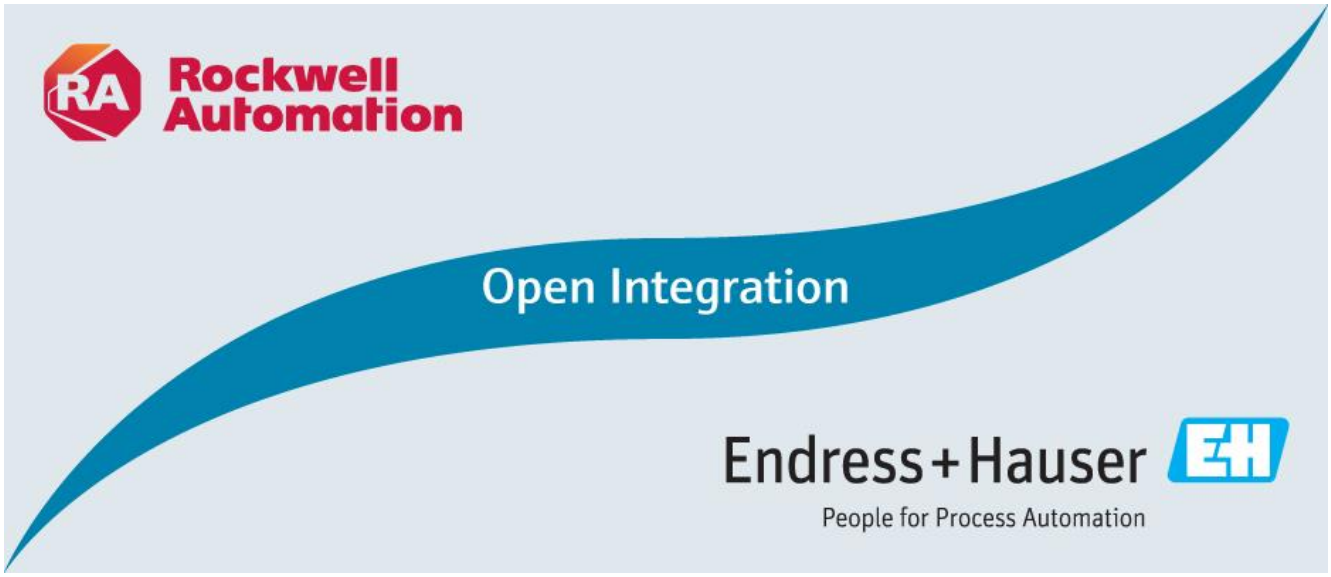
Integration Tutorial RA01

Rockwell Automation ControlLogix and EtherNet/IP plus HART for Food & Beverage Industry



Supported by:

bürkert
FLUID CONTROL SYSTEMS

Table of Contents

1 Document Information

1.1 Purpose and Scope

This document provides a step by step description on how to integrate EtherNet/IP and HART devices with the Rockwell Automation ControlLogix system. All content of this document is jointly developed, reviewed and approved by Rockwell Automation and Endress+Hauser as a common deliverable of Open Integration.

1.2 Document History

This is version 1.01.00 of this document. Version history:

Version	Released	Description
1.00.00	2018-10	Initial version
1.01.00	2020-08	Update to PlantPAx 4.x and new FactoryTalk® Linx Comm/ModuleDTMs

1.3 Related Documents

Please refer to related documents as listed below:

Document	Description
SD02272S/04/EN/02.20	Reference Topology RA01
SD02274S/04/EN/02.20	Integration Test Summary RA01
SD02275S/04/EN/02.20	List of Tested Devices and Versions RA01

2 Pre-Requisites

Readers of this document should be familiar with related documents as listed in chapter 1.3 and basics on how to work with the Rockwell Automation ControlLogix System as well as EtherNet/IP and HART in general. Please refer to recommended literature as listed in chapter 2.1.

2.1 Recommended Literature

2.1.1 Rockwell Automation

Document	Description
1783-UM007G-EN-P	Stratix Managed Switches
1794-IN131C-EN-P	Flex I/O Dual Port EtherNet/IP Adapter Modules
1794-UM065C-EN-E	FLEX I/O Isolated Input/Output HART Analog Modules
1756-UM533E-EN-P	ControlLogix HART Analog I/O Modules
PROCES-RM010B-EN-P	Rockwell Automation Library of Process Objects: HART Modules for PlantPAx DCS
PROCES-SG001J-EN-P	PlantPAx Distributed Control System
PROCES-SG003A-EN-P	Integrate Endress+Hauser Instruments in a PlantPAx DCS

2.1.2 Endress+Hauser

Document	Description
KA01303S/04/A2/04.18	FieldCare / DeviceCare Getting Started

2.2 Operable Control System

This document assumes an operable Rockwell Automation ControlLogix System as defined by Reference Topology RA01. Please refer to the manuals listed in chapter 2.1.1 for an explanation on how to use hard- and software provided by Rockwell Automation.

2.3 Operable Asset Management System

This document assumes an operable Endress+Hauser PAM System as defined by Reference Topology RA01. Please refer to manuals listed in chapter 2.1.2 for installing of software provided by Endress+Hauser.

2.4 Operable Field Devices

This document assumes an operable selection of Endress+Hauser EtherNet/IP and HART devices, as defined by Reference Topology RA01. Each field device is powered if needed and adequately connected to the Rockwell Automation ControlLogix System. If required, please refer to individual device manuals for further advice.

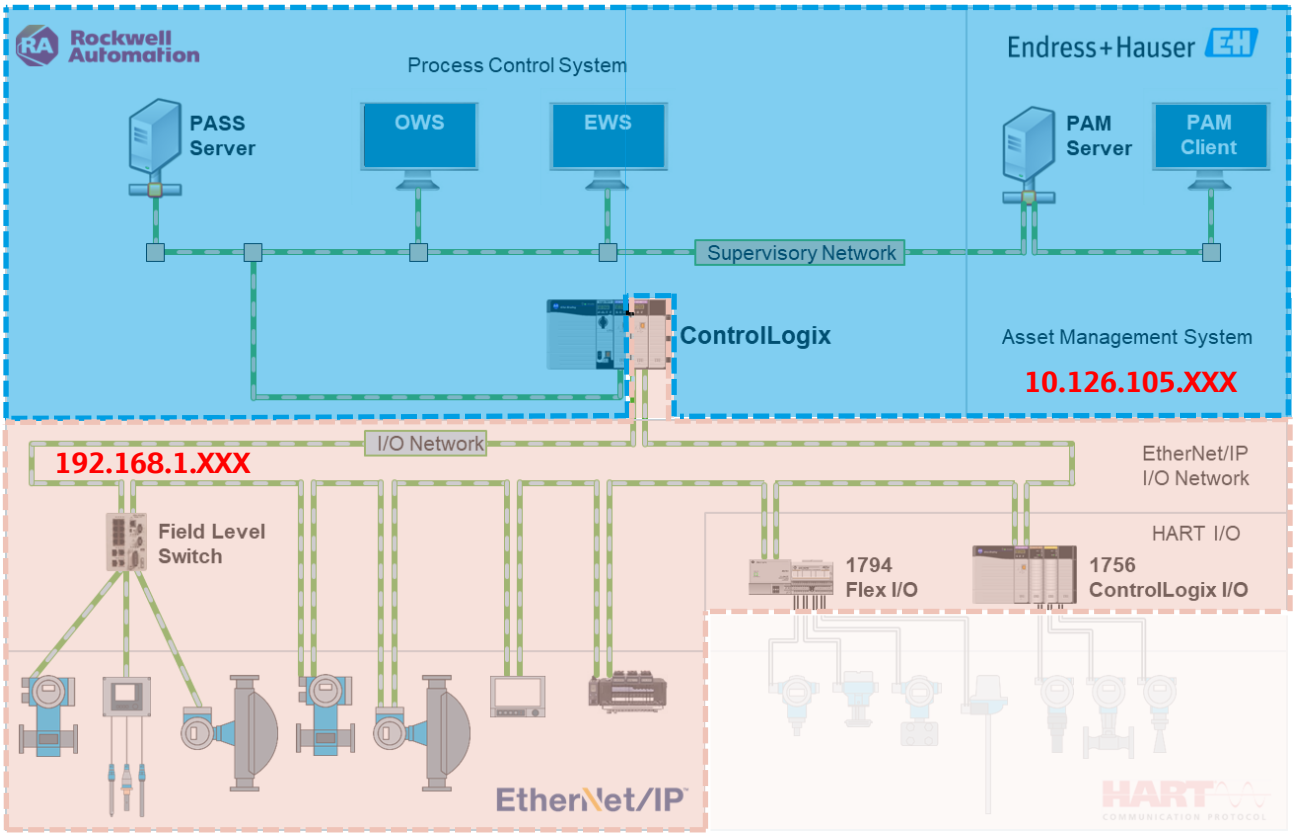
3 Basic Integration

This chapter describes the main workflow for integration of EtherNet/IP and HART devices into the Rockwell Automation System. As a result, the EtherNet/IP cyclic communication as well as the 4-20 mA/HART communication are running. Process values and status information are available within the control strategy of the system for further processing.

3.1 Network Configuration

3.1.1 Network Overview

The RA01 topology is using two networks, a supervisory network and an I/O network:



New components might be delivered without or with default IP addresses. This chapter explains how the IP addresses have been configured.

There exists different methods for setting the modules IP Addresses (via BOOTP, RSLinx, USB, Rotary switch or Web server) depending of course on the components to configure.

The table below lists all IP addresses to configure with the used method:

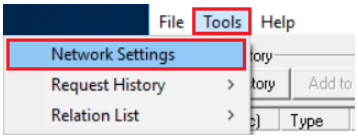
Network	Component		Configured IP Address	Subnet Mask	IP Configuration Method
Supervisor Network	Control System	1756-EN2TR (ControlLogix)	10.126.105.75	255.255.252.0	BOOTP + RSLinx
IO Network	Control System	1756-EN2TR (ControlLogix)	192.168.1.2	255.255.255.0	BOOTP + RSLinx
	Remote IO	1756-EN2TR (ControlLogix IO)	192.168.1.120	255.255.255.0	BOOTP + RSLinx
	Remote IO	1794-AENTR (Flex IO)	192.168.1.130	255.255.255.0	Rotary switch
	Switch	Stratix5400	192.168.1.179	255.255.255.0	Web server
	EtherNet/IP Devices	Promag100	192.168.1.170	255.255.255.0	Web server
		Promass100	192.168.1.171	255.255.255.0	Web server
		Liquiline CM44x	192.168.1.173	255.255.255.0	Web server
		Promag500	192.168.1.174	255.255.255.0	Web server
		Promass300	192.168.1.175	255.255.255.0	Web server
		Memograph RSG45	192.168.1.176	255.255.255.0	Web server
		AirLINE 8652	192.168.1.177	255.255.255.0	Device display

3.1.2 Supervisor System Network Configuration

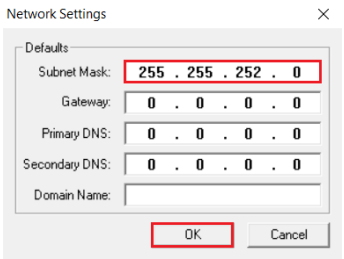
This chapter describes the steps for configuring the IP address of the ControlLogix 1756-EN2TR module connected to the supervisor network. In this example, the 1756-EN2TR module IP address configuration is firstly set dynamically by using BOOTP and then statically by using RSLinx.

3.1.2.1 1756-EN2TR Dynamic IP Address Configuration

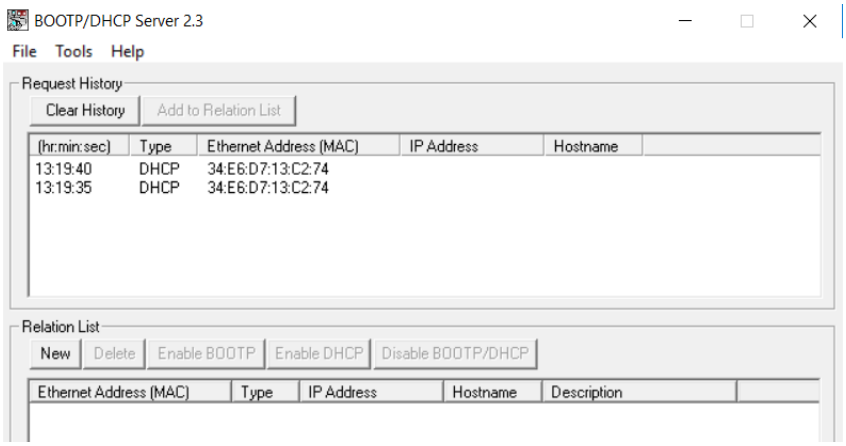
- Connect a Laptop to the Ethernet module 1756-EN2TR with an Ethernet cable.
- Start the tool “BOOTP”.
- Click on the menu “Tools→Network Settings”:



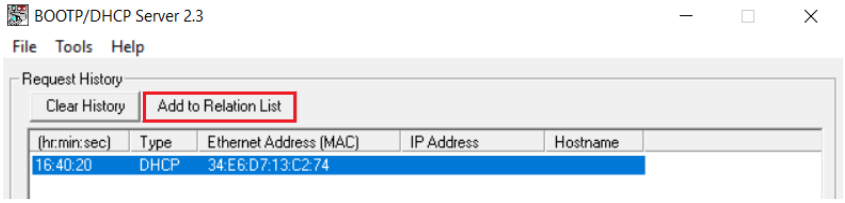
- Set the subnet mask according to the network, in this example 255.255.252.0 and click on the button “OK”:



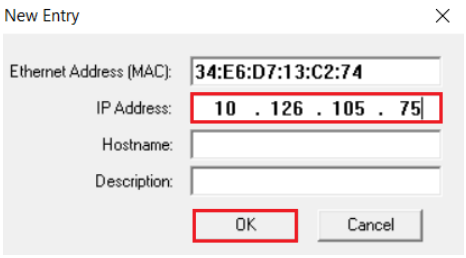
- MAC Address is automatically detected and appears:



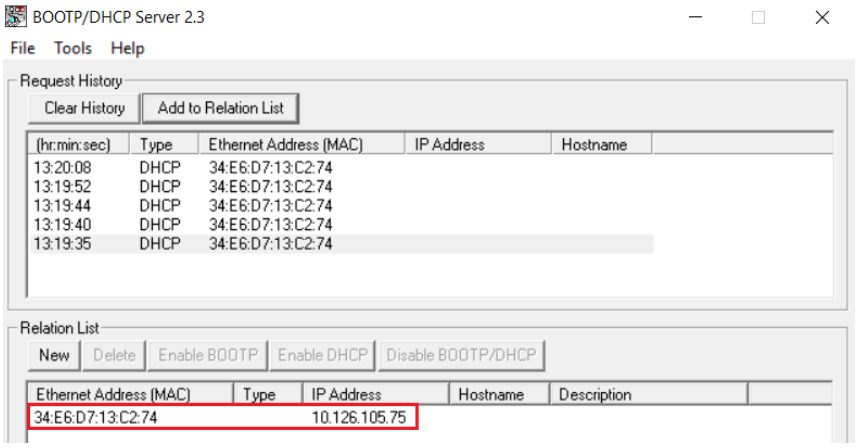
- Select the MAC address and click on the button “Add to Relation List”:



- These opens the window “New Entry”. Enter the MAC address and the requested IP address, then click on the button “OK”:



- This assigns dynamically the IP address:

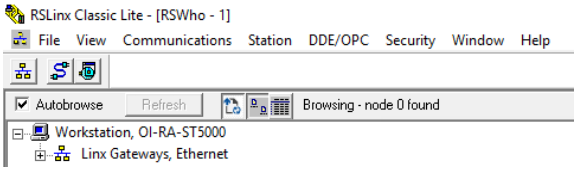


3.1.2.2 Static IP Address Configuration with RSLinx

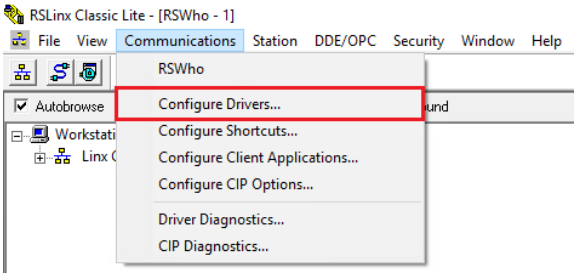
3.1.2.2.1 RSLinx First Configuration

- Start the tool RSLinx Classic:

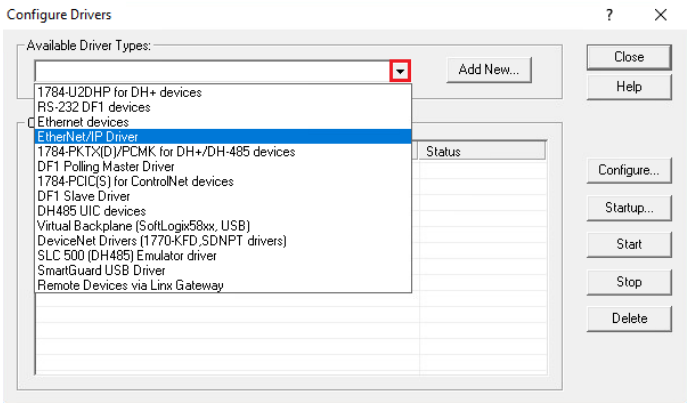
- RSLinx window is opened:



- Select the menu “Communications→Configure Drivers…”:

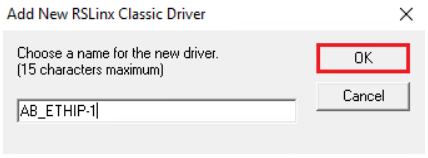


- Select the option “EtherNet/IP Driver”:

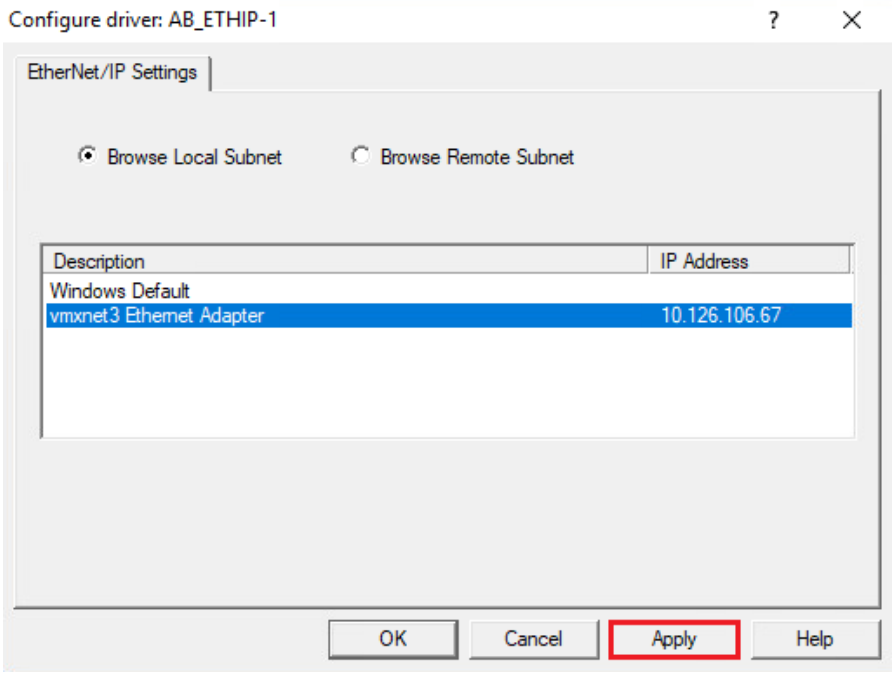


- Click on the button “Add New...”:

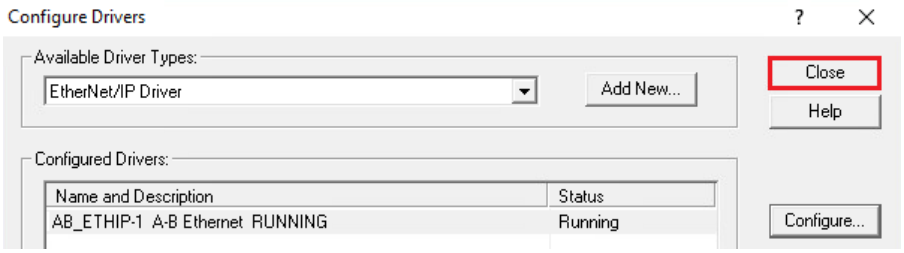
- Rename the driver name if needed and click on the button “OK”:



- Select the subnet and click on the button “Apply”:

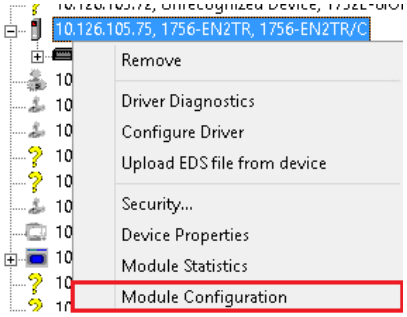


- New driver is running. Click on the button “Close”:

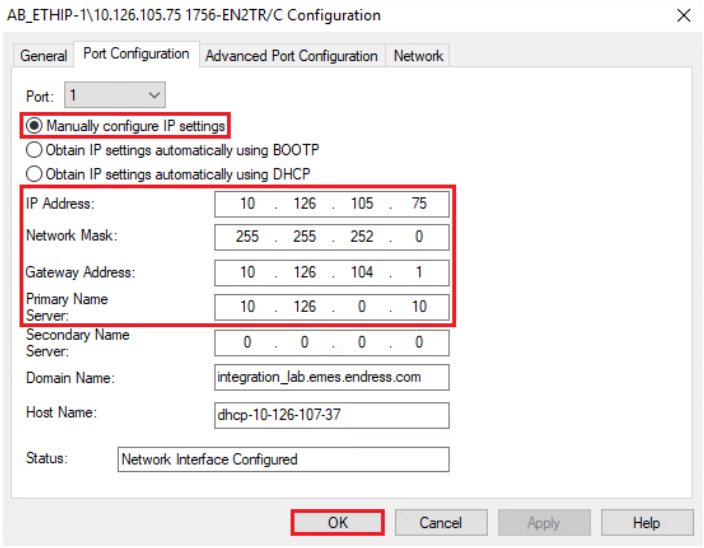


3.1.2.2.2 IP Address Static Configuration

- In RSLinx Workstation view, right-click on the 1756 EN2TR module and select the menu “Module Configuration”:



Select the Static “Network Configuration Type” and verify configured IP settings and then click on the button “OK”:



This 1756 EN2TR module can now be connected to the supervisor network.

3.1.3 I/O Network Configuration

This chapter describes the steps for configuring the IP addresses of the I/O Network components. We assume that all these components are still not connected together.

3.1.3.1 1756 EN2TR Module IP Address Configuration

I/O network EN2TR modules are configured as this of the supervisory network. Please refer to chapter 3.1.2.

3.1.3.2 1794 AENTR Module IP Address Configuration

- The1794 AENTR Module IP configuration is done via hardware switch:
  - If the configured value equals “999”, that means that the DHCP mode is enabled.
  - If the configured value is between “2” and “254”, that means the adapter is into a network with IP address 192.168.1.X (X corresponds to the rotary switch value) with subnet mask 255.255.255.0.

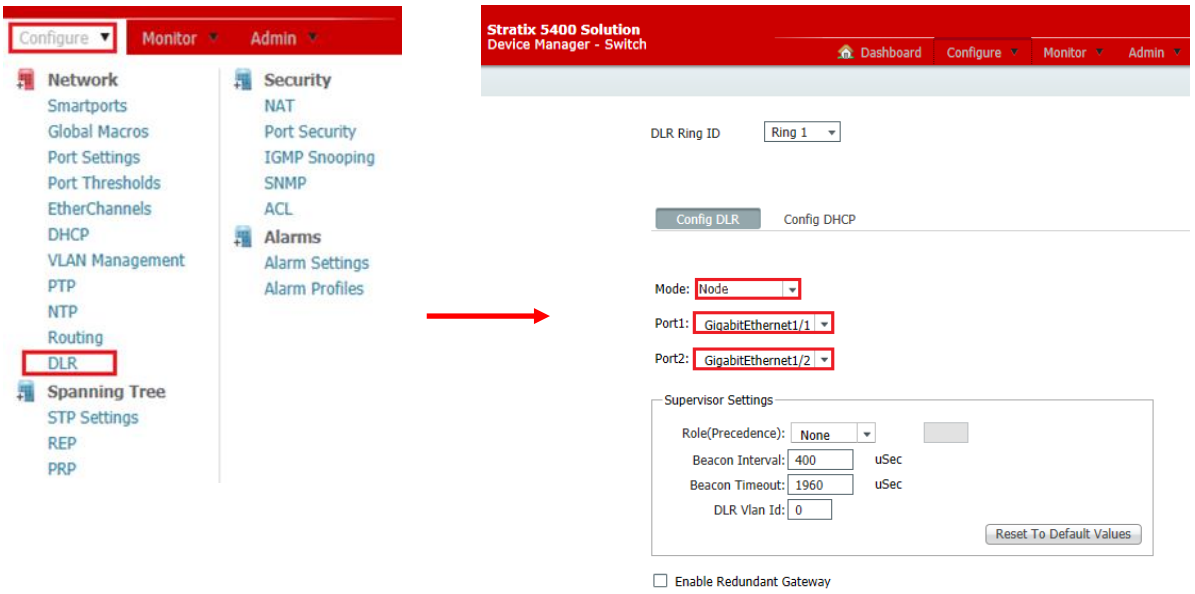
- In this example, the rotary switch is set on “130”, that means the IP address of then 1794 AENTR module is 192.168.1.130:

3.1.3.3 Stratix 5400 IP Address Configuration

In this example, the Stratix5400 IP address has been configured by using the “Express Setup”. Refer to the user manual “Stratix Managed Switches” for further details.

The EtherNet/IP ring is connected between port1 and port2.

- The DLR settings (Ports and mode) can be configured by clicking on the menu “Configure→DLR”:



Remark

- In this example, the mode is “Node” because the “Supervisor” mode is set in the ControlLogix Ethernet adapter in chapter 3.4.3 and the DLR ports are Port1 and Port2.

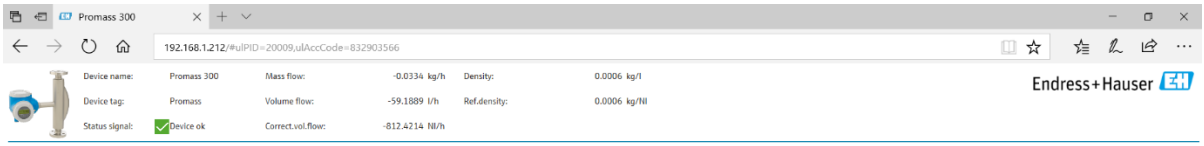
3.1.3.4 Endress+Hauser device IP Address Configuration

IP addresses of Endress+Hauser EtherNet/IP devices may be configured directly on the display if available or by using the web server.

This example describes the main steps for configurating the IP address of a Promass 300 by using the Web server. Refer to the device manual for further details.

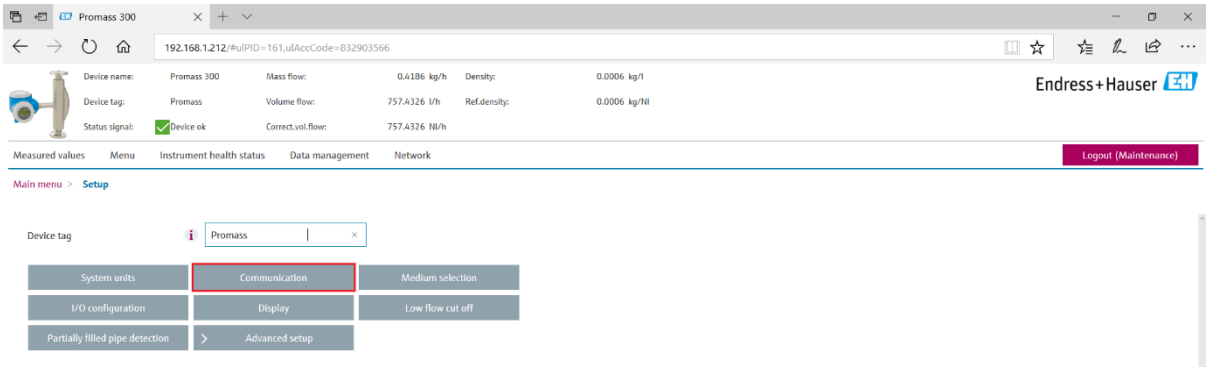
- Power off the device.
- Set the device DIP switch 2 to ON in order to select the default IP address 192.168.1.212.
- Reboot the device.
- Connect a laptop with private network settings (192.168.1.1/24) to the Promass300 with an Ethernet cable.

- Open a browser and enter the IP address 192.168.1.212:

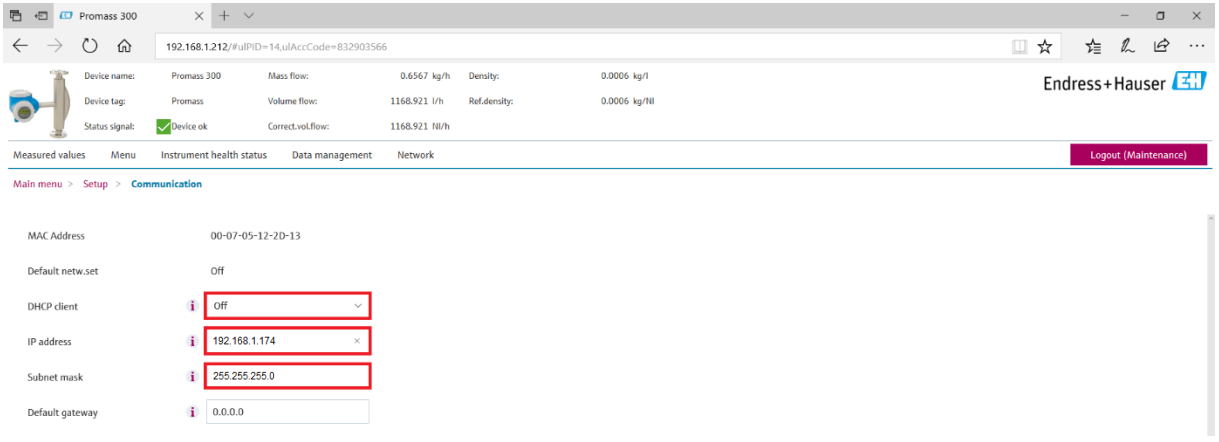


Enter the access code “0000” and click on the button Login.

- Click on the button “Menu→Setup→Communication”:



- Disactivate the option “DHCP client” and set the new IP addresses.



Remark

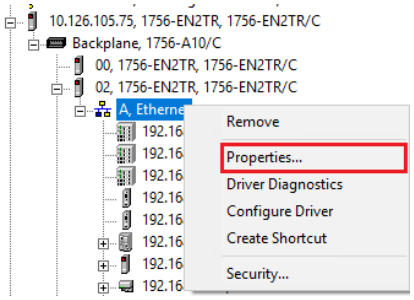
- Once done, the connection to the Web server is lost.
- Reconfigure the DIP switch 2 to OFF.

3.1.3.5 Bürkert Valve Island 8652 AirLINE IP Address

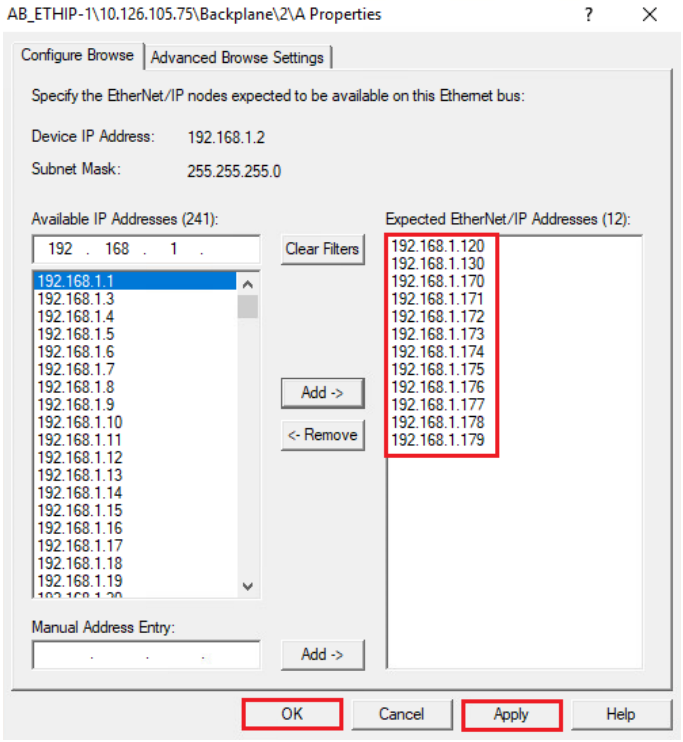
IP address 192.168.1.41/24 of Bürkert valve island 8652 AirLINE has been set directly on the display of the ME43 module.

3.1.4 Allowed IP Address

- In this example, the I/O network can be configured in order to restrict the network to undesired connection. Right-click on the Ethernet adapter and select the option “Properties”:



- Select the relevant IP addresses allowed to be used and click on the button “Add->”:

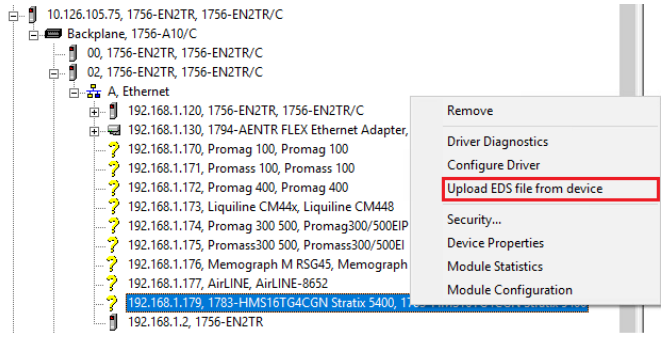


- Click on the buttons “Apply” and “OK” to save the configuration.
  In this example, the private network is limited to the configured devices. Other IP addresses will be ignored.

3.1.5 Network Connection

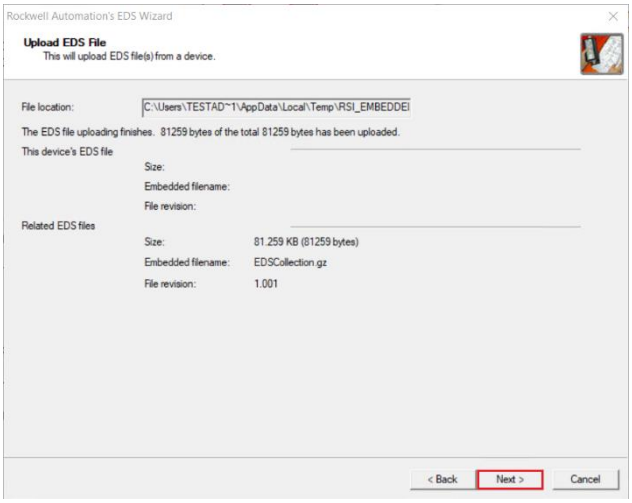
All components IP addresses have now been configured. Connect all EtherNet/IP devices together as defined in reference topology RA01.

- Open RSLinx and verify that all devices appear. Yellow questions marks my appear. These corresponds to scanned EtherNet/IP devices, whose EDS drivers have still not been installed in RSLinx:



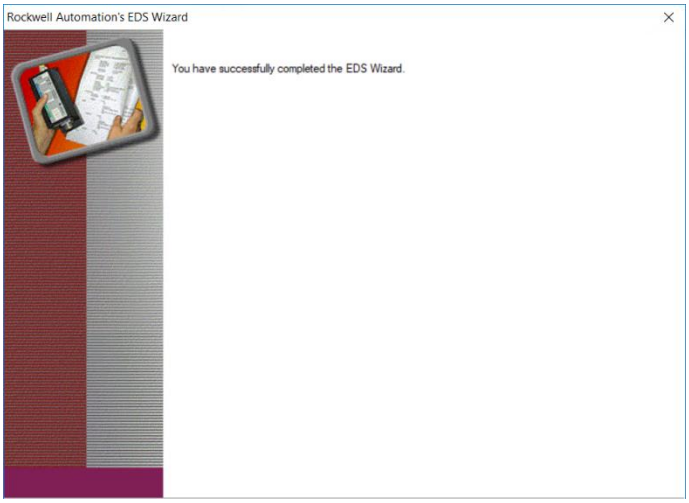
  For example, right-click on the Stratix5400 switch with IP address 192.168.1.179 and choose the option “Upload EDS File from device”.

- This opens the Rockwell Automation’s EDS Wizard:

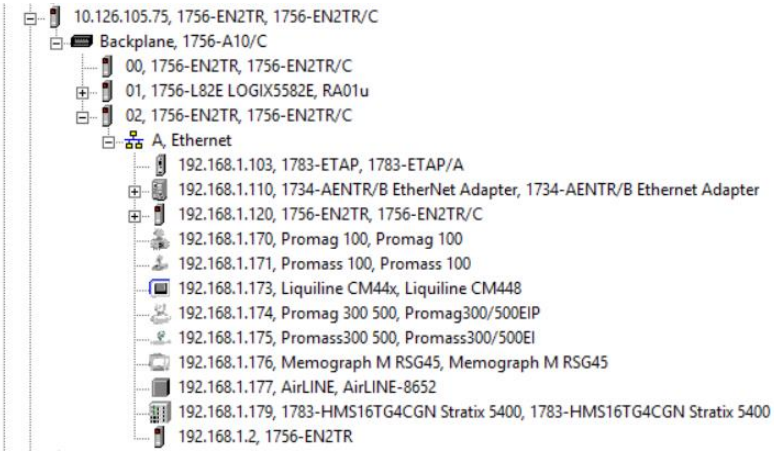


  Click on the button “Next>” and follow the installation Wizard.

- Click on the button “Finish” when setup has been successful:



- Repeat the EDS Upload for all other devices:



Remark

The EDS file upload does not work for the RSG45 and AirLINE-8652. Corresponding EDS files must be imported as described in chapter 3.3.1.2.

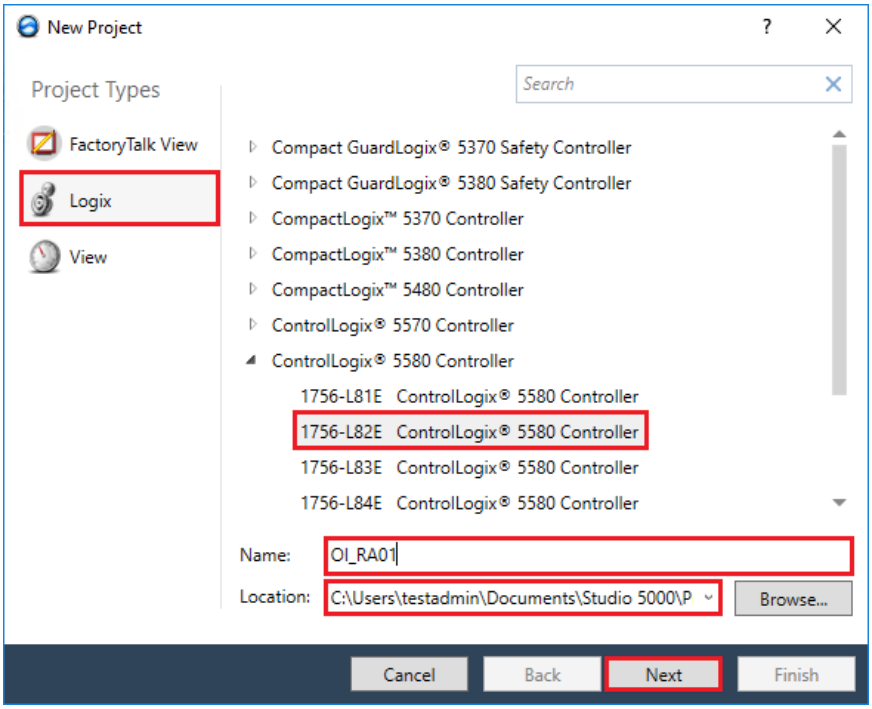
3.2 System Configuration

3.2.1 New Project

- Start the software Studio5000:

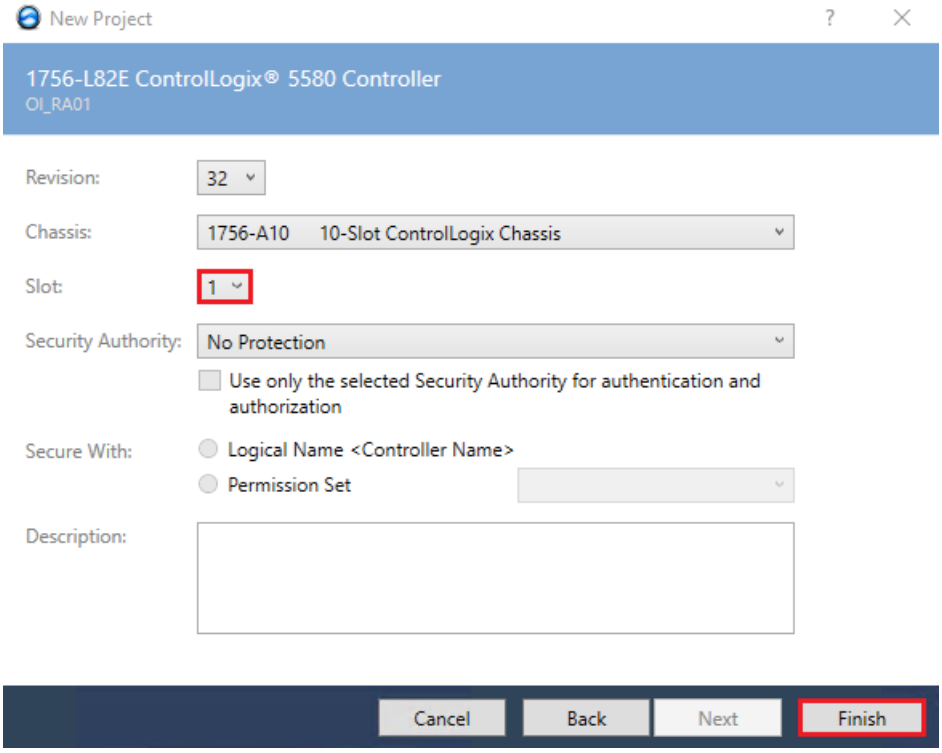
- Create a new project by clicking on the menu “New Project”:

- The new project configuration window is displayed. Click on the menu “Logix” and indicate the used controller according to the network environment as well as project name and location:



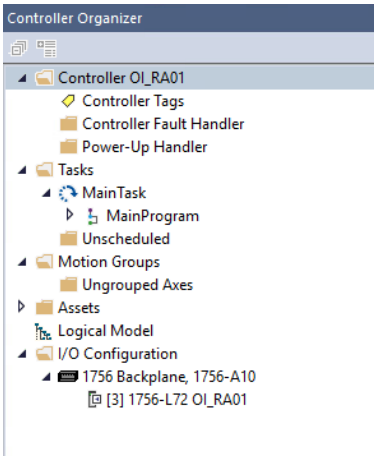
- Click on the button “Next” to continue the project configuration.

- Configure the PLC settings according to the network environment:

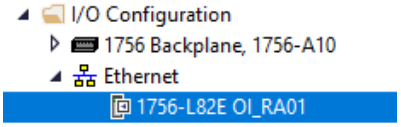


In this example, the PLC has the revision "**32"** and is located in "**Slot 1"** of the backplane "**1756-A10**". Click on the button "Finish" save and close this sequence.

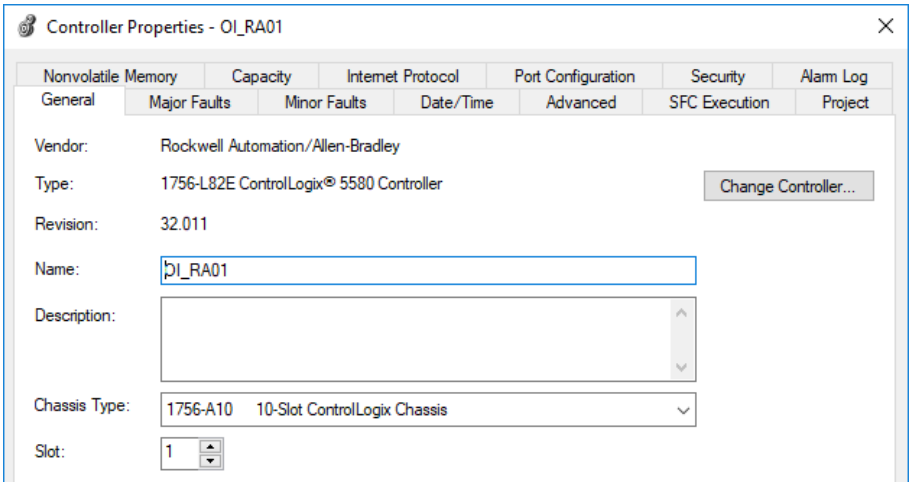
- Controller Organizer view is opened in Studio5000:



- Controller properties as slot index, chassis type or name can still be edited if needed. Double-click on the controller “1756-L82”:



- This opens the controller properties:



3.2.2 System Offline Configuration

This chapter describes the system offline configuration workflow.

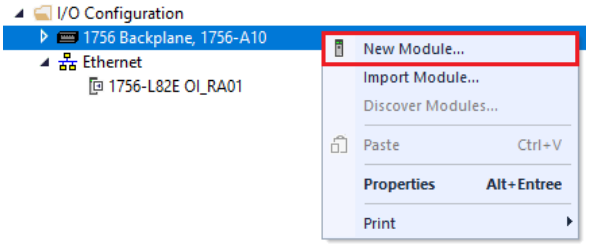
3.2.2.1 ControlLogix

In our example, the ControlLogix part is composed of a backplane “1756-A10”, a PLC “1756-L82E” and two Ethernet module “1756-EN2TR” for Supervisory and IO networks.

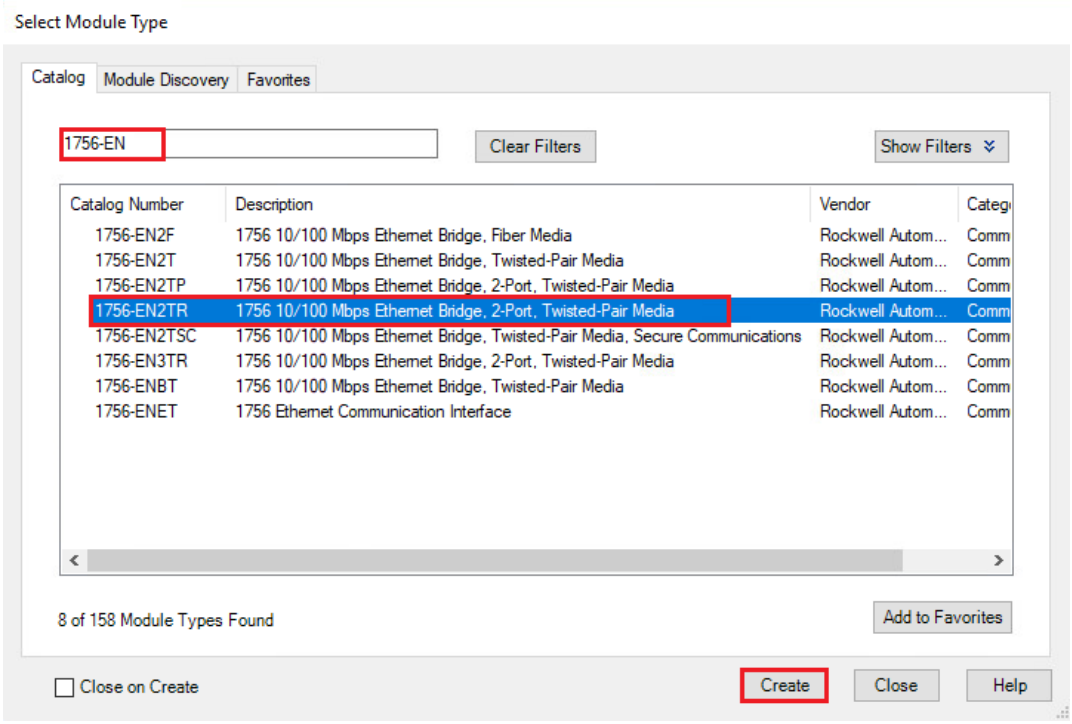
Backplane “1756-A10” and PLC “1756-L82E” have already been added during the project creation.

3.2.2.1.1 EthernetBridge for Supervisory Network

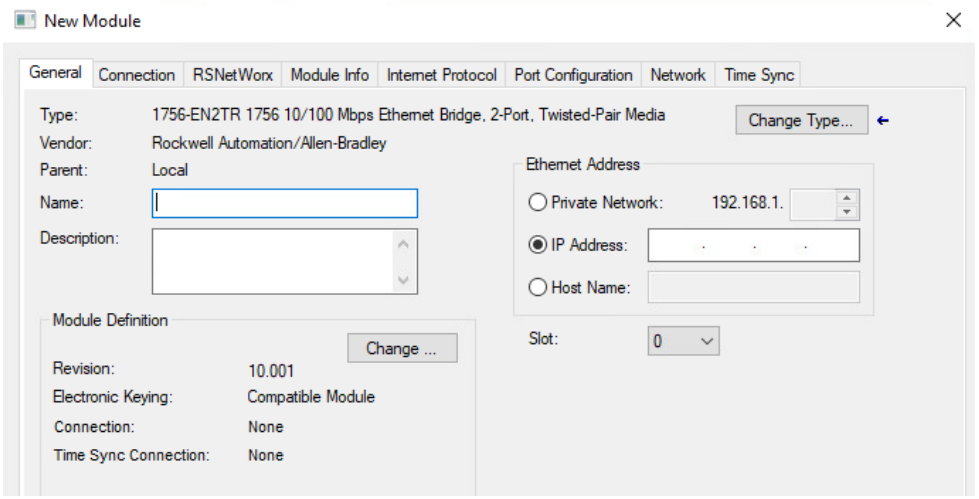
- For inserting the Ethernet module “1756-EN2TR”, right-click on the Backplane “1756-A10” and select the option “New Module”:



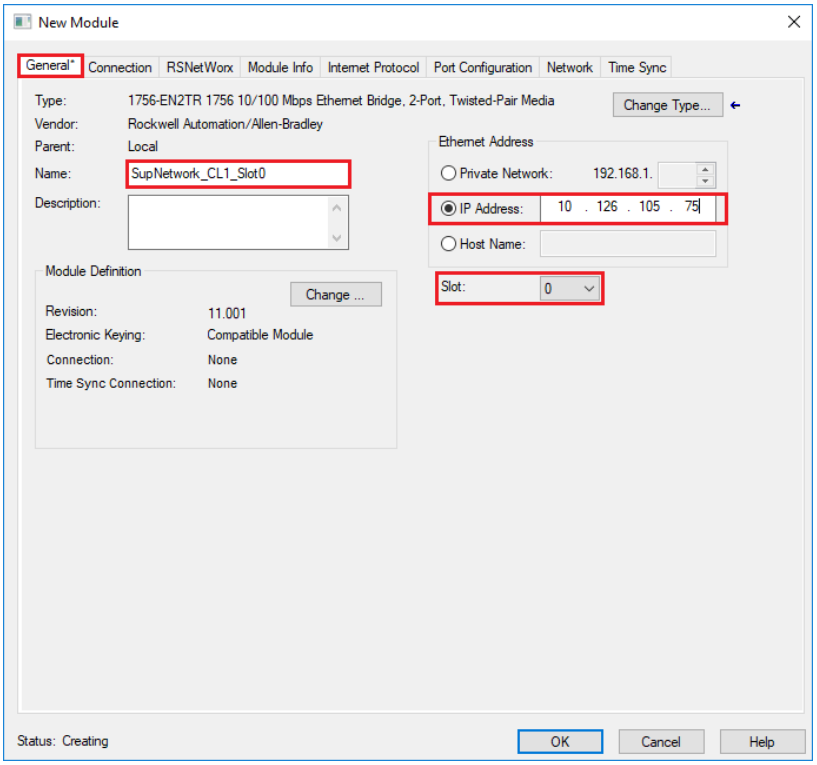
- Use the filter for faster search, select the card “1756-EN2TR”and click on the button “Create”:



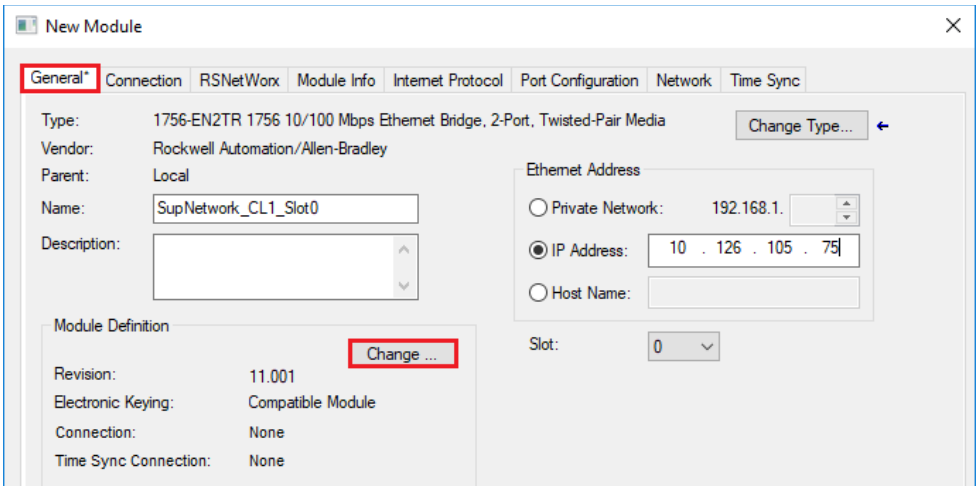
- This opens automatically the window “New Module”:



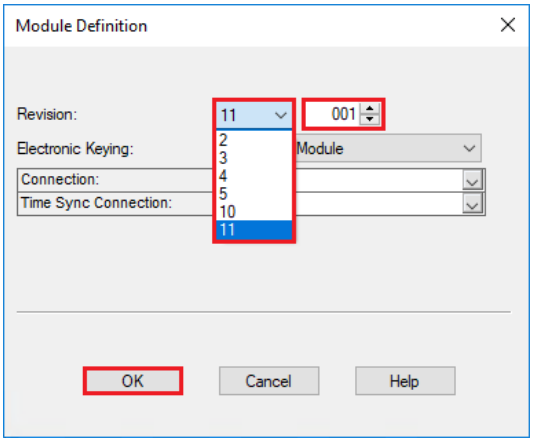
- In the tab “General”, configure the Name, IP Address and Slot according to the network settings:



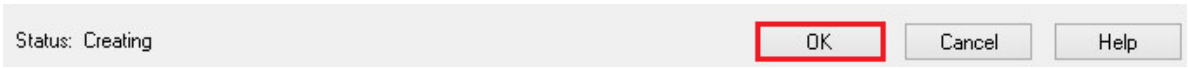
- Studio5000 allows the user to configure different module revisions. If required, click on the button “Change...” in the tab “General” for setting another Module revision:



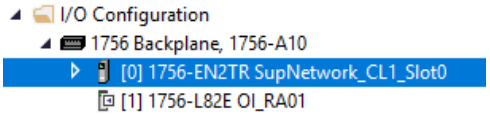
- Choose the requested Revision and click on the button “OK”:



- Close the “New Module” window by clocking on the button “OK”:

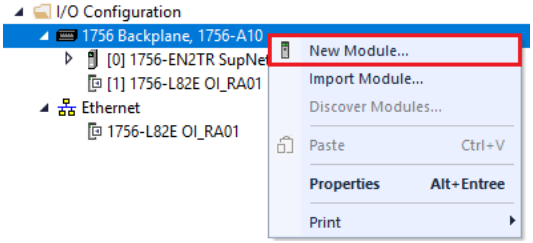


- Clicking on the button “OK” inserts the card in the I/O Configuration project view:

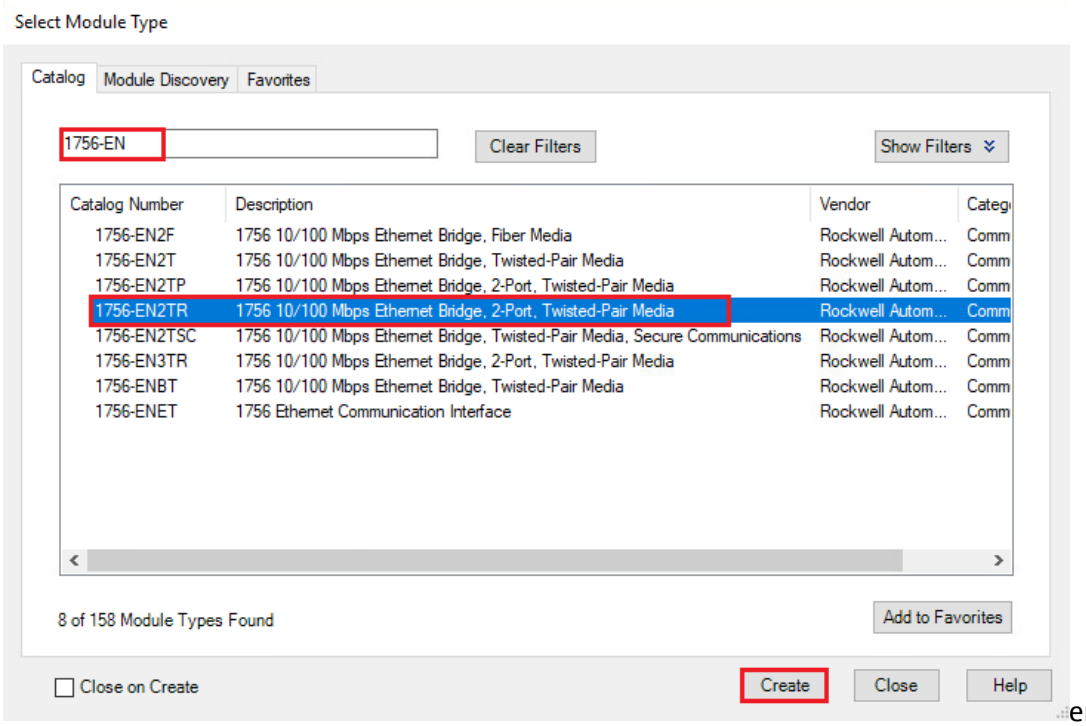


3.2.2.1.2 EthernetBridge for IO Network

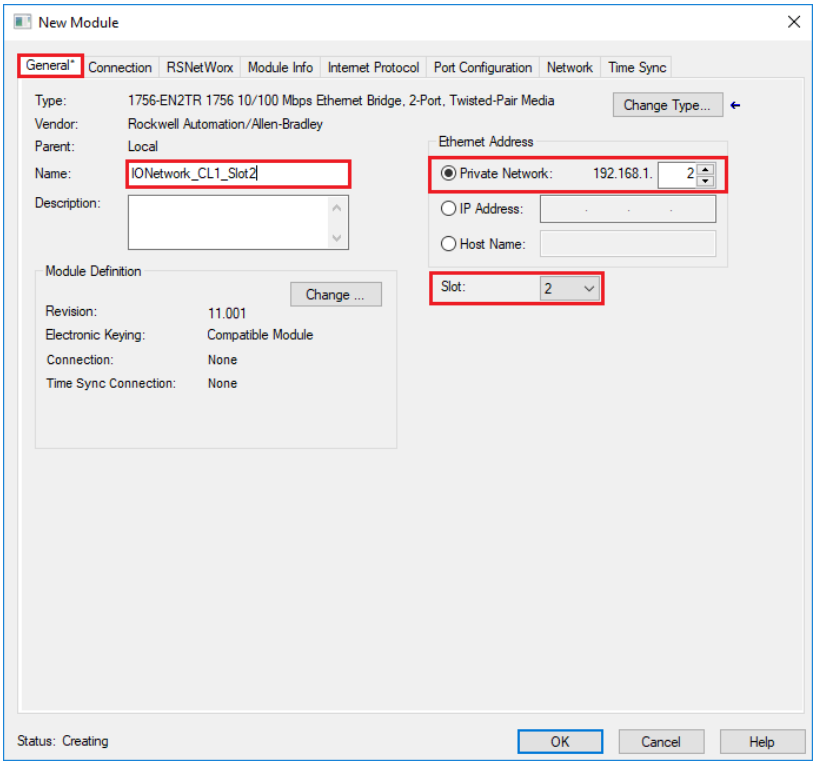
- For inserting the Ethernet module “1756-EN2TR”, right-click on the Backplane “1756-A10” and select the option “New Module”:



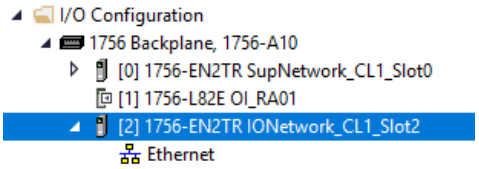
- Use the filter for faster search, select the card “1756-EN2TR”and click on the button “Create”:



- This opens automatically the window “New Module”. In the tab “General”, configure the Name, IP Address and Slot according to the network settings:



- Click on the button “OK” to validate the settings. This inserts the card “1756-EN2TR” with corresponding backplane in the project view:

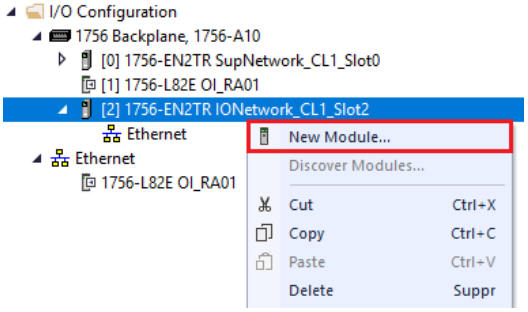


3.2.2.2 ControlLogix I/O

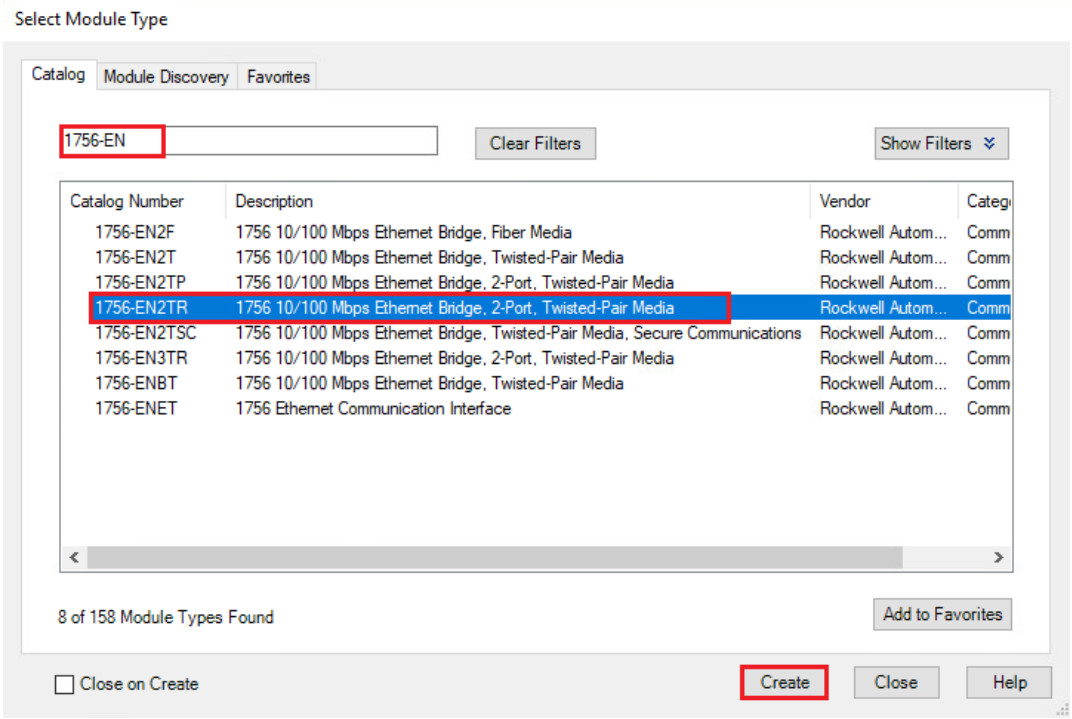
In our example, the ControlLogix I/O part is composed of a backplane “1756-A10”, an Ethernet module “1756-EN2TR” and a HART analog input card “1756-IF8IH/A”.

3.2.2.2.1 Ethernet Bridge

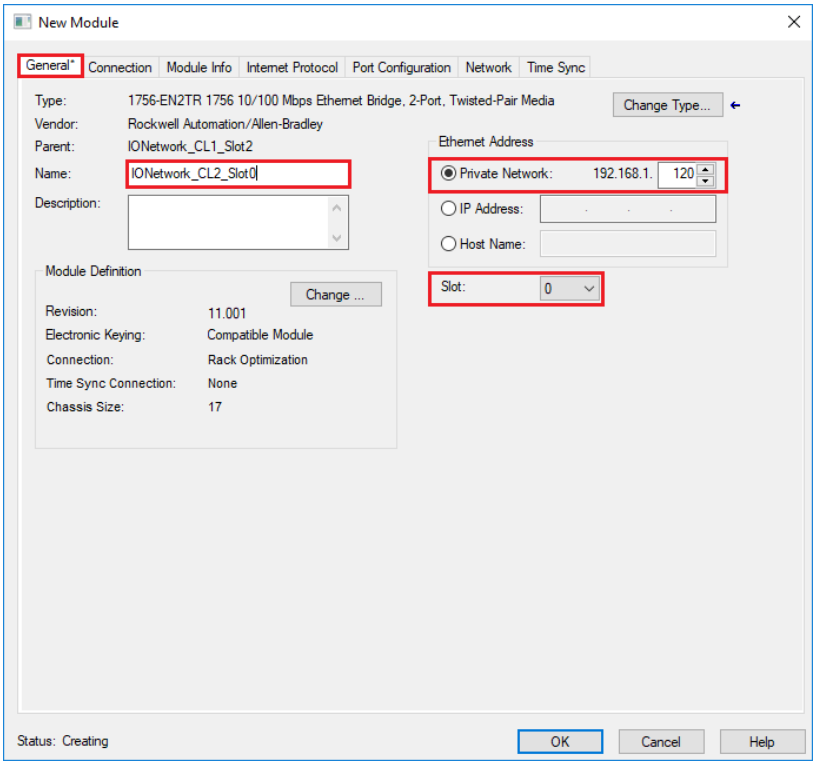
- For inserting the ControlLogix I/O Network Ethernet module “1756-EN2TR”, right-click on the menu “Ethernet” and select the option “New Module”:



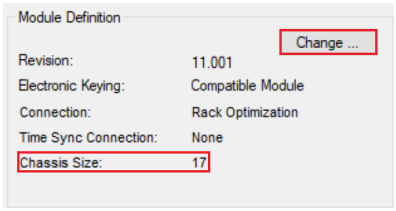
- Use the filter for faster search, select the card “1756-EN2TR”and click on the button “Create”:



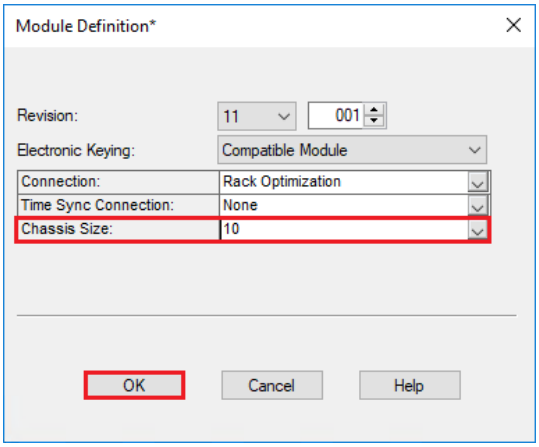
- This opens automatically the window “New Module”. In the tab “General”, configure the Name, IP Address and Slot according to the network settings:



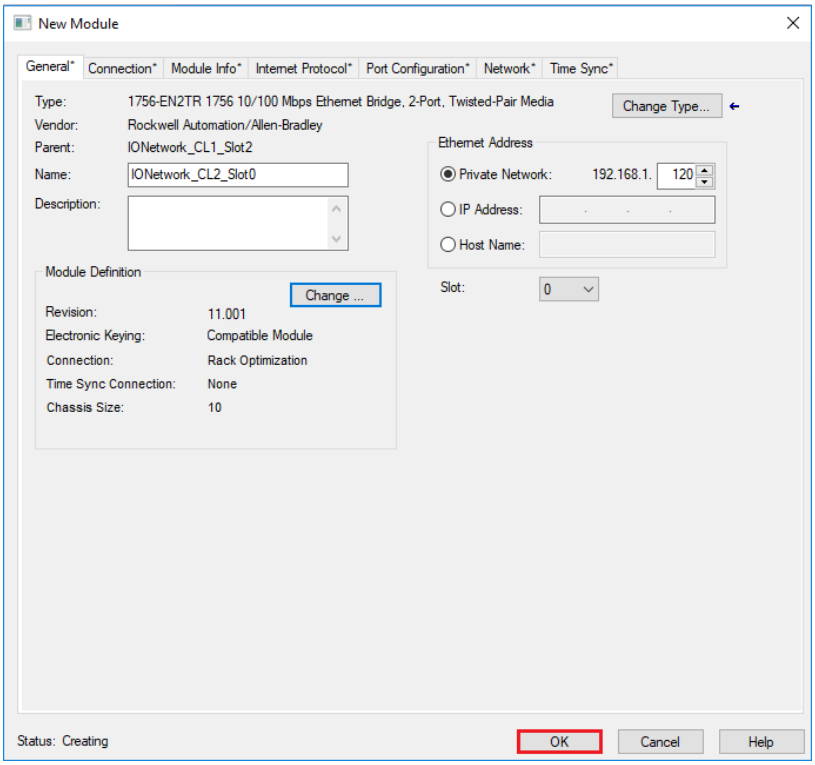
- In this example, the chassis size is 10. This parameter must be changed.Click on the button “Change”:



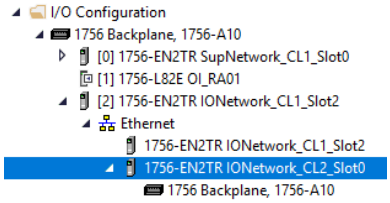
- Change the parameter “Chassis Size” to the value 10 and click on the button “OK”:



- Click on the button “OK” to create the new module:

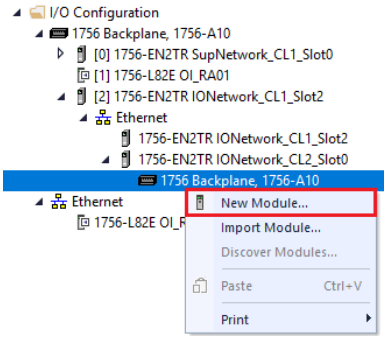


- This inserts the card “1756-EN2TR” with corresponding backplane in the project view:

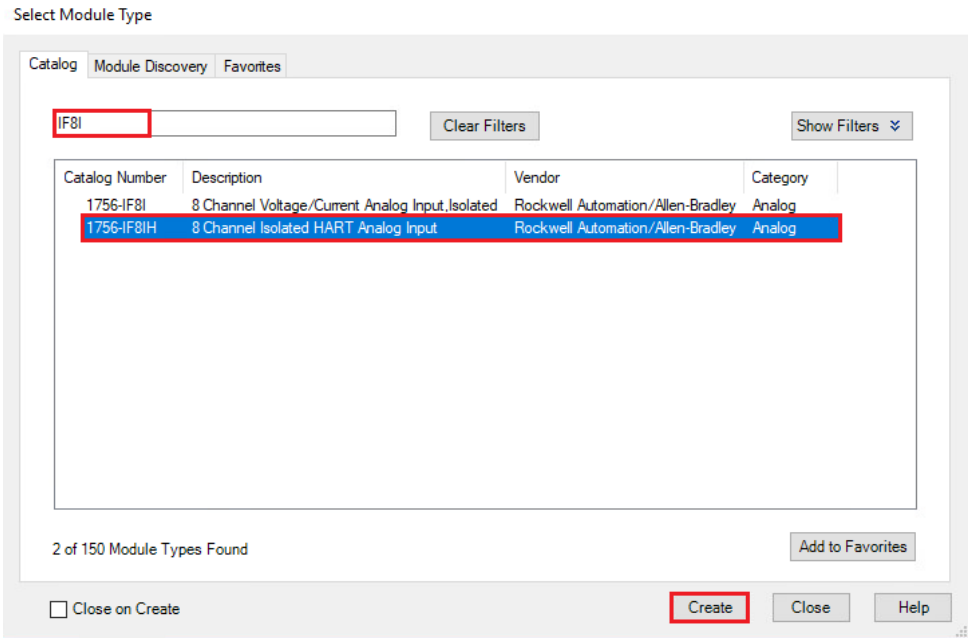


3.2.2.2.2 HART Analog Input Module

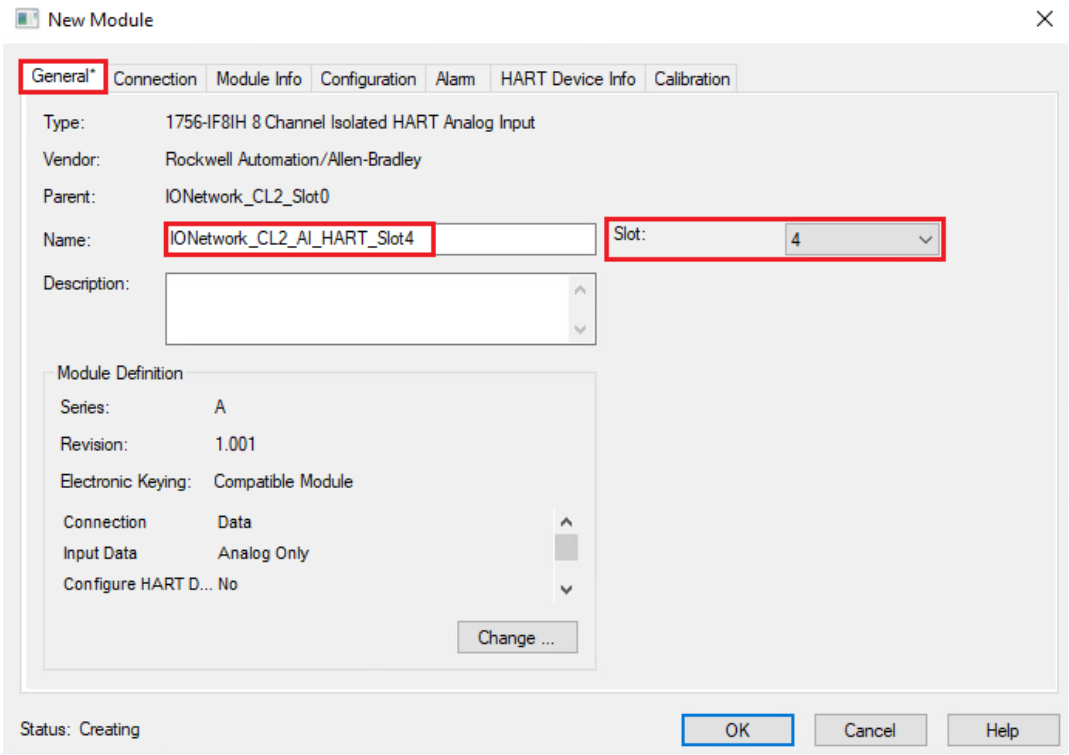
- For inserting the ControlLogix I/O HART analog input card “1756-IF8IH”, right-click on the menu “1756 Backplane, 1756-A10” and select the option “New Module”:



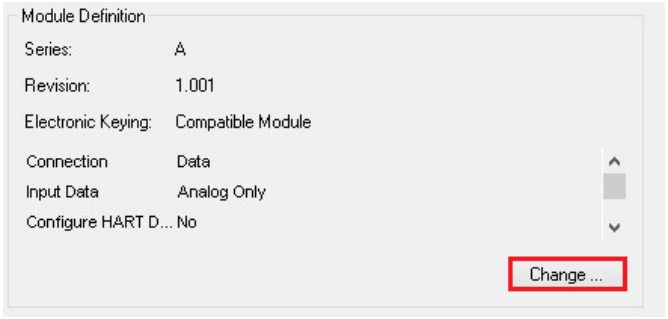
- Use the filter for faster search, select the card “1756-IF8IH”and click on the button “Create”:



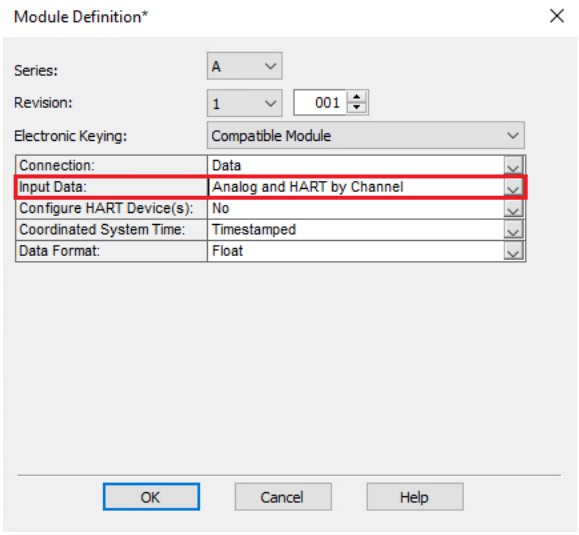
- This opens automatically the window “New Module”. In the tab “General”, indicate the Name and Slot number according to the network settings:



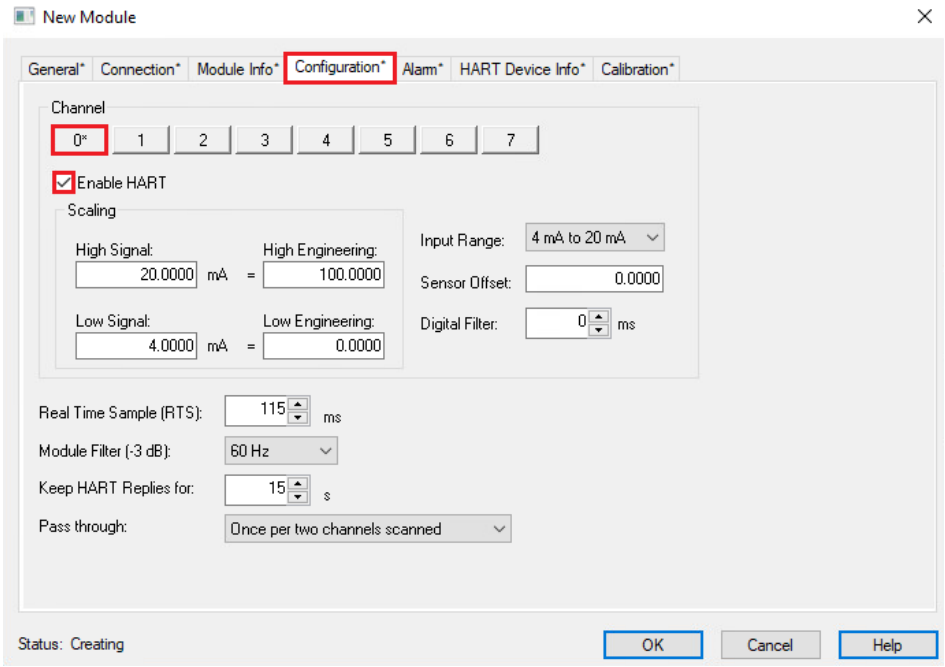
- Click on the button “Change…” to configure the input Data:



- This opens the window “Module Definition”. Select the Input Data option “Analog and HART by Channel” and click on the button “OK”:

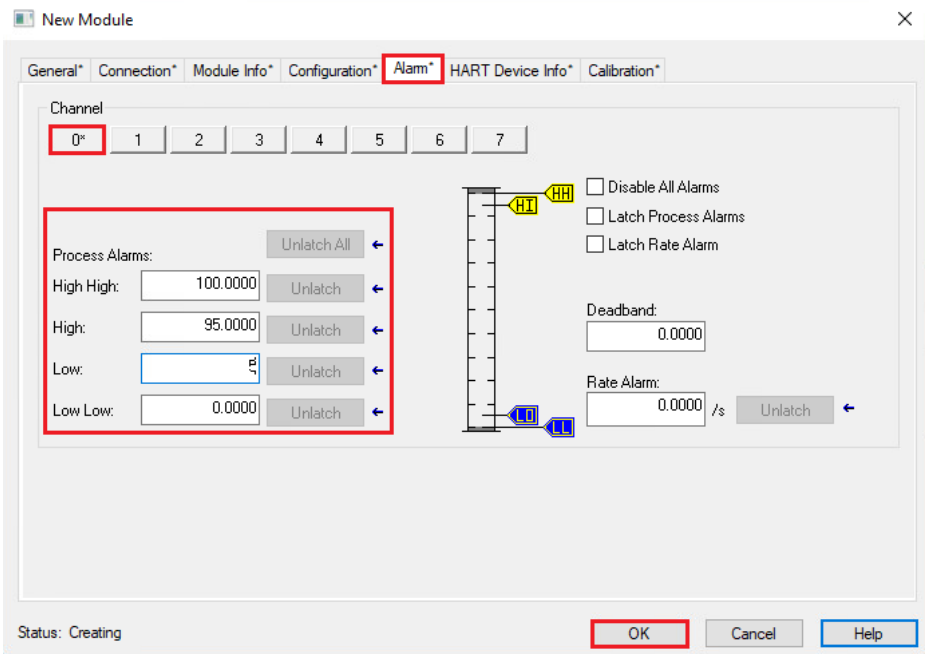


- Select the tab “Configuration” to parameter the HART settings of each channel:



- In this example:
  - Channel 0 is selected.
  - HART option is enabled with default settings.

