GX Works2

Programming and
Documentation System

Beginner's Manual

10 08 2011
Version A

About this Manual

The texts, illustrations, diagrams and examples in this manual are only intended as aids to help explain the functioning, operation, use and programming of the **GX Works2** programming and documentation system.

For using and usage of this software only the user his own is responsible.

If you have any questions regarding the installation and operation of the software described in this manual, please do not hesitate to contact your sales office or one of your Mitsubishi distribution partners. You can also obtain information and answers to frequently asked questions from our Mitsubishi website under www.mitsubishi-automation.com.

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Beginner's Manual for MELSOFT GX Works2	
Version	**Changes / Additions / Corrections**
A 08/2011 pdp	First issue

Typographic Conventions

Use of notes

Notes containing important information are clearly identified as follows:

NOTE | Note text

Use of examples

Examples containing important information are clearly identified as follows:

Example ▽ Example text △

Numbering in figures and illustrations

Reference numbers in figures and illustrations are shown with white numbers in a black circle and the corresponding explanations shown beneath the illustrations are identified with the same numbers, like this:

❶ ❷ ❸ ❹

Procedures

In some cases the setup, operation, maintenance and other instructions are explained with numbered procedures. The individual steps of these procedures are numbered in ascending order with black numbers in a white circle, and they must be performed in the exact order shown:

① Text

② Text

③ Text

Footnotes in tables

Footnote characters in tables are printed in superscript and the corresponding footnotes shown beneath the table are identified by the same characters, also in superscript.

If a table contains more than one footnote, they are all listed below the table and numbered in ascending order with black numbers in a white circle, like this:

① Text
② Text
③ Text

Character formatting and orientation aids

Menu names, menu commands, submenu commands, and dialog box options are printed in **boldface** type. Examples: The menu item **New** in the menu **Project** or the options **PLC interface** and **Computer Link** in the dialog box **Transfer-Setup**.

Please keep this manual in a place where it is always available for the users.

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1 Introduction

1.1 This manual…

...is a compact guide to using GX Works2, suitable both for beginners and experienced users upgrading from other systems. The "Getting Started" chapter provides a step-by-step description of how to use GX Works2, followed by some precisely descriped sample projects. These executable applications are used to demonstrate the operation of a program with the help of the exercises provided in this manual.

1.2 If you are not yet familiar with Windows®…

… please at least read the Windows® Fundamentals section in the Windows® User's Guide, or work through the Windows® Tutorial accessible through the Help menu of the Windows® Program Manager. This will teach you what you need to know about using the basic elements of Microsoft Windows® , and the operating procedures that are identical in all Windows® application programs.

NOTE

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1.3 If you get stuck…

… do not despair, help is never far away! If you run up against seemingly insoluble problems, or if you have questions about GX Works2 or the connected programmable controller (PLC) configuration, please first refer to the manuals and documentation. Many answers and solutions can also be found directly in the GX Works2 online help system, which can always be accessed by pressing the F1 key. Make use of the **Search** command in the **Help** menu as well, as this will often locate the information you need.

If you cannot find answers to your questions in any of these places, contact your local MITSUBISHI ELECTRIC representative or call our European headquarters in Ratingen directly. The addresses and phone numbers are provided on the back covers of all our manuals.

1.4 Manuals

Related manuals are separately issued according to the purpose of their functions in GX Works2.

The manuals related to this product are shown below.

Refer to the following table when ordering required manuals.

Manual name	Manual number (Model code)
GX Works2 Operating Manual (Simple Project) Explains operation methods such as creating and monitoring programs in Simple project of GX Works2.	SH-080780ENG (13JU64)
GX Works2 Operating Manual (Structured Project) Explains operation methods such as creating and monitoring programs in Structured project of GX Works2.	SH-080781ENG (13JU65)
GX Works2 Operating Manual (Intelligent Function Module) Explains operation methods of intelligent function module such as parameter setting, monitoring programs, and predefined protocol support function in GX Works2.	SH-080921ENG (13JU69)

Tab. 1-1: *Manuals related to Operation of GX Works2*

1.4.1 Displaying operating manuals

To display the operating manuals select **Help → Operating Manual →** [manual name].

2 Getting to Know GX Works2

GX Works2 is a programming tool for designing, debugging, and maintaining programs on Windows®.
GX Works2 has improved functionality and operability, with easier-to-use features compared to existing GX Developer.

2.1 Main functions of GX Works2

GX Works2 can manage programs and parameters in units of projects for each programmable controller CPU.
The following explains the main functions.

2.1.1 Programming

Programs can be created in a Simple project in a similar way with existing GX Developer. Structured programming in a Structured project is also available with GX Works2.

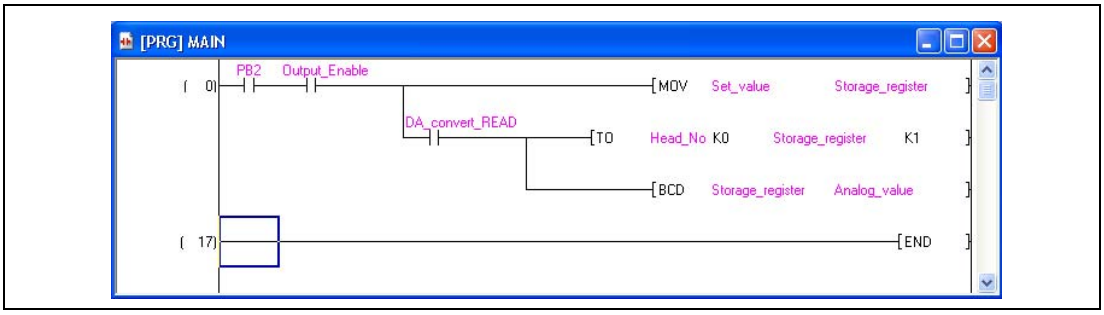


Fig. 2-1: *Sample program*

GX Works2 increases your productivity:

The modular architecture of GX Works2 brings big advantages for complex programming projects. Frequently-needed program blocks and functions only need to be created once. Thanks to the building block system you can then insert them again and again wherever and whenever required. This significantly reduces your programming overheads, enabling you to make major changes to your programs with just a few simple operations.

2.1.2 Setting parameters

Programmable controller CPU parameter and Network parameter can be set with GX Works2.
Intelligent function module parameter can be set as well.
(For FXCPU, Network parameter setting is not available.).

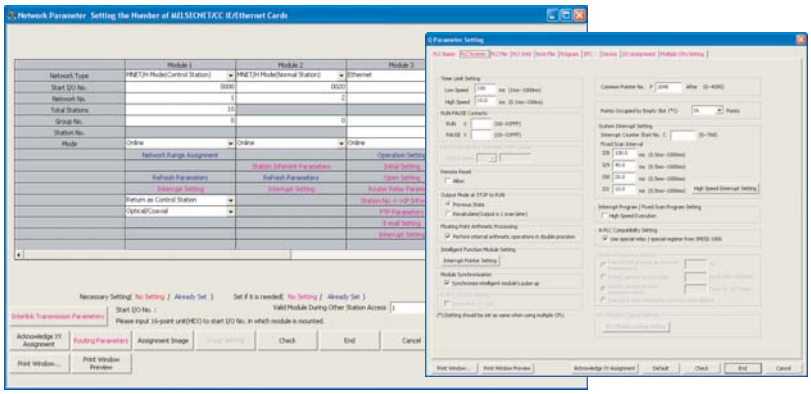


Fig. 2-2: *Setting parameters*

2.1.3 Writing/reading data to/from a programmable controller CPU

Created sequence programs can be written to/read from a programmable controller CPU using the Read from PLC/Write to PLC function. Also, using the Online program change function, the sequence programs can be changed even when the programmable controller CPU is in RUN.

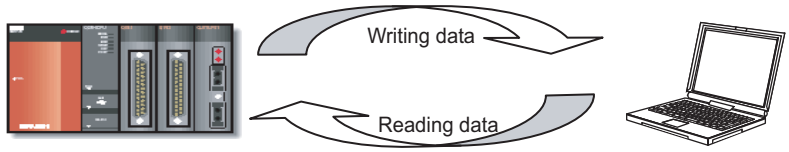


Fig. 2-3: *Writing/reading data*

2.1.4 Monitoring/debugging

Created sequence programs can be written to the programmable controller CPU and device value at operation can be monitored online/offline.

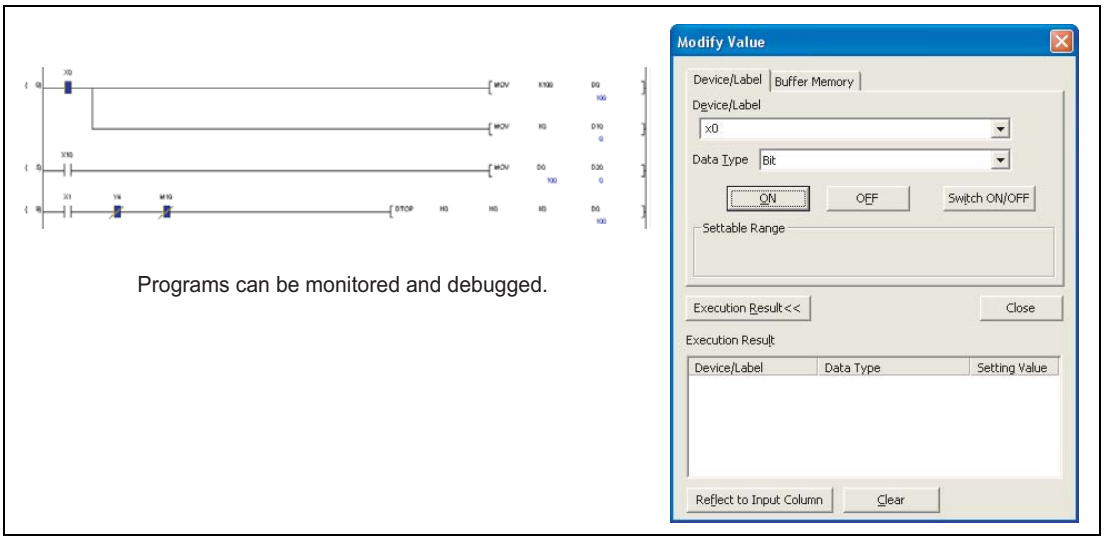


Fig. 2-4: *Monitoring/debugging*

2.1.5 Diagnostics

The current error status and error history of the programmable controller CPU can be diagnosed. Using the diagnostics function, the recovery work is completed in a short time.

Using the System monitor function (for QCPU (Q mode)/LCPU), detailed information on such as intelligent function modules can be obtained. This helps to shorten the recovery work time at error occurrence.

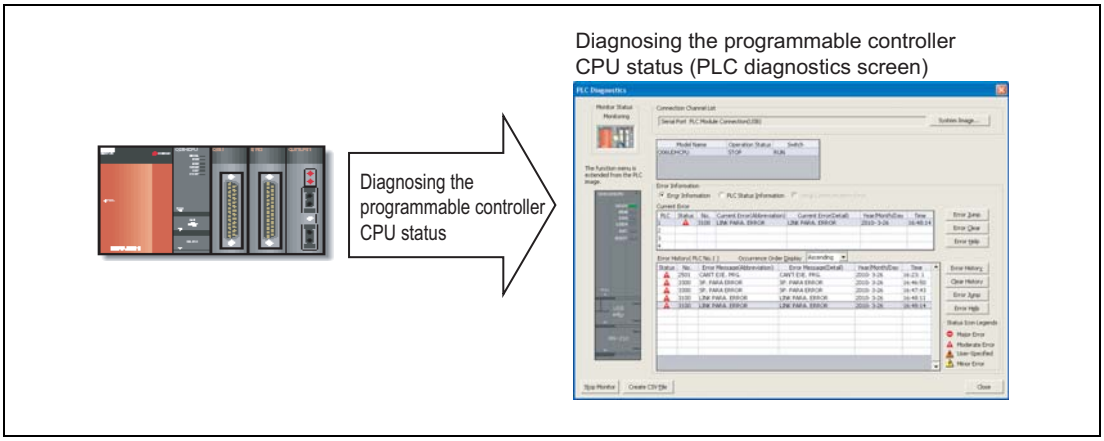


Fig. 2-5: *Diagnostics*

2.2 Features

This section explains the features of GX Works2.

2.2.1 Project types in GX Works2

In GX Works2, the project type can be selected from either of Simple project or Structured project.

Simple project

The Simple project creates sequence programs using instructions for Mitsubishi programmable controller CPU.
Programs in a Simple project can be created in a similar way with existing GX Developer.
Programming without labels and label programming are supported as in GX Developer and GX IEC Developer.

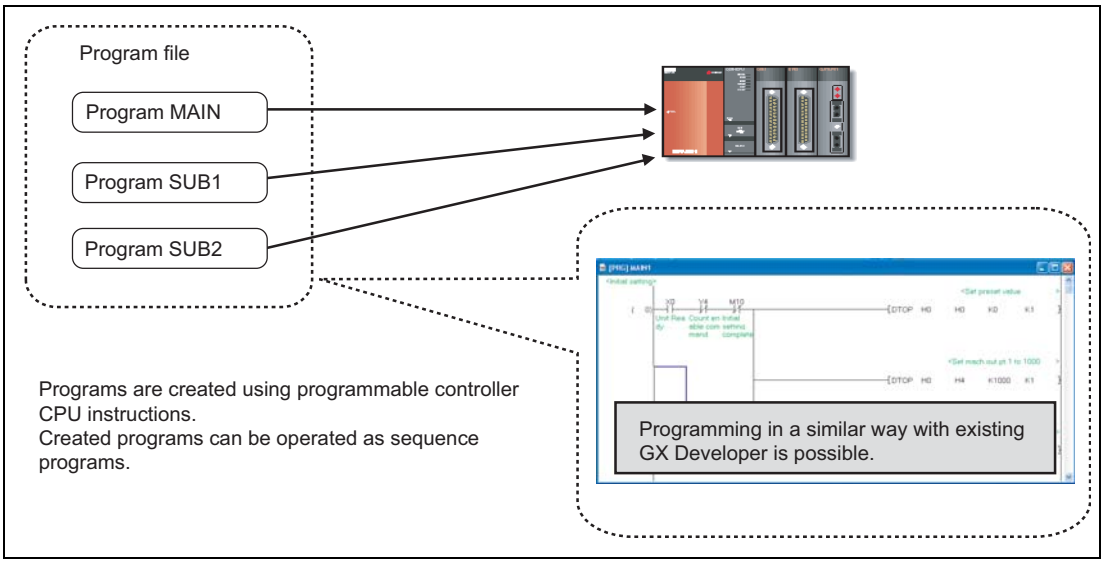


Fig. 2-6: *Simple project*

Structured project

In a Structured project, programs can be created by structured programming.
By segmenting a whole control process program into common program parts, highly manageable and usable programming (structured programming) is possible.
Only label programming is supported.

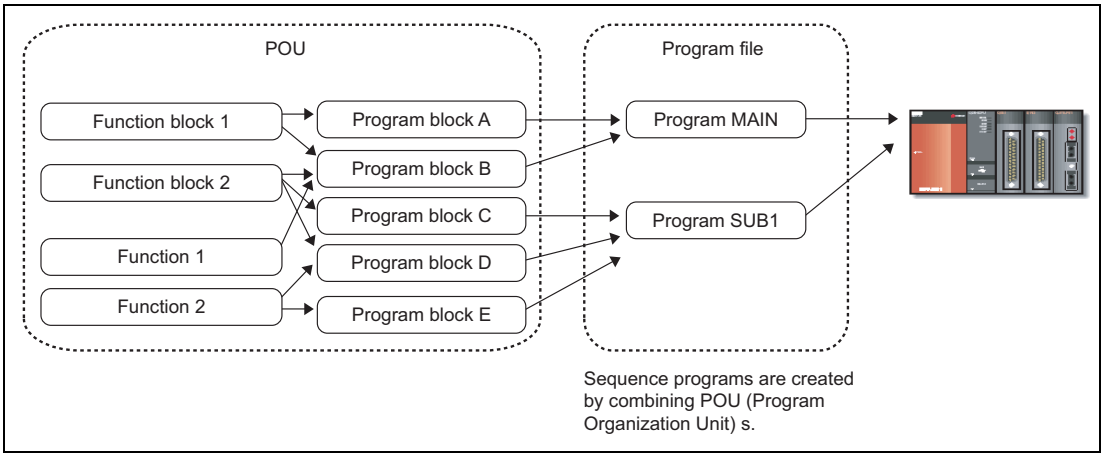


Fig. 2-7: *Structured project*

2.2.2 Programming using labels

Using the label programming, programs can be created without regard for the device numbers.
By compiling a program created with the label programming, devices are automatically assigned and the program becomes available as an actual program.

Created global labels can be utilized for other programs.

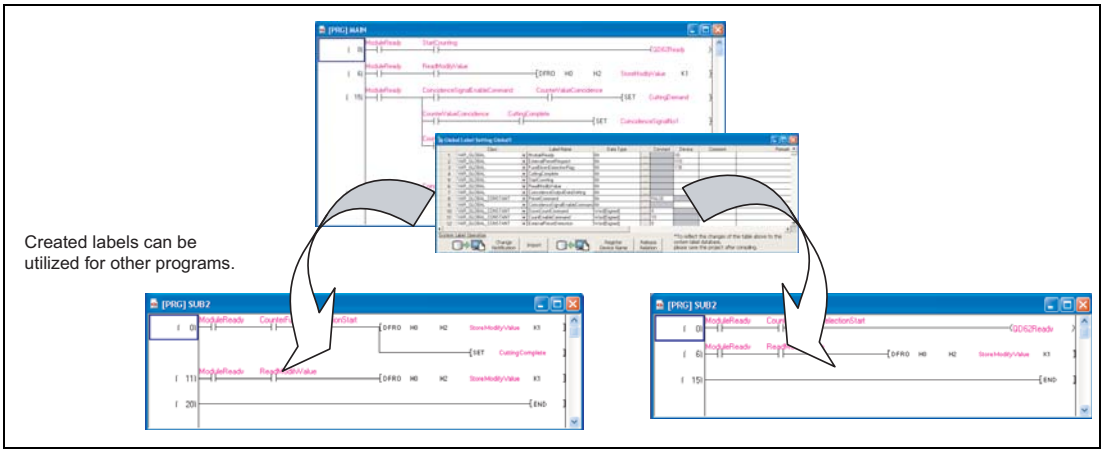


Fig. 2-8: *Programming using labels*

In addition, global labels can be registered as system labels and be shared within iQ Works compliant products (GX Works2, MT Developer2, and GT Designer3).

For details of system labels, refer to the following manual:

- iQ Works Beginner's Manual

2.2.3 Enhanced use of program assets

Projects created with existing GX Developer or GX IEC Developer can be utilized in GX Works2. GX Developer projects are opened as Simple projects and GX IEC Developer projects, as Structured projects. Utilizing the past assets improves the efficiency of program design.

For further details please see Cap. 3.

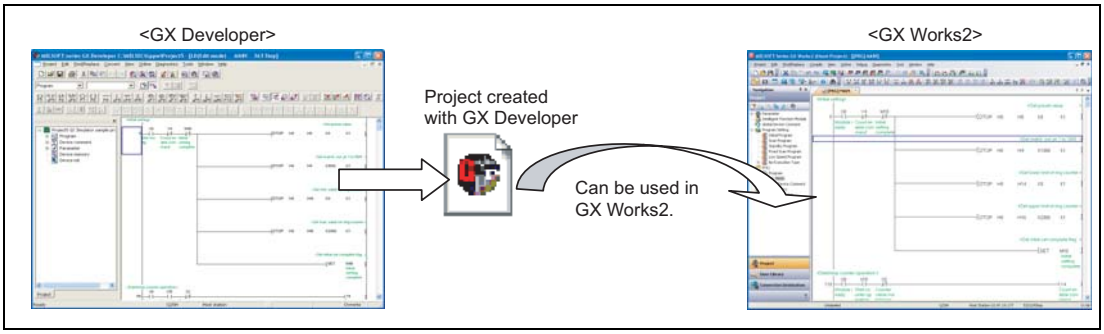


Fig. 2-9: *Utilizing existing projects*

2.2.4 Sharing Program Organization Unit (POU) registered as libraries

In a Structured project, programs, global labels, and structures frequently used can be registered as libraries. Utilizing these libraries reduces time required for creating programs.

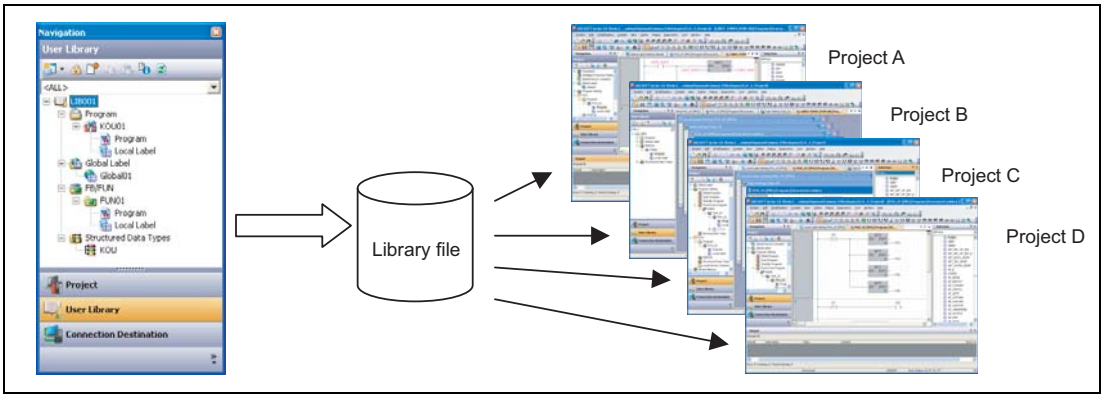


Fig. 2-10: *Sharing POUs*

2.2.5 Wide variety of programming languages

GX Works2 is a multi-language system:

GX Works2 supports programming in different languages. Several graphical and text-based editors help you to write tailor-made programs quickly and easily, choosing the language that best suits the problem.

The wide variety of programming languages available with GX Works2 enables to select the optimum programming language depending on control.

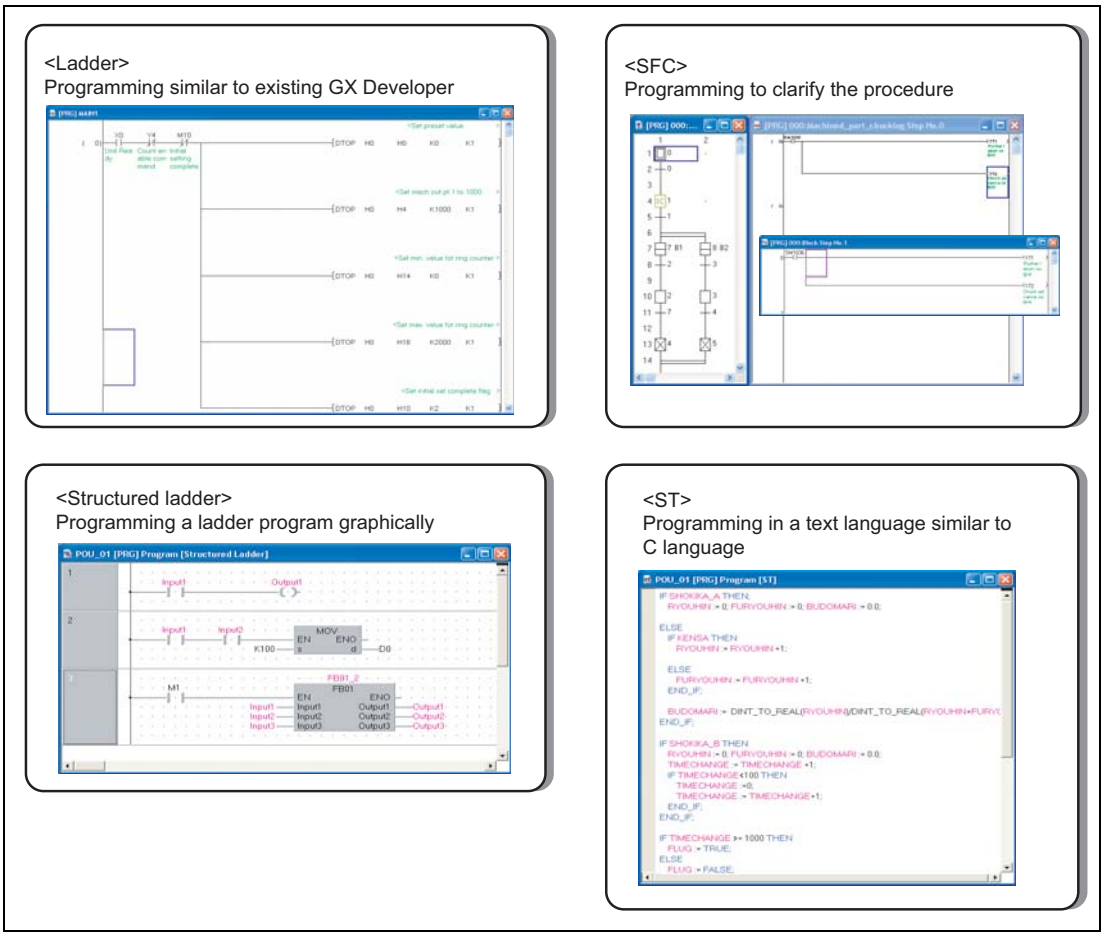


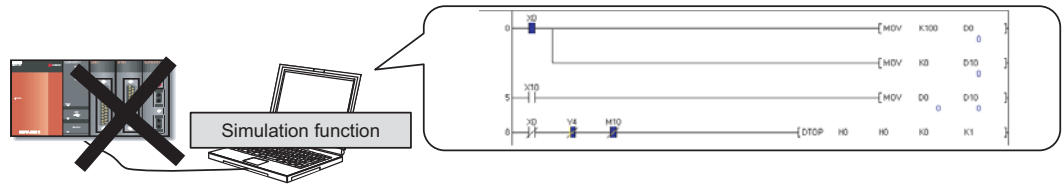
Fig. 2-11: *Programming languages*

ST programs can be used on the ladder editor of GX Works2 using the **Inline structured text** function.

2.2.6 Other features

Offline debugging

Offline debugging using the simulation function is possible with GX Works2. This enables debugging to ensure the normal operation of created sequence programs without connecting GX Works2 to the programmable controller CPU.



Connecting to the programmable controller is unnecessary.

Without connecting to the programmable controller CPU, programs can be monitored and debugged in the same way with debugging by the programmable controller CPU.

Fig. 2-12: *Offline debugging*

The screen layout can be customized to the user's preference

The docking windows enable to change the screen layout of GX Works2 without restriction.

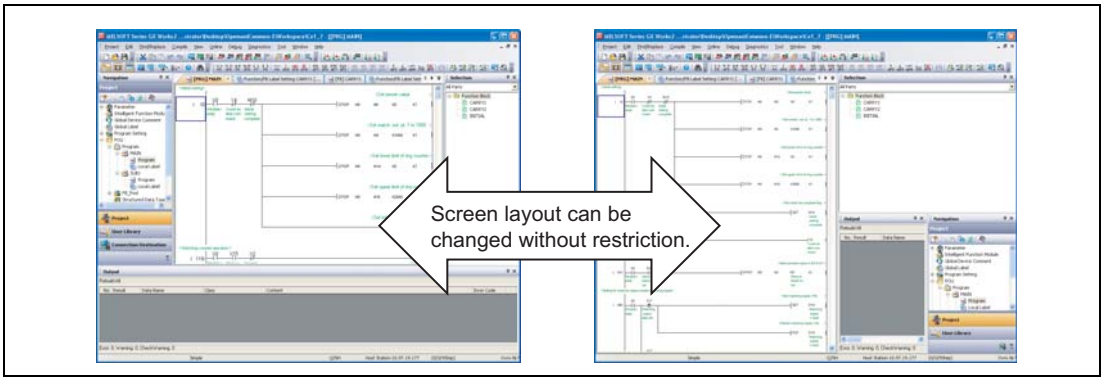


Fig. 2-13: *Customizing the screen layout*

3 Utilizing projects from GX Developer or GX IEC Developer

3.1 Utilizing Projects and Data in Other Formats

This section explains the method for utilizing projects created with GX Developer or GX IEC Developer, and files (ASCII files) created using the Export function of GX IEC Developer in GX Works2. Projects edited with GX Works2 can also be utilized in GX Developer.

