Basic manual

Programmable Logic Controller

and PLC editor

TOSHIBA

Safety Precautions

Before using the equipment, please read this chapter carefully.

This chapter describes the safety precautions recommended when using GR equipment. Before installing and using the equipment, this chapter must be thoroughly read and understood.

Explanation of symbols used

Signal words such as DANGER, WARNING, and CAUTION, will be followed by important safety information that must be carefully reviewed.

⚠ DANGER	Indicates an imminently hazardous situation which will result in death or serious injury if you do not follow the instructions.
⚠WARNING	Indicates a potentially hazardous situation which could result in death or serious injury if you do not follow the instructions.
⚠CAUTION	Indicates a potentially hazardous situation which if not avoided, may result in minor injury or moderate injury or property damage.

⚠CAUTION

•Project file

In the event of downloading data to an IED, the user shall tick the check-box “Include Sources” as described in section 3.3. We strongly recommend that the user save a project file on a PC, even though it can be retrieved from the IED if the option “Include Sources” has been selected.

•Disclaimer of liability

We have checked the description of this manual against the hardware and software described, but we cannot guarantee that all deviations have been eliminated from the description completely; hence, no liability can be accepted for any errors or omissions contained in the information given. We review the information in this manual regularly and there will be some corrections in subsequent editions. We reserve the right to make technical improvements without notice.

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1 Overview

1.1 PLC software

PLC (Programmable Logic Controller) software is used for configuring the Inputs/outputs (I/Os), alarms, indications, recording and others. PLC logic consist of “timers”, “flip-flops”, and logic gates “AND, OR, XOR, NOT”. The user can configure PLC-logic using the PLC editor (MULTIPROG®), which should be installed in the user’s PC. Figure 1.1-1 shows the screen for the PLC editor.

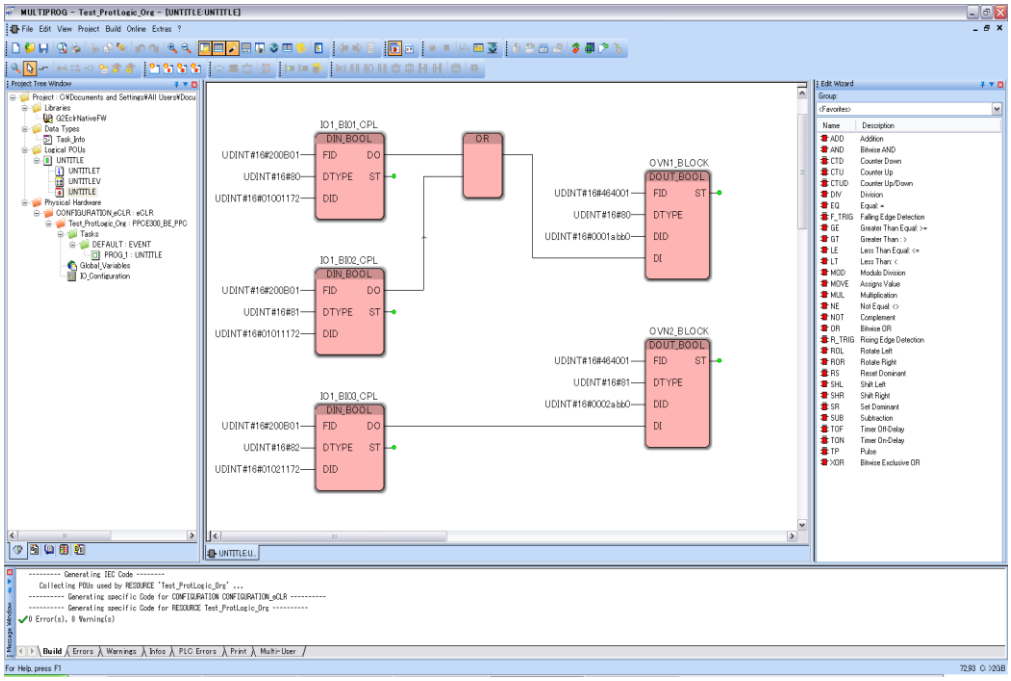


Figure 1.1-1 MULTIPROG® screen

1.2 Required environments

When the user runs two software at the same time in the PC (i.e., the PLC editor and the GR-TIMES†), the two software consume about 3G bytes memories of the physical memories. Therefore, the physical memories are required 4G bytes or larger in the user’s PC.

†Note: For more inform with regard to the GR-TIMES, see manual “*Operation manual GR-TIMES (6F2M1082)*”.

2 Installation and setting of PLC editor

The user should install the PLC editor in the PC using administrator login. The following sections describe how to install the PLC editor in a PC.

Note: If the PC is not running in an "English" language environment, the user should change the language environment in the PLC editor to "English". Otherwise, the menu screens will be displayed in the PC language environment or will be displayed incorrectly. To change the language environment, refer to section 2.1(vii).

2.1 Software installation in the PC

(i) Login ID at installation

The user should login to the PC as an administrator for the software installation.

(ii) Installation of MULTIPROG5.35 in the PC

Run "setup.exe" in folder "1_MULTIPROG535_Build*xxx*"; the following screen appears. The user should follow the steps as below.

Click "**Next**" in the Setup Wizard window.



Figure 2.1-1 MULTIPROG® Setup Wizard

Note: The user should uninstall the previous-MULTIPROG5.35 software when a new version of MULTIPROG5.35 is required for installation on the PC. The user can confirm the software revision number using the last three *xxx* of the folder name."

After confirming the license agreement, click "**Next**".



Figure 2.1-2 License confirmation

Select the destination folder and click "**Next**"

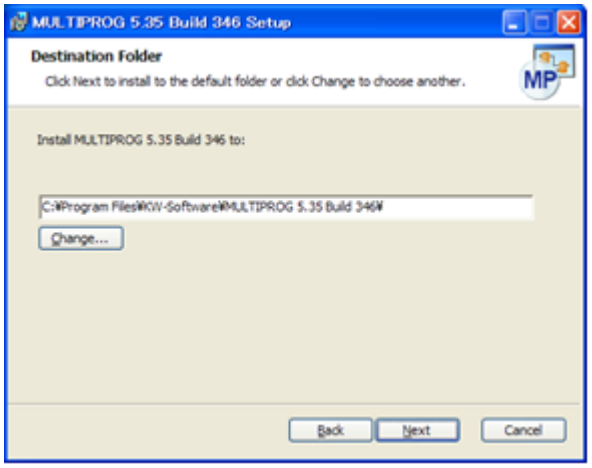


Figure 2.1-3 Selection of destination folder

Click "**Install**"

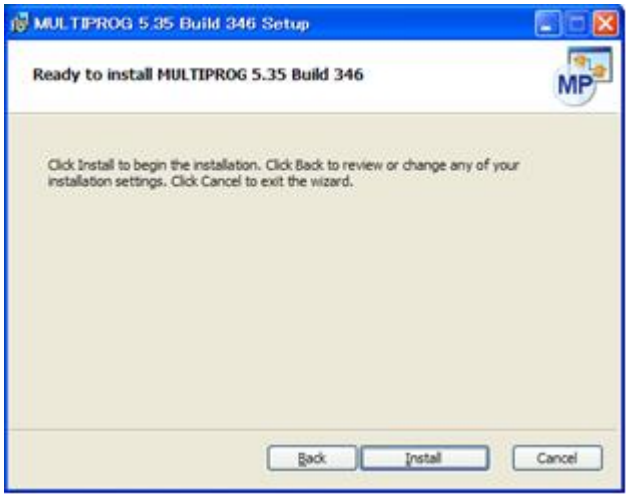


Figure 2.1-4 Commence of installation

The following screen appears during the installation. (This will take a few minutes)

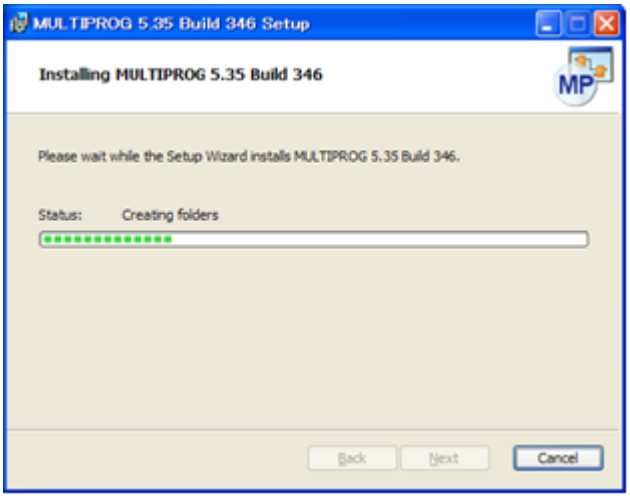


Figure 2.1-5 Installation progress screen

If the installation is successful, the following screen will appear and then click "**Finish**".

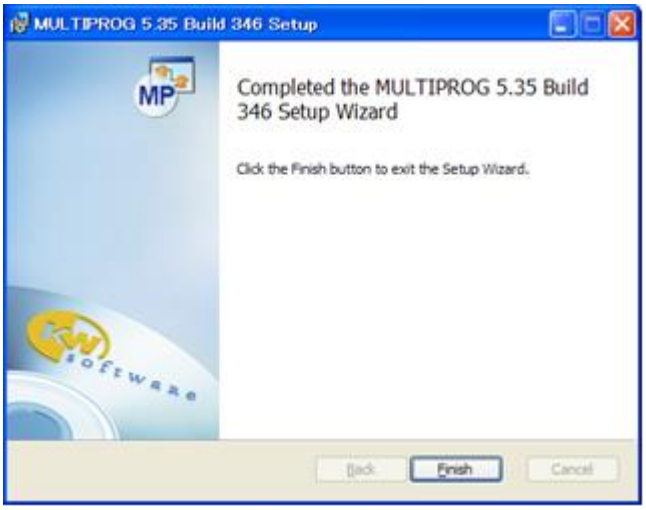


Figure 2.1-6 Installation completion screen

(iii) Installation of PPCE in the PC

The user should install adaption software "2_PPCE300_BE_PPC_eCLR" in the PC.

Run "PPCE300_BE_PPC_eCLR_3.0.xxxx.exe" in folder "2_PPCE300_BE_PPC_eCLR". The following screen will appear and click "**Next**".

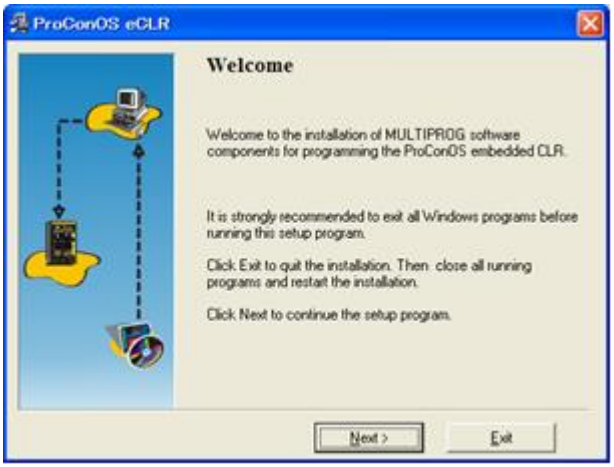


Figure 2.1-7 Startup of PPCE installation

Select "I accept the terms in the license agreement", and then click "**Next**".

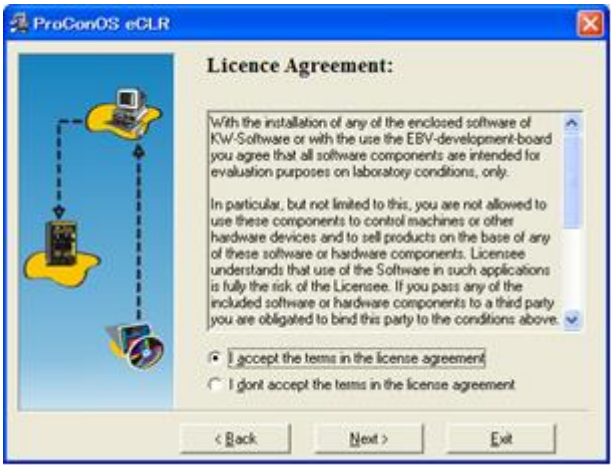


Figure 2.1-8 License agreement screen

Browse the folder to install and click "**Next**".

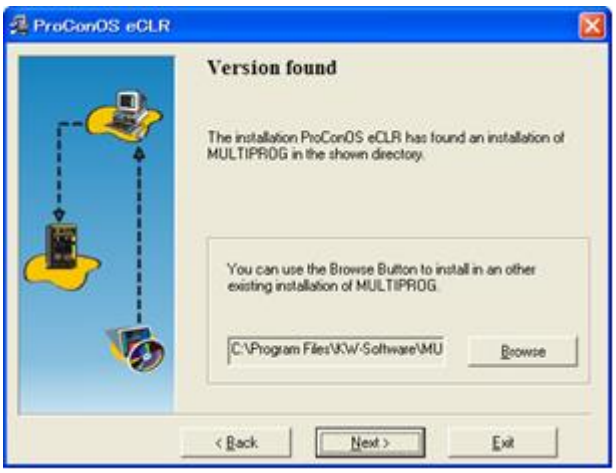


Figure 2.1-9 Selection of destination folder

Click the check box "Install Visual Studio / Visual C# Express Support" and then click "**Next**".

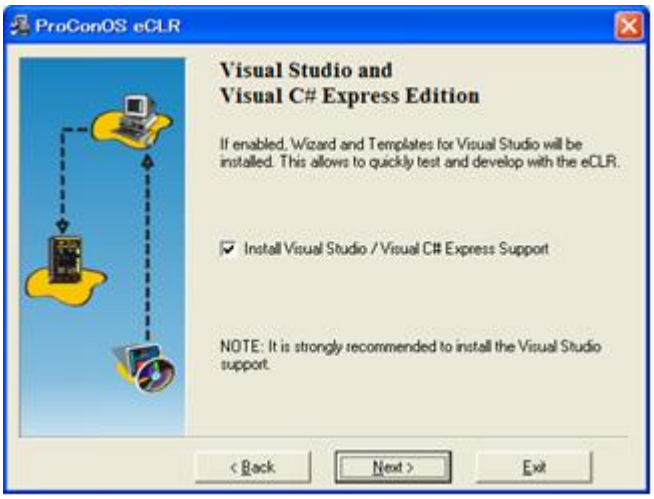


Figure 2.1-10 Confirmation of Visual Studio C# Express support installation

Click "**Install**". (It will take few minutes for the installation to complete)



Figure 2.1-11 Ready to install

Note: If "ms-dotnet3.5" is required to be installed during the installation, the user should also run "dotnetfx35.exe" to install it. This execution file exists in folder "dotnetfx35.30729.01".

If the installation is successful, the following screen will appear and then click "**Finish**".



Figure 2.1-12 Installation completion screen

(iv) Installation of ARM in the PC

Similar to the installation of the PPCE, the user should install adaption software "ARM" in the PC. Run "ARM_LE_GCC3_eCLR_3.0.xxxx.exe" in folder "3_ARM_LE_GCC3_eCLR".

(v) Installation of .NET Framework in the PC

If .NET Framework is not installed in the PC, the error message shown in Figure 2.1-13 will appear when the user runs the PLC editor; hence, the user should install "Microsoft .NET

Framework4.0®" in the PC. This software is in the folder "dotnetfx40".



Figure 2.1-13 Error message of .NET Framework

To install this software, run "dotNetFx40_Full_x86_x64.exe". Click the check box "I have read and accept the license terms"; then click "**Install**". Following the time necessary for downloading "Microsoft .NET Framework4.0®" will be installed in the PC.

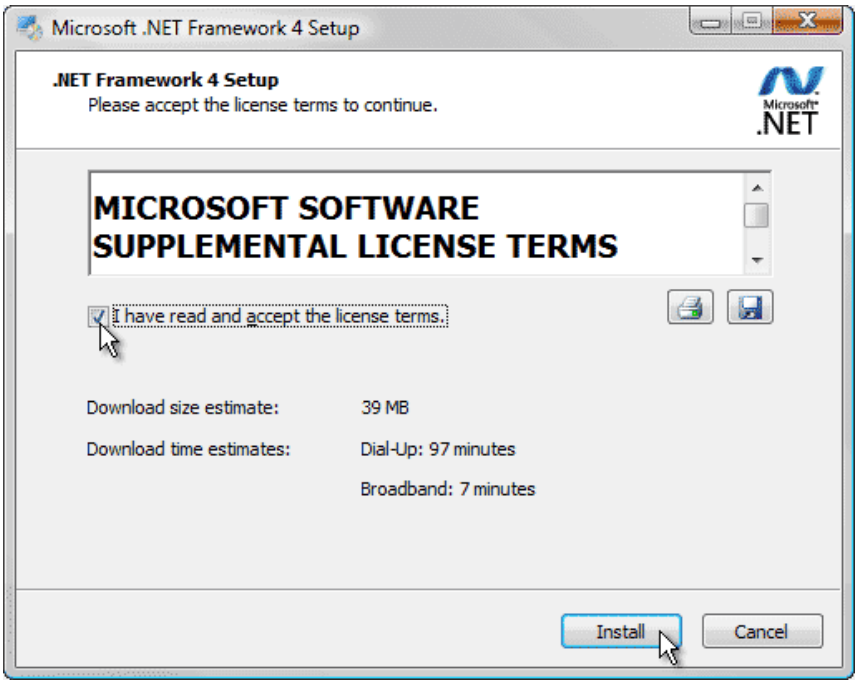


Figure 2.1-14 License terms of .NET Framework®

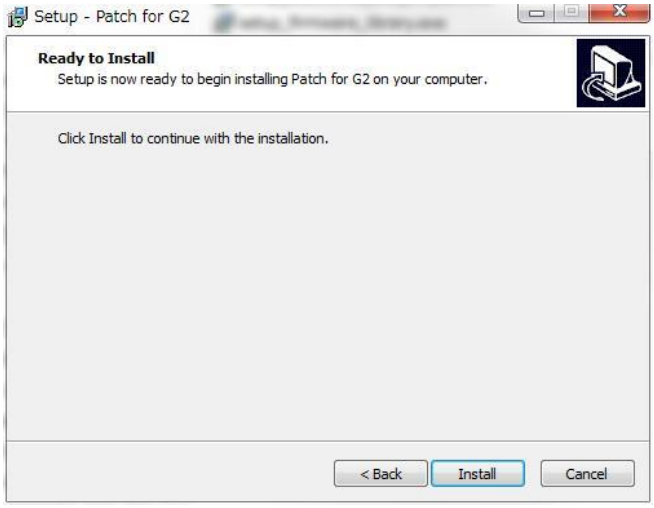
(vi) Run installer program to customize MULTIPROG® configuration

Since MULTIPROG® will run in accordance with the PC environment, the following customization is required in the PC when the software installation is completed. To do the customization, the user should run four installer programs ((vi)-1 to (vi)-5)) by starting "setup_patch_for_G2_*x_x_x_x*.exe", which is saved in folder "4_TOSHIBA. Following which, libraries and data will be copied into a folder that is designated by TOSHIBA.

(vi)-1 Execute "setup_patch_for_G2_*x_x_x_x*.exe" in "4_TOSHIBA".



Click "Next"

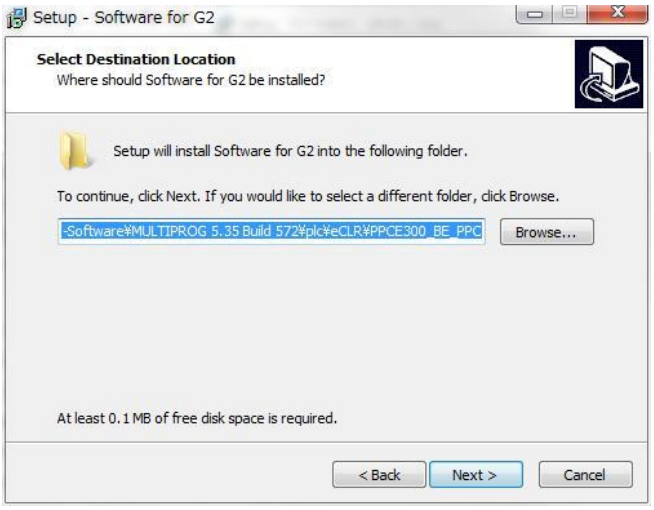


Click "Install"

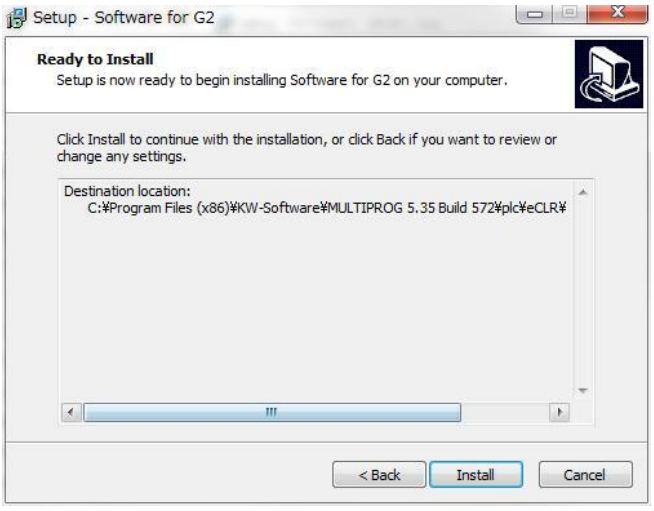
(vi)-2 Click “Install”. Software for G2 installer auto-start



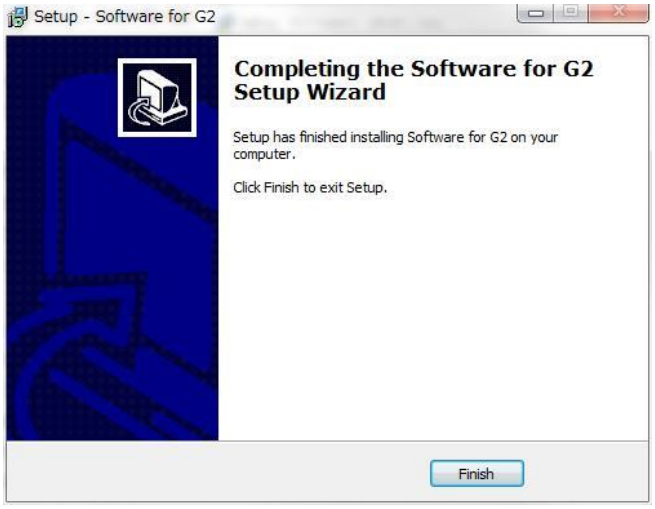
Click “Next”



Click “Next”



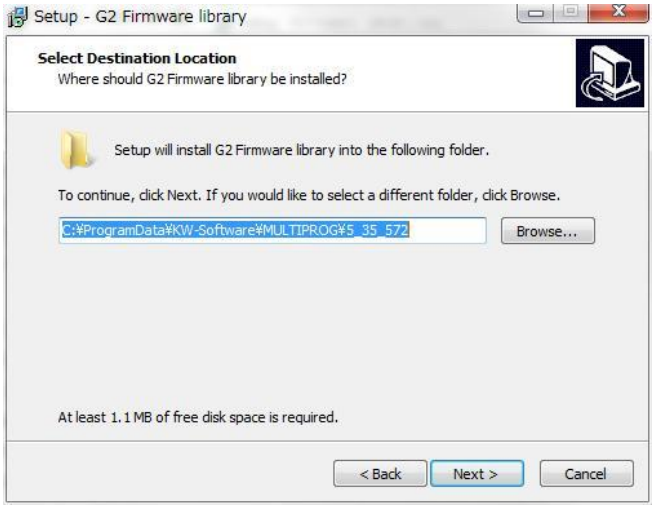
Click “Install”



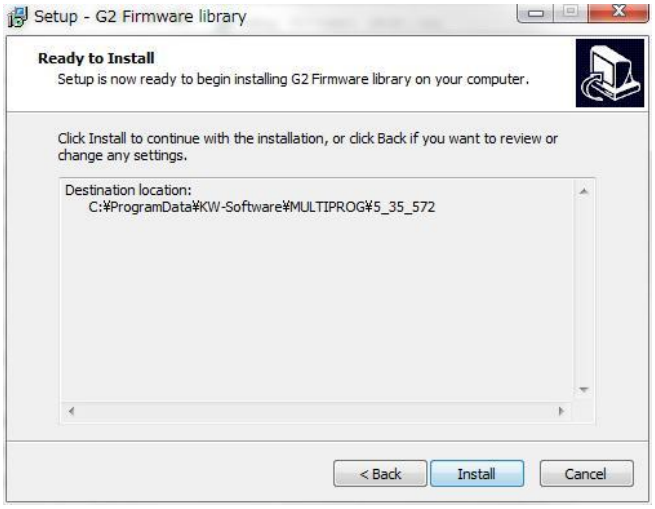
(vi)-3 G2 Firmware library installer auto-start



Click “Next”



Click “Next”



Click “Install”

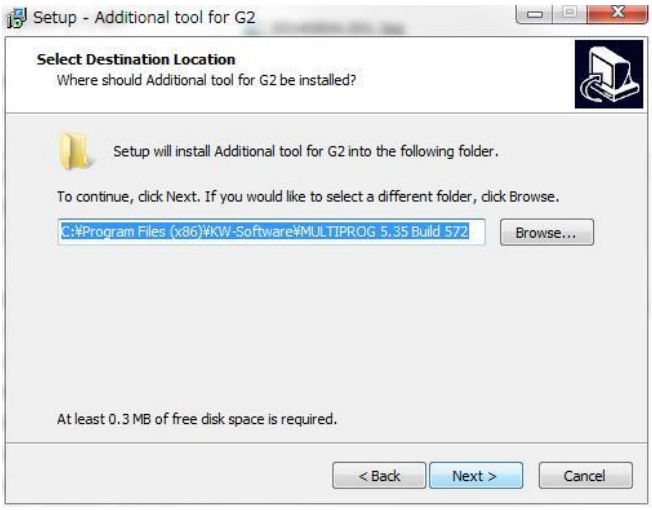


Click “Finish”

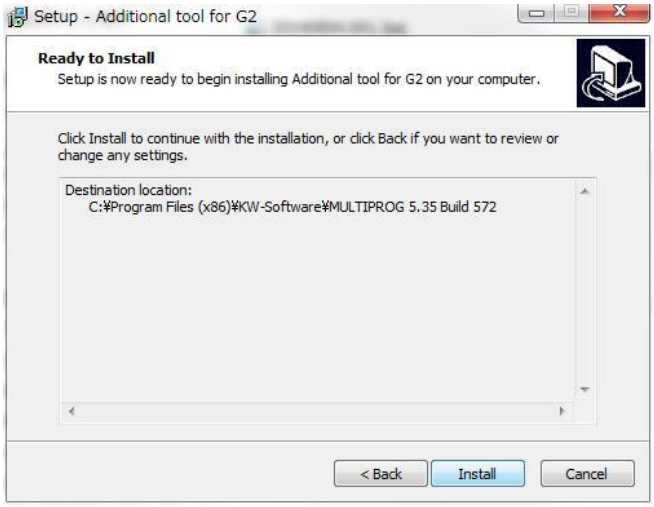
(vi)-4 Additional tool for G2 installer auto-start