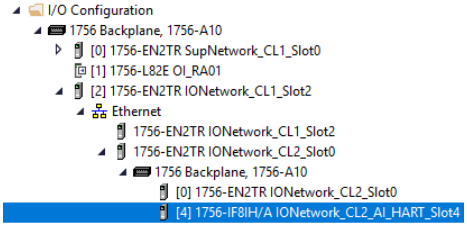
- Select the tab “Alarm” to configure if needed, the Process alarms:



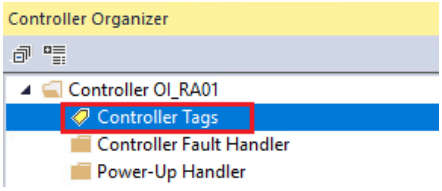
- Other channels on which a HART device is connected can be configured on the same principle.

- Click on the button “OK” to save and close the configuration.

- This inserts the HART analog input module in the project view:



- The card 1756-IF8IH can be configured in the Controller Tags as well. In Studio5000, double-click on the field “Controller Tags”:



- Expand the variable “IONetwork_CL2_Slot0:4:C”:

Name	Value	Force Mask	Style	Data Type
IONetwork_CL2_Slot0:4:C	{...}	{...}		AB:1756_IF8IH:C:0
IONetwork_CL2_Slot0:4:C.ModuleFilter	2		Decimal	SINT
IONetwork_CL2_Slot0:4:C.RealTimeSample	115		Decimal	INT
IONetwork_CL2_Slot0:4:C.Ch0Config	{...}	{...}		AB:1756_IF8IH_ChConfig_Struct:C:0
IONetwork_CL2_Slot0:4:C.Ch1Config	{...}	{...}		AB:1756_IF8IH_ChConfig_Struct:C:0
IONetwork_CL2_Slot0:4:C.Ch2Config	{...}	{...}		AB:1756_IF8IH_ChConfig_Struct:C:0
IONetwork_CL2_Slot0:4:C.Ch3Config	{...}	{...}		AB:1756_IF8IH_ChConfig_Struct:C:0
IONetwork_CL2_Slot0:4:C.Ch4Config	{...}	{...}		AB:1756_IF8IH_ChConfig_Struct:C:0
IONetwork_CL2_Slot0:4:C.Ch5Config	{...}	{...}		AB:1756_IF8IH_ChConfig_Struct:C:0
IONetwork_CL2_Slot0:4:C.Ch6Config	{...}	{...}		AB:1756_IF8IH_ChConfig_Struct:C:0
IONetwork_CL2_Slot0:4:C.Ch7Config	{...}	{...}		AB:1756_IF8IH_ChConfig_Struct:C:0
IONetwork_CL2_Slot0:4:C.PassthroughHandleTimeout	15		Decimal	INT
IONetwork_CL2_Slot0:4:C.PassthroughFreq_14	0		Decimal	BOOL
IONetwork_CL2_Slot0:4:C.PassthroughFreq_15	0		Decimal	BOOL
IONetwork_CL2_Slot0:4:I	{...}	{...}		AB:1756_IF8H_AnalogHARTbyChannel:I:0
IONetwork_CL2_Slot0:I	{...}	{...}		AB:1756_ENET_10SLOT:I:0
IONetwork_CL2_Slot0:O	{...}	{...}		AB:1756_ENET_10SLOT:O:0

- Expand for example the variable “IONetwork_CL2_Slot0:4:C.Ch0Config”:

Name	Value	Force Mask	Style	Data Type
IONetwork_CL2_Slot0:4:C	{...}	{...}		AB:1756_IF8IH:C:0
IONetwork_CL2_Slot0:4:C.ModuleFilter	2		Decimal	SINT
IONetwork_CL2_Slot0:4:C.RealTimeSample	115		Decimal	INT
IONetwork_CL2_Slot0:4:C.Ch0Config	{...}	{...}		AB:1756_IF8IH_ChConfig_Struct:C:0
IONetwork_CL2_Slot0:4:C.Ch0Config.Config	2#1000_0000		Binary	SINT
IONetwork_CL2_Slot0:4:C.Ch0Config.RateAlarmLatch	0		Decimal	BOOL
IONetwork_CL2_Slot0:4:C.Ch0Config.ProcessAlarm...	0		Decimal	BOOL
IONetwork_CL2_Slot0:4:C.Ch0Config.AlarmDisable	0		Decimal	BOOL
IONetwork_CL2_Slot0:4:C.Ch0Config.HARTEn	1		Decimal	BOOL
IONetwork_CL2_Slot0:4:C.Ch0Config.RangeType	4		Decimal	SINT
IONetwork_CL2_Slot0:4:C.Ch0Config.DigitalFilter	0		Decimal	INT
IONetwork_CL2_Slot0:4:C.Ch0Config.RateAlarmLimit	0.0		Float	REAL
IONetwork_CL2_Slot0:4:C.Ch0Config.LowSignal	4.0		Float	REAL
IONetwork_CL2_Slot0:4:C.Ch0Config.HighSignal	20.0		Float	REAL
IONetwork_CL2_Slot0:4:C.Ch0Config.LowEngineeri...	0.0		Float	REAL
IONetwork_CL2_Slot0:4:C.Ch0Config.HighEngineeri...	100.0		Float	REAL
IONetwork_CL2_Slot0:4:C.Ch0Config.LAlarmLimit	5.0		Float	REAL
IONetwork_CL2_Slot0:4:C.Ch0Config.HAlarmLimit	95.0		Float	REAL
IONetwork_CL2_Slot0:4:C.Ch0Config.LLAlarmLimit	0.0		Float	REAL
IONetwork_CL2_Slot0:4:C.Ch0Config.HHAlarmLimit	100.0		Float	REAL
IONetwork_CL2_Slot0:4:C.Ch0Config.AlarmDeadba...	0.0		Float	REAL
IONetwork_CL2_Slot0:4:C.Ch0Config.CalBias	0.0		Float	REAL

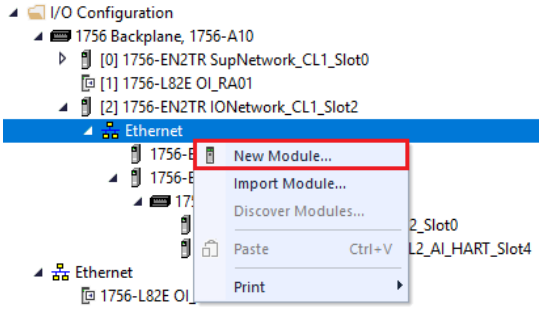
This displays all configurable variable for channel0 as displayed in the AOP. Refer to the 1756-IF8IH user manual for further details.

3.2.2.3 Flex I/O

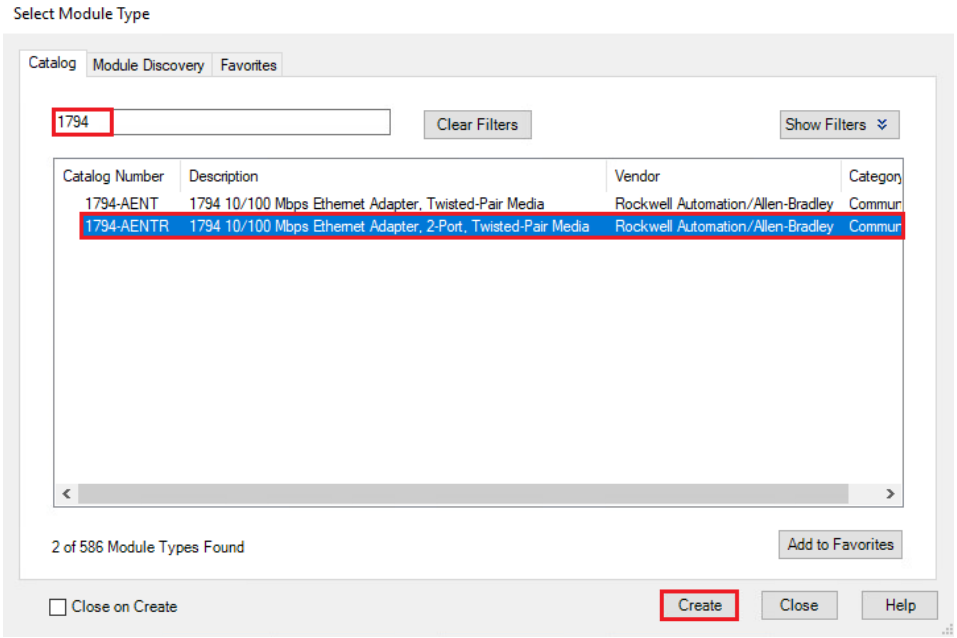
In our example, the Flex I/O part is composed of a backplane “1756-A10”, an Ethernet module “1794-AENTR” and a HART analog input card “1794-IF8IH/A”.

3.2.2.3.1 EtherNet/IP Adapter

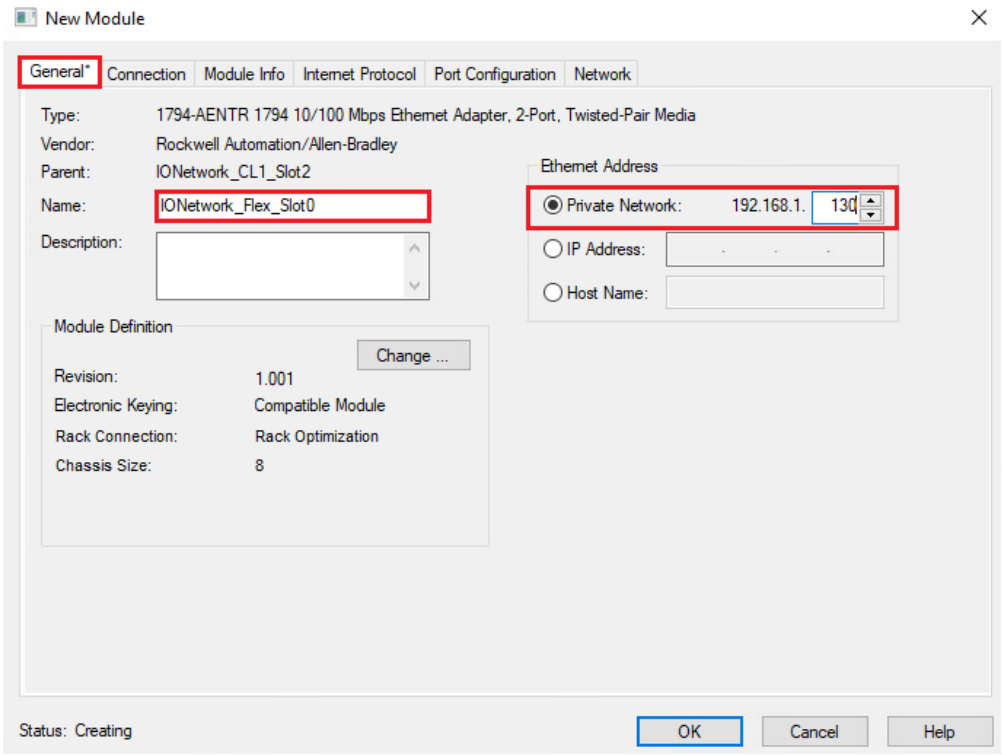
- For inserting the Flex I/O card “1794-AENTR”, right-click on the menu “Ethernet” and select the option “New Module”:



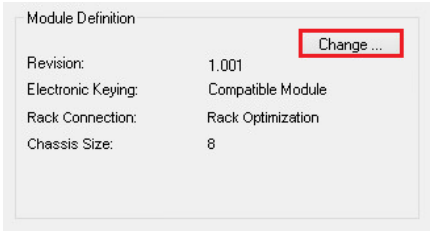
- Use the filter for faster search, select the card “1794-AENTR”and click on the button “Create”:



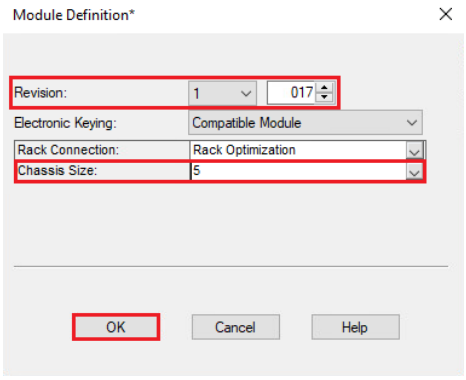
- This opens automatically the window “New Module”. In the tab “General”, configure the Name, IP Address and according to the network settings:



- In this example, the module Revision must be changed. Click on the button “Change…”:

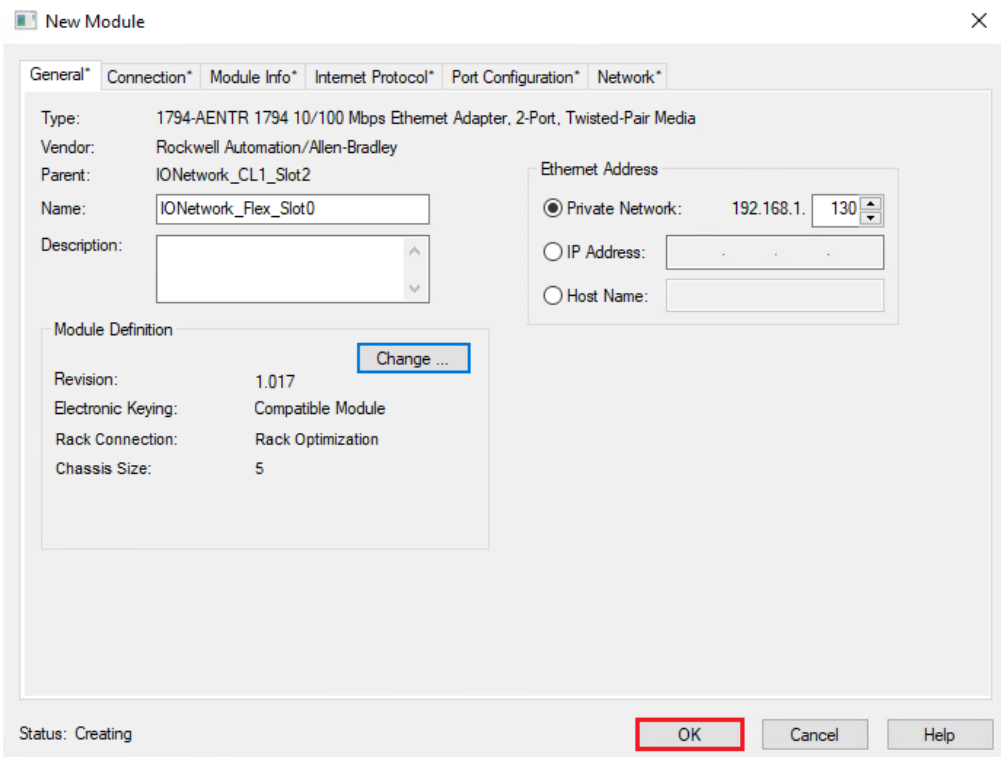


- Update the module Revision to “1.017” and the Chassis size to “5”:

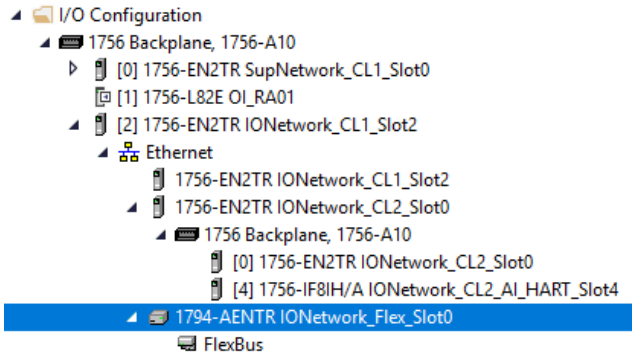


- Click on the button “OK”:

- Click on the button “OK” to save and close this window:

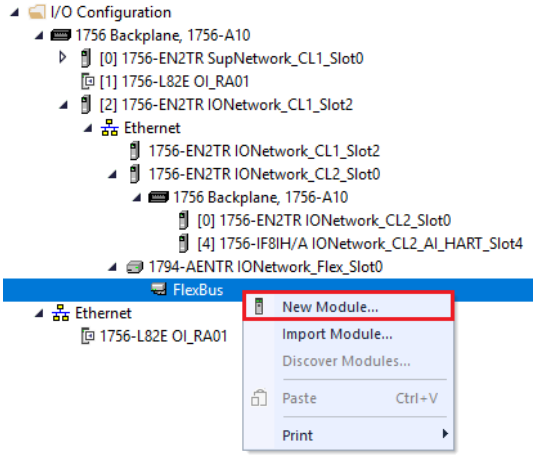


- This inserts the card “1794-AENTR” in the project view:

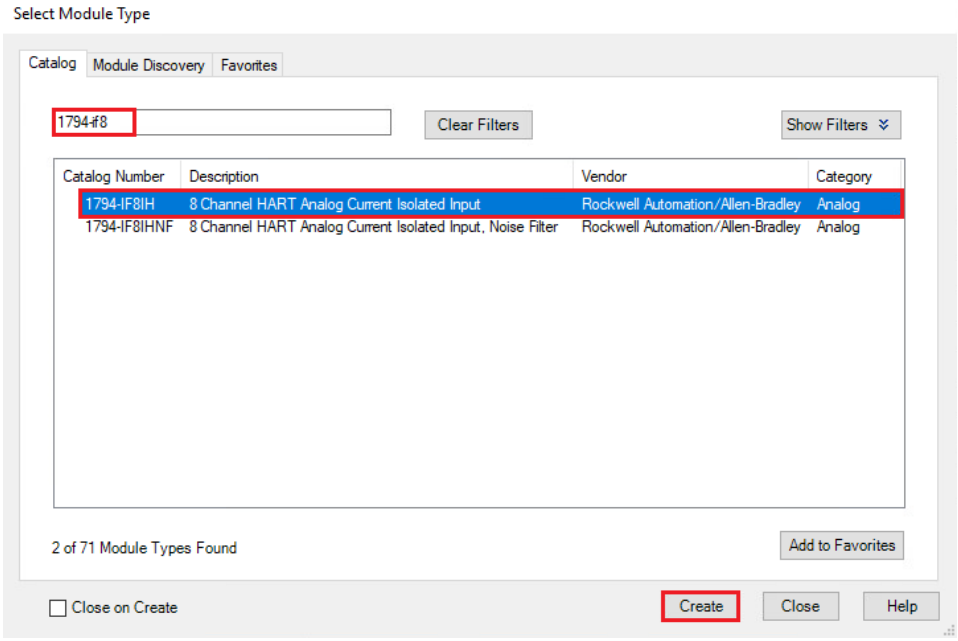


3.2.2.3.2 HART Analog Input Module

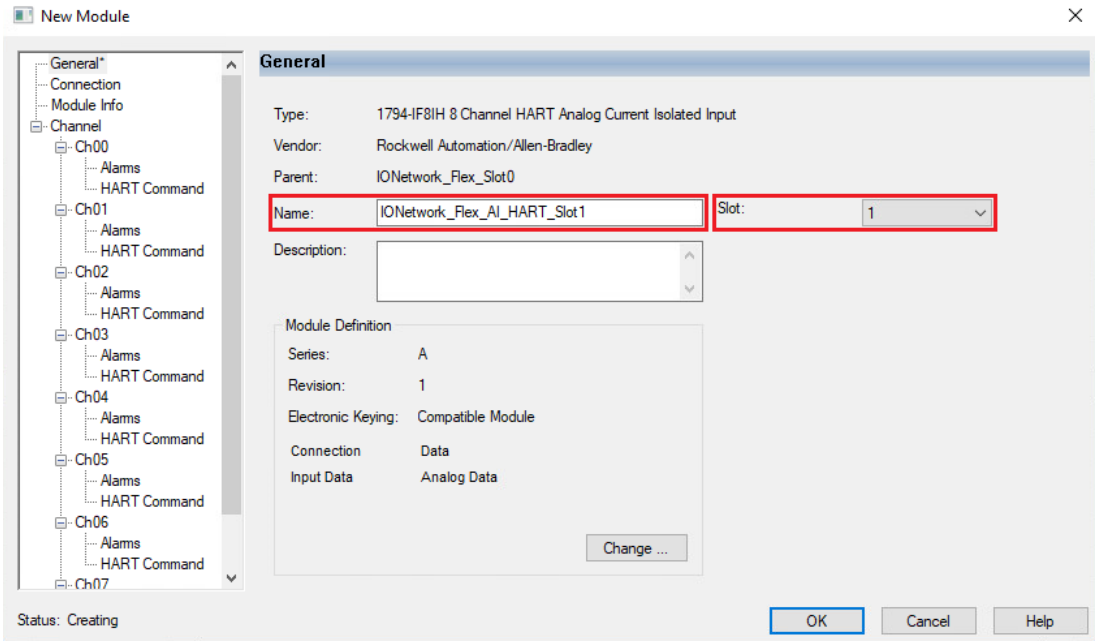
- For inserting the Flex I/O Ethernet module “1794-IF8IH/A”, right-click on the menu “1794-AENTR Flex IO” and select the option “New Module”:



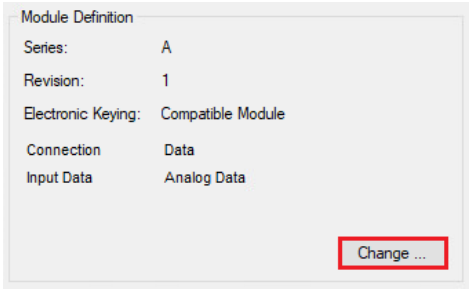
- Use the filter for faster search, select the card “1794-IF8IH”and click on the button “Create”:



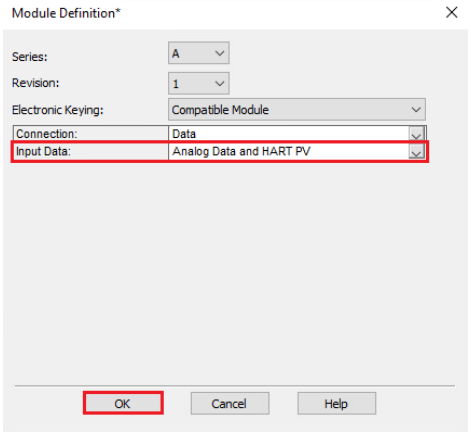
- This opens automatically the window “New Module”. Indicate the Name and Slot number, according to the network settings:



- In this example, the Input Data “Analog Data” must be changed. Click on the button “Change...”:

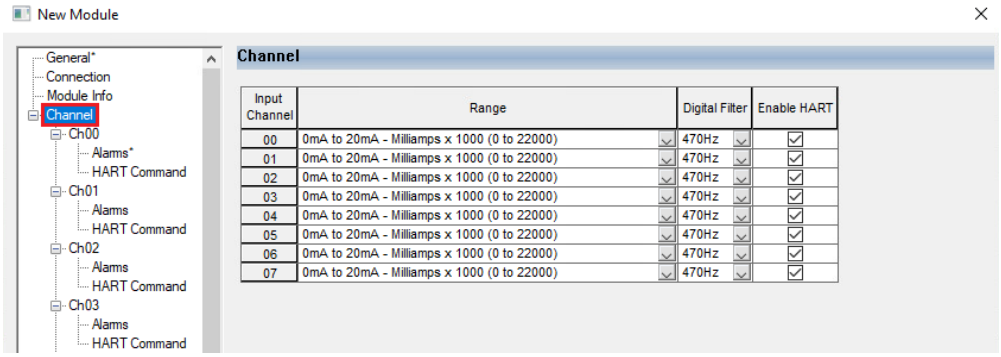


- Change the Input Data to “Analog Data and HART PV”:

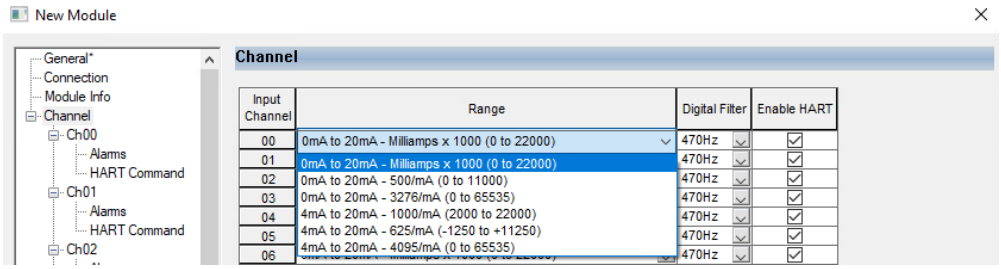


- Click on the button “OK” to save and close the window.

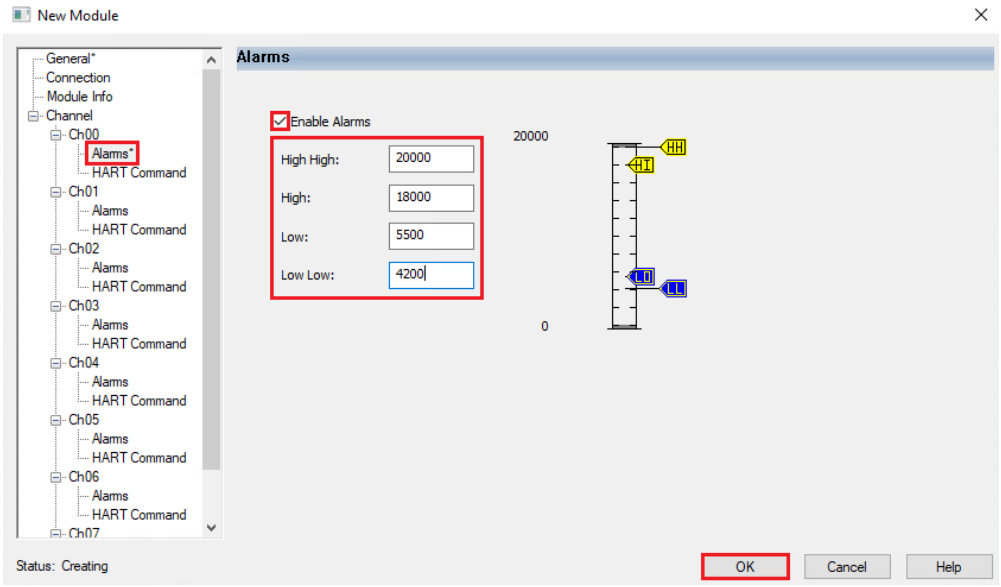
- Click on the tab “Channel”. This displays the default configuration of the 8 inputs:



- Each channel range can be configured independently with following settings:



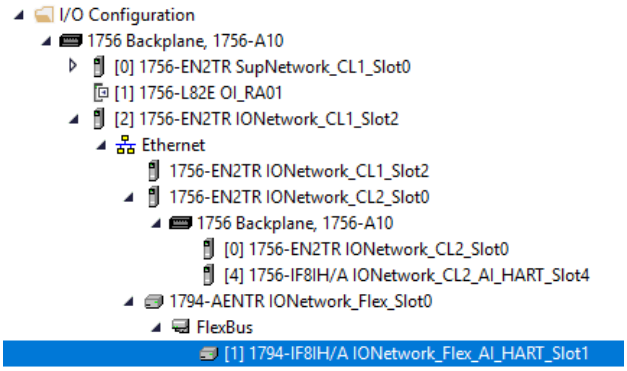
- Select the tab “Alarm” to configure if needed, the Process alarms:



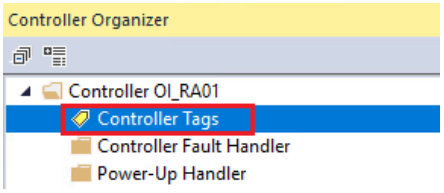
- Other channels on which a HART device is connected can be configured on the same principle.

- Click on the button “OK” to save and close the configuration.

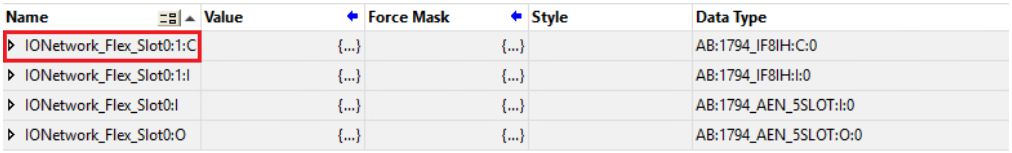
- This inserts the HART analog input module in the project view:



- The card 1784-IF8IH can be configured in the Controller Tags as well. In Studio5000, double-click on the field “Controller Tags”:



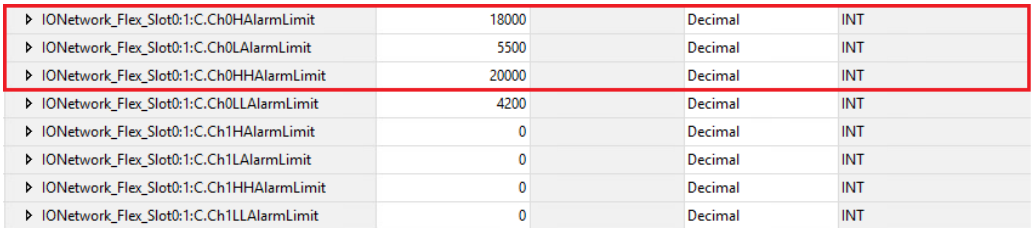
- Expand the menu “Flex_IO:1:C”:



Name	Value	Force Mask	Style	Data Type
IONetwork_Flex_Slot0:1:C	{...}	{...}		AB:1794_IF8IH:C:0
IONetwork_Flex_Slot0:1:I	{...}	{...}		AB:1794_IF8IH:I:0
IONetwork_Flex_Slot0:I	{...}	{...}		AB:1794_AEN_5SLOT:I:0
IONetwork_Flex_Slot0:O	{...}	{...}		AB:1794_AEN_5SLOT:O:0

“Flex_IO:1:C” is the concatenation of three parts: “Flex_IO” is the name given during the card configuration, “1” is for Slot1 and ”C” for configuration.

- All 1794-IF8IH card settings can be configured in this menu:



IONetwork_Flex_Slot0:1:C.Ch0HAlarmLimit	18000		Decimal	INT
IONetwork_Flex_Slot0:1:C.Ch0LAlarmLimit	5500		Decimal	INT
IONetwork_Flex_Slot0:1:C.Ch0HHAlarmLimit	20000		Decimal	INT
IONetwork_Flex_Slot0:1:C.Ch0LLAlarmLimit	4200		Decimal	INT
IONetwork_Flex_Slot0:1:C.Ch1HAlarmLimit	0		Decimal	INT
IONetwork_Flex_Slot0:1:C.Ch1LAlarmLimit	0		Decimal	INT
IONetwork_Flex_Slot0:1:C.Ch1HHAlarmLimit	0		Decimal	INT
IONetwork_Flex_Slot0:1:C.Ch1LLAlarmLimit	0		Decimal	INT

In this example, we see the Alarms linit set previously in the AOP.

- Please refer to the 1794-IF8IH user manual for more details.

3.3 EtherNet/IP Field Device Configuration

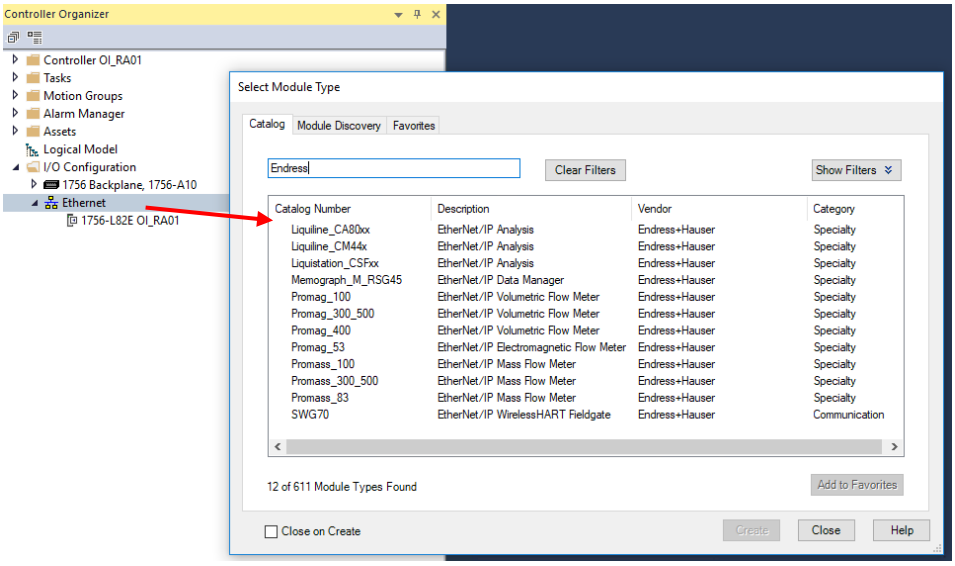
This chapter describes how to integrate an EtherNet/IP device with the Rockwell Automation ControlLogix System by using two types of drivers: EDS (Electronic Data Sheet) and AOP (Add On Profile).

3.3.1 Field Device Library

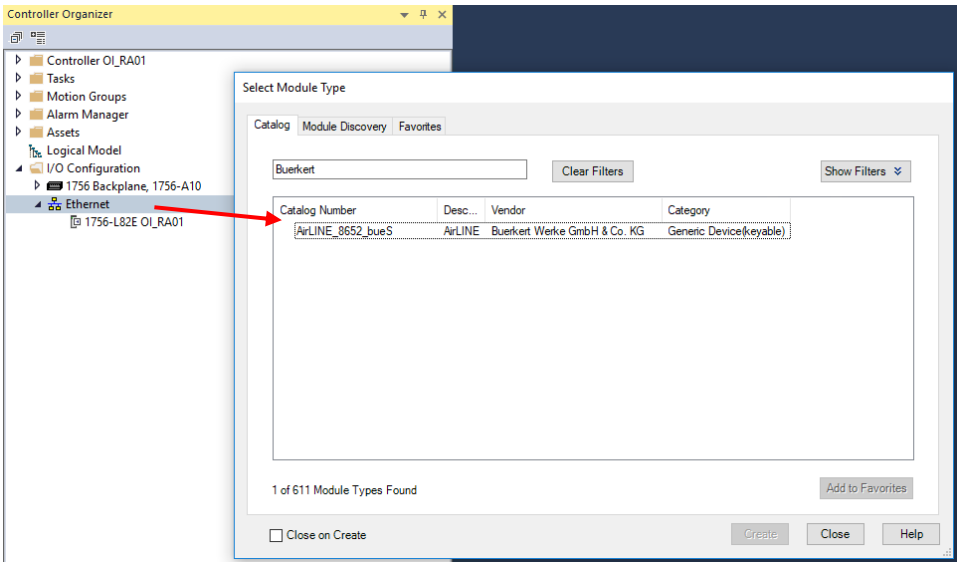
3.3.1.1 General

Studio5000 provides a hierarchical view of installed drivers. The user can display the installed components for a selected module.

- Overview of Endress+Hauser installed AOP:



- Overview of installed Bürkert EDS:



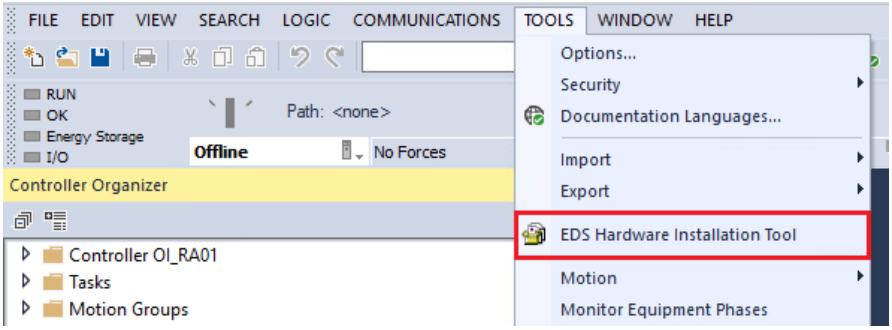
Remarks

- EDS drivers are registered under the filter “Generic Device” and AOP under “Specialty”:
- Device EDS driver and AOP cannot coexist simultaneously in the catalog. As soon as the AOP package is installed, then the EDS driver does not appear in the catalog anymore.

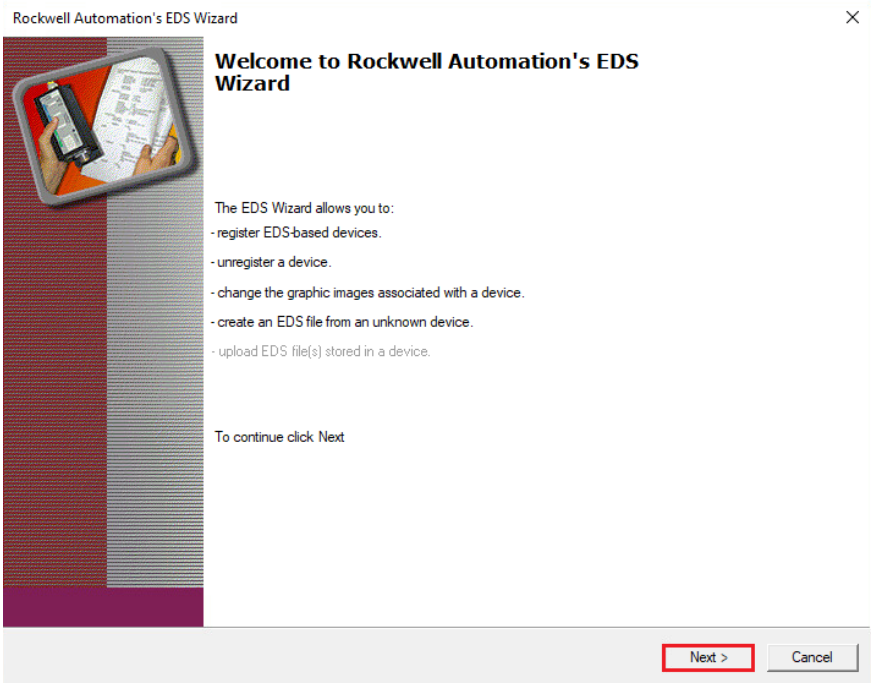
3.3.1.2 EDS File Import

EDS files can be uploaded from the device with RSLinx or installed offline to prepare a project independent from connected devices:

- Select the menu “Tools” and select the menu “Tools→EDS Hardware Installation Tool”:



- This opens the Rockwell Automation’s Wizard:



- Click on the button “Next>” to continue and follow all steps.

3.3.1.3 AOP Packages

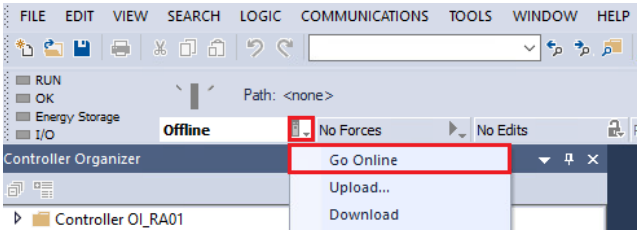
AOPs for Endress+Hauser devices are typically pre-installed and delivered with Studio 5000, however new or updated AOP Packages may be installed manually. Please follow the setup instructions accordingly. Latest AOP Packages may be found on Endress+Hauser Download area web page.

3.3.2 Device Integration with EDS

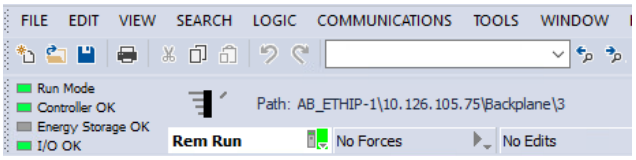
3.3.2.1 Online Configuration of Bürkert Valve Island 8652 AirLINE

The following chapter describes the configuration workflow of a Bürkert EtherNet/IP valve island 8652 AirLINE device from Online to project by using the EDS file.

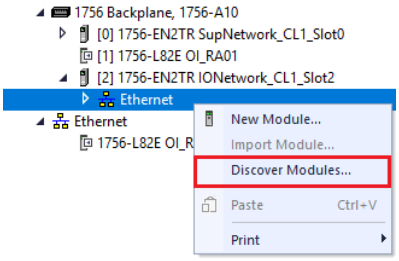
- Click on the shortcut button closed to the Offline status and select the menu “Go Online”:



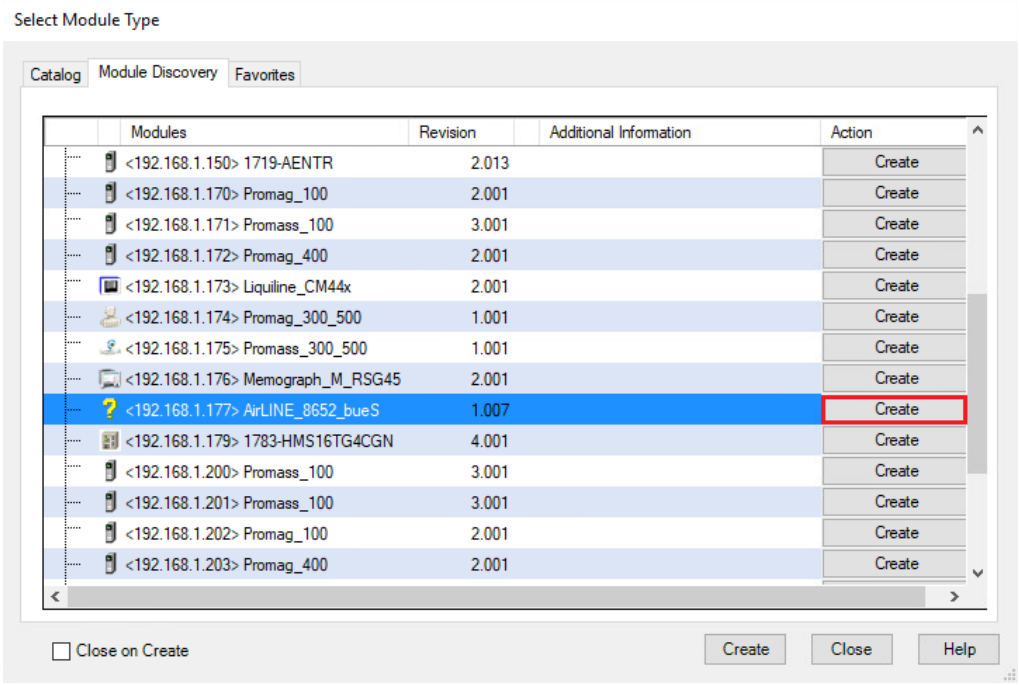
- Online connection is established:



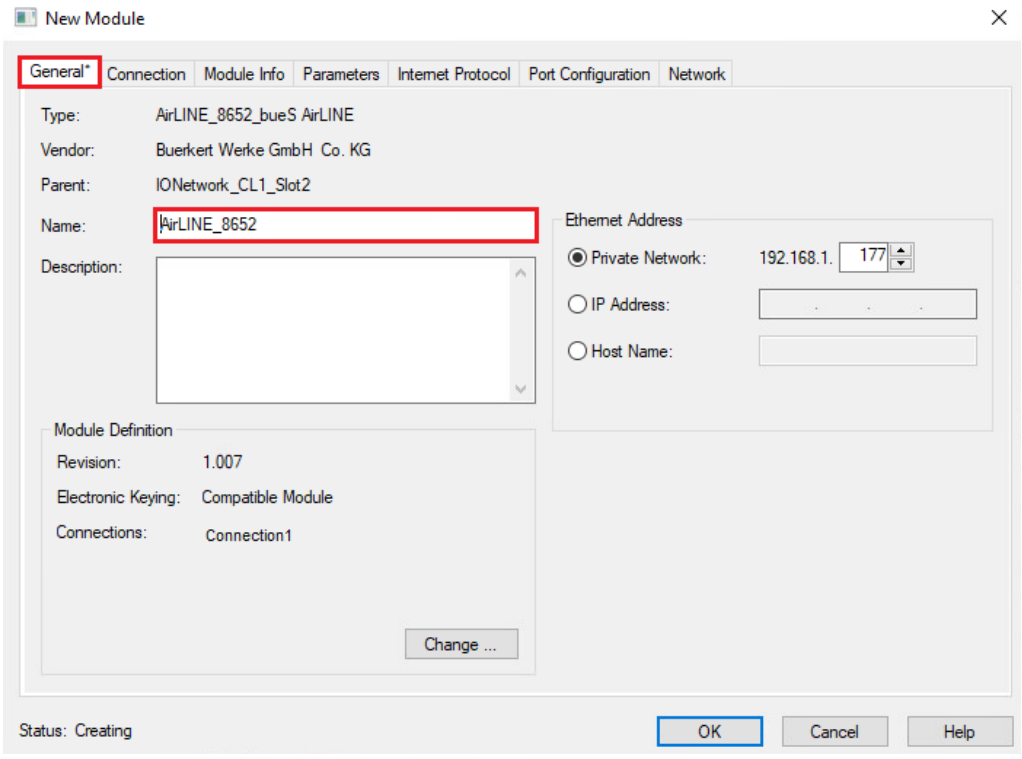
- Right-click on the field “Ethernet” and select the menu “Discover Modules”:



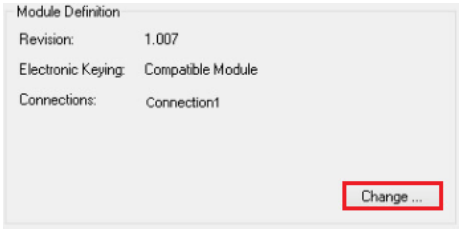
- This scans the connected network. After few seconds, all detected devices on this network are displayed. In this example, select the module “AirLINE_8652_bueS” and click on the button “Create”:



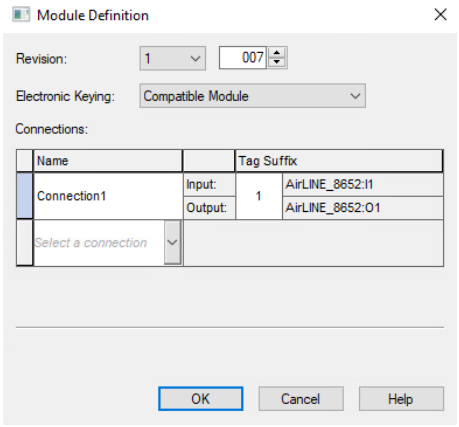
- In the tab “General”, indicate Name:



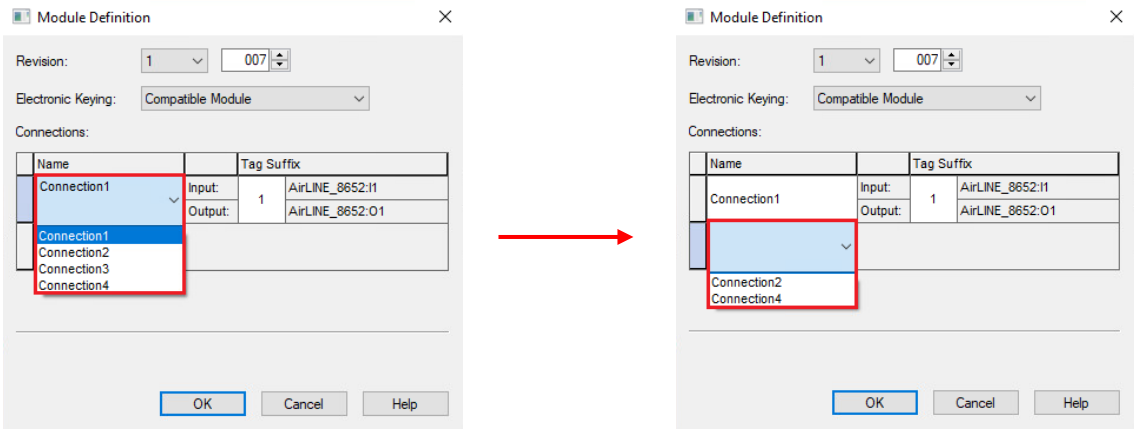
- In this example, the default configured parameter “Connections” is “Connection1” with module revision 1.007. If needed, click on the button change to modify these parameters:



- This displays the window “Module Definition”:

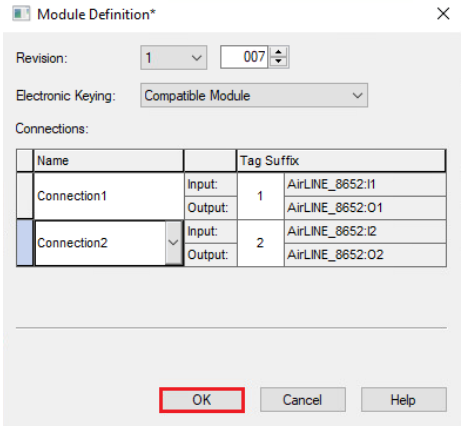


- Default “Connection” can be modified. Click on the arrow to expand all available connections: A second connection type can be configured if needed. However, the second connection type choice is depending on what has been configured on the first connection type:



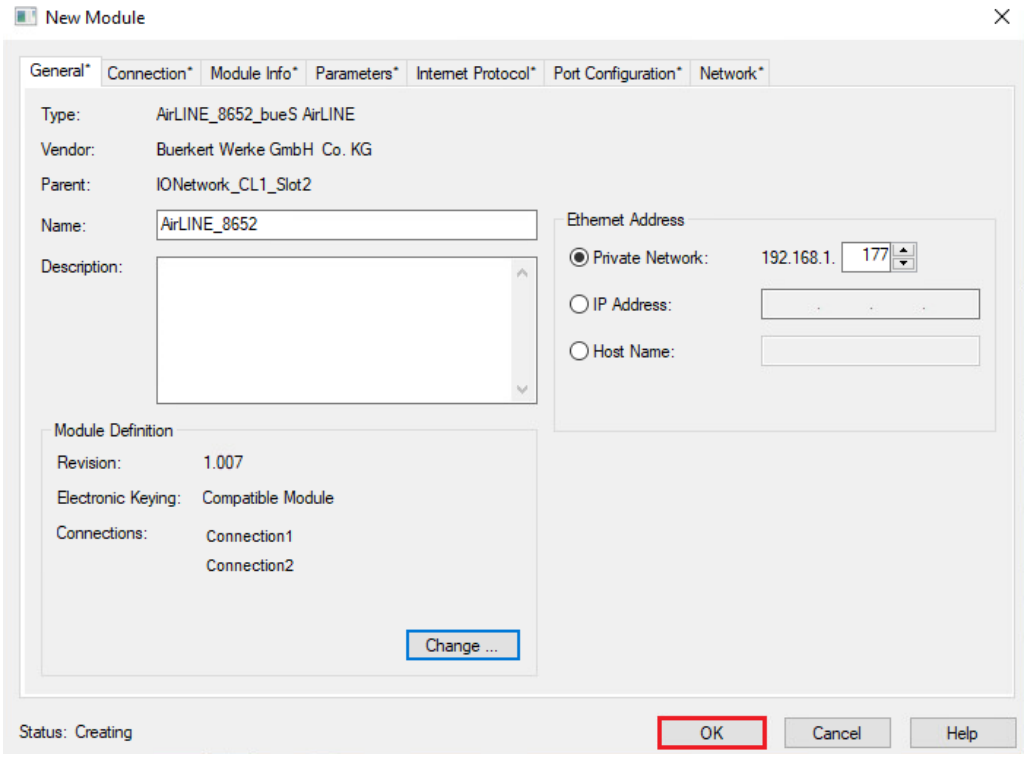
If the first connection is “Connection1”, the second one may only be “Connection2” or “Connection4.”

- In this example, “Connection1” and “Connection2” are configured:



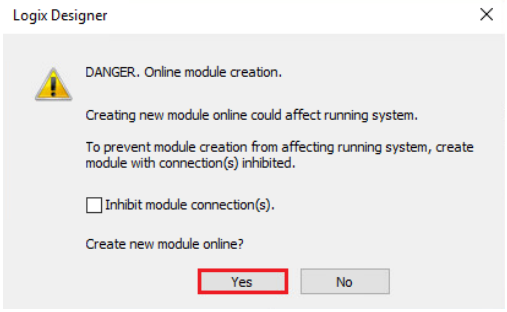
Click on the button “OK”.

- Module Definition is updated:

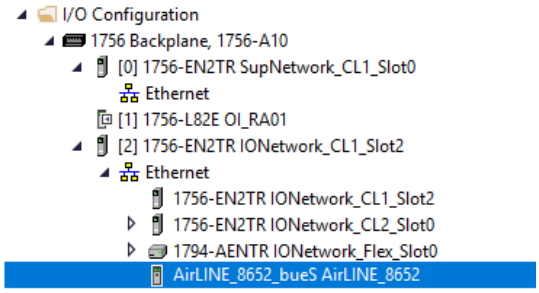


Click on the button “OK” to save the configuration.

- Click on the button “Yes” to create the module in Online mode:



- AirLINE 8652 is successfully added in the project:



- Close the wizard window “Select Module Type”.

3.3.3 Device Integration with AOP

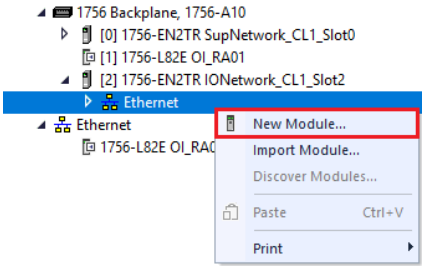
This chapter describes the steps for configuring an EtherNet/IP device by using the AOP. The following steps requires the installation of Endress+Hauser AOP packages.

3.3.3.1 Offline Configuration of Endress+Hauser Promag500 EIP

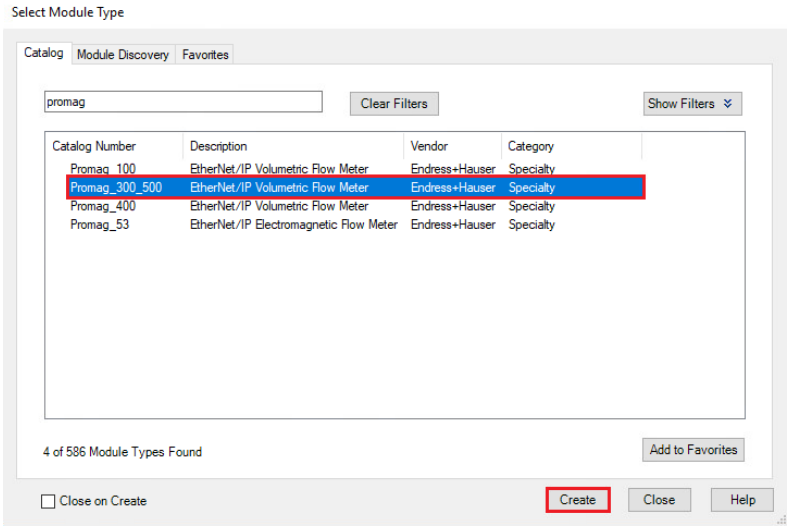
The following chapter describes the Offline Configuration workflow of an Endress+Hauser Promag500 EtherNet/IP device by using the AOP.

New Device

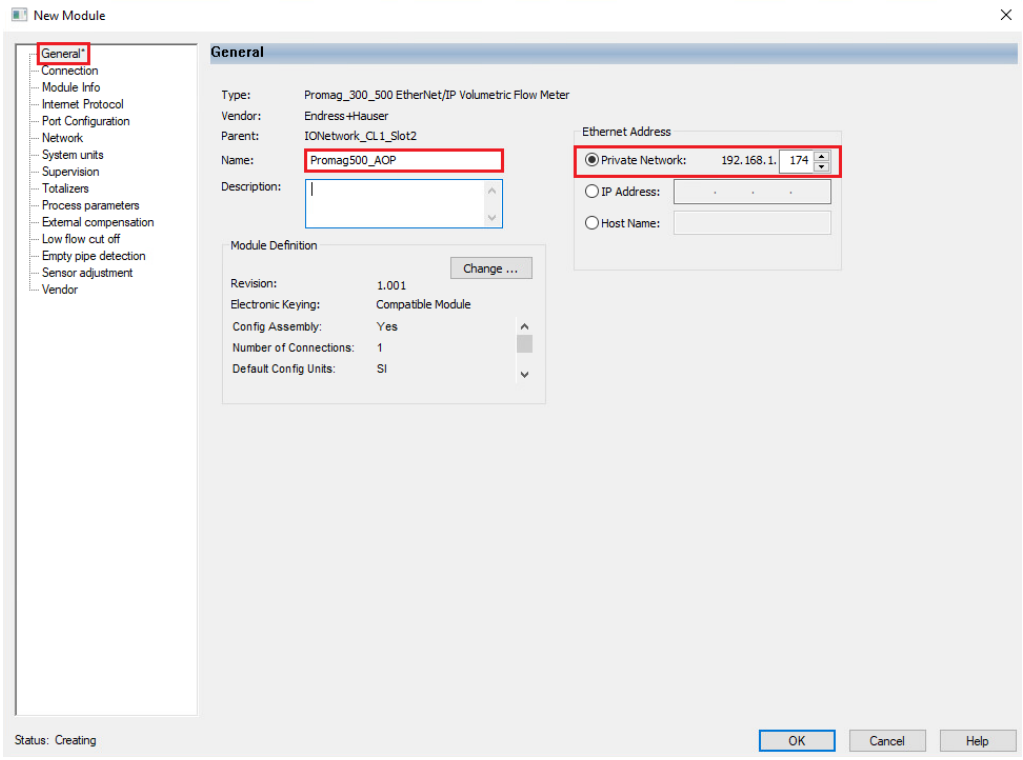
- Right-click on the field “Ethernet” and select the menu “New Module...”:



- Search the Endress+Hauser Promag100 device and click on the button “Create”:

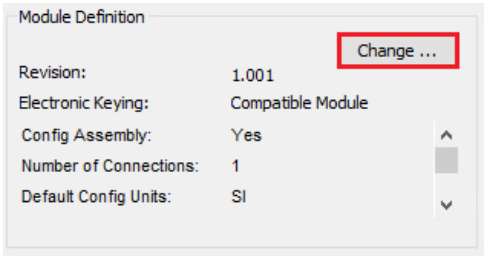


- In the tab “General”, indicate Name and IP address according to the network:

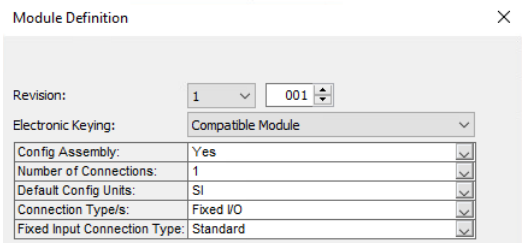


Connection Type

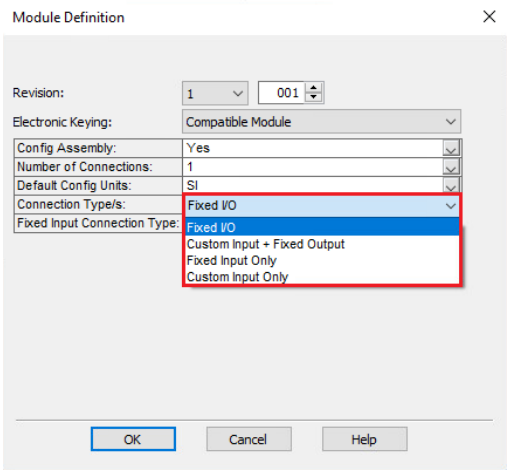
- Click on the button “Change” for configuring the Connection type and the AOP revision:



- Default Settings:



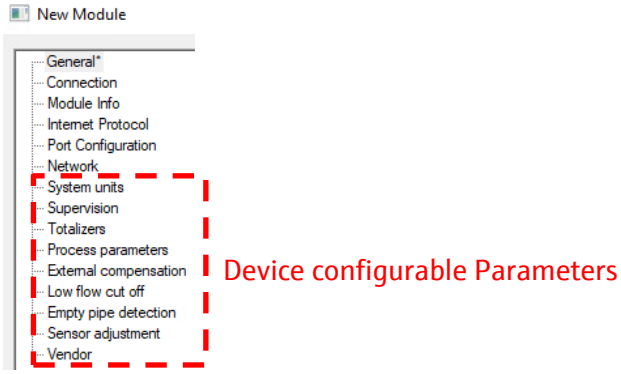
- Following connection are available for this device:



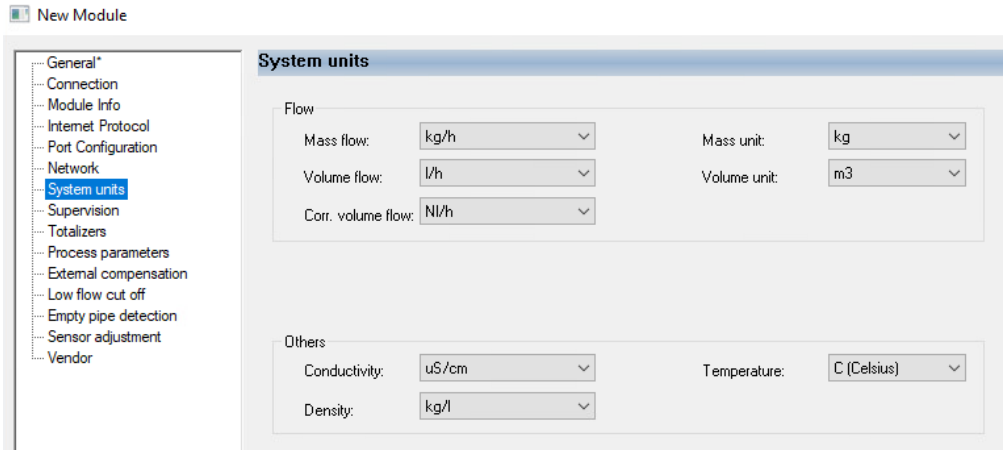
Click on the button “OK” to save the configuration and close this window.

Device parameters

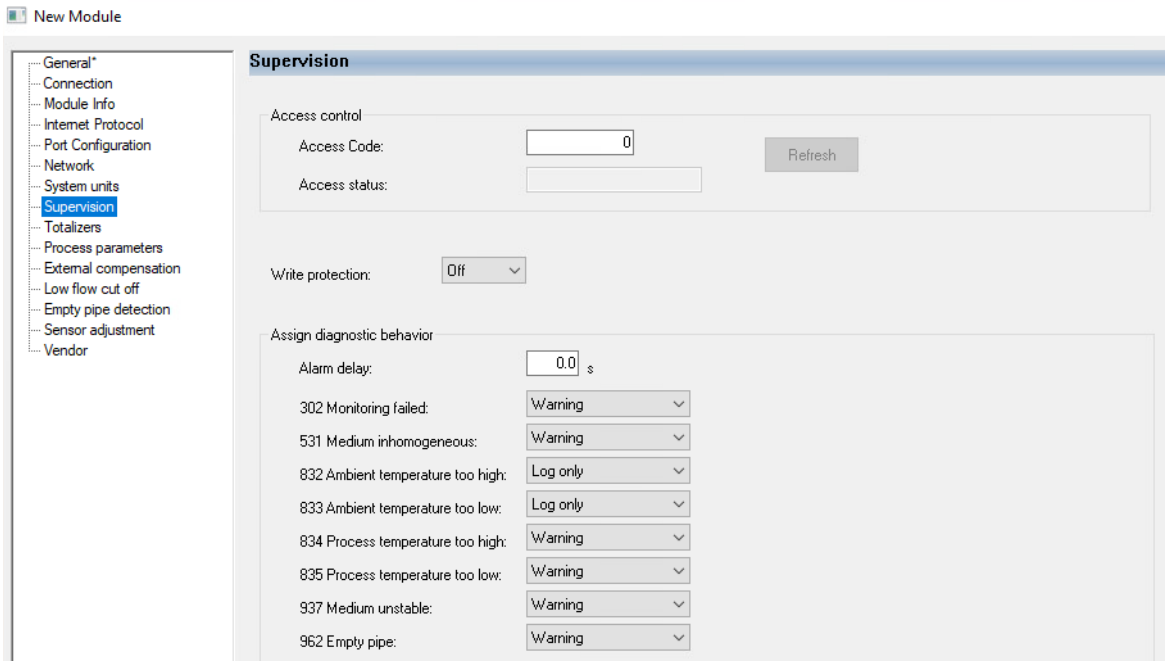
- Compared to the EDS integration method, in which all parameters are listed in one table, the AOP menu displays the device settings per category in tabs:



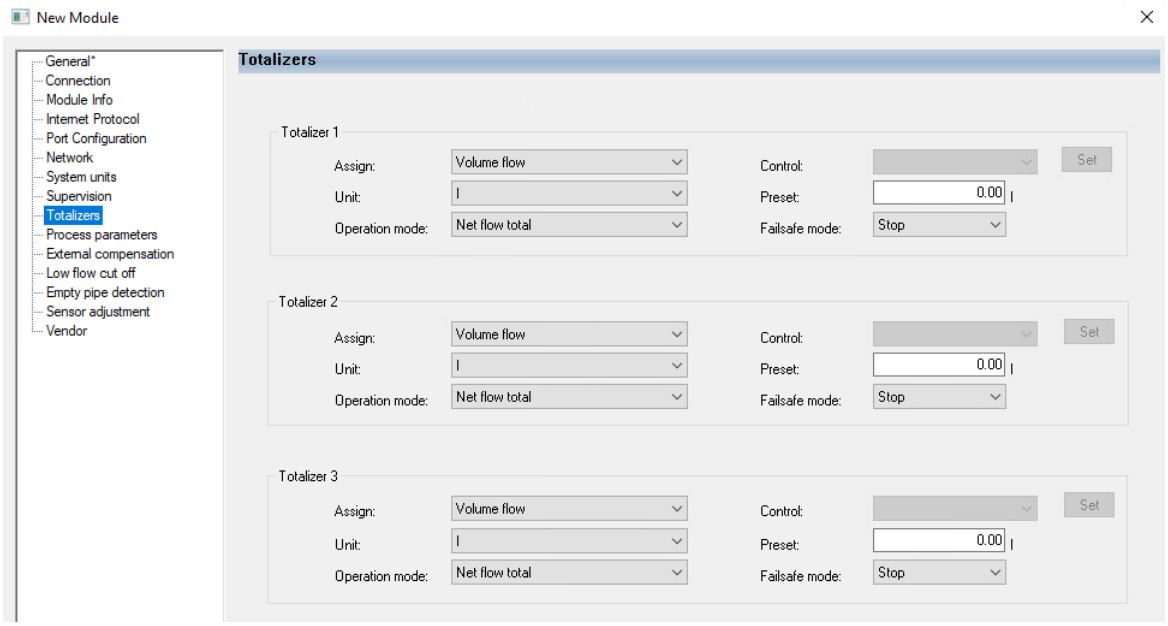
- For example, click on the tab “System units” to modify device parameter units:



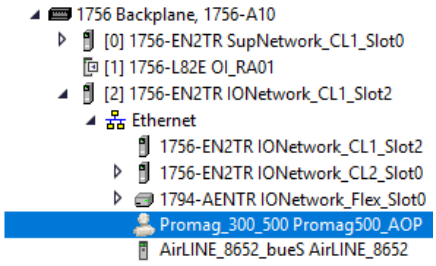
- For example, click on the tab “Supervision” to modify the diagnostics events configuration:



- For example, click on the tab “Totalizers” to modify Totalizers parameters configuration:



- This inserts the device in the project view:

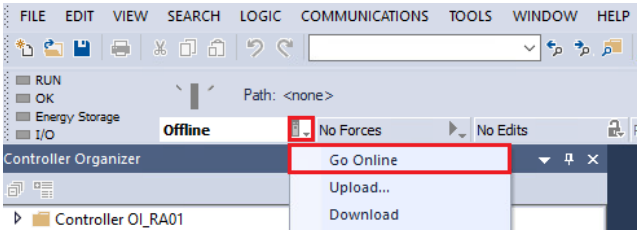


- The device configuration can be downloaded. Please refer to chapter 3.4.2.

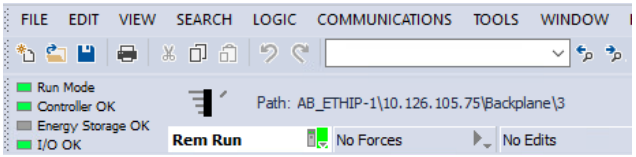
3.3.3.2 Online Configuration of Endress+Hauser Promag500 EIP

The following chapter describes the configuration workflow of an Endress+Hauser Promag500 EtherNet/IP device from Online to project by using the Add On Profile (AOP).

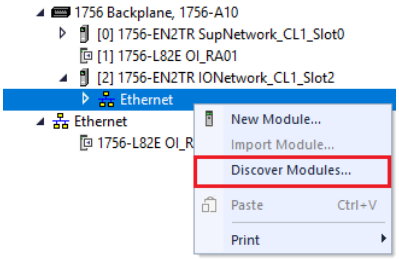
- Click on the shortcut button closed to the Offline status and select the menu “Go Online”:



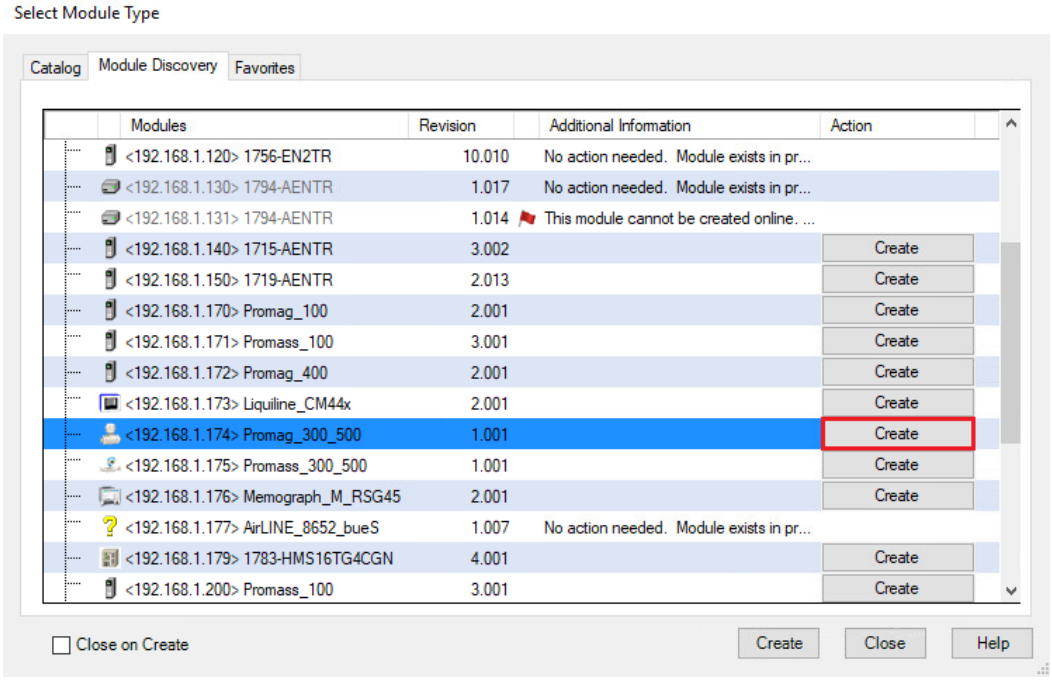
- Online connection is established:



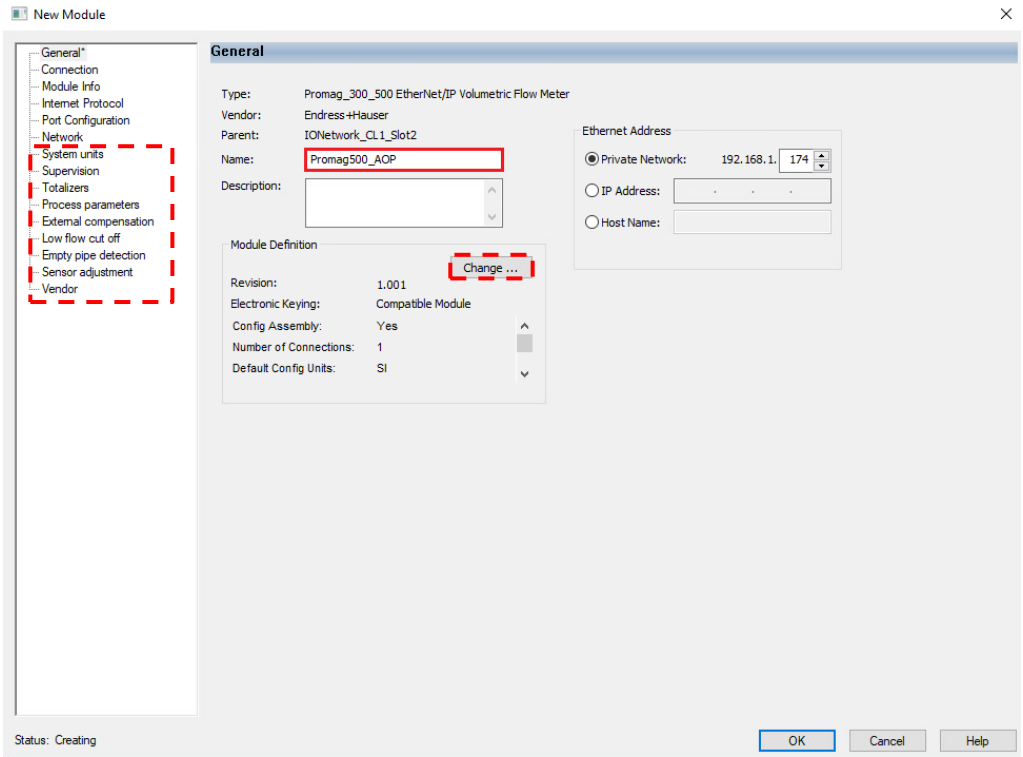
- Right-click on the field “Ethernet” and select the menu “Discover Modules”:



- This scans the connected network. After few seconds, all detected devices on this network are displayed. In this example, select the module “Promag_300_500” and click on the button “Create”:



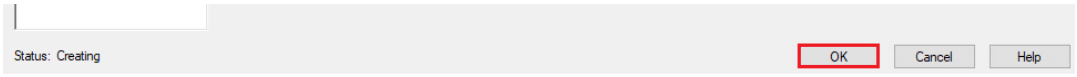
- This opens the “New Module” wizard:



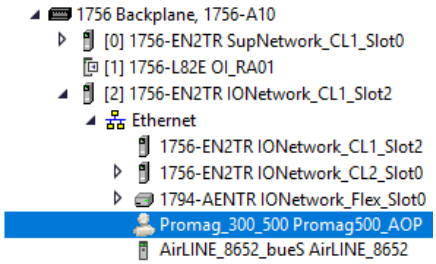
Configure the parameter “Name”, “Promag500_AOP” in this example.

- Configure the connection type as well and other AOP settings as done in chapter 3.3.3.1.

