

Integration Tutorial RA01

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



Table of Contents

1	Document Information.....	6
1.1	Purpose and Scope	6
1.2	Document History	6
1.3	Related Documents	6
2	Pre-Requisites	6
2.1	Recommended Literature	7
2.1.1	Rockwell Automation	7
2.1.2	Endress+Hauser.....	7
2.2	Operable Control System	7
2.3	Operable Asset Management System.....	7
2.4	Operable Field Devices	7
3	Basic Integration.....	8
3.1	Network Configuration.....	8
3.1.1	Network Overview	8
3.1.2	Supervisor System Network Configuration.....	9
3.1.3	I/O Network Configuration.....	14
3.1.4	Allowed IP Address.....	17
3.1.5	Network Connection	19
3.2	System Configuration.....	21
3.2.1	New Project	21
3.2.2	System Offline Configuration	23
3.3	EtherNet/IP Field Device Configuration	41
3.3.1	Field Device Library	41
3.3.2	Device Integration with EDS.....	43
3.3.3	Device Integration with AOP	49
3.4	Commissioning of the Control Project	55
3.4.1	Path Configuration	55
3.4.2	Project Configuration Download	57
3.4.3	Network Supervisor Mode.....	59
3.5	Monitoring of Process Values and Status Information	60

3.5.1	EtherNet/IP Data	60
3.5.2	HART Data	64
4	Specific Integration	68
4.1	Add On Instructions	68
4.1.1	AOI Library.....	68
4.1.2	AOI Integration for HART devices connected on ControlLogix I/O	70
4.1.3	AOI Integration for HART devices connected on Flex I/O	98
4.1.4	AOI Integration for EtherNet/IP devices	100
4.1.5	Configuration Download	113
4.2	Faceplates	114
4.2.1	General Configuration	114
4.2.2	Library Objects.....	123
4.2.3	Generic Analog Input Faceplate	127
4.2.4	HART Analog Input Faceplate	128
4.2.5	EtherNet/IP Faceplate.....	132
4.2.6	Faceplates Online Connection	135
4.3	HART Commands	144
4.3.1	Principle.....	144
4.3.2	CMD48 Configuration by using HART object data	144
4.3.3	HART Pass-through CIP messages	170
5	Rooted Tool Integration.....	192
5.1	RSLink Tool	192
5.2	New FieldCare Project.....	193
5.3	EtherNet/IP Integration.....	193
5.3.1	Adding an EtherNet/IP Devices with the Function Create Network	195
5.3.2	Adding Manually an EtherNet/IP Device	197
5.3.3	Device Online Connection.....	199
6	Bypassed Tool Integration	201
6.1	Configuration	201
6.2	Connection	201
6.3	EDS File Upload	203

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 1.00.00 of this document. Version history:

Version	Released	Description
1.00.00	2018-10	Initial version

1.3 Related Documents

Please refer to related documents as listed below:

Document	Description
SD02272S/04/EN/01.18	Reference Topology RA01
SD02274S/04/EN/01.18	Integration Test Summary RA01
SD02275S/04/EN/01.18	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
BA00027S/04/A2/22.16	FieldCare / Device Care 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.

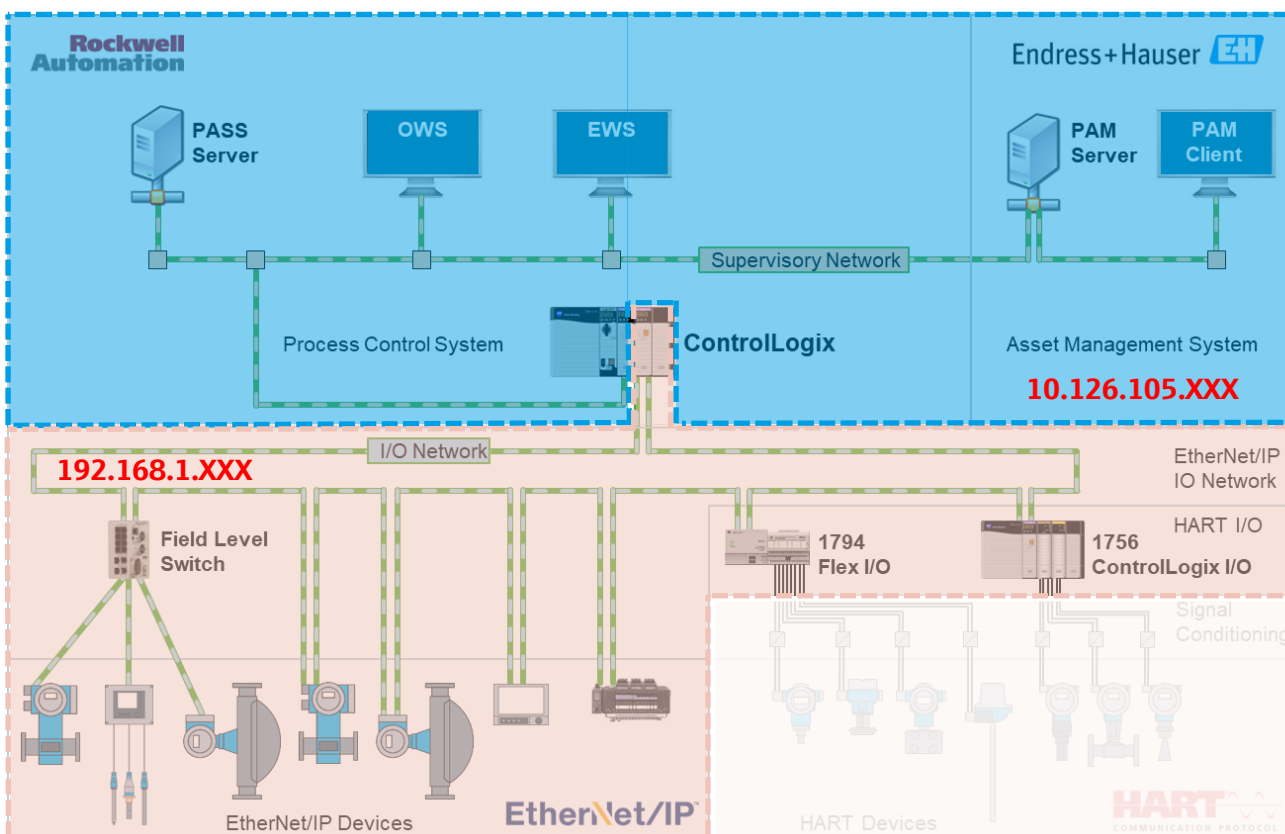
3 Basic Integration

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:

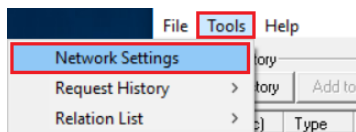
Network	Component		Configured IP Address	Subnet Mask	IP Configuration Method
Supervisor Network	Control System	1756-EN2TR (ControlLogix)	10.126.105.75	255.255.252.0	BOOTP + RSLinx
IO Network	Control System	1756-EN2TR (ControlLogix)	192.168.1.111	255.255.255.0	BOOTP + RSLinx
	Remote IO	1756-EN2TR (ControlLogix IO)	192.168.1.110	255.255.255.0	BOOTP + RSLinx
	Remote IO	1794-AENTR (Flex IO)	192.168.1.112	255.255.255.0	Rotary switch
	Switch	Stratix5400	192.168.1.20	255.255.255.0	Web server
	EtherNet/IP Devices	Liquiline CM44x	192.168.1.30	255.255.255.0	Web server
		Promag100	192.168.1.31	255.255.255.0	Web server
		Promass100	192.168.1.32	255.255.255.0	Web server
		Memograph RSG45	192.168.1.33	255.255.255.0	Web server
		Promag500	192.168.1.34	255.255.255.0	Web server
		Promass300	192.168.1.35	255.255.255.0	Web server
		AirLINE 8652	192.168.1.41	255.255.255.0	Device display

3.1.2 Supervisor System Network Configuration

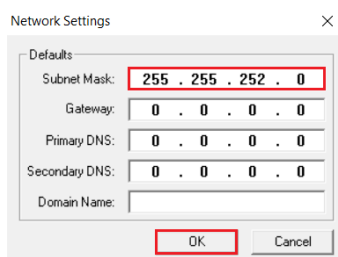
This chapter describes the steps for configuring the IP address of the ControlLogix 1756-EN2TR module connected to the supervisor network. In this example, the 1756-EN2TR module IP address configuration is firstly set dynamically by using BOOTP and then statically by using RSLinx.

3.1.2.1 1756-EN2TR Dynamic IP Address Configuration

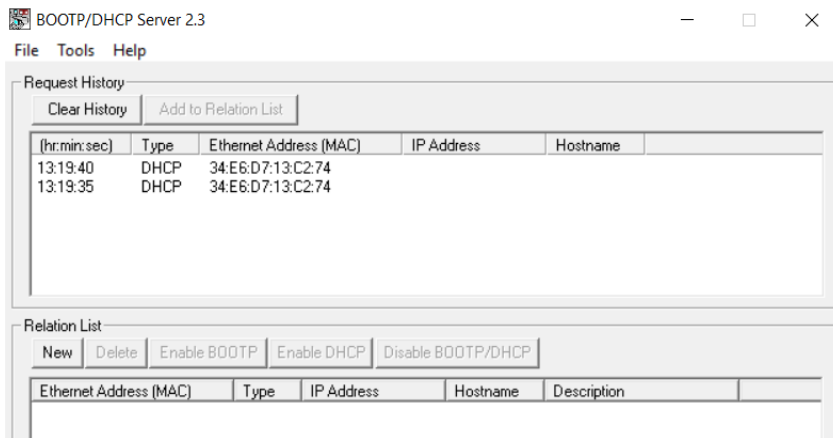
- Connect a Laptop to the Ethernet module 1756-EN2TR with an Ethernet cable.
- Start the tool "BOOTP".
- Click on the menu "Tools→Network Settings":



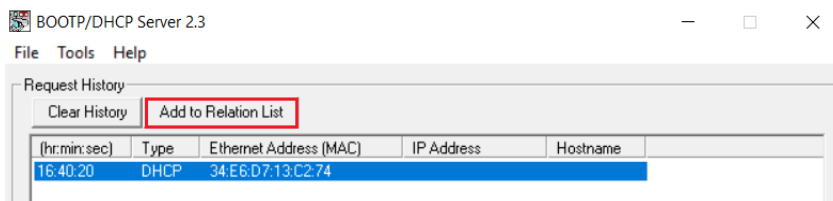
- Set the subnet mask according to the network, in this example 255.255.252.0 and click on the button "OK":



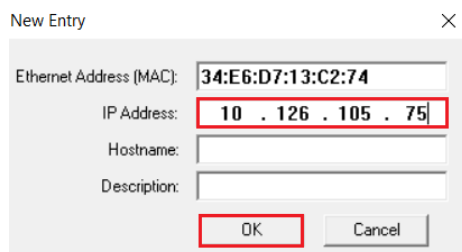
- MAC Address is automatically detected and appears:



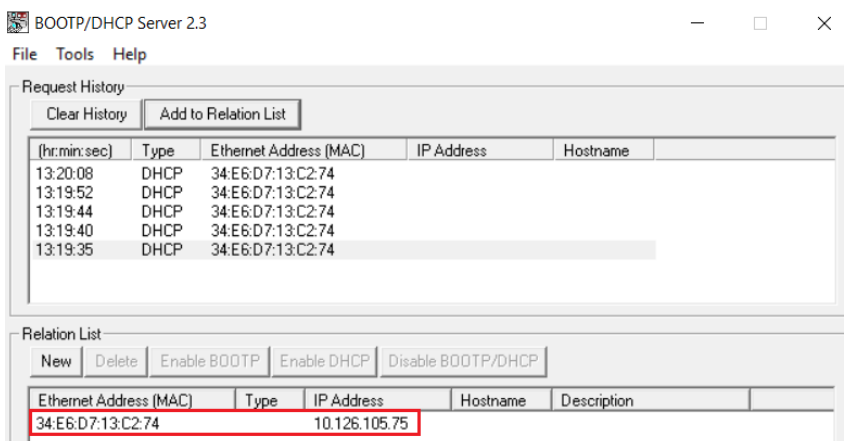
- Select the MAC address and click on the button "Add to Relation List":



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



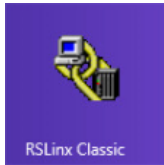
- This assigns dynamically the IP address:



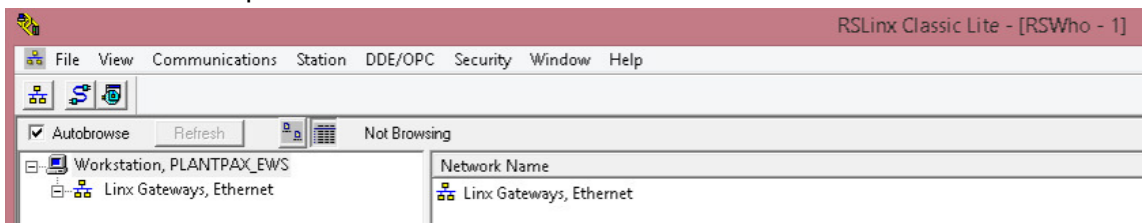
3.1.2.2 Static IP Address Configuration with RSLinx

3.1.2.2.1 RSLinx First Configuration

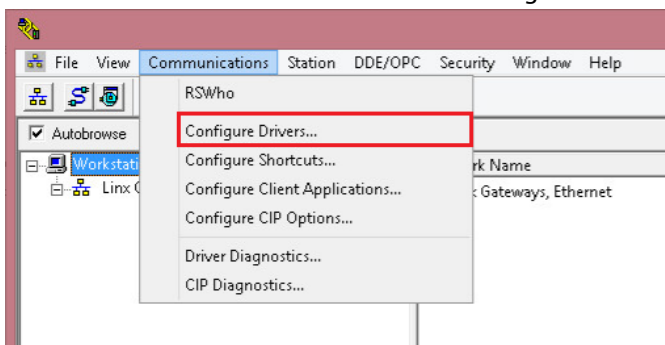
- Start the tool RSLinx Classic:



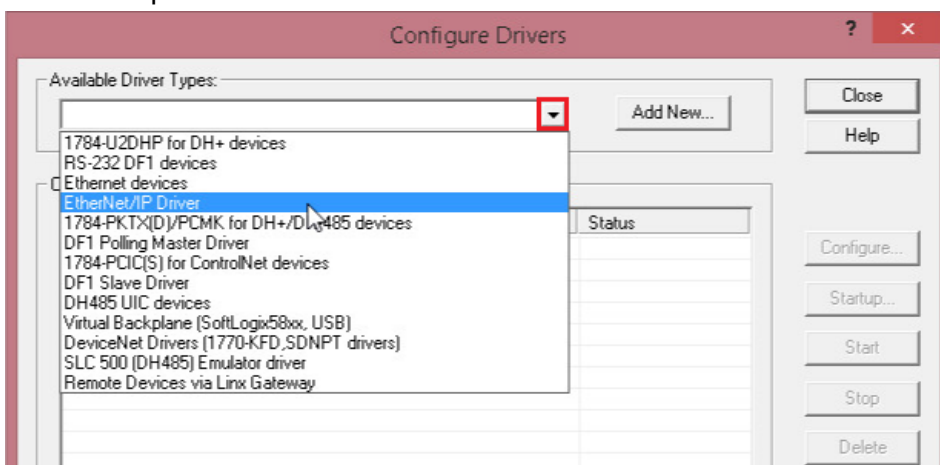
- RSLinx window is opened:



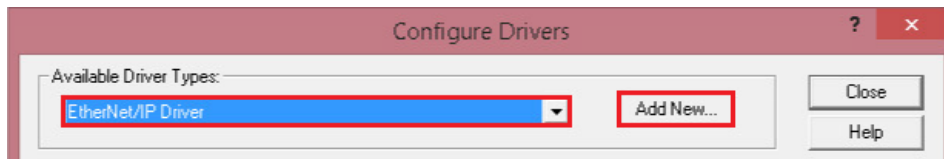
- Select the menu "Communications→Configure Drivers...":



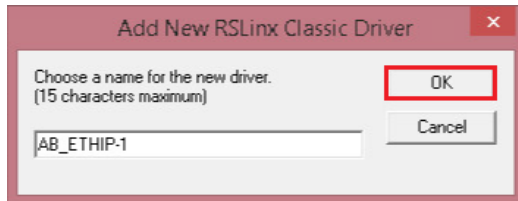
- Select the option "EtherNet/IP Driver":



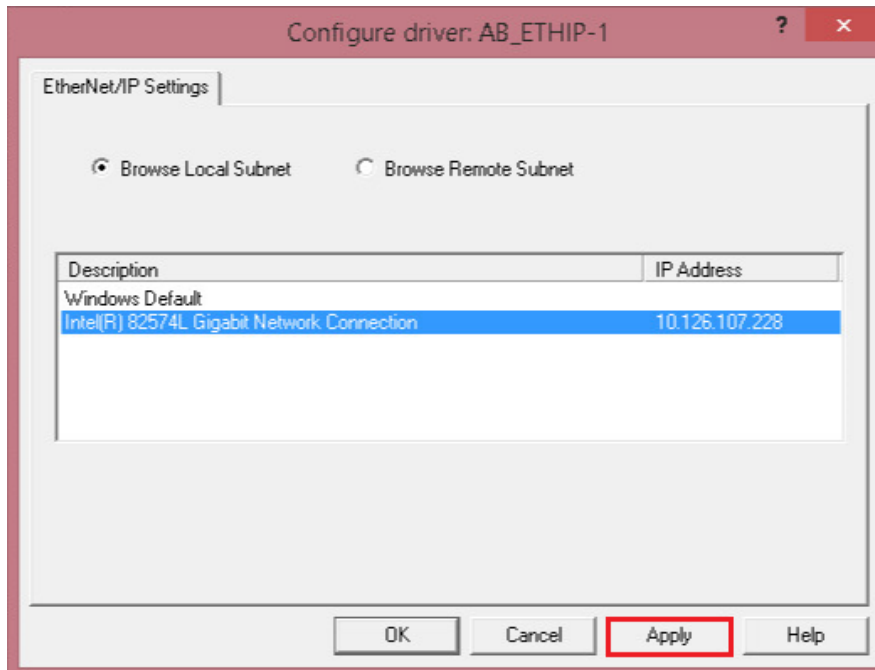
- Click on the button "Add New...":



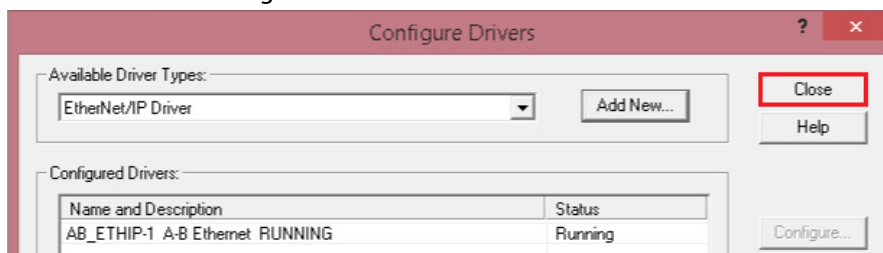
- Rename the driver name if needed and click on the button "OK":



- Select the subnet and click on the button "Apply":

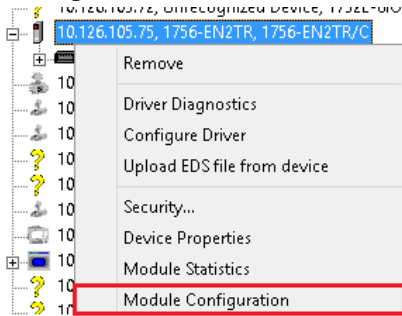


- New driver is running. Click on the button "Close":

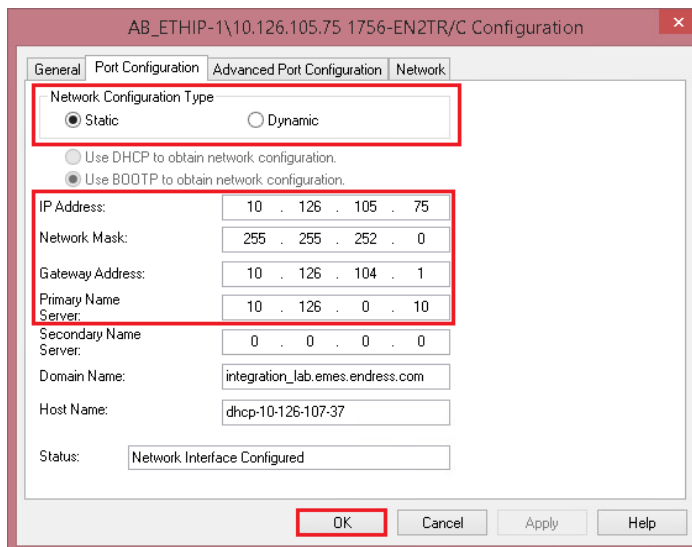


3.1.2.2.2 IP Address Static Configuration

- 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

- The 1794 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 "112", that means the IP address of then 1794 AENTR module is 192.168.1.112:

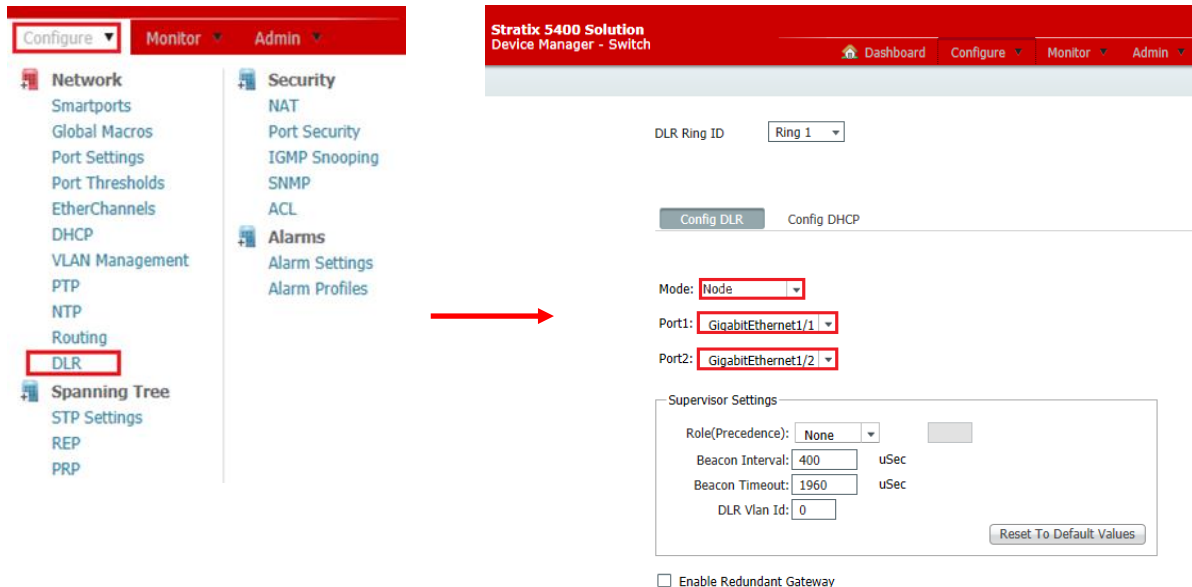


3.1.3.3 Stratix 5400 IP Address Configuration

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.

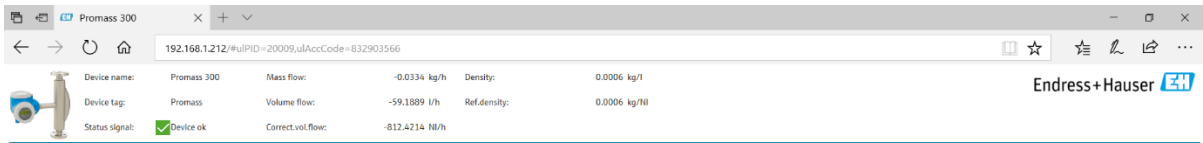
3.1.3.4 Endress+Hauser device IP Address Configuration

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 configuring the IP address of a Promass 300 by using the Web server. Refer to the device manual for further details.

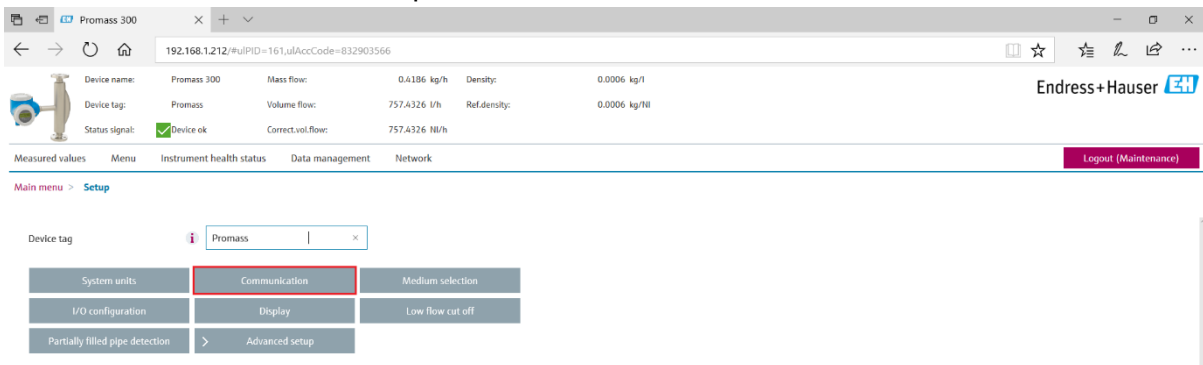
- Power off the device.
- Set the device DIP switch 2 to ON in order to select the default IP address 192.168.1.212.
- Reboot the device.
- Connect a laptop with private network settings (192.168.1.1/24) to the Promass300 with an Ethernet cable.

- Open a browser and enter the IP address 192.168.1.212:

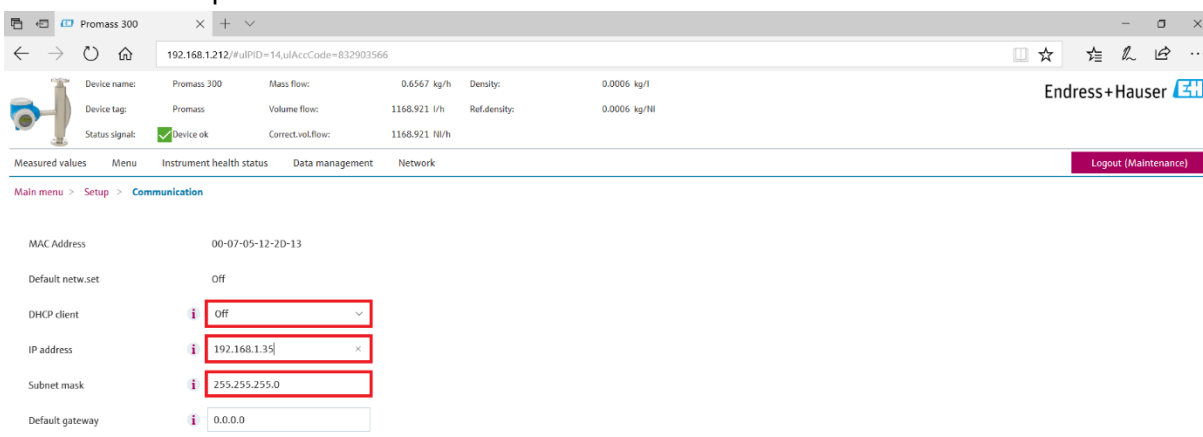


Enter the access code "0000" and click on the button Login.

- Click on the button "Menu→Setup→Communication":



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



Remark

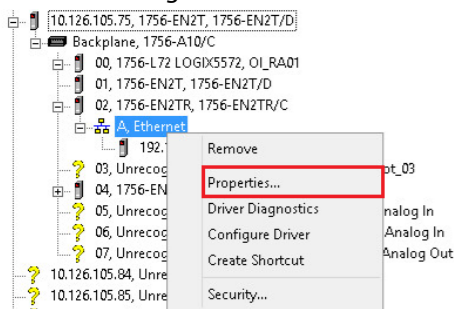
- Once done, the connection to the Web server is lost.
- In this step, the DIP switch 2 is still on position 2. That means, if the device is set again to delivery settings, the IP address will be initialized to 192.168.1.212.

3.1.3.5 Bürkert Valve Island 8652 AirLINE IP Address

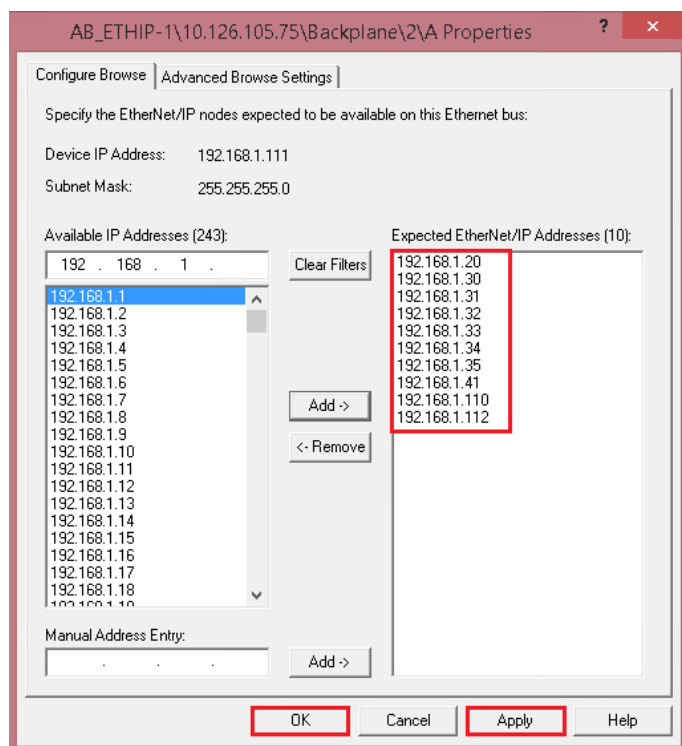
IP address 192.168.1.41/24 of the Bürkert valve island 8652 AirLINE has been set directly on the display of the ME43 module.

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->":

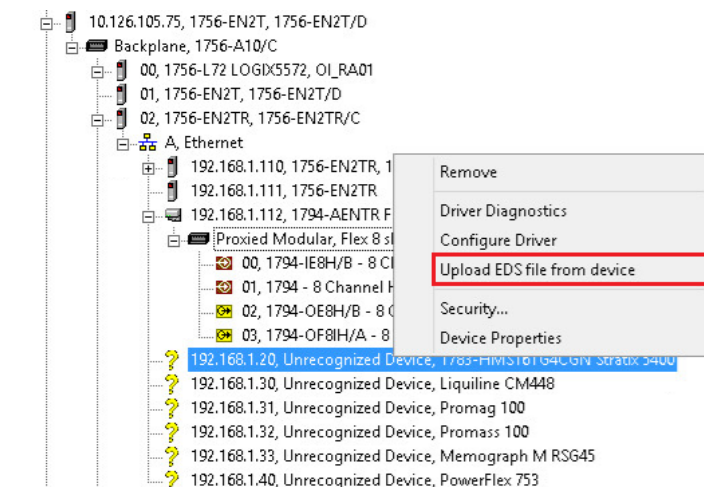


- Click on the buttons “Apply” and “OK” to save the configuration.
In this example, the private network is limited to ten devices. Other IP addresses will be ignored.

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 question marks appear. These correspond to scanned EtherNet/IP devices, whose EDS drivers have still not been installed in RSLinx:



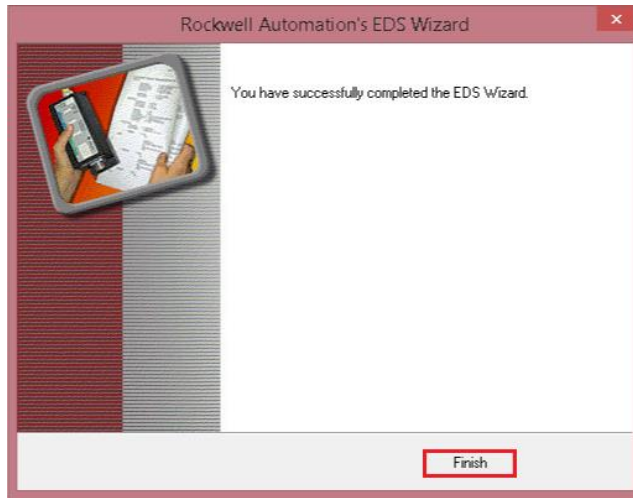
For example, right-click on the Stratix5400 switch with IP address 192.168.1.20 and choose the option “Upload EDS File from device”.

- This opens the Rockwell Automation’s EDS Wizard:

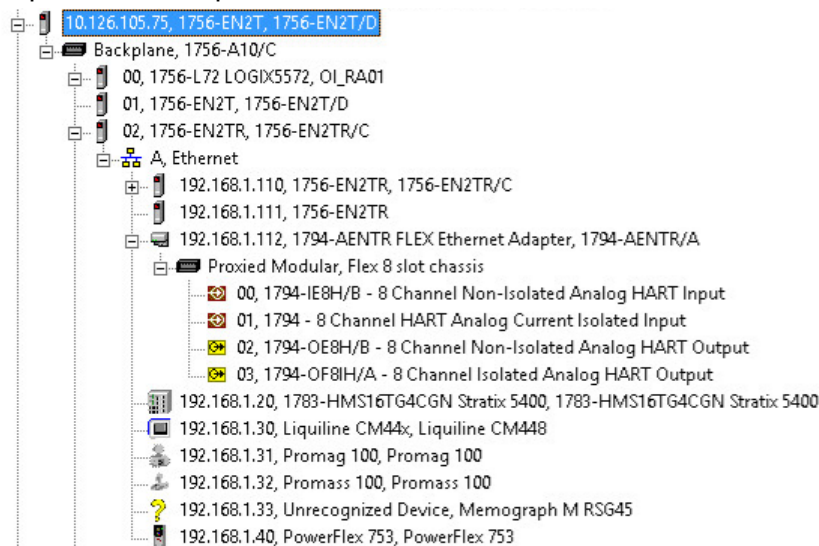


Click on the button “Next>” and follow the installation Wizard.

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



- Repeat the EDS Upload for all other devices:



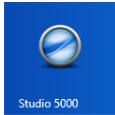
Remark

The EDS file upload does not work for the RSG45. The EDS file must be imported as described in chapter 3.3.1.2.

3.2 System Configuration

3.2.1 New Project

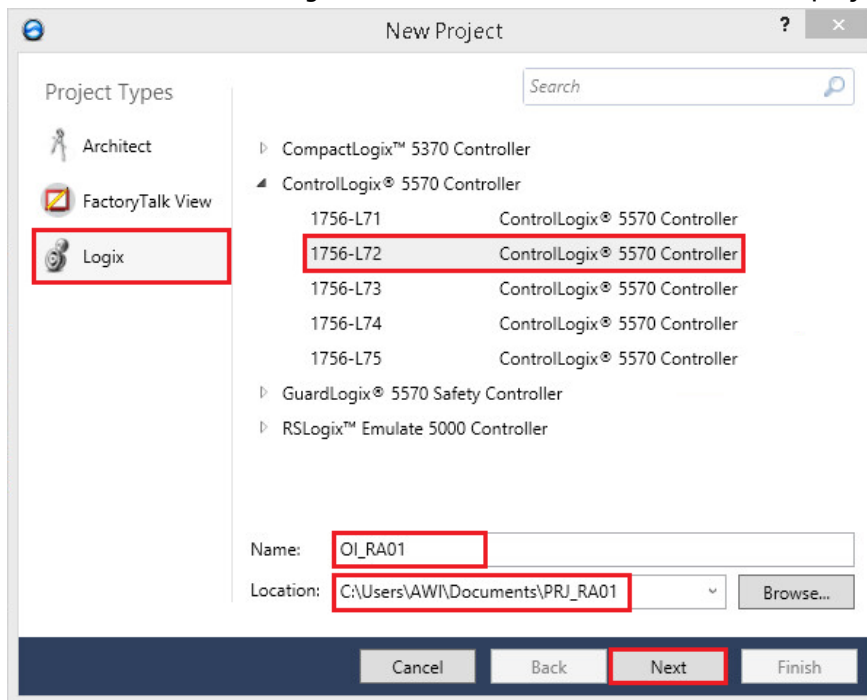
- Start the software Studio5000:



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

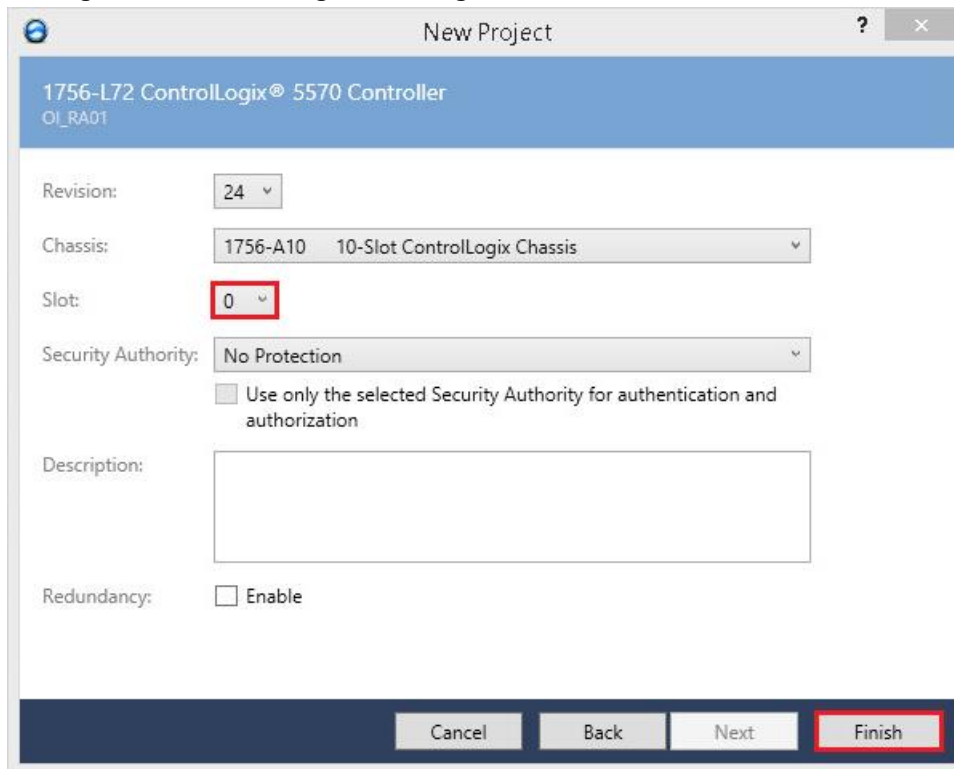


- The new project configuration window is displayed. Click on the menu "Logix" and indicate the used controller according to the network environment as well as project name and location:



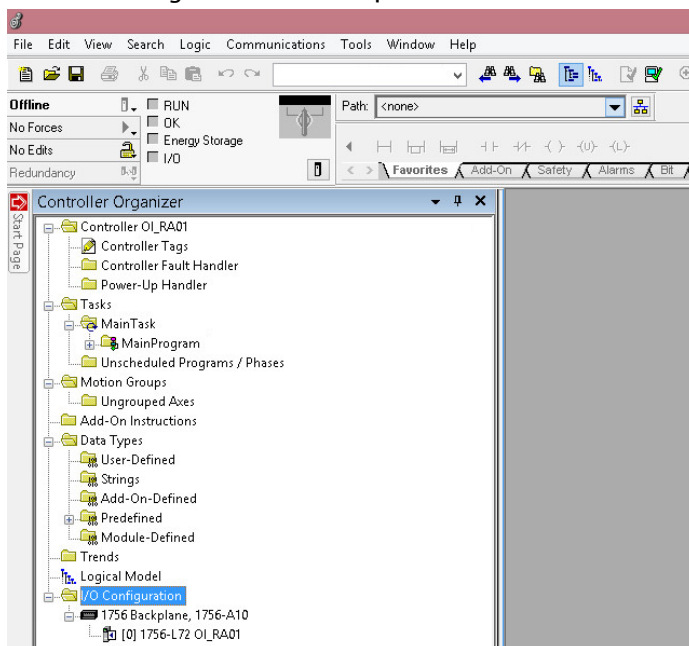
- Click on the button "Next" to continue the project configuration

- .Configure the PLC settings according to the network environment:

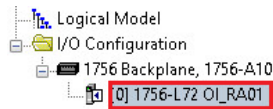


In this example, the PLC has the revision “24” and is located in “Slot 0” of the backplane “1756-A10”. Click on the button “Finish” save and close this sequence.

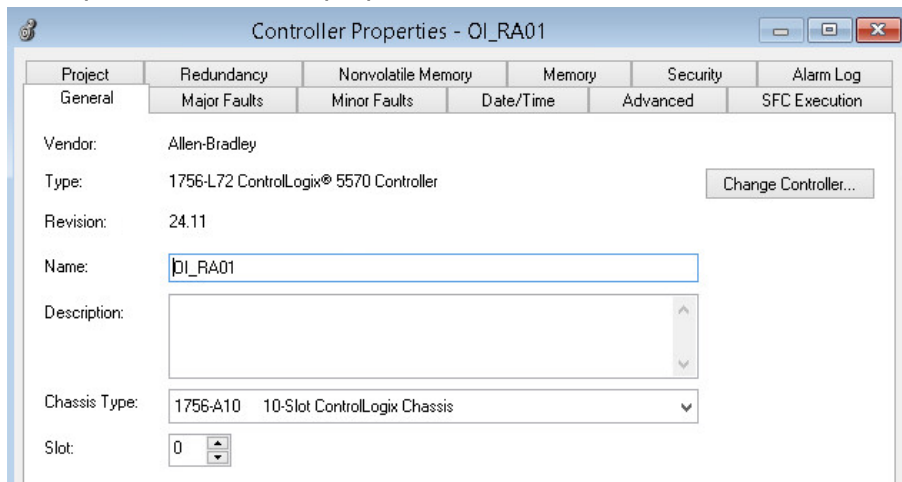
- Controller Organizer view is opened in Studio5000:



- Controller properties as slot index, chassis type or name can still be edited if needed. Double-click on the controller "1756-L72":



- This opens the controller properties:



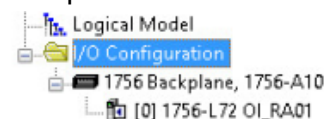
3.2.2 System Offline Configuration

This chapter describes the system offline configuration workflow.

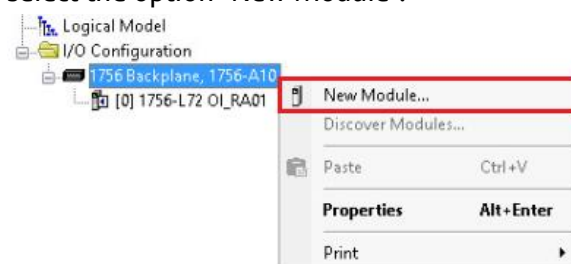
3.2.2.1 ControlLogix

In our example, the ControlLogix part is composed of a backplane "1756-A10", a PLC "1756-L72" and an Ethernet module "1756-EN2TR".