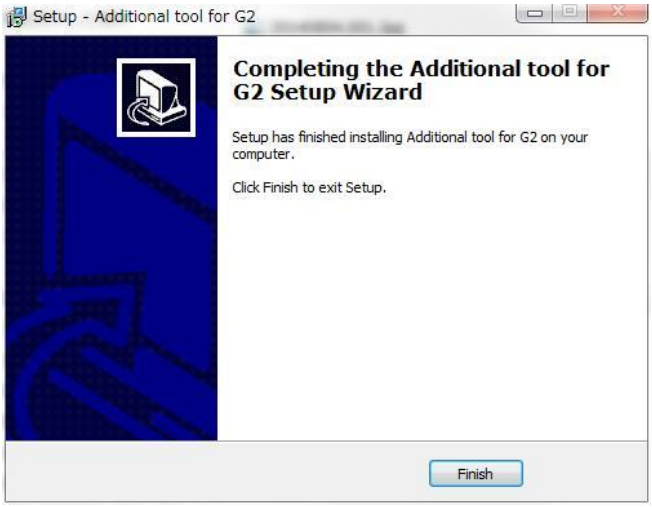
Click “Next”



Click “Next”



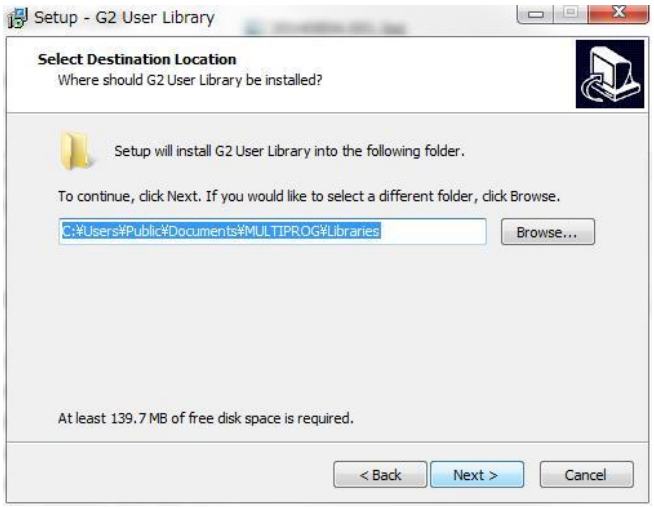
Click “Install”



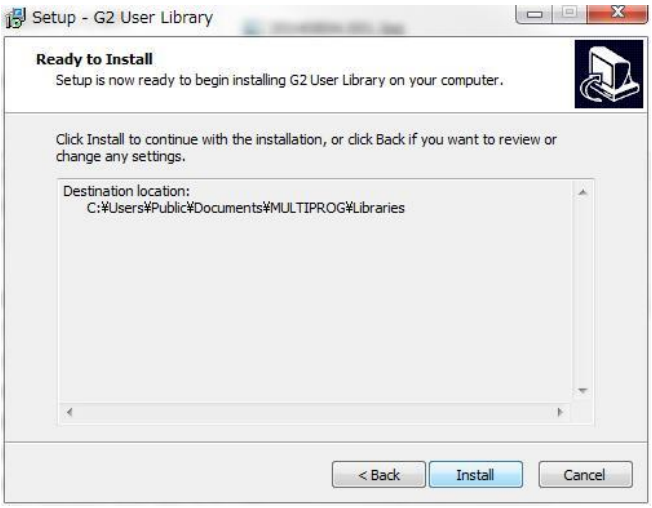
(vi)-5 G2 User Library installer auto-start



Click “Next”



Click “Next”



Click “Install”





Finally, click "Finish" button. After that, "G2 User libraries" will be copied to the folder, shown in Table 2.1-1.

Table 2.1-1 Folder for G2 User libraries

Windows OS	Copied libraries	Destination
7 / 8.1 / 10	custom\document\ Libraries	C:\Users\Public\Documents\MULTIPLOG

(vi)-6 Additional registration library "G2EclrNativeFW"

Library "G2EclrNativeFW" will be copied into the following folder.

Table 2.1-2 Folder for Library G2EclrNativeFW

Windows OS	Copied libraries	Destination
7 / 8.1 / 10	custom\appdata\ G2EclrNativeFW	C:\Documents and Settings\All Users\Application Data\KW-Software\MULTIPROG\5_35_xxx\plc\FW_LIB

Note: The number "xxx" depends on the software revision number.

(vi)-7 DLL “G2Sharedmemory”

DLL “G2Sharedmemory” in” custom\program” folder will be copied into the following folder.

Table 2.1-3 Folder for G2Sharedmemory and other s

Windows OS	Copied DLL	Destination
7 / 8.1 / 10	G2SharedMemory.dll[1] eCLRDeviceProfiles.xml[2] src.st1[3]	C:\Program Files[4]\KW-Software\MULTIPROG 5.35 Build xxx[5]\plc\eCLR\PPCE300_BE_PPC

[1]Note: This file is copied into a new folder.

[2]Note: This file is overwritten onto existing “G2SharedMemory.dll”.

[3]Note: This file is overwritten onto existing “src.st1” to correct Event messages.

[4]Note: If a 64bit OS is running, it will be copied to “C:\Program Files(x86)\....”

[5]Note: The number “xxx” depends upon the software revision number.

(vii) Setting language environment in PLC editor

If the PC is not running in an “English” language environment, the user should change the language environment to “English”. To change the language environment, the user should select the “Options… menu”.

Run the PLC editor, and then select “Options…” in the “Extras drop down list.

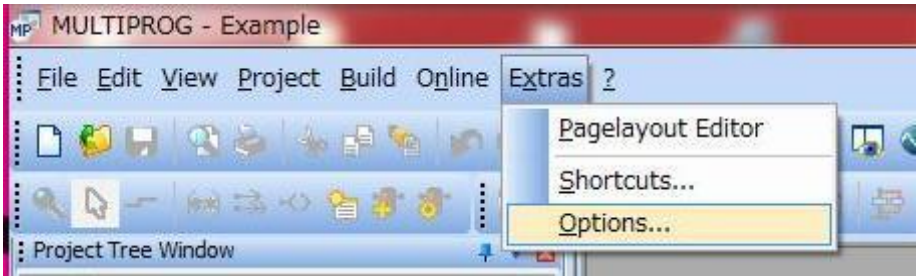


Figure 2.1-15 Language selection menu

In the Options menu, select “English” from the language drop down list under the “General” tab.



Figure 2.1-16 Language selection from Option menu

(viii) Keying registration code

The user shall key a registration code, which is printed in the license sheet.



Figure 2.1-17 Keying registration code

Enter the registration code, and click "**OK**".

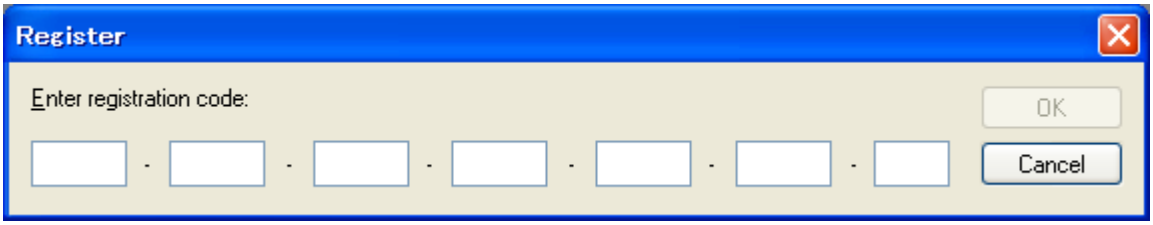


Figure 2.1-18 Screen for registration code

2.2 Open Project file

The user should open “Project file” to use the PLC editor. To open the “Project file”, click “New project” from the File menu.

(i) To open new project

Select “File”, and click “New Project…”. After that, click “G2_Sample” in New project.

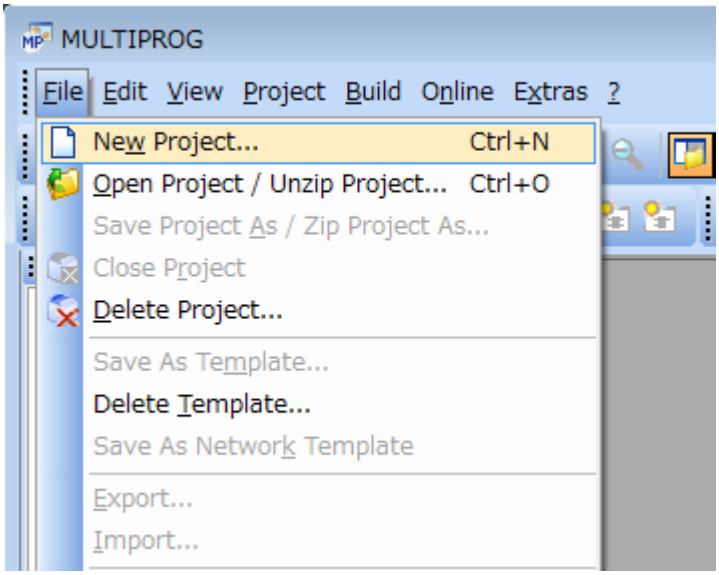


Figure 2.2-1 Selection of New project

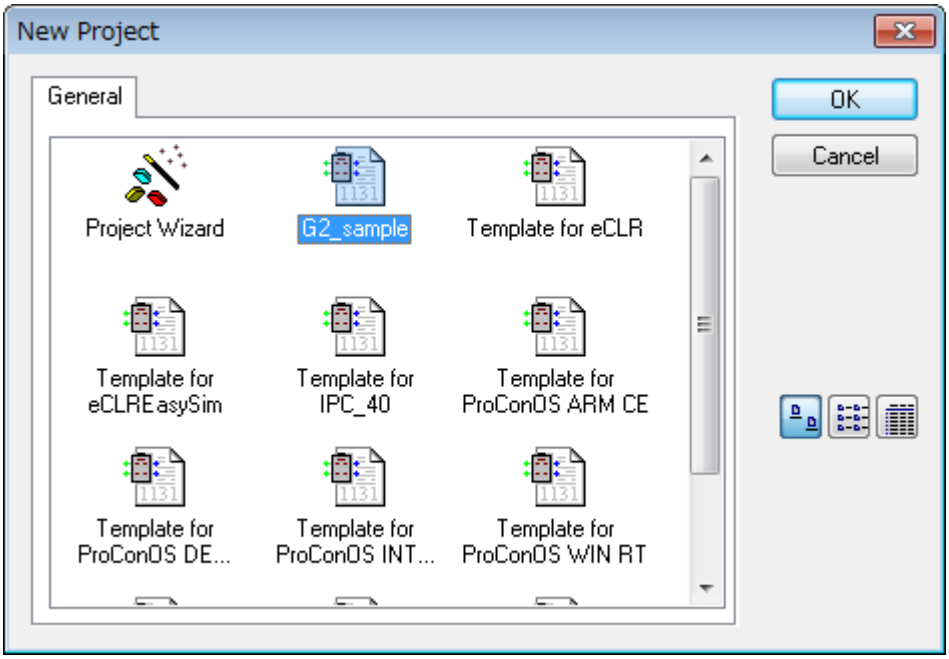


Figure 2.2-2 Screen of New Project

(ii) To open existing project

Select “File”, and click “Open Project / Unzip Project…” and select a project file.

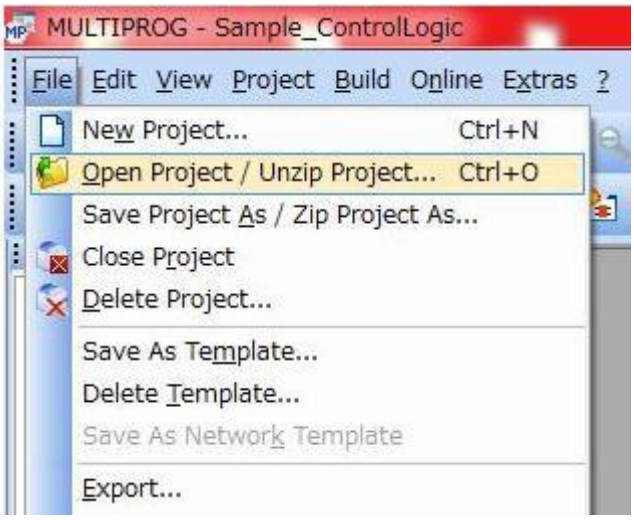


Figure 2.2-3 Selection of "Open Project/Unzip Project"

2.3 Save project file

Select "File" from the Menu bar, and click "Save Project As / Zip project as…"

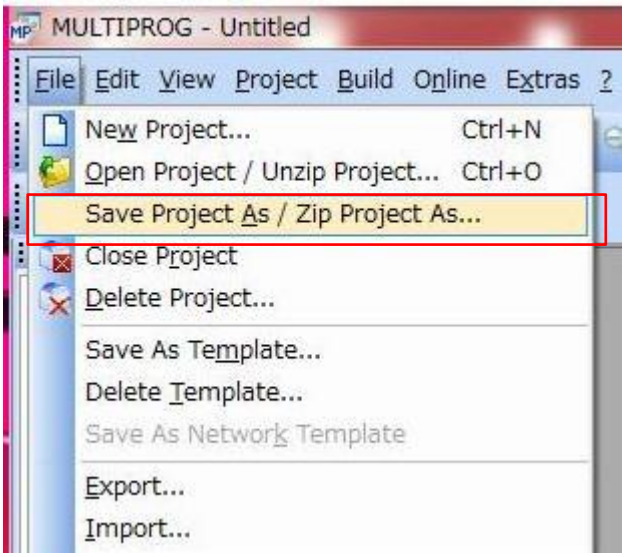


Figure 2.3-1 Save project As / Zip Project As

In the window shown in Figure 2.3-2; select a folder and a type for the Project file; enter the name of the Project file; then, click "Save". The user can select either a normal type (*.mwt) or compressed type (*.zwt) from the window. Note that the user should remove the check (✔) marks in the check box for Zip options while saving.

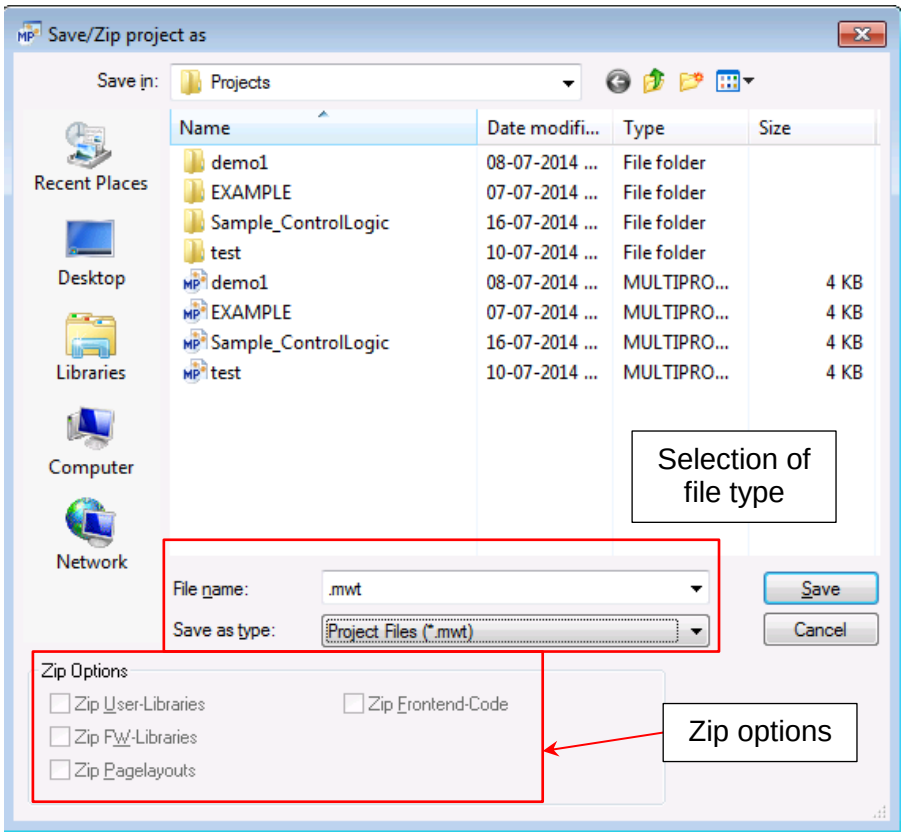


Figure 2.3-2 Selection of folder and file type to save

(i) Icon operation

The user can also open the project clicking the icon “Open Project / Unzip Project” in the tool bar. Following which, the user can see the project data on the PLC editor.

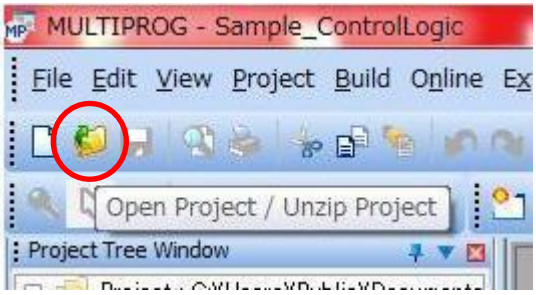


Figure 2.3-3 Open Project / Unzip Project button

2.4 Embedding firmware library

The user should import a firmware library into MULTIPROG® because there are special function-blocks (FBs) provided by TOSHIBA. The following figures show how to import the firmware library into MULTIPROG®.

Go to “Project Tree Window”, select “Libraries”, right click on Insert and select “Firmware Library”.

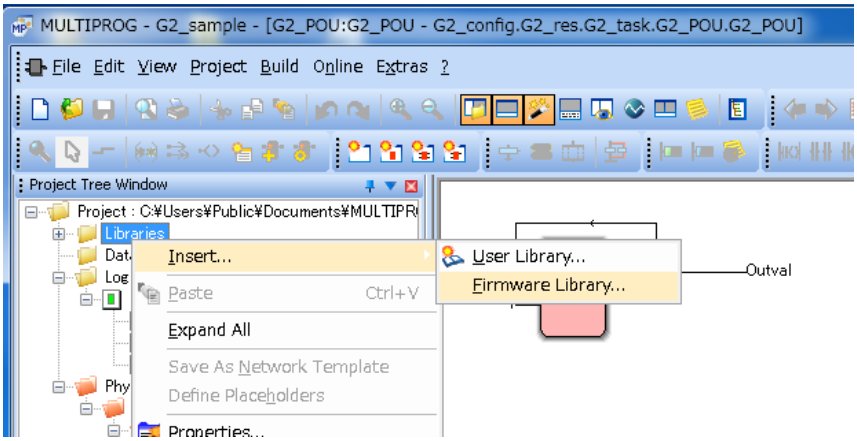


Figure 2.4-1 Inclusion of Firmware library

Seclet “G2EclrNatveFW”.

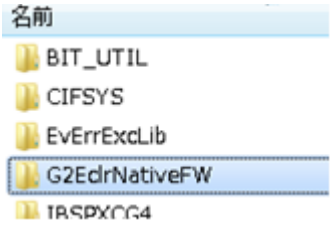


Figure 2.4-2 Selection of “G2EclrNatveFW”

As shown in Figure 2.4-3, the user should select file “G2EclrNativeFW.FWL[1]”, and click “**Include**”.

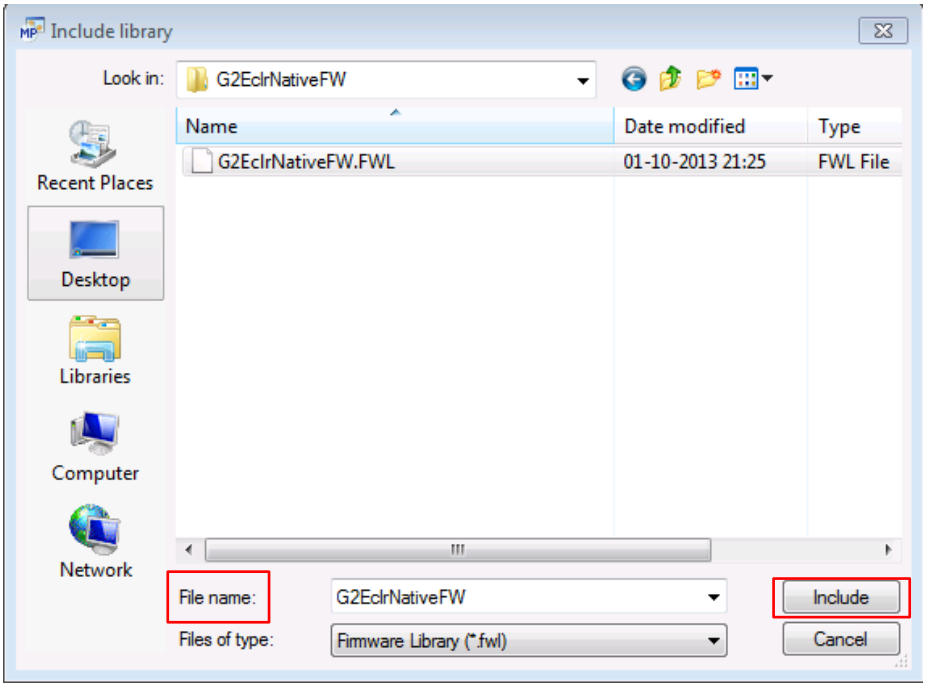


Figure 2.4-3 Selection of file

[1]Note: Library file "G2EclrNativeFW.FWL" will be copied into a folder when installation is completed. Table 2.4-1 shows libraries and its respective folder which is copied into the PC.

Table 2.4-1 Folder for Firmware library

Windows OS	File name	Destination
7 / 8.1 / 10	G2EclrNativeFW.FWL	C:\ProgramData\KW-Software\MULTIPROG®\5_35_xxx\plc\FW_LIB\G2EclrNativeFW

Note: The number "xxx" depends the software revision number.

When the firmware libraries are embedded into the PLC editor, the user can select function blocks (FBs) from the "Group" drop down list in the Edit Wizard panel, as shown in Figure 2.4-4. See chapter **5** when a FB selection is required.

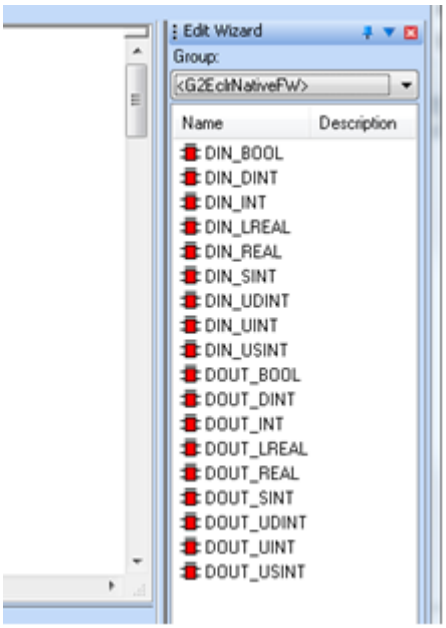


Figure 2.4-4 Selection of IED function blocks

2.5 Embedding User library

In order to use binary input and output (BIO) data, the user should import “User library” into MULTIPROG®. The following figures show how to import “User library” into MULTIPROG®.

In the “Project Tree Window”, select “Libraries”, right click Insert and select “User Library”.

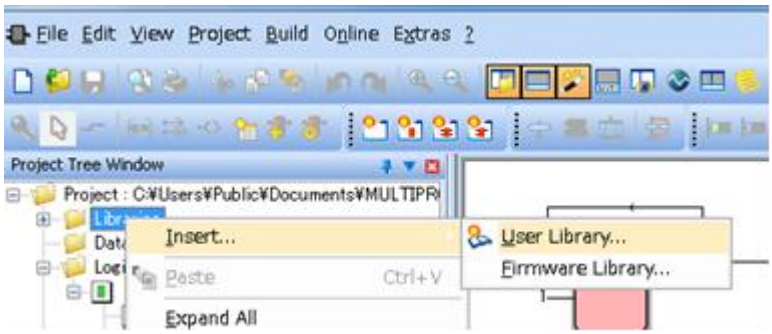


Figure 2.5-1 Inserting User Library

Table 2.5-1 shows the required library files when the user operates BIO data.

Table 2.5-1 File names for User library and function of User library

File names[1]	Contents of User Library
G2lib_200B01(BIO_slot1).mwt	Access library when a binary input/binary output circuit exists on IO#1 in the IED.
G2lib_200B02(BIO_slot2).mwt	Access library when a binary input/binary output circuit exists on IO#2 in the IED.
G2lib_200B03(BIO_slot3).mwt	Access library when a binary input/binary output circuit exists on IO#3 in the IED.
G2lib_200B04(BIO_slot4).mwt	Access library when a binary input/binary output circuit exists on IO#4 in the IED.
G2lib_200B05(BIO_slot5).mwt	Access library when a binary input/binary output circuit exists on IO#5 in the IED.
G2lib_200B06(BIO_slot6).mwt	Access library when a binary input/binary output circuit exists on IO#6 in the IED.
G2lib_200B07(BIO_slot7).mwt	Access library when a binary input/binary output circuit exists on IO#7 in the IED.
G2lib_200B08(BIO_slot8).mwt	Access library when a binary input/binary output circuit exists on IO#8 in the IED.
G2lib_240001(keyinput).mwt	Access library for the key information of HMI

[1]Note: The above files are stored in the folder shown in Table 2.5-2.

Table 2.5-2 Destination folder for User library

Windows OS	Destination
7 / 8.1 / 10	C:\Users\Public\Documents\MULTIPROG\Libraries

After the User libraries are imported, the user can use the BIO libraries in the "Group" drop down list, as shown in Figure 2.5-2.

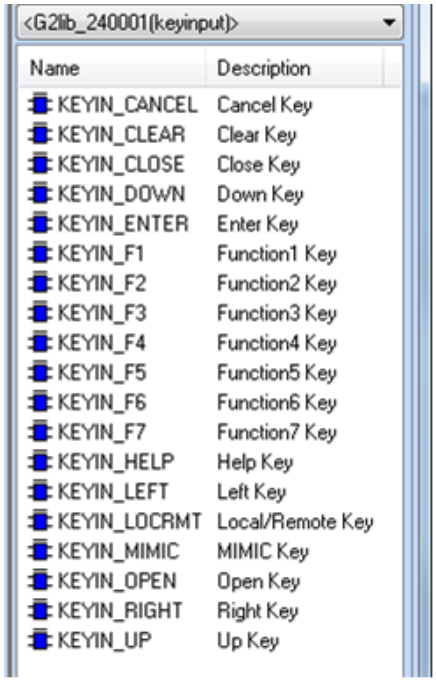


Figure 2.5-2 Function blocks in file "G2lib_240001 (keyinput).mwt"

2.6 Compilation and verification of compile results

When the operation in section 2.1 is completed, the user should compile the libraries. Compile the libraries from the "Build" menu, as shown in Figure 2.6-1. (The user can also compile pressing F9 key.)

