HIOT-63-0002-03

HITACHI

INDUSTRIAL CONTROLLER FOR IoT APPLICATIONS

HF-W100E/IoT

STARTUP GUIDE

USER'S MANUAL

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INDUSTRIAL CONTROLLER FOR IoT APPLICATIONS

HF-W100E/IoT

STARTUP GUIDE

Read and keep this manual.

- **Read safety instructions carefully and understand them before starting your operation.**
- **Keep this manual at hand for reference.**

USER'S MANUAL

First Edition, September 2017, HIOT-63-0002-01 (out of print)
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SAFETY INSTRUCTIONS

● Product Safety Precautions

Carefully read and fully understand the safety precautions below before operating the equipment.

- Operate the equipment by following the instructions and procedures described in this manual.
- Pay attention especially to safety precautions displayed on the equipment or in this manual. Make sure you follow them. Otherwise, personal injury and property damage including damage to the equipment may result.
- A safety precaution is indicated by a heading as shown below. A heading is either a safety alert symbol; a word such as “DANGER”, “WARNING”, “CAUTION”, or “NOTICE”; or a combination of both.

This is a safety alert symbol. This symbol is used to signify potential hazards that may result in personal injury or death. Make sure you follow the safety message that follows this symbol in order to avoid possible injury or death.
DANGER: This symbol is used to indicate imminent hazards that will highly likely result in serious personal injury or death.
WARNING: This symbol is used to indicate potential hazards that may result in serious personal injury or death.
CAUTION: This symbol is used to indicate potential hazards that may result in minor or moderate personal injury.

NOTICE: This symbol is used to indicate hazards that may result in equipment or property damage but not personal injury.

The heading “NOTE” is used to indicate a cautionary note about handling and operation of the equipment.

- Do not attempt to perform any operation that is not described in this manual. If there is any problem with the equipment, call your maintenance personnel.
- Read this manual carefully and fully understand the directions and precautions written in this manual before operating the equipment.
- Keep this manual nearby so that you can reference the manual anytime you need it.
- Every effort has been made to specify the best precautions on the equipment and in the manual. Nevertheless, unexpected incidents may occur. When you use the equipment, you are asked not only to follow the instructions but also to use your own judgment on safety.

SAFETY INSTRUCTIONS (Continued)

● Common Safety Precautions

Carefully read and fully understand the following safety precautions.

< WARNING>

- This equipment is not designed and manufactured to be used for a life-critical system that requires extreme safety. If there is a possibility that the equipment may be used for this purpose, contact relevant sales representatives.

- In case of smoke, a burning smell, or the like, turn off the power to the equipment, disconnect the power cord from the outlet, and contact your supplier or maintenance personnel. Using the faulty equipment without repair may result in a fire or an electric shock.

- This equipment has built-in hard disk drives. Do not hit the equipment or give a shock or vibration to the equipment because that may cause the equipment to fail. Should you drop the equipment or damage its chassis, disconnect the power cord from the outlet and contact your maintenance personnel. Using the faulty equipment without repair may result in a fire or an electric shock. Do not give a shock to the equipment when unpacking or carrying the equipment.

- Never disassemble or modify this equipment. Failure to do so may result in death or serious injury. In addition, note beforehand that Hitachi is not responsible for the results caused by modification.

SAFETY INSTRUCTIONS (Continued)

< CAUTION>

- If the equipment drops or is tipped over, personal injury may result. Pay full attention when transporting the equipment.
- Make sure you do not catch or hit your fingers to cause personal injury when unpacking or carrying the equipment.
- There may be a danger of injury or damage to this equipment. Do not use this equipment for purposes other than its original usage.
- Do not touch this equipment directly during operation or immediately after shutting off the power because the equipment may become hot. There is a fear of burn. Install the equipment where the user does not touch the equipment in operation directly by hand.
- This equipment alone cannot guarantee the system safety. In order to ensure sufficient safety of your system even when this equipment should fail, malfunction, or have program bugs, you must add systemic protections such as building external protective/safety circuits to facilitate safety measures to prevent personal injury and serious accidents.
- An emergency stop circuit must be provided externally to this product. Disregarding this rule may result in a damage to the equipment or a hazard to the user if this product fails.
- Perform the operation such as the change pf the program, the forced output, and stop during online (during system operation) after confirming the safety thoroughly. Otherwise, it may result in a damage to the equipment or an accident by wrong operation.

SAFETY INSTRUCTIONS (Continued)

<NOTICE>

- When you work on installation or replacement of hardware, wear an antistatic wrist strap to prevent the buildup of static electricity.

- When you tighten or remove a screw, use a screwdriver that fits the size and type of the head of the screw to avoid stripping the head.
  When you tighten a screw, drive a screw along the axis of a tapped hole without adding too much torque in order to avoid damaging the thread.

- Do not use the equipment in the environment full of dust or with corrosive gas because that may cause the equipment to fail.

- Do not give a shock to the equipment when unpacking or carrying the equipment. If you do, that may cause the equipment to fail.

- Make sure sufficient clearance is provided for air intake and exhaust in front of and behind the equipment. Otherwise, the temperature inside the equipment may rise and that may cause a failure or short life span of the equipment. In addition, you need to ensure sufficient clearance for maintenance work.

- Use an operating system specified by the Manufacturer. The Manufacturer cannot guarantee proper operation of the equipment if you use an operating system not specified by the Manufacturer.

- Performing emergency shutdown (that is, unplugging the power cord from the outlet or shutting off the breaker without proper shutdown of the OS) may cause the OS or applications not to work properly or may cause saved data to be corrupted. Do not perform emergency shutdown unless you must stop the system immediately due to some kind of error.

- Stop this device (OS shutdown, power-off) after confirming a peripheral equipment is in stop or not influenced.

- When using this device which the equipment targeted for control is connected to, read carefully the attached instruction manual of this equipment and inspect the movement thoroughly.

- Keep in mind that if the power supply is cut, the system may not be able to recover automatically.

PREFACE

This manual mainly describes how to use the software programmable logic controller (PLC) for the industrial controller HF-W100E/IoT (hereinafter denoted as HF-W100E/IoT).

<Organization of this manual>

This manual is organized as follows.

CHAPTER 1 INTRODUCTION TO HF-W100E/IoT
CHAPTER 2 SETUP
CHAPTER 3 CREATING A PLC PROGRAM
CHAPTER 4 CONFIGURATION OF EtherCAT CONNECTION
CHAPTER 5 CONFIGURATION FOR USING OPC
CHAPTER 6 RAS FEATURES IN HF-W100E/IoT

For information about the instructions and cautionary notes related to using devices (hardware) and about how to use the basic RAS features already built into the Hitachi industrial computers, download the electronic manuals for the HF-W100E from the following home page.

http://www.hitachi.co.jp/hfw/

Titles of the electronic manuals	Manual number
HITACHI INDUSTRIAL COMPUTER HF-W100E INSTRUCTION MANUAL	WIN-62-0069
HITACHI INDUSTRIAL COMPUTER HF-W100E RAS FEATURES MANUAL	WIN-63-0095

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- EtherCAT® is licensed and patented by and a registered trademark of Beckhoff Automation GmbH, Germany.
- PLCopen® is a registered trademark of PLCopen.
- All other product names (software and hardware) not from Hitachi described in this manual are registered trademarks, trademarks, or products of their respective owners.

<Note for storage capacity calculations>

- Memory capacities and requirements, file sizes and storage requirements, etc. must be calculated according to the formula 2^n. The following examples show the results of such calculations by 2^n (to the right of the equals signs).
  1 KB (kilobyte) = 1,024 bytes
  1 MB (megabyte) = 1,048,576 bytes
  1 GB (gigabyte) = 1,073,741,824 bytes
  1 TB (terabyte) = 1,099,511,627,776 bytes
- Disk capacities, however, must be calculated using the formula 10^n. Listed below are the results of calculating the above example capacities using 10^n in place of 2^n.
  1 KB (kilobyte) = 1,000 bytes
  1 MB (megabyte) = $1{,}000^2$ bytes
  1 GB (gigabyte) = $1{,}000^3$ bytes
  1 TB (terabyte) = $1{,}000^4$ bytes

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FIGURES

TABLES

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CHAPTER 1 INTRODUCTION TO HF-W100E/IoT

1.1 Overview

The HF-W100E/IoT is a Hitachi industrial computer HF-W100E equipped with a software PLC. It has the features of both an industrial computer and a programmable logic controller (PLC).
A software PLC is a development environment/runtime environment that executes PLC functions on a computer with a general-purpose OS. HF-W100E/IoT uses CODESYS®, a software PLC developed by 3S-Smart Software Solutions GmbH, Germany (hereinafter denoted as 3S).

■ About CODESYS

CODESYS is a software PLC developed by 3S. It consists of a development environment that supports programming languages defined in the international standard IEC 61131-3 and a realtime execution environment (runtime environment) that runs control applications developed by the development environment.
In HF-W100E/IoT, the following CODESYS packages are pre-installed. (You can download the development environment from the Web site of 3S, but note that only the following version is verified to work with the HF-W100E/IoT.)
• Development environment: CODESYS Development System (V3.5 SP10 Patch 1)
• Runtime environment: CODESYS Control Softmotion RTE (V3.5 SP10 Patch 1)

■ Using CODESYS

For information about the instructions on how to use CODESYS not described in this manual, refer to the online help for the development environment. You can start the online help on the help menu in CODESYS.
In addition to the online help, CODESYS original manuals (PDF format in English) from 3S are available and stored in the following locations. Refer to them when needed.
Note that Adobe® Reader® from Adobe Systems Incorporated is required to read a PDF file.

No.	File name	Storage folder	Description
1	CODESYS Installation and Start.pdf	C:\Program Files (x86)\3S CODESYS \CODESYS\Documentation	Creating a project, executing a task, and debugging in the CODESYS development environment
2	CODESYSControlRTEV3_ Manual.pdf	C:\Program Files\3S CODESYS \CODESYS Control RTE3\Documentation	Mechanism and the settings of the CODESYS runtime environment
3	CoDeSys_OPC_Server_V3 _User_Guide.pdf	C:\Program Files (x86)\3S CODESYS \CODESYS OPC Server 3	Instructions for using OPC Config, which is a configuration tool for the OPC server and for the communication interface between the CODESYS development environment and the PLC.
4	AeConfigurator_UserGuide .pdf		Instructions for using AeConfigurator, which is a tool for adding and setting up alarm events when you use OPC AE.
5	WebServerSSL_en.pdf	C:\Program Files (x86)\3S CODESYS \GatewayPLC\Documentation	Procedure for deploying WebServer with safe connections when Web Visualization is used.

1.2 Specifications

The instruction manual of the HF-W100E, base hardware of HF-W100E/IoT, (hereinafter denoted as HF-W instruction manual) describes the specifications of the industrial computer, and this section supplements them with HF-W100E/IoT-specific specifications.

1.2.1 Software specifications

This manual describes the software specifications only. The hardware specifications are the same as those of the HF-W100E. For details about the hardware specifications, refer to “5.1 Equipment Specifications” in the HF-W instruction manual.

Item		Specifications	
		Motion model	CNC model
Model		HJ-100E-PAMM HJ-100E-PGMM	HJ-100E-PBMM HJ-100E-PHMM
Pre-installed OS		See “(1)Pre-installed OS”	
Development environment		CODESYS® Development System (V3.5 SP10 Patch1)	
	Programming languages	IEC 61131-3 standard programming languages • LD: Ladder diagram • FBD: Function block diagram (including CFC) • SFC: Sequential function chart • ST: Structured text	
Runtime environment		CODESYS® Control SoftMotion RTE (V3.5 SP10 Patch1)	
	I/O control	Software PLC	
	Motion control	SoftMotion (PLCopen® compliant)	SoftMotion (PLCopen® compliant) CNC (G-code)
	Field network	EtherCAT® master	
	Data exchange standard	OPC server	
	HMI features	Visualization features	

(1) Pre-installed OS

HJ-100E-PAMM	Microsoft® Windows® 10 IoT Emterprise 2016 LTSB (64bit)
HJ-100E-PBMM	Microsoft® Windows® 10 IoT Emterprise 2016 LTSB (64bit)
HJ-100E-PGMM	Microsoft® Windows® Embedded Standard 7 SP1 (64bit)
HJ-100E-PHMM	Microsoft® Windows® Embedded Standard 7 SP1 (64bit)

1.2.2 LAN interface specifications

(1) EtherCAT connection

Built-in LAN port are handled as follows.

Item		Default factory setting	EtherCAT capable	Remarks
Built-in LAN port	LAN A	Ethernet	Yes	
	LAN B	EtherCAT	Yes	(*)
	LAN C	EtherCAT	Yes	(*)

(*) CODESYS EtherExpress driver for EtherCAT is installed at the factory.

To use different interfaces than the ones set up at the factory, update the network driver. For information about how to update the driver, see “2.3 Updating the Network Driver”. For information about the location of the LAN port connectors, refer to “1.5 Name and Function of Each Part” in the HF-W instruction manual.

(2) LAN cables

In “5.8 Interface Specifications” in the HF-W instruction manual, UTP cables are recommended for use in connection to LAN ports. In spite of that, we recommend using cables with the following specifications if the cables are used for EtherCAT connection on HF-W100E/IoT.

Cable specification: STP cable (shielded twisted-pair cable) category 5e or better

[Caution]

When an STP cable is used, the grounds of the devices at both ends must be at the same voltage level.

1.2.3 BIOS settings

The factory default BIOS settings for HF-W100E/IoT are as follows. Do not change these settings. If you do, it may affect the processing of realtime control.
BIOS settings other than those below are the same as the default settings for the HF-W100E. For details about the setup menu, refer to “5.3 BIOS Setup” in the HF-W instruction manual.

Top menu	Setting item			Value	Caution
Chipset	South Bridge	USB Configuration	Legacy USB Support	Disabled	Do not change these settings.

[Caution]
If you use **Restore Defaults for Windows 7** (in the case of Windows® Embedded Standard 7) or **Restore Defaults for Windows 10** (in the case of Windows® 10) in the setup menu, the BIOS settings go back to the initial settings of the HF-W100E. After you use this menu, restore the BIOS settings to the factory default settings of HF-W/IoT (as in the above table).

1.3 Changes to the HF-W Instruction Manual

This section explains the changes you must make to the HF-W instruction manual.

1.3.1 Time required for restoring the factory condition with the recovery DVD

In “7.1 Overview of Restoration Procedure” in the HF-W instruction manual, the time required for restoring the factory condition is approximately 30 minutes for HF-W100E/IoT.

1.3.2 Recovery DVD name

The name of the recovery DVD described in “7.2 Preparation” and “7.3 Restoring the System Drive Back to the Factory-Shipped Condition” in the HF-W instruction manual must be replaced as follows.

<Name to replace>

Before	HITACHI HJ-100E-**** Product Recovery DVD (The underlined part is the model number of the device you purchased.)
After	HITACHI HF-W/IoT HJ-100E-**** Product Recovery DVD (The underlined part is the model number of the device you purchased.)

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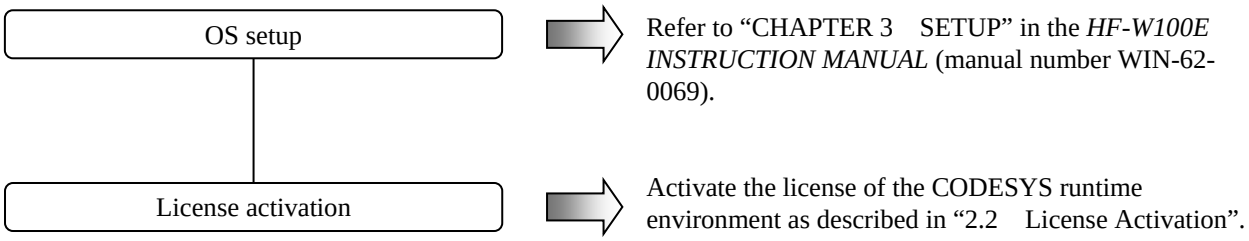
CHAPTER 2 SETUP

This chapter describes how to set up the HF-W100E/IoT.

- After setting up the OS, activate the license of the CODESYS runtime environment. However, since devices shipped after September 2018 will be automatically licensed, it is not necessary to perform the activation process. Please check to "2.2.1 Confirmation of Activation Status" to see if license activation is being done.
- The CODESYS development environment and the runtime environment are pre-installed. You do not have to install or set them up.

2.1 Setup Items



2.2 License Activation

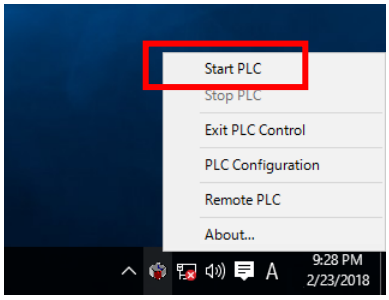
Product activation is required for the CODESYS runtime environment (CODESYS SoftMotion RTE) installed on this device. You must go through license authentication (product activation) against 3S, the manufacturer.

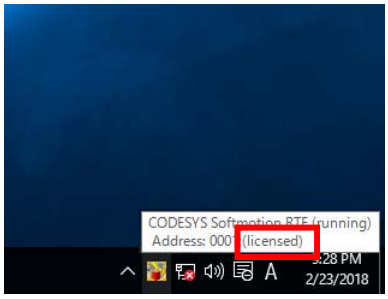
2.2.1 Confirmation of Activation Status

You can check if license activation is done by the following procedure.

1. Click the CODESYS Control RTE V3 icon in notification area on the taskbar. (The icon is hidden by default, and you must click "^" to find it. (Note)) Then click **Start PLC** to start the CODESYS Softmotion RTE.
   (Note)You can set it to display an icon in the notification area by the following procedure.
   - Right-click "∧" in the notification area and click **Properties** from the displayed menu.
   - Click **Customize** on the displayed screen.
   - Click **Select which icons appear on the taskbar**.
   - Set the icon of [CODESYS "Control RTE V3" RTE SysTray] to ON.

2. After the icon turns yellow, point the CODESYS Control RTE V3 icon again and check the display contents(last string of "Address:" line in lower row).





Display contents	Meaning and Action
(licensed)	License activation has already been done. License activation procedure is unnecessary.
(DEMO)	License activation has not been done yet. Please perform license activation by the method described in "2.2.2 License activation method"

NOTE

Make sure you activate the license. If the license is not activated, the runtime environment stops after running two hours.

2.2.2 License activation method

(1) Online activation
Activate the license on this device. In this case, you must connect to the Internet.
• Using the CODESYS development environment
• Using a Web browser

(2) Offline activation
Activate the license on the environment (PC with Internet access) outside this device. You can activate the license without connecting this device to the Internet.

For the procedure, refer to "2.2.3 License activation procedure" in the next section.

2.2.3 License activation procedure

(1) Online activation

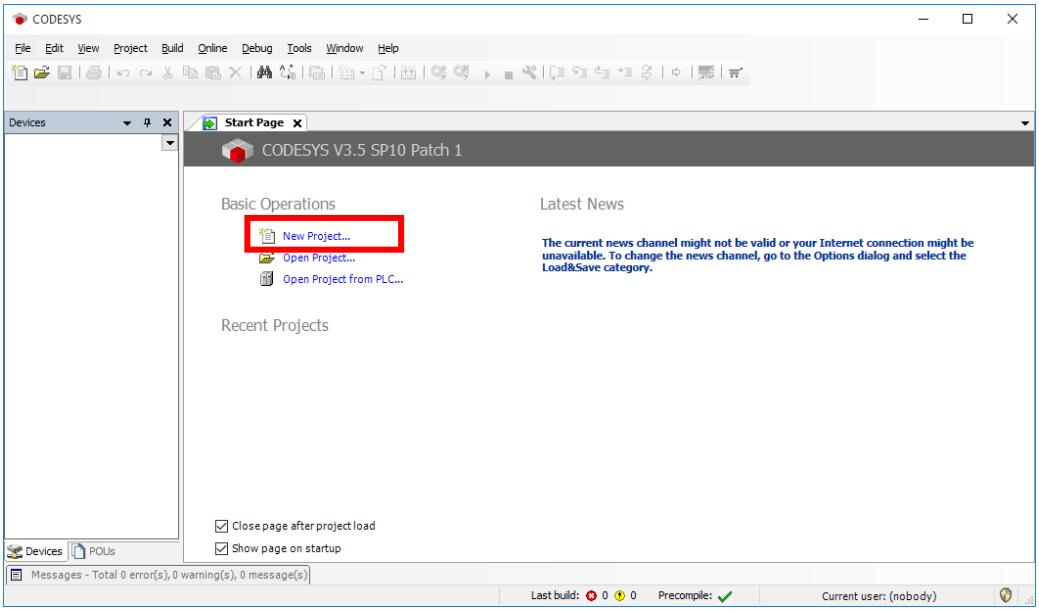
(a) Using the CODESYS development environment

1. Start the CODESYS development environment in the following steps. Wait until the startup process is complete. Be aware that it may take dozens of seconds.
   • If the OS is Windows® Embedded Standard 7, click **Start**, and click **All Programs** > **3S CODESYS** > **CODESYS** > **CODESYS V3.5 SP10 Patch1**.
   • If the OS is Windows® 10, click **Start**, and click **3S CODESYS** > **CODESYS** > **CODESYS V3.5 SP10 Patch1** from the list of applications.
   (Alternatively, double-click the **CODESYS V3.5 SP10 Patch1** icon on the desktop.)

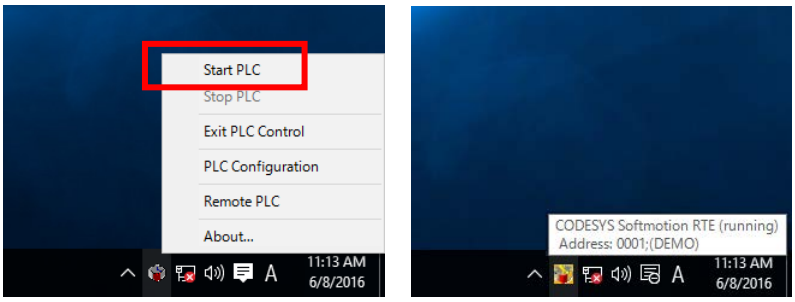
2. The CODESYS development environment starts. Click **New Project**. Create a new project as follows.
   • Categories: Projects
   • Templates: Standard project
   • Name: Any
   • Location: Any
   • Device: Different depending on the model you purchased. Select as follows.

Model name	Device name
Motion model	HJ-100E RTE SoftMotion 64bit (Hitachi Industry & Control Solutions, Ltd.)
CNC model	HJ-100E RTE CNC 64bit (Hitachi Industry & Control Solutions, Ltd.)

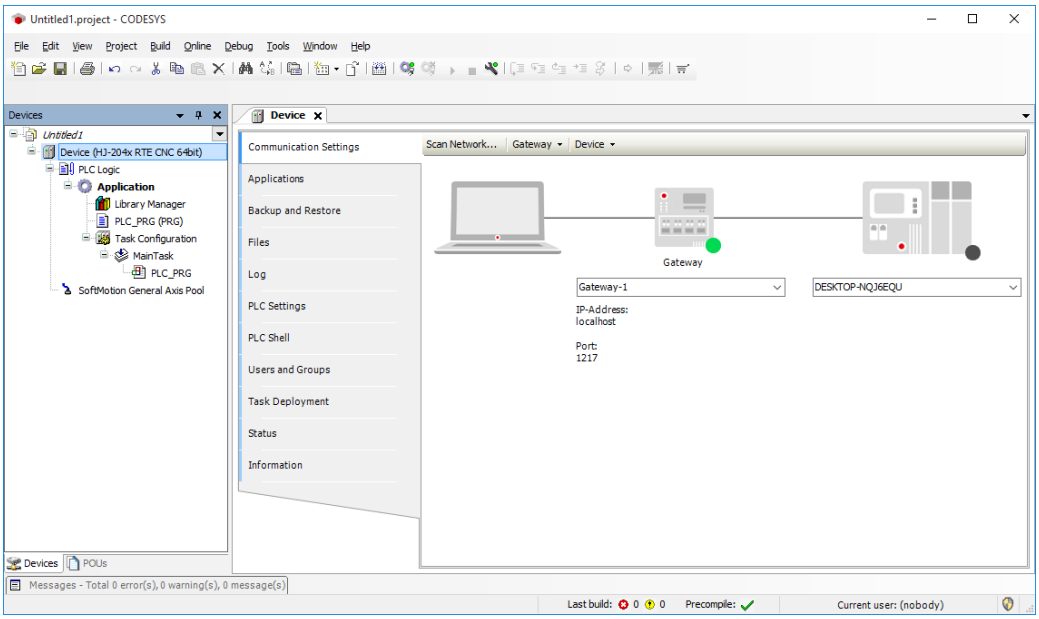
   • PLC_PRG in: Any



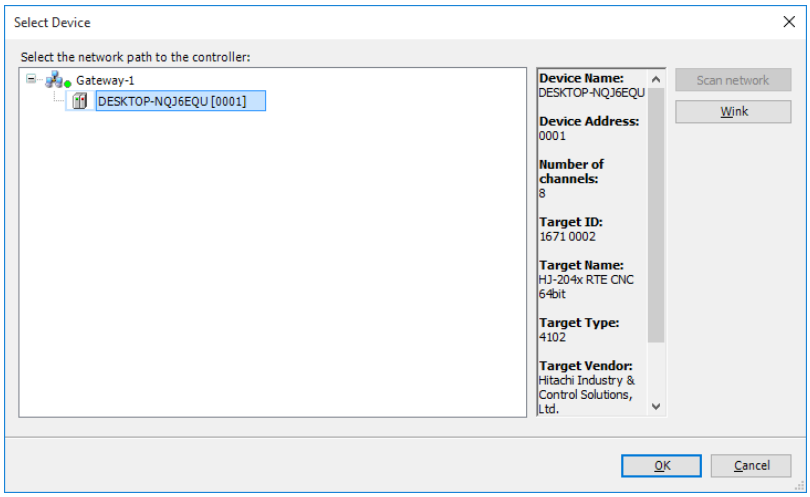
3. Click the CODESYS Control RTE V3 icon in notification area on the taskbar. (The icon is hidden by default, and you must click "^" to find it.) Then click **Start PLC** to start the CODESYS Softmotion RTE. Before the activation, the CODESYS Softmotion RTE runs in DEMO mode.



4. Double-click **Device (*****)** in the **Devices** window. ((*****) shows the selected device name.) Then click **Scan network**.

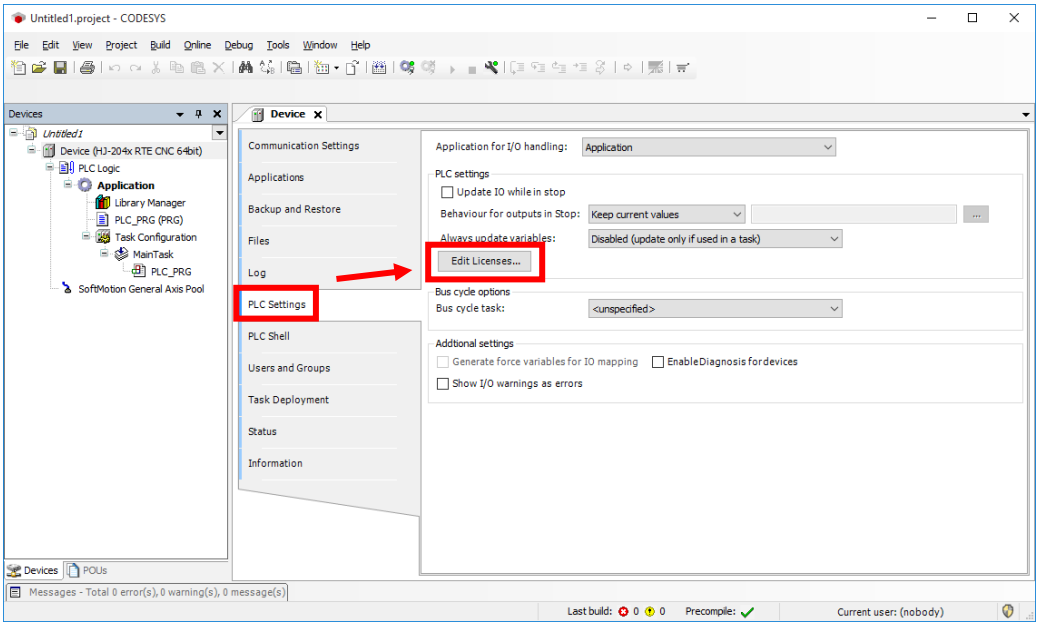


5. The **Select Device** window opens. Select the device you want to select, and click **OK**.

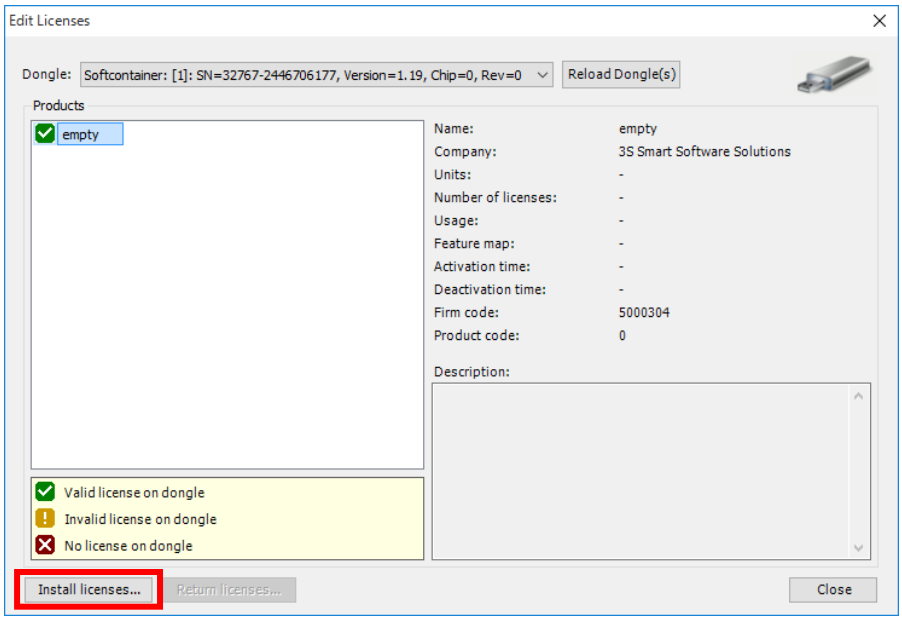


Note: If no devices are shown under **Select the network path to the controller**, repeat clicking **Scan network**. If you still cannot find any devices, the CODESYS Softmotion RTE may not have started yet. Do the following.
- Check that the settings in Step 2 are all correct.
- Stop and then restart the CODESYS Softmotion RTE. To stop the CODESYS Softmotion RTE, click **Stop PLC** in Step 3.

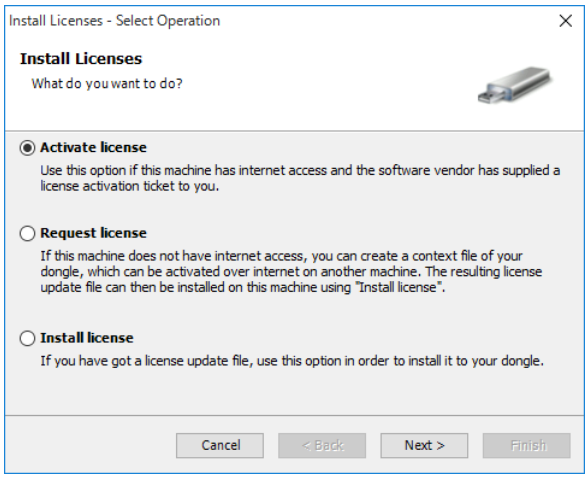
6. Click **PLC Settings** in the **Device** tab. Then click **Edit License**.



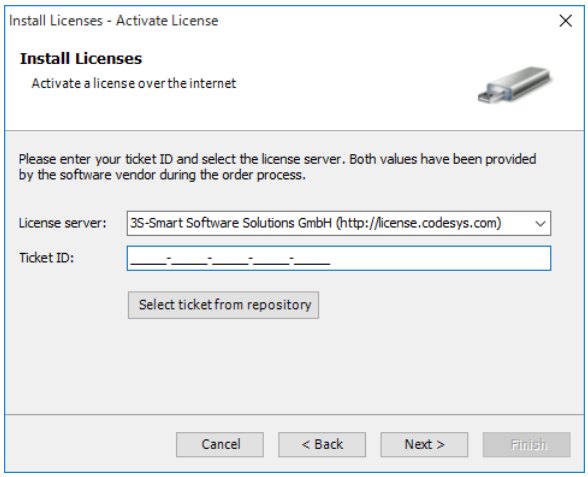
7. The **Edit Licenses** window is displayed. Click **Install licenses**.



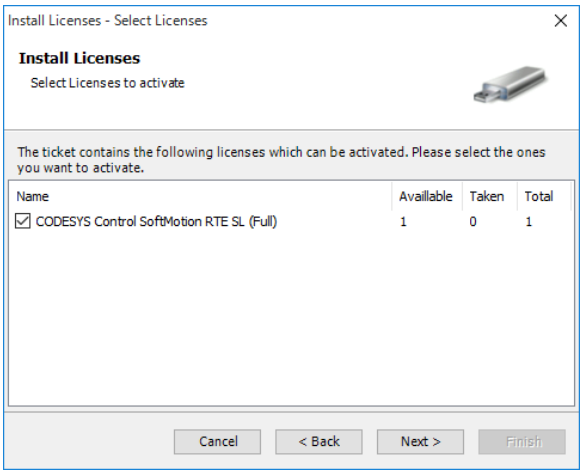
8. The **Select Operation** window is displayed. Select **Activate license**, and then click **Next**.



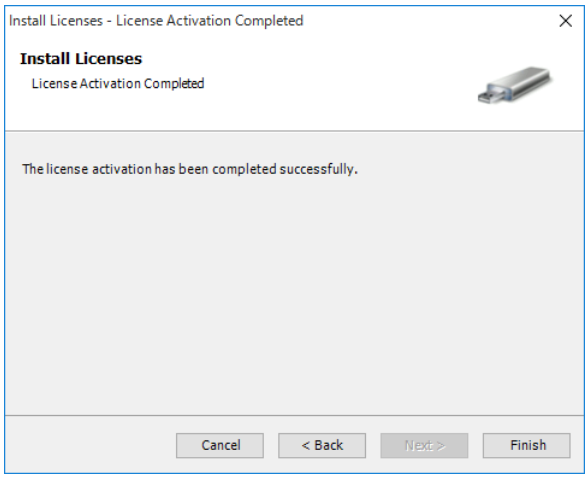
9. The **Active License** window is displayed. Enter the ticket ID shown on the license certificate (included with the product) in the **Ticket ID** box. Then click **Next**.



