Honeywell

ControlEdge PLC

ControlEdge RTU

Release 170

ControlEdge Builder User's Guide

RTDOC-X283-en-170A
March 2021

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1 ABOUT THIS GUIDE

Revision history

Revision	Date	Description
A	March 2021	Initial release of this document

Intended audience

This documentation is intended for the following audience: Users who plan, install, configure, operate, or maintain ControlEdge™ 900 and 2020 controllers running the eCLR (IEC 61131-3) execution environment.

Prerequisite skills

Knowledge of SCADA systems and experience of working in a Microsoft Windows environment are required.

Introduction to ControlEdge Technology

Item	Description
ControlEdge PLC	ControlEdge 900 controllers running the eCLR (IEC 61131-3) execution environment with PLC software options configured with ControlEdge Builder.
ControlEdge RTU	ControlEdge 2020 controllers running the eCLR (IEC 61131-3) execution environment with RTU software options configured with ControlEdge Builder.
ControlEdge UOC	ControlEdge 900 controllers running the Honeywell control execution environment (CEE) configured with Experion Control Builder.

Special terms

The following table describes some commonly used industry-wide and Honeywell-specific terminology:

Terminology	Description
AI	Analog Input
AO	Analog Output
BootP	Bootstrap Protocol
ControlEdge Builder	A integrated configuration tool to design, configure, program and maintain ControlEdge controllers.
CDA	Control Data Access
CPM	Control Processor Module
DD file	Device Description file: A DD file is usually a zip file that can be downloaded from the device vendor's website. It contains information about the device type, commands that are supported by the device, and other devicespecific data. A DD file for a particular field device is used to describe the device and to interpret messages and the device status.
DI	Digital Input
DNP3	Distributed Network Protocol V3.0
DO	Digital Output
EDS	Electronic Data Sheet: A text file which specifies all the properties of an EtherNet/IP™ device necessary for a Scanner module to communicate with it. EDS files my be used in the first step of creating an I/O module or device block for interfacing to an EtherNet/IP device.
EFM	Electronic Flow Measurement
Enron Modbus	An extension of standard Modbus supports for 32-bit Integer and Floating Point variables, and historical and flow data.
EPM	Expansion Processor Module
Expansion I/O rack	I/O rack with EPM installed
Experion® PKS	Experion® Process Knowledge System
FDAP	Field Device Access Point
FD	Field Device
FTE	Fault Tolerant Ethernet
HART-IP	HART-IP extends the HART protocol to Ethernet connected nodes. This facilitates host level systems and asset management applications to

Terminology	Description
	access and integrate measurement and device diagnostics information from HART-enabled field devices using the existing plant networking infrastructure.
Local I/O rack	I/O rack with CPM installed (non-redundant)
Meter run	Meter run in a flow measurement system represents a physical system comprising primary flow measurement element supported by devices measuring secondary parameters like density, pressure, temperature and composition etc., to determine the quantifiable flow through the measurement system. In ControlEdge RTU, meter run is used to calculate quantifiable flow according to different standards mandated by AGA, API and other international standards.
Modbus	A communication protocol supports communication between Modbus slave devices and Modbus master devices via serial port or Ethernet port.
MQTT	Message Queuing Telemetry Transport, an open OASIS and ISO standard (ISO/IEC 20922) lightweight, publish-subscribe network protocol that transports messages between devices. The protocol runs over TCP/IP, or over other network protocols that provide ordered, lossless, bi-directional connections.
OPC UA	An industrial machine-to-machine (M2M) communication protocol is developed by the OPC Foundation, which provides a path forward from the original OPC communications model (namely the Microsoft Windows only process exchange COM/DCOM) to a cross-platform service-oriented architecture (SOA) for process control, while enhancing security and providing an information model.
PI	Pulse Input
POU	Programming Organization Unit
QTR	Quantity Transaction Record
QoS	The Quality of Service (QoS) level is an agreement between the sender and the receiver of a message that defines the guarantee of delivery for a specific message. There are 3 QoS levels in MQTT: • At most once delivery (0);

Terminology	Description
	• At least once delivery (1); • Exactly once delivery (2).
RTU	Remote Terminal Unit
Redundant Controller Rack	Redundant Controller Rack with 2 Power supply slots, 2 CPM slots.
UIO	Universal Input/Output Module
SCADA	Supervisory Control and Data Acquisition
Sparkplug	Sparkplug provides an open and freely available specification for how Edge of Network (EoN) gateways or native MQTT enabled end devices and MQTT Applications communicate bi-directionally within an MQTT Infrastructure.
TLS	Transport Layer Security; TLS is a cryptographic protocol that provide communications security over a computer network.

Related documents

The following list identifies publications that may contain information relevant to the information in this document.

- ControlEdge Builder Software Installation User’s Guide
- ControlEdge Builder Software Change Notice
- ControlEdge PLC and ControlEdge RTU Getting started
- ControlEdge 900 Platform Hardware Planning and Installation Guide
- ControlEdge 2020 Platform Hardware Planning and Installation Guide
- ControlEdge Builder Function and Function Block Configuration Reference
- ControlEdge Builder Protocol Configuration Reference Guide
- ControlEdge PLC and ControlEdge RTU Network and Security

Planning Guide

- ControlEdge PLC EtherNet/IP User's Guide
- ControlEdge RTU and PLC DNP3 Device Profile
- Enhanced Logic Manager Module with ControlEdge PLC User's Guide
- ControlEdge Bulk Configuration User's Guide
- ControlEdge PLC PROFINET User’s Guide
- ControlEdge RTU Electronic Flow Measurement User's Guide
- Firmware Manager User Guide

CHAPTER

2

GETTING STARTED WITH CONTROLEDGE BUILDER

Before you start

Make sure all the hardware modules used in the system are installed with the right firmware version and the engineering station has the latest ControlEdge Builder. You can find the firmware and software updates on *http://www.honeywellprocess.com* with valid credentials.

The latest ControlEdge Builder allows you to open an R110 or later projects, and configure, compile, download, upload, debug it without upgrading the project.

Before you begin with the configuration, ensure that ControlEdge Builder has been correctly installed.

See *ControlEdge Builder Software Installation User's Guide* for more information regarding the ControlEdge Builder installation.

See *ControlEdge 2020 Platform Hardware Planning and Installation Guide* for more information regarding ControlEdge 2020 controller installation and configuration.

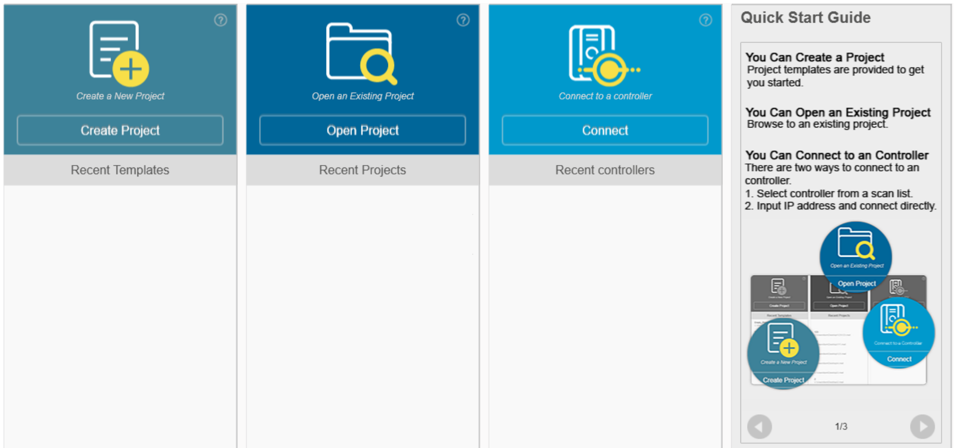
See *ControlEdge 900 Platform Hardware Planning and Installation Guide* for more information regarding ControlEdge 900 controller installation and configuration.

Launching ControlEdge Builder

Click **Start** > **All Programs** > **Honeywell** > **ControlEdge Builder** > **ControlEdge Builder** to launch ControlEdge Builder and the Start Page appears. Start Page is outside any project context, and enables the user to select an option to start. It provides several options:

- **Create Project**: click the icon to create a new project with the default controller configuration.
- **Open Project**: click the icon to open an existing project.
- **Connect**: click the icon to connect to a controller.

Figure 2-1: Start Page



> **TIP:** When the third-party SCADA is Experion, you can launch ControlEdge Builder from the Configuration Studio (Control Strategy > ControlEdge Integration > Configure control strategy).

Working with projects

You can create a new project or open an existing project in ControlEdge Builder.

Creating a project

The configuration and programming details are stored in a project.

To create a new project

1. From the Start Page, click **Create Project**.
2. In the **Create New Project from Template** window, click **General** and select the target template from the **Available Templates** list.
   - Select **900cp1** to create a project for a ControlEdge 900 controller.
   - Select **sc-ucmx01**, **sc-ucmx02** or **sc-ucnn11** to create a project for a ControlEdge 2020 controller.
     - **sc-ucmx01** is for 2020 controller, 28 MIXED IO, 128MB DRAM.

       Only compatible with firmware and project R151 and lower.

- **sc-ucmx02** is for 2020 controller, 28 MIXED IO, 256MB DRAM.

  Only compatible with firmware and project R160 and later.
- **sc-ucnn11** is for a redundant controller.

3. Click **Next**. The **Save As** window appears.
4. Select an appropriate directory to save the project and enter a name for the project in the **File name** field.
   - The project name must not contain any of the following characters: '.\/:*?"<>|'.
   - The project name must not exceed 24 characters.
   - The directory path length must not exceed 171 characters.
5. Click **Save**. A project is created, and the Home Page appears. You can click **Set Controller Name** under **Controller and Programming** and enter the desired name for the controller.

   If using Experion integration with ControlEdge 900 or 2020 controller, this name is used to identify the controller during Experion configuration.

Figure 2-2: Home Page for ControlEdge 2020 controller

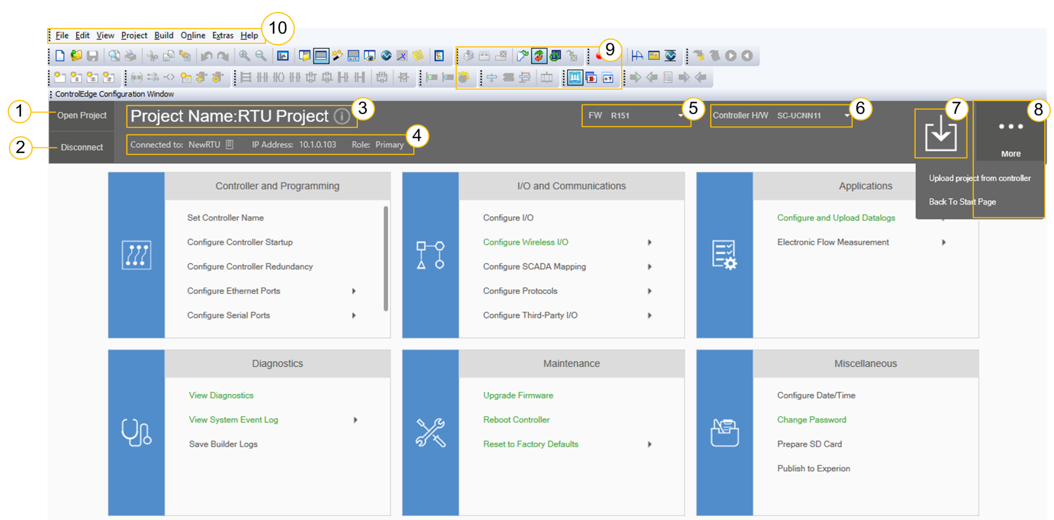
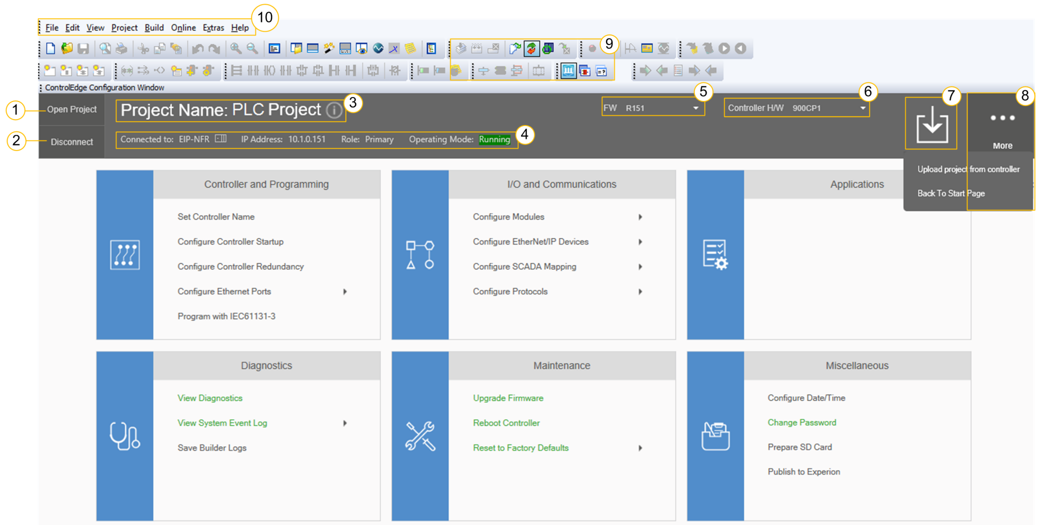


Figure 2-3: Home Page for ControlEdge 900 controller

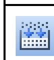
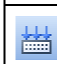


Item	Description
1	**Open Project**: open an existing project. If the existing project has stored a Device Description (DD) file, and the DD revision is different with the one in the ControlEdge Builder repository, a message will prompt you to use the latest DD file.
2	**Connect/Disconnect**: connect/disconnect with a controller.
3	**Project Name**: display the project name.
4	After connecting with a controller, the connection status, name, IP address, role and operating mode of the connected controller are displayed.
5	**FW**: select and display the target firmware version used for the project.
6	**Controller HW**: select and display the target hardware version used for the project. **ATTENTION:** This operation will reset the existing DNP3 mapping table "Experion". If this table has been used, it should be renamed before this operation. After this operation, it should be bound to DNP3 Outstation protocol again.

Item	Description
7	**Download**: download the configuration to the connected controller.
8	• **More** > **Back To Start Page**: return back to the Start Page. • **More** > **Upload project from controller**: upload and open a project in ControlEdge Builder, or save it to the PC.
9	Toolbar. See the table Description of toolbar icons.
10	Menu bar. See the table Description of menu bar items.

The following table lists the commonly used toolbar icons which are highlighted in callout 9 of the screenshot above.

Table 2-1: Description of toolbar icons

Icon	Name	Description
	ControlEdge Configuration Workspace	Click it to move to the Home Page.
	IEC Programming Workspace	Click it to move to the IEC Programming Workspace.
	Make	Click it to compile the changed worksheets.
	Rebuild Project	It is used to compile the whole project for the first time or if an announced user library has been changed. The command Rebuild Project should only be used if 'Make' generates compiling errors or you have unzipped your project without the frontend code.
	Project Control Dialog	It is used to download a project to the controller.
	Debug on/off	Click it to switch all worksheets between offline and online mode.

Icon	Name	Description
		• Online: monitor the online values of the project. • Offline: configure the project.

The following table lists items for the menu bar. Depending on the program part or editor you are working with, particular menu items may not accessible.

Table 2-2: Description of menu bar items

Menu	Description
File	It can be used to create, save and zip/unzip projects, to save a project as a template and to delete templates. It also contains commands for printing, print setup and print preview.
Edit	It contains all commands which are necessary for editing such as marking, choosing different working modes or cutting and pasting.
View	It is used to hide or show the different windows and controls of the user interface (project tree window, message window, cross references window, watch window, Logic Analyzer, multi-element variable window, Edit Wizard, Project Comparison Result window) as well as the status bar and to switch the workspaces (if implemented).
Project	It is used to insert data type worksheets and POUs and to announce libraries.
Build	It consists of different commands for starting the compilation after editing, for displaying the errors detected while compiling, for building the cross references and for removing the declarations of unused local variables and FB instances.
Online	The 'Online' menu provides commands for debugging a project, calling the resource control dialog and activating the powerflow display.
Extras	It can be used to call the dialogs 'Shortcut Keys' and 'Options' as well as other optional tools, such as the

Menu	Description
	pagelayout editor.
Help	It contains all commands for calling the embedded help.
For more information, from the menu bar, select **Help** > **Contents**, and search **Menu bar** to display the details.	

Opening an existing project

1. From the Start Page or Home Page, click **Open Project**. The default folder of all the available projects in the system appears.
2. Select the target project and click **Open**to open the project.

Managing a project

In ControlEdge Builder, a project can be archived as a zipped file and saved as a template. A previously archived project can be unzipped and then used. It is recommended to zip your files regularly to back up your work. You can also print parts of a project or the whole project.

To save the opened project as a template

You can save an existing project as a template. Then you can select this new template when you create a new project.

1. Click **File** > **Save As Template**. The **Save As Template** dialog box appears.
2. Enter the **Template Name** and select **Group**.
3. Click **OK**.

   The project will be saved as a template and it is displayed in the **Available Templates**.

To save the opened project to a zipped file

EDS files cannot be saved when you back up a project, you must copy them to the folder manually: C:\ProgramData\Honeywell\ControlEdge Builder\EDSFiles.

1. Click **File** > **Save Project As / Zip Project As**. The **Save/Zip project as** dialog box appears.
2. From the **Save as type** drop-down list, select **Zipped Project Files (*zwt)**.
3. Select the required folder and enter a file name for the archive.
4. If user libraries are required in the zipped project, in the **Zip Options**, select both **Zip User-Libraries** and **Zip Frontend-Code**.

   If **Zip Frontend-Code** is not selected, when the project is unzipped, the user libraries might become unusable.
5. Click **Zip**.

To extract a zipped project

1. Click **File** > **Open Project / Unzip Project** from the toolbar. The **Open/Unzip project** dialog box appears.
2. From the **Files of type** drop-down list, select **Zipped Project Files (*zwt)**.
3. Select the zipped file you want to extract, and then click **Unzip**.
4. Click **Yes** to accept the folder specified, or click **No** to navigate to another folder.
5. Click **Save** to extract the zipped project. You must select **No** or **Not to all** if the "HWFBLib" overwrite dialog appears.

To print a project

1. Open the target project and click **File** > **Print Project**. The **Print Project** dialog appears.
2. For the **Range**, select either:
   - **All** to print the whole project; or,
   - **Selected** to print the selected parts of the project.
3. For the **Page Range**, select either:
   - **All** to print all pages; or,
   - **Pages** to enter the page numbers you want to print.
4. **Print** options can be used to print the following:

- Data Type Worksheet
- Description Worksheet
- Variable Worksheet
- Code Worksheet
- Task and Resource Information
- Local Cross Reference
- Global Cross Reference
- OEM specific data
- Table of Contents

5. Click **Print**. The **Save As** dialog appears.
6. Select the target directory and click **Save**. A pdf file is saved.

To protect a project

Password protection restricts access to entire projects or parts of projects or libraries. With password protection, you can:

- lock the entire project or library
- protect single POUs against unauthorized change
- restrict actions like downloading or starting/stopping a controller

1. Call the corresponding properties dialog and choose the desired restrictions by marking the related checkboxes. Which dialog you need for which restriction is described in the following table. Confirm the security settings.

Target	Securable object	Possible restrictions	Dialog for defining the security settings
Project folder	Protection of the structures within the subtrees and folders of the project.	Insertion and deletion of objects in the following folders: Libraries Data types Logical POUs	These settings are made in the dialog 'Project properties', which is called using the context menu item 'Properties...' of the project folder icon.

Target	Securable object	Possible restrictions	Dialog for defining the security settings
		Configuration Resources	
Data types worksheet	Protection of data type worksheets	Read protection Write protection	Properties dialog of the data types worksheet icon.
POU folder	Protection of variables worksheets, code body worksheets and description worksheets	Read protection Write protection	Properties dialog of the data types worksheet icon.
Configuration folder	Protection of worksheets.	Read protection Write protection	Properties dialog of the corresponding configuration folder icon.
Resource folder	Protection of worksheets as well as restriction of download and debug commands	Read protection Write protection Download protection Debug protection	Properties dialog of the corresponding resource folder icon.

2. Call the dialog 'Project password' using the menu item 'Enter password...' in the 'File' menu. In the dialog enter a password and verify it by typing it a second time in the lower field 'Password confirmation'.
3. The password protection becomes only valid after activating the defined password. This means, that is it not enough to define a password; you have to activate it explicitly by clicking on the button 'Activate assword'. After activating the password, a key symbol is added to each restricted object in the project tree.

Bulk configuration

This feature only applies to ControlEdge 2020 controller.

ControlEdge Builder supports bulk configuration to create multiple projects.

ControlEdge Builder provides **bulkconfig.exe** file and **bulk_config_template.xls** template. These are installed in the main directory of ControlEdge Builder. The default directory is C > Program Files or Program Files (x86) > Honeywell > ControlEdge Builder > builder.

1. Open file bulk_config_template.xls, and fill in the table according to your requirement. Each row is corresponding with a project. Then save the file as another name.
   - To configure the “create file?”, fill in “Yes” or “No”. “Yes” means create the projects, while “No” means do not create the projects.
   - To configure the serial ports, see Configuring serial ports for more information.
2. Open a command prompt window. Under the directory of **BulkConfig.exe**, drag **BulkConfig.exe** into the command window and press **Enter**. Then the following display is shown indicating the parameters should be configured:

```
Usage: BulkConfig -s Project -i Configs.xls -o OutputFolder

  -s FOLDER, --set=FOLDER        Required. set base project folder to load.

  -i FILE, --input=FILE          Required. Input the template file

  -o FOLDER, --output=FOLDER     Required. Set Output folder

  --help                         Display this help screen.
```

Parameter	Description
S	Specify the project folder that you target to bulk copy the configuration except the ones configured in the excel file.
I	Specify path to the excel file that you have saved as.
O	Specify the destination folder that you want to save the output bulk projects.

3. Enter the above parameters and press **Enter**. Bulk configuration

tool creates multiple projects accordingly in the “output” folder.

If you execute the tool with the privilege of administrator, all the generated projects can only be accessed by the administrator.

Connecting a controller

Click **Connect** from the Home Page, and the **Connect controller** page appears.

Select one of the following two methods to connect a controller:

- Scan the network to connect a controller

  a. Click the **Scan and Select** tab to view detailed information for the discovered controllers in the system.

     You can connect to a physical controller or a simulated controller (not available for all releases).

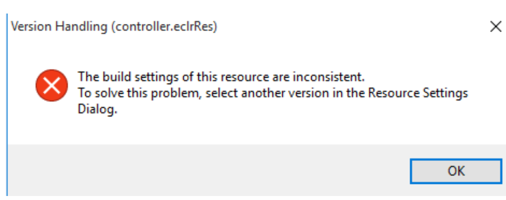
     Select the controller type. The available options are:

     - : ControlEdge 2020 controller
     - : ControlEdge 2020 controller simulator
     - : ControlEdge 900 controller
     - : ControlEdge 900 controller simulator

  b. Select the user name and enter the password. For the initial password of each user type, see User privileges for more information.

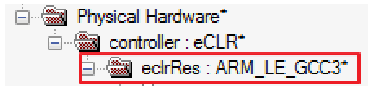
  c. Click **Connect**.

     If the current and previously connected controller types are different, the following dialog appears. Click **OK** to automatically configure the settings.

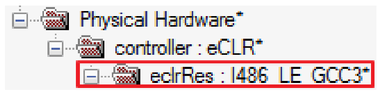
     

  d. Click **IEC Programming Workspace** and check that the build settings is correct.

- The build settings for a physical controller is ARM_LE_GCC3.



- The build settings for a controller simulator is I486_LE_GCC3.



■ Manually enter IP address to connect a controller

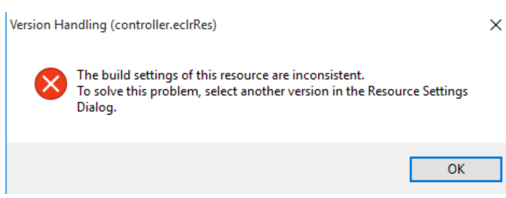
a. Click **Connect manually** tab, enter the IP address of the target controller.

- For the non-redundant controller, if the DHCP client is not enabled on ETH2, the default static IP address of ETH2 is 192.168.1.50.
- For the redundant controller, if DHCP clients are not enabled on ETH1 and ETH2, the default static IP address of the primary controller (CPM1) on ETH2 is 192.168.1.50, and the secondary controller (CPM2) is 192.168.1.51.

b. Select the user name and enter the password. For the default password of each user type, see User privileges for more information.

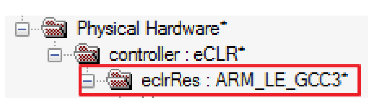
c. Click **Connect**.

If the current and previously connected controller types are different, the following dialog appears. Click **OK** to automatically configure the settings.

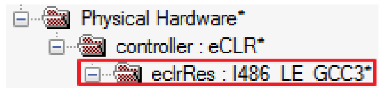


d. Click **IEC Programming Workspace** and check that the build settings is correct.

- The build settings for a physical controller is ARM_LE_GCC3.



- The build settings for a controller simulator is I486_LE_GCC3.



> **TIP:** Due to the cyber security, ControlEdge Builder will disconnect with the controller automatically if there is no communication between them including displaying the diagnostic view, uploading the datalog, downloading the configuration, and upgrading the firmware for over ten minutes.

Configuring controller type

This function enables you to configure the controller type for ControlEdge 900 controller.

1. Under **Controller and Programming**, select **Configure Controller Type**. The **Configure Controller Type** dialog appears.
2. Select **Yes** if the controller is configured with PLC-FTE.
3. Click **OK**.

   After that, you should configure **BootP Available**. See Configuring ETH1 and ETH2 for more information.

Configuring controller start up

This function enables you to configure the controller status after the power cycle.

For ControlEdge 900 controller, this feature is only applicable when the mode switch is in REMOTE position.

Under **Controller and Programming**, select **Configure Controller Start Up**, and the **Configure Controller Start Up** page appears. There are four options for controller start up:

- **Last operating mode, or Running after an abnormal stop**

  This option is the default setting for ControlEdge 2020 controller.

  The controller will start in the last operating mode in prior to a power off, unless there was an abnormal stop caused by a system error such as a watchdog timeout issue. It will then start in *Running* mode.

- If the controller was in *Running* mode before power off, the controller will warm start in *Running*. If the warm start fails, the controller will go to *Stopped* mode.
- If the controller was stopped manually before power off, the controller will start in *Stopped* mode.
- If the controller was stopped abnormally before power off, the controller will warm start in *Running* mode. If the warm start fails, the controller will go to *Stopped* mode.

- **Last operating mode, or Stopped after an abnormal stop**

  This option is the default setting for ControlEdge 900 controller.

  The controller will start in the last operating mode in prior to a power off, unless there was an abnormal stop caused by a system error such as a watchdog timeout issue. It will then start in *Stopped* mode.

  - If the controller was in *Running* mode before power off, the controller will warm start in *Running*. If the warm start fails, the controller will go to *Stopped* mode.
  - If the controller was stopped manually before power off, the controller will start in *Stopped* mode.
  - If the controller was stopped abnormally before power off, the controller will start in *Stopped* mode.

- **Running**

  The controller will warm start in *Running* mode. If the warm start fails, the controller will go to *Stopped* mode.

- **Stopped**

  The controller will start in *Stopped* mode.

> **ATTENTION:** If you reboot the controller manually, the configuration in this section will not take effect. For example: If you select **Running** here, and you select **Reboot Controller** under **Maintenance**, and click **Cold Reboot**. The controller will perform cold start, but not warm start after it reboots.

Configuring controller redundancy

To disable redundancy

1. Under **Controller and Programming**, select **Configure Controller Redundancy**.
2. Select **Disable Controller Redundancy** to disable the redundancy function.
3. Click **OK**. Redundancy has been disabled. The IP address configured for the secondary controller will be disabled.

To enable redundancy

1. Under **Controller and Programming**, select **Configure Controller Redundancy**.
2. Select **Enable Controller Redundancy**, and then click **OK**.

   The configuration of I/O modules in the rack local to the controller will be removed and a static IP address must be configured for the secondary controller.
3. Configure the IP address of the controllers.
   - If the **Obtain an IP Address Automatically** options of ETH1 and ETH2 were enabled, this option will be disabled automatically. Configure **Primary Controller IP Address** and **Secondary Controller IP Address** manually.
   - If the **Obtain an IP Address Automatically** options of ETH1 and ETH2 were disabled, configure the **Secondary Controller IP Address** manually.

Publishing to Experion

This function enables the user to publish the related configuration for Experion to configure point and system status for ControlEdge 900 controller or ControlEdge 2020 controller in Experion.

- Experion server to ControlEdge 900 controller communication is with the OPC UA protocol, so the OPC UA Server must be enabled on the Ethernet port(s) connected to the same network as the Experion Server.

  Experion can read, write and monitor global variable, program local variable and function block instance variable through the Identifier defined by OPC UA protocol. The maximum length of the Identifier is 73 characters.

  Global variable's Identifier is @GV. <Varname>.

  Program local variable's Identifier is <Program Instance Name>.<Varname>.

Function block instance variable's Identifier is <Program Instance Name>.<Function Block Instance>.<Varname>.

- Experion server to ControlEdge 2020 controller communication is with the DNP3 protocol, so DNP3 must be enabled on the Ethernet port(s) connected to the same network as the Experion Server.
- For peer to peer connection to C300 or other Experion CEE based controller, you need to publish the configuration to the Experion Server through CDA.

  Before that, you need to first:

  a. Install and start the ControlEdge integration service on the Experion Server. See "Installing ControlEdge integration service" in the *ControlEdge Builder Software Installation User's Guide* for more information.

  b. Select **CDA Responder** on the Ethernet port(s) connected to the same network as the Experion Server. See Configuring ETH1 and ETH2 for more information.

  c. This step ONLY applies to projects with versions prior to R161.

     Select CDA for the global variables or local variables you want to publish to Experion.

     See the following table for data type matching between ControlEdge 900 controller variables and Experion Server parameters.

Data type in ControlEdge 900 controller	Data type in Experion
IEC_BOOL	BOOLEAN
IEC_SINT	INT8
IEC_INT	INT16
IEC_DINT	INT32
IEC_USINT	UINIT8
IEC_UINT	UINT16
IEC_UDINT	UINT32
IEC_REAL	FLOAT32

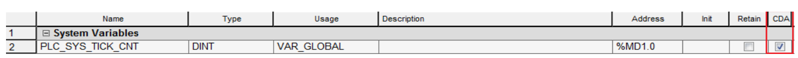
Data type in ControlEdge 900 controller	Data type in Experion
IEC_LREAL	FLOAT64
IEC_BYTE	UINT8
IEC_WORD	UINT16
IEC_DWORD	UINT32
IEC_ULINT	UINT64
IEC_LWORD	UINT64
IEC_STRING	STRING
C_STRUCT	See Note1 below.

> **NOTE:** Structure is a data type of I/O variable, so you should create a single variable for each parameter in the structure for CDA communication.

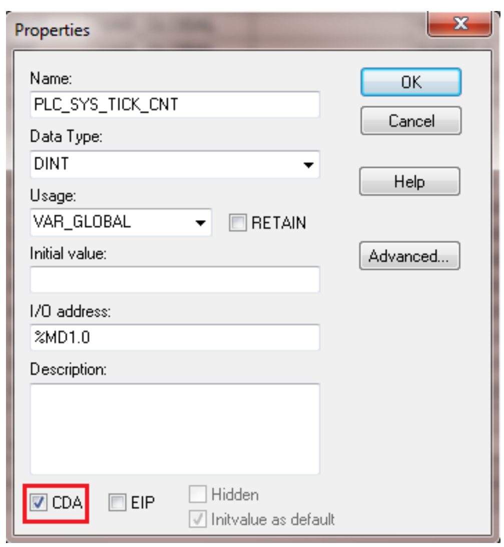
i. Click **IEC Programming Workspace** on the toolbar.

ii. Perform either of the following methods to select CDA.

- From the variable sheets, select CDA.



- From the variable properties dialog, select CDA.



d. Compile the configuration to the controller. See Compiling a project for more information.

For more details about the Experion integration with ControlEdge 900 controller, see the *Experion PKS ControlEdge PLC Integration Reference*.

For more details about the Experion integration with ControlEdge 2020 controller, see the *Experion PKS DNP3 Interface Reference*.

Publishing when ControlEdge Builder is launched from Configuration Studio

In this scenario, ControlEdge Builder is launched from **Configuration Studio** > **Control Strategy** > **ControlEdge Integration** > **Configure control strategy**. The ControlEdge Builder is already running under the user credentials supplied from Configuration Studio.

1. From the Home Page, click **Publish to Experion** under **Miscellaneous**. The project configuration will be published to Experion directly.
2. If the publish fails for ControlEdge 2020 controller, you can export the configuration manually.
   a. A warning message appears that the publish has failed. Click **OK**.
   b. Click the browse icon, and select a location to store the exported file.

      > **TIP:** It is recommended to save the file to the folder "\\ControllerIntegration" shared on the current primary Experion server.

   c. Enter a name for the exported file, and click **Save**.

      > **TIP:** It is recommended to name the file as "ControllerName_SAVED". For example, if the controller name is "NewController", then enter "NewController_SAVED" for the file name.

   d. Click **Export**. The exported file is saved successfully.
   e. Click **OK**.

Publishing when ControlEdge Builder is launched separately on an Experion node

In this scenario the Experion client components are available on the node, but the context for establishing the connection to the Server and the user credentials are not available from Configuration Studio.

Prerequisites

ControlEdge Builder is launched separately on an Experion node, not from Configuration Studio.

1. From the Home Page, click **Publish to Experion** under **Miscellaneous**.
2. Enter **Experion server**, **Domain**, **User name** and **Password**.

   See the following table for the parameter description.

Parameter	Description
Experion server	The base part of the Experion server name you would like to connect to. For example if you have redundant Experion Servers, enter the hostname of the server without the last “A” or “B” letter.
Use current Windows account	Connect with current Windows account. If you select this checkbox, you do not need to enter **Domain**, **User name** or **Password**.
Domain	Domain name. If you enter ".", it means current application domain.
User name	User account name
Password	Password for the user account, which is case-sensitive.

3. Click **Publish**. A message appears indicating that the configuration is published successfully. Click **OK**.
4. If the publish fails for ControlEdge 2020 controller, you can export the configuration manually.
   a. A warning message appears that the publish has failed. Click **OK**.
   b. Click the browse icon, and select a location to store the

exported file.

> **TIP:** It is recommended to save the file to the folder "\\ControllerIntegration" shared on the current primary Experion server.

c. Enter a name for the exported file, and click **Save**.

> **TIP:** It is recommended to name the file as "ControllerName_SAVED". For example, if the controller name is "NewController", then enter "NewController_SAVED" for the file name.

d. Click **Export**. The exported file is saved successfully.

e. Click **OK**.

Publishing when ControlEdge Builder is launched on non-Experion node

The “Experion PKS Server Client Side Components” optional installation package must be installed from the Experion Installation Media which you want to communicate with for the **Publish to Experion** function to work. These can be installed through the “Experion PKS Install Option” selection on the installation media. If these components are not installed, a message appears indicating “Unable to publish to Experion as client components are not installed”, but all other ControlEdge Builder functions should continue to work as expected.

Prerequisites

- The "Experion PKS Server Client Side Components" are installed on the ControlEdge Builder node.
- ControlEdge Builder is installed on a same version of Microsoft Windows that is supported for either Experion Client or Server that you want to communicate with. Refer to the Experion specifications for the specific release for supported operation system details.
- ControlEdge Builder is launched.

1. From the Home Page, click **Publish to Experion** under **Miscellaneous**.
2. Enter **Experion server**, **Domain**, **User name** and **Password**.
   See the following table for the parameter description.

Parameter	Description
Experion server	The base part of the Experion server name you would like to connect to. For example if you have redundant Experion Servers, enter the hostname of the server without the last “A” or “B” letter.
Use current Windows account	Connect with current Windows account. If you select this checkbox, you do not need to enter **Domain**, **User name** or **Password**.
Domain	Domain name. If you enter ".", it means current application domain.
User name	User account name
Password	Password for the user account, which is case-sensitive.

3. Click **Publish**. A message appears indicating that the configuration is published successfully. Click **OK**.
4. If the publish fails for ControlEdge 2020 controller, you can export the configuration manually.
   a. A warning message appears that the publish has failed. Click **OK**.
   b. Click the browse icon, and select a location to store the exported file.

   > **TIP:** It is recommended to save the file to the folder "\\ControllerIntegration" shared on the current primary Experion server.

   c. Enter a name for the exported file, and click **Save**.

> **TIP:** It is recommended to name the file as "ControllerName_SAVED". For example, if the controller name is "NewController", then enter "NewController_SAVED" for the file name.

d. Click **Export**. The exported file is saved successfully.

e. Click **OK**.

CHAPTER

3 CONFIGURING COMMUNICATION

Configuring Ethernet ports

There are three Ethernet ports, **ETH1**, **ETH2** and **ETH3**, on ControlEdge 2020 Controller. ETH3 can only be used to communicate with Expansion I/O.

There are four Ethernet ports, **ETH1**, **ETH2**, **ETH3** and **ETH4**, on ControlEdge 900 Controller. ETH1 and ETH2 are used for communicating with PC application and/or other controllers, or other devices. ETH3 and ETH4 are used for communicating with EPMs on the I/O network.

See the following tips for configuring the Ethernet ports:

- (This only applies to ControlEdge 2020 controller)The Ethernet port will be enabled automatically once it is bound with a protocol. If a port is not enabled, it consumes less power.
- For FTE networks, the ETH1 and ETH2 subnets must be the same, but for non-FTE networks they must be different and not be included in each other's subnet.
- The ETH3 subnet must not be the same as subnets used for ETH1 and ETH2, and must be outside the ETH1 and ETH2 subnets.

Configuring ETH1 and ETH2

1. Click the arrow beside **Configure Ethernet Ports** from Home Page, and select **ETH1** or **ETH2**.
2. (Only apply to ControlEdge 900 controller) If you configure the controller with PLC-FTE, **FTE Setting** appears. See Configuring controller type for more information.

   Configure **BootP Available**.

Item	Description
BootP Available	BootP is a low-lever protocol that provides configuration to other nodes on a TCP/IP network with the Windows operating system. Two options are provided:

Item	Description
	• Select **Yes** to enable BootP. An IP address will be assigned to the controller automatically. • Select **No** to disable BootP. You should configure IP address under **Network Setting** manually. **NOTE:** You must reboot the controller after changing the setting from **No** to **Yes** on ETH1.

NOTE: When the controller is configured as an FTE node, ETH2 has the same configuration as ETH1.

3. Under **Network Setting**, perform following steps to configure the IP address of the Ethernet port for the non-redundant controller and redundant controller.

NOTE: For ControlEdge 2020 controller, the 198.198.x.x subnet is reserved, so do not configure the IP address on this subnet.

- For the non-redundant controller, perform one of the following methods:

  a. Click **Obtain an IP address automatically** to acquire an IP address dynamically.

     If DHCP client is enabled on any Ethernet port, and DHCP server is not available, that port is assigned an IPv4LL address which is in the 169.254.x.x subnet.

  b. Select **Use the following IP address** to specify a static IP address, and enter the **IP Address**, **Subnet Mask** and **Gateway**.

> **NOTE:** An IP address consists of a network ID and a host ID. It is not allowed to set all bits of host ID as 0 or 1 for **Gateway**. Host ID in which all bits are set to 0 is used to represent the network ID of the IP address. Host ID in which all bits are set to 1 is reserved as a broadcast address.

- For the redundant controller, select **Use the following IP address** to specify a static IP address, and enter the **Primary Controller IP Address**, **Secondary Controller IP Address**, **Subnet Mask** and **Gateway**.

  The **Secondary Controller IP Address** is unavailable if the redundancy function is disabled. See Configuring controller redundancy for more information.

4. Under the **Protocol Binding**, select the protocol which you want to bind to the port.

   See the following table for details of the supported protocols:

Table 3-1: Protocol Supported by ETH1 and ETH2

Protocol	Description	Apply to
Controller Configuration protocol	Used for ControlEdge Builder communication, including data logging and diagnosis. The TCP port number is 41103.	ControlEdge RTU
DNP3 Outstation	Used for communication between the controller and a DNP3 Master such as a SCADA system like Experion. The controller acts as the DNP3 Outstation. The TCP port number is configurable and the default value is 20000.	ControlEdge RTU and ControlEdge PLC
DNP3 Master	Used for communication between the controller and a DNP3 Outstation.	ControlEdge RTU

Protocol	Description	Apply to
	The controller acts as a DNP3 Master.	
Modbus Slave	Used for communication between the controller and a Modbus TCP master such as a SCADA system like Experion. The controller acts as the Modbus slave. The TCP port number is configurable and the default value is 502. When using a controller as an FTE node, the port number is fixed as 502.	ControlEdge RTU and ControlEdge PLC
Enron Modbus Slave	Used for Electronic Flow Measurement (EFM) application.	ControlEdge RTU
Modbus TCP Master	Used for communication between the controller and third-party Modbus slave devices. The controller acts as the Modbus TCP Master. For how to configure the Modbus TCP Master, see "Modbus Master Configuration" in the *Function and Function Block Configuration Reference Guide*.	ControlEdge RTU and ControlEdge PLC
MQTT	Used for communication between the controller and MQTT brokers (servers).	ControlEdge RTU
OPC UA Server	Used for communication between the controller and an OPC UA client such as a SCADA system like Experion or other controllers. The controller acts as the OPC UA Server. The TCP port number is	ControlEdge PLC

Protocol	Description	Apply to
	configurable and the default value is 4840.	
HART-IP	HART-IP is a HART connection option over Ethernet that facilities a HART Host system like Honeywell FDM to access and integrate information from the controller connected HART-enabled field devices. HART Host commands are passed through the controller to the connected HART devices. The TCP port number is configurable and the default value is 5094.	ControlEdge RTU and ControlEdge PLC
Wireless I/O	Used for assigning Wireless I/O protocol to Ethernet port.	ControlEdge RTU
OPC UA Client	Used for communication between the controller and an OPC UA server such as a SCADA system like Experion or other controllers. The controller acts as the OPC UA Client. For how to configure the OPC UA Client, see *ControlEdge Builder Protocol Configuration Reference Guide*.	ControlEdge PLC
CDA Responder	Used for communication between the controller and C300 and other Experion CEE controllers. The controller acts as a CDA responder. It must be selected for either ETH1 or ETH2 if you want to communicate with C300 or other	ControlEdge PLC

Protocol	Description	Apply to
	Experion CEE controllers.	
EtherNet/IP Server	Used for communication between the controller and EtherNet/IP Client. The controller acts as an EtherNet/IP Server. It must be selected for either ETH1 or ETH2 if you want to communicate with EtherNet/IP Client.	ControlEdge PLC
EUCN	Select it to enable connectivity to Enhanced Universal Control Network. The controller is required to reboot when you select this protocol. It only appears after you configure controller as an FTE node. See Configuring controller type for more information.	ControlEdge PLC

5. Under **Static Routing**, you can configure multiple routes on either Ethernet port, ETH1 or ETH2, which allows external device access to ControlEdge 2020 controller. See Configuring Static Routing for more information.
6. Click **Save** to complete the Ethernet port configuration.
7. Click **Back** to return to the Home Page.

Configuring ETH3 for ControlEdge 2020 controller

Configuring I/O network communication for the non-redundant controller

1. Click the arrow beside **Configure Ethernet Ports** from Home Page, and select **ETH3**.
2. Under **Protocol Binding**, select the protocol **Expansion I/O**.

Information about supported protocol for port3 is listed in the following table.

Table 3-2: Protocols Supported by ETH3

Protocol	Description
Expansion I/O	Used for Expansion I/O communication.

> **NOTE:** Before downloading a prject to the controller with IOM connected, make sure Expansion I/O is bound to ETH3.

3. Under **Network Setting**, enter the **IP Address** and the **Subnet Mask** of the Ethernet port.
   - The IP address cannot be in the same network subnet as ETH1 and ETH2.
   - The first 100 IP addresses are reserved for I/O modules. The IP address of ETH3 must be beyond this range.
   - Do not configure the IP address on the 198.198.x.x subnet.
4. Click **Save** to complete the Ethernet port configuration.
5. Click **Back** to return to the Home Page.

Configuring I/O network communication for the redundant controller

1. Click the arrow beside **Configure Ethernet Ports** from Home Page, and select **ETH3**.
2. Select the protocol **Expansion I/O** under **Protocol Binding**.

   See Protocols Supported by ETH3 for more information.
3. Under **Network Setting**, configure the IP addresses. Enter the **Slot 1 IP Address**, **Slot 2 IP Address** and the **Subnet Mask** of the Ethernet port.
   - If redundancy is enabled: enter the **Slot 1 IP Address**, and **Slot 2 IP Address** is automatically incremented by 1. Enter the **Subnet Mask** for the Ethernet port.

For example: **Slot 1 IP Address** is configured as 192.168.1.1, and **Slot 2 IP Address** will be 192.168.1.2.

- If redundancy is disabled: enter the **Slot 1 IP Address**, and **Slot 2 IP Address** is disabled. Enter the **Subnet Mask** for the Ethernet port.
- The IP address cannot be in the same network subnet as ETH1 and ETH2.
- The first 100 IP addresses are reserved for I/O modules. The IP address of ETH3 must be beyond this range.

4. Click **Save** to complete the Ethernet port configuration.
5. Click **Back** to return to the Home Page.

Configuring ETH3 and ETH4 for ControlEdge 900 controller

ETH4 has the same configuration as ETH3, so only ETH3 should be configured manually.

Configuring I/O network communication for the non-redundant controller

1. Click the arrow beside **Configure Ethernet Ports** from Home Page, and select **ETH3** or **ETH4**
2. Under **Network Setting**, enter the **IP Address** and the **Subnet Mask** of the Ethernet port.
   - The default IP address is 172.168.0.101.
   - The range of the IP address is from 101 to 254.
   - The IP address cannot be in the same network subnet as ETH1 and ETH2.
   - If you want to communicate with EtherNet/IP devices, the IP address must be in the same network subnet as the EtherNet/IP device, and also it cannot be conflict with the EPM IP address.
   - If you want to communicate with PROFINET devices, the IP address must be in the same network subnet as the PROFINET device, and also it cannot be conflict with the EPM IP address.
3. If you want to communicate with EtherNet/IP devices, under

Protocol Binding, select **EtherNet/IP Client**.

4. If you want to communicate with PROFINET devices, under **Protocol Binding**, select **PROFINET**.

5. Select **Ring Topology**, **Star Topology** or **DLR Topology** under **I/O Network Topology**.

> **NOTE:** If you select **EtherNet/IP Client** for the **Protocol Binding**, only **Star Topology** and **DLR Topology** can be selected.

> **NOTE:** If you select **PROFINET** for the **Protocol Binding**, only **DLR Topology** is available for I/O network topology and is selected automatically.

> **NOTE:** You must reboot the controller if you change the I/O network topology from **Ring Topology** or **Star Topology** to **DLR Topology** and vice versa.

This configuration should match the position of 100X switch on the EPM hardware. 3 is for Ring network topology, 4 is for Star network topology and 5 is for DLR network topology. For more information about the switch, see “Assembling I/O racks” in the *ControlEdge 900 Controller Hardware Planning and Installation Guide*.

If you select DLR Topology, you should configure the following 4 options.

- **Role**: Specify the role for CPM as **Supervisor** or **Member**. The default value is **Supervisor**. A supervisor yields to another supervisor with a higher precedence, such that the highest precedence is always the Active Supervisor.

- **Supervisor Precedence**: Set the precedence of a ring supervisor in the network with multiple ring supervisors. Numerically higher value indicates higher precedence. Node with highest Supervisor Precedence value becomes Active Supervisor. The configuration value ranges from 1 to 255. The default value is 250.

- **Beacon Interval (usec)**: Set Beacon interval (in micro seconds) that supervisor transmits. The configuration value ranges from 400 to 10000. The default value is 400.

- **Beacon Timeout (usec)**: Set the amount of time (in micro seconds) all nodes in ring network shall wait before timing out reception of Beacon frames and taking the appropriate action. Beacon timeout must be set to 2-3X Beacon Interval. The configuration value ranges from 800 to 50000. The default value is 1960.

6. Click **Save** to complete the Ethernet port configuration.
7. Click **Back** to return to the Home Page.

Configuring I/O network communication for the redundant controller

1. Click the arrow beside **Configure Ethernet Ports** from Home Page, and select **ETH3** or **ETH4**
2. Under **Network Setting**, configure the IP addresses. Enter the **CPM Primary IP Address**, **CPM Secondary IP Address**and the **Subnet Mask** of the Ethernet port.
   - If redundancy is enabled: enter the **CPM Primary IP Address**, and **CPM Secondary IP Address** is automatically incremented by 1. Enter the **Subnet Mask** for the Ethernet port.

     For example: **CPM Primary IP Address** is configured as 172.168.0.101, and **CPM Secondary IP Address** will be 172.168.0.102.
   - If redundancy is disabled: enter the **CPM Primary IP Address**, and **CPM Secondary IP Address** is disabled. Enter the **Subnet Mask** for the Ethernet port.
   - The default IP address is 172.168.0.101.
   - The range of the IP address is from 101 to 254.
   - The IP address cannot be in the same network subnet as ETH1 and ETH2.
   - If you want to communicate with EtherNet/IP devices, the IP address must be in the same network subnet as the EtherNet/IP device, and also it cannot be conflict with the EPM IP address.
   - If you want to communicate with PROFINET devices, the IP address must be in the same network subnet as the PROFINET device, and also it cannot be conflict with the EPM IP address.
3. If you want to communicate with EtherNet/IP devices, under

Protocol Binding, select **EtherNet/IP Client**.

4. If you want to communicate with PROFINET devices, under **Protocol Binding**, select **PROFINET**.

5. Select **Ring Topology**, **Star Topology** or **DLR Topology** under **I/O Network Topology**.

> **NOTE:** If you select **EtherNet/IP Client** for the **Protocol Binding**, only **Star Topology** and **DLR Topology** can be selected.

> **NOTE:** If you select **PROFINET** for the **Protocol Binding**, only **DLR Topology** is available for I/O network topology and is selected automatically.

> **NOTE:** You must reboot the controller if you change the I/O network topology from **Ring Topology** or **Star Topology** to **DLR Topology** and vice versa.

This configuration should match the position of 100X switch on the EPM hardware. 3 is for Ring network topology, 4 is for Star network topology and 5 is for DLR network topology. For more information about the switch, see “Assembling I/O racks” in the *ControlEdge 900 Controller Hardware Planning and Installation Guide*.

If you select DLR Topology, you should configure the following 4 options.

- **Role**: Specify the role for CPM as **Supervisor** or **Member**. The default value is **Supervisor**. A supervisor yields to another supervisor with a higher precedence, such that the highest precedence is always the Active Supervisor.

- **Supervisor Precedence**: Set the precedence of a ring supervisor in the network with multiple ring supervisors. Numerically higher value indicates higher precedence. Node with highest Supervisor Precedence value becomes Active Supervisor. The configuration value ranges from 1 to 255. The default value is 250.

- **Beacon Interval (usec)**: Set Beacon interval (in micro seconds) that supervisor transmits. The configuration value ranges from 400 to 10000. The default value is 400.

- **Beacon Timeout (usec)**: Set the amount of time (in micro seconds) all nodes in ring network shall wait before timing out reception of Beacon frames and taking the appropriate action. Beacon timeout must be set to 2-3X Beacon Interval. The configuration value ranges from 800 to 50000. The default value is 1960.

6. Click **Save** to complete the Ethernet port configuration.
7. Click **Back** to return to the Home Page.

Configuring Static Routing

This feature enables external device access to ControlEdge 2020 controller via routers. Routes are defined in the routing table and bind on either Ethernet port, ETH1 or ETH2. Each route consists of gateway of the local machine, IP address and Subnet Mask of the destination machine.

1. Click the arrow beside **Configure Ethernet Ports** from Home Page, and select **ETH1** or **ETH2**.
2. Under **Static Routing**, you can add or delete routes, and import or export a routing table.
   - **To add routes**:
     a. Click **Add**, the **Add Route Address** dialog appears.
     b. Enter **Local Gateway**, **Destination IP** and **Destination Subnet Mask**.
        - If you only add one route this time, click **OK**.
          The route is added successfully, and the **Add Route Address** dialog is closed.
        - If you want to add multiple routes continuously:
          i. Select the **Continue** checkbox and click **OK**.
             The route is added successfully, and the **Add Route Address** dialog keeps open.
          ii. Enter another **Local Gateway**, **Destination IP** and **Destination Subnet Mask**, then click **OK**.
          iii. After adding the required routes, uncheck **Continue**, and click **OK** to complete the operation.
     c. You can click delete or edit icon besides a route to delete or edit it.

- **To delete routes**:
  a. Check routes you want to delete, and click **Delete**. A dialog appears to make sure you are going to delete the routes.
  b. Click **OK** to delete selected routes, or click **No** to cancel the procedure.
- **To export a routing table**:
  a. Click **Export**, the **Save As** dialog appears.
  b. Enter the file name, and click **Save**. A .csv file is exported.
     You can edit or add routes in the .csv file.
- **To import a routing table**:
  The routing table should be exported before importing it. Before being imported, **Local Gateway**, **Destination IP** and **Destination Subnet Mask** must be added in the routing table.
  a. Click **Import**, A warning message appears to ensure that you want to continue, the imported data may overwrite current data.
  b. Click **Yes** to continue, or click **No** to cancel the procedure.
  c. If you click **Yes** to continue, a **Open** dialog appears.
  d. Select the routing table you want to import, and click **Open**.
  e. A dialog appears indicating the import is completed. Click **OK**.

3. Click **Save** to complete the configuration.
4. Click **Back** to return to the Home Page.

Configuring serial ports

The ControlEdge 2020 Controller supports two RS232 and two RS485 serial ports.

To configure serial ports:

1. From the Home Page, click the arrow besides **Configure Serial Ports** to view the four options, **RS232-1**, **RS232-2**, **RS485-1**, and **RS485-2**. Select the corresponding ports to be used.
2. Under **General**, the **Port Name** and **Port Type** are displayed automatically. Select appropriate values from the **Baud Rate**, **Parity**, **Data Bits** and **Stop Bits** drop-down lists. See the following table for

the parameter descriptions.

Parameter	Description
Baud Rate	300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 For non-redundant controller, RS232 does not support 57600 and 115200.
Parity	None, ODD, EVEN
Data Bits	7, 8 If you select Modbus RTU Slave or Modbus RTU Master for the Protocol Binding, the Data Bits is set as 8 by default.
Stop Bits	1, 2

For RS232-1 and RS232-2, there are two more options to configure: **Flow Control** and **Force Online**. See the following table for the parameter descriptions.

Parameter	Description
Flow Control	Only for RS232-1 and RS232-2 • None • RTS-CTS • RTS
Force Online	Only for RS232-1 and RS232-2. Force Online is used to save energy when there is no device connected to the controller RS232 ports by disabling it. Select the desired option from the Force Online drop-down list: • Disable It is selected by default and the controller is on power saving mode. RS232 transmitter will detect the connection of external device. If external device is connected to the controller, the local transmitter will be enabled for communication. If

Parameter	Description
	there is no external device connected, the local transmitter will remain disabled to save energy. • Enable RS232 transmitter will not detect external device and if you force enable, more energy is consumed.

The following table describes four scenarios that will happen for **Force Online** option between the controller and the device it communicates.

Controller Force Online Option	Third-party Device Force Online Option	Communication
Enabled	Enabled	Normal
Disabled	Enabled	Normal, with energy saving on the controller
Enabled	Disabled	Normal, with energy saving on Device
Disabled	Disabled	Invalid configuration. Both devices would consider there is no device connected to it and hence there is no communication between them.

3. If you want the controller to save energy and not sure if the device connected to the controller is in power saving mode, perform the following steps to check:
   a. Enable “force online” on the controller and make sure that the controller communicates with the device.
   b. Disable “force online” on the controller side and download.
   c. Unplug the RS232 cable and then plug in the cable to make “force online disabled” effective.
   d. Check the communication status. If it is active, disable “force online” to save energy.
4. Under **Protocol Binding**, select a port protocol from the **Port**

Protocol drop-down list.

The following table provides information about various protocols supported by serial ports.

Protocol	Description
Modbus RTU Slave	The controller acts as the Modbus Slave and used for communication between: • Controller and SCADA • Controller and third-party Modbus Master devices If you select Modbus RTU Slave, Data Bits is set as 8 by default.
Modbus RTU Master	The controller acts as the Modbus Master and used for communication between The controller and third-party Modbus Slave devices, for example I/O modules. If you select Modbus RTU Master, Data Bits is set as 8 by default.
Modbus ASCII Slave	The controller acts as the Modbus Slave and used for communication between: • Controller and SCADA • Controller and third-party Modbus Master
Modbus ASCII Master	The controller acts as the Modbus Master and used for communication between The controller and third-party Modbus Slave devices, for example: I/O modules.
User Defined	User Defined protocol. When you select this option, the **Delimiter Mode (Optional)** panel appears including three settings: **Read-interval Timeout (ms)**, **Max Length (Bytes)** and **End Delimiter (Hex)**. You can configure them optionally to validate if a data frame is sent completely. • **Read-interval Timeout (ms)**: The interval between the last data packet sent and the first keepalive probe, ranging from 0 to 10000 (ms). If the interval between the arrivals of any two bytes exceeds this Timeout, system regards it has already received a complete data frame.

Protocol	Description
	The default value is 0 which means this option is disabled. • **Max Length (Bytes)**: The maximum number of bytes for a data frame, ranging from 0 to 1024. If the length of a received data frame exceeds the Max Length, system regards it has already received a complete data frame. The default value is 0 which means this option is disabled. • **End Delimiter (Hex)**: Configured special characters in hexadecimal and based on bytes validates if a data frame is sent completely. If the received data frame has same characters with the End Delimiter, system regards it has already received a complete data frame. The default setting is blank which means this option is disabled. For how to configure User Defined protocol, see "User Defined Protocol" in the *ControlEdge Builder Function and Function Block Configuration Reference*.

5. Click **Save** to complete the serial configuration.

Configuring Certificate

ControlEdge 2020 uses the Private Key and Product Certificate which are signed by Honeywell PKI (Public Key Infrastructure) CA (Certification Authority) and flashed into ControlEdge 2020 during manufacturing for TLS secured communication. The CA certificate of ControlEdge 2020 is included in the media. You can find it under `Certificates` > `Root` in root directory. The file name is *HPSProductCA.pem*.

You can configure all the certificate relevant settings. Certificate settings are grouped into four parts:

- Certificate Signing Request (CSR)
- Certificate
- Trust Chain
- CRL (Certificate Revocation List)

In R170, only "Trust Chain" is required and available for user configuration. The CA certificate of external devices, which will be used to authenticate the access from particular external device, can be configured in "Trust Chain".

You should get the CA certificate from your vendor first, and then follow the instructions below to download this certificate file into ControlEdge 2020.

To configure Turst Chain:

1. Under **I/O and Communications** tab, click **Configure Certificate** > **Trust Chain**.
2. Click Browse icon in Trust Chain field.
3. Select the certificate you want to download, and click **Open**.
4. Click **Download** to download the certificate to the controller.
5. Click **Save**.

Configuring protocols

You can configure protocols including Modbus Slave, OPC UA Client, OPC UA Server, DNP3 Outstation, HART-IP Server and the Enron Modbus Slave.

> **ATTENTION:** For ControlEdge 900 controller, from R140 onwards, the maximum quantity of the port number configured for the bound protocols communication is 16.

Configuring a Modbus Slave

1. Click **Configure Protocols** > **Modbus Slave** and select the target communication ports.
2. Select **Slave ID**.
   - For Ethernet ports, the range is from 0 to 255
   - For Serial ports, the range is from 1 to 247

3. For Ethernet ports, configure the **TCP Port/UDP Port** number and select **Type** from **UDP** or **TCP**.

4. For Ethernet ports, when the type is configured as **TCP**, set **Inactivity Timeout(s)** ranging from 20 to 86400 seconds.

   > **NOTE:** The default value is 20. The configuration value must be greater than the scan rate of Modbus master.

5. Select the required mapping table from the **Mapping** drop-down list. See Adding a Modbus Slave mapping table for more information.

   The same mapping table may be selected for use on multiple ports. For example, this could be used when a SCADA system communicates through 2 ports for redundant communication channels.

Configuring an OPC UA Client

OPC UA client maintains sessions in response to each execution of the UaConnect function block. One execution of the UaConnect function block contains that one corresponding session will be created by the OPC UA client on the controller and correspondingly one session will be created on the target OPC UA server.

For more information of programing the OPC UA Client, see *ControlEdge Builder Protocol Configuration Reference Guide*.

> **ATTENTION:** Make sure that the OPC UA Server's time is synchronized to the controller's time.

To configure an OPC UA client

1. Click **Configure Protocols** > **OPC UA Client**. The **OPC UA Client** page appears.

2. Select the values for the **Max Session Count** and **Max Subscription Per Session** parameters.

   See the following table for the parameter description.

Parameter	Description
Max Session Count	The maximum number of concurrent sessions allowed by the client.

Parameter	Description
	If you enter a value of 0, the number of sessions allowed is unlimited. The default value is 100.
Max Subscriptions Per Session	The maximum number of subscriptions allowed by the client for one session. If you enter a value of 0, the number of subscriptions allowed is unlimited.

3. Click **Save**.

Configuring an OPC UA Server

> **ATTENTION:** Make sure that the OPC UA client's time is synchronized to the controller's time. It is recommended to use the default values for the parameters of OPC UA Server.

To configure an OPC UA server

1. Click **Configure Protocols** > **OPC UA Server**. The **OPC UA Server** page appears.
2. Configure the following parameters if required:

Parameter	Description
Port	The port that clients will use to connect. For example: opc.tcp://192.168.0.15:**4840** The default value is 4840.
Max Request Age	The maximum age of a request (in milliseconds) the server allows. Zero value is defined as unlimited. The default value, which is 0, indicating that the request age allowed is unlimited.
Max Session Count	The maximum number of concurrent sessions the server allows. If you enter a value of 0, the number of sessions allowed is unlimited.

Parameter	Description
	The default value is 100.
Max Subscription Per Session	The maximum number of subscriptions allowed by the server for one session. If you enter a value of 0, the number of subscription allowed is unlimited.
Max Session Per Client	The maximum number of concurrent sessions the server allows per client. The default value, which is 0, indicating that the number of sessions allowed is unlimited.
Min Session Timeout	The minimum timeout for a session (in milliseconds). If you enter a value of 0, the minimum timeout is unlimited. The default value is 10000.
Max Session Timeout	The maximum timeout for a session (in milliseconds). If you enter a value of 0, the maximum timeout is unlimited. The default value is 3600000.
Max Browse Continuation Points	The maximum number of browse continuation points managed by a session. The default value is 0.
Max Browse Results	The maximum number of browse results for one browse operation. The default value, which is 0, indicating that the number of browse results is unlimited.
Max Nodes To Browse	The maximum number of nodes to browse. The default value, which is 0, indicating that the number of nodes allowed is unlimited.
Min Publishing Interval	The minimum cycle rate of the Subscription. The default value is 50 milliseconds.

Parameter	Description
Max Publishing Interval	The maximum cycle rate of the Subscription. The default value, which is 0, indicating that the publishing interval allowed is unlimited.
Min Keep Alive Interval	The minimum interval after which the subscription sends a notification to the client. This notification ensures the subscription is maintained. The default value is 5000 milliseconds.
Min Subscription Lifetime	Provides assurance to the client that the server is still alive. The minimum period after which the subscription will be deleted if no publish request is received. If you enter a value of 0, the subscription lifetime allowed is unlimited. The default value is 10000 milliseconds.
Max Subscription Lifetime	Provides assurance to the server that the client is still alive. The maximum period after which the subscription will be deleted if no publish request is received. The default value, which is 0 milliseconds, indicating that the subscription lifetime allowed is unlimited.
Max Retransmission Queue Size	The maximum number of messages allowed per Subscription in the republish queue. The default value is 10.
Max Notifications Per Publish	The maximum number of notifications allowed per Publish. The default value, which is 0, indicating that the number of notifications allowed is unlimited.
Max Data Queue	The maximum size of data monitored item

Parameter	Description
Size	queues. The default value is 100.
Max Event Queue Size	The maximum size of event monitored item queues. The default value is 1000.
Max Subscription Count	The maximum number of subscriptions that can be created. The default value, which is 0, indicating that the number of subscriptions allowed is unlimited.
Max Monitored Item Count	The maximum number of items that can be monitored. The default value, which is 0, indicating that the number of items allowed is unlimited.
Max Monitored Item Per Subscription Count	The maximum number of items that can be monitored for each subscription. The default value, which is 0, indicating that the number of items allowed is unlimited.
Max Monitored Item Per Session Count	The maximum number of items that can be monitored for each session. The default value, which is 0, indicating that the number of items allowed is unlimited.
For more information about the parameter descriptions, see the specification in the https://opcfoundation.org/.	

3. Click **Save**.

Configuring HART-IP Server

1. Click **Configure Protocols** > **HART-IP Server** and select the target communication ports.
2. Enter port number in the **Port**.

Configuring DNP3 Outstation

ATTENTION: DNP3 event generation is not to exceed 500 per second.

1. Under **I/O and Communications** tab, click **Configure Protocols** > **DNP3 Outstation**.
2. Click **Add a Master**, and the **Add DNP3 Master** dialog appears.
3. Select **Ethernet port** and **Master Index**.

   TIP: Up to 5 DNP3 masters are supported for one Ethernet port.

4. Select **Enable Channel Redundancy**.

   NOTE: This option is ONLY available for Ethernet port ETH1.

5. Click **OK** to add a master.

   If you select **Enable Channel Redundancy**, both ports ETH1 and ETH2 appear. They share a single configuration form at ETH1.

6. In the **General** group, configure the following parameters.

Parameter	Description
Mapping	Select the required mapping table from the drop-down list. If the Mapping is empty, you must add a mapping table first. See Adding a DNP3 Outstation mapping table for more information. **For redundant channel**, the same mapping table must be selected on multiple ports. For example, this could be used when a SCADA system communicates through 2 ports in a redundant arrangement. **For individual channel**: For R151 and before, one mapping table must be used for one port. Starting from R160, one mapping table can be used for multiple ports.

Parameter	Description
TCP Port	Configure TCP port number.
Master Address	Configure Master Address.
Controller Outstation Address	Configure Controller Outstation Address.
Enable Self Address	Select **Enable Self Address** for the controller to respond with its unique individual address, if a message is sent with the "Self Address". If **Enable Self Address** is not selected, the controller will ignore the message that is sent to the "Self Address".
Data Link Confirmation	**Never** is selected by default. It is not recommended to select **MultiFrag** or **Always** options. If you select **MultiFrag** or **Always**, ensure that the **Data Link Retries** and **Data Link Retry Timeout** are set.
Data Link Retries	It must be configured if **Data Link Confirmation** is selected as **MultiFrag** or **Always**. The maximum value is 255.
Data Link Retry Timout	It must be configured if **Data Link Confirmation** is selected as **MultiFrag** or **Always**. The maximum value is 3,600,000ms.

7. In the **Application Layer** group, if you select **Enable Unsolicited Responses**, the controller sends event data to SCADA without any request from SCADA. Unsolicited Response is an operation mode in which the outstation spontaneously transmits a response without a specific request for the data.

Parameter	Description
Send NULL Unsolicited Responses on Reconnect	The DNP3 driver sends a null unsolicited message upon reconnect once it is selected.

Parameter	Description
Maximum Hold Delay for Class1/Class2/Class3	The maximum hold delay is the maximum amount of time that the controller will wait after an event occurs before sending an unsolicited response. This setting allows the controller to queue several events before sending an unsolicited response, improving bandwidth usage at the expense of delayed communication. Minimum value: 0 ms and maximum value: 3,600,000ms.
Maximum Hold Count for Class1/Class2/Class3	The maximum hold count is the maximum number of events that may be queued before sending an unsolicited response. This setting allows the controller to send multiple events in a single message, improving bandwidth usage at the expense of delayed communication.
Unsolicited Response Retries	Enter the number of times the DNP3 driver attempts to send the unsolicited application fragment upon not receiving confirmation. The value can be 0 to 255.
Unsolicited Response Retry Delay	Enter the time intervals between retry to send the unsolicited response.
Delete Oldest Event on Event Overflow	According to requirement, select Delete the oldest event when queue is full or not. If this option is checked, in case the DNP3 event buffer is full, then any new event overwrites the oldest event.
Validate Controller Outstation Address	Select this option, the controller only accept data from some specific outstation address.
Keepalive Interval	Enter the interval that DNP3 outstation station sends response to master station to make sure if the connection is normal.
Enable DNP3 Time Synchronization	Enable time synchronization from the DNP3 master.

Parameter	Description
	NOTE: Only one master can be enabled time synchronization.
DNP3 Time Synchronization Period	Select the time that the controller should indicate to SCADA that the time synchronization is required. **ATTENTION:** If you select DNP3 Time Sync here, you cannot enable Primary Server and Secondary Server under Miscellaneous > Configure Date/Time options at the same time, or else you cannot download your configuration.
Solicited Response Confirmation Timeout	Enter the time in milliseconds the DNP3 driver waits for confirmation for the sent solicited application fragment.
Unsolicited Response Confirmation Timeout	Enter the time in milliseconds the DNP3 driver waits for confirmation for the sent unsolicited application fragment. Maximum value for timeout is 3600000ms.
Select Before Operation (SBO) Timeout	Enter the time in milliseconds the DNP3 driver waits for SBO.
EFM Data Class	Select the corresponding class for EFM data to SCADA communication. Set the time interval for getting the EFM responses back to Experion from the controller through the DNP3 virtual terminal point. There are three options defined by the DNP3 master: • Class 1

Parameter	Description
	• Class 2 • Class 3

8. In the **Default Variation** group, configure the default variation for each type of DNP3 point. Default variation defines the data format that is used by the controller to send data to the DNP3 Master, when the Master does not ask for a specific data variation.

Parameter	Description
Binary Input	Used to report the current value of a binary input point with three options: • Any variation • Packed format • Value with flags
Binary Input Event	Used to report events related to a binary input point with four options: • Any variation • Value without time • Value with absolute time • Value with relative time
Double-bit Binary Input	Used to report the current value of a double-bit binary input point with three options: • Any variation • Packed format • Value with flags
Double-bit Binary Input Event	Used to report events related to a double-bit binary input point with four options: • Any variation • Value without time • Value with absolute time • Value with relative time

Parameter	Description
Binary Output	Used to control or report the state of one or more binary output points with three options: • Any variation • Packed format • Status with flags
Binary Output Event	A Binary Output Event Object is an instance of a report for an outstation's corresponding Binary Output Static object. • Any variation • Status without time • Status with time
Binary Output Command Event	A Binary Output Command Event object reports that a command has been attempted on an outstation's corresponding binary output point. • Any variation • Status without time • Status with time
Counter	Used to report the current value of a counter point with five options: • Any variation • 32-bit integer with flag • 16-bit integer with flag • 32-bit integer without flag • 16-bit integer without flag
Frozen Counter	Used to report the value of a counter point captured at the instant when the count is frozen with seven options: • Any variation • 32-bit integer with flag

Parameter	Description
	• 16-bit integer with flag • 32-bit integer with flag. time • 16-bit integer with flag. time • 32-bit integer without flag • 16-bit integer without flag
Counter Event	Used to report the value of a counter point after the count has changed with five options: • Any variation • 32-bit integer with flag • 16-bit integer with flag • 32-bit integer with flag. time • 16-bit integer with flag. time
Frozen Counter Event	Used to report, as an event, the value of a counter point captured at the instant when the count is frozen. • Any variation • 32-bit integer with flag • 16-bit integer with flag • 32-bit integer with flag. time • 16-bit integer with flag. time
Analog Input	Used to report the current value of an analog input point with seven options: • Any variation • 32-bit integer with flag • 16-bit integer with flag • 32-bit integer without flag. time • 16-bit integer without flag. time • Single-precision float with flag • Double-precision float with flag

Parameter	Description
Analog Input Event	Used to report events related to an analog input point with nine options: • Any variation • 32-bit integer with time • 16-bit integer with time • 32-bit integer without time • 16-bit integer without time • Single-precision float with time • Double-precision float with time • Single-precision float without time • Double-precision float without time
Analog Input Deadband	Used to set and report the deadband value of an analog input point with four options: • Any variation • 16-bit integer • 32-bit integer • Single-precision float
Analog Output Status	Used to report the status of an analog output point with seven options: • Any variation • 32-bit integer with flag • 16-bit integer with flag • Single-precision float with flag • Double-precision float with flag
Analog Output Event	An Analog Output Event Object is an instance of a report for an outstation’s corresponding Analog Output Status object. There are nine options: • Any variation

Parameter	Description
	• 32-bit integer with time • 16-bit integer with time • 32-bit integer without time • 16-bit integer without time • Single-precision float with time • Double-precision float with time • Single-precision float without time • Double-precision float without time
Analog Output Command Event	An Analog Output Command Event object reports that a command has been attempted on an outstation's corresponding Analog Output point. There are nine options: • Any variation • 32-bit integer with time • 16-bit integer with time • 32-bit integer without time • 16-bit integer without time • Single-precision float with time • Double-precision float with time • Single-precision float without time • Double-precision float without time

9. Select **Flash** or **SD card** from the drop-down list besides **Save DNP3 Events to:**.
   - If you want to save DNP3 events to SD card, you must allocate the space for DNP3 events first. See Preparing SD card for more information.
   - Up to 200,000 DNP3 events can be saved to Flash per ControlEdge 2020 controller.
   - Up to 100,000 DNP3 events can be saved to Flash per ControlEdge 900 controller.