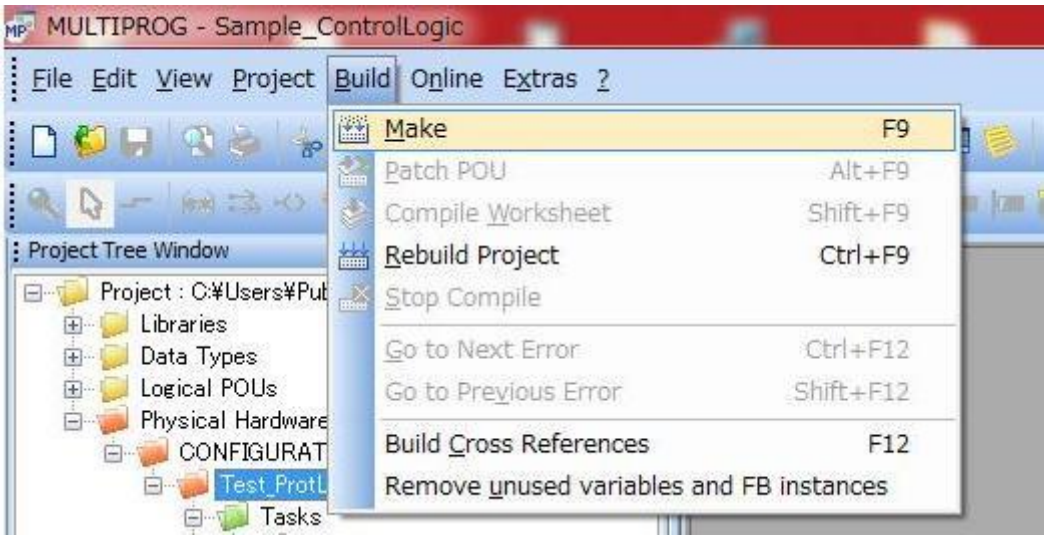


Figure 2.6-1 Compile operation in "Build" menu

After the compilation is finished, the completion message will appear in the "Build" tab.

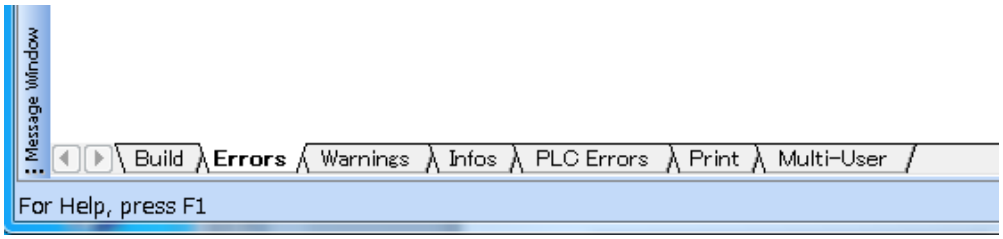


Figure 2.6-2 Message window and tabs

2.7 Software update

When an update of MULTIPROG5.35 is required, the user should uninstall the current MULTIPROG5.35 using the Control Panel. After uninstalling, the user can install the new software for the PC. (For the installation procedure, the user should carry out the operation discussed in section 2.1(ii))

3 Connection between the IED and the PC

The connection between the PC and the IED is required when the user operates the PLC editor. The PLC editor provides two connection methods: **LAN-cable connection** and **USB-cable connection**.

3.1 IP address and Build setting

Prior to the connection, user should set IP address[1] in the PLC editor. Following procedure shows the setting of IP address[1].

1) Run the PLC editor and open "Project file".
2) In the "Project Tree Window", move to the third hierarchy of "Physical Hardware". Choose the Project, right click and then select "Settings".

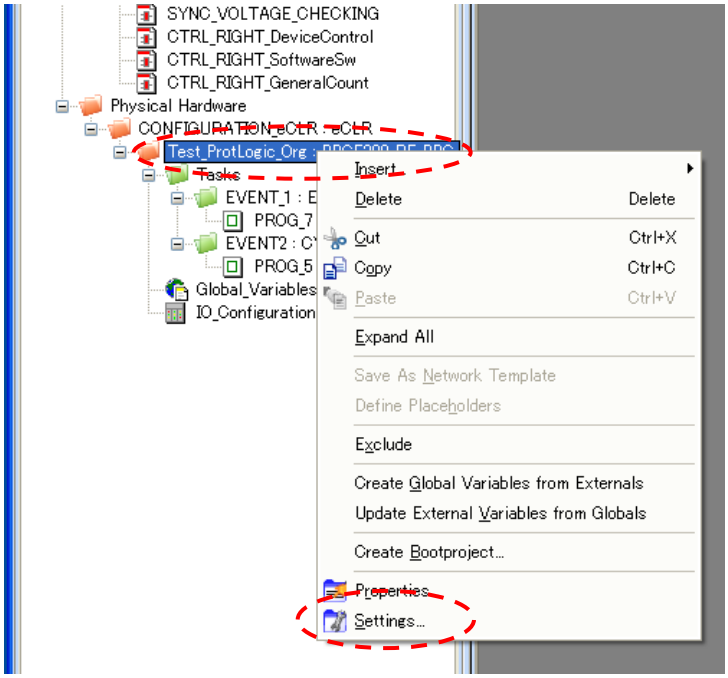


Figure 3.1-1 Physical Hardware in the PLC editor menu

The user should set an IP address[1], as shown in Figure 3.1-2.

[1]Note: When the PC is connected to the IED using the "**LAN-cable connection**" (Figure 3.1-3), the user should key the IP address of the IED into the PLC editor. The user can get the actual information of IP address from the IED screen. (See Chapter *Communcaion protocl: LAN communicaion* on the GR200 series instruction manuals.)

If the PC is connected to the IED using the "**USB-cable connection**" (Figure 3.1-4), users should key the address of the communication port in the PC. For example, when communicaiton port "COM10" is used, the IP address is configured

as “127.0.1.10”; and user should key this IP address into the PLC editor. As a rule, if communication port “COM X” is used, user should set IP address “127.0.1.X” into the PLC editor.

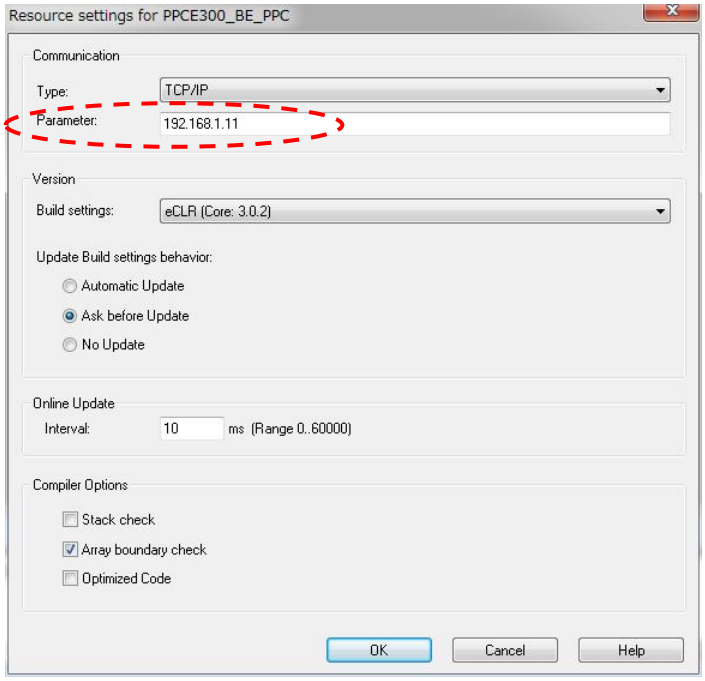


Figure 3.1-2 Keying IP address and version selection)

(i) LAN-cable connection

Figure 3.1-3 shows the connection using the Ethernet LAN cable. User can connect the PC to the IED through a HUB by using an UTP cable. (For the information of the location of LAN port and others, see *Chapter Technical description: Signal processing and communication module* on the GR200 series instruction manuals)

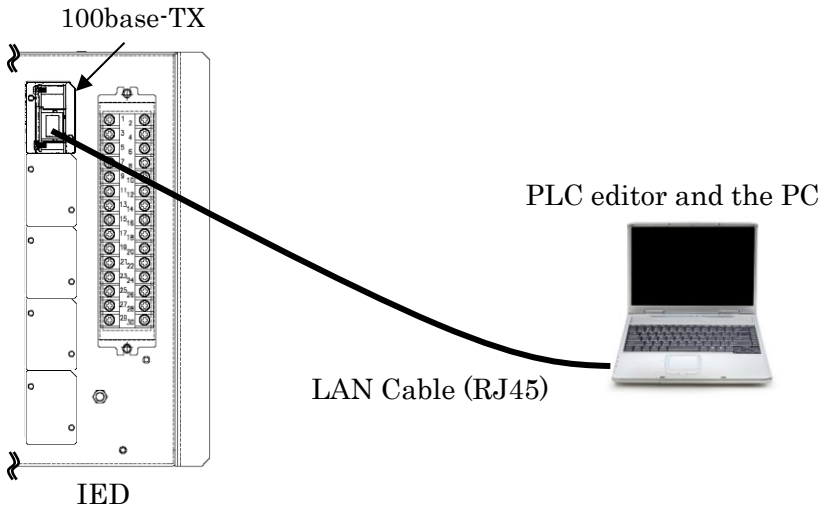


Figure 3.1-3 Access via Ethernet LAN

(ii) USB-cable connection

Figure 3.1-4 shows USB-cable connection. The USB port is available on the IED front panel. (For details, see *Chapter Communication protocol: USB communication* on the GR200 series instruction manuals)

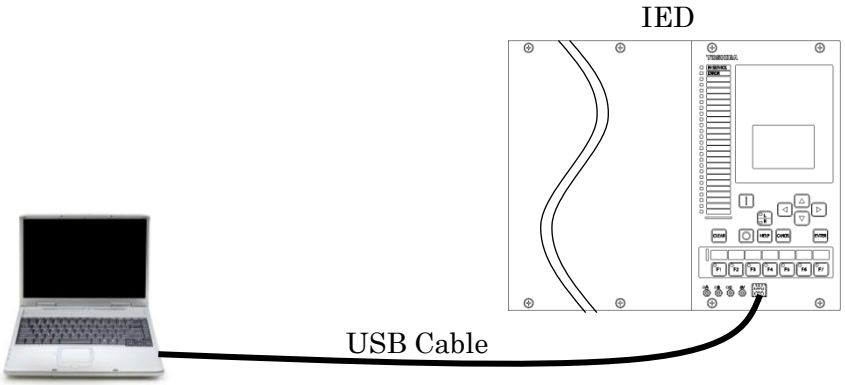


Figure 3.1-4 Access via USB-cable

When the USB-cable connection is made physically, user should run "TPC_SERIAL_IF.exe" file before operating the PLC editor. The "TPC_SERIAL_IF.exe" is the software of serial communication tool and users can find it in the folder, as shown in Table 3.1-1. "Activity" window appears, as shown in Figure 3.1-6, where the user can examine the serial communication status.

Table 3.1-1 Folder for "TPC_SERIAL_IF.exe"

Windows OS	Destination
7 / 8.1 / 10	C:\Program Files(x86)\KW-Software\MULTIPROG 5.35 Build *xxx*\G2_tool

Note: The number "*xxx*" is the software revision number.

(ii)-1 Selection of the communication speed operated in the "ARM†" software

As to having the USB-cable connection with the IED, the user can select the communication speed by selection in the setting menu, as shown in Figure 3.1-5. Either 115.2kbps or 921.6kbps is selectable for the communication. Note that the user should also set the same speed on the USB port of the IED. For the operation, refer to the GR200 series instruction manuals.

†Note:The user can identify the 'ARM' software by checking on the software model representing '3' at the "G" position of the order number.

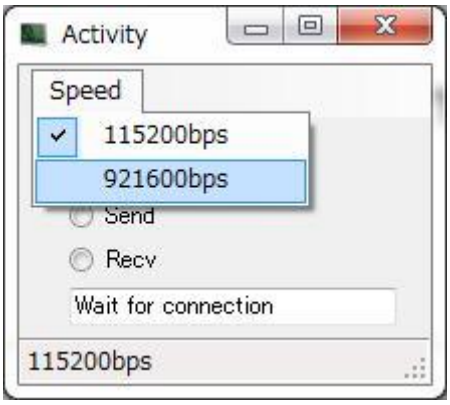


Figure 3.1-5 Selection of communication Speed on the USB cable connection

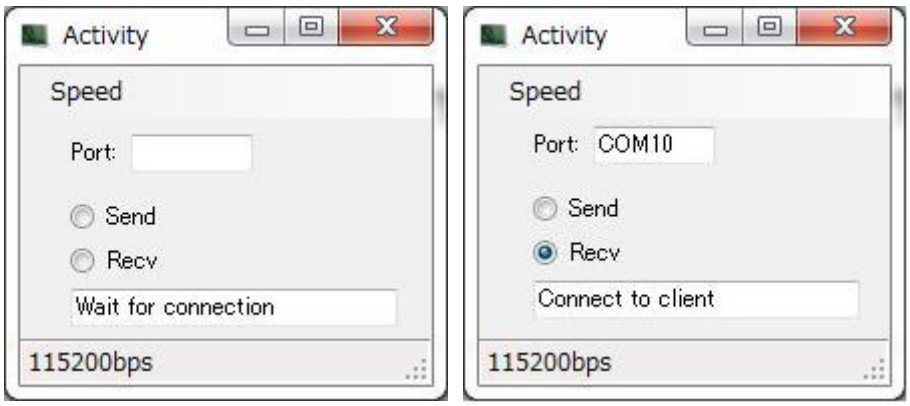


Figure 3.1-6 Serial communication status at COM 10 in 115.2kbps (left image shows waiting for connection, right image shows connected with the IED)

(ii)-2 Selection of the communication speed operated in the "PPCE‡" software

As for making the communion with the PPCE software, the communication speed is only available in 115kbps. Thus, the user should just select 115kbps in the setting menu. No setting for the communication speed is required for the USB port of the IED.

†Note:The user can identify the 'PPCE' software by checking on the software model representing either '1' or '2' at the "G" position of the order number.

3.2 Setting project file

(i) Preparation of new Project file

When the user needs to edit “Project file”, the user should upload new “Project file” from the IED. Prior to uploading, the user should verify the content of “Project file”. Additionally, the user should verify the IP address of “Project file”.

(ii) Types of Project file

Two file types (normal file and compressed file) are available for Project file.

Table 3.2-1 Types of project file

File type	filename extension	File structure	Remark
Normal	.mwt	“****.mwt” being stored in “****/” folder	
Compressed	.zwt	“****.zwt”	The user can make this file type by using “Compressed files” option, which is selected from MULTIPROG®. This file type is a compressed file and is uncompressed when reading the project file.

(iii) Verification of PLC type and Processor type

The user should examine the PLC type and Processor type.

In the “Project Tree Window”, select the third hierarchy under “Physical Hardware”. Select the Project, right click and select “Properties”.

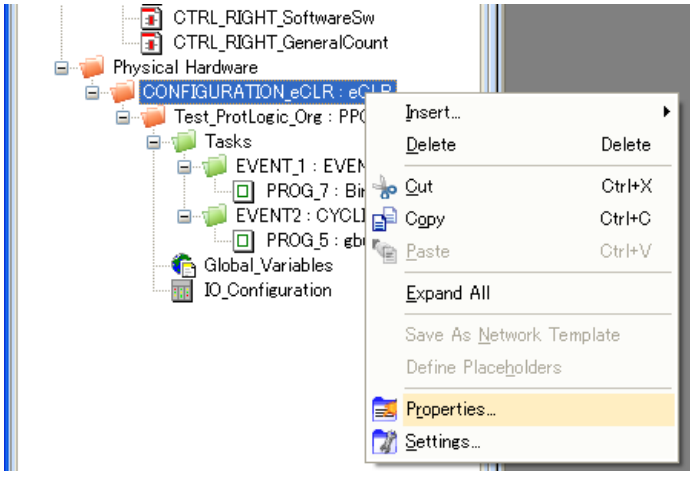


Figure 3.2-1 Selection “Properties”

The user should select “eCLR” in the PLC Type drop down list.

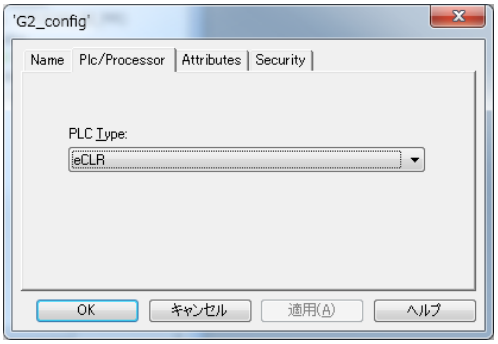


Figure 3.2-2 Selection of PLC Type

Again, choose the Project file, right click and select “Properties”.

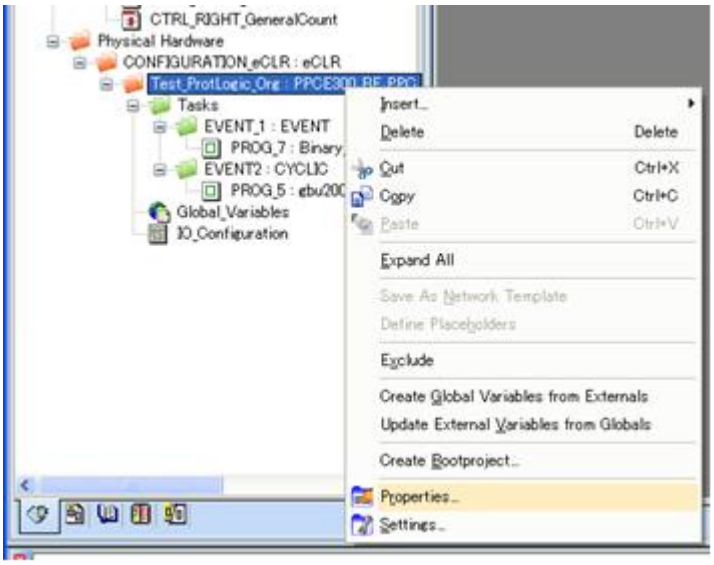


Figure 3.2-3 Selection of Properties

In the “Plc/Processor” tab, select either “ARM_LE_GCC3”[1] or “PPCE300_BE_PPC”[2] in the Processor Type drop down list.

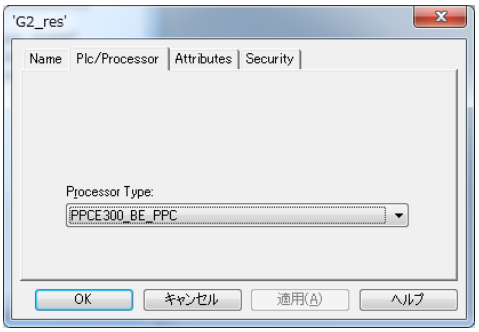


Figure 3.2-4 Selection of PPCE300_BE_PPC

[1]Note: The “ARM_LE_GCC3” is available for the software model representing ‘3’ at the “G” position of the order number.

[2]Note: The “PPCE300_BE_PPC” is available for the software model representing either ‘1’ or ‘2’ at the “G” position of the order number.

(iv) Verification of IP address and Build setting

Following procedure shows the setting of IP address.

Open “Project file”, in the “Project Tree Window”, select the third hierarchy under “Physical Hardware”. Choose the Project; right click and select “Settings”.

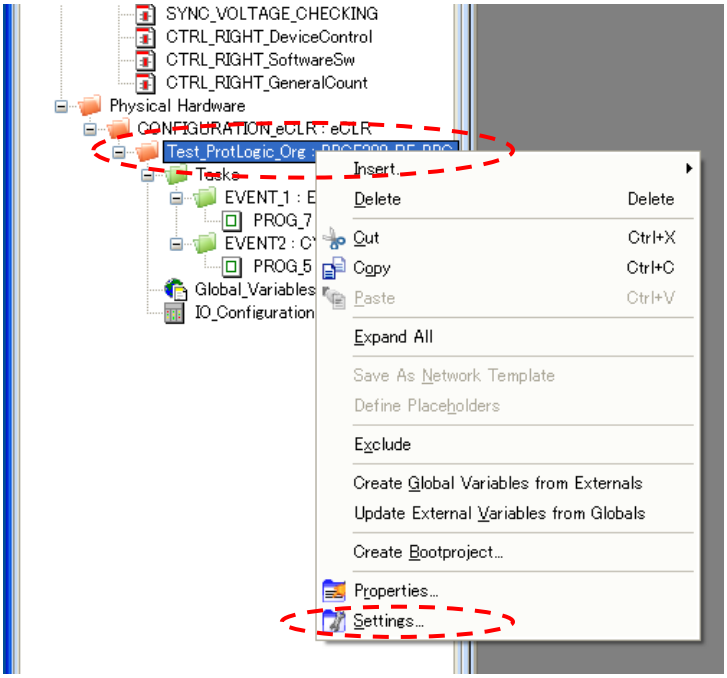


Figure 3.2-5 Physical Hardware in the menu

The user should key in the IP address[1] of the IED and select either “eCLR (Core 3.0.6)”[2] or “eCLR (Core 3.0.2)”[3] in version “Build settings”.

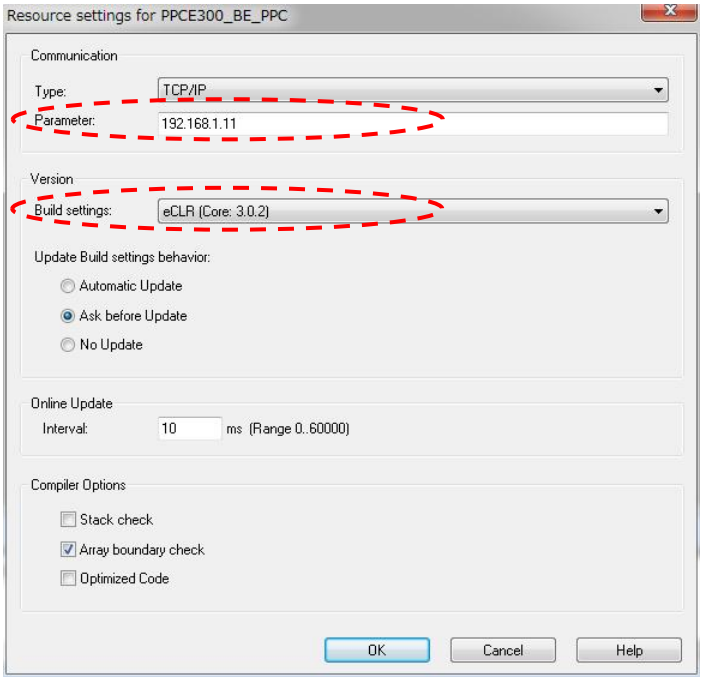


Figure 3.2-6 Keying IP address and version selection (An example)

[1]Note: The user can find the IP address from the IED screen. (See Chapter *User interface: Setting: Communication* in GR200 series instruction manuals.)

[2]Note: The "eCLR (Core 3.0.6)" is available for the software model representing '3' at the "G" position of the order number.

[3]Note: The "eCLR (Core 3.0.2)" is available for the software model representing either '1' or '2' at the "G" position of the order number.

(v) Task setting

By default, task type is "EVENT". However, the user can change task type by following the steps below:

Select the Project file; and go to "Tasks". Under "Tasks", select the task required to execute; right click and select "Properties".

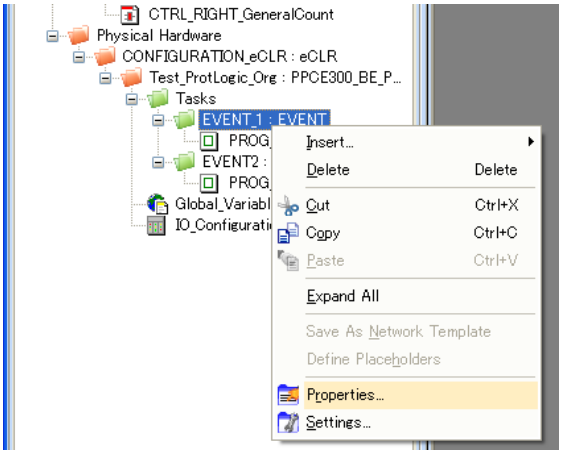


Figure 3.2-7 Selection of Properties

Select a task type. Table 3.2-2 shows the meaning of each task type.

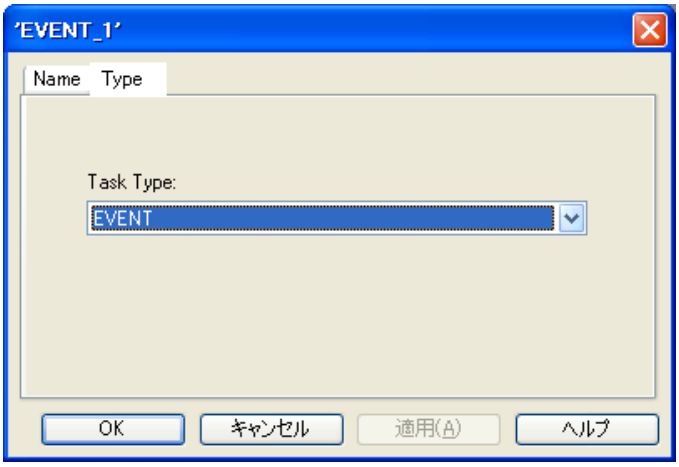


Figure 3.2-8 Task type selection

Table 3.2-2 Types of tasks

Task Type	Meaning
EVENT	Conventional task (Default)
CYCLE	Cyclic execution task, which is managed by “eCLR”. Minimum cycle is identical to special sampling period (SSP).
DEFAULT	Execution task runs during idle time. (Unused)
SYSTEM	System event task runs during outage, data-download, and others. (Unused)

After selecting the task, move to the task required and select “Settings”.