- Click on the button “OK“ to save the configuration:

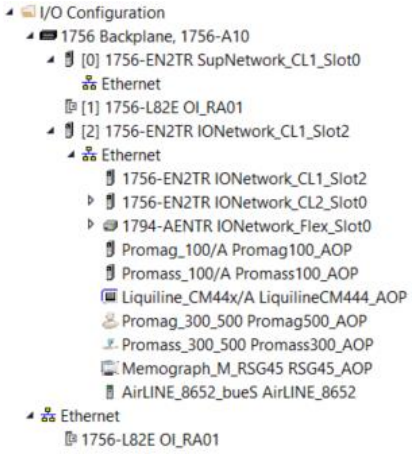


- Promag500 is successfully added in the project:



Remark

- The configuration does not need to be downloaded in the PLC.
- Other Endress+Hauser EtherNet/IP field devices have been integrated as well:



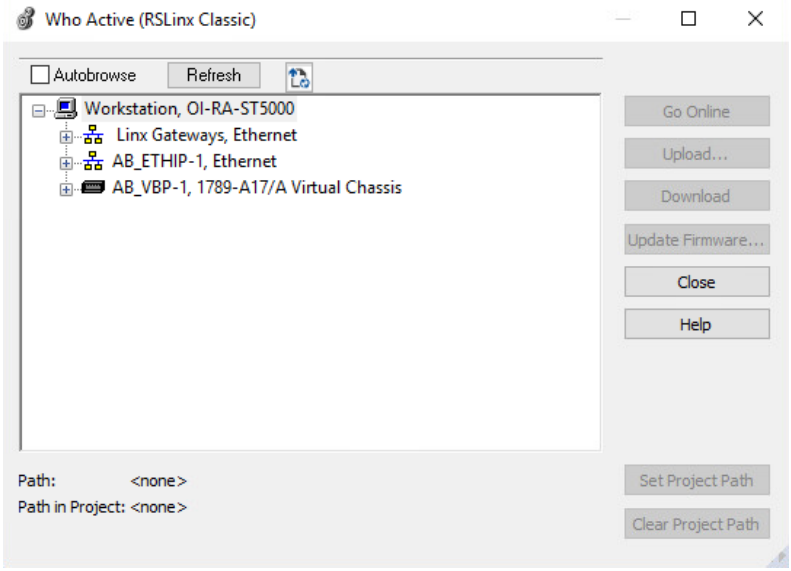
3.4 Commissioning of the Control Project

3.4.1 Path Configuration

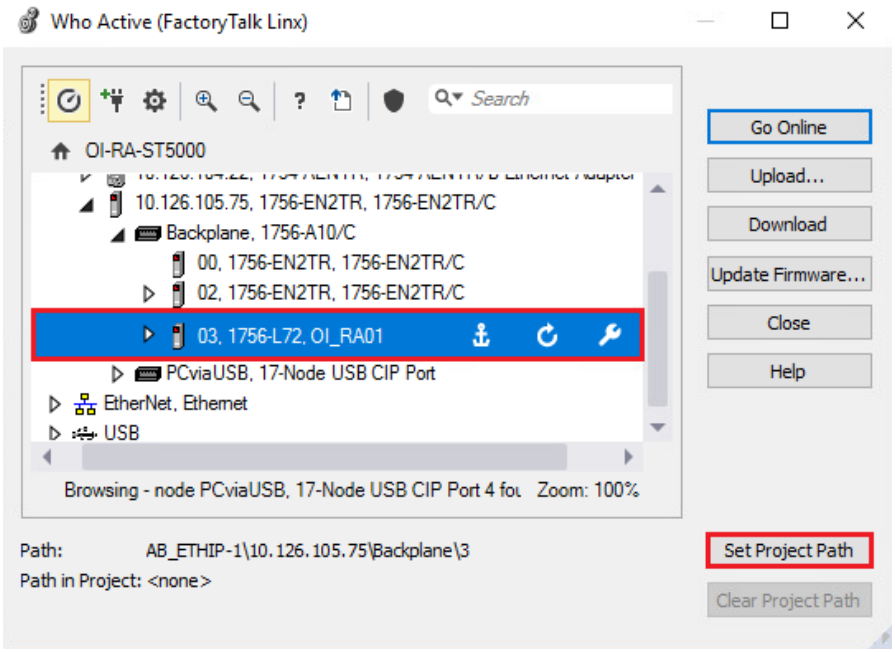
- The PLC path needs to be configured in order to connect the PLC:

- Click on the small shortcut button:

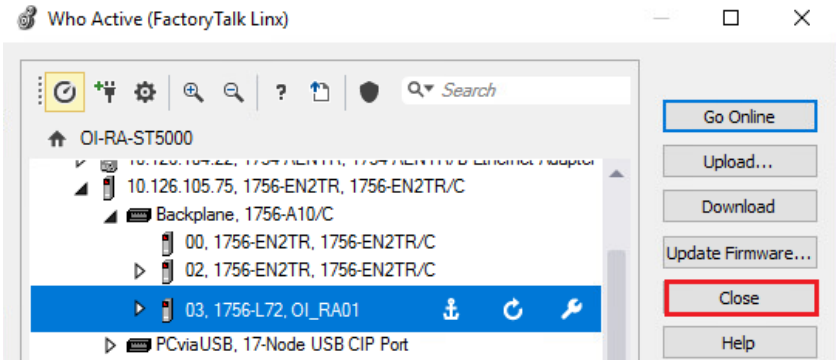
- This opens the window “Who Active”. In this example, expand the field “AB_ETHIP-1,Ethernet”:



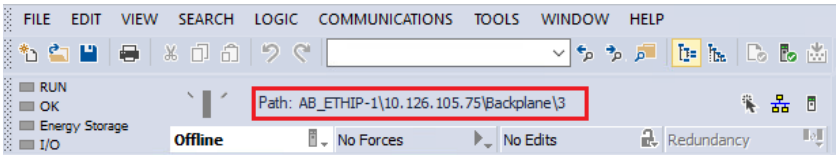
- Expand the location to choose the PLC and click on the button “Set Project Path”.
  In our example, the used PLC is the 1756-L82E ControlLogix:



- Close the window by clicking on the button “Close”:

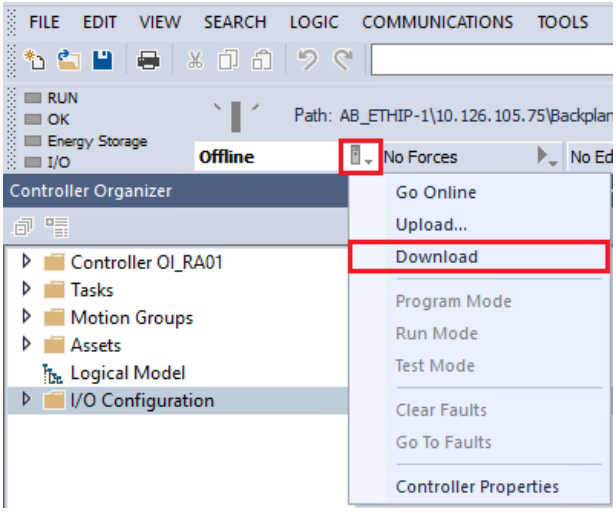


- Project path is updated in the project view:

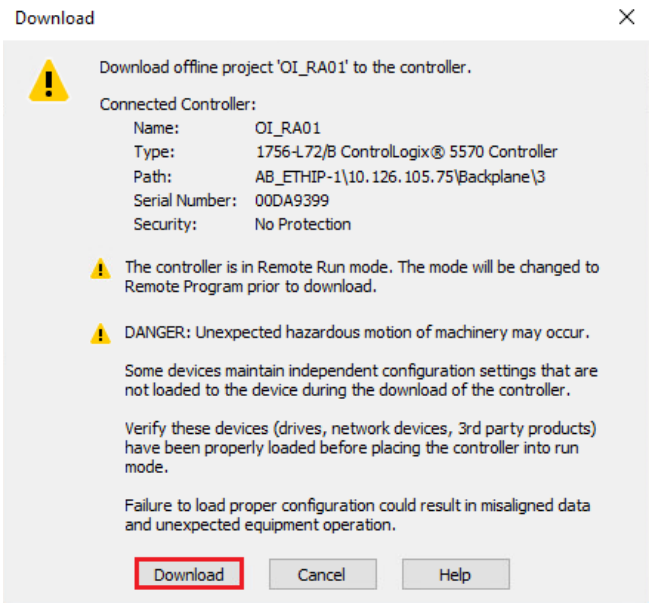


3.4.2 Project Configuration Download

- Click on the shortcut button closed to the Offline status and select the menu “Download”:

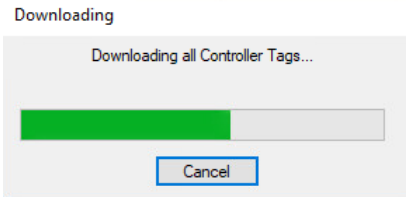


- This opens the window “Download”:

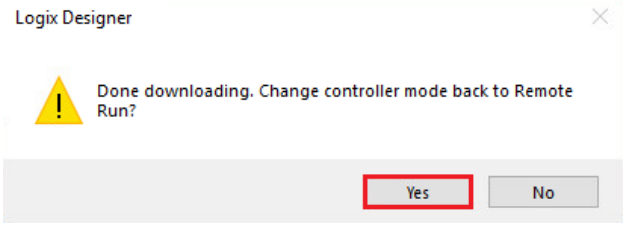


Click on the button “Download”.

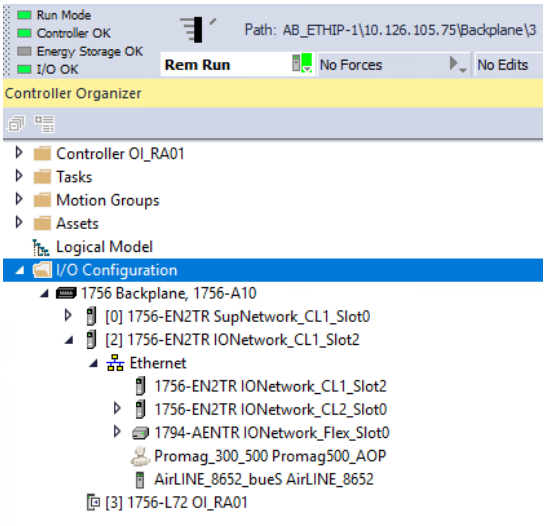
- Download is processing:



- Click on the button “Yes” to change controller status to “Run”:

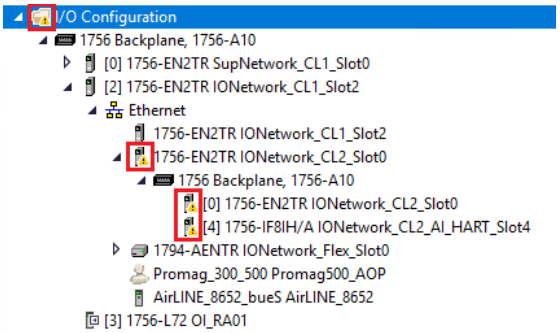


- Remote Run Status is active. In this example, there are no errors:



Remark

- In case of wrong configuration or error, a symbol would be displayed closed to each concerned device:

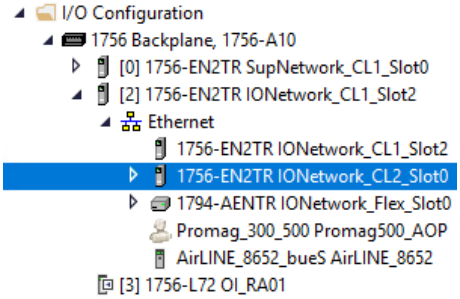


3.4.3 Network Supervisor Mode

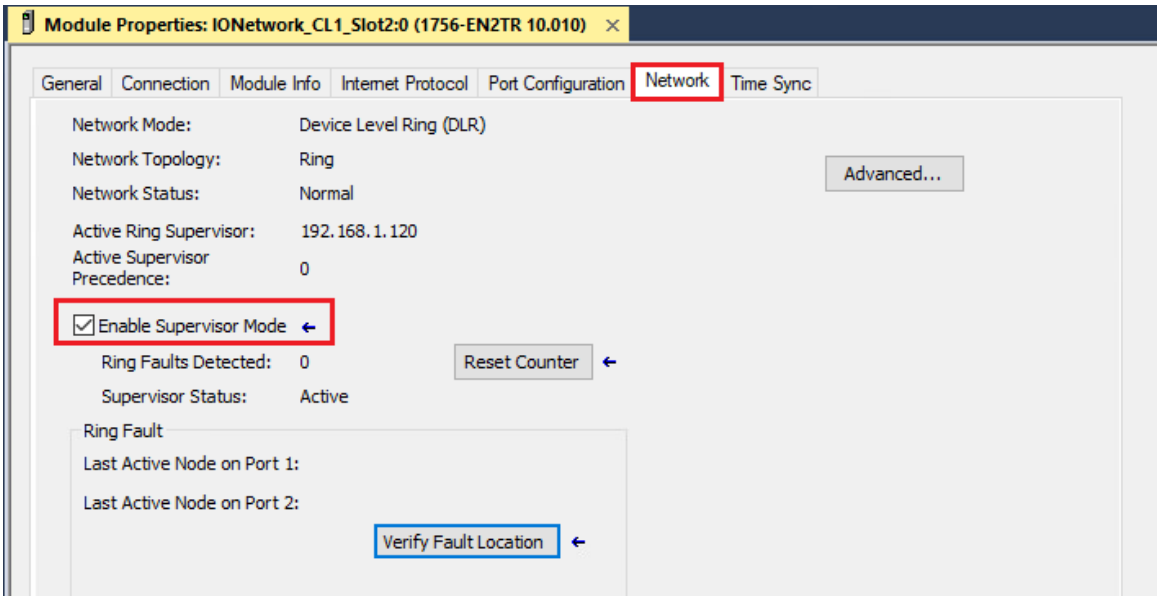
There must be one supervisor in the EtherNet/IP ring. In the topology RA01, this can be configured in the Ethernet module “1756-EN2TR” or in the Stratix switch 5400.

In this example, the supervisor mode is configured in the Ethernet module “1756-EN2TR” of the ControlLogix.

- In the project view, double-click on “1756-EN2TR NET”:



- This opens the ControlLogix Ethernet module Properties window. Select the tab “Network” and check that the option “Enable Supervisor Mode” is enabled:



3.5 Monitoring of Process Values and Status Information

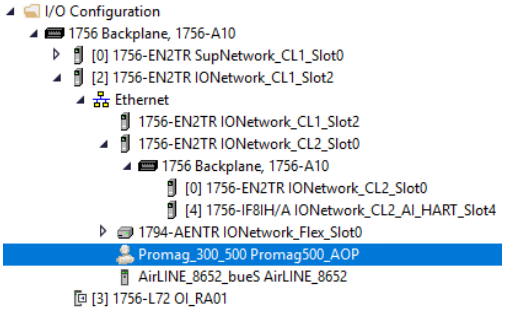
3.5.1 EtherNet/IP Data

This chapter explains where are displayed the EtherNet/IP online data of connected field devices, shown here for example with a Promag500 flowmeter and a valve island 8652 AirLINE:

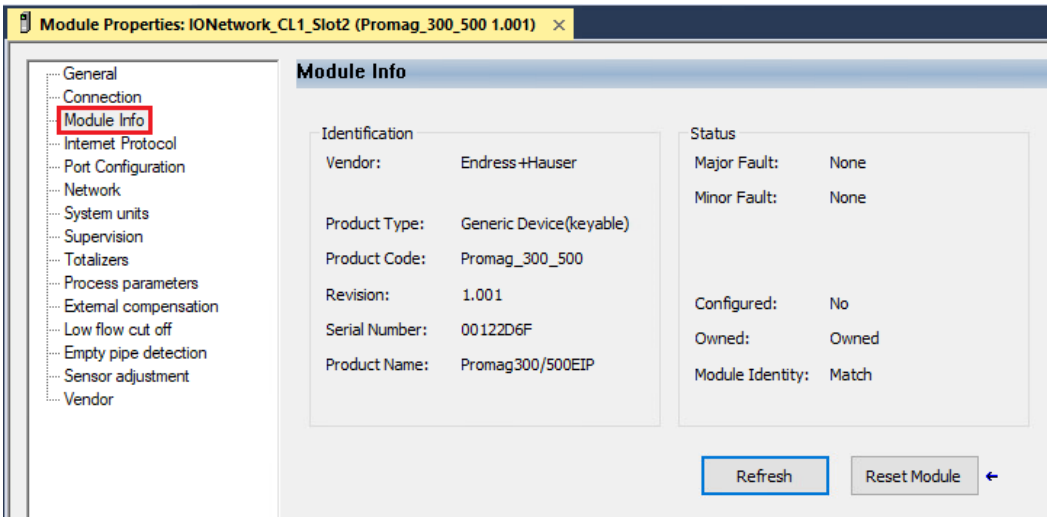
3.5.1.1 Promag500 EIP

3.5.1.1.1 Promag500 AOP

- Double-click on the Promag500:

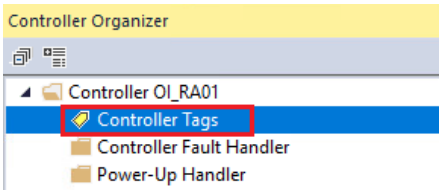


- Click for example on the tab “Module Info” to get device status:



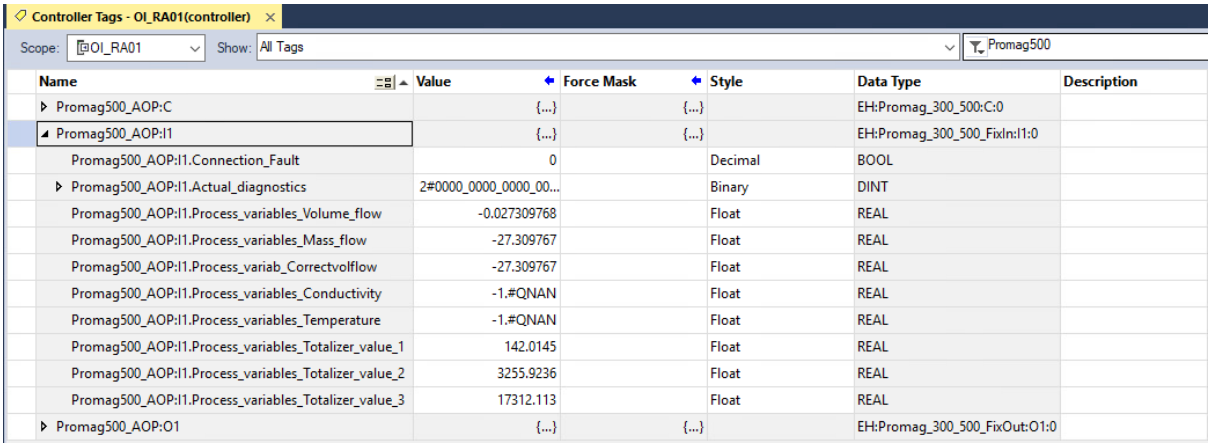
3.5.1.1.2 Promag500 Controller Tags

- Double-click on the field “Controller Tags” to open the table view and search for the Promag100:



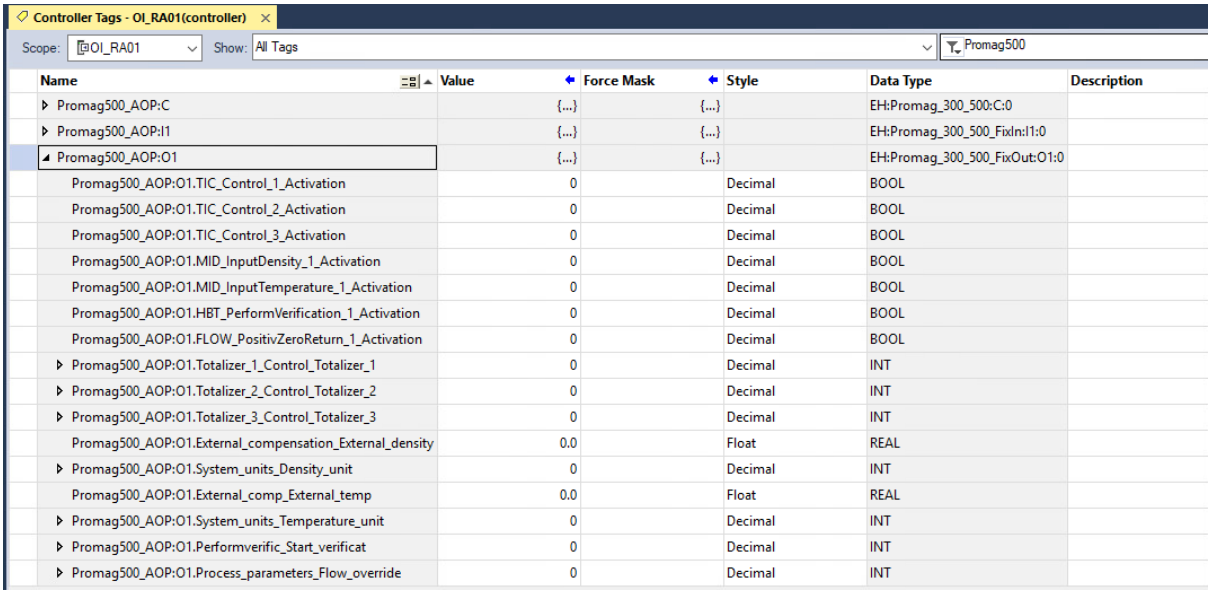
- Displayed variables correspond to these defined by the configured connection “Fix Input/Output + Configuration Assembly”:

Inputs:



Name	Value	Force Mask	Style	Data Type	Description
Promag500_AOP:C	{...}	{...}		EH:Promag_300_500:C:0	
Promag500_AOP:I1	{...}	{...}		EH:Promag_300_500_FixIn:I1:0	
Promag500_AOP:I1.Connection_Fault	0		Decimal	BOOL	
Promag500_AOP:I1.Actual_diagnostics	2#0000_0000_0000_00...		Binary	DINT	
Promag500_AOP:I1.Process_variables_Volume_flow	-0.027309768		Float	REAL	
Promag500_AOP:I1.Process_variables_Mass_flow	-27.309767		Float	REAL	
Promag500_AOP:I1.Process_variab_Correctvolflow	-27.309767		Float	REAL	
Promag500_AOP:I1.Process_variables_Conductivity	-1.#QNAN		Float	REAL	
Promag500_AOP:I1.Process_variables_Temperature	-1.#QNAN		Float	REAL	
Promag500_AOP:I1.Process_variables_Totalizer_value_1	142.0145		Float	REAL	
Promag500_AOP:I1.Process_variables_Totalizer_value_2	3255.9236		Float	REAL	
Promag500_AOP:I1.Process_variables_Totalizer_value_3	17312.113		Float	REAL	
Promag500_AOP:O1	{...}	{...}		EH:Promag_300_500_FixOut:O1:0	

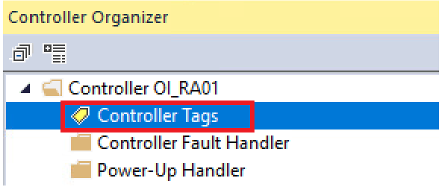
Outputs:



Name	Value	Force Mask	Style	Data Type	Description
Promag500_AOP:C	{...}	{...}		EH:Promag_300_500:C:0	
Promag500_AOP:I1	{...}	{...}		EH:Promag_300_500_FixIn:I1:0	
Promag500_AOP:O1	{...}	{...}		EH:Promag_300_500_FixOut:O1:0	
Promag500_AOP:O1.TIC_Control_1_Activation	0		Decimal	BOOL	
Promag500_AOP:O1.TIC_Control_2_Activation	0		Decimal	BOOL	
Promag500_AOP:O1.TIC_Control_3_Activation	0		Decimal	BOOL	
Promag500_AOP:O1.MID_InputDensity_1_Activation	0		Decimal	BOOL	
Promag500_AOP:O1.MID_InputTemperature_1_Activation	0		Decimal	BOOL	
Promag500_AOP:O1.HBT_PerformVerification_1_Activation	0		Decimal	BOOL	
Promag500_AOP:O1.FLOW_PositivZeroReturn_1_Activation	0		Decimal	BOOL	
Promag500_AOP:O1.Totalizer_1_Control_Totalizer_1	0		Decimal	INT	
Promag500_AOP:O1.Totalizer_2_Control_Totalizer_2	0		Decimal	INT	
Promag500_AOP:O1.Totalizer_3_Control_Totalizer_3	0		Decimal	INT	
Promag500_AOP:O1.External_compensation_External_density	0.0		Float	REAL	
Promag500_AOP:O1.System_units_Density_unit	0		Decimal	INT	
Promag500_AOP:O1.External_comp_External_temp	0.0		Float	REAL	
Promag500_AOP:O1.System_units_Temperature_unit	0		Decimal	INT	
Promag500_AOP:O1.Performverific_Start_verificat	0		Decimal	INT	
Promag500_AOP:O1.Process_parameters_Flow_override	0		Decimal	INT	

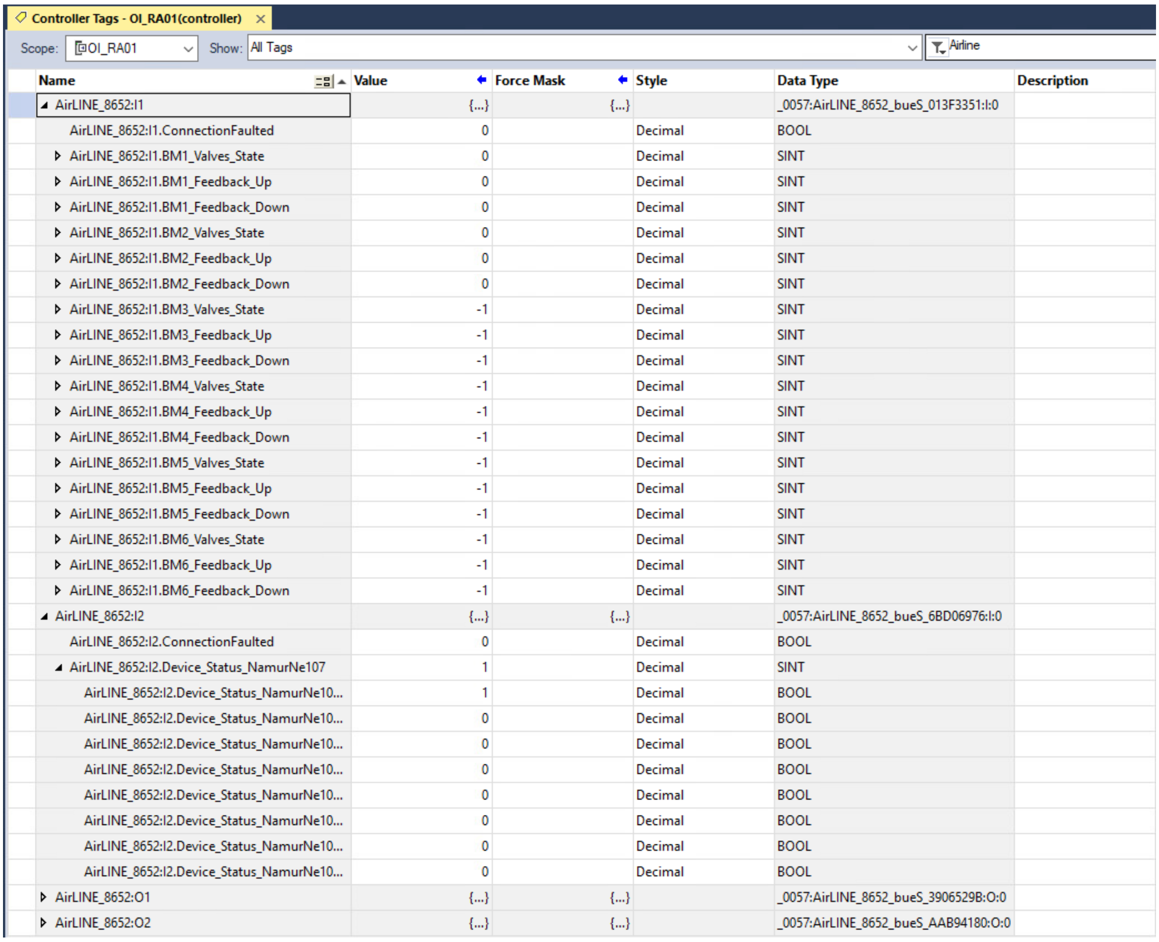
3.5.1.2 Valve Island 8652 AirLINE EIP

- Double-click on the field “Controller Tags” to open the table view and search for the AirLINE_8652:



- Displayed variables correspond to these defined by the configured connection “Connection1” and “Connection2”:

Inputs:



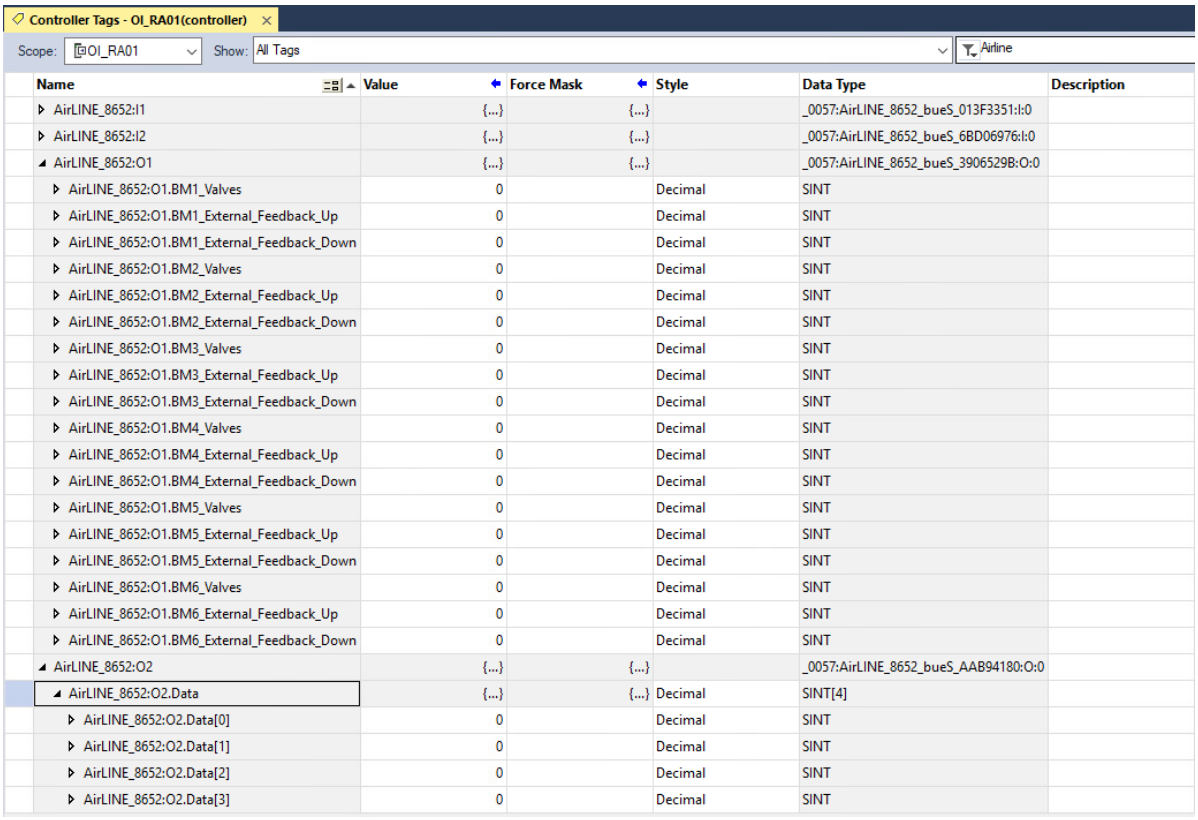
Controller Tags - OI_RA01(controller)

Scope: OI_RA01 Show: All Tags Airline

Name	Value	Force Mask	Style	Data Type	Description
AirLINE_8652:I1	{...}	{...}		_0057:AirLINE_8652_bueS_013F3351:I:0	
AirLINE_8652:I1.ConnectionFaulted	0		Decimal	BOOL	
AirLINE_8652:I1.BM1_Valves_State	0		Decimal	SINT	
AirLINE_8652:I1.BM1_Feedback_Up	0		Decimal	SINT	
AirLINE_8652:I1.BM1_Feedback_Down	0		Decimal	SINT	
AirLINE_8652:I1.BM2_Valves_State	0		Decimal	SINT	
AirLINE_8652:I1.BM2_Feedback_Up	0		Decimal	SINT	
AirLINE_8652:I1.BM2_Feedback_Down	0		Decimal	SINT	
AirLINE_8652:I1.BM3_Valves_State	-1		Decimal	SINT	
AirLINE_8652:I1.BM3_Feedback_Up	-1		Decimal	SINT	
AirLINE_8652:I1.BM3_Feedback_Down	-1		Decimal	SINT	
AirLINE_8652:I1.BM4_Valves_State	-1		Decimal	SINT	
AirLINE_8652:I1.BM4_Feedback_Up	-1		Decimal	SINT	
AirLINE_8652:I1.BM4_Feedback_Down	-1		Decimal	SINT	
AirLINE_8652:I1.BM5_Valves_State	-1		Decimal	SINT	
AirLINE_8652:I1.BM5_Feedback_Up	-1		Decimal	SINT	
AirLINE_8652:I1.BM5_Feedback_Down	-1		Decimal	SINT	
AirLINE_8652:I1.BM6_Valves_State	-1		Decimal	SINT	
AirLINE_8652:I1.BM6_Feedback_Up	-1		Decimal	SINT	
AirLINE_8652:I1.BM6_Feedback_Down	-1		Decimal	SINT	
AirLINE_8652:I2	{...}	{...}		_0057:AirLINE_8652_bueS_6BD06976:I:0	
AirLINE_8652:I2.ConnectionFaulted	0		Decimal	BOOL	
AirLINE_8652:I2.Device_Status_NamurNe107	1		Decimal	SINT	
AirLINE_8652:I2.Device_Status_NamurNe10...	1		Decimal	BOOL	
AirLINE_8652:I2.Device_Status_NamurNe10...	0		Decimal	BOOL	
AirLINE_8652:I2.Device_Status_NamurNe10...	0		Decimal	BOOL	
AirLINE_8652:I2.Device_Status_NamurNe10...	0		Decimal	BOOL	
AirLINE_8652:I2.Device_Status_NamurNe10...	0		Decimal	BOOL	
AirLINE_8652:I2.Device_Status_NamurNe10...	0		Decimal	BOOL	
AirLINE_8652:I2.Device_Status_NamurNe10...	0		Decimal	BOOL	
AirLINE_8652:I2.Device_Status_NamurNe10...	0		Decimal	BOOL	
AirLINE_8652:O1	{...}	{...}		_0057:AirLINE_8652_bueS_3906529B:O:0	
AirLINE_8652:O2	{...}	{...}		_0057:AirLINE_8652_bueS_AAB94180:O:0	

In this example, data structure AirLINE_8652:I1 corresponds to Connection1 Inputs and data structure AirLINE_8652:I2 corresponds to Connection2 Inputs.

Outputs:



Name	Value	Force Mask	Style	Data Type	Description
AirLINE_8652:I1	{...}	{...}		_0057:AirLINE_8652_bueS_013F3351:I:0	
AirLINE_8652:I2	{...}	{...}		_0057:AirLINE_8652_bueS_6BD06976:I:0	
AirLINE_8652:O1	{...}	{...}		_0057:AirLINE_8652_bueS_3906529B:O:0	
AirLINE_8652:O1.BM1_Valves	0		Decimal	SINT	
AirLINE_8652:O1.BM1_External_Feedback_Up	0		Decimal	SINT	
AirLINE_8652:O1.BM1_External_Feedback_Down	0		Decimal	SINT	
AirLINE_8652:O1.BM2_Valves	0		Decimal	SINT	
AirLINE_8652:O1.BM2_External_Feedback_Up	0		Decimal	SINT	
AirLINE_8652:O1.BM2_External_Feedback_Down	0		Decimal	SINT	
AirLINE_8652:O1.BM3_Valves	0		Decimal	SINT	
AirLINE_8652:O1.BM3_External_Feedback_Up	0		Decimal	SINT	
AirLINE_8652:O1.BM3_External_Feedback_Down	0		Decimal	SINT	
AirLINE_8652:O1.BM4_Valves	0		Decimal	SINT	
AirLINE_8652:O1.BM4_External_Feedback_Up	0		Decimal	SINT	
AirLINE_8652:O1.BM4_External_Feedback_Down	0		Decimal	SINT	
AirLINE_8652:O1.BM5_Valves	0		Decimal	SINT	
AirLINE_8652:O1.BM5_External_Feedback_Up	0		Decimal	SINT	
AirLINE_8652:O1.BM5_External_Feedback_Down	0		Decimal	SINT	
AirLINE_8652:O1.BM6_Valves	0		Decimal	SINT	
AirLINE_8652:O1.BM6_External_Feedback_Up	0		Decimal	SINT	
AirLINE_8652:O1.BM6_External_Feedback_Down	0		Decimal	SINT	
AirLINE_8652:O2	{...}	{...}		_0057:AirLINE_8652_bueS_AAB94180:O:0	
AirLINE_8652:O2.Data	{...}	{...}	Decimal	SINT[4]	
AirLINE_8652:O2.Data[0]	0		Decimal	SINT	
AirLINE_8652:O2.Data[1]	0		Decimal	SINT	
AirLINE_8652:O2.Data[2]	0		Decimal	SINT	
AirLINE_8652:O2.Data[3]	0		Decimal	SINT	

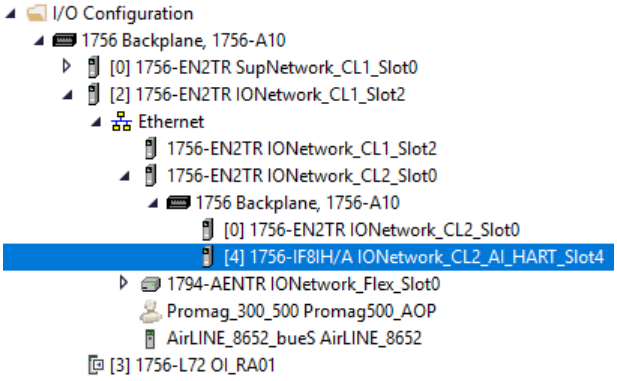
In this example, data structure AirLINE_8652:O1 corresponds to Connection1 Outputs and data structure AirLINE_8652:O2 corresponds to Connection2 Outputs.

3.5.2 HART Data

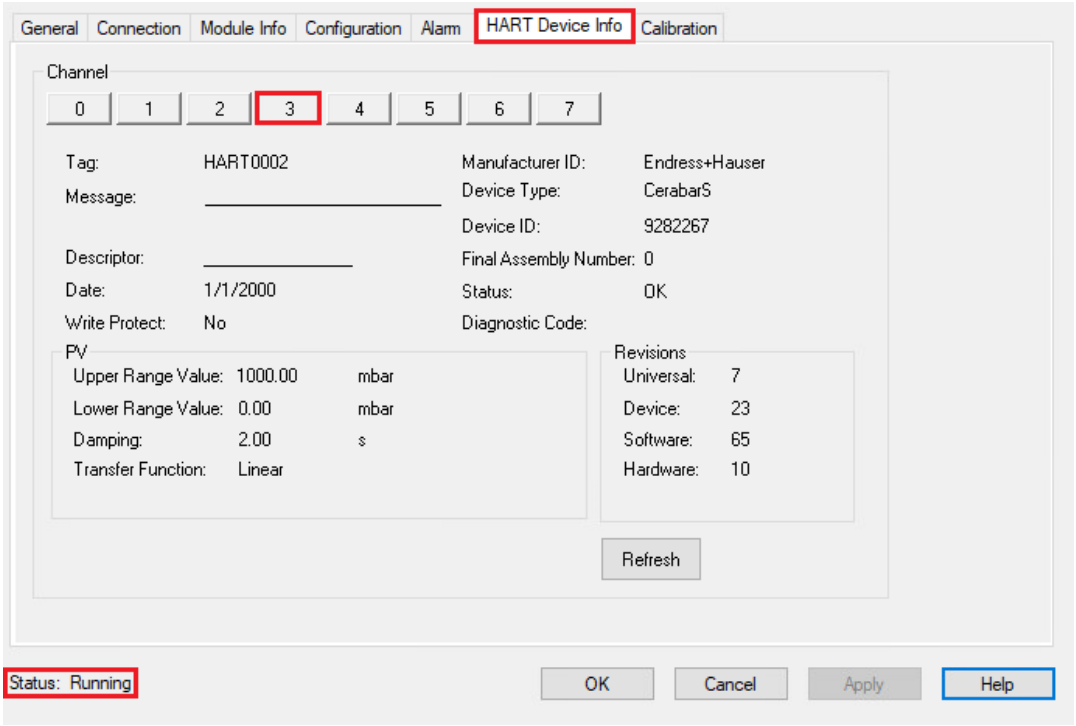
3.5.2.1 ControlLogix I/O Analog Input 1756-IF8IH

3.5.2.1.1 ControlLogix I/O AOP

- Double-click on the Controller “IONetwork_CL2_AI_HART_Slot4”:



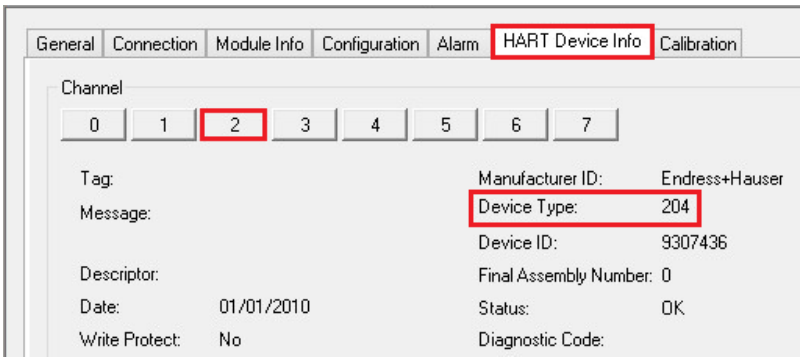
- Select the tab “HART Device Info” to display the device HART settings:



In this example, Channel3 is selected. Main information of HART CMD0 are displayed.

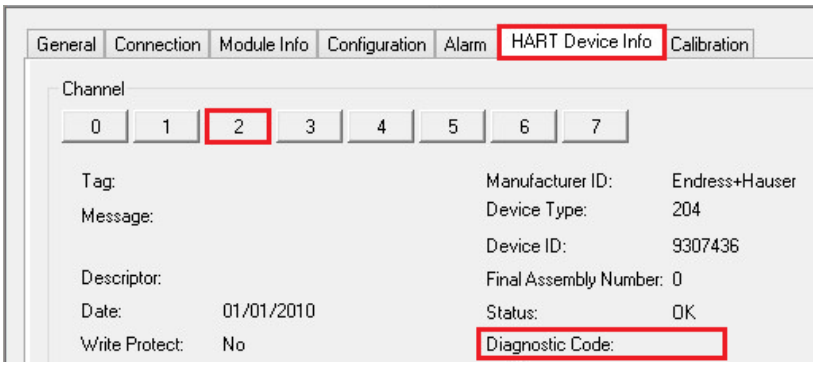
Remarks

- The device Type “DeltabarS” in this example is displayed as a name. For some devices, there could be that a decimal value is displayed:



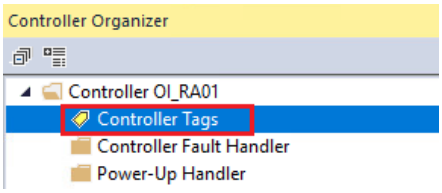
In this example, the device type is ”204”, which corresponds to “0x00CC” (TMT82).

- No Diagnostic Code is displayed when no errors:



3.5.2.1.2 ControlLogix I/O Controller Tags

- Double-click on the field “Controller Tags” to open the table view and search for the 1756 HART input module:



In this data structure can be found the 4..20mA signal as well the HART process data PV, SV, TV and FV with their corresponding Status 0xC0 (0xC0= Good).

Controller Tags - OI_RA01(controller)

Scope: OI_RA01 Show: All Tags CL2

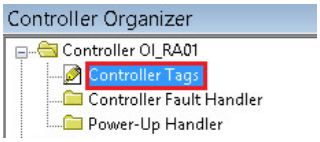
Name	Value	Force Mask	Style	Data Type
IONetwork_CL2_Slot0:4:C	{...}	{...}		AB:1756_IF8IH:C:0
IONetwork_CL2_Slot0:4:I	{...}	{...}		AB:1756_IF8H_AnalogHARTbyChannel...
IONetwork_CL2_Slot0:4:I.ChannelFaults	2#0000_0000_0000_01...		Binary	INT
IONetwork_CL2_Slot0:4:I.Ch0Fault	0		Decimal	BOOL
IONetwork_CL2_Slot0:4:I.Ch1Fault	0		Decimal	BOOL
IONetwork_CL2_Slot0:4:I.Ch2Fault	1		Decimal	BOOL
IONetwork_CL2_Slot0:4:I.Ch3Fault	0		Decimal	BOOL
IONetwork_CL2_Slot0:4:I.Ch4Fault	0		Decimal	BOOL
IONetwork_CL2_Slot0:4:I.Ch5Fault	0		Decimal	BOOL
IONetwork_CL2_Slot0:4:I.Ch6Fault	0		Decimal	BOOL
IONetwork_CL2_Slot0:4:I.Ch7Fault	0		Decimal	BOOL
IONetwork_CL2_Slot0:4:I.ModuleFaults	2#0000_0000		Binary	SINT
IONetwork_CL2_Slot0:4:I.CalFault	0		Decimal	BOOL
IONetwork_CL2_Slot0:4:I.Calibrating	0		Decimal	BOOL
IONetwork_CL2_Slot0:4:I.UpdatedStatusReady	0		Decimal	BOOL
IONetwork_CL2_Slot0:4:I.AnalogGroupFault	0		Decimal	BOOL
IONetwork_CL2_Slot0:4:I.Ch0	{...}	{...}		AB:1756_IF8H_HARTDataAll_Struct:I:0
IONetwork_CL2_Slot0:4:I.Ch1	{...}	{...}		AB:1756_IF8H_HARTDataAll_Struct:I:0
IONetwork_CL2_Slot0:4:I.Ch2	{...}	{...}		AB:1756_IF8H_HARTDataAll_Struct:I:0
IONetwork_CL2_Slot0:4:I.Ch3	{...}	{...}		AB:1756_IF8H_HARTDataAll_Struct:I:0
IONetwork_CL2_Slot0:4:I.Ch4	{...}	{...}		AB:1756_IF8H_HARTDataAll_Struct:I:0
IONetwork_CL2_Slot0:4:I.Ch4.Data	-1.093338		Float	REAL
IONetwork_CL2_Slot0:4:I.Ch4.DeviceStatus	{...}	{...}		AB:1756_IF8H_HARTStatusAll_Struct:I:0
IONetwork_CL2_Slot0:4:I.Ch4.PV	-1.073049		Float	REAL
IONetwork_CL2_Slot0:4:I.Ch4.SV	27.024193		Float	REAL
IONetwork_CL2_Slot0:4:I.Ch4.TV	23.0		Float	REAL
IONetwork_CL2_Slot0:4:I.Ch4.FV	0.0		Float	REAL
IONetwork_CL2_Slot0:4:I.Ch4.PVStatus	16#c0		Hex	SINT
IONetwork_CL2_Slot0:4:I.Ch4.SVStatus	16#c0		Hex	SINT
IONetwork_CL2_Slot0:4:I.Ch4.TVStatus	16#c0		Hex	SINT
IONetwork_CL2_Slot0:4:I.Ch4.FVStatus	16#00		Hex	SINT

Please refer to the 1756-IF8IH user manual for more details of all displayed parameters.

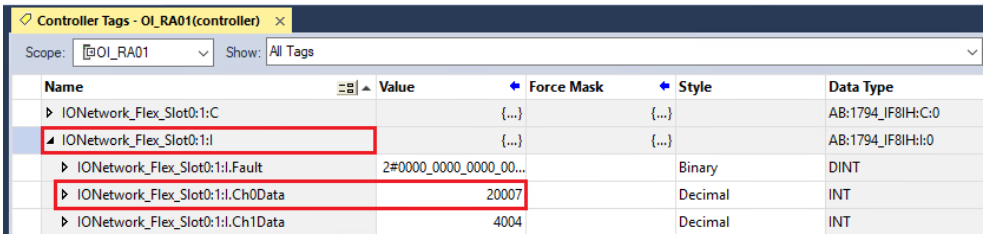
3.5.2.2 Flex I/O Analog Input 1794-IF8IH

Flex I/O HART Data are only available in the Controller Tags.

- Double-click on the field “Controller Tags” to open the table view and search for the 1794 HART input module:

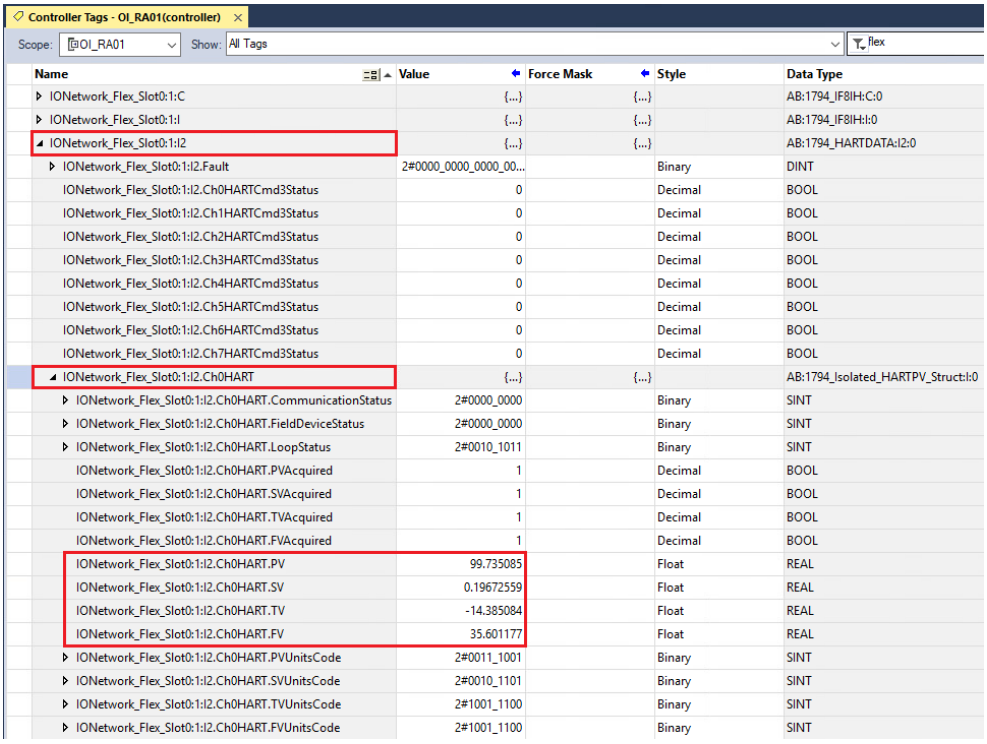


- Expand the Flex I/O analog input card Tag “IONetwork_Flex_Slot0:1:I” and look for a channel’s “Data” parameter to display the 4...20mA value, e.g. for channel 0:



Displayed values from 4000 to 20000 correspond to 4 to 20mA.

- Expand the “IONetwork_Flex_Slot0:1:I2” to display the corresponding HART process data:



- This displays the four HART data PV, SV, TV and QV. Please refer to the 1794-IF8IH user manual for more details.

4 Specific Integration

This chapter describes the implementation of Add On Instructions (AOI) and faceplates with Endress+Hauser field devices.

4.1 Add On Instructions

- The AOI is a specific source code delivered from Rockwell. The AOI uses the information of the AOP and converts them in a specific data structure needed later for the faceplates.

4.1.1 AOI Library

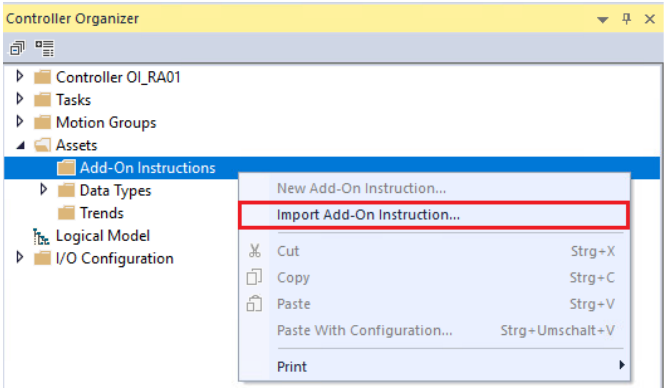
- The table below is specific for our example and shows the used AOI for ControlLogix I/O, Flex I/O and EtherNet/IP devices:

Device Protocol	RA_EH_Integration_Objects_v4.10.00				
	HART Input Card	AOI Module	HART Standard AOI	EtherNet/IP Specific AOI	EtherNet/IP Device AOI
HART	ControlLogix IO	I_1756IF8IH_4.10.00_AOI.L5X	P_AInHART_4.10.00_AOI.L5X		
	FlexIO	I_1794IF8IH_4.10.00_AOI.L5X	P_AInHART_4.10.00_AOI.L5X		
EtherNet/IP				I_EH_Flowmeter_4.10.00_AOI.L5X	I_EH_Promag100_FW2_4.10.00_AOI.L5X
					I_EH_Promass100_FW3_4.10.00_AOI.L5X
					I_EH_Promag300_500_4.10.00_AOI.L5X
					I_EH_Promass300_500_4.10.00_AOI.L5X
				I_EH_Heartbeat_4.10.00_AOI.L5X	
				I_EH_Sensor_4.10.00_AOI.L5X	

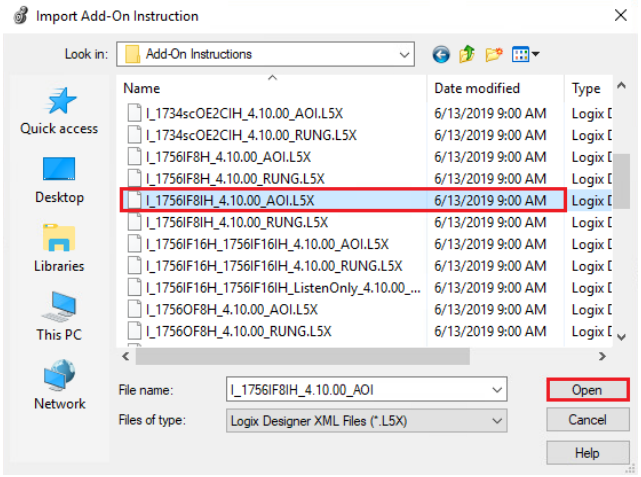
All these AOIs are part of the library “RA_EH_Integration_Objetcs_v4.10.01” and need at first to be imported.

Steps to import an AOI:

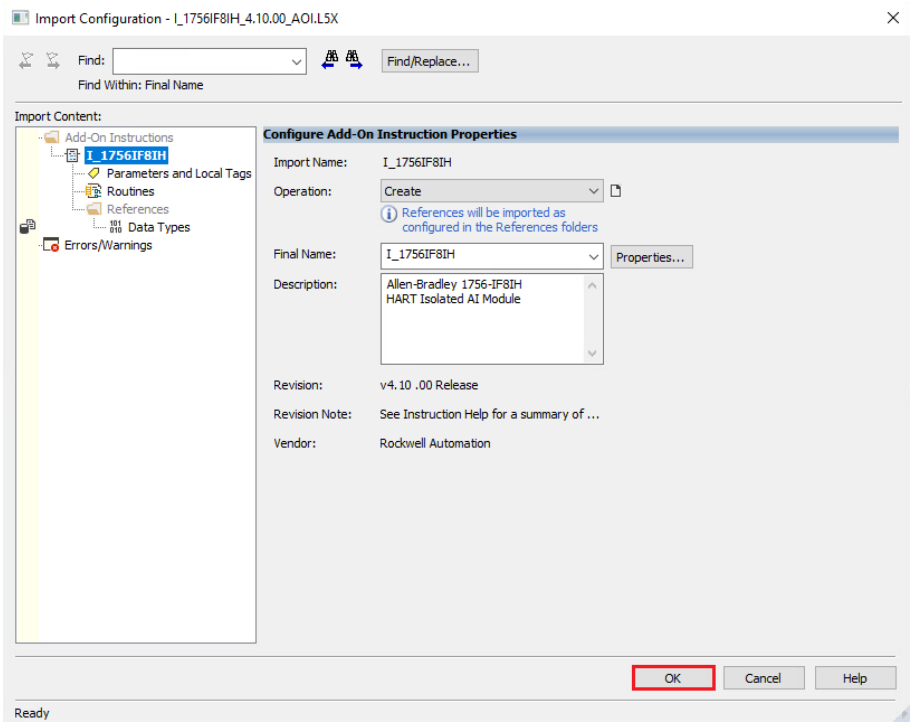
- In the project view, right-click on “Add-On Instructions” and select the menu “Import Add-On Instruction...”:



- In the Rockwell Process Library, search the AOI “I_1756IF8IH_3_5-01_AOI.L5X” of the “1756-IF8IH” card and click on the button “Open”:

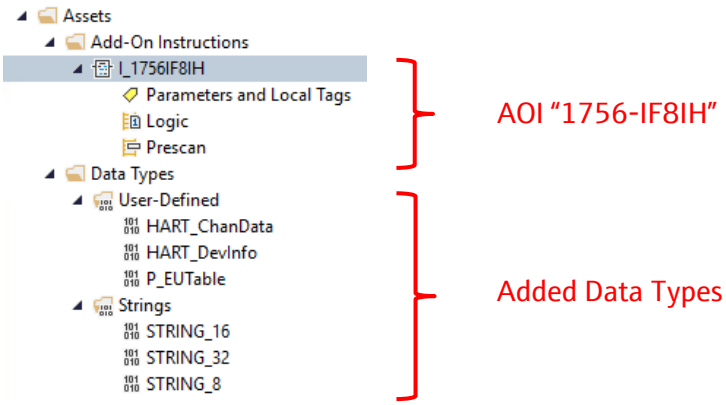


- This opens following window:

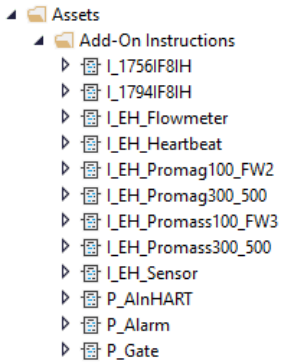


Click on the button “OK”.

- AOI has been successfully imported:



- Use the same method as done for the AOI "I_1756IF8IH" to import the other required AOIs:



4.1.2 AOI Integration for HART devices connected on ControlLogix I/O

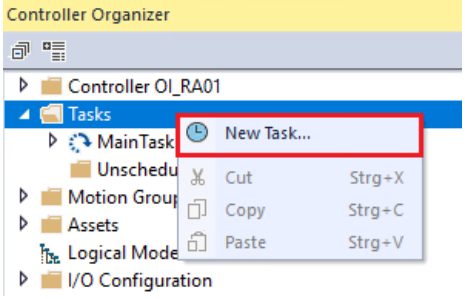
The AOI integration for a HART device requires the use of two AOI, the first one related to the HART analog input module and the second one to the device.

The following example explains how implementing AOI for the ControlLogix I/O by using the AOI "I_1756IF8IH" and "P_AinHART".

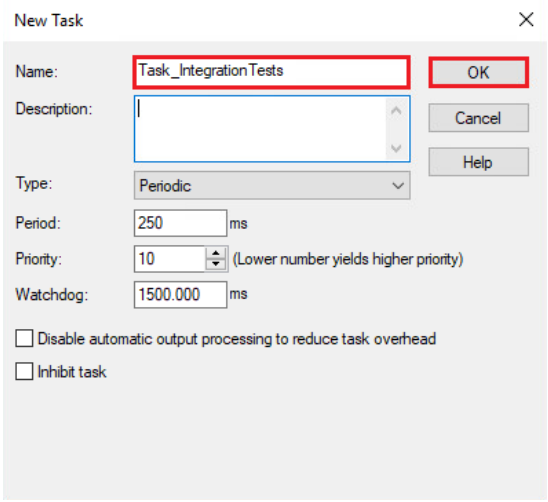
4.1.2.1 New Task

In the project view, create a new task, in which will be configured the program.

- Right-click on the field "Tasks" and select the menu "New Task...":

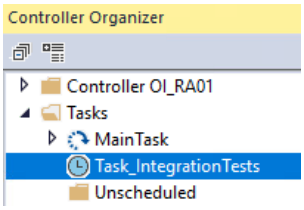


- In the new Task window enter a name and configure “Period” and “Watchdog” settings:



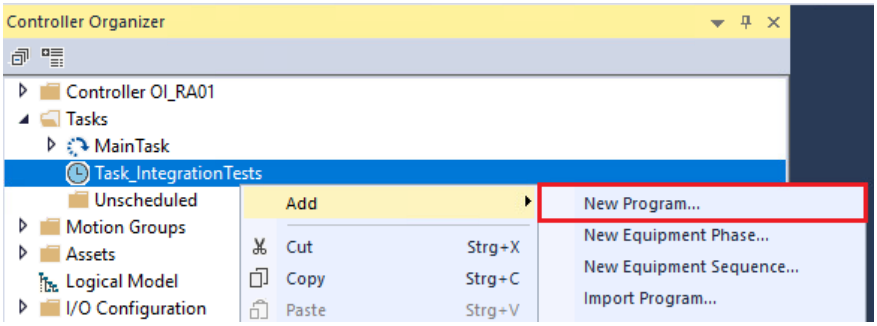
Click on the button “OK”.

- New task is inserted in the project:

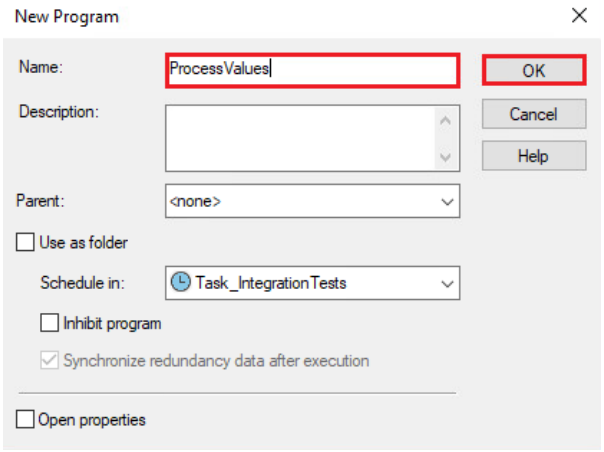


4.1.2.2 New Program

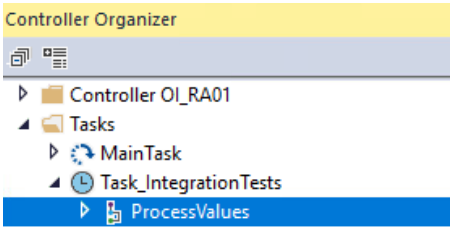
- Right-click on the created Task “Task_IntegrationTests” and select the menu “Add→New Program...”:



- Enter a name and click on the button “OK”:



- New program is added in the project view:



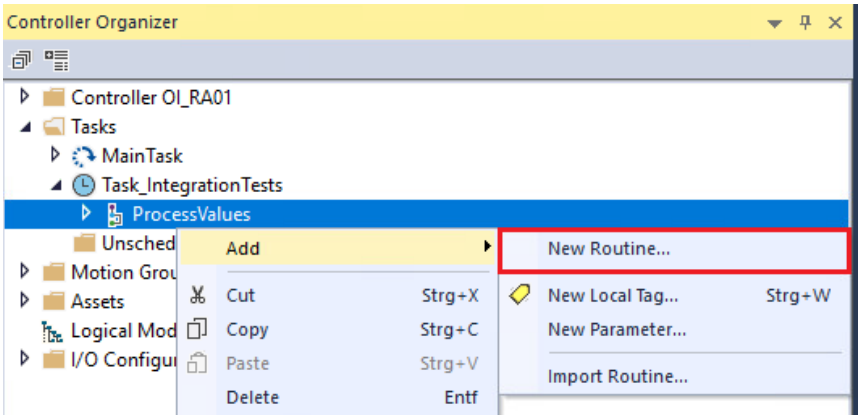
4.1.2.3 New Routines

Three routines are created in this example: “mainRoutine”, “r_1756IF8IH_CL2_Slot4” and “r_1756IF8IH_CL2_Slot4_Channels”.

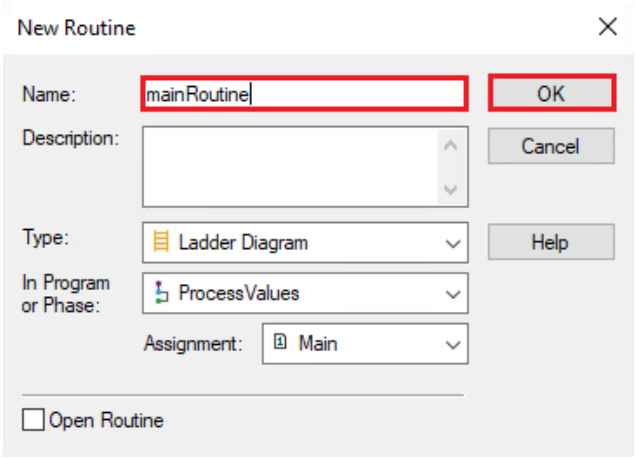
4.1.2.3.1 Routines Creation

Main Routine

- Right-click on the program “ProcessValues” and select the menu “Add→New Routine…”:

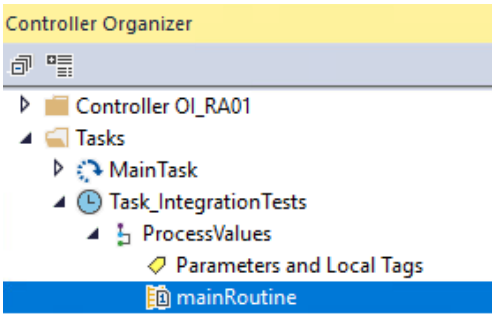


- Enter a name and choose the language type:



Click on the button “OK”.

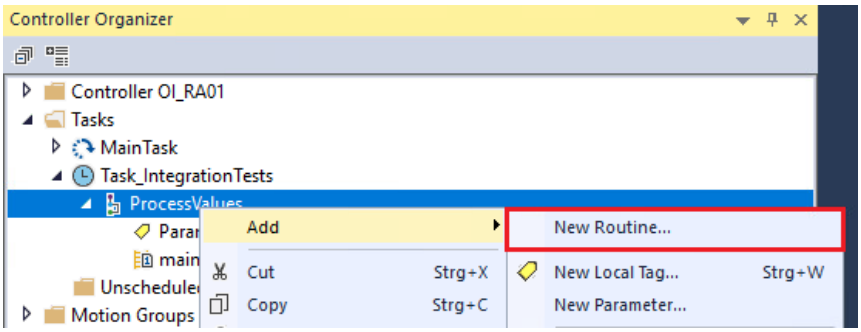
- This adds the routine in the project view:



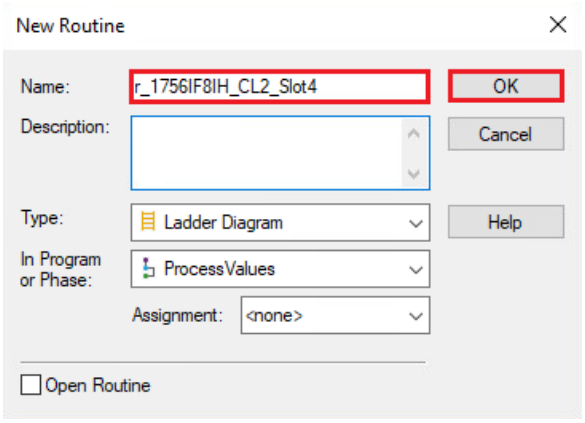
The main routine is marked with the symbol “1”.

Routine for the analog input card 1756-IF8IH module

- Right-click on the program “ProcessValues” and select the menu “Add→New Routine...”:

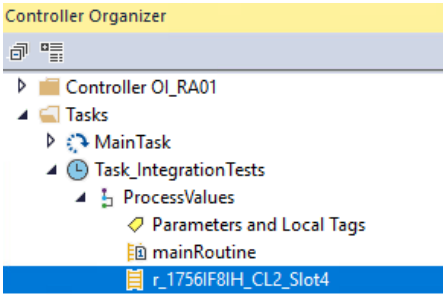


- Enter a name and choose the language type:



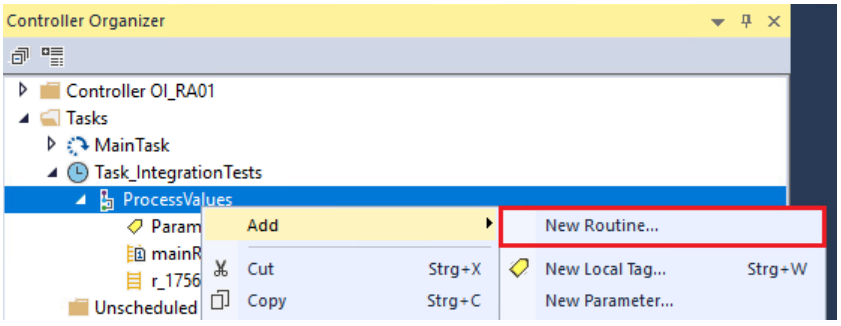
Click on the button “OK”.

- This adds the routine in the project view:

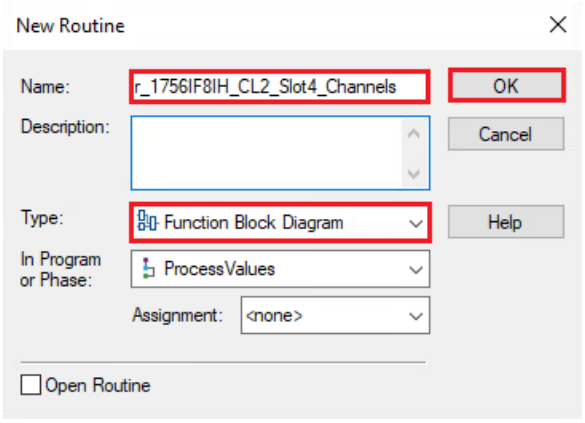


Routine for P_AinHART

- Right-click on the program “ProcessValues” and select the menu “Add→New Routine...”:

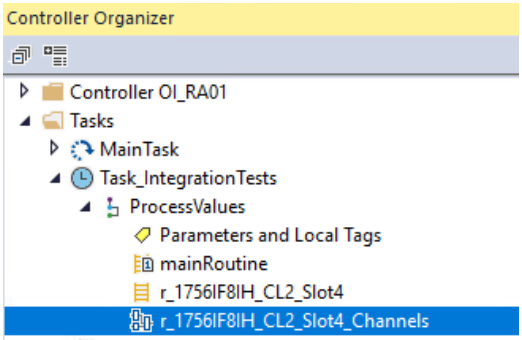


- Enter a name and choose the language type:



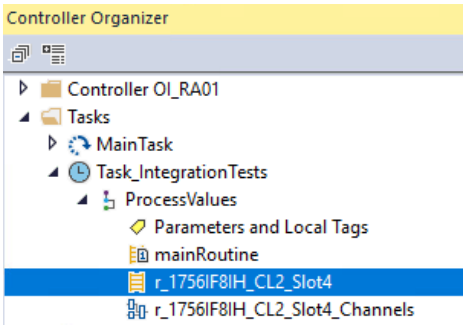
Click on the button “OK”.

- This adds the routine in the project view:

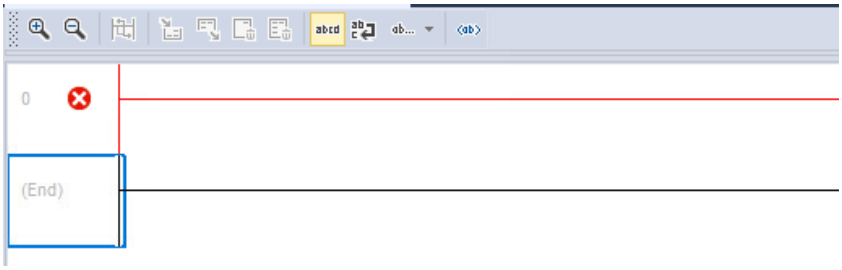


4.1.2.3.2 ControlLogix 1756 IF8IH Routine Configuration

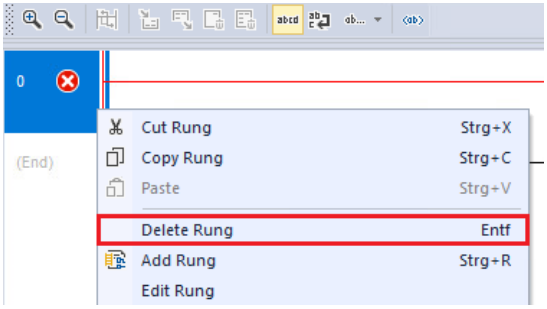
- Double-click on the routine “r_1756IF8IH_CL2_Slot4”:



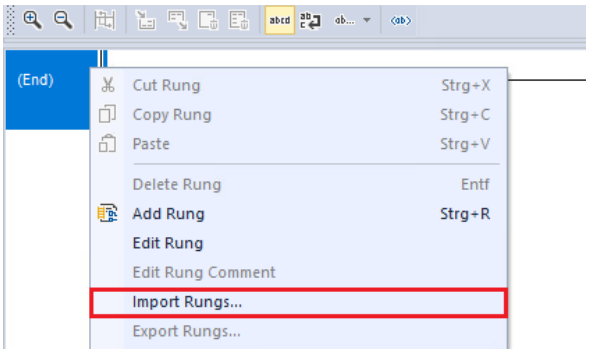
- This opens the Ladder routine “routine_1756_IF8IH”:



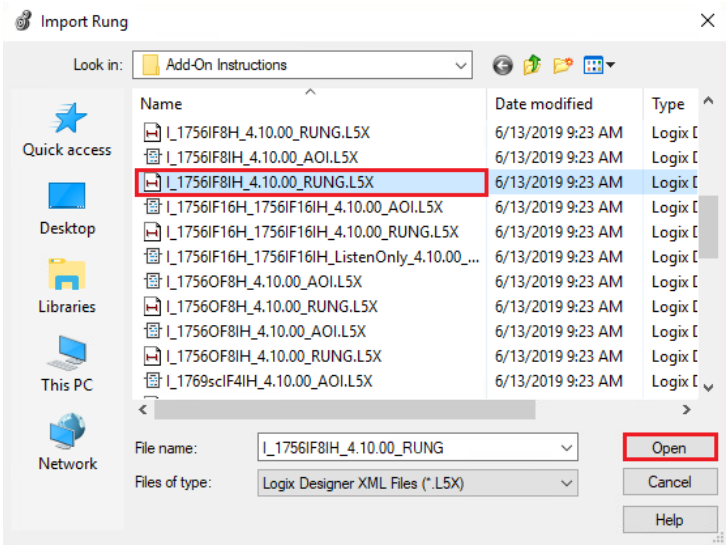
- In this example, delete the rung 0. Right-click on the rung 0 and select the option “Delete”:



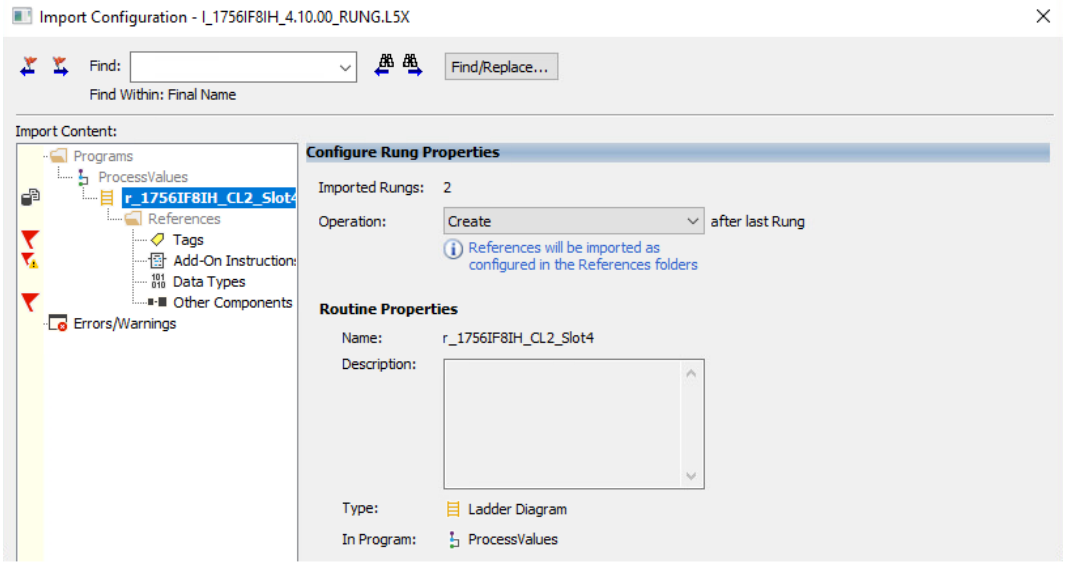
- Right-click on “End” and select the menu “Import Rungs...”:



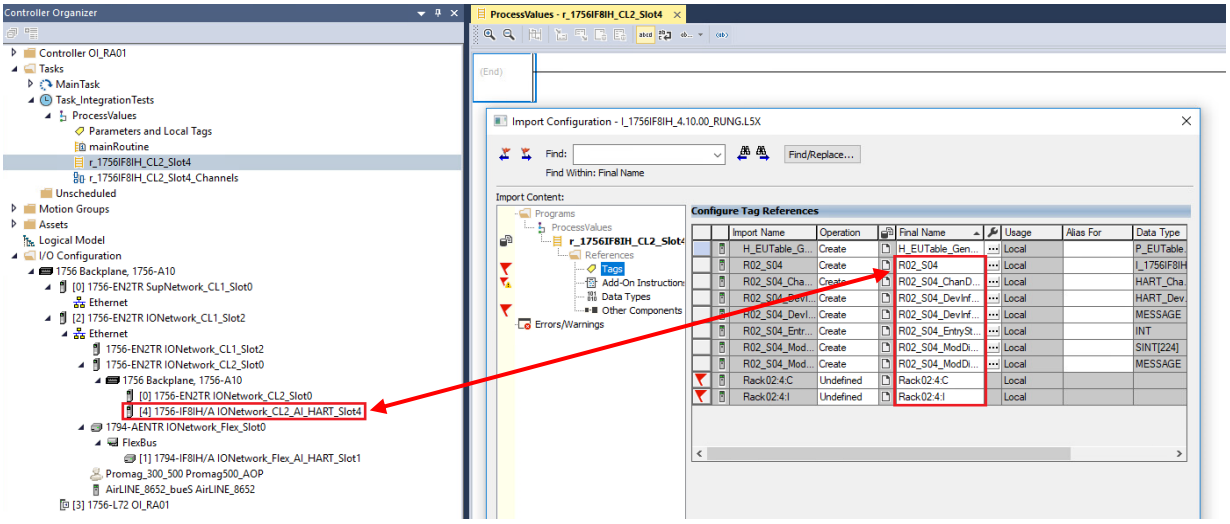
- Select the rung "I_1756IF8IH_3_5-01_RUNG.L5X":



- This opens following window:

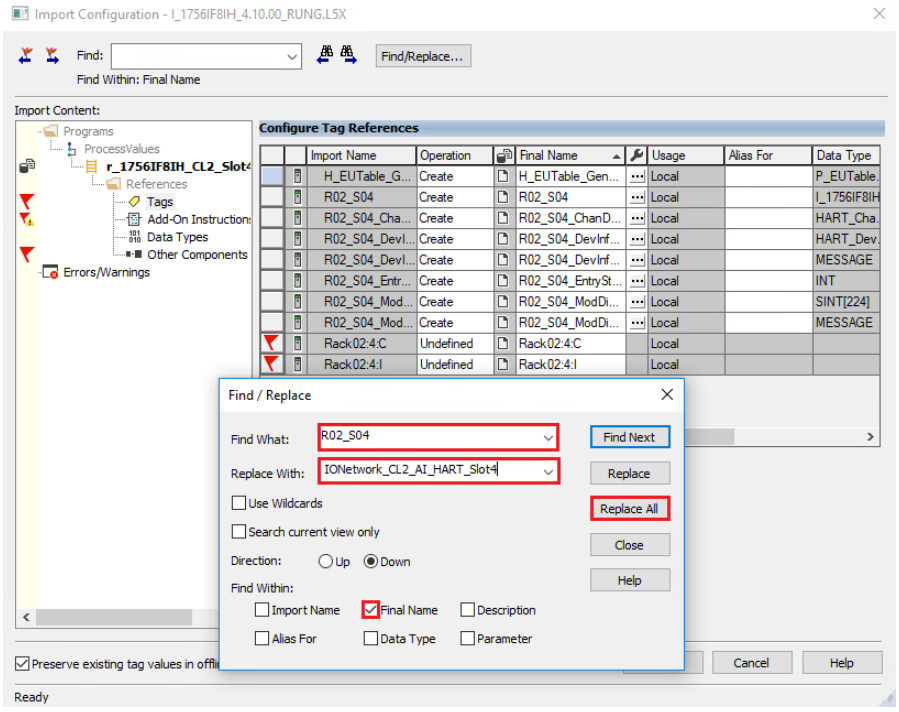


- Click on the field “Tags”:

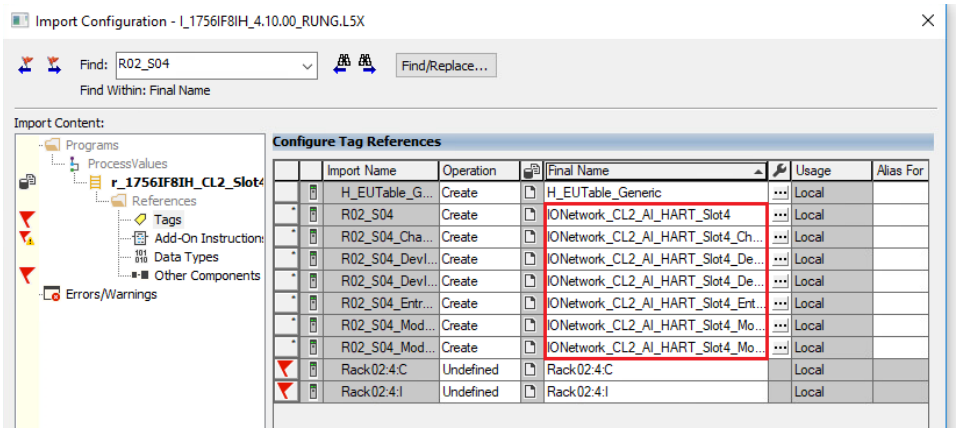


Update the “Final Name” variables according to the project architecture. In this example, the names will correspond to the card “1756-IF8IH” with Tag “IONetwork_CL2_AI_HART_Slot4”.