10. The **Select Licenses** window is displayed. Select the checkbox for **CODESYS Control SoftMotion RTE SL**, and then click **Next**.
When the authentication process is finished, click **Finish**.

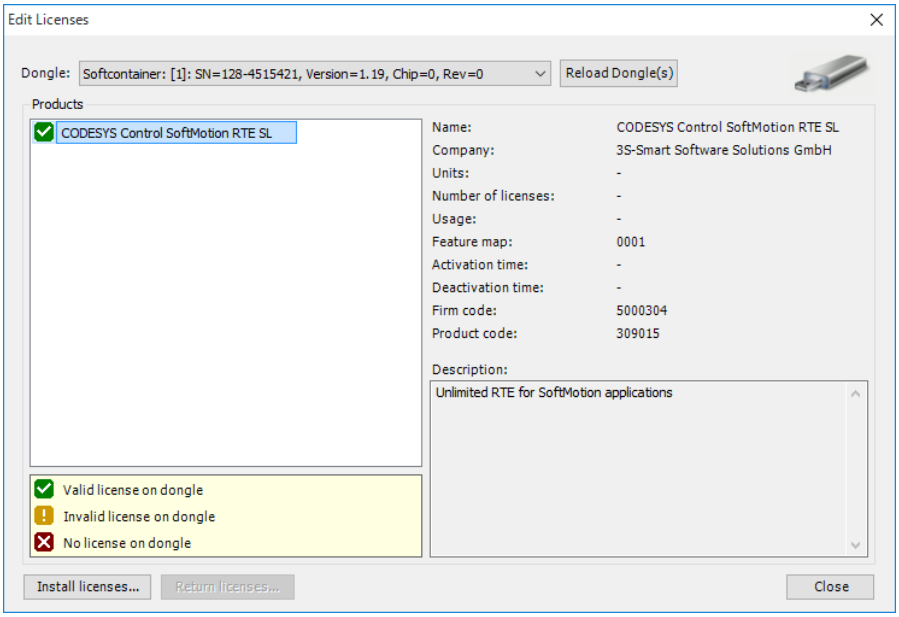


11. If the activation is successful, the following window appears. Click **Finish**.



<Confirming the license activation status>

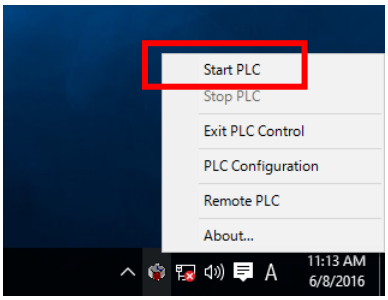
In the **Edit Licenses** window, you can check that the license for CODESYS Control SoftMotion RTE has been activated.



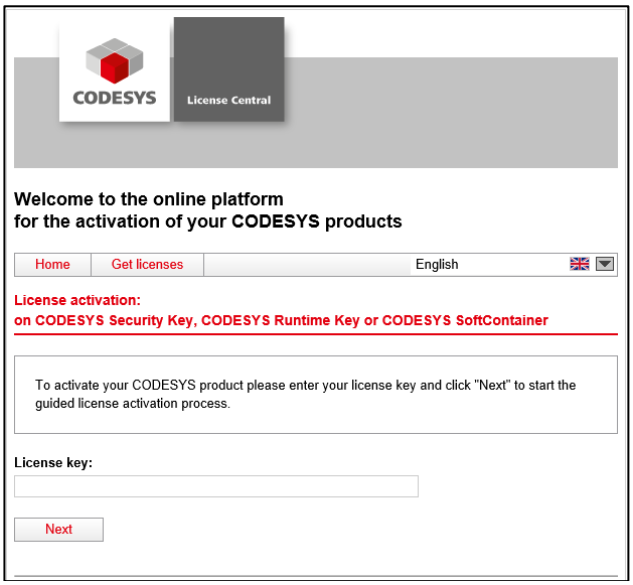
You can also check the display status of the CODESYS Control RTE V3 icon in notification area on the taskbar to see whether the mode has been changed from DEMO to licensed.

(b) Using the Web browser

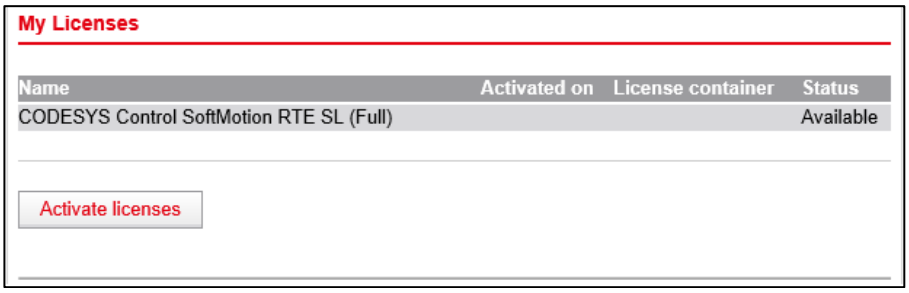
1. Click the CODESYS Control RTE V3 icon in notification area on the taskbar. (The icon is hidden by default, and you must click "^" to find it.) Then click **Start PLC** to start the CODESYS Softmotion RTE. Before the activation, the CODESYS Softmotion RTE runs in DEMO mode.



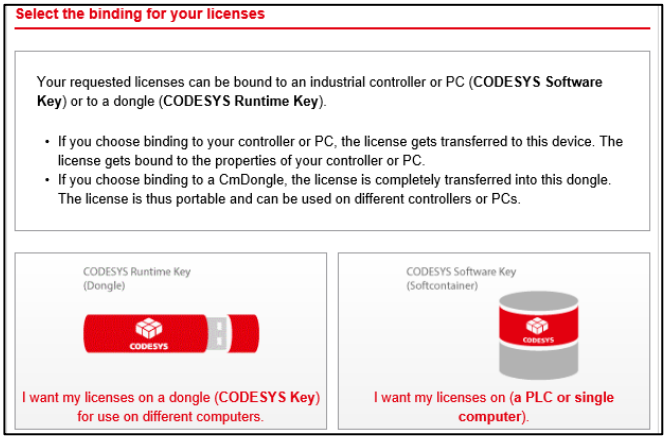
2. Visit the CODESYS license activation site (http://license.codesys.com). Enter the ticket ID shown on the license certificate (included with the product) in the **License key** box. Then click **Next**.



3. The activation status of the license is displayed. Click **Activate licenses**.

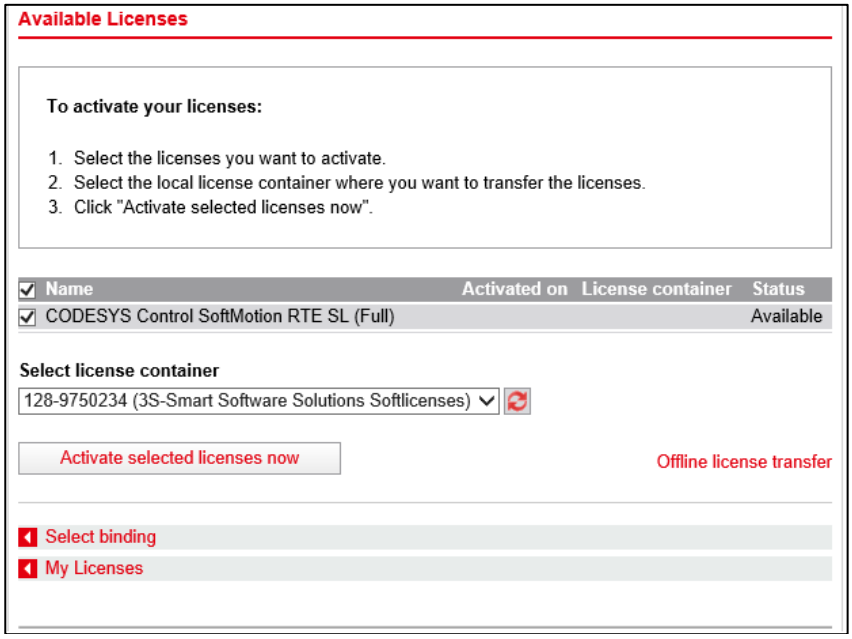


4. Click **CODESYS Software Key (Softcontainer)** as the binding for the license.



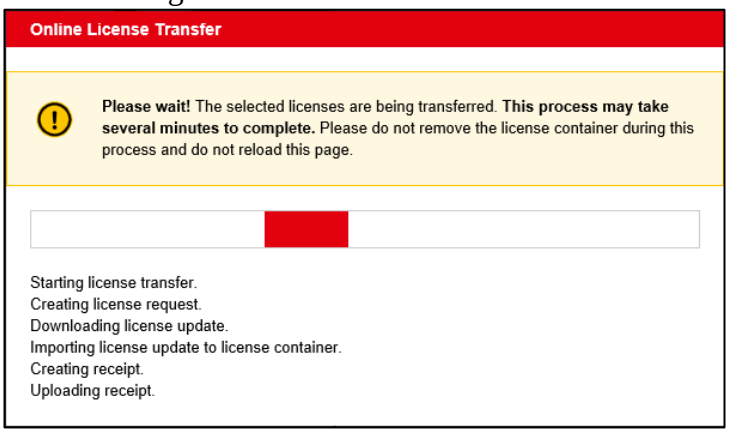
Note: Do not select **CODESYS Runtime Key (Dongle)** (not supported by this device).

5. Select the license container, and click **Activate selected licenses now**.



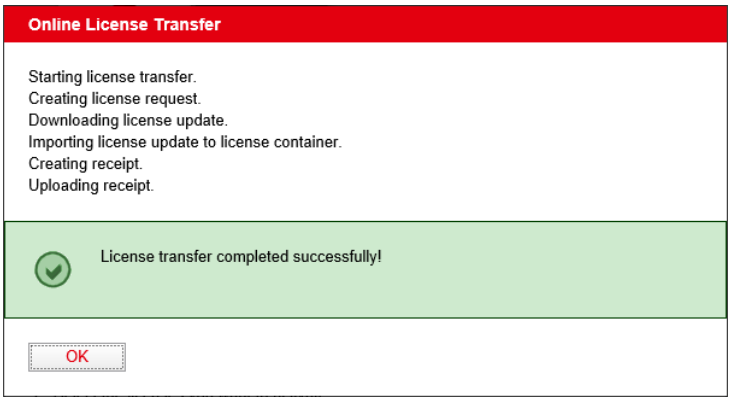
↓

License being activated



↓

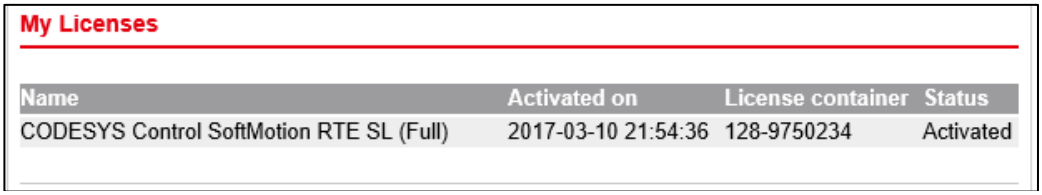
License activated



A window is displayed to indicate that license activation was successful. Click **OK**.

<Confirming the license activation status>

In the window in Step 2, enter the ticket ID in the **License key** box again, and click **Next**. Then you can confirm that the license status has changed to “Activated”. (You cannot reactivate using the same ticket ID.)

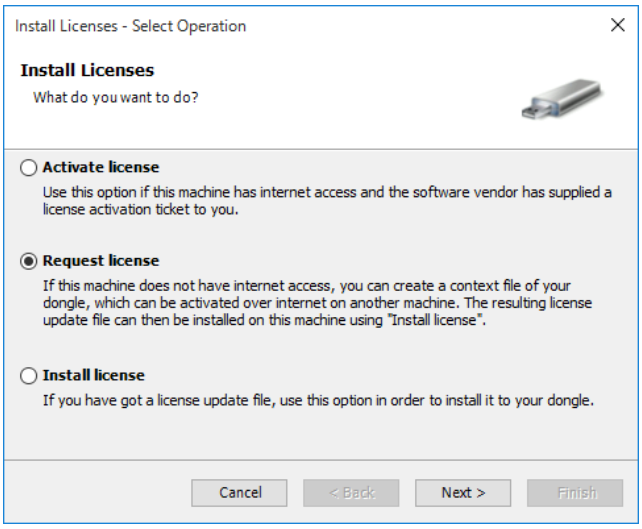


You can also check the display status of the CODESYS Control RTE V3 icon in notification area on the taskbar to see whether the mode has been changed from DEMO to licensed.

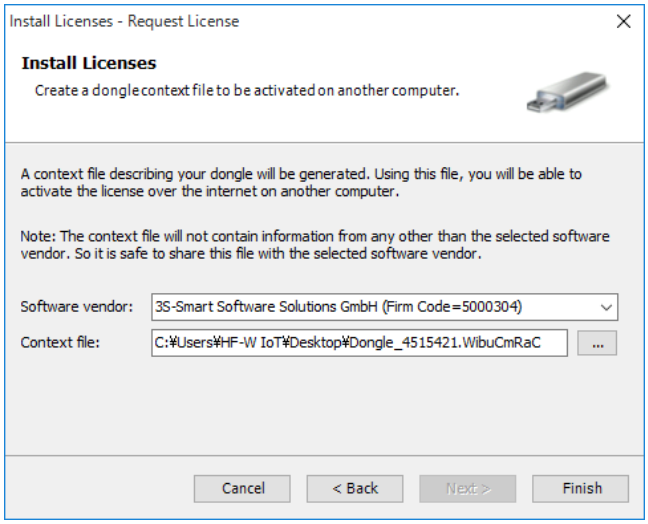
(2) Offline activation

1. Execute Steps 1 to 7 in “(1) Online activation (a) Using the CODESYS development environment”.

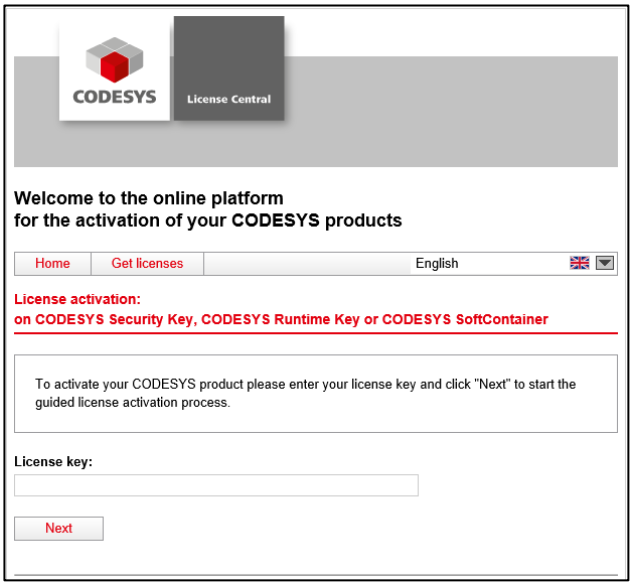
2. The **Select Operation** window is displayed. Select **Request license**, and then click **Next**.



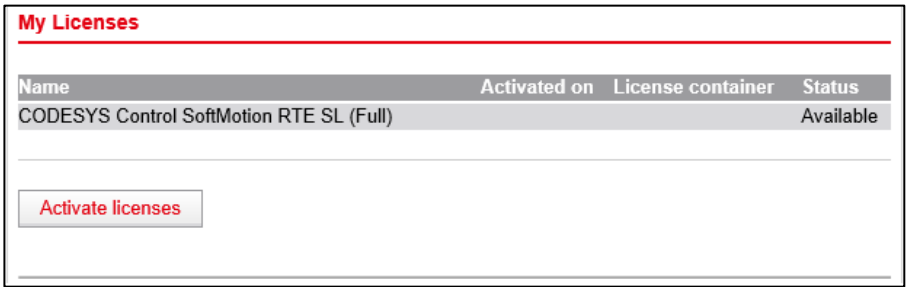
3. The **Request License** window is displayed. Create a request file (WibuCmRaC) to be used in license activation. Specify the Software vendor and the file save location, and click **Finish**.



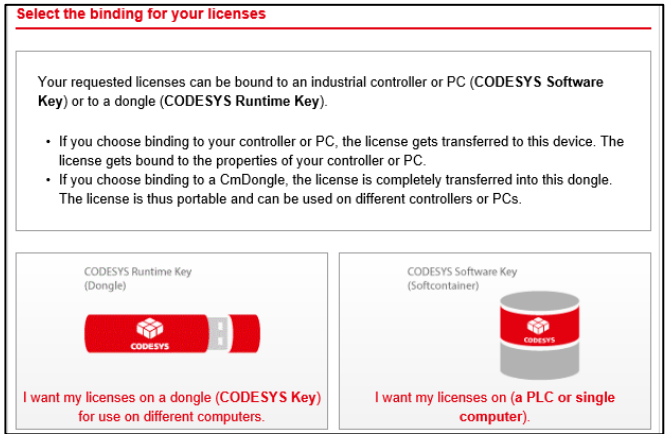
4. Use a PC with Internet access to visit the CODESYS license activation site (http://license.codesys.com). Enter the ticket ID shown on the license certificate (included with the product) in the **License key** box. Then click **Next**.



5. The activation status of the license is displayed. Click **Activate licenses**.

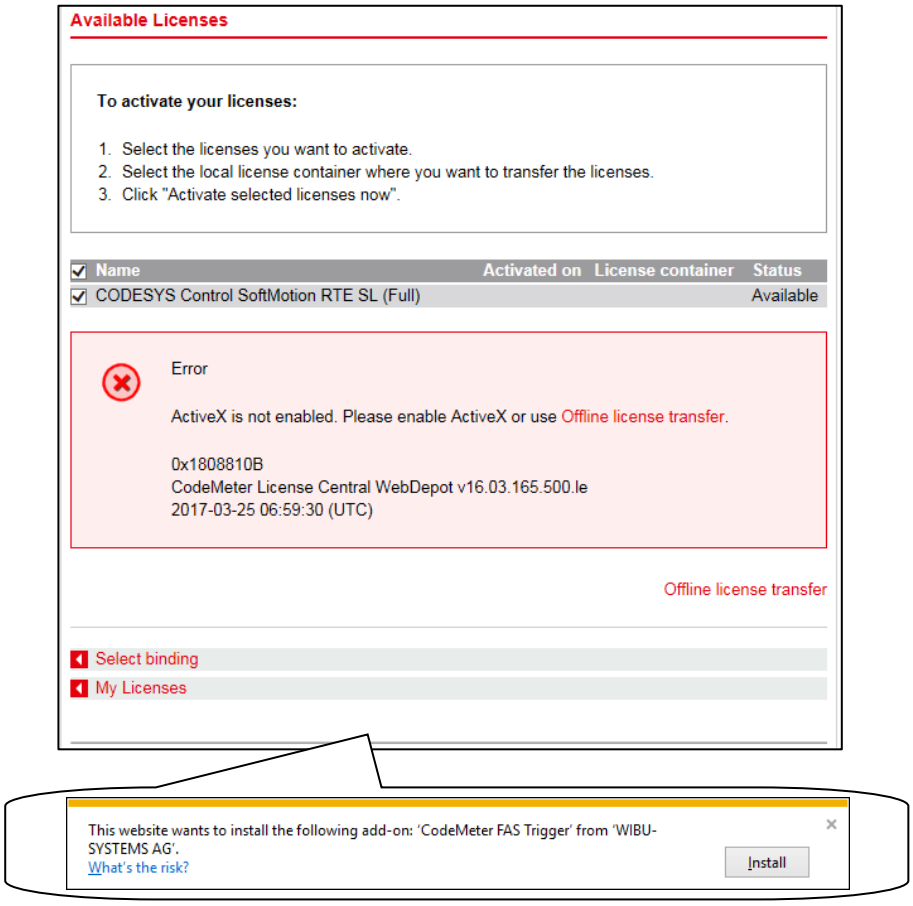


6. Click **CODESYS Software Key (Softcontainer)** as the binding for the license.

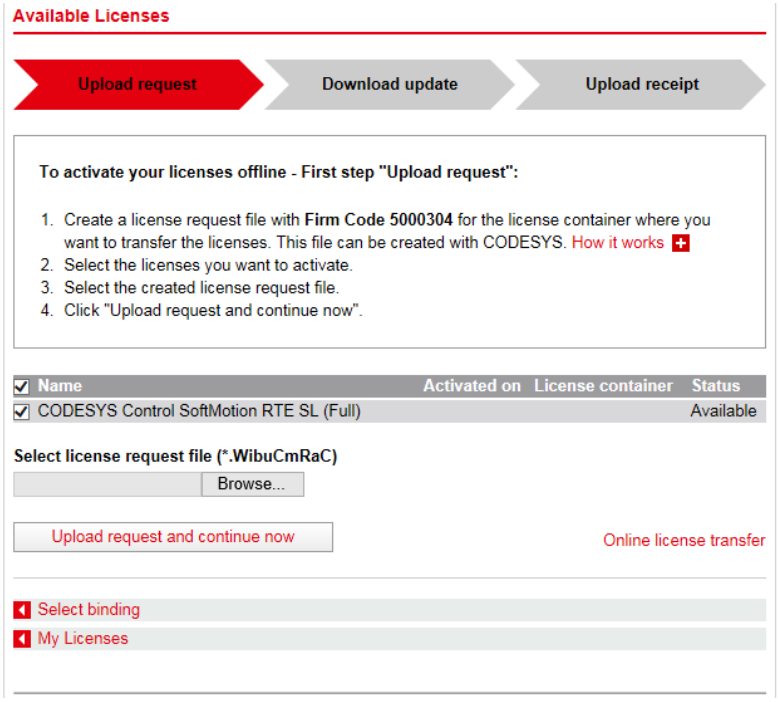


Note: Do not select **CODESYS Runtime Key (Dongle)** (not supported by this device).

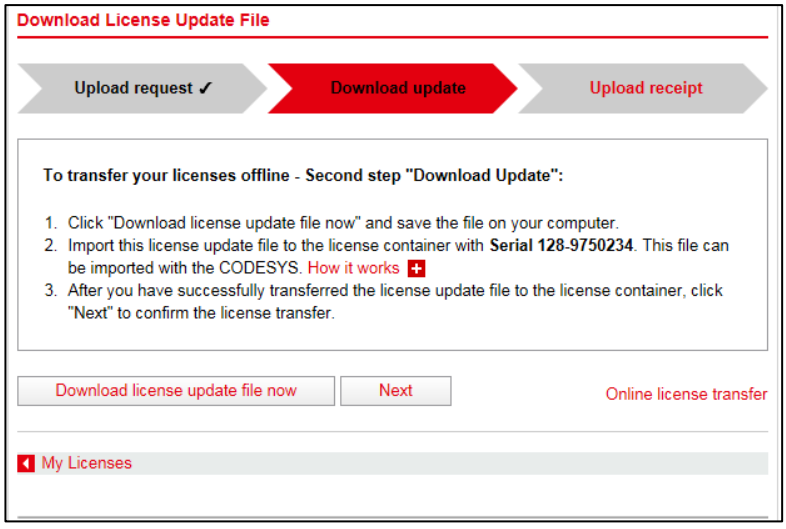
7. To jump to the window for online activation, click the **Offline license transfer** link near the lower right corner. In the following examples, CODESYS is not installed, and therefore, an error message is shown to indicate that the license activation system (CodeMeter) is not supported.
   If you are prompted to install a CodeMeter add-on, you do not have to install the add-on because offline activation is still possible.



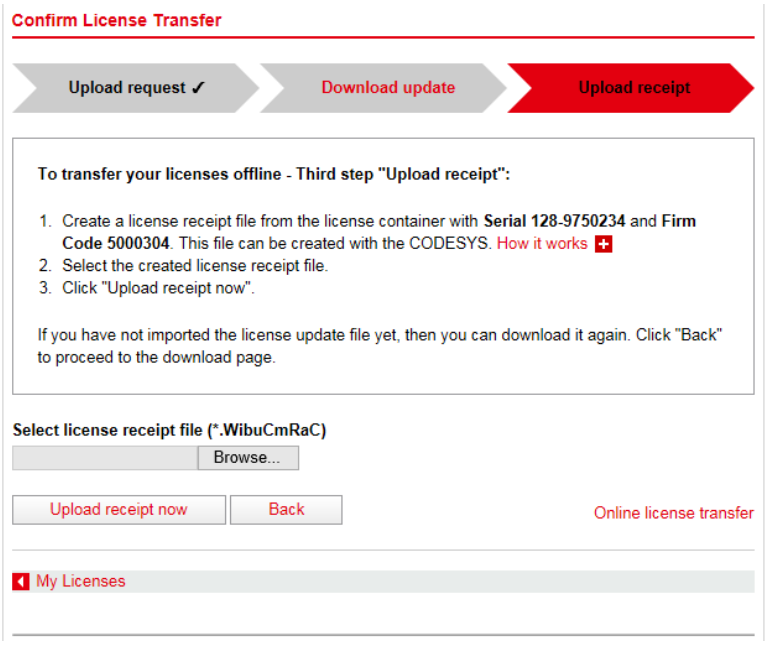
8. In **Select license request file**, specify the path of the request file created in Step 3. Click **Upload request and continue now** to upload the request file.



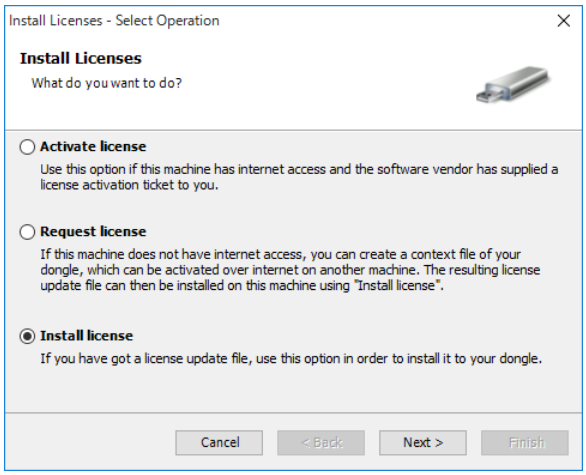
9. Click **Download license update file now** to obtain the license update (WibuCmRaU) file.



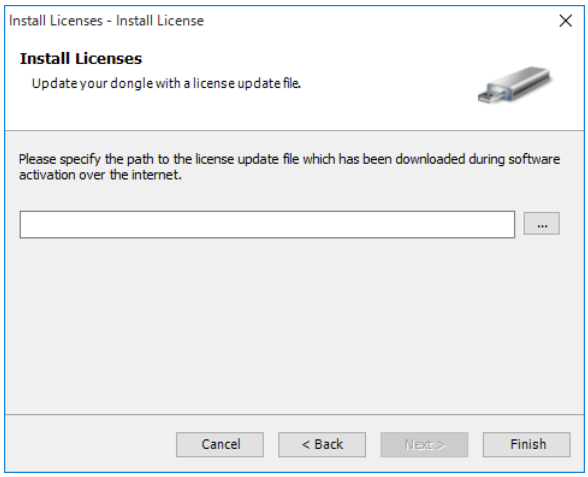
10. The following window is displayed for uploading the result of the license activation, but first execute the following Steps 11 to 13.



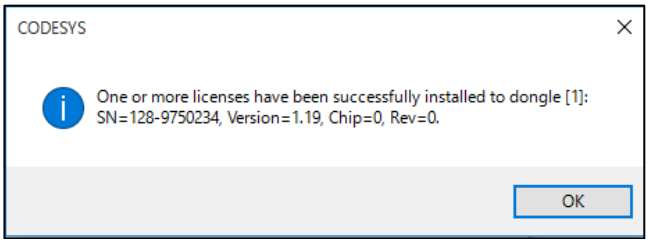
11. In the **Select Operation** window of HF-W100E/IoT, select **Install license**, and then click **Next**.



12. The **Install License** window is displayed. Specify the path of the license update file you obtained in Step 9, and then click **Finish**.



13. If the activation is successful, the following message is displayed. Click **OK**.



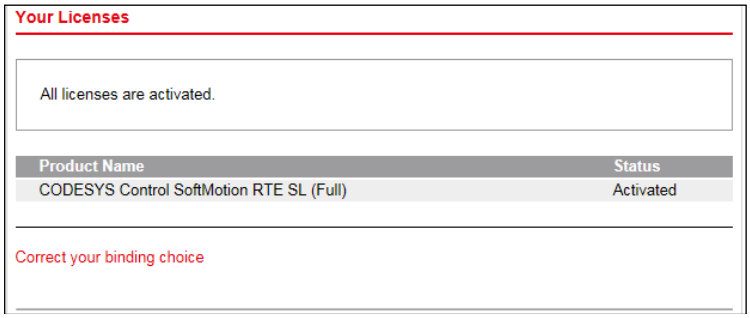
14. In order to report the successful license activation to the license activation site, follow Steps 1 to 3 again and create a new request file (WibuCmRaC).

15. Go back to the PC with Internet access. In **Select license receipt file** in the window in Step 10, specify the path of the request file created in Step 14. Click **Upload receipt now** to upload the result of the license activation.

16. A message is displayed to indicate that the result of the license activation has been reported. Click **OK**.

<Confirming the license activation status>

In the window in Step 4, enter the ticket ID in the **License key** box again, and click **Next**. Then you can confirm that the license status has changed to “Activated”. (You cannot reactivate using the same ticket ID.)



You can also check the display status of the CODESYS Control RTE V3 icon in notification area on the taskbar to see whether the mode has been changed from DEMO to licensed.

2.3 Updating the Network Driver

In the factory settings of HF-W100E/IoT, the Intel® Network driver is used for the built-in LAN (LAN A), and the CODESYS EtherExpress driver is used for the built-in LAN (LAN B and LAN C) to support EtherCAT.
To use the built-in LAN (LAN A) as EtherCAT, or to use the built-in LAN (LAN B and LAN C) as Ethernet (TCP/IP), update network drivers. To update a network driver, follow the procedure below:

NOTE

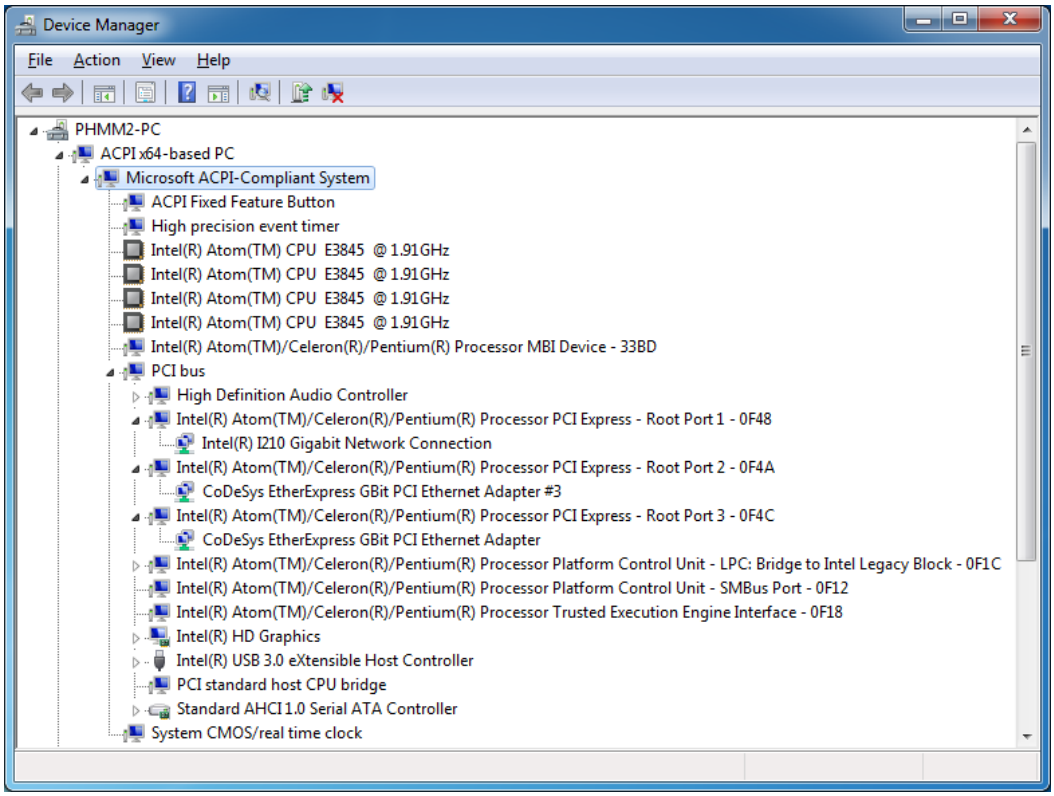
This product may record the following events in the event log during update the CODESYS EtherExpress driver to the Intel® Network driver. These events do not affect the operation of the system.

Event ID	Source	Type	Description
10317	NDIS	Error	Miniport (*1), {(*2)}, had event Fatal error: The miniport has detected an internal error

(*1) shows the network adapter name.
(*2) shows the GUID.

1. Log on to the computer as an administrator account.
2. Open **Control Panel**.
   • If the OS is Windows® Embedded Standard 7, click **Start**, and click **Control Panel**.
   • If the OS is Windows® 10, right-click **Start**, and click **Control Panel** from the menu.
3. Click **Start** > **Control Panel** > **System and Security**. Click the **System** icon, and then **Device Manager**.
4. The **Device Manager** window appears. Click the **View** menu, and select **Devices by connection**.
5. If the OS is Windows® Embedded Standard 7, expand **ACPI x64-based PC** > **Microsoft ACPI-Compliant System** > **PCI bus**.
   If the OS is Windows® 10, expand **ACPI x64-based PC** > **Microsoft ACPI-Compliant System** > **PCI Root Complex**.

6. As in the following example, right-click on the network adapter where you want to update the driver. Then a menu appears. Click **Update Driver Software**.
   The following screenshot is just an example. Be aware that network adapter names are displayed differently for the HF-W100E/IoT.



<To update the driver for built-in LAN (LAN A)>
Click **Intel(R) Atom(TM)/Celeron(R)/Pentium(R) Processor PCI Express – Root Port1 – 0F48**. Then, right-click on the network adapter displayed below (in the example above, **Intel(R) I210 Gigabit Network Connection** (*)).

<To update the driver for built-in LAN (LAN B)>
Click **Intel(R) Atom(TM)/Celeron(R)/Pentium(R) Processor PCI Express – Root Port2 – 0F4A**. Then, right-click on the network adapter displayed below (in the example above, **CoDeSys EtherExpress GBit PCI Ethernet Adapter #3** (*)).

<To update the driver for built-in LAN (LAN C)>
Click **Intel(R) Atom(TM)/Celeron(R)/Pentium(R) Processor PCI Express – Root Port3 – 0F4C**. Then, right-click on the network adapter displayed below (in the example above, **CoDeSys EtherExpress GBit PCI Ethernet Adapter #2** (*)).