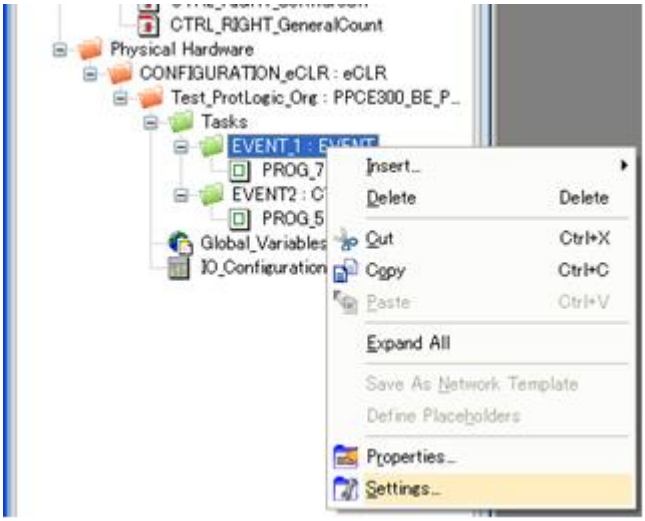


Figure 3.2-9 Selection of Settings

The user can select an event type in this menu; Table 3.2-3 shows the types of settings for the “ARM_LE_GCC3” and the “PPCE300_BE_PPC”. Note that, the value “0” is set for “Priority” when the user selects either “Main 1”, “Main 2”, and “Main 3”; additionally, the value “1” or greater are set for the “Priority” when the user selects except “Main”.



Figure 3.2-10 Selection of Event and Priority

Table 3.2-3 Event types and meanings

Event	Priority[1]		Meaning of event setting
	ARM_LE_GCC3	PPCE300_BE_PPC	
Main1	0	0	An event is occurred before relay computation by SSP task[2]
Main2	0	0	An event is occurred after relay computation by SSP task[2]
Main3	0	0	An event is occurred after sequence operation by SSP task[2]
5ms	1	1	An event is occurred by a periodic task (every 5ms).
10ms	2	1	An event is occurred by a periodic task (every 10ms).
100ms	3	1	An event is occurred by a periodic task (every 100ms).
200ms	4	1	An event is occurred by a periodic task (every 200ms).

[1]Note: The “ARM_LE_GCC3” is available for the software model representing ‘3’ at the “G” position of the order number, whereas the “PPCE300_BE_PPC” is available for the software model representing either ‘1’ or ‘2’ at the “G” position of the order number..

[2]Note: Setting “Main1”, “Main2” or “Main3” requires more computation time. Thus, the selection of these settings is not recommended.

3.3 Download data into IED

After compiling the libraries, the user should write compiled data into the IED ("Write" means that data is downloaded to the IED). To write data into the IED, the user should follow the steps below. After downloading, the user can run the PLC logic in the IED.

Note that the user can retrive the downloaded project-file when the data is uploaded into the PC from the IED. On this account, the download procedure should be selected an option from menu "Download Opetions" , which is discussed in secion 3.3(iii).

(i) Linking IED and PC

The user should connect the PC to the IED.

(ii) Stopping PLC

Prior to download, the user should stop the PLC. Select "Project Control…" from the "Online" menu bar.

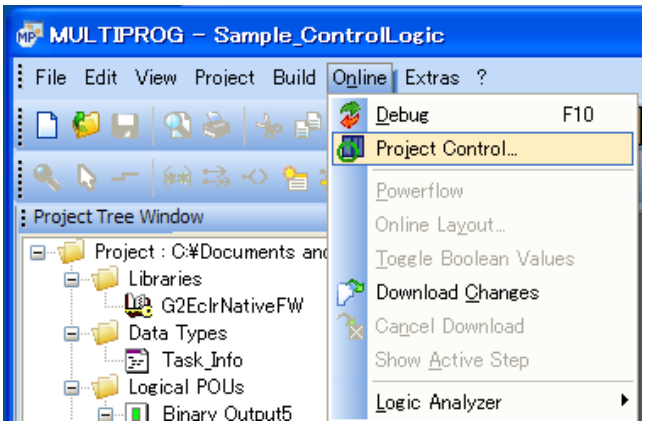


Figure 3.3-1 Online menu

To stop the PLC, click "Stop", in the screen shown below.



Figure 3.3-2 Stop button

(iii) Setting download options

Click “More”.



Figure 3.3-3 Stop and More button

In the “Download Options” window, tick the boxes “Permanent as Bootproject” and “Include Sources”.

The user shall tick both check-boxes “Permanent as Bootproject”and “Include Sources”. This is because the user is able to upload the PLC data (IMG file) from the IED.

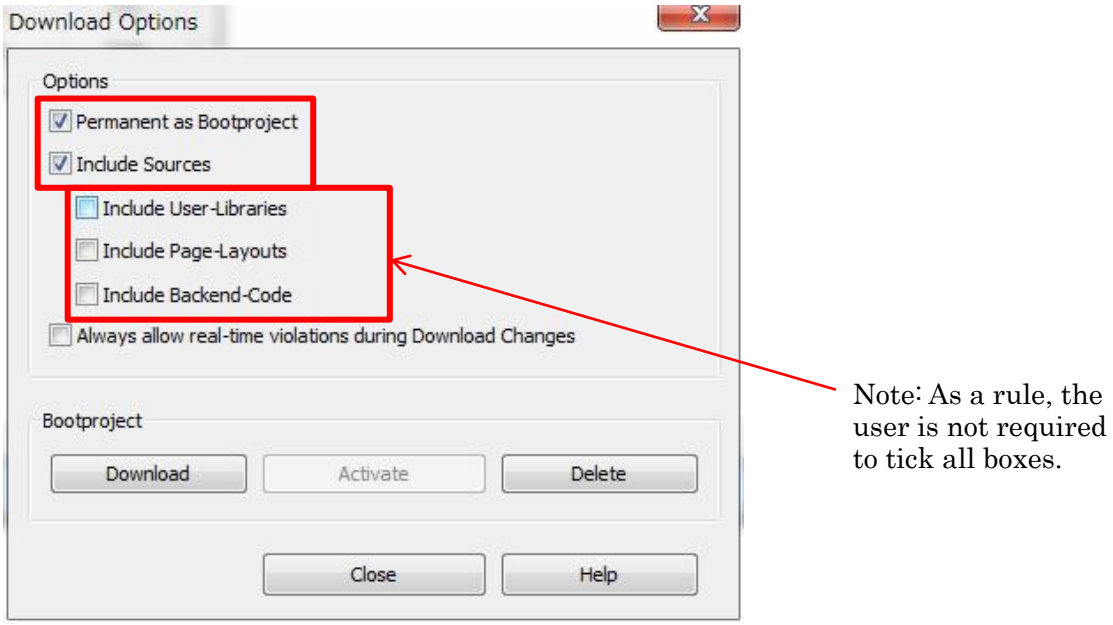


Figure 3.3-4 Check boxes for Include source

Note: If the user cannot tick boxes in “Download Option” above, the following operations are required: (1) Select “Option (Figure 3.3-5)” and (2) Uncheck the checkbox “Use master settings of download options (Figure 3.3-6)”.

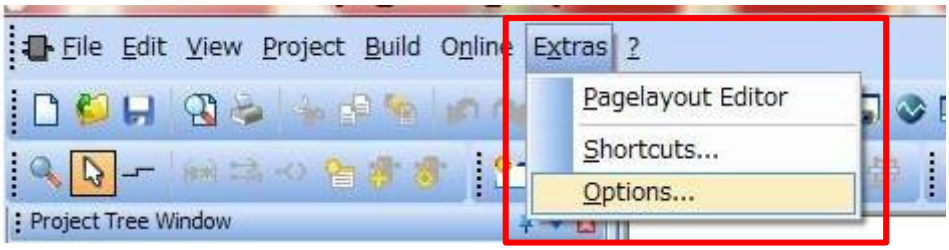


Figure 3.3-5 Select "Options" in Extras bar

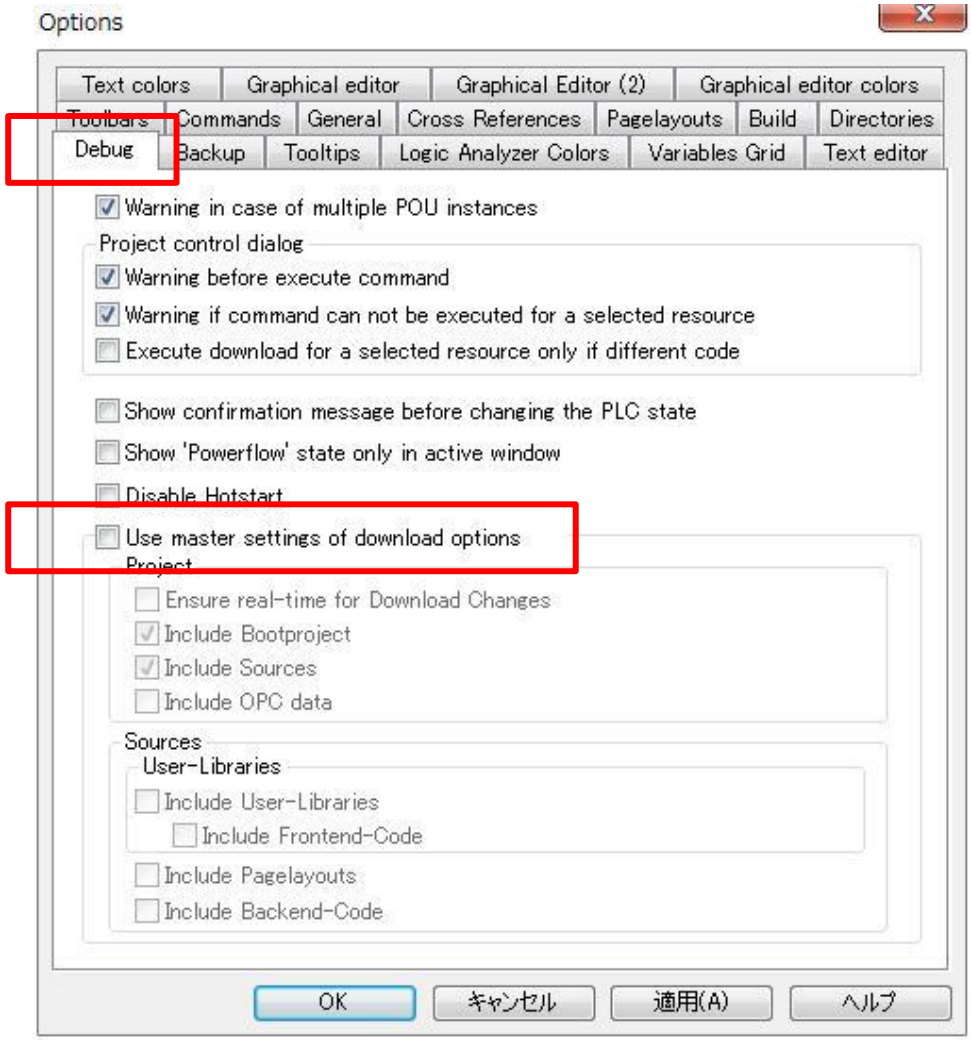


Figure 3.3-6 Untick the checkbox "Use muster settings" of Debug" tab

(iv) Download data

Click "Download", writing the PLC data for the IED is initiated. Note that writing the PLC data requires longer time than the download operation time that does not include the download options. This is because the PLC source code is also written into the IED.



Figure 3.3-7 Download button

(v) Start PLC

The user can select one of the start types† as shown in Table 3.3-1 to run the PLC.



Figure 3.3-8 Start button

Table 3.3-1 Start-up types in PLC operation

PLC start-up type	Description
Cold (Cold Start)	The user can start the PLC from the initial process.
Warm (Warm Start)	The user can start the PLC without the initial process.
Hot (Hot Start)	The user can start the PLC from the point where the PLC had stopped earlier.
Reset	Reset PLC. Note that the PLC cannot start until data is downloaded again.

†Note:The user should select “Cold (Cold Start)”.

(vi) Upload data

After the download operation, the user can upload data from the IED. Following steps show how to save PLC data into the PC.

Click “Cold”, and then click “Upload”.

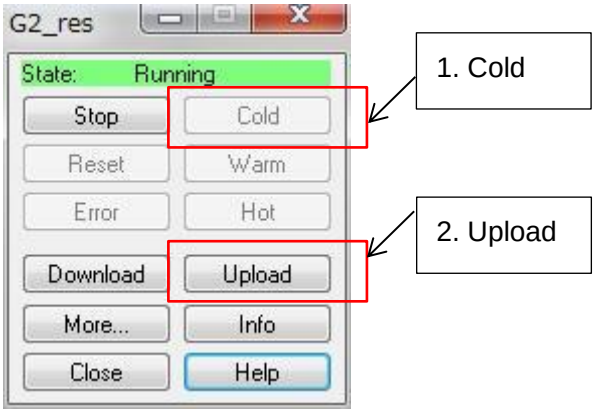


Figure 3.3-9 Upload button

In the Upload window, click “Project Source”.

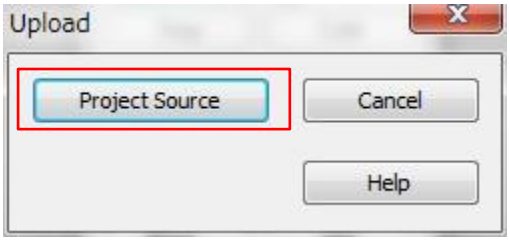


Figure 3.3-10 Source button

Select a folder for saving the data. Note that the uploading time depends on the data size that is downloaded in section 3.2(i).

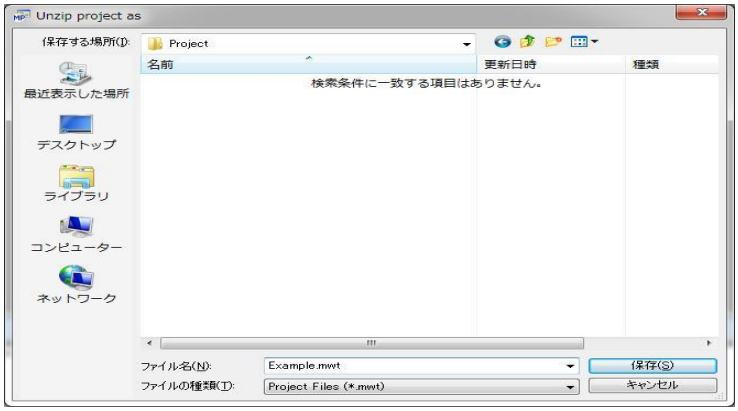


Figure 3.3-11 File save window

4 PLC debug

The logic programmed by the PLC editor can be debugged using a debugging function. Additionally, the IED has Automatic supervision function†; it can detect the error occurred at the logic programmed by the PLC editor.

†Note:The automatic supervision function is furnished in the IED in order to report error information. See respective IED instruction manuals; see Chapter *Automatic supervision.*

4.1 Debug using the PLC editor

When the user selects the debug monitor function in the PLC editor, the user can monitor and examine the data when PLC is running.

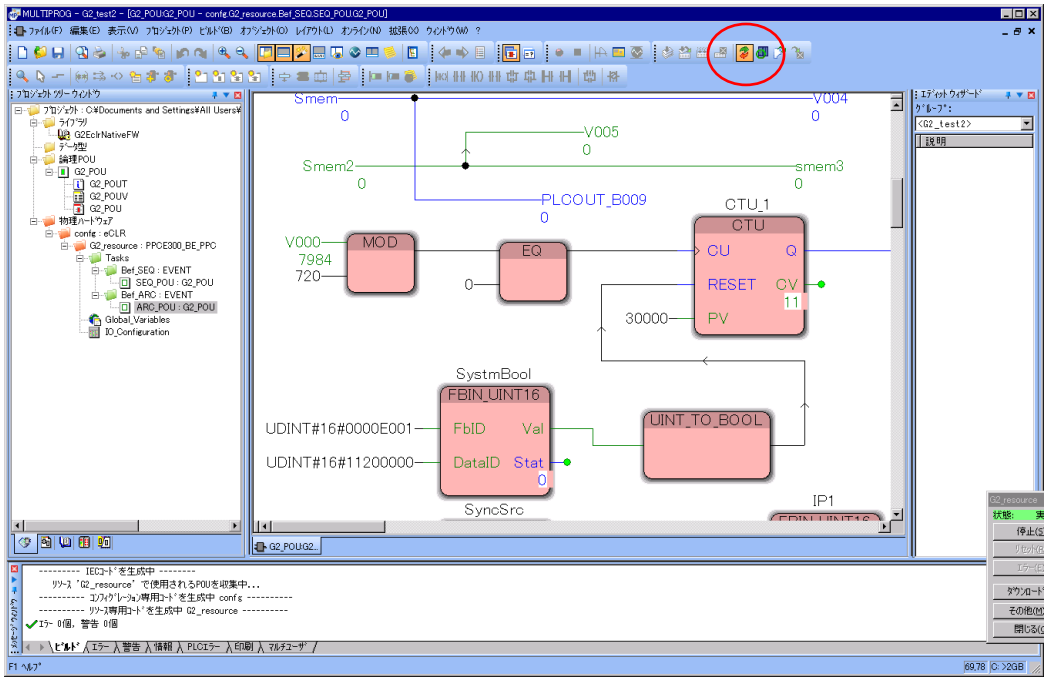


Figure 4.1-1 PLC debugging function

Note: The user cannot edit PLC from PLC debugging function. To start the PLC editing, the user should click “Debug” button again to exit this function.

4.2 Checking the PLC error

Automatic supervision function† can report the error information when an error occurs in the PLC logic. The error information is shown on the diagnostic sub-menu† on the IED screen (see Figure 4.2-1); Table 4.2-1 shows that error codes and their contents. The error code concerning the PLC is shown at the first row and the first column. When two or more errors exit at the same time, the error code is given by the summation of the codes. That is, when two errors (e.g., the Input DataID and the Output DataID) occur, the sum value "0x00000006" is given on the sub-menu.

Table 4.2-1 Error code and its information

Error code	Content of the error code
0x00000001	No PLC data exists in the IED.
0x00000002	Errors owing to the "Input Data ID (in the DIN function)‡
0x00000004	Errors owing to the "Output Data ID (in the DOUT function) ‡
0x00000008	Time over in the computation§
0x00000010	PLC stopped by the operation of the PLC editor

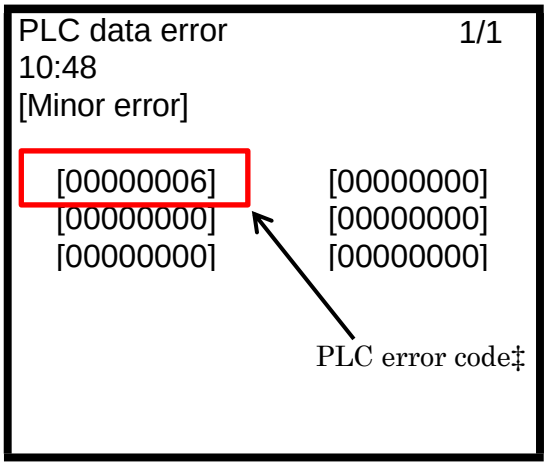


Figure 4.2-1 Error code at 1st row and 1st column on the monitoring sub-menu

†Note:The operation of the diagnostic sub-menu is discussed separately. The user can find the operation in respective IED instruction manuals; see Chapter *User interface: Monitoring sub-menu* of the IED instruction manuals.

‡Note:The error code can be displayed when Data IDs are set erroneously.

§Note: Tasks corresponding to Main_1, Main_2, and Main_3 may be too large. (For more information with regard to the task and the main, see Chapter *PLC editing*)

5 PLC Functions

5.1 Basic logic

Table 5.1-1 shows the data types available in the PLC.

Table 5.1-1 Data types and descriptions

Data type	Description	Size	Range	Default initial value
BOOL	Boolean	1	Either 0 or 1	0
SINT	Short integer	8	−128 to 127	0
INT	Integer	16	−32,768 to 32,767	0
DINT	Double integer	32	−2,147,483,648 up to 2,147,483,647	0
USINT	Unsigned short integer	8	0 up to 255	0
UINT	Unsigned integer	16	0 up to 65,535	0
UDINT	Unsigned double integer	32	0 up to 4,294,967,295	0
REAL	Real numbers	32	−3.402823466 E+38 (44pprox.. 7 digits) up to −1.175494351 E−38 (44pprox.. 7 digits) and +1.175494351 E−38 (44pprox.. 7 digits) up to +3.402823466 E+38 (44pprox.. 7 digits)	0.0
LREAL	Long real numbers	64	−1.798 E+308 (44pprox.. 15 digits) up to −2.225 E−308 (44pprox.. 15 digits) and +2.225 E−308 (44pprox.. 15 digits) up to +1.798 E+308 (44pprox.. 15 digits)	0.0
TIME	Duration	32	0 up to 4,294,967,295	t#0s
BYTE	Bit string of length 8	8	0 up to 255 (16#00 ... 16#FF)	0
WORD	Bit string of length 16	16	0 up to 65,535 (16#00...16#FFFF)	0
DWORD	Bit string of length 32	32	0 up to 4,294,967,295 (16#00....16#FFFFFFFF)	0

Table 5.1-2 shows the literal types for numerical data.

Table 5.1-2 Numerical literals and ranges

Type	Examples
Integer literals	-12 0 123_456 +986
Integer literals with fixed data type	[Data Type]#[base]#Number
Real literals	-12.0 0.0 0.4560 3.14159_26
Real literals with exponent	-1.34E-12 -1.34e-12 1.0E+6
Long Real literals	LREAL#-12.0
Long Real literals with exponent	LREAL#2.3E-89
Base 2 literals	INT#2#1111_1111
Base 8 literals	INT#8#377
Base 16 literals	INT#16#FF SINT#16#ff
Boolean FALSE and TRUE	FALSE TRUE
Boolean 0 and 1	0,1
Time	T#100ms

5.2 Function blocks

Table 5.2-1 shows logic blocks.

Table 5.2-1 Logic function

Function	Function block	Short description
Flip Flop	SR	Set dominant
	RS	Reset dominant
Edge detector	F_TRIG	Falling edge detector
	R_TRIG	Rising edge detector
Counter	CTU	Up-counter
	CTD	Down-counter
	CTUD	Up-down-counter
Timer	TP	Pulse
	TON	On-delay timer
	TOF	Off-delay timer

5.3 Basic functions

Table 5.3-1 shows basic functions in PLC.

Table 5.3-1 Basic function

Function	Function	Short description
Bitwise Boolean functions	AND	AND connection
	NOT	Complement
	OR	OR connection
	XOR	XOR connection
Bit-string functions	ROL	Rotate left
	ROR	Rotate right
	SHL	Shift left
	SHR	Shift right
Arithmetic functions	ADD	Addition of ANY_NUM
	DIV	Divisor of ANY_NUM
	EXPT	Exponentiation
	MOD	Modulo division
	MOVE	Assignment
	MUL	Multiplier for ANY_NUM
	NEG	Double complement
	SUB	Subtractor of ANY_NUM
Numerical functions	ABS	Absolute value
	ACOS	Arc cosine
	ASIN	Arc sine
	ATAN	Arc tangent
	COS	Cosine
	EXP	Exponent
	LN	Natural logarithm
	LOG	Logarithm to the base of 10
	SIN	Sine
	SQRT	Square root
	TAN	Tangent
Selection functions	LIMIT	Limitation
	MAX	Maximum
	MIN	Minimum
	SEL	Binary selection
Comparison functions	EQ	Comparison: =
	GE	Comparison: >=
	GT	Comparison: >
	LE	Comparison: <=
	LT	Comparison: <
	NE	Comparison: <>
Type conversion functions	*_TO_**	Type conversion from * to **

5.4 Bit operation functions

Table 5.4-1 shows the function of bit operation.

Table 5.4-1 Bit operation function

Function	Short description
BIT_TEST	reads the value of a single bit in a bit string
GET_CHAR	extracts one character out of a string
GET_LSB	reads the value of the least significant BYTE of a bit string
GET_MSB	reads the value of the most significant BYTE of a bit string
I_BIT_IN_*	inverts a single bit in a bit string
PARITY_*	checks if the number of set bits is even or odd
R_BIT_IN_*	resets a single bit in a bit string
S_BIT_IN_*	sets a single bit in a bit string
SET_LSB	writes a value on the least significant BYTE of a bit string
SET_MSB	writes a value on the most significant BYTE of a bit string
SWAP	exchanges the most and the least significant BYTE of a bit string

*Note: To execute this function, the user should install the “BIT_UTIL” library.

6 PLC editing

6.1 Worksheet operation

(i) Opening a worksheet

To open a worksheet, follow the steps below:

1. In the “Project Tree Window”, click “Logical POUs”, select “G2_POU*”, and double click “G2_POU*”. Or

   Right click “G2_POU*” and click “Open Worksheet” as shown in Figure 6.1-1. By default, the ADD function will be inserted in the worksheet as shown in Figure 6.1-2; the user can delete this function if not required.