- Up to 500,000 DNP3 events can be saved to SD card per controller.

10. Click **Save**.

Configuring Enron Modbus Slave

1. Click **Configure Protocols** > **Enron Modbus Slave** and select the target communication ports.
2. Select **Slave ID**. For Ethernet ports, the port number must be configured.

   The port configured for Enron Modbus Slave cannot be the same port as that configured for Modbus Slave.

Configuring MQTT

ControlEdge 2020 controllers support MQTT messaging with Sparkplug B payloads to communicate with SCADA/IIOT Host since R170.

1. Under **I/O and Communications** tab, click **Configure Protocols** > **MQTT**.
2. Click **Add Connection**, and the **Add MQTT Connection** dialog appears.
3. Select **Ethernet port**.
4. Click **OK** to add MQTT connection.
5. In the **Basic Configuration** group, configure the following parameters.

Parameter	Description
Broker Address	The IP address of broker.
Port	The TCP port of MQTT broker.
Clean Session	It specifies the handling of the Session state. When this option is checked, the controller will not receive old Application Messages and has to subscribe afresh to any topics that it is interested in each time it connects. When this option is unchecked, the controller will receive all QoS 1 or QoS 2 messages that were published while it was disconnected. Hence, to ensure that you do not lose

Parameter	Description
	messages while disconnected, use QoS 1 or QoS 2 with CleanSession unchecked.
Keep alive interval	A time interval measured in seconds. Expressed as a 16-bit word, it is the maximum time interval that is permitted to elapse between the point at which the controller finishes transmitting one Control Packet and the point it starts sending the next.
Enable TLS	It is used to enable/disable TLS security for MQTT. If this option is enabled, you should configure the CA certificate. See Configuring Certificate for more information.
Connection Timeout	It specifies the allowed maximum waiting time for the establishing of network connection between the controller and MQTT broker.
Client ID	Identifier of the controller. The Client ID should be maximum 23 UTF-8 encoded bytes in length, and contains only the characters 0~9, a~z and A~Z.
SCADA Host ID	Identifier of SCADA/IIoT Host. The SCADA Host ID should be maximum 23 UTF-8 encoded bytes in length, and contains alphanumeric characters with the exception of the reserved characters of '+' (plus), '/' (forward slash), and '#' (number sign).
Group ID	Identifier of logical grouping of MQTT EoN nodes. The Group ID should be maximum 23 UTF-8 encoded bytes in length, and contains alphanumeric characters with the exception of the reserved characters of '+' (plus), '/' (forward slash), and '#' (number sign).
Node ID	Identifier of MQTT EoN node. The Node ID should be maximum 23 UTF-8 encoded bytes in length, and contains alphanumeric characters with the exception of the reserved characters of '+' (plus), '/' (forward slash), and '#' (number sign).

6. Click **Publish** to display more configuration options, and configure the following parameters.

Parameter	Description
Topic	Topic is part of a MQTT message. All MQTT clients using the Sparkplug™ specification will use the following Topic Namespace structure: *namespace/'Group ID'/message_type/'Node ID'*.
QoS	Configure the Quality of Service level of the data topic. There are 3 QoS levels in MQTT: • At most once delivery (0) • At least once delivery (1) • Exactly once delivery (2)
Payload	Select MQTT mapping from the drop-down list. See Adding a MQTT mapping table for more information.
Trigger Type	Select the trigger type. Event: Publish data when data changes. Periodic: Publish data periodically.
Interval (seconds)	The time interval is measured in seconds, and the default value is 1. It is only configurable when **TriggerType** is set to Periodic.

7. In the **Subscribe** group, specify the **QoS** level of the subscribe topics.
8. Click **Save**.

Configuring SCADA mapping

When a controller acts as a slave to a master, such as in a SCADA system, mapping tables are used to map controller variables to protocol addresses.

Adding a Modbus Slave mapping table

1. From the Home Page, under **I/O and Communications**, select **Configure SCADA Mapping** > **Modbus Slave**.
2. Click **Add Mapping**, and enter the mapping table name in the **Name**

field. Then, click **OK**.

3. Configure address mapping for each of the data types **Discrete Inputs**, **Coil**, **Holding Register**, and **Input Register** as required. The address range for each data type is 1 to 65536.
4. In the **Discrete Inputs** tab, click **Add** to add more addresses as required. See the following table for the maximum quantity of registers for different controllers.

Controller	Maximum quantity of 16-bit registers
ControlEdge 2020 Controller	16000
ControlEdge 900 Controller	16000

5. For each address:

   For efficient communications, Modbus addresses should be sequential in the mapping table.

   a. Modify the **Modbus Address** if required.

   b. Click the browse button under the **Variable Name** field and select the relevant variable.

   c. Click **OK**.
6. Repeat Step 4 and Step 5 for each data type.
7. Click **Save**.

Adding a DNP3 Outstation mapping table

1. From the Home Page, under **I/O and Communications**, select **Configure SCADA Mapping** > **DNP3 Outstation**.

   A read-only **Experion** mapping table is set up by default ONLY for reference. You can refer to it for creating a new mapping table, but do not use it directly and do not delete it.
2. Click **Add Mapping** and enter the mapping table in the **Name** field.
3. Select **Enable Experion Integration** if this mapping table is going to be assigned to the DNP3 outstation interface that is communicating with Experion. This mapping table will then also be included in the configuration that is exported for use in Experion integration.

> **NOTE:** ONLY one mapping table can select **Enable Experion Integration**.

4. Click **OK** to add the mapping table.
5. If the mapping table will be used for Experion integration, before configuring it, you must import **Experion** mapping table to it to avoid the syntax error on Quick Builder. See Importing a mapping table for more information.

> **NOTE:** Do not change any content imported from **Experion** mapping table.

6. Configure address mapping for each of the data types **Binary Inputs**, **Binary Outputs**, **Double Bit Inputs**, **Analog Inputs**, and **Analog Outputs** , **Counters** and **Strings** as required.

   User can configure maximum of 6000 variables per DNP3 outstation. A counter type occupies two addresses, one for storing the counter values and the other for freeze operation. That is to say, up to 3000 counter variables can be added if you only configure the counters.

> **ATTENTION:** Up to 6000 variables can be configured for a controller, which means all variables of multiple masters cannot exceed 6000.

7. In the **Binary Inputs** tab, click **Add** to add more addresses as required.
8. For each address:

   For efficient communications, DNP3 addresses should be contiguous in the mapping table.

   a. Modify the **DNP3 Address** if required.
   b. Click the browse button under the **Variable Name** field and select the relevant variable.
   c. Click **OK**.
   d. Select a respective class from the **Class** drop-down list. The available classes are Class 0, Class 1, Class 2 and Class 3. Selecting Class 1, 2 or 3 results in events being generated for

the address. Selecting Class 0 does not have events generated.

e. Select a deadband type from the **DeadBand Type** drop-down list. There are three types of Dead Band.

- Absolute (EU): raw value changes of the analog point
- Percentage: value change in percentage of the analog point's full-scale range
- Integrating: the product of raw value change and time interval

f. (Analog Inputs and Analog Outputs only) Modify the **Dead Band Value**. When the change of a point exceeds the Dead Band Value, an event is generated. If **Dead Band Value** is set as 0, any change of a point will trigger to generate an event.

9. Repeat Step 5 to Step 7 for each data type.
10. Click **Save**.

Adding a MQTT mapping table

1. From the Home Page, under **I/O and Communications**, select **Configure SCADA Mapping** > **MQTT**.
2. Click **Add Mapping**, and enter the mapping table name in the **Name** field. Then, click **OK**.
3. Click the newly added mapping to display configuration options.
4. In the **Metrics** tab, click **Add** to add more points as required.
5. For each point:

   a. Click the browse button under the **Variable Name** field and select the relevant variable.

   b. Click **OK**.

   c. Modify the **Dead Band Value.** When the change of a point exceeds the Dead Band Value, an event is generated. If **Dead Band Value** is set as 0, any change of a point will trigger to generate an event.
6. Repeat Step 5 for each address.
7. Click **Save**.

Renaming a mapping table

> **ATTENTION:** If the mapping table has been bound to communication ports, renaming the mapping table will unbind it from the ports automatically.

1. Select the target mapping table, and click the edit icon .
2. Enter the new name for this mapping table and click **OK**.

Deleting a mapping table

1. Select the target mapping table, and click .
2. Click **Yes** to delete the table.

Exporting a mapping table

1. Select the target mapping table, and click the export icon .
2. Enter the file name in the dialog provided and then click **Save**.

   The exported .csv file with global variables is not immediately editable in Microsoft Excel. If you want to edit it, first right-click the column with variable name and select **Format Cells**. In the **Number** tab, select **Text** and click **OK**.

Importing a mapping table

The mapping table should be exported before importing it. See Exporting a mapping table for more information.

Before being imported , the variables should be created in IEC Programming Workspace.

To import mapping addresses

1. Select the target mapping table, and click the import icon .
2. Select the target .csv file and click **Open**, a warning message appears indicating that the imported variables will overwrite all the existing variables in the mapping table.
3. Click **Yes** to import the mapping table.

CHAPTER

4 CONFIGURING MODULES AND CHANNELS

Configuring ControlEdge 2020 I/O modules

Configure the following channels for I/O modules.

- Eight Analog Input (HART) channels
- Two Analog Output (HART) channels
- Ten Digital Input channels
- Six Digital Output channels
- Two Pulse Input (High Speed) or Digital Input channels

Two PI channels can be configured as DI channels.

Adding an I/O module

1. From the Home Page, under **I/O and Communications** and click **Configure I/O**.
2. Click **Add I/O Module**, the **Add I/O Module** dialog appears.
3. Select the **Type**, and set the **IOM Scan Time** for the I/O module. The minimum IOM scan time of MIO28 Mixed SC-UMIX01 is 10 ms. IOM scan time should be multiples of 10 and configured as one of the following values: 10, 20, 30, 40, 50, 100, 150, 200, 250, 300, 350, 400, 450, 500, 1000, 2000 and 3000ms.

   IOM scan time and task execution time should be set carefully. The I/O data refresh time in a controller depends on the slower of the IOM scan time and task execution time, so improper settings can result in excessive overrun or tasks not being processed. Additionally, Honeywell recommends configuring IOM scan time and task execution time either as the same value, or as one being an integral multiple of the other.

Table 4-1: Relationship between IOM scan time, task execution time and I/O data refresh time

IOM scan time (ms)	Task execution time (ms)	I/O data refresh time (ms)
10	10	10
10	100	100
100	10	100
100	100	100

ATTENTION: When the task execution time is shorter than the IOM scan time, all the delta time values will be ignored. The value for the output channel is updated according the IOM scan time.

4. Enter the **Description** and select the **Address** for the I/O module which must be same as the rotary switch setting of the physical device. The range of the address is from 1 to 99.
5. Click **OK** to complete the configuration.

Configuring Onboard I/O

From the Home Page, under the **I/O and Communications**, click **Configure I/O**. Click **Onboard I/O** and you can view the five channels **AI**, **AO**, **DI**, **DO** and **PI**. If the two PI channels are not enabled in the PI tab, they can be used as 11th and 12th DI channels.

Configuring AI Channels

1. Click **AI** tab. The AI configuration parameters appear.
2. Select **50Hz** or **60Hz** from the **AI Filtering** drop-down list optionally. The numerical value of AI filtering affects the response time of enabled channels in the analog input module.
3. Select the channels to be used and configure the parameters as required. See the following table for a description of each

parameter:

Parameter	Description
Mode	There are two options: • Voltage • Current
Raw Low	• If you select **Voltage** from the **Mode** drop-down list, Raw Low default value is 1. • If you select **Current** from the **Mode** drop-down list, Raw Low default value is 4.
Raw High	• If you select **Voltage** from the **Mode** drop-down list, Raw High default value is 5. • If you select **Current** from the **Mode** drop-down list, Raw High default value is 20.
HART	Enable or Disable the **HART** protocol.
EU Low[1]	EU Low default value is 0.
EU High[1]	EU High default value is 100.
EU Ex Low[1]	EU Ex Low default value is -10.
EU Ex High[1]	EU Ex High default value is 110.
EU Description	(Optional) Enter Engineering Unit description if it is required.
Note: Use the following algorithm to configure EU Low, EU High, EU EX Low and EU EX High values to avoid warning messages. • EU_EX _Low <= Fault Value <= EU_EX_High • EU_EX _Low = EU_Low – (EU_High – EU_Low) * 10% • EU_EX_High = EU_High + (EU_High – EU_Low) * 10% • EU_EX _Low <= EU_Low < EU_High <= EU_EX_High	

4. Bind I/O variables to physical I/O channels as follows:
   a. For the target channel, click **Bind**.
      The **Select I/O Variable** dialog appears. The available I/O variables with data types compatible to the selected I/O channel type are displayed automatically.
   b. If the required I/O variable exists in the list, select it and click **Bind**. If the required I/O variable is not existing in the list, click **Add New Variable** to create a new I/O variable. The **Select I/O Variable** dialog appears.
   c. Type the **Name** and **Description**, and then click **Add**.
      The I/O variable is created and bound to the I/O channel successfully.
   d. Click **Save**.
   e. Program the I/O variable optionally. See Programming with IEC 61131-3 for more information.
5. (Optional)You can unbind I/O variables to physical I/O channels as follows:
   a. For the target channel, click **Unbind**. A warning message appears that all the bound variables will be unbounded after channel unbinding.
   b. Click **Yes** to unbind the channel. Or you can click **No** to cancel the procedure.

Configuring AO Channels

1. Click **AO** tab. The AO configuration parameters appear.
2. Select the channels to be used and configure the parameters as required. See the following table for a description of each parameter:

Parameter	Description
Raw Low	Raw Low default value is 4.
Raw High	Raw High default value is 20.
HART	Enable or Disable the **HART** protocol.
Fail Safe Output Mode	There are two options: • Hold Last Value

Parameter	Description
	• Failsafe Value **TIP:** Fail safe value will take effective within two seconds once the communication between I/O module and controller fails.
User Config Output	An appropriate value is needed for **User Config Output** if the **Fail Safe Output Mode** is selected as **Failsafe Value**.
EU Low[1]	EU Low default value is 0.
EU High[1]	EU High default value is 100.
EU Ex Low[1]	EU Ex Low default value is -10.
EU Ex High[1]	EU Ex High default value is 110.
EU Description	(Optional) Enter Engineering Unit description if it is required.
Note: Use the following algorithm to configure EU Low, EU High, EU EX Low and EU EX High values to avoid warning messages. • EU_EX _Low <= Fault Value <= EU_EX_High • EU_EX _Low = EU_Low – (EU_High – EU_Low) * 10% • EU_EX_High = EU_High + (EU_High – EU_Low) * 10% • EU_EX _Low <= EU_Low < EU_High <= EU_EX_High	

3. Bind I/O variables to physical I/O channels as follows:
    a. For the target channel, click **Bind**.

       The **Select I/O Variable** dialog appears. The available I/O variables with data types compatible to the selected I/O channel type are displayed automatically.
    b. If the required I/O variable exists in the list, select it and click **Bind**. If the required I/O variable is not existing in the list, click **Add New Variable** to create a new I/O variable. The **Select I/O Variable** dialog appears.
    c. Type the **Name** and **Description**, and then click **Add**.

The I/O variable is created and bound to the I/O channel successfully.

d. Click **Save**.

e. Program the I/O variable optionally. See Programming with IEC 61131-3 for more information.

4. (Optional)You can unbind I/O variables to physical I/O channels as follows:

   a. For the target channel, click **Unbind**. A warning message appears that all the bound variables will be unbounded after channel unbinding.

   b. Click **Yes** to unbind the channel. Or you can click **No** to cancel the procedure.

Configuring DI Channels

1. Click the **DI** tab. The DI configuration page appears.

2. Select the channels to be used and configure the parameters as required. See the following table for a description of each parameter:

Parameter	Description
Direction	There are two options: • **Direct**: when a high level input is given to a DI channel, the BOOL type DI value is **TRUE**; for a low level input, it is **FALSE**. • **Reversed**: when a high level input is given to a DI channel, the BOOL type DI value is **FALSE**; for a low level input, it is **TRUE**.
EU Description	(Optional) Enter Engineering Unit description if it is required.
State 0 Description	(Optional) Enter description if it is required.
State 1 Description	(Optional) Enter description if it is required.

3. Bind I/O variables to physical I/O channels as follows:

a. For the target channel, click **Bind**.

   The **Select I/O Variable** dialog appears. The available I/O variables with data types compatible to the selected I/O channel type are displayed automatically.

b. If the required I/O variable exists in the list, select it and click **Bind**. If the required I/O variable is not existing in the list, click **Add New Variable** to create a new I/O variable. The **Select I/O Variable** dialog appears.

c. Type the **Name** and **Description**, and then click **Add**.

   The I/O variable is created and bound to the I/O channel successfully.

d. Click **Save**.

e. Program the I/O variable optionally. See Programming with IEC 61131-3 for more information.

4. (Optional)You can unbind I/O variables to physical I/O channels as follows:

   a. For the target channel, click **Unbind**. A warning message appears that all the bound variables will be unbounded after channel unbinding.

   b. Click **Yes** to unbind the channel. Or you can click **No** to cancel the procedure.

Configuring DO Channels

1. Click **DO** tab. The DO configuration page appears.
2. Select the channels to be used and configure the parameters as required. See the following table for a description of each parameter:

Parameter	Description
Direction	There are two options: • **Direct**: when a high level input is given to a DI channel, the BOOL type DI value is **TRUE**; for a low level input, it is **FALSE**. • **Reversed**: when a high level input is given to a DI channel, the BOOL type DI value is **FALSE**; for a low level input, it is **TRUE**.

Parameter	Description
Fail Safe Output Mode	There are two options: • Hold Last State • Failsafe State **TIP:** Fail safe value will take effective within two seconds once the communication between I/O module and controller fails.
User Config Output	An appropriate value is needed for **User Config Output** if the **Fail Safe Output Mode** is selected as **Failsafe State**.
EU Description	(Optional) Enter Engineering Unit description if it is required.
State 0 Description	(Optional) Enter description if it is required.
State 1 Description	(Optional) Enter description if it is required.

3. Bind I/O variables to physical I/O channels as follows:

   a. For the target channel, click **Bind**.

      The **Select I/O Variable** dialog appears. The available I/O variables with data types compatible to the selected I/O channel type are displayed automatically.

   b. If the required I/O variable exists in the list, select it and click **Bind**. If the required I/O variable is not existing in the list, click **Add New Variable** to create a new I/O variable. The **Select I/O Variable** dialog appears.

   c. Type the **Name** and **Description**, and then click **Add**.

      The I/O variable is created and bound to the I/O channel successfully.

   d. Click **Save**.

   e. Program the I/O variable optionally. See Programming with IEC 61131-3 for more information.

4. (Optional)You can unbind I/O variables to physical I/O channels as follows:

a. For the target channel, click **Unbind**. A warning message appears that all the bound variables will be unbounded after channel unbinding.

b. Click **Yes** to unbind the channel. Or you can click **No** to cancel the procedure.

Configuring PI Channels

1. Click **PI** tab. The PI configuration page appears.
2. Select the channels to be used and enter the **EU Description**.
3. Bind I/O variables to physical I/O channels as follows:
   a. For the target channel, click **Bind**.

      The **Select I/O Variable** dialog appears. The available I/O variables with data types compatible to the selected I/O channel type are displayed automatically.

   b. If the required I/O variable exists in the list, select it and click **Bind**. If the required I/O variable is not existing in the list, click **Add New Variable** to create a new I/O variable. The **Select I/O Variable** dialog appears.

   c. Type the **Name** and **Description**, and then click **Add**.

      The I/O variable is created and bound to the I/O channel successfully.

   d. Click **Save**.

   e. Program the I/O variable optionally. See Programming with IEC 61131-3 for more information.
4. (Optional)You can unbind I/O variables to physical I/O channels as follows:
   a. For the target channel, click **Unbind**. A warning message appears that all the bound variables will be unbounded after channel unbinding.

   b. Click **Yes** to unbind the channel. Or you can click **No** to cancel the procedure.

Configuring Expansion I/O

1. From the Home Page, under **I/O and Communications**, click **Configure I/O**.

2. Click the target expansion I/O, the five types of channel (**AI**, **AO**, **DI**, **DO** and **PI**) are displayed as tabs. If the two PI channels are not enabled in the PI page, they can be enabled as 11th and 12th DI channels.
3. Configure each of the I/O channels, see Configuring Onboard I/O for more information.

Configuring a third-party I/O, ST103A

The ST103A is an ultra-reliable data acquisition module that provides I/O capabilities to controllers requiring high accuracy, or to fiscal or custody transfer metering interfaces (e.g. Dual pulse fidelity checking). The ST103A reads and updates its I/Os within 500 ms, and provides external data access through a Modbus serial port.

While using ST103A as an I/O module, three cyclic tasks are created during configuration:

- STTask: Reads the I/O from ST103A to the controller.
- AITask: Scales up AI channel inputs into engineering units and determine its status.
- LiqTask: API 21.2 meter run task.

Prerequisites

Make sure ST103_DataTypes exists in the Data Types list. If not, you should insert it manually.

1. From the IEC Programming Workspace, right-click **Data Types**, and select **Insert** > **Datatypes**.
2. Enter the name **ST103_DataTypes**, and click **OK**.

To configure ST103A

1. From the Home Page, under **I/O and Communications**, click **Configure Third-Party I/O** > **ST103A**.
2. Click **Add ST103A Module**. The **Add I/O Module** dialog appears.
3. Enter **Description** for ST103A module which will be a unique identifier for binding with specific meter runs.
4. Select **Slave ID** for the drop-down list. The valid value is from 1 to 15.

The ST103A should be opened to set Slave ID and row 4 bit switches will be available to configure the value from 1 to 15. See "Configuring ST103A" in the *ControlEdge 2020 Platform Hardware Planning and Installation Guide* for how to set Slave ID.

> **ATTENTION:** If there are other Modbus devices connected to the same RS485 port along with ST103A, ensure that they do not conflict with each other.

5. Select the port number, and provide values for **Retries** and **Timeout**.

Item	Description
Port Number	The physical interface of serial port connected: 3: RS 485 port 1 4: RS 485 port 2
Retries	Retry times before it is classified as Failed. The default value is 1.
Timeout	The default value is 500 ms. Timeout unit: millisecond.

6. Click **OK** to complete the configuration.
7. Only ST103A's analog input, pulse input, frequency and raw pulse output can be configured via ControlEdge Builder. For more information, see ST103A communication users manual.

Configuring AI channels

1. Click **AI** tab, and select the channel to be used.
2. Configure the parameters as required. See the following table for a description of each parameter:

Parameter	Description
Mode	There are two options: • Voltage • Current

Parameter	Description
	See "Configuring ST103A" in the *ControlEdge 2020 Platform Hardware Planning and Installation Guide* for how to set AI channels in Voltage/Current mode.
Raw Low	• If you select **Voltage** from the **Mode** drop-down list, Raw Low default value is 1. • If you select **Current** from the **Mode** drop-down list, Raw Low default value is 4.
Raw High	• If you select **Voltage** from the **Mode** drop-down list, Raw High default value is 5. • If you select **Current** from the **Mode** drop-down list, Raw High default value is 20.
EU Low[1]	EU Low default value is 0.
EU High[1]	EU High default value is 100.
EU Ex Low[1]	EU Ex Low default value is -10.
EU Ex High[1]	EU Ex High default value is 110.
EU Description	(Optional) Enter Engineering Unit description if it is required.
Note: Use the following algorithm to configure EU Low, EU High, EU EX Low and EU EX High values to avoid warning messages. • EU_EX _Low <= Fault Value <= EU_EX_High • EU_EX _Low = EU_Low – (EU_High – EU_Low) * 10% • EU_EX_High = EU_High + (EU_High – EU_Low) * 10% • EU_EX _Low <= EU_Low < EU_High <= EU_EX_High	

3. Bind I/O variables to physical I/O channels as follows:

a. For the target channel, click **Bind**.

   The **Select I/O Variable** dialog appears. The available I/O variables with data types compatible to the selected I/O channel type are displayed automatically.

b. If the required I/O variable exists in the list, select it and click **Bind**. If the required I/O variable is not existing in the list, click **Add New Variable** to create a new I/O variable. The **Select I/O Variable** dialog appears.

c. Type the **Name** and **Description**, and then click **Add**.

   The I/O variable is created and bound to the I/O channel successfully.

d. Click **Save**.

4. (Optional)You can unbind I/O variables to physical I/O channels as follows:

   a. For the target channel, click **Unbind**. A warning message appears that all the bound variables will be unbounded after channel unbinding.

   b. Click **Yes** to unbind the channel. Or you can click **No** to cancel the procedure.

Configuring PI channels

1. Click **PI** tab, and select **A**, **B** or **E** for **Pulse Fidelity Level**.

   In order to reduce uncertainty in the flow measurement, dual pulse streams from flow meters will be checked against each other to determine missed or added pulses, pulse phase, frequency and alarm/error generation of any abnormality and correction according to API MPMS 5.5 or ISO 6551 standards.

   ST103A supports:

   - A: Level A consists of continuous monitoring and verification and correction by methods of comparison of pulse streams.
   - B: Level B consists of continuous monitoring, error indication and alarm signaling by methods of comparison of pulse streams.
   - E: Level E consists of no error checking and will be similar to 2 individual independent pulse streams.

When Pulse fidelity Level A/B is configured, 2 pulse streams from pulse input channel 1 and 2 will be used for fidelity checking and only one binding variable as output can be bound and configured with single meter run.

When Level E is configured, both pulse input channel 1 and 2 can be independently bound to 2 variables and configured to two meter runs.

2. Select the channels to be used and click **Bind**.

   The **Select I/O Variable** dialog appears. The available I/O variables with data types compatible to the selected I/O channel type are displayed automatically.

3. If the required I/O variable exists in the list, select it and click **Bind**. If the required I/O variable is not existing in the list, click **Add New Variable** to create a new I/O variable. The **Select I/O Variable** dialog appears.

4. Type the **Name** and **Description**, and then click **Add**.

   The I/O variable is created and bound to the I/O channel successfully.

5. Click **Save**.

6. (Optional)You can unbind I/O variables to physical I/O channels as follows:

   a. For the target channel, click **Unbind**. A warning message appears that all the bound variables will be unbounded after channel unbinding.

   b. Click **Yes** to unbind the channel. Or you can click **No** to cancel the procedure.

Configuring Frequency channels

ST103A can be configured to read frequency directly from densitometers like Micro Motion Coriolis meter, Micro Motion 7835/7845, UGC, Sarasota and ITT Barton densitometer in ControlEdge 2020 controller. The conversion of observed or measured density from frequency needs to be done as part of project engineering activity based on formulas provided by the manufacturers. The API 21.2 function blocks expects to be configured with measured density value along with status value. The ST103A device status connection can be used with other logics to determine final status value presented to API 21.2 function block.

1. Click **Frequency** tab, and select the channel to be used.
2. Click **Bind**.

   The **Select I/O Variable** dialog appears. The available I/O variables with data types compatible to the selected I/O channel type are displayed automatically.
3. If the required I/O variable exists in the list, select it and click **Bind**. If the required I/O variable is not existing in the list, click **Add New Variable** to create a new I/O variable. The **Select I/O Variable** dialog appears.
4. Type the **Name** and **Description**, and then click **Add**.

   The I/O variable is created and bound to the I/O channel successfully.
5. Click **Save**.
6. (Optional)You can unbind I/O variables to physical I/O channels as follows:
   a. For the target channel, click **Unbind**. A warning message appears that all the bound variables will be unbounded after channel unbinding.
   b. Click **Yes** to unbind the channel. Or you can click **No** to cancel the procedure.

Configuring PO channels

1. Click **PO** tab, and select the channel to be used.
2. Select **A** or **B** for the **Pulse Channel Selection**. It detemines which pulse stream from channles (A/B) should be selected from the meter run to provide input to Prover to support proving process.
   - A - Pulse input channel 1
   - B - Pulse input channel 2

Configuring ControlEdge 900 I/O modules

Adding an I/O module

1. From the Home Page, under **I/O and Communications**, click **Configure Modules** > **Configure 900 I/O Modules**.
2. Click **Add I/O Module**, the **Add I/O Module** dialog appears.

3. Select the **Type**, assign the **Rack** and **Slot**, and set the **IOM Scan Time** for the module.

   See the following table for the parameter descriptions:

Parameter	Description
Type	I/O module type: • UIO16-2 900U02: Redundant Universal Input/Output Module (UIO Module), 16 Channel • UIO16 900U01: Universal Input/Output Module (UIO Module), 16 Channel • UAI08 900A01: Universal Analog Input -RTD, TC, V, 8 Channel • AI16 mA/V 900A16: Analog Input, 16 Channel • AO04 900B01: Analog Output, 4 Channel • AO08 900B08: Analog Output, 8 Channel • DI16 AC 900G03: Digital Input, 120/240 VAC, 16 Channel • DI32 DC 900G32: Digital Input, 24 VDC, 32 Channel • DI16 Contact 900G01: Digital Input, 16 Channel • DI-HV16 900G04: Digital Input, High voltage, 16 Channel • DO08 AC 900H03: Digital Output, 120/240 VAC 8 Channel • DO32 DC 900H32: Digital Output, 24 VDC 32 Channel • DO08 Relay 900H01: Digital Output, 8 Channel • SF04 PFQ 900K01: Pulse & Frequency Input, Pulse Output, 4 Channel
Rack	Rack address: • If controller redundancy is enabled, the rack address range is from 1 to 99.

Parameter	Description
	• If controller redundancy is disabled, the rack address range is from 0 to 99. 0 is only for the local I/O rack. • For an expansion I/O rack, the address must be the same with the EPM address configured on 1x and 10x rotary switches. For details about the rotary switches, see "Assembling I/O racks" in the *ControlEdge 900 Controller Hardware Planning and Installation Guide*.
Slot	Slot number: the location of the I/O module mounted in the rack • If the I/O module is installed in a 4-slot rack, the slot number is ranging from 1 to 4. • If the I/O module is installed in an 8-slot rack, the slot number is ranging from 1 to 8. • If the I/O module is installed in a 12-slot rack, the slot number is ranging from 1 to 12.
IOM Scan Time	IOM scan time: the time interval for refreshing I/O module data. IOM scan time should be multiples of 10 and configured as one of the following values: 10, 20, 30, 40, 50, 100, 150, 200, 250, 300, 350, 400, 450, 500, 1000, 2000 and 3000ms. IOM scan time and task execution time should be set carefully. The I/O data refresh time in a controller depends on the slower of the IOM scan time and task execution time, so improper settings can result in excessive overrun or tasks not being processed. Additionally, Honeywell recommends configuring IOM scan time and task execution time either as the same value, or as one being an integral multiple of the other. See the following table for examples of the relationship between IOM scan time, task execution

Parameter	Description
	time and I/O data refresh time. The minimum IOM scan time for every I/O module is: • UIO16-2 900U02: 10ms • UIO16 900U01: 10ms • UAI08 900A01: 500ms • AI16 mA/V 900A16: 100ms • AO04 900B01: 500ms • AO08 900B08: 500mfs • DI16 AC 900G03: 10ms • DI32 DC 900G32: 10ms • DI16 Contact 900G01: 10ms • DI-HV16 900G04: 10ms • DO08 AC 900H03: 10ms • DO32 DC 900H32: 10ms • DO08 Relay 900H01: 10ms • SF04 PFQ 900K01: 10ms **ATTENTION:** For PFQ module, IOM scan time must be lower than task execution time.

Table 4-2: Relationship between IOM scan time, task execution time and I/O data refresh time

IOM scan time (ms)	Task execution time (ms)	I/O data refresh time (ms)
10	10	10
10	100	100
100	10	100
100	100	100

IOM scan time (ms)	Task execution time (ms)	I/O data refresh time (ms)
ATTENTION: When the task execution time is shorter than the IOM scan time, all the delta time values will be ignored. The value for the output channel is updated according the IOM scan time.		

4. Click **OK** to complete the configuration.

Configuring Universal Input/Output modules (UIO16 900U01)

From the Home Page, under the **I/O and Communications**, click **Configure Modules** > **Configure 900 I/O Modules**. Select the target Universal Input/Output (UIO) module, and double-click the field under **Type** for the target channel to configure the channel type. There are four types can be selected: **AI**, **AO**, **DI**, and **DO**.

Configuring Analog Input channels

1. Select an **AI** channel. The AI configuration parameters appear.
2. Configure the parameters as required. See the following table for a description of each parameter:

Parameter	Description
Sensor Type	There are two options: • 0-20mA • 4-20mA
Open Wire Detection	Select the checkbox to enable Open Wire Detection. It is only available when the sensor type is 4-20mA. For more information about Open Wire Detection, see “UIO module wiring” in the *ControlEdge 900 Controller Hardware Planning and Installation Guide*.
Short Circuit Detection	Select the checkbox to enable Short Circuit Detection.

Parameter	Description
HART	To enable or disable the HART protocol
EU Low[1]	EU Low default value is 0.00.
EU High[1]	EU High default value is 100.00.
EU Ex Low[1]	• It is not configurable for 0-20mA. • The default value is -10.00 for 4-20mA.
EU Ex High[1]	EU Ex High default value is 110.00.
EU Description	(Optional) Enter Engineering Unit description if it is required.
Note 1: Use the following algorithm to configure EU Low, EU High, EU EX Low and EU EX High values to avoid warning messages. • EU_EX _Low <= Fault Value <= EU_EX_High • EU_EX _Low = EU_Low – (EU_High – EU_Low) * 10% • EU_EX_High = EU_High + (EU_High – EU_Low) * 10% • EU_EX _Low <= EU_Low < EU_High <= EU_EX_High	

3. Bind I/O variables to physical I/O channels as follows:
   a. For the target channel, click **Bind**.
      The **Select I/O Variable** dialog appears. The available I/O variables with data types compatible to the selected I/O channel type are displayed automatically.
   b. If the required I/O variable exists in the list, select it and click **Bind**. If the required I/O variable is not existing in the list, click **Add New Variable** to create a new I/O variable. The **Select I/O Variable** dialog appears.
   c. Type the **Name** and **Description**, and then click **Add**.
      The I/O variable is created and bound to the I/O channel successfully.
   d. Click **Save**.
   e. Program the I/O variable optionally. See Programming with IEC 61131-3 for more information.
4. (Optional)You can unbind I/O variables to physical I/O channels as

follows:

a. For the target channel, click **Unbind**. A warning message appears that all the bound variables will be unbounded after channel unbinding.

b. Click **Yes** to unbind the channel. Or you can click **No** to cancel the procedure.

Configuring Analog Output channels

1. Select an **AO** channel. The AO configuration parameters appear.
2. Configure the parameters as required. See the following table for a description of each parameter:

Parameter	Description
Sensor Type	There are two options: • 0-20mA • 4-20mA
HART	To enable or disable the HART protocol
Open Wire Detection	Select the checkbox to enable Open Wire Detection. It is only available when the sensor type is 4-20mA. For more information about Open Wire Detection, see "UIO module wiring" in the *ControlEdge 900 Controller Hardware Planning and Installation Guide*.
Fail Safe Output Mode	There are two options: • Hold Last Value • Failsafe Value
User Config Output	An appropriate value is needed if the **Fail Safe Output Mode** is selected as **Failsafe Value**.
EU Low[1]	EU Low default value is 0.00.
EU High[1]	EU High default value is 100.00.
EU Ex Low[1]	• It is not configurable for 0-20mA.

Parameter	Description
	• The default value is -10.00 for 4-20mA. **NOTE:** When the value of OP is equal or lower than the value of **EU Ex Low**, the physical current output will be 0mA when 4-20mA is selected as the sensor type of the AO channel.
EU Ex High[1]	EU Ex Low default value is 110.00.
EU Description	(Optional) Enter Engineering Unit description if it is required.
Note 1: Use the following algorithm to configure EU Low, EU High, EU EX Low and EU EX High values to avoid warning messages. • EU_EX _Low <= Fault Value <= EU_EX_High • EU_EX _Low = EU_Low – (EU_High – EU_Low) * 10% • EU_EX_High = EU_High + (EU_High – EU_Low) * 10% • EU_EX _Low <= EU_Low < EU_High <= EU_EX_High	

3. Bind I/O variables to physical I/O channels as follows:
   a. For the target channel, click **Bind**.
      The **Select I/O Variable** dialog appears. The available I/O variables with data types compatible to the selected I/O channel type are displayed automatically.
   b. If the required I/O variable exists in the list, select it and click **Bind**. If the required I/O variable is not existing in the list, click **Add New Variable** to create a new I/O variable. The **Select I/O Variable** dialog appears.
   c. Type the **Name** and **Description**, and then click **Add**.
      The I/O variable is created and bound to the I/O channel successfully.
   d. Click **Save**.
   e. Program the I/O variable optionally. See Programming with IEC 61131-3 for more information.
4. (Optional)You can unbind I/O variables to physical I/O channels as

follows:

a. For the target channel, click **Unbind**. A warning message appears that all the bound variables will be unbounded after channel unbinding.

b. Click **Yes** to unbind the channel. Or you can click **No** to cancel the procedure.

Configuring Digital Input channels

1. Select a **DI** channel. The DI configuration parameters appear.
2. Configure the parameters as required. See the following table for a description of each parameter:

Parameter	Description
Direction	There are two options: • **Direct**: when a high level input is given to a DI channel, the BOOL type DI value is **TRUE**; for a low level input, it is **FALSE**. • **Reversed**: when a high level input is given to a DI channel, the BOOL type DI value is **FALSE**; for a low level input, it is **TRUE**.
De-bounce Time	For Channels that are configured with a de-bounce, the UIO will declare that the channel has changed state if all the consecutive samples are in the new state for the configured de-bounce time period. It ranges from 0.00 to 50.00 and its default value is 0.00. For example, if a DI has been 0 and transitions (without noise) to a 1 then the UIO detects that transition and needs the input to stay in the new state for the configured de-bounce time to declare the new state as 1. If the signal is noisy, then the counting process starts anew each time the DI leaves the 0 state until it achieves the new state for consecutive samples.
State 0 Description	(Optional) Enter description if it is required.

Parameter	Description
State 1 Description	(Optional) Enter description if it is required.
Open Wire Detection	Select the checkbox to enable Open Wire Detection. For more information about Open Wire Detection, see “UIO module wiring” in the *ControlEdge 900 Controller Hardware Planning and Installation Guide*.
Short Circuit Detection	Select the checkbox to enable Short Circuit Detection.

3. Bind I/O variables to physical I/O channels as follows:
   a. For the target channel, click **Bind**.
      The **Select I/O Variable** dialog appears. The available I/O variables with data types compatible to the selected I/O channel type are displayed automatically.
   b. If the required I/O variable exists in the list, select it and click **Bind**. If the required I/O variable is not existing in the list, click **Add New Variable** to create a new I/O variable. The **Select I/O Variable** dialog appears.
   c. Type the **Name** and **Description**, and then click **Add**.
      The I/O variable is created and bound to the I/O channel successfully.
   d. Click **Save**.
   e. Program the I/O variable optionally. See Programming with IEC 61131-3 for more information.
4. (Optional)You can unbind I/O variables to physical I/O channels as follows:
   a. For the target channel, click **Unbind**. A warning message appears that all the bound variables will be unbounded after channel unbinding.
   b. Click **Yes** to unbind the channel. Or you can click **No** to cancel the procedure.

Configuring Digital Output channels

1. Select a **DO** channel. The DO configuration parameters appear.
2. Configure the parameters as required. See the following table for a description of each parameter:

Parameter	Description
Direction	There are two options: • **Direct**: when a high level input is given to a DI channel, the BOOL type DI value is **TRUE**; for a low level input, it is **FALSE**. • **Reversed**: when a high level input is given to a DI channel, the BOOL type DI value is **FALSE**; for a low level input, it is **TRUE**.
Fail Safe Output Mode	There are two options: • Hold Last State • Failsafe State
User Config Output	An appropriate value is needed if the **Fail Safe Output Mode** is selected as **Failsafe State**.
State 0 Description	(Optional) Enter description if it is required.
State 1 Description	(Optional) Enter description if it is required.
Open Wire Detection	Select the checkbox to enable Open Wire Detection. For more information about Open Wire Detection, see “UIO module wiring” in the *ControlEdge 900 Controller Hardware Planning and Installation Guide*.
Short Circuit Detection	Select the checkbox to enable Short Circuit Detection.

3. Bind I/O variables to physical I/O channels as follows:

a. For the target channel, click **Bind**.

   The **Select I/O Variable** dialog appears. The available I/O variables with data types compatible to the selected I/O channel type are displayed automatically.

b. If the required I/O variable exists in the list, select it and click **Bind**. If the required I/O variable is not existing in the list, click **Add New Variable** to create a new I/O variable. The **Select I/O Variable** dialog appears.

c. Type the **Name** and **Description**, and then click **Add**.

   The I/O variable is created and bound to the I/O channel successfully.

d. Click **Save**.

e. Program the I/O variable optionally. See Programming with IEC 61131-3 for more information.

4. (Optional)You can unbind I/O variables to physical I/O channels as follows:

   a. For the target channel, click **Unbind**. A warning message appears that all the bound variables will be unbounded after channel unbinding.

   b. Click **Yes** to unbind the channel. Or you can click **No** to cancel the procedure.

Configuring DI modules (DI16 AC 900G03, DI32 DC 900G32 , DI16 Contact 900G01, DI-HV16 900G04)

1. From the Home Page, under **I/O and Communications**, click **Configure Modules** > **Configure 900 I/O Modules**. Select the target DI module.

2. Select a **DI** channel and configure the parameters as required. See the following table for a description of each parameter:

Parameter	Description
Direction	There are two options: • **Direct**: when a high level input is given to a DI channel, the BOOL type DI value is **TRUE**; for a low level input, it is **FALSE**. • **Reversed**: when a high level input is given to a DI channel, the BOOL type DI value is **FALSE**;

Parameter	Description
	for a low level input, it is **TRUE**.
State 0 Description	(Optional) Enter description if it is required.
State 1 Description	(Optional) Enter description if it is required.

3. Bind I/O variables to physical I/O channels as follows:
   a. For the target channel, click **Bind**.
      The **Select I/O Variable** dialog appears. The available I/O variables with data types compatible to the selected I/O channel type are displayed automatically.
   b. If the required I/O variable exists in the list, select it and click **Bind**. If the required I/O variable is not existing in the list, click **Add New Variable** to create a new I/O variable. The **Select I/O Variable** dialog appears.
   c. Type the **Name** and **Description**, and then click **Add**.
      The I/O variable is created and bound to the I/O channel successfully.
   d. Click **Save**.
   e. Program the I/O variable optionally. See Programming with IEC 61131-3 for more information.
4. (Optional)You can unbind I/O variables to physical I/O channels as follows:
   a. For the target channel, click **Unbind**. A warning message appears that all the bound variables will be unbounded after channel unbinding.
   b. Click **Yes** to unbind the channel. Or you can click **No** to cancel the procedure.

Configuring DO modules (DO08 AC 900H03, DO32 DC 900H32 , DO08 Relay 900H01)

1. From the Home Page, under **I/O and Communications**, click **Configure Modules** > **Configure 900 I/O Modules**. Select the target DO module.
2. Select an **DO** channel and configure the parameters as required.

See the following table for a description of each parameter:

Parameter	Description
Direction	There are two options: • **Direct**: when a high level input is given to a DI channel, the BOOL type DI value is **TRUE**; for a low level input, it is **FALSE**. • **Reversed**: when a high level input is given to a DI channel, the BOOL type DI value is **FALSE**; for a low level input, it is **TRUE**.
Fail Safe Output Mode	There are two options: • Hold Last State • Failsafe State
User Config Output	An appropriate value is needed if the **Fail Safe Output Mode** is selected as **Failsafe State**.
State 0 Description	(Optional) Enter description if it is required.
State 1 Description	(Optional) Enter description if it is required.

3. Bind I/O variables to physical I/O channels as follows:

   a. For the target channel, click **Bind**.

      The **Select I/O Variable** dialog appears. The available I/O variables with data types compatible to the selected I/O channel type are displayed automatically.

   b. If the required I/O variable exists in the list, select it and click **Bind**. If the required I/O variable is not existing in the list, click **Add New Variable** to create a new I/O variable. The **Select I/O Variable** dialog appears.

   c. Type the **Name** and **Description**, and then click **Add**.

      The I/O variable is created and bound to the I/O channel successfully.

   d. Click **Save**.

e. Program the I/O variable optionally. See Programming with IEC 61131-3 for more information.

4. (Optional)You can unbind I/O variables to physical I/O channels as follows:

   a. For the target channel, click **Unbind**. A warning message appears that all the bound variables will be unbounded after channel unbinding.

   b. Click **Yes** to unbind the channel. Or you can click **No** to cancel the procedure.

Configuring Universal Analog Input modules (UAI08 900A01)

The Universal Analog Input module has eight inputs, which can include any combination of the following

1. From the Home Page, under **I/O and Communications**, click **Configure Modules** > **Configure 900 I/O Modules**. Select the target Universal Analog Input module.

2. Select an **UAI** channel and configure the parameters as required. See the following table for a description of each parameter:

Parameter	Description
Sensor Group	There are four options: • T/C: Thermocouple is a sensor used to measure temperature. • RTD: Resistance Temperature Detector is a sensor used to determine the temperature by measuring the resistance of pure electrical wire. • Linear: Linear converts analog input value to corresponding output in units based on a linear 0 to 100% scale and specified high and low range values. • Special: ◦ Carbon ◦ Oxygen

Parameter	Description
Sensor Type	Select the target sensor type after you select the sensor group.
Filter Time	A software digital filter is provided for the input designated to smooth the input. You can configure the first order lag time constant from 1.00 to 120.00 seconds. The default value is 0.00. 0.00 = no filter
Bias	Bias is used to compensate the input for drift of an input value due to deterioration of a sensor, or some other cause, ranging from -9999.00 to 9999.00. The default value is 0.00.
EU Low	For T/C or RTD - EU Low is implied by the sensor type. For Linear - output value that corresponds to 0 % input value For example: Actuation Input = 4-20mA Process variable = Flow Range of Flow = 0 to 250 gal/min High Range Display Value = 250 Low range Display Value = 0 Then 20mA = 250, 4mA = 0
EU High	For T/C or RTD - EU High is implied by the sensor type. For Linear - output value that corresponds to 100 % input value For example: See "EU Low" above.
EU Description	(Optional) For Linear Only. Enter Engineering Unit description if it is required.

Parameter	Description
Burnout	• DownScale: Value set at "EU Low" field • UpScale: Value set at "EU High" field • UserValue: Use the value entered in the appropriate field, ranging from EU Low to EU High. • None: Value set at "EU Low" field
User Value	Enter the appropriate value, ranging from EU Low to EU High.
Enable RCJ	It is used only for Thermocouples when the thermocouple Cold Junction is in a remote location. Check or Uncheck the Enable RCJ checkbox. If the Enable RCJ checkbox is selected, click the browser icon to select an I/O variable.

3. Bind I/O variables to physical I/O channels as follows:

   a. For the target channel, click **Bind**.

      The **Select I/O Variable** dialog appears. The available I/O variables with data types compatible to the selected I/O channel type are displayed automatically.

   b. If the required I/O variable exists in the list, select it and click **Bind**. If the required I/O variable is not existing in the list, click **Add New Variable** to create a new I/O variable. The **Select I/O Variable** dialog appears.

   c. Type the **Name** and **Description**, and then click **Add**.

      The I/O variable is created and bound to the I/O channel successfully.

   d. Click **Save**.

   e. Program the I/O variable optionally. See Programming with IEC 61131-3 for more information.

4. (Optional)You can unbind I/O variables to physical I/O channels as follows:

   a. For the target channel, click **Unbind**. A warning message appears that all the bound variables will be unbounded after channel unbinding.

b. Click **Yes** to unbind the channel. Or you can click **No** to cancel the procedure.

Configuring AI modules (AI16 mA/V 900A16)

1. From the Home Page, under **I/O and Communications**, click **Configure Modules** > **Configure 900 I/O Modules.** Select the target AI module.
2. Select an **AI** channel and configure the parameters as required. See the following table for a description of each parameter:

Parameter	Description
Sensor Type	Select the target sensor type.
EU Low	Output value that corresponds to 0 % input value For example: Actuation Input = 4-20mA Process variable = Flow Range of Flow = 0 to 250 gal/min High Range Display Value = 250 Low range Display Value = 0 Then 20mA = 250, 4mA = 0
EU High	Output value that corresponds to 100 % input value For example: See "EU Low" above.
EU Ex Low	• It is not configurable for 0-20mA. • The default value is -10.00 for 4-20mA.
EU Ex High	EU Ex High default value is 110.00.
EU Description	(Optional) Enter Engineering Unit description if it is required.
Filter Time(sec)	A software digital filter is provided for the input designated to smooth the input. You

Parameter	Description
	can configure the first order lag time constant from 1.00 to 120.00 seconds. The default value is 0.00. 0.00 = no filter
Bias	Bias is used to compensate the input for drift of an input value due to deterioration of a sensor, or some other cause, ranging from -9999.00 to 9999.00. The default value is 0.00.

Sensor Type	Option name shown in the "Sensor Type" dropdown list	PV Input Range		Reference Accuracy
		Low	High	
mA	4-20 mA	4	20	± 0.2% F.S. (mA)*
mA	0-20 mA	0	20	± 0.2% F.S. (mA)*
Volts	0-1 V	0	1	± 0.1% F.S. (mV)
Volts	0-2 V	0	2	± 0.1% F.S. (mV)
Volts	0-5 V	0	5	± 0.1% F.S. (mV)
Volts	0-10 V	0	10	± 0.2% F.S. (mV)
Volts	-1-1 V	-1	1	± 0.1% F.S. (mV)
Volts	-2-2 V	-2	2	± 0.1% F.S. (mV)
Volts	-5-5 V	-5	5	± 0.1% F.S. (mV)
Volts	-10-10 V	-10	10	± 0.2%

				F.S. (mV)
*Tolerances for these input types include that of the external Dropping Resistors.				

3. Bind I/O variables to physical I/O channels as follows:
   a. For the target channel, click **Bind**.
      The **Select I/O Variable** dialog appears. The available I/O variables with data types compatible to the selected I/O channel type are displayed automatically.
   b. If the required I/O variable exists in the list, select it and click **Bind**. If the required I/O variable is not existing in the list, click **Add New Variable** to create a new I/O variable. The **Select I/O Variable** dialog appears.
   c. Type the **Name** and **Description**, and then click **Add**.
      The I/O variable is created and bound to the I/O channel successfully.
   d. Click **Save**.
   e. Program the I/O variable optionally. See Programming with IEC 61131-3 for more information.
4. (Optional)You can unbind I/O variables to physical I/O channels as follows:
   a. For the target channel, click **Unbind**. A warning message appears that all the bound variables will be unbounded after channel unbinding.
   b. Click **Yes** to unbind the channel. Or you can click **No** to cancel the procedure.

Configuring AO modules (AO04 900B01, AO08 900B08)

1. From the Home Page, under **I/O and Communications**, click **Configure Modules** > **Configure 900 I/O Modules**. Select the target AO module.
2. Select an **AO** channel and configure the parameters as required. See the following table for a description of each parameter:

Parameter	Description
Sensor Type	0-20mA or 4-20mA
EU Low	EU Low default value is 0.00.
EU High	EU High default value is 100.00.
EU Ex Low	• It is not configurable for 0-20mA. • The default value is -10.00 for 4-20mA. **NOTE:** When the value of OP is equal or lower than the value of EU Ex Low, the physical current output will be 0mA when 4-20mA is selected as the sensor type of the AO channel.
EU Ex High	EU Ex Low default value is 110.00.
EU Description	(Optional) Enter Engineering Unit description if it is required.
Failsafe Output Mode	There are two options: • Hold Last Value • Failsafe Value
User Config Output	An appropriate value is needed if the **Fail Safe Output Mode** is selected as **Failsafe Value**.

3. Bind I/O variables to physical I/O channels as follows:

   a. For the target channel, click **Bind**.

      The **Select I/O Variable** dialog appears. The available I/O variables with data types compatible to the selected I/O channel type are displayed automatically.

   b. If the required I/O variable exists in the list, select it and click **Bind**. If the required I/O variable is not existing in the list, click **Add New Variable** to create a new I/O variable. The **Select I/O Variable** dialog appears.

   c. Type the **Name** and **Description**, and then click **Add**.

      The I/O variable is created and bound to the I/O channel successfully.

d. Click **Save**.

e. Program the I/O variable optionally. See Programming with IEC 61131-3 for more information.

4. (Optional)You can unbind I/O variables to physical I/O channels as follows:

   a. For the target channel, click **Unbind**. A warning message appears that all the bound variables will be unbounded after channel unbinding.

   b. Click **Yes** to unbind the channel. Or you can click **No** to cancel the procedure.

Configuring PFQ modules (SF04 PFQ 900K01)

1. From the Home Page, under **I/O and Communications**, click **Configure Modules** > **Configure 900 I/O Modules**. Select the target PFQ module.
2. Select a channel and double-click the field under **Type** for the target channel to configure the channel type. There are three types can be selected: **PI**, **FI** and **PO**.

Configuring Pulse Input channels

1. Select a **PI** channel. The PI configuration parameters appear.
2. Configure the parameters as required. See the following table for a description of each parameter:

Parameter	Description
Pulse per EU	It measures quantity by scaling the number of pulses to engineering units (EU) .
Sample Time (0.5s)	Enter sample time period for the average rate calculation.
Time period	Time unit used to scale the rate
Preset	There are two options: • User Value • Variable: when variable is selected, the variable should be picked from the

Parameter	Description
	menu below.
User Value	When User Value is selected, this option scan is enabled. The default value is 0.00.
Preset Output Action	Momentary: The PFQ module output pin turns ON for 1 second. Latched Until Reset: The PFQ module output pin latches ON until reset.

3. Bind I/O variables to physical I/O channels as follows:
   a. For the target channel, click **Bind**.
      The **Select I/O Variable** dialog appears. The available I/O variables with data types compatible to the selected I/O channel type are displayed automatically.
   b. If the required I/O variable exists in the list, select it and click **Bind**. If the required I/O variable is not existing in the list, click **Add New Variable** to create a new I/O variable. The **Select I/O Variable** dialog appears.
   c. Type the **Name** and **Description**, and then click **Add**.
      The I/O variable is created and bound to the I/O channel successfully.
   d. Click **Save**.
   e. Program the I/O variable optionally. See Programming with IEC 61131-3 for more information.
4. (Optional)You can unbind I/O variables to physical I/O channels as follows:
   a. For the target channel, click **Unbind**. A warning message appears that all the bound variables will be unbounded after channel unbinding.
   b. Click **Yes** to unbind the channel. Or you can click **No** to cancel the procedure.

Configuring Frequency Input channels

1. Select a **FI** channel. The FI configuration parameters appear.
2. Configure the parameters as required. See the following table for

the description of each parameter:

Parameter	Description
Pulse Width	There are three options: • 500µs(10Hz-500Hz) • 50µs(10Hz-5KHz) • 2.5µs(10Hz-100KHz) The input signal is rejected if it is below this pulse width. The frequency of pulses above this width must be in this frequency range; otherwise the output goes to failsafe and a failure-to-convert error occurs.
Filter Time (sec)	A software digital filter is provided for the input designated to smooth the input. You can configure the first order lag time constant from 1.00 to 120.00 seconds. The default value is 0.00. 0.00 = no filter
Bias	Bias is used to compensate the input for drift of an input value due to deterioration of a sensor, or some other cause, ranging from -9999.00 to 9999.00. The default value is 0.00.
Low Input(Hz)	Low frequency value of the input device. Exceeding this limit causes an under - range error.
High Input(Hz)	High frequency value of the input device. Exceeding this limit causes an under - range error.
EU Low	EU Low default value is 0.00.
EU High	EU High default value is 100.00.

3. Bind I/O variables to physical I/O channels as follows:

a. For the target channel, click **Bind**.

   The **Select I/O Variable** dialog appears. The available I/O variables with data types compatible to the selected I/O channel type are displayed automatically.

b. If the required I/O variable exists in the list, select it and click **Bind**. If the required I/O variable is not existing in the list, click **Add New Variable** to create a new I/O variable. The **Select I/O Variable** dialog appears.

c. Type the **Name** and **Description**, and then click **Add**.

   The I/O variable is created and bound to the I/O channel successfully.

d. Click **Save**.

e. Program the I/O variable optionally. See Programming with IEC 61131-3 for more information.

4. (Optional)You can unbind I/O variables to physical I/O channels as follows:

   a. For the target channel, click **Unbind**. A warning message appears that all the bound variables will be unbounded after channel unbinding.

   b. Click **Yes** to unbind the channel. Or you can click **No** to cancel the procedure.

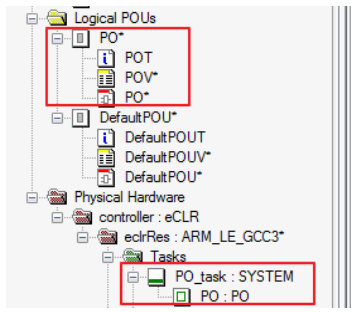
Configuring Pulse Output channels

1. Select a **PO** channel. The PO configuration parameters appear.
2. Configure the parameters as required. See the following table for a description of each parameter:

Parameter	Description
Failsafe Output Mode	• Immediate Low • Finish Pulse
Frequency(Hz)	The number of outputs per second, ranging from 25 to 10000.
Pulse Width(ms)	The input signal is rejected if it is below this pulse width. The frequency of pulses above this width must be in this frequency range;

Parameter	Description
	otherwise the output goes to failsafe and a failure-to-convert error occurs.

3. Bind I/O variables to physical I/O channels as follows:
   a. For the target channel, click **Bind**.
      The **Select I/O Variable** dialog appears. The available I/O variables with data types compatible to the selected I/O channel type are displayed automatically.
   b. If the required I/O variable exists in the list, select it and click **Bind**. If the required I/O variable is not existing in the list, click **Add New Variable** to create a new I/O variable. The **Select I/O Variable** dialog appears.
   c. Type the **Name** and **Description**, and then click **Add**.
      The I/O variable is created and bound to the I/O channel successfully.
   d. Click **Save**.
   e. Program the I/O variable optionally. See Programming with IEC 61131-3 for more information.
4. (Optional)You can unbind I/O variables to physical I/O channels as follows:
   a. For the target channel, click **Unbind**. A warning message appears that all the bound variables will be unbounded after channel unbinding.
   b. Click **Yes** to unbind the channel. Or you can click **No** to cancel the procedure.
5. (Optional) For PO channel, the controller only sends the command to PFQ module once, and the module will continuously output pulses even the eCLR is stopped. In this case, if you want to stop outputting pulses when the eCLR is stopped, you can configure a process to check the eCLR states and send a stop command to the PFQ module.
   a. From the IEC Programming Workspace, create a **System** task, and set **System Event** as **Stop**.
   b. Create a new POU and set **PO.ENABLE** as **0**.
   c. Associate the POU to the task.



Configuring ControlEdge 900 communication modules

Configuring serial modules

The section introduces how to add and configure a serial communication module. Up to six serial modules can be added.

1. From the Home Page, under **I/O and Communications**, click **Configure Modules** > **Configure Serial Modules**.
2. Click **Add Serial Module**, the **Add Serial Module** dialog appears.
3. Select the **Type**, assign the **Rack** and **Slot** for the module.

   See the following table for the parameter descriptions:

Parameter	Description
Type	Serial module type: 900ES1: Serial Comm
Rack	Rack address: • If controller redundancy is enabled, the rack address range is from 1 to 99. • If controller redundancy is disabled, the rack address range is from 0 to 99. 0 is only for the local I/O rack. • For an expansion I/O rack, the address must be the same with the EPM address configured on 1x and 10x rotary switches. For details about the rotary switches, see “Assembling I/O racks” in the *ControlEdge 900 Controller Hardware Planning and Installation*

Parameter	Description
	Guide.
Slot	Slot number: the location of the I/O module mounted in the rack • If the I/O module is installed in a 4-slot rack, the slot number is ranging from 1 to 4. • If the I/O module is installed in an 8-slot rack, the slot number is ranging from 1 to 8. • If the I/O module is installed in a 12-slot rack, the slot number is ranging from 1 to 12.

4. Click **OK** to add the serial module.
5. Select a serial module. There are four serial ports to be configured, RS232-1, RS232-2, RS485-1 and RS485-2. Select the target port and configure appropriate values for the following parameters.

Parameter	Description
Baud Rate	300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200
Parity	None, ODD, EVEN
Data Bits	7, 8 If you select Modbus RTU Slave or Modbus RTU Master for the Protocol Binding, the Data Bits is set as 8 by default.
Stop Bits	1, 2

For RS232-1 and RS232-2, you should configure one more option: **Flow Control**. See the following table for the parameter descriptions.

Parameter	Description
Flow Control	Only for RS232-1 and RS232-2 • None • RTS-CTS • RTS

6. Under **Protocol Binding**, select a protocol from the **Port Protocol** drop-down list.

   The following table provides information about various protocols supported by serial ports.

Protocol	Description
Modbus RTU Slave	The controller acts as the Modbus Slave and used for communication between: • Controller and SCADA • Controller and third-party Modbus Master devices If you select Modbus RTU Slave: • Data Bits is set as 8 by default. • There are two more options to configure: **Slave ID** and **Mapping**. If the Mapping is empty, you must add a mapping table first. See Adding a Modbus Slave mapping table for more information.
Modbus RTU Master	The controller acts as the Modbus Master and used for communication between the controller and third-party Modbus Slave devices, for example I/O modules. If you select Modbus RTU Master, Data Bits is set as 8 by default.
Modbus ASCII Slave	The controller acts as the Modbus Slave and used for communication between: • Controller and SCADA • Controller and third-party Modbus Master If you select Modbus ASCII Slave, you must configure two more options: **Slave ID** and **Mapping**. If the Mapping is empty, you must add a mapping table first. See Adding a Modbus Slave mapping table for more information.
Modbus ASCII Master	The controller acts as the Modbus Master and used for communication between The controller and third-party Modbus Slave devices, for example: I/O modules.

<table>
<tr><th>Protocol</th><th>Description</th></tr>
<tr><td>User Defined</td><td>User Defined protocol.

When you select this option, the **Delimiter Mode (Optional)** panel appears including three settings: **Read-interval Timeout (ms)**, **Max Length (Bytes)** and **End Delimiter (Hex)**. You can configure them optionally to validate if a data frame is sent completely.

• **Read-interval Timeout (ms)**: The interval between the last data packet sent and the first keepalive probe, ranging from 0 to 10000 (ms). If the interval between the arrivals of any two bytes exceeds this Timeout, system regards it has already received a complete data frame.

The default value is 0 which means this option is disabled.

• **Max Length (Bytes)**: The maximum number of bytes for a data frame, ranging from 0 to 532. If the length of a received data frame exceeds the Max Length, system regards it has already received a complete data frame.

The default value is 0 which means this option is disabled.

• **End Delimiter (Hex)**: Configured special characters in hexadecimal and based on bytes validates if a data frame is sent completely. If the received data frame has same characters with the End Delimiter, system regards it has already received a complete data frame.

The default setting is blank which means this option is disabled.

For how to configure User Defined protocol, see "User Defined Protocol" in the *ControlEdge Builder Function and Function Block Configuration Reference*.</td></tr>
</table>

7. Click **Save** to complete the configuration.

Managing a module

Removing a module

1. From the Home Page, click **Configure Modules** under **I/O and Communications**, and select the target I/O or serial module.
2. Click the **Delete** icon. A warning message appears to confirm the deletion.
3. Click **Yes** to delete the target module.

> **TIP:** After deleting an I/O module, the channels in this I/O module are unbound with the variables. However, the variables still exists in the program.

Editing a module

1. From the Home Page, click **Configure Modules** under **I/O and Communications**, and select the target I/O or serial module.
2. Click the **Edit** icon. The **Edit I/O Module** or **Edit Serial Module** page appears.
3. Modify the rack address, slot number or IOM scan time as required, and click **Yes**.

Exporting module configuration

The module configuration can be exported to a .csv file.

To export module configuration

1. From the Home Page, under **I/O and Communications**:
   - For ControlEdge 2020 controller, click **Configure I/O**, and select the target expansion I/O module.
   - For ControlEdge 900 controller, click **Configure Modules**, and select the target I/O or serial module.
2. Click **Export** icon, the **Save As** window appears.
3. Browse to the location you want to store the file and click **Save** to export the module configuration.

Importing module configuration

You can configure all I/O modules or serial modules in a .csv file and import it in ControlEdge Builder. Up to six serial modules can be added.

To get a .csv file, see Exporting module configuration for more information.

See the following table for the I/O module configuration parameters.

Parameter	Rule for I/O module configuration import
Rack Address	Valid value ranges from 0 to 99. Rack address for each channel of assigned module shall not be empty. Rack quantity must not be more than 12. For the redundant controller, the I/O configuration in Rack 0 is not applicable.
Slot Number	For 4-slot rack, the slot number ranges from 1 to 4. For 8-slot rack, the slot number ranges from 1 to 8. For 12-slot rack, the slot number ranges from 1 to 12. The quantity of slots assigned to one rack must not be more than 12. Each channel of the assigned module must be assigned a slot number. No duplicate slot numbers are allowed in a rack.
Module Type	I/O module type
Channel Enabled	Indicates whether a channel is enabled for this I/O. Enter one of the following two values: • False • True False is the default value.
Channel Number	The channel number, which can be between 1 and 16, must be aligned with the module type. All channels must have a number assigned.

Parameter	Rule for I/O module configuration import
Channel Type	The type of channel for this module. Valid values are AI, AO, DI, DO, UAI, PI, FI and PO.
I/O Variable	Optional The variable to which this channel is to be bound. Variable names cannot be duplicated, and must comply with the IEC naming conventions: • If the variable specified exists in the Variable table in the IEC Programming Workspace, you must specify a channel of the same type as that contained defined in the table. When the I/O configuration file is imported, the variable is automatically bound to the channel. • If the variable specified does not exist in the IEC Programming Workspace, it will be created automatically after importing the I/O configuration file.
Description	The description of I/O variable
EU Description	Description of engineering unit. It is available for all channels except digital input and digital output channels. If T/C or RTD is assigned as the sensor type, the assignable value to this parameter shall be between C and F as per the sensor type selected. For any other sensor types, the inputs of this parameter is free.
Sensor Type	The sensor type depends on the selected module type. UIO module supports: • For AI channel: 4-20mA or 0-20mA • For AO channel: 4-20mA or 0-20mA
EU Low	Low range of engineering unit It shall be smaller than EU High This parameter does not need to be configured if the sensor type is assigned as T/C or RTD.

Parameter	Rule for I/O module configuration import
EU High	High range of engineering unit This parameter does not need to be configured if the sensor type is assigned as T/C or RTD.
EU Ex Low	Optional Extended low should be lower than EU Low. For details of the algorithm, see Configuring Universal Input/Output modules (UIO16 900U01) for more information. (EU Low) - (EU High - EU Low)*10% is the default value.
EU Ex High	Optional Extended high should be higher than EU High. For details of the algorithm, see Configuring Universal Input/Output modules (UIO16 900U01) for more information. (EU High) + (EU High - EU Low)*10% is the default value.
HART	This parameter shall be ignored during I/O configuration import process if the assigned module type doesn't support HART functionality. HART functionality shall be disabled by default if it is not assigned any option to or the assigned value is invalid.
OpenWireDetection	Open Wire Detection: True or False Only DI and DO channel of UIO module support Open Wire Detection.
ShortCircuitDetection	Short Circuit Detection: True or False Only DI and DO channesl of UIO module support Short Circuit Detection.
State 0 Description	Optional Description of State 0 Only Digital input and Digital output channels support State 0 Description.
State 1 Description	Optional Description of State 1 Only Digital input and Digital output channels support State 1

Parameter	Rule for I/O module configuration import
	Description.
Direction	Optional The given signal of a DI or DO channel. There are two options: Reverse or Direct. Direction is direct by default.
Fail Safe Output Mode	Optional Determines the output behavior for AO and DO channel when failsafe. There are two options: Hold Last Output or User Cfg Output Hold Last Output is the default value.
AO User Configured Output	Optional To assign the user configured output. EU Ex Low <= User configured output <= EU Ex High EU Ex Low is assumed if the assigned value is smaller than EU Ex Low; EU Ex High is assumed if the assigned value is beyond EU Ex High. 0 is the default value.
DO User Configured Output	Optional Assigns the user configured output. There are two options: 0 or 1. 0 is the default value.
Remote CJ	It should be enabled for T/C sensor type if the cold junction is in the remote location. Enter one of the following two values: • TRUE • FALSE
RCJVariable	This variable should be analog input type.

Parameter	Rule for I/O module configuration import

	The variable can be used for multiple channels at same time.
	• If the variable defined in this file is existing in ControlEdge Builder, there are two scenarios:
	  • If the variable type in ControlEdge Builder does not match the required type, the I/O configuration import will be terminated.
	  • If the variable type in ControlEdge Builder matches the required type, the variable will be bound and used as Remote CJ variable automatically during I/O configuration import.
	• If the variable defined in this file does not exist in ControlEdge Builder, the system will create the variable automatically during the import process. If the variable name is not compliant with MP naming convention, the variable cannot be created successfully and I/O configuration import will be terminated.
	This variable must be assigned in this file if "Remote CJ" is enabled. It will be ignored during the import process if "Remote CJ" is disabled.

BURNOUT	It is used to disable or enable burnout function. Enter one of the following values: • Upscale • Downscale • User Value • None
User Value	Enter the appropriate value, ranging from EU Low to EU High
Filter Time	Configure the first order lag time constant from 1.00 to 120.00 seconds to smooth the input. It ranges from 0.00 to 120.00. 0 means disable this function and it is the default value.

Parameter	Rule for I/O module configuration import
Bias	Assign a value used to compensate the input for drift of an input value due to deterioration of a sensor, or some other cause. It ranges from -9999.00 to 9999.00. 0 is the default value.

See the following table for the serial module configuration parameters.

Parameter	Rule for serial module configuration import
Rack Address	Valid value ranges from 0 to 99. Rack address for each channel of assigned module shall not be empty. For the redundant controller, the serial module configuration in Rack 0 is not applicable.
Slot Number	For 4-slot rack, the slot number ranges from 1 to 4. For 8-slot rack, the slot number ranges from 1 to 8. For 12-slot rack, the slot number ranges from 1 to 12. The quantity of slots assigned to one rack must not be more than 12. No duplicate slot numbers are allowed in a rack.
Module Type	Serial module type: Serial Comm
Name	Serial port name: RS232-1, RS232-2, RS485-1 or RS485-2
Port Name	It is un-configurable. COM1: RS232-1 COM2: RS232-2 COM3: RS485-1 COM4: RS485-2
Index	Serial port No. 0: RS232-1 1: RS232_1

Parameter	Rule for serial module configuration import
	2: RS485-1 3: RS485-2
Port Type	Serial port type: RS232 or RS485
Baud Rate	BD_300, BD_600, BD_1200, BD_2400, BD_4800, BD_9600, BD_19200, BD_38400, BD_57600, BD_115200
Parity	None, ODD, EVEN
Data Bits	BIT7, BIT8 If you select Modbus RTU Slave or Modbus RTU Master protocol, you must configure BIT8 for Data Bits.
Stop Bits	BIT1, BIT2
Flow Control	Only for RS232-1 and RS232-2 • None • RTS-CTS • RTS
Protocol	• MBRTUSLAVE: Modbus RTU Slave • MBRTUMASTER: Modbus RTU Master • MBASCIISLAVE: Modbus ASCII Slave • MBASCIIMASTER: Modbus ASCII Master • USERDEFINED: User Defined protocol
Slave ID	It is required when you select Modbus RTU Slave or Modbus ASCII Slave for Protocol. It ranges from 1 to 247.
Mapping	It is required when you select Modbus RTU Slave or Modbus ASCII Slave for Protocol. If the list is empty, you need add a Modbus slave mapping table first. See Adding a Modbus Slave mapping table for more information.
Timeout	When you select the User Defined protocol, you can configure it optionally.