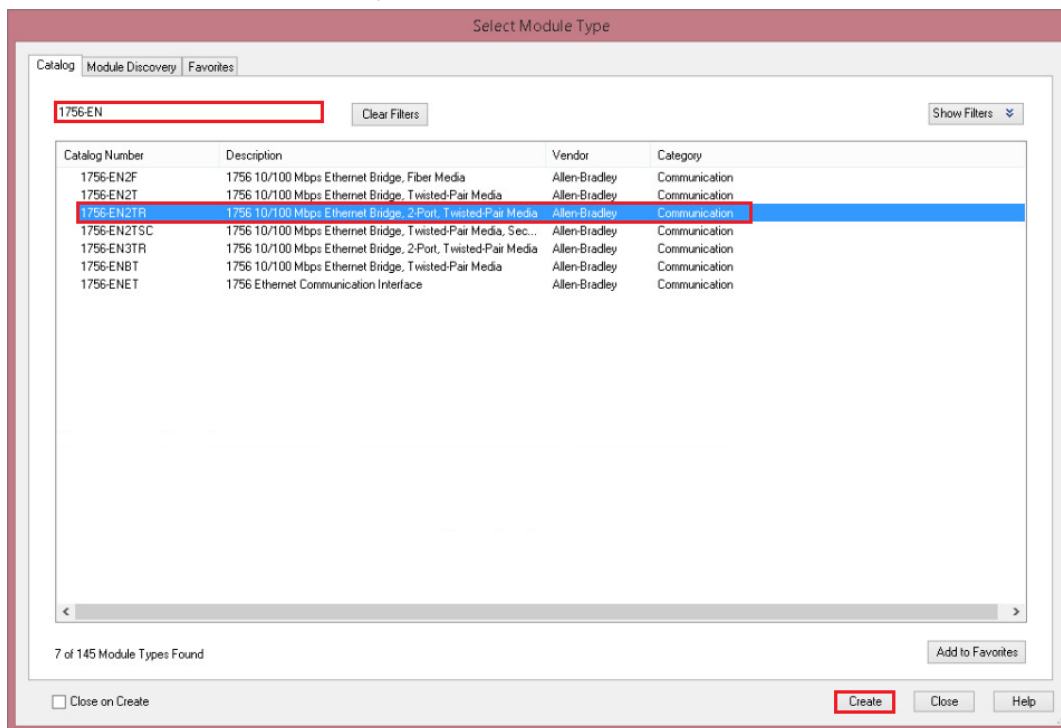
- Backplane "1756-A10" and PLC "1756-L72" have already been added during the project creation:



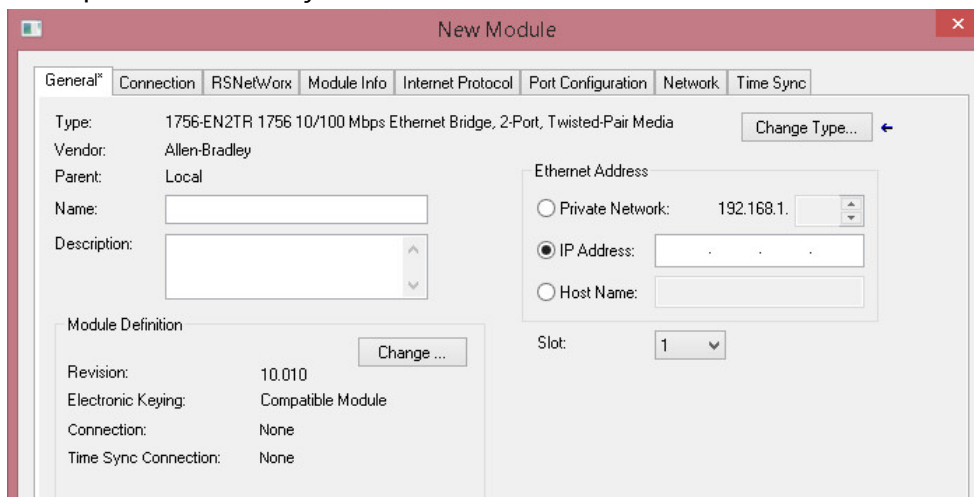
- For inserting the Ethernet module "1756-EN2TR", right-click on the Backplane "1756-A10" and select the option "New Module":



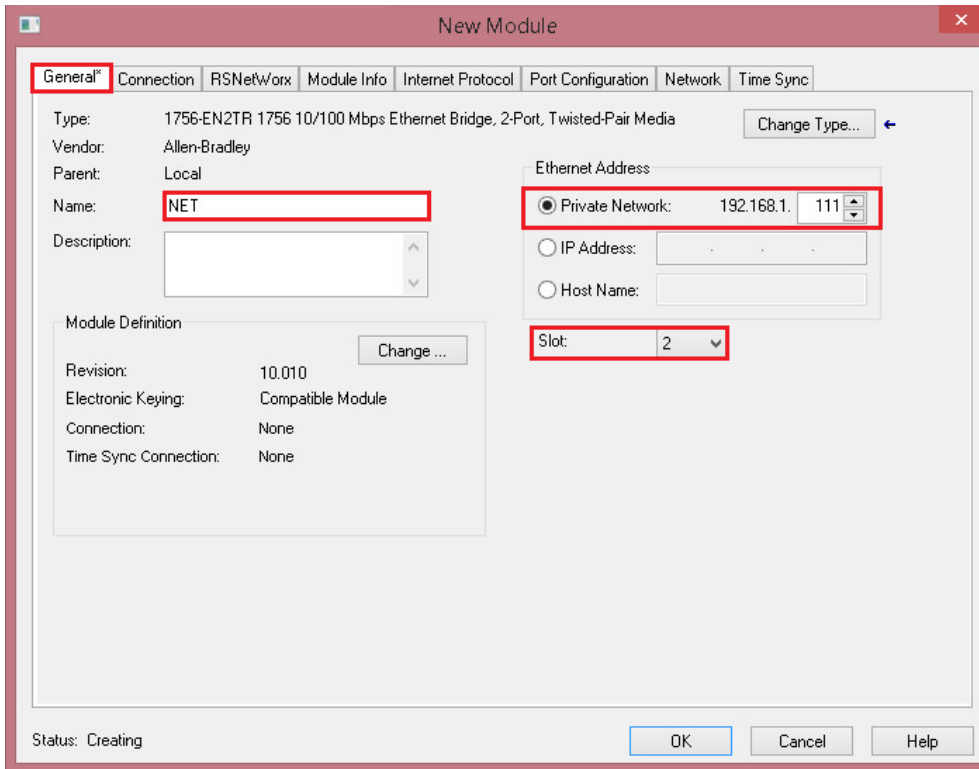
- Use the filter for faster search, select the card “1756-EN2TR” and click on the button “Create”:



- This opens automatically the window “New Module”:

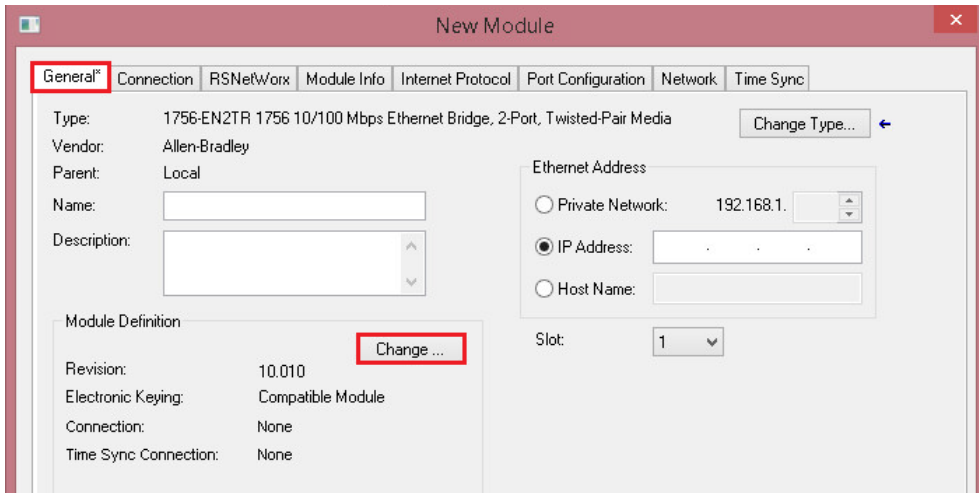


- In the tab “General”, configure the Name, IP Address and Slot according to the network settings:



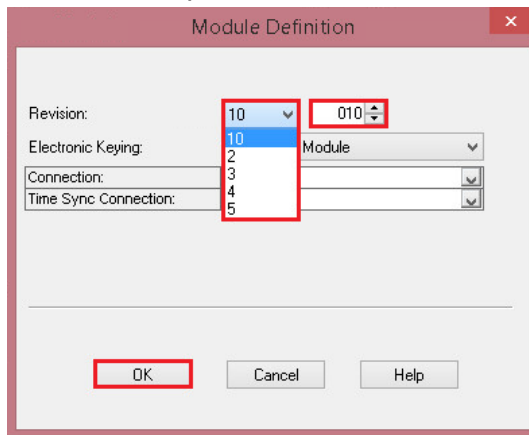
The screenshot shows the 'New Module' dialog box with the 'General' tab selected. The 'Name' field is highlighted with a red box and contains the text 'NET'. The 'Ethernet Address' section has the 'Private Network' radio button selected, and the IP address '192.168.1.111' is entered. The 'Slot' dropdown menu is also highlighted with a red box and shows the value '2'. The 'Module Definition' section shows the revision '10.010' and the 'Change ...' button.

- 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:

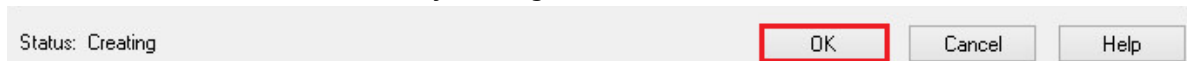


The screenshot shows the 'New Module' dialog box with the 'General' tab selected. The 'Change ...' button in the 'Module Definition' section is highlighted with a red box. The 'Name' field is empty. The 'Ethernet Address' section has the 'IP Address' radio button selected. The 'Slot' dropdown menu shows the value '1'.

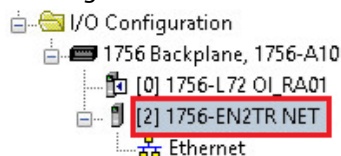
- Choose the requested Revision and click on the button "OK":



- Close the "New Module" window by clicking on the button "OK":



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

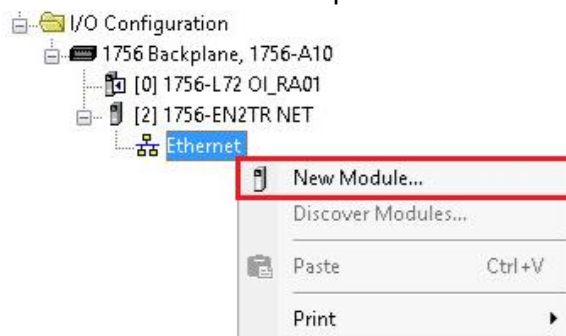


3.2.2.2 ControlLogix I/O

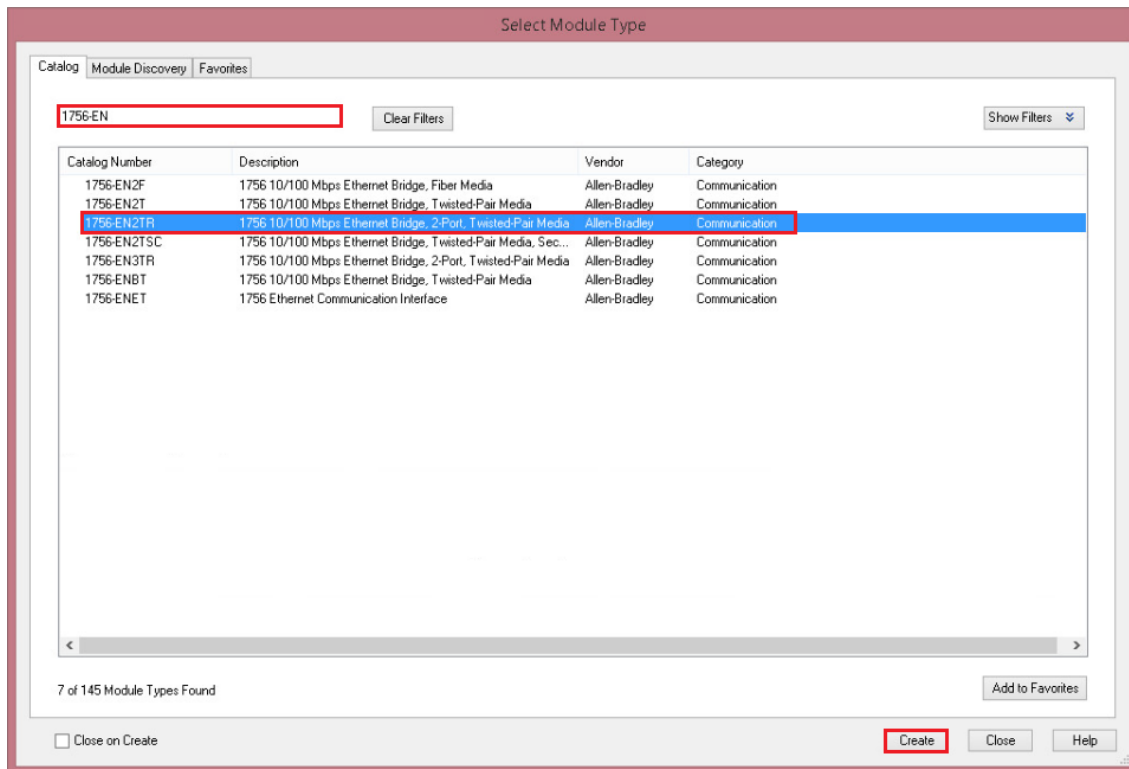
In our example, the ControlLogix I/O part is composed of a backplane "1756-A10", an Ethernet module "1756-EN2TR" and a HART analog input card "1756-IF8IH/A".

3.2.2.2.1 Ethernet Bridge

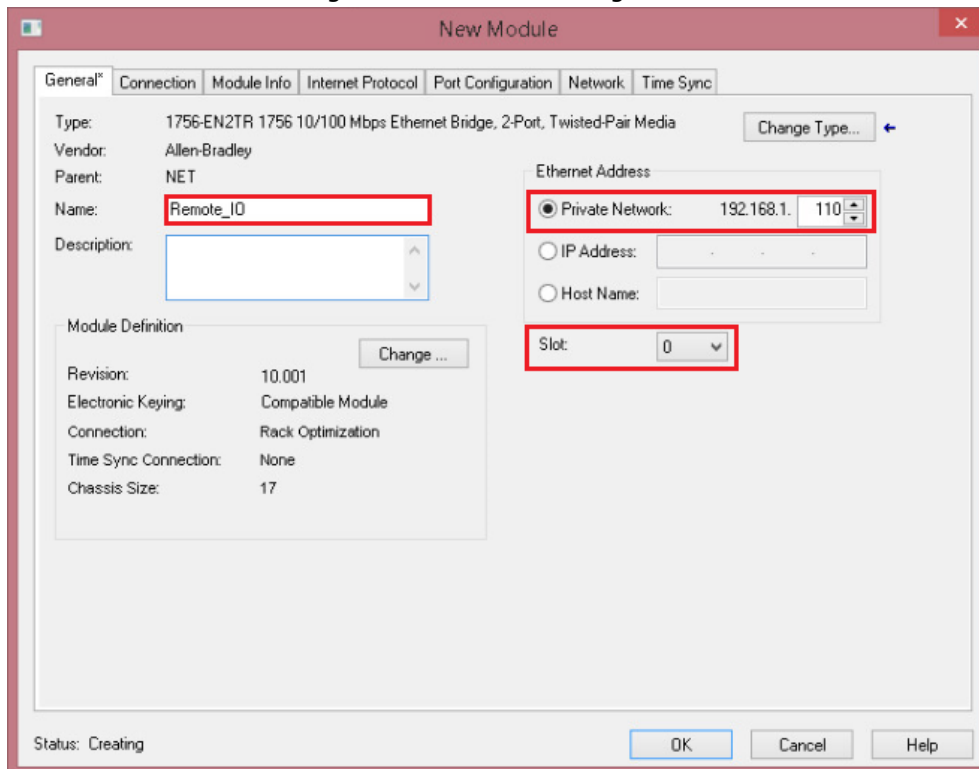
- For inserting the ControlLogix I/O Ethernet module "1756-EN2TR", right-click on the menu "Ethernet" and select the option "New Module":



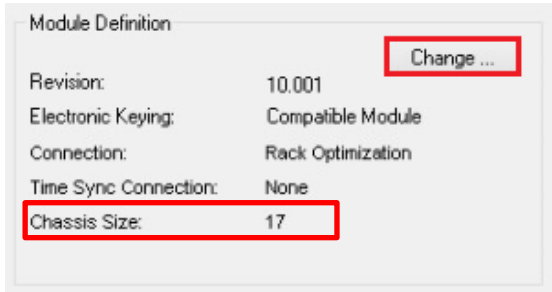
- Use the filter for faster search, select the card "1756-EN2TR" and click on the button "Create":



- 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 too.
Click on the button "Change":



Module Definition

Revision: 10.001

Electronic Keying: Compatible Module

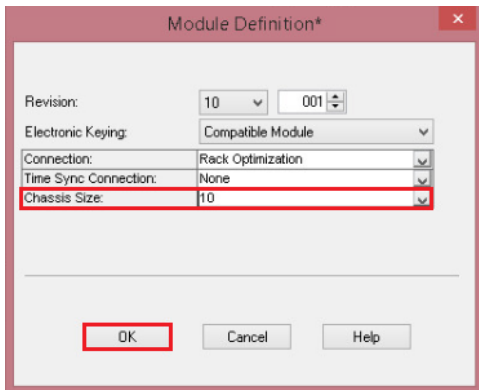
Connection: Rack Optimization

Time Sync Connection: None

Chassis Size: 17

Change ...

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



Module Definition*

Revision: 10 001

Electronic Keying: Compatible Module

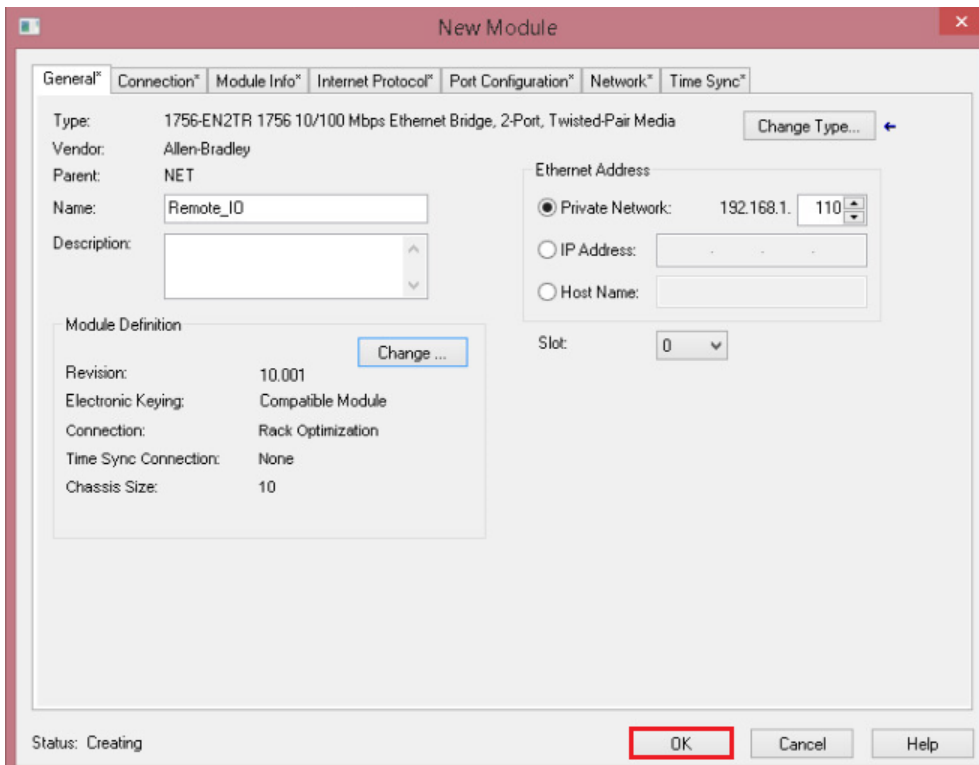
Connection: Rack Optimization

Time Sync Connection: None

Chassis Size: 10

OK Cancel Help

- Click on the button "OK" to create the new module:



New Module

General Connection* Module Info* Internet Protocol* Port Configuration* Network* Time Sync*

Type: 1756-EN2TR 1756 10/100 Mbps Ethernet Bridge, 2-Port, Twisted-Pair Media

Vendor: Allen-Bradley

Parent: NET

Name: Remote_ID

Description:

Module Definition

Revision: 10.001

Electronic Keying: Compatible Module

Connection: Rack Optimization

Time Sync Connection: None

Chassis Size: 10

Ethernet Address

Private Network: 192.168.1. 110

IP Address:

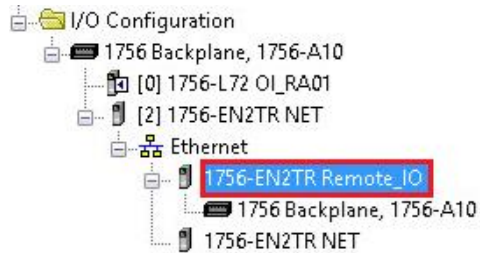
Host Name:

Slot: 0

Status: Creating

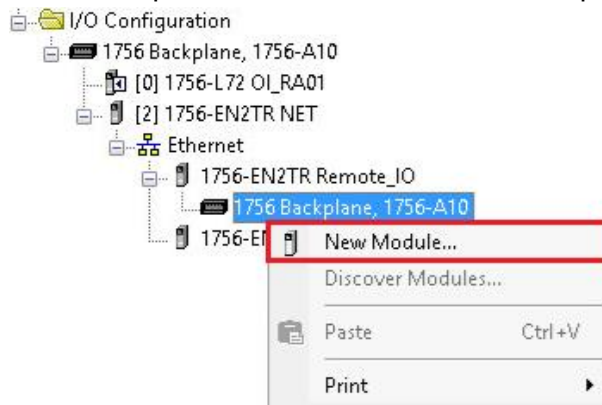
OK Cancel Help

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

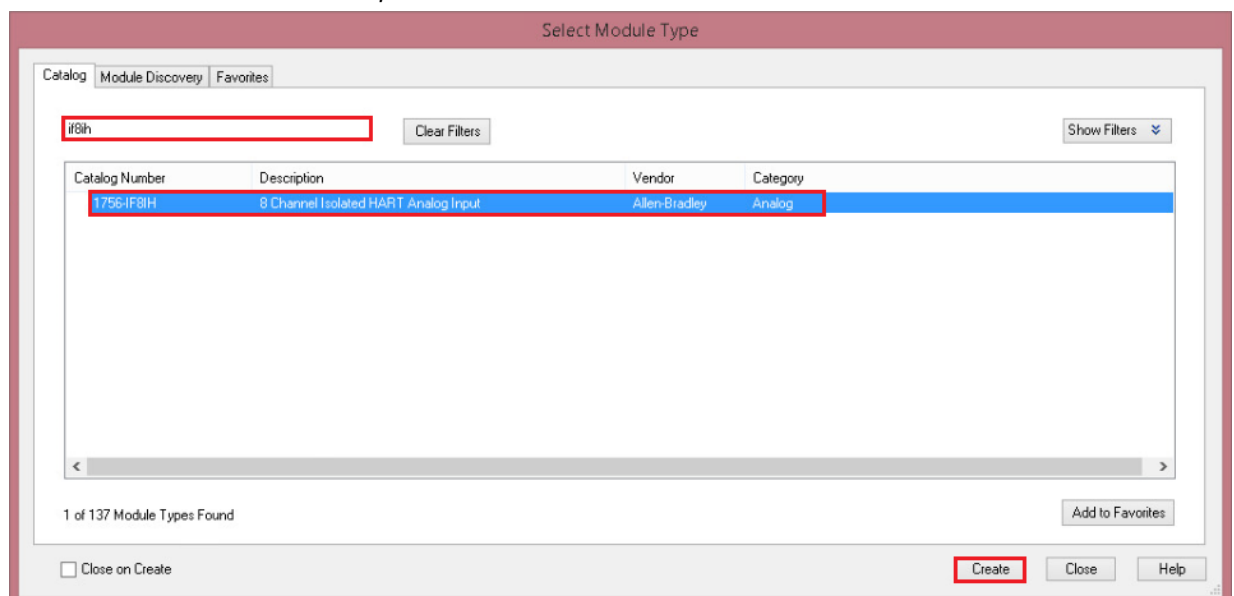


3.2.2.2.2 HART Analog Input Module

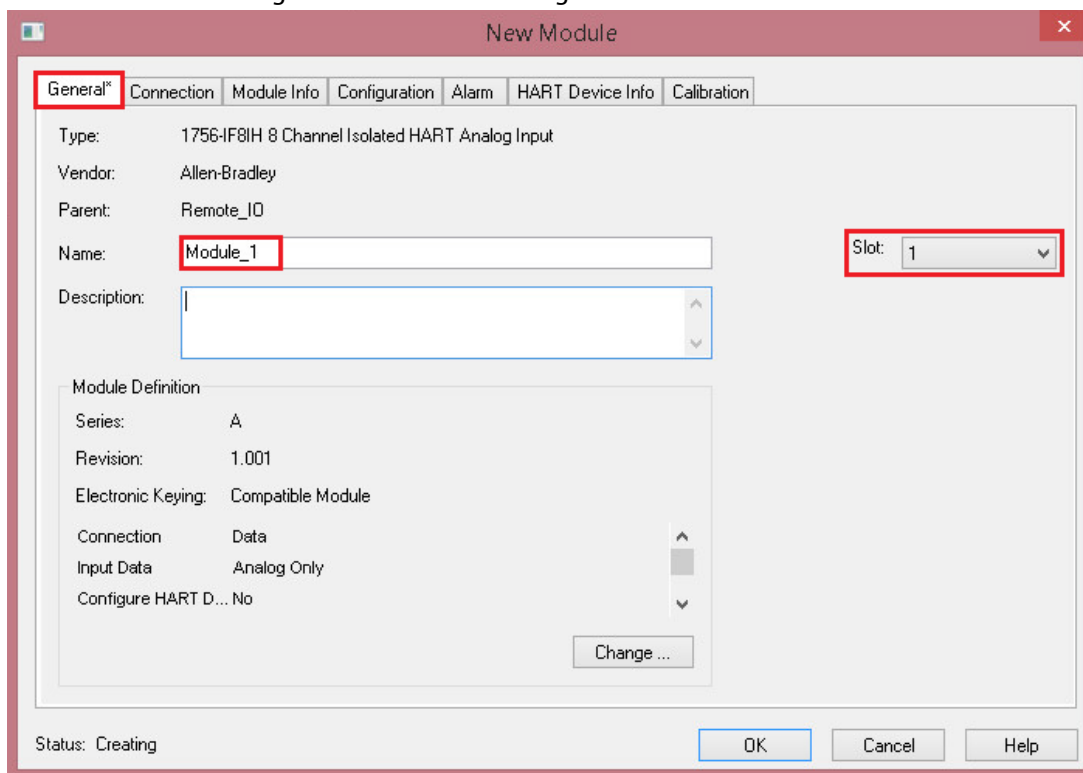
- For inserting the ControlLogix I/O HART analog input card “1756-IF8IH”, right-click on the menu “1756 Backplane, 1756-A10” and select the option “New Module”:



- 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:

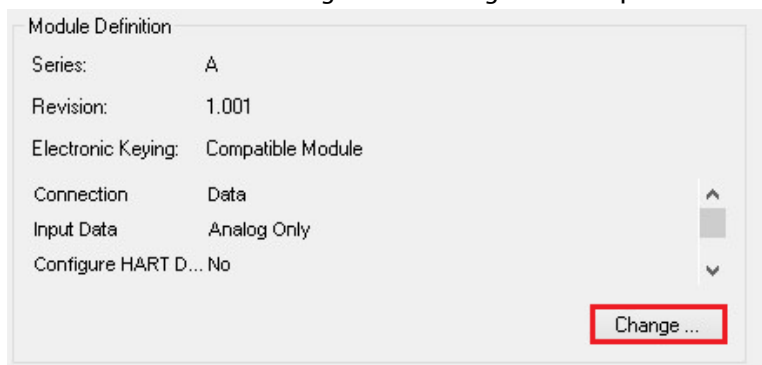


The screenshot shows the "New Module" dialog box with the "General" tab selected. The "Name" field is set to "Module_1" and the "Slot" dropdown is set to "1". The "Module Definition" section shows the following details:

Type:	1756-IF8IH 8 Channel Isolated HART Analog Input
Vendor:	Allen-Bradley
Parent:	Remote_IO
Series:	A
Revision:	1.001
Electronic Keying:	Compatible Module
Connection:	Data
Input Data:	Analog Only
Configure HART D...	No

Buttons at the bottom include "OK", "Cancel", and "Help". The status bar indicates "Status: Creating".

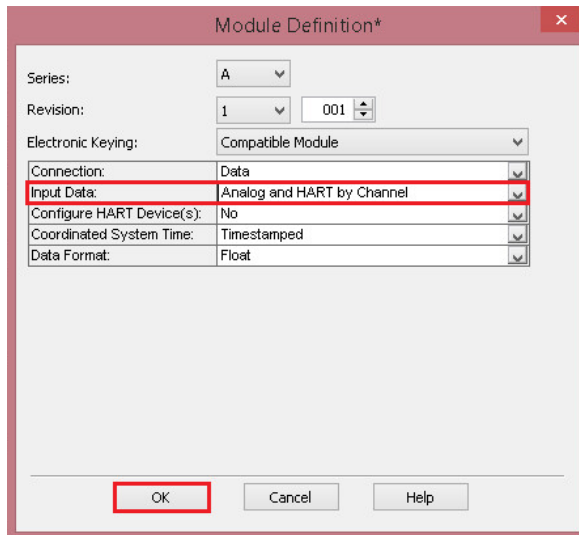
- Click on the button "Change..." to configure the input Data:



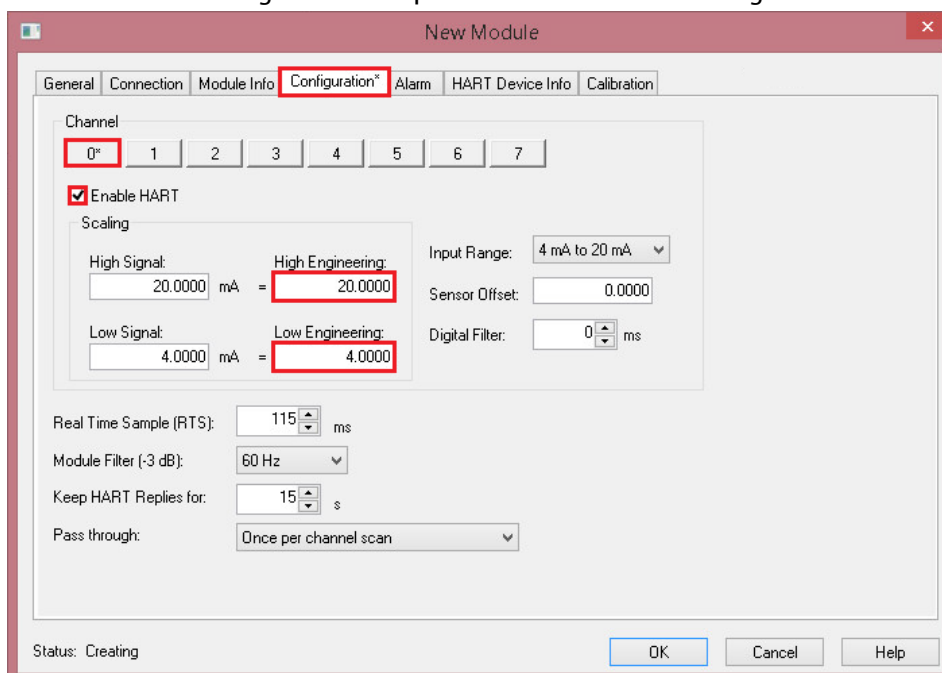
This close-up shows the "Module Definition" section with the "Change..." button highlighted. The details are consistent with the previous screenshot:

Series:	A
Revision:	1.001
Electronic Keying:	Compatible Module
Connection:	Data
Input Data:	Analog Only
Configure HART D...	No

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

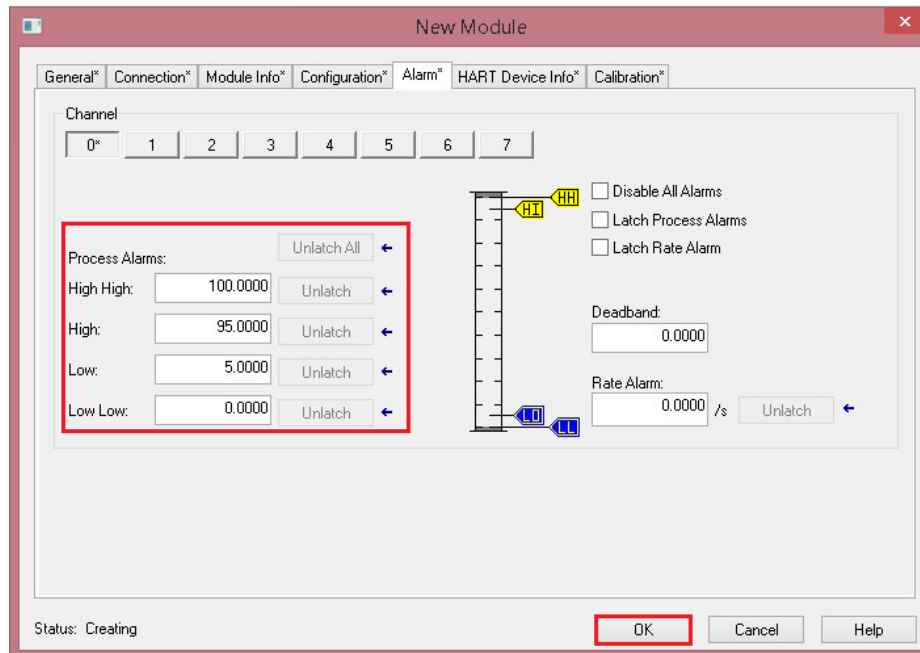


- Select the tab "Configuration" to parameter the HART settings of each channel:

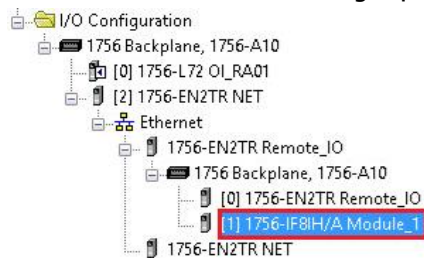


- In this example:
 - Channel 0 is selected.
 - HART option is enabled.
 - Scaling settings have been changed in order (High Engineering = 20 and Low Engineering = 4) in order to display the real current value in Online mode.

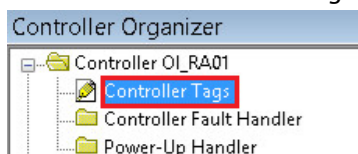
- Select the tab "Alarm" to configure if needed, the Process alarms:



- 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 "Remote_IO:1:C":

- Remote_IO:1:C	{...}	{...}		AB:1756_IF8IH:C:0
+ Remote_IO:1:C.ModuleFilter	2		Decimal	SINT
+ Remote_IO:1:C.RealTimeSample	115		Decimal	INT
+ Remote_IO:1:C.Ch0Config	{...}	{...}		AB:1756_IF8IH_ChConfig_St...
+ Remote_IO:1:C.Ch1Config	{...}	{...}		AB:1756_IF8IH_ChConfig_St...
+ Remote_IO:1:C.Ch2Config	{...}	{...}		AB:1756_IF8IH_ChConfig_St...
+ Remote_IO:1:C.Ch3Config	{...}	{...}		AB:1756_IF8IH_ChConfig_St...
+ Remote_IO:1:C.Ch4Config	{...}	{...}		AB:1756_IF8IH_ChConfig_St...
+ Remote_IO:1:C.Ch5Config	{...}	{...}		AB:1756_IF8IH_ChConfig_St...
+ Remote_IO:1:C.Ch6Config	{...}	{...}		AB:1756_IF8IH_ChConfig_St...
+ Remote_IO:1:C.Ch7Config	{...}	{...}		AB:1756_IF8IH_ChConfig_St...
+ Remote_IO:1:C.PassthroughHandleTimeout	15		Decimal	INT
- Remote_IO:1:C.PassthroughFreq_14	0		Decimal	BOOL
- Remote_IO:1:C.PassthroughFreq_15	0		Decimal	BOOL
+ Remote_IO:1:I	{...}	{...}		AB:1756_IF8IH_AnalogHAR...
+ Remote_IO:I	{...}	{...}		AB:1756_ENET_10SLOT:I:0
+ Remote_IO:O	{...}	{...}		AB:1756_ENET_10SLOT:O:0

- Expand for example the variable "Remote_IO:1:C.Ch0Config":

- Remote_IO:1:C	{...}	{...}		AB:1756_IF8IH:C:0
- Remote_IO:1:C.ModuleFilter	0		Decimal	SINT
- Remote_IO:1:C.ModuleFilter.0	0		Decimal	BOOL
- Remote_IO:1:C.ModuleFilter.1	0		Decimal	BOOL
- Remote_IO:1:C.ModuleFilter.2	0		Decimal	BOOL
- Remote_IO:1:C.ModuleFilter.3	0		Decimal	BOOL
- Remote_IO:1:C.ModuleFilter.4	0		Decimal	BOOL
- Remote_IO:1:C.ModuleFilter.5	0		Decimal	BOOL
- Remote_IO:1:C.ModuleFilter.6	0		Decimal	BOOL
- Remote_IO:1:C.ModuleFilter.7	0		Decimal	BOOL
+ Remote_IO:1:C.RealTimeSample	115		Decimal	INT
- Remote_IO:1:C.Ch0Config	{...}	{...}		AB:1756_IF8IH_ChConfig_St...
+ Remote_IO:1:C.Ch0Config.Config	2#1000_0000		Binary	SINT
- Remote_IO:1:C.Ch0Config.RateAlarmLatch	0		Decimal	BOOL
- Remote_IO:1:C.Ch0Config.ProcessAlarmLatch	0		Decimal	BOOL
- Remote_IO:1:C.Ch0Config.AlarmDisable	0		Decimal	BOOL
- Remote_IO:1:C.Ch0Config.HARTEn	1		Decimal	BOOL
+ Remote_IO:1:C.Ch0Config.RangeType	4		Decimal	SINT
+ Remote_IO:1:C.Ch0Config.DigitalFilter	0		Decimal	INT
- Remote_IO:1:C.Ch0Config.RateAlarmLimit	0.0		Float	REAL
- Remote_IO:1:C.Ch0Config.LowSignal	4.0		Float	REAL
- Remote_IO:1:C.Ch0Config.HighSignal	20.0		Float	REAL
- Remote_IO:1:C.Ch0Config.LowEngineering	0.0		Float	REAL
- Remote_IO:1:C.Ch0Config.HighEngineering	100.0		Float	REAL
- Remote_IO:1:C.Ch0Config.LAlarmLimit	0.0		Float	REAL
- Remote_IO:1:C.Ch0Config.HAlarmLimit	100.0		Float	REAL
- Remote_IO:1:C.Ch0Config.LLAlarmLimit	0.0		Float	REAL
- Remote_IO:1:C.Ch0Config.HHAlarmLimit	100.0		Float	REAL
- Remote_IO:1:C.Ch0Config.AlarmDeadband	0.0		Float	REAL
- Remote_IO:1:C.Ch0Config.CalBias	0.0		Float	REAL

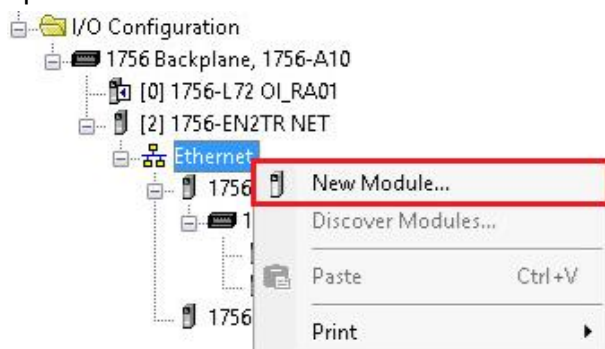
This displays all configurable variable for channel0 as displayed in the AOP. Refer to the 1756-IF8IH user manual for further details.

3.2.2.3 Flex I/O

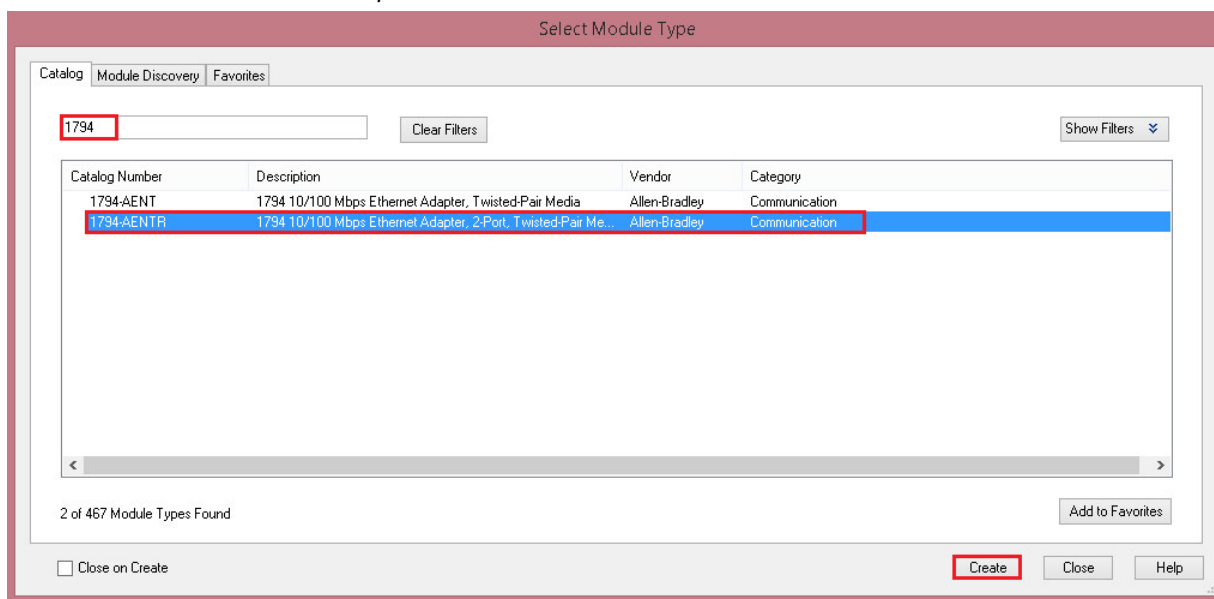
In our example, the Flex I/O part is composed of a backplane "1756-A10", an Ethernet module "1794-AENTR" and a HART analog input card "1794-IF8IH/A".