For FXCPU, only projects created with GX Developer can be utilized.

NOTE

Precautions for utilizing older projects
For a detailed description of the precautions when using GX Works2 and the differences between GX Works2 and GX Developer or GX IEC Developer please see the Appendix of the GX Works2 Operating Manual (Common).

3.1.1 Utilizing projects and data created with GX Developer or GX IEC Developer in GX Works2

Projects created with GX Developer or GX IEC Developer can be utilized in GX Works2 by using the **Open Other Project** function (see Section 3.2).

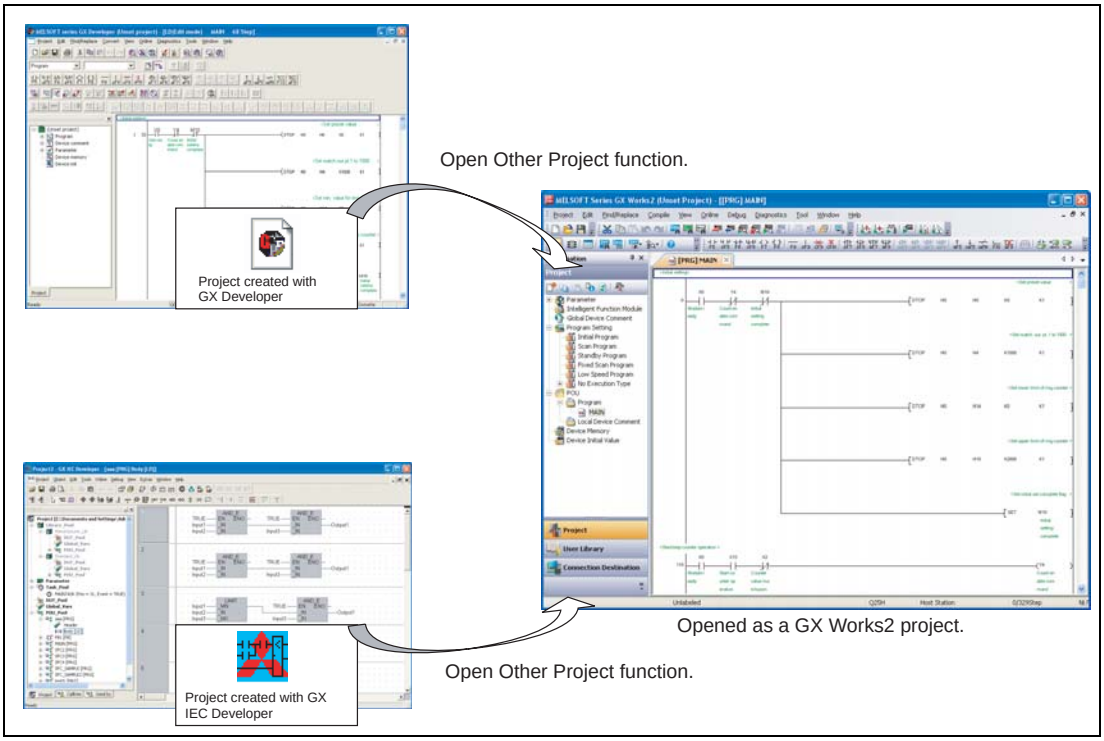


Fig. 3-1: *Utilizing older projects*

3.1.2 Utilizing files created using the Export function of GX IEC Developer

ASCII files created using the **Export** function of GX IEC Developer can be added as projects in GX Works2 by using the **Read ASC Format File** function (see Section 3.3).

This function is not supported by FXCPU.

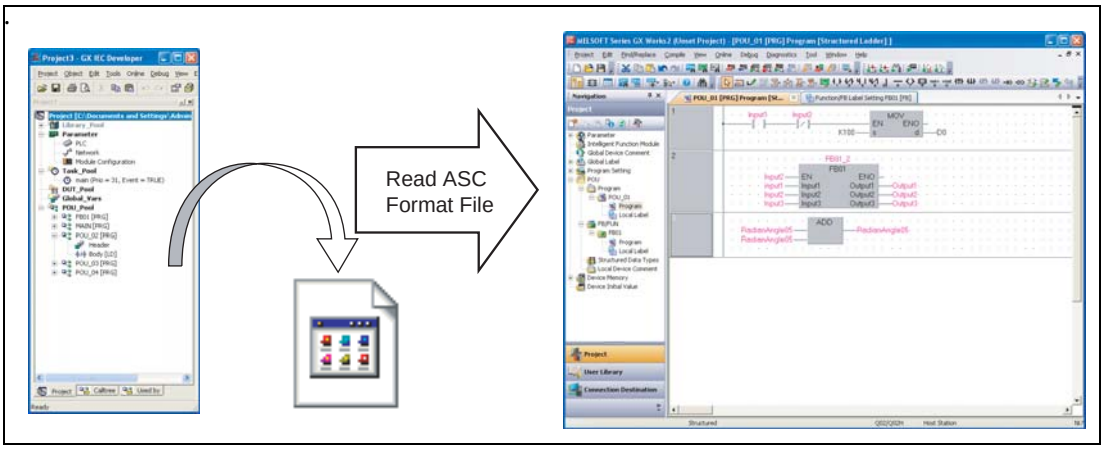


Fig. 3-2: *Utilizing projects created in GX IEC Developer using the **Export** function*

3.1.3 Utilizing projects and data created with GX Works2 in GX Developer

Files created/edited in Simple project with GX Works2 can be utilized in GX Developer by using the **Export to GX Developer Format File** function (see Section 3.4).

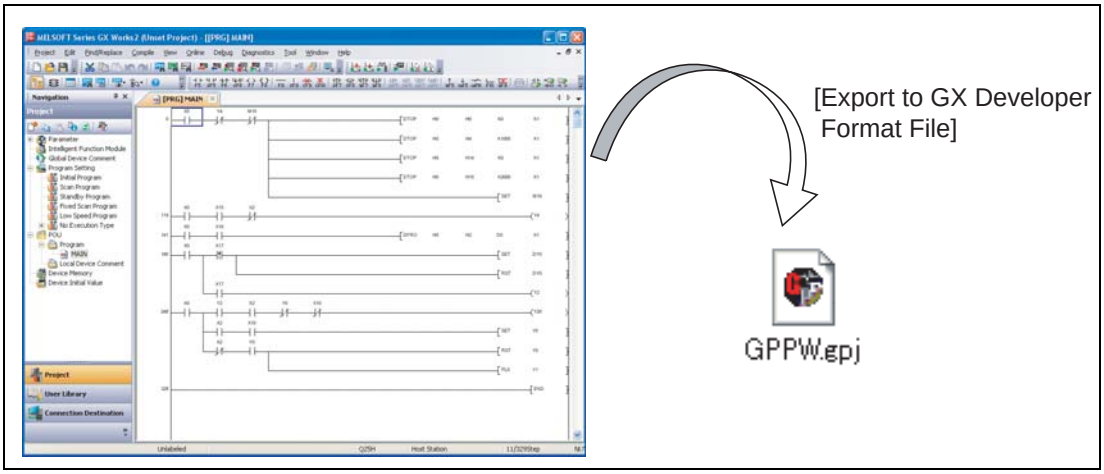


Fig. 3-3: *Export from GX Works2 to GX Developer*

3.1.4 Storage of utilized data in GX Works2

Each project and data created with GX Developer or GX IEC Developer are stored in the areas shown in the table below with GX Works2.

GX Developer projects are opened as Simple projects and GX IEC Developer projects, as Structured projects.

Comparison of projects and data storage locations between GX Developer and GX Works2

GX Developer	GX Works2 (Simple project)	GX Works2 (Structured project)
Parameter	Parameter	Parameter
Device Comment	Global Device Comment	Global Device Comment
Global variables	Global Label	Global Label
Program	Program	POU
FB	FB_Pool	FB/FUN
Structure	Structured Data Types	Structured Data Types
Device memory	Device Memory	Device Memory
Device initial value	Device Initial Value	Device Initial Value

Tab. 3-1: *Comparison between GX Developer and GX Works2*

Comparison of projects and data storage locations between GX IEC Developer and GX Works2

GX IEC Developer	GX Works2 (Structured project)
User Library	User Library
Parameter (Programmable controller parameter)	Parameter
DUT_Pool (Structure)	Structured Data Types
Global_Vars (Global variable)	Global Label
Task_Pool	POU in Project tree window → Program setting
POU_Pool	POU in Project tree window → Program setting

Tab. 3-1: *Comparison between GX IEC Developer and GX Works2*

3.1.5 Security level of GX IEC Developer

The security level in the GX IEC Developer project is cleared after reading the project.

When the GX IEC Developer project is read using GX Works2, the following **Enter Password** screen is displayed.

Fig. 3-4:
Dialog window ***Enter Password***

3.1.6 Compatible applications

For **Open Other Project** and **Export to GX Developer Format File**, the supported versions may differ depending on the CPU type.

For the application compatibility, refer to: GX Works2 Operating Manual (Common)

3.2 Opening projects in other formats

This section explains the method for opening a project created with GX Developer or GX IEC Developer in GX Works2.

For FXCPU, only projects created with GX Developer can be opened in GX Works2.

① Select **Project → Open Other Data → Open Other Project**.

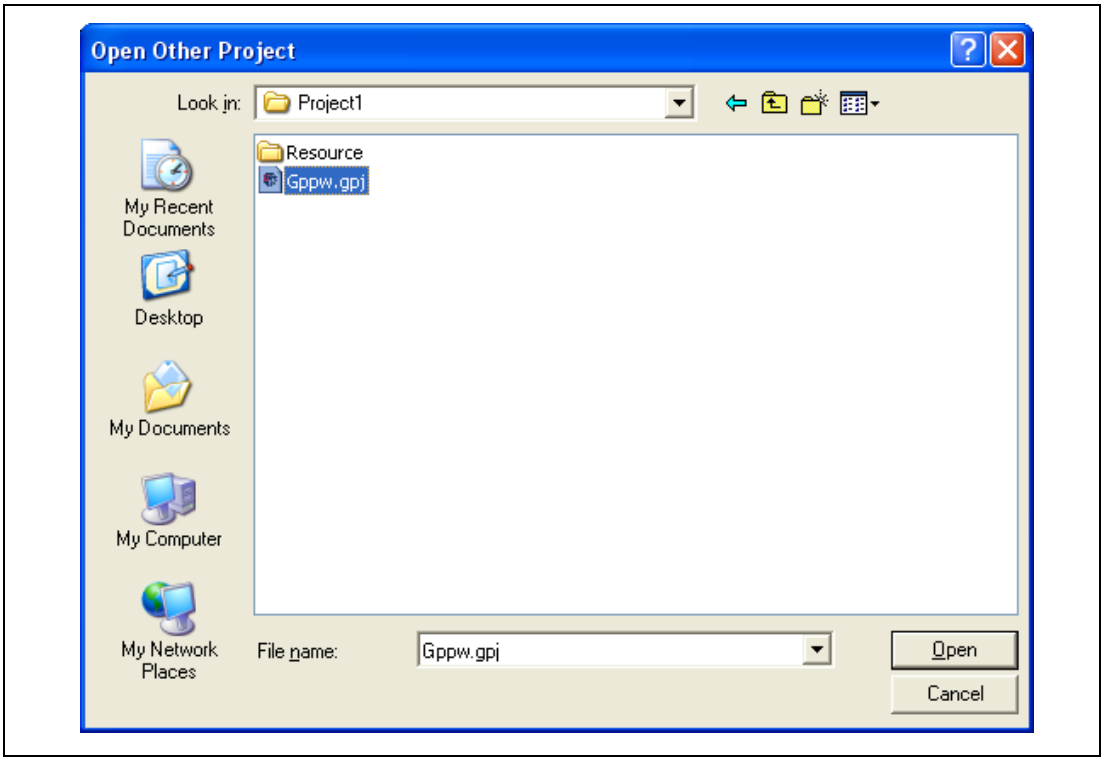


Fig. 3-5: *Dialogue window* ***Open Other Project***

② Specify the project, and click the button **Open**.

Select '*.gpj' for a GX Developer project and '*.pro' for a GX IEC Developer project.

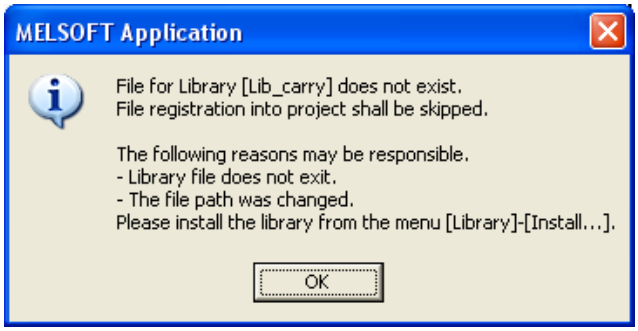
The selected project is opened.

NOTES

Status after opening projects in other formats
After opening a project in another format, the project is in the uncompiled status. Compile all programs in the project before executing online operations such as writing data and monitoring.
When a compile error occurs, correct the corresponding program following the programming manual.

Opening the project in other format that contains SFC programs
The block information, such as the block information devices, the block titles and the block statements, is set in the block data properties.

Opening the GX IEC Developer project
When the GX IEC Developer project that contains user library is opened, the following message may be displayed and the user library may not be read. If the following message is displayed, select **Project → Library → Install** in GX Works2 to obtain the user library.



3.3 Reading ASC format data

This section explains the method for adding ASC format data to a GX Works2 project being edited.

Data can be added only to Structured projects.

① Select **Project → Open Other Data → Read ASC Format File**.

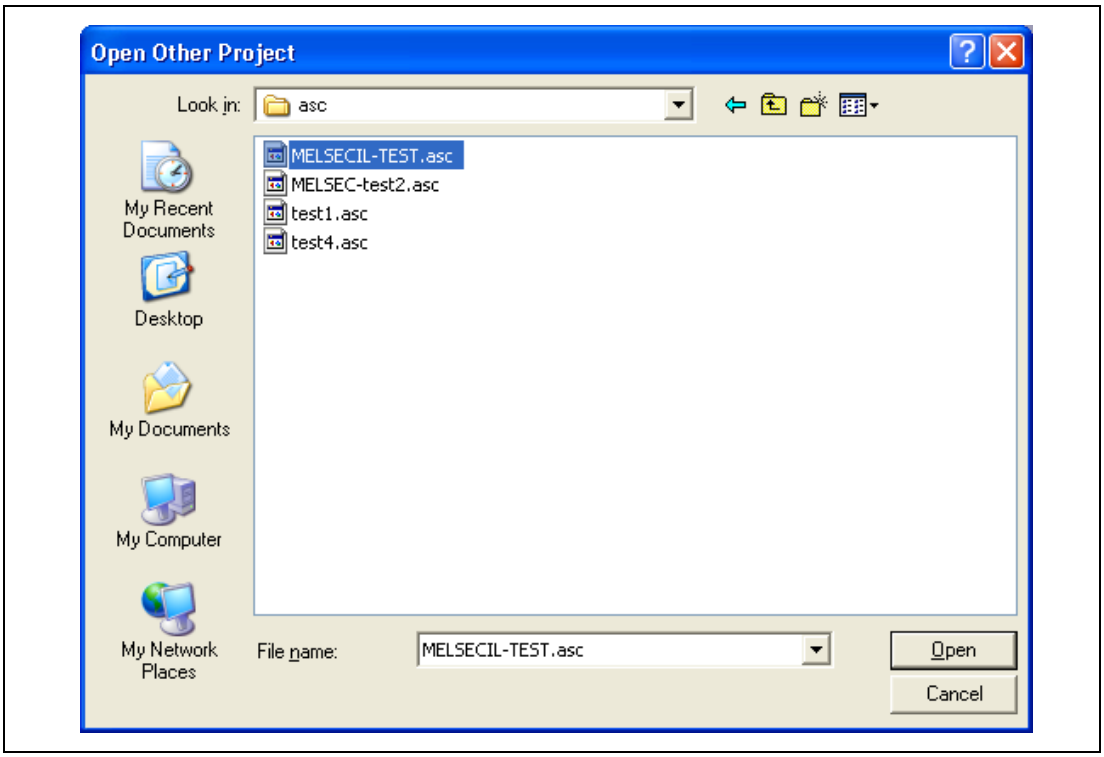


Fig. 3-6: *Dialogue window* ***Open Other Project***

② Specify the file, and click the button **Open**.

Select '*.asc' for the file.

The specified data is added to the project.

NOTES

Importing project data of different programmable controller type
Project data having a different programmable controller type can be imported to a project being open.
In this case, instructions and devices not supported in the open project are also imported.
After importing the data, compile the programs to check and correct errors.

Importing data whose name already exists in the project
A number is appended in serial order (starting from one) to the end of the data name to be imported, and then the data is added to the project.

Importing global labels
When the global labels are imported, the "Device" column of the global label may be blank. If the "Device" column is blank, check the items in the <<Device>> tab of the PLC parameter.

3.4 Saving projects in other formats

This section explains the method for saving a Simple project of GX Works2 in the GX Developer format.

① Select **Project → Export to GX Developer Format File**.

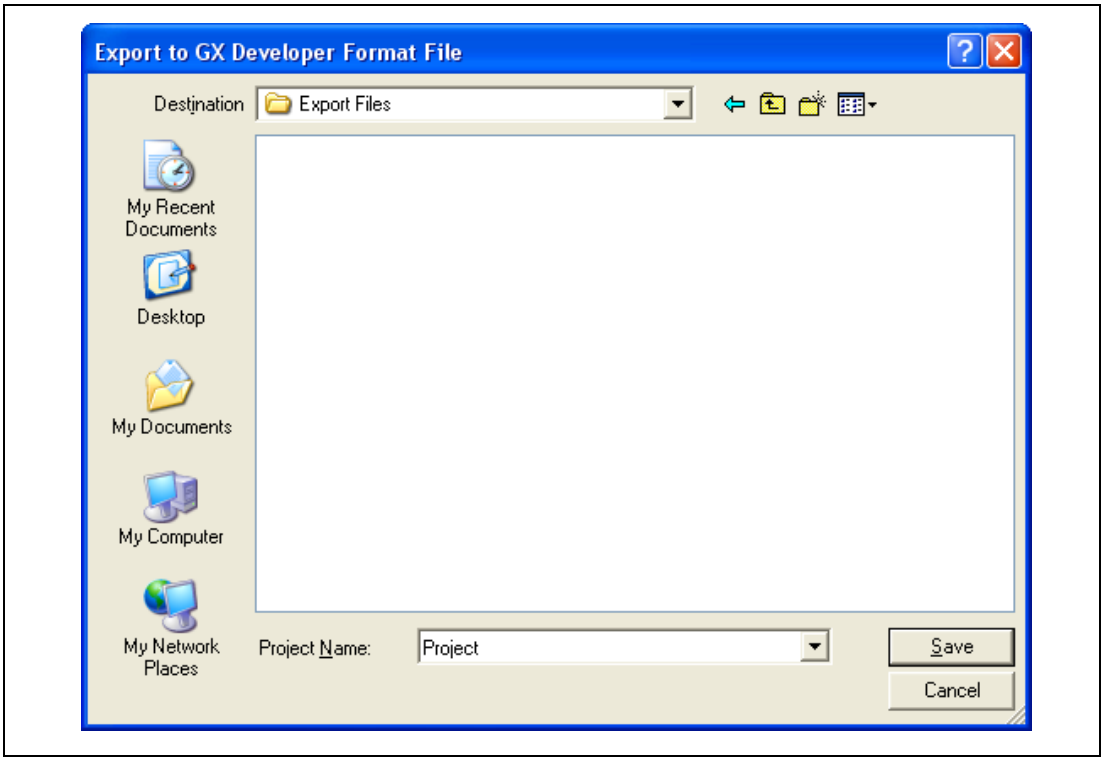


Fig. 3-7: *Dialogue window* ***Export to GX Developer Format File***

② Select the save destination of the GX Developer format project.

Enter the project name, and click the button **Save**.

NOTE

Precautions for saving projects
For the restrictions other than the ones described below, refer to the GX Works2 Operating Manual (Common).

- Programs are saved in the uncompiled status.
- The data whose access level is set to other than 'Administrators' cannot be saved. Change the access level before saving the data.
- The data with a block password cannot be saved. Unlock the block password before saving the data.

4 Installation

4.1 Hardware Requirements

4.1.1 Recommended Hardware Configuration

- PC-AT compatible personal computer
- Microsoft® Windows® 2000, Microsoft® Windows® XP SP2, Microsoft® Windows® Vista® Microsoft® Windows® 7
- 1 GB RAM or more recommended
- Serial interface (RS-232)
- USB port
- Hard disk with at least 1 GB free space
- DVD-ROM drive
- 17" (43 cm) XGA monitor (1024x768 pixels)

4.1.2 Software Requirements

GX Works2 is a 32-bit product.

Versions of Microsoft® Windows® which are based on double-byte character sets (e. g. Japanese) are not supported.

4.2 Copyright

WARNING:

This software is protected by copyright. By opening the distribution disks package you automatically accept the terms and conditions of the License Agreement. You are only permitted to make one single copy of the original distribution CD-ROM for your own backup and archiving purposes.

4.3 Precautions on the installation of GX Works2

4.3.1 Installing a MELSOFT product for the first time

At the first installation of a MELSOFT product, the following screen may be displayed during installation. To continue the installation, click the Continue Anyway button on the **Software Installation** screen. (We have checked the operation and assured that the system operates without any problems by performing this procedure.)

The **Software Installation** screen may be displayed behind another screen. Press the Alt + Tab keys to bring it to the front.

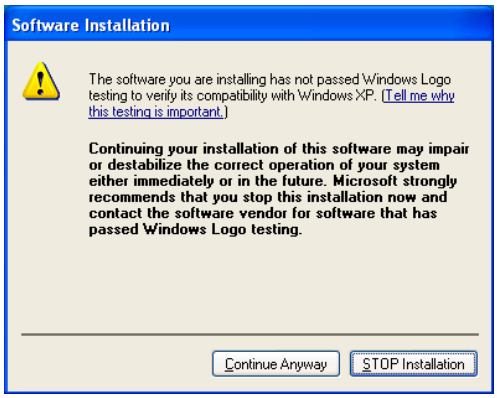


Fig. 4-1:
Dialog window ***Software Installation***

4.3.2 Procedure for continuing installation when it is not completed correctly

When the installation of a MELSOFT product or another software is not completed correctly, the following screen is displayed and the installation cannot continue unless the personal computer is restarted.

In this case, restart the personal computer and start the installation again.

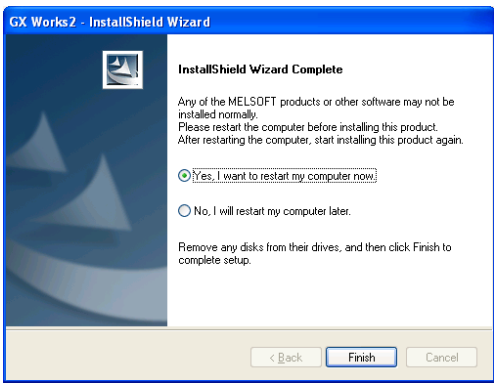


Fig. 4-2:
Dialog window ***Software Installation***

4.3.3 Precautions when installing on Windows Vista®

When installing on Windows Vista®, the following screen may be displayed after the completion of the installation.
In this case, select "This program installed correctly" and restart the personal computer.

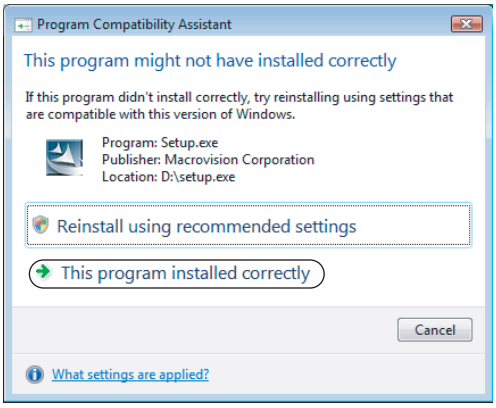
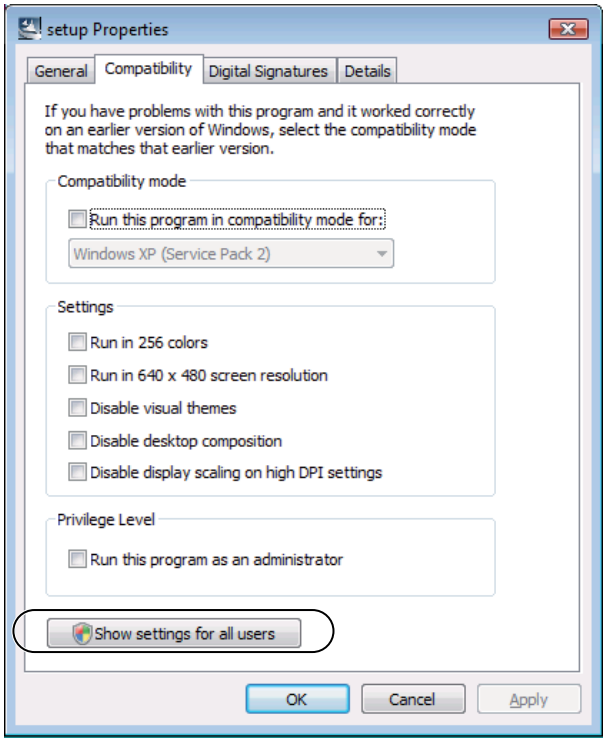


Fig. 4-3:
Dialog window ***Programm Compatibility Assistent***

When "Reinstall using recommended settings" is erroneously selected, the Windows XP SP2 compatibility mode is automatically set. Disable the Windows XP SP2 compatibility mode by following the procedure described on the following page, and perform the reinstallation.

① Right-click on the setup.exe icon of the installation target in the Windows explorer.

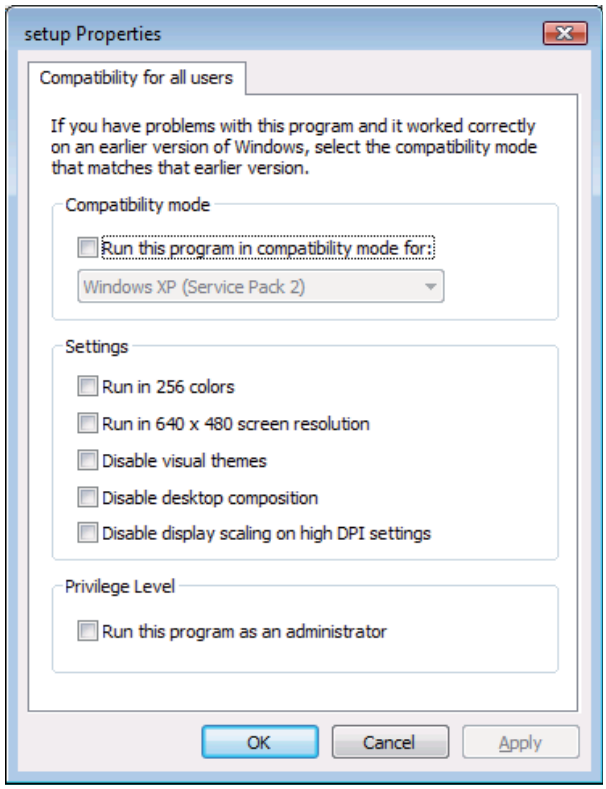
The **Setup Properties** screen is displayed.



② Click the Show settings for all users button in the **Compatibility** tab.

③ Uncheck "Run this program in compatibility mode for:" and click the OK button.

④ Click the OK button.



4.4 Installing GX Works2

During the installation procedure the setup program will create a directory on your hard disk to copy all the GX Works2 files into.

4.4.1 Installing GX Works2 on your hard disk

① Make sure that the correct Microsoft® Windows® version is properly installed on your computer. For information on using Microsoft® Windows® please refer to the Windows® User's Guide.

② Start Microsoft® Windows®.

③ Insert the installation DVD-ROM in the DVD-ROM drive.
The GX Works2 installation program starts automatically (if not, execute the file SETUP.EXE on the installation DVD-ROM).

④ Follow the instructions that appear on the screen.

⑤ Enter the user name, company name, and serial number of the software.

⑥ Follow the instructions that appear on the screen.

⑦ When the installation procedure is finished the program will create a new program group in the Start menu containing the GX Works2 program icon.