Parameter	Rule for serial module configuration import
	The interval between the last data packet sent and the first keepalive probe, ranging from 0 to 10000 (ms). If the interval between the arrivals of any two bytes exceeds this Timeout, system regards it has already received a complete data frame. The default value is 0 which means this option is disabled.
End Delimiter	When you select the User Defined protocol, you can configure it optionally. Configured special characters in hexadecimal and based on bytes validates if a data frame is sent completely. If the received data frame has same characters with the End Delimiter, system regards it has already received a complete data frame. The default setting is blank which means this option is disabled.
Max Length (Bytes)	When you select the User Defined protocol, you can configure it optionally. The maximum number of bytes for a data frame, ranging from 0 to 1024. If the length of a received data frame exceeds the Max Length, system regards it has already received a complete data frame. The default value is 0 which means this option is disabled.

See the following table for the expansion I/O module configuration parameters.

Parameter	Rule for serial module configuration import
Address	Valid value ranges from 1 to 99. It must be same as the rotary switch setting of the physical device.
Scan Time	IOM scan time. IOM scan time and task execution time should be set carefully. The I/O data refresh time in a controller depends on the slower of the IOM scan time and task execution time, so improper settings can result in excessive overrun or tasks not being processed. Additionally, Honeywell recommends configuring IOM scan time and task execution time either as the same value, or as one being an integral multiple of the other.
Module Description	IOM description

<table>
<tr><th>Parameter</th><th>Rule for serial module configuration import</th></tr>
<tr><td>Module Type</td><td>IOM type</td></tr>
<tr><td>Filter</td><td>AI Filter that affects the response time of enabled channels in the analog input module.
50HZ
60HZ</td></tr>
<tr><td>Channel Number</td><td>The channel number must be aligned with the module type. All channels must have a number assigned.
AI1~AI8
AO1~AO2
DI1~DI10
DO1~DO6
PI1~PI2
NOTE: Two PI channels can be configured as DI channels.</td></tr>
<tr><td>Channel Type</td><td>The type of channel for this module.
Valid values are AI, AO, DI, DO and PI.</td></tr>
<tr><td>Channel Enabled</td><td>Indicates whether a channel is enabled for this IOM.
FALSE
TRUE</td></tr>
<tr><td>I/O Variable</td><td>Optional
The variable to which this channel is to be bound.
Variable names cannot be duplicated, and must comply with the IEC naming conventions:
If the variable specified exists in the Variable table in the IEC Programming Workspace, you must specify a channel of the same type as that contained defined in the table. When the I/O configuration file is imported, the variable is automatically bound to the channel.</td></tr>
</table>

Parameter	Rule for serial module configuration import
	• If the variable specified does not exist in the IEC Programming Workspace, it will be created automatically after importing the I/O configuration file.
Description	Optional The description of I/O variable.
AI Mode	There are two options: • Voltage • Current
EU Ex High	Extended high should be higher than EU High. For details of the algorithm, see Configuring Onboard I/O for more information. (EU High) + (EU High - EU Low)*10% is the default value.
EU High	High range of engineering unit
EU Low	Low range of engineering unit It shall be smaller than EU High
EU Ex Low	Extended low should be lower than EU Low. For details of the algorithm, see Configuring Onboard I/O for more information. (EU Low) - (EU High - EU Low)*10% is the default value.
EU Description	Optional Description of engineering unit.
HART	Enable or Disable the **HART** protocol. • TRUE • FALSE
State 0 Description	Optional Description of State 0 Only Digital input and Digital output channels support State 0 Description.
State 1 Description	Optional

Parameter	Rule for serial module configuration import
	Description of State 1 Only Digital input and Digital output channels support State 1 Description.
Direction	The given signal of a DI or DO channel. There are two options: Reverse or Direct. Direction is direct by default.
Fail Safe Output Mode	Determines the output behavior for AO and DO channel when failsafe. There are two options: Hold Last Output or User Cfg Output Hold Last Output is the default value.
AO User Configured Output	It is only applicable when Fail Safe Output Mode is configured as User Cfg Output. To assign the user configured output. EU Ex Low <= User configured output <= EU Ex High EU Ex Low is assumed if the assigned value is smaller than EU Ex Low; EU Ex High is assumed if the assigned value is beyond EU Ex High. 0 is the default value.
DO User Configured Output	Assigns the user configured output. There are two options: 0 or 1. 0 is the default value.

To import I/O or serial module configuration

1. From the Home Page, under **I/O and Communications**:
   - For ControlEdge 2020 controller, click **Configure I/O**, and select the target expansion I/O module.
   - For ControlEdge 900 controller, click **Configure Modules**, and select the target I/O or serial module.
2. Click **Import** icon, a warning message appears indicating that the imported data may overwrite current I/O or serial module configuration.
3. Click **Yes** to continue to import.
4. Browse to the location the target file stored and select the .csv file, then click **Open** to import the I/O or serial module configuration.

CHAPTER

5 CONFIGURING WIRELESS I/O

ControlEdge 2020 Controller supports wireless I/O configuration enabling the user to design, configure, commission and monitor ISA100 wireless networks and associated wireless field devices by ControlEdge Builder.

FDAP: Field Device Access Point (FDAP) is a wireless infrastructure node that acts as an ISA100.11a access point and a mesh node member. FDAP can only communicate through ISA100.11a.

Field Device: A field instrument with no routing capability, provides input or output channels for process control data.

Wireless I/O Device: A logical instance of a wireless field device.

Channel: A logical instance that presents the real value acquired from field devices.

Provision: Associating field devices to the controller.

Commission: Configuration for FDAP and field device, including enabling over-the-air provisioning, associating field devices to the controller, configuring field device channels and so on.

> **ATTENTION:** For wireless I/O, you must use time source as a precision NTP server.

The following table lists the wireless I/O configuration procedure.

Table 5-1: Wireless I/O Configuration Checklist

	Task	Go to
Wireless I/O device configuration - offline		
Step 1	Set the controller time.	• See Setting time source for more information. • If the NTP server is not available, see “Set_ RTC” in the *Function and Function Block Configuration Reference Guide* to configure the controller time.
Step 2	Enable Wireless I/O protocol on one of the	See Configuring Ethernet port for more information.

	Task	Go to
	Ethernet port of the controller.	
Step 3	Configure ISA100 network ID.	See Configuring ISA100 network ID for more information.
Step 4	Import DD files.	See Importing DD files for more information.
Step 5	Add wireless I/O devices.	See Adding wireless I/O devices for more information.
Step 6	Configure channels for wireless I/O devices.	See Configuring channels for more information.
Step 7	Bind channels to I/O variables.	See Binding channels to I/O variables for more information.
Step 8	Configure wireless I/O diagnostic parameters	See Configuring wireless I/O diagnostic parameters for more information.
Step 9	Download the project.	See Downloading a project to the controller for more information.
Configure and commission FDAP and field device - online		
Step 10	Enable over-the-air provisioning for the controller.	See Enabling over-the-air provisioning for more information.
Step 11	Accept un-provisioned FDAPs.	See Provisioning the devices using over-the-air provisioning method for more information.
Step 12	Enable over-the-air provisioning for FDAPs.	See Enabling over-the-air provisioning for more information.
Step 13	Configure field devices.	See Configuring field devices for more information. See Configuring field device channels for more information.
Step 14	Accept un-provisioned field devices.	See Provisioning the devices using over-the-air provisioning method for more information.
Step 15	Bind wireless I/O devices to field devices.	See Binding and unbinding field devices to wireless I/O devices for more information.
Step 16	Activate channels for bound field devices.	See Activating channels for more information.

Configuring the ISA100 wireless network

Configuring Ethernet port

Only one from **ETH1** and **ETH2** can be assigned for wireless I/O.

1. Click **Configure Ethernet Ports** from the Home Page and select the target Ethernet port for wireless I/O.
2. Under **Network Setting**, configure the IP Address of the Ethernet port. Select **Use the following IP address** to type in the details in **IP Address**, **Subnet Mask** and **Gateway** manually.
3. Under **Protocol Binding**, select **Wireless I/O**.
4. **DHCP Server** is enabled automatically. Type in **Start IP** and **End IP** to configure the address range for DHCP Server.
   - DHCP address should be on the same network segment as the IP address.
   - IP address must not be in the range of DHCP address.
5. Click **Save**

Configuring ISA100 network ID

The ISA100 Network ID is the unique identifier for the network. It must contain a value between 2 (default) and 65535.

1. Under **Communication**, select **Configure ProtocolsWireless I/O**.
2. Set the **ISA100 Network ID** in the **Wireless I/O** page.

   If any Field Device Access Points (FDAP) or Field Devices (FD) have been provisioned in the wireless I/O network, the ISA100 Network ID cannot be modified. If you want to change it, you must un-provision all the devices first.

Configuring wireless I/O devices

To configure wireless I/O devices, the Device Description (DD) file for each type of device must be imported into ControlEdge Builder. Importing DD files can be performed separately or as a part of adding a new wireless I/O device. Imported DD files will be stored in ControlEdge Builder.

When you open a project with a DD file, there are three scenarios:

- If the DD file was not imported to ControlEdge Builder, it will be stored in ControlEdge Builder automatically.
- If the DD file was imported to ControlEdge Builder, and it is older than the one in the project, then it will be replaced with the newer DD file.
- If the DD file was imported to ControlEdge Builder, and it is newer than the one in the project, then it will not be replaced with the older DD file. When you add a wireless I/O device, both two DD files will be displayed in the DD file list.

Importing DD files

A DD file is usually a zip file that can be downloaded from the device vendor's website. It contains information about the device type, commands that are supported by the device, and other device-specific data. A DD file for a particular field device is used to describe the device and to interpret messages and the device status.

1. Click **Configure Wireless I/O** > **Configure Wireless I/O Devices** from the Home Page.
2. Click **Add Device**, the **Add Wireless I/O Device** page appears.
3. Confirm that the DD file for the device already exists in ControlEdge Builder. If it does not exist, click **Import DD File**, and browse to the directory location of the DD file.
4. Select the DD file and click **Open**. The DD file is imported successfully.

Updating DD files

On occasions, device vendors update DD files. To use a new version of a DD file, you must import it and then perform a download to the controller.

> **ATTENTION:** The updated DD file must be associated with at least one Wireless I/O device. Only DD files associated with Wireless I/O devices will be downloaded to the controller.

Adding wireless I/O devices

> **NOTE:** It is recommended to use same DD file for same type of wireless I/O devices.

1. Click **Configure Wireless I/O > Configure Wireless I/O Devices** from the Home Page.
2. In the pop-up window, click **Add Device**, the **Add Wireless I/O Device** page appears.
3. If the DD file list is empty, first import the DD file. See Importing DD files for more information. Select the target DD file from the list.
4. Enter the required device **Name** and optional **Description** for the newly added device. Click **OK** to add the device.

Editing wireless I/O devices

The name and description of the wireless I/O device can be edited.

1. Click on the expanded tool bar of the target wireless I/O device, the **Edit** dialog box appears.
2. Modify the **Name** and **Description**, and then click **OK**.

Configuring channels

Based on its DD file, if a wireless I/O device does not support instantiable channels, its Channel column is not editable. The channel name can be modified by double clicking the Name field.

If a wireless I/O device supports instantiable channels, its Channel column is editable. When the device is added, the default value of the channel type is 'Unassigned'.

To change the channel type and modify the channel name

1. Select the required type from the drop-down list of the **Channel**.
2. Double-click the **Name** field and type in a desired name for this channel.

Binding channels to I/O variables

Channels are the logical instances that present the real value acquired from field devices and can be implemented in programs. The user must create I/O variables before binding them to channels of wireless I/O devices.

1. From the Home Page, click **Configure Wireless I/O** > **Configure Wireless I/O Devices**.
2. For the target channel, click **Bind**.

The **I/O Variable** dialog box appears. The available I/O variables with data types compatible to the selected I/O channel type are displayed automatically.

3. If the required I/O variable exists in the list, select it and click **Bind**. If the required I/O variable is not existing in the list, click **Add New Variable** to create a new I/O variable. The **I/O Variable** page appears.

   You can also create I/O variables from **IEC Programming Workspace**. See Creating a variable for more information.

4. Enter the **Name** and **Description**, and then click **Add**.

   The I/O variable is created and bound to the channel successfully.

5. Click **Save**.

6. The bound I/O variables can be used in the program. See Programming with IEC 61131-3 for more information.

Configuring wireless I/O diagnostic parameters

Synchronize variables of wireless I/O diagnostic parameters to the **Global Variables** in **IEC Programming Workspace**.

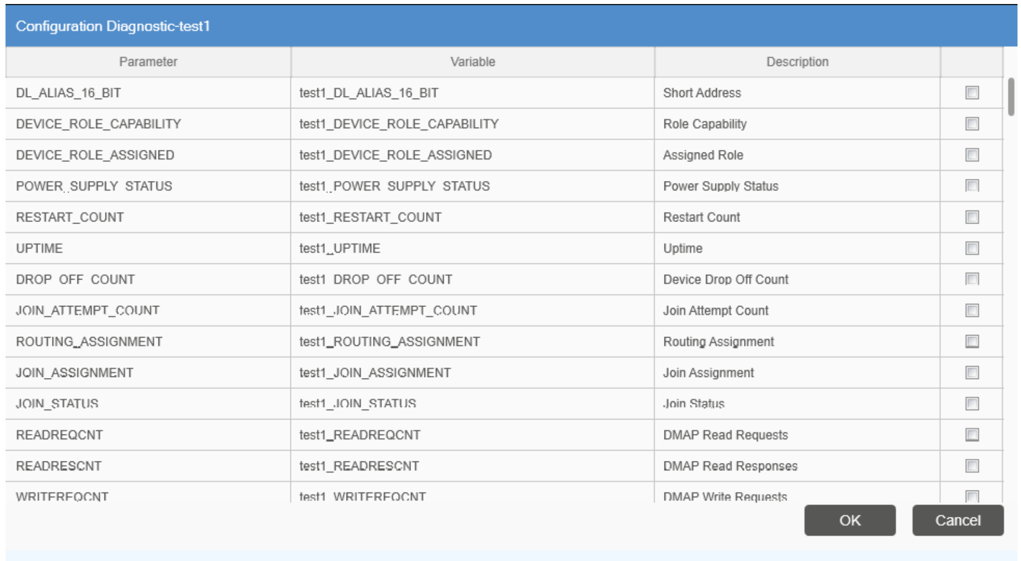
1. Click  on the expanded tool bar of the target wireless I/O device; the **Configuration Diagnostic** dialog box appears.

   Diagnostic parameters with default variable names and description defined by the DD file are displayed here .

   The length of the **Variable** text cannot exceed 30 characters and cannot be ended with an underscore.

   You can double-click the **Variable** field to edit it.

   If you rename or clear a variable which is mapped for SCADA or used in POUs, you need to map or program this variable in the POUs again.


Configuration Diagnostic-test1

Parameter	Variable	Description	
DL_ALIAS_16_BIT	test1_DL_ALIAS_16_BIT	Short Address	
DEVICE_ROLE_CAPABILITY	test1_DEVICE_ROLE_CAPABILITY	Role Capability	
DEVICE_ROLE_ASSIGNED	test1_DEVICE_ROLE_ASSIGNED	Assigned Role	
POWER_SUPPLY_STATUS	test1_POWER_SUPPLY_STATUS	Power Supply Status	
RESTART_COUNT	test1_RESTART_COUNT	Restart Count	
UPTIME	test1_UPTIME	Uptime	
DROP_OFF_COUNT	test1_DROP_OFF_COUNT	Device Drop Off Count	
JOIN_ATTEMPT_COUNT	test1_JOIN_ATTEMPT_COUNT	Join Attempt Count	
ROUTING_ASSIGNMENT	test1_ROUTING_ASSIGNMENT	Routing Assignment	
JOIN_ASSIGNMENT	test1_JOIN_ASSIGNMENT	Join Assignment	
JOIN_STATUS	test1_JOIN_STATUS	Join Status	
READREQCNT	test1_READREQCNT	DMAP Read Requests	
READRESCNT	test1_READRESCNT	DMAP Read Responses	
WRITEREQCNT	test1_WRITEREQCNT	DMAP Write Requests	

2. Select the required diagnostic parameters and click **OK**; the corresponding global variables are created in **IEC Programming Workspace**. If you do not want to do the configuration, click **Cancel**.

> **NOTE:** For detailed definition of the parameters, refer to the connected device's user guide.

Deleting wireless I/O devices

1. If a wireless I/O device is bound with a field device, you must unbound it first. See Binding and unbinding field devices to wireless I/O devices for more information.
2. From the Home Page, click **Configure Wireless I/O** > **Configure Wireless I/O Devices**, the **Configure Wireless I/O Device** page appears.
3. Click  on the expanded tool bar of the target wireless I/O device. A warning message appears indicating that all the bound variables will be unbound after deleting the device.
4. Click **Yes** to delete the device.

   The global variables created in **Configuration Diagnostics** under this wireless I/O device are also removed from the **Global Variable** in **IEC Programming Workspace**.

Commissioning wireless

When connecting the controller with Field Device Access Point (FDAP) for the first time, the user needs to set up wireless system. FDM can be used to configure field devices through either of Ethernet ports.

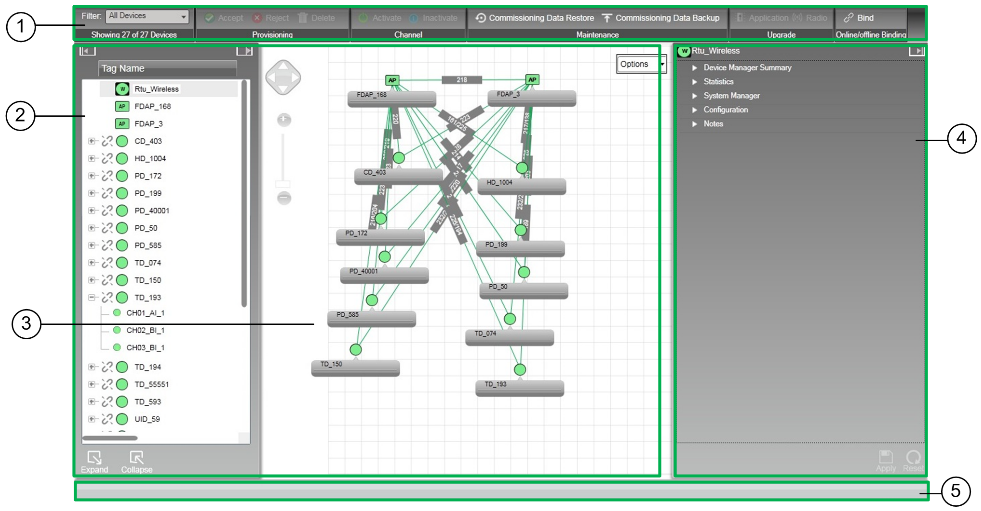
> **NOTE:** Downlink network from ControlEdge 2020 Controller to FDAP must be a private network. It is not allowed to have multiple FDAPs from different controllers in the same downlink network.

When FDAPs connect to the controller, field devices connect to the wireless network, they can be joined as un-provisioned devices. There is no data communication between ControlEdge Builder and the device in the un-provisioned state. You can accept or reject an un-provisioned device via ControlEdge Builder in **Commission Wireless I/O** page.

Understanding the wireless I/O user interface

Click **Configure Wireless I/O** > **Commission Wireless I/O** from the Home Page, and the **Commission Wireless I/O** page appears.

Figure 5-1: Commission Wireless I/O User Interface



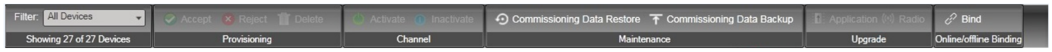
Commission wireless I/O user interface comprises of the following main elements.

Item	Name	Description
1	Ribbon Bar	It consists of groupings of user interface controls for controlling display elements and accessing various functions for monitoring and maintaining the Wireless Network. These user interface controls are contextual and are enabled based on user role and devices/channels selected in the Selection Panel.
2	Selection Panel	Display a list of all the devices that are configured in the Wireless Network.
3	Map View	Provides a visual representation of the Wireless Network.
4	Property Panel	Contains configuration properties of all the devices configured in the Wireless Network.
5	Status Bar	Provides an overview of the network status by displaying the number of online devices, active alarms and the progress of any maintenance operation.

The following sections explain each element of the user interface in detail.

Ribbon Bar

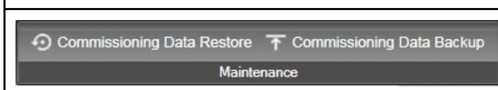
Figure 5-2: Ribbon Bar



The ribbon bar in the user interface contains the following tabs and icons.

Table 5-2: Ribbon Bar Elements

Tab/icon	Description
Filter group	
	The **Filter** option in the ribbon bar allows you to customize the device list by filtering the devices. By default, all the devices appear in the device list. You can filter by Device Type, Device Status, Vendor, Model, Power Source, Hop Level and Map. When you set a filter, various system views are altered. For example, the map highlights only the devices for which the filter option is applied. All the filtered out devices appear as blurred in the map. Filter includes an option to filter by Map. This includes the **Unplaced** map so any device that has not been placed on a map can easily be detected.
Provisioning group	
	• **Accept**: Accepts devices that can be provisioned using over-the-air provisioning method. • **Reject**: Rejects devices that are attempting to join the network using over-the-air provisioning method. • **Delete**: Removes a provisioned device from the network. Removing a device from the network clears the provisioning data and restores the device to factory default state. It can

Tab/icon	Description
	also be used to remove a rejected un-provisioned device from the user interface in case you have mistakenly rejected a device earlier. Removing a rejected device enables the device to rejoin as an un-provisioned device. You can then accept the un-provisioned device to join the network. Note the following points while deleting a device from the network. • Deleting a joined device removes the provisioning data and the configuration data from the device and the controller. Also, the device restores to factory default state. • Deleting an offline device removes the provisioning data and the configuration data of the device only from the controller. The provisioning data and the configuration data needs to be manually cleared from the device.
Channel group	
	• **Activate**: Activates all the channels of the selected field device. Clicking the **Activate** transitions the field device channel state from OOS to the currently configured Normal mode. • **Inactivate**: Inactivates all the channels of the selected field device. Clicking the **Inactivate** button transitions the field device channel state from AUTO to OOS.
Maintenance group	
	• Commissioning Data Backup: Click it to backup the commissioning data for

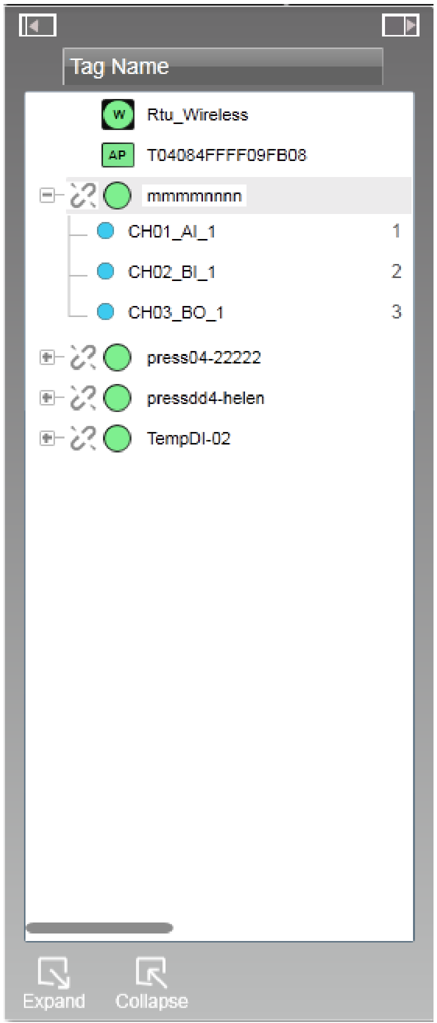
Tab/icon	Description
	the FDAPs and field devices. • Commissioning Data Restore: Click it to restore the backed up commissioning data to the FDAPs and field devices.
Upgrade group	
	• **Application**: Initiates firmware upgrade operation for the application firmware of the field devices. • **Radio**: Initiates firmware upgrade operation for the radio firmware of the field devices and FDAPs.
Online/offline Binding group	
	**Bind**: Bind/Unbind the Wireless I/O device to the field device.

Selection Panel

The Selection Panel in the Wireless user interface provides a list of all the devices configured in the Wireless Network. It is docked to the left of the user interface window and is horizontally expandable and collapsible. It also provides an option to view the extended view of the Selection Panel known as the extended Selection Panel. The extended Selection Panel displays the device information in a tabular format.

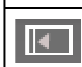
The default view of the Selection Panel displays all the devices arranged in the order - the Wireless interface, FDAPs, and field devices. You can configure multiple locations for organizing the devices. The following illustrations depict the default view of the Selection Panel.

Figure 5-3: Selection Panel



The following table describes the different elements/icons available in the Selection Panel.

Table 5-3: Selection Panel Elements

Element	Function
	Click to expand the Selection Panel.
	Click to collapse the Selection Panel.
	Click to view the extended Selection Panel. It provides information about the properties of the devices such as device type, status, vendor, model, serial

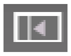
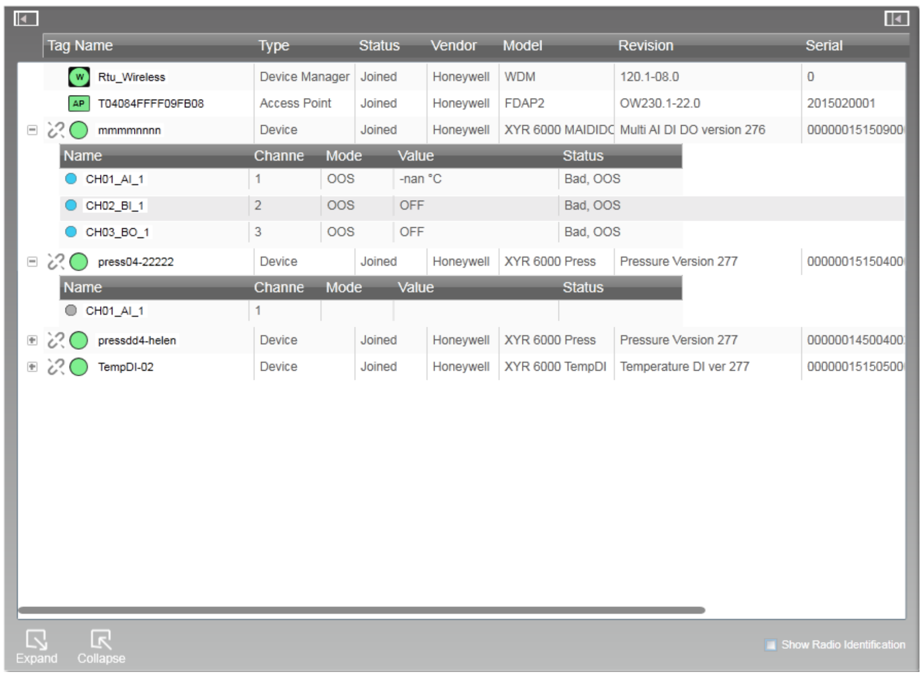
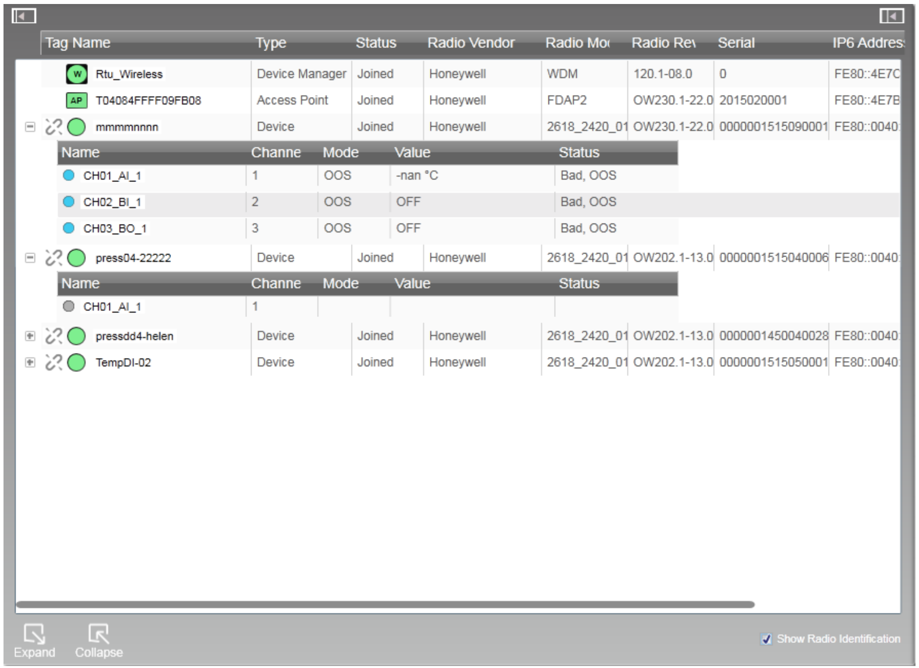
Element	Function
	number, and so on.
	Click to collapse the extended Selection Panel.
	Click to collapse the devices in the Selection Panel.
	Click to expand the devices in the Selection Panel.

Figure 5-4: Extended Selection Panel



The **Show Radio Identification** check box allows you to view the radio related details about the field devices. The following illustration depicts the extended Selection Panel with **Show Radio Identification** check box selected.

Figure 5-5: Extended Selection Panel with radio details of the devices

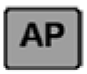
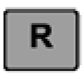
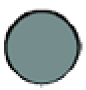
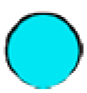
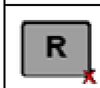
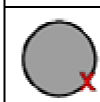


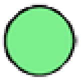
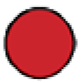
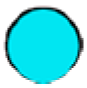
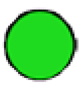
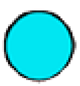
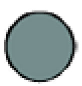
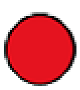
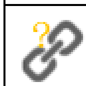
Understanding the device icons

The Selection Panel and the Property Panel display various device icons for representing the network components. The following table summarizes the appearance of the device icons and their corresponding description and state.

Table 5-4: Status Bar Panes

If the device is...	Then it represents...
AP	FDAP
R	FDAP router
AP	Offline FDAP

If the device is...	Then it represents...
	Offline FDAP router
Over-the-air provisioning icons	
	FDAP with over-the-air provisioning (OTAP) enabled
	FDAP router with OTAP enabled
	FDAP in un-provisioned state
	FDAP router in un-provisioned state
	Field device in un-provisioned state
	FDAP in joining or provisioning state
	FDAP router in joining or provisioning state
	Field device in joining or provisioning state
	FDAP in rejected state
	FDAP router in rejected state
	Field device in rejected state
Field device icons	

If the device is...	Then it represents...
	Routing field device (field device with routing capability)
	Field device that has joined the network
	Field device in offline state
	Field device in joining or provisioning state
Channel icons	
	Channel in Auto or MAN mode
	Channel in inactive or Out of Service (OOS) mode
	Channel becomes grey when the data is being fetched from the device. For a digital output channel, grey indicates the MAN mode, where you can manually set the output value.
	Offline channel
	This device is bound to one wireless I/O device successfully.
	This device is bound to one wireless I/O device, but the connection is defective.
	This device is not bound to one wireless I/O device.

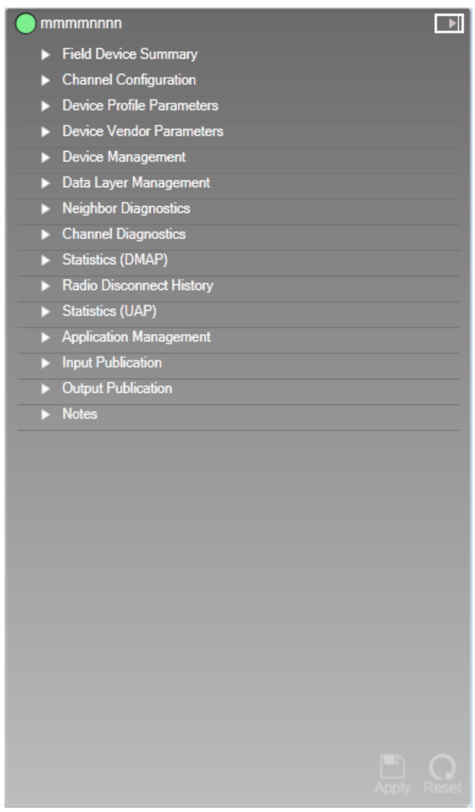
Property Panel

The Property Panel in the Wireless user interface provides configuration properties of all the devices configured in the Wireless Network. The Property Panel is docked to the right of the user interface window and is horizontally expandable and collapsible.

The Property Panel allows you to perform configuration tasks pertaining to FDAPs, and field devices and their channels. It also allows monitoring the configuration attributes of the devices such as Process Value (PV), communication links, signal quality, and so on.

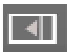
Selecting the required device in the Selection Panel, automatically displays all the configuration parameters of the devices that are accessible from the Property Panel. These configuration parameters are grouped into accordion panels that can be individually expanded or collapsed.

Figure 5-6: Property Panel



The following table describes the different elements/icons available in the Property Panel.

Table 5-5: Property Panel Elements

Element	Function
	Click to expand the Property Panel.
	Click to collapse the Property Panel.
	**Apply** icon. Click to save any configuration changes applied. This icon is enabled only if you have made any changes in the user interface.
	**Reset** icon. Click to reset any unsaved changes made to the devices through the Property Panel. This icon is enabled only if you have made any changes in the user interface.

Status Bar

The status bar that is located at the bottom of the user interface window displays messages that indicate the overall status of the network.

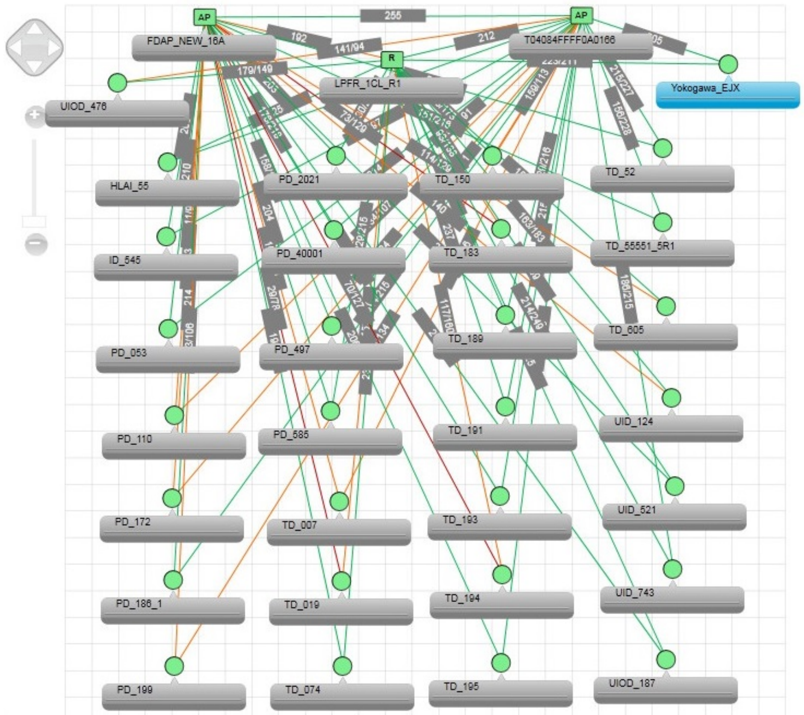
Table 5-6: Status Bar Panes

Element	Function
	Firmware upgrade status is displayed when you have initiated a firmware upgrade of any device. Since the status bar displays the progress, you can close the **Firmware Upgrade** dialog box to allow the operation to run in the background. Click this box to open the **Firmware Upgrade** dialog box.

About the map view

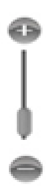
Use the map view to create a visual topology map of the network. The devices can be arranged in a map view according to the network topology. The map view allows you to edit the topology by dragging and dropping the devices from the device list in the Selection Panel. Arrange the devices on the map according to the setup and set the map visibility and overlays such as connection strength and publishing rate.

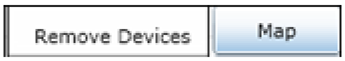
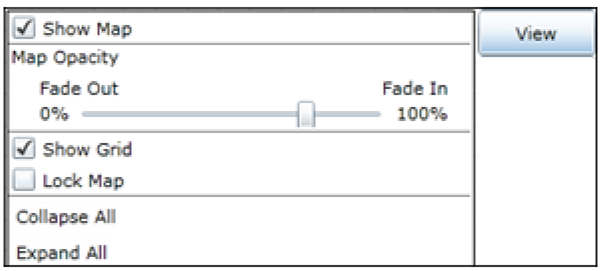
Figure 5-7: Map view

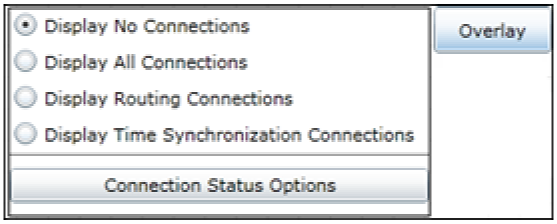


The following are the map navigation controls that are available in the map view.

Table 5-7: Map navigation controls

Map navigation control	Description
	Pan control is used to move the map in the up, down, left, and right directions. You can also pan the map by clicking and dragging on the map view.
	Zoom control is used to zoom in or zoom out the map view. You can also use the scroll button on the mouse, to zoom in or zoom out the map view.
	**Options**: On the top-right of Map view, click the Options list. The following are the options: • Map

Map navigation control	Description
	• View • Overlay
	Map: On the top-right of Map view, click **Options** > **Map** to view map option. • Remove Devices: Enables you to remove the selected devices from the current map.
	**View**: On the top-right of Map view, click **Options** > **View** to view the View options. The View option provides options for controlling the map displayed. The following are the View options: • **Show Map**: Select the **Show Map** check box to display the map image. • **Map Opacity**: Move the slider to adjust the opacity of the map. Move the slider left to increase the visibility (fade in) of the map and move the slider right to decrease the visibility (fade out) of the map. • **Show Grid**: Select the **Show Grid** check box to display grid overlay on the map. • **Lock Map**: Select the **Lock Map** check box to lock the map, locking of the map prevents moving of devices. • **Collapse All**: Click the **Collapse All** option to collapse all expanded devices on the map. • **Expand All**: Click the **Expand All** option to expand all collapsed devices on the map.

<table>
<tr><th>Map navigation control</th><th>Description</th></tr>
<tr><td>
</td><td>

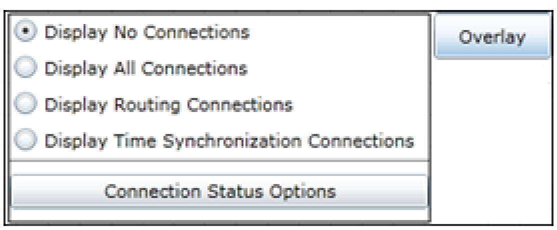
Overlay: On the top-right of Map view, click **Options** > **Overlay** to view the Overlay options.

The Overlay options provides options for controlling connections displayed.

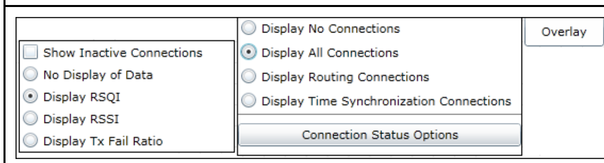
The following are the Overlay options:

- **Display No Connections**
- **Display All Connections**
- **Display Routing Connections**
- **Display Time Synchronization Connections**
- **Connection Status Options**

ATTENTION: Depending on the Overlay option selected, the other options available are displayed

</td></tr>
<tr><td>
</td><td>

Click the **Display No Connections** option for not displaying any connections on the map.

</td></tr>
<tr><td>
</td><td>

Click the **Display All Connections** option for displaying all connection details on the maps. The following are the options:

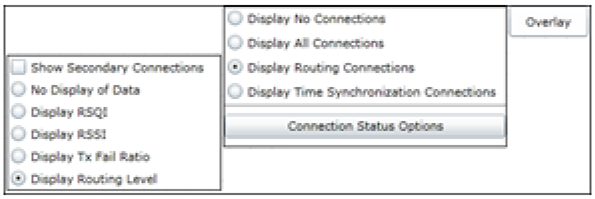
- **Show Inactive Connections**: Select the **Show Inactive Connections** check box to display inactive connections.
- **No Display of Data**: Click **No Display of Data** for not displaying the data.
- **Display RSQI**: Click **Display RSQI** to display RSQI.

</td></tr>
</table>

<table>
<tr><th>Map navigation control</th><th>Description</th></tr>
<tr><td></td><td>

- **Display RSSI**: Click **Display RSSI** to display RSSI.
- **Display Tx Fail Ratio**: Click **Display Tx Fail Ratio** to display Tx Fail Ratio.

</td></tr>
<tr><td>

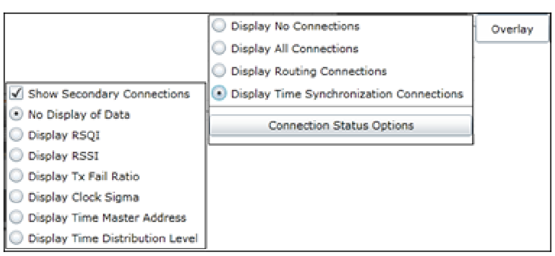


</td><td>

Click the **Display Routing Connections** option for displaying all routing connection details on the maps. The following are the options:

- **Show Secondary Connections**: Select the **Show Secondary Connections** check box to display secondary connections
- **No Display of Data**: Click **No Display of Data** for not displaying the data.
- **Display RSQI**: Click **Display RSQI** to display RSQI.
- **Display RSSI**: Click **Display RSSI** to display RSSI.
- **Display Tx Fail Ratio**: Click **Display Tx Fail Ratio** to display Tx Fail Ratio.
- **Display Routing Level**: Click **Display Routing Level** to display routing level.

</td></tr>
<tr><td>



</td><td>

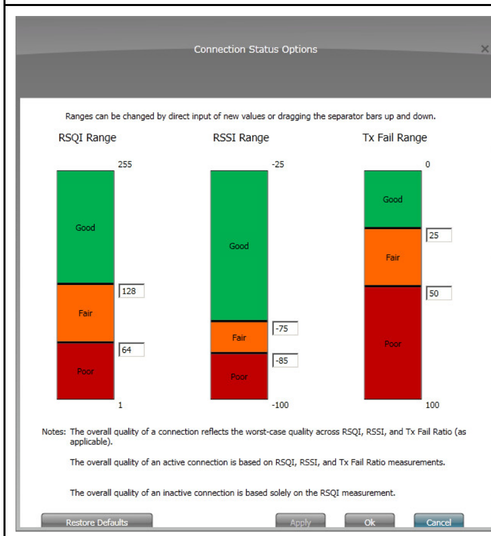
Click the **Display Time Synchronization Connections** option for displaying all clock connection details on the maps. The following are the options:

- **Show Secondary Connections**: Select the Show Secondary Connections check box to display secondary connections.
- **No Display of Data**: Click No Display of Data for not displaying the data.
- **Display RSQI: Click Display RSQI to display RSQI**.

</td></tr>
</table>

<table>
<tr><th>Map navigation control</th><th>Description</th></tr>
<tr><td></td><td>

Display RSSI: Click Display RSSI to display RSSI.
Display Tx Fail Ratio: Click Display Tx Fail Ratio to display Tx Fail Ratio.
Display Clock Sigma: Click Display Clock Sigma to display clock sigma. Clock sigma represents the standard deviation of clock corrections with respect to a node and a neighbor in units of micro seconds.
Display Time Master Address: Click Display Time Master Address to display time master address. The Time Master Address is the network address of the time master access point.
Display Time Distribution Level: Click Display Time Distribution Level to display time distribution level. The Time Distribution Level is the distance to the time master.

</td></tr>
<tr><td>
</td><td>Connection Status Options enables you to define the quality thresholds for link quality. On the top right of Map view, click Options > Overlay > Connection Status Options.</td></tr>
</table>

The device icons in the map view contain the following indicators using which you can analyze the battery level, the publishing rate, and the bandwidth usage of devices.

Table 5-8: Map view indicators

Device performance indicators	Description
	Displays the battery level as low, medium, high, or unknown.
	Displays the publishing rate at which the PV data is published.
	Displays the bandwidth usage of the devices. This attribute is used to determine the communication resource usage of field devices. It is computed based on the percentage of active neighbors and the percentage of links allocated. When the bandwidth usage becomes 100%, the device will no longer be able to handle additional communication requests.

Position the devices on the map

You can position the devices on the map to reflect the physical design and structure. The devices do not appear on the map view, by default.

The devices should be configured and commissioned.

To position the devices on the map

1. On the Selection Panel, select the device to be positioned on the map.
2. Drag the device and drop it on the required location on the map.
3. Repeat steps 1 and 2 to place the other devices.
4. On the top-right of Map view, click **Options** > **View.**
5. Select **Lock Map** check box to the lock the map.

   You must lock the map to prevent device locations from being accidentally modified.

Remove the device from the map

1. Click the **Monitoring** tab to view the map view.
2. From the **Selection Panel** or map view, select the device.

3. On the top-right of Map view, click **Options** > **Maps** > **Remove Devices**.

   The **Remove Devices From Map** dialog box appears.

4. Click **Remove** to remove the selected devices from the current map.

Enabling over-the-air provisioning

FDAPs and field devices in the Wireless Network can be provisioned using over-the-air provisioning method. The controller provisions the FDAPs and the FDAPs that are enabled to function as provisioning devices can provision the field devices. Provisioning role can be enabled in Honeywell FDAPs when acting as a back bone router. To enable over-the-air provisioning, you must enable this feature in ControlEdge Builder.

To enable over-the-air provisioning for the controller

1. In the **Commission Wireless I/O** page, select the target controller displayed, the corresponding Property Panel appears. Click **System Manager** to expand it.
2. Under **ISA100 Network Provisioning**, in the **Over the Air Provisioning** drop-down list, select **Enabled**. The controller is enabled for over-the-air provisioning support.
3. Click **Apply**. The un-provisioned FDAPs start appearing in the Selection Panel. You can filter the device list to view only the un-provisioned FDAPs in the network.

To enable over-the-air provisioning for FDAPs

1. In the **Commission Wireless I/O** page, select the target FDAP displayed, the corresponding Property Panel appears. Click **Device Management** to expand it.
2. Under **Over the Air Provisioning**, click **Enable for 60 Minutes**.

   The FDAP functions as a provisioning device for 60 minutes. The un-provisioned field devices and the FDAPs that are in the factory default state start appearing in the Selection Panel. Note that if you do not accept or reject the devices within 60 minutes, the devices automatically disappear from the user interface.

3. In the pop-up prompting dialog, click **OK** to enable provision for the FDAP.

Provisioning the devices using over-the-air provisioning method

Any field device that is in the factory default state, when connected to the Wireless Network can join the network as an un-provisioned device. Also, there is no active data communication between the controller and the device in the un-provisioned state. You can accept or reject an un-provisioned device using ControlEdge Builder. If accepted, the controller sends the provisioning data to the device and the device transitions to provisioning state. A device with the new security data sends join request to the controller.

- Wireless I/O devices have been configured in ControlEdge Builder.
- ControlEdge Builder project containing wireless I/O devices' configuration has been downloaded to the controller.

To provision FDAPs

1. From the **Commission Wireless I/O** page, select the corresponding un-provisioned wireless device.
2. Click **Accept**. When the Status changes from **Un-Provisioned** to **Joined**, the wireless device is joined to FDAP successfully.

To provision Field Devices

1. From the **Commission Wireless I/O** page, select the corresponding un-provisioned field devices.
2. Click **Apply**. When the Status changes from **Un-Provisioned** to **Joined**, the field device is provisioned successfully.

Rejecting FDAPs and field devices

Reject function is only used for un-provisioned wireless devices.

1. From the **Commission Wireless I/O** page, select the corresponding un-provisioned wireless device.
2. Click **Reject**. When the Status changes from **Un-Provisioned** to **Rejected**, the wireless device is rejected successfully.

Deleting FDAPs and field devices

A provisioned device can be removed from the network. Removing a device from the network clears the provisioning data and restores the device to factory default state. The wireless device cannot be scanned and displayed if you remove it in ControlEdge Builder.

A rejected un-provisioned device from the user interface can be removed too in case you have mistakenly rejected a device earlier. Removing a rejected device enables the device to rejoin as an un-provisioned device. You can then accept the un-provisioned device to join the network.

To delete a device

1. From the **Commission Wireless I/O** page, select the corresponding uprovisioned or rejected devices.
2. Click **Delete**. Devices will be removed from the device list.

   The provisioning capability of FDAP will be disabled automatically during the deleting progress. Click **Enable for 60 minutes** from the **Device Management** tab on the **Property Panel** to enable the provisioning capability again, and the un-provisioned devices would be scanned and displayed again.

Configuring field devices

Configuring routing assignment

After joining the network for the first time, a field device capable of operating as a router and an I/O device initializes its routing assignment based on the current default routing policy. It is possible to override the default routing policy by configuring routing assignment for field devices. Configuring device routing assignment results in restarting the device with a new role.

> **ATTENTION:** Device routing assignment can be configured only for devices that are capable of operating as routers and I/O devices.

To configure routing assignment

1. On the Selection Panel, select the field device.
2. On the Property Panel, expand **Device Management**.
3. Select **Routing Assignment**, as appropriate.

   The following are the **Routing Assignment** options available.

   - **Routing Disabled** — Disables the ability of a routing field device to function as a router. The field device can function only as an I/O device.
   - **Routing Enabled** — Enables the routing field device to function

as a router and an I/O device. The default join policy configured is **Follow System Manager Policy**.

- **Not Applicable**
  - Does not apply to devices that are capable of operating as access points.
  - Does not apply to devices that are only capable of operating as routers.

4. Select one of the following **Join Assignment** options, as required.
   - The **Join Assignment** overrides the system manager join policy. This is applicable only for routing field devices.
     - **Join Disabled** — Disables device-join through this device.
     - **Join Enabled** — Enables device-join through this device.
     - **Follow System Manager Policy** — Enables the device to follow the system manager join policy. Device-join through this device depends on the configured system manager join policy.
   - The **Join Status** is a read-only parameter that indicates the resultant join state for all the devices.
     - Access Points, FDAP access points, and FDAP routers have the **Join Assignment** permanently set to **Join Enabled**.
     - Non-routing field devices have the **Join Assignment** permanently set to **Join Disabled**.
     - Routing field devices have the default **Join Assignment** set to **Follow System Manager Policy**.
5. Click **Apply**.

Configuring publication rate

The publication data for input and output field devices can be configured using the Input Publication and Output Publication panels in the Property Panel. Depending on the device type, a field device can have an Input Publication panel, or an Output Publication panel, or both. This is determined by the DD file for the field device.

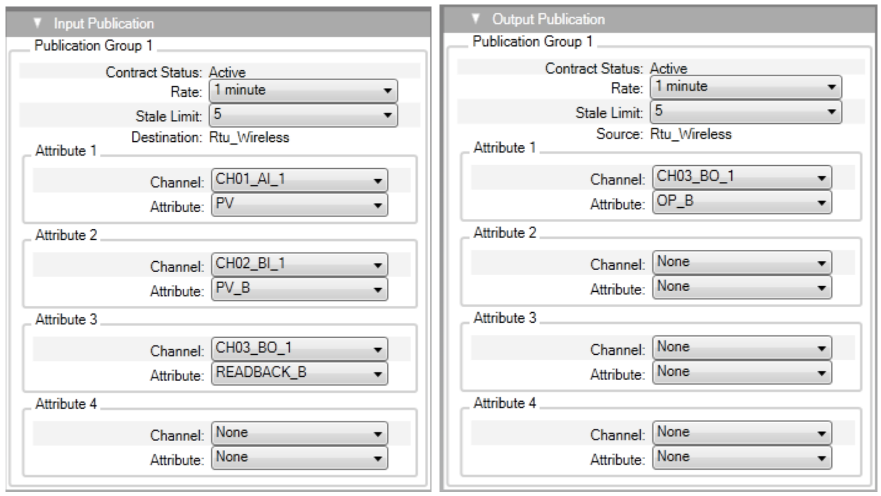
The Input/Output Publication panel contains the following configuration options.

- **Contract Status** — A contract is a communication resource (bandwidth) allocation between two devices on the ISA100 network. The following are the status values that are displayed depending on the status of the contract.
  - **Not Configured** — No contract established due to incorrect configuration of the device.
  - **Activating** — Contract establishment is in progress.
  - **Active** — Contract is active.
  - **Active**, **Negotiated Down** — If a device requests a contract for periodic publications at a fast rate (such as 1 second) and if the communication resources are not available, the contract is negotiated down to a slower publication period (such as 5 seconds).
  - **Terminating** — Contract termination is in progress.
  - **Failed** — Contract establishment is failed.
  - **Inactive** — Contract is inactive.
- **Rate** — Rate at which a source node (field device or gateway) publishes.
- **Stale Limit** — Defines the maximum number of stale input values that can be received before the input status is set to Bad. It is recommended that for 1 second publication period, the stale limit should be set to 15 seconds. For all other publication periods (5 seconds, 10 seconds, 30 seconds, and 1 minute), the stale limit should be set to 5.
- **Destination** — Destination is the target device where publications should reach.
- **Channel** — The list of channels for which the publication configuration applies.
- **Attribute** — Attribute is a parameter of a channel. It can be a process value, a measurement, a configuration or a statistic of the channel. For example MODE, PV, SCALE, and so on.

> **ATTENTION:** When a device joins the network, the controller automatically configures its publication period as 30 seconds.

To configure publication rate and stale limit

1. On the Selection Panel, select the field device.
2. On the Property Panel, expand **Input Publication** or **Output Publication**.



3. In the **Rate** field, select the publication rate, as appropriate.
4. In the **Stale Limit** field, select the stale limit, as appropriate.
5. Select the **Channel** and then the preferred **Attribute**.
6. Click **Apply**.

Calibrating field devices

Calibration can be initiated either by manually setting the calibration parameters such as Cal Cmd, Cal Point High, Cal Point Low, and Cal Unit in the **Calibration** panel or by using the **Invoke Method** button. Invoke Method initiates the method manager, which guides you through the calibration process. All the field devices might not necessarily have the ability to calibrate. This is defined in the vendor supplied DD file.

To calibrate field device using Invoke Method

1. On the Selection Panel, select the field device channel.
2. Click **Inactivate** in the Channel group from the Ribbon bar. Ensure the channel has been inactivated before starting calibration. You cannot perform calibration when the channel is online.
3. Click **Inactivate** in the pop-up **Inactivate Channels** dialog box.

4. In the Property Panel, expand **Calibration**.
5. Click **Invoke Method**, the method dialog box appears.
6. Click **Next** and follow the instructions on-screen to complete calibration. Click **Abort** to cancel the calibration process at any stage of method execution. Once completed, a message appears indicating that the calibration process completed successfully.
7. Click **Activate** in the Channel group from the Ribbon Bar.
8. Click **Activate** in the pop-up **Activate Channels** dialog box.

To calibrate field device by setting the calibration parameters

1. On the Selection Panel, select the field device channel.
2. Click **Inactivate** in the Channel group from the Ribbon bar. Ensure the channel has been inactivated before starting calibration. You cannot perform calibration when the channel is online.
3. Click **Inactivate** in the pop-up **Inactivate Channels** dialog box.
4. In the Property Panel, expand **Calibration**.
5. Set the following calibration parameters:
   - **Cal Cmd** – The options available are **None**, **Cal Lower** (to calibrate device with lower calibration limit), **Cal Upper** (to calibrate device with higher calibration limit), **Cal Restore** (to restore calibration setting), and **Cal Clear** (to clear calibration setting).
   - **Cal Point High**
   - **Cal Point Low**
   - **Cal Unit**
6. Click **Apply**.
7. Click **Activate** in the Channel group from the Ribbon Bar.
8. Click **Activate** in the pop-up **Activate Channels** dialog box.

Binding and unbinding field devices to wireless I/O devices

For process data acquired from field devices to be used in POUs, first a provisioned field device must be bound to the related wireless I/O device.

> **ATTENTION:** The field device **Tag Name** and **Channel Name** will be changed to that of the bound wireless I/O device. If you want to maintain the field device **Tag Name** and **Channel Name** , first update the wireless I/O device to the same. When a field device is unbound, its **Tag Name** will be changed to the 64-bit IEEE MAC address.

- Make sure all the channels of the filed device are inactive. See Configuring channel instantiation for more information.
- Make sure the channel types of the wireless I/O device and the field device are the same.

  For check the channel type of a wireless I/O device, see Configuring channels for more information.

  For check the channel type of a field device, see Configuring channel instantiation for more information.
- Download wireless I/O device configuration before binding or unbinding.

To bind field devices to wireless I/O devices

1. From the Home Page, select **Configure Wireless I/O** > **Commission Wireless I/O.**.

   The commission wireless I/O page appears.
2. Click **Bind** on the Ribbon Bar.

   All configured field devices in the network are displayed in the **Bind Wireless I/O Devices to Field Devices** window.
3. Click **Bind** at the end of the row of the target field device.

   All available wireless I/O devices that can be bound to the target field device are displayed.
4. Select one of the available wireless I/O devices. Follow this method to complete the binding for other wireless I/O devices, and Click **OK**.

   The **Bind Wireless I/O Devices to Field Devices** window appears.
5. Click **Apply**.

   The **Progress** displays **in progress**. And when it displays **Completed**, the binding is successful.

> **TIP:** You must back up data after commissioning wireless. See Backing up and restoring the commissioning data for more information.

To unbind field devices

1. From the Home Page, select **Configure Wireless I/O** > **Commission Wireless I/O.**

   The commission wireless I/O page appears.

2. Click **Bind** on the Ribbon Bar.

   All configured field devices in the network are displayed in the **Bind Wireless I/O Devices to Field Devices** window.

3. Click **Unbind** at the end of the row of the target field device.

   The **Unbind** button becomes **Bind**.

4. Click **Apply**.

   The **Progress** displays **in progress**. And when it displays **Completed**, the unbinding is successful.

After the binding/unbinding process is complete, the binding/unbinding status is displayed accordingly in the **Selection Panel**.

Configuring field device channels

Configuring Mode and Scale

To configure Scale

1. On the Selection Panel, select the field device channel.

2. On the Property Panel, expand **Process Variable** to view the following read-only parameters in the OneWireless user interface.

   - **EU at 100%**: Specifies the high range PV value in Engineering Units.
   - **EU at 0%**: Specifies the low range PV value in Engineering Units.
   - **Units Index**: Specifies the unit of the measurement value. The value varies according to the sensor type selected for a channel.For example, in a temperature device, when the sensor type changes to a thermocouple (TC-J) or mV-50 range, the transducer block sets the Units Index to °C or mV.

3. Click **Apply**.

   After applying the changes, the newly configured values appear under the **Scale** panel.

To configure Mode

1. On the Property Panel, expand **Mode**.
2. In the **Target** list, select the mode as required.

   The mode types available are **Normal**, **OOS**, and **Auto**. If the device type is Digital Output (DO), an additional mode **Man** is also available in the **Target** list.
3. Click **Apply**.

Configuring channel instantiation

OneWireless Network supports block instantiation for field device channels. You can add, remove, and reconfigure channels on supported field devices. An individual channel can be configured for one of the several roles, such as an analog temperature input, an analog current input, or a discrete input.

You can instantiate channels, only for supported field devices from Honeywell.

- XYR 6000 Multi AI DI
- XYR 6000 Multi AI DI DO
- XYR 6000 Temp DI

You can add, remove, and reconfigure channels on a supported field device using the user interface.

To inactivate the channel

1. On the Selection Panel, select the field device channel.
2. Do one of the following:
   - On the Ribbon Bar, in the **Channel** group, click **Inactivate**.
   - On the Property Panel, expand **Mode** and then in the **Target** list, click **OOS**.
3. Click **Apply**.

   The channel icon appears as blue indicating the inactive mode.

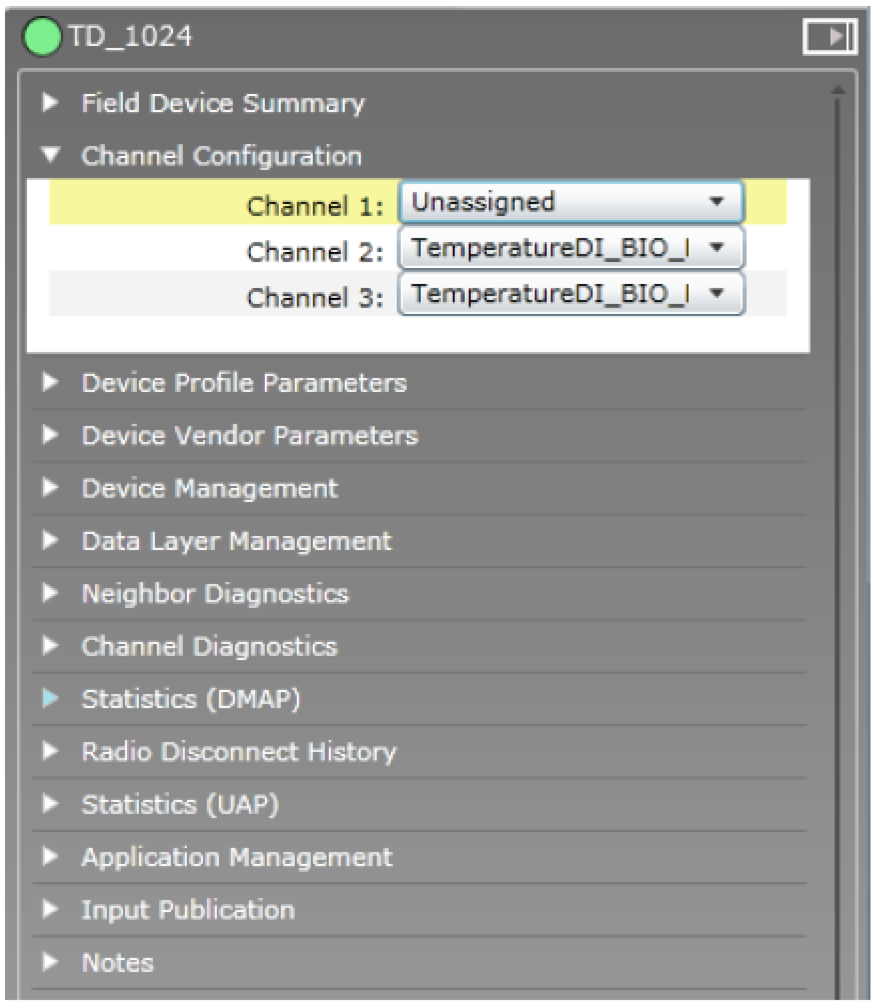
To remove channel from publication group

1. On the Selection Panel, select the field device.
2. On the Property Panel, expand **Input Publication**.
3. For the channel to be removed from the publication group, click **None** in the **Channel** drop-down list.
4. Click **Apply**.

   Wait for a few seconds to save the changes.

To delete (uninstantiate) channel

1. Expand **Channel Configuration** and click **Unassigned** in the drop-down list for the channel to be deleted.



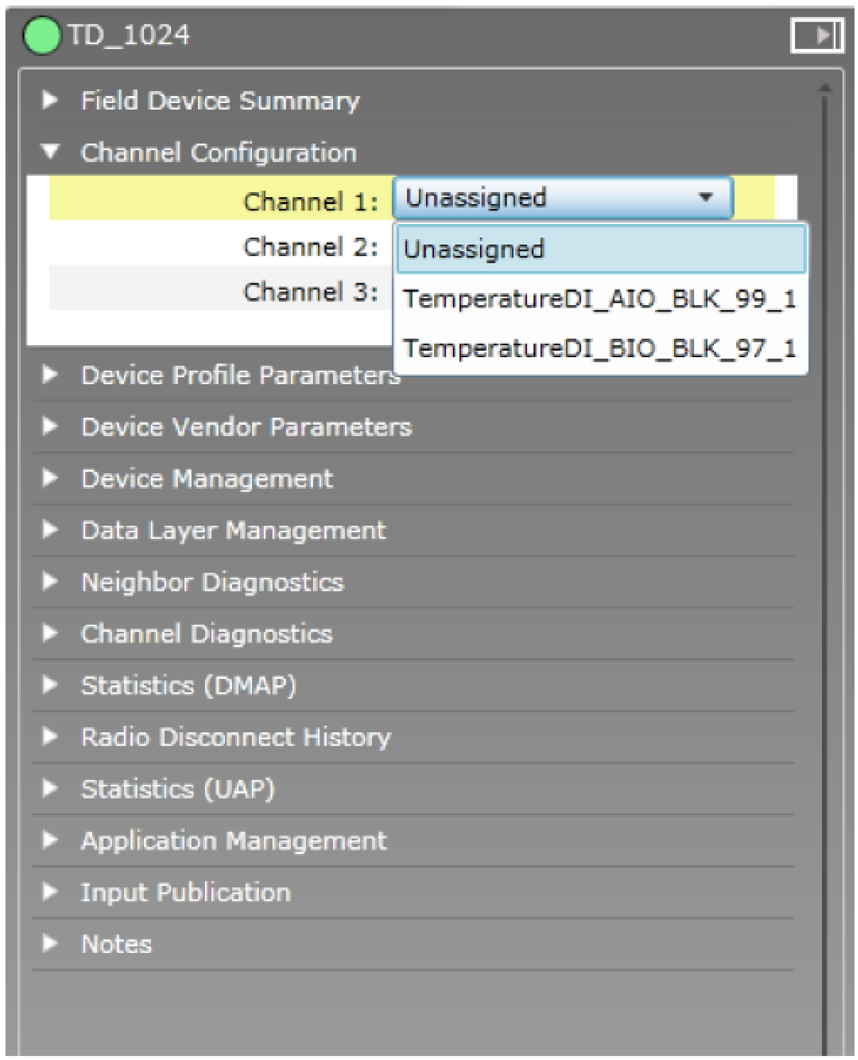
2. Click **Apply**.

   The channel disappears from the map view and the Selection Panel.

To instantiate channel

1. Expand **Channel Configuration** and click the respective instantiable object type for the channel to be instantiated.

   In the following example illustration, the temperature DI field device has three instantiable channels. Each channel can be instantiated as an analog input channel or a binary input channel.



2. Click **Apply**.

To add channel to publication group

1. On the Property Panel, expand **Input Publication** panel.
2. In the **Channel** drop-down list, click the channel for which data

publication needs to be enabled.

3. Click **Apply**.

To activate the channel

1. On the Selection Panel, select the field device channel.
2. Do one of the following:
   - On the Ribbon Bar, in the **Channel** group, click **Activate**.
   - On the Property Panel, expand **Mode** and then in the **Target** list, click **Auto**.
3. Click **Apply**.
   The channel icon appears as green indicating active mode.

Activating channels

Activating channels of the selected field device changes the field device channel state from OOS to the currently configured Normal mode.

1. On the Selection Panel, select the field device channel or multiple channels. Click and hold SHIFT key on the keyboard and select multiple items in a successive list. Click and hold CTRL key on the keyboard and select multiple items not in succession.
2. Click **Activate** in the Channel group from the Ribbon bar, the **Activate Channels** dialog box appears.
3. Click **Activate**. The channel icon appears as green indicating active mode.
4. Close the **Activate Channels** dialog box.

Removing channels from publication groups

To remove channels from publication groups

1. On the Selection Panel, select the field device channel.
2. On the Property Panel, expand **Input Publication**.
3. For the channel to be deleted from the publication group, click **None** in the **Channel** drop-down list.
4. Click **Apply**.

Deleting (uninstantiate) channels

- Ensure that the channel is set to OOS mode.
- Ensure that the channel is not configured for publication in any of the Input/Output Publication groups. If configured, remove the channel from the Publication group.

To delete channels

1. On the Selection Panel, select the field device channel.
2. On the Property Panel, expand **Channel Configuration**.

   The **Channel Configuration** panel displays a list of instantiated channels.
3. Select the channel to delete and select **Unassigned** in the corresponding drop-down list.
4. Click **Apply**.

Adding notes for devices

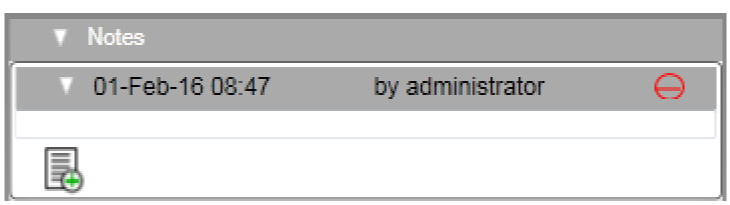
You can add device notes for the controllers, FDAPs, or field devices. These notes can be used as a logbook for the device.

Perform the following steps to add notes for any configured device. Note that the notes added for devices are saved on the controller and not on the device.

To add notes

1. On the Selection Panel, select the required device.
2. On the Property Panel, expand **Notes**.
3. Click **Add note** icon.

   A text box appears.



4. Type the note and click **Apply**.
   - All users can view all the notes added by other users.
   - To delete any note added, click delete icon adjacent to the note.

- Users with User role can delete only notes added by them.
- Users with Administrator role can delete other user's notes.

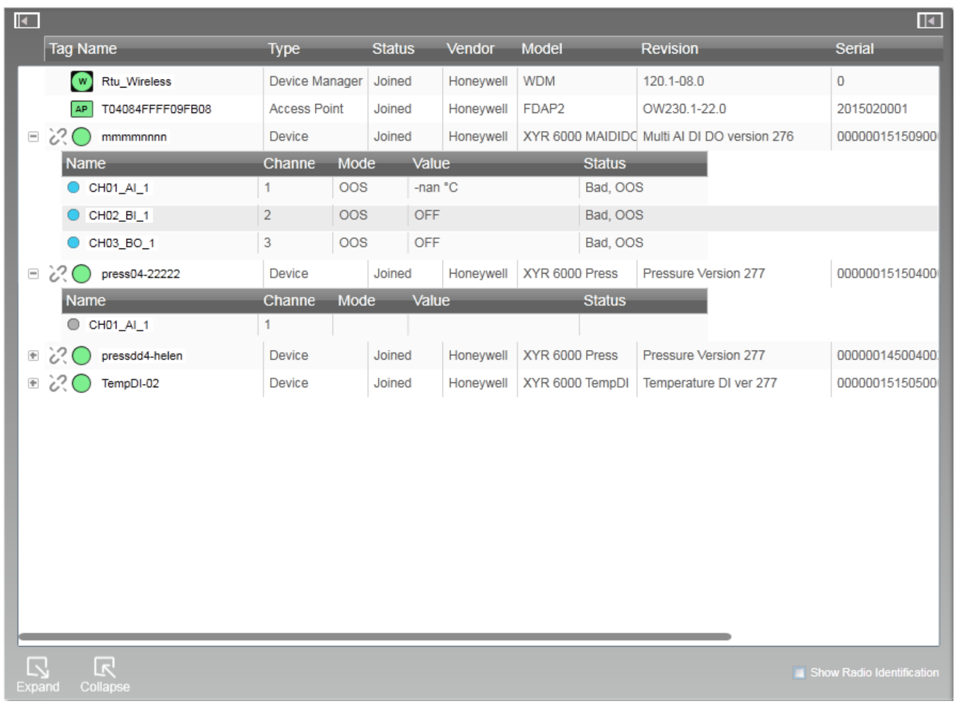
- Notes are not restored during a replace operation.

To edit a note already added, double-click on the note that you want to edit, make the necessary changes, and then click **Apply**.