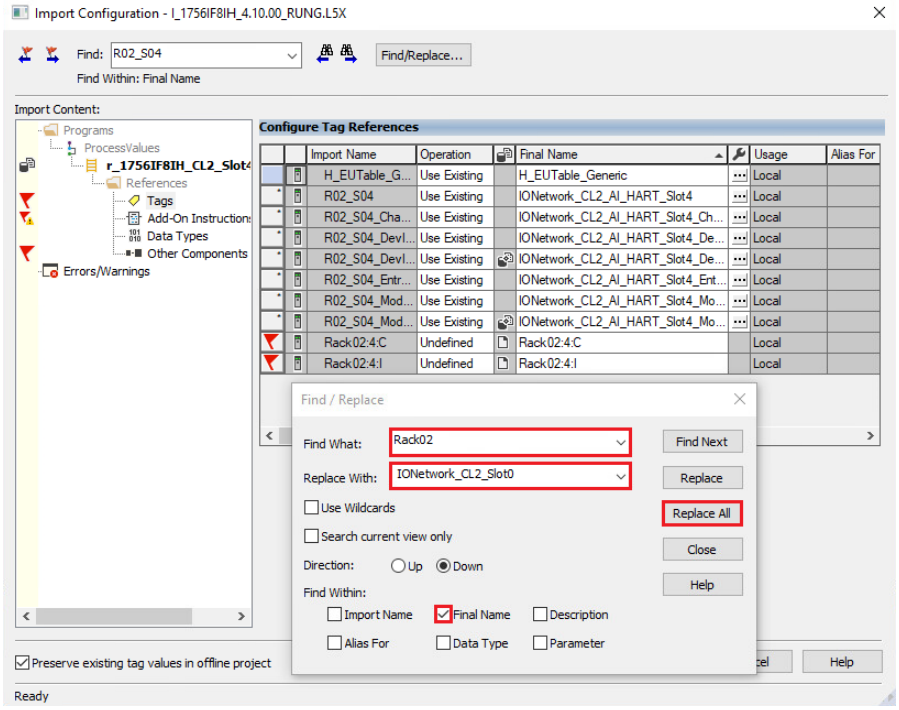
- Click on the button “Find/Replace…” and change the name of all “R02*” variables:



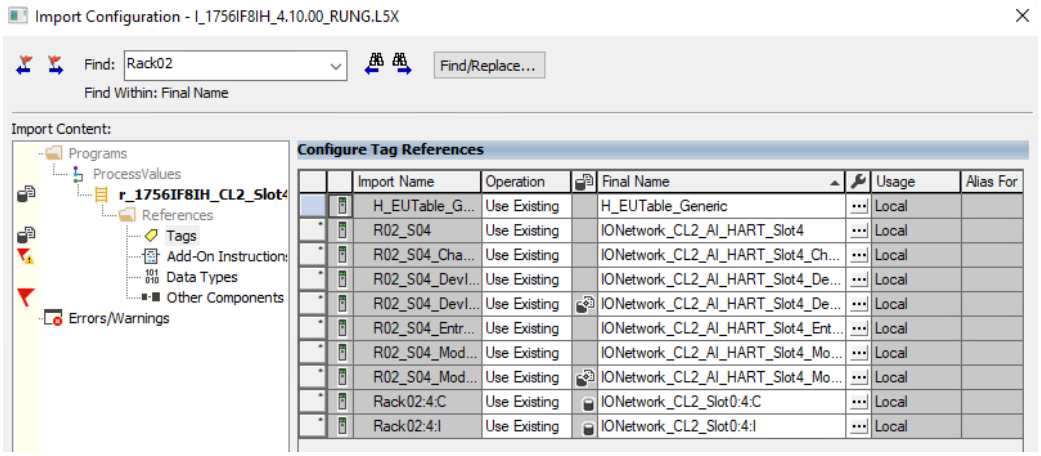
- Replaced data:



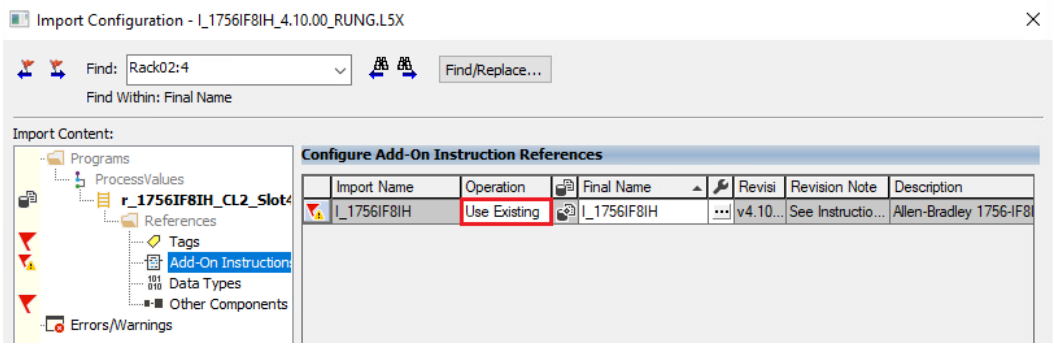
- Click on the button “Find/Replace...” and change the name of all “Rack02” and “Rack02” variables and replace it with “IONetwork_CL2_Slot0”:



- Replaced data:

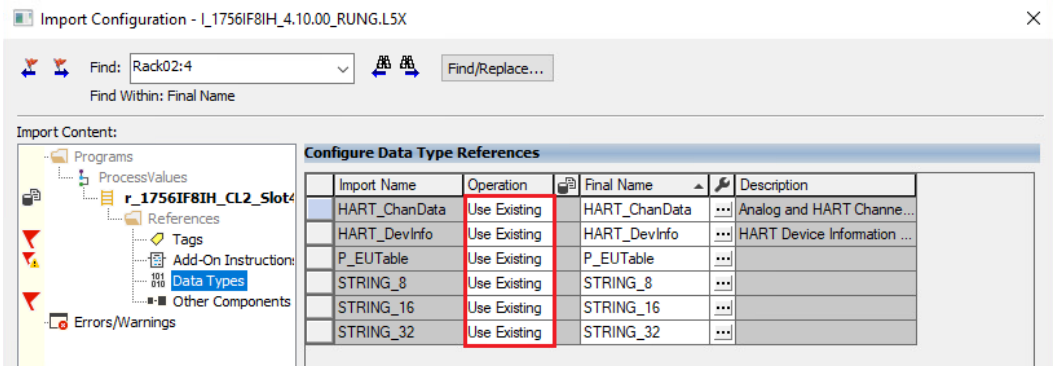


- Select the field “Add On Instruction” and select one Operation option, either “Create” when this is not existing or “Use Existing” or “Overwrite”:



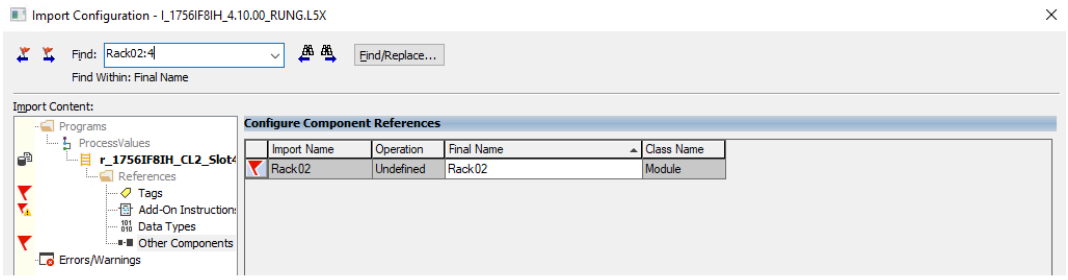
In this example, the option “Use existing” is selected.

- Select the field “Data Types” and select one Operation option, either “Create” when this is not existing or “Use Existing” or “Overwrite”:



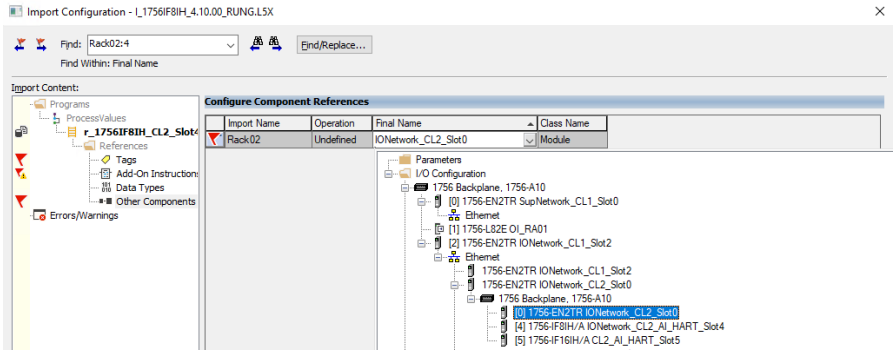
In this example, the option “Use existing” is selected.

- Select the field “Other Components” to proceed to the “Final Name” variables update:



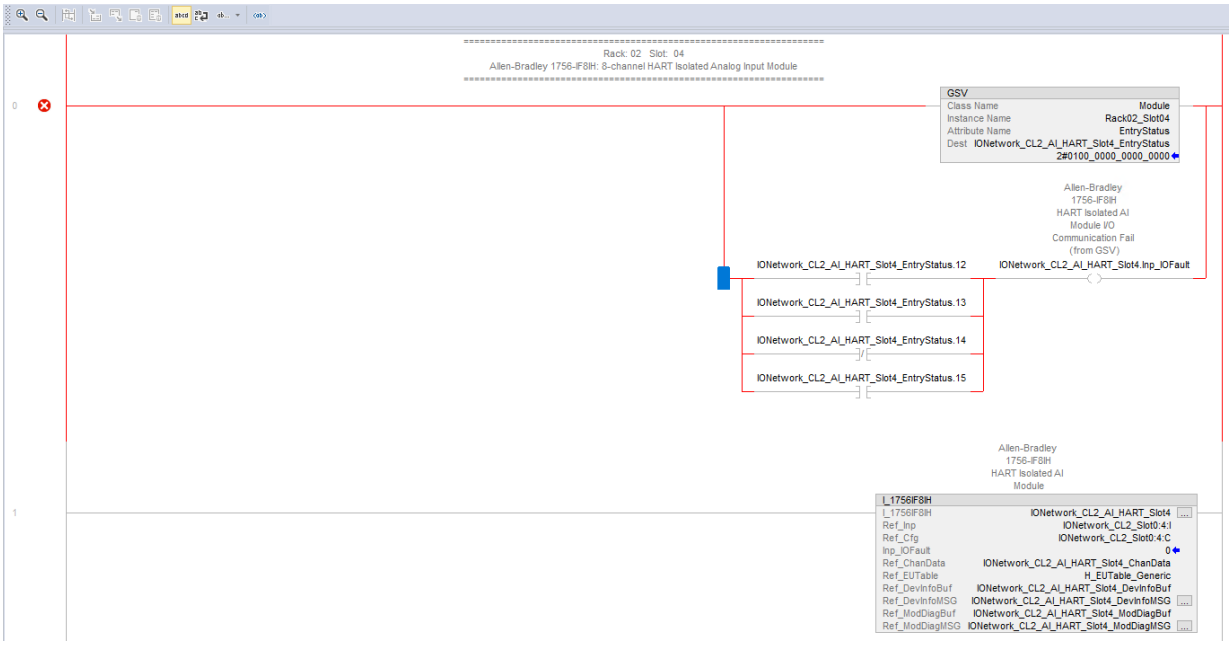
The reference “Rack02” corresponds to the communication module. In our example, this is the card “1756-EN2TR” (with Tag “IONetwork_CL2_Slot0”).

- Click on the list box of the first variable and select the Tag “IONetwork_CL2_Slot0”:

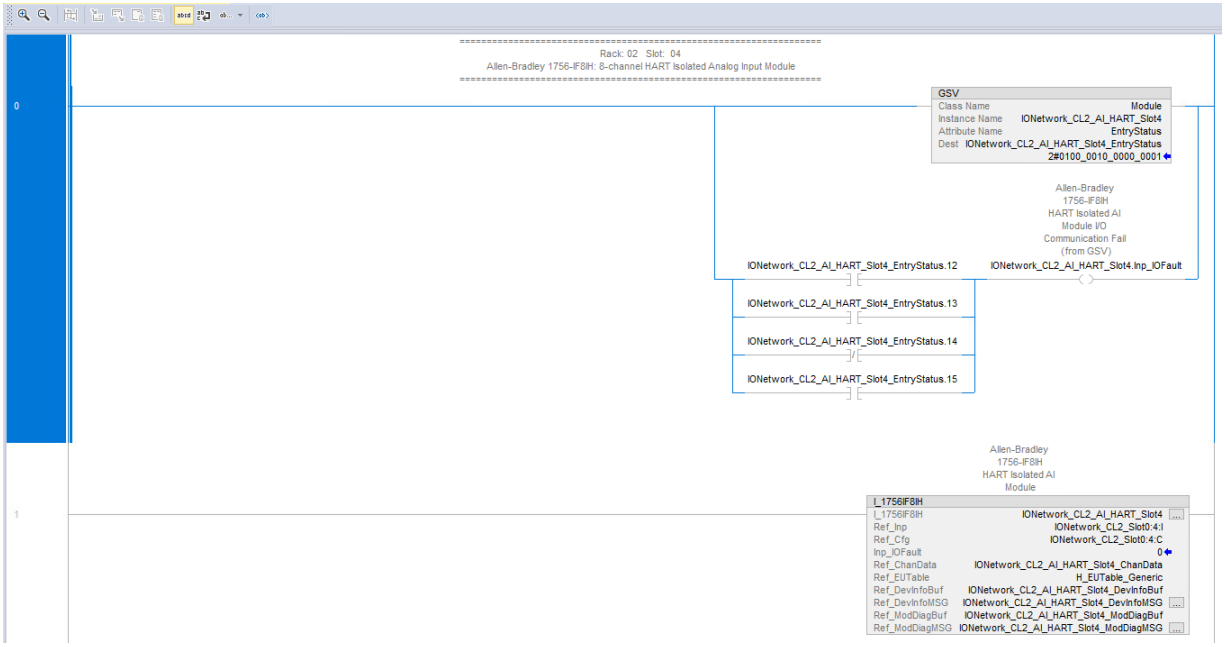


- Click on the button “OK” to save the configuration:

- Rung has been successfully imported in the routine:

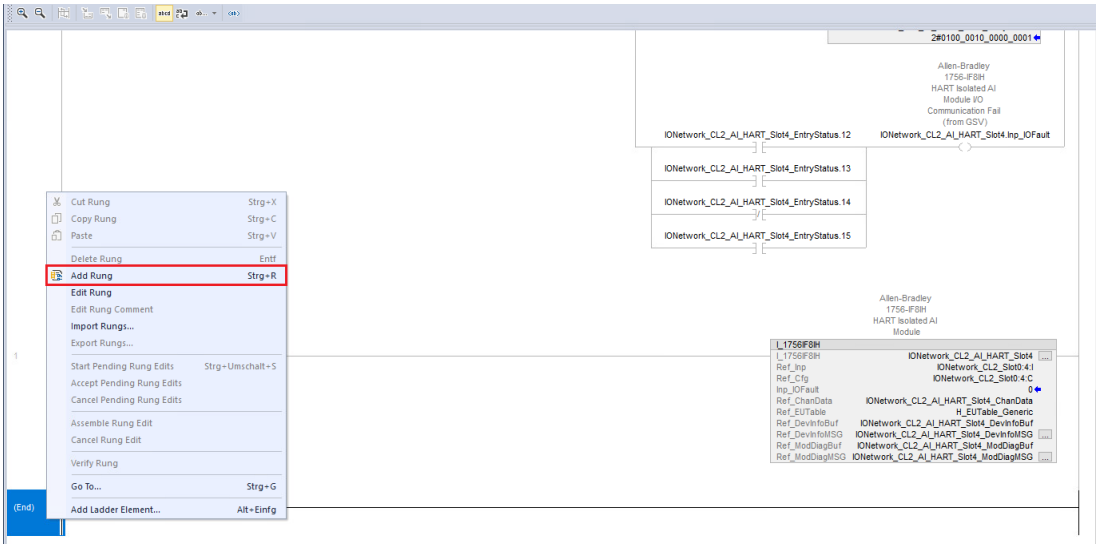


- Update the Instance name “Rack02_Slot4” with the name of the analog input module

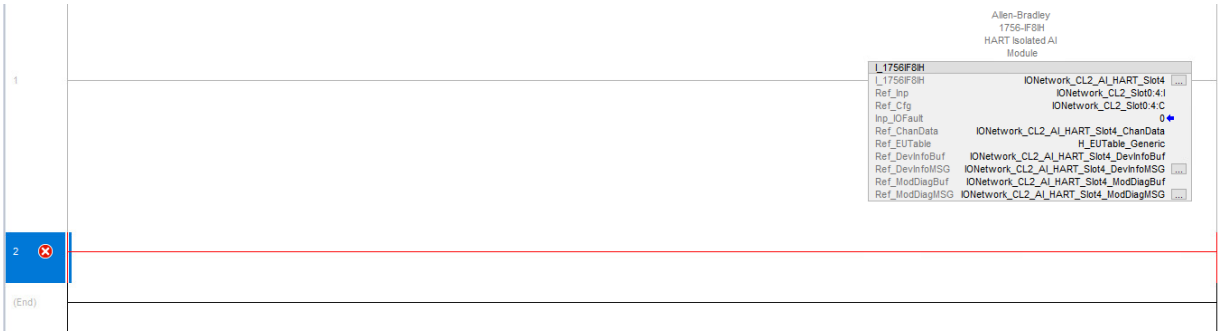


- Change the name as well in the comment of the created routine:

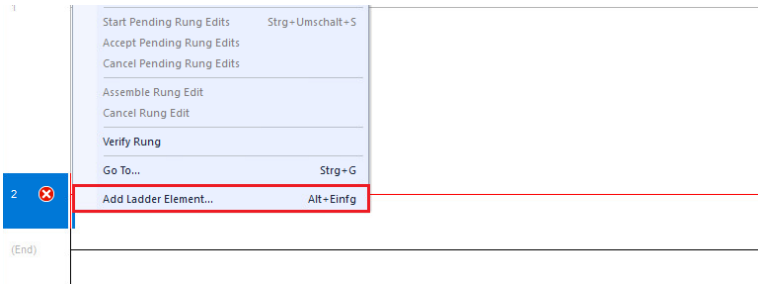
- In the routine “r_1756IF8IH_CL2_Slot4”, scroll down, then right-click on the “End” rung and select the option “Add Rung”:



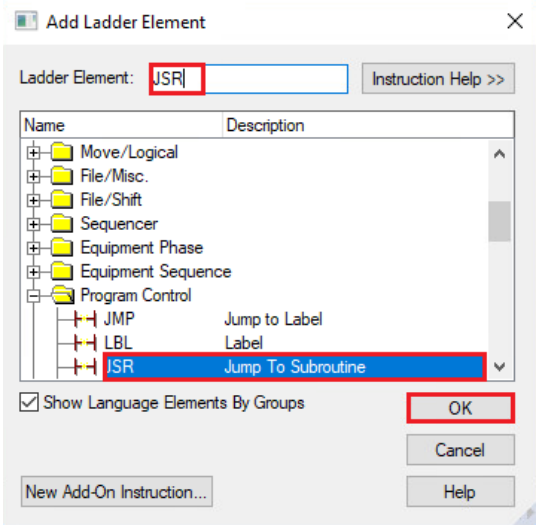
- This insert “rung 2”:



- Right-click on the rung 2 and select the option “Add Ladder Element”:

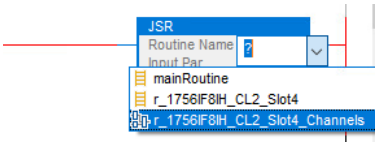


- Search the element “Jump To Subroutine”, select it and click on the button “OK”:

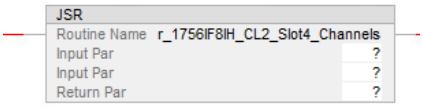


- This inserts the ladder element “Jump To Subroutine”:

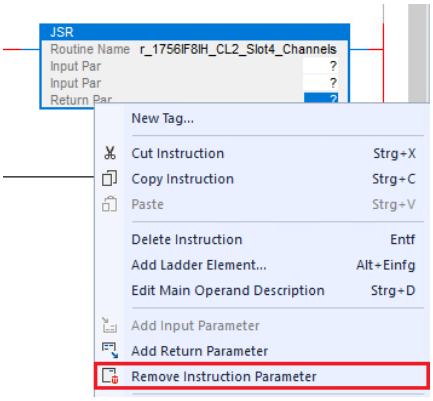
- Select the routine name and choose the routine “r_1756IF8IH_CL2_Slot4_Channels”:



- Subroutine “r_1756IF8IH_CL2_Slot4_Channels” is now linked:

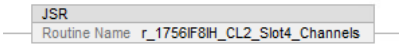


- In this example, the instruction parameters “Input Par” and “Return Par” are not used. Remove them. Right-click on “Return Par” and select the option “Remove Instruction Parameter”:

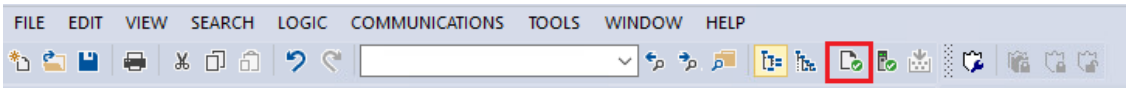


Repeat this step for the parameters “Input par”.

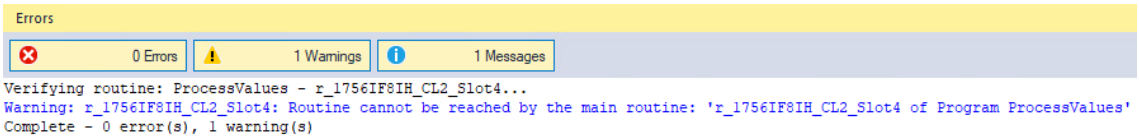
- Removed parameters:



- In the tool bar, click on the shortcut button “Verify Routine”:



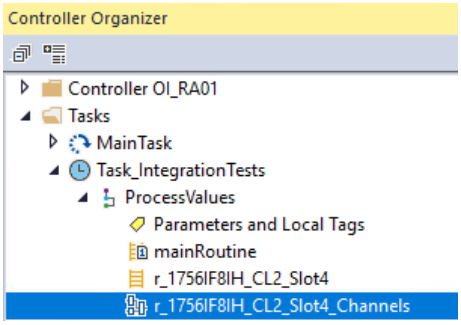
- Check the result in the Error diagnostic window:



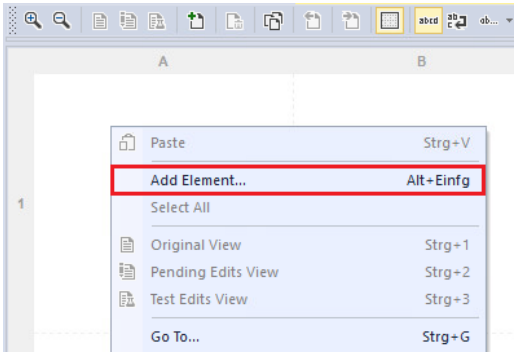
- Close the routine.

4.1.2.3.3 HART Analog Input Routine Configuration

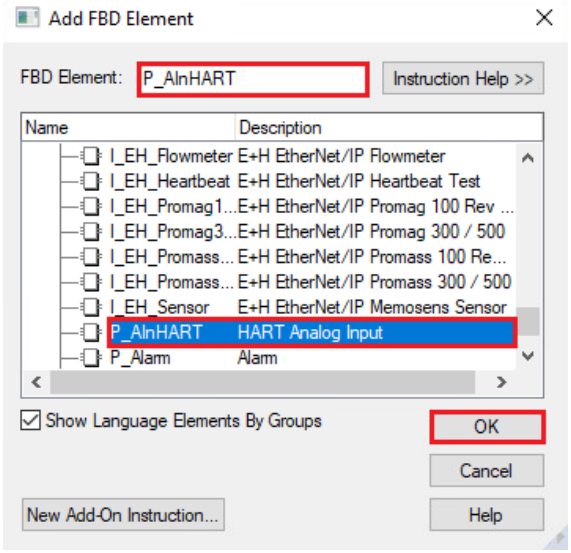
- Double-click on the routine “r_1756IF8IH_CL2_Slot4_Channels”:



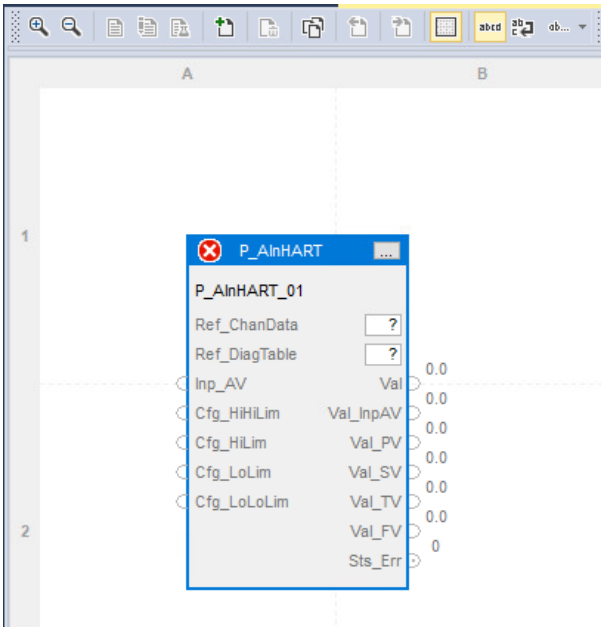
- Right-click in the program page and select the option “Add Element...”:



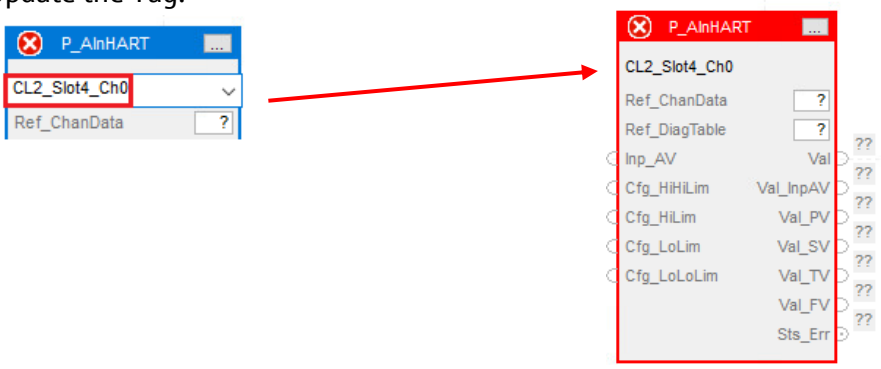
- Search the FBD Element “P_AInHART” and click on the button “OK”:



- This inserts the function block in the FBD page:

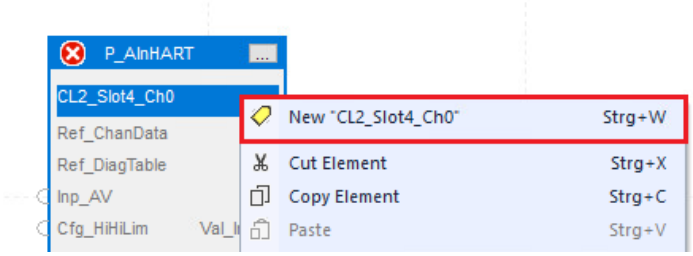


- Update the Tag:

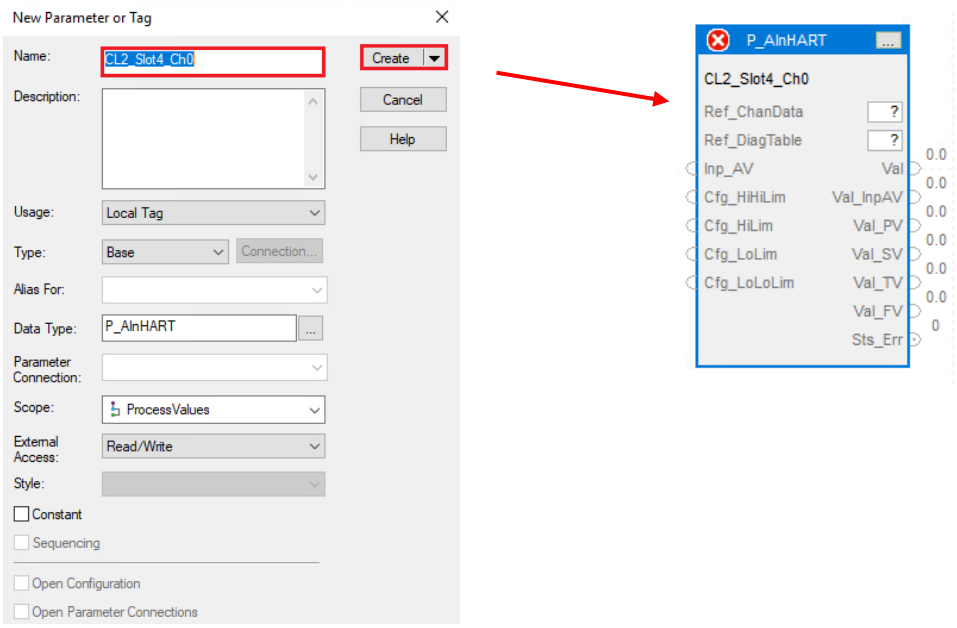


In this example, the Tag name is "CL2_Slot4_Ch0". The function block appears with red color because it is still not configured.

- Right-click on the Tag "CL2_Slot4_Ch0" and select the menu "New "CL2_Slot4_Ch0"":

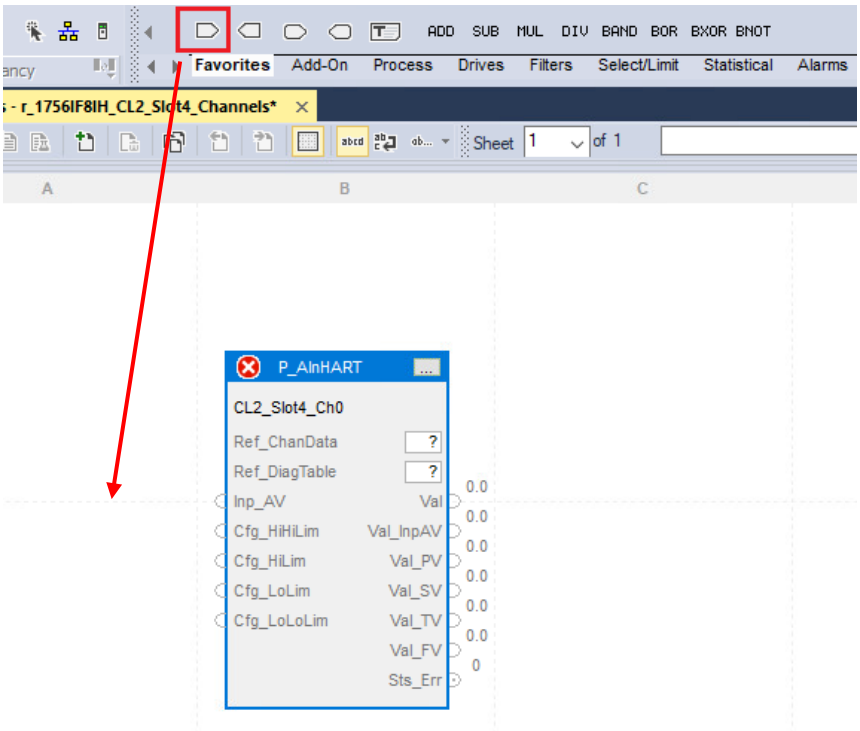


- Following window is displayed:

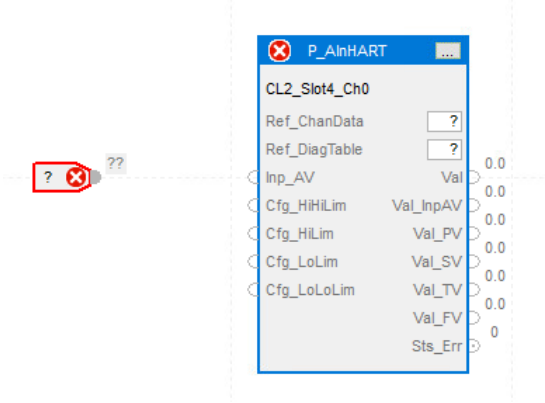


Click on the button “Create”.

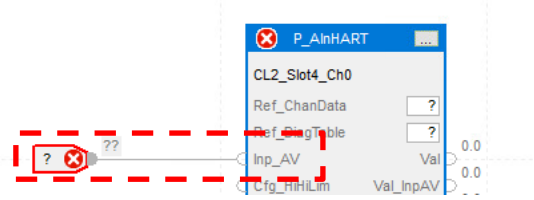
- Drag and drop the Input reference symbol in the FBD program:



- Input reference symbol:

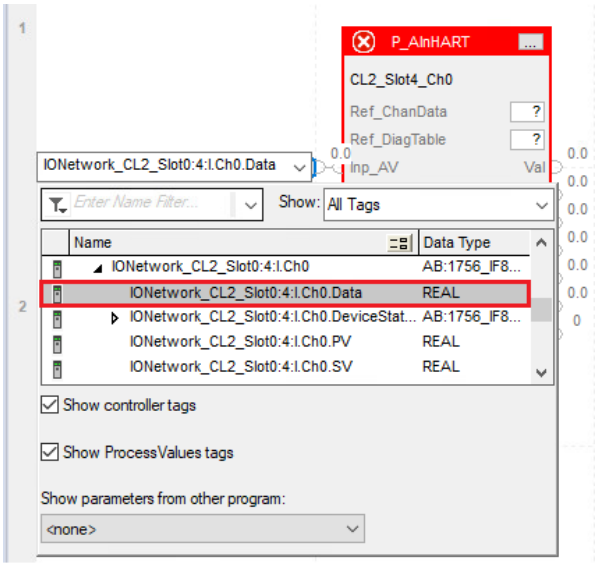


- Connect the Input reference to the Input variable “Inp_AV”:

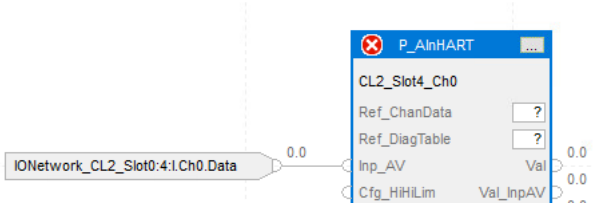


- Double-click on the Input reference symbol:

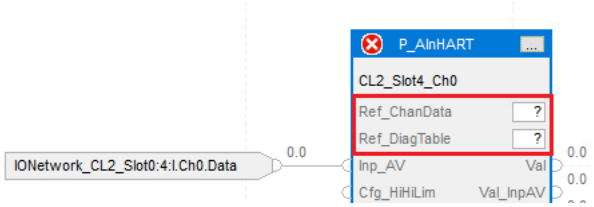
- Then choose the correct input parameter of the list box. In this example, the parameter “IONetwork_CL2_Slot0:4:I:Ch0:Data”must be connected:



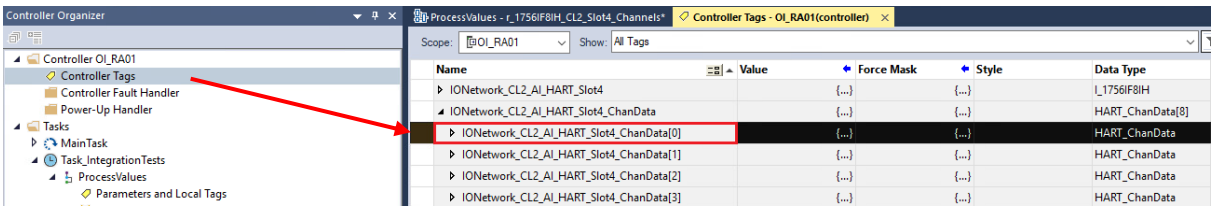
- This connects the input data:



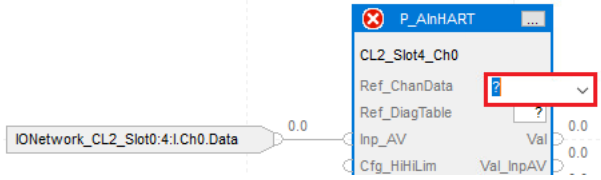
- Two other parameters must still be configured, the “Ref_ChanData” and the “Ref_DiagTable”:



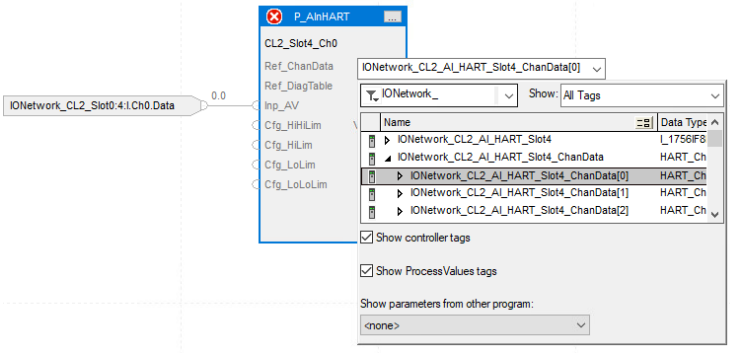
- In this example, the parameter “Ref_ChanData” corresponds to the variable “IONetwork_CL2_AI_HART_Slot4_ChanData[0]” in the Controller Tags:



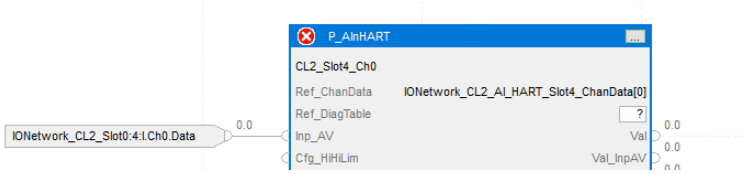
- Double-click on Ref_ChanData “?”:



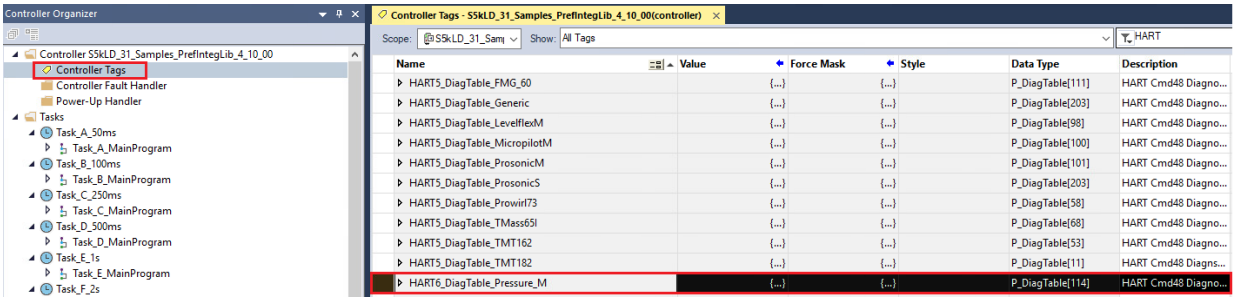
- Search and double-click on the variable “IONetwork_CL2_AI_HART_Slot4_ChanData[0]”:



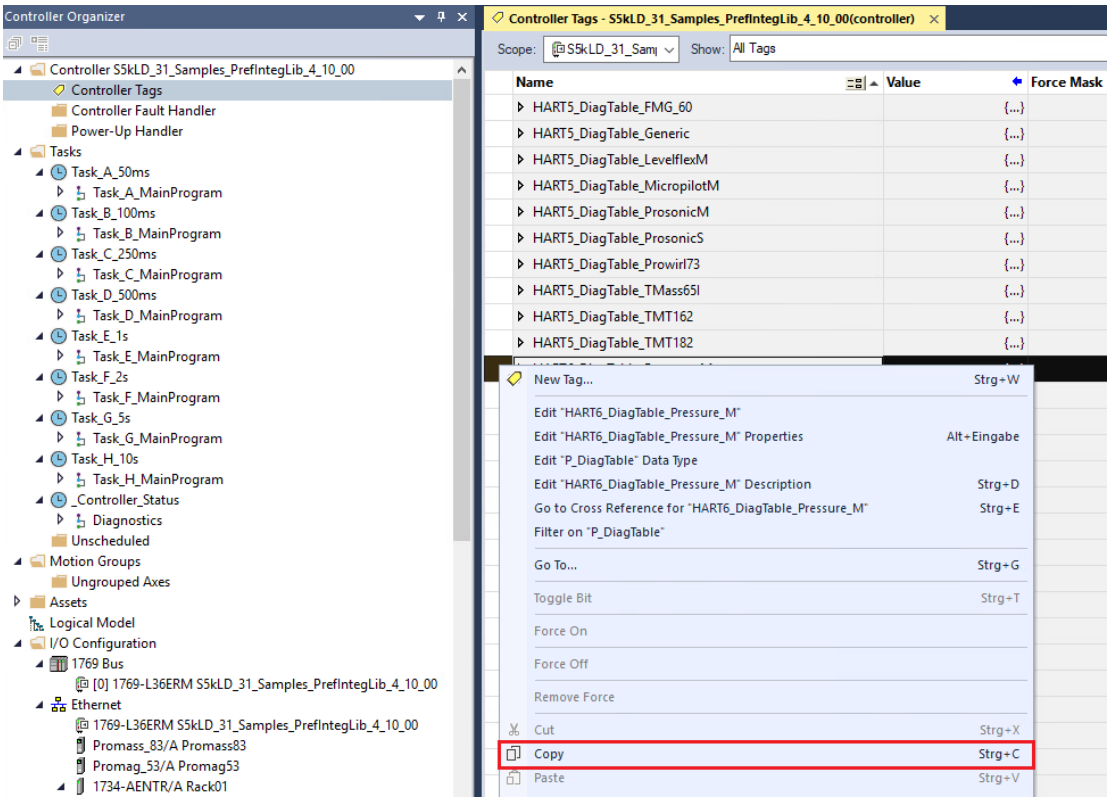
- This assigns the variable “IONetwork_CL2_AI_HART_Slot4_ChanData[0]”:



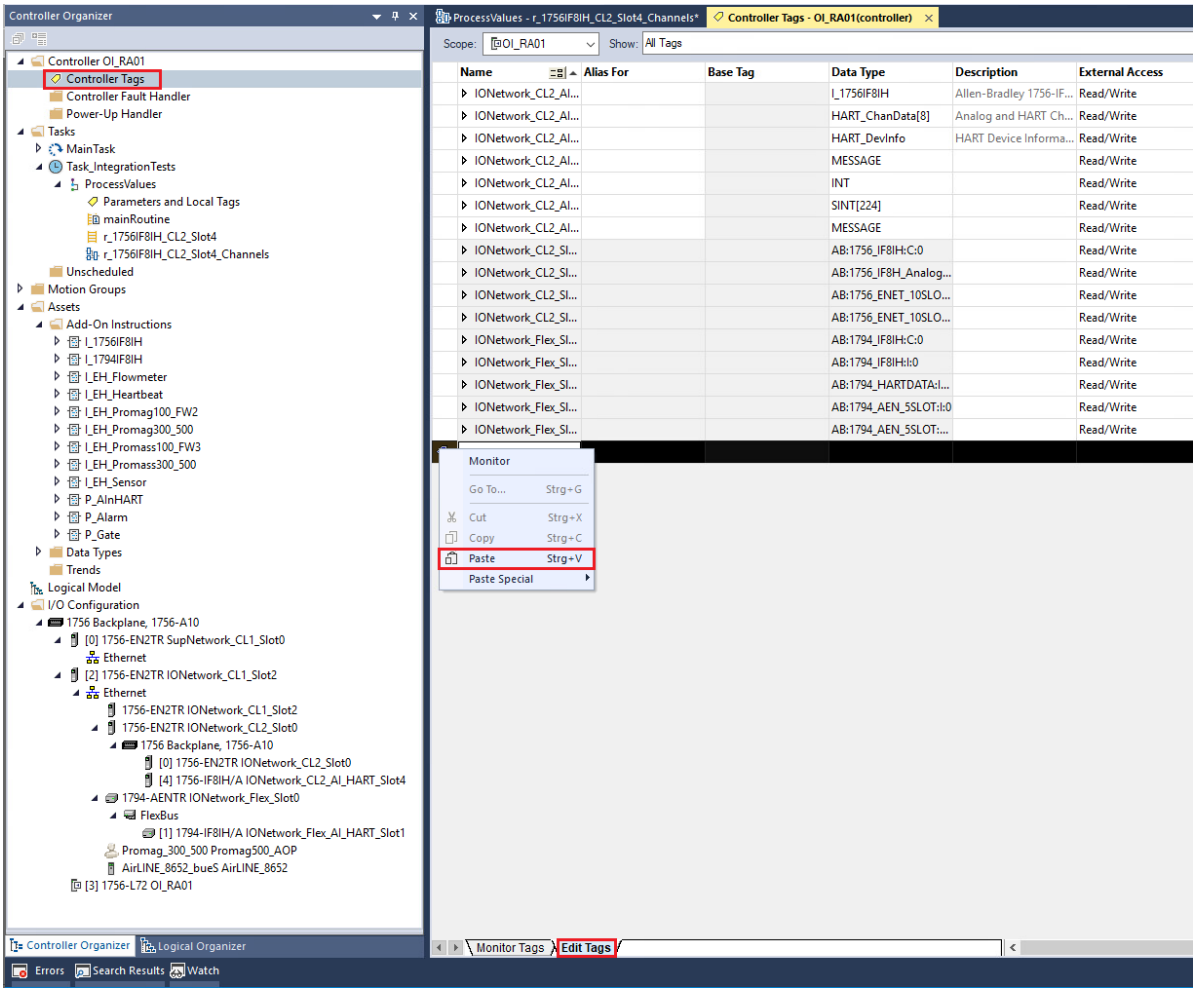
- The parameter “Ref_DiagTable” must be connected as well. A specific diagnostic table for HART devices already exists for Endress+Hauser devices and can be imported from the sample project of the Process Library. Open the Controller Tags of the sample project and select the HART diagnostic table Pressure because in this example it is a Cerabar M, which is connected on Channel0:



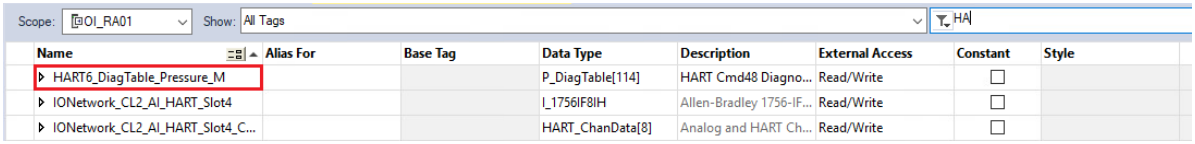
- Right-click on the table and select the menu “Copy”:



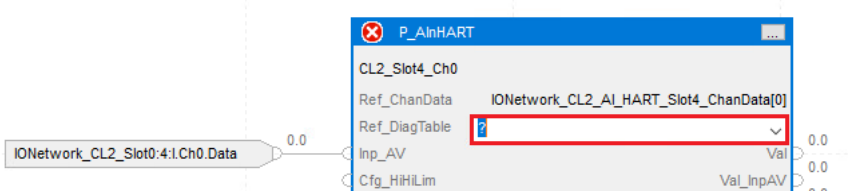
- In the current project, open “Controller Tags → Edit Tags”, right-click in the field and paste:



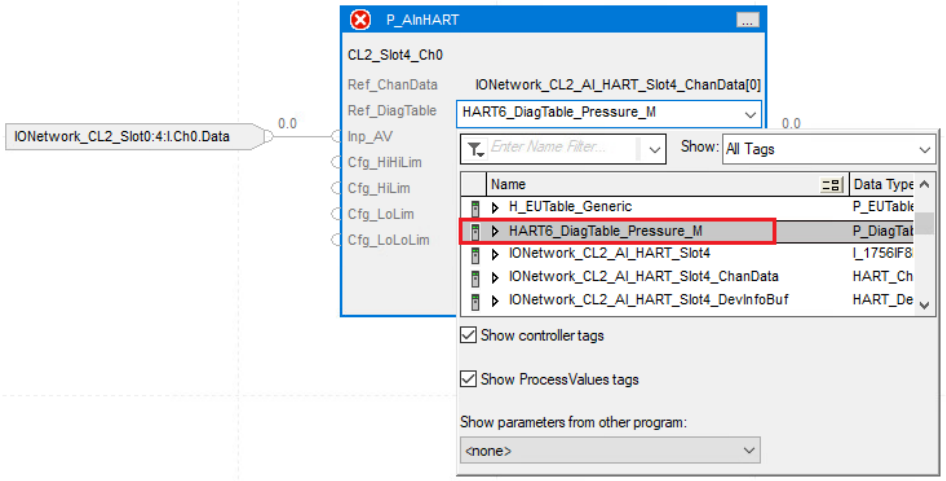
- “HART6_DiagTable_Pressure_M” is successfully imported:



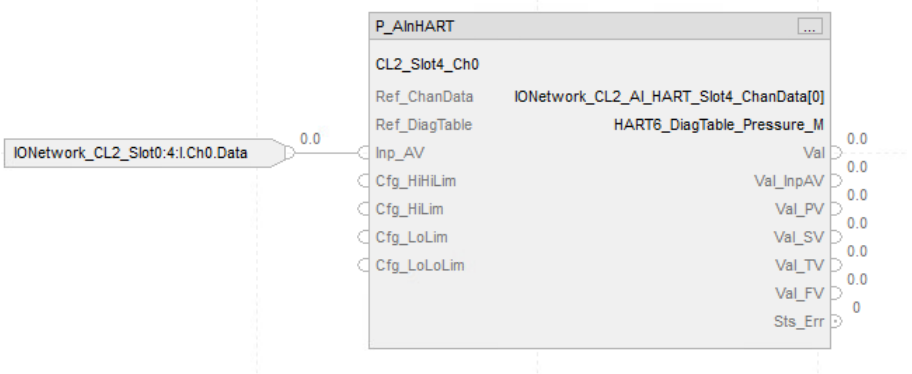
- In the routine “r_1756IF8IH_CL2_Slot4”, this table can now be assigned to the function block. Double-click on the parameter “Ref_DiagTable”:



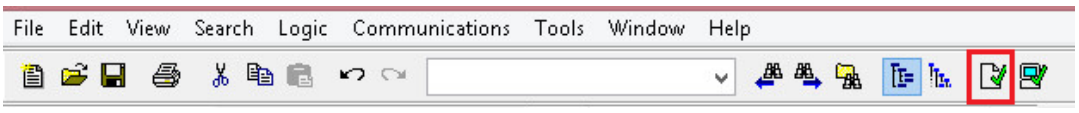
- Select the Endress+Hauser device specific HART Pressure M table “H_DiagTable_Pressure_M”:



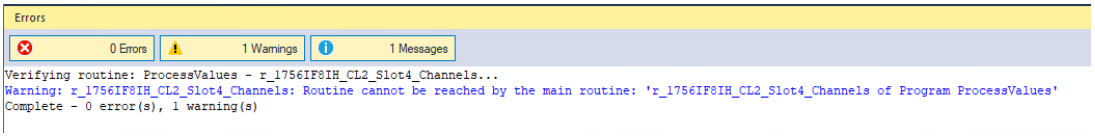
- Routine “P_AInHART” is ready:



- In the tool bar, click on the shortcut button “Verify Routine”:



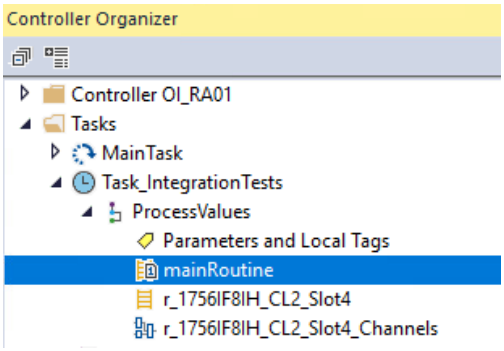
- Check the result in the Error diagnostic window:



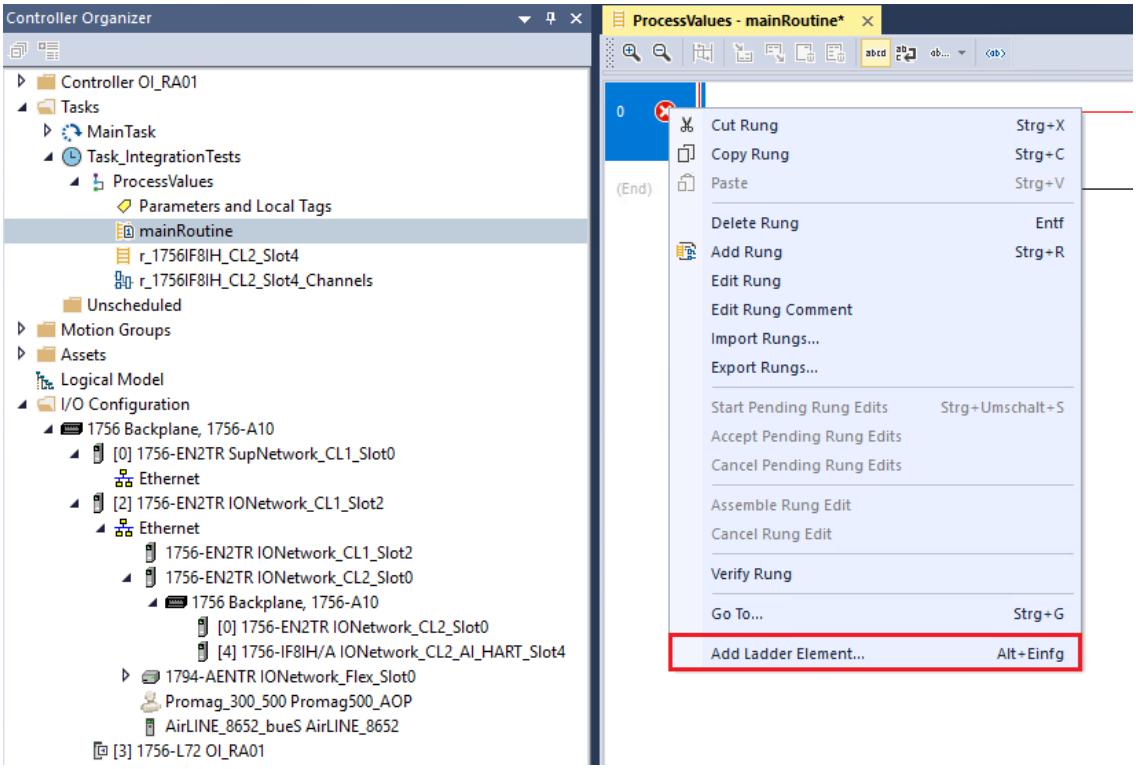
- Close the routine.

4.1.2.3.4 Main Routine Sequence

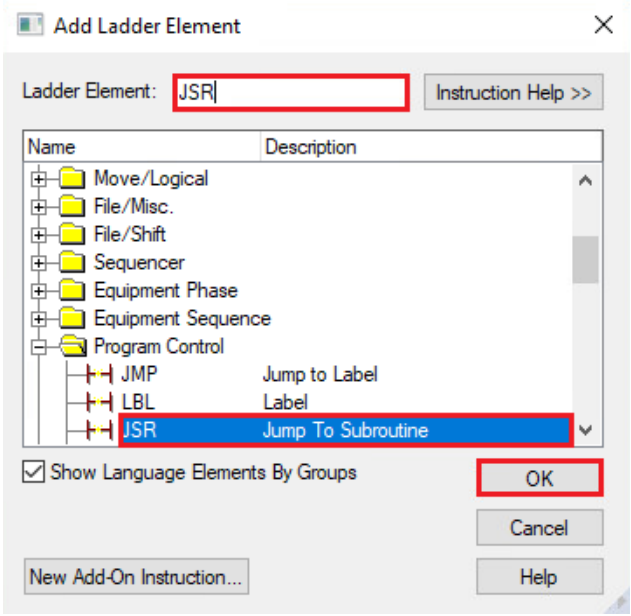
- Open the routine “mainRoutine”:



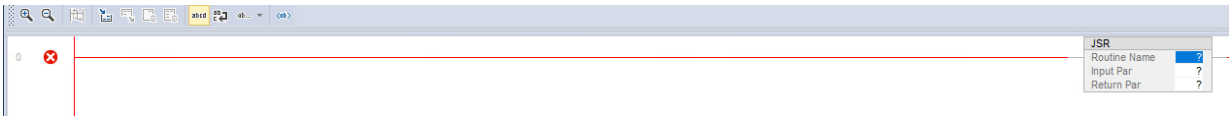
- Right-click on Rung0 and select the menu “Add Ladder Element...”:



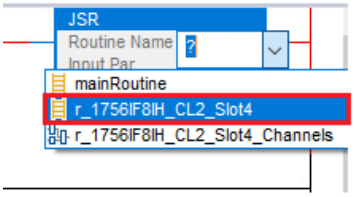
- Search the element “Jump To Subroutine”, select it and click on the button “OK”:



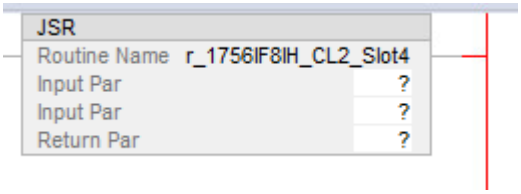
- This inserts the ladder element “Jump To Subroutine”:



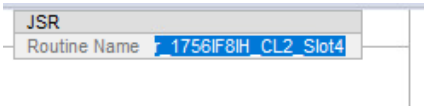
- Select the routine name and choose the routine “routine_1756_IF8IH”:



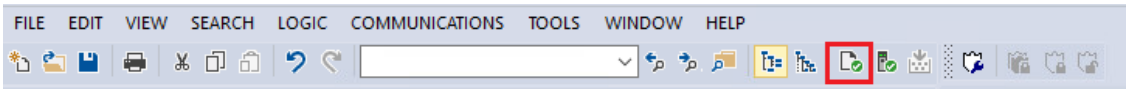
- Subroutine “r_1756IF8IH_CL2_Slot4” is linked:



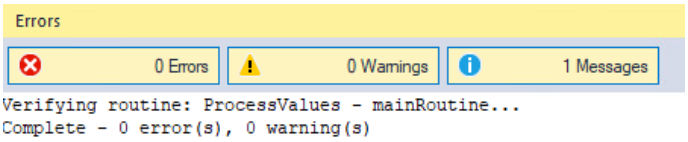
- In this example, the instruction parameters “Input Par” and “Return Par” are not used. Remove themas done in chapter 4.1.2.3.3:



- In the tool bar, click on the shortcut button “Verify Routine”:



- Check the result in the Error diagnostic window:



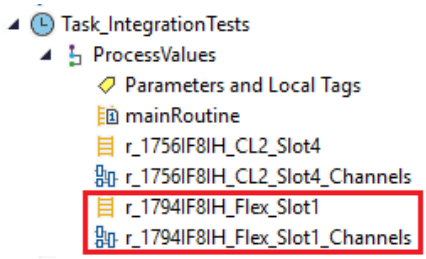
- Close the routine.

4.1.3 AOI Integration for HART devices connected on Flex I/O

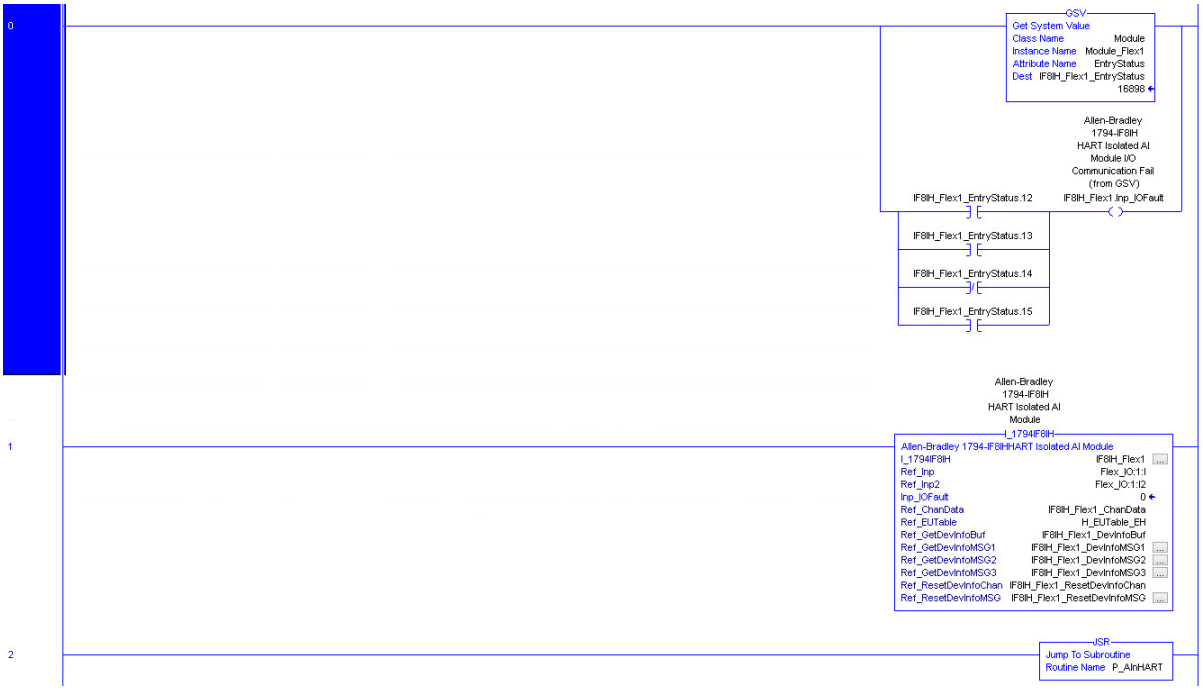
The same principle as described in chapter 4.1.2 is used to integrate the Flex I/O AOI.

Main Steps

- New routines are created:

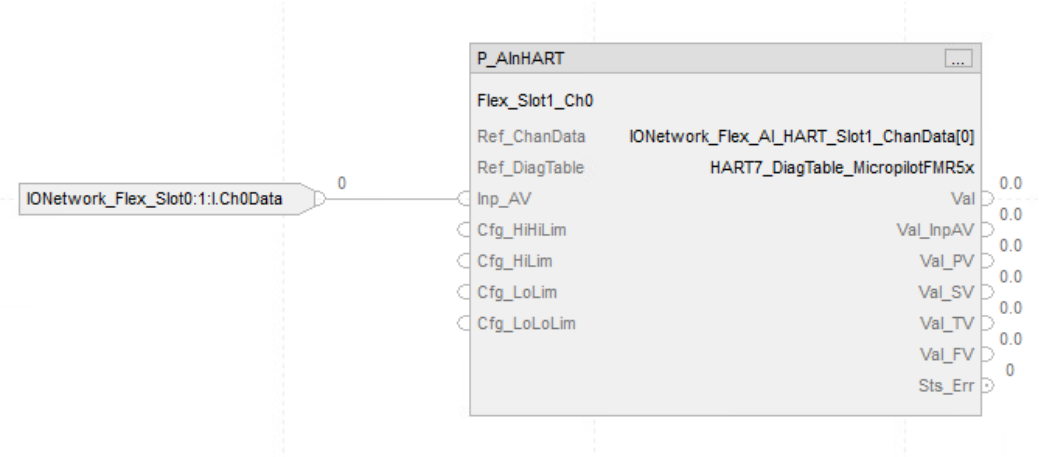


- The corresponding rung is imported from the Rockwell Library with a Jump subroutine to the configured HART analog input:



- A Jump subroutine is added in the main routine:

- The HART Analog Input channel is configured (Flex_Slot1_Ch0):



- In this example, the instance names “Flex_Slot1_Ch0” is used to connect the corresponding faceplate. Refer to chapter 4.2.4.

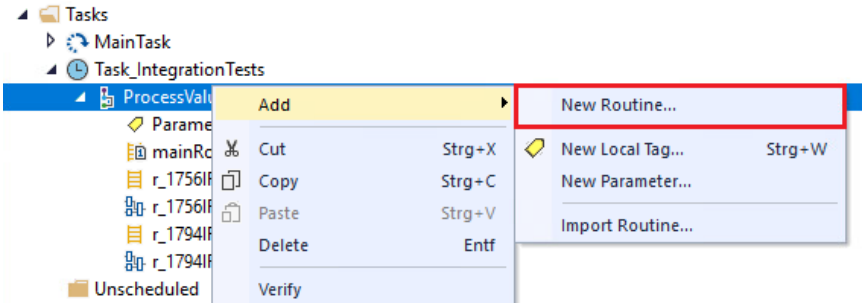
4.1.4 AOI Integration for EtherNet/IP devices

AOI for EtherNet/IP are listed in two categories depending on device types:

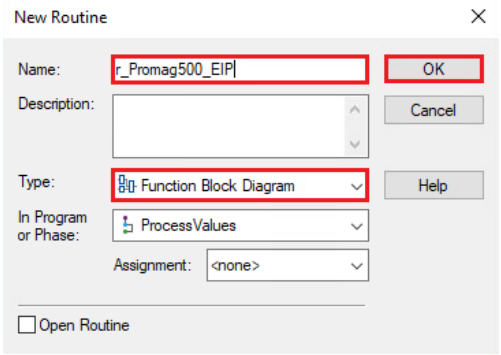
- Flow devices are using the AOI “I_EH_Flowmeter” in combination with am Endress+Hauser device specific AOI.
- Another device like Liquiline is using the AOI “I_EH_Sensor”.

4.1.4.1 AOI for Flow device

- Right-click on the program “ProcessValues” and select the menu “Add→New Routine...”:



- Enter a name and choose the language type:



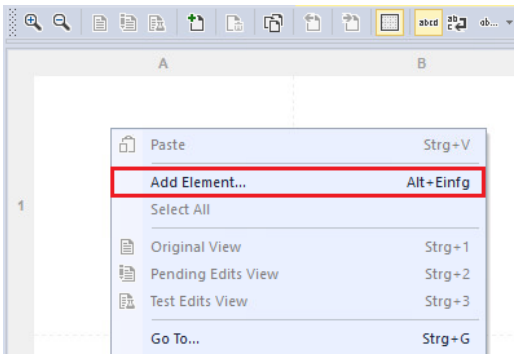
In this example, the routine name is “r_Promag500_EIP” and the selected language is “Function Block Diagram”.

Click on the button “OK”.

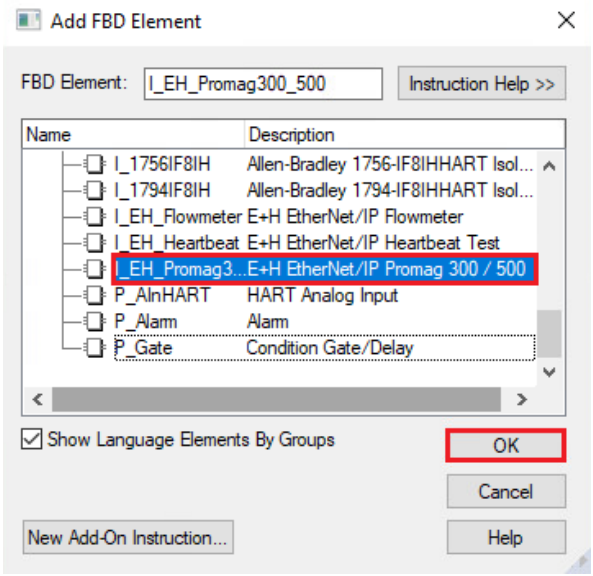
- This adds the routine in the project view.

Device Specific AOI

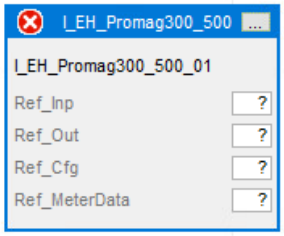
- Double-click on the routine “r_Promag500_EIP” and right-click in the opened program page. Select the option “Add Element...”:



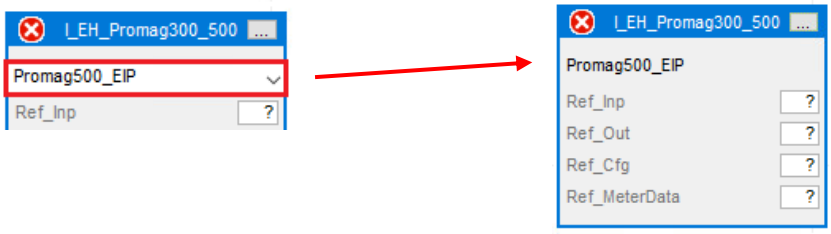
- Select the AOI “I_EH_Promag300_500” and click on the button “OK”:



- This inserts the function block in the FBD page:

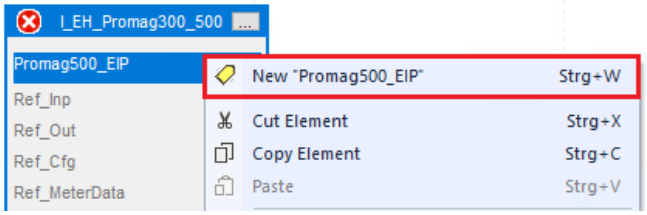


- Update the Tag:

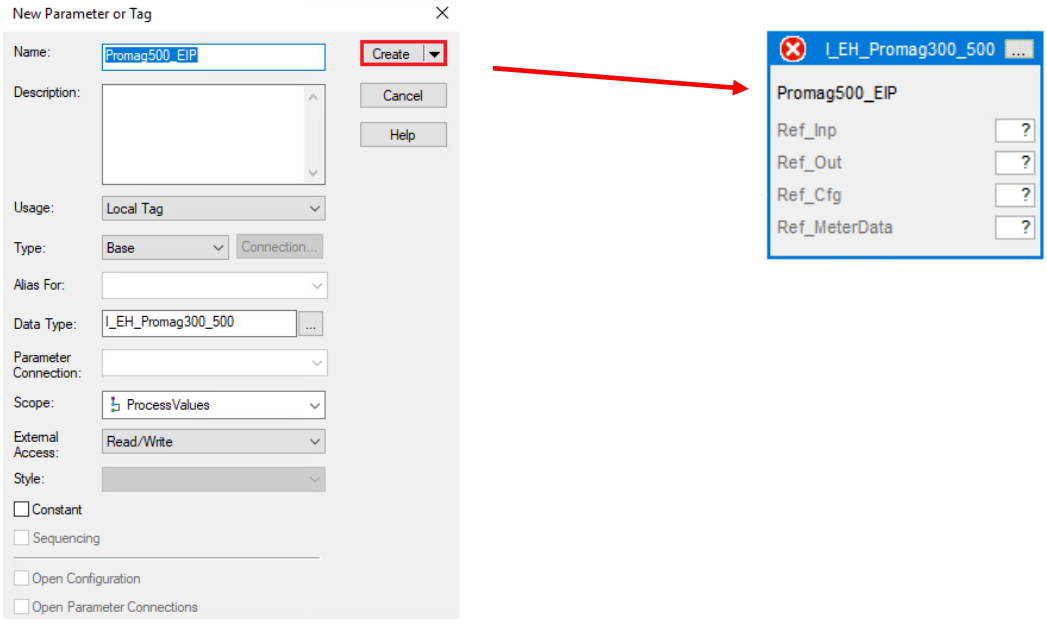


In this example, the Tag name is “Promag500_EIP”.

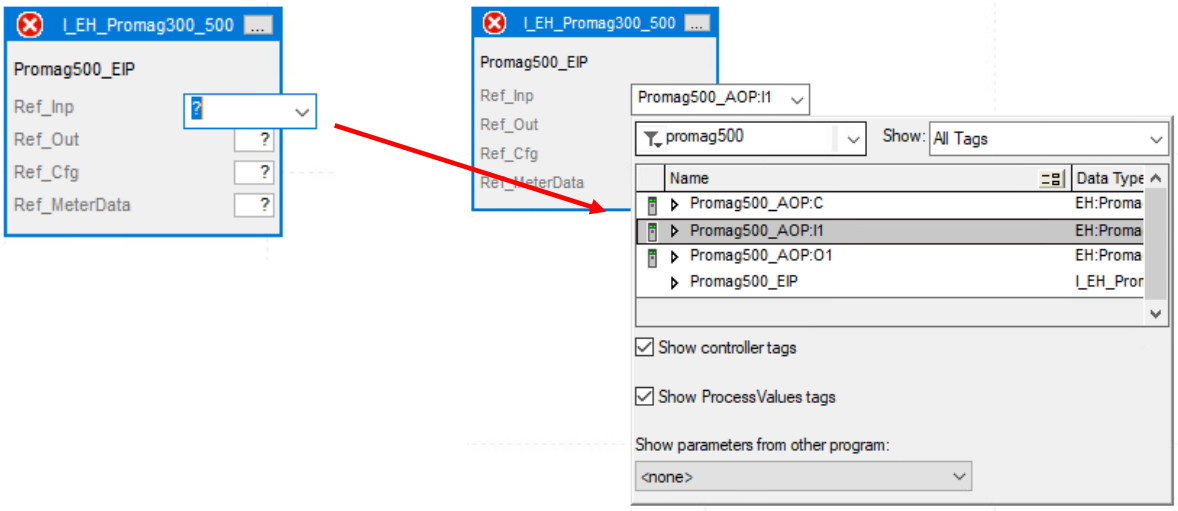
- Right-click on the Tag “Promag500_EIP” and select the menu “New “Promag500_EIP””:



- Following window is displayed. Click on the button “Create”:

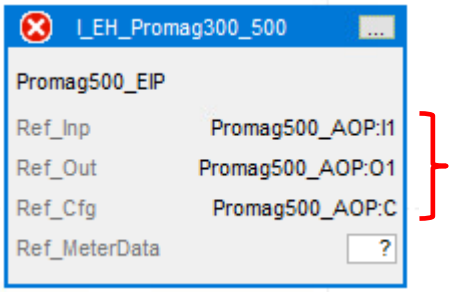


- Double-click on "?" of parameter "Ref_Input" to select the reference input variable:



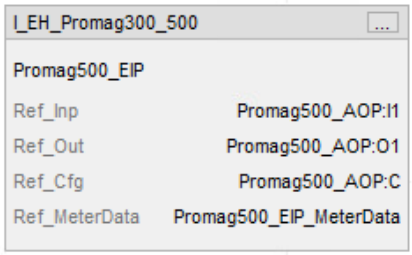
In this example, select the Promag500_AOP:I1.

- Assign the other parameters as well:



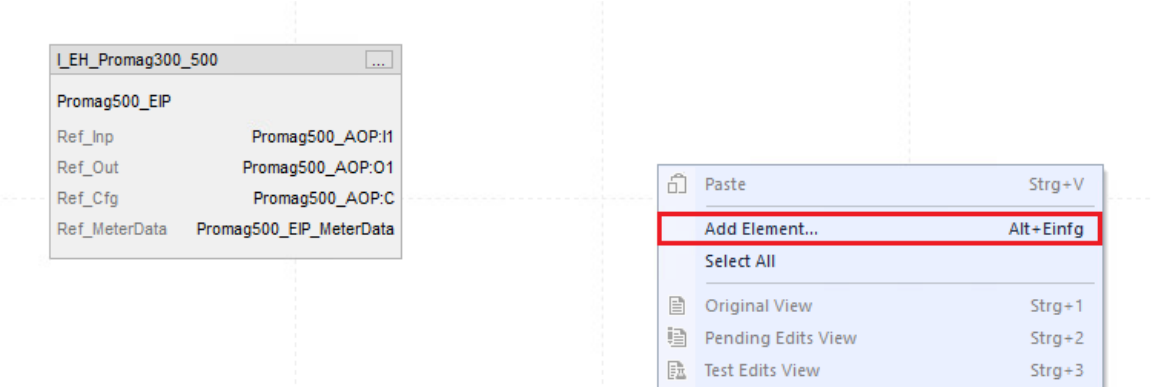
These three variables have been created during the EtherNet/IP device configuration.

- The last parameter "Ref_MeterData" must be created at first (same principle as done for the Tag Name). Enter for example the variable name "Promag500_EIP_MeterData":

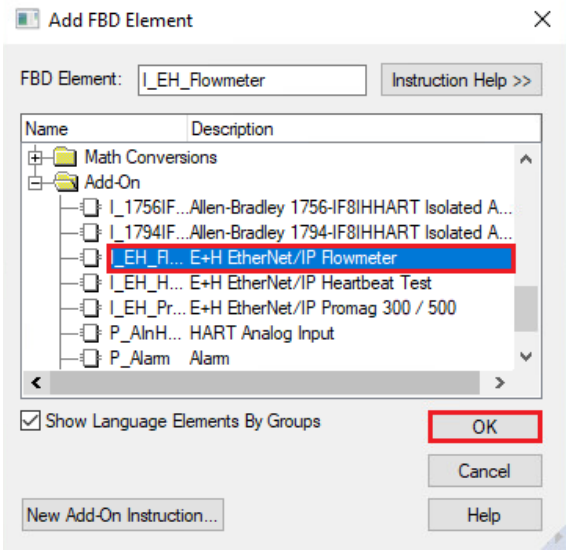


Flow device AOI

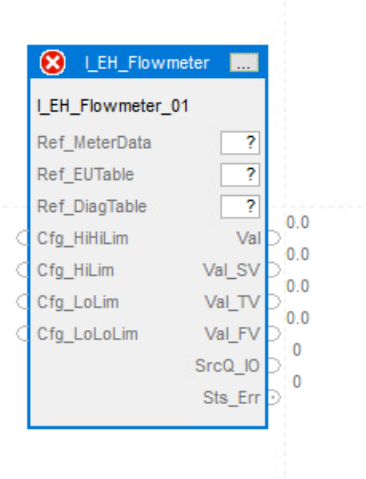
- Right-click in the routine to add another function block:



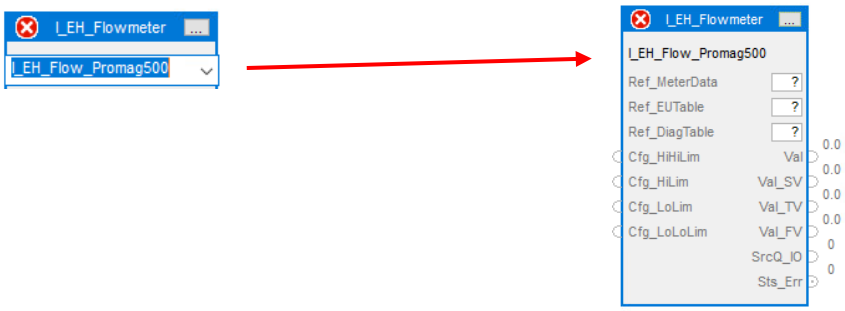
- Select the AOI "I_EH_Flowmeter" and click on the button "OK":



- This inserts the function block in the routine:

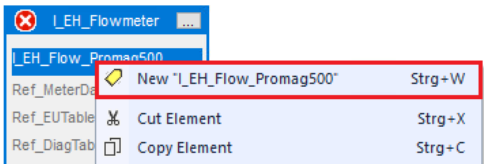


- Update the Tag:

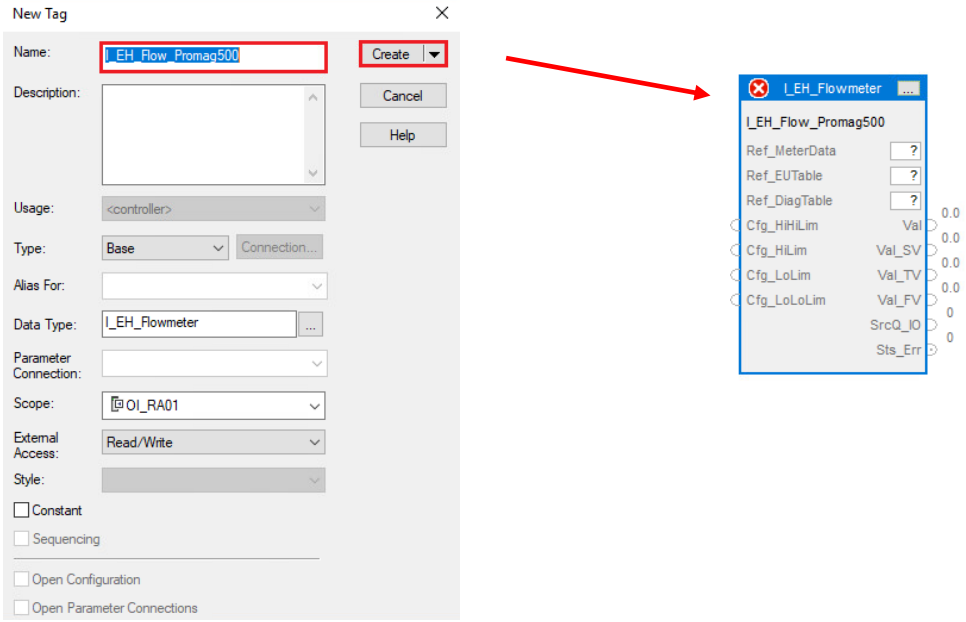


In this example, the Tag name is “I_EH_Flow_Promag500”.