For further details on the necessary Microsoft® Windows® procedures please refer to your Microsoft® Windows® documentation.

4.4.2 Starting GX Works2

① In the Start menu click on the GX Works2 program icon. The icon is located in: Start > Programs > MELSOFT Application > GX Works2. This starts GX Works2 and displays the start-up screen.

② Confirm with the Enter key.

4.4.3 Quitting GX Works2

You can quit GX Works2 directly at any point in the program by pressing the key combination Alt F4.

Or:

Click on the **Quit** command in the **Project** menu.

5 The User Interface

5.1 The Elements of the User Interface

The Project Navigator window and the complete menu bar are both only displayed after opening an existing project or creating a new one. The illustration below shows a variety of different windows: The Project Navigator, the work window, and docking windows of a project. You can resize and arrange the windows on the screen to suit your individual preferences.

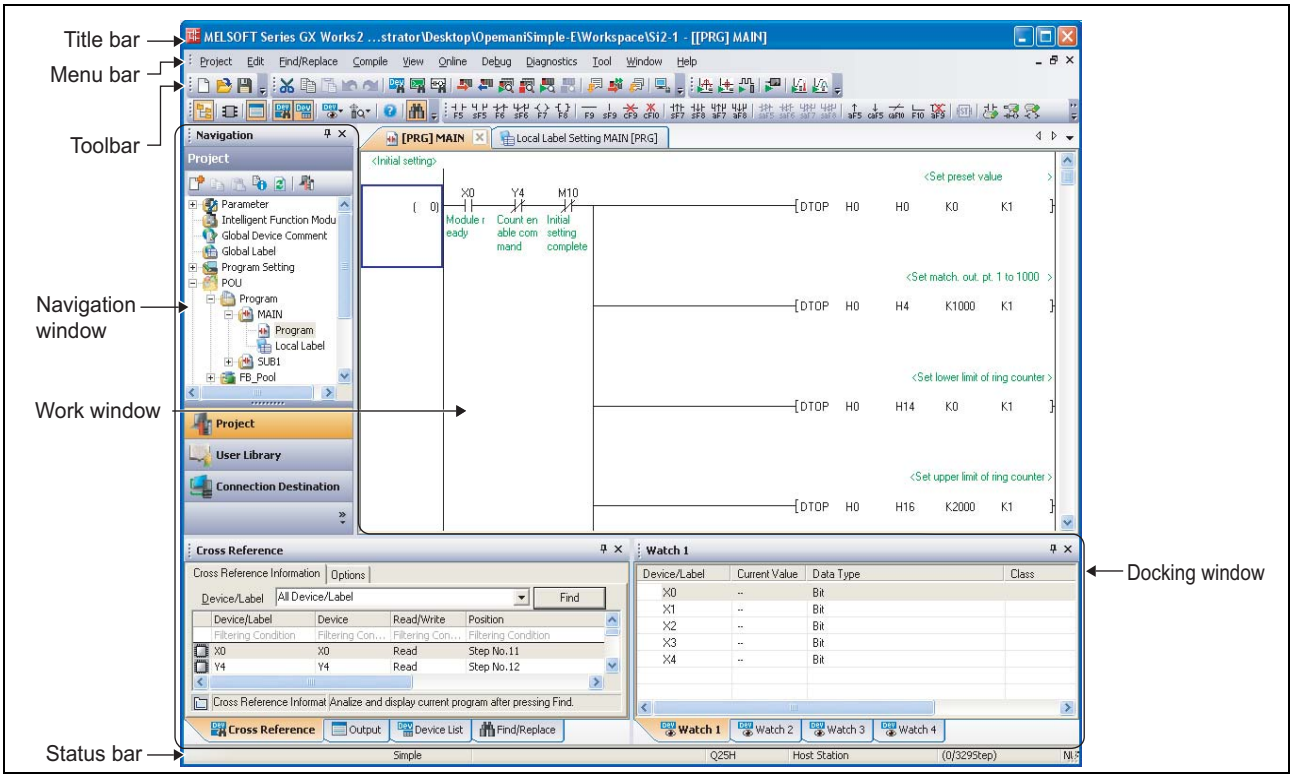


Fig. 5-1: *Elements of the user interface*

Name		Description
Title bar		Displays a project name.
Menu bar		Displays menu options for executing each function.
Toolbar		Displays tool buttons for executing each function.
Work window		A main screen used for operations such as programming, parameter setting, and monitoring
Docking window		A sub screen to support operations performed on a work window
	Navigation window	Displays contents of a project in tree format.
	Function Block Selection window	Displays a list of functions (such as function blocks) used for programming.
	Output window	Displays compilation and check results (errors and warnings).
	Cross Reference window	Displays cross reference results.
	Device List window	Displays the device usage list.
	Watch window 1 to 4	A screen used for monitoring and changing current device values.
	Intelligent Function Module Monitor 1 to 10	Screens used for monitoring intelligent function modules.
	Find/Replace window	A screen used for searching and replacing character strings in the project.
Status bar		Displays information about a project being edited.

Tab. 5-1: *Display contents*

NOTE

Focus point indication in Windows Vista®
When using Windows Vista®, the focus point may not be indicated on the screen.
To display the focus point, set the following setting.

- Select **Start → Control Panel → Ease of Access → Ease of Access Center**.
- Select "Make the keyboard easier to use".
- Select "Underline keyboard shortcuts and access keys".

5.1.1 The Menu Bar

The GX Works2 menu bar uses the standard Windows® procedures. When you select one of the menu titles in the menu bar, a drop-down list of available commands is displayed. Commands with an arrow symbol open a submenu of additional commands. Selecting a command opens a dialogue or data entry box. The menu structure and the available options are context-sensitive, changing depending on what you are currently doing in the program. Options displayed in light grey are not currently available for selection.

NOTE

A list of all menu commands (functions) with explanations is provided in the GX Works2 Operating Manual (Common) and in the **Help** menu of the application.

5.1.2 The Toolbar

The toolbar is a block of on-screen buttons for executing frequently-used functions included in a menu and enables you to select the most important menu commands directly by clicking on the corresponding icons. The toolbar is context-sensitive, i.e. different tool icons are displayed depending on what you are currently doing in GX Works2.

NOTE

A complete list of all the available tools and icons is provided in the GX Works2 Operating Manual (Common) and in the **Help** menu of the application.

5.1.3 Windows

GX Works2 allows you to edit multiple objects at the same time (e.g. work window, parameter setting, etc.). A window is opened on the screen for each object. You can change the size and position of the windows on the screen as you wish. Objects often contain more information than can be displayed in the window; when this happens, horizontal and vertical scroll bars are included that can be used to "scroll" the contents of the windows up and down and from side to side.

Work windows

A work window is a main screen used for operations such as programming, parameter setting, and monitoring in GX Works2.

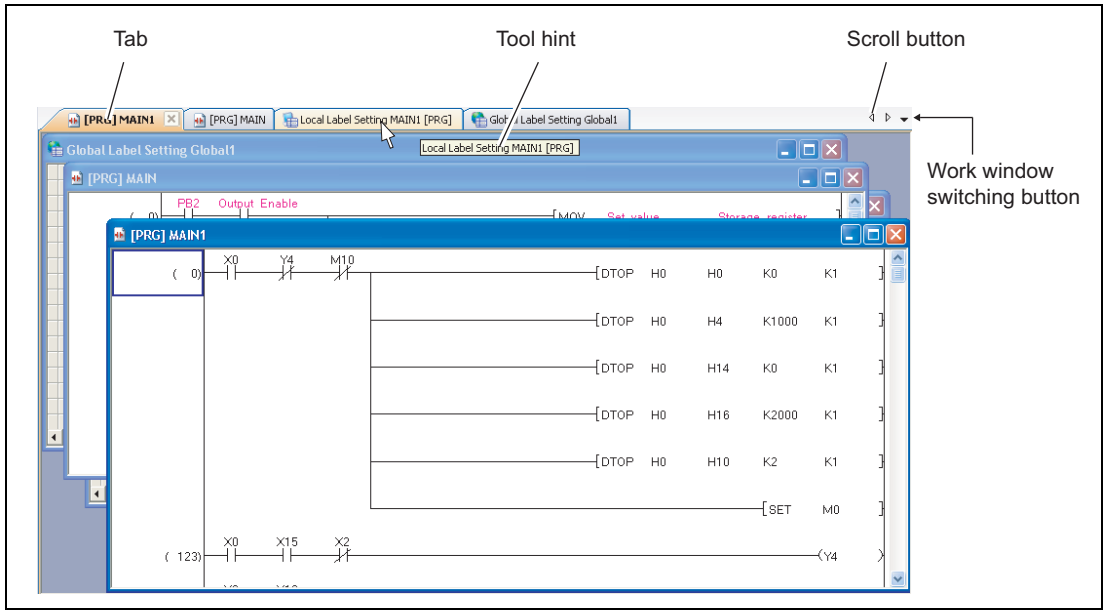


Fig. 5-2: *Work windows in cascade view*

Navigation window

The Navigation window displays the contents of a project in tree format.

The Navigator is the "control centre" used for selecting and handling the objects used in GX Works2. This is the starting place for all operations performed on GX Works2 objects. The Navigator window is not displayed until you open a project.

Operations such as creating new data or displaying editing screens can be performed in the Navigation window.

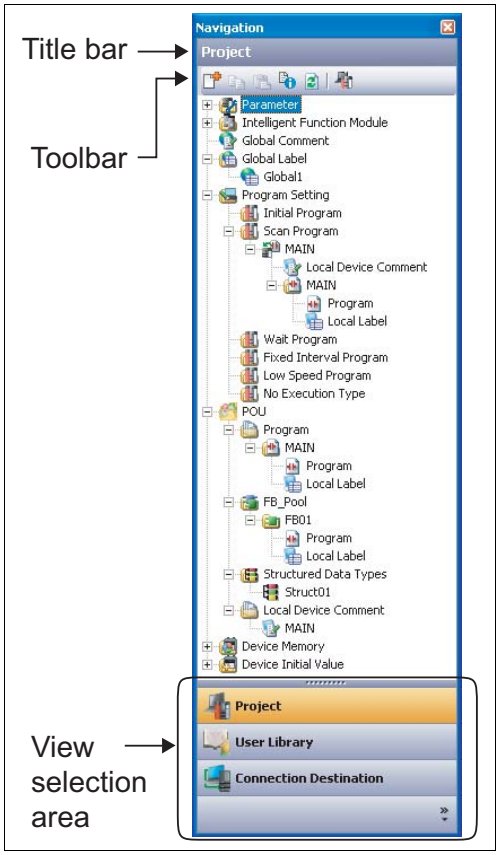


Fig. 5-3: Navigation window

Name		Description
Title bar		Displays a title of a view being displayed.
Toolbar		Displays tool buttons of functions to be executed in each view.
View selection area		Area for selecting a view to display.
	Project	Displays the Project view.
	User Library	Displays the User Library view.
	Connection Destination	Displays the Connection Destination view.

Tab. 5-2: *Display contents*

In the Navigator tree you can expand a branch by clicking on its **[+]** symbol and collapse a branch by clicking on its **[–]** symbol. Expanded and collapsed branches are identified by different symbols **[–]** or **[+]** in the tree. You can also expand or collapse branches by double-clicking on the appropriate branch icons. Double-clicking on the lowest level opens the window of the object on that level.

5.1.4 The Status Bar

The status bar at the bottom of the screen is used to display information on the current status of your project. You can disable the status bar if you wish, and you can also configure the information to be displayed to suit your needs.

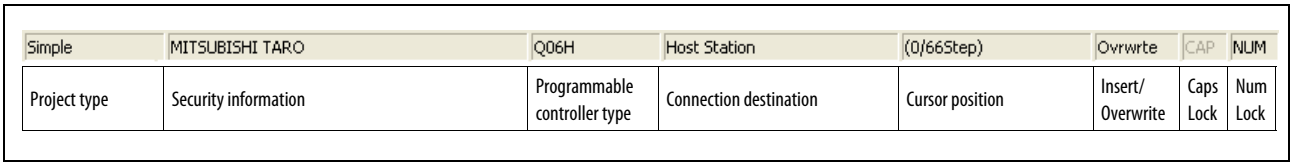


Fig. 5-4: *Status bar information*

Item	Description
Project type	Displays the project type. • Unlabeled : Simple project that does not use labels • Simple : Simple project that uses labels • Structured : Structured project
Security information	Displays the login user name when security is set for the project.
Programmable controller type	Displays the programmable controller type of the project.
Connection destination	Displays the set contents of the Transfer setup screen.
Cursor position	Displays the cursor position in the editing screen.
Insert/Overwrite	Displays the current mode (insert or overwrite).
Caps Lock	Displays the effective status of the Caps Lock.
Num Lock	Displays the effective status of the Num Lock.

Tab. 5-3: *Status bar information to be displayed*

5.2 Projects

Project contents displayed in the Project view in tree format are as follows.
Contents displayed in the view may vary depending on programmable controller types and project types.

For (Simple), (Structured), and (Intelligent) indicated in the reference destinations, refer to the following manuals respectively:

- (Simple) .....GX Works2 Operating Manual (Simple Project)
- (Structured) .....GX Works2 Operating Manual (Structured Project)
- (Intelligent) .....GX Works2 Operating Manual (Intelligent Function Module)

The following are examples for QCPU (Q mode).

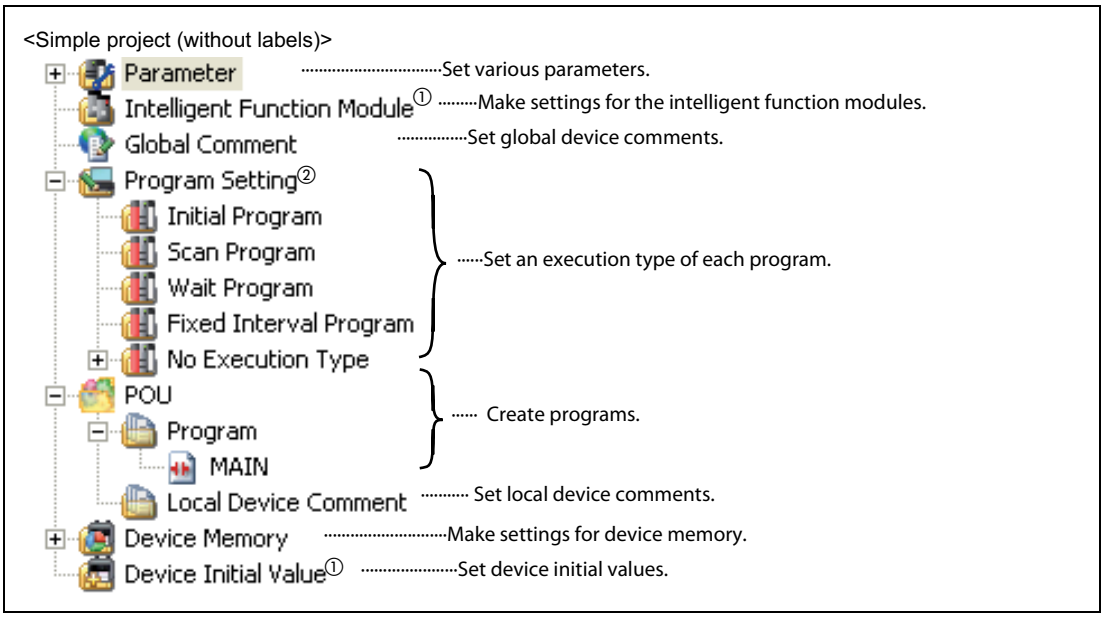


Fig. 5-5: *Project view in a simple project without labels*

① Not displayed by FXCPU.

② For FXCPU, execution types are not classed. The only one category 'Execution Program' is displayed.

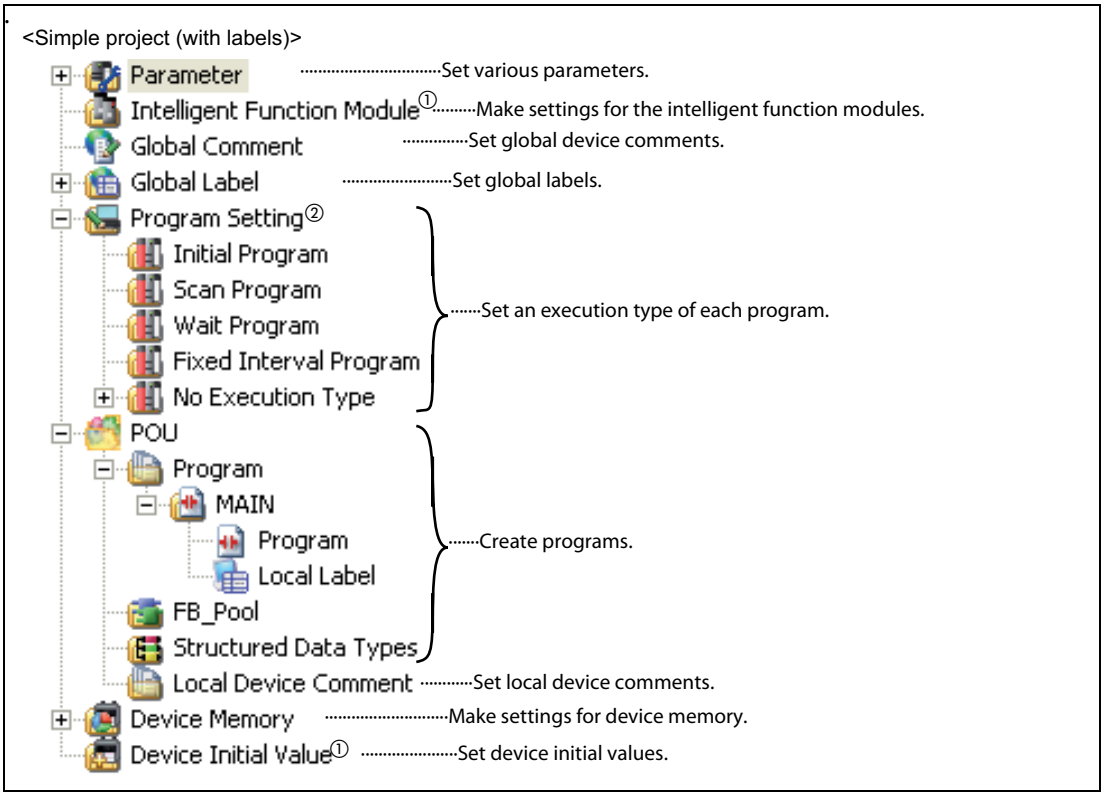


Fig. 5-6: *Project view in a simple project with labels*

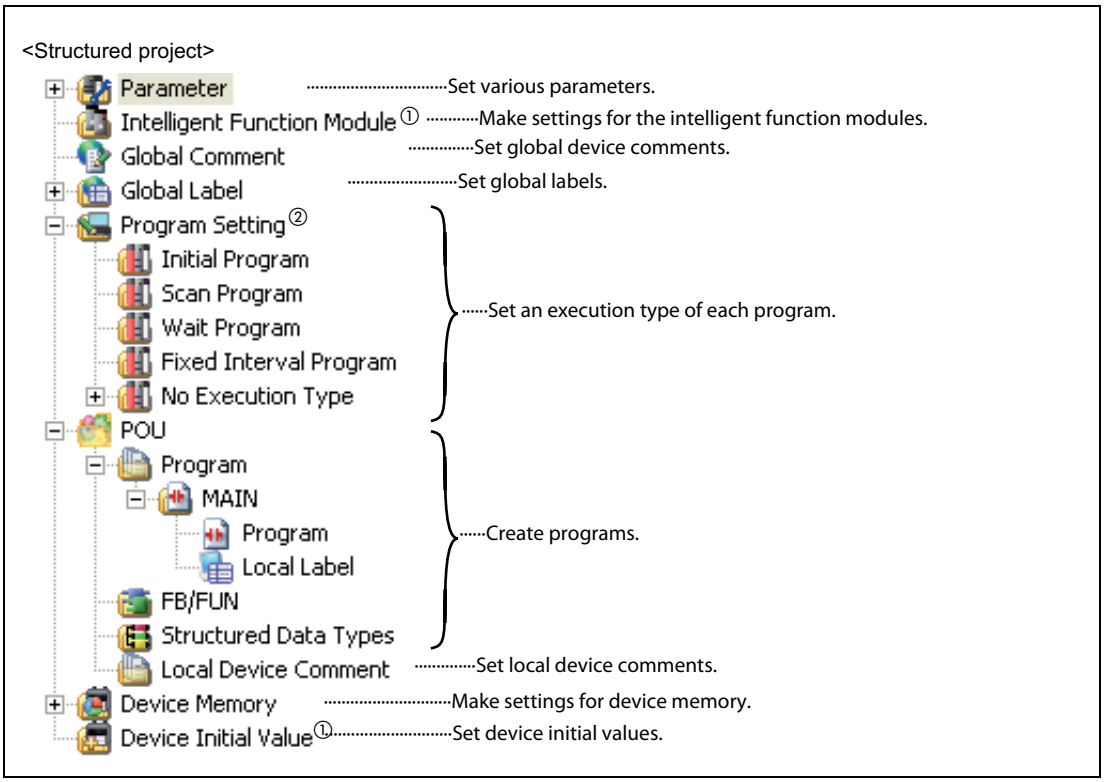


Fig. 5-7: *Project view in a structured project*

① Not displayed by FXCPU.

② For FXCPU, execution types are not classed. The only one category 'Execution Program' is displayed.

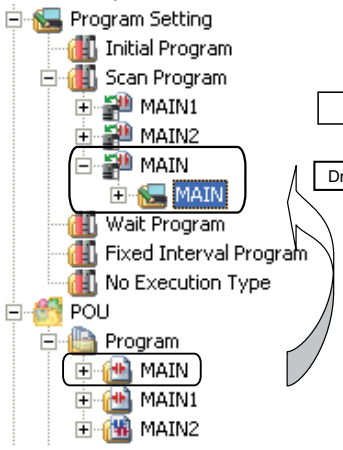
NOTE

Program Setting

In the Project view, an execution type of a program can be set by right-clicking the name of the program whose execution type is to be changed and selecting **Register Program → Initial/Scan/Wait/Fixed Scan** from the shortcut menu, or dragging and dropping it. The execution type set in the Project view is reflected to the program setting of the PLC Parameter.

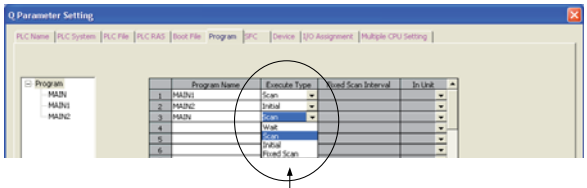
Example: Set the execution type of MAIN to **Scan Program** using drag and drop.

<Project view>



Drag & drop

<Setting screen for PLC parameter>



The setting made in the Project view is reflected.

5.3 Program Organisation Units (POUs)

POUs are divided into four classes on the basis of their functionality:

- Programs [Program],
- Function block Pool [FB_Pool] (Simple Project) or
  Function blocks and Functions [FB/FUN] (Structured Project)
- Structured Data Types [Structured Data Type]
- Local Device Comments [Local Device Comment]

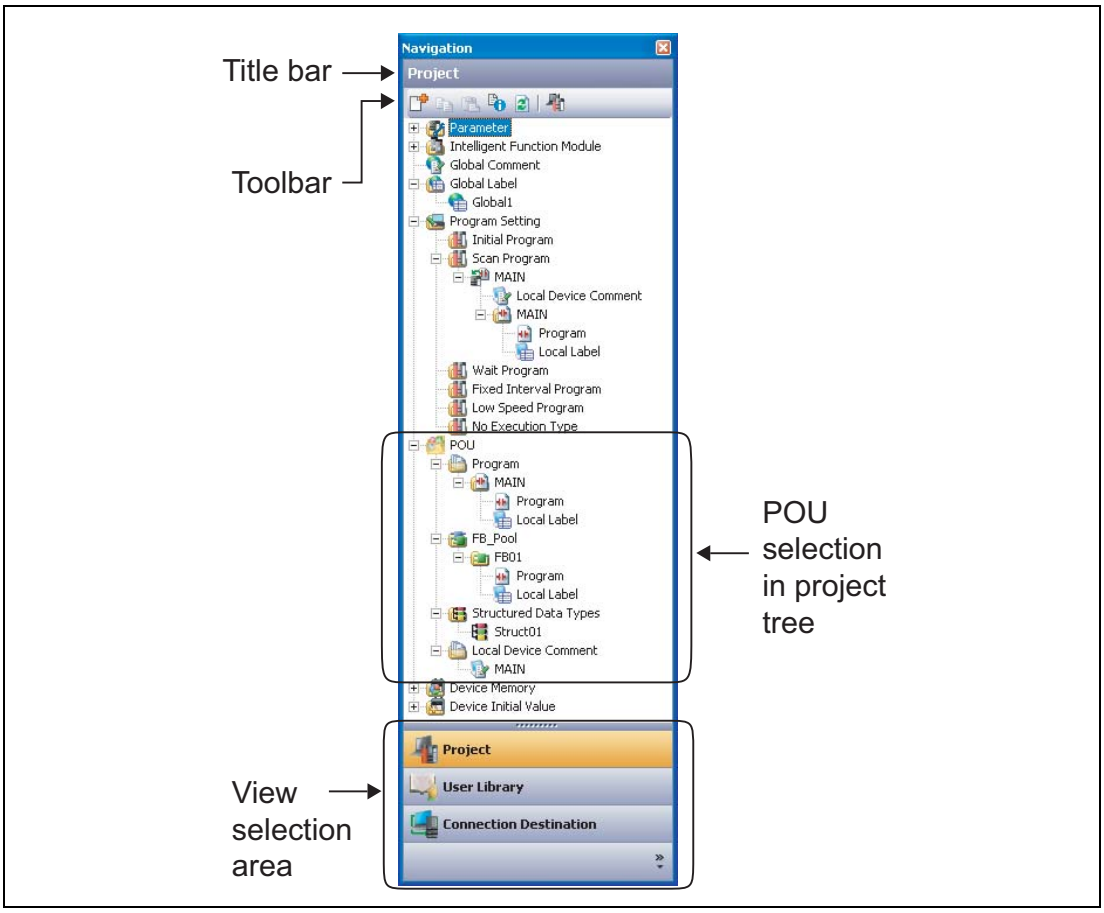


Fig. 5-8: *POU section in project tree*

Each program unit consists of

- the actual PLC program [Program]
- and its local labels [Local Label]

5.4 Programs, Function Blocks and Functions

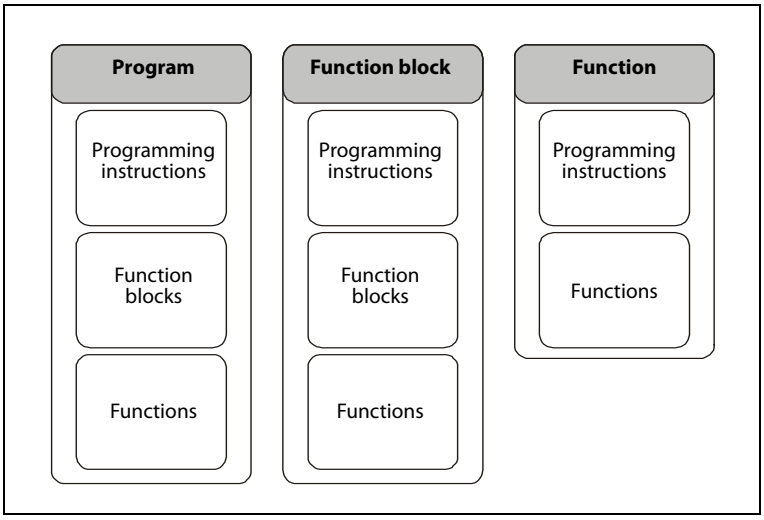


Fig. 5-9: *Programs, function blocks, and functions*

The **program POU** is the standard program organisation unit. Program POUs can contain programming instructions from libraries, functions and function blocks. The execution of the program POUs is controlled by tasks.

POUs declared as **functions** or **function blocks** are independent program elements. They function effectively as programming instructions that can be replaced whenever necessary, and they can also be used in other program modules, just like ordinary instructions.

NOTES

Function blocks can be called by program POUs and other existing function blocks, but not from functions. The function blocks themselves can contain programming instructions from the libraries, functions and other existing function blocks.