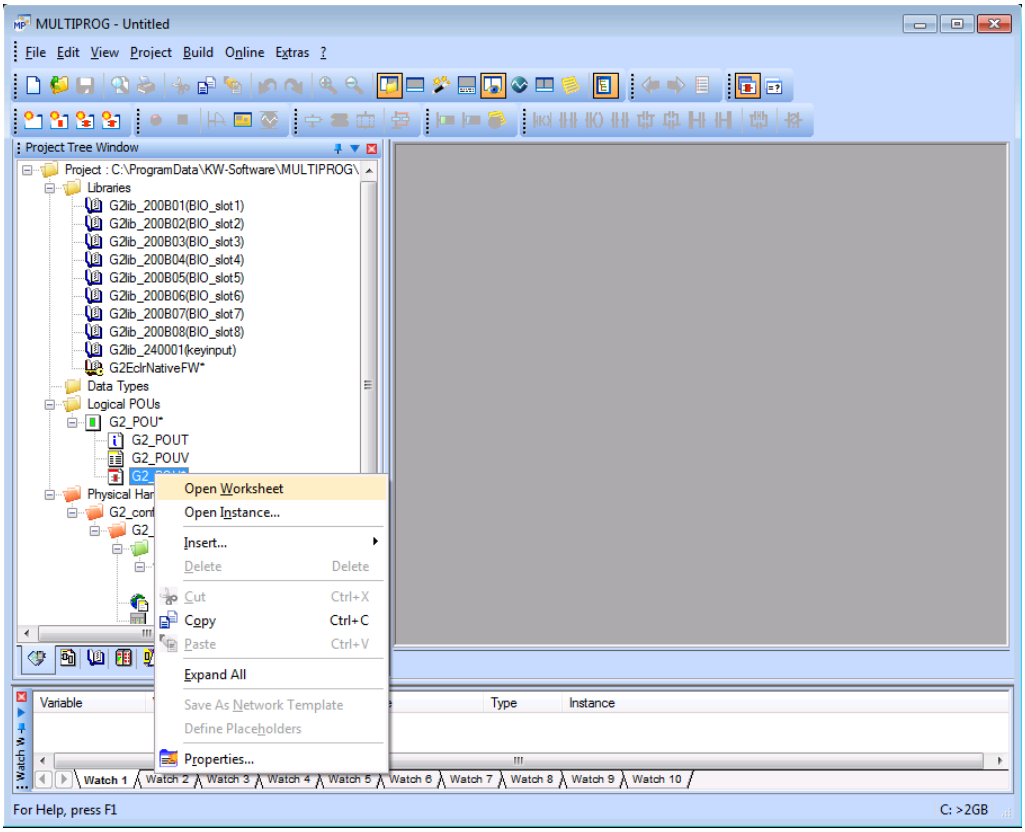


Figure 6.1-1 Opening worksheet

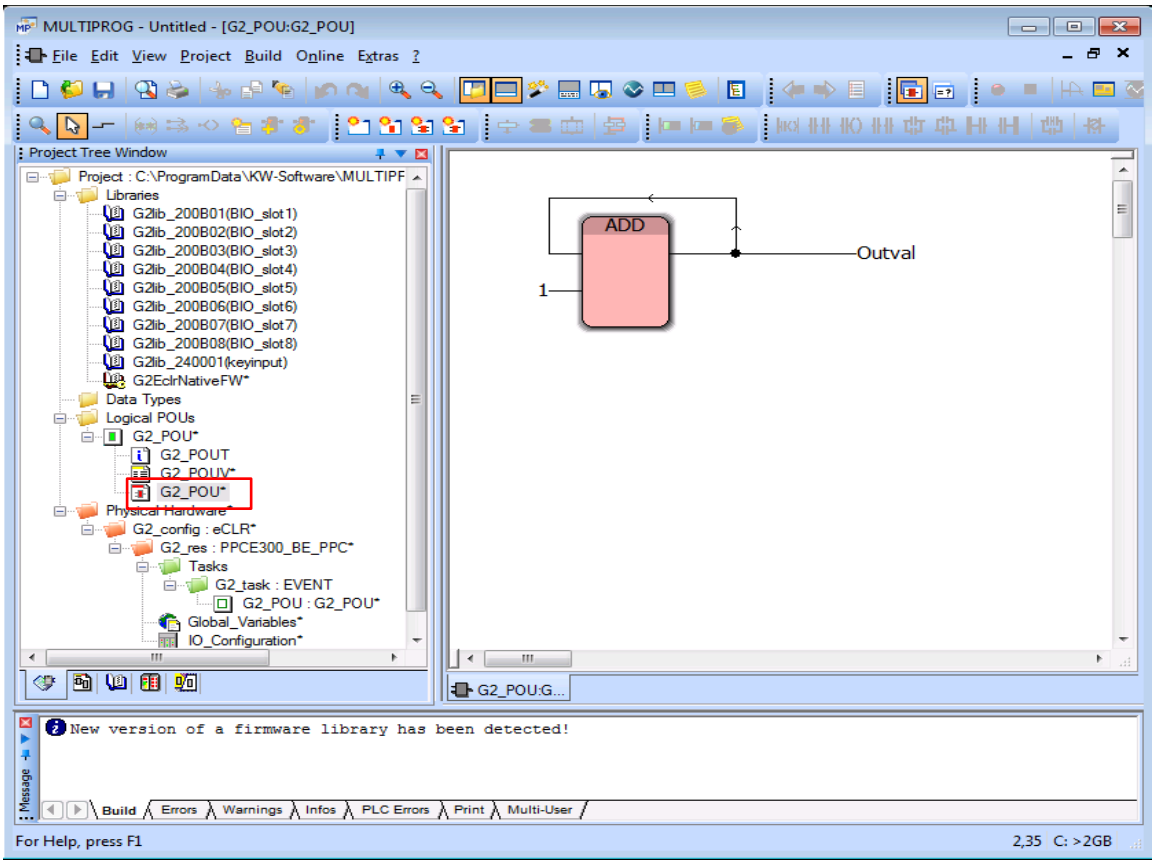


Figure 6.1-2 Default Worksheet screen

(ii) Inserting a function block (FB) or a function into a Worksheet

On the “Menu bar”, click “View”, and select “Edit Wizard”. The “Edit Wizard” panel appears on the right hand side as shown in Figure 6.1-3.

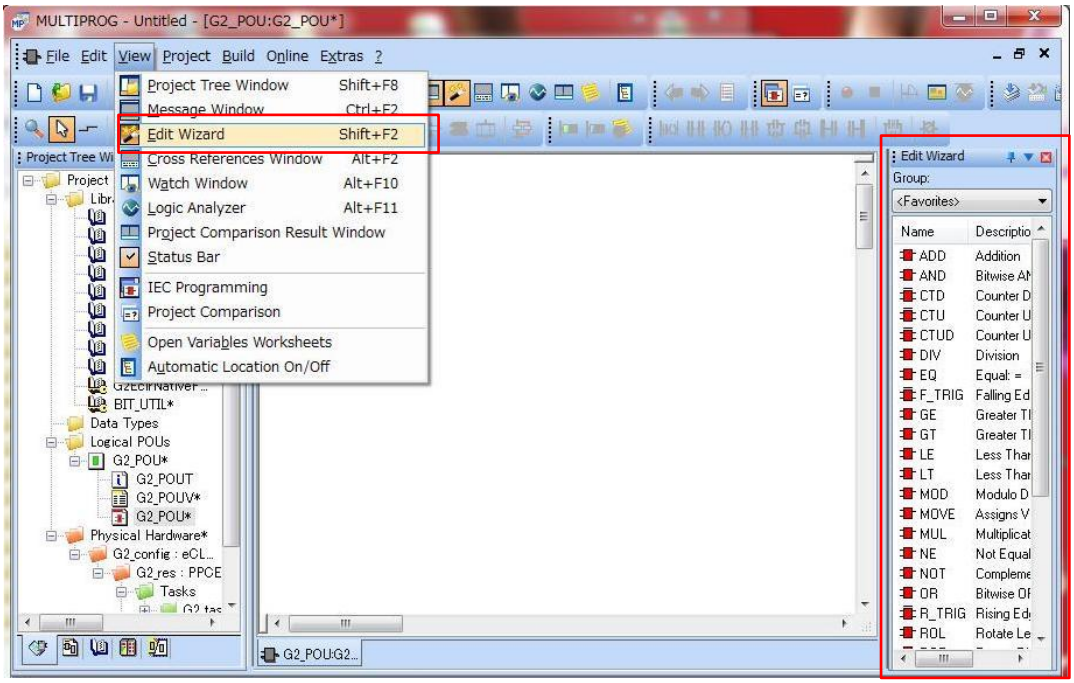


Figure 6.1-3 Edit Wizard screen

As shown in Figure 6.1-4, select the required function in the “Favorites” group; then drag and drop it onto the worksheet at the selected point.

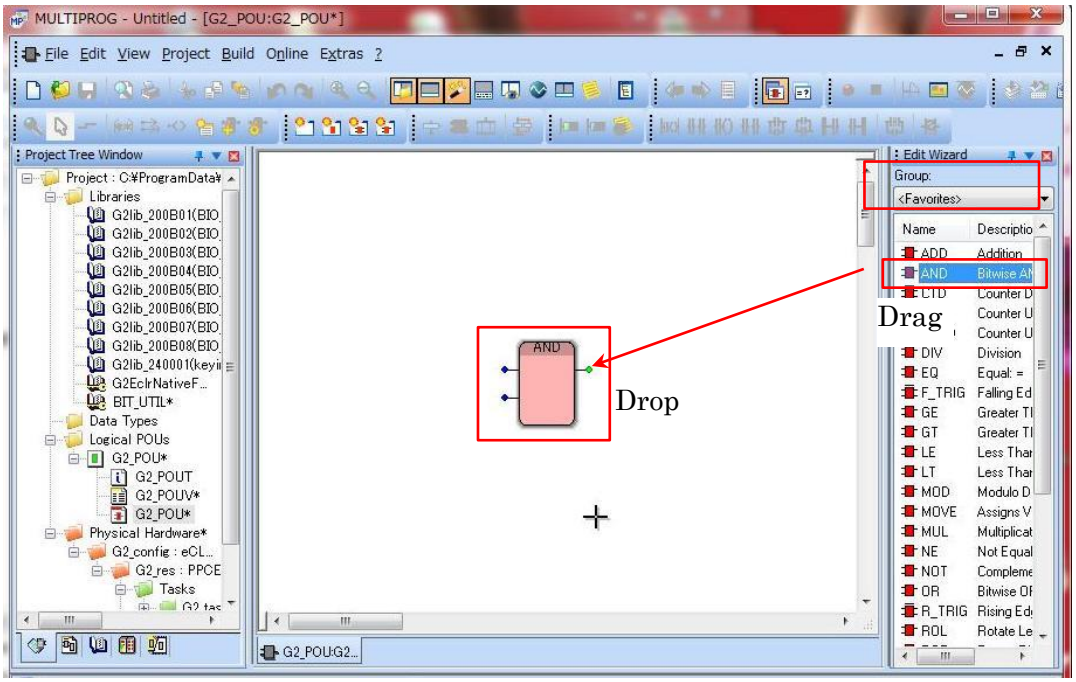


Figure 6.1-4 Inserting a FB into the worksheet

Similarly, Toshiba specific libraries are available in the “Group” drop down list under the “Edit Wizard” panel, where the user can use the different functions available. Table

6.1-1shows the list of “G2lib_200B01 (BIO_slot1)” and G2lib_240001 (keyinput)” libraries.

Table 6.1-1 Library list

Library Name	Function Name	Description
G2lib_200B01(BIO_slot1) Similarly, 7 other libraries for Slot2 to Slot8 are also available (G2lib_200B01 to G2lib_200B08).	S1_BI1	BIO Slot1 BI1
	S1_BI2	BIO Slot1 BI2
	S1_BI3	BIO Slot1 BI3
	S1_BI4	BIO Slot1 BI4
	S1_BI5	BIO Slot1 BI5
	S1_BI6	BIO Slot1 BI6
	S1_BI7	BIO Slot1 BI7
	S1_BI8	BIO Slot1 BI8
	S1_BI9	BIO Slot1 BI9
	S1_BI10	BIO Slot1 BI10
	S1_BI11	BIO Slot1 BI11
	S1_BI12	BIO Slot1 BI12
	S1_BI13	BIO Slot1 BI13
	S1_BI14	BIO Slot1 BI14
	S1_BI15	BIO Slot1 BI15
	S1_BI16	BIO Slot1 BI16
	S1_BI17	BIO Slot1 BI17
	S1_BI18	BIO Slot1 BI18
	S1_BI19	BIO Slot1 BI19
	S1_BI20	BIO Slot1 BI20
	S1_BI21	BIO Slot1 BI21
	S1_BI22	BIO Slot1 BI22
	S1_BI23	BIO Slot1 BI23
	S1_BI24	BIO Slot1 BI24
	S1_BI25	BIO Slot1 BI25
	S1_BI26	BIO Slot1 BI26
	S1_BI27	BIO Slot1 BI27
	S1_BI28	BIO Slot1 BI28
	S1_BI29	BIO Slot1 BI29
	S1_BI30	BIO Slot1 BI30
	S1_BI31	BIO Slot1 BI31
	S1_BI32	BIO Slot1 BI32
	S1_BO1	BIO Slot1 BO1
	S1_BO2	BIO Slot1 BO2
	S1_BO3	BIO Slot1 BO3

Library Name	Function Name	Description
	S1_BO4	BIO Slot1 BO4
	S1_BO5	BIO Slot1 BO5
	S1_BO6	BIO Slot1 BO6
	S1_BO7	BIO Slot1 BO7
	S1_BO8	BIO Slot1 BO8
	S1_BO9	BIO Slot1 BO9
	S1_BO10	BIO Slot1 BO10
	S1_BO11	BIO Slot1 BO11
	S1_BO12	BIO Slot1 BO12
	S1_BO13	BIO Slot1 BO13
	S1_BO14	BIO Slot1 BO14
	S1_BO15	BIO Slot1 BO15
	S1_BO16	BIO Slot1 BO16
	S1_BO17	BIO Slot1 BO17
	S1_BO18	BIO Slot1 BO18
G2lib_240001(keyinput)	KEYIN_CANCEL	CANCEL Key
	KEYIN_CLEAR	CLEAR Key
	KEYIN_CLOSE	CLOSE Key
	KEYIN_DOWN	DOWN Key
	KEYIN_ENTER	ENTER Key
	KEYIN_F1	F1 Key
	KEYIN_F2	F2 Key
	KEYIN_F3	F3 Key
	KEYIN_F4	F4 Key
	KEYIN_F5	F5 Key
	KEYIN_F6	F6 Key
	KEYIN_F7	F7 Key
	KEYIN_HELP	HELP Key
	KEYIN_LEFT	LEFT Key
	KEYIN_LOCRMT	LOCRMT Key
	KEYIN_MIMIC	MIMIC Key
	KEYIN_OPEN	OPEN Key
	KEYIN_RIGHT	RIGHT Key
	KEYIN_UP	UP Key

"G2lib_200B01 (BIO_slot1)" is the library name for the binary IO module #1. For example, the function "200B01" is the BIO module at IED slot#1. When the user wishes to use a binary

input circuit (BI1) at slot #1, the user can use the BI1 circuit by selecting “S1_BI1” from the library. As the maximum case size available for the G2 IED is 1/1, up to 8 BIO modules can be accommodated. So, 8 libraries are provided for the PLC editors, (That is, G2lib_200B01 to G2lib_200B08).

(iii) Adding variables

On the “Tool bar”, click “Variable” icon, (Alternatively, press F5) to add a variable.

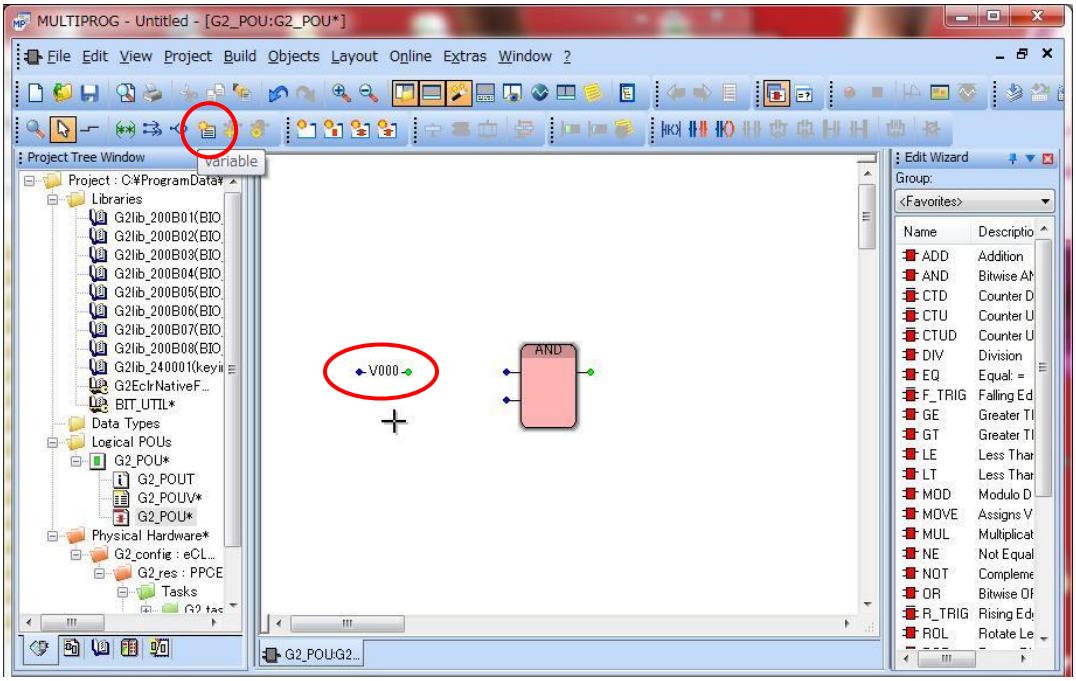


Figure 6.1-5 Adding variables

The user can assign different values (Name, Data Type, Usage and so on) to the variable in the “Variable Properties” window, as shown in Figure 6.1-6.

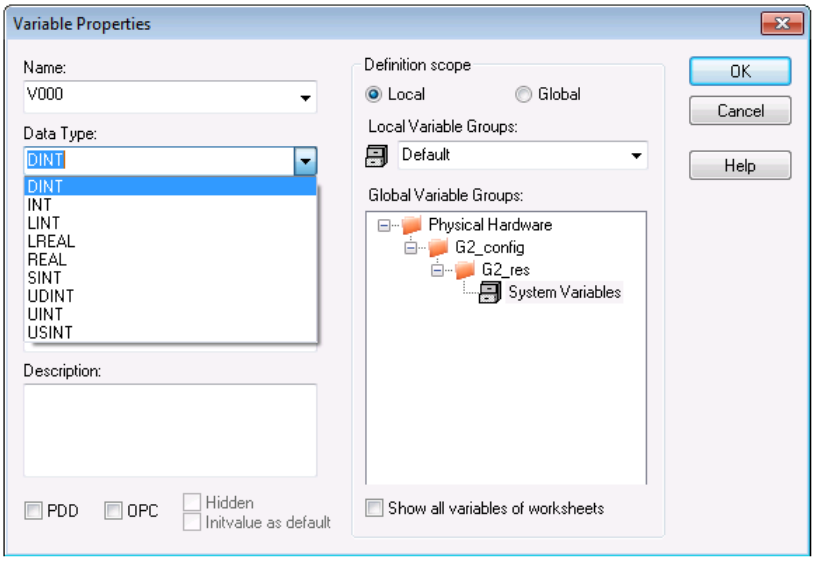


Figure 6.1-6 Variable Properties window

Table 6.1-2 shows the different data types available in PLC editor.

Table 6.1-2 Data type

Data type	Data type name in IED	Data type name on the PLC
0x00	Boolean	UDINT
0x20	Signed int8	SINT
0x21	Signed int16	INT
0x22	Signed int32	DINT
0x30	Unsigned int8	USINT
0x31	Unsigned int16	UINT
0x32	Unsigned int32	UDINT
0x42	Real32	REAL
0x43	Real64	LREAL
0x8X(X : bit-offset)*	Bit	BOOL

*Note: Suppose Bit type is used, then the 16-bit area is reserved in memory. As the offset designated by "X" is used, the user uses it in the Bit type. (X : 0x0 to 0xF)

(iv) Linking variable and function

Left click and hold the mouse button on the variable terminal point and drag to the function block terminal point to connect them as shown in Figure 6.1-7.

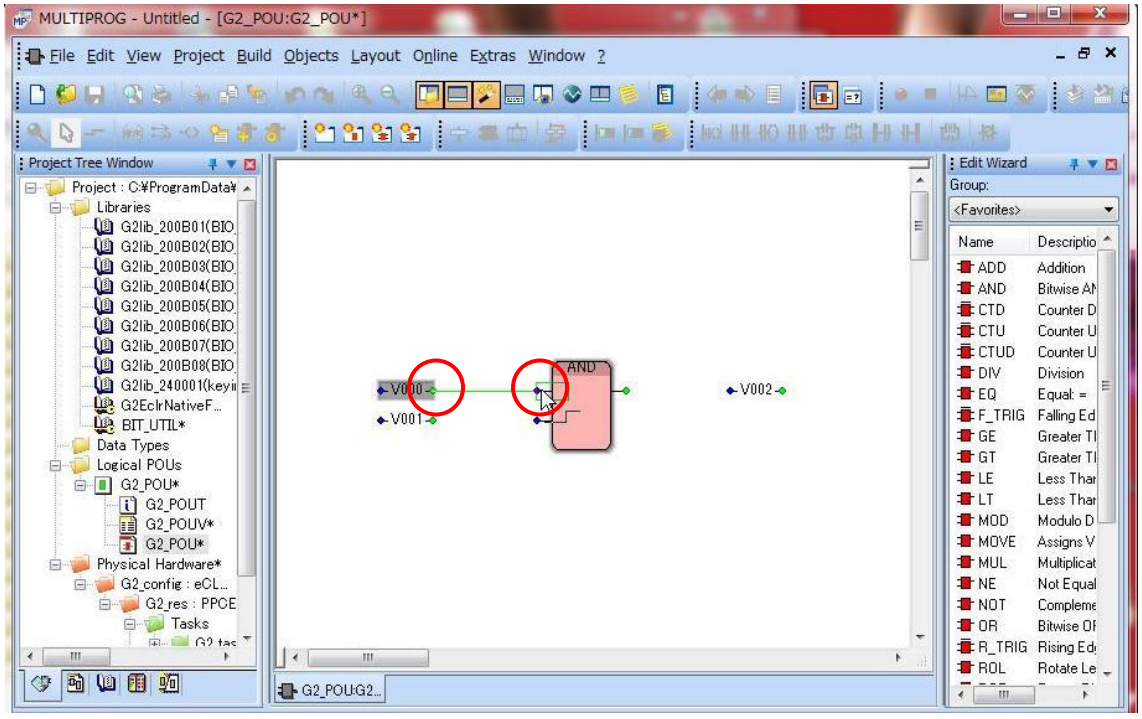


Figure 6.1-7 Connection between variable and function

(v) Connecting functions or function blocks

The functions are connected using the FBD toolbar as shown in Figure 6.1-8.

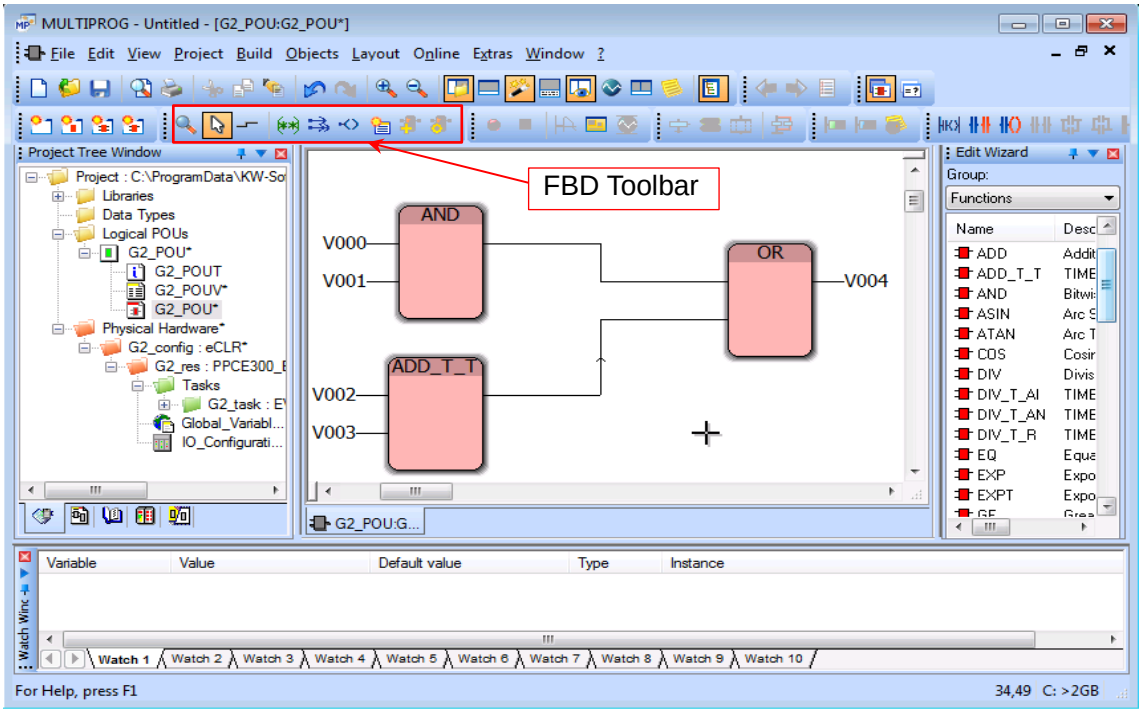


Figure 6.1-8 Connecting function blocks

Options to insert a comment, connector, label / jump, return, edit variable, duplicate FP and toggle negation of FP are done using the “Objects” drop down list on the menu bar or using the icons available on the FBD toolbar.

(vi) Adding logic

To add logic in Logical POUs, follow the steps as below:

1. In the project tree window, right click “logical POUs” and select “Insert->Program”.

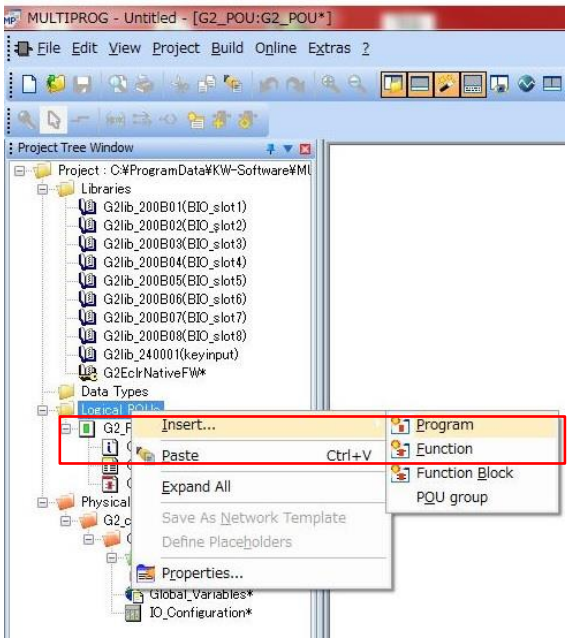


Figure 6.1-9 Adding logic in Logical POUs

2. In the “Insert” window enter the Name of the worksheet and click “OK”.

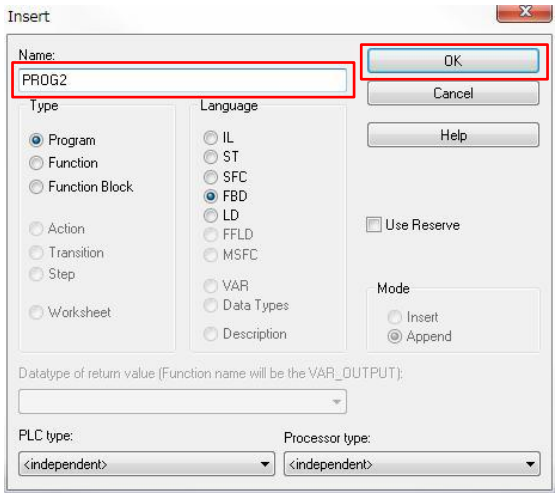


Figure 6.1-10 Insert window

3. A logic element is added in the project tree as shown in Figure 6.1-11.

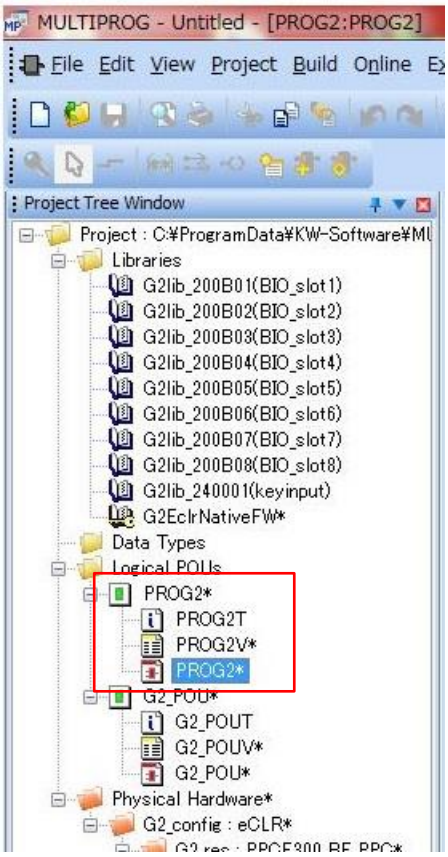


Figure 6.1-11 New logic element inserted

(vii) Adding Tasks

To add tasks under Physical Hardware*, follow the steps as below:

1. In the Project Tree Window, select “Physical Hardware->G2_config->G2_res->Task”.
2. Right click “Task” and click “Insert” as shown in Figure 6.1-12.

