OMRON

Automation Software Sysmac Studio

Startup Guide
for Project Version Control Function

SYSMAC-SE2□□□
SYSMAC-TA4□□L

SYSMAC
always in control

P125-E1-03

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INTRODUCTION

Thank you for purchasing a Sysmac Studio Team Development Option.
This manual contains operating procedure of basic functions of the Sysmac Studio Team Development Option and project version control function.
Please read this manual and make sure you understand the operating procedure of the Sysmac Studio Team Development Option before you attempt to use it to build a control system.

Intended Audience

This manual is intended for the following personnel, who must also have knowledge of electrical systems (an electrical engineer or the equivalent).
• Personnel in charge of introducing FA systems.
• Personnel in charge of designing FA systems.
• Personnel in charge of installing and maintaining FA systems.
• Personnel in charge of managing FA systems and facilities.
For programming, this manual is intended for personnel who understand the programming language specifications in international standard IEC 61131-3 or Japanese standard JIS B 3503.

Applicable Products

This manual covers the following products.
• Sysmac Studio Team Development Option
Part of the specifications and restrictions for the CPU Units are given in other manuals.
Refer to *Sysmac Studio Version 1 Operation Manual (Cat.No.W504)* and *Sysmac Studio Project Version Control Function Operation Manual (Cat.No. W589)*.

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Refer to *Sysmac Studio Version 1 Operation Manual (Cat.No.W504)* and *Sysmac Studio Project Version Control Function Operation Manual (Cat.No. W589)*.

Regulations and Standards

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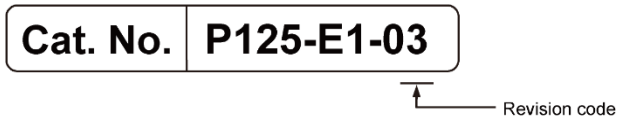
Revision History

Revision code appears as a suffix to the catalog number on the front and back covers of the guide.



Revision code	Date	Revised content
01	October 2017	Original production
02	April 2019	Revised Terms and Conditions Agreement
03	January 2020	Revised for the support of Sysmac Studio (64 bit)

1 OVERVIEW

As the scale of production machines increases, the following problems in the development of production machines are becoming more serious.

- The development scale of controller programs has been increased and the development period has become longer.
- The workload of changing controller programs has increased due to the increased variation of production machines

To offer solutions for these issues, new development environment with the following features is now required.

- Environment to develop controller programs with multiple developers
- Development environment where changes made to the common program can be applied to relevant machines with minimum operations

Sysmac Studio will offer functions to control Sysmac Studio project versions (hereinafter referred to as Version Control Function) as a solution for these issues. The version control function realizes various control capabilities by combining the Sysmac Studio with an open source software version control system commonly used in software development.

This document describes the procedures of installing the open source version control system, initial settings on Sysmac Studio, change record management which is the most basic function of the version control, development by multiple developers, and the steps to carry out derived development.

2 TERMINOLOGY

This section explains the terms used in this document.

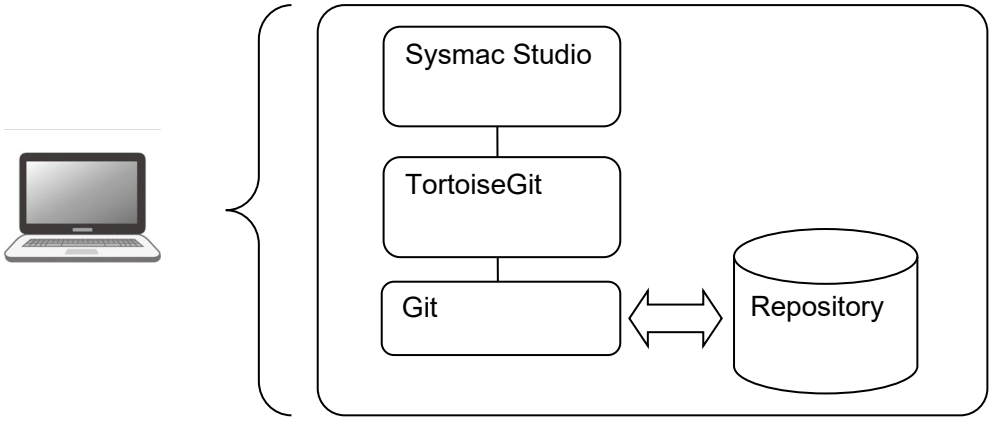
Terms	Description
Sysmac Studio Version Control Function	The function to control the changes and records of the Sysmac Studio projects. It is referred to as “Sysmac Studio version control function” or “version control function”.
Git™	An open source software used for version control. This works with the Sysmac Studio to control the versions of the Sysmac Studio projects.
“TortoiseGit”*1	Client software used for the version control system. We operate the version control functions using the “TortoiseGit” menus called from the Sysmac Studio.
Repository	A location to save the data controlled by Git. The version controlled Sysmac Studio project data and its change records are saved.
Remote repository	A repository on the network such as a server, or in a shared folder.
Local repository	A repository created in the computer of each user.
Development by multiple developers	To develop a project program sharing the program among multiple developers. It is important to manage the change contents and operation timing of each developer.
Derived development	To develop a machine program using a program of another machine according to the machine variation. It is important to reflect all changes made for the program of common functions to all the machines and to manage the changes for a specific machine.
Push	Operation to apply the changes in the local repository to the remote repository
Pull	Operation to apply the changes in the remote repository to the local repository
Change set	Information of accumulated changes in a project. With a Sysmac Studio project, this means the information of changes such as adding a global variable or a ladder rung. The version control function of the Sysmac Studio uses “change set” as a chunk of changes to restore the project data to a certain state or to show the list of changes in the chronological order.
Commit	An operation to register a change set, a chunk of information of changes in the project data in the local repository which is controlled by Git. Sysmac Studio has its Save function but it saves data to the working folder. To register changes to the local repository, perform Commit. When you perform Commit, date/time and user name of the operation are automatically registered besides the change set. You can register comments (log messages) in addition, which makes it easy to search for change content.
Revision	When you perform Commit, a change set is registered in the repository with information that makes it easy to search for a change set. At that time, a revision number (a revision identification number) to uniquely identify the change set is automatically applied. When you revert the project to a specific change set, compare a change set with a project under editing, or branch and merge the project, use this revision number to specify the change set. The revision number used in Git is a hexadecimal value of 40 digits generated by the algorithm of SHA-1.

*1: "TortoiseGit” is open source software and can be downloaded from (https://tortoisegit.org/download/).

3 SYSTEM CONFIGURATIONS

3.1 Basic Configuration

The Sysmac Studio version control function operates in an environment that consists of the Sysmac Studio, Git (version control system), “TortoiseGit” (client software for Git), and repositories (folders managed by Git).
The following figure illustrates the minimum configuration in which a single user has access to Sysmac Studio projects.



Basic configuration of the Sysmac Studio version control function environment
(In a single computer)

3.2 Configurations to Share the Repository with Multiple Users

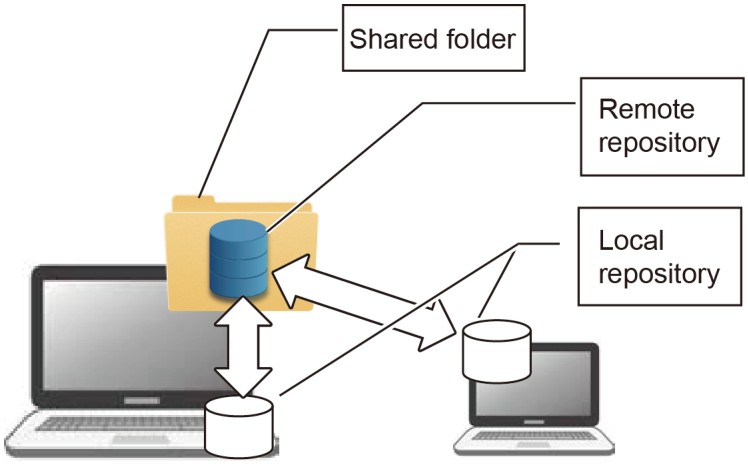
Sysmac Studio version control function works with Git which has a feature of distributed version control system and they offer a mechanism to share the repository with multiple users.
The configuration consists of local repositories registered in the computers of each user and the remote repository shared by multiple users. At a certain timing of each user, the local repository and remote repository can be synchronized.
To share changes in the local repository with other users, perform a push operation to the remote repository. To apply changes made by other users to the local repository, perform a pull operation from the remote repository.

There are the following three practical configurations depending on the difference in how the remote repository is shared.

(1) Using a shared folder on the computer to share it as the remote repository
(2) Building a dedicated Git server to share it as the remote repository
(3) Utilizing a Git Server Service on the Internet to Share the Remote Repository

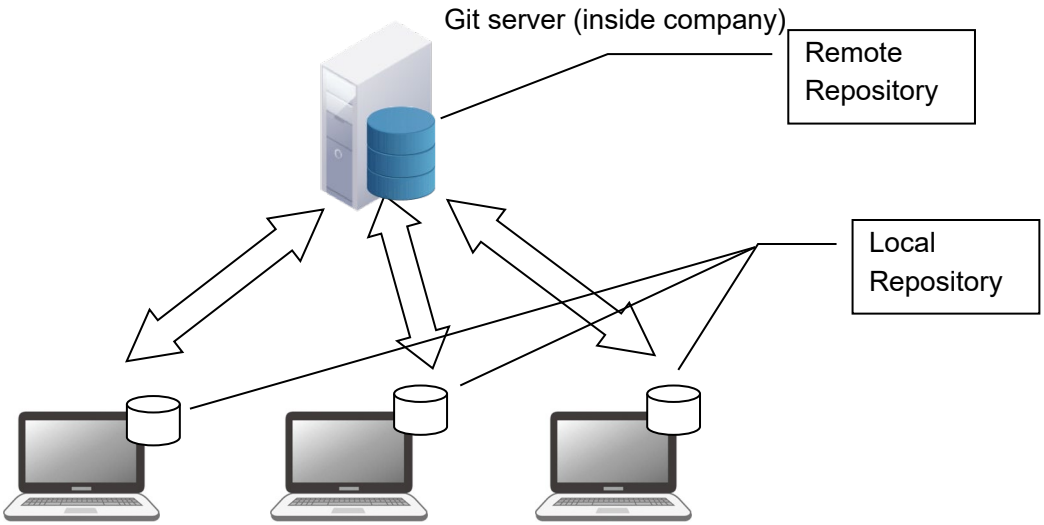
(1) Using a shared folder on the computer to share it as the remote repository
This is the easiest way to build a remote repository.
In this method, you publish a Windows shared folder which works as a remote repository in the local network. The remote repository synchronizes with the local repositories and can be accessed from other computers.

In the following description, we use a remote repository that is built in this way.



Using a shared folder on the computer to share it as the remote repository

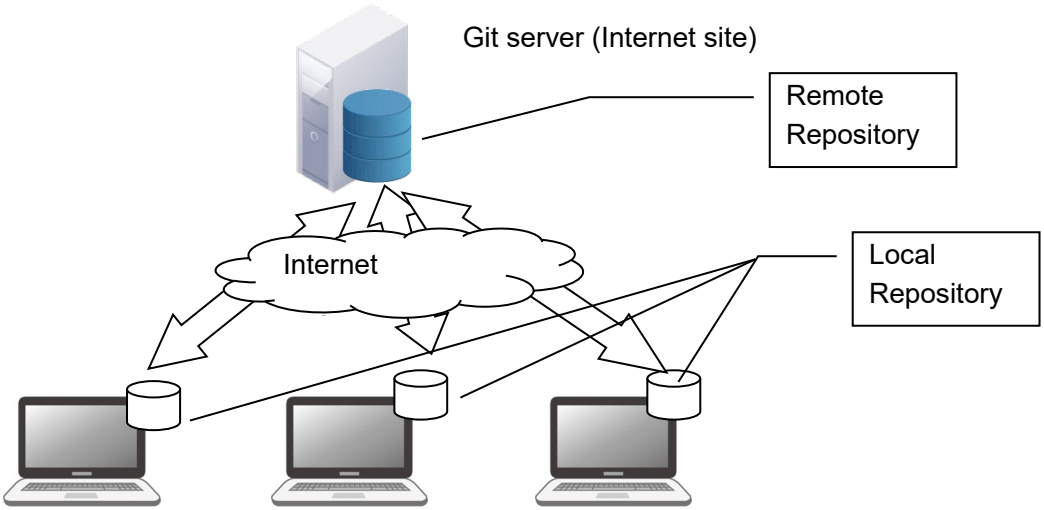
(2) Building a Dedicated Git Server to Share It as the Remote Repository
You can build a dedicated Git server to share the remote repository.
Various Git server software, Gitbucket (for Windows) or GitLab, Gitbucket, Gitblit, Gogs, and so on (for Linux) are available. Although this configuration incurs costs for building and maintaining the server, it has an advantage in reducing the risk of data leakage because the system is closed within the company.



Sysmac Studio version control system on each user's computer

(3) Utilizing a Git Server Service on the Internet to Share the Remote Repository

On the Internet, there are Git server services such as GitHub. Although these are commercial paid services that incur a cost, there are advantages that they require no server maintenance and allow development in parallel with external developers.



Sysmac Studio version control system on each user's computer

3.3 Basic operation of Version Control System

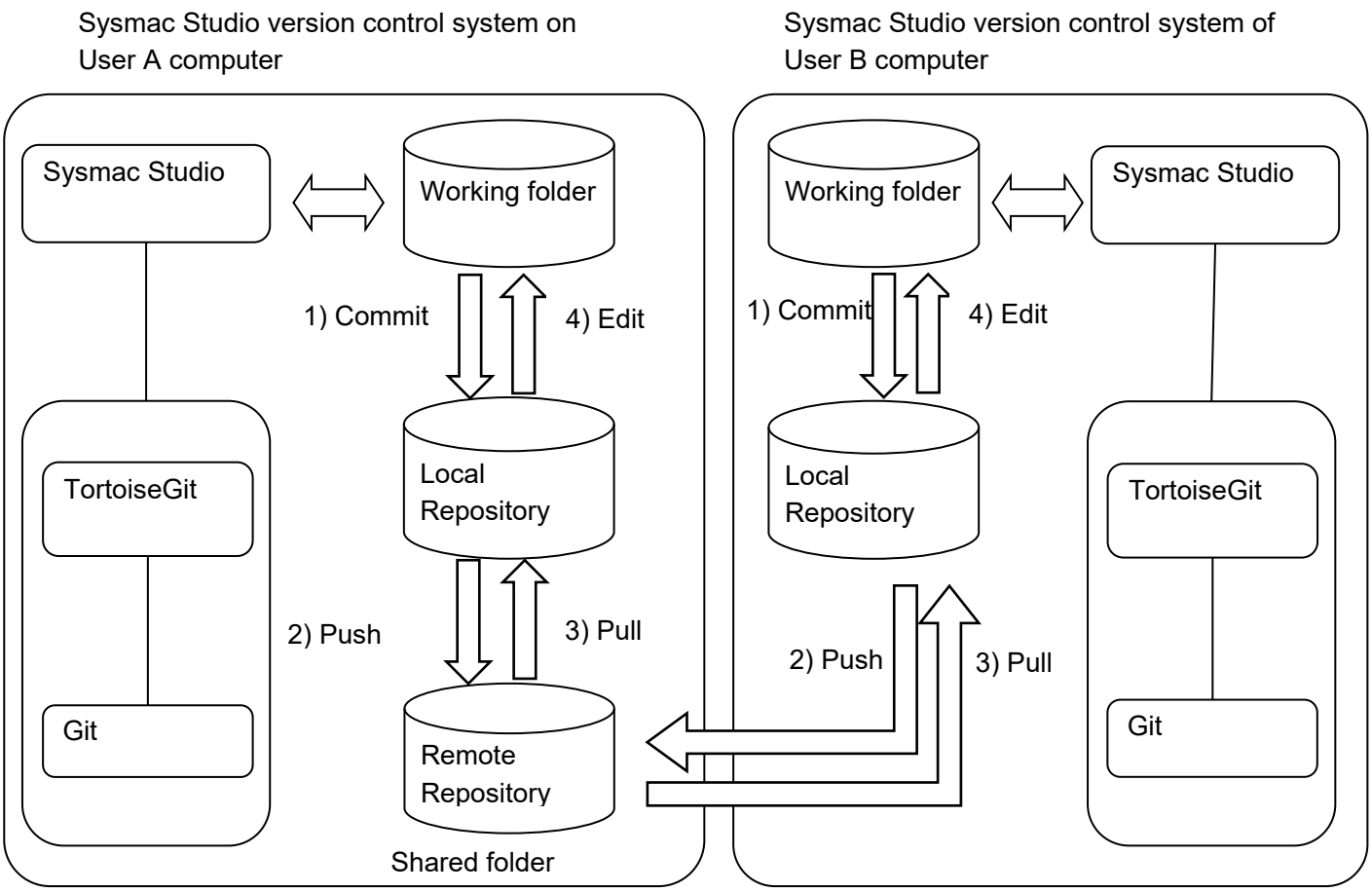
This section describes the basic operation of Version Control System on the Sysmac Studio.

1) Registering changes to the local repository (Commit)
Perform Commit to register a project edited on the Sysmac Studio to the local repository. Refer to *6.4.2 Registering Changes to the Local Repository (Commit)* for details.

2) Registering the changes to the remote repository (Push)
Apply the project registered in the local repository to the remote repository. This operation is called Push. Refer to *6.4.3 Registering the Changes to the Remote Repository (Push)* for details.

3) Updating the local repository (Pull)
Apply the contents in the remote repository to the local repository. This operation is called Pull. Refer to *6.5.1 Updating the Local Repository* for details.

4) Editing the project
Select a project in the local repository and open it on the Sysmac Studio to edit.
Refer to *6.4.1 Changing the Project Data* for details.



Basic operation of Version Control System on Sysmac Studio
(Using a shared folder on the computer to share it as the remote repository)

4 SCOPE OF THE VERSION CONTROL

The version control function is applicable to devices that are registered in the project, as well as the following data of each device.

- Data in Configurations and Setup and lower-level folders in the Multiview Explorer
- Depending on the device, however, there is other version-controlled data in addition to the above, or some of the above data is not version-controlled.

Refer to the *Sysmac Studio Project Version Control Function Operation Manual (Cat. No. W589)* for information on devices with relevant data.

Note that display settings for windows, such as the layout of each pane in the main window, are not version-controlled.

The function is applicable to Controller unit version 1.16 or later. With the Unit of unit version 1.15 or earlier, version control function cannot be used.

5 SOFTWARE SETUP AND BASIC SETTINGS

This section describes the procedure to setup the software and basic settings in a configuration where the remote repository is shared in the shared folder in a computer.

5.1 Installing the Sysmac Studio

Please install the Sysmac Studio Ver.1.20 or later.
Refer to the *Sysmac Studio Version 1 Operation Manual (Cat. No. W504)* for information on installation of the Sysmac Studio.

5.2 Registering Sysmac Studio Team Development Option

To activate the version control function, register the Sysmac Studio Team Development Option license on the Sysmac Studio.
For details on the registration procedure of the Sysmac Studio Team Development Option, refer to *Sysmac Studio Project Version Control Function Operation Manual (Cat.No. W589).*

5.3 Installing Git

1. Please download Git from the following URL site.

   https://git-scm.com/downloads

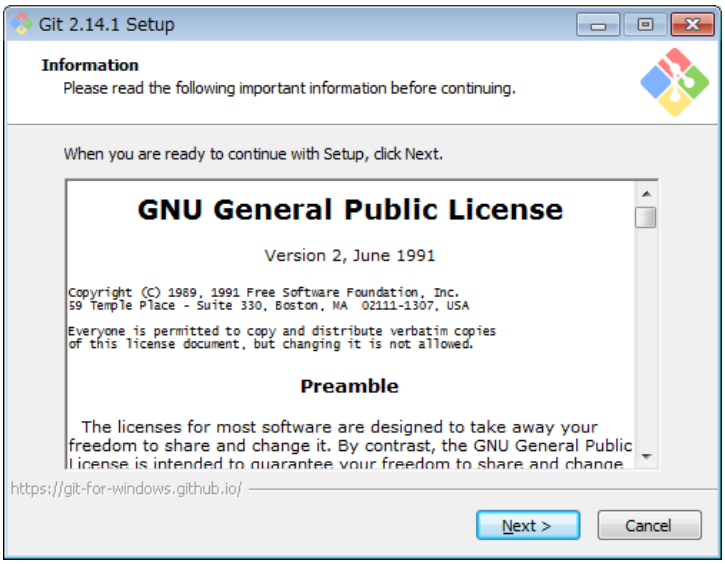
   Depending on the operating system installed on the computer, download the 32-bit or 64-bit edition of the installer.

2. Start the installer.
   The **Windows Security** dialog box is displayed according to the Windows version or user authority.

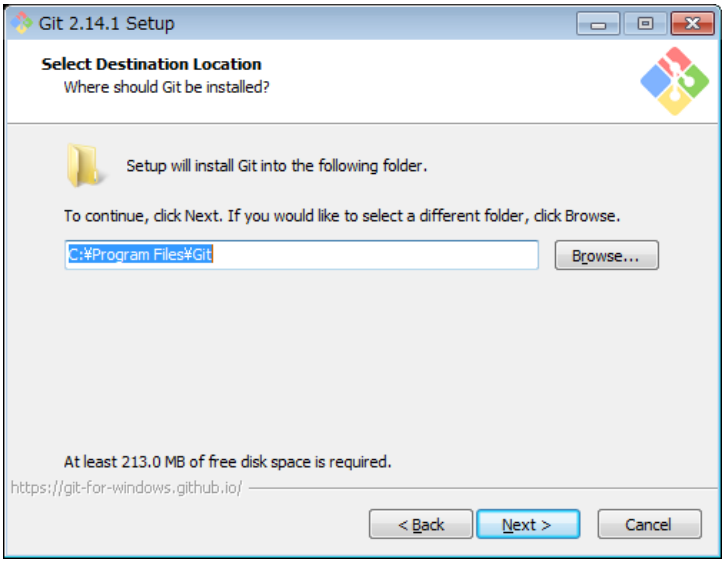
3. Click the **Execute** button in the **Windows Security** dialog box.
   The **User Account Control** dialog box is displayed according to the Windows version or user authority.

4. Click the **Yes** button in the **User Account Control** dialog box.
   The **Setup** dialog of Git is displayed.

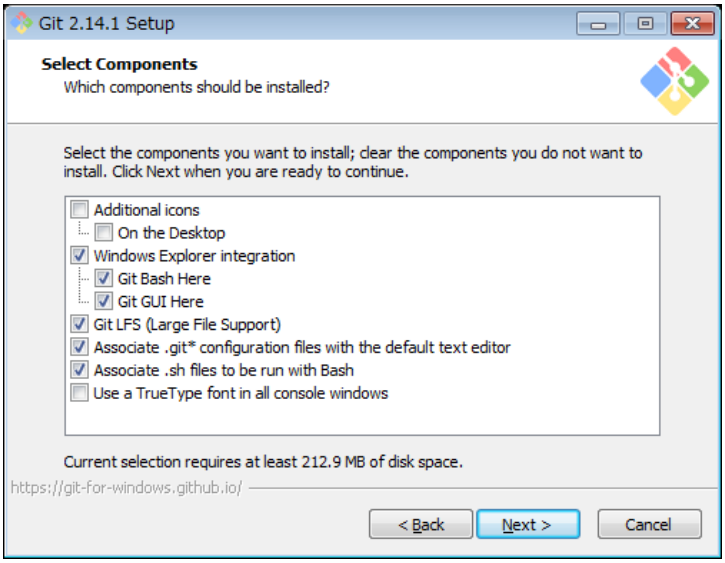
From here, the procedure to install Git 2.14.1 is described as an example.



5. Click the **Next** button.
   The **Select Destination Location** dialog box is displayed.

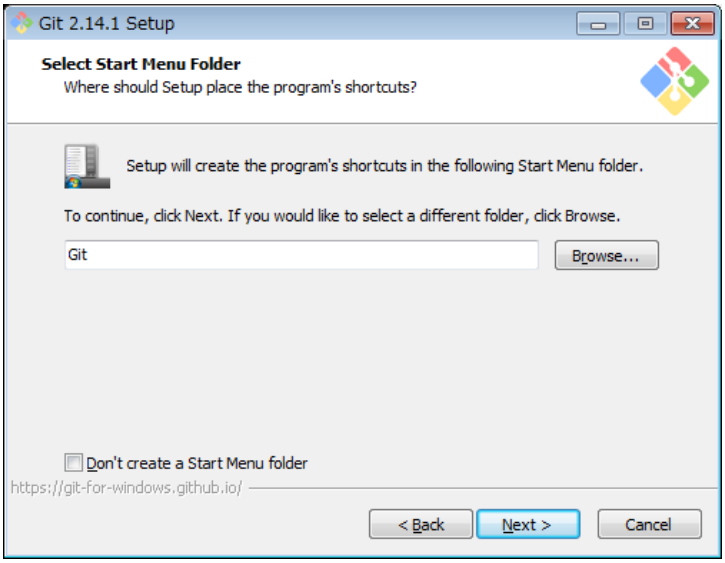


6. Select a folder to install Git, and then click the **Next** button.
   The **Select Components** dialog box is displayed.

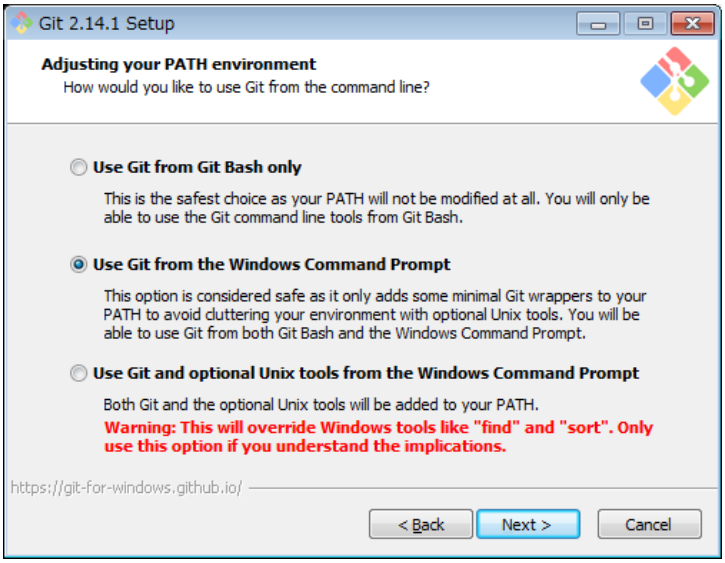


To use the Sysmac Studio version control function, you do not have to change the options selected by default.

7. Click the **Next** button.
   The **Select Start Menu Folder** dialog box is displayed.

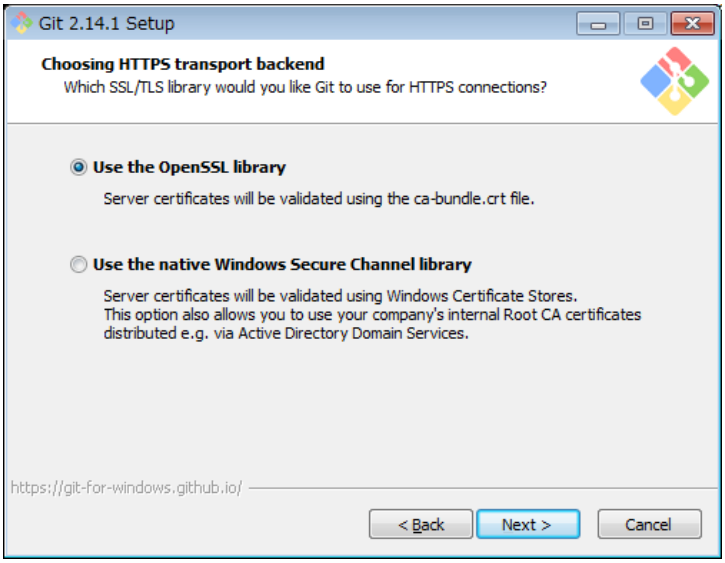


8. Enter the folder name for the Start menu, and click the **Next** button.
   The below dialog box is displayed to confirm whether to use Git in the command line.



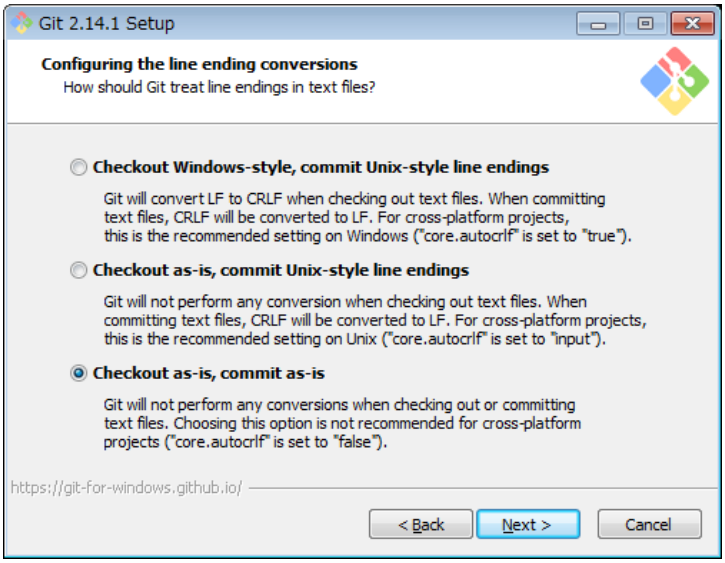
Here, be sure to select the second option **Use Git from the Windows Command Prompt**.

9. Click the **Next** button.
   The dialog box to select the library for user authentication is displayed.



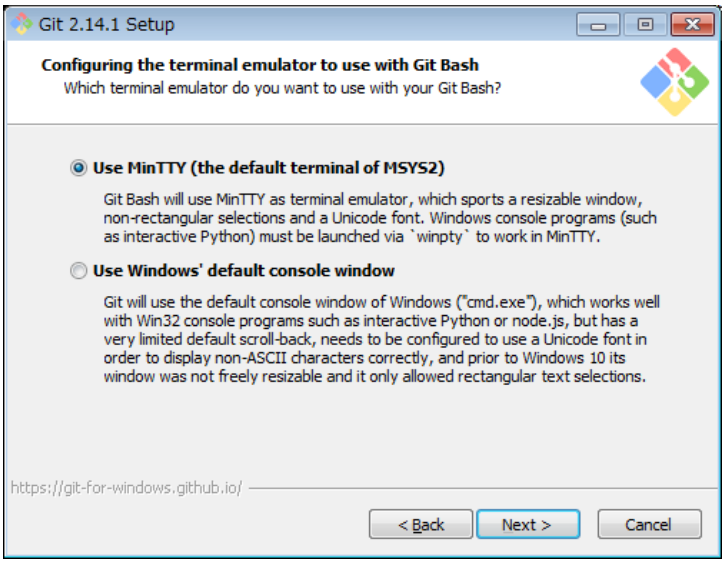
If you use a method of sharing the remote repository using the Windows shared folder, you can choose either of them. If you are using Git server, please contact the system administrator of the server. In this example, **Use the OpenSSL library** is selected.

10. Click the **Next** button.
    The dialog box to select line ending of the text files is displayed.



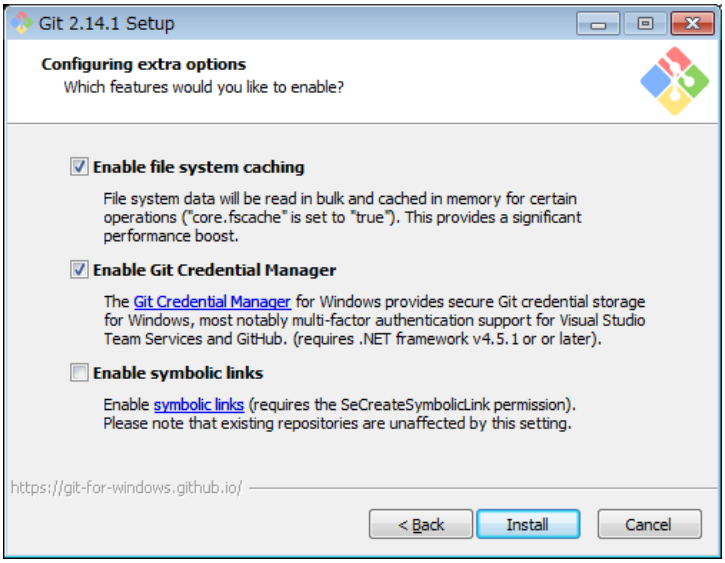
Select the treatment of the line ending in the text files. To use the Sysmac Studio version control function, be sure to select the third option **Checkout as-is,commit as-is.**

11. Click the **Next** button.
    The dialog box to select the terminal software is displayed.



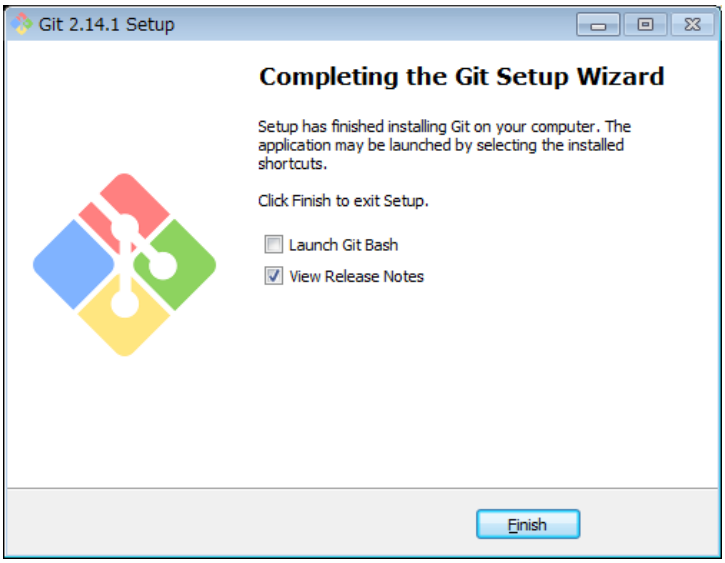
Select the terminal software to use the command line tool “Git Bash”. To use the Sysmac Studio version control function, you can choose either of them. In this example, you select the first option **Use MinTTY (the default terminal of MSYS2).**

12. Click the **Next** button.
    The **Configuring extra options** dialog box is displayed.



To use the Sysmac Studio version control function, you can choose any option. In this example, first **Enable file system caching** and second **Enable Git Credential Manager** options are selected.

13. Click the **Install** button.
    The following dialog box is displayed when installation is completed.



14. Click the **Finish** button.

5.4 Installing “TortoiseGit”

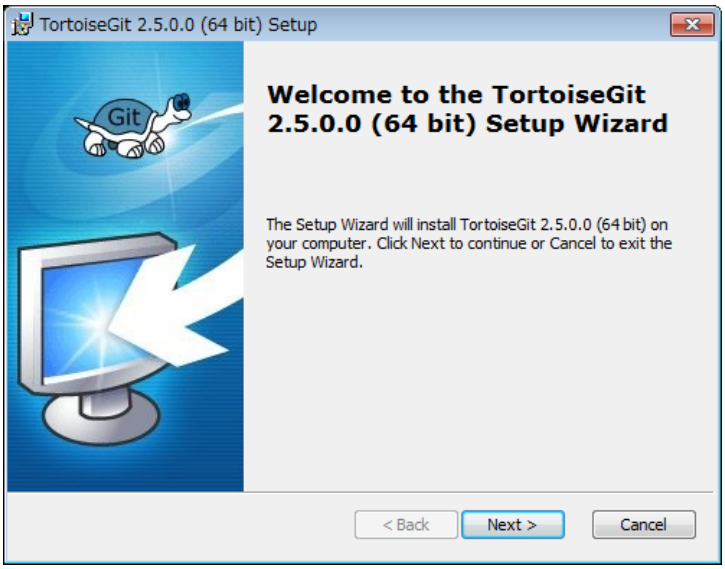
1. Please download “TortoiseGit” from the following URL site.

   https://tortoisegit.org/download/

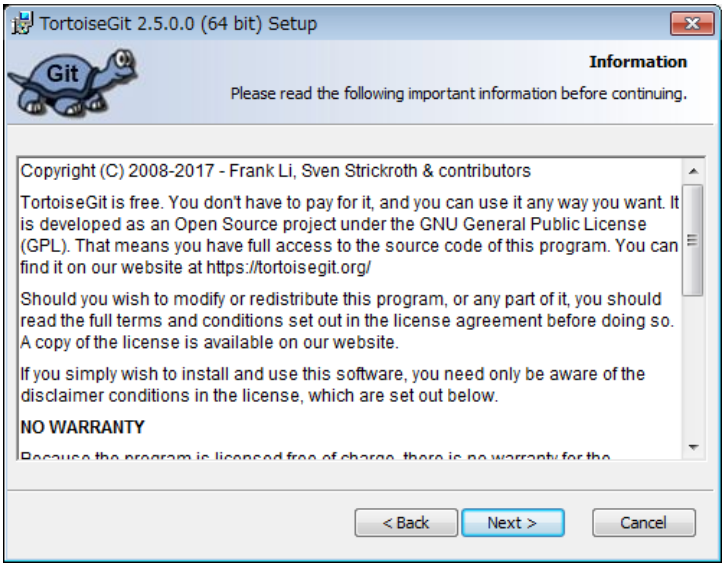
   Depending on the operating system installed on the computer, download the 32-bit or 64-bit edition of the installer. In addition, language packs are also posted on the same URL site. Please download the appropriate one as necessary.

2. Start the installer.
   The **Windows Security** dialog box is displayed according to the Windows version or user authority.

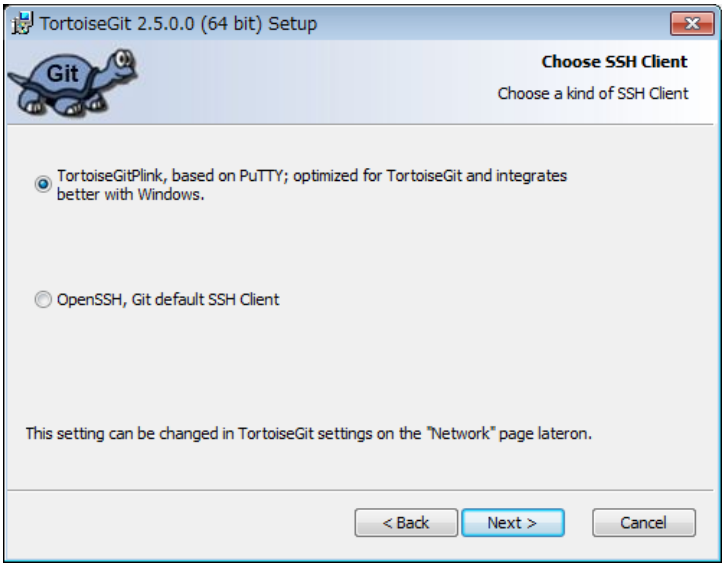
3. Click the **Execute** button.
   The **Setup** dialog box of “TortoiseGit” is displayed.
   From here, the procedure to install “TortoiseGit” 2.5.0.0, 64 bit edition is described as an example.



4. Click the **Next** button.
   The **Information** dialog box is displayed.

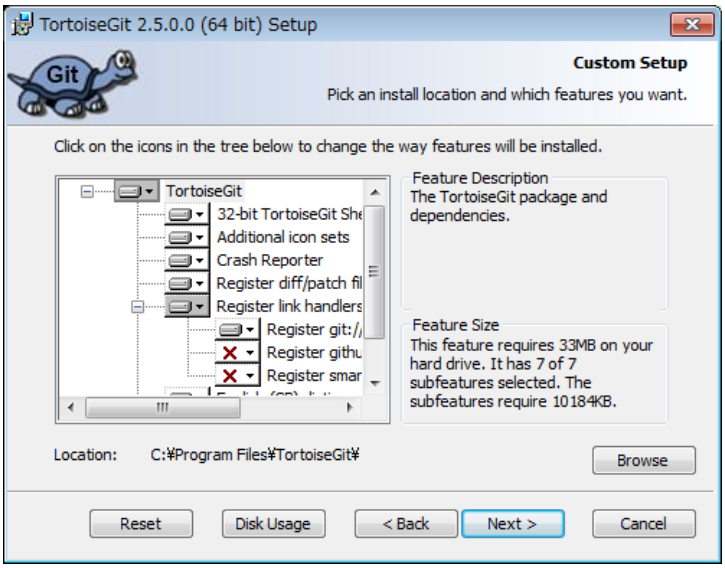


5. Click the **Next** button.
   A dialog box to select the client software for user authentication is displayed.



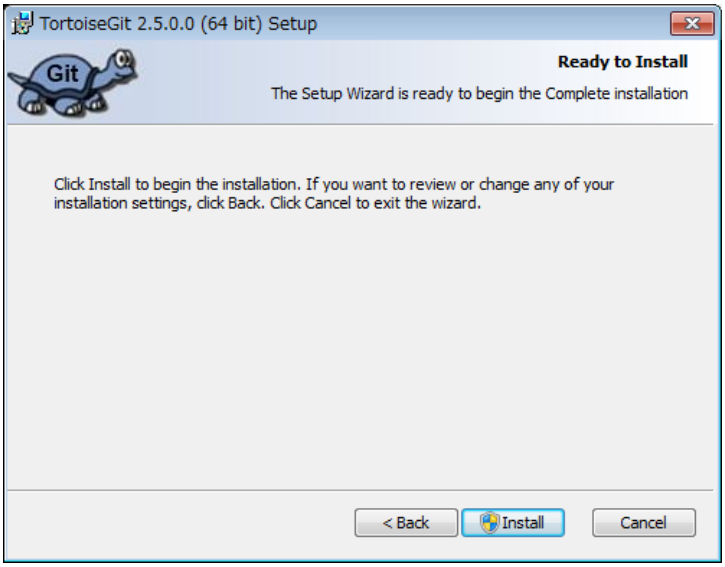
   If you use a method of sharing the remote repository using the Windows shared folder, you can choose either one. If you are using Git server, please contact the system administrator of the server. Here, select the first **TortoiseGitPink based on PuTTY; optimized for TortoiseGit and integrates better with Windows** option.

6. Click the **Next** button.
   The **Custom Setup** dialog box is displayed.



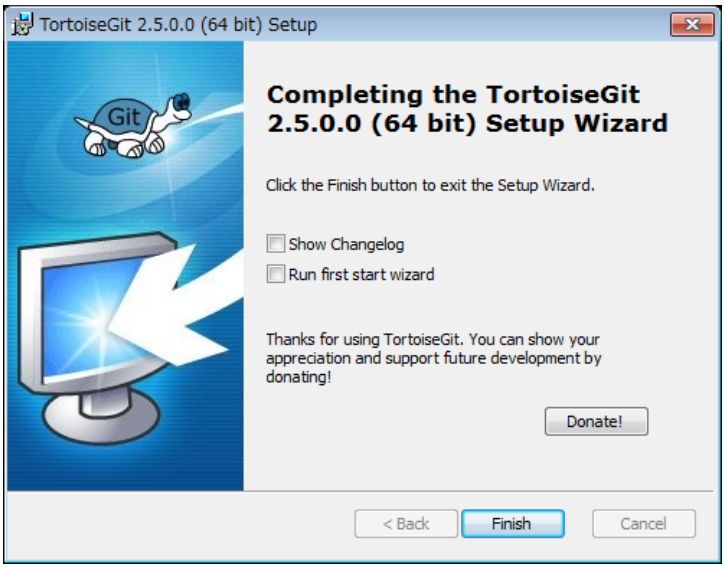
   To use the Sysmac Studio version control function, do not change the option selected by default.

7. Click the **Next** button.
   The **Ready to Install** dialog box is displayed.



8. Click the **Install** button.
   The **User Account Control** dialog box is displayed according to the Windows version or user authority.

9. Click the **Yes** button.
   The following dialog is displayed when installation is completed.



10. Deselect **Run first start wizard** option, and then click the **Finish** button.

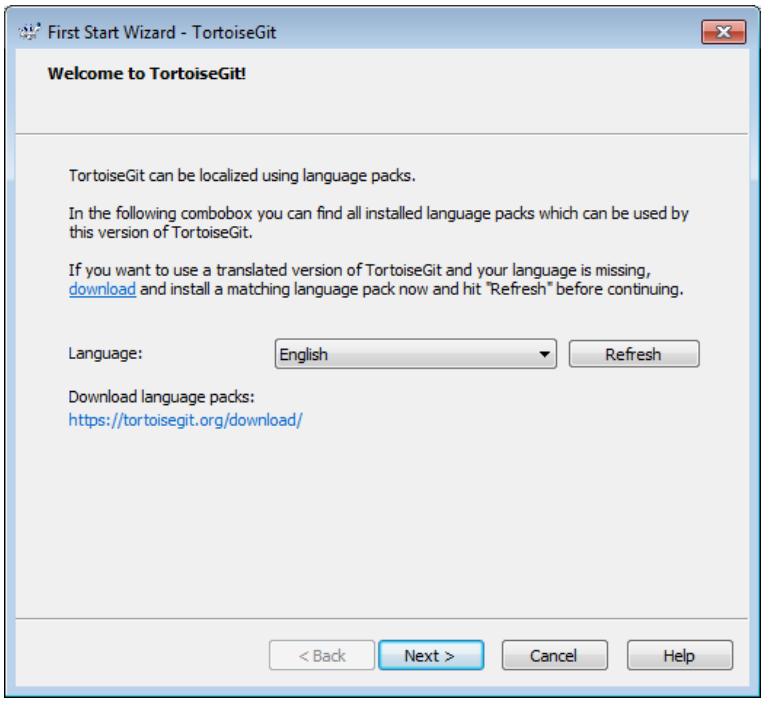
11. Please download the applicable language pack from the following URL site and set it up as necessary.

    https://tortoisegit.org/download/

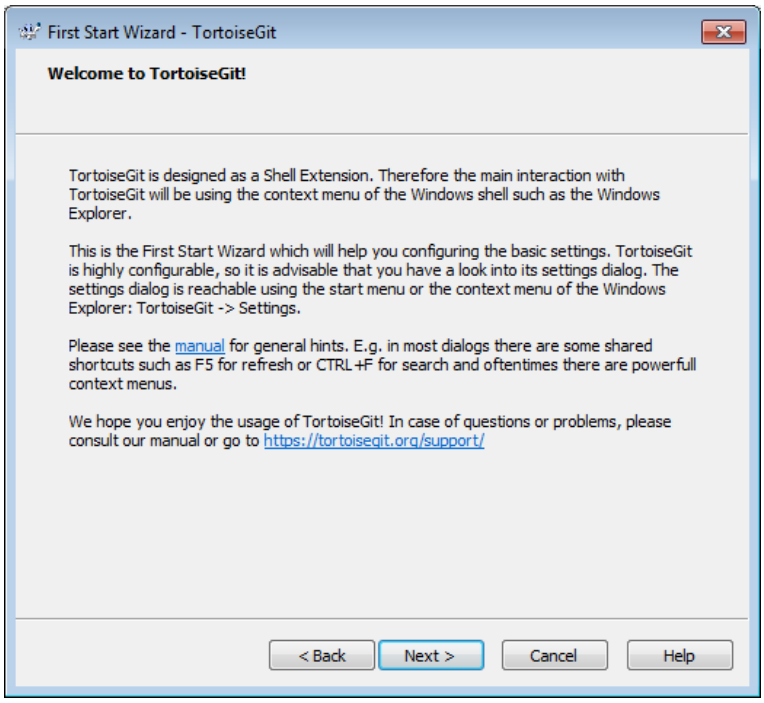
5.5 Initial Setting of “TortoiseGit”

When installation of the “TortoiseGit” is completed, perform initial settings to use it.