(*) Network adapter names are displayed differently for the HF-W100E/IoT.

7. The **Update Driver Software** window appears. Click **Browse my computer for driver software**.
8. Click **Let me pick from a list of device drivers on my computer**.
9. Select a new driver you want to update, and then click **Next**.

   <To use a port as Ethernet (TCP/IP)>
   Select **Intel(R) 210 Gigabit Network Connection**, and then click **Next**.
   Note: If the OS is Windows® 10, two [Intel (R) 210 Gigabit Network Connection] are displayed, select the upper side.

   <To use a port as EtherCAT>
   Select **CoDeSys EtherExpress GBit PCI Ethernet Adapter**, and then click **Next**.

10. A message is displayed to indicate that the driver has been successfully updated. Confirm the message, and then click **Close**.

This completes the installation of the driver. Restart the HF-W100E/IoT.

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CHAPTER 3 CREATING A PLC PROGRAM

3.1 PLC Program Creation Procedure

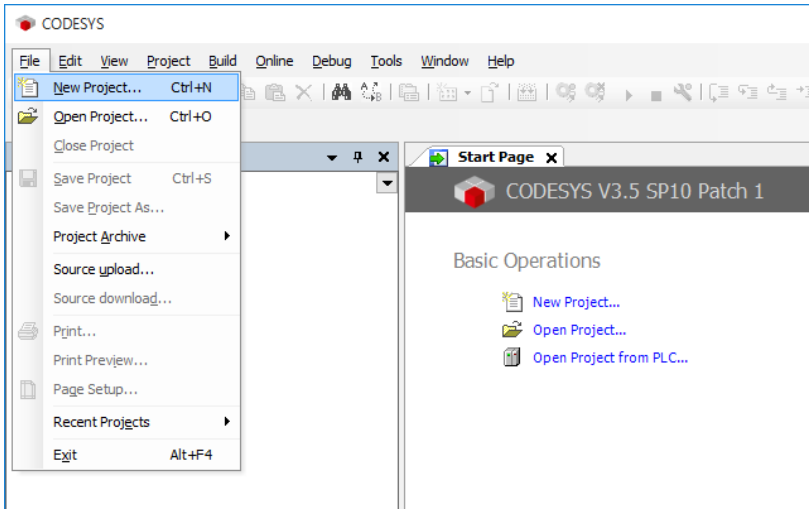
3.1.1 Creating a project

The following shows how to create a new project.

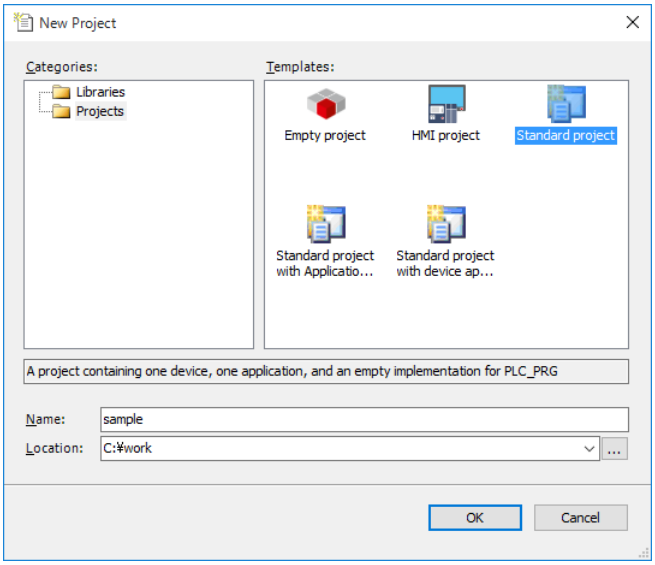
1. Start the CODESYS development environment in the following steps. Wait until the startup process is complete. Be aware that it may take dozens of seconds.
   - If the OS is Windows® Embedded Standard 7, click **Start**, and click **All Programs** > **3S CODESYS** > **CODESYS** > **CODESYS V3.5 SP10 Patch1**.
   - If the OS is Windows® 10, click **Start**, and click **3S CODESYS** > **CODESYS** > **CODESYS V3.5 SP10 Patch1** from the list of applications.

   (Alternatively, double-click the **CODESYS V3.5 SP10 Patch1** icon on the desktop.)

2. Click the **File** menu, and on the menu, click **New Project**.



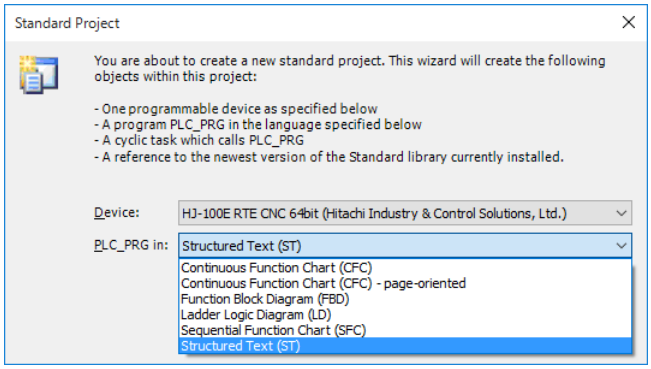
3. The **New Project** window is displayed. Select **Standard project** under **Templates**. Specify a project name for **Name** and a save location for **Location**, and then click **OK**.



4. Select a device to run and a programming language (language for PLC_PRG) to use, and then click **OK**.
   • The device differs depending on the model you purchased. Select one of the following. A device not described in the following table can be selected but it will not be supported in HF-W100E/IoT.

Model	Device
Motion model	HJ-100E RTE SoftMotion 64bit (Hitachi Industry & Control Solutions, Ltd.)
CNC model	HJ-100E RTE CNC 64bit (Hitachi Industry & Control Solutions, Ltd.)

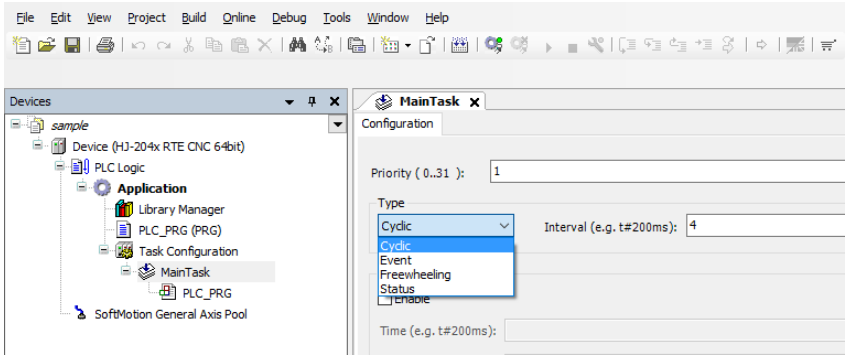
   • For **PLC_PRG in**, specify a language to use.
   In the figure below, **Structured Text (ST)** is selected as an example.



3.1.2 Creating a PLC program

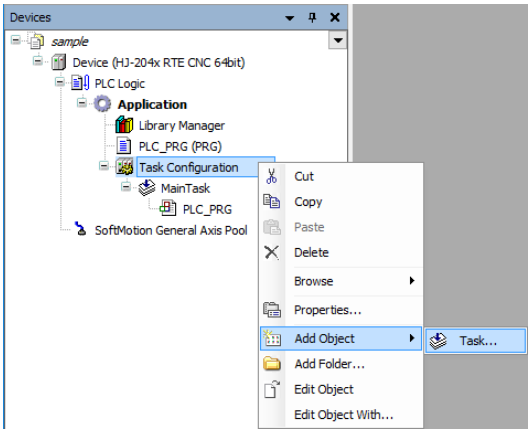
(1) Task configuration

1. Double-click **MainTask** in the **Devices** window to display a window for setting up the task configuration.
   In the **MainTask** tab, you can set task priority, type, and interval.

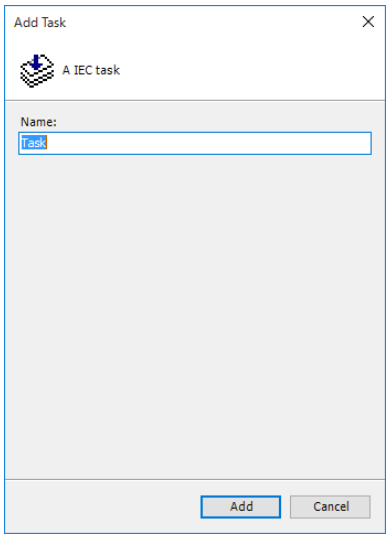


■ Adding a task

1. If you want to add a task, in the right-click menu on **Task Configuration** in the **Devices** window, click **Add Object** > **Task**.

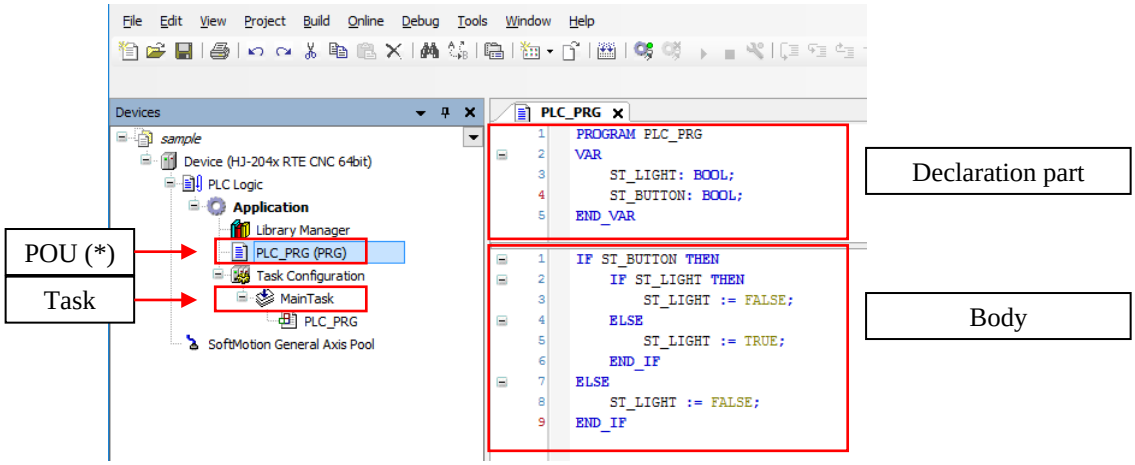


2. The **Add Task** window is displayed. Enter the task name, and then click **Add**.



(2) Creating a program

1. Double-click **PLC_PRG (PRG)** in the **Devices** window to display a window for creating a program. You can create a program in the **PLC_PRG** tab. In the declaration part in the upper pane, define variables. In the body in the lower pane, describe an algorithm.

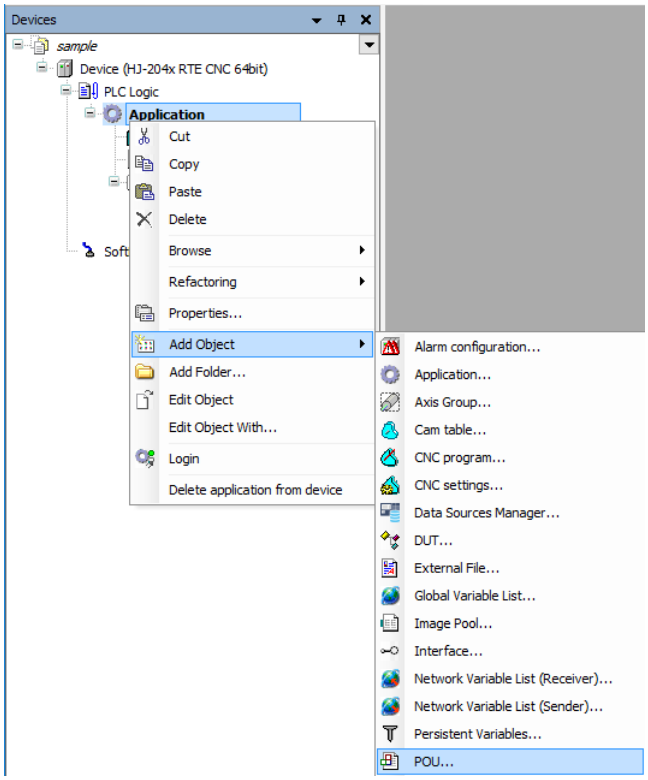


(*) POU is a program unit. Each POU is made of a declaration part and a body. Only one programming language can be used in one POU. If you want to use multiple programming languages, you must add a POU for each language.

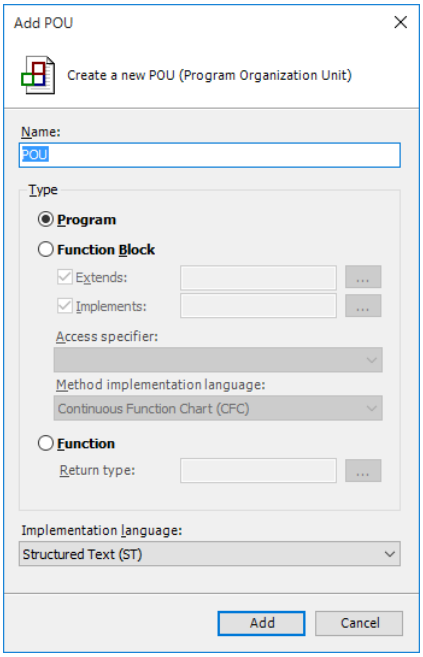
■ Adding a POU

To add a POU, follow the procedure below.

1. In the right-click menu on **Application** in the **Devices** window, click **Add Object** > **POU**.



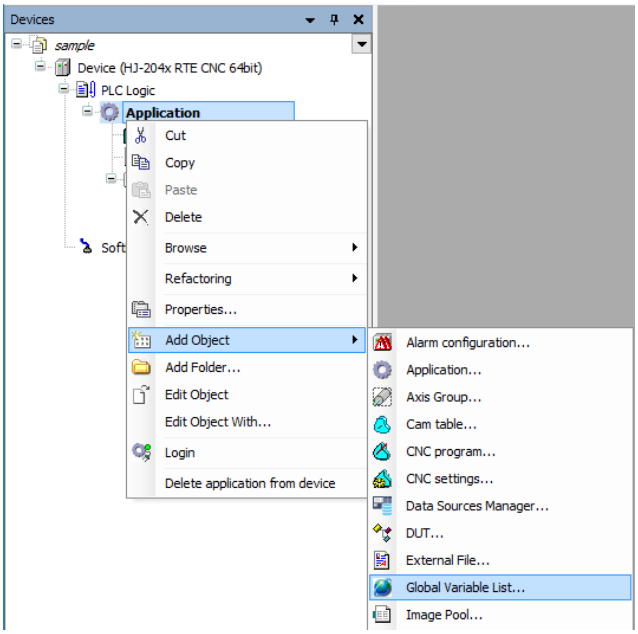
2. The **Add POU** window is displayed. Enter the POU name, configure the type and the implementation language, and then click **Add**.



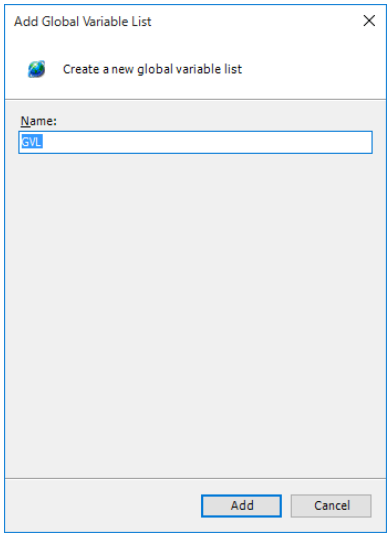
■ Creating global variables

To add global variables, follow the procedure below.

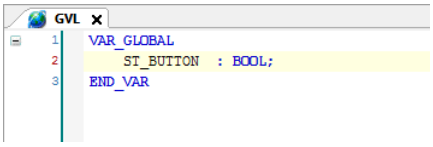
1. In the right-click menu on **Application** in the **Devices** window, click **Add Object** > **Global Variable List**.



2. The **Add Global Variable List** window is displayed. Enter a name, and then click **Add**.

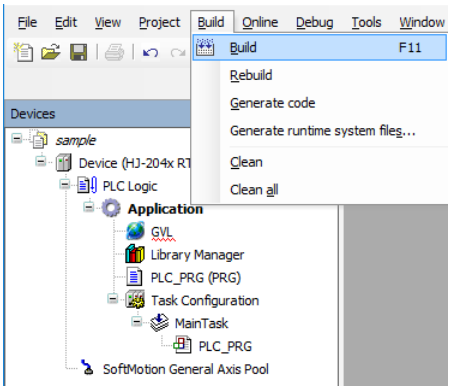


3. You can add global variables in the new **Global Variable List**.



3.1.3 Building a PLC program

1. After you finish creating a program, click the **Build** menu, and on the menu, click **Build**. (Alternatively, click the build icon on the toolbar.)

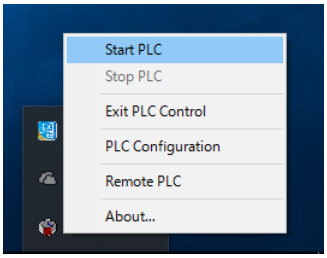


3.1.4 Starting PLC

Start PLC to run a PLC program.
For information about how to start PLC automatically when the device starts, see "(2) Starting PLC automatically".

(1) Starting PLC manually

1. Click the CODESYS Control RTE V3 icon in notification area on the taskbar. (The icon is hidden by default, and you must click "^" to find it.) Then click **Start PLC**.



Notes 1: Wait until the startup process is complete. Be aware that it may take dozens of seconds.
2: To stop PLC, click **Stop PLC**.

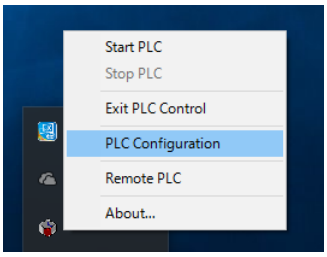
NOTE

When you start PLC by clicking **Start PLC** or stop PLC by clicking **Stop PLC**, the process may take dozens of seconds to complete.
Because of that, after you start (or stop) PLC, wait at least one minute before you stop (or start) PLC.

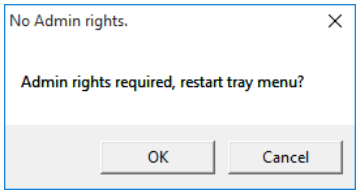
(2) Starting PLC automatically

If you enable the following settings, PLC will automatically start when the device starts.

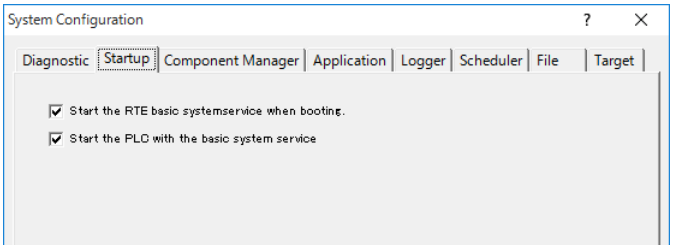
1. Click the CODESYS Control RTE V3 icon in notification area on the taskbar. (The icon is hidden by default, and you must click "^" to find it.) Then click **PLC Configuration**.



2. If a window is displayed to indicate that admin rights are required, click **OK** to obtain the admin rights. If the **User Account Control** window is displayed, click **Yes**. When the admin rights are granted, click the icon again, and then click **PLC Configuration**.



3. The **System Configuration** dialog box is displayed. Click the **Startup** tab, select the **Start the PLC with the basic system service** checkbox and the **Start the RTE basic systemservice when booting** checkbox, and then click **OK**.



Setting item	Meaning
Start the RTE basic systemservice when booting	The RTE system service is started when Windows starts.
Start the PLC with the basic system service	PLC is started when the RTE system service starts.

Note: To cancel the PLC auto start, clear **Start the PLC with the basic system service** checkbox, and then click **OK**.

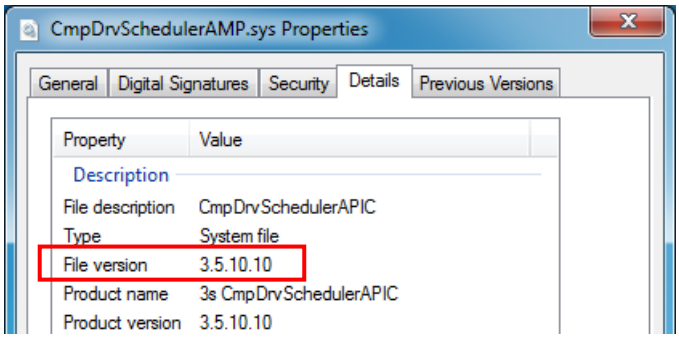
Then, PLC will start automatically when the device starts next time.

NOTE

In Windows® Embedded Standard 7, if the version of the CODESYS scheduler (file name: CmpDrvSchedulerAMP.sys) is "3.5.10.10" and you enable these settings in an attempt to start PLC automatically when Windows starts, a blue screen or a reset might occur in rare cases. This symptom occurs less frequently if the start timing of PLC is delayed. This is why “RTE system service auto start task” (delay: 3 minutes) is registered to Windows Task Scheduler to delay the start timing of PLC.

※The procedure for checking the CODESYS scheduler version is as follows.

1. Start Windows Explorer and open C:\Windows\System32\drivers.
2. Right-click the CmpDrvSchedulerAMP.sys file, and then click **Properties**.
3. Click **Details** tab.

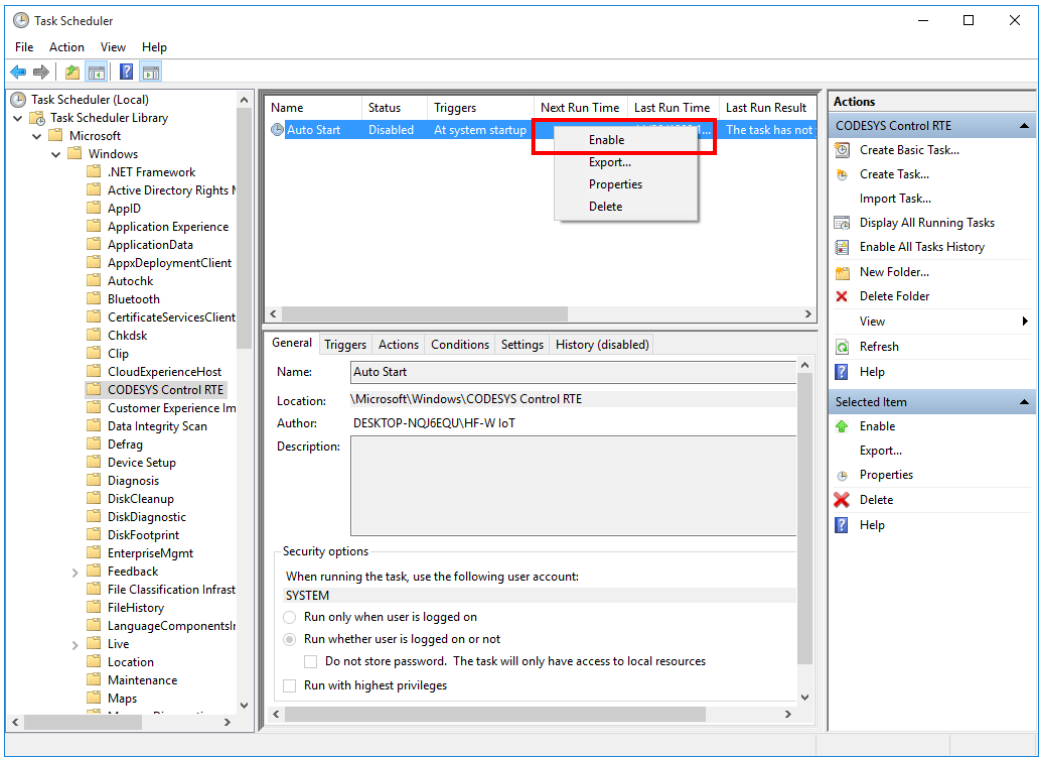


<u>If you want to start the PLC automatically when the CODESYS scheduler version is "3.5.10.10", perform the following settings (a) and (b).</u>

(a) Enabling the CODESYS RTE system service auto start task

1. Open **Control Panel**.
   Click **Start**, click **Control Panel**.
2. Click **System and Security**, click **Administrative Tools**.
3. Double-click **Task Scheduler**.
4. In the console tree, click **Microsoft** > **Windows** > **CODESYS Control RTE**.

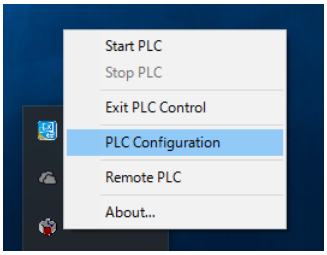
5. In the console window, right-click the **Auto Start** task, and on the menu, click **Enable**.



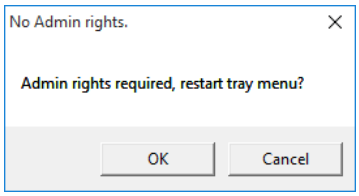
Note: To cancel the PLC auto start, right-click the **Auto Start** task, and on the menu, click **Disable**.

(b) Changing the PLC configuration

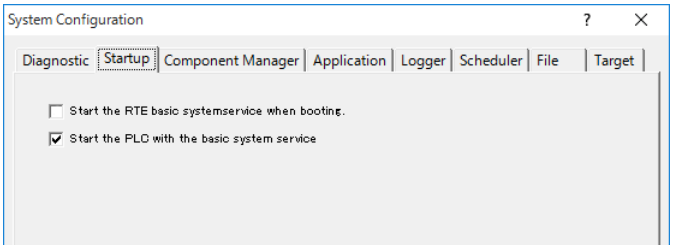
1. Click the CODESYS Control RTE V3 icon in notification area on the taskbar. (The icon is hidden by default, and you must click "^" to find it.) Then click **PLC Configuration**.



2. If a window is displayed to indicate that admin rights are required, click **OK** to obtain the admin rights. If the **User Account Control** window is displayed, click **Yes**. When the admin rights are granted, click the icon again, and then click **PLC Configuration**.



3. The **System Configuration** dialog box is displayed. Click the **Startup** tab, select only the **Start the PLC with the basic system service** checkbox, and then click **OK**. Make sure that you clear the **Start the RTE basic systemservice when booting** checkbox.

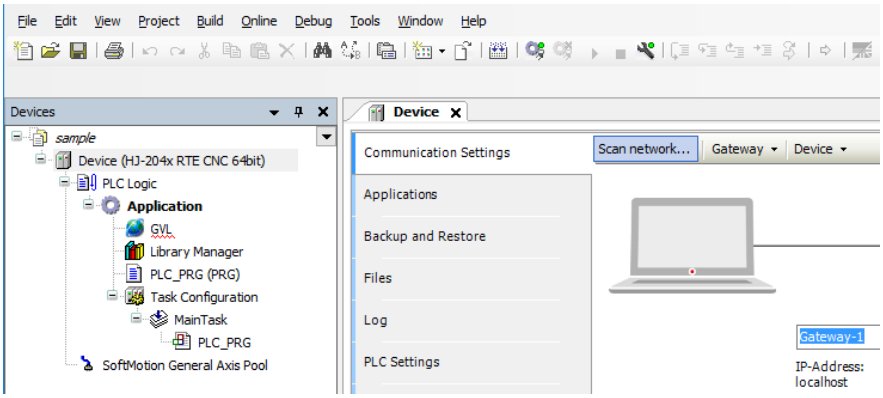


Note: To cancel the PLC auto start, clear **Start the PLC with the basic system service** checkbox, and then click **OK**.

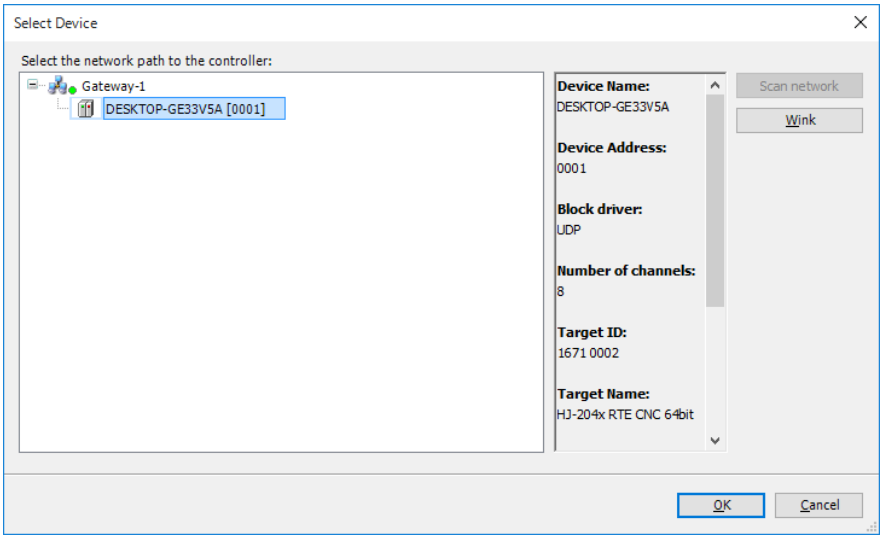
Then, PLC will start automatically when the device starts next time.

3.1.5 Running a PLC program

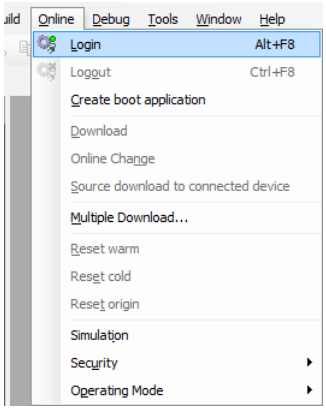
1. Double-click **Device (*****)** in the **Devices** window to display a window for setting up device configuration. ((*****) shows the selected device name.)



2. Click **Scan network** to display the **Select Device** window.
   In the **Select Device** window, select the device you want to connect to, and click **OK**.



3. After the device is connected, click the **Online** menu, and on the menu, click **Login**.
   (Alternatively, click the login icon on the toolbar.)

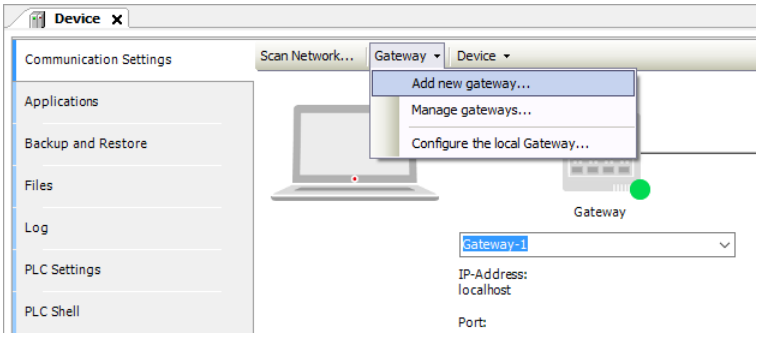


■ Selecting another device as a device to run

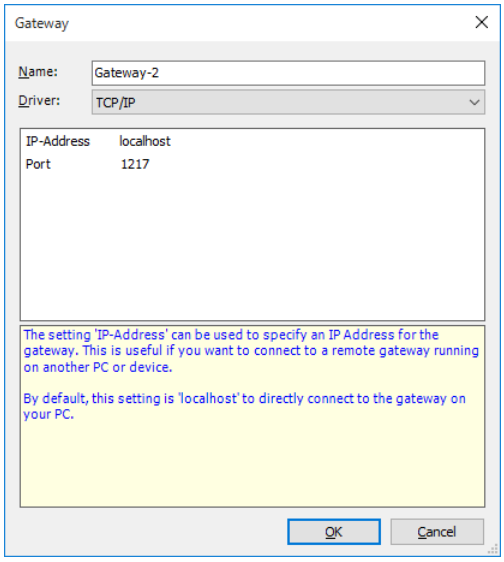
To connect another device and select the device as a device to run, follow the procedure below.

Note that, in order to connect to another device, PLC must be running on the device.

1. Double-click **Device (*****)** in the **Devices** window to display a window for setting up device configuration. ((*****) shows the selected device name.)
2. In the **Communication Settings** window, click **Gateway**. On the menu, click **Add new gateway** to open a window for adding a new gateway.



3. In the **Select Device** window, select the device you want to connect to, and click **OK**. Enter **IP-Address** and **Port** for the new device, and click **OK**.
   Note that, if you specify “localhost” for **IP-Address**, you can connect to a device connected as “localhost”.



4. In the **Communication Settings** window, click **Scan network** to display the **Select Device** window. Select the new device, and click **OK**.

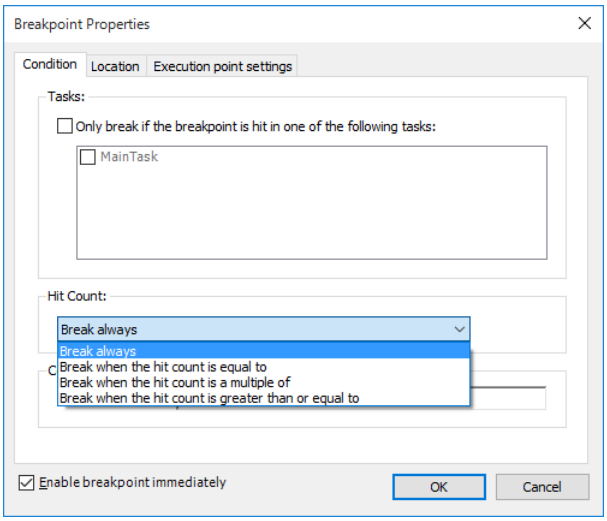
3.1.6 Debugging a PLC program

(1) Setting a breakpoint

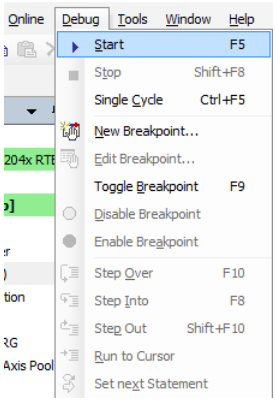
You can set a breakpoint to stop a program at any location.

1. To set a breakpoint, right-click on a line where you want to set a breakpoint, and on the menu, click **New Breakpoint**.

2. The **Breakpoint Properties** window is displayed. Under **Hit Count**, select a break condition. Select **Enable breakpoint immediately**, and click **OK**.