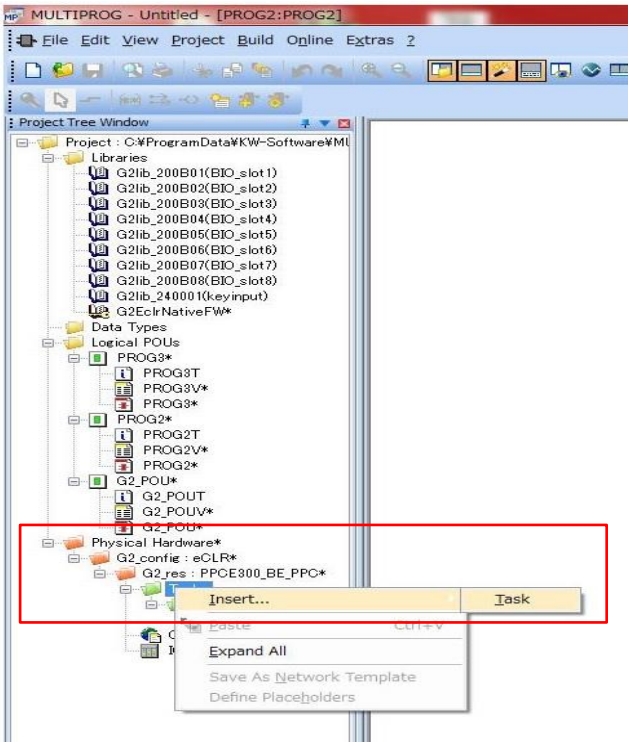


Figure 6.1-12 Adding a Task

3. In the Insert window, enter a task “Name”, select “Task type” and click “OK”.

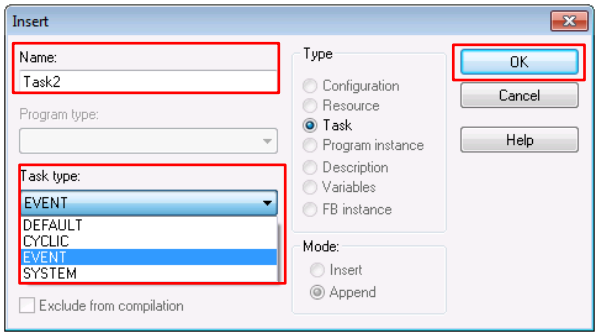


Figure 6.1-13 Configuring a Task

4. After the task has been added, select the “Event” and set the “Priority” for the task as shown in Figure 6.1-14 and Figure 6.1-15.

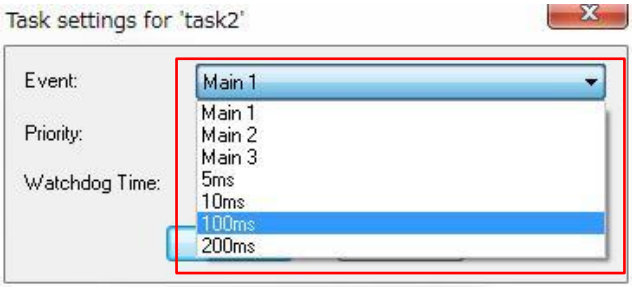


Figure 6.1-14 Selecting an Event

Note: When an event "Main X" is selected, key in '0' for the priority. When an event other than "Main X" is selected, key in '1' for the priority as shown in Figure 6.1-15.

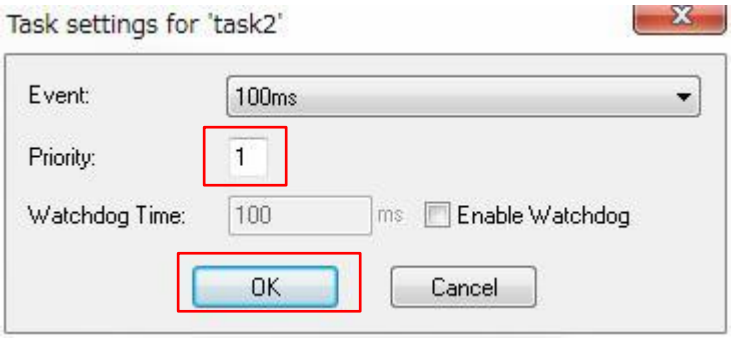


Figure 6.1-15 Setting a priority

5. After the Priority and Event have been set, the task is added in the project tree as shown in Figure 6.1-16.

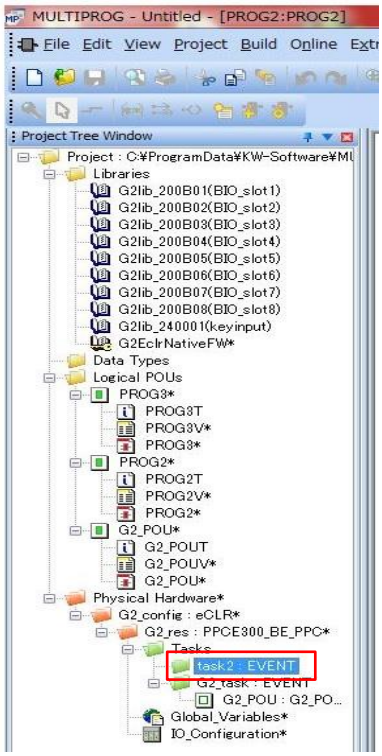


Figure 6.1-16 New task created

(vii)-1 Adding logic to a task

1. Right click on the required Task and select “Insert→Program instance” as shown in Figure 6.1-17.

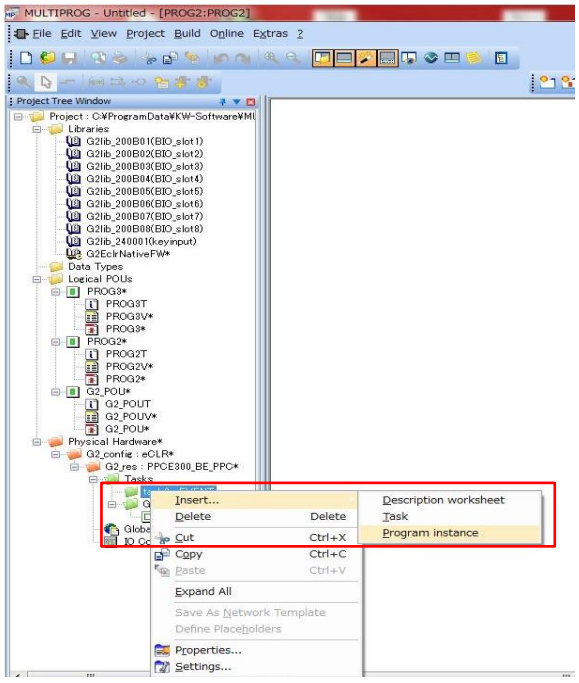


Figure 6.1-17 Adding logic

2. Enter a name for “Program instance”, select the logic required to be added from “Program type” and click “OK”.

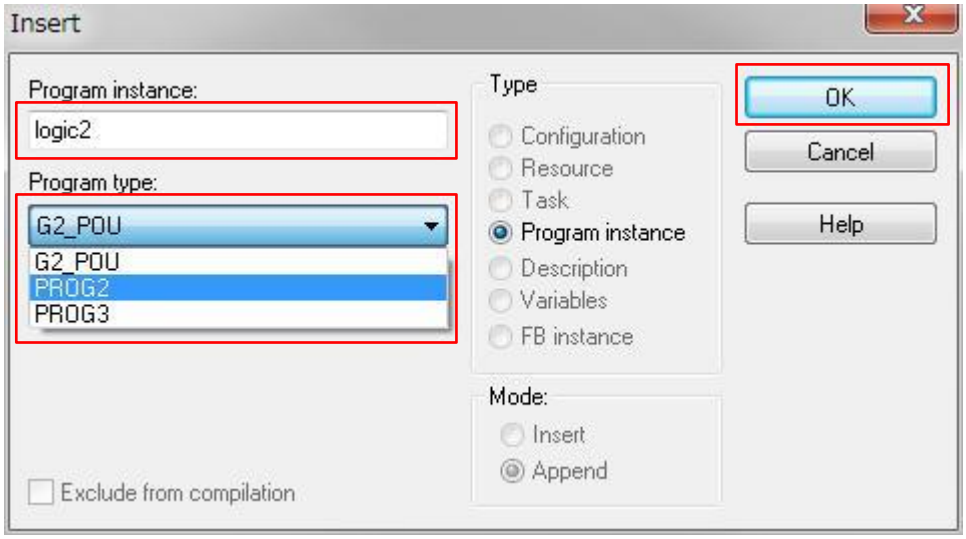


Figure 6.1-18 Logic details

The logic is added in the task as shown in Figure 6.1-19.

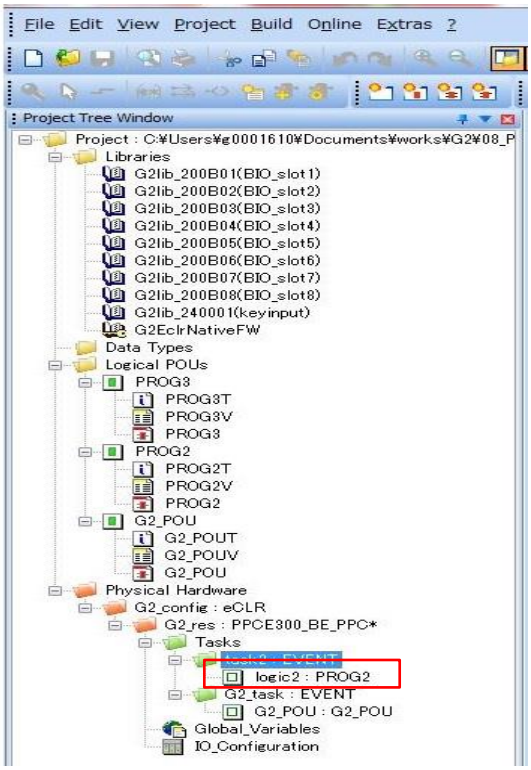


Figure 6.1-19 Logic added

The user can add several logic elements to a single task repeating steps 1 and 2.

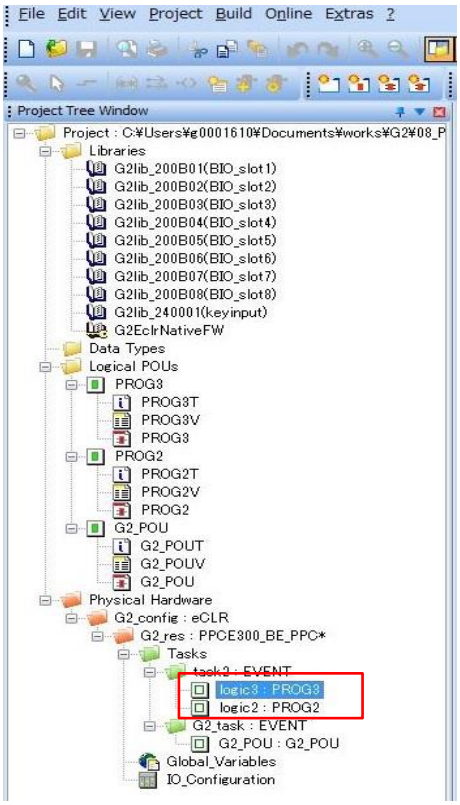


Figure 6.1-20 Two logic elements added

3. Drag and drop the Logic element to change the execution sequence. Figure 6.1-21 shows an example where logic2 is dragged and dropped over logic3.

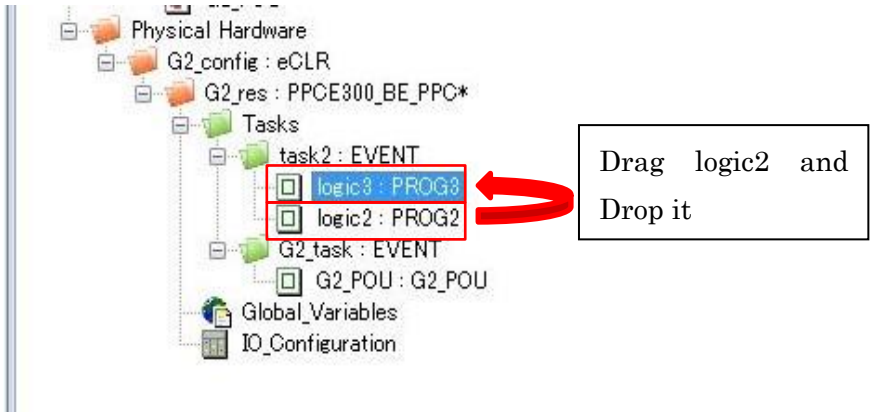


Figure 6.1-21 Changing the process sequence

As shown in Figure 6.1-22, logic2 has been moved up following the drag and drop method.



Figure 6.1-22 Revised execution sequence

(vii)-2 Moving logic to another task

The user can move logic to another task as shown in Figure 6.1-23 and Figure 6.1-24.

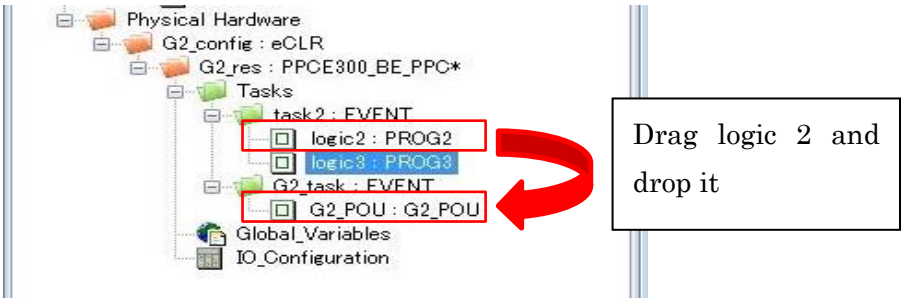


Figure 6.1-23 Moving logic to another task



Figure 6.1-24 Logic moved

6.2 Examples for creating PLC logic

(i) Example1

Figure 6.2-1 shows an example of EF logic created using libraries. “G2lib_200B01 (BIO_slot1)” is the library name for the binary IO module in slot #1. “S1_BI1_1” function block is added from this library into the Group. The “S1_BI1_1” function block is connected to the “DOUT_BOOL_1” block as shown in the figure below.

For the PLC program to examine a Data ID, function blocks “DOUT_****” are provided. For example, function block “DOUT_BOOL_1” is provided to check the status of a Data ID, and this function block generates a Boolean output. In the example below, FID (454A401) is the function ID for the EF function, DTYPE (80) is the data type and DID (0010EBBO) is the Data ID for the EF1_BLOCK signal as shown in Figure 6.2-2 and Table 6.2-1. These parameters are provided to import the attributes of the Data ID.

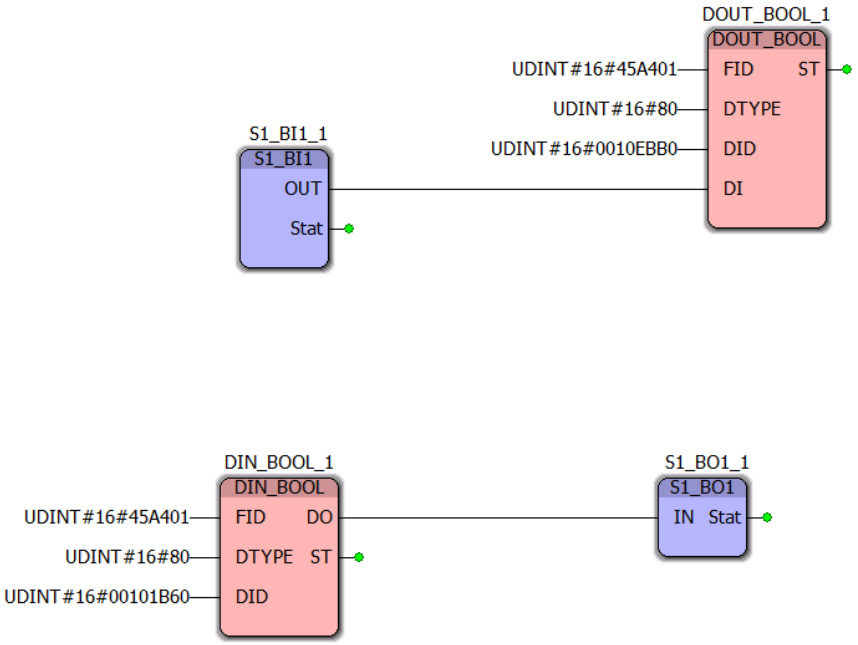


Figure 6.2-1 Example logic for EF function

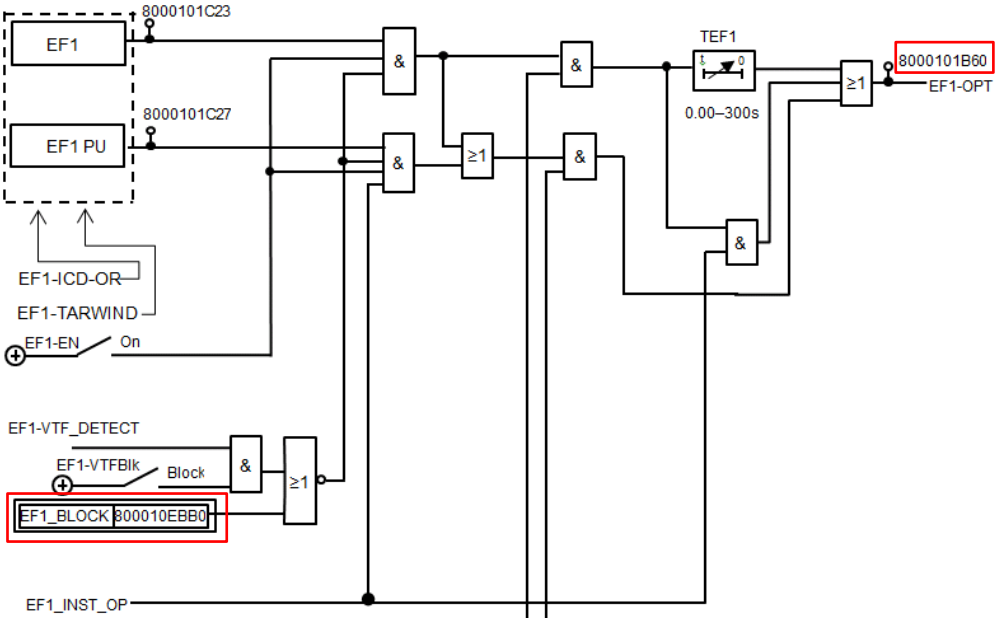


Figure 6.2-2 EF scheme logic

Table 6.2-1 EF PLC signal list

Connection point on PLC logic
EF (Function ID: 45A401)

Element ID	Name	Description
800010EBB0	EF1_BLOCK	EF1 protection block command
810020EBB0	EF2_BLOCK	EF2 protection block command
820030EBB0	EF3_BLOCK	EF3 protection block command
830040EBB0	EF4_BLOCK	EF4 protection block command
840050EBB0	EF5_BLOCK	EF5 protection block command
850060EBB0	EF6_BLOCK	EF6 protection block command
860070EBB0	EF7_BLOCK	EF7 protection block command
870080EBB0	EF8_BLOCK	EF8 protection block command

DID

DTYPE

(ii) Example2

The “G2lib_240001 (keyinput)” library is provided in the PLC program for ‘key’ operation on the IED. The user can find the key layout in the chapter “User interface”. The “KEYIN_CLOSE_1” and “KEYIN_OPEN_1” shown in Figure 6.2-3 are available in the “G2lib_240001 (keyinput)” library. The variable V000 is mapped to the memory I/O address as shown in Figure 6.2-3.

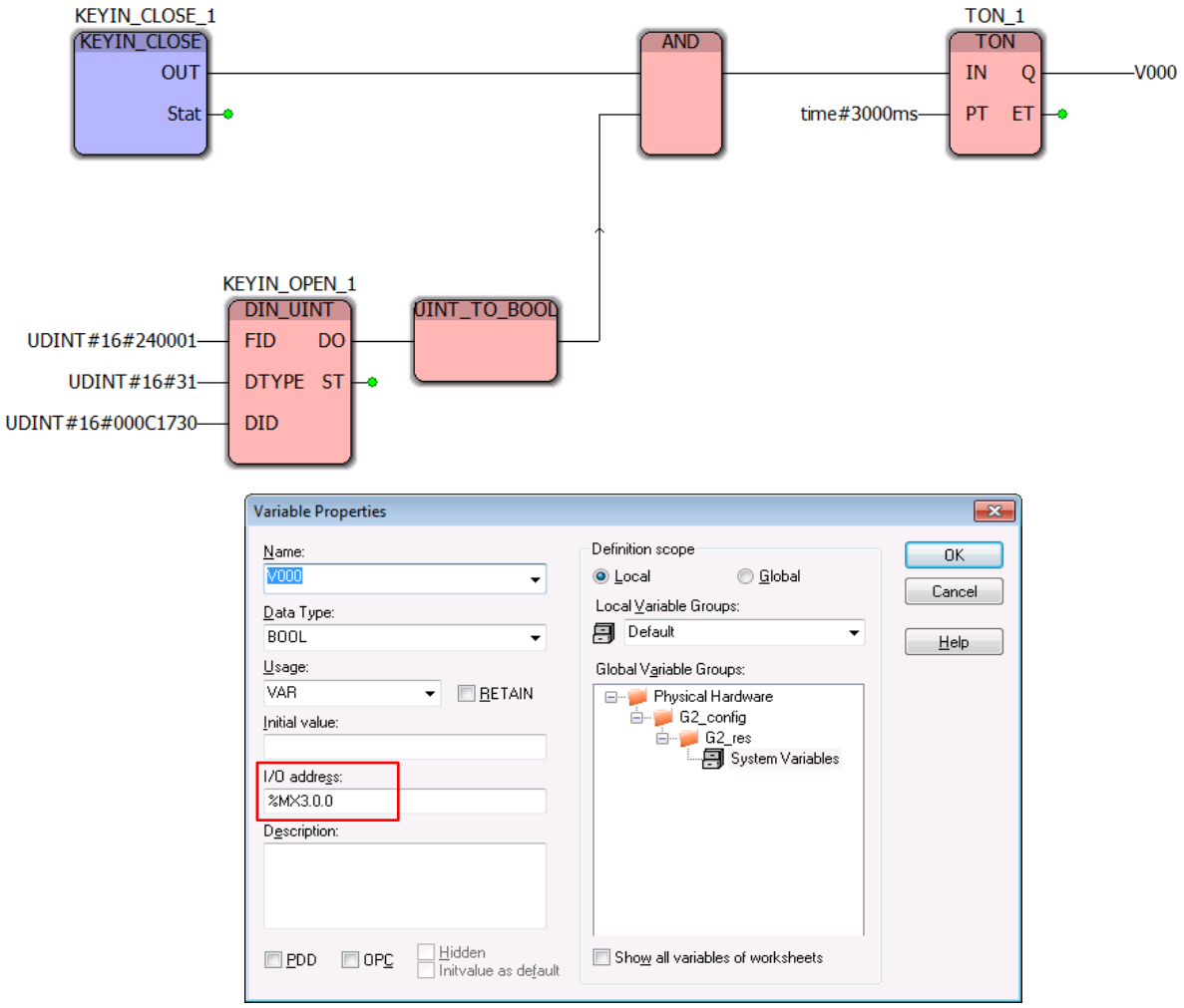


Figure 6.2-3 Example logic for key

6.3 PLC configuration with FBs in Firmware library

(i) Operation of function block “DIN_****”

There are several function blocks to import and export data in the PLC. In this section, the features and properties of the function blocks are discussed.

Note: General library is provided in place of DIN_****. See 6.4(iv) on how to use the general library.

(i)-1 Data import/export in Function block “DIN_****”

In order to import PLC data, several function blocks “DIN_****” are provided. For example, function block “DIN_BOOL” is used to import information for the Data ID in bit type.

Table 6.3-1 FB “DIN_**” import properties†**

FB name	Input property
DIN_BOOL	Bit type data import
DIN_DINT	Integer 32 bits data import
DIN_INT	Integer 16 bits data import
DIN_SINT	Integer 8 bits data import
DIN_UDINT	Unsigned integer 32 bits data import
DIN_UINT	Unsigned integer 16 bits data import
DIN_USINT	Unsigned integer 8 bits data import
DIN_LREAL	Double floating-point data import
DIN_REAL	Floating-point data import

†Note:As for the Data type, see Table 6.1-2.

(i)-2 Attribute import in function block “DIN_****”

For example, Figure 6.3-1 shows that the function block “DIN_BOOL” can obtain Data ID information, which has several attributes. Later, the function block “DIN_BOOL” can output data in BOOL type. As shown in the figure below, there are several PLC parameters, which are represented as “FID”, “DTYPE”, and so on; these parameters are provided so that the attributes of Data ID can be imported and exported. Table 6.3-2 shows the list of PLC parameters. Note that each PLC parameter has an attribute and a type.

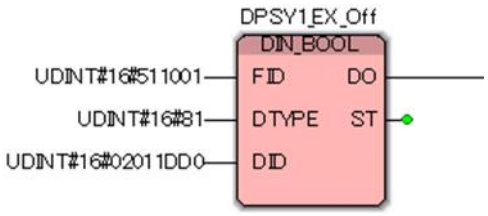


Figure 6.3-1 Data import in FB "DIN_BOOL[1]" (e.g. DataID: 511001-81-0201-1DD0)

Note: The user should note that the BOOL type in PLC is identical to BIT type in the IED.