Monitoring the devices

You can monitor the performance of the devices that have joined the network. All the devices that have joined the network are accessible from the Selection Panel. The extended Selection Panel allows you to view the details about the devices in the network.

Figure 5-8: Monitoring the network using extended Selection Panel



The following table explains the device and the channel attributes that are available in the extended Selection Panel.

Table 5-9: The Device and Channel Attributes

Device attribute	Description
Tag Name	Name of the device.
Type	Device type, which can contain the following values. • **Device Manager** for Wireless I/O Interface • **Routing** for FDAP routers • **Device**, **Routing** for field devices • **Device** for non-routing field devices
Status	Device status. The status can be **Offline**, **Joining** or **Joined**.
Vendor	Device vendor name.
Model	Device model.
Revision	Device sensor firmware revision number. To view the radio firmware revision, select the **Show Radio Identification** check box.
Serial	Serial number of the device.
IPv6 Address	IPv6 address of the device.
Power Source	Power source of the device, which can contain the following values. • **Line** for line powered FDAPs. • **High**, **Low** or **Medium** for battery powered field devices.
Name	Channel Name.
Channel	Channel number.
Mode	Device channel mode, which can contain the values **AUTO**, **OOS** or **MAN**.
Value	Process Value.
Status	PV status.

You can view the PV trend in the **Value and Trends** panel of the channel’s Property Panel.

Backing up and restoring the commissioning data

The **Backup Commissioning Data** option enables you to back up the provisioned FDAPs and field devices, field device binding information, network routing configuration, and etc.

The **Restore Commissioning Data** option enables you to restore the previously back up commissioning data to the controller replacement.

To back up the commissioning data

1. From the **Commissioning Wireless I/O** page, click **Backup Commissioning Data** on the Ribbon Bar. The **Export Wireless Device Configuration** dialog box appears.
2. Click **Save File**, browse to the target directory location, and enter the **File name**.
3. Click **Save**. The **Export Wireless Device Configuration** dialog box is displayed again indicating you that the backup is completed.
4. Click **Close**.

To restore the commissioning data

1. Open the project used to backup commissioning data and download it to the controller.
2. From the **Commissioning Wireless I/O** page, click **Restore Commissioning Data** on the Ribbon Bar. The **Import Wireless Device Configuration** dialog box appears.
3. Click **Load File**, browse to the directory location of the target backup file.
4. Click **Open**. The **Import Wireless Device Configuration** dialog box is displayed again indicating you that the restore action is completed.
5. Click **Close**.

Replacing FDAPs or field devices

You can replace a failed FDAP or a field device with a new device.

To replace an FDAP

1. Delete the failed FDAP. See Deleting FDAPs and field devices for more information.

2. Physically replace the failed FDAP with a new one. See FDAP user documentation from Honeywell support website for how to replace a failed device.
3. Provision the new FDAP to allow it to join the network. See Provisioning the devices using over-the-air provisioning method for more information.

To replace a field device

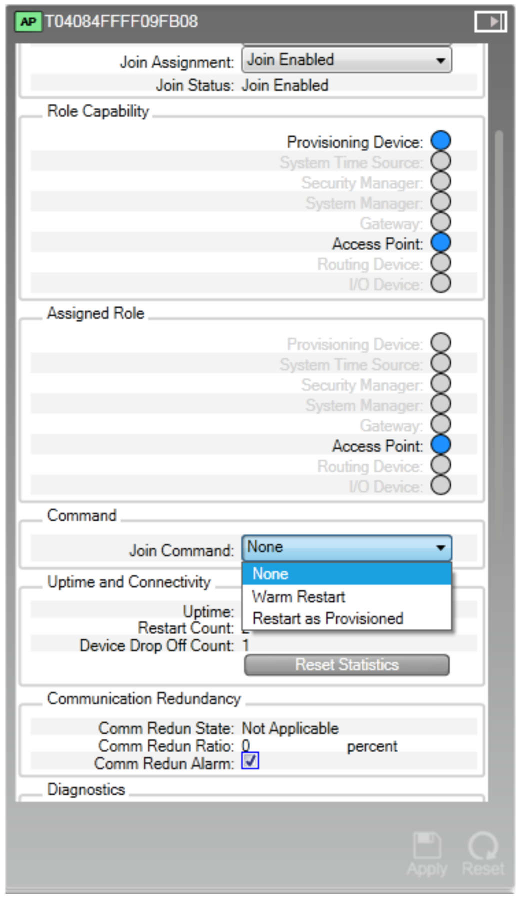
1. Delete the failed field device. See Deleting FDAPs and field devices for more information.
2. Physically replace the failed field device with a new one. See field device user documentation from vendor’s website for how to replace a failed device.
3. Provision the new field device to allow it to join the network. See Provisioning the devices using over-the-air provisioning method for more information.
4. Configure the new field device. See Configuring field devices for more information.

   Do not activate the device channels.
5. Bind the wireless I/O device which is bound to the failed field device to the new replaced one. See Binding and unbinding field devices to wireless I/O devices for more information.
6. Activate the device channels. See Activating channels for more information.

Restarting devices

To restart FDAP or field device

1. On the Selection Panel, select the device to be restarted.
2. On the Property Panel, expand **Device Management**.



3. In the **Join Command** list, select one of the following options:
   - **None**
   - **Warm Restart** – preserves static and constant attributes data.
   - **Restart as Provisioned** – corresponds to the provisioned state of the device in which the device only retains the data received during its provisioning.
4. Click **Apply**.

CHAPTER

6 ETHERNET/IP INTEGRATION

ControlEdge 900 controller supports an efficient EtherNet/IP™ (Ethernet industrial protocol) interface. The EtherNet/IP interface facilitates a comprehensive integration between ControlEdge 900 controllers and the EtherNet/IP compatible nodes and I/O devices.

ControlEdge Builder provides options to create new device types for the supported EtherNet/IP compatible devices. To enable easy integration between ControlEdge 900 Controller and third-party controllers, ControlEdge Builder also provides a function block for the communication between controllers.

EtherNet/IP terms and definitions

Term	Definition
Adapter	A communication device which connects to the EtherNet/IP network to serve data from a set of devices or modules underneath it. Adapter typically supports I/O connectivity from Scanners via implicit EtherNet/IP connections.
Assembly	A set of data passed between a Originator and a Target after an implicit I/O connection has been established on an EtherNet/IP network.
CIP	Common Industrial Protocol
EDS	Electronic Data Sheet. A text file which specifies all the properties of an EtherNet/IP device necessary for a Scanner module to communicate with it. EDS files my be used in the first step of creating an I/O module or device type for interfacing to an EtherNet/IP device.
Originator	Originator is the controller that initiate any data exchange with EtherNet/IP devices on the EtherNet/IP network.
RPI	Requested Packet Interval. The repetitive interval by which assemblies are periodically transported over EtherNet/IP I/O connections between Producer and Consumer.
Scanner	A device which connects to the EtherNet/IP network to act as a client of other EtherNet/IP connected devices. ControlEdge 900 Controller acts as EtherNet/IP Scanner. It connects to and

Term	Definition
	exchanges data with Adapters of Modular IO stations, directly connected devices and Rockwell AB ControLogix controllers.
Target	Target is the EtherNet/IP device that address any data requests generated by the controller.

Configuring EtherNet/IP Client

The ControlEdge 900 controller supports communication with EtherNet/IP compliant third-party devices, such as I/O modules, drives, and relays. To facilitate the integration of PLC with the EtherNet/IP compliant devices, you must add and configure equivalent devices by using ControlEdge Builder. Each configured device represents an equivalent physical EtherNet/IP compliant-device, which is installed on the EtherNet/IP network.

To enable communication between I/O modules and the EtherNet/IP network, an adapter is needed. The adapter provides the Assembly connection feature, which helps you in consolidating connections from a group of I/O modules.

You can create EtherNet/IP device, drive, and I/O module types by using Electronic Data Sheets (EDS) files. Or if you do not have the EDS file, you can create a generic EtherNet/IP device.

Binding EtherNet/IP Client to an Ethernet port

This section introduces how to bind EtherNet/IP Client protocol to ETH3.

ETH4 has the same configuration as ETH3, so only ETH3 should be configured manually.

Star or *DLR* topology is required if you bind EtherNet/IP Client.

To bind EtherNet/IP Client

1. From Home Page, click **Configure Ethernet Ports** and select **ETH3**.
2. Under **Network Setting**, configure the IP address and the subnet mask.
   - The default IP address is 172.168.0.101.
   - The range of the IP address is from 101 to 254.
   - The IP address cannot be in the same network subnet as ETH1

and ETH2.

- The IP address must be in the same network subnet as the EtherNet/IP device.
- The IP address cannot be conflict with the IP address of EtherNet/IP device.
- The IP address cannot be conflict with the EPM IP address.

3. Under **Protocol Binding**, select **EtherNet/IP Client**.
4. Under **I/O Network Topology**, Select **DLR Topology** or **Star Topology**.

   This configuration should match the position of 100X switch on the EPM hardware. 4 is for Star network topology and 5 is for DLR network topology. For more information about the switch, see “Assembling I/O racks” in the *ControlEdge 900 Controller Hardware Planning and Installation Guide*.

   If you select DLR Topology, you should configure the following 4 options.

   - **Role**: Specify the role for CPM as **Supervisor** or **Member**. The default value is **Supervisor**. A supervisor yields to another supervisor with a higher precedence, such that the highest precedence is always the Active Supervisor.
   - **Supervisor Precedence**: Set the precedence of a ring supervisor in the network with multiple ring supervisors. Numerically higher value indicates higher precedence. Node with highest Supervisor Precedence value becomes Active Supervisor. The configuration value ranges from 1 to 255. The default value is 250.
   - **Beacon Interval (usec)**: Set Beacon interval (in micro seconds) that supervisor transmits. The configuration value ranges from 400 to 10000. The default value is 400.
   - **Beacon Timeout (usec)**: Set the amount of time (in micro seconds) all nodes in ring network shall wait before timing out reception of Beacon frames and taking the appropriate action. Beacon timeout must be set to 2-3X Beacon Interval. The configuration value ranges from 800 to 50000. The default value is 1960.

> **NOTE:** You must reboot the controller if you change the I/O network topology from **Star Topology** to **DLR Topology** and vice versa.

5. Click **Save** to complete the Ethernet port configuration.
6. Click **Back** to return to the Home Page.

Registering device types

> **NOTE:** For Rockwell 1756&1794 series I/O modules, you do not need to import EDS files to generate device types. They are registered in ControlEdge Builder by default.

You can use EDS files to generate EtherNet/IP device types or I/O module types for communication with EtherNet/IP devices or I/O modules. See To generate a device type by importing an EDS file for more information in this section.

You can download EDS files from the third party vendor and register them into the Device Type list. The registered information will be stored under the location: C:\ProgramData\Honeywell\ControlEdge Builder\EDSFiles. The registered information cannot be saved along with project backups. You must back up them manually.

If you want to modify EDS files, you can access EZ EDS tool from ODVA official website: https://www.odva.org/software/EZ-EDS-Download. For how to modify EDS file, check the online help embedded in the EZ EDS tool.

You can also create a device type without an EDS file. See To create a device type without an EDS file for more information in this section.

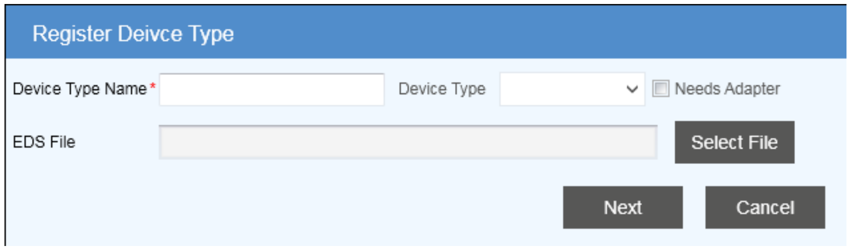
Prerequisites

- If you want to create the EtherNet/IP device types, or I/O module types by using the EDS, ensure that you have the appropriate EDS file.
- Ensure that you have all the required device-related specifications, which are available with the device, before you create the device, or I/O module type.

To register device types

1. From the Home Page, click **Configure EtherNet/IP Devices** > **Register Device Types**, and click **Register Device Type**. The following dialog

appears:



2. Enter a **Device Type Name**. The device type name cannot begin with numbers and cannot contain any spaces and special characters.
3. Select **Device Type** according to the type of the physical EtherNet/IP device.

   If a device supports both Input and Output channels, then select Output here. For example, a device has analog input and analog output, then select **Analog Output**.

   If a device supports neither Input nor Output channels, then select **Generic Device** here.
4. When you register a device type for an I/O module, indicate whether the I/O module requires an associated adapter or not. If the I/O module requires an adapter, select the **Needs Adapter** box.

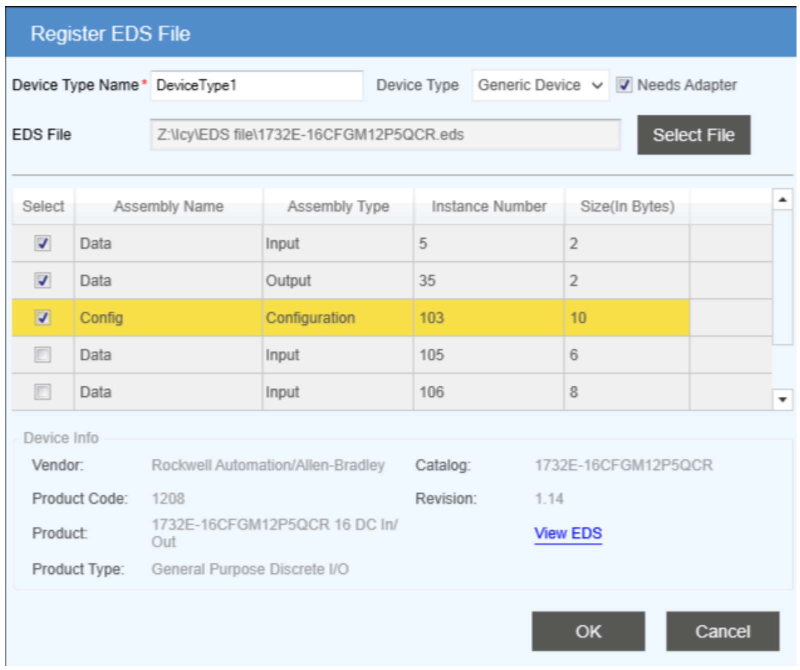
   > **NOTE:** In a scenario where multiple I/O modules share a single communication adapter to communicate with an EtherNet/IP protocol, the **Needs Adapter** must be selected. When you select **Needs Adapter**, the device type is only available on the **I/O Configuration** tab when you create or customize a generic EtherNet/IP Adapter.

   > **NOTE:** You cannot change this setting after compiling the project. You must remove the device type from both ControlEdge Configuration Workspace and IEC Programming Workspace, and re-add a device type.
5. You can import an EDS file to generate a device type or create one without EDS files:
   - **To generate a device type by importing an EDS file**
     a. Click **Select File**, browse to the location stored the target EDS file, select the EDS file and click **Open**.

b. You can view the basic information of the EDS file at the bottom panel. You can also click **View EDS** to open the EDS file to view more details.

> **NOTE:** The EDS file is read-only and not allowed to be modified here.

c. Select the boxes for the following Assembly types according to devices types:



- Input

  An assembly transfers data from an EtherNet/IP device as Producer device to a controller as Consumer.

- Output

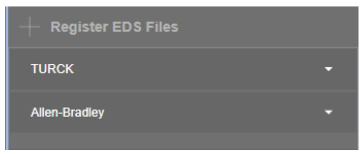
  An assembly transfers data from a controller as Producer device to an EtherNet/IP device as Consumer.

- Configuration

  An assembly which transports configuration data from the EtherNet/IP device originating the connection to the EtherNet/IP device or I/O module which is the target of the connection.

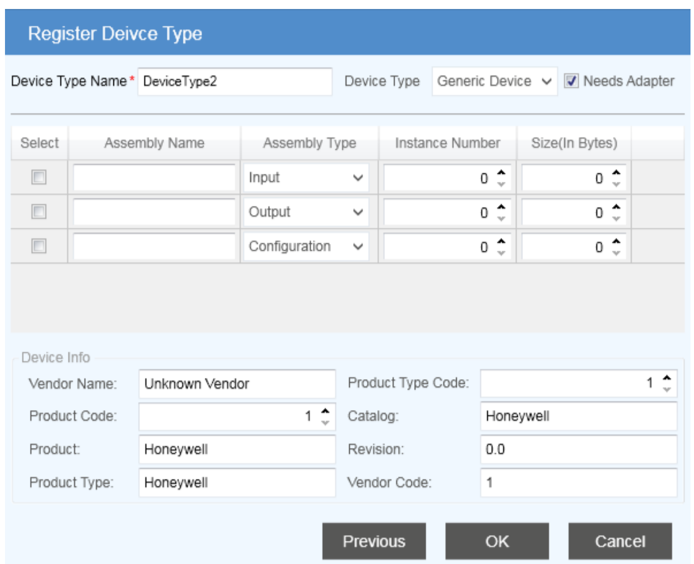
> **NOTE:** There might be more than one Input, Output and Configuration assembly types. However, ensure that you select one instance of Input, one instance of Output, and one instance of Configuration assembly type per your requirement.

d. Click **OK** to register the device type to ControlEdge Builder. Device types are created and grouped by different vendors automatically based on the "vendor" information in the EDS file.



- **To create a device type without an EDS file**

a. Click **Next**, and the following dialog appears:



b. Select the boxes for the following Assembly types according to devices types:

- Input

  An assembly transfers data from an EtherNet/IP device as Producer device to a controller as Consumer.

- Output

An assembly transfers data from a controller as Producer device to an EtherNet/IP device as Consumer.

- Configuration

  An assembly which transfers configuration data from the EtherNet/IP device originating the connection to the EtherNet/IP device or IO module which is the target of the connection.

> **NOTE:** You must select at least one instance of Input/Output/Configuration assembly per your requirement.

c. Enter **Assembly Name**, **Instance Number** and **Size (In Bytes)** for the selected Assembly.

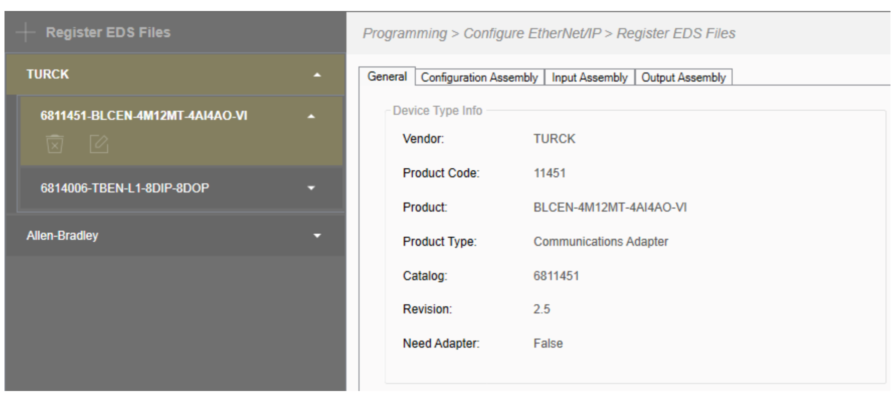
> **ATTENTION:** **Instance Number** must be greater than 0.

> **ATTENTION:** At least one **Size (In Bytes)** must be greater than 0.

d. Select **Vendor Name** from the drop-down list and other information is displayed automatically.

e. Click **OK** to register the device type to ControlEdge Builder.

6. Click the vendor name to expand the group, and select the target device type, you can view **General**, **Configuration Assembly**, **Input Assembly** and **Output Assembly** information.



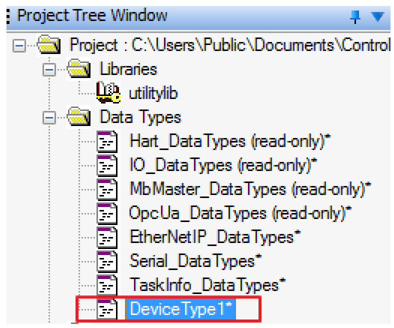
7. You can click the **Delete** icon to remove the device type.

8. You can click the **Edit Device Type** icon to modify the device type.

See Editing device types for more information.

9. Click **Save** to complete the configuration.

   After saving, the new device type will be populated in the **Data Type** library with an input and output channel in **IEC Programming Workspace**. You can use the created device type from the library to configure new devices.

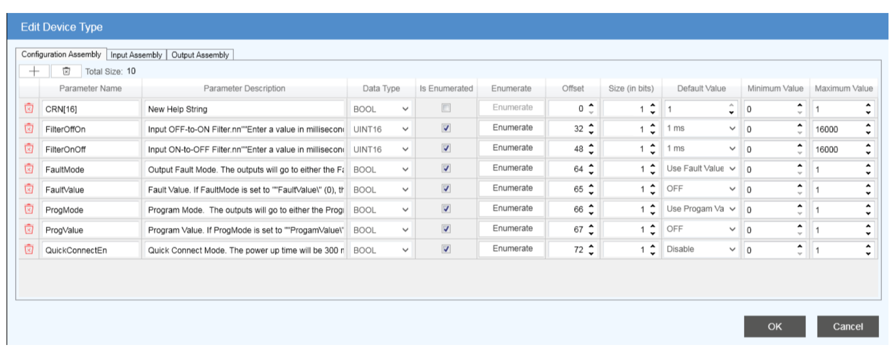


Editing device types

This feature enables you to edit device types using ControlEdge Builder.

To edit a device type

1. From the Home Page, click **Configure EtherNet/IP Devices** > **Register Device Types**.
2. Select the device type you want to modify and click the **Edit Device Type** icon. The **Edit Device Type** dialog appears.



3. In the **Configuration Assembly**, **Input Assembly** and **Output Assembly** tab, you can configure the following parameters per your requirements. For more information, see the vendor's document.

Parameter	Description
Enable Run/Idle Header	It is only applicable for **Input Assembly** and **Output Assembly**.
Parameter Name	Parameter name
Parameter Description	Parameter description
Data Type	Data type of the parameter. The following options are available: • BOOL • INT8 • BYTE • UINT8 • UINT16 • INT16 • UINT32 • INT32 • UINT64 • INT64 • FLOAT32 • REAL • LREAL • FLOAT64
Is Enumerated	Select to enable **Enumerate**
Enumerate	It is configurable if **Is Enumerated** is selected. Click **Enumerate** to configure values: 1. Enter **Value** and **String**, and click **Insert**. 2. Click **OK**.
Offset	The initial bit for the parameter

Parameter	Description
Size (in bits)	Parameter size
Default Value	Select the configuration of **Enumerate** If **Enumerate** is not configured, enter the value per your requirement.
Minimum Value	Minimum value of the parameter It depends on the data type.
Maximum Value	Maximum value of the parameter It depends on the data type.

4. (Optional) You can click [+] to add a new parameter.

> **NOTE:** Size (Bits) of existing parameters cannot exceed the Total Size (Bytes).

5. (Optional) You can click [delete all icon] to delete all parameters.
6. (Optional) You can click [delete icon] to delete a parameter.
7. Click **OK** to complete the configuration.

Configuring EtherNet/IP devices using EDS files

Prerequisites

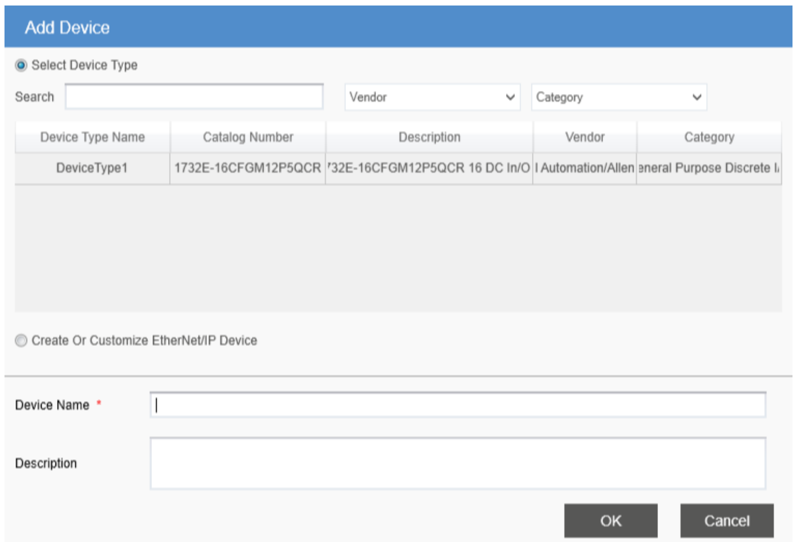
- Ensure you have registered the device type by using the EDS file of the EtherNet/IP device into ControlEdge Builder. See Registering device types for more information.
- The following information in the EDS file are critical for device type creation. Ensure that these details are available before using the EDS file.
  - Device and Vendor information
  - Parameter information
  - Assembly information
  - Connection information

- Bind EtherNet/IP Client to an Ethernet port. See Binding EtherNet/IP Client to an Ethernet port for more information.

To configure a device using an EDS file, without an adapter

1. From the Home Page, click **Configure EtherNet/IP Devices** > **Configure Devices**, and click **Add Device**.
2. Click **Select Device Type**, and all available device types are displayed.

   You can enter keywords to search device types, and also can filter them by selecting from the various filters for the **Vendor** and **Category** fields.



3. Select the target device type, and enter the **Device Name** and **Description**. The device name cannot begin with numbers and cannot contain any spaces and special characters.
4. Click **OK** to add the device.
5. In the **General** tab, configure the following parameters.

Parameter	Description
IP Address	The IP address of the EtherNet/IP device which is provided by the vendor.
Electronic Keying	It is used to control if accept the connection when the identity information of EDS file does not match the EtherNet/IP device.

Parameter	Description
	• Disable Keying: Allow the connection with EtherNet/IP device even the identity information of EDS file and the EtherNet/IP device do not match. • Exact Match: The identity information of EDS file must match the EtherNet/IP device, and then the connection will be allowed.
Connection Timeout Multiplier	Configure it according to Vendor's document. The following options are available: ***4**, ***8**, ***16**, ***32**, ***64**, ***128**, ***256**, ***512** and **Computed**.
Originator to Target RPI (ms)	Requested Packet Interval (RPI) specifies the rate at which data is updated during a connection. Set the rate for initiating the date exchange with the EtherNet/IP device.
Connection Type	The following options are available: • Null • Multicast • Point2Point It is recommended to use the default value.
Priority	The following options are available: • Low • High • Scheduled • Urgent

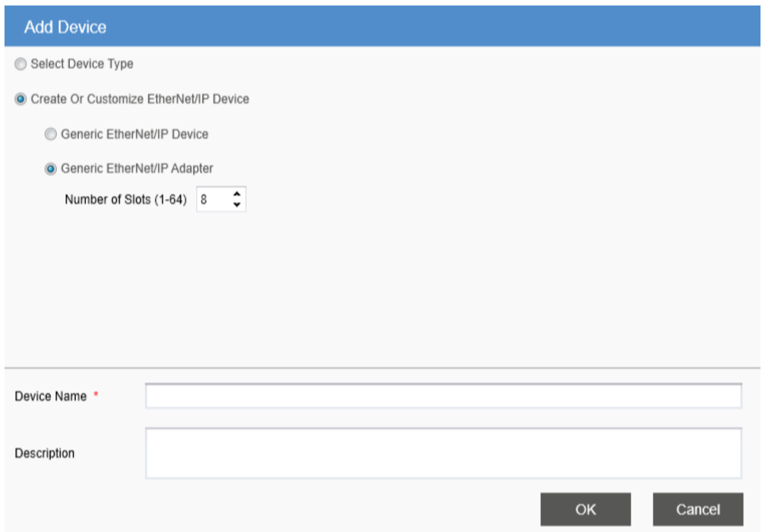
Parameter	Description
	It is recommended to use the default value.
Target to Originator RPI (ms)	Set the rate for reading data from the EtherNet/IP device.
Connection Type	The following options are available: • Null • Multicast • Point2Point **ATTENTION:** For output modules, select Multicast. **ATTENTION:** For other types of modules, use the default value.
Priority	The following options are available: • Low • High • Scheduled • Urgent It is recommended to use the default value.

6. Click **Configuration** tab to configure parameters which are defined by the corresponding EDS file. Configure them according to vendor's documents.
7. In the **Configuration** tab, you can also do the following options if required:
   - Click **Change Device Type** to re-select a device type.
   - Click **Clear Device Type** to remove the device type.
8. You can click to edit the device name and description. You can also click to remove the device if required.

9. Click **Save** to complete the configuration.

To configure a device using an EDS file, associated with an adapter

1. From the Home Page, click **Configure EtherNet/IP Devices** > **Configure Devices**, and click **Add Device**.
2. Select **Create or Customize EtherNet/IP Device**, and select **Generic EtherNet/IP Adapter**.



3. Enter the **Number of Slots** ranging from 1 to 64.

> **ATTENTION:** An attempt to communicate with the I/O module fails if the number of slots entered does not match the physical configuration. Therefore, ensure that the number of slots matches the number of the physically installed I/O modules and the adapter (number of slots = number of I/O modules + one for the adapter). For example, if the number of I/O modules is 7, the number of slots should be 8.

4. Enter the **Device Name** and **Description**. The device name cannot begin with numbers and cannot contain any spaces and special characters.
5. Click **OK** to add the device.
6. In the **General** tab, configure the following parameters.

Parameter	Description
IP Address	The IP address of the EtherNet/IP device.
Apply RPI settings on all associated I/O modules	Select the checkbox to apply the specified RPI to all I/O modules associated to the adapter. If you do not select this option, you should configure the RPI for every I/O modules separately in the **I/O Configuration** tab.
Originator to Target RPI (ms)	RPI specifies the rate at which data is updated during a connection. Set the rate for initiating the date exchange with the EtherNet/IP device. It is applicable for all the I/O modules associated to the adapter if the **Apply RPI settings on all associated I/O modules** option is selected.
Target to Originator RPI (ms)	Set the rate for reading data from the EtherNet/IP device. It is applicable for all the I/O modules associated to the adapter if the **Apply RPI settings on all associated I/O modules** option is selected.

7. In the **I/O Configuration** tab, perform the following steps to configure parameters.

   a. You can click + or − to add or remove I/O modules.

   b. Select the **Enable** box for an I/O module, configure the following parameters.

If you do not select the **Enable** box, you cannot download configurations to the controller.

Parameter	Description
I/O Module Name	Define a name for the I/O module. It cannot begin with numbers and cannot contain any spaces and special characters.
Connection Timeout Multiplier	Configure it according to Vendor's document. The following options are available: ***4**, ***8**, ***16**, ***32**, ***64**, ***128**, ***256**, ***512** and **Computed**. **ATTENTION:** For Rockwell 1756&1794 series I/O modules, the value of multiplying this parameter by RPI cannot exceed 1600. For example, if RPI is set as 50, Connection Timeout Multiplier cannot be set larger than 32.
Originator to Target RPI (ms)	Set the rate for initiating the date exchange with the EtherNet/IP device. It is un-configurable if the **Apply RPI settings on all associated I/O modules** option is selected in the **General** tab.
Connection Type	The following options are available: • Null • Multicast • Point2Point It is recommended to use the default value.
Priority	The following options are available: • Low • High • Scheduled

Parameter	Description
	• Urgent It is recommended to use the default value.
Target to Originator RPI (ms)	Set the rate for reading data from the EtherNet/IP device. It is un-configurable if the **Apply RPI settings on all associated I/O modules** option is selected in the **General** tab.
Connection Type	The following options are available: • Null • Multicast • Point2Point **ATTENTION:** For output modules, select Multicast. **ATTENTION:** For other types of modules, use the default value.
Priority	The following options are available: • Low • High • Scheduled • Urgent It is recommended to use the default value.

c. Click **Select Device Type** to choose a device type. The **Select Device Type** dialog appears.

   The available device types are displayed. You can enter keywords to search device types, and also can filter them by selecting from the various filters for the **Vendor** and **Category** fields.

d. Select the target device type, and click **Next** to configure more parameters which are defined in the corresponding EDS file.

Configure them according to vendor's documents.

For some Input and Output parameters of Rockwell 1756&1794 series I/O modules, see Input and Output parameter of Rockwell 1756 and 1794 series I/O modules for more information.

e. Click **OK** to add the device type.

f. You can select **Edit Device Type** to re-configure the device type. The **Edit Configuration Assembly** dialog appears.

- Click **Change Device Type** to re-select a device type.
- Click **Clear Device Type** to remove the device type.

g. If you complete all the configurations, the **Status** will change from to .

8. From the left panel, you can click to edit the device name and description. You can also click to remove the device if required.
9. Click **Save** to complete the configuration.

Configuring generic EtherNet/IP devices

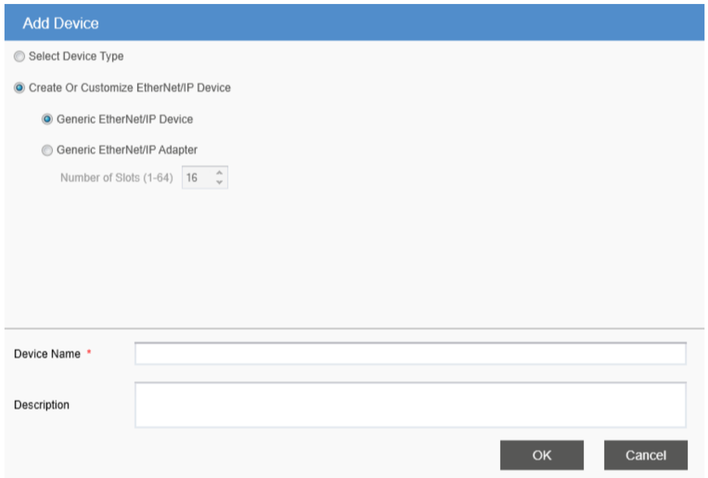
If you do not have the EDS file, you can create and configure a generic EtherNet/IP device.

Prerequisites

- Ensure that the following details are available before creating and configuring the device:
  - Device and Vendor information
  - Parameter information
  - Assembly information
  - Connection information
- Bind EtherNet/IP Client to an Ethernet port. See Binding EtherNet/IP Client to an Ethernet port for more information.

To configure a generic EtherNet/IP device

1. From the Home Page, click **Configure EtherNet/IP Devices** > **Configure Devices**, and click **Add Device**.
2. Select **Create or Customize EtherNet/IP Device**, and select **Generic EtherNet/IP Device**.



3. Enter the **Device Name** and **Description**. The device name cannot begin with numbers and cannot contain any spaces and special characters.

4. Click **OK** to add the device.

5. In the **General** tab, configure the following parameters.

Parameter	Description
IP Address	The IP address of the EtherNet/IP device
Connection Timeout Multiplier	Configure it according to Vendor's document. The following options are available: ***4**, ***8**, ***16**, ***32**, ***64**, ***128**, ***256**, ***512** and **Computed**.
Originator to Target RPI (ms)	Set the rate for initiating the date exchange with the EtherNet/IP device.
Connection Type	The following options are available: • Null • Multicast • Point2Point It is recommended to use

Parameter	Description
	the default value.
Priority	The following options are available: • Low • High • Scheduled • Urgent It is recommended to use the default value.
Target to Originator RPI (ms)	Set the rate for reading data from the EtherNet/IP device.
Connection Type	The following options are available: • Null • Multicast • Point2Point **ATTENTION:** For output modules, select Multicast. **ATTENTION:** For other types of modules, use the default value.
Priority	The following options are available: • Low • High • Scheduled

Parameter	Description
	• Urgent It is recommended to use the default value.

6. In the **Connection** tab, configure the following parameters.

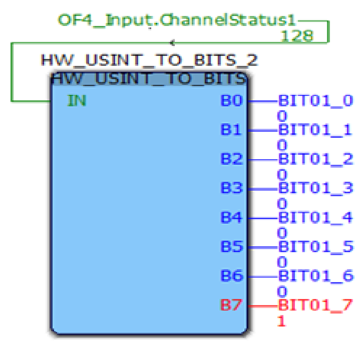
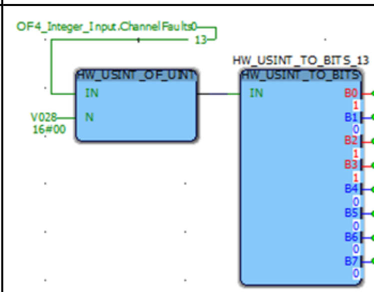
Parameter	Description
Communication Format	The data type of the update data reading from EtherNet/IP devices. There are four options: **DINT**, **INT**, **REAL**, and **SINT**
Input	**Input** assembly: An assembly transfers data from an EtherNet/IP device as Producer device to a controller as Consumer.
Output	**Output** assembly: An assembly transfers data from a controller as Producer device to an EtherNet/IP device as Consumer.
Configuration	**Configuration** assembly: An assembly which transports configuration data from the EtherNet/IP device originating the connection to the EtherNet/IP device or I/O module which is the target of the connection.
Assembly Instance	The assembly instance number provided by the vendor. For more information, see the vendor's specification.
Size	The data length of the assembly provided by the vendor. For more information, see the vendor's specification.

7. You can click to edit the device name and description. You can also click to remove the device if required.
8. Click **Save** to complete the configuration.

Input and Output parameter of Rockwell 1756 and 1794 series I/O modules

This topic introduces some parameter configuration for EDS files of Rockwell 1756&1794 series I/O modules.

Table 6-1: 1756-OF4 Analog Output Current/Voltage 4 Channel

Device type	Parameter	Data type	Description	Example
Float	ChannelStatus0	USINT/8	B6 is not used. • B0(bit): Ch0HLimitAlarm • B1(bit): Ch0LLimitAlarm • B2(bit): Ch0RampAlarm • B3(bit): Ch0InHold • B4(bit): Ch0CalFault • B5(bit): Ch0NotANumber • B7(bit): Ch0OpenWire	
Integer	ChannelFaults0	UINT/16/Byte0	• B0(bit): Ch0Fault • B1(bit): Ch1Fault • B2(bit): Ch2Fault • B3(bit): Ch3Fault	

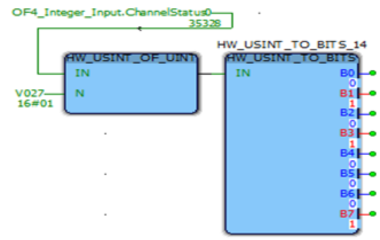
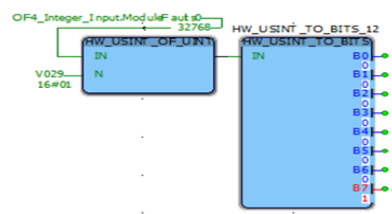
Device type	Parameter	Data type	Description	Example
	ChannelStatus0	UINT/16/Byte1	• B0(bit): Ch3InHold • B1(bit): Ch3OpenWire • B2(bit): Ch2InHold • B3(bit): Ch2OpenWire • B4(bit): Ch1InHold • B5(bit): Ch1OpenWire • B6 (bit): Ch0InHold • B7(bit): Ch0OpenWire	
	ModuleFaults0	UINT/16/Byte1	• B5(bit): CalFault • B6(bit): Calibrating • B7(bit): AnalogGroupFault	

Table 6-2: 1794-IE8/B 8 channel 24 DC Non-isolated Voltage/Current Analog Input

Parameter	Data type	Description	Example
Config_0	UINT/16	• B0(bit): Ch0FullRange • B1(bit): Ch1FullRange • B2(bit): Ch2FullRange	None

Parameter	Data type	Description	Example
		• B3(bit): Ch3FullRange • B4(bit): Ch4FullRange • B5(bit): Ch5FullRange • B6(bit): Ch6FullRange • B7(bit): Ch7FullRange • B8(bit): Ch0ConfigSelect • B9(bit): Ch1ConfigSelect • B10(bit): Ch2ConfigSelect • B11(bit): Ch3ConfigSelect • B12(bit): Ch4ConfigSelect • B13(bit): Ch5ConfigSelect • B14(bit): Ch6ConfigSelect • B15(bit): Ch7ConfigSelect	

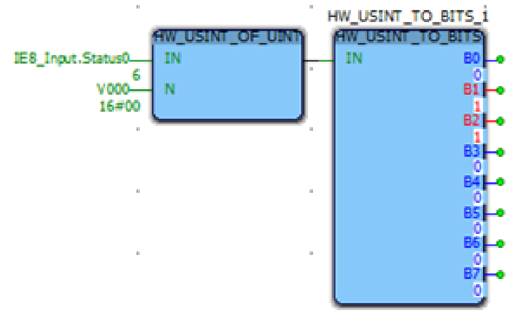
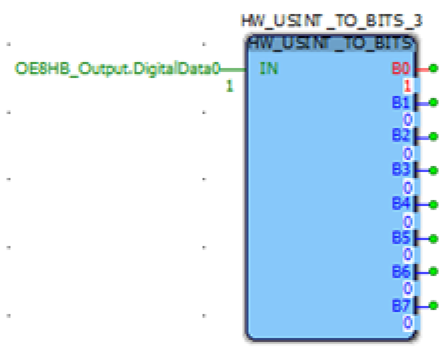
Parameter	Data type	Description	Example
Status0	UINT/16/Byte 0	• B0(bit): Ch0Underrange • B1(bit): Ch1Underrange • B2(bit): Ch2Underrange • B3(bit): Ch3Underrange • B4(bit): Ch4Underrange • B5(bit): Ch5Underrange • B6(bit): Ch6Underrange • B7(bit): Ch7Underrange	

Table 6-3: 1794-OE8H/A 8 Channel Analog Output/HART

Parameter	Data type	Description	Example
DigitalData0	USINT	• B0(bit): DigitalData0 • B1(bit): DigitalData1 • B2(bit): DigitalData2 • B3(bit): DigitalData3 • B4(bit): DigitalData4 • B5(bit): DigitalData5 • B6(bit): DigitalData6	

Parameter	Data type	Description	Example
		• B7(bit): DigitalData7	

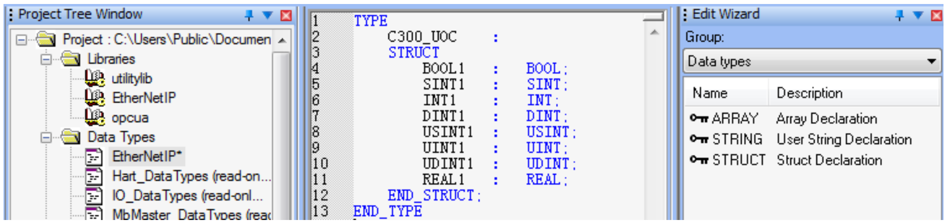
Configuring communication with third-party controllers

Configuring communication with C300/UOC

When ControlEdge 900 controller communicates with C300/UOC, it acts as an EtherNet/IP Server. Only User-defined data type **STRUCT** is supported for communicating with C300/UOC, which can include the following elementary data types:

- DATATYPE_BOOL (0x01)
- DATATYPE_SINT (0x02)
- DATATYPE_INT (0x03)
- DATATYPE_DINT (0x04)
- DATATYPE_USINT (0x05)
- DATATYPE_UINT (0x06)
- DATATYPE_UDINT (0x07)
- DATATYPE_REAL (0x08)

1. Bind EtherNet/IP Server to an Ethernet port. See Binding EtherNet/IP Server to an Ethernet port for more information.
2. Declare a STRUCT data type.
   a. From **IEC Programming Workspace**, right-click **Data Types**, select **Insert** > **Datatypes**.
   b. Enter a name for the data type, and click **OK**.
   c. Double click the new data type, and from **Edit Wizard**, double click **STRUCT**.
   d. Enter the target elementary data types, and click **Save**.



3. Configure target variables data type as the STRUCT data type.
4. Select EtherNet/IP for target variables. See Selecting EtherNet/IP for variables for more information.

Configuring communication with ControlLogix controllers

When ControlEdge 900 controller communicates with Rockwell AB ControlLogix controllers, it can act as an EtherNet/IP Client or EtherNet/IP Server.

- If ControlEdge 900 controller acts as an EtherNet/IP Client, ControlEdge Builder provides function blocks to enable communication between 900 controller and third-party controllers. For how to configure function blocks, see "EtherNet/IP" in the *ControlEdge Builder Function and Function Block Configuration Reference*.
- If ControlEdge 900 controller acts as an EtherNet/IP Server, see Configuring EtherNet/IP Server for more information.

  User-defined data types are not supported. Rockwell AB ControlLogix can read and write variables of ControlEdge 900 controller with the following data types:

  - DATATYPE_SINT (0x02)
  - DATATYPE_INT (0x03)
  - DATATYPE_DINT (0x04)
  - DATATYPE_USINT (0x05)
  - DATATYPE_UINT (0x06)
  - DATATYPE_UDINT (0x07)
  - DATATYPE_REAL (0x08)

Configuring EtherNet/IP Server

This section introduces how to configure ControlEdge 900 controller as an EtherNet/IP Server. EtherNet/IP Client can read, write and monitor global variable, program local variable of the EtherNet/IP Server through the Tag name configured in EtherNet/IP Client.

Global variable's tag name is @*GV. <Varname>*. If some controllers do not support special characters such as @, the tag name should be *GV.GV.<Varname>*.

Program Local variable's tag name is *<Program Instance Name>.<Varname>*.

Binding EtherNet/IP Server to an Ethernet port

This section introduces how to bind EtherNet/IP Server to ETH1 or ETH2. Only one Ethernet port can be bound at a time.

To bind EtherNet/IP Server

1. From Home Page, click **Configure Ethernet Ports** and select **ETH1** or **ETH2**.
2. Under **Network Setting**, configure the IP addresses, subnet mask and gateway.
3. Under **Protocol Binding**, select **EtherNet/IP Server**.
4. Click **Save** to complete the Ethernet port configuration.
5. Click **Back** to return to the Home Page.

Selecting EtherNet/IP for variables

EtherNet/IP must be selected for global variables or program local variables of EtherNet/IP Server, so that EtherNet/IP Client can read, write and monitor these variables through the Tag name configured in EtherNet/IP Client.

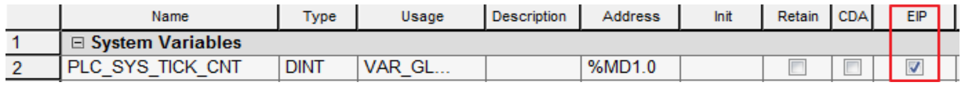
Global variable's tag name is @*GV. <Varname>*. If some controllers do not support special characters such as @, the tag name should be *GV.GV.<Varname>*.

Program Local variable's tag name is *<Program Instance Name>.<Varname>*.

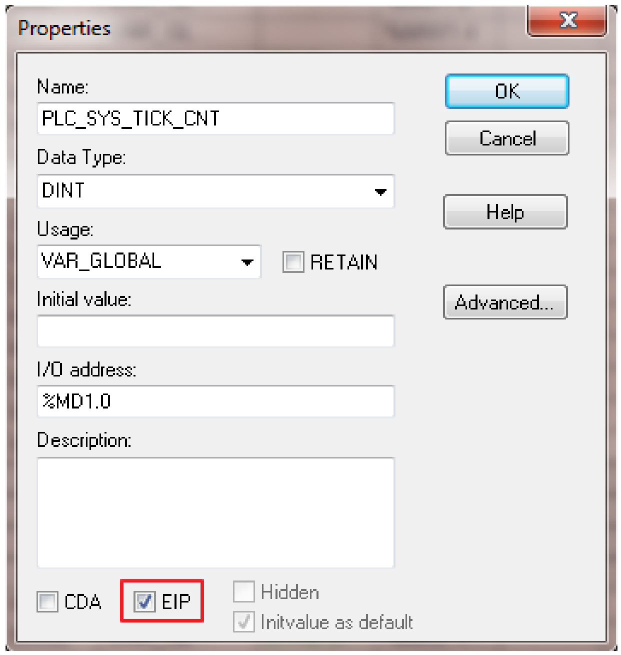
1. Click **IEC Programming Workspace** on the toolbar, or from Home Page, click **Program with IEC61131-3**.
2. Perform either of the following methods to select **EIP** for local

variables or global variables.

- From the variable sheets, select **EIP**.



- From the variable properties dialog, select **EIP**.



3. Compile the configuration to the controller. See Compiling a project for more information.

CHAPTER

7 CONFIGURING PROFINET

The ControlEdge 900 controller supports communication with PROFINET compliant third-party devices, such as I/O modules, drives, and relays. To facilitate the integration of PLC with the PROFINET compliant devices, you must add and configure equivalent devices by using ControlEdge Builder. Each configured device represents an equivalent physical PROFINET compliant-device, which is installed on the PROFINET network.

To enable communication between I/O modules and the PROFINET network, an I/O adapter (Device Access Point) supplied by the PROFINET IO vendor is needed. The adapter provides the Assembly connection feature, which helps you in consolidating connections from a group of I/O modules.

You can create PROFINET device, drive, and I/O module types by using GSDML files.

For more information, see *ControlEdge PLC PROFINET User's Guide*.

Binding PROFINET to an Ethernet port

This section introduces how to bind PROFINET to ETH3.

ETH4 has the same configuration as ETH3, so only ETH3 should be configured manually.

DLR Topology is required if you bind PROFINET.

To bind PROFINET

1. From Home Page, click **Configure Ethernet Ports** and select **ETH3**.
2. Under **Network Setting**, configure the IP address and the subnet mask.
   - The default IP address is 172.168.0.101.
   - The range of the IP address is from 101 to 254.
   - The IP address cannot be in the same network subnet as ETH1 and ETH2.
   - The IP address must be in the same network subnet as the PROFINET device.

- The IP address cannot be conflict with the IP address of PROFINET device.
- The IP address cannot be conflict with the EPM IP address.

3. Under **Protocol Binding**, select **PROFINET**.
4. Under **I/O Network Topology**, select **DLR Topology**.

   This configuration should match the position of 100X switch on the EPM hardware. 5 is for DLR network topology.

   For more information about the switch, see “Assembling I/O racks” in the *ControlEdge 900 Controller Hardware Planning and Installation Guide*.
5. Under **DLR Configuration**, configure the following 4 parameters:
   - **Role**: Specify the role for CPM as **Supervisor** or **Member**. The default value is **Supervisor**. A supervisor yields to another supervisor with a higher precedence, such that the highest precedence is always the Active Supervisor.
   - **Supervisor Precedence**: Set the precedence of a ring supervisor in the network with multiple ring supervisors. Numerically higher value indicates higher precedence. Node with highest Supervisor Precedence value becomes Active Supervisor. The configuration value ranges from 1 to 255. The default value is 250.
   - **Beacon Interval (usec)**: Set Beacon interval (in micro seconds) that supervisor transmits. The configuration value ranges from 400 to 10000. The default value is 400.
   - **Beacon Timeout (usec)**: Set the amount of time (in micro seconds) all nodes in ring network shall wait before timing out reception of Beacon frames and taking the appropriate action. Beacon timeout must be set to 2-3X Beacon Interval. The configuration value ranges from 800 to 50000. The default value is 1960.

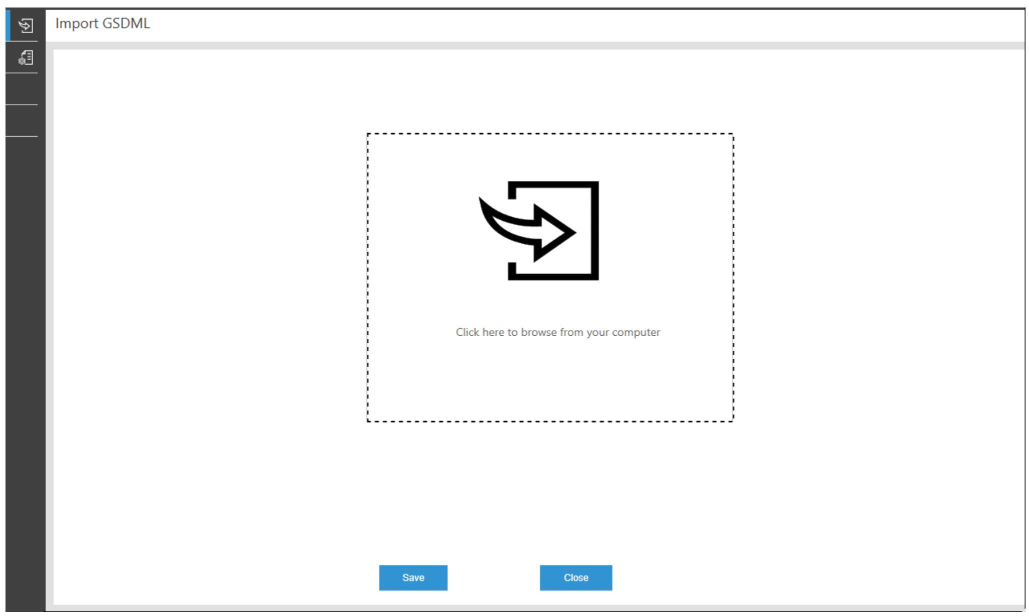
   > **NOTE:** You must reboot the controller if you change the I/O network topology from **Ring Topology/Star Topology** to **DLR Topology** and vice versa.
6. Click **Save** to complete the Ethernet port configuration.
7. Click **Back** to return to the Home Page.

Importing GSDML files

You can download GSDML files from secure sites hosted by device vendors, and import them into ControlEdge Builder. The registered information will be stored under the location: C:\ProgramData\Honeywell\ControlEdge Builder\PROFINET\Catalog\GSDMLFiles. The registered information cannot be saved along with project backups. You must back up them manually.

To import GSDML files

1. From the Home Page, click **Configure PROFINET**, and click **PROFINET Device Configuration**. **Import GSDML** dialog appears:



2. Click on the screen to browse the GSDML files from your computer.
3. Select the GSDML files and click **Open**, the GSDML files are imported successfully.

Configuring PROFINET devices

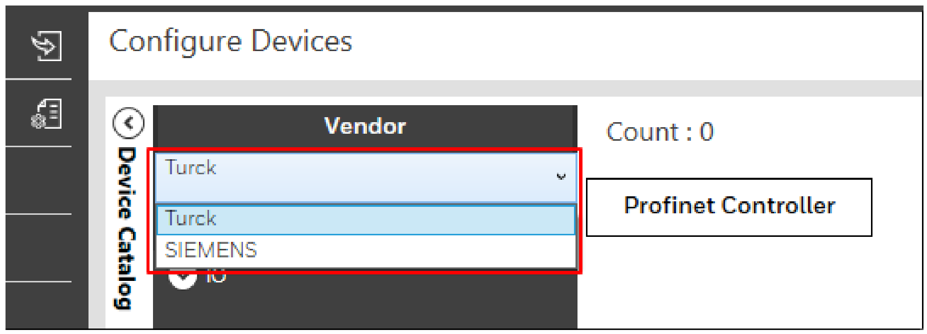
Prerequisites

- Bind PROFINET to an Ethernet port. See Binding PROFINET to an Ethernet port for more information.

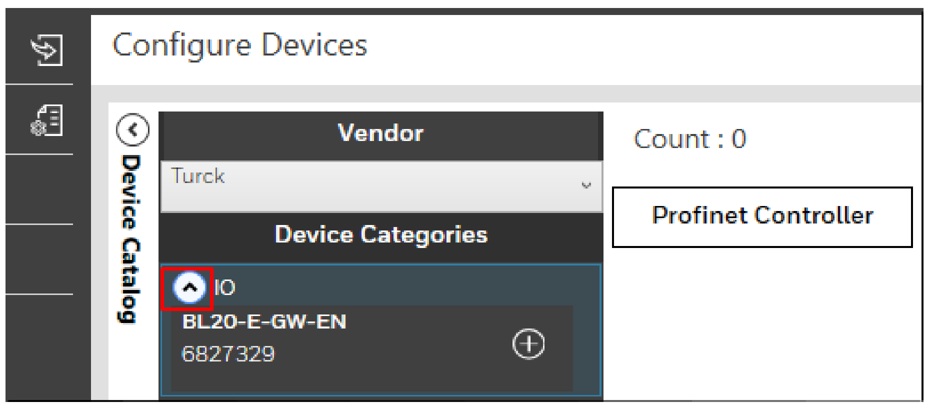
- Ensure you have imported GSDML files. See Importing GSDML files for more information.

To configure PROFINET devices

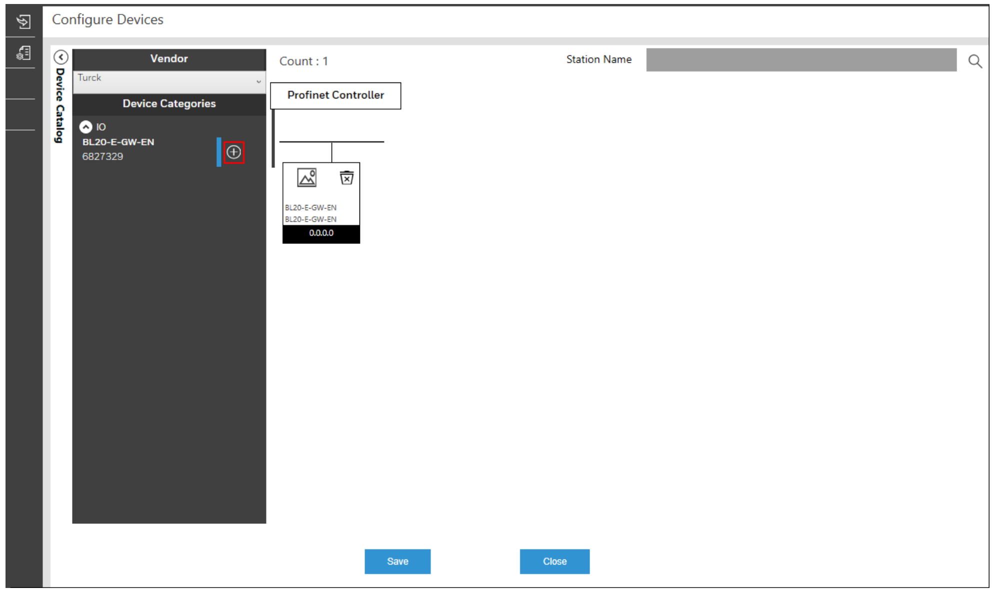
1. From the Home Page, click **Configure Profinet**, and click **Configure Device**.
2. Select the vendor from the drop down list.



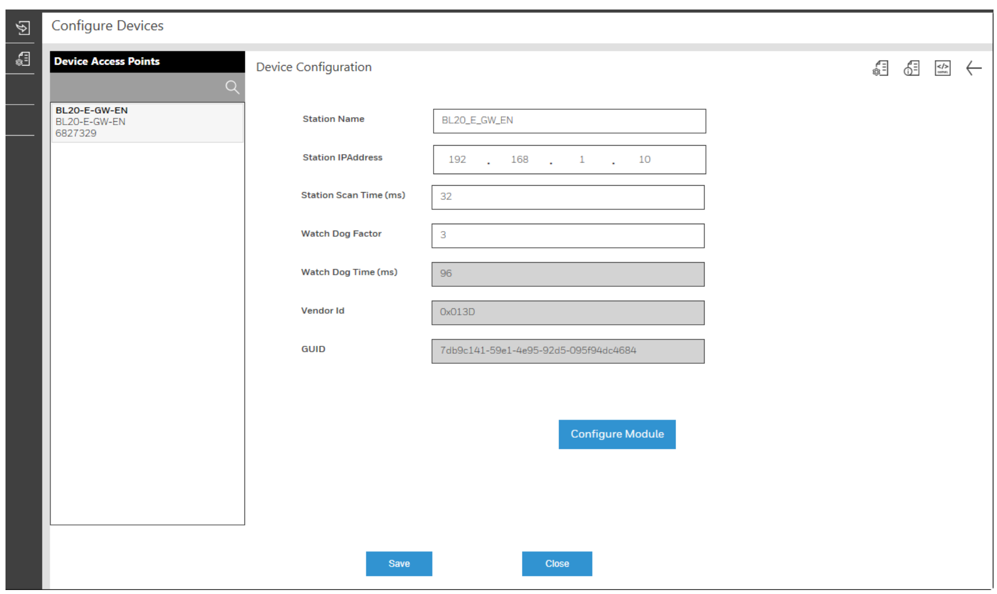
3. Click the arrow icon. PROFINET devices under that category will be displayed:



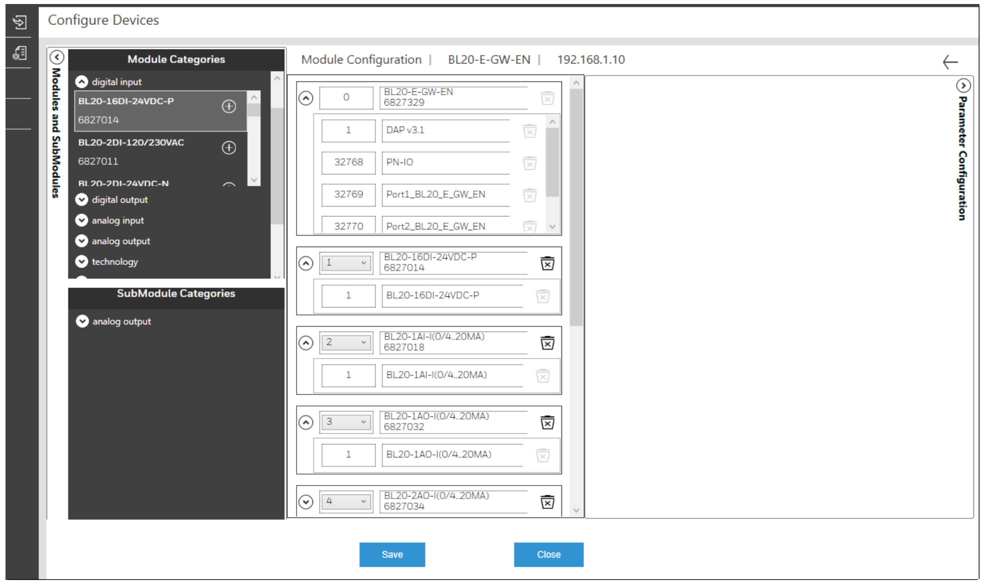
4. Click + to add the device to the PROFINET Controller page.



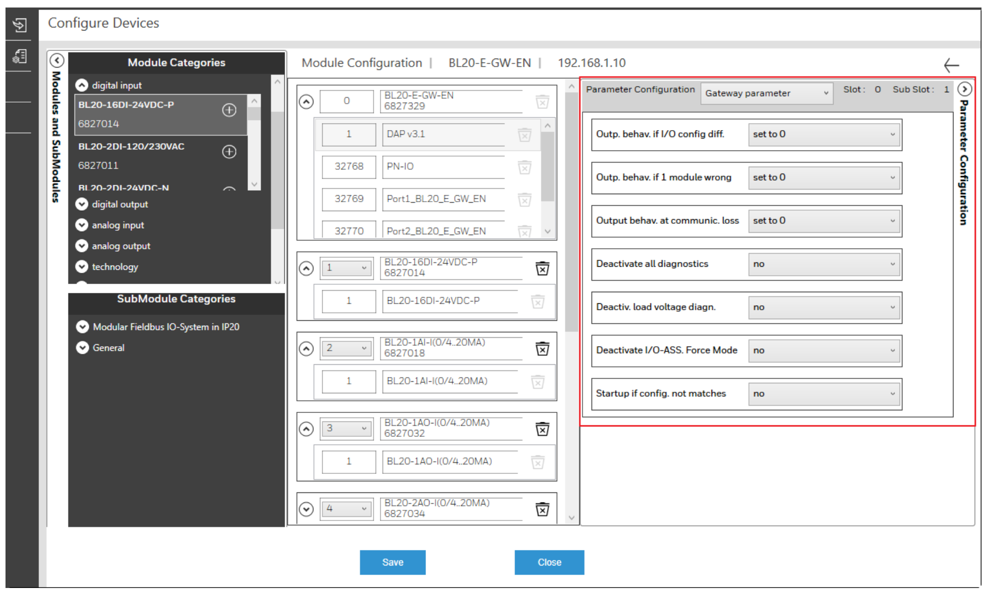
5. Click on the IP address to configure the device, enter the **Station Name**, **Station IPAddress** and **Station Scan Time (ms)**, and click **Configure Module**.



6. In the **Module Configuration** page, select the input and output as required, and set the slot number for each, and then click **Save**.

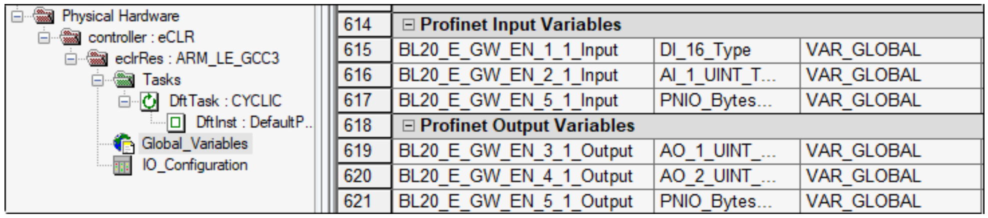


7. Select a submodule to configure the device parameters. Parameter Configuration page appears:



8. Click **Save** to complete the configuration. Click **Close** to return back to the **Profinet Device Configuration** page.

9. Click **Save** to complete the configuration, and the PROFINET I/O variables are generated automatically. You can check them in **Global_Variables** under **IEC Programming Workspace**.



NOTE: To convert bytes array to any other data types, use BUF_TO_XXXX function block in PROCONOS library. XXXX indicates the target data type you want to convert to. For more information, see the embedded online help of the corresponding function block.

CHAPTER

8

CONFIGURING AND UPLOADING DATALOGS

The controller creates data logs, time stamps them and store them in data files. These data log files must be transferred to a centralized storage system where they can be archived and viewed.

Datalogging is used to record variables. This data can be retrieved remotely and saved as .csv files.

Configuring datalog

> **TIP:** For the redundant controller, if you configure datalog, it will take longer to complete the synchronization.

1. Under **Application** of the Home Page, select **Configure and Upload Datalogs** > **Configure Datalogs**.
2. Click anywhere in the table and click **Add**. In the pop-up window, enter **Datalog Name** and **Datalog Description** to add a datalog. The maximum datalog quantity is eight.
3. Click **OK**. The new datalog appears in the list with **Log ID**, **Log Name** and **Description**. The parameter descriptions are as follows.

Parameter	Description
Log ID	This is a unique ID number for datalogging file. Its range is from 1 to 8. And it is read only.
Log Name	The name of the datalog. It can be modified by clicking **Edit**. The datalog name cannot contain any of the following characters: \ / : * ? " < > |
Description	Detailed description of the datalog.

4. To delete an existing datalog, select the target one and click **Delete**.
5. Select the target datalog and select **SD card** or **Flash** from **Save datalog to** drop-down list to save the datalog.
   - When **SD card** is selected, the datalog will be stored in the SD card. An SD card must be inserted in the controller. **Available memory** shows the memory available in the SD card space. The

first number indicates the available memory while the second one indicates the minimal recommending space of the SD card. See Preparing SD card for more information.

For SD class, both FAT and FAT32 are supported. The disk size limit for FAT is 4 G bytes. NTFS is not supported.

- When **Flash** is selected, the datalog will be stored in the Flash memory. **Available memory** shows the available memory of the Flash memory. If space is insufficient, while trying to store, an error message will be displayed.

  The total memory size of **Flash** is 45 MB, including datalog, EFM data and DNP3 events.

6. Select the appropriate values for **Log Rate** and **Record Time**. See the following table for parameter descriptions.

Parameter	Description
Log Rate	There are seven options: 1s, 5s, 10s, 1m, 5m, 10m and 1h.
Record Time	The records are logged based on the log rate. The maximum record time is 90 days.

7. Enable **Start/Stop Control** to control the start time or end time when the controller begins or stops to record datalogs.
   a. Select **Start/Stop Control**, the browse button is enabled.
   b. Click the browse button, and in the pop-up window select one variable to trigger to start or stop datalogging. You can also type in the **Filter** to search the target variable.
   c. When the selected variable is triggered, the controller will collect data at the log rate and save it in the file.
8. Under **Datalog Points**, click **Add Variable**. In the pop-up window select one Datalog Point to be logged and click **OK**. You can select a logged point and click **Delete** to remove the selected one from the Datalog Points list.
9. Select **Action on Full** to control what action will be taken if the data buffer is full.
   - **Overwrite**: The previous data in the buffer will be overwritten with new data.

- **Pause**: The controller will stop datalogging until the space for datalogging becomes available.

10. Select a datalog and its used space is displayed besides **Datalog size**.
11. Click **Save**, and then click **Back** to return to the Home Page.
12. Click **Download**.
    - If you modify **Record Time**, **Datalog Points** or change **Save Datalog To** option to the target datalog, and click **Download** from the toolbar, the previous datalog will be cleared and the new settings begin to take effect.
    - If you modify **Log Name**, **Log Rate**, **Start/Stop Control**, **Action on full** in **Configure Datalogs** tab, and click **Download** from the toolbar, it will continue to append log to existing log files.

> **NOTE:** To achieve a better performance, it is recommended to modify the settings of **Log Rate** and **Datalog Points** to keep total records logged in one second less than 1000 bytes averagely.

Uploading datalog

For uploading datalogs (upload only), you can log in as the Administrator, Engineer or Operator to connect the target controller.

For uploading and deleting datalogs, you must log in as the Administrator or Engineer to connect the target controller.

1. From the Home Page, under **Application**, select **Configure and Upload Datalogs** > **Upload Datalogs**.
2. Click **Refresh**, and the configured and downloaded datalogs are displayed.
3. Click **Settings** and **Upload Settings** window appears. Perform the following steps to configure upload settings.
    a. Select the **Date Format** from the drop-down list.
    b. Click browse button beside the **Save in** to select the directory to save the datalog.
    c. Select **UploadOnly** or **UploadDelete** besides **Option**. If **UploadDelete** is selected, the start time will be updated to the last end time automatically when the last datalog upload is completed.

4. Select the target datalog from the list and click **Upload**. The datalog is saved inside the folder specified. Datalog data is saved as csv format files. File name is in the format of “DatalogName_ StartTime _EndTime_x”. x indicates number in sequence from 1 to n.
   - Do not click **Download** during the upload progress, otherwise the datalog upload would be failed, and it could not be restored until reconnect to the controller.
   - Do not move from **Upload Datalogs** page during the upload progress.

Bulk uploading datalogs

The user can upload datalogs of multiple controllers at the same time by invoking "honeywell.controller.api.dll" file in scripts. The dll file is under the directory of Honeywell\ControlEdge Builder\builder\Apps\API\2.0 in the software installation location.

You can log in as the Administrator or Engineer or Operator to connect the target controller and bulk upload datalogs.

1. Configure the corresponding datalogs. See Configuring datalog for more information.
2. Write the scripts including the three interface functions: **Connect**, **Upload** and **Disconnect**.

   See the following table for the input parameter description of each interface function:

Interface Function	Parameter	Description
Connect	IP address	IP address of the controller
	user name	The user name logged in the controller
	password	User password
	timeout	Response time of request, the value must be 0. It cannot be modified.
Upload	Datalog ID	Configured log ID, ranging from 1 to 8. See Configuring datalog for more information.
	start time	The start time of the datalog to be uploaded.

Interface Function	Parameter	Description
	end time	The stop time of the datalog to be uploaded.
	time stamp format	Time stamp format:
		0: DD/MM/YY
		1: MM/DD/YY
		2: YY/MM/DD
	file format	Uploaded file format: .csv
	local file name	Uploaded datalog name including the absolute path the datalog restored
	timeout	Response time of the request, the default value is 20 seconds. It cannot be modified.
	mode	0: upload only
		1: upload and delete
	actual start time	The start time of the datalog stored in the controller. It is an output parameter which does not need to be configured and it will be displayed after running the script automatically.
	actual end time	The stop time of the datalog stored in the controller. It is an output parameter which does not need to be configured and it will be displayed after running the script automatically.
Disconnect	timeout	Response time of the request, the default value is 20 seconds. It cannot be modified.

Viewing and controlling datalog status

You can check datalog statistics and stop or resume the datalog under **View and Control Datalog Status.**

Before viewing and controlling datalog status, you must log in as the Administrator or Engineer or Operator to connect the target controller.

1. Under **Application**, select **Configure and Upload Datalogs** > **View and Control Datalog Status.** You can check the datalog statistics under **Datalog Details** table including the **Datalog ID**, **Datalog Name**, **Start Time**, **End Time** and **Status**.
2. Press the **Refresh** button to update the information. Also you can select from the drop-down list of **Interval** to refresh automatically.
3. If you want to stop a running datalog, select the target datalog in **Datalog Details** table and click **Stop**. Also, you can click **Resume** to start the stopped datalog again.