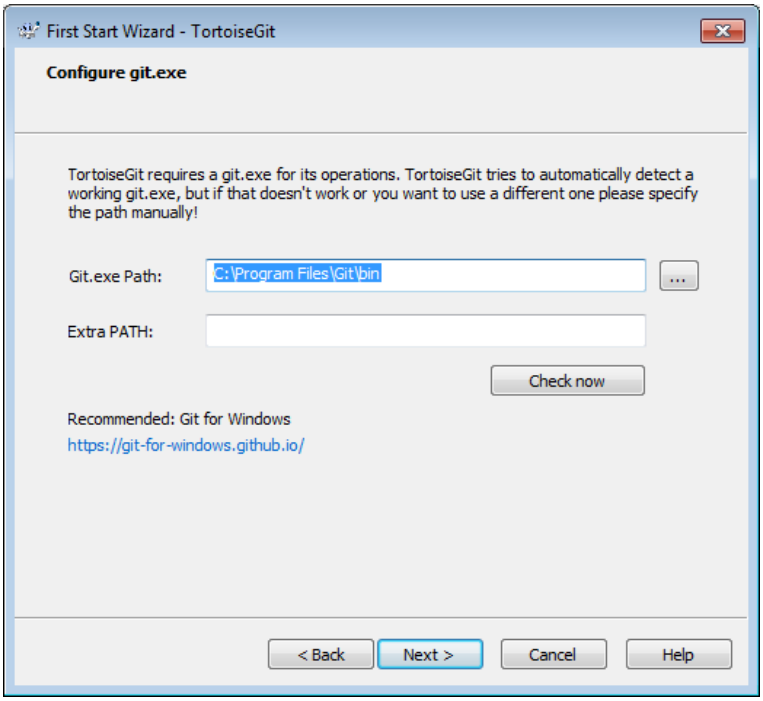
1. In the **Settings** dialog box of “TortoiseGit”, select **General** and then **Re-run First Start Wizard.**
   You can open the **Settings** dialog box by selecting the Start menu, and then **All programs** - **TortoiseGit** - **Settings**.



2. Click the **Next** button.

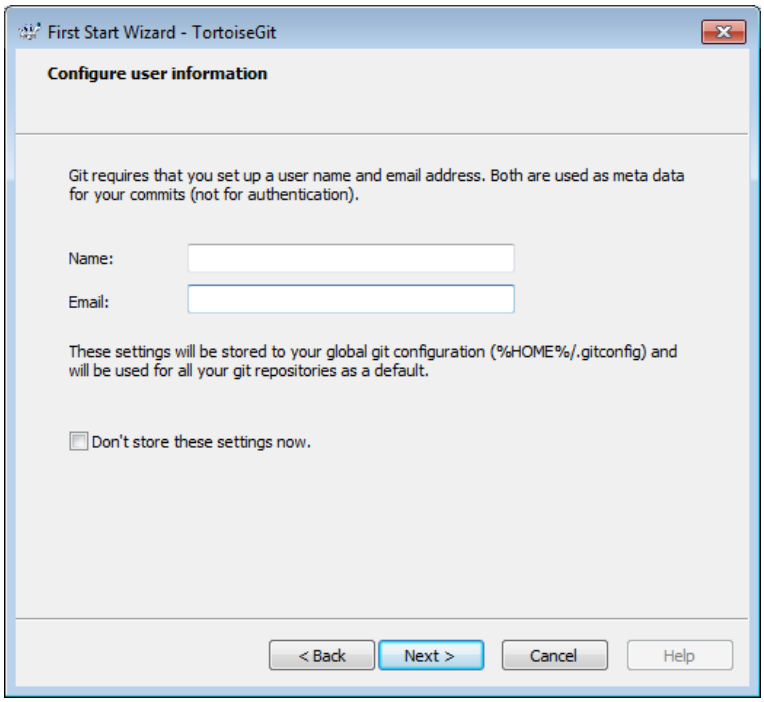


3. Click the **Next** button.
   A dialog box is displayed to configure the path to Git.exe.



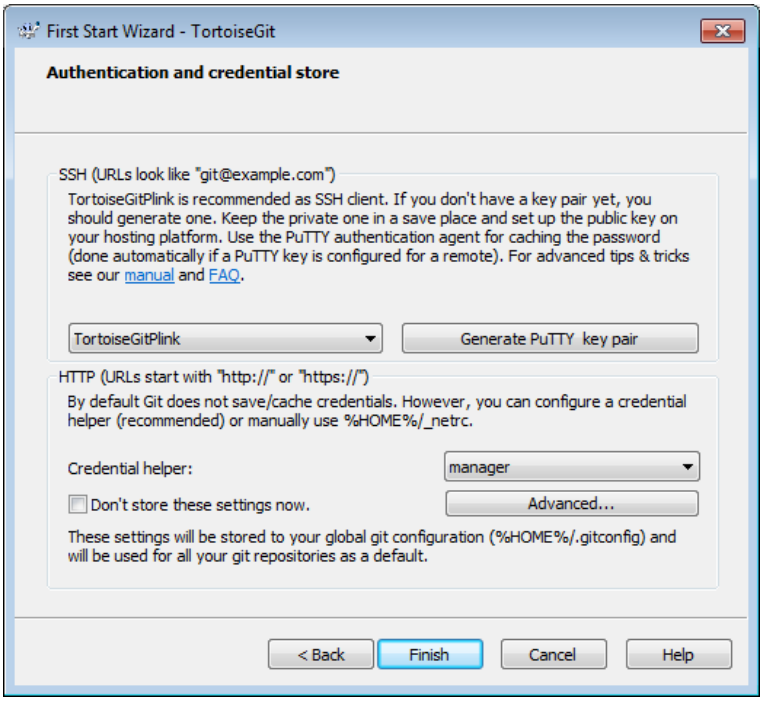
   Set the path to Git execution module “Git.exe”. If you did not change the install path when installing Git, leave it as default.

4. Click the **Next** button.
   The **Configure user information** dialog box is displayed.



   The user name and email address that you enter here will be used as change record information.

5. Enter the user name and email address, and then click the **Next** button.
   The **Authentication and credential store** dialog box is displayed.



6. To use the Sysmac Studio version control function, do not reduce the option selected from default.

7. Click the **Finish** button.
   This completes the initial setting for “TortoiseGit”.

5.6 Creating the shared folder and remote repository

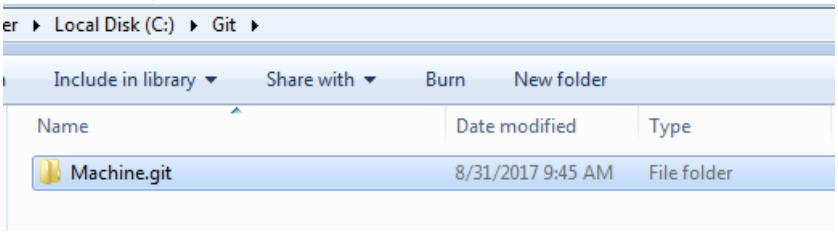
This section utilizes the configuration in which a shared folder on the computer is used as the remote repository as an example.
For this configuration, create a shared folder in which to store a remote repository, and then create a folder that serves as the remote repository in the shared folder.

1. Creating a new folder
   In Windows Explorer, create a new folder.
   You can create this folder in any location with any name. Let's assume that it is C:\Git.

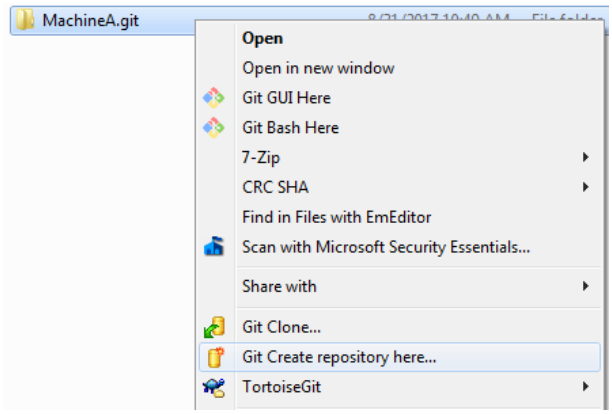
2. Settings for the shared folder
   Right-click the folder that you created in step 1 and select **Properties** from the pop-up menu. Then, in the dialog box that is displayed, click the **Share** tab to perform the sharing settings.
   Here, you configure the folder to allow full access from other users' computers on which the Sysmac Studio version control function used.

3. Creating a folder to be used as a repository
   Create a new folder under the folder created in step1.
   According to the Git conventions, it is required that you name the folder to use as a Git repository to the repository name followed by ".git". For example, if the repository name is "MachineA," then name the folder

"MachineA.git."

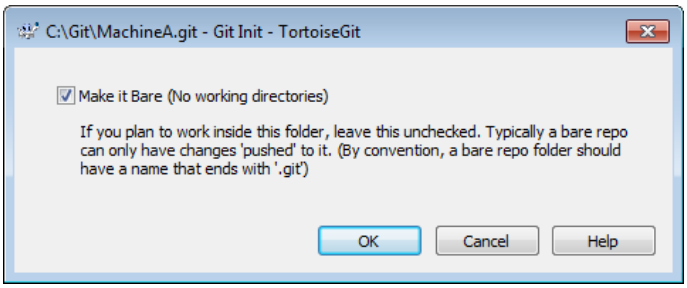


4. Registering the folder as a repository
   Right-click the folder created in step 3 and select **Git Create repository here** from the pop-up menu.

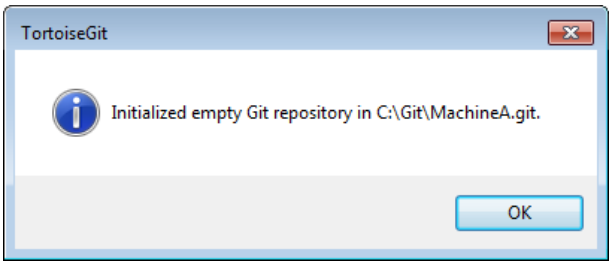


   A repository creation option dialog box is displayed.

5. Select the check box on the dialog box and click the **OK** button.



   A repository is created and the following dialog box is displayed.



6. Click the **OK** button.
   This completes the creation of a remote repository.

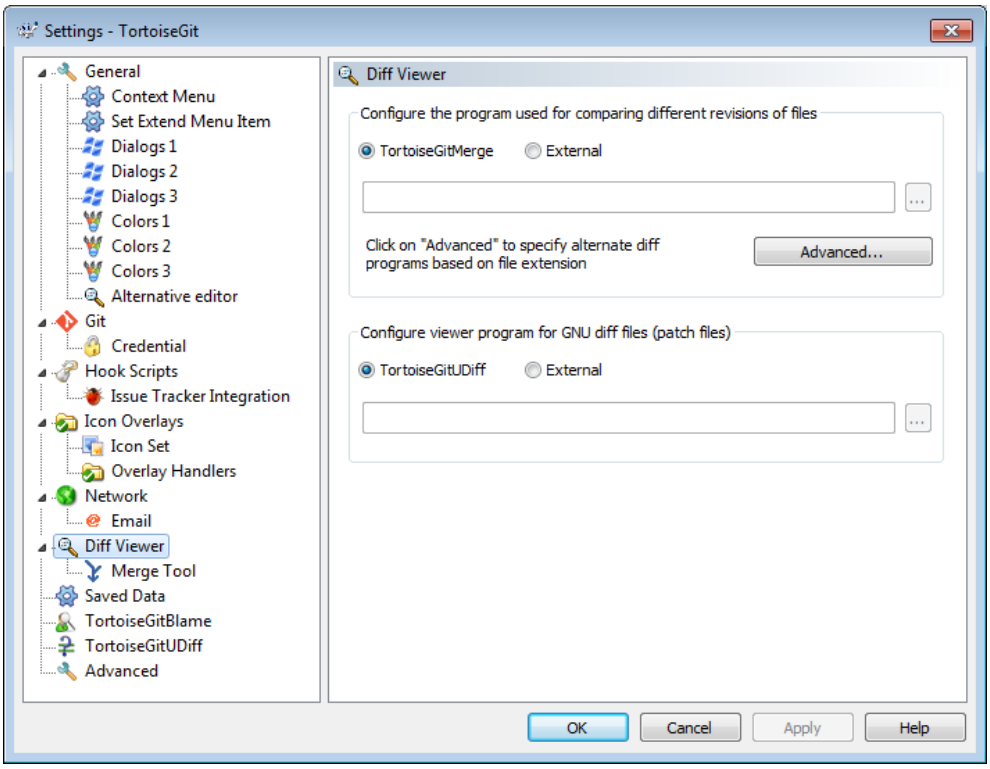
Note that you can control only one Sysmac Studio project per repository. Create a directory for each project to use version control function.

5.7 Additional Setting for “TortoiseGit”

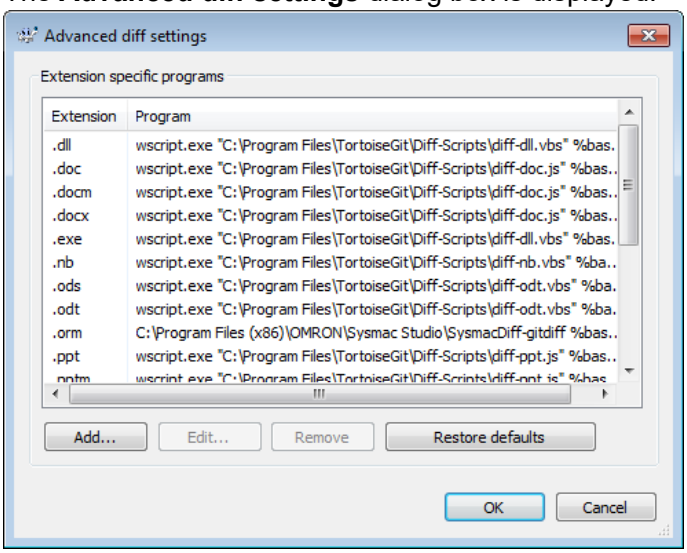
In “TortoiseGit”, add settings to enable graphical comparison of Sysmac Studio projects from “TortoiseGit”.

1. From the Start menu, select **All programs** - **TortoiseGit** - **Settings.**
   The **Settings** dialog box of the “TortoiseGit” is displayed.

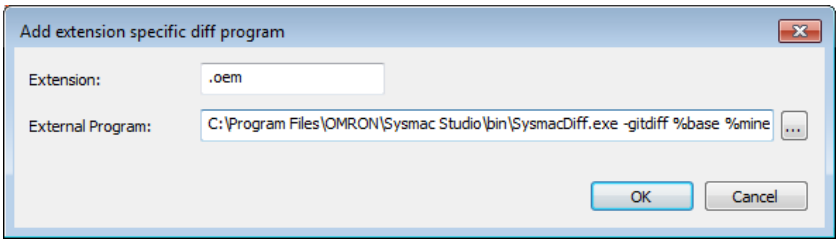
2. Select **Diff Viewer** from the tree.
   The **Diff Viewer** pane is displayed.



3. In the **Diff Viewer** pane, click the **Advanced** button.
   The **Advanced diff settings** dialog box is displayed.



4. Click the **Add** button.
   The **Add extension specific diff program** dialog box is displayed.



5. Enter the following text string, and then click the **OK** button.

Items	Text string to enter
Extension	.oem
External Program	(Sysmac Studio install folder[*1])\ SysmacDiff.exe -gitdiff %base %mine %bpath %brev %yrev

*1: The Sysmac Studio installation folder is by default as follows.

Sysmac Studio (32 bit)

Windows 32bit edition: C:\Program Files\OMRON\Sysmac Studio

Windows 64bit edition: C:\Program Files (x86)\OMRON\Sysmac Studio

Sysmac Studio (64 bit)

Windows 64bit edition: C:\Program Files\OMRON\Sysmac Studio

6. Click the **OK** button in the **Advanced diff settings** dialog box.

7. Click the **OK** button in the **Settings** dialog box.
   This completes the additional setting for “TortoiseGit”.

6 PROJECT RECORD CONTROL ON SYSMAC STUDIO

6.1 Overview of Project Record Control Using the Version Control Function

The version control system “Git” which works with the Sysmac Studio has the following four basic functions.

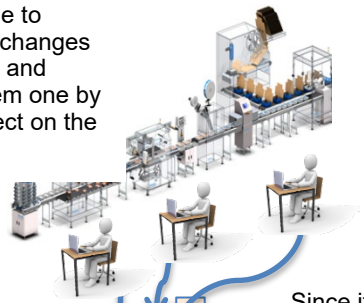
- Generates an identification number that uniquely identifies changes in saved software data and stores it with comments
- Searches for changes in specific software data by date information, comments, user name, etc.
- Comprehends (compares) differences from arbitrary software data
- Restores to software data at specific change time

The Git controls records of Sysmac Studio project data using above basic functions.

From

Every time changes are applied to the master, it takes time to copy and rename the project file. It is impossible to know who changed what.

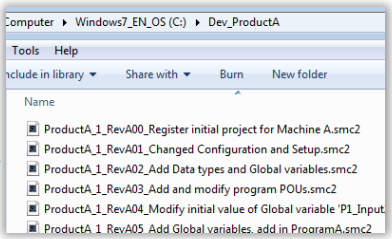
It takes time to merge the changes by copying and pasting them one by one to reflect on the master.



Every time changes are applied to the master, it takes time to copy and rename the project file in order to apply a version to the master project.

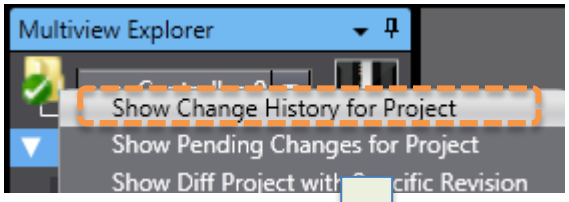
Since it is impossible to know who changed what, it takes time to deal with a problem.

The copied project files are stored for management; however, it is difficult to distinguish them by file names.

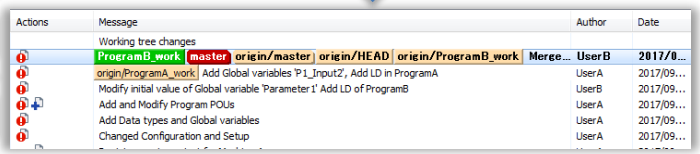


To

The version control function controls the change records of the projects.



When you show the logs...

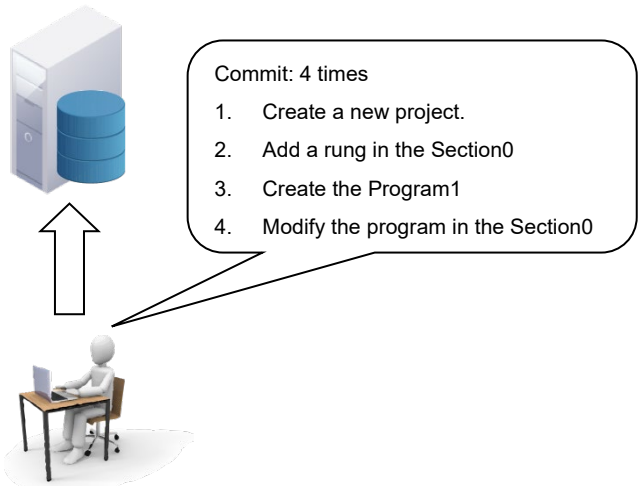


Check the change records.

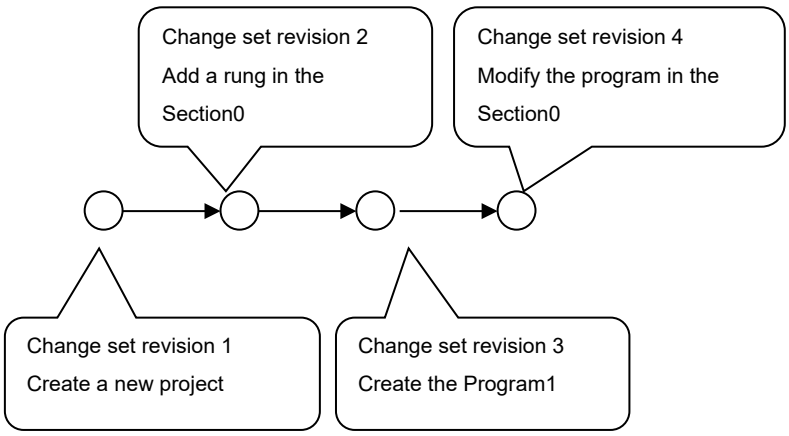
- Comparison with previous version
- Restore the project data to a specific revision
- Searching for a Comment, etc.

6.2 Operation Example of Record Control Function

This section describes an operation example to use the record control function.
E.g. Executing Commit four times to update the information in the repository.



When above course of operation is explained with the idea of change set which is a control unit of the version control system, the change information is managed as a sequential information of revision 2 -> revision 3 -> revision 4 (*) that started from the starting point of revision 1 (*). Since the information of differences between revisions and change set are combined and managed, a project opened on the Sysmac Studio can be restored to a specific revision.



*The revisions are expressed as 1, 2, 3, and 4 for simplicity of explanation, but in reality it is a numeric value of 40 digits hexadecimal number generated by the SHA - 1 algorithm, and it is not serial numbers that increase one by one.

6.3 Preparing for Starting Project Control (Creating a Base Project and Saving It)

To start controlling the versions of a Sysmac Studio project, create a base project, save it in the local repository and configure the synchronization settings of the local and remote repository.

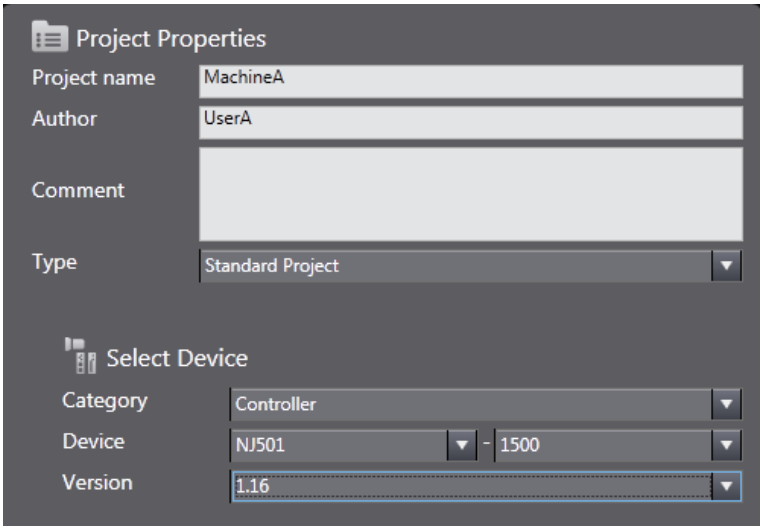
6.3.1 Creating a Base Project

1. From the Start menu, select **All Programs – OMRON – Sysmac Studio – Sysmac Studio** to start the Sysmac Studio.
   The **User Account Control** dialog box is displayed according to the Windows version or user authority. Click the **Yes** button.

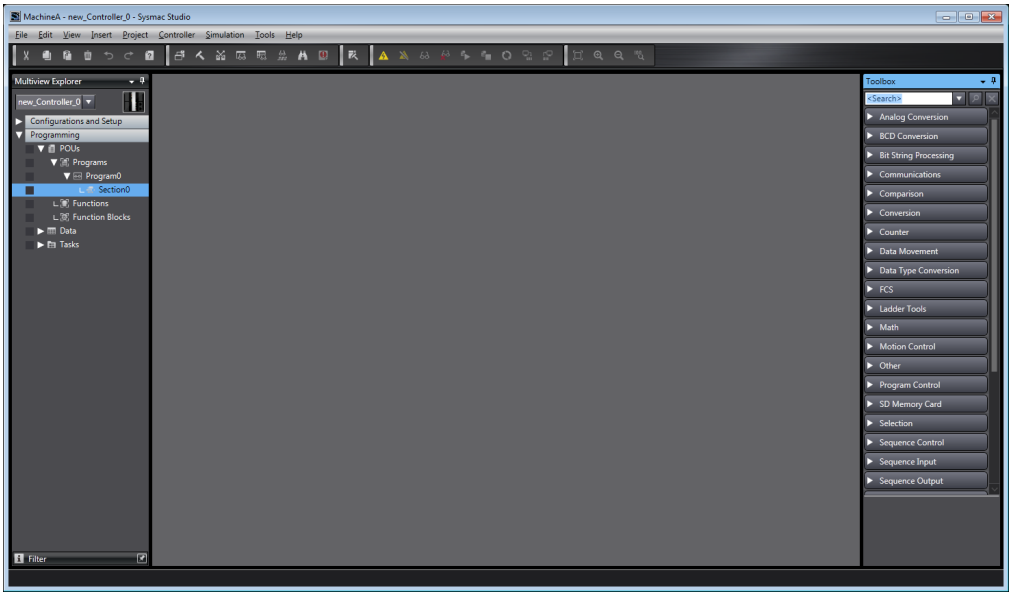
2. Create a new base project and register it.
   Here, the procedure to create a new project and register it in the repository is explained. Use the same procedure to register an already created project in the repository.
   On the Start page of the Sysmac Studio, select **New Project** and configure the necessary setting items, and then select the **Create** button.
   This example uses the settings in the following table.

Items	Entry/Selection
Project name:	MachineA
Author	UserA
Type	Standard Project
Category	Controller
Device	NJ501-1500
Version	1.16 *1

*1: When *Controller* is selected for **Category**, specify the Version 1.16 or later. With the Unit of unit version 1.15 or earlier, version control function cannot be used.



   The project with the project name MachineA is opened.

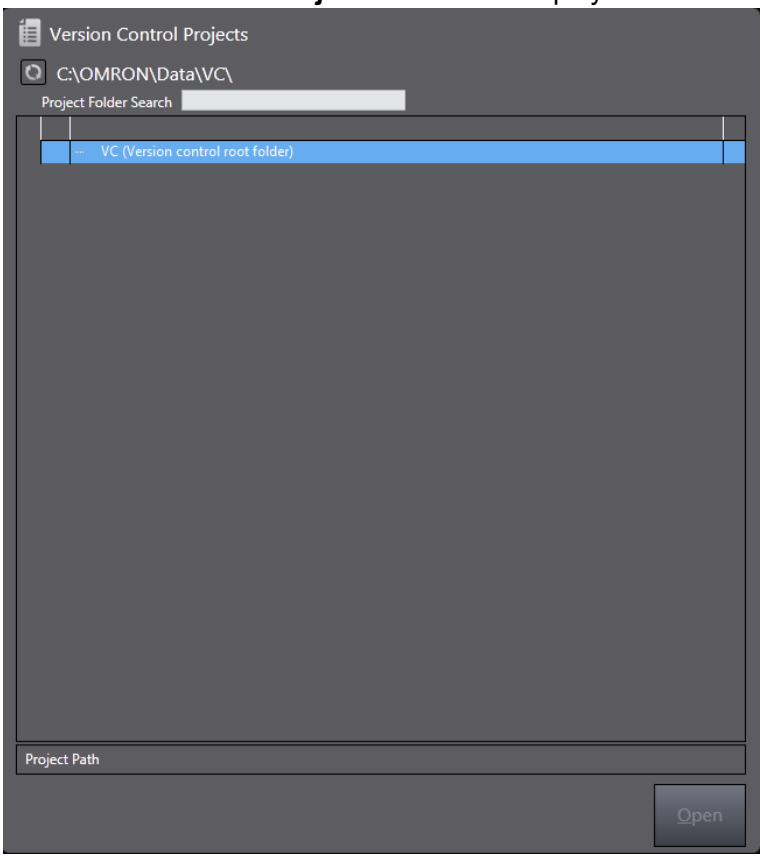


3. From the Main menu, select **File - Save** to save the project.

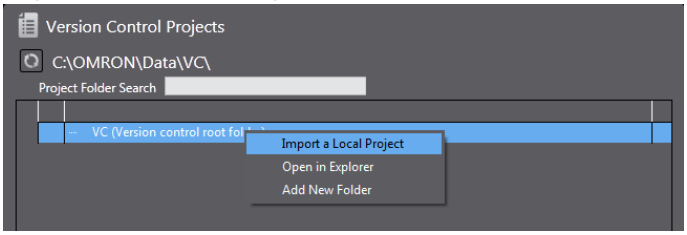
4. Select **File** - **Close** to close the project.

6.3.2 Registering the project in the Local Repository

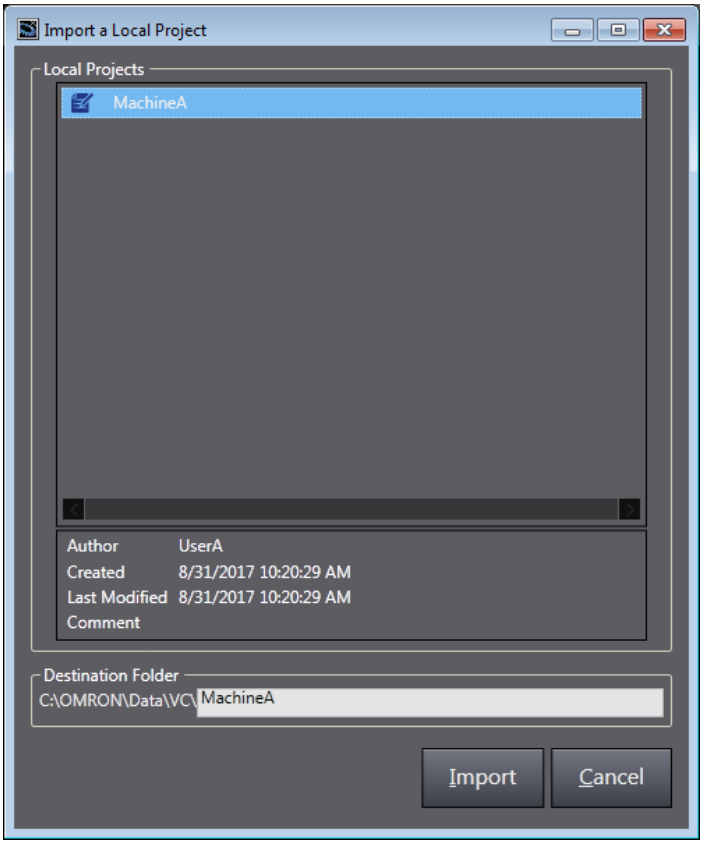
1. On the Start page of the Sysmac Studio, select **Version Control Explorer**.
   The **Version Control Projects** window is displayed.



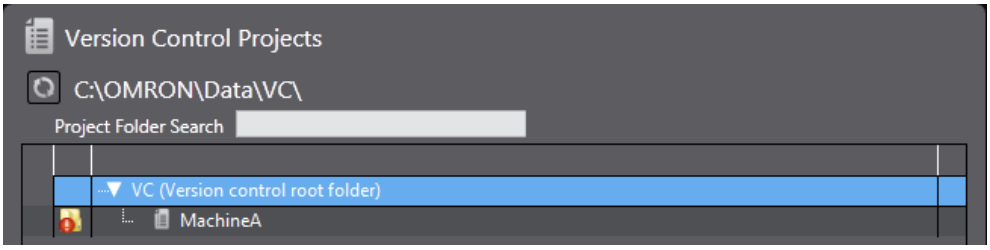
2. Right-click the working folder **VC (Version control root folder)** and select **Import a Local Project**.



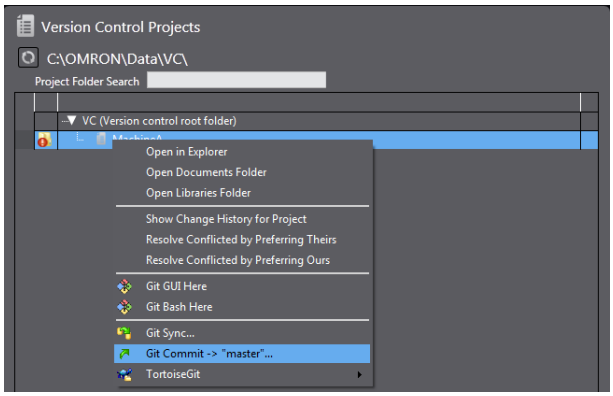
The **Import a Local Project** dialog box is displayed.



3. Select the project which you created and then click the **Import** button.
The selected project is copied to the working folder for version control.



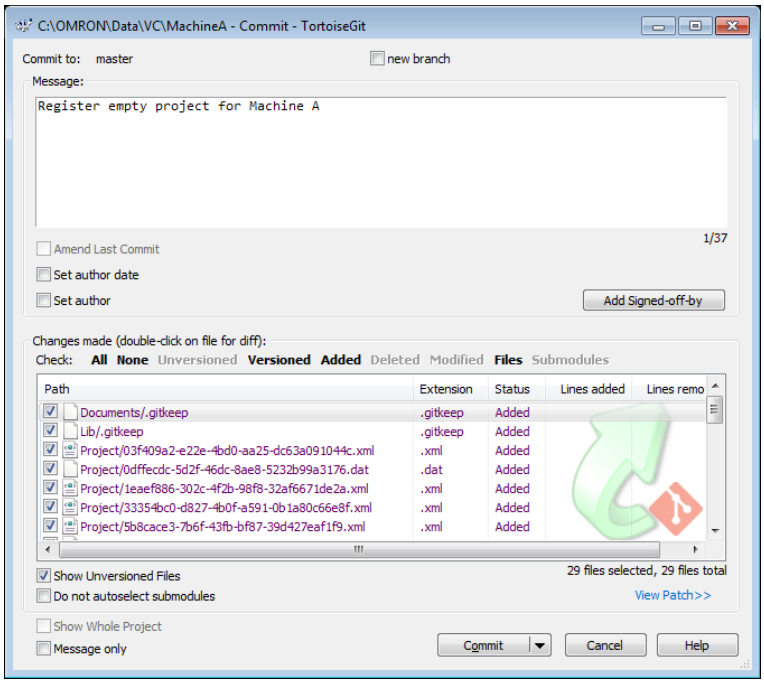
4. Right-click the copied project and select **Git commit -> ”master”** from the pop-up menu.



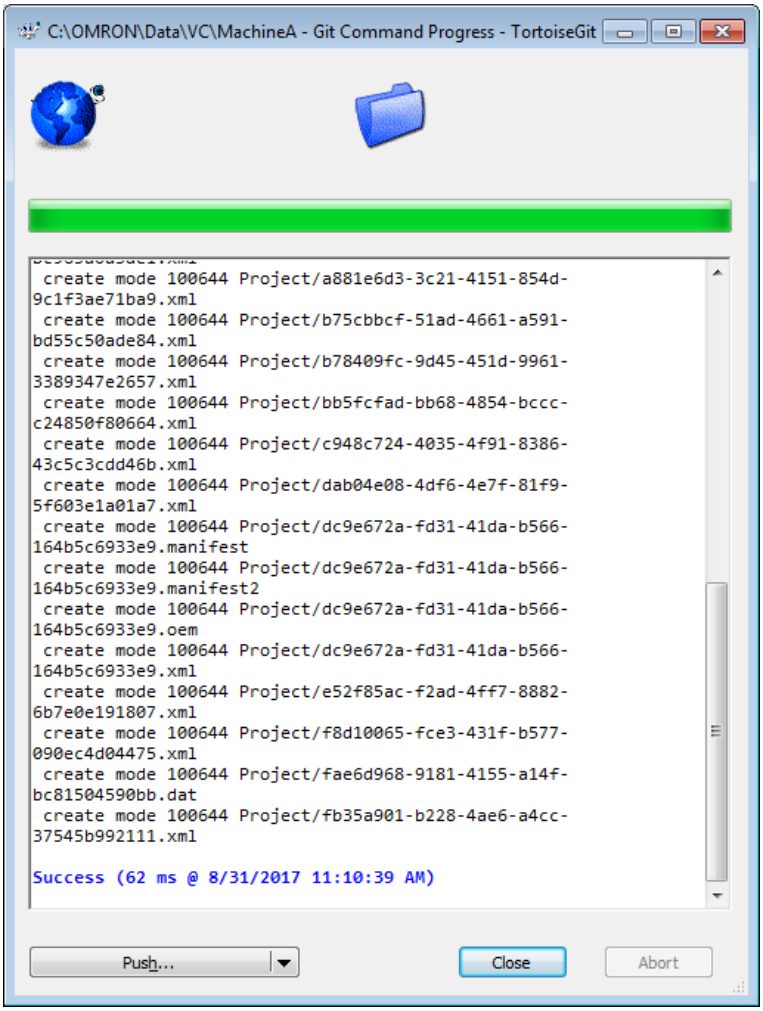
The dialog box asking for attention during Commit operation is displayed.
(Hereafter, this dialog box is omitted in the explanation of operating procedure in this manual.)

5. Confirm the description on the dialog box, select the **Don't show this again** check box, and then click the **OK** button.
The “TortoiseGit” **Commit** dialog box is displayed.

6. Enter a message that you want to leave as a record in the message area and click the **Commit** button.



The below dialog shows that Commit is successfully completed.



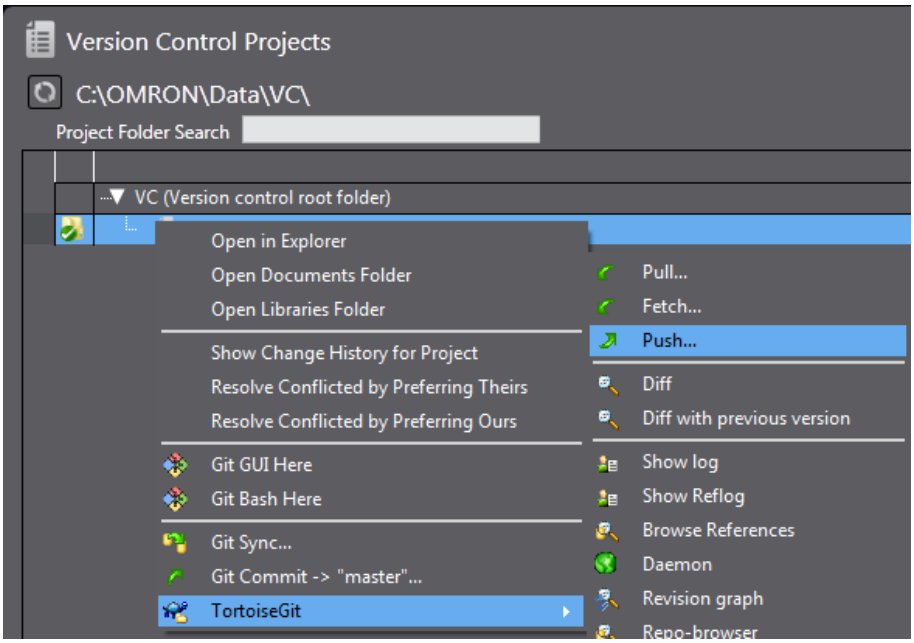
This completes the registration of the project in the computer to the local repository.

7. Click the **Close** button to exit.

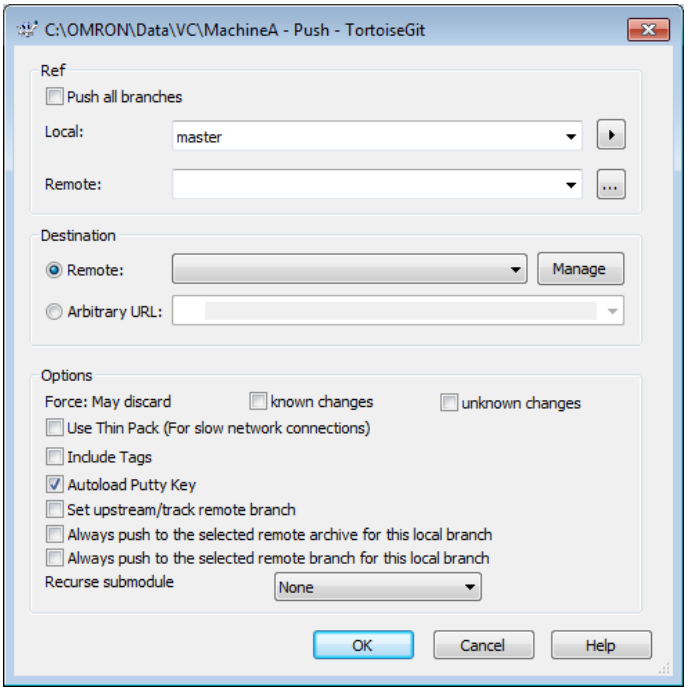
6.3.3 Synchronizing the Local Repository and Remote Repository

“Push” the project data for version control from the local repository to the remote repository.

1. Right-click the target project in the **Version Control Projects** window and select **TortoiseGit - Push** from the pop-up menu.

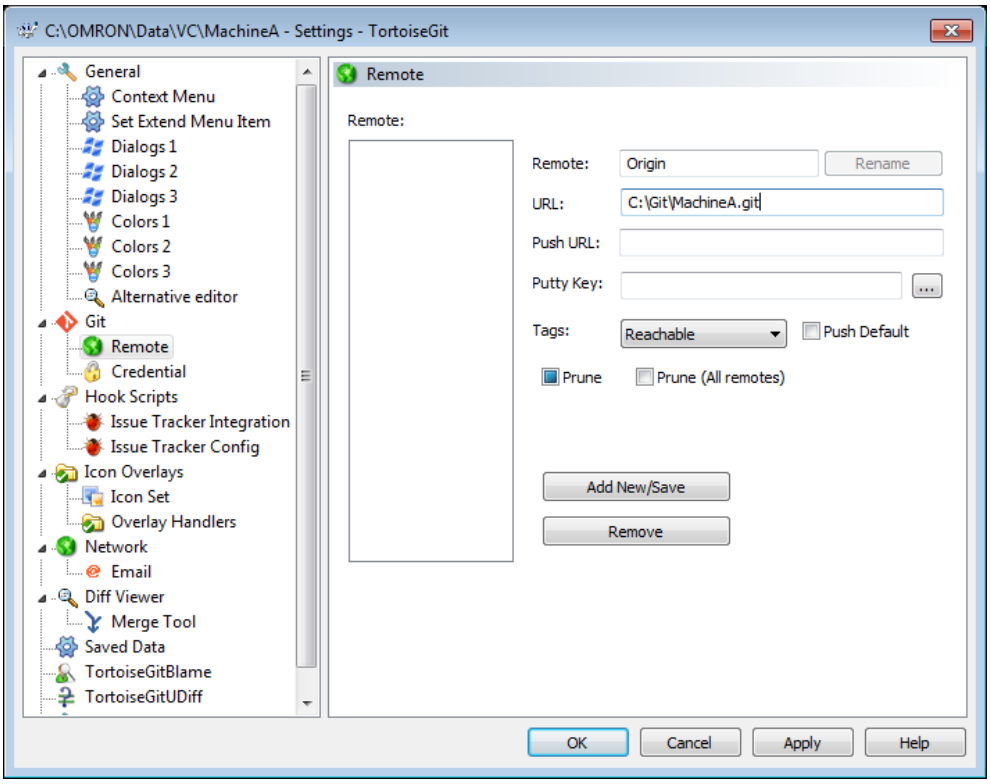


The “TortoiseGit” **Push** dialog box is displayed.



2. Select the **Push all branches** check box, and then click the **Manage** button under **Destination**.
   A dialog box appears for setting the location of the remote repository of the repository "MachineA".

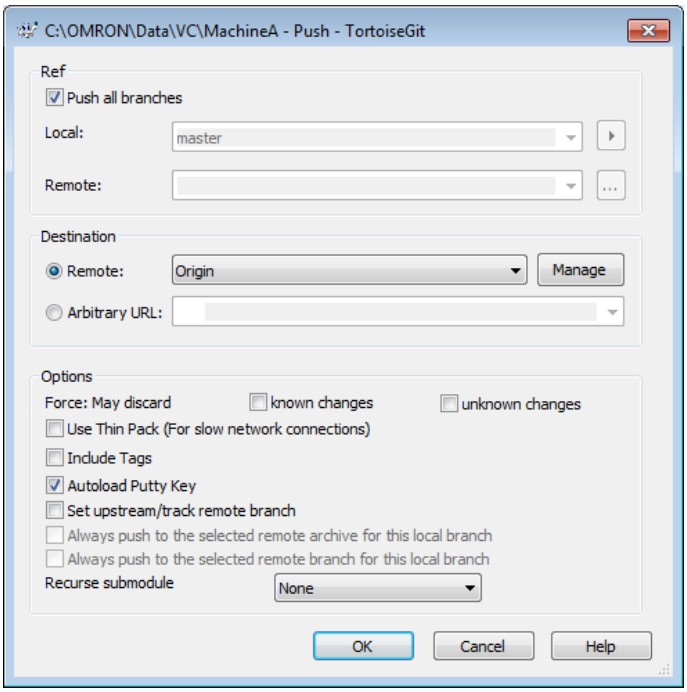
3. In the **Remote** field, enter the name of this connection (usually "Origin") and the URL (here, enter the path of the remote repository created in Section 5.5) and click the **Add New / Save** button.



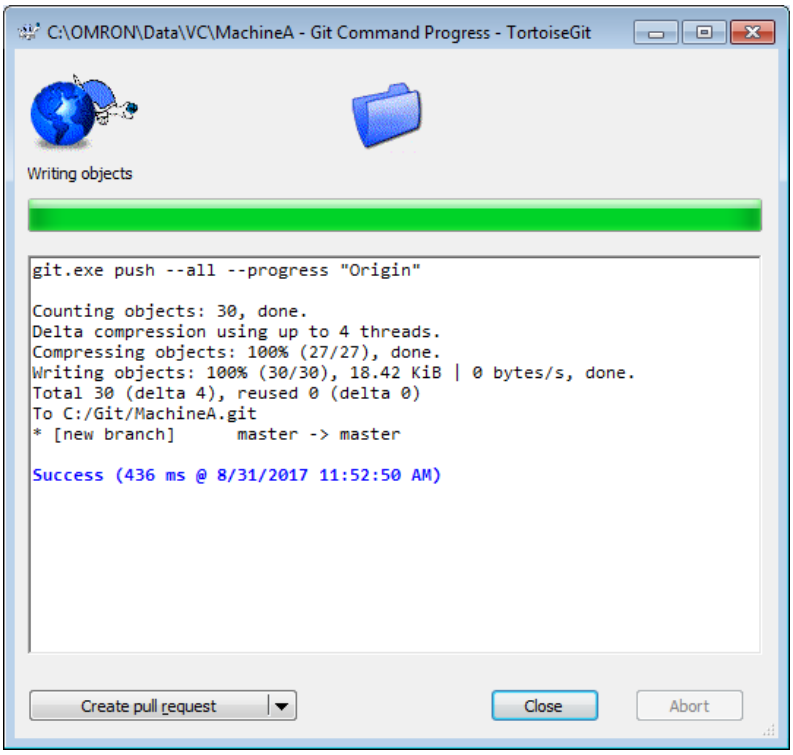
The remote name “Origin” is registered.

4. Click the **OK** button.
   The dialog box asking for attention during Push operation is displayed.
   (Hereafter, this dialog box is omitted in the explanation of operating procedure in this manual.)

5. Confirm the description on the dialog box, select the **Don't show this message again** check box, and then click the **Yes** button.
   In the “TortoiseGit” **Push** dialog box, the connection named “Origin” is set.



6. Click the **OK** button.
   The project “MachineA” in the local repository is copied to the remote repository “MachineA.git”.



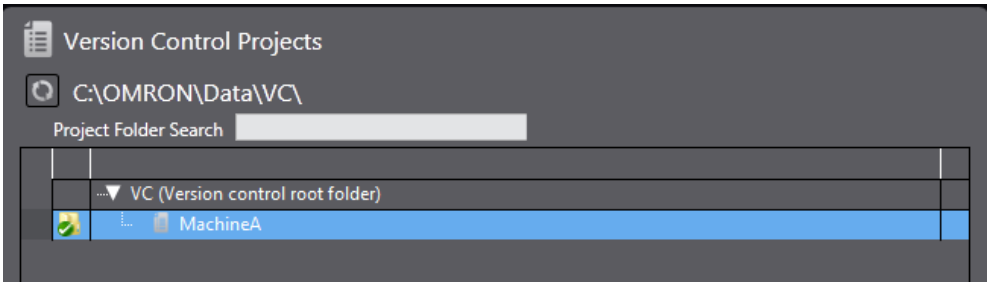
7. Click the **Close** button.

