup file to restore.



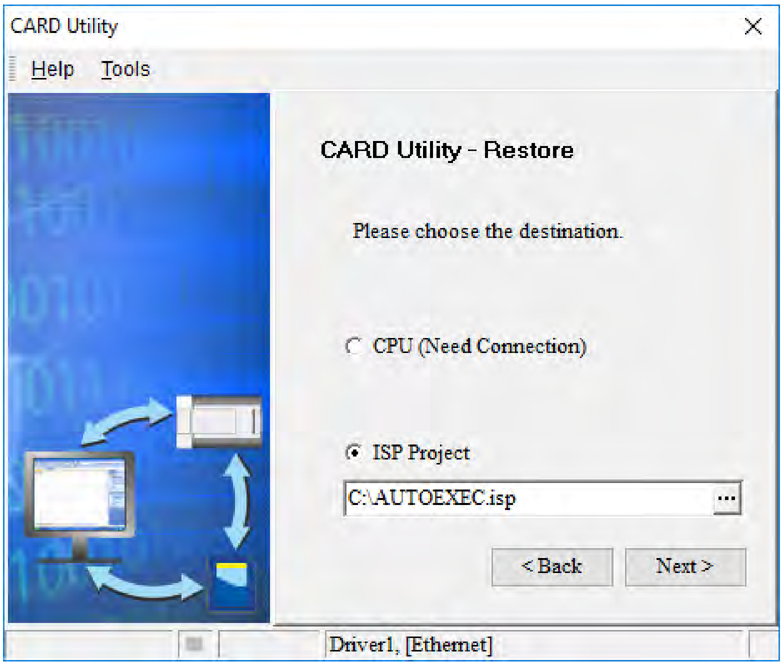
When **Memory Card (PLC side) (Need Connection)** is selected, the system automatically connect to a PLC and displays all backup files by memory card in the window. Double-click on the backup files for restoring.



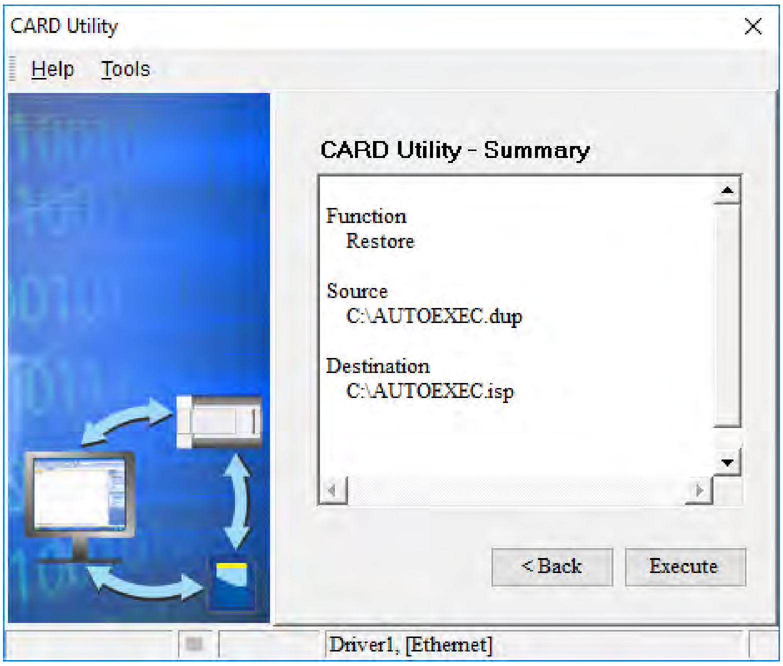
(3) Select a restoring destination, and then click **Next**.

α. If the users want to put the backup file selected into the CPU module which is connected to ISPSoft, they have to select the **CPU (Need Connection)** option button.

β. If **ISP Project** is selected, click ··· in the directory column to setup the file name and path after restoring. When the path already contains the same file name, the file content will be covered by the data restored.



(4) After the users make sure that the summary in the **CARD Utility** window is consistent with the data restoration which will be performed, they can click **Execute**.

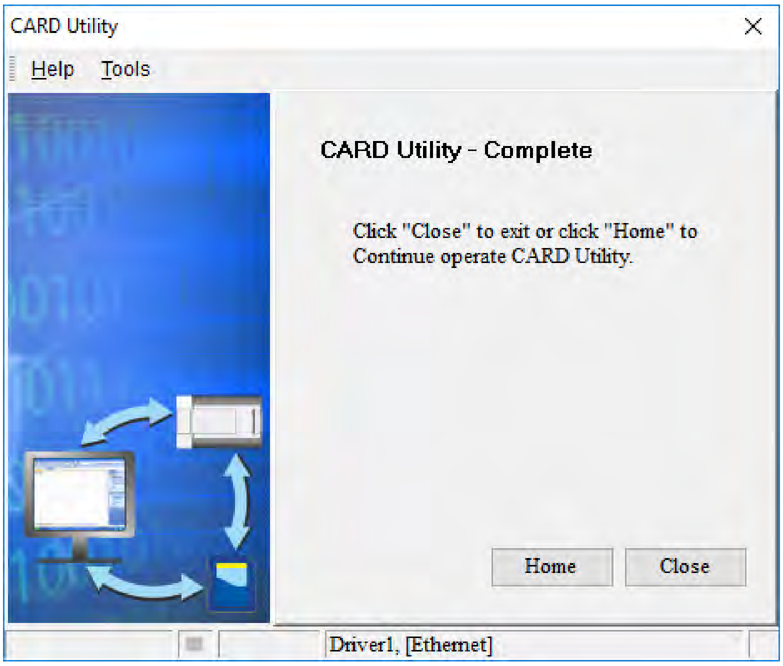


If the users click **Cancel** in the process of restoring data to the CPU module, the data will not be completely restored. To prevent the CPU module from operating incorrectly, the users have to restore the CPU module to the factory setting if they do not perform the data restoration again. Besides, the CPU module will still performs the data restoration even if the users click **Cancel** in the process of restoring a backup file in the memory card inserted in the CPU module. The users can turn off the CPU module to stop the data restoration from being performed.

If the restoration source/restoration destination contains a password and an ID, the process is as below.

Data restoration	Description
Memory card➔CPU module	**a**. The ID in the backup file must be the same as the ID in the CPU module, otherwise the data restoration will not be performed. **b**. If there is a PLC password in the CPU module, the password in the backup file must be the same as the PLC password in the CPU module. Otherwise the data restoration will not be performed. **c**. If there is no PLC password in the CPU module, and there is a password in the backup file, the system will perform the data restoration, and the password in the backup file will become the PLC password in the CPU.
Computer➔CPU module	**a**. The ID in the backup file must be the same as the ID in the CPU module, otherwise the data restoration will not be executed. **b**. If there is a PLC password in the CPU module, the password in the backup file must be the same as the PLC password in the CPU module. Otherwise the data restoration will not be performed, and a message will appear. **c**. If there is no PLC password in the CPU module, and there is a password in the backup file, the system will perform the data restoration, and the password in the backup file will become the PLC password in the CPU.
Computer➔ ISPSoft project	While restoring, if the backup file is PLC password protected, users will be asked for the password to proceed. After restoration, the ID and the password in the backup file will become the program ID and the project password in ISPSoft project but the PLC ID and PLC password will not be saved to ISPSoft.

(5) When execution is complete, users can choose **Home** to return to the main page or or **Close**.



21.3.4 Command-line Instruction Execution

CARD Utility supports instructions execution in command-line mode. The execution file (PLC CARD.exe) can be found in the installation directory of ISPSoft, which the default installation path would be set as C:\Program Files (x86)\Delta Industrial Automation\ISPSoft 3.10\PLC_CARD, then continue to follow the instructions below.

- Empty spaces are required to separate commands.
- /Lock and /UnLock cannot be used simultaneously as well as /C and /IP, /F and /V.
- /DLINK_USB, /DLINK_CDC, /DLINK_ETH cannot be used simultaneously.
- Commands and parameters are not case-sensitive; only password is set to be case-sensitive.
- Commands not required parameter inputs:

Commands	Functions
/RUN or /R	Run PLC.
/Stop	Stop PLC.
/H	Hide all message windows, but still have return codes as execution finished.
/SaveOFF	Disable the function of archiving returned codes.
/?	Display help messages. Other commands would be invalid while using this command.
/DLINK_USB	Use DirectLink function through Standard USB wire for communication. This command is only supported by DVP series and cannot be used with /C, /IP, /DLINK_ETH and /DLINK_CDC simultaneously.
/DLINK_CDC	Use DirectLink function through CDC port for communication. This command is only supported by DVP series and needs /C command to specify a communication port, which cannot be used with /IP, /DLINK_ETH and /DLINK_USB simultaneously
/DLINK_ETH	Use DirectLink function through Ethernet for communication. This command is only supported by DVP series and needs /IP command to specify an IP address, which cannot be used with /C, /DLINK_CDC and /DLINK_USB simultaneously

- Commands required parameter inputs:

Commands	Parameters	Functions
/PLC=P1	P1=PLC model type	Specify the PLC model type for connection. e.g./PLC=AS332T. Supported model types: AS300N, AS320T, AS320P, AS324MT, AS332T, AS332P AS218TX, AS218PX, AS218RX, AS228T, AS228P, AS228R, ES3 ES Series: ES, EX, SS, EC EP Series: SA, SX, SC EH Series: EH, EH2, SV, EH2-L ES2 Series: ES2, EX2, SX2, SA2, MC EH3 Series: EH3, EH3L, SV2 SE Series: SE ES2-E Series: ES2-E SS2 Series: SS2
/F=P1	P1=file name of DUP	Download DUP file to PLC, e.g./F=test.dup
/C=P1	P1=COM Port number	Assign the COM Port number of PC, e.g./C=1
/Lock=P1, P2	P1=password，P2= the limited number of retries (Set 0 mean no limits to the number of retries)	If the PLC is without password protection and no password is in the DUP file, users can set the password with this command after the download is complete. E.g./Lock=1234, 0 (Note: If there's a password in DUP file, it would be automatically set as the password for PLC after the download is complete.)
/UnLock=P1	P1=password	If the PLC has been secured by password lock and a same password does not exist in the DUP file, users must remove PLC password before downloading. E.g./Unlock=1234 (Note: Users can set password again by using /Lock command or downloading a DUP file which includes a password.)
/P=P1, P2, P3, P4	P1=Baud Rate P2=Data Bits P3=Parity P4=Stop Bits	Set the communication protocol. The default value is 9600, 7, e, 1. Leave blank for values remain unchanged, while "," is necessary to be input. ex1：Change all the setting values.　/p=115200, 8, n, 2 ex2：Only change the Baud Rate.　/p=115200, , , Must input ", ".
/Save=P1	P1=File name	Assign the path and the file name to save returned codes. If a specified path directory does not exist, it will be generated automatically. A default file name "Result.txt" will be taken as the current path when this command is not used or the parameter is empty. Ex：/Save=C:\test\result1.txt Please find the return codes table below for the corresponding messages.
/IP=P1	P1=IP address	Assign Ethernet IP address. When this command is used, it means to communicate via Ethernet, which cannot be used with /C command. Ex: /IP=192.168.1.5
/T=P1,P2	P1= Source file P2= Target file	Convert the file format between DVZ and DUP. When using this command, other commands would be invalid. This command is supported by DVP series only.

Commands	Parameters	Functions
/V=P1	P1= Name of the file to verify with PLC program.	Verify PLC program. This command is supported by DVP series only. Ex: /V=test.dup
/STN=P1	P1= Station number	Set the station number for communication with PCs. For example, set /STN=5 to communicate with the PLCs, which station number is 5. If the command is omitted, message would be sent via broadcast communication.
/SetPLCSTN=P1	P1= Station number	Change station number of a PLC. For example, set /SetPLCSTN=5 to change the station number of the PLC to 5. This command is supported by DVP series only.
/B=P1,P2,P3,P4	P1= The save as DUP file name, P2= The password to verify, P3= The verify ID P4= Whether to backup the device (N: No, Y: Yes)	Read the PLC program as well as the device data and save as DUP files. This command is supported by DVP series only. Ex1: There's no password and ID in the PLC. Device backup is not required. /B=p1.dup,,,N Ex2: There's no ID in the PLC but with password-lock. Device backup is required. /B=p1.dup,pw99,,Y If P4 is blank, the default setting is to back up the device.
/BP=P1,P2,P3,P4	P1= The target DUP file name, P2= The source project file name (dvp/isp) P3= Source register file (dvl) P4= Source file register (wft)	Backup the specified project file in DUP file format. The input values of P1 and P2 are required, which P3 and P4 can be omitted. This command is supported by DVP series only. For example, save test.dvp backup as out.dup. /BP=out.dup,test.dvp /BP=d:\dir\out.dup,d:\dir1\test.dvp The specified directory would be automatically created if it does not exist, while the existing file would be overwritten.

Example:

Ex1：Download **test.dup** to **PLC.AS332T** and run PLC with the default value of communication setting (9600, 7, e, 1) via COM port1.

File directory under the current path: "PLC CARD.exe" /PLC=AS332T /F=test.dup /RUN /C=1

File directory under the appointed path: "d:\temp\PLC CARD.exe" /PLC=AS332T /F=d:\temp\test.dup /RUN /C=1

Ex2: Stop PLC AS324MT via Ethernet.

"PLC CARD.exe" /PLC=AS324MT /Stop /IP=192.168.1.1

Ex3: Change the station number of PLC to 2 via COM port 1, which the station number .originally is set as 1.

"\PLC CARD.exe" /PLC=SS2 /C=1 /STN=1 /SetPLCSTN=2

Return Codes and Corresponding Messages

Code	Message
1	Finish!
2	Timeout!
3	The PLC type does not match!
4	DUP File is error!
5	Communication port has been used or no this port!
6	Cannot open file
7	Command is incorrect!
8	Command H is incorrect!
9	Command P is incorrect!
10	Station number is incorrect!.
11	COM port number is incorrect!
12	Command R is incorrect!

Code	Message
13	Baud rate is incorrect!
14	Data bits is incorrect!
15	Parity is incorrect!
16	Stop bits is incorrect!
17	Command STOP is incorrect!
18	Command V is incorrect!
19	Password Locked!
20	Can't get correct program!
21	Can't get actuating code in the PLC for comparison!
22	Reserved.
23	Command C is incorrect!
24	Command B is incorrect!
25	Command Lock is incorrect!
26	Command UnLock is incorrect!
27	Password Varification Failure!
28	Failed to save the backup file!
29	Locked. Please remove first!
30	Command IP is incorrect!
31	Can't get actuating code in the PLC to read!
32	Can't get correct PLD ID status!
33	PLC ID compare failure!
34	Communication error!
35	Downloads have reached the limit!
36	Machine not support!
37	Read PLC failure!
38	Write PLC failure!
39	Command failure!
40	Command PLC is incorrect!
41	The command has been cancelled by the user.
42	Command STN or SetPLCSTN is incorrect!
43	Command BP is incorrect!
44	The version of EasyDownload is incorrect!

MEMO

Chapter 22 G-Code Editor and E-CAM Editor

Table of Contents

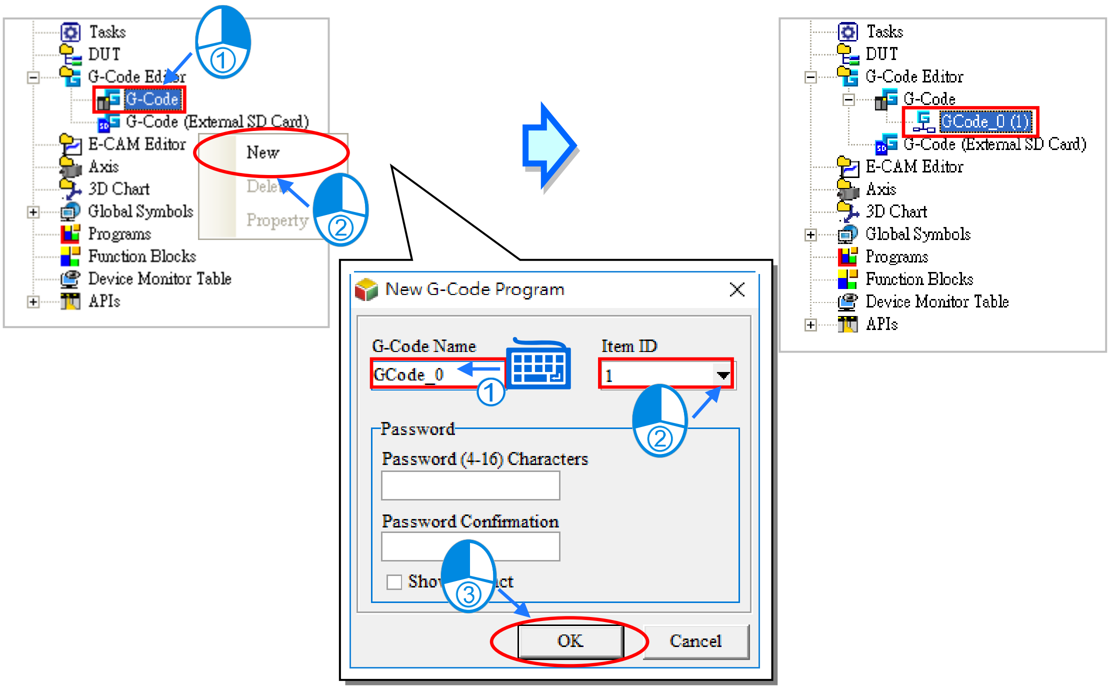
22.1 G-Code Editor (Not Supported by the Current ISPSoft Version)

22.1.1 About G-Code

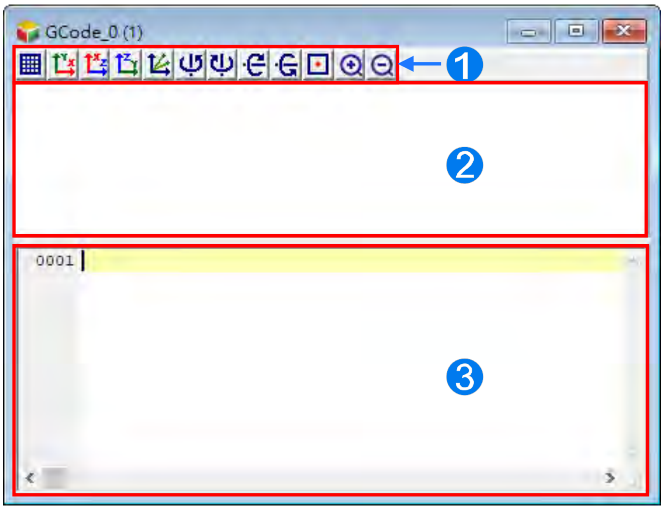
During the control of motion, users can generate G-codes for the complex processing paths of two axes (or more than two axes) by means of computer-aided manufacturing software, and the G-codes can be input to a controller which can drive the axes. The time of developing a motion program can be saved. G-code is a CNC (computer numerical control) programming language widely used in automatic equipment. Delta motion controllers and ISPSoft support the majority of G-codes on the market. The minorities of G-codes which are not supported are skipped, and are not executed.

22.1.2 Using G-Code Editor

There are 2 options under the G-Code Editor, select G-Code to save the codes in the PLC and G-Code (External SD Card) to save the codes to the external SD Card on the PLC. (Currently, the ISPSoft does not support this function in DVPxxMC and AS5XX). Select one, right-click the selected option and then click New to open the New G-Code Program setting window. Type a name and an item ID for this G-Code. Users can also set up a password to protect the G-Code data. When a password is set, the system will ask for the password upon next editing. Up to 64 sets of G-Code can be created (max. 250KB for each set) in the PLC.



After the G-Code is created, an editing window will appear.

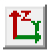
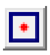


❶ Toolbar icons: functional buttons are provided for users to modify the G-Code easily.

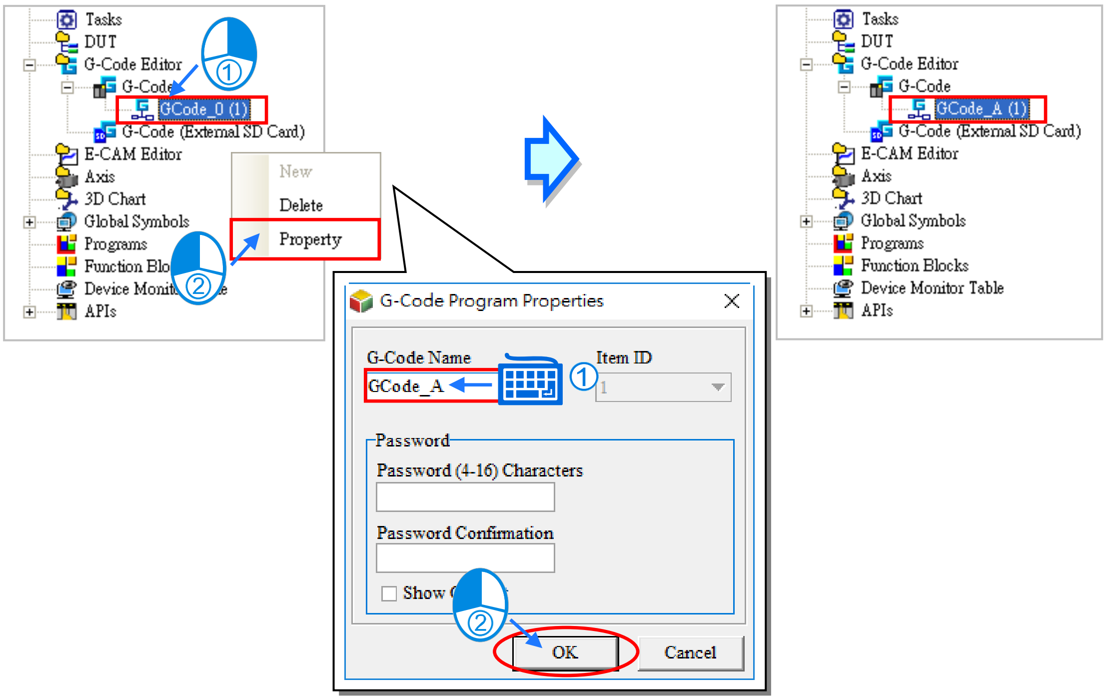
❷ Toolpath view area: the toolpath is created according to the programs written in the programming area.

❸ G-Code programming area: type the G-Code here.

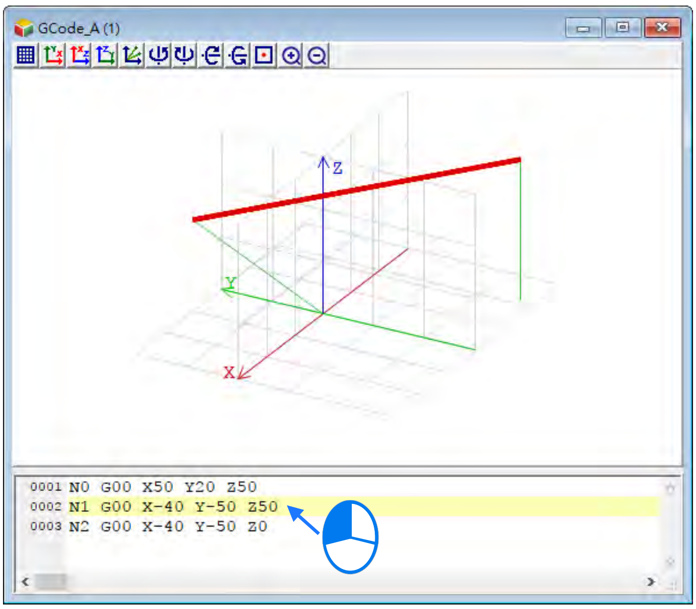
The function buttons of the G-Code Editor are described below.

Icon	Name	Description
	Show/Hide Grid	Display grids in the toolpath view area, show/hide grids in the XY, YZ, XY plane respectively.
	Switch to the XY plane	Switch the view seen to the XY plane.
	Switch to the XZ plane	Switch the view seen to the XZ plane.
	Switch to the YZ Plane	Switch the view seen to the YZ plane.
	Show/Hide G0 Trace	Show/Hide the display of dotted lines representing rapid moves (G0)
	Vertical CCW Rotation	Rotate the toolpath view counter-clock wisely.
	Vertical CW Rotation	Rotate the toolpath view clock wisely.
	Horizontal Top Rotation	To reverse the toolpath view upwardly and horizontally
	Horizontal Down Rotation	To reverse the toolpath view downwardly and horizontally
	Auto Fit	Adjust the toolpath view area automatically to fit the screen
	Zoom In	Increase the magnification of the toolpath view.
	Zoom Out	Decrease the magnification of the toolpath view.

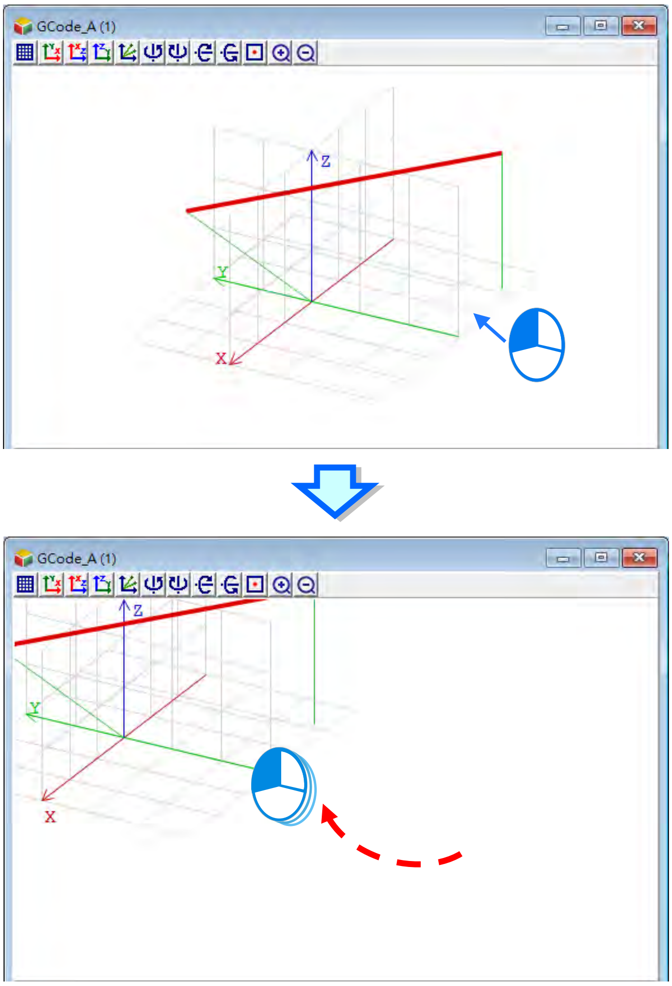
Users can right-click the created G-Code item to open the context menu and select **Delete** to delete this item. Or select **Property** to edit the name and the password. Note that Item ID is not allowed to be changed.



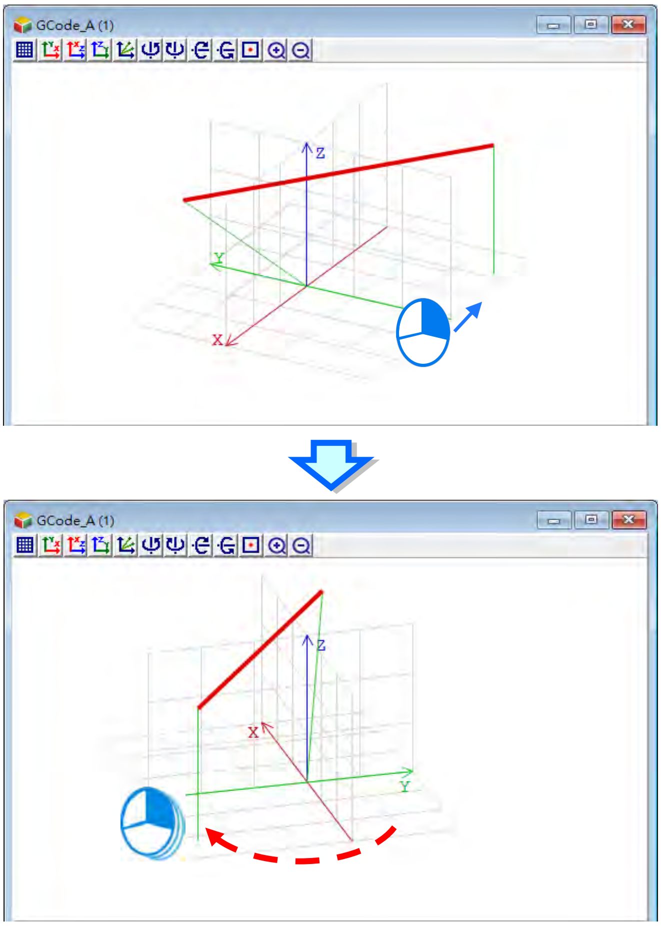
While writing a G-Code in the programming area, the current drawing G-Code will be shown in read in the toolpath view area.



Users can click, hold and drag the mouse to move the toolpath in the toolpath view area.



Users can right-click, hold and drag the mouse to rotate the toolpath in the toolpath view area.

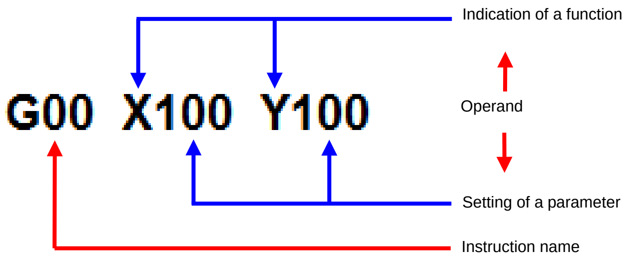


After all the setups are done, download the parameters and the project to the PLC. Refer to section 17.1.3 for Downloading / Uploading a Project.

22.1.3 G-Code Command Structure

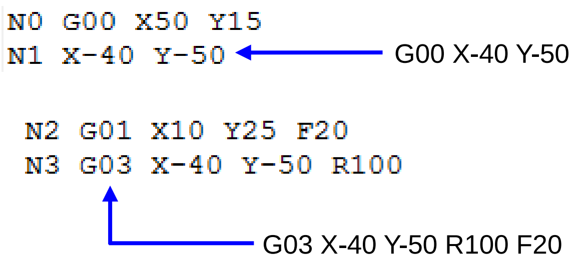
A G-code is composed of an instruction name and operands, and an operand is composed of the indication of a function and the setting of a parameter. In the figure below, the instruction name represents the function which is executed, the indication of functions represents the targets of the operands, and the setting of the parameters represents the values of the operands. The instruction

G00 indicates that the x-axis and the y-axis are moved at the maximum speed to the target position (100, 100).



Here are some basic items of the supported formats and basic G-Code instructions.

- In the beginning of every G-Code, there is a parameter mark "N" to indicate a new line for example N1 or N2.
- As long as the format of an instruction is not destroyed, leaving spaces is allowed. For example, G01X50 Y15F20 is legal, and is equivalent to G01 X50 Y15 F20.
- G00/G01/G02/G03 supports inheritance function (meaning the next row of codes without G code can inherit the previous G codes) while some G codes do not possess this function. The speed parameter (F) of G01/G02/G03 can be extended.



- Input type of constant operand parameter: Arabic numerals and floating points

  E.g. N0 G0 X100.0 Y100.0

- Quick positioning (G0) does not need to set speed

  E.g. N0 G0 X100.2 Y500.0

- At least one of the position unit of axis parameters X/Y/Z is saved in G00, G01, while other omitted axis parameters can refer to the closest parameter values from the previous rows of codes.

- There are two ways to execute comments :
  - Use “and” to wrap comments, but nested comments are not allowed. E.g. (Comment)
  - Add words after “%”, e.g. %comment

- The operand parameters X, Y, Z, I, J, K, R can be written in any order and not a particular order to fulfill the needs of writing G codes.

  E.g: N0 G1 X100 Z300 Y200.45 F400 = > N0 G1 X100 Y200.45 Z300 F400

The G codes and input formats supported by DVPxxMC and AS5XX series motion controllers are listed in the following table.

G code	Function	Format
G0	Rapid Positioning	N_G0 X_Y_Z_A_B_C
G1	Linear interpolation	N_G1 X_Y_Z_A_B_C_F_
G2	Clockwise circular arc/helical interpolation	N_G2 X_Y_Z_I_J_F_ N_G2 X_Y_Z_I_K_F_ N_G2 X_Y_Z_J_K_F_
		N_G2 X_Y_Z_R_F_
G3	Anticlockwise circular arc/ helical interpolation	N_G3 X_Y_Z_I_J_F_ N_G3 X_Y_Z_I_K_F_ N_G3 X_Y_Z_J_K_F_
		N_G3 X_Y_Z_R_F_
G4	Dwell instruction	N_G4 X_ N_G4 P_
G17	XY plane for circular interpolation	N_G17
G18	XZ plane for circular interpolation	N_G18
G19	YZ plane for circular interpolation	N_G19
G50	Precise stop	N_G50
G51	Circular arc transition	N_G51 D_
G52	Smooth path transition	N_G52
G90	Absolute mode	N_G90
G91	Relative mode	N_G91
M0~M99	M Code	N_M_D_

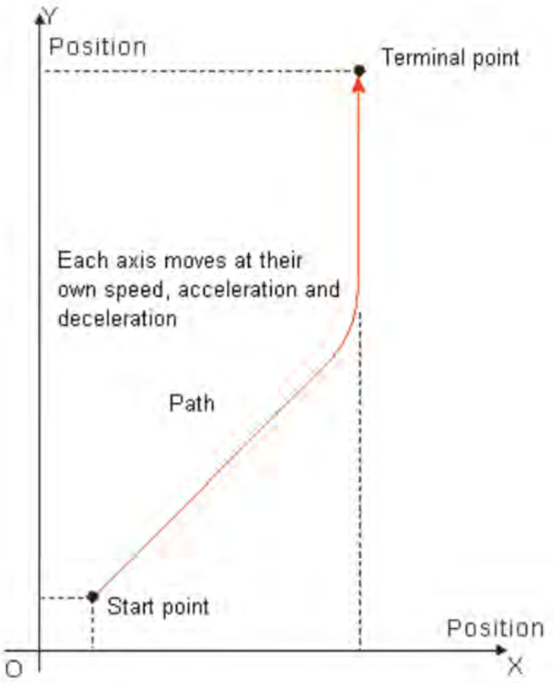
22.1.4 G-Code Functions

22.1.4.1 G0 (Rapid Positioning)

- Function:

  Axes move from current position to the terminal position at the given speed. Maximum 8 axes can be controlled and they are independent with each other in motion.

  And the motion path figure is displayed below.



➢ Format: N_G0 X_Y_Z_A_B_C

➢ Parameter explanation:

N_: The row number of G code in NC program.

X_: Specify the terminal position of axis X, Unit: unit, data type: REAL.

Y_: Specify the terminal position of axis Y, Unit: unit, data type: REAL.

Z_: Specify the terminal position of axis Z, Unit: unit, data type: REAL.

A_: Specify the terminal position of axis A, Unit: unit, data type: REAL.

B_: Specify the terminal position of axis B, Unit: unit, data type: REAL.

C_: Specify the terminal position of axis C, Unit: unit, data type: REAL.

- Instruction explanation:

  1. G0 can control one or more axes and for other axes they remain default values.
  2. The speed, acceleration, deceleration and jerk of each axis in motion can be set via DMC_SetG0Para instruction.

- Example:

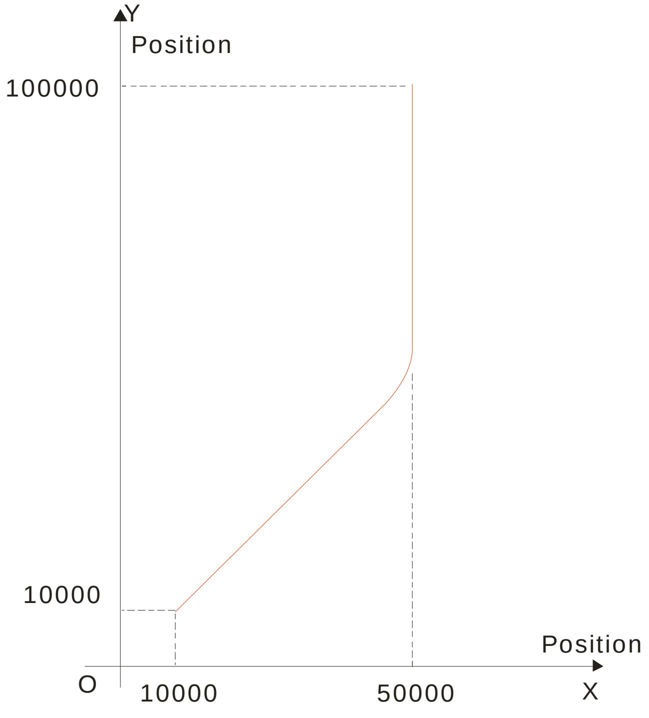
The initial positions of axis X, Y are both 10000 units and their axis parameters are both default values.

The G codes to be executed are:

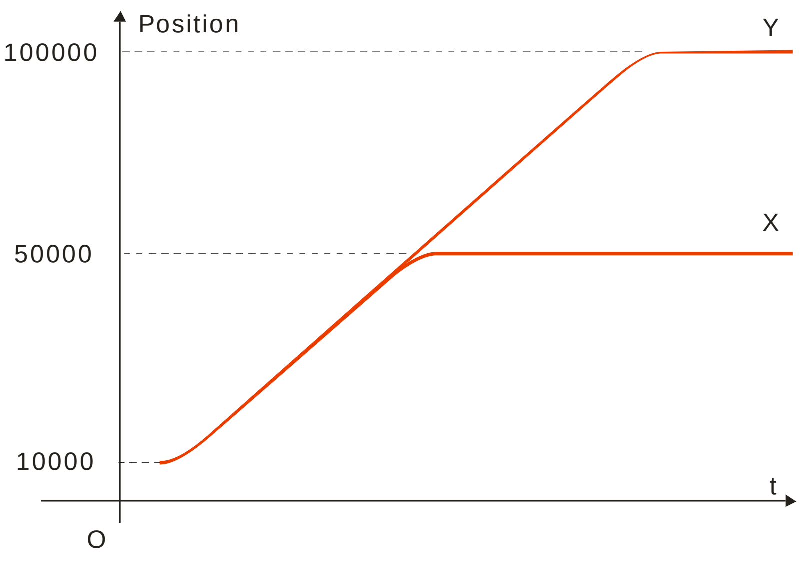
N00 G90

N01 G0 X50000 Y100000

After G codes are executed, the Y/X curve for the whole movement process is shown below:



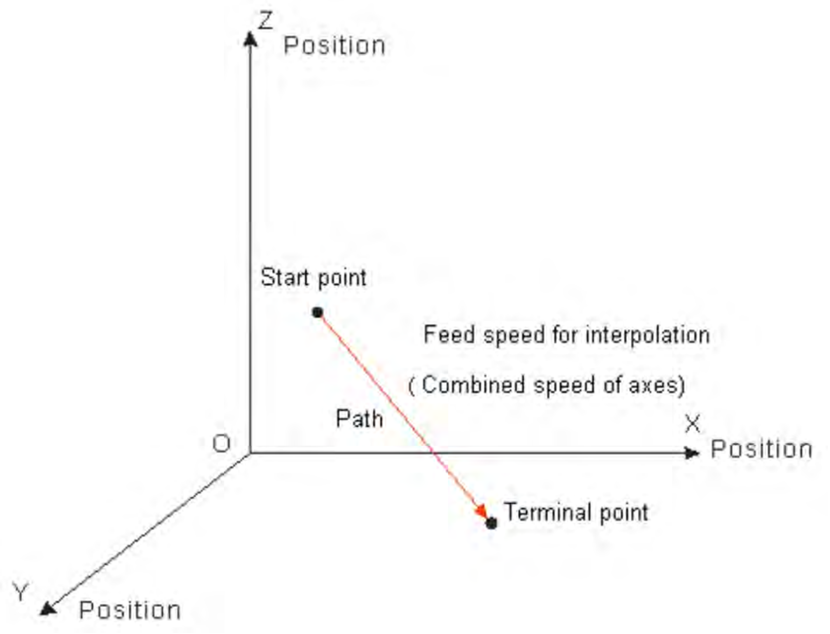
After G codes are executed, the Position/Time curve for the whole movement process is shown below:



22.1.4.2 G1 (Linear Interpolation)

- Function:

  The cutter starts off from one point and moves straight to the target position at a given speed. The instruction can control up to 8 axes and all axes start up or stop simultaneously. Three axes control the position of the cutter together as the figure shows below.



- Format: N_G1 X_Y_Z_A_B_C _F_
- Parameter explanation:

  N_: The row number of G code in NC program

  X_: Specify the terminal position of axis X, Unit: unit, data type: REAL.

  Y_: Specify the terminal position of axis Y, Unit: unit, data type: REAL.

  Z_: Specify the terminal position of axis Z, Unit: unit, data type: REAL.

  A_: Specify the terminal position of axis A, Unit: unit, data type: REAL.

  B_: Specify the terminal position of axis B, Unit: unit, data type: REAL.

  C_: Specify the terminal position of axis C, Unit: unit, data type: REAL.

  F_: Specify the feed speed of the cutter, unit: unit/second, data type: REAL.

  When the cutter moves at a constant speed, the combined speed of all axes in G code is equal to F value.

  The method of calculation is shown as below.

  When two axes exist, $F = \sqrt{V_1^2 + V_2^2}$.

  When three axes exist, $F = \sqrt{V_1^2 + V_2^2 + V_3^2}$.

  For more axes, F value could be calculated in the same way as above.
- Instruction explanation:

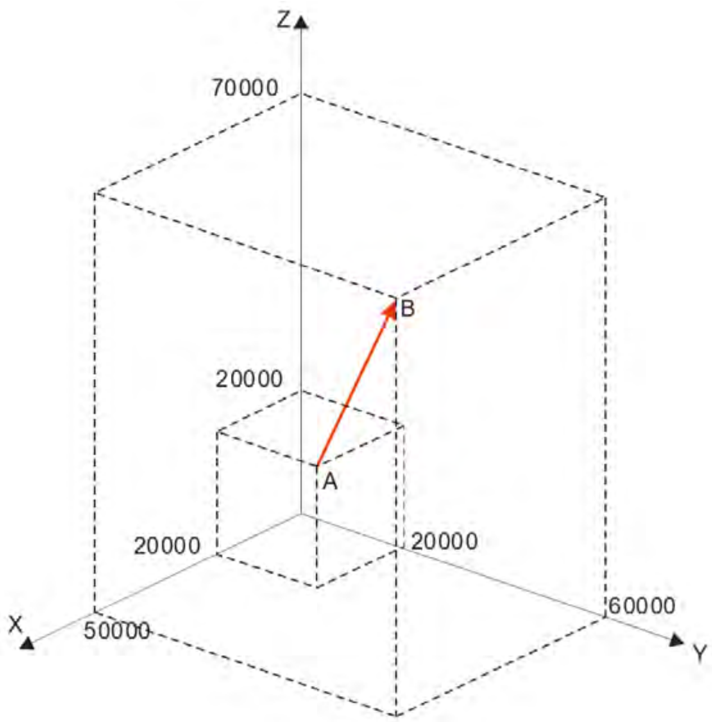
  1. G1 can control one or more axes and for other axis they remain default values.
  2. The velocity, acceleration, deceleration and jerk can be set via DMC_SetG1Para.
- Example:

  The initial positions of axis X, Y, Z are all 20000 units and their axis parameters are all default values. The G codes to be executed are below:

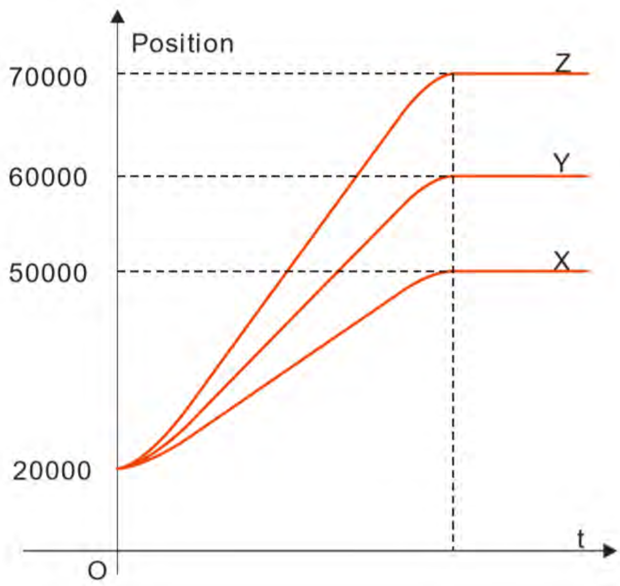
  N0 G90

  N1 G1 X50000 Y60000 Z70000

  After G codes are executed, the Y/X curve for the whole movement process is shown below:



After G codes are executed, the Position/Time curve for the whole movement process is shown below:



22.1.4.3 G2 (Clockwise Circular / Helical Interpolation)

- Function:

Circular interpolation: The cutter conducts the cutting of the object which is to be processed in the clockwise direction at the feed speed given by parameter F on the circular arc with the fixed radius or fixed circle center of the specified plane.

Helical interpolation: The cutter moves in the clockwise direction on the circular arc of the specified plane, which is circular interpolation and simultaneously moves in a straight line perpendicular to the specified plane at the feed speed given by parameter F, which is linear interpolation.

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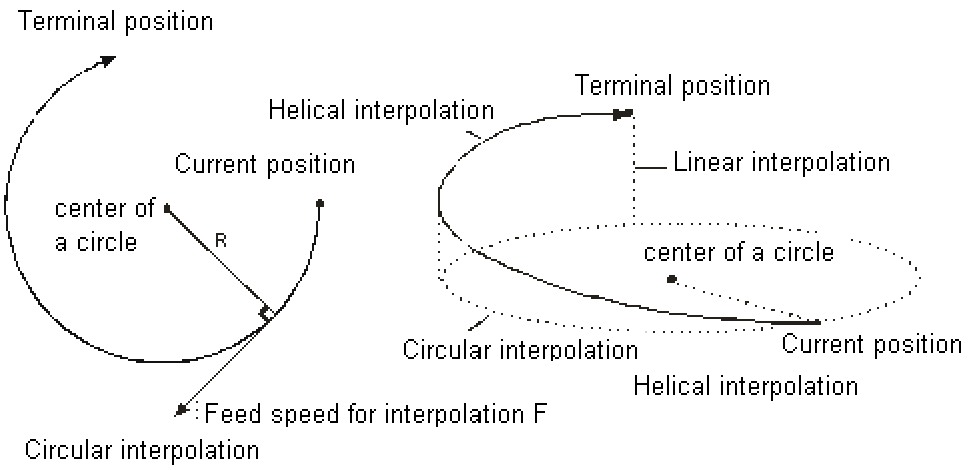


- Format:

Format 1: N_G2 X_Y_Z_I_J _F_

Format 2: N_G2 X_Y_Z_I_K_F_

Format 3: N_G2 X_Y_Z_J_K_F_

Format 4: N_G2 X_Y_Z_R_F_

- Parameter explanation:

N_: The row number of G code in NC program

X_: Specify the terminal position of axis X; Unit: unit, data type: REAL..

Y_: Specify the terminal position of axis Y; Unit: unit, data type: REAL..

Z_: Specify the terminal position of axis Z; Unit: unit, data type: REAL..

I_J_: Specify the coordinate position of a circle center on XY plane, Unit: unit, data type: REAL.

I_K_: Specify the coordinate position of a circle center on XZ plane, Unit: unit, data type: REAL.

