EPSON

Robot Controller Option
OPC UA Server

Original instructions

Rev.3
ENM256S7650F

Table of Contents

1. FOREWORD

1.1 FOREWORD

Thank you for purchasing our robot products.

This manual contains the information necessary for the correct use of Epson OPC UA Server.

Please carefully read this manual and other related manuals before installing the robot system.

Keep this manual handy for easy access at all times.

The robot system and its optional parts are shipped to our customers only after being subjected to the strictest quality controls, tests, and inspections to certify its compliance with our high performance standards. Please note that the basic performance of the product will not be exhibited if our robot system is used outside of the usage conditions and product specifications described in the manuals.

This manual describes possible dangers and consequences that we can foresee. Be sure to comply with safety precautions on this manual to use our robot system safety and correctly.

1.2 TRADEMARKS

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1.3 Notation

Microsoft® Windows® 10 operating system
Microsoft® Windows® 11 operating system
In this manual, the above operating systems are referred to as Windows 10 and Windows 11, respectively. Windows 10 and Windows 11 are sometimes collectively referred to as Windows.

1.4 Terms of Use

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Please contact us if you find any errors in this document or if you have any questions about the information in this document.

1.5 Manufacturer

SEIKO EPSON CORPORATION

1.6 Contact Information

Contact information details are listed in the "Supplier" section in the following manual.
Note that the contact information may vary depending on your region.
"Safety Manual - Contact Information"

The Safety Manual is also available at the following site.
URL: https://download.epson.biz/robots/

1.7 Before Use

Before using this manual, be sure that you understand the following information.

The Installation Folder for Epson RC+ 8.0

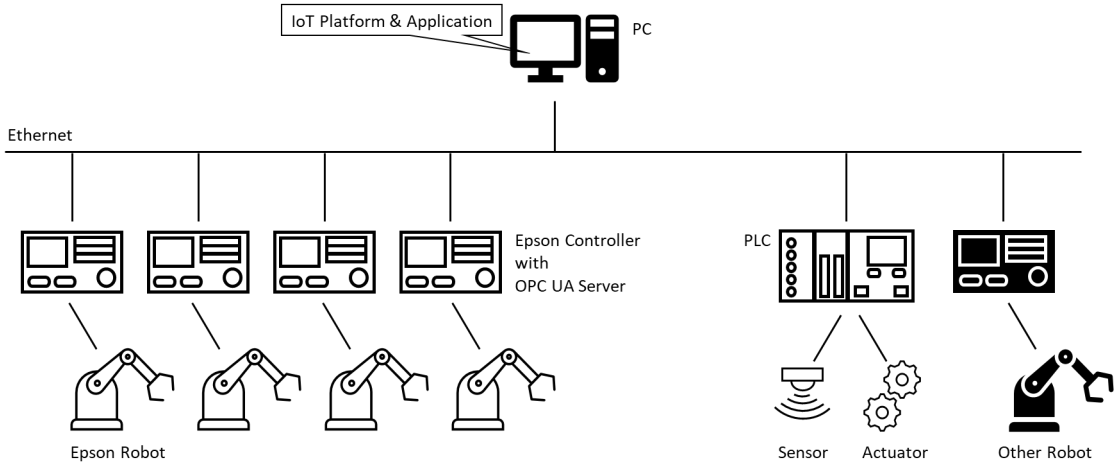
You can change the path for the installation folder for Epson RC+ 8.0 anywhere. This manual assumes that Epson RC+ 8.0 is installed in `C:\EpsonRC80\Epson RC+ 8.0`.

2. Introduction

2.1 Overview

This product is a Software that installed in the Robot Controllers. By using a software that has function of OPC UA Client that installed in PC, it is possible to get information or data of Robot or Controllers from OPC UA Server. The acquired information can be used in application built by customers on the IoT platform.

However, customers must build software that has OPC UA Client function and applications such as IoT platform. Those are not covered by this product.



2.2 Features of This Product

2.2.1 OPC UA Server

This product has OPC UA Server which is supporting OPC UA Ver1.04. It also provides an Address Space that supports the Companion Specification of OPC UA for Robotics Part1 Ver.1.00 and provides following Vender Specific Extension of Epson.

- I/O

  Acquires status of Controller’s standard I/O and expansion I/O.

- Force sensor data

  Acquires data of force sensor of connected Robot.

- SPEL variable

  Acquires variable values of SPEL+ program.

- MotionLog

  Acquires values associated with controlling the robot.

It is possible to refer the Address Space from OPC UA Client, create subscription and monitor items.

End Point

OPC UA Client can connect OPC UA Server by using following URL.

```
opc.tcp://<IP Address>:<PortNo.>
```

- IP Address: IP Address setting by user
- PortNo.: Port No. setting by user

Certificate

OPC UA Client uses Server Certificate to judge the OPC UA Server is trustable that connecting to. To activate OPC UA Server, a Server Certificate will be needed.

User Certificate

It is possible to create UserName/Password to connect to the OPC UA Server.

Client Certificate

Client authentication using Client Certificate is possible.

Security

OPC UA Server supports standard Security mode and Security Policy of OPC UA.

> **KEY POINTS**
>
> The OPC UA Server installed in the virtual controller has some specifications that are different from the one installed in the actual controller.
> For details, refer to the following.
> **Appendix A: OPC UA Server Installed in the Virtual Controller**

2.2.2 OPC UA Configurator

OPC UA Configurator provides features such as OPC UA Server configuration and management of Certificate. For details, refer to the following.

OPC UA Configurator

2.3 System Configuration

2.3.1 Controller

When updating a Controller to firmware supported OPC UA Server, refer to each Controller manual or Controller Maintenance manual.

2.3.1.1 Operating Condition

Controllers and firmware versions that can use the OPC UA Server functions, and the Epson RC+ 8.0 version that includes the virtual controller are as follows:

Controller	Firmware version
RC90/RC700 series	7.5.4.xx or later
T series/VT series	7.5.54.xx or later
RC800 series	8.0.0.xx or later

Virtual controller	Version
Epson RC+ 8.0	8.1.0.0 or later

2.3.1.2 Controller Setting

Controllers that use OPC UA Server need to be checked that configured IP Address, IP Mask, Default Gateway, and Passwords (if necessary). And need to be connected to Network by Ethernet. These settings can be done by Epson RC+. For information on how to set up, refer to the following manual.

"Epson RC+ User's Guide"

2.3.2 Network

Make sure the cable is connected to the Ethernet port and network is configured. Also, make sure that the devices are connected as shown in the system configuration example below.

Overview

2.3.2.1 Cyber Security

Set and use private IP address for the Controller.

> **KEY POINTS**
>
> When setting Global IP address for the Controller, note that there are risks of unauthorized access. For details, refer to the following manual.
>
> "Epson RC+ User's Guide"

3. OPC UA Configurator

3.1 Overview

OPC UA Configurator has following features.

Managing Controller connection

- Displaying OPC UA Server information
- Controlling Controllers collectively

Server Configuration

- Basic setting of the Server
- Settings of user configuration (UserName/Password)

Certificate

- Create or save Certificate / CSR
- Indicates expiration date of the Certificate

Activation

- Activates OPC UA Server licenses

3.2 Precautions

Precautions when using OPC UA Configurator.

> ⚠ CAUTION
>
> When connecting or operating with Controller (OPC UA Server) using OPC UA Configurator, all Robots connected to the target Controller need to be in stopped state.

> KEY POINTS
>
> There are some features you cannot use while Robot is operating (or doing tasks).

3.3 How to Start the Software

To start OPC UA Configurator, click Epson RC+ menu - [Setup] - [System Configuration] - [OPC UA] - [General] - [OPC UA Configurator] button.
The setting mode of the OPC UA Configurator changes depending on the connection status of Epson RC+ when you start the OPC UA Configurator.
If connected to a virtual controller, it starts in virtual controller setting mode.
In all other cases, it starts in normal setting mode.
Normal setting mode is explained on the following pages.
The basic functions of the virtual controller setting mode are similar to those of the normal setting mode. For differences from the normal setting mode, see below.

Appendix A-2: OPC UA Configurator Specifications in Virtual Setting Mode (Restrictions and Differences)

KEY POINTS

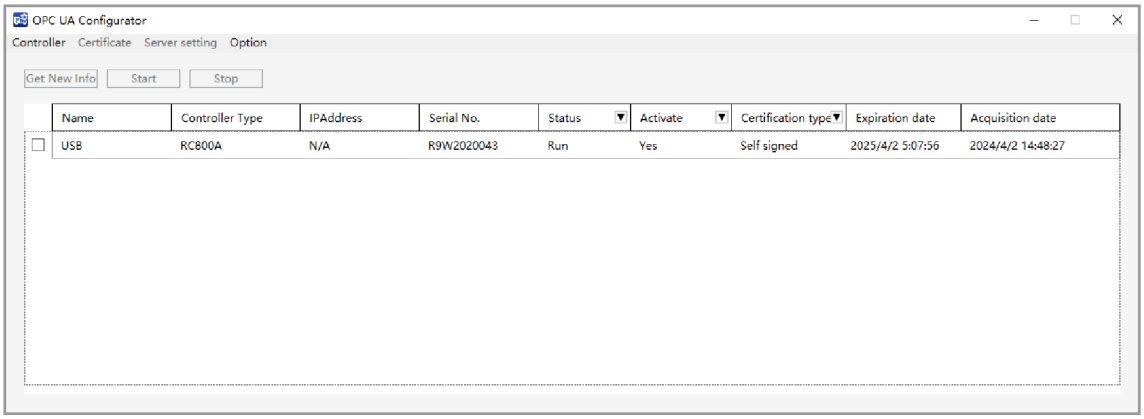
- If the Epson RC+ is connected to the actual controller, it is recommended to change to offline and then start OPC UA Configurator.
- OPC UA Configurator can only be opened up to one on the computer at a time.

3.4 OPC UA Configurator GUI

3.4.1 Outline

Following shows what Home display of this application is consisted of.

- Menu bar
- Buttons to execute
- Controller Information list



3.4.2 Menu bar

Following shows items of menu bar.

Items	Descriptions
Controller	Adding / deleting Controller, importing registered connection in Epson RC+ to the OPC UA Configurator.
Certificate	Settings regarding Certificate.
Server setting	Settings of Activation or Server.
Option	Sets up the backup function.

3.4.3 Buttons to Execute

These are executing buttons used often on OPC UA Configurator.

Clicking buttons to do functions following below.

Items	Descriptions
Start	Start the OPC UA Server for the selected Controller. When multiple Controllers selected, it starts one by one in order.

Items	Descriptions
Stop	Stop the OPC UA Server for the selected Controller. When multiple Controllers selected, it stops one by one in order.
Get New Info	Acquires information of the selected Controller and display it at Controller Information List.

3.4.4 Controller Information List

Displays Controller's data.

Check in the checkbox to select the Controller and it is possible to sort items.

Items	Descriptions
Name	Name of connection destination
Controller Type	Type of Controller
IP Address	IP Address of Controller
Serial No.	Serial No. of Controller
Status	Operation status of OPC UA Server
Expiration date	Expiration date of Server Certificate you've set
Certification type	Certificate type used as a Server Certificate
Activate	Displays Activation state of OPC UA Server
Acquisition date	Acquisition date and time to acquire information from the Controller.

3.4.4.1 Updating Information

When updating information of Controller displayed on the list, click [Get new info] button. Information is updated only for the Controller selected in the checkbox.

KEY POINTS

The information will be updated if you click the [Get new info] button.

It won't be updated by other operation. The last date and time you've updated the information is displayed in the [Acquisition date and time].

3.4.4.2 Status: Displays Server Operating Status

Following shows Server status displayed in the list.

Status	Descriptions
Run	Server is running
Stop	Server is stopped
Error	Server could not run, or an error occurred during the Run / Stop.

3.4.4.3 Activate: Displays Activation Status

Following shows OPC UA Server activation status displayed in Controller Information List.

Status	Descriptions
Yes	OPC UA Server activation enabled
No	OPC UA Server activation disabled

3.4.4.4 Certificate type: Displays Specification of Server Certificate

Following show types of Server Certificate displayed in Controller Information List.

Types	Descriptions
Self signed	Set Self Signed Certificate as a Server Certificate.
User specified	Set a Certificate prepared by user as a Server Certificate.
CA signed	Set CA Signed Certificate as a Server Certificate.

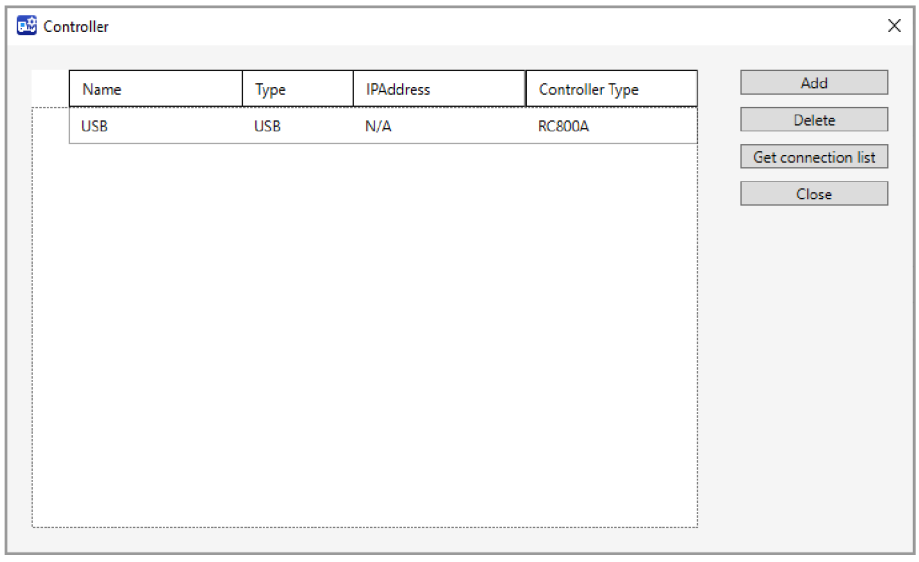
3.5 Managing Connection Destination

3.5.1 Adding Controllers

Adding Controllers to connection destination list.

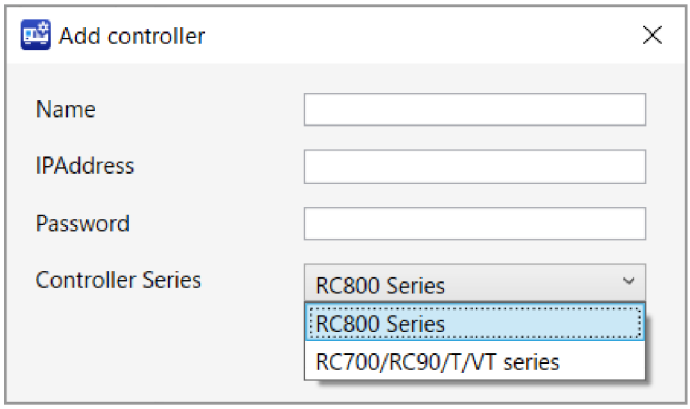
1. Select Home display Menu - [Controller].

   [Controller] dialog will be displayed.



2. Click [Add] button.

   [Add controller] dialog will be displayed.

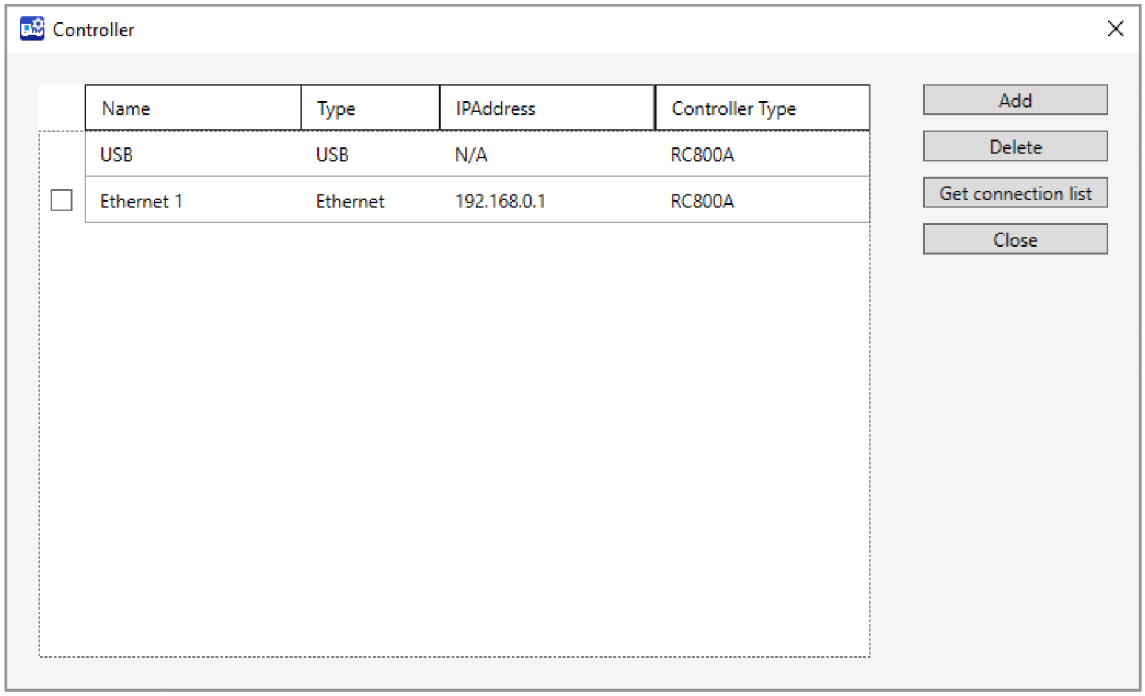


3. Set each item.

Items	Descriptions
Name	Name of connection destination
IP Address	Input IP Address of the Controller.
Password	Input password to connect the Controller to Ethernet. Input the password as same as the Controller password set in the Epson RC+. For details, refer to the following manual. "Epson RC+ User's Guide"
Controller Series	Select the Controller you wish to connect to.

4. Click [Apply] button.

Controller will be added in the connection destination list.

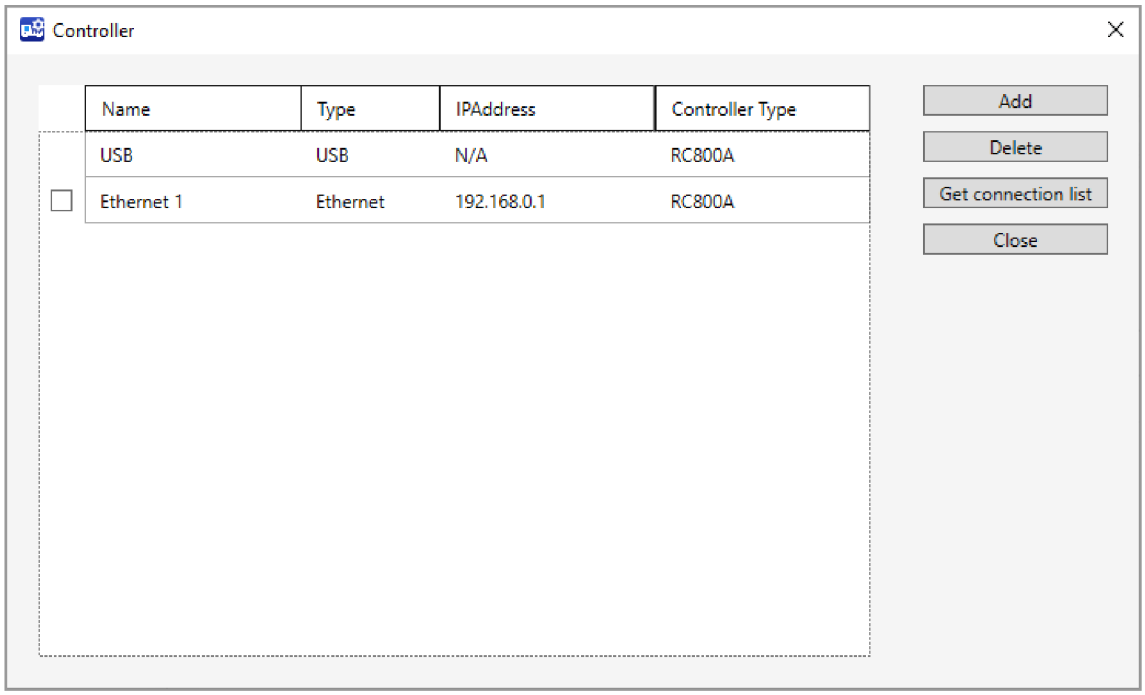


3.5.2 Deleting Controllers

This section describes deleting Controllers from the connection destination list.

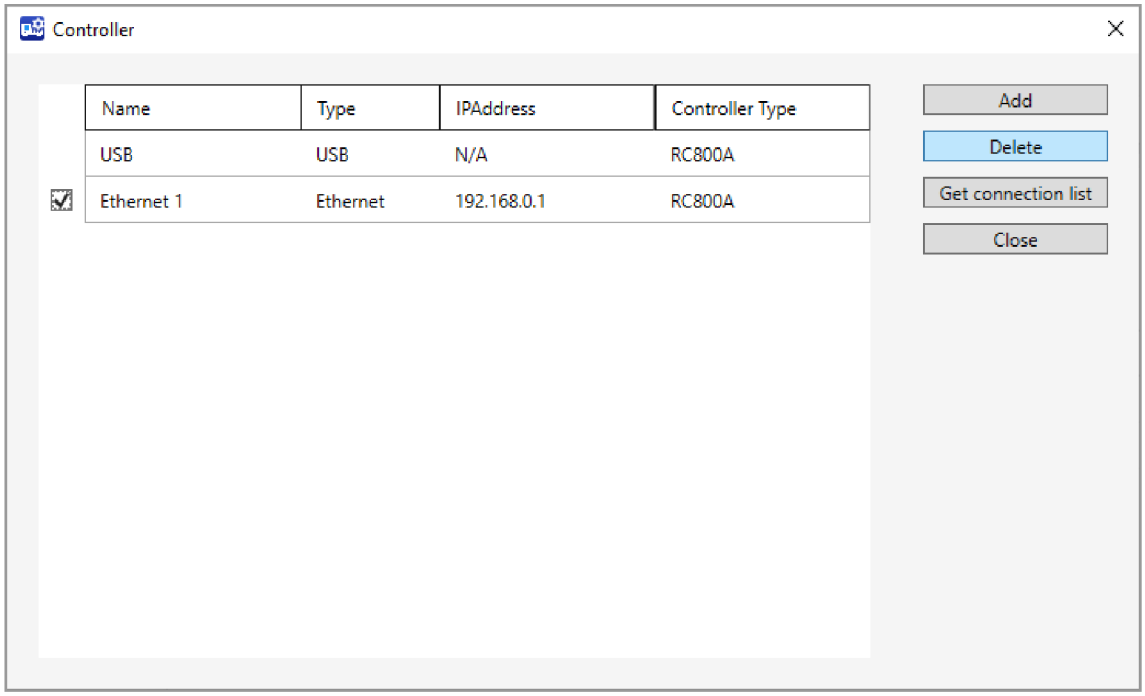
1. Select Home display Menu - [Controller].

   [Controller] dialog will be displayed.

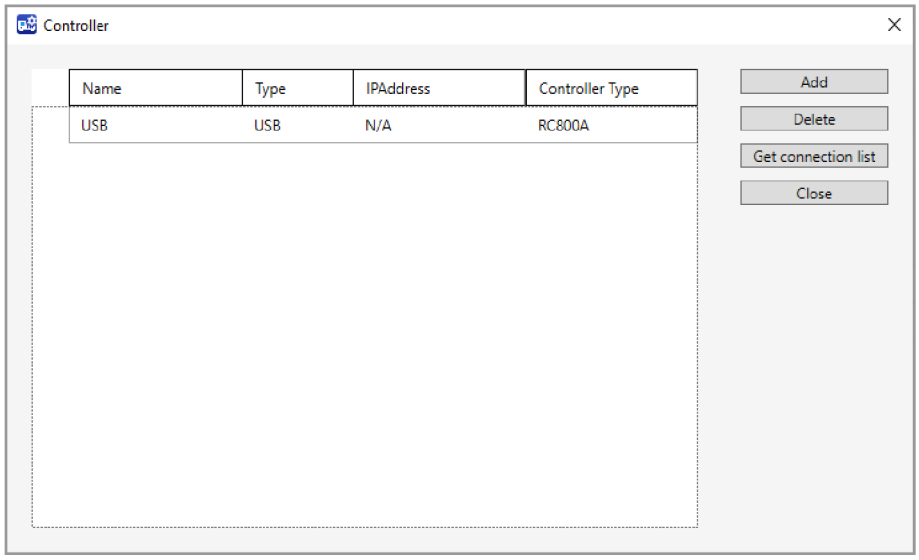


2. Check in the checkbox next to the list.

   Click [Delete] button.



3. You can see the Controller was deleted from the connection destination list.

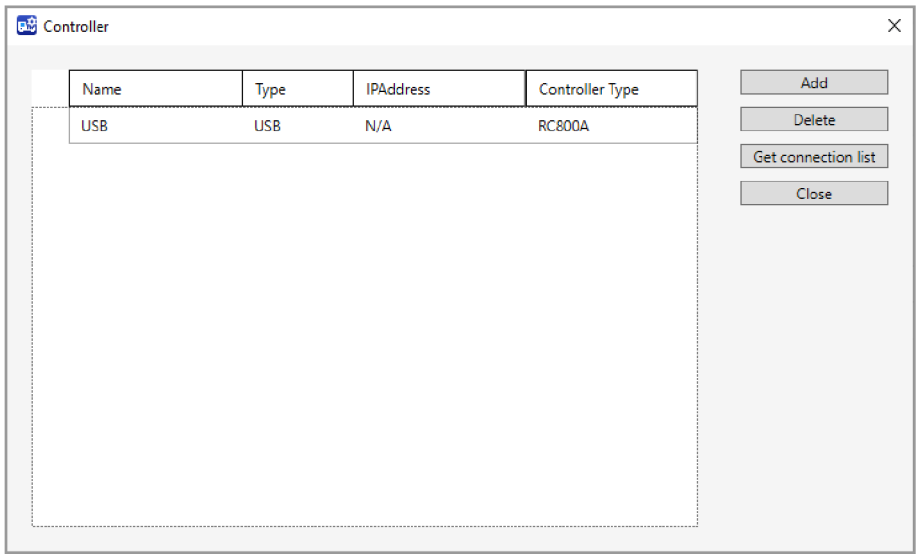


3.5.3 Setting Connection Destination of Epson RC+

Importing registered Controller in Epson RC+ to the OPC UA Configurator.

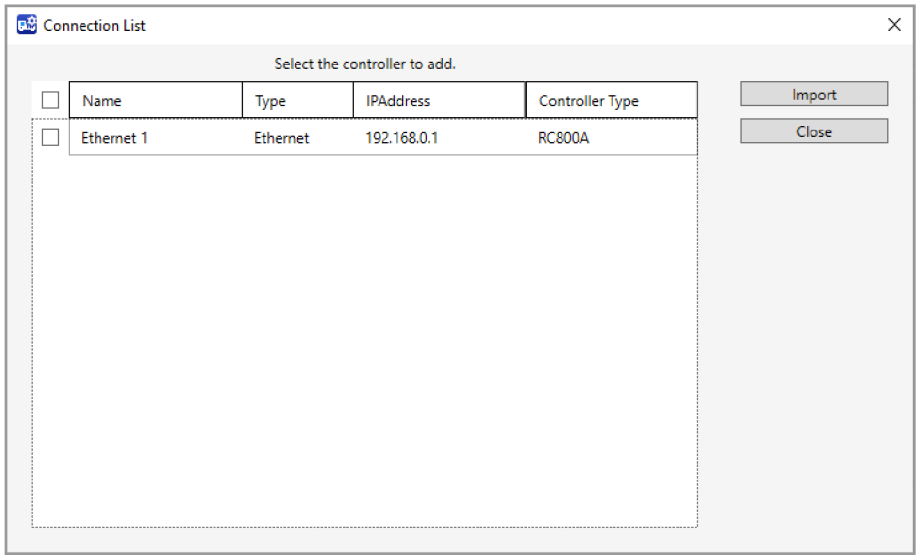
1. Select Home display Menu - [Controller].

   [Controller] dialog will be displayed.



2. Click the [Get connection list] button.

   [Connection List] dialog will be displayed.

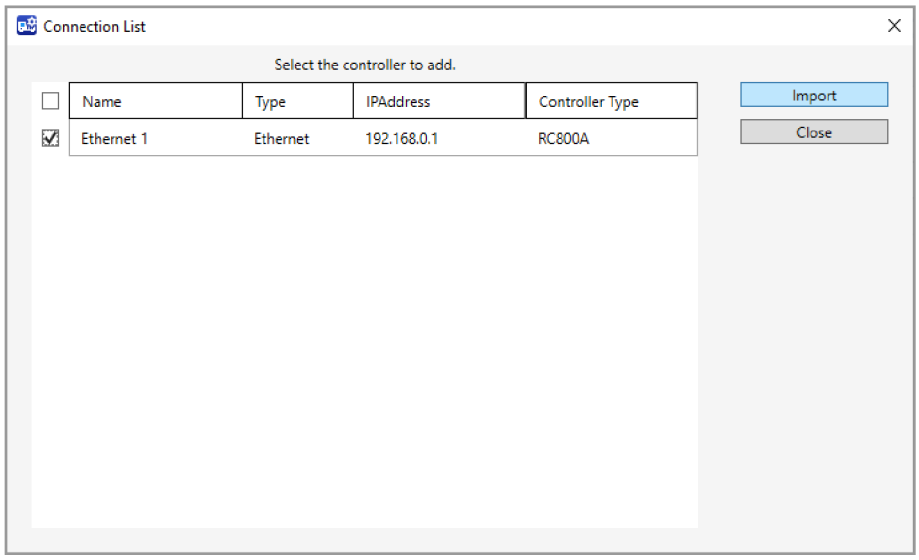


KEY POINTS

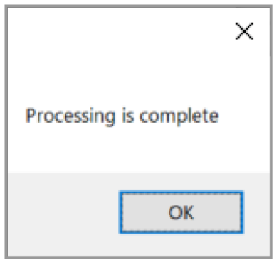
The registered connections in Epson RC+ will be displayed.

- The connections that Type is USB or Virtual are not displayed.
- IP addresses already in OPC UA Configurator's list of connections, or connections matching those names, will not be displayed.

3. Check in the check box of the connection you want to import, and click the [Import] button.

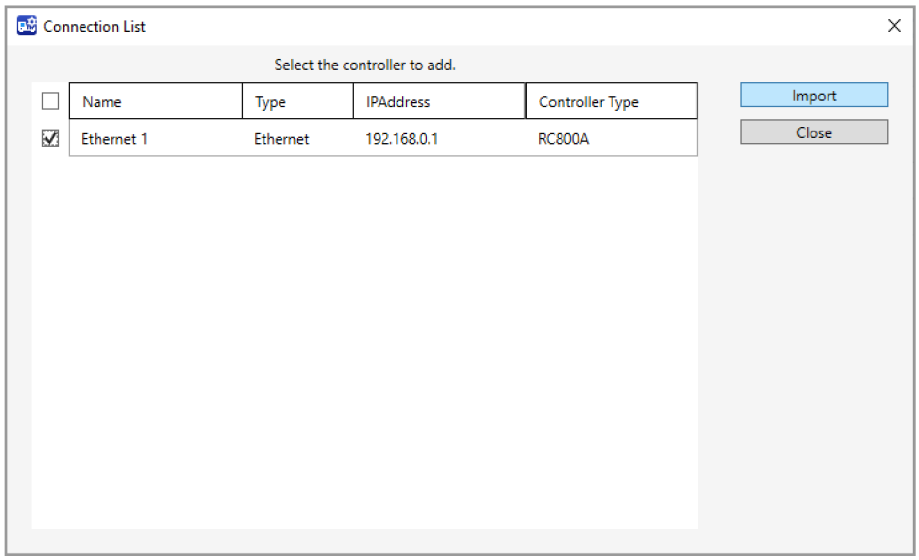


4. After the import is complete, the dialog will be displayed says the process is complete.



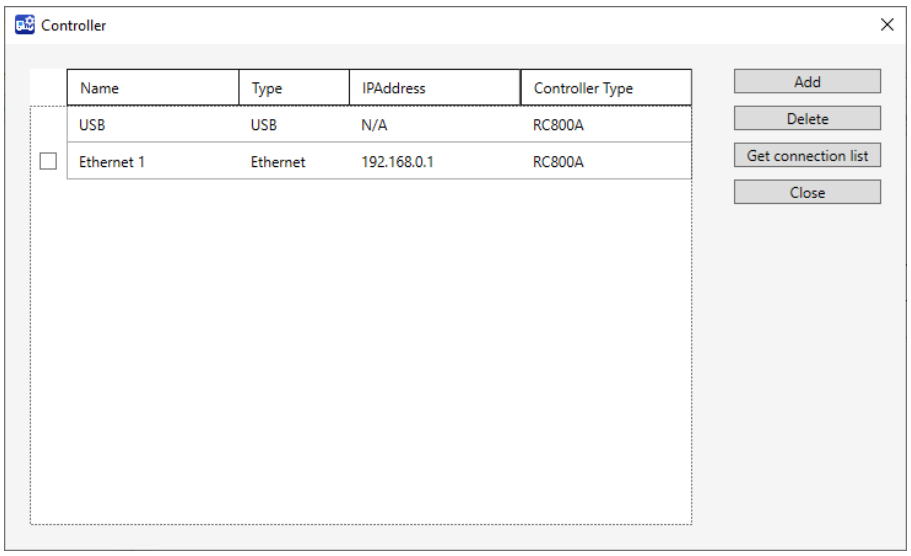
5. Click the [OK] button to go back to [Connection List] dialog.

Click the [Close] button.



6. It goes back to the [Controller] dialog.

The imported controller is added to the connection list as shown below.



3.6 OPC UA Server Setting

It is possible to set at Home display Menu bar - [Server Setting].

Server Setting Menu has following items.

Items	Descriptions
Basic Settings	Basic settings for the Server.
User	Displays users able to connect to the OPC UA Client in list-form. It is possible to add/delete a user.
Activation	Settings for the Server activation.
Import	Save the settings file saved on the PC to the Controller.
Export	Save the settings file saved on the Controller to the PC.

KEY POINTS

It is possible to use half-width alphanumeric character and underscore for file names. Other letters cannot be used.

If you select a single Controller that is using firmware version 8.0.0.xx or later, the Activation menu will not be selectable.

3.6.1 Basic Setting for Server

This section describes basic server settings.

⚠ CAUTION

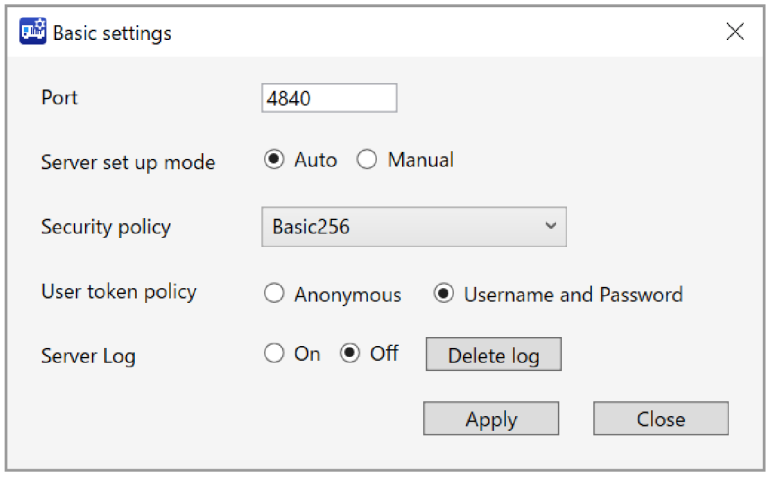
- Be careful when changing encrypt method of the server. After changing the setting, client may not be able to access OPC UA Server. Make sure to check the creation, settings and connection of the certificate with referring to the following section after you've changed the encrypt settings.

  Connecting to OPC UA Server

- At normal usage, do not change the setting of Server Log of OPC UA Server. Default setting is OFF.

1. Select a Controller to configure from the check box of Controller Information List.
2. Select Home display Menu - [Server Setting] - [Basic Settings].

   [Basic settings] dialog to input OPC UA Server setting will be displayed.



3. Set each item.

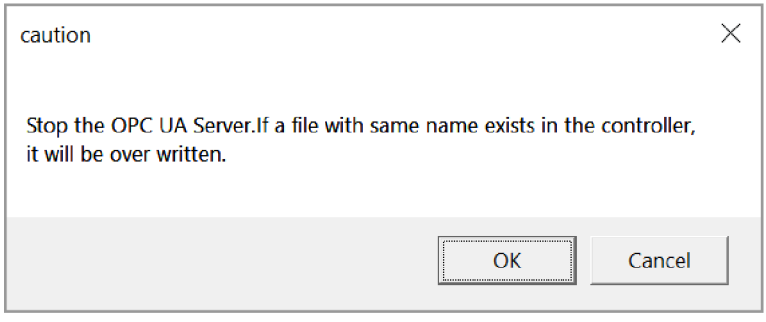
Items	Description
Port	Input Port number to connect to the OPC UA Server. Do not use Port number used in following: ▪ Remote Ethernet ▪ Currently using TCP/IP Port number * * Check your Controller setting. For details, refer to the following manual. "Epson RC+ User's Guide - [Setup] - [System Configuration] - [Controller] - [TCP/IP]"

Items	Description
Server Setup Mode	It is possible to select the way to start OPC UA Server. ■ AUTO: Start the Server when Controller is ON. ■ MANUAL: Start the Server from operation of OPC UA Configurator.
Security policy	Following types of encryption scheme can be selected. ■ None (no encrypt) ■ Basic256 ■ Basic256Rsa15 ■ Basic256Sha256 ■ Aes128Sha256RsaOaep ■ Aes256Sha256RsaPss Be careful when changing encryption scheme types.
User token policy	Following types of User Certificate can be selected. ■ Anonymous ■ UserName and Password
Delete log	Delete log file of OPC UA Server.
Server Log	Following shows Log function of OPC UA Server. ■ On ■ Off (Default) Normally, do not change the setting. ■ When changing Off to On, passcode input is required. Passcode is “199532”. ■ The Server Log is turned On when a valid passcode entered. OPC UA Server will stop when the Server Log capacity exceeds the specified value.

3. Input items and click [Apply] button. The changes saved.

   When [Apply] button clicked, a dialog displayed says the Server will be stopped.

   Click [OK] button.



   [Apply] button is not enabled when:

   ■ some items are not inputted or unselected in setting dialog

   An error dialog displayed when:

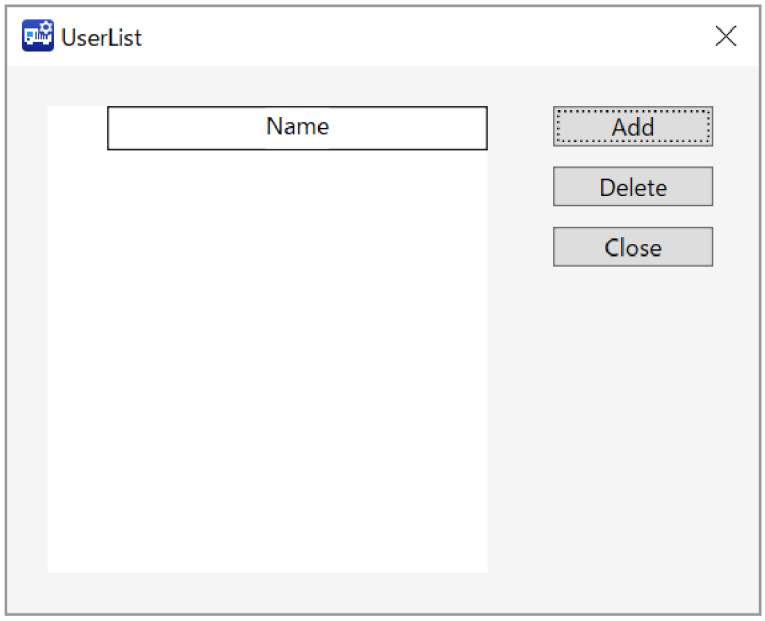
   ■ wrong port number was inputted

3.6.2 Managing Users

3.6.2.1 Checking for User list

Displays all information of users who are allowed to connect OPC UA Server. The password will not be shown.