6.4 Updating the Project

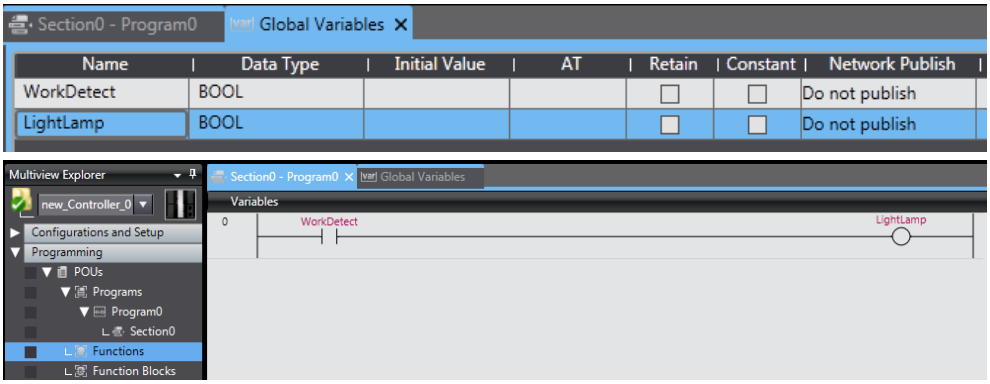
This section describes the procedure to change project data and reflect it in the repository.

6.4.1 Changing the Project Data

1. On the Start page of the Sysmac Studio, select **Version Control Explorer** to open the **Version Control Projects** window. Select the project to edit and click the **Open** button.



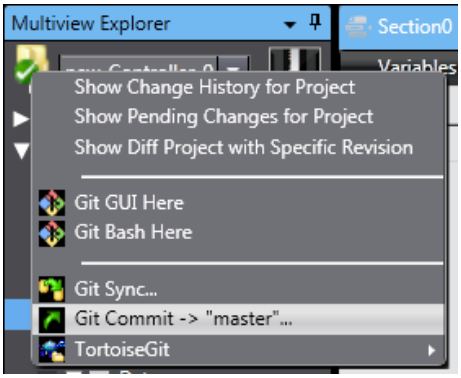
2. Modify the project data. In this example, BOOL variables “WorkDetect” and “LightLamp” are added as global variables and ladder rungs are added in the Program0-Section0.



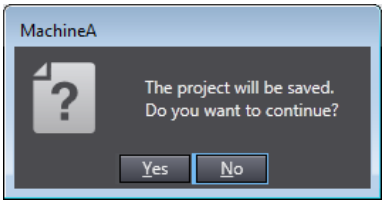
6.4.2 Registering Changes to the Local Repository (Commit)

Apply the changes made to the project to the local repository. This operation is called Commit.

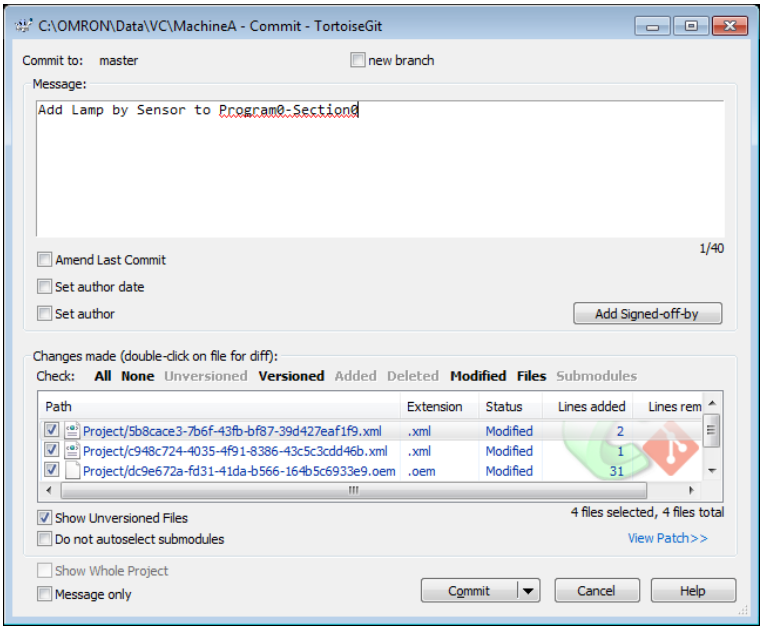
1. Right-click the folder icon in the Multiview Explorer and select **Git Commit -> “master”** from the pop-up menu.



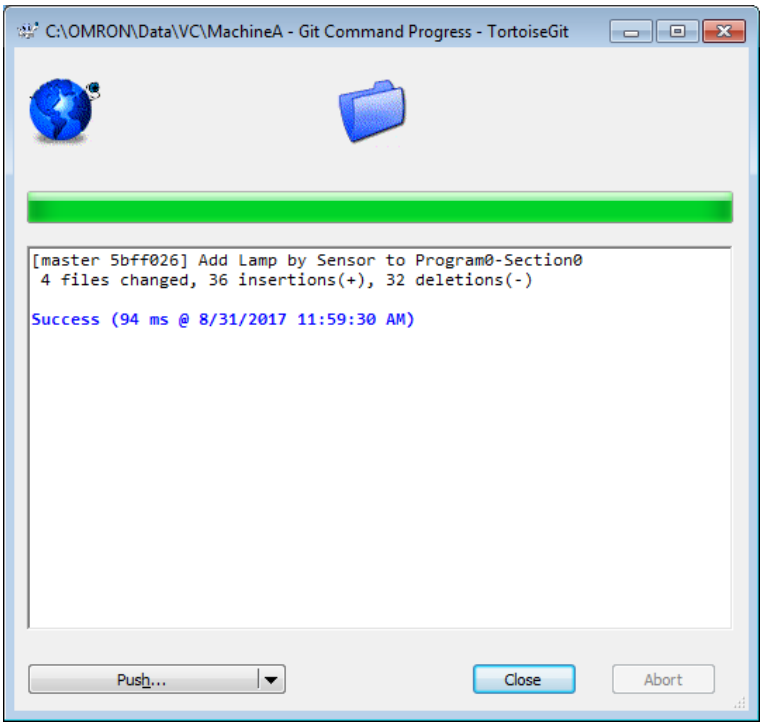
A dialog box is displayed to ask if you need to save the project.



2. Click the **Yes** button.
   The “TortoiseGit” **Commit** dialog box is displayed.

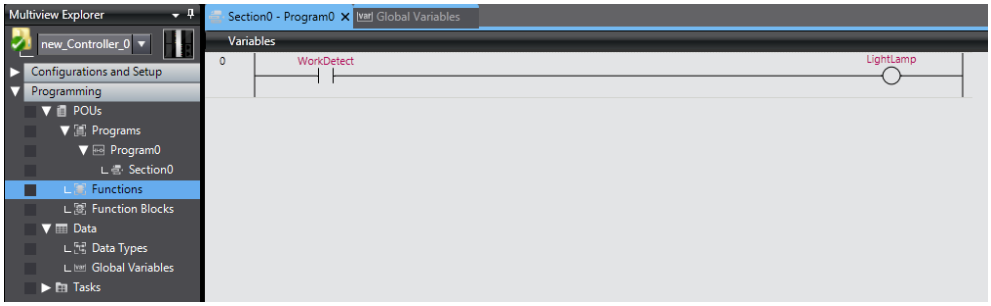


3. Enter a message that you want to leave as a record in the message area and click the **Commit** button.
   The below dialog shows that Commit is successfully completed.



The changes in the project in the computer were registered in the local repository.

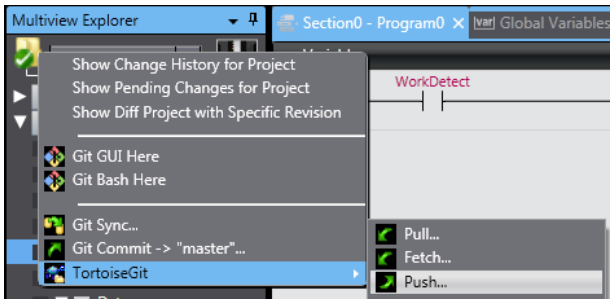
4. Click the **Close** button.
   The project under editing is displayed.



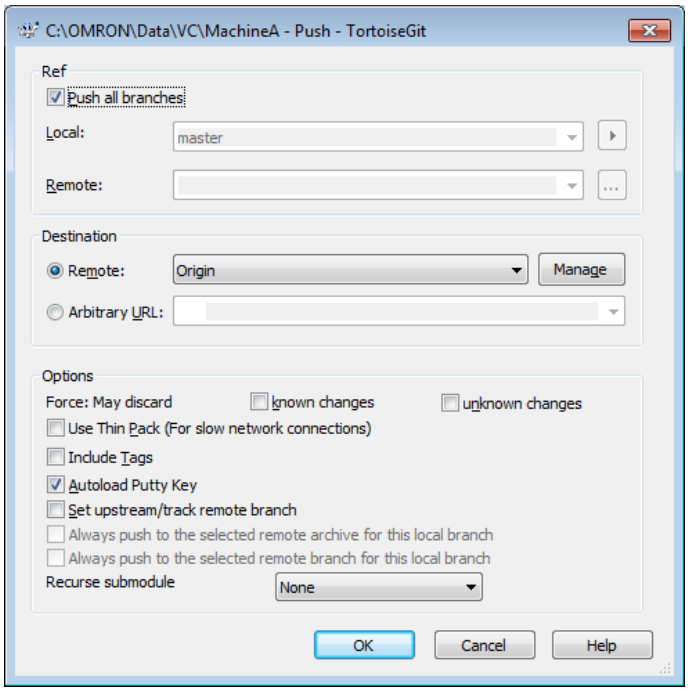
6.4.3 Registering the Changes to the Remote Repository (Push)

Apply the changes made to the project in the local directory to the remote repository. This operation is called Push.

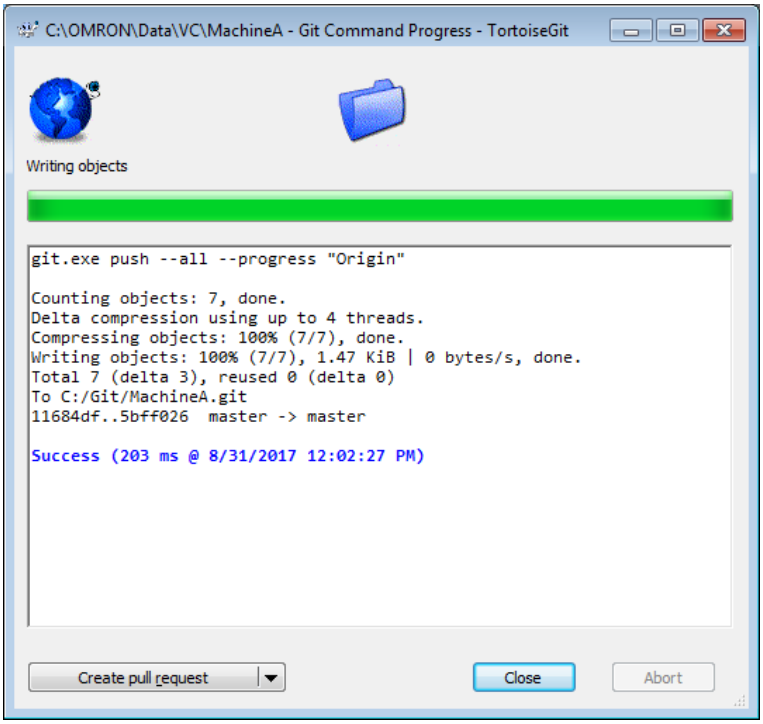
1. Right-click the folder icon in the Multiview Explorer and select **TortoiseGit - Push** from the pop-up menu.



   The “TortoiseGit” **Push** dialog box is displayed.



2. Make sure that the **Push all branches** check box is selected and **Remote** item is correctly set (“Origin” is set in this example), and then click the **OK** button.



This concludes the Push process.

3. Click the **Close** button.

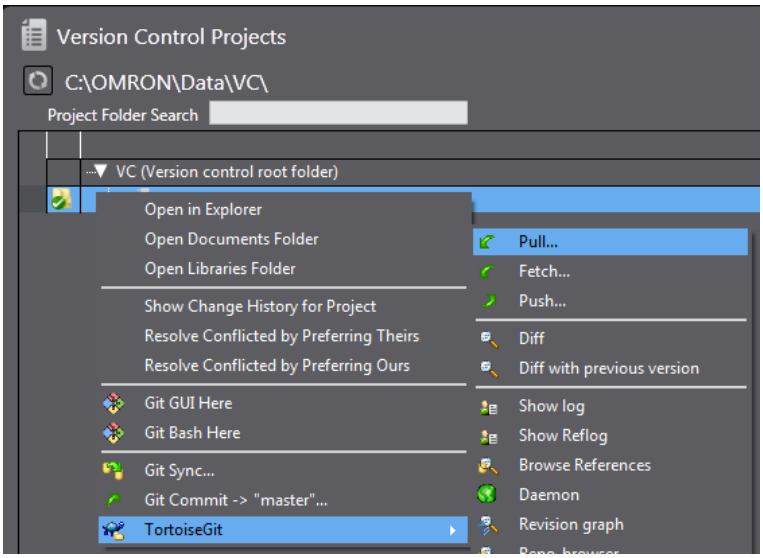
6.5 Searching for a Project

When you made a wrong change while editing a project, you might want to restore the previous project data and resume editing. In that case, you check the change contents of the past projects, change date, person who made changes, and change history information, or open the projects to identify the project revision to return.
If you use the version control function, you can search for a revision of the project by the following procedure.

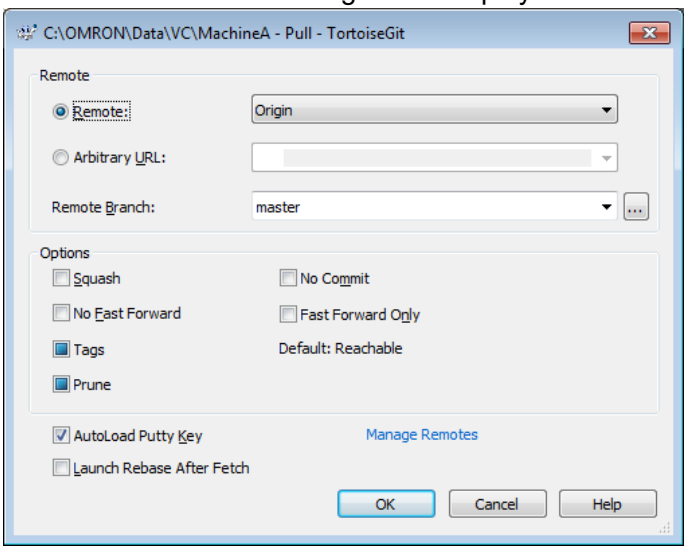
6.5.1 Updating the Local Repository

In a case that data in the remote repository is the master, it is necessary to update the local repository in the computer to the latest state.
This section describes the steps to be taken after updating the local repository and remote repository since some changes were made in the same procedure described in *6.4 Updating the Project*.

1. Right-click the target project in the **Version Control Projects** window and select **TortoiseGit - Pull** from the pop-up menu.

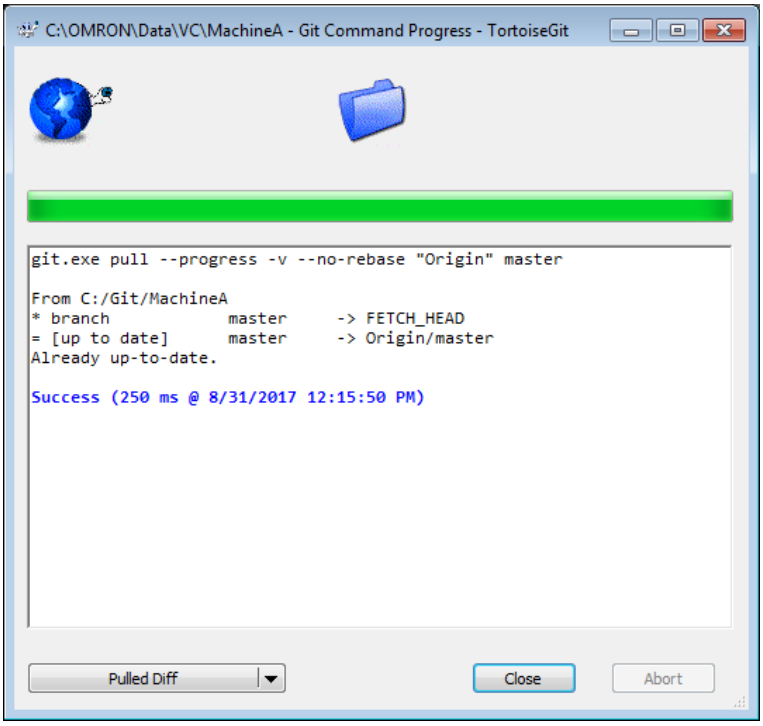


The “TortoiseGit” **Pull** dialog box is displayed.



2. Make sure that the registered remote name is correctly set (in this example, “Origin” is set) for the “Remote” item, and then click the **OK** button.

“Pull” is executed.



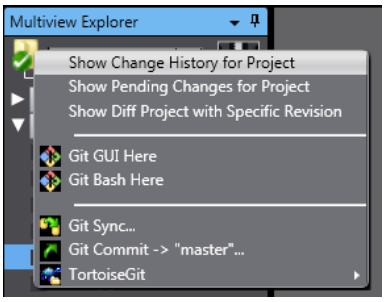
3. Click the **Close** button.

6.5.2 Displaying Project Logs

Show the change history for the project.

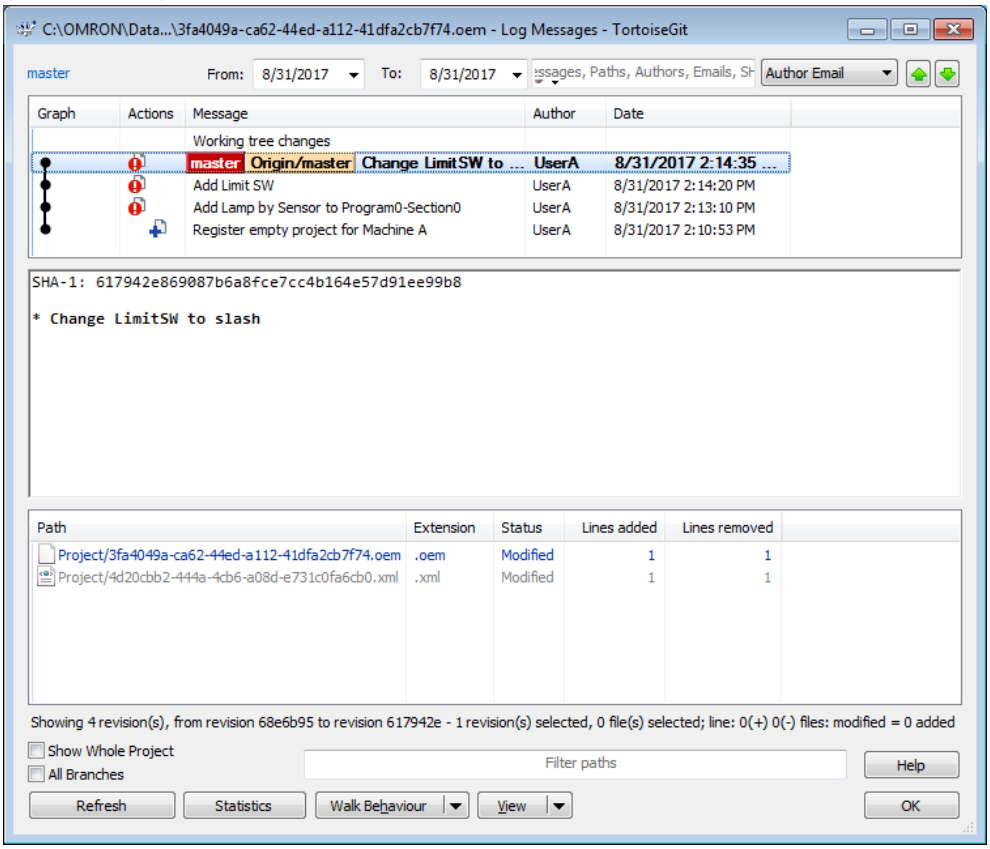
1. On the Start page of the Sysmac Studio, select **Version Control Explorer** and open the **Version Control Projects** window. Select the target project and click the **Open** button.
   The project is opened.

2. Right-click the folder icon in the Multiview Explorer and select **Show Change History for Project** from the pop-up menu.



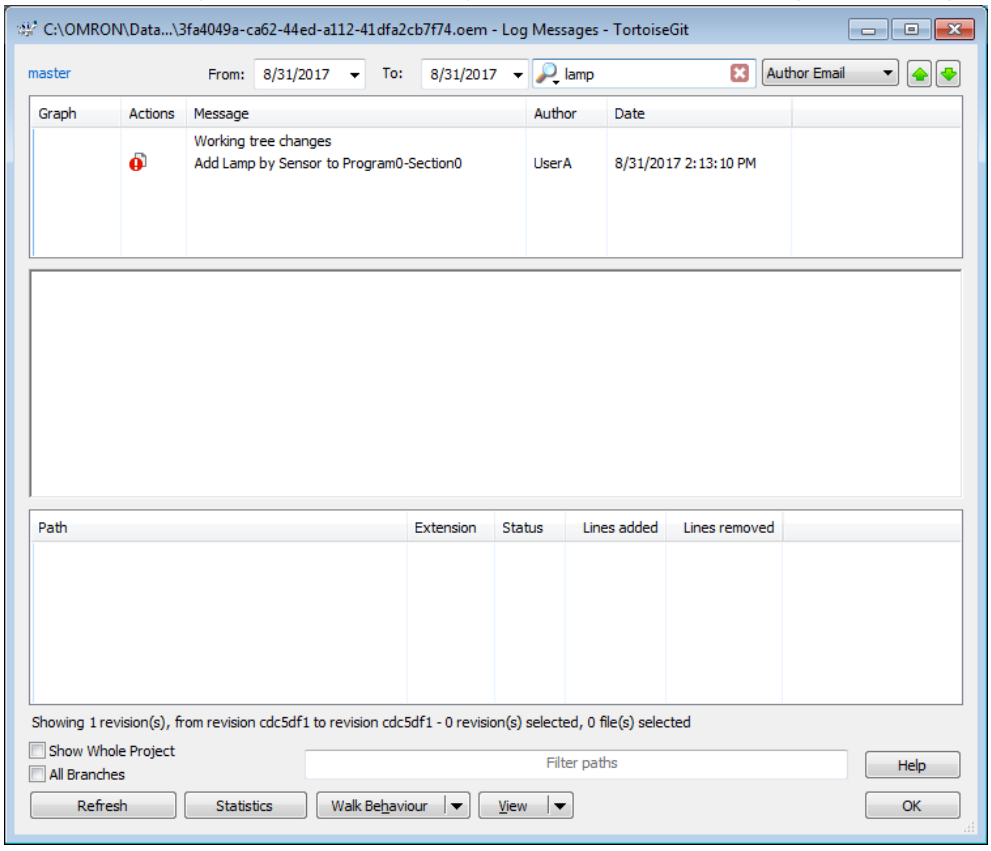
   The “TortoiseGit” **Log Messages** dialog box is displayed.
   In the upper area, Actions (change, addition, or deletion), Message (log messages entered at Commit), Author

(user names), and Date of each Commit are listed.



6.5.3 Searching for the Revision

In the search field at the top of the window, enter the keyword to search.
For example, if you enter "Lamp", only the revisions with message containing “Lamp” are displayed in the list.

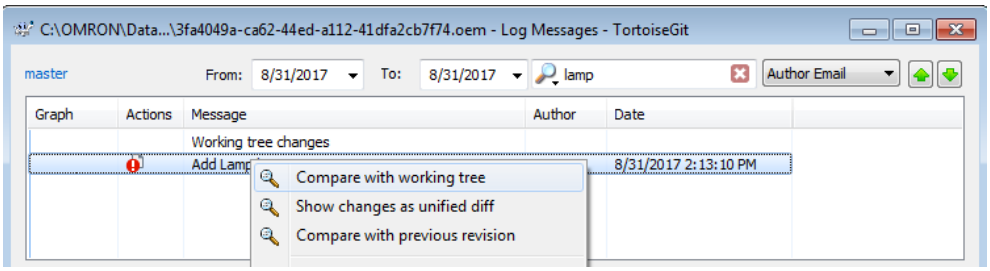


In this way, you can sort and search for the target revision by the character string of messages, date or user name.

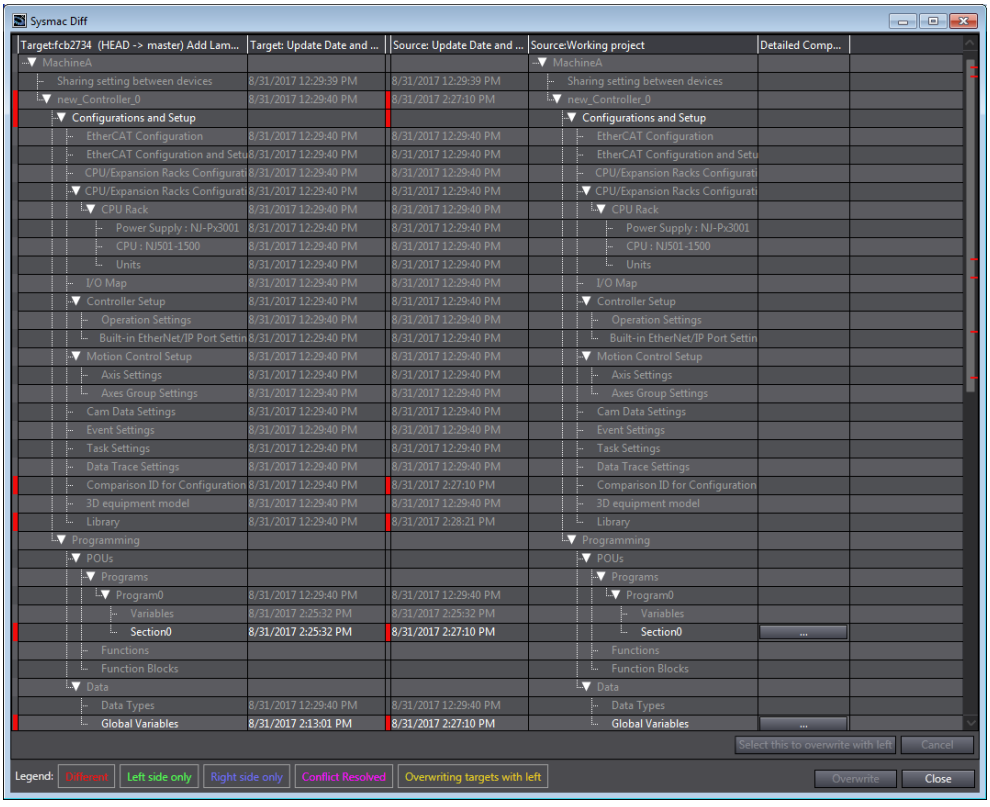
6.6 Comparing the Projects

You can compare the revision searched and a project which is currently opened.

1. On the “TortoiseGit” **Log Messages** dialog box, right-click on the target revision and select **Compare with working tree**.

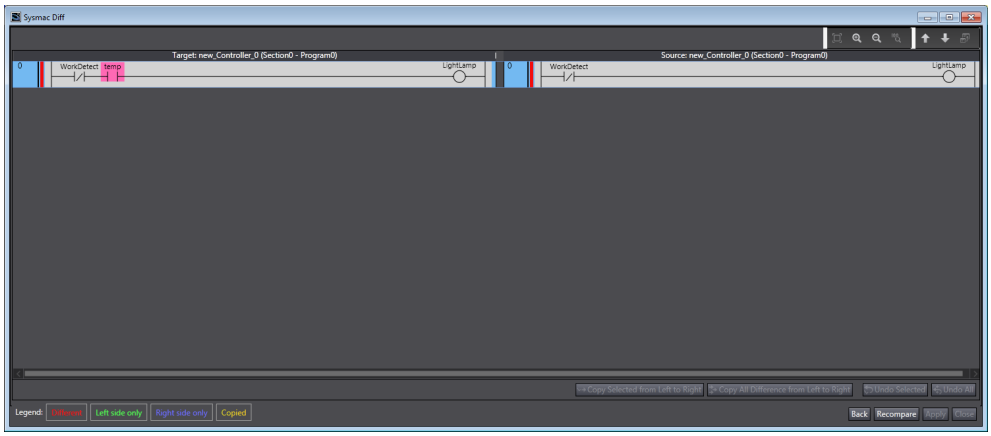


The **Sysmac Diff** dialog box shows up and the project of the selected revision and one currently opened are compared on it.
The contents with differences are shown with red bars.



2. To reference the details, select the ··· button in the **Detail Compare** column.

   Then, the ladder diagrams are displayed, and you can grasp the difference between the revisions.

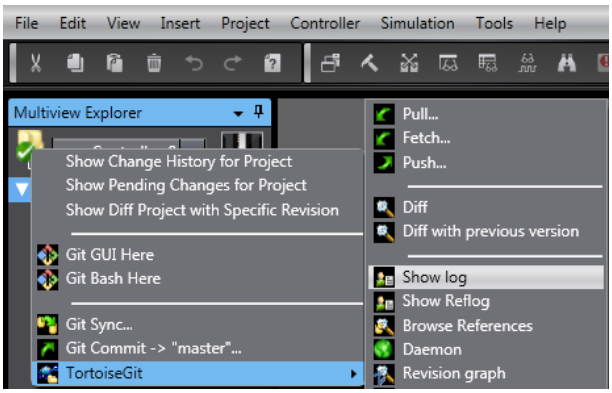


3. After referencing the difference, click the **Close** button.

6.7 Reverting the Project

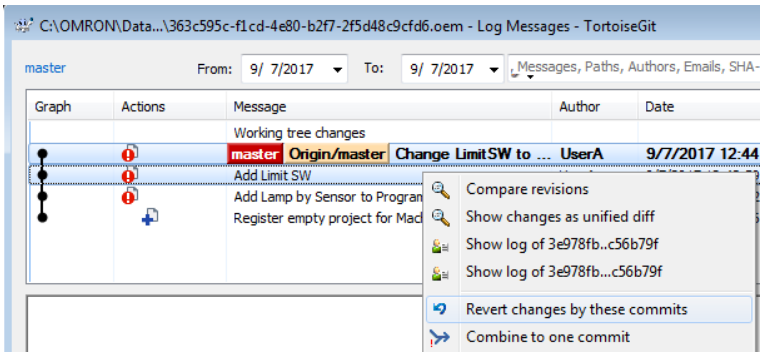
Open the project of the revision that was searched and restore the project data.

1. Right-click the folder icon in the Multiview Explorer and select **TortoiseGit – Show log** from the pop-up menu.

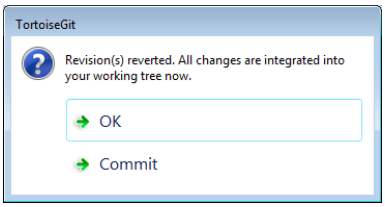


   The “TortoiseGit” **Log Messages** dialog box is displayed.

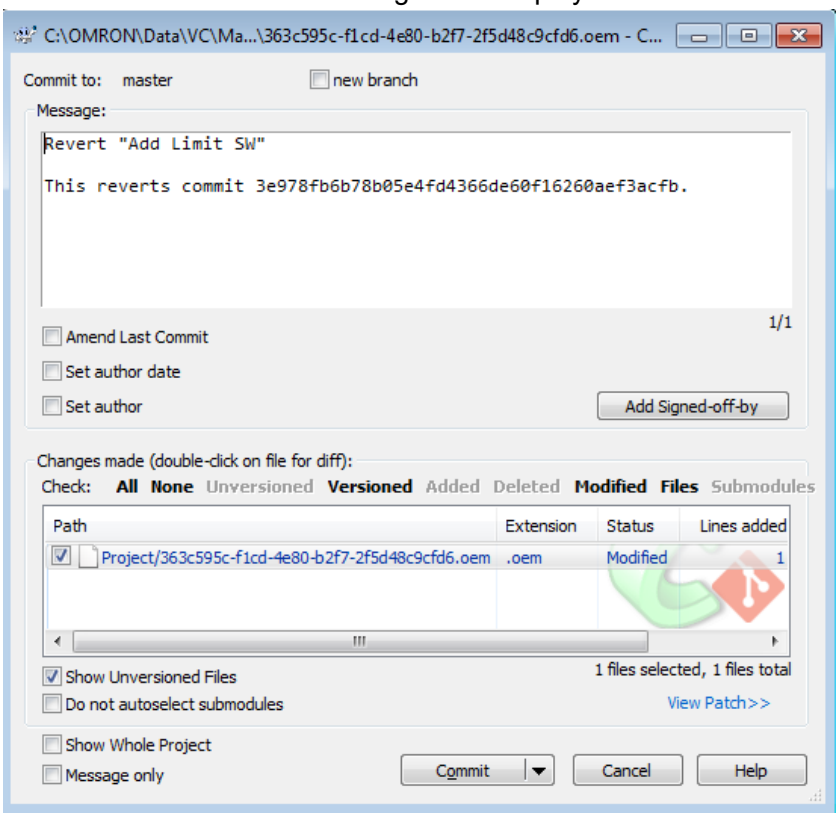
2. Select one row after another up to the revision whose contents you want to restore while holding down the Shift key, right-click it and select **Revert change by these commits** from the pop-up menu.



   The result dialog box of “TortoiseGit” is displayed.

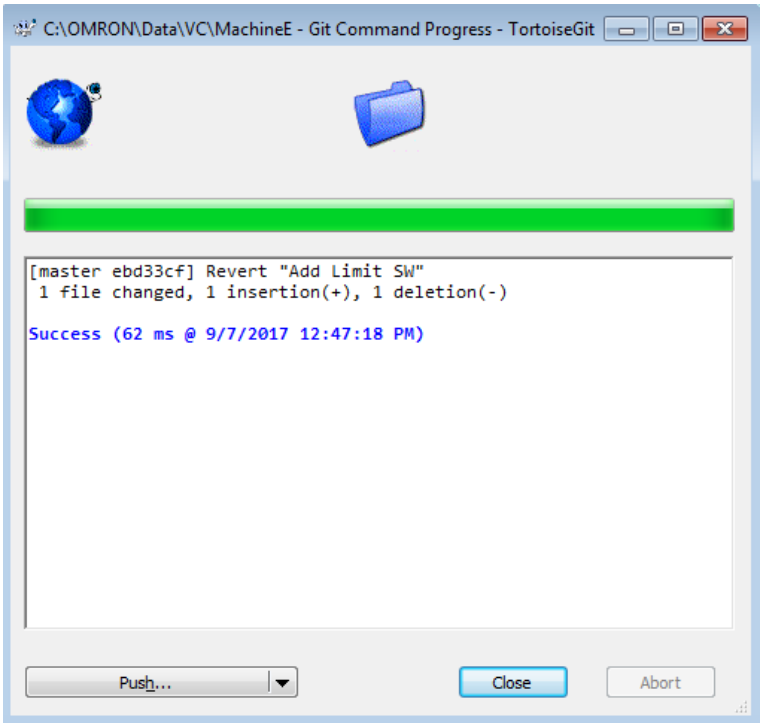


3. Click the **Commit** button.
   The “TortoiseGit” **Commit** dialog box is displayed.

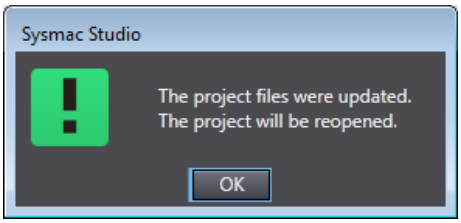


   In the **Message** area, comments on the revert processing are automatically displayed.

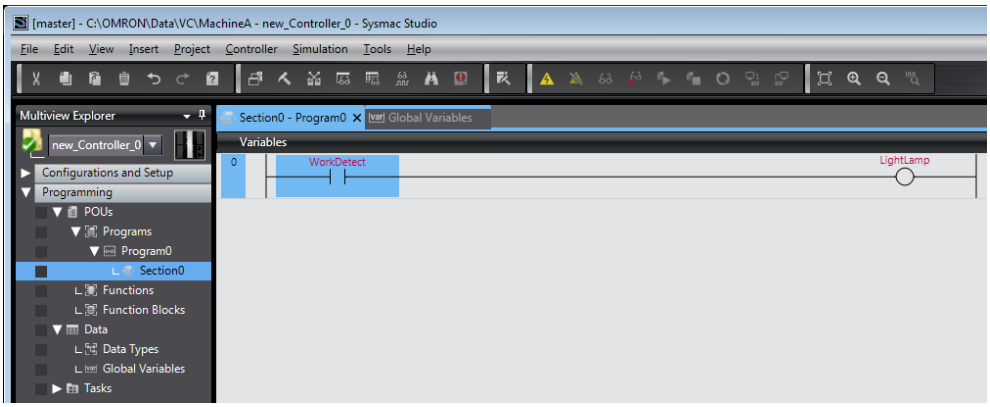
4. Confirm that the check boxes for all files listed under **Changes made** are selected, and click the **Commit** button.
   A dialog box is displayed to indicate the completion of the commit processing.



5. Click the **Close** button, and then on the “TortoiseGit” **Log Messages** dialog box click the **OK** button.
A confirmation dialog box is displayed.



6. Click the **OK** button.
The project is saved and reverted project is opened.
As shown below, the project is restored to the specified revision.



7 DEVELOPMENT BY MULTIPLE DEVELOPERS AND DERIVED DEVELOPMENT OF SYSMAC STUDIO PROJECT

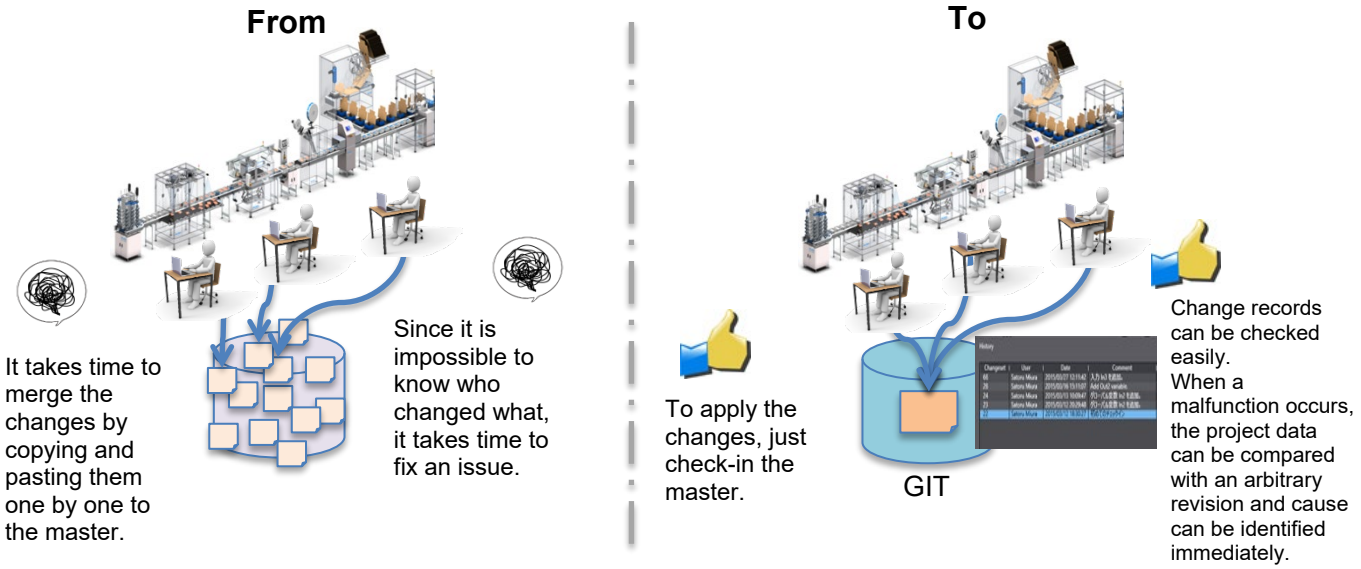
In order to shorten the development period of controller systems, some projects are carried out concurrently by multiple developers. This development method is called “development by multiple developers”. In addition, as variations of production machine increase, it is required to develop a common program for derived machines with different hardware configurations. This development method is called “derived development”.
This section explains the development by multiple developers and derived development which utilize the version control function of the Sysmac Studio projects.

- Utilization of version control function in development by multiple developers and derived development
- “Branch” and “Merge” which are essential for development by multiple developers and derived development
- Operating procedure of development by multiple developers and derived development

7.1 Utilization of version control function in development by multiple developers and derived development

(1) Development by multiple developers

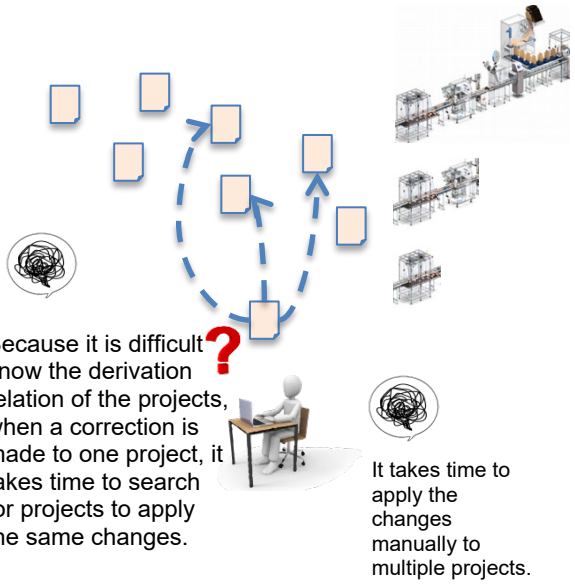
In development carried out by multiple developers, it takes time to correctly reflect all the changes made by each developer to the master project.
If different changes have been made to the same portion by multiple developers, the changes applied to the master project earlier might be canceled. For this case, errors might occur and it takes much labor hour to find the causes and correct the mistakes.
The record control function and merge function of the version control allow you to reliably apply changes of each developer to the master project.



(2) Derived development

When projects for multiple machines are individually managed in derived development, mistakes might occur or some changes can be omitted when applying changes to the common program of each project.
The record control function and merge function of the version control allow you to reliably find changes in multiple derived machine projects and apply the changes easily.

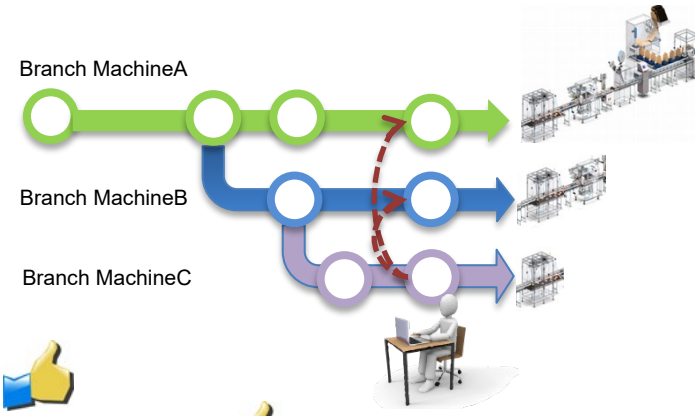
From



Because it is difficult know the derivation relation of the projects, when a correction is made to one project, it takes time to search for projects to apply the same changes.

It takes time to apply the changes manually to multiple projects.

To



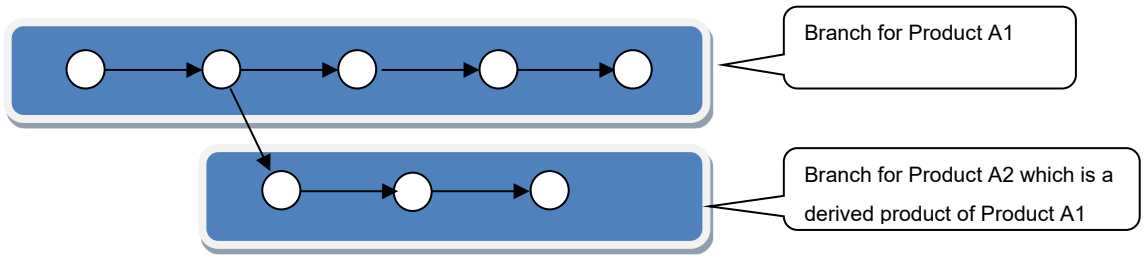
The branch tree shows the derivation relationship of the projects. You can find the project to apply the changes.

It is possible to compare arbitrary projects and check the changes.

You can easily apply the changes to other projects.

7.2 Branch and Merge

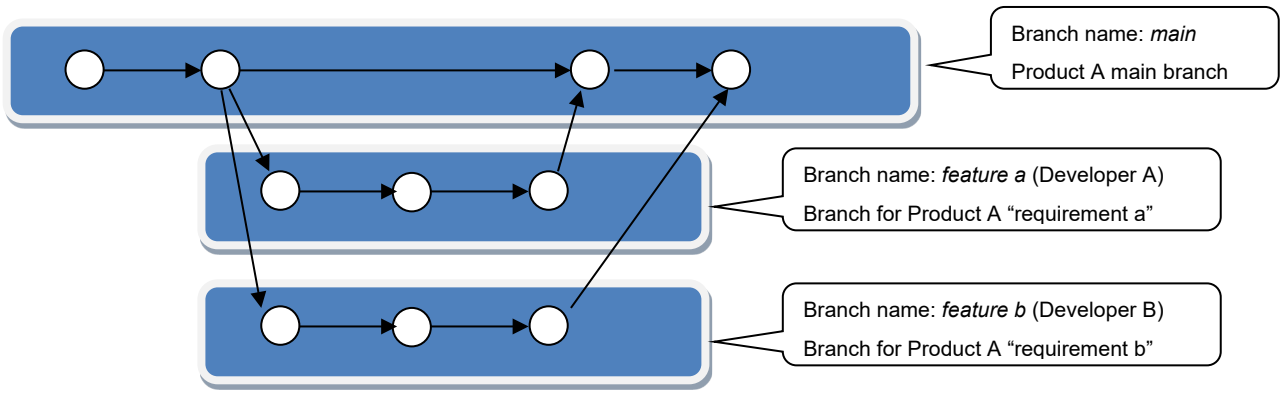
A branch represents a series of change record information.
At the time of creating and starting to use the repository, there is one branch. However, another branch can be created (branching) from a change set, and the branched project is managed without affecting the change of the original branch.



If you use the branches in concurrent development by multiple developers or development for version upgrading, project data can be managed separately so that it does not affect other projects which other developers are editing or ones for already released products.