J_K_: Specify the coordinate position of a circle center on YZ plane, Unit: unit, data type: REAL.

R_: Specify the radius of the arc, data type: REAL.

F: Specify the feed speed of the cutter, Unit: unit/second, data type: REAL.

When the cutter moves at a constant speed, the combined speed of all axes in G code is equal to F value.

The method of calculation is shown as below.

When two axes exist, $F = \sqrt{V_1^2 + V_2^2}$.

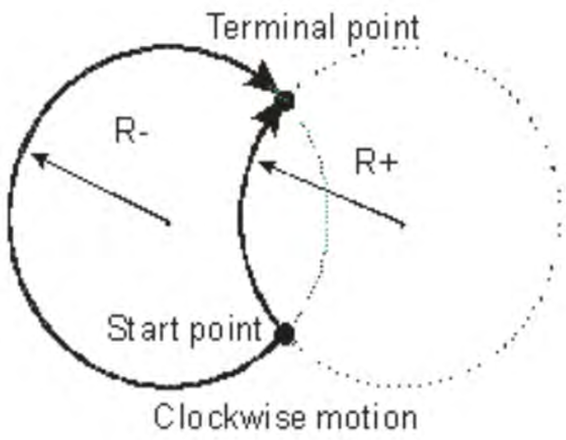
When three axes exist, $F = \sqrt{V_1^2 + V_2^2 + V_3^2}$.

For more axes, F value could be calculated in the same way as above.

- Instruction explanation:

1. Two axes among axis X, Y and Z make the circular interpolation on the plane specified by instruction G17/G18/G19. The third axis makes the linear interpolation in the direction perpendicular to the specified plane.
2. F can be omitted. If there is only one row of code in the G-code editing area and F is omitted, the velocity, acceleration and deceleration of the cutter are decided by axis group parameters. They can be set via DMC_SetG1Para instruction.

   If there are multiple rows of codes and F in G2 code is omitted, the velocity, acceleration, deceleration of the cutter are based on valid F in the previous rows of codes above the row where G2 is. If the previous rows of G codes have not specified F, “maximum velocity”, “maximum acceleration” and “maximum deceleration” among axis group parameters will prevail.
3. In absolute mode for G90, the terminal point of the circular arc is the absolute coordinate value regarding 0 unit in their own directions as reference. In relative mode for G91, the terminal point of the circular arc is the incremental value relative to the start point of the circular arc.
4. No matter whether in the absolute mode or in relative mode, the coordinates of the circle center I_J_(I_K_/J_K_) are always relative coordinates with the start point as reference
5. Regarding the relation between a coordinate plane and I, J, and K, at most two of I, J, and K exist in a circular instruction. Which two they are is determined by the corresponding plane, e.g. only I and J are allowed to be on XY plane.
6. Different from format 1, format 2 and format 3, format 4 decides a circular arc via the start point, terminal point and radius. If the input value on the right of R parameter is a positive number (R+), the circular arc is the minor arc less than 180 degrees; if the input value on the right of R parameter is a negative number (R-), the circular arc is the major arc more than 180 degrees.



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- Example

Current position (1000, 3000), axis parameters: default values,

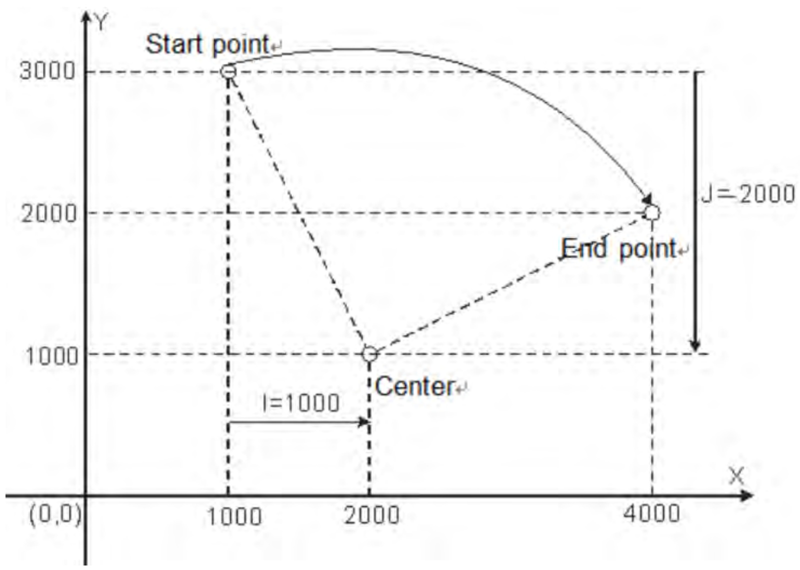
The G codes to be executed are below:

N00 G90

N01 G17

N02 G2 X4000 Y2000 I1000 J-2000 F5000

After G codes are executed, the Y/X curve for the whole movement process is shown below:

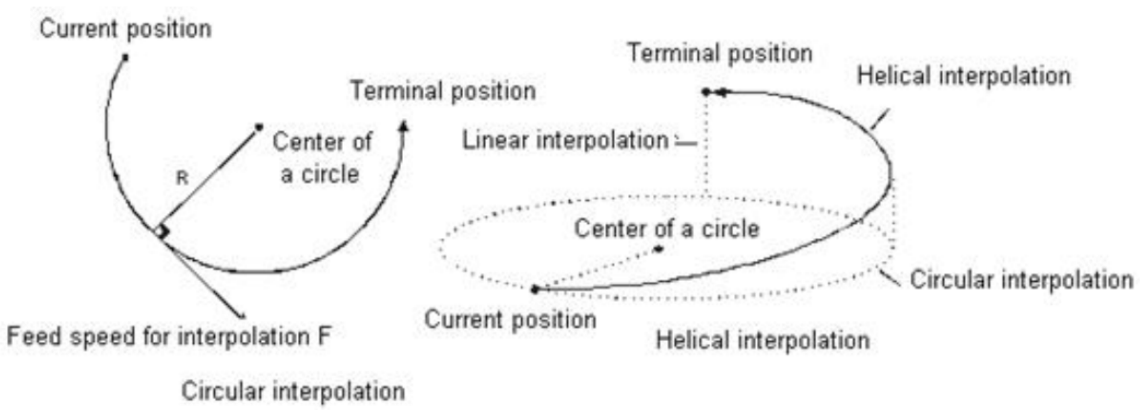


22.1.4.4 G3 (Anticlockwise Circular / Helical Interpolation)

- Function explanation:

Circular interpolation: The cutter conducts the arc cutting of the object to be processed in the anticlockwise direction at the feed speed given by parameter F on the circular arc with the fixed radius or the fixed center on the specified plane.

Helical interpolation: The cutter moves in the anticlockwise direction on the circular arc of the specified plane, which is a circular interpolation and simultaneously moves in a straight line perpendicular to the specified plane at the feed speed given by parameter F, which is a linear interpolation.



- Format:

Format 1: N_G3 X_Y_Z_I_J_F_

Format 2: N_G3 X_Y_Z_I_K_F_

Format 3: N_G3 X_Y_Z_J_K_F_

Format 4: N_G3 X_Y_Z_R_F_

- Parameter explanation:

N_: The row number of G code in NC program

X_: Specify the terminal positions of axis X, Unit: unit, data type: REAL.

Y_: Specify the terminal positions of axis Y, Unit: unit, data type: REAL.

Z_: Specify the terminal positions of axis Z, Unit: unit, data type: REAL.

I_J_: Specify the coordinate position of the circle center on XY plane, Unit: unit, data type: REAL.

I_K_: Specify the coordinate position of the circle center on XZ plane, Unit: unit, data type: REAL.

J_K_: Specify the coordinate position of the circle center on YZ plane, Unit: unit, data type: REAL.

R_: Specify the radius of the arc, data type: REAL.

F: Specify the feed speed of the cutter, Unit: unit/second, data type: REAL.

When the cutter moves at a constant speed, the combined speed of all axes in G code is equal to F value.

The method of calculation is shown as below.

When two axes exist, $F = \sqrt{V_1^2 + V_2^2}$.

When three axes exist, $F = \sqrt{V_1^2 + V_2^2 + V_3^2}$.

For more axes, F value could be calculated in the same way as above.

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- Instruction explanation:

1. Two axes among axis X, Y and Z make the circular interpolation on the plane specified by G17/G18/G19. The 3rd axis makes the linear interpolation in the direction perpendicular to the specified plane.

2. F_ can be omitted. If there is only one row of code in the G-code editing area and F is omitted, the velocity, acceleration and deceleration of the cutter are determined by axes group parameters. The parameters for velocity, acceleration and deceleration can be set by DMC_SetG1Para.

   If there are multiple rows of codes and F in G3 code is omitted, the velocity, acceleration and deceleration of the cutter are based on valid F in the previous rows of codes above the row where G3 is. If the previous rows of G codes have not specified F, “maximum velocity”, “maximum acceleration” and “maximum deceleration” among axis group parameters will prevail.

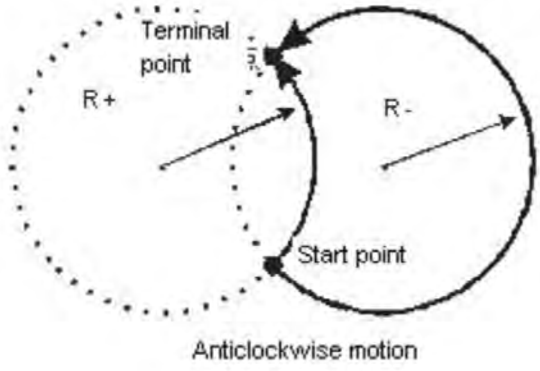
3. In absolute mode for G90, the terminal point of a circular arc is of absolute coordinate values regarding 0 unit in their respective directions as reference. In relative mode for G91, the terminal point of a circular arc is of incremental values relative to the start point of the circular arc.

4. No matter whether in the absolute mode or in relative mode, the coordinates of the circle center I_J_(I_K_/J_K_) are always the relative coordinates with the start point as reference.

5. Regarding the relation between a coordinate plane and I, J, and K, at most two of I, J, and K exist in a circular instruction. Which two they are is determined by the corresponding plane, e.g. only I and J are allowed to be on XY plane.

6. Different from format 1, format 2 and format 3, format 4 determines a circular arc via the start point, terminal point and radius. If the input value on the right of R parameter is a positive number (R+), the circular arc is a minor arc less than 180 degrees; if the input value on the right of R parameter is a negative number (R-), the circular arc is a major arc more than 180 degrees.

   The following solid curves are the motion paths when G3 selects R+ and R- and the arrows on the arcs refer to the motion direction



- Example

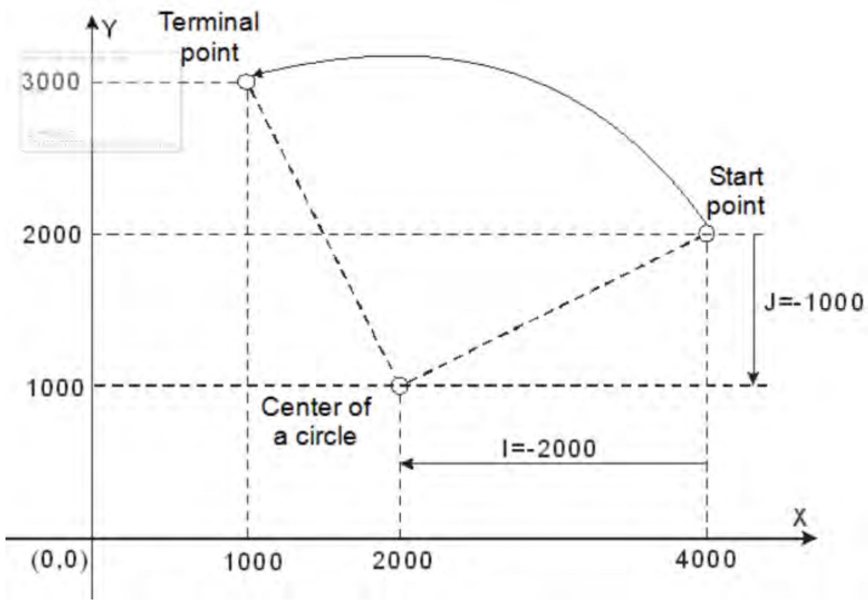
Current position (4000, 2000), axis parameters: default values.

The G codes to be executed are below:

N00 G90

N01 G17 N02 G3 X1000 Y3000 I-2000 J-1000

After G codes are executed, the Y/X curve for the whole movement process is shown below:



22.1.4.5 G4 (Dwell Instruction)

- Function: Dwell instruction
- Format:

  Format 1: N_G4 X_

  Format 2: N_G4 P_
- Parameter explanation:

  N_: The row number of G code in NC program

  X_: Specify the delay time, unit: second, data type: REAL.

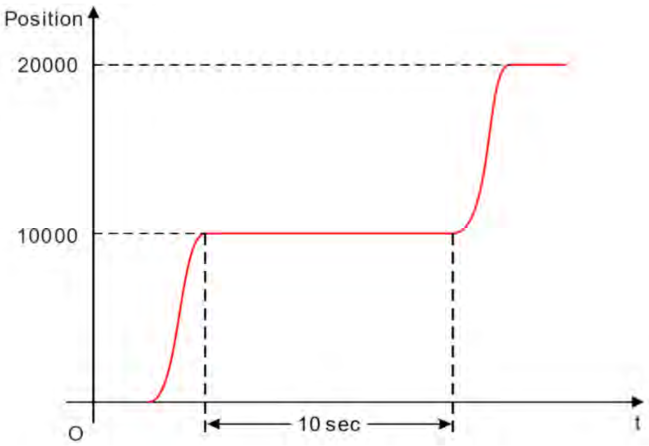
  P_: Specify the delay time, unit: millisecond, data type: REAL.
- Example:

  N00 G1 X10000

  N01 G4 X10 (or N01 G4 P10000)

  N02 G1 X20000

  After G codes are executed, the Position/t curve for the whole movement process is shown below:



22.1.4.6 G17 / G18 / G19 (Specify Circular Interpolation Plane)

- Function:

  The three instructions are used for deciding the plane selection of circular interpolation or helical interpolation and have no impact on the linear interpolation.

  While the program is being executed, the three work planes can be switched with each other. If no plane option is set, the initial state of the system is XY plane (G17).

- Format:

  N_G17

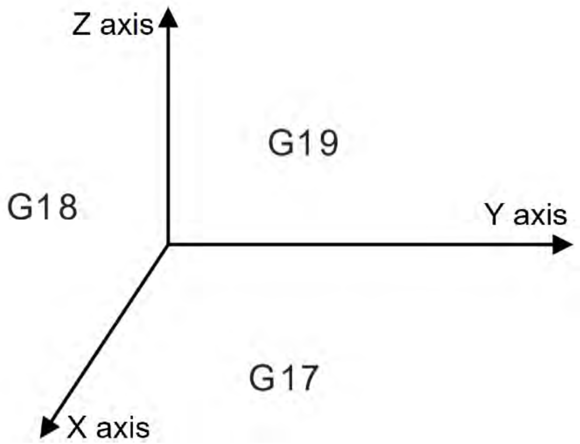
  N_G18

  N_G19

- Parameter Explanation:

  N_: The row number of G code in NC program

  The figure of the planes is shown as follows:



22.1.4.7 G50 (Precise Stop)

- Function:

  Change the transition mode into the precise stop. And afterwards the transition mode is always the precise stop. G51/G52 can be used for the transition mode switch in the execution. The terminal actuator will reduce its speed to 0 between G codes.

- Format:

  N_ G50

- Parameter Explanation:

  N_: The row number of G code in NC program

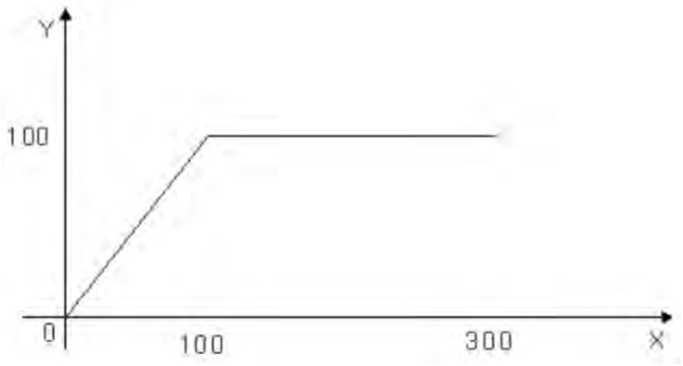
- Example:

  N00 G50

  N01 G1 X100 Y100

  N02 G1 X300 Y100

  After G codes are executed, the Y/X curve for the whole movement process is shown below:



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22.1.4.8 G51 (Round Path Transition)

- Function:

  G51 changes the transition mode into the arc transition. And afterwards the transition mode is always the arc transition. G50/G52 can be used for the switch of transition modes in the execution process. The terminal actuator will not reduce its speed between G codes and the transition curve is an arc. In this mode, the speed of the first G code prevails as the entire motion speed and F can not be used for changing the speed in the motion. VelOverride parameter of DMC_CartesianCoordinate instruction can be set to control the speed of terminal actuator.

- Format:

  N_ G51 D_

- Parameter Explanation:

  N_ : The row number of G code in NC program

  D_ : Radius of the arc

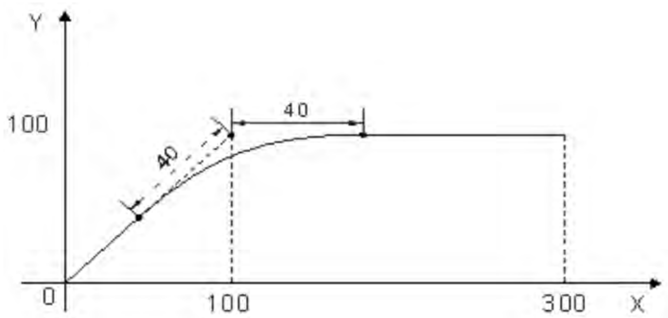
- Example:

  N00 G51 D40

  N01 G1 X100 Y100

  N02 G1 X300 Y100

  After G codes are executed, the Y/X curve for the whole movement process is shown below:



22.1.4.9 G52 (Smooth Path Transition)

- Function:

  G52 changes the transition mode into the smooth path transition and then the later transition is always the smooth path transition. G50/G51 can be used for the switch of transition modes in the execution. The terminal actuator will not reduce its speed between G codes. It is suitable for continual interpolation of small segments. In this mode, the speed of the first G code prevails as the entire motion speed and F can not be used for changing the speed in the motion. VelOverride parameter of DMC_CartesianCoordinate instruction can be set to control the speed of the terminal actuator.

- Format: N_ G52
- Parameter Explanation:

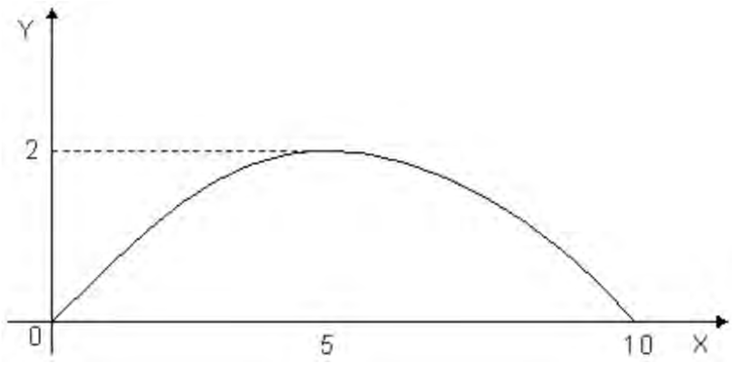
  N_ : The row number of G code in NC program

- Example:

N00 G52	N01 G1 X0 Y0 E5 E-5 F5
N02 G1 X0.1 Y0.06282151816	N03 G1 X0.2 Y0.1255810391
N04 G1 X0.3 Y0.1882166266	N05 G1 X0.4 Y0.2506664671
N06 G1 X0.5 Y0.3128689301	N07 G1 X0.6 Y0.3747626292
N08 G1 X0.7 Y0.4362864828	N09 G1 X0.8 Y0.4973797743
N10 G1 X0.9 Y0.5579822121	N11 G1 X1 Y0.6180339887
N12 G1 X1.1 Y0.6774758405	N13 G1 X1.2 Y0.7362491054
N14 G1 X1.3 Y0.7942957813	N15 G1 X1.4 Y0.8515585831
N16 G1 X1.5 Y0.9079809995	N17 G1 X1.6 Y0.9635073482
N18 G1 X1.7 Y1.018082832	N19 G1 X1.8 Y1.07165359
N20 G1 X1.9 Y1.124166756	N21 G1 X2 Y1.175570505
N22 G1 X2.1 Y1.225814107	N23 G1 X2.2 Y1.274847979
N24 G1 X2.3 Y1.322623731	N25 G1 X2.4 Y1.369094212
N26 G1 X2.5 Y1.414213562	N27 G1 X2.6 Y1.457937255
N28 G1 X2.7 Y1.500222139	N29 G1 X2.8 Y1.541026486
N30 G1 X2.9 Y1.580310025	N31 G1 X3 Y1.618033989
N32 G1 X3.1 Y1.654161149	N33 G1 X3.2 Y1.688655851
N34 G1 X3.3 Y1.721484054	N35 G1 X3.4 Y1.75261336
N36 G1 X3.5 Y1.782013048	N37 G1 X3.6 Y1.809654105
N38 G1 X3.7 Y1.835509251	N39 G1 X3.8 Y1.859552972

N40 G1 X3.9 Y1.881761538	N41 G1 X4 Y1.902113033
N42 G1 X4.1 Y1.920587371	N43 G1 X4.2 Y1.937166322
N44 G1 X4.3 Y1.951833524	N45 G1 X4.4 Y1.964574501
N46 G1 X4.5 Y1.975376681	N47 G1 X4.6 Y1.984229403
N48 G1 X4.7 Y1.991123929	N49 G1 X4.8 Y1.996053457
N50 G1 X4.9 Y1.999013121	N51 G1 X5 Y2
N52 G1 X5.1 Y1.999013121	N53 G1 X5.2 Y1.996053457
N54 G1 X5.3 Y1.991123929	N55 G1 X5.4 Y1.984229403
N56 G1 X5.5 Y1.975376681	N57 G1 X5.6 Y1.964574501
N58 G1 X5.7 Y1.951833524	N59 G1 X5.8 Y1.937166322
N60 G1 X5.9 Y1.920587371	N61 G1 X6 Y1.902113033
N62 G1 X6.1 Y1.881761538	N63 G1 X6.2 Y1.859552972
N64 G1 X6.3 Y1.835509251	N65 G1 X6.4 Y1.809654105
N66 G1 X6.5 Y1.782013048	N67 G1 X6.6 Y1.75261336
N68 G1 X6.7 Y1.721484054	N69 G1 X6.8 Y1.688655851
N70 G1 X6.9 Y1.654161149	N71 G1 X7 Y1.618033989
N72 G1 X7.1 Y1.580310025	N73 G1 X7.2 Y1.541026486
N74 G1 X7.3 Y1.500222139	N75 G1 X7.4 Y1.457937255
N76 G1 X7.5 Y1.414213562	N77 G1 X7.6 Y1.369094212
N78 G1 X7.7 Y1.322623731	N79 G1 X7.8 Y1.274847979
N80 G1 X7.9 Y1.225814107	N81 G1 X8 Y1.175570505
N82 G1 X8.1 Y1.124166756	N83 G1 X8.2 Y1.07165359
N84 G1 X8.3 Y1.018082832	N85 G1 X8.4 Y0.9635073482
N86 G1 X8.5 Y0.9079809995	N87 G1 X8.6 Y0.8515585831
N88 G1 X8.7 Y0.7942957813	N89 G1 X8.8 Y0.7362491054
N90 G1 X8.9 Y0.6774758405	N91 G1 X9 Y0.6180339887
N92 G1 X9.1 Y0.5579822121	N93 G1 X9.2 Y0.4973797743
N94 G1 X9.3 Y0.4362864828	N95 G1 X9.4 Y0.3747626292
N96 G1 X9.5 Y0.3128689301	N97 G1 X9.6 Y0.2506664671
N98 G1 X9.7 Y0.1882166266	N99 G1 X9.8 Y0.1255810391
N100 G1 X9.9 Y0.06282151816	N101 G1 X10 Y0

After G codes are executed, the Y/X curve for the whole movement process is shown below:



22.1.4.10 G90 (Absolute Mode)

- Function:

  After G90 is executed, the terminal position of each axis in G code is based on 0 unit and G91 can be used to switch into the relative mode in the execution process. It is absolute mode for NC program by default.

- Format:

  N_G90

- Parameter Explanation:

  N_ : The row number of G code in NC program

- Example:

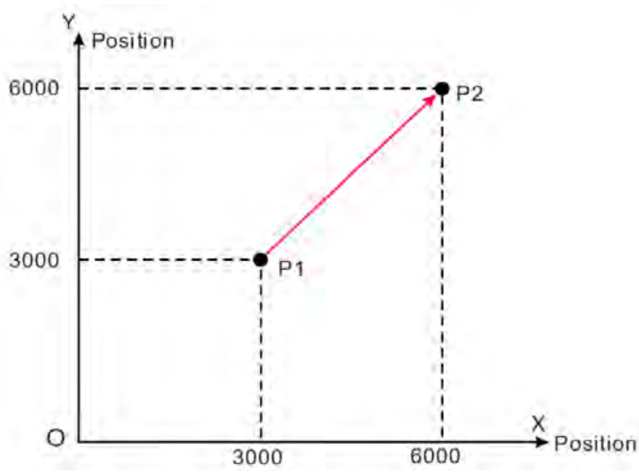
  The initial positions of axis X and Y are both 3000 units and the axis parameters are both default values.

  The G codes to be executed are as follows:

  N00 G90

  N01 G0 X6000 Y6000

  After G codes are executed, the Y/X curve for the whole movement process is shown below:



22.1.4.11 G91 (Relative Mode)

- Function:

  After G91 is executed, the terminal position of each axis in G code is counted in the incremental method beginning from the current position and G90 can be used to switch into the absolute mode in the process.

- Format:

  N_G91

- Parameter Explanation:

  N_: The row number of G code in NC program

- Example:

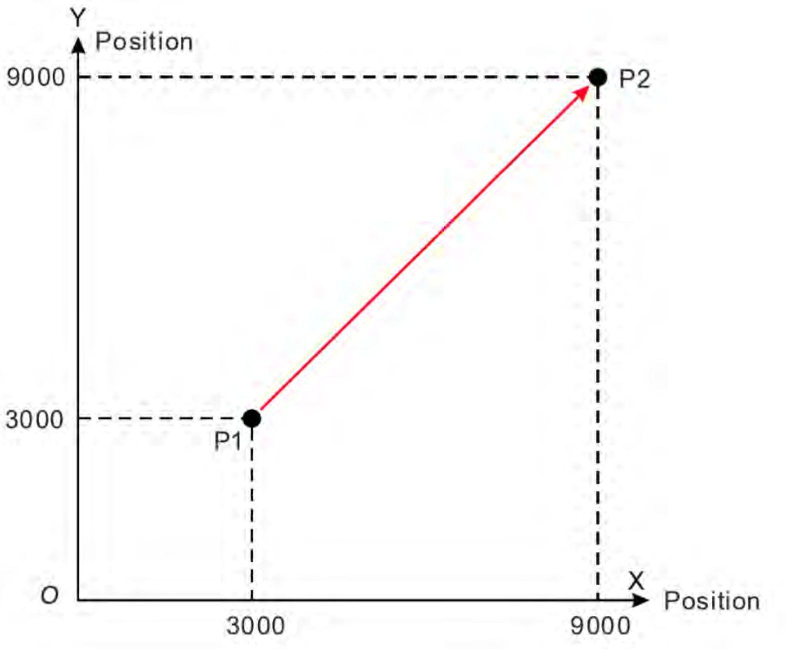
  The initial positions of axis X and Y are both 3000 units and the axis parameters are both default values.

  The G codes to be executed are as follows:

  N00 G91

  N01 G0 X6000 Y6000

  After G codes are executed, the Y/X curve for the whole movement process is shown below:



22.1.4.12 M Code

- Function:

  Interacts with general programs.

- Format:

  N_ M_ D_

- Instruction Explanation:

  1. D_ can be omitted and then no parameter is output after M code is executed.
  2. Two methods of using M code: one is to write it outside the row of G code; the other is to write it in the row of G code.
  3. When M code and G code are not in the same row, e.g. N0 M10 D10.02 ; N1 G1 X100 Y100. When arriving at the row N0, G code execution will stop. Meanwhile, DMC_ReadMFunction is used to read the state of M code, MFuntion is TRUE and the value of MFunctionValue is 10.02. After M code is reset by using DMC_ResetMFunction instruction, G code execution will continue and then N1 row will be executed.
  4. When M code and G code are in the same row and M code can only be placed after G code, e.g. N0 G1 X100 M10 D10.02. When the execution arrives at N0 row, G1 is executed. Meanwhile, DMC_ReadMFunction is used to read the state of M code, MFuntion is TRUE and the value of MFunctionValue is 10.02. After G1 execution is finished the following execution will continue without the resetting of M code by the reset instruction.

- Example:

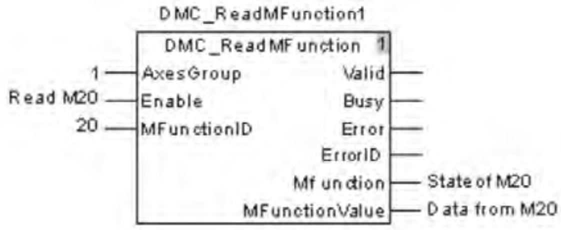
  N0 G1 X100 Y50

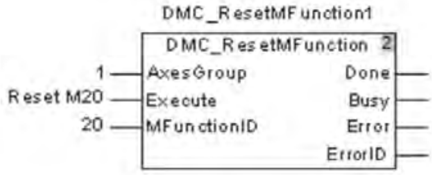
  N1 M20

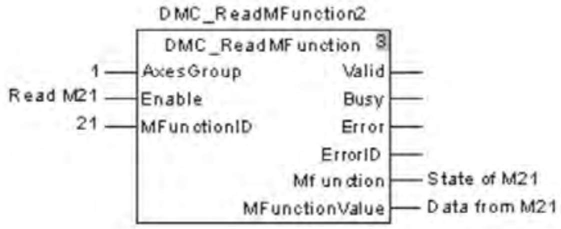
  N2 G1 X200 Y50 M21 D3.14

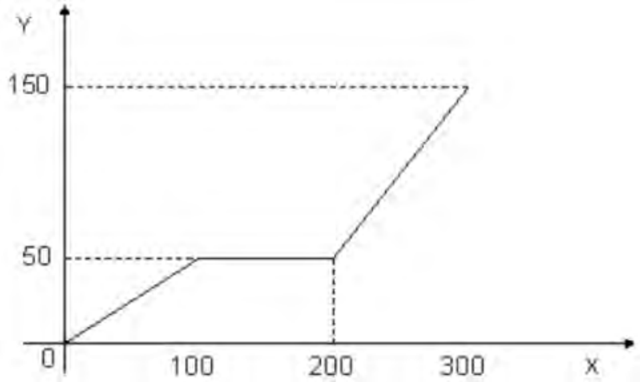
  N3 G1 X300 Y150

  After G codes are executed, the Y/X curve for the whole movement process is shown below:







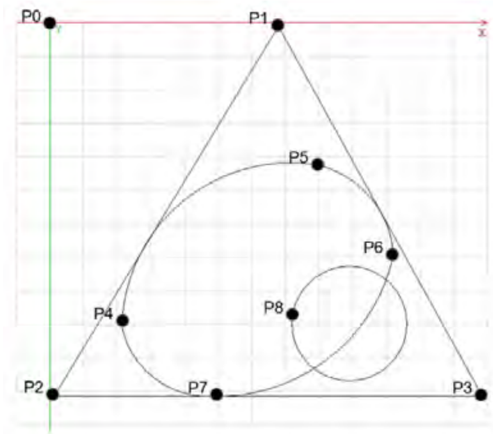


When the two variables “Read M20” and “Read M21” are TRUE, G code execution starts and the terminal actuator stops at the position (100, 50). At the moment, the variable “State of M20” is TRUE. After the execution of other actions is done, the variable “Reset M20” changes to TRUE and M code is reset. Then G code execution continues. The terminal actuator starts to move to (200, 50). Meanwhile, the variable “state of M21” changes to TRUE and the value of “Data from M21” variable is 3.14. The terminal actuator will not stop at that time. After reaching the position (200, 50), it will keep moving till the position (300, 150) is reached and then the execution is completed.

22.1.5 G-Code Example of Drawing Delta Logo through Three-Axis Motion

Through G Codes and absolute addressing, edit and draw the paths to form Delta logo.

[Delta logo to be drawn]



［**G-Code Program**］

```
N0 G90                                  (P0)
N1 G0 Z5000
N2 G0 X32500 Y-500                      (P1)
N3 G0 Z0
N4 G1 X600 Y-53400 F10000               (P2)
N5 G1 X61500 Y-53400 F10000             (P3)
N6 G1 X32500 Y-500  f10000              (P4)
N7 G0 Z5000
N8 G0 X23100 Y-53400                    (P5)
N9 G0 Z0
N10 G2 X10300 Y-43600 R12600            (P6)
N11 G2 X38440 Y-20500 R23900            (P7)
N12 G2 X48880 Y-33300 R13900            (P8)
N13 G2 X23100 Y-53400 R25600            (P5)
N14 G0 Z5000
N15 G0 X34500 Y-43000                   (P9)
N16 G0 z0
N17 G2 X34500 Y-43000 I8150 J0 F5000    (P9)
N18 G0 z5000
N19 G0 x0 y0                            (P0)
```

[Path Description]

Steps to execute the program:

Step 1: Lift the tool in the direction of Z axis and then move it from P0 to P1.

Step 2: Lower the tool until P1 point in the direction of Z axis, move it from P1 to P2, from P2 to P3 and from P3 to P1 and then lift the tool in the direction of Z axis to finish the drawing of the triangle.

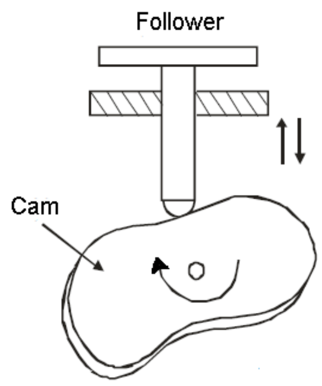
Step 3: Move the tool from P1 to P4 and then lower the tool until P4 point in the direction of Z axis. Subsequently move it in the way from P4 to P5, from P5 to P6, from P6 to P7 and from P7 to P4 and then lift the tool in the direction of Z axis to finish the drawing of the oval shape.

Step 4: Move the tool from P4 to P8, lower the tool until P8 point in the direction of Z axis, draw a circle straight from P8 to P8 and then lift the tool in the direction of Z axis to finish the drawing of the circle.

Step 5: Move the tool to the home point P0 to complete the drawing of the entire Delta log

22.2 E-CAM Editor

22.2.1 About E-CAM (Electronic CAM)



A mechanical cam is an input object with irregular shape. It makes a follower move regularly by coming into contact with the follower. A traditional mechanical cam is composed of a cam, a follower, and a support. As the image shown, when a cam rotates, the follower will go move according to the shape of the cam. For an operation of motion control, the relative movements between axes are achieved by the rotation of a cam.

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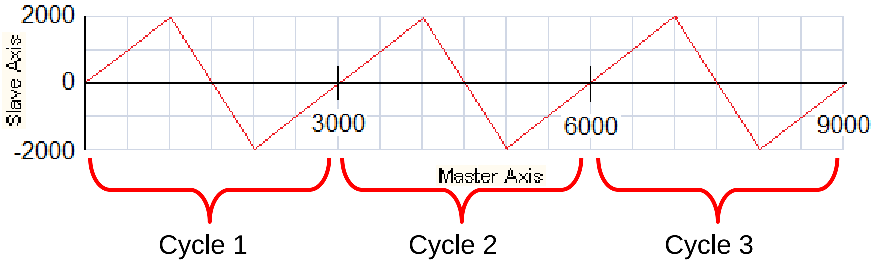
Use a cam chart to define the relation between a follower and a cam to simulate the movements of a cam controlled by a PLC, making a slave axis to move by the master axis according to their defined relation. The benefit of using a E-CAM is that users can modify the electronic cam data in an electronic cam in software. Users do not need to modify the mechanical design and no depreciation costs.

22.2.2 The Significance and Description of E-CAM

A created E-CAM chart is as the image shown below. In the cam chart, the horizontal axis represents the master axis used and the vertical axis represents the slave axis used. Values (such as number of pulses sent) on the cam chart are all single digits. The range of 0-3000 on the horizontal axis represents an E-CAM cycle and the vertical axis represents the units of the relative slave axis outputs.

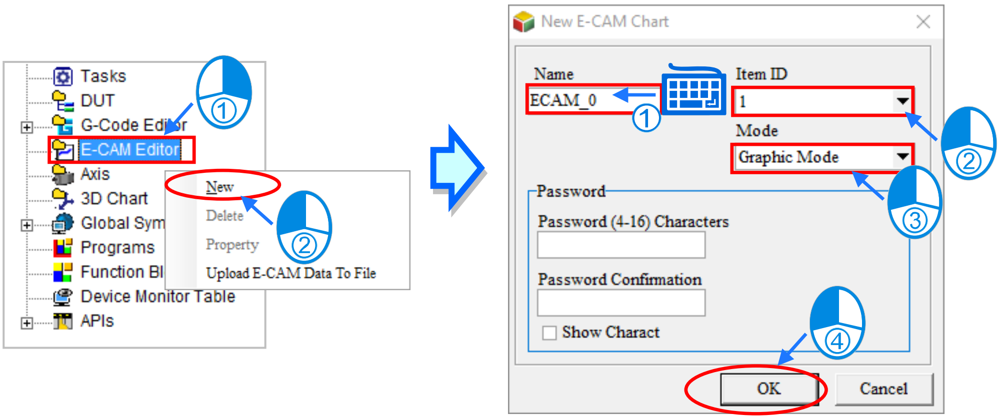
If an electronic cam operates cyclically, the slave axis of the electronic cam moves in accordance with electronic cam data when the master axis of the electronic cam moves. After the master axis completes an electronic cam cycle (3000 units sent), the number of pulses that the master axis sends will continue to increase. However, after the slave axis completes an electronic cam cycle, it will repeat the electronic cam cycle. The relation between the positions of a master axis and the positions of a slave axis is the repeated extension of electronic cam data.

If a motion controller is connected to a master servo motor and a slave servo motor, the master servo motor will regarded as a drive shaft rotating in a direction, and the slave servo motor will be regarded as a processing shaft which rotates back and forth. This characteristic can be applied to flyingsaws and flyingcuts.



22.2.3 Using E-CAM Editor

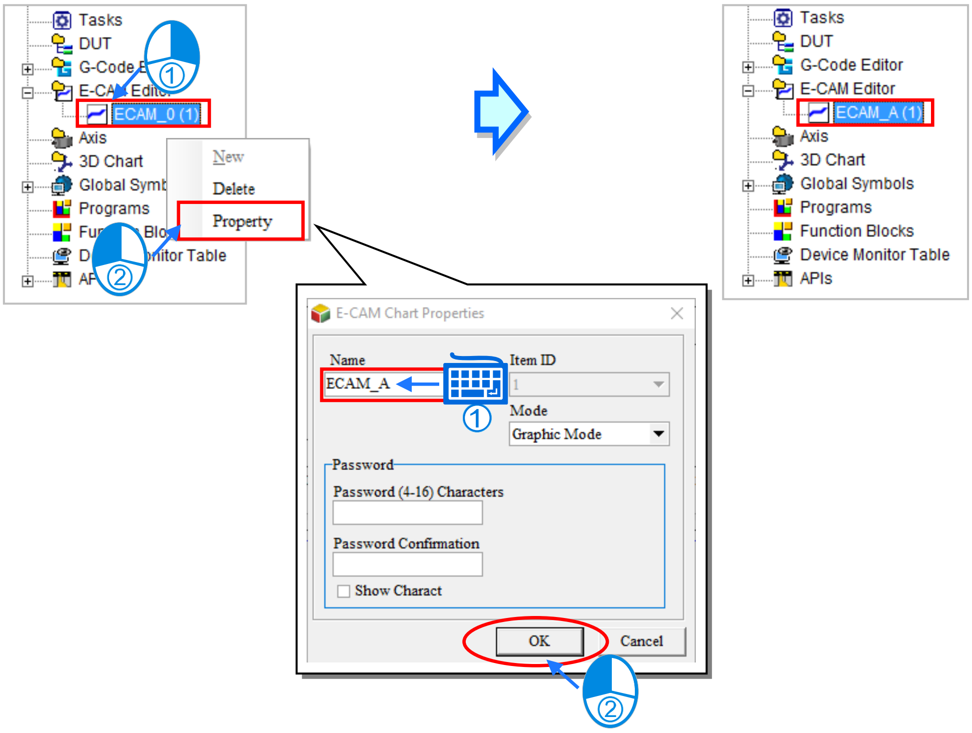
Right-click the E-CAM Editor in the project management area and then click **New** to see a New E-CAM Chart setting window. Type a name and select an item ID and a mode. Users can also set up a password to protect the E-CAM data. After a password is set, the system will ask for the password upon next editing when the mode is set to **Graphic Mode**. When the mode is set to **File mode**, the password will be asked for upon each import and export.



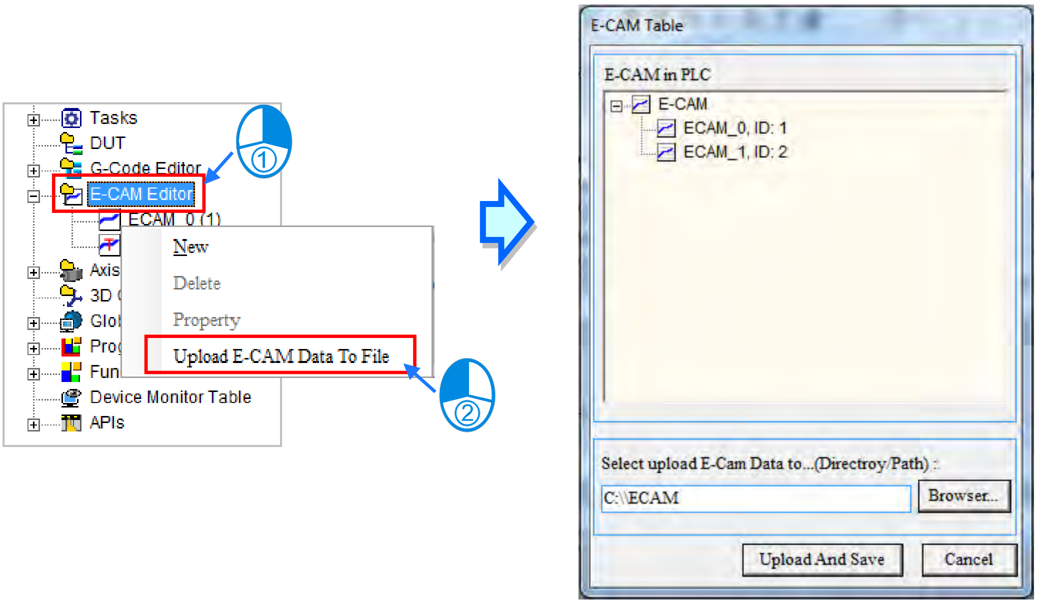
Name	Function Description	AS	AHxxEMC	AS5XX DVPxxMC
Item ID	E-CAM table item ID	Max.16	Max.32	Max.64
ASDA File	Using ASDA file format in	V		
File Mode	E-CAM table in file mode		V	
Graphic mode	E-CAM table in graphic mode		V	V
Flag Cycle	When dragging the first and last control point, data synchronization of the two			V

Name	Function Description	AS	AHxxEMC	AS5XX DVPxxMC
Password	Password for E-CAM table		V	V
Upload E-CAM to File	Upload master axis and slave axis position from PLC		V	

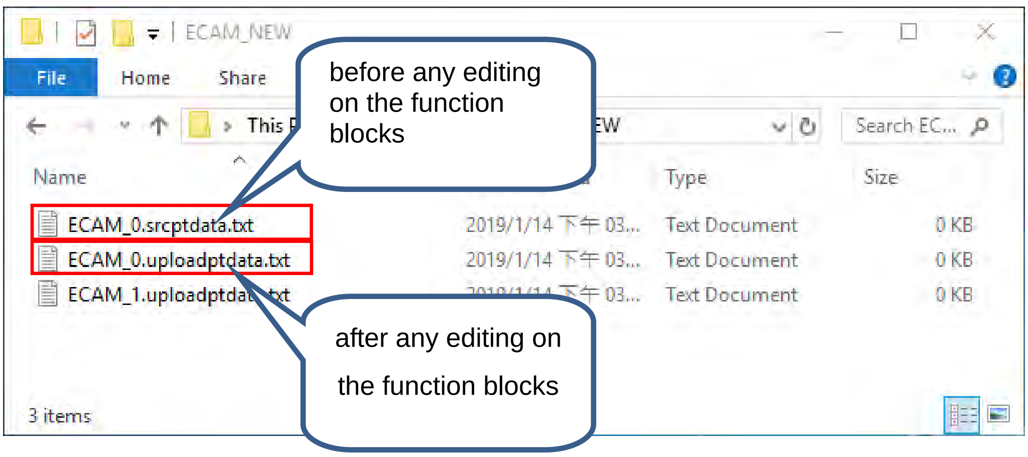
Right-click on the created E-CAM item and choose Delete to remove the item; or select Property to reset item name or password but the item ID cannot be changed.



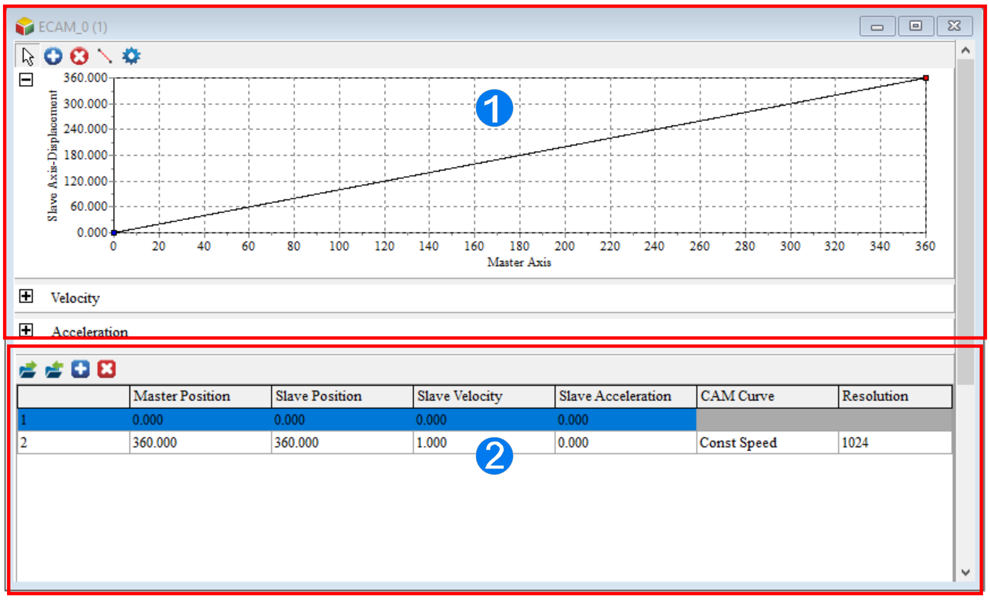
Use the AH-Motion function block in Delta library, e.g. DFB_CamWire to modify E-Cam graph point position online and then implement **Upload E-CAM Data to File** function to save the master axis and slave axis position in E-CAM table in another file. The function requires connection with AHxxEMC hosts first then right-click **Upload E-CAM Data to File** in **E-CAM Editor.** Meanwhile, **the E-CAM in PLC** window will appear.