3.2.2.3.1 EtherNet/IP Adapter

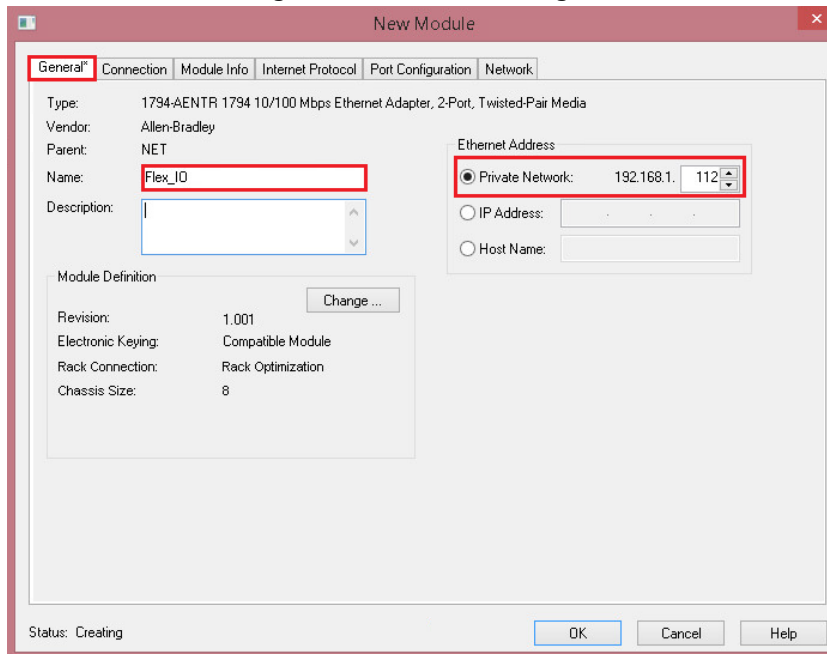
- For inserting the Flex I/O card "1794-AENTR", right-click on the menu "Ethernet" and select the option "New Module":



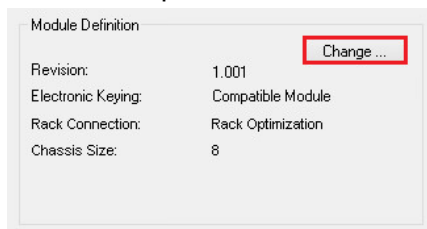
- Use the filter for faster search, select the card "1794-AENTR" and click on the button "Create":



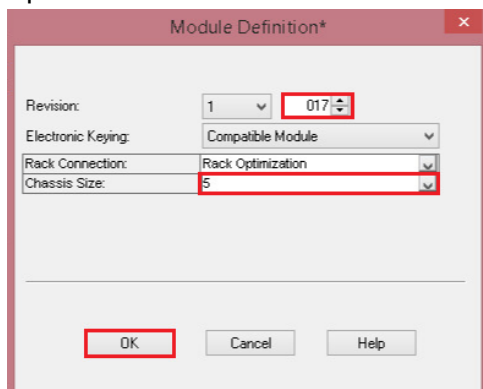
- This opens automatically the window "New Module". In the tab "General", configure the Name, IP Address and according to the network settings:



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

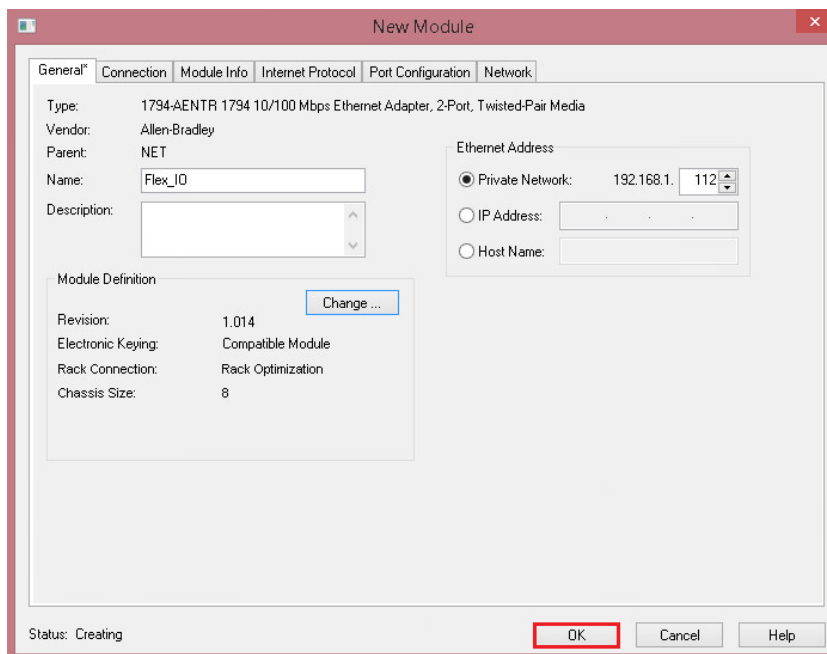


- Update the module Revision to "1.017" and the Chassis size to "5":

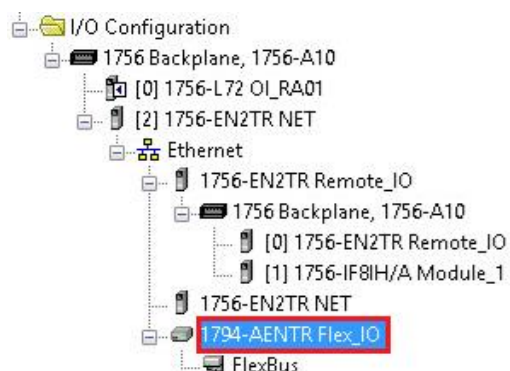


- Click on the button "OK":

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

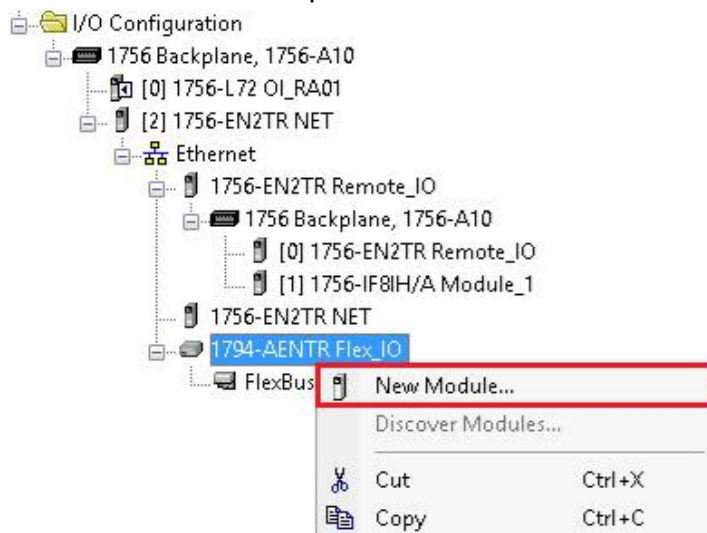


- This inserts the card “1794-AENTR” in the project view:

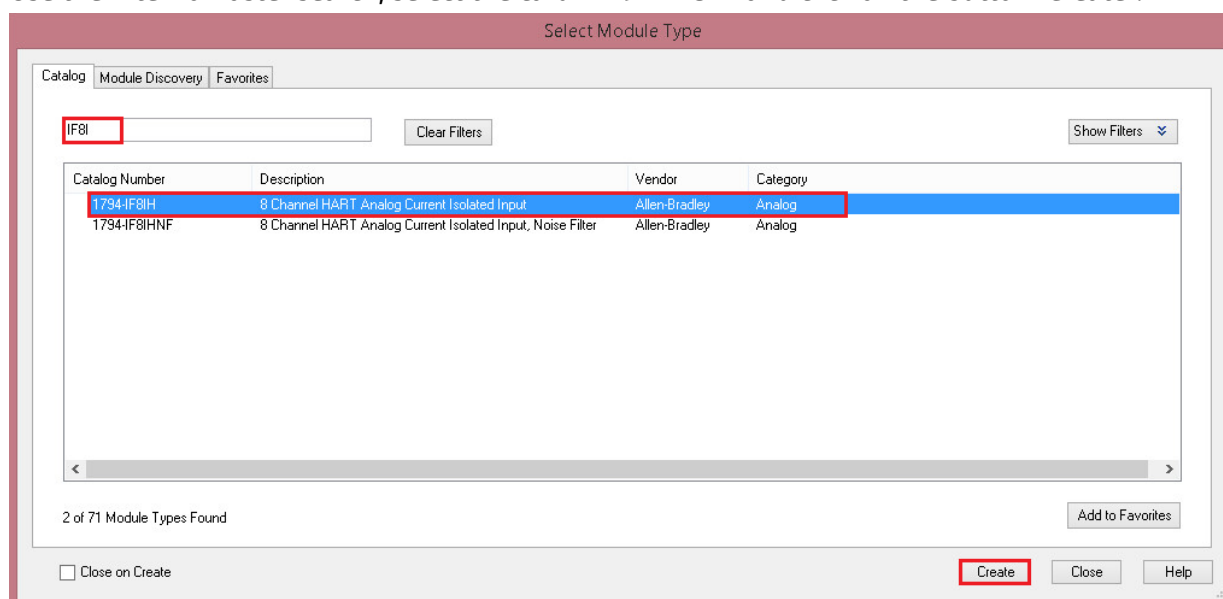


3.2.2.3.2 HART Analog Input Module

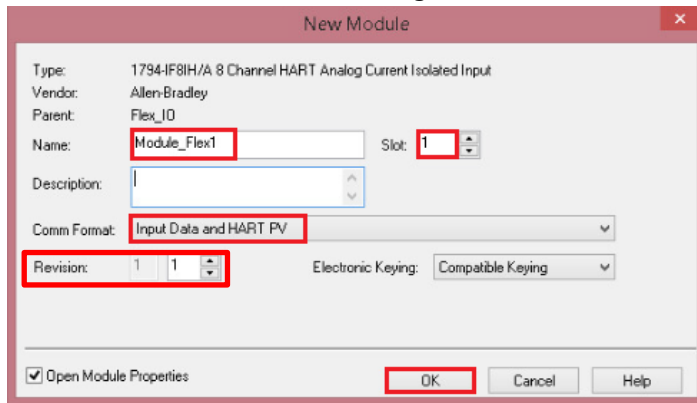
- For inserting the Flex I/O Ethernet module "1794-IF8IH/A", right-click on the menu "1794-AENTR Flex IO" and select the option "New Module":



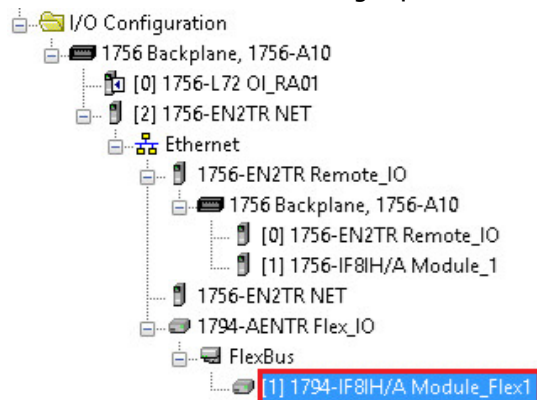
- Use the filter for faster search, select the card "1794-IF8IH" and click on the button "Create":



- This opens automatically the window "New Module". Indicate the Name, Slot number, Communication Format according to the network settings and Revision:

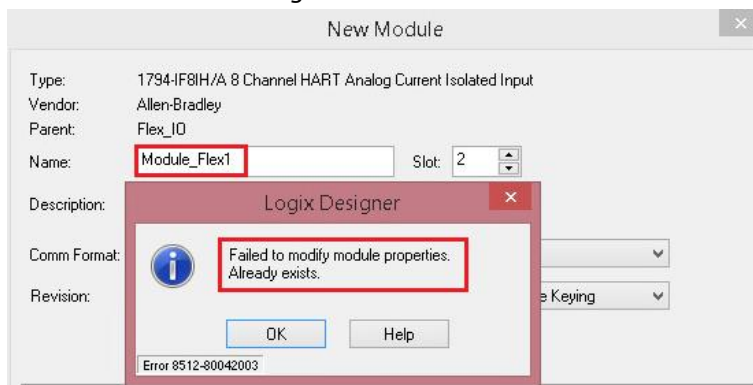


- Click on the button "OK" to save and close the window.
- This inserts the HART analog input module in the project view:



Remark

- Take care when naming the modules. Two modules cannot have the same names:



In this case, the message "Failed to modify module properties Already exists" is displayed.

- Channels configuration must be done in the Controller Tags. In Studio5000, double-click on the field "Controller Tags":



- Expand the menu "Flex_IO:1:C":

+ Flex_IO:1:C	{...}	{...}		AB:1794_IF8IH:C:0
+ Flex_IO:1:I	{...}	{...}		AB:1794_IF8IH:I:0
+ Flex_IO:1:I2	{...}	{...}		AB:1794_HARTDATA:I2:0
+ Flex_IO:1	{...}	{...}		AB:1794_AEN_5SLOT:I:0
+ Flex_IO:0	{...}	{...}		AB:1794_AEN_5SLOT:0:0

"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:

- Flex_IO:1:C	{...}	{...}		AB:1794
- Flex_IO:1:C.Ch0FaultEn	0		Decimal	BOOL
- Flex_IO:1:C.Ch1FaultEn	0		Decimal	BOOL
- Flex_IO:1:C.Ch2FaultEn	0		Decimal	BOOL
- Flex_IO:1:C.Ch3FaultEn	0		Decimal	BOOL
- Flex_IO:1:C.Ch4FaultEn	0		Decimal	BOOL
- Flex_IO:1:C.Ch5FaultEn	0		Decimal	BOOL
- Flex_IO:1:C.Ch6FaultEn	0		Decimal	BOOL
- Flex_IO:1:C.Ch7FaultEn	0		Decimal	BOOL
+ Flex_IO:1:C.HARTDisable	2#0000_0000		Binary	SINT
- Flex_IO:1:C.Ch0HARTDisable	0		Decimal	BOOL
- Flex_IO:1:C.Ch1HARTDisable	0		Decimal	BOOL
- Flex_IO:1:C.Ch2HARTDisable	0		Decimal	BOOL
- Flex_IO:1:C.Ch3HARTDisable	0		Decimal	BOOL
- Flex_IO:1:C.Ch4HARTDisable	0		Decimal	BOOL
- Flex_IO:1:C.Ch5HARTDisable	0		Decimal	BOOL
- Flex_IO:1:C.Ch6HARTDisable	0		Decimal	BOOL
- Flex_IO:1:C.Ch7HARTDisable	0		Decimal	BOOL
- Flex_IO:1:C.Ch0DataFormat_0	0		Decimal	BOOL
- Flex_IO:1:C.Ch0DataFormat_1	0		Decimal	BOOL
- Flex_IO:1:C.Ch0DataFormat_2	0		Decimal	BOOL
- Flex_IO:1:C.Ch0DataFormat_3	0		Decimal	BOOL
- Flex_IO:1:C.Ch1DataFormat_4	0		Decimal	BOOL
- Flex_IO:1:C.Ch1DataFormat_5	0		Decimal	BOOL
- Flex_IO:1:C.Ch1DataFormat_6	0		Decimal	BOOL
- Flex_IO:1:C.Ch1DataFormat_7	0		Decimal	BOOL
- Flex_IO:1:C.Ch2DataFormat_8	0		Decimal	BOOL
- Flex_IO:1:C.Ch2DataFormat_9	0		Decimal	BOOL
- Flex_IO:1:C.Ch2DataFormat_10	0		Decimal	BOOL
- Flex_IO:1:C.Ch2DataFormat_11	0		Decimal	BOOL
- Flex_IO:1:C.Ch3DataFormat_12	0		Decimal	BOOL
- Flex_IO:1:C.Ch3DataFormat_13	0		Decimal	BOOL
- Flex_IO:1:C.Ch3DataFormat_14	0		Decimal	BOOL
- Flex_IO:1:C.Ch3DataFormat_15	0		Decimal	BOOL
- Flex_IO:1:C.Ch4DataFormat_0	0		Decimal	BOOL

In this example, the standard configuration is used, i.e. "0" everywhere.

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

This table (from 1794-IF8IH user manual) shows for example how configuring another scaling:

Format ⁽¹⁾	Bits				Format Name	Signal Range		User Range		Resolution
	15	14	13	12		LO	HI	LO	HI	
	11	10	9	8						
	7	6	5	4						
	3	2	1	0						
0	0	0	0	0	0...20 mA in Milliamps	0.00	22.00	0 (0.000 mA)	22000 (22.000 mA)	1.0 µA
1	0	0	0	1	0...20 mA in % Full Scale	0.00	22.00	0 (0%)	11000 (110.00%)	2.0 µA
3	0	0	1	1	0...20 mA in UINT	0.00	20.00	0	65535	0.3052 µA
4 ⁽²⁾	0	1	0	0	4...20 mA in Milliamps	2.00	22.00	2000 (2.000 mA)	22000 (22.000 mA)	1.0 µA
5 ⁽²⁾	0	1	0	1	4...20 mA in % Full Scale	2.00	22.00	-1250 (-12.50%)	11250 (112.50%)	1.6 µA
7 ⁽²⁾	0	1	1	1	4...20 mA in UINT	4.00	20.00	0	65535	0.2441 µA

⁽¹⁾ All other formats are invalid.

⁽²⁾ HART Communications supported with these data formats only.

- Example of "Format 5" configuration for channel1:

Scope: 01_RA01		Show: All Tags		
Name	Value	Force Mask	Style	Data Type
Flex_ID:1:C	{...}	{...}		AB:1794_IF8IH:C:0
Flex_ID:1:C.Ch0FaultEn	0		Decimal	BOOL
Flex_ID:1:C.Ch1FaultEn	0		Decimal	BOOL
Flex_ID:1:C.Ch2FaultEn	0		Decimal	BOOL
Flex_ID:1:C.Ch3FaultEn	0		Decimal	BOOL
Flex_ID:1:C.Ch4FaultEn	0		Decimal	BOOL
Flex_ID:1:C.Ch5FaultEn	0		Decimal	BOOL
Flex_ID:1:C.Ch6FaultEn	0		Decimal	BOOL
Flex_ID:1:C.Ch7FaultEn	0		Decimal	BOOL
+ Flex_ID:1:C.HARTDisable	2#0000_0000		Binary	SINT
Flex_ID:1:C.Ch0HARTDisable	0		Decimal	BOOL
Flex_ID:1:C.Ch1HARTDisable	0		Decimal	BOOL
Flex_ID:1:C.Ch2HARTDisable	0		Decimal	BOOL
Flex_ID:1:C.Ch3HARTDisable	0		Decimal	BOOL
Flex_ID:1:C.Ch4HARTDisable	0		Decimal	BOOL
Flex_ID:1:C.Ch5HARTDisable	0		Decimal	BOOL
Flex_ID:1:C.Ch6HARTDisable	0		Decimal	BOOL
Flex_ID:1:C.Ch7HARTDisable	0		Decimal	BOOL
Flex_ID:1:C.Ch0DataFormat_0	0		Decimal	BOOL
Flex_ID:1:C.Ch0DataFormat_1	0		Decimal	BOOL
Flex_ID:1:C.Ch0DataFormat_2	0		Decimal	BOOL
Flex_ID:1:C.Ch0DataFormat_3	0		Decimal	BOOL
Flex_ID:1:C.Ch1DataFormat_4	1		Decimal	BOOL
Flex_ID:1:C.Ch1DataFormat_5	0		Decimal	BOOL
Flex_ID:1:C.Ch1DataFormat_6	1		Decimal	BOOL
Flex_ID:1:C.Ch1DataFormat_7	0		Decimal	BOOL
Flex_ID:1:C.Ch2DataFormat_8	0		Decimal	BOOL
Flex_ID:1:C.Ch2DataFormat_9	0		Decimal	BOOL
Flex_ID:1:C.Ch2DataFormat_10	0		Decimal	BOOL
Flex_ID:1:C.Ch2DataFormat_11	0		Decimal	BOOL
Flex_ID:1:C.Ch3DataFormat_12	0		Decimal	BOOL

Monitor Tags / Edit Tags /

3.3 EtherNet/IP Field Device Configuration

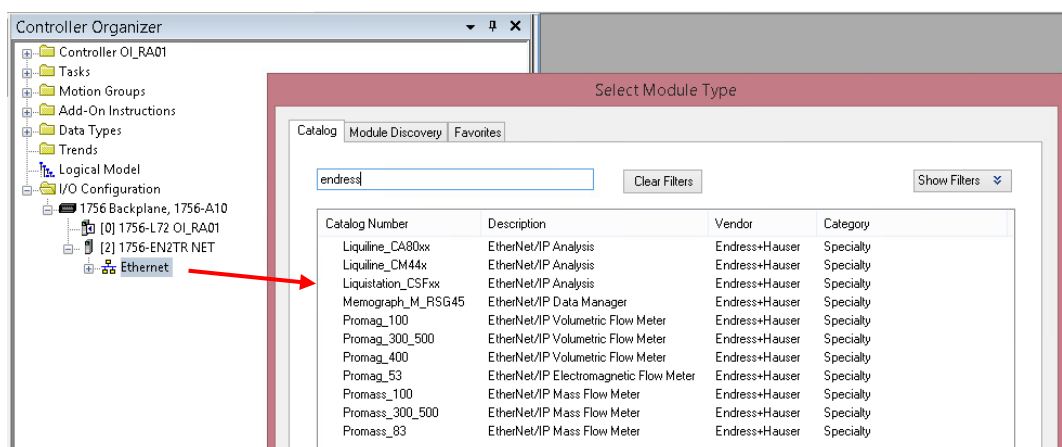
This chapter describes how to integrate an EtherNet/IP device with the Rockwell Automation ControlLogix System by using two types of drivers: EDS (Electronic Data Sheet) and AOP (Add On Profile).

3.3.1 Field Device Library

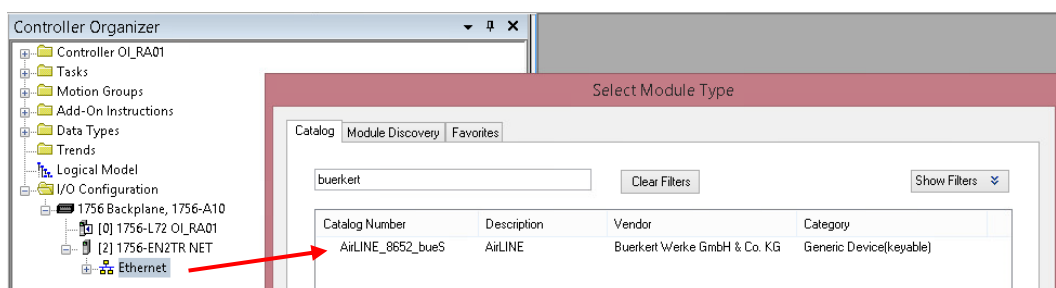
3.3.1.1 General

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:



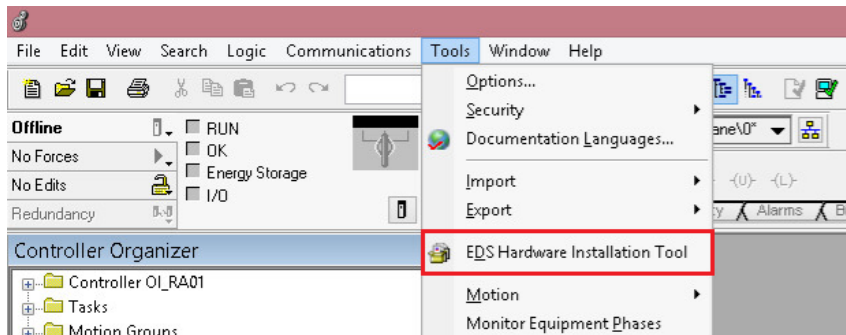
Remarks

- 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.

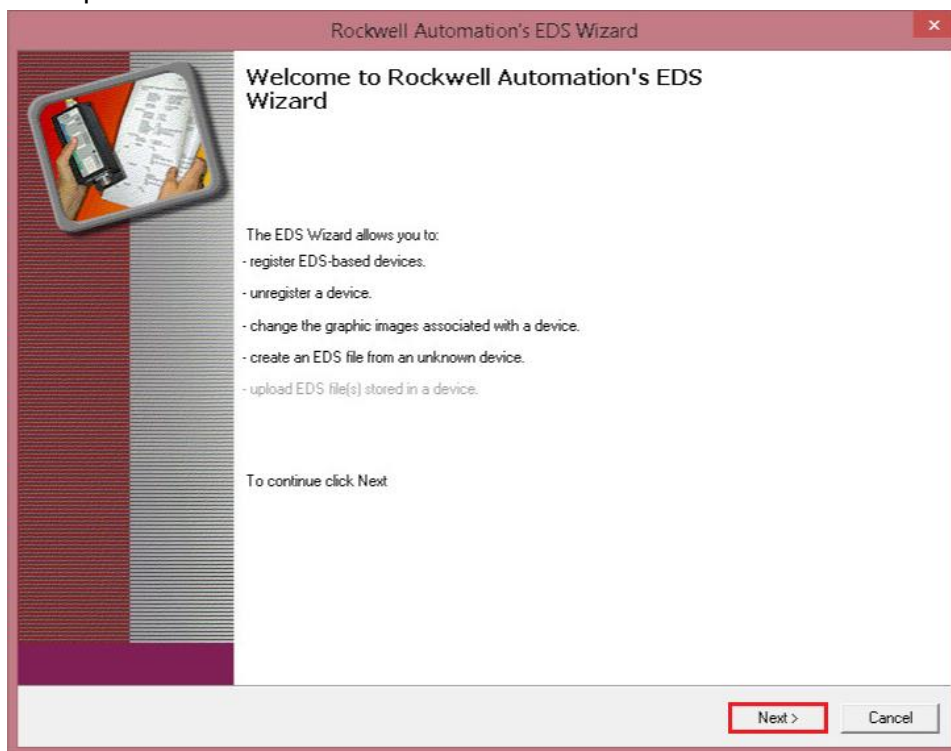
3.3.1.2 EDS File Import

EDS files can be uploaded from the device with RSLinx or installed offline to prepare a project independent from connected devices. This chapter describes the workflow for adding the Memograph RSG45 EDS files in Studio5000:

- 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

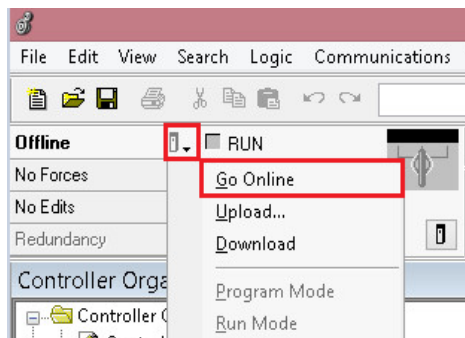
AOPs for Endress+Hauser devices are typically pre-installed and delivered with Studio 5000, however new or updated AOP Packages may be installed manually. Please follow the setup instructions accordingly. Latest AOP Packages may be found on Endress+Hauser Download area web page.

3.3.2 Device Integration with EDS

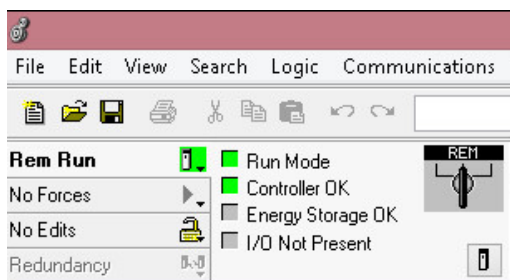
3.3.2.1 Online Configuration of Bürkert Valve Island 8652 AirLINE

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.

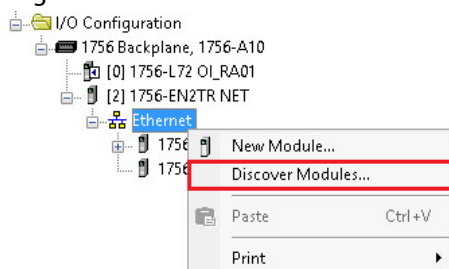
- Click on the shortcut button closed to the Offline status and select the menu "Go Online":



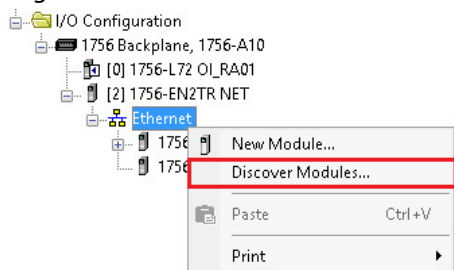
- Online connection is established:



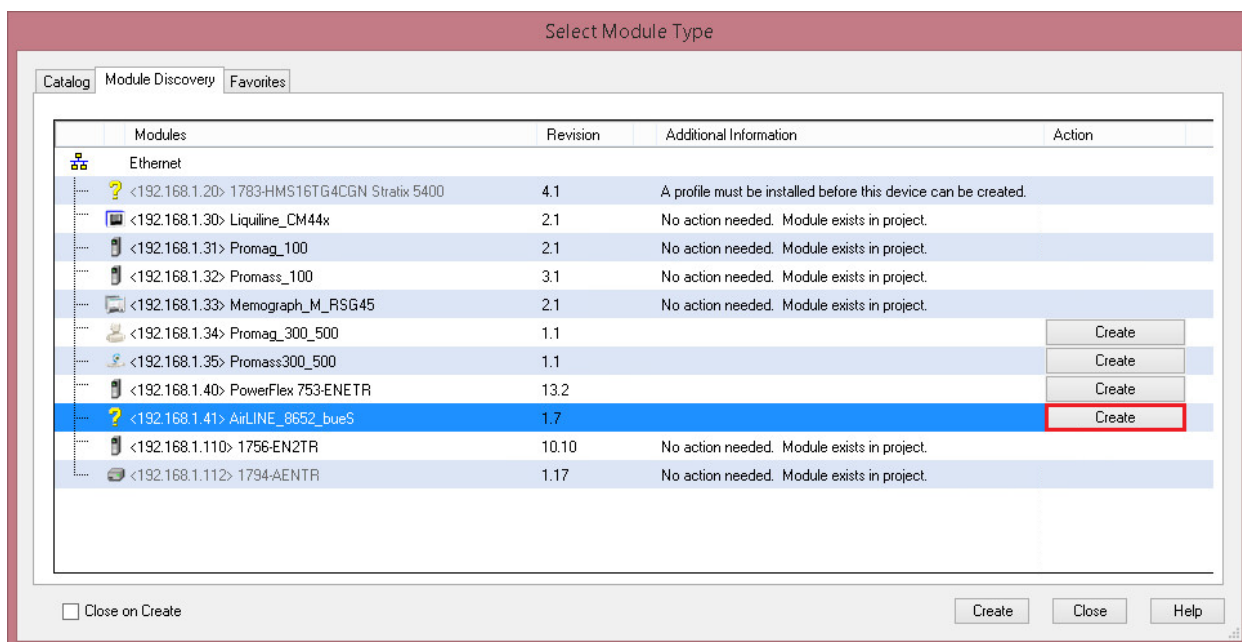
- Right-click on the field "Ethernet" and select the menu "Discover Modules":



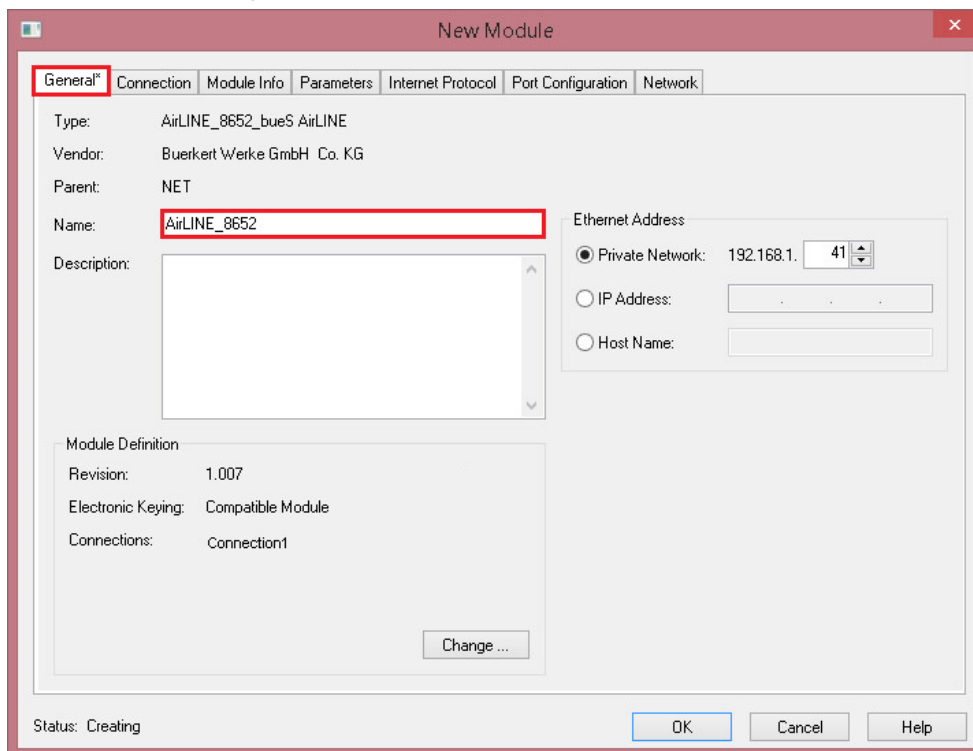
- Right-click on the field "Ethernet" and select the menu "Discover Modules":



- 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:

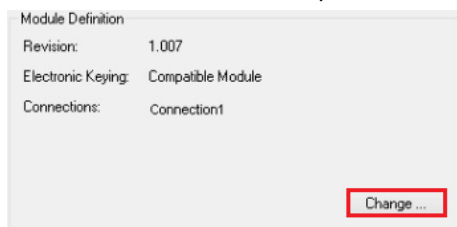


New Module

General | Connection | Module Info | Parameters | Internet Protocol | Port Configuration | Network

Type: AirLINE_8652_bueS AirLINE
 Vendor: Buerkert Werke GmbH Co. KG
 Parent: NET
 Name: **AirLINE_8652**
 Description:
 Ethernet Address:
☒ Private Network: 192.168.1. 41
☐ IP Address:
☐ Host Name:
 Module Definition
 Revision: 1.007
 Electronic Keying: Compatible Module
 Connections: Connection1
 Change ...
 Status: Creating
 OK Cancel Help

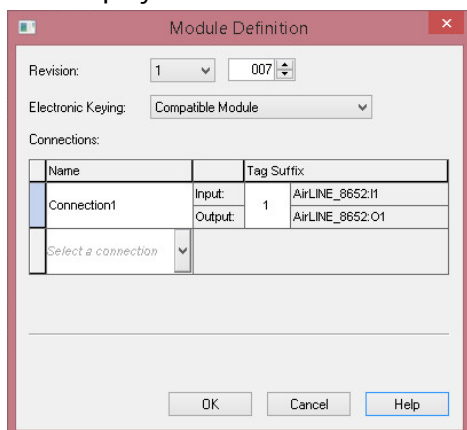
- In this example, the default configured parameter “Connections” is “Connection1” with module revision 1.007. If needed, click on the button change to modify these parameters:



Module Definition

Revision: 1.007
 Electronic Keying: Compatible Module
 Connections: Connection1
 Change ...

- This displays the window “Module Definition”:



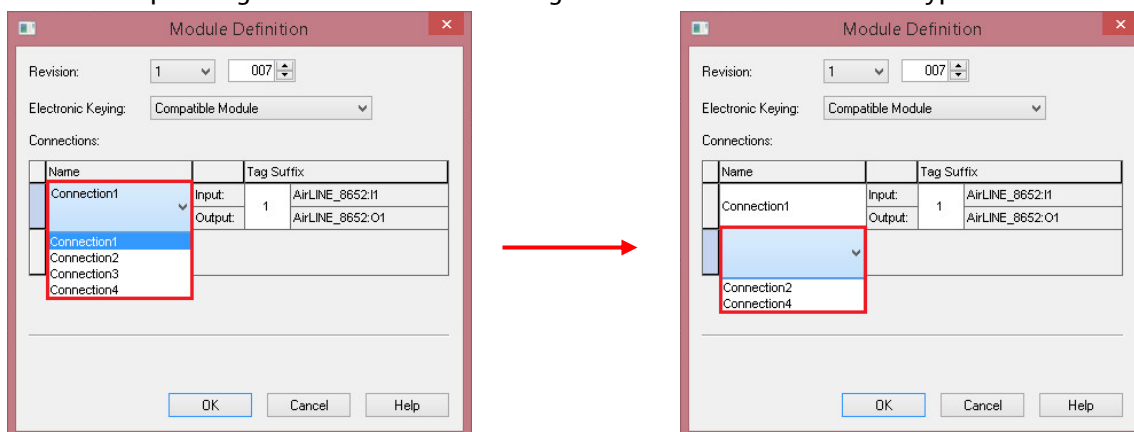
Module Definition

Revision: 1.007
 Electronic Keying: Compatible Module
 Connections:

Name	Input	Output	Tag Suffix
Connection1	1		AirLINE_8652:11
		1	AirLINE_8652:01

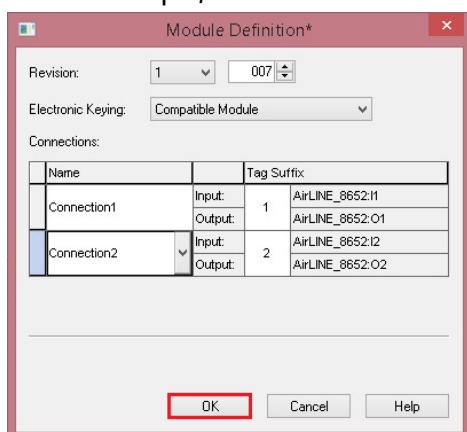
Select a connection
 OK Cancel Help

- 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:



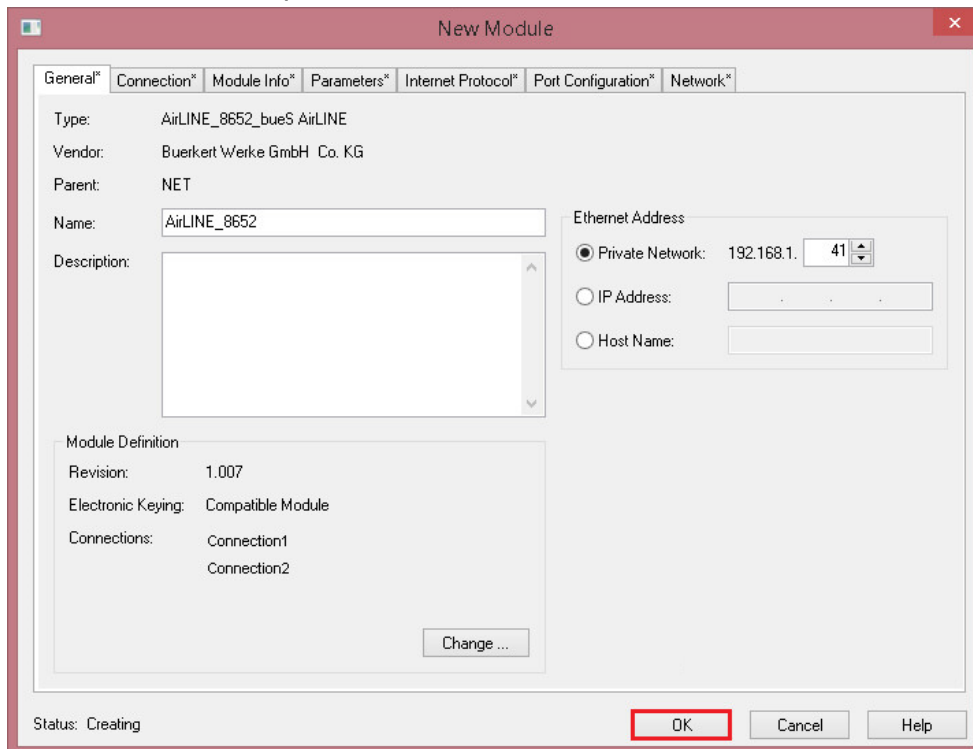
If the first connection is “Connection1”, the second one may only be “Connection2” or “Connection4.”

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



Click on the button “OK”.

- Module Definition is updated:



New Module

General* Connection* Module Info* Parameters* Internet Protocol* Port Configuration* Network*

Type: AirLINE_8652_bueS AirLINE
Vendor: Buerkert Werke GmbH Co. KG
Parent: NET
Name: AirLINE_8652
Description:

Ethernet Address
☒ Private Network: 192.168.1. 41
☐ IP Address:
☐ Host Name:

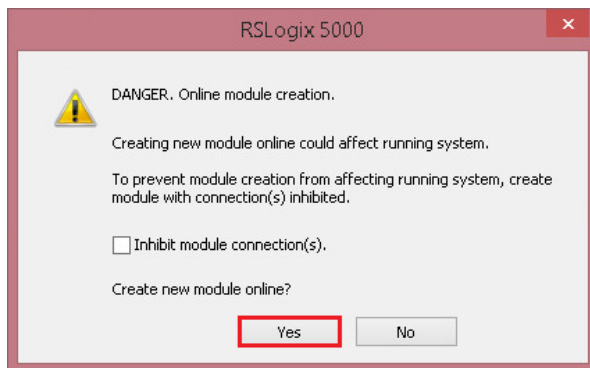
Module Definition
Revision: 1.007
Electronic Keying: Compatible Module
Connections: Connection1
Connection2
Change ...

Status: Creating


OK Cancel Help

Click on the button "OK" to save the configuration.

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



RSLogix 5000

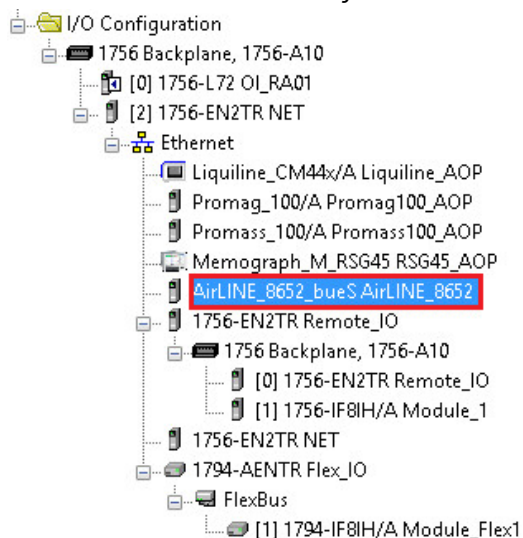
 DANGER: Online module creation.
Creating new module online could affect running system.
To prevent module creation from affecting running system, create module with connection(s) inhibited.

☐ Inhibit module connection(s).

Create new module online?

Yes No

- AirLINE 8652 is successfully added in the project:



- Close the wizard window "Select Module Type".

3.3.3 Device Integration with AOP

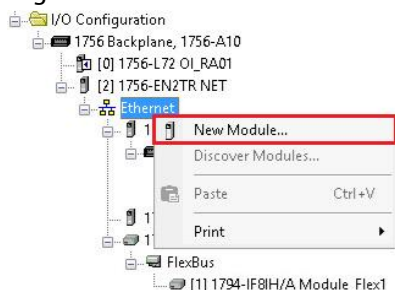
This chapter describes the steps for configuring an EtherNet/IP device by using the AOP. The following steps requires the installation of Endress+Hauser AOP packages.

3.3.3.1 Offline Configuration of Endress+Hauser Promag100 EIP

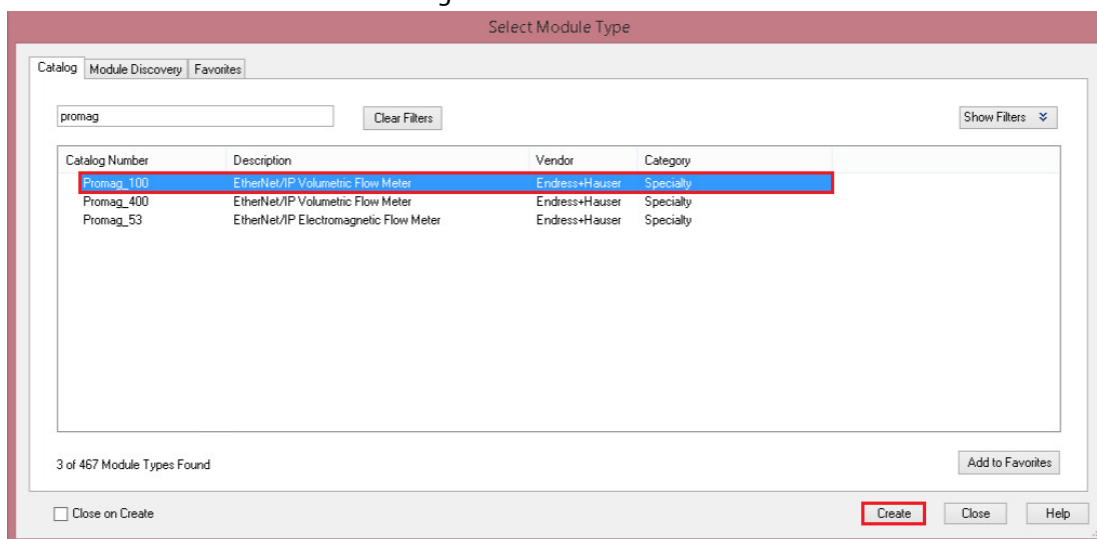
The following chapter describes the Offline Configuration workflow of an Endress+Hauser Promag100 EtherNet/IP device by using the AOP.

New Device

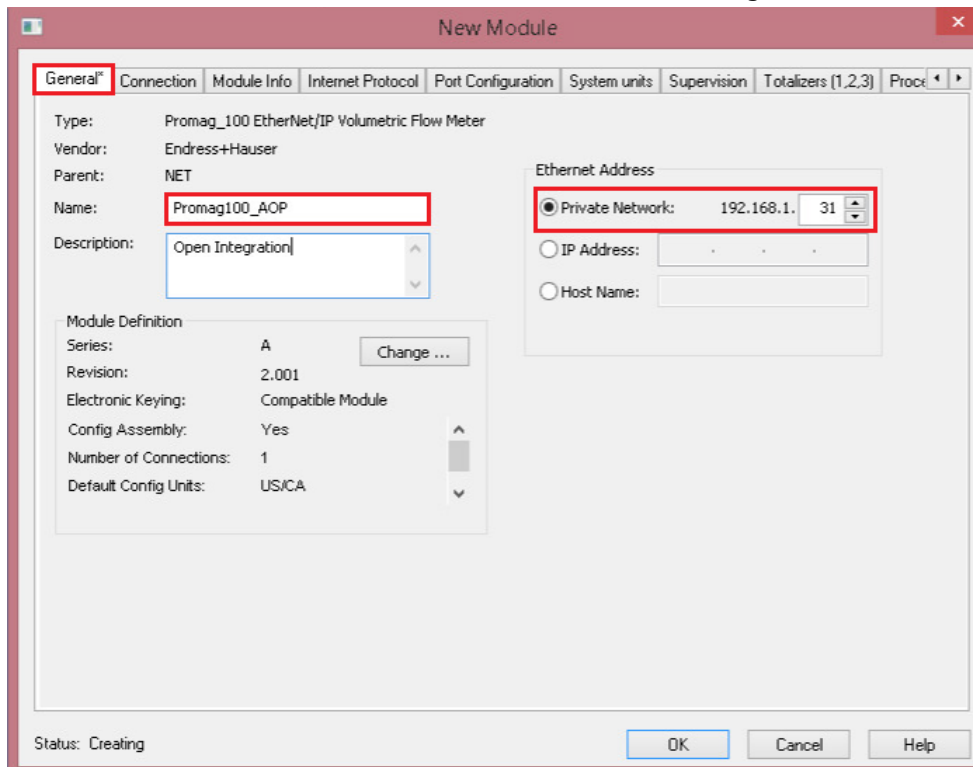
- Right-click on the field "Ethernet" and select the menu "New Module...":



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



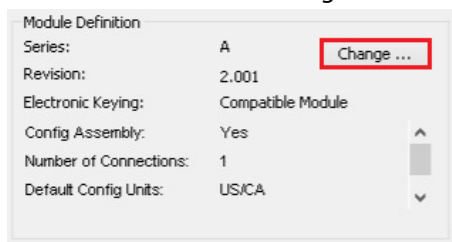
- In the tab "General", indicate Name and IP address according to the network:



The screenshot shows the 'New Module' dialog box with the 'General' tab selected. The 'Name' field is highlighted with a red box and contains the text 'Promag100_AOP'. The 'Ethernet Address' section has the 'Private Network' radio button selected, and the IP address '192.168.1. 31' is entered. The 'Module Definition' section shows various parameters: Series: A, Revision: 2.001, Electronic Keying: Compatible Module, Config Assembly: Yes, Number of Connections: 1, and Default Config Units: US/CA. The status at the bottom is 'Creating'.