1. Select one Controller to configure from the check box of Controller Information List.
2. Select Home display Menu - [Server Setting] - [User]. [UserList] dialog will be displayed.

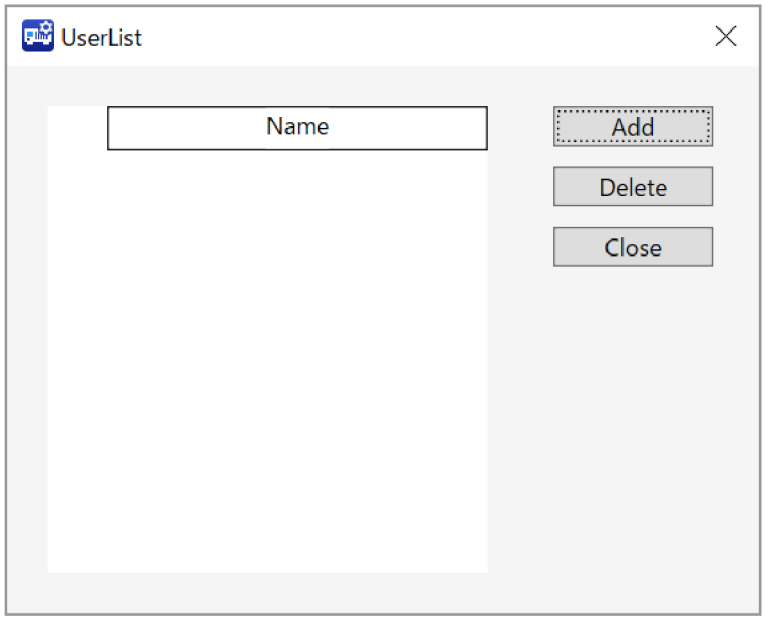


3.6.2.2 Adding User

Adding a user who are allowed to connect to OPC UA Server.

1. Select one Controller to configure from the check box of Controller Information List.
2. Select Home display Menu - [Server Setting] - [User].

   [UserList] dialog will be displayed.

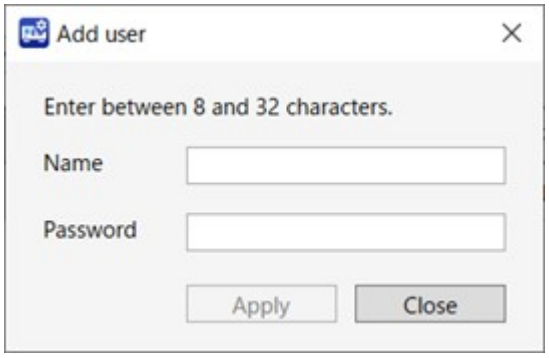


(2) [UserList] dialog will not be displayed, (3) [AddUser] dialog will be displayed instead when:

- selecting multiple Controllers at check box of Controller Information List

3. Click [Add] button.

   [Add user] dialog will be displayed.



   [Add] button is not enabled when:

   - already 10 users are registered

4. Set each item.

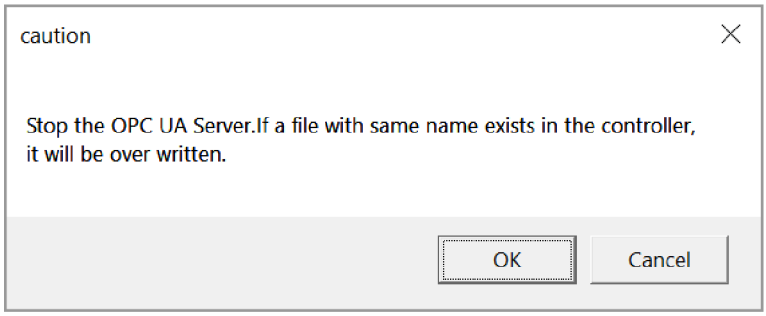
Items	Descriptions
Name	Enter a username. Enter 8 letters or more and 32 letters or less with half-width alphanumeric characters. (no symbols)
Password	Enter a password. Enter 8 letters or more and 32 letters with half-width alphanumeric characters. (no symbols)

5. Click [Apply] button.

   A dialog will be displayed says the Server will be stopped for server processing.

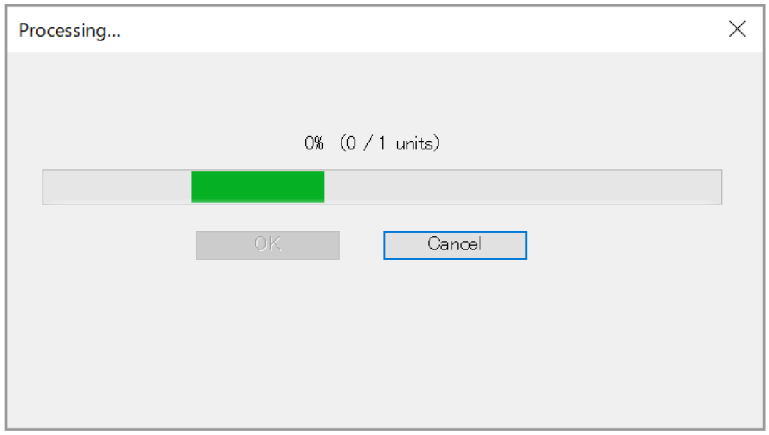
   If you continue processing, click [OK] button. A user will be added.

   If [Cancel] button clicked, user will not be added.

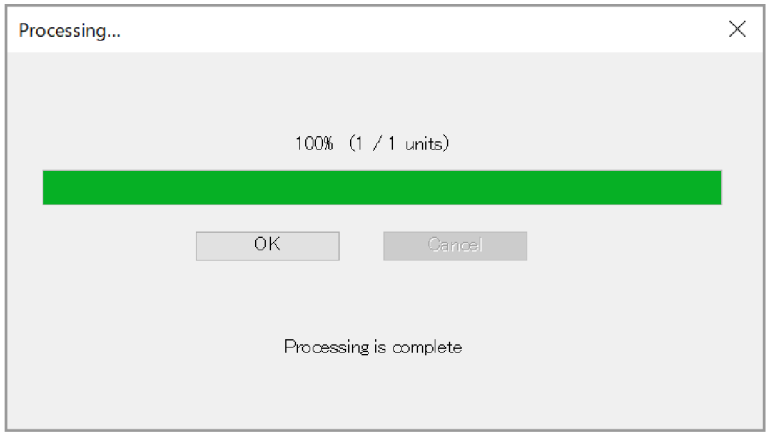


6. During the process of user adding, [Processing] dialog will be displayed.

   If you click [Cancel] button, a dialog displayed says the process will be stopped. To stop user adding process, click [OK] button. Processing that has already been completed cannot be undone.



7. After the process complete, a massage will be sent says process complete in the dialog. Click [OK] button.

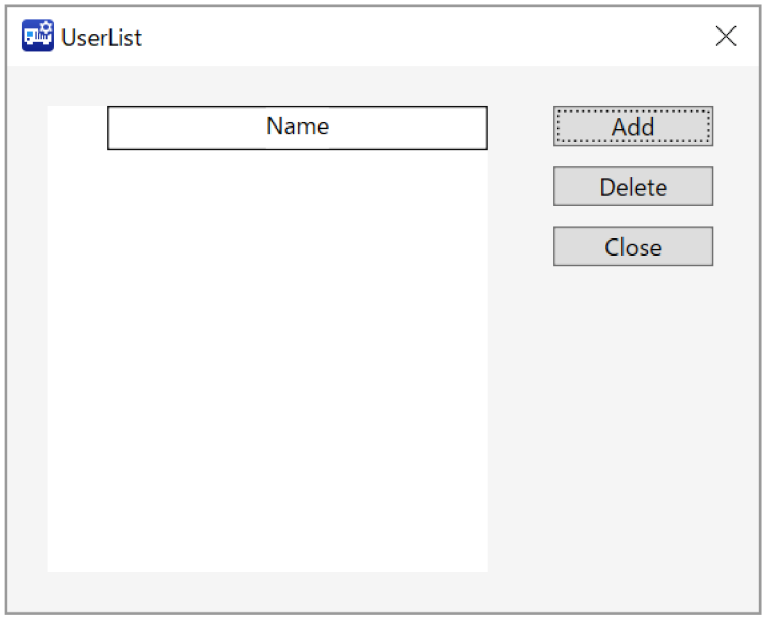


3.6.2.3 Deleting User

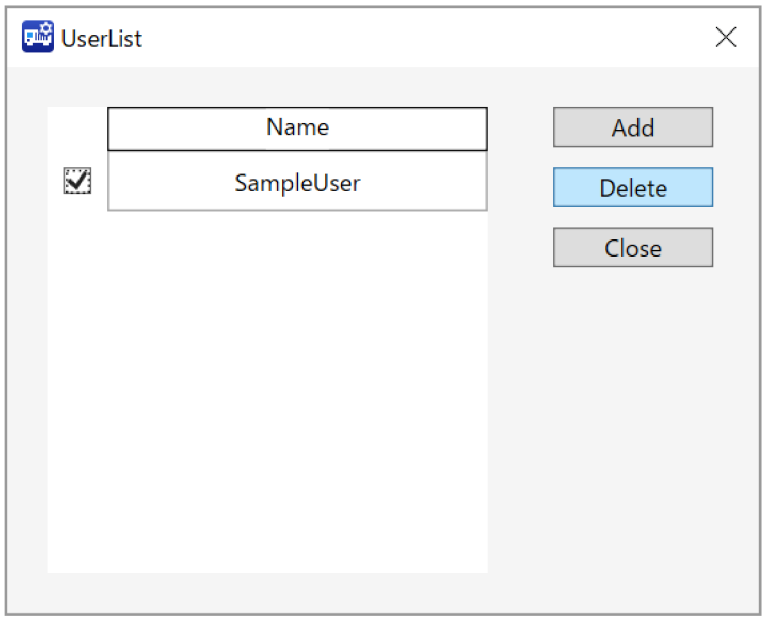
Deleting a user who are allowed to connect to OPC UA Server.

1. Select one Controller to configure from the checkbox of Controller Information List.
2. Select Home display Menu - [Server Setting] - [User].

   [UserList] dialog will be displayed.



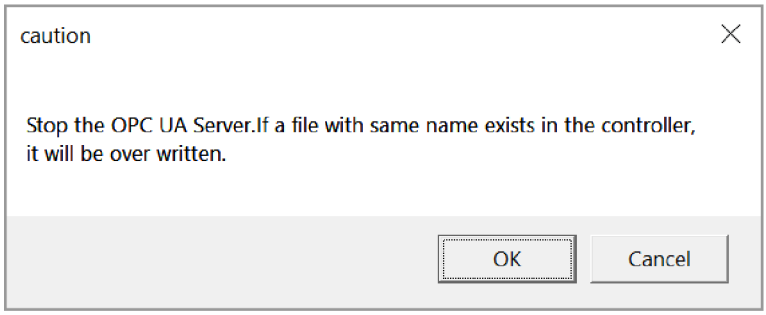
3. Check in the checkbox of users you want to delete from the list.



4. Click [Delete] button. A dialog will be displayed says the Server will be stopped for server processing.

   If you continue processing, click [OK] button. A user will be deleted.

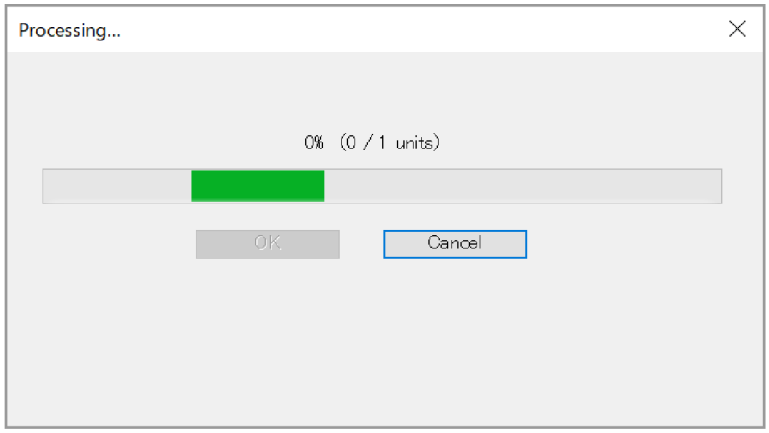
   If [Cancel] button clicked, user will not be deleted.



5. During the process of user deleting, [Processing] dialog will be displayed.

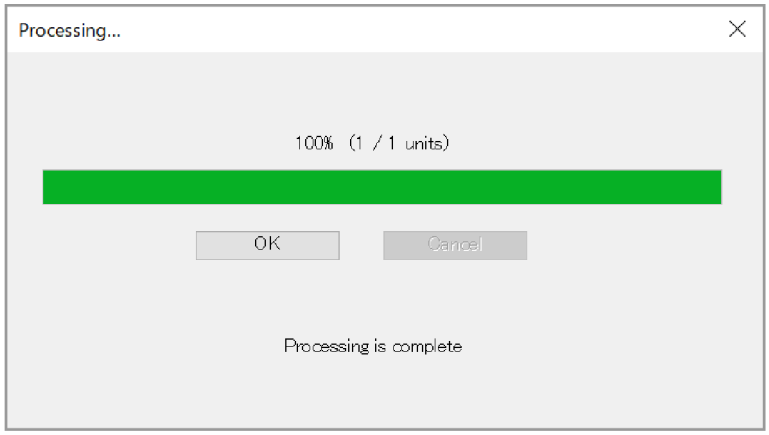
If you click [Cancel] button, a dialog displayed says the process will be stopped. To stop user deleting process, Click [OK] button.

Processing that has already been completed cannot be undone.



6. After the process complete, following dialog will be displayed.

   Click [OK] button.



3.6.3 Activation (Firmware Versions 7.5.xx or Lower Only)

This function is valid only for actual controllers with firmware version 7.5.xx or lower. Activation of virtual controllers and actual controllers with firmware version 8.0.0.xx or later must be performed from the Epson RC+ options settings.

3.6.3.1 Activate OPC UA Server Function

This section describes how to activate OPC UA Server function.

Activate a Controller one by one

1. Select a Controller to configure from the check box of Controller Information List.
2. Select Home display Menu - [Server Setting] - [Activation].

   [Activation] dialog to input setting will be displayed.

3. Set each item.

Items	Descriptions
License key	Enter a license key of OPC UA for Robotics Part1.
Activation key	Enter an activation key.

For information on how to obtain a license key and activation key, refer to the following.

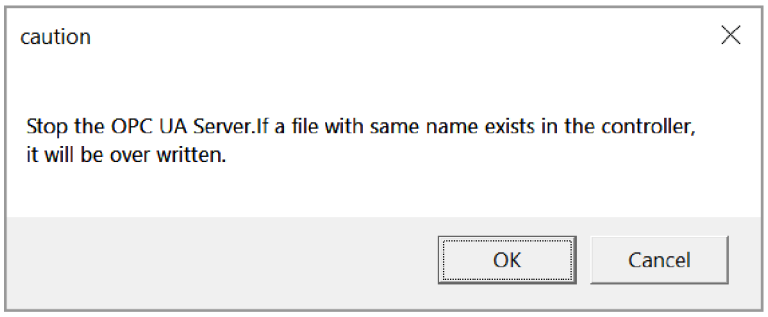
About Purchasing Products

Click [Apply] button. Activation process will be started using information of key you've entered.

[Apply] button is not enabled when:

- Some items are not entered.
- Number of letters are not enough.
- Other than half-width alphanumeric character was entered.

A dialog displayed says the Server will be stopped for activation.



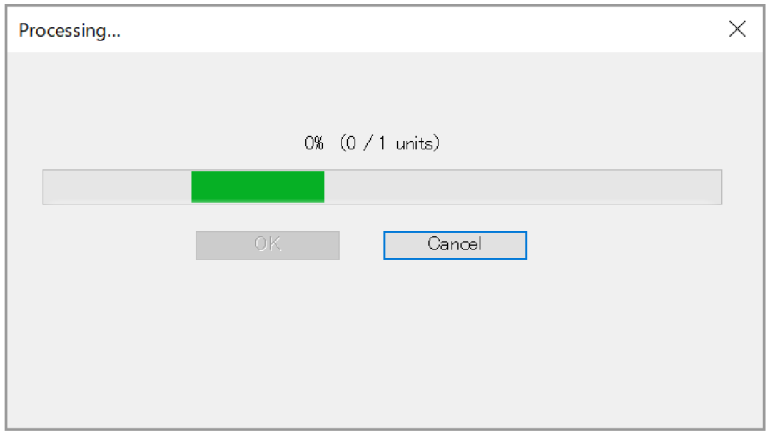
If you continue processing, click [OK] button. The Controller will be activated.

If [Cancel] button clicked, activation will be canceled.

4. During the process of activation, following dialog will be displayed.

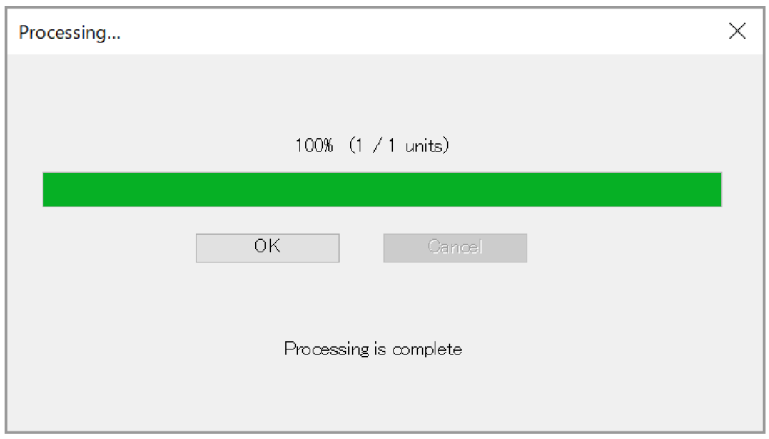
If you click [Cancel] button, a dialog displayed says the process will be canceled. To stop the process of activation, click [OK] button.

Processing that has already been completed cannot be undone.



5. After the process complete, following dialog will be displayed.

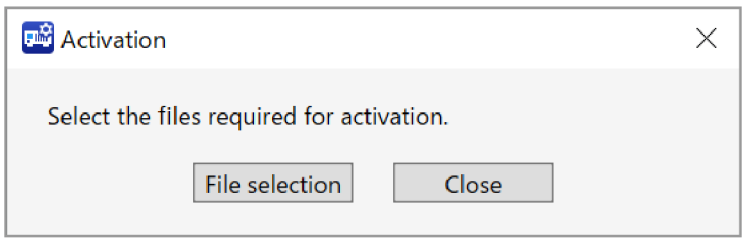
   Click [OK] button.



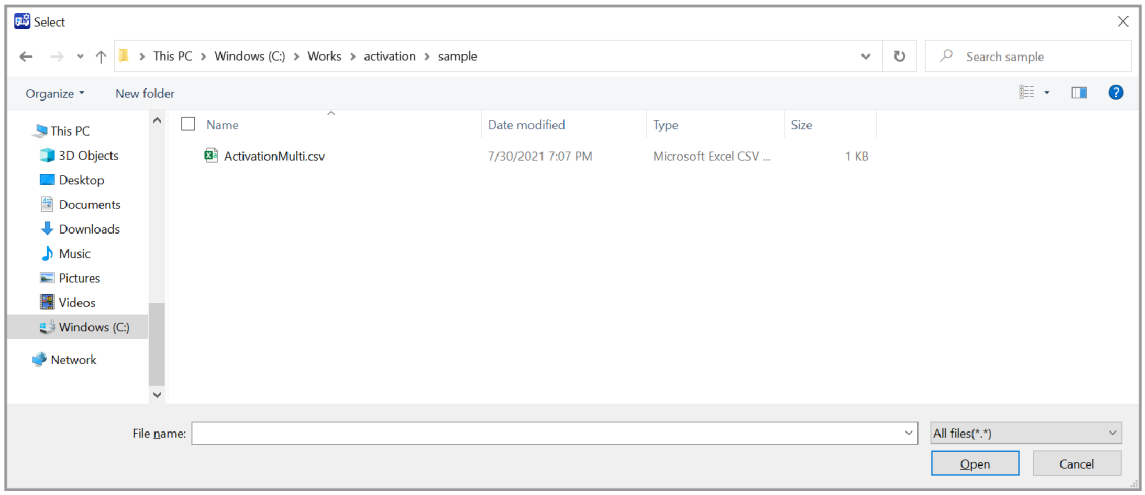
Activate Multiple Controllers at Once

1. Select multiple Controllers to configure from the check box of Controller Information List.
2. Select Home display Menu - [Server Setting] - [Activation].

   [Activation] dialog will be displayed. Click [File selection] button.



3. A dialog to select a file will be displayed.



4. Select a file listed information for activation.

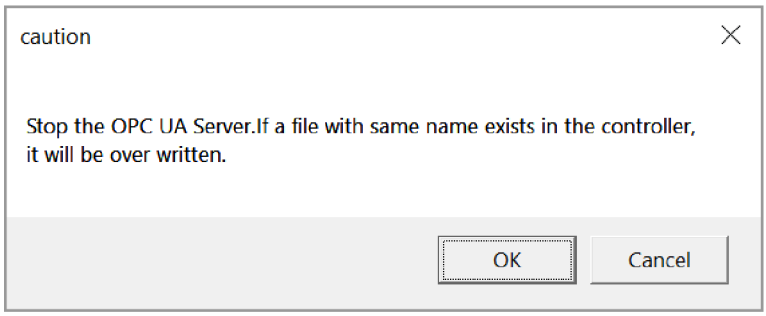
5. Input following contents in the file.
   - Controller serial No.
   - License key
   - Activation key

   See below for file format.

   Appendix B: Format of Activation File

6. Click [Apply] button of file setting dialog.

   A dialog will be displayed says the Server will be stopped for activation.

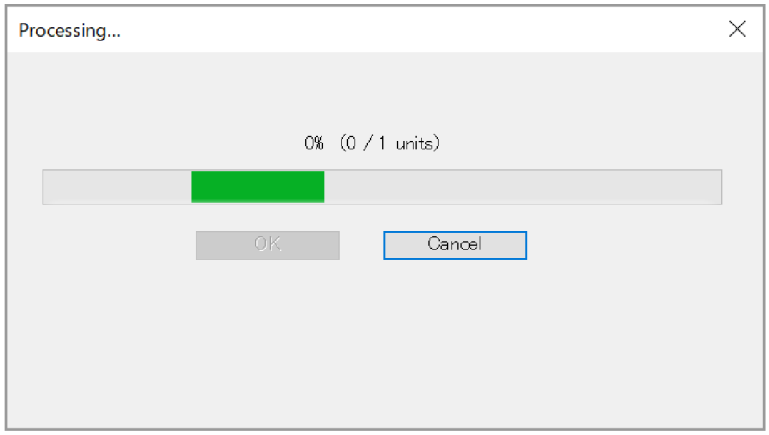


   If you continue processing, click [OK] button. The Controller will be activated.

   If [Cancel] button clicked, the process of activation will be canceled.

7. During the process of activation, following dialog will be displayed.

   If you click [Cancel] button, it is possible to cancel the process. Processing that has already been completed cannot be undone.



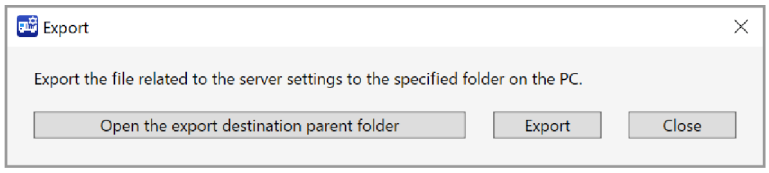
An error message will be displayed in processing dialog when:

- The information of the Controller selected in the check box is not listed in the file selected in the file setting dialog.

3.6.4 Export Settings (Firmware Versions 7.5.xx or Lower Only)

Export settings files related to the OPC UA Server from the Controller to a PC. For Controllers with firmware version 8.0.0.xx and later, it is recommended that you export the files using Epson RC+'s Backup function.

1. Select a Controller to configure from the check box of Controller Information List.
2. Select Home display Menu - [Server Setting] - [Export]. [Export] dialog will be displayed.



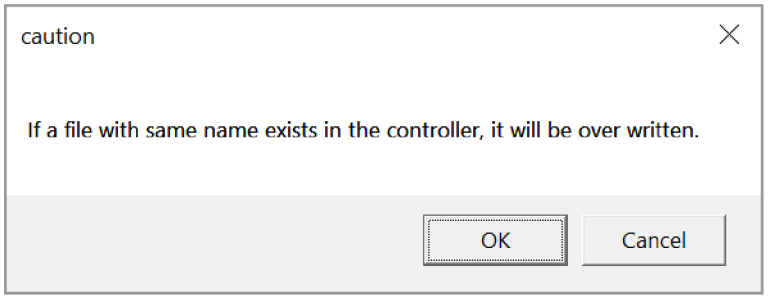
3. Set each item at export dialog.

Items	Descriptions
Open the export destination parent folder	Displays the folder of export destination. Click [Open the export destination parent folder] button to open the parent folder of the export destination.

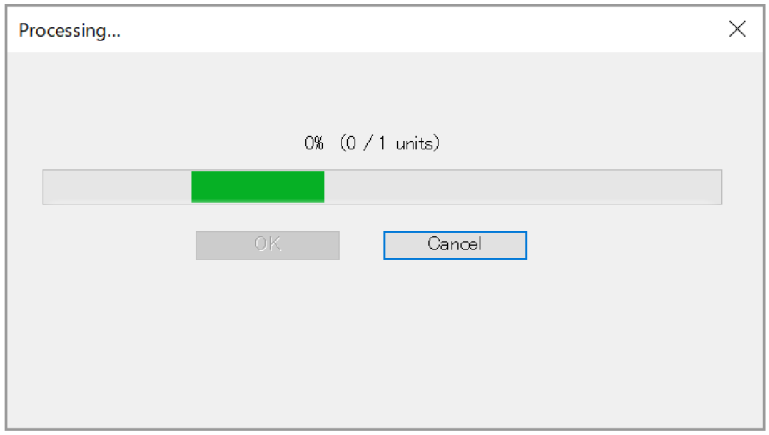
4. Click [Export] button then a dialog displayed says it is overwriting on PC.

   To save and continue process, click [OK] button. The setting will be exported.

   Click [Cancel] button to cancel the export.



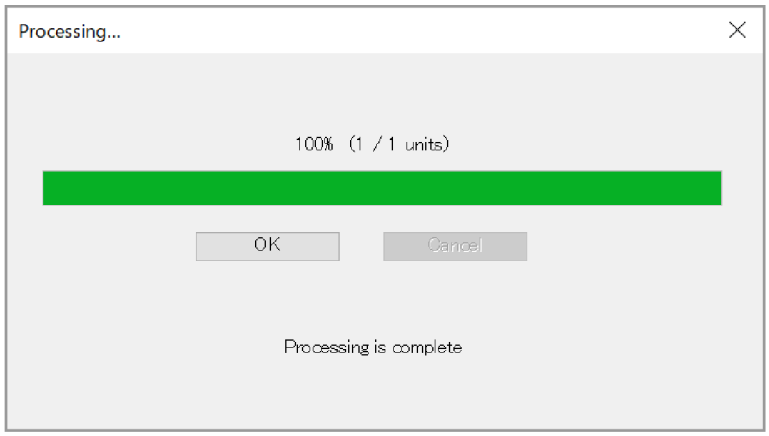
5. During the process of export, following dialog will be displayed.



Click [Cancel] button, then a dialog displayed says export will be canceled.

Click [OK] button to cancel the export. Processing that has already been completed exporting Controller cannot be undone.

6. After completing the export, following dialog will be displayed. Click [OK] button.

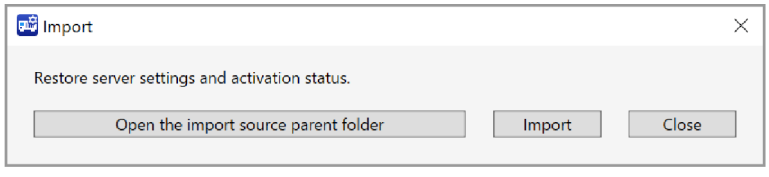


3.6.5 Import Settings (Firmware Versions 7.5.xx or Lower Only)

Import a PC's activation key file and a server settings file to the Controller. For Controllers with firmware version 8.0.0.xx and later, it is recommended that you import the files using Epson RC+'s Backup function.

1. Select a Controller to configure from the check box of Controller Information List.
2. Select Home display Menu - [Server Setting] - [Import].

   [Import] dialog will be displayed.



3. Set each item at import dialog.

Item	Description
Open the import source parent folder	Displays the folder of export destination. Click [Open the import source parent folder] button to open the parent folder of the import source.

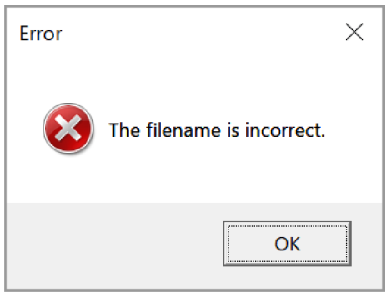
4. Click [Import] button.

   Import will be executed.

   An error dialog will be displayed before executing import when:

   - File name to import is incorrect.

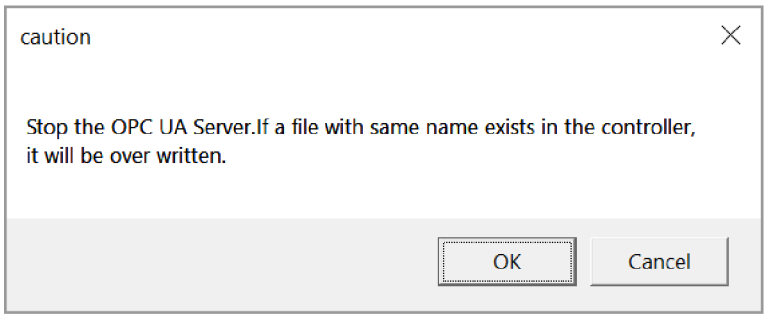
     (Do not rename the exported file.)



5. Click [Import] button. A dialog displayed says the server will be stopped and overwrite for import.

   Click [OK] button to continue the process. The setting will be imported.

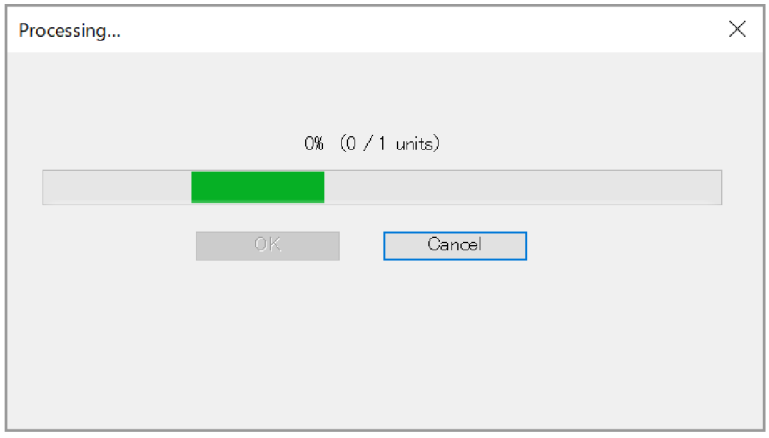
   Click [Cancel] button to cancel the import setting.



6. During the process of import, following dialog will be displayed. If you click [Cancel] button, a dialog displayed says the process will be canceled.

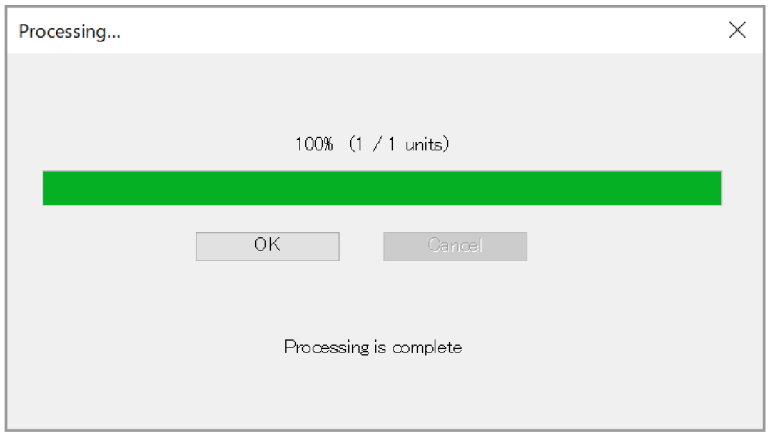
   Then you click [OK] button, import will be canceled.

   Processing that has already been completed cannot be undone.



7. After completing the import, following dialog will be displayed.

Click [OK] button.



3.7 About Certificate

Following Certificates are possible to configure from Home display Menu bar-[Certificate]. It has following items.

Items	Descriptions
Create/Save	Creates a Server Certificate or saves it in the Controller.
Export (Self signed)	Exports Self signed Server Certificate to PC.
Type select	Setup type of the Server Certificate.
Client certificate	Displays a Client Certificate or saves in the Controller.
CRL	Manages registration of CRL.

KEY POINTS

It is possible to use half-width alphanumeric character and underscore for file names. Other letters cannot be used.

3.7.1 Creating/Saving Server Certificate

Creates / saves the Server Certificate to the Controller.

Select one of the three type of the Server Certificate describes in next section. And save it in the Controller. Mostly the last one saved is selected as a valid Server Certificate.

To activate OPC UA Server, a Server Certificate needs to be registered at minimum.

3.7.1.1 Steps of Creating/Saving Server Certificate

1. Select a Controller to configure from the check box of Controller Information List.
2. Select Home display Menu - [Certificate] - [Create/Save].

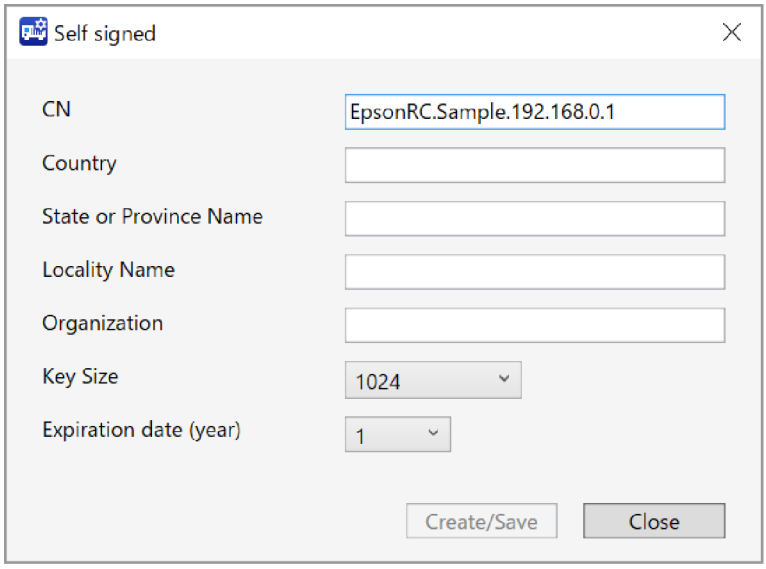
   The [Certificate type] pull down menu will be displayed. Following shows construction of the menu. However, User specified menus are enabled only when you have selected a single Controller whose firmware version is prior to 8.0.0.xx.

Items	Descriptions
Self signed	Create and register of Self signed Certificate.
User specified	Register a Certificate user prepared and private key.
CA signed	Create CSR and register CA signed certificate.

3.7.1.2 Creating Self Signed Certificate

1. Select a Controller to configure from the check box of Controller Information List.
2. Select Home display Menu - [Certificate] - [Create/Save] - [Self signed].

   [Self signed] dialog to create Self signed Certificate will be displayed.



3. Set each item at [Self signed] dialog to create Self signed Certificate.

Items	Descriptions	Examples
CN	Enter a common name. [EpsonRC.Serial No. of Controller.IP Address] is entered at first. (It is same as Application Name of OPC UA server. If it changed, a warning when connecting from OPC UA client may displayed because name is not matched.)	EpsonRC.SN0000123.192.168.010.001
Country	Enter a country code referring ISO 3166-1 alpha-2. Specifically, use two single-byte uppercase alphabetical characters.	JP
State or Province Name	Enter your State or Province Name. Half-width alphabetic characters can be entered.	Nagano
Locality Name	Enter your Locality Name. Half-width alphabetic characters can be entered.	(city) Azumino

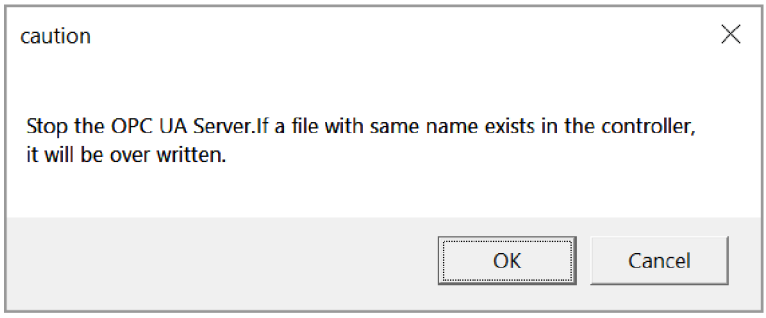
Items	Descriptions	Examples
Organization	Enter your Organization Name. Half-width alphabetic characters and the following symbols can be entered. "_",",".""	(company) Epson
Key Size	Select a private key size to create. Length of the key you can select depends on the communication encrypt system selected at [Basic Setting]. ■ None: 2048(bit) ■ Basic256: 1024/2048(bit) ■ Basic128Rsa15: 1024/2048(bit) ■ Basic256Sha256: 2048/4096(bit) ■ Aes128Sha256RsaOaep: 2048/4096(bit) ■ Aes256Sha256RsaPss: 2048/4096(bit)	-
Expiration date (year)	Select an expiration date of Self signed Certificate to create. 1 to 10 years can be entered.	-

4. Click [Create/Save] button.

   A dialog displayed says the server will be stopped and overwritten to configure the server settings.

   Click [OK] button to continue the process. Self signed Certificate will be created and registered.

   Click [Cancel] button to cancel saving Certificate.



   When doing back up the created Self signed Certificate automatically, please set it in the application settings.

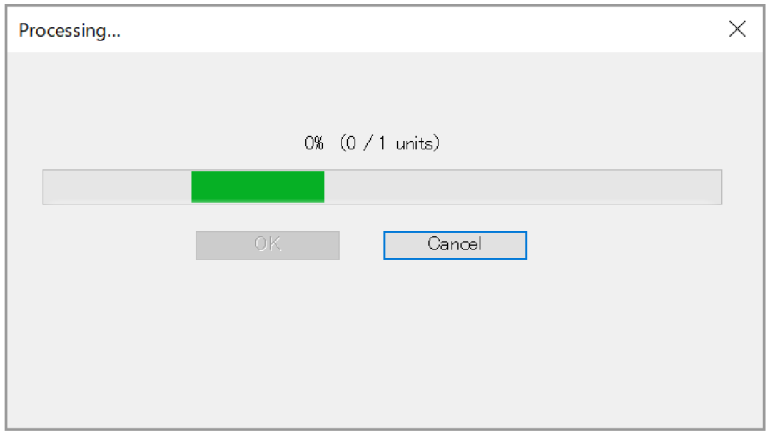
   For details, refer to the following.