When the directory/path for file saving is selected, click **Upload and Save**. Two files, one is the xxxx_scrptdata.txt that appears in the directory before any editing on the function blocks and xxxx_uploadptdata.txt that appears after any editing on the function blocks. The xxxx is the E-CAM name (see below).



When selecting **Graphic Mode**, it will open E-CAM edit window once E-CAM graph is created. The description are as followed.



❶ E-CAM curve area: the chart is created according to the position, velocity and acceleration of the E-CAM. Users can also use their mouse to move the points directly in the chart or use the function buttons to add new data points or sections on the created chart.

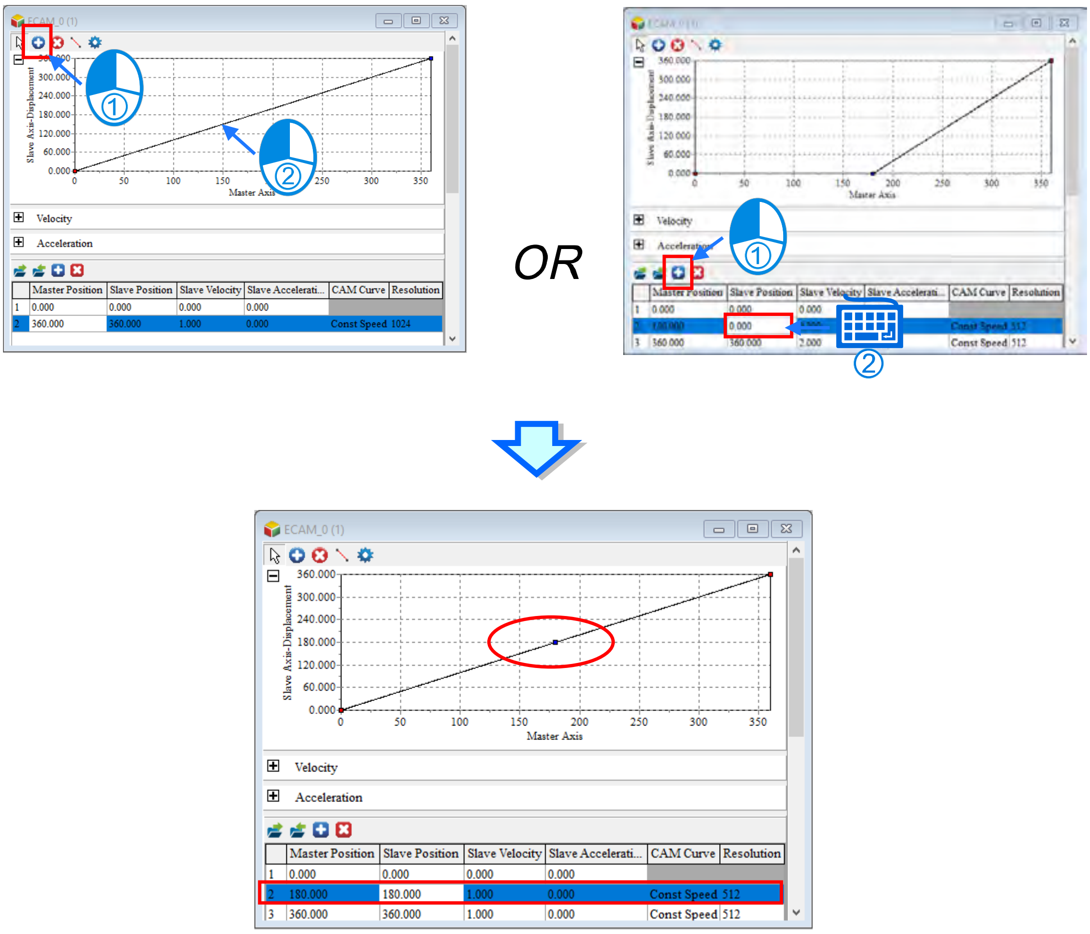
❷ Data setting area: users can use the function buttons to add, edit, or delete the created charts. The data in the Data setting area and the E-CAM chart will be synchronized with one another.

Explanation of E-CAM Editor function icons (see below).

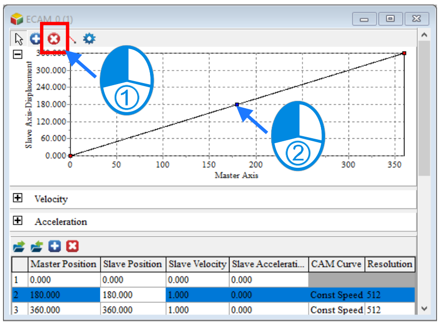
Icon	Name	Description	AS	AHxxEMC	AS5XX DVPxxMC
	Select tools	Switch to the selected tool	V	V	V
	Add a key point	Add a key point in the	V	V	V
	Delete a key point	Delete a key point in the	V	V	V
	Add line segment	Add a line segment that		V	V
	Setting	Open setting window	V	V	V
	Export	Export E-CAM in	.csv	.dst	.dst
	Import	Import E-CAM in	.csv	.dst	.dst
	Upload slave axis	Upload data from data	V		

Icon	Name	Description	AS	AHxxEMC	AS5XX DVPxxMC
	Download slave axis	Download data to data	V		
	Add a row	Add a key point data in the	V	V	V
	Delete a row	Delete a key point data in the	V	V	V
	Add tappet point	Add a tappet point icon on			V
	Display CAM table	Display CAM table			V
	Display tappet point	Display tappet point table			V

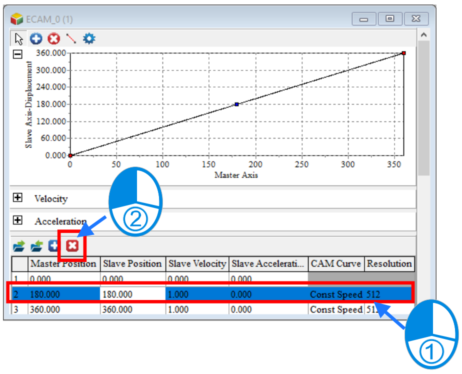
Click to add new point then click on the diagram for the added key point position. Meanwhile, the section below will automatically add the key point data or select in the planning section and input master axis data as 180 (see below). To add several key points, click and then click several times on the diagram to add the key points data.

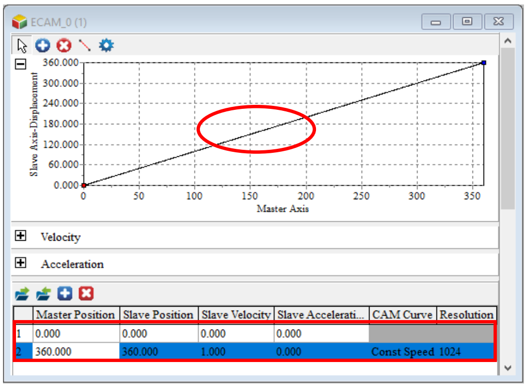


Users can click then select the key point to delete on the diagram and the section below will automatically delete the key point data or select in the planning section to delete the key point data (see below). To delete several key points, click and then continuously click on the key points to delete.



OR



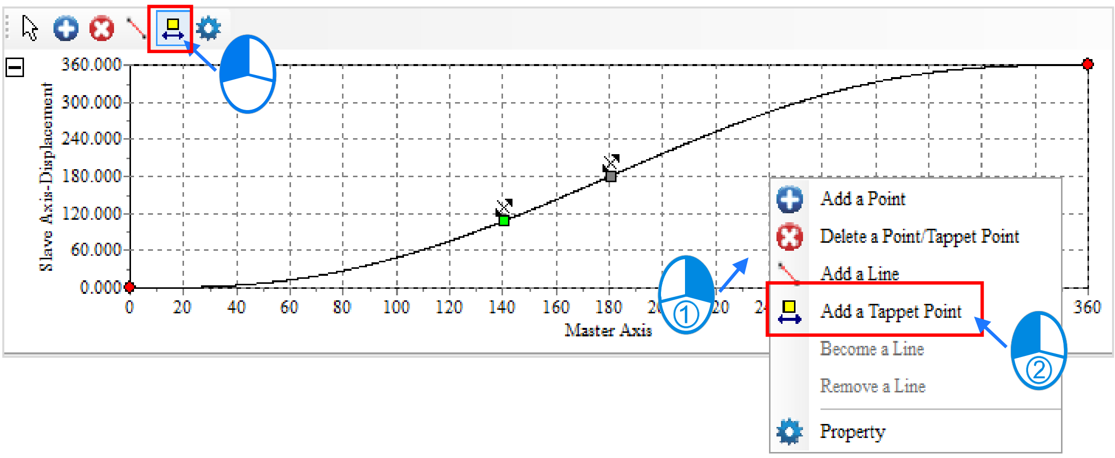


During E-CAM execution, the CAM may trigger corresponding action in certain specific position and this requires a close/open state setting regarding the assigned position of CAM. When CAM moves to that position, the close/open state change can control the corresponding action and the close/open state is called CAM-tappet.

The CAM-tappet can set in any position of CAM and one CAM can set up a maximum of 128 CAM-tappet. When CAM moves across in positive or negative direction, the tappet state can be configured into (close, set, reset, reverse). The tappet state can be obtained through the corresponding command of CAM-tappet in the controller program. The following chart describes the CAM-tappet state:

Close	When CAM passes the corresponding position of tappet, the tappet state does not change.
Set	When CAM passes the corresponding position of tappet, the tappet state is set to TRUE.
Reset	When CAM passes the corresponding position of tappet, the tappet state is set to FALSE.
Reverse	When CAM passes the corresponding position of tappet, the tappet state switch once between TRUE and FALSE. (If TRUE then change to FALSE, if FALSE then change to TRUE).

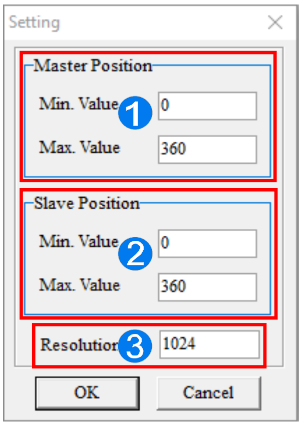
Note: CAM-tappet state will reset once the next CAM cycle starts. Use the add tappet point icon on the toolbar or right-click on the diagram to choose add a tappet point (see below).



Each key point data in the planning section allows users to setup a CAM curve section. Then, several rows of key points data form the CAM curve and all the created key points data forms a E-CAM cycle. For each key point data, users can input the master and slave axis relations. The descriptions are shown below.

Name	Function Description	AS	AHxxEMC	AS5XX DVPxxMC
Key Point	Record E-CAM motion	Max.721	Max.40	Max.40
CAM Curve Const Speed	Constant speed		V	
CAM Curve Const Acc.	Constant acceleration		V	
CAM Curve Single Hypot.	Single Hypothesis		V	
CAM Curve Cycloid	Cycloid		V	
CAM Curve Polynomial	Polynomial	V	V	V
CAM Curve B-Spline	B- Spline		V	
Resolution	Used data points of the current section.		V	

Click Setting or  to open other setting windows. Explanations are as followed.



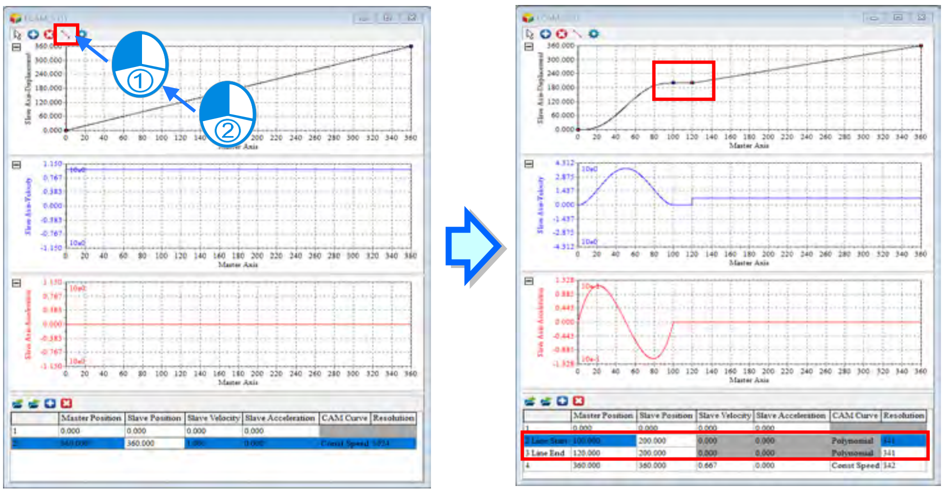
❶ Master position: Setting main axis display range in the diagram.

❷ Slave position: Setting slave axis display range in the diagram.

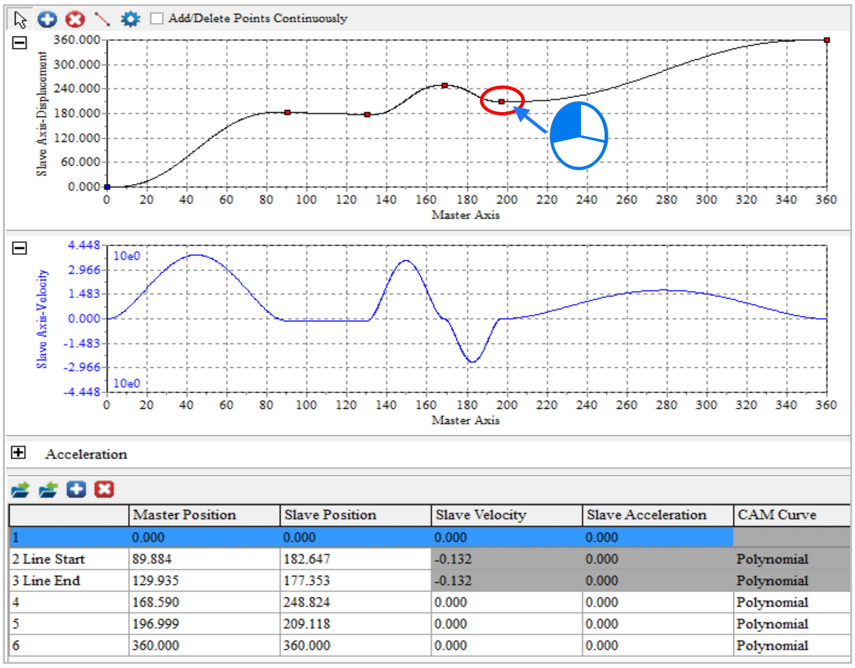
❸ Resolution: Setting the E-CAM table, the total interval curve resolution

Item	Feature Description	AS	AHxxEMC	AS5xx DVPxxMC
Master Position	Sets main axis display range in the diagram.	Fixed; not configurable.	V	Min value is fixed (0).
Slave Position	Sets slave axis display range in the diagram.	V	V	V
Resolution	Sets the E-CAM table, the total interval curve resolution		V	

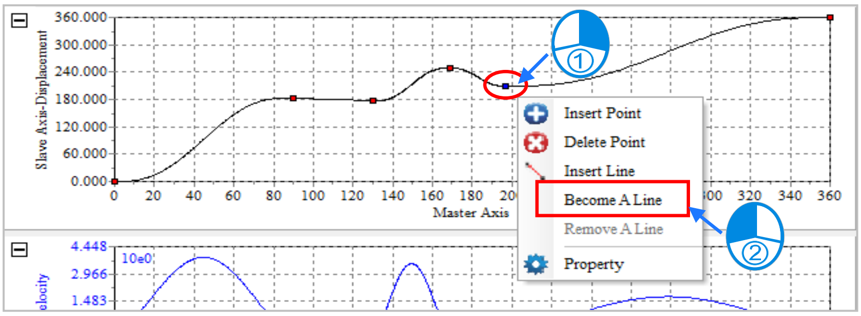
Click **add line segment** or  and click on the position to add in the diagram and the section below will automatically add the linesegment containing two key points data. When the line segment is added, the function of the CAM curve with line segment added is fixed in Polynomial mode. On the left of the line segment, item ID appears and on the right, Line Start and Line End shows.

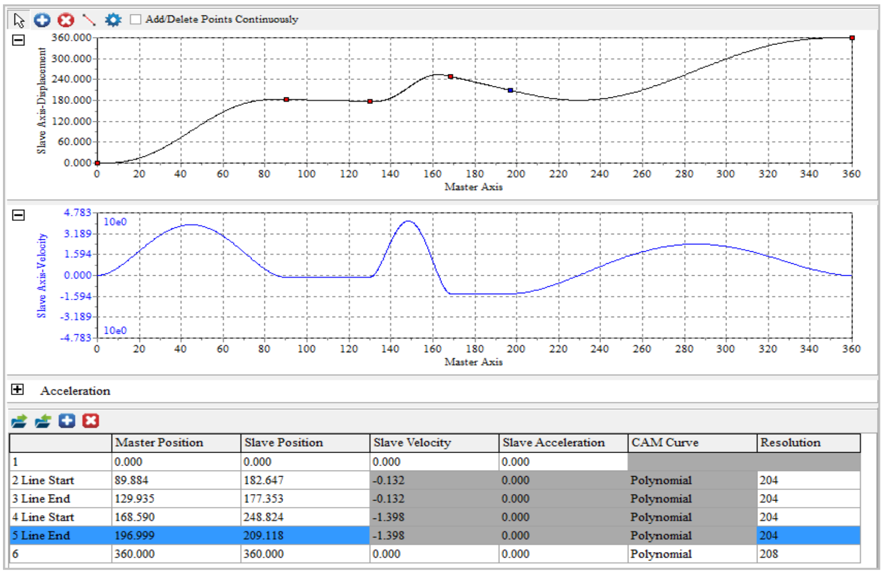


To set the interval line segment to into a line n Polynomial mode, right-click the key point in the diagram and then select **Become A Line**.



	Master Position	Slave Position	Slave Velocity	Slave Acceleration	CAM Curve
1	0.000	0.000	0.000	0.000	
2 Line Start	89.884	182.647	-0.132	0.000	Polynomial
3 Line End	129.935	177.353	-0.132	0.000	Polynomial
4	168.590	248.824	0.000	0.000	Polynomial
5	196.999	209.118	0.000	0.000	Polynomial
6	360.000	360.000	0.000	0.000	Polynomial



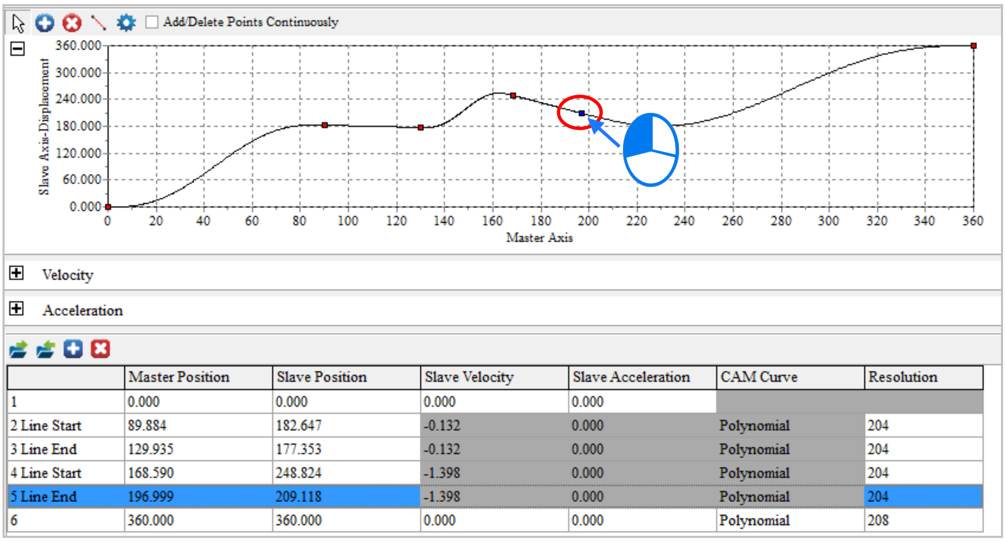


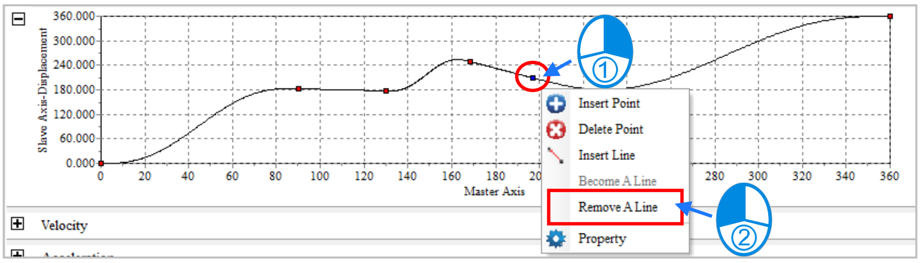
	Master Position	Slave Position	Slave Velocity	Slave Acceleration	CAM Curve	Resolution
1	0.000	0.000	0.000	0.000		
2 Line Start	89.884	182.647	-0.132	0.000	Polynomial	204
3 Line End	129.935	177.353	-0.132	0.000	Polynomial	204
4 Line Start	168.590	248.824	-1.398	0.000	Polynomial	204
5 Line End	196.999	209.118	-1.398	0.000	Polynomial	204
6	360.000	360.000	0.000	0.000	Polynomial	208

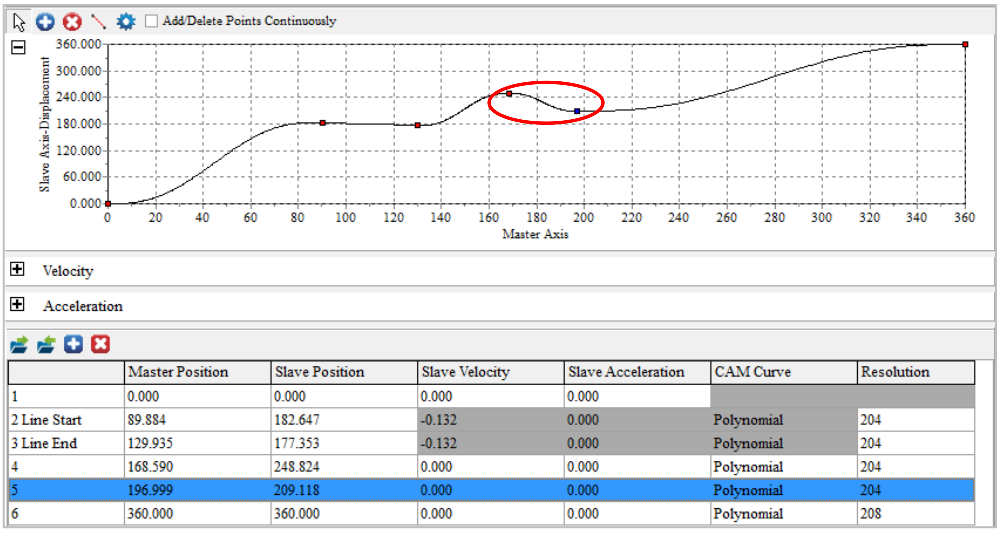
When setting to **Become A Line**, please take note:

- The previous and current section has to be polynomial to use this function.
- The key points of Line Start and Line End cannot share line property with other line intervals.

To remove the created line property, right-click the key point of Line Start or Line End of the polynomial interval line sections in the diagram and then choose **Remove A Line.**



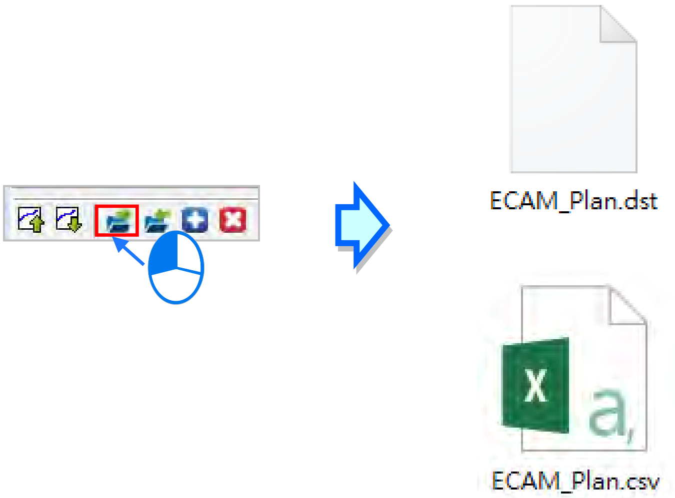




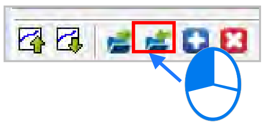
When using **Remove A Line** function, please take note:

- Property regarding Line Start or Line End key points can use this function.

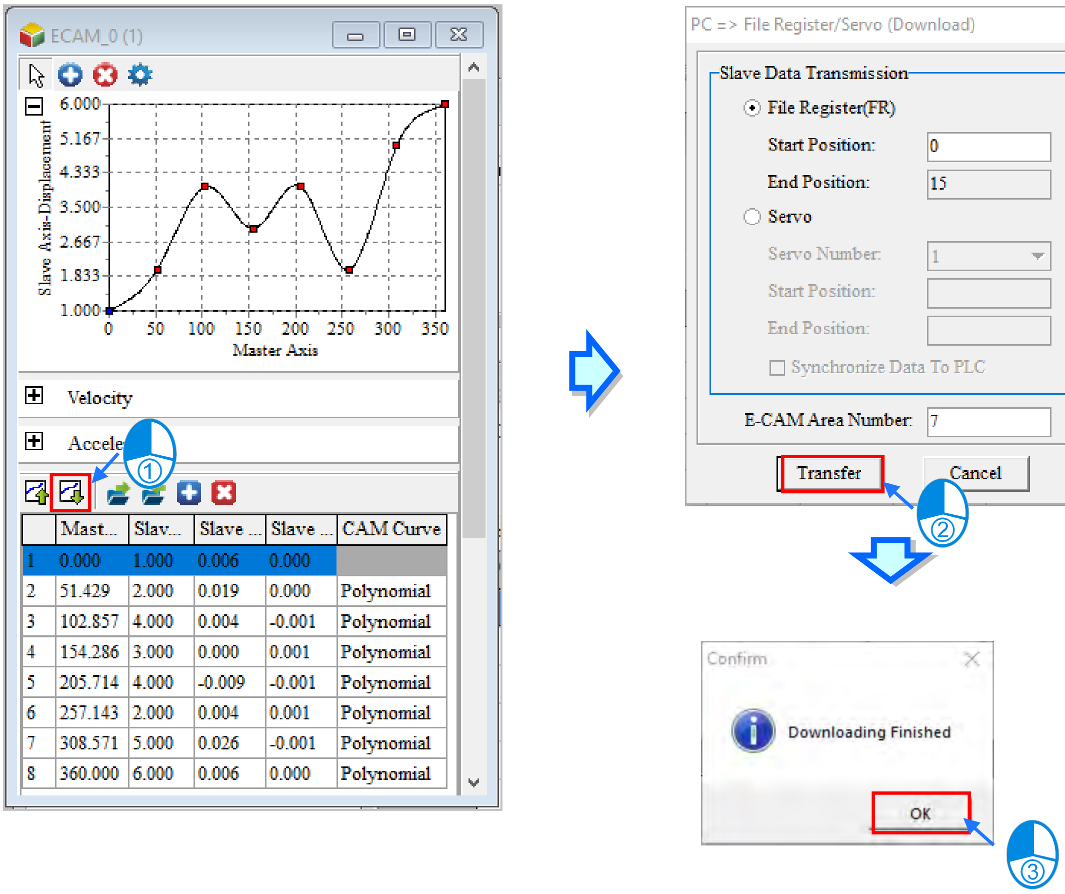
Click the upper toolbar icon  to export planning table data. However, the file format to export is different based on the project PLC types and cannot be in common use.



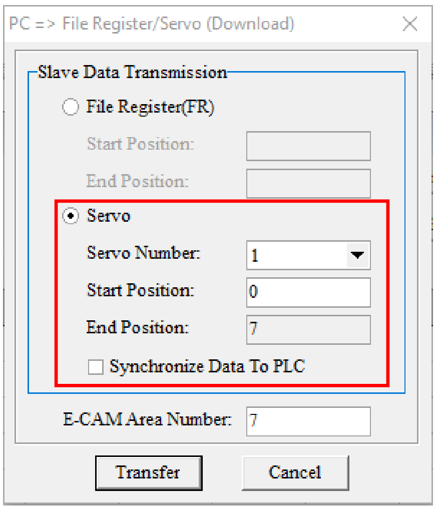
To import planning table data, click the icon  to import the selected files.



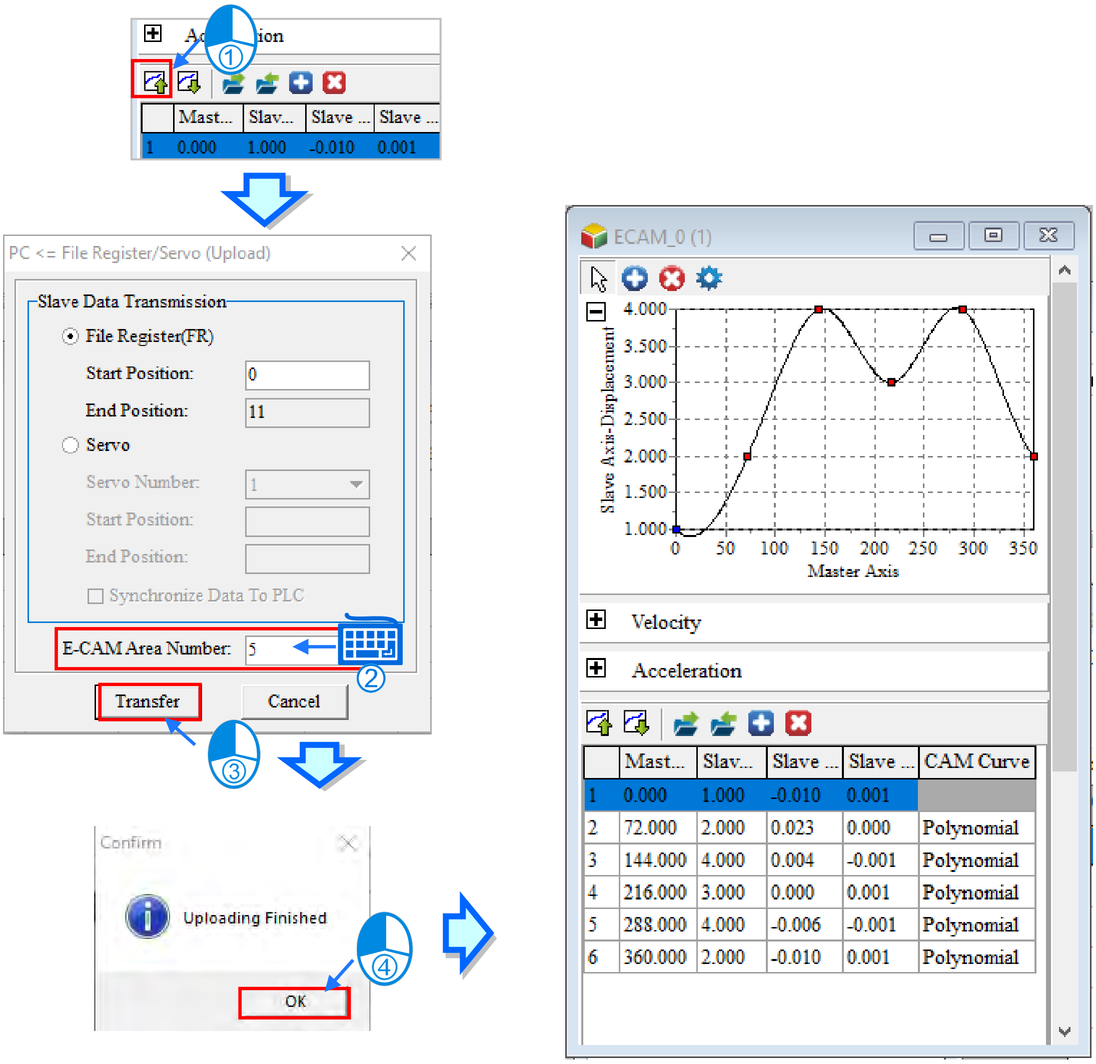
To download slave data, users need to setup connection between ISPSoft and AS series PLCs first. The following example demonstrates by opening an E-CAM table and increase up to 8 key points. Then, select **Download Slave Data [PC=> Data Register/Servo]** and choose to download to file register (FR) or servo from the pop-up window. The E-CAM area number is set to save the curve area. Here, we download 8 key points which equals to 7 curve area. When changing the start position or E-CAM area number, the system automatically calculates the ending position. Click Transfer and a pop-up window appears when transfer is complete.



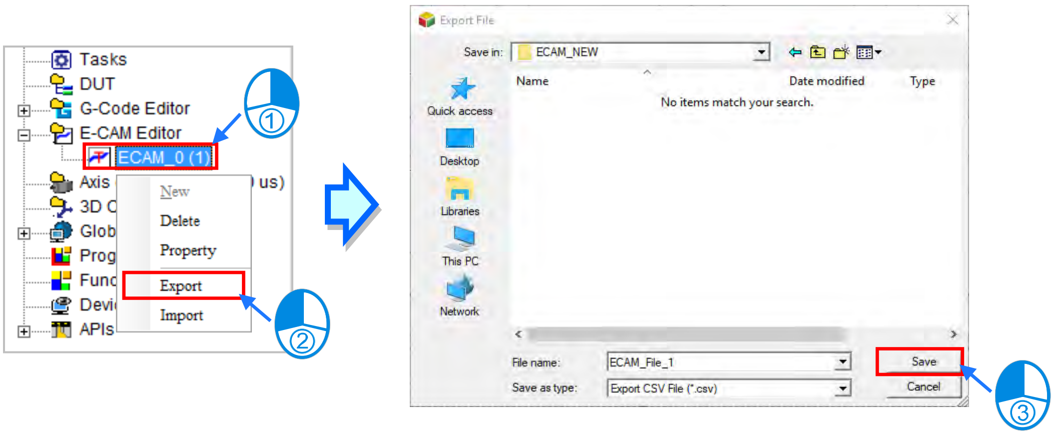
Click Servo to download the files to the servo. First, users need to select a corresponding servo number, then setup the start position. When Synchronization Data to PLC is selected, the current E-CAM data will synchronize into PLC, however, the E-CAM number and item ID need to be the same as in PLC for data synchronization.



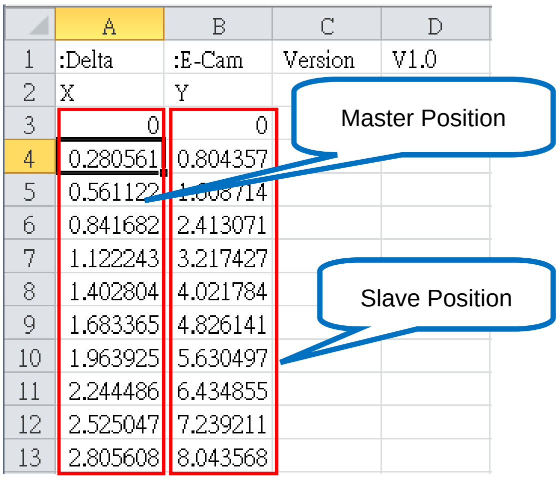
Click **Upload Slave Data [PC=> Data Register/Servo]** and in the pop-up window, we can upload 6 key points, so the E-CAM area number is changed to 5 and click Transfer to finish uploading. The following diagram shows that 6 key points are re-drawn on the E-CAM table.



When in **File Mode**, users need to export E-CAM table for edit. Right-click on the E-CAM item and choose **Export.** Select a path and file name, then click **Save** to complete exporting.

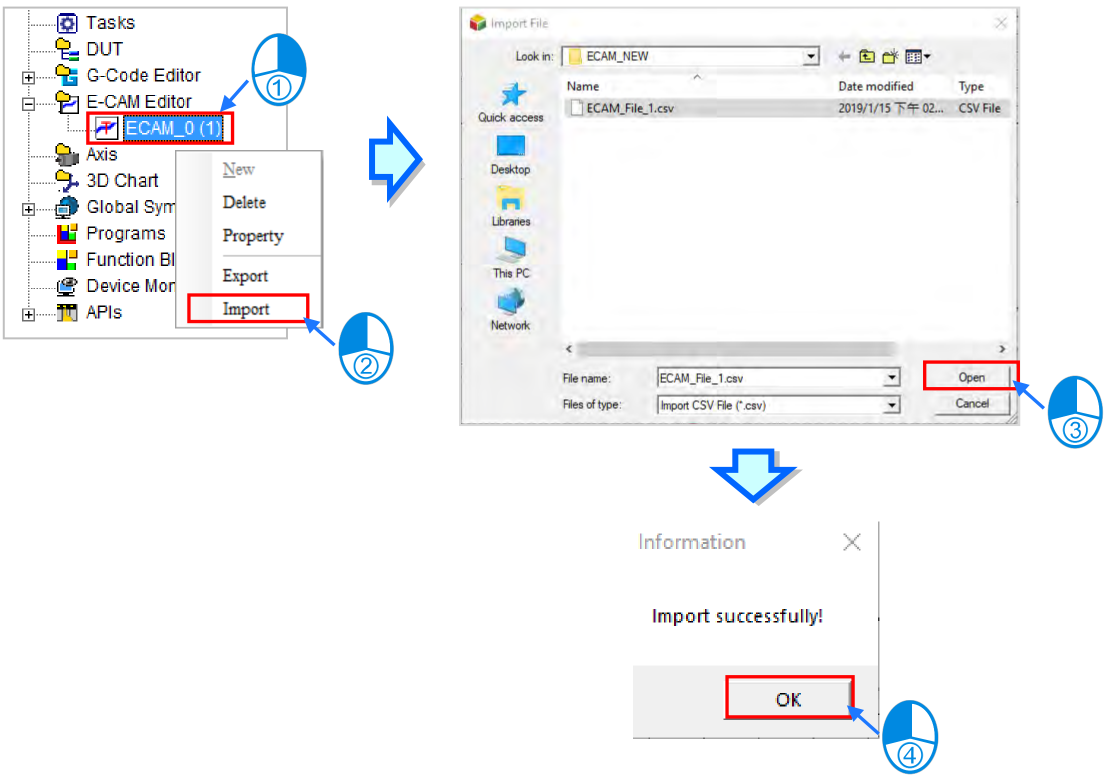


Input E-CAM master position (X) and slave position (Y) and format as 0 for the export file in csv format; input maximum of 2048 sets of XY position points and at least 2 sets of XY position points. When input is complete, click save and return to ISPSoft to execute import.

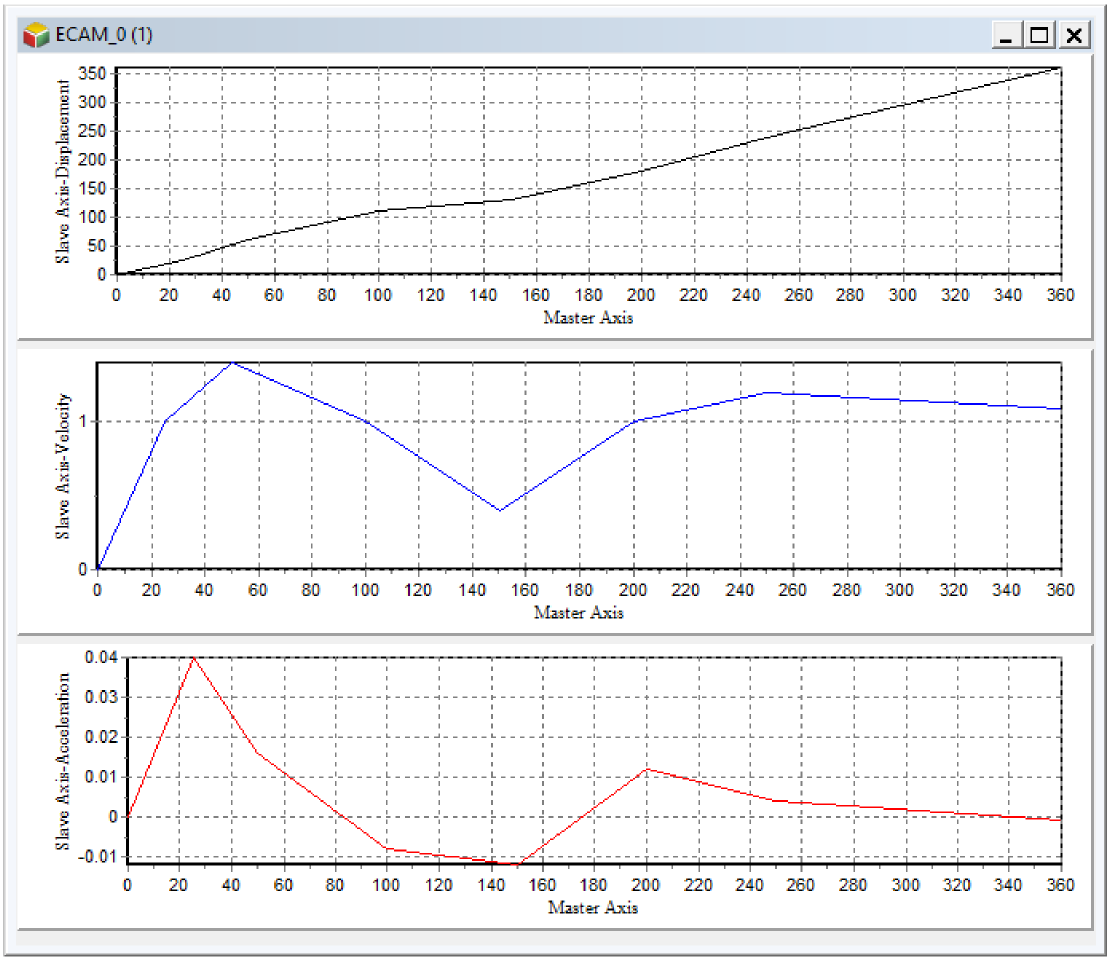


	A	B	C	D
1	:Delta	:E-Cam	Version	V1.0
2	X	Y		
3	0	0		
4	0.280561	0.804357		
5	0.561122	1.608714		
6	0.841682	2.413071		
7	1.122243	3.217427		
8	1.402804	4.021784		
9	1.683365	4.826141		
10	1.963925	5.630497		
11	2.244486	6.434855		
12	2.525047	7.239211		
13	2.805608	8.043568		

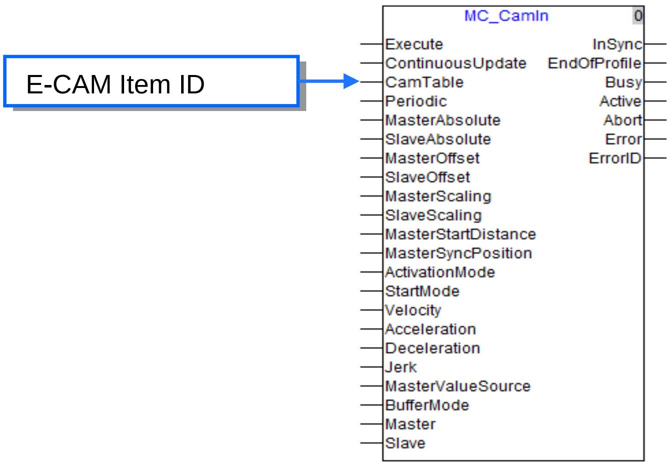
Once return to ISPSoft, right-click on the selected E-CAM item and choose **Import.** Then, select on the file to open and a pop-up window indicating successful import appears. Click **OK** to complete importing.



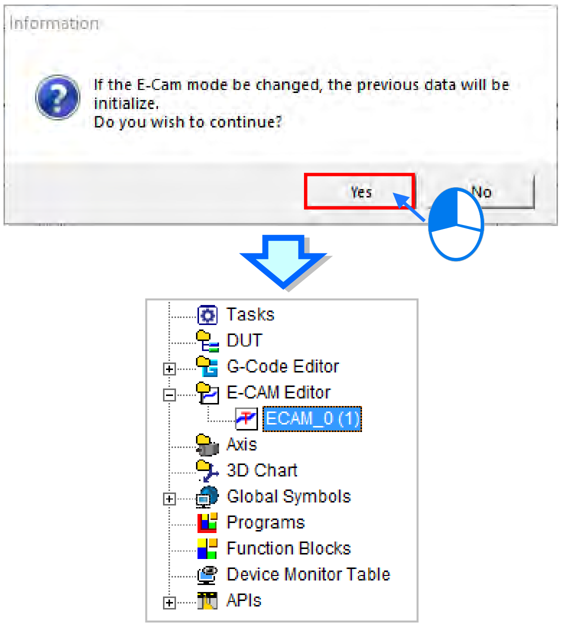
When importing is complete, the corresponding E-CAM diagram is shown to view graphic data regarding imported files.



When finish programming E-CAM Editor, it can be used together with motion control commands or function blocks in POU. E.g. MC_Camin command enables assigned E-CAM item according to E-CAM Editor item ID. For more information on using MC_Camin command, please refer to the programming manuals of related PLC types.



When switching to E-CAM graphic mode, click OK and an Information window appears asking “If the E-CAM mode is changed, the previous data will be initialized. Do you wish to continue? ” Choose **Yes** and all E-CAM data is initialized.



Chapter 23 Wizard Tool

Table of Contents

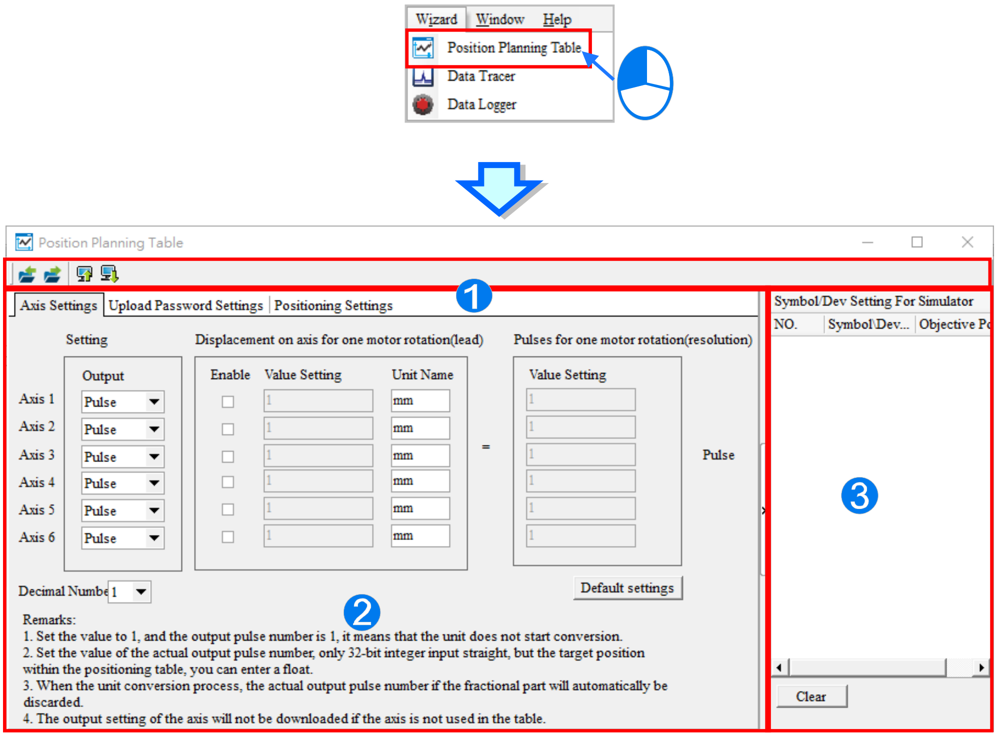
23.1 Position Planning Table

23.1.1 About the Position Planning Table

ISPSoft provides an easy table for users to set up the single-axis or 2-axis motion control. It is not required for users to know the complicated motion control rules to complete the setup. Create and download a position planning table and then along with the instructions, the PLC can output axis motions in the set number and order accordingly.