Table 6.3-2 PLC parameters and others in function blocks "DIN_**"**

Parameter	Attribute	Type	Contents
FID	IN	UDINT	Function ID (16bits) + instance number (8bits)
DTYPE	IN	DINT	Data type (8bits) part of element ID
DID	IN	UDINT	Group ID (16bits) and Attribute type (16bits) parts of element ID
DO	OUT	ANY_TYPE	depends on _*
ST	OUT	BOOL	True: Data ID is valid False: Data ID is invalid

(i)-3 Check following the configuration of function block "DIN_*****"

The user can check the configuration of the DIN function block by following the steps below:

1 Run the PLC configured by the user.

2 Execute the PLC debugging function. (To run debugging, see chapter **4**)

3 Check the value of ST in the DIN function block. When "1" is observed at ST, the configuration of the DIN function block has been successful (Figure 6.3-2). When "0" is observed, the configuration has failed (Figure 6.3-3).

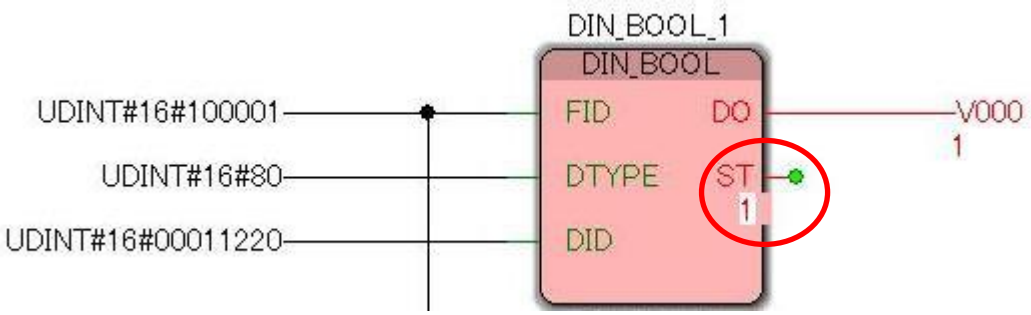


Figure 6.3-2 When 1 is observed at ST, configuration is successful

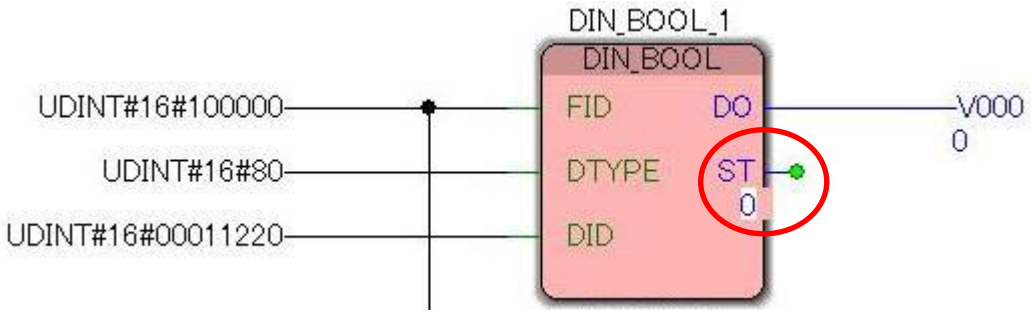


Figure 6.3-3 When 0 is observed at ST, configuration has failed.

(ii) Operation of function block "DOUT_****"

When it is required that a function block examines a Data ID, function blocks "DOUT_****" are provided; these function blocks can output either "True(1)" or "False(0)" in response to the state of the Data ID. Note that the single Data ID is not allowed to connected with a number of function blocks (FBs) at the same time.

Note: General library is provided in place of DOUT_****. See 6.4(iv) on how to use the general library.

(ii)-1 Data export in function block "DOUT_****"

For the PLC program to examine a Data ID, function blocks "DOUT_****" are provided. For example, function block "DOUT_BOOL" is provided to examine a Data ID, and this function block outputs the result in bit type. Table 6.3-3 shows the list of "DOUT_****" function blocks.

Table 6.3-3 Data export in function blocks "DOUT_**"**

FB name	Output property
DOUT_BOOL	Data export in bit type
DOUT_DINT	Integer data export in 32 bits type
DOUT_INT	Integer data export in 16 bits type
DOUT_SINT	Integer data export in 8 bits type
DOUT_UDINT	Unsigned integer data export in 32 bits type
DOUT_UINT	Unsigned integer data export in 16 bits type
DOUT_USINT	Unsigned integer data export in 8 bits type
DOUT_LREAL	Double floating-point data export
DOUT_REAL	Floating-point data export

†Note:As for the Data type, see Table 6.1-2.

(ii)-2 Attribute import in function block "DOUT_****"

For example, Figure 6.3-4 shows that the function block "DOUT_BOOL" can obtain the Data

ID information, which has several attributes. The function block “DOUT_BOOL” outputs a result at ST in BOOL type. As shown in the figure below, there are several PLC parameters, which are represented as “FID”, “DTYPE”, and so on; these parameters are provided to import the attributes of Data ID. Table 6.3-4 shows the list of PLC parameters. Note that each PLC parameter has an attribute and a type.

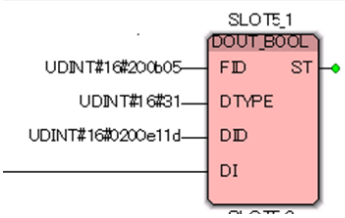


Figure 6.3-4 Data export in FB “DOUT_BOOL” (e.g. DataID: 200B05-31-020e-e11d)

Table 6.3-4 parameters and others in function blocks “DOUT_**”**

Parameter	Attribute	Type	Contents
FID	IN	UDINT	Function ID(16bits) + instance number(8bits)
DTYPE	IN	UDINT	Data type(8bits) part of element ID
DID	IN	UDINT	Group ID(16bits) and Attribute type(16bits)e parts of element ID
DI	IN	ANY_TYPE	depends on _*
ST	OUT	BOOL	True: Data ID is valid False: Data ID is invalid

(ii)-3 Check following the configuration of function block “DOUT_****”

The user can check the configuration of the DOUT function block by following the steps below:

1 Run the PLC configured by the user.

2 Execute the PLC debugging function. (To run debugging, see chapter 4)

3 Check the value of ST in the DOUT function block. When “1” is observed at ST, the configuration of the DOUT function block has been successful (Figure 6.3-5). When “0” is observed, the configuration has failed (Figure 6.3-6).

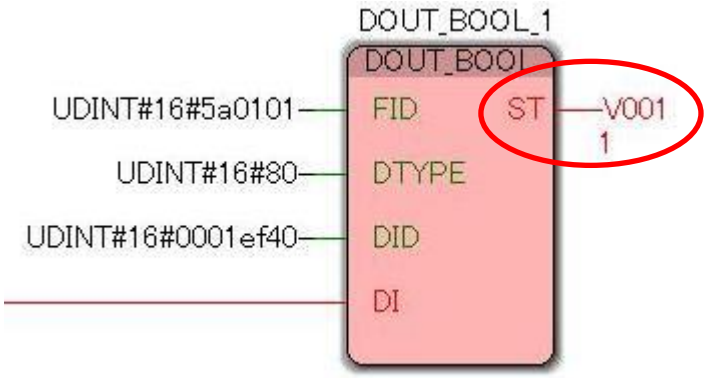


Figure 6.3-5 When 1 is observed at ST, configuration is successful

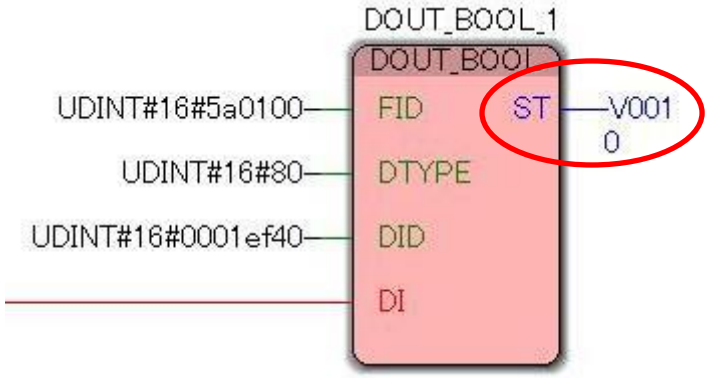


Figure 6.3-6 When 0 is observed at ST, configuration has failed.

(iii) Assigning a variable to a PLC driver

Users can assign several variables to a PLC driver[1], which can initiate PLC logic. Several variables are used for PLC outputs. Table 6.3-5 below shows the data types available in the PLC drivers, which can provide output IDs for the user.

Table 6.3-5 Data types in the PLC driver

Type	Signal name[3]	Number of contents	Comments
BIT	BIT_xx_y	128	xx: byte offset; y: bit offset
USINT	U08_xx	32	xx: serial numbers
UINT	U16_xx	32	xx: serial numbers
UDINT	U32_xx	32	xx: serial numbers
SINT	S08_xx	32	xx: serial numbers
INT	S16_xx	32	xx: serial numbers
DINT	S32_xx	32	xx: serial numbers
REAL	R32_xx	32	xx: serial numbers

Type	Signal name[3]	Number of contents	Comments
LREAL	R64_xx	32	xx: serial numbers
BIT[2]	PMX3.xx.y	*(Equal to BIT_xx_y)*	xx: byte offset; y: bit offset

[1]Note: PLC drivers are furnished in function "PLC_DRV (Function ID: 230301 or 230302)". For example, users can find 128 drivers in bit type; they are listed as signal monitoring points. (See GR200 series instruction manual; signal lists are listed with Data IDs).

[2]Note: As PMX3 and BIT are provided for the BIT type, both their contents are identical. However, note that both of their operations are different. For PMX3, users will need to use its data type in accordance with the example in 6.3(iii)-2; users should notice that PMX3 is available only in the Function ID "230301".

[3]Note: Data IDs corresponding to the signal names are also shown in the GR200 series instruction manual; signal lists are listed with Data IDs

(iii)-1 How to use types "BIT", "U03", "U16" and other data types

- Open "Work sheet", click the "Variable" icon on the "FBD Tool bar" (alternatively press the [F5] key) the "Variable Properties" window will appear. (Step 1)
- Select the definition scope "Global". Remove the check mark in "Show all variables of worksheets" (Step2).
- Choose a data type in the "Global Variable Groups". (Step 3)
- Select an object signal from the "Name" drop-down list (Step 4). The object signal is shown as a "M_signal name".

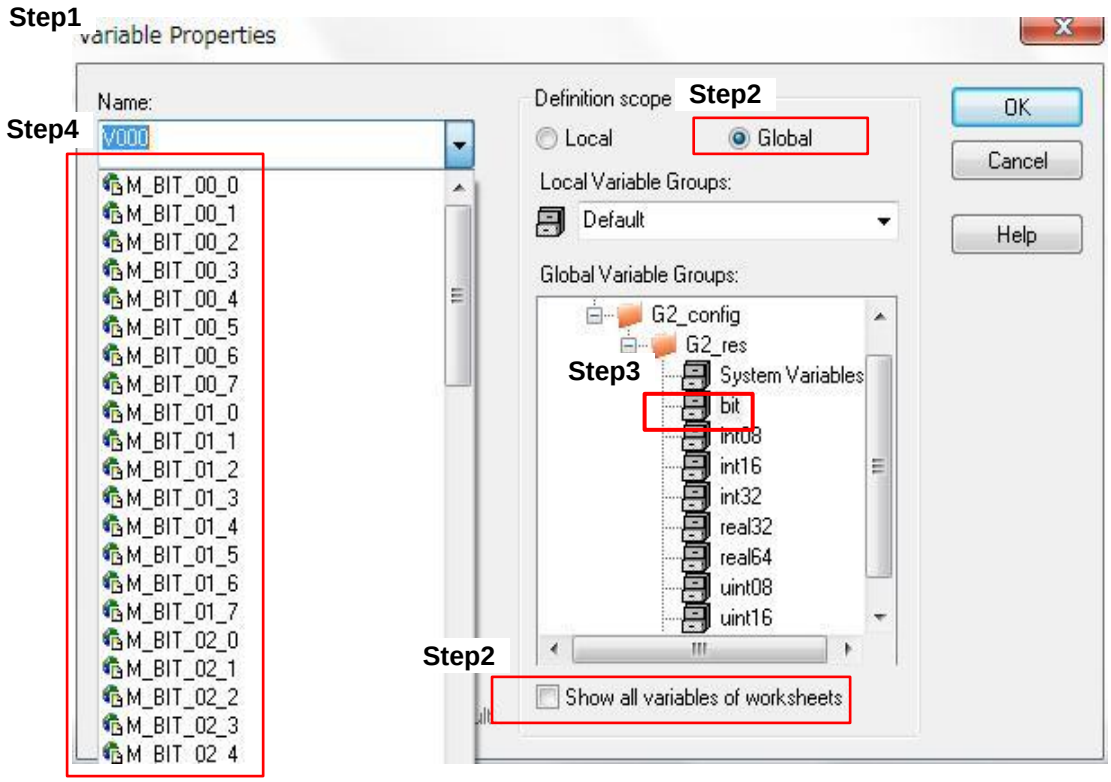


Figure 6.3-7 "Variable Properties" window

(iii)-2 How to use data type "PMX3"

Note that the variable "ViewPoint" is provided within the PLC, as shown in Figure 6.3-8. For example, if the user requires that "ViewPoint" be connected to the PLC driver[2] "PMX3_15_7", they should follow the steps below:

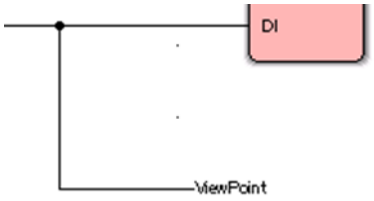


Figure 6.3-8 Variable "ViewPoint" in PLC

[2]Note: The PLC driver "PMX3_15_7" is also represented by both Function ID (230301) and Element ID (8710071BBF).

As shown in section 6.1(iii), when adding variables in the PLC, the "Variable Properties" window will appear. In this window, the user should key the PLC driver into "I/O address", as shown in Figure 6.3-9.

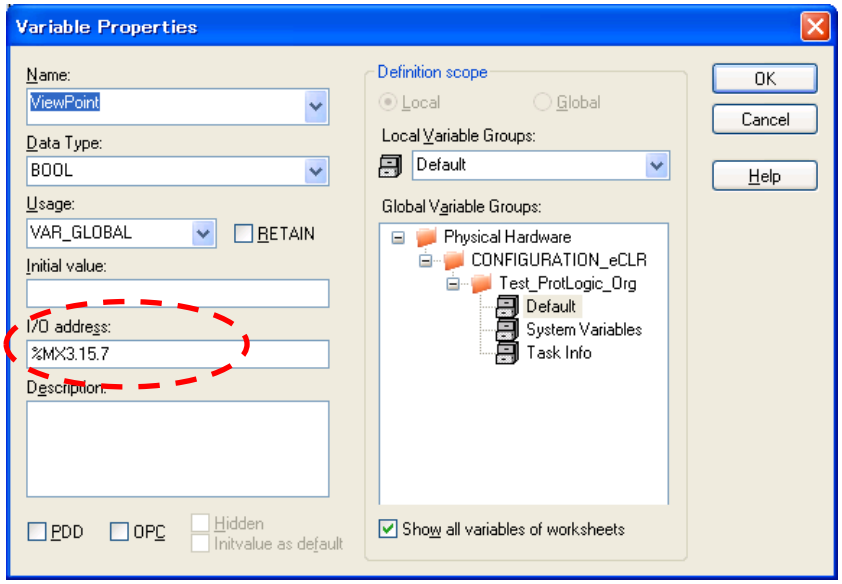


Figure 6.3-9 I/O address in screen "Variable Properties"

The user should change the PLC driver name in accordance with the PLC format, as shown in Table 6.3-6.

Table 6.3-6 Example of name change between Signal list and PLC editor

Expression	PLC driver name[3]	Data ID(Function ID–Element ID)
Signal list expression	PMX3_15_7	230301 – 8710071BBF
PLC expression	%MX3.15.7	230301 – 8710071BBF

[3]Note: The user should change letters "P" to "%" to express a signal name in the PLC editor. Likewise, change "_" to ".".S

6.4 PLC configuration with FBs in User library

(i) Key input FB

For example, the user can select FB "KEYIN_CANCEL" from the User libraries during PLC editing; this FB logic is drawn in the PLC screen. Table 6.4-1 shows the parameters of FB "KEYIN_****".

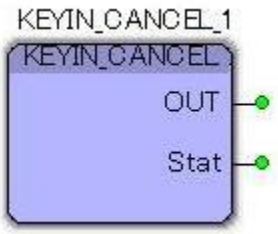


Figure 6.4-1 FB "KEYIN_CANCEL" on PLC editing

Table 6.4-1 PLC parameters and others in in function blocks "KEYIN_**"**

Parameter	Attribute	Type	Contents
OUT	OUT	BOOL	Key Input Value
Stat	OUT	BOOL	True: Key Input is valid False: Key Input is invalid

(ii) Binary input FB

For example, the user can select FB "S1_BI1" from the User libraries when the user wishes to program binary input circuit#1 in Slot#1; this FB logic is drawn in the PLC screen. Table 6.4-2 shows the parameters of FB "S*_BI**".

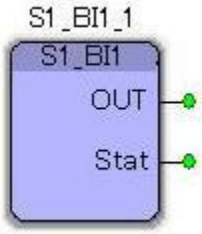


Figure 6.4-2 FB "S*_BI*" on PLC editing

Table 6.4-2 PLC parameters and others in function blocks "S*_BI*"

Parameter	Attribute	Type	Contents
OUT	OUT	BOOL	Binary Input Value
Stat	OUT	BOOL	True: BI is valid False: BI is invalid

(iii) Binary output FB

For example, the user can select FB "S1_BO1" from the User libraries when the user wishes to program binary output circuit#1 in Slot#1; this FB logic is drawn in the PLC screen. Table 6.4-3 shows the parameters of FB "S*_BI**".

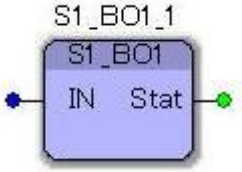


Figure 6.4-3 FB "S*_BO*" on PLC editing

Note: The user can use a binary output only once for programming. That is, the binary output is not allowed to connect with a number of signals generated in function blocks at the same time.

Table 6.4-3 PLC parameters and others in function blocks "S*_BO*"

Parameter	Attribute	Type	Contents
IN	IN	BOOL	Binary Output Value
Stat	OUT	BOOL	True: BO is valid False: BO is invalid

(iv) General libraries in place of DIN/DOUT

As the DIN and DOUT functions are described previously (in sections 6.3(i) and 6.3(ii)), the user can use the same DIN and DOUT features using the libraries provided TOSHIBA.

When the libraries are installed on the PC, the PC has a number of libraries corresponding to the protection and control functions in the IED. The DIN and DOUT functions require the user to key the Data ID values for the respective DIN and DOUT ones. The user may avoid the need to manually enter all of the Data ID values by using the libraries instead of keying all of the Data ID values in. Table 6.4-4 below shows the rules for the libraries.

Table 6.4-4 Rules for library

Library items	Naming rules†	Example (e.g. Trip circuit)
Library name (i.e., file name)	G2lib_[F ID]([Function_name]).mwt	G2lib_4A0001(TRC).mwt
Connection point in function	C_[Function_name]_[signal name]	C_TRC_TRIP_ADD
Monitoring point in function	M_[Function_name]_[signal name]	M_TRC_GEN_TRIP_B

†Note: Function ID (FB), the FB name, the FB signal are defined by TOSHIBA and the user can find this information from the GR-series Instruction manual. For more information, see the instruction manual, or contact Toshiba. The table below shows the actual ID lists in the instruction manual (e.g., TRC function) Due to limitations in the PLC function, some FBs and signal names are represented by shorter names. For confirmation, use the "Help function" described later.

◆ Signal monitoring points

TRC(Function ID: 4A0001)

Element ID	Name	Description
8600001B6B	OPT-CAR	operation (CAR)
8000001B6C	GEN.TRIP-A	General trip (Phase-A)
8100001B6D	GEN.TRIP-B	General trip (Phase-B)
8200001B6E	GEN.TRIP-C	General trip (Phase-C)
8300001B6F	GEN.TRIP	General trip

◆ Connection points in PLC logic

TRC(Function ID: 4A0001)

Element ID	Name	Description
820000EBB2	ADD_OPT_COM	Additional operation command
800000EBB3	TRIP-A_ADD	Additional A-phase trip command
810000EBB4	TRIP-B_ADD	Additional B-phase trip command
820000EBB5	TRIP-C_ADD	Additional C-phase trip command
830000EBB6	TRIP_ADD	Additional trip command

There are two parameters for the connection points in the library. In order to understand these parameters, see the table below. Note that the single connection point (in the library) is not allowed to connected with a number of PLC logics at the same time.

Note: The user can use a connection point only once for programing. That is, the connection point represented with a Data ID is not allowed to connect with a number of signals generated in function blocks (FBs) at the same time.

Table 6.4-5 Parameters for connection points

Parameter	Attribute	Type	Output content
IN	IN	(a type depends on the signal on a connection point)	Output value
Stat	OUT	BOOL	True: Connection point is valid. False: Connection point is not valid.

Similarly, the monitoring points have two parameters.

Table 6.4-6 Parameters on the monitoring

Parameter	Attribute	Type	Input content
OUT	OUT	(type depends on the signal on a connection point)	Input value
Stat	OUT	BOOL	True: Monitoring point is valid. False: Monitoring point is not valid.

Help function

The user can use the help function in the menu “Edit Wizard”. Right-click on a function, and choose “Help on FB/FU”. Then a help screen will appear as shown in Figure 6.4-5.

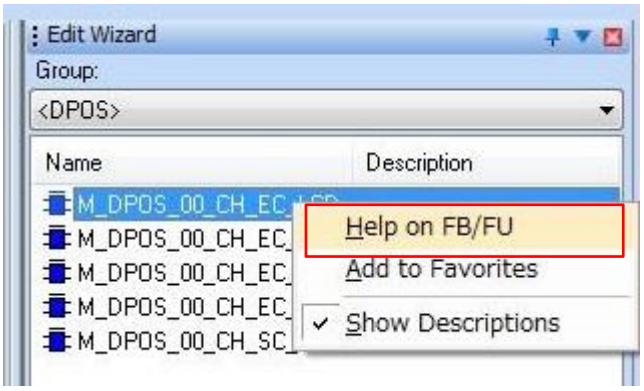


Figure 6.4-4 Edit wizard menu (E.g., selection of DPOS function)

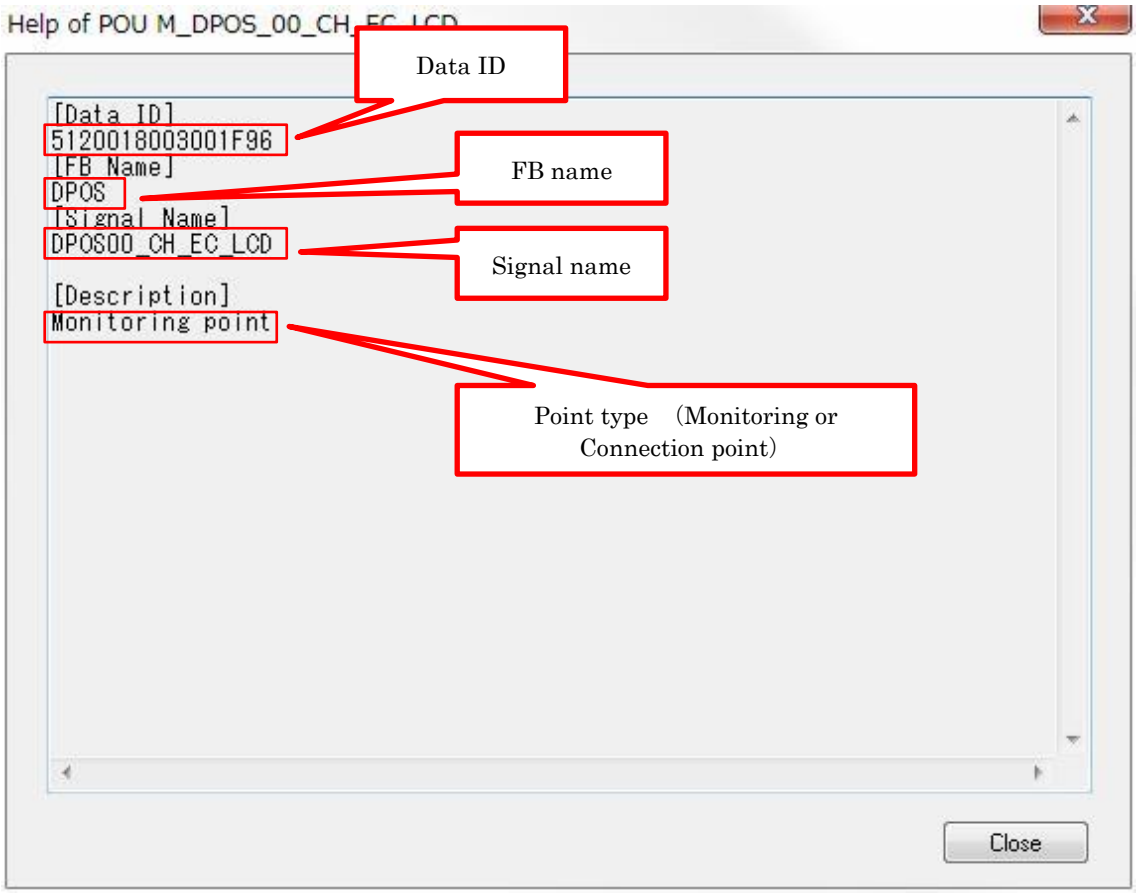


Figure 6.4-5 Help screen for the case “DPOS control function”

6.5 Import / export of Project files

The user can import or export a Project file either partially or entirely. This function is useful when the user wants to recover an old Project file or when the user wishes to import some parts of another Project file.

(i) Exporting a Project file

The user can select either a XML type or an IEC 61131-3 type when exporting a project file.

(i)-1 Export procedure for XML type

Open the project file that the user wishes to export. Select the project in the project tree. Figure 6.5-1 shows the selection of the project being executed for all contents, but a partial selection of the project is possible.

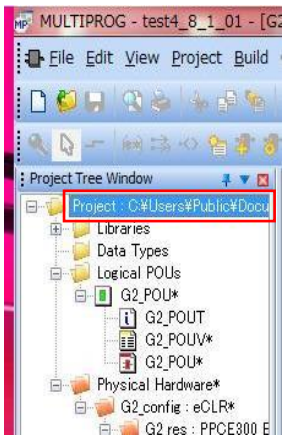


Figure 6.5-1 Selection of Project required to export in XML

Select “File->+Export” from the menu bar.