3. Click the **Debug** menu, and on the menu, click **Start**. (Alternatively, click the start icon on the toolbar.)

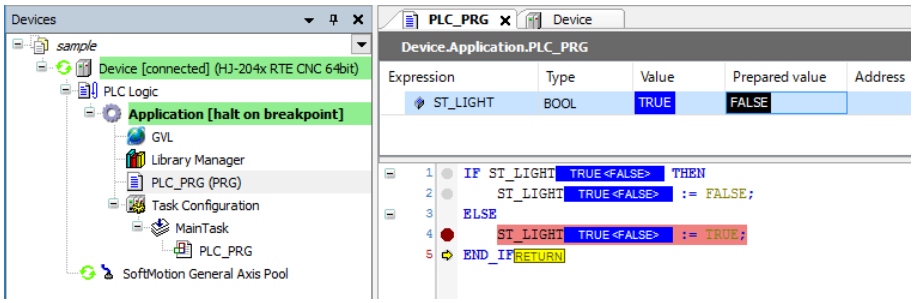


4. The program stops at the line with the breakpoint.

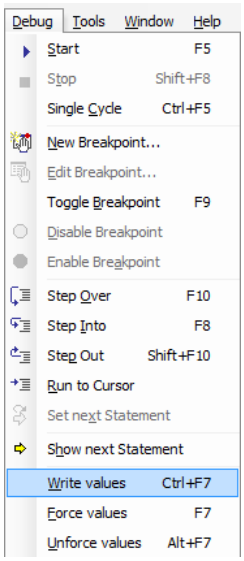
(2) Writing a value

You can write a value to a variable while the program is running.

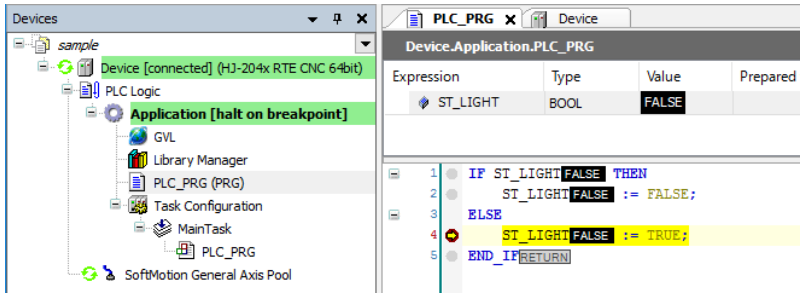
1. Enter a value (example: FALSE) in **Prepared value** while the program is running. In the body, the value is shown as “TRUE <FALSE>”.



2. Click the **Debug** menu, and on the menu, click **Write values**. (Alternatively, press **Ctrl** + **F7**.)



3. At the next cycle, the “Value” is changed to the value shown as “Prepared value” (example: FALSE).



3.2 Programming Languages

In CODESYS, you can program using the programming languages defined in IEC 61131-3 (Structured Text (ST), Ladder Diagram (LD), Function block diagram (FBD), and Sequential Function Chart (SFC)) as well as the CODESYS proprietary language Continuous Function Chart (CFC).

Programming languages	Description
Structured Text	Language suitable for numerical calculation and logical expression
Ladder Diagram	Language that describes logic circuits
Function Block Diagram	Graphical language that combines multiple functions into one
Sequential Function Chart	Language that describes the chronological order of the control
Continuous Function Chart	Graphical programming language based on FBD

For details about each programming language, refer to the following topic in the online help.

- CODESYS Development System > Reference, Programming > Programming Languages and their Editors

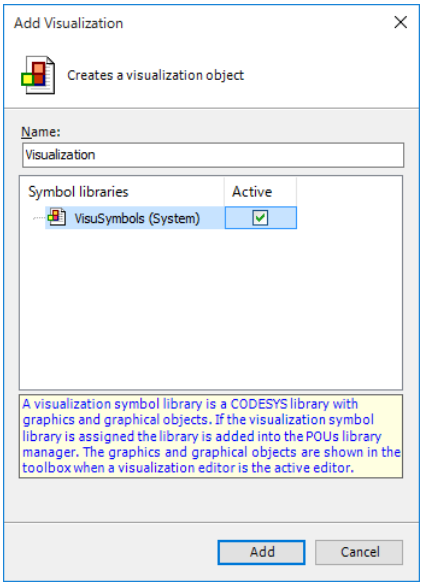
3.3 Visualization Objects

CODESYS offers visualization features for creating a graphical user interface.
This section shows how to add and run a typical visualization object, Lamp.
For details about visualization features, refer to the following topic in the online help.
• CODESYS Visualization

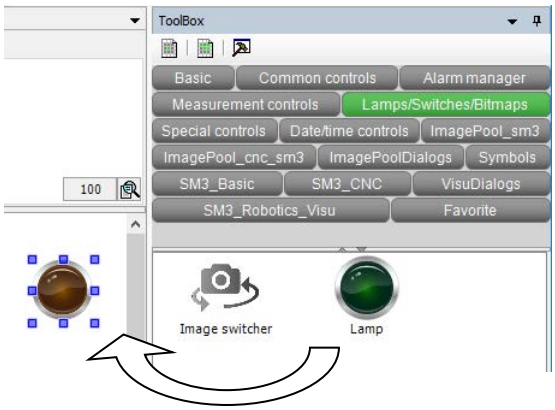
(1) Creating a visualization object

1. To add a visualization object, right-click **Application** in the **Devices** window, and on the menu, click **Add Object** > **Visualization**.

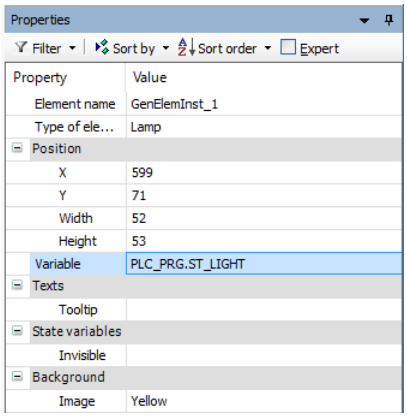
2. The **Add Visualization** window is displayed. Select the **Active** checkbox for **VisuSymbols (System)**, and then click **Add**.
   After the visualization is added, the **ToolBox** window appears.



3. In the **ToolBox** window, click **Lamps/Switches/Bitmaps**, and drag and drop the Lamp1 icon onto the visualization editor.

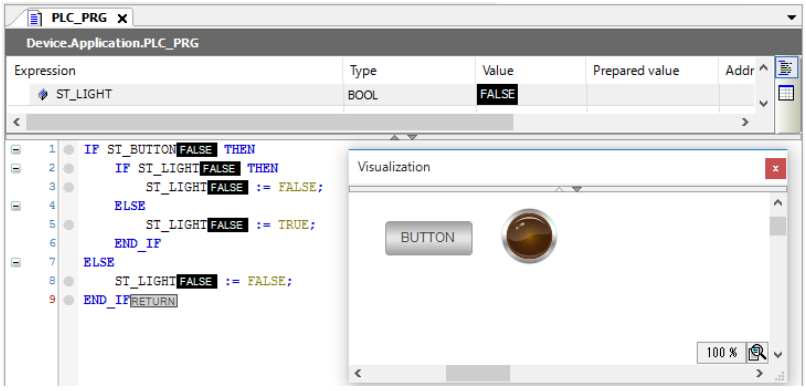


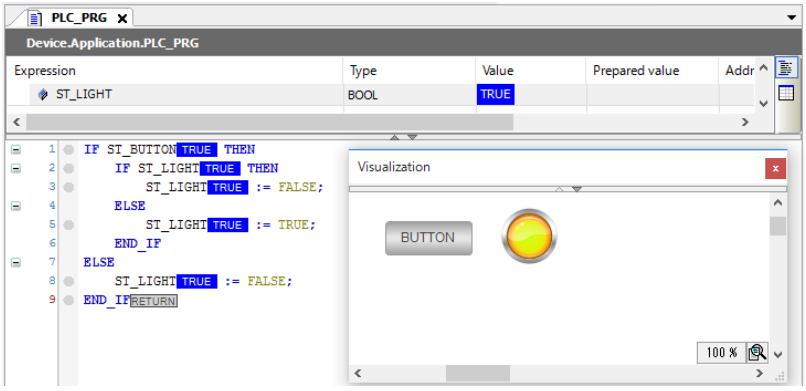
4. Select the created Lamp. The **Properties** window is displayed. In the **Properties** window, you can change the settings of the Lamp. For example, by clicking **Position** > **Variable**, you can specify a variable output to the Lamp.



<Running an object>

1. Build, login, and then run the object.
   Whenever the variable is switched between FALSE and TRUE, the created Lamp turns on or off accordingly.

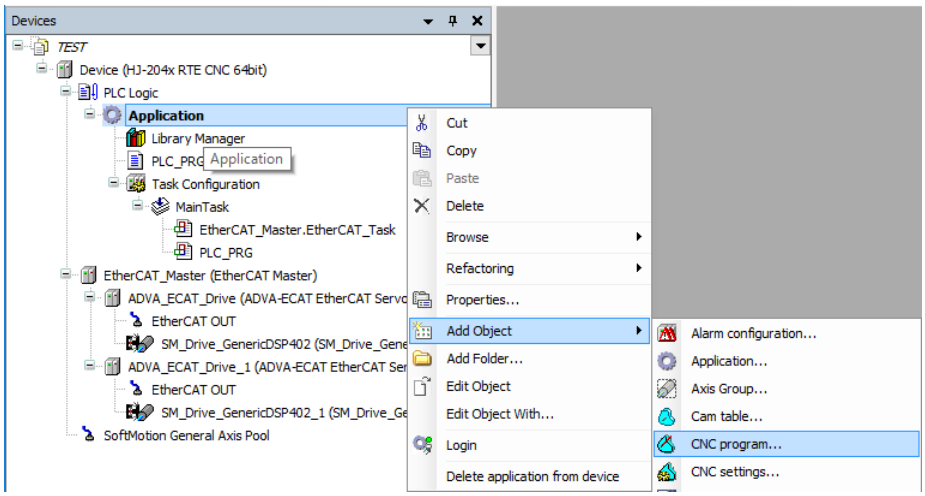




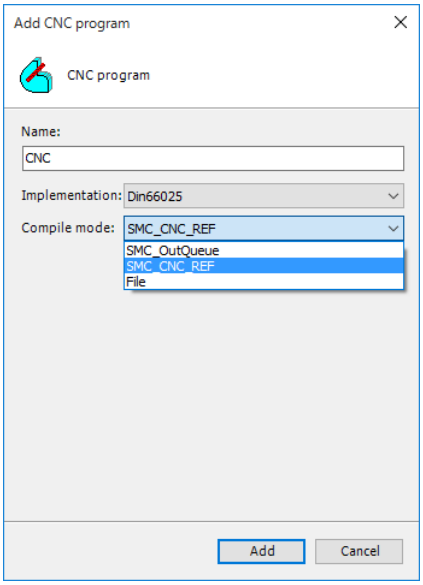
3.4 Creating and Setting Up a G-Code

(1) Adding an object

1. In the right-click menu on **Application** in the **Devices** window, click **Add Object** > **CNC program**.
   (In the following, the project created in "4.2 Configuration for Using Servo Amplifiers and Servo Motors" is used.)



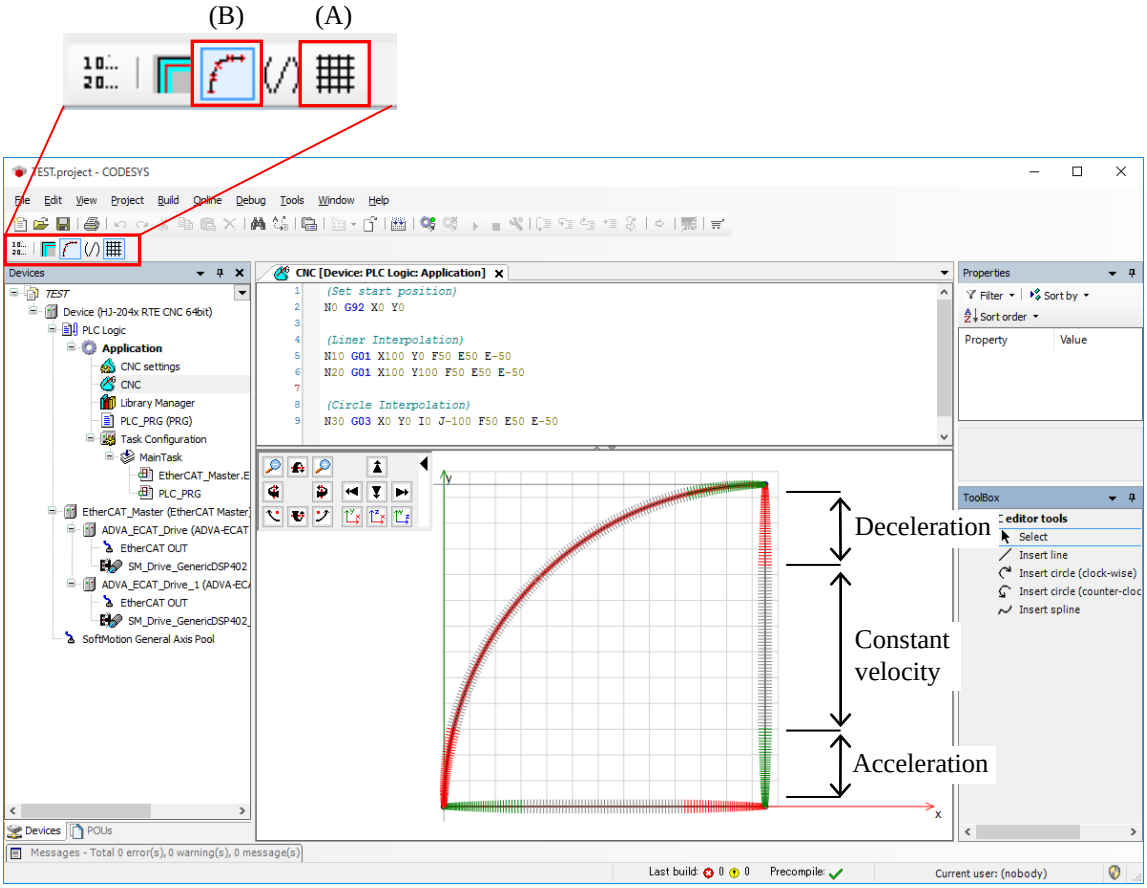
2. The **Add CNC program** window is displayed. Select **Din66025** for **Implementation** and **SMC_CNC_REF** for **Compile mode**. Then click **Add**.



(2) Creating a G-code

1. Double-click **CNC** in the **Devices** window to display a window for creating a G-code.

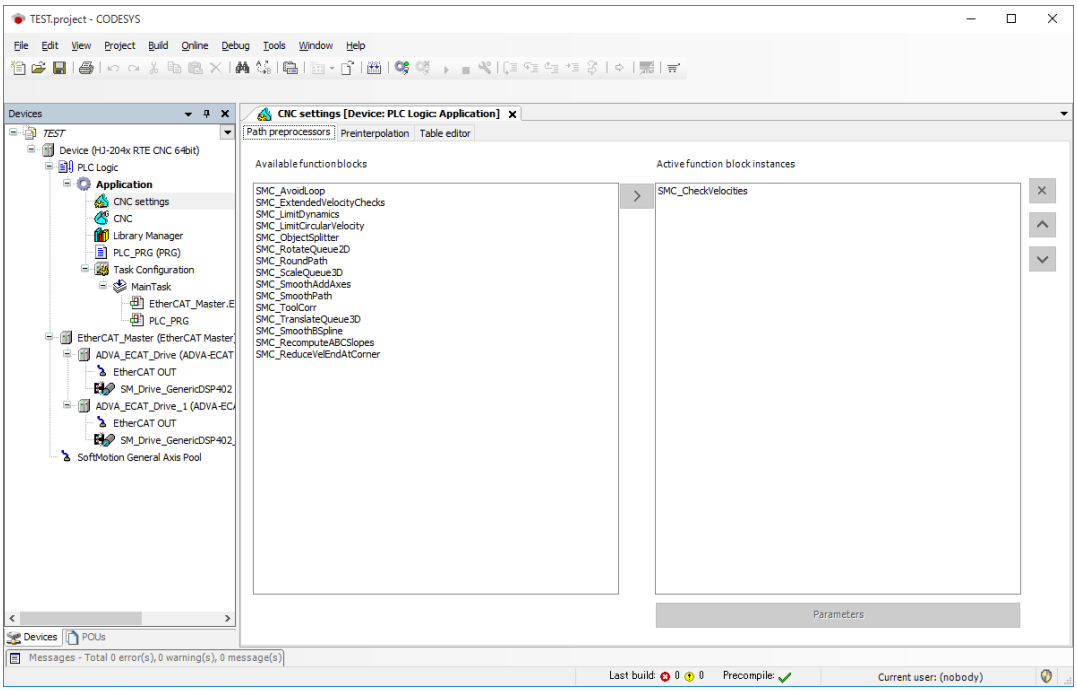
2. If you click a meshed icon ((A) in the following figure) on the menu near the upper left corner of the window, an auxiliary line is shown. Moreover, if you click an icon with a line and dots ((B) in the following figure), the acceleration, deceleration, and constant velocity sections of the track created by the G-code are shown color-coded.
   Note that if you make changes in either the G-code or the Graphic Editor, the other is automatically updated.



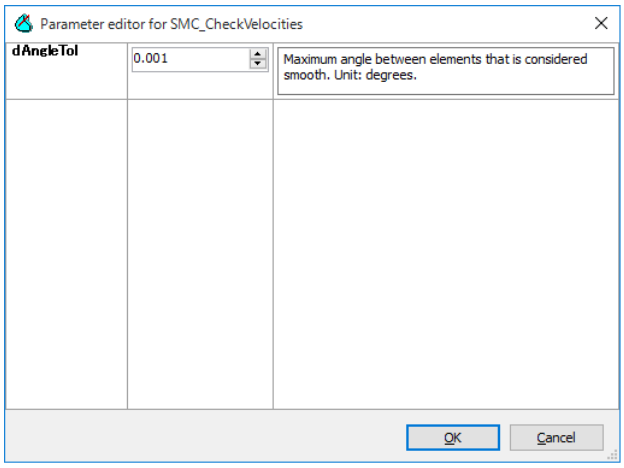
(3) CNC settings

1. Double-click **CNC settings** in the **Devices** window to display a window for CNC settings.

2. Click the **Path preprocessors** tab to display a list of **Available function blocks**. Select the function block you want to use, and then click >.
   The function block is registered under **Active function block instances**.



3. Select the registered function block, and click **Parameters**. The **Parameter editor** window for the function block is displayed. Set up the parameters as required.



For details about G-codes, CNC, and SoftMotion, refer to the following topic in the online help.

• Add-ons > SoftMotion

3.5 Reset Action When an Error Occurs

The CODESYS runtime environment stops executing a program when exceptions such as a watchdog timer timeout error are detected. You can reset these exceptions with a reset action. Reset actions include three types of resets: warm up reset, cold reset, and reset (PLC initialization).

For details about each reset action, refer to the following topic in the online help.

• CODESYS Development System > Reference, User Interface > Commands > 'Online'

For information about the behavior of remanent variables at each reset action, refer to the following topic in the online help.

• CODESYS Development System > Reference, Programming > Variable Types and special Variables > Remanent Variables - RETAIN, PERSISTENT "Overview table for the behavior with RETAIN and PERSISTENT declared variables"

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CHAPTER 4 CONFIGURATION OF EtherCAT CONNECTION

This chapter explains how to configure EtherCAT. Use the procedure that fits your needs.
• When I/O modules are used
• When servo amplifiers and servo motors are used

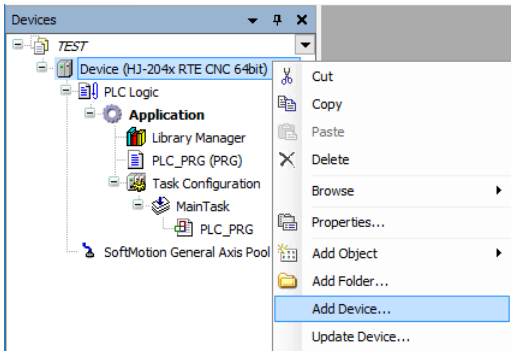
4.1 Configuration for Using I/O Modules

4.1.1 Adding EtherCAT devices (I/O modules)

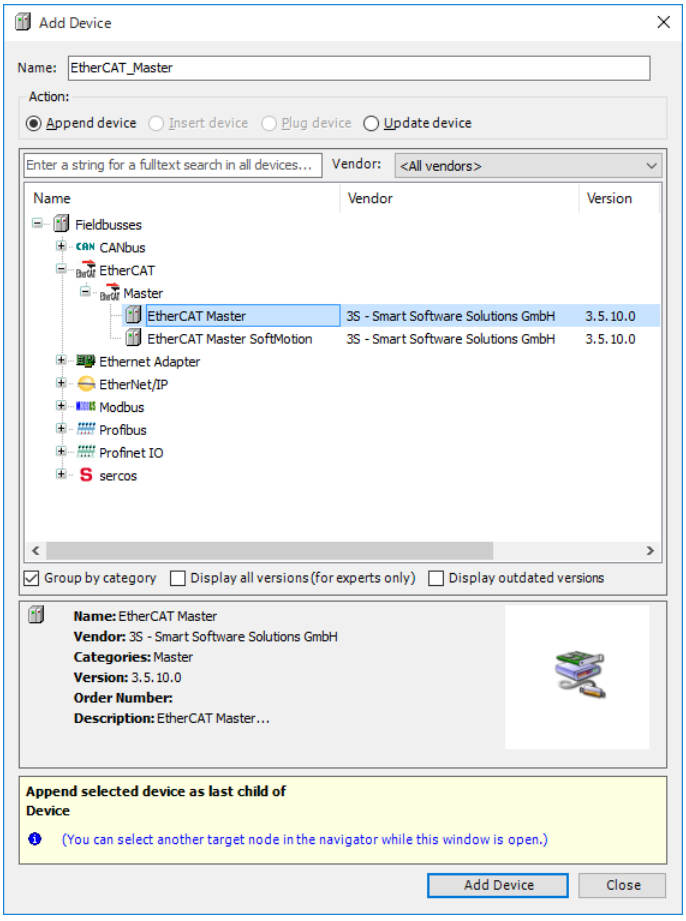
The following procedure shows how to add EtherCAT devices.
This procedure uses I/O modules (EH-IOCA) from Hitachi Industrial Equipment Systems Co.,Ltd. as an example.

(1) Adding EtherCAT masters

1. Right-click on **Device (*****)** in the **Devices** window. ((*****) shows the selected device name.) On the menu, click **Add Device**.

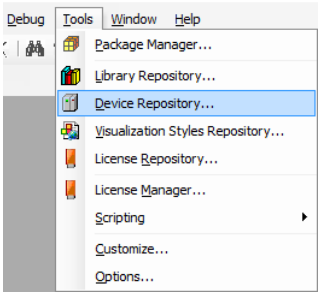


2. The **Add Device** window is displayed. Select **EtherCAT** > **Master** > **EtherCAT Master**. Click **Add Device**, and then click **Close**.

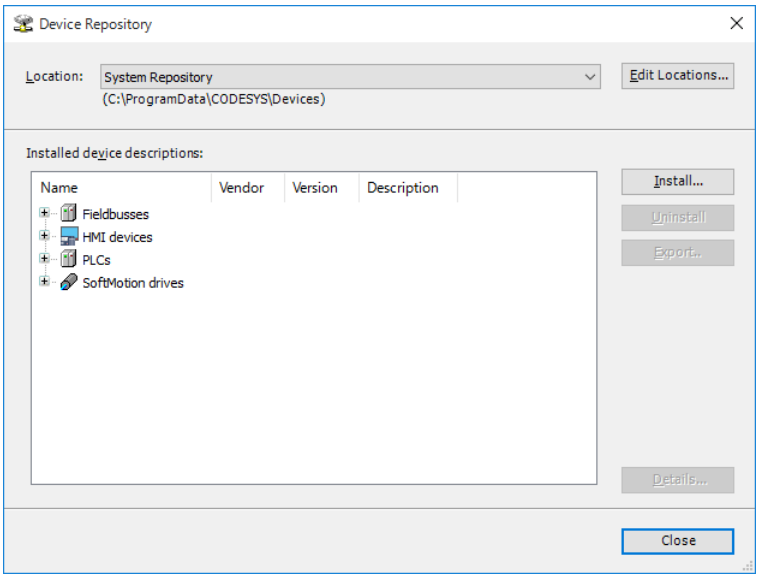


(2) Adding EtherCAT slaves

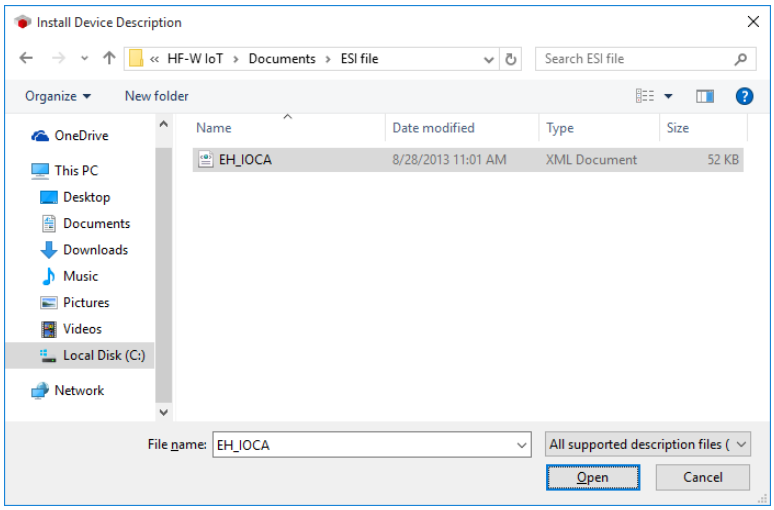
1. Click the **Tools** menu, and on the menu, click **Device Repository**.



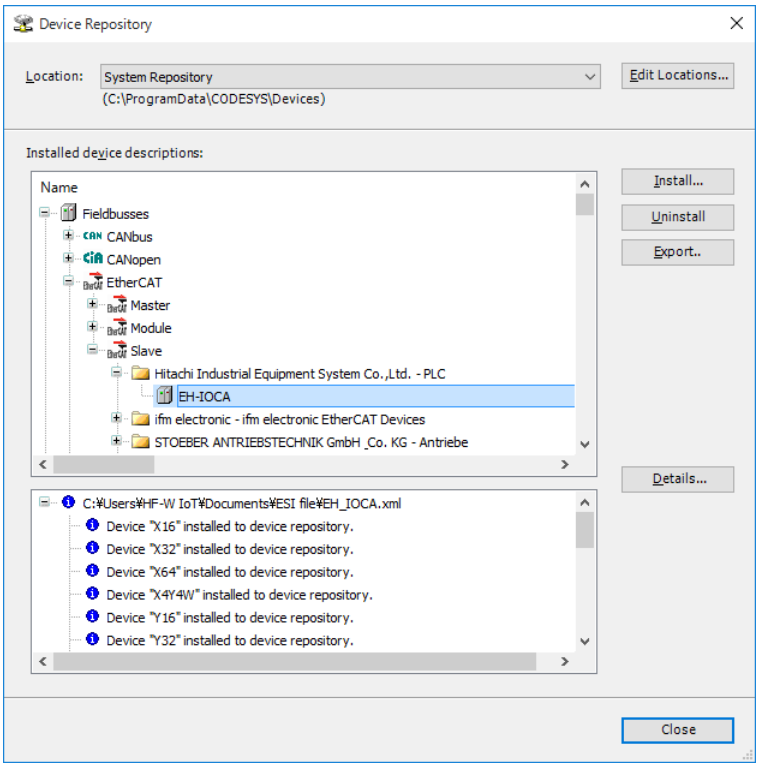
2. The **Device Repository** window is displayed. Install the configuration file for the device you want to connect. In this example, click **Install**.



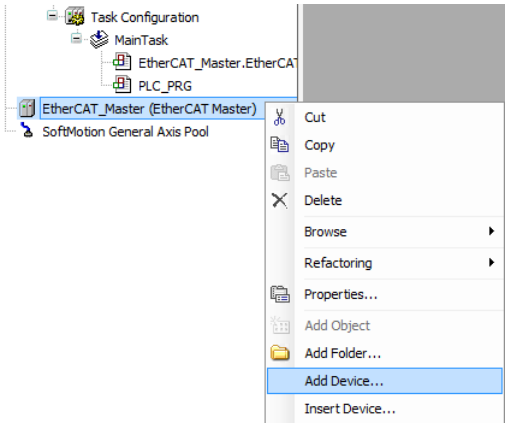
3. The **Install Device Description** window is displayed. Select the ESI file (EtherCAT Slave Information File) you obtained beforehand, and click **Open**.



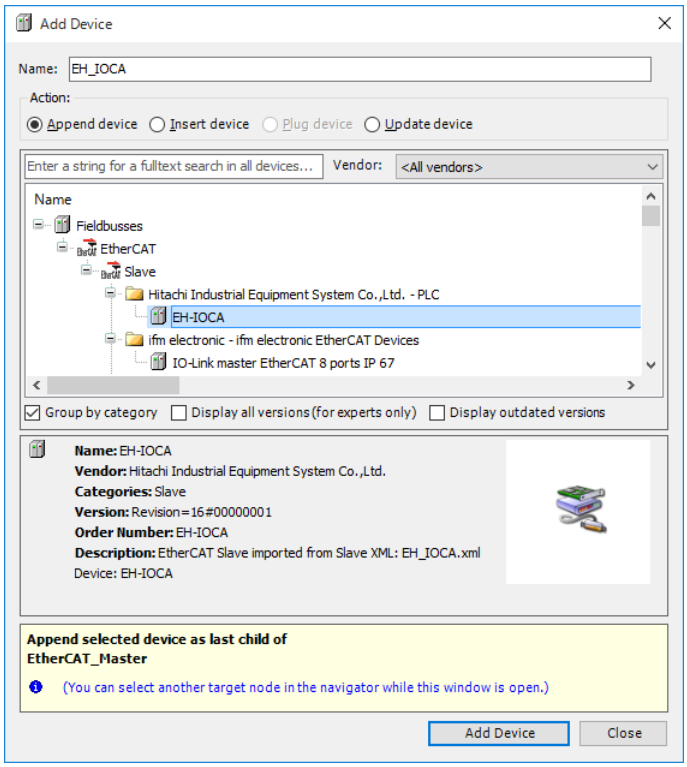
4. When installation is complete, **EH-IOCA** is added to the list of installed devices. Confirm that the device has been added to the list, and click **Close**.

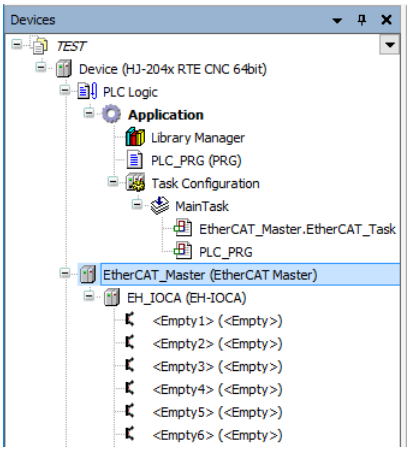


5. Right-click on **EtherCAT_Master (EtherCAT Master)** in the **Devices** window. On the menu, click **Add Device**.



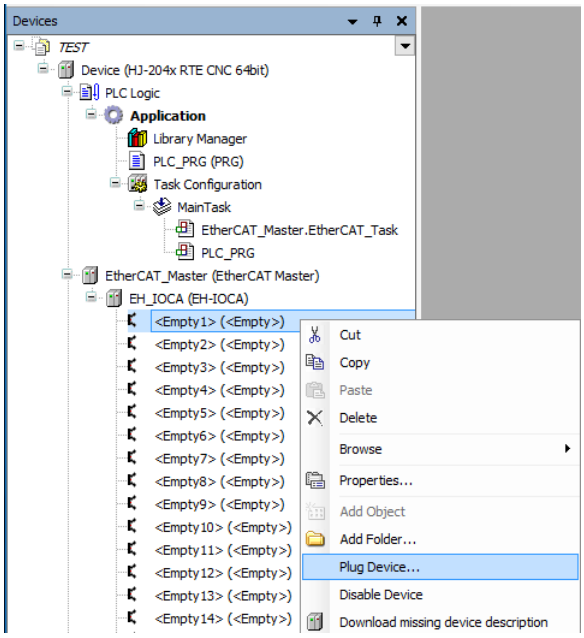
6. The **Add Device** window is displayed. Select **EH-IOCA**, and then click **Add Device**. **EH_IOCA (EH-IOCA)** is added under **EtherCAT_Master (EtherCAT Master)** in the **Devices** window.
   • Repeat this step for all the EtherCAT slaves you want to add.
   • Click **Close** after you confirm that the EtherCAT slaves were successfully added.



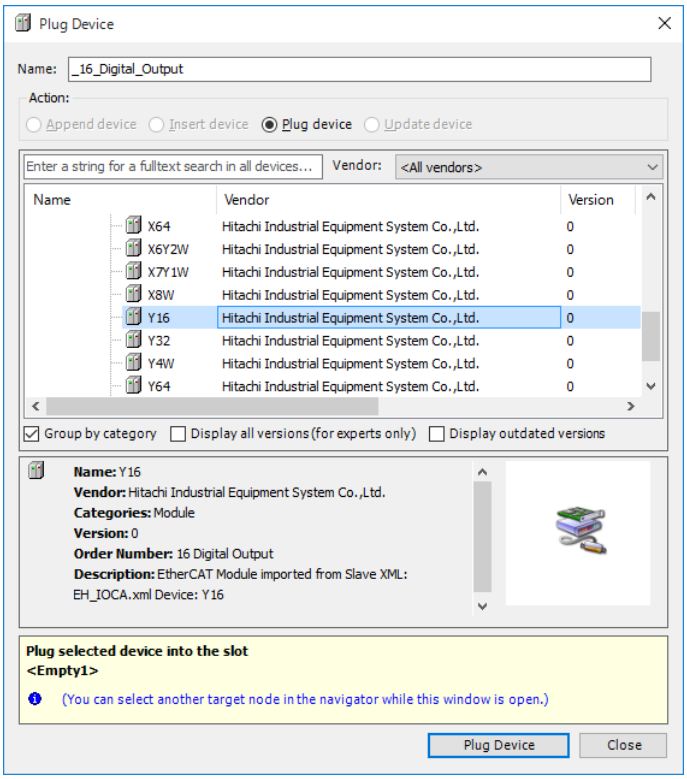


(3) Adding devices (I/O modules) to connect

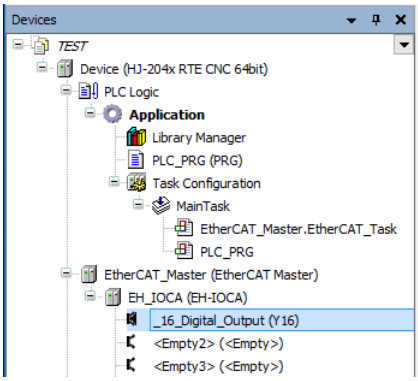
1. Add devices to connect. In this example, an I/O module is added to an EtherCAT slave. Right-click on **<Empty1> (<Empty>)** under **EH_IOCA (EH-IOCA)**. On the menu, click **Plug Device**.
   Repeat this action for each EtherCAT slave according to your needs.