23.1.2 Setting the Position Planning Table

Click **Wizard (!) > Position Planning Tabl**e on the tool bar to open the **Position Planning Table** window which is categorized into 3 sections as shown in the image shown below.



❶ Icon toolbar: Provide buttons for various functions with function description explained below.

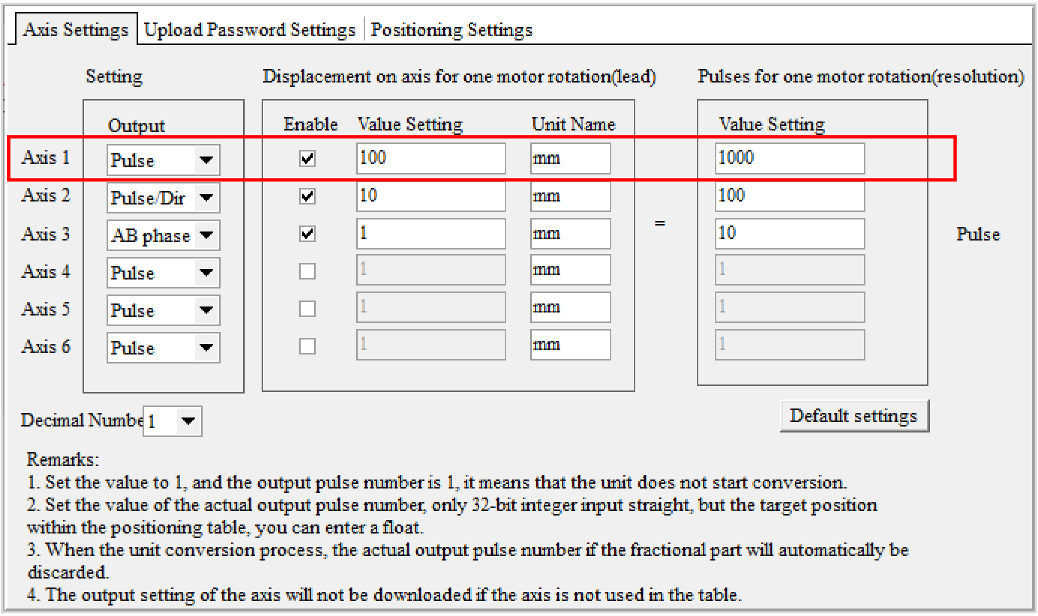
❷ Parameter setting area: Settings regarding axis control. Upload password protection is used for password setting. Provides axis control mode and motion path setting in the position table.

❸ Setting for Simulator: Use **relative mode (symbol/address)** or **absolute mode (symbol/address)** to simulate for the objective position.

Icon toolbar description:

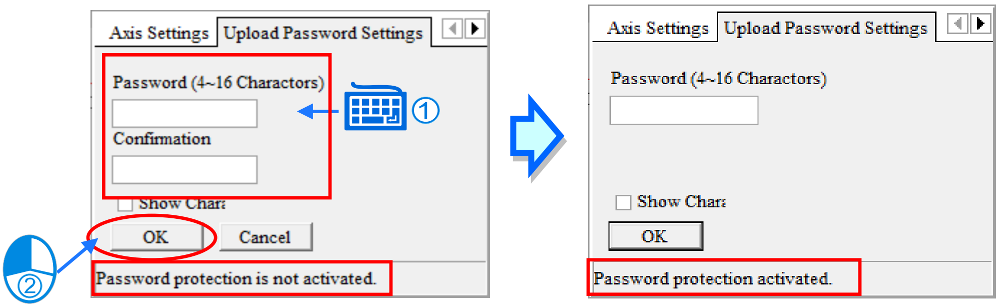
Icon	Name	Function Description
	Import	Import *.pnt to the current position planning table.
	Export	Export positioning table to *.pnt.
	Upload	Read positioning table settings via hosts.
	Download Positioning Table	Write positioning table settings in hosts.

In Axis Settings page, users can setup each axis control output. The number of axis shown varies according to the supported PLC types. When executing 2-axis interpolation movement, do NOT choose Pulse for **Output** instead choose Pulse/Dir or AB phase. Then click **Enable** next to the **Output** and input self-defined **Value Setting** and **Unit Name** as well as the **Value Setting** of **Pulses for one motor rotation**. The follow image shows that the setups of Axis 1 for 100 mm can output 1000 pulses in one motor rotation. Click **Default Setting** to restore the initial setup for the unit setting page.

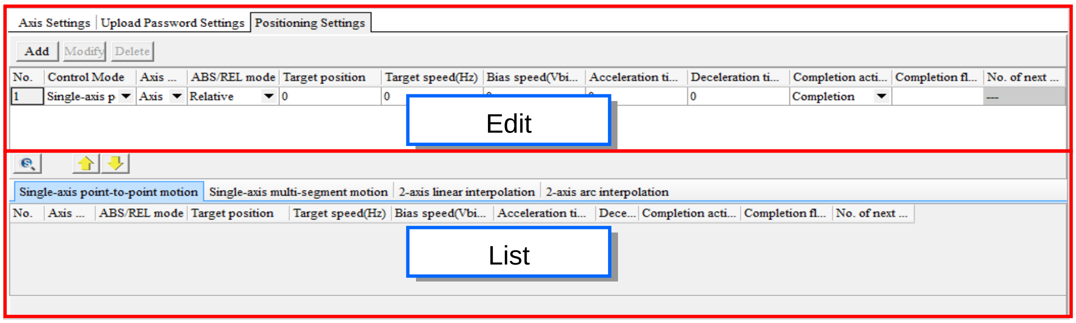


In Upload Password Settings page, the passwords are set to protect during uploading for position planning table downloaded to the host. After typing in the **Password** and again for **Confirmation,** click **OK** and when successful, a hint indicating ‘password protection activated’ is shown below. To remove the password setting, input the **Password** in the box to click **OK** and when successful a hint indicating ‘password protection is not activated’ is shown below.

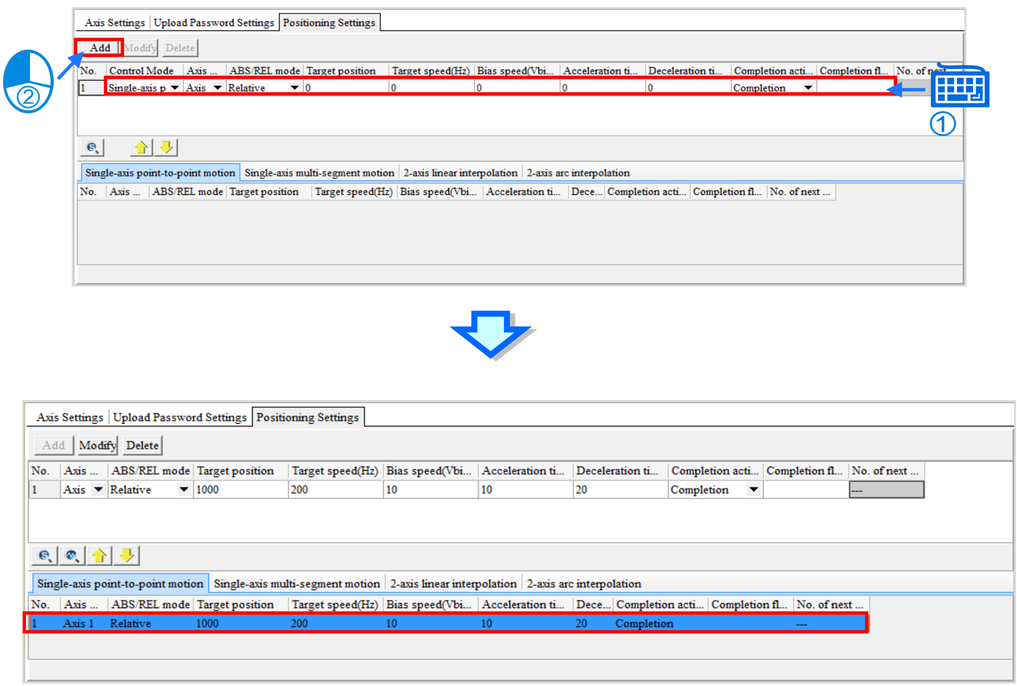
⚠ Please note that Upload Password Settings only provides password for uploading the position planning table. When other planning table is downloaded to hosts with Upload Password Settings, the position planning table will be covered.



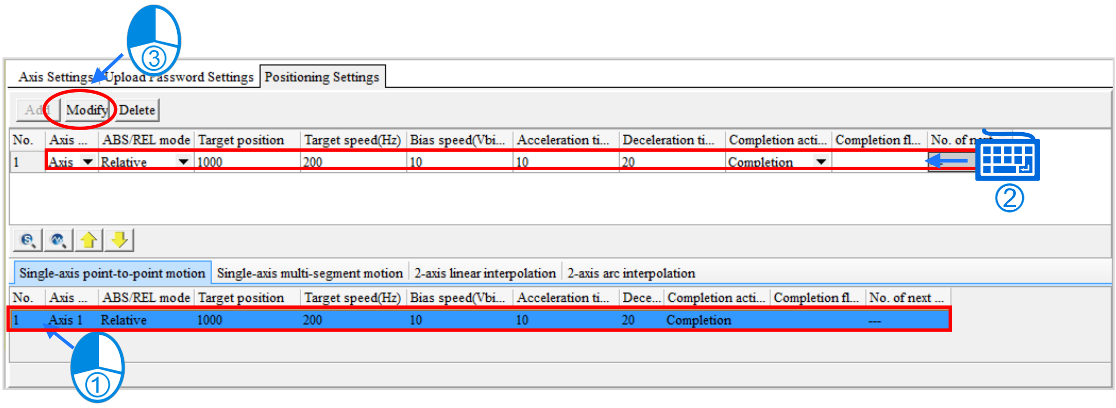
In Positioning Settings page, the edit section provides functions to add, modify or delete. When data are added, it will appear in the list section.



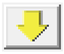
To add data, first input settings in each column of the edit section and click **Add** so the data is added to the corresponding axis control mode page (see below) based on **Control Mode.**

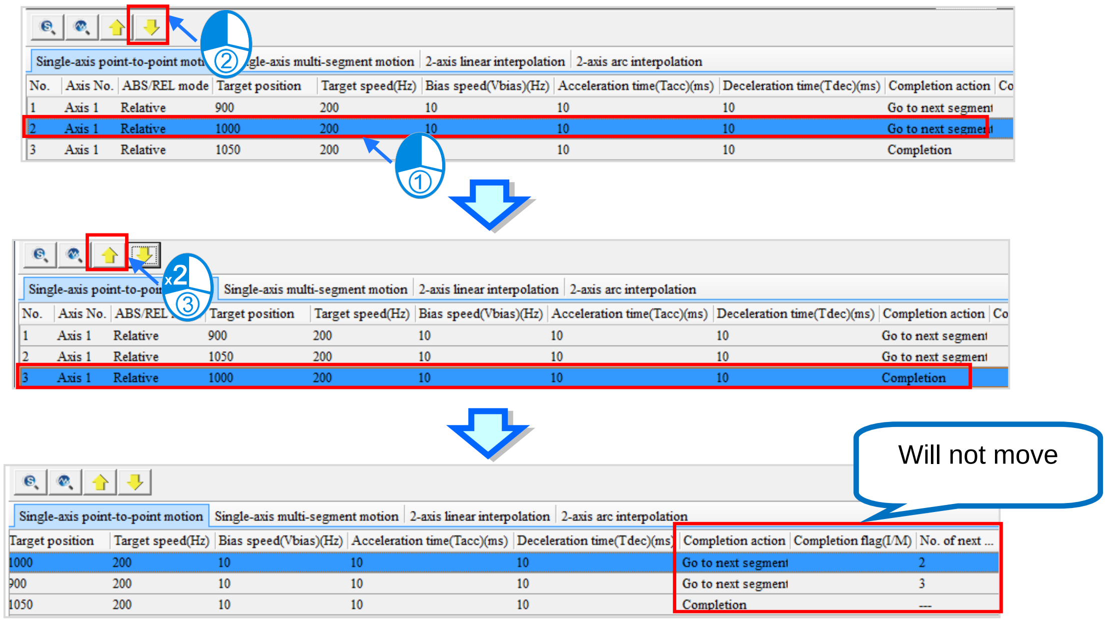


To modify, select the data in the list section then edit its content in the edit section and click **Modify** to update this data in the list section (see below).

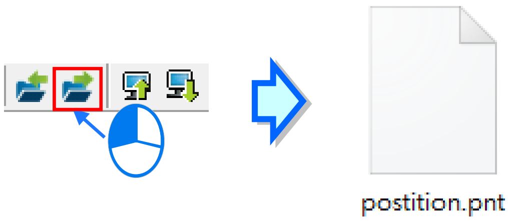


To delete, select the data in the list section and click **Delete** in the edit section. This data is deleted from the list section.

Every number in the list section can move up or down by click  / . But please note that **Completion action**, **No. of next section** and **Completion flag (I/M)** will not move (see below).

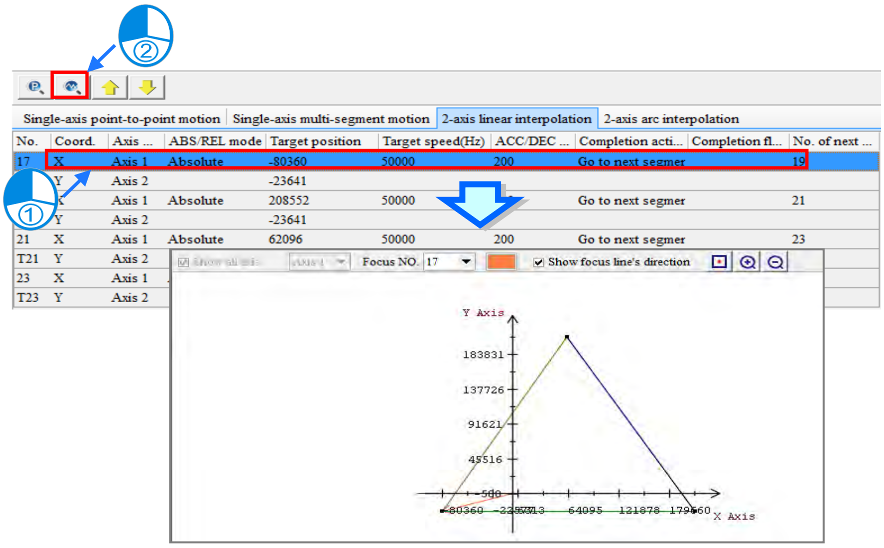


When completing the positioning table data, click **Export** data to *.pnt (see below). Then, click **Import** and choose *.pnt file to import the positioning data.

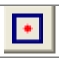
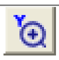
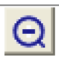


23.1.3 Positioning Table Simulation

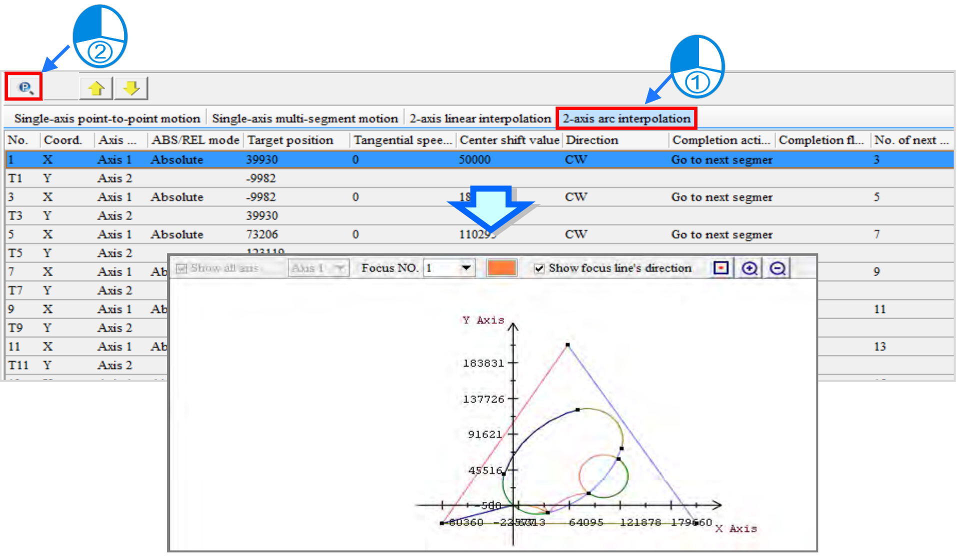
Select a row in the list section for simulation then click **Assigned Number Diagram** [icon] to view a pop-up window that contains a complete graph-based path planning (see below) that begins with No.17.



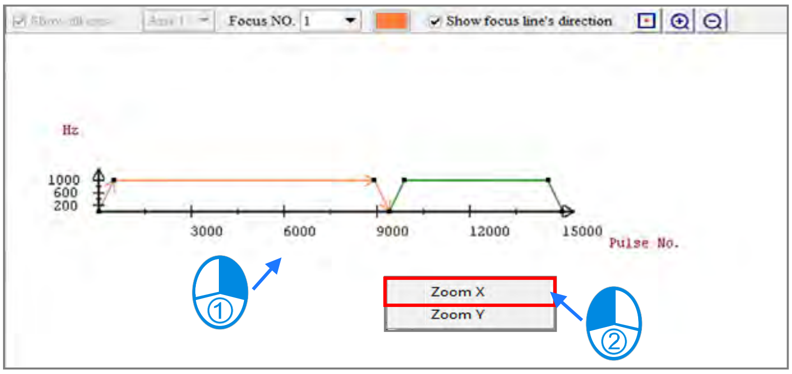
Simulation toolbar description:

Figure	Function
☐ Show All Axis / Axis 1 ▼	Select to show all axes or choose an axis from the
Focus NO 1 ▼	Select a No. in the graph to be in bold type or change and choose a color in the right side.
☑ Show focus line's direction	Select to view the arrow indicating motion direction.
	Adjust the graphs to appropriate fit.
	Enlarge the graph in X direction.
	Narrow the graph in X direction.
	Enlarge the graph in Y direction.
	Narrow the graph in Y direction.
	Enlarge the graph.
	Narrow the graph.

By clicking 2-axis arc interpolation in the list section, then click 2-axis simulation mode (see below), both 2-axis linear interpolation and arc interpolation are shown on the same simulation graph with a mixture image of both continuous paths.

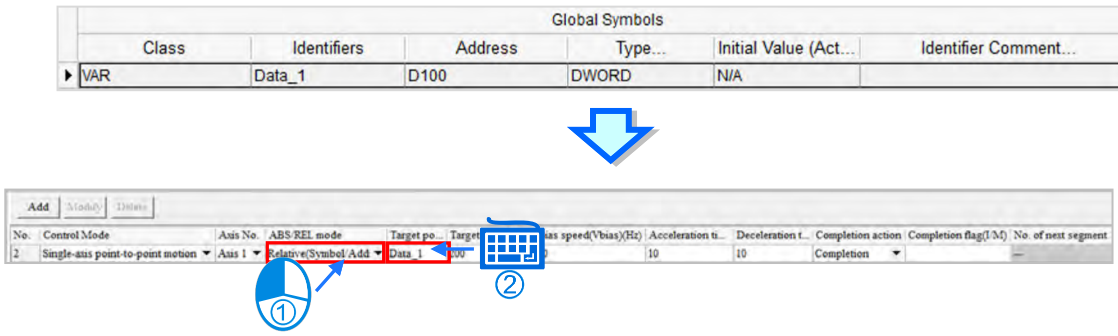


By clicking Single-axis point-to-point motion page, then click single axis simulation mode , the single-axis point-to-point and multi-segment simulation graphs only shows the same mode path. Also, right-click on an empty spot in the single simulation graph window and a pop-up list appears for switching the scroll wheel direction (see below).

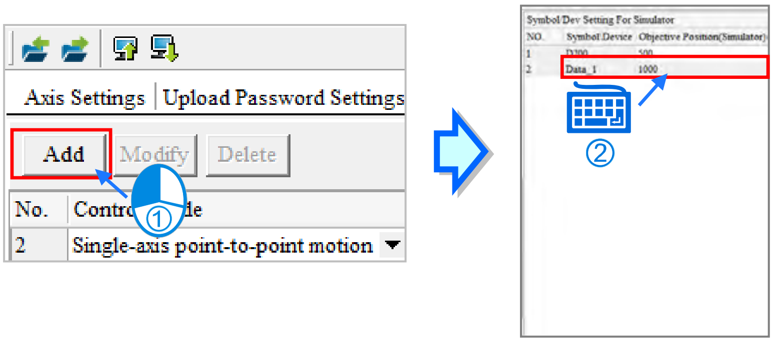


For Target Simulation functions, users need to declare symbols in DWORD or DINT type in global symbols. Then, select either **Absolute (Symbol/Address)** or **Relative (Symbol/Address)** for ABS/REL mode in edit section, and type in symbol or device for Objective position (see below).

⚠ For **Objective position** in the position planning table, the smallest unit is DWORD. So, please be aware that D100 is estimated to occupy the length of D100 and D101.

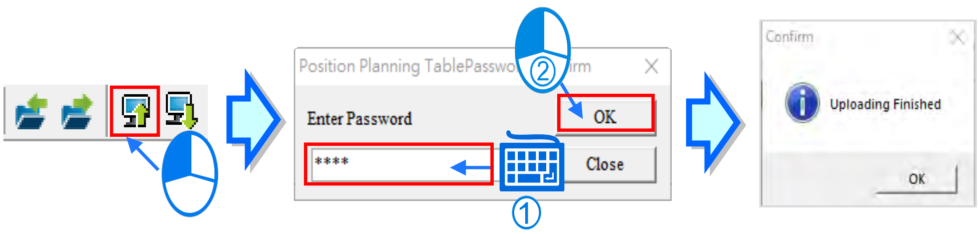


When completed, click **Add** in the target simulation section to automatically add this data. Meanwhile, type a value in Objective Position (Simulator) item list, users can check the simulation path in **Single simulation mode** or **2-Axis simulation mode**.

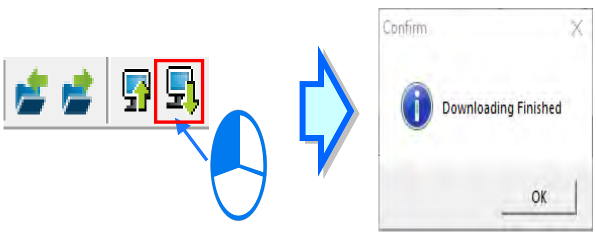


23.1.4 Upload and Download Position Planning Table

When uploading or downloading position planning table, users need to connect ISPSoft to a host and select **Upload** for the position planning table saved in the host. When the table contains upload password protection, a window referring to password appears. Input the correct password to upload the position planning table (see below).



Choose the Download icon for downloading the position planning table to the host.



23.1.5 Control Mode – Single axis point-to-point motion

Description regarding single axis point-to-point mode setting.

No.	Control Mode	Axis No.	ABS/REL mode	Target position	Target speed(Hz)	Bias speed(Vbias)(Hz)	Acceleration time(Tacc)(ms)	Deceleration time(Tdec)(ms)	Completion action	Completion flag(I/M)	No. of next segme
1	Single-axis point-to-point motion	Axis 1	Relative	0	0	0	0	0	Completion		---

- **No.**: The number is generated by the system and the maximum No. is 200.

- **Control Mode:** A motion type. Choose **Single-axis point-to-point motion**.

- **Axis No.:** An axis controlled by the data.

- **ABS/REL mode:**

  Relative Mode increases or decreases based on the current coordinates.

  Absolute Mode increases or decreases based on the absolute coordinates as target position.

  Relative mode (Symbol/Address) increases or decreases based on the current coordinate address, symbol or address are allowed.

  Absolute mode (Symbol/Address) increases or decreases based on the absolute coordinates as target position, symbol or address are allowed.

- **Target position:** Target coordinate. For **ABS/REL mode**, the options include symbol/address.

- **Target speed**: Maximum speed of the target.

- **Bias speed:** The start and ending speed.

- **Acceleration time:** The time to reach target speed.

- **Deceleration time:** The time to reach stop.

- **Completion action:**

  Go to next segment to complete the data and continue to the next.

  Completion refers to an end once data is complete.

- **Completion flag (I/M)**: When the data execution is complete, set the register to ON. The register range is set as M0~M8191 or I510~I519 only when **Completion action** is set to **Completion**.

- **No. of next segment:** Continue with the next data number, not limited to the same assigned axis number. But, take note that the same axis number cannot output more than 2 numbers from the table or output position command at the same time. When **Completion action** is set to **Completion**, the number is automatically continued to the next segment ---

Notice for table input:

1. The target speed cannot be set to 0. The objective position also cannot be set to 0 in the relative mode.
2. I number can be used more than once. Users must determine through which row number the I number can be completely outputted.
3. The instruction which the start table outputs is API2718 TPO. API2719 TPWS can be used to modify the output parameters while PLC is running.

23.1.6 Control Mode – Single axis multi-segment

Description regarding single axis multi-segment mode setting.

No.	Control Mode	Axis No.	ABS/REL mode	Target position	Target speed(Hz)	ACC/DEC time(ms)	Abort signal(I/M)	Completion action	Completion flag(I/M)	No. of next segment
1	Single-axis multi-segment motion	Axis 1	Relative	0	0	0		Go to next segment		2

➢ **No.:** The number is generated by the system and the maximum No. is 200.

➢ **Control Mode:** A motion type. Choose **Single-axis multi-segment motion**.

➢ **Axis No.:** An axis controlled by the data.

➢ **ABS/REL mode:**

Relative Mode increases or decreases based on the current coordinates.

Absolute Mode increases or decreases based on the absolute coordinates as target position.

Relative mode (Symbol/Address) increases or decreases based on the current coordinate address, symbol or address are allowed.

Absolute mode (Symbol/Address) increases or decreases based on the absolute coordinates as target position, symbol or address are allowed.

➢ **Target position:** Target coordinate. For **ABS/REL mode**, the options include symbol/address.

➢ **Target speed:** Maximum speed of the target.

➢ **ACC/DEC time:** The time to reach target speed and stop.

➢ **Abort signal (I/M):** When execution of the table is not yet complete and the register of abort signal is set ON, the next segment of position planning is executed. Users can input I for abort number or M for register bane. For information on supported abort numbers, please refer to related product programming manuals.

- **Completion action:**

  Go to next segment to complete the data and continue to the next.

  Completion refers to an end once data is complete.

- **Completion flag (I/M)**: When the data execution is complete, set the register to ON. The register range is set as M0~M8191 or I510~I519 only when **Completion action** is set to **Completion**.

- **No. of next segment:** Continue with the next data number, not limited to the same assigned axis number. But, take note that the same axis number cannot output more than 2 numbers from the table or output position command at the same time. When **Completion action** is set to **Completion**, the number is automatically continued to the next segment **---**

Notice for table input:

1. The objective position cannot be set to 0 in the relative mode. The objective positions of two adjacent row numbers cannot be set to the same value in the absolute mode.
2. If the value in the ACC/DEC time is not 0, the acceleration/deceleration is fixed to 1ms. If the value in the ACC/DEC time is set to 0, it means there is no acceleration or deceleration.
3. I number can be used more than once. Users must determine through which row number the I number can be completely outputted.
4. The instruction which the start table outputs is API2718 TPO. API2719 TPWS can be used to modify the output parameters while PLC is running.

23.1.7 Control Mode - 2-axis linear interpolation motion

Description regarding 2-axis linear interpolation mode performs the motion on XY plane. Two data are used for this mode.

No.	Control Mode	Coord.	Axis No.	ABS/REL mode	Target position	Target speed(Hz)	ACC/DEC time(ms)	Completion action	Completion flag(I/M)	No. of next segment
1	2-axis linear interpolation	X	Axis 1	Relative	0	0	0	Completion		---
T1		Y	Axis 2		0					

- **No.**：The number is generated by the system, the 2-axis mode occupies two data. The second data No. will add a T in front of the number. Under 2-axis mode, the maximum No. is 100 and T100, a total of 100 set.

- **Control Mode:** A motion type. Choose **2-axis linear interpolation motion**.

- **Coord:** The X or Y coordinates in the simulation graph.

- **Axis No.:** An axis controlled by the data.

- **ABS/REL mode:**

  Relative Mode increases or decreases based on the current coordinates.

  Absolute Mode increases or decreases based on the absolute coordinates as target position.

  Relative mode (Symbol/Address) increases or decreases based on the current coordinate address, symbol or address are allowed.

  Absolute mode (Symbol/Address) increases or decreases based on the absolute coordinates as target position, symbol or address are allowed.

- **Target position:** Target coordinate. For **ABS/REL mode**, the options include symbol/address.

- **Target speed：** Maximum speed of the target.

- **ACC/DEC time:** The time to reach target speed and stop.

- **Completion action:**

  Go to next segment to complete the data and continue to the next.

  Completion refers to an end once data is complete.

- **Completion flag (I/M)**: When the data execution is complete, set the register to ON. The register range is set as M0~M8191 or I510~I519 only when **Completion action** is set to **Completion**.

- **No. of next segment:** Continue with the next data number, not limited to the same assigned axis number. But, take note that the same axis number cannot output more than 2 numbers from the table or output position command at the same time. When **Completion action** is set to **Completion**, the number is automatically continued to the next segment **---**

Notice for table input:

1. The PLC will automatically run at the set speed when the target speed or the Acc\Dec time is set to 0. The objective position cannot be set to 0 in the relative mode. The objective positions of two adjacent row numbers cannot be set to the same value in the absolute mode.

2. I number can be used more than once. Users must determine through which row number the I number can be completely outputted.

3. The instruction which the start table outputs is API2718 TPO. API2720 TPWL can be used to modify the output parameters while PLC is running.

23.1.8 Control Mode - 2-axis Arc Interpolation Motion

Description regarding 2-axis arc interpolation mode performs the motion on XY plane. Two data are used for this mode.

No.	Control Mode	Coord.	Axis No.	ABS/REL mode	Target position	Tangential speed(Hz)	Center shift value	Direction	Completion action	Completion flag(I/M)	No. of next segment
1	2-axis arc interpolation	X	Axis 1	Relative	0	0	0	CW	Completion		---
T1		Y	Axis 2		0						

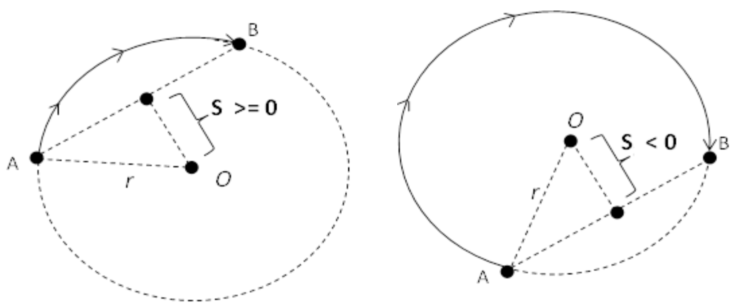
- **No.：** The number is generated by the system, the 2-axis mode occupies two data. The second data No. will add a T in front of the number. Under 2-axis mode, the maximum No. is 100 and T100, a total of 100 set.
- **Control Mode:** A motion type. Choose **2-axis arc interpolation motion**.
- **Coord:** The X or Y coordinates in the simulation graph.
- **Axis No.:** An axis controlled by the data.
- **ABS/REL mode:**

  Relative Mode increases or decreases based on the current coordinates.

  Absolute Mode increases or decreases based on the absolute coordinates as target position.

  Relative mode (Symbol/Address) increases or decreases based on the current coordinate address, symbol or address are allowed.

  Absolute mode (Symbol/Address) increases or decreases based on the absolute coordinates as target position, symbol or address are allowed.
- **Target position:** Target coordinate. For **ABS/REL mode**, the options include symbol/address.
- **Tangential speed (Hz):** Movement in a circular path in three dimensions and the magnitude of that vector is the tangential speed.
- **Center shift value:** The distance from the center of the line between the arc target point and start point to the center of a circle, such as S in the following figures. From point A to point B, a clockwise rotation will generate an arc less than 180° if S>0 and an arc more than 180° if S<0.



- **Direction:** Users can select **CW** clockwise motion or **CCW** counter clockwise motion.

- **Completion action:**

  Go to next segment to complete the data and continue to the next.

  Completion refers to an end once data is complete.

- **Completion flag (I/M)**: When the data execution is complete, set the register to ON. The register range is set as M0~M8191 or I510~I519 only when **Completion action** is set to **Completion**.

- **No. of next segment:** Continue with the next data number, not limited to the same assigned axis number. But, take note that the same axis number cannot output more than 2 numbers from the table or output position command at the same time. When **Completion action** is set to **Completion**, the number is automatically continued to the next segment **---**

Notice for table input:

1. The PLC automatically calculates the output speed in this function. The objective position cannot be set to 0 in the relative mode. The objective positions of two adjacent row numbers cannot be set to the same value in the absolute mode.

2. I number can be used more than once. Users must determine through which row number the I number can be completely outputted.

3. The instruction which the start table outputs is API2718 TPO. API2721 TPWL can be used to modify the output parameters while PLC is running.

23.2 Data Tracer

23.2.1 About Data Tracer

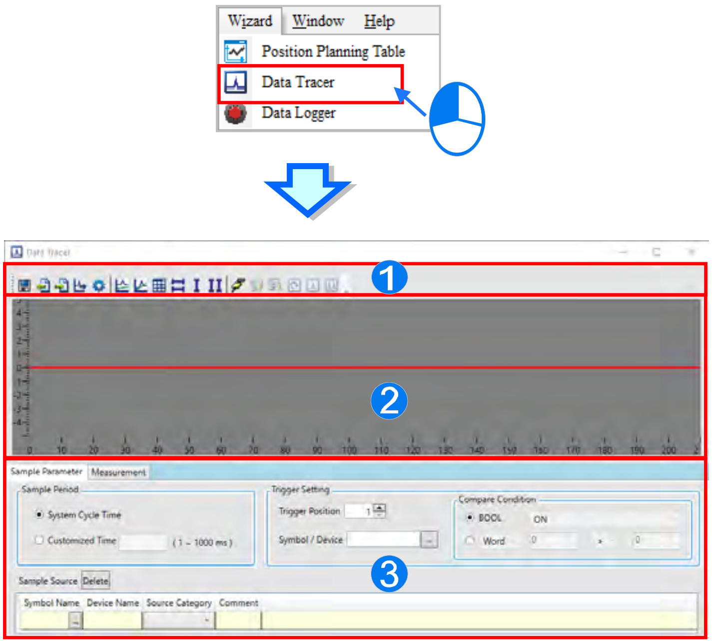
Data Tracer is used once a triggering condition is reached to collect real-time symbol variables or status and using waveform graphs to analyze the value trends. A new generation of DIA data tracer gives a brand new user interface with a better integration, which makes it faster and easier to complete the operation and settings.

SW \ Models	AS	AH5x1	AHxxEMC	AS5xx DVPxxMC
Data tracer	V	V	V	
DIA data tracer			V (Note 1)	V

Note 1: Go to **Toolbar > Tools > Option > Default Setting** and the data tracer item can be seen, then select **Enable SyncMode** and click OK. Thereafter, you are able to open DIA data tracer generally by selecting **DIA Data Tracer** from **Wizard**.

23.2.2 Opening the Data Tracer Window

Please compile the current project before using the function. Click **Wizard > Data Tracer** on the tool bar to open the **Data Tracer** setup window as the image shown below.



❶ Icon toolbar: Provides functions in icons and explanation below.

❷ Waveform display area: Displays real-time symbol variables or waveform of the device.

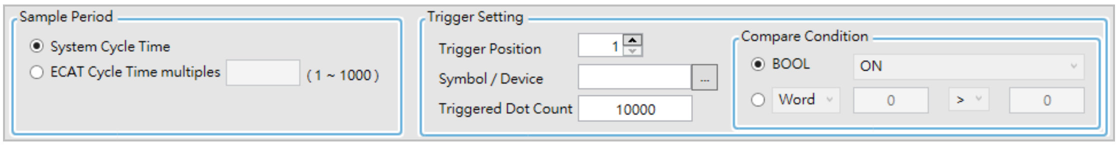
❸ Parameter setting area: Sample Parameter page is for setting the sample source and trigger condition. Measurement page is for displaying the values and adjusted waveform colors and proportions through measuring equipment.

Explanation of icon toolbar:

Icon	Name	Function
	Save All	The sample settings and curve data results are saved to the specified path.
	Export Sampling Config	The sample settings are exported to the specified path.
	Import Sampling Config	The sample settings are imported from the specified path.
	Export Curve Data	The sample curve data are exported in the format of.bmp and .csv to the specified path.
	Configuration	The colors of curves in the data tracer and environment can be set.
	Separate Curves	Multiple curves are separated automatically.
	Overlap Curves	Multiple curves are overlapped with the center line.
	Show Grid Line	Show or Hide the grid line.
	Horizontal Measuring Lines	There will be two horizontal lines in the curve display area for users to measure the curve.
	Vertical Measuring Lines	There will be one vertical line in the curve display area for users to measure the curve.
	Vertical Measuring Lines	There will be two vertical lines in the curve display area for users to measure the curve.
	Connect/Disconnect	Connect or disconnect the PC and PLC.
	Upload Sampling	The sample settings in the data tracer are read from the PLC.
	Download Sampling Config to PLC	The sample settings in the data tracer are written to the PLC.
	Real Time Monitor	The PC reads the curve of the source from the PLC in real time.
	One-Shot Trigger	After the trigger condition is met, a total 200 points of curve data, including pre- and post- of the triggered point will be read from the PLC.
	Continuous Trigger	Whenever the trigger condition is met, a total 200 points of curve data, including pre- and post- of the triggered point will be read from the PLC.

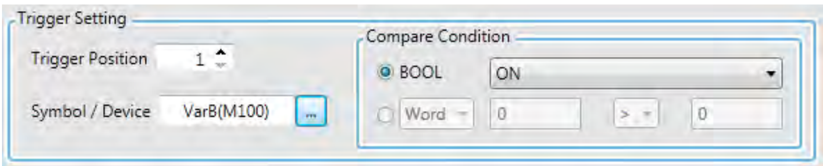
23.2.3 Sample Parameter Settings

For sample setting page, the following chart shows that the items may differ based on different PLC types. The **Sample Period** is for setting sample time period. While **Trigger Setting** is for trigger position and condition settings. When trigger condition is reached, the host maintains a total of 200 data and reflected in the Waveform area.



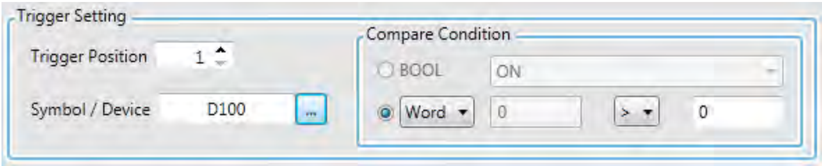
Name	Desc	AS	AHxxEMC	AH5x1
System Cycle Time	Host scan time	V	V	V
ECAT Cycle Time	ECAT scan cycle		Max. 1000	
User-defined Time	User-defined time	Max.1000		Max.1000
Trigger Position	Triggering position	Max. 200	Max. 10000	Max. 200
Symbol/Device	Triggering device/ symbol	Supports Global Symbol	Supports Global Symbol, Local Symbol, Axis Symbol, ECAT	Supports Global Symbol
Triggered Points	Max. value for trigger position		Max. 10000	

When selecting symbol variables or device in BOOL for Symbol/Device column, the compare condition will auto-select BOOL (see below). Or choose **ON, OFF, rising edge-triggered, falling edge-triggered, rising or falling edge-triggered** from the drop-down list. When the symbol or device fulfills the setting condition, the trigger will show on the data tracer.

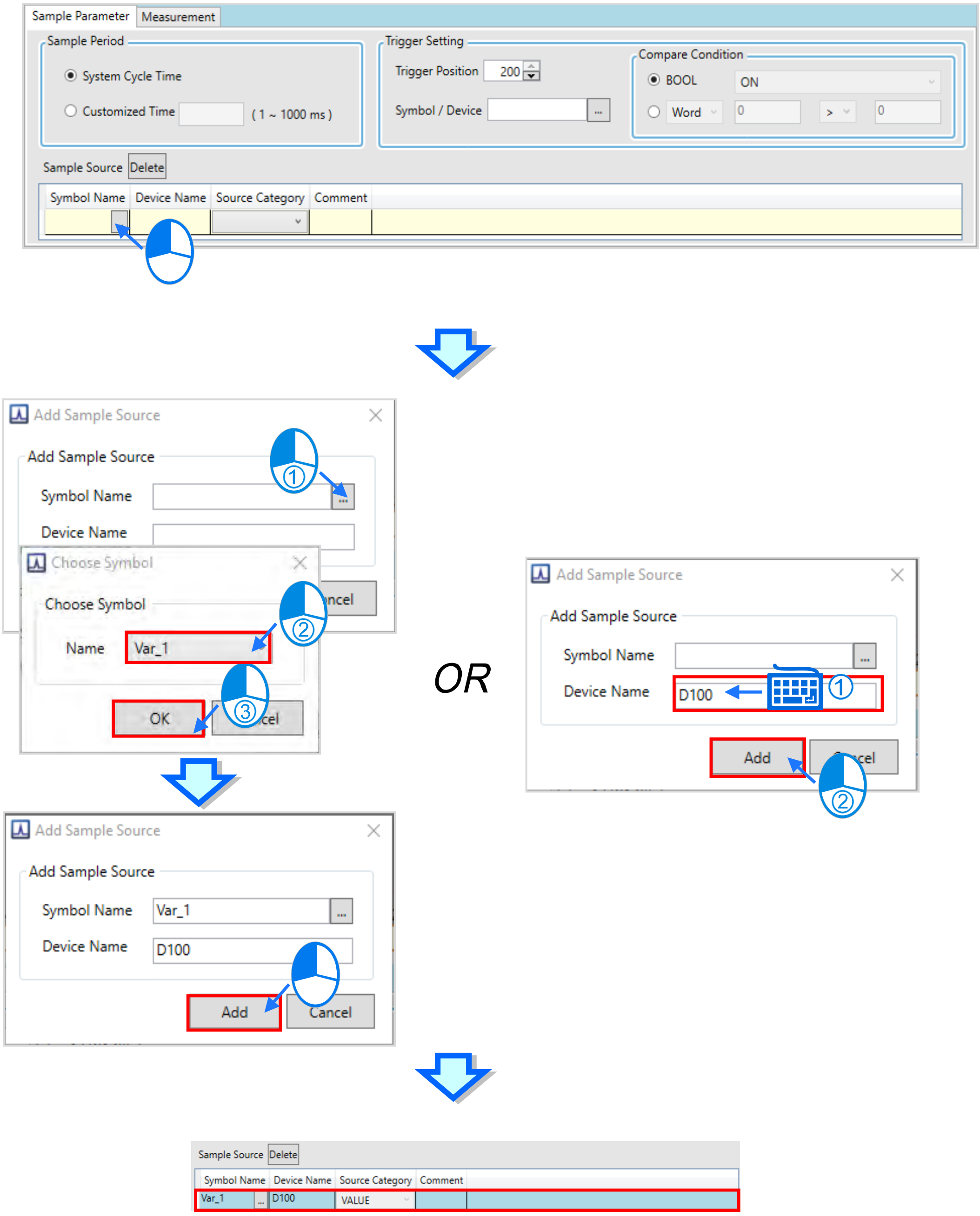


When choosing Word, DWord or Real as symbol variables or devices for Symbol/Device column, the system auto-selects Word (see below) or select DWord or Real from the drop-down list and select conditions by choosing >, <, =, != (not equal), ~ (a range) or !~ (out of a range) together with the numbers in front and back of the setting. When the setting symbol or device fulfills the condition, the trigger is shown on the data tracer.

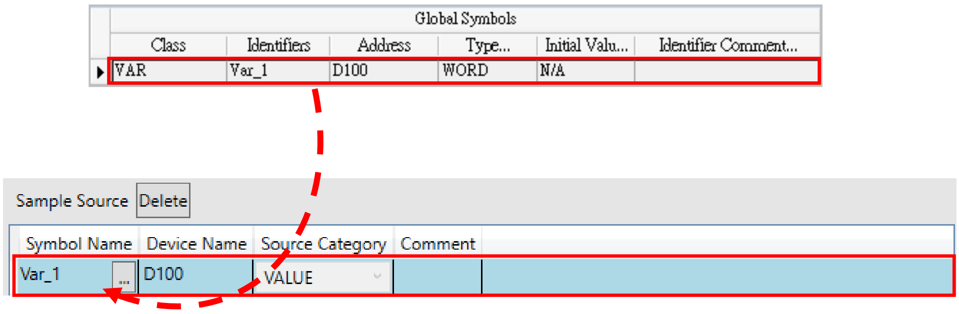
The following image shows value in D100 is 0 > 0 and fulfills trigger condition; when setting is 10 **!~** 100, this means D100 is no more than 10 or exceeds 100 to fulfill trigger condition.



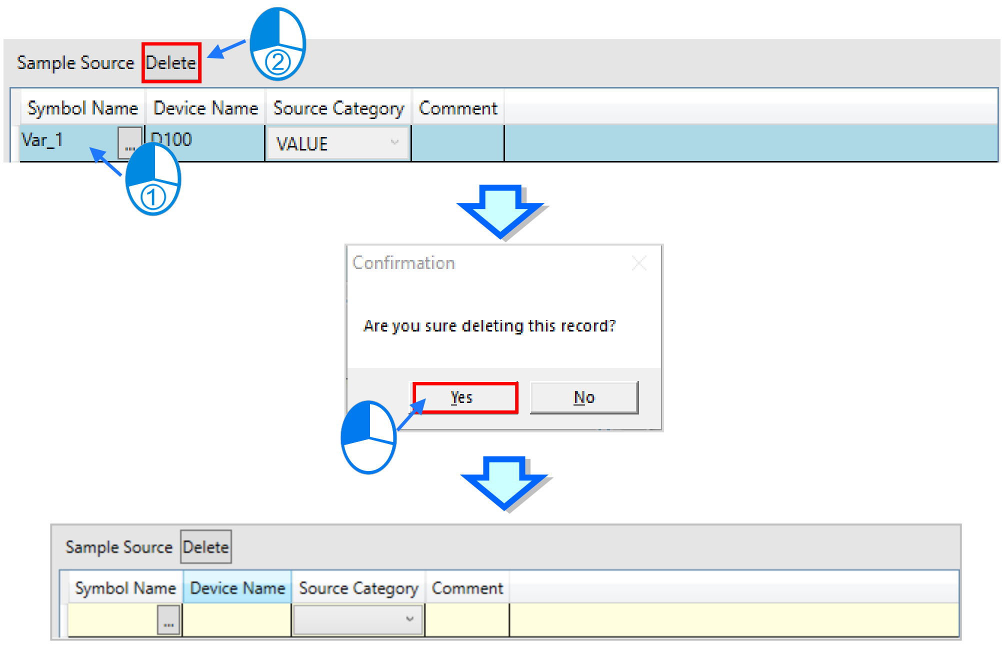
To add sample symbols, click button in Symbol Name and a pop-up Add Sample Source window appears. Then click the button to select the added symbol variables or type the device name in the window and click **Add** to the sample source list (see below).