Function blocks pass one or more output variables as their result. All the values of the output variables and the internal values within the function block are stored for the following execution of the function block. These values are then used the next time the function block is invoked. This means that invoking the same function block twice with the same input parameters does not necessarily result in the same output values!

Functions can be called by program POUs, function blocks and other existing functions. Functions can contain programming instructions from the libraries and other existing functions.

Functions always pass an output value, and they do not store any internal status information. Thus, you should always get the same output value every time you invoke a function with the same input parameters.

Item	Function Block	Function
Internal variable storage	Storage	No storage
Instancing	Required	Not required
Outputs	No output One output Multiple Outputs	One output
Repeated execution with same input values	Does not always deliver the same output value	Always delivers the same output value

Tab. 5-4: *Differences: Function Blocks and functions*

6 Getting Started

6.1 Simple Project and Structured Project

6.1.1 Simple Project

In a Simple Project, you can create sequence programs using instructions for the Mitsubishi programmable controller CPU.
The Simple Project offers the same operability for program creation as the conventional GX Developer.

You can create sequence programs using the following programming languages:

Graphic languages

- Ladder
  Use this graphic language to describe programs as ladders consisting of contacts, coils, etc, using the same operating procedures as the conventional GX Developer.
- SFC
  Use this graphic language to describe sequence control in a way easy to understand.
  Describe steps which specify the processing and transition conditions which specify conditions for proceeding to the next step.
  You can describe steps and transition conditions using the ladder language.

Text language

- ST (Structured Text)
  This text language allows you to describe controls by syntax including alternative sequences offered by conditional sentences and repetition offered by repetition sentences in the same way as high-level languages such as the C language. Accordingly, you can briefly create programs easy to look at.

6.1.2 Structured Project

In a Structured Project, you can create programs by structured program.
By dividing controls into small portions and making parts of common contents, you can create programs easy to understand and applicable to many cases (by structured program.)

You can create sequence programs using the following programming languages:

Graphic languages

- Ladder
  Use this graphic language to describe programs as ladders consisting of contacts, coils, etc, using the same operating procedures as the conventional GX Developer.
- Structured Ladder
  This graphic language is created based on the relay circuit design technology. Because this language is easy to understand intuitively, it is used generally for ladder programs.
  Every ladder always starts from a base line on the left.
  Structured Ladder consists of contacts, coils, function blocks and functions which are connected each other with vertical lines and horizontal lines.
- SFC
  Use this graphic language to describe sequence control in a way easy to understand.
  Describe steps which specify the processing and transition conditions which specify conditions for proceeding to the next step.
  You can describe steps and transition conditions using the ladder language.

Text language

- ST (Structured Text)
  This text language allows you to describe controls by syntax including alternative sequences offered by conditional sentences and repetition offered by repetition sentences in the same way as high-level languages such as the C language. Accordingly, you can briefly create programs easy to look at.

NOTE

The FXCPU does not support the ST language in Simple Project, and does not support the ladder language and SFC language in Structured Project.

6.2 Program Creation Procedure in a Simple Project

The figure below shows how to create a program with a Simple Project and execute it in a programmable controller CPU.

① Opening a project

Procedure	Reference
Start GX Works2.	7.1.3
Create a new Simple Project. Or open an existing Simple Project.	7.1.4

② Setting parameters

Procedure	Reference
Set the parameters.	7.1.5

③ Setting labels

Procedure	Reference
Define global labels.	7.1.6
Define local labels.	—

④ Editing the program

Procedure	Reference
Edit the program in each program part.	7.1.7 7.2.7

⑤ Conversion and compiling

Procedure	Reference
Convert ladder blocks.	7.1.8
Compile the program.	7.1.9

⑥ Connecting the programmable controller CPU

Procedure	Reference
Connect the personal computer to the programmable controller CPU.	—
Set the connection destination.	

⑦ Writing to the programmable controller

Procedure	Reference
Write the parameters to the programmable controller CPU.	—
Write the program to the programmable controller CPU.	

⑧ Checking operations

Procedure	Reference
Monitor the sequence program execution status and device contents, and check operations.	—
Check for errors in the programmable controller.	

⑨ Printing

Procedure	Reference
Print the program and parameters.	—

⑩ Exiting GX Works2

Procedure	Reference
Save the project.	7.1.10
Exiting GX Works2.	—

6.3 Program Creation Procedure in a Structured Project

The figure below shows how to create a program with a Structured Project and execute it in a programmable controller CPU.

① Opening a project

Procedure	Reference
Start GX Works2.	8.1.3
Create a new Structured Project. Or open an existing Structured Project.	8.1.4

② Setting parameters

Procedure	Reference
Set the parameters.	8.1.5

③ Creating the program configuration

Procedure	Reference
Create Program File.	—
Create Task in Program File.	
Create POU.	
Register program block of POU to Task in Program File.	

④ Setting labels

Procedure	Reference
Define global labels.	8.1.6
Define local labels.	—

⑤ Editing the program

Procedure	Reference
Edit the program in each POU.	8.1.7 8.2.7

⑥ Conversion

Procedure	Reference
Compile the program.	8.1.8

⑦ Connecting the programmable controller CPU

Procedure	Reference
Connect the personal computer to the programmable controller CPU.	—
Set the connection destination.	

⑧ Writing to the programmable controller

Procedure	Reference
Write the parameters to the programmable controller CPU.	—
Write the program to the programmable controller CPU.	

⑨ Checking operations

Procedure	Reference
Monitor the sequence program execution status, and check operations.	—
Check for errors in the programmable controller.	

⑩ Printing

Procedure	Reference
Print the program and parameters.	—

⑪ Exiting GX Works2

Procedure	Reference
Save the project.	8.1.9
Exiting GX Works2.	—

7 Sample Program: Simple Project

7.1 Creating a Program of LADDER

This section explains the operations to create a ladder program.

7.1.1 Operations of program

- When X0 turns ON, the programmable controller turns ON Y10, and then turns OFF Y10 1 second later.
- When X1 turns ON, the programmable controller transfers K10 to D0 (which is defined with the Label "VAR1").
- When X2 turns ON, the programmable controller transfers K20 to D0 (which is defined with the Label "VAR1").

7.1.2 Created program

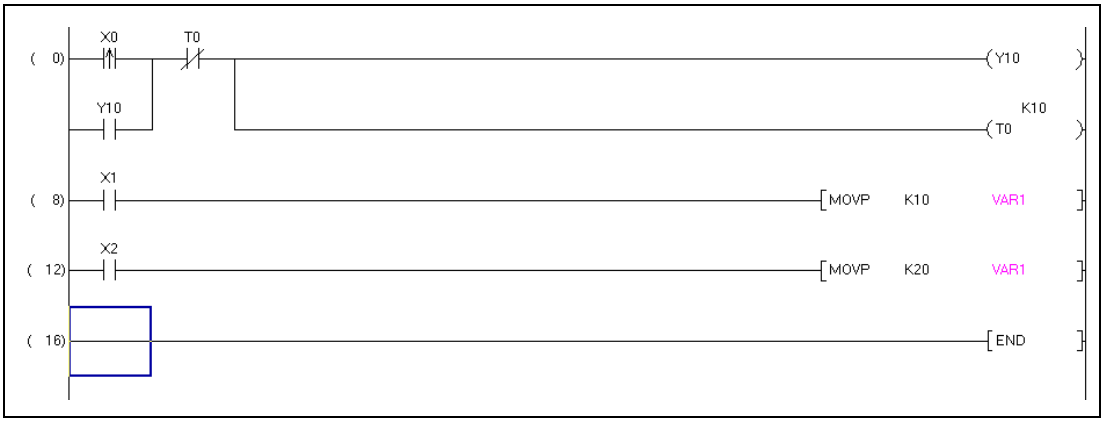
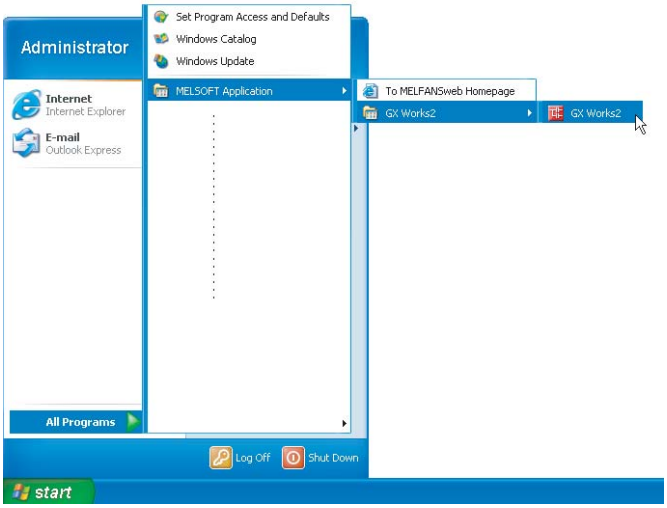


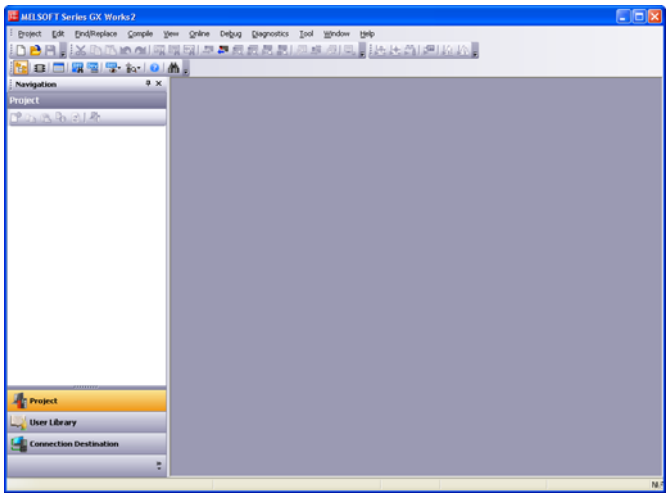
Fig. 7-1: *Sample program*

7.1.3 Starting GX Works2

① Select the software package menu to be started.



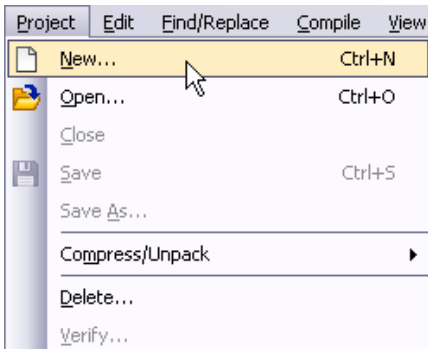
② The selected software package is started.



7.1.4 Creating a new project

① Perform either procedure below to display the New Project screen.

- Select **Project** → **New**.
- Click (New).



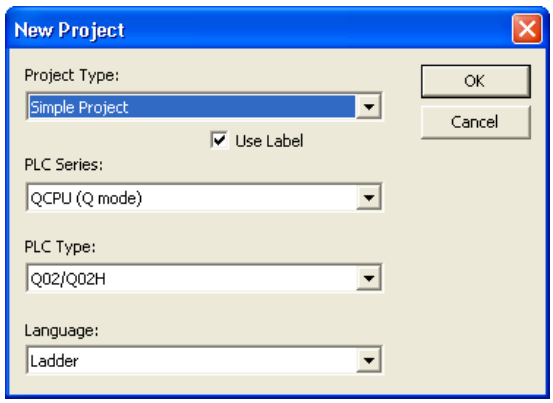
② Select the "Project Type", "PLC Series", "PLC Type" and "Language" from the list boxes for the new project to be created.

Check "Use Label" when using labels in the program to be created.

After the setting, click the OK button.

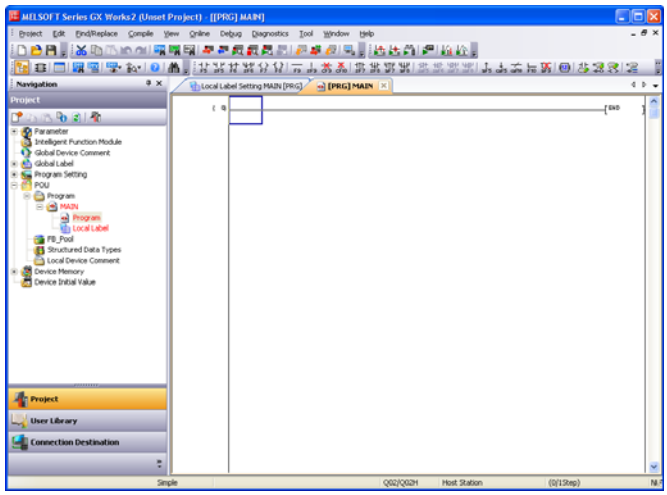
Settings:

- Project Type: Simple Project
- Use Label: Checked
- PLC Series: QCPU (Q mode)
- PLC Type: Q02/Q02H
- Language: Ladder



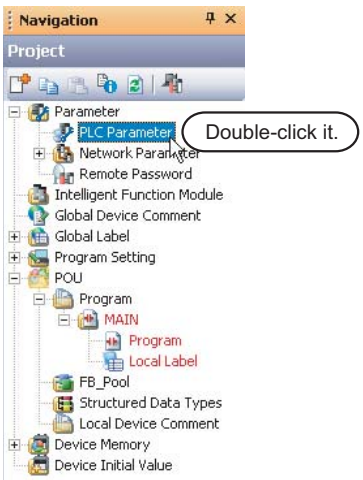
NOTE When using labels in Simple project, check "Use Label" on the New Project screen.

③ GX Works2 creates a new project.



7.1.5 Setting parameters

① Double-click "Parameter" → "PLC Parameter" on the Project view to display the Q Parameter Setting screen.



② Click the [End] button to determine the settings and close the screen.

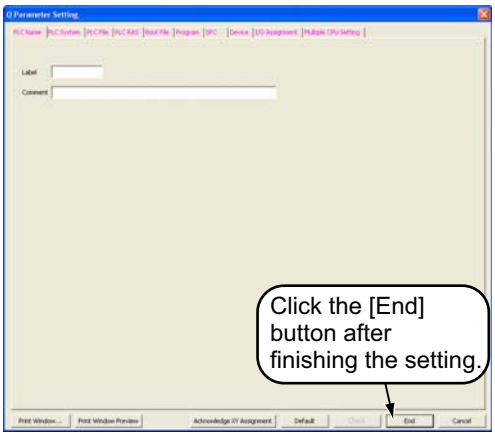
The parameters remain unchanged from the initial setting in the example in this manual.

Refer to the following manuals for the details on parameter setting:

– GX Works2 Operating Manual (Common)

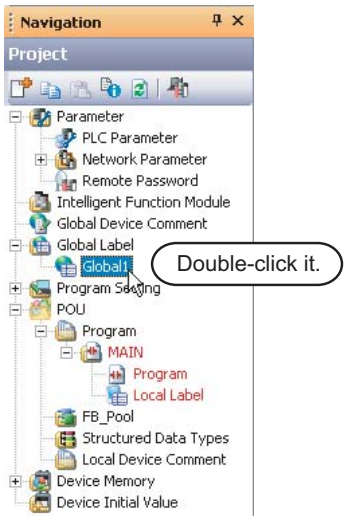
– Manual of the programmable controller being used

– Manual of the Network being used



7.1.6 Setting labels

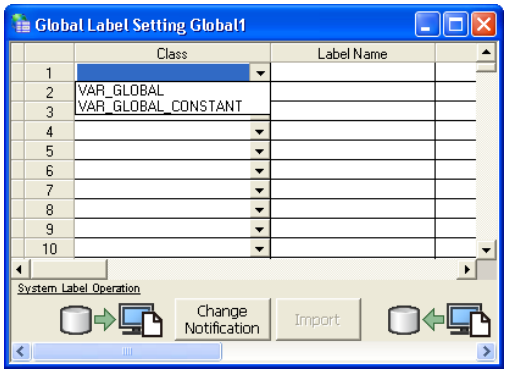
① Double-click "Global Label" → "Global1" on the Project view to display the Global Label Setting screen.



② Select the "Class" from the list box on the Global Label Setting screen.

Settings:

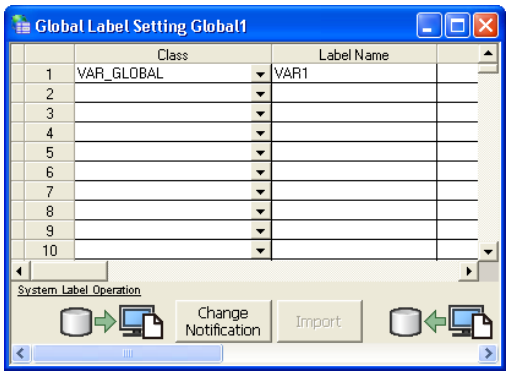
– Class: VAR_GLOBAL



③ Directly input the "Label Name" on the Global Label Setting screen.

Settings:

– Label Name: VAR1



NOTE

Characters available for the label name
You can enter up to 32 characters as the label name.
However, note that the following label name will cause a compile error.

- Label name which contains space
- Label name whose first character is a number
- Label name equivalent to a device name

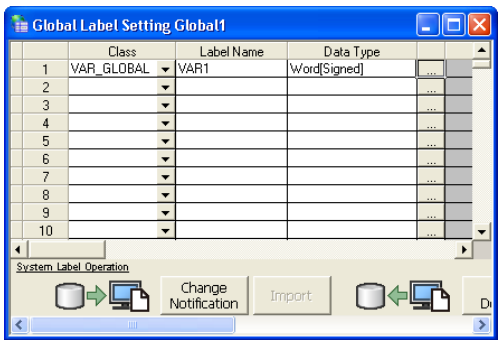
For other characters unavailable for the label name, refer to the following manual.

- GX Works2 Operating Manual (Common)

④ Directly input the "Date Type" on the Global Label Setting screen.

Settings:

– Date Type: Word [Signed]



NOTE

You can click [...] to display the Type Selection screen, and then select the Types on this screen.

Settings①:

① Libraries: ALL

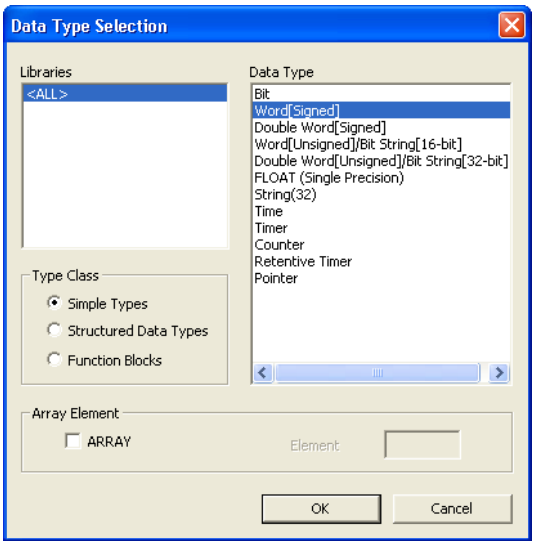
② Type Class: Simple Types

③ Types: Word [Signed]

④ Array Element: Not checked

① Set "Libraries", "Type Class", "Types" and "Array Element" in this order.

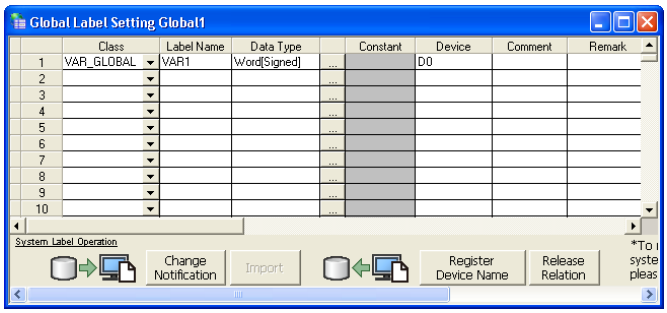
After completing the setting, click the button.



⑤ Directly input the "Device" on the Global Label Setting screen.

Settings:

– Device: D0



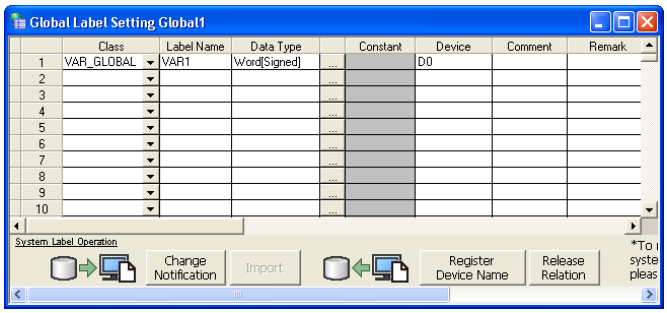
⑥ Set the "Constant", "Comment" and "Remark" on the Global Label Setting screen.
"Relation with System Label", "System Label Name" and "Attribute" are not used in examples shown in this manual.

Settings:

– Constant: When the label class is "VAR_GOBAL", you cannot set or change the constant value.

– Comment: No setting

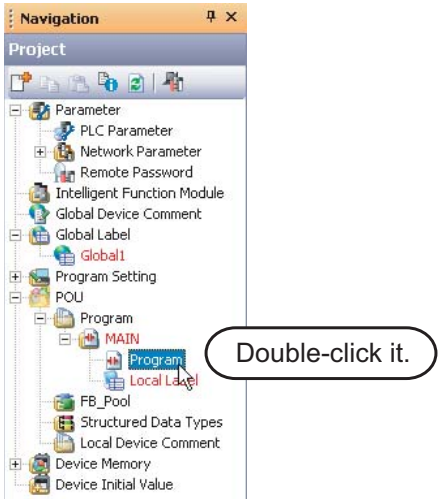
– Remark: No setting



7.1.7 Creating a program

Create the ladder program shown in Section 7.1.2.
You can select "Overwrite" or "Insert" when creating a program. Select either mode.
This section explains the creation procedure in the Overwrite.
Every time you click the Insert key, the mode is switched between "Overwrite" and "Insert".

① Double-click "POU" → "Program" → "MAIN" → "Program" on the Project view to display the [PRG] MAIN screen.

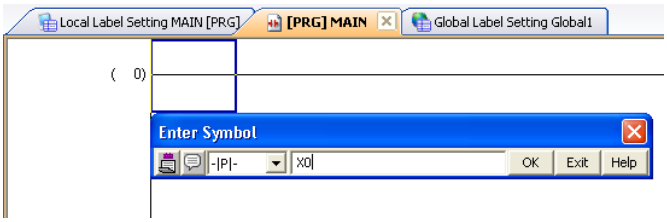


② Click (sF7) (Rising Pulse) on the Ladder toolbar to display the Enter Symbol screen.

Directly input a device on the Enter Symbol screen, and click the OK button to display the Rising Pulse.

Settings:

– X0



NOTE

Click an icon on the Ladder toolbar to open the Enter Symbol screen for inputting a device or instruction.

Set a device or instruction, and click the OK button to display the corresponding ladder symbol or vertical line in the cursor position.

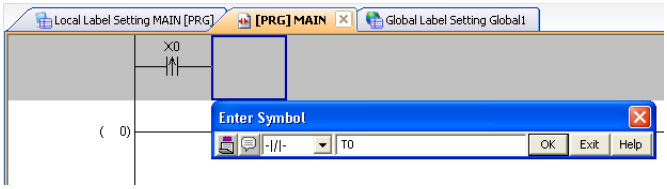
Ladder tool bar

③ Click (F6) (Close Contact) on the Ladder tool bar to display the Enter Symbol screen.

Directly input a device on the Enter Symbol screen, and click the OK button to display the Close Contact.

Settings:

– T0

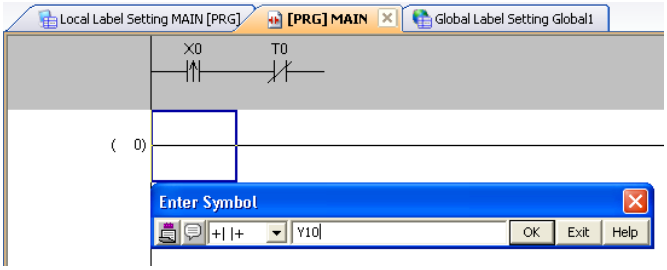


④ Click (sF5) (Open Branch) on the Ladder tool bar to display the Enter Symbol screen.

Directly input a device on the Enter Symbol screen, and click the OK button to display the Open Branch.

Settings:

– Y10

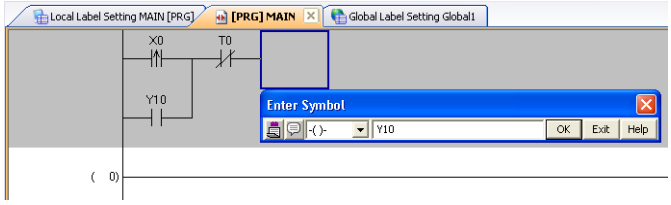


⑤ Click (F7) (Coil) on the Ladder toolbar to display the Enter Symbol screen.

Directly input a device on the Enter Symbol screen, and click the OK button to display the Coil.

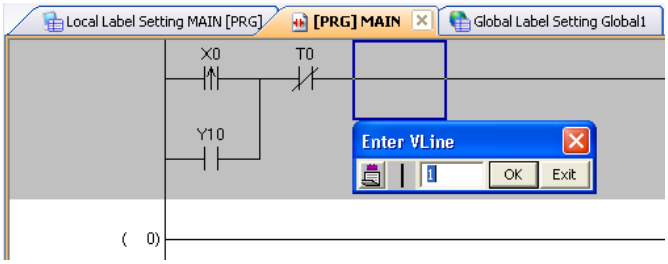
Settings:

– Y10



⑥ Click sF9 (Vertical Line) on the Ladder toolbar to display the Enter Vertical Line screen.

Click the OK button to display the Vertical Line.

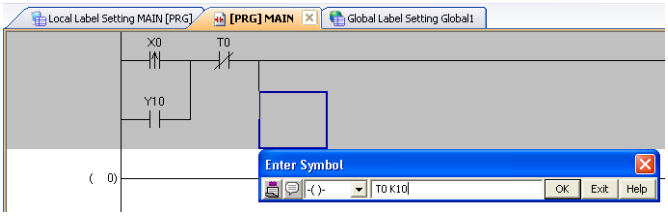


⑦ Click F7 (Coil) on the Ladder toolbar to display the Enter Symbol screen.

Directly input a device and set value on the Enter Symbol screen, and click the OK button to display the Coil.

Settings:

– T0 Space K10

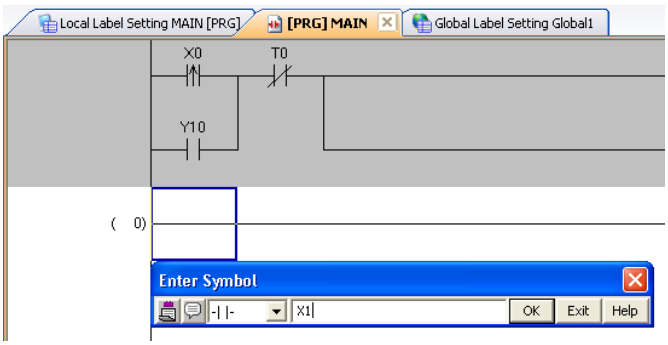


⑧ Click F5 (Open Contact) on the Ladder tool bar to display the Enter Symbol screen.

Directly input a device on the Enter Symbol screen, and click the OK button to display the Open Contact.

Settings:

– X1

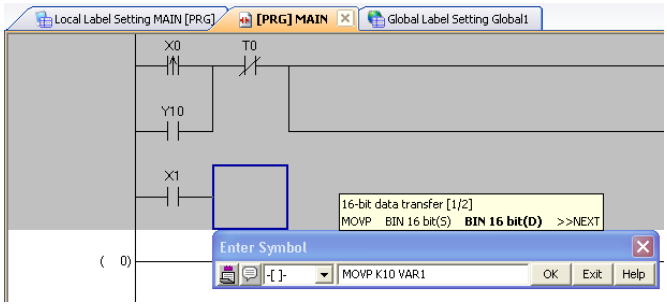


⑨ Click F8 (Application Instruction) on the Ladder toolbar to display the Enter Symbol screen.

Directly input an application instruction and operand on the Enter Symbol screen, and click the OK button to display the Application Instruction.

Settings:

– MOVP Space K10 Space VAR1
The label VAR1 is set in Section 7.1.6.
Specify the device D0 when not using labels.