   Backup Setting

5. During the process of creating Self signed Certificate, following dialog will be displayed.

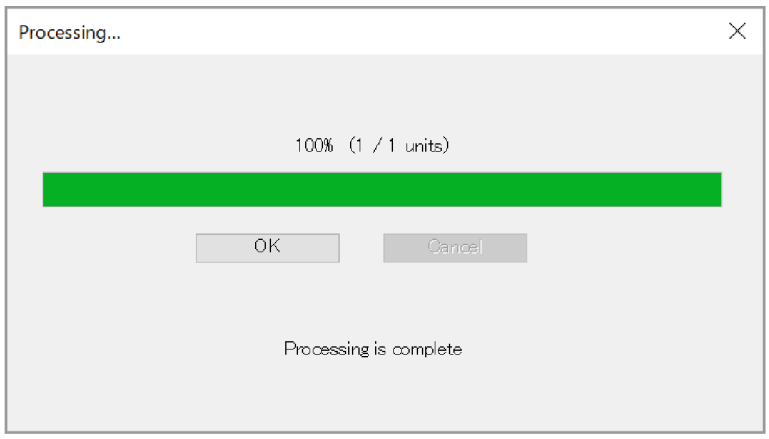
   Click [Cancel] button, then a dialog displayed says process will be canceled.

   If you want to cancel creating Self signed Certificate, click [OK] button. The Self signed Certificate of Controller that has already been completed processing cannot be deleted.



6. After completing the process of Creating Self signed Certificate, following dialog will be displayed.

   Click [OK] button.



KEY POINTS

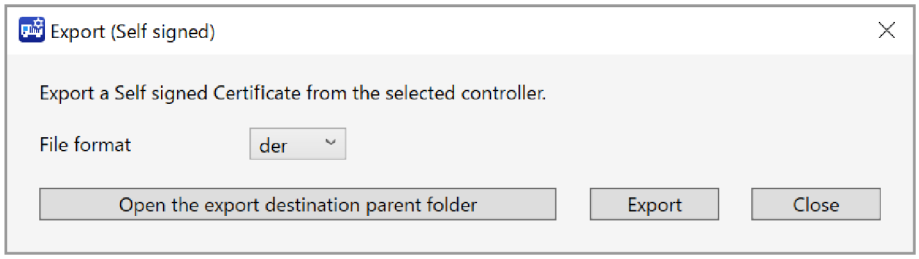
Precautions when selecting multiple Controllers

- User editing is invalid for CN.
- Entered value other than CN will be applied for all controller's certificate.
- Self signed Certificate to create will be the same except CN.

3.7.1.3 Exporting Self Signed Certificate

1. Select a Controller to configure from the check box of Controller Information List.
2. Select Home display Menu - [Certificate] - [Export].

   [Export (Self signed)] dialog will be displayed.



3. Click [Export] button. The exported files are saved for each Controller like following.

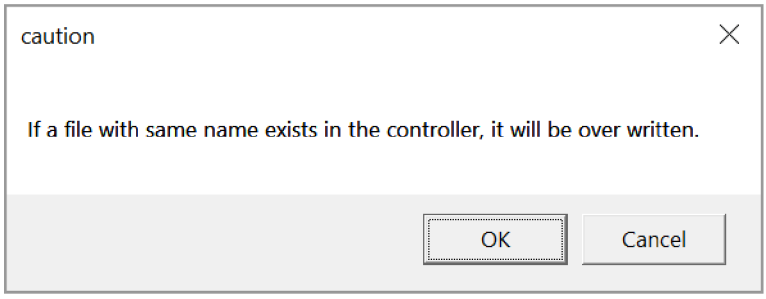
   `C:\EpsonRC80\OPCUA\[Controller serial No.]\Cert\SelfSigned` folder

> **KEY POINTS**
>
> The extension is the one that setup in File Format of Export dialog (.der or .pem).

Click [Export] button then a dialog displayed says it is saved in PC and overwritten.

Click [OK] button to overwrite and continue the process. Self signed Certificate will be exported.

Click [Cancel] button to cancel exporting the Self signed Certificate.



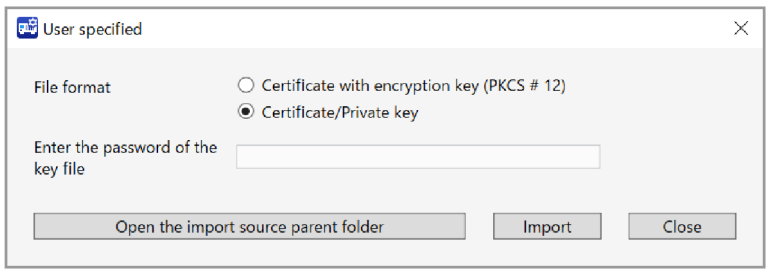
3.7.1.4 User Specified Certificate

> **⚠ CAUTION**
>
> When creating a Certificate or private key with a tool other than this application, for the certificate creation library such as OpenSSL used by the tool, use the version of OpenSSL installed on the PC using this application or one compatible with it. Operation is not guaranteed when using different version of OpenSSL.

This function is enabled only when you have selected a RC700/90/T/VT series virtual controller or controller with firmware version 7.5.xx or earlier.

1. Select a Controller to configure from the check box of Controller Information List.
2. Select Home display Menu - [Certificate] - [Create/Save] - [User specified].

   [User specified] dialog will be displayed.



   [User specified] can not be selected when:

   - Selecting multiple Controllers.

3. Set each item at [User specified] dialog.

When [Certificate with encryption key] is selected:

- You will need to enter the password you set when you created the Certificate with encryption key.
- The Certificate files you want to register need to be saved only one in following folder for each Controller.

  `C:\EpsonRC80\OPCUA\[Controller serial No.]\Cert\UserSpecified` folder

> **KEY POINTS**
>
> Name the Certificate file with half-width alphanumeric characters and underscores. Enter the extension with pfx.

When [Certificate/Private key] is selected:

- The Certificate files you want to register need to be saved only one in following folder for each Controller.

  `C:\EpsonRC80\OPCUA\[Controller serial No.]\Cert\UserSpecified` folder

> **KEY POINTS**
>
> Name the Certificate file with half-width alphanumeric characters and underscores. Enter the extension with der.

- The files of private key you want to register need to be saved only one in following folder for each Controller just.

  `C:\EpsonRC80\OPCUA\[Controller serial No.]\Cert\UserSpecified` folder

> **KEY POINTS**
>
> Name the Certificate file with half-width alphanumeric characters and underscores. Enter the extension with key.

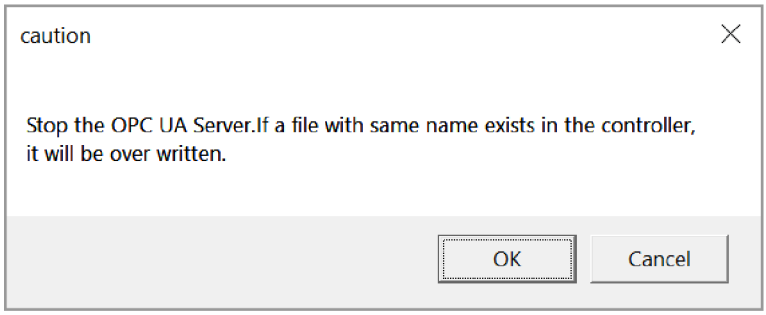
Item	Description
Open the import source parent folder	Displays designated folder of export destination. Click [Open the import source parent folder] button to open designated folder of the import.

3. Import the Certificate with encrypt or Certificate and private key from PC to the Controller depending on the type of the file you selected in (3).

   Click [Import] button, then a dialog will be displayed says the server will be stopped and overwritten for the import process.

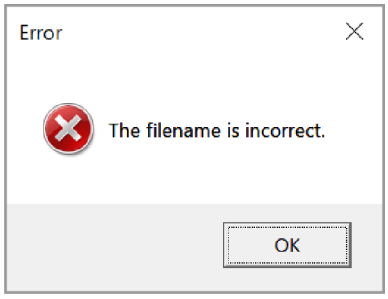
   Click [OK] button to continue the process. User specified Certificate will be imported.

   Click [Cancel] button to stop importing the Use specified Certificate.



An error dialog will be displayed before importing when:

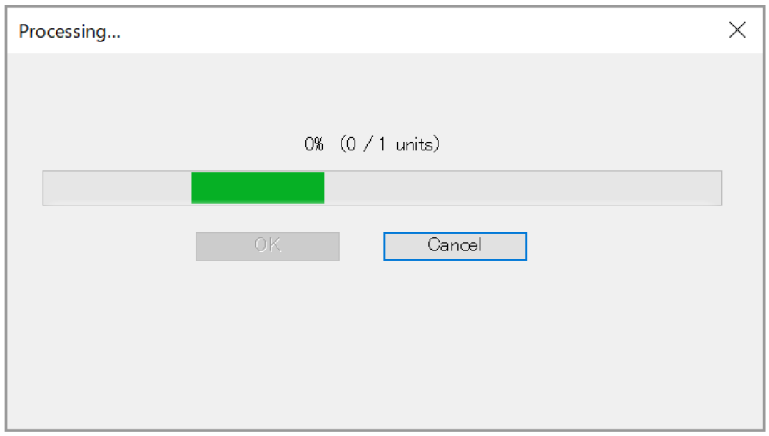
- File name to import is incorrect. For about correct file name, refer to step (3).



4. During the process of importing User specified Certificate, following dialog will be displayed.

   Click [Cancel] button then a dialog will be displayed says import will be canceled. Click [OK] button to stop importing the User specified Certificate.

   Processing that has already been completed cannot be undone.



3.7.1.5 CA Signed Certificate

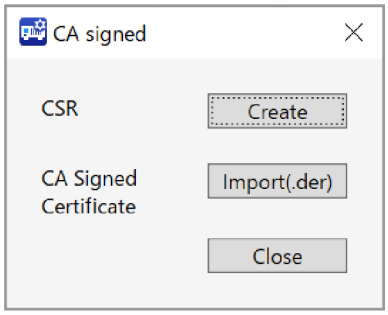
Creating CSR

> ⚠ CAUTION
>
> If you click the [Create / Save] button when creating a CSR, the CA signed certificate you are currently using will be invalidated.

1. Select a Controller to configure from the check box of Controller Information List.

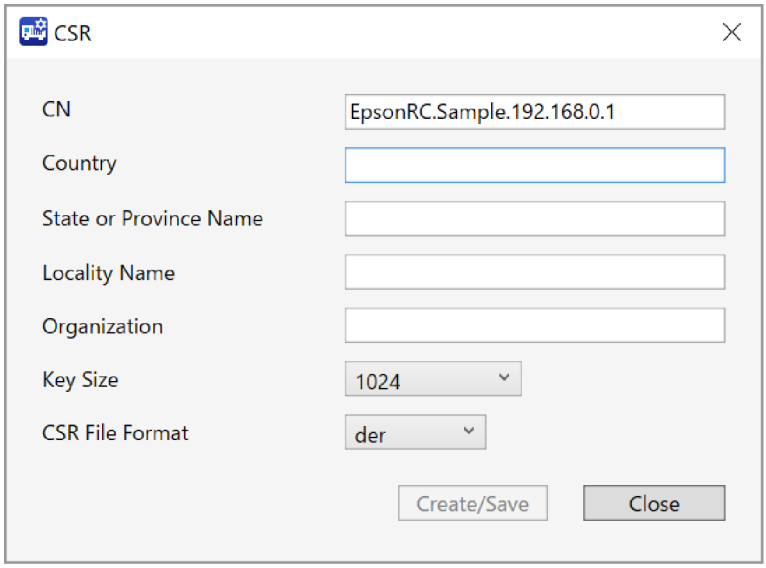
2. Select Home display Menu - [Certificate] - [Create/Save] - [CA signed].

   [CA signed] will be displayed.



3. Click [Create] button.

   [CSR] dialog will be displayed. CSR will be needed when issuing the CA signed Certificate.



4. Set each item at dialog of creating CSR.

   Created CSR files will be saved in following folder.

   `C:\EpsonRC80\OPCUA\[Controller serial No.]\Cert\CSR` folder

KEY POINTS

The extension is the one that setup in CSR File Format of creating CSR dialog (.der or .pem).

Items	Descriptions	Examples
CN	Enter a common name. [EpsonRC.Serial No. of Controller.IP Address] is entered at first. (It is same as Application Name of OPC UA server. If it changed, a warning when connecting from OPC UA client may displayed because name is not matched.)	EpsonRC.SN0000123.192.168.010.001

Items	Descriptions	Examples
Country	Enter a country code referring ISO 3166-1 alpha-2. Specifically, use two single-byte uppercase alphabetical characters.	JP
State or Province Name	Enter your State or Province Name. Half-width alphabetic characters can be entered.	Nagano
Locality Name	Enter your Locality Name. Half-width alphabetic characters can be entered.	(city) Azumino
Organization	Enter your Organization Name. Half-width alphabetic characters and the following symbols can be entered. "_","."	(company) Epson
Key Size	Select a private key size to create. Length of the key you can select depends on the communication encrypt system selected at [Basic Setting]. ■ None: 2048(bit) ■ Basic256: 1024/2048(bit) ■ Basic128Rsa15: 1024/2048(bit) ■ Basic256Sha256: 2048/4096(bit) ■ Aes128Sha256RsaOaep: 2048/4096(bit) ■ Aes256Sha256RsaPss: 2048/4096(bit)	-
CSR File Format	Select an encoding way of the private key file when generating the private key file. ■ der ■ pem	-

5. Click [Create/Save] button.

   Start creating CSR.

6. Clicking [Create/Save] button makes the CA signed certificate that you are currently using will be invalidated. Send the created CSR to CA and issue the CA signed certificate.

   Before start working on the step (7), save only one in each of the following folders corresponding to the target Controller.

KEY POINTS

Name the Certificate file with half-width alphanumeric characters and underscores. Enter the extension with der.

`C:\EpsonRC80\OPCUA\[Controller serial No.]\CASigned` folder

KEY POINTS

Precautions when selecting multiple Controllers

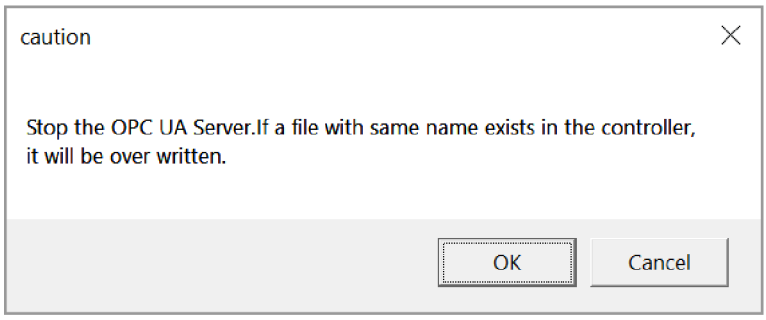
- CN will be setup automatically by OPC UA Configurator.
- Entered values except CN are applied to CSR of all Controllers.

Importing CA Signed Certificate

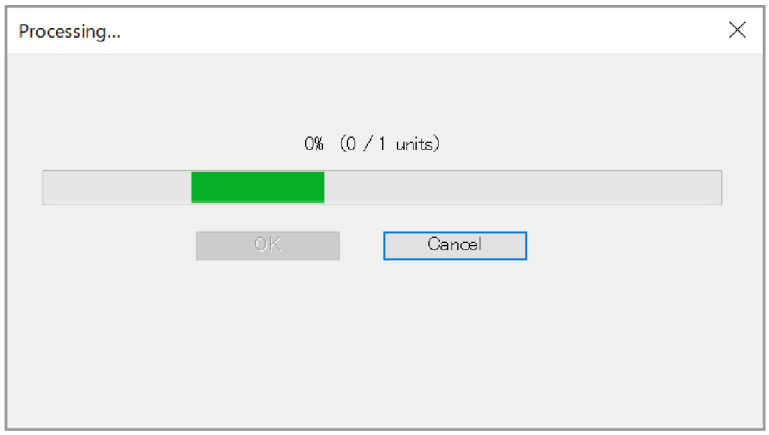
7. Select a Controller to configure from the check box of Controller Information List.
8. Start importing the CA signed certificate from the PC to the Controller.

   Click [Import] button.

   Click [Import] button then a dialog will be displayed says the server stops when saving CA signed certificate to the Controller and the Certificate will be overwritten.



   Click [OK] button, import will be done.

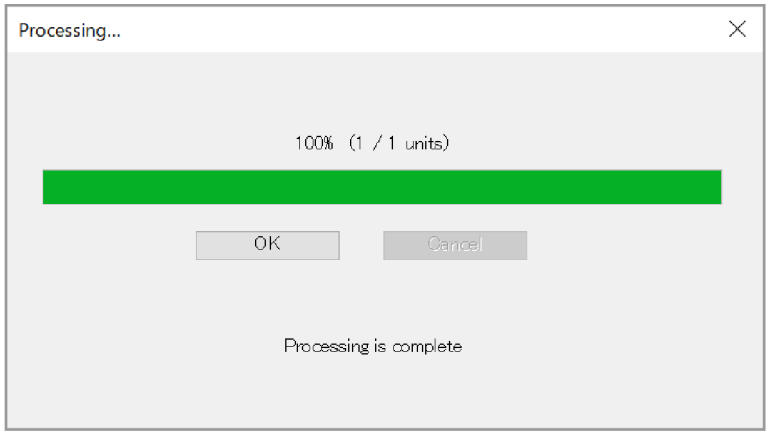


   An error message will be displayed progress dialog and import will be canceled when:

   - The certificate imported from PC to Controller and CSR that saved in Controller do not match.

9. After you have completed importing CA signed certificate, the following dialog will be displayed.

   Click [OK] button.



3.7.2 Setup using type of Server Certificate

There are some ways to create the Server Certificate. It is possible to specify the Certificate type using for OPC UA Configurator.

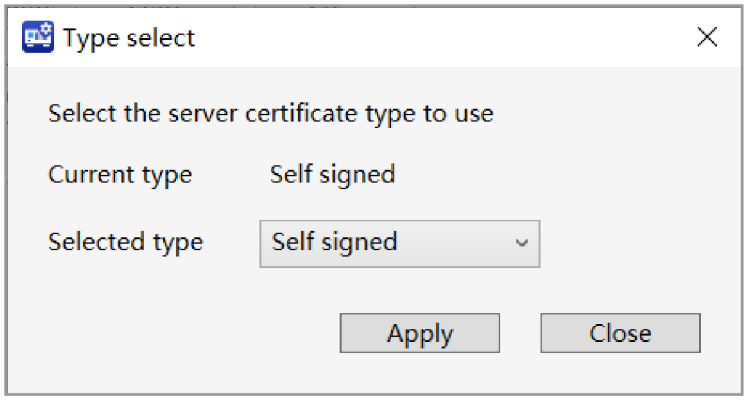
3.7.2.1 Auto Setup Function for Server Certificate

When saving the Certificate file in the Controller of OPCUA Configurator, the using type of Certificate will be selected automatically.

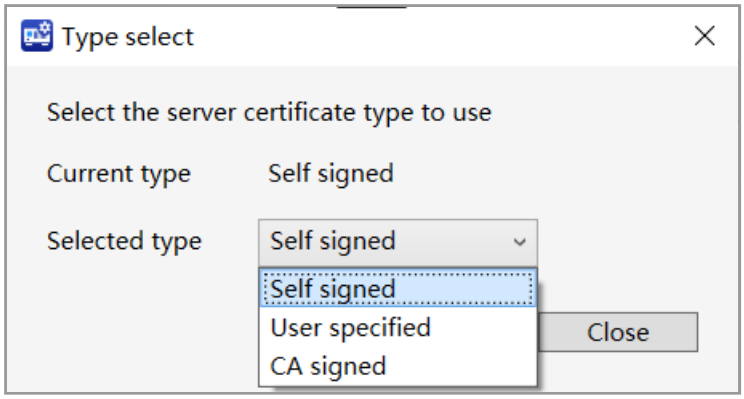
3.7.2.2 Type Setting of Server Certificate

1. Select a Controller to configure from the check box of Controller Information List.
2. Select Home display Menu - [Certificate] - [Type Selection].

   [Type select] dialog will be displayed.



3. Select the Certificate type you want to use for the Server Certificate from the [Selected type] pull-down menu. However, if you select a virtual RC800 series controller or a controller with firmware version 8.0.0.xx or later, "User Specified" will not be displayed in the list.



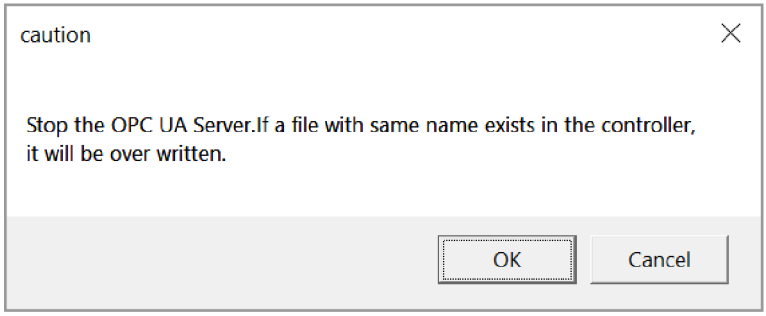
4. Click [Apply] button.

   Start setup for using type of the Server Certificate.

   An error dialog will be displayed when:

   - Selected Certificate is not saved.

5. Following dialog will be displayed to inform you that the server will be stopped for configuring the Server Certificate type displaying following dialog.



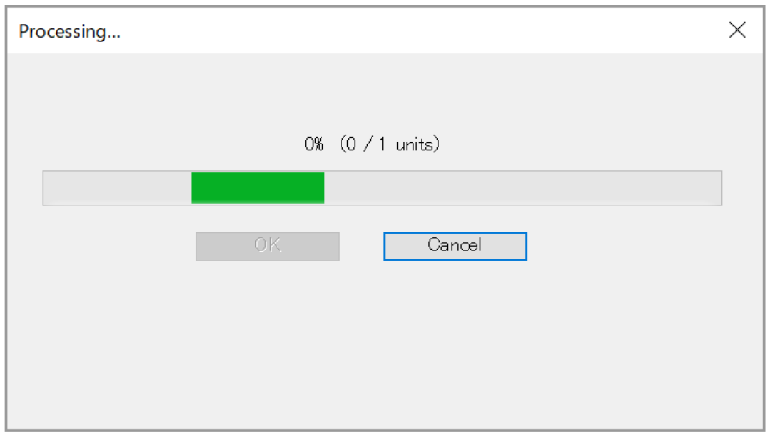
   To continue the process, click [OK] button. The setting for using type of Server Certificate will be done.

   Click [Cancel] button to cancel the setting.

6. During the process of setting the Server Certificate type, following dialog will be displayed.

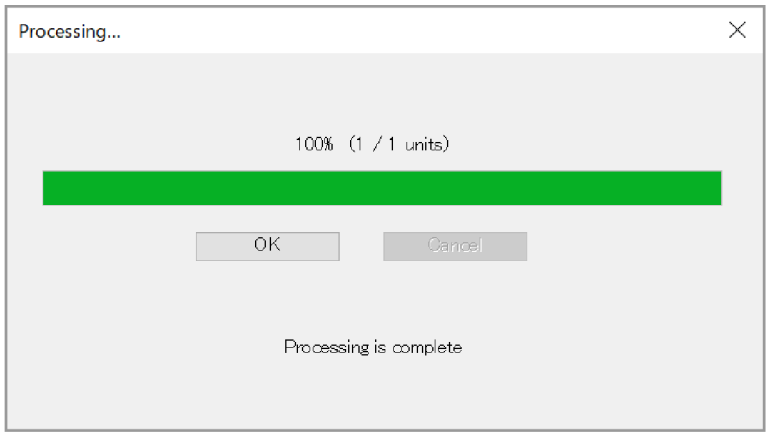
   Click [Cancel] button then a dialog will be displayed says the process will be canceled. Click [OK] button to stop setting up for Server Certificate type.

   Processing that has already been completed cannot be undone.



7. After completing the setup for the using type of Server Certificate, following dialog will be displayed.

Click [OK] button.



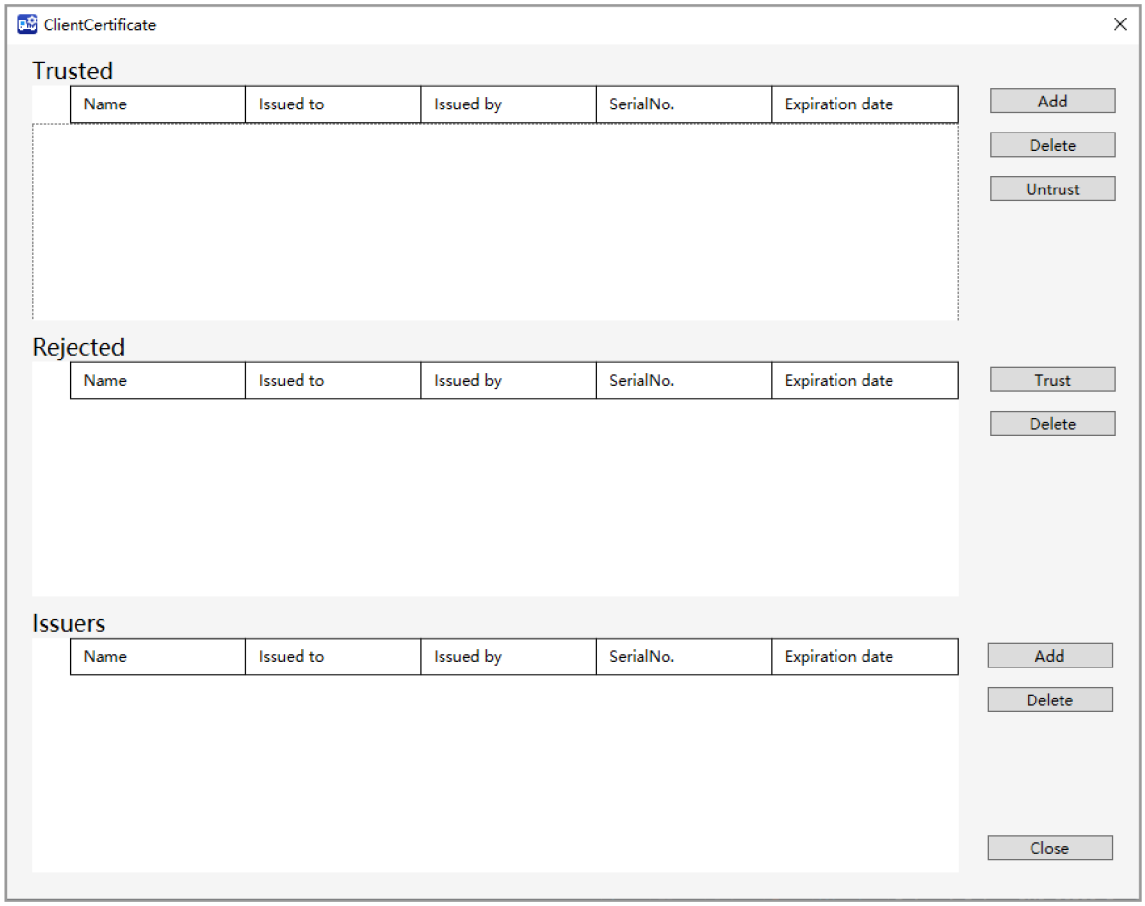
3.7.3 Client Certificate

Client Certificate will be used for Client authentication when connecting to OPC UA Sever. It is possible to import Client Certificate to OPC UA Server or to manage imported Client Certificate by using OPC UA Configurator. You can also manage Issuer certificates, which are included in certificate chains. The function for managing Issuers' certificates is supported by Controllers using firmware version 8.0.0.xx or later.

3.7.3.1 Displaying Information of Client Certificate

1. Select a Controller to configure from the check box of Controller Information List.
2. Select Home display Menu- [Certificate] - [Client Certificate].
3. After the process, a dialog displayed says it is completed.

   Click [OK] button, then [Client certificate] dialog will be displayed.



The following describes the Trust, Rejected, and Issuers lists displayed in the [Client certificate] dialog.

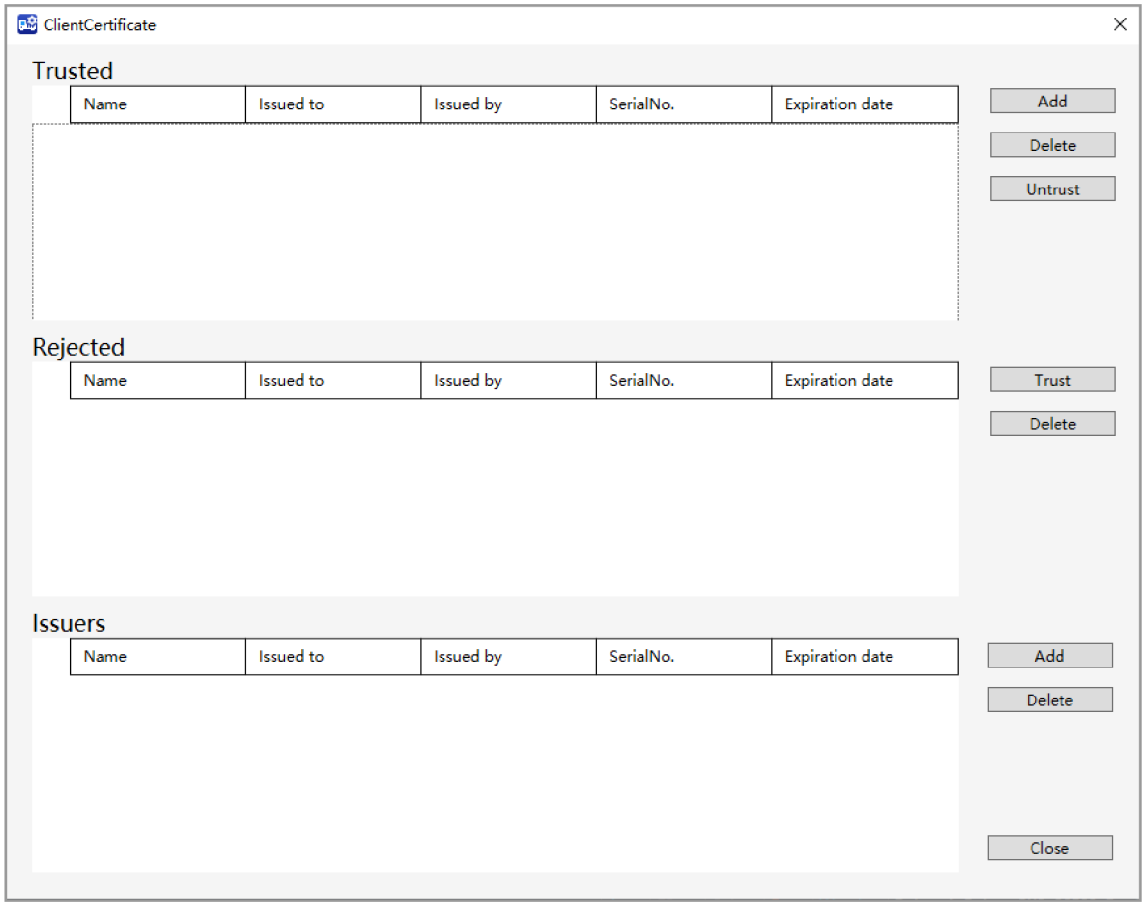
Items	Descriptions
Name	File name of the Client Certificate that acquired.
Issued to	The issue destination of the Client Certificate.
Issued by	The issuer of the Client Certificate.
Serial No.	Serial Number of the Client Certificate.
Expiration date	The expiration date of the Client Certificate.

3.7.3.2 Deleting Client Certificate

It is possible to select and delete the Client Certificate imported in the OPC UA Server.

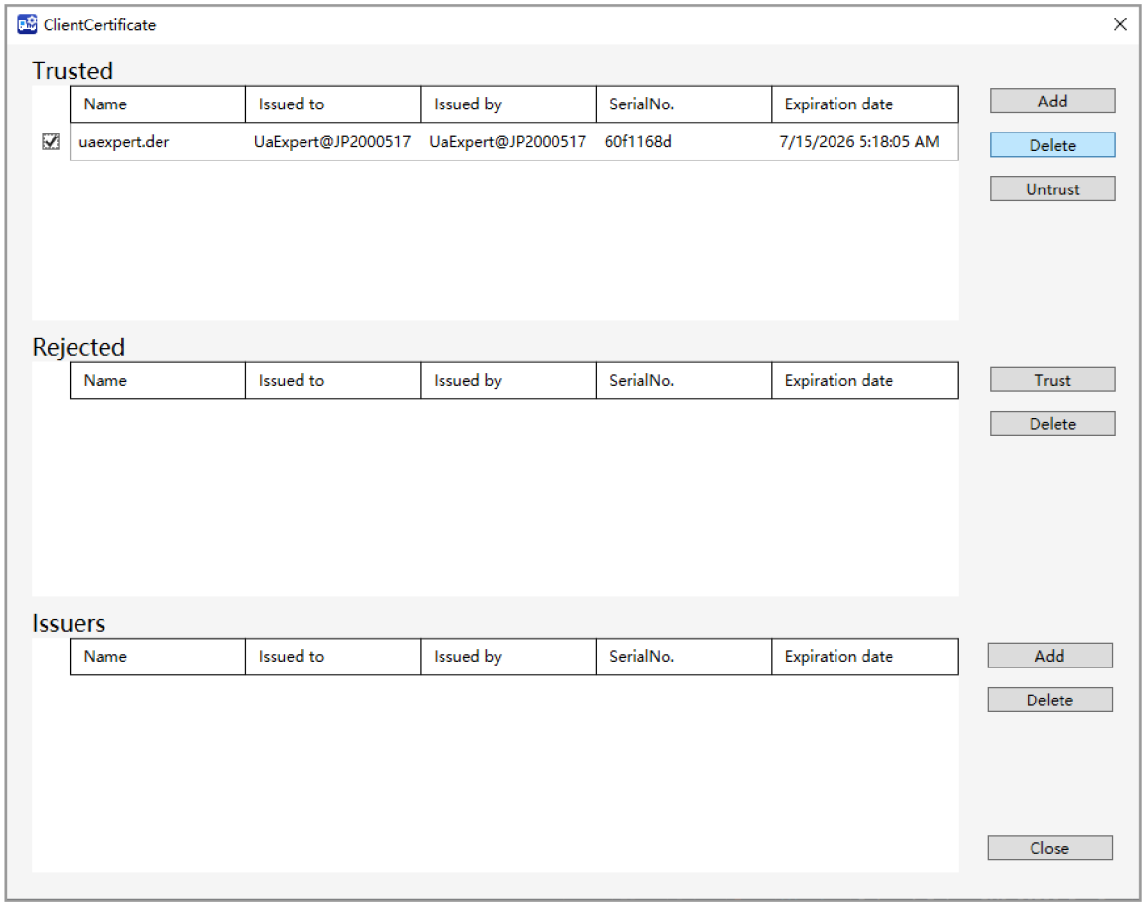
1. Select a Controller to configure from the check box of Controller Information List.
2. Select Home display Menu - [Certificate] - [Client Certificate].

   [Client certificate] dialog will be displayed.



3. Check in the check box in next of the list, click [Delete] button.

   The Client Certificate will be deleted from the Certificate list.



3.7.3.3 Importing Client Certificate

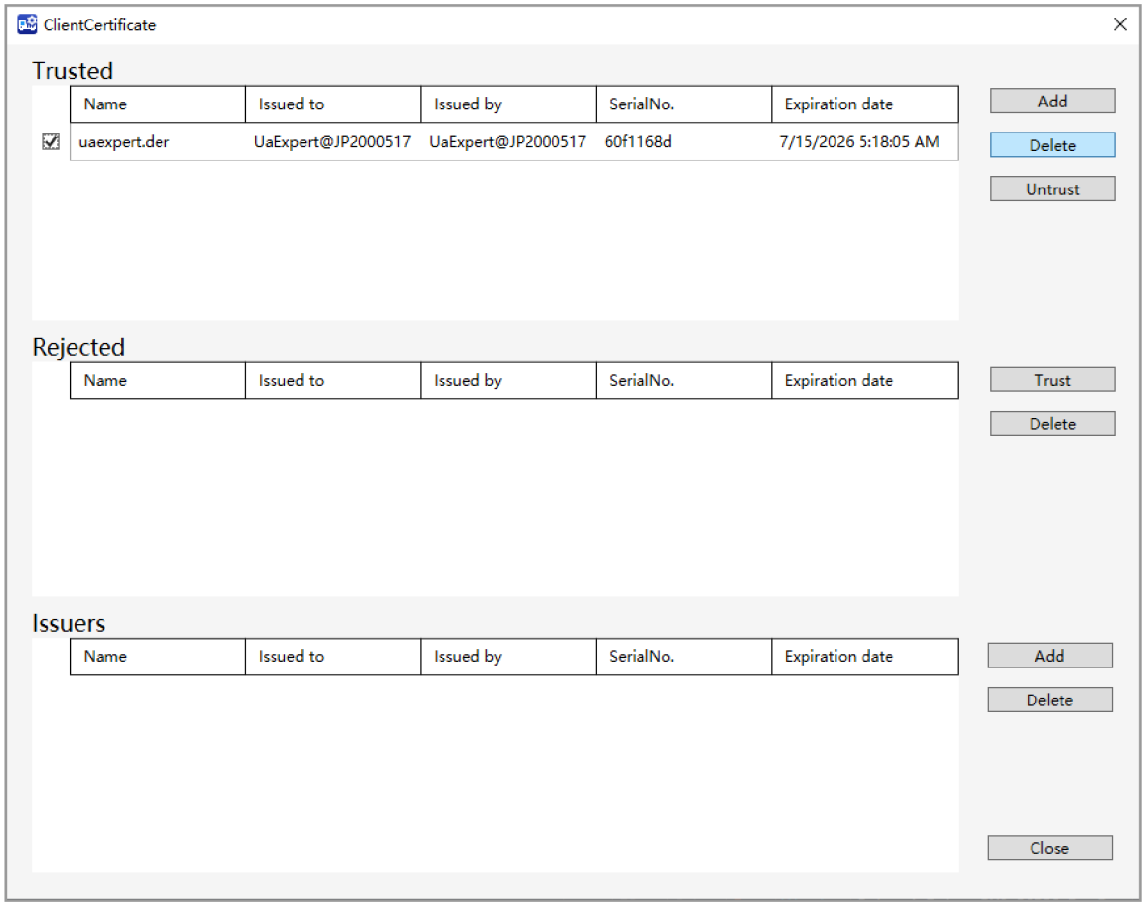
It is possible to import (register) Client Certificate to OPC UA Server.