CHAPTER

9 CONFIGURING ELECTRONIC FLOW MEASUREMENT (EFM)

Electronic flow measurement systems are used for the measurement and recording of flow parameters of gaseous phase hydrocarbon and other related fluids for custody transfer applications utilizing industry recognized primary measurement devices.

This section outlines how to build and manage Electronic Gas/Liquid Flow Measurement components using ControlEdge Builder.

For the non-redundant controller, up to four meter runs, including gas and liquid meter runs, can be created.

For the redundant controller, up to twelve meter runs, including gas and liquid meter runs, can be created.

> **NOTE:** Meter runs created in ControlEdge Builder R161.2 will obtain new features of API21_1_V2 and API21_2_V2 function blocks, but existing meter runs created in earlier releases cannot.

> **NOTE:** If any upgraded project from earlier releases to R161.2 is running in the controller, before downloading a new project created using ControlEdge Builder R161.2 with API21_1_V2 & API21_2_V2 function blocks, you must remove all the meter runs in the upgraded project and download it to the controller. It is required to re-initialize the memory resources of the controller.

Configuring gas meter runs

As for register range, offset, system event and description, see EFM meter run registers for more information.

Creating a new meter run

1. In **Applications** tab, click **Electronic Flow Measurement** > **Configure Gas Meter Runs**.
2. Click **Add** and select a type of meter run. There are four meter run types can be selected and see the following table for information of the four meter types.

Parameter	Description
Orifice	Orifice meter run calculates the volumetric flow-rate for an orifice meter using flange or pipe tap based on the differential pressure, temperature and pressure input parameters.
Turbine	Turbine meter run corrects measured volume at flowing conditions read by turbine meter to volume at base conditions. The main input parameter of the Turbine meter is pulse.
Ultrasonic	Ultrasonic meter run also corrects measured volume at flowing conditions read by Ultrasonic meter to volume at base conditions. The main input parameter of the Ultrasonic meter is pulse. Technically both Turbine and Ultrasonic meters are same.
Coriolis	Coriolis meter run converts gas mass to volume. Gas mass is directly measured from Coriolis Meter.

3. Configure parameters of the added meter according to the navigation tab, and click **Finish** to add the meter to the list at left of the page.
4. Click the arrow besides each meter to unfold tabs, including **Meter Information**, **Variable Selection**, **Contract Settings**, **Composition** and **Record**. You can check and modify parameters in corresponding tabs if applicable.
5. Click **Save**. It will take 3~5 minutes to save the configuration.

You can also copy a existing meter run by clicking to create a new meter run.

Editing a meter run

1. Select EFM meters from the Navigation pane. A list of meters appears with the first meter selected.
2. Select the target meter you want to edit. The properties tabs enable you to edit the configuration of the meter.
3. Click **Save**. It will take 3~5 minutes to save the configuration.

Meter Information properties for a gas meter run

The **Meter Information** tab defines the basic information and advance information of a meter.

- See the following table for basic information parameter descriptions.

Parameter	Description
Meter name	The name of the meter In most cases, the meter number is also used as the tag name.
Meter ID	The unique identifier of the meter Third-party flow analysis applications use the meter ID to uniquely identify the meter.
Meter type	There are four meter types: Orifice, Turbine, Ultrasonic and Coriolis.
Input units	Input unit system : US Unit or Metric Unit
Contract units	Contract unit system : US Unit or Metric Unit
Description	(Optional) A description of the meter Up to 132 alphanumeric characters including spaces can be added.

- Advanced information is different according to selected meter run type.
  - If meter run type is **Orifice**, see the following table for parameter descriptions.

Parameter	Description
Flow calculation type	Starting from R161.2, different AGA3 standard can be selected: • AGA 3(1992) • AGA 3(2012)
Orifice Material	If Flow calculation type is selected as AGA 3 (1992), **Stainless Steel**, **Monel**, **CarbonSteel** are

Parameter	Description
	available. If Flow calculation type is selected as AGA 3 (2012), **Stainless Steel**, **Monel**, **CarbonSteel**, **Stainless_S_304**, **Stainless_S_316** are available.
Tap type	Flange, PIPE
Tap location	UpStream, DownStream
Pipe material	If Flow calculation type is selected as AGA 3 (1992), **Stainless Steel**, **Monel**, **CarbonSteel** are available. If Flow calculation type is selected as AGA 3 (2012), **Stainless Steel**, **Monel**, **CarbonSteel**, **Stainless_S_304**, **Stainless_S_316** are available.
Orifice diameter	Orifice diameter in inches for US units or in millimeter for Metric units
Pipe Diameter	Pipe diameter in inches for US units or in millimeter for Metric units
Viscosity	Viscosity in CENTIPOISES for any unit system
Orifice reference temperature	Unit: F° (Fahrenheit in US units) Unit: C° (Celcius in Metric Units)
Pipe reference temperature	Unit: F° (Fahrenheit in US units) Unit: C° (Celcius in Metric Units)
Beta radio	Beta ratio is the ratio of Orifice diameter to Pipe diameter.
Isentropic exponent	It is a constant number.
Fluid type	Compressible, Non-Compressible

- If meter run type is **Turbine**, **Ultrasonic** or **Coriolis**, see the following table for parameter descriptions.

Parameter	Description
Meter K factor	Meter factor is meter calibration factor.

Variable Selection properties for a gas meter run

The **Variable Selection** tab defines the static pressure, differential pressure, pulse, gas mass and temperature for a meter.

See the following table for Static Pressure parameter descriptions.

Parameter	Description
Variable name	Name of variable
LOLO	This parameter is extreme low value for static pressure. If static pressure goes below this value then an alarm is logged. This value should be in the same units chosen by user for static pressure.
LO	This parameter is low value for static pressure. If static pressure goes below this value then an alarm is logged. This value should be in the same units chosen by user for static pressure.
HI	This parameter is extreme high value for static pressure. If static pressure goes beyond this value then an alarm is logged. This value should be in the same units chosen by user for static pressure.
HIHI	This parameter is high value for static pressure. If static pressure goes beyond this value then an alarm is logged. This value should be in the same units chosen by user for static pressure.
Status	Status for Static Pressure. The value should be {0} for good status, or any positive integer for bad status.
Override Value	Keypad value for Static Pressure. This value is used when the Static Pressure status is bad.
I/O Selection	I/O selection for Static Pressure. The value should be 1 for Live or 2 for Keypad value.
Atmospheric pressure	Absolute Pressure, Gauge Pressure
Local atmospheric pressure	If Atmospheric Pressure option is Gauge Pressure then local atmospheric pressure must be entered by the user. Unit: This value should be in the same units chosen by the user for static pressure.

There are different configurable parameters according to different meter run types.

- If meter run type is **Orifice**, configure **Differential Pressure** parameters. See the following table for parameter descriptions.

Parameter	Description
Variable name	Name of variable
LOLO	This parameter is extreme low value for differential pressure. If differential pressure goes below this value then an alarm is logged. This value should be in the same units chosen by user for differential pressure.
LO	This parameter is low value for differential pressure. If differential pressure goes below this value then an alarm is logged. This value should be in the same units chosen by user for differential pressure.
HI	This parameter is extreme high value for differential pressure. If differential pressure goes beyond this value then an alarm is logged. This value should be in the same units chosen by user for differential pressure.
HIHI	This parameter is high value for differential pressure. If differential pressure goes beyond this value then an alarm is logged. This value should be in the same units chosen by user for differential pressure.
Low DP cutoff	Low DP cutoff value checks the no flow condition in the calculations. The value should be in the same units chosen by user for differential pressure.

- If meter run type is **Turbine** or **Ultrasonic**, configure **Pulse** parameters. See the following table for parameter descriptions.

Parameter	Description
Variable name	Name of variable
Input	Pulse: If the input is pulse. Analog: if the input is uncorrected analog value.
LOLO	It appears when **Input** is **Analog**.

Parameter	Description
	This is the LoLo limit for analog input. The value should be in lb^3/hr for US unit or m^3/hr for Metric unit.
LO	It appears when **Input** is **Analog**. This is the Lo limit for analog input. The value should be in lb^3/hr for US unit or m^3/hr for Metric unit.
HI	It appears when **Input** is **Analog**. This is the Hi limit for analog input. The value should be in lb^3/hr for US unit or m^3/hr for Metric unit.
HIHI	It appears when **Input** is **Analog**. This is the HiHi limit for analog input. The value should be in lb^3/hr for US unit or m^3/hr for Metric unit.
Low pulse cutoff	It appears when **Input** is **Pulse**. Low pulse cutoff value checks the no flow condition in the calculations. If the Pulse increment is less than this number, it will be considered as no flow condition.
Low flow cutoff	It appears when **Input** is **Analog**. Low flow cutoff value checks the no flow condition in the calculations. If the flow is s less than this number, it will be considered as no flow condition. Unit is m3/hr for Metric unit, ft3/hr for US unit.

- If meter run type is **Coriolis**, configure **Gas Mass** parameters. See the following table for parameter descriptions.

Parameter	Description
Variable name	Name of variable
Input	**Pulse**: If the input is pulse. **Analog**: If the input is uncorrected analog value.
LOLO	It appears when **Input** is **Analog**.

Parameter	Description
	This is the LoLo limit for analog input. The value should be in lb^3/hr for US unit or m^3/hr for Metric unit.
LO	It appears when **Input** is **Analog**. This is the Lo limit for analog input. The value should be in lb^3/hr for US unit or m^3/hr for Metric unit.
HI	It appears when **Input** is **Analog**. This is the Hi limit for analog input. The value should be in lb^3/hr for US unit or m^3/hr for Metric unit.
HIHI	It appears when **Input** is **Analog**. This is the HiHi limit for analog input. The value should be in lb^3/hr for US unit or m^3/hr for Metric unit.
Low pulse cutoff	It appears when **Input** is **Pulse**. Low pulse cutoff value checks the no flow condition in the calculations. If the Pulse increment is less than this number, it will be considered as no flow condition.
Low flow cutoff	It appears when **Input** is **Analog**. Low flow cutoff value checks the no flow condition in the calculations. If the flow is s less than this number, it will be considered as no flow condition. Unit is m3/hr for Metric unit, ft3/hr for US unit.

See the following table for **Temperature** parameter descriptions.

Parameter	Description
Variable name	Name of variable
LOLO	This parameter is extreme low value for temperature. If temperature goes below this value then an alarm is logged. This value should be in the same units chosen by user for temperature.
LO	This parameter is low value for temperature. If temperature goes below this value then an alarm is

Parameter	Description
	logged. This value should be in the same units chosen by user for temperature.
HI	This parameter is extreme high value for temperature. If temperature goes beyond this value then an alarm is logged. This value should be in the same units chosen by user for temperature.
HIHI	This parameter is high value for temperature. If temperature goes beyond this value then an alarm is logged. This value should be in the same units chosen by user for temperature.
Status	Status for Temperature. The value should be {0} for good status, or any positive integer for bad status.
Override Value	Keypad value for Temperature. This value is used when the Temperature status is bad.
I/O Selection	I/O selection for Temperature. The value should be 1 for Live or 2 for Keypad value.

Contract Settings properties for a gas meter run

See the following table for **Contract Settings** parameter descriptions.

Parameter	Description
Compressibility calculation	Starting from R161.2, compressibility calculation can be selected from different AGA 8 versions: • AGA 8(1994) • AGA 8(2017)
Calculation type	• Detailed: Gas densities calculation with all gas composition parameters • GrossMethod1: Gas densities calculation with fewer number of parameters (CO2, Hydrogen and CO) • GrossMethod2: Gas densities calculation with fewer number of parameters (CO2, Hydrogen, CO and Nitrogen) • GERG: Compressibility calculation using GERG method based on AGA 8 (2017) with all gas composition details are available.

Parameter	Description
	NOTE: With AGA 8 (1994) method, GERG method can't be selected.
Averaging Method	TimeWeighted: Parameter to choose the Averaging method. By default in AP21.1, the averaging method is time weighted average.
Contract Hour	It is the hour when day QTR is closed and new one starts.
Base Temperature	Base temperature is input parameter for any compressibility method to calculate density at base condition.
Base Pressure	Base pressure is input parameter for any compressibility method to calculate density at base condition.
Maintenance Mode Flag	Parameter to Start or Stop the Maintenance Mode. The value should be either {0} Maintenance End or {1} for Maintenance Start.

Composition properties for a gas meter run

Composition tab defines **Gas Composition** of a meter and you can configure percentage of each composition.

The configurable composition is different by selecting the different **Compressibility Method** in **Contract Settings** tab.

- If Compressibility Method is **Detailed**, see the following table for parameter descriptions.

Parameter	Description
Source	Constant, Live
Format	Percentage, Mole Fraction
Configurable Composition	Methane, CO2, Propane, H2S, CO, Argon, I_Butane, I_Pentane, Hexane, Octane, Decane, Nitrogen, Ethane, Water, Hydrogen, Oxygen, Helium, N_ Butane, N_Pentane, Heptane, and Nonane.
Normalize	To normalize the gas composition values if their sum is not 100.

- If Compressibility Method is **GrossMethod1** or **GrossMethod2**, see the following table for parameter descriptions.

Parameter	Description
Source	Constant, Live
Format	Percentage, Mole Fraction
Composition Parameter	• CO2 • Hydrogen • CO • Nitrogen(Only for GrossMethod2)
Gas relative density	Gas relative density measured at reference condition, input parameter for Gross Method 1 & 2.
Reference Temperature For Calorimeter Density	Reference temperature for calorimeter density required parameter for Gross Method 1 & 2.
Gas heating value	Heating value for the gas mixture.
Reference Pressure For Calorimeter Density	Reference pressure for calorimeter density required parameter for Gross Method 1 & 2.
Reference Temperature For Combustion	Reference temperature for combustion required parameter for Gross Method 1 & 2.

Record properties for a gas meter run

Record tab defines **Daily/Hourly Record Parameters** of a meter. See the following table for parameter descriptions.

Parameter	Description
Start Date	Start date of the logged hourly/ daily QTR (Quantity Transaction Record)
Start Time	Start time of the logged hourly/ daily QTR.
End Date	End date of the logged hourly/ daily QTR.
End Time	End time of the logged hourly/ daily QTR
Flow Time	Flow time in seconds for hourly/ daily QTR
Volume at	Accumulated volume at base condition for hourly/ daily QTR

Parameter	Description
Base	
Mass	Accumulated gas mass for hourly/ daily QTR
Energy	Accumulated energy for hourly/ daily QTR
Temperature	Averaged temperature for hourly/ daily QTR
Pressure	Averaged pressure for hourly/ daily QTR
Differential Pressure	Only apply to Orifice Meter. Averaged differential pressure for hourly/ daily QTR
Analog	Only applicable to Turbine, Ultrasonic and Coriolis meter when flow type is selected as Analog. This parameter provides average value of analog input for daily/hourly QTR.
Density	Averaged density for hourly/ daily QTR
Flow Extension	Only apply to Orifice Meter. Flow extension value for hourly/ daily QTR.
Uncorrected flow	Only apply to Turbine and Ultrasonic Meter. It provides uncorrected flow average value for daily/hourly QTR.
None	Only apply to Coriolis Meter. This record is empty and generally filled with zero.
Relative Density	Averaged relative density for hourly/ daily QTR
Non-Resettable Volume at Base	Non-Resettable or Cumulative total for volume at Base
Non-Resettable Mass	Non-Resettable or Cumulative total for Mass
Non-Resettable Energy	Non-Resettable or Cumulative total for Energy
Maintenance	Non-Resettable or Cumulative total Volume at Base (Turbine Ultrasonic

Parameter	Description
Volume at Base or, Maintenance Mass	and Orifice Meter) or Mass (Coriolis) in Maintenance mode
Pulse Start	This is applicable for Turbine, Ultrasonic and Coriolis meter when flow type is selected as Pulse. This is snapshot value when transaction time starts (hour/day).
Pulse End	This is applicable for Turbine, Ultrasonic and Coriolis meter when flow type is selected as Pulse. This is snapshot value when transaction time ends (hour/day).
UserDefined1	Average value of user defined parameter for hourly and daily QTR
UserDefined2	Average value of user defined parameter for hourly and daily QTR
UserDefined3	Average value of user defined parameter for hourly and daily QTR
UserDefined4	Average value of user defined parameter for hourly and daily QTR

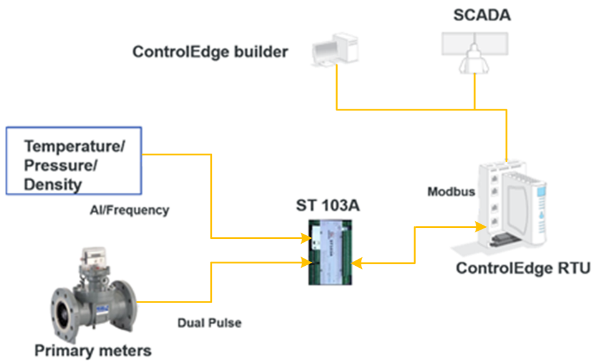
Configuring liquid meter runs

As for register range, offset, system event and description, see EFM meter run registers for more information.

The ST103A is an ultra-reliable data acquisition module that provides I/O capabilities to controllers requiring high accuracy, or to fiscal or custody transfer metering interfaces (e.g. Dual pulse fidelity checking). The ST103A reads and updates its I/Os within 500 ms, and provides external data access through a Modbus serial port.

See the following solution diagram for Liquid Electronic Flow Measurement system:

Figure 9-1: Liquid Electronic Flow Measurement system



See the following table for the recommended configurations of liquid meter runs:

- For a non-redundant system, up to 4 liquid meter runs are supported:

No. of meter run	No. of ST103A connected to serial port	Task execution time	Set task time automatically?
1 ~ 3	3 ST103A devices connect to one serial port.	STTask: 250ms AITask: 500ms LiqTask: 1000ms	Yes
4	3 ST103A devices connect to one serial port, and the fouth device connects to the other serial port.		

- For a redundant system, up to 12 liquid meter runs are supported.

No. of meter run	No. of ST103A connected to serial port	Task execution time	Set task time automatically?
1 ~ 3	3 ST103A devices connect to 1 serial port.	STTask: 250ms AITask: 500ms LiqTask: 1000ms	Yes
1 ~ 6	3 ST103A devices connect to one serial port, and the		

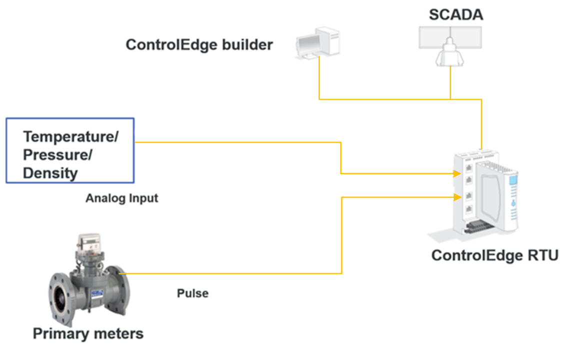
No. of meter run	No. of ST103A connected to serial port	Task execution time	Set task time automatically?
	rest devices connect to the other serial port.		
7 ~ 12	6 ST103A devices connect to one serial port, and the rest devices connect to the other serial port.	STTask: 750ms AITask: 1500ms LiqTask: 3000ms	No. You should set it manually.[1]
Note1: The slowest execution time for the LiqTask is <= 5000ms. The execution time of the STTask is 25% of LiqTask's, and AITask is 50% of LiqTask's.			

TIP: If there are other Modbus serial devices needing to be connected with ST103A in the same daisy chain, it will impact the number or execution time of meter runs in the current configuration. You should reduce the number of meter runs based on the previous execution time. Alternatively, you should slow the execution time and keep the previous number of meter runs.

When a project requires flow calculation based on single pulse stream from primary flow meter and secondary measurements as analog input, onboard I/O or expansion I/O can be used.

See the following solution diagram for Liquid Electronic Flow Measurement system with the onboard I/O or expansion I/O:

Figure 9-2: Liquid Electronic Flow Measurement system with the onboard or expansion I/O



Prerequisites

Make sure BatchTotalizer_DataTypes exists in the Data Types list. If not, you should insert it manually.

1. From the IEC Programming Workspace, right-click **Data Types**, and select **Insert** > **Datatypes**.
2. Enter the name **BatchTotalizer_DataTypes**, and click **OK**.

Creating a new meter run

1. In **Applications** tab, click **Electronic Flow Measurement** > **Configure Liquid Meter Runs**.
2. Click **Add** and select a type of meter run. There are five meter run types can be selected and see the following table for information of the five meter types.

Parameter	Description
Turbine, Positive Displacement, Ultrasonic, Coriolis	Different primary meter types measuring liquid flow in a meter run.
Station Totalizer	Station Totalizer is used when multiple streams are connected to a station and the totals should be calculated from multiple streams.

3. Configure parameters of the added meter according the navigation tab, and click **Finish** to add the meter to the list at left of the page.
4. Click the arrow besides each meter to unfold tabs, including

Information, **Liquid Type**, **Densitometer**, **Meter Information**, **Contract Settings**, **Natural Gas Liquefied** and **Records**. You can configure each tab with required parameters.

5. Click **Save**. It will take 3~5 minutes to save the configuration.

Editing a meter run

1. Select EFM meters from the Navigation pane. A list of meters appears with the first meter selected.
2. Select the target meter you want to edit. The properties tabs enable you to edit the configuration of the meter.
3. Click **Save**. It will take 3~5 minutes to save the configuration.

Information properties for a Liquid meter run

The **Basic Information** tab defines the basic information of a meter.

- See the following table for basic information parameter descriptions.

Parameter	Description
Meter name	The name of the meter In most cases, the meter number is also used as the tag name.
Meter ID	The unique identifier of the meter Third-party flow analysis applications use the meter ID to uniquely identify the meter.
Meter bank name	Meter Bank identifier.
Meter type	There are five meter types: Orifice, Turbine, Ultrasonic, Coriolis and Station Totalizer.
Input units	Input unit system : US Unit or Metric Unit
Contract units	Contract unit system : US Unit or Metric Unit
Description	(Optional) A description of the meter Up to 132 alphanumeric characters including spaces can be added.

Liquid type properties for a Liquid meter run

The **Liquid Type** tab provides the options to select the liquid type to be measured.

- See the following table for **Liquid Type** parameter descriptions.

Parameter	Description
Liquid to be measured	You can measure the following liquid: • Crude oil • Refined Products • Special products • Lubricating Oil • Natural Gas Liquefied
Thermal expansion factor at 60F	It is ONLY applicable for the **Special products** liquid type. Thermal expansion coefficient at 60°F.

- See the following table for **I/O Selection** parameter descriptions.

Parameter	Description
I/O Type for the Meter Run	• ST103A • Others Select it if onboard I/O or expansion I/O or any other device is used as an I/O.
I/O Identifier	It is available when you select **ST103A** for **I/O Type for the Meter Run**. Identifier of the connected ST103A I/O. Select the target ST103A you have added.
MessageID	It is available when you select **ST103A** for **I/O Type for the Meter Run**. Message ID from the connected ST103A device. It is used as a heartbeat to know whether ST103A is alive and able to communicate with ControlEdge 2020

Parameter	Description
	controller. Message ID will increment 2 in 1 second. The global variable created automatically after you add a ST103A device.
Watch Dog Time	It is available when you select **ST103A** for **I/O Type for the Meter Run**. Maixmum wait time in seconds for ST103A to restore the connection after the connection failure with ControlEdge 2020 controller. Beyond this limit, pulse increment will not be utilized in volume calculations. The status for hourly/daily/Batch totals will be set to 1, i.e. the totals are unreliable.
Pulse Max Increment	It is available when you select **ST103A** for **I/O Type for the Meter Run**. Maximum pulse increment limit for an execution cycle. If the pulse increment is beyond the limit, pulse increment will not be utilized in volume calculations and an alarm will be generated.

Densitometer properties for a Liquid meter run

The **Densitometer** tab provides the configuration required for meter run calculations from densitometers.

- See the following table for **Densitometer** parameter descriptions.

Parameter	Description
Densitometer is available	Option to set whether the Densitometer is available or not. The value should be either 1 for Yes or 0 for No. • Yes • No
Coriolis meter to provide density measurement	It is available when the meter run type is Coriolis. If the Coriolis meter is measuring both flow and density measurement, select the appropriate option.
No. of Densitometer	It is available when you select **Yes** for **Densitometer is available**. The number of Densitometers available. The value should be either 1 for Single or 2 for Dual densitometer. • 1 (A) • 2 (A, B)
Base density	It is available when you select **No** for **Densitometer is available**. Density at Base conditions. The value should be in lb/ft^3 for US unit and kg/m^3 for Metric unit. If the measurement system does not have on-line densitometer and takes input from offline density measurement, this option should be selected.

- If you select **Yes** for **Densitometer is available**, configure the **Temperature** parameters. See the following table for parameter descriptions.

Parameter	Description
Variable name	Parameter to set the Densitometer temperature. The value should be in Fahrenheit for US unit and in Celcius for Metric unit.
Status	Status for Densitometer Temperature. The value should be {0} for good status, or any positive integer for bad status.
LOLO	This is the LoLo limit for Densitometer temperature. The value should be in Fahrenheit for US unit and in Celcius for Metric unit.
Override Value	Keypad value for Densitometer temperature. This value is used when the densitometer temperature status is bad.
LO	This is the Lo limit for Densitometer temperature. The value should be in Fahrenheit for US unit and in Celcius for Metric unit.
I/O Selection	I/O selection for Densitometer Temperature. The value should be 1 for Live or 2 for Keypad value.
HI	This is the Hi limit for Densitometer temperature. The value should be in Fahrenheit for US unit and in Celcius for Metric unit.
HIHI	This is the HiHi limit for Densitometer temperature. The value should be in Fahrenheit for US unit and in Celcius for Metric unit.

- If you select **Yes** for **Densitometer is available**, configure the **Gauge Pressure** parameters. See the following table for parameter descriptions.

Parameter	Description
Variable name	Parameter to set the Densitometer pressure. The value should be in Psig for US unit and in Kpag for Metric unit.
Status	Status for Densitometer Pressure. The value should be {0} for good status, or any positive integer for bad status.
LOLO	This is the LoLo limit for Densitometer pressure. The value should be in Psig for US unit and in Kpag for Metric unit.
Override Value	Keypad value for Densitometer pressure. This value is used when the densitometer pressure status is bad.
LO	This is the Lo limit for Densitometer pressure. The value should be in Psig for US unit and in Kpag for Metric unit.
I/O Selection	I/O selection for Densitometer pressure. The value should be {1} for Live or {2) for Keypad value.
HI	This is the Hi limit for Densitometer pressure. The value should be in Psig for US unit and in Kpag for Metric unit.
HIHI	This is the HiHi limit for Densitometer pressure.The value should be in Psig for US unit and in Kpag for Metric unit.

- If you select **Yes** for **Densitometer is available**, configure the **Density** parameters. See the following table for parameter descriptions.

Parameter	Description
Measured density	Density value of the Densitometer. The value should be in lb/ft^3 for US unit and kg/m^3 for Metric unit. If you select **2 (A, B)** for **No. of Densitometer**, there will be two options **Measured density A** and **Measured density B** to be configured.
Status	Status of Densitometer. The value should be {0} for good status, or any positive integer for bad status. If you select **2 (A, B)** for **No. of Densitometer**, there will be two options **Status A** and **Status B** to be configured.
Preferred Densitometer	It is available when you select **2 (A, B)** for **No. of Densitometer**. • A • B
Override Value	Keypad value for Densitometer measured density. This value is used when the densitometer status is bad. The value should be in lb/ft^3 for US unit and kb/m^3 for Metric unit. When the number of densitometer is 2 and the status of preferred densitometer is bad, the function block automatically switches to the other densitometer if its status is good. If both densitometer status is bad, then an override (keypad) value will be used. In case of measured density, the keypad value needs to be a base density.

Parameter	Description
I/O Selection	I/O selection for Density. The value should be {1} for Live or {2} for Keypad value.

Meter Information properties for a Liquid meter run

The **Meter Information** tab defines the basic information related to primary measurement element and associated secondary measurement devices.

- See the following table for the **Advanced information** parameter descriptions.

Parameter	Description
Meter K factor	Meter K factor converts pulse from flow meter into volume. The value should be in pulses/m3 or pulses/ft3. When the flow type is analog, this is the correction factor to apply for volume calculation and the default value should be 1.0.

- See the following table for **Temperature** parameter descriptions.

Parameter	Description
Variable name	Parameter to set the meter temperature. The value should be in Fahrenheit for US unit and in Celcius for Metric unit.
Status	Analog input channel status for meter temperature. The value should be {0} for good status, or any positive integer for bad status.
LOLO	This is the LoLo limit for meter temperature. The value should be in Fahrenheit for US unit and in Celcius for Metric unit.
Override Value	Keypad value for meter temperature. The value is used when the densitometer temperature status is not good.

Parameter	Description
LO	This is the Lo limit for meter temperature. The value should be in Fahrenheit for US unit and in Celcius for Metric unit.
I/O Selection	I/O selection for meter temperature. The value should be {1} for Live or {2) for Keypad value.
HI	This is the Hi limit for meter temperature. The value should be in Fahrenheit for US unit and in Celcius for Metric unit.
HIHI	This is the HiHi limit for meter temperature. The value should be in Fahrenheit for US unit and in Celcius for Metric unit.

- If the meter run type is **Coriolis**, configure the **Density** parameters. See the following table for parameter descriptions.

Parameter	Description
Measured density	Density value from the Densitometer. The value should be in lb/ft^3 for US unit and kg/m^3 for Metric unit.
Status	Status of Densitometer. The value should be {0} for good status, or any positive integer for bad status.
Override Value	Keypad value is used when measured density status is bad. Generally this will be base density. The value should be in lb/ft^3 for US unit and kg/m^3 for Metric unit.
I/O Selection	I/O selection for Density. The value should be {1} for Live or {2} for Keypad value.

- See the following table for **Gauge pressure** parameter descriptions.

Parameter	Description
Variable name	Parameter to set the meter pressure. The value should be in Psig for US unit and in Kpag for Metric unit.
Status	Analog input channel status for meter pressure. The value should be {0} for good status, or any positive integer for bad status.
LOLO	This is the LoLo limit for meter pressure. The value should be in Psig for US unit and in Kpag for Metric unit.
Override Value	Keypad value for meter pressure. The value is used when the meter pressure status is bad.
LO	This is the Lo limit for meter pressure. The value should be in Psig for US unit and in Kpag for Metric unit.
I/O Selection	I/O selection for meter pressure. The value should be {1} for Live or {2) for Keypad value.
HI	This is the Hi limit for meter pressure.The value should be in Psig for US unit and in Kpag for Metric unit.
HIHI	This is the HiHi limit for meter pressure. The value should be in Psig for US unit and in Kpag for Metric unit.

- See the following table for **Pulse** parameter descriptions.

Parameter	Description
Variable name	The parameter to set pulse/analog input for flow.
Input	Parameter to set the flow type. The

<table>
<tr><th>Parameter</th><th>Description</th></tr>
<tr><td></td><td>value should be {0} for Pulse and {1} for Analog.
Select Pulse if the flow meter provides pulse stream as an output.
Select Analog if the flow meter provides flow rate as an output, and the value should be in lb^3/hr. for US unit or m^3/hr. for Metric unit.
TIP: For applications related to control a flow rate, it is recommended to select Analog and use flow meters which supports analog output.

NOTE: When Analog is selected, you cannot select Batch for Operation Type in the Contract Settings tab.</td></tr>
<tr><td>Low pulse cutoff</td><td>Low pulse cut off limit determines no flow conditions.</td></tr>
<tr><td>LOLO</td><td>It is available when you select Analog for Input.

This is the LoLo limit for analog input. The value should be in lb^3/hr for US unit or m^3/hr for Metric unit.</td></tr>
<tr><td>LO</td><td>It is available when you select Analog for Input.

This is the Lo limit for analog input. The value should be in lb^3/hr for US unit or m^3/hr for Metric unit.</td></tr>
</table>

Parameter	Description
HI	It is available when you select **Analog** for **Input**. This is the Hi limit for analog input. The value should be in lb^3/hr for US unit or m^3/hr for Metric unit.
HIHI	It is available when you select **Analog** for **Input**. This is the HiHi limit for analog input. The value should be in lb^3/hr for US unit or m^3/hr for Metric unit.

Contract Settings properties for a Liquid meter run

The **Contract Settings** tab defines the additional settings required for Quantity Transaction Record (QTR) computation.

- See the following table for **Contract Settings** parameter descriptions.

Parameter	Description
Averaging Method	FlowWeighted: Parameter to choose the Averaging method. By default in AP21.2, the averaging method is flow weighted average.
Averaging Variable	Parameter to set the variable used for averaging. The value should be {0} for Gross Volume or {1} for Mass.
Contract Hour	Parameter represents the time of daily QTR generation. Its value should be from 0 to 23.
Base Temperature	Temperature at Base conditions. The value should be in Fahrenheit for US units and in Celcius for Metric units. The contract unit setting on the **Basic Information** is used for QTR calculation. The default value for US unit is 60 Deg F and ranges from 15 to 20 Deg C for Metric units.
API Rounding	Option to enable or disable the API rounding. This option will round-off the input and output float values according to API standards.

Parameter	Description
	• Enable • Disable
Sediments & water measurement is available	Parameter to set whether the Water and Sediments is available in the Crude Oil or not. The value should be {1} if it is available, otherwise it should be {0}. • Yes • No
Sediments & water	Parameter to set the percentage of Water and Sediments present in the Crude Oil.
Status	Analog input channel status for Water and Sediments. The value should be {0} for Good or any positive integer for Bad status.
Override Value	Keypad value in percentage for Water and Sediments. The value that should be used when the Water and Sediments status is not good.
I/O Selection	I/O selection for Water and Sediments value. The value should be {1} for Live or {2} for Keypad value.

- See the following table for **Operation** parameter descriptions.

Parameter	Description
Maintenance Mode Flag	Parameter to Start or Stop the Maintenance Mode. The value should be either {0} Maintenance End or {1} for Maintenance Start.
Operation Type	Parameter to set the type of Operation. The value should be {1} for **Continuous** or {2} for **Batch**. **NOTE:** If **Analog** is selected for **Input** in the **Variable Selection** tab, you cannot

Parameter	Description
	select **Batch** here.
Batch Identifier	It is available when you select **Batch** for **Operation Type**. Identifier for a Batch operation. This number will be incremented for every batch run.
Retrospective K-factor Correction	It is available when you select **Batch** for **Operation Type**. Option to enable or disable the retrospective K-factor handling in Batch totolization.

Natural Gas Liquefied properties for a Liquid meter run

The **Natural Gas Liquefied** tab defines the inputs parameters required for Natural Gas Liquefied liquid type.

See the following table for the corresponding parameter descriptions.

Parameter	Description
CPL calculation type	CPL Calculation Type. The value should be {1} for None or {2} for API21.2 or {3} for API21.2M.
Convergence criteria	IP2 Convergence limit. Default value is 0.001.
Maximum iterations	IP2 Max loop limit. Default value is 50.
Iteration method	Main calculation method. The value should be either {1} for ASTM or {2} for IP2.
Vapor pressure input	Parameter to set the Vapour Pressure Input.
Vapor pressure calculation method	Vapour Pressure calculation options. The value should be {1} for None, {2} for User Observed or {3} for API 11.2.5

Station Totalizer properties for a Liquid meter run

When you create a Station Totalizer meter run, the **Station Totalizer** tab appears.

The LiquidStationTotalizer function block calculates the meter station totals for the multiple streams connected to the station. The station totals are calculated by adding relevant individual totals from each stream and totalizing them to create Station totals. Station totalizer by default totalize Gross standard Volume, Net Standard Volume, Mass and water and sediments volume. The station totalizer by default generate hourly and daily QTR similar to any other meter runs.

Station totalizer can be configured for totalizing 2 ~ 4 meter runs. The maximum meter runs that can be added to station totalizer is 4 and minimum is 2.

While configuring station totalizer, meter runs should have same liquid type, operation type (period/batch) and same contract hour. The function block will not do any error handling if the above conditions are not met.

See the following table for the corresponding parameter descriptions.

Parameter	Description
Meter ID	The unique identifier of the meter. Third-party flow analysis applications use the meter ID to uniquely identify the meter.
Liquid Type	Liquid to be measured: • Crude oil • Refined Products • Special products • Lubricating Oil • Natural Gas Liquefied
Contract units	Contract unit system: US Unit or Metric Unit.
Operation Type	Parameter to set the type of Operation. The value should be {1} for Continuous or {2} for Batch.

Records properties for a Liquid meter run

Records tab defines **Daily/Hourly Record Parameters** of a meter. See the following table for parameter descriptions.

Parameter	Description
Start Date	Start date of the Quantity Transaction Record (QTR).
Start Time	Start time of the QTR.
End Date	End date of the QTR.
End Time	End time of the QTR.
Pulse Start	Pulse value at the start of the QTR.
Pulse End	Pulse value at the end of the QTR.
Meter K-Factor	Meter K factor converts pulse from flow meter into volume. The value should be in pulses/m3 or pulses/ft3. When the flow type is analog, this is the correction factor to apply for volume calculation and the default value should be 1.0.
CTL	Flow weighted average temperature correction factor.
CPL	Flow weighted average pressure correction factor.
Observed Density	Flow weighted Average of Observed Density for the hour / day.
Observed Temperature	Flow weighted Average of Observed Temperature for the hour / day.
Observed Pressure	Flow weighted Average of Observed Pressure for the hour / day.
Base Density	Flow weighted Average of Base Density for the hour / day.
Temperature	Flow weighted Average of Temperature for the hour / day.
Pressure	Flow weighted Average of Pressure for the hour / day.
Gross Volume	Gross Standard volume total for this hour/day.
SW Volume	Sediments and Water volume total for this hour/day.
Mass	Mass total for this hour/day.
Non Resettable Gross Std	Apply to **Turbine**, **Positive Displacement**, **Ultrasonic** and **Station Totalizer** meters.

Parameter	Description
Vol	Non-Resettable or Cumulative total for Gross Standard volume.
Non Resettable Mass	Only apply to **Coriolis** meter. Non-Resettable or Cumulative total for Mass.
Status	Status of the flow calculation for the current hour/day.
Batch ID	Identifier for a Batch operation.
Maint Gross Std Vol or Maint Mass	Non-resettable or cumulative total for Gross Standard volume/mass in Maintenance mode. For a Coriolis meter, this parameter represents mass, and for other meter types, it represents volume.
Analog	Only apply to when flow type is selected as analog. This parameter provides average value of analog input for daily/hourly QTR.

For station totalizer, the same description in the above table are applicable.

Changing meter run types

This section introduces how to change meter run types from Gas to Liquid or vice versa in a project.

You must reinitialize memory resources for the required meter run in the controller. Perform the following steps:

1. Obtain QTR data from ControlEdge 2020 controller via SCADA for the meter run that needs to be deleted.
2. Delete the meter run from the project.
3. Compile the project, and download it to the controller.
4. Add and configure the required meter run with required type (Gas/Liquid).
5. Compile the project, and download it to the controller.

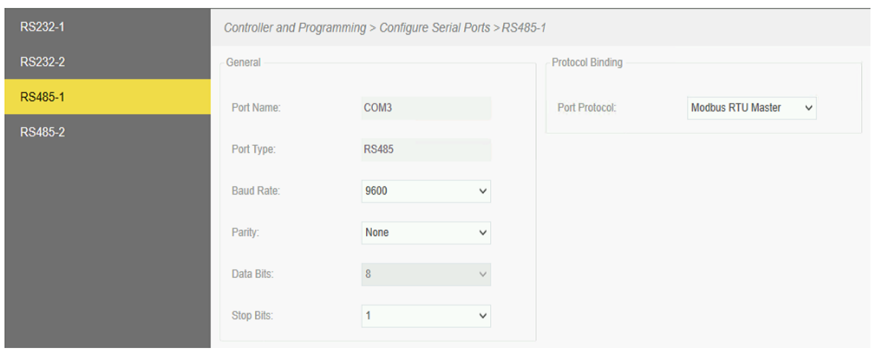
> **NOTE:** It is recommended not to change Input Unit and Contract Unit when the function block is running.

CHAPTER

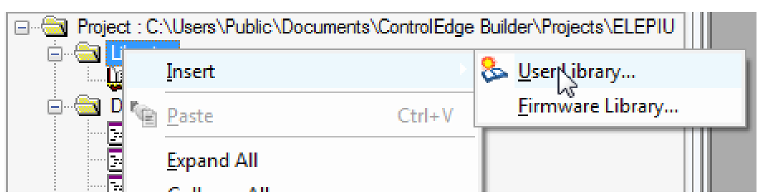
10 CONFIGURING ENHANCED LOW ENERGY PROCESS INTERFACE UNIT (ELEPIU)

This topic shows how to use ELEPIU Library in a project.

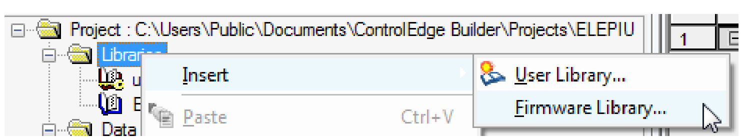
1. Configure serial port RS485-1.
   a. Baud Rate: 9600
   b. Parity: None
   c. Data Bits: 8
   d. Stop Bits: 1
   e. Port Protocol: Modbus RTU Master.



2. Insert User Library.



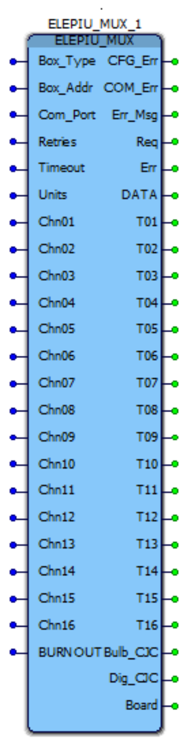
3. Select ELEPIULib.
4. Insert Firmware Library.



5. Select MODBUS and select modbus.fwl.
6. Create Global Variable MUX_Data with data type MUX_EU_Data.

17	⊟ Common Variables		
18	MUX_Data	MUX_EU_Data	VAR_GLOBAL

7. From ELEPIULib, drag ELEPIU_MUX to the sheet for the first MUX box. Repeat for all additional MUX boxes.



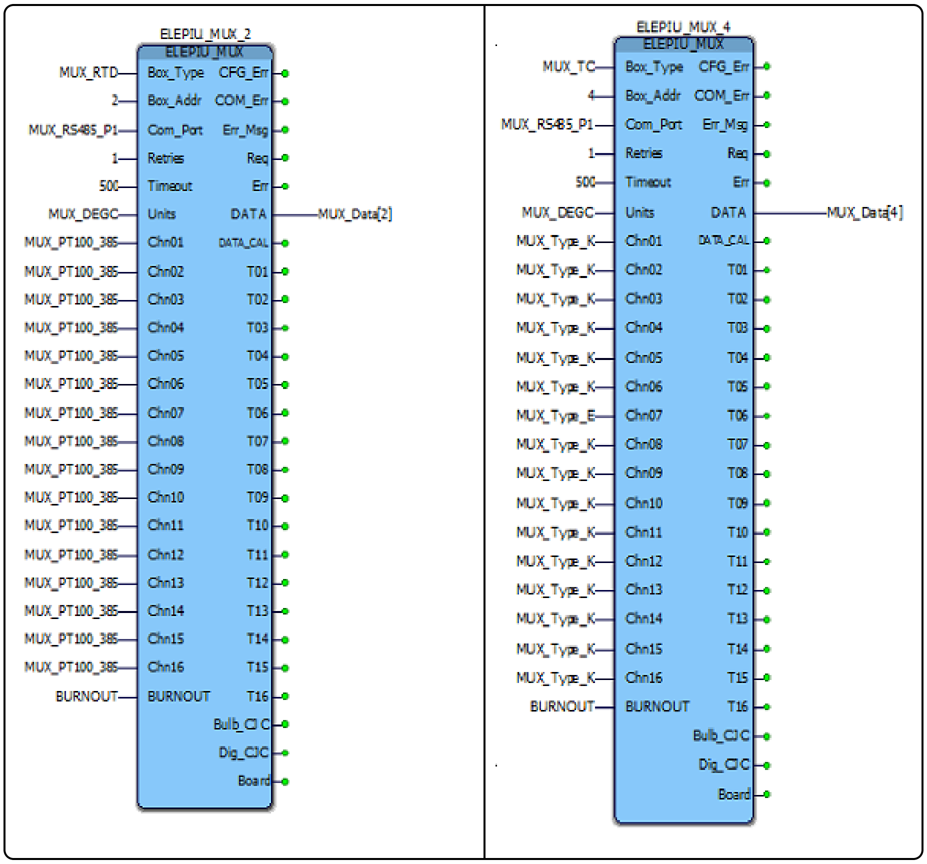
8. Configure the block(s) according to the site configuration.

Parameter	Data Type	Description
Box_Type	INT	Specifies the type of box 0 – Not Used 1 – Thermocouple 2 - RTD
Box_Addr	INT	Address of the MUX Box Valid Values - 1-16
Com_Port	INT	RS485 Comm Port to Use Use 1

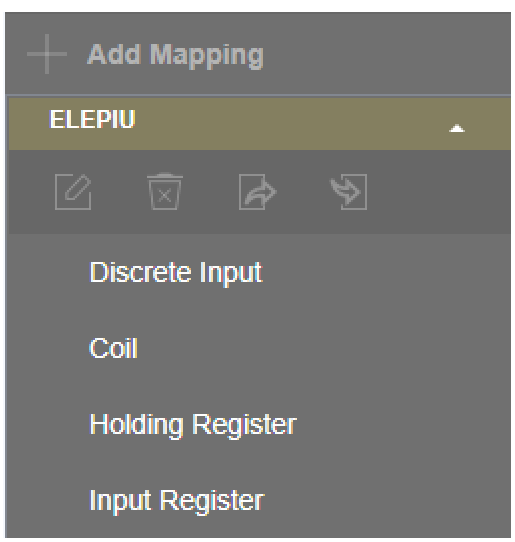
Parameter	Data Type	Description
Retries	INT	Number of reties
Timeout	INT	Time out value before a retry. Value is milliseconds.
Units	INT	Specifies the temperature units 0 – DegC 1 – DegF 2 – DegK 3 – DegR
Chn01..Chn16	INT	Temperature Element Type 1 – Type B 2 – Type E 3 – Type J 4 – Type K 5 – Type N 6 – Type R 7 – Type S 8 – Type T 10 – PT390 11 – PT385
BURNOUT	REAL	User defined Burnout Value Default 850.0
CFG_Err	BOOL	MUX Function Block is not configured correctly
COM_Err	BOOL	Communication error has occurred to target MUX Box
Err_Msg	STRING	Plain text error message
Req	UDINT	Total number of requests mad to MUX

Parameter	Data Type	Description
		Box
Err	UDINT	Total number of errors
DATA	MUX_ DATA	Data Structure used for Modbus interface
T01..T16	REAL	Channel Temperature
Bulb_CJC	REAL	Temperature at termination board
Dig_CJC	REAL	On Board CJC
Board	REAL	MUX Board Type read from MUX Box 2 – Thermocouple 4 – RTD

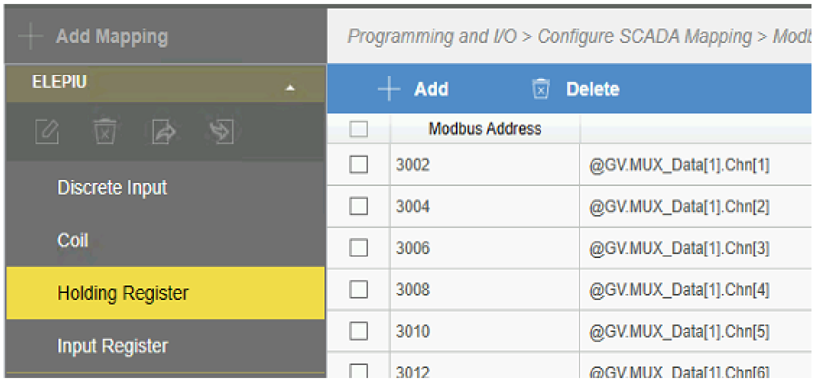
This is the completed Function Block for MUX box 1 show that while the block is ready for use, the Box_Type is set to Not Used.	This is the completed Function Block for MUX box 2 that is configured as an RTD MUX Box.



9. Create Modbus Slave Mapping.



10. Configure the Modbus Mapping.



11. Compile and download the project.

CHAPTER

11

CONFIGURING A CONTROLLER SIMULATOR

Controller simulator is not available for all releases. Project version must correspond to the controller simulator version.

Controller simulator can be deployed on a Virtual Machine, and enables the user to configure a controller without connecting a physical controller.

Currently, controller simulator does not support I/O communication and EFM application.

NOTE: It is not allowed to download a project with EFM configured to a simulator.

ATTENTION: It is not recommended to use the simulator in a production environment, because simulator does not support secured communication.

The following table lists the supported and non-supported features of the controller simulator.

Features	Support
Connect a controller simulator	Yes
Download a project to a controller simulator	Yes
Download a redundant project to a controller simulator	Yes
Debug a program	Yes
Force I/O value through I/O variables	Yes
Force I/O value through I/O channels	No
Upload system event log	Yes
Monitor link status	Yes
System diagnostics	Yes
Secure communication	No
Communication between SCADA and controller simulator	Yes

Features	Support
Communication between controller simulators	Yes
Communication between virtual and physical controllers	Yes
Modbus TCP master/slave	Yes
Modbus UDP slave	No
Enron Modbus slave	No
DNP3 outstation	No
OPC UA Server	Yes
OPC UA Client	No
CDA responder	No
EtherNet/IP	No
HART/HART-IP	No
Wireless I/O	No
Data logging	No
EFM	No
Secured communication	No
PROFINET	No
DNP3 Master	No
MQTT	No

Prerequisite

Make sure the IP addresses for the PCs installed simulator and ControlEdge Builder are on the same subnet.

One virtual machine only supports one controller simulator.

> **NOTE:** Before installing a virtual machine, make sure INTEL VT-x is enabled in Basic Input / Output System (BIOS) for the PC.

Procedures

1. Install a virtual machine. Two virtual machines are verified:
   - VMware Workstation Player 12.5.8 or higher hypervisor
   - VMware vCenter Server 6.0.0 or higher hypervisor

For more information, see the vendor's documents.

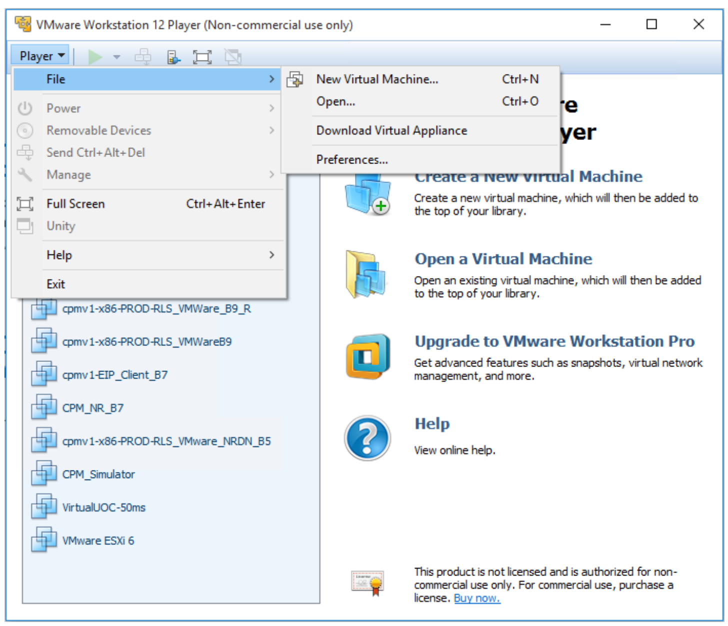
2. Import or open an OVA file in the virtual machine, and play the virtual machine. Honeywell provides three OVA files stored in Simulator folder in the Media.

   RXXX indicates the release number.

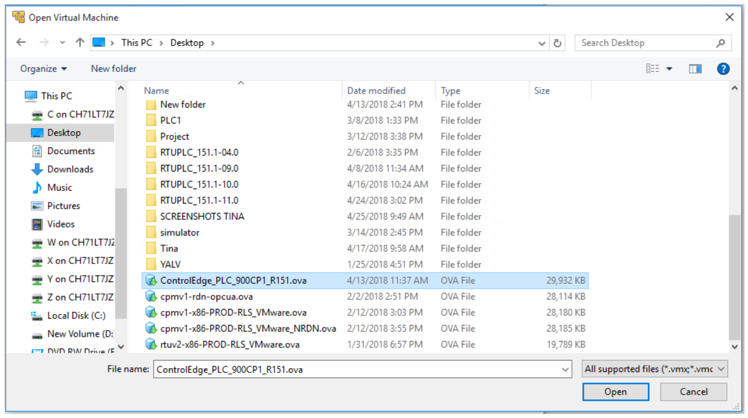
   - ControlEdge 900 controller: ControlEdge_PLC_900CP1_RXXX.ova
   - ControlEdge 2020 controller:
     - Non-redundant controller: ControlEdge_RTU_SCUCMX02_RXXX.ova
     - Redundant controller: ControlEdge_RTU_SCUCNN11_RXXX.ova

   Take VMware Workstation Player 12.5.8 as an example here:

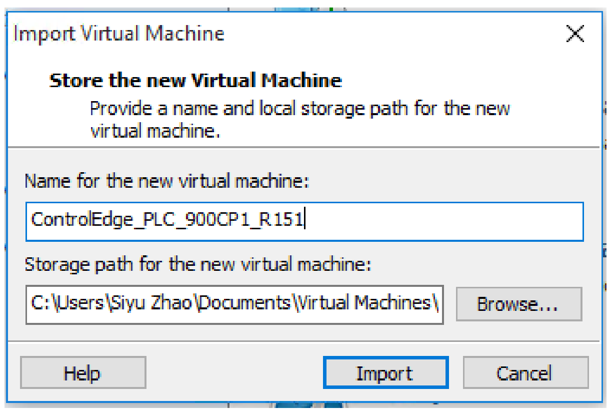
   a. Click **Player** > **File** > **Open**, the **Open Virtual Machine** dialog appears.



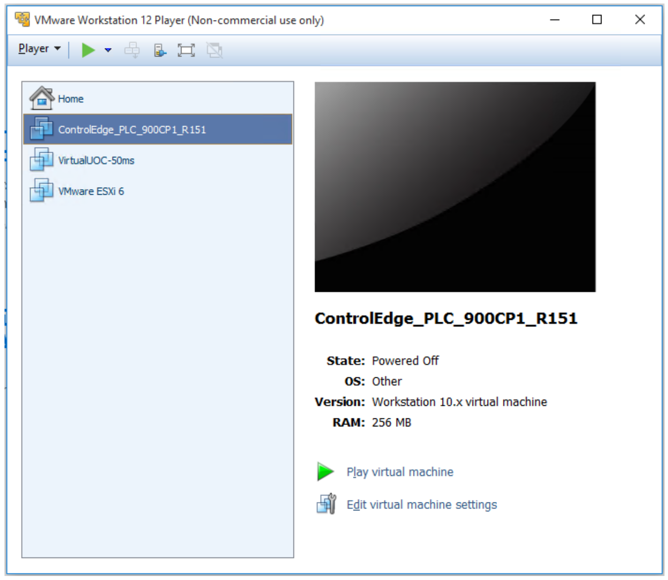
   b. Browse to the location stored the target OVA file, select the OVA file and click **Open**.



c. From the **Import Virtual Machine** dialog, name the virtual machine, and select a storage location for the virtual machine. Click **Import**.

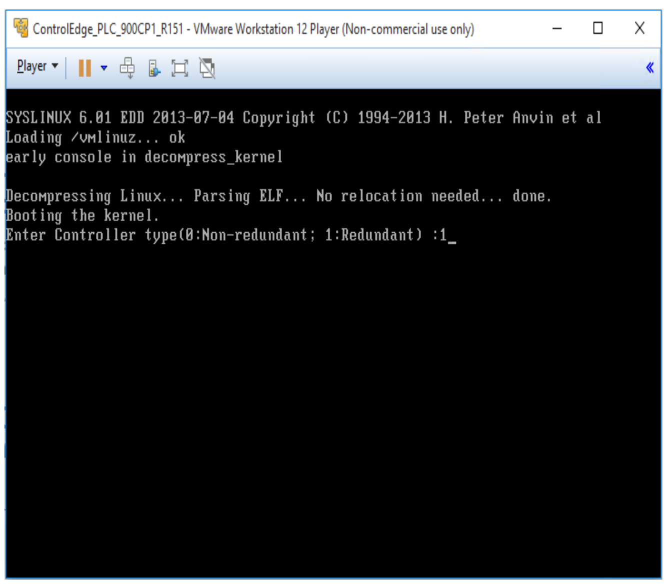


d. Click **Play virtual machine**.



e. For ControlEdge 900 controller, you should configure the controller type.

- Enter 0 to configure the controller type as non-redundant.
- Enter 1 to configure the controller type as redundant.



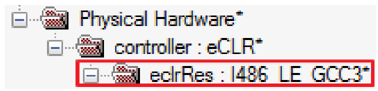
NOTE: The controller type cannot be changed once you configure it, and you should re-import the OVA file and configure it again.

An OVA file defines a controller simulator. To change the controller simulator version, import the corresponding OVA file.

For more information, see the vendor's documents.

3. Connect to a controller simulator. See Connecting a controller for more information.

   After you connect to a controller simulator, make sure the build settings is I486_LE_GCC3. Click **IEC Programming Workspace** and check the following parameter:

4. Configure a controller simulator. See the table above for the supported configuration. Project version must match with the controller simulator version.

5. Compile the project. See Compiling a project for more information.

6. Download the project to the controller simulator. See Downloading a project to the controller for more information.

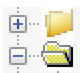
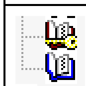
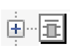
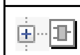
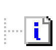
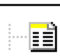
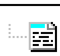
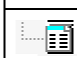
CHAPTER

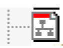
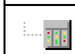
12 PROGRAMMING WITH IEC 61131-3

This chapter introduces general information about programming with IEC 61131-3.

The following table shows and introduces the items in the **Project Tree Window**.

> **TIP:** Items in the **Project Tree Window** cannot use the same name.

Icon	Description
	Folder (closed/open) in the subtree "Libraries", "Data Types" or "Logical POUs". This folder icon is also visible in SFC POUs, containing detail worksheets (see below).
	Libraries, includes firmware library (upper icon with key) and user library, both contained in the "Libraries" folder.
	Data types worksheet in the "Data Types" folder.
	Program POU in the "Logical POUs" folder containing one or several code worksheets, a variables grid worksheet and an optional description worksheet.
	Function block POU in the "Logical POUs" folder containing one or several code worksheets, a variables grid worksheet and an optional description worksheet.
	Function POU in the "Logical POUs" folder containing one or several code worksheets, a variables grid worksheet and an optional description worksheet.
	Description worksheet, contained in a POU or configuration folder. The worksheet contains optional description for documentation purposes.
	Variables grid worksheet which is part of each POU containing the local variables declarations. Contained in each POU folder.
	Code worksheet in the textual programming language ST. Contained in each ST POU folder.
	Code worksheet in the textual programming language IL. Contained in each IL POU folder.

Icon	Description
	Code worksheet in the graphical programming language LD created with the standard graphical editor. Contained in each LD POU folder.
	Code worksheet in the graphical programming language FBD. Contained in each FBD POU.
	Code worksheet in the graphical programming language SFC. Contained in each SFC POU.
	Action or transition worksheet contained in an SFC POU.
	Folder (closed/open) in the "Physical Hardware" tree, representing either the entire subtree, a configuration or a resource.
	Task folder (closed/open) in the "Physical Hardware" tree representing either the "Task" root folder or a particular task with program and function block instances inside.
	DEFAULT task
	CYCLIC task
	EVENT task
	SYSTEM task
	Program instance contained in a task folder.
	Function block instance contained in a program instance folder of a task folder.
	Global variables grid worksheet containing the declarations of resource-global variables of the particular resource.
	I/O configuration worksheet containing the declarations of input and output groups (addresses) for the particular resource.

The following table introduces programming languages.

Programming language	Description
IL	**Instruction List**: Code programmed in the textual language IL consists of a sequence

Programming language	Description
	of instructions. Each instruction starts at a new line. A line number is displayed in front of each line. Each line begins with an operator followed by one operand.
ST	**Structured Text**: Code programmed in the textual language ST consists of statements and expressions. Each code line must be terminated with a semicolon.
SFC	**Sequential Function Chart**: Code programmed in the graphical language SFC is composed of steps and transitions which are connected with directed links. One or several action blocks can be associated to a step.
FBD	**Function Block Diagram**: Code programmed in the graphical language FBD is composed of functions and function blocks which are connected with each other or with variables using lines. These lines can also be connected with each other. In FBD networks it is not possible to connect outputs with outputs. The set of connected objects is called FBD network.
LD	**Ladder Diagram**: Code programmed in the graphical language LD is composed of contacts and coils. According to IEC 61131-3 different types of contacts and coils can be used. Contacts lead (according to their type) the power from the left to the right. Coils store the incoming value. Both, contacts and coils, are assigned to Boolean variables.

See the embedded help for details about programming. Select **Help** > **Contents** from the toolbar. In the pop-up help, expand **Programming System Help** and click **Programming a project**.

Adding a library

The Libraries that are included in your project are either user-defined libraries or firmware libraries.

- User Library: contains programs, function blocks, functions and user-defined data types, and can be reused across projects. Honeywell provides user libraries and user can create their own. The file extensions for user library are *.mwt and *.mwe.

- Firmware Library: contains function blocks and functions prepared by Honeywell for specific hardware. The file extension for firmware library is *.fwl.

For more information about the function and function block, see the *ControlEdge Builder Function and Function Block Configuration Reference Guide*.

To add a library

1. Click **IEC Programming Workspace** from the toolbar, or from Home Page, click **Program with IEC61131-3**.
2. Right-click **Libraries** and click **Insert**. Select **User Library** or **Firmware Library**.
   - For **User Library**, select .mwt file and click **Include**.
   - For **Firmware Library**, click the corresponding folder and select the target .fwl file, and then click **Include**.

Creating a data type

Honeywell provides some read-only user-defined data types, and user can also create and define data types. The maximum number of user defined data types is 1024. User-defined data types can be used within user function blocks and programs. They cannot be used in user functions.

To create a data type

1. Click **IEC Programming Workspace** from the toolbar, or from Home Page, click **Program with IEC61131-3**.
2. From the **Project Tree Window**, right-click **Data Types** and select **Insert** > **Datatypes** and name the target data type.

   NOTE: Date type names must be in uppercase letters.

3. Double-click the newly added data type, you can edit it in the text editor.

For **I/O_DataTypes**, each I/O Channel has one or two structures. All of the related information for this channel is grouped together in the structures as shown below. You can use this information as reference for I/O channel configuration and programming.

Table 12-1: I/O channel structures of the ***I/O_DataTypes***

Structure type	Parameter	Parameter type
ANALOG_INPUT_TYPE	STS	USINT
	PV	REAL
	EUHI	REAL
	EULO	REAL
	EUHIEX	REAL
	EULOEX	REAL
ANALOG_OUTPUT_TYPE	OP	REAL
ANALOG_OUTPUT_READBACK_ TYPE	STS	USINT
	OP_READBACK	REAL
	EUHI	REAL
	EULO	REAL
	EUHIEX	REAL
	EULOEX	REAL
DIGITAL_INPUT_TYPE	STS	USINT
	PV	BOOL
DIGITAL_OUTPUT_TYPE	OP	BOOL
DIGITAL_OUTPUT_READBACK_TYPE	STS	USINT
	OP_READBACK	BOOL
PULSE_INPUT_TYPE	STS	USINT
	COUNTER[1]	UDINT
	RATE[2]	REAL
	PREI[3]	BOOL
PULSE_INPUT_CONTROL_TYPE	RST[4]	BOOL
	HOLD[5]	BOOL

Structure type	Parameter	Parameter type
FREQUENCY_INPUT_TYPE	STS	USINT
	FREQUENCY	REAL
PULSE_OUTPUT_TYPE	PULSES	UDINT
	ENABLE	BOOL
	START	BOOL
	CONTINUE	BOOL
PULSE_OUTPUT_READBACK_TYPE	STS	USINT
	REMAIN	UDINT

1. COUNTER: The accumulated Engineering Unit (EU) count.

2. RATE: Rate in EU/Time Period. Input pulses are counted over a specified Sample Time and scaled to EU/Second, EU/Minute or EU/Hour.

3. PREI: Preset indicator. OFF [0] when COUNTER = less than the local or remote preset value, ON when the count reaches the local or remote preset value. The hardware module determines the state of the PREI output. PREI is cleared by the RST input. A preset value of 0 effectively turns off the Preset allowing the counter to count continuously until held or reset.

4. RST: An OFF to ON transition resets the module's pulse counter and the OUT to zero. It also clears the FAIL, Overflow in STS and PREI.

5. HOLD: A Boolean value when set to 1 holds the EU count at its current value.

Creating a variable

This section introduces how to create and declare variables to diagnose and monitor the system.

To create a variable

1. Click **IEC Programming Workspace** from the toolbar, or from Home Page, click **Program with IEC61131-3**.
2. You can create local variables or global variables from the corresponding grid worksheet.  is the grid worksheet for local variables, and  is the grid worksheet for global variables. For the following steps, let us take the global variable as an example.

3. Double-click **Global_Variables** under **Physical Hardware**, the global variable sheet appears.
4. Right-click under the corresponding group, and select **Insert variable** to add a new I/O variable.

   For output channel variables, you must add corresponding read back variables with suffix "_READBACK" in the **Input I/O Variables** group.
5. Double-click the **Name** and **Description** fields to modify, and select **Type** and **Usage** from the drop-down lists.

   > **NOTE:** Uppercase letters are required if you enter **Type** manually.

   The maximum quantity of characters for a variable name is 30.

   IEC address of the I/O variable is generated automatically after you bind it with an I/O channel and click **Make**. If you add a new I/O variable by copying an existing bound one in a compiled project, you should delete the IEC address of the new variable manually and click **Make** to generate it automatically.
6. Configure **Retain** for variables as required. See Holding a variable value after a warm reboot for more information.

Creating a Programming Organization Unit

Logical Program Organization Units (POUs) are the language elements of a program. They are small, independent software units containing the program code. The name of a POU must be unique within the project.

There are three different POU types:

- **Program**: contains a logical combination of function or function block calls. Programs have input and output parameters and they can have an internal memory.
- **Function Block**: POUs with multiple input/output parameters and internal memory.
- **Function**: POUs with multiple input parameters and exactly one output parameter.

To create a POU

1. Click **IEC Programming Workspace** from the toolbar, or from Home Page, click **Program with IEC61131-3**.
2. From the **Project Tree Window**, right-click **Logical POUs** and select **Insert** > **Program/Function Block/Function**, the **Insert** dialog appears.
3. Enter the **Name** for the new POU.
4. Select the desired programming Language. Depending on your system configuration, some programming language are possibly not available.
5. Enter a **PLC type** and/or a **Process type** if required.
6. Click **OK**, the new POU is inserted in the project tree. It contains one code worksheet in the chosen language, a variable worksheet and a description worksheet.
7. Expand the POU, and double-click the code worksheet, the workplace appears.
8. Drag the target function or function block from the Edit Wizard pane, and the function or function block is displayed.
9. Double-click the pin-outs of the function or function block, the **Variable Properties** dialog appears.
10. Accept the proposed name, or enter a new name or select an already existing name from the **Name** combo box.
11. Select the **Data Type** and **Usage** from the drop-down lists.
    - If you are creating a Program, there are two options for Usage: VAR and VAR_GLOBAL.
    - If you are creating a Function Block, there are five options for Usage: VAR, VAR_INPUT, VAR_OUTPUT, VAR_IN_OUT and VAR_GLOBAL.
    - If you are creating a Function, there are two options for Usage: VAR and VAR_INPUT.

    See the following table for the description of variables.

Variable	Description
VAR	Local variable
VAR_GLOBAL	Global variable
VAR_INPUT	Local FB input variable
VAR_OUTPUT	Local FB output variable

Variable	Description
VAR_IN_OUT	Local input/output variable

12. Assign the initial value and I/O address.
13. It is optional to select the target group from **Global Variable Groups**. Click **OK** and the new variables are added to the selected groups.

    If you do not select a **Global Variable Group**, the variables are added to the **Common Variables** group by default.

Associating a program to a task

Tasks determine the time scheduling of the programs associated with them. This means that programs have to be associated to tasks in order to be executed. The settings of the task determine the time scheduling.

To create a task and associate a program

1. Click **IEC Programming Workspace** from the toolbar, or from Home Page, click **Program with IEC61131-3**.
2. From the **Project Tree Window**, under **Physical Hardware**, right-click **Task** and select **Insert** > **Task**.
3. Enter the **Name**.

   Task name and Instance name must start with a letter or an underscore. The rest of the characters can be letters, numbers or underscores. The maximum quantity of characters which a task name can have is 7 and that of a program instance is 24.
4. Select the **Task type**. See the following table for the descriptions of task types.

Task type	Description
DEFAULT	Each resource can contain one default task. It is the task with the lowest priority (lower than cyclic tasks) and is not time scheduled.
CYCLIC	Cyclic task executes their associated programs in fixed time intervals.
EVENT	Event task executes their associated programs each time a particular event occurs.

Task type	Description
SYSTEM	System task executes its associated programs each time a particular system event occurs.

5. Click **OK**.
6. Configure the parameters as required in the **Task settings** dialog. See the following table for the parameter descriptions.

   Depending on the associated task type, only some of the parameters are available.

Parameter	Description
Event No.	Specifies the event which activates the execution of the event task. Only available for event tasks.
Interval	Specifies the time interval in ms in which the cyclic task is executed. Only available for cyclic tasks. The fastest task time interval of 2020 controller, 28 MIXED IO, 128MB DRAM (SC-UCMX01) is 50 ms. The fastest task time interval of redundant 2020 controller (SC-UCNN11) and 2020 controller, 28 MIXED IO, 256MB DRAM (SC-UCMX02) is 20 ms. The fastest task time interval of ControlEdge 900 Controller is 10 ms.
SPG No.	Specifies the system program (SPG) which is associated with the task System programs. Only available for system tasks.
Priority	Assigns a priority for calling a task. 0 represents the highest and 31 the lowest priority. The task with the highest priority is called first.
Watchdog Time	Watchdog Time is unchecked by default for a newly created project. Specifies the time interval when the watchdog checks if the cycle time has been exceeded or not. This time interval should be shorter than or equal to the cycle time of the cyclic tasks. The recommended Watchdog Time is longer than 50ms.

Parameter	Description
	ATTENTION: If the task execution time exceeds the watchdog time, the controller will stop. See Checking task execution time for more information. **ATTENTION:** As for the project with multiple tasks, it is recommended to disable the Watchdog function for lower priority tasks.
Stack	Specifies the size of the task stack. The stack size depends on the amount of the local variables used. In case of a task switching the values of the local variables are stored in the stack. The default setting is medium. Only if you get several times a stack overflow you should use a higher stack size.
SAVE_ FPU	Saves the floating point register when switching the tasks. This checkbox should be activated only, if you use the data type REAL in different tasks and if the hardware supports saving floating point registers while task switching.
BYPASS	Removes the task switching so that the associated programs are executed immediately if the event happens. Only available in case of an event task.
NO_ SUSPEND	Specifies that the associated program is executed in all operational states including the STOP state. This checkbox should be used for tasks with associated programs containing code bodies which should be executed continuously. It might be also useful if you are setting breakpoints to assure that parts of your programs are although executed.

7. Click **OK**. The new task is inserted.
8. Right-click the task you have inserted, and select **Insert** > **Program instance**.
9. Enter a name in the **Program instance** field.

   The program instance must not be named “RTU” or “GlobalVariable”.

10. Select the program you want to associate in the **Program type** drop-down list.

11. Click **OK**.

Holding a variable value after a warm reboot

This section introduces how to hold a variable value after a warm reboot.

The values of retentive variables are kept even if power is switched off. In the case of a warm reboot the last value of the variable is going to be used. The "Retain" property of a variable can be used to hold a variable value after a warm reboot.

> **NOTE:** You must complete retain configuration before starting the controller.