NOTE

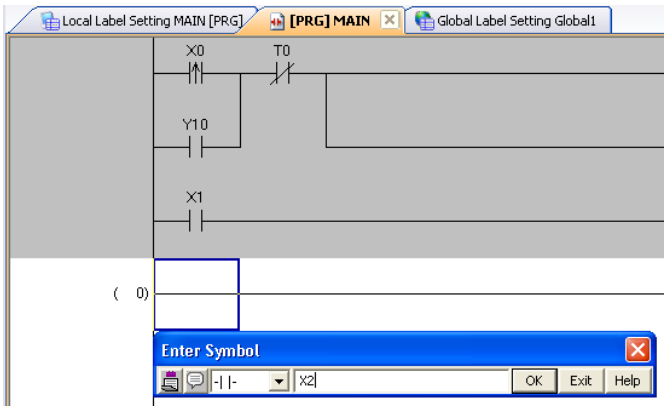
In labels (VAR1 in this example), the programmable controller distinguishes uppercase characters and lower case characters. Pay rigid attention to use uppercase characters and lower case characters correctly in inputting a label.

⑩ Click F5 (Open Contact) on the Ladder tool bar to display the Enter Symbol screen.

Directly input a device on the Enter Symbol screen, and click the OK button to display the Open Contact.

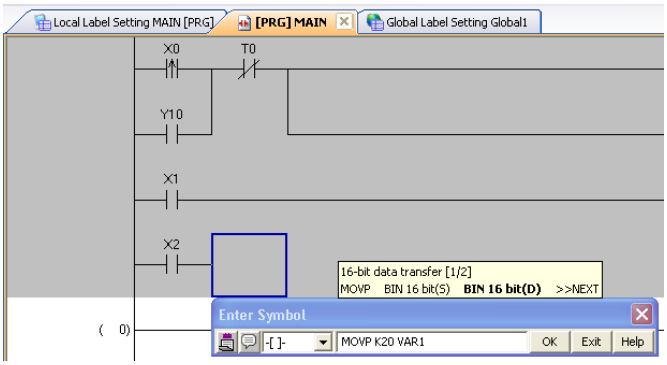
Settings:

– X2



⑪ Click F8 (Application Instruction) on the Ladder toolbar to display the Enter Symbol screen.

Directly input an application instruction and operand on the Enter Symbol screen, and click the OK button to display the Application Instruction.



Settings:

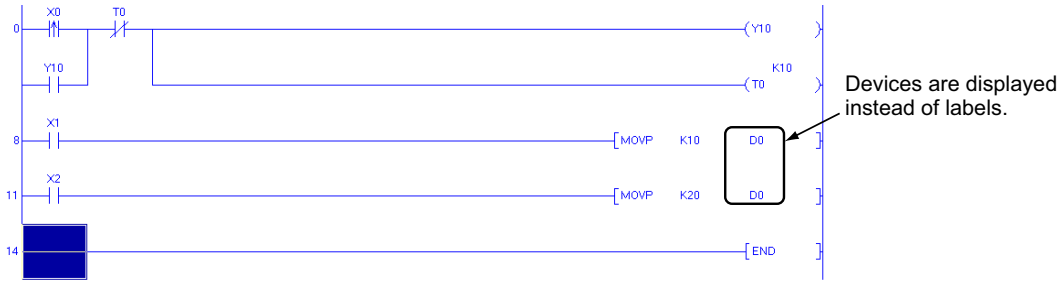
– MOVP Space K20 Space VAR1
The label VAR1 is set in Section 7.1.6.
Specify the device D0 when not using labels.

NOTES

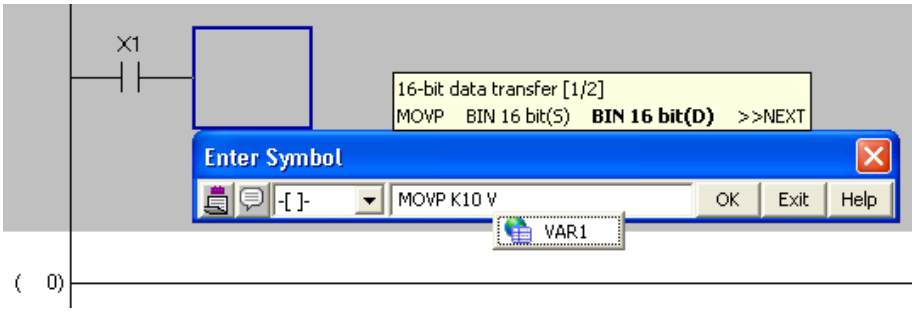
Make sure to ladder conversion and compile the created or edited program to make it a sequence program executable in the programmable controller CPU.
Only ladder conversion is required, and compilation is not required when using the FXCPU or not using labels.
Refer to the following sections for ladder conversion and compile:

- Section 7.1.8
- Section 7.1.9

If the following operation is performed after compilation, devices are displayed instead of labels.
Operation to convert labels into devices for display
Select **View** → **Address Display** to check the menu item.
(Note that the menu item is unchecked when you select **View** → **Address Display** while the menu item is checked.)



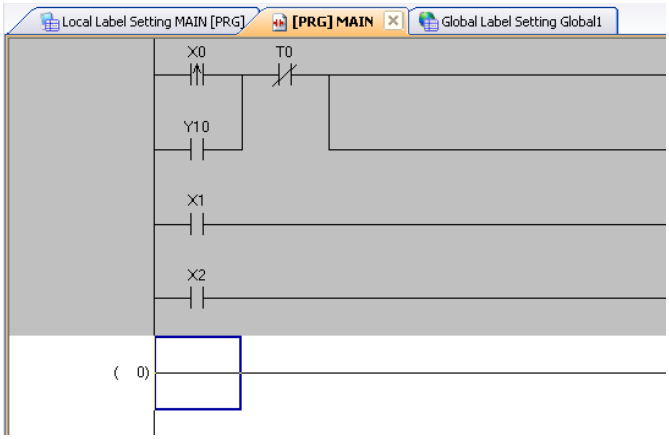
Displaying label candidates
GX Works2 displays label candidates whose former portion agrees with the entered character string.
In this program example, GX Works2 displays labels starting from "V" when you enter "V".
You can select a displayed label instead of entering the label completely.



7.1.8 Converting ladder blocks

① Select **Compile** → **Build** to display the Execution Confirmation for Build screen.

You can press the F4 key instead to display the Execution Confirmation for Build screen.

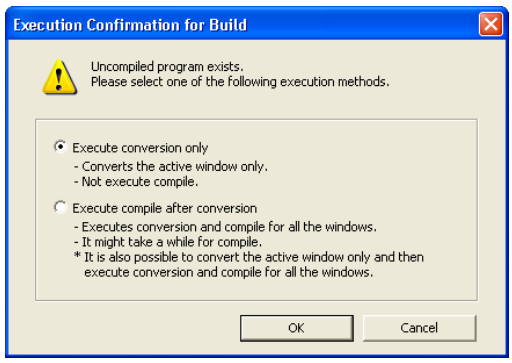


② Set the execution method of build. In this example, GX Works2 will execute only conversion.

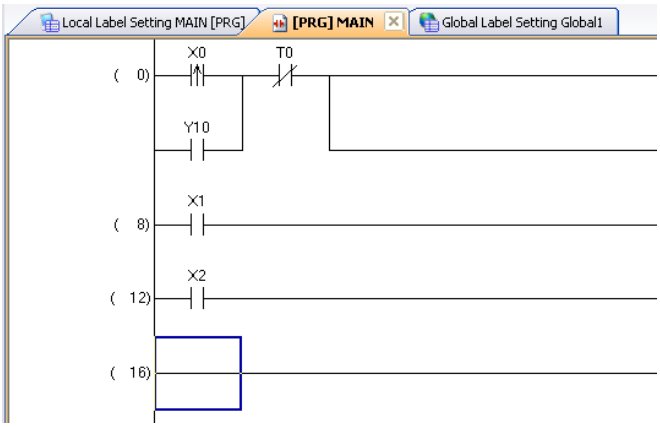
After setting the execution method, click the OK button to execute conversion.

Settings:

– Select "Execute conversion only".



③ **Build** converts the unconverted ladder block, and changes its background color as shown on the left.



7.1.9 Compiling a program

There are following two types of compiling. The compiling target is different between the two types.

Select "Rebuild All" for this example.
The "Rebuild All" procedure is described below.
Refer to the following manual for compiling:

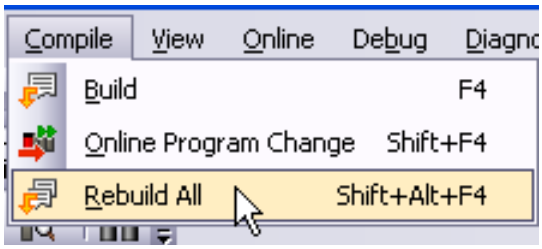
- GX Works2 Operating Manual (Simple Project)

Action	Target program to be compiled
Build	Converts non-compiled programs into sequence program. (Does not compile already compiled programs.)
Rebuild All	Converts all programs into sequence program. (Compiles already compiled programs also.)

Tab. 7-1: *Function of compiler instructions*

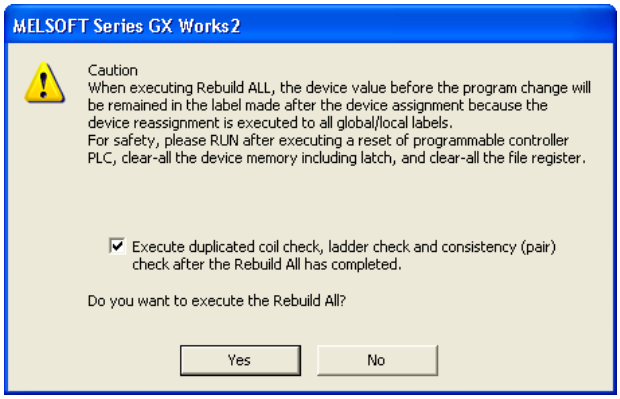
① Select **Compile** → **Rebuild All** to execute "Rebuild All".

You can click (Rebuild All) to execute "Rebuild All".

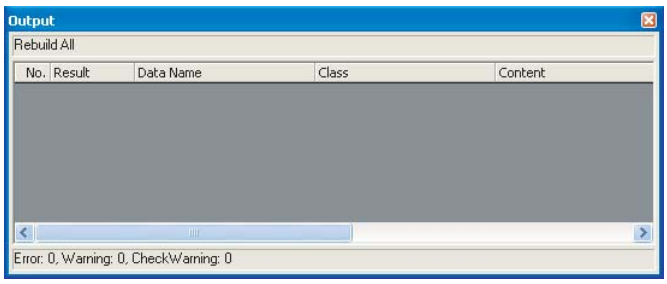


② The screen shown on the left appears.

Click the button to execute "Rebuild All".



③ When finishing "Rebuild All", GX Works2 displays the result on the Output window.
If an error occurs, check the contents, eliminate the cause of error, and then execute "Build" or "Rebuild All" as described in the step 1.

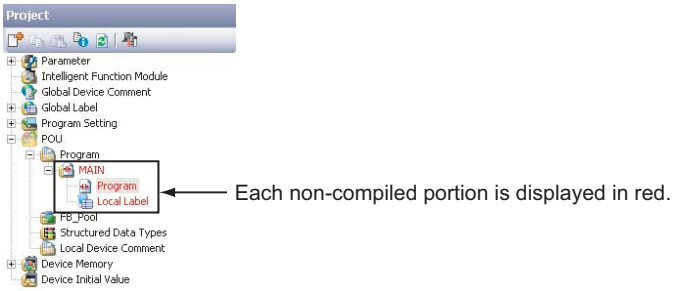


NOTES

When you convert a ladder block, GX Works2 automatically compiles the program at the time of conversion if labels are not used.
If labels are used, make sure to compile the created or edited sequence program after conversion so that the created or edited sequence program will be an executable sequence program.
Refer to the following manual for the details on "Build", "Rebuild All":

- GX Works2 Operating Manual (Simple Project)

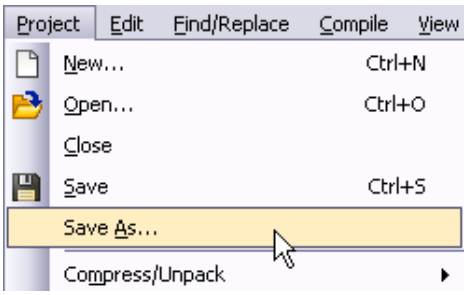
Compile status checking method
You can check the compile status on the Project view.



7.1.10 Saving a project

You can save a project.
When saving a newly created project, use the menu item **Save As**.

① Select **Project** → **Save As** to display the **Save As** screen.

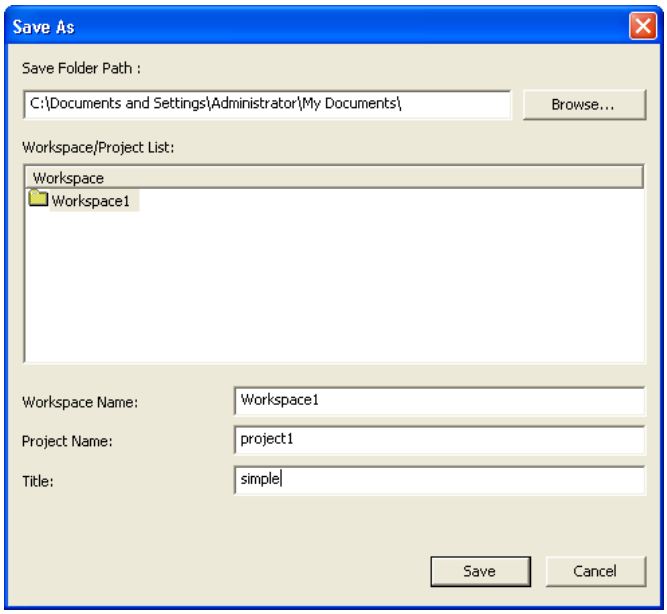


② Set "Save Folder Path", "Workspace Name", "Project Name", "Title", etc.

After the setting, click the Save button to save the project (program).

Refer to the following manual for the details:

– GX Works2 Operating Manual (Common)



Settings:

- Workspace folder path: Specify the save destination folder.
- Workspace Name: Specify the save destination folder name.
- Project Name: Specify the project name.
- Title: Specify the title. You can save a project without specifying a title.

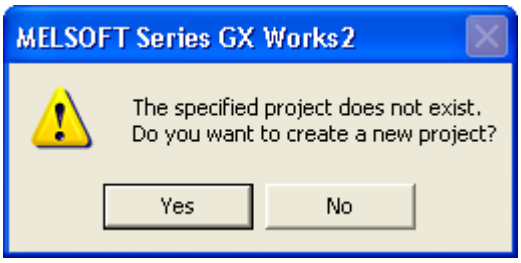
NOTES

Input within 128 characters to "Title".

Make sure that the total characters of "Save Folder Path", "Workspace Name" and "Project Name" is 200 or less.

You cannot save any project to route directories such as "C:\" or "D:\".

③ Click the Yes button to save the new project.



7.2 Creating a Program of SFC

This section explains the operations to create a SFC program.

7.2.1 Operations of program

This program controls fountain (cycle operation/continuous operation).

- Cycle operation (when X1 is OFF)

  When the start button (X0) is pressed, the program will make progress in the sequence "Standby status (S0) → Center lamp (S1) → Center fountain (S2) → Loop line lamp (S3) → Loop line fountain (S4) → Standby status (S0)".

  Each output is switched by the timer at every 2 seconds.

- Continuous operation (when X1 is ON)

  When the start button (X0) is pressed, the program will make progress in the sequence "Standby status (S0) → Center lamp (S1) → Center fountain (S2) → Loop line lamp (S3) → Loop line fountain (S4) → Center lamp (S1)", and then repeat this sequence.

  Each output is switched by the timer at every 2 seconds.

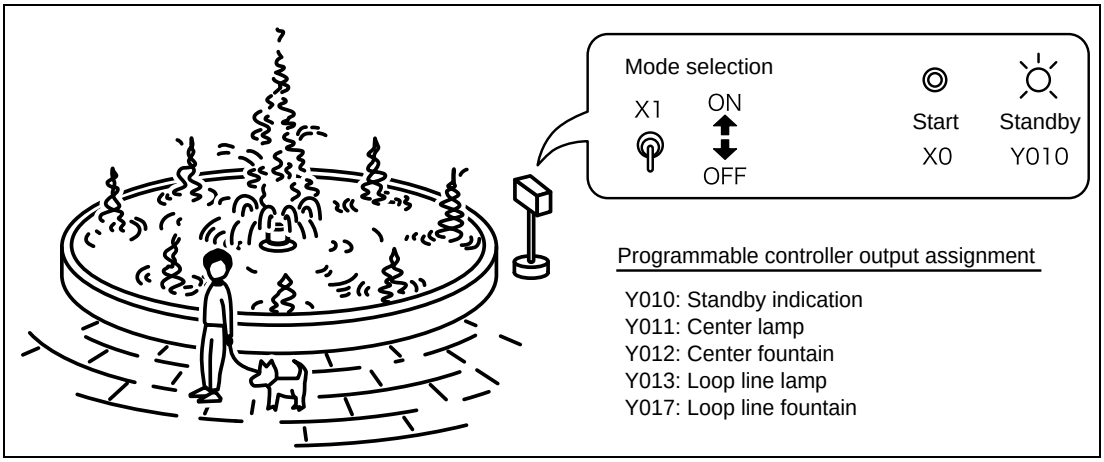


Fig. 7-2: *Scetch of the fountain*

7.2.2 Created program

For QCPU/LCPU

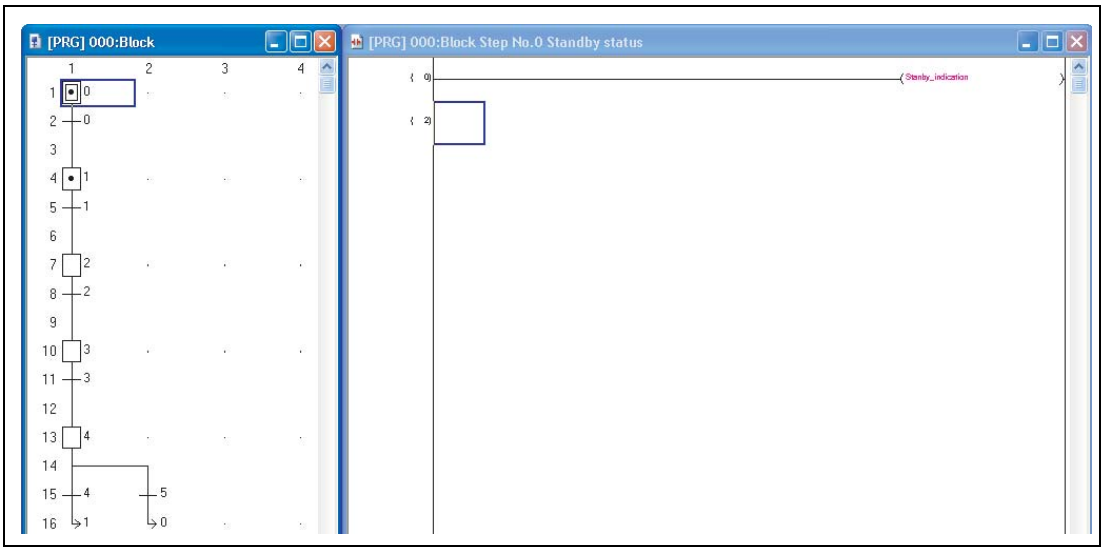


Fig. 7-3: *Sample program for QCPU/LCPU*

For FXCPU

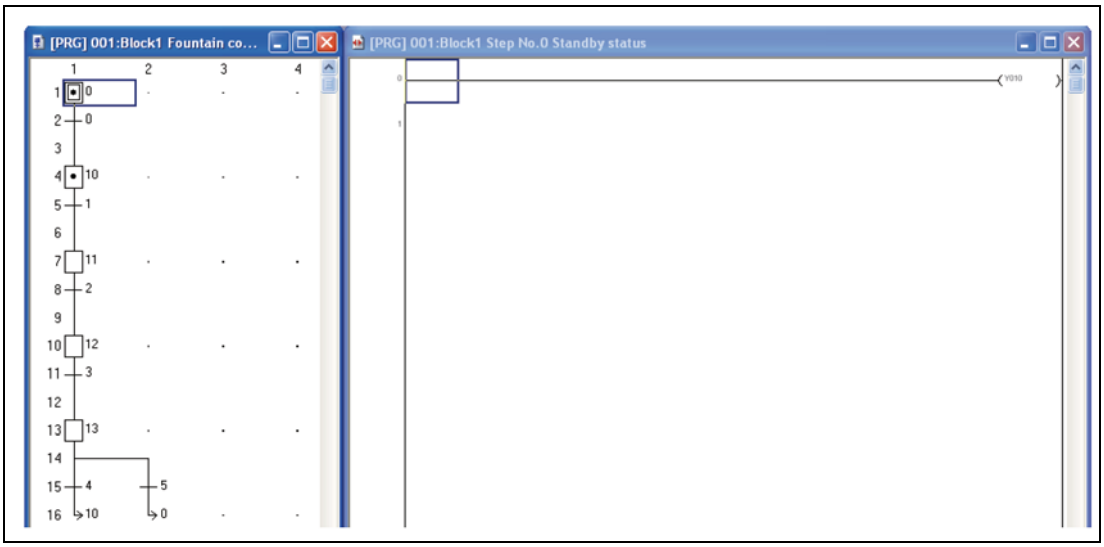


Fig. 7-4: *Sample program for FXCPU*

7.2.3 Starting GX Works2

For the GX Works2 starting procedure, refer to Section 7.1.3.

7.2.4 Creating a new project

For the new project creating procedure, refer to Section 7.1.4.

Select SFC as the "programming language".

NOTE

Perform the following when using the FXCPU:

- Labels are not available for SFC.
  Uncheck "Use Label".
  If it is checked, SFC is not selectable as the "Language".
- When you select SFC as the "Language" and create a new project, the Block Information Setting screen appears.
  Refer to Section 7.2.7 for the setting procedure.

7.2.5 Setting parameters

For the Parameter setting procedure, refer to Section 7.1.5.

7.2.6 Setting labels

For the Global Label setting procedure, refer to Section 7.1.6.

NOTE

The FXCPU does not support the Label in ST language.
Directly input a device.

Setting on the Global Label

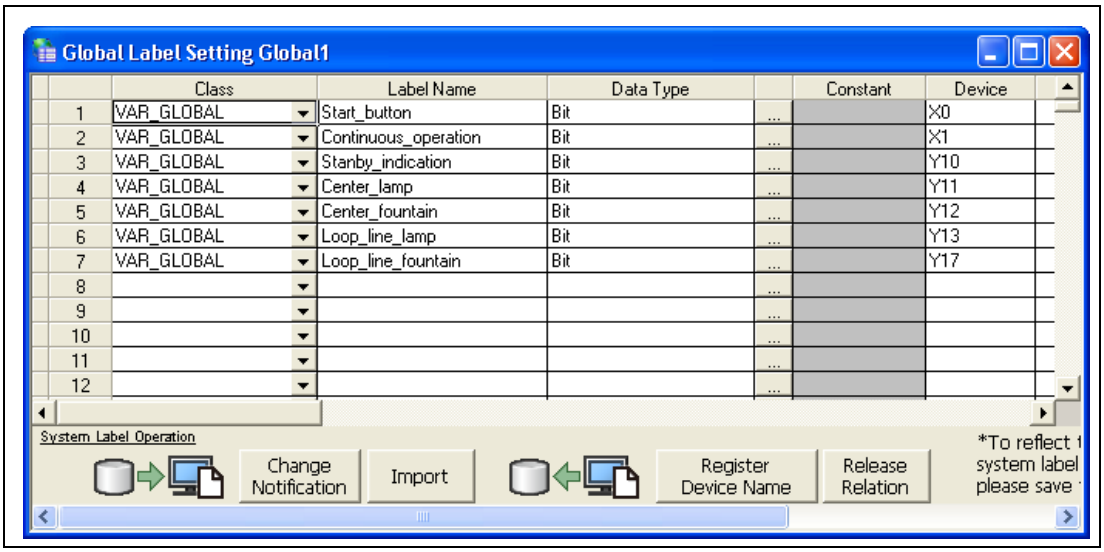


Fig. 7-5: *Setting on the Global Label*

7.2.7 Creating a program

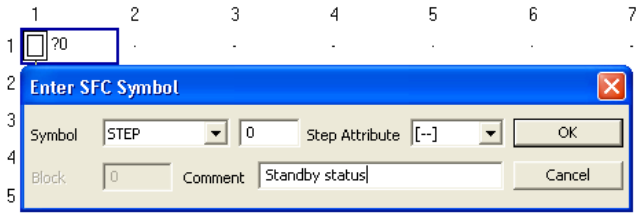
Create the SFC program shown in Section 7.2.2.

Refer to the following item when using the FXCPU:

- Page 7-27, "The following procedure is required when the FXCPU is used."

① Double-click "POU" → "Program" → "MAIN" → "000:Block" → "Program" on the Project view to display the SFC screen for "[PRG] 000:Block".
When using the FXCPU, double-click "001: Block1".

② Creating the SFC Diagram (step 0)
Put the cursor in the position "row number 1, column number 1" on the screen, and double-click it to display the Enter SFC Symbol screen.

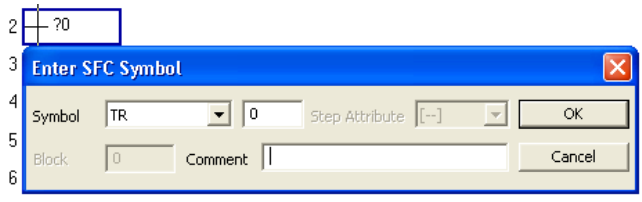


After setting the items, click the OK button to move the cursor to the next row.

Settings:

- Symbol :STEP/0
- Step Attribute :[--]
- Comment :Standby status

③ Creating the SFC Diagram (Series transition 0)
Put the cursor in the position "row number 2, column number 1" on the screen, and double-click it to display the Enter SFC Symbol screen.



After setting the items, click the OK button to move the cursor to the next row.

Settings:

- Symbol :TR/0
- Comment :blank

④ Creating the SFC Diagram (step 1)

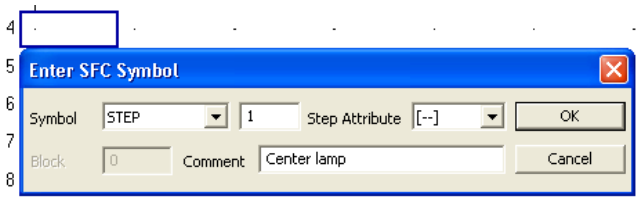
For the creation method, refer to the following.

Put the cursor in the position "row number 4, column number 1".

See step ② in Section 7.2.7.

Settings:

- Symbol :STEP/1
- Step Attribute :[--]
- Comment : Center lamp



⑤ Creating the SFC Diagram (Series transition 1)

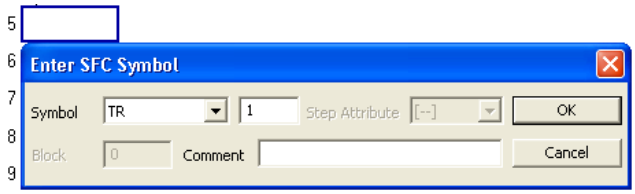
For the creation method, refer to the following.

Put the cursor in the position "row number 5, column number 1".

See step ③ in Section 7.2.7.

Settings:

- Symbol :TR/1
- Comment : blank



⑥ Creating the SFC Diagram (step 2)

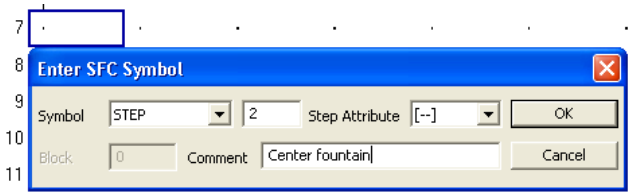
For the creation method, refer to the following.

Put the cursor in the position "row number 7, column number 1".

See step ② in Section 7.2.7.

Settings:

- Symbol :STEP/2
- Step Attribute :[--]
- Comment : Center fountain



⑦ Creating the SFC Diagram (Series transition 2)

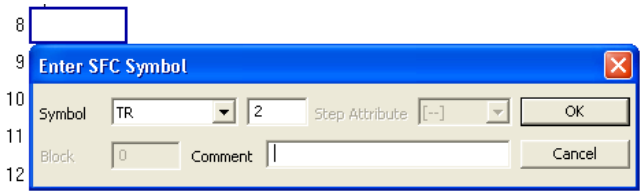
For the creation method, refer to the following.