When importing with one Controller

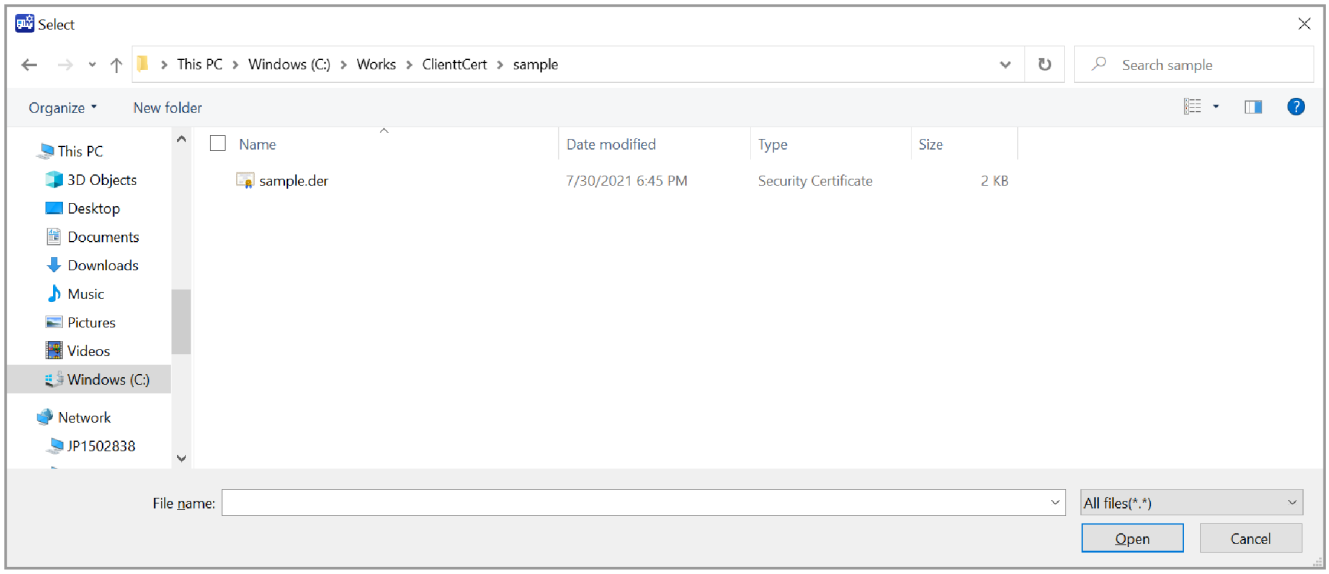
1. Select a Controller to configure from the check box of Controller Information List.
2. Select Home display Menu - [Certificate] - [Client Certificate].

   [Client certificate] will be displayed.

   - Add to Trusted: Click the [Add] button to the right of the Trusted list.
   - Add to Issuers: Click the [Add] button to the right of the Issuers list.



3. Following dialog to select a file will be displayed. Click [Open] button.



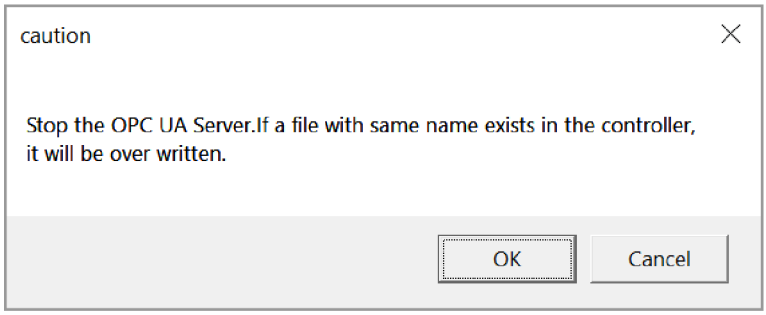
KEY POINTS

Do not use space or full-width character for the file name.

4. A dialog will be displayed says it is overwritten for import process.

   To overwrite and continue the process, click [OK] button. The Client Certificate will be imported.

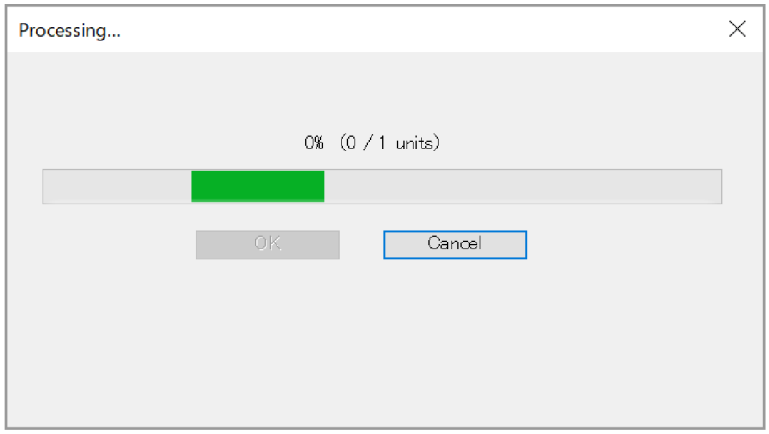
   If you click [Cancel] button, importing the Client Certificate will be canceled.



An error dialog is displayed, and import will be canceled when:

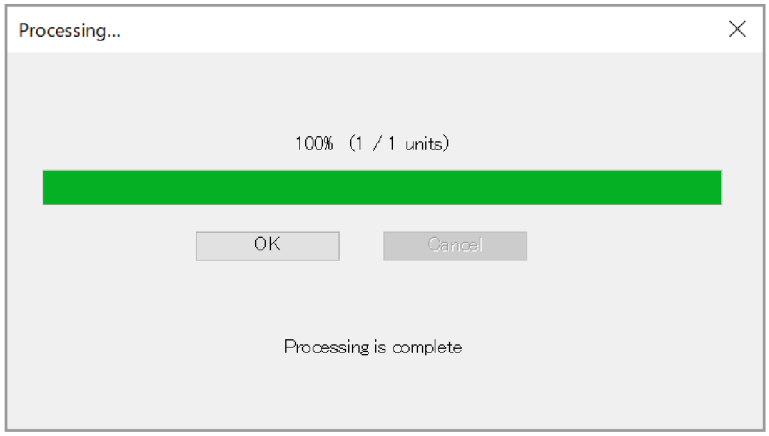
- There are no files, or the file is invalid.
- The number of files exceeds the upper limit (Trusted: Up to 10 files, Issuers: Up to 50 files).

5. During the importing the Client Certificate, following dialog will be displayed. Click [Cancel] button, a dialog will be displayed says the process will be canceled. Click [OK] button to stop importing the Client Certificate. Processing that has already been completed cannot be undone.



6. After complete importing the Client Certificate, following dialog will be displayed.

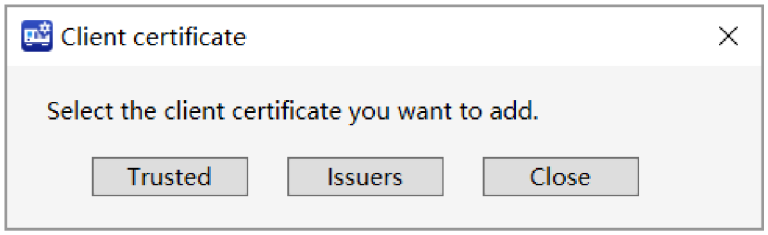
   Click [OK] button of the dialog.



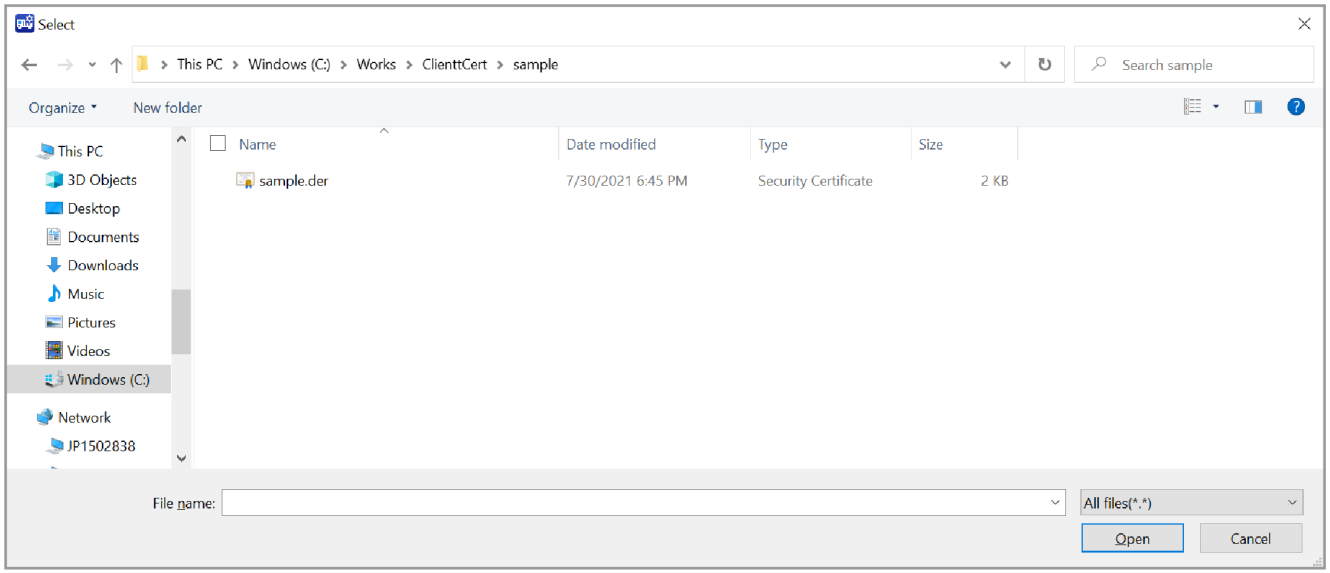
When importing with multiple Controllers

1. Select multiple Controller to configure from the check box of Controller Information List.
2. Select Home display Menu - [Certificate] - [Client Certificate].

   [Client certificate] dialog will be displayed. Click the [Trusted] or [Issuers] button depending on which list you want to add to.



3. A dialog to select a file will be displayed. Click [Open] button.

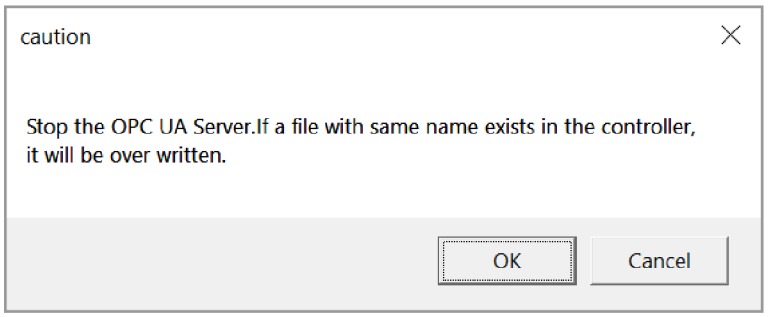


KEY POINTS

Do not use space or full-width character for the file name.

4. A dialog will be displayed says the Server will stop and overwritten to import.

   Click [OK] button



An error dialog will be displayed, and import will not be performed when:

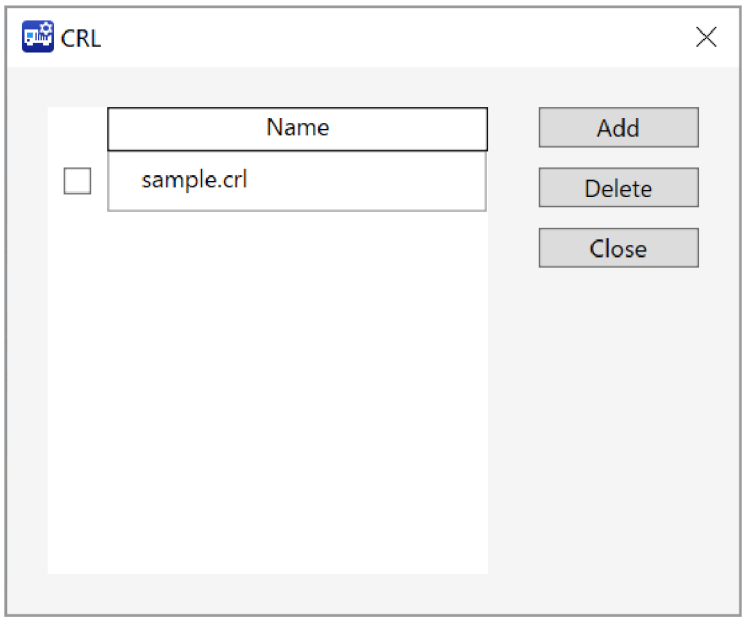
- There are no files, or the file is invalid.
- The number of files exceeds the upper limit (Trusted: Up to 10 files, Issuers: Up to 50 files).

3.7.3.4 Displaying CRL Files in a List-Form

1. Select one Controller to configure from the check box of Controller Information List.

2. Select Home display Menu - [Certificate] - [CRL].

3. [CRL] dialog will be displayed.

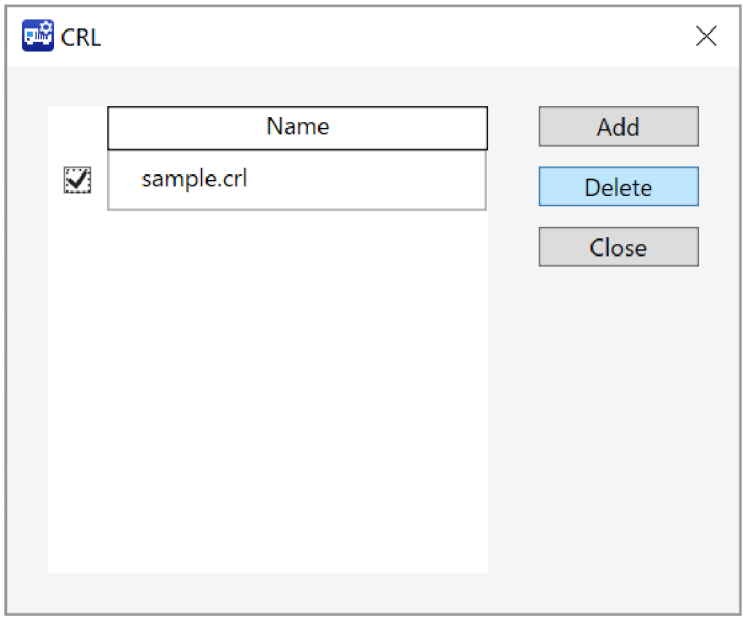


CRL dialog will not be displayed when:

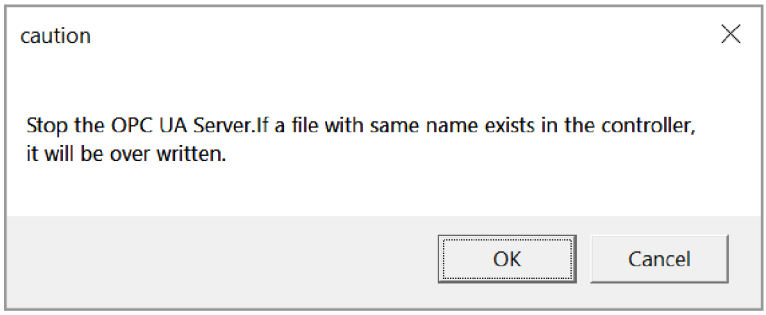
- Multiple Controllers are selected.

3.7.3.5 Deleting CRL Files

1. Select one Controller to configure from the check box of Controller Information List.
2. Select Home display Menu - [Certificate] - [CRL].
3. [CRL] dialog will be displayed.



4. Check in the check box in next of the list and click [Delete] button.
5. A dialog will be displayed says the Server will be stopped. Click [OK] button.

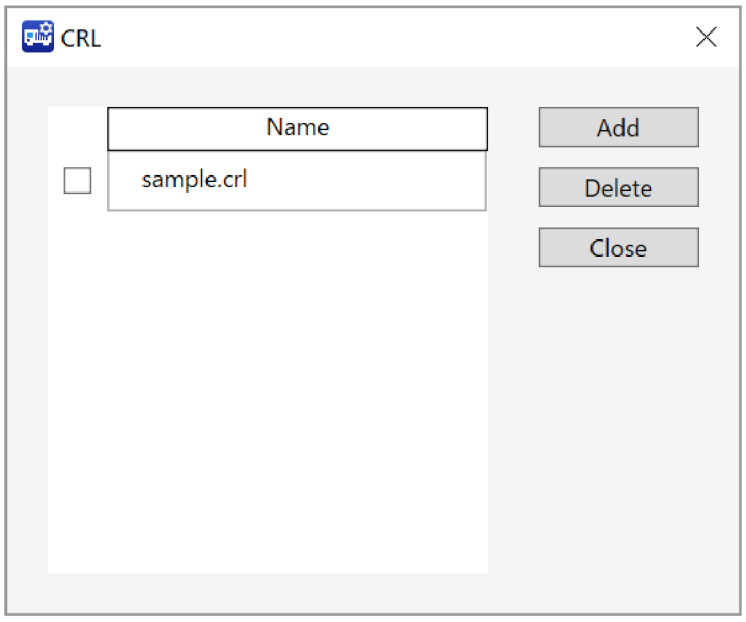


3.7.3.6 Importing CRL Files

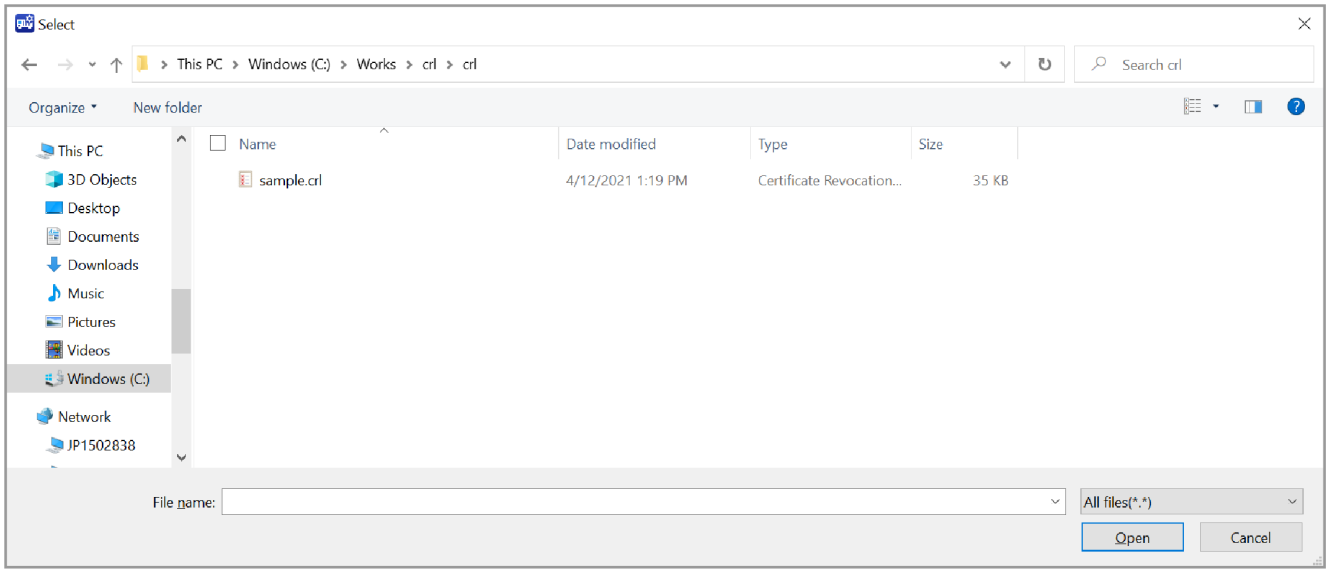
When importing with one Controller:

1. Select a Controller to configure from the check box of Controller Information List.
2. Select Home display Menu - [Certificate] - [CRL].

   [CRL] dialog will be displayed. Click [Add] button.



3. A dialog to select a file will be displayed. Click [Open] button.

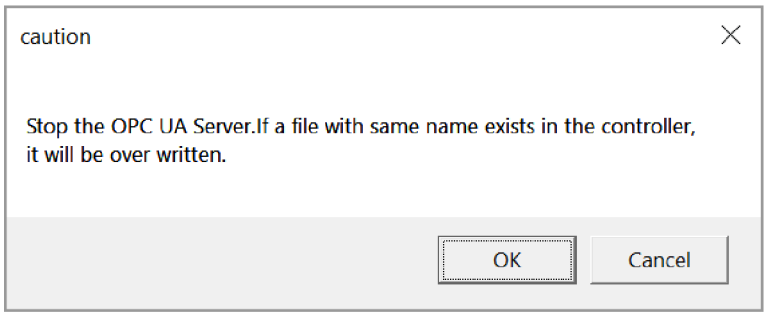


KEY POINTS

Do not use space or full-width character for the file name.

4. A dialog will be displayed says the Server will stop and overwritten to import.

   Click [OK] button.



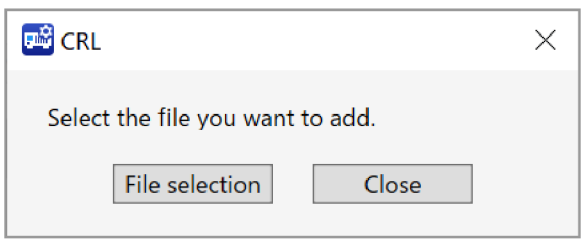
An error dialog will be displayed, and import will not be performed when:

- There are no files, or the file is invalid.
- The number of files exceeds the upper limit (up to 50 files).

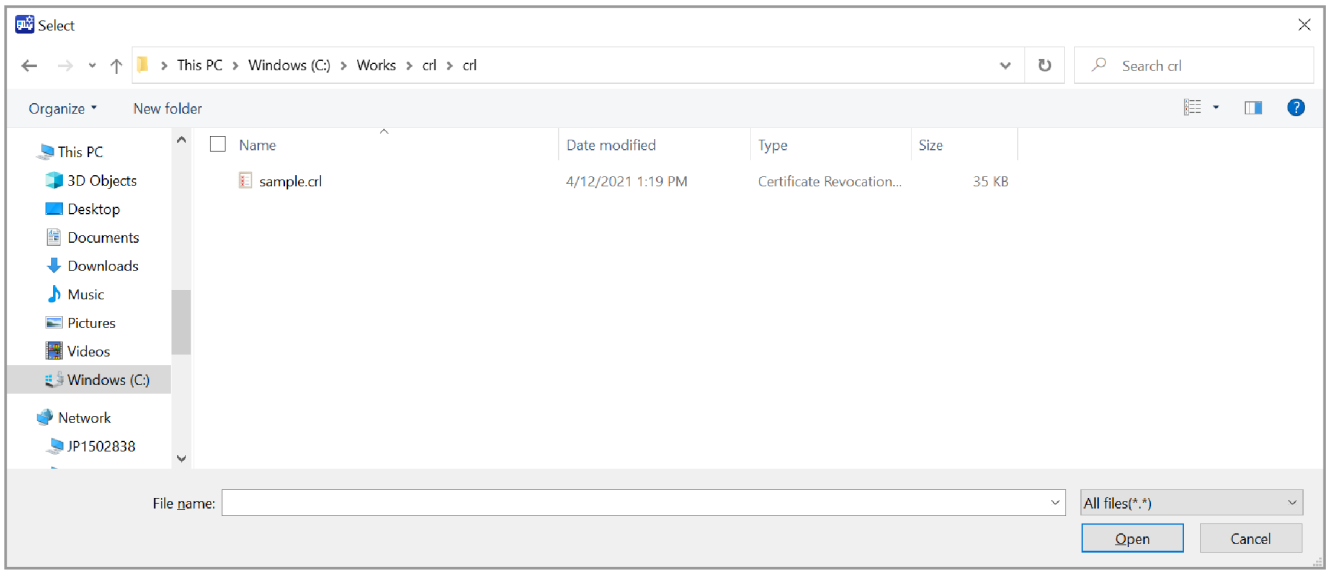
When importing with multiple Controllers:

1. Select multiple Controllers to configure from the check box of Controller Information List.
2. Select Home display Menu - [Certificate] - [CRL].

   [CRL] dialog will be displayed. Click [File selection] button.



3. A dialog to select a file will be displayed. Click [Open] button.

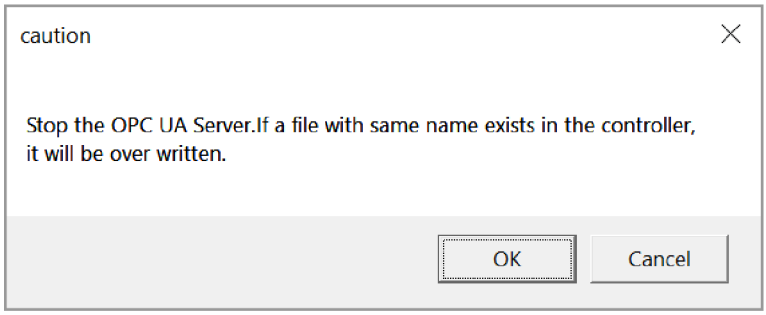


KEY POINTS

Do not use space or full-width character for the file name.

4. A dialog will be displayed says the Server will stop and overwritten to import.

   Click [OK] button.



   An error dialog will be displayed, and import will not be performed when:

   - There are no files, or the file is invalid.
   - The number of files exceeds the upper limit (up to 50 files)

3.8 Setting of OPC UA Configurator

It is possible to configure in Home display Menu – [Option]. Option menu has following items.

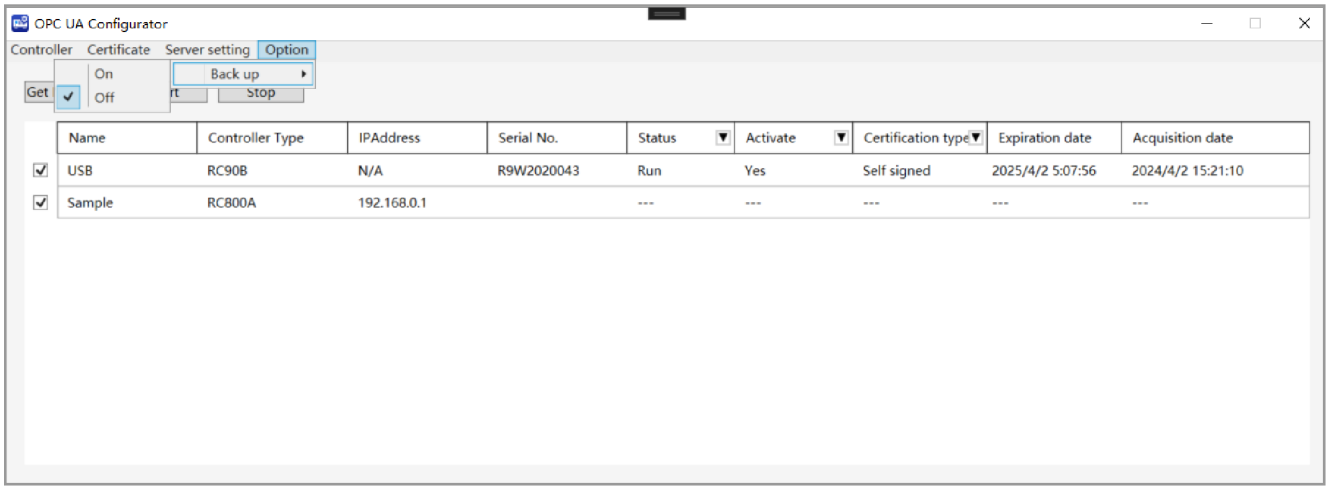
Items	Descriptions
Back up	Setting the backup function of the file created with the application.

3.8.1 Backup Setting

When you create the Self signed Server Certificate, you can configure whether to back up the created Server Certificate and private key to the PC.

> **⚠ CAUTION**
>
> The private key is very important for the security. Be careful managing the private key.

1. Select Home display Menu - [Option] - [Back up] to start configuring back up.



2. If [On] selected, the backup of file you created is automatically created.

   Created files are in:

   Self Signed Certificate

   `C:\EpsonRC80\OPCUA\[Controller serial No.]\SelfSigned` folder

   If [Off] selected, no backups created.

   You can backup Self signed Server Certificate created in this application, Private key file or CSR and Private key file. However, a virtual RC800 series controller or a controller with firmware version 8.0.0.xx or later, does not generate a backup for the Private key file.

   CA signed Server Certificate, a Server Certificate prepared by customer, Client Certificate and CRL need to be backed up by the customers.

4. OPC UA Server

4.1 Specifications of the OPC UA Server

Following shows specification of OPC UA Server.

Items	Specifications
OPC UA Version	Ver.1.04
Data Encoding	UA Binary
Security Mode	■ Sign&Encrypt ■ Sign ■ None
Security Policy	■ None ■ Basic256 ■ Basic128Rsa15 ■ Basic256Sha256 ■ Aes128Sha256RsaOaep ■ Aes256Sha256RsaPss
Client Certificate	Authentication by Certificate. Possible to register up to 10 files for Client Certificate/CRL.
User Token Policy	■ UserName and Password ■ Anonymous
User Certificate	Authentication by UserName and Password. Possible to register up to 10 users.
Endpoint URL	`opc.tcp://<IP Address>:<PortNo.>`
Minimum Publishing Interval	100 ms

4.2 Address Space

4.2.1 Introduction

For OPC UA, the unit that represents the information and functions of the target device is called as “node”. Each node has various parameters (also called as Attribute or Property), and each content of parameter shows actual information of target device. Also tying a node and other node with a relationship of “Reference” is how node is structured. The space in which such structured nodes are (conceptually) arranged is called the address space. Address space is a where data used by OPC UA Sever is placed.

⚠ CAUTION

When changing structure of Robot or option (DU, I/O board tec.), the node ID may be changed. After changed the structure, check for the node ID.

4.2.2 Covered Companion Spec

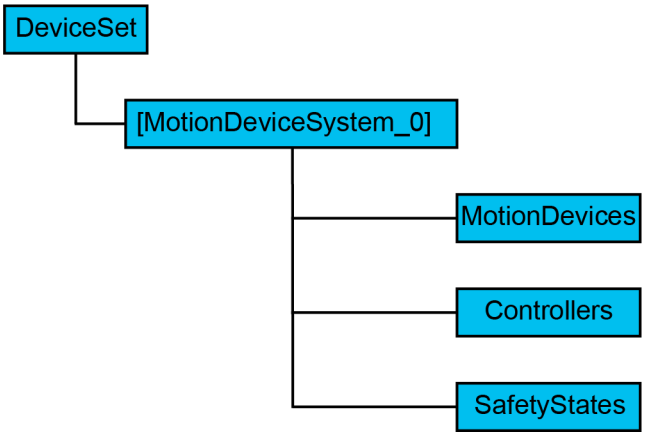
This product covers CS (Companion Specification) Robotics Part1 Ver1.00.

Following describes address space of this product and data assigned in each node.

Refer to OPC UA Online Reference for detailed specification of each node.

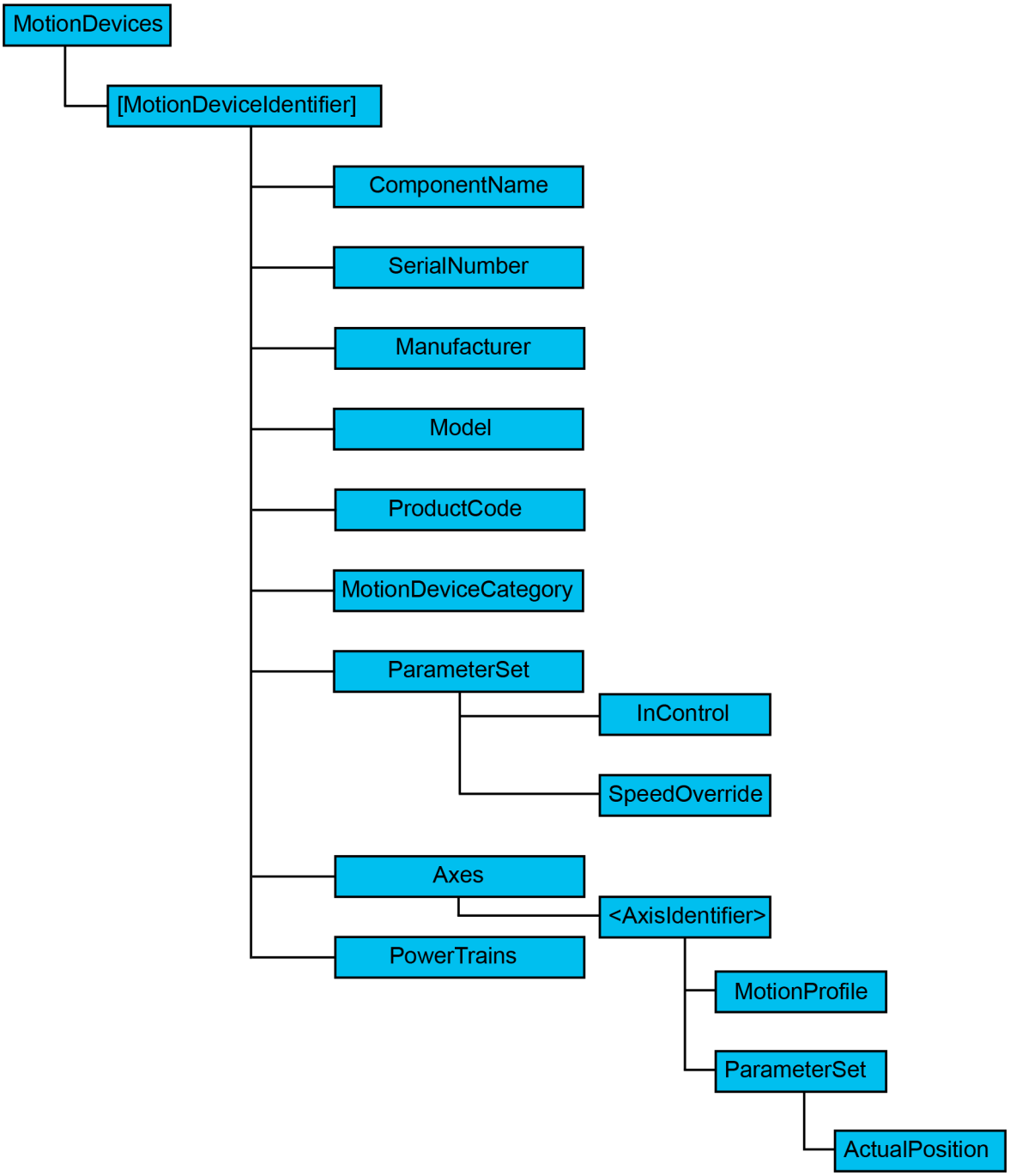
4.2.2.1 Supporting for OPC UA for Robotics

Device Set



Browse Name	Descriptions
[MotionDeviceSystem_0]	Indicates a Controller installed OPC UA Server and a device that under its control.
MotionDevices	Container of instance of MotionDeviceType.
Controllers	Container of instance of ControllerType.
SafetyStates	Container of instance of SafetyStateType.

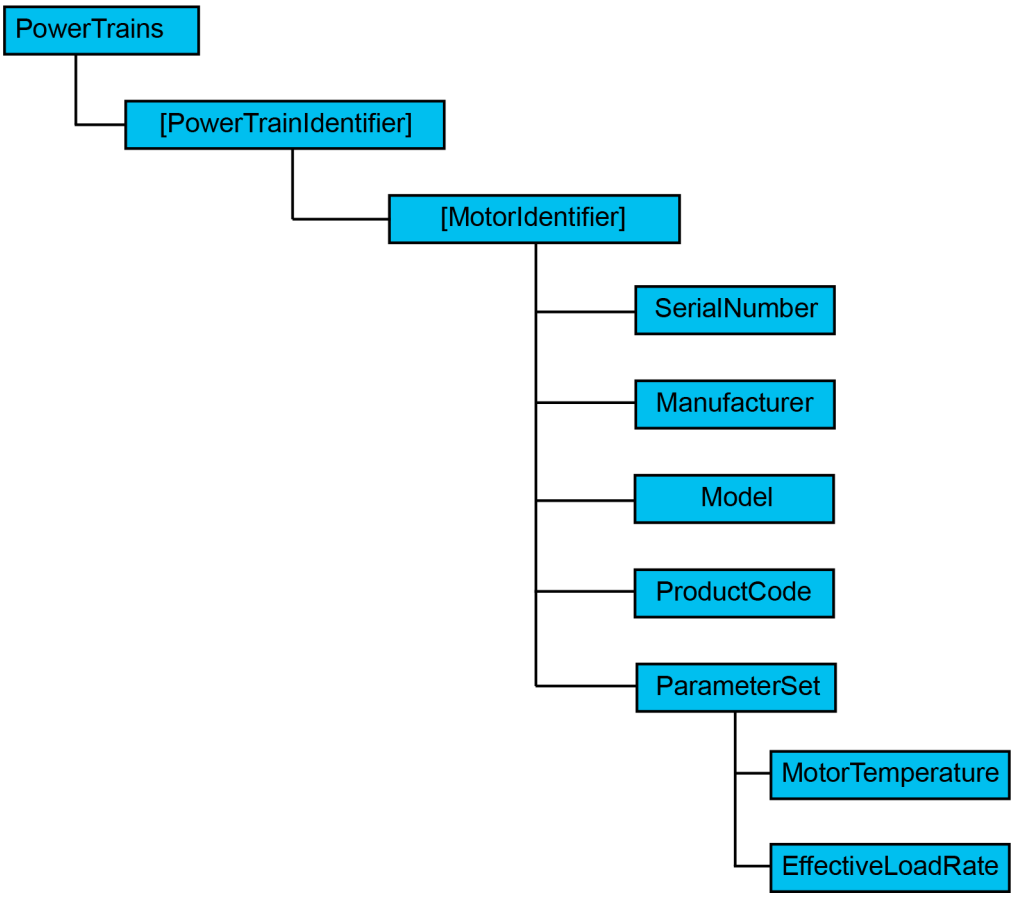
MotionDevices



BrowseName	Descriptions
[MotionDeviceIdentifier]	Indicates robot itself.
ComponentName	Indicates robot name. It is possible to setup in Epson RC+.
SerialNumber	Serial number of the robot.
Manufacturer	Manufacturer of the robot.
Model	Model name of the robot.
ProductCode	Model name of the robot.
MotionDeviceCategory	Robot category based on ISO 8373. (1 for 6-axis robot, 2 for SCARA robot)

BrowseName	Descriptions
InControl	Indicates the motor is ON or OFF.
SpeedOverride	Percentage of current speed. A value that can be configured in SpeedFactor command.
Axes	Container of instance of AxisType.
[AxisIdentifier]	Indicates a movable axis.
MotionProfile	Indicates a kind of axis. Rotation axis is 1, straight axis is 3. For example, J3 is 3 for SCARA robot, and others are 1.
ActualPosition	Current position of axis.
PowerTrains	Container of instance of PowerTrainType.