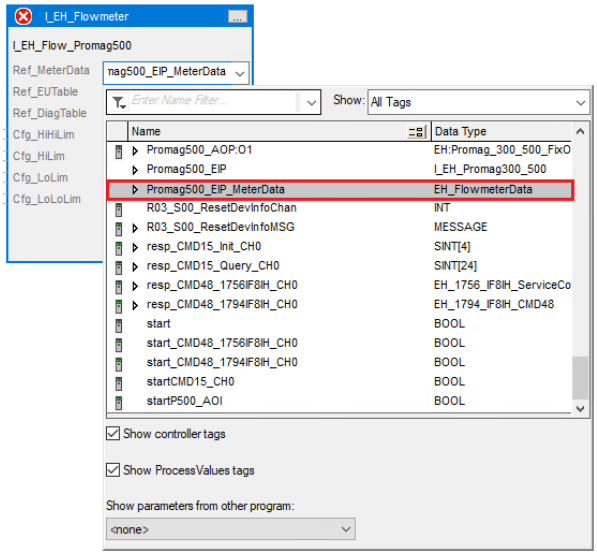
- Right-click on the Tag “I_EH_Flow_Promag500” and select the menu “New “I_EH_Flow_Promag500””:



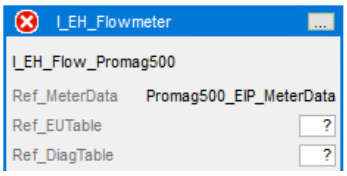
- Following window is displayed. Click on the button “Create”:



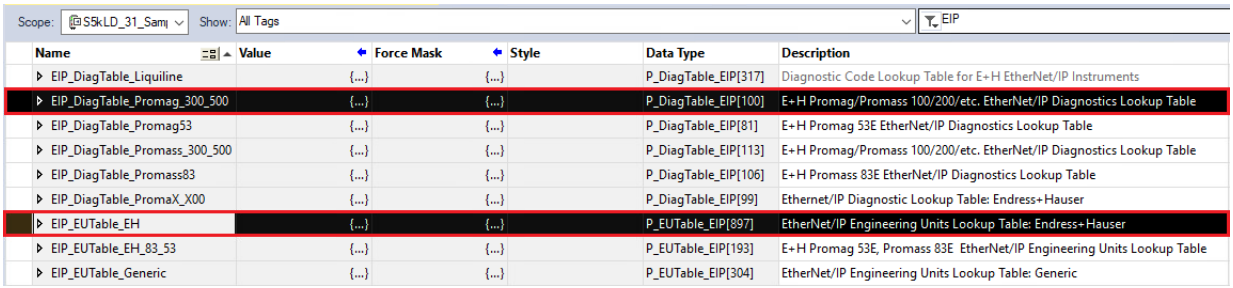
- Double-click on "?" of parameter "Ref_MeterData" and assign the variable "Promag500_EIP_MeterData":



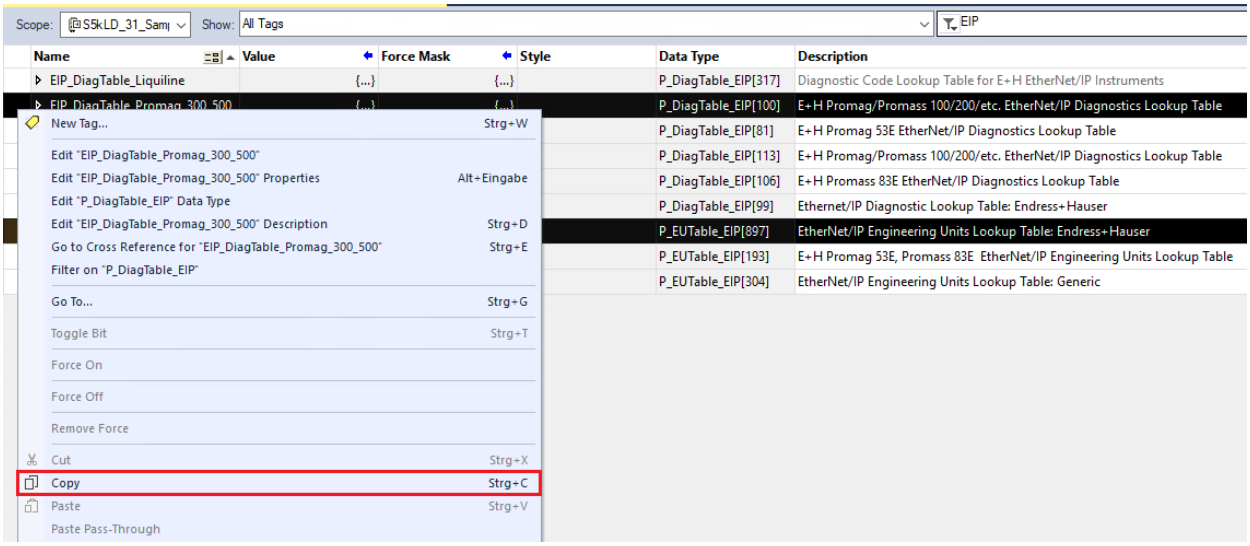
- Variable is assigned:



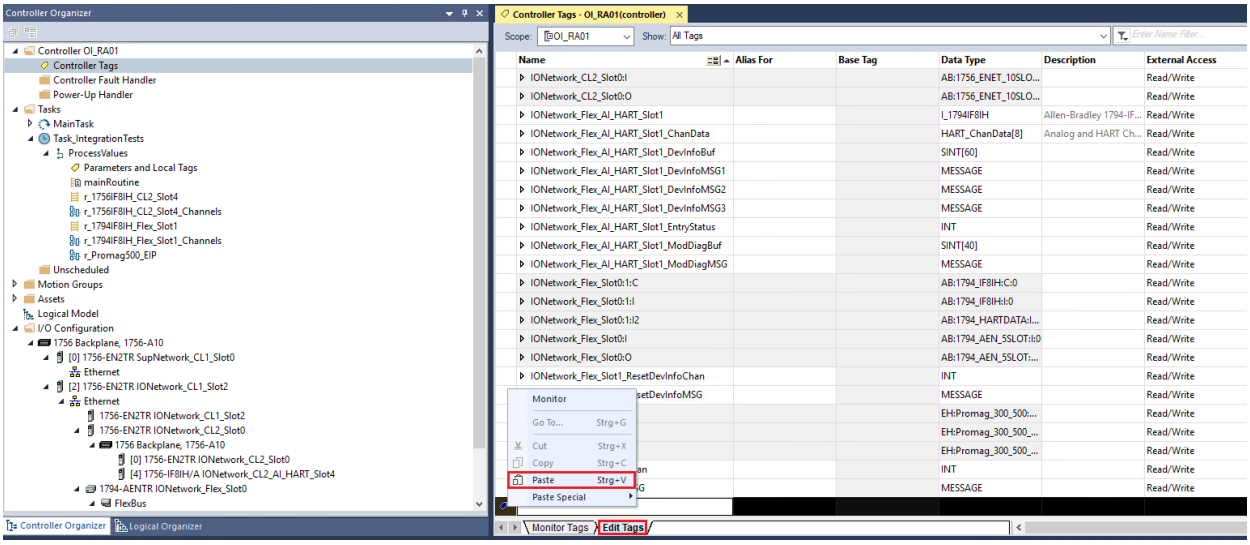
- The parameters "Ref_EUTable" and "Ref_DiagTable" must be connected as well. Specific diagnostic tables already exist for Endress+Hauser EtherNet/IP devices and can be imported from the sample project of the Process Library. Open the Controller Tags of the sample project and select the EIP diagnostic table "EIP_DiagTable_Promag300_500" and "EIP_EUTable_EH":



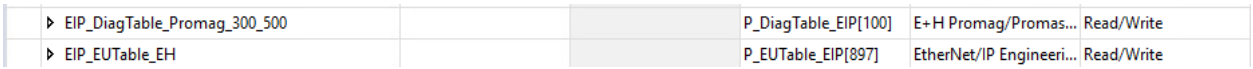
- Then right-click on the selected tables and click on the menu “Copy”:



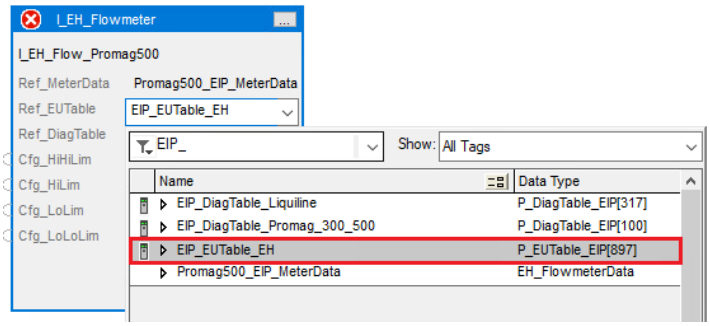
- In the current project, open “Controller Tags → Edit Tags”, right-click in the field and paste:



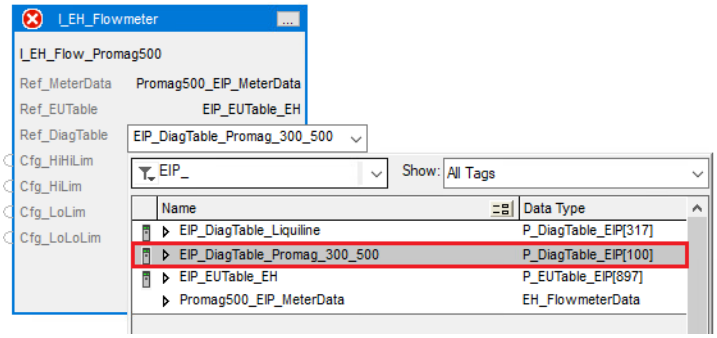
- This inserts the two variables:



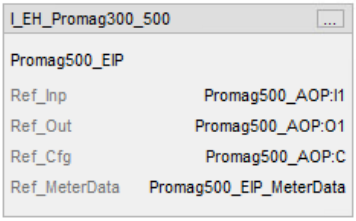
- In the routine “r_Promag500_EIP”, double-click on “?” of parameter “Ref_EUTable” and assign the Endress+Hauser EtherNet/IP table “EIP_EUTable_EH”:

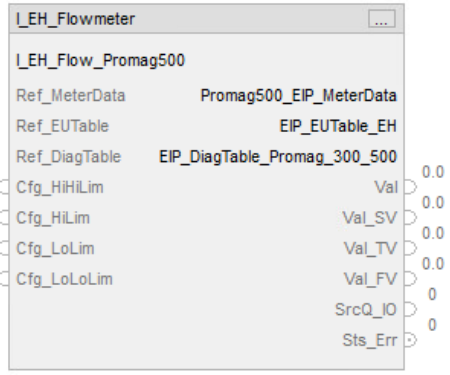


- In the routine “r_Promag500_EIP”, double-click on “?” of parameter “Ref_DiagTable” and assign the device specific diagnostic table “EIP_DiagTable_Promag_300_500”:

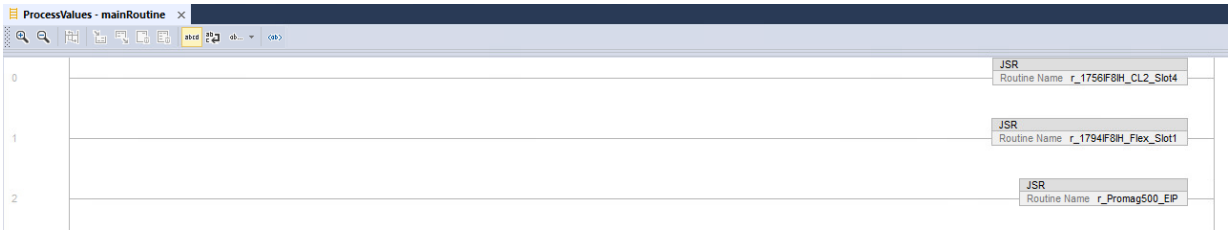


- Configured function blocks for Promag500:





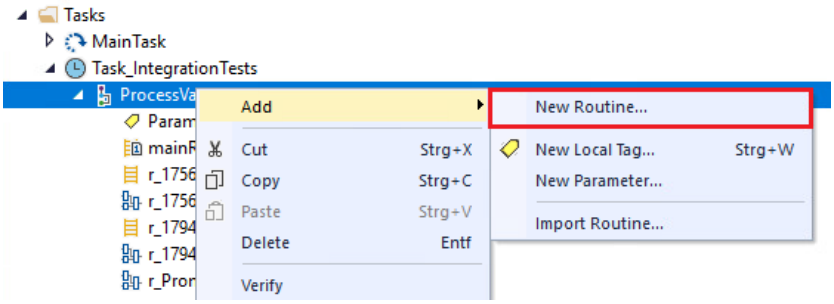
- Add a Jump subroutine in the main routine as done in chapter 4.1.2.3.4:



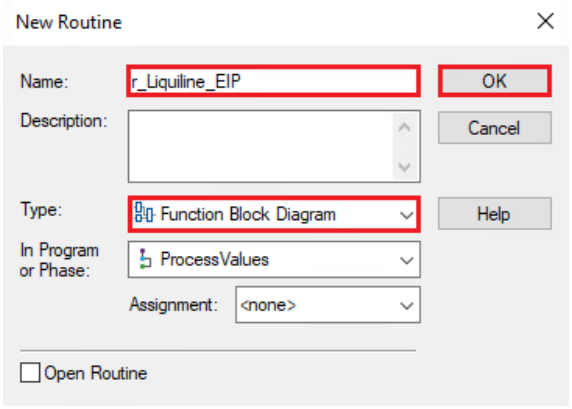
4.1.4.2 AOI for Liquiline

This example describes how to configure the other EtherNet/IP AOI specific for the Liquiline.

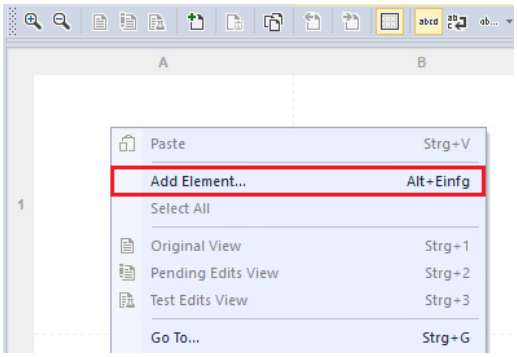
- Right-click on the program “ProcessValues” and select the menu “Add→New Routine...”:



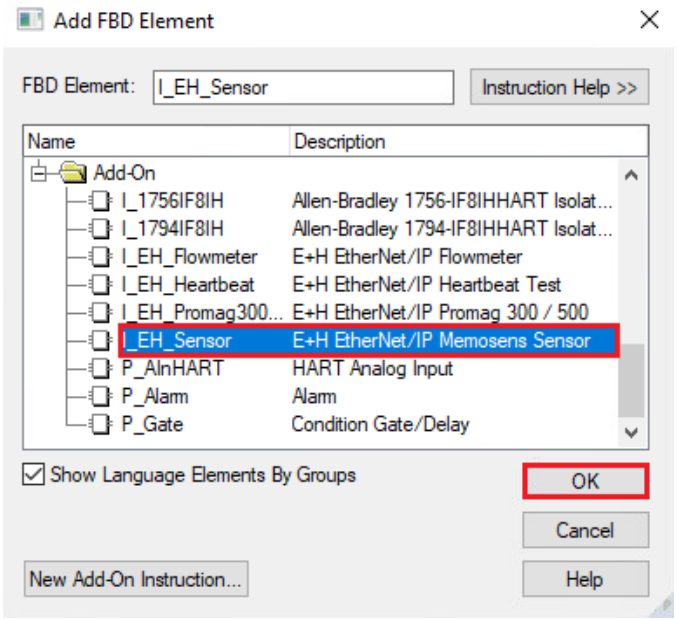
- Enter a name and choose the language type:



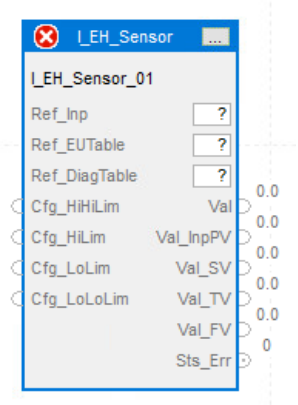
- In this new page, right-click in the opened program page. Select the option “Add Element...”:



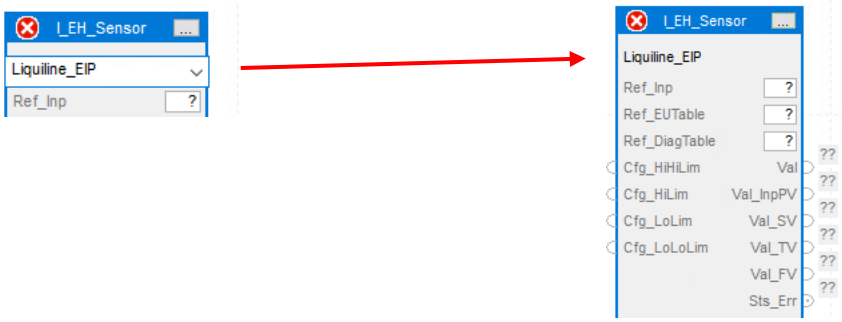
- Select the AOI “I_EH_Sensor” and click on the button “OK”:



- This inserts the function block in the routine:

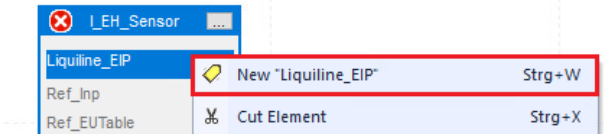


- Update the Tag:

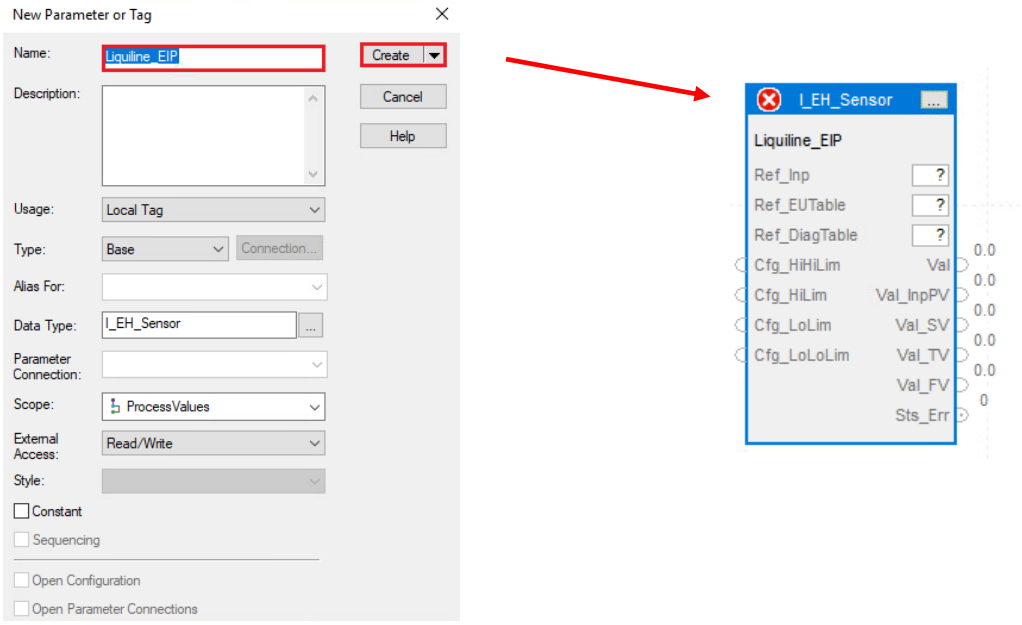


In this example, the Tag name is “Liquiline_EIP”.

- Right-click on the Tag “Liquiline_EIP” and select the menu “New “LiquilineEIP””:

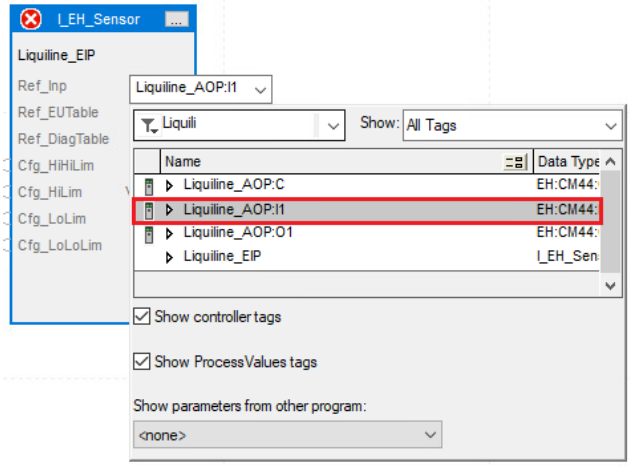


- Following window is displayed. Click on the button “Create”:

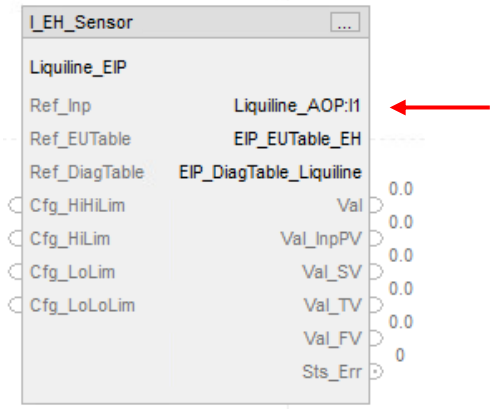


- In this example, the instance name “Liquiline_EIP” is used to connect the faceplate.

- Double-click on "?" of parameter "Ref_Input":



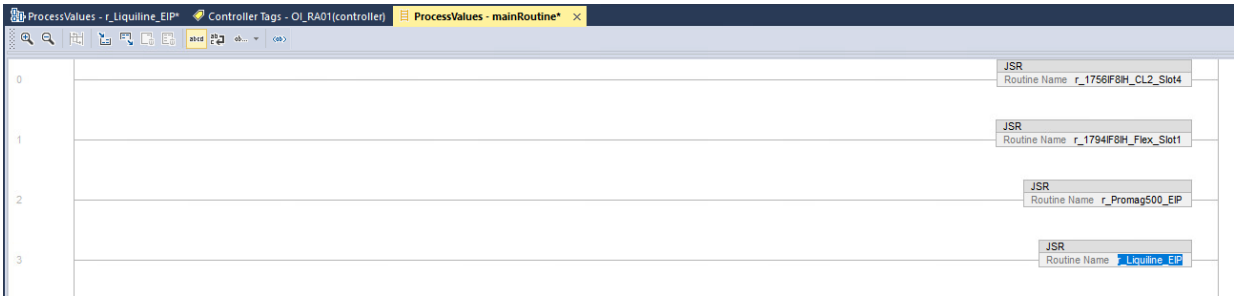
- Assign the variables "Ref_EUTable" and "Ref_DiagTable" as well:



The variable "Liquiline_AOP" has been created during the EtherNet/IP device configuration.

As done in chapter 4.1.4.1, the Endress+Hauser specific EtherNet/IP parameters "Ref_EUTable" and "Ref_DiagTable" are imported from a sample project.

- Add a Jump subroutine in the main routine as done in chapter 4.1.2.3.4:



4.1.5 Heartbeat AOI Integration for EtherNet/IP devices

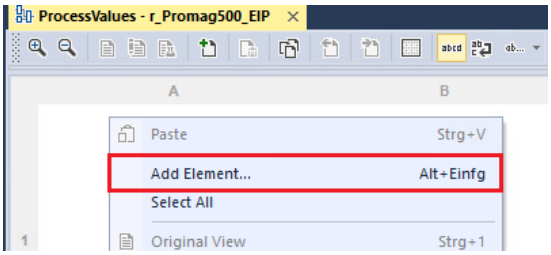
A specific Heartbeat AOI for EtherNet/IP devices is available in the process library. This AOI allows the user to trigger the Endress+Hauser Heartbeat function directly from the control sytem.

This chapter describes the implementation of the Heartbeat AOI for the Promag500 EtherNet/IP.

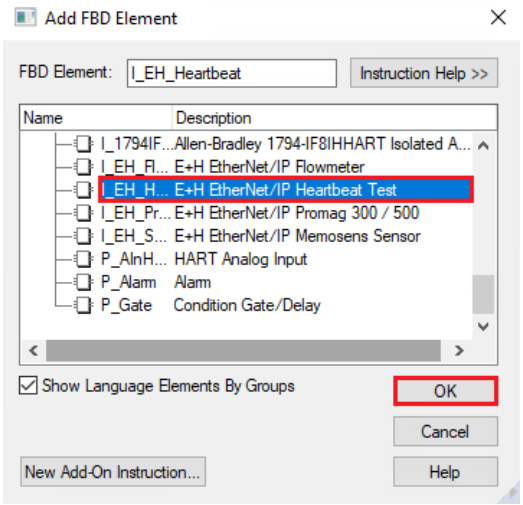
4.1.5.1 Heartbeat AOI Configuraiton

In the project view, open for example the routine “r_Promag500_EIP”.

- Right-click in the routine and select then menu “Add Element...”:

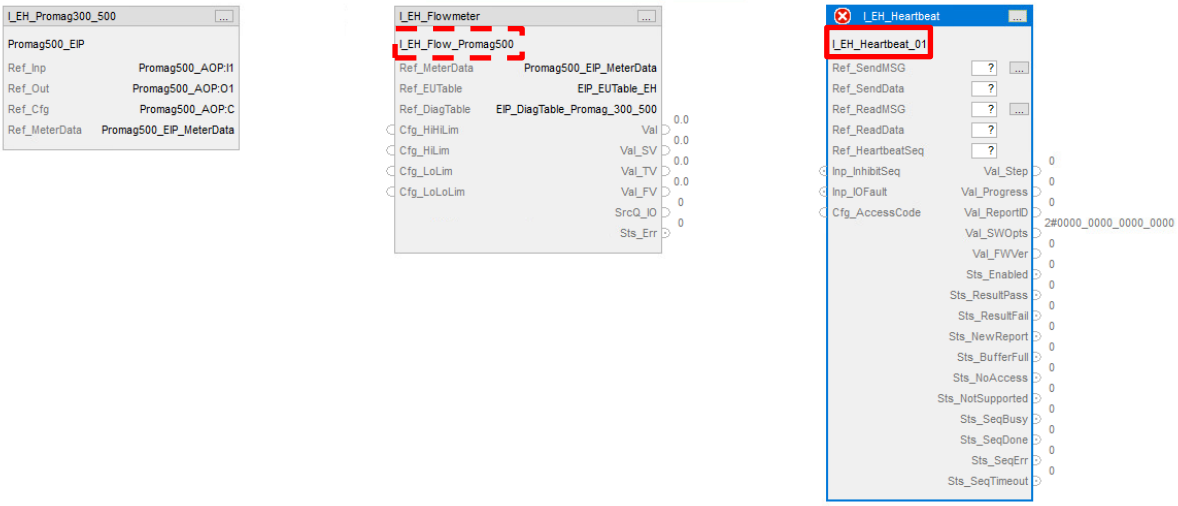


- Select the AOI “I_EH_Heartbeat”:



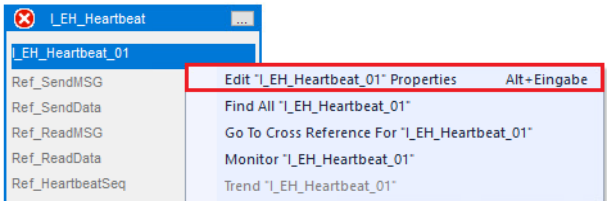
Click on the button “OK”.

- This inserts the “I_EH_Heartbeat_01” AOI in the program:

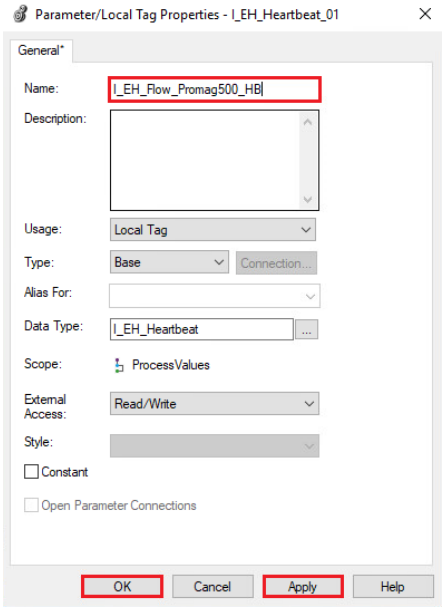


The Tag name of the “I_EH_Heartbeat” AOI must be updated, based on the name “I_EH_Flowmeter” AOI plus the three caracters “_HB”. In this example, I_EH_Flowmeter AOI Tag name is “I_EH_Flow_Promag500”. In consequence, “I_EH_Heartbeat” AOI tag name will be “I_EH_Flow_Promag500_HB”.

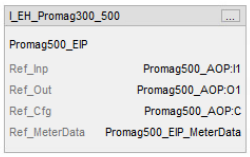
- Right-click on the Tag “I_E_Heartbeat_01” and click on the menu “Edit “I_EH_Heartbeat_01””:

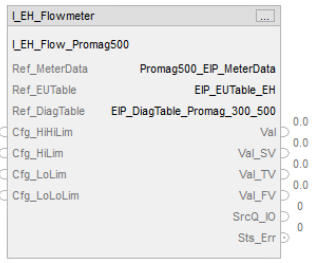


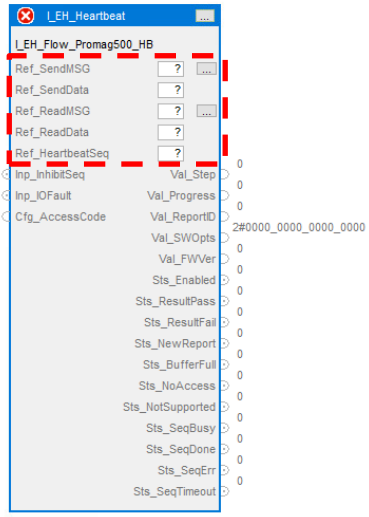
- Update the Tag name and click on the buttons “Apply” and “OK”:



- Next steps consists in creating and assigning all requested variables:

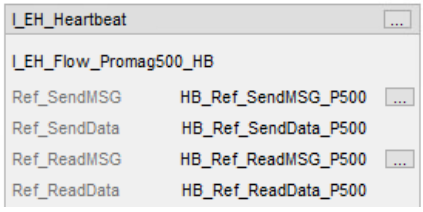




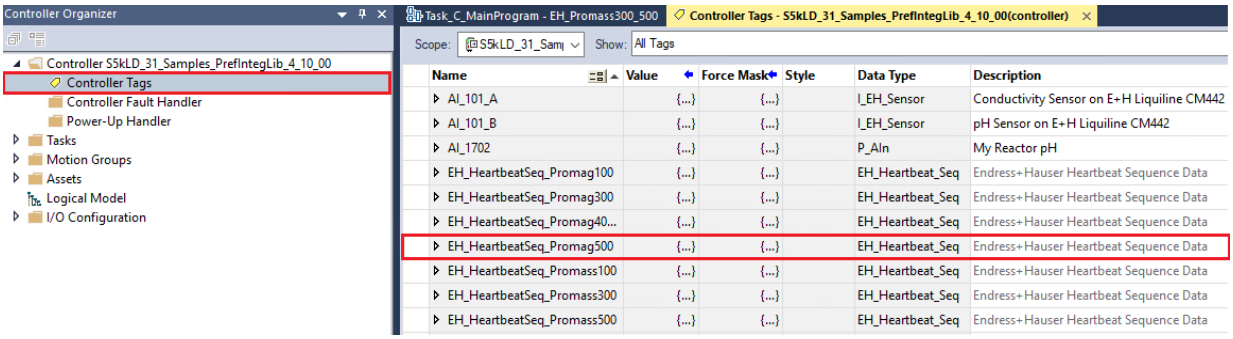


4.1.5.2 AOI Variables

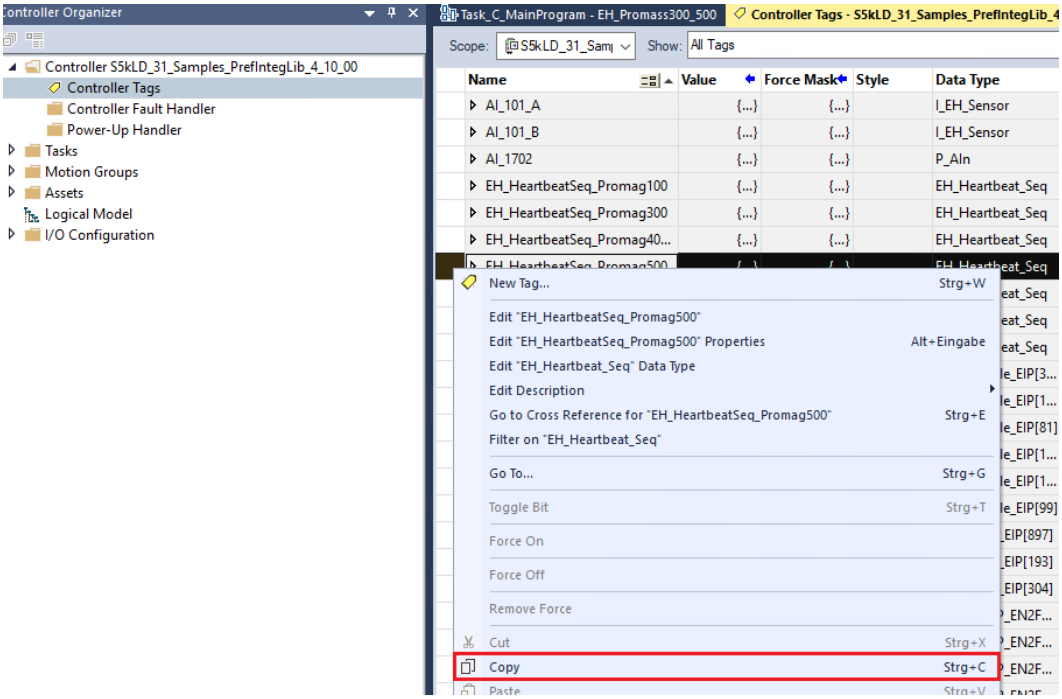
- Create a variable for each of following AOI parameters “Ref_SendMSG”, “Ref_SendData”, “Ref_ReadMSG” and “Ref_ReadData”:



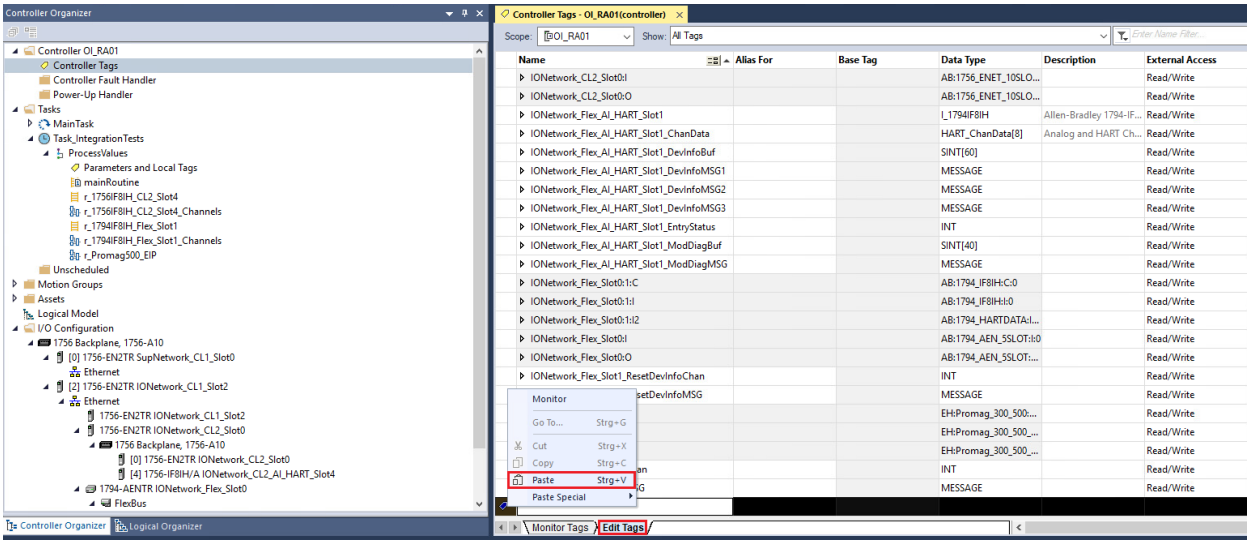
- The variable “Ref_HeartbeatSequence” is device specific. The easiest way is to copy the complete structure from the sample project and then to adapt the tag name if needed. Search the Heartbeat sequence parameter of the Promag500:



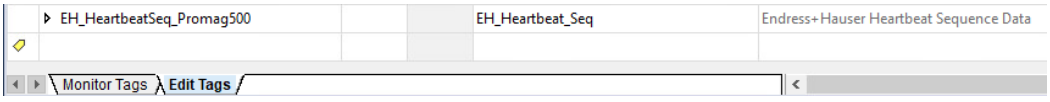
- Right-click on it and select the menu “Copy”:



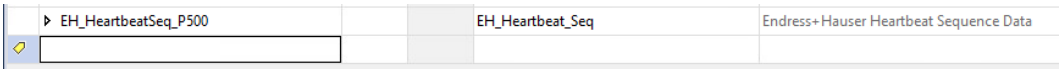
- In the current project, open “Controller Tags → Edit Tags”, right-click in the field and paste:



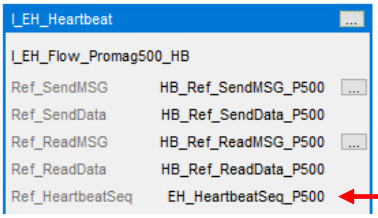
- This inserts the variable “EH_HeartbeatSeq_Promag500”:



- In this example, the variable is renamed:



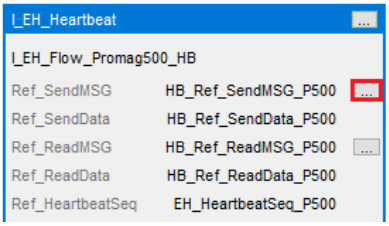
- Configured variables:



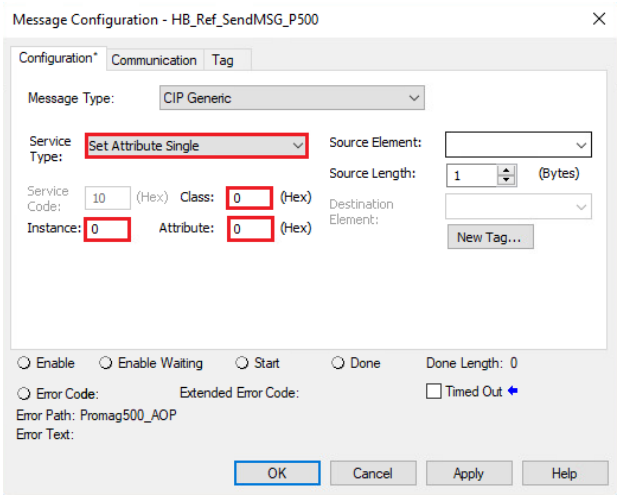
Heartbeat Sequence for Promag500

4.1.5.3 SendMSG Parameter Configuration

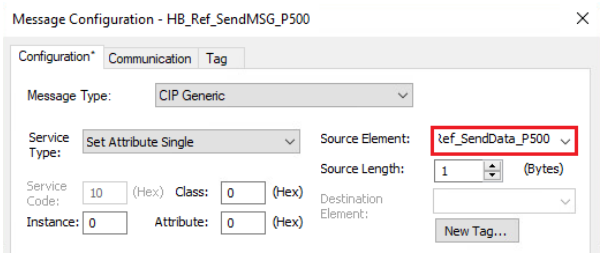
- Click on the Shortcut button closed to the variable “HB_Ref_SendMSG_P500”:



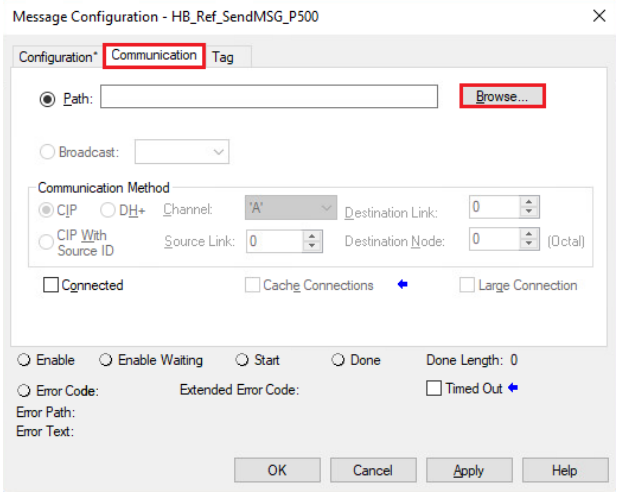
- Configure the Service Type to “Set Attribute Single” and assign the value “0” to the parameters “Class”, “Instance” and “Attribute”::



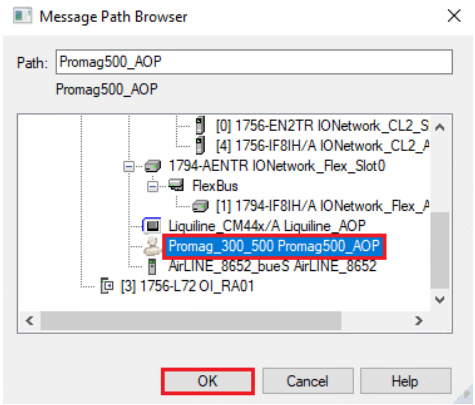
- Assign the variable “HB_Ref_SendData_P500” to the Source Element:



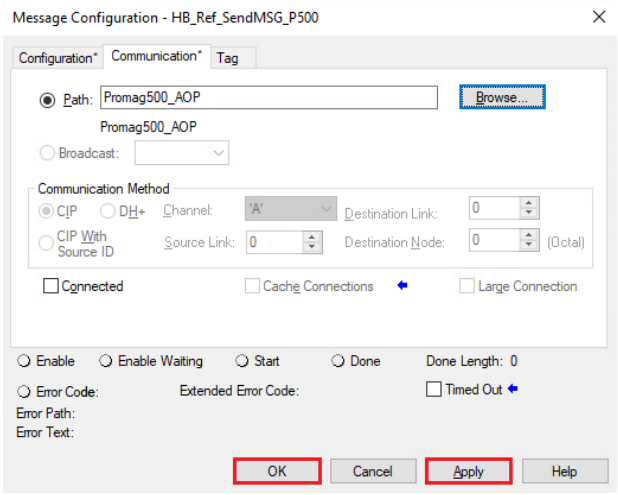
- Click on the tab “Communication” and on the button “Browse”:



- Select the Promag500 and click on the button “OK”:

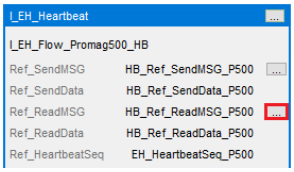


- Click on the button “Apply” and “OK” to save the configuration:

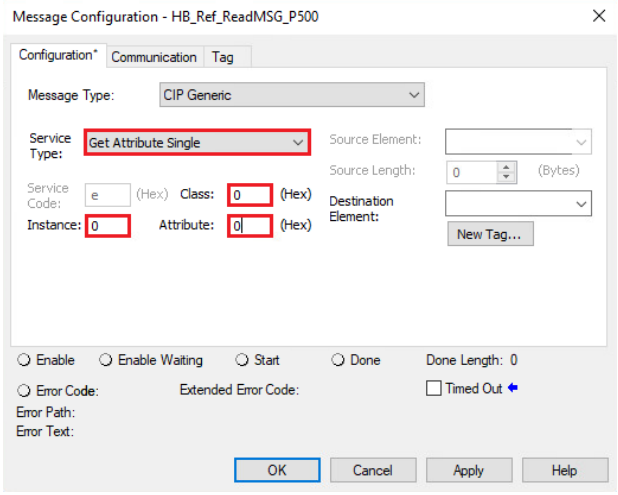


4.1.5.4 ReadMSG Parameter Configuration

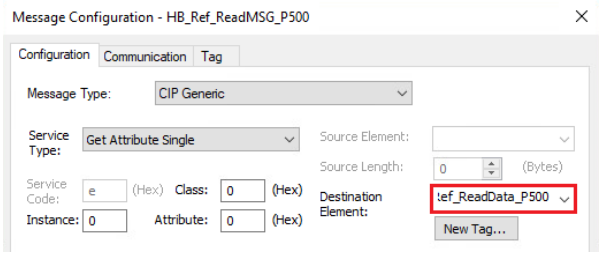
- Click on the Shortcut button closed to the variable “HB_Ref_ReadMSG_P500”:



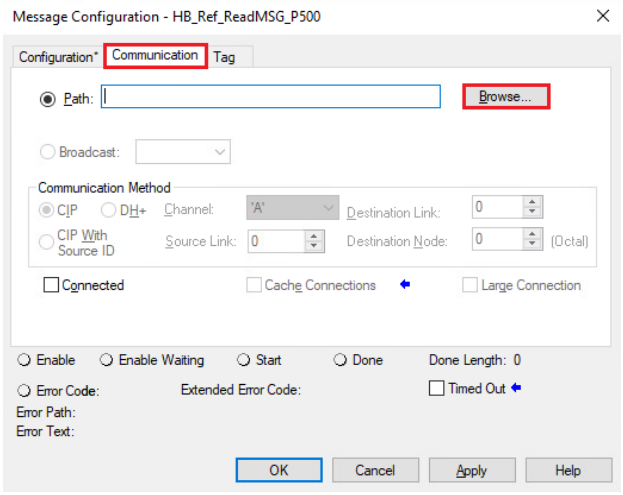
- Configure the Service Type to “Get Attribute Single” and assign the value “0” to the parameters “Class”, “Instance” and “Attribute”::



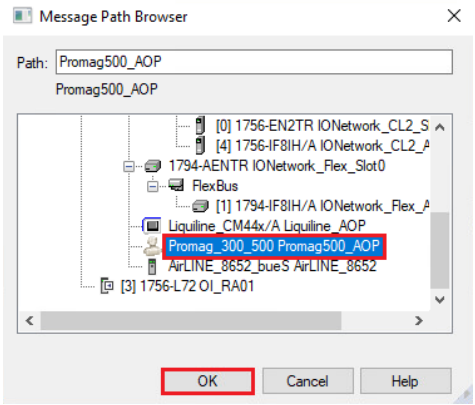
- Assign the variable “HB_Ref_ReadData_P500” to the Source Element:



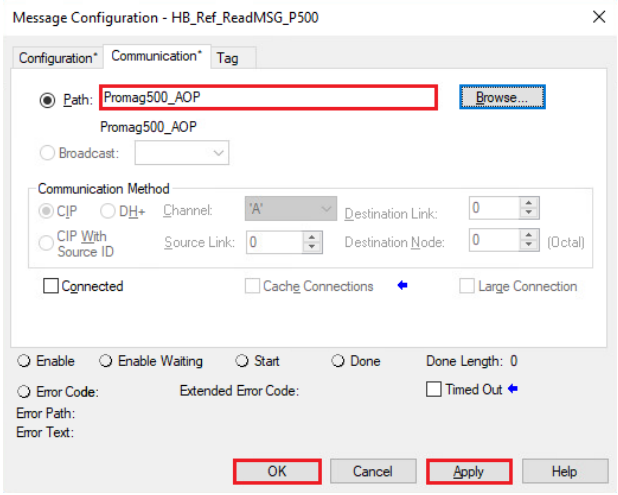
- Click on the tab “Communication” and on the button “Browse”:



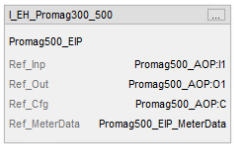
- Select the Promag500 and click on the button “OK”:

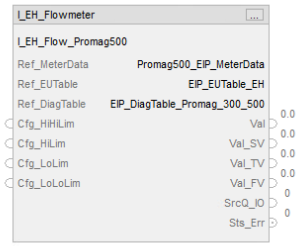


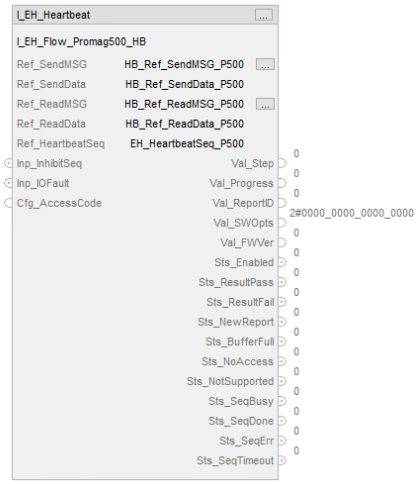
- Click on the button “Apply” and “OK” to save the configuration:



- Routine is ready to be downloaded:







4.1.6 Configuration Download

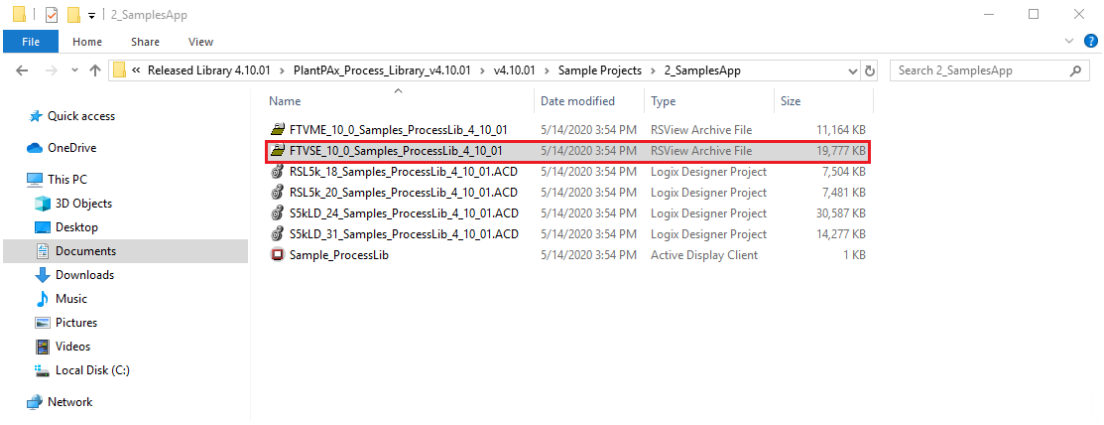
- Download the AOI programs in the PLC. Refer to chapter 3.4.2 to proceed.

4.2 Faceplates

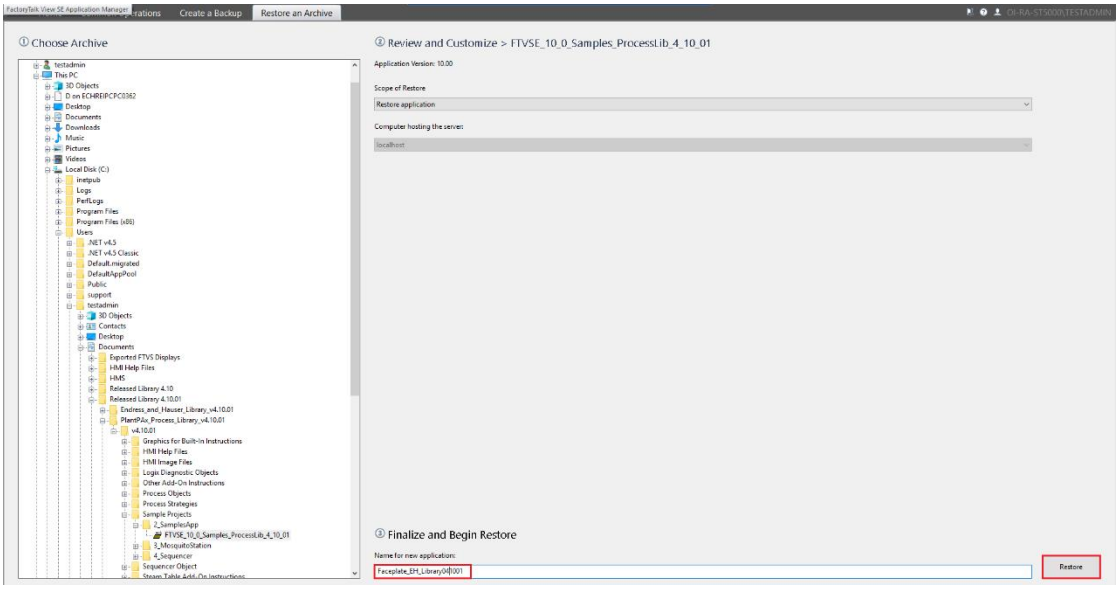
The following example uses as basis the available process library sample project. In a first part, the project will be restored and in a second part will be explained how configure analog input faceplates for Endress+Hauser field devices.

4.2.1 Restore a Sample Archive project

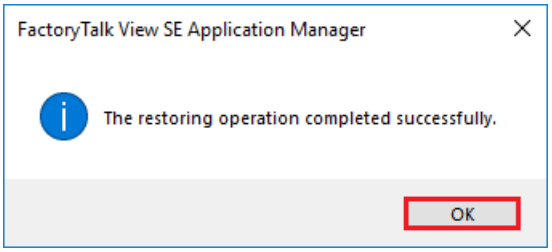
- Open the Process Library and double-click on the archive "FTVSE§10_0_Samples_ProcessLib_4_10_01":



- Enter a name for the Archive and click on the button "Restore":

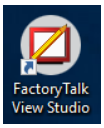


- Archive has been successfully restored:

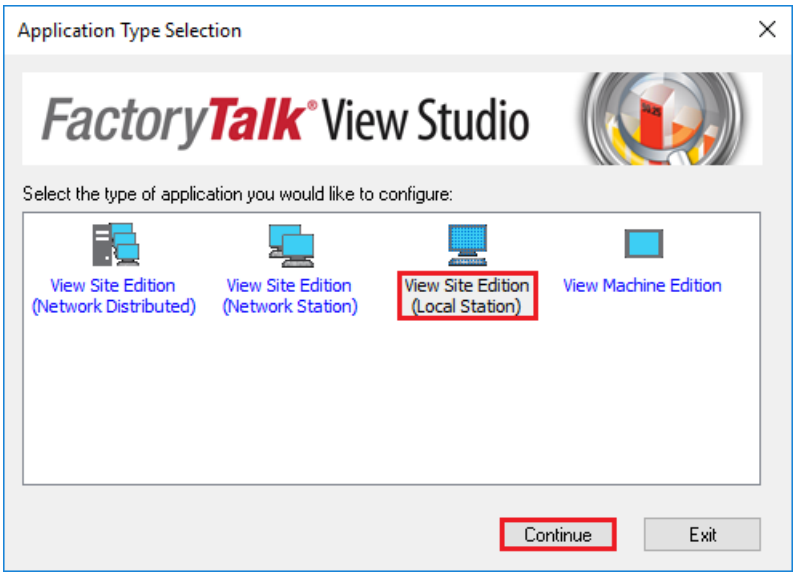


4.2.2 General Configuration

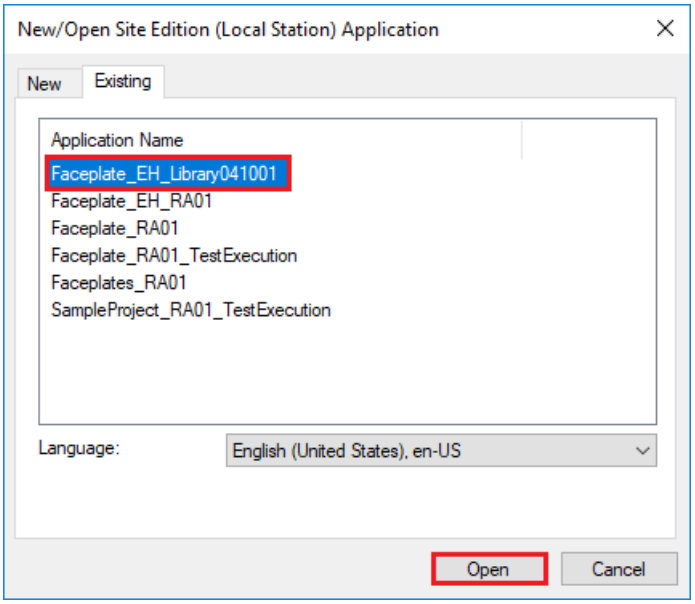
- Start the tool “FactoryTalk View Studio”:



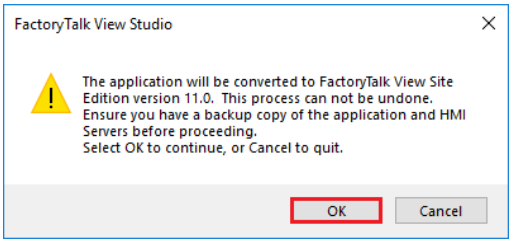
- Select the version “View Site Edition” and click on the button “Continue”:



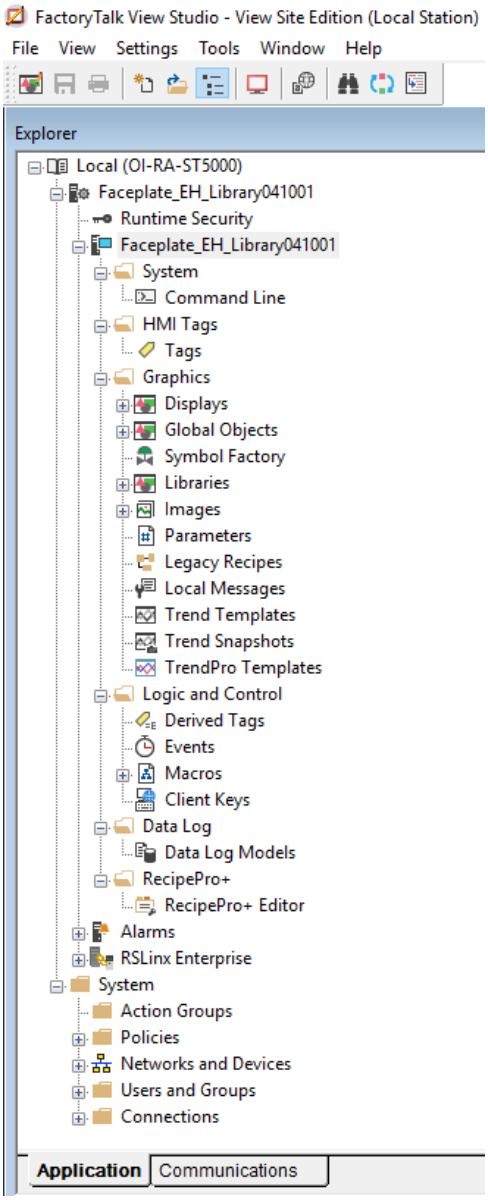
- Select the sample archive restored previously, “Faceplate_EH_Library041001” in this example and click on the button “Open”:



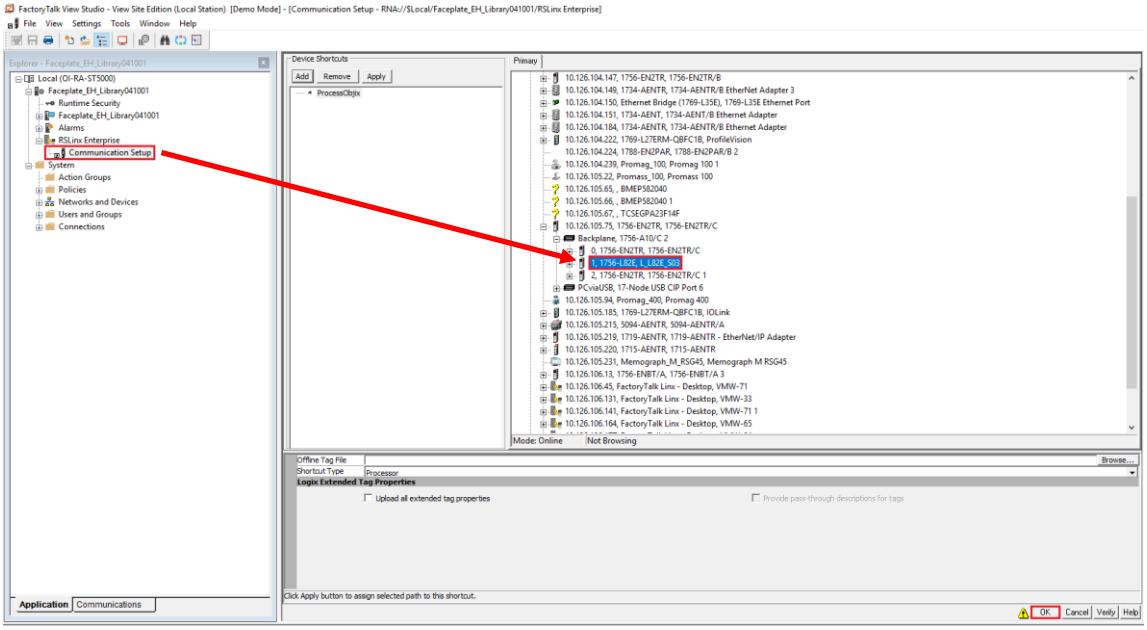
- Confirm by clicking on the button “OK”:



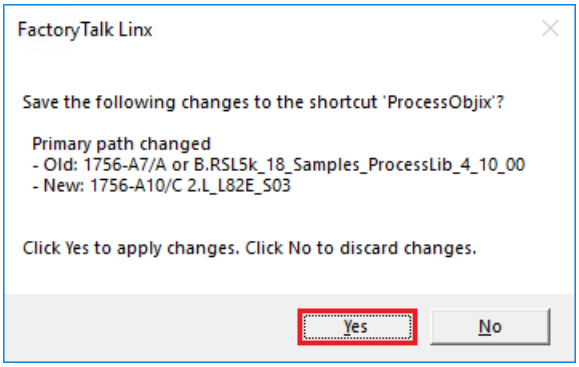
- Project is opened in Factory Talk View Studio:



- In the Explorer view, double click on the menu “Communication Setup” and select the used controller, then click on the button “OK”:

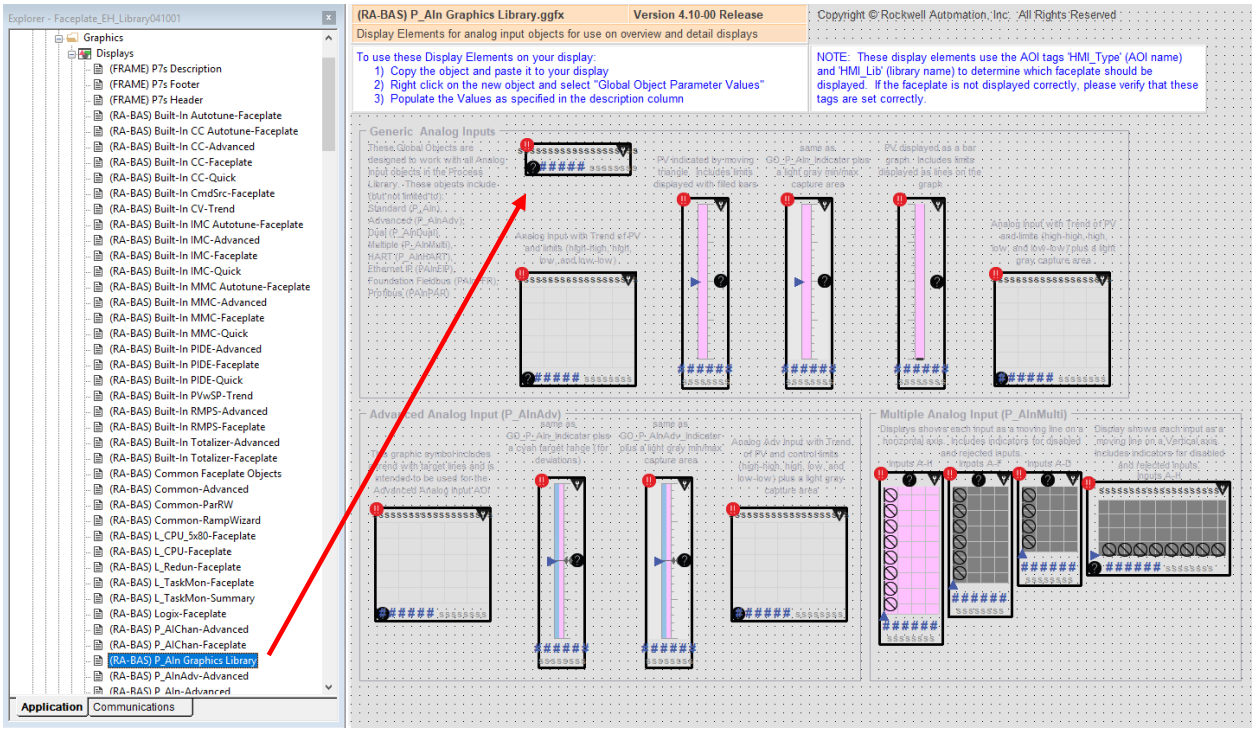


- Confirm by clicking on the button “Yes”:

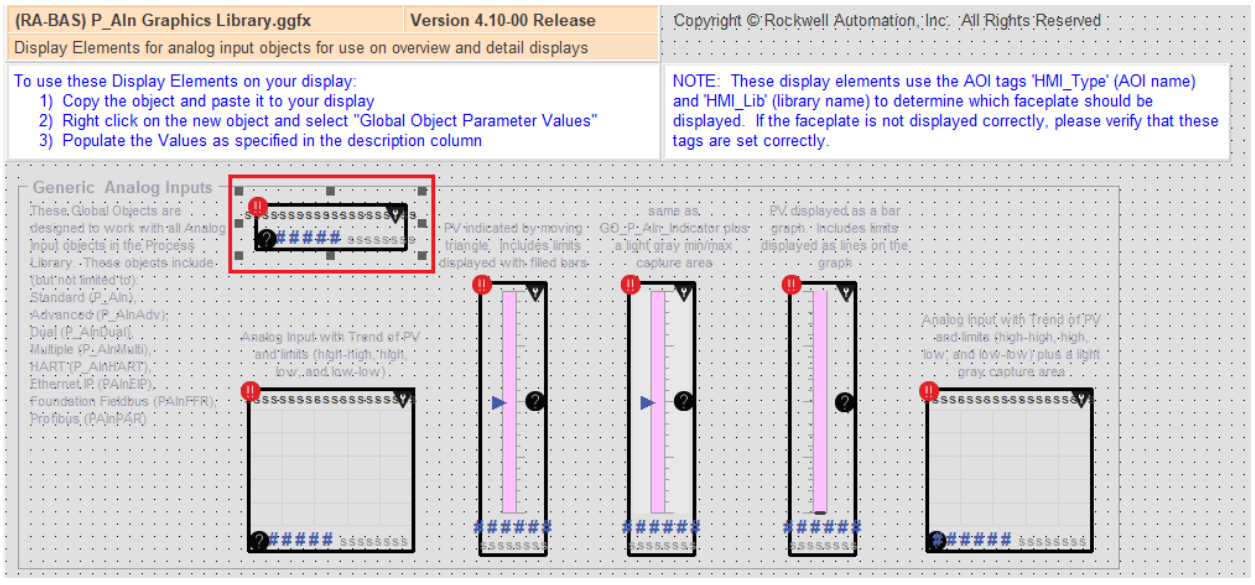


4.2.3 Generic Analog Input Faceplate

- In the menu “Display”, double-click on “(RA-BAS)P_Ain Graphics Library”. This opens a page with predefined objects, which can be copied and paste in another page:

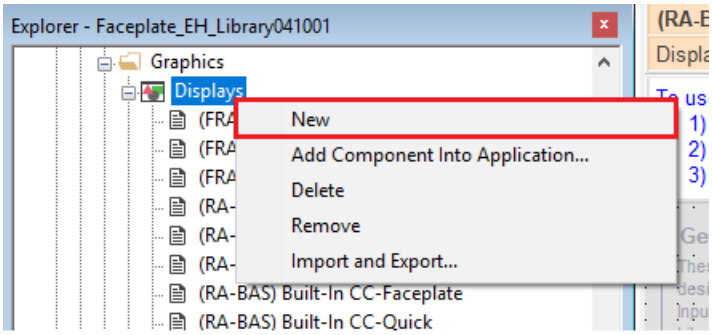


- On the top of this display are written in blue the steps to follow. Copy for example following faceplate:

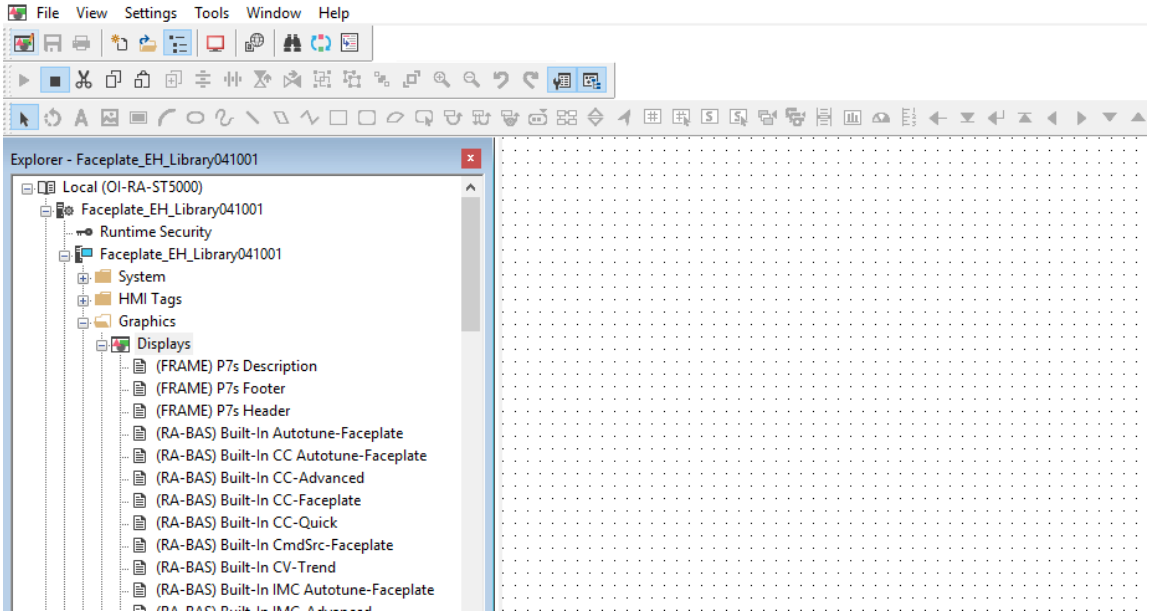


4.2.4 New Display

- Right-click on the menu “Displays” and select the menu “New”:

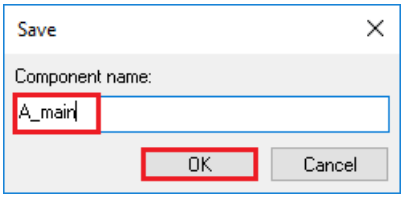


- This opens a new window:

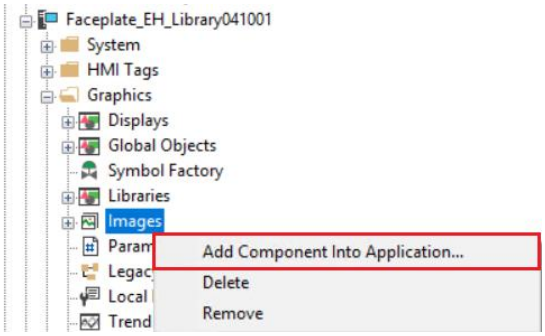


- Click on the button “Save”.