Put the cursor in the position "row number 8, column number 1".

See step ③ in Section 7.2.7.

Settings:

- Symbol : TR/2
- Comment : blank



⑧ Creating the SFC Diagram (step 3)

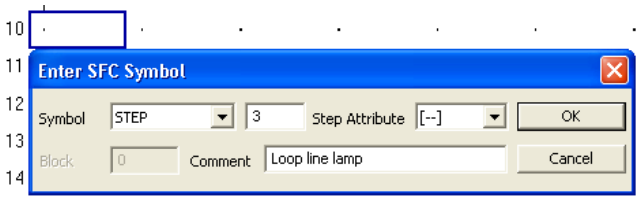
For the creation method, refer to the following.

Put the cursor in the position "row number 10, column number 1".

See step ② in Section 7.2.7.

Settings:

- Symbol :STEP/3
- Step Attribute :[--]
- Comment : Loop line lamp



⑨ Creating the SFC Diagram (Series transition 3)

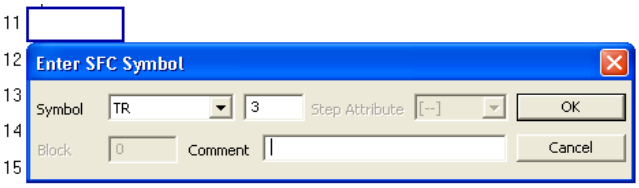
For the creation method, refer to the following.

Put the cursor in the position "row number 11, column number 1".

See step ③ in Section 7.2.7.

Settings:

- Symbol :TR/3
- Comment : blank



⑩ Creating the SFC Diagram (step 4)

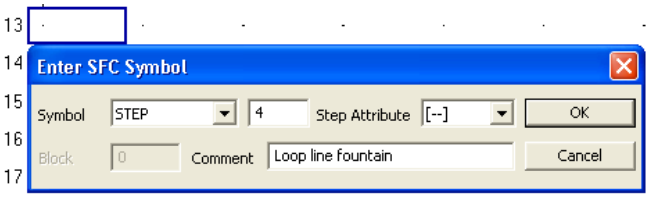
For the creation method, refer to the following.

Put the cursor in the position "row number 13, column number 1".

See step ② in Section 7.2.7.

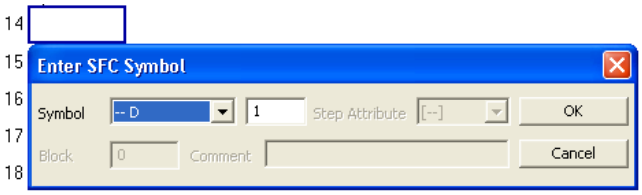
Settings:

- Symbol :STEP/4
- Step Attribute :[--]
- Comment : Loop line fountain



⑪ Creating the SFC Diagram (Selective branch)

Put the cursor in the position "row number 14, column number 1" on the screen, and double-click it to display the Enter SFC Symbol screen.



After setting the items, click the High Speed Int button to move the cursor to the next row.

Settings:

- Symbol :--D/1

⑫ Creating the SFC Diagram (Series transition 4)

For the creation method, refer to the following.

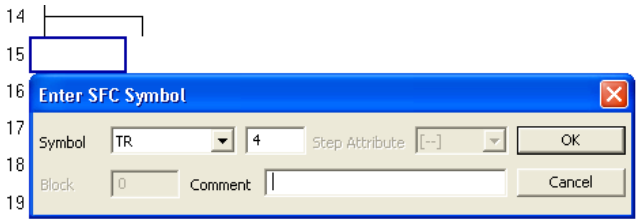
Put the cursor in the position "row number 15, column number 1".

See step ③ in Section 7.2.7.

Settings:

– Symbol :TR/4

– Comment : blank



⑬ Creating the SFC Diagram (Series transition 5)

For the creation method, refer to the following.

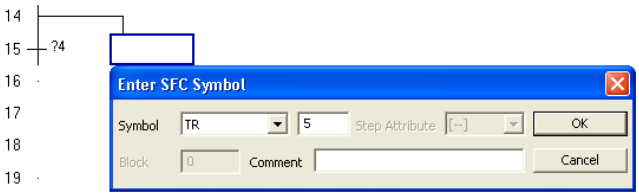
Put the cursor in the position "row number 15, column number 2".

See step ③ in Section 7.2.7.

Settings:

– Symbol :TR/5

– Comment : blank

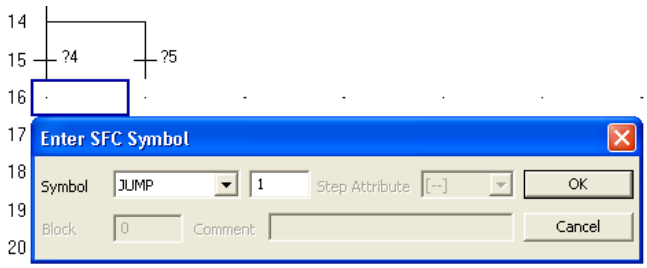


⑭ Creating the SFC Diagram (Jump to the Continuous operation)

Put the cursor in the position "row number 16, column number 1" on the screen, and double-click it to display the Enter SFC Symbol screen.
After setting "Symbol", click the High Speed Int button to display the jump destination step number.

Settings:

– Symbol :JUMP/1

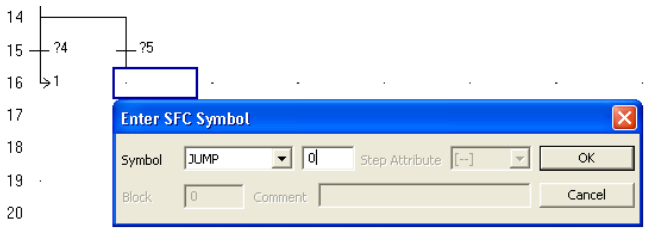


⑮ Creating the SFC Diagram (jump to the Cycle operation)

Put the cursor in the position "row number 16, column number 2" on the screen, and double-click it to display the Enter SFC Symbol screen.
After setting "Symbol", click the High Speed Int button to display the jump destination step number.

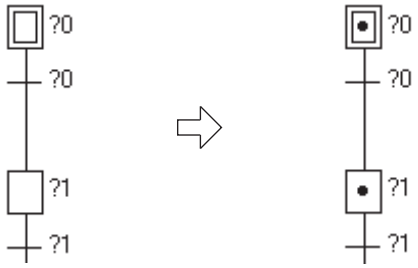
Settings:

– Symbol :JUMP/0

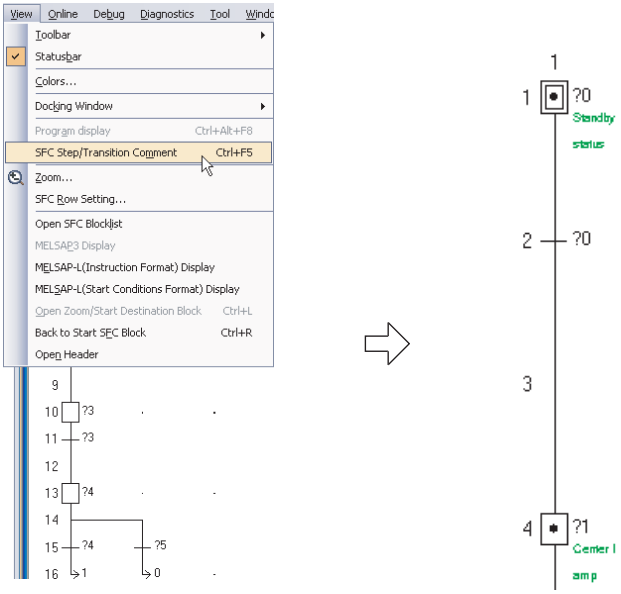


NOTES

The step (☐) specified as the jump destination will change into (⊡)



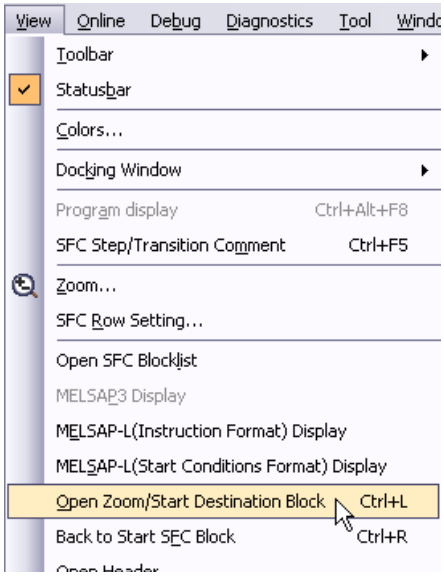
Perform the following procedure to display comments set on the Enter SFC Symbol screen.
Select **View → SFC Step/Transition Comment**.



⑯ Creating the zoom
(operation output of the step 0)

Put the cursor in the zoom block (such as step and serial transition), and then perform the following procedure to display the zoom.

In this case, put the cursor in the step 0.
Select **View → Open Zoom/Start Destination Block**.
Perform the following to return to the SFC screen:
Select **View → Back to Zoom SFC Block**.
Create the operation output of the step 0 (standby status), and convert the ladder.



For operation output creation and ladder conversion, refer to the following:

– Section 7.1.7 Creating a program

– Section 7.1.8 Converting ladder blocks

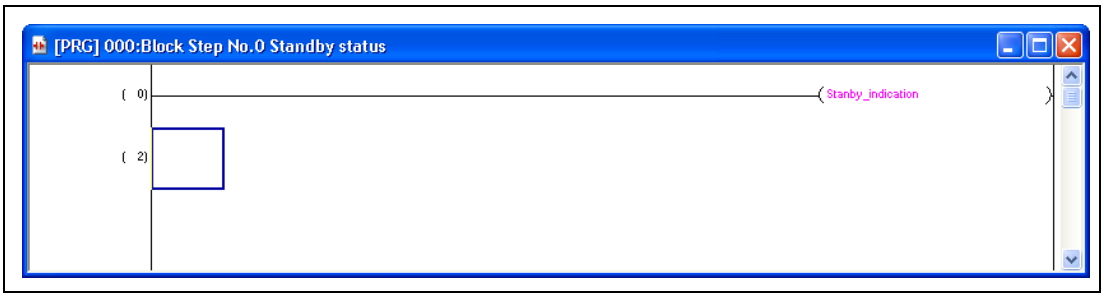
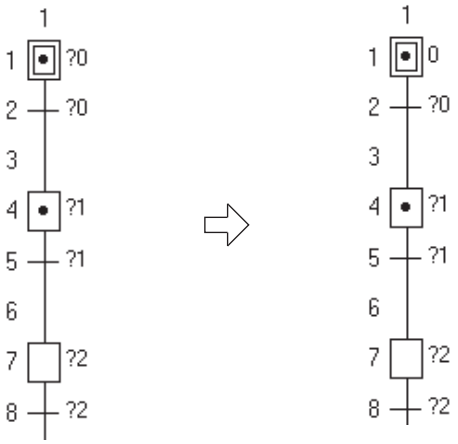


Fig. 7-6: *Zoomed view of selected block*

NOTES

The step (□?) whose operation output is created will change into (□)



SFC diagram and Zoom screen display
By the following setting, the Zoom screen will be automatically displayed together when you open the SFC diagram.
Select **Tool → Options → Program Editor → SFC → SFC Diagram → Tile SFC and Zoom vertically**.

⑰ Creating the zoom
(Transition condition of series transition 0)

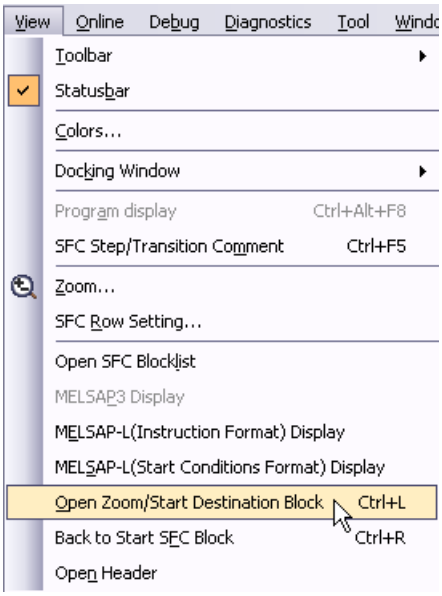
Display the zoom.

For the display method, refer to the following.

See step ⑯ in Section 7.2.7.

For operation output creation and ladder conversion, refer to the following:

- Section 7.1.7 Creating a program
- Section 7.1.8 Converting ladder blocks



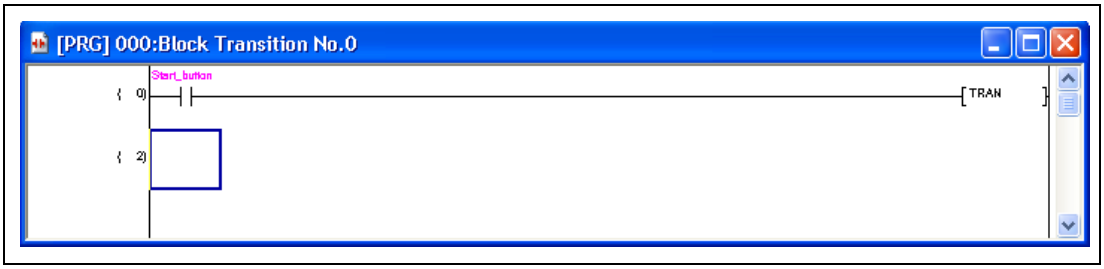


Fig. 7-7: *Zoomed view of selected block*

NOTE

In the transition condition, the coil instruction accepts only one dummy coil ([TRAN]).

Click " F7 " or " F8 ", and click the High Speed Int button to enter the dummy coil. Then, "[TRAN]" will be entered automatically.

⑱ Creating the zoom (step ①, series transition 1, step ②, series transition 2, step ③, series transition 3, step ④, series transition 4, series transition 5)

For the zoom display and creation methods, refer to the following:

– See step ⑯ in Section 7.2.7.

– See step ⑰ in Section 7.2.7.

– See Note in step ⑰ in Section 7.2.7.

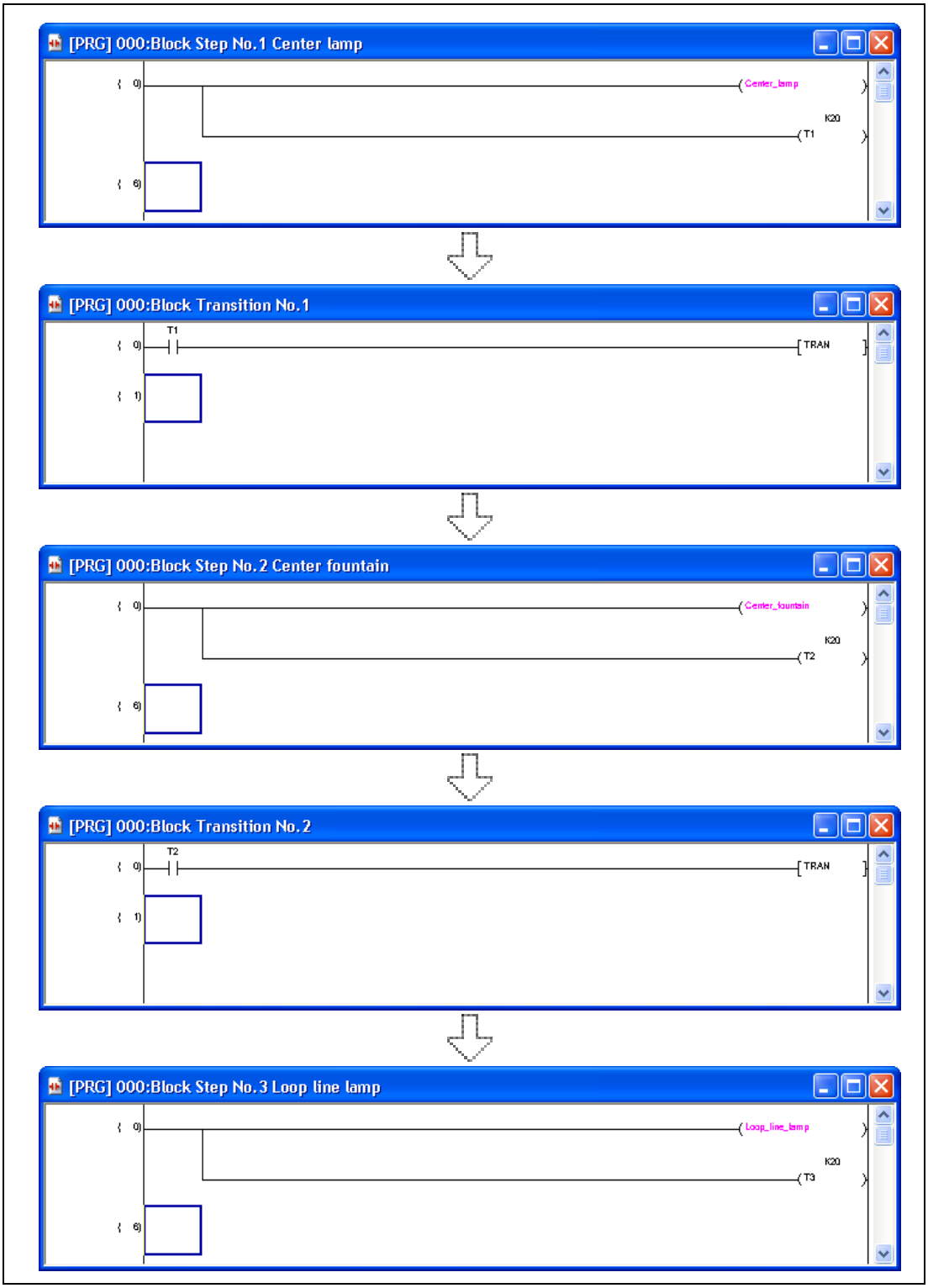


Fig. 7-8: *Zoomed view of selected block*

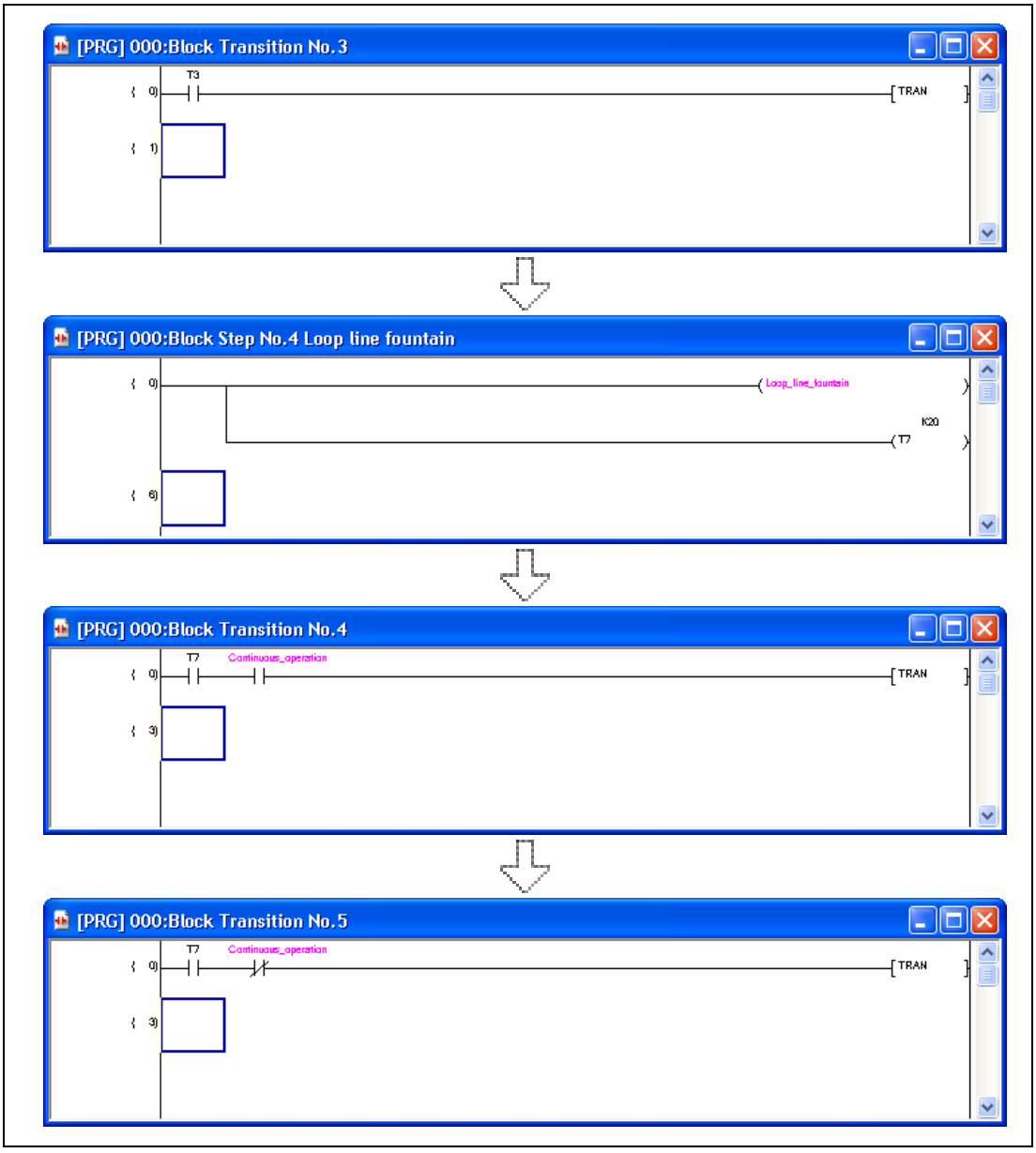


Fig. 7-9: *Zoomed view of selected block*

⑲ When the FXCPU is used, it is necessary to create a ladder for turning ON the SFC program using a ladder block.
Double-click "000: Block", and create a necessary circuit.

In this example, the initial state S0 is set to ON using the special auxiliary relay M8002 that is actuated instantaneously when the programmable controller mode is changed from STOP to RUN.

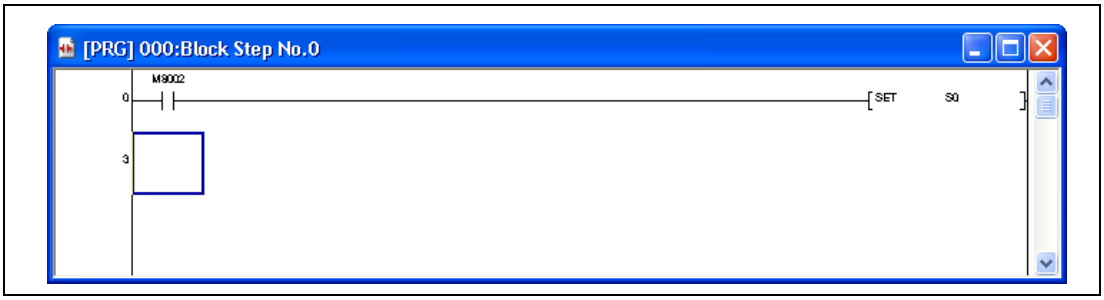
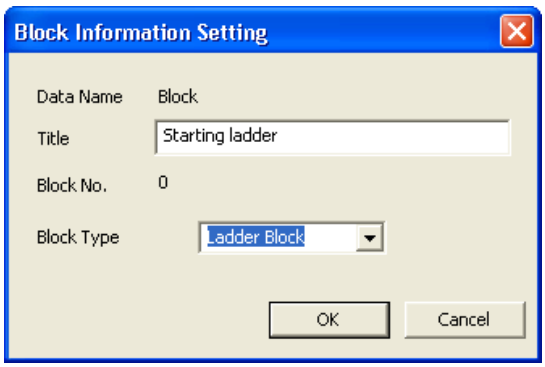


Fig. 7-10: *Zoomed view of selected block*

The following procedure is required when the FXCPU is used.

① The Block Information Setting screen appears when a new project is created.
After setting, click the OK button to close the Block Information Setting screen and add "000: Block" (ladder block) on the Project view screen.

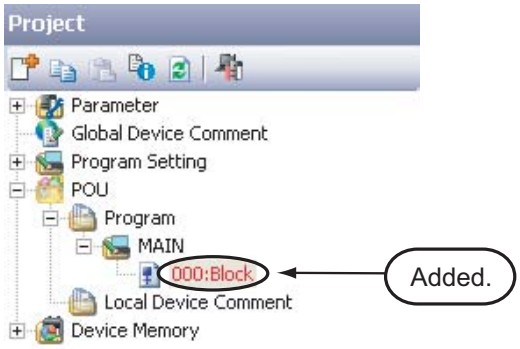


When the FXCPU is used, it is necessary to create a ladder for turning ON the SFC program using a ladder block.

Settings:

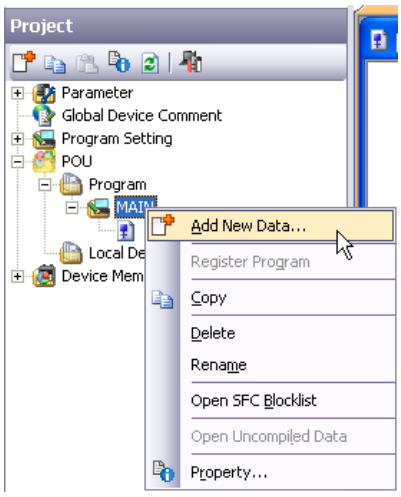
– Title : Starting ladder

– Block Type : Ladder Block



② Select "MAIN" on the Project view screen, right-click it, and then select the menu item "Add New Data".

The New Data screen will appear.

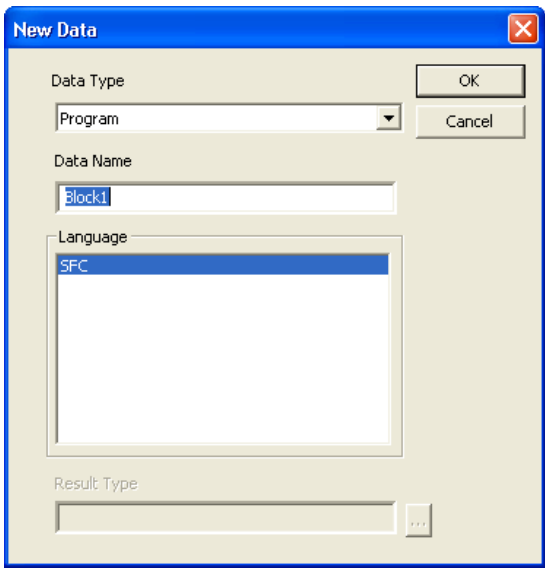


③ Set "Data Type" and "Language". Leave "Data Name" in the initial setting (001: Block1).
After setting, click the OK button to close the New Data screen and display the Block Information Setting screen.

Settings:

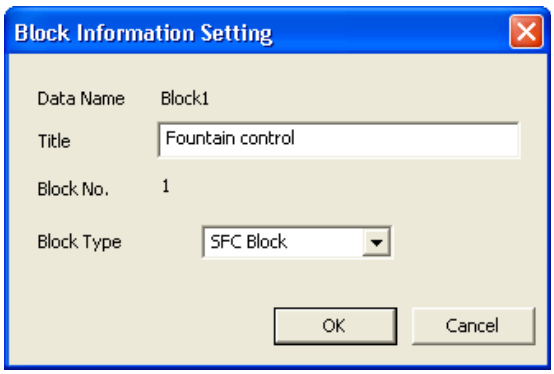
– Data Type : Program

– Language : SFC



④ Set "Title" and "Block Type".
After setting, click the OK button to close the Block Information Setting screen and add "001: Block1" (SFC block) on the Project view screen.

When using the FXCPU, create an SFC program in this block.

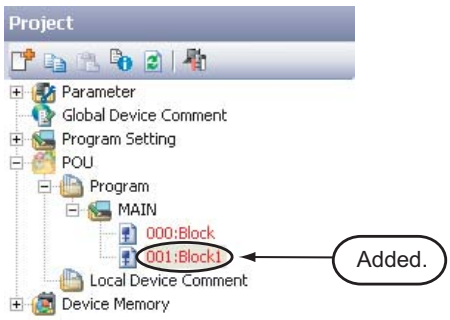


Set to ON the initial step of this block using the ladder block created in "000: Block".