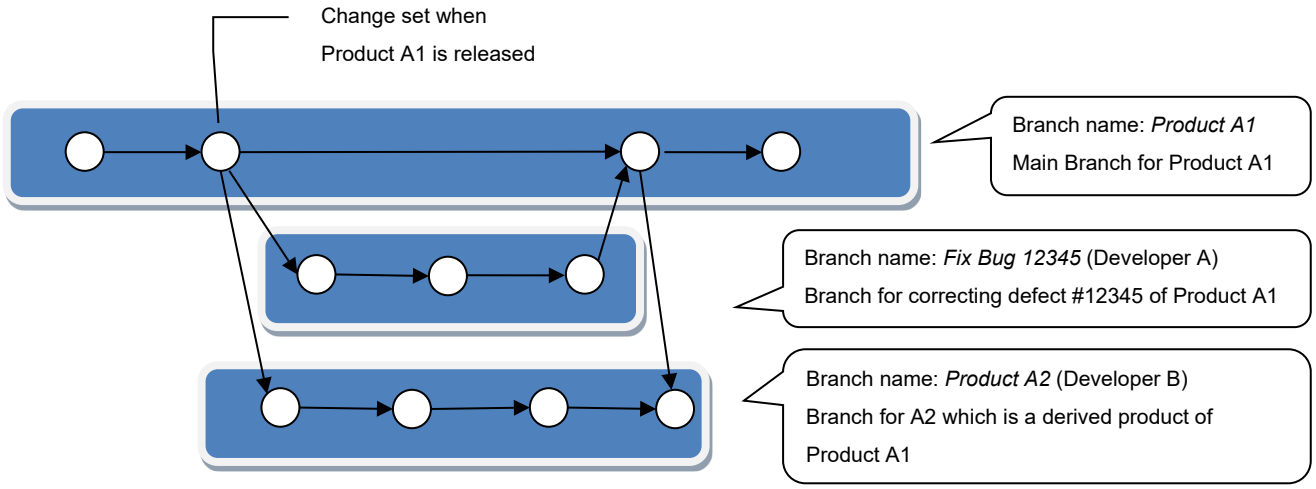
In development by multiple developers or derived development, changes made in branches may also be applied to the original branch.
At this time, we use the function called "merge" that combines the original branch with other branches.

(1) Example of branching and merging in concurrent development



As shown in the above figure, a branch *main* is created to be the starting point. From the *main* branch, to carry out development for “requirement a” and” b” concurrently, create *feature a*, a branch for “requirement a” and *feature b*, a branch for “requirement b”.
When development in both branches is completed and satisfactory quality is achieved, merge them to the *main* branch.

(2) Example of branching and merging in derived development



As shown in above figure, when you develop A2 which is a derivative product of product A1, create a branch *Product A2* from the change set of branch *Product A1* at the time of product release.
When a problem occurs in product A1 and it is necessary to modify the project, create a branch *Fix Bug 12345* for defect correction from the change set at the time of product A1 release. When quality is secured in the branch, merge it to the original branch *Product A1*.
If it is necessary to apply this modification not only to Product A1 but also to Product A2, you can apply the changes in the branch *Fix Bug 12345* all together to the branch *Product A2*. Merge the change set of branch for Product A1 after merging fix bug branch into the branch of Product A2.

7.3 Sysmac Studio Project Development by Multiple Developers

This section describes how to develop the Sysmac Studio project concurrently by multiple developers, example of sharing the development works and operation procedure.

7.3.1 Sharing Edit Works to Concurrently Develop a Project by Multiple Developers

The version control function has a feature to help multiple developers to edit one project concurrently and to combine their changes when they “Push” their changes to the remote repository.
However, if multiple developers edit the same portion at the same time and try to merge the changes, a conflict occurs and merging fails. To avoid this problem, a specific developer edits the data which does not support the development by multiple developers (“No” in below table), and data which allows multiple developers to edit (“Yes” in below table) can be edited by multiple developers.

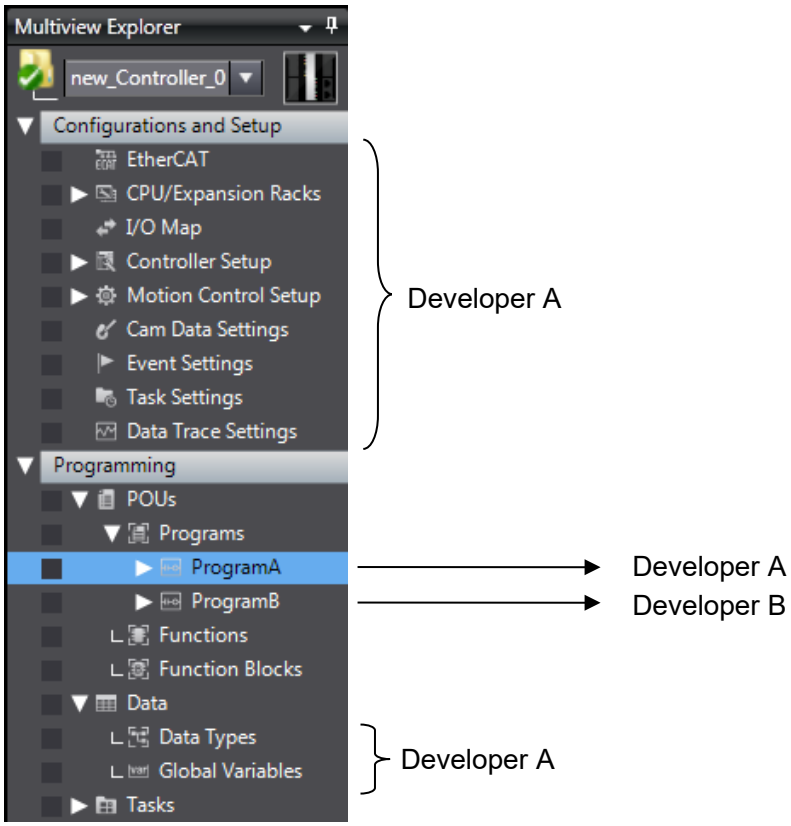
Data name	Edit by multiple developers
EtherCAT	No
CPU/Expansion Racks	No
I/O Map	No
Controller Setup	No
Axis Settings	No
Axes Group Settings	No
Cam Data Settings	No
Event Settings	No
Task Settings	No
Programs	Yes
Functions	Yes
Function Blocks	Yes
Data Types	No
Global Variables	No

7.3.2 Example of Dividing Tasks

This section describes how to divide the roles of developers and the scenario as a prerequisite of the next section.

7.3.2.1 How to Divide Tasks

In this example, two developers (Developer A and B) are working on a project.
Developer A configures Configurations and Setup, Data Types, and Global Variables, and develops ProgramA.
Developer B develops ProgramB.



7.3.2.2 Scenario

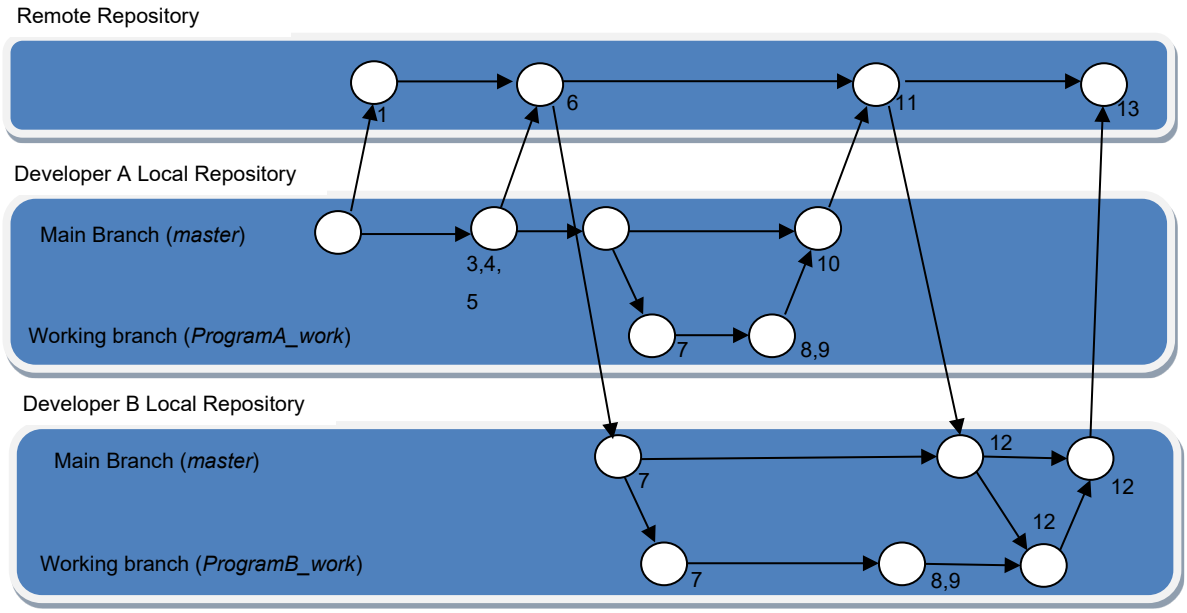
The Developer A and B work on above mentioned tasks of the project in the procedure of the below table.

No.	Developer A tasks	Developer B tasks	Reference for the tasks
1	Register a project in the remote repository *Developer A registers the base project in the repository.	-	7.3.3.1 Register a project in the remote repository (No.1: Developer A)
2	Load the project from the remote repository	-	7.3.3.2 Load the project from the remote repository (No.2: Developer A)
3	Configure Configurations and Setup	-	7.3.3.3 Commit the project in which Configurations and Setup, Data Types, Global Variables, and program POUs are registered (No. 3,4,5: Developer A)
4	Set the Data Types, Global Variables, and program POUs	-	
5	Commit the project in which Configurations and Setup, Data Types, Global Variables, and program POUs are registered	-	
6	Push the changes in the local repository to the remote repository *After this operation, Developer A and B can concurrently edit the project data.	-	7.3.3.4 Push the changes in the local repository to the remote repository (No.6: Developer A)
7	Create the working branch of Developer A in the local repository	· Copy the target project in the remote repository to the computer of Developer B and create the local repository · Create the working branch	<Developer A> 7.3.3.6 Create the working branch of Developer A (No.7 Developer A) <Developer B> 7.3.3.5 Create the local repository in the Developer B computer (No.7: Developer B) 7.3.3.9 Create the working branch of Developer B (No.7: Developer B)
8	Develop Program A Add Global Variables	Develop Program B Change the initial values of Global Variables	7.3.3.7 Commit changes of Program A and Global Variables to the working branch (No.8, 9: Developer A) 7.3.3.10 Commits changes of Program B and Global Variables to the branch (No.8, 9: Developer B)
9	Commit changes of Program A and Global Variables to the working branch	Commit changes in Program B and Global Variables to the working branch	
10	Merge the changes of working branch to the main branch * The project in the local repository created in No,1 is the main branch of Developer A.	-	7.3.3.8 Merges the changes of working branch to the main branch (No.10: Developer A)
11	Push the changes in the local repository of Developer A to the remote repository * After this operation, changes made by Developer A and B can be merged.	-	7.3.3.11 Push the changes in the local repository of Developer A to the remote repository (No.11: Developer A)
12	-	Obtain the latest data from the main branch and merge it to Developer B's working branch. Then, remerge the data after merging to the main branch	7.3.3.12 Merges the changes in the working branch of Developer B to the main branch (No.12: Developer B)
13	-	Push the changes in the main branch of Developer B from the local repository to the remote repository	7.3.3.13 Push the changes in the main branch of Developer B to the remote repository (No.13: Developer B)

-: No task

The following figure illustrates the relationship between the repositories and branches.
The changes in the main branch of the local repository of each developer's computer are exchanged through the remote repository. On the local repository of each developer, a working branch is created and the changes are merged.

The numbers next to ○ in the figure correspond to the task numbers of Developers A and B shown in the above table.



7.3.3 Operating Procedure

This section explains the operating procedure along with the description in *7.3.2.2 Scenario*.

7.3.3.1 Register a project in the remote repository (No.1: Developer A)

1. Creating a remote repository
   Create a remote repository to share with multiple developers.
   Here, create a remote repository with the folder name "C: \ Git \ MachineA.git" on Developer A's computer.
   Refer to *5.6 Creating the shared folder and remote repository* for details.

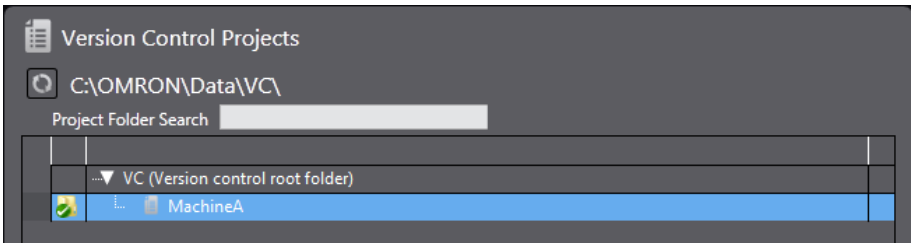
2. Registering the local repository and creating and saving the base project
   Create a new project and register it in the local repository.
   Here, create a project “MachineA” in the Developer A’s computer, commit it to the local repository, and then push it to the remote repository.
   Refer to *6.3 Preparing for Starting Project Control (Creating a Base Project and Saving It)* for details.

7.3.3.2 Load the project from the remote repository (No.2: Developer A)

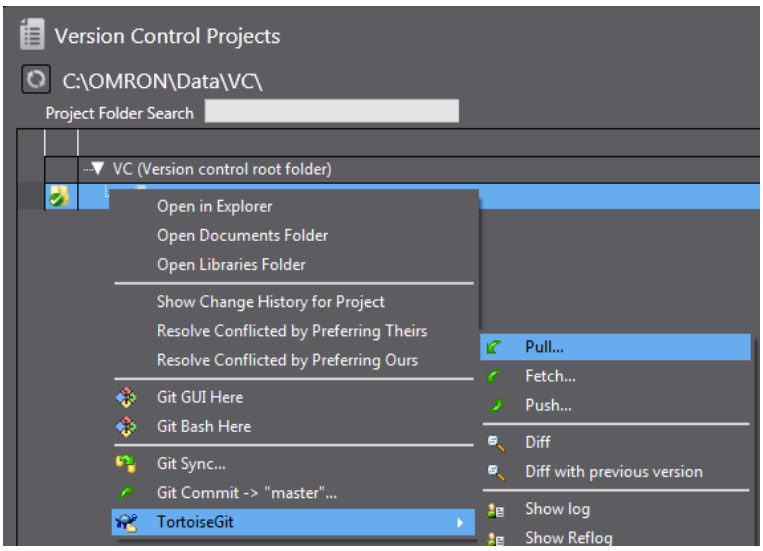
After the project is registered in the remote repository, there is a possibility that other developers are updating the target project of the remote repository. In order to synchronize the local repository in the Developer A’s computer with the remote repository which functions as the master, take the following steps.

In this scenario, this operation is unnecessary immediately after the procedure in *7.3.3.1 Register a project in the remote repository (No.1: Developer A)*, since only Developer A accesses the remote repository.

1. On the Start page of the Sysmac Studio, select **Version Control Explorer** and open the **Version Control Projects** window.

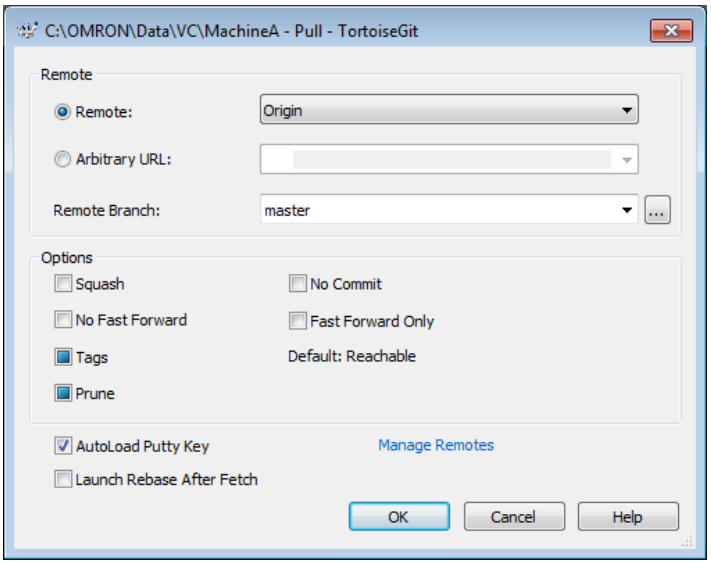


2. Right-click the MachineA and select **TortoiseGit** - **Pull** from the pop-up menu.

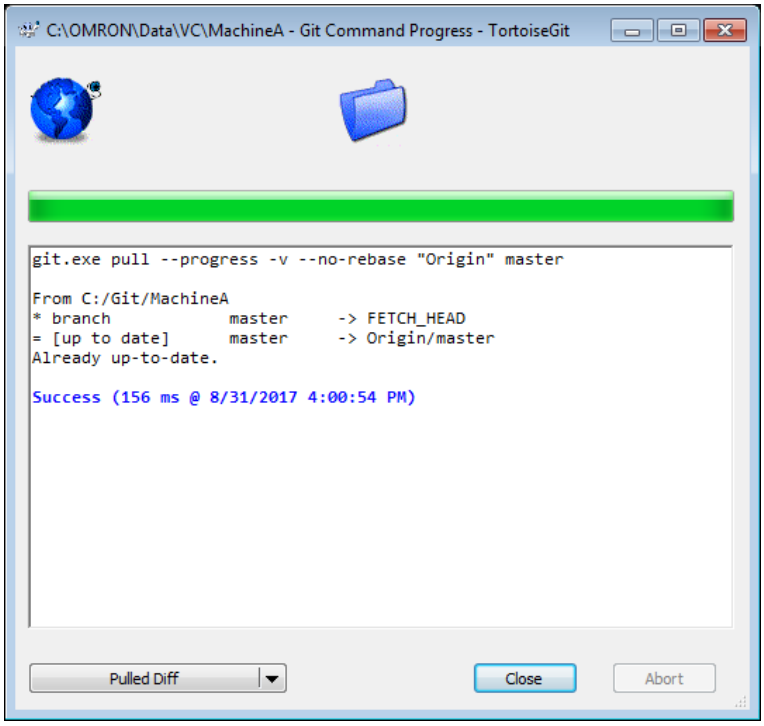


The “TortoiseGit” **Pull** dialog box is displayed.

3. Check that “Origin” is selected in **Remote** (the path to the remote repository is set as C:\Git\MachineA.git) and click the **OK** button.



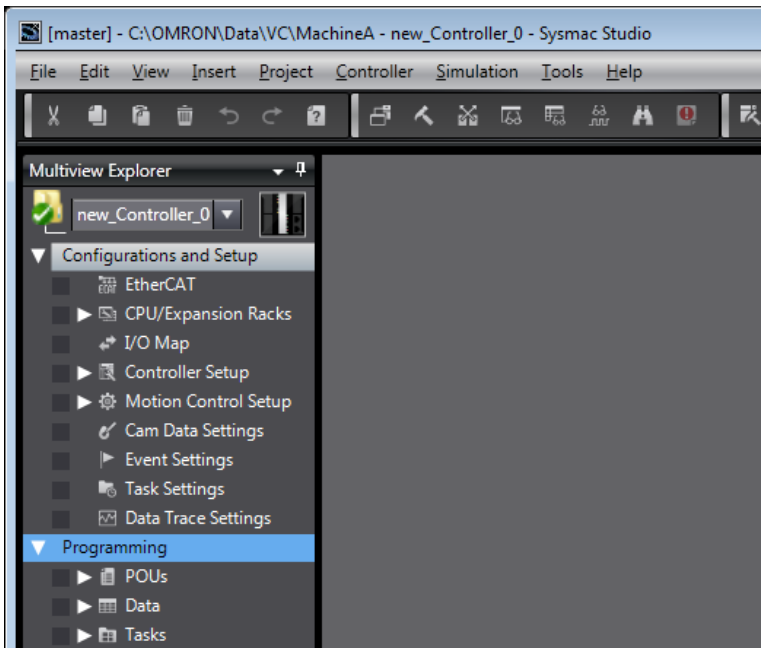
This completes Pull processing.



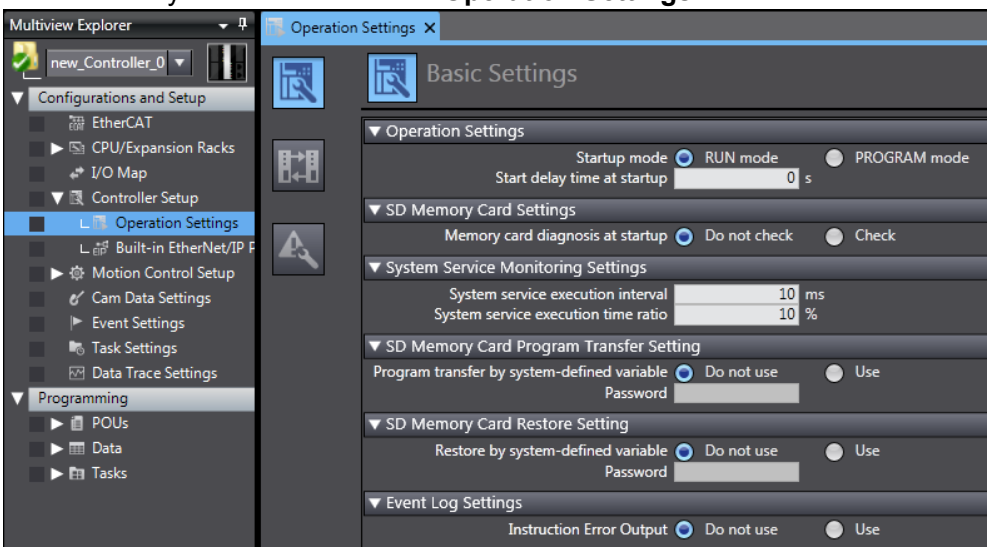
4. Click the **Close** button.

7.3.3.3 Commit the project in which Configurations and Setup, Data Types, Global Variables, and program POUs are registered (No. 3,4,5: Developer A)

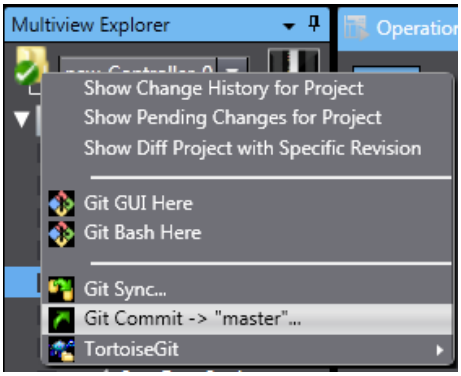
1. Select the project *MachineA* in the **Version Control Explorer**, and then click the **Open** button.
   The new project is opened.



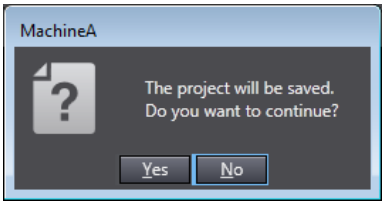
2. Set necessary data for the items in **Operation Settings** tab.



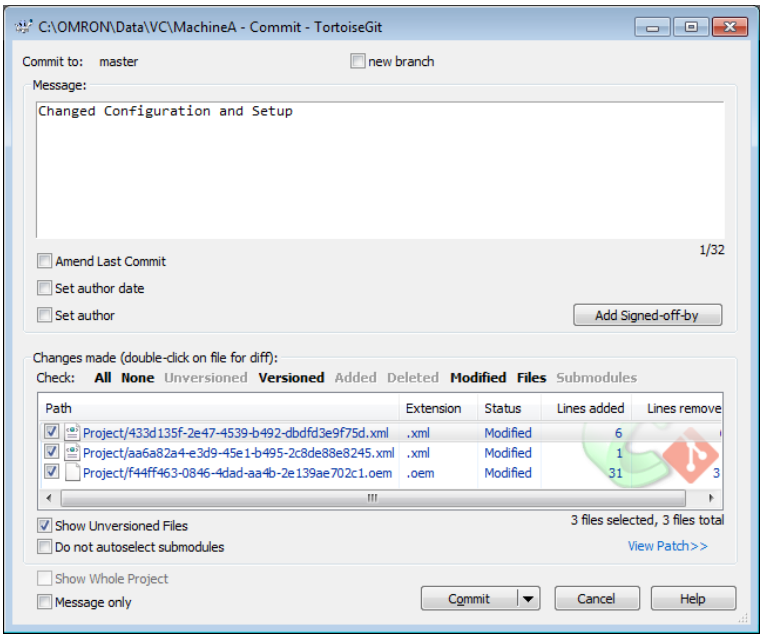
3. In order to Commit it to the local repository, right-click the folder icon in the Multiview Explorer and select **Git Commit -> "master"** from the pop-up menu.



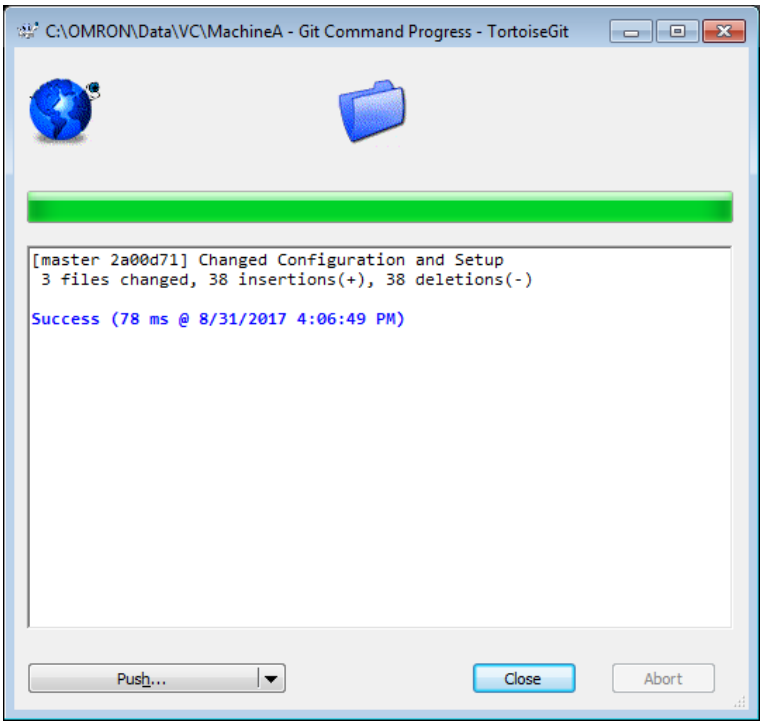
The confirmation dialog box is displayed.



4. Click the **Yes** button.
   The “TortoiseGit” **Commit** dialog box is displayed.

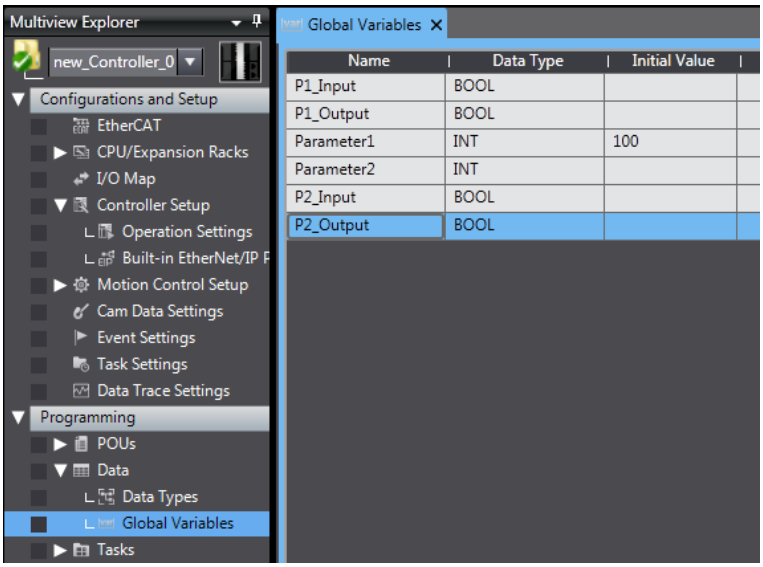


5. Enter comment in the **Message** area and click the **Commit** button.
   Commit is completed.

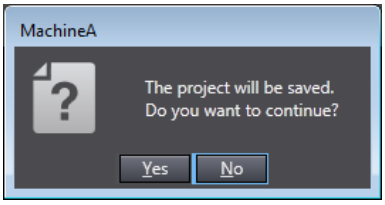


6. Click the **Close** button.

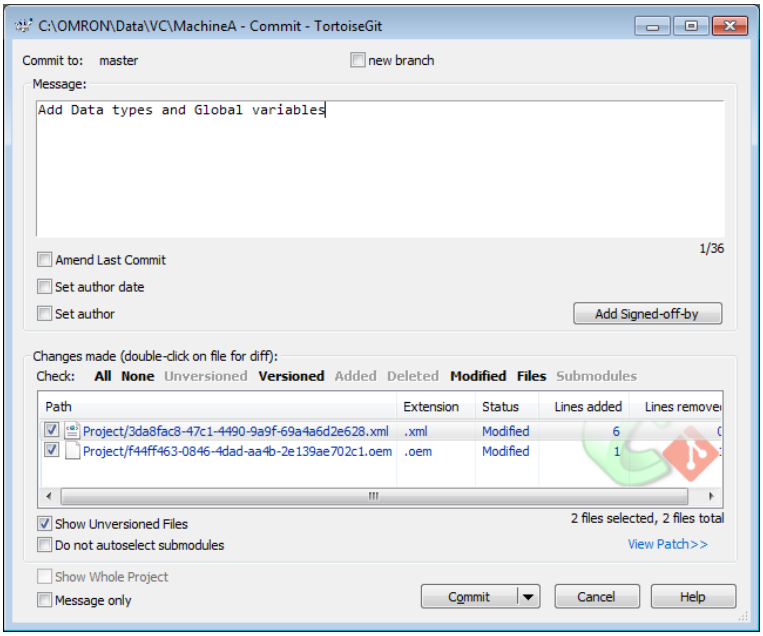
7. Then, enter the Data Types and Global Variables.



8. In order to Commit them to the local repository, right-click the folder icon in the Multiview Explorer and select **Git Commit -> "master"** from the pop-up menu.
   A confirmation dialog box is displayed.



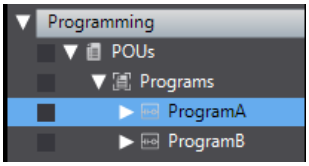
9. Click the **Yes** button.
   The "TortoiseGit" **Commit** dialog box is displayed.



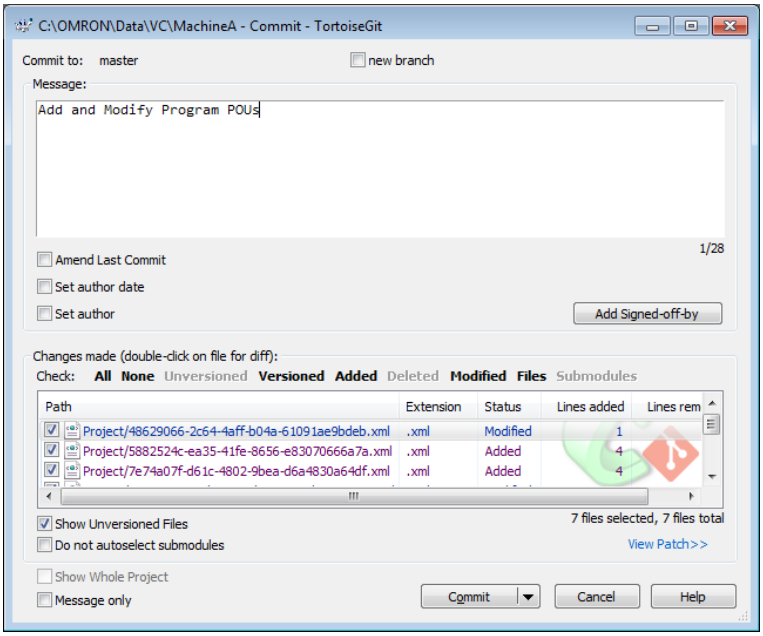
10. Enter comment in the **Message** area and click the **Commit** button.

11. Click the **Close** button in the **Complete Commit** dialog box.

12. Next, create the program POUs.
    In this example, Developer A develops Program A and Developer B develops Program B. First, Developer A creates the both program POUs in advance.



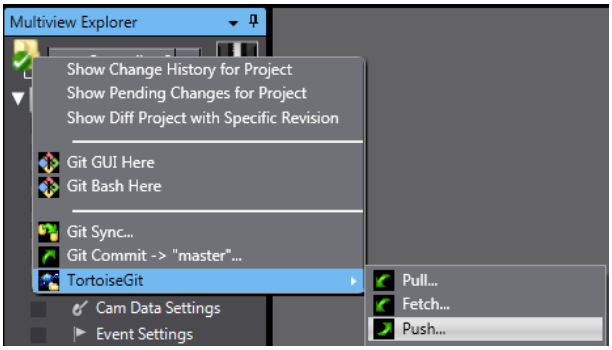
13. Commit the POUs in the same way as data types and global variables were committed.



7.3.3.4 Push the changes in the local repository to the remote repository (No.6: Developer A)

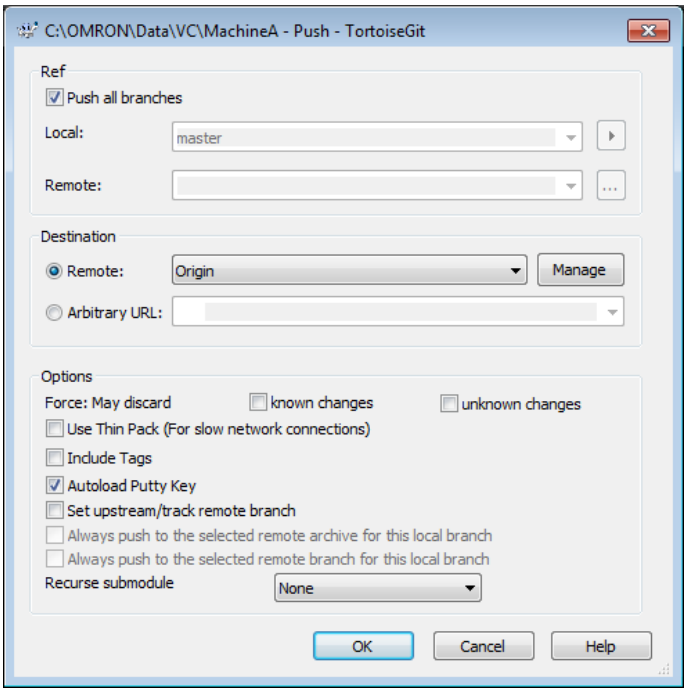
Before Developer B starts working concurrently with Developer A, Developer A pushes his/her working result of common data (Configurations and Setup, Data Types, Global Variables, and program POUs) to the remote repository.

1. Right-click the folder icon in the Multiview Explorer or on the target project in the **Version Control Projects** window, and select **TortoiseGit - Push**.

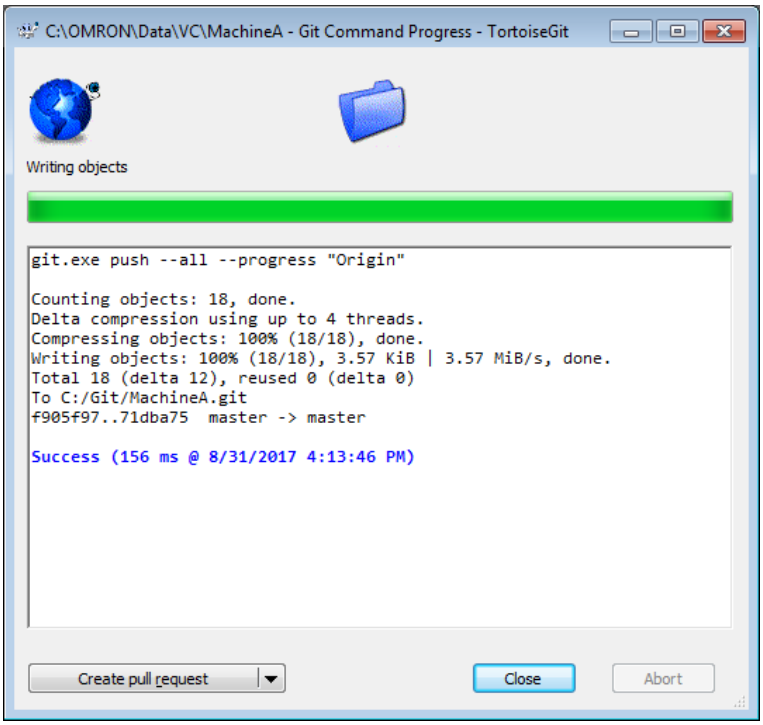


   The “TortoiseGit” **Push** dialog box is displayed.

2. Make sure that the **Push all branches** check box is selected and **Remote** item is correctly set (“Origin” is set in this example), and then click the **OK** button.



This completes Push processing.

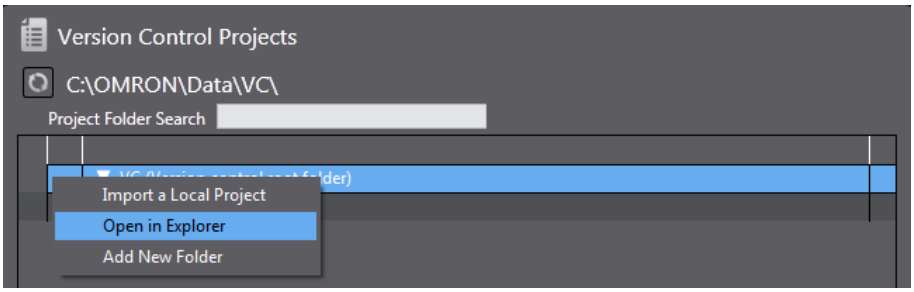


3. Click the **Close** button.

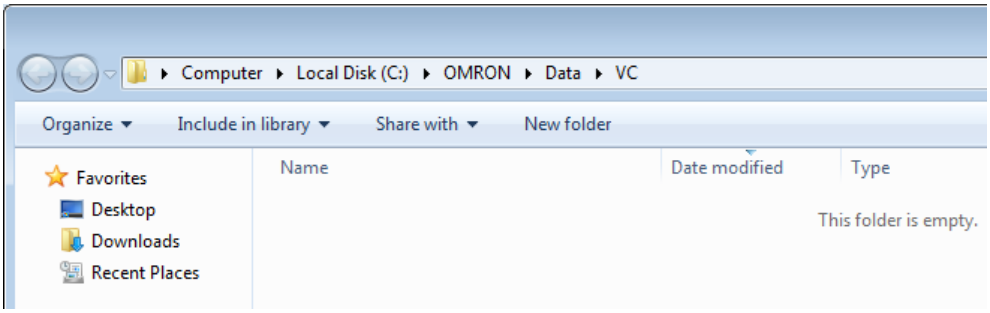
7.3.3.5 Create the local repository in the Developer B computer (No.7: Developer B)

By the operation so far, data that Developer A edited (Configurations and Setup, Data Types, and Global Variables) has been registered in the remote repository.
From this point forward, in order to make it possible for Developer B to work concurrently, obtain the target project from the remote repository and create a local repository in the Developer B's computer.
It is assumed that setup and basic settings of software in the Developer B's computer have been completed.

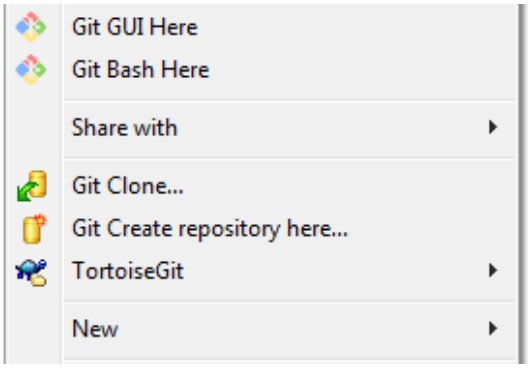
1. In the **Version Control Projects** window, right click on **VC (Version Control root folder)** and select **Open in Explorer** from the pop-up menu.



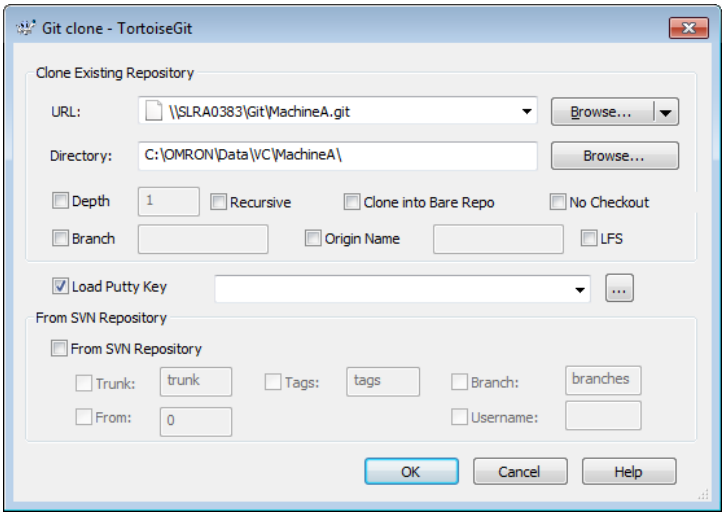
In Windows Explorer, the *VC* folder is opened.



2. Right-click on the arbitrary position in the *VC* folder and select **Git Clone**.



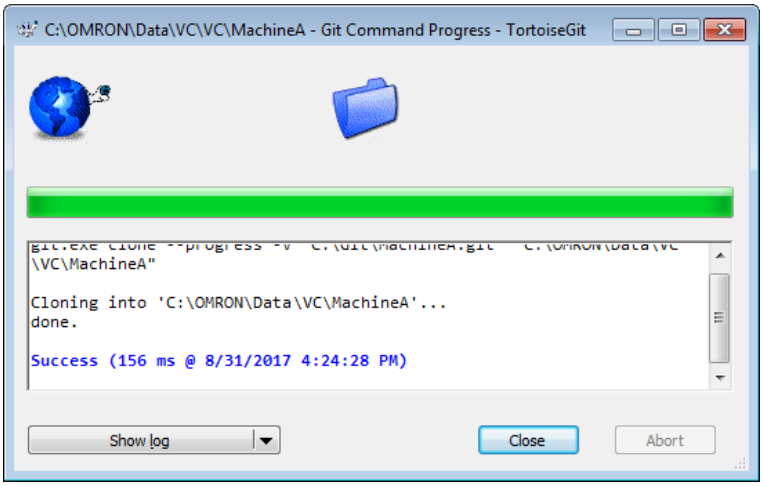
The TortoiseGit **Git Clone** dialog box is displayed.



3. Enter the following information in the **Git clone** dialog box.

- The path to the remote repository in **URL**
  (In this example, \\SLRA0383\Git\MachineA.git, PC name: SLRA0383, shared name: Git, Repository name: MachineA.git)
- The path to the local repository in **Directory**
  (In this example, C:\OMRON\Data\VC\MachineA)

4. Click the **OK** button.
   The Git clone command copied the remote repository to the Developer B's computer. After this, this repository is called “Local repository”.



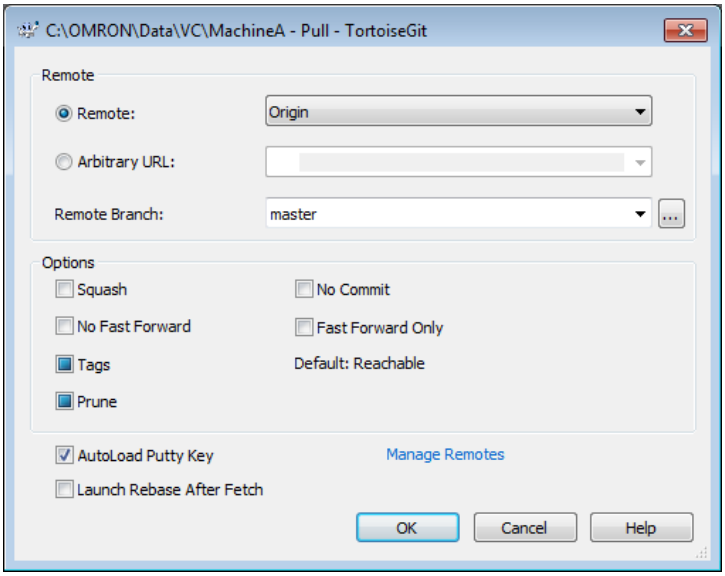
7.3.3.6 Create the working branch of Developer A (No.7 Developer A)

After the project was registered in the remote repository, there is a possibility that other developers are updating the target project in the remote repository. In order to synchronize the local repository in the Developer A’s computer with the remote repository which functions as the master, take the following steps.

1. On the Start page of the Sysmac Studio, select **Version Control Explorer** and open the **Version Control Projects** window.

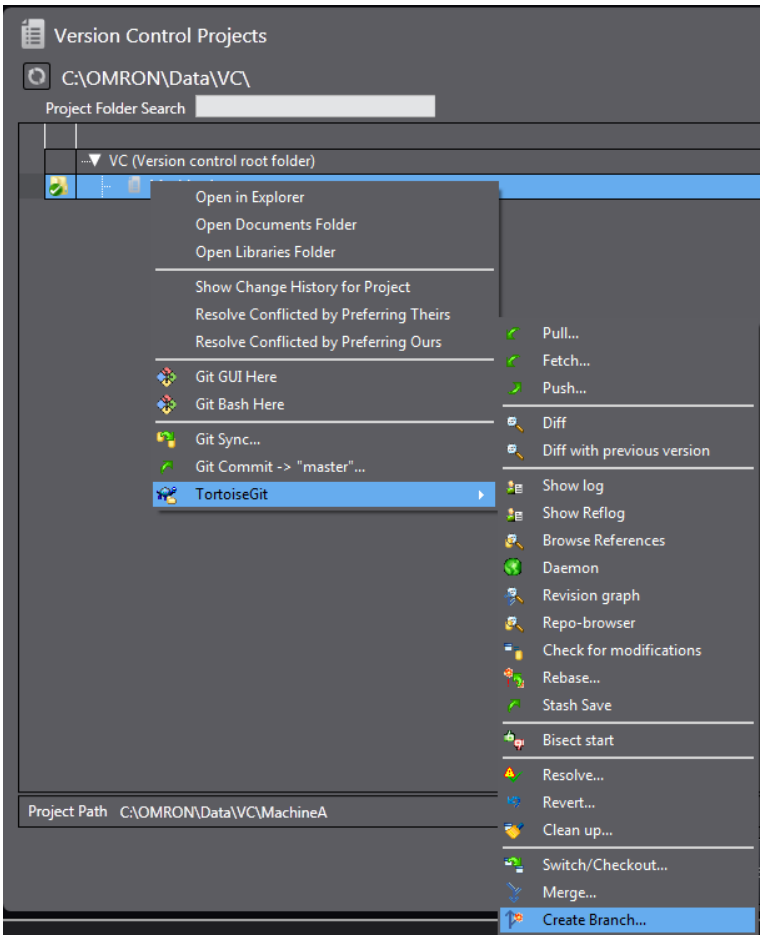
2. Right-click the MachineA and select **TortoiseGit - Pull** from the pop-up menu.
   The “TortoiseGit” **Pull** dialog box is displayed.

3. Check that “Origin” is selected in **Remote** (the path to the remote repository is set as C:\Git\MachineA.git) and click the **OK** button.



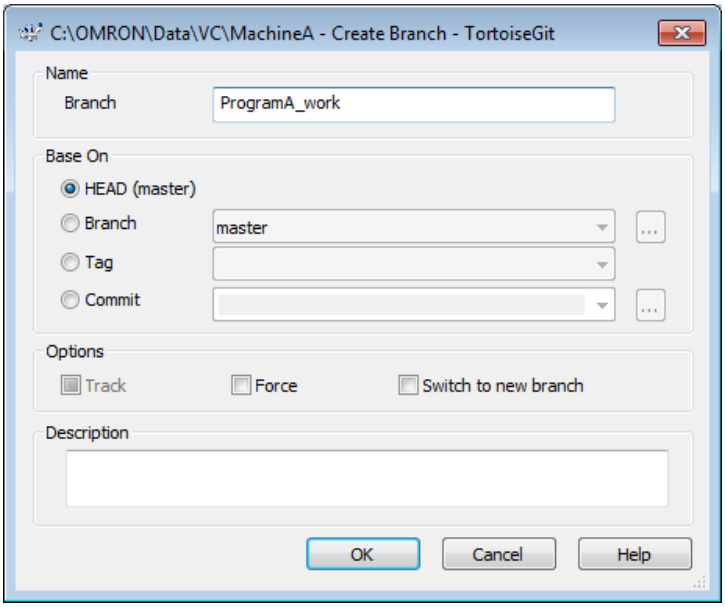
4. Click the **Close** button in the **Complete Pull** dialog box.