Symbols that are declared in global symbols and compiled in projects, are selected here. Manual device settings or identifier comments are also included.



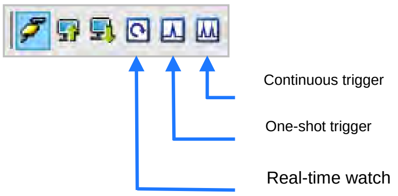
To delete the sample source which has been added, select the deleted item and click **Delete**.



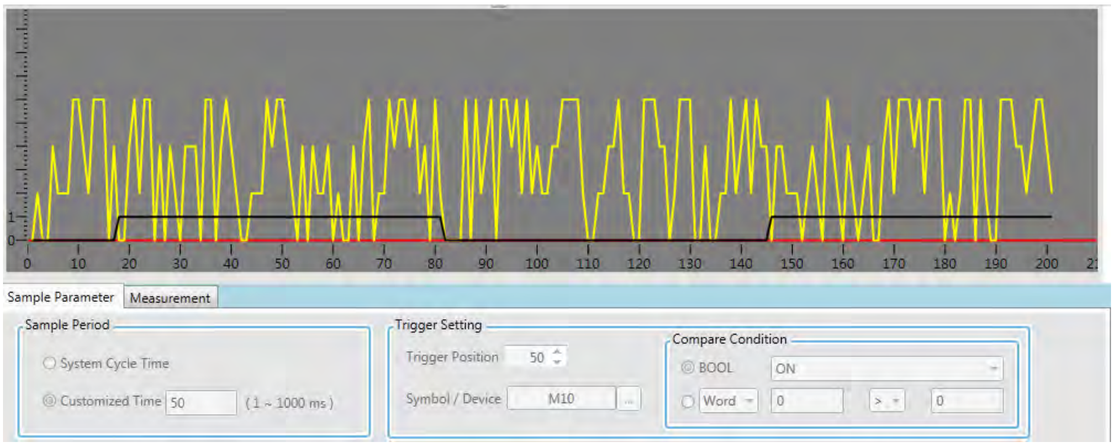
When sample parameter settings are complete, click **Export** or from the icon toolbar and save the sample parameter settings in .dtr format. Then, users can choose **Import** or to restore sample parameter settings in new projects.

23.2.4 Sampling Modes

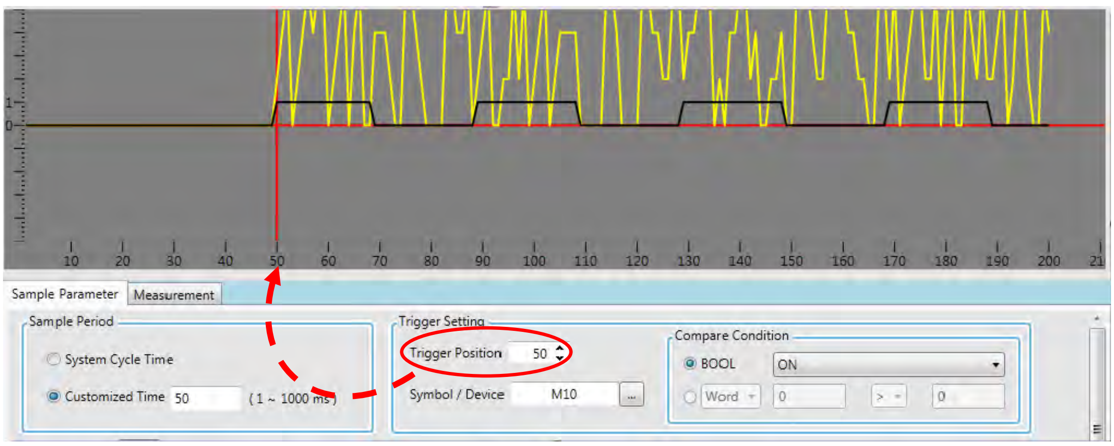
When sample parameter setting for data tracer is complete, download parameter setting during connection mode  and use the icon toolbar to switch and view the waveforms from the following three modes.



- Real-time watch: According to the set sample period, the curves for variable symbol or device value or state in the sample source are constantly drawn to the data tracer. The curve chart will keep the latest 200 pieces of data while moving leftward.

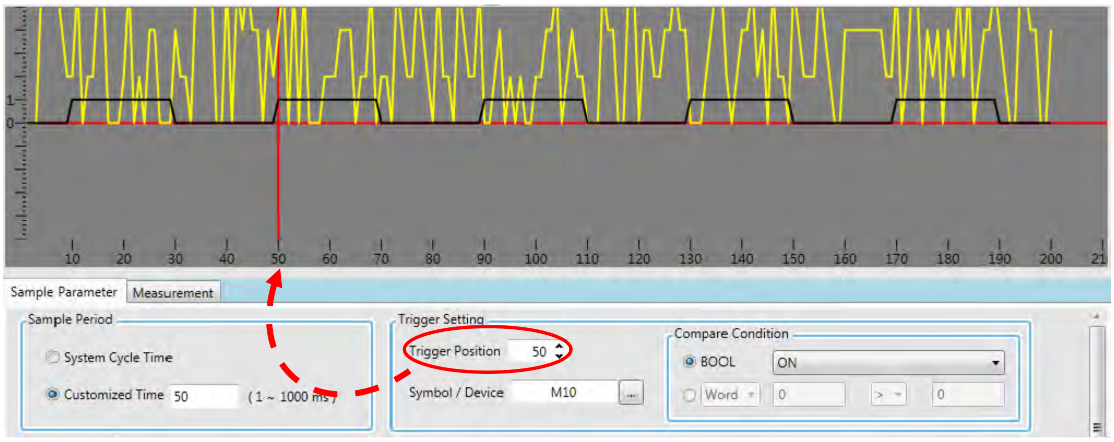


- One-shot trigger: According to the trigger position setting, the sample data to the right of the trigger position will be displayed in waveforms when the trigger condition is met and the trigger is done once only. The following diagram shows that the trigger position is set to 50. When trigger condition M10 is ON, the sample source drawing ranges from 50~200 based on sample period. The following red vertical line represents the trigger position in the waveform.



- Continuous trigger: The data tracer will keep the state of constant reading according to the trigger position setting. The sample data of the pre- and post- triggered points will be displayed in the data tracer whenever the trigger condition is met.

  To view the curve chart, the state of the continuous trigger button must be restored from OFF to ON. As the following example shows the trigger position is set to 50 and thus the curves for the sample source according to the sample period setting will be drawn 200 pieces including 49 pieces of the pre-triggered points and 150 pieces of the post-triggered points whenever the trigger condition M10=ON is met. Where the red vertical line is represents the trigger position in the wave shape chart.



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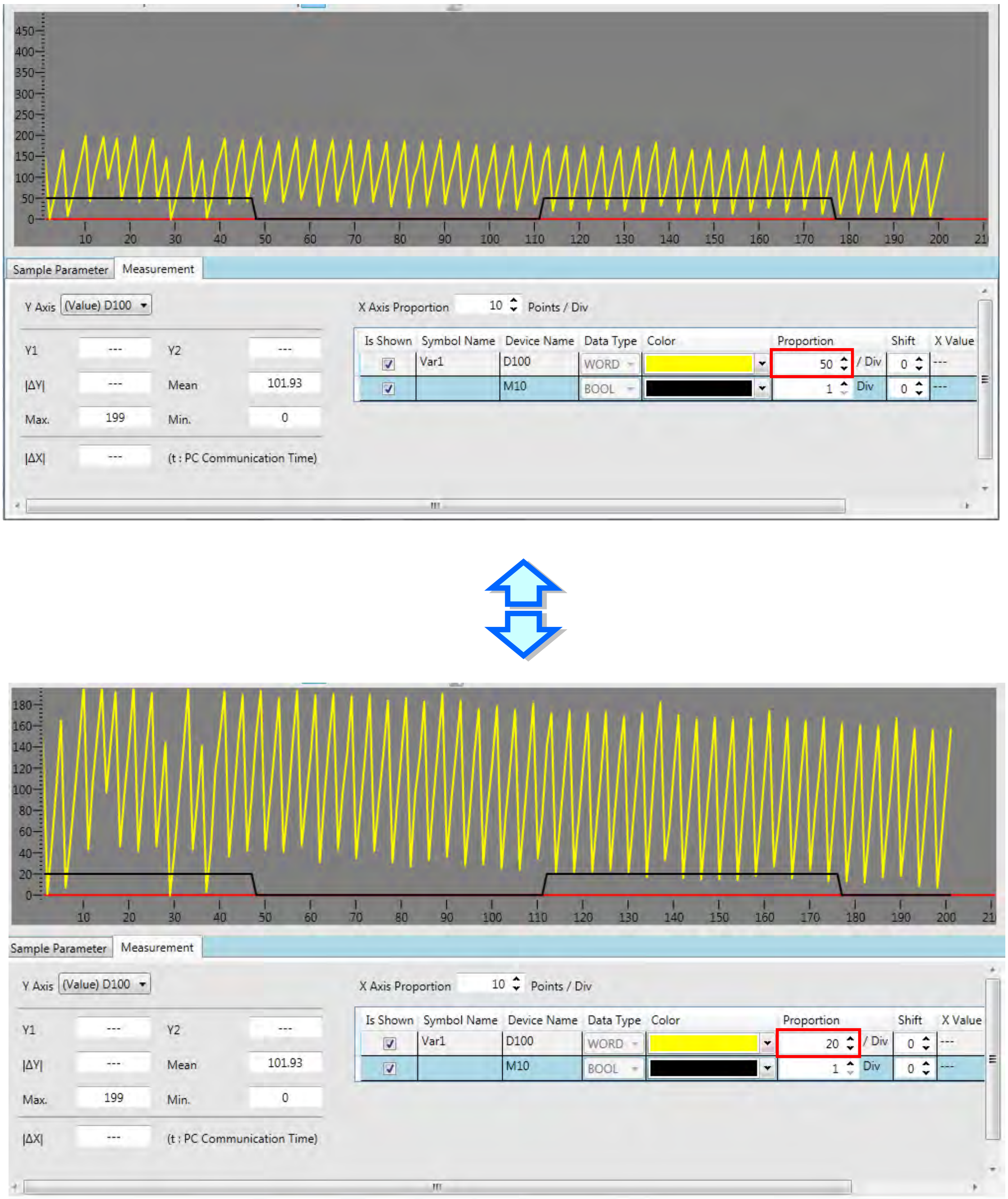
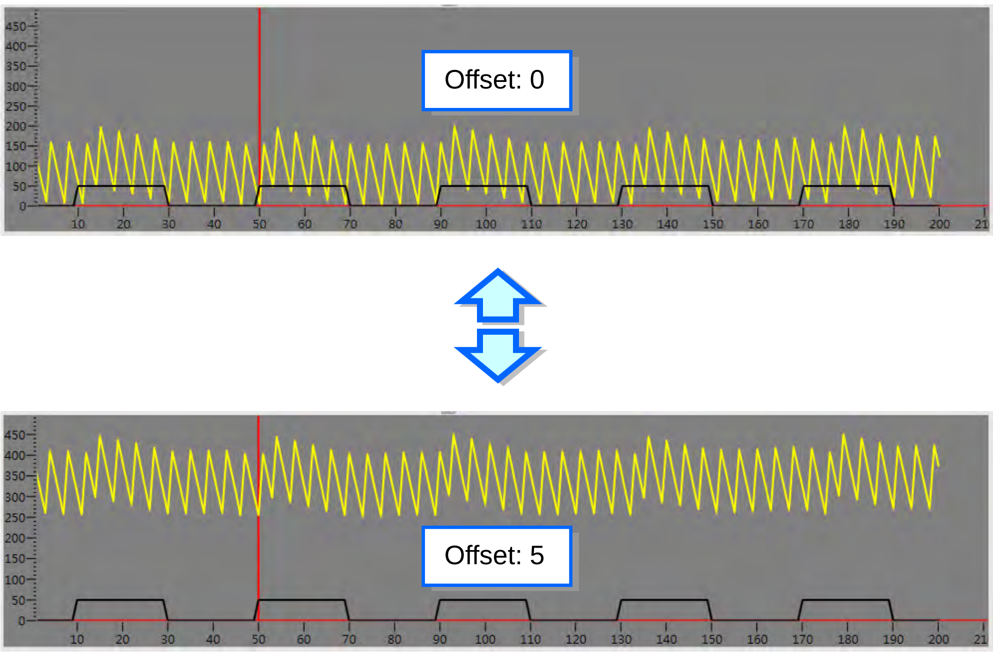
23.2.5 Measurement

In **Measurement**, the page provides adjustment regarding the waveform shape of the data tracer for enhanced display effect. The following image shows the points of each scale in adjusting the horizontal coordinate for **X Axis Proportion** modification.

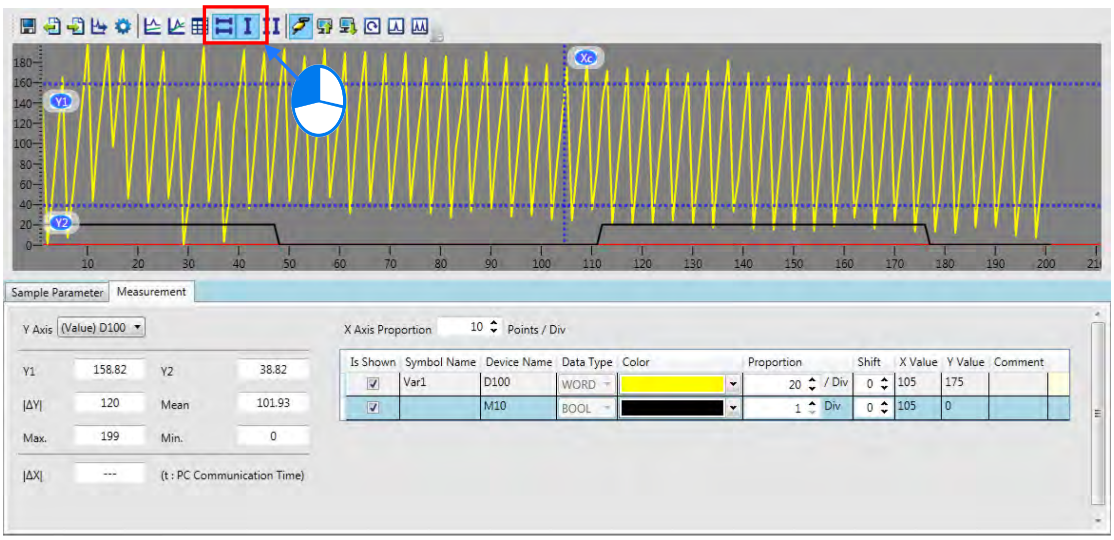
In Measurement, the page offers the values of mean, maximum and minimum regarding waveform information of selected device in Y axis. Each waveform has different color, proportion and shift settings. The **Proportion** refers to the proportion of vertical coordinate and the following diagram shows proportion of each scale set in 50 and 20 for comparison.



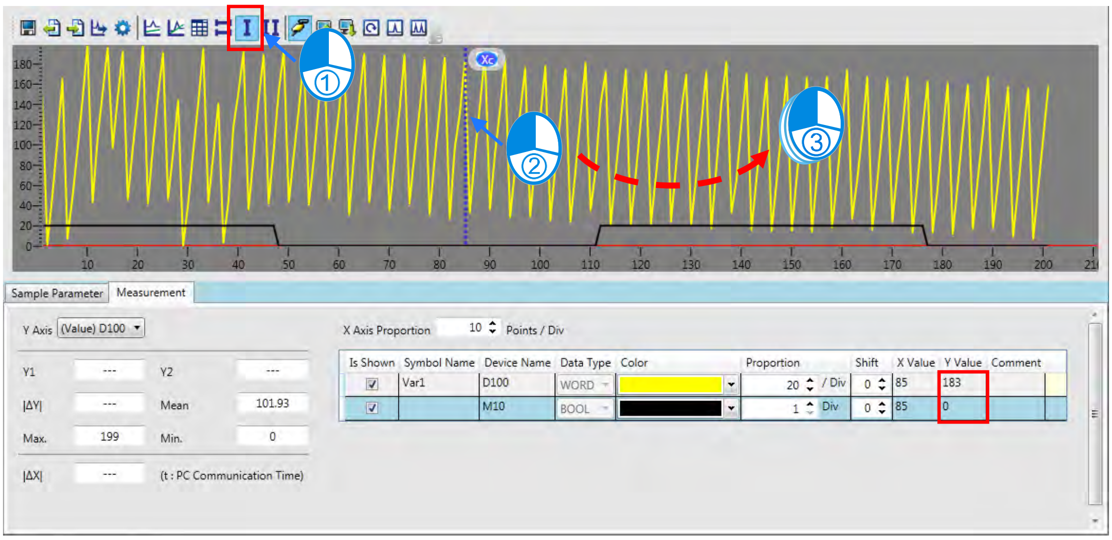
Shift can be set to modify the position of the curve in the display as shown in the following figures.



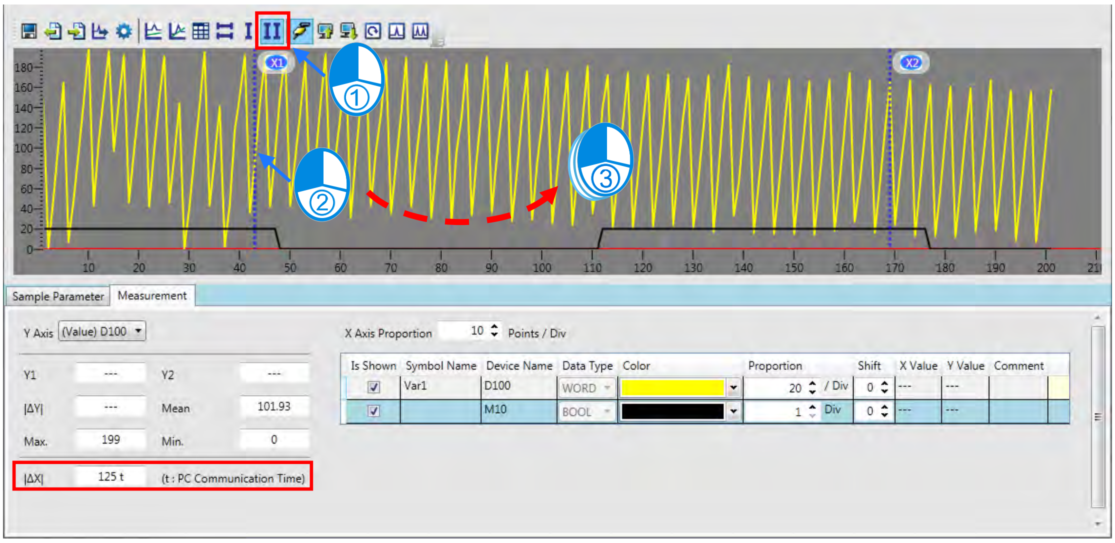
Drag the two horizontal measuring lines Y1 and Y2 and adjust to the measured position together with horizontal measuring lines. The parameter setting area displays every value regarding horizontal measuring lines. The Y1 value refers to Y1 column, Y2 value refers to Y2 column and differences between Y1 and Y2 refers to **I Δ Y I column.**



Drag the vertical measuring line Xc to match with other vertical measuring lines. The Y value column below shows an intersected corresponding value regarding each sample resource and measuring line Xc.

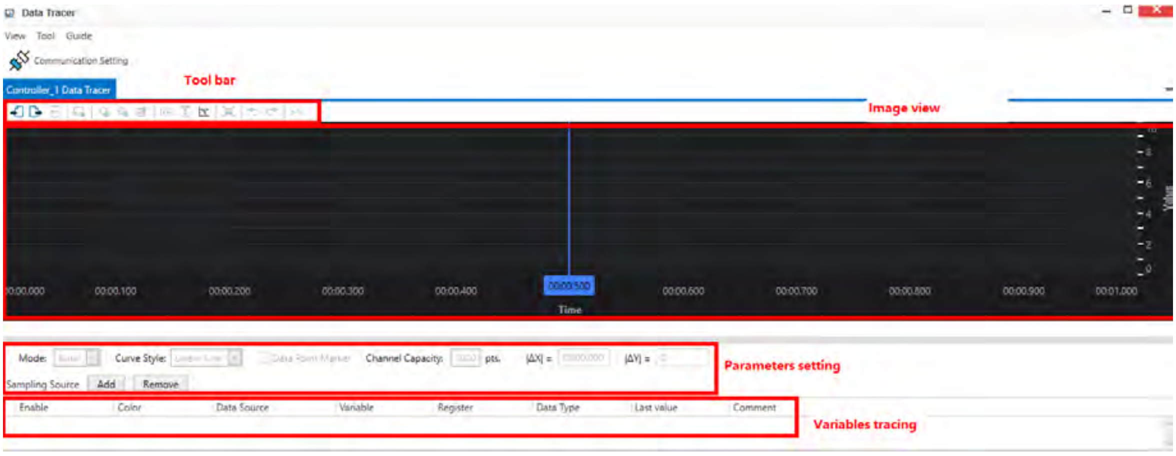


The following diagram measures the time value of data tracer by matching two vertical measuring lines. Click **II** from the toolbar to start the two vertical measuring lines and use the mouse to drag the two vertical lines, X1 and X2 in adjusting to the measured position. Time value is shown in the following **I** Δ **X1** column. (t value: the communication time between a PC and PLC)



23.2.6 DIA Data Tracer

After opening Data Tracer, the default interface would display Toolbar, Image view, Parameter setting and Variable tracing as the following shown.



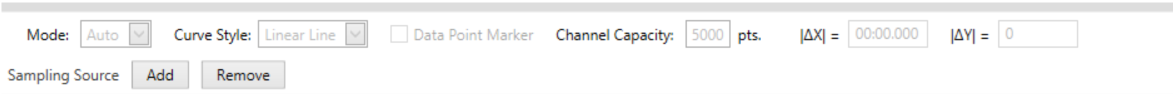
- **Toolbar**

You can perform the following operations with the toolbar as described below.

Icon	Feature
	Open the file
	Save the file
	Export
	Screenshot
	Start data trace
	Stop data trace
	Clear the screen
	Vertical measuring line
	Horizontal measuring line
	Center the measuring line
	Fit size
	Recover
	Undo
	Analyze

- **Parameter Setting**

The following parameters can be set in this area. Some particular parameters would only need to be configured under certain tracing modes, which are detailed in the description of tracing modes.



❶ **Mode:** Three tracing modes are supported by DIA data tracer, which are respectively Auto, Sync and Trigger.

❷ **Curve Style:** Two curve styles are supported by DIA data tracer, which are respectively linear line and digital line. The former uses linear interpolation to construct data points; the latter connects data points in ladder style.

❸ **Data Point Marker:** By checking the checkbox, data points would be displayed on the tracking image.

❹ **Channel Capacity:** As more of the number of data points displayed on the image, more data the tracing image has, which causes longer waiting time to display the image. Under Auto mode, the max capacity would be 100000. The max capacity is 1000000 in Sync mode.

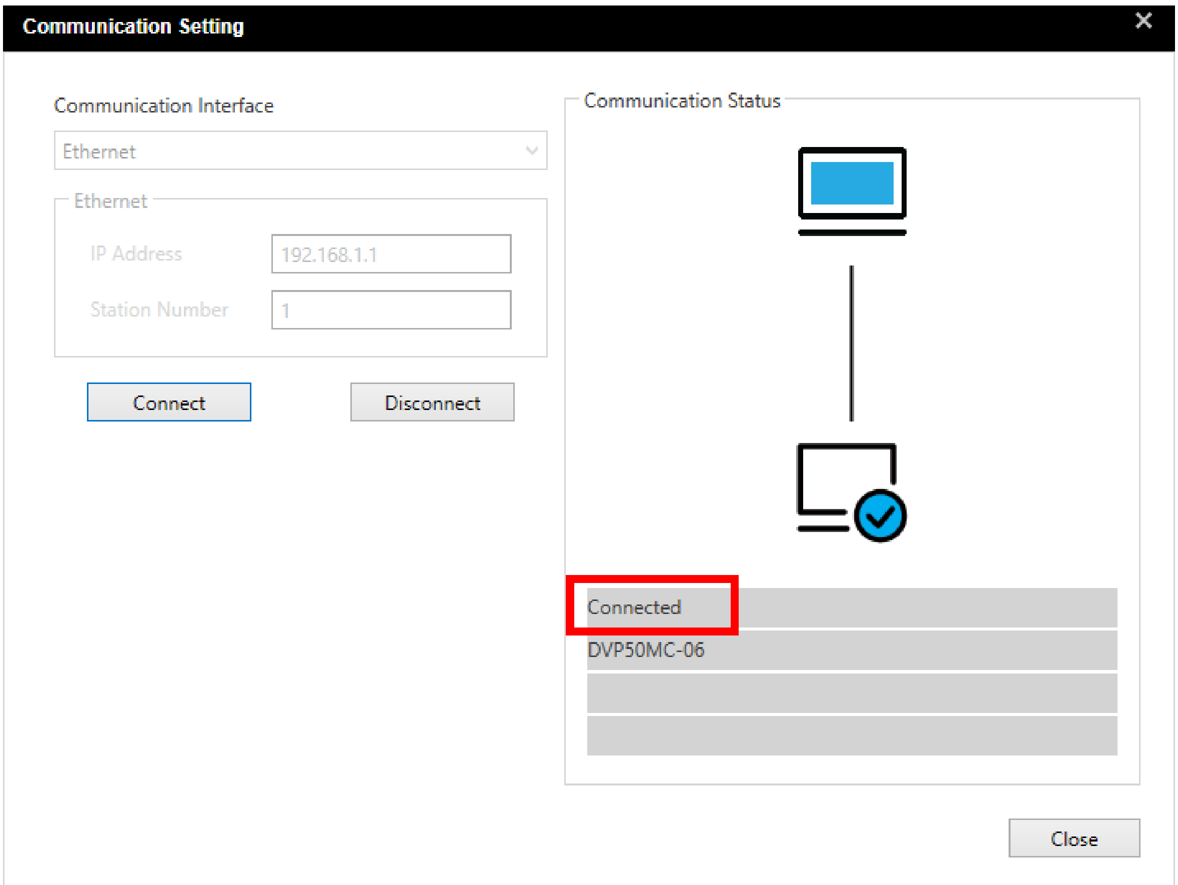
❺ **|△X|：** Differentials of vertical measurement.

❻ **|△Y|：** Differentials of horizontal measurement.

- **Operating the data tracer**

➢ Communication Setting

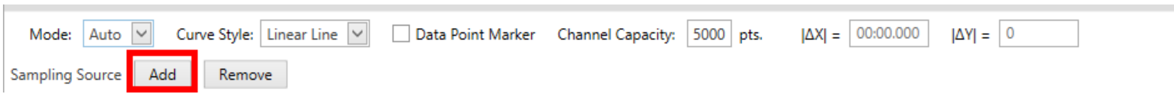
Click “Communication Setting” on the toolbar and the setting page would be displayed. Please make sure the communication is successfully connected before performing variable tracing as shown below.



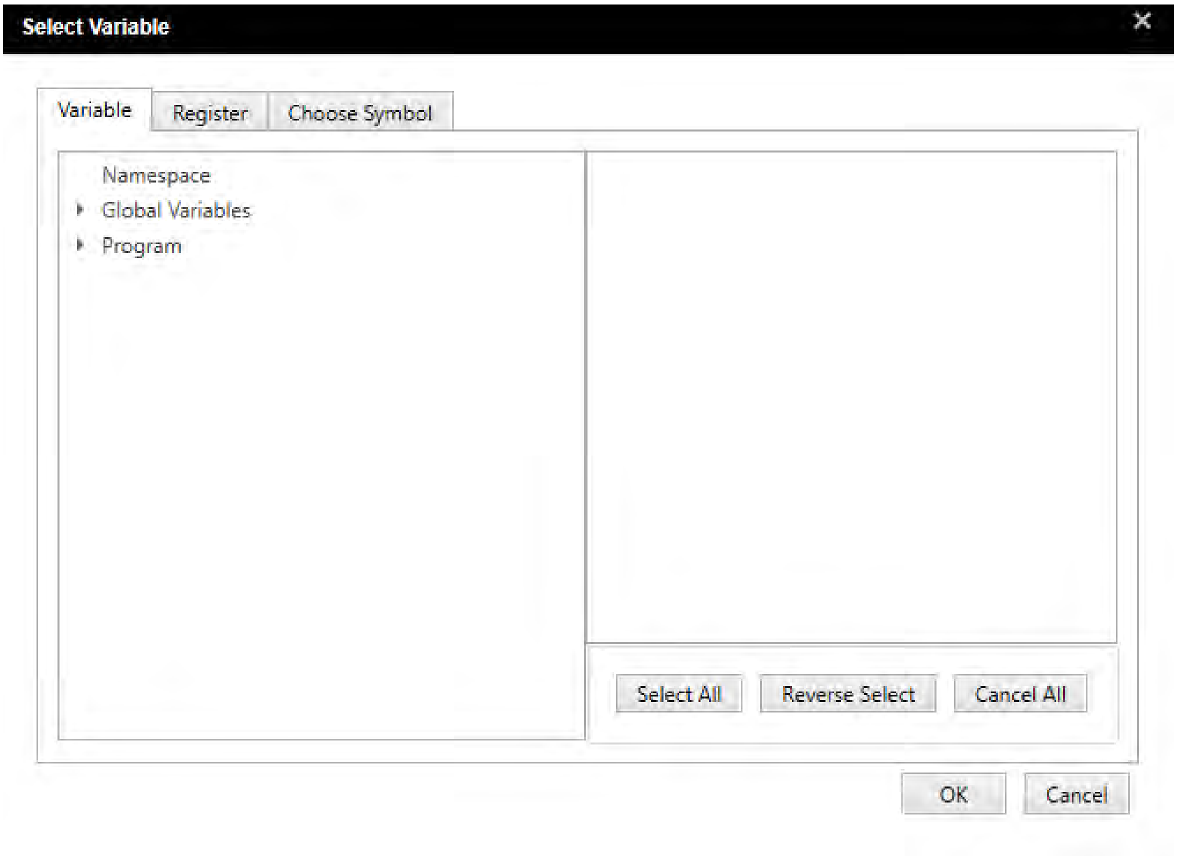
When Data Tracer is opened, it would create connection to controllers automatically. If the connection status does not show as "**Connected**", please check the Ethernet cable. The communication interface should be set as **Ethernet**, while IP address is the IP address of the controller. After confirmation, click "**Connect**".

- Add new trace variables

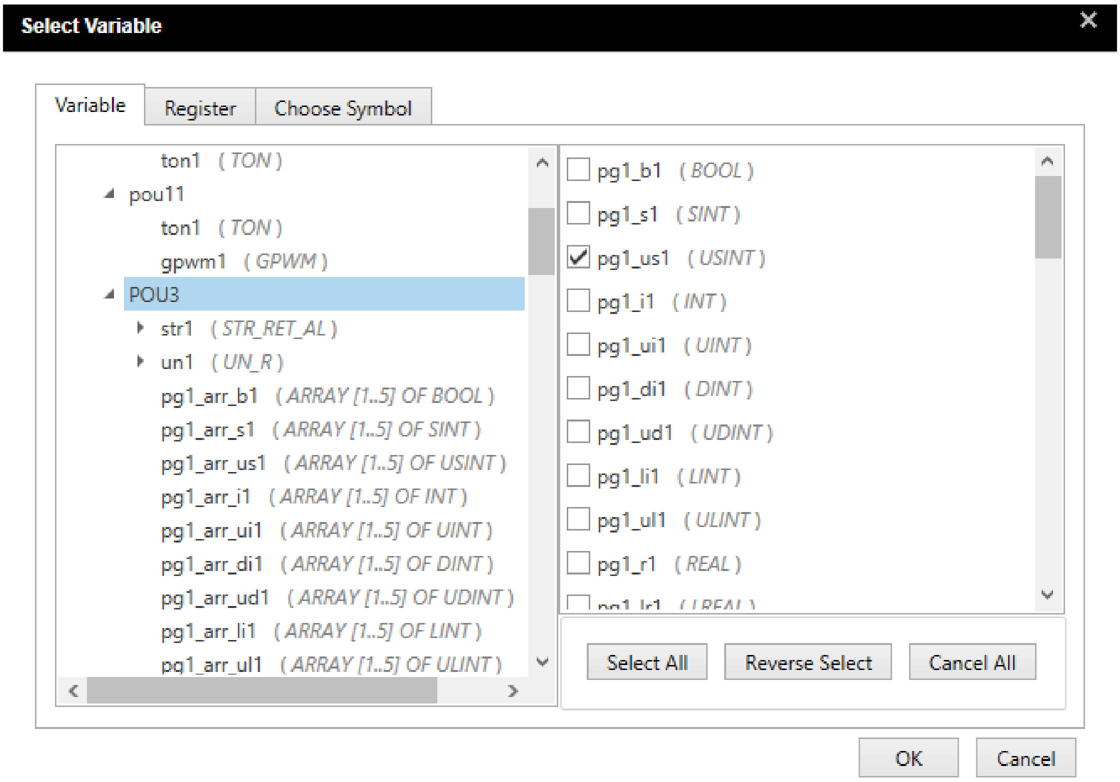
Click the "Add" button of sampling source as shown below.



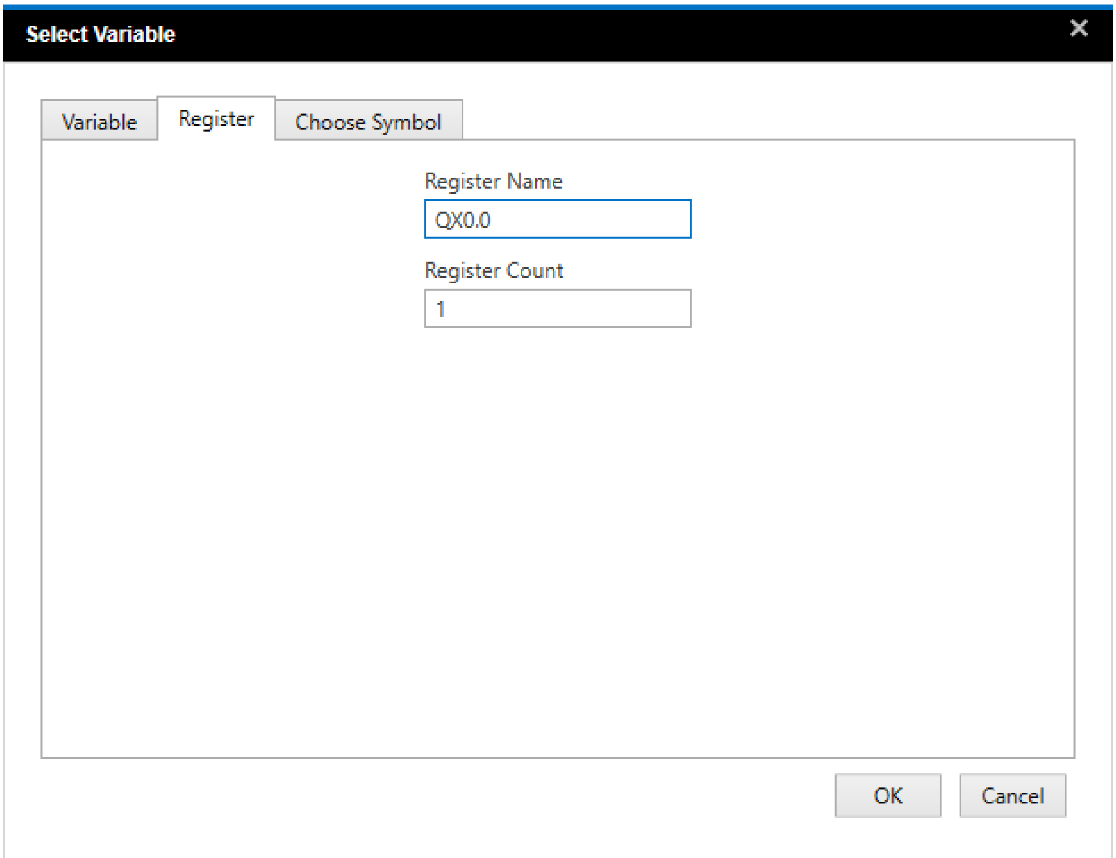
Then Select Variable window pops up with three add methods (Variable, Register, Choose Symbol).



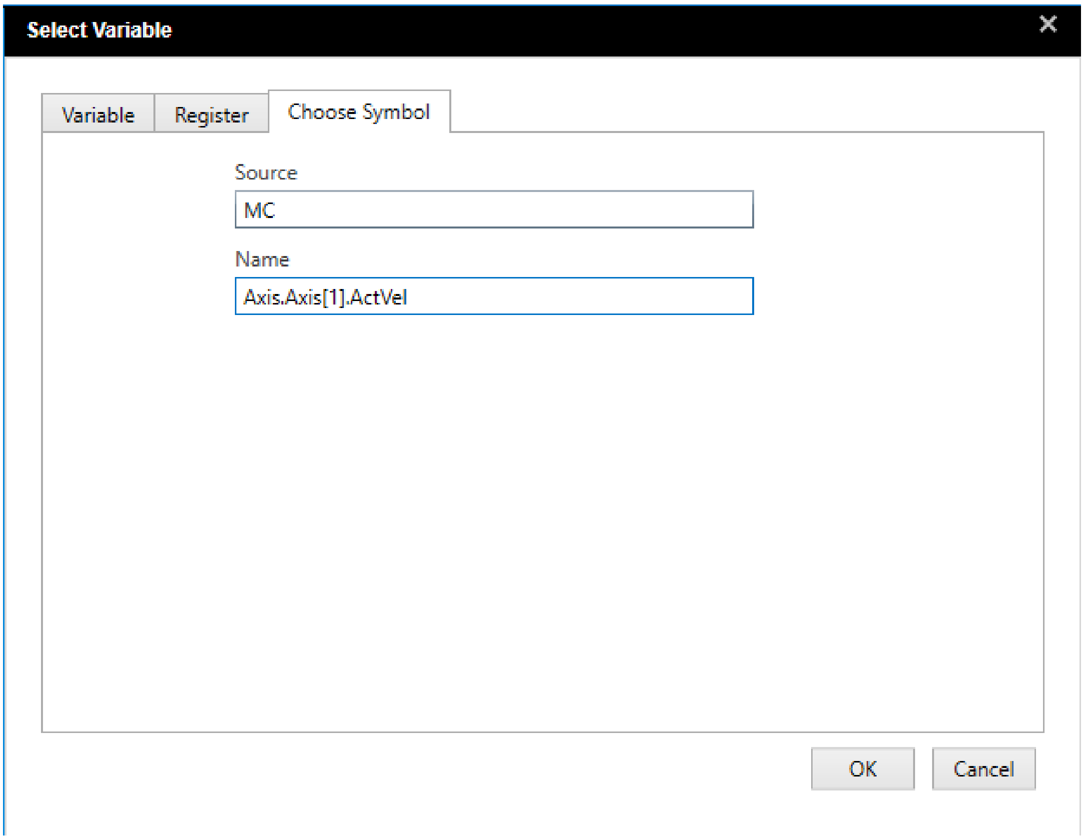
Select the desired variables from global and local variables by clicking the triangle icon to expand the options. Check the checkbox of variables to trace and click "OK" to complete as shown below.



To select the desired register, enter the name of the device to trace in the field of Register Name and input the number of the devices for Register Count. Then click “OK” to complete.



If selecting "**Choose Symbol**", you need to input the specific name and source of the variable, then click "**OK**" to finish. Or you can click on "**Source**" and hit the Down key to display all the variable sources, then select the desired source and hit the Enter key. Continue to click on "**Name**" and hit the Down key to expand the first layer of the reminder, then hit the right navigation key to expand more until you find the desired variable to trace and hit the Enter key.



- **Remove variables:** Select the variables to remove and click **Remove** button in parameter setting.
- **Start data tracing:** Click the start tracing button in the toolbar to start data tracing.
- **Stop data tracing:** Click the stop tracing button in the toolbar to stop data tracing
- **Auto-resize image:** Click the fit size button in the toolbar to auto adjust the image size.
- **Zoom in and out:** Click and hold the left mouse button to choose the target area, then scroll the wheel of the mouse to zoom in and out on the current position.
- **Pan tracing image:** Click and hold the right mouse button while dragging to pan the image.
- **Tracing image measurement:**

  <u>Cursor display</u>: Click the Centered measuring line button to locate a vertical line in the center of the image which displays the current values of the trace variables.

  <u>Vertical measurement</u>: Click the vertical measuring line button to display a pair of vertical lines on the tracing image, which can be dragged to the target position for measurement. And the differential would be displayed in the field of **|△X|** in parameter setting.

<u>Horizontal measurement</u>: Click the horizontal measuring line button to display a pair of horizontal lines on the tracing image, which can be dragged to the target position for measurement. And the differential would be displayed in the field of **|△Y|** in parameter setting.

- **Save the file:** Click the save button in the toolbar to save the tracing image.
- **Open the file:** Click the open button in the toolbar to open up the previously saved tracing image.
- **Display or hide the data points on the tracing image:** Check or uncheck the checkbox of Data Point Marker in Parameter setting.

- **Tracing mode**

With three supported tracing modes, you can set the **Mode** in Parameter setting among the options of Auto, Sync and Trigger.

- **Auto**

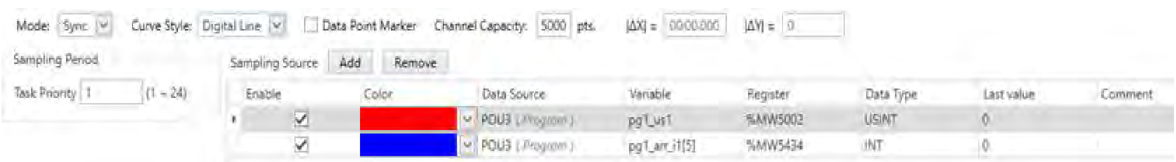
In Auto mode, values of traced variables in the controller would be read periodically based on the performance of the computer, while the values read in each period would not be displayed entirely on the image. Hence, this mode would be applied only to display the trend of trace variables with a maximum of 20 variables being traced at the same time.

- **Sync**

Base on the setting of **Task Priority** to periodically read values of traced variables in the controller. Therefore, all variable values traced and read in each period can be displayed in Sync mode with a maximum of 4 variables being traced at the same time.

The required parameter settings shown in the following figure are detailed in the description of Parameter setting, which are **Mode**, **Curve Style**, **Data Point Marker**, **Channel Capacity**, **|△X|**, and **|△Y|**. Here only introduces certain parameters in Sync mode.

The settings for **Task Priority** should be same as the setting in ISPSoft. For example, if the parameter is set to be 1, the sampling period of data tracer would be same as the period of the task with 1st priority in ISPSoft.



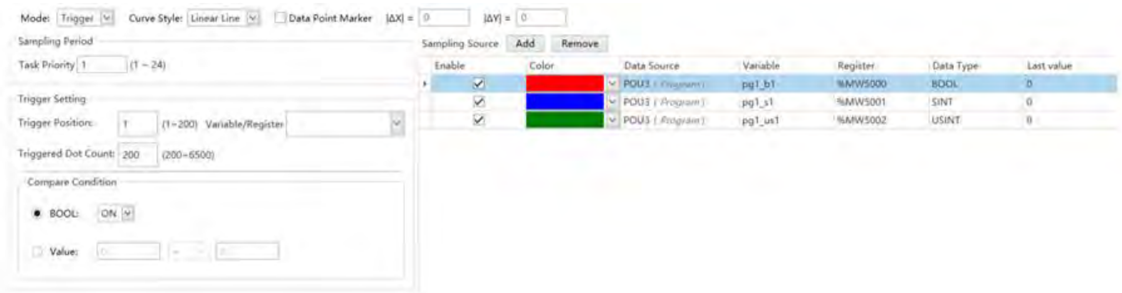
Steps to start data tracing in Sync mode:

1. Check if the communication is connected successfully in Communication Setting. If not, please create the connection manually, which is detailed in the information of **Operating the data tracer**.
2. Configure settings in Parameter Setting: **Mode:** Sync/ **Curve Style:** Digital line/ **Channel Capacity:** 100000/ **Task Priority** is set to be the priority of the task applied in ISPSoft.
3. Add new variables to trace, which is detailed in the information of **Add new trace variables**.
4. Click the start tracing button in the toolbar to start variable tracing.
5. Click the stop tracing button in the toolbar to stop variable tracing and get the tracing image.

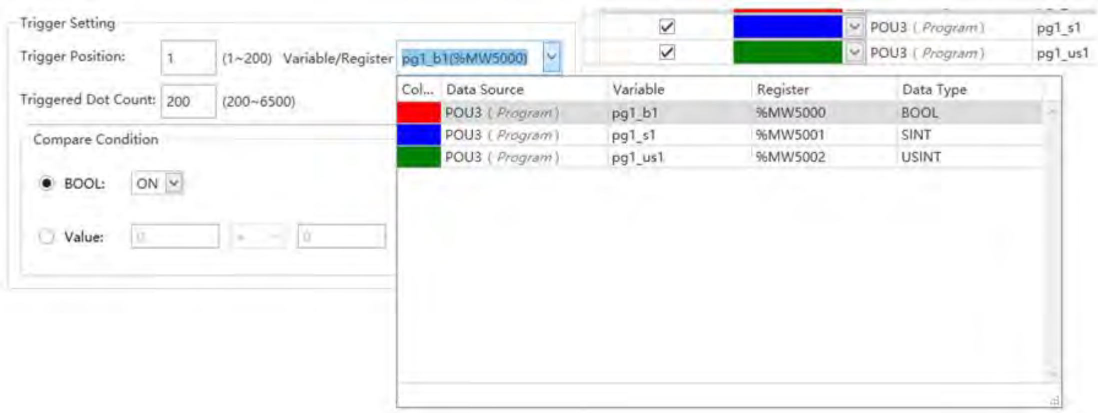
➢ **Trigger**

A trace variable needs to be selected as the trigger variable as well as configuring trigger conditions for Trigger mode. When the conditions are satisfied, all the variable values traced in a certain period would be displayed on the image, which the period is determined by **Triggered Dot Count**. Up to 20 variables can be traced at the same time in Trigger mode.

The required parameter settings shown in the following figure are detailed in the description of Parameter setting, which are **Mode**, **Curve Style**, **Data Point Marker**, **Channel Capacity**, **|△X|**, and **|△Y|**. **Task Priority** is referred in the information of **Sync** mode. Here only introduces specific parameters in Trigger mode.



Expand the drop-down list of **Variable/ Register** to view all the added trace variables. You can select one of the variable as the variable for triggering.



- Trigger Dot Count

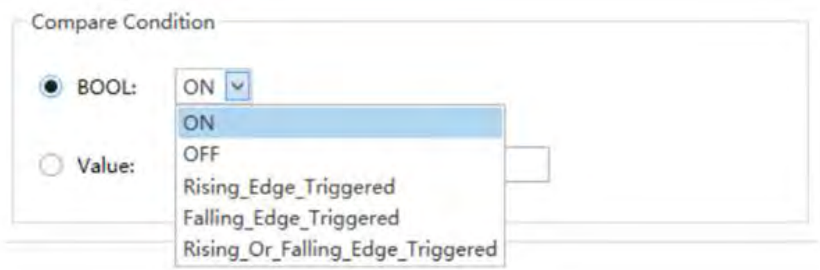
  Determines the numbers of period for variable tracing which would be displayed on the image view. The greater the setting value of Trigger Dot Count, the more period counts would be acquired when the trigger conditions are satisfied. The setting range is from 200 to 6500 and the default is 200.