  Enter the name of the display and click on the button “OK”:

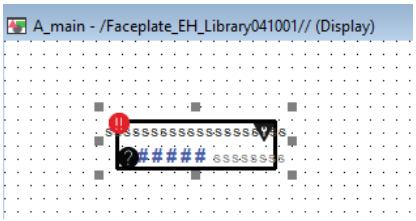


Remark

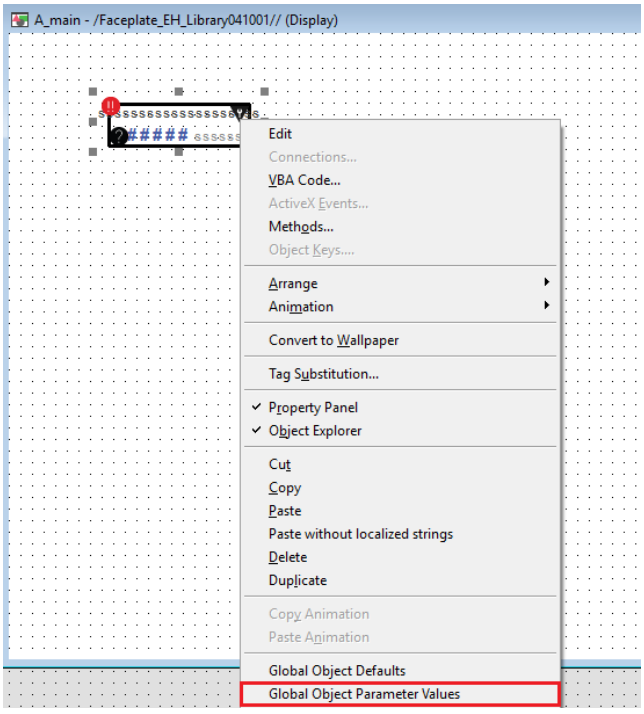
- In this example, images of the Endress+Hauser Process library have been imported as well. Right-click on the menu “Images” and select the menu “Add Component Into Apllication” to proceed:
- 

4.2.5 HART Analog Input Faceplate Configuration

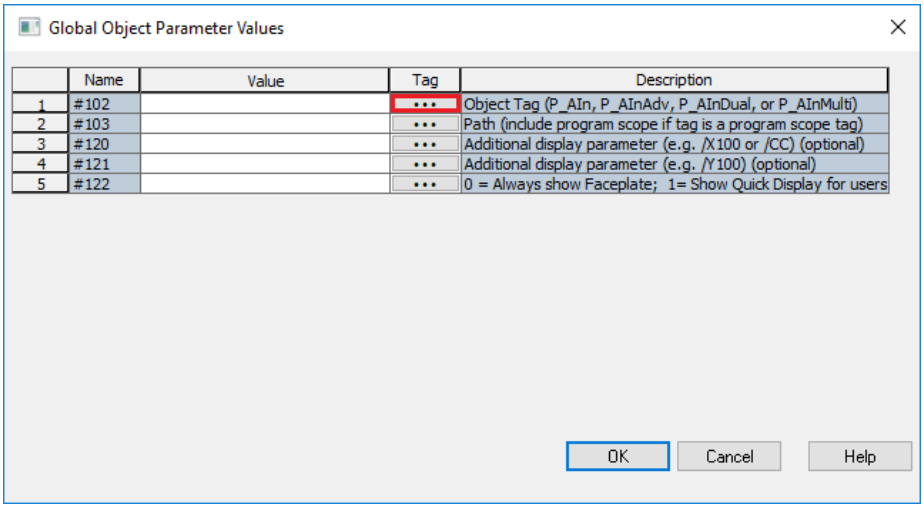
- In the created display “A_main”, paste the analog input faceplate copied previously from the display “(RA-BAS) P_AIn Graphics Library”:



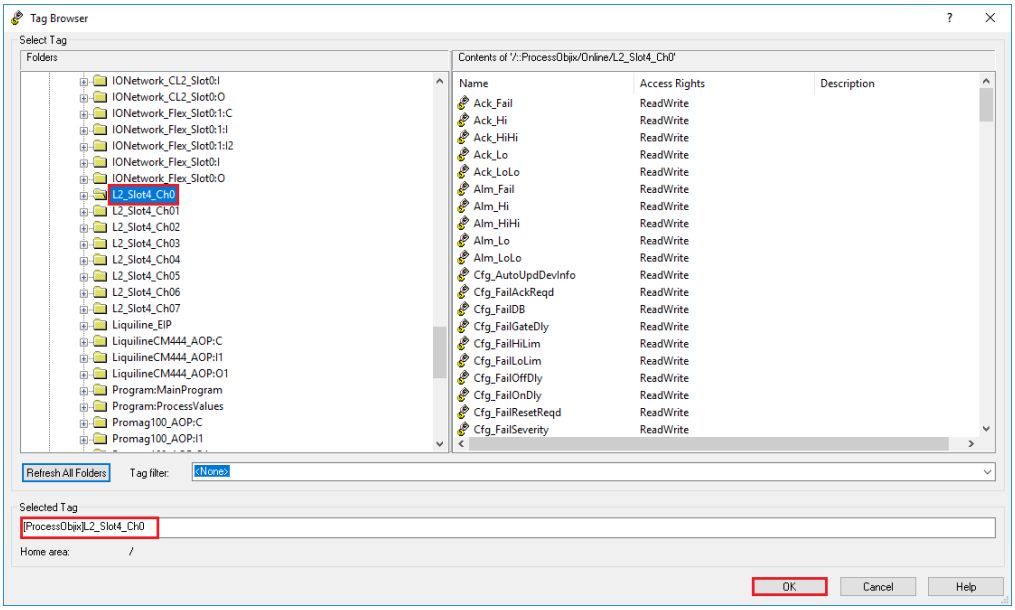
- Right-click on the faceplate and select the menu “Global Object Parameter Values”:



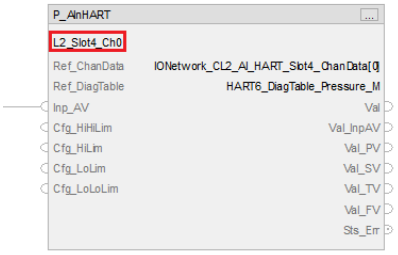
- Following window is displayed. Click on the shortcut button to search the variable to address:



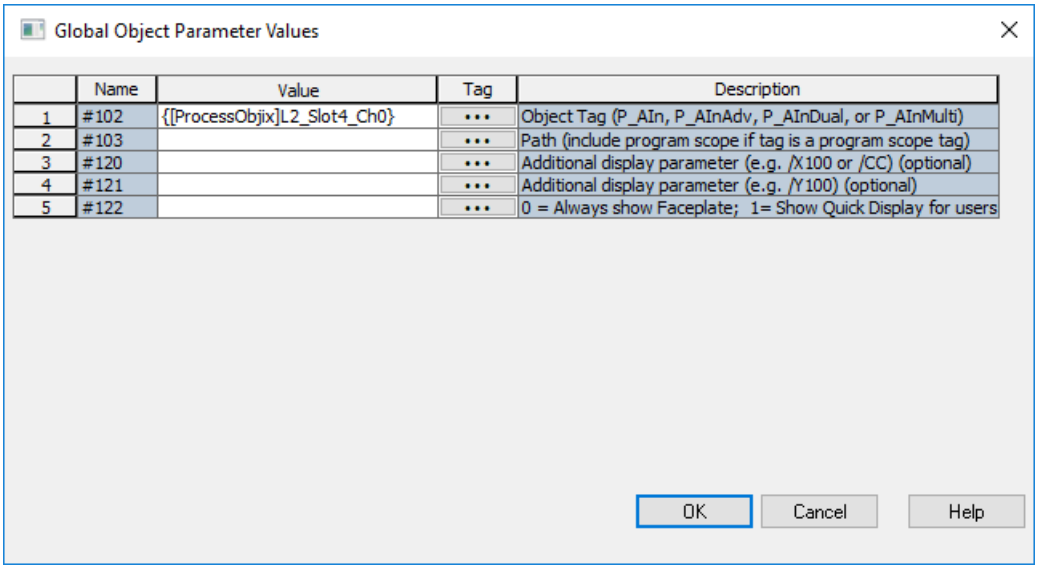
- Select the P_AinHART datatype variable, "L2_Slot4_Ch0" in this example, which refers to the channel to connect and click on the button "OK":



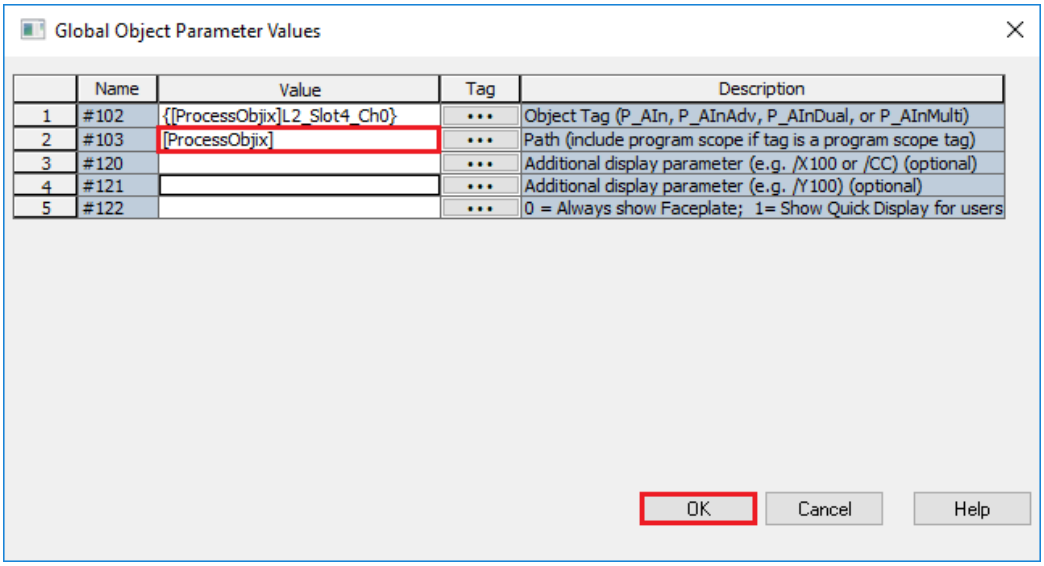
- The selected variable correpsonds to the AOI defined in chapter 4.1.2.3.3 for Channel 0:



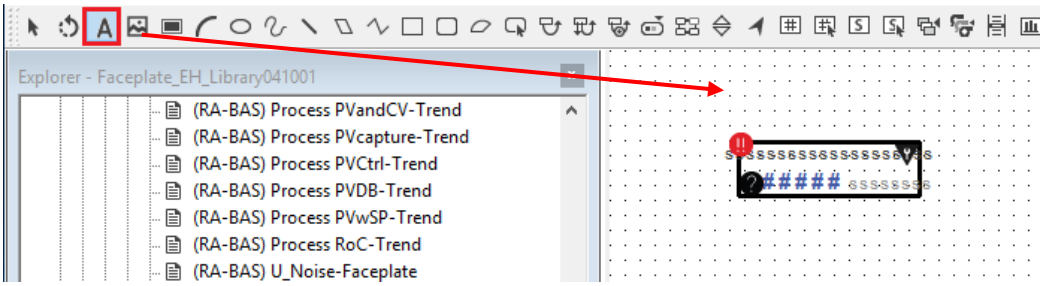
- Click on the second shortcut button:



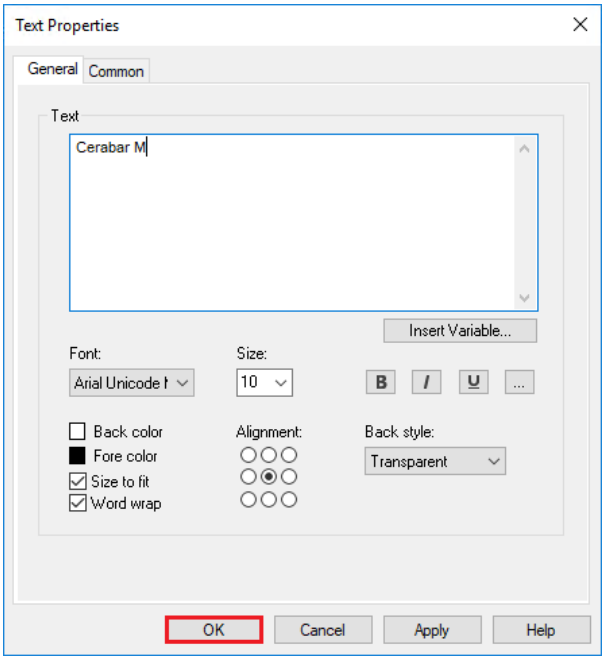
- Include as well the second variable, which refers to the path name defined in the communication setup and click on the button “OK”:



- Click on the shortcut “Text”. Then drag and drop it in the page:



- This automatically opens the window “Text Properties”:

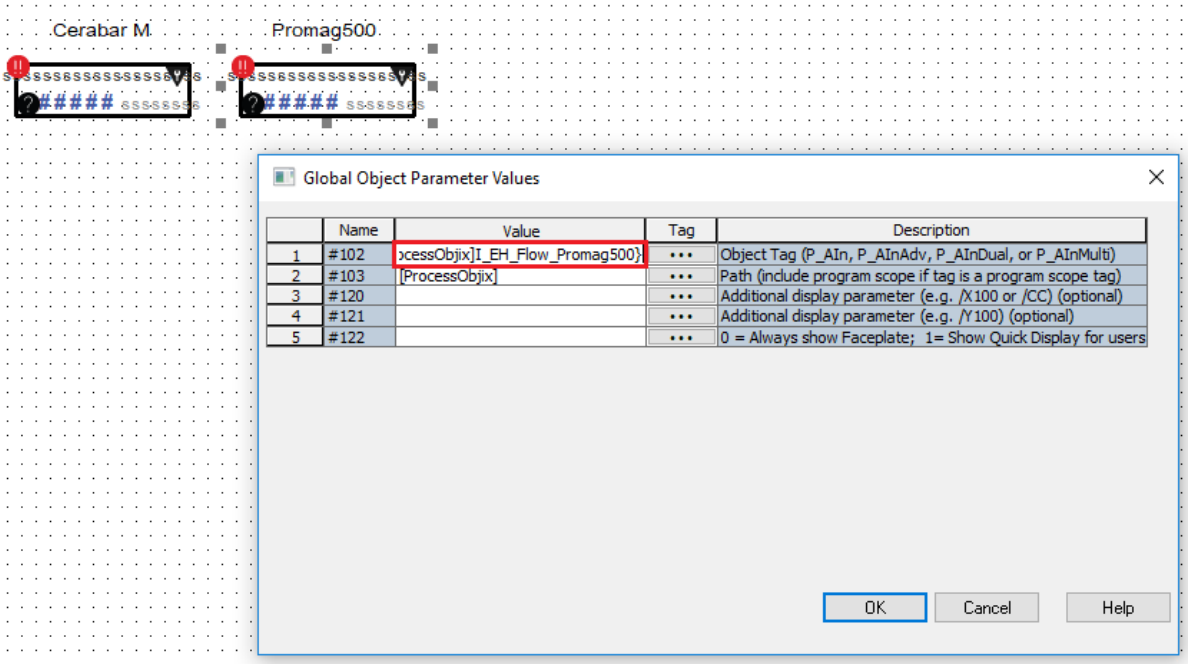


In this example, the text is “Cerabar M”. Click on the button “Apply” and “OK”.

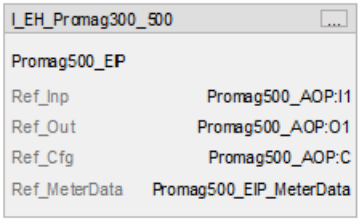
- This inserts the text in the page:

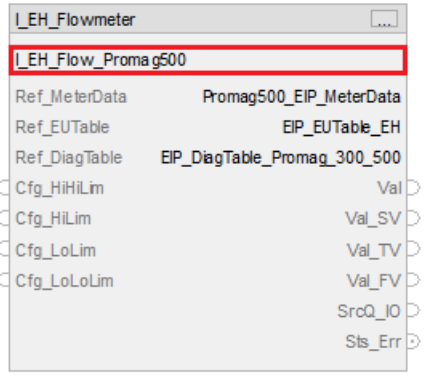
4.2.6 EtherNet/IP Faceplate Configuration

- Repeat the same steps as done for the HART analog input faceplate (Only the variable assignment is different and has to refer to the Ethernet IP AOI):



- The selected variable correpsonds to the AOI defined in chapter 4.1.4.1 for the Promag500:





4.2.7 Faceplates Online Connection

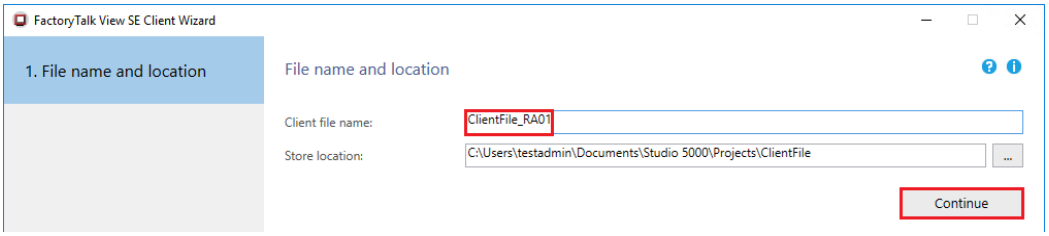
4.2.7.1 Client Wizard Configuration

4.2.7.1.1 First Connection

- Save the configuration and click on the shortcut button “Launch SE Client”:

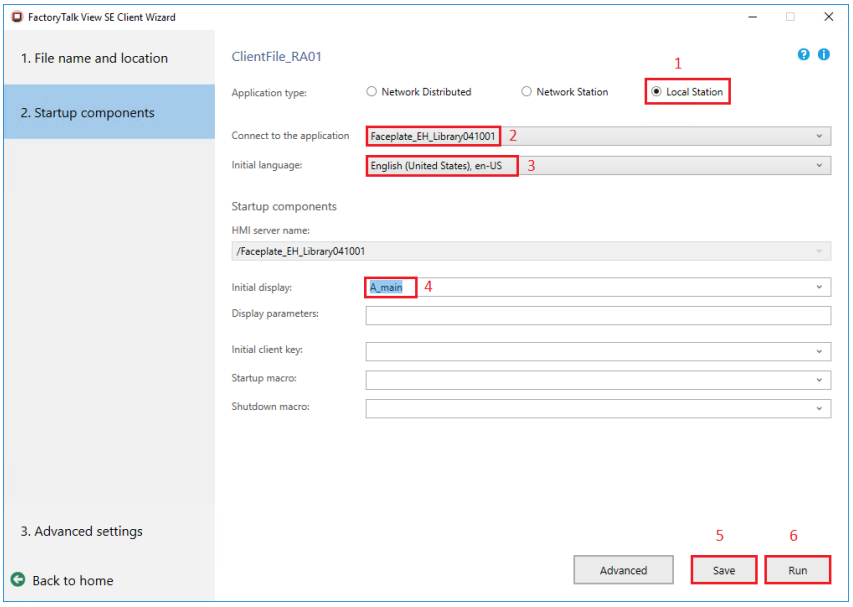
- A new client configuration file must be created the first time. Click on the button “Create a FactoryTalk View SE Client configuration file”:

- Enter a configuration file name and click on the button “Continue”:

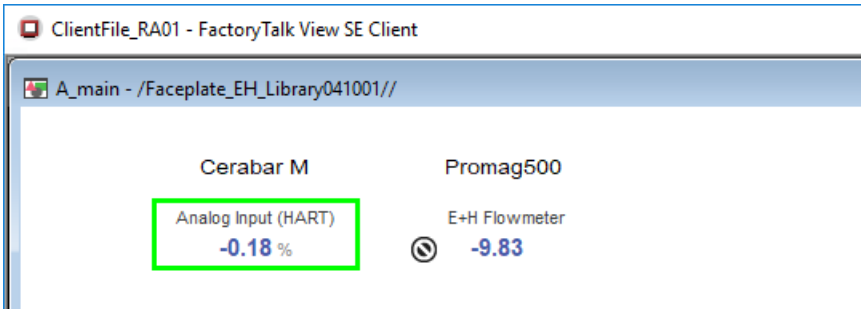


In this example, the configuration file name is “ClientFile_RA01”.

- Following configuration has be done for this example:



- This runs the application:

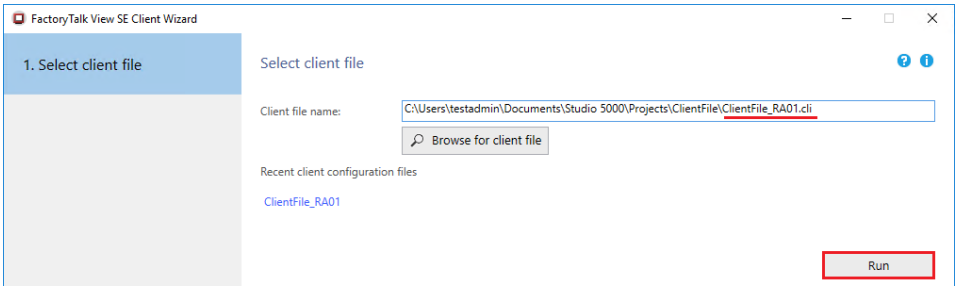


4.2.7.1.2 Normal Use Case

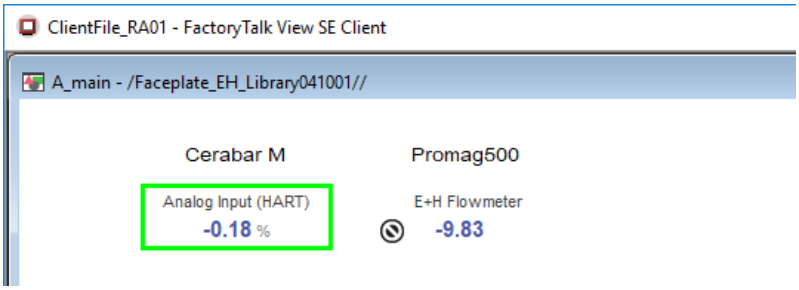
- Save the configuration and click on the shortcut button “Launch SE Client”:

- If the client configuration file has already been created, click on the button “Run an existing FactoryTalk View SE Client configuration file”:

- The created client configuration file is already select. Click on the button “Run”:



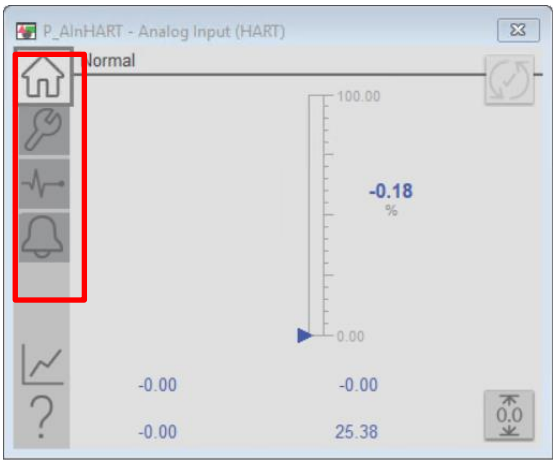
- This runs the application:



4.2.7.2 HART Analog Input Faceplate

- Click for example on the “Cerabar M” analog input box:

- This opens the faceplate main page:



On the left part of this page are displayed the main shortcut buttons:

Home - Operator

Maintenance

Diagnostics

Alarms

4.2.7.2.1 Process Values

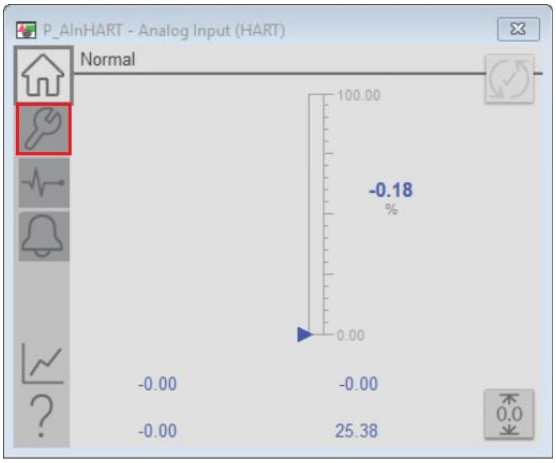
- The main page displays the process data:

HART data (PV, SV, TV, QV)

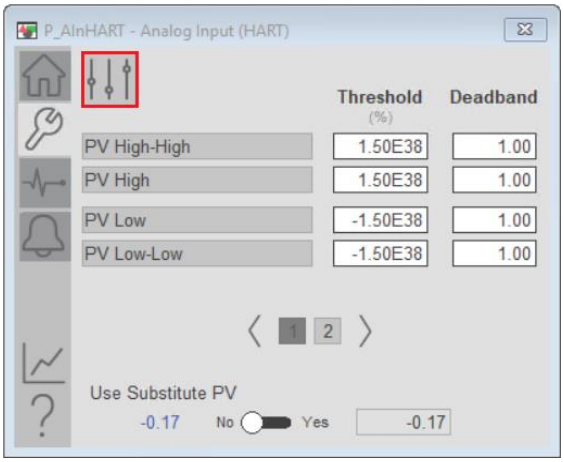
Labels and units must be entered manually

4.2.7.2.2 Raw Input Scaling

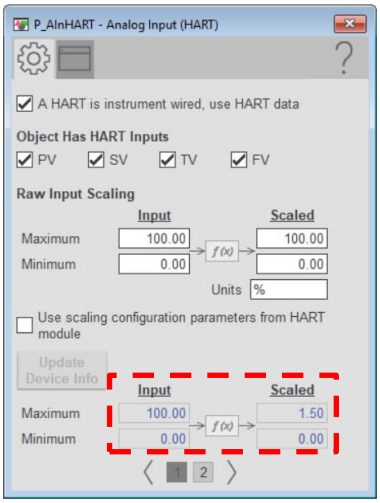
- Click on the “Maintenance” symbol:



- Click on “Display/Advanced Properties“ symbol:



- This allows the user to configure the HART inputs and the Raw Input Scaling:



When cross-checked, corresponding HART data is displayed in the main faceplate

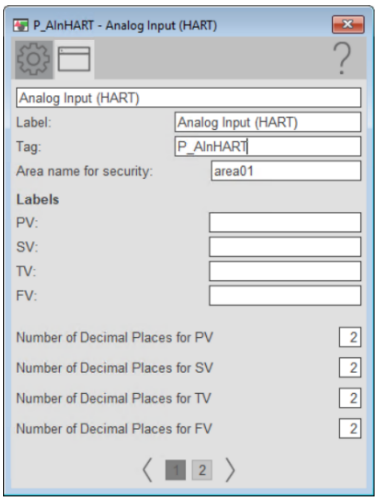
Default Raw Input Scaling and unit

Selecting this option configures following values for the “Raw Input Scaling”

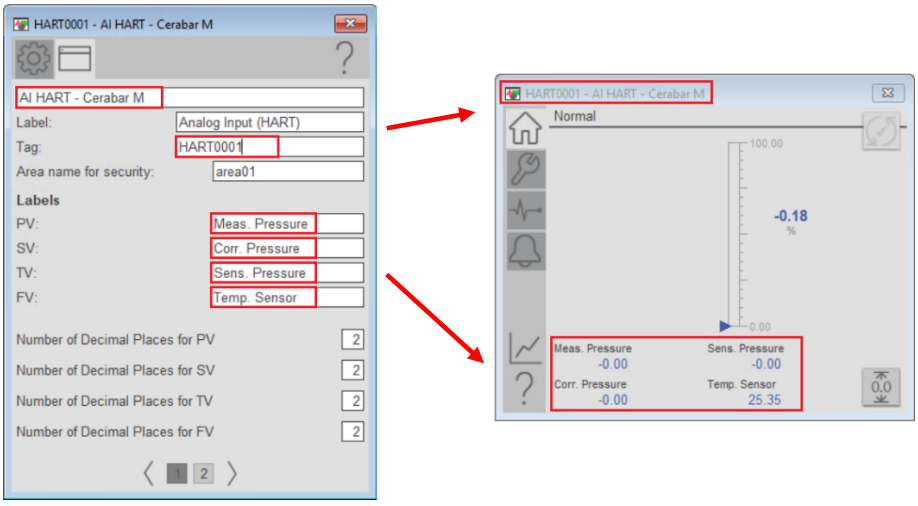
4.2.7.2.3 HART Process Data Labels and Units

- Click on the buton “HMI Configuration”:

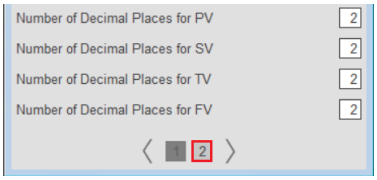
- This opens the following window:



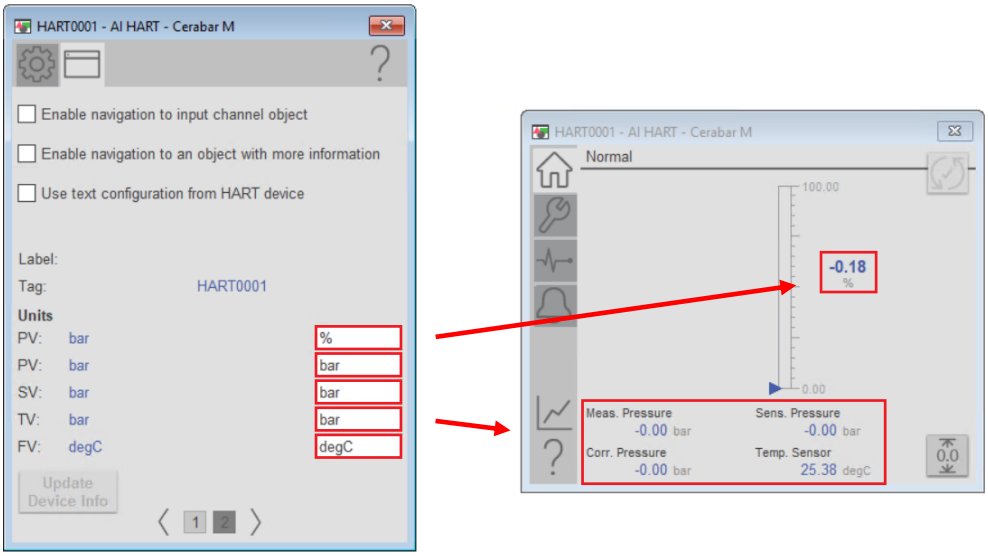
- Update the field device labels. This will be update the main page:



- Click on the button “2” to go to the next page:

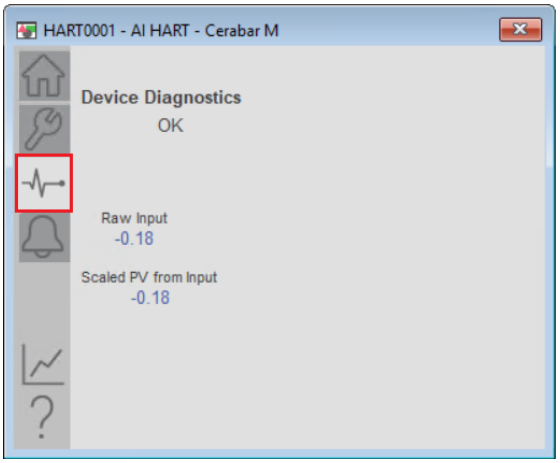


- Update the field device units. This will be update the main page:



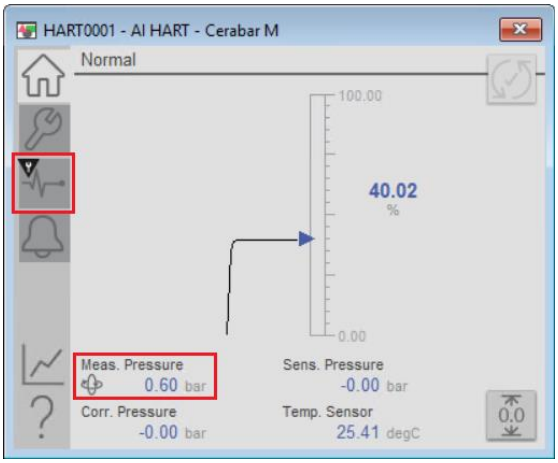
4.2.7.2.4 Device Diagnostics

- Click on the shortcut button Diagnostics:



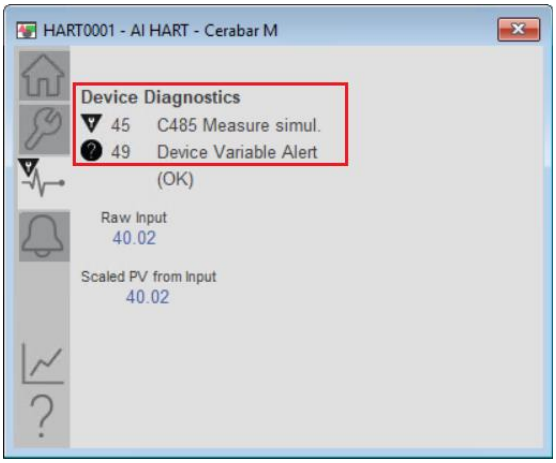
Current field device diagnostics is “OK”.

- In following example, the Cerabar M pressure is simulated and equals 0.6 bar:



The symbol “Diagnostics” displays the NAMUR status “Function Check”.

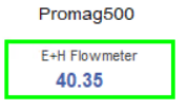
- Corresponding messages in the Diagnostics menu:



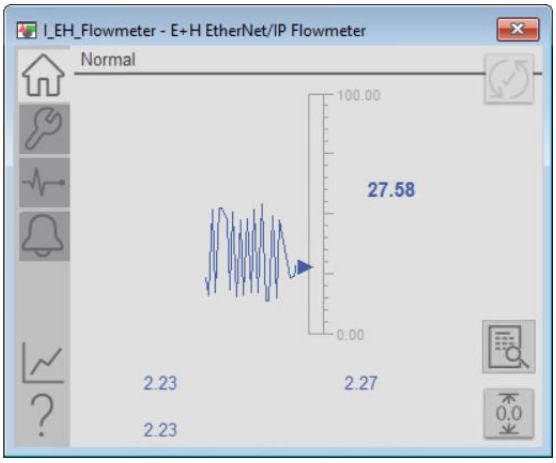
Refer to Rockwell Automation documentation for further details about faceplates handling.

4.2.7.3 EtherNet/IP Promag500 Faceplate

- Click for example on the “Promag500EIP”:

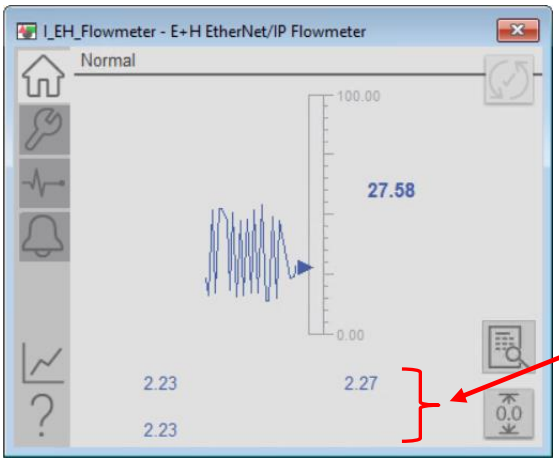


- This opens the faceplate main page:



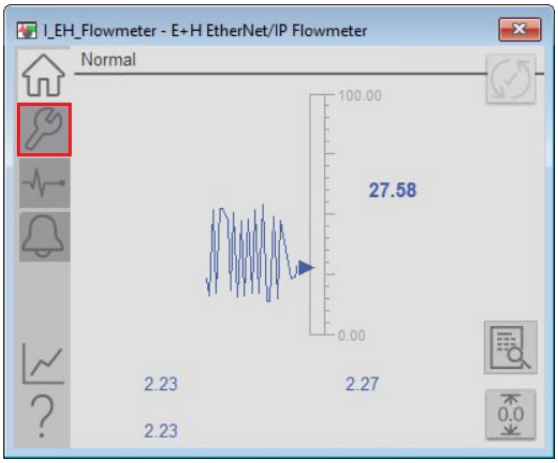
4.2.7.3.1 Process Values

- The main page displays the process data:

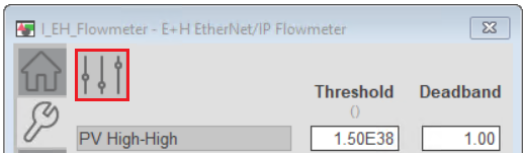


4.2.7.3.2 Input Mapping

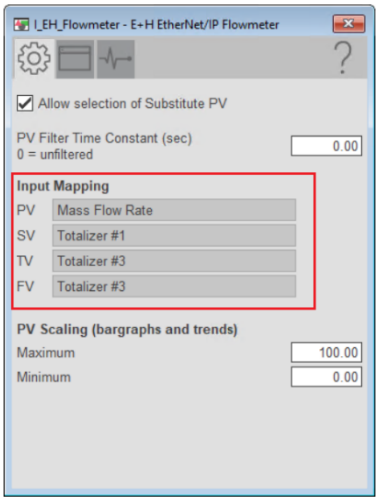
- Click on the buton “Maintenance”:



- Click on the buton “Display Advanced Properties”:

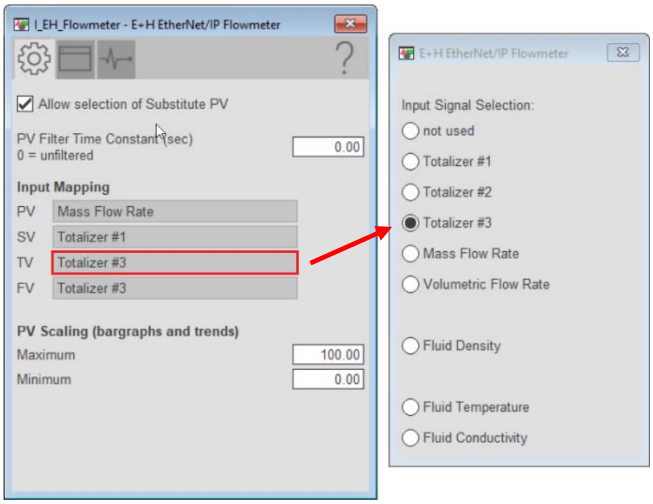


- This displays following window:

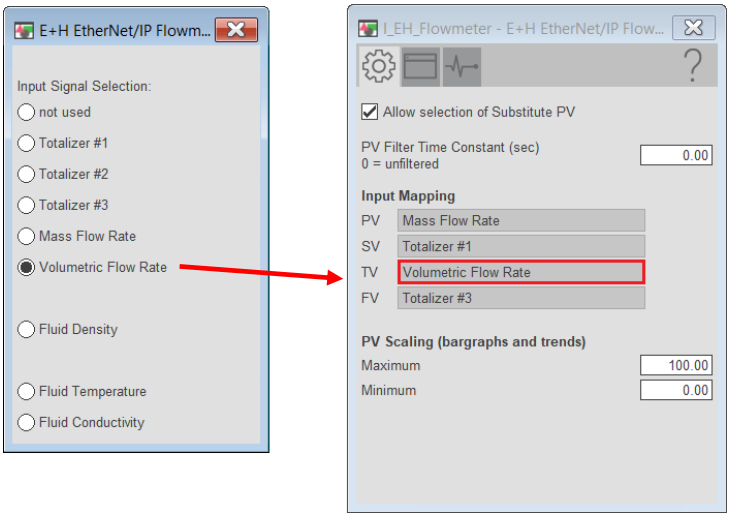


The four inputs of the main page can be configured here.

- Click for example on the TV input “Totalize#3”:

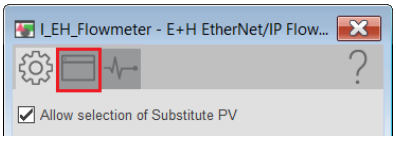


Selecting another variable updates automatically the Input Mapping variable:

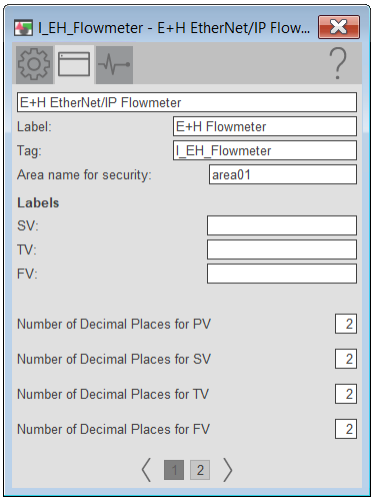


4.2.7.3.3 Process Data Labels and Units

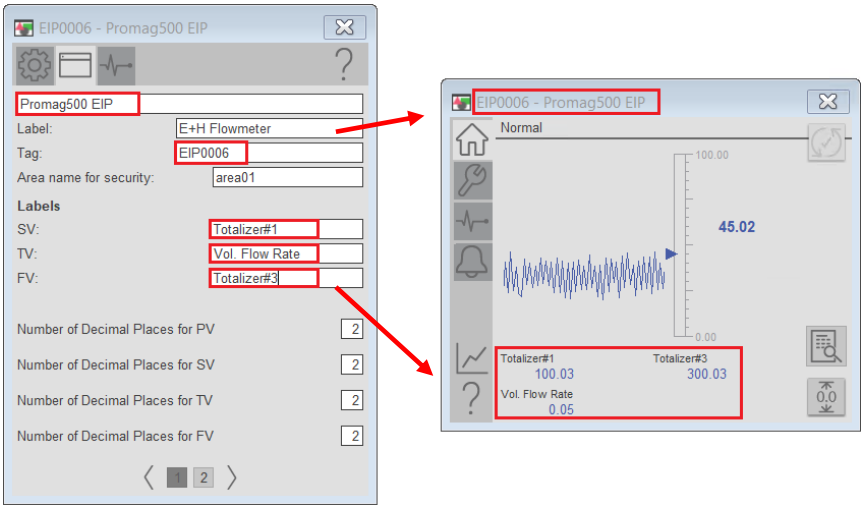
- Click on the button “HMI Configuration”:



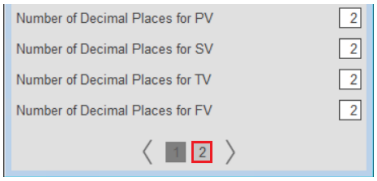
- This opens the following window:



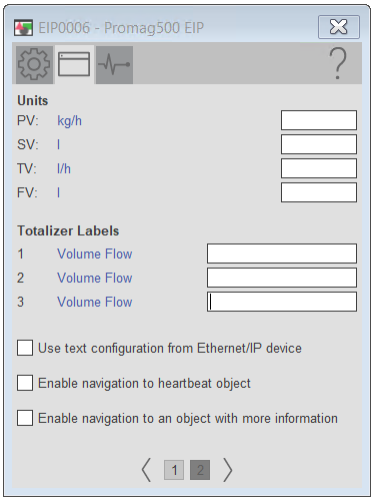
- Update the field device labels. This will be update the main page:



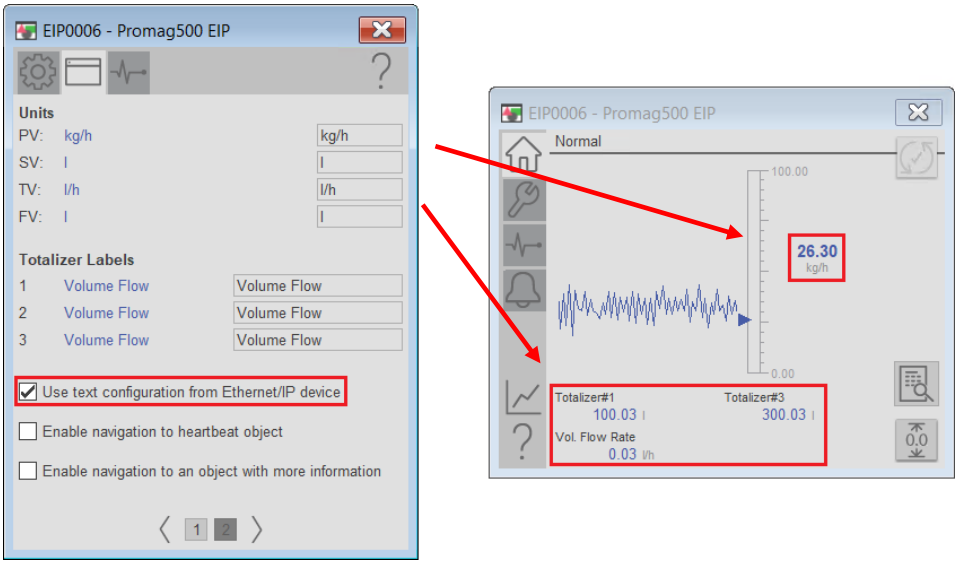
- Click on the button “2” to go to the next page:



- This opens the following window:



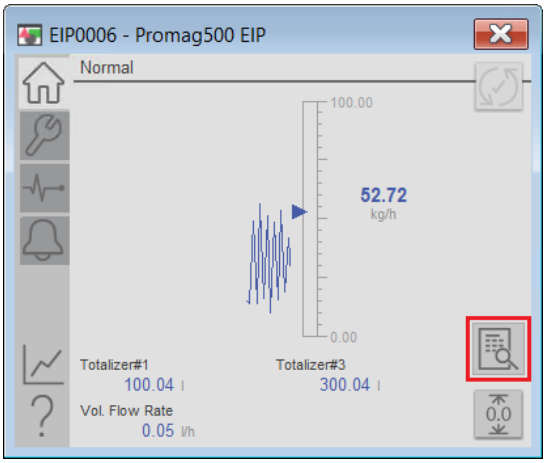
- Select for example the option “Use text configuration from Ethernet/IP device”



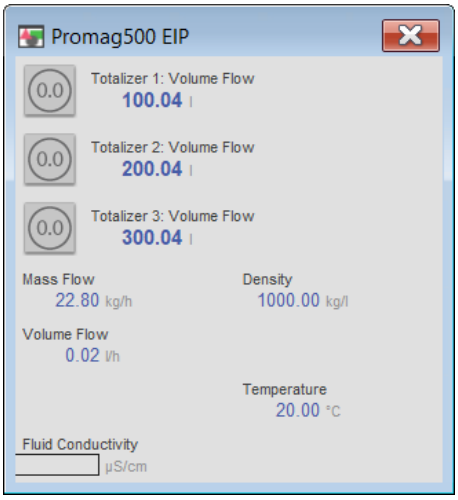
This updates the Units and Totalizer labels on the current page and automatically on the main page.

4.2.7.3.4 Reset Totalizer

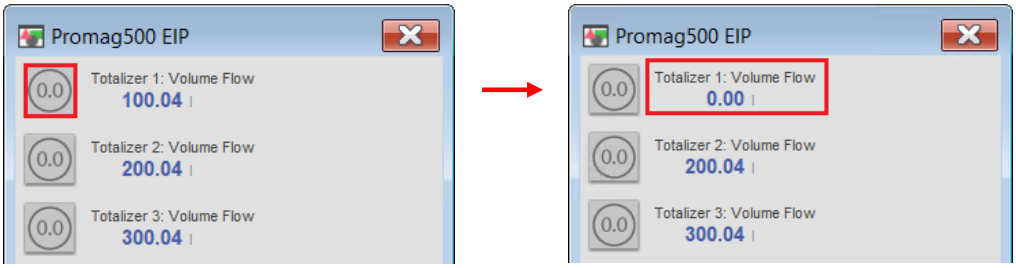
- On the main Faceplate, click on the button “Display Flowmeter Inputs”:



- This opens following window:



- For example, to reset Totalizer#1, click on the shortcut button:

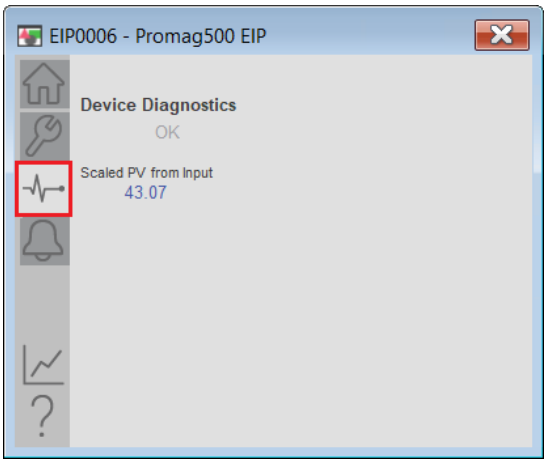


Remarks:

- Totalizer labels have been configured in previous chapter
- The variable “Fluid Conductibity” is empty because the measurement does not exist.

4.2.7.3.5 Device Diagnostics

- Click on the shortcut button Diagnostics:

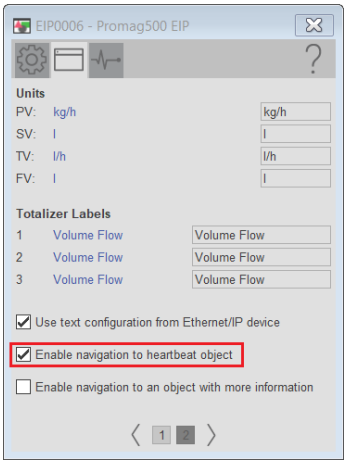


Current field device diagnostics is “OK”.

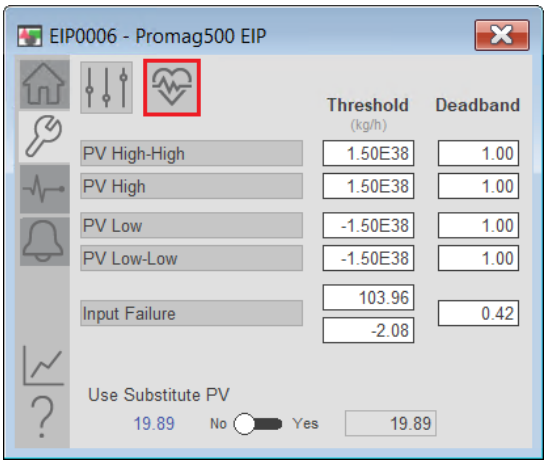
4.2.7.3.6 Heartbeat

The Heartbeat function can only be executed if the option is enabled in the device and in the faceplate.

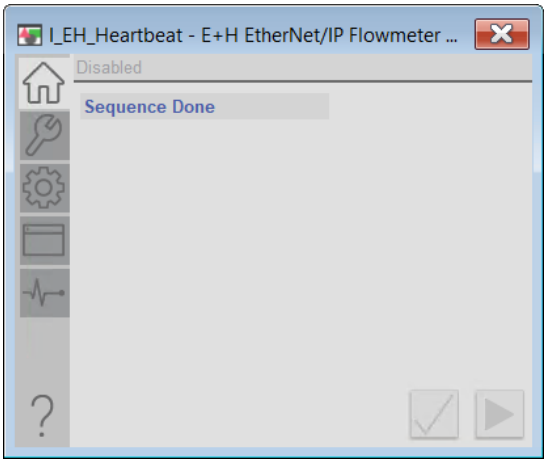
- The Heartbeat option can be enabled in the faceplate by going through the menus "Maintenance→Display Advanced Properties→HMI Configuration" and then by selecting page 2:



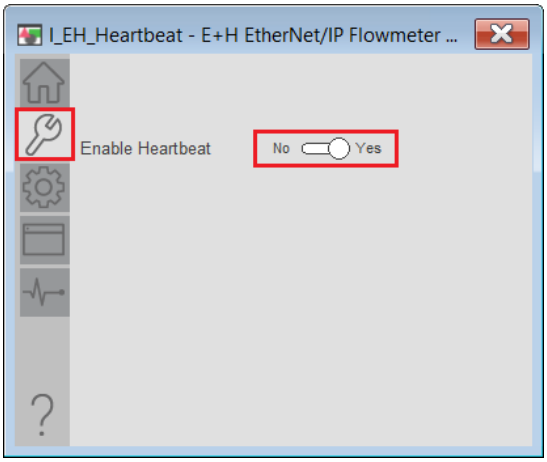
- Once enabled, the maintenance menu contains one additional shortcut button. Click on this button:



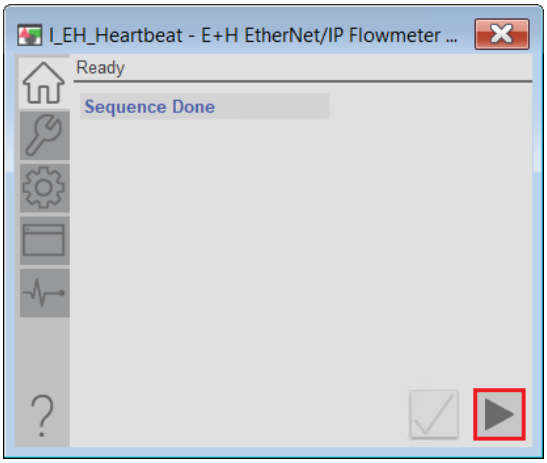
- This displays the Heartbeat main page:



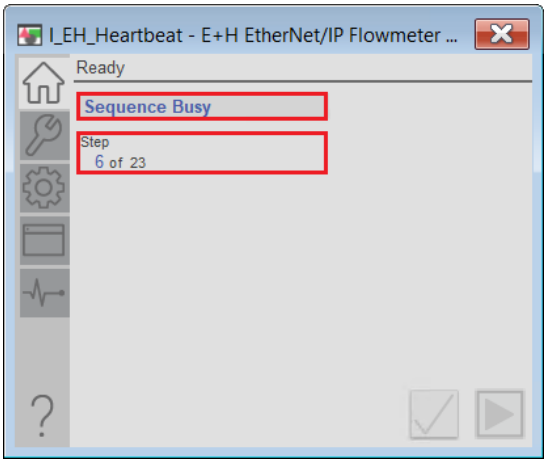
- Click on the button “Maintenance” and enable the Heartbeat function:



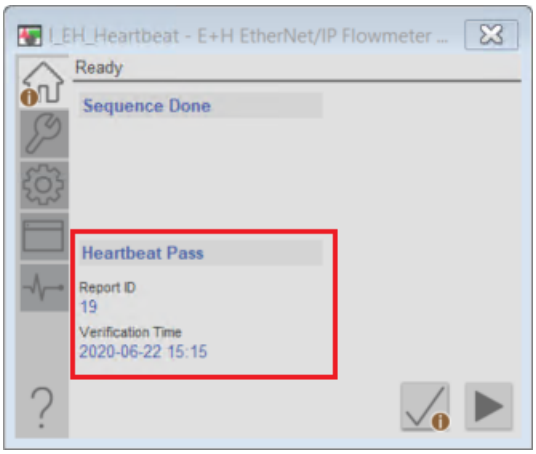
- Go back to the main page and click on the button “Start heartbeat verification”:



- Hearbeat verification is running, Status (“Sequence Busy”)and Sequence Step (“6 of 23”) are displayed:



- A Message is displayed when the Heartbeat Verification is finished:



Heartbeat verification report can be downloaded either by using the DTMs or via Web Server. Refer to chapter 6.3.

4.3 HART Commands

This chapter explains how to handle HART commands over Ethernet IP from the control strategy.

4.3.1 Principle

There are two aspects to consider, either the message is intended to the communication module (with CIP Services) or to the device (with pass-through messages). The configuration of these possibilities is different and is not identical for the 1756 ControlLogix HART analog input modules and the 1794 Flex I/O modules.

4.3.2 CMD48 Configuration by using HART object data

4.3.2.1 Case of 1756 ControlLogix HART analog input module IF8IH

Following example explains how to configure the HART CMD48 to get information on a device connected on the HART analog input module 1756-IF8IH on Channel 7.

4.3.2.1.1 Specific Data Type

The structure of the CMD48 response telegram is defined in the ControlLogix HART Analog I/O Modules user manual in the chapter “Read Additional Status Service Code 16#4C”:

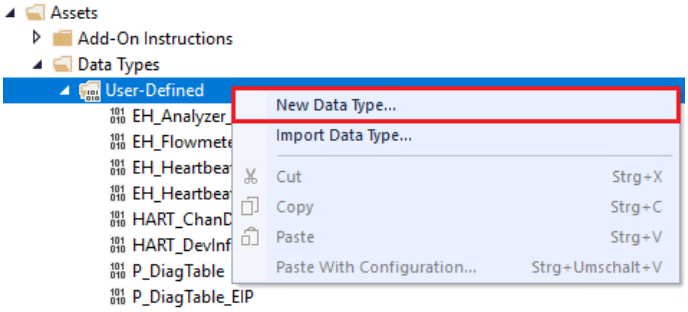
Table 94 - Reply Packet - Request Succeeded

Offset	Offset	Data Type	Definition
0	Status	USINT	Command status
1	Count		Number of Ext Status bytes available
2…26	Ext Status Bytes		Extended Status bytes returned by CMD48
7	Pad		Pad type

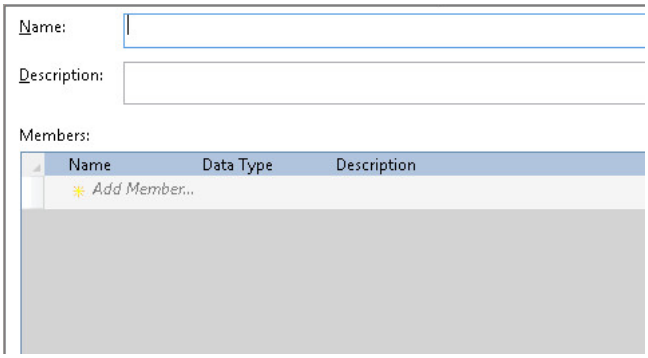
Reply Size = Instance 1…8: 2…28 bytes; Instance 0: 224 bytes. If sent to Instance 0, all channels of the module are included in the response, which results in 28 bytes per channel. This total is due to 27 bytes of response to the HART Read Additional Status plus 1 byte of pad to align the data to a 32-bit boundary.

This data structure must now be defined.

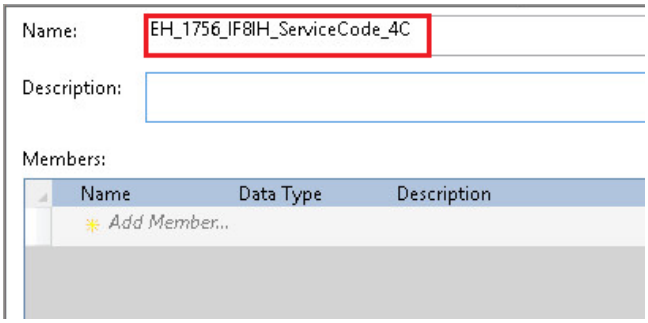
- In the project view, right-click on the “User-Defined” menu of “Data Types” and select “New Data Type”:



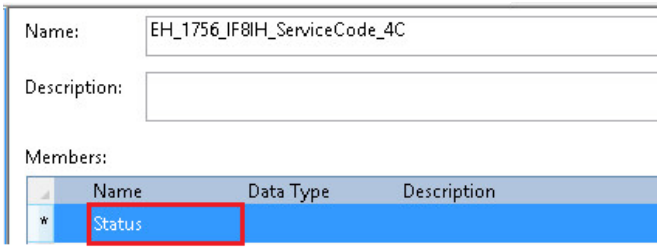
- This opens the data type configuration window:



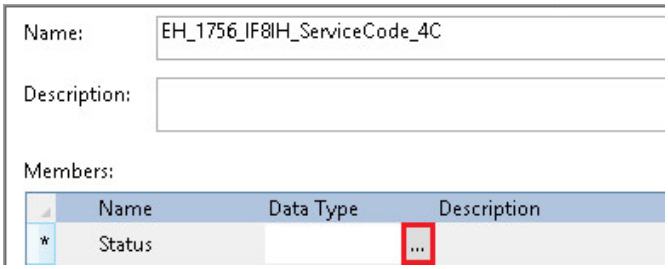
- Enter a data type name, for example “EH_1756_IF8IH_ServiceCode_4C”:



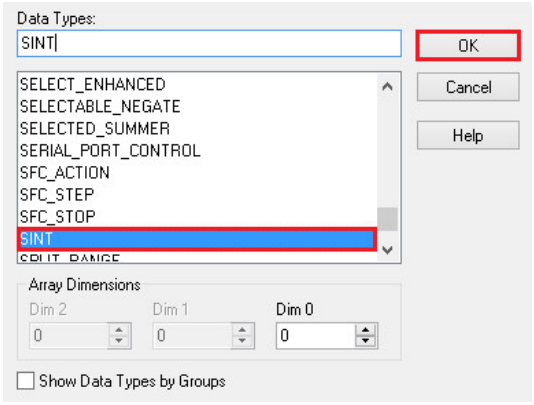
- Add all members according the user manual specification. Click in the field “Add Member” and add the member “Status”:



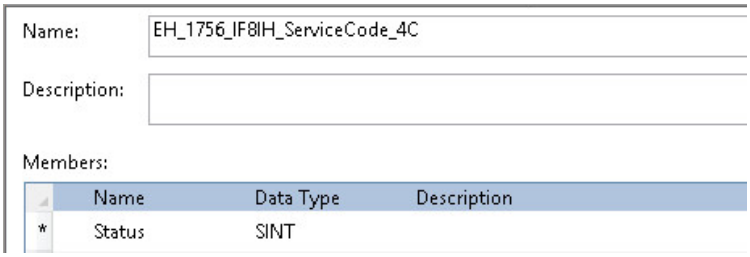
- Click in the data type field and then click on the icon:



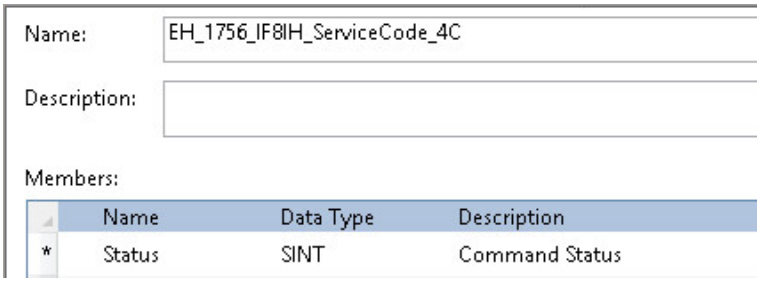
- Select the “SINT” data type and click on the button “OK”:



- “Status” data type is set:



- Description may be added as well:



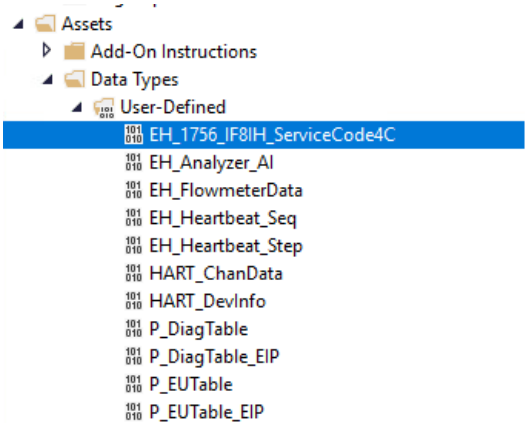
- Repeat the previous steps for all members:

Members:

	Name	Data Type	Description
*	Status	SINT	Status Command
*	Count	SINT	Number of Ext Status bytes available
*	Ext_Status_Byte_00	SINT	
*	Ext_Status_Byte_01	SINT	
*	Ext_Status_Byte_02	SINT	
*	Ext_Status_Byte_03	SINT	
*	Ext_Status_Byte_04	SINT	
*	Ext_Status_Byte_05	SINT	
*	Ext_Status_Byte_06	SINT	
*	Ext_Status_Byte_07	SINT	
*	Ext_Status_Byte_08	SINT	
*	Ext_Status_Byte_09	SINT	
*	Ext_Status_Byte_10	SINT	
*	Ext_Status_Byte_11	SINT	
*	Ext_Status_Byte_12	SINT	
*	Ext_Status_Byte_13	SINT	
*	Ext_Status_Byte_14	SINT	
*	Ext_Status_Byte_15	SINT	
*	Ext_Status_Byte_16	SINT	
*	Ext_Status_Byte_17	SINT	
*	Ext_Status_Byte_18	SINT	
*	Ext_Status_Byte_19	SINT	
*	Ext_Status_Byte_20	SINT	
*	Ext_Status_Byte_21	SINT	
*	Ext_Status_Byte_22	SINT	
*	Ext_Status_Byte_23	SINT	
*	Ext_Status_Byte_24	SINT	
	Pad	SINT	
	Add Member...		

- Then click on the button “Apply” and “OK”:

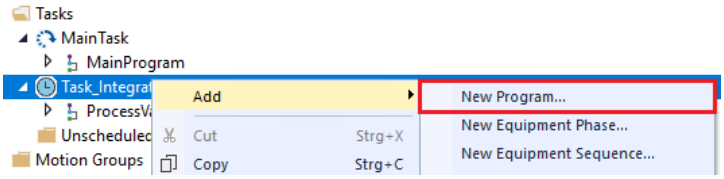
- New data type “EH_1756_IF8IH_ServiceCode_4C” appears in the list:



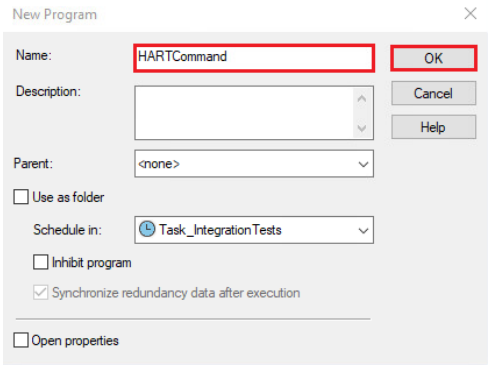
4.3.2.1.2 CIP Message Configuration

The next step consists in configuring the CIP message function block. In this example, a new program “HARTCommand”is created to implement the routine “r_CMD48_1756IF8IH” handling the CIP message.

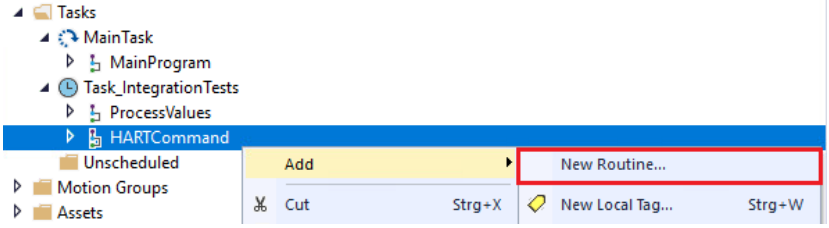
- Right-clik on the Task “Task_Integration” and select the menu “Add→New Program...”:



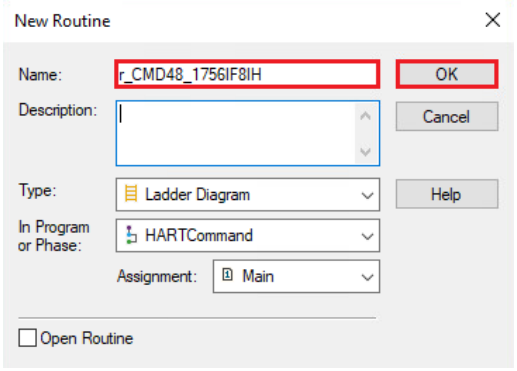
- Configure the Program name and click on the button “OK”:



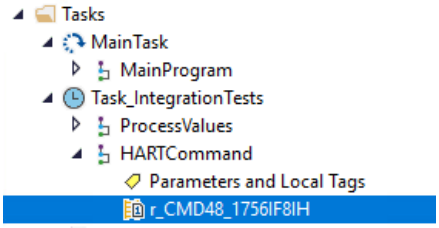
- Right-click on the program “HARTCommand” and select the menu “Add→New Routine...”:



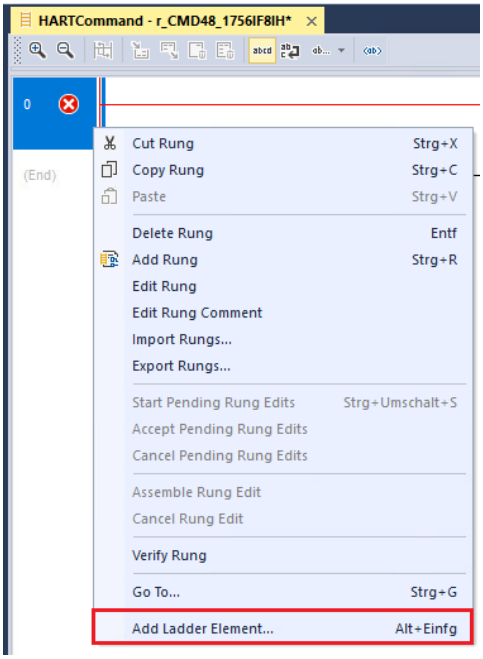
- Enter a routine name, check the language type (Ladder Diagram) and click on the button “OK”:



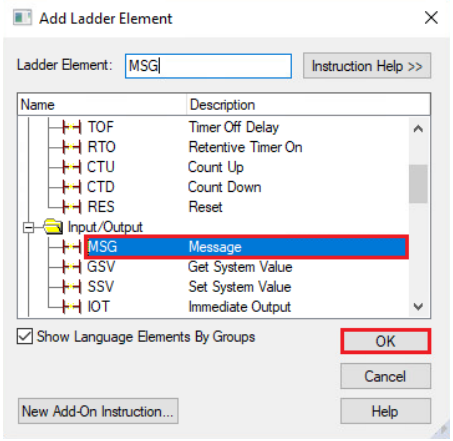
New Routine is inserted:



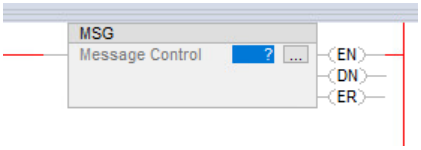
- Double-click on the routine “r_CMD48_1756IF8IH” to open it, right-click on the first rung and select the menu “Add Ladder Element...”:



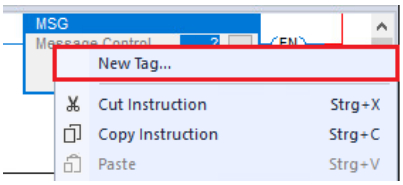
- Select the Element “MSG” and click on the button “OK”:



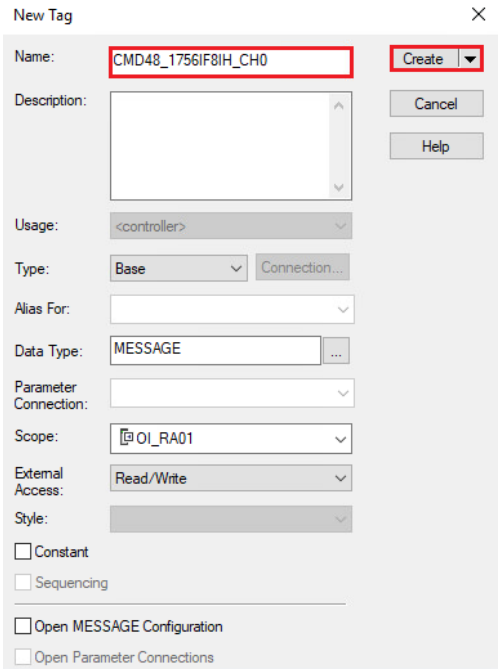
- Ladder element is inserted in the routine:



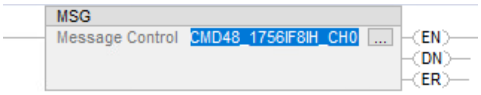
- Right-click on “?” of the Message Control field and select the menu “New Tag...”:



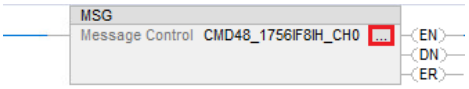
- Enter for example the name “CMD48_1756_IF8IH_CH7” and click on the button “Create”:



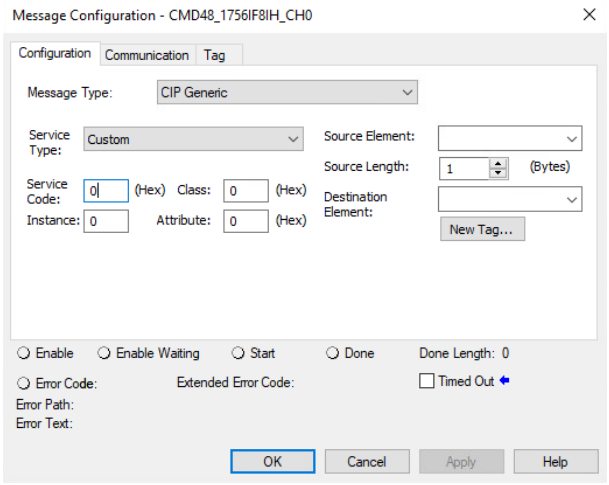
- This sets the Tag name:



- Click on the shortcut icon near to the Tag name:



- Following window is displayed:



- "Service Code", "Instance" and "Class" parameters are defined in the ControlLogix HART Analog I/O Modules user manual in the chapter "Use MSG Instructions to Access the HART Object":

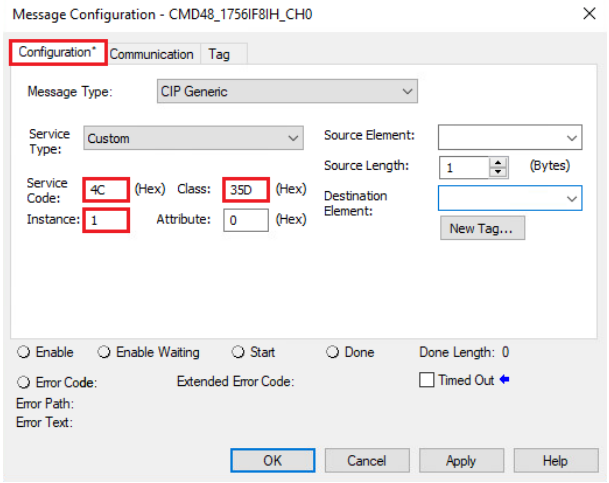
This table shows channel and instance correspondence.

Channel	Instance
0	1
1	2
2	3
3	4
…	…
15	16

These tables show service codes for CIP services.

Class	Service Code	Function
16#35D	16#4B	Read Dynamic Variables
	16#4C	Read Additional Status
	16#4D	Get HART Device Information

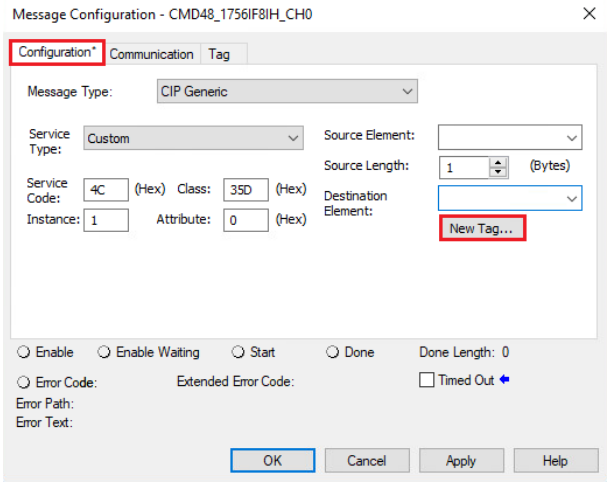
- In the tab “Configuration”, set the “Service Code”, “Instance” and “Class” parameters:



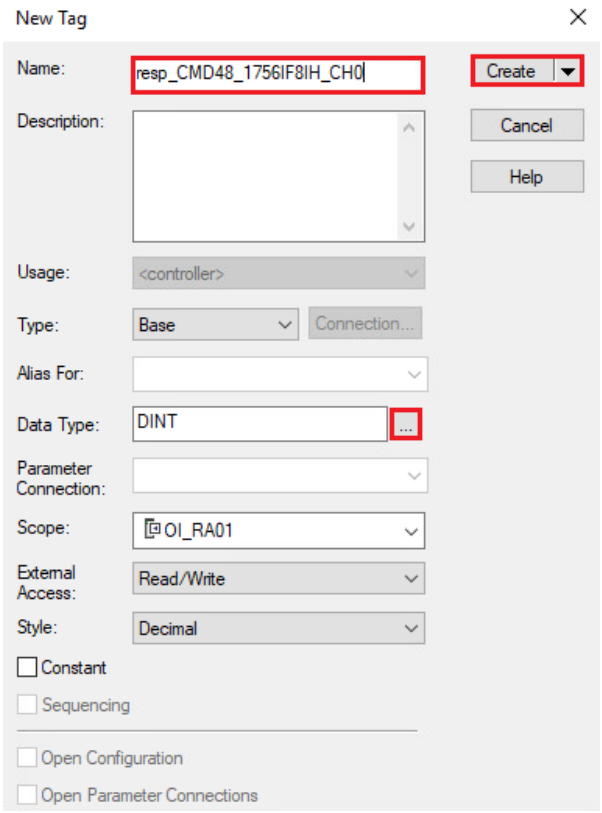
In this example, the aim is to send HART CMD48 on channel0, that means:

- Service Code = 16#4C
- Instance = 1 (this corresponds to channel0)
- Class = 16#35D

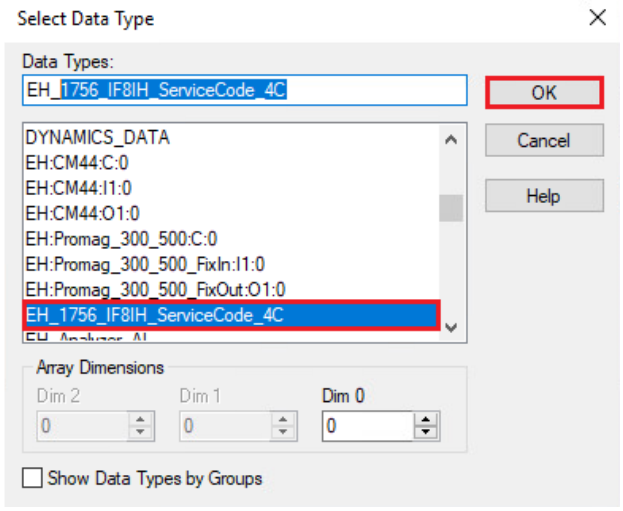
- Then, click on the button “New Tag“ of the Destination Element:



- Enter the Tag name, for example “response_CMD48_1756_IF8IH_CH7”:

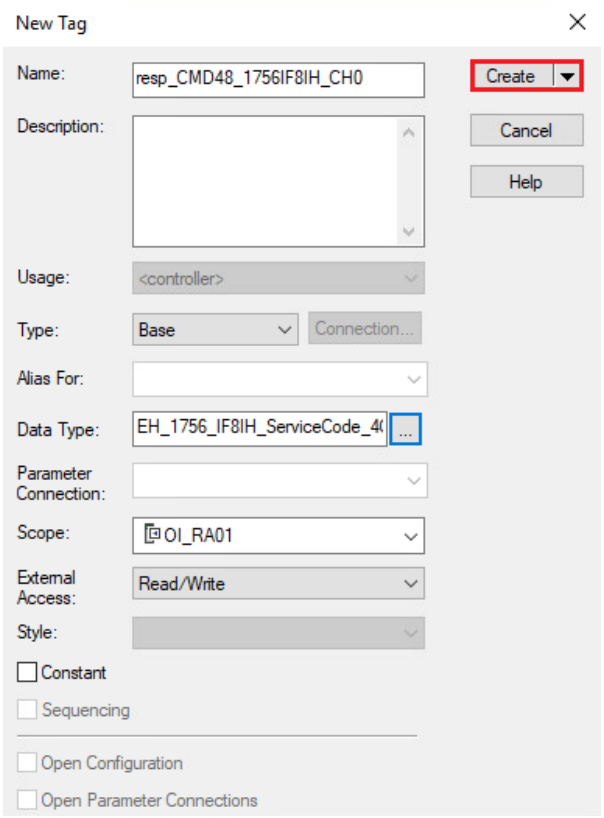


- Click on the “Data Type” shortcut button and choose the data type created in chapter 4.3.2.1.1:

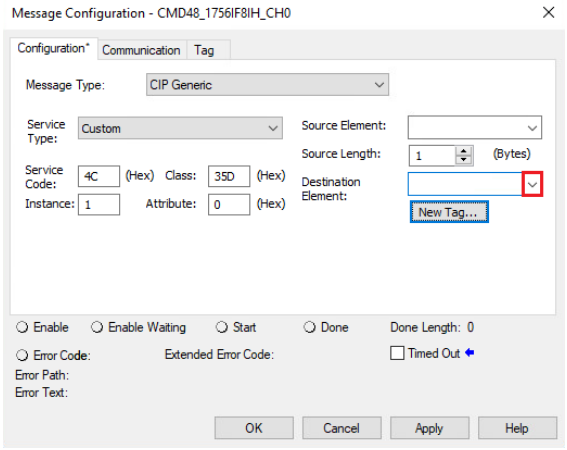


Click on the button “OK”.

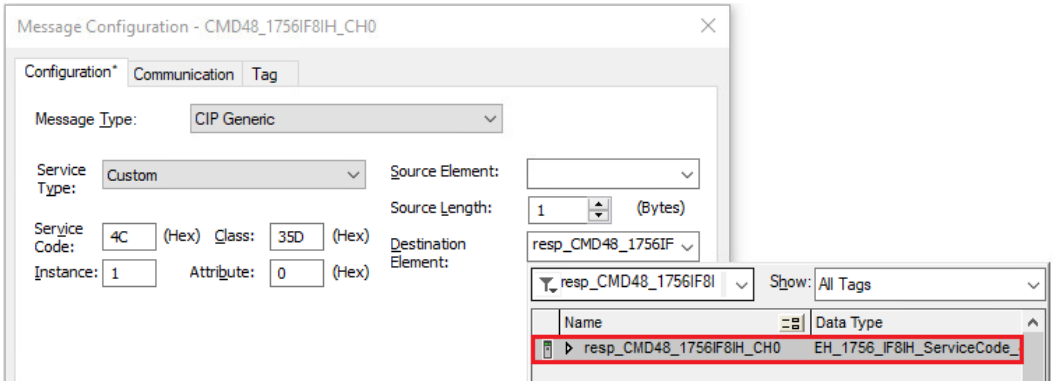
- Click on the button “Create”:



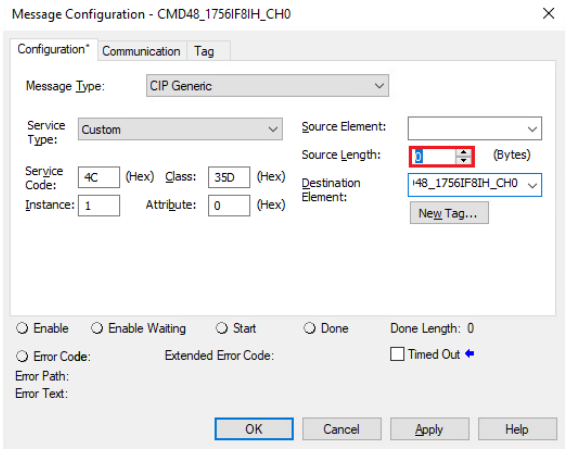
- Click on the list box to search the created Tag “resp_CMD48_1756IF8IH_CH0”:



- Search the Tag “resp_ CMD48_1756IF8IH_CH0” and double-click on it to assign the Destination Element:



- Change the Source length to “0”:

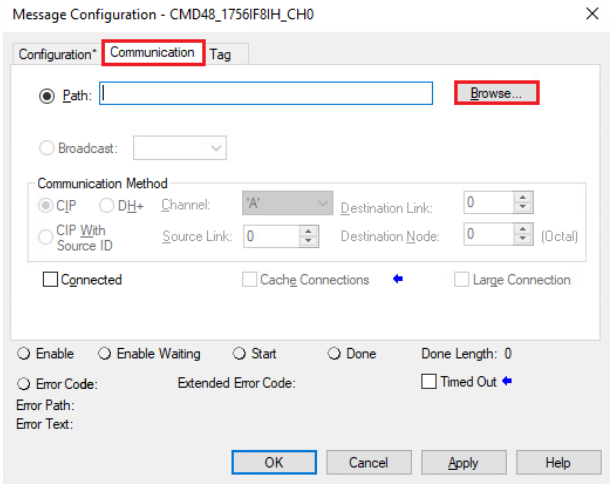


This information (Request size = 0 bytes) is specified in the ControlLogix HART Analog I/O Modules user manual in the chapter “Read Additional Status (Service Code = 16#4C)”:

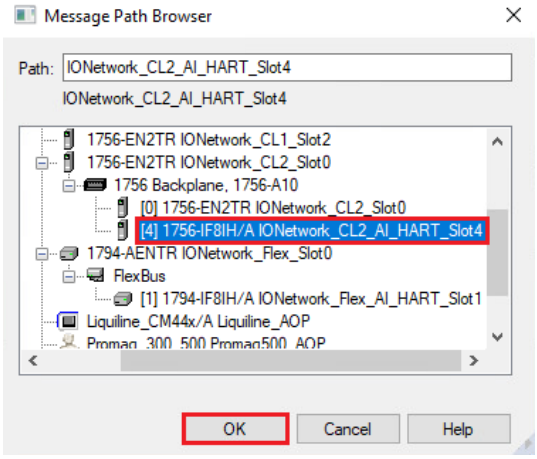
Table 92 - Request Packet

Offset	Field	Data Type	Definition
			No request data
Request size = 0 bytes			

- Click on the tab “Communication” and on the button “Browse”:

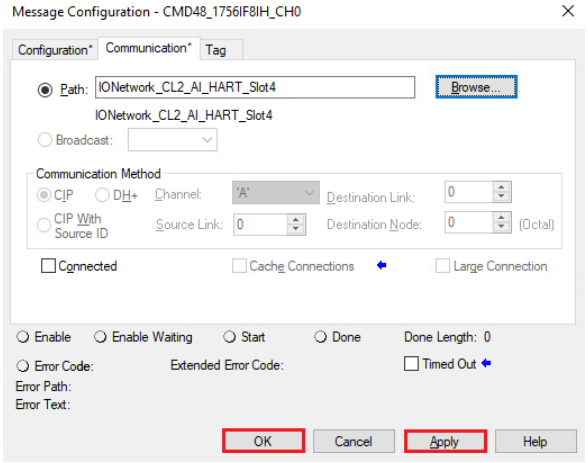


- Select the HART analog input module 1756-IF8IH on which is connected the device:

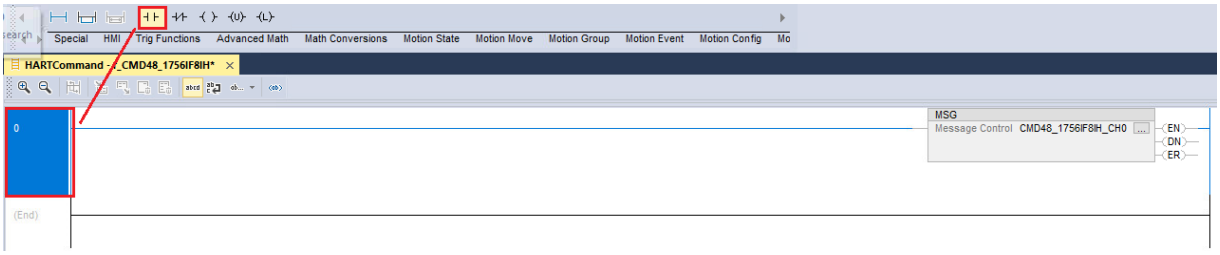


Click on the button “OK”.