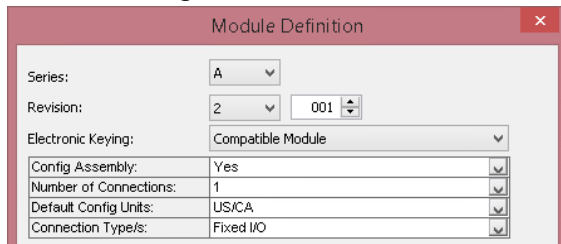
Connection Type

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



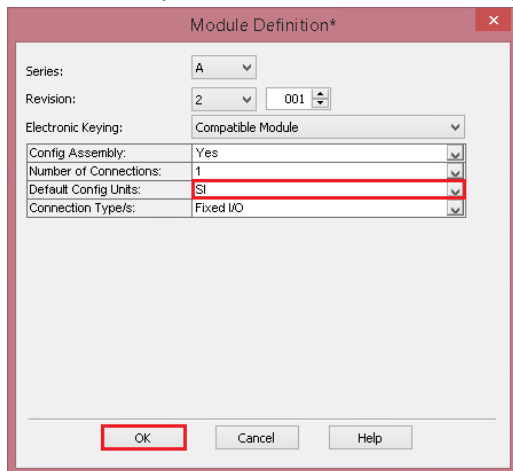
The screenshot shows the 'Module Definition' dialog box. The 'Change ...' button is highlighted with a red box. The parameters are: Series: A, Revision: 2.001, Electronic Keying: Compatible Module, Config Assembly: Yes, Number of Connections: 1, and Default Config Units: US/CA.

- Default Settings:



The screenshot shows the 'Module Definition' dialog box with the following default settings: Series: A, Revision: 2, 001, Electronic Keying: Compatible Module, Config Assembly: Yes, Number of Connections: 1, Default Config Units: US/CA, and Connection Type/s: Fixed I/O.

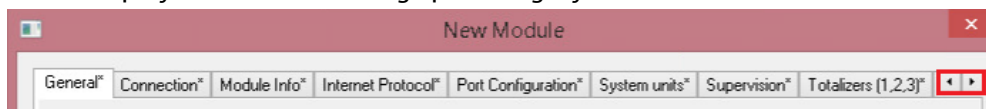
- In this example, the units has been configured to "SI":



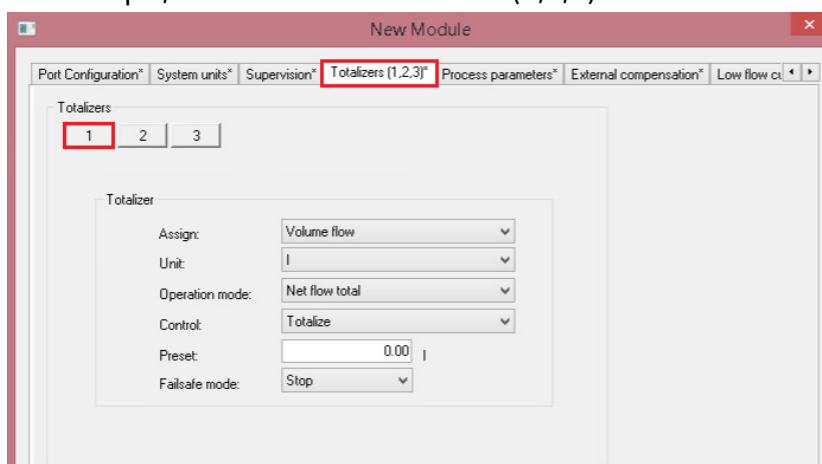
Click on the button "OK" to save the configuration and close this window.

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:

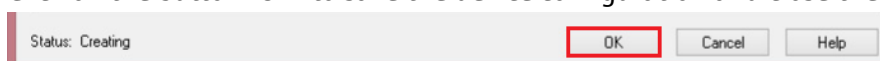


- Use the scroll button to display the other menus.
- For example, click on the tab "Totalizers (1,2,3)":

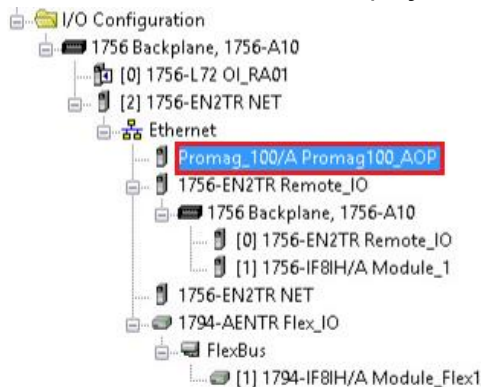


Click on the button "1" to configure Totalizer1 settings.

- Click on the button "OK" to save the device configuration and close the window:



- This inserts the device in the project view:

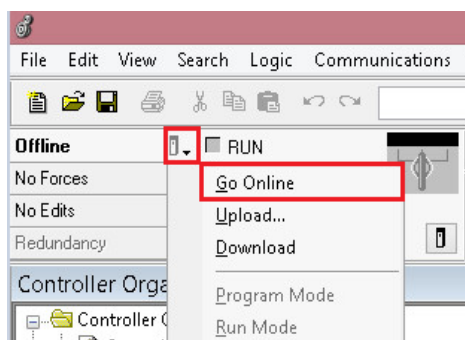


- The device configuration can be downloaded. Please refer to chapter 3.4.2.

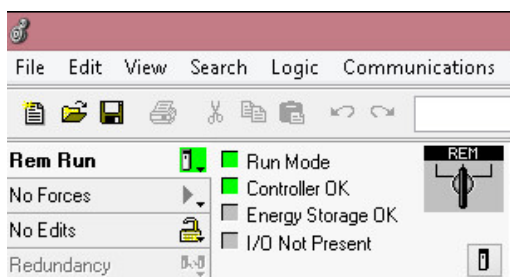
3.3.3.2 Online Configuration of Endress+Hauser Promag100 EIP

The following chapter describes the configuration workflow of an Endress+Hauser Promag100 EtherNet/IP device from Online to project by using the Add On Profile (AOP).

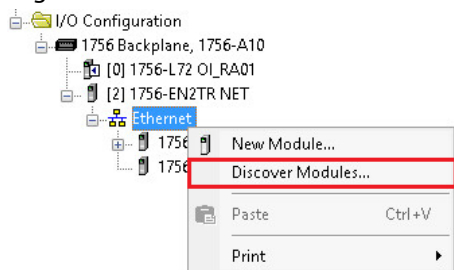
- Click on the shortcut button closed to the Offline status and select the menu "Go Online":



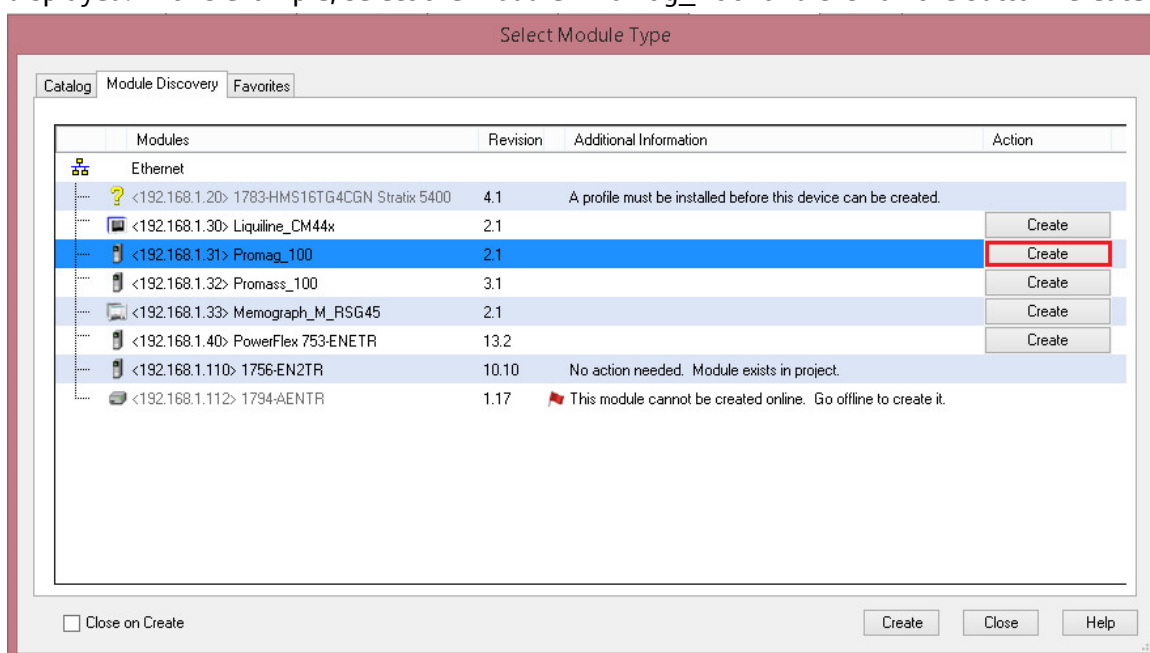
- Online connection is established:



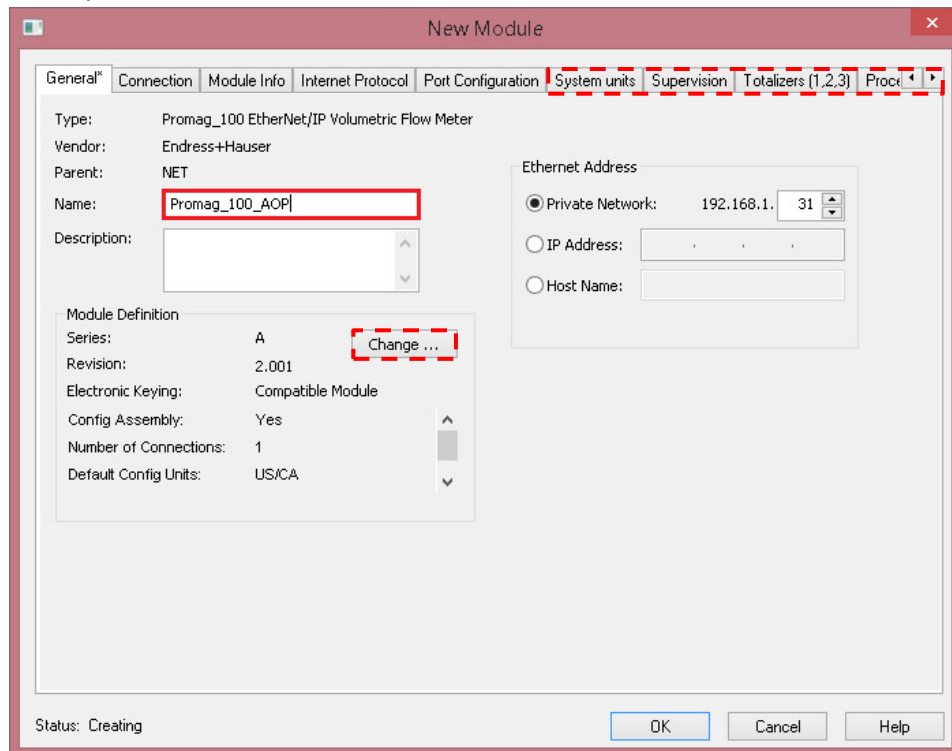
- Right-click on the field "Ethernet" and select the menu "Discover Modules":



- This scans the connected network. After few seconds, all detected devices on this network are displayed. In this example, select the module "Promag_100" and click on the button "Create":

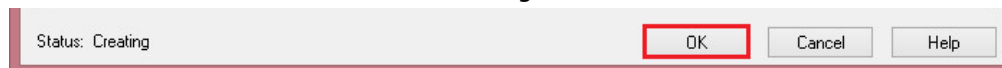


- This opens the “New Module” wizard:

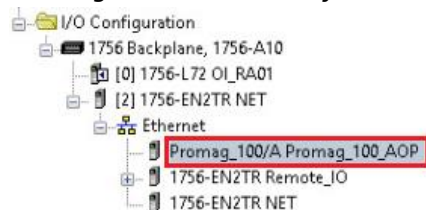


Configure the parameter “Name”, “Promag_100_AOP” in this example.

- 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:



- Promag100 is successfully added in the project:



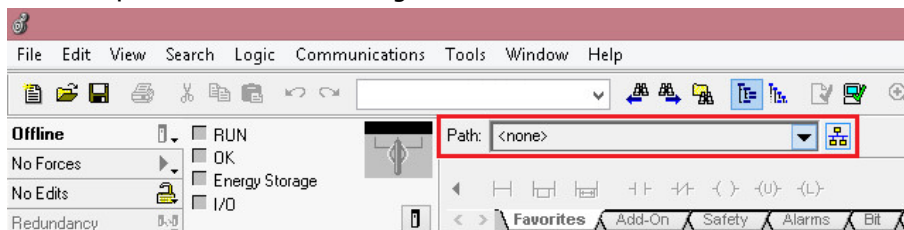
Remark

- The configuration does not need to be downloaded in the PLC.

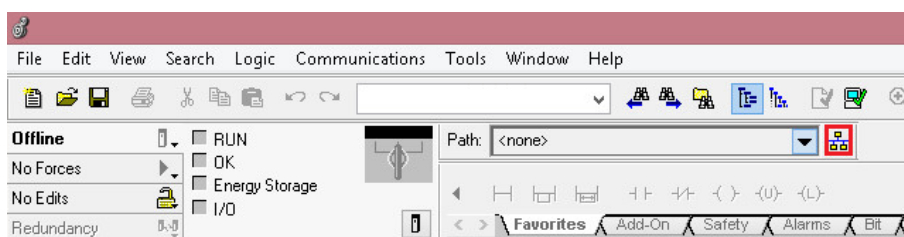
3.4 Commissioning of the Control Project

3.4.1 Path Configuration

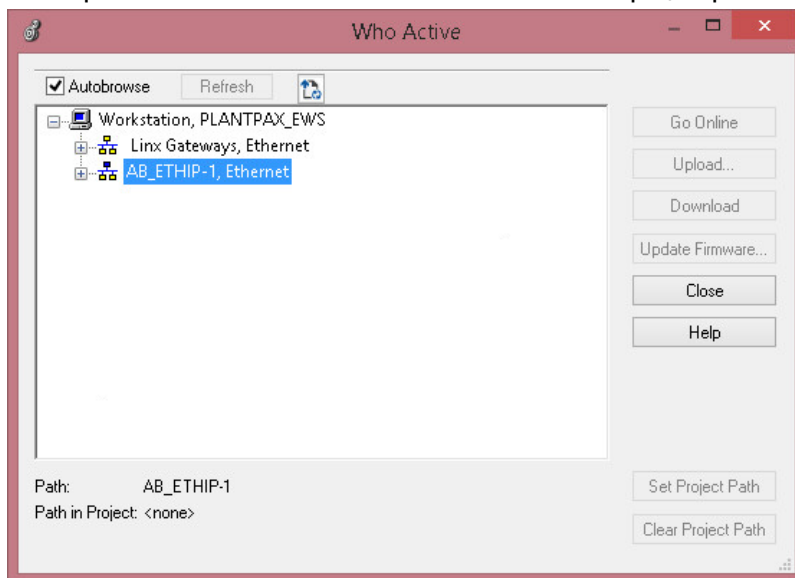
- The PLC path needs to be configured in order to connect the PLC:



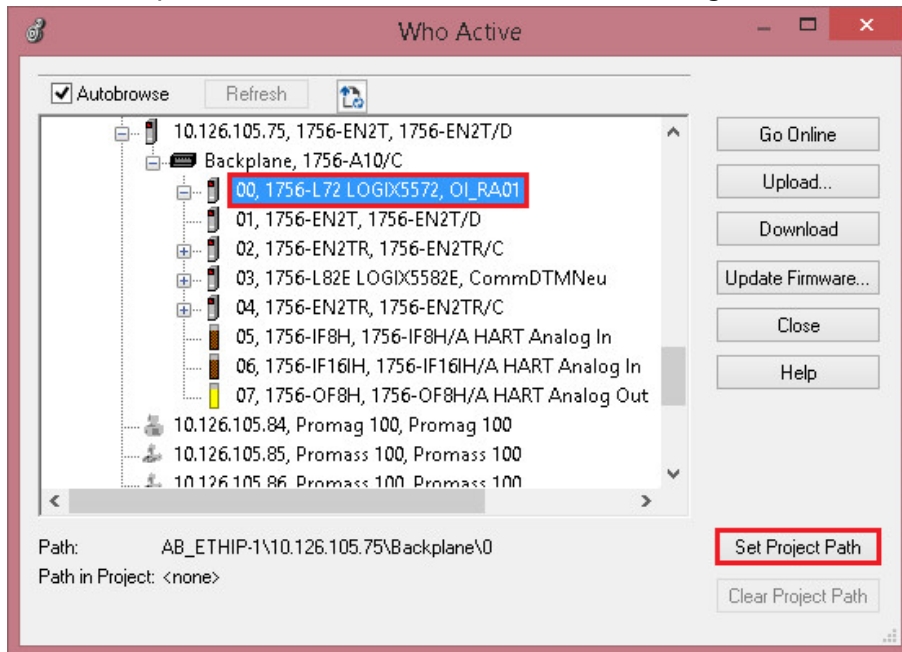
- Click on the small shortcut button:



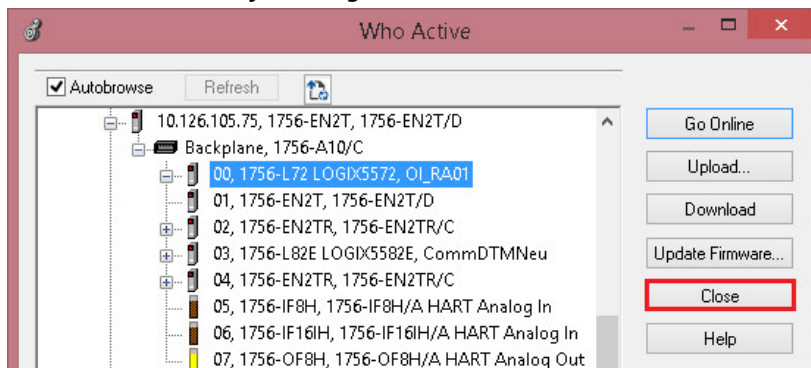
- This opens the window "Who Active". In this example, expand the field "AB_ETHIP-1,Ethernet":



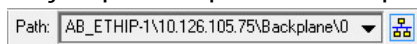
- Expand the location to choose the PLC and click on the button "Set Project Path".
In our example, the used PLC is the 1756-L72 ControlLogix:



- Close the window by clicking on the button "Close":

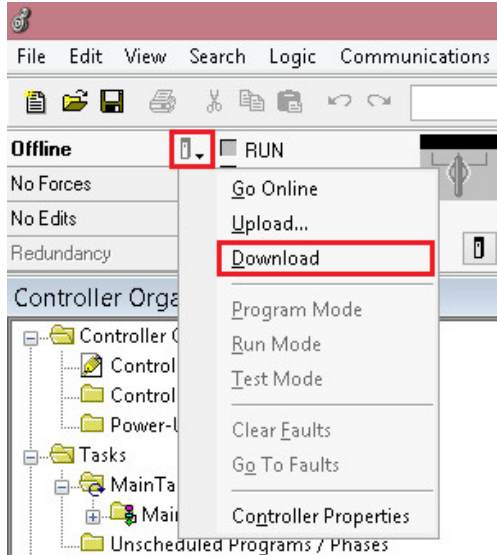


- Project path is updated in the project view:

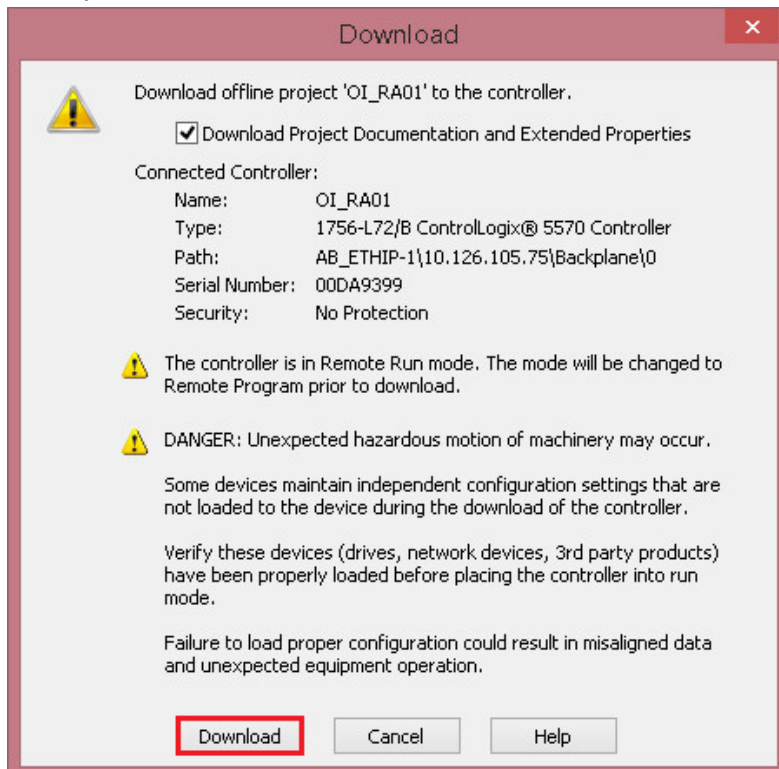


3.4.2 Project Configuration Download

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

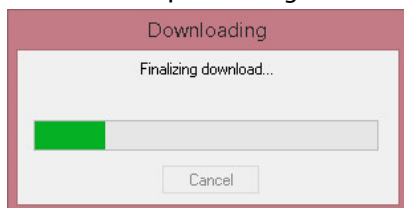


- This opens the window "Download":

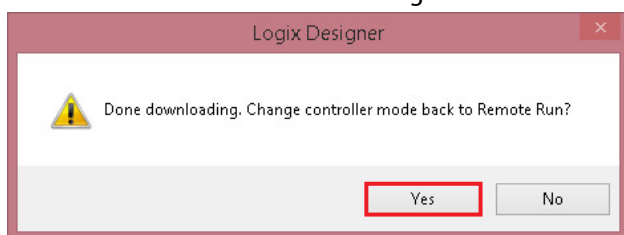


Click on the button "Download".

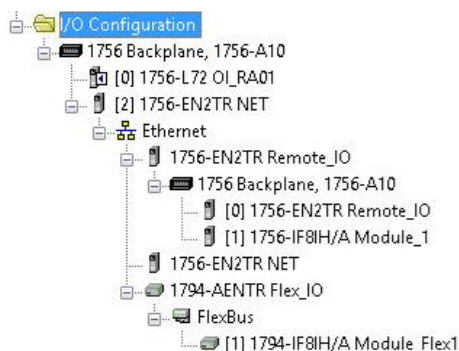
- Download is processing:



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

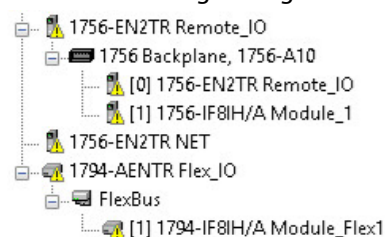


- Remote Run Status is active. In this example, there are no errors:



Remark

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

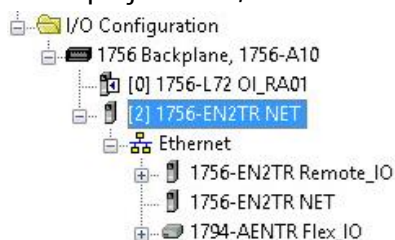


3.4.3 Network Supervisor Mode

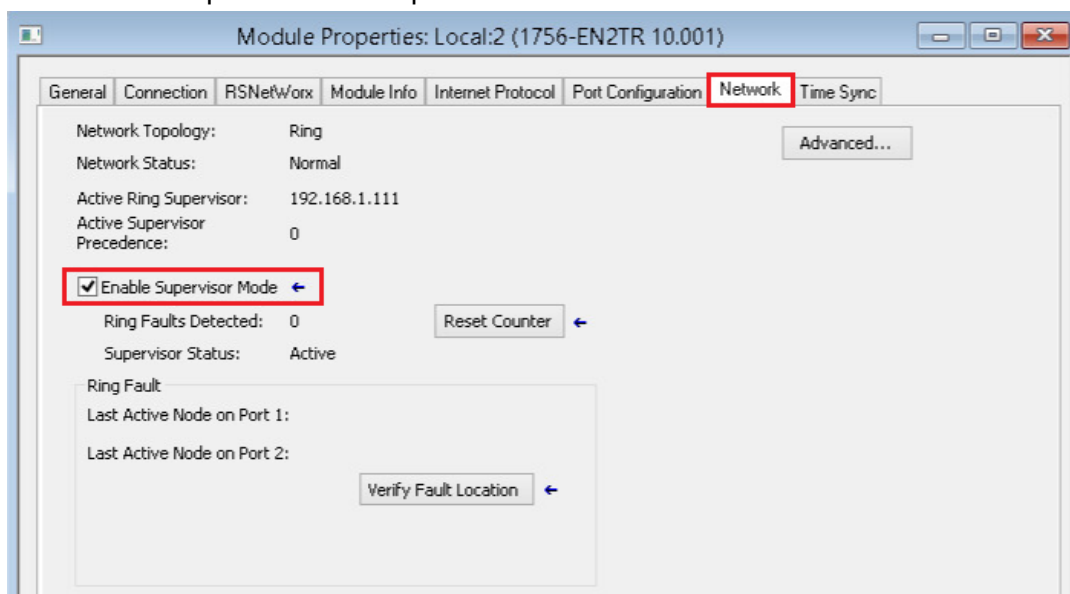
There must be one supervisor in the EtherNet/IP ring. In the topology RA01, this can be configured in the Ethernet module "1756-EN2TR" or in the Stratix switch 5400.

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

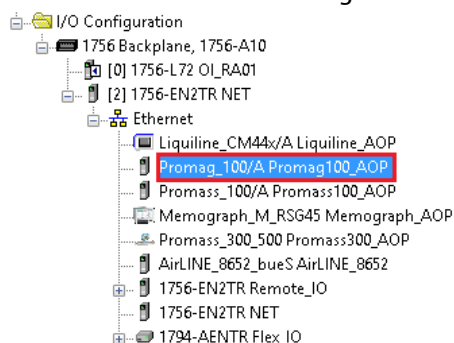
3.5.1 EtherNet/IP Data

This chapter explains where are displayed the EtherNet/IP online data of connected field devices, shown here for example with a Promag100 flowmeter and a valve island 8652 AirLINE:

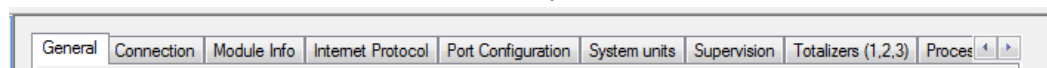
3.5.1.1 Promag100 EIP

3.5.1.1.1 Promag100 AOP

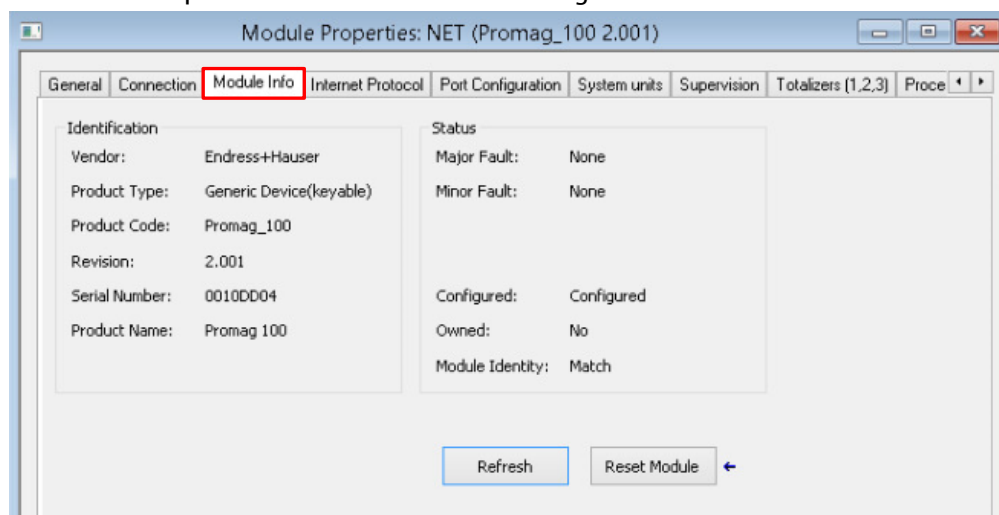
- Double-click on the Promag100:



- Use the tabs to select the available device option:

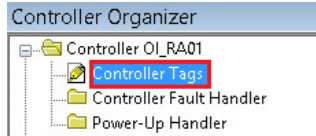


- Click for example on the tab "Module Info" to get device status:



3.5.1.1.2 Promag100 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:

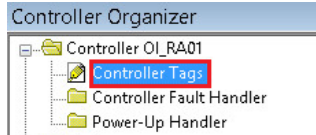
Scope: OI_RA01		Show: All Tags		Enter Name Filter...	
Name	Value	Force Mask	Style	Data Type	
+ Flex_IO:1:C		{...}	{...}	AB:1794_IF8IH:C:0	
+ Flex_IO:1:I		{...}	{...}	AB:1794_IF8IH:I:0	
+ Flex_IO:1:I2		{...}	{...}	AB:1794_HARTDATA:I2:0	
+ Flex_IO:I		{...}	{...}	AB:1794_AEN_5SLOT:I:0	
+ Flex_IO:0		{...}	{...}	AB:1794_AEN_5SLOT:0:0	
+ Promag100_ADP:C		{...}	{...}	EH:Promag_100_Rev2:C:0	
- Promag100_ADP:I1		{...}	{...}	EH:Promag_100:I1:0	
- Promag100_ADP:I1.Connection_Fault		0		Decimal	BOOL
+ Promag100_ADP:I1.Status_Actual_diagnostics	2#0000_0000_0000_0000_0000_0000_0000_0000			Binary	DINT
- Promag100_ADP:I1.Process_variables_Volume_Flow	1.72937918e-003			Float	REAL
- Promag100_ADP:I1.Process_variables_Mass_Flow	0.0			Float	REAL
- Promag100_ADP:I1.Process_variables_Corrected_Volume_Flow	0.0			Float	REAL
- Promag100_ADP:I1.Process_variables_Conductivity	-1.#QNAN			Float	REAL
- Promag100_ADP:I1.Process_variables_Temperature	-273.15			Float	REAL
- Promag100_ADP:I1.Process_variables_Totalizer1	446.8784			Float	REAL
- Promag100_ADP:I1.Process_variables_Totalizer2	7090.322			Float	REAL
- Promag100_ADP:I1.Process_variables_Totalizer3	3056.1792			Float	REAL
+ Promag100_ADP:01		{...}	{...}	EH:Promag_100:01:0	

Outputs:

Scope: OI_RA01		Show: All Tags		Enter Name Filter...	
Name	Value	Force Mask	Style	Data Type	
+ Flex_IO:1:C		{...}	{...}	AB:1794_IF8IH:C:0	
+ Flex_IO:1:I		{...}	{...}	AB:1794_IF8IH:I:0	
+ Flex_IO:1:I2		{...}	{...}	AB:1794_HARTDATA:I2:0	
+ Flex_IO:I		{...}	{...}	AB:1794_AEN_5SLOT:I:0	
+ Flex_IO:0		{...}	{...}	AB:1794_AEN_5SLOT:0:0	
+ Promag100_ADP:C		{...}	{...}	EH:Promag_100_Rev2:C:0	
+ Promag100_ADP:I1		{...}	{...}	EH:Promag_100:I1:0	
- Promag100_ADP:01		{...}	{...}	EH:Promag_100:01:0	
- Promag100_ADP:01.Totalizer_Control_1_Activation	0			Decimal	BOOL
- Promag100_ADP:01.Totalizer_Control_2_Activation	0			Decimal	BOOL
- Promag100_ADP:01.Totalizer_Control_3_Activation	0			Decimal	BOOL
- Promag100_ADP:01.Ref_Density_Compensation_Activation	0			Decimal	BOOL
- Promag100_ADP:01.Temperature_Compensation_Activation	0			Decimal	BOOL
- Promag100_ADP:01.Verification_Activation	0			Decimal	BOOL
+ Promag100_ADP:01.Totalizer_1_Control	0			Decimal	INT
+ Promag100_ADP:01.Totalizer_2_Control	0			Decimal	INT
+ Promag100_ADP:01.Totalizer_3_Control	0			Decimal	INT
- Promag100_ADP:01.External_density	0.0			Float	REAL
+ Promag100_ADP:01.Density_unit	0			Decimal	INT
- Promag100_ADP:01.External_temperature	0.0			Float	REAL
+ Promag100_ADP:01.Temperature_unit	0			Decimal	INT
+ Promag100_ADP:01.Start_verification	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:

Scope: <input type="text" value="OI_RA01"/>		Show: All Tags			
Name	Value	Force Mask	Style	Data Type	
- 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_NamurNe1...	1		Decimal	BOOL	
- AirLINE_8652:I2.Device_Status_NamurNe1...	0		Decimal	BOOL	
- AirLINE_8652:I2.Device_Status_NamurNe1...	0		Decimal	BOOL	
- AirLINE_8652:I2.Device_Status_NamurNe1...	0		Decimal	BOOL	
- AirLINE_8652:I2.Device_Status_NamurNe1...	0		Decimal	BOOL	
- AirLINE_8652:I2.Device_Status_NamurNe1...	0		Decimal	BOOL	
- AirLINE_8652:I2.Device_Status_NamurNe1...	0		Decimal	BOOL	
+ AirLINE_8652:O1	{...}	{...}			_0057:AirLINE_8652_bueS_39065298:O:0
+ AirLINE_8652:O2	{...}	{...}			_0057:AirLINE_8652_bueS_AA894180: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:

Scope:	 01_RA01	Show:	All Tags		
	Name	Value	Force Mask	Style	Data Type
	+ 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_39065298: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_D...	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_D...	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_D...	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_D...	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_D...	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_D...	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

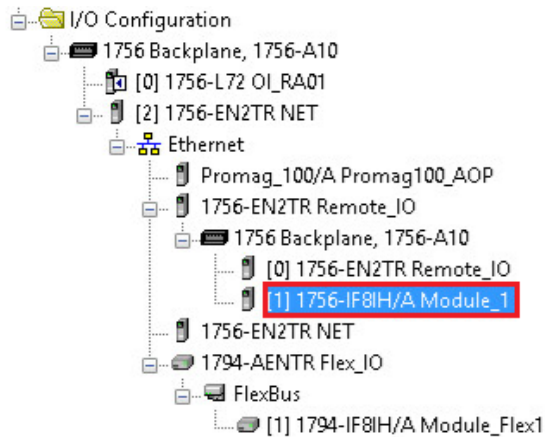
In this example, data structure AirLINE_8652:O1 corresponds to Connection1 Outputs and data structure AirLINE_8652:O2 corresponds to Connection2 Outputs.

3.5.2 HART Data

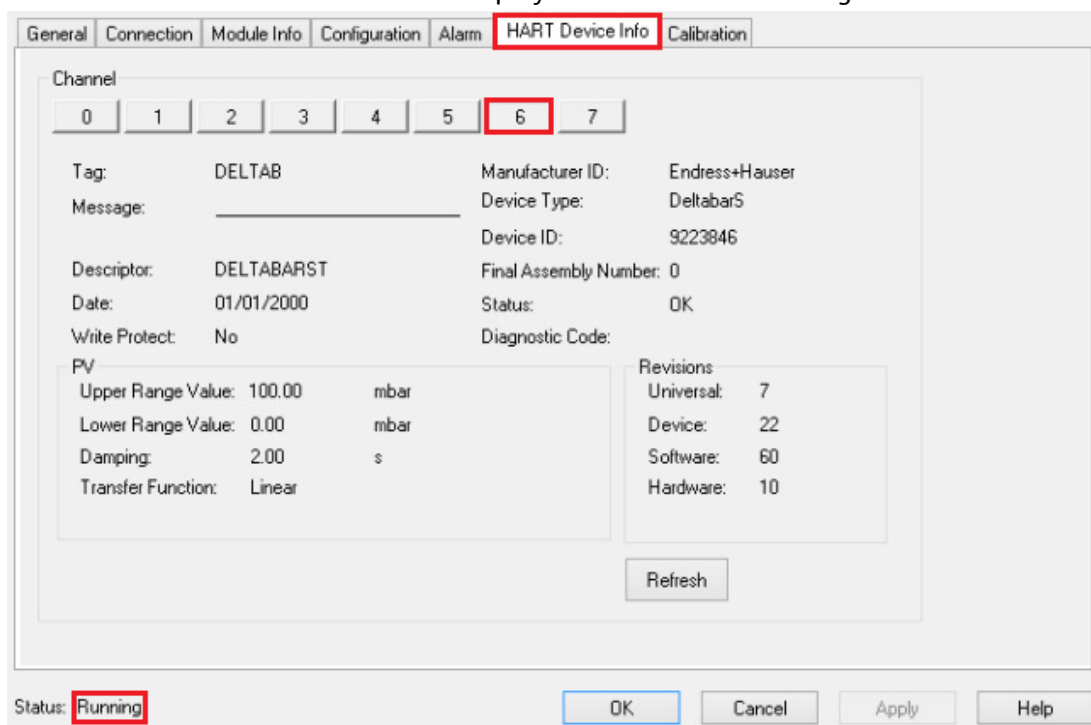
3.5.2.1 ControlLogix I/O Analog Input 1756-IF8IH

3.5.2.1.1 ControlLogix I/O AOP

- Double-click on the Controller "1756-EN2TR Module_1":



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



General Connection Module Info Configuration Alarm **HART Device Info** Calibration

Channel: 0 1 2 3 4 5 **6** 7

Tag:	DELTAB	Manufacturer ID:	Endress+Hauser
Message:		Device Type:	DeltabarS
		Device ID:	9223846
Descriptor:	DELTABARST	Final Assembly Number:	0
Date:	01/01/2000	Status:	OK
Write Protect:	No	Diagnostic Code:	

PV		Revisions
Upper Range Value:	100.00 mbar	Universal: 7
Lower Range Value:	0.00 mbar	Device: 22
Damping:	2.00 s	Software: 60
Transfer Function:	Linear	Hardware: 10

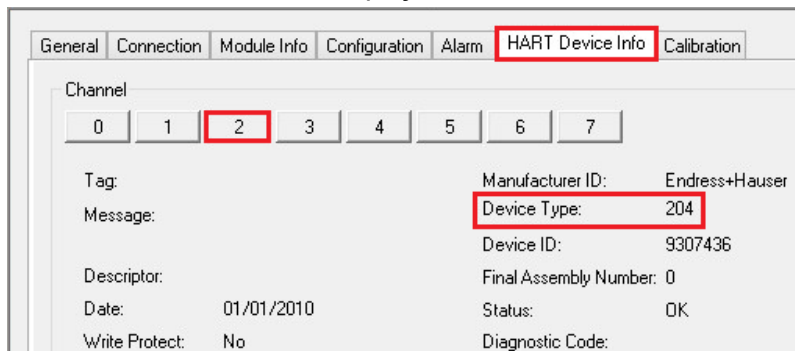
Refresh

Status: **Running** OK Cancel Apply Help

In this example, Channel6 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:

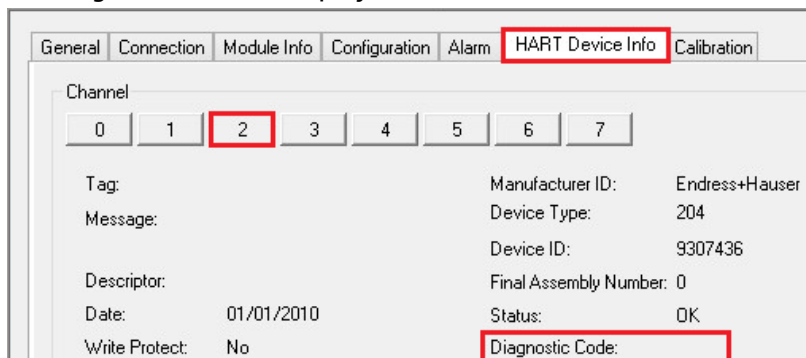


Channel	
0	1
2	3
4	5
6	7

Tag:	Manufacturer ID:	Endress+Hauser
Message:	Device Type:	204
Descriptor:	Device ID:	9307436
Date:	Final Assembly Number:	0
Write Protect:	Status:	OK
No	Diagnostic Code:	

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

- No Diagnostic Code is displayed when no errors:



Channel	
0	1
2	3
4	5
6	7

Tag:	Manufacturer ID:	Endress+Hauser
Message:	Device Type:	204
Descriptor:	Device ID:	9307436
Date:	Final Assembly Number:	0
Write Protect:	Status:	OK
No	Diagnostic Code:	

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).

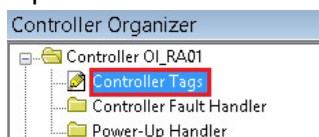
Name	Value	Force Mask	Style	Data Type
Remote_IO:1:	{...}	{...}		AB:1756_IF8H_AnalogHARTb...
+ Remote_IO:1:1.ChannelFaults	2#0000_000...		Binary	INT
Remote_IO:1:1.Ch0Fault	0		Decimal	BOOL
Remote_IO:1:1.Ch1Fault	0		Decimal	BOOL
Remote_IO:1:1.Ch2Fault	0		Decimal	BOOL
Remote_IO:1:1.Ch3Fault	0		Decimal	BOOL
Remote_IO:1:1.Ch4Fault	0		Decimal	BOOL
Remote_IO:1:1.Ch5Fault	1		Decimal	BOOL
Remote_IO:1:1.Ch6Fault	0		Decimal	BOOL
Remote_IO:1:1.Ch7Fault	0		Decimal	BOOL
+ Remote_IO:1:1.ModuleFaults	2#0000_0000		Binary	SINT
Remote_IO:1:1.CalFault	0		Decimal	BOOL
Remote_IO:1:1.Calibrating	0		Decimal	BOOL
Remote_IO:1:1.UpdatedStatusReady	0		Decimal	BOOL
Remote_IO:1:1.AnalogGroupFault	0		Decimal	BOOL
- Remote_IO:1:1.Ch0	{...}	{...}		AB:1756_IF8H_HARTDataAll...
Remote_IO:1:1.Ch0.Data	3.9729118		Float	REAL
+ Remote_IO:1:1.Ch0.DeviceStatus	{...}	{...}		AB:1756_IF8H_HARTStatusAll...
Remote_IO:1:1.Ch0.PV	-2.6376692...		Float	REAL
Remote_IO:1:1.Ch0.SV	-2.6376168...		Float	REAL
Remote_IO:1:1.Ch0.TV	-5.7885050...		Float	REAL
Remote_IO:1:1.Ch0.FV	24.372284		Float	REAL
+ Remote_IO:1:1.Ch0.PVStatus	16#c0		Hex	SINT
+ Remote_IO:1:1.Ch0.SVStatus	16#c0		Hex	SINT
+ Remote_IO:1:1.Ch0.TVStatus	16#c0		Hex	SINT
+ Remote_IO:1:1.Ch0.FVStatus	16#c0		Hex	SINT
+ Remote_IO:1:1.Ch1	{...}	{...}		AB:1756_IF8H_HARTDataAll...
+ Remote_IO:1:1.Ch2	{...}	{...}		AB:1756_IF8H_HARTDataAll...
+ Remote_IO:1:1.Ch3	{...}	{...}		AB:1756_IF8H_HARTDataAll...
+ Remote_IO:1:1.Ch4	{...}	{...}		AB:1756_IF8H_HARTDataAll...
+ Remote_IO:1:1.Ch5	{...}	{...}		AB:1756_IF8H_HARTDataAll...