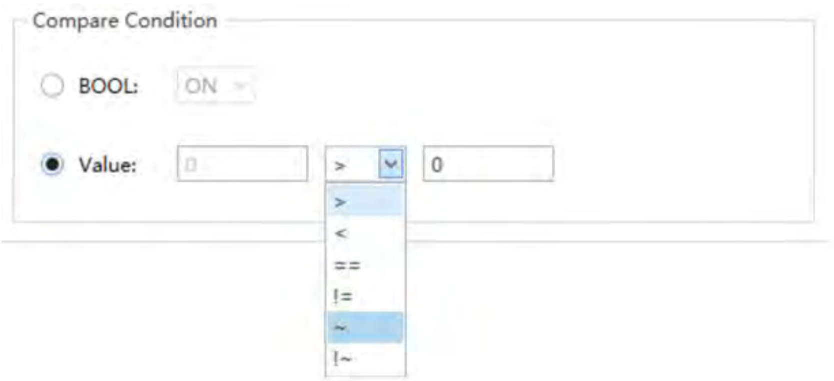
- Trigger Position

  Determines the position where the trigger condition is satisfied for the first time. The setting range for triggering position is from 1 to 200 and the default value is 1. If you want to acquire the values of variables traced within 100 time periods ahead of the trigger condition being satisfied, the trigger position needs to be set to 101.

- Compare Condition

  Based on the types of trigger variables, there are two kinds of compare conditions, which are **BOOL** and **Value**. The ways to compare BOOL values are ON, OFF, Rising Edge Triggered, Falling Edge Triggered and Rising Or Falling Edge Triggered, while the compare conditions for Value are > (Greater), < (Less), = (Equal), != (Not equal), ~ (within the range), !~ (Outside the range) as the following shown.





Note:

1. For DVP50MC, the DIA data tracer feature is supported by hardware version 1.11.31 and above.
2. In case you modify the program of the project while performing tracing, you would need to start over add all the trace variables.

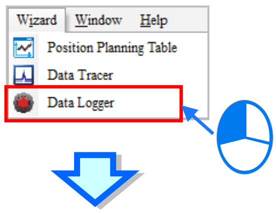
23.3 Data Logger

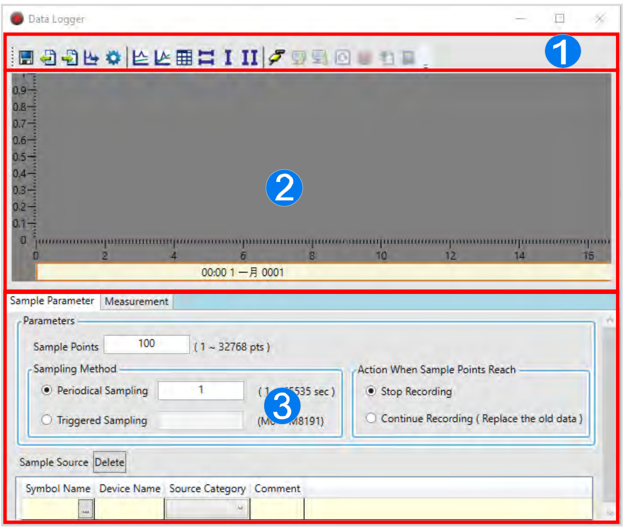
23.3.1 About Data Logger

Data logger is used long-term recording of symbol variables or device values and status that uses waveforms for diagram display. The data are saved in the hosts and memory card for convenient value trend analysis.

23.3.2 Opening the Data Logger Window

Please compile the current project before using the function. And then click **Wizard**> **Data Logger** to open the **Data Logger** window as below.





❶ Icon toolbar: Provides function buttons for operating the data logger with function descriptions below.

❷ Waveform display area: Displays real-time symbol variables or waveform of the device.

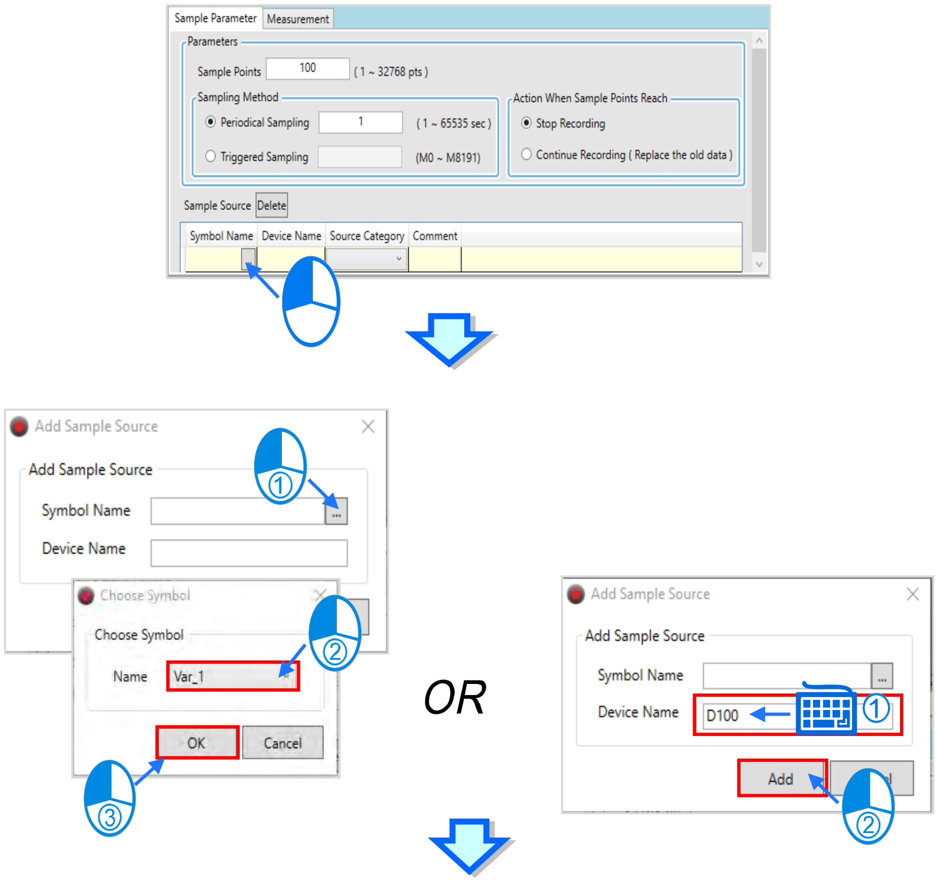
❸ Parameter Setting area: Sample Parameter page is for setting sample source and parameters. Measurement page is for displaying the values and adjusted waveform colors and proportions through measuring equipment.

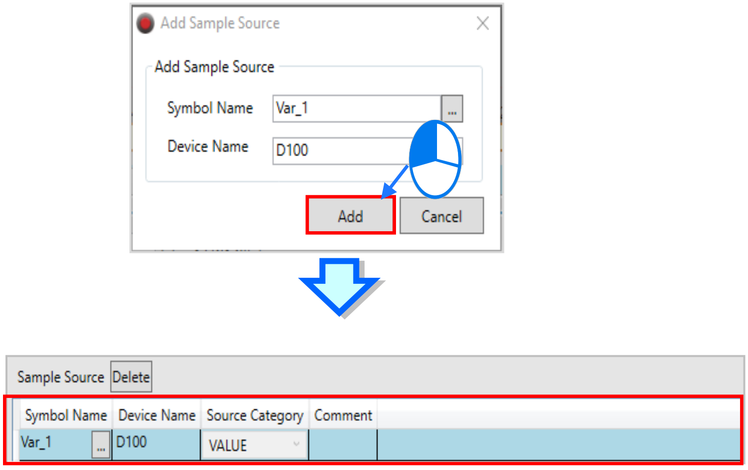
Explanation of icon buttons on the icon toolbar

Icon	Name	Function
	Save All	The sample settings and curve data result are saved to the specified path.
	Export Sampling Config	The sample settings are exported to the specified path.
	Import Sampling Config	The sample settings are imported from the specified path.
	Export Curve Data	The sample curve data are exported in the format of.bmp and .csv to the specified path.
	Configuration	The colors of curves in the data tracer and environment are set.
	Separate Curves	Multiple curves are separated automatically.
	Overlap Curves	Multiple curves are overlapped with the center line.
	Show Grid Line	Show or Hide grids
	Horizontal Measuring Lines	There will be two horizontal lines in the curve display area for users to measure the curve.
	Vertical Measuring Lines	There will be one vertical line in the curve display area for users to measure the curve.
	Vertical Measuring Lines	There will be two vertical lines in the curve display area for users to measure the curve.
	Connect/Disconnect	The PC and PLC are connected or disconnected.
	Upload Sampling Config from PLC	The sample settings in the data tracer are read from the PLC.
	Download Sampling Config to PLC	The sample settings in the data tracer are written to the PLC.
	Real Time Monitor	The PC reads the curve of the source from the PLC in real time.
	Record Data	Click this button to start recording or cancel the clicking of the button to stop recording.
	Upload Sampling Config from PLC	The recorded data in the data logger are read from the PLC.
	Write to Memory Card	Write the data recorded in the PLC to the memory card.

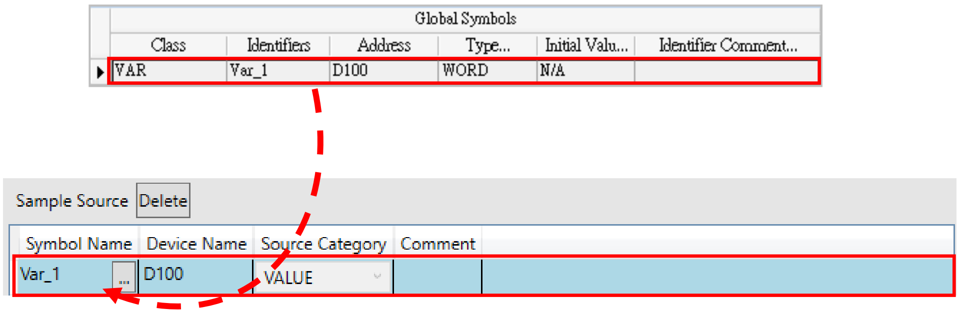
23.3.3 Sample Parameter Settings

In sample parameter page, the Sample Points are used to setup the number of samples; **Sampling Method** can be categorized into **Periodical Sampling** and **Triggered Sampling**. When using **Periodical Sampling**, users need to setup cycle time once every week; when using **Triggered Sampling,** users need to setup triggered device. When triggered device is ON, the sampling takes place, however, the triggered device is auto-switched to OFF once sampling is complete. When the number of sample points has reached, users can select either **Stop Recording** or **Continue Recording (Replace old data).** To add sample symbols, click button in Symbol Name and a pop-up Add Sample Source window appears. Then click the button to select the added symbol variables or type the device name in the window and click Add to the sample source list (see below).

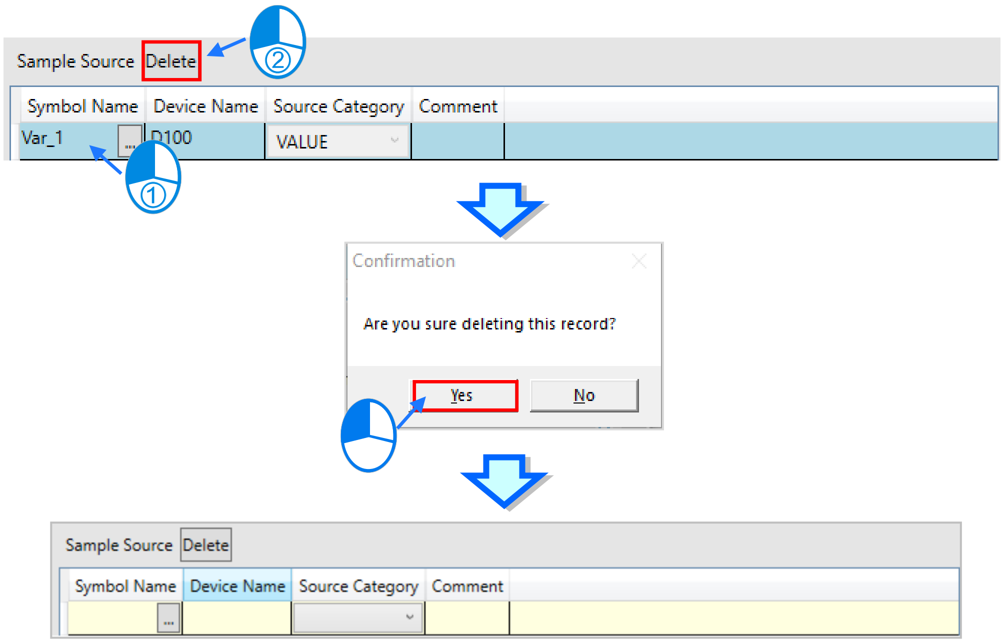




Symbols that are declared in global symbols and compiled in projects, are selected here. Manual device settings or identifier comments are also included.



To delete the sample source which has been added, select the deleted item and click **Delete**.

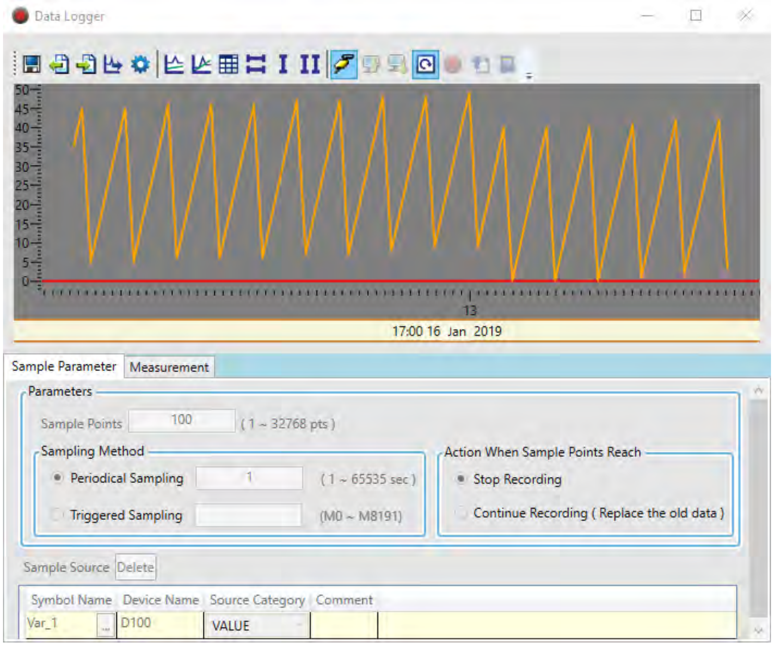


When sample parameter settings are complete, click **Export** or from the icon toolbar and save the sample parameter settings in .dlg format. Then, users can choose **Import** or to restore sample parameter settings in new projects.

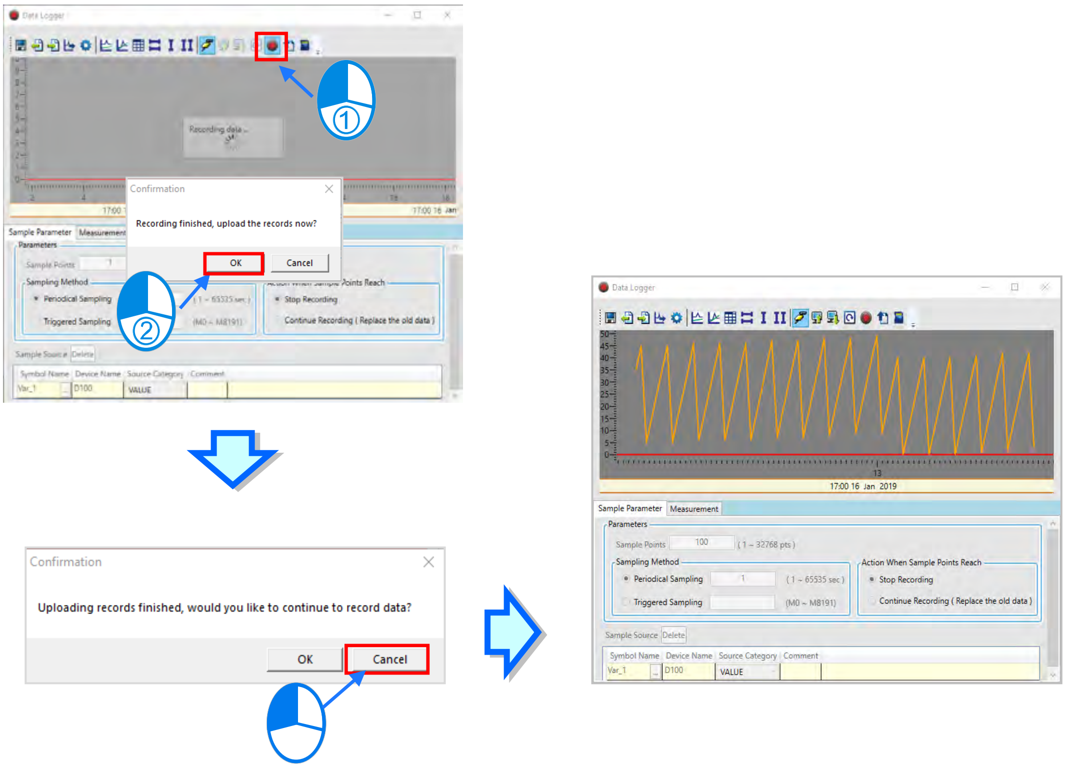
23.3.4 Watch and Record

When sample parameter setting for data logger is complete, download parameter setting during connection mode and use the icon toolbar to switch and watch or record real-time data.

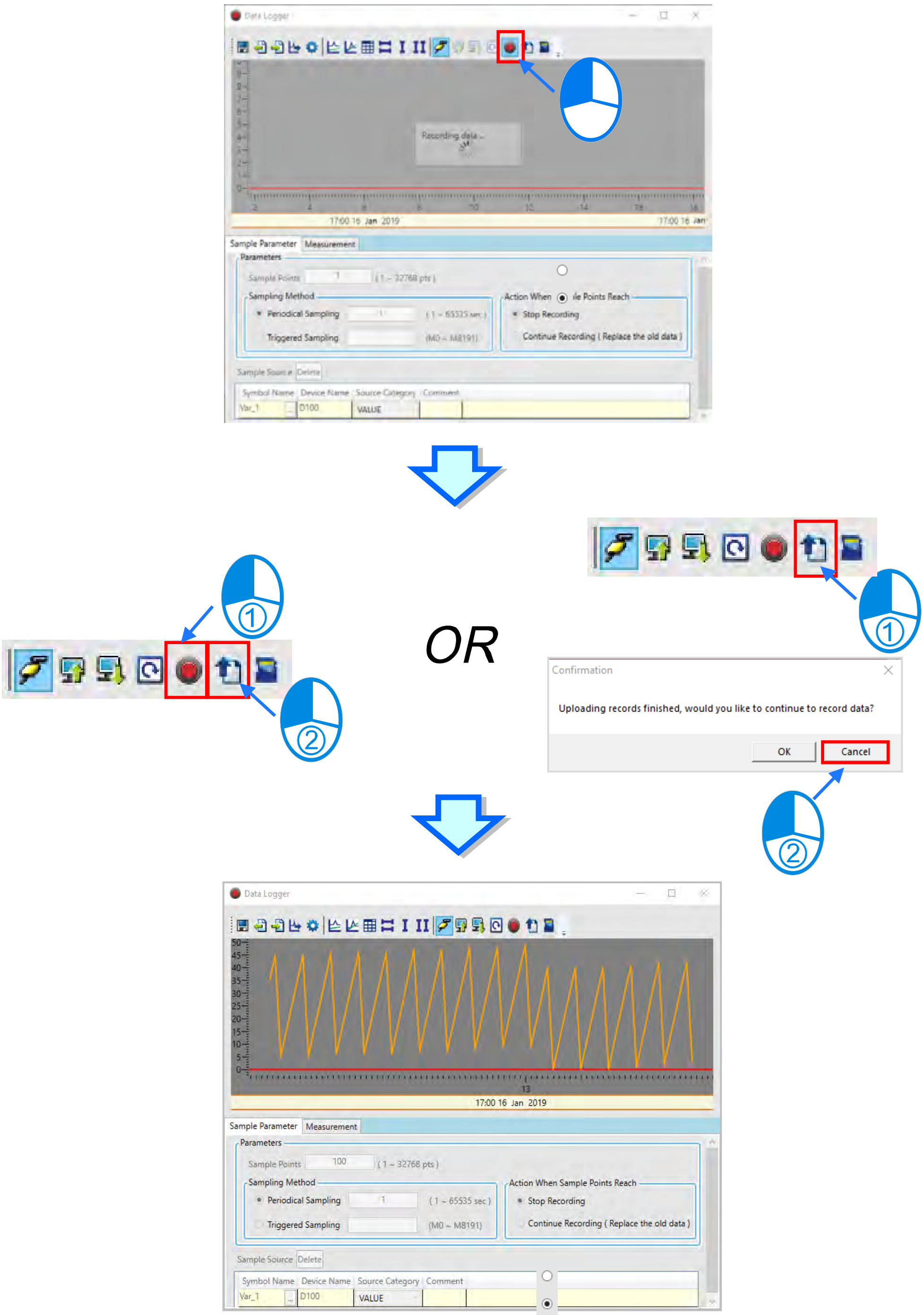
- Real-time Watch: According to the set sample period, the curves for the variable symbol or device value or state of the sample source are constantly drawn to the data logger. The screen will be adjusted to the appropriate range based on the curve shape and only the data of the latest sample points are kept. The PLC does not record the sample source in this mode.



- **Record Data**: To record symbol variables or device value status of sample sources and save in the internal memory of hosts. Click **Record Data** to start recording. Use **When Sample Points Reach** to **Stop Recording**, a pop-up window appears to confirm whether or not to upload records. Click OK and a confirmation window pops-up to confirm whether data recording need to be continued, select cancel and the uploaded data appear in the waveform display area.



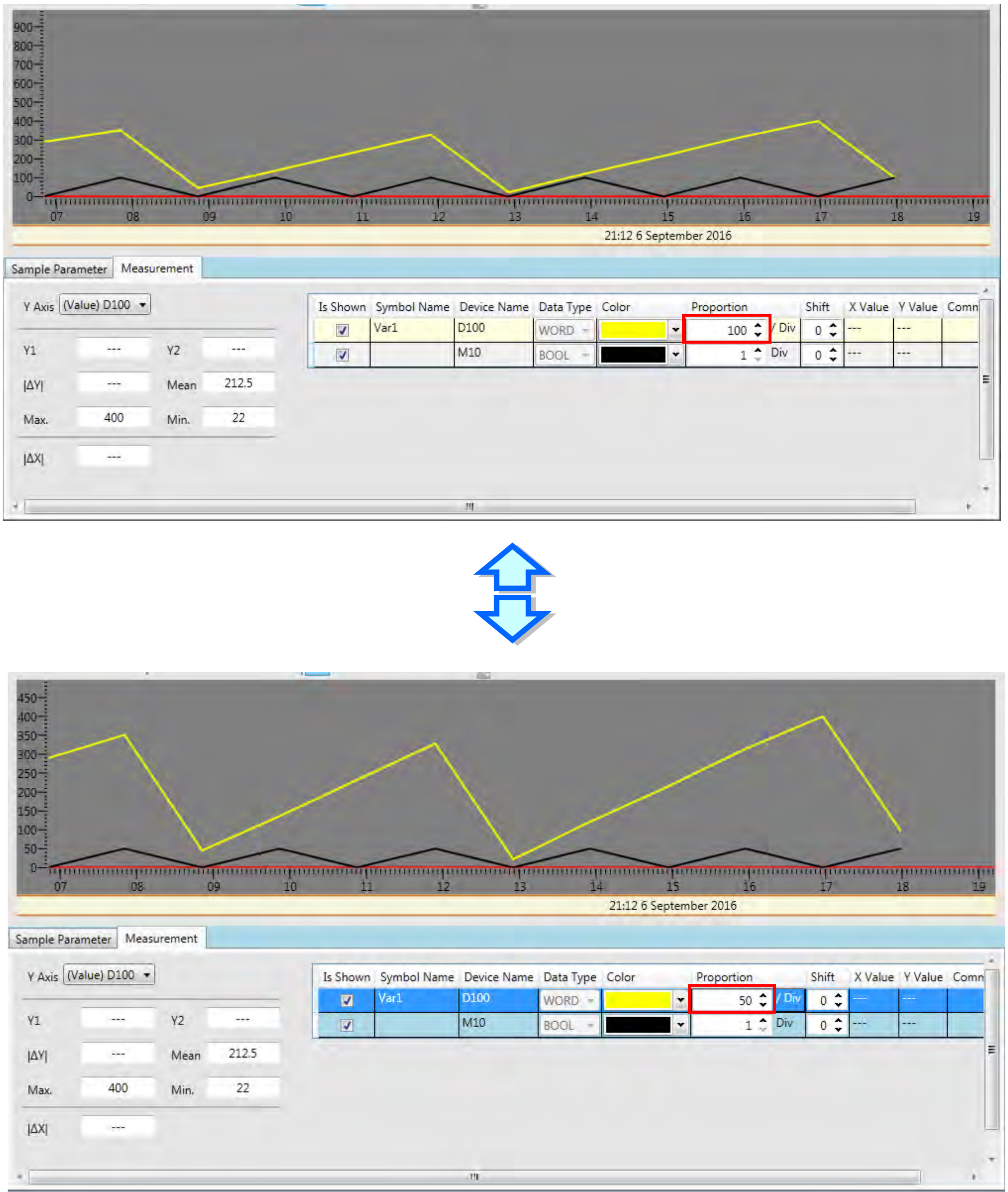
When the sample points reach to **Continue Recording** (**Replace the old data**), the hosts will continue to record sample resource data and keep the latest sample point range data. Click record **Record Data** and once recording stops then click **Upload PLC records** or directly click **Upload PLC records** during non-stop recording in the pop-up window to confirm recording again. Click **Cancel** to display recording data from hosts in the waveform display area.



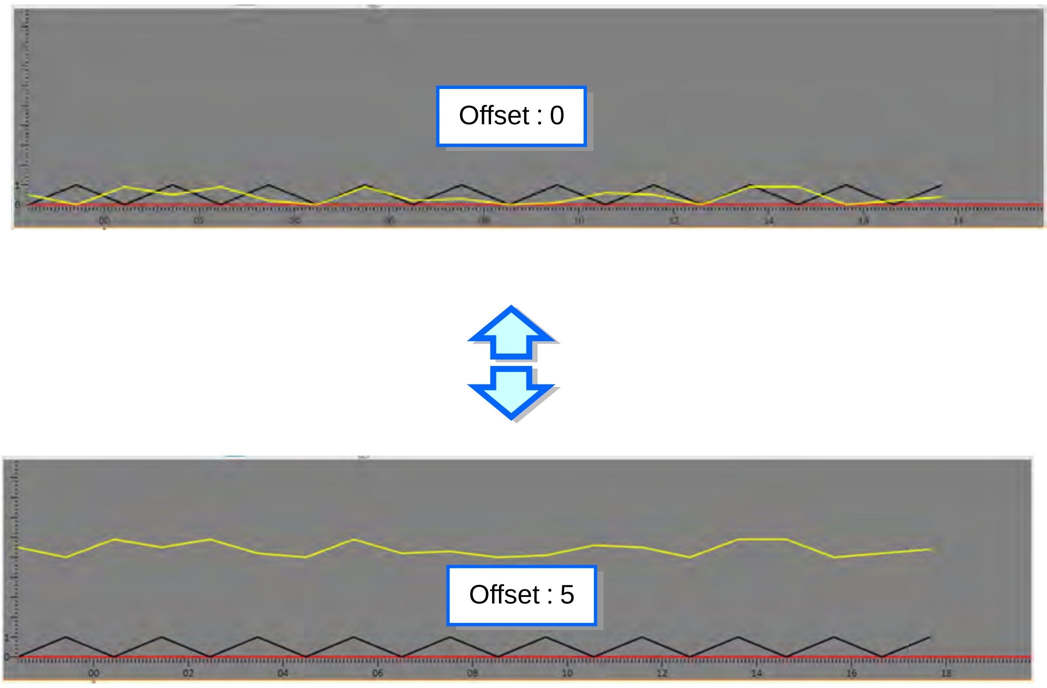
Whether recording data or not, users can click Write in Memory Card or so that recording data from hosts can write in the memory card & content\ **PLC CARD\Type\Log**DATA_LOGGER_YMD_HMS.

23.3.5 Measurement

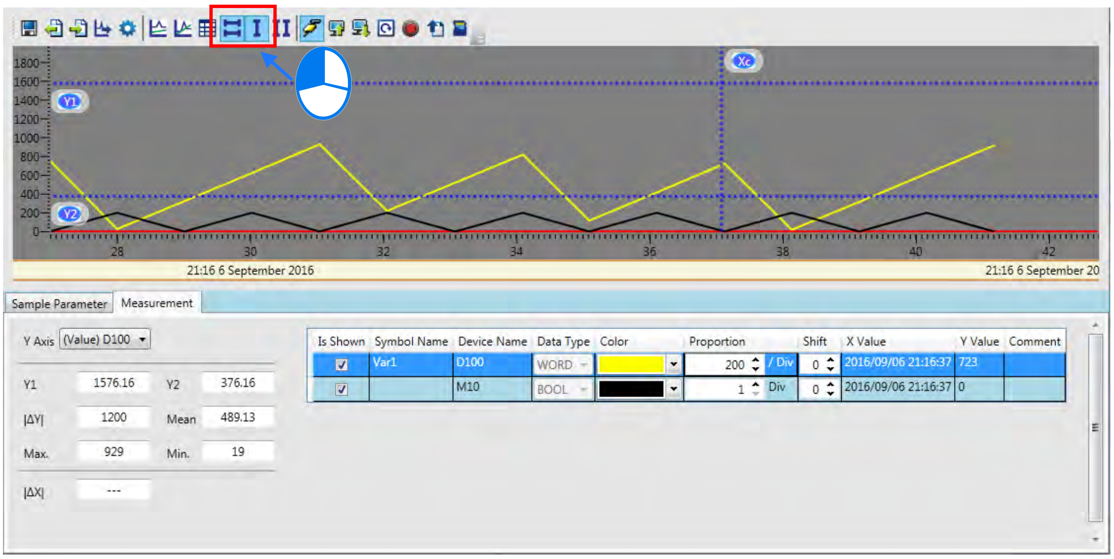
In Measurement, the page offers the values of mean, maximum and minimum regarding waveform information of selected device in Y axis. Each waveform has different color, proportion and shift settings. The **Proportion** refers to the proportion of vertical coordinate and the following diagram shows proportion of each scale set in 100 and 50 for comparison.



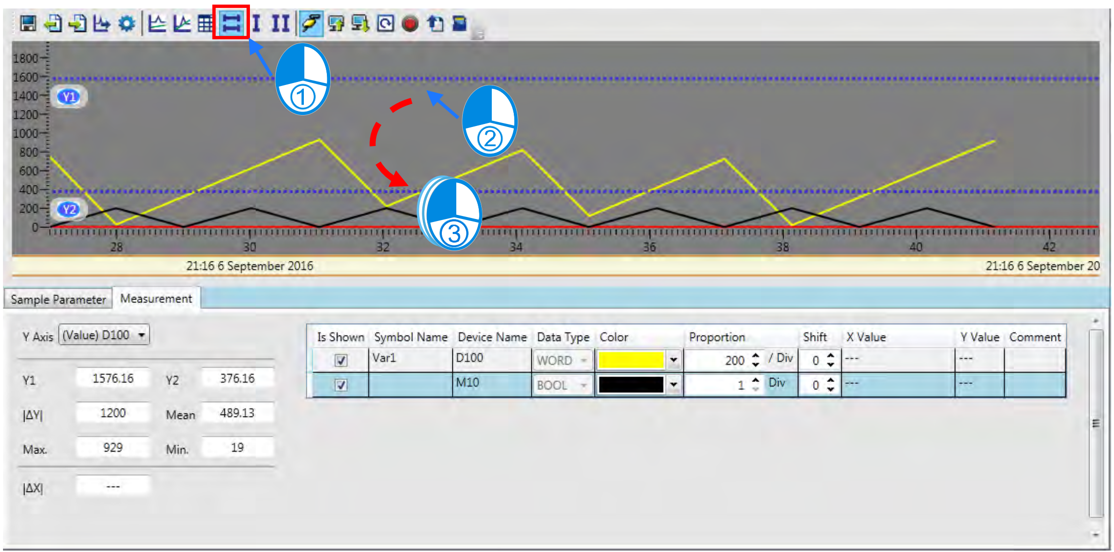
To set **Shift**, users can adjust the position of the waveforms in the screen (see below).



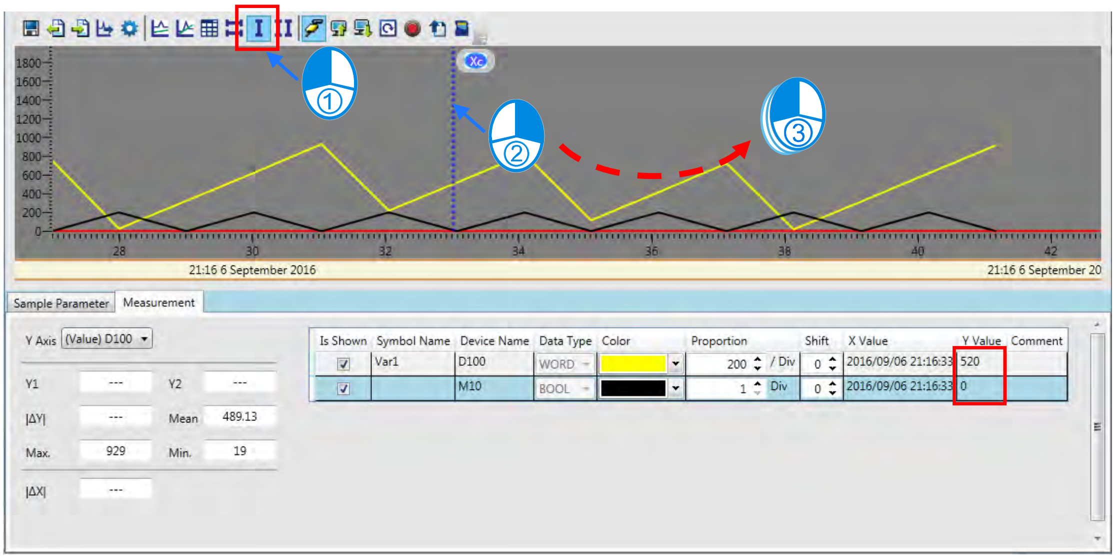
The waveform values in the data logger can be measured by using horizontal and vertical measuring lines after the **Measurement** tab is clicked. Click to open the horizontal measuring line and to open the vertical measuring line.



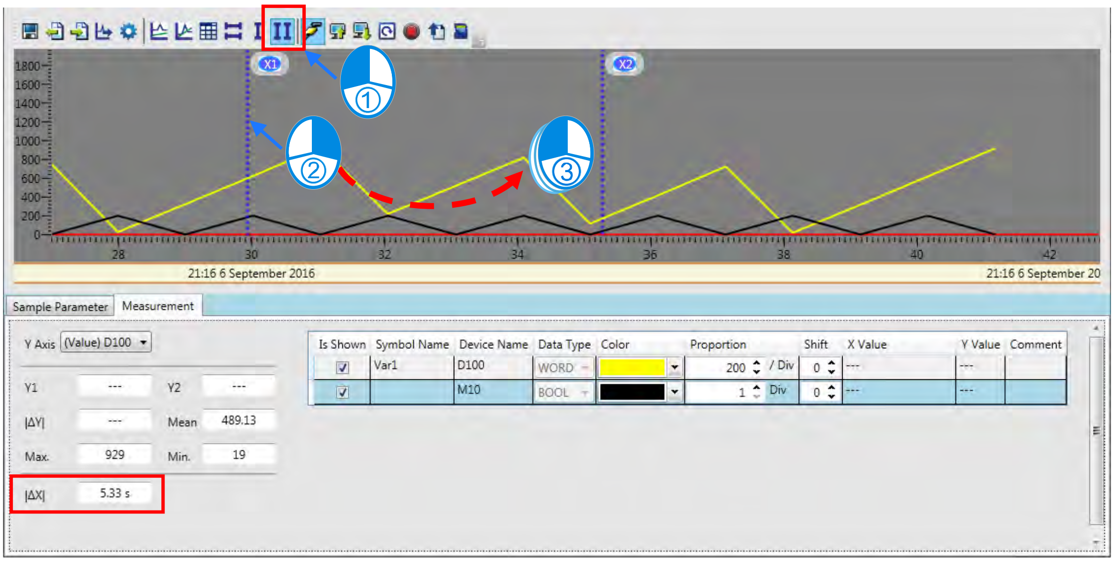
Drag the two horizontal measuring lines Y1 and Y2 and adjust to the measured position together with horizontal measuring lines. The parameter setting area displays every value regarding horizontal measuring lines. The Y1 value refers to Y1 column, Y2 value refers to Y2 column and differences between Y1 and Y2 refers to **I∆Y I column.**



Drag the vertical measuring line Xc to match with other vertical measuring lines. The Y value column below shows an intersected corresponding value regarding each sample resource and measuring line Xc.



The following diagram measures the time value of data logger by matching two vertical measuring lines. Click  from the toolbar to start the two vertical measuring lines and use the mouse to drag the two vertical lines, X1 and X2 in adjusting to the measured position. Time value is shown in the following **I∆X1** column.



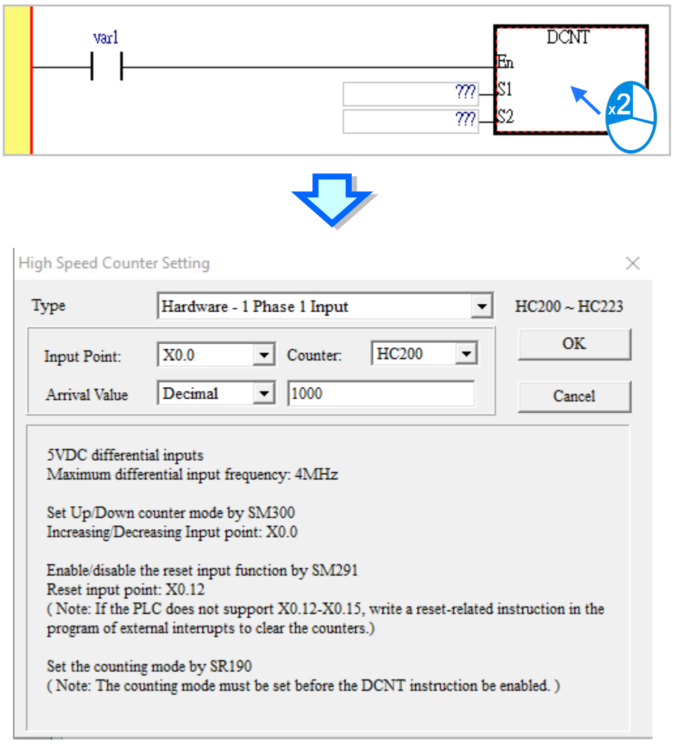
23.4 High Speed Counter

23.4.1 About High Speed Counter

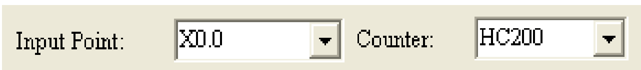
The high speed counter tool enables users to select the register number of the corresponding high speed counter based on the type of the high speed counter, format of the value to be counted and input point number so that DCNT instruction can be set quickly.

23.4.2 Using High Speed Counter

Double-click DCNT instruction in the ladder diagram to open the **High Speed Counter Setting** window as follows.

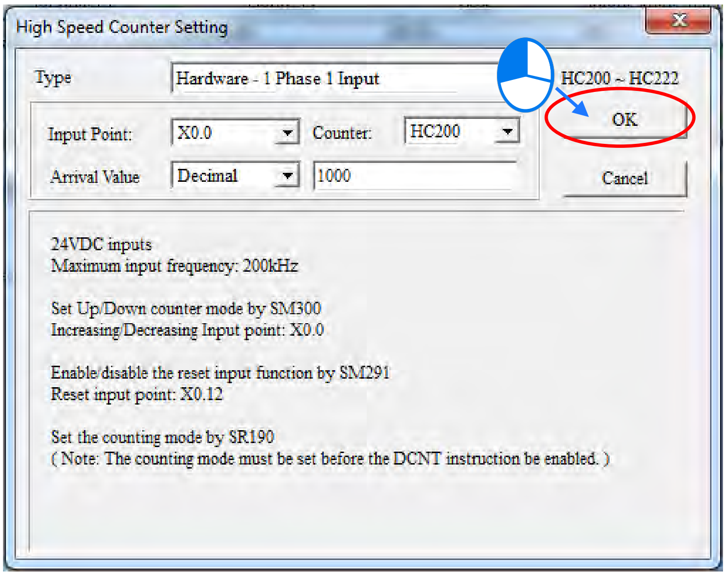


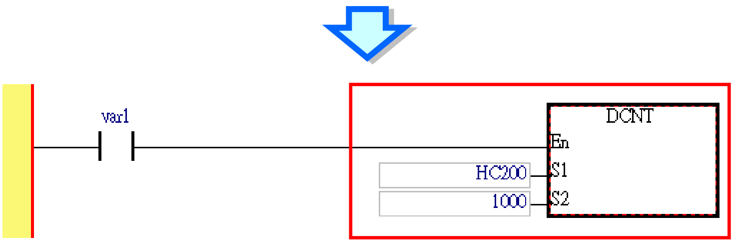
Firstly, select the type of the high speed counter such as **Hardware-1 Phase 1 Input**, **Hardware 1 Phase 2 Input** and so on. Then select **Input Point** or **Counter** device (see below).



Set the arrival value with options including Decimal, Hex or D device from the drop-down menu and input the value or D device number on the right.

Click OK and the high speed counter number and setting values are put in DCNT instruction.





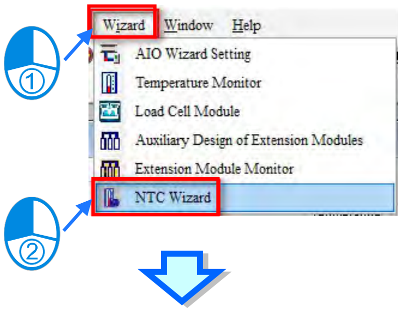
23.5 NTC Module Wizard

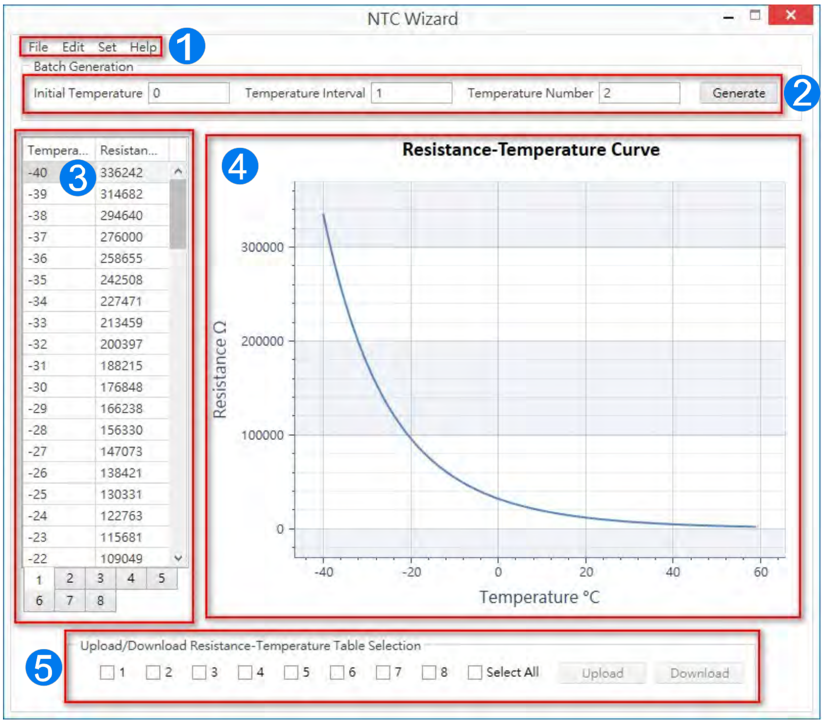
23.5.1 About the Wizard

This wizard is designed for DVP08NTC-S featuring user-defined resistance/temperature table, importing/exporting csv file, downloading parameters of one or multiple modules at a time, etc. please refer to the DVP08NTC-S Operation Manual for detailed instruction.

23.5.2 Using NTC Wizard

To enable this function, click “Wizard” and choose “NTC Wizard”, then a window of NTC Wizard will be opened as below shown.





❶ Options include,
File: Save/Open the file, Import/Export the resistance/temperature table.
Edit: Load default values, Clear the resistance/temperature table.
Set: Communication settings, RS485 direct to module or connecting to module via PLC CPU.
Help: Operation instructions, Software information.

❷ A blank form would be generated after you input the initial temperature, temperature interval and temperature number.

❸ A total of eight resistance/temperature tables are available for users to fill in the form with corresponding resistance values.

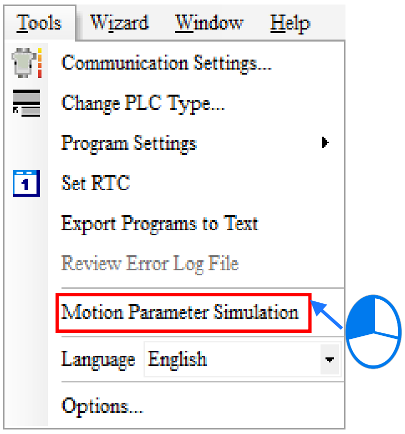
❹ The curve chart is generated according to the resistance/temperature tables on the left side.

❺ Choose the target table to upload/download.