5. Right-click the folder icon in the Multiview Explorer or on the target project in the **Version Control Projects** window, and select **TortoiseGit - Create Branch**.



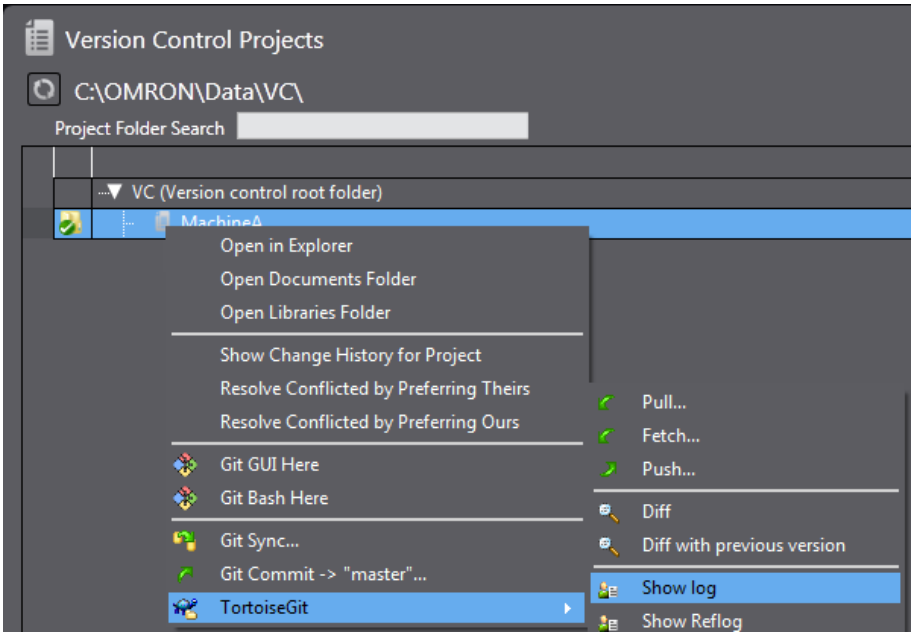
The “TortoiseGit” **Create Branch** dialog box is displayed.

6. Enter the branch name (in this example, *ProgramA_work*), and click the **OK** button.
   For **Base On**, select the latest revision. Select **Head (master).**

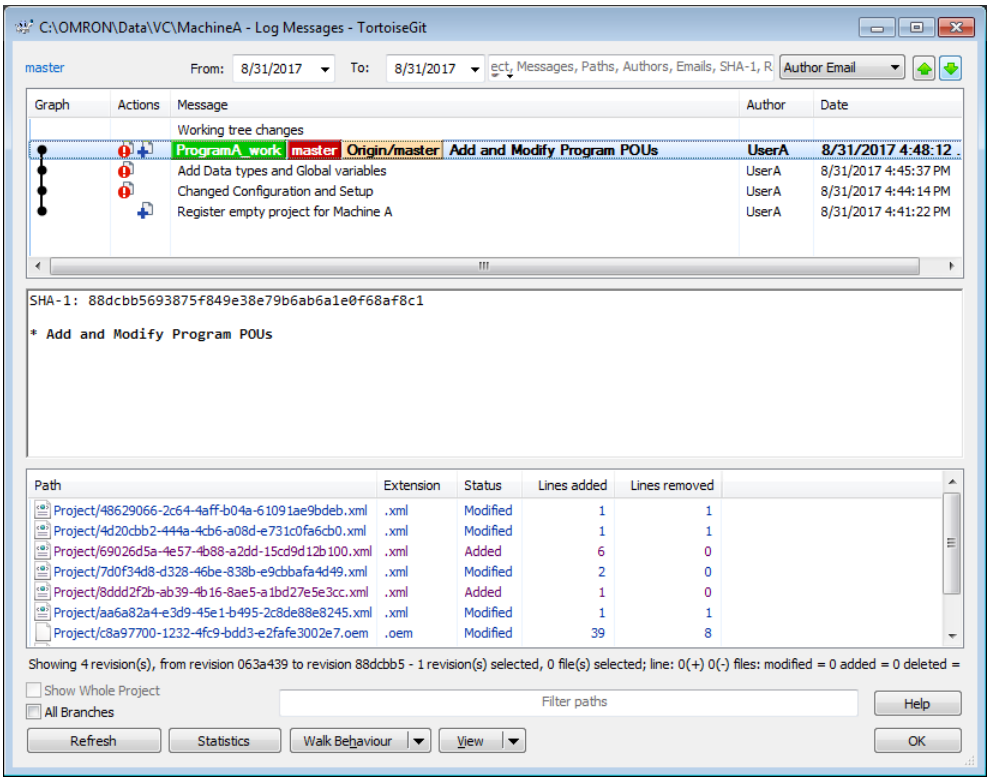


The branch is successfully created.

7. To confirm that the branch has been created, right-click the folder icon in the MultiView Explorer or the project in the **Version Control Projects** window and select **TortoiseGit - Show log.**



The “TortoiseGit” **Log Messages** dialog box is displayed.

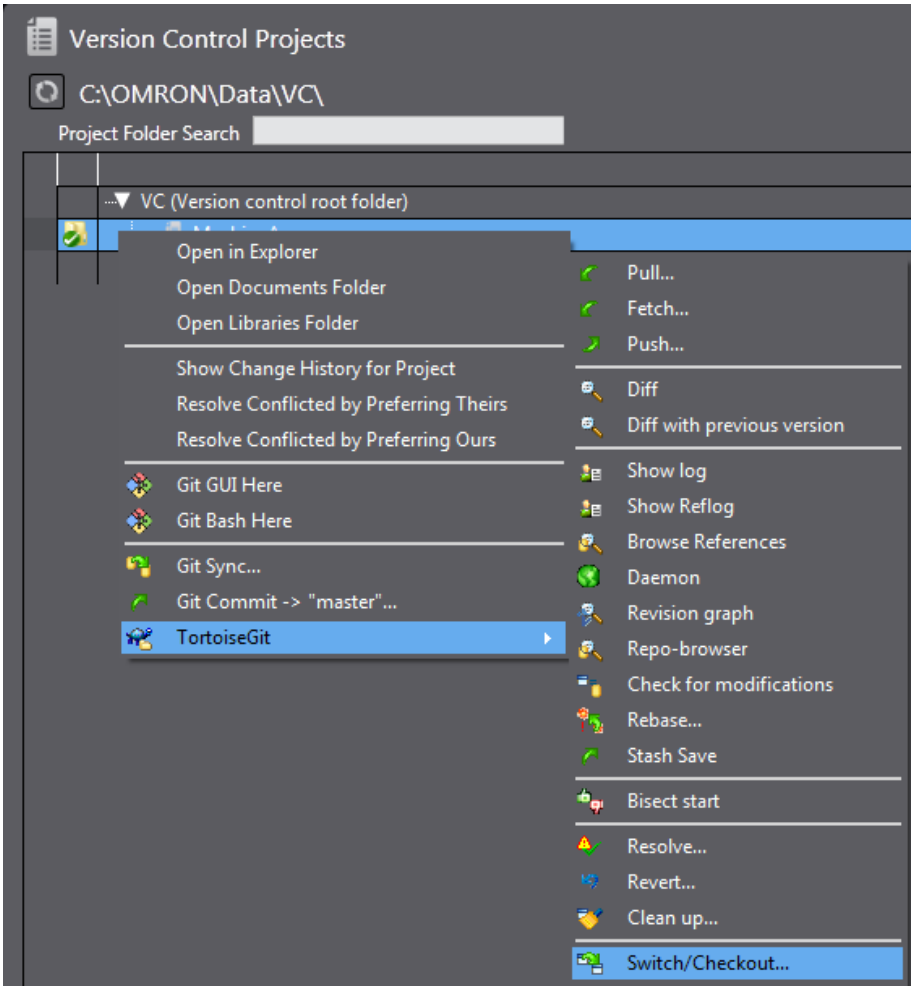


On the top of the upper pane, *ProgramA_work, master*, and *Origin/master* are shown. You can know that the working branch *ProgramA_work* was successfully created.
This line shows that the last revision named as *Add and Modify Program POUs* exists in *ProgramA_work* which is the working branch in the local repository, the main branch *master*, and the *master* in the remote repository (connecting to Origin).

7.3.3.7 Commit changes of Program A and Global Variables to the working branch (No.8, 9: Developer A)

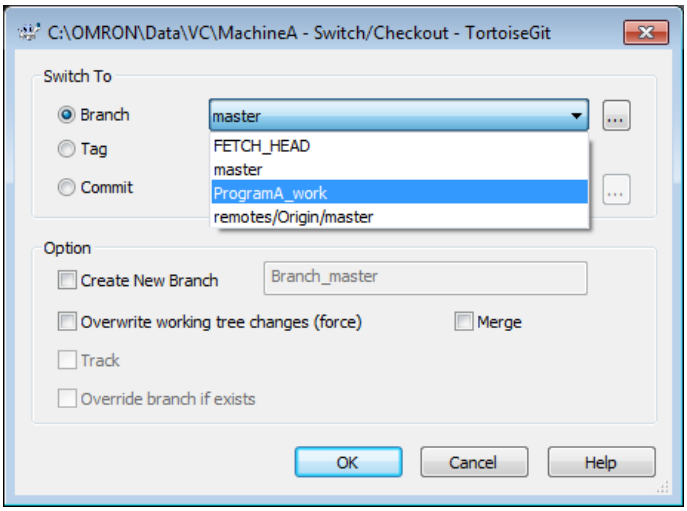
Switch the branch to work on in the Developer A's computer and modify Program A and global variables.

1. Right-click the folder icon in the Multiview Explorer or on the target project in the **Version Control Projects** window, and select **TortoiseGit - Switch/Checkout**.

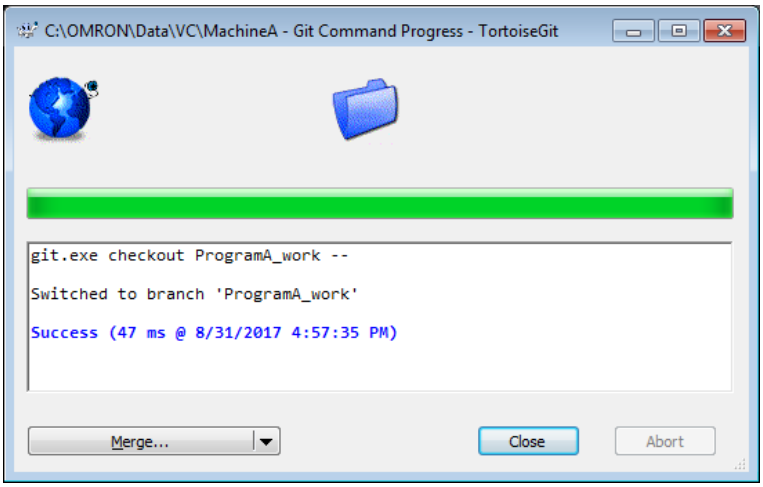


The TortoiseGit **Switch/Checkout** dialog box is displayed.

2. Select **Branch** option and *ProgramA_work* which is the working branch of Developer A created in *7.3.3.6 Create the working branch of Developer A (No.7 Developer A)*, and then click the **OK** button.

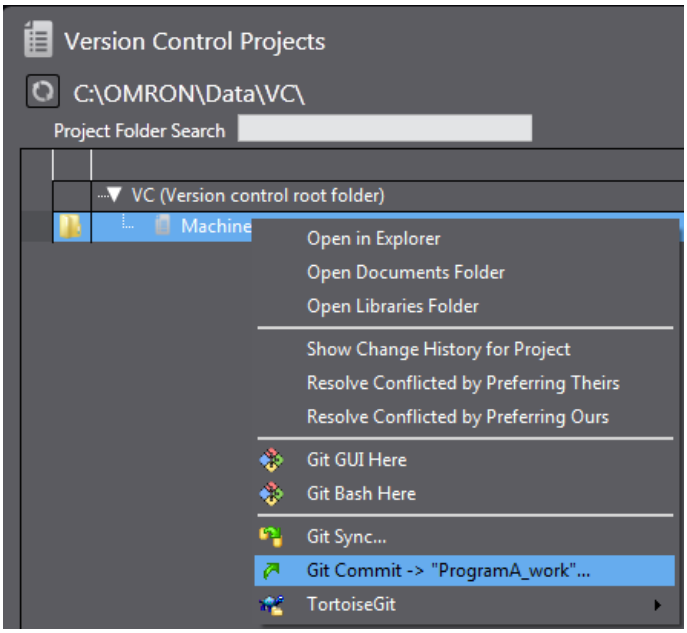


The branch is switched.

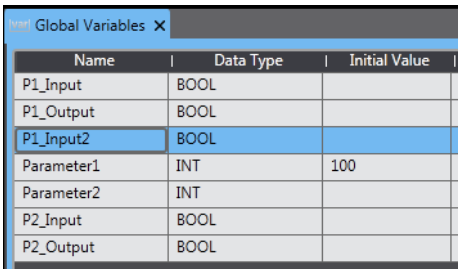


3. Click the **Close** button.

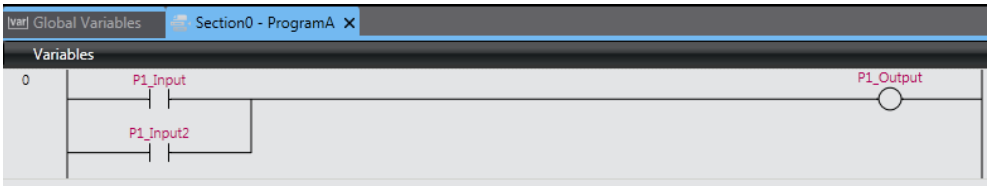
4. Right-click the folder icon in the Multiview Explorer or on the target project in the **Version Control Projects** window. You can check that the branch name that follows **Git Commit ->** is changed.



5. Develop the ProgramA and modify the settings of the Global Variables.
   Here, the following edits were made.
   Add new Global Variable “P1_Input2”.



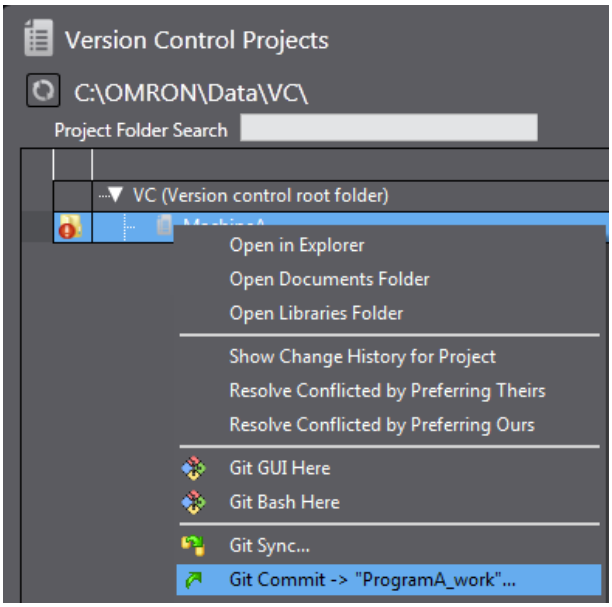
Create the following ladder diagram in the ProgramA-Section0.



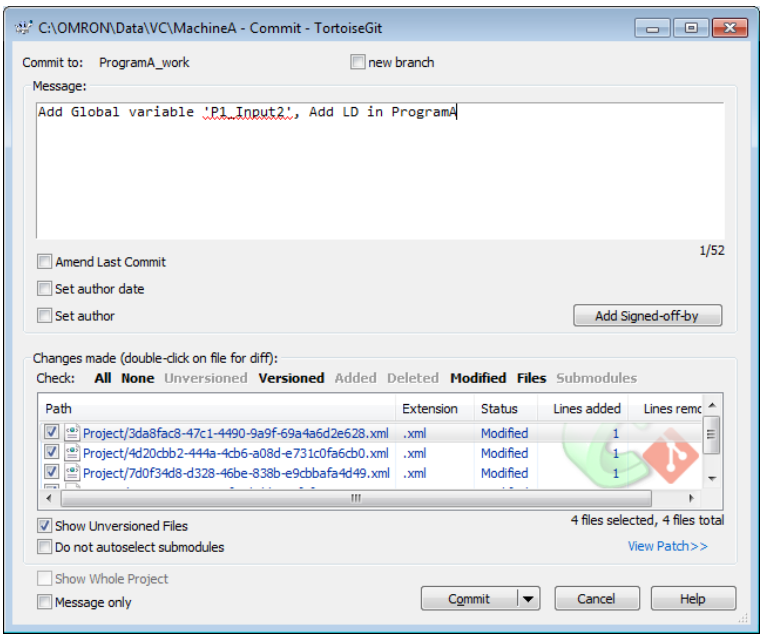
6. From the Main menu, select **File - Save** to save the project.

7. Select **File - Close** to close the project.

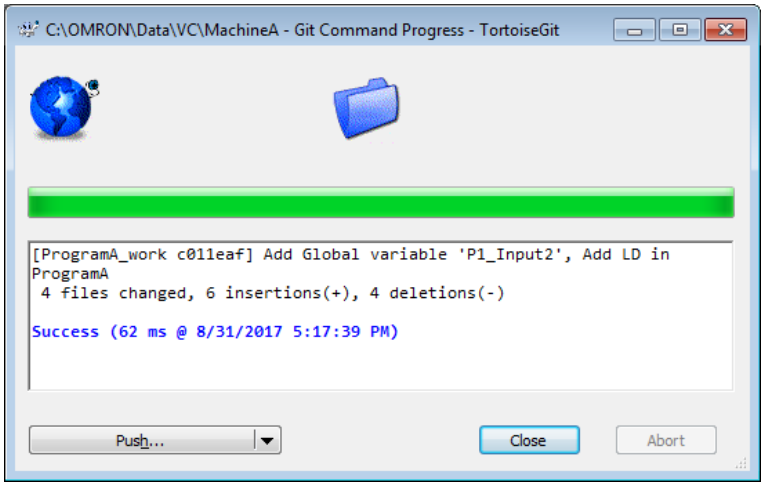
8. Right-click the target project in the **Version Control Projects** window and select **Git Commit -> "ProgramA_work"** from the pop-up menu.



The "TortoiseGit" **Commit** dialog box is displayed.



9. Enter comment in the **Message** area and click the **Commit** button.
   Commit is completed.

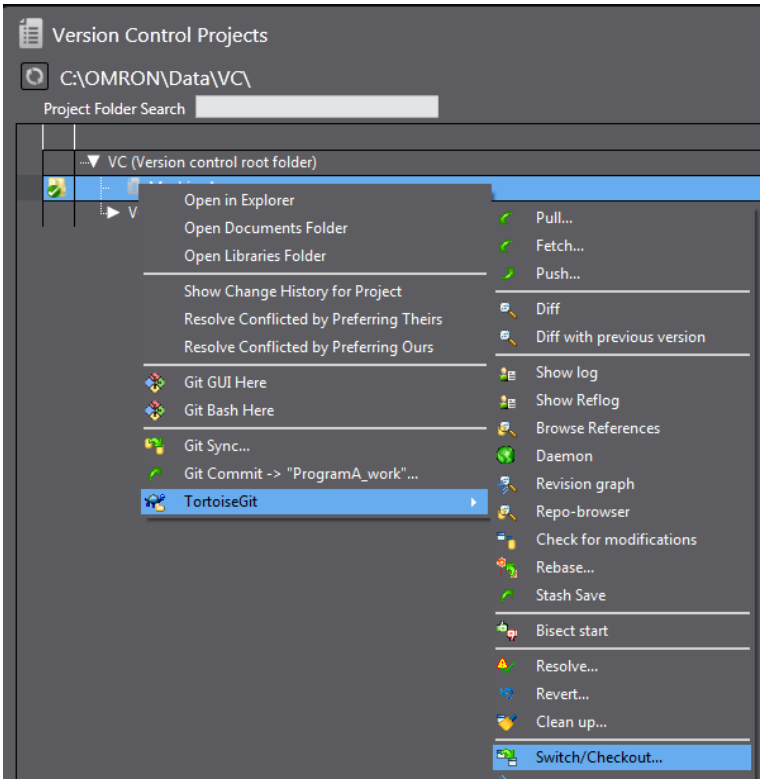


10. Click the **Close** button.

7.3.3.8 Merges the changes of working branch to the main branch (No.10: Developer A)

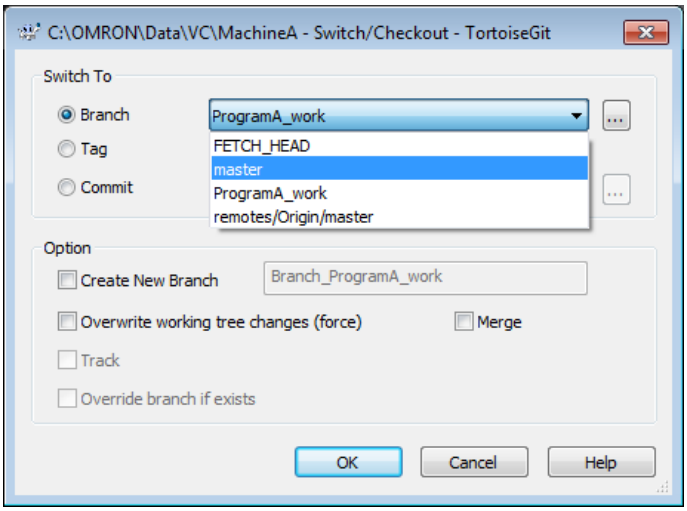
Switch the branch you work on to the main branch and then merge the changes in the working branch to the main branch.

1. Right-click the target project in the **Version Control Projects** window and select **TortoiseGit - Switch/Checkout** from the pop-up menu.

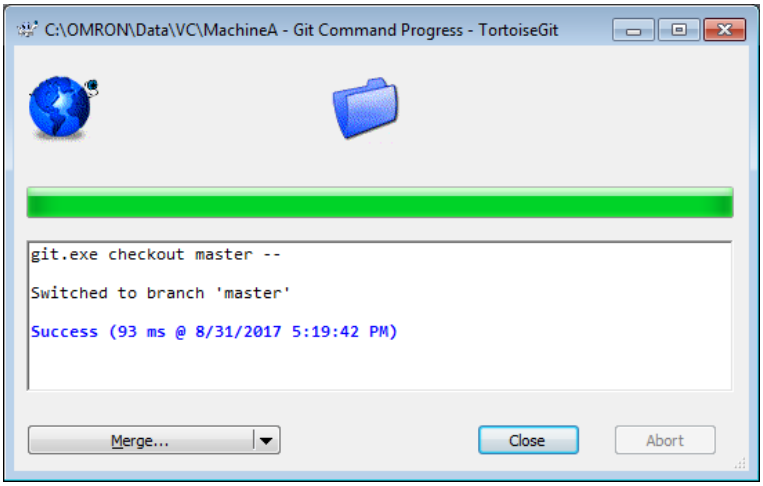


   The “TortoiseGit” **Switch/Checkout** dialog box is displayed.

2. Select **Branch** option, then *master* (main branch), and click the **OK** button.

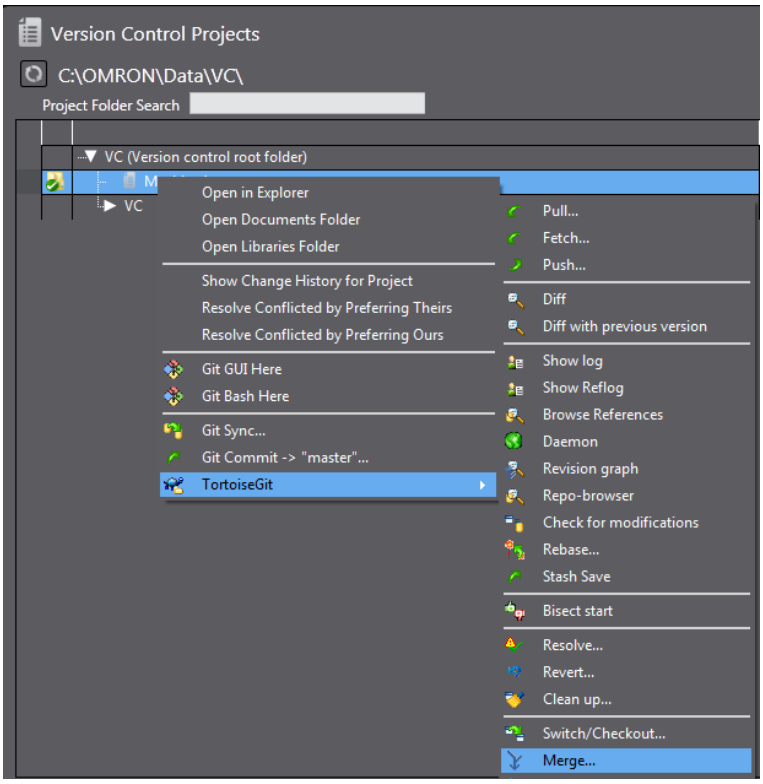


The branch is switched.



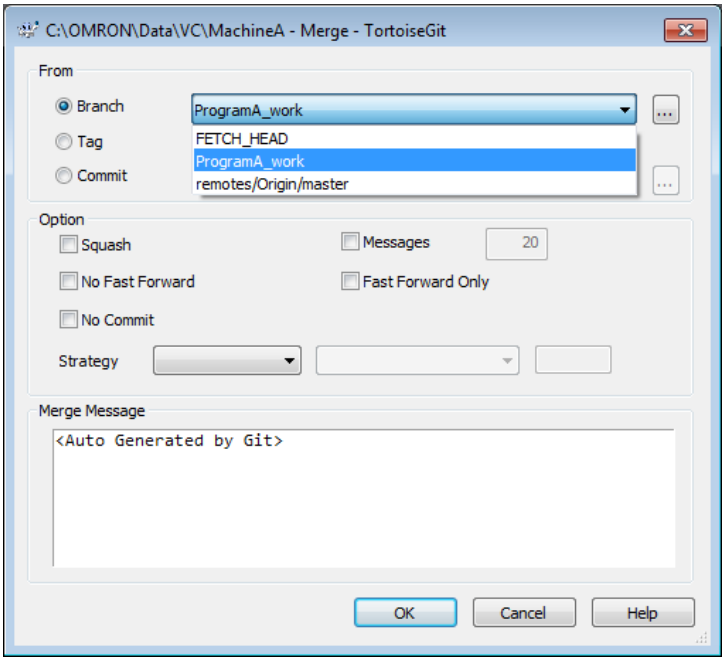
3. Click the **Close** button.

4. To merge the changes to the main branch, right-click the target project in the **Version Control Projects** window and select **TortoiseGit - Merge** from the pop-up menu.

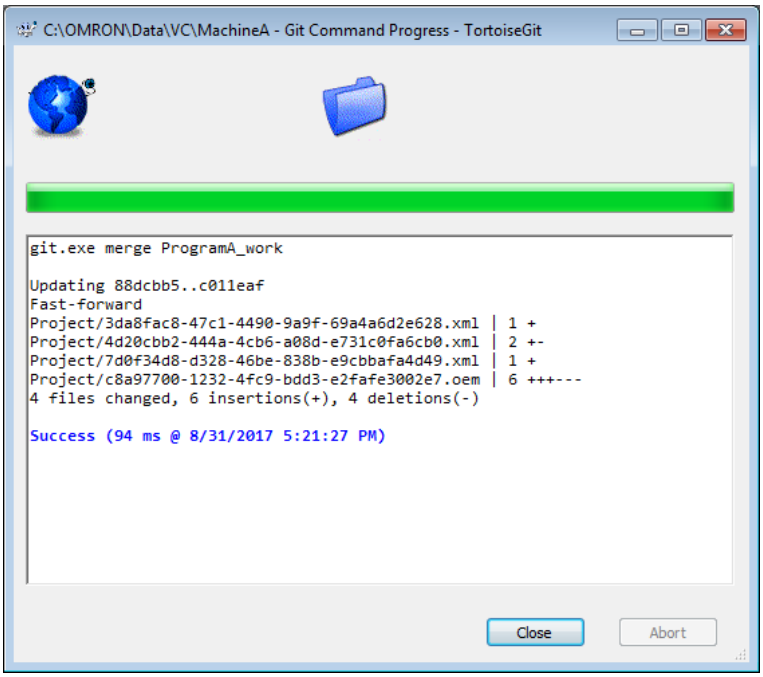


The “TortoiseGit” **Merge** dialog box is displayed.

5. Select **Branch** option, then the working branch *ProgramA_work* to merge to the main branch *master*, and then click the **OK** button.

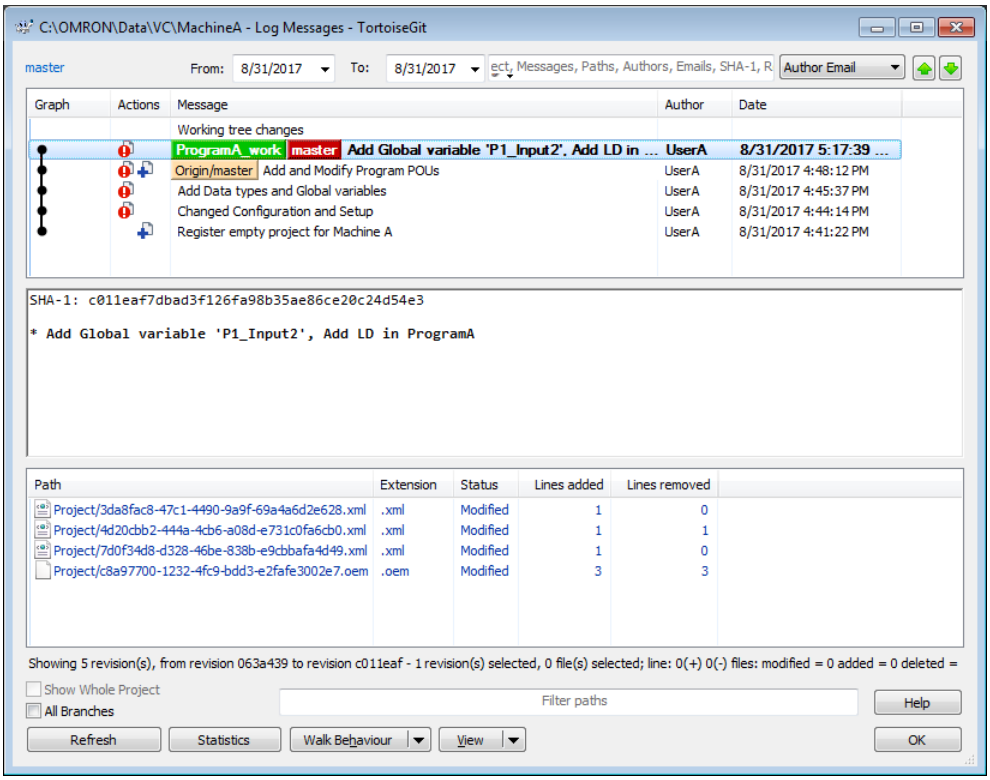


This completes Merge processing.



6. Click the **Close** button.

7. Right-click the folder icon in the MultiView Explorer or the project in the **Version Control Projects** window and select **TortoiseGit - Show log.**
   The “TortoiseGit” **Log Messages** dialog box is displayed.



On the top of the upper pane, *ProgramA_work* and *master* are shown, and in the middle pane *Add Global variable ‘P1_Input2* and *Add LD in ProgramA* are indicated. You can know that it is the latest revision of the

working branch *ProgramA_work*, and the main branch *master* is the same as the working branch *ProgramA_work*.

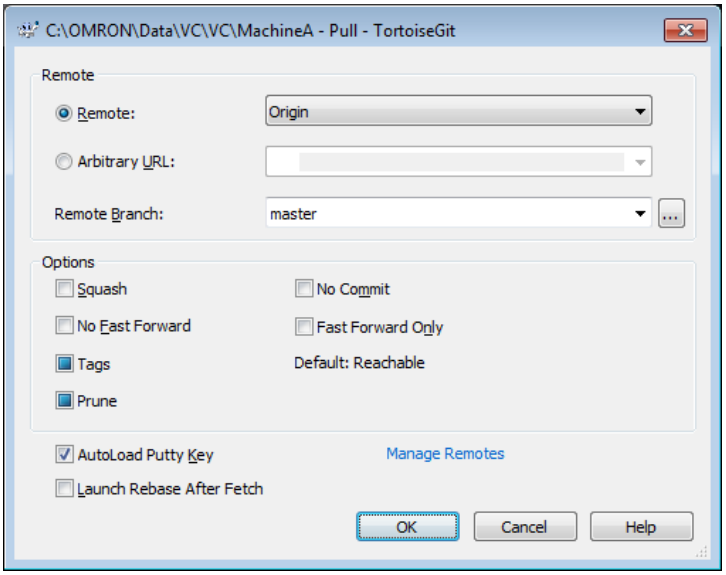
7.3.3.9 Create the working branch of Developer B (No.7: Developer B)

After registering the local repository in the Developer B's computer, there is a possibility that other developers are updating the target project in the remote repository. In order to synchronize the local repository in the Developer B's computer with the remote repository which functions as the master, take the following steps.

1. On the Start page of the Sysmac Studio, select **Version Control Explorer** and open the **Version Control Projects** window.

2. Right-click the *MachineA* and select **TortoiseGit** - **Pull** from the pop-up menu.
   The "TortoiseGit" **Pull** dialog box is displayed.

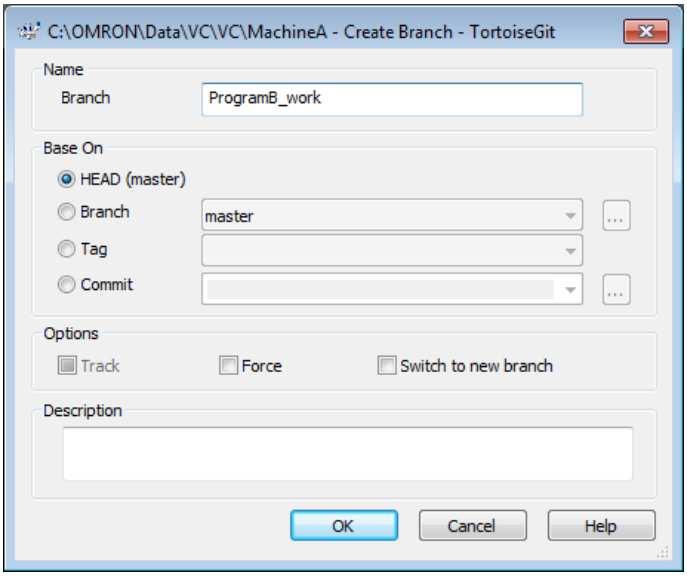
3. Check that **Origin** is selected in **Remote** (the path to the remote repository is set as \\SLRA0383\Git\MachineA.git in this explanation) and click the **OK** button.



4. Click the **Close** button in the **Complete Pull** dialog box.

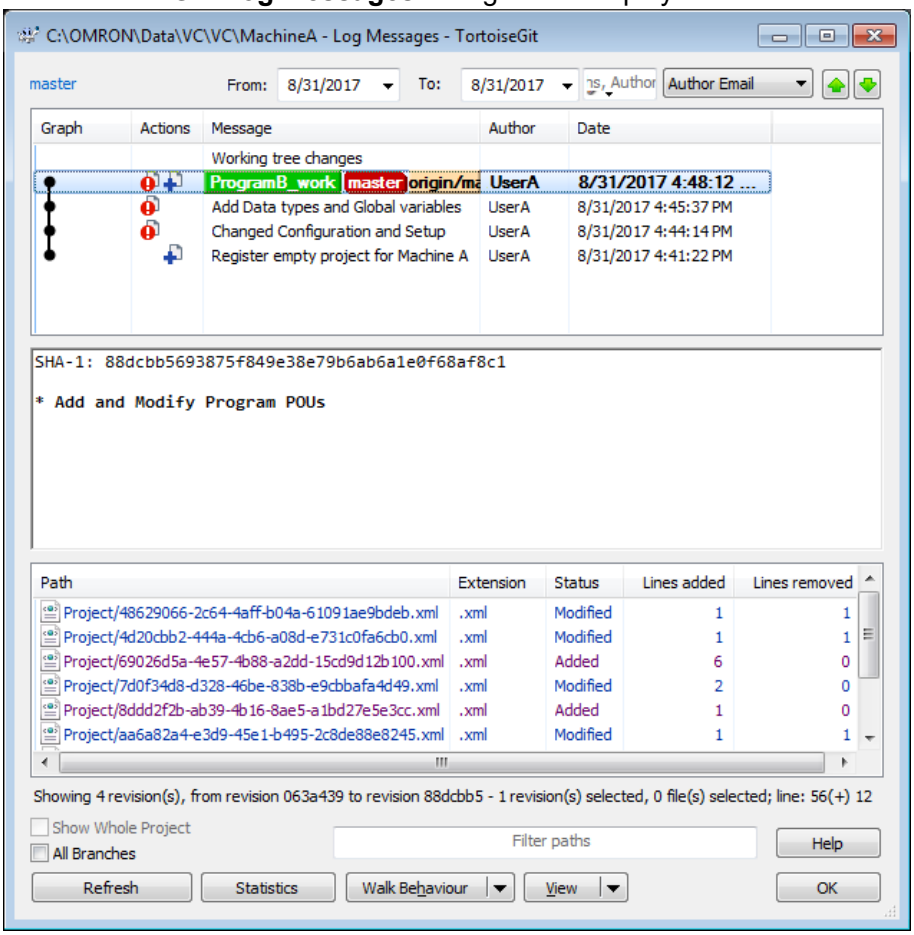
5. Right-click the folder icon in the Multiview Explorer or on the target project in the **Version Control Projects** window, and select **TortoiseGit - Create Branch**.
   The "TortoiseGit" **Create Branch** dialog box is displayed.

6. Enter the branch name (in this example, *ProgramB_work*), and click the **OK** button.
   For **Base On**, select the latest revision. Select **Head (master)**.



The branch is successfully created.

7. Right-click the folder icon in the MultiView Explorer or the project in the **Version Control Projects** window and select **TortoiseGit - Show log.**
   The “TortoiseGit” **Log Messages** dialog box is displayed.



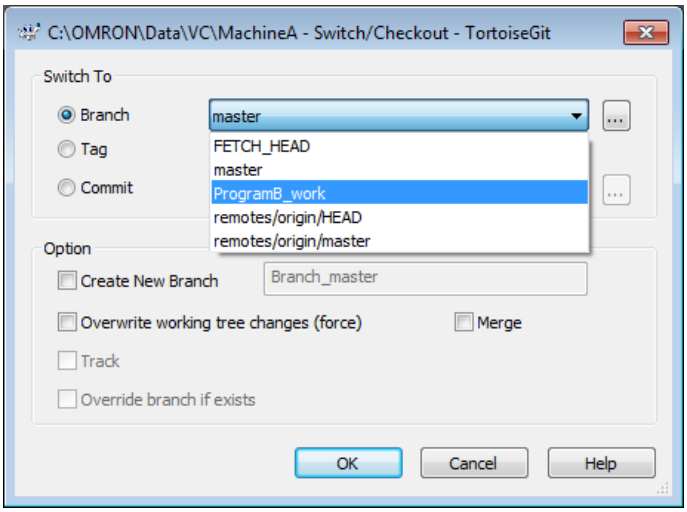
On the top of the upper pane, *ProgramB_work, master, origin/master* and *origin/HEAD* are shown. You can know that the working branch *ProgramB_work* was successfully created.
This line shows that the changes named as *Add and Modify Program POUs* applied in the latest revision by Developer A exists in ProgramB_work which is the working branch of the Developer B’s local repository, the main branch *master*, and the *master* in the remote repository (connecting to Origin).

7.3.3.10 Commits changes of Program B and Global Variables to the branch (No.8, 9: Developer B)

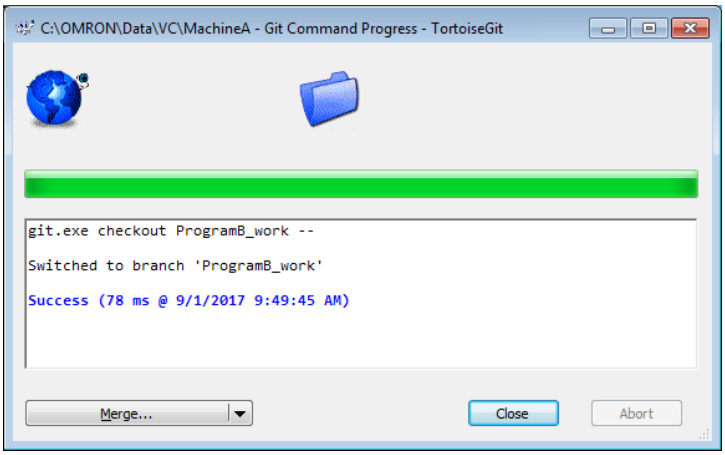
Switch the branch to work on in the Developer B's computer and modify Program B and Global Variables.

1. Right-click the folder icon in the Multiview Explorer or on the target project in the **Version Control Projects** window, and select **TortoiseGit - Switch/Checkout**.
   The "TortoiseGit" **Switch/Checkout** dialog box is displayed.

2. Select **Branch** option and *ProgramB_work* which is the working branch of Developer B created in *7.3.3.9 Create the working branch of Developer B (No.7: Developer B)*, and then click the **OK** button.



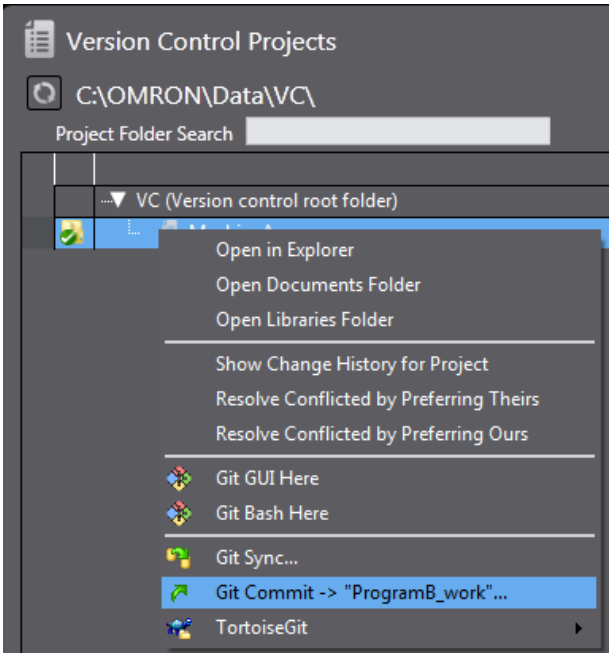
   The branch is switched.



3. Click the **Close** button.

4. Right-click the folder icon in the Multiview Explorer or on the target project in the **Version Control Projects** window.

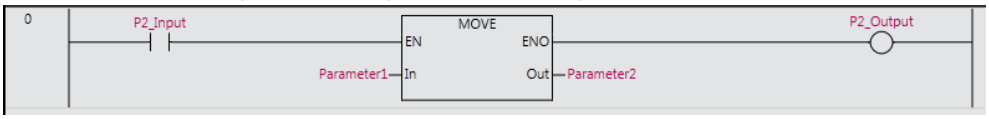
You can check that the branch name that follows **Git Commit ->** is changed.



5. Develop the ProgramB and change the Global Variables.
   Here, the following edits are made.
   Change the initial value of Global Variable *Parameter1* to 200.

P1_Input	BOOL	
P1_Output	BOOL	
Parameter1	INT	200
Parameter2	INT	
P2_Output	BOOL	
P2_Input	BOOL	

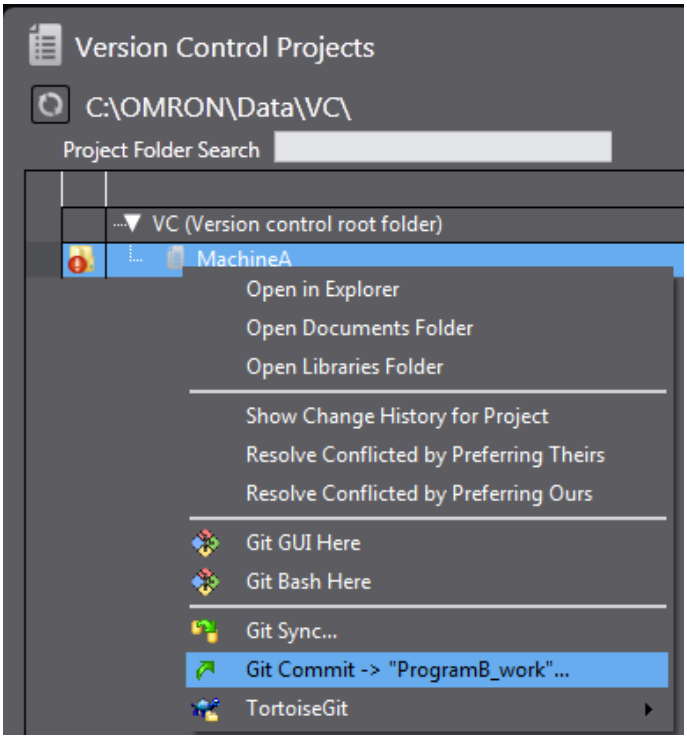
   Create the following ladder diagram in the ProgramB-Section0.



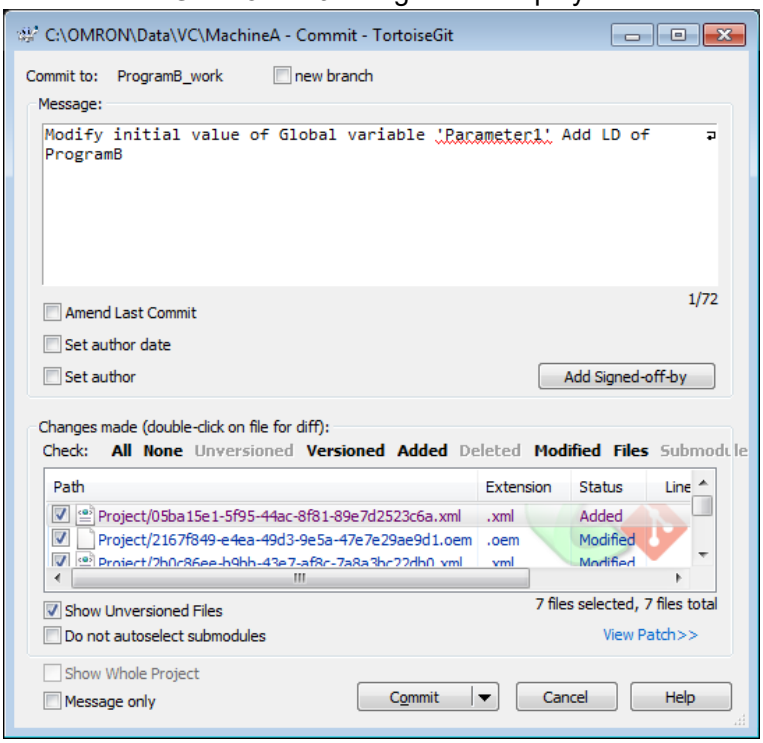
6. From the Main menu, select **File - Save** to save the project.