> **NOTE:** If a variable is listed in the **Common Variables** group, or a variable is used for Modbus, EFM or PID, it is recommended to select **Retain**.

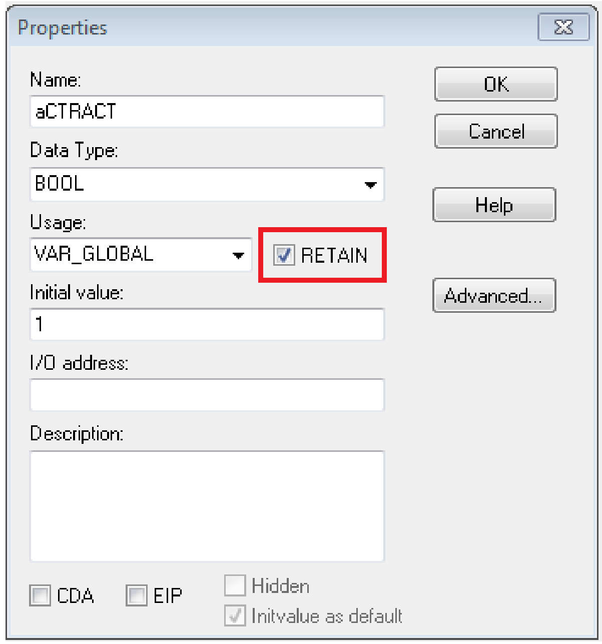
> **NOTE:** It is recommended not to select **Retain** for I/O variables.

Perform either of the following methods to hold a variable value after a warm reboot:

- From the variable sheets, select **Retain**.

	Name	Address	Init	Retain	CDA	EIP
1	⊞ **System Variables**					
17	⊟ **Common Variables**					
18	aCTRACT		1	☑	☐	☐
19	aEXIO_01_DI_07			☐	☐	☐
20	aEXIO_01_DI_08			☐	☐	☐

- From the variable properties dialog, select **RETAIN**, and click **OK**.



Checking task execution time

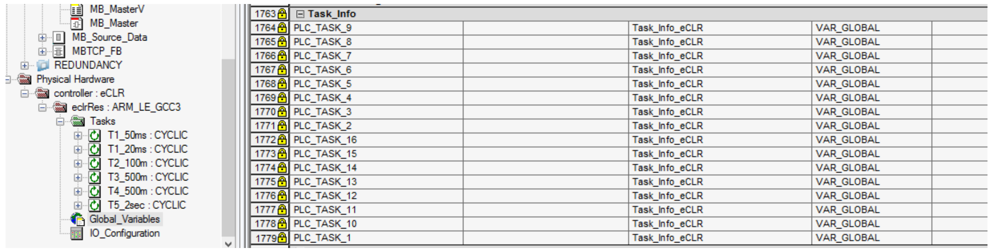
This section introduces how to check task execution time from **Task Info**.

Prerequisites:

- The controller is connected. See Connecting a controller for more information.
- Debug mode must be on. See Debugging the program for more information.

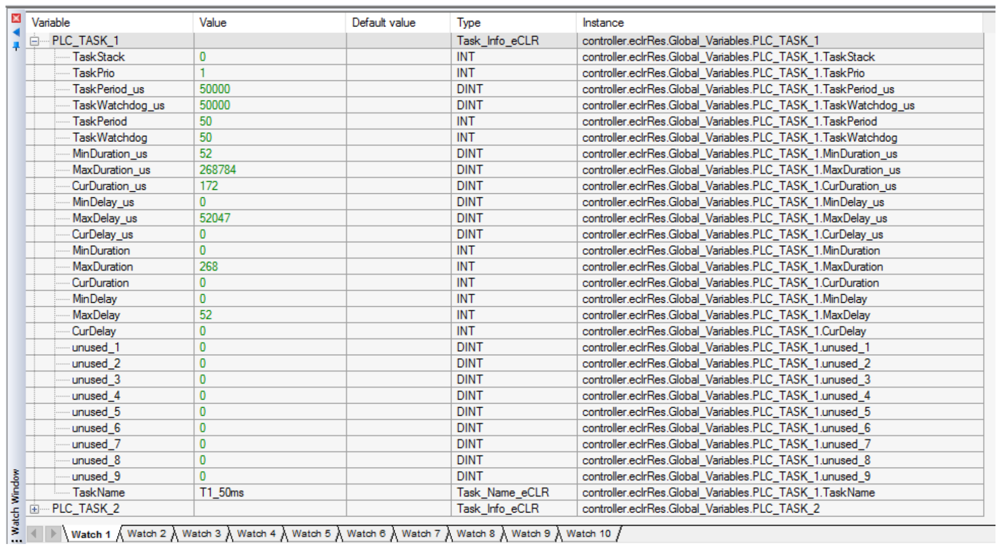
To check the task execution time

1. Click **IEC Programming Workspace** from the toolbar, or from Home Page, click **Program with IEC61131-3**.
2. From **Project Tree Window**, under **Physical Hardware**, double click **Global_Variables** and expand the **Task_Info** group.



1763	Task_Info			
1764	PLC_TASK_9		Task_Info_eCLR	VAR_GLOBAL
1765	PLC_TASK_8		Task_Info_eCLR	VAR_GLOBAL
1766	PLC_TASK_7		Task_Info_eCLR	VAR_GLOBAL
1767	PLC_TASK_6		Task_Info_eCLR	VAR_GLOBAL
1768	PLC_TASK_5		Task_Info_eCLR	VAR_GLOBAL
1769	PLC_TASK_4		Task_Info_eCLR	VAR_GLOBAL
1770	PLC_TASK_3		Task_Info_eCLR	VAR_GLOBAL
1771	PLC_TASK_2		Task_Info_eCLR	VAR_GLOBAL
1772	PLC_TASK_16		Task_Info_eCLR	VAR_GLOBAL
1773	PLC_TASK_15		Task_Info_eCLR	VAR_GLOBAL
1774	PLC_TASK_14		Task_Info_eCLR	VAR_GLOBAL
1775	PLC_TASK_13		Task_Info_eCLR	VAR_GLOBAL
1776	PLC_TASK_12		Task_Info_eCLR	VAR_GLOBAL
1777	PLC_TASK_11		Task_Info_eCLR	VAR_GLOBAL
1778	PLC_TASK_10		Task_Info_eCLR	VAR_GLOBAL
1779	PLC_TASK_1		Task_Info_eCLR	VAR_GLOBAL

3. Right-click the target task and select **Add to Watch Window**, then click **OK**.
4. Right-click the target task again, and select **Open Watch Window**. **Watch Window** appears with the task information.



Variable	Value	Default value	Type	Instance
PLC_TASK_1			Task_Info_eCLR	controller.eclrRes.Global_Variables.PLC_TASK_1
TaskStack	0		INT	controller.eclrRes.Global_Variables.PLC_TASK_1.TaskStack
TaskPrio	1		INT	controller.eclrRes.Global_Variables.PLC_TASK_1.TaskPrio
TaskPeriod_us	50000		DINT	controller.eclrRes.Global_Variables.PLC_TASK_1.TaskPeriod_us
TaskWatchdog_us	50000		DINT	controller.eclrRes.Global_Variables.PLC_TASK_1.TaskWatchdog_us
TaskPeriod	50		INT	controller.eclrRes.Global_Variables.PLC_TASK_1.TaskPeriod
TaskWatchdog	50		INT	controller.eclrRes.Global_Variables.PLC_TASK_1.TaskWatchdog
MinDuration_us	52		DINT	controller.eclrRes.Global_Variables.PLC_TASK_1.MinDuration_us
MaxDuration_us	268784		DINT	controller.eclrRes.Global_Variables.PLC_TASK_1.MaxDuration_us
CurDuration_us	172		DINT	controller.eclrRes.Global_Variables.PLC_TASK_1.CurDuration_us
MinDelay_us	0		DINT	controller.eclrRes.Global_Variables.PLC_TASK_1.MinDelay_us
MaxDelay_us	52047		DINT	controller.eclrRes.Global_Variables.PLC_TASK_1.MaxDelay_us
CurDelay_us	0		DINT	controller.eclrRes.Global_Variables.PLC_TASK_1.CurDelay_us
MinDuration	0		INT	controller.eclrRes.Global_Variables.PLC_TASK_1.MinDuration
MaxDuration	268		INT	controller.eclrRes.Global_Variables.PLC_TASK_1.MaxDuration
CurDuration	0		INT	controller.eclrRes.Global_Variables.PLC_TASK_1.CurDuration
MinDelay	0		INT	controller.eclrRes.Global_Variables.PLC_TASK_1.MinDelay
MaxDelay	52		INT	controller.eclrRes.Global_Variables.PLC_TASK_1.MaxDelay
CurDelay	0		INT	controller.eclrRes.Global_Variables.PLC_TASK_1.CurDelay
unused_1	0		DINT	controller.eclrRes.Global_Variables.PLC_TASK_1.unused_1
unused_2	0		DINT	controller.eclrRes.Global_Variables.PLC_TASK_1.unused_2
unused_3	0		DINT	controller.eclrRes.Global_Variables.PLC_TASK_1.unused_3
unused_4	0		DINT	controller.eclrRes.Global_Variables.PLC_TASK_1.unused_4
unused_5	0		DINT	controller.eclrRes.Global_Variables.PLC_TASK_1.unused_5
unused_6	0		DINT	controller.eclrRes.Global_Variables.PLC_TASK_1.unused_6
unused_7	0		DINT	controller.eclrRes.Global_Variables.PLC_TASK_1.unused_7
unused_8	0		DINT	controller.eclrRes.Global_Variables.PLC_TASK_1.unused_8
unused_9	0		DINT	controller.eclrRes.Global_Variables.PLC_TASK_1.unused_9
TaskName	T1_50ms		Task_Name_eCLR	controller.eclrRes.Global_Variables.PLC_TASK_1.TaskName
PLC_TASK_2			Task_Info_eCLR	controller.eclrRes.Global_Variables.PLC_TASK_2

5. Check **MaxDuration_us** (microsecond) or **MaxDuration** (millisecond) which indicates the task execution time.

CHAPTER

13

COMPILING A PROJECT

After configuring the project, you have to compile it.

To compile a project

Click **Make** or **Rebuild Project** as required to compile the project.

- **Make**: It is used to compile the changed worksheets.
- **Rebuild Project**: It is used to compile the whole project for the first time or if an announced user library has been changed. The command Rebuild Project should only be used if 'Make' generates compiling errors or you have unzipped your project without the frontend code.

While compiling, the message window displays the compilation process. Any detected errors and warnings (e.g. syntax errors, memory or file problems) and additional information are also displayed in the appropriate message window sheet. You can use the message window to access the suspected code body worksheet by double clicking on the error message.

After compiling without any error, you have to download the project to the controller. See Downloading a project to the controller for more information.

CHAPTER

14

DOWNLOADING A PROJECT TO THE CONTROLLER

ATTENTION: Before downloading a project, you must compile it. See Compiling a project for more information.

ATTENTION: Before downloading a project to ControlEdge 2020 controller with IOM(s) connected, even though the IOM(s) are not configured, make sure Expansion I/O is bound to ETH3. Otherwise, it will damage your I/O communication. See Configuring ETH3 for ControlEdge 2020 controller for more information.

After compiling a project without any error, you can download the project to the controller.

Prerequisites:

- The project is opened in ControlEdge Builder. See Opening an existing project for more information.
- Log in as the Administrator or Engineer to connect the target controller. See Connecting a controller for more information.
- The primary CPM is connected if the controller is redundant.

To download a project

1. From the Home Page, click **Download**. A **eclrRes** window appears.

   See the following table for the parameter description of the **eclrRes** window.

Parameter	Description
State	• **On**: The controller is running and accessible via online communication, but no application is loaded. • **Loading**: The state 'Loading' is only visible while installing a controller application (e.g. while loading a bootproject). • **Stop**: The controller application is loaded and

Parameter	Description
	ready to execute (by pressing one of the start buttons). • **Starting**: All necessary initializations are performed including loading the drivers depending on the start up modes (cold/warm/hot). • **Running**: The controller application is executed. • **state [DEBUG]**: The appendix [DEBUG] after the actual state can appear in conjunction with the states RUN, STOP or HALT. [DEBUG] indicates, that the debug mode is active, i.e. either variables are forced or breakpoints are set (if a breakpoint is reached, the state changes to HALT [DEBUG]). • **HALT**: The program execution is halted at a breakpoint which has been set using the 'Debug' dialog. In this state all user tasks are inactive and the I/O images are not updated. The program execution can be resumed with one of the control dialog buttons 'Go', 'Step' or 'Trace'. • **HaltRequested**: Intermediate state: During program execution, a set breakpoint has been reached. All necessary actions to halt the execution of the controller application are performed. • **Stopping**: All necessary actions to stop the execution of the controller application are performed including unloading the drivers. • **Resetting**: Unloads the controller application and clears the eCLR application. • **TIMEOUT**: This state which is also displayed in the control dialog 'Resource_name' indicates that the connection between the programming system and the controller was not established within the given time interval. The corresponding time interval is set in the dialog 'Resource settings...' (field 'Timeout'). During

Parameter	Description
	this interval, the system tries to connect the controller. If the interval has elapsed without a successful connection, the online part of the programming tool enters the TIMEOUT state.
Stop	Stop the program execution on the controller.
Cold	When a cold start is executed: • all data are initialized. • all I/O drivers are executed. • user task which is triggered by System event "Cold start" is called. • all user tasks are activated (ready to be scheduled and executed).
Warm	When a warm start is executed: • only non-retentive data are initialized. • all I/O drivers are executed. • user task which is triggered by System event "Warm start" is called. • all user tasks are activated (ready to be scheduled and executed).
Reset	Reset the controller.
Download	Download the current project to the controller.
For more information, see the embedded online help. Select **Help** > **Contents**, and search for **PLC state machine** to display the corresponding content.	

There are three scenarios:

- If the controller does not contain any project, a dialog appears indicating that download changes are not possible. You must close the dialog and click **Download** from the **eclrRes** window.
- If the project name is different from the one in the running controller, a dialog appears indicating that download changes are not possible. You must close the dialog and click **Stop** in the

eclrRes window to stop the program execution. Then click **Download** from the **eclrRes** window to continue the download.

> **ATTENTION:** If the project is renamed and will be downloaded to the controller, you must compile it before clicking **Download** from the **eclrRes** window even though you have compiled it before renaming.

- If the project name is same as the one in the running controller, the project will be downloaded directly without stopping the program execution. It is also possible while variables are forced.

  The following changes can be downloaded without stopping the program execution:

Item	Changes
1	Changing code of existing POU(s)
2	Inserting/deleting local and global variables
3	Changing local and global variables (incl. initial value)
4	Declaring new function block (user/firmware) instance
5	Adding/deleting data types
6	Changing data type declarations
7	Changing comments in code bodies
8	Using a new POU type in a resource
9	Adding/deleting program instances
10	Adding/deleting tasks
11	Changing any task properties (task type, cycle times, priority, event number, SPG assignment, changing the watchdog time, etc.)
12	Changing configuration in ControlEdge Configuration Workspace

> **ATTENTION:** If the system is not able to ensure real-time, because too many POUs have been changed and the volume of POU instance data to be copied is too large, a user interaction is required. The system displays a message that informs you the program execution will be stopped if you continue the download. Click **Yes** to continue the download. Click **No** to cancel the download.

2. A download confirmation dialog appears to make sure you want to download. Click **Yes**.

> **ATTENTION:** If you want to upload this project in the future, you should select **Download the project to controller**, and a zip file of the archived project will be stored in the controller.

> **ATTENTION:** If you change the I/O network topology from Ring/Star to DLR or from DLR to Ring/Star, a checkbox **Reboot controller** is provided here to reboot the controller automatically after downloading the project. If you do not select the checkbox here, you must reboot the controller manually. See Rebooting a controller for more information.

3. Click **OK** after the project is downloaded to the controller successfully.

   Occasionally, an error message "Missing variables for Modbus Slave" may appear, but it does not have impact. The error message is invalid.

CHAPTER

15

DEBUGGING THE PROGRAM

After the project has been downloaded to the controller, and you have performed a cold or warm start, you can switch the worksheet to online mode to verify and debug the program.

To debug the program, click  from the toolbar under the **IEC Programming Workspace**.

For more information about debugging and online mode, see the embedded online help. Select **Help** > **Contents**, and search for **Phase 5: Debugging the project in online mode** to display the corresponding content.

CHAPTER

16 FORCING AND OVERWRITING VARIABLES

Our system and controller support force and overwrite variables to check the behavior of the program and to eliminate errors while commissioning.

TIP: Forcing and overwriting is only possible while the system is in debugging and online mode.

ATTENTION: Forcing is ONLY applicable for I/O variables.

The difference between forcing and overwriting

Overwriting means the new value of the variable is written ONCE and then the variable is processed normally. Thus, the new value of the variable remains until another new value is assigned to the variable.

Forcing means using the new value for the variable until the forced variable is reset to its normal value by the user.

The necessary steps for forcing and overwriting are nearly the same.

For redundant controller

From ControlEdge Builder R170, it is supported to overwrite some primitive type variables for a synchronized redundant controller, for example BOOL, INT, REAL, STRING and so on. However, it is not allowed to modify variables with STRUCT datatype. A warning will prompt when you modify these complex datatype.

So you have to break controller synchronization before forcing and overwriting variables, then force or overwrite required variables. After that , re-enable controller synchronization.

1. Break controller synchronization.

    a. Click **View Diagnostics** under **Diagnostics**. The diagnostics page appears.

    b. Expand the **System** tab and click the **Redundancy** tab.

   c. Click **Disable Synchronization**.

   d. Expand the **Redundancy** tab and select **Local Status**.

   e. Confirm **Redundancy.RdnSyncState** is **not synchronized....**

2. Force or overwrite required variables. See [To force or overwrite variables]() for more information.

3. Re-enable controller synchronization.

   a. Click **View Diagnostics** under **Diagnostics**. The diagnostics page appears.

   b. Expand the **System** tab and click the **Redundancy** tab.

   c. Click **Enable Synchronization**.

   d. Expand the **Redundancy** tab and select **Local Status**.

   e. Confirm **Redundancy.RdnSyncState** is **synchronized**.

To force or overwrite variables

1. Click the icon  from the toolbar under the **IEC Programming Workspace**, and double-click the variable you want to force. The **Debug: eclrRes** dialog appears.

2. Enter the desired value for a non-Boolean value or choose **TRUE** or **FALSE** for a Boolean variable.

   For the real data type, its value should have at least one digit after the decimal place. For example, if you want to set the force value as 50, you should enter 50.0.

3. Click **Force** to force the variable or **Overwrite** to overwrite the variable.

   Forced variables are indicated by a colored background in the variables worksheet in online mode.

To reset forced variables

You can either reset one specific forced variable or all forced variables.

1. Double-click the variable you want to reset, the **Debug: eclrRes** dialog appears.

2. Click **Reset force** to reset the marked variable or **Reset force list** to reset all forced variables at the same time.

CHAPTER

17 UPLOADING A PROJECT

It is only applicable for ControlEdge 900 controller, the new non-redundant ControlEdge 2020 controller (SC-UCMX02) and Redundant ControlEdge 2020 controller.

If a project is archived in a controller, you can upload and open this project in ControlEdge Builder. Alternatively, you can upload and save it to the PC.

> **ATTENTION:** Only Administrator or Engineer levels can upload a project.

Prerequisite

The project must be archived as a zip file in the controller. See Downloading a project to the controller for more information.

To upload a project

1. From the Home Page, select **More** > **Upload project from controller**. The **Upload Confirmation** dialog appears.
2. There are two options:
   - Click **Open**. If a project is already open when you upload this project, the open project will be saved and closed.

     The uploaded project is saved to the following location by default: C:\Users\Public\Documents\ControlEdge Builder\ArchivedProjects

     Click **OK** to open the project in ControlEdge Builder.
   - Click **Save As**, and select a location to save this project. Click **OK**.

   The uploaded project is stored in a folder named "Project name_ Date_Time".

CHAPTER

18

ADMINISTRATION OF THE SYSTEM

Configuring date/time

Setting time source

The section introduces how to synchronize the controller time to the SNTP server.

For ControlEdge 900 controller, the synchronization is required in order to ensure robust operation of the embedded OPC UA server.

1. From the Home Page, under **Miscellaneous**, click **Configure Date/Time Options**.
2. Select **Enable** and enter the IP addresses of SNTP servers in the **Primary Server** and **Secondary Server** fields.

> **CAUTION:** If you check **Enable** here, under **Configure Protocols** > **DNP3 Outstation**, you should not select **Enable DNP3 Time Synchronization** in **Application Layer** tab to set DNP3 Master as a time soure at the same time.

> **CAUTION:** If using IPsec encrypted communication, users must check **Enable** to set SNTP server as the time source.

3. Adjust the **Poll Interval** to synchronize current controller time to the SNTP server.

   The SNTP message poll interval is Poll Interval power of 2 ($2^{(\text{Poll Interval})}$) in unit of second.

   The maximum poll interval is 17 (approx. 36 hours) and the minimum is 6 (64 seconds).

   It is recommended to set Poll Interval as 16 (approx. 18 hours). To avoid the communication storm, the controller will pick a random poll interval time in the range [2**(Poll Interval)**, 2**(Poll Interval+1)**], not exactly what is configured.

   If the NTP server is not available, you can use the function block (Set_RTC) to configure the controller time. For more information, see “Set_RTC” in the *ControlEdge Builder Function and Function Block Configuration Reference Guide*.

> **TIP:** The recommended poll interval for EFM application is 14.

Setting time zone

1. Click **Configure Date/Time Options** under **Miscellaneous**.
2. Select **Set Time Zone** tab, and select the target time zone from the **Time Zone** drop-down list.
3. Select **Automatically Switch to Daylight Saving Time** if it is applicable.

User privileges

ControlEdge Builder supports three user types namely Operator, Engineer and Administrator. Privileges for the various user types are listed as following:

Table 18-1: Privileges for the various user types

Action Description	Operator	Engineer	Administrator
Change own password	Yes	Yes	Yes
Change other's password	N/A	N/A	Yes
View system diagnostics	Yes	Yes	Yes
View I/O diagnostics	Yes	Yes	Yes
Reset statistics	N/A	Yes	Yes
Disable synchronization	N/A	Yes	Yes
Enable synchronization	N/A	Yes	Yes
Switchover	N/A	Yes	Yes
Become primary	N/A	Yes	Yes
Upload datalog (upload only)	Yes	Yes	Yes
Upload datalog (upload and delete)	N/A	Yes	Yes
View and control datalog status	Yes	Yes	Yes
Upload bulk datalog	Yes	Yes	Yes
Upload system event log	N/A	Yes	Yes

Action Description	Operator	Engineer	Administrator
Download configuration and program	N/A	Yes	Yes
Upload a project	N/A	Yes	Yes
Upgrade firmware	N/A	N/A	Yes
Reboot the controller	N/A	Yes	Yes
Reset the connected controller to factory defaults	N/A	Yes	Yes

The default password of each user type is listed as follows:

Table 18-2: Default password of each user type

User Name	Password
Operator	Oper@123
Engineer	Engr@123
Administrator	Admin@123

Changing the password

You must connect to the controller to change the password. Each user (Administrator, Engineer and Operator) must change the default password after logging in for the first time.

To change a user's password

1. To change a user's password, select **Change Password** under **Miscellaneous**. The **Change Password** dialog appears.
2. Select the target **User Name**, type in the relevant information in the **Original password**, **New password** and **Confirm password** fields and click **OK**.

   The password must have at least one capital letter, one lowercase letter, one number and one non-alpha numeric character (E.g. !@#$%^&;*()) and the length must be minimum eight characters.

Preparing SD card

If you want to use SD card to save datalog or DNP3 event, you must allocate files for data logging or DNP3 event in SD card.

If a redundant controller is used, you should insert SD cards with the same type in both primary and secondary CPM. Otherwise, the datalog or DNP3 event can only be saved in the CPM inserted an SD card.

1. Insert an SD card (32GB Class 6 / Class 10 industry standard) into the computer in which ControlEdge Builder is installed.
2. In the Home Page, click **Prepare SD Card** under **Miscellaneous**.
3. In the pop-up window, the available memory of inserted SD card is displayed in the **Selected SD card volume** field.
4. Select the suitable **SD Card Size** to set the memory in which the datalogs or DNP3 events can be saved. Selected SD card size cannot exceed the available memory of inserted SD card.
5. Click **Start**.

CHAPTER

19

CONTROLLER OPERATION

This section applies to both ControlEdge 900 and 2020 controllers, including non-redundant and redundant controllers. For operations unique to redundant controllers, see Redundant controller operation for more information.

For related hardware diagnostic indications and actions, see "Diagnostics and Troubleshooting" in *ControlEdge 900 Platform Hardware Planning and Installation Guide* or *ControlEdge 2020 Platform Hardware Planning and Installation Guide*.

Overview

The operation of the system varies according to the following factors:

- **Power transitions: Power off / Power on**

  Power off transitions are usually planned and controlled, but in some cases such as power outages, are unintended. To ensure proper operation in either case, the controller includes software that controls operation at power restoration. The controller handles a Power on transition as one of two types: **Cold Start** or **Warm Start**.

- **Operating modes: Running, Stopped, Run Locked and Stop Locked**

  Run Locked and Stop Locked only apply for ControlEdge 900 Controller.

  Operating Modes are selected:

  - (Only apply to ControlEdge 900 Controller)by positioning the physical Mode switch on the CPM,
  - by selecting parameters on ControlEdge Builder.

  In some cases, mode transitions also restart (Cold Start or Warm Start) controller operation.

- **Results of faults**: in case of system hardware or software fault, the controller automatically alters operation as appropriate for the diagnosed conditions.

Warm Start

When a warm start is executed:

- Only non-retentive data are initialized.
- All I/O drivers are executed.
- User task which is triggered by System event "Warm start" is called.
- All user tasks are activated (ready to be scheduled and executed).

Cold Start

When a cold start is executed:

- All data are initialized.
- All I/O drivers are executed.
- User task which is triggered by System event "Cold start" is called.
- All user tasks are activated (ready to be scheduled and executed).

Figure 19-1: Flowchart for the ControlEdge 900 Controller operation

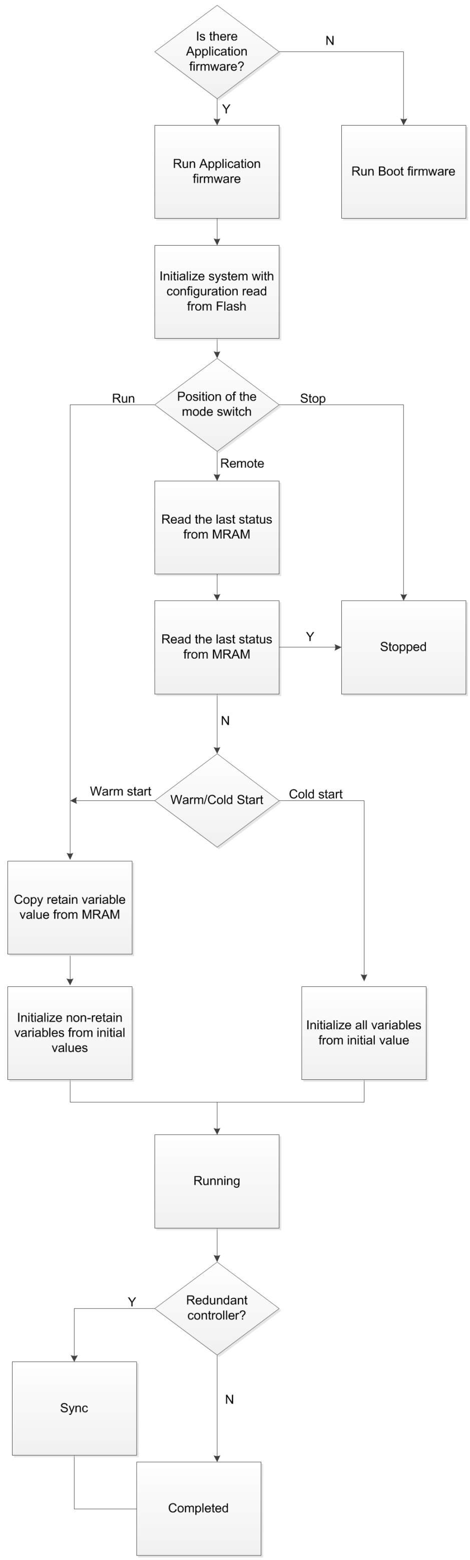
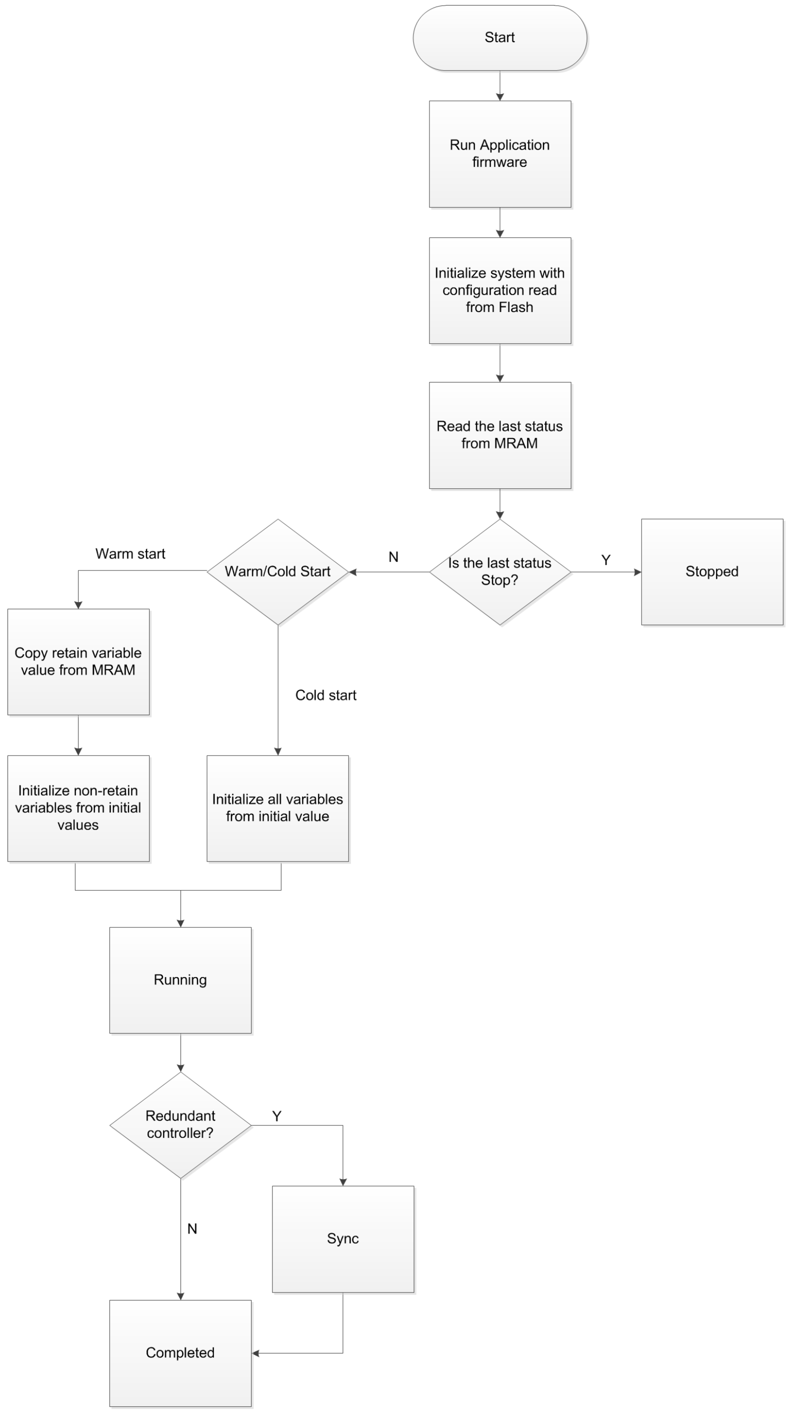


Figure 19-2: Flowchart for the ControlEdge 2020 Controller operation



Redundant controller operation

This section describes operations specific to redundant CPMs. In a redundant system, the primary CPM performs all primary tasks including interfacing with I/O racks, communicating with a local HMI, exchanging data with other controllers, interfacing with Modbus devices, and communicating with a Host PC application.

The primary CPM will initiate a switchover due to the CPM failure, that is, transfer all primary tasks to the secondary CPM, establishing this CPM as primary. A switchover can also be manually commanded by using the global variable **CNTLR_RDNSWITCHCMD** under **Redundancy Local** group.

For the operation flowchart, see the two figures above, Flowchart for the ControlEdge 900 Controller operation or Flowchart for the ControlEdge 2020 Controller operation.

Three operation buttons are provided under **Diagnostics**, Disable/Enable Synchronization, Switchover and Become Primary. See Viewing system diagnostics for more information.

Start up

- Assignment of primary and secondary status is determined at start up.
  - First available CPM assumes the primary.
  - In case of a tie, CPM mounted in the left position of the rack will be the primary.
  - No user configuration or manual operations required to establish the primary / secondary status.
- Primary CPM assumes control of I/O and all external communication interfaces.
- Secondary CPM receives the configuration from the primary CPM.

Sync operations

- Primary CPM issues polls to IOMs for inputs.
- The primary CPM reads I/O responses from IOMs, and syncs to the secondary CPM.
- Primary and secondary both execute function blocks in the control strategy

- Only the primary CPM writes physical outputs to the IOMs.
- Primary CPM responds to communication messages from host devices on the control network.
- Primary and secondary exchange system status data to determine conditions for switchover.

Primary/Secondary CPM synchronization

- Primary CPM automatically synchronizes the Secondary with the configuration database.
  - After download of a configuration from ControlEdge Builder to the Primary
  - After the operation to bring a secondary CPM from the Unavailable state to the On-Line state
- Primary CPM automatically synchronizes the Secondary with run-time data during each execution cycle.
- Both the primary and secondary CPMs execute the application program in the control strategy, but only the primary CPM writes the physical outputs to the IOMs.
- The primary and secondary CPMs exchange system status to determine conditions for switchover.

Switchover

Automatic Switchover

Triggered on any of the following conditions of the primary CPM:

- Loss of communications with IOM(s)
- Processor exception conditions
- Loss of communications to the control network

> **ATTENTION:** During the switchover, analog and digital output status is maintained at the IOMs.

ATTENTION: Redundant ControlEdge 900 controller switchover will lead to PROFINET devices offline for 3s. Some PROFINET devices support failsafe setting. To avoid output signals becoming "0" or a specific value during ControlEdge 900 controller switchover, it is suggested to set it as "Hold Last Value".

Manual Switchover

Via Software Command from ControlEdge Builder, or from controller CPM detail display when integration with Experion, or from the third-party SCADA/ HMI.

Redundancy Diagnostic Monitoring

From ControlEdge Buider:

- Redundant System Status – current status of Primary/Secondary CPM’s
- On-Line Monitoring, CPM Diagnostics
- Redundant Link Status – status of communications between primary and secondary CPMs
- The primary CPM status
- The secondary CPM status

TIP: Redundancy diagnostics can also be monitored from the CPM tab of the controller detail display when integration with Experion, or from the third-party SCADA/HMI. For more information about monitoring diagnostics from Experion, see "Monitoring channel and controller communications" in the *Experion Server and Client Configuration Guide*.

Setting operating modes

The operating modes for the CPM are:

- (Only apply to ControlEdge 900 Controller) **Stop Locked**: All tasks are inactive and ready to be executed, therefore the I/O channels hold last value and no output signals are transmitted to the I/Os.

- (Only apply to ControlEdge 900 Controller) **Run Locked**: CPM performs all control and communication tasks and on-line configuration editing and configuration changes are inhibited.
- **Running**: CPM performs all control and communication tasks and on-line configuration editing are permitted.
- **Stopped**: All tasks are inactive and ready to be executed, therefore the I/O channels hold last value and no output signals are transmitted to the I/Os.

See the following table as a reference when determining your CPM operating mode:

Table 19-1: Operating modes for ControlEdge 900 Controller

Mode Switch position on CPM	STOP	RUN	REMOTE	
Operating mode	Stop Locked	Run Locked	Running	Stopped
Switchover command	Yes	Yes	Yes	Yes
Enabling sync	Yes	Yes	Yes	Yes
Disabling sync	Yes	Yes	Yes	Yes
Becoming primary	Yes	Yes	Yes	Yes
Resetting statistics	Yes	Yes	Yes	Yes
Configuration download	Yes	No	Yes[1]	Yes
Firmware download	Yes	No	Yes[2]	Yes
Forcing outputs	Yes[3]	Yes	Yes	Yes[3]
Warm/Cold reboot	Yes	No	No	Yes
Factory reset	Yes	No	No	Yes
Warm/Cold	No	N/A	N/A	Yes

Mode Switch position on CPM	STOP	RUN	REMOTE	
start command				
Stop Command	N/A	No	Yes	N/A

Note:

1. Two types of configuration download: download changes and download all. Download all is only available when the system is in Stopped or Stop Locked operating mode.
2. Only on-process firmware upgrade is allowed in the Running operating mode.
3. When forcing outputs are in the Stopped state, the forced values are pending until it transits to the Running mode. When forcing outputs are in the Stopped or Stop Locked operating mode, the forced values are pending until it transits to the Running or Run Locked operating mode.

To change the operating modes, turn the mode switch on CPM or configure from the configuration tool when the mode switch is in REMOTE position.

Table 19-2: Operating modes for ControlEdge 2020 Controller

Operating mode	Running	Stopped
Switchover command	Yes	Yes
Enabling sync	Yes	Yes
Disabling sync	Yes	Yes
Becoming primary	Yes	Yes
Resetting statistics	Yes	Yes
Configuration download	Yes[1]	Yes
Firmware download	Yes[2]	Yes
Forcing outputs	Yes	Yes[3]
Warm/Cold reboot	No	Yes
Factory reset	No	Yes
Warm/Cold start command	N/A	Yes

Operating mode	Running	Stopped
Stop Command	Yes	N/A

Note:

1. Two types of configuration download: download changes and download all. Download all is only available when the system is in Stopped or Stop Locked operating mode.
2. Only on-process firmware upgrade is allowed in the Running operating mode.
3. When forcing outputs are in the Stopped state, the forced values are pending until it transits to the Running mode. When forcing outputs are in the Stopped or Stop Locked operating mode, the forced values are pending until it transits to the Running or Run Locked operating mode.

To change the operating mode

1. From the Home Page, click the **Project Control Dialog** icon on the toolbar.
2. Click **Warm** or **Cold** to change the operating mode to Running. Click **Stop** to change the operating mode to Stopped. About **Warm**, **Cold** and **Stop**. See Downloading a project to the controller for more information.

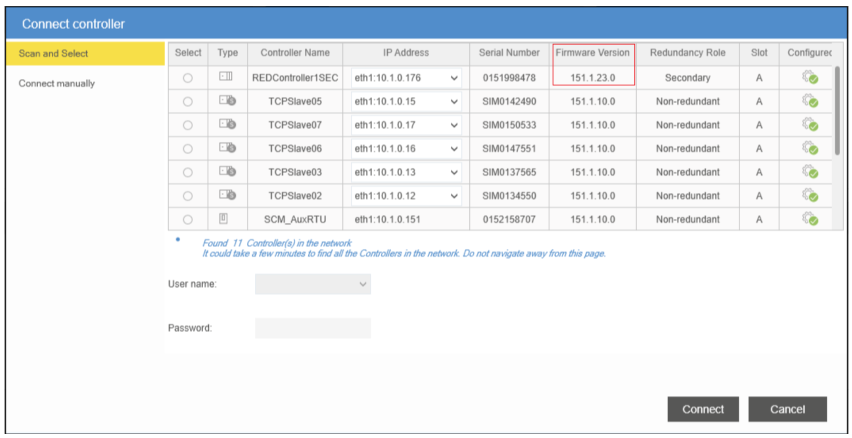
CHAPTER 20

MAINTENANCE

Checking firmware versions

To check the CPM firmware version

1. From the Home Page of ControlEdge Builder, click **Connect**, and then the **Connect controller** page appears.
2. All available CPMs in the same network are listed, check the firmware version.

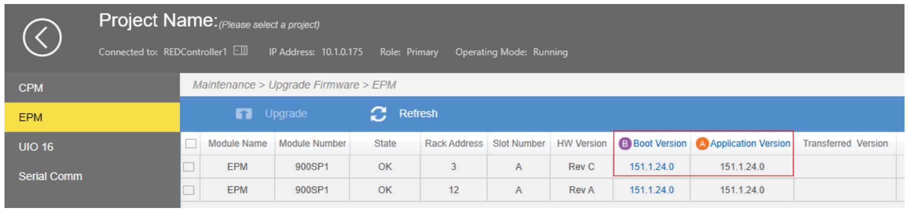


To check the EPM, IOM firmware version

> **ATTENTION:** Using ControlEdge Builder R151, ControlEdge 2020 controller with firmware R151 cannot detect or upgrade Expansion I/O modules with firmware R150 and lower. Starting from ControlEdge Builder R160, there is no such limitation. A check box **List R150 or lower Expansion IOMs** is provided to show IOMs with firmware R150 and lower.

1. From the Home Page of ControlEdge Builder, click **Upgrade Firmware** under **Maintenance**.
2. Click EPM or I/O module tab, it will show the connected EPM,

IOM Boot Version and Application Version.



Downgrading firmware

For ControlEdge 2020 controller, this section is only applicable for R110, R140, R150, R151 and later.

For ControlEdge 900 controller, it is applicable for any releases.

> **NOTE:** Only one ControlEdge Builder can be installed on one computer.

Downgrading CPM

Prerequisite

- Install R151 or later ControlEdge Builder on your computer.
- Get the target CPM firmware package ready.

Procedure

See Upgrading firmware for a non-redundant controller for more information.

See Upgrading firmware for a redundant controller for more information.

Downgrading I/O modules

Prerequisite

- Use your existing ControlEdge Builder, or install a ControlEdge Builder that is higher than the CPM version on your computer.
- Get the target IOM firmware package ready.

Procedure

See Upgrading ControlEdge 2020 Expansion I/O firmware for more information.

See Upgrading ControlEdge 900 I/O module firmware for more information.

See Upgrading serial module firmware for more information.

Downgrading EPM

Prerequisite

- Make sure that CPM version is same with or higher than EPM version. If CPM version is lower than EPM's, you must upgrade CPM first.
- Install ControlEdge Builder that is same with or higher than the CPM version on your computer.
- Get the target EPM firmware package ready.

Procedure

See Upgrading EPM firmware for more information.

Upgrading a system

Upgrading ControlEdge RTU

> **NOTE:** This section only considers upgrading R110, R140, R150 to R151 and later.

Prerequisite

- Install R151 or later ControlEdge Builder on your computer.
- Get R151 or later CPM and IOM firmware packages ready.

Procedure

1. Upgrade all IOM firmwares. See Upgrading ControlEdge 2020 Expansion I/O firmware for more information.
2. Upgrade CPM firmware.

   See Upgrading firmware for a non-redundant controller for more information.

   See Upgrading firmware for a redundant controller for more information.
3. Upgrade the project. See Upgrading a project for more

information.

4. Compile and download the project to the upgraded controller.
   a. See Compiling a project for more information.
   b. See Downloading a project to the controller for more information.

Upgrading ControlEdge PLC

> **NOTE:** This section is applicable for upgrading any releases to R151 and later.

Prerequisite

- Install R151 or later ControlEdge Builder on your computer.
- Get R151 or later CPM, EPM and IOM firmware packages ready.

Procedure

1. Upgrade CPM firmware.

   See Upgrading firmware for a non-redundant controller for more information.

   See Upgrading firmware for a redundant controller for more information.
2. Upgrade EPM firmwares. See Upgrading EPM firmware for more information.
3. Upgrade all IOM firmwares.

   See Upgrading ControlEdge 900 I/O module firmware for more information.

   See Upgrading serial module firmware for more information.
4. Upgrade the project. See Upgrading a project for more information.
5. Compile and download the project to the upgraded controller.
   a. See Compiling a project for more information.
   b. See Downloading a project to the controller for more information.

Converting a project among different type of controllers

It is ONLY applicable for ControlEdge 2020 Controller.

Starting from R150, you can convert a project to apply to different type of controllers.

> **NOTE:** SC-UCMX02 project cannot be converted to SC-UCMX01 project.

> **NOTE:** SC-UCMX01 project can be converted to SC-UCMX02 project R160.

Prerequisite

Install the latest ControlEdge Builder in your computer. See the *Software Installation User's Guide* for how to install ControlEdge Builder.

To convert a project

1. Launch the latest ControlEdge Builder, and open the project you want to convert.
2. From the **Controller HW** drop-down list, select the model number of the target controller.

   A warning message appears that this operation will reset the existing DNP3 mapping table "Experion". If this table has been used, it must be renamed before this operation. And after conversion, it must be bound to DNP3 outstation protocol again.
3. Click **Yes** to continue or click **No** to cancel.

   After conversion successful, **Controller HW** will show the model number of the target controller.
4. Click **Rebuild** to compile the project.
5. Click **Download** to load the configuration to the controller.

   Before downloading the converted project, make sure the controller firmware version is same as the project version.

   If the controller firmware version is different to the project version, you can perform one of the following operations.

   - Upgrade/Downgrade controller firmware. See Upgrading firmware for more information.

- Upgrade the project. See Upgrading a project for more information.

Upgrading a project

> **ATTENTION:** This upgrade process is non-interruptible and non-reversible. Once the project is upgraded to the new version, it cannot be opened with a previous release of ControlEdge Builder.

> **ATTENTION:** Do not upgrade user defined libraries if any.

For ControlEdge 900 Controller:

From R140 onwards, a maximum of 16 TCP ports can be configured for bound protocol communications. If more than 16 TCP ports have previously been configured, only 16 of them, randomly selected, will receive data.

For ControlEdge 2020 Controller:

SC-UCMX01 project cannot be upgraded to R160 or later.

Before upgrading a project, it is recommended to:

- Upload any existing datalog files from the controller because they will be deleted after the project is upgraded. See Uploading datalog for more information.
- Back up the project. See Managing a project for more information.

Prerequisite

- Install the latest ControlEdge Builder in your computer. See the *Software Installation User's Guide* for how to install ControlEdge Builder.
- The controller firmware is upgraded successfully.

To upgrade a project

1. Launch the target ControlEdge Builder and open a project.
2. Select the target version from **FW** drop-down list. Click **Yes** to continue or click **No** to cancel.

> **ATTENTION:** The upgrade is a non-interruptible and non-reversible operation, and the DNP3 mapping table "Experion" will not be available after upgrade. If this table has been used, it should be renamed before this operation. And after upgrade, it should be bound to DNP3 outstation protocol again.

3. If TimeUTC and TimeLocal function blocks are used, they should be replaced. See Replacing TimeUTC and TimeLocal with GetRealTimeClock for more information.
4. If the OPC UA function block with Timeout pins used, the data type UINT of Timeout should be replaced with Time.
5. If you have defined the data type **UINTList**, you must remove it. Otherwise, a error message appears when you compile the project. See Project compile fails with error message Data type UINTList is defined more than once for more information.
6. Click **Rebuild** to compile the project.
7. Click **Download** to load the configuration to the controller.

   For ControlEdge 2020 controller:

   - From previous releases to R151, click **Project Control Dialog** and click **Download**.
   - From R151 to later releases, click **Download** from Home Page.

Upgrading firmware

> **ATTENTION:** Do not power off when upgrading firmware.

- If a connected field device or FDAP is OWR300 firmware, the controller must be upgraded to R140 or later releases.
- If a connected field device is Honeywell OW R300 or third party ISA100 2011 device, the controller must be upgraded to R140 or later releases, and FDAP must be upgraded to OW R300.
- For ControlEdge 2020 controller:
  - Using ControlEdge Builder R151, ControlEdge 2020 controller with firmware R151 cannot detect or upgrade Expansion I/O modules with firmware R150 and lower. Starting from ControlEdge Builder R160, there is no such limitation. You can

check the option "**List R150 or lower Expansion IOMs**" to display these IOMs.

- For ControlEdge 900 controller, make sure the CPM version is same as or higher than the EPM version. In this case:
  - No specific upgrade sequence
  - Downgrade EPM before CPM

Before upgrading the firmware, it is required to:

- Log in as the Administrator to connect the target controller. See Connecting a controller for more information.
- Install the latest ControlEdge Builder on your computer. See the *ControlEdge Builder Software Installation User's Guide* for details.

> **NOTE:** After upgrading the firmware, it is recommended to check the firmware version to ensure the firmware is upgraded successfully. See Checking firmware versions for more information.

Upgrading firmware for a non-redundant controller

> **ATTENTION:** It is recommended to upgrade the firmware without opening a project. Firmware upgrade could cause loss of control in an operating process.

For ControlEdge 900 controller, the firmware upgrade is ONLY allowed in **Stop Locked**, **Running** or **Stopped** operating modes.

You can rotate the mode switch on CPM to change operating modes, see "CPM mode switch" in *ControlEdge 900 Platform Hardware Planning and Installation Guide*. If the mode switch is in the REMOTE position, see Setting operating modes for more information.

To upgrade the firmware

1. From the Start Page, click **Connect** to connect the target controller.
2. From the Home Page, select **Upgrade Firmware** under **Maintenance**, and select the controller you want to upgrade. See the following tables for the target controller information.

Parameter	Description
Module	The configured controller name

Parameter	Description
Name	
Model Number	Model number of the connected controller
State	• **Running**: The program execution is activated and the inputs and outputs of the I/O image are updating according to the I/O configuration. • **Stopped**: A program is loaded in the controller but all user tasks are inactive, therefore the I/O images are not updated and no output signals are being transmitted to the I/O. • **On**: No program is loaded in the controller. • **FW Upgrading**: Controller is in firmware upgrade process. • **Not Available**: It is failed to detect the controller in an expected time after firmware upgrade is started.
Redundancy Role	• **Non-Redundant**: Indicates a non-redundant controller system. • **Primary**: Indicates a redundant controller system and the primary controller is connected. • **Secondary**: (apply to ControlEdge 900 Controller) Indicates a redundant controller system and the secondary controller is connected.
Rack Address	Address of the rack in which the controller is installed
Slot Number	The position of the slot on which the controller is installed: • **A** • **B** (only apply to a redundant controller)

Parameter	Description
HW Version	(apply to ControlEdge 900 Controller) Controller hardware version
HW-Kernal Version	(apply to ControlEdge 2020 Controller) The version of the Kernal board
HW-Application Version	(apply to ControlEdge 2020 Controller) The version of the App board
B Boot Version[1]	(apply to ControlEdge 900 Controller and the redundant ControlEdge 2020 Controller) Boot firmware version The controller runs the boot firmware if the application firmware is not available or corrupt. The boot version has a colored icon to differentiate it from application firmware version.
A Application Version[1]	Application firmware version User configuration settings can only be downloaded if the controller is running application firmware.
Transferred Version	The version of the firmware image which has been transferred to the controller. The version has a colored icon. • B: Indicates the transferred image is the boot firmware image • A: Indicates the transferred image is the application firmware image The transferred firmware image will be deleted from the controller after reboot.
Note1: If either of the Boot firmware or Application firmware is invalid, only the invalid one can be upgraded.	

3. Click **Upgrade**. The **Upgrade firmware** dialog appears.

The controller is keeping running when you transfer the firmware to the controller, and will be stopped when you upgrade the firmware. So when the controller is running, we provide the interactive mode to control when the controller stops.

- If you select the Interactive mode, a dialog appears confirming that the transfer is complete. Click **Next** to upgrade the firmware, and the controller is stopped. You can also click **Cancel** to quit the upgrade process.
- If you do not select the Interactive mode , the firmware will be upgraded directly after the transfer. The controller will be stopped without any prompt.

4. Click **Proceed with Upgrade** to continue.
5. From the **Release Number** list, select the target release module. The target firmware version is displayed.

> **TIP:** If you want to use a controller as an FTE node, you must select "Release number_FTE".

6. Click **Next**. The target firmware name, state and version are displayed.
7. Click **Next** to transfer and upgrade the firmware.
8. After the boot firmware is upgraded, enter the password to re-connect the controller. The application firmware is transferred and upgraded.
9. After the application has been upgraded, enter the password to re-connect the controller.
10. Click **OK** to complete the firmware upgrade.

Upgrading firmware for a redundant controller

> **ATTENTION:** It is recommended to upgrade the firmware without opening a project.

There are two procedures for the firmware upgrade of an redundant controller.

- **On-process**: The primary CPM is synced with the secondary CPM.

> **ATTENTION:** On-process is ONLY applicable for upgrading R150 to later release firmwares.

- **Off-process**: The primary CPM is not synced with the secondary CPM.

  For ControlEdge 900 Controller, it is ONLY allowed in **Stopped, Running** or **Stop Locked** operating mode.

  You can rotate the mode switch on CPM to change the operating mode, see "CPM mode switch" in *ControlEdge 900 Platform Hardware Planning and Installation Guide*. If the mode switch is in the REMOTE position, see Setting operating modes for more information.

Prerequisites

- Assume the primary CPM is at slot A and the secondary CPM is at slot B.
- Both primary (slot A) and secondary (slot B) CPMs are powered on.

To upgrade the firmware with On-process procedure

1. From the Start Page, click **Connect** to connect the target primary CPM (slot A).
2. From the Home Page, select **Upgrade Firmware** under **Maintenance**, and select the CPM you want to upgrade.
3. Click **Upgrade**. The **Upgrade firmware** dialog appears.
4. From the **Release Number** list, select the target release module. The target firmware version is displayed.

   > **TIP:** If you want to use a controller as an FTE node, you must select "Release number_FTE".

5. Click **Next**. The target firmware name, state, and version are displayed.
6. Click **Next** to transfer and upgrade the firmware.
7. After the boot and application firmware is upgraded, enter the password to re-connect the controller.
8. Click **Go Back** to revert to the previous firmware version, or click

Proceed to complete the upgrade.

9. The primary CPM is synchronizing with the secondary CPM. Click OK to complete the firmware upgrade.

   The secondary CPM (slot B) becomes the primary one and the original primary CPM (slot A) becomes the secondary one.

To upgrade the firmware with Off-process procedure

> **ATTENTION:** This procedure could cause loss of control in an operating process.

> **ATTENTION:** For ControlEdge 2020 controller, if the controller is connected with I/O modules, you must stop the program before performing the off-process procedure.

1. From the Start Page, click **Connect** to connect the target primary CPM (slot A).
2. From the Home Page, select **Upgrade Firmware** under **Maintenance**, and select the CPM you want to upgrade.
3. Click **Upgrade**. The **Upgrade firmware** dialog appears.

   The controller is keeping running when you transfer the firmware to the controller, and will be stopped when you upgrade the firmware. So when the controller is running, we provide the interactive mode to control when the controller stops.

   - If you select the Interactive mode, a dialog appears confirming that the transfer is complete. Click **Next** to upgrade the firmware, and the controller is stopped. You can also click **Cancel** to quit the upgrade process.
   - If you do not select the Interactive mode , the firmware will be upgraded directly after the transfer. The controller will be stopped without any prompt.
4. Click **Proceed with Upgrade** to continue.
5. From the **Release Number** list, select the target release number. The target firmware version is displayed.

   > **TIP:** If you want to use a controller as an FTE node, you must select "Release number_FTE".
6. Click **Next**. The target firmware name, state and version are

displayed.

7. Click **Next** to transfer and upgrade the firmware.
8. After the boot firmware is upgraded, enter the password to re-connect the controller. The application firmware is transferred and upgraded.
9. After the application has been upgraded, enter the password to re-connect the controller.
10. The firmware upgrades.
11. Perform the relevant procedures for ControlEdge 2020 controller and ControlEdge 900 controller.
    - For ControlEdge 2020 controller:
        a. Click **OK**. The primary CPM synchronizes the firmware with the secondary CPM, and upgrades the firmware of the secondary CPM automatically.
        b. To check whether the secondary CPM upgrade is complete, click **Connect** from the Home Page and check that the **Firmware version** is the same as the primary CPM.
    - For ControlEdge 900 controller:
        - Upgrading the previous release to R150
            a. Connect to the secondary CPM (slot B).
            b. Repeat Step 1 to Step 10 to upgrade the firmware on the secondary CPM.
        - Upgrading R150 to the later release
            a. Click **OK**. The primary CPM synchronizes the firmware with the secondary CPM, and upgrades the firmware of the secondary CPM automatically.
            b. To check whether the secondary CPM upgrade is complete, click **Connect** from the Home Page and check that the **Firmware version** is the same as the primary CPM.

Upgrading EPM firmware

EPM firmware upgrade is ONLY allowed in **Stop Locked**, **Running** or **Stopped** operating modes.

You can rotate the mode switch on CPM to change operating modes, see "CPM mode switch" in *ControlEdge 900 Platform Hardware Planning and Installation Guide*. If the mode switch is in REMOTE position, see Setting operating modes for more information.

> **ATTENTION:** If the EPM is being upgraded, all I/O modules in the same rack will keep in failsafe state until the firmware upgrade is completed.

Prerequisites

For a redundant system with ring topology, you must disable the synchronization first.

To upgrade EPM

1. From the Start Page, click **Connect** to connect the target controller.
2. From the Home Page, select **Upgrade Firmware** under **Maintenance**, The **Upgrade Firmware** dialog appears.
3. Click **EPM** tab, all available EPMs are displayed with the following information.

   At least one I/O module, which is in the same rack with the target EPM, must be added in the Configure I/O page and downloaded to the controller, then the target EPM will be displayed here. See Configuring modules and channels for more information.

Parameter	Description
Module Name	The configured EPM module type
Model Number	Model number of EPM
States	• **OK**: EPM is working normally. • **Error**: Error exists in EPM. • **Not Configured**: Indicates the detected EPM is not configured. • **FW Upgrading**: Indicates EPM is in firmware upgrade process. • **Offline**: It is failed to detect the EPM in an expected time after firmware upgrade is started.

Parameter	Description
Redundancy Role	• **Non-Redundant:** Indicates a non-redundant EPM. • **Active:** Indicates the EPM is active in dual EPMs application.
Rack Address	Rack address configured from 1x and 10x rotary switches on EPM hardware, ranging from 1 to 99.
Slot Number	The position of the slot on which EPM is installed. • **A** • **B** (only applicable for a redundant EPMs)
HW Version	EPM hardware version
B Boot Version[1]	Boot firmware version EPM runs the boot firmware if the application firmware is not available or corrupt. The boot version has a colored icon to differentiate it from application firmware version.
A Application Version[1]	Application firmware version User configuration settings can only be downloaded if the EPM is running application firmware.
Transferred Version	The version of the firmware image which has been transferred to the target module. The version has a colored icon. • B: Indicates the transferred image is the boot firmware image • A: Indicates the transferred image is the application firmware image The transferred firmware image will be deleted after reboot.
Note1: If either of the Boot firmware or Application firmware is invalid, only the invalid one can be upgraded.	

4. Select or multiselect the target EPMs and click **Upgrade**. The **Upgrade firmware** dialog appears.

   The controller is keeping running when you transfer the firmware to the controller, and will be stopped when you upgrade the firmware. So when the controller is running, we provide the interactive mode to control when the controller stops.

   - If you select the Interactive mode, a dialog appears confirming that the transfer is complete. Click **Next** to upgrade the firmware, and the controller is stopped. You can also click **Cancel** to quit the upgrade process.
   - If you do not select the Interactive mode , the firmware will be upgraded directly after the transfer. The controller will be stopped without any prompt.
5. Click **Proceed with Upgrade** to continue.
6. From the **Release Number** list, elect the target release number. The target firmware version is displayed.
7. Click **Next**. The target firmware name, state and version are displayed.
8. Click **Next** to transfer and upgrade the firmware.
9. After the upgrade is completed, a dialog appears. You can check which EPM is upgraded successfully, which one is failed.
10. Click **OK**.

Upgrading ControlEdge 900 I/O module firmware

I/O module firmware upgrade is ONLY allowed in **Stop Locked**, **Running** or **Stopped** operating modes.

> **ATTENTION:** The target I/O module must be added in the Configure I/O page and downloaded to the controller. See Configuring modules and channels for more information.

To upgrade I/O modules

1. From the Start Page, click **Connect** to connect the target controller.
2. From the Home Page, select **Upgrade Firmware** under **Maintenance**, The **Upgrade Firmware** dialog appears.
3. Click the **UIO 16** tab, all available I/O modules are displayed with the following information.

Parameter	Description
Module Name	The configured I/O module type
Model Number	Model number of the I/O module
States	• **OK**: The module is working normally. • **Error**: Error exists in the module. • **Not Configured**: Indicates the detected module is not configured. • **Offline**: It is failed to detect the module in an expected time within which upgrade process is expected to be completed.
Redundancy Role	**N/A**: Not applicable to I/O module.
Rack Address	Rack address, 0 or ranging from 1 to 99 • If the I/O module is mounted in the local I/O rack, the rack address is 0. • If the I/O module is mounted in the expansion I/O rack, the rack address is ranging from 1 to 99.
Slot Number	The position of the slot on which the I/O module is mounted, ranging from 1 to 12. • If the I/O module is mounted in the 4-slot rack, the slot number is ranging from 1 to 4. • If the I/O module is mounted in the 8-slot rack, the slot number is ranging from 1 to 8. • If the I/O module is mounted in the 12-slot rack, the slot number is ranging from 1 to 12.

Parameter	Description
HW Version	I/O module hardware version
B Boot Version[1]	Boot firmware version The I/O module runs the boot firmware if the application firmware is not available or corrupt. The boot version has a colored icon to differentiate it from application firmware version.
A Application Version[1]	Application firmware version User configuration settings can only be downloaded if the I/O module is running application firmware.
Transferred Version	The version of the firmware image which has been transferred to the target module. The version has a colored icon. • B: Indicates the transferred image is the boot firmware image • A: Indicates the transferred image is the application firmware image The transferred firmware image will be deleted after reboot.
Note1: If either of the Boot firmware or Application firmware is invalid, only the invalid one can be upgraded.	

4. Select or multiselect the target I/O modules and click **Upgrade**. The **Upgrade firmware** dialog appears.

   The controller is keeping running when you transfer the firmware to the controller, and will be stopped when you upgrade the firmware. So when the controller is running, we provide the interactive mode to control when the controller stops.

   - If you select the Interactive mode, a dialog appears confirming that the transfer is complete. Click **Next** to upgrade the firmware, and the controller is stopped. You can also click **Cancel** to quit the upgrade process.

- If you do not select the Interactive mode , the firmware will be upgraded directly after the transfer. The controller will be stopped without any prompt.

5. Click **Proceed with Upgrade** to continue.
6. From the **Release Number** list, select the target release number. The target firmware version is displayed.
7. Click **Next**, the target firmware name, state and version are displayed.
8. Click **Next** to transfer and upgrade the firmware.
9. After the upgrade is completed, a dialog appears. You can check which module is upgraded successfully, which one is failed.
10. Click **OK**.

Upgrading serial module firmware

Serial module firmware upgrade is ONLY allowed in **Stop Locked**, **Running** or **Stopped** operating modes.

> **ATTENTION:** The target serial module must be added in the Configure Serial Modules page and downloaded to the controller. See Configuring serial modules for more information.

To upgrade serial modules

1. From the Start Page, click **Connect** to connect the target controller.
2. From the Home Page, select **Upgrade Firmware** under **Maintenance**, The **Upgrade Firmware** dialog appears.
3. Click the **Serial Comm** tab, all available serial modules are displayed with the following information.

Parameter	Description
Module Name	The configured serial module type
Model Number	Model number of the serial module
States	• **OK**: The module is working normally.

Parameter	Description
	• **Error**: Error exists in the module. • **Not Configured**: Indicates the detected module is not configured. • **Offline**: It is failed to detect the module in an expected time within which upgrade process is expected to be completed.
Rack Address	Rack address, 0 or ranging from 1 to 99 • If the serial module is mounted in the local I/O rack, the rack address is 0. • If the serial module is mounted in the expansion I/O rack, the rack address is ranging from 1 to 99.
Slot Number	The position of the slot on which the serial module is mounted, ranging from 1 to 12. • If the serial module is mounted in the 4-slot rack, the slot number is ranging from 1 to 4. • If the serial module is mounted in the 8-slot rack, the slot number is ranging from 1 to 8. • If the serial module is mounted in the 12-slot rack, the slot number is ranging from 1 to 12.
HW Version	Serial module hardware version
B Boot Version[1]	Boot firmware version The serial module runs the boot firmware if the application firmware is not available or corrupt. The boot

Parameter	Description
	version has a colored icon to differentiate it from application firmware version.
A Application Version[1]	Application firmware version User configuration settings can only be downloaded if the serial module is running application firmware.
Transferred Version	The version of the firmware image which has been transferred to the target module. The version has a colored icon. • B: Indicates the transferred image is the boot firmware image • A: Indicates the transferred image is the application firmware image The transferred firmware image will be deleted after reboot.
Note1: If either of the Boot firmware or Application firmware is invalid, only the invalid one can be upgraded.	

4. Select or multiselect the target serial modules and click **Upgrade**. The **Upgrade firmware** dialog appears.

   The controller is keeping running when you transfer the firmware to the controller, and will be stopped when you upgrade the firmware. So when the controller is running, we provide the interactive mode to control when the controller stops.

   - If you select the Interactive mode, a dialog appears confirming that the transfer is complete. Click **Next** to upgrade the firmware, and the controller is stopped. You can also click **Cancel** to quit the upgrade process.
   - If you do not select the Interactive mode , the firmware will be upgraded directly after the transfer. The controller will be stopped without any prompt.

5. Click **Proceed with Upgrade** to continue.
6. From the **Release Number** list, select the target release number. The target firmware version is displayed.
7. Click **Next**, the target firmware name, state and version are displayed.
8. Click **Next** to transfer and upgrade the firmware.
9. After the upgrade is completed, a dialog appears. You can check which module is upgraded successfully, which one is failed.
10. Click **OK**.

Upgrading ControlEdge 2020 Expansion I/O firmware

> **ATTENTION:** It is recommended to upgrade the firmware without opening a project.

> **ATTENTION:** Using ControlEdge Builder R151, ControlEdge 2020 controller with firmware R151 cannot detect or upgrade Expansion I/O modules with firmware R150 and lower. Starting from ControlEdge Builder R160, there is no such limitation.

> **ATTENTION:** The target I/O module must be added in the Configure I/O page and downloaded to the controller. See Configuring modules and channels for more information.

1. From the Start Page, click **Connect** to connect the target controller.
2. From the Home Page, select **Upgrade Firmware** under **Maintenance**, The **Upgrade Firmware** dialog appears.
3. Click **Expansion I/O** tab, all available expansion I/O modules are displayed with the following information.

Parameter	Description
Module Name	Expansion I/O module name
IOM Address	The address of the expansion I/O module, ranging from 1 to 99.
HW	Expansion I/O module hardware version

Parameter	Description
Version	
A Application Version	Application firmware version User configuration settings can only be downloaded if the expansion I/O is running application firmware.
Transferred Version	The version of the firmware image which has been transferred to the target module. The version has a colored icon A, indicating the transferred image is the application firmware image. The transferred firmware image will be deleted after reboot.

4. If you want to upgrade firmware of Expansion I/O modules R150 and lower, check the box **List R150 or lower Expansion IOMs** to display these IOMs first. It takes several seconds to display IOMs.
5. Select or multiselect the target Expansion I/O modules and click **Upgrade**. The **Upgrade firmware** dialog appears.

   The controller is keeping running when you transfer the firmware to the controller, and will be stopped when you upgrade the firmware. So when the controller is running, we provide the interactive mode to control when the controller stops.

   - If you select the Interactive mode, a dialog appears confirming that the transfer is complete. Click **Next** to upgrade the firmware, and the controller is stopped. You can also click **Cancel** to quit the upgrade process.
   - If you do not select the Interactive mode , the firmware will be upgraded directly after the transfer. The controller will be stopped without any prompt.
6. Click **Proceed with Upgrade** to continue.
7. From the **Release Number** list, select the target release number. The target firmware version is displayed.
8. Click **Next**. The target firmware name, state and version are displayed.
9. Click **Next** to transfer and upgrade the firmware.
10. After the upgrade is completed, a dialog appears. You can check which Expansion I/O is upgraded successfully, which one is failed.

11. Click **OK**.

Upgrading the FDAP and field device firmware via Wireless

The FDAPs and field devices have radio firmware that can be upgraded. Some field devices may have a separate application firmware, which handles the functioning of the sensor in the device. This can also be upgraded over the wireless network. For more information about upgrading the firmware of field devices, refer to the field device vendor's documentation. Honeywell field devices usually have separate firmware files for radio firmware and application firmware. FDAPs have only radio firmware.

> **ATTENTION:** If either of the field device and FDAP is upgraded to OW R300, the other one should be upgraded too.

Upgrading the field device firmware

The devices at the farthest hop level must be upgraded first.

To upgrade a field device firmware

1. On the Selection Panel, select the field device. You can select multiple devices of the same type using the Selection Panel. Click and hold SHIFT key on the keyboard and select multiple items in a successive list. Click and hold CTRL key on the keyboard and select multiple items not in succession.

   > **TIP:** It is recommended to select and accept up to three devices at a time.

2. Click one of the following icons as required in the **Upgrade** group from the Ribbon Bar. Application firmware must be upgraded before upgrading the radio firmware.
   - **Application**: To upgrade the application firmware of the selected field device.
   - **Radio**: To upgrade the radio firmware of the selected field device.

   The **Application/Radio Firmware Upgrade** dialog box appears.

3. Depending on the firmware type, the available upgrade files

appear by default. Select the required file from the list of upgrade files. If the file is not available in the list, perform the following steps.

   a. Click **Add** to browse to the directory location of the firmware upgrade file.

   b. Select the target firmware upgrade file, and click **Open**.

4. Click **Upgrade**. The **Application/Radio Firmware Upgrade** dialog box closes. The **Firmware Upgrade Status** dialog box displaying the status of the upgrade appears. Closing the dialog box allows the upgrade operation to run in the background.

   Once the upgrade is complete, the status column displays the status as complete. If firmware upgrade fails for a device, you can abort the upgrade and start again. To abort firmware upgrade for individual devices, click the abort button next to the status indicator.

   See the following tips for other operations:

   - To abort any firmware upgrade operation, click the **Abort Upgrade** icon besides the upgrade status.
   - To remove the devices whose firmware was upgraded successfully, click the **Clear Upgrade** icon besides the upgrade status.
   - The field device will be rebooted after the field device radio firmware upgraded successfully.

5. Close the **Firmware Upgrade Status** dialog box.

6. Verify the upgraded version of the field device firmware as follows:

   a. On the Selection Panel, select the field device.

   b. On the Property Panel, expand **Device Manager Summary**.

   c. Under **Identification**, check **Revision**.

Upgrading the FDAP firmware

1. On the Selection Panel, select the target FDAP. You can select multiple devices of the same type using the Selection Panel. Click and hold SHIFT key on the keyboard and select multiple items in a successive list. Click and hold CTRL key on the keyboard and select multiple items not in succession.

2. Click **Radio** in the **Upgrade** group from the Ribbon Bar. The **Radio Firmware Upgrade** dialog box appears.

3. In the **Available Firmware Files** list, select the required firmware upgrade file. The firmware upgrade file should appear in the list by default. If the file is not available in the list, perform the following steps to open the firmware file.

   a. Click **Add** to browse to the directory location of the firmware upgrade file.

   b. Select the target firmware upgrade file, and click **Open**.

   Firmware files are stored in volatile memory due to memory limitations in the controller. Hence these files will be removed on power cycle.

4. Click **Upgrade**. The **Firmware Upgrade Status** dialog box appears. The Progress column displays the progress of the upgrade.

   See the following tips for other operations:

   - To abort any firmware upgrade operation, click the **Abort Upgrade** icon besides the upgrade status.
   - To remove the devices whose firmware was upgraded successfully, click the **Clear Upgrade** icon besides the upgrade status.
   - The field device will be rebooted after the field device radio firmware upgraded successfully.

5. Close the **Firmware Upgrade Status** dialog box.

6. Verify the upgraded version of the FDAP firmware as follows:

   a. On the Selection Panel, select the FDAP.

   b. On the Property Panel, expand **Device Manager Summary**.

   c. Under **Identification**, check **Revision**.

Rebooting a controller

You can use ControlEdge Builder to remotely reboot a controller.