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 "Flex_IO:1:I" and look for a channel's "Data" parameter to display the 4...20mA value, e.g. for channel 1:

Name	Value	Force Mask	Style	Data Type
+ Flex_IO:1:C	{...}	{...}		AB:1794_IF8IH:C:0
- Flex_IO:1:I	{...}	{...}		AB:1794_IF8IH:I:0
+ Flex_IO:1:I.Fault	2#0000_000...		Binary	DINT
+ Flex_IO:1:I.Ch0Data	3989		Decimal	INT
+ Flex_IO:1:I.Ch1Data	20028		Decimal	INT
+ Flex_IO:1:I.Ch2Data	4004		Decimal	INT
+ Flex_IO:1:I.Ch3Data	20057		Decimal	INT
+ Flex_IO:1:I.Ch4Data	0		Decimal	INT
+ Flex_IO:1:I.Ch5Data	17		Decimal	INT
+ Flex_IO:1:I.Ch6Data	1		Decimal	INT
+ Flex_IO:1:I.Ch7Data	52		Decimal	INT

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

- Expand the "Flex_IO:1:I2" to display the corresponding HART process data:

Scope: 01_RA01		Show: All Tags		
Name	Value	Force Mask	Style	Data Type
+ Flex_IO:1:C	(...)	(...)		AB:1794_IF8IH:C:0
+ Flex_IO:1:I	(...)	(...)		AB:1794_IF8IH:I:0
- Flex_IO:1:I2	(...)	(...)		AB:1794_HARTDATA:I2:0
+ Flex_IO:1:I2 Fault	2#0000_000...		Binary	DINT
- Flex_IO:1:I2 Ch0HARTCmd3Status	0		Decimal	BOOL
- Flex_IO:1:I2 Ch1HARTCmd3Status	0		Decimal	BOOL
- Flex_IO:1:I2 Ch2HARTCmd3Status	0		Decimal	BOOL
- Flex_IO:1:I2 Ch3HARTCmd3Status	0		Decimal	BOOL
- Flex_IO:1:I2 Ch4HARTCmd3Status	0		Decimal	BOOL
- Flex_IO:1:I2 Ch5HARTCmd3Status	0		Decimal	BOOL
- Flex_IO:1:I2 Ch6HARTCmd3Status	0		Decimal	BOOL
- Flex_IO:1:I2 Ch7HARTCmd3Status	0		Decimal	BOOL
+ Flex_IO:1:I2 Ch0HART	(...)	(...)		AB:1794_Isolated_HARTPV_S...
- Flex_IO:1:I2 Ch1HART	(...)	(...)		AB:1794_Isolated_HARTPV_S...
+ Flex_IO:1:I2 Ch1HART.CommunicationStatus	2#0000_0000		Binary	SINT
+ Flex_IO:1:I2 Ch1HART.FieldDeviceStatus	2#0000_0000		Binary	SINT
+ Flex_IO:1:I2 Ch1HART.LoopStatus	2#0010_1011		Binary	SINT
- Flex_IO:1:I2 Ch1HART.PVAcquired	1		Decimal	BOOL
- Flex_IO:1:I2 Ch1HART.SVAcquired	1		Decimal	BOOL
- Flex_IO:1:I2 Ch1HART.TVAcquired	1		Decimal	BOOL
- Flex_IO:1:I2 Ch1HART.FVAcquired	1		Decimal	BOOL
- Flex_IO:1:I2 Ch1HART.PV	99.74984		Float	REAL
- Flex_IO:1:I2 Ch1HART.SV	0.19083874		Float	REAL
- Flex_IO:1:I2 Ch1HART.TV	-14.050015		Float	REAL
- Flex_IO:1:I2 Ch1HART.FV	35.93625		Float	REAL
+ Flex_IO:1:I2 Ch1HART.PVUnitsCode	2#0011_1001		Binary	SINT
+ Flex_IO:1:I2 Ch1HART.SVUnitsCode	2#0010_1101		Binary	SINT
+ Flex_IO:1:I2 Ch1HART.TVUnitsCode	2#1001_1100		Binary	SINT
+ Flex_IO:1:I2 Ch1HART.FVUnitsCode	2#1001_1100		Binary	SINT
+ Flex_IO:1:I2 Ch2HART	(...)	(...)		AB:1794_Isolated_HARTPV_S...
+ Flex_IO:1:I2 Ch3HART	(...)	(...)		AB:1794_Isolated_HARTPV_S...
+ Flex_IO:1:I2 Ch4HART	(...)	(...)		AB:1794_Isolated_HARTPV_S...
+ Flex_IO:1:I2 Ch5HART	(...)	(...)		AB:1794_Isolated_HARTPV_S...
+ Flex_IO:1:I2 Ch6HART	(...)	(...)		AB:1794_Isolated_HARTPV_S...
+ Flex_IO:1:I2 Ch7HART	(...)	(...)		AB:1794_Isolated_HARTPV_S...

- 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

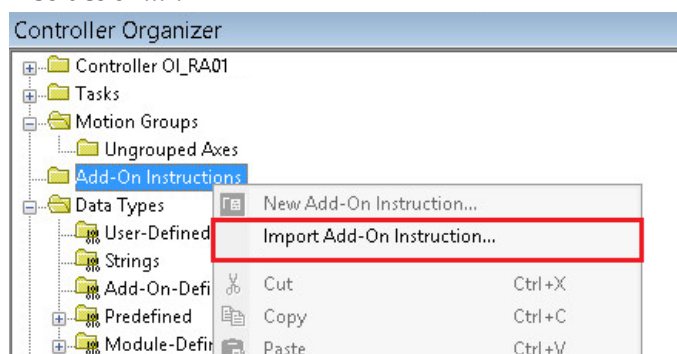
- The table below is specific for our example and shows the used AOI for ControlLogix I/O, Flex I/O and EtherNet/IP devices:

Device Protocol	RA_EH_Integration_Objects_v3.5-09				
	HART Input Card	AOI Module	HART Standard AOI	EtherNet/IP Specific AOI	EtherNet/IP Device AOI
HART	ControlLogix IO	I_1756IF8IH_3_5-01_AOI.L5X	P_AInHART_3_5-04_AOI.L5X		
	FlexIO	I_1794IF8IH_3_5-01_AOI.L5X	P_AInHART_3_5-04_AOI.L5X		
EtherNet/IP				I_EH_Flowmeter_3_5-01_AOI.L5X	I_EH_Promag100_FW2_3_5-01_AOI.L5X
				I_EH_Sensor_3_5-01_AOI.L5X	I_EH_Promass100_FW2_3_5-01_AOI.L5X

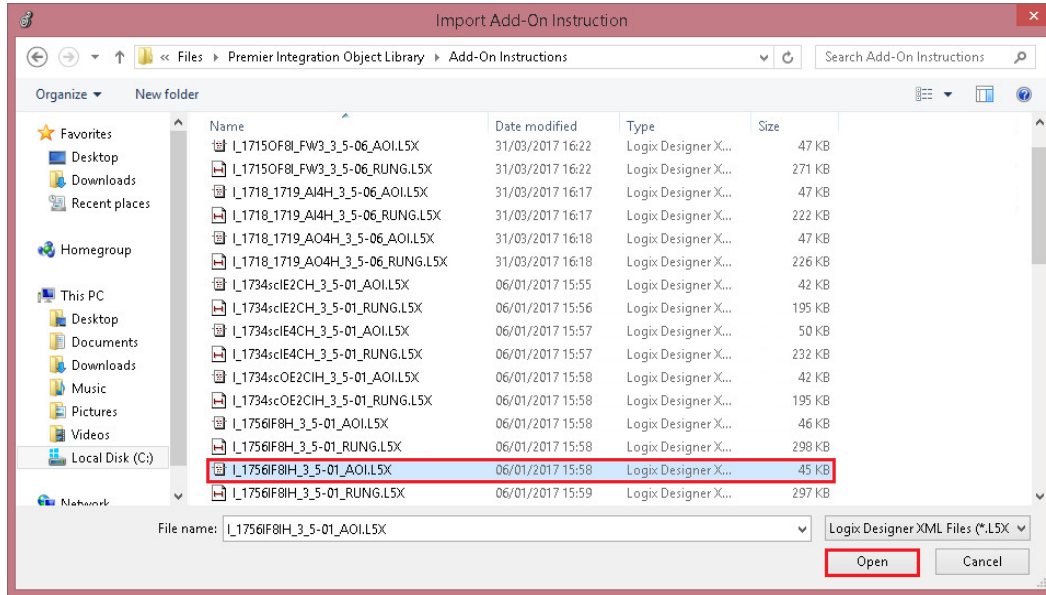
All these AOIs are part of the library "RA_EH_Integration_Objetscs_v3.5-09" and need at first to be imported.

Steps to import an AOI:

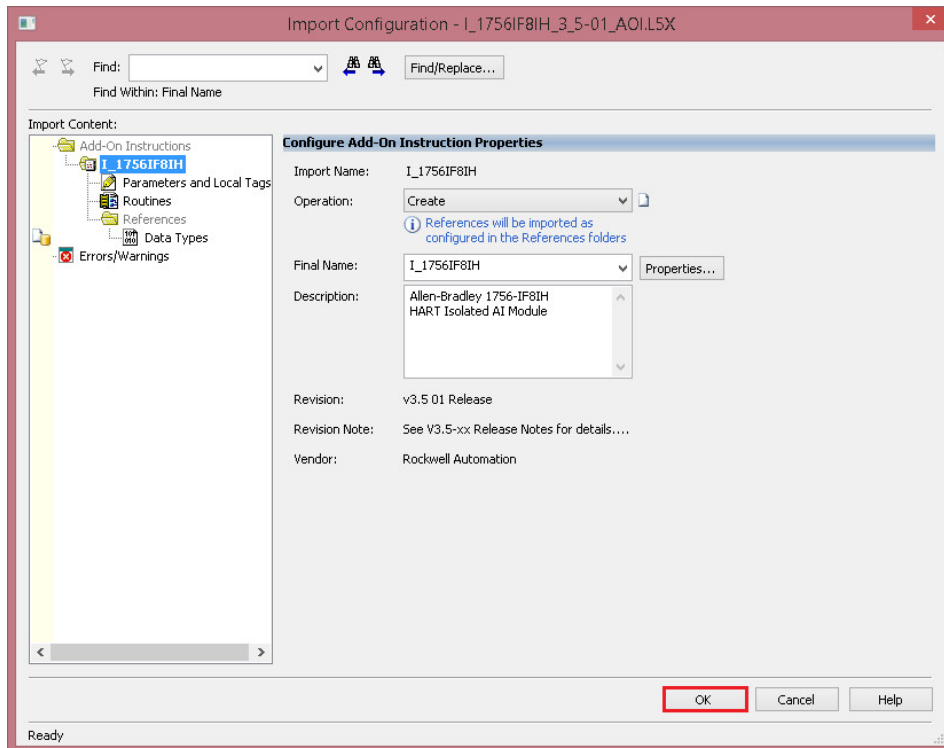
- In the project view, right-click on "Add-On Instructions" and select the menu "Import Add-On Instruction...":



- 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”:

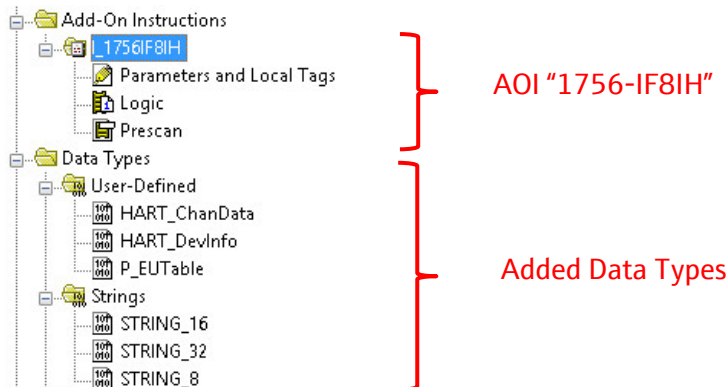


- This opens following window:

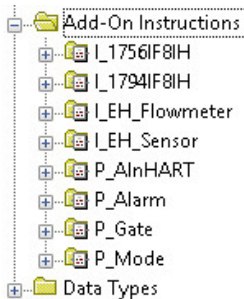


Click on the button “OK”.

- 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

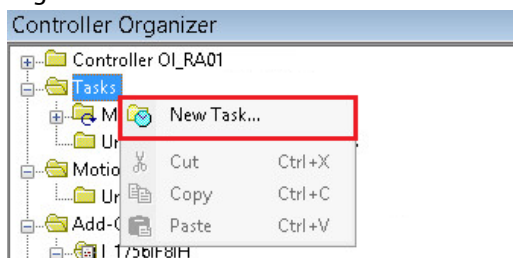
The AOI integration for a HART device requires the use of two AOI. The first one related to the HART analog input module and the second one to the device.

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

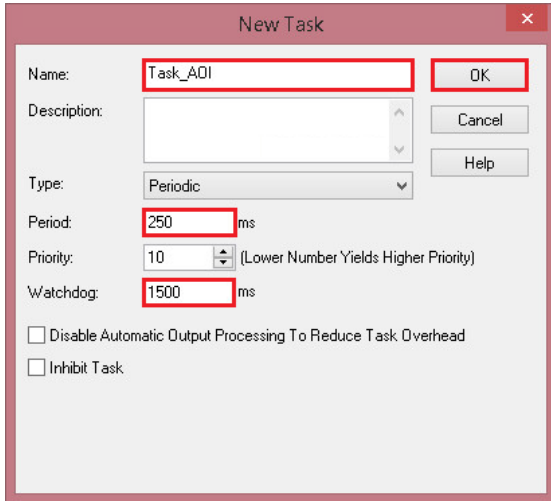
4.1.2.1 New Task

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:



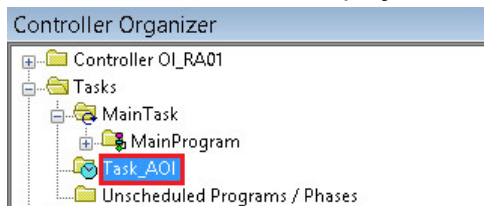
The "New Task" dialog box is shown with the following settings:

- Name: Task_AOI
- Description: (empty)
- Type: Periodic
- Period: 250 ms
- Priority: 10 (Lower Number Yields Higher Priority)
- Watchdog: 1500 ms
- ☐ Disable Automatic Output Processing To Reduce Task Overhead
- ☐ Inhibit Task

Buttons: OK, Cancel, Help

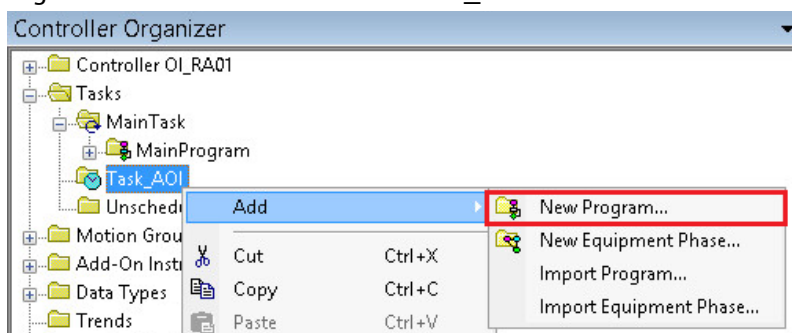
Click on the button "OK".

- New task is inserted in the project:

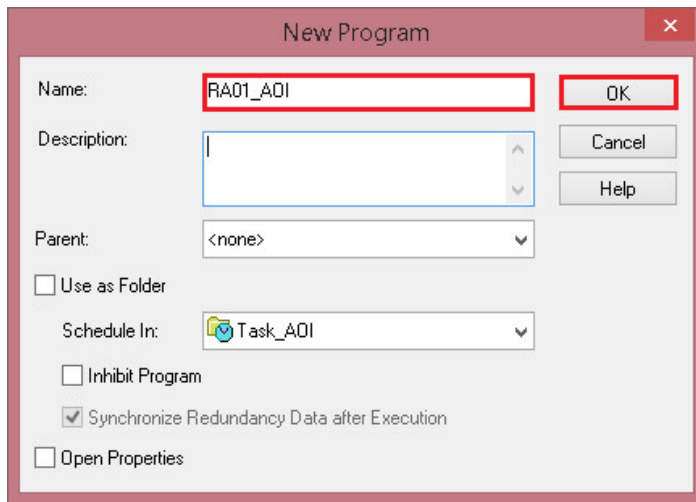


4.1.2.2 New Program

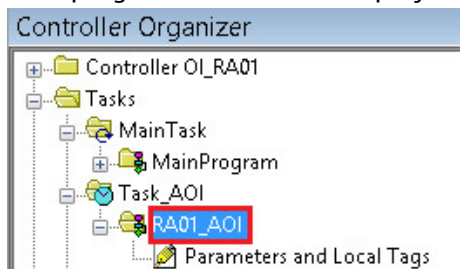
- Right-click on the created Task "Task_AOI" and select the menu "Add→New Program...":



- Enter a name and click on the button "OK":



- New program is added in the project view:



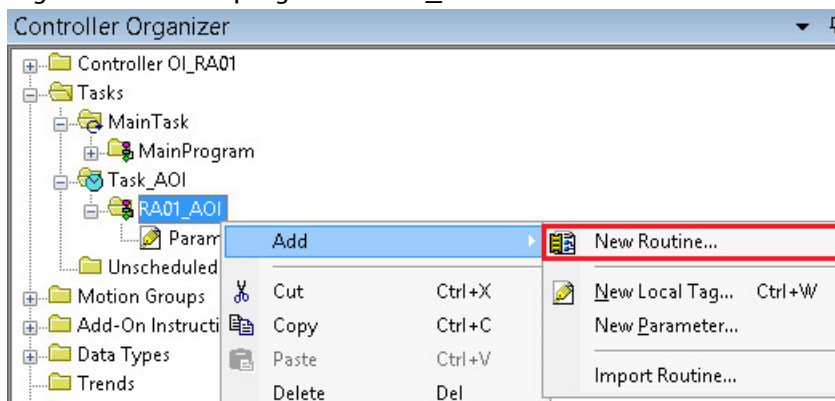
4.1.2.3 New Routines

Three routines are created in this example: "mainRoutine", "routine_1756_IF8IH" and "P_AlnHART".

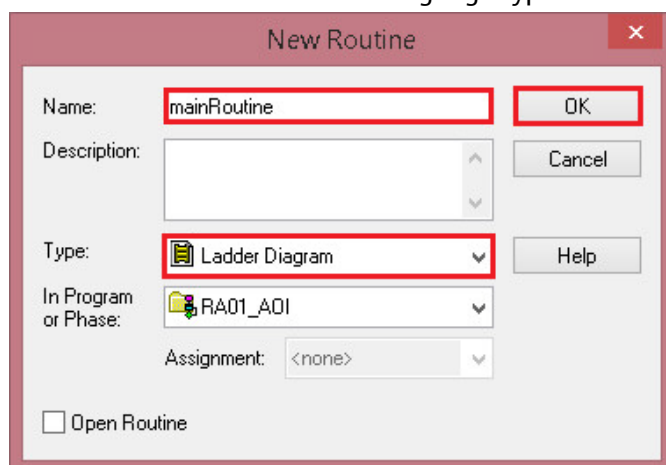
4.1.2.3.1 Routines Creation

Main Routine

- Right-click on the program "RA01_AOI" and select the menu "Add→New Routine...":

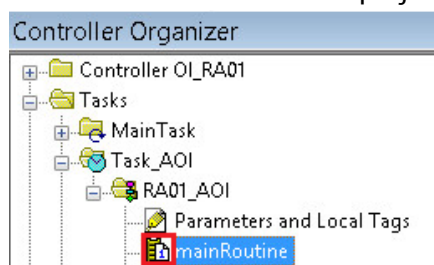


- Enter a name and choose the language type:



Click on the button "OK".

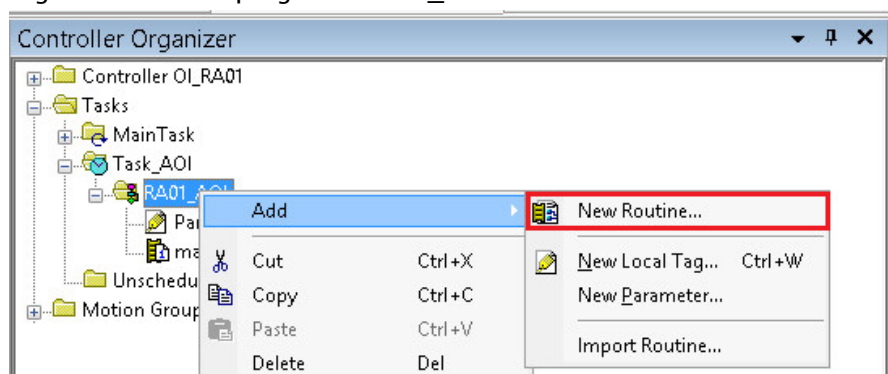
- This adds the routine in the project view:



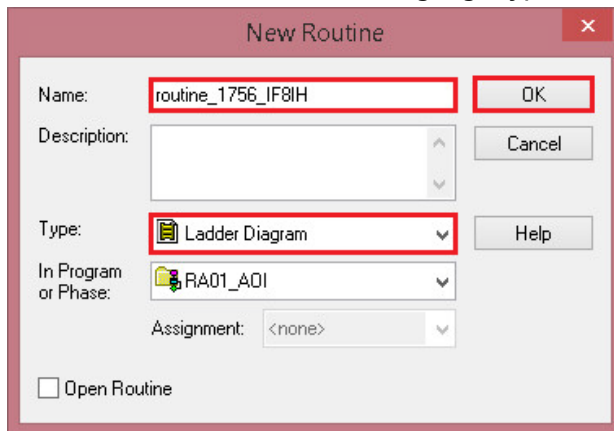
The main routine is marked with the symbol "1".

Routine for Analog input card 1756-IF8IH module

- Right-click on the program "RA01_AOI" and select the menu "Add→New Routine...":

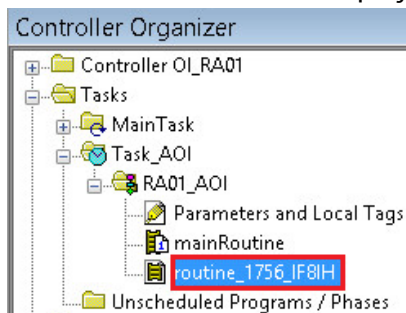


- Enter a name and choose the language type:



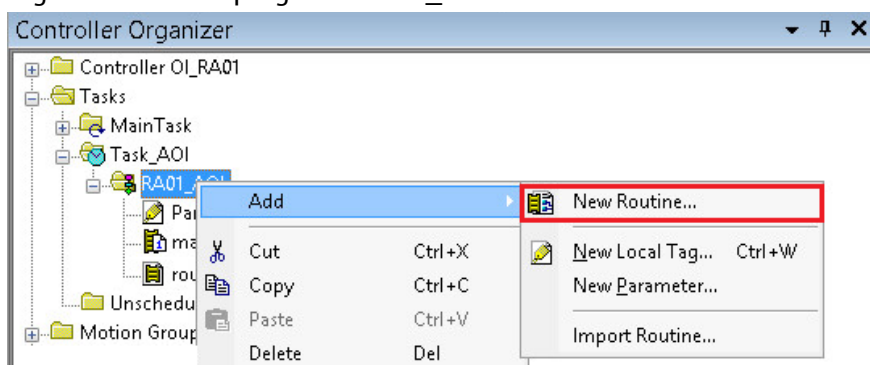
Click on the button "OK".

- This adds the routine in the project view:

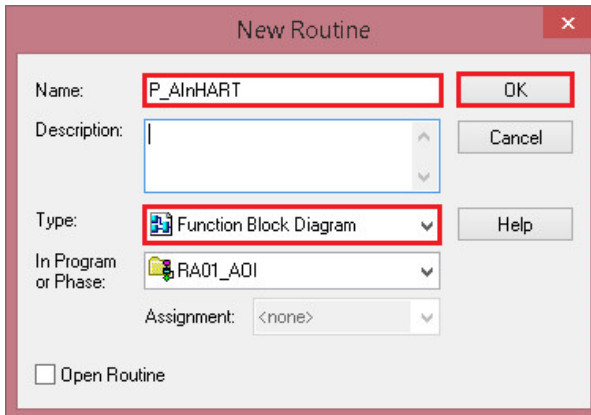


Routine for P_AinHART

- Right-click on the program "RA01_AOI" and select the menu "Add→New Routine...":



- Enter a name and choose the language type:

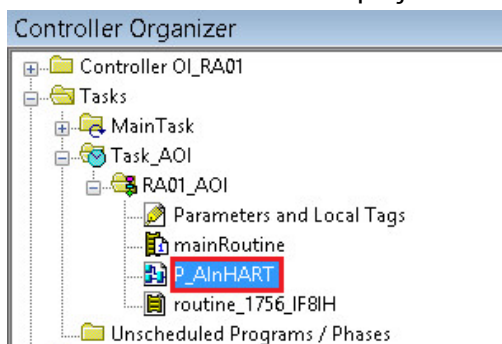


The 'New Routine' dialog box is shown with the following fields and options:

- Name:** P_AlnHART (highlighted with a red box)
- Description:** (empty text box)
- Type:** Function Block Diagram (highlighted with a red box)
- In Program or Phase:** RA01_AOI (highlighted with a red box)
- Assignment:** <none>
- Buttons:** OK, Cancel, Help
- Open Routine:** (unchecked checkbox)

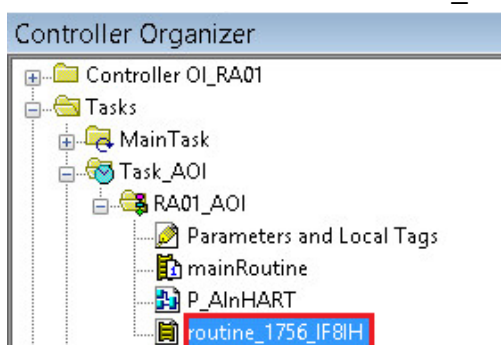
Click on the button "OK".

- This adds the routine in the project view:

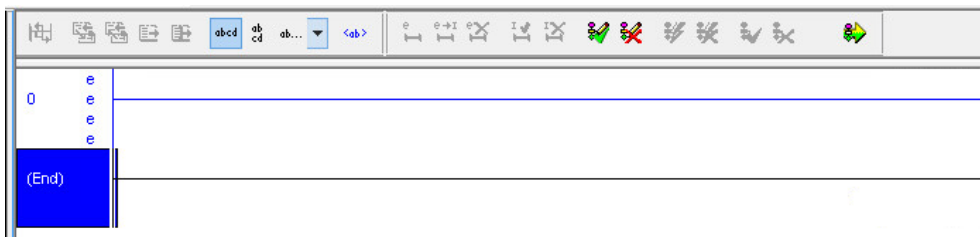


4.1.2.3.2 ControlLogix 1756 IF8IH Routine Configuration

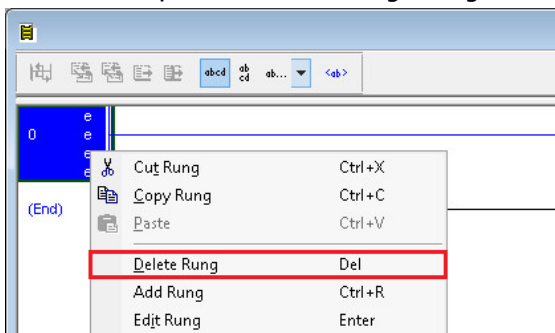
- Double-click on the routine "routine_1756_IF8IH":



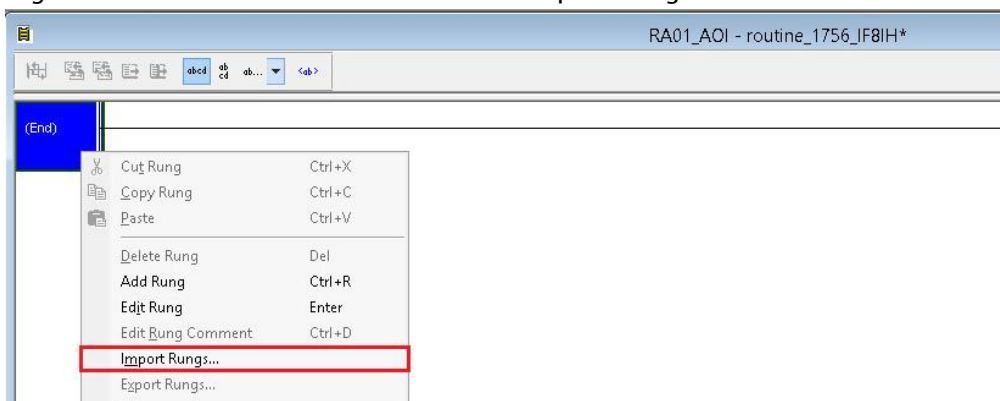
- This opens the Ladder routine “routine_1756_IF8IH”:



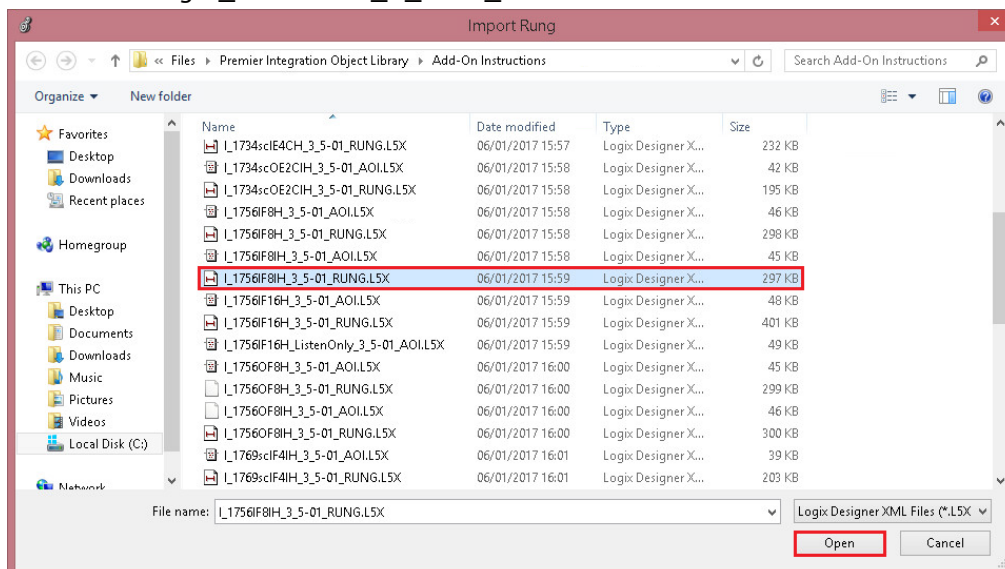
- In this example, delete the rung 0. Right-click on the rung 0 and select the option “Delete”:



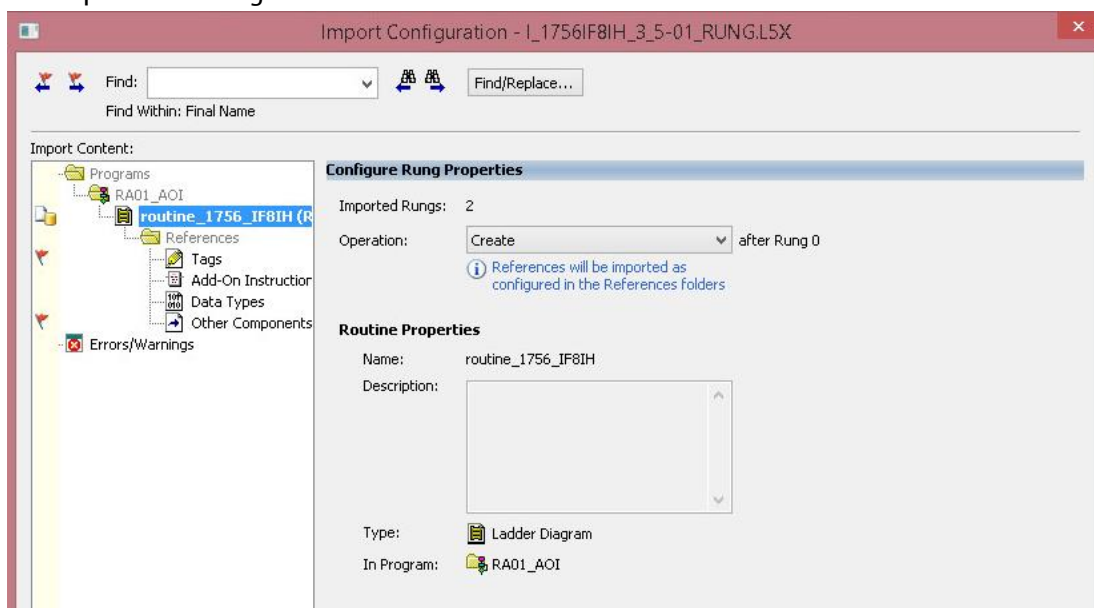
- Right-click on “End” and select the menu “Import Rungs...”:



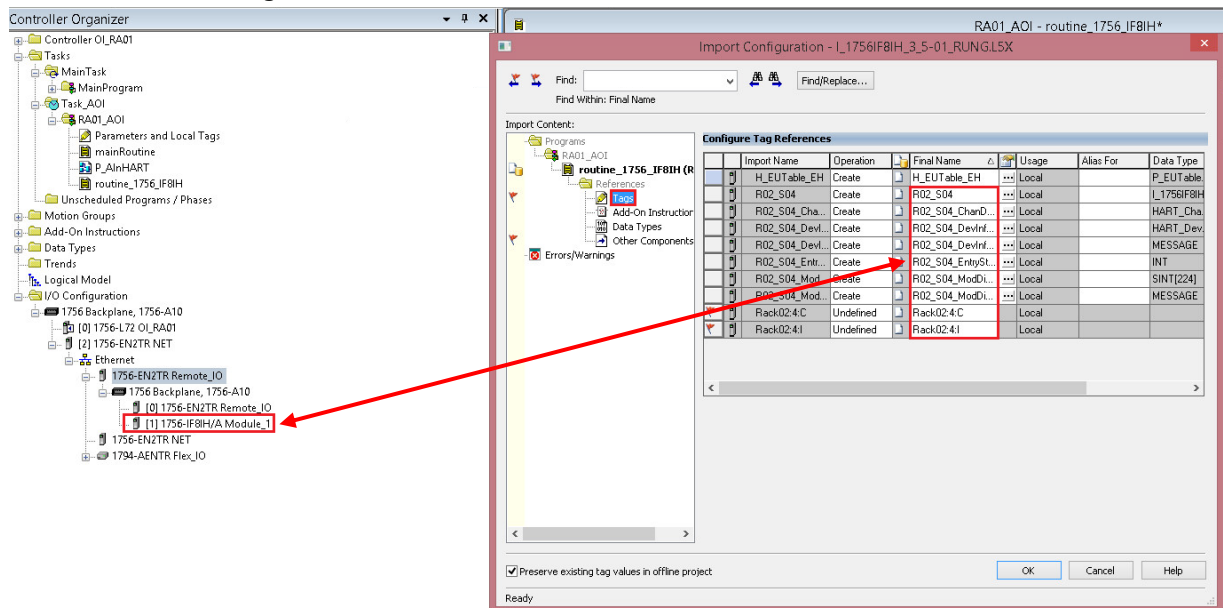
- Select the rung "I_1756IF8IH_3_5-01_RUNG.L5X":



- This opens following window:

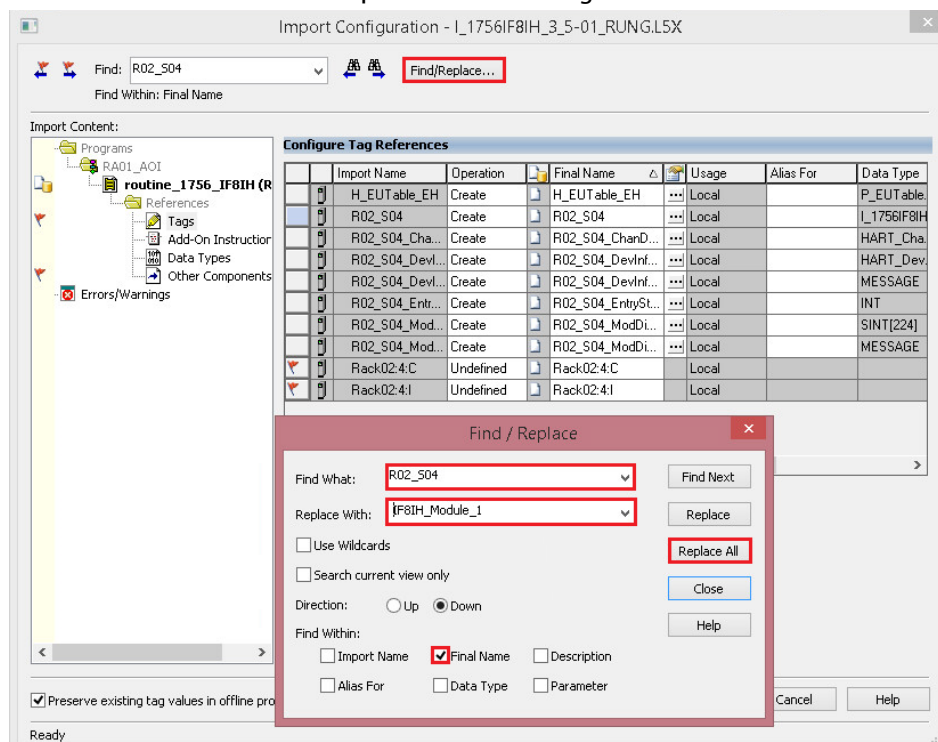


- Click on the field "Tags":

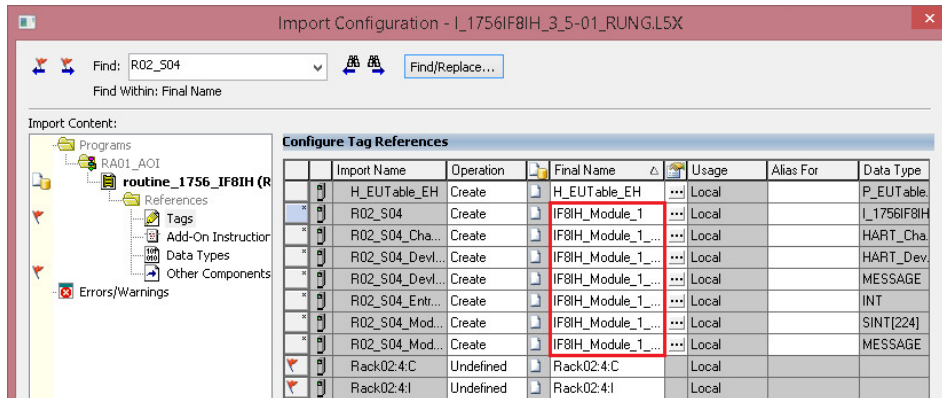


The target now is to change the names of the "Final Name" variables according to the project architecture. In this example, the names will correspond to the card "1756-IF8IH" with Tag "Module_1".

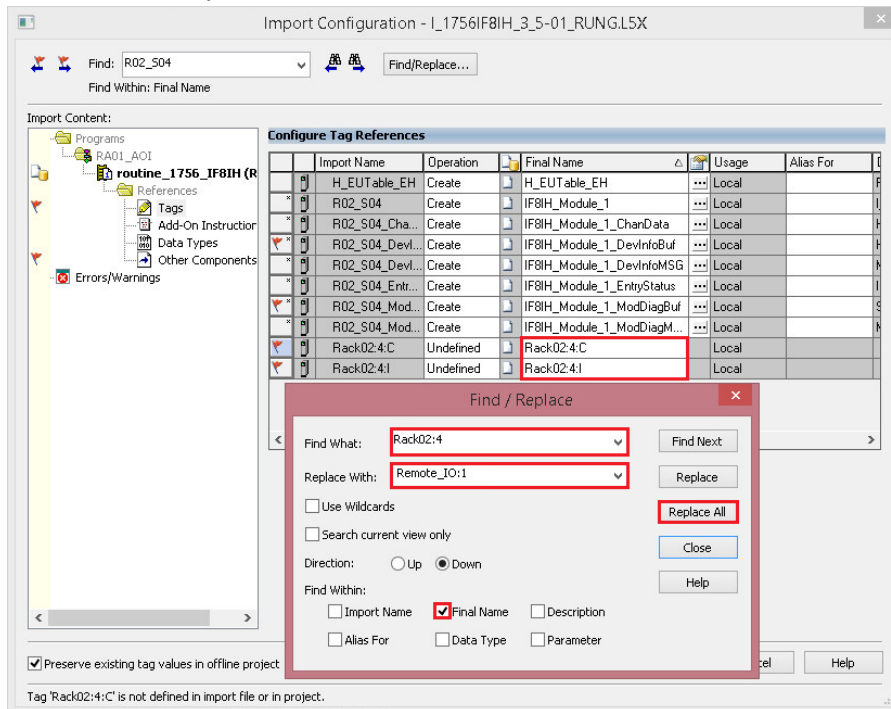
- Click on the button "Find/Replace..." and change the name of all "R02*" variables:



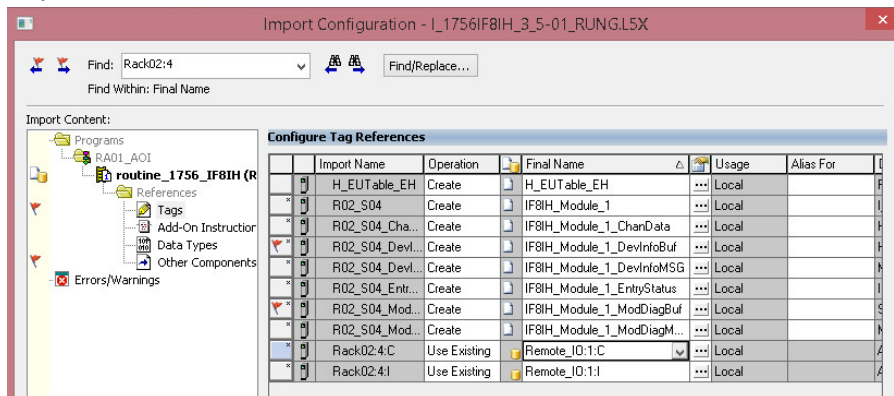
- Replaced data:



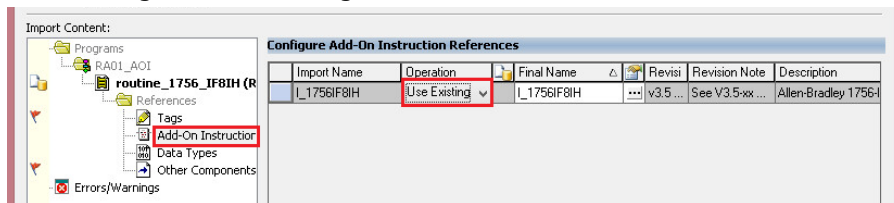
- Click on the button "Find/Replace..." and change the name of all "Rack02:4C" and "Rack02:4I" variables and replace it with "Remote_IO:1":



- Replaced data:

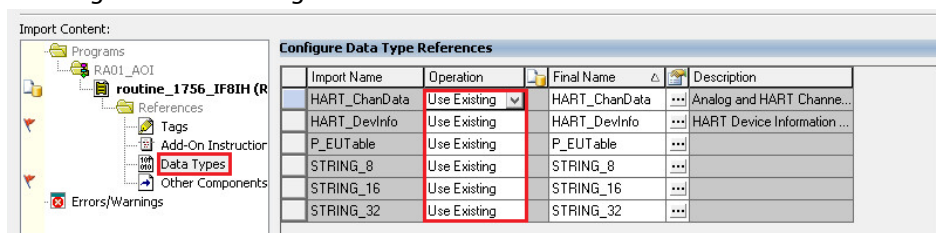


- Select the field "Add On Instruction" and select one Operation option, either "Create" when this is not existing or "Use Existing" or "Overwrite":



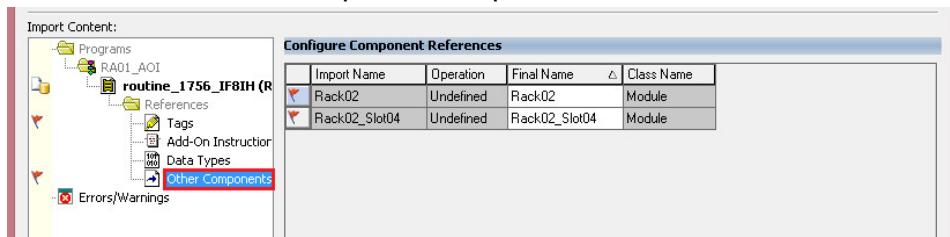
In this example, the option "Use existing" is selected.

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



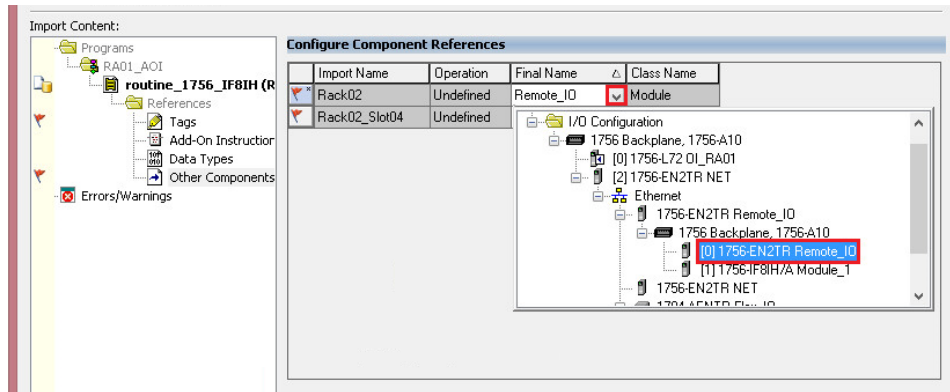
In this example, the option "Use existing" is selected.

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

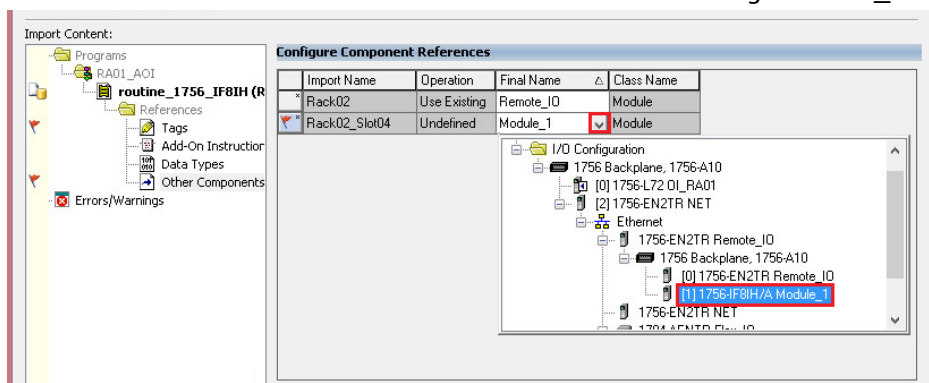


These two references “Rack02” and “Rack 02_Slot04” correspond to the communication module and to the HART analog input module. In our example, these are the cards “1756-EN2TR” (with Tag “Remote_IO” and “1F8IH” (with Tag “Module_1”).