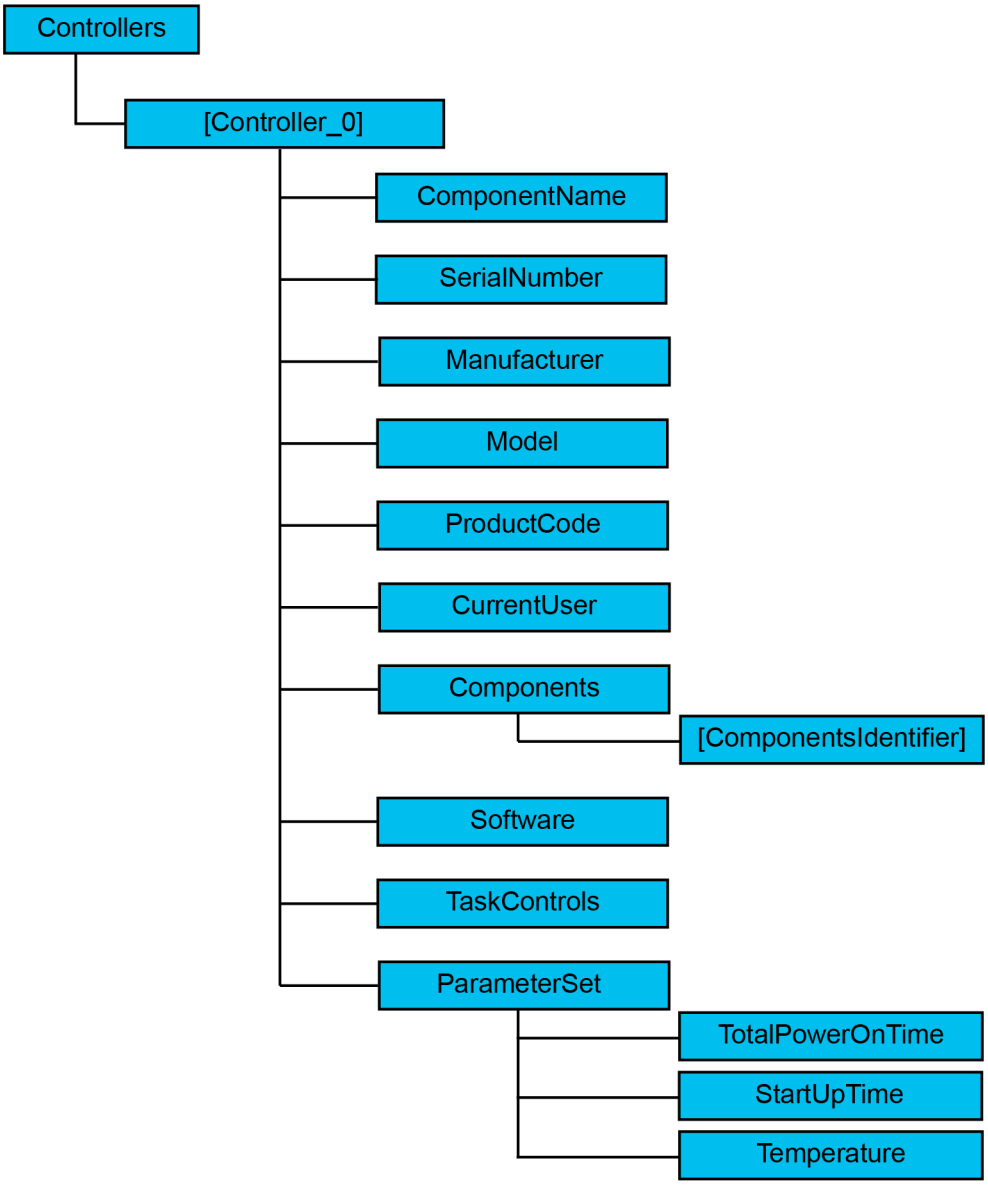
PowerTrains



BrowseName	Descriptions
[PowerTrainIdentifier]	Drive mechanism (a pair of motor and gear)
[MotorIdentifier]	Motor
SerialNumber	Not supported (Null)
Manufacturer	Not supported (Null)
Model	Not supported (Null)

BrowseName	Descriptions
ProductCode	Not supported (Null)
MotorTemperature	Not supported (Null)
EffectiveLoadRate	Loading factor of axis A value OLRate command indicates

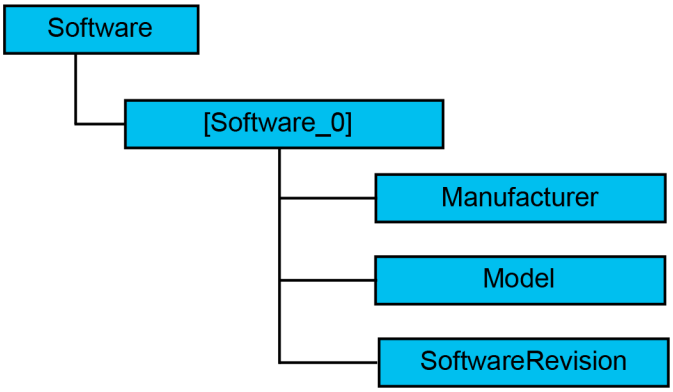
Controllers



Names	Descriptions
[Controller_0]	Controller
ComponentName	Controller name It can be configured in Epson RC+
SerialNumber	Serial number of Controller
Manufacturer	Manufacturer of Controller
Model	Model name of Controller

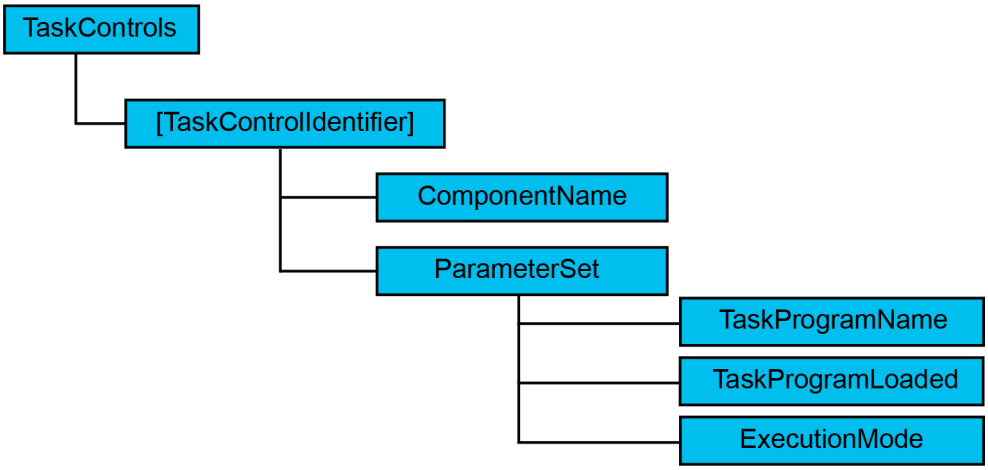
ProductCode	Model name of Controller
CurrentUser	Not supported (Null)
Components	Container of component related to Controller
Software	Container of Software node
TotalPowerOnTime	Amount of time the Controller has been turned ON
StartUpTime	Last date and time the Controller has turned ON
Temperature	Temperature of inside of the Controller

Software



Names	Descriptions
[Software_0]	Software
Manufacturer	Manufacturer of software
Model	Model name of software
SoftwareRevision	Version of software.

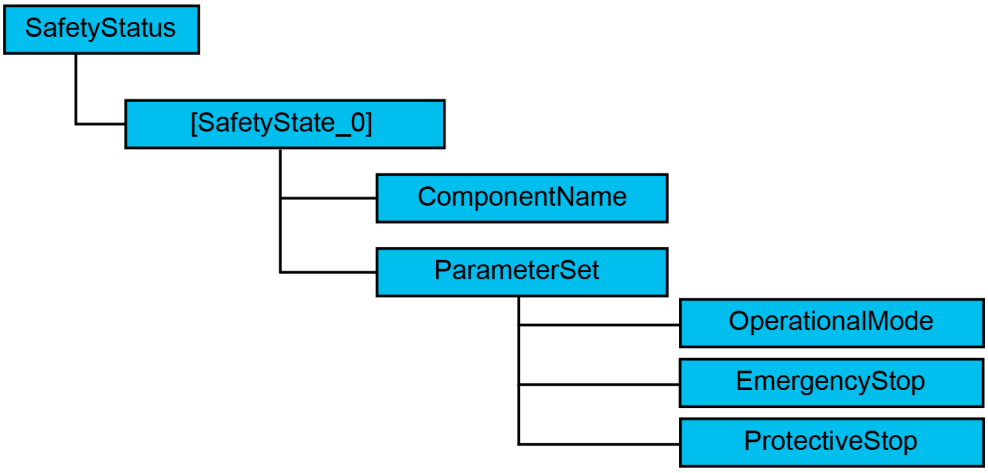
TaskControls



Names	Descriptions
[TaskControlIdentifier]	Indicates tasks. For details of the task, refer to the following manual. "Epson RC+ User's Guide"

Names	Descriptions
ComponentName	Function name
TaskProgramName	Program name
TaskProgramLoaded	True when task is executing (includes wait or pause)
ExecutionMode	Indicates executing state of the program. Normal execute is CYCLE. Step in, Step over or Walk are STEP.

SafetyStates



Names	Descriptions
SafetyState_0	Safety state of robot and Controller.
ComponentName	Target name of safety state.
OperationalMode	Current operation mode. Either of MANUAL_REDUCED_SPEED, MANUAL_HIGH_SPEED and AUTOMATIC.
EmergencyStop	ON/OFF in emergency stop
ProtectiveStop	ON/OFF in protective stop (Safety door open/close)

4.2.2.2 Robot Displayed in Address Space

Following Robot are displayed in address space.

- Epson SCARA Robots
- Epson 6 Axis Robots

KEY POINTS

PG robots and robots other than those listed above are not supported. Unsupported robots are not displayed in the address space even if they are connected to the Controller.

4.2.3 Epson Original Node

For:

The following chart shows which firmware versions support Epson's original nodes.

Node	Prior to version 8.0.0	Version 8.0.0 or later
I/O Node	✓	✓
ForceSensorMonitorSystemType Node	✓	✓
SPELProjectType Node	✓	✓
MotionLogSystemType Node		✓
RobotNumber Node		✓
RobotStatus Node		✓
ConsumableStatus Node		✓
RobotAdditionalInfo Node		✓
AxisAdditionalInfo Node		✓
ControllerStatus Node		✓

4.2.3.1 Specification of I/O Node

All I/O including Out port are Read-only in this system.

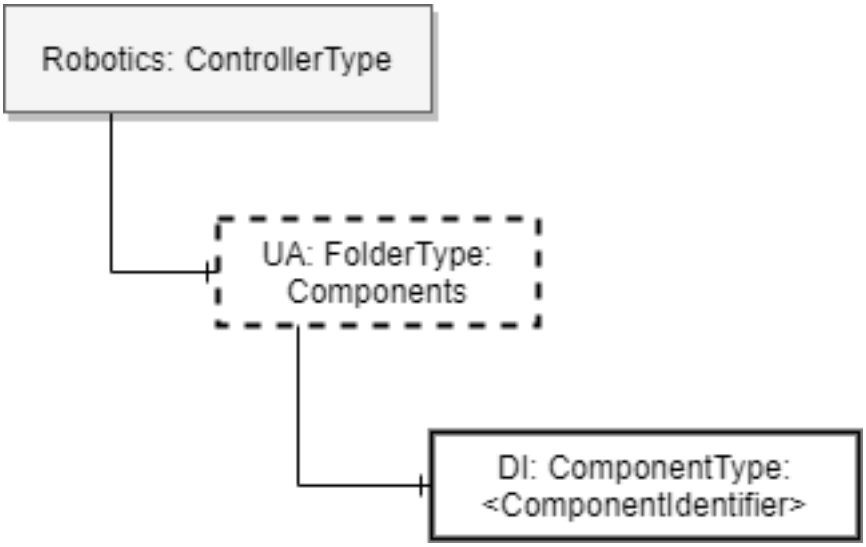
I/O Port

Following shows supported I/O port.

I/O Type	Prior to 8.0.0	8.0.0 or later
Standard I/O	✓	✓
Extended I/O	✓	✓
Fieldbus Slave I/O		✓
Fieldbus Master I/O		✓
Memory I/O		✓
Drive Unit I/O	✓	

Relation of CS Robotics Part1

I/O node is placed as the one of [ComponentIdentifier] under the Components node on address space of CS Robotics Part1 Ver.1.00.

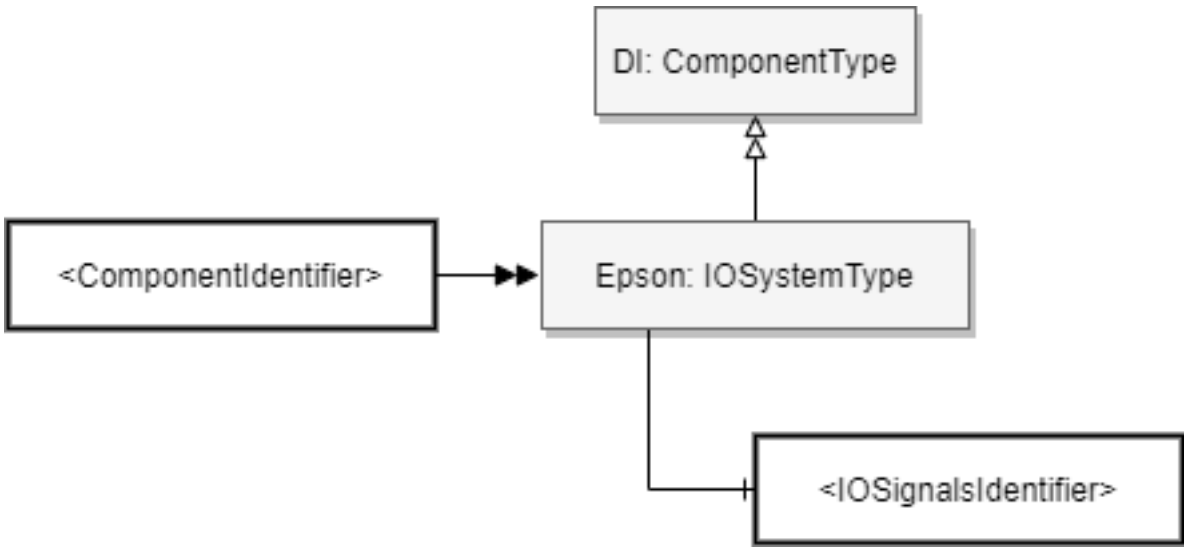


IOSystemType ObjectType Definition

- Overview

  IOSystemType indicates I/O system installed in the Controller.

  Instancing this type for each type of I/O system installed in the Controller.



ObjectType Definition

Following shows definition of IOSystemType.

Attribute	Value
BrowseName	IOSystemType
IsAbstract	FALSE

References	Node Class	BrowseName	DataType	TypeDefinition	Modelling Rule
Subtype of the ComponentType defined in OPC Unified Architecture for Devices (DI)					
HasComponent	Object	[IOSignalsIdentifier]	-	Epson: IOSignalsType	MandatoryPlaceholder

ObjectType Description

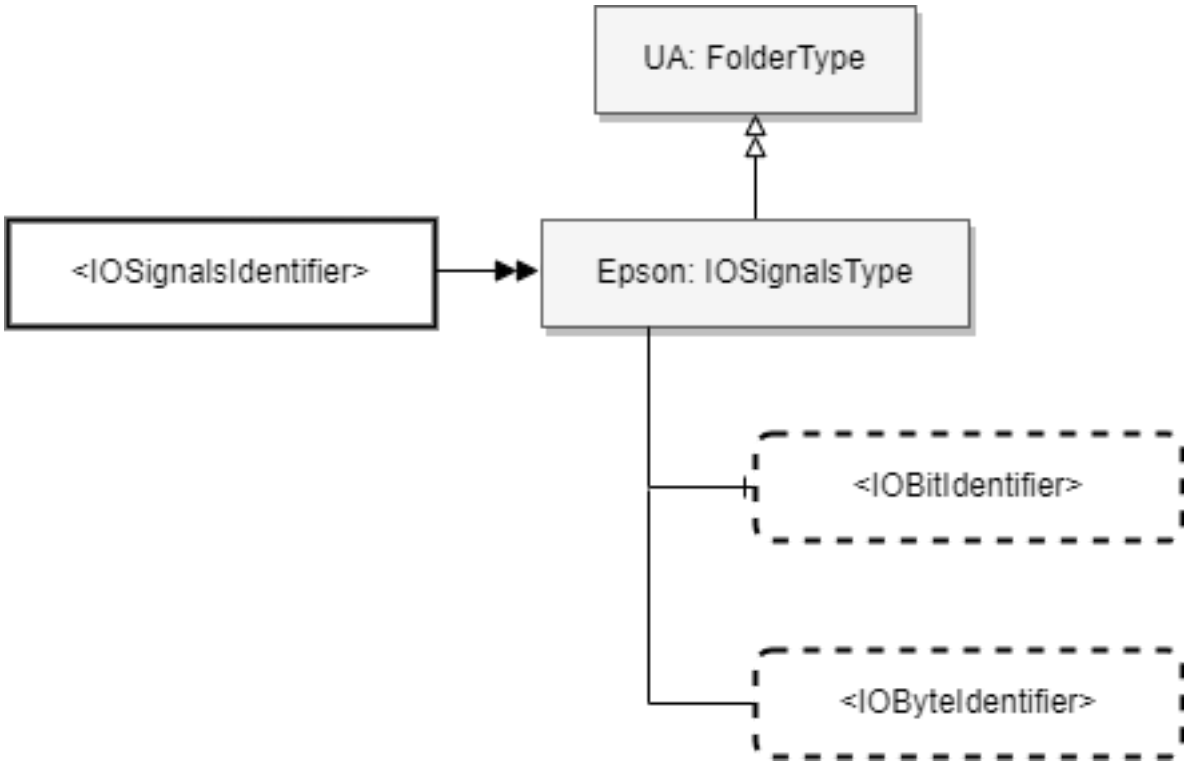
- Object [IOSignalsIdentifier]

  [IOSignalsIdentifier] indicates I/O system is including more than one I/O port and indicated by IOSignalsType instance.

IOSignalsType ObjectType Definition

- Overview

  IOSignalsType indicates I/O port including multiple I/O signals, and it functions as a container of Variable node indicating I/O signals. Instancing this Type for each type of I/O signal such as In/Out.



ObjectType Definition

Following shows definition of IOSignalsType.

Attribute	Value
BrowseName	IOSignalsType
IsAbstract	FALSE

References	Node Class	BrowseName	DataType	TypeDefinition	Modelling Rule
Subtype of the FolderType defined in OPC Unified Architecture					
HasComponent	Variable	[IOBitIdentifier]	Boolean	BaseDataVariableType	OptionalPlaceholder
HasComponent	Variable	[IOByteIdentifier]	Byte	BaseDataVariableType	OptionalPlaceholder

ObjectType Description

- Variable [IOBitIdentifier]

  [IOBitIdentifier] indicates I/O port is including multiple I/O signals, and there are this Variable node exists for each bit of the I/O signal.

Value=TRUE means I/O signal is ON, FALSE means I/O signal is OFF.

- Variable [IOByteIdentifier]

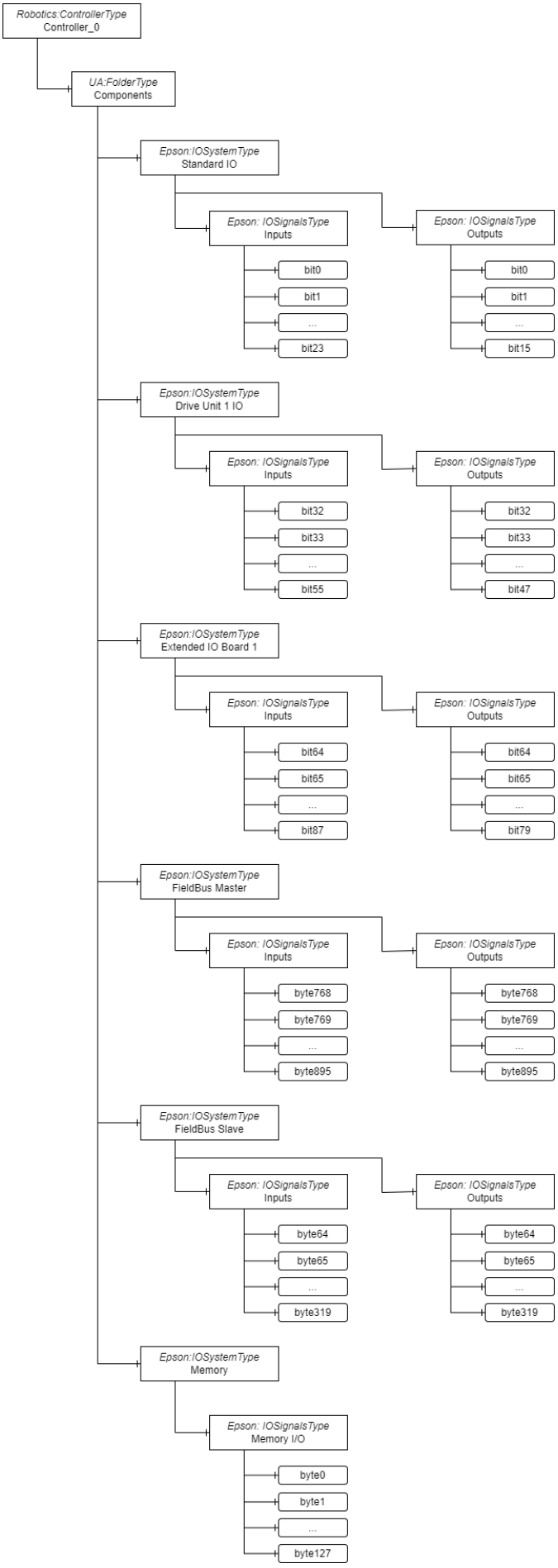
  [IOByteIdentifier], like [IOBitIdentifier], indicates that the I/O port includes multiple I/O signals. This variable node exists for each byte of the I/O signal. When the Value is converted into a binary bit string, the port of the number(0~) of the bit that becomes 1 means ON in the I/0 signal, and the port of the number of the bit that becomes 0 means OFF in the I/O signal.

- Variable [IOWordIdentifier]

  [IOByteIdentifier], like [IOByteIdentifier] and [IOBitIdentifier], indicates that the I/O port includes multiple I/O signals. This variable node exists for each word of the I/O signal. When the Value is converted into a binary bit string, the port of the number(0~) of the bit that becomes 1 means ON in the I/O signal, and the port of the number of the bit that becomes 0 means OFF in the I/O signal.

Examples of Address Space

Following the definitions of the nodes described above, examples of address spaces whose nodes have been instanced are as follows:


Robotics:ControllerType
Controller_0
UA:FolderType
Components
Epson:IOSystemType
Standard IO
Epson: IOSignalsType
Inputs
bit0
bit1
...
bit23
Epson: IOSignalsType
Outputs
bit0
bit1
...
bit15
Epson:IOSystemType
Drive Unit 1 IO
Epson: IOSignalsType
Inputs
bit32
bit33
...
bit55
Epson: IOSignalsType
Outputs
bit32
bit33
...
bit47
Epson:IOSystemType
Extended IO Board 1
Epson: IOSignalsType
Inputs
bit64
bit65
...
bit87
Epson: IOSignalsType
Outputs
bit64
bit65
...
bit79
Epson:IOSystemType
FieldBus Master
Epson: IOSignalsType
Inputs
byte768
byte769
...
byte895
Epson: IOSignalsType
Outputs
byte768
byte769
...
byte895
Epson:IOSystemType
FieldBus Slave
Epson: IOSignalsType
Inputs
byte64
byte65
...
byte319
Epson: IOSignalsType
Outputs
byte64
byte65
...
byte319
Epson:IOSystemType
Memory
Epson: IOSignalsType
Memory I/O
byte0
byte1
...
byte127

4.2.3.2 Specifications of Force Sensor Node

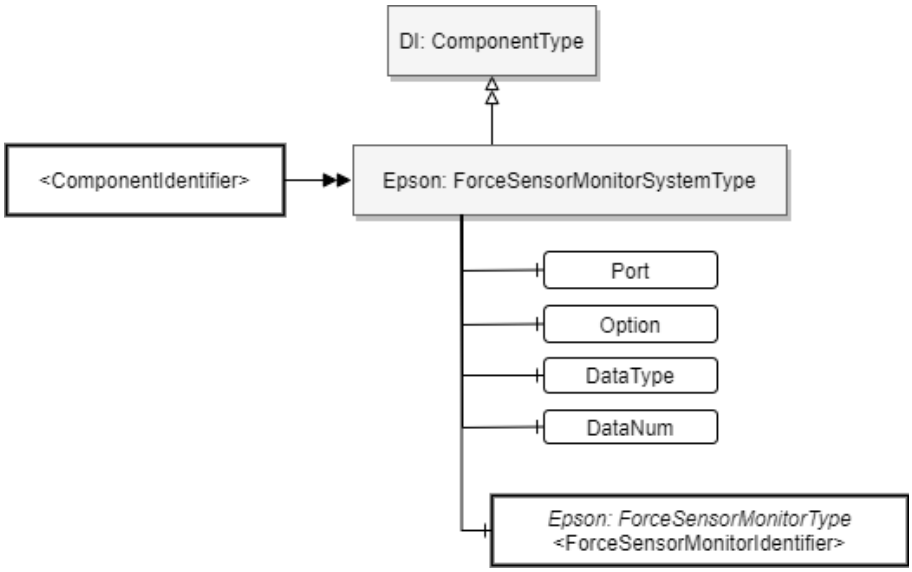
This section describes the specifications of the force sensor node. For information on how to use it, refer to the following manual.

Acquisition of Force Sensor Data

ForceSensorMonitorSystemType ObjectType Definition

- Overview

  ForceSensorMonitorSystemType indicates the monitoring system for the force sensor data in the Controller. Instantiate this type for each force sensor monitoring system installed in the Controller.



ObjectType Definition

ForceSensorMonitorSystemType is defined below.

Attribute	Value
BrowseName	ForceSensorMonitorSystemType
IsAbstract	FALSE

References	Node Class	BrowseName	DataType	TypeDefinition	ModellingRule
Subtype of the ComponentType defined in OPC Unified Architecture for Devices (DI)					
HasComponent	Variable	Port	Boolean	BaseDataVariableType	Mandatory
HasComponent	Variable	Option	String	BaseDataVariableType	Mandatory
HasComponent	Variable	DataType	Uint16	BaseDataVariableType	Mandatory
HasComponent	Variable	DataNum	UInt16	BaseDataVariableType	Mandatory
HasComponent	Object	[ForceSensorMonitor Identifier]	-	Epson: ForceSensorMonitorType	MandatoryPlace holder

ObjectType Description

- Variable Port

This is a configuration node for switching the data output destination. It determines whether data will be output to OPC UA or to an existing output destination (Epson RC+).

The values are described in the following table.

Value	Description
True	Outputs data to OPC UA.
False	Outputs data to Epson RC+.

KEY POINTS

Data is output to either Epson RC+ or OPC UA.

- Variable Option

  This node is not normally used. Do not change the value.

- Variable DataType

  DataType is a configuration node for selecting the data to be acquired. The relationship between the value and the data to be acquired is shown in the following table.

Value	Data to be acquired
0	ElapsedTime, Force, CurPos, RefPos, Diff, TCPSpeed, CurAngle, OLRate, FCOn, StepID, SeqNo, ObjNo, Time
1	ElapsedTime, CurPos, TCPSpeed, CurAngle, OLRate, StepID, SeqNo, ObjNo, Time
2	ElapsedTime, Force, CurPos, StepID, SeqNo, ObjNo
3	ElapsedTime, CurPos, StepID, SeqNo, ObjNo

  For details on the data to be acquired, refer to the following.

  Data Formatting

- Variable DataNum

  The DataNum node is used to specify the maximum number of data items to be acquired from the server at one time.

Value	Description
0	Does not set maximum number of data items (Determined by server)
1~	Sets maximum number of data items

- Object [ForceSensorMonitorIdentifier]

  [ForceSensorMonitorIdentifier] indicates that the force sensor monitoring system has one or more monitoring channels. It is expressed by an instance of ForceSensorMonitorType.

KEY POINTS

When a sensor data acquisition instruction (RecordStart) is executed, data and status are output to a node under ForceSensorMonitor_1. If two cases are executed simultaneously, the data and status of the second case will be output to a node under ForceSensorMonitor_2.

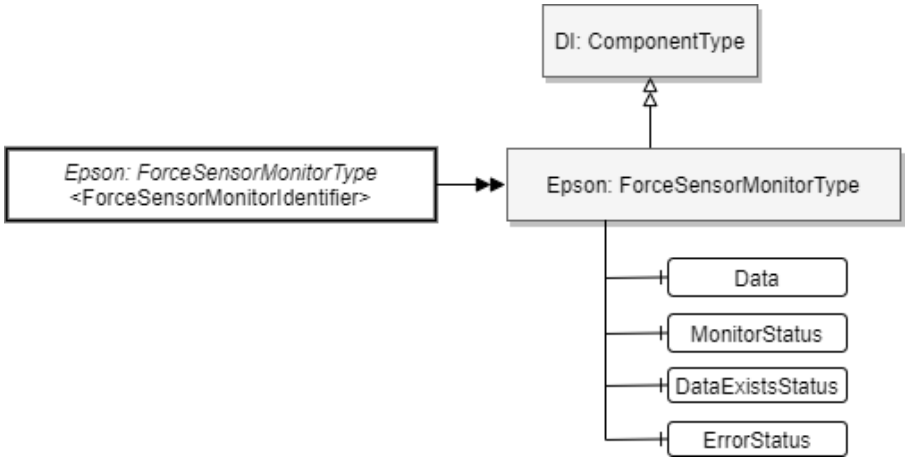
ForceSensorMonitorType ObjectType Definition

- Overview

  ForceSensorMonitorType indicates the monitor data generated by the ForceSensorMonitorSystemType instance. This type is instantiated for each monitor data item (each monitor channel) contained in the ForceSensorMonitorSystemType instance.

  For details, refer to the following.

  Specifications of Force Sensor Node - ForceSensorMonitorSystemType



ObjectType Definition

ForceSensorMonitorType is defined below.

Attribute	Value
BrowseName	ForceSensorMonitorType
IsAbstract	FALSE

References	Node Class	BrowseName	DataType	TypeDefinition	Modelling Rule
Subtype of the ComponentType defined in OPC Unified Architecture for Devices (DI)					
HasComponent	Variable	Data	ByteString	BaseDataVariableType	Mandatory
HasComponent	Variable	MonitorStatus	String	BaseDataVariableType	Mandatory
HasComponent	Variable	DataExistsStatus	String	BaseDataVariableType	Mandatory
HasComponent	Variable	ErrorStatus	String	BaseDataVariableType	Mandatory

ObjectType Description

- Variable Data

This is the node to which the data will be output. When this node is read, data can be acquired by the force sensor. For the details of data format, refer to the following.

Data Formatting

After data acquisition has successfully started by SPEL command, the data held inside the Controller at that time can be read by acquiring this node.

If there is no data held inside the Controller, Null is returned when the node is read.

The types of data that can be acquired include header, data part, and footer, all of which can be acquired from this node. Only one type of data can be acquired in a single read: header, data part, or footer. Headers and data parts, data parts and footers, and such are not mixed.

- Variable MonitorStatus

  Indicates the execution status of sensor data acquisition. The values are described below.

Value	Description
Stop	Indicates that sensor data acquisition is stopped
Run	Indicates that sensor data acquisition is in progress Executing the RecordStart command results in this value

- Variable DataExistsStatus

  Indicates whether data can be acquired from the Data node. The data acquisition timing can be determined from this value. The values are described below.

Value	Description
Empty	Indicates that there is no data that can be acquired from the Data node
Ready	Indicates that there is data that can be acquired from the Data node

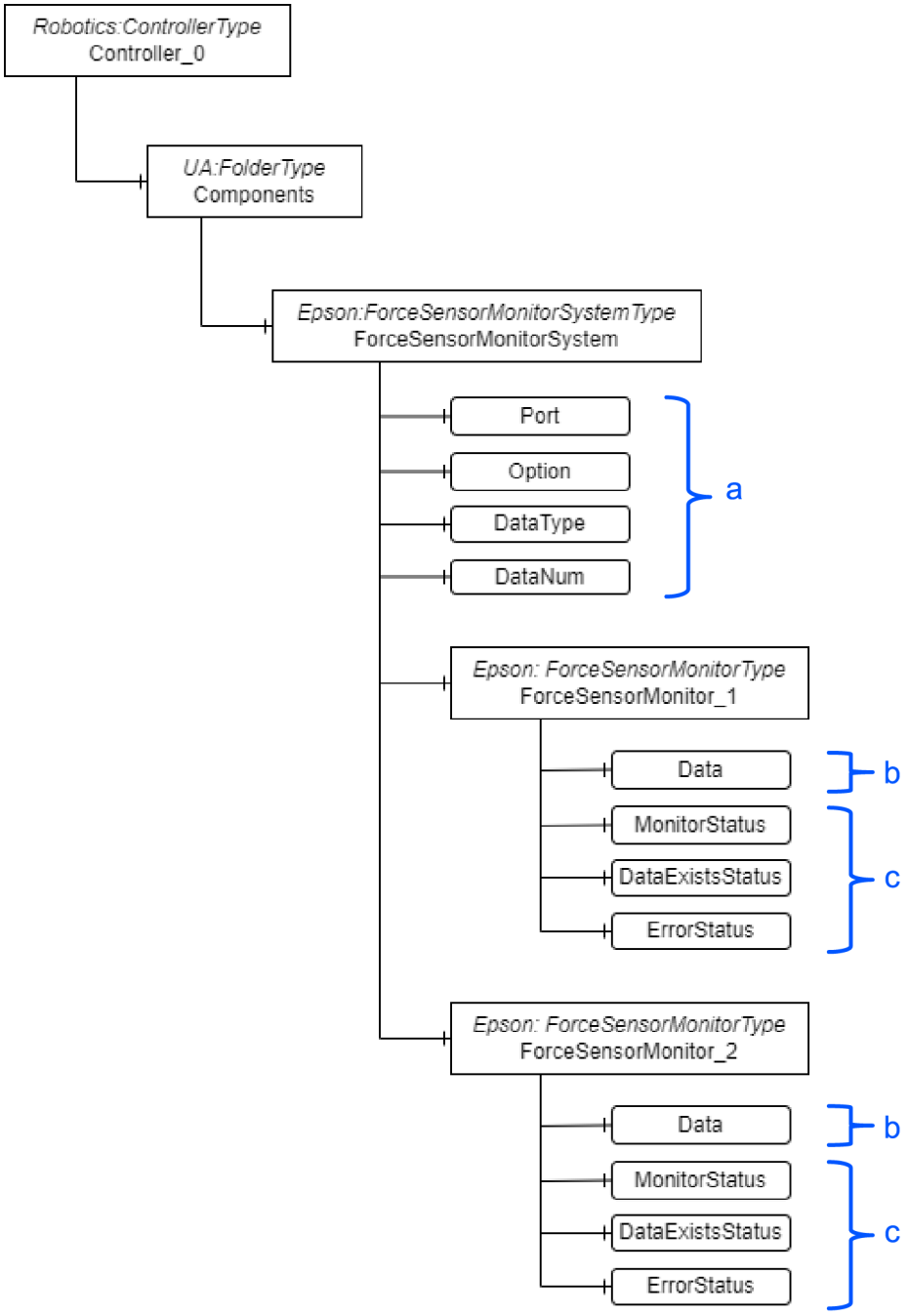
- Variable ErrorStatus

  Indicates the occurrence of errors and warnings during data acquisition. From this value, you can determine how to handle the data. The values are described below.

Value	Description
None	Indicates that there is no abnormality
Warning	Indicates that data overwriting has occurred Data acquisition will continue
Error	Indicates that data acquisition has been interrupted

Example of address space

The following is an example of an instance of address space when the force sensor data acquisition function is available.



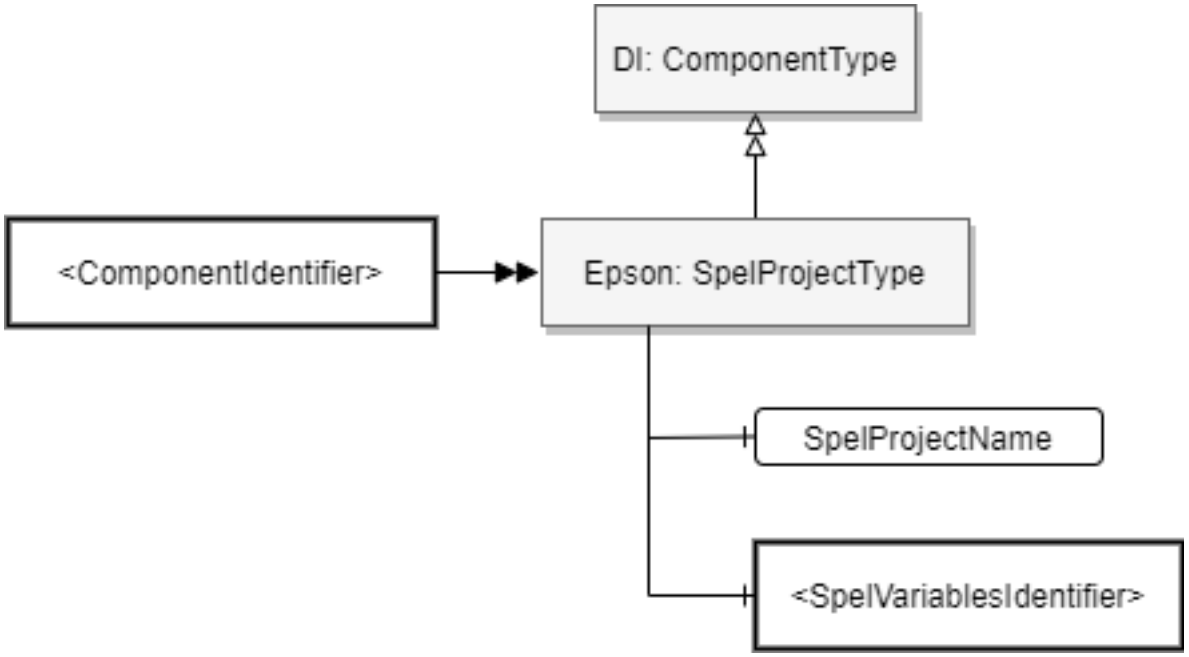
Symbol	Description
a	Configuration node
b	Data acquisition node
c	Status indicator nodes

4.2.3.3 Specifications of SPEL Project Node

SpelProjectType ObjectType Definition

- Overview

  SpelProjectType indicates the SPEL project loaded in the Controller.



ObjectType Definition

SpelProjectType is defined below.

Attribute	Value
BrowseName	SpelProjectType
IsAbstract	False

References	Node Class	BrowseName	DataType	TypeDefinition	Modelling Rule
Subtype of the ComponentType defined in OPC Unified Architecture for Devices (DI)					
HasComponent	Variable	SpelProjectName	String	BaseDataVariableType	Mandatory
HasComponent	Variable	[SpelVariablesIdentifier]		Epson:SpelVariableType	Mandatory

ObjectType Description

- Variable SpelProjectName

  Indicates the name of the SPEL project loaded in the Controller.

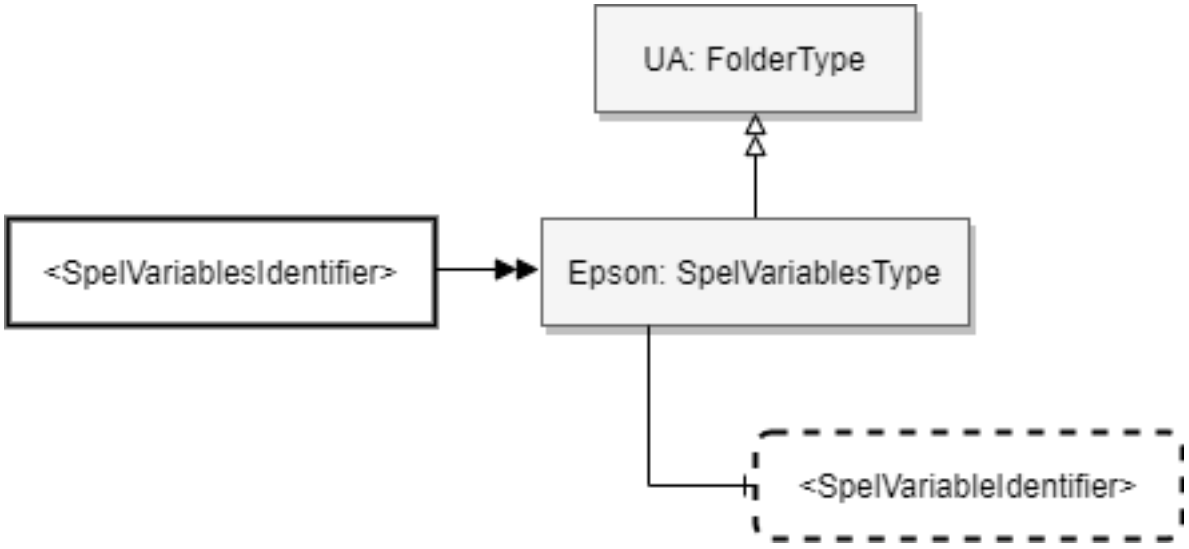
- Object [SpelVariablesIdentifier]

  [SpelVariablesIdentifier] indicates the set of variables included in the SPEL project and is expressed by a SpelVariablesType instance.