- Before rebooting the controller, you must log in as the Administrator or Engineer to connect the target controller.
- For ControlEdge 900 controller, reboot is only allowed in *Stopped* or *Stop Locked* operating mode.

> **NOTE:** For a redundant controller, only the connected CPM is rebooted, and there is no impact to the partner CPM.

To remotely reboot the controller

1. Click **Reboot Controller** under **Maintenance**. In the pop-up window, select **Warm Reboot** or **Cold Reboot** and click **Reboot**. See the following table for details on the effect of warm reboot and cold reboot:

Items	Warm Reboot	Cold Reboot
Program	Program is stopped and then given a Warm start; Only non-retentive are initialized.	Program is stopped and then given a Cold start; All variables are initialized.
I/O	AO/DO goes to Fail Safe Output Mode setting.	AO/DO goes to Fail Safe Output Mode setting.
DNP3	DNP3 event buffer is retained.	DNP3 event buffer is cleared.
Datalogging	No impact.	No impact.
HART	Online HART device list is cleared.	Online HART device list is cleared.
Firmware Upgrade	Transferred firmware is cleared.	Transferred firmware is cleared.

2. A warning message prompts the user that ControlEdge Builder will disconnect with the controller during the reboot. Click **Yes** to continue.
3. In the pop-up message which prompts the user to check the reboot result after 30 seconds, click **OK**.

Resetting to factory defaults

The controller can be reset to factory settings in the following two ways:

- Reset Connected Controller Directly.
- Reset via SD Card.

> **ATTENTION:** Factory reset is only allowed in Stopped or Stop Locked operating mode.

Resetting a connected controller directly

Before resetting a controller, you must log in as the Administrator or Engineer to connect the target controller.

For a redundant controller, you should connect the primary CPM. This option will reset both the primary and secondary CPMs.

1. From the Home Page, under **Maintenance**, click **Reset to Factory Defaults** > **Reset Connected Controller Directly**.
2. A warning message prompts you that the controller will be reset to the default factory settings and all configurations in the controller will be lost. During the reset, the controller will be rebooted automatically and disconnected. Click **OK** to continue.
3. A pop-up message prompts you to check the reset status after 180 seconds. Click **OK**.

Resetting via SD card

1. Insert SD card into the computer in which ControlEdge Builder is installed.
2. From the Home Page, under **Maintenance**, click **Reset to Factory Defaults** > **Reset via SD Card**.
3. Enter the **Serial Number** of the target controller in the pop-up window, and click **Save**. The serial number can be found on the label of the controller. Or click **Platform** under **View Diagnostic** to find the **Platform.SerialNumber**.
4. In the pop-up window, select the root directory of SD card to save the resetfile.rst file.

   Do not rename the factory reset file.
5. Do the following steps to reset the non-redundant or redundant controller.
   - To reset the non-redundant controller:
     a. Power off the controller and insert the SD card.
     b. Power on the controller. The default factory settings are applied.
   - To reset the redundant controller:

a. Pull out the secondary CPM.

b. Power off the primary CPM and insert the SD card.

c. Power on the primary CPM. The default factory settings are applied.

d. Re-insert the secondary CPM. The primary CPM synchronizes the default factory settings to the secondary CPM, which then reboots.

Replacing TimeUTC and TimeLocal with GetRealTimeClock

This only applies to ControlEdge 2020 controller.

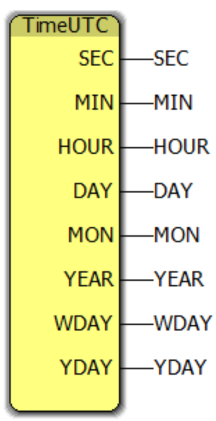
Starting with R120, TimeUTC and TimeLocal function blocks are replaced with GetRealTimeClock function block.

For more information about the relevant function blocks, see the **ControlEdge Builder Function and Function Block Configuration Reference Guide**.

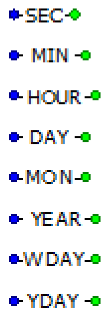
Let us use TimeUTC as an example, with variables SEC, MIN, HOUR, DAY, MON, YEAR, WDAY, YDAY connected to the outputs of TimeUTC function block.

To replace TimeUTC with GetRealTimeClock

1. Once the project is upgraded, the **TimeUTC** function block is highlighted as yellow indicating it is invalid.



2. Delete the function block but keep the input and output variables unchanged.



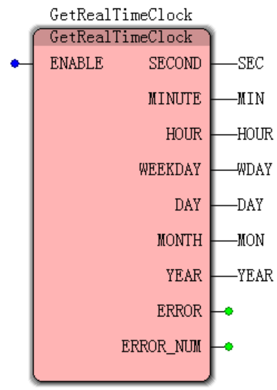
3. Double-click the variable worksheet . Delete **TimeUTC** and **YDAY** variables.

Name	Type	Usage	Description
⊟ Default			
TimeUTC	TimeUTC	VAR	
SEC	INT	VAR	
MIN	INT	VAR	
HOUR	INT	VAR	
DAY	INT	VAR	
MON	INT	VAR	
YEAR	DINT	VAR	
WDAY	INT	VAR	
YDAY	INT	VAR	

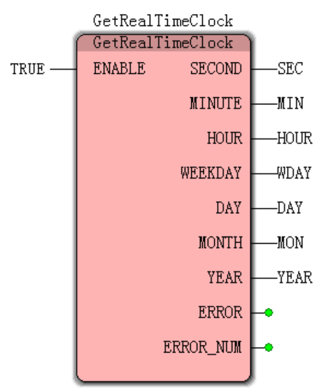
4. Click the **Type** field and change the type as **USINT** for the outputs variables of TimeUTC function block.

Name	Type	Usage	Description
⊟ Default			
SEC	USINT	VAR	
MIN	USINT	VAR	
HOUR	USINT	VAR	
DAY	USINT	VAR	
MON	USINT	VAR	
YEAR	USINT	VAR	
WDAY	USINT	VAR	

5. Double-click POU . Drag and drop **GetRealTimeClock** from function library **utilitylib** in the Edit Wizard window to this POU. Re-map the input and output variables to the pins accordingly.



6. Double-click the pin-out of the new input **ENABLE** and add a new variable or a constant value.
   - Add a new variable: Enter a **Name** and select the **Data Type** as **BOOL**. Click **OK**.
   - Add the constant value: Enter the **Name** as **True**, and then click **OK**



7. Save and close the POU.

CHAPTER

21 DIAGNOSTICS

User can view diagnostics of **System**, **I/O**, **EtherNet/IP Device** and **PROFINET Device** from ControlEdge Builder. The **System Event Log** and the **Dump File** can also be uploaded from the controller.

Viewing diagnostics

You can log in as the Administrator, Engineer or Operator to connect the target controller and view diagnostics information of **System**, **I/O**, **EtherNet/IP Device** and **PROFINET Device**.

1. Click **View Diagnostics** under **Diagnostics**. The diagnostics page appears.

2. You can view diagnostics information of **System**, **I/O**, **EtherNet/IP Device** and **PROFINET Device**. Click down arrow on the right of the target tab to expand the group.

   The **System** group includes Platform, Redundancy, Certificate, Modbus Slave, Modbus Master, MQTT, HART Server, EtherNet/IP Server, DNP3 Outstation, UaClient, UaServer, FTE, OnlineDiagnostic and Wireless information.

   The **I/O** group includes all I/O modules diagnostics.

   The **EtherNet/IP Device** group includes all EtherNet/IP devices diagnostics.

   The **PROFINET Device** group includes all PROFINET devices diagnostics.

   > **NOTE:** If the description of an item is too long to display completely, you can hold the mouse cursor over the description to show the full description.

Viewing system diagnostics

You can log in as the Administrator, Engineer or Operator to connect the target controller and view basic diagnostics information.

1. Click **View Diagnostics** under **Diagnostics**. The diagnostics page appears.

2. **Auto-refresh** is selected by default, you can set a refresh rate to update diagnostics regularly. You can also click **Auto-refresh** to close it, and click **Refresh** to update diagnostics manually.

3. You can click **Reset Statistics** to reset statistic values to the default values.

4. Click **System**, the controller diagnostics appears at the right page including **Controller Name**, **CPM Status**, **CPU Free**, **Memory Free**, **I/O Network Topology**, **Current Controller Time** and **Enclosure Temperature**.

5. Click the down arrow on the right of the **System** tab to expand the group. This group includes Platform, Redundancy, Modbus Slave, Modbus Master, HART-IP Server, EtherNet/IP Server, DNP3 Outstation, OnlineDiagnostic and Wireless information.

6. Click **Platform**, the general information for platform appear. You can click **Locate fault** and **Recover from Rapid Fault** to set the DLR network status.

Name	Description
Locate fault	When Ring Fault occurs in the **DLR Network Status**, click this button and check the IP address in **DLR Last Active Node Port 1** and **DLR Last Active Node Port 2** to identify the fault location.
Recover from Rapid Fault[1]	When Rapid Fault occurs in the **DLR Network Status**, click this button to recover the network communication if the fault is resolved.
Note1: Rapid fault may be caused by any of the following: • Manually disconnect or reconnect network nodes 5 times in 30 seconds • Duplex mismatch between two connected devices • Bad Electro Magnetic Compatibility (EMC) environment • Unstable physical connections	

7. Click **Redundancy**, the general information for redundancy appears.

There are three options to be selected. These options are only allowed for *Engineer* or *Administrator*.

Name	Description
Disable Synchronization	It is available only for the synchronization was enabled. Disable synchronization between the primary controller and the secondary controller.
Enable Synchronization	It is available only for the synchronization was disabled. Enable synchronization between the primary controller and the secondary controller.
Switchover	Exchange the roles of the primary and secondary controllers. After that, ControlEdge Builder and the controller will be disconnected. The previous primary controller will reboot. **NOTE:** For ControlEdge 2020 controller, after the controller switchover, IOM LED flashes on Yellow for 1~2 seconds. .The I/O communication is without impact.
Become Primary	When the primary controller is disconnected, first connect the secondary controller and click this option to set it to be the primary one.

8. Click the down arrow on the right of the **Redundancy** tab to expand the group. This group includes **Local Status**, **Local History**, **Partner Status** and **Partner History** information.

   Under **Local Status**, you can check **Redundancy.RdnSyncState** for controller synchronization status.

Value	Description
synchronized	Controller synchronization is enabled.
not synchronized...	Controller synchronization is disabled.

9. Click **Wireless**, the following diagnostics appears.

Name	Description
ISA100 Network ID	It is the unique identifier for the network. It must contain a value between 2 (default) and 65535.
Over the Air Provisioning	Over-the-air provisioning for ISA100 network. Devices in the OneWireless network can be provisioned using the over-the-air provisioning method. The controller provisions the access points and the access points that are enabled to function as provisioning devices can provision the field devices/line-powered FDAPs.
Maximum Route Depth	It specifies maximum number of hops between the controller and a field device over ISA100 network. Hops are defined as the number of routing devices through which the data must pass to reach its destination. By default, this parameter is set to four.
Default Routing Policy	It defines the routing behavior of a field device that is capable of operating as a router as well as an I/O device, after it joins the network. • Routing Enabled = 0 Enables all the routing field devices to function as a router and an I/O device. • Routing Enabled, Line Powered Only = 1 Enables all the line-powered routing field devices to function as a router and an I/O device. In this case, the battery powered routing field devices function only as I/O devices. • Routing Disabled = 2 Disables the ability of the routing field devices to function as routers. The field devices with routing capability can function only as I/O devices.
Default Join Policy	It specifies the system-wide join policy for the routing devices (FDAP routers and routing field devices). The system – wide join policy can be overridden by the join policy of the device. By default, the join policy for the devices is configured as Join Enabled.

Name	Description
	• Join Enabled = 0 Enables the devices to join the network through FDAP routers and routing field devices. • Join Enabled, Line Powered Only = 1 Enables the devices to join the network only through FDAP routers.
Link Quality Threshold	It is equivalent to the RSQI value between the devices. The link between the devices is established only if RSQI is equal to or greater than the Link Quality Threshold limit. By default, Link Quality Threshold is set to 127.
Link Strength Threshold	Minimum link strength (RSSI) to be considered as a neighbor.
Transmit Count	Number of messages transmitted from the controller to a field device sensor.
Receive Count	Number of messages received from a field device sensor to the controller.
Timeout Count	Number of timeouts between the controller and a field device sensor.
Transmit Rate	Number of messages per second transmitted from the controller to a field device sensor.
Receive Rate	Number of messages received per second from a field device sensor to the controller.
Timeout Rate	Number of timeouts per second between the controller and a field device sensor.
Transmit Rate Max	High water mark of messages per second transmitted from the controller to a field device sensor.
Receive Rate Max	High water mark of messages received per second from a field device sensor to the controller.
Timeout Rate Max	High water mark of timeouts per second between the controller and a field device sensor.

Viewing I/O diagnostics

For error codes, see Error code reference for more information.

You can log in as the Administrator, Engineer or Operator to connect the target controller and view I/O diagnostics.

1. From the Home Page, click **View Diagnostics** under **Diagnostics**. The diagnostics page appears.
2. Click the down arrow on the right of the **I/O** tab to view diagnostics of I/O modules.
   - For ControlEdge 2020 controller
     a. The expansion I/O modules list is expanded. On the right panel, the overview of the modules which are running in the controller appears in **Diagnostic** tab.

        See the following table for the configuration parameters:

Parameter	Description
Module Address	The assigned module address from the I/O configuration in the running controller.
Module Type	The type of the I/O module.
Status	Status of I/O module: • OK: No module level error exits and all the channels of the module are running without error. • Error: Module level error exists, or a module channel is with an error. • Offline: Configured module is not detected.

        Auto-refresh is selected by default, you can set a refresh rate to update diagnostics regularly. You can also click **Auto-refresh** to close it, and click **Refresh** to update diagnostics manually.

        You can click **Reset Statistics** to reset statistic values to the default values.

     b. Click **Communication** tab, you can check the following parameters.

Parameter	Description
Module Address	The assigned module address from the I/O configuration in the running controller.
CPM Write Request	Write request count sent from CPM to IOM
IOM Received Write Request	Write request count that IOM receives from CPM
CPM Read Request	Read request count sent from CPM to IOM
IOM Received Read Request	Read request count that IOM receives from CPM
IOM Response for Read Request	Response sent from IOM to CPM for read request
CPM Received Response for Read Request	Response received from IOM for read request

c. Click **IOM Offline** tab, you can check the following parameters. Click the down arrow on the right end to expand the Offline history. At most 10 history records can be displayed.

> **NOTE:** Suggest to use **Manual-refresh** before viewing the history. Otherwise the records collapse automatically after the time specified by **refresh rate**.

Parameter	Description
Module Address	The assigned module address from the I/O configuration in the running controller and populates these addresses here.
Times Offline Since Reset	The offline count of an IOM since the latest statistics reset
Reason for IOM Offline	The reason for IOM offline

Parameter	Description
CPM Disconnects Since Reset	The count that IOM loses connection with CPM since the latest statistics reset
Reason for CPM Disconnection	The reason for IOM lost connection with CPM

d. Click **IOM Failsafe** tab, you can check the following parameters.Click the down arrow on the right end to expand the Failsafe history. At most 10 history records can be displayed.

> **NOTE:** Suggest to use **Manual-refresh** before viewing the history. Otherwise the records collapse automatically after the time specified by **refresh rate**.

Parameter	Description
Module Address	The assigned module address from the I/O configuration in the running controller.
Times Failsafe Since Reset	The failsafe count of an IOM since the latest statistics reset
Reason for IOM Failsafe	The reason for IOM failsafe

e. Click **Others** tab, you can check the following parameters.

Parameter	Description
Controller Drop-sync COUNT caused by IOM	The count of controller drop-sync caused by IOM
Controller Switchover count caused by IOM	The count of controller switchover caused by IOM
IOM Failsafe count caused by controller	The count of IOM failsafe caused by controller

f. Click a module in the module List to view the following information.

Parameter	Description
Module Number	Module number of I/O module
Hardware Version	Hardware version of I/O module
Firmware Version	Firmware version of I/O module
Status	Status of I/O module: • OK: No module level error exits and all the channels of the module are running without error. • Error: Module level error exists, or a module channel is with an error. Hold the mouse cursor over the shown error code of a faulty I/O module to see a description of the error. • Offline: Configured module is not detected.
Channel	Defined channel of the assigned module type
Status	Status of channel: • OK • Error Hold the mouse cursor over the shown error code of a faulty channel to see a description of the error. The channel status will not be displayed if the type of the physically installed module does not match the configured one. The channel status cannot reflect signal status, such as OverRangeHighExtended (11), OverRangeHigh (12), OverRangeLow (13) and OverRangeLowExtended (14).
Description	Description of the channel

- For ControlEdge 900 controller

a. The rack list is expanded, and the overview of the racks which are running in the controller appears on the right panel.

See the following table for the configuration parameters:

Parameter	Description
Rack Address	The assigned Rack Address number from the I/O configuration in the running controller and populates these addresses in Rack Overview table.
Rack Type	Based on the Rack Address, the system detects physically installed racks with specific addresses and populates them along with their respective types and working status in the Rack overview table.
Status	Status of rack: • OK: All the modules installed on the rack are running without error. • Error: Error exists in one or more of the modules installed on the rack. • Offline: A configured Rack address is not detected, it may be caused by a communication error between controller and EPM, or the EPM with related address is not physically existed.

Auto-refresh is selected by default, you can set a refresh rate to update diagnostics regularly. You can also click **Auto-refresh** to close it, and click **Refresh** to update diagnostics manually.

You can click **Reset Statistics** to reset statistic values to the default values.

b. From the rack list panel, click the down arrow on the right of a rack name to view the module list for that rack. All the slots of the rack are listed with or without module type according to the configuration and the rack type detected.

The naming format used is:

- **Slot XX - Module Type**: the slot is assigned to an IOM.
- **Slot XX - Empty**: the slot is not assigned to an IOM.

On the rightmost page, the detailed information of the rack appears including the following parameters.

Parameter	Description
Module Number	Module number of CPM or EPM **TIP:** If the I/O module is mounted in a local I/O rack, the information of CPM is displayed. If the I/O module is mounted in an expansion I/O rack, the information of EPM is displayed.
Hardware Version	Hardware version of CPM or EPM
Firmware Version	Firmware version of CPM or EPM
Status	Status of CPM or EPM: • OK • Error Holding the mouse cursor over the shown error code, the description of the error appears. • Offline
Power Supply	Power supply status: • OK • Error
Slot Number	Slot number mounted in the rack, ranging from 1 to 12.
Module Type	The type of I/O module
Status	Status of I/O module:

Parameter	Description
	• OK: No module level error exits and all the channels of the module are running without error. • Error: Module level error exists, or a module channel is with an error. • Offline: Configured module is not detected.

c. Click a module in the Module List to view its diagnostic information.

See the following table for the detailed diagnostic information of *I/O modules*.

Parameter	Description
Module Number	Module number of I/O module
Module Types	The type of the target I/O module
Hardware Version	Hardware version of I/O module
Firmware Version	Firmware version of I/O module
Status	Status of I/O module: • OK: No module level error exits and all the channels of the module are running without error. • Error: Module level error exists, or a module channel is with an error. Hold the mouse cursor over the shown error code of a faulty I/O module to see a description of the error. • Offline: Configured module is not detected.
Channel	Defined channel of the assigned module type

Parameter	Description
Status	Status of channel: • OK • Error Hold the mouse cursor over the shown error code of a faulty channel to see a description of the error. The channel status will not be displayed if the type of the physically installed module does not match the configured one. The channel status cannot reflect signal status, such as OverRangeHighExtended (11), OverRangeHigh (12), OverRangeLow (13) and OverRangeLowExtended (14).
Description	Description of the channel

See the following table for the detailed diagnostic information of *serial modules*.

Parameter	Description
Protocol Type	The protocol bound to the port of the serial module
Status	Status of the serial module: • OK • Offline
Error Frame Counter	The number of data frame with parity error
Tx Frame Counter	The number of frames sent by the module
Rx Frame Counter	The number of received frames
Name	Diagnostic name

Parameter	Description
Value	Diagnostic value
Description	Diagnostic description If the description is too long to display completely, you can hold the mouse cursor over the description to show the full description.

For more information of LED indicators, see "Serial communication module indicators" in the *ControlEdge 900 Platform Hardware Planning and Installation Guide*.

Viewing EtherNet/IP device diagnostics

You can log in as the Administrator, Engineer or Operator to connect the target controller and view EtherNet/IP device diagnostics.

1. From the Home Page, click **View Diagnostics** under **Diagnostics**. The diagnostics page appears.
2. Click the down arrow on the right of the **EtherNet/IP Device** tab to expand the group. The overview of the EtherNet/IP devices which are connected with the controller appears at the rightmost page.

   See the following table for the configuration parameters:

Parameter	Description
CIP Connection Used	The number of the used CIP connections.
CIP Connection Remaining	The number of the unused CIP connections.
CIP Connection Active	The number of the active CIP connections.
Device Name	EtherNet/IP device name
Device Type	EtherNet/IP device type
Status	Status of EtherNet/IP device: • OK: All the devices are running without error.

Parameter	Description
	• Error: Error exists for the connection.
Total Packets Sent	The number of packets sent by the client
Total Packets Received	The number of received packets from the server
Packets Received Per Second	The number of received packets from the server per second
Packets Sent Per Second	The number of packets sent by the client per second
IP Address	IP Address of the EtherNet/IP device
Connection Timeout	The number of connection timeout

Auto-refresh is selected by default. You can set a refresh rate to update diagnostics regularly. You can also click **Auto-refresh** to close it, and click **Refresh** to update diagnostics manually.

You can click **Reset Statistics** to reset statistic values to the default values.

3. Click an EtherNet/IP device name to view its diagnostics displayed at the rightmost page.

Parameter	Description
Module Status	The status of EtherNet/IP device See EtherNet/IP device error codes for more information.
IP Address	The IP Address of EtherNet/IP device
Device Type	The EtherNet/IP device type
Vendor	Vendor of EtherNet/IP device
Product Code	EtherNet/IP device code
Revision	EtherNet/IP device revision
Total Packets Sent	The number of packets sent by the client
Total Packets	The number of received packets from the

Parameter	Description
Received	server
Packets Sent Per Second	The number of packets sent by the client per second
Packets Received Per Second	The number of received packets from the server per second
Communication Errors	The number of communication error
Communication Timeout	The number of device offline

4. For the EtherNet/IP device with an adapter, click the down arrow at the right of the device to view I/O module list. Click an I/O module to view its diagnostics.

Parameter	Description
Module Status	The status of I/O module
IP Address	The IP Address of I/O module
Device Type	The I/O module type
Vendor	Vendor of EtherNet/IP device
Product Code	EtherNet/IP device code
Revision	EtherNet/IP device revision
Total Packets Sent	The number of packets sent by the client
Total Packets Received	The number of received packets from the server
Packets Sent Per Second	The number of packets sent by the client per second
Packets Received Per Second	The number of received packets from the server per second
Communication Errors	The number of communication error
Communication Timeout	The number of device offline

Viewing PROFINET device diagnostics

You can log in as the Administrator, Engineer or Operator to connect the target controller and view PROFINET device diagnostics.

1. From the Home Page, click **View Diagnostics** under **Diagnostics**. The diagnostics page appears.
2. Click the down arrow on the right of the **PROFINET Device** tab to expand the group. The overview of the PROFINET devices which are connected with the controller appears at the rightmost page.

   See the following table for the configuration parameters:

Parameter	Description
Num of PROFINET Devices	The number of the connected PROFINET devices.
Total Input Image Size	The total byte length of configured PROFINET devices' input data, including IOPS&IOCS.
Total Output Image Size	The total byte length of configured PROFINET devices' output data, including IOPS&IOCS.
Device Name	PROFINET device name
Communication Status	Communication status of PROFINET devices
Input Image Size	The byte length of configured PROFINET devices' input data, including IOPS&IOCS.
Output Image Size	The byte length of configured PROFINET devices' output data, including IOPS&IOCS.
Device IP Address	IP Address of the PROFINET device

   Auto-refresh is selected by default. You can set a refresh rate to update diagnostics regularly. You can also click **Auto-refresh** to close it, and click **Refresh** to update diagnostics manually.

   You can click **Reset Statistics** to reset statistic values to the default values.

3. Click a PROFINET device name to view its diagnostics displayed at the rightmost page.

Parameter	Description
Device Name	PROFINET device name
IP Address	IP Address of the PROFINET device
Vendor ID	PROFINET device vendor ID which is defined in GSDML file
Device ID	PROFINET device ID which is defined in GSDML file
Scan Time	The configured scan time interval of the PROFINET device
Watch Dog Time	Watch dog timer factor
Communication Status	Communication status of PROFINET devices

4. Click the down arrow at the right of the device to view Slot list. Click a Slot to view its diagnostics.

Parameter	Description
Slot number	Configured PROFINET device slot number
Submodule type	Submodule type of configured subslot, Input or Output
Subslot Number	Configured PROFINET subslot number
Input Provider Status	The provider (sender) of a cyclic I/O data element uses this to signal the input status (good/bad with error location)
Input Consumer Status	The consumer (receiver) of a cyclic I/O data element uses this to signal the input status (good/bad with error location)
Output Provider Status	The provider (sender) of a cyclic I/O data element uses this to signal the output status (good/bad with error location)
Output Consumer Status	The consumer (receiver) of a cyclic I/O data element uses this to signal the output status (good/bad with error location)

Uploading and viewing system event log

The controller logs operational and diagnostic events in the **System Event Log**. Follow these procedures to upload and then view the events.

Uploading system event log

Before uploading system event log, you must log in as the Administrator or Engineer to connect the target controller.

1. Click **View System Event Log** > **Upload System Event Log** under **Diagnostics**.
2. Select **CPM**, **EPM** or **MIO28Mixed** for **Device Type**. If you select **MIO28Mixed**, then select **IOM Address**.
3. Select **Event Log** for **File Type**.
4. The current system event log destination path and name is displayed. You can click the browse button to change the destination and file name.
5. Click **Upload** button to retrieve the system event log from the controller, EPM or expansion I/O module and store it to the destination file. The system event log is now ready for viewing. See Viewing system event log for more information.

Viewing system event log

To view system events, you must upload the system event log from the controller to a file on the computer first. See Uploading system event log for more information.

To view the system events

1. Click **View System Event Log** > **View System Event Log** under **Diagnostics**.
2. Click **View** to select the relevant file you have uploaded, click **Open**. The system events contained in the file will be displayed.
3. You can filter the events by selecting from the various filters for the **Application**, **Category**, **From** and **To** fields. Then click **Apply**. See the following tables for descriptions of Application filters and Category filters.

Table 21-1: Description of Application filters

Filter	Description
eclr	Embedded common language runtime
eipclient	EtherNet/IP client
platform	Application process management
logsigner	Tagged eventlog files
opcuaserver	OPC UA server
rdnapp	Redundancy application manager
root	Printed by Linux kernel libraries
sntp	Simple network time protocol
mbslave	Modbus slave
cdarcoa	CDA responder
hartsrv	HART server
gclnamesrv	Name server for gcl protocols
kernel	Linux kernel
diagnostic	Used to upload error.tar and dump file
watchdogmgr	Watchdog manager
certmngrapp	Certificate manager
cpmiomgr	I/O manager in CPM
onlinediag	Online diagnostic manger
fwmgr	Firmware upgrade manager
post	Post test after system power on
init	Boot process of Linux
udhcpc	Dynamic host IP address configuration tool
all	All above

Table 21-2: Description of Category filters

Category	Description
crit	Critical conditions
err	Error conditions
warn	Indicates that an error will occur if an action is not taken.
notice	Events that are unusual, but not error conditions.
info	Normal operational messages that require no action.
debug	Information useful to developers for debugging the application.
all	All above

Uploading a dump file

The dump file contains additional information for Honeywell technical support. It does not contain any user actionable information. If Honeywell technical support requests the dump file, follow these procedures to upload the file before sending it to Honeywell.

> **ATTENTION:** For the controller to generate a dump file, an SD card (32GB Class 6 / Class 10 industry standard) must be installed in the controller before an incident occurs. Without an SD card, a dump file cannot be generated. After uploading a dump file, if the file appears to be empty, then an SD card may not have been inserted in the controller at the time of the incident or the SD card may be full.

1. Click **View System Event Log** > **Upload System Event Log** under **Diagnostics**.
2. Select **CPM**, **EPM** or **MIO28Mixed** for **Device Type**. If you select **MIO28Mixed**, then select **IOM Address**.
3. Select **Dump File** for **File Type**.
4. The current dump file destination path and name is displayed. You can click the browse button to change the destination path and file name.
5. Click **Upload** button to retrieve the dump file from the controller,

EPM or expansion I/O module and store it to the destination file. The dump file is now ready for sending to Honeywell technical support.

Capturing project diagnostic information

You can save the log files of a project, and send it back to Honeywell technical support if ControlEdge Builder has an exception.

1. From **Home Page**, select **Save Builder Logs** under **Diagnostics**. The **Save Builder Logs** dialog box appears.
2. Click the browser icon to select a directory and enter a file name. Click **Save**.
3. Click **Save**.

CHAPTER

22 TROUBLESHOOTING

Unable to open ControlEdge Builder

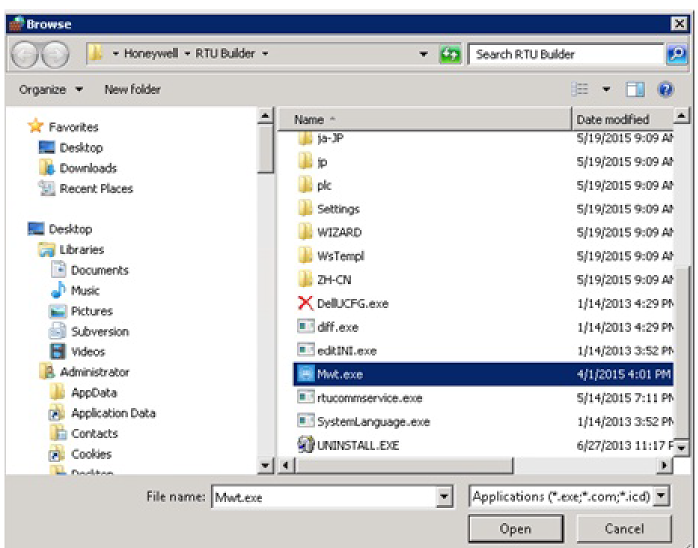
Cause

The Windows Firewall running on the system prevents ControlEdge Builder from communicating to the controller.

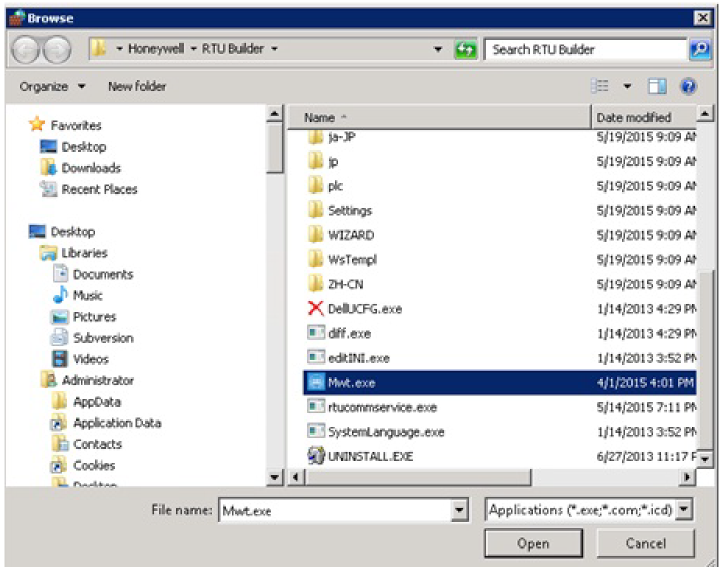
Solution

Add ControlEdge Builder as an allowed program in the Windows Firewall settings:

1. Select **Control Panel** and find **Windows Firewall**.
2. Click **Allow a program or feature through Windows Firewall**.
3. In the **Allowed Programs** pop-up window, click **Change settings**, and then click **Allow another program**.
4. In the **Add a Program** pop-up window, click **Browse** and select Mwt.exe file. Click **Open** to add it into **Allowed program and features** list.



5. Select appropriate options for **mwt**, and click **OK** to complete the configuration.



Project rebuild fails

Cause

No available free space for new variables.

Solution

Delete unnecessary variables from the Global_Variables list.

Unable to delete POUs

The POUs under Project Tree Window in IEC programming workspace cannot be deleted.

Cause

The eclrRes download dialog box is opened.

Solution

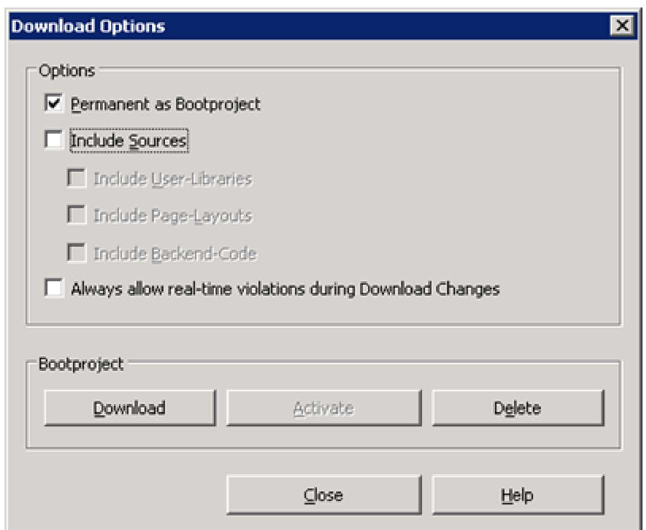
Close eclrRes download dialog box.

The controller does not show any control strategy loaded. The status LED flashes in yellow.

- After the controller has been power cycled, it shows no control strategy loaded. The status LED flashes in yellow. or
- When the project is downloaded, it prompts that an existing project is still running even though new project has been downloaded successfully.

Check

Click **Project Control Dialog** from the toolbar, and press **More** button to check if the option **Permanent as Bootproject** is selected:



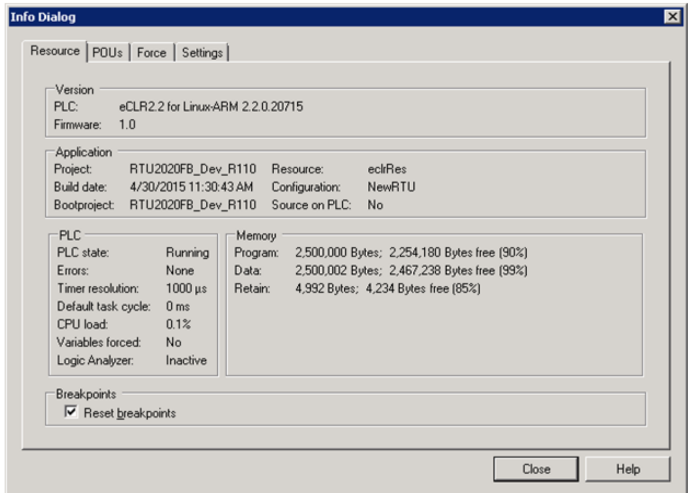
Cause

The checkbox **Permanent as Bootproject** is not selected.

Solution

Select the checkbox Permanent as Bootproject.

To verify that boot project is loaded correctly, click Project Control Dialog from the toolbar and press Info button to display state of the controller as shown below:



Illogical variable value change

Variable value is changed rapidly and illogically when traced in debug mode.

Cause

- Execution order is not expected.
- You may have accidentally copied an existing variable, and two variables end up with a same address so it consequently causes odd behavior.

Solution

- Turn on the execution order (Menu item Layout/Execution Order) to ensure logic is executing in the order you are expecting. If not, you may need to move position of function blocks to change execution order. Function blocks are executed from left to right via connections. The execution order precedence is top-to-bottom and left-to-right, if the function blocks are connected using variables. If that is not your issue, check the properties of variable.
- If it has an address, delete it and “make” project again. This should not be a problem in R120.

Downloading a project fails with “download failed” error

Downloading a project in ControlEdge Builder is failed and throws a with “download failed” error.

Cause

SD card is not formatted according to the prescribed procedure.

Solution

If you are downloading any application data logs to an SD Card, ensure the SD card is formatted according to the prescribed procedure.

Projects not able to be downloaded with error code 27

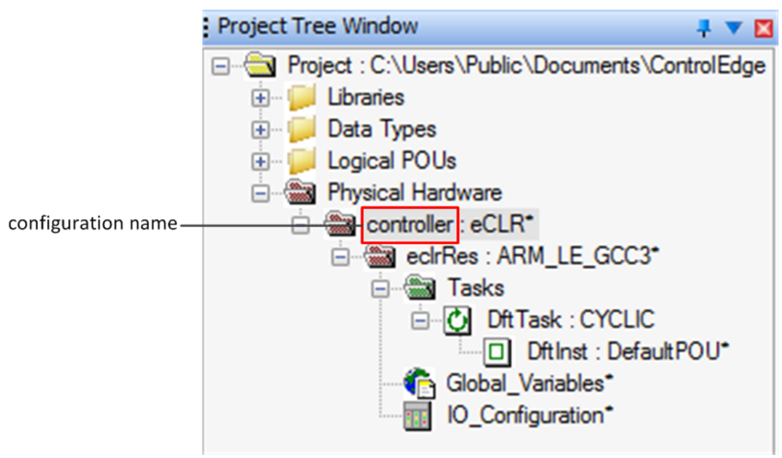
Projects not able to be downloaded with error code 27.

Cause

Space constrain.

The maximum size of image.bin for the non-redundant ControlEdge 2020 Controller is 1.5MB. The image.bin file is stored in "Project name" > c > "configuration name" > r > eclrres.

See the following example for how to check the configuration name:



Solution

1. Click **More** and in the pop-up window, click **delete**.
2. Download the project again.

A project automatically connects with the incorrect controller

When opening a new project by clicking **File** > **Open Project** from the menu bar, or clicking **Open Project** from the toolbar, it connects with a previously used, and incorrect controller.

Cause

The controller used previously is not automatically disconnected when opening a new project.

Solution

1. From the Home Page, click **Disconnect** to disconnect the previous controller.
2. From the Home Page, click **Connect** to connect the new controller.

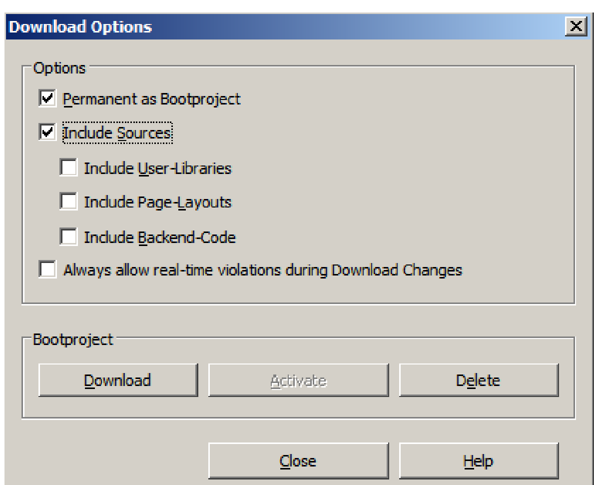
   See Connecting a controller for more information.

Settings in ControlEdge Configuration Workspace are not downloaded to the controller.

The settings in ControlEdge Configuration Workspace are not downloaded to the controller successfully.

Check

Click **Project Control Dialog** from the toolbar, and press **More** button to check if the option **Include Sources** is selected:



Cause

The checkbox **Include Sources** is selected.

Solution

Uncheck the option **Include Sources**.

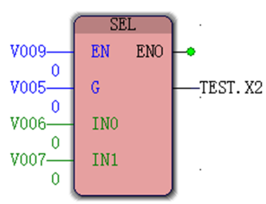
The controller is stuck with 0% CPU free.

A controller will be stuck with 0% CPU free if it is running with "SEL" function block in use with the following two conditions. ControlEdge Builder is no responding and eCLR is timeout.

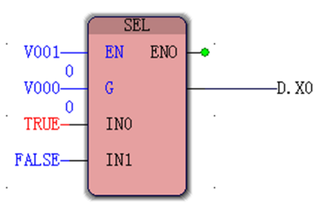
Cause

- "EN" is set to "TRUE".
- WORD or DWORD data type is used for output .B1/B2, or .X1/X2...

SEL with WORD output

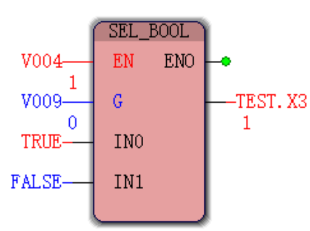


SEL with DWORD output



Solution

1. Recover the issue.
   - For ControlEdge 900 controller. Manually stop the controller using the mode switch, set "EN" to "False", and then download a project to overwrite the current project.
   - For ControlEdge 2020 controller. Power cycle the controller, set "EN" to "False", and then download a project to overwrite the current project.
2. Use "SEL_*" function blocks instead of the "SEL" function block. Here is an example for using SEL_BOOL function block.



Watchdog timeout

Watchdog timeout issue appears when a controller execute too many programs.

Cause

Programs are too many to be executed completely within the Interval of a task.

Solution

Configure a longer Interval for the task, and set a longer watchdog time.

> **NOTE:** Watchdog time should be shorter than or equal to the Interval of tasks.

Redundant controller will drop sync due to error between 88 and 232

Redundant controller drops sync.

Cause

The redundant controller drops sync due to the error between 88 and 232. See Enumerations for more information.

Solution

Remove and insert the secondary CPM again.

Project compile fails with error message Data type UINTList is defined more than once

After upgrading a project of a previous release to R160, compiling the project fails with a error message "Data type 'UINTList' defined more than once!".

Cause

Pior to R160, the data type should be defined by user in the user library HonUaFbHelpers. However, it is added in OpcUa_DataTypes starting from R160. So the data type will be defined twice when you upgrade a project with the user defined data type to R160.

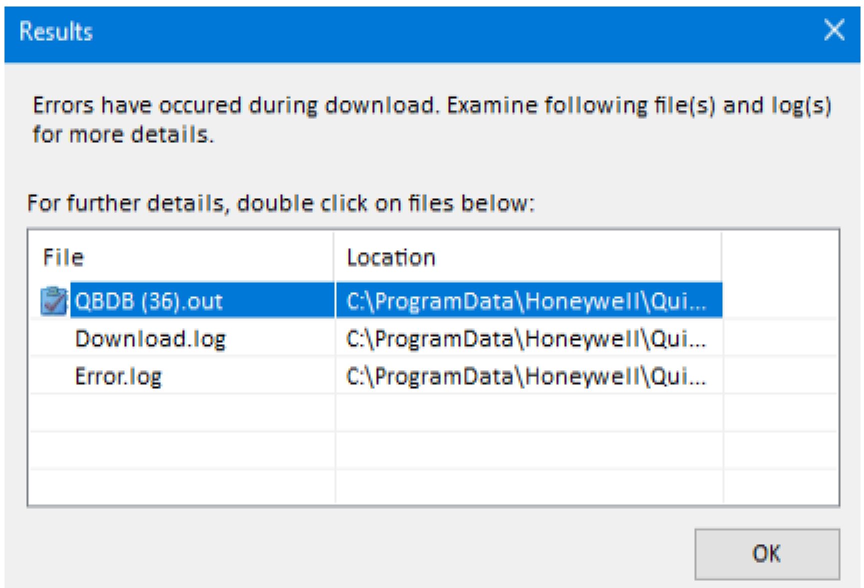
Solution

Remove the data type UINTList from the HonUaFbHelper user library.

A syntax error appears when downloading DNP3 configuration which is published from ControlEdge to Experion on Quick Builder

When downloading DNP3 configuration which is published from ControlEdge to Experion on Quick Builder, a syntax error appears.

Take global diagnostic variables of I/O module status and I/O channel status as an example, the following dialog appears:



Open the file **QBDB (36).out**, the following error message appears:

```
PVSOURCE $CONTROLLER0004.ExpIOBoard02Status 0004 @GV.IOM02_STATUS
***** PNTBLD ERROR ***** syntax

PVPERIOD $CONTROLLER0004.ExpIOBoard02Status 60
***** PNTBLD ERROR ***** there is no source address

PVSOURCE $CONTROLLER0004.ExpIOBoard02ChnStatus01to32 0004 @GV.IOM02_CHN_STATUS
***** PNTBLD ERROR ***** syntax

PVPERIOD $CONTROLLER0004.ExpIOBoard02ChnStatus01to32 60
***** PNTBLD ERROR ***** there is no source address
```

Cause

Not all global diagnostic variables of configured I/O modules, including @GV.IOMXX_STATUS and @GV.IOMXX_CHN_STATUS, are bound to the DNP3 mapping table.

> **NOTE: XX** indicates the I/O module address.

Solution

Bind all global diagnostic variables of configured I/O modules to the DNP3 mapping table.

APPENDIX

A

ERROR CODE REFERENCE

See the following sections for error codes in ControlEdge Builder.

In this section:

System error code

Error Code	Description	Cause	Action
0	SUCCESS	Success	N/A
1	FAILURE	Operation failure. Generic failure	Upload System Event Logs for debugging.
4	INVALID_OBJ_ID	Invalid Object Id	Upload System Event Logs for debugging.
6	FB_GEN_ERR_FTE_ PORT_ADD_ FAILURE	Failed to add TCP port in FTE firewall. All entries are occupied	Disable unused communication protocols or avoid using different TCP ports to communicate with Modbus Slave devices.
12	INVALID_VALUE	Value not acceptable for other reason (too large/too small/invalid eng. units code)	Upload System Event Logs for debugging.
14	INVALID_SIZE	Size not valid (may be too big/too small)	Upload System Event Logs for debugging.
27	INSUFFICIENT_ DEVICE_ RESOURCES	Insufficient device resources e.g. queue full, buffers/memory unavailable	1. From the eclr board, click **More**, the Download Options dialog appears. 2. Click **Delete** to remove the old projects from the controller.
40	INVALID_DATA	Invalid data received from the builder.	Send the controller error log and builder log to Honeywell.
129	TIMEOUT	Usually the connection between the controller and the builder is broken.	Check the status of the controller.
501	INVALID_APP_ID	Application ID in the request is invalid.	Upload System Event Logs for debugging.
502	INVALID_ATTR_ID	Attribute ID in the request is invalid.	Upload System Event Logs for debugging.
503	INVALID_ATTR_IDX	Attribute index in the request is invalid.	Upload System Event Logs for debugging.
504	INVALID_FC	Function code in the request is invalid.	Upload System Event Logs for debugging.
505	READ_ONLY	Attribute write request	Upload System Event Logs for debugging.

Error Code	Description	Cause	Action
		failed because attribute is read-only.	
506	INAPPROPRIATE_PROCESS_MODE	Request cannot be executed in the current state. For example:	Wait for current operation to complete or cancel current operation (if possible and appropriate) and retry.
		Controller load request fails because the controller is either in the process of upgrade, reboot or shutdown.	
		Controller reboot request fails because a reboot is already in progress.	
		Controller upgrade request fails because the controller startup is not completed, or it is in the process of reboot, load, upgrade or shutdown.	
507	UNSUPPORTED	N/A	N/A
508	INVALID_FILE_ID	File ID specified in the request is invalid	Upload System Event Logs for debugging.
509	INVALID_CONFIG_ENTITY	Config file is corrupted or not compatible with existing release.	Upload System Event Logs for debugging.
510	CONFIGFILE_NOTEXIST	Config file does not exist. Controller database might be corrupted.	Upload System Event Logs for debugging.
511	UPLOADDATA_NOTEXIST	Archiving backup files is having issue due to memory limitations.	Try multiple times. If it is still not working, upload System Event Logs for debugging.

Error Code	Description	Cause	Action
513	IP_ADDRESS_NOT_AVAILABLE	Requested static IP address cannot be assigned to the interface because another node with the same IP address already exists on the network.	Assign a different static IP address or remove the node with the same IP address from the network and retry.
514	INVALID_AUTHORIZATION_ID	The user doesn't have corresponding authorization to perform the operations. For example, the operator does not have the privilege to change password for other users, administrators or engineers.	Builder pops up an error message.
515	INVALID_DATA_TYPE	Data type in the request is invalid.	Upload System Event Logs for debugging.
518	SESSION_EXPIRED	No communication between the controller and the builder for over ten minutes.	Reconnect to the controller.
520	NOT_ALLOWED_DOWNLOAD_NR_PROJECT_TO_RED_SETUP	Download a non-redundant project to a redundant controller.	Enable controller redundancy or change a redundant project to download.
521	SFC_FTE_PORT_ADD_FAILURE	Failed to add TCP port in FTE firewall, all entries are occupied.	Disable unused protocols.

Wireless error code

Error Code	Description	Cause	Action
25	FIELD_OPERATION_	Field specific condition prevented request from succeeding e.g. lockout	Upload System Event Logs for debugging.

Error Code	Description	Cause	Action
	CONDITION	or environmental condition not in range	
26	CONFIGURATION_ MISMATCH	Configuration conflict was detected	Upload System Event Logs for debugging.
28	VALUE_LIMITED	Value is limited by device	Upload System Event Logs for debugging.
29	DATA_WARNING	Value has been modified due to a device specific reason	Upload System Event Logs for debugging.
30	INALID_ FUNCTION_ REFERENCE	Function referenced for execution is invalid	Upload System Event Logs for debugging.
31	FUNCTION_ PROCESS_ERROR	Function referenced could not be performed due to a device specific reason	Upload System Event Logs for debugging.
32	WARNING	Operation is successful; but there is additional info that may be of interest to the user e.g. via accessing an attribute or by sending an alert	Upload System Event Logs for debugging.
33	WRITE_ONLY_ ATTRIBUTE	Write-only attribute (e.g. a command attribute	Upload System Event Logs for debugging.
34	OPERATION_ ACCEPTED	Method operation accepted	Upload System Event Logs for debugging.
35	INVALID_BLOCK_ SIZE	Upload or download block size not valid	Upload System Event Logs for debugging.
36	INVALID_ DOWNLOAD_SIZE	Total size for upload or download is not valid	Upload System Event Logs for debugging.
37	UNEXPECTED_ METH_ SEQUENCE	Required method sequencing has not been followed	Upload System Event Logs for debugging.
38	TIMING_ VIOLATION	Object timing requirements have not been satisfied	Upload System Event Logs for debugging.
39	OPERATION_ INCOMPLETE	Method operation, or method operation sequence not successful	Upload System Event Logs for debugging.

Error Code	Description	Cause	Action
40	SFC_INVALID_ DATA	Data received is not valid (e.g., checksum error, data content not as expected)	Upload System Event Logs for debugging.
41	DATA_ SEQUENCE_ ERROR	Data is ordered; data received is not in the order required e.g. duplicate data was received	Upload System Event Logs for debugging.
42	OPERATION_ ABORTED	Operation aborted by server	Upload System Event Logs for debugging.
43	INVALID_BLOCK_ NUMBER	Invalid block number	Upload System Event Logs for debugging.
44	BLOCK_DATA_ ERROR	Error in block of data, example, wrong size, invalid content	Upload System Event Logs for debugging.
45	BLOCK_NOT_ DOWNLOAD	Specified block of data has not been successfully downloaded	Upload System Event Logs for debugging.
46-127	ISA100_ STANDARD_ RESERVED	Standard ISA100 reserved error codes	Upload System Event Logs for debugging.
128-255	ISA100_VENDOR_ SPECIFIC_ERROR	ISA100 Vendor specific error codes	Upload System Event Logs for debugging.
516	WIRELESS_NOT_ ENABLED	Wireless is not enabled or FDAP is not connected to ControlEdge Builder.	Enable wireless by binding to one of the Ethernet ports or connect FDAP to Ethernet port configured for wireless I/O.
517	WIRELESS_ ISA100_ NETWORKID_FAIL	If the Wireless protocol configuration in project in done with different ISA100 network ID, but there are existing commissioned devices in the controller with different ISA100 network ID	Either change the ISA100 network Id under Wireless protocol in project configuration and download or delete all the wireless device in Commissioning page

EPM status

The system provides 4 BYTE long variable (32 bit) to indicate the working state of the module. Each bit represents one state, "1" means the state defined is active. For example, if the value of bit 0 is "1", the state is offline; if the value is "0", the state is online.

Multiple states can be detected at the same time.

Bit	State	Cause	Action
0	Offline	EPM is not installed or the communication between controller and EPM is error.	Check if EPM have been installed or communication line have been connected.
1	Address Conflict	Duplicated Rack Address is detected.	Check the address setting on the rack.
2	Hadrware Error	Some hardware failure because of high temperature voltage or striking.	Reboot or replace EPM hardware.
4	Rack mismatch	The maximum slot number in the configuration is bigger than the maximum slot number on the physical rack.	Check the rack type which is physically installed and replcace it with a proper type.
5	Flash Hard Failure	Firmware signature on low rate on first bank.	Update EPM firmware.
6	EEPROM Soft Failure	FW public key and it’s CRC error.	1. Reboot controller and check whether this failure status, if it always true, go step 2. 2. Upgrade firmware and check whether this failure status, if it always true, go step 3. 3. Replace the module.
7	MRAMHF	The read value is inconsistent with the value written in reserved area.	1. Reboot controller and check whether this failure status, if it always true, go step 2. 2. Upgrade firmware and check whether this failure status, if it always true, go step 3. 3. Replace the module.
8	FPGA Hard failure	FPGA INIT signal check error.	Reboot or replace EPM hardware.
9	RAM Soft Failure	The memory register show single bit error.	Reboot or replace EPM hardware.

Bit	State	Cause	Action
10	RAM Hard Failure	The memory register show muti bits error.	Reboot or replace EPM hardware.
11	Invalid CRC	Data was disturbed by enviroment elements during transferring.	Chech EPM working enviroment or replace EPM hardware.
12	Left Power Supply Module error	The left power supply module is broken.	Replace the module.
13	Right Power Supply Module error	The right power supply module is broken.	Replace the module.

I/O module status

The system provides 4 BYTE long variable (32 bit) to indicate the working state of the module. Each bit represents one state, "1" means the state defined is active. For example, if the value of bit 0 is "1", the state is offline; if the value is "0", the state is online.

Multiple states can be detected at the same time.

Bit	State	Cause	Action
0	Offline	Communication error or module doesn't physically exist or module is not powered on.	Check the physical installation and the configuration.
1	IOM Type Mismatch	Configured IOM is different from the one physically installed.	Check the installed IOM on the rack and the configuration. Then replace the I/O module if the type of the installed module is not expected or Change the I/O Module type in the configuration if the configured type is not correct.
2	Hardware Error	Internal hardware error.	Power recycle the field power for the affected module. Replace module hardware if error persists.
3	Factory DataErr	Module does not contain the correct factory data or factory data is	Replace I/O module hardware.

Bit	State	Cause	Action
		corrupted.	
5	FWImageErr	Module does not contain the correct firmware image or firmware image.	Upgrade the firmware image again. Replace I/O module hardware if error persists.
6	WDTErr	Module encountered a watchdog reset.	Restart the I/O module by powering it off and powering back ON. Replace I/O module if error persists.
7	ExternalPowerErr	The external 24V supply is not connected/has lost power/has an overvoltage.	Check the 24V connections, check the 24V external power supply and ensure that it is powered on and connected. Check if the 24 V power supply does not have an undervoltage/overvoltage.
8	InternalPowerErr	Bad power supply module on the rack or hardware failure on the UIO.	Check that the power supply and UIO modules are correctly inserted in the rack and the mounting screws are tight. Replace rack power supply if the power supply error is still seen on this module or other modules. Replace UIO hardware if error persists.
9	Over temperature	The UIO module detected that the board temperature is higher than the threshold.	Check if there is sufficient ventilation between the racks. Check if the current drawn from the UIO module to the DO and AO channels do not exceed the specification limits of 4.2 A. If the error persists, replace module hardware.
10	FWUpgrading	Module firmware is upgrading.	None.
11	Not factory calibrated	Module is not factory calibrated or calibration data corrupted.	Replace I/O module hardware.
12	HI CJ Temperature	One of the two CJs on the module is indicating a temperature reading greater than 70 degrees C.	Replace the UAI module.
13	CJ Failure	Either of the below two condition will	Replace the UAI module

Bit	State	Cause	Action
		trigger CJ failure: • The CJs are converting properly, but their differential is greater than 10 degrees C (|CJ1-CJ2| > 10); • Both cold-junction sensors are failing to convert.	
14	CJ Warning	One cold-junction sensors are failing to convert and the other is normal.	Replace the UAI module

I/O channel status

Error Code	State	Cause	Action	Apply to
0	Good	N/A	N/A	All I/O modules
1	Bad Channel	The module is offline, or; The module is with errors.	Check the module status	All I/O modules
11[1]	OverRangeHighExtended	When input value is larger than (EU High) + (EU High - EU Low)*10%	Check the input signal	UIO(AI, AO), UAI, AO04, AO08, HLAI, MIO28, SC-UCMX01,

Error Code	State	Cause	Action	Apply to
				SC-UCMX02
12[1]	OverRangeHigh	When input value is in the range from EU High to (EU High) + (EU High - EU Low)*10%	Check the input signal	UIO(AI, AO), PFQ (FI), AO04, AO08, HLAI, MIO28, SC-UCMX01, SC-UCMX02
13[1]	OverRangeLow	When input value is in the range from (EU Low) - (EU High - EU Low)*10% to EU Low	Check the input signal	UIO(AI, AO), PFQ (FI), AO04, AO08, HLAI, MIO28, SC-UCMX01, SC-UCMX02
14[1]	OverRangeLowExtended	When input value is smaller than (EU Low) - (EU High - EU Low)*10%	Check the input signal	UIO(AI, AO), UAI, AO04, AO08, HLAI, MIO28, SC-UCMX01, SC-UCMX02
15	NoCalibration	No calibration on the channel. It is for AI and AO only.	Calibrate the module	MIO28, SC-UCMX01, SC-UCMX02

Error Code	State	Cause	Action	Apply to
16²	OpenWired	Field cable broken or not connected to the terminals of the module	Check field cable connections and ensure that the sensor or actuator is connected to the I/O module. In case of DI, the correct values of external resistors have to be used to detect open wire	UIO, MIO28, SC-UCMX01, SC-UCMX02
17	Wireless ChnBad	State of object in conflict with action requested	Upload System Event Logs for debugging	Wireless I/O
18	ShortCircuit	Field cable has a short circuit	Check field cable for short circuit and ensure that the sensor or actuator is connected to the I/O module. In case of DI, the correct values of external resistors have to be used to detect short circuit. In case of DO, the short circuit protection prevents the output to be driven.	UIO(AI, DI, DO)
19	I/O HardwareErr	Internal hardware error	Power recycle the field power for the affected module or Replace module hardware if error persists	UAI, PFQ, HLAI
20	Read Back Test Fail	Analog/Digital output channel is unable to drive the desired output current on the terminals. This could happen due to high load resistance or a broken wire.	Check field cable connections and ensure that the actuator is connected to the I/O module	UIO (AO, DO)
21	Channel conversion fail	Internal hardware error	Power recycle the filed power for the affected module. Replace the module hardware if error persists.	UIO, UAI, PFQ, HLAI

Error Code	State	Cause	Action	Apply to
22	Reserve	Reserve	Reserve	
23	T/C Warning	Thermocouple measures between 100 ohms and 179 ohms	Check and replace the TC if it is fault	UAI
24	T/C Failing	Thermocouple measures 180 ohms or more	Check and replace the TC if it is faulty.	UAI
25	CJ Warning	One cold-junction sensors are failing to convert and the other is normal.	Replace the UAI module.	UAI
26	Burnout Failure	When channel response burnout fail, then return burnout failure.	Check and replace the TC if it is faulty.	UAI
27	CJ High Temperature	Value of Local CJ1 or Local CJ2 is greater than 70.	Check and replace the TC if it is faulty.	UAI
28	CJ Failure	Both local CJ1 and Local CJ2 are failed.	Check and replace the TC if it is faulty.	UAI
29	Over current	TBC	1. Check the wiring of DO channel. 2. If the channel still cannot work after the recovery from over current, replace the fuse of the channel.	DO DC
30	Remote CJ Failed	Return Remote CJ Failed except the case of remote CJ AI is good, over range high or over range low.	Check and replace the TC if it is faulty.	UAI
31	Remote CJ Value too Low	RCJ value < -30	Check and replace the TC if it is faulty.	UAI
32	Remote CJ Value too High	RCJ value > 90	Check and replace the TC if it is faulty.	UAI

Error Code	State	Cause	Action	Apply to
33	PI Overflow	Count on the module is overflow	Reset the channel.	PFQ
NOTE 1: These codes are only for I/O status parameter (STS). They are not reflected by I/O channel status on the I/O diagnostics page. NOTE 2: Error Code 16 only applies to AO channel on MIO28, SC-UCMX01, SC-UCMX02.				

EtherNet/IP device error codes

EtherNet/IP device diagnostics are also displayed in **IEC Programming Workspace**. Click **IEC Programming Workspace**, double-click **Global_Variables**, and check the **EtherNetIP Diagnostics** group.

Error code	Status	Description
0x0000	EIP_IO_STATE_STANDBY	Device is standby.
0x1000	EIP_IO_STATE_FAULTED	Connecting failed
0x1100	EIP_IO_STATE_FAULTED_WAITING_TO_CONNECT	Connecting failed, waiting to re-connect
0x1200	EIP_IO_STATE_FAULTED_CONNECTING	Connecting failed, re-connecting
0x1300	EIP_IO_STATE_FAULTED_BAD_IP_ADDR	Invalid IP address specified
0x1400	EIP_IO_STATE_FAULTED_SERVER_ALLOC_FAILED	I/O server allocation failed
0x1500	EIP_IO_STATE_FAULTED_IO_ALLOC_FAILED	I/O allocation failed
0x1600	EIP_IO_STATE_FAULTED_BAD_T2O_DATAPTR	Invalid Target to Originator data size and/or pointer
0x1700	EIP_IO_STATE_FAULTED_BAD_O2T_DATAPTR	Invalid Originator to Target data size and/or pointer
0x1800	EIP_IO_STATE_FAULTED_BAD_T2O_RPI	Invalid Target to Originator RPI
0x1900	EIP_IO_STATE_FAULTED_BAD_O2T_RPI	Invalid Originator to Target RPI
0x1a00	EIP_IO_STATE_FAULTED_BAD_CONFIGPTR	Invalid configuration size and/or

Error code	Status	Description
		pointer
0x3000	EIP_IO_STATE_CONNECTING	Connecting
0x4000	EIP_IO_STATE_RUNNING	Running
0x5000	EIP_IO_STATE_SHUTTING_DOWN	Shutting down
0x7100	EIP_IO_STATE_WAITING_TO_CONNECT	Waiting to connect
0x7200	EIP_IO_STATE_WAITING_TO_SHUTDOWN	Waiting to shut down
0x7300	EIP_IO_STATE_WAITING_TO_RECONNECT	Re-connect after forward close, instead of freeing I/O
0x9000	EIP_IO_STATE_CNTRLR_SWITCHOVER	Forward closing of I/O modules with input channels after the controller switch over

APPENDIX

B

EFM METER RUN REGISTERS

This appendix introduces meter run register range, offset and register description.

In this section:

Meter run register range

Table B-1: Meter run register range

Purpose	Hourly (Interval)/ Daily Archive	Hourly/ Daily Archive pointers	Alarm Archive	AE Pointer	Boolean Range	Integer Range	Long Integer	Float
Run 1	701 - 702	7001-7002	32	7041	1100 to 1199	3100 to 3199	5100 to 5199	7100 to 7349
Run 2	703 to 704	7003-7004	32	7041	1200 to 1299	3200 to 3299	5200 to 5299	7350 to 7599
Run 3	705 to 706	7005-7006	32	7041	1300 to 1399	3300 to 3399	5300 to 5399	7600 to 7849
Run 4	707 to 708	7007-7008	32	7041	1400 to 1499	3400 to 3499	5400 to 5499	7850 to 8099
Run 5	709 to 710	7009-7010	32	7041	1500 to 1599	3500 to 3599	5500 to 5599	8100 to 8349
Run 6	711 to 712	7011-7012	32	7041	1600 to 1699	3600 to 3699	5600 to 5699	8350 to 8599
Run 7	713 to 714	7013-7014	32	7041	1700 to 1799	3700 to 3799	5700 to 5799	8600 to 8849
Run 8	715 to 716	7015-7016	32	7041	1800 to 1899	3800 to 3899	5800 to 5899	8850 to 9099
Run 9	717 to 718	7017-7018	32	7041	1900 to 1999	3900 to 3999	5900 to 5999	9100 to 9349
Run 10	719 to 720	7019-7020	32	7041	2000 to 2099	4000 to 4099	6000 to 6099	9350 to 9599
Run 11	721 to 722	7021-7022	32	7041	2100 to	4100	6100	9600

Purpose	Hourly (Interval)/ Daily Archive	Hourly/ Daily Archive pointers	Alarm Archive	AE Pointer	Boolean Range	Integer Range	Long Integer	Float
					2199	to 4199	to 6199	to 9849
Run 12	723 to 724	7023-7024	32	7041	2200 to 2299	4200 to 4299	6200 to 6299	9850 to 10099

Meter run register offset

Table B-2: Meter run register offset

Purpose	Boolean Offset	Integer Offset	Long Integer Offset	Float Offset
Run 1	0	0	0	0
Run 2	100	100	100	250
Run 3	200	200	200	500
Run 4	300	300	300	750
Run 5	400	400	400	1000
Run 6	500	500	500	1250
Run 7	600	600	600	1500
Run 8	700	700	700	1750
Run 9	800	800	800	2000
Run 10	900	900	900	2250
Run 11	1000	1000	1000	2500
Run 12	1100	1100	1100	2750

QTR rollover details

Gas QTR

Hourly rollover index: 1050

Daily rollover index: 100

Liquid QTR

Hourly rollover index for API21_2: 918

Hourly rollover index for API21_2_V2: 1050

Daily rollover index: 100

System events

The system events registers are for event reference and cannot be read. System events table is as follows.

Table B-3: System Events

Enron Register	System Events
3001	EV_SYSTEM_COLD_START
3002	EV_SYSTEM_WARM_START
3003	EV_SYSTEM_POWER_OFF
3004	EV_SYSTEM_WATCHDOG_RESET
3005	EV_SYSTEM_TIME_CHANGED

Meter run register description

The Enron register mapping for the controller is displayed as follows. The actual meter run specific register can be calculated by adding the offset mentioned in the offset table.