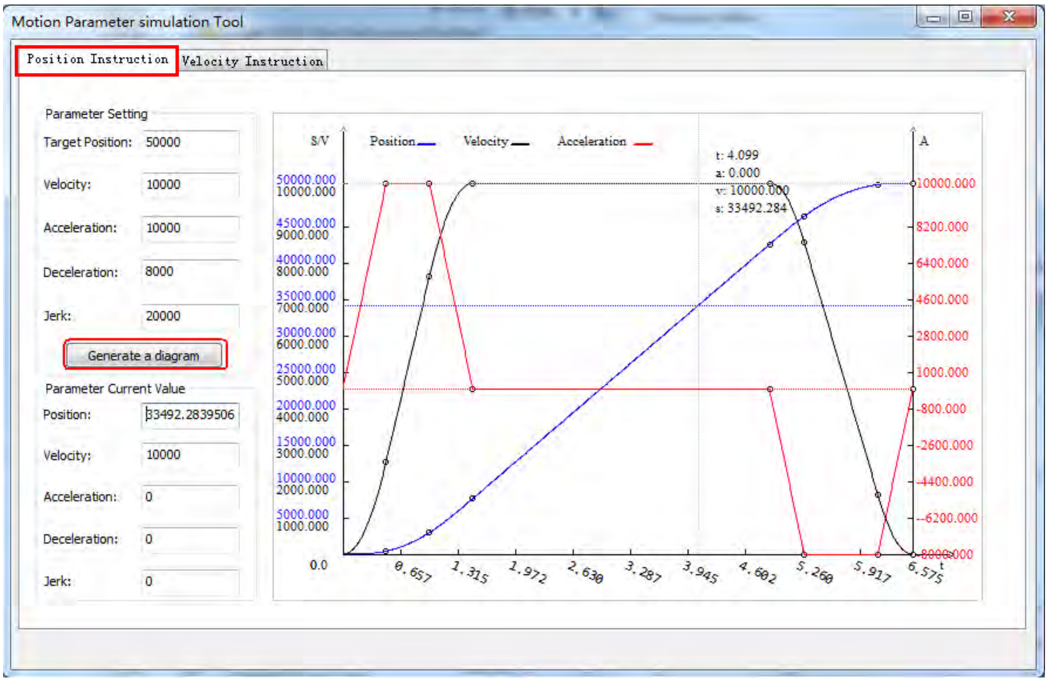
23.6 Motion Parameter Simulation

23.6.1 About Motion Parameter Simulation

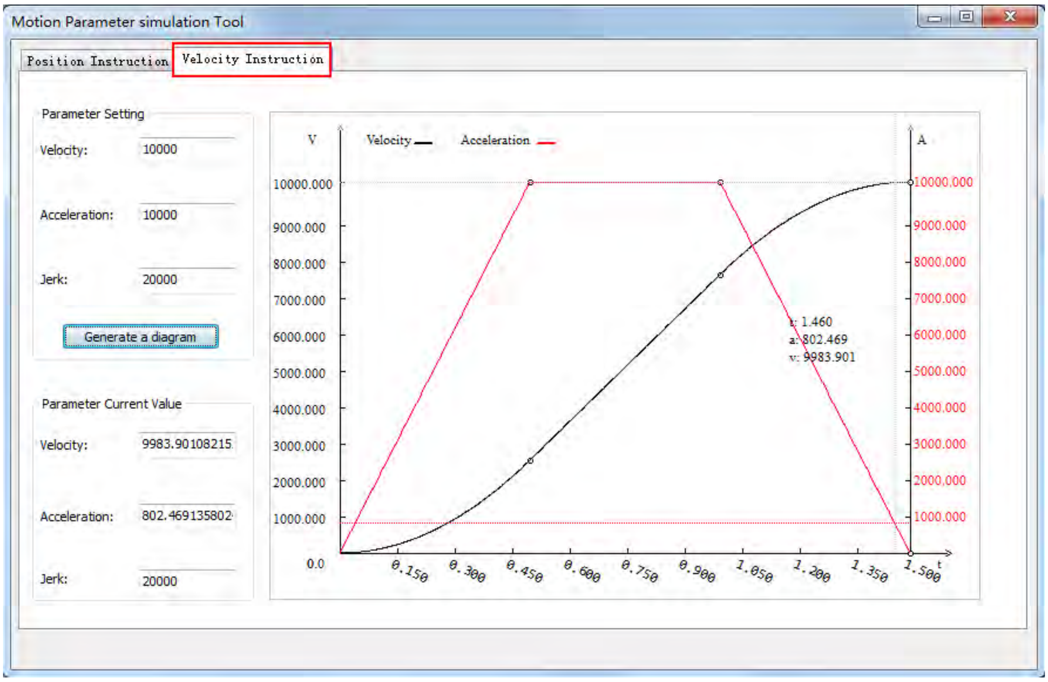
Select “Motion Parameter Simulation” from “Tools” in the toolbar. This feature is used to display the relative position as well as curves of velocity and acceleration after inputting related parameters so as to make it convenient for you to use when not knowing the appropriate motion parameters to input.



On the Position Instruction tab page, click “Generate a diagram” button circled in red in the figure below to display the relative position as well as curves of velocity and acceleration on the right side of the page. Parameter setting is to configure each setting, while Parameter Current Value displays the position, velocity and acceleration from the mouse cursor position on the image.



When choosing Velocity Instruction, click “Generate a diagram” button circled in red in the figure below to display the relative curves of velocity and acceleration on the right side of the page. Parameter setting is to configure each setting, while Parameter Current Value displays the velocity and acceleration from the mouse cursor position on the image.



MEMO

Appendix A USB Connection

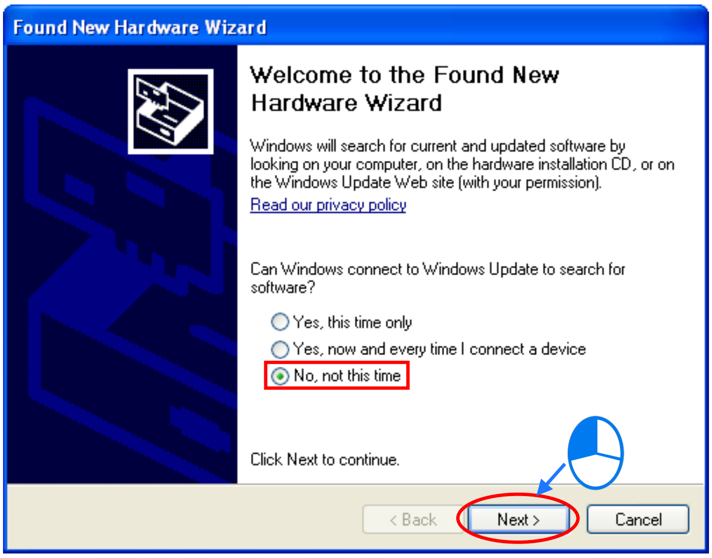
Table of Contents

A.1 Installing the USB Driver for an AS Series CPU module

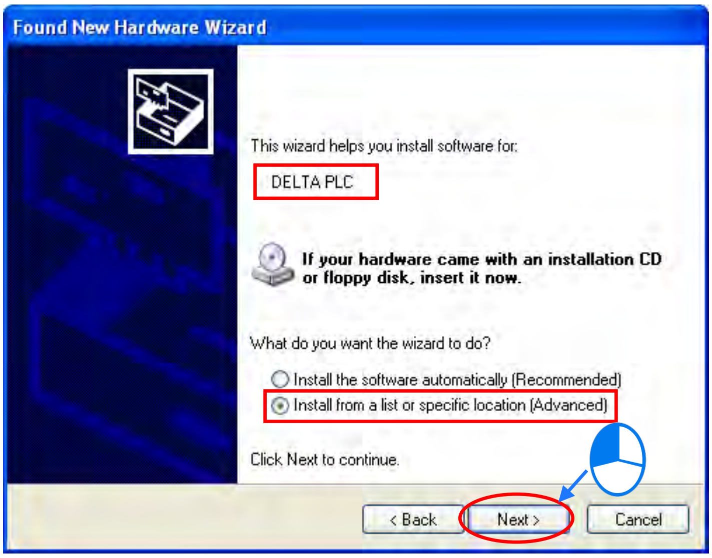
A.1.1 Installing the USB Driver in Windows XP with SP3

The installation of the USB driver for a PLC on Windows XP is introduced below. If users want to install the USB driver for a PLC on another operating system, they have to refer to the instructions in the operating system for more information about the installation of new hardware.

(1) Make sure that the PLC is supplied with power normally. Connect the PLC to a USB port on the computer with a USB cable. Select the **No, not this time** option button in the **Found New Hardware Wizard** window, and then click **Next**.



(2) The name of the USB device detected is displayed in the window. The device name shown in the figure below is the name of an AH500 series CPU module. Different models have different names. Please select the **Install from a lost or specific location (Advanced)** option button.

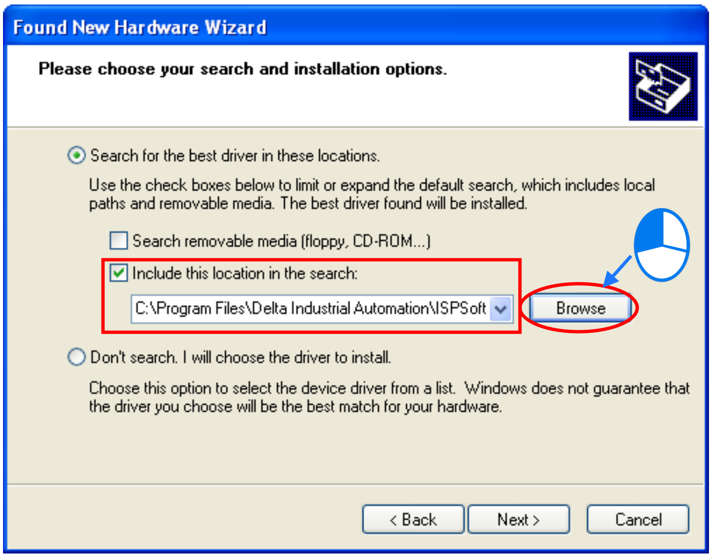


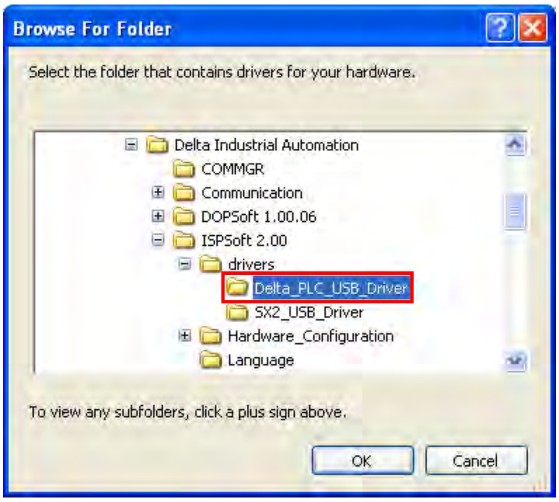
(3) The Delta PLCs which are equipped with built-in USB interfaces are listed in the tabled below. After ISPSoft version 2.00 or above is installed, the drivers for DVP-SX2 series PLCs, DVP-SE series PLCs, and AH500 series CPU modules will be in the folders denoted by the paths in the table.

Model	Path
DVP-SX2, AH560EN2	Installation path of ISPSoft\drivers\SX2_USB_Driver\
DVP-SE	Installation path of ISPSoft\drivers\Delta_PLC_USB_Driver\
AH500	Installation path of ISPSoft\drivers\Delta_PLC_USB_Driver\

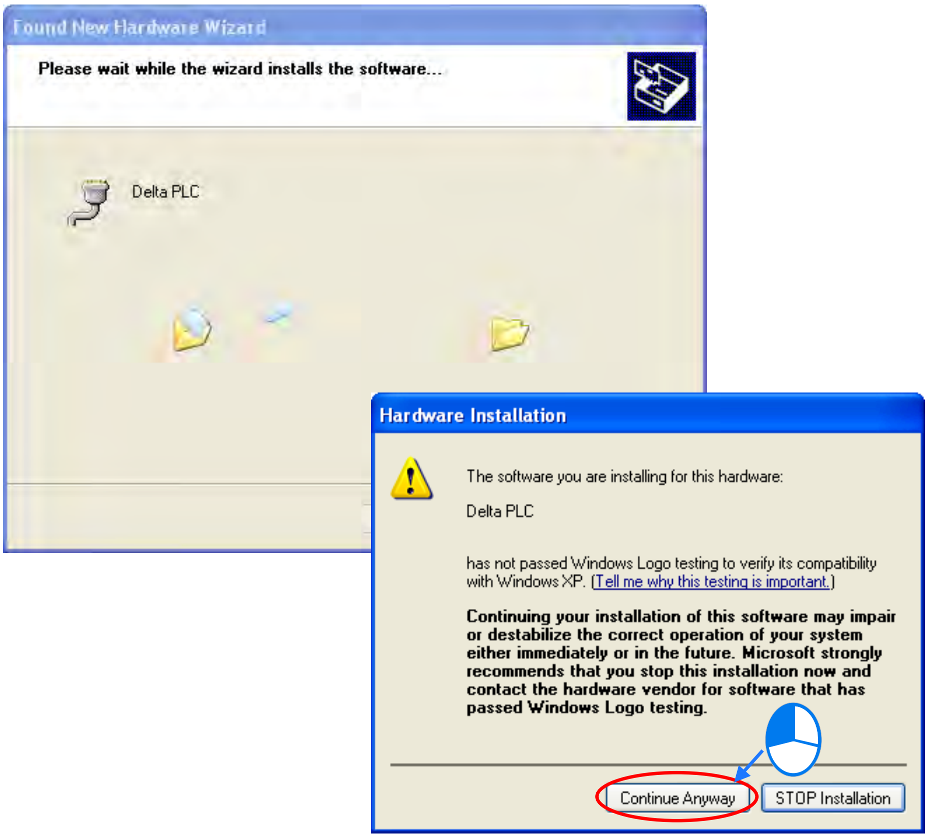
***. The default installation path of ISPSoft is C:\Program Files(x86)\Delta Industrial Automation\ISPSoftx.xx.**

Specify a path according to the PLC which is connected. If the driver for a PLC is gotten in another way, users have to specify the corresponding path. Click **Next** to carry on the installation.

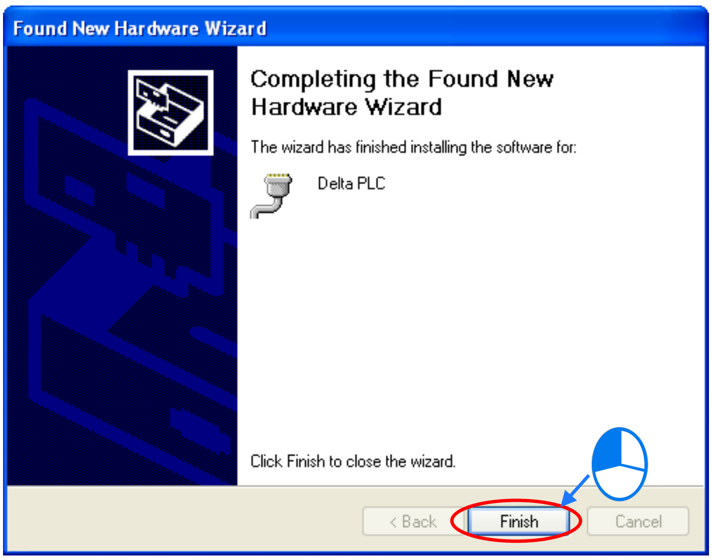




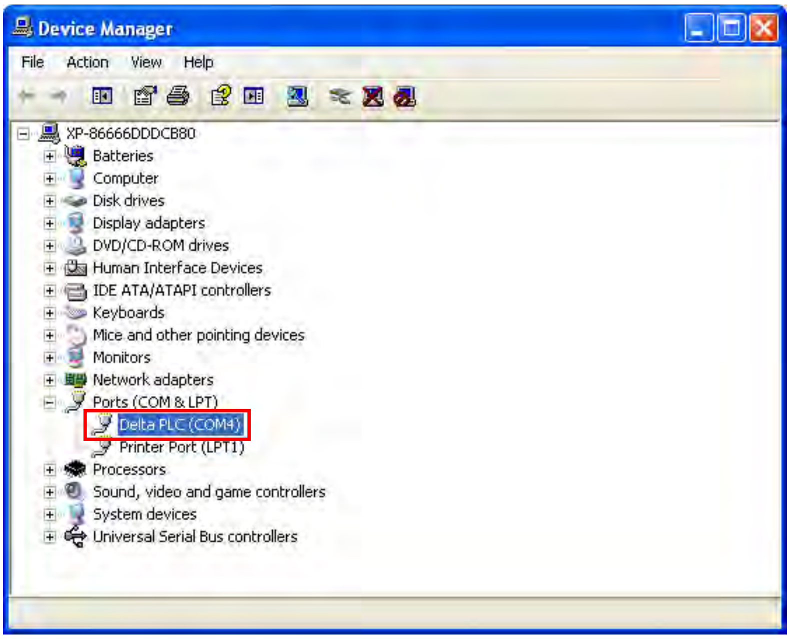
(4) After the correct driver is found in the folder denoted by the path, the system will install the driver. If the **Hardware Installation** window appears during the installation, please click **Continue Anyway**.



(5) Click **Finish** after the installation is finished.



(6) Open the **Device Manager** window after the installation is finished. If the name of the USB device connected is under **Ports (COM&LPT)**, the installation of the driver is successful. The operating system assigns a communication port number to the USB device.



***. The device name shown in the figure above is the name of an AH500 series CPU module. Different models have different names.**

Additional remark

- If the PLC is connected to another USB port on the computer, the system may ask users to install the driver again. The users can follow the steps above, and install the driver again. After the driver is installed, the communication port number that the operating system assigns to the USB device may be different.
- If Windows XP SP3 has not been installed on the computer, an error message will appear during the installation. Users can deal with the problem in either way below.

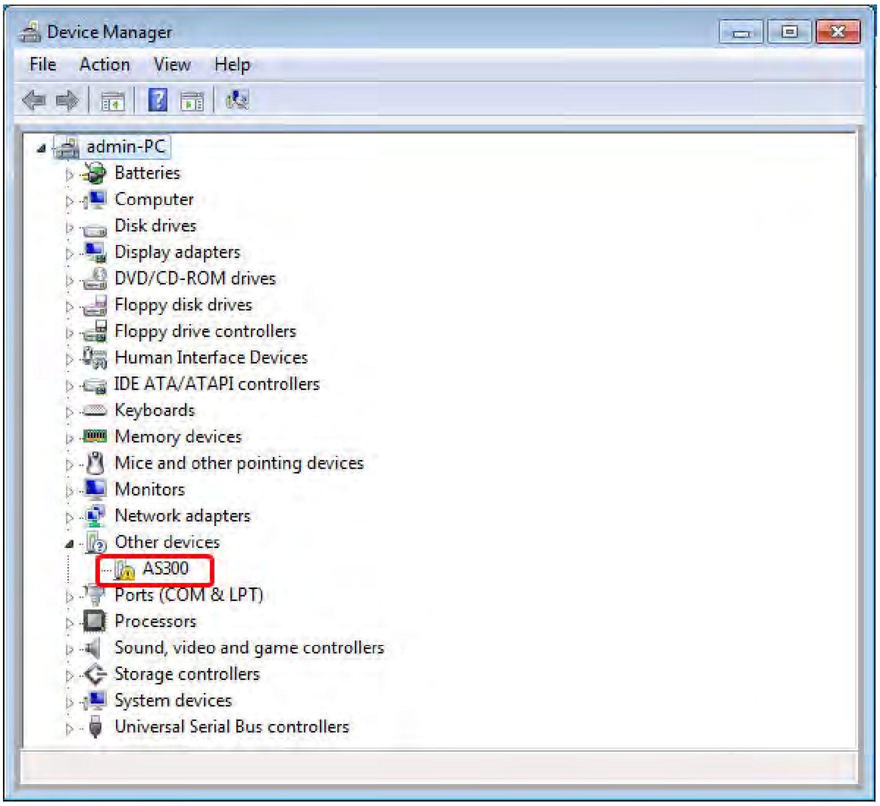
  (a) Cancel the installation, install Windows XP SP3, and reinstall the driver according to the steps above.

  (b) Get the file needed, and specify the path pointing to the file in the **Files Needed** window.

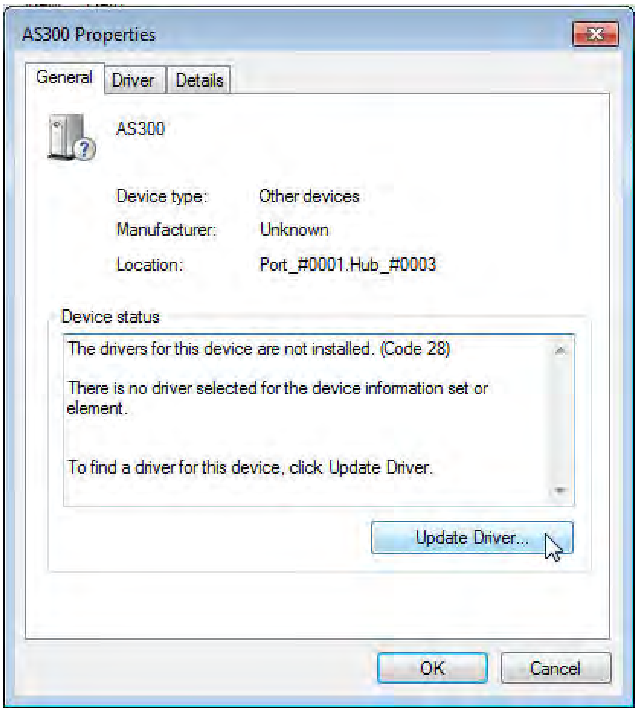
A.1.2 Installing the USB Driver in Windows 7

The installation of the USB driver for an AS series CPU module on Windows 7 is introduced below. If users want to install the USB driver for an AS series CPU module on another operating system, they have to refer to the instructions in the operating system for more information about the installation of new hardware.

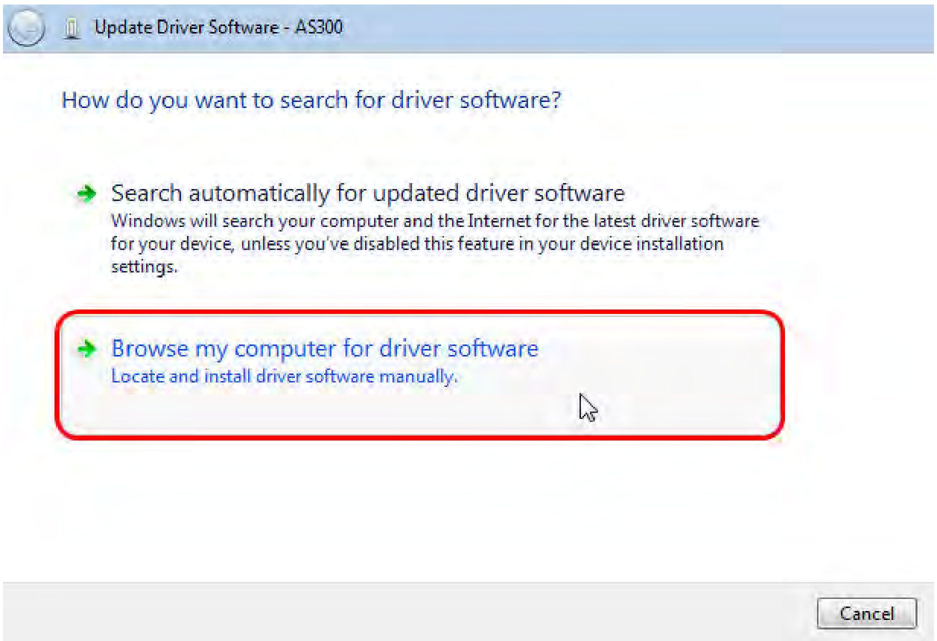
- Make sure that the AS series CPU module is supplied with power normally. Connect the AS series CPU module to a USB port on the computer with a USB cable.
- The name of the USB device detected will be displayed in the Control Panel > Device Manager window. Please select and double-click AS300.



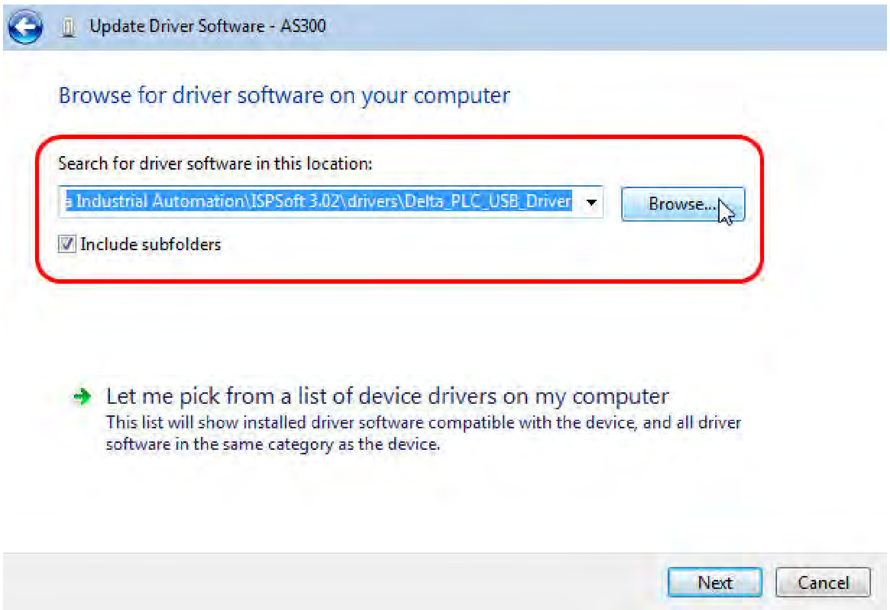
- Click **Update Driver....** in the **AS300 Properties** window.

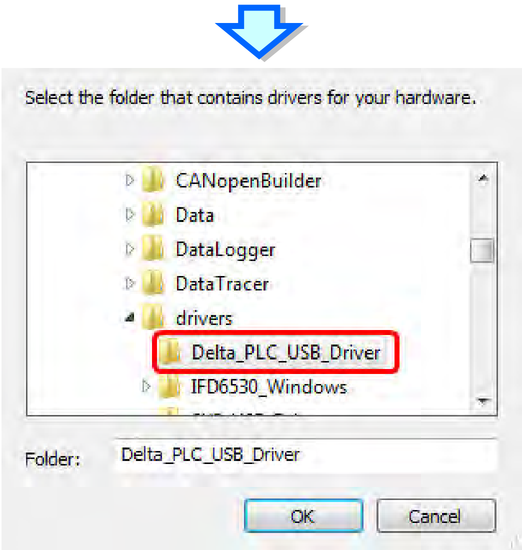


- Click **Browse my computer for driver software**.

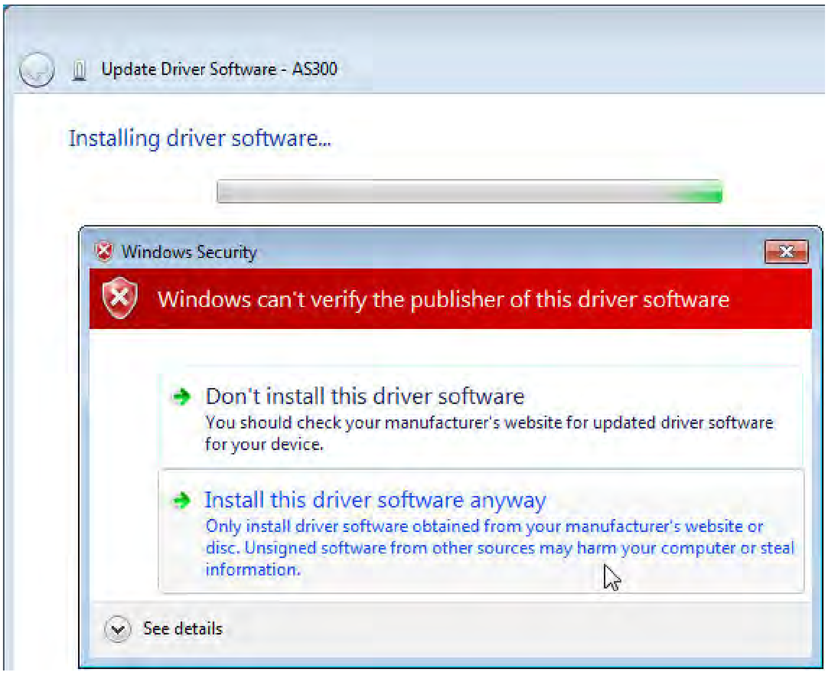


- After ISPSoft version 3.00 or above is installed, the driver for the AS series CPU module will be in the folder denoted by the path Installation path of **ISPSoft \drivers\Delta_PLC_USB_Driver**.
- Specify the correct path. If the driver for the AS series CPU module is gotten in another way, users have to specify the corresponding path. Click **Next** to carry on the installation.

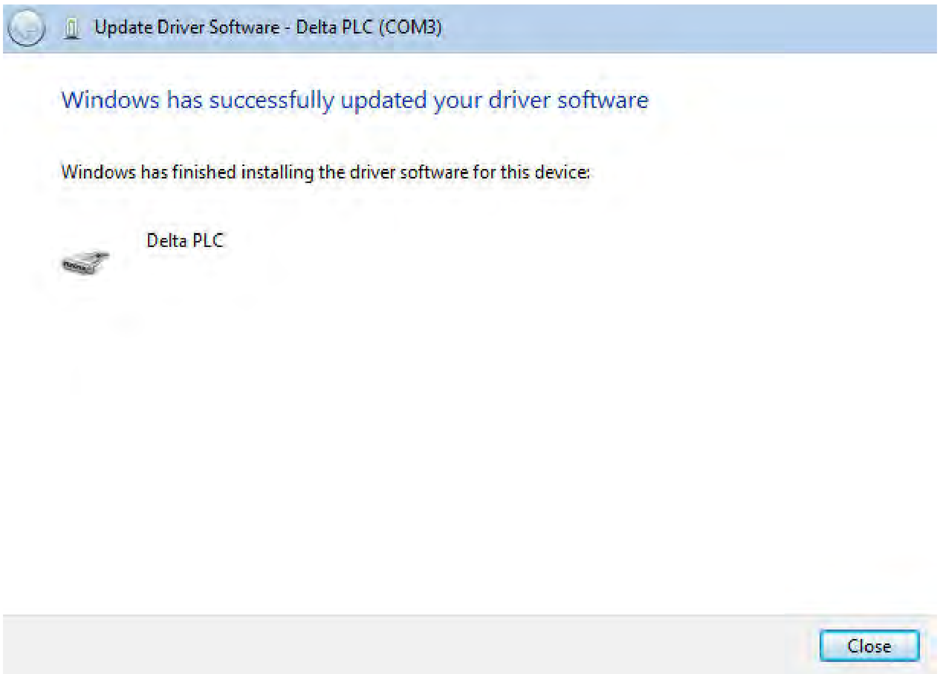




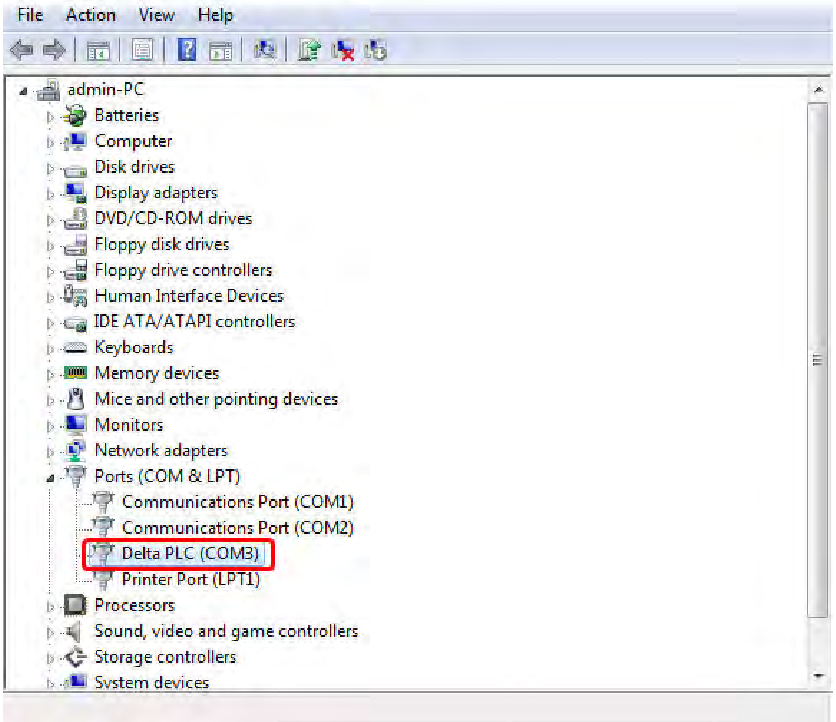
- After the correct driver is found in the folder denoted by the path, the system will install the driver. If the **Windows Security** window appears during the installation, please click **Install this driver software anyway**.



- Click **Close** after the installation is finished.



- Open the **Device Manager** window after the installation is finished. If the name of the USB device connected is under **Ports (COM&LPT)**, the installation of the driver is successful. The operating system assigns a communication port number to the USB device.



Additional remark

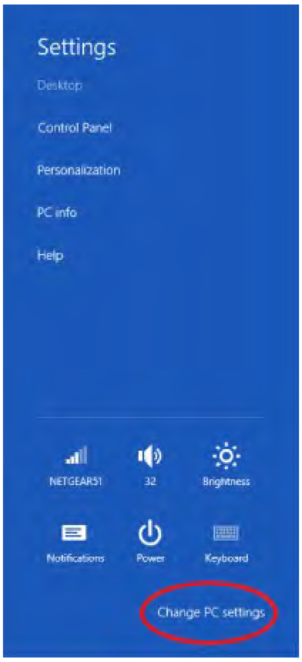
- If the PLC is connected to another USB port on the computer, the system may ask users to install the driver again. The users can follow the steps above, and install the driver again. After the driver is installed, the communication port number that the operating system assigns to the USB device may be different.

A.1.3 Installing the USB Driver in Windows 8.1

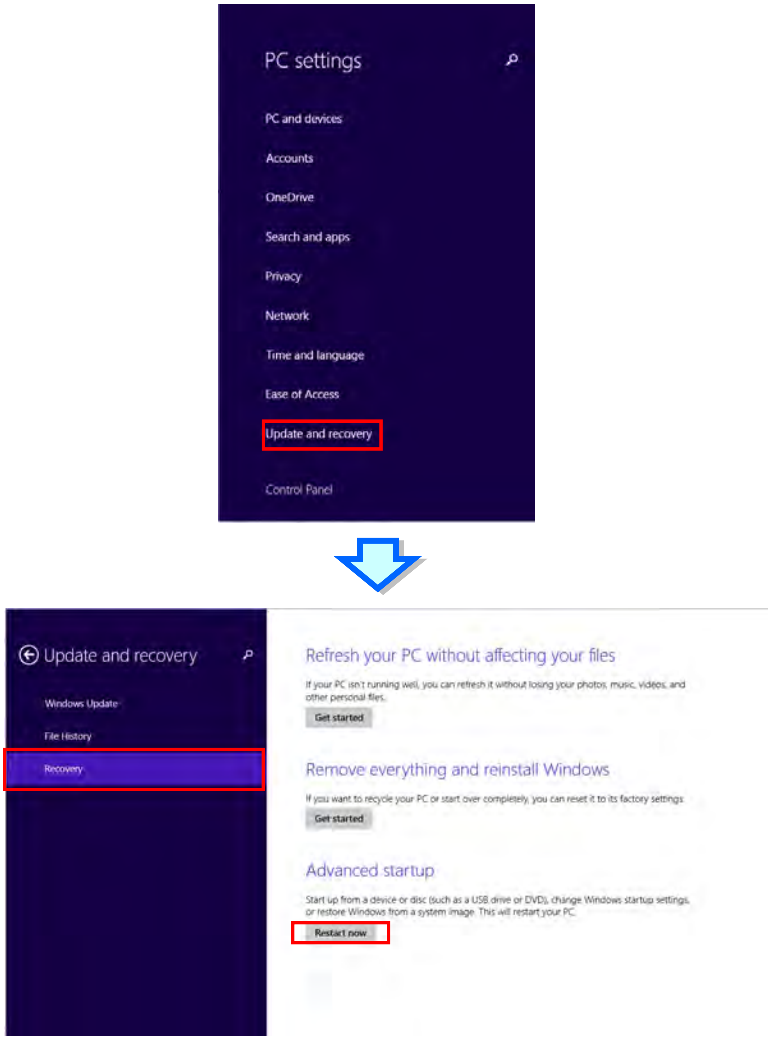
Windows 8.1 driver signature enforcement provides a way to improve the security of the operating system by validating the integrity of a driver or system file each time it is loaded into memory. However since Delta PLC USB driver does not include the driver signature, this section will help users to disable driver signature enforcement functionality in Windows 8.1 to ensure a success Delta PLC USB installation. This act is only valid for a single time. The setting will return to its original state after restarting.

Steps to disable driver signature enforcement in Windows 8:

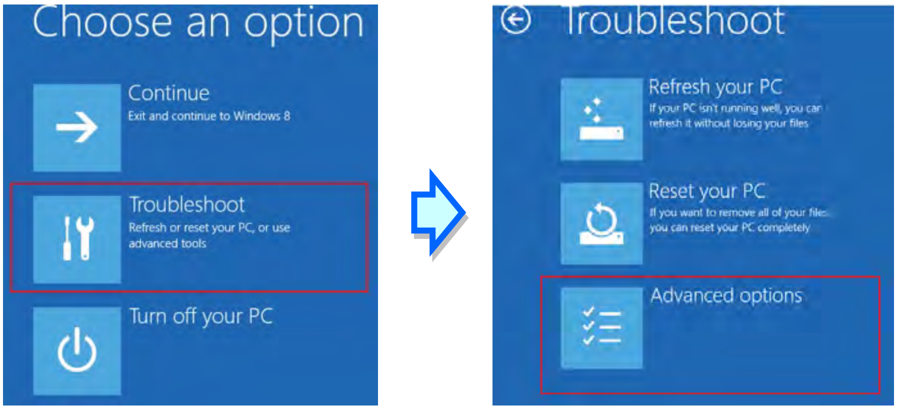
1. Press the button  【WIN】+【I】 on the keyboard to see the Setting interface. Click “Change PC settings”.



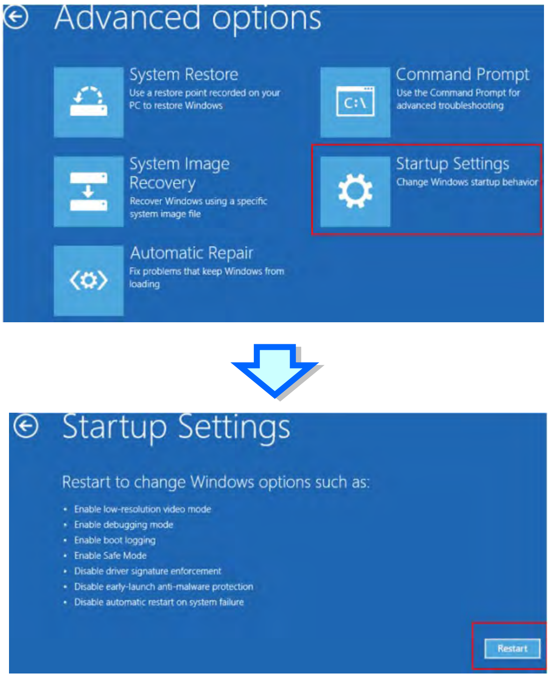
2. The PC settings window will appear. Select “General” and then “Restart now” under “Advanced startup”.



3. After the computer is restarted, select “Troubleshoot”under “Choose an option”. And then select “Advanced options”.



4. From the Advanced options page, select “Startup Settings” to see the Startup Settings. From this page select “Restart” to restart the computer.



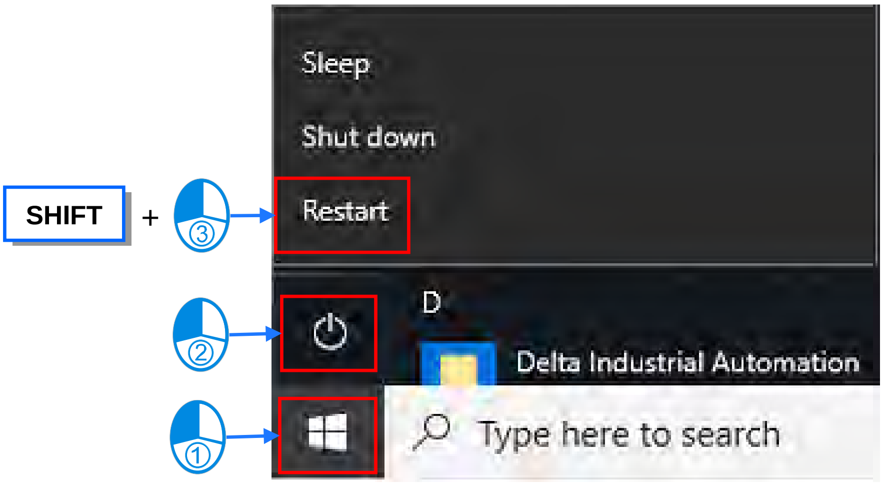
5. Press “7” or “F7” to choose “Disable driver signature enforcement” and the system will direct you to the Windows 8 operating page. Users can then install the Delta PLC USB driver now.
6. For the Delta USB drive installation, please refer to installation in Windows 7 section.

A.1.4 Installing the USB Driver in Windows 10

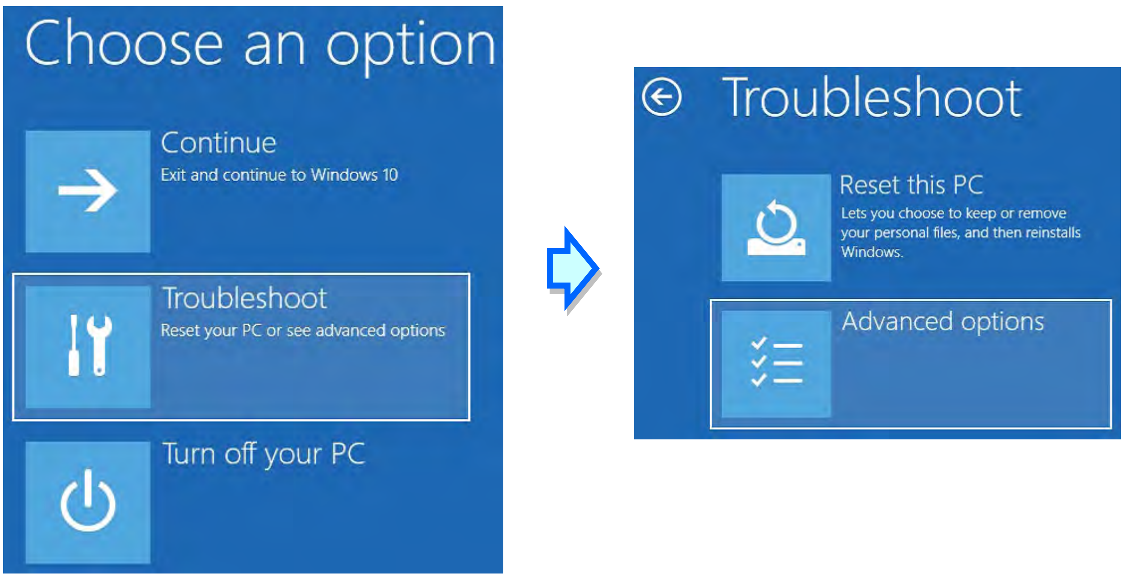
Windows 10 driver signature enforcement provides a way to improve the security of the operating system by validating the integrity of a driver or system file each time it is loaded into memory. However since Delta PLC USB driver does not include the driver signature, this section will help users to disable driver signature enforcement functionality in Windows 10 to ensure a success Delta PLC USB installation. This act is only valid for a single time. The setting will return to its original state after restarting.

Steps to disable driver signature enforcement in Windows 10:

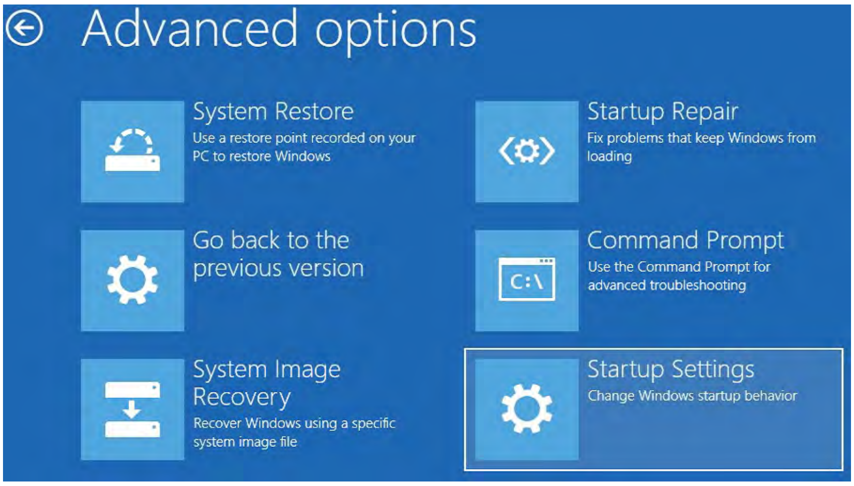
1. Click Start and then Settings. Then, press SHIFT key and click Restart

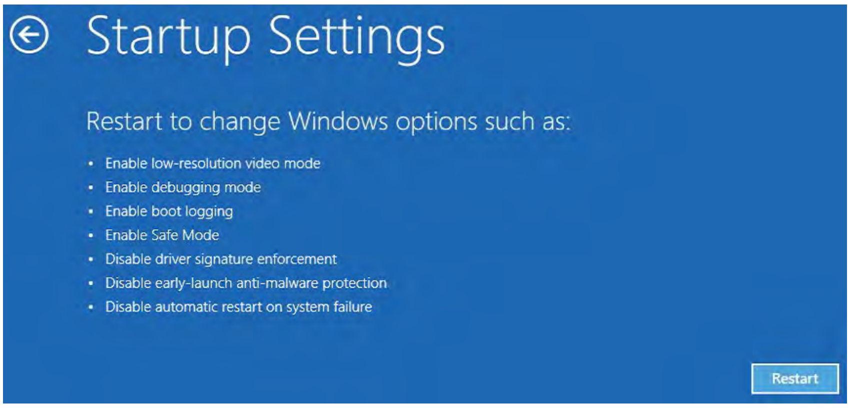


2. After the computer is restarted, select Troubleshoot, then choose “Advanced options”.

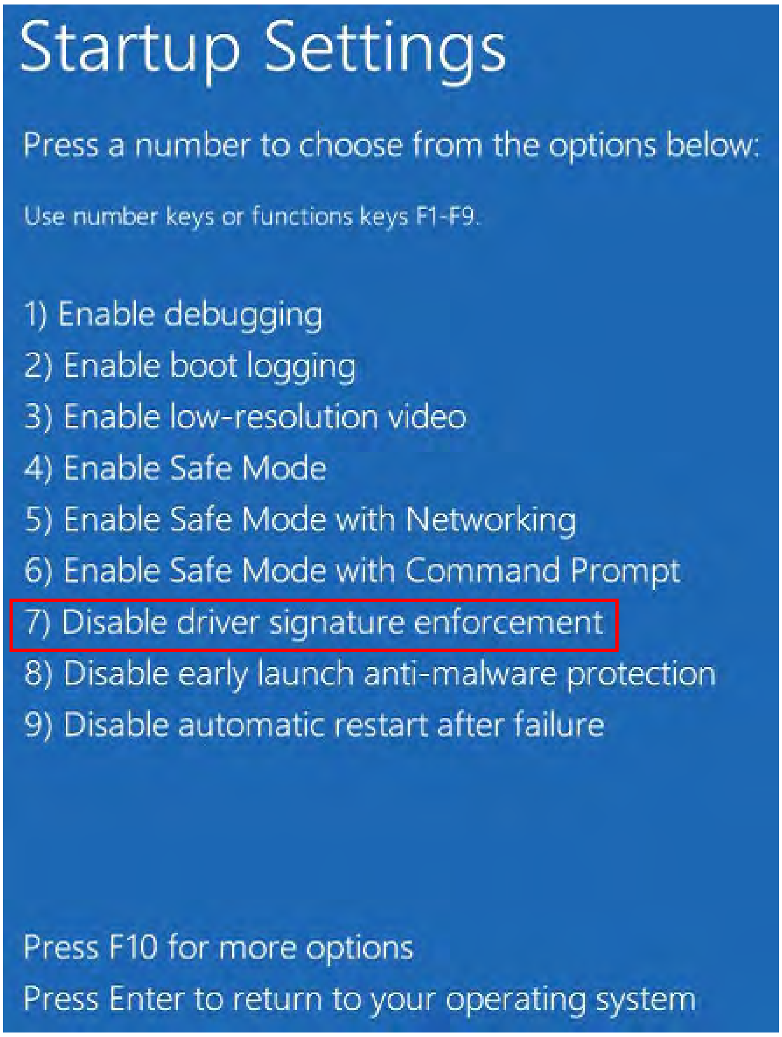


3. Select Startup Settings from the Advanced options page, then click “Restart” .

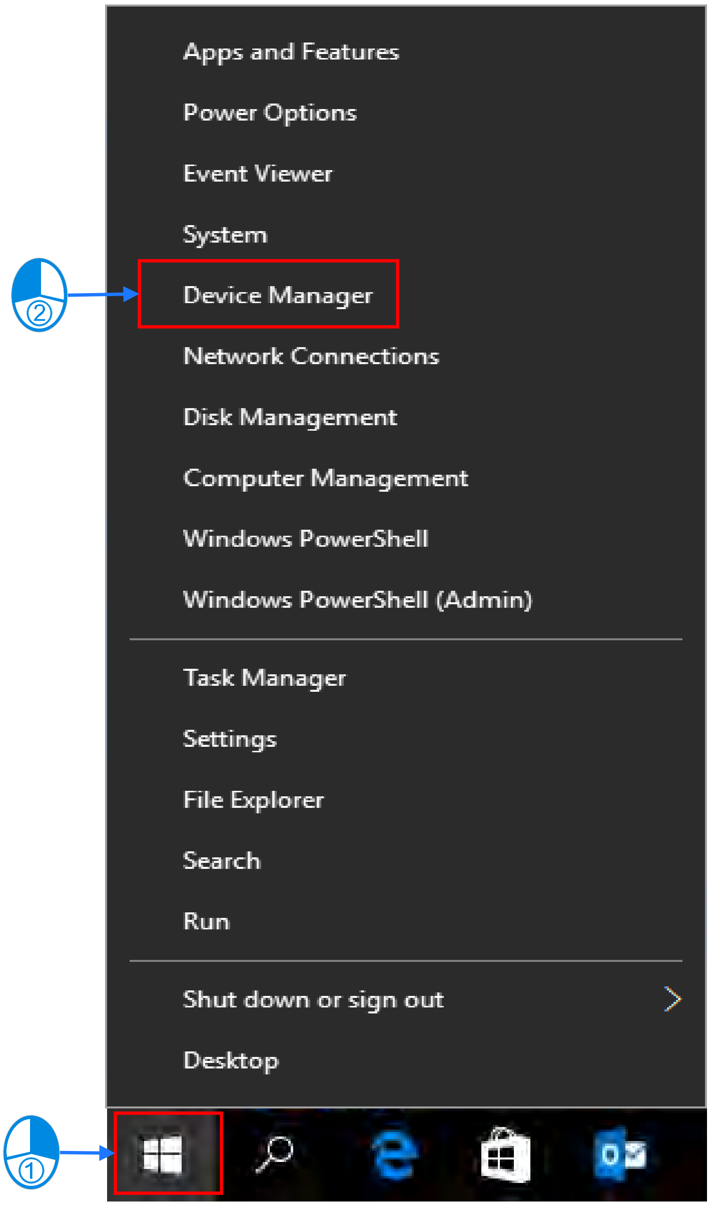




4. In Startup Setting page, press 7 or F7 to execute “Disable driver signature enforcement” and the system will restart once completed.