SpelVariablesType

- Overview

  SpelVariablesType indicates a set of multiple SPEL variables and serves as a container to group together Variable nodes representing SPEL variables. Only backup variables are subject to instantiation with this function.



ObjectType Definition

SpelVariableType is defined below.

Attribute	Value
BrowseName	SpelVariableType
IsAbstract	False

References	Node Class	BrowseName	DataType	TypeDefinition	Modelling Rule
Subtype of the ComponentType defined in OPC Unified Architecture for Devices (DI)					
HasComponent	Variable	[SpelVariablesIdentifier]	Boolean	BaseDataVariableType	OptionalPlaceholder
HasComponent	Variable	[SpelVariablesIdentifier]	SByte	BaseDataVariableType	OptionalPlaceholder
HasComponent	Variable	[SpelVariablesIdentifier]	Int16	BaseDataVariableType	OptionalPlaceholder
HasComponent	Variable	[SpelVariablesIdentifier]	Int32	BaseDataVariableType	OptionalPlaceholder
HasComponent	Variable	[SpelVariablesIdentifier]	Int64	BaseDataVariableType	OptionalPlaceholder
HasComponent	Variable	[SpelVariablesIdentifier]	Byte	BaseDataVariableType	OptionalPlaceholder
HasComponent	Variable	[SpelVariablesIdentifier]	UInt16	BaseDataVariableType	OptionalPlaceholder
HasComponent	Variable	[SpelVariablesIdentifier]	UInt32	BaseDataVariableType	OptionalPlaceholder
HasComponent	Variable	[SpelVariablesIdentifier]	UInt64	BaseDataVariableType	OptionalPlaceholder
HasComponent	Variable	[SpelVariablesIdentifier]	Float	BaseDataVariableType	OptionalPlaceholder
HasComponent	Variable	[SpelVariablesIdentifier]	Double	BaseDataVariableType	OptionalPlaceholder
HasComponent	Variable	[SpelVariablesIdentifier]	String	BaseDataVariableType	OptionalPlaceholder

ObjectType Description

- Variable [SpelVariablesIdentifier]

  This node indicates a SPEL variable. One node represents one SPEL variable.

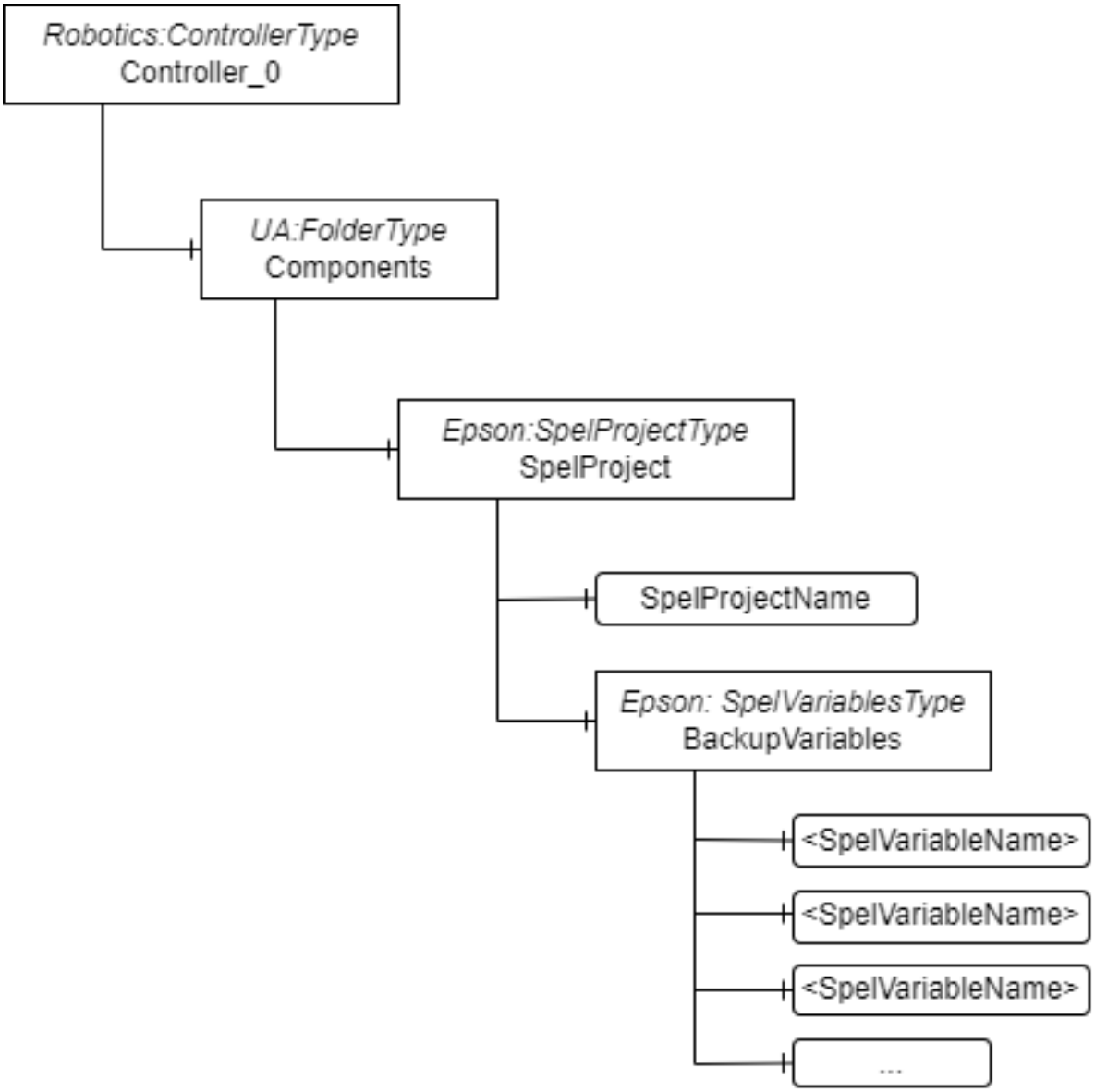
  This node is read only.

The correspondence between type of SPEL variable and OPC UA DataType is shown in the table below.

SPEL variable type	OPC UA Data Type
Boolean	Boolean
Byte	SByte
Short, Integer	Int16
Long, Int32	Int32
Int64	Int64
UByte	Byte
UShort	UInt16
UInt32	UInt32
UInt64	UInt64
Real	Float
Double	Double
String	String

Example of address space

Here is an example of an instance of an address space related to the SPEL variable read function.



4.2.3.4 Specifications of the MotionLogSystemType Node

This section describes the specifications of the MotionLogSystemType node.

For information on how to use it, refer to the following manual.

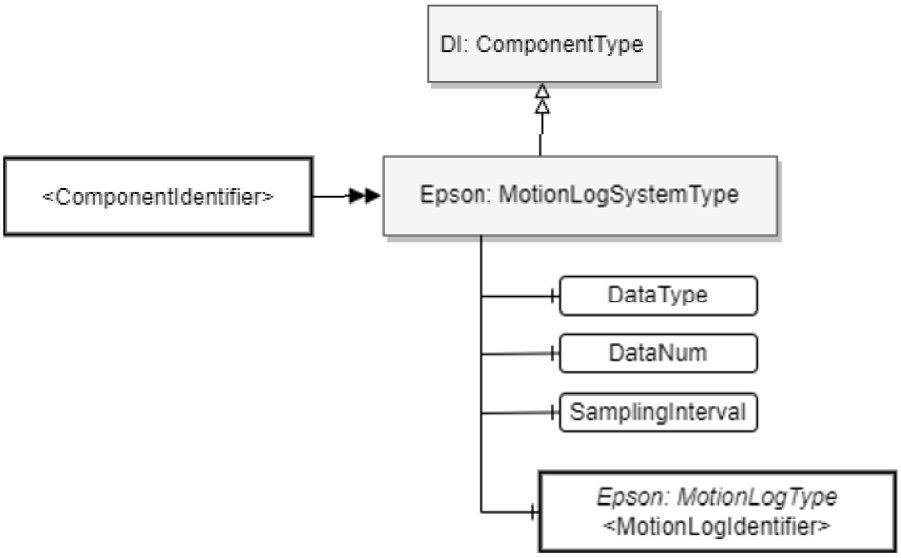
Acquisition of Sensor Data

This node is supported by firmware version 8.0.0.xx and later.

MotionLogSystemType ObjectType Definition

- Overview

  MotionLogSystemType refers to a monitoring system loaded in the Controller which monitors a robot’s motion log data.



ObjectType Definition

MotionLogSystemType is defined below.

Attribute	Value
BrowseName	MotionLogSystemType
IsAbstract	FALSE

References	Node Class	BrowseName	DataType	TypeDefinition	ModellingRule
Subtype of the ComponentType defined in OPC Unified Architecture for Devices (DI)					
HasComponent	Variable	DataType	UInt16	BaseDataVariableType	Mandatory
HasComponent	Variable	DataNum	UInt16	BaseDataVariableType	Mandatory
HasComponent	Variable	SamplingInterval	UInt16	BaseDataVariableType	Mandatory
HasComponent	Object	[MotionLogIdentifier]	-	Epson: MotionLogType	MandatoryPlace holder

ObjectType Description

- Variable DataType

  This is a configuration node for switching the dataset's type. The only value this can be set to is "0".

- Variable DataNum

  The DataNum node is used to specify the maximum number of data items to be acquired from the server at one time. The allowable values are described below.

Value	Description
0	Does not set maximum number of data items (Determined by server)
1~ 200	Sets the maximum number of data items

KEY POINTS

We recommend setting this to “0” unless there is a special reason to do otherwise. If you do not set DataNum to “0” or a sufficiently high value, it may not be possible to acquire continuous Motion Log data.

- Variable SamplingInterval

  This node is used to set the sampling interval for data acquired from the server. The minimum value this can be set to is “0”. When the sampling interval value is set to a nonzero value “n”, you can acquire data at a sampling interval that is 2^n times that of when the value is zero. The allowable values are described below.

Value	Description
0~4	Sets the data sampling interval.

KEY POINTS

The smaller you set the SamplingInterval, the higher the sampling rate you can acquire. However, depending on the operational environment of the Controller, you may be unable to acquire continuous Motion Log data at the designated SamplingInterval. In such cases, set a larger SamplingInterval to improve the performance.

- Object [MotionLogIdentifier]

  [MotionLogIdentifier] indicates the channel by which data is acquired from the MotionLog function and expresses it with a MotionLogType instance.

KEY POINTS

If no data exists, the TIMESTAMP will become “0”. Because of this, the TIMESTAMP interval may not match the value set for the SamplingInterval.

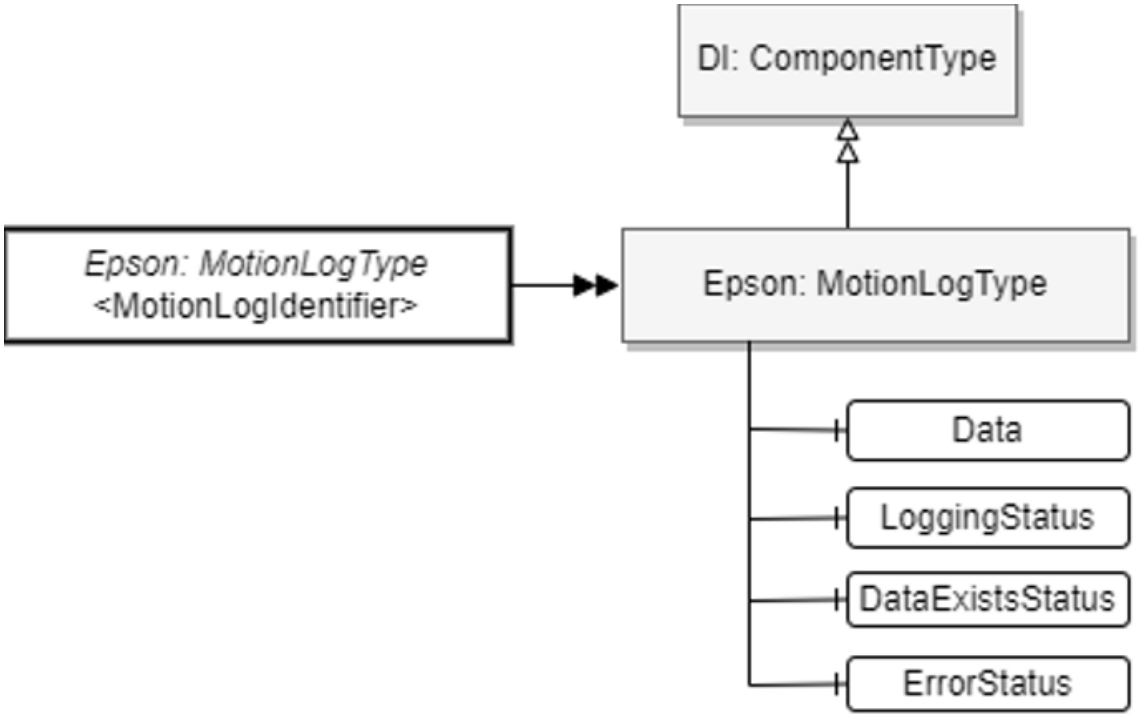
For the details on data format, refer to the following.

Data Formatting

MotionLogType ObjectType Definition

- Overview

  MotionLogType indicates the data generated by a MotionLogSystemType instance (refer to Section 3.2.3.4). This Type is instantiated for each monitor channel contained in the MotionLogSystemType instance.



ObjectType Definition

MotionLogType is defined below.

Attribute	Value
BrowseName	MotionLogType
IsAbstract	FALSE

References	Node Class	BrowseName	DataType	TypeDefinition	Modelling Rule
Subtype of the ComponentType defined in OPC Unified Architecture for Devices (DI)					
HasComponent	Variable	Data	ByteString	BaseDataVariableType	Mandatory
HasComponent	Variable	LoggingStatus	String	BaseDataVariableType	Mandatory
HasComponent	Variable	DataExistsStatus	String	BaseDataVariableType	Mandatory
HasComponent	Variable	ErrorStatus	String	BaseDataVariableType	Mandatory

ObjectType Description

- Variable Data

  This is the node to which the data will be output. When this node is read, the client can acquire data recorded by the MotionLog function.

  For the details of data format, refer to the following.

  Data Formatting

  If there is no data held inside the controller, Null is returned when the node is read.

- Variable LoggingStatus

  Indicates the status of data recording by the MotionLog function. The values are described in the following table.

Value	Description
Stop	Data recording by the MotionLog function is stopped.
Run	Data recording by the MotionLog function is running.

- Variable DataExistsStatus

  Indicates whether data can be acquired from the Data node. The data acquisition timing can be determined from this value. The values are described in the following table.

Value	Description
Empty	Indicates that there is no data that can be acquired from the Data node
Ready	Indicates that there is data that can be acquired from the Data node

- Variable ErrorStatus

  Indicates the occurrence of errors and warnings during data acquisition. From this value, you can determine how to handle the data. The values are described in the following table.

Value	Description
None	Indicates that there is no abnormality
Warning	Indicates that data overwriting has occurred
Error	Indicates that something has interrupted data recording by the MotionLog function.

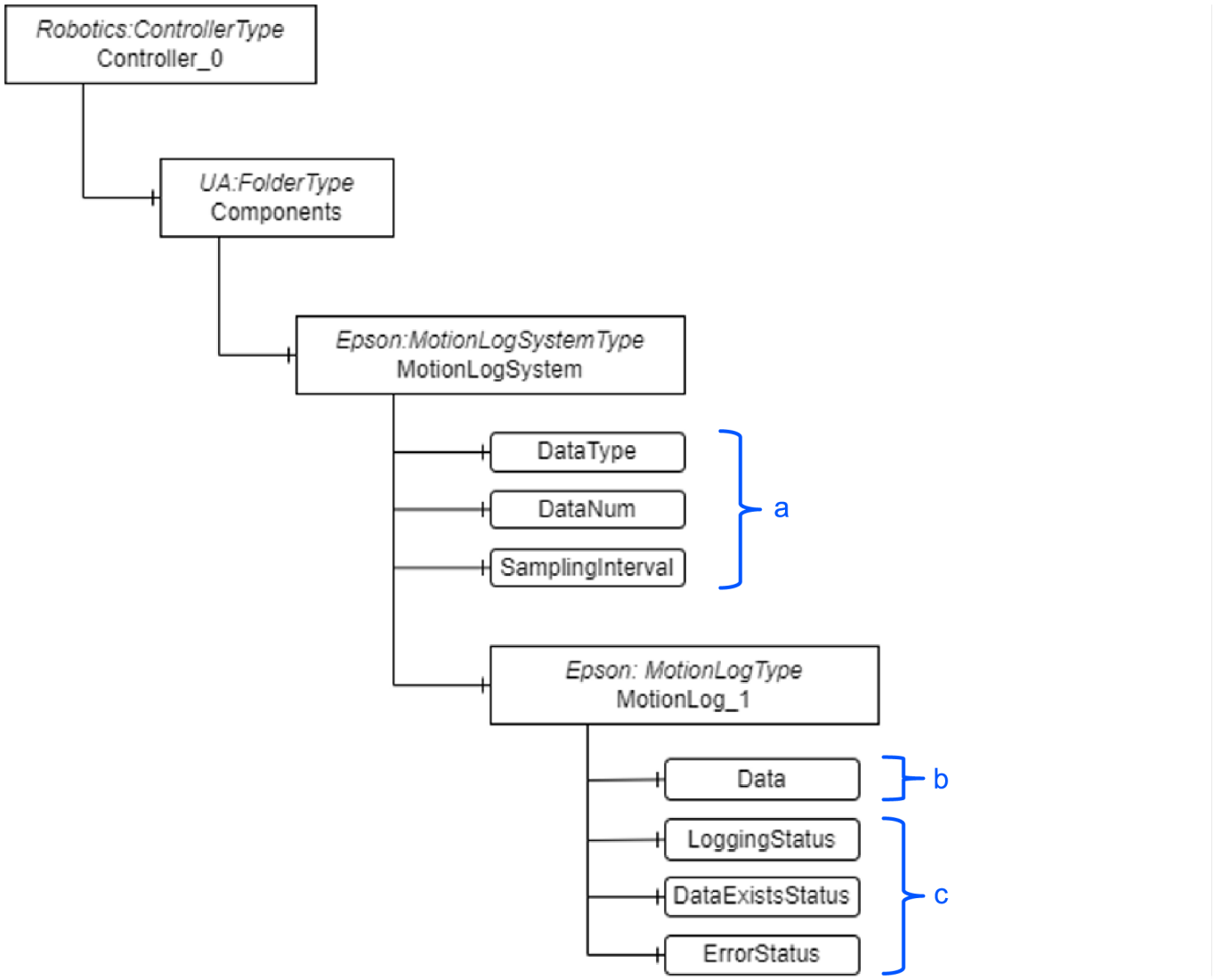
KEY POINTS

When the ErrorStatus is “Error,” there is no guarantee that normal data can be read, so it is recommended that the OPC UA client stop data acquisition.

When the ErrorStatus is “Warning,” it means that the acquired data is not contiguous. There is no problem with continuing to read data.

Example of address space

Indicates a series of instances of the Robot MotionLog data acquisition function’s address space.



Symbol	Description
a	Configuration node
b	Data acquisition node
c	Status indicator nodes

4.2.3.5 Specifications of the RobotNumber Node

RobotNumber

- Overview

  The RobotNumber node indicates robot numbers used by the Controller.

  This node is supported by firmware version 8.0.0.xx and later.

4.2.3.6 Specifications of the RobotStatus Node

RobotStatus

- Overview

The RobotStatus node indicates the status of the robot.

This node is supported by firmware version 8.0.0.xx and later.

Object Definition

RobotStatus is defined below.

Attribute	Value
BrowseName	RobotStatus
IsAbstract	False

References	Node Class	BrowseName	DataType	TypeDefinition	Modelling Rule
Subtype of the ComponentType defined in OPC Unified Architecture for Devices (DI)					
HasComponent	Variable	Power	Boolean	BaseDataVariableType	Mandatory
HasComponent	Variable	Home	Boolean	BaseDataVariableType	Mandatory
HasComponent	Variable	IntegrationMotorOnTime	DurationString	BaseDataVariableType	Mandatory
HasComponent	Variable	MotorOnCount	UInt32	BaseDataVariableType	Mandatory

Object Description

- Variable Power

  Indicates whether the robot is on high or low power. The values are described in the following table.

Value	Description
True	Power HIGH
False	Power LOW

- Variable Home

  Indicates whether the robot is presently in the Home position. The values are described in the following table.

Value	Description
True	The present position is Home.
False	The present position is not Home, or the Home position is not specified.

- Variable IntegrationMotorOnTime

  Indicates the manipulator’s excitation time.

- Variable MotorOnCount

  Indicates the number of times the manipulator undergoes excitation.

4.2.3.7 Specifications of the ConsumableStatus Node

ConsumableStatus

- Overview

  The ConsumableStatus node indicates data on consumables for the Controller, the robot, each of the robot's axes.

  This node is supported by firmware version 8.0.0.xx and later.

  The parent nodes added by the Consumable node and the data that can be acquired on consumables are as shown below.

Parent Node	Consumable from which data can be acquired
[ControllerIdentifier]	Battery
[MotionDeviceIdentifier]	Battery
[AxisIdentifier]	Battery, Belt, Grease, Motor, Gear, BallScrewSpline

Object Definition

ConsumableStatus is defined below.

Attribute	Value
BrowseName	ConsumableStatus
IsAbstract	False

References	Node Class	BrowseName	DataType	TypeDefinition	Modelling Rule
Subtype of the FolderType defined in OPC Unified Architecture					
HasComponent	Variable	[PartsIdentifier]		BaseObjectType	MandatoryPlaceholder

Object Description

- Object [PartsIdentifer]

  [PartsIdentifier] indicates that it has information on one or more consumable.

PartsIdentifier

- Overview

  PartsIdentifier displays consumables information generated by the ConsumableStatus object (see Section 3.2.3.6). One of these objects will be generated for each consumable.

Object Definition

PartsIdentifier is defined below.

Attribute	Value
BrowseName	[PartsIdentifier]
IsAbstract	False

References	Node Class	BrowseName	DataType	TypeDefinition	Modelling Rule
Subtype of the ComponentType defined in OPC Unified Architecture for Devices (DI)					
HasComponent	Variable	Available	Boolean	BaseDataVariableType	Mandatory

References	Node Class	BrowseName	DataType	TypeDefinition	Modelling Rule
HasComponent	Variable	InstallationDate	DateTime	BaseDataVariableType	Mandatory
HasComponent	Variable	MonthRemaining	Double	BaseDataVariableType	Mandatory
HasComponent	Variable	ConsumptionRate	Double	BaseDataVariableType	Mandatory

Object Description

- Variable Available

  Indicates whether the parts' consumables are being managed. The values are described in the following table.

Value	Description
True	Consumables management is enabled.
False	Consumables management is disabled, or there are no parts.

- Variable InstallationDate

  Indicates the dates on which consumables were replaced. If "Available" is False, a null character goes here.

- Variable MonthRemaining

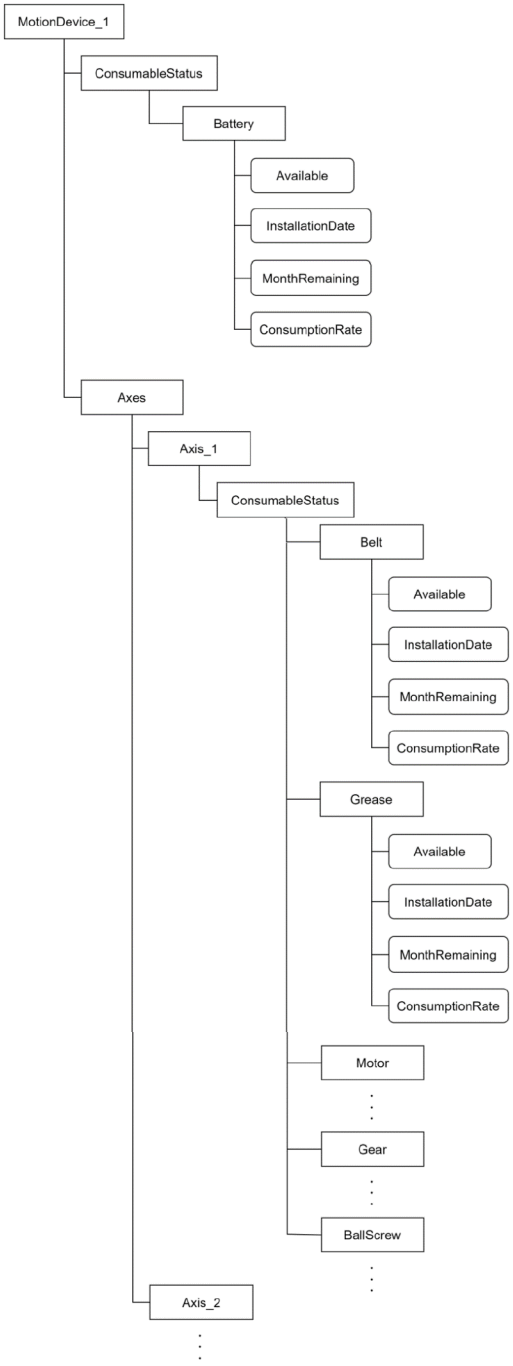
  Indicates the number of months remaining until the recommended time for replacing consumables. If "Available" is False, this is -1.

- Variable ConsumuptionRate

  Indicates the rate at which consumables are being consumed. If "Available" is False, this is -1.

Example of address space

An example of an Address Space is shown below. When the parent nodes are [MotionDeviceIdentifier], [AxisIdentifier], and [ControllerIdentifier], it will look like this.



4.2.3.8 Specifications of the AdditionalInfo Node

AdditionalInfo

- Overview

  The AdditionalInfo node indicates additional information about the robot.

  This node is supported by firmware version 8.0.0.xx and later.

Object Definition

AdditionalInfo is defined below.

Attribute	Value
BrowseName	AdditionalInfo
IsAbstract	False

References	Node Class	BrowseName	DataType	TypeDefinition	Modelling Rule
Subtype of the ComponentType defined in OPC Unified Architecture for Devices (DI)					
HasComponent	Variable	CurPos	String	BaseDataVariableType	Mandatory
HasComponent	Variable	RealPos	String	BaseDataVariableType	Mandatory

Object Description

- Variable CurPos

  Indicates the position of the robot’s current movement destination. The format of the coordinates is described below.

  {"X":0.0, "Y":0.0, "Z":0.0, "U":0.0, "V":0.0, "W":0.0}

- Variable RealPos

  Indicates the robot’s current position. The format of the coordinates is described below.

  {"X":0.0, "Y":0.0, "Z":0.0, "U":0.0, "V":0.0, "W":0.0}

4.2.3.9 Specifications of the AdditionalInfo Node

AdditionalInfo

- Overview

  This AdditionalInfo node shows additional information about the axes. This node has the same name as the AdditionalInfo node in Section 3.2.3.8, but the configuration of its child nodes is different.

  This node is supported by firmware version 8.0.0.xx and later.

Object Definition

AdditionalInfo is defined below.

Attribute	Value
BrowseName	AdditionalInfo
IsAbstract	False

References	Node Class	BrowseName	DataType	TypeDefinition	Modelling Rule
Subtype of the ComponentType defined in OPC Unified Architecture for Devices (DI)					
HasComponent	Variable	Torque	Double	BaseDataVariableType	Mandatory
HasComponent	Variable	Hofs	Double	BaseDataVariableType	Mandatory

Object Description

- Variable Torque

  Indicates the torque on the axis.

- Variable Hofs

  Indicates the Hofs information of the axis.

4.2.3.10 Specifications of the ControllerStatus Node

ControllerStatus

- Overview

  ControllerStatus is a node that indicates the status of the Controller.

  This node is supported by firmware version 8.0.0.xx and later.

Object Definition

ControllerStatus is defined below.

Attribute	Value
BrowseName	ControllerStatus
IsAbstract	False

References	Node Class	BrowseName	DataType	TypeDefinition	Modelling Rule
Subtype of the ComponentType defined in OPC Unified Architecture					
HasComponent	Variable	[StatusIdentifier]	Boolean	BaseDataVariableType	MandatoryPlaceholder
HasComponent	Variable	StatusCode	UInt16	BaseDataVariableType	Mandatory
HasComponent	Variable	CPULoad	Double	BaseDataVariableType	Mandatory

Object Description

- Variable [StatusIdentifier]

  Indicates the status of the Controller. One node shows one status, and whether that status is On or Off. The values are described in the following table.

Value	Description
True	Indicates that the Controller presently has this status.
False	Indicates that the Controller presently does not have this status.

- Variable StatusCode

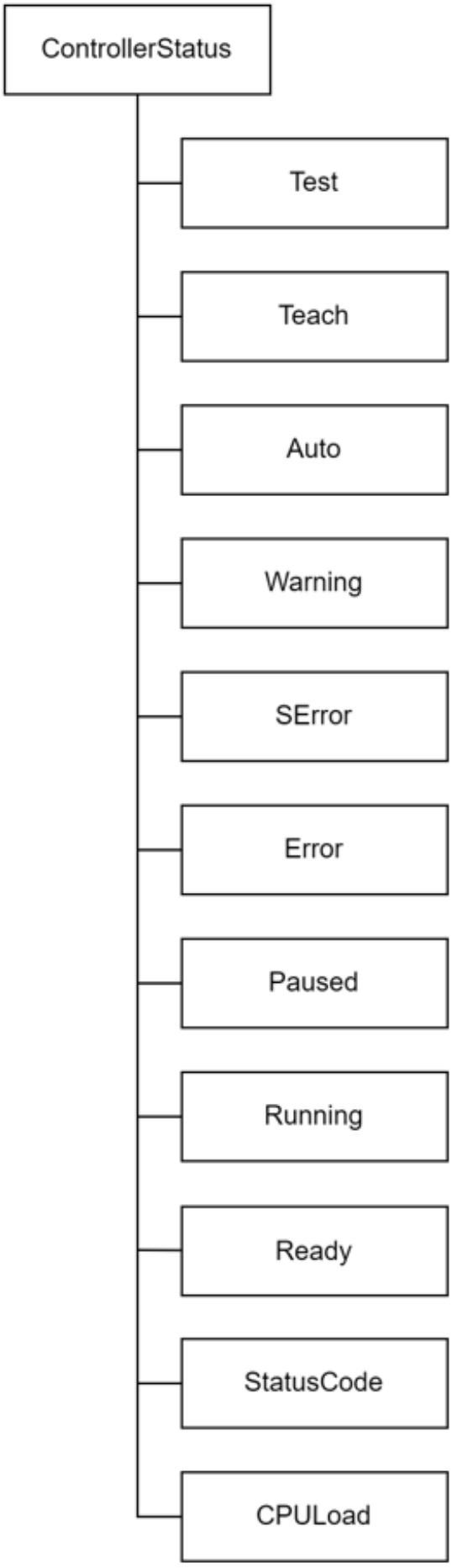
  Indicates the Controller’s status code, warning numbers, and error numbers.

- Variable CPULoad

  Indicates the load on the Controller’s CPU.

Example of address space

An example of an Address Space is shown below.


ControllerStatus
Test
Teach
Auto
Warning
SError
Error
Paused
Running
Ready
StatusCode
CPULoad

4.3 Activate / Deactivate OPC UA Server

4.3.1 Activating OPC UA Server

There are two ways to activate the server.

- Activate automatically: Server turns ON automatically when the Controller is turned ON.
- Activate manually: Server turns ON by an operation of OPC UA Configurator.

> **KEY POINTS**
>
> It takes several minutes to activate the OPC UA Server. If you turn ON automatically activate, it will take longer to turn ON the Controller.

4.3.2 Deactivating OPC UA Server

To deactivate the server, stop it manually by operating OPC UA Configurator.

4.4 Connecting to OPC UA Server

4.4.1 Overview

This section describes example of connecting to OPC UA Server installed in Robot Controller from OPC UA Client. UaExpert (from Unified Automation https://www.unified-automation.com/) is used for OPC UA Client in the described example.

4.4.2 Preparations

Before starting the following tasks, activate the OPC UA Server by following the procedure below.

OPC UA Configurator

4.4.2.1 Setting for Server

1. Configure the Server in OPC UA Configurator. For detailed information, see the table below.

   Basic Setting for Server

   In this example, the setting are as follows.

Items	Set values
Port	4840
Server Setup Mode	AUTO
Security Policy	Basic256Sha256
User Token Policy	Username/Password

2. Set up the user in OPC UA Configurator For details, refer to the following.

   Managing Users

In this example, the setting are as follows.

Items	Set values
Username	test0001
Password	********

4.4.2.2 Setting for Server Certificate

1. Prepare the Server Setting. In this example, we will use the server certificate created below using the OPC UA Configurator.

   Creating Self Signed Certificate

2. Set the using type of the Server Certificate in OPC UA Configurator. For details, refer to the following.

   Setup using type of Server Certificate

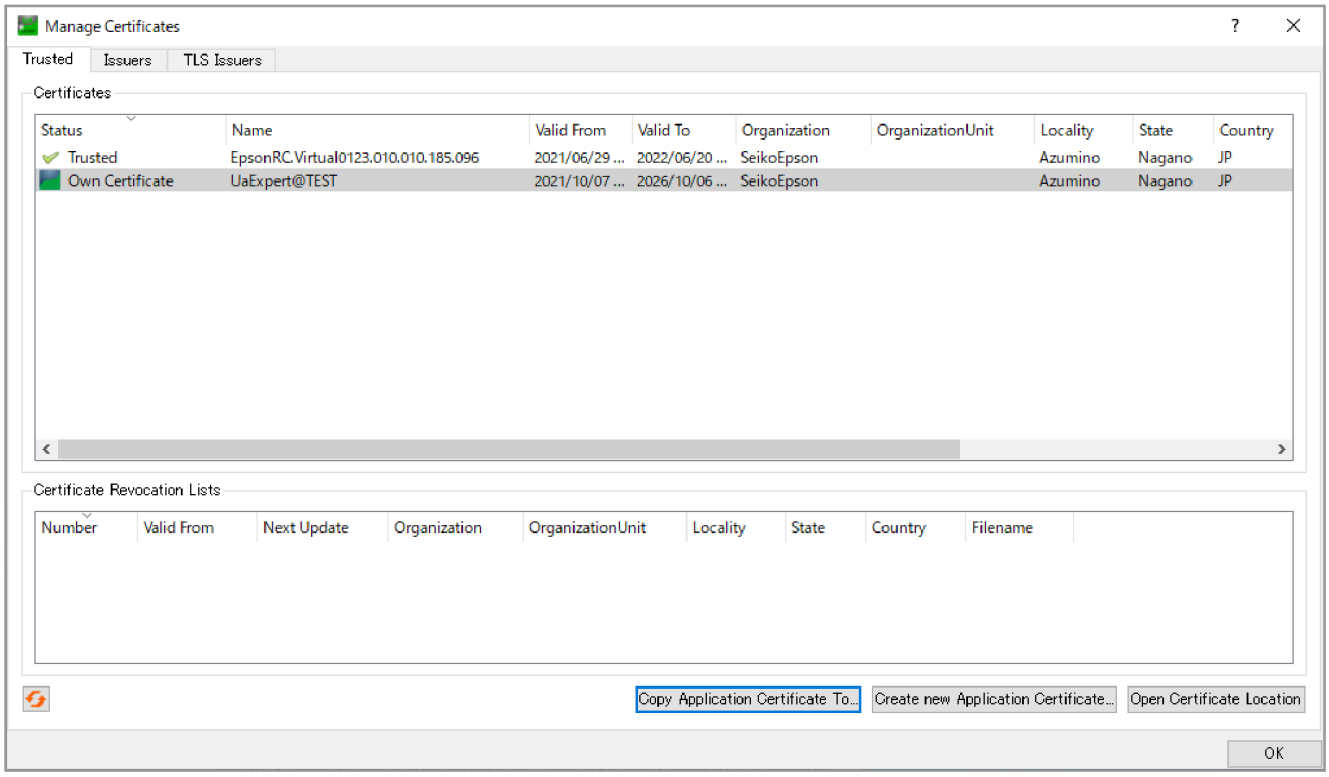
   In this example, the setting are as follows.

Item	Set value
Select Type	1: Self signed

3. Register the Server Certificate in UaExpert.

   Click [UaExpert] - [Setting] - [Manage Certificates…] - Open Certificate Location.

   Copy the Server Certificate you created to the opened folder. Check for the Server is added to the Certificates list, and [Status] states “Trusted”.



4.4.2.3 Setting for Client Certificate

1. Start creating Application Certificate of UaExpert.

   Open [UaExpert] - [Setting] - [Manage Certificates…] and click [Create New Application Certificate] button. Fill in the blanks and click [OK] button.

2. Acquire the Application Certificate of UaExpert.

   Click [Copy Application Certificate To..] and save the Certificate where you want to.

3. Import the Client Certificate in OPC UA Configurator, add the Certificate saved in step (2) to “Trusted” list. For details, refer to the following.

   Importing Client Certificate

4.4.3 Procedures of connecting to OPC UA Server

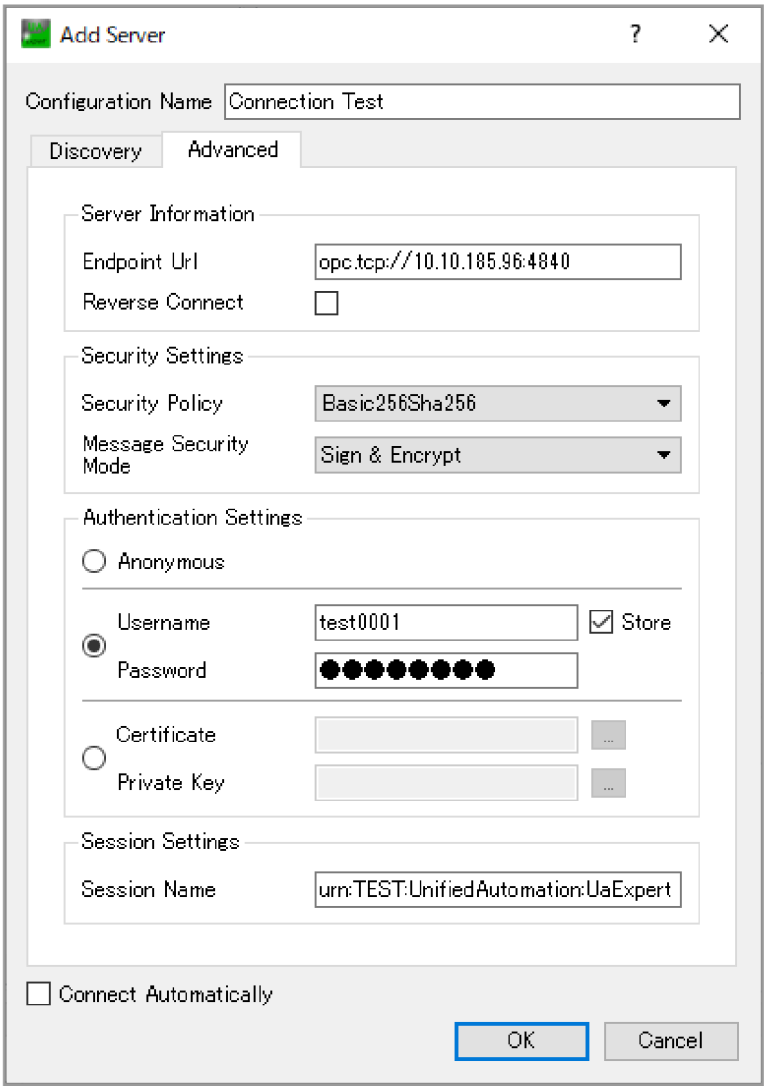
4.4.3.1 Adding Server

Registering the OPC UA Server in UaExpert.