7. Select **File** - **Close** to close the project.

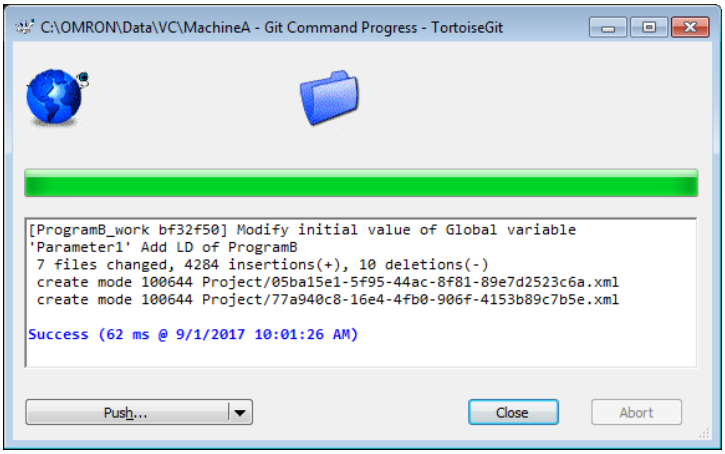
8. Right-click the target project in the **Version Control Projects** window and select **Git Commit -> "ProgramB_work"** from the pop-up menu.



The “TortoiseGit” **Commit** dialog box is displayed.



9. Enter comment in the **Message** area and click the **Commit** button.
   Commit is completed.

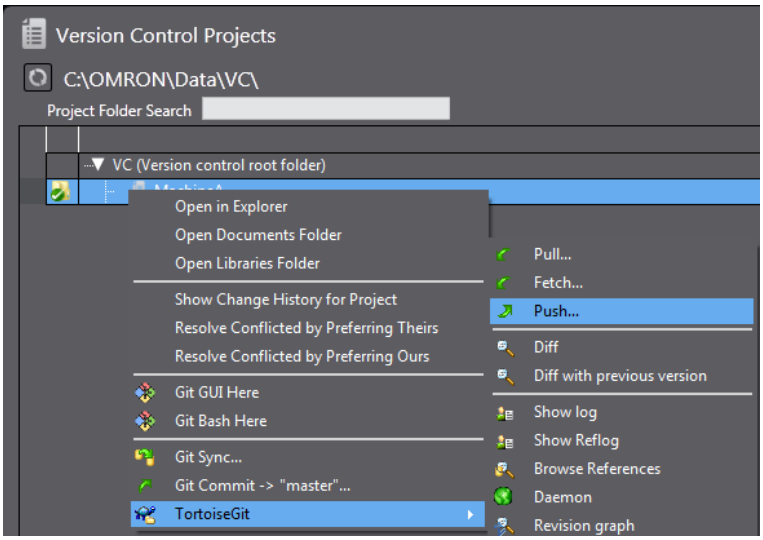


10. Click the **Close** button.

7.3.3.11 Push the changes in the local repository of Developer A to the remote repository (No.11: Developer A)

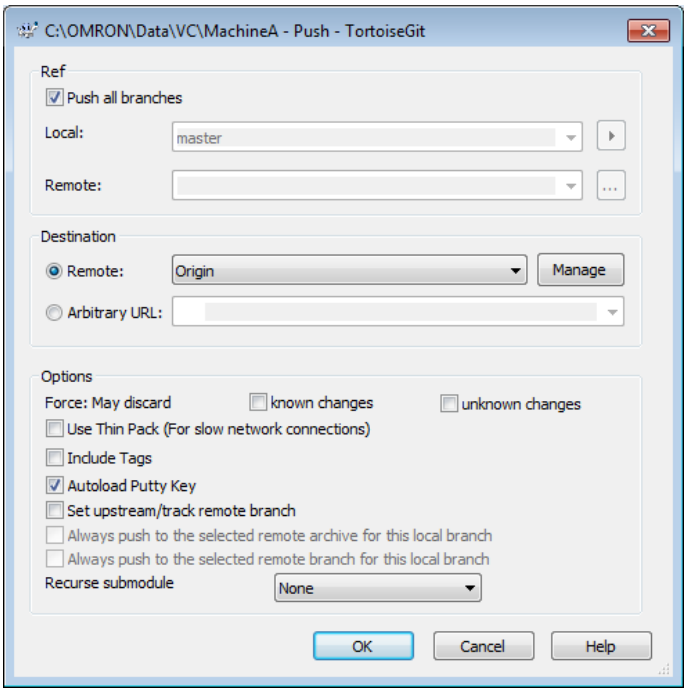
In order to merge the changes made by Developer A and Developer B, first push the changes in the Developer A's local repository to the remote repository, and then apply the changes in the remote repository to the Developer B's local repository. Then, merge the changes of Developer B.
This section explains how to push changes in Developer A's local repository to the remote repository.

1. Right-click the target project in the **Version Control Projects** window and select **TortoiseGit - Push** from the pop-up menu.

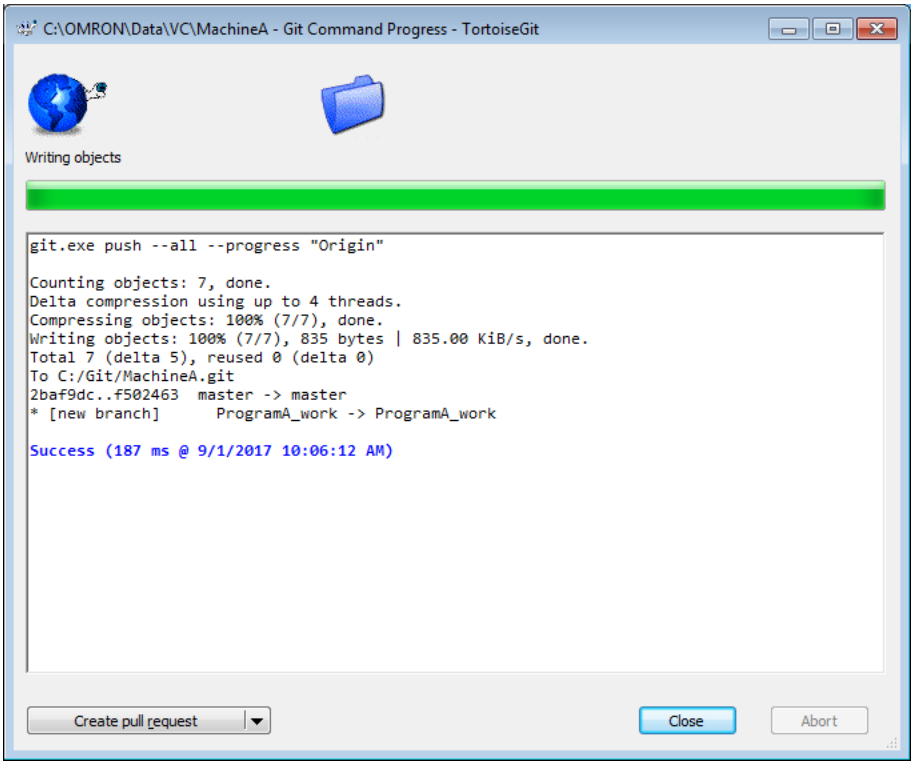


   The "TortoiseGit" **Push** dialog box is displayed.

2. Make sure that the **Push all branches** check box is selected and **Remote** item under **Destination** is correctly set ("Origin" is set in this example), and then click the **OK** button.



This completes Push processing.



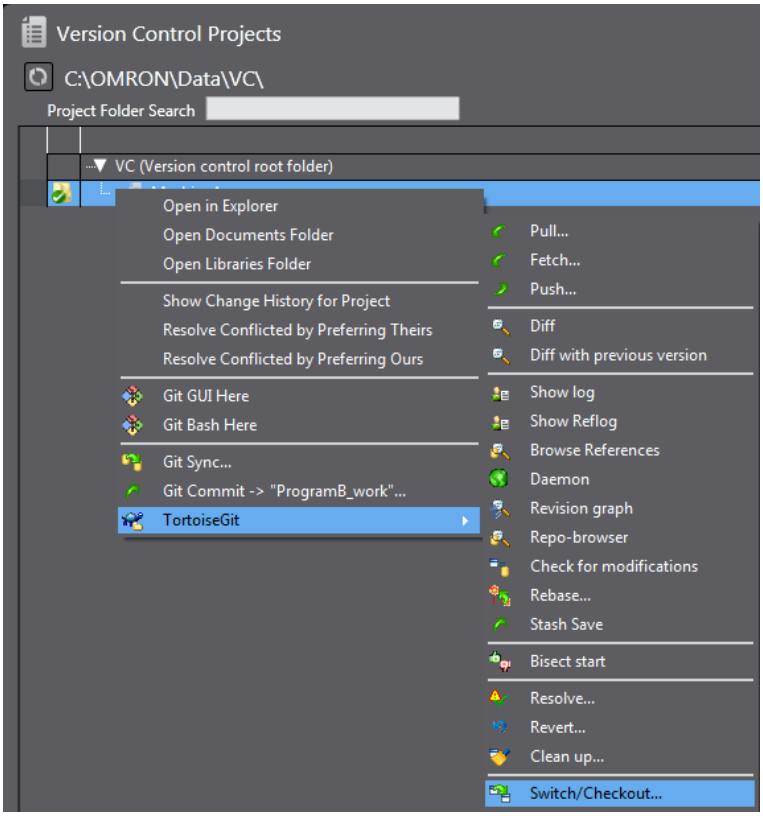
3. Click the **Close** button.

7.3.3.12 Merges the changes in the working branch of Developer B to the main branch (No.12: Developer B)

Switch the branch you work on to the main branch and then acquire the changes made by Developer A from the remote repository. After that, switch to the working branch of Developer B and merge the changes made by Developer A in the main branch to the working branch of Developer B. Since the changes made by Developer A conflict with the changes of Developer B, merge processing fails. In this case, resolve the conflicts and complete merging.

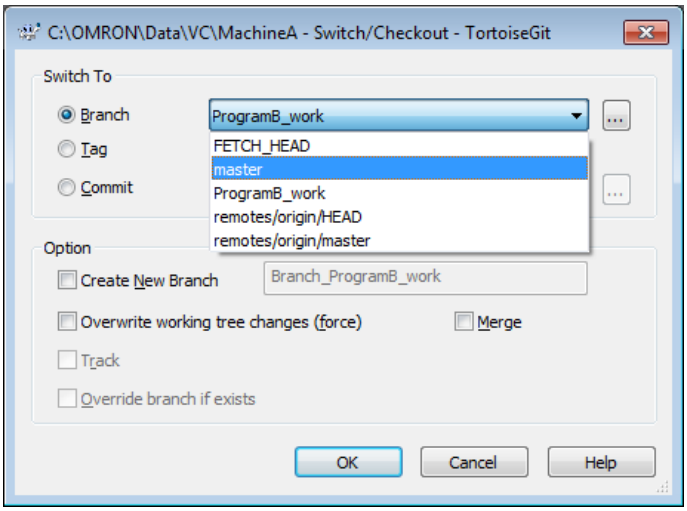
After merging, switch the branch you work on to the main branch and then merge the data after resolving conflicts to the main branch. This completes the merge processing.

1. Right-click the target project in the **Version Control Projects** window and select **TortoiseGit - Switch/Checkout** from the pop-up menu.

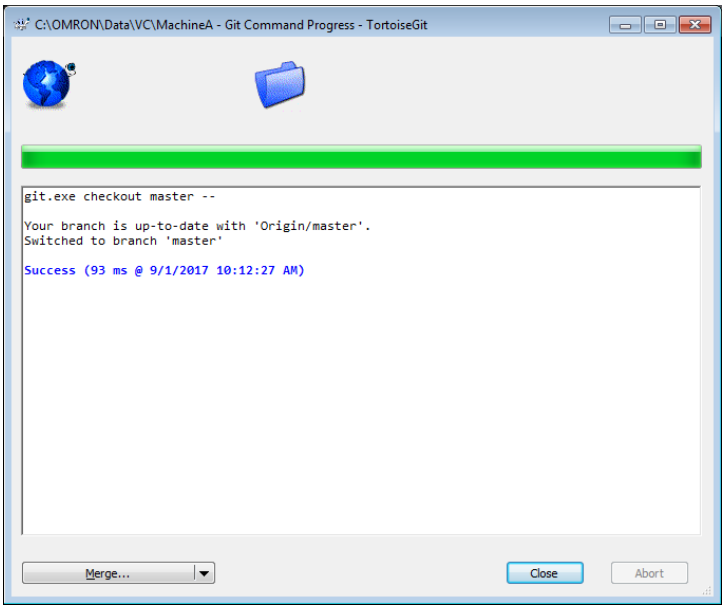


The “TortoiseGit” **Switch/Checkout** dialog box is displayed.

2. Select **Branch** option, then *master* (main branch), and click the **OK** button.



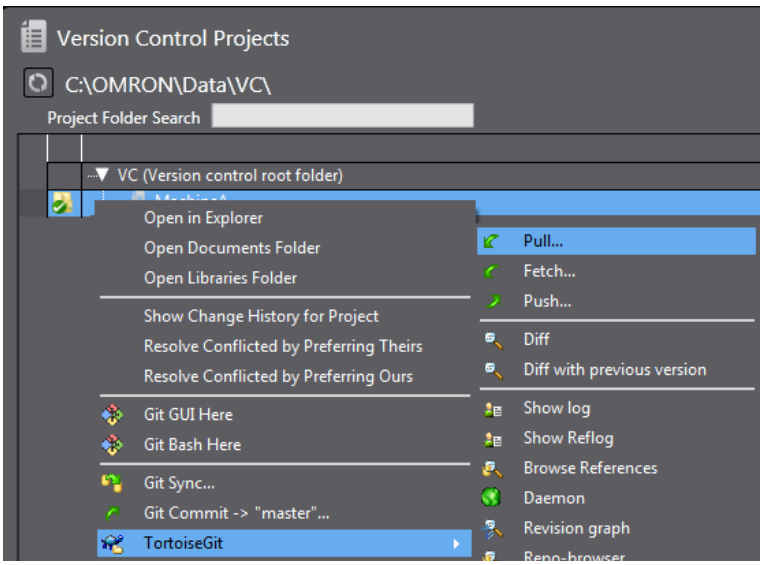
The branch is switched.



3. Click the **Close** button.

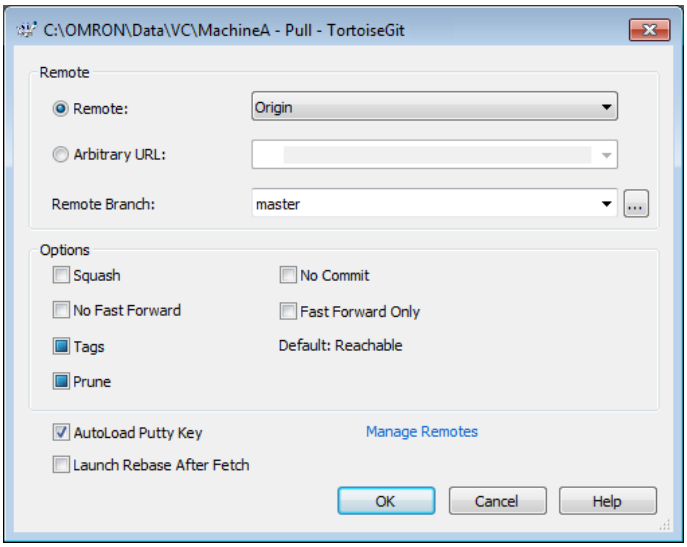
4. Since the remote repository includes the changes made by Developer A, take the following steps to synchronize the remote repository and the local repository of the Developer B's computer.
   On the Start page of the Sysmac Studio, select **Version Control Explorer** and open the **Version Control Projects** window.

5. Right-click the *MachineA* and select **TortoiseGit** - **Pull** from the pop-up menu.

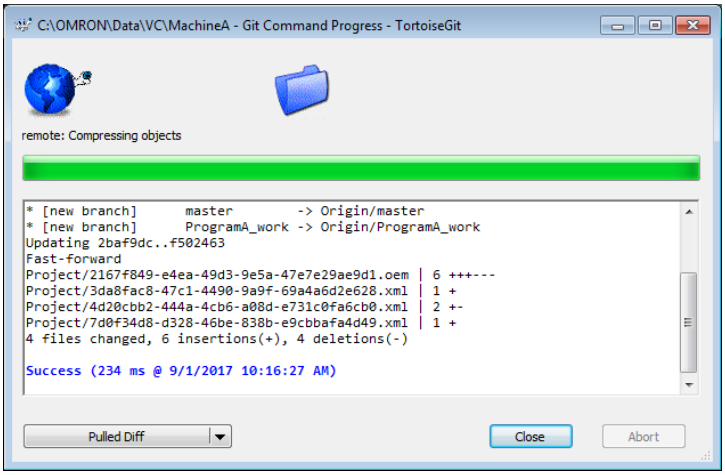


The "TortoiseGit" **Pull** dialog box is displayed.

6. Check that *Origin* is selected in **Remote** (the path to the remote repository is set as \\SLRA0383\Git\MachineA.git in this explanation) and click the **OK** button.

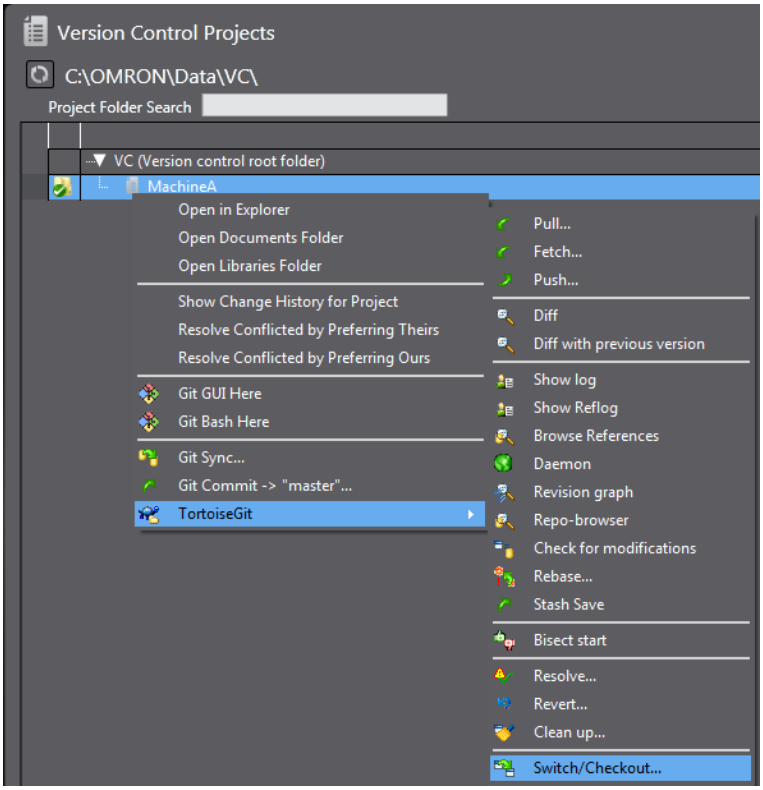


This completes Pull processing.



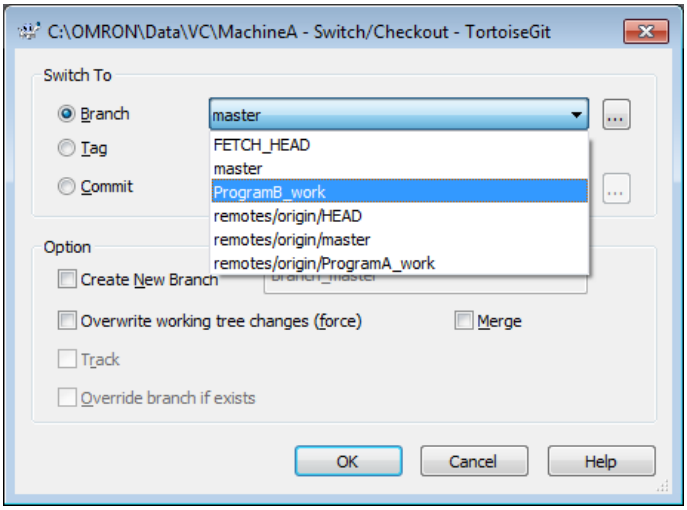
7. Click the **Close** button.

8. Next, switch to the *ProgramB_work* in order to merge the changes made by Developer A in the main branch *master* to the working branch of Developer B *ProgramB_work*. Right-click the target project in the **Version Control Projects** window and select **TortoiseGit - Switch/Checkout** from the pop-up menu.

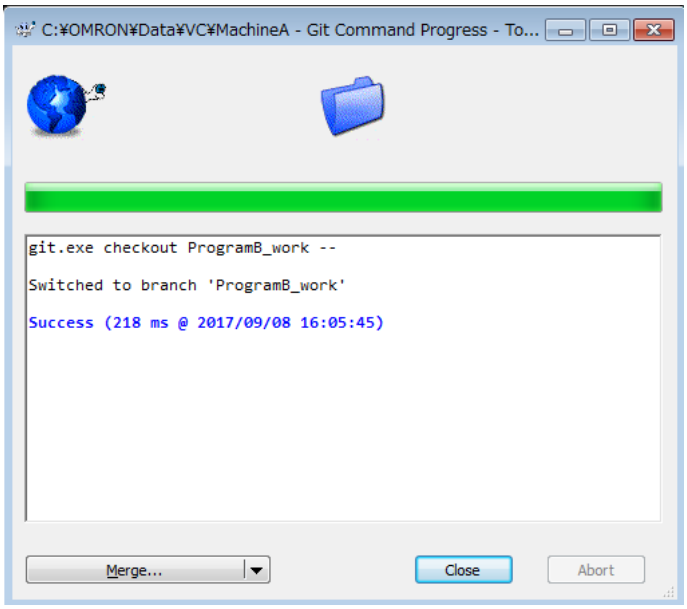


The “TortoiseGit” **Switch/Checkout** dialog box is displayed.

9. Select **Branch** option and *ProgramB_work* which is the working branch of Developer B, and then click the **OK** button.



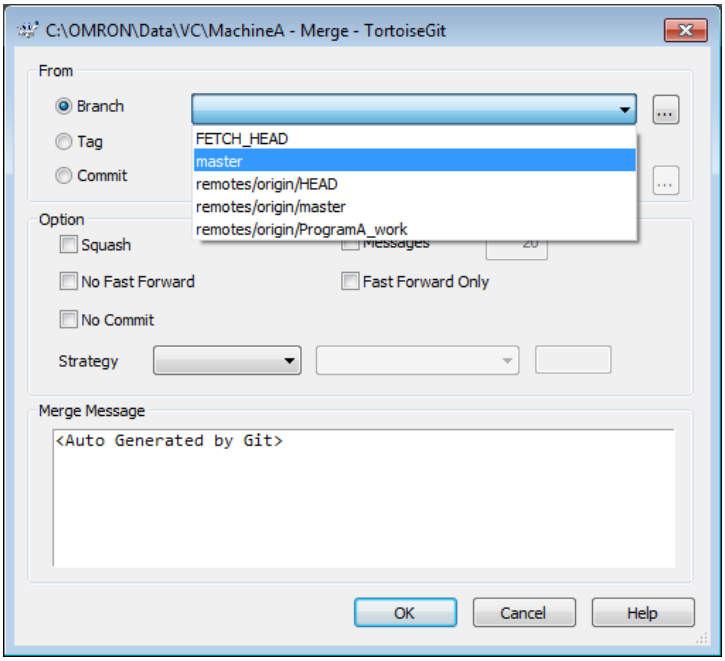
The branch is switched.



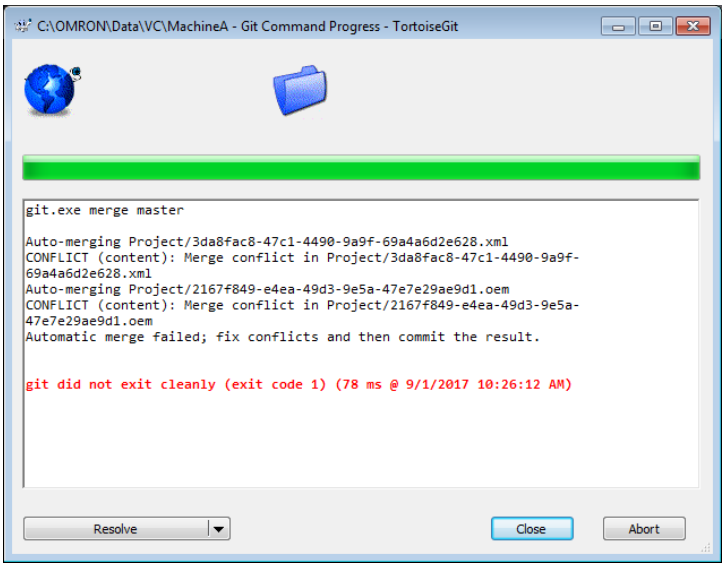
10. Click the **Close** button.

11. Right-click the target project in the **Version Control Projects** window and select **TortoiseGit - Merge** from the pop-up menu. The “TortoiseGit” **Merge** dialog box is displayed.

12. Select **Branch** option, then the main branch *master* to merge it to the working branch *ProgramB_work*, and click the **OK** button.



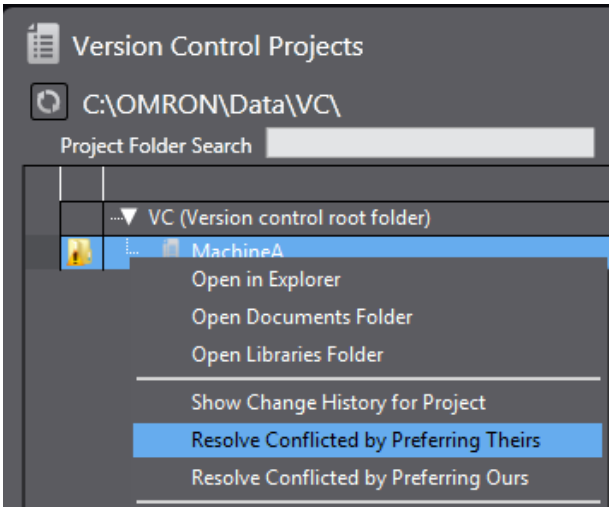
Merge fails.



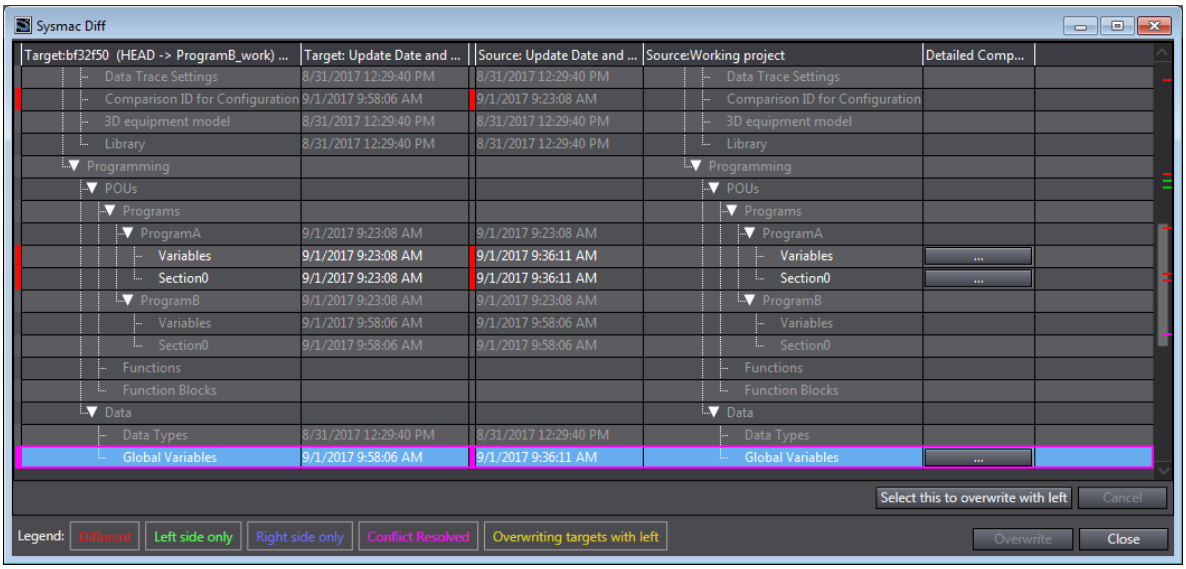
This is because Developer A and Developer B made changes in the same global variables and a conflict occurred.

13. Click the **Close** button.

14. Right-click the target project in the **Version Control Projects** window and select **TortoiseGit - Resolve Conflicted by Preferring Theirs** from the pop-up menu.

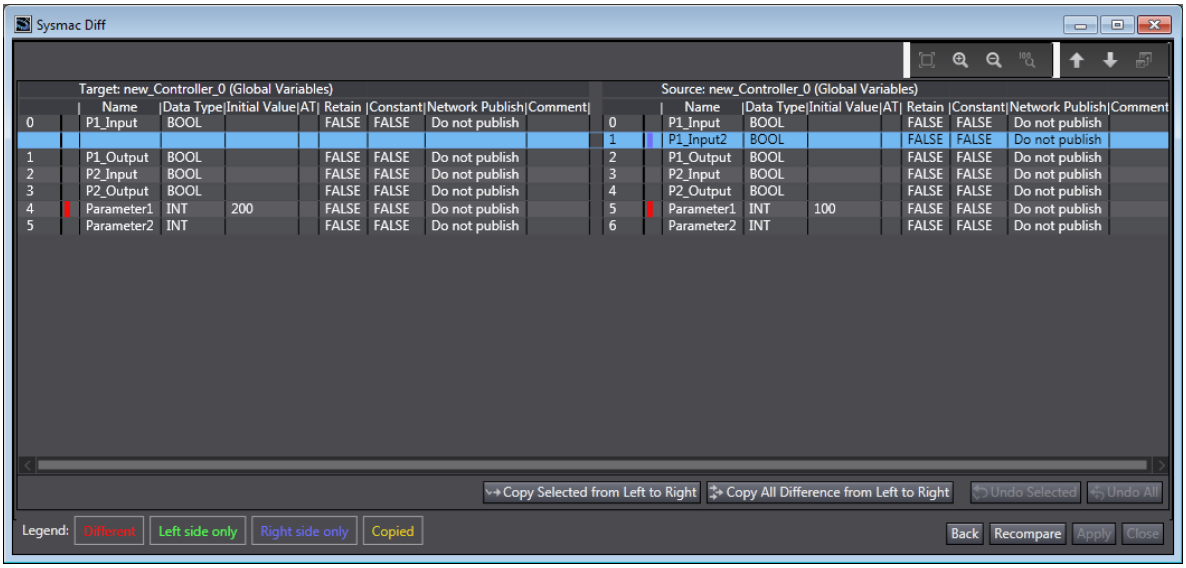


The menu **Resolve Conflicted by Preferring Theirs** forcibly merges the data with a conflict caused by changes made in the same files. This command prioritizes the changes in merge target data specified in the **From** section in the “TortoiseGit” **Merge** dialog box, assuming that changes in the merge source data are invalid. In this example, changes in the *master* are given priority in merge processing.
In this explanation, a conflict occurred in the Global Variables. If you select **Resolve Conflicted by Preferring Theirs** menu, merge result is shown on the **Sysmac Diff** dialog box.



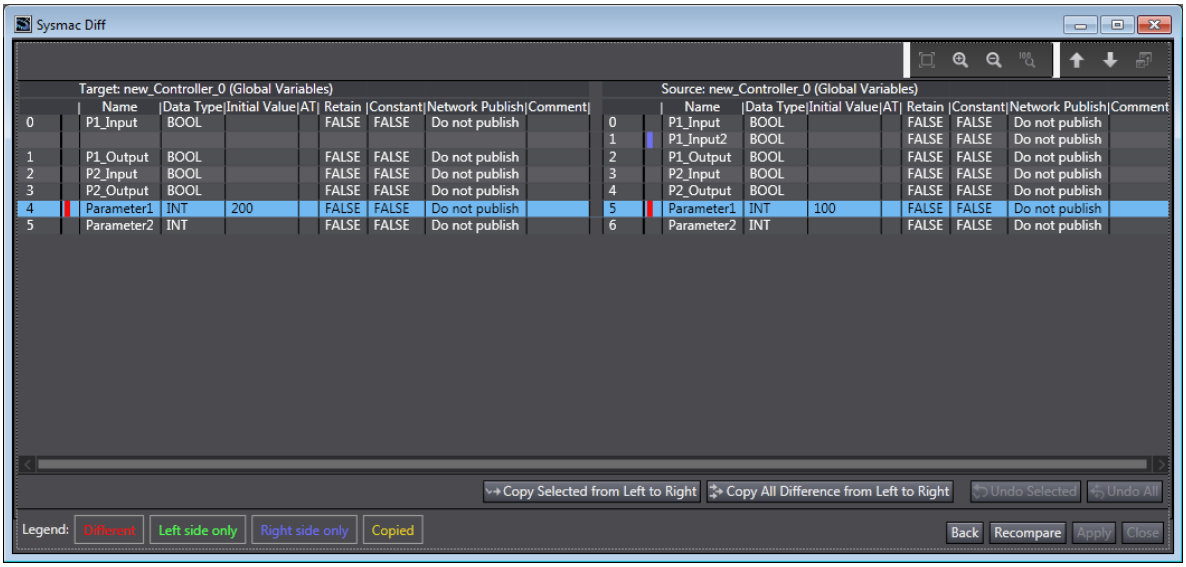
The purple bar is shown on the left end for the data in which a conflict occurs. The red bar is for the data which were merged without conflict though there were differences.

15. Click the **...** button of the Global Variables with conflicts.
    The **Detailed Comparison** dialog box is displayed.

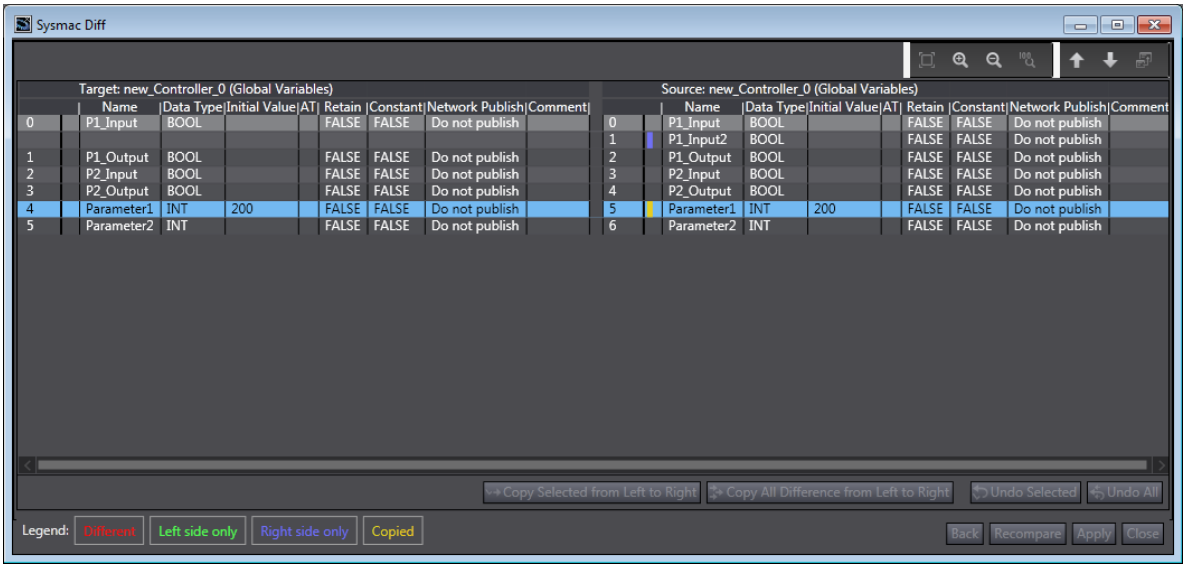


The data of the working branch *ProgramB_work* (changes of Developer B) before merging is displayed on the left pane and the right pane shows the data being edited to which data was merged preferring the main branch (changes of Developer A).

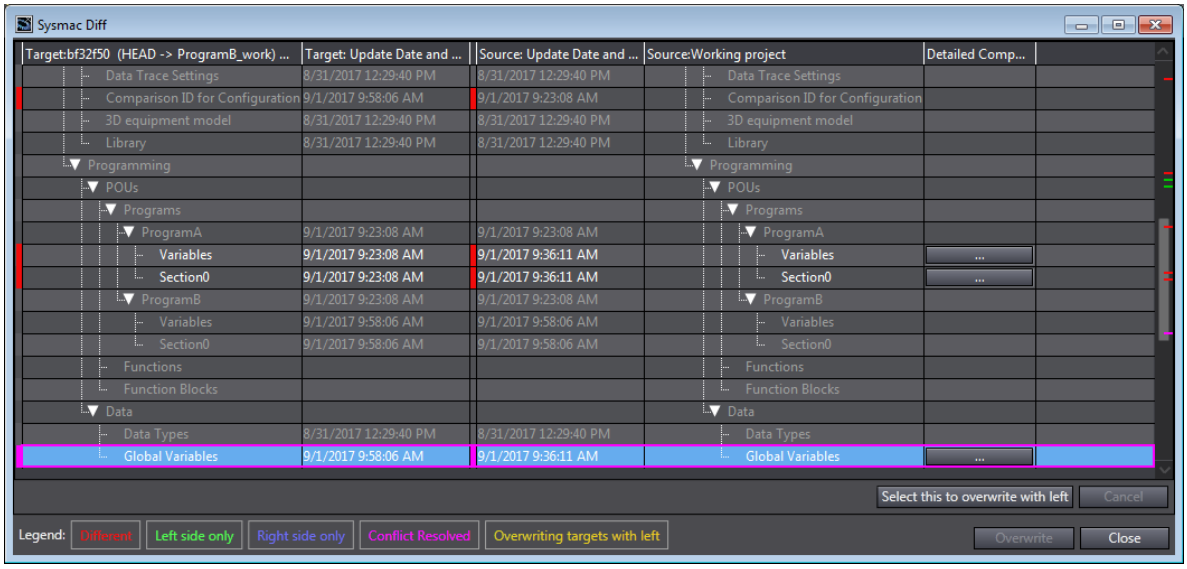
16. Here, you need to leave the value of the variable *Parameter1* on the fourth line. For that, select the fourth line.



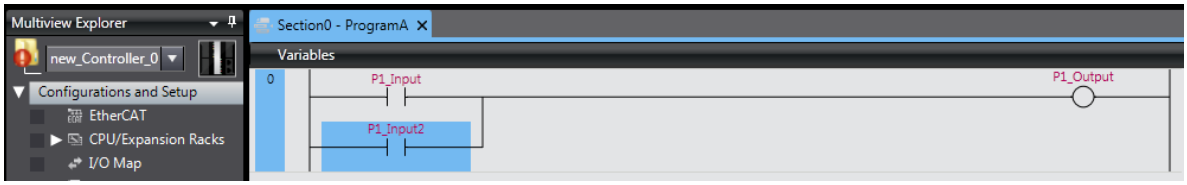
17. Click the **Copy Selected from Left to Right** button. The value of variable *Parameter1* is set to the data being edited on the right pane.



18. Click the **Apply** button, and then click the **Back** button.
    The **Sysmac Diff** dialog box appears again.

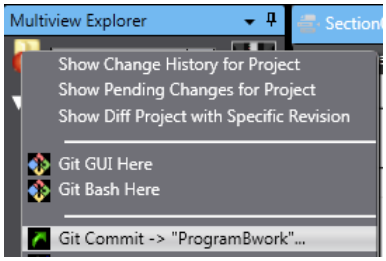


19. Make sure there is no other conflict (with purple bar) and click the **Close** button.
    When the project is opened, you can find, in the working branch *ProgramB_work*, the variable *P1_Input2* which was registered by Developer A.

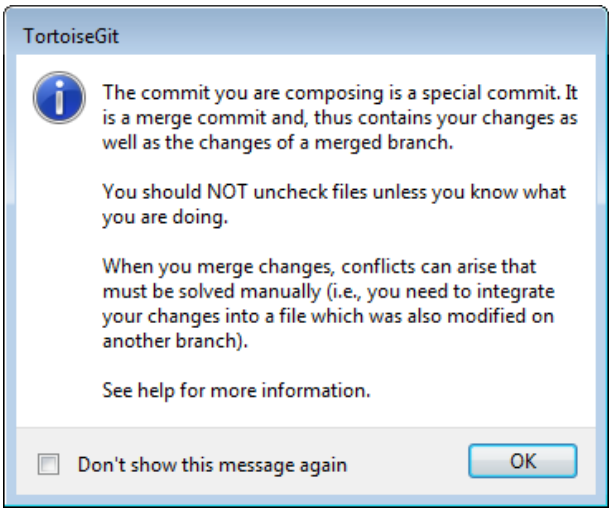


    The conflict was resolved and changes made by Developer A and B were successfully merged.

20. Next, commit the changes (merge result) to the local repository. Right-click the folder icon in the Multiview Explorer and select **Git Commit -> "ProgramB_work"** from the pop-up menu.



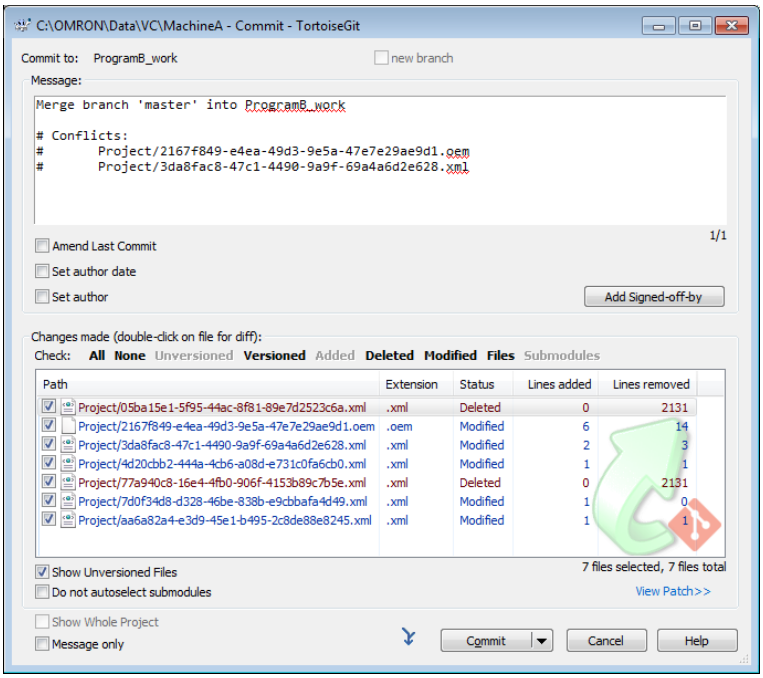
    When the project is not yet saved, a confirmation dialog box is displayed to ask if you need to save the project. Click the **Yes** button.
    The following dialog box is displayed with the "TortoiseGit" **Commit** dialog box.



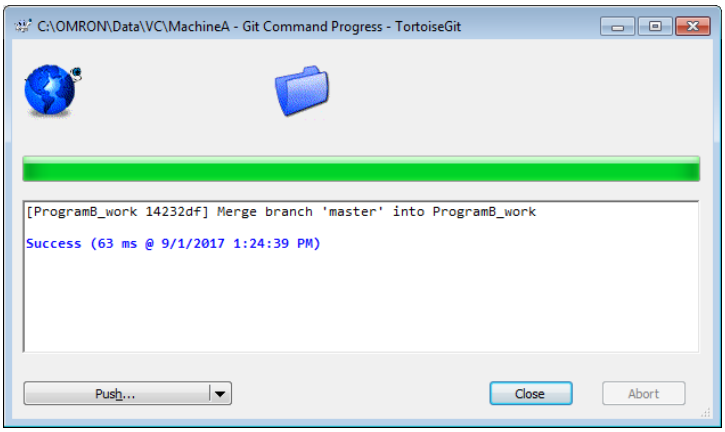
This dialog box is displayed in order to call attention for the conflict occurred when merging the branches.

21. Click the **OK** button.

22. The **Message** area of the “TortoiseGit“Commit dialog box automatically shows comments that conflicts occurred when merging the branches. If necessary, add or change comments in the **Message** area and click the **Commit** button.

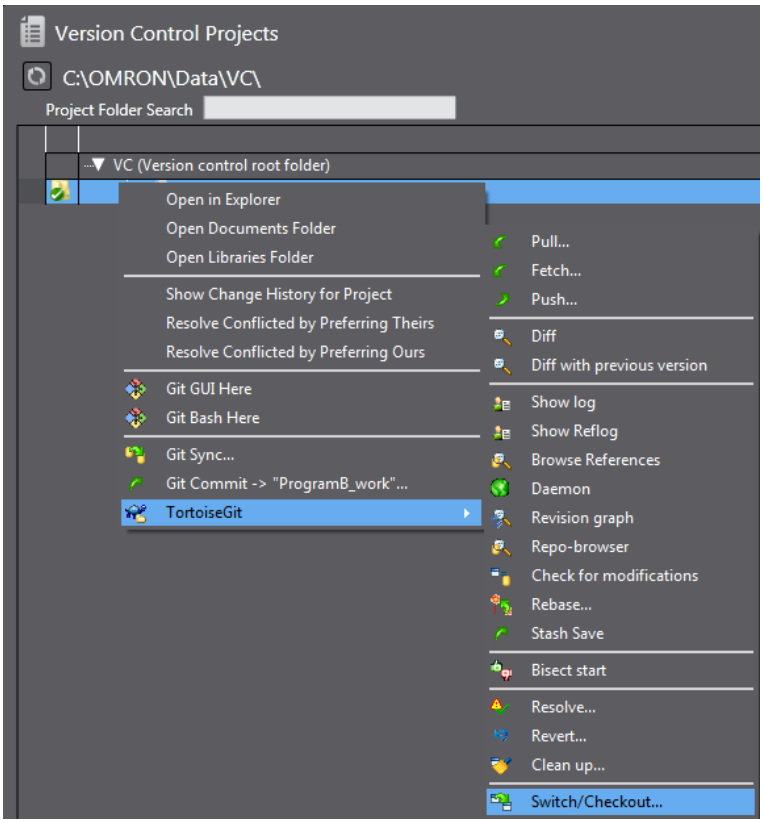


This completes Commit processing.



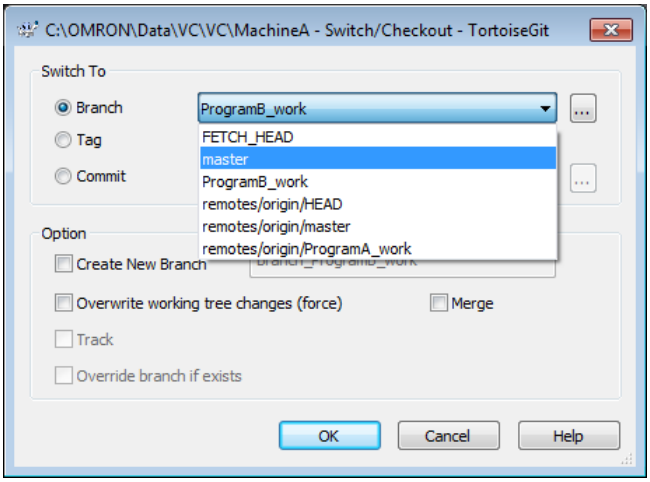
23. Click the **Close** button.

24. Then, switch to the main branch and apply it the data in the branch *ProgramB_work* after merging. Right-click the target project in the **Version Control Projects** window and select **TortoiseGit - Switch/Checkout** from the pop-up menu.

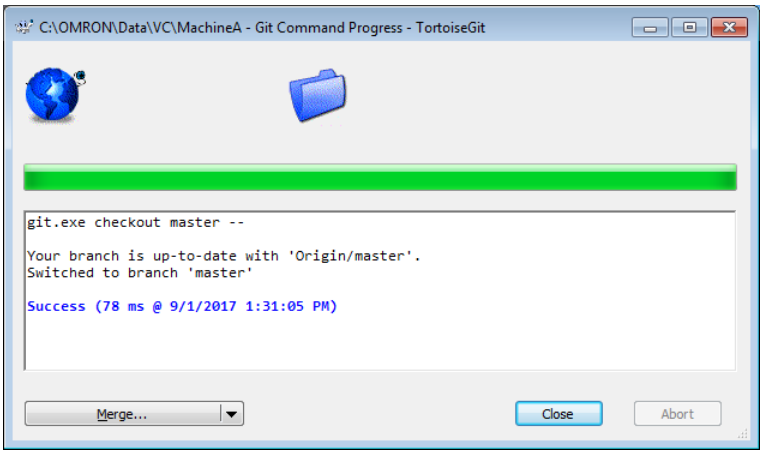


The “TortoiseGit” **Switch/Checkout** dialog box is displayed.