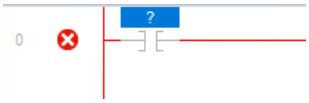
- Click on the buttons “Apply” and “OK” to close the window:



- Click on Step 0 and add the ladder element “Examine on” to toggle the read of the function:

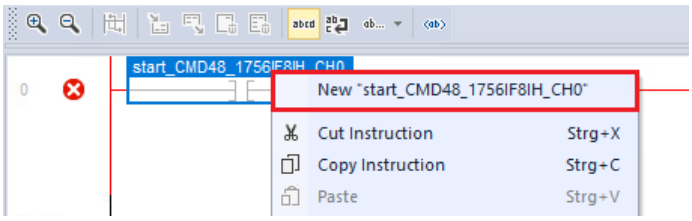


- Inserted ladder element:

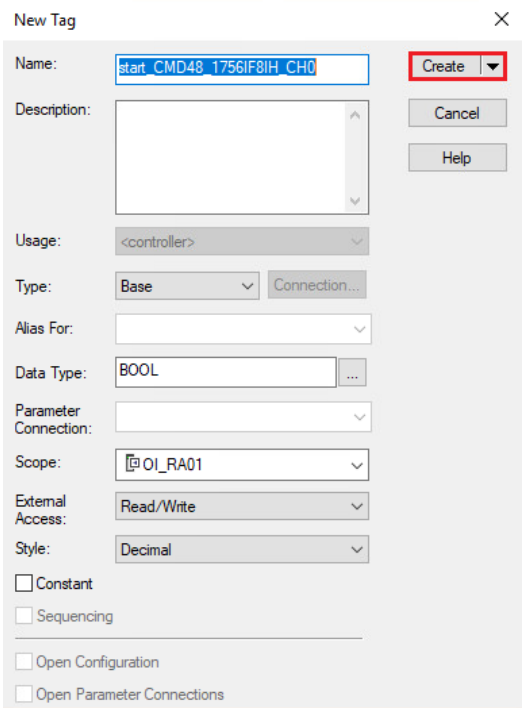


- Enter a variable name, for example “startToggle_CMD48_IF8IH_CH7”:

- Right-click on the Tag and select the menu “New startToggle_CMD48_IF8IH_CH7”:



- Click on the button “Create”:

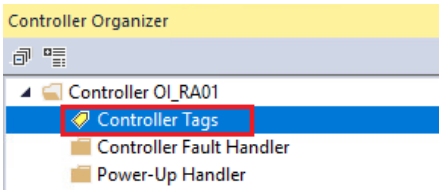


- Configured routine:

- Download the routine in the PLC. Refer to chapter 3.4.2 to proceed.

4.3.2.1.3 Controller Tag Online Data

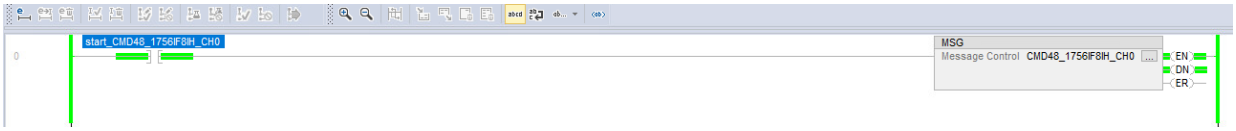
- Open the Controller Tags:



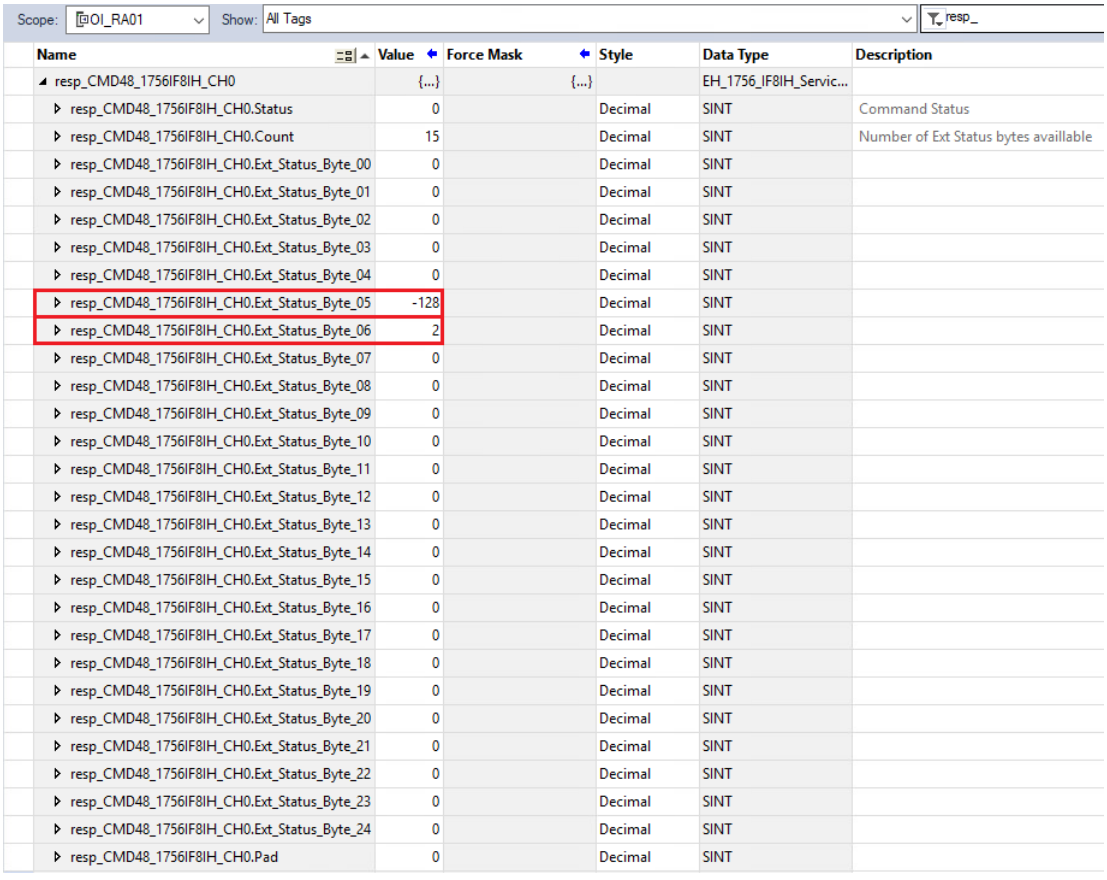
- Select the variable “startToggle_CMD48_IF8IH_CH7” and set the value to “1”:

Name	Value	Force Mask	Style	Data Type
start_CMD48_1756IF8IH_CH0	1		Decimal	BOOL

- No errors are detected in the function block:



- Select the variable “resp_CMD48_1756IF8IH_CH0” to display the read values:



Scope: OI_RA01 Show: All Tags resp_

Name	Value	Force Mask	Style	Data Type	Description
resp_CMD48_1756IF8IH_CH0	{...}	{...}		EH_1756_IF8IH_Servic...	
resp_CMD48_1756IF8IH_CH0.Status	0		Decimal	SINT	Command Status
resp_CMD48_1756IF8IH_CH0.Count	15		Decimal	SINT	Number of Ext Status bytes availlable
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_00	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_01	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_02	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_03	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_04	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_05	-128		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_06	2		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_07	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_08	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_09	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_10	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_11	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_12	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_13	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_14	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_15	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_16	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_17	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_18	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_19	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_20	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_21	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_22	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_23	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_24	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Pad	0		Decimal	SINT	

- Read of CMD48 after a Diagnostic C484simulation (from the device):

Scope: OI_RA01 Show: All Tags resp_

Name	Value	Force Mask	Style	Data Type	Description
resp_CMD48_1756IF8IH_CH0	{...}	{...}		EH_1756_IF8IH_Servic...	
resp_CMD48_1756IF8IH_CH0.Status	0		Decimal	SINT	Command Status
resp_CMD48_1756IF8IH_CH0.Count	15		Decimal	SINT	Number of Ext Status bytes availlable
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_00	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_01	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_02	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_03	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_04	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_05	-128		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_06	2		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_07	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_08	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_09	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_10	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_11	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_12	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_13	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_14	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_15	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_16	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_17	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_18	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_19	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_20	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_21	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_22	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_23	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Ext_Status_Byte_24	0		Decimal	SINT	
resp_CMD48_1756IF8IH_CH0.Pad	0		Decimal	SINT	

- Refer to the device specification for decoding byte0 to 5 and byte14 to 24 as well as the HART specification for decoding byte6 to 13.

- Decoding for this example:
  - Byte4 = $(128)_{10}$ = 0x80 → “Error Simulation” (Diagnostic number 484).
  - Byte6 = $(2)_{10}$= 0x02 → “Device Variable Alert”.

4.3.2.2 Case of 1794 ControlLogix HART analog input module IF8IH

Following example explains how to configure the HART CMD48 to get information on a device connected on the HART analog input module 1794-IF8IH on Channel 2.

4.3.2.2.1 Specific Data Type

The structure of the CMD48 response telegram is defined in the FLEX I/O Isolated Input/Output HART Analog Modules user manual in the chapter “Get Device Information Block 4 Message”:

Get Device Information Block 4 Message – Reply Packet Structure

Offset(1)	Field	Value	Definition
0	Status	00 = SUCCESS 0x86 = Channel is not HART Enabled 0x87 = No Device Found	Command status
1	Echo of Channel	0…7	Channel
2	pad	0	
3	pad	0	
4…7	Loop Current	Float(4 bytes)	
8…11	Count	0…25 (DINT,4 bytes)	Number of extended status bytes that device returned.
12…36	Ext Status Bytes[25]	0…255	Extended status bytes returned by CMD48. Unused bytes are set to 0.
37	pad	0	

(1) Data in offsets 4…36 will be set to 0 if Status in offset 0 indicates a problem (Status = 0x86 or 0x87).

This data structure must now be defined as done in for the card 1756-IF8IH. Refer to chapter 4.3.2.1.1 for all detailed steps.

- Created Data type “EH_1794_IF8IH_CMD48”:

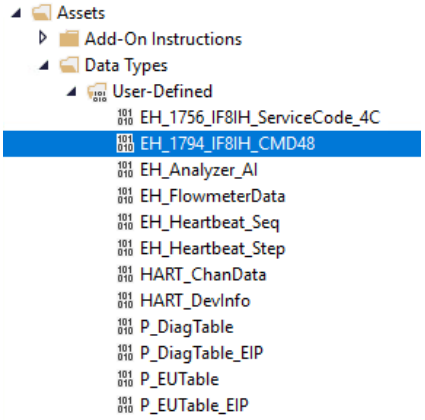
Name: EH_1794_IF8IH_CMD48

Description:

Members:

Name	Data Type	Description
pad1	SINT	
pad2	SINT	
Loop_Current	REAL	
Count	DINT	Number of extended status bytes that device returned
Ext_Status_Byte_00	SINT	
Ext_Status_Byte_01	SINT	
Ext_Status_Byte_02	SINT	
Ext_Status_Byte_03	SINT	
Ext_Status_Byte_04	SINT	
Ext_Status_Byte_05	SINT	
Ext_Status_Byte_06	SINT	
Ext_Status_Byte_07	SINT	
Ext_Status_Byte_08	SINT	
Ext_Status_Byte_09	SINT	
Ext_Status_Byte_10	SINT	
Ext_Status_Byte_11	SINT	
Ext_Status_Byte_12	SINT	
Ext_Status_Byte_13	SINT	
Ext_Status_Byte_14	SINT	
Ext_Status_Byte_15	SINT	
Ext_Status_Byte_16	SINT	
Ext_Status_Byte_17	SINT	
Ext_Status_Byte_18	SINT	
Ext_Status_Byte_19	SINT	
Ext_Status_Byte_20	SINT	
Ext_Status_Byte_21	SINT	
Ext_Status_Byte_22	SINT	
Ext_Status_Byte_23	SINT	
Ext_Status_Byte_24	SINT	
pad3	SINT	

- New data type “EH_1794_IF8IH_CMD48” appears in the list:

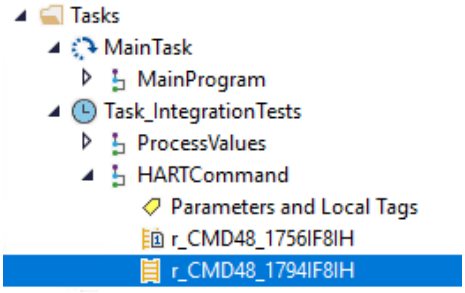


4.3.2.2.2 CIP Message Configuration

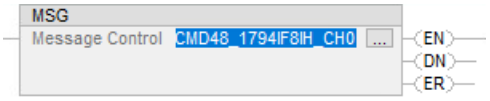
The next step consists in configuring the CIP message function block. In this example, this block will be implemented in the routine “r_CMD48_1794IF8IH”.

For detailed steps, please refer to chapter 4.3.2.1.2.

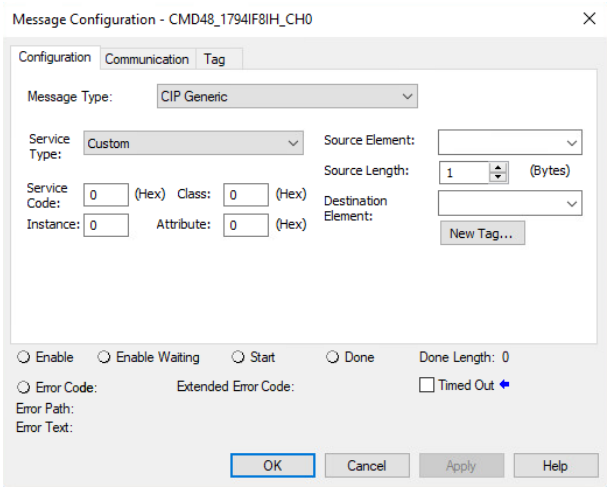
- Double-click on the routine “r_CMD48_1794IF8IH” to open it:



- Add the function block “MSG” and create a new Tag, for example “CMD48_1794IF8IH_CH0”:



- Open the function block properties:



- "Service Type", "Instance", "Class" and "Attribute" parameters are defined in the FLEX I/O Isolated Input/Output HART Analog Modules user manual in the chapter "Get Device Information 4 Message":

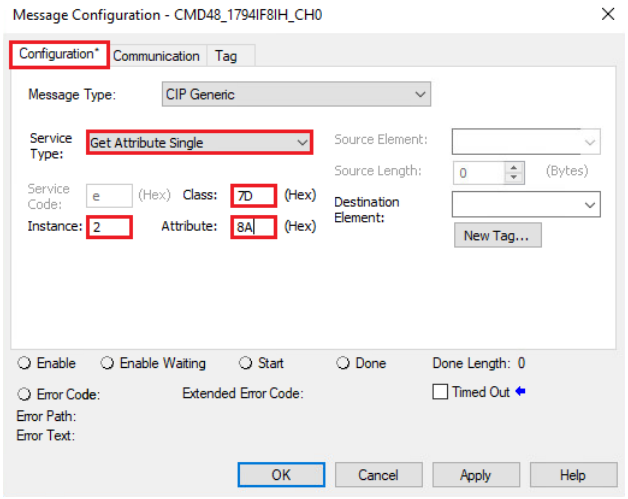
Get Device Information Block 4 Message

Get Device Information Block 4 Message – Request Packet Structure

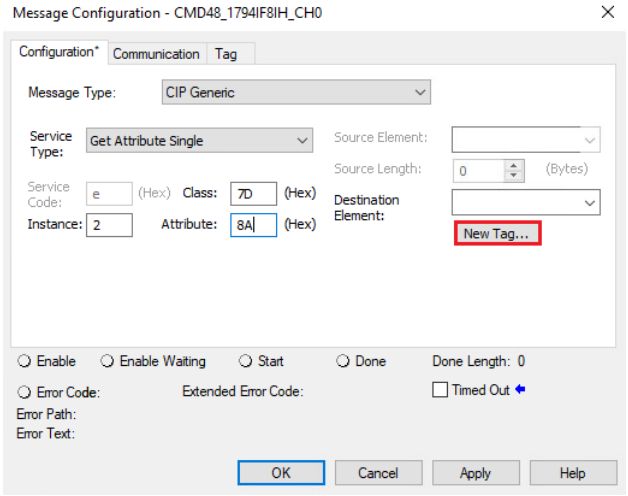
Field	Value	Definition
Message Type	"CIP Generic"	
Service Type	Get Attribute Single	Read from module.
Service Code	0x0E	
Class Name	0x7D	FLEX module object.
Instance	1…8 (Module next to Adapter = 1)	Module location.
Object Attribute	0x8A = Channel 0 (Add 4 for next channel) 0x8E = Channel 1 0x92 = Channel 2 0x96 = Channel 3 0x9A = Channel 4 0x9E = Channel 5 0xA2 = Channel 6 0xA6 = Channel 7	Selects channel that the data is from.
Reply Size	38 bytes	
Request Size	0	

In this example, Channel0 is configured.

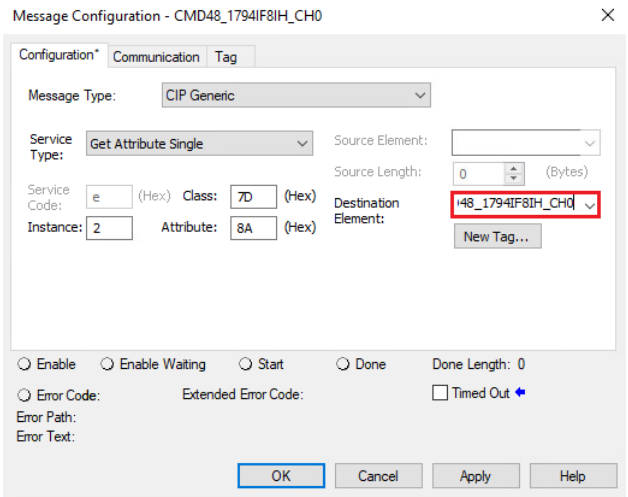
- In the tab “Configuration”, set the “Service Type”, “Instance”, “Class” and “Attribute” parameters:



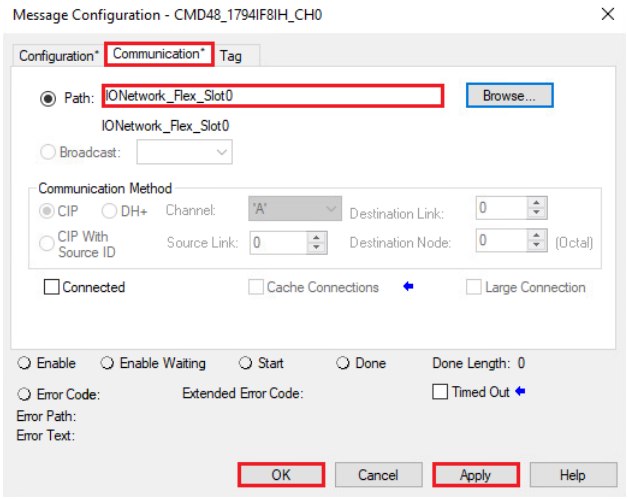
- Then configure the Tag of Destination Element:



- In this example, the Destination Tag is “resp_CMD48_1794IF8IH_CH0”:



- In the tab “Communication”, select the Flex I/O Communication module (and not the HART analog input card, this is different from the ControlLogix):



Click on the button “Apply” and “OK”.

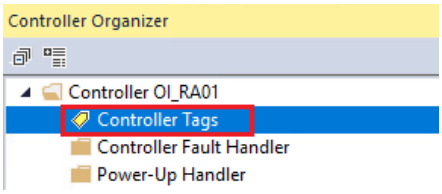
- Insert a ladder element “Examine on” to toggle the read of the function:

Remark:
In this example, a JSR function block is added in the “r_CMD48_1756IF8IH” in order to jump to the routine “r_CMD48_1794IF8IH:”

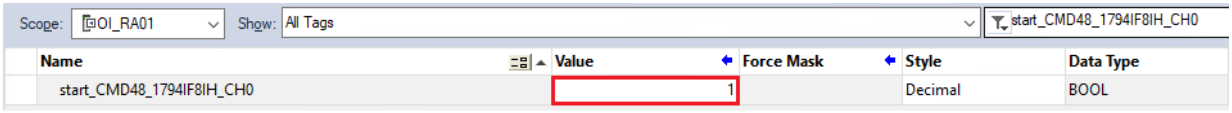
- Download the routine in the PLC. Refer to chapter 3.4.2 to proceed.

4.3.2.2.3 Controller Tag Online Data

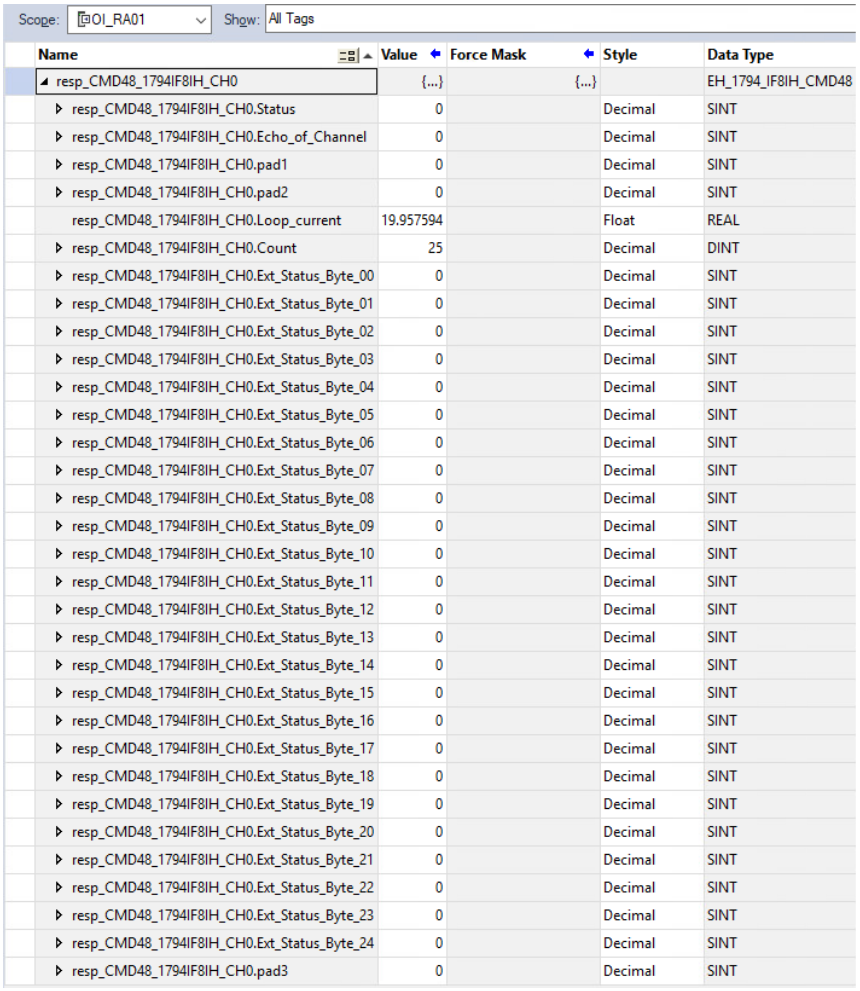
- Open the Controller Tags:



- Select the variable “start_CMD48_1794IF8IH_CH0” and set the value to “1”:



- Select the variable “response_Cmd48_1794_IF8IH_CH2” to display the read values:



- Read of CMD48 after a Diagnostic Event 801 simulation (from the device):

Scope: OI_RA01 Show: All Tags

Name	Value	Force Mask	Style	Data Type
resp_CMD48_1794IF8IH_CH0	{...}	{...}		EH_1794_IF8IH_CMD48
resp_CMD48_1794IF8IH_CH0.Status	0		Decimal	SINT
resp_CMD48_1794IF8IH_CH0.Echo_of_Channel	0		Decimal	SINT
resp_CMD48_1794IF8IH_CH0.pad1	0		Decimal	SINT
resp_CMD48_1794IF8IH_CH0.pad2	0		Decimal	SINT
resp_CMD48_1794IF8IH_CH0.Loop_current	19.95765		Float	REAL
resp_CMD48_1794IF8IH_CH0.Count	25		Decimal	DINT
resp_CMD48_1794IF8IH_CH0.Ext_Status_Byte_00	0		Decimal	SINT
resp_CMD48_1794IF8IH_CH0.Ext_Status_Byte_01	0		Decimal	SINT
resp_CMD48_1794IF8IH_CH0.Ext_Status_Byte_02	0		Decimal	SINT
resp_CMD48_1794IF8IH_CH0.Ext_Status_Byte_03	0		Decimal	SINT
resp_CMD48_1794IF8IH_CH0.Ext_Status_Byte_04	64		Decimal	SINT
resp_CMD48_1794IF8IH_CH0.Ext_Status_Byte_05	0		Decimal	SINT
resp_CMD48_1794IF8IH_CH0.Ext_Status_Byte_06	32		Decimal	SINT
resp_CMD48_1794IF8IH_CH0.Ext_Status_Byte_07	0		Decimal	SINT
resp_CMD48_1794IF8IH_CH0.Ext_Status_Byte_08	17		Decimal	SINT
resp_CMD48_1794IF8IH_CH0.Ext_Status_Byte_09	0		Decimal	SINT
resp_CMD48_1794IF8IH_CH0.Ext_Status_Byte_10	0		Decimal	SINT
resp_CMD48_1794IF8IH_CH0.Ext_Status_Byte_11	0		Decimal	SINT
resp_CMD48_1794IF8IH_CH0.Ext_Status_Byte_12	0		Decimal	SINT
resp_CMD48_1794IF8IH_CH0.Ext_Status_Byte_13	0		Decimal	SINT
resp_CMD48_1794IF8IH_CH0.Ext_Status_Byte_14	0		Decimal	SINT
resp_CMD48_1794IF8IH_CH0.Ext_Status_Byte_15	0		Decimal	SINT
resp_CMD48_1794IF8IH_CH0.Ext_Status_Byte_16	4		Decimal	SINT
resp_CMD48_1794IF8IH_CH0.Ext_Status_Byte_17	0		Decimal	SINT
resp_CMD48_1794IF8IH_CH0.Ext_Status_Byte_18	0		Decimal	SINT
resp_CMD48_1794IF8IH_CH0.Ext_Status_Byte_19	0		Decimal	SINT
resp_CMD48_1794IF8IH_CH0.Ext_Status_Byte_20	0		Decimal	SINT
resp_CMD48_1794IF8IH_CH0.Ext_Status_Byte_21	0		Decimal	SINT
resp_CMD48_1794IF8IH_CH0.Ext_Status_Byte_22	0		Decimal	SINT
resp_CMD48_1794IF8IH_CH0.Ext_Status_Byte_23	0		Decimal	SINT
resp_CMD48_1794IF8IH_CH0.Ext_Status_Byte_24	0		Decimal	SINT
resp_CMD48_1794IF8IH_CH0.pad3	0		Decimal	SINT

- Refer to the device specification for decoding byte0 to 5 and byte14 to 24 as well as the HART specification for decoding byte6 to 13.

- Decoding for this example:
  - Byte4 = $(64)_{10}$ = 0x40 → "Diagnostic Event Simulation" (Diagnostic number 495).
  - Byte6 = $(32)_{10}$= 0x22 → "Function Check", "Out of Specification" and "Device Variable Alert".
  - Byte8 = $(17)_{10}$= 0x11 → "Power Supply Conditions Out of Range" and "Device Variable Simulation Active".
  - Byte16 = $(4)_{10}$ = 0x04 → "Energy too low" (Event 801).

4.3.3 HART Pass-through CIP messages

This chapter gives an example on how to handle HART commands over EtherNet/IP from the control strategy. More details are available in both HART analog input cards user manuals “FLEX I/O Isolated Input/Output HART Analog Modules” and “ControlLogix HART Analog I/O Modules”.

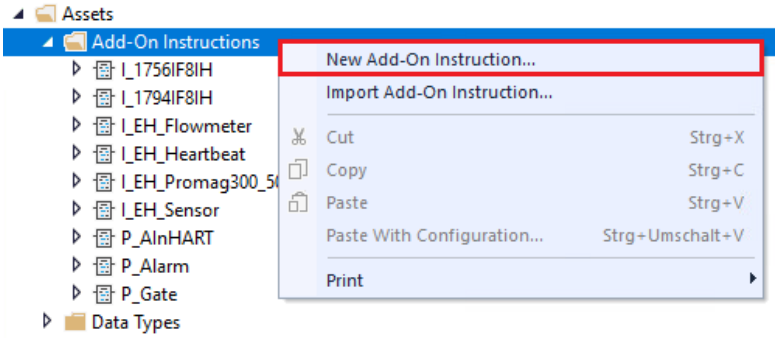
4.3.3.1 CIP Messages Configuration with ControlLogix 1756-IF8IH

The HART pass-through method requires the configuration of two CIP messages called “Pass-through Init” and “Pass-through Query”.

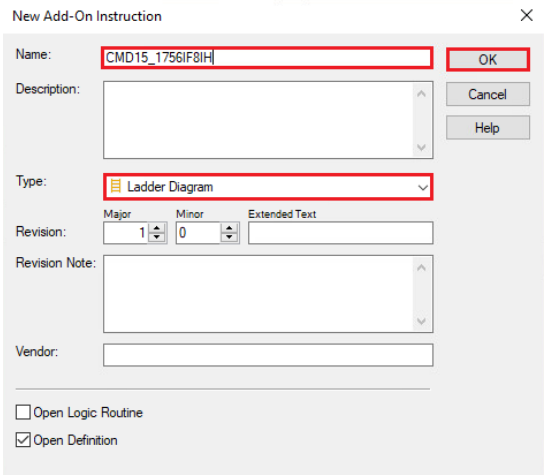
4.3.3.1.1 New Add On Instruction

Following example explains how to configure a function block implementing HART CMD15.

- Right-click on “Add-On Instructions” and select the menu “New Add-On Instruction...”:

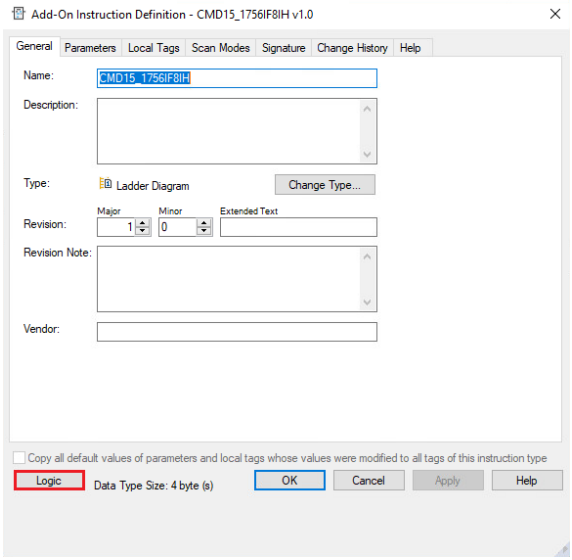


- This opens the window “New Add-On Instruction”:



Enter a name and select the programming language. In this example, the AOI name is “CMD15_1756IF8IH” and the selected programming language is “Ladder Diagram”. Then click on the button “OK”.

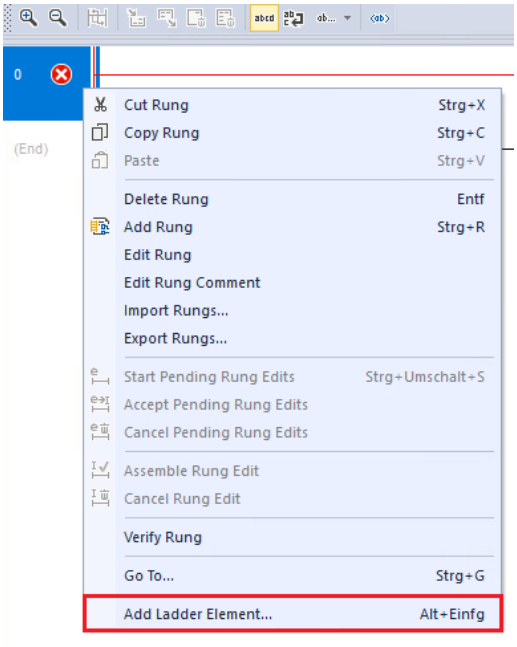
- This creates the window “Add-On Instruction Definition”:



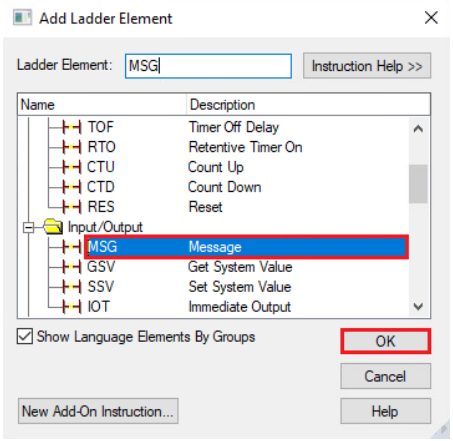
Click on the button “Logic” to access the routine logic window.

Init and Query Message Function block

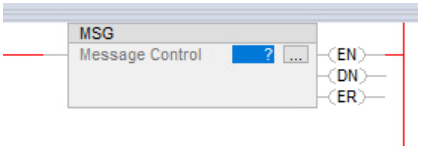
- Right-click on the rung 0 and select the menu “Add Ladder Element”:



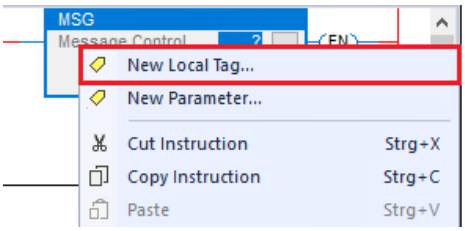
- Select the ladder element “MSG” and click on the button “OK”:



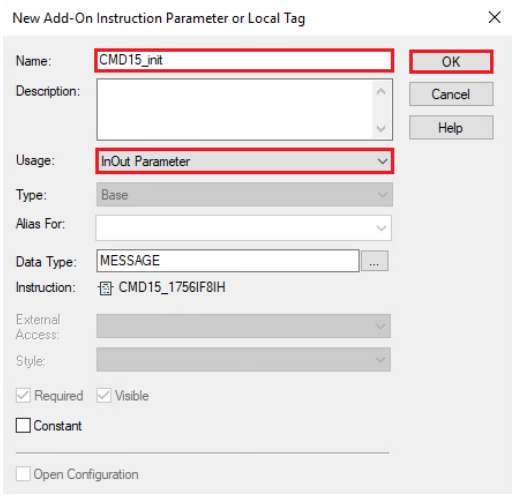
- Ladder element is inserted in the routine:



- Right-click on the Message Control field and select the menu “New Tag...”:

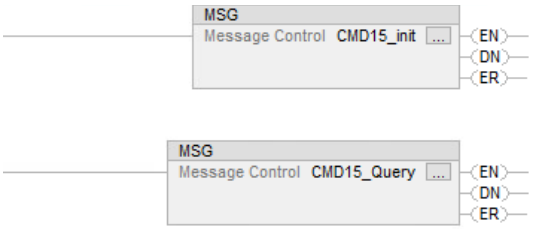


- Enter for example the name “CMD15_init”, select the usage “**InOut Parameter**” and click on the button “Create”:



MSG function bloc is inserted:

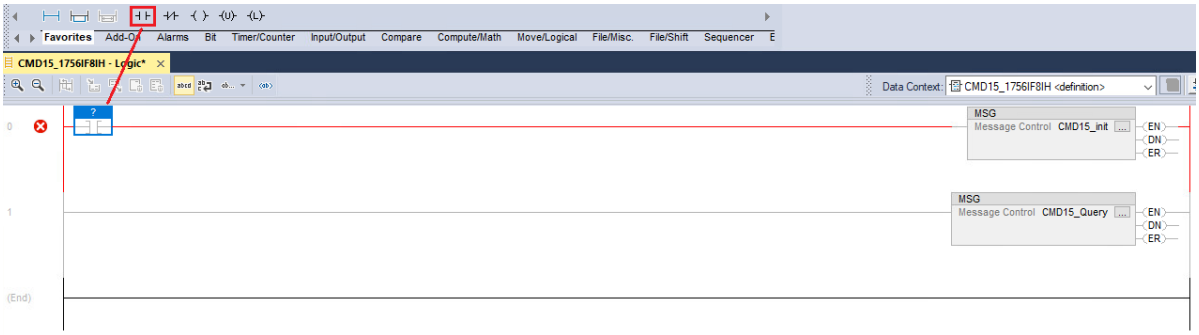
- Repeat the previous steps to add another MSG function block called “CMD15_Query” and defined as a “**InOut Parameter**”:



Init and Query Message Input Trigger

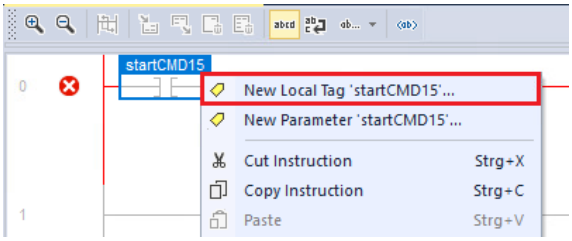
Two inputs are required to trigger the sequence, the first one is the sequence start bit and the second one is a feedback received from the ControlLogix 1756-IF8IH card allowing triggering the Query message.

- Drag and drop a “If” ladder element:

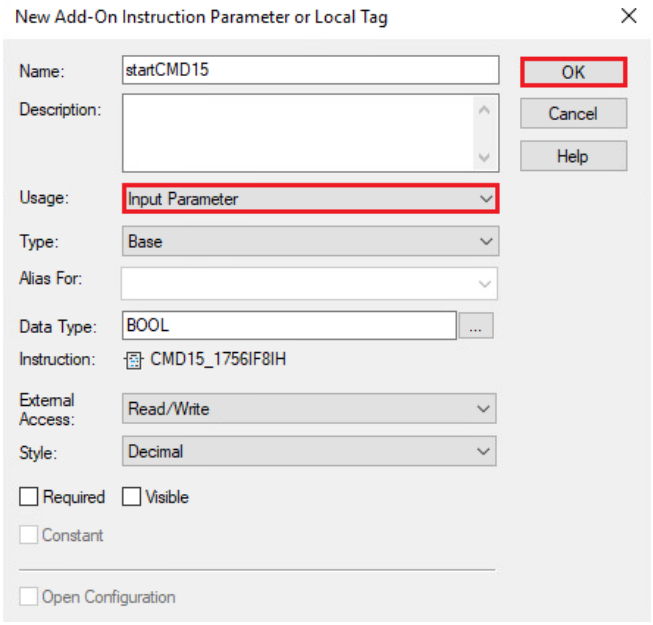


- Enter a Tag, for example “startCMD15”:

- Right-click on the Tag and select the option “New Local Tag ’startCMD15’ ”:



- Select the “Usage” parameter “Input Parameter” and click on the button “OK”:



- Repeat the previous step to add the second Tag “messageReady” defined as a “**Input Parameter**” too:

For triggering the second function block, we add in this example a second input, the bit “CMD15_init.DN”. When this bit is set to “TRUE”, this ensures that the CMD15_Init message has been successfully transferred:

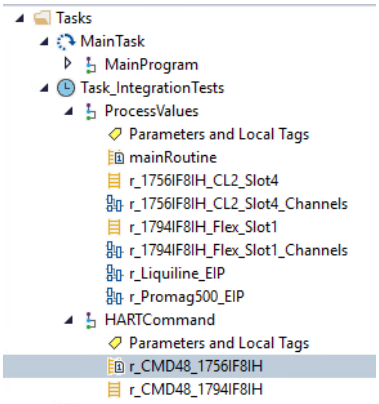
Messages Status handling

- In this example, the Message function blocks error status is checked as well. If one error occurs, the output Tag “error” (defined as **Ouput Parameter**) is set to “TRUE” and if there are no errors, the output Tag “done” (defined as **Ouput Parameter**) is set to “TRUE”:

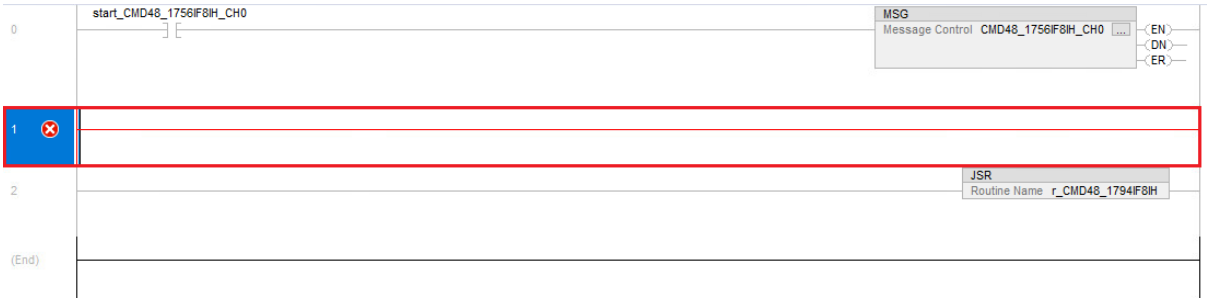
- Save and close the AOI logic “CMD15_1756IF8IH”. The AOI can now be implemented in a routine.

4.3.3.1.2 AOI Tags Assignment

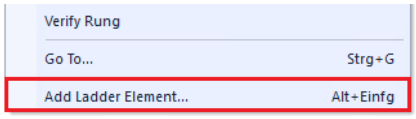
- Open a routine, for example “r_CMD48_1756IF8IH”:



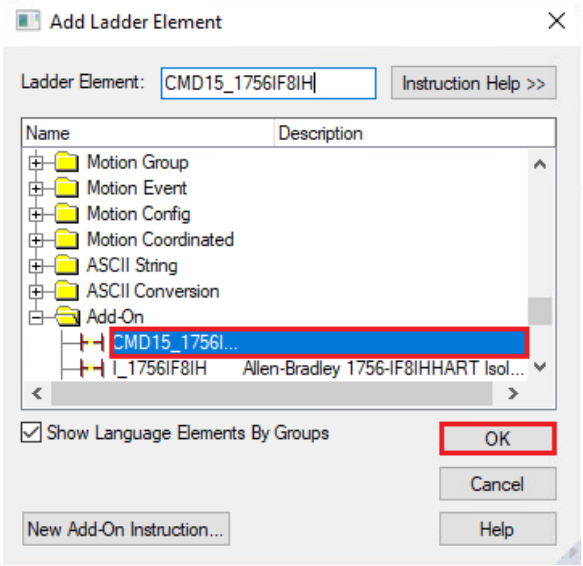
- Add a rung:



- Right-click on the rung 3 and select the menu “Add Ladder Element”:

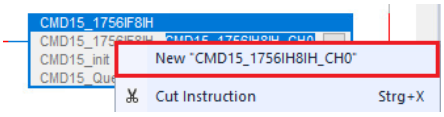


- Insert the AOI “CMD15_1756” and click on the button “OK”:

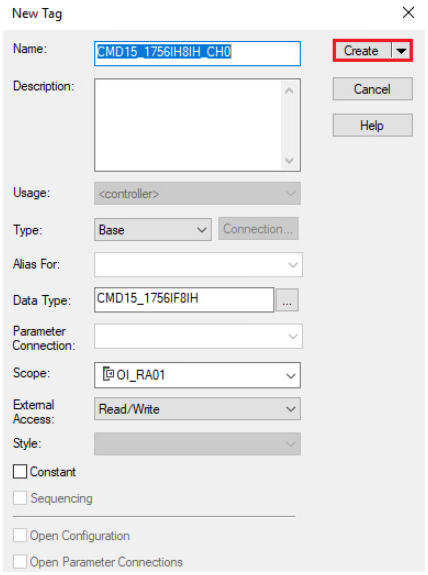


- Enter a Tag for this function block, for example “CMD15_1756IF8IH_CH0”:

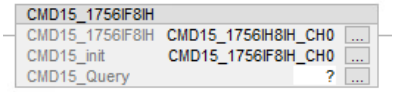
- Right-click on it and select the menu “New “CMD15_1756_CH7””:



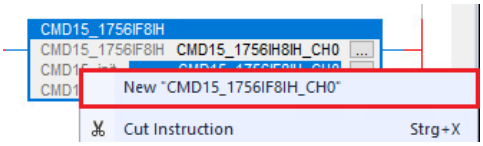
- Click on the button “Create”:



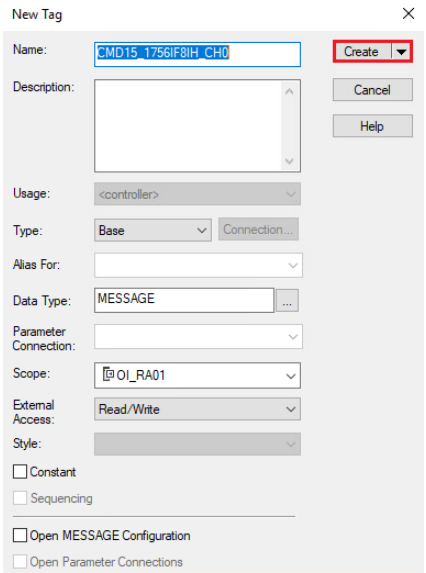
- Enter a Tag for the parameter “CMD15_Init”, for example “CMD15_Init_CH0”:



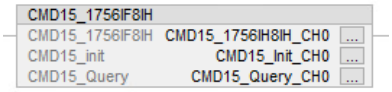
- Right-click on it and select the menu “New “CMD15_Init_CH0””:



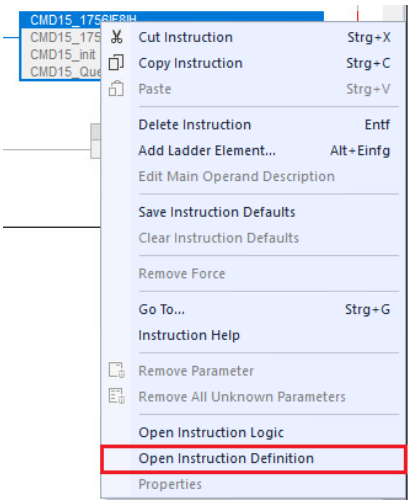
- Click on the button “Create”:



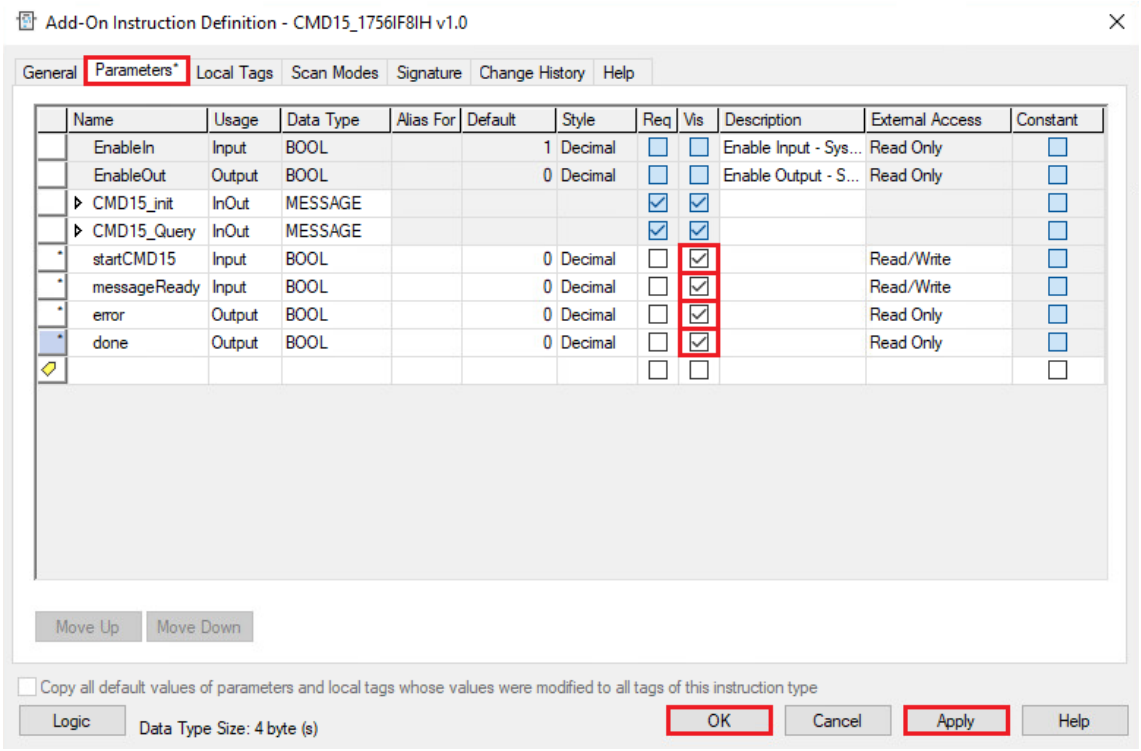
- Create as well another “MESSAGE” Tag, “CMD15_Query_CH0” in this example for the function block parameter “CMD15_Query”:



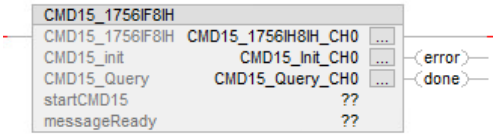
- Right-click on the function block and select the menu “Open Instruction Definition”:



- In the Tab “Parameters”, select the input and output variables to display and click on the buttons “Apply” and “OK”:



- This displays now the Input and Output parameters of the function block as well:



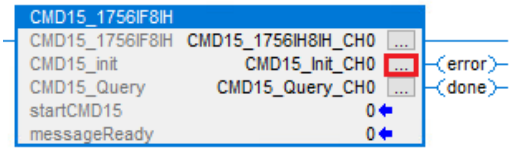
- In two new rungs, initialize the inputs “CMD15_1756IF8IH_CH0.startCMD15” and “CMD15_1756IF8IH _CH0.messageReady”:

Remark

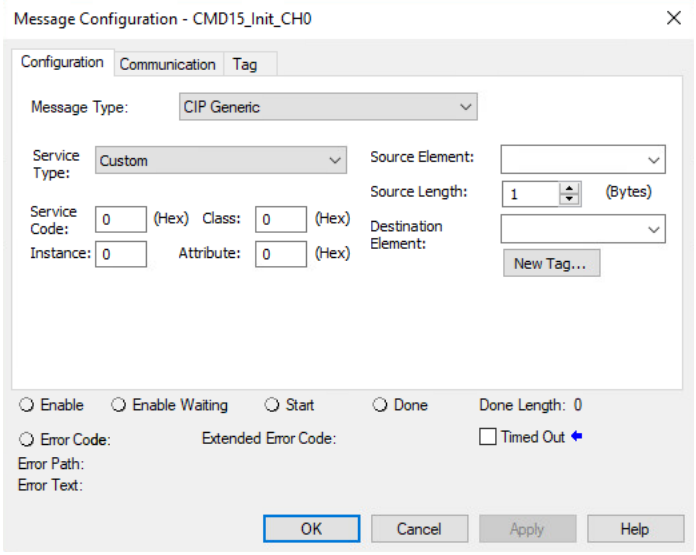
- The parameter MsgReady is channel specific (Channel0 for this example) and can be found in the ControlLogix 1756-IF8IH DeviceStatus Tags:

4.3.3.1.3 AOI Init Message configuration

- Click on the Tag “CMD15_Init_CH7”:



- This opens the Message Configuration window for the “CMD15_Init” message:



- “Service Code”, “Instance” and “Class” parameters are defined in the ControlLogix HART Analog I/O Modules user manual in the chapter “Use MSG Instructions to Access the HART Object”:

This table shows channel and instance correspondence.

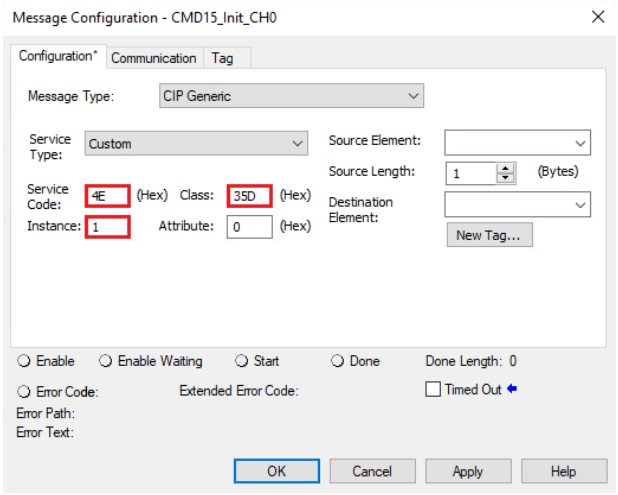
Channel	Instance
0	1
1	2
2	3
3	4
…	…
15	16

These tables show service codes for CIP services.

Class	Service Code	Function
16#35D	16#4B	Read Dynamic Variables
	16#4C	Read Additional Status
	16#4D	Get HART Device Information

Class	Service Code	Pass-through Messages
16#35D	16#4E	Init
	16#4F	Query
	16#50	Flush Queue

- Configured “Service Code”, “Class” and “Instance” parameters according to previous table:



The parameter “Instance” is “1” because the HART command is attended for channel0.

- The parameter “Source Element” is defined in the ControlLogix HART Analog I/O Modules user manual in the chapter “HART Pass-through CIP Message Layout Details”:

Table 98 - Short Format (Ladder) Request Packet (service code 16#4E)

Offset	Field	Data Type	Definition
0	HART Command	USINT	HART Command Number(1) (2)
1	HART Data Size	USINT	Number of Data Bytes for Selected HART Command(1)(2)
2…256	HART Data bytes	As many bytes as in HART Data Size	HART Command Data(1)
Request Size = 2…257 bytes			

(1) See Appendix B on page 227 for more information.
(2) If this field is displayed as SINT in Logix Designer application, values > 127 appear negative.

In our example, we want to implement HART Command 15. The HART CMD15 request packet does not need any HART data. Therefore, the parameter “Source Element” will be a SINT table with a length of 2.

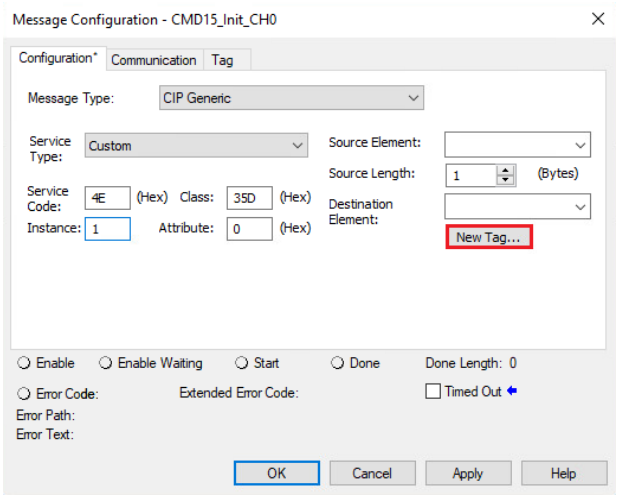
- The parameter “Destination Element” is defined in the ControlLogix HART Analog I/O Modules user manual in the chapter “HART Pass-through CIP Message Layout Details”. This is a 4 bytes response:

Table 100 - Short Format (Ladder) Reply Packet

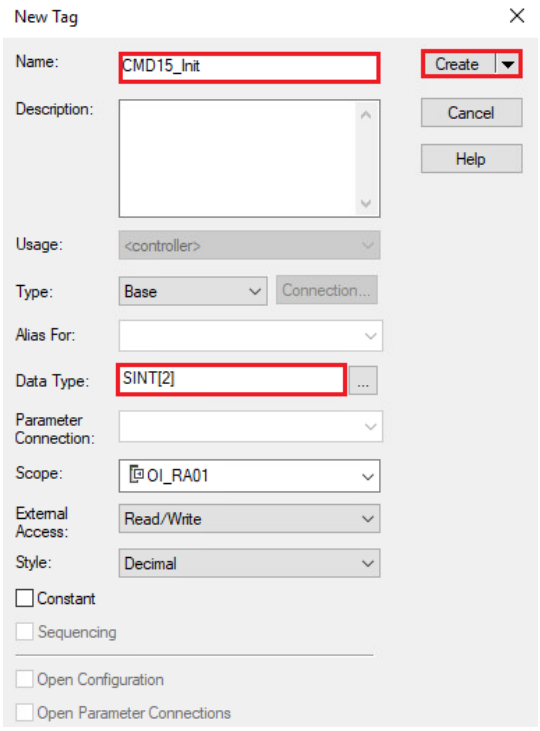
Offset	Field	Data Type	Definition
0	Status	USINT	Command status 32 = Busy (queues full) - try again later 33 = Initiated - command started - send Query to get the reply 35 = Dead - Device not online
1	HART Command	USINT	Echo of HART Command number(1)
2	Handle	USINT	Handle Used in Query Operation(1)
3	Queue space remaining	USINT	Number of queues still Available for This Channel(1) If status (bit 0) is 35, refer to Table 104 for the error code description.
Reply Size = 4 bytes			

(1) If this field is displayed as SINT in Logix Designer application; values > 127 appear negative.

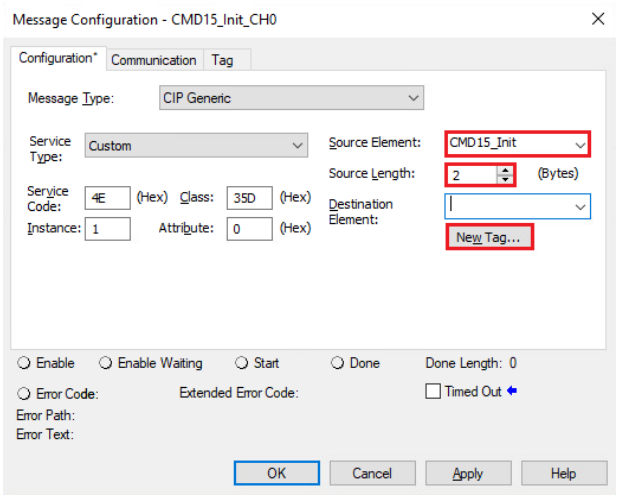
- Click on the button “New Tag...” to create the “Source Element” and “Destination Element” tables:



- Enter for example the name “CMD15_Init” with Data Type “SINT[2]” and click on the button “Create”:

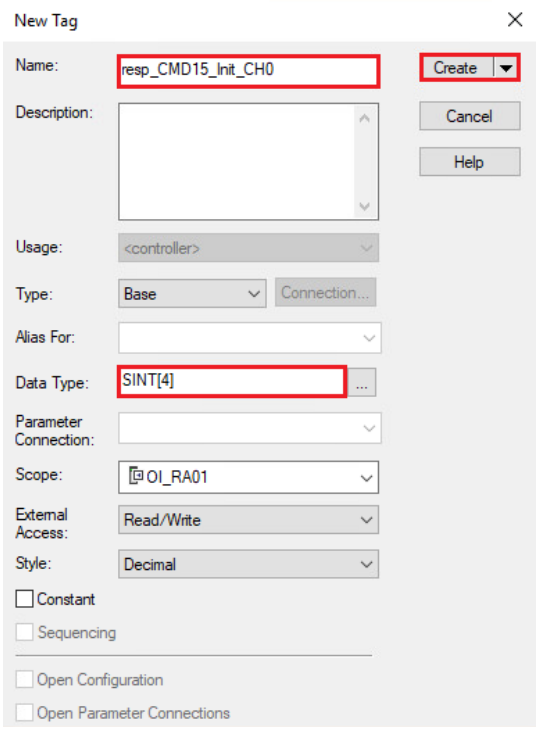


- Then assign the table “CMD15_Init” as well as the Source length which is 2:

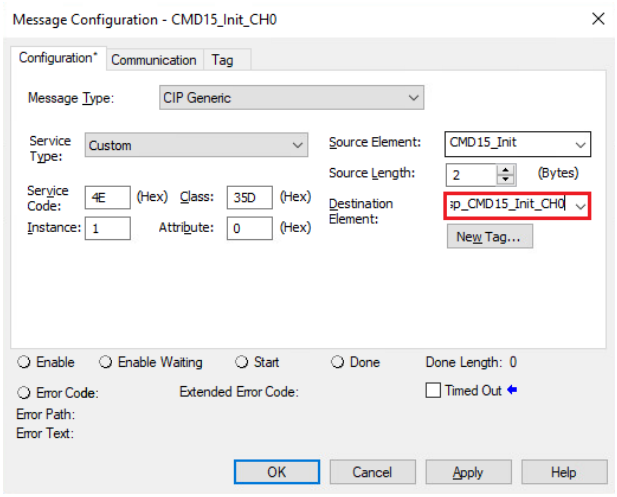


Then click on the button “New Tag...”.

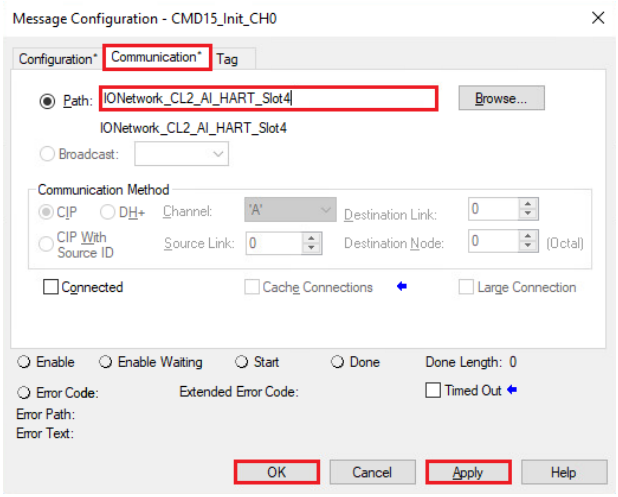
- Enter for example the name “response_CMD15_Init_CH7” with Data Type “SINT[4]” and click on the button “Create”:



- Then assign the table “resp_CMD15_Init_CH0”:



- Select the menu “Communication” and configure the path to the ControlLogix 1756-IF8IH card:



Click on the button “Apply” and “OK” to close the window.

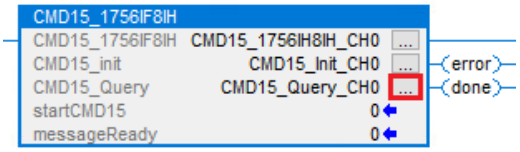
- Open the Controller Tags and initialize the HART Command of the tag “CMD15_Init”:

Name	Value	Force Mask	Style	Data Type
CMD15_Init	{...}	{...}	Decimal	SINT[2]
CMD15_Init[0]	15		Decimal	SINT
CMD15_Init[1]	0		Decimal	SINT

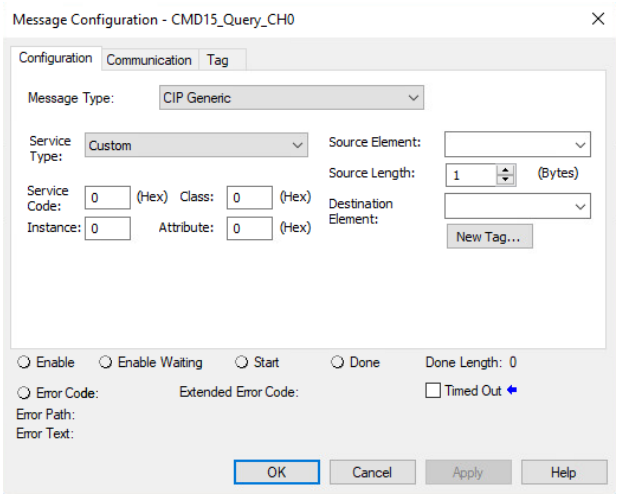
  - CMD15_Init[0] = 15 corresponds to the HART Command
  - CMD15_Init[1] = 0 corresponds to the HART data length

4.3.3.1.4 AOI Query Message configuration

- Click on the Tag “CMD15_Query_CH0”:



- This opens the Message Configuration window for the “CMD15_Init” message:



- “Service Code”, “Instance” and “Class” parameters are defined in the ControlLogix HART Analog I/O Modules user manual in the chapter “Use MSG Instructions to Access the HART Object”:

This table shows channel and instance correspondence.

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These tables show service codes for CIP services.

Class	Service Code	Function
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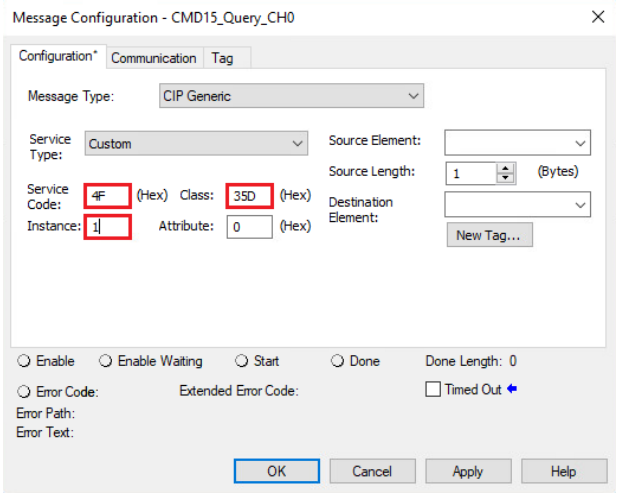
	16#4C	Read Additional Status
	16#4D	Get HART Device Information

Class	Service Code	Pass-through Messages
16#35D	16#4E	Init
	16#4F	Query
	16#50	Flush Queue

- Configured “Service Code”, “Class” and “Instance” parameters according to previous table:



The parameter “Instance” is “1” because the HART command is attended for channel0.

- The parameter “Source Element” is defined in the ControlLogix HART Analog I/O Modules user manual in the chapter “HART Pass-through CIP Message Layout Details”:

Table 102 - Request Packet

Offset	Field	Data Type	Definition
0	Handle	USINT	Handle for Query (from Handle Field above)(1)
Request Size = 1 byte			

(1) If this field is displayed as SINT in Logix Designer application, values > 127 appear negative.

In our example, the parameter “Handle” is received in the “CMD15_Init” message in byte2.

- The parameter “Destination Element” is defined in the ControlLogix HART Analog I/O Modules user manual in the chapter “HART Pass-through CIP Message Layout Details”:

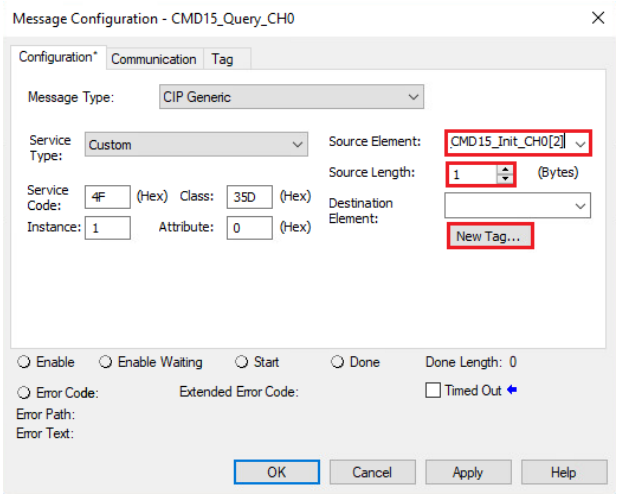
Table 103 - Reply Packet

Offset	Offset	Data Type	Definition
0	Status	USINT	Query Status 00 = Success 34 = Running - try again later 35 = Dead (See MsgReady in Input Tag)
1	HART Command	USINT	Echo of HART Command(1)
2	HART CommStatus	USINT	HART Reply Status Byte #1 (response code)(1)
3	HART FieldDeviceStatus	USINT	HART Reply Status Byte #2(1) If status (bit 0) is 35, refer to Table 104 for the error code description.
4	Data Size	USINT	Number of Data Bytes in Reply for HART Command(1)
5...259	HART Reply Data ...	USINT	Data Bytes Returned in Data Field of HART Reply to Requested Command(1)
Reply Size = 6...260 bytes			

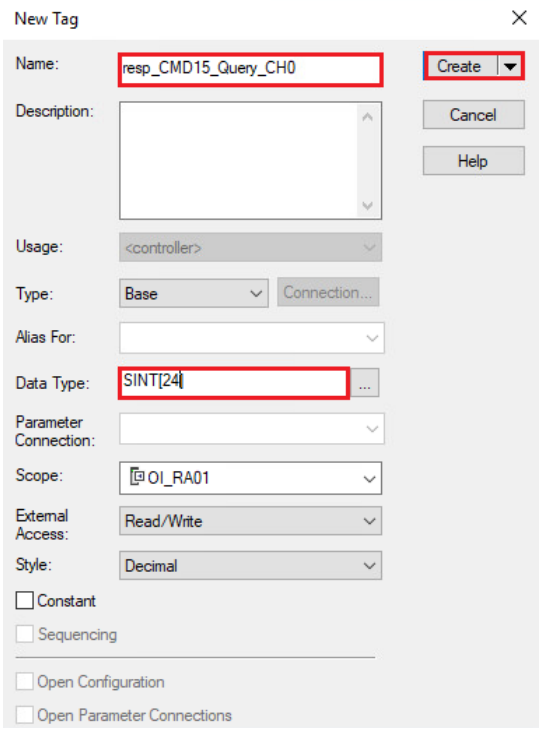
(1) If this field is displayed as SINT in Logix Designer application, values > 127 appear negative.

In our example, HART CMD15 returns 18 bytes. Therefore a table with 24 elements is enough.

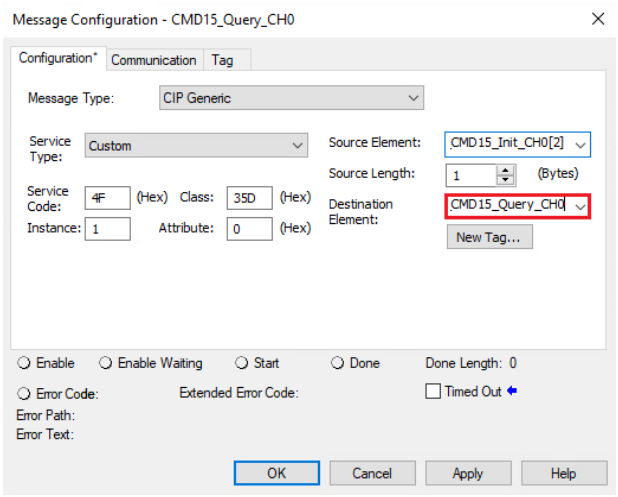
- Assign the byte “Handle” addressed in the table “resp_CMD15_Init_CH0[2]”, check that the “Source Length” is 1 and click on the button “New Tag...”:



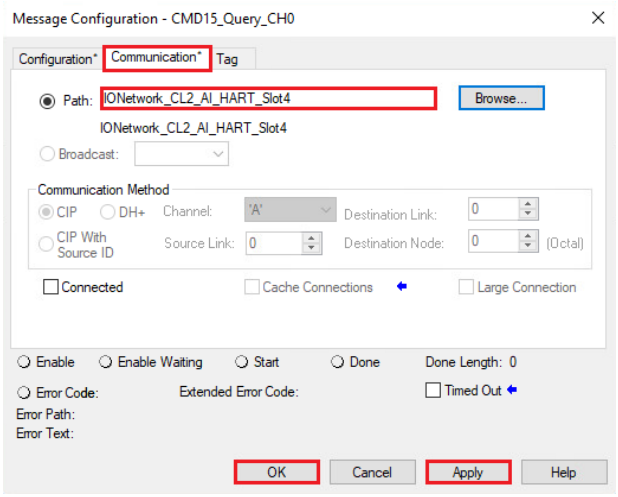
- Enter for example the name “resp_CMD15_Query_CH0” with Data Type “SINT[24]” and click on the button “Create”:



- Then assign the table “response_CMD15_Query_CH7”:



- Select the menu “Communication” and configure the path to the ControlLogix 1756-IF8IH card:

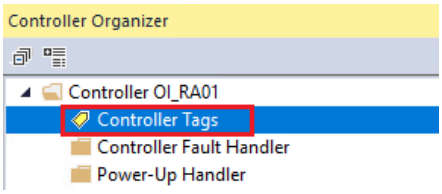


Click on the button “Apply” and “OK” to close the window.

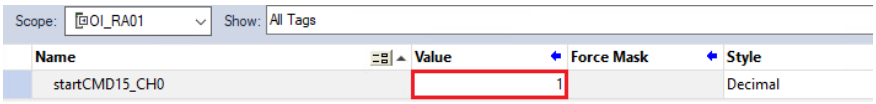
- Download the routine in the PLC. Refer to chapter 3.4.2 to proceed.

4.3.3.1.5 Controller Tag Online Data

- Open the Controller Tags:



- Select the variable “startCMD15_CH0” and set the value to “1”:



Results:

- Response from the Init MSG function block:

Name	Value	Force Mask	Style	Data Type
resp_CMD15_Init_CH0	{...}	{...}	Decimal	SINT[4]
resp_CMD15_Init_CH0[0]	33		Decimal	SINT
resp_CMD15_Init_CH0[1]	15		Decimal	SINT
resp_CMD15_Init_CH0[2]	1		Decimal	SINT
resp_CMD15_Init_CH0[3]	0		Decimal	SINT

  - Byte0 = 33 → ”Command status: Initiated – command started – send query to get reply.”
  - Byte1 = 15 → ”Echo of HART Command number”.
  - Byte2 = 1 → “Handle Used in Query Operation”.

- Response from the Query MSG function block:

Name	Value	Force Mask	Style	Data Type
resp_CMD15_Query_CH0	{...}	{...}	Hex	SINT[24]
resp_CMD15_Query_CH0[0]	16#00	Status: Success	Hex	SINT
resp_CMD15_Query_CH0[1]	16#0f	Echo of HART Command	Hex	SINT
resp_CMD15_Query_CH0[2]	16#00	HART CommStatus	Hex	SINT
resp_CMD15_Query_CH0[3]	16#10	HART Field Device Status	Hex	SINT
resp_CMD15_Query_CH0[4]	16#12	Data Size	Hex	SINT
resp_CMD15_Query_CH0[5]	16#00		Hex	SINT
resp_CMD15_Query_CH0[6]	16#00		Hex	SINT
resp_CMD15_Query_CH0[7]	16#07	Unit: bars	Hex	SINT
resp_CMD15_Query_CH0[8]	16#3f		Hex	SINT
resp_CMD15_Query_CH0[9]	16#c0	PV Upper Range: 1.5	Hex	SINT
resp_CMD15_Query_CH0[10]	16#00		Hex	SINT
resp_CMD15_Query_CH0[11]	16#00		Hex	SINT
resp_CMD15_Query_CH0[12]	16#00		Hex	SINT
resp_CMD15_Query_CH0[13]	16#00	PV Lower Range: 0	Hex	SINT
resp_CMD15_Query_CH0[14]	16#00		Hex	SINT
resp_CMD15_Query_CH0[15]	16#00		Hex	SINT
resp_CMD15_Query_CH0[16]	16#3e		Hex	SINT
resp_CMD15_Query_CH0[17]	16#4c	PV Damping Value: 0.2	Hex	SINT
resp_CMD15_Query_CH0[18]	16#cc		Hex	SINT
resp_CMD15_Query_CH0[19]	16#cd		Hex	SINT
resp_CMD15_Query_CH0[20]	16#00		Hex	SINT
resp_CMD15_Query_CH0[21]	16#11	Endress+Hauser ID Code	Hex	SINT
resp_CMD15_Query_CH0[22]	16#00		Hex	SINT
resp_CMD15_Query_CH0[23]	16#00		Hex	SINT

HART CMD15

5 Rooted Tool Integration

This chapter describes the main workflow for integration of Rockwell Automation system components into the Endress+Hauser Plant Asset Management system by means of Communication DTMs. As a result, the Endress+Hauser PAM system can access underlying EtherNet/IP and HART devices for device configuration. By the way, Condition Monitoring can be executed with HART devices connected to the ControlLogix 1756-IF8IH.

This chapter describes two workflows. The first one explains how to configure the Communication DTMs to connect the field device DTMs (HART and EIP). The second one describes the steps to establish Condition Monitoring communication.