Table B-4: Meter run register description

Enron Register	Alarm & Events Description	Meter run Configuration Parameter
3108	EV_CHANGE_INPUT_UNITS	Input Units change
3109	EV_CHANGE_CONTRACT_UNITS	Contract Units change

Honeywell

Enron Register	Alarm & Events Description	Meter run Configuration Parameter
3110	EV_CHANGE_VOLUME_UNIT	Volume unit change
3111	EV_CHANGE_TEMPRATURE_UNIT	Temperature unit change
3112	EV_CHANGE_PRESSURE_UNIT	Pressure unit change
3113	EV_CHANGE_DENSITY_UNIT	Density unit change
3114	EV_CHANGE_FLOW_UNIT	Flow unit change
3115	EV_CHANGE_SOFTWARE_REVISION	Software revision change
3116	EV_CHANGE_METER_ID	Meter Id value change
3117	EV_CHANGE_LIQUID_TYPE	Liquid type change
7101	EV_CHANGE_IS_ABSOLUTE_ PRESSURE	IS_Absolute_Pressure change
7102	EV_CHANGE_ATMOSPHERIC_PRES	Atmospheric_Pressure change
7111	EV_CHANGE_DP_LOW_CUTOFF	DP low cutoff change
7112	EV_CHANGE_IS_PULSE	IS_Pulse change
7113	EV_CHANGE_PULSE_LOW_CUTOFF	Pulse low cutoff change
7114	EV_CHANGE_LOW_FLOW_DETECT_ TIME	Low flow detect time change
7115	EV_CHANGE_LOW_GAS_MASS_ CUTOFF	Low gas mass cutoff change
7120	EV_CHANGE_COMPRESSIBILITY_ METHOD	Compressibility method change
7121	EV_CHANGE_AVERAGING_METHOD	Averaging method change
7122	EV_CHANGE_CONTRACT_HOUR	Contract hour change
7123	EV_CHANGE_BASE_TEMP	Base temperature change
7124	EV_CHANGE_BASE_PRES	Base pressure change
7131	EV_CHANGE_ORIFICE_MATERIAL	Orifice material change
7132	EV_CHANGE_ORIFICE_TAP_TYPE	Orifice tap type change
7133	EV_CHANGE_ORIFICE_TAP_ LOCATION	Orifice tap location change
7134	EV_CHANGE_ORIFICE_PIPE_	Orifice pipe material change

Enron Register	Alarm & Events Description	Meter run Configuration Parameter
	MATERIAL	
7135	EV_CHANGE_ORIFICE_DIAMETER	Orifice diameter change
7136	EV_CHANGE_ORIFICE_PIPE_ DIAMETER	Orifice pipe diameter change
7137	EV_CHANGE_ORIFICE_VISCOSITY	Orifice viscosity change
7138	EV_CHANGE_ORIFICE_REF_TEMP	Orifice ref temperature change
7139	EV_CHANGE_ORIFICE_PIPE_REF_ TEMP	Orifice pipe ref temperature change
7140	EV_CHANGE_ORIFICE_ ISENTROPIC_EXP	Orifice isentropic exp change
7141	EV_CHANGE_ORIFICE_FLUID_TYPE	Orifice fluid type change
7148	EV_CHANGE_THERMAL_ EXPANSION	Thermal Expansion Factor value change
7149	EV_CHANGE_TEMP_KEYPAD_ VALUE	Temperature keypad value change
7150	EV_CHANGE_PRES_KEYPAD_ VALUE	Pressure keypad value change
7151	EV_CHANGE_TURB_METER_ FACTOR	Turb meter factor change
7152	EV_CHANGE_ULTRA_METER_ FACTOR	Ultra meter factor change
7153	EV_CHANGE_LIQ_METER_FACTOR	Liquid Meter Factor value change
7160	EV_CHANGE_GAS_COMP_SOURCE	Gas comp source change
7161	EV_CHANGE_GAS_COMP_FORMAT	Gas comp format change
7162	EV_CHANGE_GAS_COMP_ METHANE	Gas comp Methane change
7163	EV_CHANGE_GAS_COMP_ NITROGEN	Gas comp Nitrogen change
7164	EV_CHANGE_GAS_COMP_CO2	Gas comp CO2 change
7165	EV_CHANGE_GAS_COMP_ETHANE	Gas comp Ethane change
7166	EV_CHANGE_GAS_COMP_	Gas comp Propane change

Enron Register	Alarm & Events Description	Meter run Configuration Parameter
	PROPANE	
7167	EV_CHANGE_GAS_COMP_WATER	Gas comp Water change
7168	EV_CHANGE_GAS_COMP_H2S	Gas comp H2S change
7169	EV_CHANGE_GAS_COMP_ HYDROGEN	Gas comp Hydrogen change
7170	EV_CHANGE_GAS_COMP_CO	Gas comp CO change
7171	EV_CHANGE_GAS_COMP_OXYGEN	Gas comp Oxygen change
7172	EV_CHANGE_GAS_COMP_ARGON	Gas comp Argon change
7173	EV_CHANGE_GAS_COMP_HELIUM	Gas comp Helium change
7174	EV_CHANGE_GAS_COMP_I_ BUTANE	Gas comp I_Butane change
7175	EV_CHANGE_GAS_COMP_N_ BUTANE	Gas comp N_Butane change
7176	EV_CHANGE_GAS_COMP_I_ PENTANE	Gas comp I_Pentane change
7177	EV_CHANGE_GAS_COMP_N_ PENTANE	Gas comp N_Pentane change
7178	EV_CHANGE_GAS_COMP_HEXANE	Gas comp Hexane change
7179	EV_CHANGE_GAS_COMP_ HEPTANE	Gas comp Heptane change
7180	EV_CHANGE_GAS_COMP_OCTANE	Gas comp Octane change
7181	EV_CHANGE_GAS_COMP_NONANE	Gas comp Nonane change
7182	EV_CHANGE_GAS_COMP_DECANE	Gas comp Decane change
7190	EV_CHANGE_GAS_RELATIVE_ DENSITY	Gas relative density change
7191	EV_CHANGE_GAS_HEATING_VALUE	Gas heating value change
7192	EV_CHANGE_REFTEMPERATURE_ COMBUSTION	Ref temperature combustion change
7193	EV_CHANGE_REFTEMPERATURE_ CALORIMETER	Ref temperature calorimeter change

Enron Register	Alarm & Events Description	Meter run Configuration Parameter
7194	EV_CHANGE_REFPRESSURE_ CALORIMETER	Ref pressure calorimeter change
7201	EV_CHANGED_TEMP_LOW_LOW	Temperature low low limit change
7202	EV_CHANGED_TEMP_LOW	Temperature low limit change
7203	EV_CHANGED_TEMP_HIGH	Temperature high limit change
7204	EV_CHANGED_TEMP_HI_HI	Temperature high high limit change
7205	EV_CHANGED_PRES_LOW_LOW	Pressure low low limit change
7206	EV_CHANGED_PRES_LOW	Pressure low limit change
7207	EV_CHANGED_PRES_HIGH	Pressure high limit change
7208	EV_CHANGED_PRES_HI_HI	Pressure high high limit change
7209	EV_CHANGED_DIFFPRES_LOW_ LOW	Diff pressure low low limit change
7210	EV_CHANGED_DIFFPRES_LOW	Diff pressure low limit change
7211	EV_CHANGED_DIFFPRES_HIGH	Diff pressure high limit change
7212	EV_CHANGED_DIFFPRES_HI_HI	Diff pressure high high limit change
7213	EV_CHANGED_PULSE_LOW_LOW	Pulse low low change
7214	EV_CHANGED_PULSE_LOW	Pulse low change
7215	EV_CHANGED_PULSE_HIGH	Pulse high change
7216	EV_CHANGED_PULSE_HI_HI	Pulse high high change
7217	EV_CHANGED_GASMASS_LOW_ LOW	Gasmass low low change
7218	EV_CHANGED_GASMASS_LOW	Gasmass low change
7219	EV_CHANGED_GASMASS_HIGH	Gasmass high change
7220	EV_CHANGED_GASMASS_HI_HI	Gasmass high high change
7201	EV_ALARM_TEMP_LOW_LOW	Alarm for temp low low
7202	EV_ALARM_TEMP_LOW	Alarm for temp low
7203	EV_ALARM_TEMP_HIGH	Alarm for temp high
7204	EV_ALARM_TEMP_HI_HI	Alarm for temp high high

Enron Register	Alarm & Events Description	Meter run Configuration Parameter
7205	EV_ALARM_PRES_LOW_LOW	Alarm for pressure low low
7206	EV_ALARM_PRES_LOW	Alarm for pressure low
7207	EV_ALARM_PRES_HIGH	Alarm for pressure high
7208	EV_ALARM_PRES_HI_HI	Alarm for pressure high high
7209	EV_ALARM_DIFFPRES_LOW_LOW	Alarm for diff pressure low low
7210	EV_ALARM_DIFFPRES_LOW	Alarm for diff pressure low
7211	EV_ALARM_DIFFPRES_HIGH	Alarm for diff pressure high
7212	EV_ALARM_DIFFPRES_HI_HI	Alarm for diff pressure high high
7213	EV_ALARM_PULSE_LOW_LOW	Alarm for pulse low low
7214	EV_ALARM_PULSE_LOW	Alarm for pulse low
7215	EV_ALARM_PULSE_HIGH	Alarm for pulse high
7216	EV_ALARM_PULSE_HI_HI	Alarm for pulse high high
7217	EV_ALARM_GASMASS_LOW_LOW	Alarm for gasmass low low
7218	EV_ALARM_GASMASS_LOW	Alarm for gasmass low
7219	EV_ALARM_GASMASS_HIGH	Alarm for gasmass high
7220	EV_ALARM_GASMASS_HI_HI	Alarm for gasmass high high
7201	EV_ALARM_TEMP_LOW_LOW_ RESET	Reset alarm for temp low low
7202	EV_ALARM_TEMP_LOW_RESET	Reset alarm for temp low
7203	EV_ALARM_TEMP_HIGH_RESET	Reset alarm for temp high
7204	EV_ALARM_TEMP_HI_HI_RESET	Reset alarm for temp high high
7205	EV_ALARM_PRES_LOW_LOW_ RESET	Reset alarm for pressure low low
7206	EV_ALARM_PRES_LOW_RESET	Reset alarm for pressure low
7207	EV_ALARM_PRES_HIGH_RESET	Reset alarm for pressure high
7208	EV_ALARM_PRES_HI_HI_RESET	Reset alarm for pressure high high
7209	EV_ALARM_DIFFPRES_LOW_LOW_ RESET	Reset alarm for diff pressure low low

Enron Register	Alarm & Events Description	Meter run Configuration Parameter
7210	EV_ALARM_DIFFPRES_LOW_RESET	Reset alarm for diff pressure low
7211	EV_ALARM_DIFFPRES_HIGH_RESET	Reset alarm for diff pressure high
7212	EV_ALARM_DIFFPRES_HI_HI_RESET	Reset alarm for diff pressure high high
7213	EV_ALARM_PULSE_LOW_LOW_RESET	Reset alarm for pulse low low
7214	EV_ALARM_PULSE_LOW_RESET	Reset alarm for pulse low
7215	EV_ALARM_PULSE_HIGH_RESET	Reset alarm for pulse high
7216	EV_ALARM_PULSE_HI_HI_RESET	Reset alarm for pulse high high
7217	EV_ALARM_GASMASS_LOW_LOW_RESET	Reset alarm for gasmass low low
7218	EV_ALARM_GASMASS_LOW_RESET	Reset alarm for gasmass low
7219	EV_ALARM_GASMASS_HIGH_RESET	Reset alarm for gasmass high
7220	EV_ALARM_GASMASS_HI_HI_RESET	Reset alarm for gasmass high high
7227	EV_CHANGE_DEN_TEMP_LOW_LOW	Desitometer Temperature Low Low alarm value change
7228	EV_CHANGE_DEN_TEMP_LOW	Desitometer Temperature Low alarm value change
7229	EV_CHANGE_DEN_TEMP_HIGH	Desitometer Temperature High alarm value change
7230	EV_CHANGE_DEN_TEMP_HI_HI	Desitometer Temperature High High alarm value change
7231	EV_CHANGE_DEN_PRES_LOW_LOW	Desitometer Pressure Low Low alarm value change
7232	EV_CHANGE_DEN_PRES_LOW	Desitometer Pressure Low alarm value change
7233	EV_CHANGE_DEN_PRES_HIGH	Desitometer Pressure High alarm value change
7234	EV_CHANGE_DEN_PRES_HI_HI	Desitometer pressure High High alarm value change

Enron Register	Alarm & Events Description	Meter run Configuration Parameter
7227	EV_CHANGE_DEN_TEMP_LOW_LOW_RST	Desitometer Temperature Low Low alarm reset
7228	EV_CHANGE_DEN_TEMP_LOW_RST	Desitometer Temperature Low alarm value reset
7229	EV_CHANGE_DEN_TEMP_HIGH_RST	Desitometer Temperature High alarm value reset
7230	EV_CHANGE_DEN_TEMP_HI_HI_RST	Desitometer Temperature High High alarm value reset
7231	EV_CHANGE_DEN_PRES_LOW_LOW_RST	Desitometer Pressure Low Low alarm value reset
7232	EV_CHANGE_DEN_PRES_LOW_RST	Desitometer Pressure Low alarm value reset
7233	EV_CHANGE_DEN_PRES_HIGH_RST	Desitometer Pressure High alarm value reset
7234	EV_CHANGE_DEN_PRES_HI_HI_RST	Desitometer pressure High High alarm value reset
7235	EV_ALARM_DEN_TEMP_KEYPAD_SET	Densitometer Temperature Keypad alarm set
7236	EV_ALARM_DEN_PRES_KEYPAD_SET	Densitometer Pressure Keypad alarm set
7237	EV_ALARM_TEMP_KEYPAD_SET	Temperature Keypad alarm set
7238	EV_ALARM_PRES_KEYPAD_SET	Pressure Keypad alarm set
7239	EV_ALARM_DESITY_KEYPAD_SET	Density Keypad alarm set
7240	EV_ALARM_BASE_DESITY_KEYPAD_SET	Base Density Keypad alarm set
7241	EV_ALARM_WATER_SED_KEYPAD_SET	Water and Sediments Keypad alarm set
7242	EV_ALARM_THERMAL_EXP_KEYPAD_SET	Thermal Expansion Factor Keypad alarm set
7249	EV_CHANGE_TEMP_KEYPAD_VALUE	Meter Temperature Keypad Value change
7250	EV_CHANGE_PRES_KEYPAD_	Meter Pressure Keypad Value change

Enron Register	Alarm & Events Description	Meter run Configuration Parameter
	VALUE	
7257	EV_CHANGE_DEN_TEMP_KEYPAD_VALUE	Desitometer Temperature Keypad Value change
7258	EV_CHANGE_PRES_TEMP_KEYPAD_VALUE	Desitometer pressure Keypad Value change
7260	EV_CHANGE_WATER_SED_KEYPAD_VALUE	Water and Sediments Keypad Value change
7286	EV_ALARM_NO_FLOW_START	No Flow start alarm set
7286	EV_ALARM_NO_FLOW_END	No Flow end alarm set
7287	EV_ALARM_ERROR_START	Error Start alarm
7287	EV_ALARM_ERROR_END	Error End alarm
7288	EV_ALARM_MAINTENANCE_MODE_START	Maintenance mode start alarm
7288	EV_ALARM_MAINTENANCE_MODE_END	Maintenance mode end alarm
7289	EV_CHANGE_ANALOG_LOW_LOW	Analog Low Low Alarm Value Change
7290	EV_CHANGE_ANALOG_LOW	Analog Low Alarm Value Change
7291	EV_CHANGE_ANALOG_HIGH	Analog High alarm value change
7292	EV_CHANGE_ANALOG_HIGH_HIGH	Analog High High alarm value change
7289	EV_ALARM_ANALOG_LOW_LOW	Alarm for Analog low low
7290	EV_ALARM_ANALOG_LOW	Alarm for Analog low
7291	EV_ALARM_ANALOG_HIGH	Alarm for Analog high
7292	EV_ALARM_ANALOG_HIGH_HIGH	Alarm for Analog high high
7289	EV_ALARM_ANALOG_LOW_LOW_RST	Reset alarm for Analog low low
7290	EV_ALARM_ANALOG_LOW_RST	Reset Alarm for Analog low
7291	EV_ALARM_ANALOG_HIGH_RST	Reset Alarm for Analog high
7292	EV_ALARM_ANALOG_HIGH_HIGH_RST	Reset Alarm for Analog high high
7293	EV_CHANGE_PULSE_LOW_CUTOFF	Low Pulse Cut off value change

Enron Register	Alarm & Events Description	Meter run Configuration Parameter
7294	EV_CHANGE_MAX_PULSE_ INCREMENT	Max Pulse increment value change
7295	EV_ALARM_RETRO_K_FACTOR_ CoRRECTED	Retrospective K-factor value corrected alarm
7296	EV_CHANGE_DEN_TEMP_IO_ SELECTION	Densitometer Temperature IO Selection change
7297	EV_CHANGE_DEN_PRES_IO_ SELECTION	Densitometer Pressure IO Selection change
7298	EV_CHANGE_MEASURED_ DENSITY_IO_SELECTION	Measured Density IO Selection change
7299	EV_CHANGE_TEMP_IO_SELECTION	Temperature IO Selection change
7300	EV_CHANGE_PRES_IO_SELECTION	Pressure IO Selection change
7301	EV_CHANGE_IO_TYPE	IO Type change
7302	EV_CHANGE_SDWD_WAIT_TIME	ST103A Watchdog wait time value change
7303	EV_CHANGE_CORIOLISMTR_AS_ DENSIMTR	Coriolis Meter as Densitometer value change
7304	EV_CHANGE_BASE_DENSITY	Base Density value change
7305	EV_CHANGE_DEN_KEYPAD_VALUE	Densitometer keypad value change
7306	EV_CHANGE_DENSITOMETER_ AVAILABLE	Densitometer Available value change
7307	EV_CHANGE_DENSITOMETER_ COUNT	Densitometer Count value change
7308	EV_CHANGE_PREFERRED_ DENSIMTR	Preferred Densitometer change
7309	EV_CHANGE_IS_SEDIMENTS_ WATER	Sediments and Water available change
7310	EV_CHANGE_ROUNDING_METHOD	Rounding Method change
7312	EV_CHANGE_CPL_CALC_TYPE	CPL Calc type change
7313	EV_CHANGE_CONVERGENCE_ CRITERIA	Convergence Criteria value change

Enron Register	Alarm & Events Description	Meter run Configuration Parameter
7314	EV_CHANGE_MAX_ITERATIONS	Maximum iterations value change
7315	EV_CHANGE_ITERATIONS_METHOD	Iterations method change
7316	EV_CHANGE_VAPOUR_PRES	Vapour Pressure value change
7317	EV_CHANGE_VAPOUR_PRES_ CALC_METHOD	Vapour Pressure Calc method change
7318	EV_CHANGE_LOW_FLOW_CUTOFF	Low flow cutoff change
7319	EV_CHANGE_TEMP_HIGH_LIMIT	Temperature high limit change
7320	EV_CHANGE_TEMP_LOW_LIMIT	Temperature low limit change
7321	EV_CHANGE_PRES_HIGH_LIMIT	Pressure high limit change
7322	EV_CHANGE_PRES_LOW_LIMIT	Pressure low limit change
7323	EV_CHANGE_DEN_TEMP_HIGH_ LIMIT	Densitometer Temperature high limit change
7324	EV_CHANGE_DEN_TEMP_LOW_ LIMIT	Densitometer Temperature low limit change
7325	EV_CHANGE_DEN_PRES_HIGH_ LIMIT	Densitometer Pressure high limit change
7326	EV_CHANGE_DEN_PRES_LOW_ LIMIT	Densitometer Pressure low limit change

Alarm and event operator Bit definition

The table below describes the meaning of each bit of the Alarm/Event value read from the controller over Enron Modbus.

Table B-5: Alarm and event operator Bit definition

Bit	Description
0	Fixed value changed bit
1	NoFlow=1 Flow=0
2	KeyPad SET=1 RST=0
3	Operator entry work value
4	Error Alarm SET=1 RST=0
5	Fixed or variable flag
6	Maintainance Alarm SET=1 RST=0
7	System command change bit
8	Maxpulse Increment/Retrospective K Factor Alarm SET=1 RST=2
9	Operator change identified bit , 1 for events
10	LoLo bit
11	Lo bit
12	Hi bit
13	HiHi bit
14	Rate of change limit
15	• 1 = Alarm Set • 0 = Alarm Reset

See the following example:

If the Alarm/Event received is 36864 which is 0x9000 in hex and its bitmap is shown below.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0

From the table we see that bit 15 (alarm) and bit 12 (HI) are set. Thus it is a HI Alarm.

See the following table for the alarm or event type and its alarm state as well as event state:

Alarm/Event Type	Alarm State	Event State
LoLo	33792	1536
LoLo-Reset	1024	N/A
Lo	34816	2560
Lo-Reset	2048	N/A
Hi	36864	4608
Hi-Reset	4096	N/A
HiHi	40960	8704
HiHi-Reset	8192	N/A
Flow	2	N/A
No-Flow	32770	N/A
KeyPad Set	32772	516
KeyPad Reset	4	N/A
Error Alarm Set	32784	N/A
Error Alarm Reset	16	N/A
Mainitainance ALarm Set	32832	N/A
Mainitainance Alarm Reset	64	N/A
Maxpulse Increment/ Retrospective K Factor Alarm Set	33024	N/A
Maxpulse Increment/ Retrospective K Factor Alarm Reset	256	N/A
For Gas: • Any Gas component Percentage change • Base Temperature change • Base Pressure change • Flow Temp IO Selection change • Flow Press IO Selection change • Low Pulse cut off change	N/A	520

<table>
<tr><th>Alarm/Event Type</th><th>Alarm State</th><th>Event State</th></tr>
<tr><td>Low Flow cut off change
Contract start day change
Atmospheric Press change
Meter factor change</td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>For Liquid:
Densitometer Available change
Densitometer Count change
Coriolis Meter as Densitometer change
Density Temp IO Selection change
Density Press IO Selection change
Measured Density IO Selection change
Preferred Densitometer change
Base Density change
Base temperature change
Meter factor change
Rounding method change
Temperature IO Selection change
Pressure IO Selection change
Low Pulse Cutoff change
Low Flow Cutoff change
Max Pulse Increment change</td></tr>
</table>

APPENDIX

C

GLOBAL VARIABLE PARAMETERS REFERENCE DICTIONARY

You can check the diagnostic variable values and system status by checking the global variables.

In this section:

Hxxxx parameters

Hardware code

Specific to Block (s)	SC-UCMX01, SC-UCNN11
Display Name	FirmwareMngr.HardwareCode
Variable Name	CNTLR_HARDWARECODE
Description	Hardware Code
Data Type	STRING
Data Size	1 character
Range	• 1 is for CPM • 2 is for EPM
Class	Static
Access	Read Only
Related Parameters	HardwareType

Hardware major version

Specific to Block (s)	SC-UCMX01, SC-UCNN11
Display Name	FirmwareMngr.HardwareMajor
Variable Name	CNTLR_HARDWAREMAJOR
Description	Hardware Major Version
Data Type	STRING
Data Size	1 character
Range	A, B, C, D...Z
Class	Static
Access	Read/Write
Related Parameters	HardwareMinor

Pxxxx parameters

PartnerRdnHistReason [1...16]

Specific to Block (s)	SC-UCNN11
Display Name	Redundancy.PartnerRdnHistReason
Variable Name	N/A
Description	Redundancy History Reason
Data Type	UINT
Data Size	2
Range	See Redundancy History Reason Enumeration for more information.
Class	Dynamic
Access	Read Only
Related Parameters	PartnerRdnHistState, PartnerRdnHistTime
Remarks	This parameter is read from the redundant partner. The Redundancy History Reason provides the rational for the occurrence of a redundancy history state. Includes rational for initial redundancy role determination, partner compatibility, commencing initial sync, redundancy role change, loss-of-sync, and inhibit sync.

PartnerRdnHistState [1...16]

Specific to Block (s)	SC-UCNN11
Display Name	Redundancy.PartnerRdnHistState
Variable Name	N/A
Description	Redundancy History State

Data Type	UINT
Data Size	2
Range	See Redundancy History State Enumeration for more information.
Class	Dynamic
Access	Read Only
Related Parameters	PartnerRdnHistTime, PartnerRdnHistReason
Remarks	This parameter is read from the redundant partner. The Redundancy History State indicates the last 16 milestones of redundancy related activities. Refer to the associated Redundancy History Reason entry for additional information (when applicable).

PartnerRdnHistTime [1...16]

Specific to Block (s)	SC-UCNN11
Display Name	Redundancy.PartnerRdnHistTime
Variable Name	N/A
Description	Redundancy History Time
Data Type	UINT
Data Size	4
Range	Local time, seconds since 00:00 1-Jan-1970 (UTC)
Class	Dynamic
Access	Read Only
Related Parameters	PartnerRdnHistState, PartnerRdnHistReason
Remarks	This parameter is read from the redundant partner. The Redundancy History Reason provides the rational for the occurrence of a redundancy history state. Includes rational for initial redundancy role determination, partner compatibility, commencing initial sync, redundancy role change, loss-of-sync, and inhibit sync.

Enumerations

Redundancy History Reason Enumerations

Not all enumerations listed are used with all controllers.

Reason	Description
Null (0)	History State does not require rational.
PreviouslyPrimary (1)	Initial redundancy role of Primary was chosen because previously retained primary role.
PreviouslySynchronizedSecondary (2)	Initial redundancy role of Secondary was chosen because previously retained synchronized secondary role.
PreviouslyStandbySecondary (3)	Initial redundancy role of Secondary was chosen because previously retained standby secondary role.
PreviouslyUnsynchronizedSecondary (4)	Initial redundancy role of Secondary was chosen because previously retained not synchronized secondary role.
PreviouslyNonRedundant (5)	Initial redundancy role of Non-Redundant was chosen because previously retained non-redundant role.
PrimaryIpOccupied (6)	Initial redundancy role of Secondary was chosen because primary IP address occupied.
SecondaryIpOccupied (7)	Initial redundancy role of Primary was chosen because secondary IP address occupied.
HardwareLimitation (8)	Initial redundancy role was chosen because of hardware restriction.
OddDeviceIndex (9)	Initial redundancy role of Primary was chosen because module is configured with odd device index.
EvenDeviceIndex (10)	Initial redundancy role of Secondary was chosen because module is configured with even device index.
PartnerIsPrimary (11)	Initial redundancy role of Secondary was chosen because partner already in primary role.
PartnerIsSecondary (12)	Initial redundancy role of Primary was chosen because partner already in secondary role.
PartnerIsNonRedundant (13)	Initial redundancy role of Secondary was chosen because partner already in non-redundant role.

Reason	Description
PartnerIsNoDb (14)	Initial redundancy role of Primary was chosen because partner has no loaded strategy. Note that as a consequence, the partner in NODB State is rebooted into the secondary role.
PartnerRunningInBootFirmware (15)	Initial redundancy role of Primary was chosen because partner running in boot firmware. Note that if the partner was in the primary role, it transitions into the secondary role.
LaterWallClockTime (16)	Initial redundancy role of Primary was chosen because simultaneous conflict resolved by more recent wall-clock time.
Compatible (17)	Partner module is present and compatible. Compatible indication for those platforms not sensitive to difference in firmware versions. This includes FIM, FIM4, FIM8, FTEB, IOLIM, PGM2, PLC, and RTU.
DirectCompatible (18)	Partner module is present, compatible, and has identical firmware version. Compatible indication for those platforms sensitive to difference in firmware versions when firmware versions are identical.
MigrateCompatible (19)	Partner module is present, compatible, but only supports On Process Migration due to different firmware versions. Compatible indication for those platforms sensitive to difference in firmware versions when firmware versions differ. This implies that the Controller Migration Wizard must be invoked to coordinate OPM initial synchronization and switchover to the different firmware version.
HardwareType (20)	Incompatible - Different Hardware Types. Check for a Factory Information mismatch between the redundant pair.
FirmwareType (21)	Incompatible - Different Firmware Types.
DeviceIndex (22)	Incompatible - Incorrect Device Index. Redundant pair requires consecutive Device index pair.
OpmNotImplemented (23)	Incompatible - On Process Migration not implemented.

Reason	Description
OpmSequence (24)	Incompatible - On Process Migration not supported across specified releases. Attempting to migrate across more than one major release. For example, migration between R101 and R300 is not allowed; this may be allowed in later releases. This reason is also used to prevent synchronization from a primary controller with newer firmware to a secondary controller with older firmware because the secondary controller would not be able to interpret any new synchronization data from primary controller with newer firmware.
InitiateSwitchoverCommand (25)	User issued switchover command.
InitiateSwapCommand (26)	User issued swap command.
PrimaryLonelyOnFte (27)	The original synchronized primary module became lonely on FTE resulting in automatic switchover. In addition, the unsynchronized controller performs initial-sync with immediate switchover with this reason when the primary controller suffers from dual FTE cable disconnect and the secondary controller has visibility to the FTE network.
Migration (28)	Automatic redundancy role change due to on-process migration.
AlternateSync (29)	Automatic redundancy role change due to Alternate Sync command (that is, one time initial sync across FTE instead of private path).
DiagnosticFailure (30)	Switchover triggered due to diagnostic failure.
FatalError (31)	Switchover triggered due to fatal error.
FteDeafMute (32)	Switchover triggered due to FTE becoming deaf & mute even though link integrity signal is still being sensed.
Link1IolLoopbackError (33)	Link 1 IOL Loopback Error. The IOL processor has detected that it cannot see what it has transmitted onto the wire. This is a switchover trigger because it may represent a fault in the IOL communication electronics. Bad IOL wiring and/or rogue IOL device communications also could cause Loopback Error.
PartnerRequest (34)	Partner Requested operation. The redundant partner has either requested initial sync to be inhibited / aborted or

Reason	Description
	for role change. Refer to the partner's redundancy history parameter for the actual reason.
PartnerBetterPrimary (35)	Force role change because partner is better primary candidate.
DisableSyncCommand (36)	User issued disable synchronization command.
PartnerAbsent (37)	Partner module absent. Initial-sync is not applicable without a redundant partner.
PartnerNotCompatible (38)	Partner module not compatible. Initial-sync is not applicable with an incompatible redundant partner.
PartnerPrivatePathDisconnected (39)	Redundancy private path cable disconnected.
RedundancyCommOutOfSequenceError (40)	Redundancy communication out-of-sequence error. Redundancy communication buffers have been lost resulting in the receipt of an unexpected sequence number. This could be a fault in the redundancy communication private path or in the redundancy communication electronics.
DataFormatError (41)	Redundancy communication format error. Receipt of a redundancy communication buffer that has an unknown format ID indicates corrupted data. This could be a fault in the redundancy communication private path or in the redundancy communication electronics.
DataChecksumError (42)	The secondary received corrupt sync data. The primary redundancy subsystem applies a checksum on the sync-data communication buffer and the secondary validates the checksum against the received sync-data communication buffer. This could be a fault in the redundancy communication private path or in the redundancy communication electronics.
SyncHardwareError (43)	Synchronization hardware error. Loss-of-sync due to sync hardware error disables Auto-Sync. Use the Enable Synchronization command to trigger initial-sync.
CleanPointTimeout (44)	Encountered a timeout condition while performing clean-point processing. The primary is not able to send redundancy data to the secondary partner in a timely fashion.
PrimaryUnknownError (45)	Unknown cause on primary module.

Reason	Description
SecondaryUnknownError (46)	Unknown cause on secondary module.
AlternateSyncCommand (47)	User commanded Alternate Synchronization.
EnableSyncCommand (48)	User commanded Enable Synchronization.
MigrationCommand (49)	Controller on-process migration.
PartnerReady (50)	Compatible partner completed startup initialization.
PartnerPrivatePathConnected (51)	Redundancy private path cable reconnected.
PartnerPrivatePathCommunicationError (52)	Redundancy private path communication error. Invalid redundancy data was received or the periodic partner status message was not received over the redundancy private path.
DataMessageSizeError (53)	Redundancy unexpected message size error.
AutoSyncState (54)	Auto Sync state is disabled. Initial sync is inhibited while the Auto Sync State is set to disabled. This is a persistent inhibit sync reason that is canceled via the Enable Sync command.
NoFbStart (55)	Missing FB_START indication.
SyncDataReceiveError (56)	Error occurred on secondary receive of parameterized sync data.
OutOfSyncBuffers (57)	Sync data and tag buffers not allocated.
OutOfIMRs (58)	Unable to acquire IMR for receipt of sync data.
LiveListMismatch (59)	Mismatch between primary & secondary live list.
LinkStatus (60)	Link status.
RtpAttendance (61)	RTP attendance.
FteCableStatus (62)	Indicates that either both FTE Ethernet cables have been disconnected (i.e. FTE lonely) or at least one FTE Ethernet cable has been reconnected. The primary triggers switchovers due to dual-FTE-cable disconnect. The synchronized secondary aborts sync due to dual-FTE-cable disconnect and the secondary inhibits sync due to dual-FTE-cable disconnect. This secondary persistent inhibit sync reason can only be canceled by restoring FTE communications.

Reason	Description
Link1NvsCommands (63)	Link 1 Flash operations. Synchronization is aborted and/or initial- sync is inhibited during the database initialization that occurs upon I/O Link FB commanded NVS compaction.
OpmRequired (64)	Controller OPM required but not yet enabled.
OpmWaitRestore (65)	Controller OPM waiting for Secondary Checkpoint Restore.
OpmWaitSyncCommand (66)	Controller OPM waiting for sync/ switch command from the Controller Migration Wizard.
OpmAbortCommand (67)	Control Migration Wizard commanded migration abort.
OpmRestoreTimeout (68)	Controller OPM Secondary Checkpoint Restore timed out; this occurs if the flow of checkpoint data is stalled for longer than 2 minutes. This represents abnormal OPM session termination.
OpmTimeout (69)	The redundancy subsystem aborts controller OPM if control is frozen (during the one-time OPM initial-sync transfer of Dynamic Data) longer than the maximum specified time. This represents abnormal OPM session termination.
OpmInitialSyncTimeout (70)	Controller OPM commence initial sync timed out. Initial sync failed to commence within two minutes following the receipt of the Migration Wizard command to commence initial-sync as part of an OPM session. This represents abnormal OPM session termination.
OpmIoConnectionsTimeout (71)	Controller OPM I/O connection timeout. Loss-of-sync occurred while waiting for the Secondary controller to form at least the same number of I/O Connections as the primary controller (as part of initial-sync during an OPM session). The Secondary Platform FB's LASTOPMNAME parameter is blank in this case. This represents abnormal OPM session termination.
OpmIoDataFailure (72)	Controller OPM I/O Data failure. Loss-of-sync occurred while transferring I/O Connection Data (as part of initial-sync during an OPM session). Although any loss-of-sync triggers this behavior, the most probable loss-of-sync cause is the inability of the secondary controller to interpret the I/O Connection Data format. The Secondary Platform FB's LASTOPMNAME parameter is blank in this

Reason	Description
	case. This represents abnormal OPM session termination.
OpmPeerReferencesMismatch (73)	Controller OPM peer reference mismatch. Loss-of-sync occurred while transferring Peer Cross-Reference ID data (as part of initial-sync during an OPM session). Although any loss-of-sync triggers this behavior, the most probable loss-of- sync cause is the presence of a ghost peer connection reference. A ghost peer connection reference exists if the primary controller has knowledge of a peer connection ID that was not instantiated in the Secondary controller during OPM Secondary Checkpoint Restore. The Secondary Platform FB's LASTOPMNAME parameter is blank in this case. This represents abnormal OPM session termination.
OpmPeerReferencesFailure (74)	Controller OPM peer reference data fail. The one-time OPM initial-sync transfer of Dynamic Data that occurs with control frozen contains two components of Peer Dynamic Data and Block Dynamic Data with the latter typically being the larger of the two. Loss-of-sync occurred while transferring Peer Dynamic Data. Although any loss-of-sync triggers this behavior, the most probable loss-of-sync cause is the inability of the secondary controller to interpret the Peer Dynamic Data format. The Secondary Platform FB's LASTOPMNAME parameter is blank in this case. This represents abnormal OPM session termination.
OpmBlockDataTimeout (75)	Controller OPM block data transfer timeout. The redundancy subsystem aborts controller OPM if control is frozen (during the one-time OPM initial-sync transfer of Dynamic Data) longer than the maximum specified time. This represents abnormal OPM session termination.
OpmBlockDataFailure (76)	Controller OPM block data fail. The one-time OPM initial-sync transfer of Dynamic Data that occurs with control frozen contains two components of Peer Dynamic Data and Block Dynamic Data with the latter typically being the larger of the two. Loss-of-sync occurred while transferring Block Dynamic Data. This represents abnormal OPM session termination. Although any loss-of-sync triggers this behavior, the most probable loss-of-sync cause is either the inability of the

Reason	Description
	secondary controller to interpret the Block Dynamic Data format or the secondary controller has no destination block to receive the Dynamic Data. The latter is possible in the presence of a ghost block; a ghost block exists if the primary controller has knowledge of a block that was not instantiated in the Secondary controller during OPM Secondary Checkpoint Restore. The Secondary Platform FB's LASTOPMNAME parameter indicates the name of the last block to be (on-process) migrated; the LASTOPMNAME is used to isolate the name of the first CEE subordinate block that has detected a dynamic state data error. In the special case of a ghost block, the LASTOPMNAME is either blank (because the ghost block name no longer exists in the ERDB) or indicates the name of a block that is not loaded to the controller (that is, only exists on the Control Builder project tree).
OpmFormatError (77)	Receive of Controller OPM data failed.
StartupInProgress (78)	Platform startup in progress. Initial sync is not allowed until after the controller has completed system startup. This is a transient inhibit sync reason that is usually not seen.
PlatformFunctionBlockLoadState (79)	Platform FB load state. Initial-sync is not allowed until after the Platform FB has been loaded to the controller.
RedundancyConfigurationState (80)	The controller is configured as non-redundant. Initial-sync is not allowed when explicitly configured as non-redundant. This persistent inhibit sync reason can only be canceled by reconfiguring the non-redundant controller as redundant.
Link1PartnerTimeout (81)	Link 1 partner startup timeout.
Link2PartnerTimeout (82)	Link 2 partner startup timeout.
Link1PartnerNotVisible (83)	Link 1 Partner Not Visible.
Link2PartnerNotVisible (84)	Link 2 Partner Not Visible.
Link1PartnerMismatch (85)	Link 1 Partner Mismatch.
Link2PartnerMismatch (86)	Link 2 Partner Mismatch.
StateUnexpected (87)	Unexpected State in State Machine. Loss-of-sync occurred due to internal redundancy state machine

Reason	Description
	unexpected transition.
InitialSyncDelay (88)	Anti thrash delay in between initial sync attempts. There is a guaranteed 30 second delay in between initial-sync attempts. More specifically, for 30 seconds after a compatible partner is identified, initial-sync is inhibited with this transient reason.
InitialSyncFail (89)	Multiple consecutive initial sync failures. After 3 failed attempts to perform initial-sync, the Auto Sync State is automatically set to disabled and the inhibit sync reason is set to this persistent value. Refer to the redundancy history for the reasons why initial-sync failed, and issue the Enable Sync command to attempt initial-sync again after correcting the abort-sync reason.
DroppingSync (90)	Drop-synchronization in progress. Initial-sync cannot commence until the previous abort sync operation has been completed. This is a transient inhibit sync reason that is usually not seen.
CclBinaryLoad (91)	Synchronization cannot be maintained during CCL Binary load.
CeeLoadOrDelete (92)	Synchronization cannot be maintained during the database initialization that occurs upon CEE FB load or delete.
UnsupportedHardwareVersion (93)	Unsupported controller HW version. Initial-sync is inhibited for controller hardware version that does not support controller redundancy.
BothRunningInBootFirmware (94)	Both running in boot firmware. Initial-sync is only possible when both partners of a redundant pair are running in application firmware.
ThisRunningInBootFirmware (95)	This module running in boot firmware. Initial-sync is only possible when both partners of a redundant pair are running in application firmware.
RedundancyCommOutOfTxBuffersError (96)	Redundancy communication out-of-TX-buffers error. The redundancy subsystem cannot send any more redundancy messages because the TX buffers have been exhausted. This is a drop-sync trigger.
RedundancyCommTransmitError (97)	Redundancy communication transmit error.

Reason	Description
RedundancyCommReceiveError (98)	Redundancy communication receive error.
RedundancyCommDeviceReset (99)	Redundancy communication device reset.
RedundancyCommBadBufferIndex (100)	Redundancy communication bad buffer index.
BecomePrimaryCommand (101)	Become Primary command.
LowerSerialNumber (102)	When performing initial-role-determination or dual role correction upon re-establishing partner communication, the redundancy subsystem’s role decision was chosen due to lower serial number. This reason indicates that the physical ID of the redundant pair is not well formed resulting in serial number tie breaker.
HigherSerialNumber (103)	When performing initial-role-determination or dual role correction upon re-establishing partner communication, the redundancy subsystem’s role decision was chosen due to higher serial number. This reason indicates that the physical ID of the redundant pair is not well formed resulting in serial number tie breaker.
BetterControlAbility (104)	Indicates that the controller is a better candidate to be the primary controller. Switchover immediately occurs following initial-sync when the secondary controller has better control ability. Initial-sync is inhibited when the primary controller has better control ability.
WorseControlAbility (105)	Indicates that the controller is a worse candidate to be the primary controller. Switchover immediately occurs following initial-sync when only the primary controller has worse control ability. Initial-sync is inhibited when only the secondary controller has worse control ability.
PartnerFaultDetected (106)	Partner Fault Detected. The partner module was rebooted and/or powered off.
Link1LoadState (107)	Link 1 load has not completed/occurred. Initial-sync is not allowed to commence until after all link function blocks have been loaded. This persistent inhibit sync reason is negated upon load of the link function block to the controller.
Link2LoadState (108)	Link 2 load has not completed/occurred. Initial-sync is not allowed to commence until after all link function blocks have been loaded. This persistent inhibit sync

Reason	Description
	reason is negated upon load of the link function block to the controller.
Link3LoadState (109)	Link 3 load has not completed/occurred. Initial-sync is not allowed to commence until after all link function blocks have been loaded. This persistent inhibit sync reason is negated upon load of the link function block to the controller.
Link4LoadState (110)	Link 4 load has not completed/occurred. Initial-sync is not allowed to commence until after all link function blocks have been loaded. This persistent inhibit sync reason is negated upon load of the link function block to the controller.
Link5LoadState (111)	Link 5 load has not completed/occurred. Initial-sync is not allowed to commence until after all link function blocks have been loaded. This persistent inhibit sync reason is negated upon load of the link function block to the controller.
Link6LoadState (112)	Link 6 load has not completed/occurred. Initial-sync is not allowed to commence until after all link function blocks have been loaded. This persistent inhibit sync reason is negated upon load of the link function block to the controller.
Link7LoadState (113)	Link 7 load has not completed/occurred. Initial-sync is not allowed to commence until after all link function blocks have been loaded. This persistent inhibit sync reason is negated upon load of the link function block to the controller.
Link8LoadState (114)	Link 8 load has not completed/occurred. Initial-sync is not allowed to commence until after all link function blocks have been loaded. This persistent inhibit sync reason is negated upon load of the link function block to the controller.
UnexpectedPdTagSetOnLink (115)	Unexpected set PD_TAG on link.
UnexpectedPdTagClearOnLink (116)	Unexpected clear PD_TAG on link.
UnexpectedNodeAddrSetOnLink (117)	Unexpected set node address on link.
UnexpectedNodeAddrClearOnLink	Unexpected clear node address on link.

Reason	Description
(118)	
DupeNodeAddrDetectedOnLink (119)	Duplicate node address detected on link.
UnknownSmEventIndicationOnLink (120)	Unknown SM event indication on link.
OnProcessMigrationDSDThrottling (121)	Secondary cannot commit DSD fast enough
RedundancyCommBufferOverflow (122)	Communication buffer overflow.
RedundancyDataOverrun (123)	Secondary received more synchronization data than it can accumulate. This is an indication that the secondary cannot keep up with the rate of redundancy data being generated by the primary controller.
RedundancyResourceLocked (124)	Resource Locked.
OpenIoConnectionsTimeout (125)	I/O connections open timeout.
RedundancyModuleRemoval (126)	Controller detected removal under power. This may indicate that the controller is not fully inserted into the rack.
OpenSyncDataConnectionError (127)	Sync connection open error.
OpenTrackDataConnectionError (128)	Track connection open error.
InitialSyncTimeout (129)	Initial-sync timed out
EnableStandbyCommand (130)	User commanded Enable Standby.
BadAddressOnLink1 (131)	Incorrect address on link 1. This is typically caused by bad wiring, bad hardware, or both. 1 - Check that there is no "noise on the wire" as this causes the FIM to change addresses per FF spec. 2 - Check that the primary and secondary FIMs are connected to the same RTP. 3 - Check that the RTP is good and that it has a good fuse. 4 - Check for proper termination on the H1 link. 5 - Check that there are no shorts in the wiring. 6 - Check that the wiring is properly shielded.

Reason	Description
	7 - Check that there are no failed devices.
BadAddressOnLink2 (132)	Incorrect address on link 2. This is typically caused by bad wiring, bad hardware, or both. 1 - Check that there is no "noise on the wire" as this causes the FIM to change addresses per FF spec. 2 - Check that the primary and secondary FIMs are connected to the same RTP. 3 - Check that the RTP is good and that it has a good fuse. 4 - Check for proper termination on the H1 link. 5 - Check that there are no shorts in the wiring. 6 - Check that the wiring is properly shielded. 7 - Check that there are no failed devices.
BadAddressOnLink3 (133)	Incorrect address on link 3. This is typically caused by bad wiring, bad hardware, or both. 1 - Check that there is no "noise on the wire" as this causes the FIM to change addresses per FF spec. 2 - Check that the primary and secondary FIMs are connected to the same RTP. 3 - Check that the RTP is good and that it has a good fuse. 4 - Check for proper termination on the H1 link. 5 - Check that there are no shorts in the wiring. 6 - Check that the wiring is properly shielded. 7 - Check that there are no failed devices.
BadAddressOnLink4 (134)	Incorrect address on link 4. This is typically caused by bad wiring, bad hardware, or both. 1 - Check that there is no "noise on the wire" as this causes the FIM to change addresses per FF spec.

Reason	Description
	2 - Check that the primary and secondary FIMs are connected to the same RTP. 3 - Check that the RTP is good and that it has a good fuse. 4 - Check for proper termination on the H1 link. 5 - Check that there are no shorts in the wiring. 6 - Check that the wiring is properly shielded. 7 - Check that there are no failed devices.
BadAddressOnLink5 (135)	Incorrect address on link 5. This is typically caused by bad wiring, bad hardware, or both. 1 - Check that there is no "noise on the wire" as this causes the FIM to change addresses per FF spec. 2 - Check that the primary and secondary FIMs are connected to the same RTP. 3 - Check that the RTP is good and that it has a good fuse. 4 - Check for proper termination on the H1 link. 5 - Check that there are no shorts in the wiring. 6 - Check that the wiring is properly shielded. 7 - Check that there are no failed devices.
BadAddressOnLink6 (136)	Incorrect address on link 6. This is typically caused by bad wiring, bad hardware, or both. 1 - Check that there is no "noise on the wire" as this causes the FIM to change addresses per FF spec. 2 - Check that the primary and secondary FIMs are connected to the same RTP. 3 - Check that the RTP is good and that it has a good fuse. 4 - Check for proper termination on the H1 link. 5 - Check that there are no shorts in the wiring.

Reason	Description
	6 - Check that the wiring is properly shielded. 7 - Check that there are no failed devices.
BadAddressOnLink7 (137)	Incorrect address on link 7. This is typically caused by bad wiring, bad hardware, or both. 1 - Check that there is no "noise on the wire" as this causes the FIM to change addresses per FF spec. 2 - Check that the primary and secondary FIMs are connected to the same RTP. 3 - Check that the RTP is good and that it has a good fuse. 4 - Check for proper termination on the H1 link. 5 - Check that there are no shorts in the wiring. 6 - Check that the wiring is properly shielded. 7 - Check that there are no failed devices.
BadAddressOnLink8 (138)	Incorrect address on link 8. This is typically caused by bad wiring, bad hardware, or both. 1 - Check that there is no "noise on the wire" as this causes the FIM to change addresses per FF spec. 2 - Check that the primary and secondary FIMs are connected to the same RTP. 3 - Check that the RTP is good and that it has a good fuse. 4 - Check for proper termination on the H1 link. 5 - Check that there are no shorts in the wiring. 6 - Check that the wiring is properly shielded. 7 - Check that there are no failed devices.
FTEB_IoManager (139)	FTEB IO Manager.
Link1PartnerNotLoaded (140)	Link 1 Partner Not Loaded.
Link2PartnerNotLoaded (141)	Link 2 Partner Not Loaded.

Reason	Description
Link1IoLinkLonely (142)	Link 1 IOLINK Lonely.
Link2IoLinkLonely (143)	Link 2 IOLINK Lonely.
Link2IolLoopbackError (144)	Link 2 IOL Loopback Error. The IOL processor has detected that it cannot see what it has transmitted onto the wire. This is a switchover trigger because it may represent a fault in the IOL communication electronics. Bad IOL wiring and/or rogue IOL device communications also could cause Loopback Error.
Link2NvsCommands (145)	Link 2 Flash operations. Synchronization is aborted and/or initial- sync is inhibited during the database initialization that occurs upon I/O Link FB commanded NVS compaction.
CommDriverTxFault (146)	Redundancy communication driver TX fault. There are too many outstanding requests prohibiting any further transmissions.
Link1IntCircuitFail (147)	Link 1 IOL Interrupt Circuit Failed. Upon receipt of an Interrupt Circuitry Fault error from the IOL processor, attempt redundancy role change. This occurs if the IOL signals, CLRGHO and/or GAPINT, are rendered inoperable (SA0 or SA1).
Link2IntCircuitFail (148)	Link 2 IOL Interrupt Circuit Failed. Upon receipt of an Interrupt Circuitry Fault error from the IOL processor, attempt redundancy role change. This occurs if the IOL signals, CLRGHO and/or GAPINT, are rendered inoperable (SA0 or SA1).
SimultaneousStartup (149)	Simultaneous Startup detected. Target role is primary or non-redundant but primary IP has been requested (that is, ARPed during dual power on); override as secondary to avoid dual primary role. Note that this intentionally may result in dual secondary that is considered as being better than dual primary.
ClnPointOverrun (150)	Secondary received more cleanpoints than it can process. This is an indication that the secondary cannot keep up with the rate of redundancy data being generated by the primary controller.
PrimaryRole (151)	Primary redundancy role.

Reason	Description
SecondaryRole (152)	Secondary redundancy role.
NonRedundantRole (153)	Non-Redundant redundancy role.
FieldDevNetworkAddr (154)	Incompatible - Incorrect Sensor Network Address.
IpAddress (155)	Incompatible - Incorrect IP Address.
NotLoaded (156)	Configuration Not Loaded
ConfigurationMismatch (157)	Configuration Mismatch
MessageType (158)	Unexpected message type.
PartnerConnection (159)	Connection not established with partner.
FieldDevNetworkID (160)	Incompatible - Incorrect Sensor Network ID.
PriPartnIpAddress (161)	Incompatible - Incorrect Pri Partner IP Address configuration.
SecPartnIpAddress (162)	Incompatible - Incorrect Sec Partner IP Address configuration.
FieldDevFreqHopMode (163)	Incompatible - Incorrect Sensor Frequency Hopping Mode.
FieldDevFreqHopID (164)	Incompatible - Incorrect Sensor Frequency Hopping ID.
FieldDevNetworkNotCnfg (165)	Incompatible - Sensor Network not configured.
InvalidSystemStatusMemory (166)	System Status Memory in RAM or NVS is invalid or resulted in access error.
NonRetentionStartup (167)	Non-Retention Startup.
PhysicalIdA (168)	Physical ID A.
PhysicalIdB (169)	Physical ID B.
PrimaryAndSecondaryIpOccupied (170)	Both Primary & Secondary IP addresses occupied.
Link1FieldNetworkFailure (171)	PROFIBUS Network communication failure on link 1.
Link2FieldNetworkFailure (172)	PROFIBUS Network communication failure on link 2.
FdnPrimaryIpOccupied (173)	Initial redundancy role of Secondary was chosen because the primary IP address is occupied on the Field Device Network (FDN).
PcnPrimaryIpOccupied (174)	Initial redundancy role of Secondary was chosen because the primary IP address is occupied on the

Reason	Description
	Process Control Network (PCN).
FdnSecondaryIpOccupied (175)	Initial redundancy role of Primary was chosen because the secondary IP address is occupied on the Field Device Network (FDN).
PcnSecondaryIpOccupied (176)	Initial redundancy role of Primary was chosen because the secondary IP address is occupied on the Process Control Network (PCN).
FdnBothRedunIpOccupied (177)	Primary and Secondary FDN IP Addresses are occupied.
PcnBothRedunIpOccupied (178)	Primary and Secondary PCN IP Addresses are occupied.
FdnPcnBothRedunIpOccupied (179)	Primary and Secondary, FDN and PCN IP Addresses are occupied.
FdnConfiguration (180)	Incorrect FDN Ethernet Interface configuration. Redundant partners must have identical subnet masks, and redundant partners must have unique IP addresses that are visible to one another for the given subnet mask.
PcnConfiguration (181)	Incorrect PCN Ethernet Interface configuration. Redundant partners must have identical subnet masks, and redundant partners must have unique IP addresses that are visible to one another for the given subnet mask.
FdnEthernetStatus (182)	Indicates that the FDN Ethernet cable was either disconnected or reconnected. The synchronized primary triggers switchovers due to FDN Ethernet cable disconnect. The synchronized secondary aborts sync and the secondary in general inhibits sync due to FDN Ethernet cable disconnects. This secondary persistent inhibit sync reason can only be canceled by restoring FDN Ethernet communications.
PcnEthernetStatus (183)	Indicates that the PCN Ethernet cable was either disconnected or reconnected. The synchronized primary triggers switchovers due to PCN Ethernet cable disconnect. The synchronized secondary aborts sync and the secondary in general inhibits sync due to PCN Ethernet cable disconnects. This secondary persistent inhibit sync reason can only be canceled by restoring PCN Ethernet communications.
PartIDConflict (184)	Indicates that both controllers have the same physical ID.

Reason	Description
NtpConfigNeeded (185)	Indicates that secondary has not yet configured its NTP daemon from primary. Initial sync is blocked until NTP configuration completes.
UCNnumber (186)	The controller was loaded resulting in a different UCN address and redundancy state than the current redundancy state requiring a role change.
SecureCommConfigMisMmtch (187)	The primary and secondary have different secure communication security levels which inhibits initial synchronization.
SecureCommPolicyMismatch (188)	The primary and secondary have different secure communication active policies which inhibits initial synchronization.
DownlinkNetworkCableSts (189)	Indicates that the Downlink Ethernet cable was either disconnected or reconnected. The synchronized primary triggers switchovers due to Downlink Ethernet cable disconnect. The synchronized secondary aborts sync due to Downlink Ethernet cable disconnect and the secondary inhibits sync due to Downlink Ethernet cable disconnects. This secondary persistent inhibit sync reason can only be canceled by restoring Downlink Ethernet communications.
FdnPartNotVis (190)	Partner not visible across FDN interface.
PcnPartNotVis (191)	Partner not visible across PCN interface.
UpgStartTask (192)	C200-to-C300 Upgrade: Start Task
UpgConnOpened (193)	C200-to-C300 Upgrade: Connection Opened
UpgResetEnable (194)	C200-to-C300 Upgrade: Reset Enable
UpgSessionComplete (195)	C200-to-C300 Upgrade: Session Complete
UpgConnFailed (196)	C200-to-C300 Upgrade: Connection to the Targets Failed.
UpgResetFailed (197)	C200-to-C300 Upgrade: Reset Targets Failed.
Unused (198)	Unused
Unused (199)	Unused
Unused (200)	Unused

Reason	Description
FteNetworkDisconnected (201)	A redundancy communication error over the FTE network implies there is break in the communication path.
DownlinkNetworkDisconnected (202)	A redundancy communication error over the Downlink Ethernet network implies there is break in the communication path.
FTENetworkCommunicationError (203)	Invalid redundancy data was received or the periodic partner status message was not received over the FTE network.
DownlinkNetworkCommunicationError (204)	Invalid redundancy data was received or the periodic partner status message was not received over the Downlink Ethernet network.
SyncDataUnexpectedState (205)	The primary controller is unable to participate in initial-sync because a block refused to commence initial-sync.
ProfibusDriverWatchdogTimeout (206)	The PROFIBUS Driver has abnormally terminated operation due to watchdog timeout. When detected on a synchronized primary, this results in redundancy switchover. One possible cause may be that the controller has a high CPU load.
ProfibusDriverStoppingTimeout (207)	The PROFIBUS Driver has abnormally terminated operation due to stop command timeout. When detected on a synchronized primary, this results in redundancy switchover.
ProfibusDriverResettingTimeout (208)	The PROFIBUS Driver has abnormally terminated operation due to reset command timeout. When detected on a synchronized primary, this results in redundancy switchover.
ProfibusDriverChannelInitFail (209)	The PROFIBUS Driver has abnormally terminated operation due to channel initialization failure. When detected on a synchronized primary, this results in redundancy switchover.
ProfibusDriverConfLoadFail (210)	The secondary has lost view to the primary because PROFIBUS Driver has failed to load link configuration. When detected, the synchronized or synchronizing secondary aborts sync.
ProfibusDriverLostViewToPrimary (211)	The secondary controller monitors the presence of the partner across the PROFIBUS network and aborts synchronization when it the primary does not respond to

Reason	Description
	the secondary's scan request.
ProfibusDriverChannelReadFail (212)	The PROFIBUS Driver has abnormally terminated operation due to I/O read failure. When detected on a synchronized primary, this results in redundancy switchover.
FTENetworkConnectionReset (213)	The partner intentionally reset the redundancy communication connection over the FTE network. When detected, the synchronized or synchronizing controller aborts sync.
DownlinkNetworkConnectionReset (214)	The partner intentionally reset the redundancy communication connection over the Downlink Ethernet network. When detected, the synchronized or synchronizing controller aborts sync.
PrimaryLonelyOnDownlinkNetwork (215)	When an unsynchronized primary controller suffers from Downlink Ethernet network cable disconnect and the secondary controller has visibility to the Downlink Ethernet network, the controller performs initial-sync with immediate switchover with this reason.
PrimaryDupIpOnDownlinkNetwork (216)	When an unsynchronized primary controller suffers from Duplicate IP Address on the Downlink Ethernet network and the secondary controller has visibility to the Downlink Ethernet network, the controller performs initial-sync with immediate switchover with this reason.
DownlinkNetworkDuplicateIp (217)	The primary and secondary controllers change their controllability parameter to worse with this reason when they detect a duplicate IP Address on the Downlink Ethernet network.
DownlinkNetworkConfiguration (218)	The secondary controller inhibits synchronization until it has configured its IP Address and Mask for the Downlink Ethernet network communication and confirmed that no duplicate IP address exists on the Downlink Ethernet network.
DownlinkNetworkCommunication (219)	When the primary has visibility to the Downlink Ethernet network, it inhibits synchronization (with this reason) until it establishes communication with the secondary over the Downlink Ethernet network. This ensures that the secondary has the same view as the primary on the

Reason	Description
	Downlink Ethernet network.
FTENetworkCommunication (220)	When the primary has visibility to the FTE network, it inhibits synchronization (with this reason) until it establishes communication with the secondary over the FTE network. This ensures that the secondary has the same view as the primary on the FTE network.
DeviceConnectionStatus (221)	The Primary Interface Module triggers switchover (with this reason) when the primary transitions from communicating with at least one Device to unable to communicate with all Devices (and there are Devices configured). The Secondary Interface Module drops synchronization (with this reason) when the secondary is unable to open a connection with a Device (when the primary interface module has successfully established a connection with the same Device).
RedundancyCommOutOfRxBuffersError (222)	Redundancy communication out-of-RX-buffers error. The redundancy subsystem cannot receive any more redundancy messages because the RX buffers have been exhausted. This is a drop-sync trigger because received messages are discarded until RX buffers are freed resulting in suspect redundancy communication.
RedundancyCommQueueFull (223)	Redundancy communication queue is full error. The redundancy subsystem has received more communication events than it can process resulting in queue overflow. This is a drop-sync trigger because received messages are discarded until queue entries are freed resulting in suspect redundancy communication.
LiveListReadFailedLink1 (224)	Live List reads fail on Link 1. The primary controller triggers switchover (with this reason) when the primary can no longer read and verify its copy of the Fieldbus Live List. The secondary controller aborts synchronization (with this reason) when the secondary can no longer read and verify its copy of the Fieldbus Live List. This is typically caused by bad wiring, bad hardware, or both. 1 - Check that there is no "noise on the wire" as this

Reason	Description
	prevents normal communications on the H1 link. 2 - Check for proper termination on the H1 link. 3 - Check that there are no shorts in the wiring. 4 - Check that the wiring is properly shielded. 5 - Check that there are no failed devices.
LiveListReadFailedLink2 (225)	Live List reads fail on Link 2. The primary controller triggers switchover (with this reason) when the primary can no longer read and verify its copy of the Fieldbus Live List. The secondary controller aborts synchronization (with this reason) when the secondary can no longer read and verify its copy of the Fieldbus Live List. This is typically caused by bad wiring, bad hardware, or both. 1 - Check that there is no "noise on the wire" as this prevents normal communications on the H1 link. 2 - Check for proper termination on the H1 link. 3 - Check that there are no shorts in the wiring. 4 - Check that the wiring is properly shielded. 5 - Check that there are no failed devices.
LiveListReadFailedLink3 (226)	Live List reads fail on Link 3. The primary controller triggers switchover (with this reason) when the primary can no longer read and verify its copy of the Fieldbus Live List. The secondary controller aborts synchronization (with this reason) when the secondary can no longer read and verify its copy of the Fieldbus Live List. This is typically caused by bad wiring, bad hardware, or both. 1 - Check that there is no "noise on the wire" as this

Reason	Description
	prevents normal communications on the H1 link. 2 - Check for proper termination on the H1 link. 3 - Check that there are no shorts in the wiring. 4 - Check that the wiring is properly shielded. 5 - Check that there are no failed devices.
LiveListReadFailedLink4 (227)	Live List reads fail on Link 4. The primary controller triggers switchover (with this reason) when the primary can no longer read and verify its copy of the Fieldbus Live List. The secondary controller aborts synchronization (with this reason) when the secondary can no longer read and verify its copy of the Fieldbus Live List. This is typically caused by bad wiring, bad hardware, or both. 1 - Check that there is no "noise on the wire" as this prevents normal communications on the H1 link. 2 - Check for proper termination on the H1 link. 3 - Check that there are no shorts in the wiring. 4 - Check that the wiring is properly shielded. 5 - Check that there are no failed devices.
LiveListReadFailedLink5 (228)	Live List reads fail on Link 5. The primary controller triggers switchover (with this reason) when the primary can no longer read and verify its copy of the Fieldbus Live List. The secondary controller aborts synchronization (with this reason) when the secondary can no longer read and verify its copy of the Fieldbus Live List. This is typically caused by bad wiring, bad hardware, or both. 1 - Check that there is no "noise on the wire" as this prevents normal communications on the H1 link. 2 - Check for proper termination on the H1 link.

Reason	Description
	3 - Check that there are no shorts in the wiring. 4 - Check that the wiring is properly shielded. 5 - Check that there are no failed devices.
LiveListReadFailedLink6 (229)	Live List reads fail on Link 6. The primary controller triggers switchover (with this reason) when the primary can no longer read and verify its copy of the Fieldbus Live List. The secondary controller aborts synchronization (with this reason) when the secondary can no longer read and verify its copy of the Fieldbus Live List. This is typically caused by bad wiring, bad hardware, or both. 1 - Check that there is no "noise on the wire" as this prevents normal communications on the H1 link. 2 - Check for proper termination on the H1 link. 3 - Check that there are no shorts in the wiring. 4 - Check that the wiring is properly shielded. 5 - Check that there are no failed devices.
LiveListReadFailedLink7 (230)	Live List reads fail on Link 7. The primary controller triggers switchover (with this reason) when the primary can no longer read and verify its copy of the Fieldbus Live List. The secondary controller aborts synchronization (with this reason) when the secondary can no longer read and verify its copy of the Fieldbus Live List. This is typically caused by bad wiring, bad hardware, or both. 1 - Check that there is no "noise on the wire" as this prevents normal communications on the H1 link. 2 - Check for proper termination on the H1 link. 3 - Check that there are no shorts in the wiring.

Reason	Description
	4 - Check that the wiring is properly shielded. 5 - Check that there are no failed devices.
LiveListReadFailedLink8 (231)	Live List reads fail on Link 8. The primary controller triggers switchover (with this reason) when the primary can no longer read and verify its copy of the Fieldbus Live List. The secondary controller aborts synchronization (with this reason) when the secondary can no longer read and verify its copy of the Fieldbus Live List. This is typically caused by bad wiring, bad hardware, or both. 1 - Check that there is no "noise on the wire" as this prevents normal communications on the H1 link. 2 - Check for proper termination on the H1 link. 3 - Check that there are no shorts in the wiring. 4 - Check that the wiring is properly shielded. 5 - Check that there are no failed devices.
PlatformConfig (232)	Indicates the controller blocks initial-sync to perform configuration alignment where the secondary controller is updated to match the primary controller’s configuration.
RS232SignalFailure (233)	RS232 Signal Failure
RS485SignalFailure (234)	RS485 Signal Failure
Ethernet0LinkStatus (235)	Ethernet device #0 cable connection status.
Ethernet1LinkStatus (236)	Ethernet device #1 cable connection status.
Ethernet2LinkStatus (237)	Ethernet device #2 cable connection status.
Ethernet2RingStatus (238)	Ethernet device #2 ring switch status.
FirmwareAlignment (239)	Indicates the controller blocks initial-sync to perform firmware alignment where the secondary controller is updated to match the primary controller’s firmware version.

Reason	Description
OnProcessMigration (240)	Firmware Load - On-Process Migration.
OffProcessMigration (241)	Firmware Load - Off-Process Migration.
SDCardValidation (242)	Check the redundant pair have compatible SD Cards.
IOTASlot1 (243)	When performing initial-role-determination or dual role correction upon re-establishing partner communication, the redundancy subsystem’s role decision was chosen due to lower slot number. This reason indicates that the physical ID of the redundant pair is well formed resulting in slot number tie breaker.
IOTASlot2 (244)	When performing initial-role-determination or dual role correction upon re-establishing partner communication, the redundancy subsystem’s role decision was chosen due to lower slot number. This reason indicates that the physical ID of the redundant pair is well formed resulting in slot number tie breaker.
DualRoleOnLoad (245)	Configuration load resulted in dual-role. This scenario is possible when a CPM in slot 1 is configured non-redundant, another CPM is inserted into the partner slot 2, and this new partner takes the primary role. Upon updating the configuration of the slot 1 CPM to enable redundancy, it detects the partner in slot 2 and commands it to reboot with this reason.
RestartCmd (246)	The restart command to the primary controller is an off-process operation that results in drop-sync with this reason before performing the commanded operation.
ResetFactoryDefaultCmd (247)	The reset-to-factory-defaults command to the primary controller is an off-process operation that results in drop-sync with this reason before performing the commanded operation.
EthernetConfiguration (248)	On startup the default Ethernet configuration is not valid for redundant controller operation when the controller is at factory default configuration. Load the controller with a valid configuration to recover.
SecEclrException (249)	The secondary controller encountered a common language runtime.
SecRecErrSeqNum(250)	The secondary controller’s common language runtime

Reason	Description
	application received an erroneous sequence number.
PreviouslyInitialSyncdSecondary (251)	Initial redundancy role of Primary was chosen because previously retained initial-syncd secondary role.
EthCommsException (252)	I/O communication exception resulted switchover.
IOConnectionIsZero (253)	I/O connection count is zero so cause Drop on secondary, check secondary connection count.
PriEclrException (254)	The primary controller encountered a common language runtime exception.
DnpRetainedEventsInit (255)	Retained events initialization.
FlashRDWRErr (256)	Internal flash read/write error.
MRAMRDWRErr (257)	Internal MRAM read/write error.
OnlineDiagSoftFailure (258)	Online diagnostics detected a soft failure.
OnlineDiagHardFailure (259)	Online diagnostics detected a hard failure.
PlcStop (260)	Inhibit sync when controller is in the stopped state.
ConfigLoad (261)	Synchronization is not supported during configuration load to the controller. The controller drops and inhibits sync on configuration load with this transient reason.
PreInitialSyncFail (262)	Multiple consequtive pre-initial-sync failures. After 3 failed attempts to perform pre-initial-sync, the Auto Sync State is automatically set to disabled and the inhibit sync reason is set to this persistent value. Refer to the redundancy history for the reasons why pre-initial-sync failed, and issue the Enable Sync command to attempt initial-sync again after correcting the abort-sync reason.
ModeSwitchMismatch (263)	Synchronization is not supported when the controllers have mismatched Mode Switch settings.
SecureBootMismatch (264)	Synchronization is not supported when the controllers have mismatched Secure Boot status.
InvalidBootFirmware (265)	The controller has two firmware versions boot (recovery) and application (product). Steady-state synchronization is not supported while a controller’s boot firmware is invalid.
ReportConnStatus (266)	Report Connection Status.

Reason	Description
IPSecEnrollmentInfoMismatch (267)	Primary does not have IPSec enrollment information, but secondary does.
IPSecProfileStatusMismatch (268)	One or more profile statuses do not match.
IPSecStatusMismatch (269)	IPSec statuses on the primary and secondary do not match.
IPSecSyncFailure (270)	Failure on primary when attempting to send sync data to secondary.
SecureBootKrlMismatch (271)	The Secure Boot Key Revocation List (KRL) of the primary and secondary controllers are different.

Redundancy History State Enumerations

Not all enumerations listed are used with all controllers.

State	Description
Null (0)	N/A history state null entry.
Startup (1)	Module released from reset.
NonRedun (2)	Module configured as non-redundant.
Primary (3)	Module transitioned into the Primary redundancy role. Refer to the associated Redundancy History Reason for the reason why.
Secondary (4)	Module transitioned into the Secondary redundancy role. Refer to the associated Redundancy History Reason for the reason why.
NoPartner (5)	Partner absent synchronization state. This module is not communicating with a redundant partner This could be due to a fault in the redundancy private path, a fault in the redundancy communication electronics, or simply because the partner is powered off.
Incompatible (6)	Incompatible synchronization state. This module is communicating with a partner across the redundancy private path, but that partner is incompatible. Refer to the associated Redundancy History Reason for the reason why.
PartnerVisble (7)	Partner visible synchronization state. This module is communicating with a compatible redundancy partner.

State	Description
SyncInProgress (8)	Synchronization in progress synchronization state. This module is performing initial transfer of redundancy data from the primary to the secondary. Redundancy role change is not possible in this state. Initial synchronization takes on the order of minutes.
Synchronized (9)	Synchronized synchronization state. This redundant pair has completed initial synchronization and is performing continuous synchronization maintenance. Redundancy role change is allowed in this state.
Standby (10)	Standby synchronization state. The purpose of the Standby mode of operation is to improve the software upgrade scenario by providing the user with a convenient means to fallback to a previous software and database, if problems are encountered during upgrade. While in the Standby State, the secondary controller has a database that was previously synchronized with the primary controller but the secondary is no longer receiving synchronization-data updates from the primary controller. Moreover, a Standby Secondary controller is able to switchover into the primary role with this stale database. There is no time limit to the time duration of the Standby mode of operation, and as a consequence of the secondary not being synchronized, switchover to the secondary may cause a bump in outputs.
AutoSyncDsbled (11)	Auto synchronization disabled. Refer to the associated Redundancy History Reason for the reason why.
AutoSyncEnbled (12)	Auto synchronization enabled. This transition only occurs on the receipt of the Enable Synchronization command.
AlternateSyncCommand (13)	Module received the Alternate Synchronization Command. When the primary redundancy electronics are faulted, this is used to perform one-time initial-sync over FTE (instead of the redundancy private path) followed by immediate switchover.
BecomePrimaryCommand (14)	Module received the Become Primary command. This commands an unsynchronized secondary module to transition into the primary role in the absence of a partner module. More specifically, this command is only applicable if the unsynchronized secondary has no view to a partner module across the redundancy cable and the primary IP address is not occupied.
DisableSyncCommand (15)	Module received the Disable Sync Command. This is used to

State	Description
	drop synchronization for a module in the syncing/syncd/standby state and prevent future initial-sync attempts by disabling Auto-Sync.
EnableSyncCommand (16)	Module received the Enable Sync Command. This transitions the Auto-Sync state to Enabled, resets the initial-sync failure count (to allow maximum of 3 trys), and triggers initial-sync.
EnableStandbyCommand (17)	Module received the Enable Standby Command. This commands a redundant controller pair in the Synchronization Maintenance State to switchover into the Standby State. While in the Standby State, the secondary controller has a database that was previously synchronized with the primary controller but the secondary is no longer receiving synchronization-data updates from the primary controller. This command is useful for testing the expected behavior of a configured control strategy if the redundant controller pair ever had to invoke the Go-Back option during a controller On-Process Migration. More specifically, after entering the Standby State, issue the switchover command, and the controller with the stale database switches into the primary role. The Disable Synchronization command exits the Standby State.
SyncAbort (18)	Encountered loss-of-sync condition. Refer to the associated Redundancy History Reason for the reason why.
RoleChange (19)	Redundancy Role Change occurred. Refer to the associated Redundancy History Reason for the reason why.
InitialSyncFail (20)	Once the Auto Sync State is enabled, loss of synchronization is automatically followed by an automatic attempt to resynchronize the redundant controller pair. However, after a maximum of 3 initial-sync failures, the Auto Sync State is disabled with an inhibit sync reason of Initial Sync Fail. Once initial-sync is inhibited due to “Initial Sync fail”, the Enable Synchronization command must be used to retry initial-sync (after the problem preventing initial-sync has been resolved).
AbortSync (21)	Encountered loss-of-sync condition. Refer to the associated Redundancy History Reason for the reason why.
AllowSync (22)	Indicates negation of an inhibit sync reason. Refer to the associated Redundancy History Reason for the reason why.
InhibitSync (23)	Indicates assertion of an inhibit sync reason. Refer to the

State	Description
	associated Redundancy History Reason for the reason why.
ControllabilityBetter (24)	This module is better able to control. Refer to the associated Redundancy History Reason for the reason why.
ControllabilityEqual (25)	Both modules of a redundant pair are equally able to control.
ControllabilityWorse (26)	This module is worse able to control. Refer to the associated Redundancy History Reason for the reason why.
OpmSessionEnabled (27)	The Controller Migration Wizard has commenced a controller On-Process Migration session.
OpmBlocksCreated (28)	As part of an OPM session, the Migration Wizard completed Secondary Checkpoint Restore to instantiate the control strategy on the secondary controller.
OpmInitialSync (29)	Controller Migration Wizard commanded the controller to commence initial-sync as part of an OPM session.
OpmOpenIoConnections (30)	The primary controller has commenced transfer of I/O connection related data as part of initial-sync during an OPM session.
OpmMatchPeerReferences (31)	The primary controller has commenced transfer of CDA Peer Cross-Reference ID data as part of initial-sync during an OPM session.
OpmTransferData (32)	The primary controller has commenced transfer of Block Dynamic Data as part of initial-sync during an OPM session.
OpmSessionSuccess (33)	Upon the successful completion of OPM initial-sync, switchover follows shortly after (for example, <100 ms). This represents successful completion of the controller OPM session.
OpmSessionFailure (34)	OPM session terminated due to failure. Refer to the associated Redundancy History Reason for the reason why.
RedundancyCommunicationError (35)	Redundancy Communication Error. Refer to the associated Redundancy History Reason for the reason why.
BecomePrimaryDecision (36)	When redundancy communication is established after both modules are committed to the same redundancy role, the redundancy subsystem tries to correct dual-role situations. This module has won primaryship in a dual primary situation. Refer to the associated Redundancy History Reason for the reason why.

State	Description
BecomeSecondaryDecision (37)	When redundancy communication is established after both modules are committed to the same redundancy role, the redundancy subsystem tries to correct dual-role situations. This module has won secondaryship in a dual secondary situation. Refer to the associated Redundancy History Reason for the reason why.
SwitchoverTrigger (38)	Redundancy role change has been requested. Refer to the associated Redundancy History Reason for the reason why.
OpmPartialColdInit (39)	In the event that one or more blocks have not yet implemented OPM support, the default behavior is to cold initialize that block. This indicates that one or more blocks have been cold initialized. This represents successful completion of the controller OPM session.
ConfiguredRedundant (40)	The controller is configured as redundant.
ConfiguredNonRedundant (41)	The controller is configured as non-redundant.
PhysicalIdA (42)	[WDM] Physical ID changed to A. On the primary, the user issued the command to toggle physical ID. On the secondary, either the secondary’s physical ID was the same as that of primary (i.e. automatic correction) or the user issued the command to toggle physical ID.
PhysicalIdB (43)	[WDM] Physical ID changed to B. On the primary, the user issued the command to toggle physical ID. On the secondary, either the secondary’s physical ID was the same as that of primary (i.e. automatic correction) or the user issued the command to toggle physical ID.
UCNAddrChg (44)	Redundancy Role Change occurred for a UCN resident controller. Refer to the associated RDNHISTREASON for the reason why.
UpgStartTask (45)	C200-to-C300 Upgrade: Start Task
UpgConnOpened (46)	C200-to-C300 Upgrade: Connection Opened
UpgResetEnable (47)	C200-to-C300 Upgrade: Reset Enable
UpgSessionComplete (48)	C200-to-C300 Upgrade: Session Complete
UpgConnFailed (49)	C200-to-C300 Upgrade: Conn to the Targets Failed
UpgResetFailed (50)	C200-to-C300 Upgrade: Reset Targets Failed

State	Description
UpgBecomePriCmd (51)	C200-to-C300 Upgrade: Become Primary command
CutoverStart (52)	ACERR
InitialSyncd (53)	Initial Syncd synchronization state. This module is performing post-initial-syncr of non-critical redundancy data from the primary to the secondary. Redundancy role change is possible in this state. Post-initial-synchronization can take on the order of hours depending on the amount of non-critical data.

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