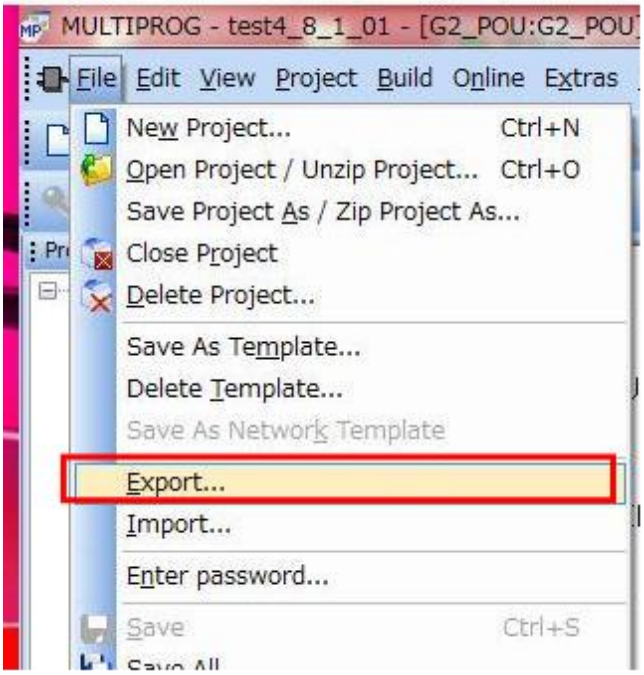


Figure 6.5-2 Selection of Export in XML

Select “Export PLC open XML file” from the following window. The user can then save the XML file into any folder.

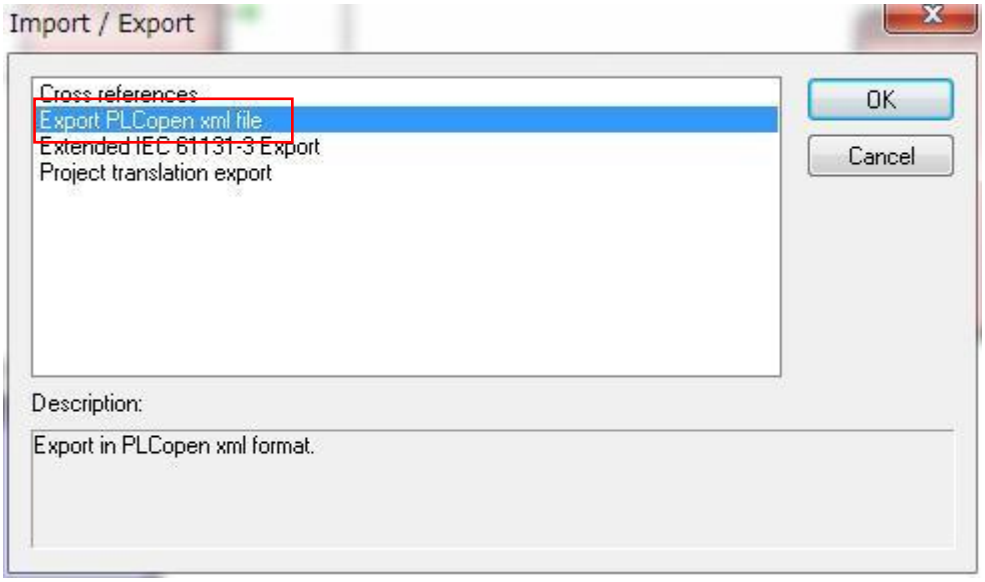


Figure 6.5-3 Selection of XML file type

(i)-2 Export procedure for IEC 61131-3

Open the project file that the user wishes to export. (Figure 6.5-4) Select the project in the project tree. Figure 6.5-4 shows the selection of the project being executed for all contents, but a partial selection in the project tree is possible.

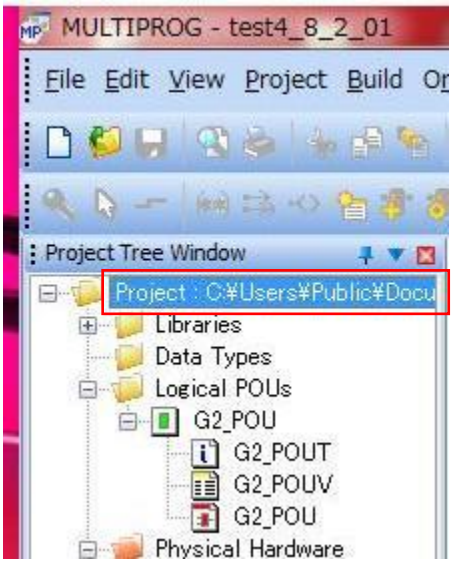


Figure 6.5-4 Selection of Project required to export in IEC 61131-3

Select “File->Export” from the menu bar.

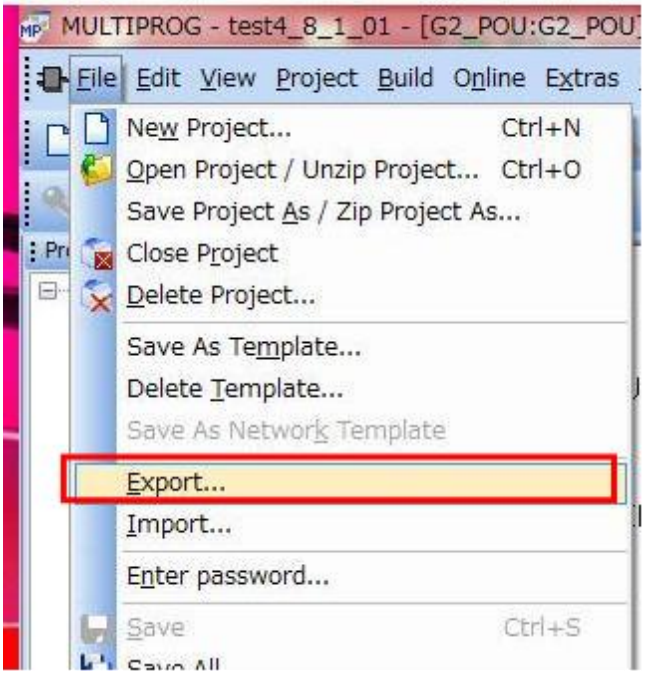


Figure 6.5-5 Selection of Export in IEC61131-3

Select “Extended IEC 61131-3 Export” from the following window. Then create a new folder for exporting, the user can then save the file into the new folder.

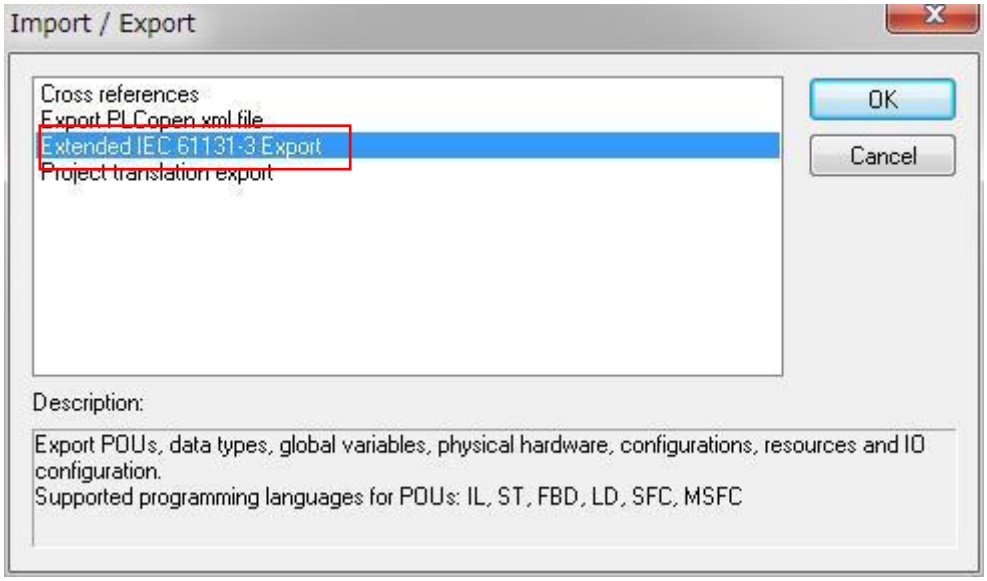


Figure 6.5-6 Selection of in IEC61131-3 type

(ii) Importing a Project file

The user can import a Project file in both XML type and IEC 61131-3 type.

(ii)-1 Import procedure for XML type

Create a new Project, then, select "G2_sample". After selecting the new Project from the project tree, choose "File->Import" as shown in Figure 6.5-7.

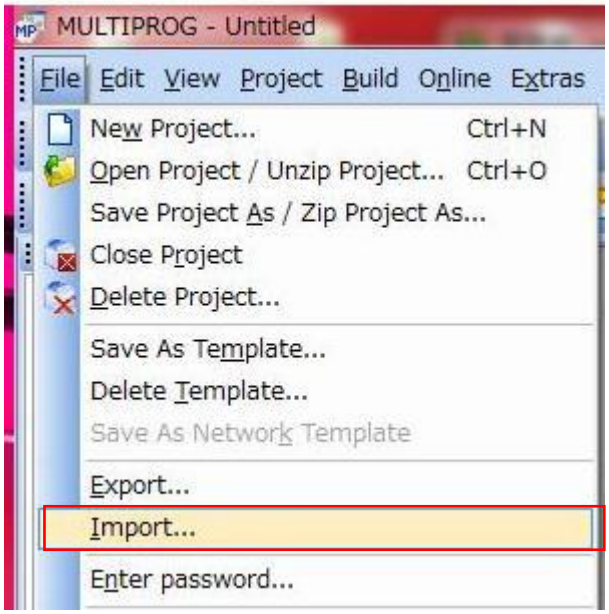


Figure 6.5-7 Selection of Import in XML

Select “Import PLC open XML file” from the following window. The user can then import the XML file, which is exported from another Project.

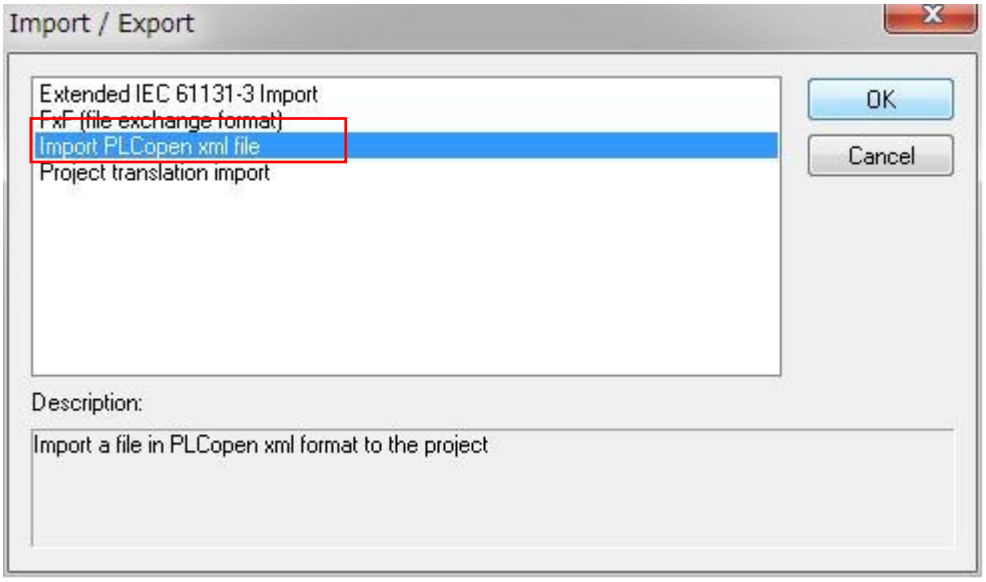


Figure 6.5-8 Selection of XML file type

When the import is complete, the user can save the new Project by selecting “File->Save Project As / Zip Project As” in the File menu. Then, the user can edit the new Project or compile it.

(ii)-2 Importing procedure for IEC 61131-3

Create a new project; select G2_sample. Then, choose the new Project in the project tree. Select “File->Import” from the menu bar.

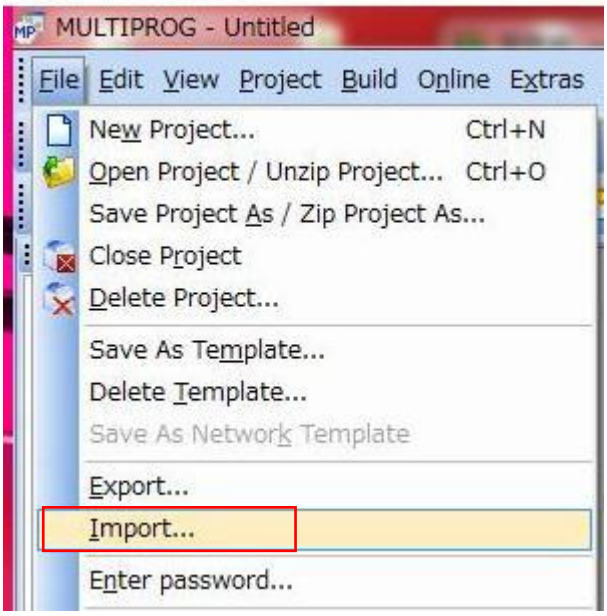


Figure 6.5-9 Selection of Import in IEC 61131-3

Select “Extended IEC 61131-3 Import” from the following window.

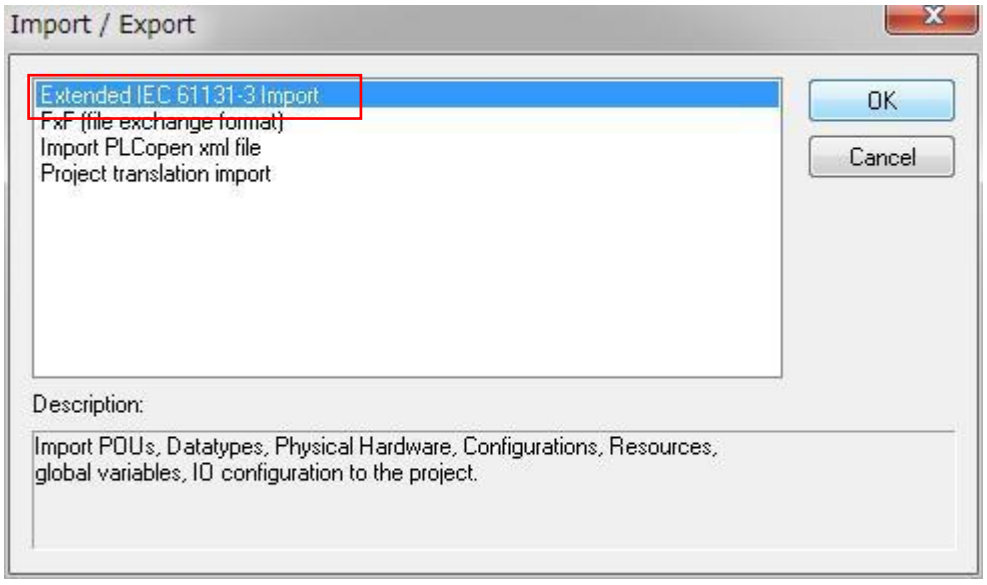


Figure 6.5-10 Selection of IEC 61131-3 type

Select “POU” in the Object types window (Figure 6.5-11) and click “OK”.

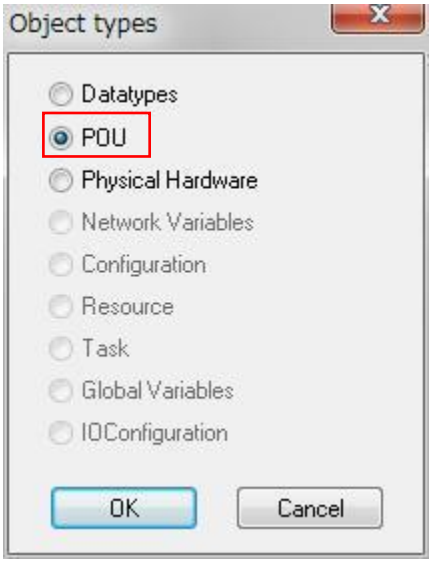


Figure 6.5-11 Selection of object types

Another window is opened to select an exported file. (Figure 6.5-12) The user can choose the "G2_POU" file to be exported. Clicking "OK" will be required to overwrite the file when the confirmation message appears.

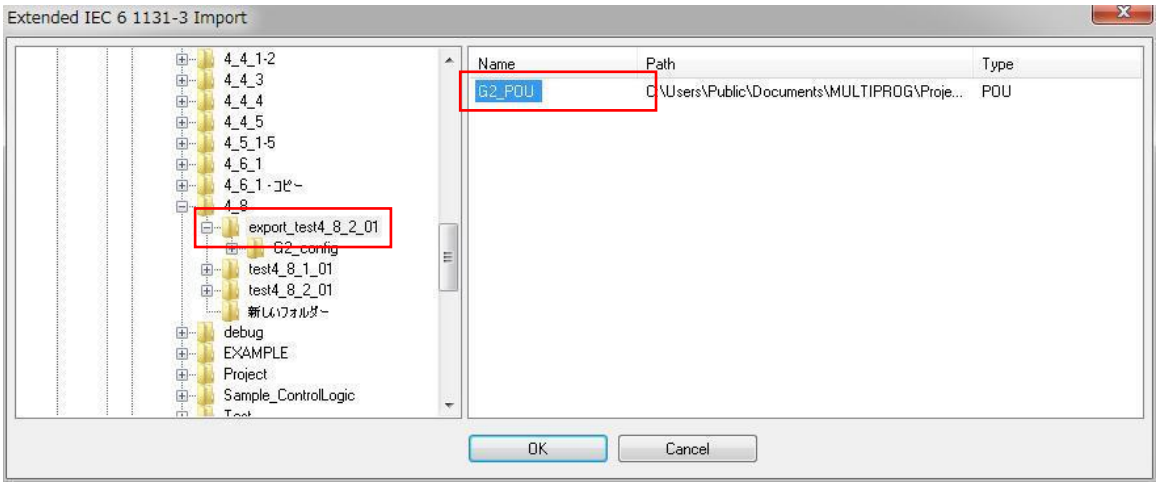


Figure 6.5-12 Selection of G2_POU

Repeat the operations in Figure 6.5-9 and Figure 6.5-10. Then select "Physical Hardware" in the "Object types" window as shown in Figure 6.5-13.

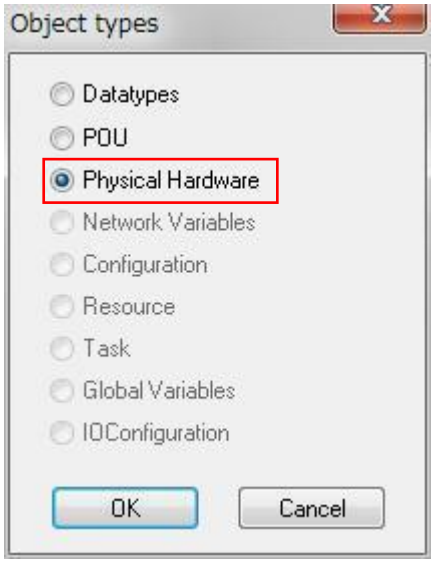


Figure 6.5-13 Selection of object types

Another window will appear to select an exported file. Select an exported "PHYSHARDWARE". Clicking "OK" will be required to overwrite the file when the confirmation message appears.

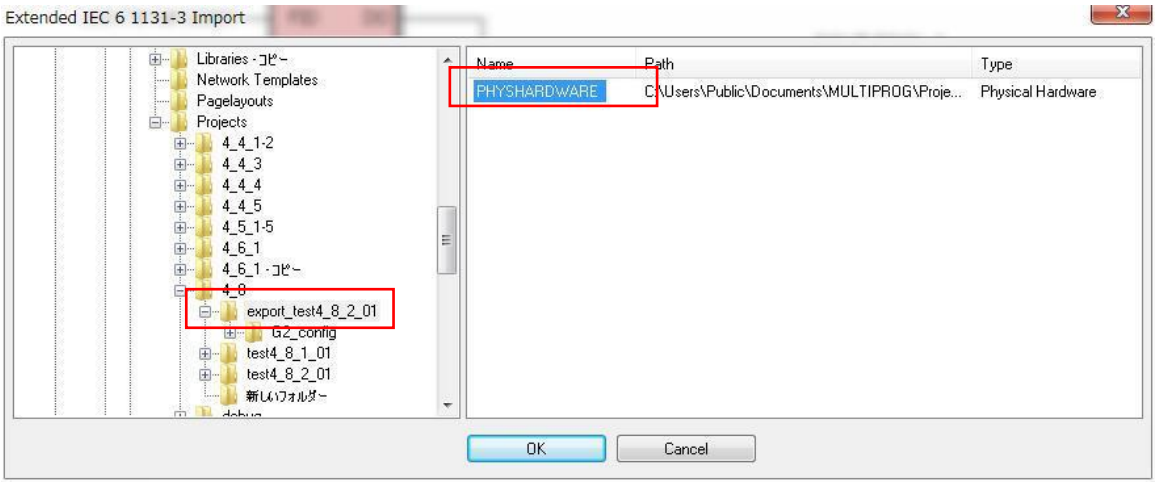
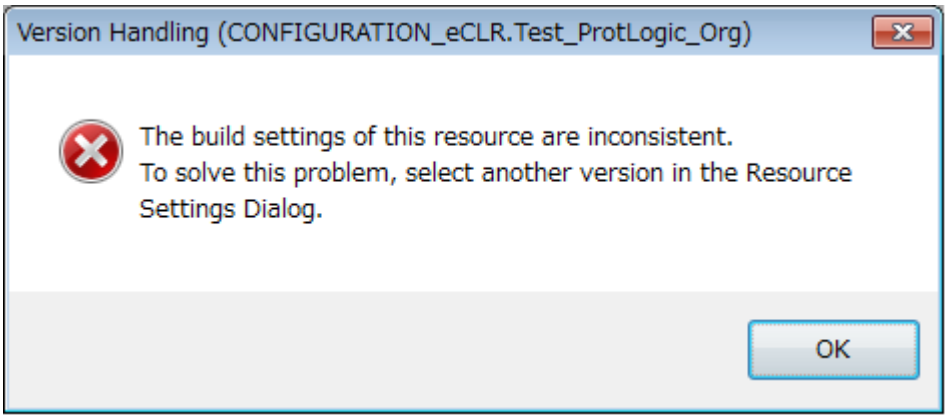


Figure 6.5-14 Selection of PHYSHARDWARE

When the import is complete, the user can save the new Project by selecting "File->Save Project As / Zip Project As" in the menu bar. Then, the user can edit the new Project file or compile it.

7 Troubleshooting

Item#	Problems and Correction
1	Problem: Error message is screened when project opens.  Correction: Make correct settings with referencing *Chapter 3.2 (iii) and (iv)*

Revision-up Records

Rev. and Date	Section (page)	Change place and contents	Approved by	Checked by	Prepared by
-- Oct. 26 2013	--	Tentative edition	--	--	T. Kaneko Oct. 26
0.1 Jan. 16, 2014	--	First issue	--	N. Iizuka Jan. 16	T. Kaneko Jan.15
0.2 Feb. 20, 2014	1.2.1 1.5.2 1.5.3	Added the save operation of project file Added the confirmation procedure of DIN and DOUT FB Added the operation of import/export	--	N. Iizuka Feb. 20	T. Kaneko Feb. 19
0.21 Mar. 27, 2014	1.2.1 (ix)	The selection of Zip option is forbidden.	--	N. Iizuka Mar. 27	T. Kaneko Mar. 26
0.3 Jul. 10, 2014	1.2.3	Connection means added. Deleted the installation for Windows XP	--	N. Iizuka Jul. 10	T. Kaneko Jul. 9
0.4 July 24, 2014	1.5.2(iii) 1.5.3(iv)	New PLC drivers added Libraries added	--	N. Iizuka Jul. 10	T. Kaneko Jul. 9
0.5 Aug. 4, 2014	2.1(v)	Chapter number revised; the new explanation for installation software was added.	--	N. Iizuka Aug. 4	T. Kaneko Aug. 3
0.6 Oct 20, 2014	3.2 and 3.3	Revised data download procedures	--	N. Iizuka Oct. 20	T. Kaneko Oct. 19
0.61 Oct 28, 2014	3.3	Added the notice for downloading data	F. Kawano Oct. 20	N. Iizuka Oct. 20	T. Kaneko Oct. 20
0.71 Nov 4, 2014	3.2 3.3	Added the notice for selection of "Priority" Altered the explanation for the download	F. Kawano Nov. 4	N. Iizuka Nov. 4	T. Kaneko Oct. 28
0.8 Dec 22, 2014	4	Added the information corresponding to the error code	F. Kawano Dec. 22	N. Iizuka Dec. 22	T. Kaneko Dec. 17
0.81 Dec 25, 2014	2.7 4.2	Added the information of software update Revised the information of the error-codes	F. Kawano Dec. 24	N. Iizuka Dec. 24	T. Kaneko Dec. 23
0.82 Jan 6, 2015	2.1	Added the notice of software update	F. Kawano Jan. 6	N. Iizuka Jan. 6	T. Kaneko Jan. 6
0.83 Jan 21, 2015	Table 6.3-5	Added missing signal names	N. Iizuka Jan. 21	--	T. Kaneko Jan. 21
1.00 Apr 23, 2015	All sections 1.2	Renovate the readability Required PC physical memories	N. Iizuka Apr. 23	--	T. Kaneko Apr. 20
1.10 Aug 25, 2015	2.1 3.1 3.2 6.4	Added the installation of the software for the ARM Added the speed setting for the USB-connection Added the meaning as for the ARM in Table 3.3-4 Added the notice that a single is available for a logic	N. Iizuka Aug. 25	--	T. Kaneko Aug. 25
1.11 Oct 26, 2015	3.2 6.4	Revised Fig. 3.1-2 and Fig. 3.2-6 Revised the description in Note in Sec. 6.4 (iii) and (iv)	N. Iizuka Oct. 26	--	T. Kaneko Oct. 26
1.12 Nov 17, 2015	3.3 (iii)	Revised the selection of Download options Added the notice for download operation if impossible	N. Iizuka Nov. 17	--	T. Kaneko Nov. 17
1.13 Nov 19, 2015	3.3 (iii)	Modified typos	N. Iizuka Nov. 19	--	T. Kaneko Nov. 19
1.14 May 31,2017	2.1 (ii),(iii),(iv),(v)	Revised the file holder names during the installation Added the tips to check the software revision number	N. Iizuka May. 30	T.Hashimoto May. 11	T. Kaneko Apr. 27
	2.1	Deleted the contents "User libraries G2EclrNativeFW"; added new contents "Folder for G2 User libraries"	N. Iizuka May. 30	T.Hashimoto May. 11	T. Kaneko Apr. 27
	2.2 (i)	Modified the contents to open new project or existing project	N. Iizuka May. 30	T.Hashimoto May. 11	T. Kaneko Apr. 27
	7	Added trouble shooting list	N. Iizuka May. 30	T.Hashimoto May. 11	T. Kaneko Apr. 27

TOSHIBA