2. In the **Plug Device** window, select the I/O module you want to plug in. **Y16** is selected as an example. Click **Plug Device**.



3. **Y16** is added under **EH_IOCA (EH-IOCA)**.



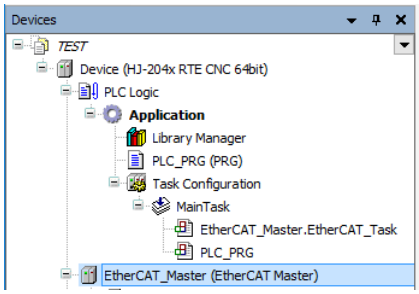
Add a plugged device to **<Empty2> (<Empty>)** and subsequent slaves according to your needs.

4.1.2 EtherCAT NIC setting

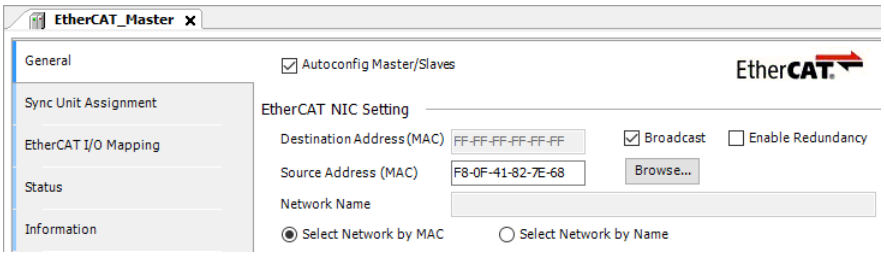
The following procedure shows how to configure the EtherCAT NIC setting.
The PLC must be started and connected before starting the following procedure.

- If the PLC has not been started
  See “3.1.4 Starting PLC”, and start the PLC.
- If the PLC is not connected
  See Steps 1 and 2 in “3.1.5 Running a PLC program”, and connect the PLC.

1. Double-click **EtherCAT_Master (EtherCAT Master)** in the **Devices** window to display a window for the EtherCAT_Master configuration.



2. In **Source Address (MAC)** under **EtherCAT NIC Setting** in the **General** tab, enter the MAC address of the LAN port used for EtherCAT. Alternatively, you can click **Browse** and select the MAC address.

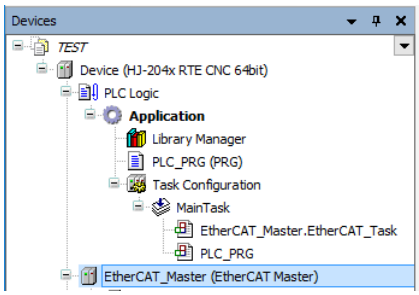


4.1.3 Setting cycle time for the EtherCAT master and interval for the task

The following procedure shows how to set up the cycle time for the EtherCAT master and the interval for the task.

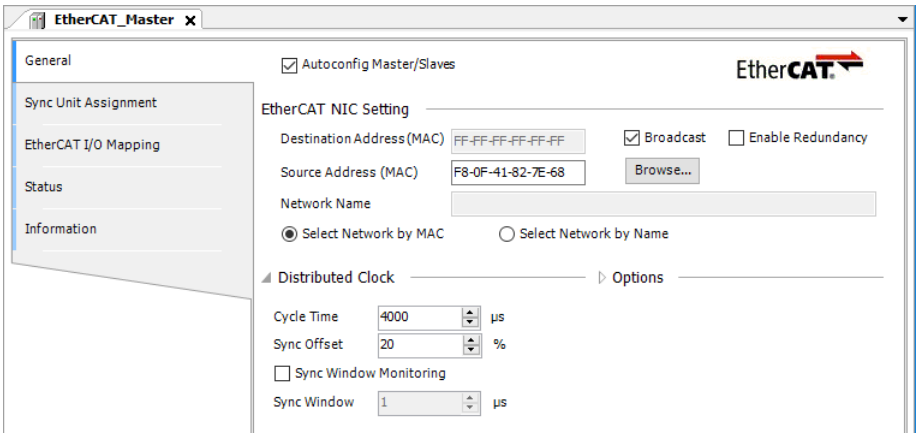
(1) Cycle time setting for the EtherCAT master

1. Double-click **EtherCAT_Master (EtherCAT Master)** in the **Devices** window to display a window for EtherCAT_Master configuration.



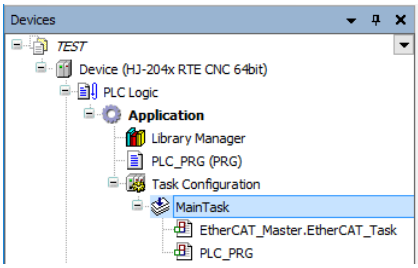
2. For **Cycle Time** under **Distributed Clock** in the **General** tab, specify **4000 (µs)** (default setting).

Note: The interval of the task (MainTask) might be automatically changed when the value of **Cycle Time** is changed. For information about how to configure the cycle time of the task, see “(2) Interval setting for the task”.



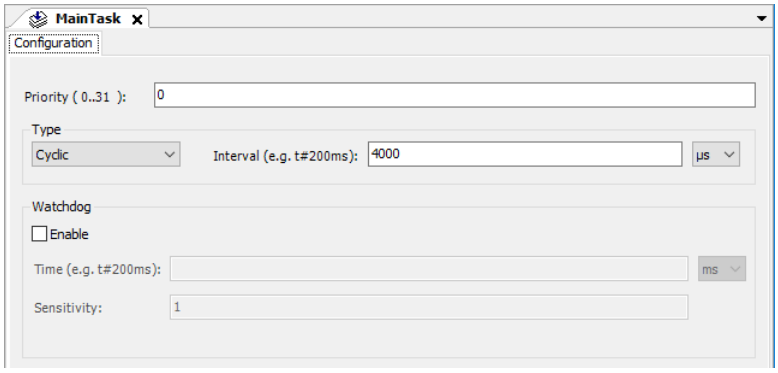
(2) Interval setting for the task

1. Double-click **MainTask** in the **Devices** window to display a window for task configuration.
   In the **MainTask** tab, you can set task priority, type, and interval.



2. In the task configuration window, select **Cyclic** for **Type**, and then specify **4000 (µs)** (default setting) for **Interval**.
   If **EtherCAT_Master.EtherCAT_Task** is inserted under the task, you must specify the same value as **Cycle Time** in the aforementioned EtherCAT_Master configuration window.

Note: The interval of the task might be automatically changed when the value of **Cycle Time** is changed in "(1) Cycle time setting for the EtherCAT master". If you change the cycle time setting of the EtherCAT master, check the interval setting of the task, and reconfigure the setting if necessary.



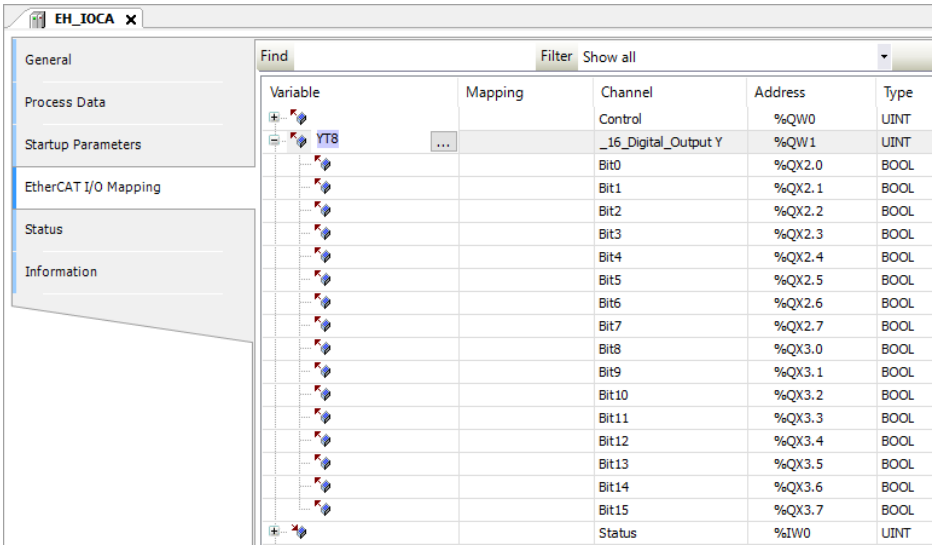
If you want an I/O module to be controlled using a different cycle time than the EtherCAT master, create a control task for the I/O module as an independent task from the task where **EtherCAT_Master.EtherCAT_Task** is inserted.
For information about how to create a task, see "■ Adding a task" in "(1) Task configuration" in "3.1.2 Creating a PLC program".

4.1.4 EtherCAT slave setting

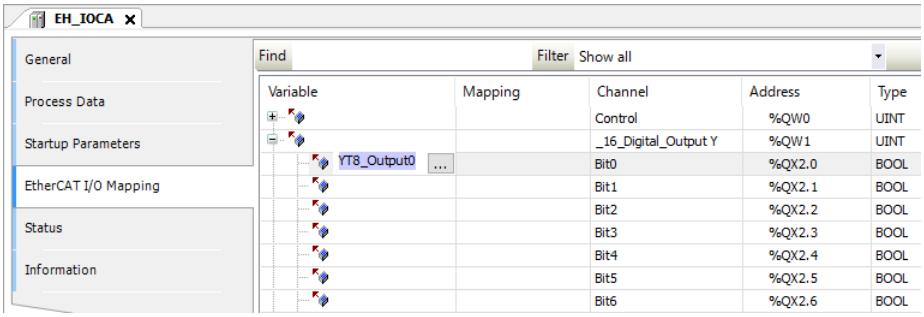
(1) I/O mapping setting

The following procedure shows how to allocate variables to the module I/Os you configured.

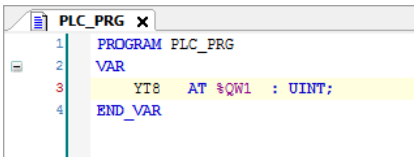
1. Double-click **EH_IOCA (EH-IOCA)** under **EtherCAT_Master (EtherCAT Master)** in the **Devices** window. Then, click **EtherCAT I/O Mapping**. As an example, a UINT variable is allocated to Output. (Alternatively, you can click **...** and specify a variable you have already created.)



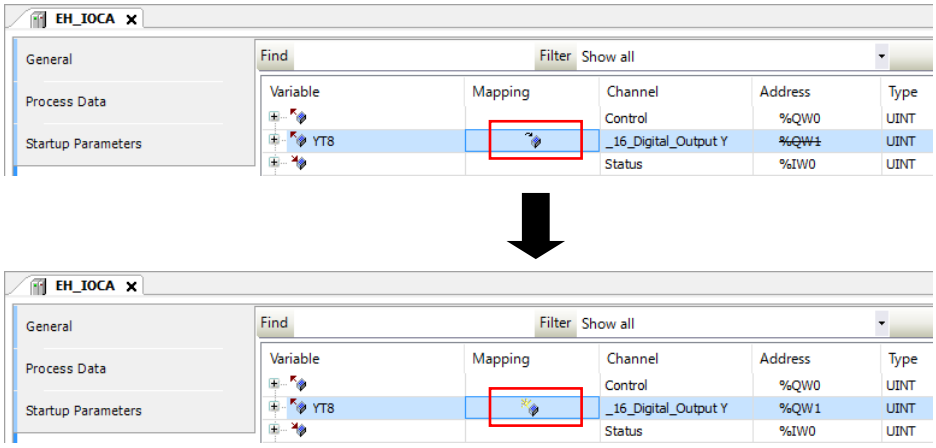
You can also allocate a BOOL variable to each Bit of the module you configured. If you do so, however, you cannot use the UNIT variable allocated above.



2. As VAR (variable), declare the Output variable and the address you configured in **EtherCAT I/O Mapping**.



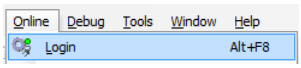
3. After you declare a variable for a device, confirm that the variable you declared for the device has been successfully allocated. If a strikethrough value is shown under **Address**, the variable has not been allocated. In such cases, double-click the icon under **Mapping** to allocate the variable.



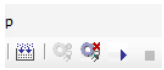
4.1.5 Checking the EtherCAT connection

The following procedure shows how to check the status of the EtherCAT connection.

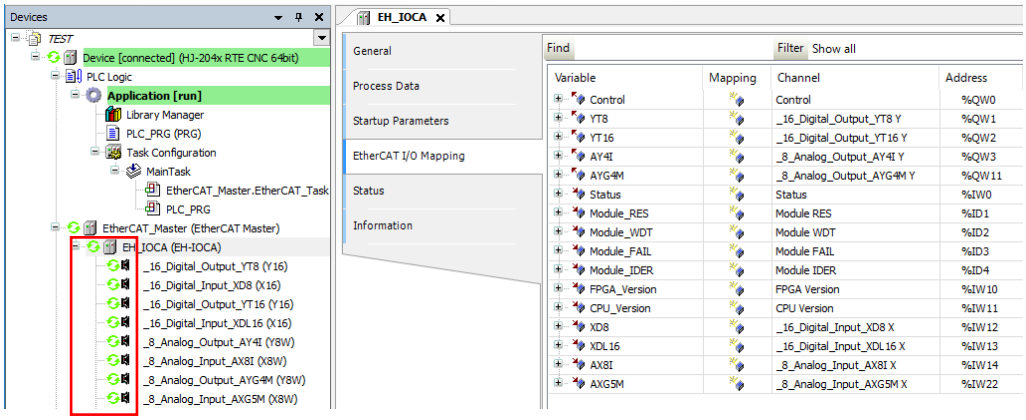
1. Click the **Online** menu, and on the menu, click **Login** to log in to the PLC.



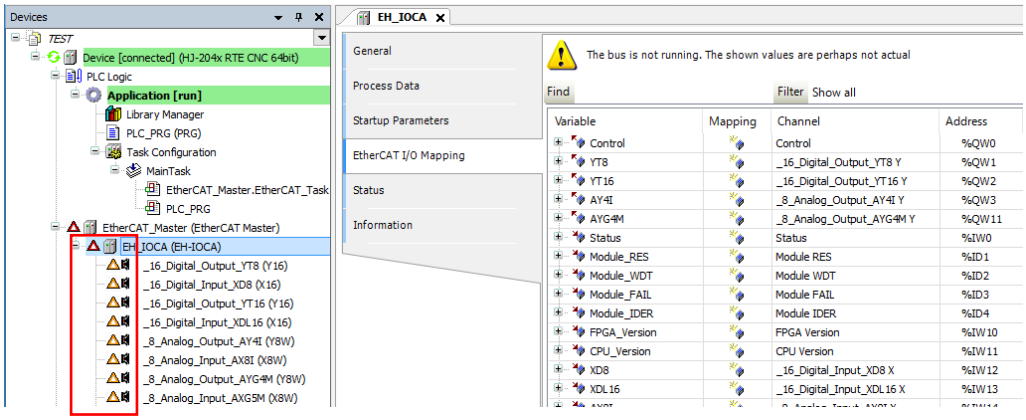
2. After you log in, click ▶ at the top of the toolbar to run the PLC.



3. If EtherCAT connects successfully, the icons beside the devices become green.



In the **Devices** window, △ icons can be shown beside devices and modules. These icons are shown when the configuration is not consistent with the connected modules.
Moreover, △ icons are sometimes shown even after you confirm that the connection of the devices and modules is OK. If this happens, log in to the PLC, click **Online** > **Cold reset**, and run the PLC again. Then the △ icons should disappear. If △ icons are still displayed, check the wire connections and power cycle the main power to the EtherCAT slaves.



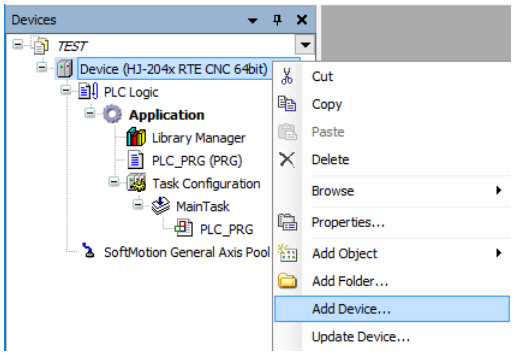
4.2 Configuration for Using Servo Amplifiers and Servo Motors

4.2.1 Adding EtherCAT devices (servo amplifiers and servo motors)

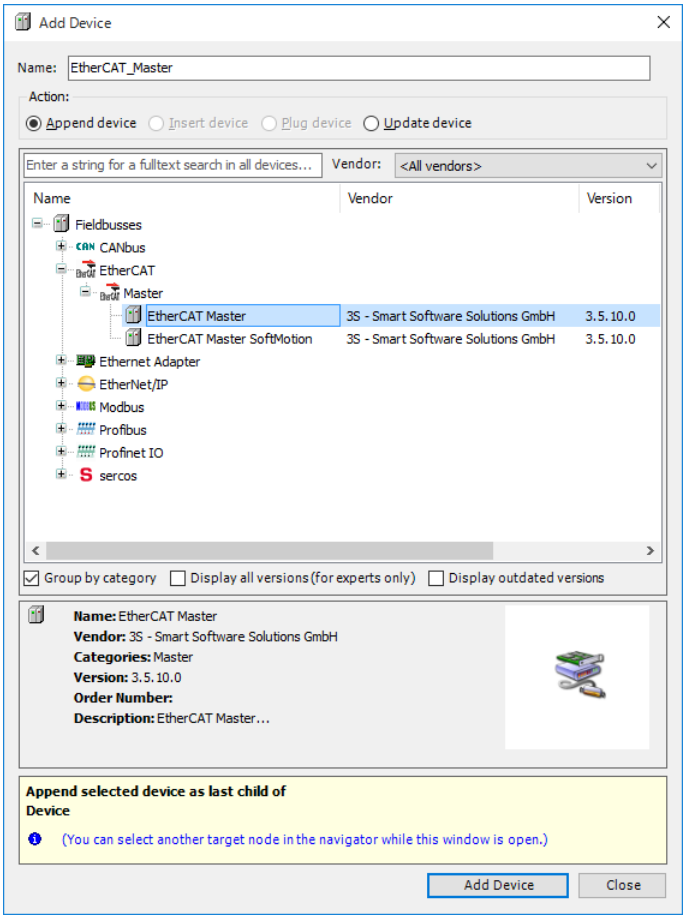
The following procedure shows how to add EtherCAT devices.
This procedure uses servo amplifiers (ADVA-R5MSEC) and servo motors (ADMA-R5MF111) from Hitachi Industrial Equipment Systems Co.,Ltd. as an example.

(1) Adding EtherCAT masters

1. Right-click on **Device (*****)** in the **Devices** window. ((*****) shows the selected device name.) On the menu, click **Add Device**.

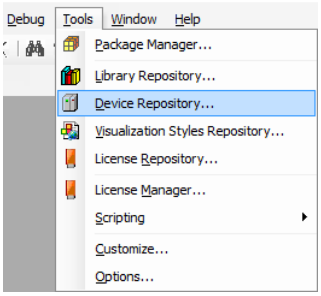


2. The **Add Device** window is displayed. Select **EtherCAT** > **Master** > **EtherCAT Master**. Click **Add Device**, and then click **Close**.

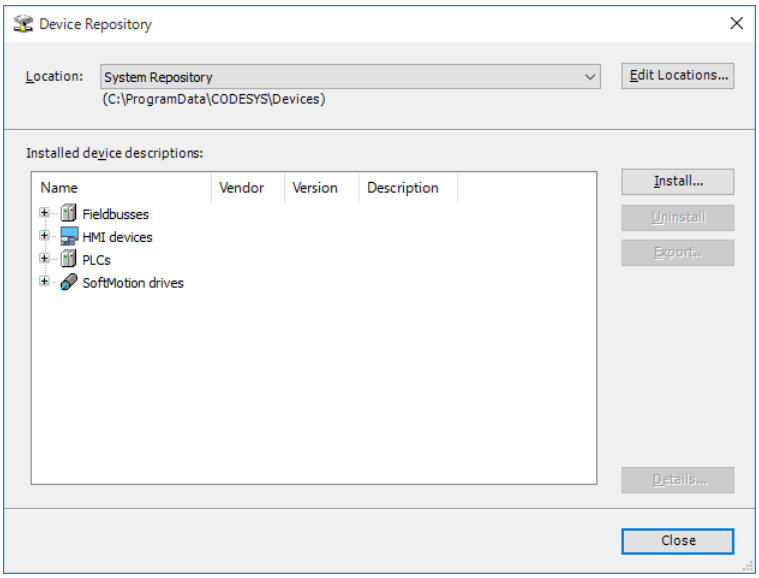


(2) Adding EtherCAT slaves

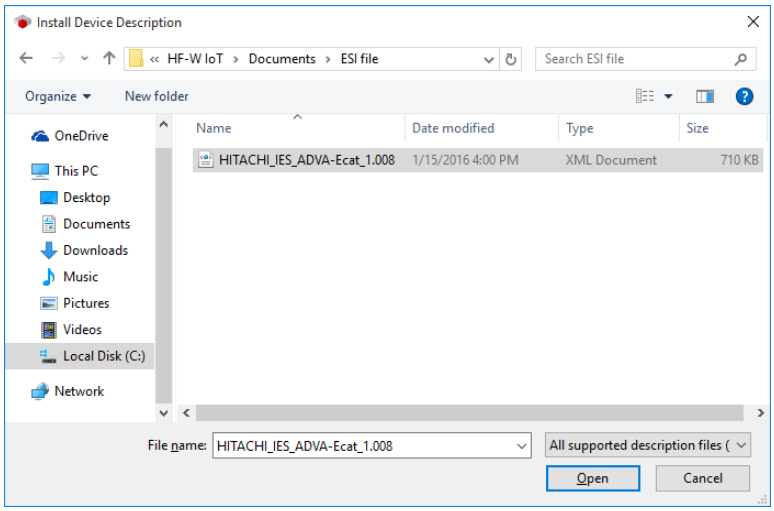
1. Click the **Tools** menu, and on the menu, click **Device Repository**.



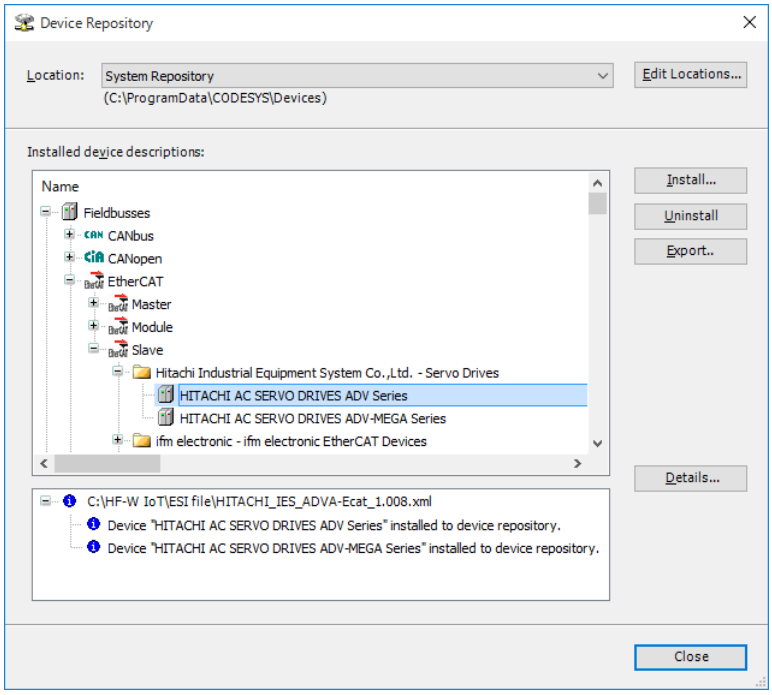
2. The **Device Repository** window is displayed. Install the configuration file for the device you want to connect. In this example, click **Install**.



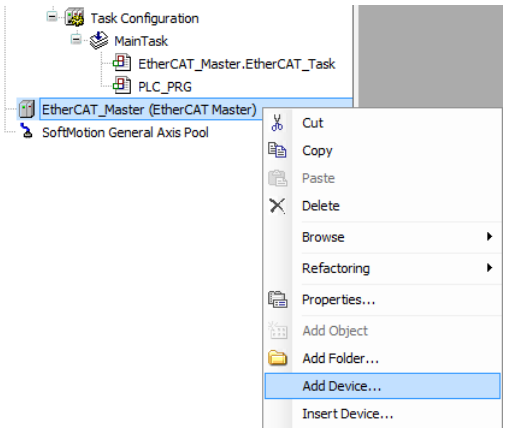
3. The **Install Device Description** window is displayed. Select the ESI file (EtherCAT Slave Information File) you obtained beforehand, and click **Open**.



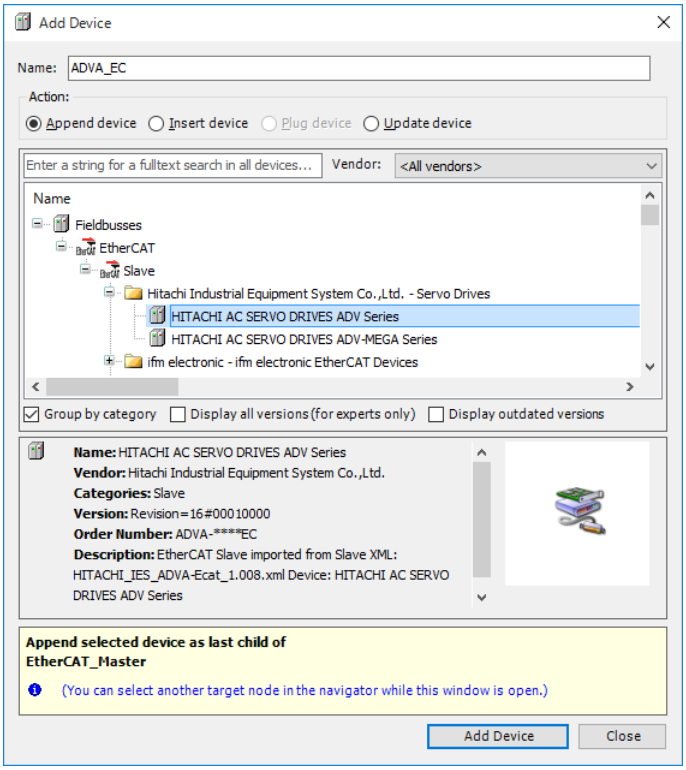
4. When installation is complete, **HITACHI AC SERVO DRIVES ADV Series** is added to the list of installed devices. Confirm that the device has been added to the list, and click **Close**.

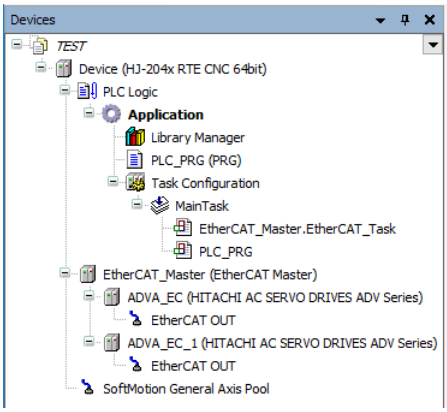


5. Right-click on **EtherCAT_Master (EtherCAT Master)** in the **Devices** window. On the menu, click **Add Device**.



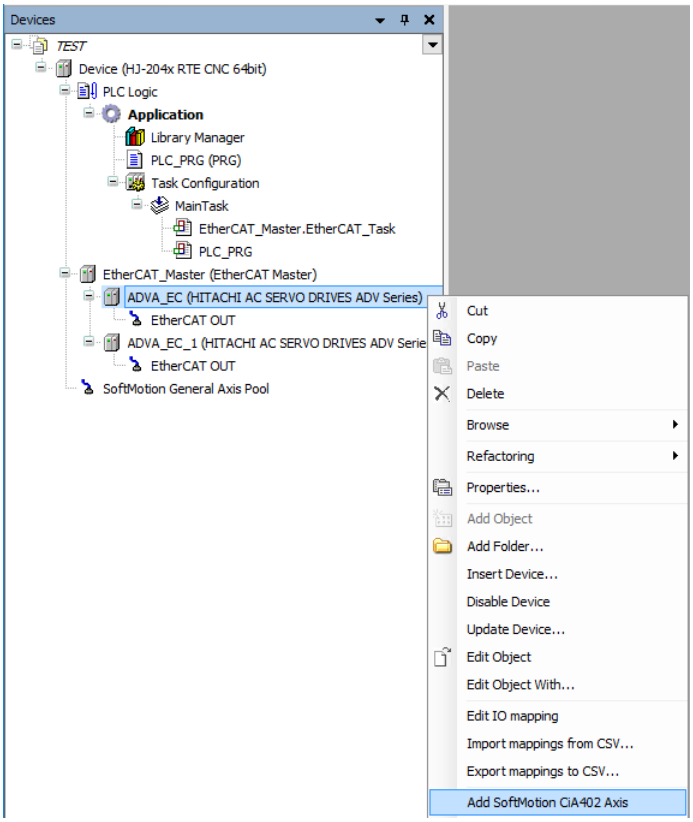
6. The **Add Device** window is displayed. Select **HITACHI AC SERVO DRIVES ADV Series**, and then click **Add Device**. Then, **ADVA_EC (HITACHI AC SERVO DRIVES ADV Series)** is added under **EtherCAT_Master (EtherCAT Master)** in the **Devices** window.
   - Repeat this step for all the EtherCAT slaves you want to add.
     In the following figure, **Add Device** was clicked twice to add two devices.
   - Click **Close** after you confirm that the EtherCAT slaves were successfully added.



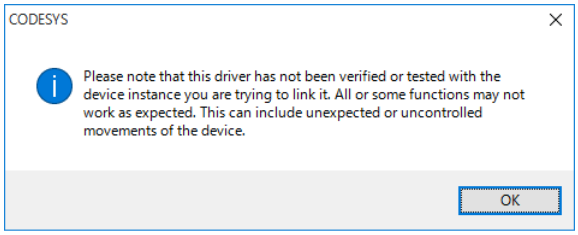


(3) Adding devices (Axis) to connect

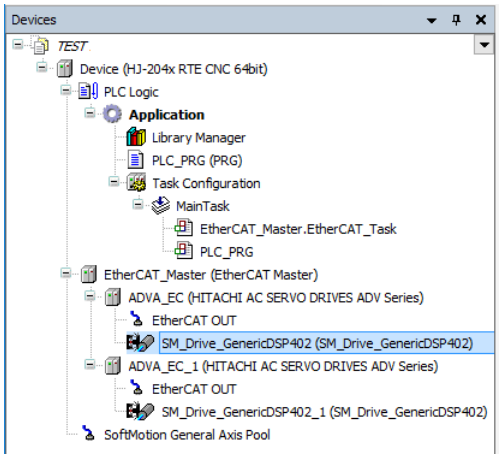
1. Add devices to connect. In this example, an Axis is added to an EtherCAT slave.
   Right-click on **ADVA_EC (HITACHI AC SERVO DRIVES ADV Series)**. On the menu, click **Add SoftMotion CiA402 Axis**.
   Repeat this action for each EtherCAT slave according to your needs.



2. If the following message dialog box appears, click **OK**.



3. The **SM_Drive_GenericDSP402** you selected is added under **ADVA_EC (HITACHI AC SERVO DRIVES ADV Series)**. In the following figure, two devices were added.

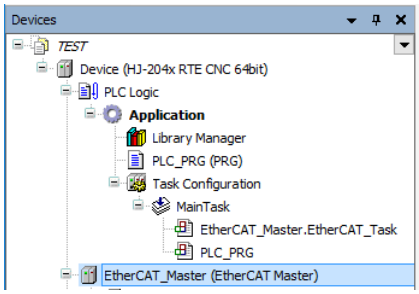


4.2.2 EtherCAT NIC setting

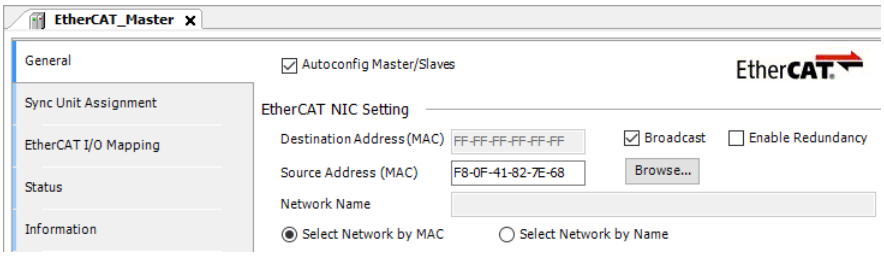
The following procedure shows how to configure the EtherCAT NIC setting.
The PLC must be started and connected before starting the following procedure.

- If the PLC has not been started
  See “3.1.4 Starting PLC”, and start the PLC.
- If the PLC is not connected
  See Steps 1 and 2 in “3.1.5 Running a PLC program”, and connect the PLC.

1. Double-click **EtherCAT_Master (EtherCAT Master)** in the **Devices** window to display a window for the EtherCAT_Master configuration.



2. In **Source Address (MAC)** under **EtherCAT NIC Setting** in the **General** tab, enter the MAC address of the LAN port used for EtherCAT. Alternatively, you can click **Browse** and select the MAC address.

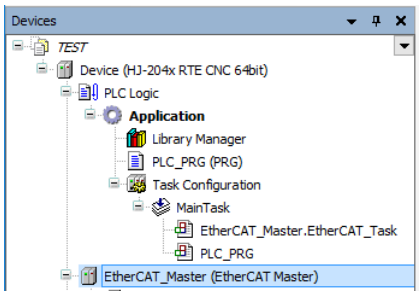


4.2.3 Setting cycle time for the EtherCAT master and interval for the task

The following procedure shows how to set up the cycle time for the EtherCAT master and the interval for the task.