Settings:

– Title : Fountain control

– Block Type : SFC Block



NOTE

When using the FXCPU, set steps of the SFC program as follows:

- States S0 to S9 are called initial steps (states), and used only as head step numbers of SFC blocks. Accordingly, you can create up to 10 SFC blocks (starting from S0 to S9) when using the FXCPU.
- States S10 and later can be used as general step numbers. However, note that the maximum number of steps in 1 block is 512.
- Each step (state) number can be used only once throughout all blocks.

The SFC program creation procedure explains a case using the QCPU.
Use the above creation procedure when using the FXCPU.

7.2.8 Compiling a program (for QCPU/LCPU) or converting a SFC diagram (for FXCPU)

Compiling a program (QCPU/LCPU)

For the program compiling procedure, refer to Section 7.1.9.

Converting a SFC Diagram (FXCPU)

① Select **View** → **Back to Zoom SFC Block** to return to the SFC screen, and convert a SFC diagram.

② Select **Compile** → **Build** to execute the conversion.

7.2.9 Saving a project

For the Saving a Project procedure, refer to Section 7.1.10, Saving a project.

8 Sample Program: Structured Project

8.1 Creating a Program of STRUCTURED LADDER

This section explains the operations to create a structured ladder program.

8.1.1 Operations of program

- When X0 turns ON, the programmable controller turns ON Y10, and then turns OFF Y10 1 second later.
- When X1 turns ON, the programmable controller transfers K10 to D0 (which is defined with the Label "VAR1").
- When X2 turns ON, the programmable controller transfers K20 to D0 (which is defined with the Label "VAR1").

8.1.2 Created program

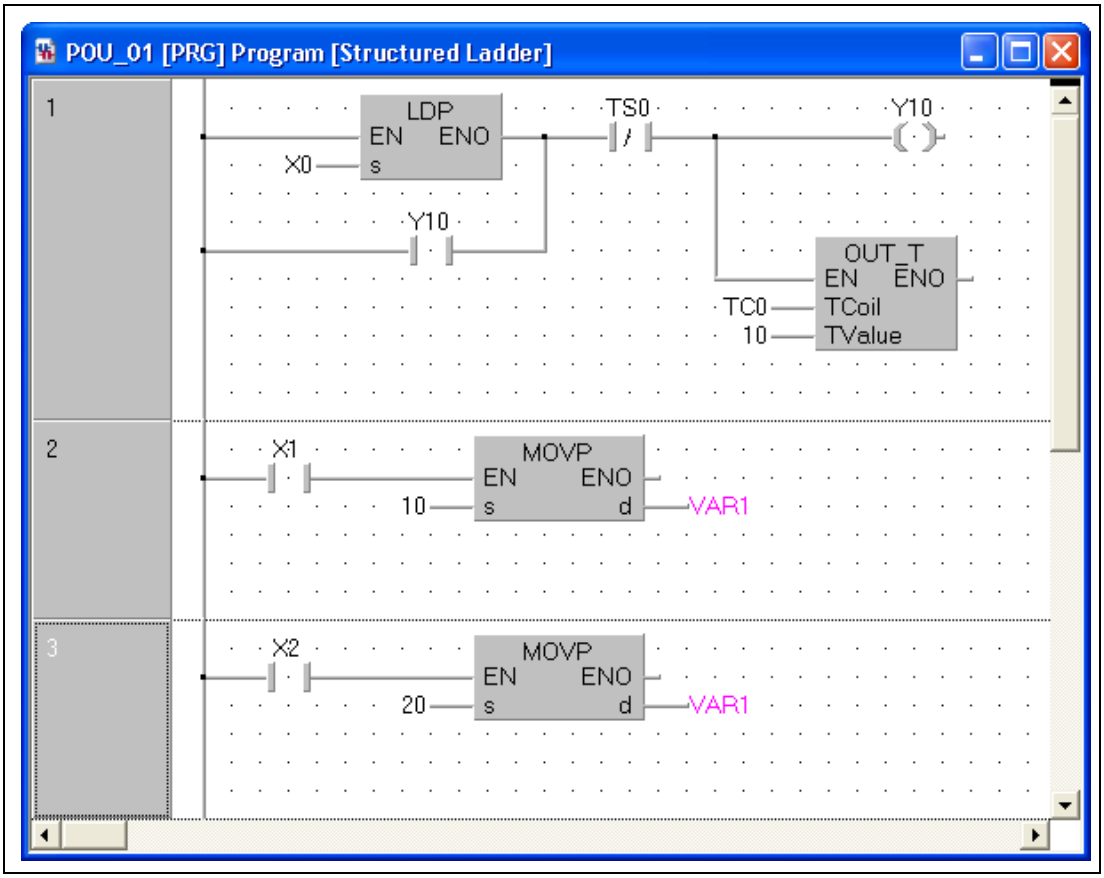
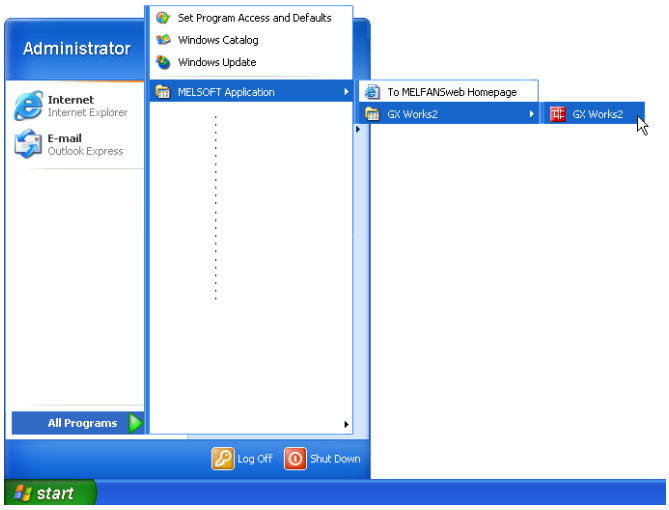


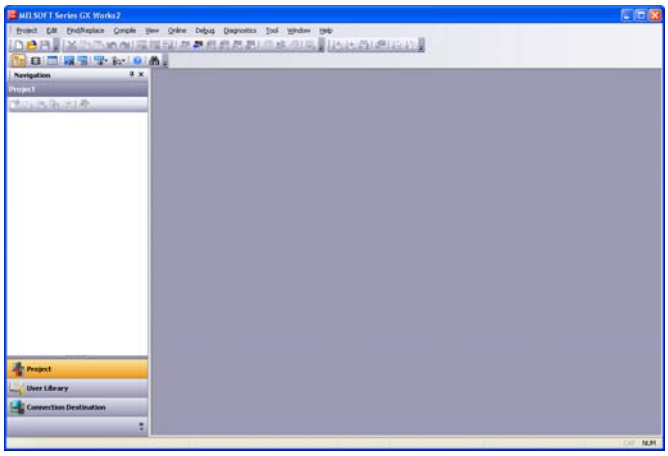
Fig. 8-1: *Sample program*

8.1.3 Starting GX Works2

① Select the software package menu to be started.



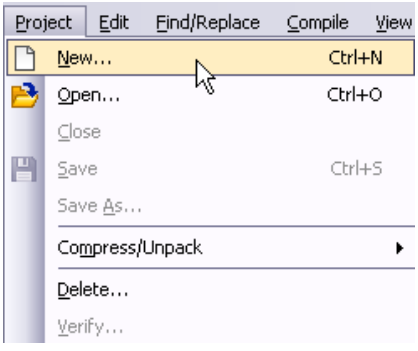
② The selected software package is started.



8.1.4 Creating a new project

① Perform either procedure below to display the New Project screen.

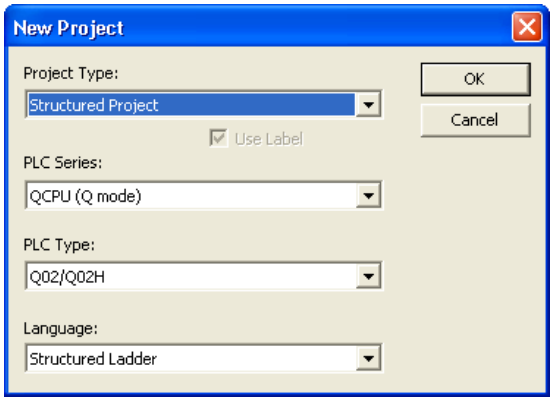
- Select **Project** → **New**.
- Click (New).



② Select the "Project Type", "PLC Series", "PLC Type" and "Language" from the list boxes for the new project to be created.

Check "Use Label" when using labels in the program to be created.

After the setting, click the OK button.

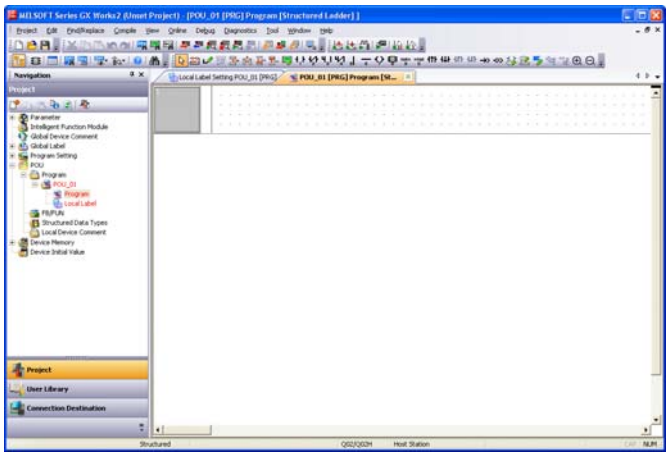


Settings:

- Project Type : Structured Project
- PLC Series:QCPU (Q mode)
- PLC Type: Q02/Q02H
- Language: Structured Ladder

NOTE Labels are always available in structured projects. You do not have to check "Use Label".

③ GX Works2 creates a new project.



8.1.5 Setting parameters

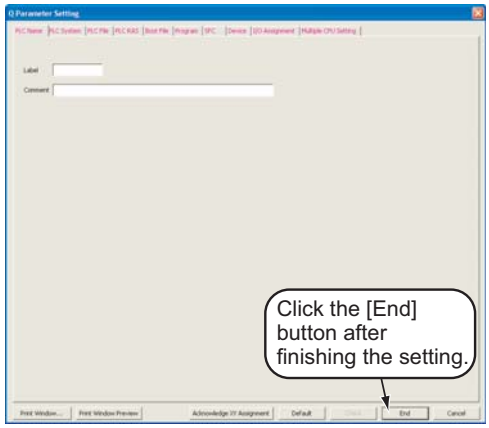
① Double-click "Parameter" → "PLC Parameter" on the Project view to display the Q Parameter Setting screen.

② Click the End button to determine the settings and close the screen.

The parameters remain unchanged from the initial setting in the example in this manual.

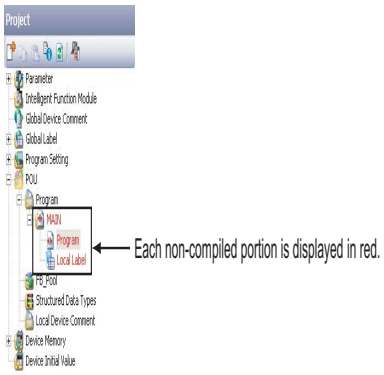
Refer to the following manuals for the details on parameter setting:

- GX Works2 Operating Manual (Common)
- Manual of the programmable controller being used
- Manual of the Network being used



8.1.6 Setting labels

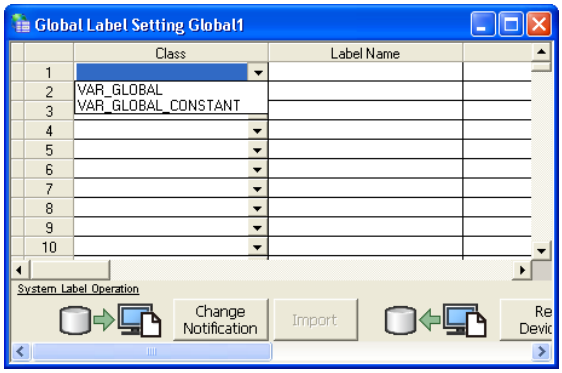
① Double-click "Global Label" → "Global1" on the Project view to display the Global Label Setting screen.



② Select the "Class" from the list box on the Global Label Setting screen.

Settings:

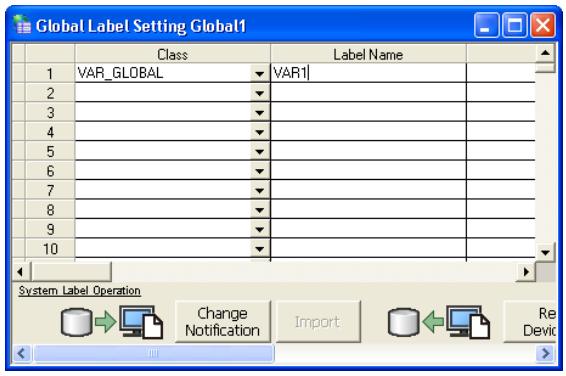
– Class: VAR_GLOBAL



③ Directly input the "Label Name" on the Global Label Setting screen.

Settings:

– Label Name: VAR1



NOTE

Characters available for the label name
You can enter up to 32 characters as the label name.
However, note that the following label name will cause a compile error.

- Label name which contains space
- Label name whose first character is a number
- Label name equivalent to a device name

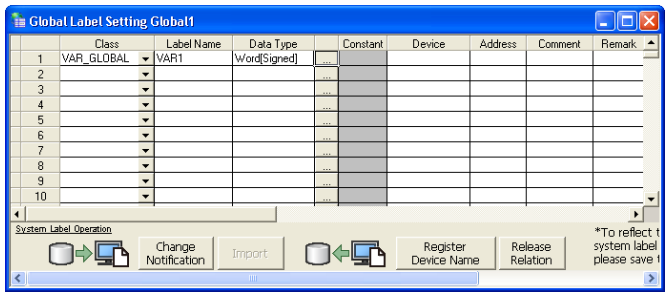
For other characters unavailable for the label name, refer to the following manual.

- GX Works2 Operating Manual (Common)

④ Directly input the "Date Type" on the Global Label Setting screen.

Settings:

– Date Type: Word[Signed]



NOTE

You can click [...] to display the Type Selection screen, and then select the Types on this screen.

Settings①:

① Libraries: ALL

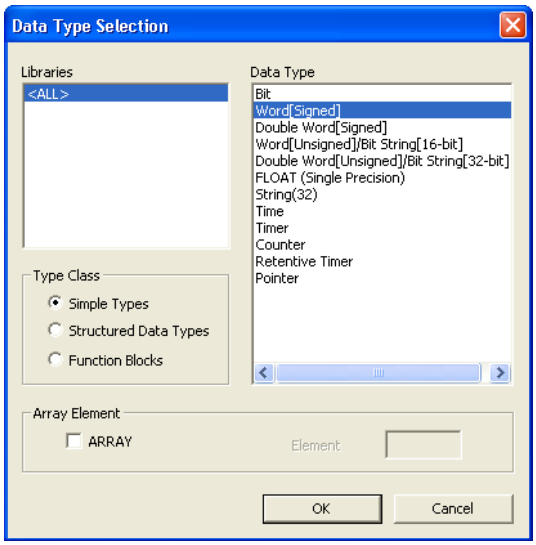
② Type Class: Simple Types

③ Types: Word[Signed]

④ Array Element: Not checked

① Set "Libraries", "Type Class", "Types" and "Array Element" in this order.

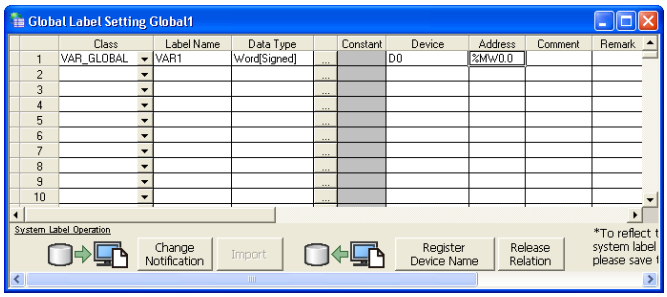
After completing the setting, click the button.



⑤ Directly input the "Device" on the Global Label Setting screen.

Settings:

– Device: D0



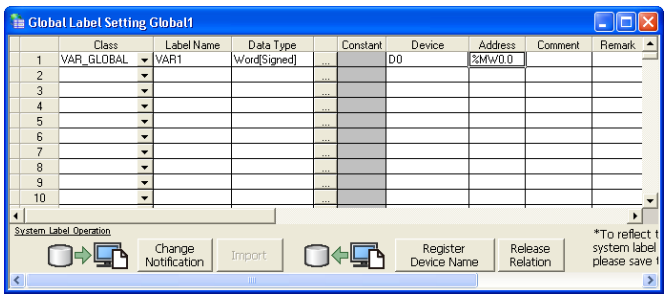
⑥ Set the "Constant", "Comment" and "Remark" on the Global Label Setting screen.
"Relation with System Label", "System Label Name" and "Attribute" are not used in examples shown in this manual.

Settings:

– Constant: When the label class is "VAR_GOBAL", you cannot set or change the constant value.

– Comment: No setting

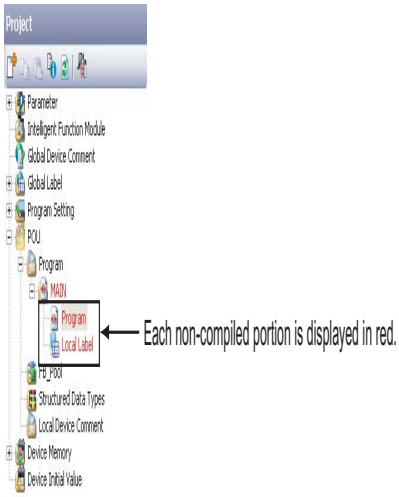
– Remark: No setting



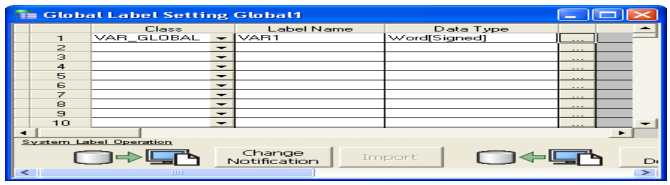
8.1.7 Creating a program

Create the structured ladder program shown in Section 8.1.2.

① Double-click "POU" → "Program" → "POU_01" → "Program" on the Project view to display the POU_01 [PRG] Program [Structured Ladder] screen.



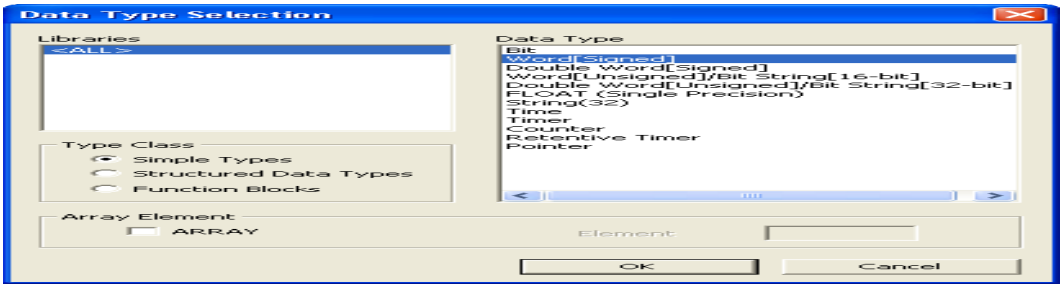
② Drag "Function" → "LDP" from the Function Block Selection window, and drop it on the POU_01 [PRG] Program [Structured Ladder] screen to position it there.



NOTES

Positioning Function and Function block using the Function Block Selection window
You can easily position Function and Function block by dragging them from the Function Block Selection window.
Perform the following procedure to display the Function Block Selection Window:
Select "View" → "Docking window" → "Function Block Selection Window".
In the example below, drag the Function "LDP" from the Function Block Selection window, and drop it on the POU_01 [PRG] Program [Structured Ladder] screen to position it there.
Refer to the following manual for the details:

- GX Works2 Operating Manual (Structured Project)

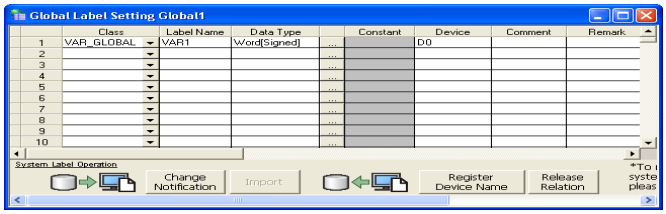


Using network elements instead of the Function "LDP (Rising Edge)"
Click (Rising Edge) on the structured ladder toolbar, and then click a desired location to position the Rising Edge there.

③ Click (Interconnect Mode) on the Structured Ladder toolbar to specify the Interconnect mode.

Click the start point and end point in this order to draw a grid line as shown left.

(GX Works2 is using the Auto Connect function described in "Point" in the previous page.)



NOTE

Connection with grid line

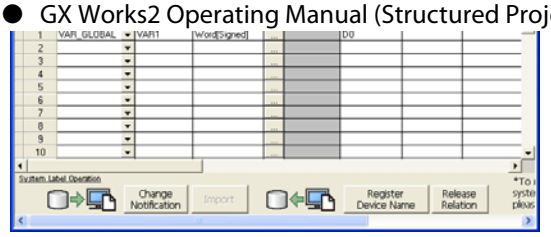
Connect Network Elements such as contacts, coils, Function and Function block with grid lines.

Click (Interconnect Mode), and draw a grid line.

Make valid the Auto Connect function to easily draw a grid line only by specifying the start point and end point using the mouse.

Refer to the following manual for the details:

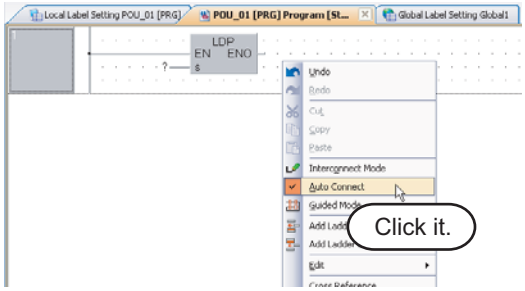
- GX Works2 Operating Manual (Structured Project)



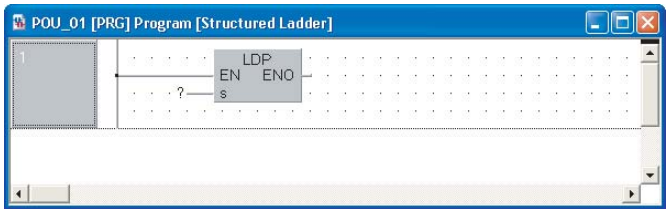
You can easily connect grid lines by making valid the Auto Connect function in the Interconnect Mode.

Perform the following procedure to make valid the Auto Connect function.

- Select **Edit** → **Auto Connect** to put a check mark.
- Right-click the Structured Ladder work window to display the menu, and select "Auto Connect" to put a check mark.



④ Click (Select Mode) on the Structured Ladder toolbar to specify the Select mode.



⑤ Set the function "LDP".

Click the input variable "?" of "s", and set the input variable.

Settings:

– s: X0

NOTE

Referring to the data type of input/output labels in a Function or Function block
Double-click a positioned function or function block to display the Function/FB Label Setting screen where you can refer to the data type of labels.
Refer to the following manual for the details:

- GX Works2 Operating Manual (Structured Project)

⑥ Click (Contact) on the Structured Ladder toolbar, and then click a desired position to position a Contact there.

Click "?", and set the variable.

Settings:

– Variable: Y10

⑦ Click (Contact Negation) on the Structured Ladder toolbar, and then click a desired position to position Contact Negation there.

Click "?" and, set the variable.

Settings:

– Variable: TS0 (TS0 indicates a contact of the timer T0.)

⑧ Draw grid lines in three positions (❶, ❷ and ❸) using the procedure described in the step ③.

After drawing grid lines, click (Select Mode) on the Structured Ladder toolbar to specify the Select mode.

⑨ Click (Coil) on the Structured Ladder toolbar, and then click a desired position to position a Coil there.

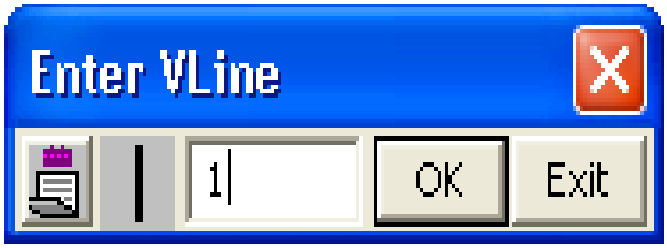
Click "?", and set the variable.

Settings:

– Variable: Y10

⑩ Draw a grid line (❶) using the procedure described in the step ③.

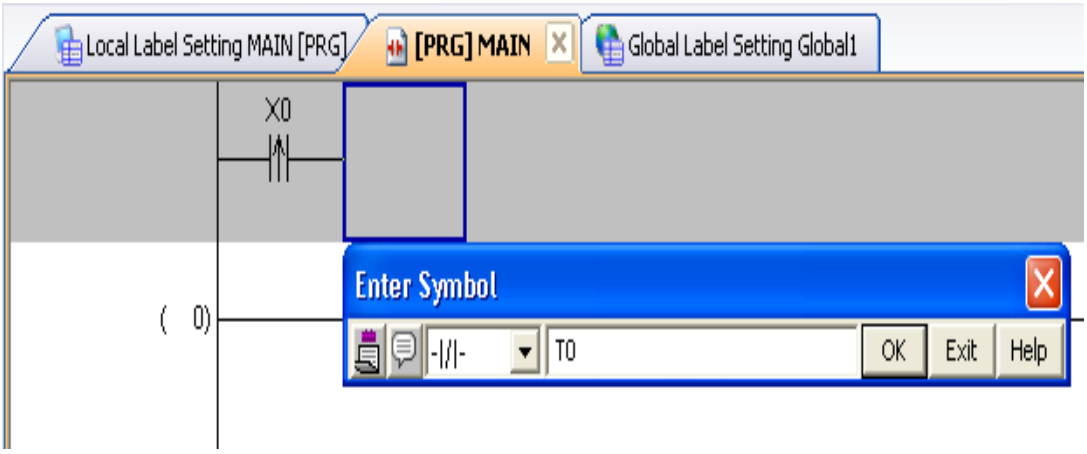
After drawing a grid line, click (Select Mode) on the Structured Ladder toolbar to specify the Select mode.



NOTE

If there is no input or output in the connection source and connection destination as shown below, you can connect a grid line as shown below while the Auto Connect function is valid.
Refer to the following manual for the details:

- GX Works2 Operating Manual (Structured Project)



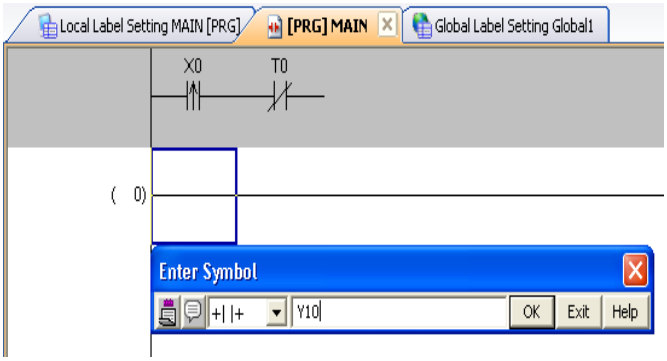
⑪ Select "Function" → "OUT_T" on the Function Block Selection window, drag it, and drop it in a desired position to position "OUT_T" there.

Click "?" of "TCoil①" and "TValue②", and set the input variables.

Settings

– TCoil : TC0③

– TValue: 10



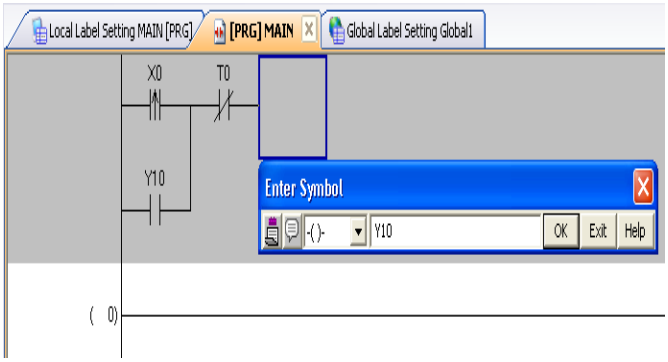
① Set a coil of the timer to "TCoil".