25. Select **Branch** option, then *master* (main branch), and click the **OK** button.

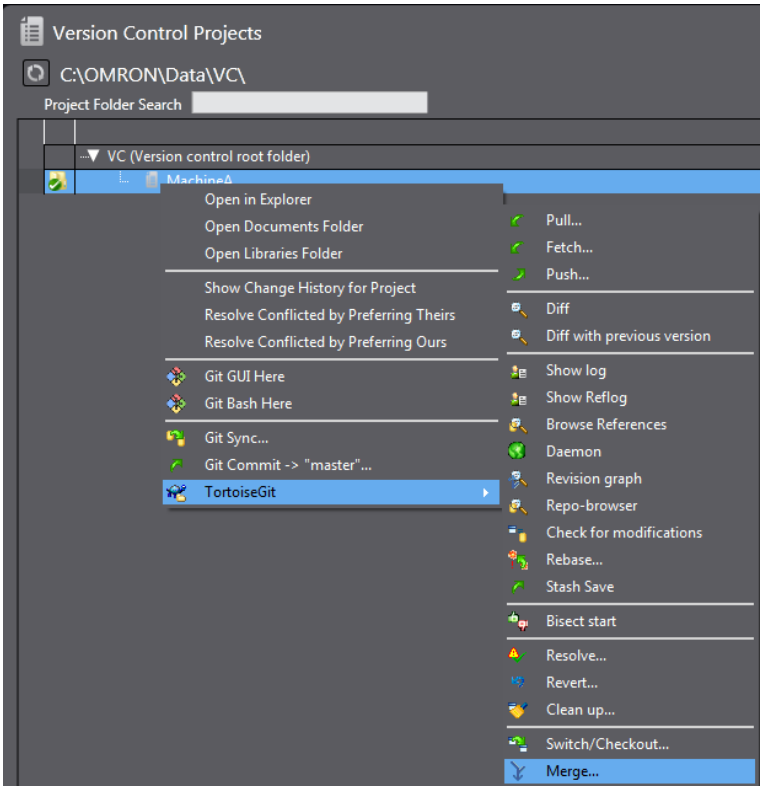


The branch is switched.



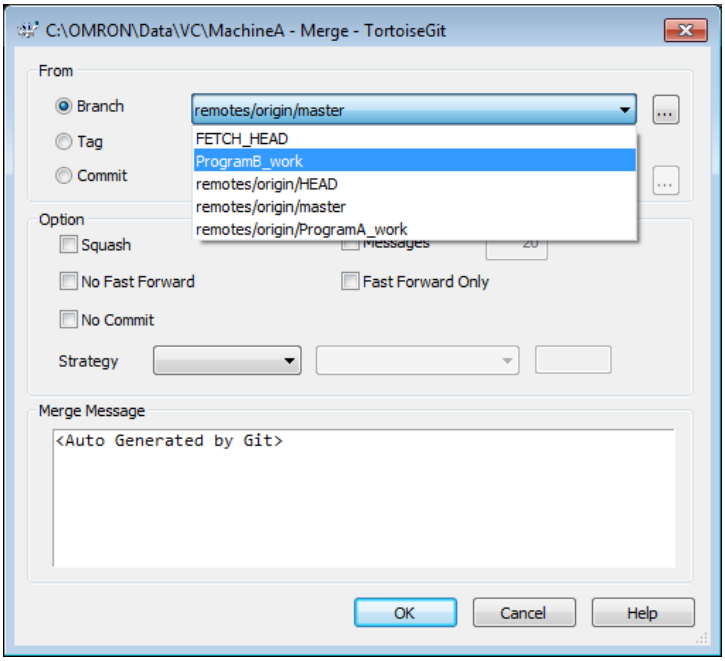
26. Click the **Close** button.

27. Right-click the target project in the **Version Control Projects** window and select **TortoiseGit - Merge** from the pop-up menu.

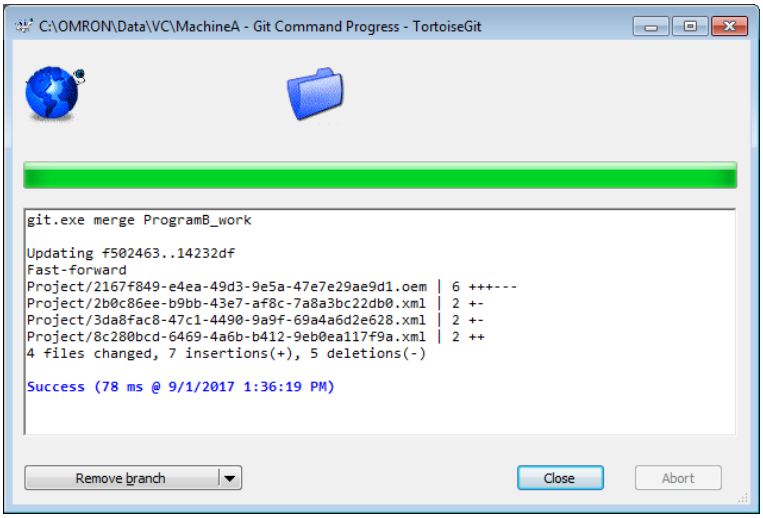


The “TortoiseGit” **Merge** dialog box is displayed.

28. Select **Branch** option, then the working branch *ProgramB_work* to merge it to the main branch *master,* and click the **OK** button.



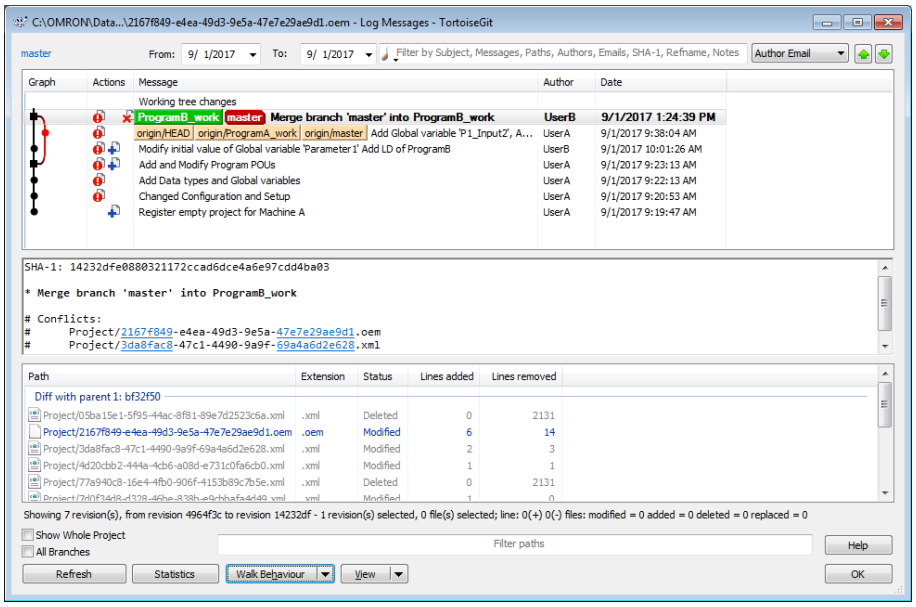
A dialog box is displayed to indicate the completion of the merging.



The data in the main branch is overwritten with the merged data after resolving the conflicts caused by changes of Developer A and B.

29. Click the **Close** button.

30. Right-click the folder icon in the Multiview Explorer and select **TortoiseGit - Show log** from the pop-up menu. The “TortoiseGit” **Log Messages** dialog box is displayed.

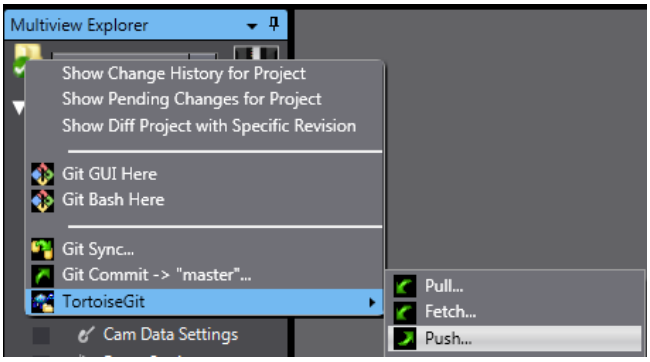


On the upper pane, you can know that the edits made by Developer B on the working branch *PrgramB_work* have been merged to the main branch *master*. Click the **OK** button to close the dialog box.

7.3.3.13 Push the changes in the main branch of Developer B to the remote repository (No.13: Developer B)

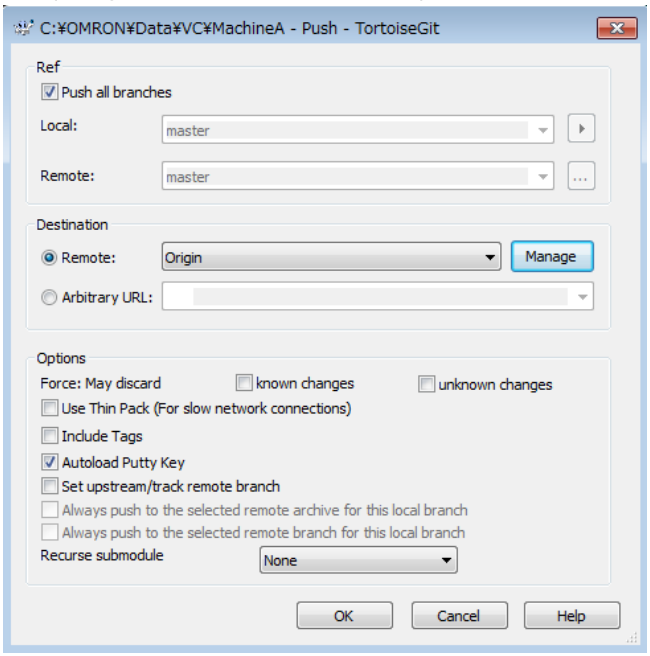
Apply (Push) the changes merged in the Developer B’s computer into the remote repository.

1. Right-click the folder icon in the Multiview Explorer or on the target project in the **Version Control Projects** window, and select **TortoiseGit - Push**.

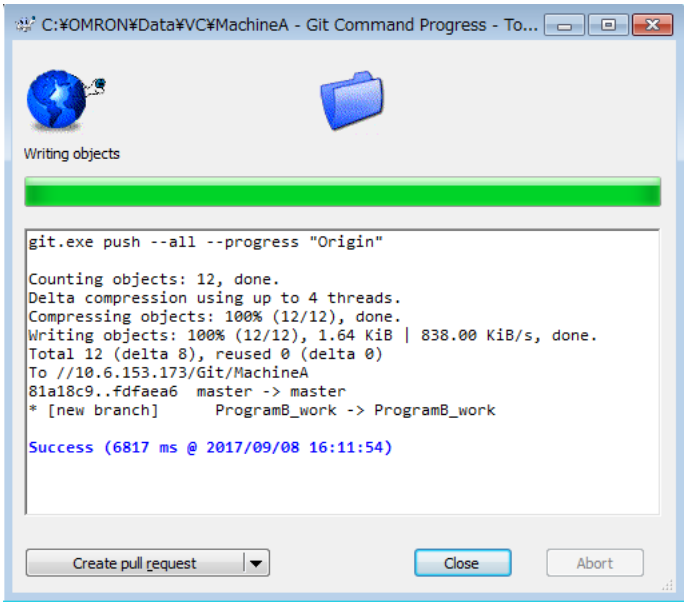


The “TortoiseGit” **Push** dialog box is displayed.

2. Make sure that the **Push all branches** check box is selected and **Remote** item under **Destination** is correctly set (“Origin” is set in this example), and then click the **OK** button.

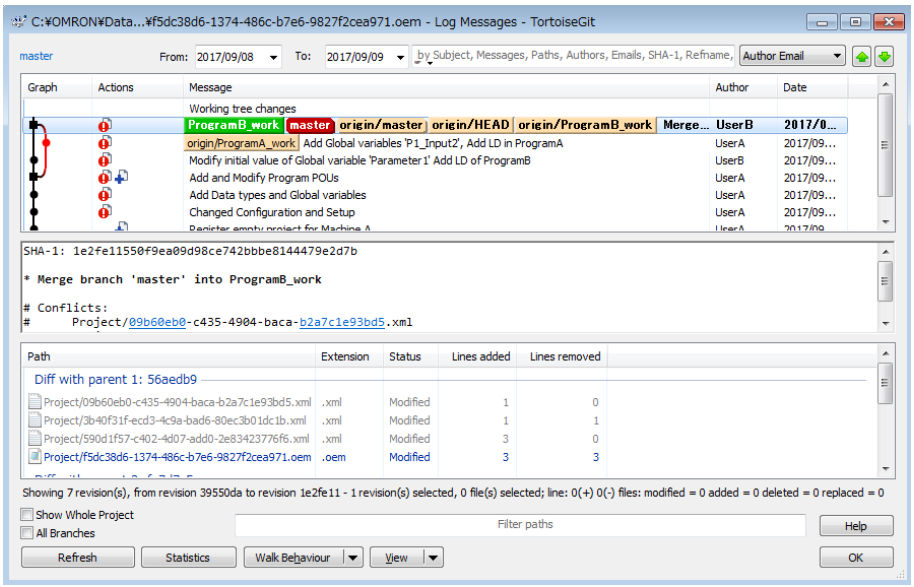


This completes Push processing.



3. Click the **Close** button.

4. Right-click the folder icon in the Multiview Explorer and select **TortoiseGit - Show log** from the pop-up menu. The “TortoiseGit” **Log Messages** dialog box is displayed.



On the upper pane, you can find that the edits made by Developer B on the working branch *PrgramB_work* are taken into the main branch *master* and the *master* of the remote repository (origin) also synchronizes. Click the **OK** button to close the dialog box.

7.4 Derived Development of Sysmac Studio Projects

This section describes the operating procedure to promote derived development of Sysmac Studio projects on an example.
This example uses a configuration in which the remote repository is shared using the shared folder.

7.4.1 An example of derived development

In this example, Machine B is developed and derived from Machine A. While the Machine B is being developed, defects were found and corrected in the common program of Machine A and Machine B. The correction is applied to the project of Machine B to complete the development.

7.4.1.1 About the Project

It is assumed that, based on the project of Machine A, one developer develops a project of derivative Machine B.
ProjectA: the project of Machine A. On the base of this project, the project of the derived Machine B is developed.
ProjectB: the project of Machine B derived from Machine A project. It has different configurations and setup. This project utilizes the same program as that of ProjectA.

7.4.1.2 Scenario

Create and manage branches *master, ProductA, and ProductB; master* is for common program management, *ProductA* is for Machine A, and *ProductB* is for Machine B. The common program is modified in the *master* and the changes are applied to the *ProductA* and *ProductB*.

1. In the development of Machine A, create a new project *ProjectA* and incorporate it into the Machine A as Ver.1.0. Register this *ProjectA* to the *master* as the master project of derivation development.
2. In the development of Machine B, create *ProjectB* on the base of *ProjectA* Ver.1.0 and change the settings in Configurations and Setup.
3. Defects are found in the program of Machine A and the program is modified to fix them. Modify the program in the *master* project and apply the corrections to the Machine A as Ver.1.1.
4. In the same way, apply the corrections to the *ProjectB* which is being developed and incorporate it to the Machine B as its Ver.1.0.

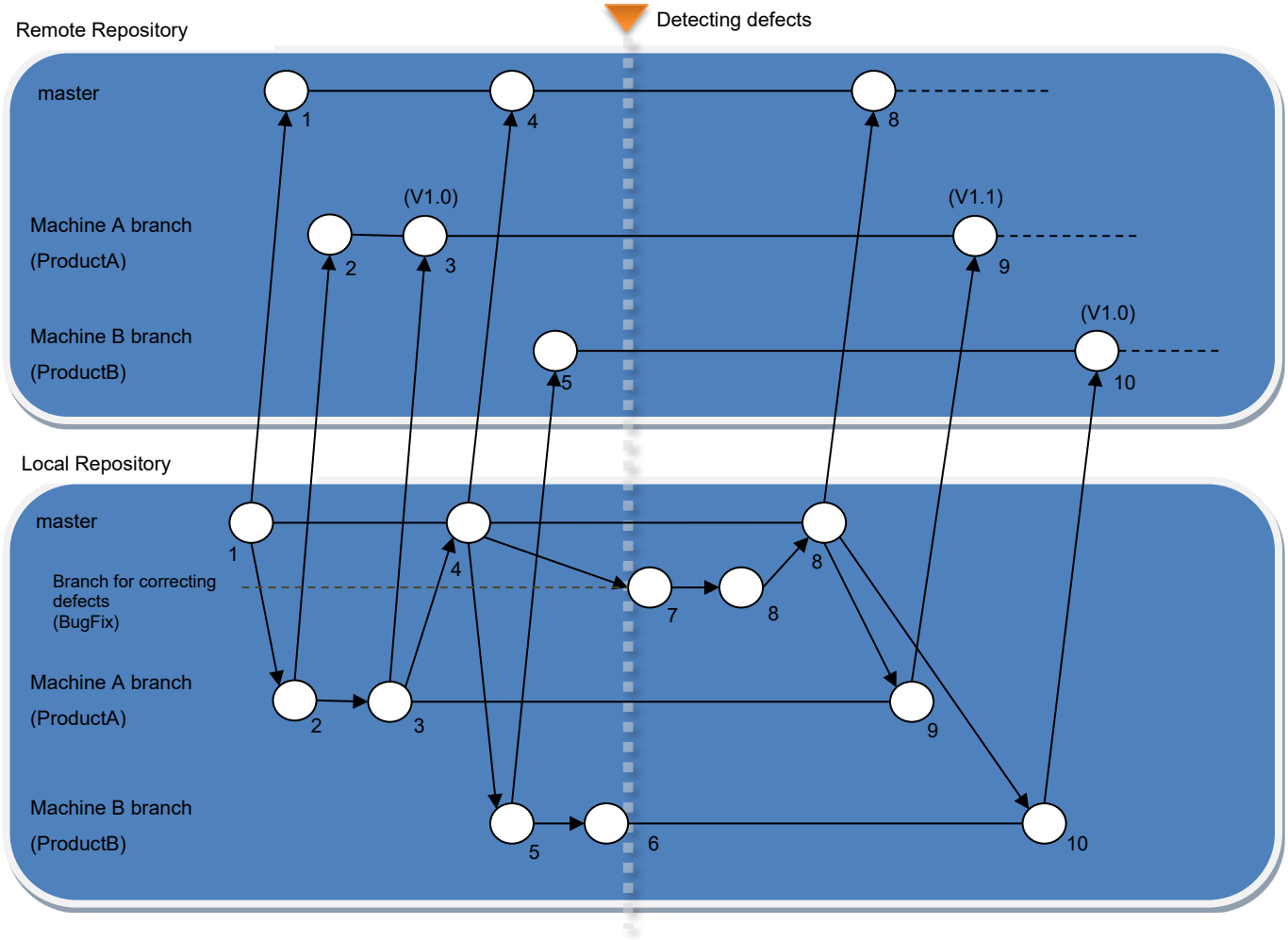
7.4.2 Operation flow on the version control system

No.	Machine A development	Machine B development	Correction of defects	Reference for the tasks
1	Register a project in the remote repository	-	-	7.4.3.1 Register a project in the remote repository (No.1: Machine A development)
2	Create a branch for Machine A in the local repository and push it to the remote repository * The project of Machine A is developed in this branch.	-	-	7.4.3.2 Create a branch for Machine A in the local repository and push it to the remote repository (No.2: Machine A development)
3	Create the program of Machine A, commit it, and push it to the remoter repository * The tag as Ver.1.0 is applied to this project and the project is incorporated in the Machine A.	-	-	7.4.3.3 Create the program of Machine A, commit it, and push it to the remoter repository (No.3: Machine A development)

4	Merge the changes in the Machine A to the *master* in the local repository and push it to the remote repository * Register the project of the Machine A in the *master* as the master project of subsequent derivation development.	-	-	7.4.3.4 Merge the changes in the Machine A into the *master* in the local repository and push it to the remote repository (No.4: Machine A development)
5	-	Create a branch for Machine B in the local repository and push it to the remote repository * The project of Machine B is developed in this branch.	-	7.4.3.5 Create a branch for Machine B in the local repository and push it to the remote repository (No.5: Machine B development) *The Project of Machine B is developed in this branch.
6	-	Modify the settings in Configurations and Setup of the Machine B and commit them * Right after this, defects are found in the common program and they are corrected.	-	7.4.3.6 Modify the settings in Configurations and Setup of the Machine B and commit them (No.6: Machine B development) *Right after this, defects are found in the common program and they are corrected.
7	-	-	From the *master* in the local repository, create a branch for correcting defects.	7.4.3.7 From the *master* in the local repository, create a branch for correcting defects (No.7: Correction of defects)
8	-	-	Commit correction of the defects, merge them to the *master* and push it to the remote repository	7.4.3.8 Commit correction of the defects, merge it to the *master* and push it to the remote repository (No.8: Correcting defects)
9	Merge correction of defects into the branch of the Machine A and push it to the remote repository * Apply a tag as Ver.1.1 to this project and incorporate it into the Machine A.	-	-	7.4.3.9 Merge correction of defects into the branch of the Machine A and push it to the remote repository (No.9: Machine A development) *Apply a tag as Ver.1.1 to this project and incorporate it into the Machine A.
10	-	Merge the correction of defects to the branch of Machine B and push it to the remote repository * Apply a tag as Ver.1.0 to this project and incorporate it into the Machine B.	-	7.4.3.9 Merge correction of defects into the branch of the Machine A and push it to the remote repository (No.9: Machine A development) *Apply a tag as Ver.1.0 to this project and incorporate it into the Machine B.

-: No task

The following figure illustrates the relationship between the repositories and branches.



7.4.3 Operating Procedure

Operating procedure is explained along with the steps in *7.4.1.2 Scenario*.

7.4.3.1 Register a project in the remote repository (No.1: Machine A development)

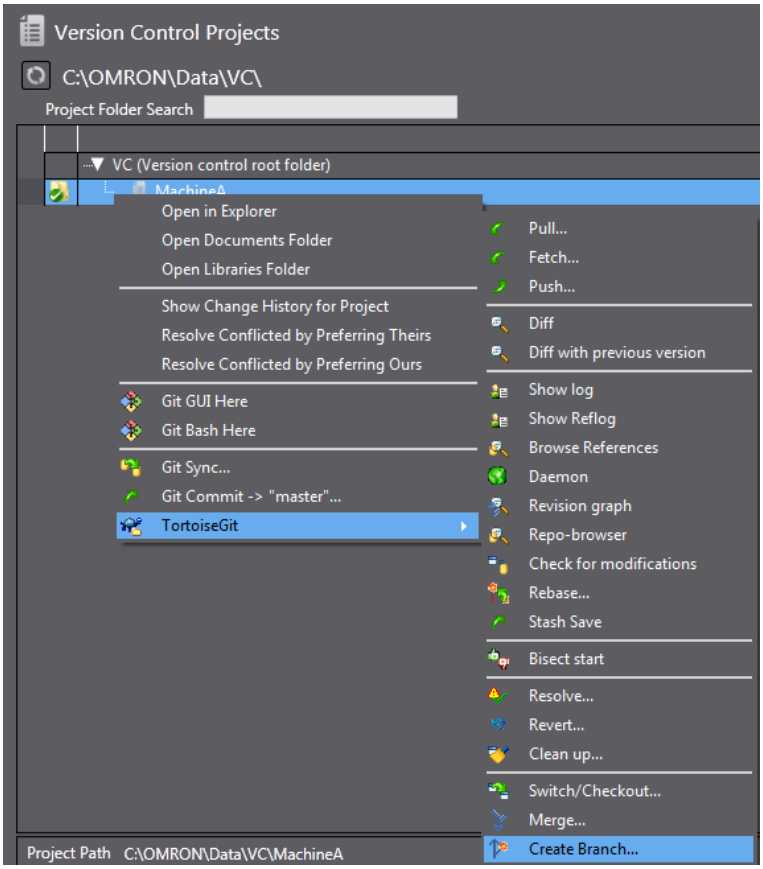
1. Creating a remote repository
   Create a remote repository to manage the deliverables.
   Here, create a remote repository with the folder name *C: \ Git \ MachineA.git* in the Developer's computer.
   Refer to *5.6 Creating the shared folder and remote repository* for details.

2. Registering a local repository and creating and saving the base project
   Create a new project and register it in the local repository.
   Here, create a project *MachineA*, commit it to the local repository, and then push it to the remote repository.
   Refer to *6.3 Preparing for Starting Project Control (Creating a Base Project and Saving It)* for details.

7.4.3.2 Create a branch for Machine A in the local repository and push it to the remote repository (No.2: Machine A development)

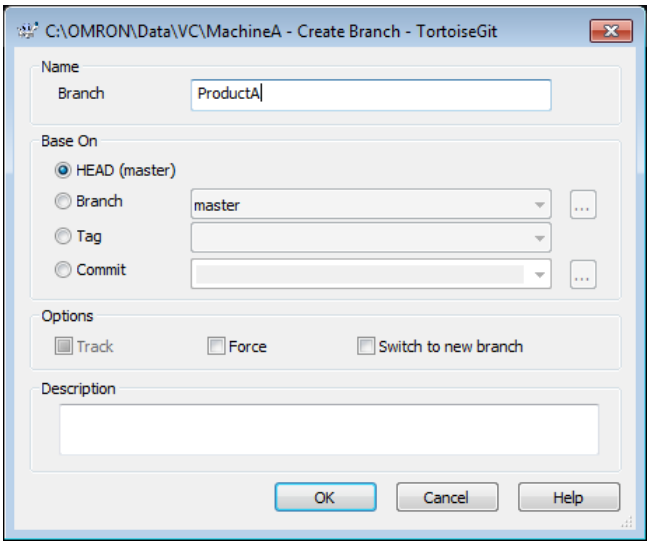
1. Synchronizing the remote repository and local repository
   After the project is registered in the remote repository, there is a possibility that other developers are updating the target project in the remote repository. Configure the settings to synchronize the remote repository to be the master and the local repository in the Developer A's computer. Refer to *7.3.3.2 Load the project from the remote repository (No.2: Developer A)* for details.
   In this scenario, this operation is unnecessary immediately after the procedure described in *7.4.3.1 Register a project in the remote repository (No.1: Machine A development)* since only the Developer A accesses the remote repository.

2. Right-click the folder icon in the Multiview Explorer or on the target project in the **Version Control Projects** window, and select **TortoiseGit - Create Branch**.



   The "TortoiseGit" **Create Branch** dialog box is displayed.

3. Enter the branch name (in this example, *ProductA*), and click the **OK** button.
   For **Base On**, select the latest revision. Select **Head (master)**.



The branch is successfully created.

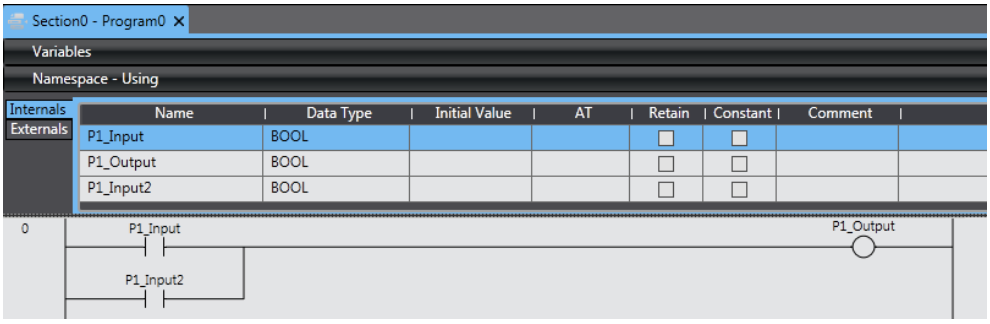
4. Push the created branch *ProductA* from the local repository to the remote repository. For the procedure to push the project data to the remote repository, refer to *6.4.3 Registering the Changes to the Remote Repository (Push).*

7.4.3.3 Create the program of Machine A, commit it, and push it to the remoter repository (No.3: Machine A development)

Switch the working branch on the developer's computer and register Global Variables and create programs. After creation, consider this as a finished data and apply the tag as "Version 1.0". Then, push this to the remote repository.

1. Switch to the branch for Machine A *ProductA* to edit it. For the procedure to switch to the branch to edit, refer to *7.3.3.7 Commit changes of Program A and Global Variables to the working branch (No.8, 9: Developer A)*.

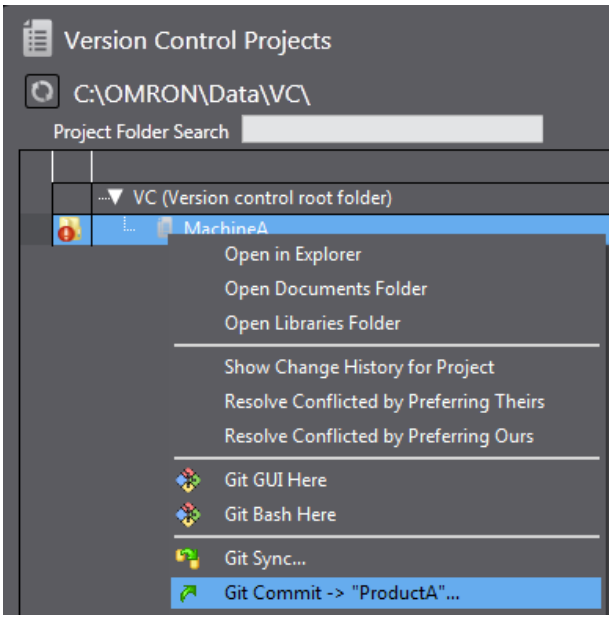
2. Create the program for the product A. The figure below illustrates an example of the program.



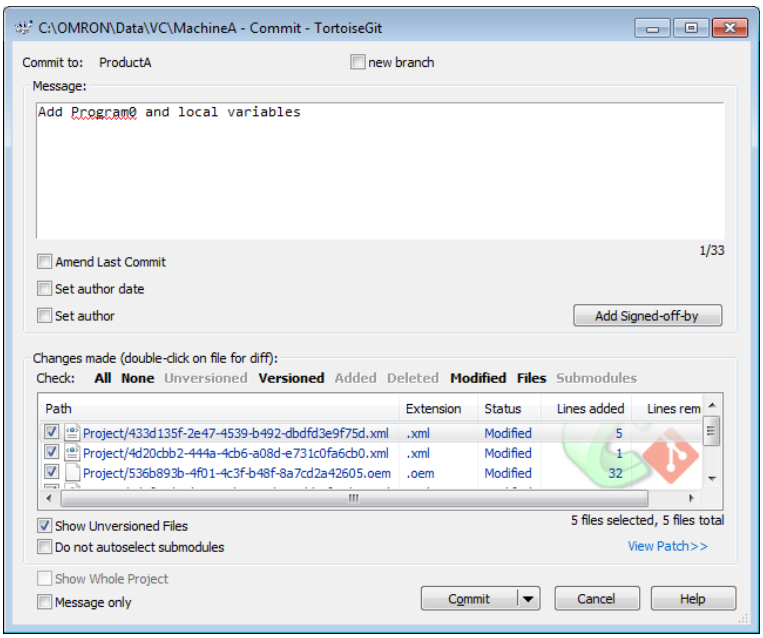
3. From the Main menu, select **File - Save** to save the project.

4. Select **File - Close** to close the project.

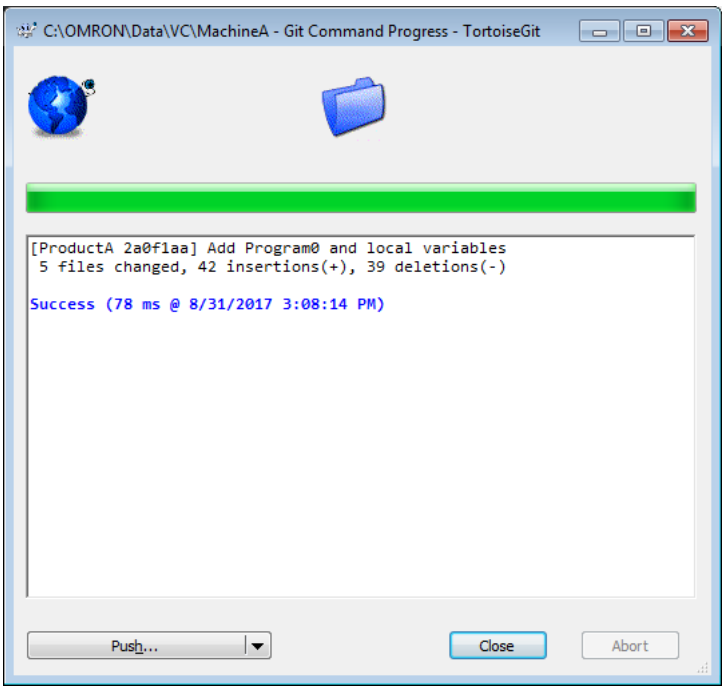
5. Right-click the target project in the **Version Control Projects** window and select **Git Commit -> "ProductA"** from the pop-up menu.



The “TortoiseGit” **Commit** dialog box is displayed.

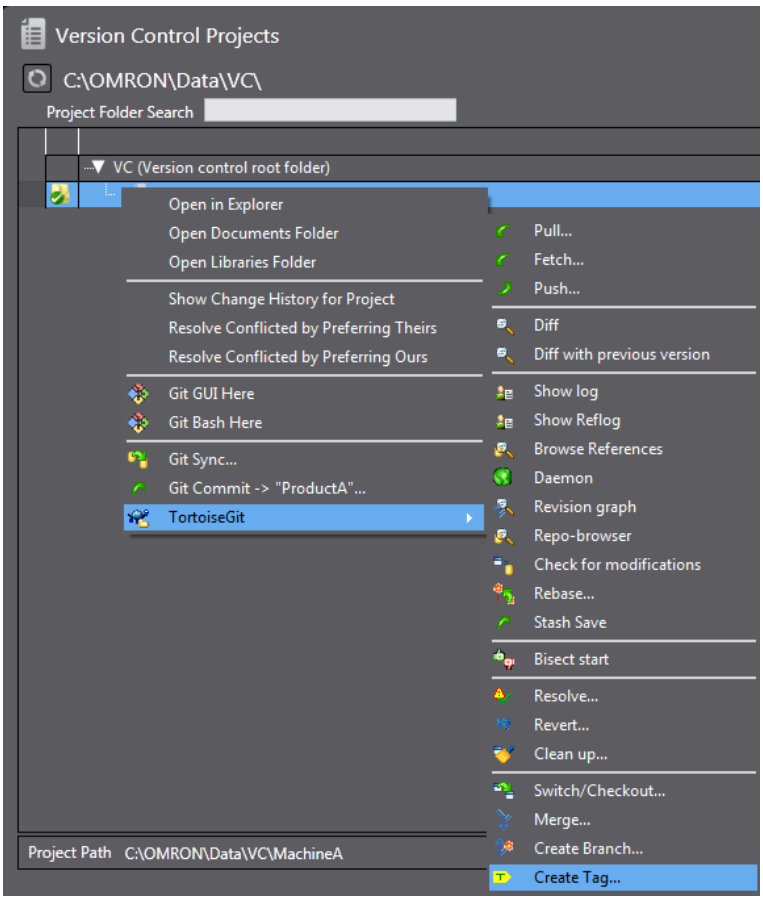


6. Enter comment in the **Message** area and click the **Commit** button.
   Commit is completed.



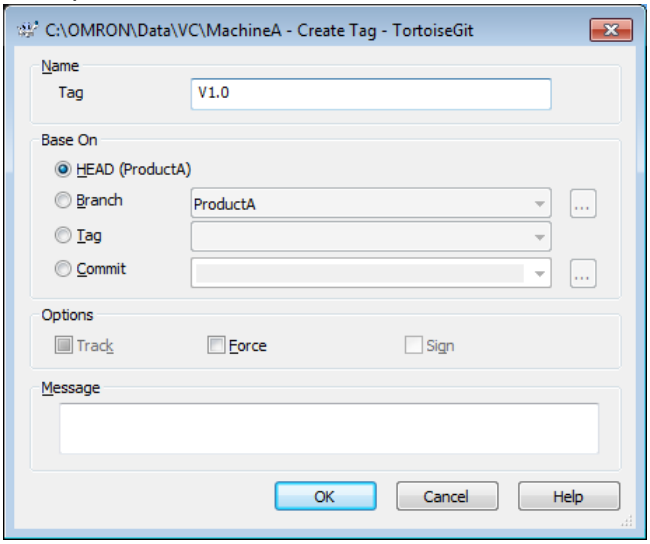
7. Click the **Close** button.

8. Right-click the target project in the **Version Control Projects** window and select **TortoiseGit - Create Tag** from the pop-up menu.



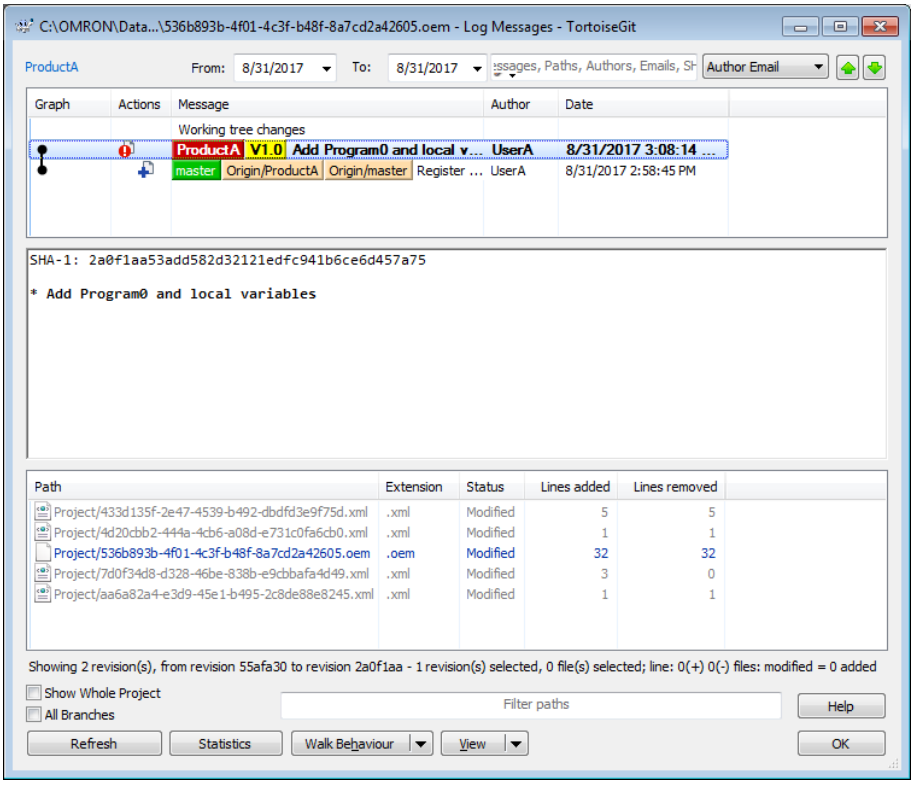
The “TortoiseGit” **Create Tag** dialog box is displayed.

9. Enter the version No. or other text string to identify the tag in the **Tag** text box and click the **OK** button. In this example, enter *V1.0.*



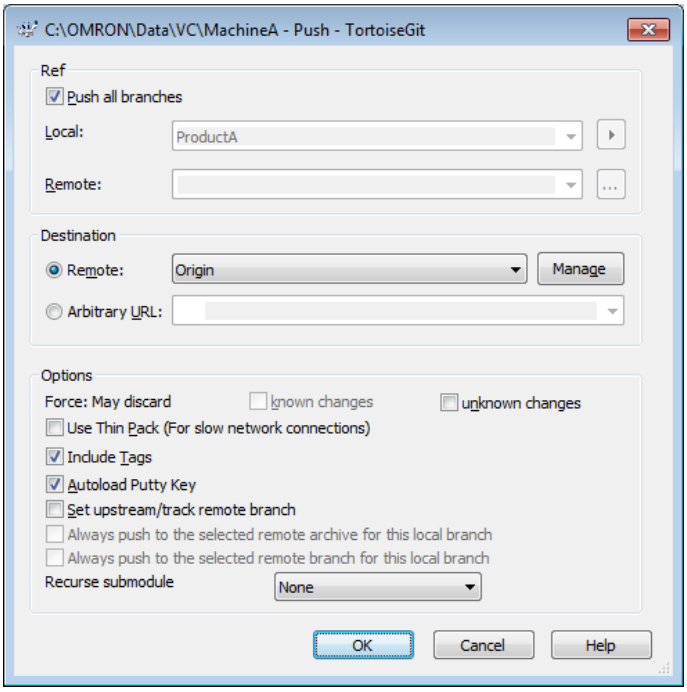
10. Right-click the folder icon in the MultiView Explorer or the project in the **Version Control Projects** window and select **TortoiseGit - Show log.**
    The “TortoiseGit” **Log Messages** dialog box is displayed.

11. You can see that the tag name is displayed in the **Working tree changes** field.



12. Push the changes (entry of a program) in the branch of Machine A from the local repository to the remote repository. Refer to *6.4.3 Registering the Changes to the Remote Repository (Push)* for details of the procedure.
    In the “TortoiseGit” **Push** dialog box, select the check box for **Include Tags** under **Options**, and then click the

OK button.

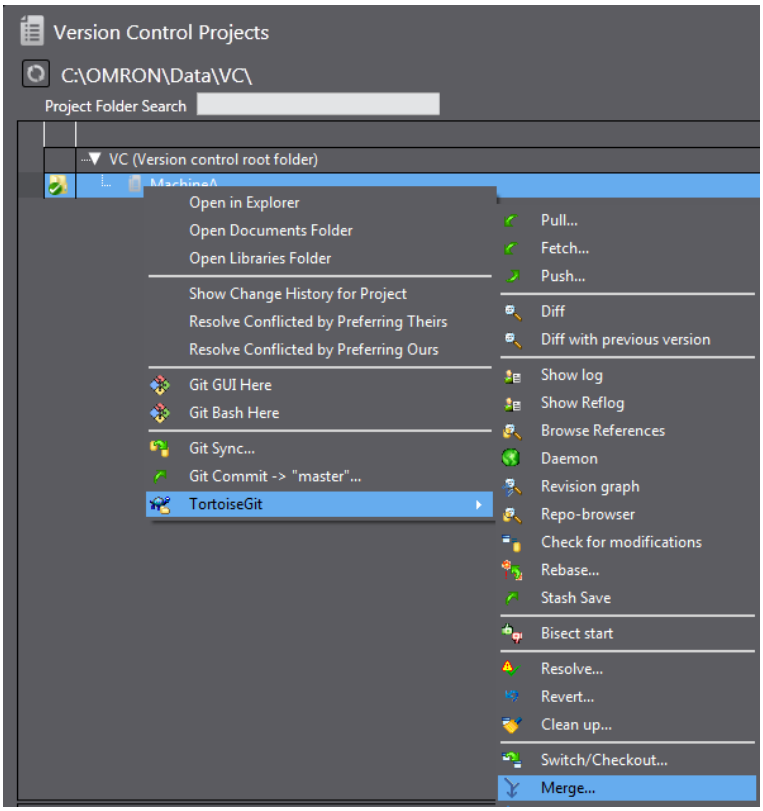


7.4.3.4 Merge the changes in the Machine A into the *master* in the local repository and push it to the remote repository (No.4: Machine A development)

Switch to the *master* branch and then merge the changes in the the Machine A branch *ProductA* into the *master* branch.

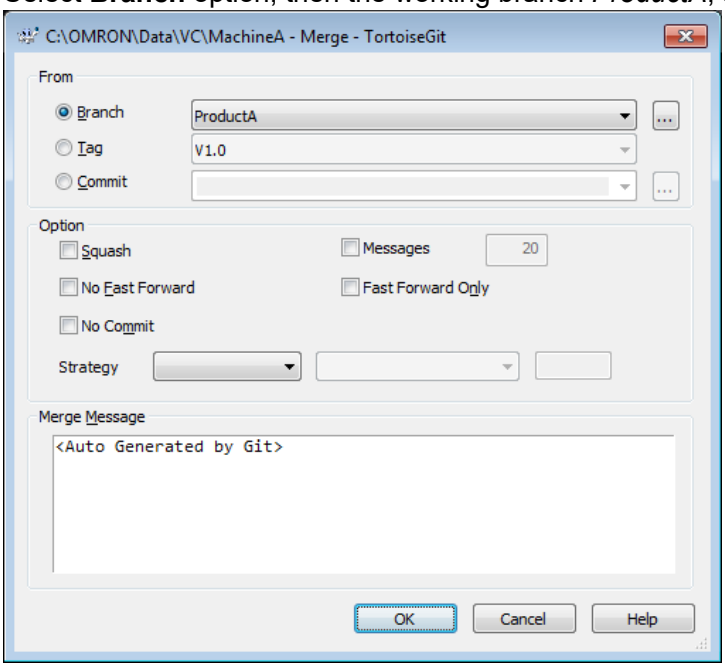
1. Switch to the *master* branch to edit it. For the procedure to switch to the branch to edit, refer to *7.3.3.7Commit changes of Program A and Global Variables to the working branch (No.8, 9: Developer A)*.

2. To merge the changes to the *master* branch, right-click the target project in the **Version Control Projects** window and select **TortoiseGit - Merge** from the pop-up menu.



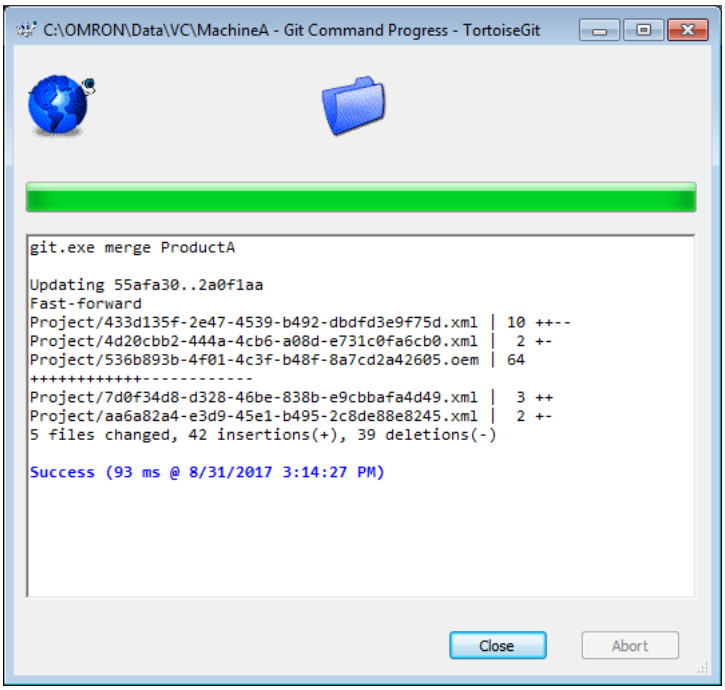
The “TortoiseGit” **Merge** dialog box is displayed.

3. Select **Branch** option, then the working branch *ProductA*, and click the **OK** button.



In this scenario, since the contents of the *ProductA* branch and *Tag V1.0* are the same, you can also select **Tag** option and *V1.0*.

Merging is completed.