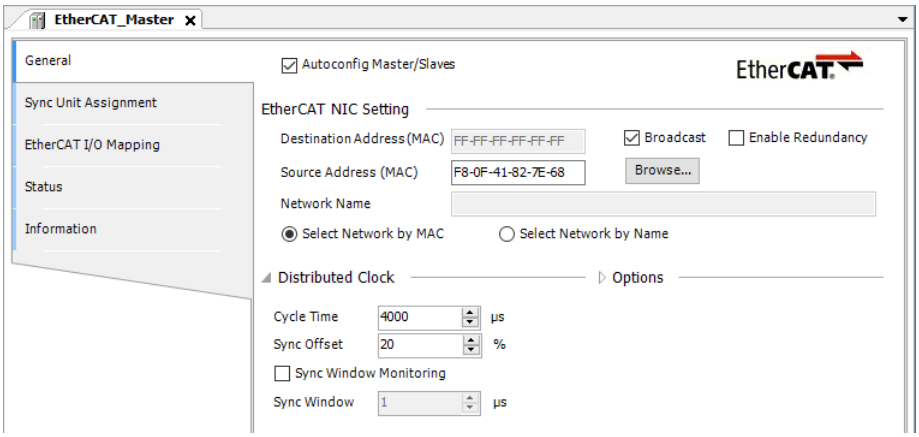
(1) Cycle time setting for the EtherCAT master

1. Double-click **EtherCAT_Master (EtherCAT Master)** in the **Devices** window to display a window for EtherCAT_Master configuration.



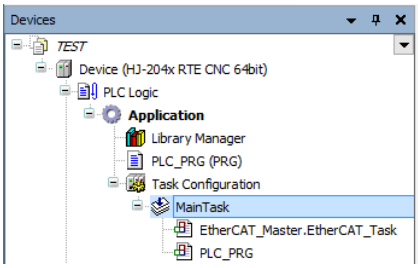
2. For **Cycle Time** under **Distributed Clock** in the **General** tab, specify **4000 (µs)** (default setting).

Note: The interval of the task (MainTask) might be automatically changed when the value of **Cycle Time** is changed. For information about how to configure the interval of the task, see “(2) Interval setting for the task”.



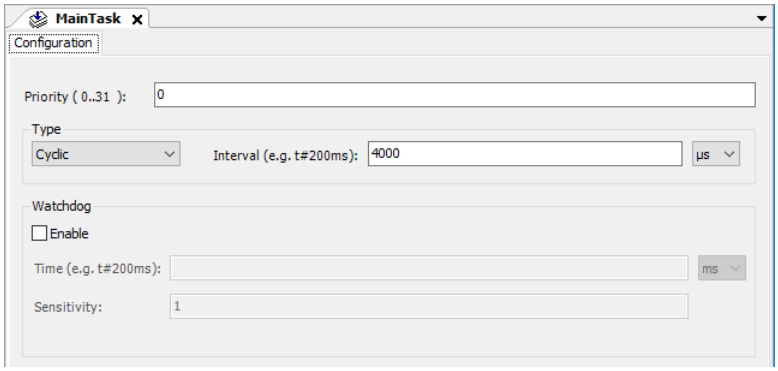
(2) Interval setting for the task

1. Double-click **MainTask** in the **Devices** window to display a window for task configuration.
   In the **MainTask** tab, you can set task priority, type, and interval.



2. In the task configuration window, select **Cyclic** for **Type**, and then specify **4000 (µs)** (default setting) for **Interval**.
   If **EtherCAT_Master.EtherCAT_Task** is inserted under the task, you must specify the same value as **Cycle Time** in the aforementioned EtherCAT_Master configuration window.

Note: The interval of the task might be automatically changed when the value of **Cycle Time** is changed in "(1) Cycle time setting for the EtherCAT master". If you change the cycle time setting of the EtherCAT master, check the interval setting of the task, and reconfigure the setting if necessary.



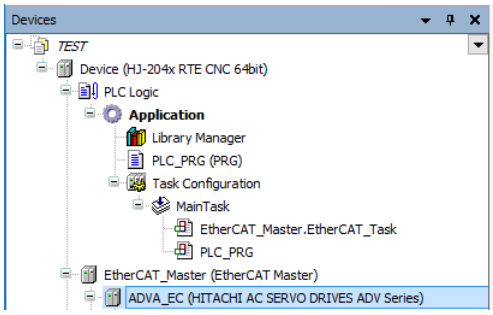
4.2.4 EtherCAT slave setting

(1) Process data setting

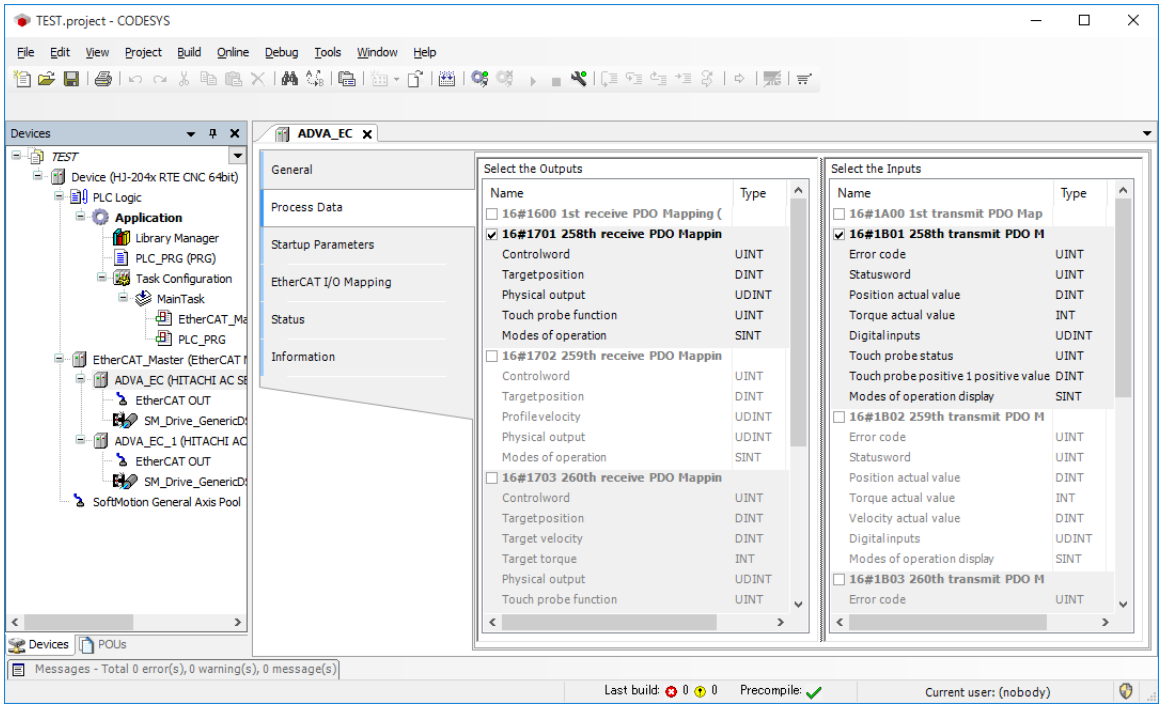
In this example, a process data object (PDO) is selected.

- Repeat this action for each EtherCAT slave according to your needs.
- Select an appropriate PDO for your needs. PDOs are defined on a per EtherCAT slave basis. For details about the PDOs, refer to the user's manual of the EtherCAT slave you use.

1. Double-click **ADVA_EC (HITACHI AC SERVO DRIVES ADV Series)** in the **Devices** window to display a window for EtherCAT slave configuration.



2. Click **Process Data**, clear the checkboxes selected under **Select the Outputs** and **Select the Inputs**, and select the checkboxes for the PDO you want to use.



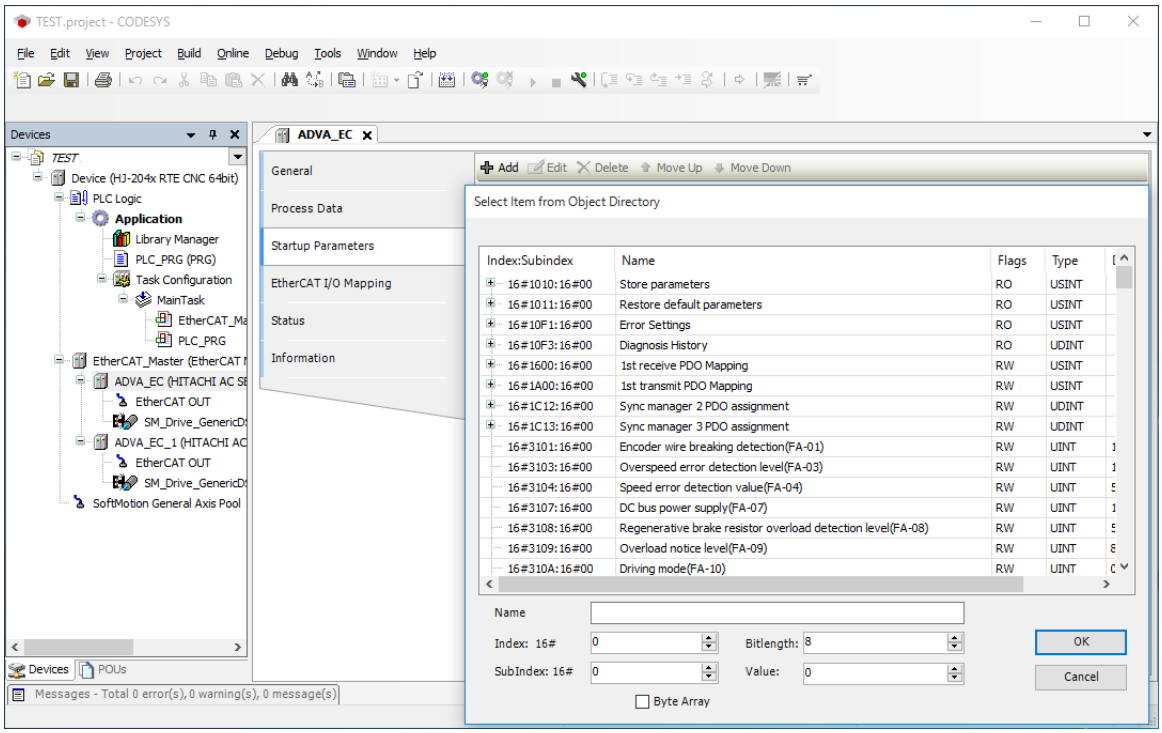
(2) Setting startup parameters

As startup parameters, you can specify parameter values that cannot be mapped to the PDO. You can use this feature to set up parameters that have to be set only once. For example, you can adjust the response frequency of the PID control and gain parameters.

- Repeat this action for each EtherCAT slave according to your needs.
- Parameters are defined on a per EtherCAT slave basis. For details about the parameters, refer to the user's manual of the EtherCAT slave you want to use.

1. Double-click **ADVA_EC (HITACHI AC SERVO DRIVES ADV Series)** in the **Devices** window to display a window for the EtherCAT slave configuration.

2. Click **Startup Parameters**. Click **Add** to show a list of parameters.

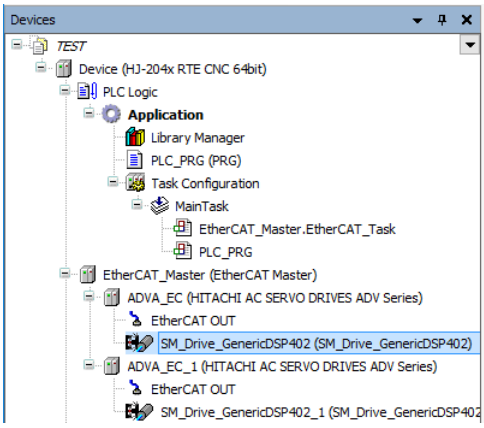


4.2.5 SoftMotion Axis setting

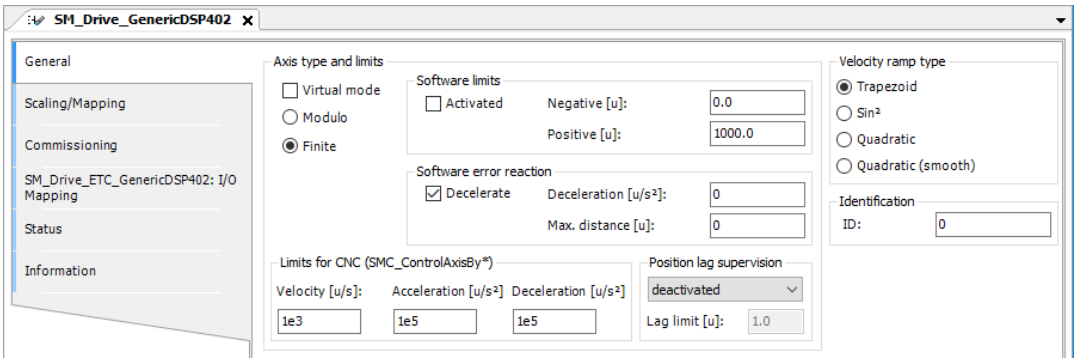
In this example, an Axis setting is configured.

• Repeat this action for each Axis according to your needs.

1. Double-click **SM_Drive_GenericDSP402 (SM_Drive_GenericDSP402)** in the **Devices** window to display a window for Axis configuration.

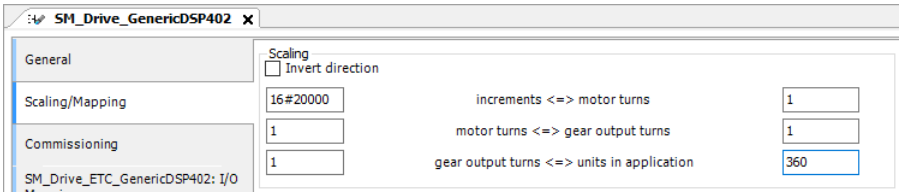


2. Click **General**, and configure **Axis type and Limits** and **Velocity ramp type**.
   In this example, default values are used.



■ If CNC is used
If CNC is used in your program, the function block that starts with "SMC_ControlAxisBy" must be used for the axis control. To use this function, you must define the upper limits of the velocity, acceleration, and deceleration under **Limits for CNC (SMC_ControlAxisBy*)** in the above screen.

3. Click **Scaling/Mapping** to configure **Scaling**.
   In the following setting example, 360 counts in the CODESYS program correspond to one rotation of the motor. (This setting is for using a 17-bit encoder (16#0~16#1FFFF).)



4.2.6 Checking the EtherCAT connection

For information about how to check the EtherCAT connection, see “4.1.5 Checking the EtherCAT connection”.

If EtherCAT is connected successfully, the icons beside the devices are shown in green in the same way as for I/O modules.

4.3 Troubleshooting for EtherCAT Slave Connection Errors

When an error occurs, for example, an EtherCAT slave does not function, follow the procedure below to investigate and identify the cause.

1. Read the user’s manual of the slave device, and check whether the symptom is listed in the manual.
   If yes, troubleshoot according to the description in the manual.

2. Start the CODESYS development environment, and check the PLC log.
   For information about the PLC log, refer to the following topic in the online help.
   • CODESYS Development System > Reference, User Interface > Object > Object ‘Device’ and Generic Device Editor > Tab ‘Log’

   If you have any questions about the PLC log, contact the sales representatives.

3. Check the Windows event log to see if any errors from CODESYS are recorded.

If you have any questions after you go through all the steps above, contact the sales representatives.

CHAPTER 5 CONFIGURATION FOR USING OPC

5.1 Overview

CODESYS supports the OPC server and allows you to use OPC Classic (OPC DA/AE) and OPC UA. For information about an overview of the OPC server and how to use OPC server tools, refer to the CODESYS original manuals in the following locations.

■ Folder location
C:\Program Files (x86)\3S CODESYS \CODESYS OPC Server 3

■ List of manuals

File name	Description
CoDeSys_OPC_Server_V3_User_Guide.pdf	Instructions for using OPC Config, which is a configuration tool for the OPC server and for the communication interface between the CODESYS development environment and the PLC.
AeConfigurator_UserGuide.pdf	Instructions for using AeConfigurator, which is a tool for adding and setting up alarm events when you use OPC AE.

This chapter describes the setup procedure necessary for using OPC.

(1) Using OPC Classic (OPC DA/AE)
In addition to adding OPC objects, you must configure DCOM. See “5.2 Adding OPC Objects” and “5.3 DCOM Settings”.
Moreover, configure the following items according to your needs.

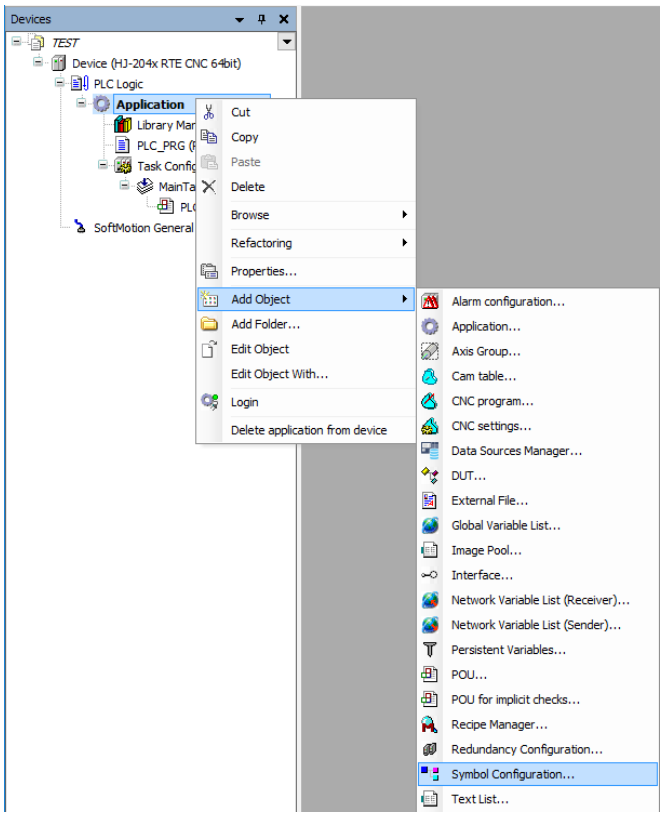
- OPC server setting
  CODESYS offers OPC Config, a tool for setting up the OPC server and the communication interface between the CODESYS development environment and the PLC. (Note that you can use OPC with the default settings.)
  For details about OPC Config, refer to CoDeSys_OPC_Server_V3_User_Guide.pdf.
- Alarm event setting
  To use OPC AE, you must use AE Configurator to configure alarm events notified from CODESYS to OPC AE. For details about AE Configurator, refer to AeConfigurator_UserGuide.pdf.

(2) Using OPC UA
You can use OPC UA simply by adding OPC objects. For information about how to add OPC objects, see “5.2 Adding OPC Objects”.

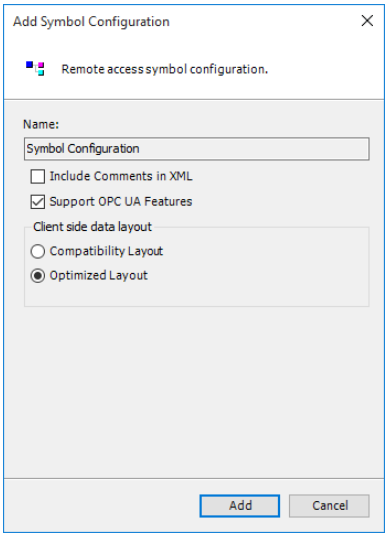
5.2 Adding OPC Objects

You must add a Symbol configuration object to disclose variables to the OPC client.

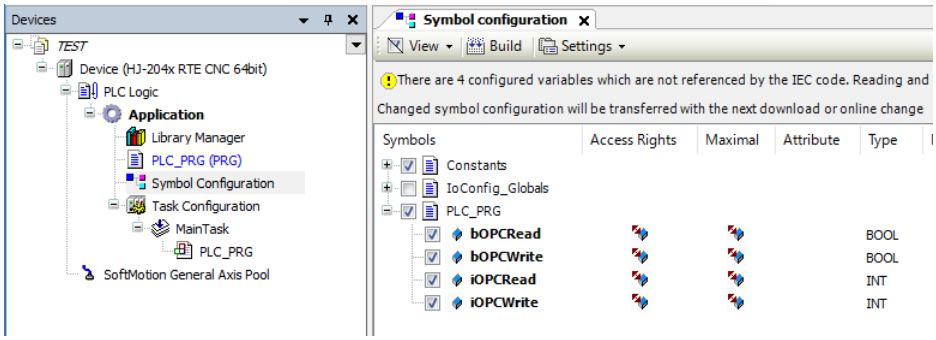
1. In the right-click menu on **Application** in the **Devices** window, click **Add Object** > **Symbol configuration**.



2. The **Add Symbol Configuration** window is displayed. Click **Add**.
   • If you want to use OPC UA, select **Support OPC UA Features**.



3. Select the variables you want to disclose to the OPC client.
   • You can select variables after you build the PLC program.
   • If you want to use OPC UA, also select **Constants**.



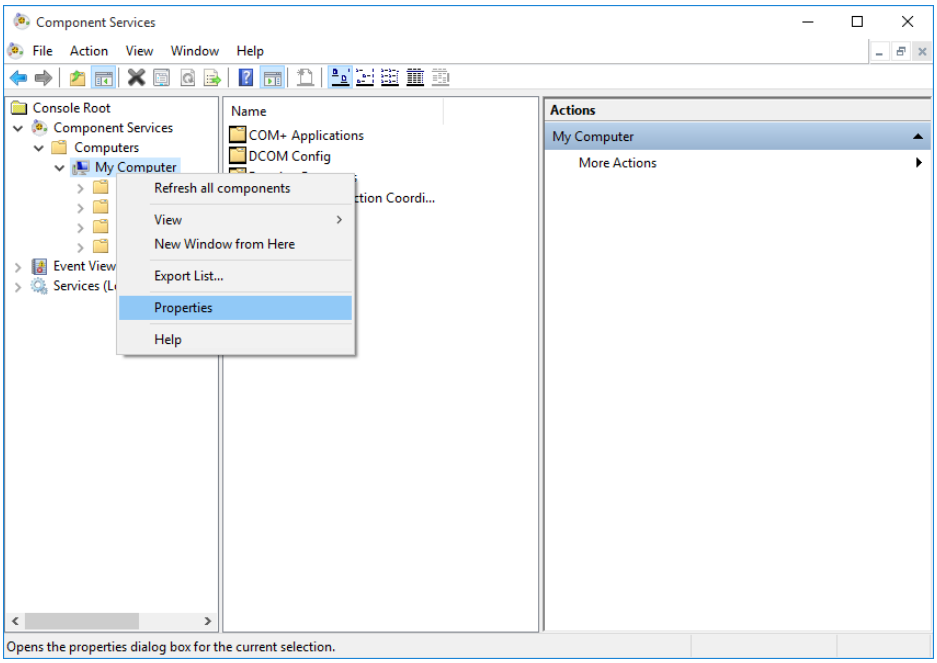
5.3 DCOM Settings

DCOM is a technology used for communication between PC software components distributed in the network. If you want to use a remote connection to link an OPC client to the local device where the CODESYS OPC server is running, you must configure DCOM settings.
To enable DCOM connection, a user of the OPC client PC must be authenticated on the local device. If workgroups are used in the system, you can authenticate a client user by creating the same user account with the same password on both the local device and the OPC client PC.
When you start using the CODESYS OPC server, follow the procedure below to set up the DCOM configuration.

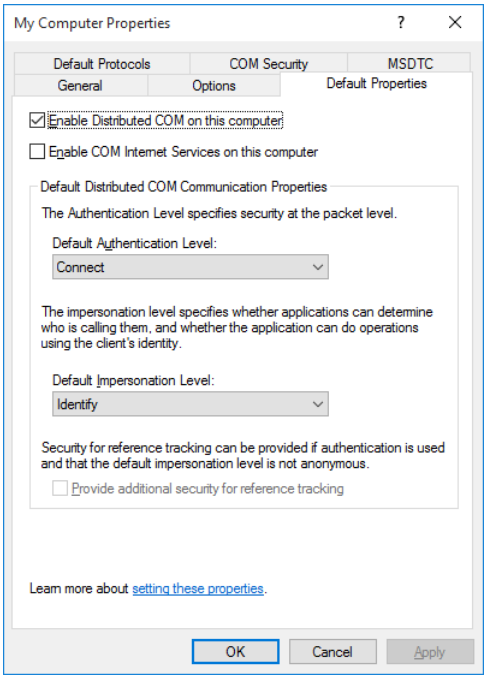
Notes 1: Follow the setup procedure only when you use OPC Classic. If you use OPC UA instead, it is not necessary to do so.
2: Follow the setup procedure on both the local device and the OPC client PC.

5.3.1 DCOM security settings

1. Sign in to the computer using an administrator account (Administrator).
2. Start the **Component Services** in the following steps.
   - If the OS is Windows® Embedded Standard 7, click **Start**, type the following in the **Search programs and files** box at the lower left corner on the Start menu, and then press **Enter**.
     mmc comexp.msc /32
   - If the OS is Windows® 10, click search icon at the right on the Start button, type the following in the **Search Windows** box, and then press **Enter**.
     mmc comexp.msc /32
3. The **Component Services** window appears. Select **Console Root** > **Component Services** > **Computers** > **My Computer** to expand trees, and then right-click on **My Computer**. On the menu, click **Properties**.

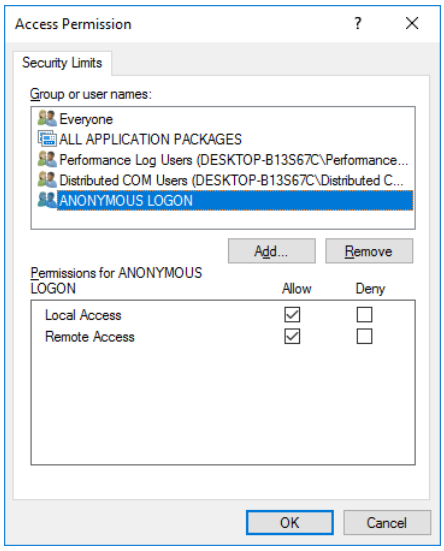


4. The **My Computer Properties** window is displayed. Select the **Default Properties** tab to configure as follows.
   • Select **Enable Distributed COM on this computer**.
   • Specify **Connect** for **Default Authentication Level**.
   Note: On the OPC client PC, specify **None** for **Default Authentication Level**.
   • Specify **Identify** for **Default Impersonation Level**.

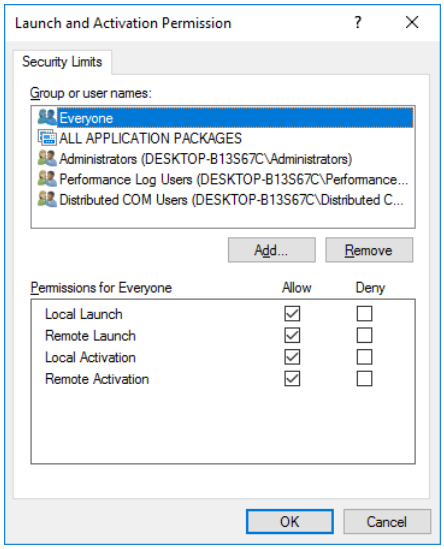


This completes the DCOM configuration on the OPC client PC. Click **OK** and proceed to "5.3.2 Firewall settings".

5. In the **My Computer Properties** window, select the **COM Security** tab. Under **Access Permissions**, click **Edit Limits**.
   • For **Permissions for ANONYMOUS LOGON**, select all **Allow** checkboxes, and then click **OK**.

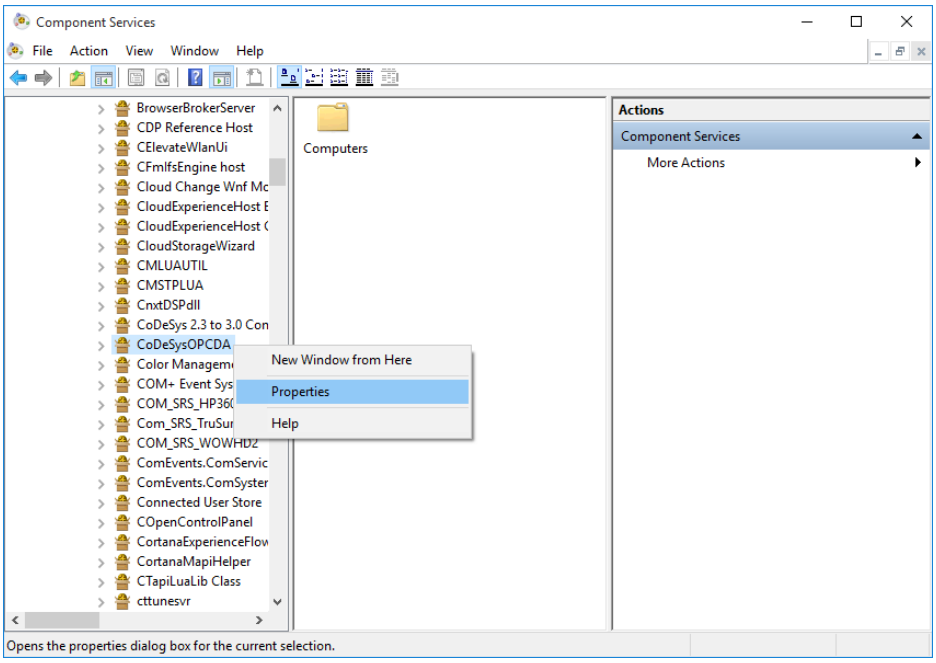


6. The **Launch and Activation Permission** window is displayed. Click **Edit Limits**.
   • For **Permission for Everyone**, select all **Allow** checkboxes, and then click **OK**.

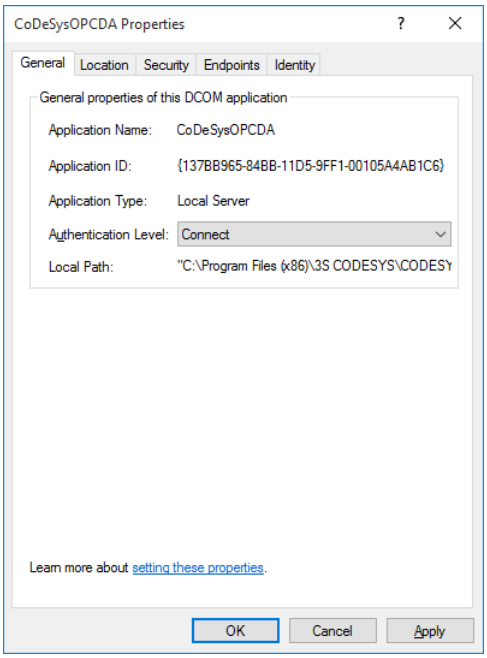


7. In the **My Computer Properties** window, click **Apply**, and then click **OK**.
   If the **DCOM configuration on the whole computer** dialog box is displayed, click **Yes**.

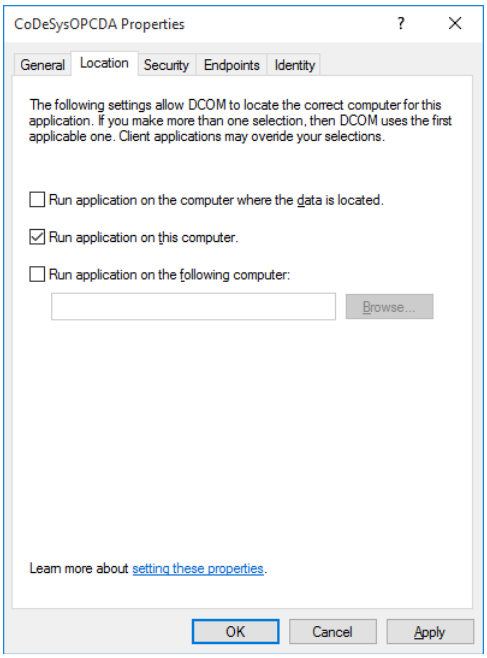
8. Select **My Computer** > **DCOM Config** to expand trees, and right-click on **CoDeSysOPCDA**. On the menu, click **Properties**.



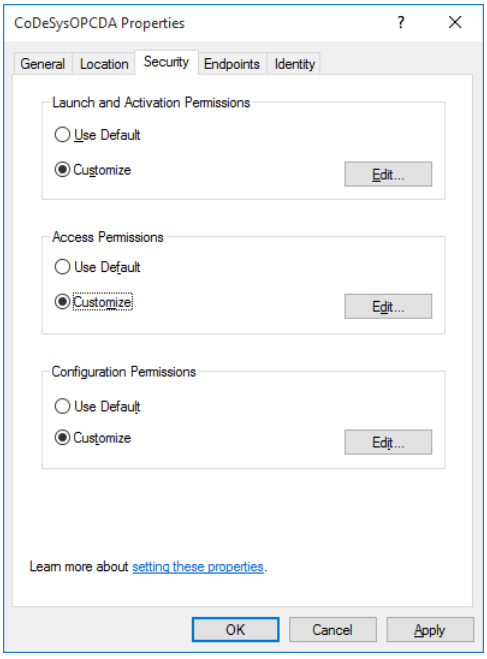
9. The **CoDeSysOPCDA Properties** window is displayed. Select the **General** tab, and specify **Connect** for **Authentication Level**.



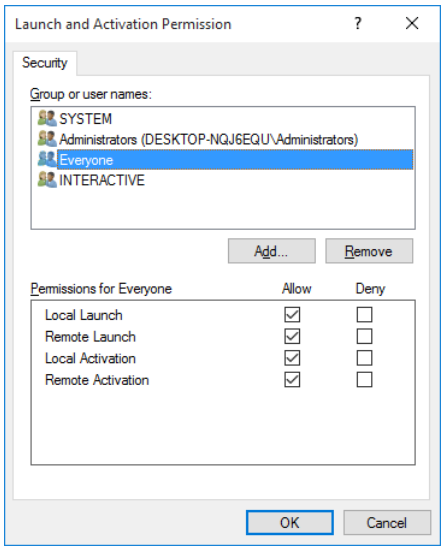
10. Select the **Location** tab, and then select **Run application on this computer**.



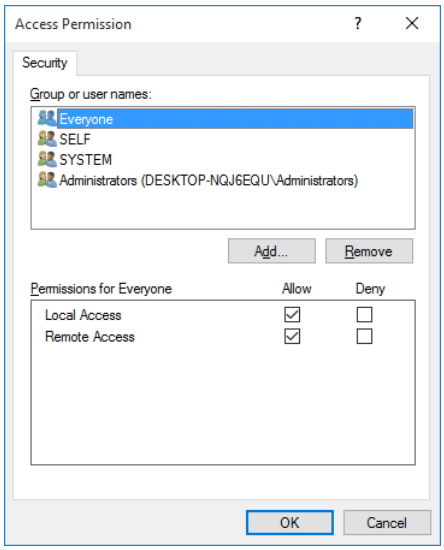
11. Select the **Security** tab. Under **Launch and Activation Permissions** and **Access Permissions**, select **Customize**.