② Set the set value of the timer to "TValue".

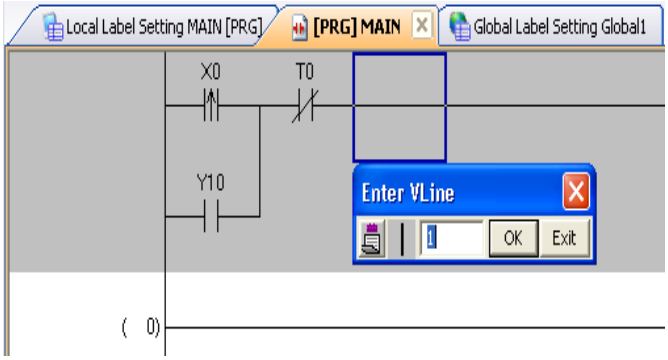
③ "TC0" indicates a coil of the timer T0.

⑫ Draw a grid line (❶) using the procedure described in the step ③.

After drawing a grid line, click (Select Mode) on the Structured Ladder toolbar to specify the Select mode.



⑬ Select a network, and click (ADD Ladder Block After) on the Structured Ladder toolbar to add a network.



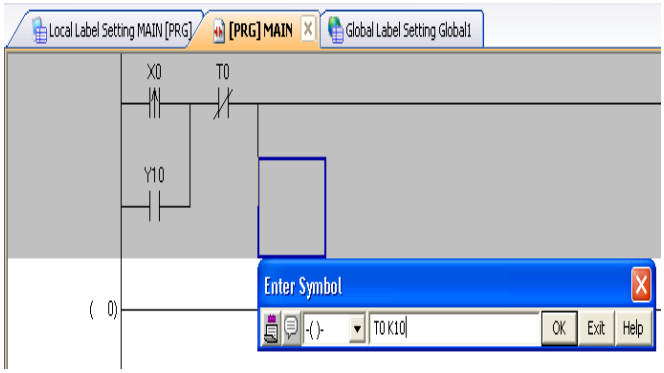
NOTE Create a "one Structured Ladder block" program in one network.

⑭ Click (Contact) on the Structured Ladder toolbar, and then click a desired position to position a Contact there.

Click "?", and set the variable.

Settings:

– Variable: X1



⑮ Select "Function" → "MOVP" on the Function Block Selection window, drag it, and drop it in a desired position to position "MOVP" there.

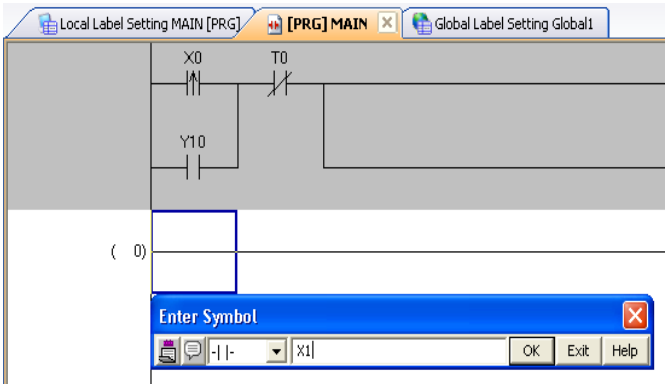
Draw a grid line (❶, ❷) using the procedure described in the step ③.

Click "?" of "s" and "d", and set the input and output variables.

Settings

– s: 10

– d: VAR1①



① "VAR1" is the label set in Section 8.1.6.

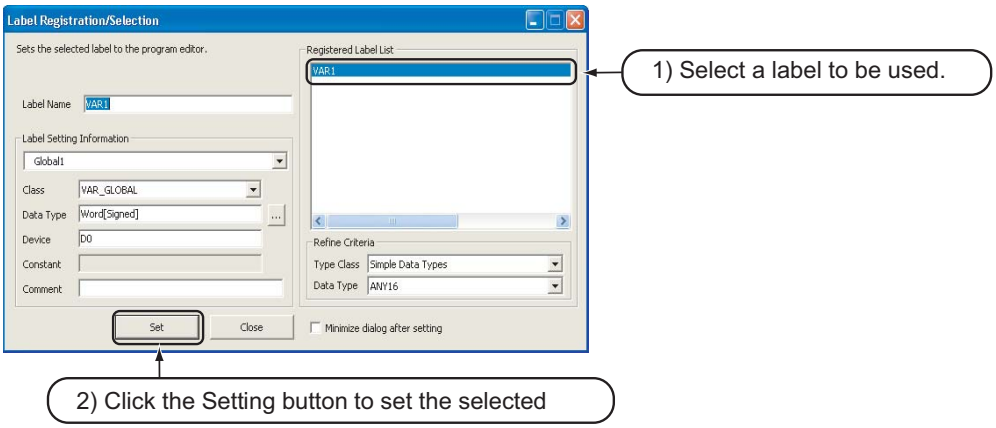
NOTE

Selecting a label from the Label Registration/Selection screen
You can input a label also by selecting it from the Label Registration/Selection screen.
Perform the following procedure to display the Label Registration/Selection screen.

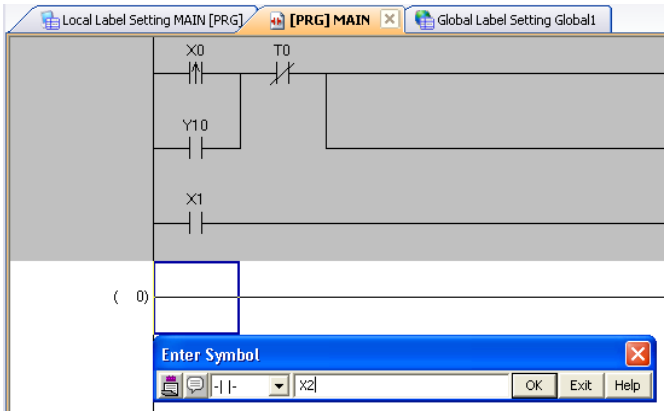
- Select "Edit" → "List Operands".
- Click (List Operands).

Refer to the following manual for the details on the Label Registration/Selection screen:

- GX Works2 Operating Manual (Structured Project)



⑯ Select a network, and click (ADD Ladder Block After) on the Structured Ladder toolbar to add a network.

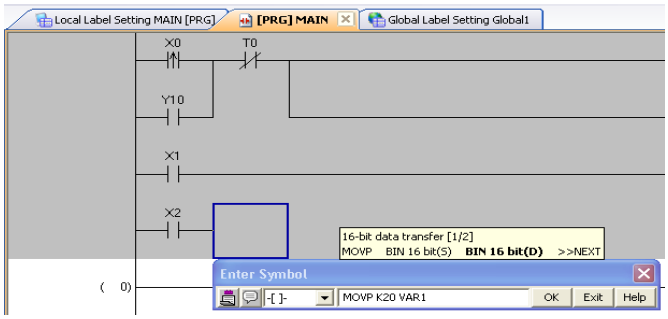


⑰ Click (Contact) on the Structured Ladder toolbar, and then click a desired position to position a Contact there.

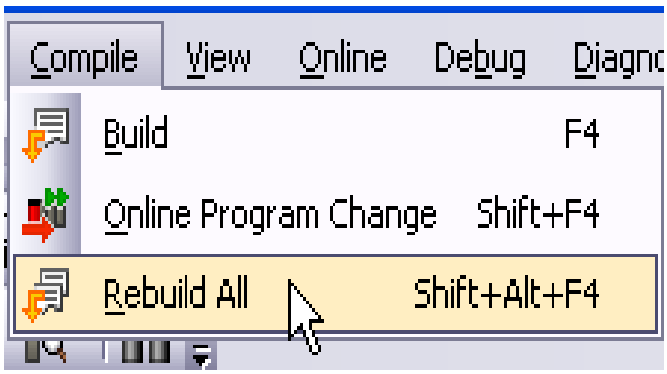
Click "?", and set the variable.

Settings:

– Variable: X2



⑱ Select "Function" → "MOVP" on the Function Block Selection window, drag it, and drop it in a desired position to position "MOVP" there.



Draw a grid line (❶, ❷) using the procedure described in the step ③.

Click "?" of "s" and "d", and set the input and output variables.

Settings:

– s: 20

– : VAR1①

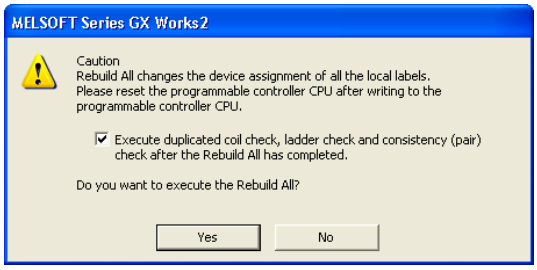
① "VAR1" is the label set in Section 8.1.6.

NOTES

Copying a network by drag & drop

When there is a similar network, you can create a new network efficiently by copying the existing similar network and editing necessary portions.

Drag an existing network, and drop it while pressing the Ctrl key to copy the existing network.



Changing over the device display format

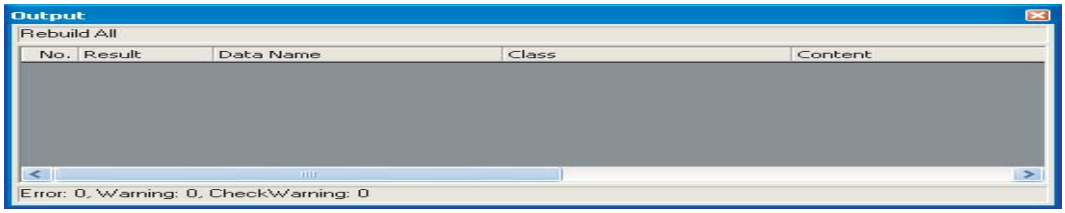
You can check a program by changing over the device display format between "Device" and "Address".

Switch the device display format after performing compiling" or compiling all when using local labels.

Refer to the following section for compiling:

Section 8.1.8, Compiling a program

- Procedure to display Device
  Select **View** → **View Mode** → **Device**.
- Procedure to display Address
  Select **View** → **View Mode** → **Address**.



8.1.8 Compiling a program

There are following two types of compiling. The compiling target is different between the two types.

Select "Rebuild All" for this example.
The "Rebuild All" procedure is described below.
Refer to the following manual for compiling:

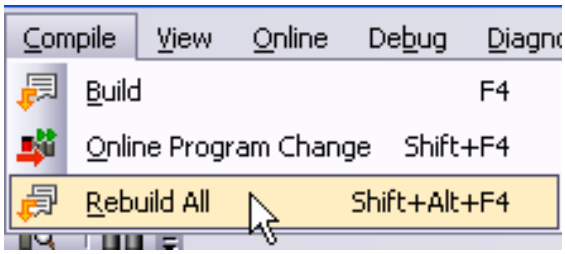
- GX Works2 Operating Manual (Structured Project)

Action	Target program to be compiled
Build	Converts non-compiled programs into sequence program. (Does not compile already compiled programs.)
Rebuild All	Converts all programs into sequence program. (Compiles already compiled programs also.)

Tab. 8-1: *Function of compiler instructions*

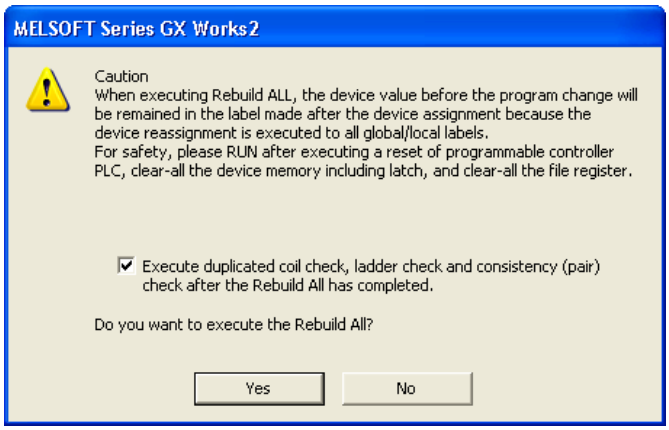
① Select [Compile] → [Rebuild All] to execute "Rebuild All".

You can click (Rebuild All) to execute "Rebuild All".

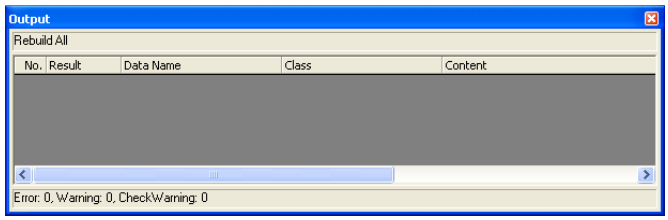


② The screen shown on the left appears.

Click the button to execute "Rebuild All".



③ When finishing "Rebuild All", GX Works2 displays the result on the Output window.
If an error occurs, check the contents, eliminate the cause of error, and then execute "Build" or "Rebuild All" as described in the step 1.

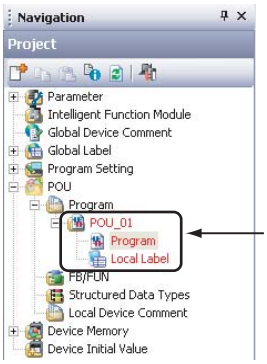


NOTES

Make sure to compile the created or edited program to make it a sequence program executable in the programmable controller CPU.

"Warning C9062" is compiled correctly as a program, and can be monitored.

Compile status checking method
You can check the compile status on the Project view.

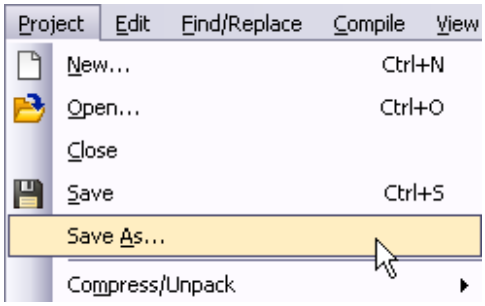


Each non-compiled portion is displayed in red.

8.1.9 Saving a project

You can save a project.
When saving a newly created project, use the menu item [Save as].

① Select **Project** → **Save As** to display the Save As screen.

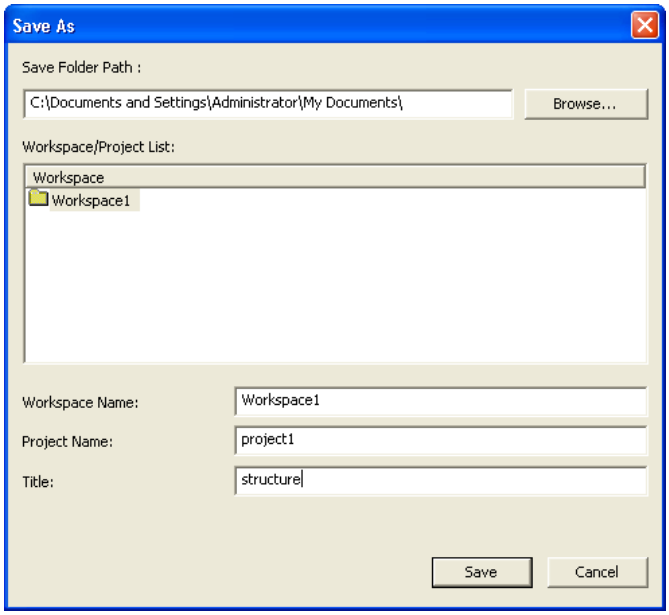


② Set "Save Folder Path", "Workspace Name", "Project Name", "Title", etc.

After the setting, click the Save button to save the project (program).

Refer to the following manual for the details:

– GX Works2 Operating Manual (Common)



Settings:

- Workspace folder path: Specify the save destination folder.
- Workspace Name: Specify the save destination folder name.
- Project Name: Specify the project name.
- Title: Specify the title. You can save a project without specifying a title.

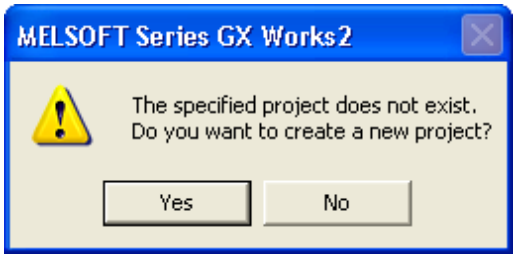
NOTES

Input within 128 characters to "Title".

Make sure that the total characters of "Save Folder Path", "Workspace Name" and "Project Name" is 200 or less.

You cannot save any project to route directories such as "C:\" or "D:\".

③ Click the Yes button to save the new project.



8.2 Creating a Program of ST LANGUAGE

This section explains the operations to create a ladder program.

8.2.1 Operations of program

- When X0 turns ON, the programmable controller turns ON Y10, and then turns OFF Y10 1 second later.
- When X1 turns ON, the programmable controller transfers K10 to D0 (which is defined with the Label "VAR1").
- When X2 turns ON, the programmable controller transfers K20 to D0 (which is defined with the Label "VAR1").

8.2.2 Created program

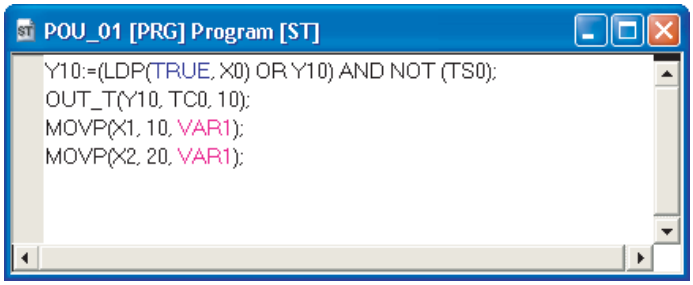


Fig. 8-2: *Sample program*

8.2.3 Starting GX Works2

For the GX Works2 starting procedure, refer to Section 8.1.3.

8.2.4 Creating a new project

For the new project creating procedure, refer to Section 8.1.4.

Select ST as the "programming language".

NOTE Labels are always available in structured projects. You do not have to check "Use Label".

8.2.5 Setting parameters

For the Parameter setting procedure, refer to Section 8.1.5.

8.2.6 Setting labels

For the Global Label setting procedure, refer to Section 8.1.6.

NOTE

Characters available for the label name
You can enter up to 32 characters as the label name.
However, note that the following label name will cause a compile error.

- Label name which contains space
- Label name whose first character is a number
- Label name equivalent to a device name

For other characters unavailable for the label name, refer to the following manual.
☞ GX Works2 Operating Manual (Common)

8.2.7 Creating a program

Create the ST program shown in Section 8.2.2.

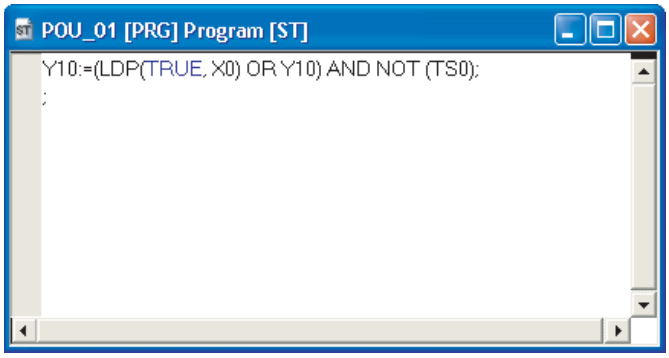
① Double-click "POU" → "Program" → "POU_01" → "Program" on the Project view to display the POU_01 [PRG] Program [ST] screen.

② Input "Y10:=(LDP(TRUE①, X0) OR Y10) AND NOT (TS0②);" directly, and click the Enter key.

You can use the Function Block Selection window for the input.

Settings:

– Y10:= (LDP(TRUE①, X0) OR Y10) AND NOT (TS0②);



① "TRUE" indicates the ON status.

② "TS0" indicates the contact of timer T0.

NOTES

Basic description and display colors

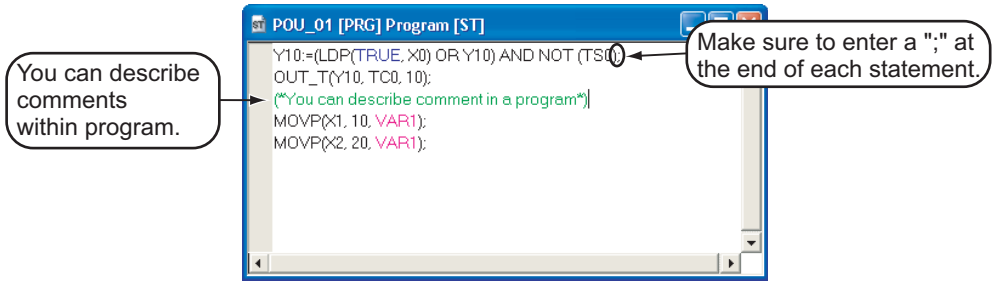
Programming in the ST language consists of syntaxes, operators, function, function block, devices, labels, etc.

Refer to the following manual for syntaxes, operators and programming:

MELSEC-Q/L/F Structured Programming Manual (Fundamentals)

- Make sure to write ";" at the end of a statement.
- Comment

  You can describe comments in a program.



- Display colors

  GX Works2 displays syntax, operators, comments, constants, string constants, devices and labels using the following colors (in the initial setting).

  - Syntax: (blue)
  - Operator: (black)
  - Comment: (dark green)
  - Constant: (black)
  - String constant: (black)
  - Device: (black)
  - Global label: (Device Initia)
  - Local label: (Device Initia)

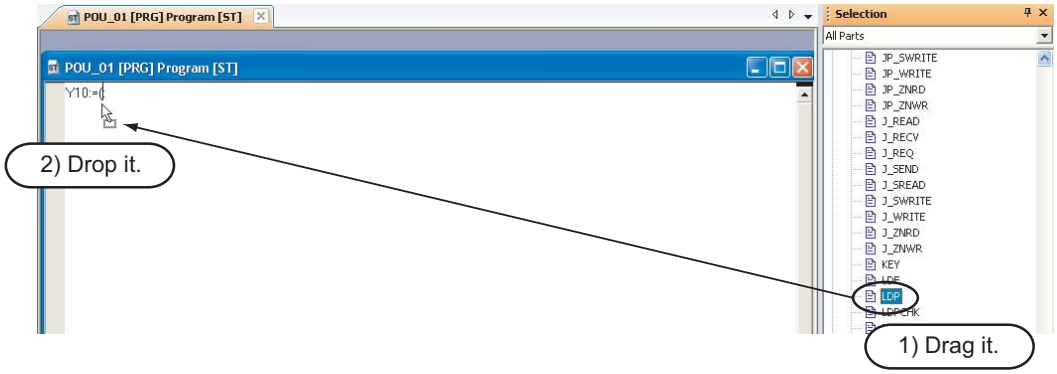
Input using the FB Selection window

You can easily input the function name of a Function or Function block by dragging it to the cursor position from the Function Block Selection window.

In the example below, drag the function "LDP" from the Function Block Selection window, and drop it on the POU_01 [PRG] Program [ST] screen to input it there. After that, input the parameters of the function.

Refer to the following manual for the details:

GX Works2 Operating Manual (Structured Project)



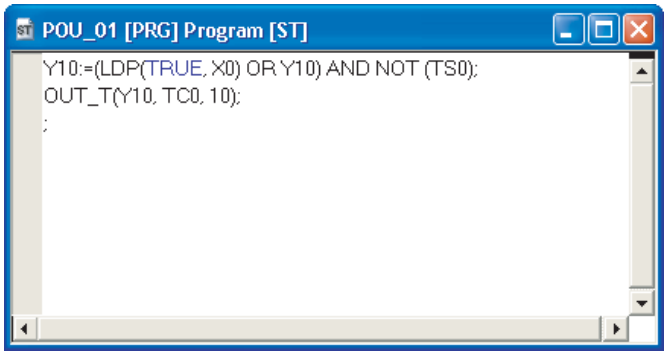
③ Input "OUT_T(Y10,TC0①,10);" directly, and click the Enter key.

You can select "Function" → "OUT_T" on the Function Block Selection window.

Settings:

– OUT_T(Y10,TC0①,10);

① "TC0" indicates the coil of timer T0.



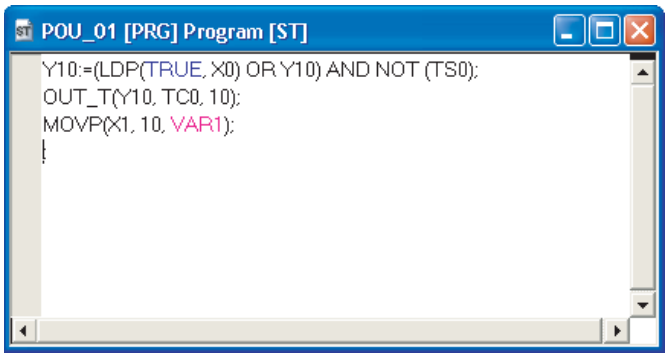
④ Input "MOVP(X1,10,VAR1②);" directly, and click the Enter key.

You can select "Function" → "MOVP" on the Function Block Selection window.

Settings:

– MOVP(X1,10,VAR1②);

② "VAR1" is the label set in Section 8.1.5.



NOTES

Selecting a label from the Label Registration/Selection screen

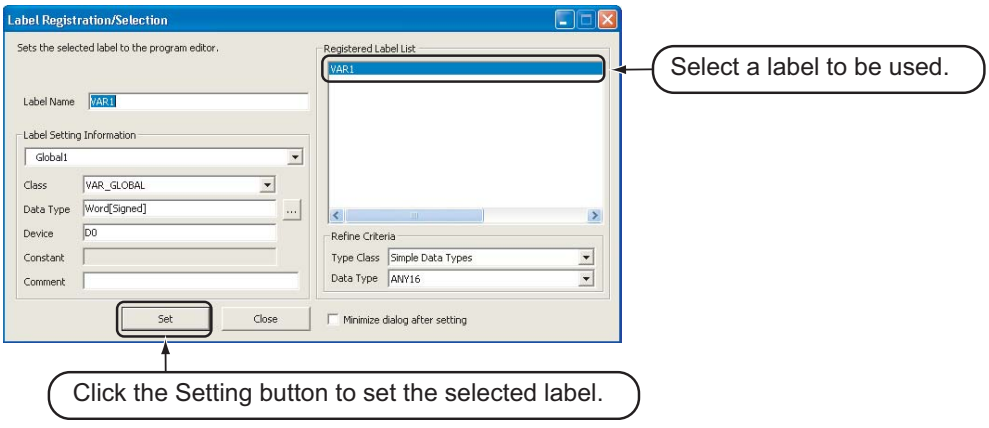
You can input a label also by selecting it from the Label Registration/Selection screen.

Perform the following procedure to display the Label Registration/Selection screen.

- Select "Edit" → "List Operands".
- Click (List Operands).

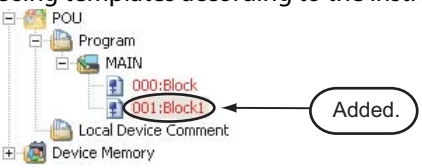
Refer to the following manual for the details on the Label Registration/Selection screen:

- GX Works2 Operating Manual (Structured Project)



Using templates

Using templates according to the instructions/functions.



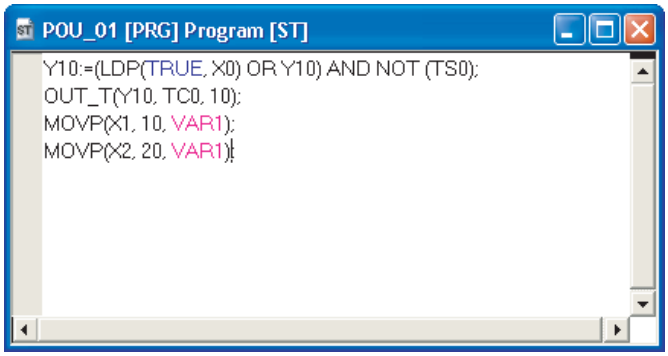
⑤ Input "MOVP(X2,20,VAR1①)" directly .

You can select "Function" → "MOVP" on the Function Block Selection window.

Settings:

– MOVP(X2,20,VAR1①)

① "VAR1" is the label set in Section 8.1.5.



8.2.8 Compiling a program

For the compiling procedure, refer to Section 8.1.8.

8.2.9 Saving a project

For the Saving a Project procedure, refer to Section 8.1.9, Saving a project.

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