5. To install Delta USB drive, right-click Start and select Device Manager.



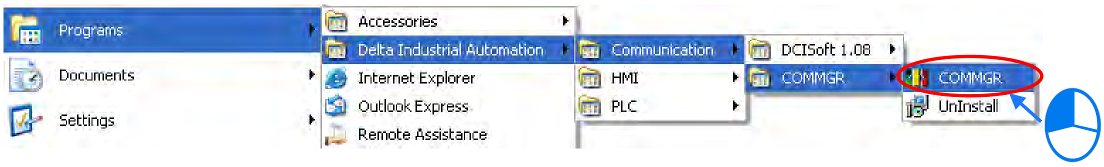
6. Please refer to A1.2 for installing USB drive (Delta_PLC_USB_Driver) in Window 7.

A.2 Create USB Driver in COMMGR

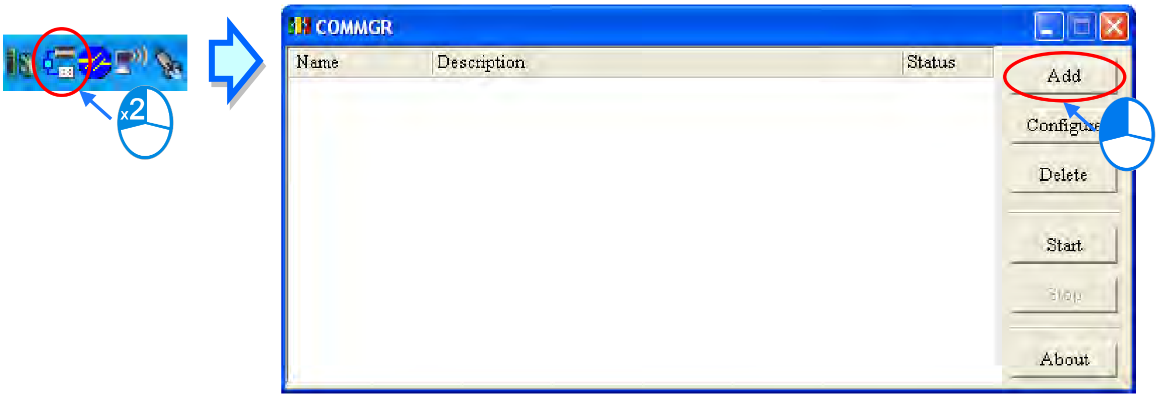
The steps of creating a driver whose connection type is USB in COMMGR are as follows.

(1) Make sure that the PLC is supplied with power normally. Connect the PLC to a USB port on the computer with a USB cable.

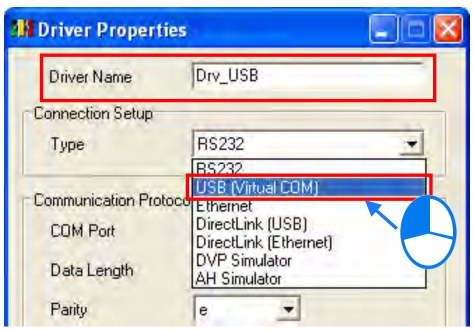
(2) Make sure that COMMGR is started, and the icon representing COMMGR is displayed on the system tray. If the icon representing COMMGR is not displayed on the system tray, users can start COMMGR by clicking the shortcut on the **Start** menu (**Start**>**Programs**>**Delta Industrial Automation**>**Communication**>**COMMGR)**.



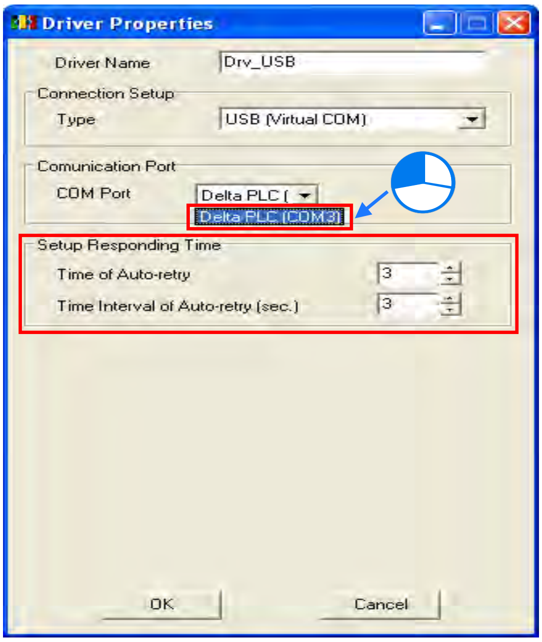
(3) Double-click the icon representing COMMGR on the system tray, and then click **Add** in the **COMMGR** window.



(4) Type a driver name in the **Driver Name** box, and then select **USB (Virtual COM)** in the **Type** drop-down list box in the **Connection Setup** section. If the PLC connected is a DVP-SX2 series PLC, **RS232** in the **Type** drop-down list box must be selected. Please refer to the following section for more information.

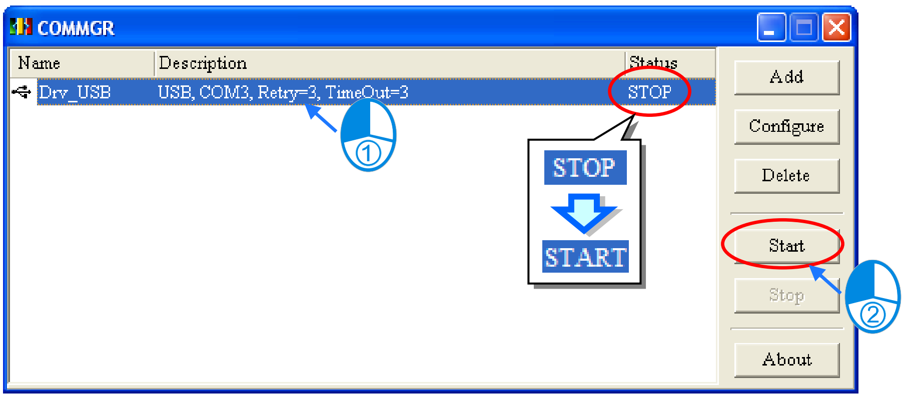


(5) Select a device name which corresponds to the PLC connected in the **COM Port** drop-down list box in the **Communication Port** section, select the number of times the sending of a command is retried if a connection error occurs in the **Time of Auto-retry** box, and select an interval of retrying the sending of a command in the **Time Interval of Auto-retry** box. Click **OK**.



If the device name corresponding to the PLC connected does not appear in the **COM Port** drop-down list box, users have to check whether the device name of the PLC connected is under **Ports (COM&LPT)**. If the device name of the PLC connected is not under **Ports (COM&LPT)**, the users have to check whether the PLC is correctly connected to the computer with the USB cable, and check whether the driver for the PLC is corrected installed on the computer. After the users make the checks, they have to close the **Driver Properties** window, and open the window again.

(6) Click the driver created in the **COMMGR** window, and then click **Start**.

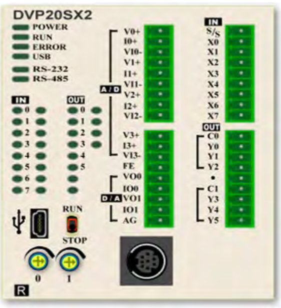


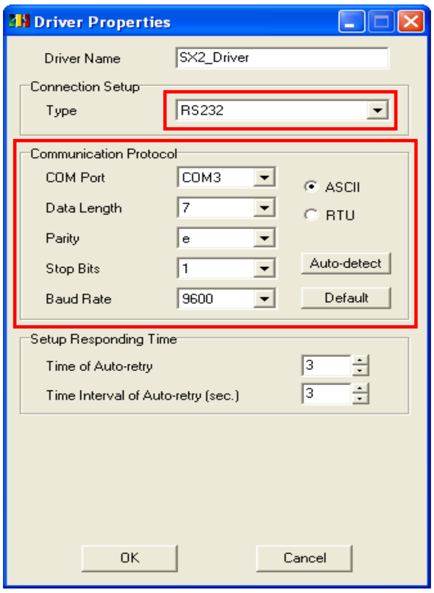
***. Please refer to section 2.4 for more information about subsequent tests and the operation of COMMFR.**

A.3 Setting the USB Port on a DVP-SX2 Series PLC

The operation of the USB port on a DVP-SX2 series PLC differs from the operation of the USB ports on other models in that a circuit which converts USB to RS-232 is installed in the DVP-SX2 series PLC. As a result, the operation inside the DVP-SX2 series PLC adopts RS-232 although the port on the PLC is a USB port. Users must select **RS232** in the **Type** drop-down list box in the **Driver Properties** window if they want to create a driver in COMMGR. The setting of the communication protocol for exchanging data through the USB port is the same as the setting of the communication protocol for exchanging data through a general RS-232 port.

Users can set the communication protocol for exchanging data through the USB port on a DVP-SX2 PLC by means of writing a value into D1109. Please refer to the programming manual for DVP-SX2 series PLCs for more information. If users want to create the driver in COMMGR, they have to make sure that the communication protocol for exchanging data through the driver is the same as the communication protocol for exchanging data through the USB port on a DVP-SX2.





Appendix B Notification for PLC Types

Table of Contents

AH/AS series PLCs are slightly different from DVP series PLCs. Users have to read the manuals for different models before they develop projects. The points to which users have to pay attention when they develop a project for an AH/AS series CPU module are described in appendix B.

B.1 Device Addresses for PLC Types

B.1.1 AH / AS Series Device Types

The device types of AH/AS series CPU modules are listed in the following table.

Device type	Access property	Description
X	Bit/Word	Input relay: It represents the state of a digital input. (*1)
Y	Bit/Word	Output relay: It represents the state of a digital output. (*1)
M	Bit	Auxiliary relay: The state of a bit is stored in an auxiliary relay.
S	Bit	Stepping relay: It is used as a state flag for a step in a sequential function chart.
D	Bit/Word	Data register: Operation data is stored in a data register. (*1)
L	Bit/Word	Link register: A link register is used for data exchange. (*1) (*2)
T	Bit	Timer: If a timer is used as a bit device, the timer is ON when the time interval which is measured conforms to the setting value, and the timer is OFF when the time interval which is measured does not conform to the setting value.
	Word	Timer: If a timer is used as a word device, the value stored in the timer is the present value of the timer.
C	Bit	Counter: If a counter is used as a bit device, the counter is ON when the number of times a particular event or process has occurred conforms to the setting value, and the counter is OFF when the number of times a particular event or process has occurred does not conform to the setting value.
	Word	Counter: If a counter is used as a word device, the value stored in the counter is the present value of the counter.
HC	Bit	32-bit counter: If a 32-bit counter is used as a bit device, the 32-bit counter is ON when the number of times a particular event or process has occurred conforms to the setting value, and the 32-bit counter is OFF when the number of times a particular event or process has occurred does not conform to the setting value.

Device type	Access property	Description
	Word	32-bit counter: If a 32-bit counter is used as a word device, the value stored in the 32-bit counter is the present value of the 32-bit counter.
E	Word	Index register: The value stored in an index register indicates the offset for a device modified. (*3)
SM	Bit	Special auxiliary relay: It is used as a state flag for a special function of the system. (*4)
SR	Word	Special data register: It is used as a data register for a special function of the system. (*4)

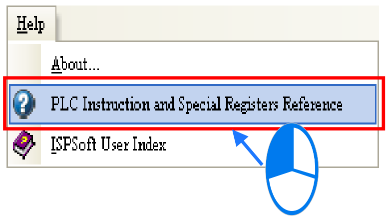
***1. AH/AS series CPU modules support the manipulation of the bits in the input relays, the output relays, the data registers, and the link registers. For example, X0.1 indicates that bit 1 in X0 is manipulated, Y0.1 indicates that bit 1 in Y0 is manipulates, D0.1 indicates that bit 1 in D0 is manipulates, and L0.1 indicates that bit 1 in L0 is manipulated. Please refer to the following sections for more information.**

***2. A link register is used for data exchange, but it can also be used as a general data register. There is no link register for AS series PLC.**

***3. The index registers that AH/AS series CPU modules have are E devices. AH500 series CPU modules do not have F devices.**

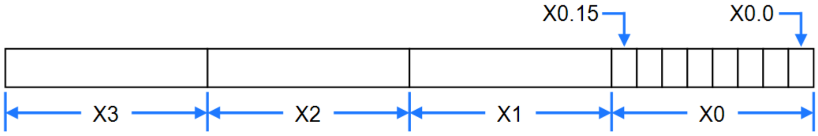
***4. AH/AS series PLCs are different from DVP series PLCs in that the special auxiliary relays and the special data registers in AH500 series PLCs are called SM devices and SR devices.**

Please refer to Programming Manual or **PLC Instructions and Special Registers Reference** in a project for a CPU module in ISPSoft for more information.

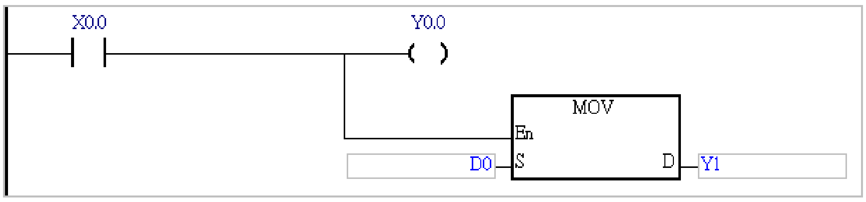


B.1.2 The X/Y/D/L Device Address Format in AH/AS Series

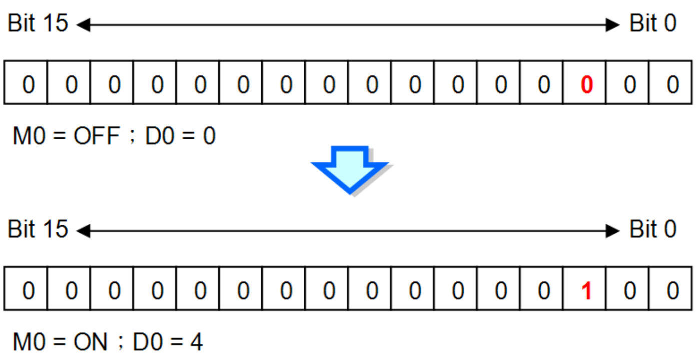
The X/Y devices in DVP series PLCs are represented by X0, Y1, and etc. The X/Y devices which are used as bit devices in AH/AS series CPU modules are represented by X0.0, Y0.0, and etc. The X/Y devices which are used as word devices in AH/AS series CPU modules are represented by X0, Y0, and etc. X0.0 represents the first bit (the lowest bit) in X0, and X0.15 represents the last bit (the highest bit) in X0.



After the value in D0 is moved to Y1, the states of Y1.0~Y1.15 will change.



The bits in the X/Y devices in AH/AS series CPU modules can be manipulated. The bits in the D/L devices in AH500 series CPU modules can also be manipulated in the same way. Please refer to the following example. The state of M0 is sent to D0.2. Suppose the initial value in D0 is 0. When M0 is ON, the value in D0 becomes 4.

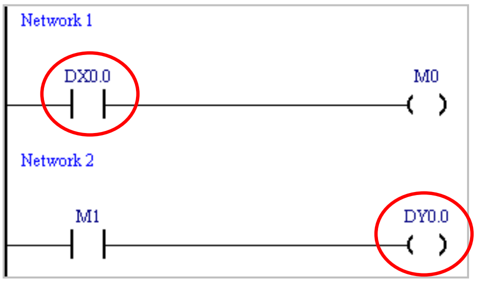


If the bits in the X/Y/D/L devices which are word devices in an AH500 series CPU module are manipulated, the memory blocks that the X/Y/D/L devices occupy are manipulated. However, the memory blocks that the T/C/HC devices used as bit devices occupy are different from the memory blocks that the T/C/HC devices used as word devices occupy. If a timer is used as a bit device, the timer is ON when the time interval which is measured conforms to the setting value, and the timer is OFF when the time interval which is measured does not conform to the setting value. If a timer is used as a word device, the value stored in the timer is the present value of the timer. If a counter is used as a bit device, the counter is ON when the number of times a particular event or process has occurred conforms to the setting value, and the counter is OFF when the number of times a particular event or process has occurred does not conform to the setting value. If a counter is used as a word device, the value stored in the counter is the present value of the counter.

B.1.3 Real-time Access of X / Y Contact in AH / AS Series

The way in which the input/output in an AH/AS series CPU module is updated is similar to the way in which the input/output in a DVP series PLC is updated in that the input/output in either model will be updated after the program in the model is scanned. However, an AH/AS series CPU module supports a special modification. If the X device or the Y device in the network in a program is modified by “D”, the system updates the state of the device when the network is executed. Only X devices and Y devices can be modified by “D”. Symbols can not be modified by “D”.

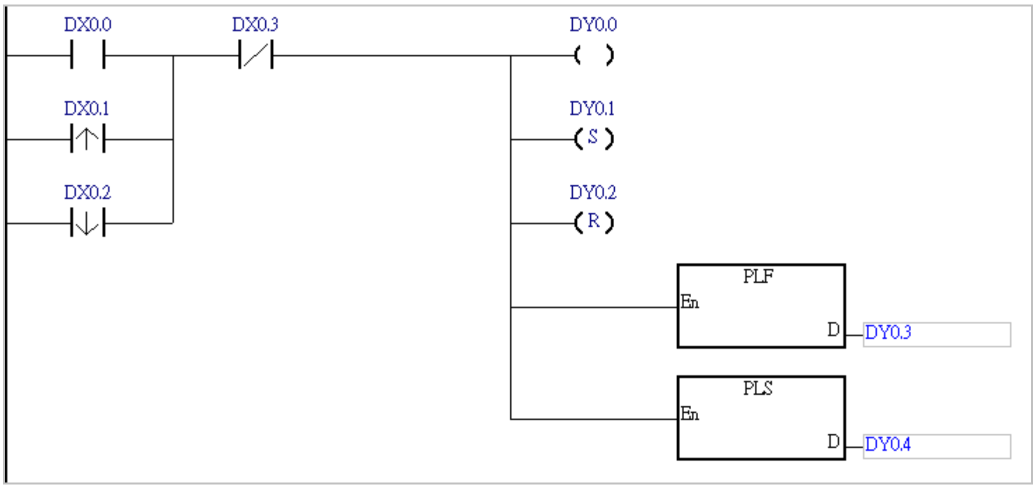
When network 1 is executed, the system reads the state of X0.0. Likewise, the system sends the state of M1 to Y0.0 when network 2 is executed.



The instructions which support the modification by “D” are listed in the following table. If an X device which is modified by “D” or a Y device which is modified by “D” is used in an instruction which is not listed in the table below, the system will regard it as incorrect syntax, and an error will occur after the program is compiled. Besides, only the bits in the X devices which are word devices and the bits in the Y devices which are word devices can be modified by “D”, and the operands in the applied instructions can not be modified by “D”.

Device type	Instruction
X	LD/LDI/LDP/LDF/OR/ORI/ORP/ORF/AND/ANI/ANDP/ANDF
Y	OUT/SET/RST/PLS/PLF

The figure below is an example of applying the modification by “D” legally.

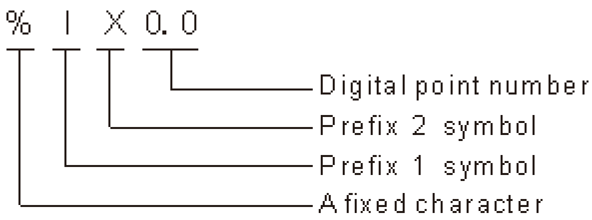


The figure below is an example of applying the modification by “D” illegally. The Y device is modified by “D”. It can not be used as an input contact.

B.1.4 DVPxxMC Device Types

- **Device Name Explanation**

  Unlike AH/AS or DVP series, DVPxxMC series adopts standard IEC (see below).



- **Device List used in DVPxxMC Software**

No.	Item	Content				
1	Prefix 1 symbol	I	Q	M		
2	Prefix 1 name	Input device	Output device	Intermediate device		
3	Prefix 2 symbol	X	B	W	D	L
4	Data type of prefix 2	BIT	BYTE	WORD	DWORD	QWORD
5	Device example	%IX0.0	%IB0	%IW0	%ID0	%IL0
6		%QX0.0	%QB0	%QW0	%QD0	%QL0
7		%MX0.0	%MB0	%MW0	%MD0	%ML0

B.1.5 DVPxxMC Series Device Address Format

- **The Corresponding Relationships of Devices**

The table below shows %ML0 includes %MB0~%MB7, %MD0 includes %MB0~%MB3 and %MW0 includes %MB0~%MB1.

<table>
<tr><th rowspan="3">Device name</th><th colspan="24">Corresponding relationships</th></tr>
<tr><th colspan="6">The 1st WORD</th><th colspan="6">The 2nd WORD</th><th colspan="6">The 3rd WORD</th><th colspan="6">The 4th WORD</th></tr>
<tr><th>Bit 0</th><th>…</th><th>Bit 7</th><th>Bit 8</th><th>…</th><th>Bit 15</th><th>Bit 0</th><th>…</th><th>Bit 7</th><th>Bit 8</th><th>…</th><th>Bit 15</th><th>Bit 0</th><th>…</th><th>Bit 7</th><th>Bit 8</th><th>…</th><th>Bit 15</th><th>Bit 0</th><th>…</th><th>Bit 7</th><th>Bit 8</th><th>…</th><th>Bit 15</th></tr>
<tr><td>%MX</td><td colspan="3">%MX0.0~0.7</td><td colspan="3">%MX1.0~1.7</td><td colspan="3">%MX2.0~2.7</td><td colspan="3">%MX3.0~3.7</td><td colspan="3">%MX4.0~4.7</td><td colspan="3">%MX5.0~5.7</td><td colspan="3">%MX6.0~6.7</td><td colspan="3">%MX7.0~7.7</td></tr>
<tr><td>%MB</td><td colspan="3">%MB0</td><td colspan="3">%MB1</td><td colspan="3">%MB2</td><td colspan="3">%MB3</td><td colspan="3">%MB4</td><td colspan="3">%MB5</td><td colspan="3">%MB6</td><td colspan="3">%MB7</td></tr>
<tr><td>%MW</td><td colspan="6">%MW0</td><td colspan="6">%MW1</td><td colspan="6">%MW2</td><td colspan="6">%MW3</td></tr>
<tr><td>%MD</td><td colspan="12">%MD0</td><td colspan="12">%MD1</td></tr>
<tr><td>%ML</td><td colspan="24">%ML0</td></tr>
</table>

Below, the table shows %ML1 includes %MB8~%MB15, %MD2 includes %MB8~%MB11, %MW4 includes %MB8~%MB9 and %MB8 includes %MX8.0~8.7.

<table>
<tr><th rowspan="3">Device name</th><th colspan="24">Corresponding relationships</th></tr>
<tr><th colspan="6">The 5th WORD</th><th colspan="6">The 6th WORD</th><th colspan="6">The 7th WORD</th><th colspan="6">The 8th WORD</th></tr>
<tr><th>Bit 0</th><th>…</th><th>Bit 7</th><th>Bit 8</th><th>…</th><th>Bit 15</th><th>Bit 0</th><th>…</th><th>Bit 7</th><th>Bit 8</th><th>…</th><th>Bit 15</th><th>Bit 0</th><th>…</th><th>Bit 7</th><th>Bit 8</th><th>…</th><th>Bit 15</th><th>Bit 0</th><th>…</th><th>Bit 7</th><th>Bit 8</th><th>…</th><th>Bit 15</th></tr>
<tr><td>%MX</td><td colspan="3">%MX8.0~8.7</td><td colspan="3">%MX9.0~9.7</td><td colspan="3">%MX10.0~10.7</td><td colspan="3">%MX11.0~11.7</td><td colspan="3">%MX12.0~12.7</td><td colspan="3">%MX13.0~13.7</td><td colspan="3">%MX14.0~14.7</td><td colspan="3">%MX15.0~15.7</td></tr>
<tr><td>%MB</td><td colspan="3">%MB8</td><td colspan="3">%MB9</td><td colspan="3">%MB10</td><td colspan="3">%MB11</td><td colspan="3">%MB12</td><td colspan="3">%MB13</td><td colspan="3">%MB14</td><td colspan="3">%MB15</td></tr>
<tr><td>%MW</td><td colspan="6">%MW4</td><td colspan="6">%MW5</td><td colspan="6">%MW6</td><td colspan="6">%MW7</td></tr>
<tr><td>%MD</td><td colspan="12">%MD2</td><td colspan="12">%MD3</td></tr>
<tr><td>%ML</td><td colspan="24">%ML</td></tr>
</table>

B.1.6 DVPxxMC Retentive Devices

The retentive devices include %MW0~%MW999. Also, variables in the software can set to retentive or non-retentive. The retentive volume is 100K byte.

B.2 Device Resources for PLC Types

B.2.1 AHCPU500-EN / AHCPU500-RS2

Device type	Address range	
X	Word: X0~X63	Bit: X0.0~X63.15
Y	Word: Y0~Y63	Bit: Y0.0~Y63.15
D	Word: D0~D16383	Bit: D0.0~D16383.15
L	Word: L0~L16383	Bit: L0.0~L16383.15
M	M0~M8191	
S	S0~S2047	
C	C0~C2047	
HC	HC0~HC63	
T	T0~T2047	
E	E0~E31	
SR	SR0~SR2047	
SM	SM0~SM2047	
Number of memory blocks which can be assigned to function block instances	64	

B.2.2 AHCPU510-EN / AHCPU510-RS2

Device type	Address range	
X	Word: X0~X127	Bit: X0.0~X127.15
Y	Word: Y0~Y127	Bit: Y0.0~Y127.15
D	Word: D0~D32767	Bit: D0.0~D32767.15
L	Word: L0~L32767	Bit: L0.0~L32767.15
M	M0~M8191	
S	S0~S2047	
C	C0~C2047	
HC	HC0~HC63	
T	T0~T2047	
E	E0~E31	
SR	SR0~SR2047	
SM	SM0~SM2047	
Number of memory blocks which can be assigned to function block instances	256	

B.2.3 AHCPU520-EN / AHCPU520-RS2

Device type	Address range	
X	Word: X0~X255	Bit: X0.0~X255.15
Y	Word: Y0~Y255	Bit: Y0.0~Y255.15
D	Word: D0~D65535	Bit: D0.0~D65535.15
L	Word: L0~L65535	Bit: L0.0~L65535.15
M	M0~M8191	
S	S0~S2047	
C	C0~C2047	
HC	HC0~HC63	
T	T0~T2047	
E	E0~E31	
SR	SR0~SR2047	
SM	SM0~SM2047	
Number of memory blocks which can be assigned to function block instances	512	

B.2.4 AHCPU530-EN / AHCPU530-RS2

Device type	Address range	
X	Word: X0~X511	Bit: X0.0~X511.15
Y	Word: Y0~Y511	Bit: Y0.0~Y511.15
D	Word: D0~D65535	Bit: D0.0~D65535.15
L	Word: L0~L65535	Bit: L0.0~L65535.15
M	M0~M8191	
S	S0~S2047	
C	C0~C2047	
HC	HC0~HC63	
T	T0~T2047	
E	E0~E31	
SR	SR0~SR2047	
SM	SM0~SM2047	
Number of memory blocks which can be assigned to function block instances	1024	

B.2.5 AHCPU501-EN / AHCPU501-RS2

Device type	Address range	
X	Word: X0~X127	Bit: X0.0~X127.15
Y	Word: Y0~Y127	Bit: Y0.0~Y127.15
D	Word: D0~D24575	Bit: D0.0~D24575.15
L	Word: L0~L24575	Bit: L0.0~L24575.15
M	M0~M8191	
S	S0~S2047	
C	C0~C2047	
HC	HC0~HC63	
T	T0~T2047	
E	E0~E31	
SR	SR0~SR2047	
SM	SM0~SM2047	

B.2.6 AHCPU511-EN / AHCPU511-RS2

Device type	Address range	
X	Word: X0~X255	Bit: X0.0~X255.15
Y	Word: Y0~Y255	Bit: Y0.0~Y255.15
D	Word: D0~D49151	Bit: D0.0~D49151.15
L	Word: L0~L49151	Bit: L0.0~L49151.15
M	M0~M8191	
S	S0~S2047	
C	C0~C2047	
HC	HC0~HC63	
T	T0~T2047	
E	E0~E31	
SR	SR0~SR4096	
SM	SM0~SM4096	

B.2.7 AHCPU521-EN / AHCPU521-RS2

Device type	Address range	
X	Word: X0~X511	Bit: X0.0~X511.15
Y	Word: Y0~Y511	Bit: Y0.0~Y511.15
D	Word: D0~D98303	Bit: D0.0~D98303.15
L	Word: L0~L98303	Bit: L0.0~L98303.15
M	M0~M8191	
S	S0~S2047	
C	C0~C2047	
HC	HC0~HC63	
T	T0~T2047	
E	E0~E31	
SR	SR0~SR2047	
SM	SM0~SM2047	

B.2.8 AHCPU531-EN / AHCPU531-RS2

Device type	Address range	
X	Word: X0~X1023	Bit: X0.0~X1023.15
Y	Word: Y0~Y1023	Bit: Y0.0~Y1023.15
D	Word: D0~D131071	Bit: D0.0~D131071.15
L	Word: L0~L131071	Bit: L0.0~L131071.15
M	M0~M8191	
S	S0~S2047	
C	C0~C2047	
HC	HC0~HC63	
T	T0~T2047	
E	E0~E31	
SR	SR0~SR4095	
SM	SM0~SM4095	

B.2.9 AHCPU560-EN2

Device type	Address range	
X	Word: X0~X4095	Bit: X0.0~X4095.15
Y	Word: Y0~Y4095	Bit: Y0.0~Y4095.15
D	Word: D0~D262143	Bit: D0.0~D262143.15
L	Word: L0~L262143	Bit: L0.0~L262143.15
M	M0~M8191	
S	S0~S4095	
C	C0~C2047	
HC	HC0~HC63	
T	T0~T2047	
E	E0~E31	
SR	SR0~SR4095	
SM	SM0~SM4095	

B.2.10 AHxxEMC

Device type	Address range	
X	Word: X0~X511	Bit: X0.0~X511.15
Y	Word: Y0~Y511	Bit: Y0.0~Y511.15
D	Word: D0~D65535	Bit: D0.0~D65535.15
L	Word: L0~L65535	Bit: L0.0~L65535.15
M	M0~M8191	
S	S0~S2047	
C	C0~C2047	
HC	HC0~HC63	
T	T0~T2047	
E	E0~E31	
SR	SR0~SR2047	
SM	SM0~SM2047	

B.2.11 AS200 / AS300

Device type	Address range	
X	Word: X0~X63	Bit: X0.0~X63.15
Y	Word: Y0~Y63	Bit: Y0.0~Y63.15
D	Word: D0~D29999	Bit: D0.0~D29999.15
M	M0~M8191	
S	S0~S2047	
C	C0~C511	
HC	HC0~HC255	
T	T0~T511	
E	E0~E14	
SR	SR0~SR2047	
SM	SM0~SM4095	

B.2.12 DVPxxMC

Device type	Address range
%IX	%IX0.0~%IX127.7
%QX	%QX0.0~%QX127.7
%MX	%MX0.0~%MX131071.7
%IB	%IB0~%IB127
%QB	%QB0~%QB127
%MB	%MB0~%MB131071
%IW	%IW0~%IW63
%QW	%QW0~%QW63
%MW	%MW0~%MW65535
%ID	%ID0~%ID31
%QD	%QD0~%QD31
%MD	%MD0~%MD32767
%IL	%IL0~%IL15
%QL	%QL0~%QL15
%ML	%ML0~%ML16383

B.3 Compile & Uploading / Downloading Time

The duration for ISPSoft to compile programs is involved with the size, quantity of the programs and the variable symbols and the condition of the computer. The duration to upload/download is involved with the size of the project, the connection type and the communication speed. The following information is listed for reference.

Operation System on the computer: CPU Intel(R) I7, RAM 4GB, Windows 7 32-bit

Project contents: 2 variable symbols and a basic ladder diagram with a total of 5000 networks; each network contains 1 contact and 1 output coil.

Program compilation time: about 2 seconds

Program capacity: 10K STEP

Time for uploading: about 4.9 seconds via USB port

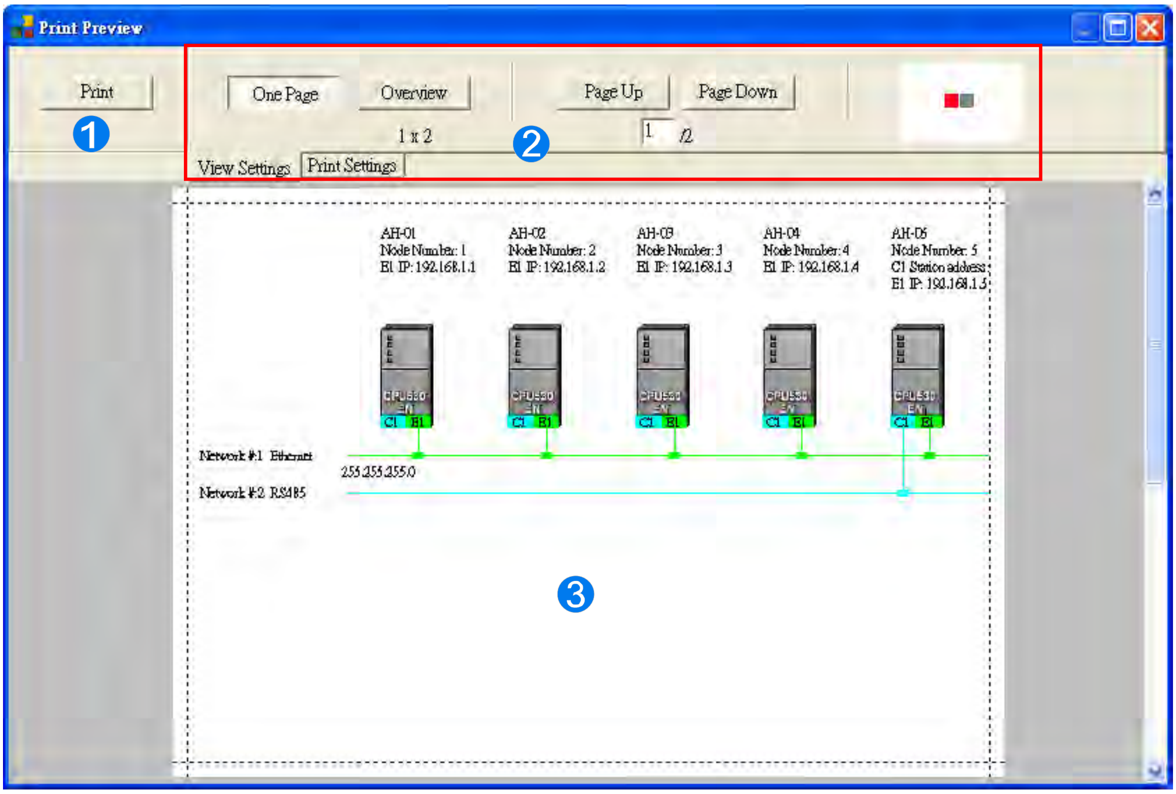
Time for downloading: about 4.6 seconds via USB port

Appendix C Print Management Tool

Table of Contents

C.1 Introduction of the Environment

The print management tool provides a convenient operation interface. Users can set a print format, and preview the document which will be printed in the **Print Preview** window.

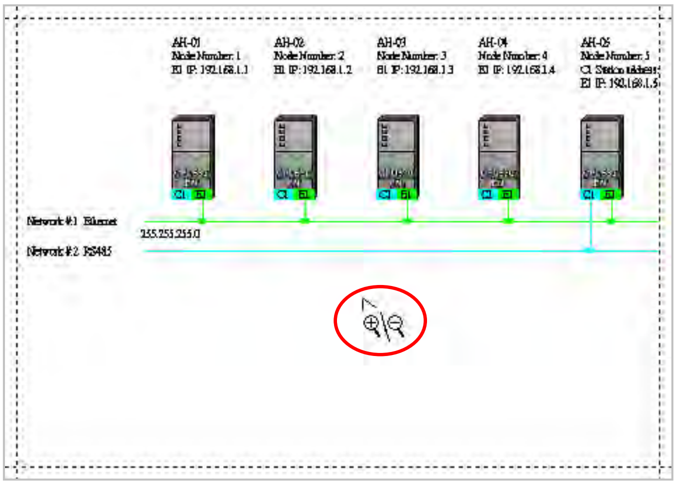


❶ **Print button**: After the setting is complete, users can click the **Print** button to start the printing of the document.

❷ **Setting area**: There are two tabs in the setting area. One is the **View Settings** tab, and the other is the **Print Settings** tab.

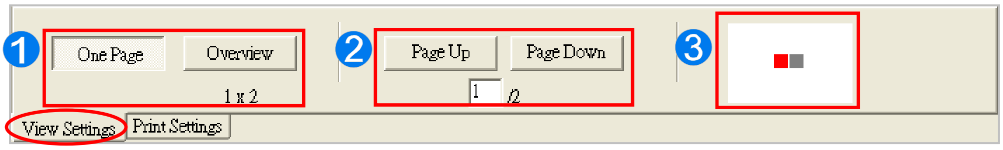
❸ **Preview area**: The document which will be printed is displayed in this area.

If users move the mouse cursor to the preview area and click the left mouse button, the pointer will become a magnifying glass. After the left mouse button is clicked, ISPSoft will zoom in on the preview area. After the right mouse button is clicked, ISPSoft will zoom out on the preview area.



C.2 Introduction of the Setting Area

After users click the **View Settings** tab, they can adjust the display state of the preview area.

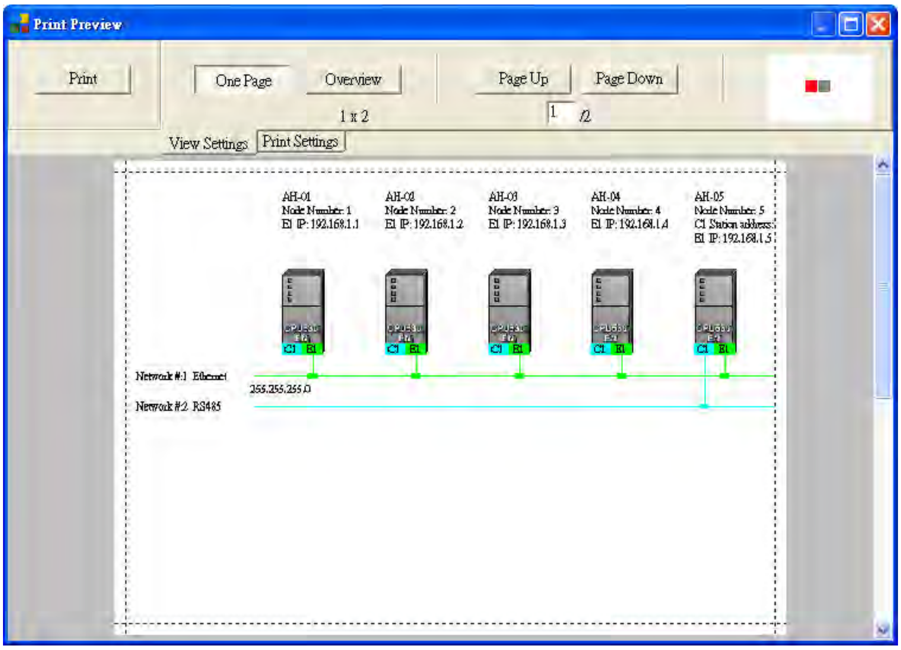


❶ If the print area does not fit the printed page, the system will divide the print area into several pages. After **One Page** is clicked, one page will be displayed. After **Overview** is clicked, all the pages will be displayed. The number of pages into which the print area is divided is under the **Overview** button.

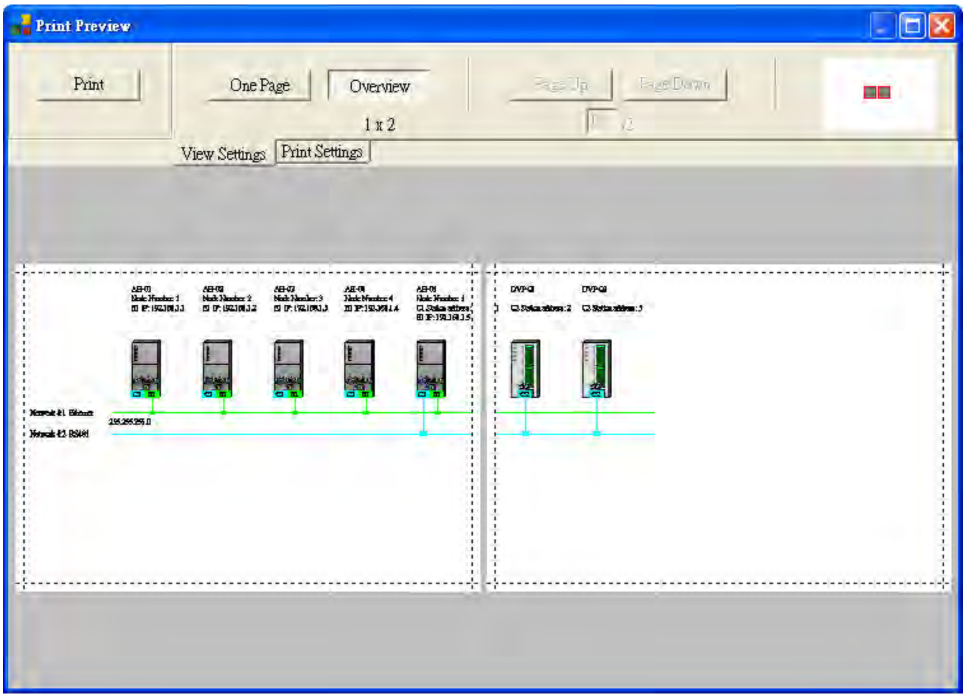
❷ Users can select a page which will be displayed by clicking **Page Up** or **Page Down**. The present page number and the total number of pages are under the buttons.

❸ The graphic representations show the relative positions of all the pages. The red block represents the present page.

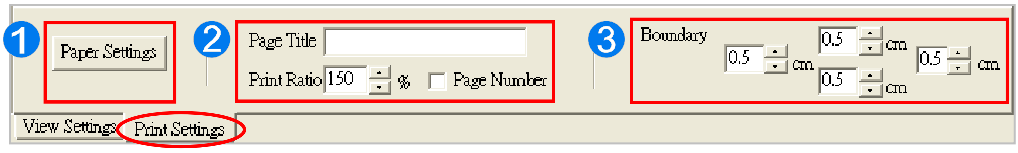
- **One page**



● **Overview**



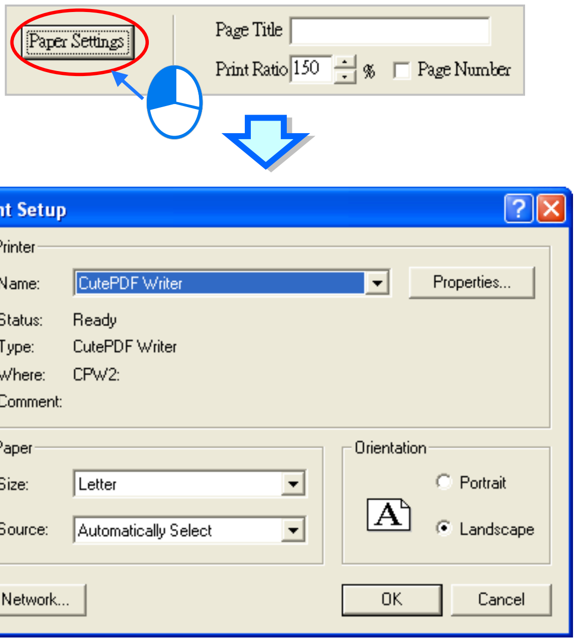
After users click the **Print Setting** tab, they can set the print format.



❶ After **Paper Settings** is clicked, the **Print Setup** window will appear.

❷ Users can scale the document by selecting a percentage in the **Print Ratio** box. The users can also insert page numbers and a page title in the document.

❸ User can set document margins they want.



After the setting is complete, users can click the **Print** button to start the printing of the document.