Open [UaExpert] - [Server] - [Add].

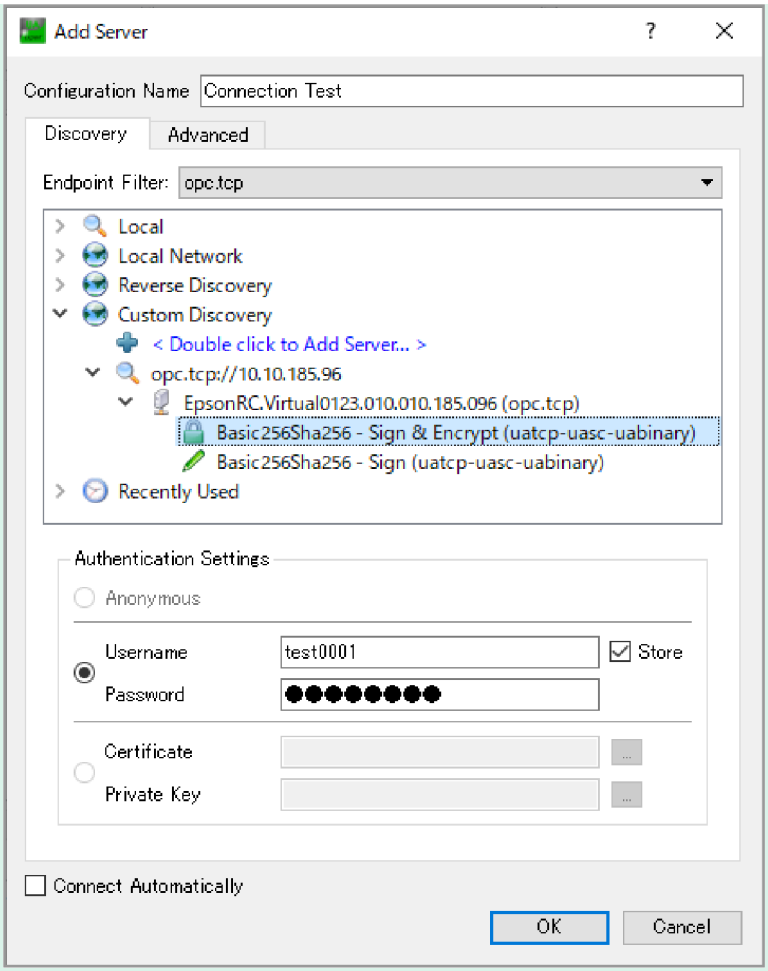
Enter like following in the [Advanced] panel and click [OK] button. The value entered here should be the value set below.

Setting for Server



KEY POINTS

It is possible to select OPC UA Server to connect from [Discovery] panel instead of (1).

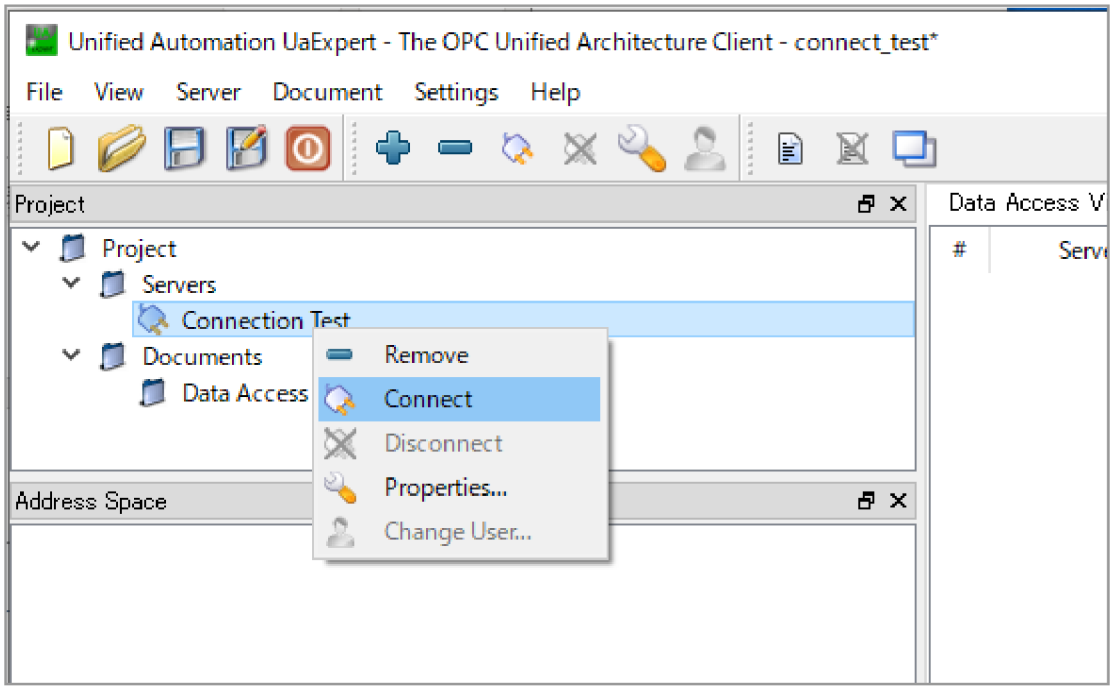


4.4.3.2 Connecting to Server

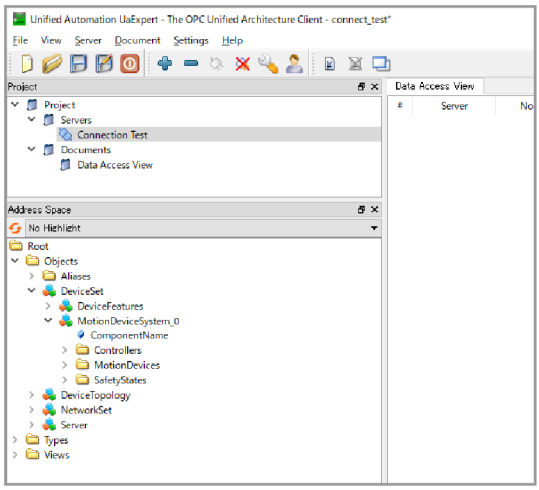
1. Select the Server added in following section from [UaExpert] – [Project] window – [Servers].

   Adding Server

   Right-click and select “Connect”.



2. If UaExpert succeeds in connecting to the OPC UA Server, node is displayed in Address Space window like following below.



5. How to Use Epson Original Nodes

5.1 Acquisition of Force Sensor Data

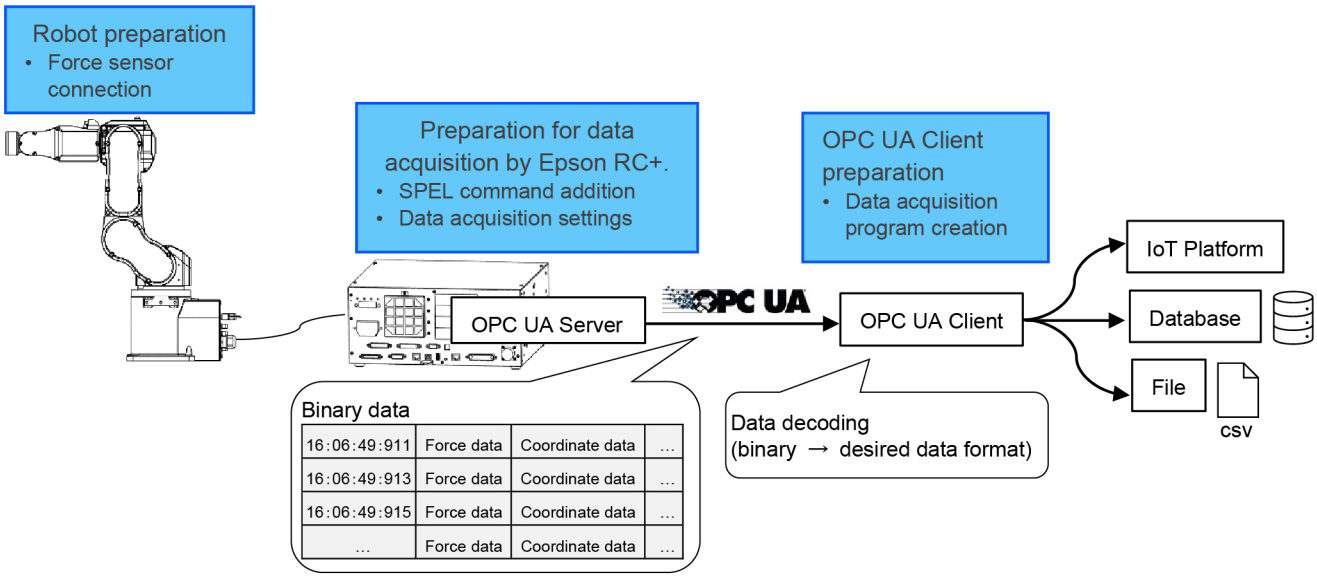
5.1.1 Overview

If you use the node of the force sensor, you can acquire the force sensor data from OPC UA Client. The data you can acquire is the same with the one you can acquire when you connecting to Epson RC+.

Below is an example of a system configuration.

KEY POINTS

Data is output to either Epson RC+ or OPC UA.



To use this function, prepare the three items below after completing the OPC UA Server configuration. For details, refer to the following.

Usage

- Robot preparation: Prepare a manipulator to which a force sensor can be connected and connect it to the force sensor.
- Creation of data acquisition program by Epson RC+: Add the “RecordStart” command to the SPEL program for using.
- Preparation of OPC UA Client: Create an OPC UA Client program to acquire data from the OPC UA Server. Convert acquired data to fit your system.

5.1.2 Usage

Prepare the Robot and OPC UA Client software as explained below.

5.1.2.1 Robot Preparation

Connect the force sensor to the Robot by referring to the following manual:

"Epson RC+ Option Force Guide 8.0"

5.1.2.2 Creation of Data Acquisition Program by Epson RC+

To start force sensor data acquisition, use the “RecordStart” property of the FM object in the SPEL program. This method is the same as when outputting data by the Epson RC+. For detailed control and setting information, see the following manual:

- "Epson RC+ Optional Force Guide 8.0"
- "SPEL+ Language Reference"

If you already have a program that uses RecordStart, you can use it as is.*

*: One concurrent execution of RecordStart is recommended. If two RecordStart cases are executed simultaneously, the data and status of the second case will be output to a node under ForceSensorMonitor_2.

Acquiring force sensor data ends when the task ends or the measurement time is reached. Or you can end it whenever you want by executing “RecordEnd” property.

Force sensor data acquisition settings (selection of sensors to acquire data, configuration of coordinate system, etc.) are made with the properties of the FM object, an existing Epson RC+ object. For more information on FM object settings, see the following manual:

"Epson RC+ Option Force Guide 8.0"

After creating a program, see the following manual and perform a build:

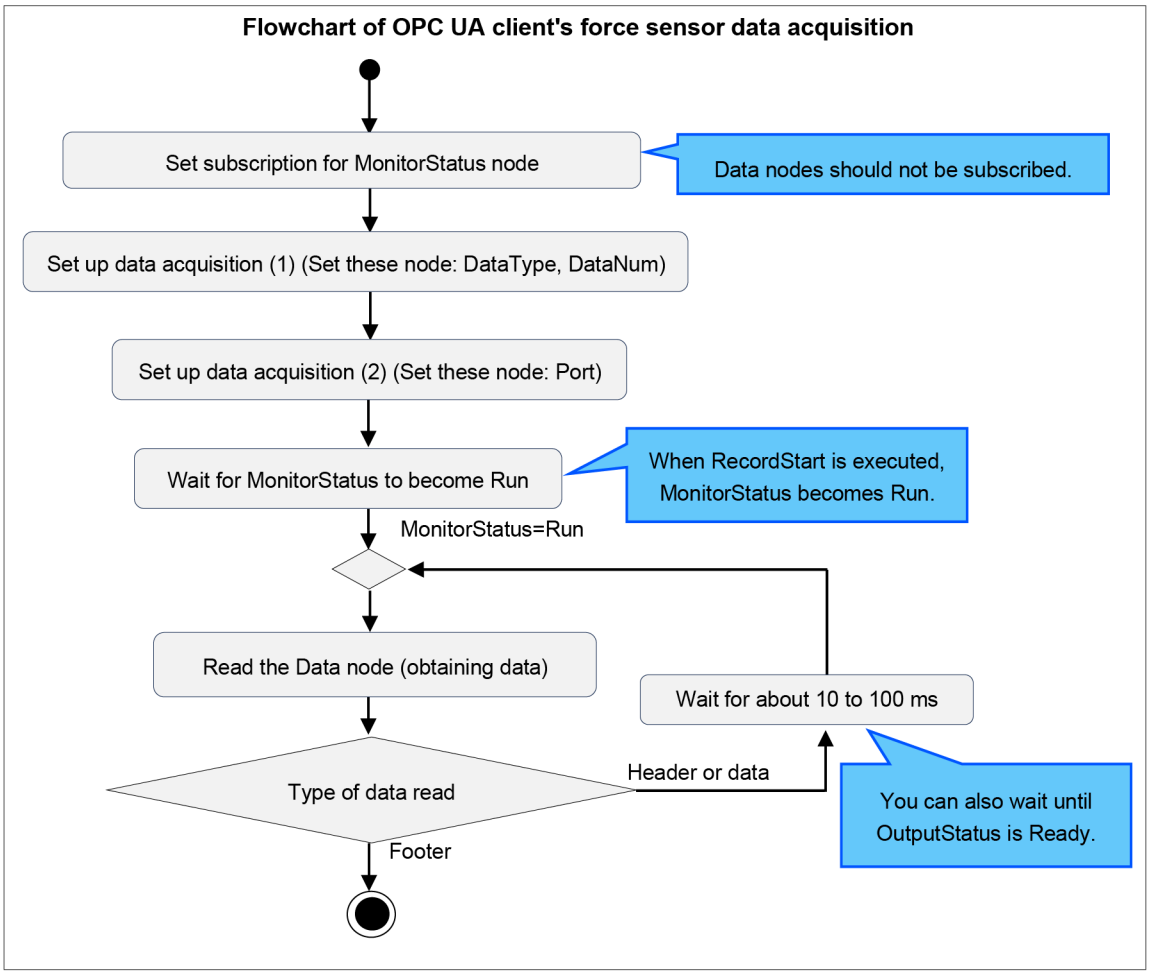
"Epson RC+ 8.0 User's Guide"

5.1.2.3 Creation of OPC UA Client Program

Overview

Prerequisite: It is assumed that an OPC UA Client library (such as node-opcua library of Node.js, and opcua-asyncio library of python) will be used.

Creates an OPC UA Client program to acquire and utilize force sensor data with OPC UA. The data acquisition flowchart of the OPC UA client for acquiring the data for one RecordStart is shown below.



Selecting the data type

Set the DataType node to a value of 0 to 3 depending on the type of data you want to acquire. For the differences in the data that can be acquired, refer to the following.

Data Formatting

Setting the maximum number of data items

The maximum number of data items to be acquired from the OPC UA Server at one time can be set in the DataNum node.

Do the above settings before setting up the Port node.

Selecting the data output destination

You can select either Epson RC+ or OPC UA as the output destination for data obtained by executing RecordStart. To output to OPC UA, set the Port node to True. Set the Port node before executing RecordStart.

> ⚠ CAUTION
>
> Data can be output to either Epson RC+ or OPC UA, but not to both. Data cannot be acquired for both Epson RC+ and OPC UA simultaneously.

Start time of Data node reading

Execute Start Data node reading according to the status of the MonitoringStatus node as a judgement condition. MonitoringStatus nodes can also be registered for subscriptions. While the MonitoringStatus node value is Stop, standby as reading is not performed.

Alternatively, DataExistsStatus can be also used as a condition for deciding.

Data node reading

By referencing the data node, you can read the data described in the following chapters.

Data Formatting

Read the header first. Read the multiple data parts next, and finally the footer to complete the process. Decode data as needed. Execute or end reading according to the value of the OPCUACommonTag.

> ⚠ CAUTION
>
> - After executing RecordStart, continue to acquire data with OPC UA Client at intervals of several 10 to several 100 ms. If the reading interval of data node is too long, data may be missing. In that case, the ErrorStatus node will become Warning. If Warning occurs, check the time stamp and process the data appropriately.
> - If you want to reduce the amount of missing data mentioned above, speed up the data acquisition cycle, change the data type using the DataType node, or increase the measurement interval specified in RecordStart.
> - To ensure that the data is read, the Data node should not be registered for subscriptions.

End condition for Data node reading

End Data node reading when the read data's OPCUACommonTag is 4.

OPCUACommonTag=4 indicates that the footer was read.

> KEY POINTS
>
> To repeat RecordStart, repeat the above data acquisition flow.

Written in pseudo code, a program for acquiring data corresponding to one RecordStart is shown below. Create your program according to the usage of the OPC UA client library you use.

```
#### Collect the force sensor data from OPC UA Server of Epson Robot Controller.
#### * This is pseudo code.

#### Create OPC UA Client
client = create_opcua_client()                  # Create OPC UA Client Instance
client.connect('opc.tcp://192.168.0.1:4840')    # Connect to OPC UA Server

#### Get node object
node_DataType           = client.getNode('ns=1;i=196611')   # DataType Node
node_DataNum            = client.getNode('ns=1;i=196612')   # DataNum Node
node_Port               = client.getNode('ns=1;i=196609')   # Port Node
node_DataExistsStatus   = client.getNode('ns=1;i=196867')   # DataExistsStatus Node
node_MonitorStatus      = client.getNode('ns=1;i=196866')   # MonitorStatus Node
node_Data               = client.getNode('ns=1;i=196865')   # Data Node

#### Setup necessary settings
node_DataType.setValue(0)       # set DataType
```

```
node_DataNum.setValue(1000)     # set DataNum
node_Port.setValue(True)        # set Port

#### Start data collection
while node_MonitorStatus.getValue() is not 'Run':   # wait to RecordStart
    sleep(0.1)                                      # wait 100ms

while True:                                                 # loop for collect data
    while node_DataExistsStatus.getValue() is not 'Ready':  # wait to data Exists
        sleep(0.1)                                          # wait 100ms

   binary_data = node_Data.getValue()      # read force sensor data
    decoded_data = decode(binary_data)      # decode binary data to readable format
    writefile(decoded_data)                 # write data to file

    if binary_data[0] == 0x4:               # if Footer received,
        break                               # then end loop
```

5.1.3 Data Formatting

This section describes the format of data that can be read from a Data node.

The content of table below will be added to the header, data part, and footer. For a details of other data, see the RecordStart property in the following manual:

- "Epson RC+ Option Force Guide"
- "SPEL+ Language Reference"

Data name	Description
OPC UA CommonTag	Used to identify headers, data parts, and footers. The meaning of each value is as follows: Value: Meaning 1: Header 2: Data part 4: Footer
OPCUACommonVer	Data format version 1: Controller firmware version prior to 8.0.0.xx 2: Controller firmware version 8.0.0.xx or later
OPCUACommonID	Incremented each time RecordStart is started. By looking at this ID, you can check the correspondence between the header, data part, and footer.
OPCUACommonRsv	Reserved
OPCUADataType	Value for data part. Value of DataType is entered.
OPCUADataRsv	Reserved

Content of header

The content of the header varies depending on your Controller firmware version. Controller firmware versions and the data they are able to acquire are displayed on the chart below.

Controller firmware version prior to 8.0.0.xx

Data category	Data item	Overview	Type	Size of 1 unit	Quantity	Total bytes	Index
OPC UA	OPCUACommonTag	OPC UA, common header, tag	BYTE	1	1	1	0
	OPCUACommonVer	OPC UA, common header, version	BYTE	1	1	1	1
	OPCUACommonID	OPC UA, common header, dataID	ushort	2	1	2	2
	OPCUACommonRsv	OPC UA, common header, reserve	BYTE	1	2	2	4
Common	PacketVersion	Packet version	BYTE	1	1	1	6
Common	PacketType	Packet type (not used)	BYTE	1	1	1	7
Channel	Channel	Data output channel	BYTE	1	1	1	8
Mode	Mode	Recording mode (not used)	BYTE	1	1	1	9
Start Time	Year	Year	short	2	1	2	10
	Month	Month	BYTE	1	1	1	12
	Day	Day	BYTE	1	1	1	13
	Hour	Hour	BYTE	1	1	1	14
	Minutes	Minute	BYTE	1	1	1	15
	Second	Second	BYTE	1	1	1	16
	MilliSecond	Millisecond	short	2	1	2	17
Duration	Duration	Measurement duration	float	4	1	4	19
Interval	Interval	Measurement interval	float	4	1	4	23
Robot No	RobotNo	Robot number	short	2	1	2	27
Robot Name	RobotNameLength	Characters in Robot name	BYTE	1	1	1	29
	RobotName	Robot name	BYTE	1	32	32	30
Sensor No	SensorNo	Sensor number	BYTE	1	1	1	62
Sensor Serial	SensorSerialLength	Number of characters in sensor serial	BYTE	1	1	1	63
	SensorSerial	Force sensor serial number	BYTE	1	10	10	64
Sensor Label	SensorLabelLength	Number of characters in sensor label	BYTE	1	1	1	74
	SensorLabel	Force sensor label	BYTE	1	32	32	75
FM No	FMNo	Force monitor object number	short	2	1	2	107
FM Label	FMLabelLength	Number of characters in FM label	BYTE	1	1	1	109
	FMLabel	Force monitor object label	BYTE	1	32	32	110

Data category	Data item	Overview	Type	Size of 1 unit	Quantity	Total bytes	Index
FCS No	FCSNo	Force coordinate system object number	short	2	1	2	142
FCS Label	FCSLabelLength	Number of characters in FCS label	BYTE	1	1	1	144
	FCSLabel	Force coordinate system object label	BYTE	1	32	32	145
Output FileName	FileNameLength	Number of characters in file name	BYTE	1	1	1	177
	FileName	File name specified by RecordStart	BYTE	1	64	64	178
Seq No	SeqNo	Sequence number	BYTE	1	1	1	242
Seq Name	SeqNameLength	Number of characters in sequence name	BYTE	1	1	1	243
	SeqName	Sequence name	BYTE	1	32	32	244
Force Name	ForceNameLength	Number of characters in force name	BYTE	1	1	1	276
	ForceName	Force file name	BYTE	1	32	32	277
RobotLocal	RobotLocal	Force monitor object RobotLocal	BYTE	1	1	1	309
Total						310	310

Controller firmware version 8.0.0.xx or later

Data category	Data item	Overview	Type	Size of 1 unit	Quantity	Total bytes	Index
OPC UA	OPCUACommonTag	OPC UA, common header, tag	BYTE	1	1	1	0
	OPCUACommonVer	OPC UA, common header, version	BYTE	1	1	1	1
	OPCUACommonID	OPC UA, common header, dataID	ushort	2	1	2	2
	OPCUACommonRsv	OPC UA, common header, reserve	BYTE	1	2	2	4
Common	PacketVersion	Packet version	BYTE	1	1	1	6
Common	PacketType	Packet type (not used)	BYTE	1	1	1	7
Channel	Channel	Data output channel	BYTE	1	1	1	8
Mode	Mode	Recording mode (not used)	BYTE	1	1	1	9

Data category	Data item	Overview	Type	Size of 1 unit	Quantity	Total bytes	Index
Start Time	Year	Year	short	2	1	2	10
	Month	Month	BYTE	1	1	1	12
	Day	Day	BYTE	1	1	1	13
	Hour	Hour	BYTE	1	1	1	14
	Minutes	Minute	BYTE	1	1	1	15
	Second	Second	BYTE	1	1	1	16
	MilliSecond	Millisecond	short	2	1	2	17
Duration	Duration	Measurement duration	float	4	1	4	19
Interval	Interval	Measurement interval	float	4	1	4	23
Robot No	RobotNo	Robot number	short	2	1	2	27
Robot Name	RobotNameLength	Characters in Robot name	BYTE	1	1	1	29
	RobotName	Robot name	BYTE	1	32	32	30
Sensor No	SensorNo	Sensor number	BYTE	1	1	1	62
Sensor Serial	SensorSerialLength	Number of characters in sensor serial	BYTE	1	1	1	63
	SensorSerial	Force sensor serial number	BYTE	1	10	10	64
Sensor Label	SensorLabelLength	Number of characters in sensor label	BYTE	1	1	1	74
	SensorLabel	Force sensor label	BYTE	1	32	32	75
FM No	FMNo	Force monitor object number	short	2	1	2	107
FM Label	FMLabelLength	Number of characters in FM label	BYTE	1	1	1	109
	FMLabel	Force monitor object label	BYTE	1	32	32	110
FCS No	FCSNo	Force coordinate system object number	short	2	1	2	142
FCS Label	FCSLabelLength	Number of characters in FCS label	BYTE	1	1	1	144
	FCSLabel	Force coordinate system object label	BYTE	1	32	32	145
Output FileName	FileNameLength	Number of characters in file name	BYTE	1	1	1	177
	FileName	File name specified by RecordStart	BYTE	1	64	64	178
Seq No	SeqNo	Sequence number	BYTE	1	1	1	242

Data category	Data item	Overview	Type	Size of 1 unit	Quantity	Total bytes	Index
Seq Name	SeqNameLength	Number of characters in sequence name	BYTE	1	1	1	243
	SeqName	Sequence name	BYTE	1	32	32	244
Force Name	ForceNameLength	Number of characters in force name	BYTE	1	1	1	276
	ForceName	Force file name	BYTE	1	2	32	277
RobotLocal	RobotLocal	Force monitor object RobotLocal	BYTE	1	1	1	309
RecordStartTime	RecordStartTime	TimeStamp at the time of RecordStart.	UInt64	8	1	8	310
		For synchronizing with MotionLogSystemType data.					
Total						318	318

Content of data part

The content of the data part depends on the DataType setting. The tables below show DataType values and their correspondence to data content that can be acquired.

If DataType=0

Data to be acquired	Data category	Data item	Overview	Type	Size of 1 unit	Quantity	Total bytes	Index
✓	OPC UA	OPCUACommonTag	OPC UA, common header, tag	BYTE	1	1	1	0
		OPCUACommonVer	OPC UA, common header, version	BYTE	1	1	1	1
		OPCUACommonID	OPC UA, common header, dataID	ushort	2	1	2	2
		OPCUACommonRsv	OPC UA, common header, reserve	BYTE	1	2	2	4
		OPCUADataType	OPC UA, data header, data type	ushort	2	1	2	6
		OPCUADataRsv	OPC UA, data header, reserve	BYTE	1	2	2	8
✓	Common	PacketVersion	Packet version	BYTE	1	1	1	10
✓	Common	PacketType	Packet type (not used)	BYTE	1	1	1	11

Data to be acquired	Data category	Data item	Overview	Type	Size of 1 unit	Quantity	Total bytes	Index
✓	Channel	Channel	Data output channel	BYTE	1	1	1	12
✓	Mode	Mode	Recording mode (not used)	BYTE	1	1	1	13
✓	Count	Count	Data serial number	DWORD	4	1	4	14
✓	ElapsedTime	ElapsedTime	Elapsed time from start of measurement	DWORD	4	1	4	18
✓	Force	Fx	Sensor value, resultant force, and resultant torque for each axis in force coordinate system	float	4	1	4	22
		Fy			4	1	4	26
		Fz			4	1	4	30
		Tx			4	1	4	34
		Ty			4	1	4	38
		Tz			4	1	4	42
		Fmag			4	1	4	46
		Tmag			4	1	4	50
✓	CurPos	CurPos(X)	Command position, including Robot position control and force control	float	4	1	4	54
		CurPos(Y)			4	1	4	58
		CurPos(Z)			4	1	4	62
		CurPos(U)			4	1	4	66
		CurPos(V)			4	1	4	70
		CurPos(W)			4	1	4	74
✓	RefPos	RefPos(X)	Command position for Robot position control only	float	4	1	4	78
		RefPos(Y)			4	1	4	82
		RefPos(Z)			4	1	4	86
		RefPos(U)			4	1	4	90
		RefPos(V)			4	1	4	94
		RefPos(W)			4	1	4	98
✓	Diff	Diff(X)	Amount of correction by force control function	float	4	1	4	102
		Diff(Y)			4	1	4	106
		Diff(Z)			4	1	4	110

Data to be acquired	Data category	Data item	Overview	Type	Size of 1 unit	Quantity	Total bytes	Index
		TCPSpeed	Tool tip speed in base coordinate system	float	4	1	4	114
✓	TCPSpeed	TCPSpeed(X)	Components of tool tip speed in each axis direction in base coordinate system	float	4	1	4	118
		TCPSpeed(Y)			4	1	4	122
		TCPSpeed(Z)			4	1	4	126
		Joint(J1)	Angle of each joint of Robot	float	4	1	4	130
		Joint(J2)			4	1	4	134
		Joint(J3)			4	1	4	138
✓	Joint	Joint(J4)			4	1	4	142
		Joint(J5)			4	1	4	146
		Joint(J6)			4	1	4	150
		OLRate(J1)	Overload rate of each joint of Robot Overload rate ranges from 0 to 200. To match the units with the OLRate command in SPEL+, divide this value by 100.	BYTE	1	1	1	154
		OLRate(J2)			1	1	1	155
		OLRate(J3)			1	1	1	156
✓	OLRate	OLRate(J4)			1	1	1	157
		OLRate(J5)			1	1	1	158
		OLRate(J6)			1	1	1	159
✓	FCOn	FCOn	Status of force control function execution	BYTE	1	1	1	160
✓	StepID	StepID	Value set by StepID property	DWORD	4	1	4	161
		Year	Year	short	2	1	2	165
		Month	Month	BYTE	1	1	1	167
		Day	Day	BYTE	1	1	1	168
✓	Time	Hour	Hour	BYTE	1	1	1	169
		Minutes	Minute	BYTE	1	1	1	170
		Second	Second	BYTE	1	1	1	171
		MiliSecond	Millisecond	short	2	1	2	172

Data to be acquired	Data category	Data item	Overview	Type	Size of 1 unit	Quantity	Total bytes	Index
✓	Seq No	SeqNo	Sequence number When not in progress, fixed to 0	BYTE	1	1	1	174
✓	Object No	ObjectNo	Object number	BYTE	1	1	1	175
✓	FM No	FMNo	Force monitor object number	short	2	1	2	176
Total							178	178

If DataType=1

Data to be acquired	Data category	Data item	Overview	Type	Size of 1 unit	Quantity	Total bytes	Index
✓	OPC UA	OPCUACommonTag	OPC UA, common header, tag	BYTE	1	1	1	0
		OPCUACommonVer	OPC UA, common header, version	BYTE	1	1	1	1
		OPCUACommonID	OPC UA, common header, dataID	ushort	2	1	2	2
		OPCUACommonRsv	OPC UA, common header, reserve	BYTE	1	2	2	4
		OPCUADataType	OPC UA, data header, data type	ushort	2	1	2	6
		OPCUADataRsv	OPC UA, data header, reserve	BYTE	1	2	2	8
✓	Common	PacketVersion	Packet version	BYTE	1	1	1	10
✓	Common	PacketType	Packet type (not used)	BYTE	1	1	1	11
✓	Channel	Channel	Data output channel	BYTE	1	1	1	12
✓	Mode	Mode	Recording mode (not used)	BYTE	1	1	1	13
✓	Count	Count	Data serial number	DWORD	4	1	4	14
✓	ElapsedTime	ElapsedTime	Elapsed time from start of measurement	DWORD	4	1	4	18

Data to be acquired	Data category	Data item	Overview	Type	Size of 1 unit	Quantity	Total bytes	Index
	Force	Fx	Sensor value, resultant force, and resultant torque for each axis in force coordinate system	float	4	0	0	
		Fy			4	0	0	
		Fz			4	0	0	
		Tx			4	0	0	
		Ty			4	0	0	
		Tz			4	0	0	
		Fmag			4	0	0	
		Tmag			4	0	0	
✓	CurPos	CurPos(X)	Command position, including Robot position control and force control	float	4	1	4	22
		CurPos(Y)			4	1	4	26
		CurPos(Z)			4	1	4	30
		CurPos(U)			4	1	4	34
		CurPos(V)			4	1	4	38
		CurPos(W)			4	1	4	42
	RefPos	RefPos(X)	Command position for Robot position control only	float	4	0	0	
		RefPos(Y)			4	0	0	
		RefPos(Z)			4	0	0	
		RefPos(U)			4	0	0	
		RefPos(V)			4	0	0	
		RefPos(W)			4	0	0	
	Diff	Diff(X)	Amount of correction by force control function	float	4	0	0	
		Diff(Y)			4	0	0	
		Diff(Z)			4	0	0	
✓	TCPSpeed	TCPSpeed	Tool tip speed in base coordinate system	float	4	1	4	46
		TCPSpeed(X)	Components of tool tip speed in each axis direction in base coordinate system	float	4	1	4	50
		TCPSpeed(Y)			4	1	4	54
		TCPSpeed(Z)			4	1	4	58

Data to be acquired	Data category	Data item	Overview	Type	Size of 1 unit	Quantity	Total bytes	Index
✓	Joint	Joint(J1)	Angle of each joint of Robot	float	4	1	4	62
		Joint(J2)			4	1	4	66
		Joint(J3)			4	1	4	70
		Joint(J4)			4	1	4	74
		Joint(J5)			4	1	4	78
		Joint(J6)			4	1	4	82
✓	OLRate	OLRate(J1)	Overload rate of each joint of Robot Overload rate ranges from 0 to 200. To match the units with the OLRate command in SPEL+, divide this value by 100.	BYTE	1	1	1	86
		OLRate(J2)			1	1	1	87
		OLRate(J3)			1	1	1	88
		OLRate(J4)			1	1	1	89
		OLRate(J5)			1	1	1	90
		OLRate(J6)			1	1	1	91
	FCOn	FCOn	Status of force control function execution	BYTE	1	0	0	
✓	StepID	StepID	Value set by StepID property	DWORD	4	1	4	92
✓	Time	Year	Year	short	2	1	2	96
		Month	Month	BYTE	1	1	1	98
		Day	Day	BYTE	1	1	1	99
		Hour	Hour	BYTE	1	1	1	100
		Minutes	Minute	BYTE	1	1	1	101
		Second	Second	BYTE	1	1	1	102
		MilliSecond	Millisecond	short	2	1	2	103
✓	Seq No	SeqNo	Sequence number When not in progress, fixed to 0	BYTE	1	1	1	105
✓	Object No	ObjectNo	Object number	BYTE	1	1	1	106
✓	FM No	FMNo	Force monitor object number	short	2	1	2	107
Total							109	109

If DataType=2

Data to be acquired	Data category	Data item	Overview	Type	Size of 1 unit	Quantity	Total bytes	Index
✓	OPC UA	OPCUACommonTag	OPC UA, common header, tag	BYTE	1	1	1	0
		OPCUACommonVer	OPC UA, common header, version	BYTE	1	1	1	1
		OPCUACommonID	OPC UA, common header, dataID	ushort	2	1	2	2
		OPCUACommonRsv	OPC UA, common header, reserve	BYTE	1	2	2	4
		OPCUADataType	OPC UA, data header, data type	ushort	2	1	2	6
		OPCUADataRsv	OPC UA, data header, reserve	BYTE	1	2	2	8
✓	Common	PacketVersion	Packet version	BYTE	1	1	1	10
✓	Common	PacketType	Packet type (not used)	BYTE	1	1	1	11
✓	Channel	Channel	Data output channel	BYTE	1	1	1	12
✓	Mode	Mode	Recording mode (not used)	BYTE	1	1	1	13
✓	Count	Count	Data serial number	DWORD	4	1	4	14
✓	ElapsedTime	ElapsedTime	Elapsed time from start of measurement	DWORD	4	1	4	18
✓	Force	Fx	Sensor value, resultant force, and resultant torque for each axis in force coordinate system	float	4	1	4	22
		Fy			4	1	4	26
		Fz			4	1	4	30
		Tx			4	1	4	34
		Ty			4	1	4	38
		Tz			4	1	4	42
		Fmag			4	1	4	46
		Tmag			4	1	4	50

Data to be acquired	Data category	Data item	Overview	Type	Size of 1 unit	Quantity	Total bytes	Index
✓	CurPos	CurPos(X)	Command position, including Robot position control and force control	float	4	1	4	54
		CurPos(Y)			4	1	4	58
		CurPos(Z)			4	1	4	62
		CurPos(U)			4	1	4	66
		CurPos(V)			4	1	4	70
		CurPos(W)			4	1	4	74
	RefPos	RefPos(X)	Command position for Robot position control only	float	4	0	0	
		RefPos(Y)			4	0	0	
		RefPos(Z)			4	0	0	
		RefPos(U)			4	0	0	
		RefPos(V)			4	0	0	
		RefPos(W)			4	0	0	
	Diff	Diff(X)	Amount of correction by force control function	float	4	0	0	
		Diff(Y)			4	0	0	
		Diff(Z)			4	0	0	
	TCPSpeed	TCPSpeed	Tool tip speed in base coordinate system	float	4	0	0	
		TCPSpeed(X)	Components of tool tip speed in each axis direction in base coordinate system	float	4	0	0	
		TCPSpeed(Y)			4	0	0	
		TCPSpeed(Z)			4	0	0	
	Joint	Joint(J1)	Angle of each joint of Robot	float	4	0	0	
		Joint(J2)			4	0	0	
		Joint(J3)			4	0	0	
		Joint(J4)			4	0	0	
		Joint(J5)			4	0	0	
		Joint(J6)			4	0	0	
	OLRate	OLRate(J1)	Overload rate of each joint of Robot Overload rate ranges from 0 to 200. To match the units with	BYTE	1	0	0	
		OLRate(J2)			1	0	0	
		OLRate(J3)			1	0	0	
		OLRate(J4)			1	0	0	
		OLRate(J5)			1	0	0	

Data to be acquired	Data category	Data item	Overview	Type	Size of 1 unit	Quantity	Total bytes	Index
		OLRate(J6)	command in SPEL+, divide this value by 100.		1	0	0	
	FCOn	FCOn	Status of force control function execution	BYTE	1	0	0	
✓	StepID	StepID	Value set by StepID property	DWORD	4	1	4	78
	Time	Year	Year	short	2	0	0	
		Month	Month	BYTE	1	0	0	
		Day	Day	BYTE	1	0	0	
		Hour	Hour	BYTE	1	0	0	
		Minutes	Minute	BYTE	1	0	0	
		Second	Second	BYTE	1	0	0	
		MilliSecond	Millisecond	short	2	0	0	
✓	Seq No	SeqNo	Sequence number When not in progress, fixed to 0	BYTE	1	1	1	82
✓	Object No	ObjectNo	Object number	BYTE	1	1	1	83
✓	FM No	FMNo	Force monitor object number	short	2	1	2	84
Total							86	86