5.1 FieldCare for Device Configuration Management (DCM)

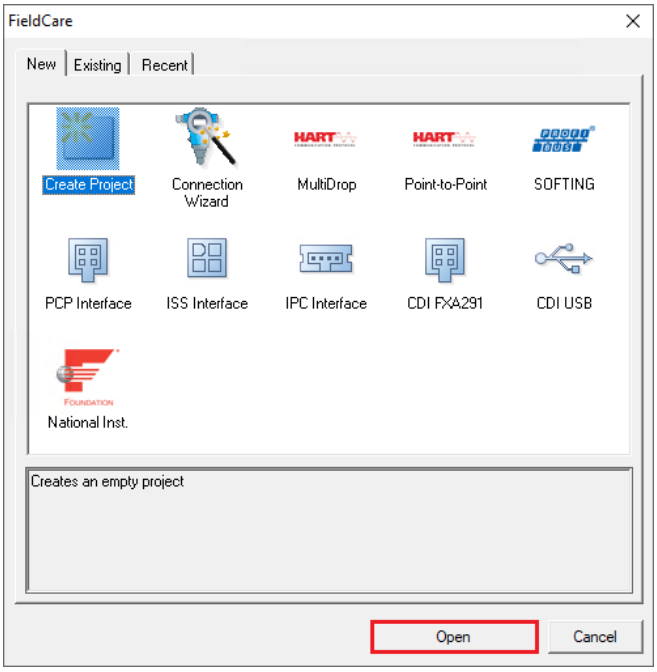
In following example, we assume that following steps have already been executed:

- Endress+Hauser FieldCare working as a DCM tool and device DTMs (HART, EtherNet/IP) installed
- Rockwell Automation RSLinx tool and CommDTM installed

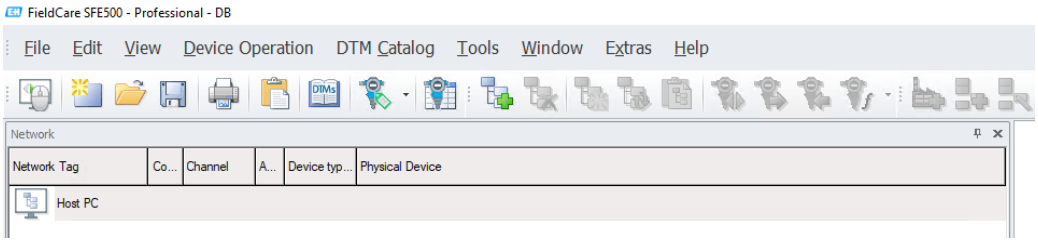
5.1.1 New Project

- Start the FieldCare application:

- Create a new project:

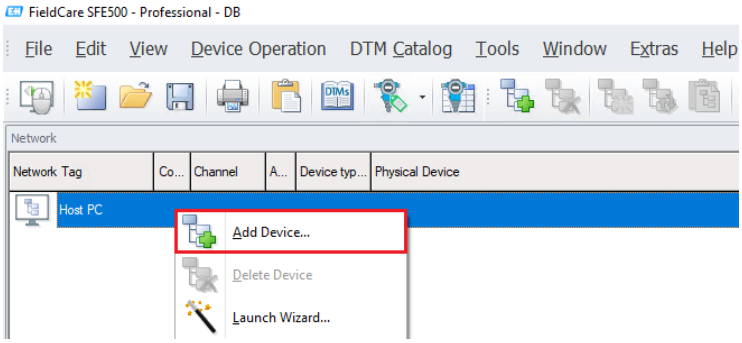


- This opens a new project:

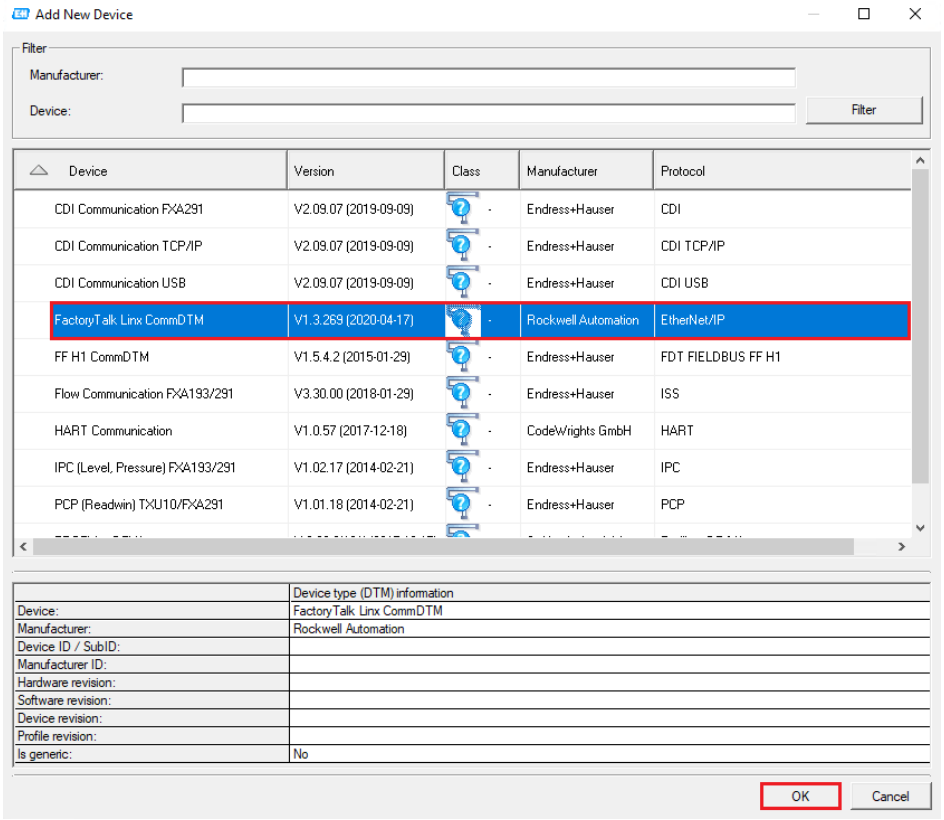


5.1.2 CommDTM Configuration

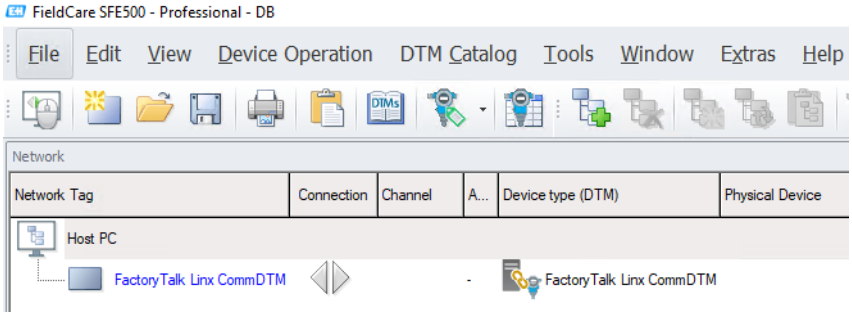
- In the network view, right-click on "Host PC" and select "Add Device...":



- Select the Rockwell Automation CommDTM "FactoryTalk Linx CommDTM" and click on the button "OK":

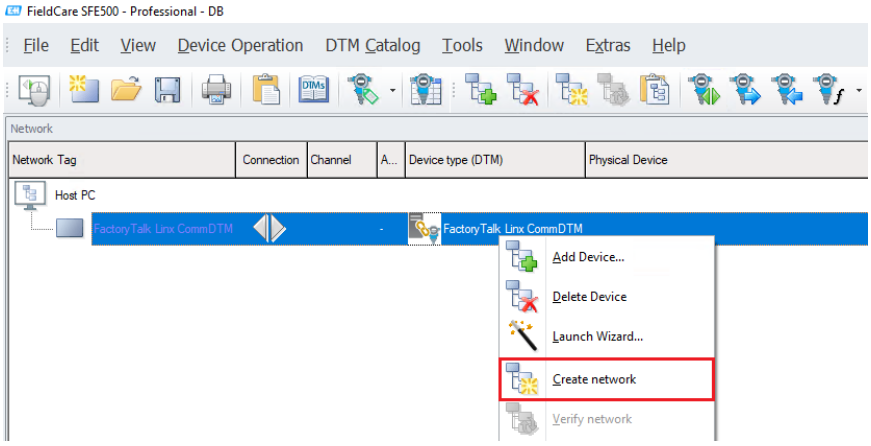


- CommDTM is inserted in the project:

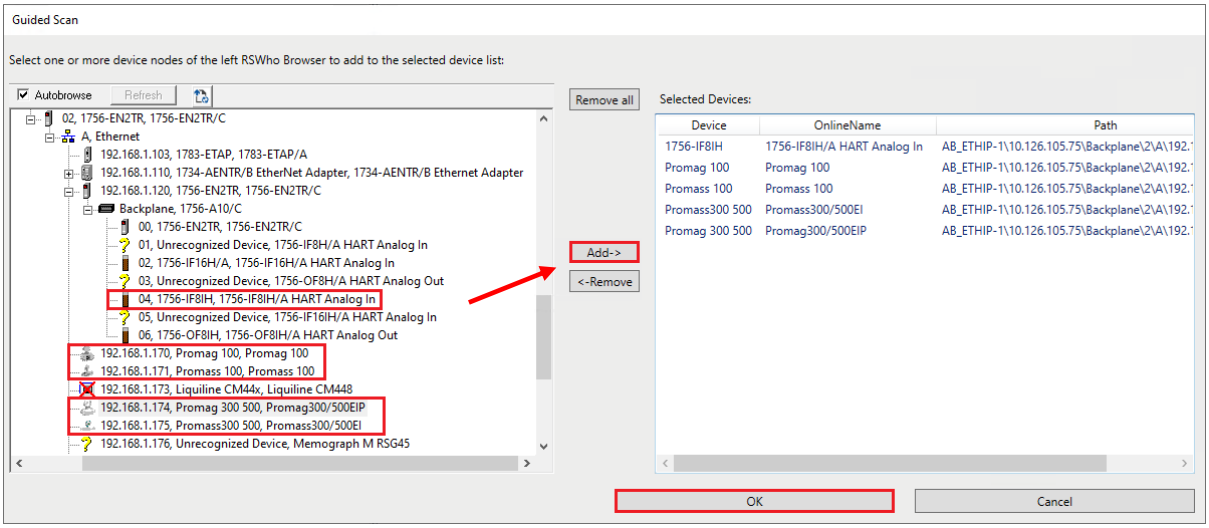


5.1.3 Network Scanning

- Right-click on the CommDTM "Factory Talk Linx CommDTM" and select the menu "Create Network":

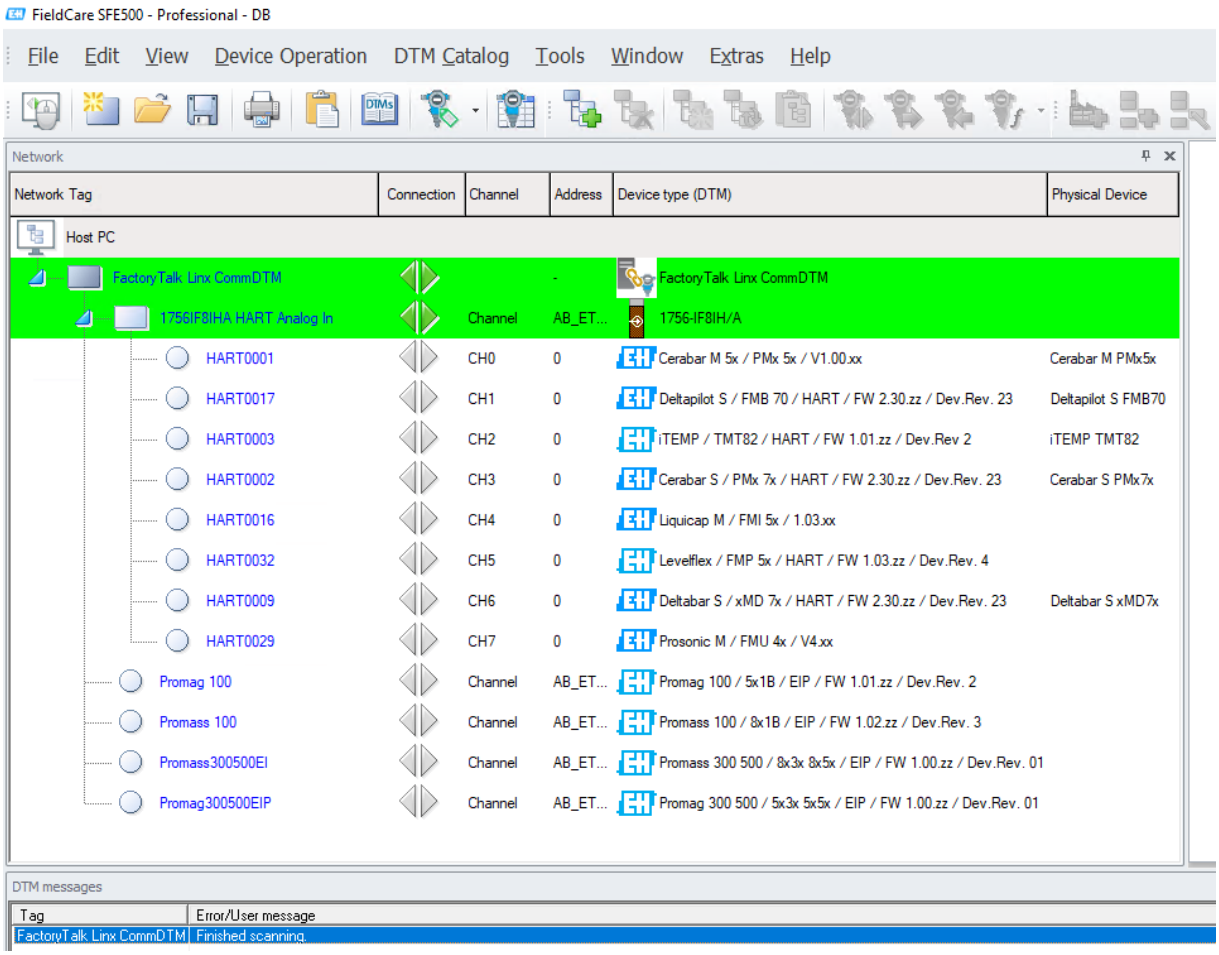


- Select the network components, which needs to be scanned, click on the button "Add->" and then on the button "OK":



In this example, the 1756-IF8IH module and some EtherNet/IP field devices are selected.

- Scanned field devices:



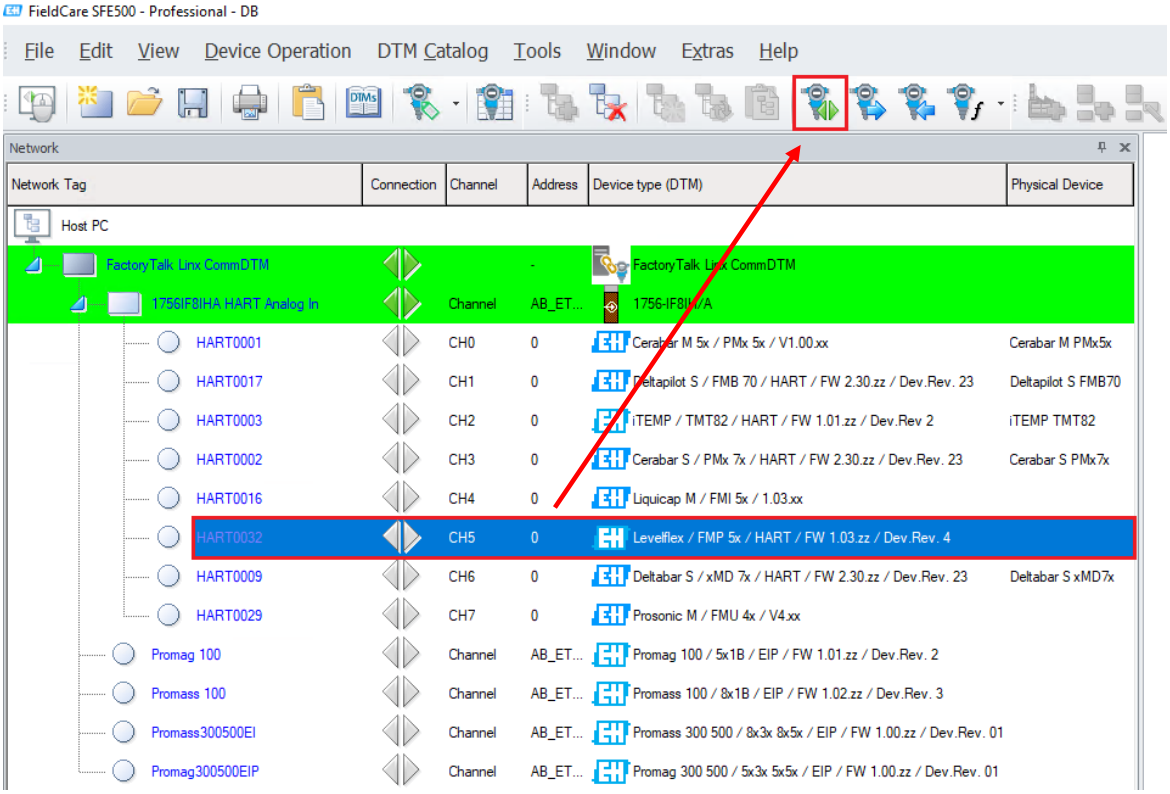
Remarks about TAGs

- The table below summarizes the displayed Tags in the FieldCare network view after a Create Network:

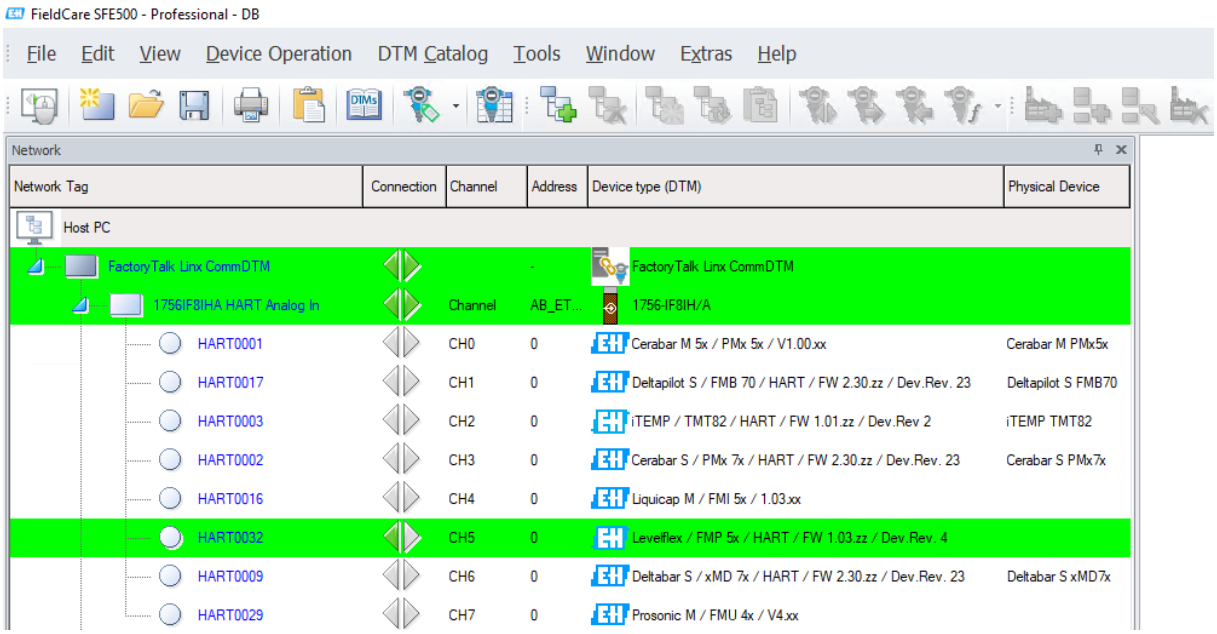
Field Devices	Protocol	Corresponding FieldCare Network TAG in deviceDTM
Cerabar M	HART	Customer Tag Number
Deltapilot S		Customer Tag Number
iTEMP TMT82		Short Tag
Cerabar S		Customer Tag Number
Liquicap		Short Tag
Levelflex		Device Tag
Deltabar S		Customer Tag Number
Prosonic M		Tag Number
Promag100	EIP	Tag is not read
Promass100		Tag is not read
Promass300		Tag is not read
Promag500		Tag is not read

5.1.4 Online Connection

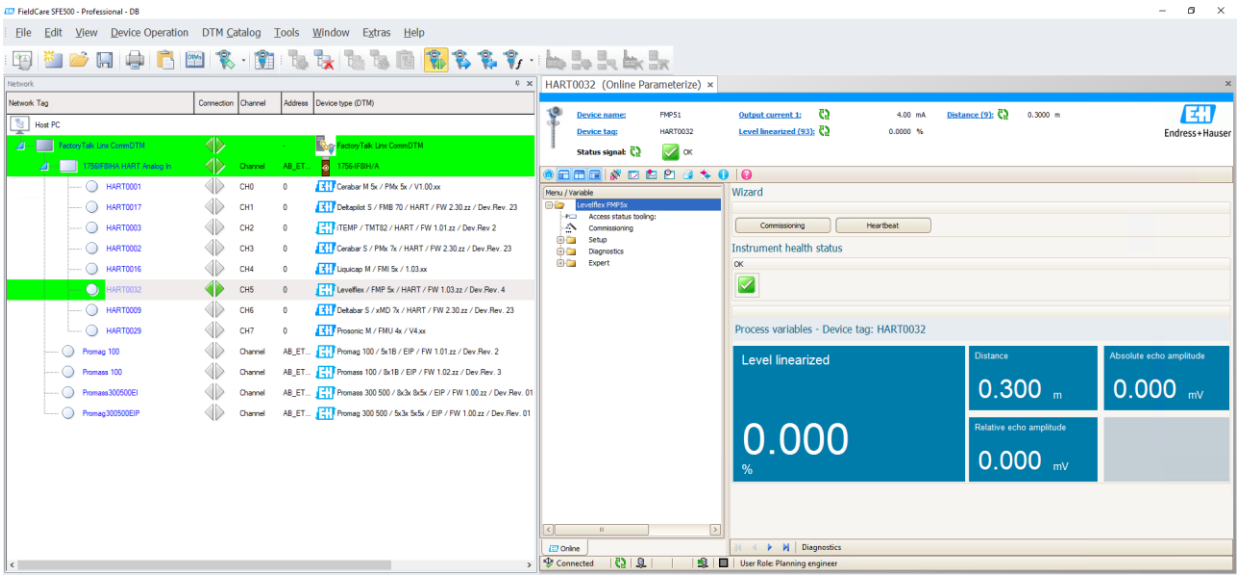
- Select the deviceDTM and click on the shortcut button “Connect”:



- Device is connected:



- Double-click on the deviceDTM to open the window “Online Parameterize”:



5.2 SRP700 Asset Health Monitoring (AHM) Solution

This chapter describes the steps to operate SRP700 AHM solution with HART field devices connected to the 1756-IF8IH analog input module.

In this example, the Endress+Hauser SRP700 Asset Health Monitoring (AHM) solution is composed of three major components, SRP700 PAM gateway (FieldCare as a Server), SRP700 Client (FieldCare as a Client) and SRP700 Asset Health Monitor. The SRP700 Gateway and Client operating systems must be configured adequately for working as Asset Health Monitoring (Condition Monitoring) application. Please contact your local Endress+Hauser Sales Center to get supports in case of installation and setup.

5.2.1 SRP700 PAM Gateway (FieldCare as a Server)

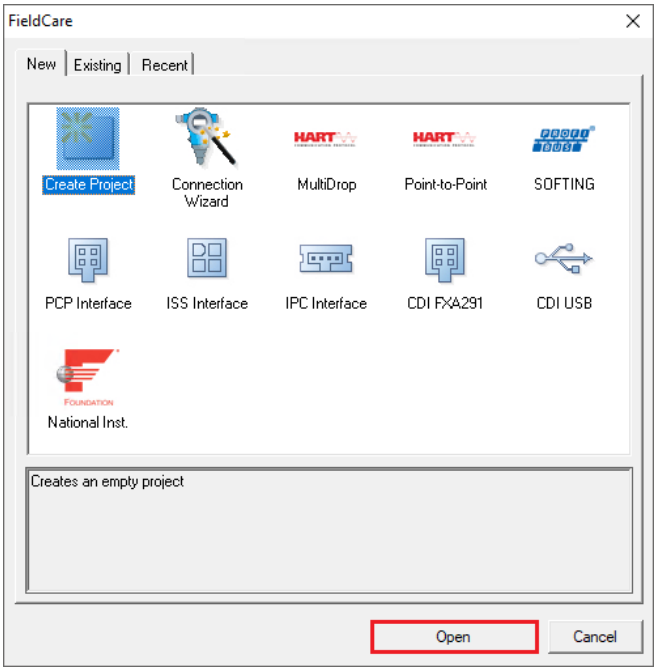
In following example, we assume that following steps have already been executed:

- Operating system configuration (Firewall, SQL database)
- Endress+Hauser FieldCare working as a Server (SRP700 PAM Gateway) and specific device drivers installed
- Rockwell Automation RSLinx tool and CommDTM installed

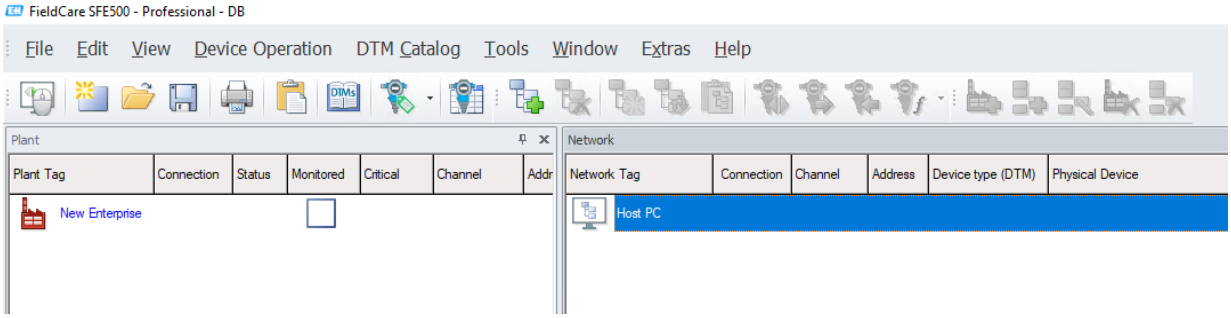
5.2.1.1 New Project

- Start the FieldCare application:

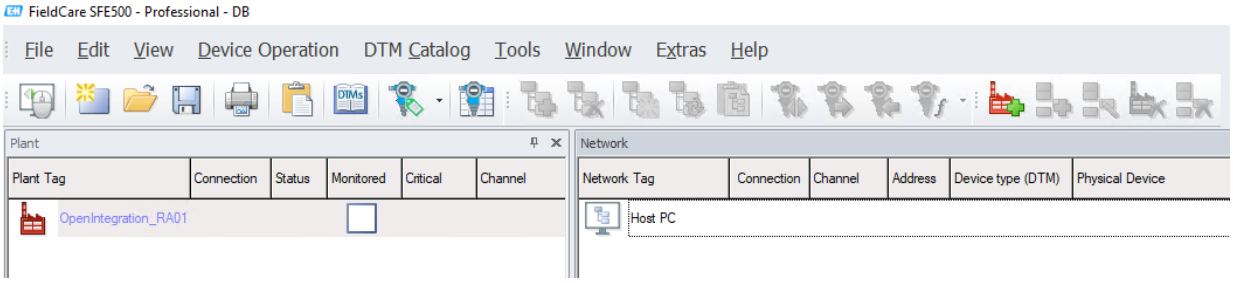
- Create a new project:



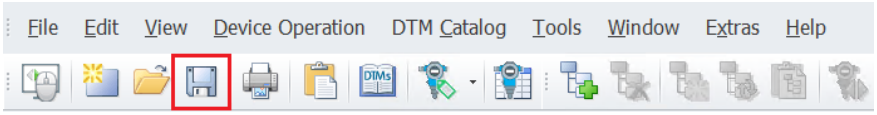
- This opens a new project:



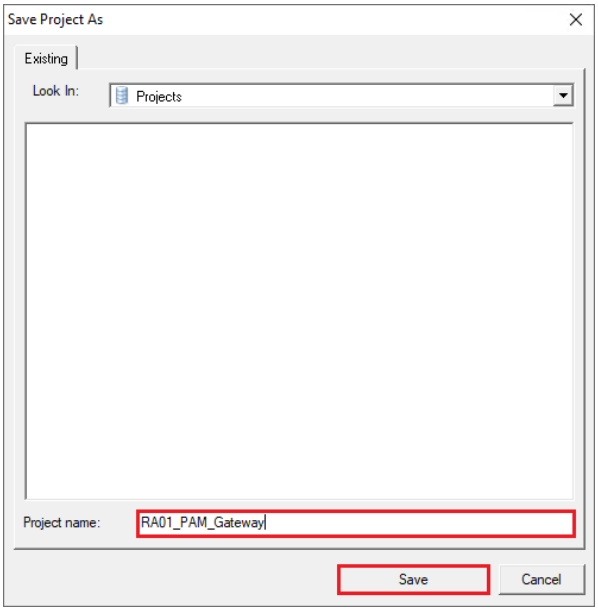
- Update the Plant tag name, for example “OpenIntegration_RA01“:



- Click on the button “Save” in the tool bar menu to save the project:

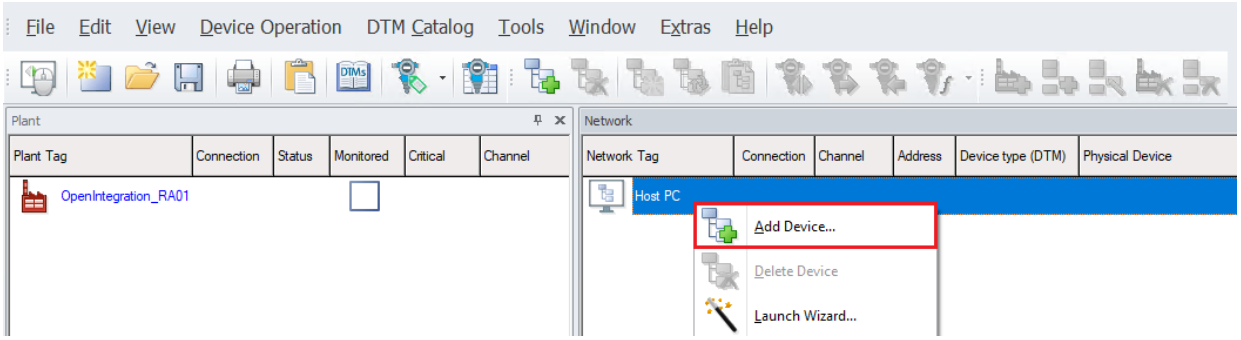


- Enter a project name, for example “RA01_PAM_Gateway” and click on the button “Save:”

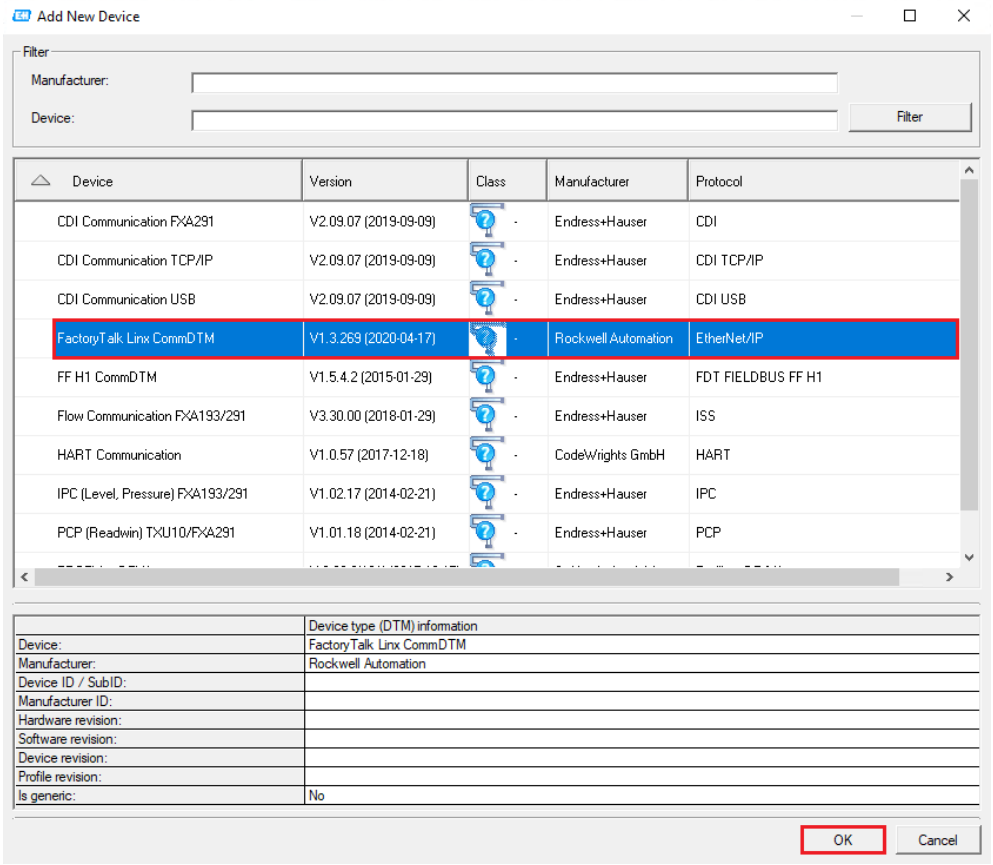


5.2.1.2 CommDTM Configuration

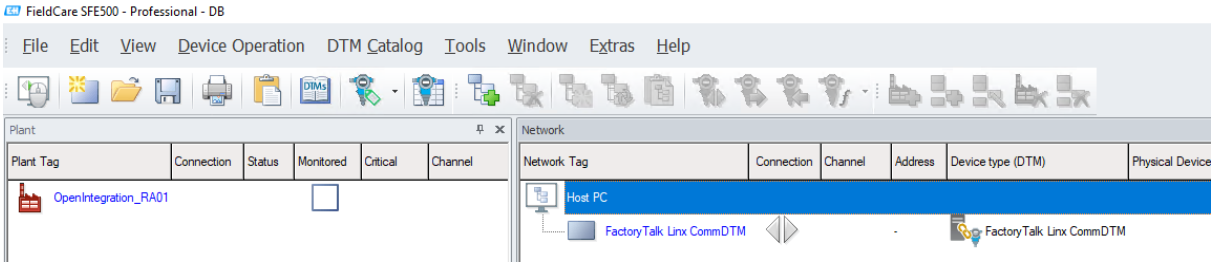
- In the network view, right-click on “Host PC” and select ”Add Device...”:



- Select the Rockwell Automation CommDTM "FactoryTalk Linx CommDTM" and click on the button "OK":

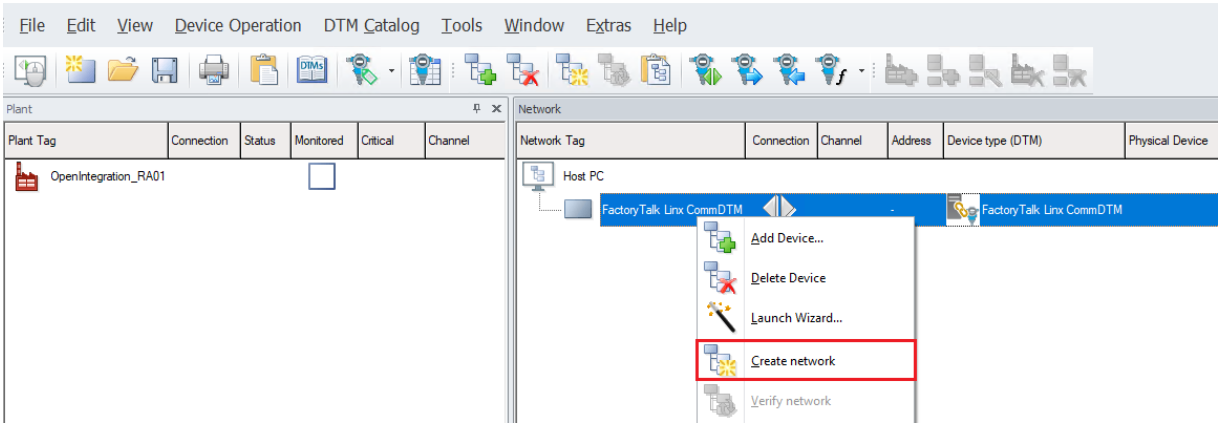


- CommDTM is inserted in the project:

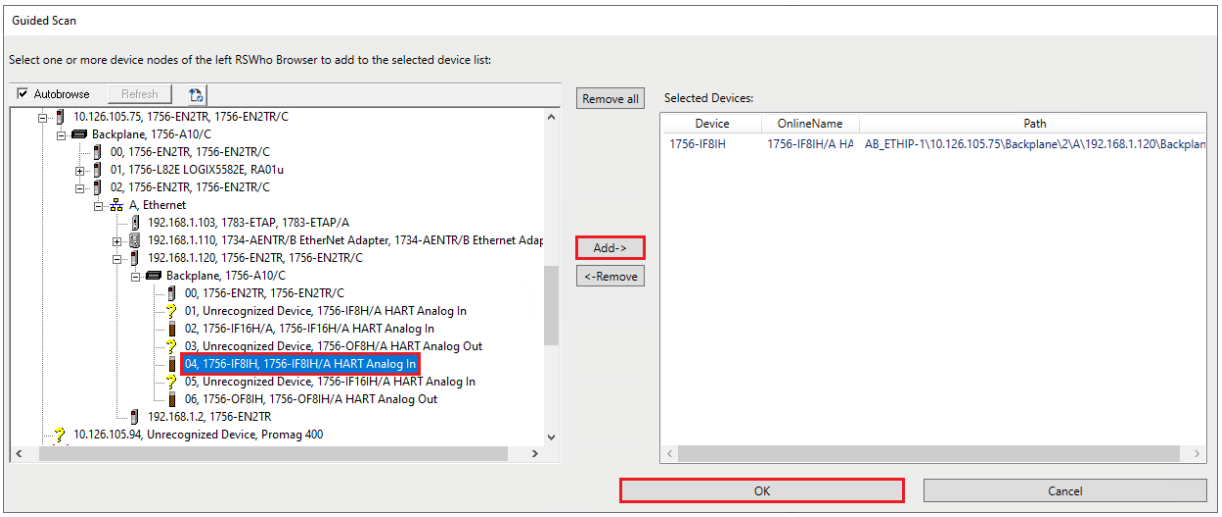


5.2.1.3 Network Scanning

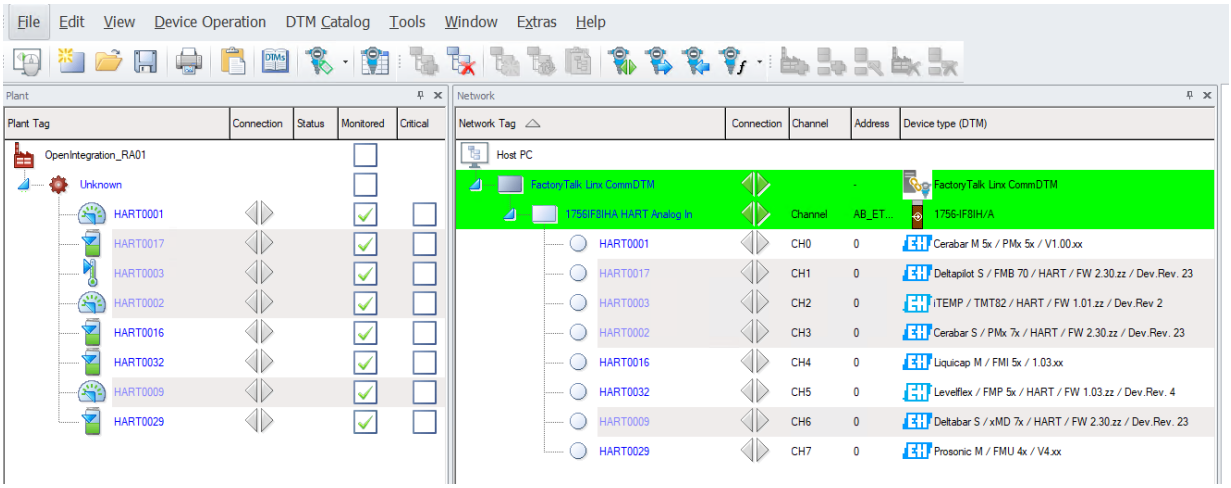
- Right-click on the CommDTM “Factory Talk Linx CommDTM” and select the menu “Create Network”:



- Select the network components, which needs to be scanned, click on the button “Add->” and then on “OK”. In this example, the 1756-IF8IH module is selected:



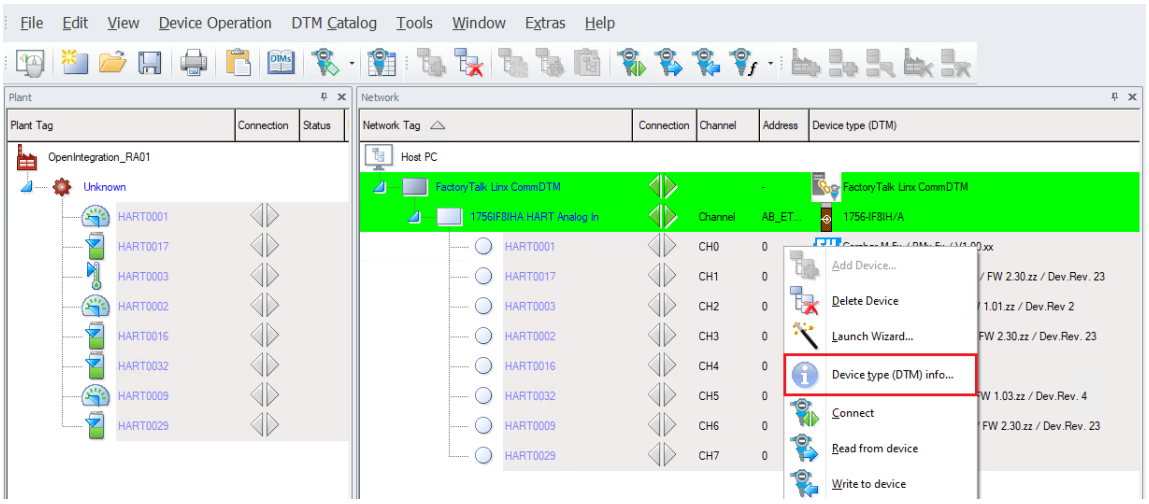
- Scanned field devices:



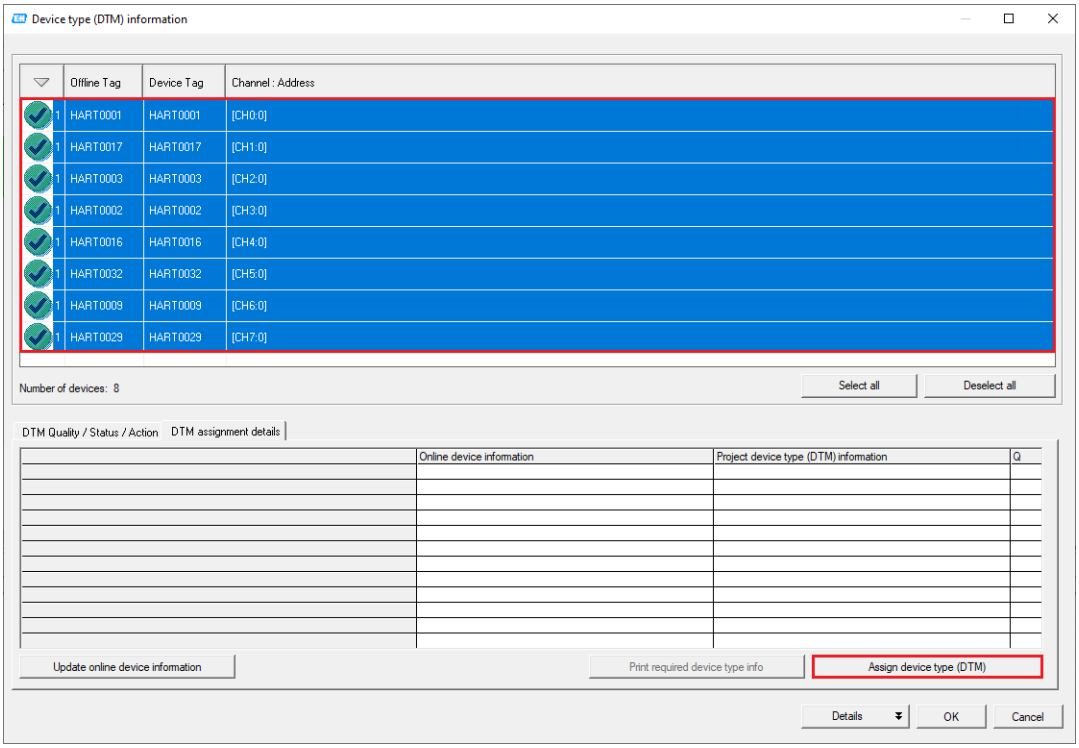
5.2.1.4 Placeholder FieldDevice

Configuring a SRP700 Asset Health Monitoring solution requires using “Placeholder FielDevice” DTMs on the SRP700 PAM Gateway and not deviceDTMs. In this example, the DTM library contains as well the Endress+Hauser device Library, that’s why these have been inserted in the project.

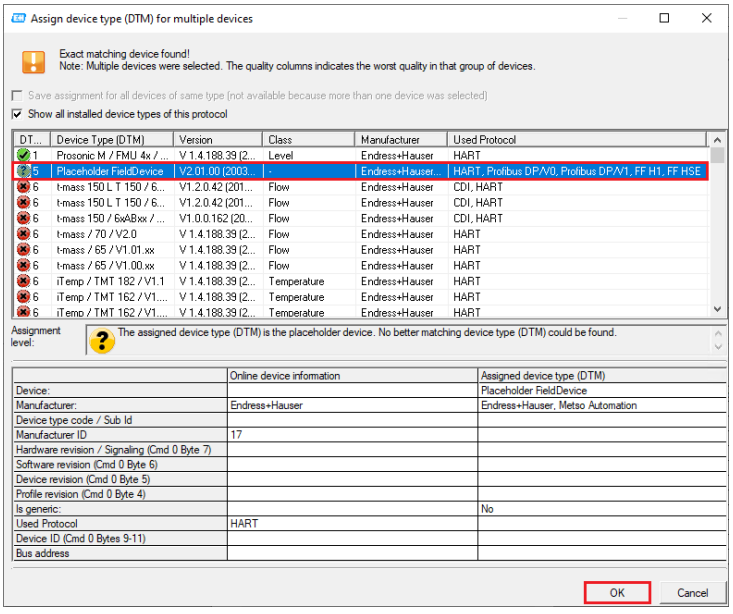
- To replace the deviceDTMs with a “Placeholder FieldDevice” DTM, select all deviceDTMs, then right-click and select the menu “Device type (DTM) info...”:



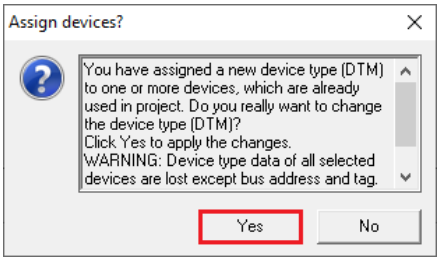
- Select all devices and click on the button “Assign device type (DTM)”



- Select the “Placeholder FieldDevice” DTM and click on the button “OK”:

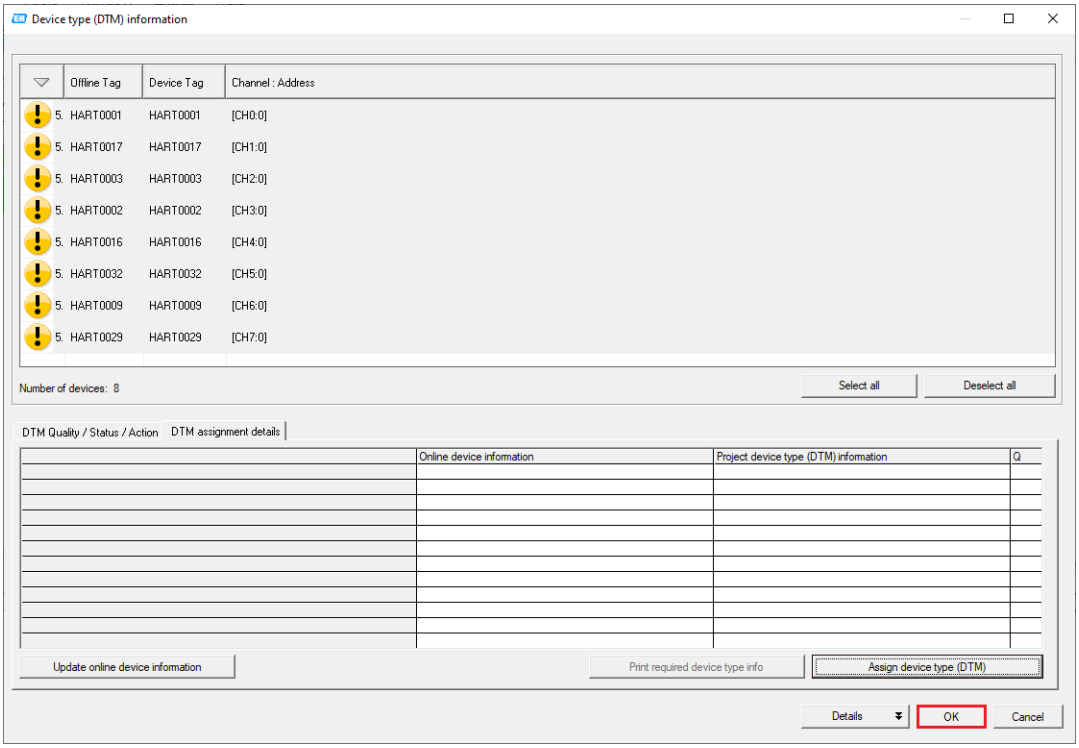


- This displays following window:

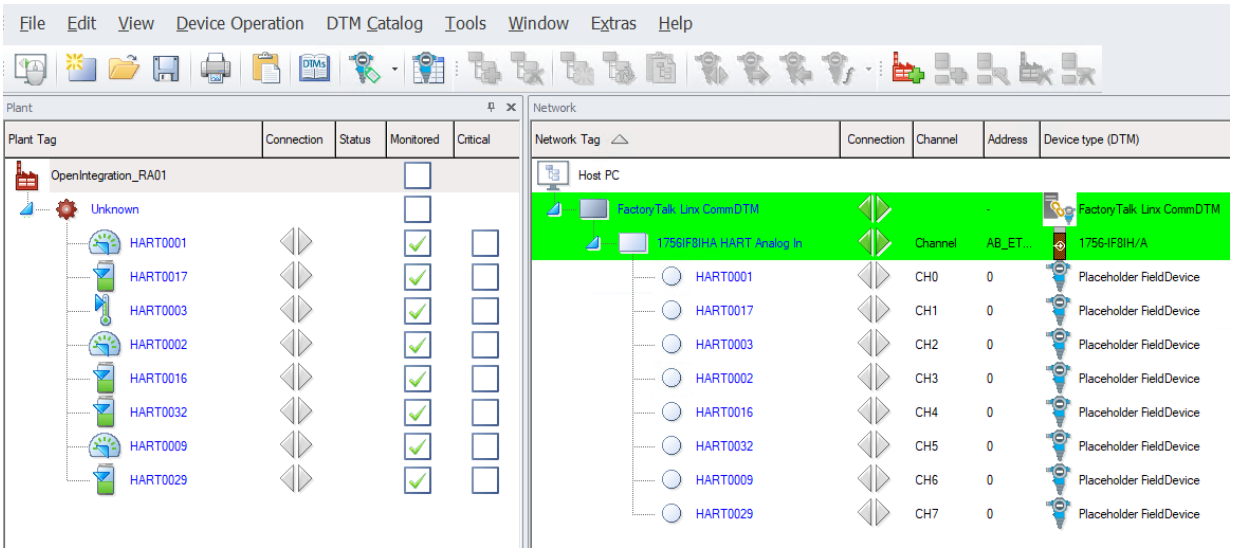


Click on the button “Yes”.

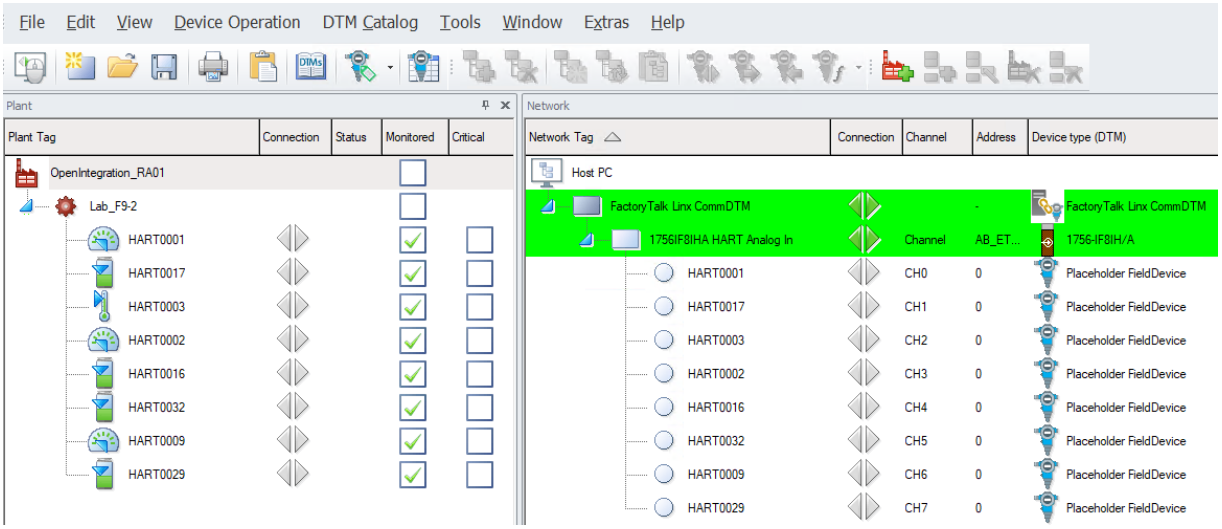
- Click on the button “ok” to valid:



- DeviceDTMs have been replaced:



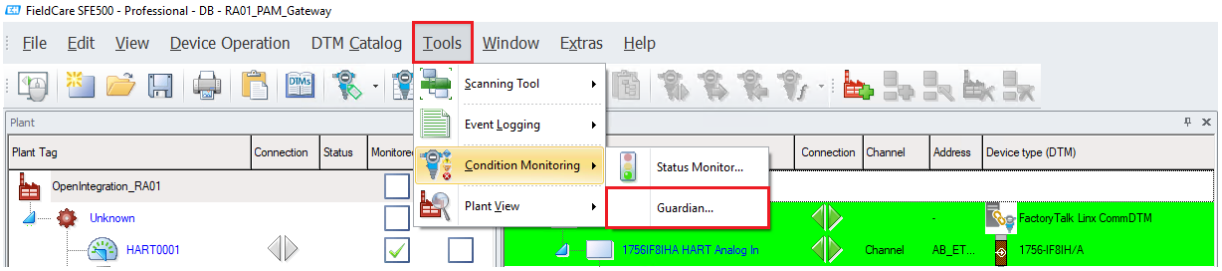
- Modify the name of the Plant Unit (Lab_F9-2 in this example) and save the project:



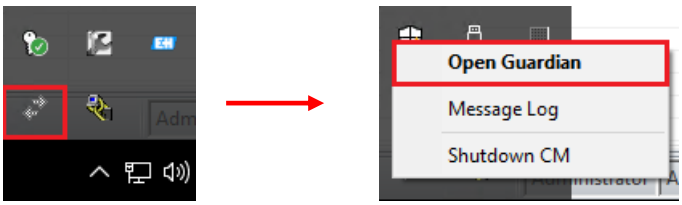
In this example, all devices are “Monitored” in the Plant Tag view for Condition Monitoring.

5.2.1.5 Condition Monitoring Guardian

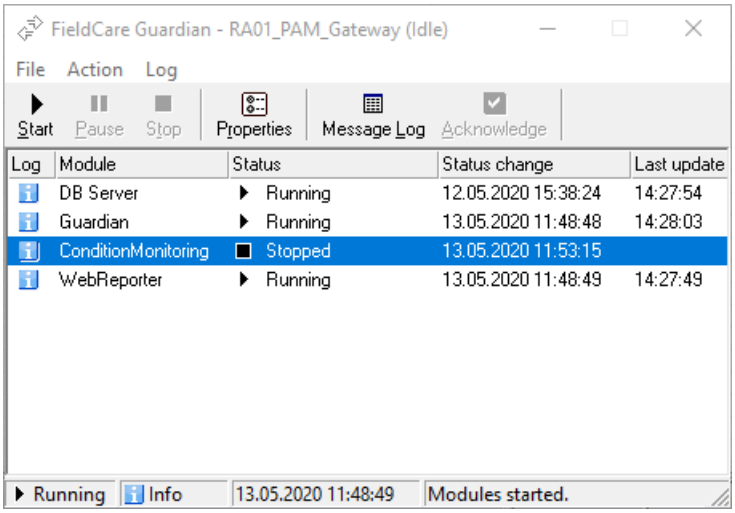
- Select the menu “Tools → Condition Monitoring → Guardian...”:



- The Guardian symbol appears in the Windows task list. Right-click on it and select the menu “Open Guardian”:



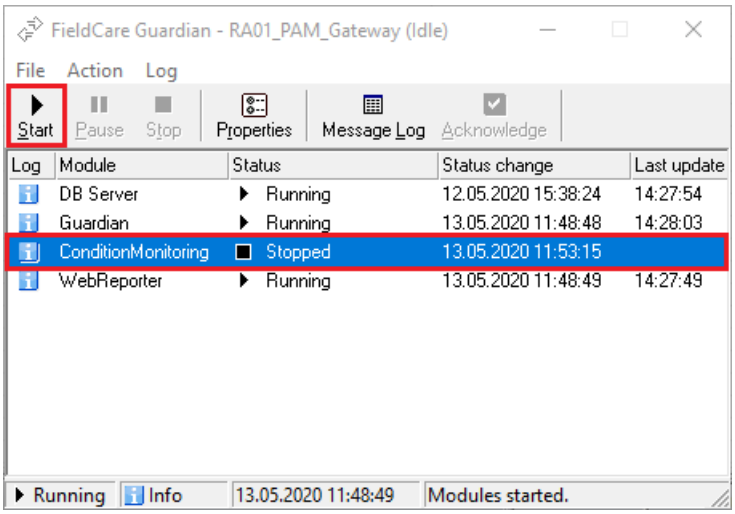
- This opens the Guardian window:



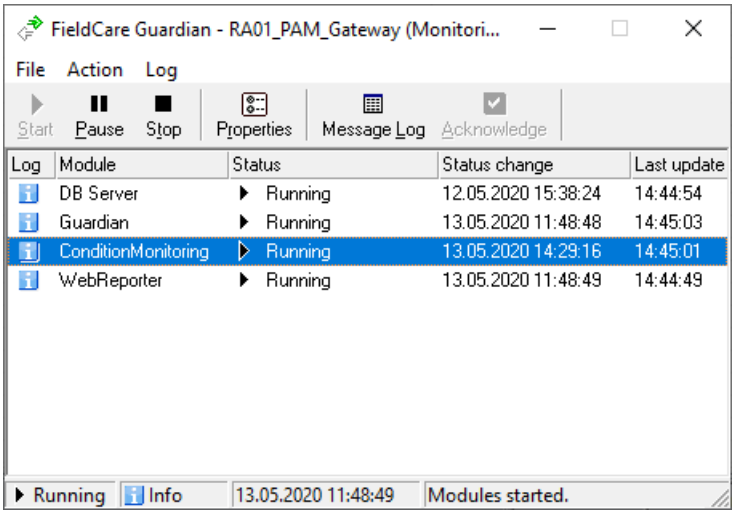
The menu “Properties” allows the user to configure further settings. Please contact your local Endress+Hauser Sales Center for further information about this configuration.

5.2.1.6 Condition Monitoring Start

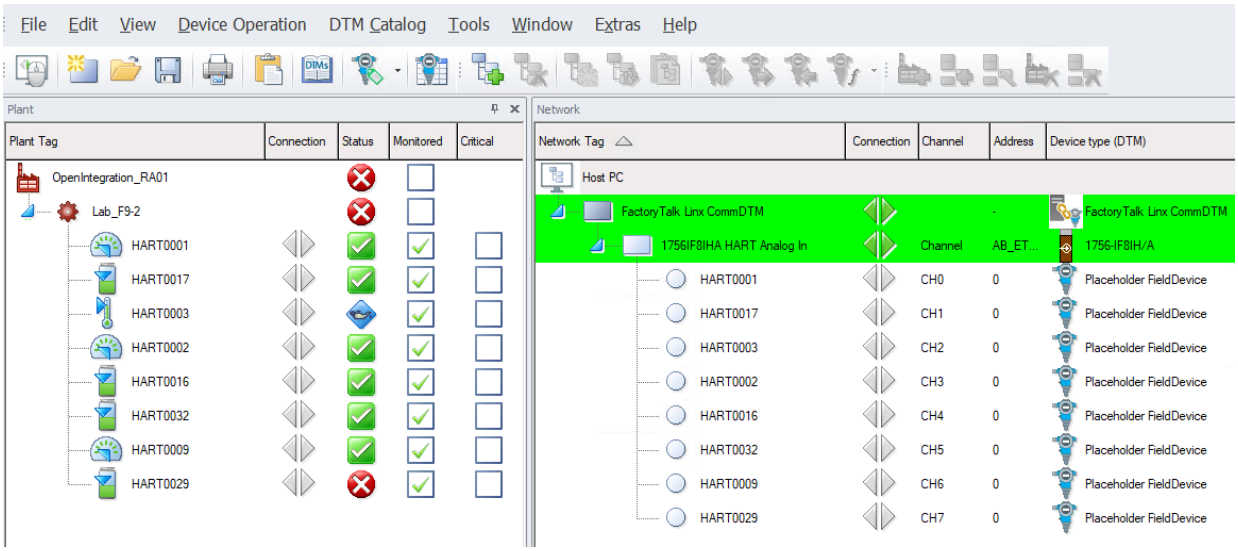
- In the Guardian window, select the field “Condition Monitoring” and click on the button “Start” to start the Condition Monitoring:



- Condition Monitoring is running:



- As soon as the Condition Monitoring is started, each device after the other is monitored in FieldCare Plan Tag view with its corresponding NAMUR status:



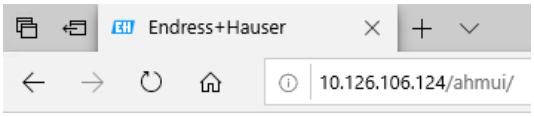
5.2.2 SRP700 Client (FieldCare as a Client)

In following example, we assume that following steps have already been executed:

- Operating system configuration (Firewall)
- SRP700 Asset Health Monitor software installed (as a separate application)
- Endress+Hauser FieldCare working as a Client (SRP700 Client), deviceDTMs and CommDTM installed

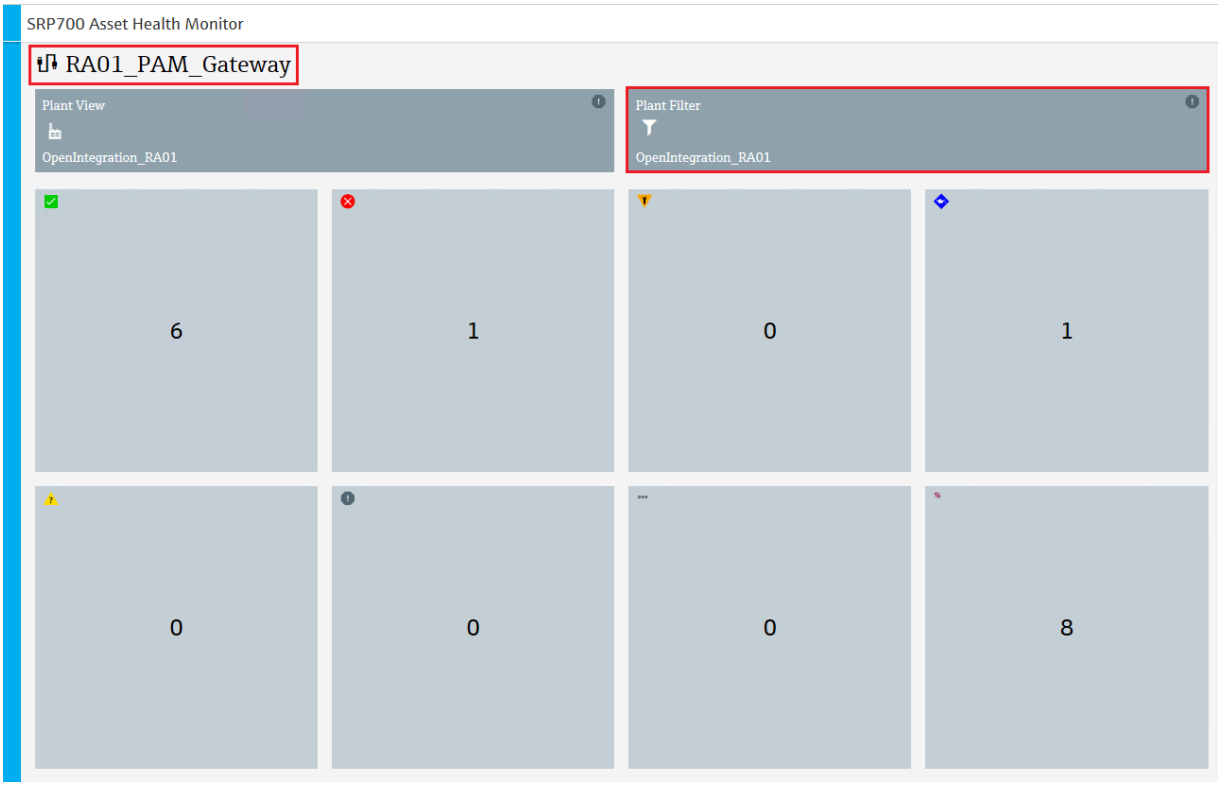
5.2.2.1 Asset Health Monitoring

- Open a Web browser and enter the IP address of the PAM Gateway:



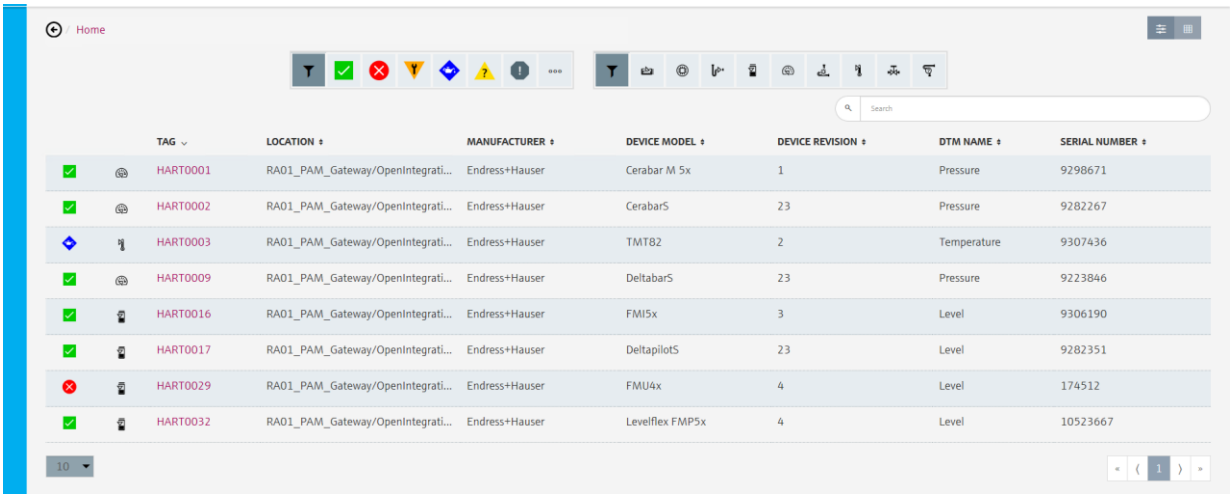
In this example, the PAM Gateway IP address is 10.126.106.124.

- Web browser is successfully opened with the configured PAM Gateway FieldCare project (RA01_PAM_Gateway):

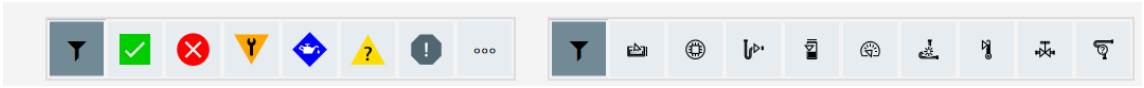


We already can see the connected devices sorted according their NAMUR status. Click on the button Plant Filter.

- This displays all available assets, which can be selected :



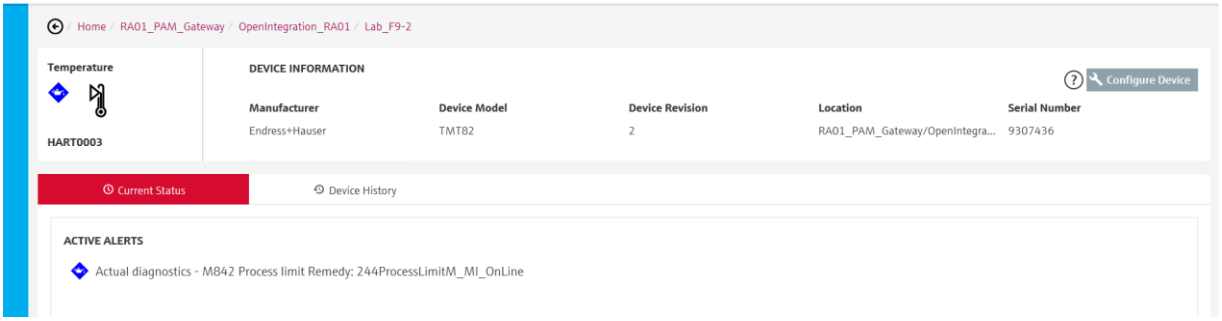
- The upper tool bar allows the user to filter devices according to their NAMUR status or their device measurement principle, … .



All filters are selected per default.

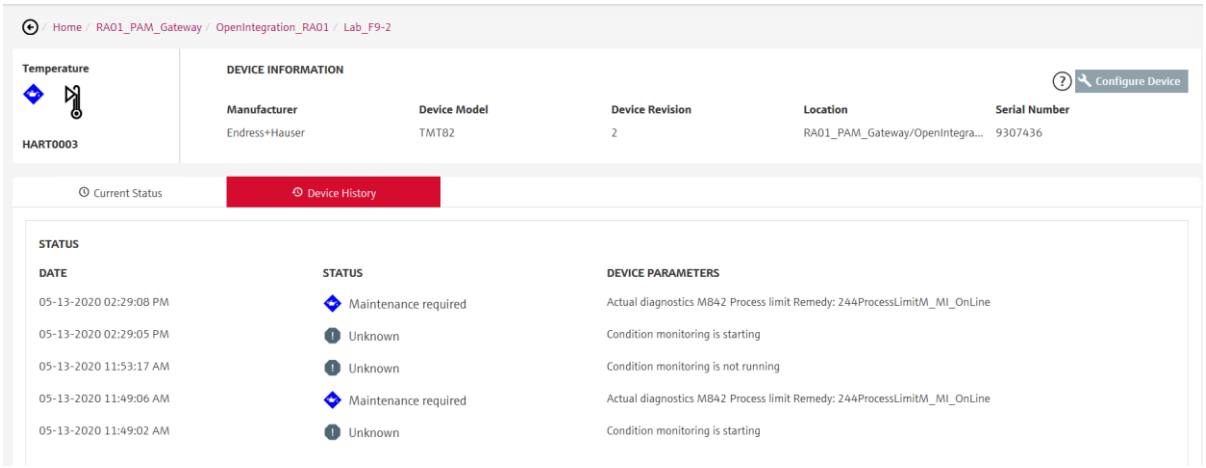
5.2.2.2 Device Information

- In this example, the asset HART0003 has been selected:



In this view are displayed the device information as well as the device status and diagnostics. In this example, the TMT82 has the status “Maintenance” due to the diagnostic event “M842” .

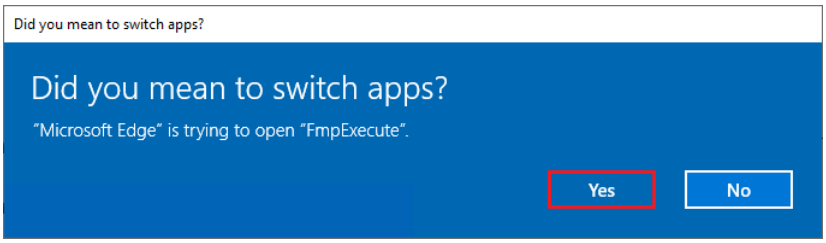
- Clicking on the tab “Device History” provides further events:



5.2.2.3 Device Configuration

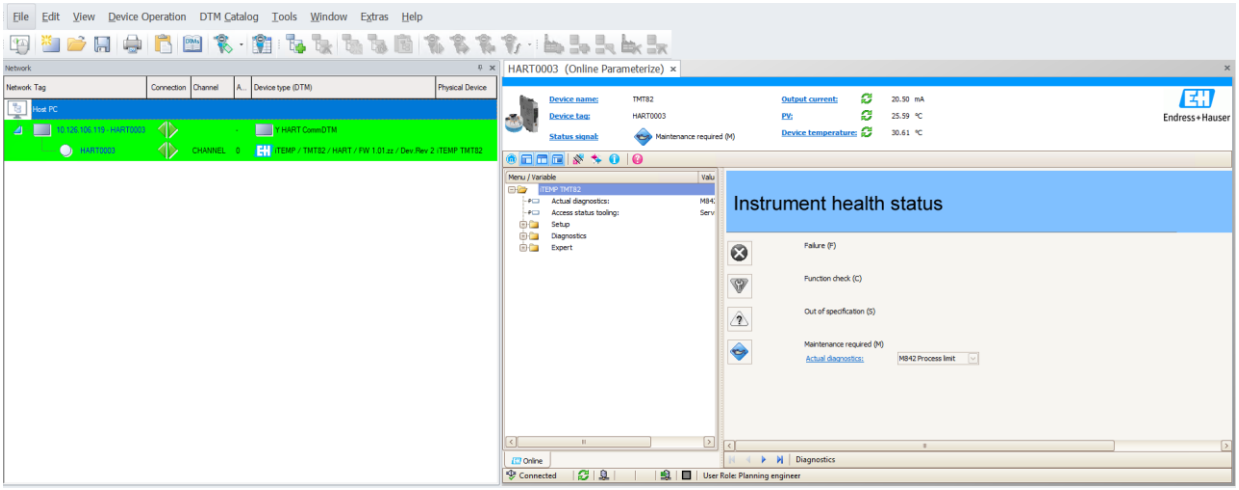
- The asset can be configured in FieldCare by clicking on the button “Configure Device”.

- This opens following window:



Click on the button “Yes”.

- This opens FieldCare working as SRP700 Server or Client and the communication is automatically established with the device for further process:



6 Bypassed Tool Integration

This chapter describes how to access the EtherNet/IP devices by using the integrated device Web server for device configuration.

6.1 Configuration

The Web server feature can be used under two conditions:

- The function “Web server” is enabled in the device (Menu “Expert→Communication→Web server”).
- The station from which is opened the web server has to connect the EtherNet/IP I/O network and this connection depends of course of the network architecture.
  Our network topology is composed of two different IP address ranges: supervisory and I/O network. The Web server cannot be opened from the supervisory network but only from the I/O network level. In this example, a port has been enabled on the Stratix5400 switch to connect the Web server station.

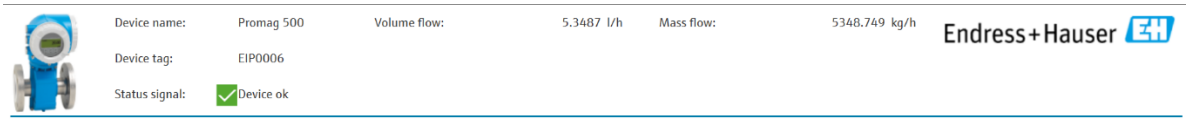
6.2 Connection

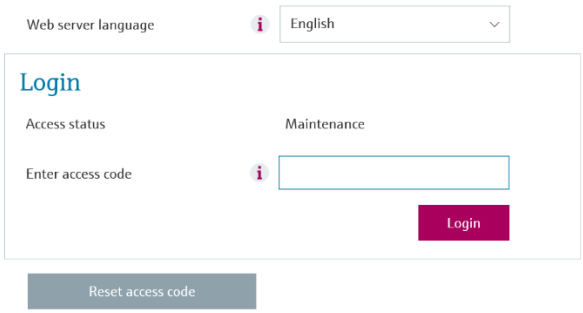
- Open a Web browser and enter the device IP address:

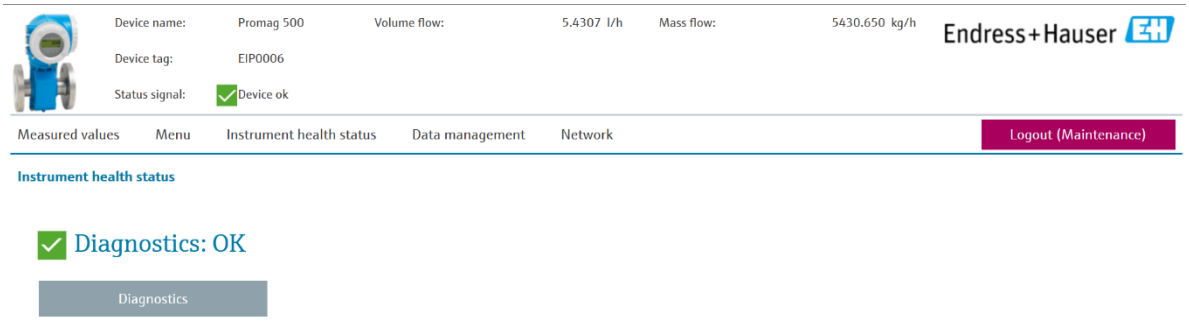
  In this example, the IP address 192.168.1.174 corresponds to the Promag500.

- Device Web server is opened. Enter the user level code “0000” and click on the button “Login”:

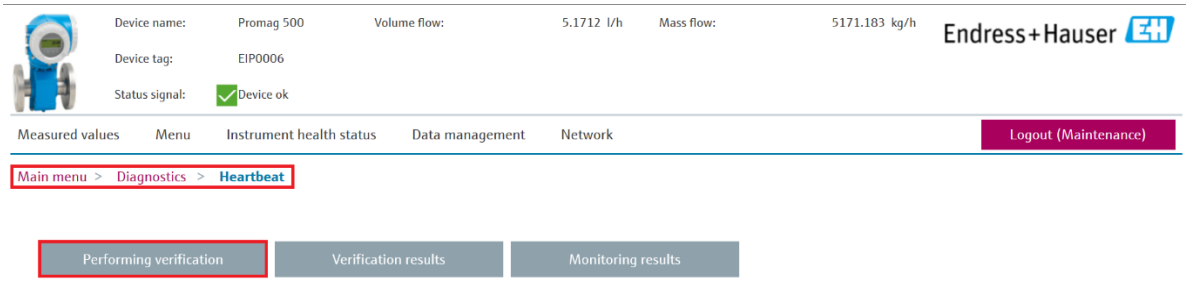
  

- This directly opens the Instrument health status window:

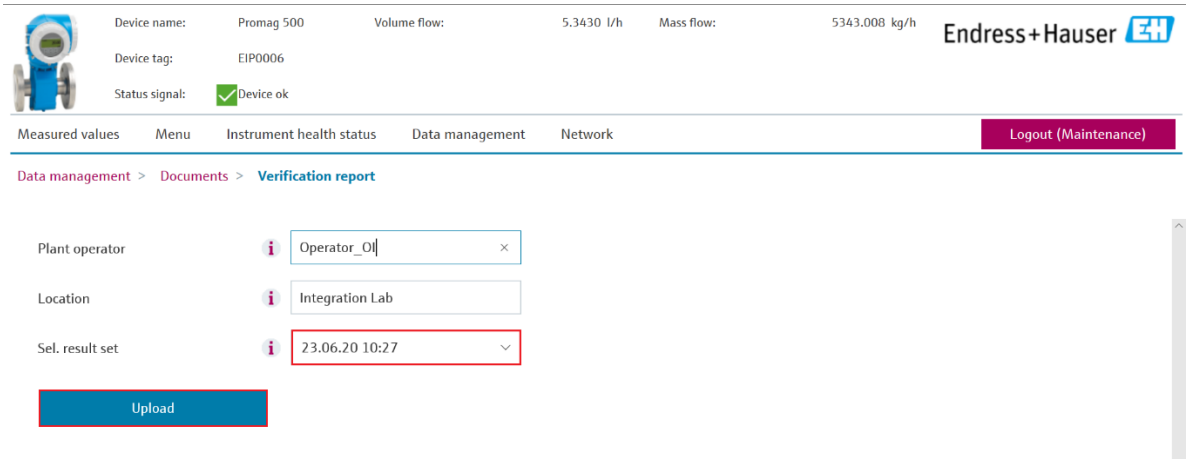


6.3 Heartbeat Verification Report

- Click on the menu “Main menu→Diagnostics→Heartbeat→Performing Verification”:



- Select the Report to download with the list box “Sel. Result set” and click on the button “Upload”:



- Heartbeat Verification report can be saved as a *pdf file.

www.endress.com/open-integration