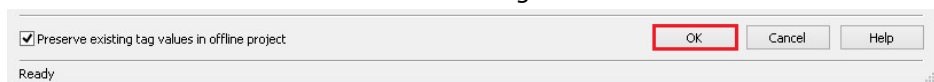
- Click on the list box of the first variable and select the Tag “Remote_IO”:



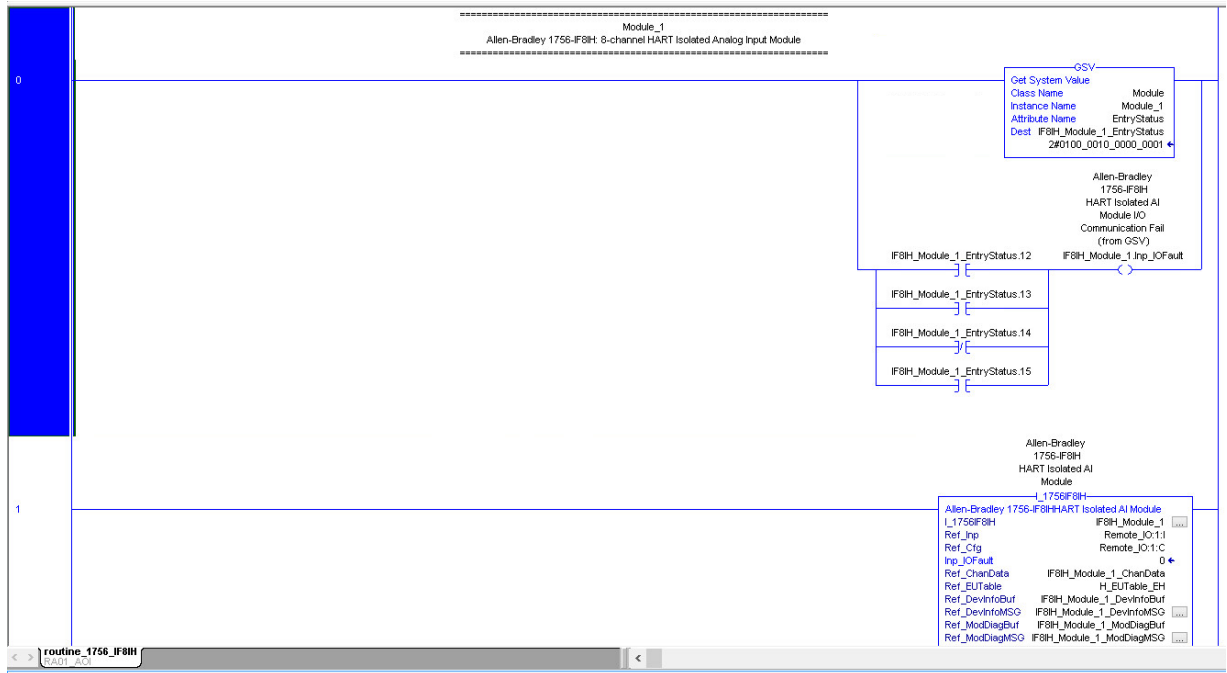
- Click on the list box of the second variable and select the Tag “Module_1”:



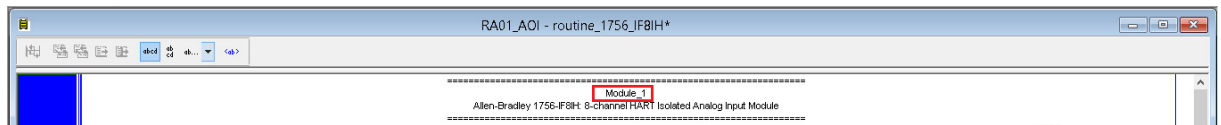
- Click on the button “OK” to save the configuration:



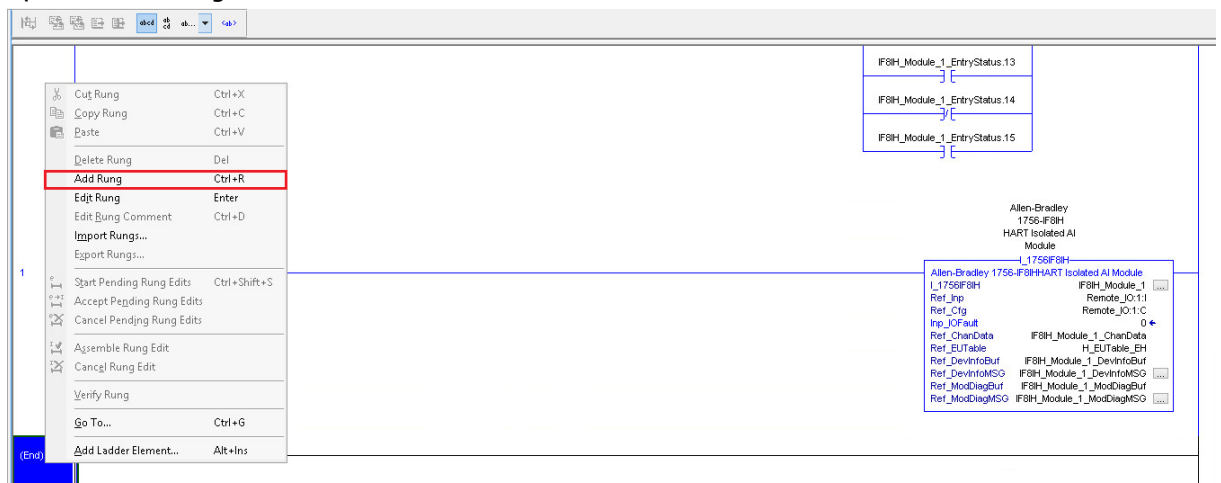
- Rung has been successfully imported in the routine:



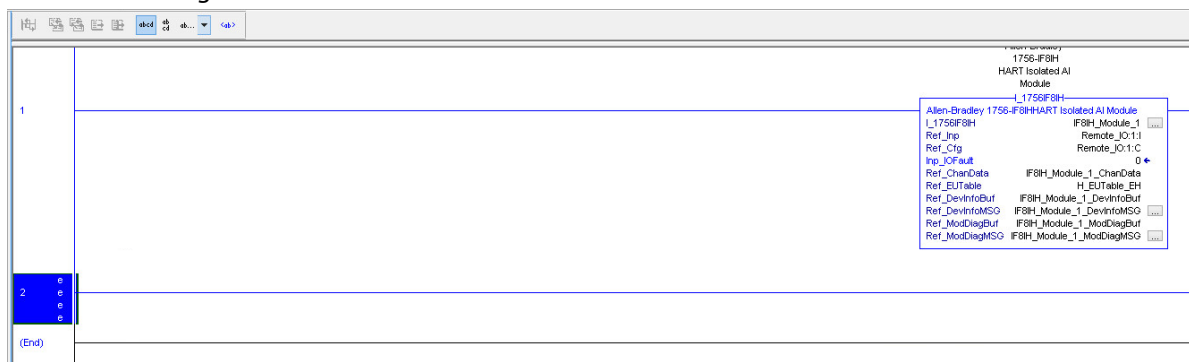
- Change the name as well in the comment of the created routine:



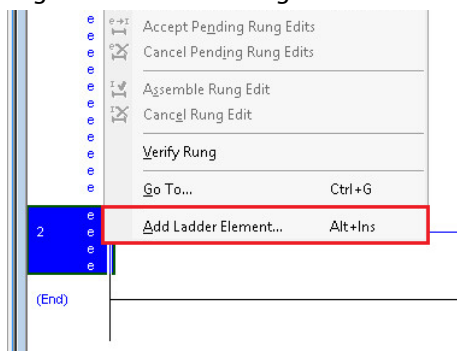
- In the routine "routine_1756_IF8H", scroll down, then right-click on the "End" rung and select the option "Add Rung":



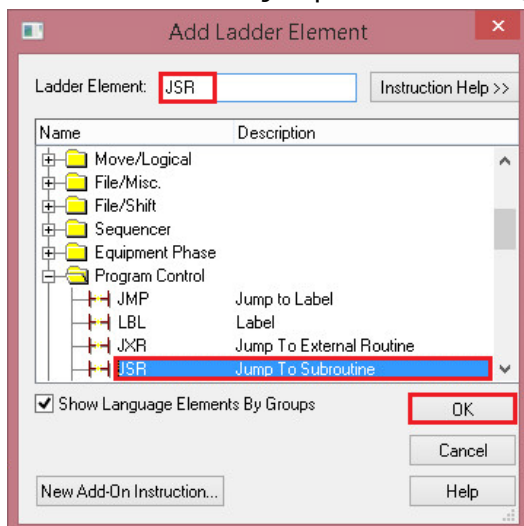
- This insert “rung 2”:



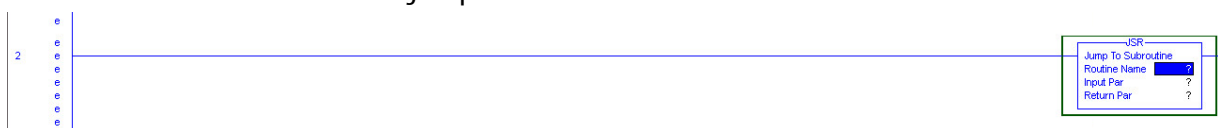
- Right-click on the rung 2 and select the option “Add Ladder Element”:



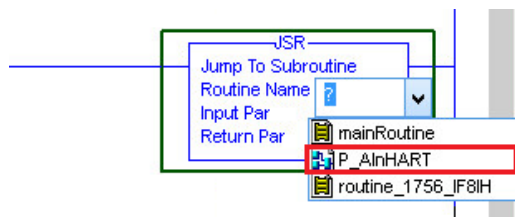
- Search the element “Jump To Subroutine”, select it and click on the button “OK”:



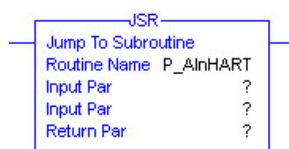
- This inserts the ladder element “Jump To Subroutine”:



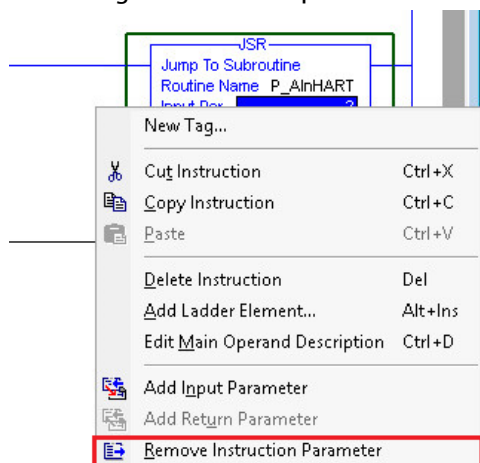
- Select the routine name and choose the routine "P_AlnHART":



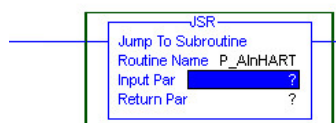
- Subroutine "P_AlnHART" is linked:



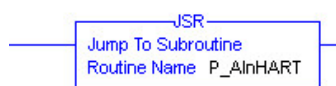
- In this example, the instruction parameters "Input Par" and "Return Par" are not used. Remove them. Right-click on "Input Par" and select the option "Remove Instruction Parameter":



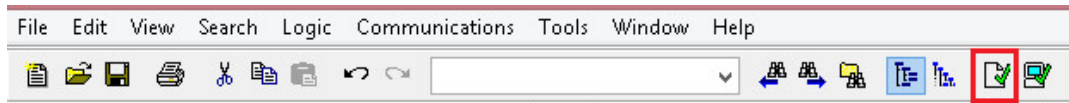
- Instruction parameter "Input Par" has been removed:



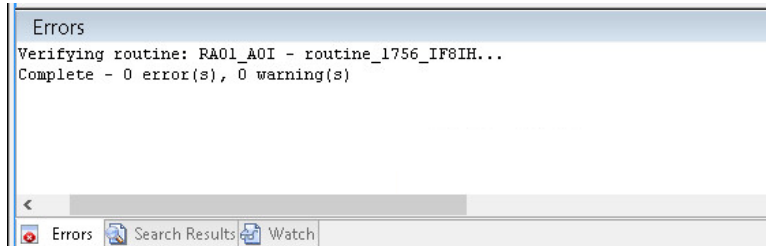
- Removed parameters:



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



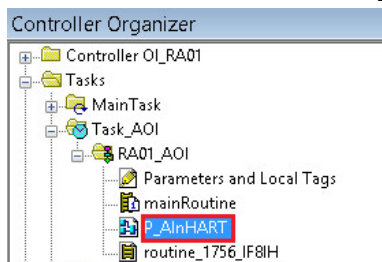
- Check the result in the Error diagnostic window:



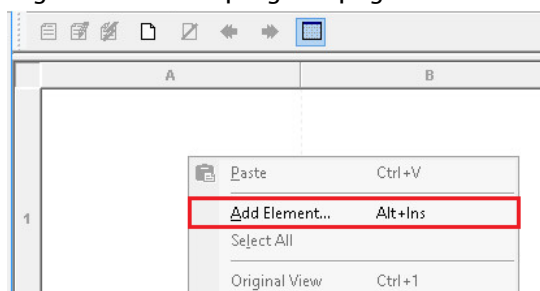
- Close the routine.

4.1.2.3.3 HART Analog Input Routine Configuration

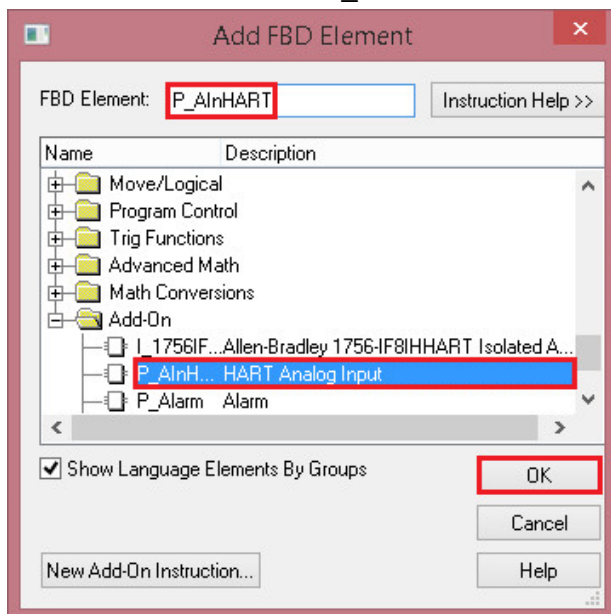
- Double-click on the routine “P_InHART”:



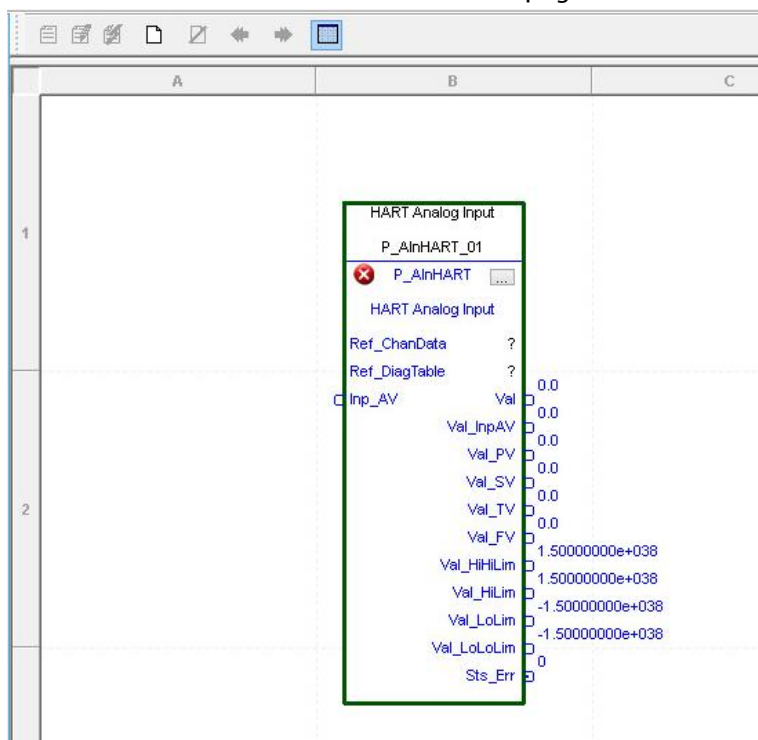
- Right-click in the program page and select the option “Add Element...”:



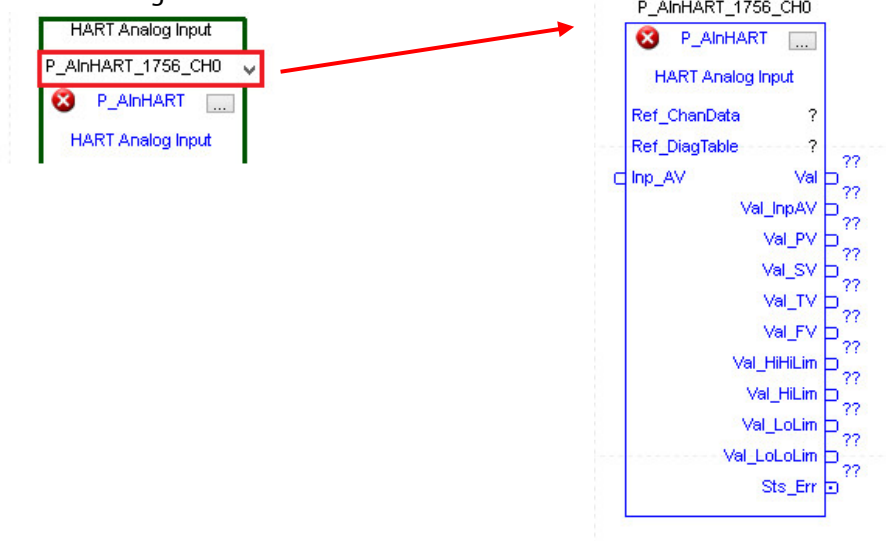
- Search the FBD Element "P_InHART" and click on the button "OK":



- This inserts the function block in the FBD page:

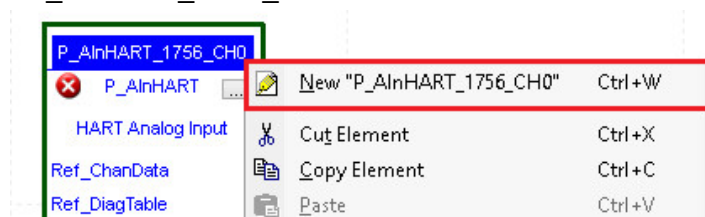


- Update the Tag:

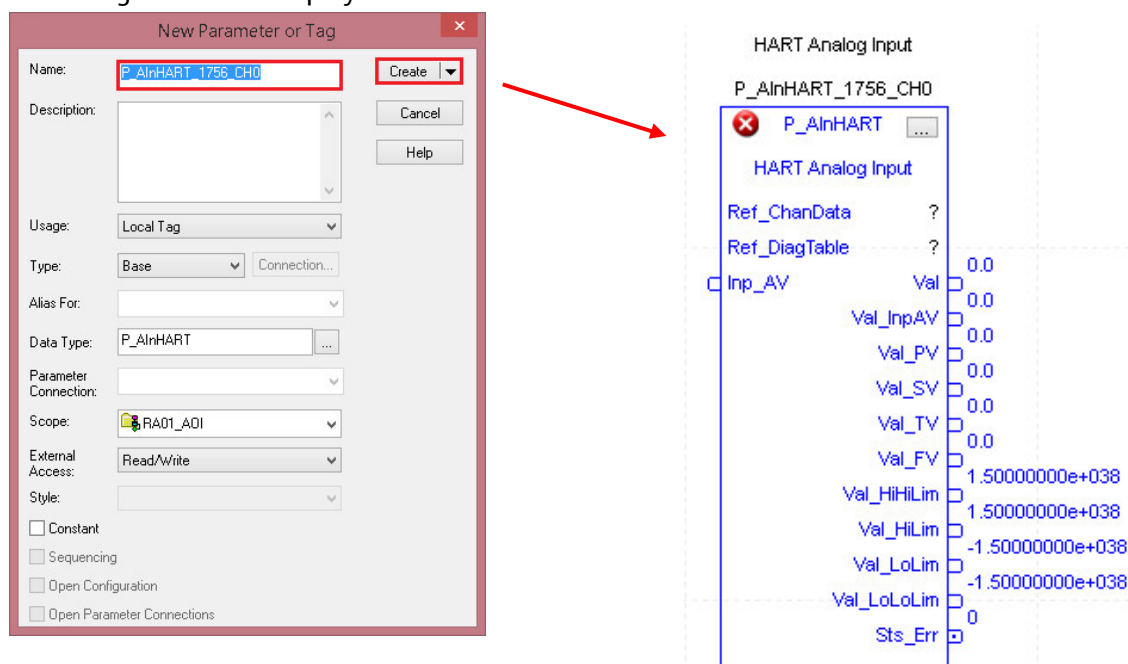


In this example, the Tag name is "P_AlnHART_CH0".

- Right-click on the Tag "P_AlnHART_1756_CH0" and select the menu "New "P_AlnHART_1756_CH0"":

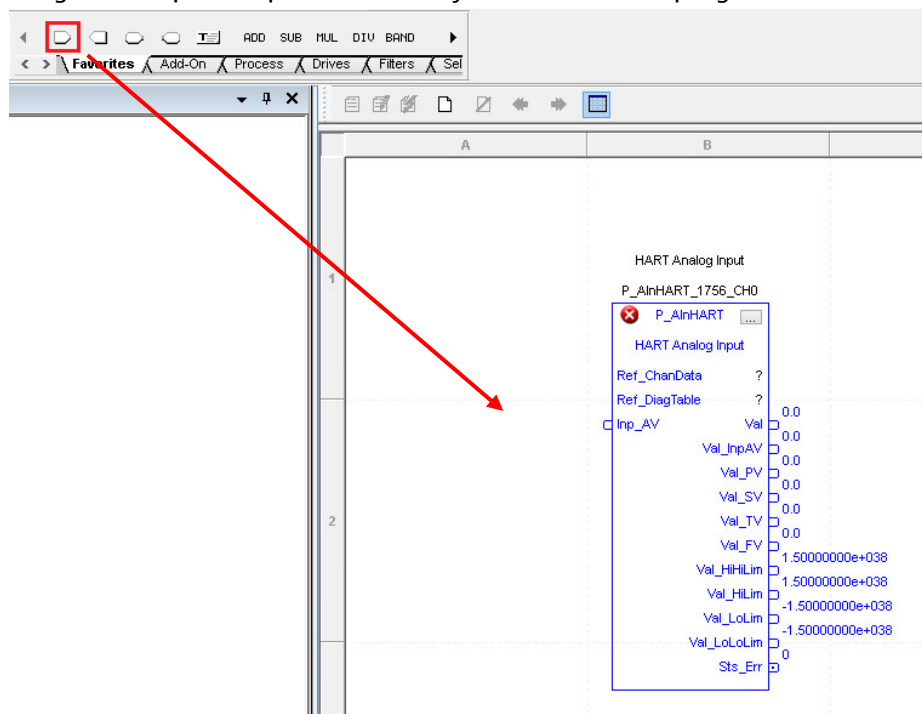


- Following window is displayed:

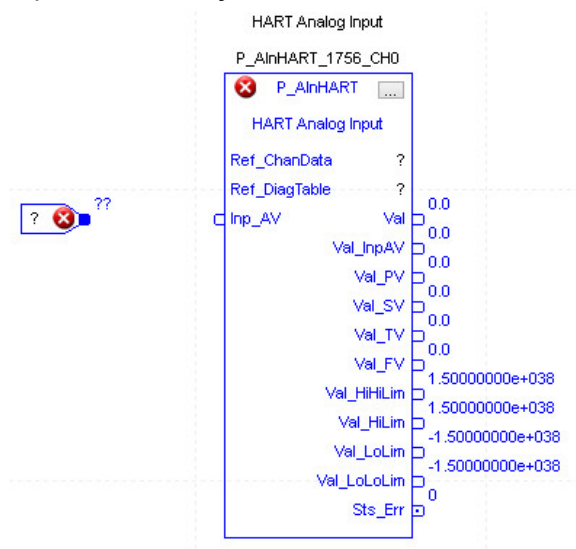


Click on the button "Create".

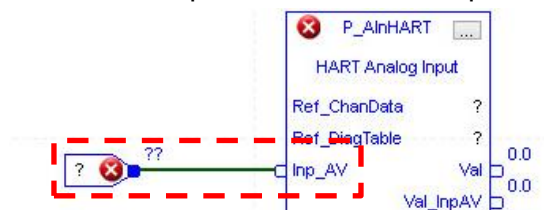
- Drag and drop the Input reference symbol in the FBD program:



- Input reference symbol:



- Connect the Input reference to the Input variable "Inp_AV":



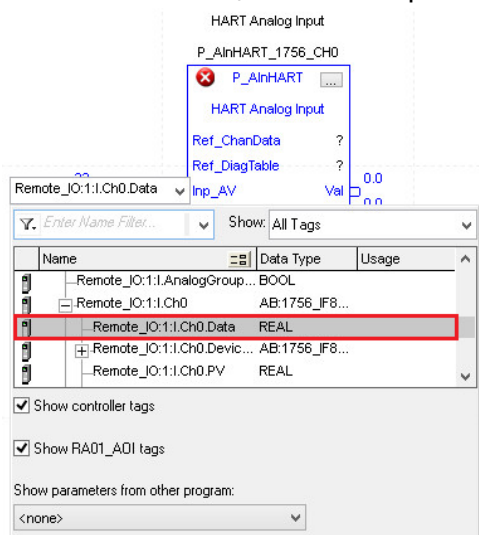
- Double-click on the Input reference symbol:



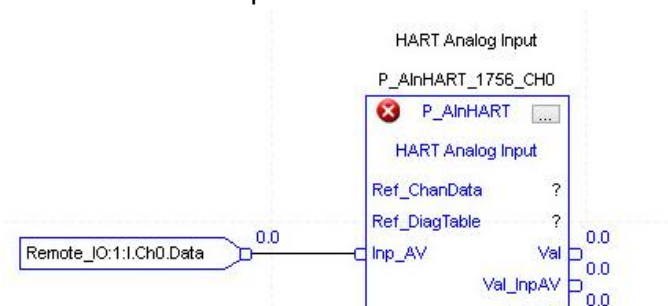
- Open the list box:



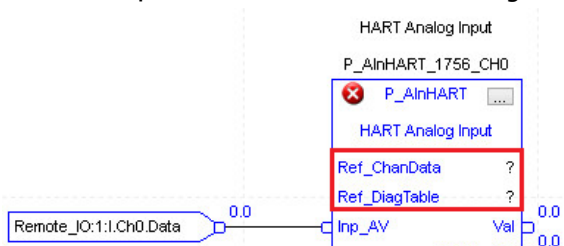
- Then choose the correct input parameter. In this example, **RemoteIO Channel 0 Data** parameter must be connected, which corresponds to the current value:



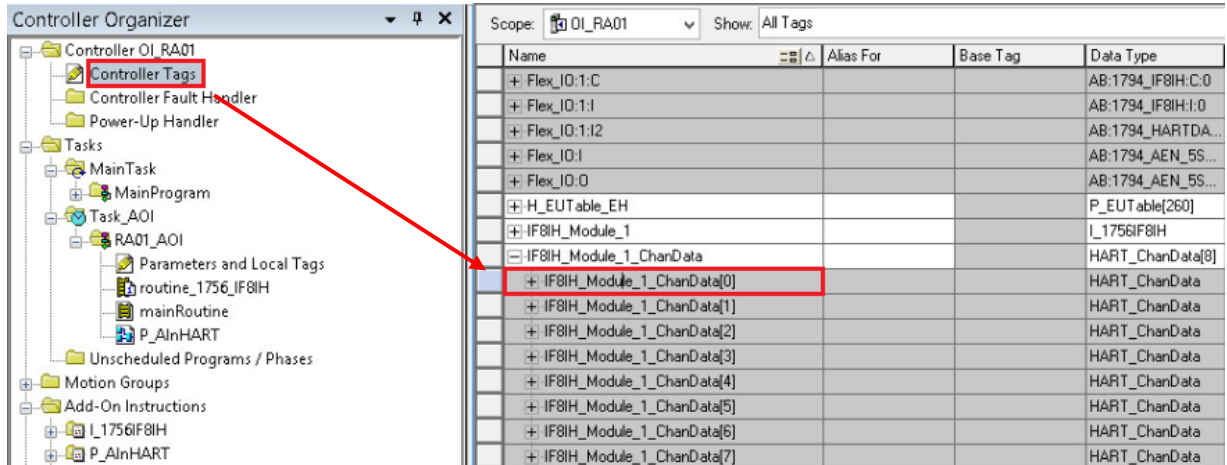
- This connects the input data:



- Two other parameters must still be configured, the "Ref_ChانData" and the "Ref_DiagTable":

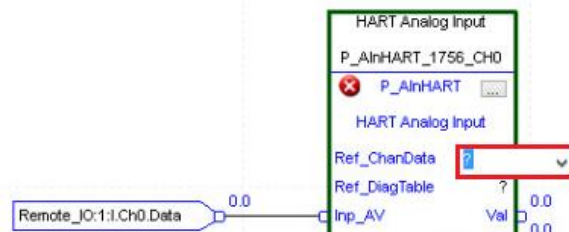


- In this example, the parameter "Ref_ChanData" corresponds to the variable "IF8IH_Module_1_ChanData[0]" in the Controller Tags:

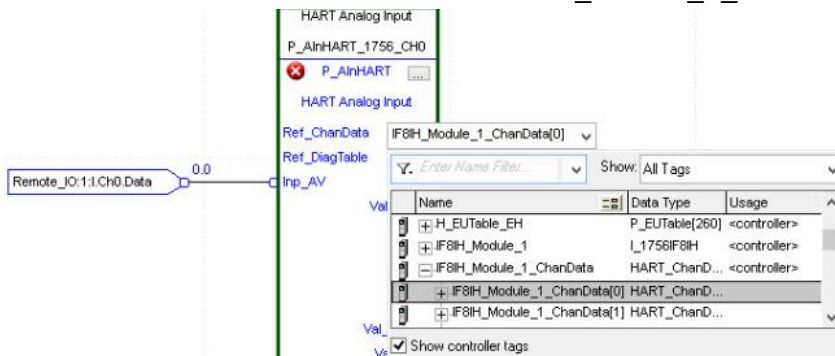


Name	Alias For	Base Tag	Data Type
+ Flex_IO:1:C			AB:1794_IF8IH:C:0
+ Flex_IO:1:I			AB:1794_IF8IH:I:0
+ Flex_IO:1:I2			AB:1794_HARTDA...
+ Flex_IO:I			AB:1794_AEN_5S...
+ Flex_IO:O			AB:1794_AEN_5S...
+ H_EUTable_EH			P_EUTable[260]
+ IF8IH_Module_1			I_1756IF8IH
+ IF8IH_Module_1_ChanData			HART_ChanData[8]
+ IF8IH_Module_1_ChanData[0]			HART_ChanData
+ IF8IH_Module_1_ChanData[1]			HART_ChanData
+ IF8IH_Module_1_ChanData[2]			HART_ChanData
+ IF8IH_Module_1_ChanData[3]			HART_ChanData
+ IF8IH_Module_1_ChanData[4]			HART_ChanData
+ IF8IH_Module_1_ChanData[5]			HART_ChanData
+ IF8IH_Module_1_ChanData[6]			HART_ChanData
+ IF8IH_Module_1_ChanData[7]			HART_ChanData

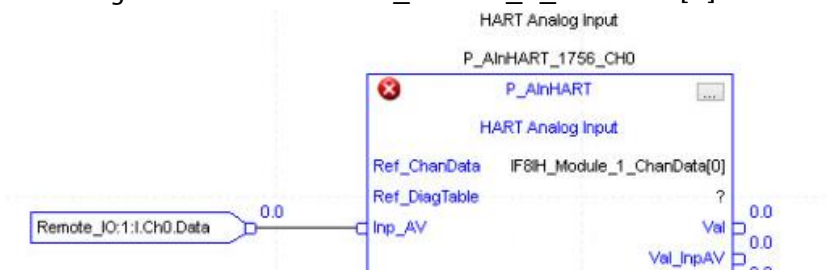
- Double-click on Ref_ChanData "?":



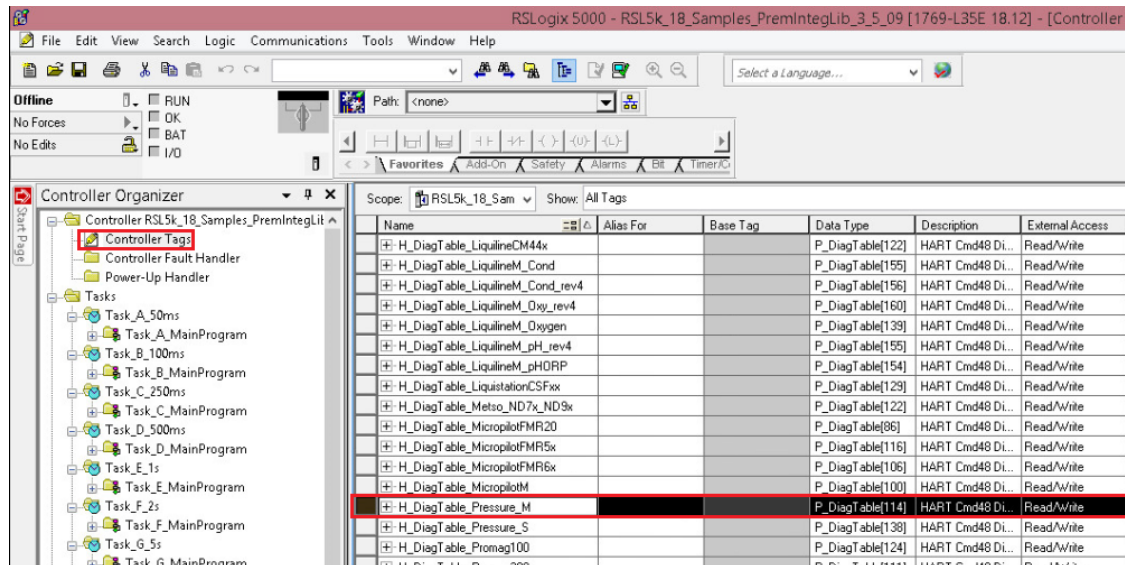
- Search and double-click on the variable "IF8IH_Module_1_ChanData[0]":



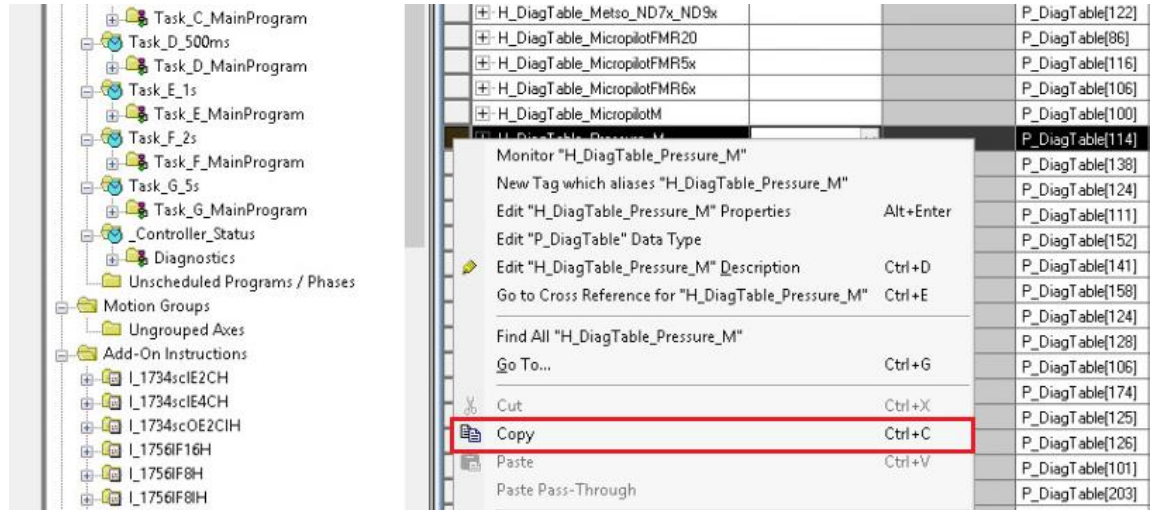
- This assigns the variable "IF8IH_Module_1_ChanData[0]":



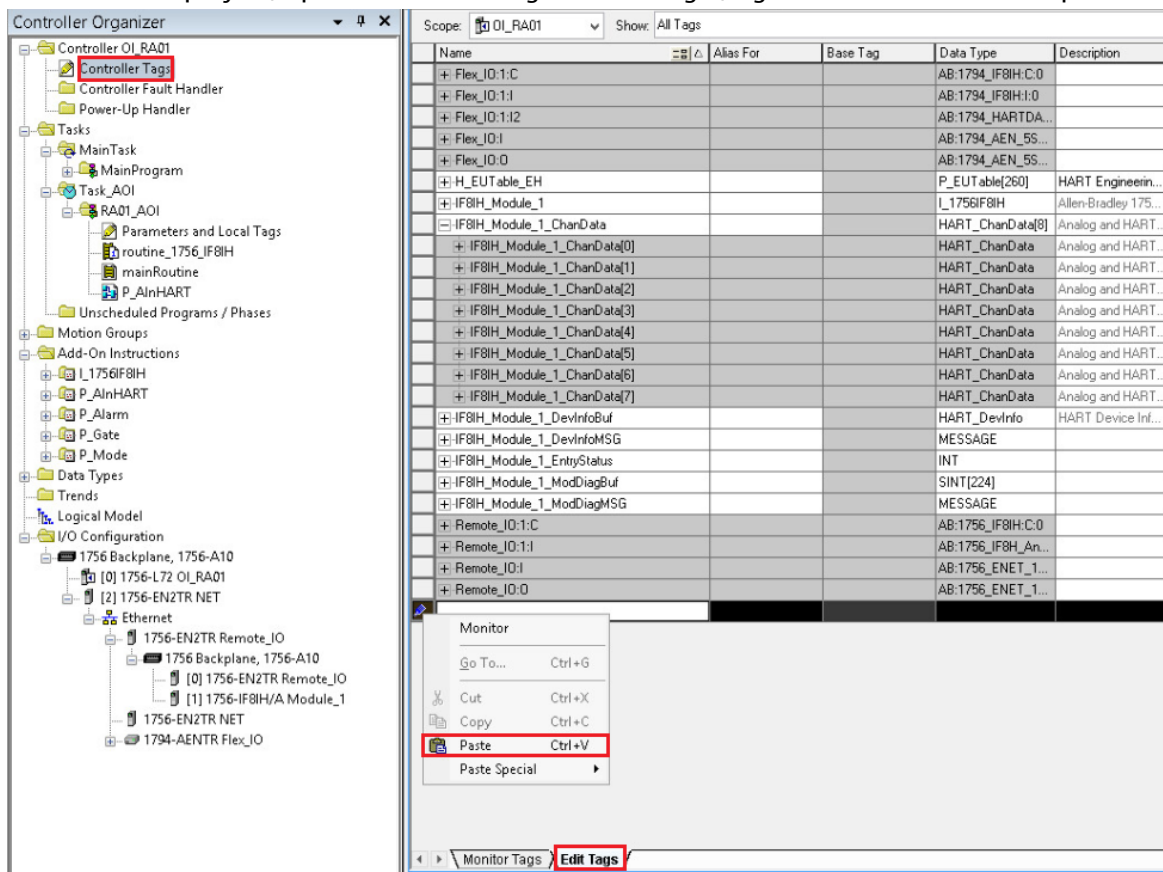
- The parameter "Ref_DiagTable" must be connected as well. A specific diagnostic table for HART devices already exists for Endress+Hauser devices and can be imported from the sample project of the Process Library. Open the Controller Tags of the sample project and select the HART diagnostic table Pressure 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:

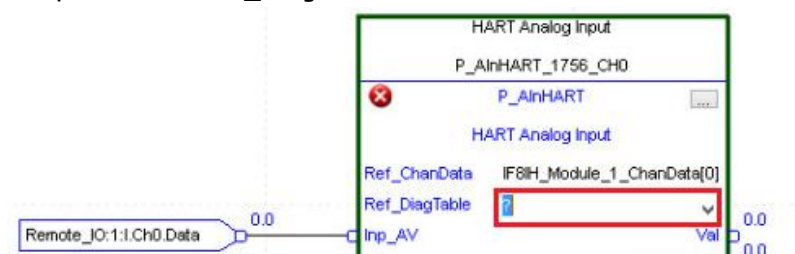


The screenshot shows the Rockwell Studio interface. On the left, the 'Controller Organizer' tree is visible, with 'Controller Tags' highlighted. On the right, the 'Edit Tags' dialog is open, showing a list of tags. The 'Monitor' button is highlighted in the dialog. Below the dialog, the 'Monitor Tags' tab is selected, and the 'Edit Tags' button is highlighted.

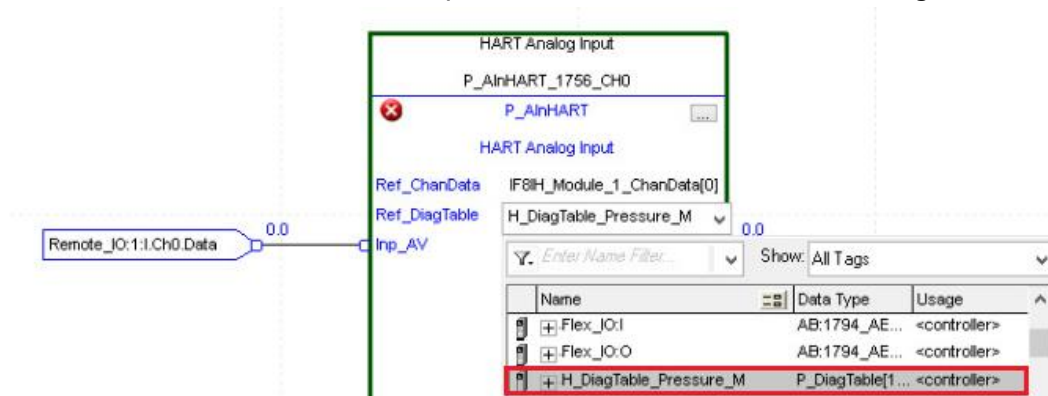
- “H_DiagTable_Pressure_M” is successfully imported:

+ Remote_IO:1			AB:1756_ENET_1...	Read/Write	<input type="checkbox"/>
+ Remote_IO:0			AB:1756_ENET_1...	Read/Write	<input type="checkbox"/>
+ H_DiagTable_Pressure_M			P_DiagTable[114]	HART Cmd48 Dia...	<input type="checkbox"/>

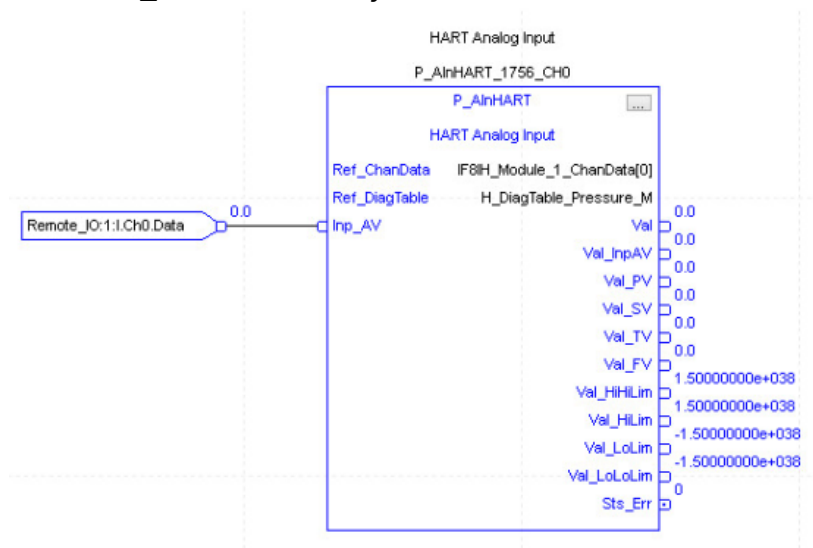
- In the routine “P_InHART”, this table can now be assigned to the function block. Double-click on the parameter “Ref_DiagTable”:



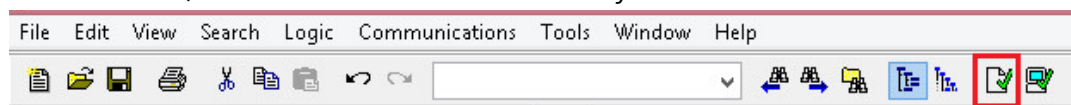
- Select the Endress+Hauser device specific HART Pressure M table "H_DiagTable_Pressure_M":



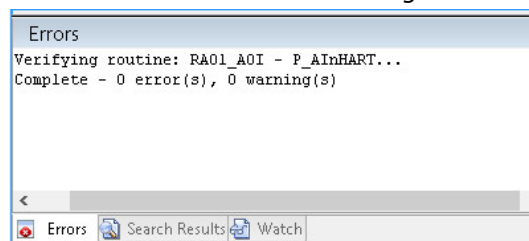
- Routine "P_AInHART" is ready:



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



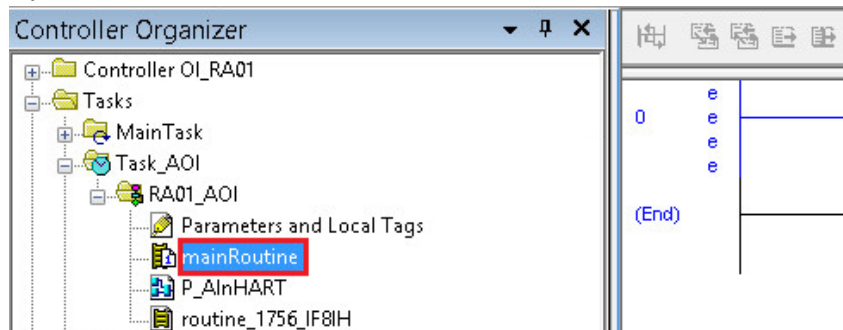
- Check the result in the Error diagnostic window:



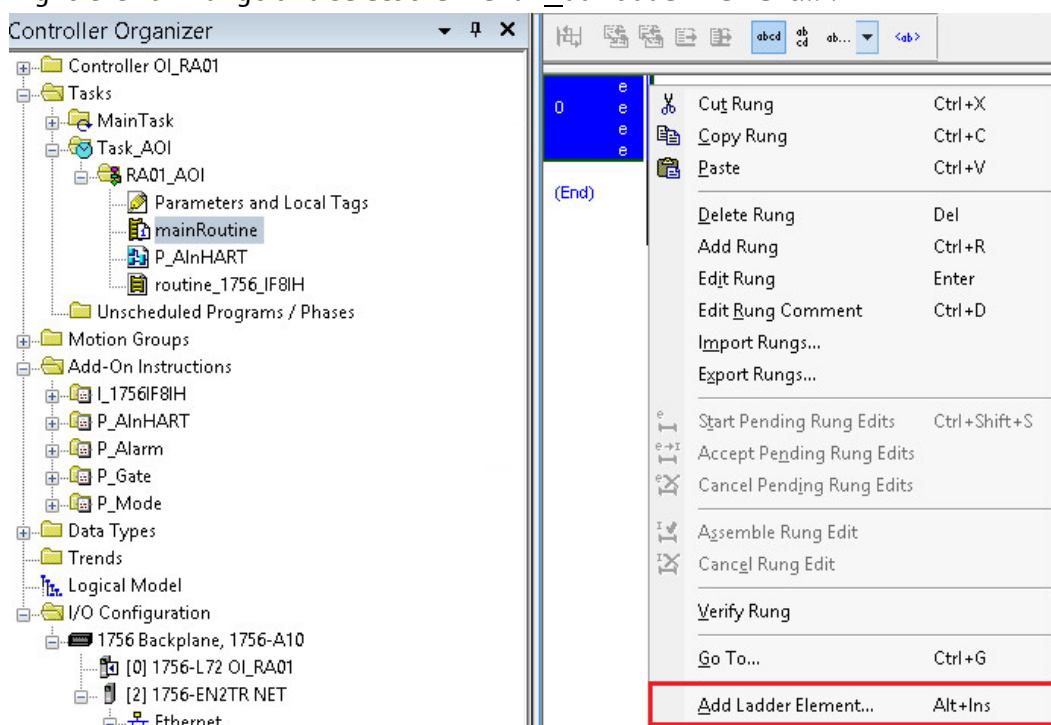
- Close the routine.