12. Under **Launch and Activation Permission**, click **Edit**. Set all access permission for **Everyone** to "Allow" as follows.
    • Click **Add**.
    • The **Select Users and Groups** window is displayed. Click **Advanced**.
    • Click **Search Now**. Select **Everyone** under **Search results**, and then click **OK**.
    • In the **Select Users and Groups** window, click **OK**.
    • For **Permission s for Everyone**, select all **Allow** checkboxes, and then click **OK**.



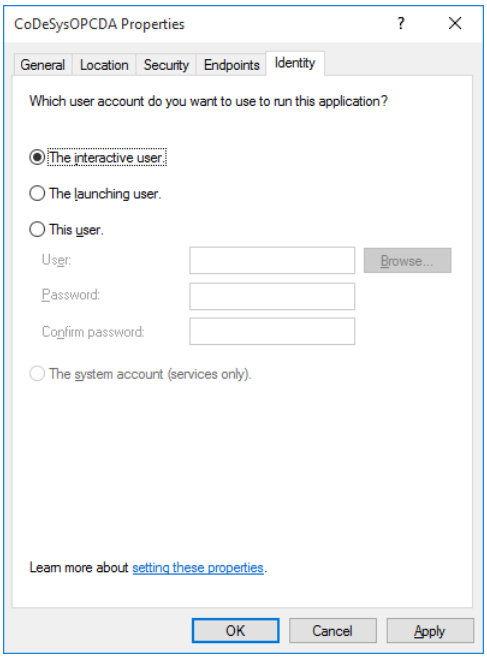
13. Also for **Access Permissions**, add **Everyone**, and select all **Allow** checkboxes in the same way as in Step 12.



The following table shows the possible settings in addition to “Everyone” and shows which users are granted access rights for each.
Select a user according to the system security requirements.

Setting	Users granted with access rights
Everyone	All users
INTERACTIVE	Local access users
NETWORK	Remote access users
SYSTEM	Service applications
Specific domain group	All users belonging to the specific domain group
Specific user name	Specific user

14. Select the **Identity** tab, and select **The interactive user**.



15. Click **Apply**, and then click **OK**.

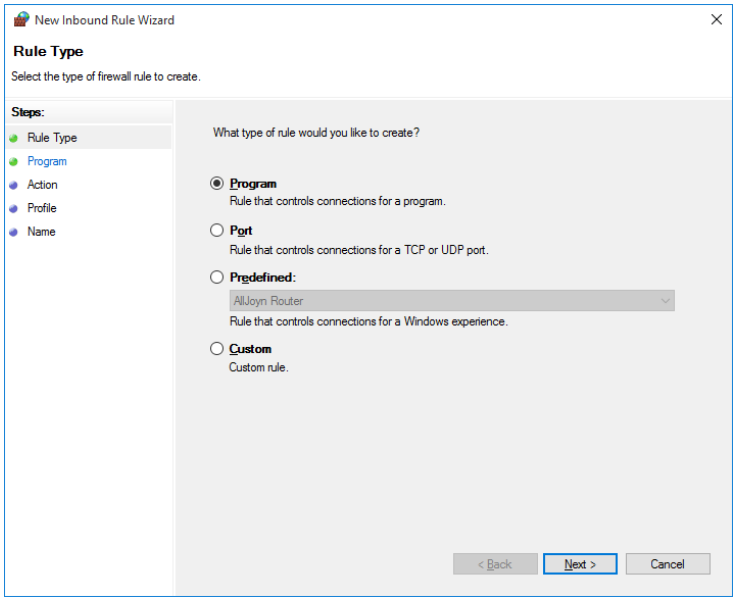
5.3.2 Firewall settings

Windows Firewall is enabled by default, and consequently, DCOM connection is not allowed with the default settings. Follow the procedure below to allow DCOM connections to pass through Windows Firewall.
If you already disabled Windows Firewall, this procedure is not necessary.

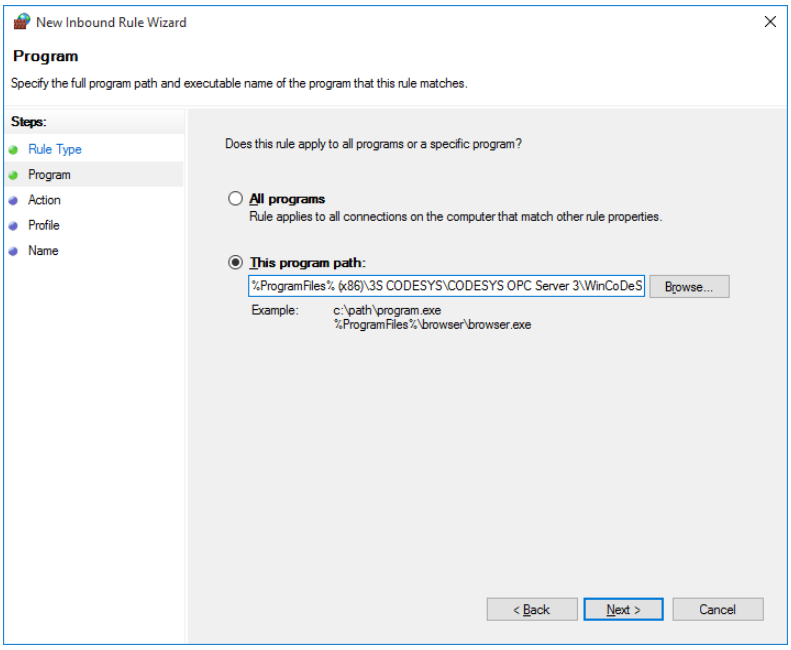
1. Sign in to the computer using an administrator account (Administrator).
2. Open **Control Panel**.
   • If the OS is Windows® Embedded Standard 7, click **Start**, and click **Control Panel**.
   • If the OS is Windows® 10, right-click **Start**, and click **Control Panel** from the menu.
3. The **Control Panel** window appears. Click **System and Security**.
4. The **System and Security** window appears.
   • Click **Windows Firewall**.
5. The **Windows Firewall** window appears.
   • Click **Advanced**.
6. The **Windows Firewall with Advanced Security** window is displayed.
   • Click **Inbound Rules** or **Outbound Rules**.
   • In the **Actions** pane, click **New Rule**.

   Note: Create a new rule using the same procedure for both **Inbound Rules** and **Outbound Rules**.
   The following shows how to add a new rule when **Inbound Rules** is selected.

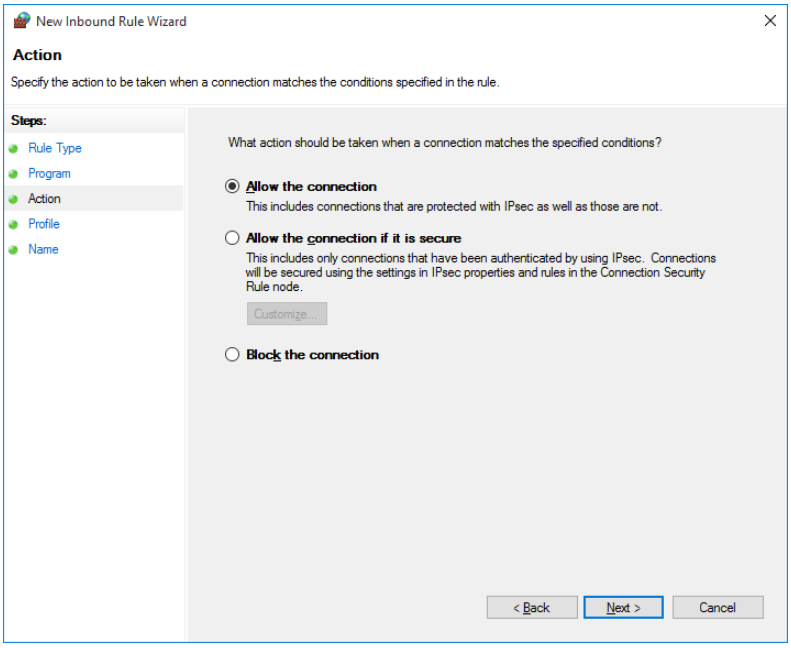
7. The **Rule Type** window of **New Inbound Rule Wizard** is displayed.
   • Select **Program**, and then click **Next**.



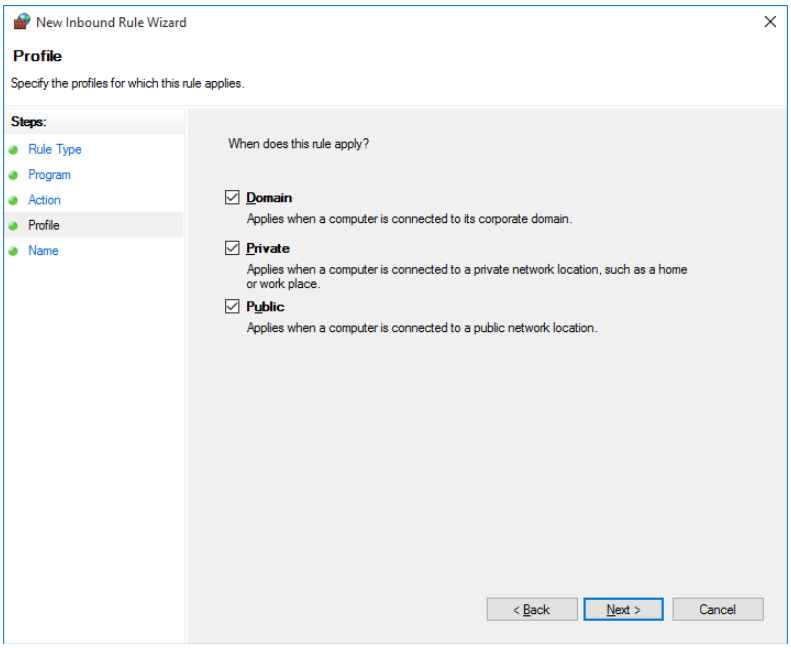
8. The **Program** window of **New Inbound Rule Wizard** is displayed.
   • Select **This program path**.
   • Click **Browse**, select the following file, and then click **Next**.
   C:\Program Files (x86)\3S CODESYS\CODESYS OPC Server 3\WinCoDeSysOPC.exe



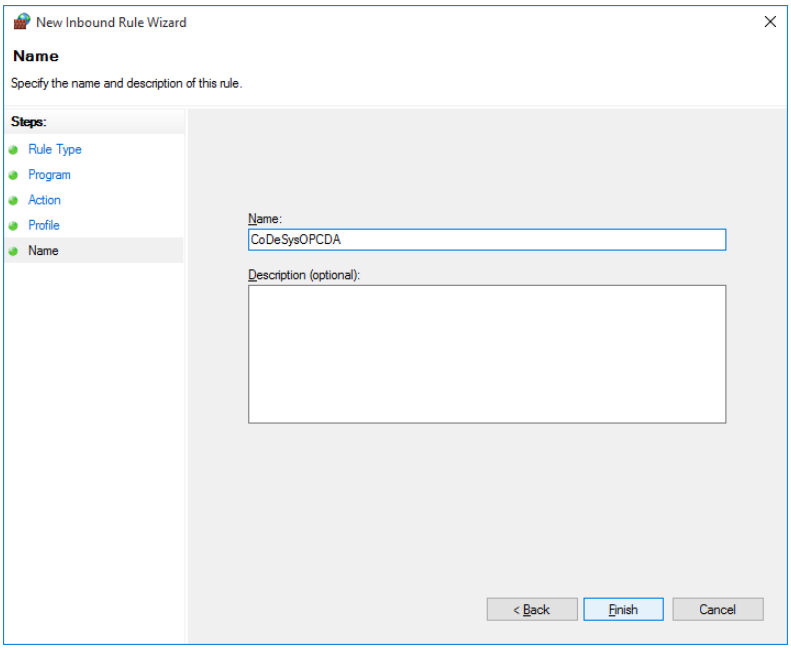
9. The **Action** window of **New Inbound Rule Wizard** is displayed.
   • Select **Allow the connection**, and then click **Next**.



10. The **Profile** window of **New Inbound Rule Wizard** is displayed.
    • Select all checkboxes, and then click **Next**.



11. The **Name** window of **New Inbound Rule Wizard** is displayed.
    • Enter the rule name, and then click **Finish**.



12. Confirm that the rule just created is registered in **Inbound Rules** in the **Windows Firewall with Advanced Security** window. Then close the window.
13. Close the **Windows Firewall** window.

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CHAPTER 6 RAS FEATURES IN HF-W100E/IoT

6.1 Overview

In addition to the standard RAS features on HF-W, HF-W100E/IoT offers additional HF-W100E/IoT's own RAS features. These include such functionalities as the ability to control hardware from the CODESYS runtime environment and to monitor the CODESYS runtime environment.
This section provides an overview of the HF-W100E/IoT's own RAS features.

Table 6-1 RAS Features in HF-W100E/IoT

Category	Item
Control functionality	Controlling the external general purpose I/O
Monitoring functionality	Monitoring the CODESYS runtime environment

<Control functionality>

(1) Controlling the external general purpose I/O
You can use the RAS library for the CODESYS runtime environment to control external general purpose I/O from applications running on the CODESYS runtime environment. If you use this functionality, you can input signals from and output signals to external devices. Seven input and eight output external general purpose I/O are available for a user.

<Monitoring functionality>

(2) Monitoring the CODESYS runtime environment
You can use a watchdog timer on HF-W100E/IoT to monitor whether the CODESYS runtime environment is running properly. If any abnormality is detected, it is recorded in the Windows event log and notified to user applications by using an event object.

This chapter describes functionalities (1), (2) offered by the HF-W100E/IoT's own RAS features.
For information about the standard RAS features on HF-W, see *HF-W100E RAS FEATURES MANUAL* (manual number WIN-63-0095).
For information about the hardware specifications of the Controlling the external general purpose I/O described in this chapter, see *HF-W100E INSTRUCTION MANUAL* (manual number WIN-62-0069).

6.2 RAS Library for the CODESYS Runtime Environment

This chapter describes the interface of the RAS library for the CODESYS runtime environment (hereinafter denoted simply as “RAS library”) and how to use the library. By using the RAS library, you can control the external general purpose I/O.

6.2.1 RAS library interface

Table 6-2 shows a list of RAS library functions.

Table 6-2 List of RAS Library Functions

No.	Function name	Functionality
1	GendoControlN	Controls the output of the external general purpose outputs.
2	GetGendiN	Acquires the status of the external general purpose inputs.

NOTE

- If the RAS features on HF-W are not functioning, the RAS library cannot be used for control.
- If the RAS library is used for controlling external general purpose I/O from the CODESYS runtime environment, control from Windows must be disabled.

(1) Control function for the external general purpose outputs (GendoControlN)

<Name>
GendoControlN - Controls the external general purpose outputs (output1 to 8)

<Syntax>
DWORD GendoControlN(USINT usiOutput, USINT usiMask);

<Description of the functionality>
This function controls the external general purpose outputs (output1 to 8).
The parameters of this function are explained below.

usiOutput: Sets the output level to the general purpose outputs. Table 6-3 shows how bits are allocated to each general purpose output. To set a general purpose output to the low level, set the bit to “0”. To set the output to the high level, set the bit to “1”.
usiMask: Specifies a general purpose output to be controlled. The bit allocation is the same as usiOutput as shown in Table 6-3. If the parameter is to be controlled, set the bit to “1”, Otherwise, set the bit to “0”.

Table 6-3 Bit Allocation of usiOutput and usiMask for GendoContorlN

bit0	output1
bit1	output2
bit2	output3
bit3	output4
bit4	output5
bit5	output6
bit6	output7
bit7	output8

<Return value>
If this function completes successfully, the function returns RET_TRUE (0x01). If this function terminates with an error, the function returns a value as follows.

Table 6-4 Return Value from the GendoControlN Function (Error Cases)

Return value	Description
W2KRAS_INVALID_PARAMETER (0x2001)	There is an error in the specified arguments.
W2KRAS_INTERNAL_ERROR (0x2007)	An internal error has been generated.
W2KRAS_RESOURCE_LOCKED (0x2101)	Another process uses the same resources.
RET_FALSE (0x00)	An error other than W2KRAS_INVALID_PARAMETER, W2KRAS_INTERNAL_ERROR, or W2KRAS_RESOURCE_LOCKED has been generated.

<Explanation>

The GendoControlN function sets the output state of the general purpose output with usiOuput and specifies a control target with usiMask. Figure 6-1 shows an operation example to illustrate the relationship between usiOutput and usiMask.

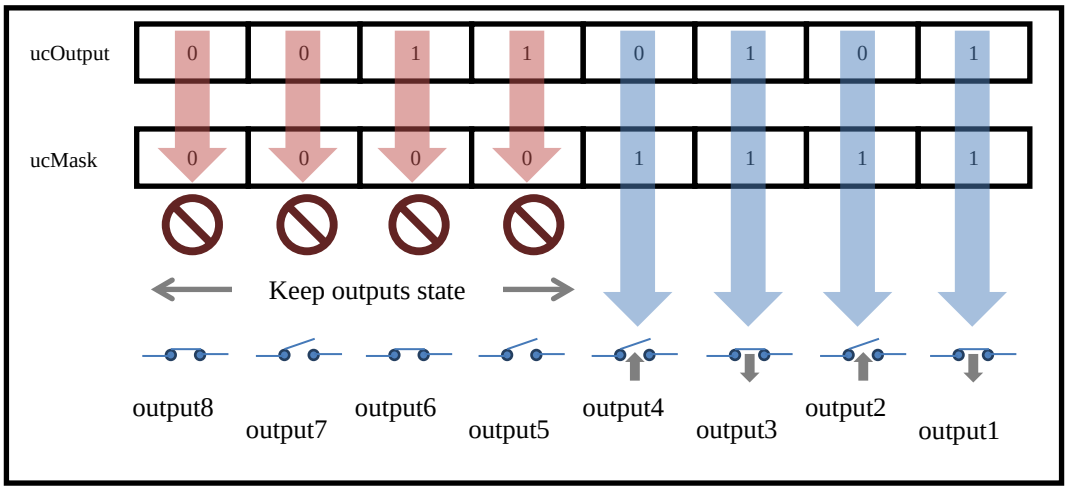


Figure 6-1 Operation Example of the GendoControlN Function

<Supplementary information>

Figure 6-2 shows the operation of the general purpose output1 when the GendoControlN function is used. The dashed lines show the general purpose output level, and the bold line show the transition of the general purpose output1.

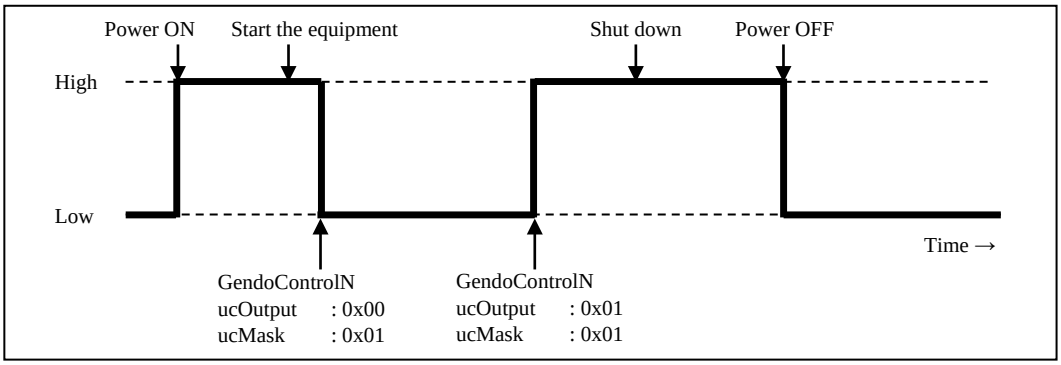


Figure 6-2 Operation Example of the External General Purpose Output1

<Program example>

For an example of a program using this function, see “6.2.3 Examples of using the RAS library”.

NOTE

Do not use this function if you are using the RAS library in the HF-W RAS features to control the external general purpose I/O. In the presence of contention caused by simultaneous access, the output cannot be controlled properly.

(2) Get function for the external general purpose inputs (GetGendiN)

<Name>
GetGendiN - Acquires the status of the external general purpose inputs (general-purpose input1 to 7)

<Syntax>
DWORD GetGendiN(POINTER TO USINT pusiInput);

<Description of the functionality>
This function acquires the status of the external general purpose inputs.
The parameters of this function are explained below.

pusiInput: The input state of external general purpose input is stored. Table 6-5 shows how bits are allocated to each general purpose input. If the input level of a general purpose input is low, “0” is stored to the corresponding bit, and “1” otherwise.

Table 6-5 Bit Allocation of pusiInput for GetGendiN

bit0	input1
bit1	input2
bit2	input3
bit3	input4
bit4	input5
bit5	input6
bit6	input7
bit7	Not used

<Return value>
If this function completes successfully, the function returns RET_TRUE (0x01). If this function terminates with an error, the function returns a value as follows.

Table 6-6 Return Value from the GetGendiN Function (Error Cases)

Return value	Description
W2KRAS_INVALID_PARAMETER (0x2001)	There is an error in the specified arguments.
W2KRAS_INTERNAL_ERROR (0x2007)	An internal error has been generated.
W2KRAS_RESOURCE_LOCKED (0x2101)	Another process uses the same resources.
RET_FALSE (0x00)	An error other than W2KRAS_INVALID_PARAMETER, W2KRAS_INTERNAL_ERROR, and W2KRAS_RESOURCE_LOCKED has been generated.

<Program example>
For an example of a program using this function, see “6.2.3 Examples of using the RAS library”.

NOTE

Do not use this function if you are using the RAS library in the HF-W RAS features to control the external general purpose I/O. In the presence of contention caused by a simultaneous access, the correct input level cannot be obtained.

(3) List of enumeration types in the RAS library
The following table shows a list of enumeration types defined in the RAS library.

Table 6-7 List of Enumeration Types in the RAS Library

Tag name	Definition	Value	Description
W2KRAS_ERROR	W2KRAS_INVALID_PARAMETER	0x2001	There is an error in the specified arguments.
	W2KRAS_INTERNAL_ERROR	0x2007	An internal error has been generated.
	W2KRAS_RESOURCE_LOCKED	0x2101	Other process uses the same resources.
RET_VAL	RET_FALSE	0x00	Termination with an error (other than the predefined causes)
	RET_TRUE	0x01	Normal termination

6.2.2 Adding the RAS library

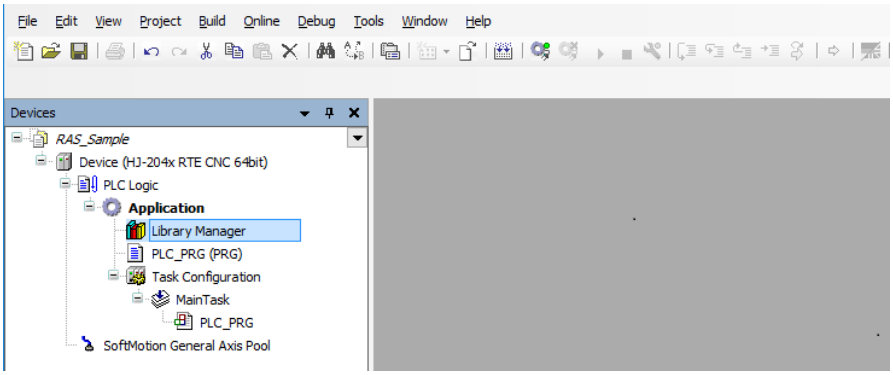
To use the RAS library in the CODESYS runtime environment, you must add the RAS library using the following procedures.

- Install the RAS library in the library repository.
- Add the RAS library to the library manager.

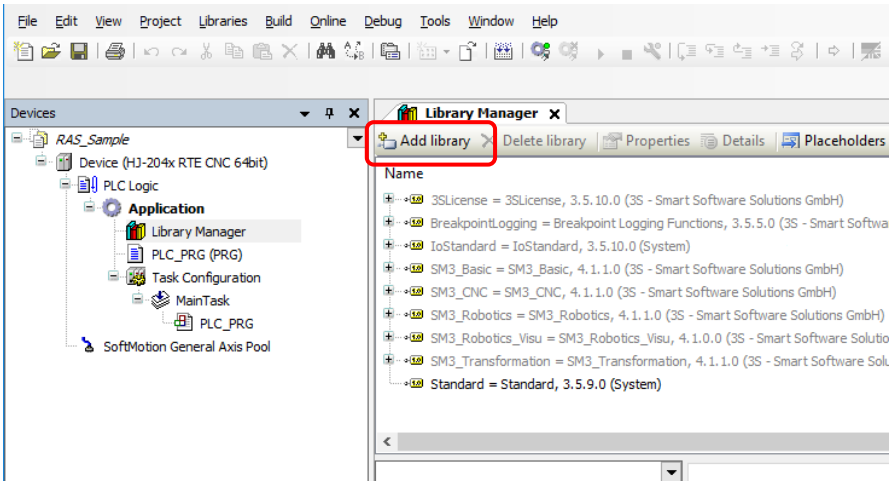
(1) Installing the RAS library in the library repository

If the RAS library has been installed at least once, this step is not necessary. In that case, go to "(2) Adding the RAS library to the library manager".

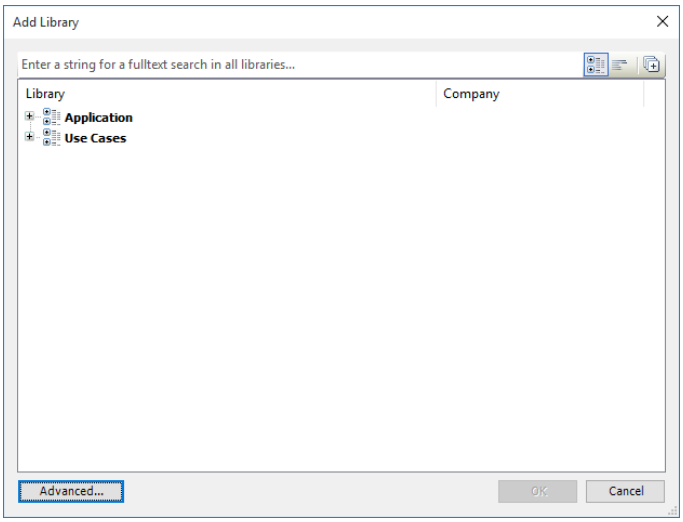
1. Double-click **Library Manager** in the **Devices** window.



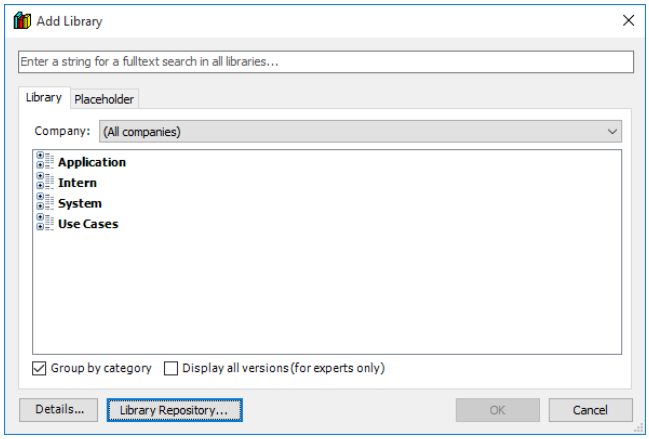
2. Click **Add library** in **Library Manager**.



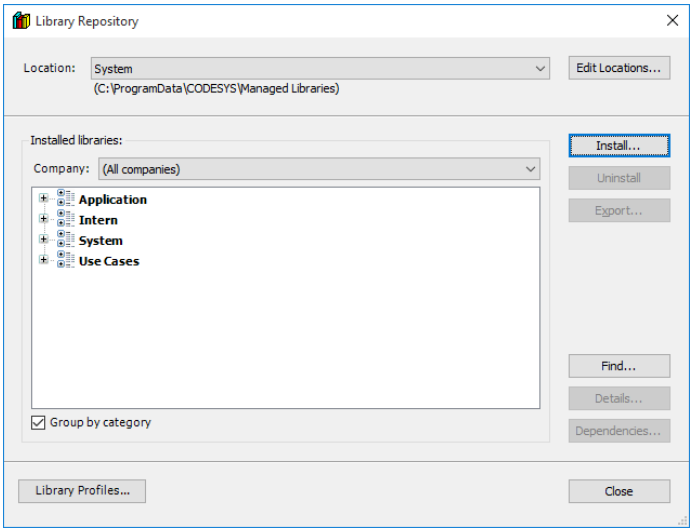
3. The **Add Library** dialog box appears. Click **Advanced**.



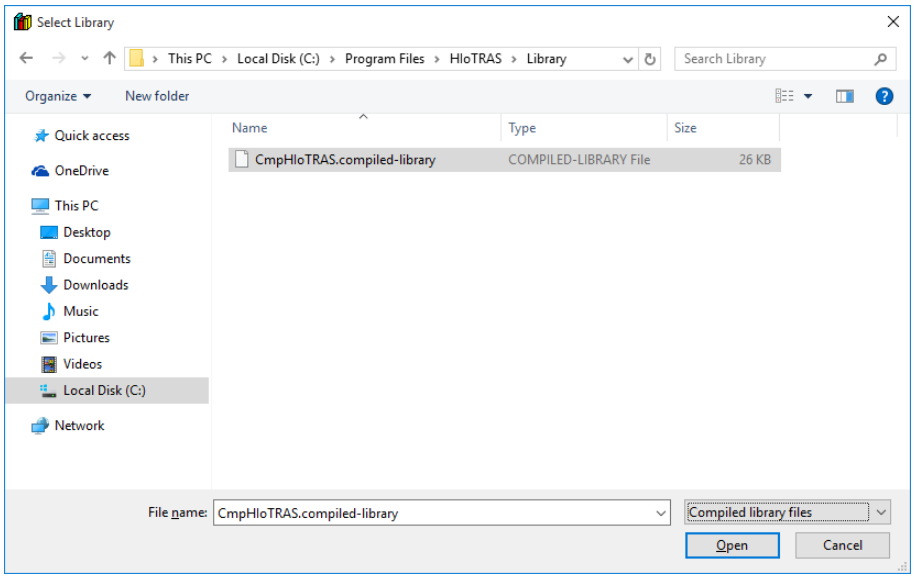
4. The **Add Library** dialog box appears. Click **Library Repository**.



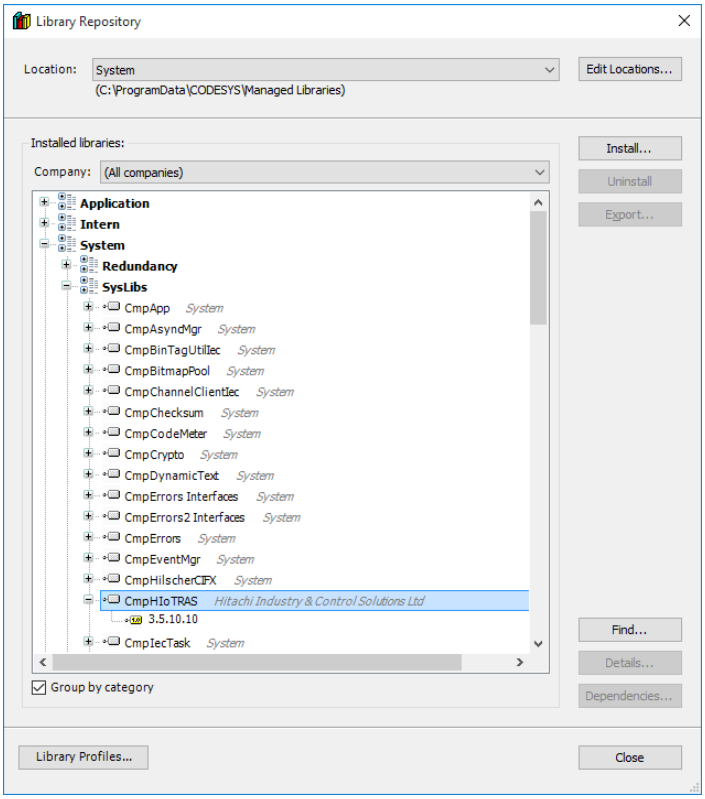
5. The **Library Repository** dialog box appears. Click **Install**.



6. Specify the CmpHIoTRAS.compiled-library file in the C:\Program Files\HIoTRAS\Library folder, and click **Open**.



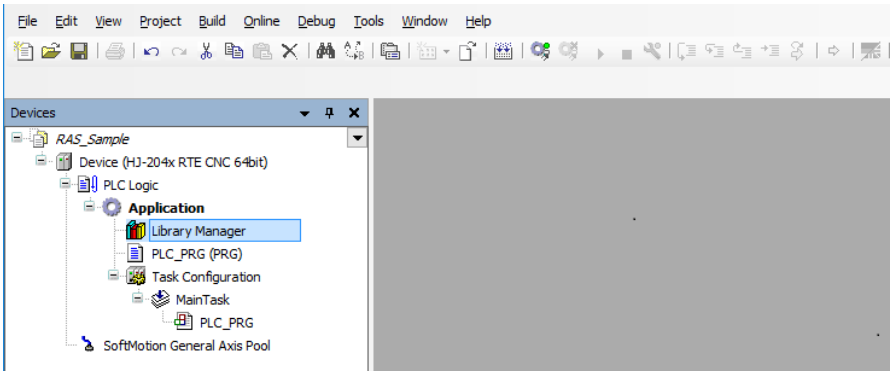
7. Confirm that CmpHIoTRAS is added in System\SysLibs. Click **Close**.



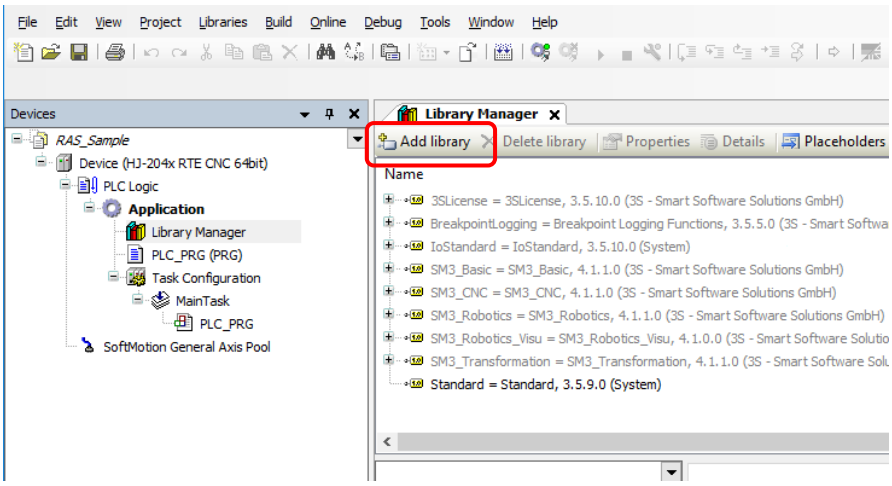
This completes installation of the RAS library.
Click the close button (×) at the upper right corner of the **Add Library** dialog box to close the dialog box.