If DataType=3

Data to be acquired	Data category	Data item	Overview	Type	Size of 1 unit	Quantity	Total bytes	Index
✓	OPC UA	OPCUACommonTag	OPC UA, common header, tag	BYTE	1	1	1	0
		OPCUACommonVer	OPC UA, common header, version	BYTE	1	1	1	1
		OPCUACommonID	OPC UA, common header, dataID	ushort	2	1	2	2
		OPCUACommonRsv	OPC UA, common header, reserve	BYTE	1	2	2	4

Data to be acquired	Data category	Data item	Overview	Type	Size of 1 unit	Quantity	Total bytes	Index
		OPCUADataType	OPC UA, data header, data type	ushort	2	1	2	6
		OPCUADataRsv	OPC UA, data header, reserve	BYTE	1	2	2	8
✓	Common	PacketVersion	Packet version	BYTE	1	1	1	10
✓	Common	PacketType	Packet type (not used)	BYTE	1	1	1	11
✓	Channel	Channel	Data output channel	BYTE	1	1	1	12
✓	Mode	Mode	Recording mode (not used)	BYTE	1	1	1	13
✓	Count	Count	Data serial number	DWORD	4	1	4	14
✓	ElapsedTime	ElapsedTime	Elapsed time from start of measurement	DWORD	4	1	4	18
	Force	Fx	Sensor value, resultant force, and resultant torque for each axis in force coordinate system	float	4	0	0	
		Fy			4	0	0	
		Fz			4	0	0	
		Tx			4	0	0	
		Ty			4	0	0	
		Tz			4	0	0	
		Fmag			4	0	0	
		Tmag			4	0	0	
✓	CurPos	CurPos(X)	Command position, including Robot position control and force control	float	4	1	4	22
		CurPos(Y)			4	1	4	26
		CurPos(Z)			4	1	4	30
		CurPos(U)			4	1	4	34
		CurPos(V)			4	1	4	38
		CurPos(W)			4	1	4	42
	RefPos	RefPos(X)	Command position for Robot position control only	float	4	0	0	
		RefPos(Y)			4	0	0	
		RefPos(Z)			4	0	0	
		RefPos(U)			4	0	0	

Data to be acquired	Data category	Data item	Overview	Type	Size of 1 unit	Quantity	Total bytes	Index
		RefPos(V)			4	0	0	
		RefPos(W)			4	0	0	
	Diff	Diff(X)	Amount of correction by force control function	float	4	0	0	
		Diff(Y)			4	0	0	
		Diff(Z)			4	0	0	
	TCPSpeed	TCPSpeed	Tool tip speed in base coordinate system	float	4	0	0	
		TCPSpeed(X)	Components of tool tip speed in each axis direction in base coordinate system	float	4	0	0	
		TCPSpeed(Y)			4	0	0	
		TCPSpeed(Z)			4	0	0	
	Joint	Joint(J1)	Angle of each joint of Robot	float	4	0	0	
		Joint(J2)			4	0	0	
		Joint(J3)			4	0	0	
		Joint(J4)			4	0	0	
		Joint(J5)			4	0	0	
		Joint(J6)			4	0	0	
	OLRate	OLRate(J1)	Overload rate of each joint of Robot Overload rate ranges from 0 to 200. To match the units with the OLRate command in SPEL+, divide this value by 100.	BYTE	1	0	0	
		OLRate(J2)			1	0	0	
		OLRate(J3)			1	0	0	
		OLRate(J4)			1	0	0	
		OLRate(J5)			1	0	0	
		OLRate(J6)			1	0	0	
	FCOn	FCOn	Status of force control function execution	BYTE	1	0	0	
✓	StepID	StepID	Value set by StepID property	DWORD	4	1	4	46

Data to be acquired	Data category	Data item	Overview	Type	Size of 1 unit	Quantity	Total bytes	Index
	Time	Year	Year	short	2	0	0	
		Month	Month	BYTE	1	0	0	
		Day	Day	BYTE	1	0	0	
		Hour	Hour	BYTE	1	0	0	
		Minutes	Minute	BYTE	1	0	0	
		Second	Second	BYTE	1	0	0	
		MilliSecond	Millisecond	short	2	0	0	
✓	Seq No	SeqNo	Sequence number When not in progress, fixed to 0	BYTE	1	1	1	50
✓	Object No	ObjectNo	Object number	BYTE	1	1	1	51
✓	FM No	FMNo	Force monitor object number	short	2	1	2	52
Total							54	54

Content of footer

Data category	Data item	Overview	Type	Size of 1 unit	Quantity	Total bytes	Index
OPC UA	OPCUACommonTag	OPC UA, common header, tag	BYTE	1	1	1	0
	OPCUACommonVer	OPC UA, common header, version	BYTE	1	1	1	1
	OPCUACommonRsv	OPC UA, common header, dataID	ushort	2	1	2	2
	OPCUACommonRsv	OPC UA, common header, reserve	BYTE	1	2	2	4
Common	PacketVersion	Packet version	BYTE	1	1	1	6
Common	PacketType	Packet type (not used)	BYTE	1	1	1	7
Channel	Channel	Data output channel	BYTE	1	1	1	8
Mode	Mode	Recording mode (not used)	BYTE	1	1	1	9
End Time	Year	Year	short	2	1	2	10
	Month	Month	BYTE	1	1	1	12
	Day	Day	BYTE	1	1	1	13
	Hour	Hour	BYTE	1	1	1	14
	Minutes	Minute	BYTE	1	1	1	15

Data category	Data item	Overview	Type	Size of 1 unit	Quantity	Total bytes	Index
	Second	Second	BYTE	1	1	1	16
	MilliSecond	Millisecond	short	2	1	2	17
Duration	Duration	Measurement duration	float	4	1	4	19
Interval	Interval	Measurement interval	float	4	1	4	23
Robot No	RobotNo	Robot number	short	2	1	2	27
Robot Name	RobotNameLength	Characters in Robot name	BYTE	1	1	1	29
	RobotName	Robot name	BYTE	1	32	32	30
Sensor No	SensorNo	Sensor number	BYTE	1	1	1	62
Sensor Serial	SensorSerialLength	Number of characters in sensor serial	BYTE	1	1	1	63
	SensorSerial	Force sensor serial number	BYTE	1	10	10	64
Sensor Label	SensorLabelLength	Number of characters in sensor label	BYTE	1	1	1	74
	SensorLabel	Force sensor label	BYTE	1	32	32	75
FM No	FMNo	Force monitor object number	short	2	1	2	107
FM Label	FMLabelLength	Number of characters in FM label	BYTE	1	1	1	109
	FMLabel	Force monitor object label	BYTE	1	32	32	110
FCS No	FCSNo	Force coordinate system object number	short	2	1	2	142
FCS Label	FCSLabelLength	Number of characters in FCS label	BYTE	1	1	1	144
	FCSLabel	Force coordinate system object label	BYTE	1	32	32	145
End Condition	EndCondition	End condition 0: Duration elapsed 1: End executed property 2: Stop requested 4: Build executed 7: Task ended -1: Error occurred	BYTE	1	1	1	177
Error No	ErrorNo	Error number	short	2	1	2	178
Seq No	SeqNo	Sequence number	BYTE	1	1	1	180
Reserve		Reserved	BYTE	1	1	1	181
Total						182	182

5.2 Acquisition of SPEL Variable Data

5.2.1 Usage

The values of variables used in SPEL+ programs can be read by the OPC UA Client.

The specifications of SPEL variables that can be read by the OPC UA Client are shown in the table below.

Items	Specifications
Variable memory type	Only variables declared in Global Preserve (backup variables)
Variable type	Support all SPEL+ types
Array type	Not supported
Access type	Read Only
Maximum quantity	256
Variable naming rule	The prefix “OPCUA_” must be present

5.2.2 Usage

Backup variables are declared. See below for specifications.

Overview

An example of a variable definition is shown below.

```
' OPC UA output variables
Global Preserve UShort OPCUA_ItemCode
Global Preserve UInt32 OPCUA_ElectricPower
Global Preserve UInt32 OPCUA_NumOfProduced
Global Preserve UInt32 OPCUA_NumOfDefective
Global Preserve UShort OPCUA_CycleTime
Global Preserve UInt32 OPCUA_ConsumedStatus
Global Preserve UShort OPCUA_OperatingStatus
Global Preserve UInt32 OPCUA_ErrorCode
```

SPEL variable nodes appear in the address space positions below.

Objects>DeviceSet>MotionDeviceSystemIdentifier>Controllers>Components>SpelProject>BackupVariables

⚠ CAUTION

- SPEL variables whose values are to be read by OPC UA must be prefixed with “OPCUA_”.
- To apply variable definitions (including type and variable name changes, and variable additions and deletions), restart the OPC UA Server after building the project.

5.3 Acquisition of Sensor Data

5.3.1 Overview

Sensor data can be acquired by the OPC UA Client.

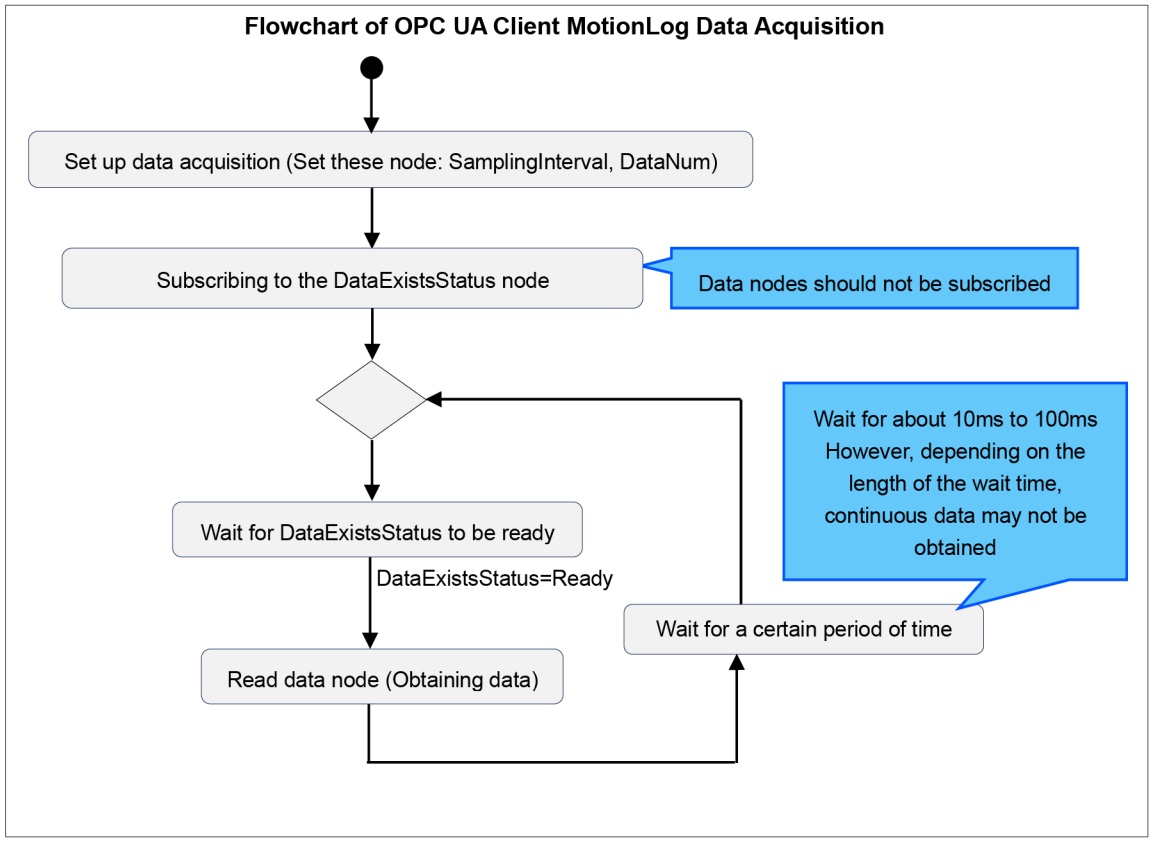
This node is supported by firmware version 8.0.0.xx and later.

5.3.2 Usage

Following explanation below to create the OPC UA Client Program.

Precondition: It is assumed that an OPC UA Client library will be used. (For example, Node.js's node-opcua library, or Python's opcua-asyncio library)

Creates an OPC UA Client program to acquire and utilize sensor data with OPC UA. A flowchart of the OPC UA client's data acquisition process is shown below.



Setting the maximum number of data items

The maximum number of data items to be acquired from the OPC UA Server at one time can be set in the DataNum node.

Data acquisition cycle settings

Set the data acquisition cycle with the OPC UA Server. This can be set on the SamplingInterval node. Be careful of things that differ from the OPC UA Client-run data acquisition cycle

> ⚠ CAUTION
>
> Depending on your DataNum and data acquisition cycle settings, it might not be possible to acquire continuous sensor data. In such cases, set DataNum to "0" and your data acquisition cycle to a larger value.

Start time of Data node reading

Make it so that the status of the DataExistsStatus node is a condition for starting the reading of the Data node. DataExistsStatus nodes can also be registered for subscriptions. While the DataExistsStatus node value is “Stop,” put the Data node on standby, as reading is not performed.

Data node reading

By referencing the data node, you can read the data described in the following chapters. Decode data as needed.

Data Formatting

> ⚠ CAUTION
>
> - Make it so that after Data node reading begins, OPC UA Client will continue to acquire data at intervals of 10 to 100 ms. If there is a long interval between readings of the Data node, data may be missing. In that case, the ErrorStatus node will become Warning. If Warning occurs, check the time stamp and process the data appropriately.
> - If you want to reduce the amount of missing data mentioned above, speed up the data acquisition cycle, set DataNum to “0” or “200,” and increase the value of the SamplingInterval.
> - To ensure that the data is read, the Data node should not be registered for subscriptions.

Response to ErrorStatus

By referring to the ErrorStatus node, you can determine whether it is possible to acquire proper data. The chart below describes the meaning of the ErrorStatus node’s values, and provides an example of how to respond to each.

ErrorStatus Node	Meaning	Response
None	Proper data can be acquired.	Continue reading the Data node.
Warning	Part of the data is missing. Read the Data node. The ErrorStatus will return to “None.”	Continue to read data, bearing in mind that data is missing from the period when the Warning status was active.
Error	Robot MotionLog data cannot be acquired by the OPC UA Server. When Robot MotionLog data can be read again, the ErrorStatus will return to “None.”	Stop reading data.

Written in pseudo code, a program for acquiring Robot MontionLog data is shown below. Create your program according to the usage of the OPC UA client library you use.

```
# Collect the MotionLog data from OPC UA Server of Epson Robot Controller.
# * This is pseudo code.

# Create OPC UA Client
client = create_opcua_client()                  # Create OPC UA Client Instance
client.connect('opc.tcp://192.168.0.1:4840')    # Connect to OPC UA Server

# Get node object
node_DataNum            = client.getNode('ns=1;i=20313')   # DataNum Node
node_SamplingInterval   = client.getNode('ns=1;i=20314')   # SamplingInterval Node
node_Data               = client.getNode('ns=1;i=20316')   # Data Node
node_LoggingStatus      = client.getNode('ns=1;i=20317')   # MonitorStatus Node
node_DataExistsStatus   = client.getNode('ns=1;i=20318')   # DataExistsStatus Node

# Setup necessary settings
```

```
node_DataNum.setValue(0)                          # set DataNum
node_SamplingInterval.setValue(0)                 # set SamplingInterval

# Start data collection
while True:                                                    # loop for collect data
    while node_DataExistsStatus.getValue() is not 'Ready':  # wait to data Exists
        sleep(0.01)                                            # wait 10ms

    binary_data = node_Data.getValue()       # read MotionLog data
    decoded_data = decode(binary_data)       # decode binary data to readable format
    writefile(decoded_data)                  # write data to file
```

5.3.3 Data Formatting

This section describes the content and format of the data that can be read from a Data node. A Data node contains multiple data chunks. Each data chunk is composed of multiple items of the data shown below.

Contents of Data Chunks

The table below shows the content of the data that can be acquired. Each large data item is described in detail below.

Data category	Large Data item	Overview	of 1 Size	Quantity	Total bytes	Index
ENC	ENC_1	Encoder (Axis 1)	24	8	192	0
	ENC_2	Encoder (Axis 2)	24	8	192	192
	ENC_3	Encoder (Axis 3)	24	8	192	384
	ENC_4	Encoder (Axis 4)	24	8	192	576
	ENC_5	Encoder (Axis 5)	24	8	192	768
	ENC_6	Encoder (Axis 6)	24	8	192	960
DRVCMD	DRVCMD_1	Current Command (Axis 1)	20	8	160	1152
	DRVCMD_2	Current Command (Axis 2)	20	8	160	1312
	DRVCMD_3	Current Command (Axis 3)	20	8	160	1472
	DRVCMD_4	Current Command (Axis 4)	20	8	160	1632
	DRVCMD_5	Current Command (Axis 5)	20	8	160	1792
	DRVCMD_6	Current Command (Axis 6)	20	8	160	1952
RT-I/O	RT-I/O	RealTime I/O	16	8	128	2112
STD-I/O	STD-I/O	Standard I/O	24	8	192	2240
FSENS	FSENS	Force Sensor data	72	1	72	2432
PLSCNT	PLSCNT	Pulse Counter	24	1	24	2504
TCP	TCP	Tip of the robot arm	80	1	80	2528
Total					2608	2608

KEY POINTS

If no data exists, the TIMESTAMP will become “0”. See the table below.

Content of ENC

For each of the robot’s axes, 8 items of ENC data are included. The data in these 8 items are arranged chronologically. This section describes the format of each of the ENC data.

Large data item	Small data item	Overview	of 1 Size	Data type	Quantity	Total bytes	Index
ENC_n	TIMESTAMP	TIMESTAMP 1 sec per 80,000,000. When converting to seconds, divide by 80,000,000. Do the same for the following TIMESTAMPs as well. The starting point is when the Controller is turned on or is rebooted. The same is true for the following TIMESTAMPs as well.	8	UInt64	1	8	0
	ENC_POS	Encoder position information (pulse value)	8	Int64	1	8	8
	ENC_TMR	Timer value (Number of internal clocks in the encoder)	4	UInt32	1	4	16
	ENC_TEMP	Temperature (°C)	1	SByte	1	1	20

Content of DRVCMD

For each of the robot’s axes, 8 items of DRVCMD data are included. The data in these 8 items are arranged chronologically. This section describes the format of each of the DRVCMD data.

Large data item	Small data item	Overview	of 1 Size	Data type	Quantity	Total bytes	Index
DRVCMD_n	TIMESTAMP	TIMESTAMP	8	UInt64	1	8	0
	RESERVE	Reserved	2	Byte	1	2	8
	IDREF	D-Axis Current Command Value	2	Int16	1	2	10
	IQREF	Q-Axis Current Command Value	2	Int16	1	2	12
	EANGLE	Electrical angle * This is the angle if 360 degrees is expressed as 65,536.	2	Uint16	1	2	14
	VEL	Velocity	2	Int16	1	2	16
	RESERVE	Reserved	2	Int16	2	2	18

Content of RT-I/O

For each item of data, 8 pieces of RT-I/O data are included. The data in these 8 items are arranged chronologically. This section describes the format of each of the RT-I/O data.

Large Data Item	Small Data item	Overview	of 1 Size	Data type	Quantity	Total bytes	Index
RT-I/O	TIMESTAMP	TIMESTAMP	8	UInt64	1	8	0
	RTIO_IN	RealTime Input The following 4 bits are Standard R-I/O Input.	1	Byte	1	1	8
	RESERVE	Reserved	3	-	1	3	9
	RTIO_OUT	RealTime Output The following 4 bits are Standard R-I/O Output.	1	Byte	1	1	12
	RESERVE	Reserved	3	-	1	3	13

Content of STD-I/O

For each item of data, 8 pieces of STD-I/O data are included. The data in these 8 items are arranged chronologically. This section describes the format of each of the STD-I/O data.

Large data item	Small data item	Overview	of 1 Size	Data type	Quantity	Total bytes	Index
STD-I/O	TIMESTAMP	TIMESTAMP	8	UInt64	1	8	0
	RESERVE	Reserved	8	UInt32	1	8	8
	STDIO_IN	Standard Input The following 3 bits are Standard Input.	4	UInt32	1	4	16
	STDIO_OUT	Standard Output The following 2 bits are Standard Output.	4	Uint32	1	4	20

Content of FSENS

For each item of data, 1 piece of FSENS data is included. This section describes the format of each of the FSENS data.

Data Large data item	Data Small data item	Overview	of 1 Size	Data type	Quantity	Total bytes	Index
FSENS	TIMESTAMP	TIMESTAMP	8	UInt64	1	8	0
	RESERVE	Reserved Area	4	-	1	4	8
	FSENS_RESP_6D_DATA	Force Sensor data For detailed information, see the table below.	18	-	1	18	12
	RESERVE	Reserved Area	2	-	1	2	30
	FSENS_RESP_16D_DATA	Force Sensor data For detailed information, see the table below.	40	-	1	40	32

Describes details of the data from FSENS_RESP_6D_DATA in the table above. Be aware that the unit for Index is “bit”.

Data Small data item	Data item	Overview	Size (bit)	Index (bit)
FSENS_RESP_6D_DATA	Fx_2_17	of each axis in the Force coordinate system Within the Sensor data (g), data from bit 2 to bit 17	16	0
	Fy_2_17		16	16
	Fz_2_17		16	32
	Mx_2_17		16	48
	My_2_17		16	64
	Mz_2_17		16	80
	Fx_0_1	of each axis in the Force coordinate system Within the Sensor data (g), the data from bit 0 to bit 1	2	96
	Fy_0_1		2	98
	Fz_0_1		2	100
	RESERVE	Reserved	2	102
	Mx_0_1	of each axis in the Force coordinate system Within the Sensor data (g), the data from bit 0 to bit 1	2	104
	My_0_1		2	106
	Mz_0_1		2	108
	RESERVE	Reserved	2	110
	Temperature_0_15	Temperature (℃)	16	112
	RESERVE	Reserved	16	128

Describes details of the data from FSENS_RESP_16D_DATA in the table above. Be aware that the unit for Index is “bit”.

Data Small data item	Data item	Overview	Size (bit)	Index (bit)
FSENS_RESP_16D_DATA	Xa_2_17	Within the Element Output data (g), the data from bit 2 to bit 17 Z and T have a constant value of “0”	16	0
	Ya_2_17		16	16
	Za_2_17		16	32
	Ta_2_17		16	48
	Xa_0_1	Within the Element Output data (g), the data from bit 0 to bit 1 Z and T have a constant value of “0”	2	64
	Ya_0_1		2	66
	Za_0_1		2	68
	Ta_0_1		2	70
	Xb_2_17	Within the Element Output data (g), the data from bit 2 to bit 17 Z and T have a constant value of “0”	16	72
	Yb_2_17		16	88
	Zb_2_17		16	104
	Tb_2_17		16	120
	Xb_0_1	Within the Element Output data (g), the data from bit 0 to bit 1 Z and T have a constant value of “0”	2	136
	Yb_0_1		2	138
	Zb_0_1		2	140
	Tb_0_1		2	142
	Xc_2_17	Within the Element Output data (g), the data from bit 2 to bit 17 Z and T have a constant value of “0”	16	144
	Yc_2_17		16	160
	Zc_2_17		16	176
	Tc_2_17		16	192
	Xc_0_1	Within the Element Output data (g), the data from bit 0 to bit 1 Z and T have a constant value of “0”	2	208
	Yc_0_1		2	210
	Zc_0_1		2	212
	Tc_0_1		2	214
	Xd_2_17	Within the Element Output data (g), the data from bit 2 to bit 17 Z and T have a constant value of “0”	16	216
	Yd_2_17		16	232
	Zd_2_17		16	248
	Td_2_17		16	264
	Xd_0_1	Within the Element Output data (g), the data from bit 0 to bit 1 Z and T have a constant value of “0”	2	280
	Yd_0_1		2	282
	Zd_0_1		2	284
	Td_0_1		2	286

Data Small data item	Data item	Overview	Size (bit)	Index (bit)
	Temperature_0_15	Temperature(℃)	16	288
	RESERVE	Reserved	16	304

Content of PLSCNT

For each item of data, 1 piece of PLSCNT data is included. This section describes the format of each of the PLSCNT data.

Data Large data item	Data Small data item	Overview	of 1 Size	Data type	Quantity	Total bytes	Index
PLSCNT	TIMESTAMP	TIMESTAMP	8	UInt64	1	8	0
	PLSCNT1_NOW	The present Pulse Counter value	4	Byte	1	4	8
	PLSCNT1_LATCH	The Latched Pulse Counter value	4	Byte	1	4	12
	PLSCNT2_NOW	The present Pulse Counter value	4	Byte	1	4	16
	PLSCNT2_LATCH	The latched Pulse Counter value	4	Byte	1	4	20

Content of TCP

For each item of data, 1 piece of TCP data is included. This section describes the format of each of the TCP data.

Data Large data item	Data Small data item	Overview	of 1 Size	Data type	Quantity	Total bytes	Index
TCP	TIMESTAMP	TIMESTAMP	8	UInt64	1	8	0
	X	X component of the position of the tip of the robot arm	8	Double	1	8	8
	Y	Y component of the position of the tip of the robot arm	8	Double	1	8	16
	Z	Z component of the position of the tip of the robot arm	8	Double	1	8	24
	U	U component of the position of the tip of the robot arm	8	Double	1	8	32
	V	V component of the position of the tip of the robot arm	8	Double	1	8	40
	W	W component of the position of the tip of the robot arm	8	Double	1	8	48
	R	R component of the position of the tip of the robot arm	8	Double	1	8	56
	S	S component of the position of the tip of the robot arm	8	Double	1	8	64
	T	T component of the position of the tip of the robot arm	8	Double	1	8	72

6. About Purchasing Products

6.1 About Purchasing Products

This product is paid for.

Contact your distributor to purchase a license for this product.
"Safety Manual - Contact Information - SUPPLIER"

- An options key code is required to activate and purchase the license for this product of the RC700, RC90, T, and VT series. For details, see below.
  "User's Guide - License Configuration for RC700, RC90, T, and VT Series"

- Once you have obtained your license key and activation key, refer to the following to activate this product.
  RC700,RC90,T,VT series:
  Activation (Firmware Versions 7.5.xx or Lower Only)

  RC800 series:
  "User's Guide - Enabling an option license (online authentication)"
  Or
  "User's Guide - Enabling an option license (offline authentication for one license at a time)"

7. Trouble Shooting

7.1 Errors of Controllers

Following shows error messages and solutions of Controller regarding OPC UA Server.

No.	Message	Remedy
7930	OPC UA Server. Not Activated.	Activate the OPC UA function.
7931	OPC UA Server. Certificate not configured.	Register a Sever Certificate. Or reconsider the using type of the Server Certificate.
7932	OPC UA Server. Invalid parameter.	Reconsider the setting of the Server.
7933	OPC UA Server. Port number conflicts.	Change the port number.
580	OPC UA Server. Server error.	Reboot the Controller.
581	OPC UA Server. Server log is activated.	Turn OFF the log function of OPC UA Server. Reboot the Controller.
582	OPC UA Server. File size of the server log is exceeded.	Turn OFF the log function of OPC UA Server. Reboot the Controller.

KEY POINTS

There is no description for Controller errors elated to sensor data acquisition. For more information about errors or warnings related to sensor data, refer to following.

Specifications of Force Sensor Node - ErrorStatus Node

7.2 Errors of OPC UA Configurator

Errors occurred during process of OPC UA Configurator are displayed in the error dialog or processing dialog.

- Errors displayed in the error dialog: Errors in checking file names or number of files before executing processing.
- Errors displayed in the processing dialog: Errors occurred when executing processing in application or errors in checking file names or number of files before executing processing when selecting multiple Controllers.

Following shows errors related to processing of OPC UA Configurator.

7.2.1 Errors displayed in error dialog

Message	Reason	Remedy
Controller FW Version does not support OPC UA.	The FW version of your Controller is not supported OPC UA.	Refer to the following and update the firmware. **Operating Condition**
Cannot connect with the controller because the task is running.	Controller is working on a task, so Controller and OPC UA Configurator cannot be connected with Program mode.	Wait for process of the task then connect.

Message	Reason	Remedy
The file format is invalid.	The file format importing from PC is different from the file format selected in the application.	Change the file format to specified format.
The file name is incorrect.	You are using letters other than half-width alphanumeric characters or underscore for the file name. File mane is not specified name.	Change the file name. Enter with half-width alphanumeric characters.
Attempted to import more than the file limit.	You've tried to import files more than maximum number of files that can be imported.	Delete a file you already imported. Reduce the number of files to import.
No files found to import.	There is no file to import in the folder of import source.	Place a file with the specified name in the folder of the PC of import source.
Parameter Error	Full-width alphanumeric character or symbol are entered in setting for CSR or Self signed Certificate.	Re-enter the correct value.
You tried to import a certificate that is not paired with the CSR.	CSR saved in the Controller and Certificate to import is not paired.	Import a CA signed Certificate for CSR.
The password you entered is incorrect.	Private key password is entered accidentally when importing User Certificate.	Re-enter the correct password.
The port number must be between 0 and 65535.	Full-width alphanumeric character or values not specified is entered.	Re-enter the correct value.

KEY POINTS

When error occurred with selecting multiple Controllers during the process of application, the error will be displayed in processing dialog.

7.2.2 Errors displayed in processing dialog

Message	Reason	Remedy
Connect Error	■ Controller is not turned ON. ■ Password for Ethernet connection is wrong. ■ LAN cable is not connected. ■ USB cable is not connected. ■ Controller is working on a task. ■ Controller is connecting with TP.	■ Turn ON the Controller. ■ Set the new password for Ethernet connection at Epson RC+ and enter the new password when adding Controller. ■ Connect the LAN cable. ■ Connect the USB cable. ■ Re-connect after task completed. ■ Disconnect with TP and re-connect.
Failed to import file	OPC UA Configurator and Controller communication is disconnected during sending file. (LAN cable is disconnected from PC, Start mode of the Controller was different.)	Check for Start mode of the Controller and double check the connection with the Controller and operate again.

Message	Reason	Remedy
No files found to import.	There is no file to import in the folder.	Place a file with the specified name in the folder of the PC of import source.
Attempted to import more than the file limit.	You've tried to import files more than maximum number of files that can be imported.	Delete a file you already imported. Reduce the number of files to import.
Update failed: File does not exist	Selected type of Certificate file is not existed in Controller.	Importing a Certificate you want to use as a Server Certificate.
Not match Certificate and CSR	CSR saved in the Controller and Certificate to import is not paired.	Import a CA signed Certificate for CSR.

7.3 How to Acquire OPC UA Server Log

⚠ CAUTION

Make sure to turn OFF the Server Log after acquired OPC UA Server Log.

In normal using, do not change the setting to ON.

1. Change the setting of [Server Startup Mode] to "MANUAL" in OPC UA Configurator.

   Reference: **Basic Setting for Server**

2. Reboot the Controller.

3. Turn ON the [Server Log] in OPC UA Configurator.

   Reference: **Basic Setting for Server**

4. Activate OPC UA Server in OPC UA Configurator.

   Reference: **Buttons to Execute**

5. Deactivate OPC UA Server in OPC UA Configurator.

6. Back up the Controller. Log of OPC UA Server is included in acquired back up file.

   Reference: "Epson RC+ User's Guide" or Controller manual

7. Turn OFF the ServerLog in OPC UA Configurator.

   Reference: **Basic Setting for Server**

8. Appendix

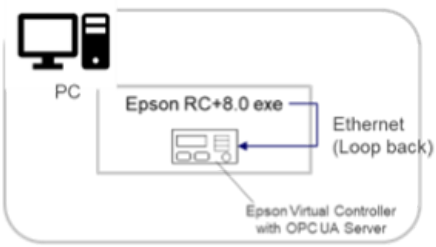
8.1 Appendix A: OPC UA Server Installed in the Virtual Controller

The OPC UA Server installed in the virtual controller is intended to be used in production line simulations before introducing or setup actual equipment.

Therefore, there are some differences in functionality and settings compared to the OPC UA Server of the actual controller. This section explains the differences and limitations.

8.1.1 Appendix A-1: System Configuration

The Epson RC+ and the virtual controller communicate via loopback on the same device. Therefore, you can use the OPC UA Server without configuring Ethernet.



In addition, you can connect to the OPC UA Server of the virtual controller at the following endpoints:

opc.tcp://127.0.0.1:[PortNo.]

KEY POINTS

The endpoint for the external device is opc.tcp:/[device IP address]:[PortNo.].

8.1.2 Appendix A-2: OPC UA Configurator Specifications in Virtual Setting Mode (Restrictions and Differences)

This section describes the limitations and specification differences of the OPC UA Configurator launched in virtual controller setting mode.

Locations described in the manual	Limitations and Specifications
Overview	In virtual controller setting mode, the OPC UA Configurator can only select virtual controllers connected to Epson RC+.
Menu bar	(*1) The menu "Controller" cannot be selected in virtual controller setting mode.
Controller Information List	In virtual controller setting mode, only one device, "Virtual", will be displayed in the information list.
Controller Information List	The controller type will show as “Virtual” if in virtual controller setting mode. The serial number will be displayed as blank if in virtual controller setting mode.
Export Settings (Firmware Versions 7.5.xx or Lower Only)	For virtual controllers, option.json is not exported.
Import Settings (Firmware Versions 7.5.xx or Lower Only)	For virtual controllers, option.json is not imported.

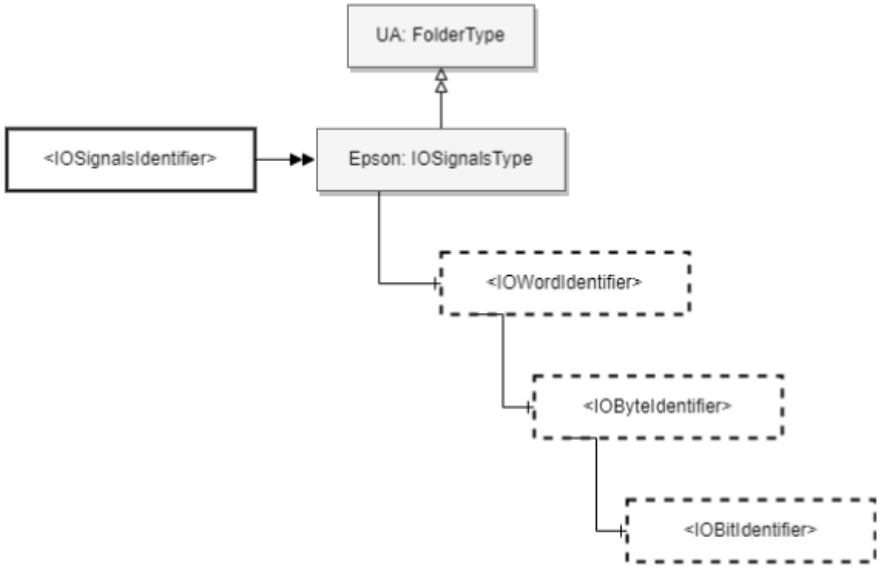
Creating Self Signed Certificate	For a virtual controller, the initial value of the common name is [EpsonRC.first 8 characters of the hash value generated from the controller name.loopback address].
Exporting Self Signed Certificate	For virtual controllers, it is stored in:
User Specified Certificate (3) When [Certificate with encryption key] is selected:	For the virtual controller, save only one certificate file you want to register in the following folder.
User Specified Certificate (3) When [Certificate/Private key] is selected:	For the virtual controller, save only one certificate file you want to register in the following folder.
CA Signed Certificate Creating CSR (4)	For the virtual controller, the created CSR files will be saved in following folder.
CA Signed Certificate Creating CSR (4)	For a virtual controller, the initial value of the common name is [EpsonRC.first 8 characters of the hash value generated from the controller name.loopback address].
CA Signed Certificate Creating CSR (6)	For a virtual controller, save the CA signed certificate in the following folder.

8.1.3 Appendix A-3: Specification of the I/O Node

The specifications of the I/O node differ between real and virtual controllers. The main differences are as follows:

	Actual controller	Virtual controller
AccessLevel	Input Port: CurrentRead Output Port: CurrentRead	Input Port: CurrentRead,CurrentWrite Output Port: CurrentRead
Address Space	I/O nodes with either bit or byte only	I/O nodes of all data types displayed on Epson RC+ I/O monitor

The I/O nodes in the virtual controller are organized in a hierarchical structure, with nodes with smaller data sizes as child nodes. An example of I/O node's Address Space is shown below.



ObjectType Description

The virtual controller also supports Word type I/O data.

- Variable[IOWordIdentifier]

[IOWordIdentifier], like [IOByteIdentifier] and [IOBitIdentifier], indicates that the I/O port includes multiple I/O signals. This Variable node exists for each word of the I/O signal. When the Value is converted into a binary bit string, the port of the number(0~) of the bit that becomes 1 means ON in the I/O signal, and the port of the number of the bit that becomes 0 means OFF in the I/O signal.

8.1.4 Specifications of the MotionLogSystemType Node

This node cannot be used with a virtual controller.

8.2 Appendix B: Format of Activation File

- When activating all at once with select multiple Controllers, you will need a file for activation. Create a file of csv file.
- Naming file is optional. Enter “OPCUA.Activation.Ver.1.0” in the first line of the file. From after second line, license key information of each Controller will be there. Enter information for one Controller per line.

KEY POINTS

Enter like following order.

Serial No, LicenseKey, ActivationKey

Put a “,” between Serial No and License Key. And, between License Key and Activation Key as well.

Entering example:

OPCUA.Activation.Ver.1.0

R7A0000001,aaaa-aaaa-aaaa-aaaa,XXXX-XXXX-XXXX-XXXX-XXXX-XXXX

R9B0000001,bbbb-bbbb-bbbb-bbbb,YYYY-YYYY-YYYY-YYYY-YYYY-YYYY

…

8.3 Appendix C-1: Folder Configuration

Following shows example of folder structure.

C
└EpsonRC80
└OPCUA
└ 00001 A folder named as the Controller’s serial number.(Created automatically)
├ Cert Certificate folder
│ ├─ SelfSigned Self signed Certificate folder
│ │ ├ 1_cert.der Self signed Certificate file
│ │ └ 1_key.pfx Private key file (Only when user made a backup.)
│ ├─ CASigned CA signed Certificate folder
│ │ ├ aaa.der CA signed Certificate file (File name is optional)
│ │ └ 3_key.pfx Private key file (Only when user made a backup.)
│ ├─ CSR CSR saving folder
│ │ └ 3_csr.pem CSR file
│ └─ UserSpecified User specified Certificate folder

```
│   ├ccc.der Certificate file (File name is optional)
│   └ddd.key Private key file (File name is optional)
│   └eee.pfx Certificate file with encryption key (File name is optional)
│
├option.json Configuration file
└epson_opcua_config.json Configuration file
```

8.4 Appendix C-2: OSS License

OSS License for OPC UA Server

As for the Open Source Software used in the OPC UA Server, we're using it in accordance with the terms of the license agreement presented by the copyright holder.

Each license contract of Open Source Software program, copyright notice and license information are in the Epson RC+ you installed. Information can be checked below.

License information for each open source software used in OPC UA Server:

"Epson_RC+****\EULA_OSSLicenses\OPCUA" (****: Epson RC+ version)

license_opcua.txt

license_others.txt