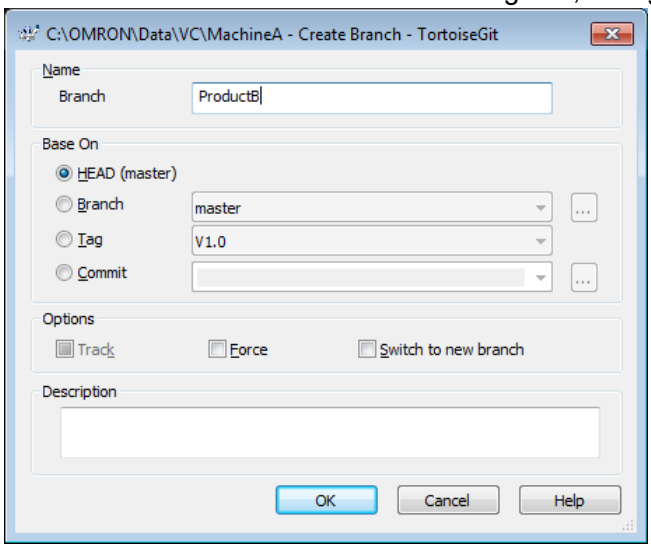


4. Click the **Close** button.

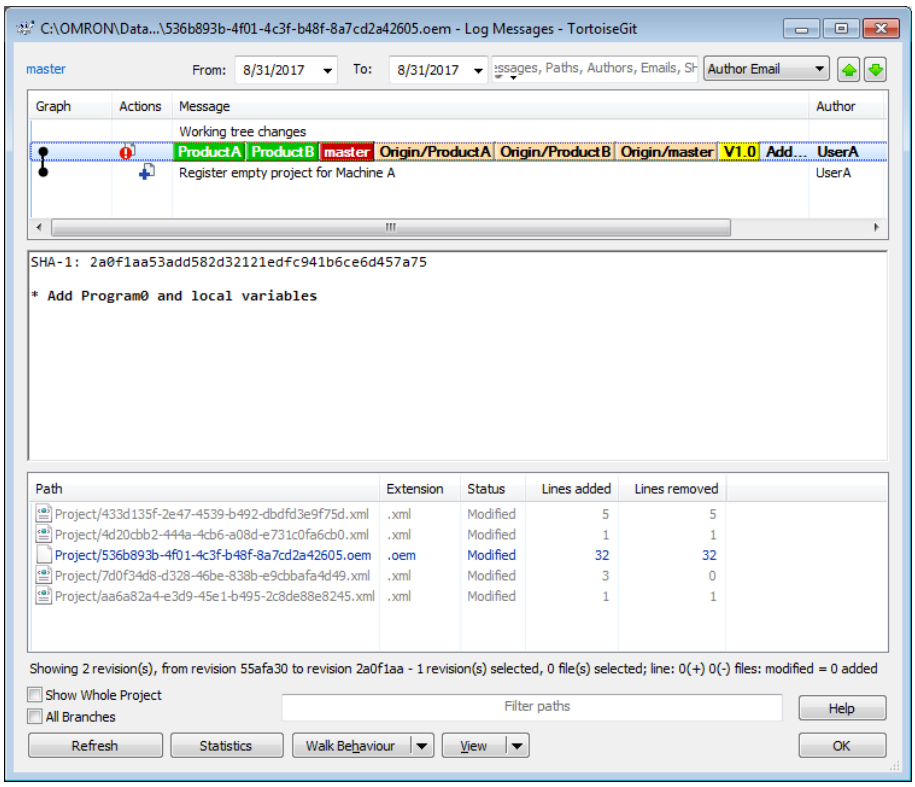
5. Push the changes (entry of program) in the branch of Machine A from the local repository to the remote repository. For the procedure to push the project data to the remote repository, refer to *6.4.3 Registering the Changes to the Remote Repository (Push)*.

7.4.3.5 Create a branch for Machine B in the local repository and push it to the remote repository (No.5: Machine B development)

Here, create a branch *ProductB* from the *master*, and then push the changes to the remote repository. For details on the series of procedure, refer to *7.4.3.2 Create a branch for Machine A in the local repository and push it to the remote repository (No.2: Machine A development)*.
In the “TortoiseGit” **Create Branch** dialog box, configure the settings as follows.



Create the *ProductB* branch in the local repository and then push this change to the remote repository.
After Push operation, the “TortoiseGit” **Log Messages** dialog box is displayed as shown below.

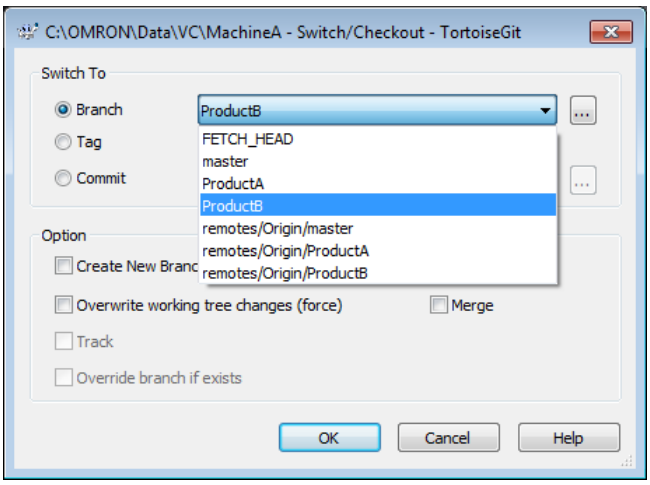


You can see that, in both of the remote and local repositories, *master*, *ProductA* and *ProductB* branches are synchronized.

7.4.3.6 Modify the settings in Configurations and Setup of the Machine B and commit them (No.6: Machine B development)

Create the project for the Machine B and commit it. In this scenario, it is assumed that Machine B project is developed on the base of Machine A project and they utilize the same program, but their Configurations and Setup differ.

1. Switch to the branch of Machine B to edit it. For the procedure to switch to the branch to edit, refer to *7.3.3.7 Commit changes of Program A and Global Variables to the working branch (No.8, 9: Developer A).*
   In the “TortoiseGit” **Switch/Checkout** dialog box, select **Branch** option and *ProductB*.

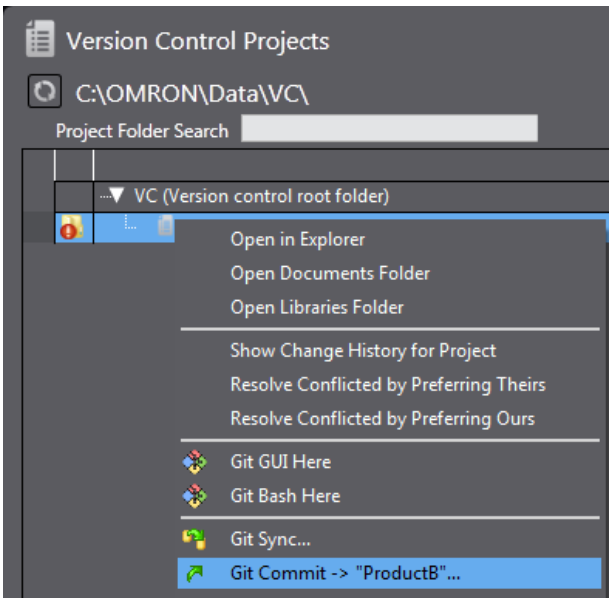


2. Modify the settings in Configurations and Setup for the Machine B. For example, add an EtherCAT slave.

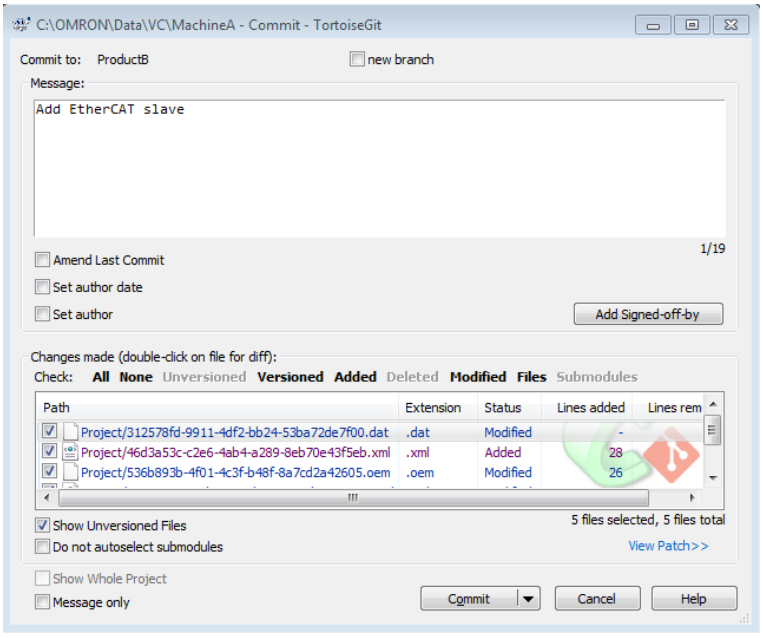
3. From the Main menu, select **File - Save** to save the project.

4. Select **File - Close** to close the project.

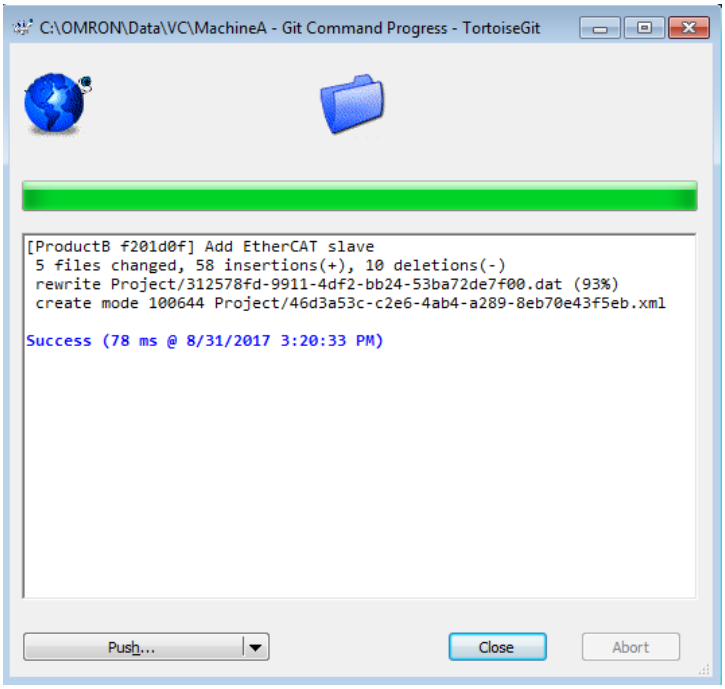
5. Right-click the target project in the **Version Control Projects** window and select **Git Commit -> "ProductB"** from the pop-up menu.



The "TortoiseGit" **Commit** dialog box is displayed.



6. Enter comment in the **Message** area and click the **Commit** button.
Commit is completed.



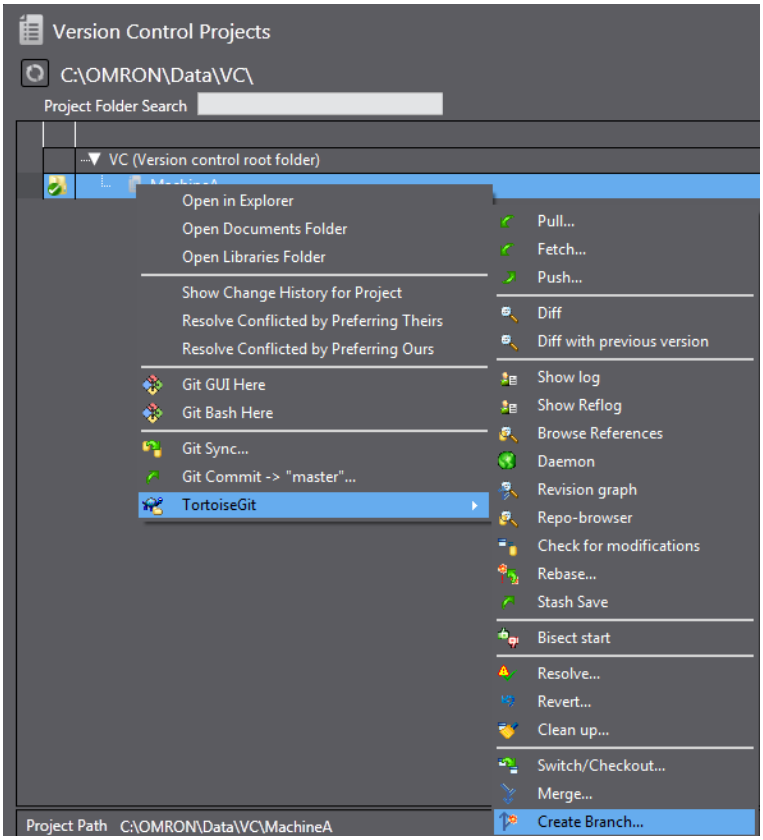
7. Click the **Close** button.

7.4.3.7 From the *master* in the local repository, create a branch for correcting defects (No.7: Correction of defects)

In order to apply correction of defects found in the Machine A to the Machine B, fix defects in the *BugFix* branch that is branched from the *master*. First create the *BugFix* branch.

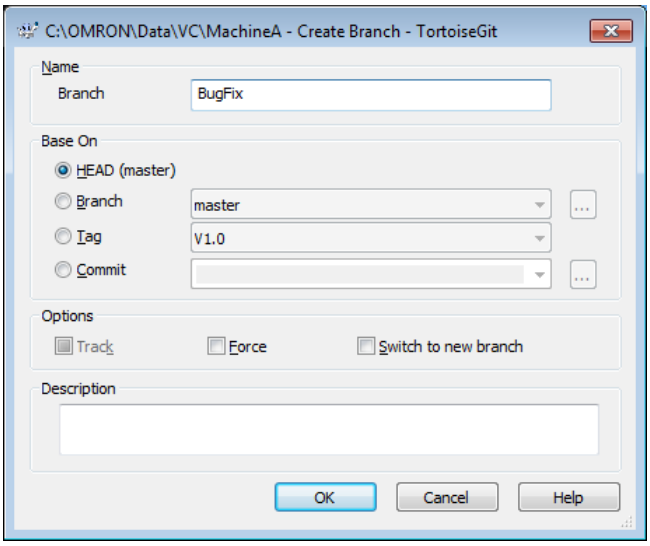
1. Switch to the *master* branch to edit it. For the procedure to switch to the branch to edit, refer to *7.3.3.7 Commit changes of Program A and Global Variables to the working branch (No.8, 9: Developer A)*.

2. Right-click the folder icon in the Multiview Explorer or on the target project in the **Version Control Projects** window, and select **TortoiseGit - Create Branch**.



The “TortoiseGit” **Create Branch** dialog box is displayed.

3. Enter the branch name (in this example, enter *BugFix*), and click the **OK** button.
   For **Base On**, select the latest revision. Select **Head (master)**.



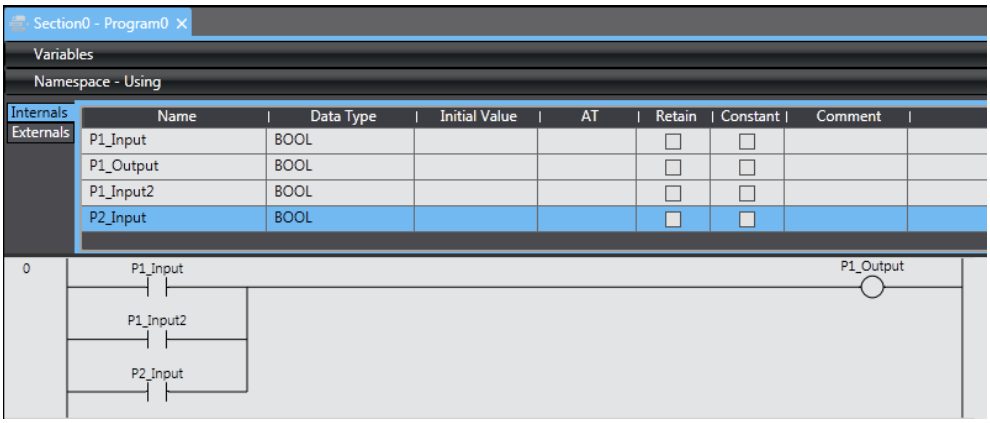
The branch is successfully created.

7.4.3.8 Commit correction of the defects, merge it to the *master* and push it to the remote repository (No.8: Correcting defects)

Switch to the *BugFix* branch and modify the program. After that, merge the changes to correct defects to the *master*, and push it to the remote repository.

1. Switch to the *BugFix* branch to fix the defects. For the procedure to switch to the branch to edit, refer to *7.3.3.7 Commit changes of Program A and Global Variables to the working branch (No.8, 9: Developer A).*

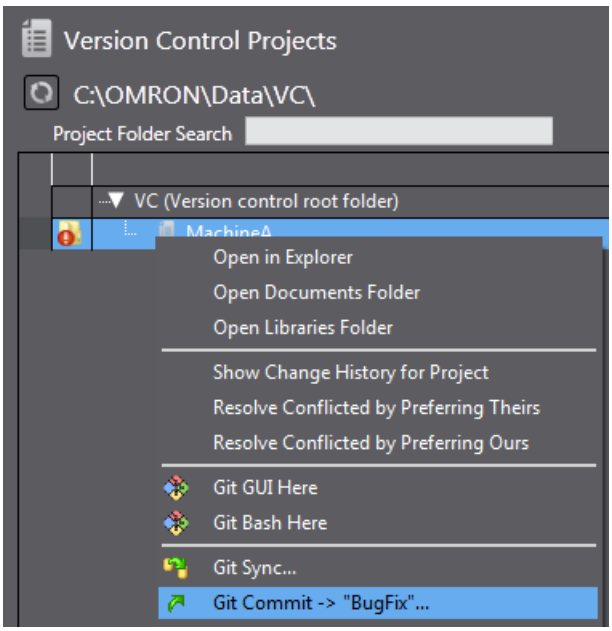
2. Modify the program to fix the defects. The figure below illustrates an example of the program.



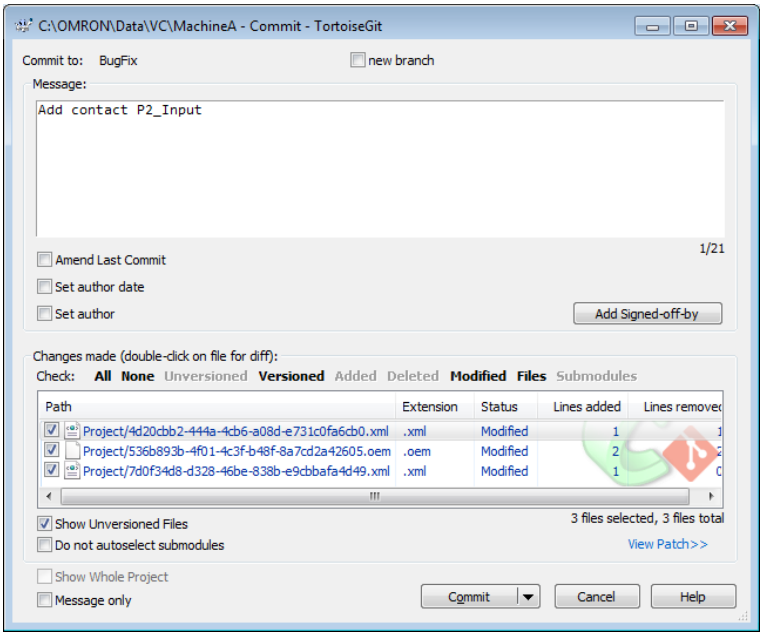
3. From the Main menu, select **File - Save** to save the project.

4. Select **File** - **Close** to close the project.

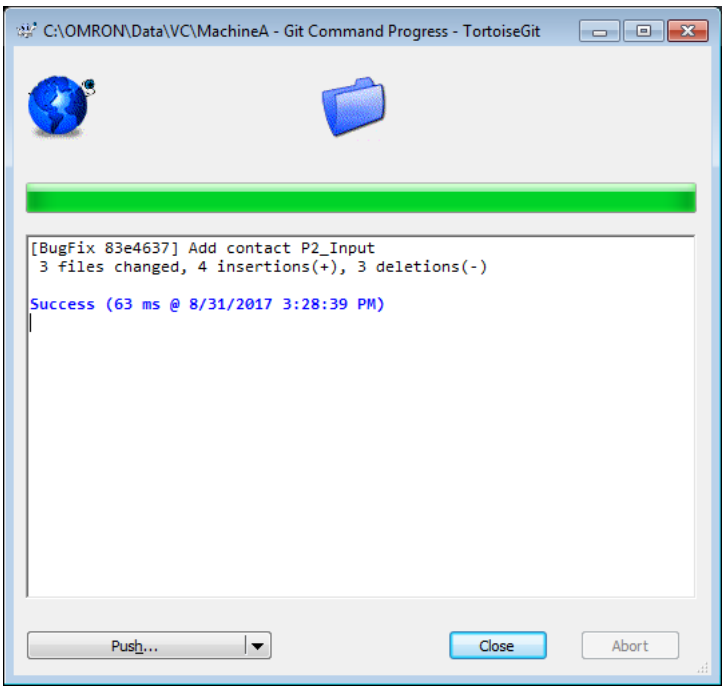
5. Right-click the target project in the **Version Control Projects** window and select **Git Commit -> "BugFix"** from the pop-up menu.



The "TortoiseGit" **Commit** dialog box is displayed.



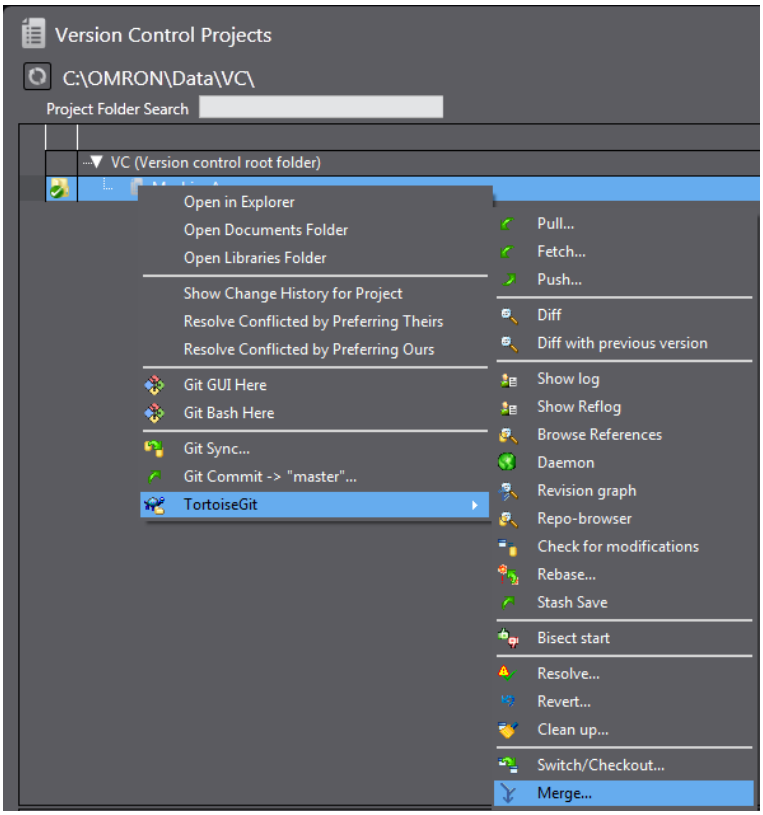
6. Enter comment in the **Message** area and click the **Commit** button.
   Commit is completed.



7. Click the **Close** button.

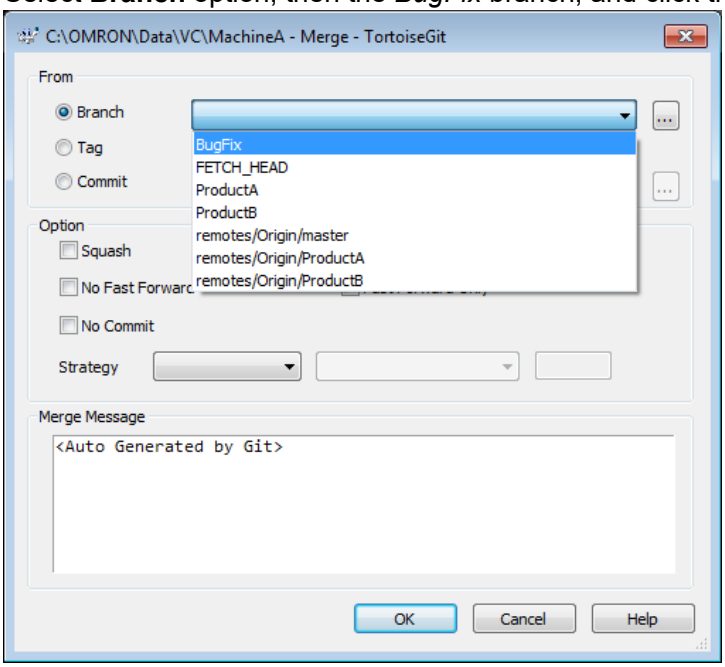
8. Switch to the *master* branch to edit it. For the procedure to switch to the branch to edit, refer to *7.3.3.7 Commit changes of Program A and Global Variables to the working branch (No.8, 9: Developer A)*.

9. To merge the changes in the *BugFix* branch to the *master* branch, right-click the target project in the **Version Control Projects** window and select **TortoiseGit - Merge** from the pop-up menu.

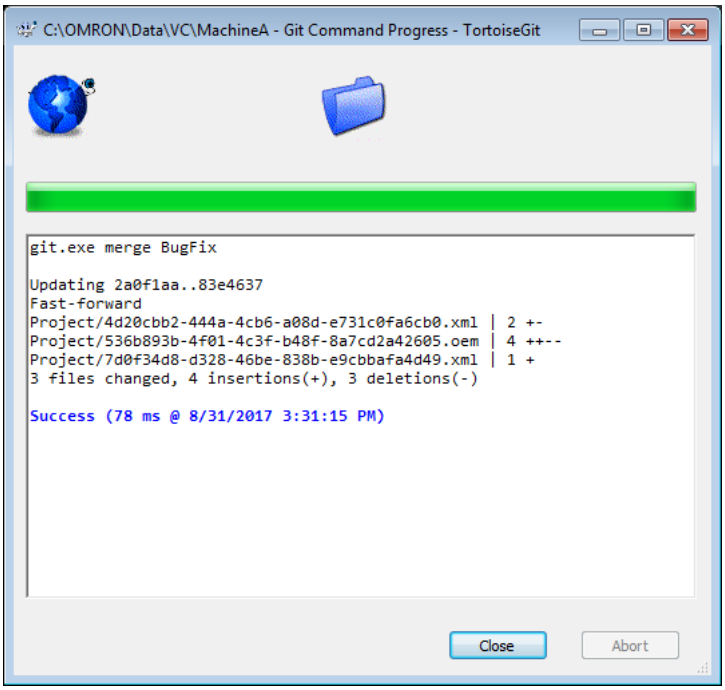


The “TortoiseGit” **Merge** dialog box is displayed.

10. Select **Branch** option, then the *BugFix* branch, and click the **OK** button.



11. Merging is completed.



12. Click the **Close** button.

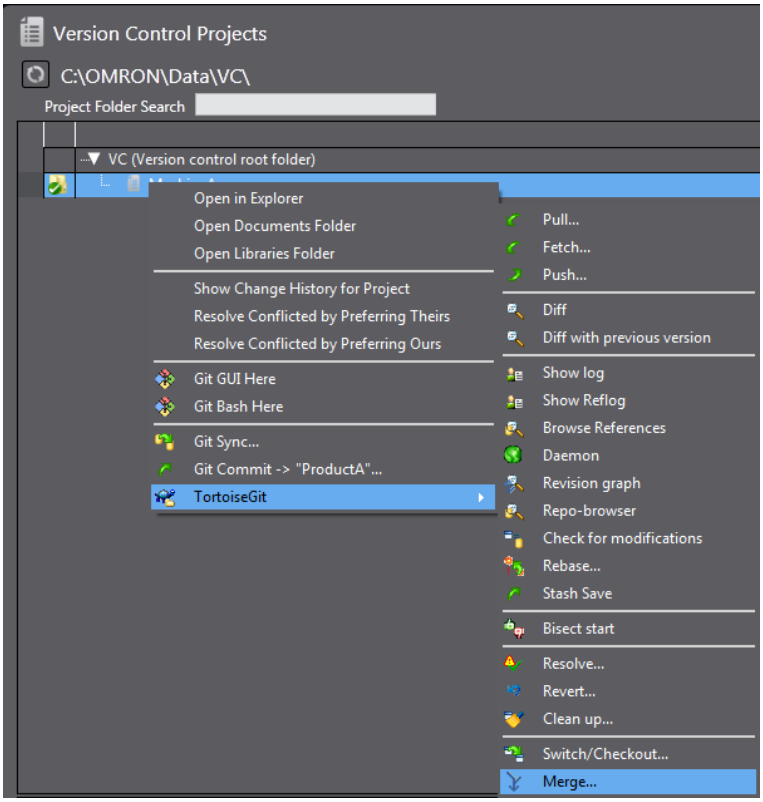
13. Push the changes in the branch to correct defects and *master* branch from the local repository to the remote repository. For the procedure to push to the remote repository, refer to *6.4.3 Registering the Changes to the Remote Repository (Push).*

7.4.3.9 Merge correction of defects into the branch of the Machine A and push it to the remote repository (No.9: Machine A development)

Merge the changes to fix defects of the Machine A merged into the *master* to the branch of Machine A. After merging, consider this as a finished data after correcting defects and apply the tag as "Version 1.1". Then, push this to the remote repository.

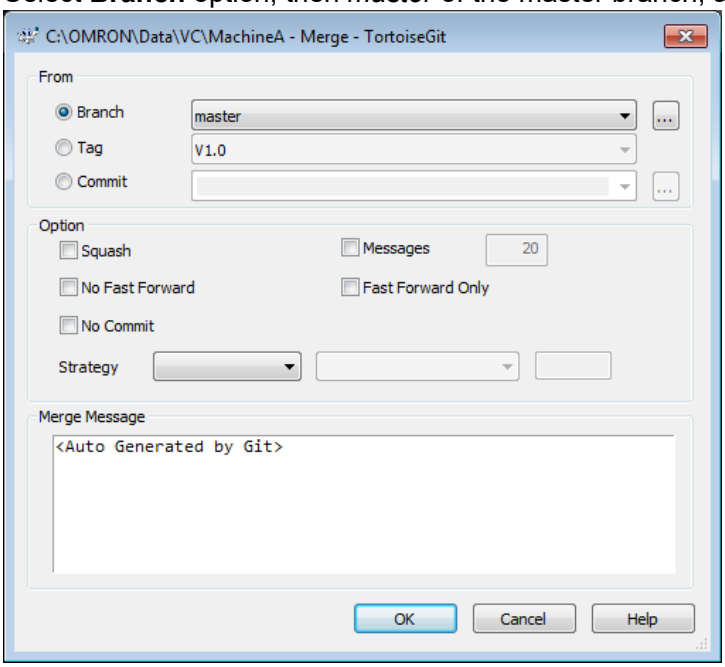
1. Switch to the branch for Machine A *ProductA* to edit it. For the procedure to switch to the branch to edit, refer to *7.3.3.7Commit changes of Program A and Global Variables to the working branch (No.8, 9: Developer A).*

2. To merge the changes to the *ProductA* branch, right-click the target project in the **Version Control Projects** window and select **TortoiseGit - Merge** from the pop-up menu.

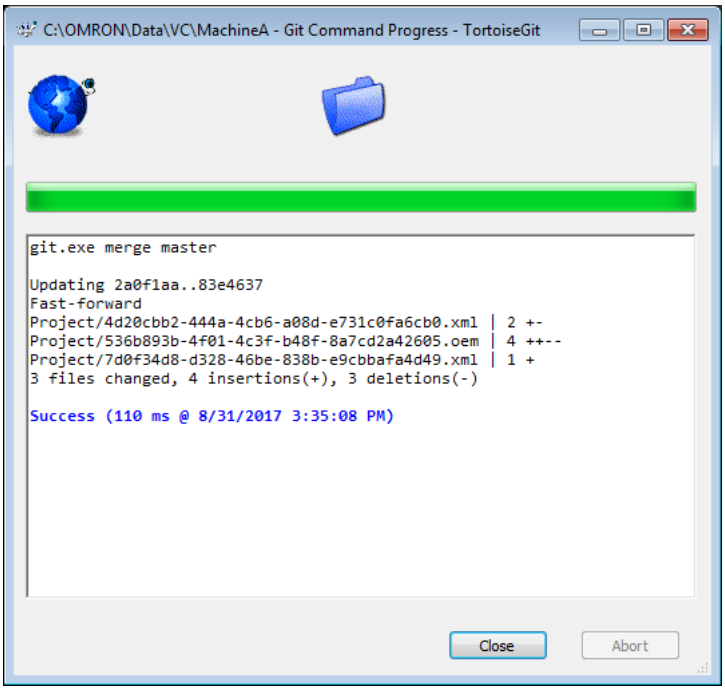


The “TortoiseGit” **Merge** dialog box is displayed.

3. Select **Branch** option, then *master* of the master branch, and click the **OK** button.



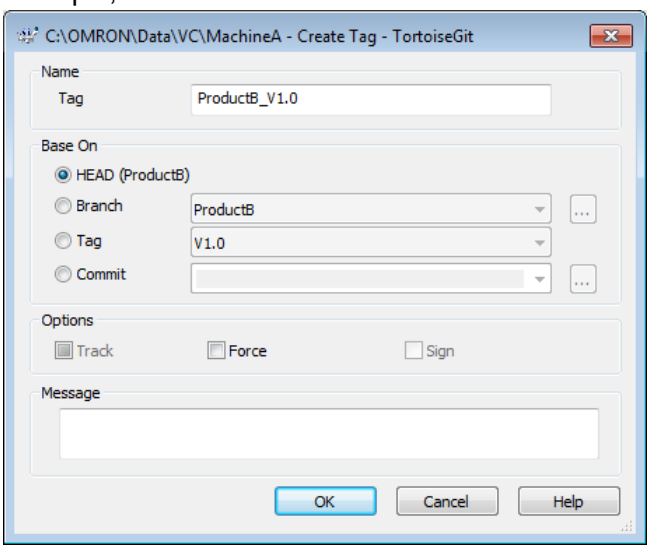
Merging is completed.



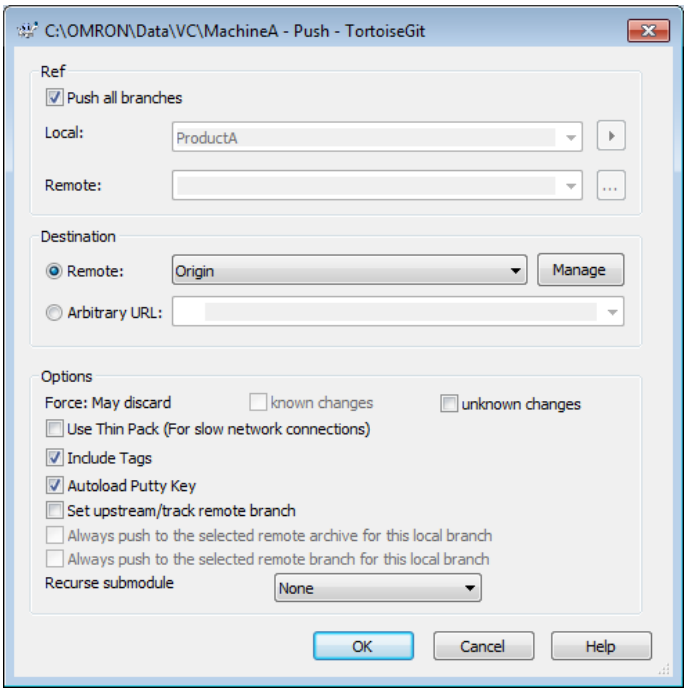
4. Click the **Close** button.

5. Right-click the target project in the **Version Control Projects** window and select **TortoiseGit - Create Tag** from the pop-up menu.
   The “TortoiseGit” **Create Tag** dialog box is displayed.

6. Enter the version No. or other text string to identify the tag in the **Tag** text box and click the **OK** button. In this example, enter *V1.1.*



7. Push the changes in the branch of Machine A (applying defect correction) from the local repository to the remote repository. Refer to *6.4.3 Registering the Changes to the Remote Repository (Push)* for details of the procedure.
   In the “TortoiseGit” **Push** dialog box, select the check box for **Include Tags** under **Options**, and then click the **OK** button.



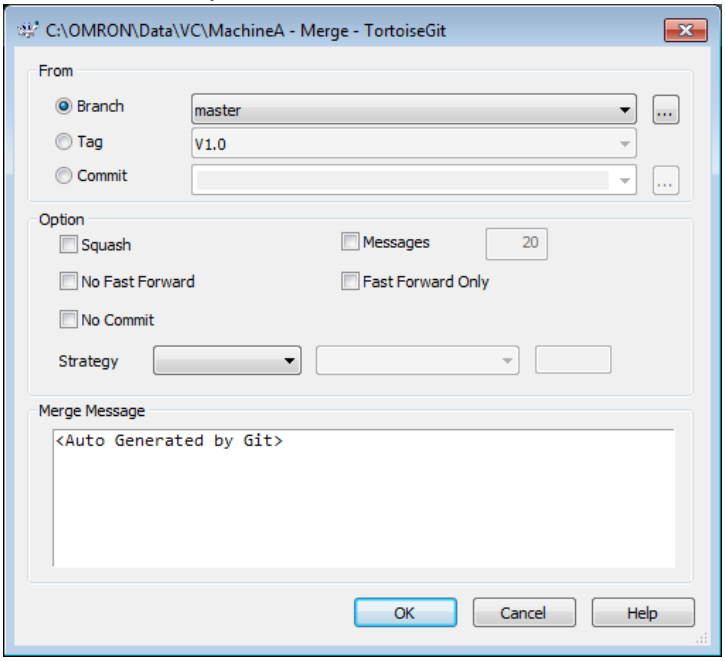
7.4.3.10 Merge the correction of defects to the branch of Machine B and push it to the remote repository (No.10: Machine A development)

Merge modifications to correct defects in Machine A merged into the *master* to the branch of the Machine B. After merging, consider this as a finished program of the Machine B and apply the tag as "Version 1.0". Then, push this to the remote repository.

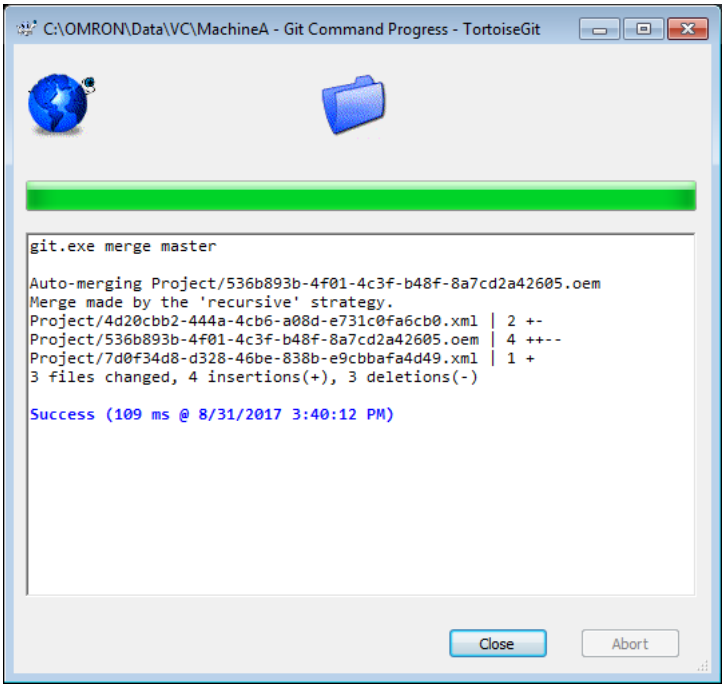
1. Switch to the *ProductB* branch of the Machine B to edit it. For the procedure to switch to the branch to edit, refer to *7.3.3.7 Commit changes of Program A and Global Variables to the working branch (No.8, 9: Developer A)*.

2. To merge the changes to the *ProductB* branch, right-click the target project in the **Version Control Projects** window and select **TortoiseGit - Merge** from the pop-up menu.
   The “TortoiseGit” **Merge** dialog box is displayed.

3. Select **Branch** option, then *master* of the master branch, and click the **OK** button.



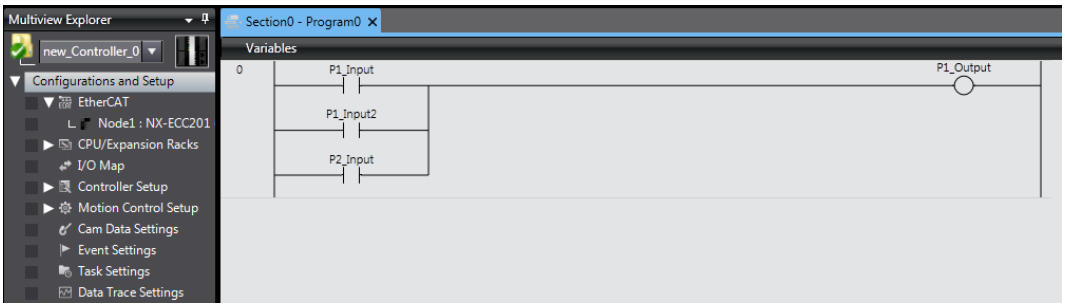
Merging is completed.



4. Click the **Close** button.

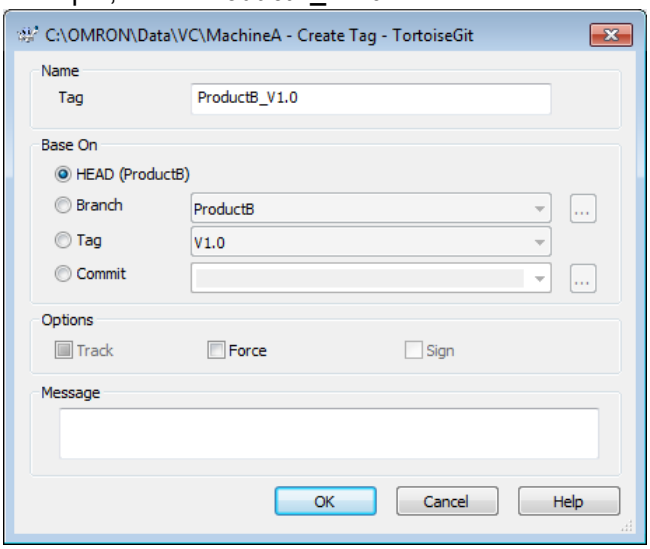
<Precaution for correct use>
In the example of this document, conflicts do not occur when merging the changes. If the same portion of data in the Machine A and B are modified, a conflict occurs and merge processing fails. In that case, in order to maintain the changes for Machine B in Configurations and Setup, merge the changes preferring changes of Product B branch. For the procedure to resolve conflicts, refer to *7.3.3.12 Merges the changes in the working branch of Developer B to the main branch (No.12: Developer B).*

5. If you open the project, as shown below, you can confirm that the program has been changed while maintaining the Configurations and Setup that was modified for the Machine B.

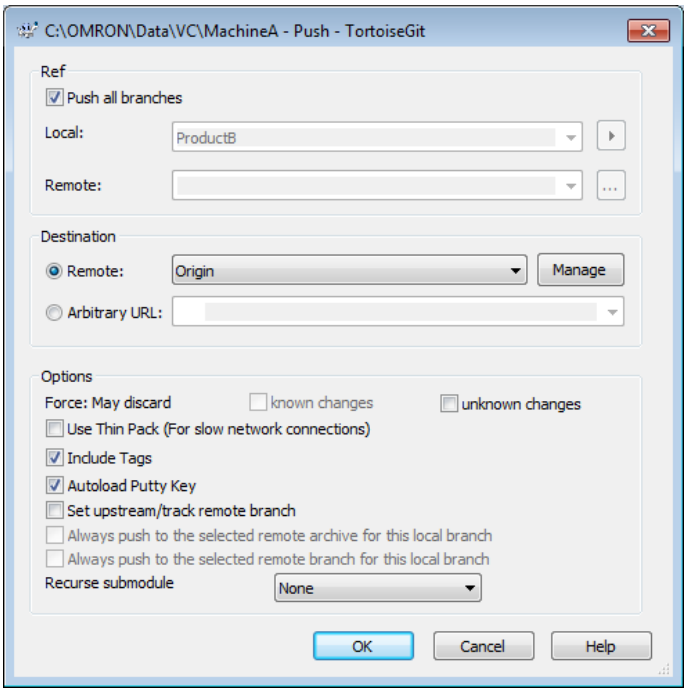


6. Right-click the target project in the **Version Control Projects** window and select **TortoiseGit - Create Tag** from the pop-up menu.
   The “TortoiseGit” **Create Tag** dialog box is displayed.

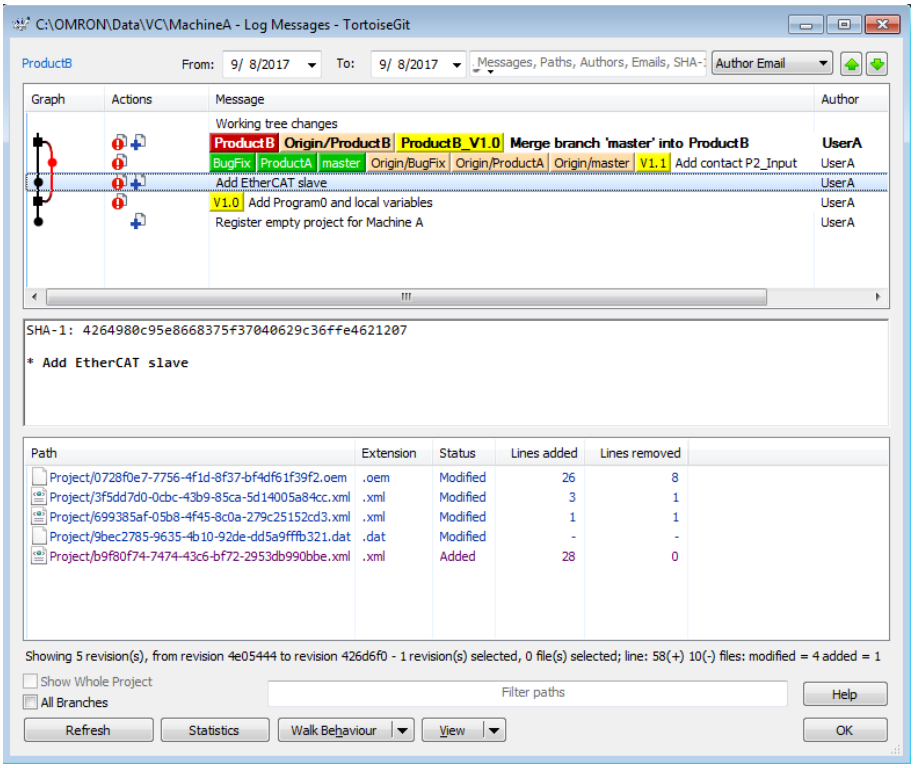
7. Enter the version No. or other text string to identify the tag in the **Tag** text box and click the **OK** button. In this example, enter *ProductB_V1.0.*



8. Push the changes (changing Configurations and Setup and applying defect correction) in the branch of Machine B from the local repository to the remote repository. Refer to 6.4.3 Registering the Changes to the Remote Repository (Push) for details of the procedure.
   In the “TortoiseGit” **Push** dialog box, select the check box for **Include Tags** under **Options**, and then click the **OK** button.



9. After Push operation, the “TortoiseGit” **Log Messages** dialog box is displayed as shown below.



In the **Message** field, you can know that changes made in the *BugFix* branch were applied to the *master* branch and *ProductA* branch, and contents in the *master* branch (reflection of changes in *BugFix* branch) is applied to the *ProductB* branch.

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