(2) Adding the RAS library to the library manager

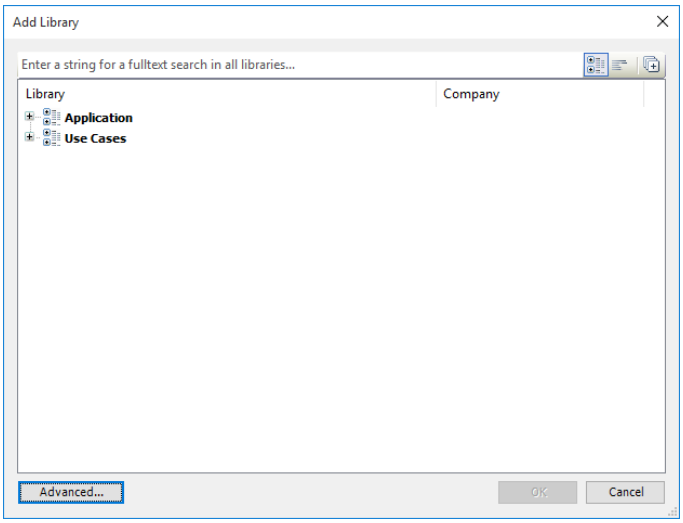
1. Double-click **Library Manager** in the **Devices** window.



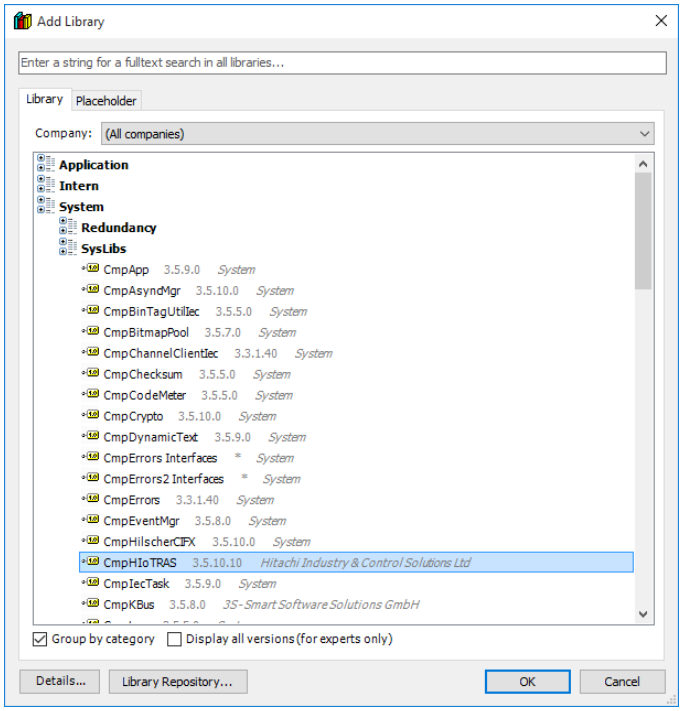
2. Click **Add library** in **Library Manager**.



3. The **Add Library** dialog box appears. Click **Advanced**.

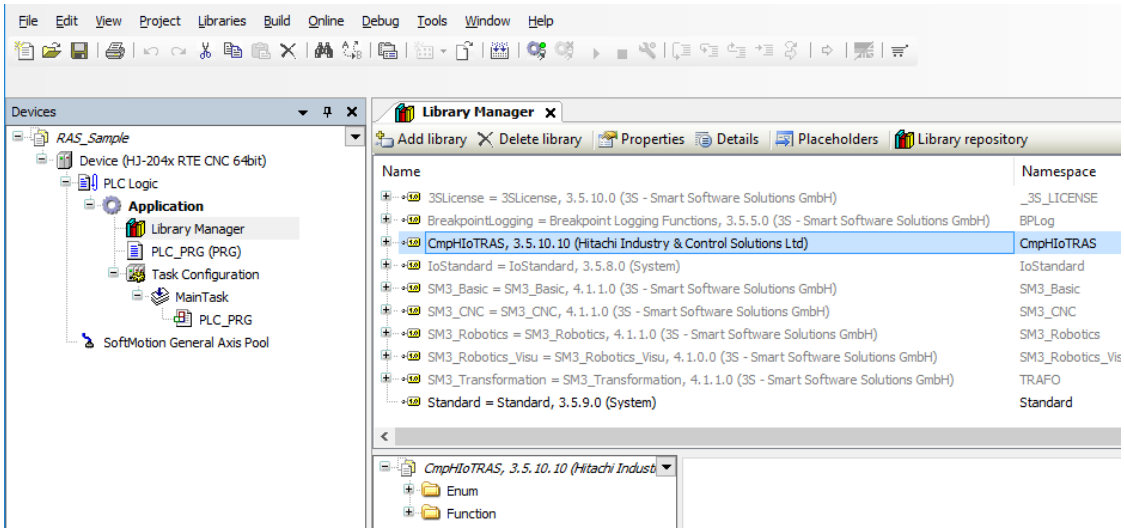


4. The **Add Library** dialog box appears. Click **System** > **SysLibs** > **CmpHIoTRAS**, and then click **OK**.
   Note that you can use the search bar to search the libraries.



5. If the following library is shown in library manager, the library was added successfully.

   CmpHIoTRAS,*.*.*.* (Hitachi Industry & Control Solutions Ltd.) (Asterisks (*) denote the version information.)



6.2.3 Examples of using the RAS library

This subsection describes how to control the external general purpose I/O from applications running on the CODESYS runtime environment.

■ Adding the RAS library

Add the RAS library. For information about how to add the RAS library, the library functions, see “6.2.2 Adding the RAS library”.

■ Implementation of a program using the RAS library

Implement a program. “(1) General purpose external I/O” shows an example of using the RAS library.

(1) General purpose external I/O

The following is an example of using the RAS library for the external general purpose I/O.

<Variables in use>

Table 6-8 shows a list of variables declared in VAR.

Table 6-8 Variables Used in the External General Purpose I/O Functions

Type	Name	Use
INT	uiState	Determines the execution state.
USIINT	dwDO_port	Specifies the output state for the external general purpose outputs.
USIINT	dwDO_cmd	Specifies which external general purpose outputs to control.
USIINT	dwDI_port	Variable used for acquiring the input state of the external general purpose inputs.
DWORD	dwResult_out	Result of the external general purpose output
DWORD	dwResult_in	Result of the external general purpose input

<Functions to use>

Table 6-9 shows which external general purpose I/O functions are used.

Table 6-9 External General Purpose I/O Functions

Function name	Use
GendoControlN	Used for controlling the output of the specified external general purpose. (For details about the function interface, see “6.2.1 RAS library interface (1) Control function for the external general purpose outputs (GendoControlN)”.)
GetGendiN	Used for getting the status of the input of the specified external general purpose. (For details about the function interface, see “6.2.1 RAS library interface (2) Get function for the external general purpose inputs (GetGendiN)”.)

<Program>

In the example of Figure 6-3, the program outputs to the external general purpose output (output1) and obtains the input state of a external general purpose input.

PLC_PRG (declaration part)

```
PROGRAM PLC_PRG
VAR
  uiState: INT;
  usiOutput : USINT;
  usiMask : USINT;
  usiInput : USINT;
  dwResult_out : DWORD;
  dwResult_in : DWORD;
END_VAR
```

PLC_PRG (body)

```
IF uiState = 0 THEN
  uiState := 1;

  // GENDO output
  usiOutput := 1;
  usiMask := 1;
  dwResult_out := GendoControlN(usiOutput, usiMask);

  // GENDI input
  dwResult_in := GetGendiN(ADR(usiInput));
END_IF
```

Figure 6-3 Example of External General Purpose I/O Control Program

6.3 Monitoring the CODESYS Runtime Environment

6.3.1 Overview

This function monitors whether the CODESYS runtime environment is running properly. The function consists of the WDT control component that periodically triggers the watchdog timer on HF-W100E/IoT from the CODESYS runtime environment and the CODESYS monitor service running on the Windows environment.

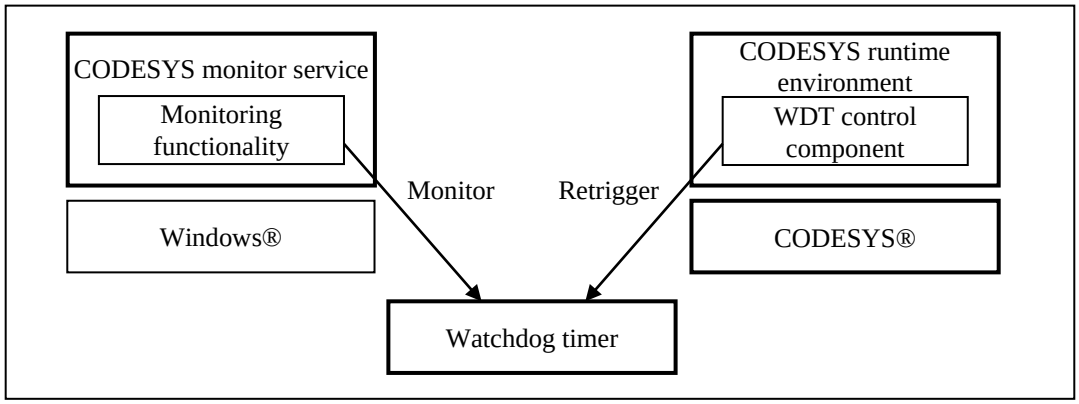


Figure 6-4 Block Diagram of the Monitoring Functionality

(1) The WDT control component runs on the scheduler of the CODESYS runtime environment and periodically retriggers the watchdog timer.

(2) The CODESYS monitor service periodically checks if a timeout is generated by the watchdog timer. A watchdog timer timeout is generated when the WDT control component is unable to retrigger and the time in the watchdog timer is less than the timeout threshold (*1).

(3) When a timeout occurs, the CODESYS monitor service infers that some sort of error occurred in the CODESYS runtime environment and notifies user applications by means of the Windows event log and event objects. In addition, the CODESYS monitor service executes the predefined action at the time of time-out (*2).

(*1) The timeout threshold is 63 seconds minus the timeout.
For information about how to set the value, see “6.3.5 HIoTRAS setting command”.
The factory setting is 0 (seconds) because the timeout is set to 63 seconds.
(*2) You can select one of the following for the action at the time of time-out.
• Stop and restart the CODESYS runtime environment
• Shut down and restart the device
• Shut down and restart the device (forced)
For information about how to set the action, see “6.3.5 HIoTRAS setting command”.
No action is set in the factory setting.

The monitoring functionality can be disabled or enabled. For information about how to disable or enable this functionality, see “6.3.2 Enabling/Disabling the CODESYS runtime environment monitor”.

NOTE

- When the monitoring functionality is used, **Not used** is selected for **Watchdog timer setting** in the **RAS Setup** window in the HF-W RAS features (factory setting). If **Automatic retrigger** or **Retriggered by application program** is selected, the monitoring functionality cannot function. For information about the **RAS Setup** window, see “3.1.3 Using the RAS Setup window” in the *HF-W100E RAS FEATURES MANUAL* (manual number WIN-63-0095).
- When the monitoring functionality is used, a watchdog timer cannot be used by the HF-W RAS features. If you want the HF-W RAS features to use a watchdog timer, disable the monitoring functionality as described in “6.3.2 Enabling/Disabling the CODESYS runtime environment monitor”.
- When 63 seconds elapse without the state in which retriggering cannot be performed is canceled, 150 seconds after the value of the timer becomes 0, the blue screen (STOP code: 0x9231) is displayed by the HF-W RAS features to acquire a memory dump.

6.3.2 Enabling/Disabling the CODESYS runtime environment monitor

You can enable and disable the CODESYS runtime environment monitor by editing the CODESYS config file and changing the settings of the monitor service. The monitoring functionality is enabled in the factory setting. Note that, if the CODESYS runtime environment monitor is disabled, a shutdown of the CODESYS runtime environment will not be detected.

(1) Disabling the CODESYS runtime environment monitor

(a) Editing the config file

1. Launch Notepad as administrator.
   - If the OS is Windows® Embedded Standard 7, click **Start**, and then click **All Programs** > **Accessories**. right-click **Notepad**. On the menu, click **Run as administrator**.
   - If the OS is Windows® 10, click **Start**, and then click **Windows Accessories** from the list of applications. right-click **Notepad**. On the menu, click **More** > **Run as administrator**.
   - If the **User Account Control** window is displayed, click **Yes**.
2. Notepad starts. Click the **File** menu, and on the menu, click **Open**.
3. Select the CoDeSysControl.cfg file in C:\Program Files\3S CODESYS\CODESYS Control RTE3, and then click **Open**.
4. The CoDeSysControl.cfg file opens. In the ComponentManager section, add "; (semicolon)" to the beginning of the following line to comment out the WDT control component (CmpHWdtControl).

   Component.*=CmpHWdtControl

   Note: The number added after "Component." is an index and different depending on the environment.

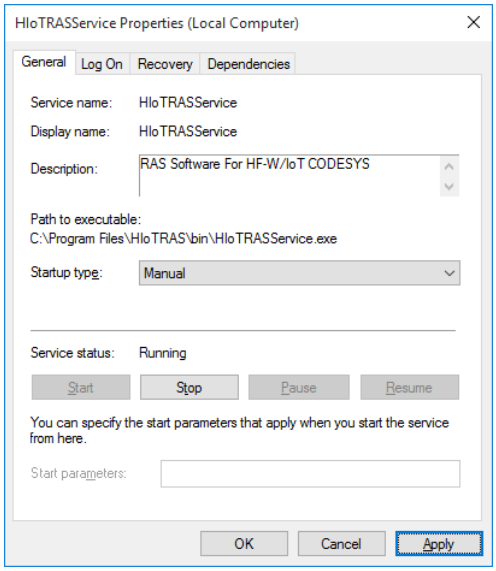
```
[CmpRouter]
0.MainNet=ether x

[ComponentManager]
Component.1=CmpDrvSchedulerAPIC
Component.2=CmpCodeMeter
;Component.3=CmpHWdtControl
;Component.3=CmpSJACanDrv
;Component.3=CmpEt100Drv
;Component.3=CmpEt1000Drv
;Component.3=CmpRTL81x9Mpd
;Component.3=CmpRTL8169Mpd
;Component.3=CmpHilscherCIFX
;Component.3=CmpSercos3Master
```

Figure 6-5 Editing the Config File (Disabling the Monitor)

5. Click the **File** menu, and on the menu, click **Save**.
6. Close the CoDeSysControl.cfg file.

(b) Stopping the monitor service

1. Open **Control Panel**.
   - If the OS is Windows® Embedded Standard 7, click **Start**, and click **Control Panel**.
   - If the OS is Windows® 10, right-click **Start**, and click **Control Panel** from the menu.
2. After the **Control Panel** window opens, click **System and Security**.
3. After the **System and Security** window opens, click **Administrative Tools**.
4. After the **Administrative Tools** window opens, double-click **Services**.
5. In the **Services** window, double-click **HIoTRASService**. The **HIoTRASService Properties** dialog box opens.
6. Change **Startup type** to **Manual**, click **Apply**, and then click **OK**. Then, restart the PC.



(2) Enabling the CODESYS runtime environment monitor

(a) Editing the config file

1. Follow the Steps 1 to 3 in “(a) Editing the config file” in “(1) Disabling the CODESYS runtime environment monitor”.
2. The CoDeSysControl.cfg file opens. In the ComponentManager section, insert the following line to add the WDT control component (CmpHWdtControl) as a loading component.

   Component.*=CmpHWdtControl

   Note: The number added after “Component.” is an index and different depending on the environment.
   When you add CmpHWdtControl, add 1 to the index of the last component, and use that value as the index for the CmpHWdtControl. (The lines that start with “; (semicolon)” in the CoDeSysControl.cfg file are commented out and therefore disabled.)

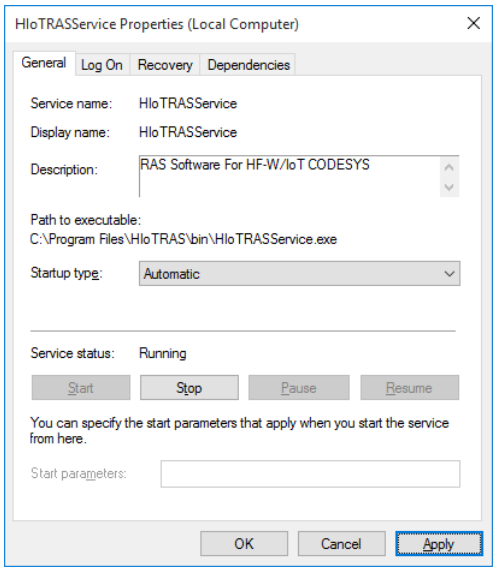
```
[CmpRouter]
0.MainNet=ether x

[ComponentManager]
Component.1=CmpDrvSchedulerAPIC
Component.2=CmpCodeMeter
Component.3=CmpHWdtControl
;Component.3=CmpSJACanDrv
;Component.3=CmpEt100Drv
;Component.3=CmpEt1000Drv
;Component.3=CmpRTL81x9Mpd
;Component.3=CmpRTL8169Mpd
;Component.3=CmpHilscherCIFX
;Component.3=CmpSercos3Master
```

Figure 6-6 Editing the Config File (Enabling the Monitor)

3. Click the **File** menu, and on the menu, click **Save**.
4. Close the CoDeSysControl.cfg file.

(b) Starting the monitor service

1. Follow the Steps 1 to 5 in “(b) Stopping the monitor service” in “(1) Disabling the CODESYS runtime environment monitor”.
2. Change **Startup type** to **Automatic**, click **Apply**, and then click **OK**. Then, restart the PC.



6.3.3 Event notification

The CODESYS runtime environment monitor uses an event object and notifies an application when a watchdog timer timeout occurs.
The application can infer that a watchdog timer timeout has occurred when the event object is in the signaled state.
The event object is reset when the watchdog timer is retriggered once again after the action at the time of time-out is complete.

(1) Detecting the event

The application can detect when a watchdog timer timeout occurs using the following procedure.

1. Use the OpenEvent Windows API function to get the handle to the event object. If an event object is not created by executing the OpenEvent function, retry the function until the event object is created.

2. Use the WaitForSingleObject or WaitForMultipleObject Windows API function to monitor whether the event object is in the signaled state.

   Table 6-10 shows the event object name used when a watchdog timer timeout occurs. When an event object is used in a program, you need to add “Global\” to the beginning of the name of the event object.

Table 6-10 Event Object

Event	Event object name
Watchdog timer timeout	HIOTRAS_WDT_TIMEOUT_EVENT

6.3.4 Recording the event log

Table 6-11 shows the data recorded in the Event Log by the CODESYS runtime environment monitor.

Table 6-11 List of Events Recorded in the Event Log

Event ID	Source	Type	Description
1000	HIoTRAS_APP	Information	Watchdog timer monitoring has been started.
2000	HIoTRAS_APP	Information	Timeout occurs for the watchdog timer. Timeout action is executed.
2001	HIoTRAS_APP	Information	Timeout action is completed successfully.
1100	HIoTRAS_APP	Warning	Initialization of watchdog timer monitoring service terminates with an error. The service has been started with default value.
1200	HIoTRAS_APP	Error	Initialization of watchdog timer monitoring service terminates with an error. The service could not been started.
2100	HIoTRAS_APP	Error	Execution of timeout action terminates with an error.

Note: If the action at the time of time-out is either of the following, Event ID 2001 is not recorded.

- Shutting down and restarting the device
- Shutting down and restarting the device (forced)

6.3.5 HIoTRAS setting command

The HIoTRAS setting command can set the timeout threshold for the CODESYS runtime environment monitor and the action at the time of time-out.

Table 6-12 List of Items Set by the HIoTRAS Setting Command

Item	Setting	Description of the setting
Timeout threshold	0 to 62	Timeout threshold for the watchdog timer (in seconds) (Factory setting: 0)
Action at the time of time-out	0: Not performed the action at the time of time-out.	No action is executed when a timeout is detected (factory setting).
	1: Codesys Stop	Stops the CODESYS runtime environment.
	2: Codesys Restart	Restarts the CODESYS runtime environment.
	3: HF-W Shutdown	Shuts down the HF-W.
	4: HF-W Reboot	Restart the HF-W.
	5: HF-W Shutdown (Forced)	Shuts down the HF-W forcibly.
	6: HF-W Reboot (Forced)	Restart the HF-W forcibly.

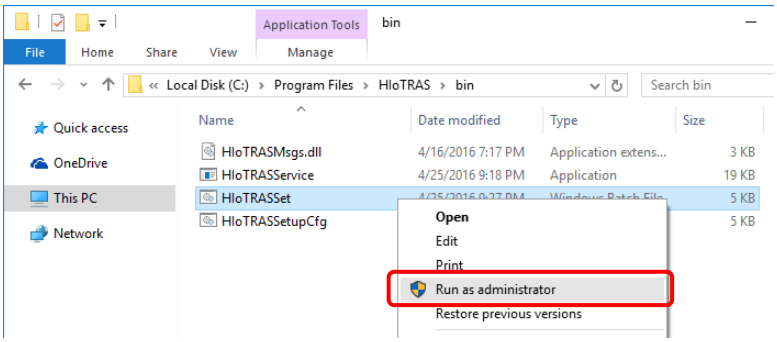
NOTE

If you want to set the action at the time of time-out to Codesys Stop or Codesys Restart, you must set the startup setting of the CODESYS runtime environment to **Start the PLC with the basic system service**. For information about how to configure the startup setting, see “6.3.6 Changing the startup setting”.
If this option is not selected for the startup setting, the CODESYS runtime environment will not be stopped or restarted even if the action at the time of time-out is set to Codesys Stop or Codesys Restart.

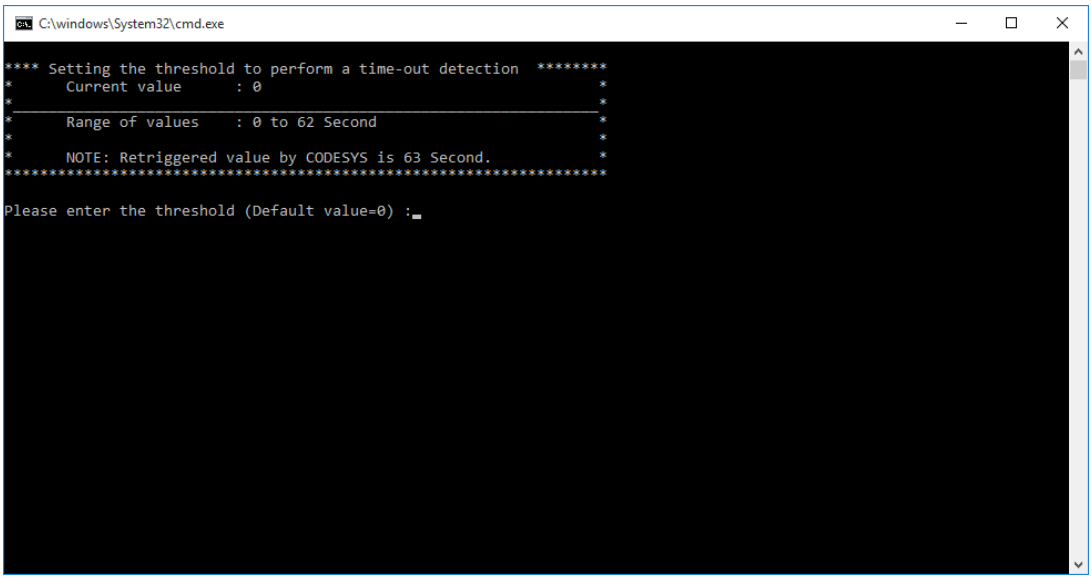
(1) Using the HIoTRAS setting command

1. Start the Windows Explorer in the following steps.
   - If the OS is Windows® Embedded Standard 7, click **Start**, type the following in the **Search programs and files** box at the lower left corner on the Start menu, and then press **Enter**.
     C:\Program Files\HIoTRAS\bin
   - If the OS is Windows® 10, click search icon at the right on the Start button, type the following in the **Search Windows** box, and then press **Enter**.
     C:\Program Files\HIoTRAS\bin

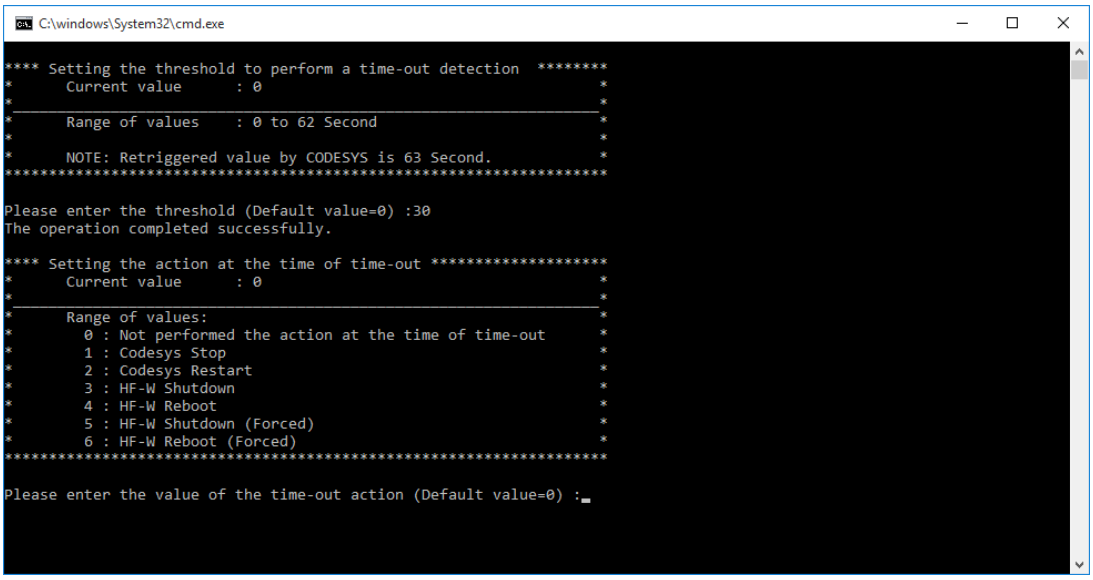
2. When the Explorer window is opened, right-click the HIoTRASSet.bat file. On the menu, click **Run as administrator**.



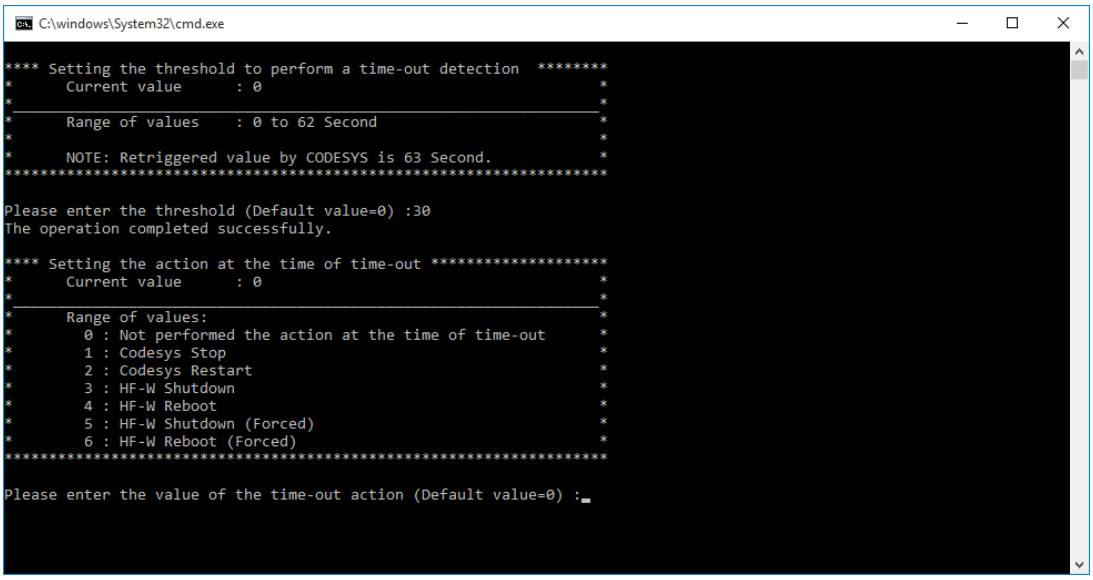
3. When Command Prompt is opened, enter the timeout threshold (0 to 62), and press the **Enter** key.
   Enter 63 seconds minus the timeout for the timeout threshold. For example, if you want to set the timeout to 20 seconds, enter 43 (64 seconds minus 20 seconds).
   • The current value is displayed as **Current value**.
   • If you just press **Enter** without entering a value, the current value is kept. Then, move to Step 5.



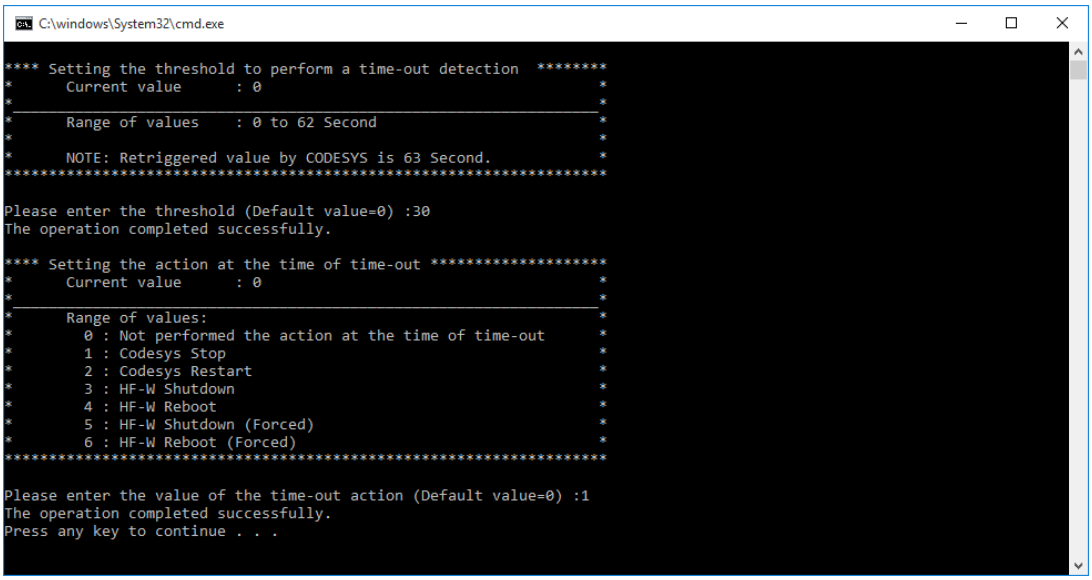
4. As an example, enter **30** for the timeout threshold. If the setting is completed successfully, “The operation completed successfully.” is displayed.



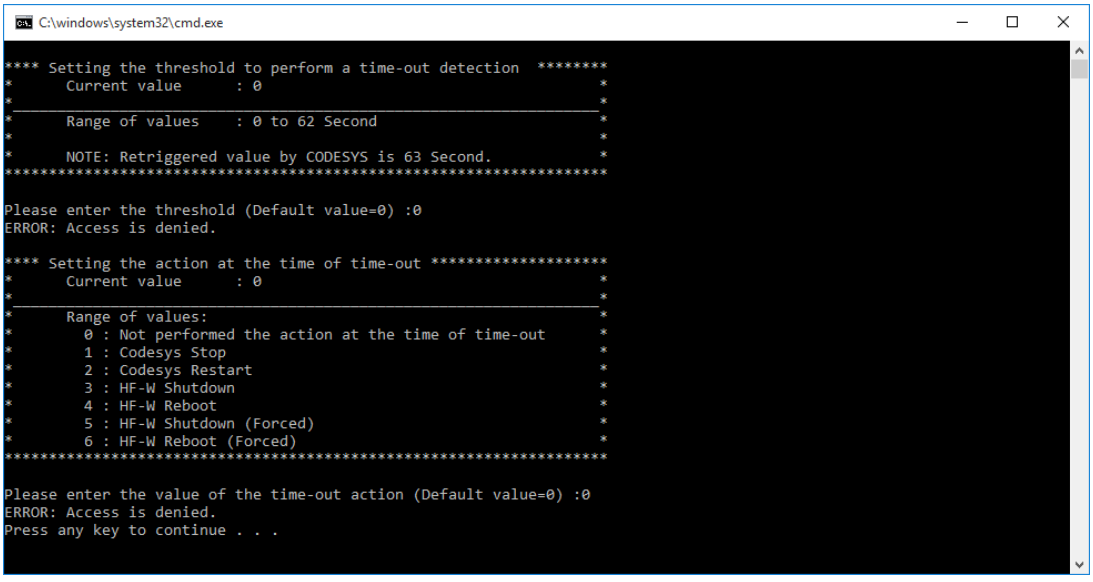
5. Next, enter the action at the time of time-out (0 to 6), and press **Enter**.
   - The current value is displayed as **Current value**.
   - If you just press **Enter** without entering a value, the current value is kept. If you press **Enter** again, the command exits.



6. As an example, enter 1 for the action at the time of time-out. If the setting is complete successfully, “The operation completed successfully.” is displayed.
   When “Press any key to continue...” is displayed, press any key to exit the batch file. Then, restart the device.



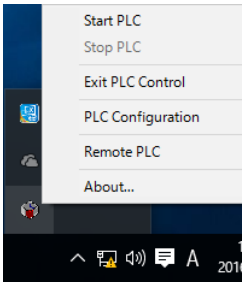
   If you do not launch the batch file as administrator, “ERROR: Access is denied.” is displayed.
   If this message is displayed, run the command as administrator.



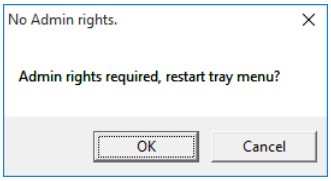
6.3.6 Changing the startup setting

The following is a procedure to change the startup setting of the CODESYS runtime environment to **Start the PLC with the basic system service**. If this option is not selected for the startup setting, the CODESYS runtime environment will not be stopped or restarted even if the action at the time of time-out is set to Codesys Stop or Codesys Restart.

1. Click the CODESYS Control RTE V3 icon in notification area on the taskbar. (The icon is hidden by default, and you must click "^" to find it.) Then click **PLC Configuration**.



2. If a window is displayed to indicate that admin rights are required, click **OK** to obtain the admin rights.



If the **User Account Control** window is displayed, click **Yes**.
When the admin rights are granted, click the icon again, and then click **PLC Configuration**.

3. The **System Configuration** dialog box is displayed. Click the **Startup** tab, select the **Start the PLC with the basic system service** checkbox, and then click **OK**.