4.1.2.3.4 Main Routine Sequence

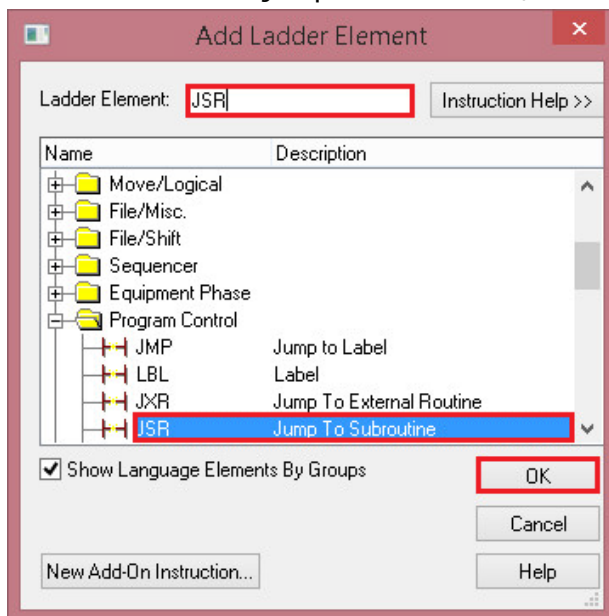
- Open the routine "mainRoutine":



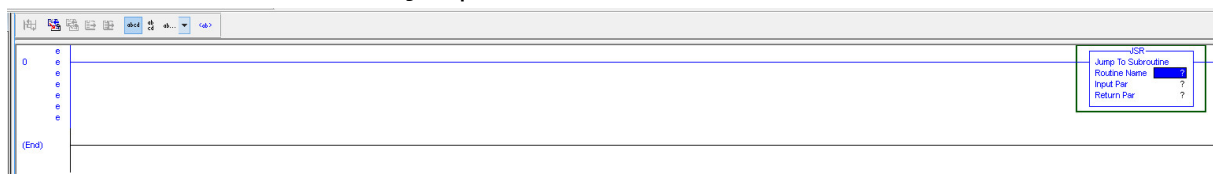
- Right-click on Rung0 and select the menu "Add Ladder Element...":



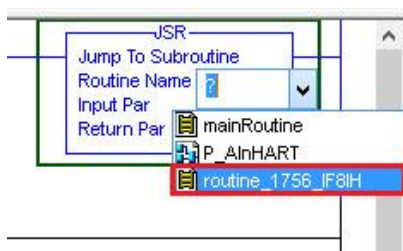
- Search the element "Jump To Subroutine", select it and click on the button "OK":



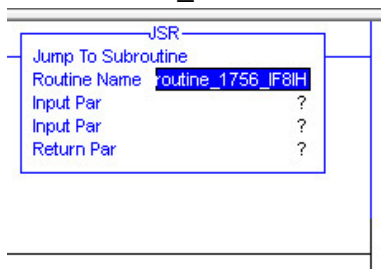
- This inserts the ladder element "Jump To Subroutine":



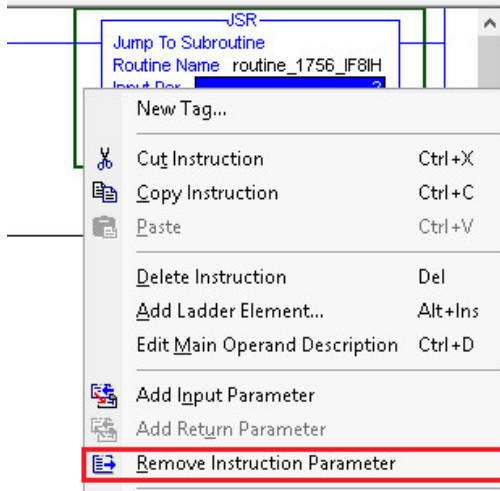
- Select the routine name and choose the routine "routine_1756_IF8IH":



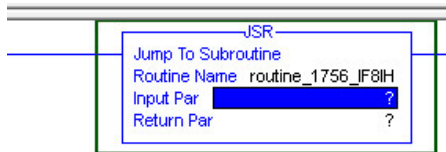
- Subroutine "P_AlnHART" is linked:



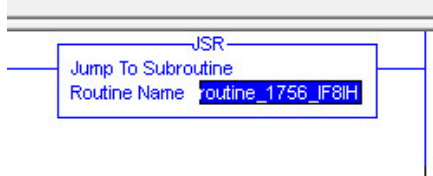
- In this example, the instruction parameters "Input Par" and "Return Par" are not used. Remove them. Right-click on "Input Par" and select the option "Remove Instruction Parameter":



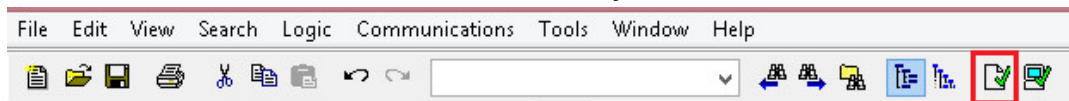
- Instruction parameter "Input Par" has been removed:



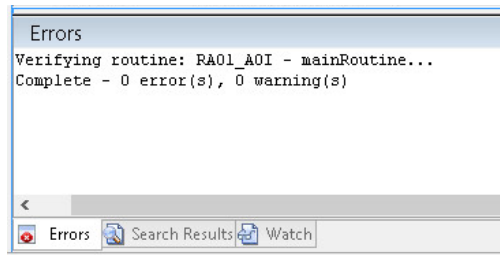
- Remove the parameters as well "Input Par" and "Return Par":



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



- Check the result in the Error diagnostic window:



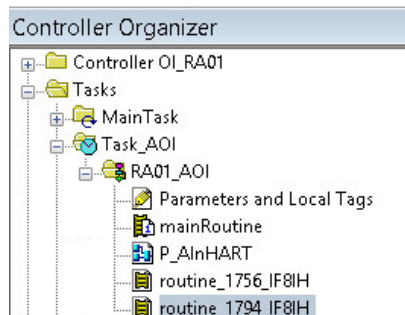
- Close the routine.

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

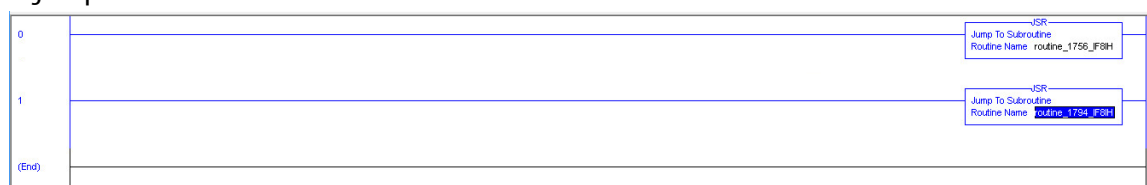
- A new ladder routine is created:



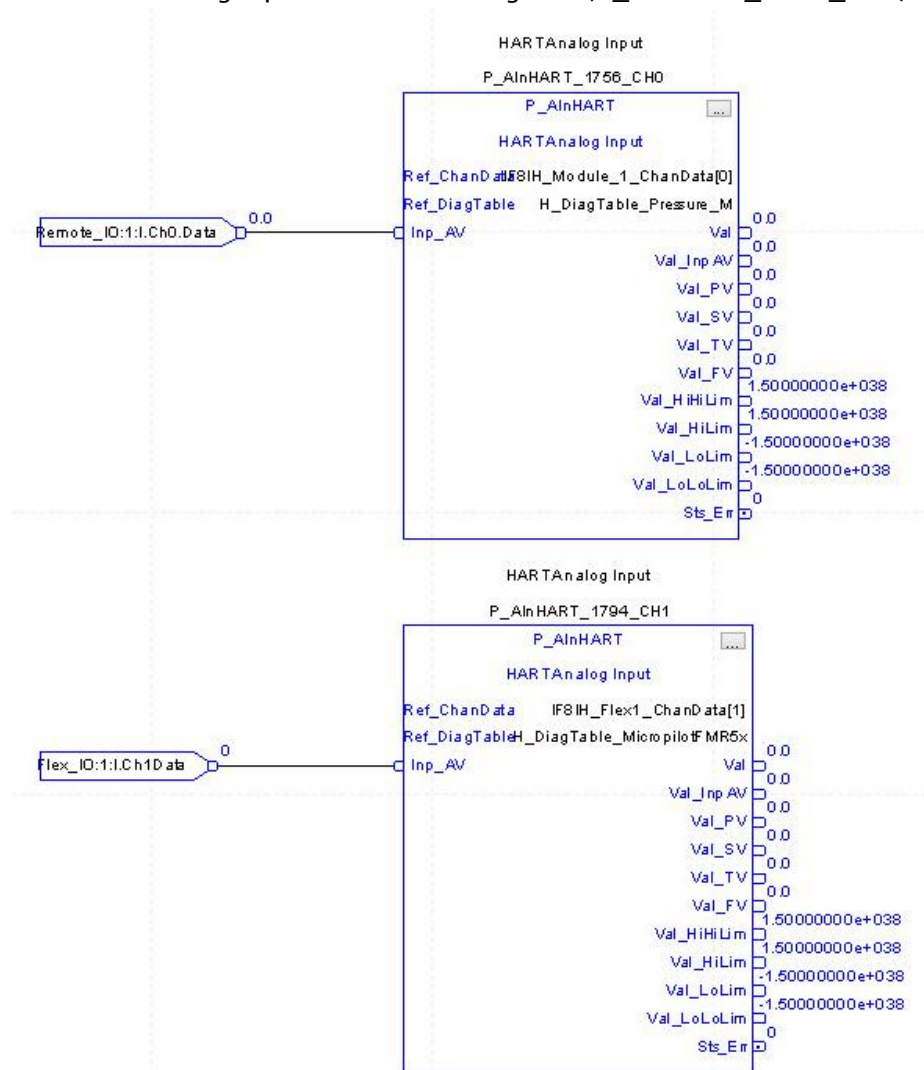
- Its corresponding rung is imported from the Rockwell Library with a Jump subroutine to the configured HART analog input:



- A Jump subroutine is added in the main routine:



- The HART Analog Input channel is configured (P_AlnHART_1794_CH1):



- In this example, the instance names "P_AlnHART_1756_CH0" is used to connect the corresponding faceplate. Refer to chapter 4.2.4.

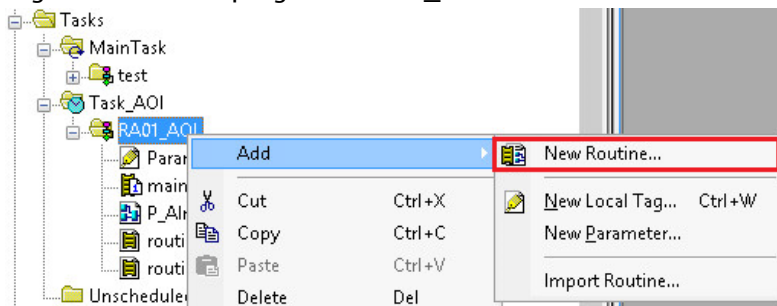
4.1.4 AOI Integration for EtherNet/IP devices

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

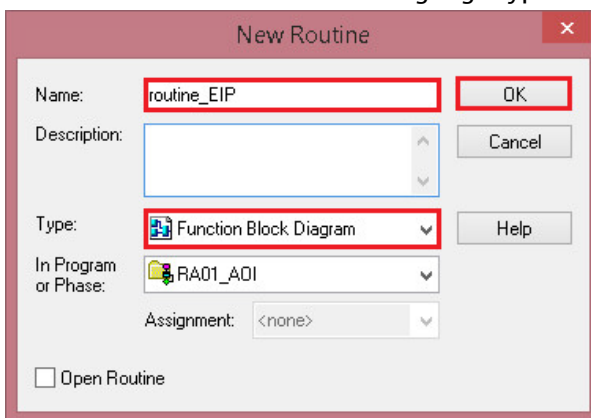
- Flow devices are using the AOI "I_EH_Flowmeter" in combination with an Endress+Hauser device specific AOI.
- Another device like Liquiline is using the AOI "I_EH_Sensor".

4.1.4.1 AOI for Flow device

- Right-click on the program "RA01_AOI" and select the menu "Add→New Routine...":



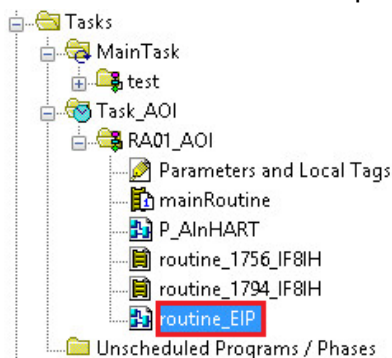
- Enter a name and choose the language type:



In this example, the routine name is "routine_EIP" and the selected language is "Function Block Diagram".

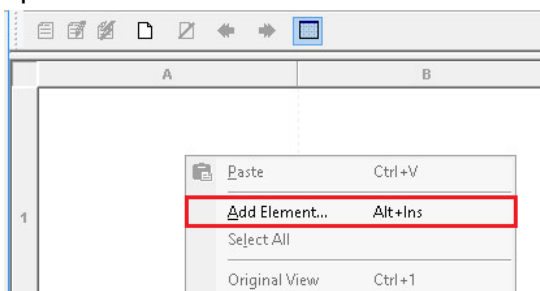
Click on the button "OK".

- This adds the routine in the project view:

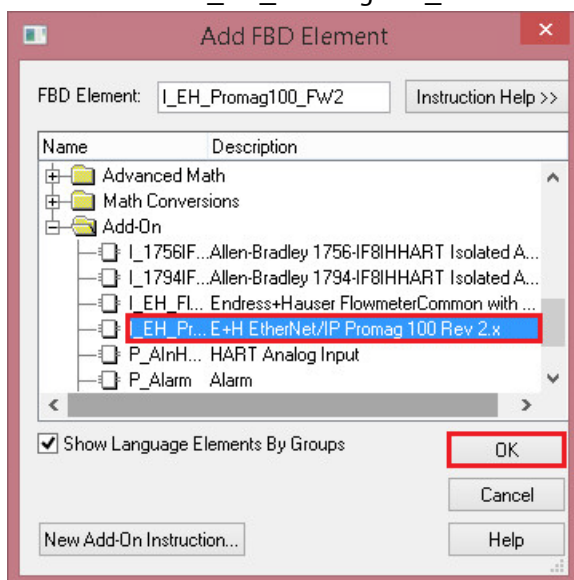


Device Specific AOI

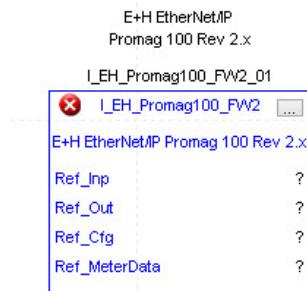
- Double-click on the routine "routine_EIP" and right-click in the opened program page. Select the option "Add Element...":



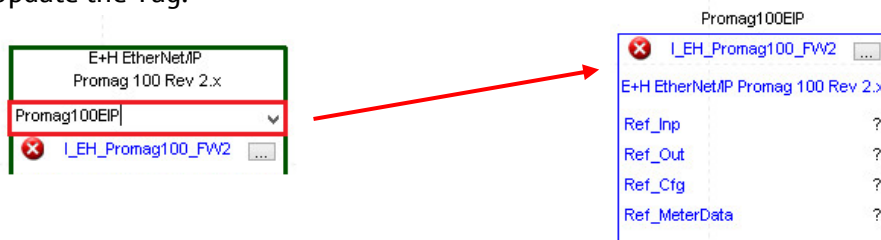
- Select the AOI "I_EH_Promag100_FW2" and click on the button "OK":



- This inserts the function block in the FBD page:

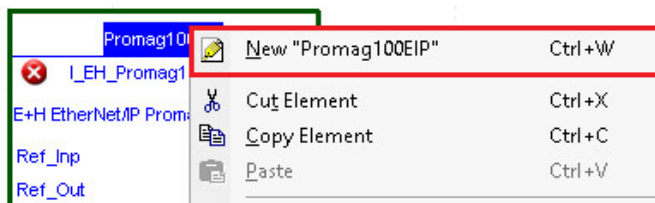


- Update the Tag:

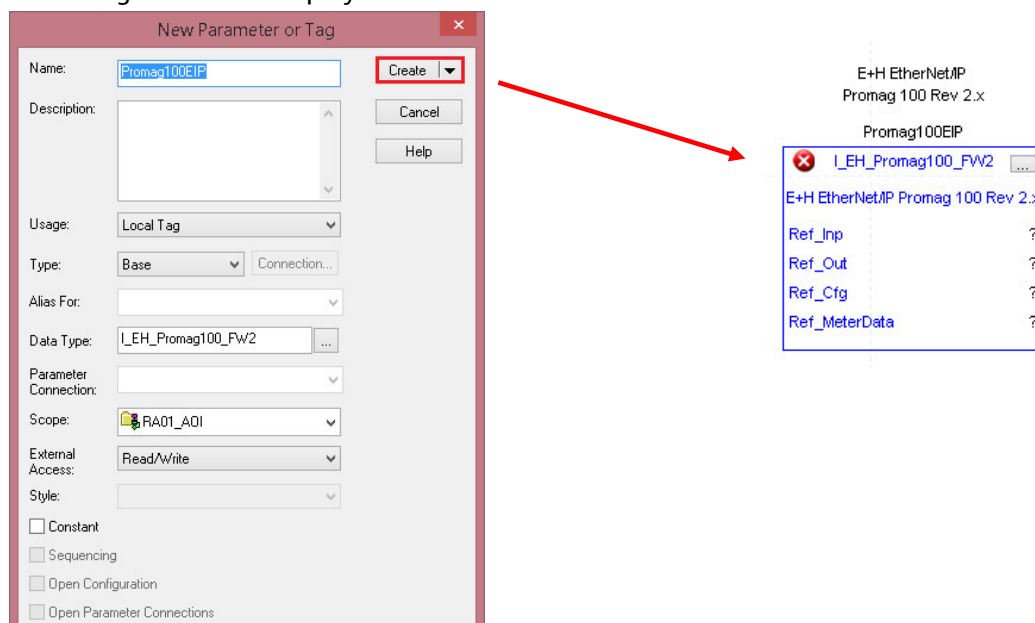


In this example, the Tag name is "Promag100EIP".

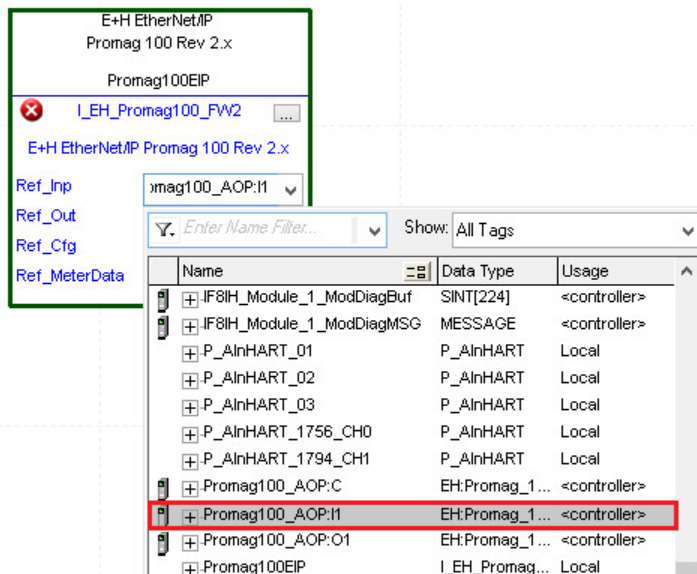
- Right-click on the Tag "Promag100EIP" and select the menu "New "Promag100EIP"":



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

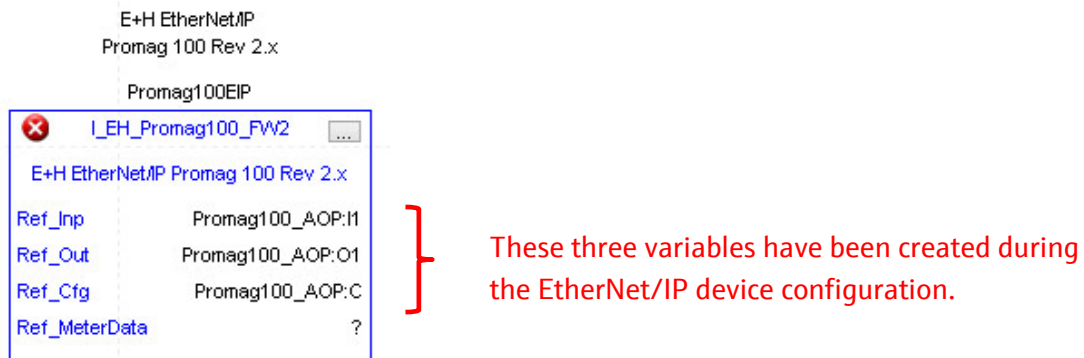


- Double-click on "?" of parameter "Ref_Input" to select the reference input variable:

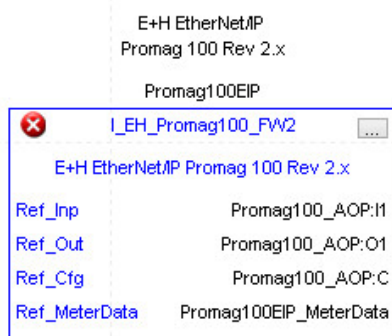


In this example, select the Promag100_AOP:I1.

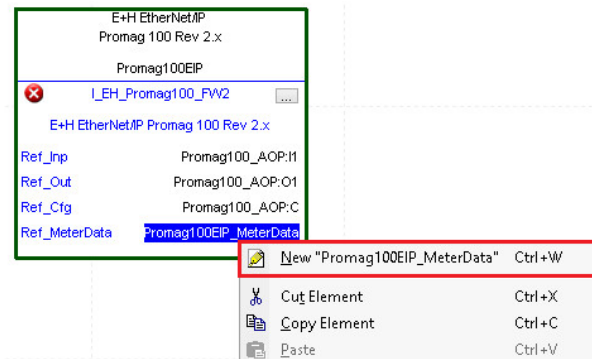
- Assign the other parameters as well:



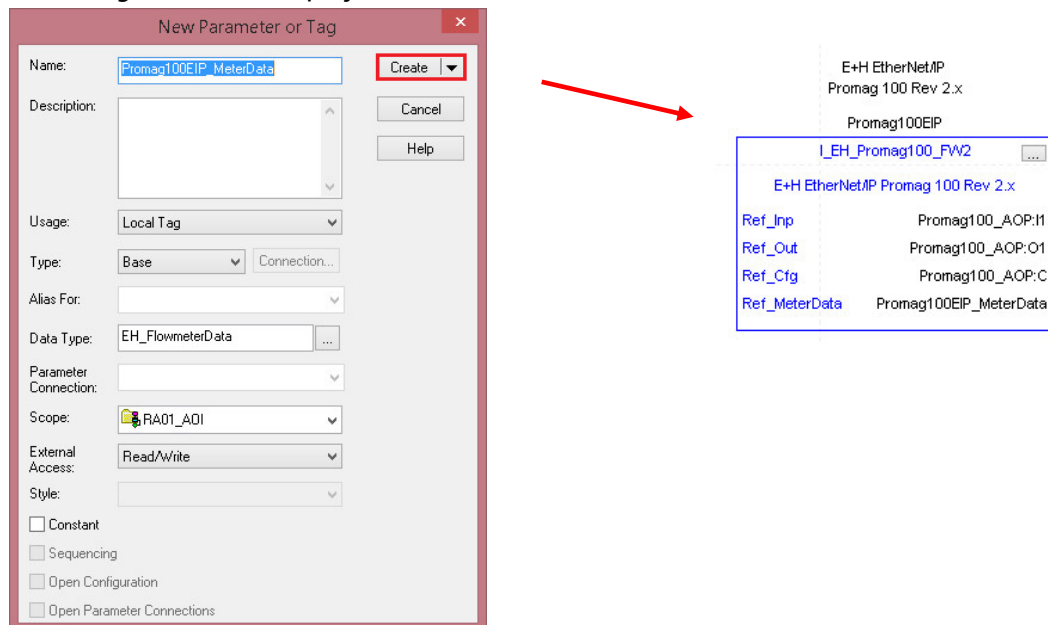
- The last parameter "Ref_MeterData" must be created at first. Enter for example the variable name "Promag100EIP_MeterData":



- Right-click on this parameter and select the option "New "Promag100EIP_MeterData"":

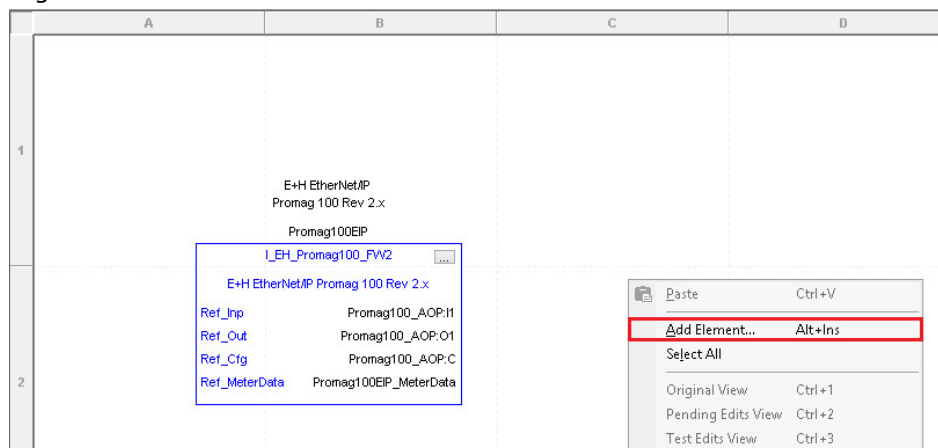


- Following window is displayed. Click on the button "Create":

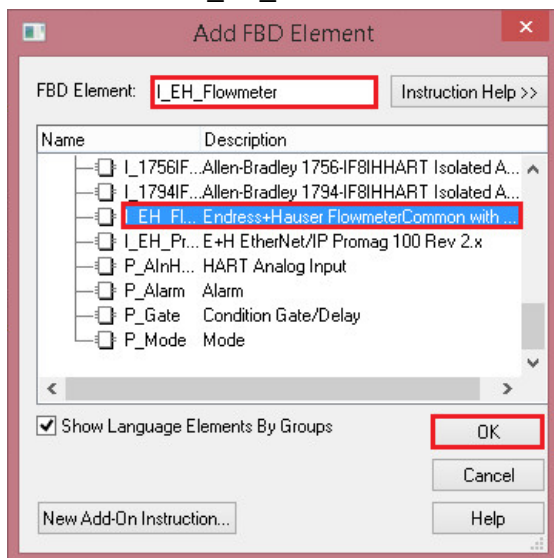


Flow device AOI

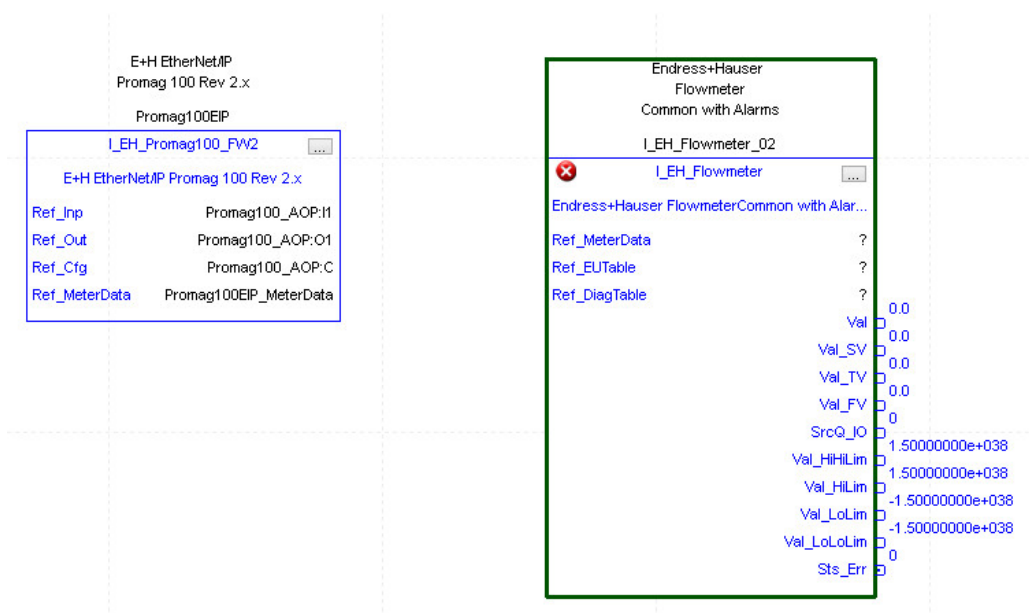
- Right-click in the routine to add another function block:



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

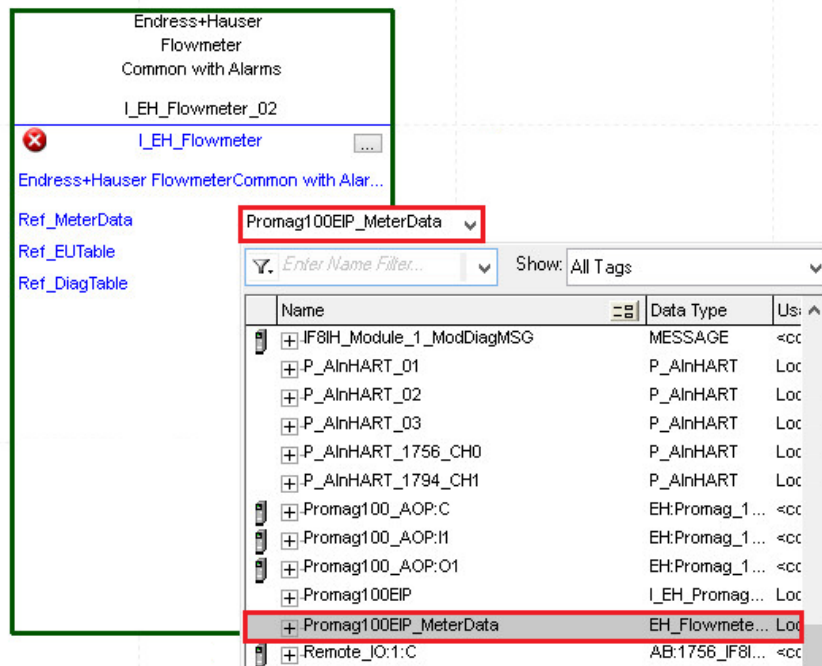


- This inserts the function block in the routine:

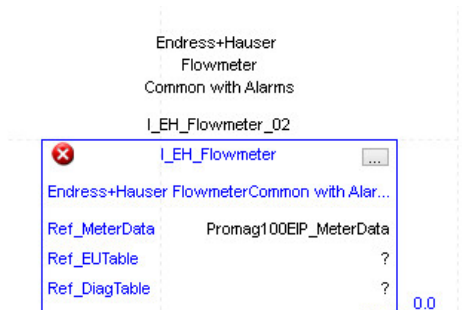


- In this example, the instance name “I_EH_Flowmeter_02” is used to connect the faceplate. Refer to chapter 4.2.5.

- Double-click on “?” of parameter “Ref_MeterData” and assign the variable “Promag100EIP_MeterData”:



- Variable is assigned:



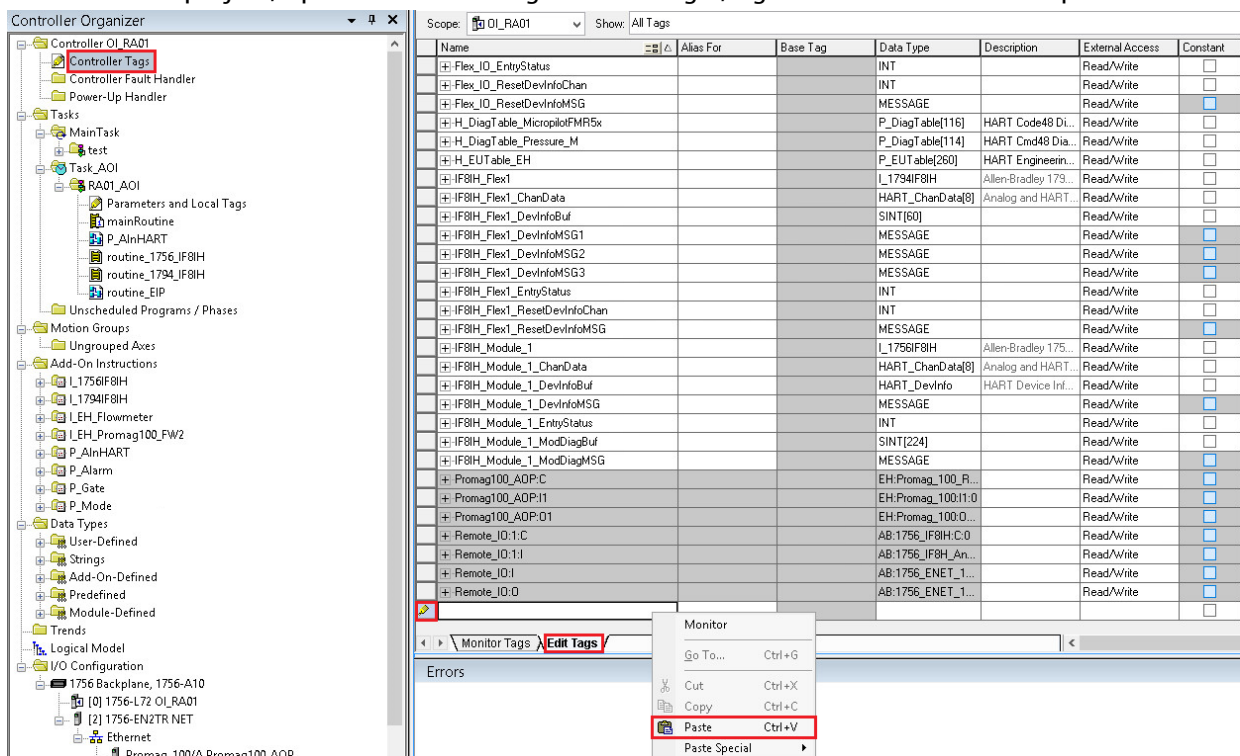
- The parameters “Ref_EUTable” and “Ref_DiagTable” must be connected as well. Specific diagnostic tables already exist for Endress+Hauser EtherNet/IP devices and can be imported from the sample project of the Process Library. Open the Controller Tags of the sample project and select the EIP diagnostic table “EIP_DiagTable_PromaX_X00” and “EIP_EUTable_EH”:

Name	Alias For	Base Tag	Data Type	Description	External Access	Constant
EIP_DiagTable_Liquiline			P_DiagTable_EIP[...]	Diagnostic Code L...	Read/Write	<input type="checkbox"/>
EIP_DiagTable_Promag53			P_DiagTable_EIP[...]	E+H Promag 53E ...	Read/Write	<input type="checkbox"/>
EIP_DiagTable_Promass83			P_DiagTable_EIP[...]	E+H Promass 83E...	Read/Write	<input type="checkbox"/>
EIP_DiagTable_PromaX_X00			P_DiagTable_EIP[...]	Ethernet/IP Diagn...	Read/Write	<input type="checkbox"/>
EIP_EUTable_EH			P_EUTable_EIP[510]	EtherNet/IP Engin...	Read/Write	<input type="checkbox"/>
EIP_EUTable_EH_83_53			P_EUTable_EIP[193]	E+H Promag 53E...	Read/Write	<input type="checkbox"/>
EIP_EUTable_Generic			P_EUTable_EIP[304]	EtherNet/IP Engin...	Read/Write	<input type="checkbox"/>

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

	Name	Alias For	Base Tag	Data Type	Description	External Access	Constant
	+ EIP_DiagTable_Liquiline			P_DiagTable_EIP[...	Diagnostic Code L...	Read/Write	<input type="checkbox"/>
	+ EIP_DiagTable_Promag53			P_DiagTable_EIP[...	E+H Promag 53E ...	Read/Write	<input type="checkbox"/>
	+ EIP_DiagTable_Promag83			P_DiagTable_EIP[...	E+H Promag 83E...	Read/Write	<input type="checkbox"/>
	+ EIP_DiagTable_PromagX_X00			P_DiagTable_EIP[...	Ethernet/IP Diagn...	Read/Write	<input type="checkbox"/>
	+ EIP_EUTable_EH			P_EUTable_EIP[510]	EtherNet/IP Engin...	Read/Write	<input type="checkbox"/>
	+ EIP_EUTable_EIP[193]			P_EUTable_EIP[193]	E+H Promag 53E...	Read/Write	<input type="checkbox"/>
	+ EIP_EUTable_EIP[304]			P_EUTable_EIP[304]	EtherNet/IP Engin...	Read/Write	<input type="checkbox"/>
	+ L1794IF8IH			L1794IF8IH	Allen-Bradley 179...	Read/Write	<input type="checkbox"/>

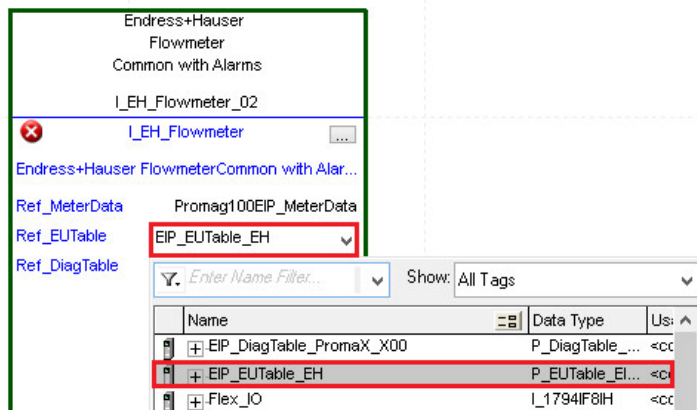
- In the current project, open "Controller Tags → Edit Tags", right-click in the field and paste:



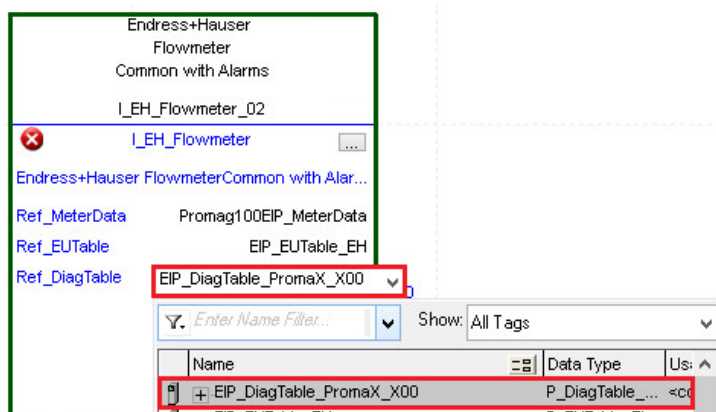
- This inserts the two variables:

+ Remote_IO:0			AB:1756_ENET_1...		Read/Write
+ EIP_DiagTable_PromagX_X00			P_DiagTable_EIP[...	Ethernet/IP Diagn...	Read/Write
+ EIP_EUTable_EH			P_EUTable_EIP[510]	EtherNet/IP Engin...	Read/Write

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



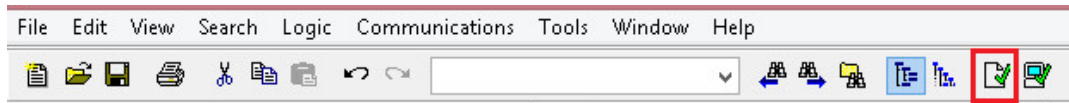
- In the routine "routine_EIP", double-click on "?" of parameter "Ref_DiagTable" and assign the device specific diagnostic table "EIP_DiagTable_PromaX_X00":



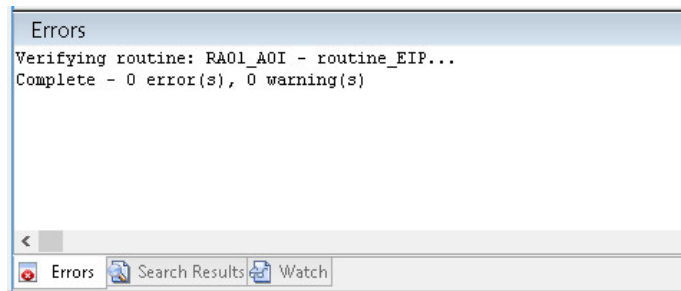
- Configured function blocks for Promag100:



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



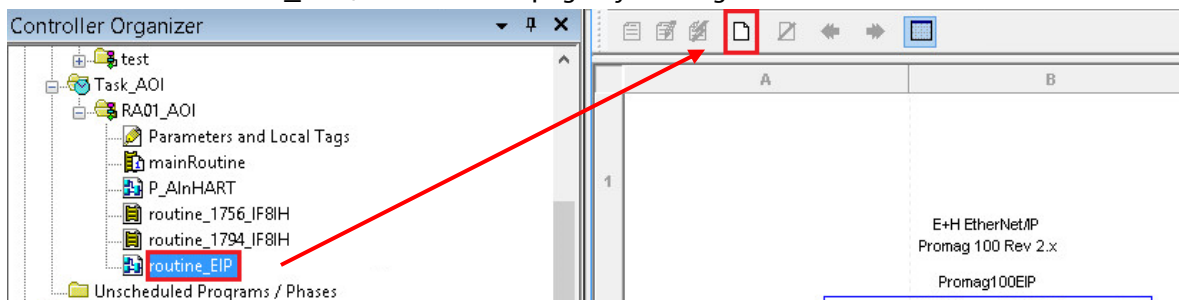
- Check the result in the Error diagnostic window:



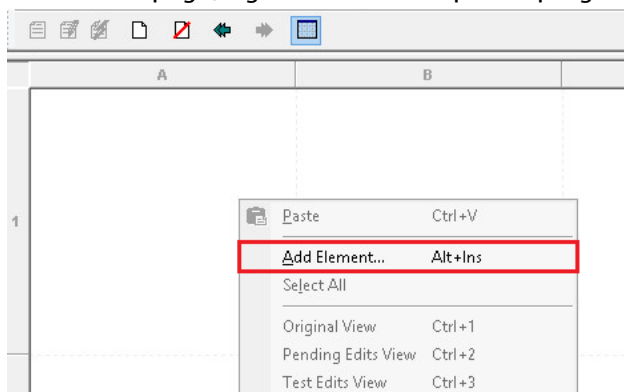
4.1.4.2 AOI for Liquiline

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

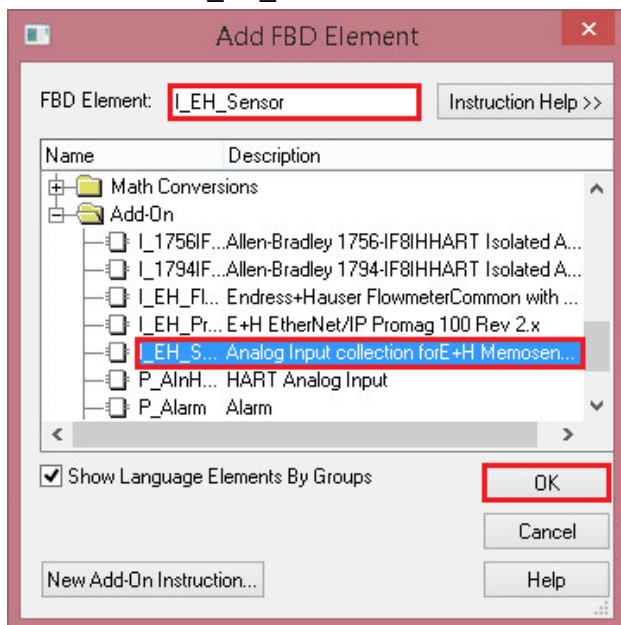
- In the routine "routine_EIP", create a new page by clicking on the small shortcut button:



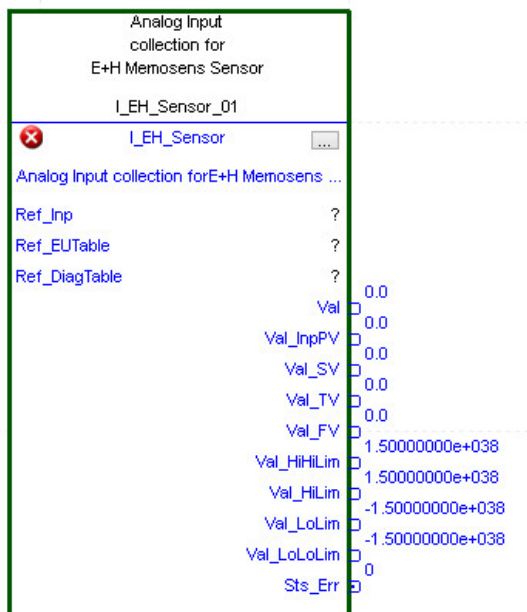
- In this new page, right-click in the opened program page. Select the option "Add Element...":



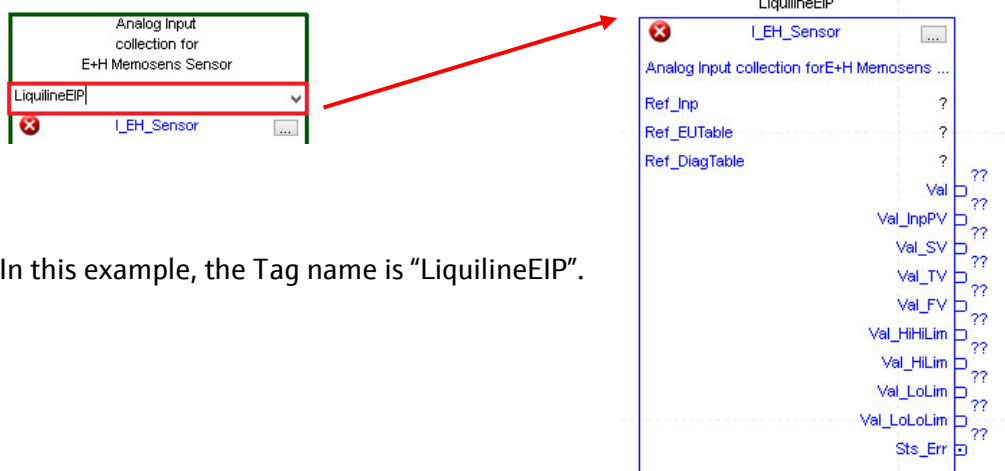
- Select the AOI "I_EH_Sensor" and click on the button "OK":



- This inserts the function block in the routine:

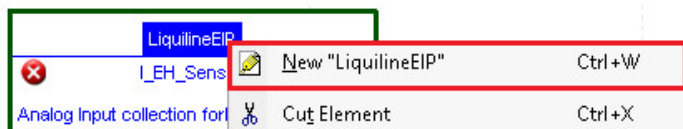


- Update the Tag:

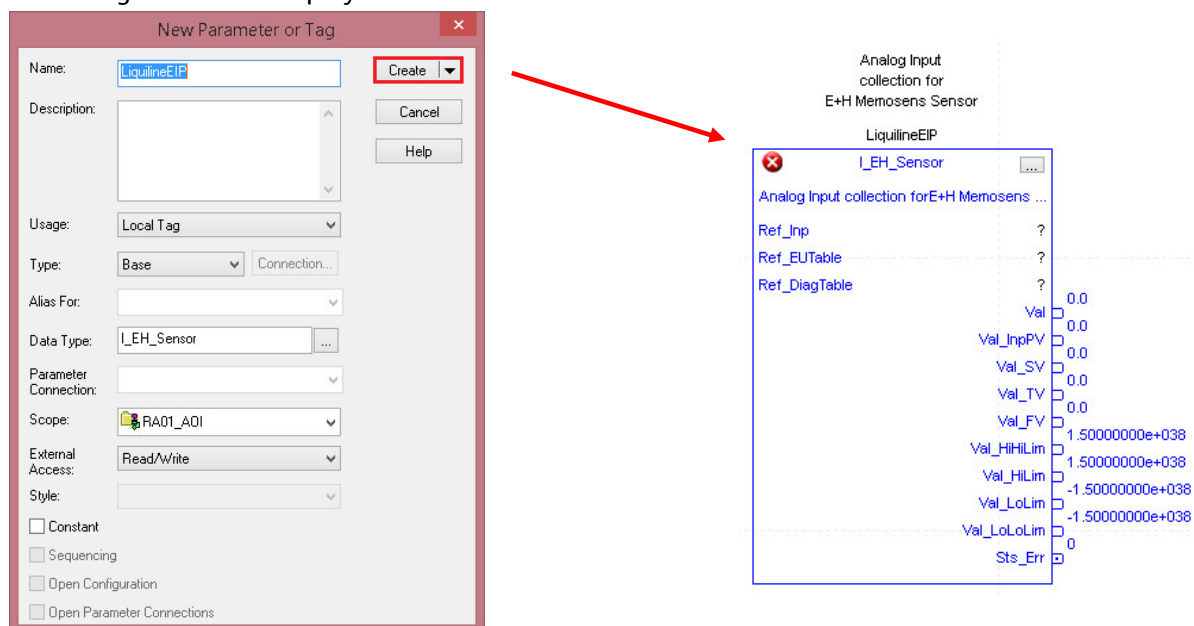


In this example, the Tag name is "LiquilineEIP".

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

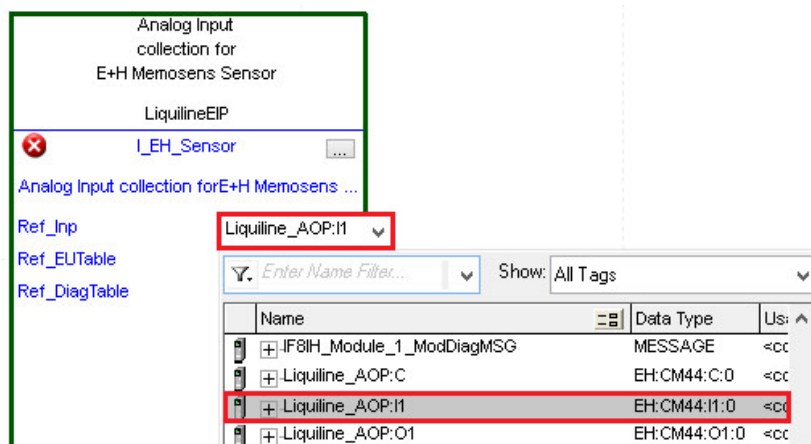


- Following window is displayed. Click on the button "Create":

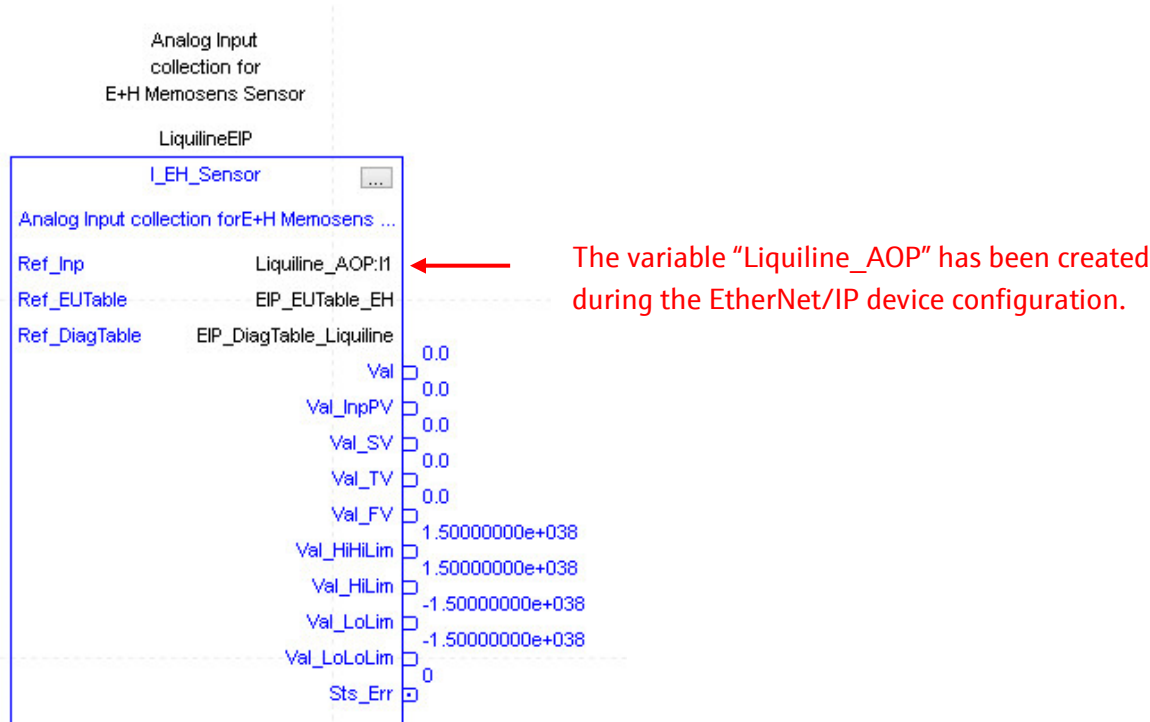


- In this example, the instance name "LiquilineEIP" is used to connect the faceplate.

- Double-click on “?” of parameter “Ref_Input”:

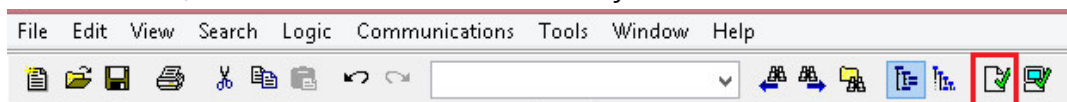


- Assign the variables “Ref_EUTable” and “Ref_DiagTable” as well:

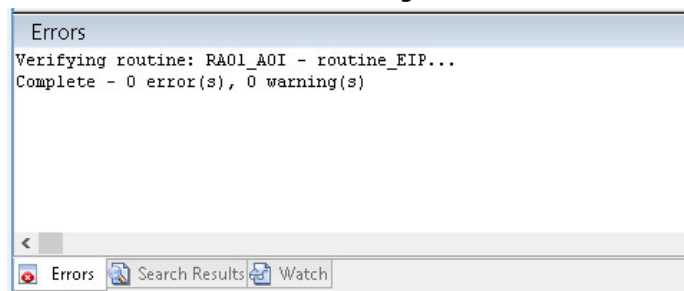


As done in chapter 4.1.4.1, the Endress+Hauser specific EtherNet/IP parameters “Ref_EUTable” and “Ref_DiagTable” are imported from a sample project.

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



- Check the result in the Error diagnostic window:



4.1.5 Configuration Download

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

4.2 Faceplates

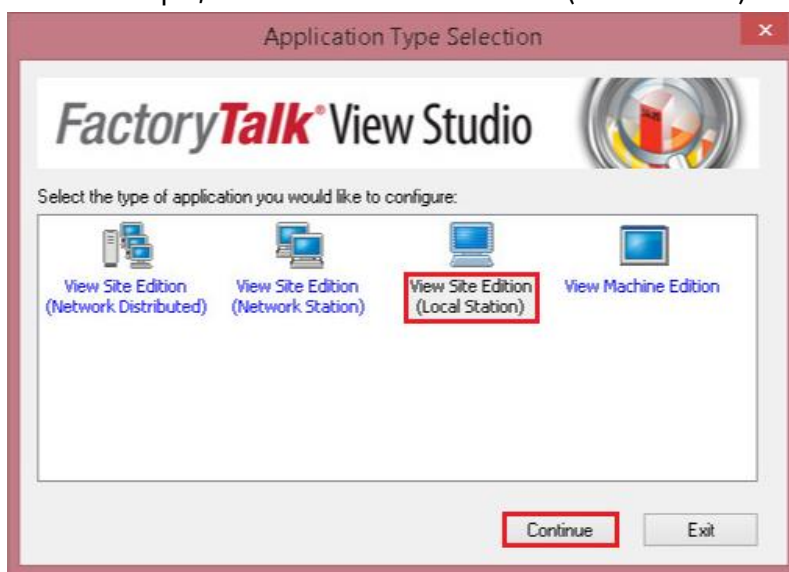
4.2.1 General Configuration

4.2.1.1 View Site Edition

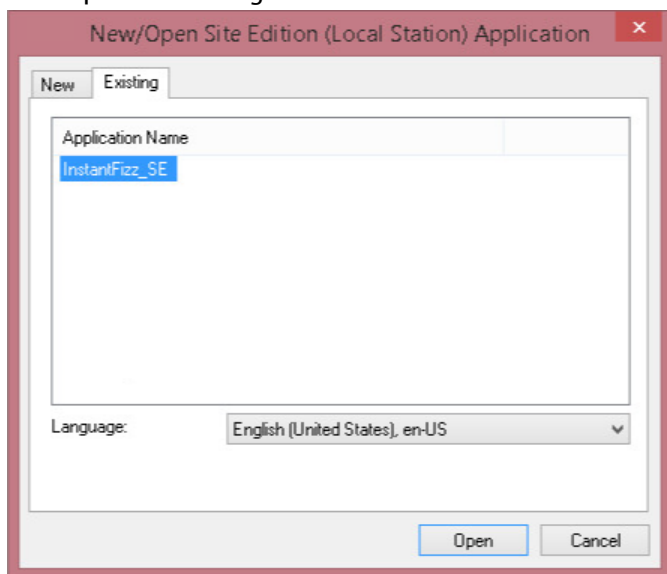
- Start the tool "FactoryTalk View Studio":



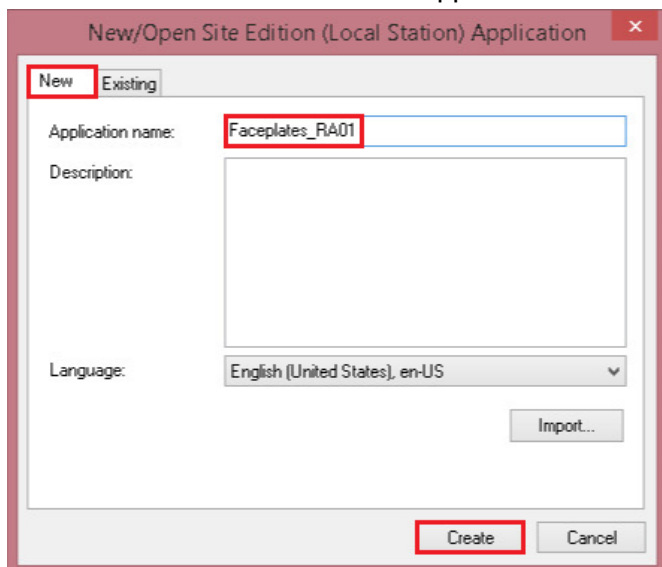
- In this example, select the "View Site Edition (Local Station)" and click on the button "Continue":



- This opens following window:

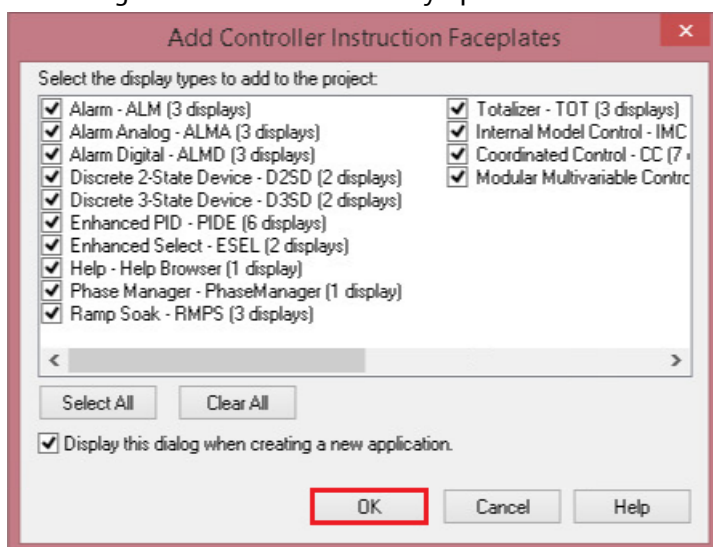


- Click on the tab "New". Enter the Application name and click on the button "Create":



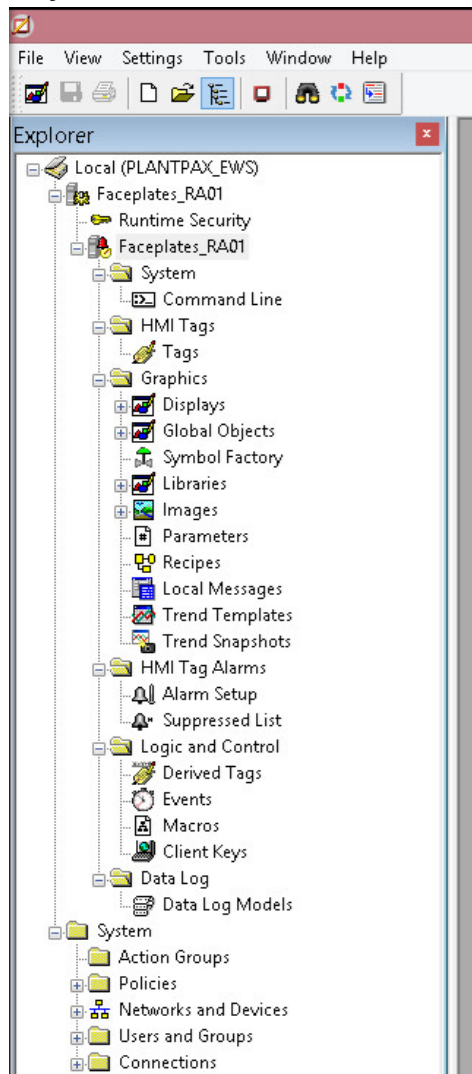
In this example, the application name is "Faceplates_RA01".

- Following window is automatically opened:



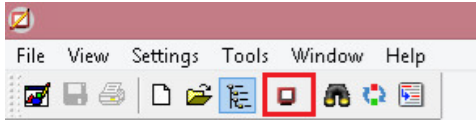
Select all and click on the button "OK".

- Project overview:

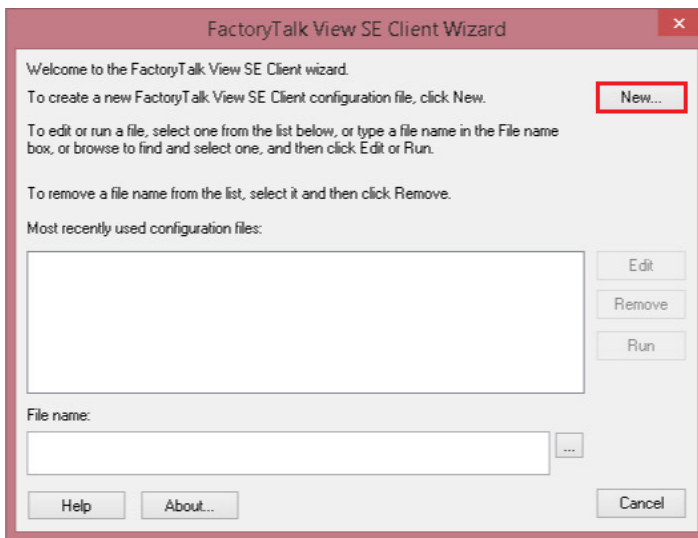


4.2.1.2 Client Wizard Configuration

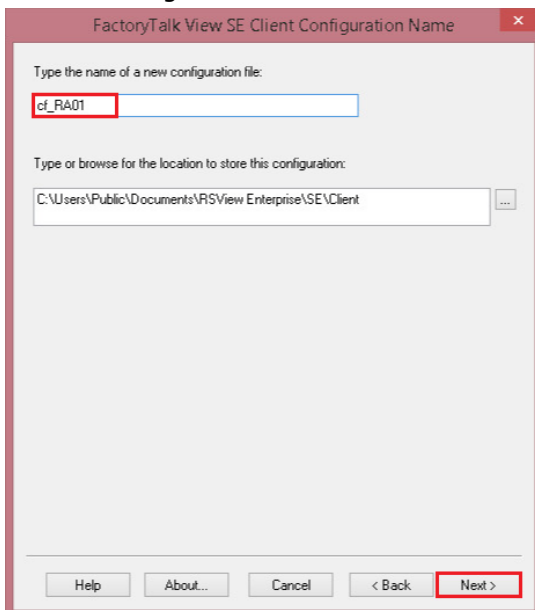
- Save the configuration and click on the shortcut button "Launch SE Client":



- Click on the button "New..." to start:

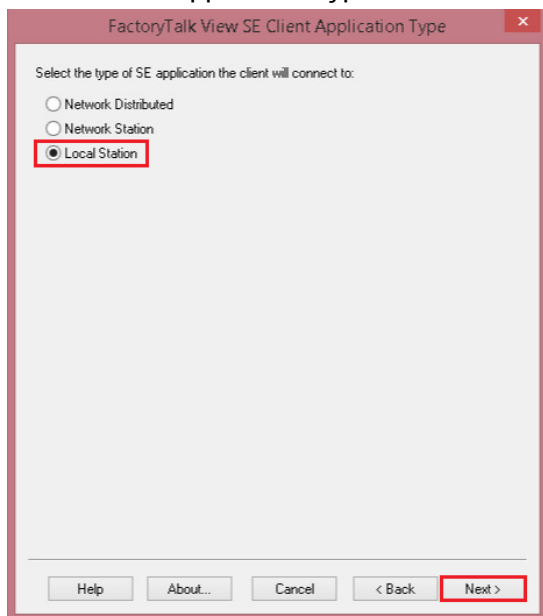


- Enter a configuration file name and click on the button "Next>":



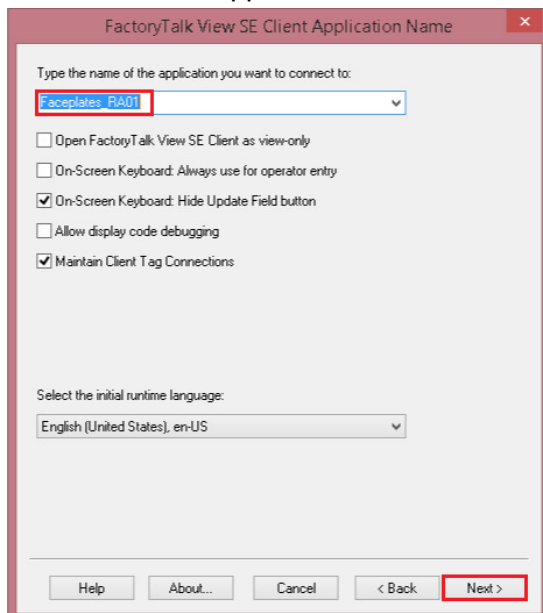
In this example, the configuration file name is "cf_RA01".

- Select the SE application type and click on the button "Next>":



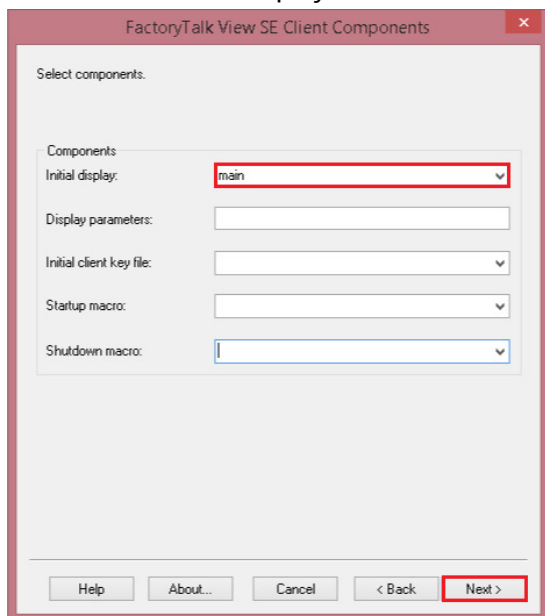
In this example, the application type is "Local Station".

- Link the created application name and click on the button "Next>":



In this example, the application name is "Faceplates_RA01".

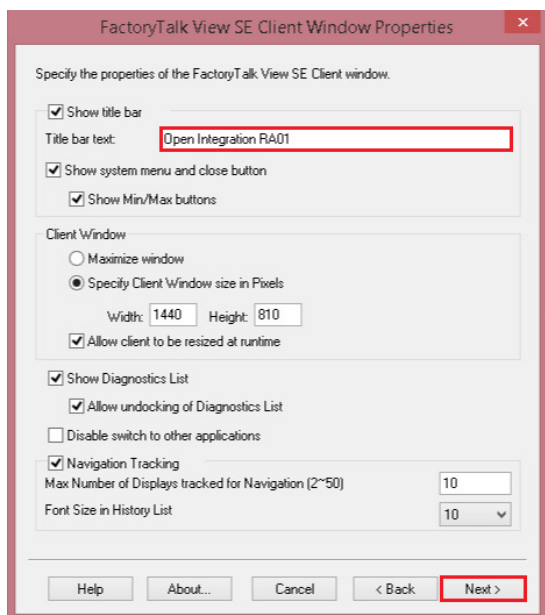
- Indicate the initial display and click on the button "Next>":



The screenshot shows the 'FactoryTalk View SE Client Components' dialog box. It has a title bar with a close button. The main area is titled 'Select components.' and contains several fields: 'Initial display:' with a dropdown menu showing 'main', 'Display parameters:', 'Initial client key file:', 'Startup macro:', and 'Shutdown macro:'. At the bottom, there are buttons for 'Help', 'About...', 'Cancel', '< Back', and 'Next >'. The 'Next >' button is highlighted with a red box.

In this example, the initial display is "main".

- Edit the title and click on the button "Next>":



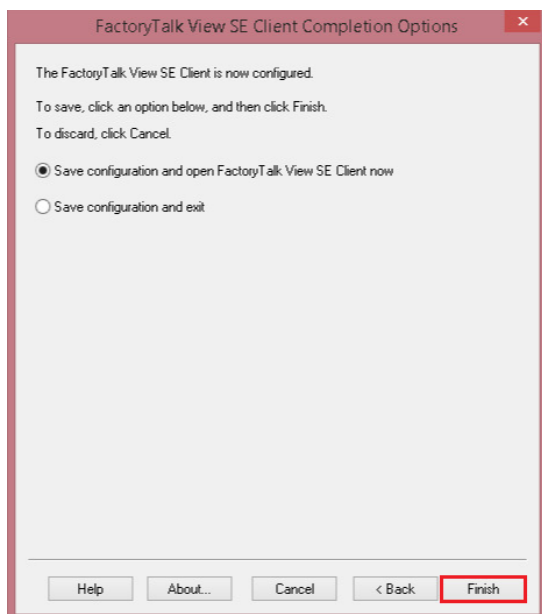
The screenshot shows the 'FactoryTalk View SE Client Window Properties' dialog box. It has a title bar with a close button. The main area is titled 'Specify the properties of the FactoryTalk View SE Client window.' and contains several sections: 'Show title bar' (checked), 'Title bar text:' (text box with 'Open Integration RA01'), 'Show system menu and close button' (checked), 'Show Min/Max buttons' (checked), 'Client Window' (radio buttons for 'Maximize window' and 'Specify Client Window size in Pixels', with 'Specify Client Window size in Pixels' selected), 'Width: 1440', 'Height: 810', 'Allow client to be resized at runtime' (checked), 'Show Diagnostics List' (checked), 'Allow undocking of Diagnostics List' (checked), 'Disable switch to other applications' (unchecked), 'Navigation Tracking' (checked), 'Max Number of Displays tracked for Navigation (2~50)' (text box with '10'), and 'Font Size in History List' (dropdown menu with '10'). At the bottom, there are buttons for 'Help', 'About...', 'Cancel', '< Back', and 'Next >'. The 'Next >' button is highlighted with a red box.

In this example, the title is "Open Integration RA01". This text will be displayed in the GUI.

- If needed, enable the “Enable auto logout” option and click on the button “Next>>”:



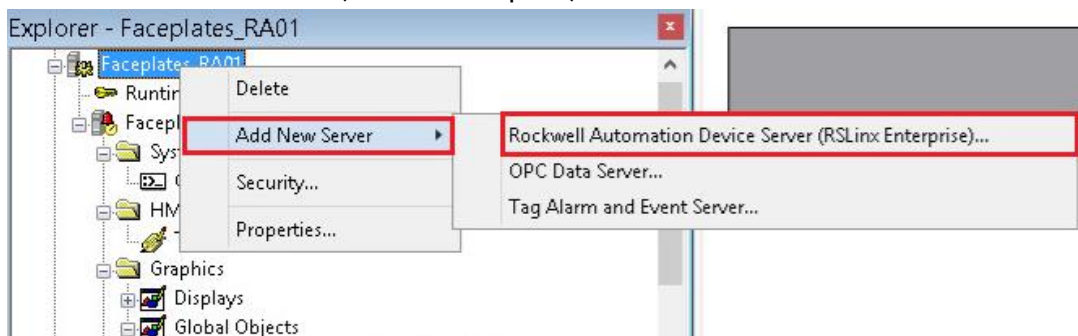
- Click on the button “Finish”:



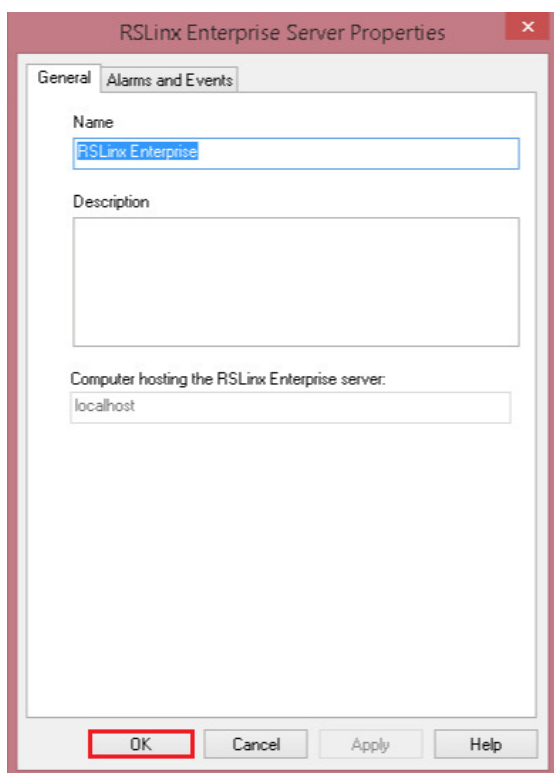
4.2.1.3 Rockwell Automation Device Server

This step is required to link the graphic objects to the AOI.

- Right-click on the item "Faceplates_RA01" and select the menu "Add New Server→Rockwell Automation Device Server (RSLinx Enterprise)":



- The server Name can be edited. Click on the button "OK":



In this example, the default name is let.

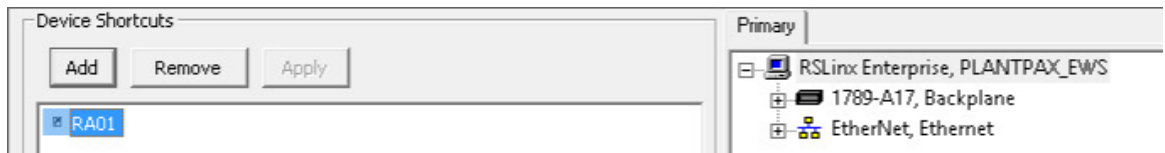
- This inserts the server in the project view. Double-click on "Communication Setup":



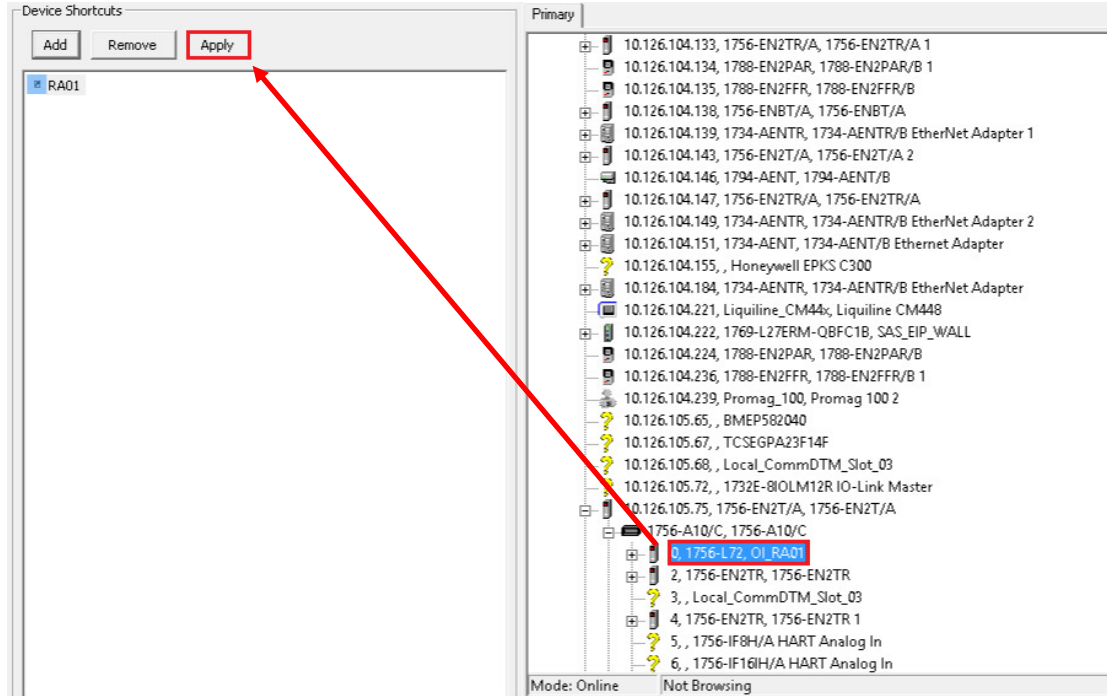
- Click on the button "Add" to insert a new device Shortcut:



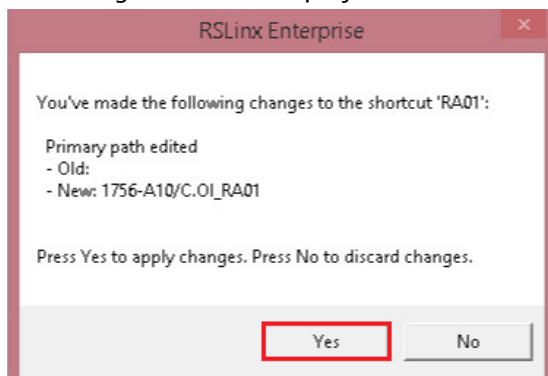
- Rename this new shortcut:



- On the right side of the window, select the connected PLC and click on the button "Apply":

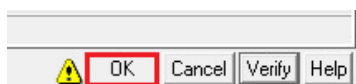


- Following window is displayed:



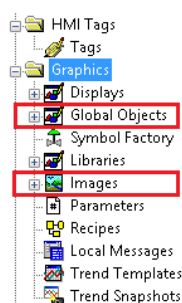
Click on the button "Yes".

- Click on the button "OK":



4.2.2 Library Objects

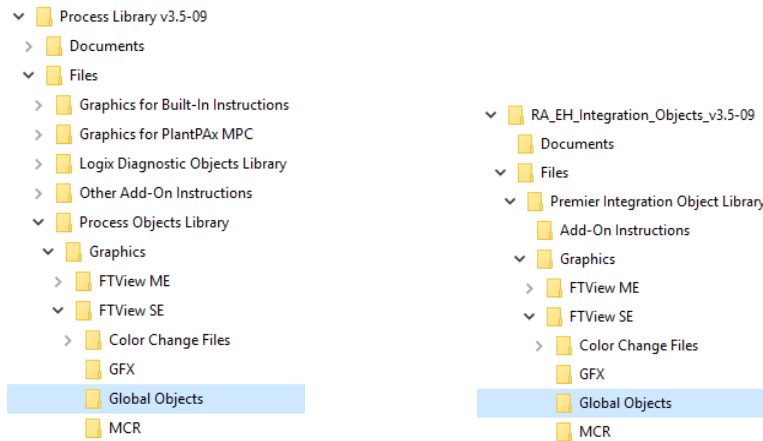
Graphic objects (Global Objects, GFX and Images) must be imported from the "Process_Library" and from the "RA_EH_Integration_Objects" in the project menus "Global Objects" and "Images":



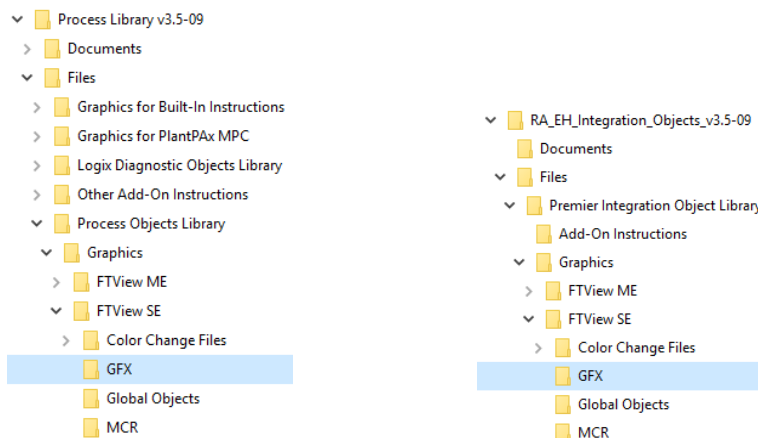
In our example, we are using the Site Edition (SE) option and not the Machine Edition (ME) one. Take care to select the correct data in the libraries as described in the next chapters.

4.2.2.1 Global Objects Path

- Path for “Process Library” and “RA_EH_Integration_Objects” Global Objects:

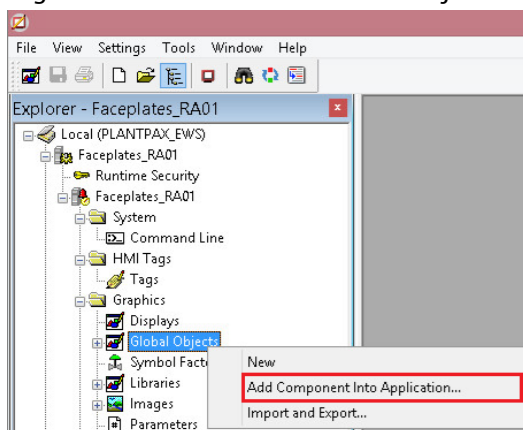


- Path for “Process Library” and “RA_EH_Integration_Objects” GFX:

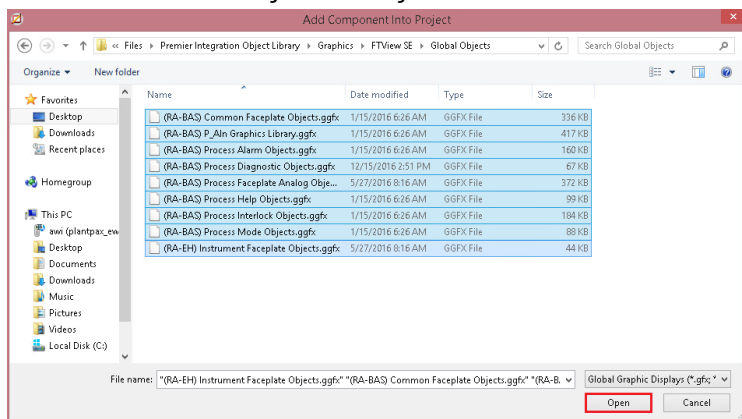


This example explains how to import the Global objects of the “RA_EH_Integration_Objects” library. This step must be repeated for all needed Global Objects.

- Right-click on the menu “Global Objects” and select the menu “Add Component Into Application”:



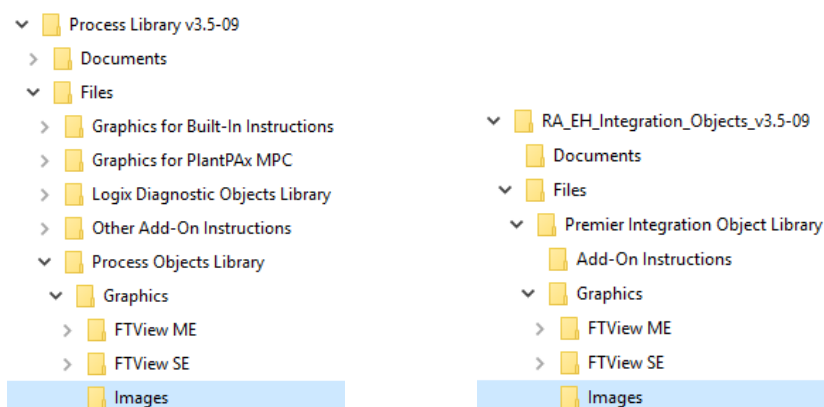
- Select the Process Object Library data and click on the button “Open”:



- This imports the objects in the menu “Global Objects”.

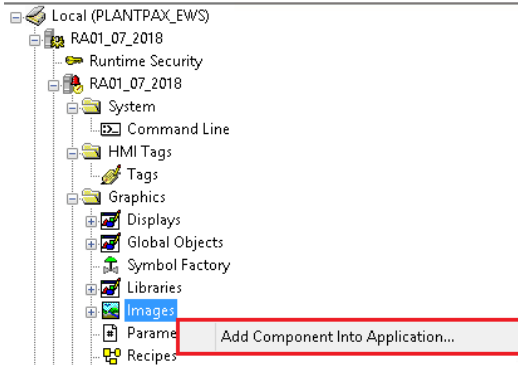
4.2.2.2 Images Path

- Path for “Process Library” and “RA_EH_Integration_Objects” Images:

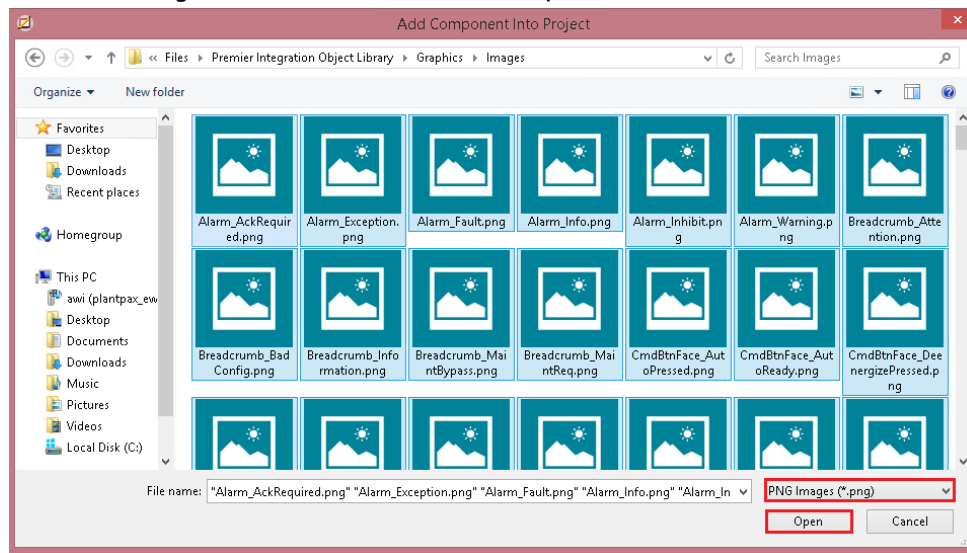


This example explains how to import Images of the "RA_EH_Integration_Objects" library. This step must be repeated to import Images of the "Process Library".

- Right-click on the menu "Images" and select the menu "Add Component Into Application":



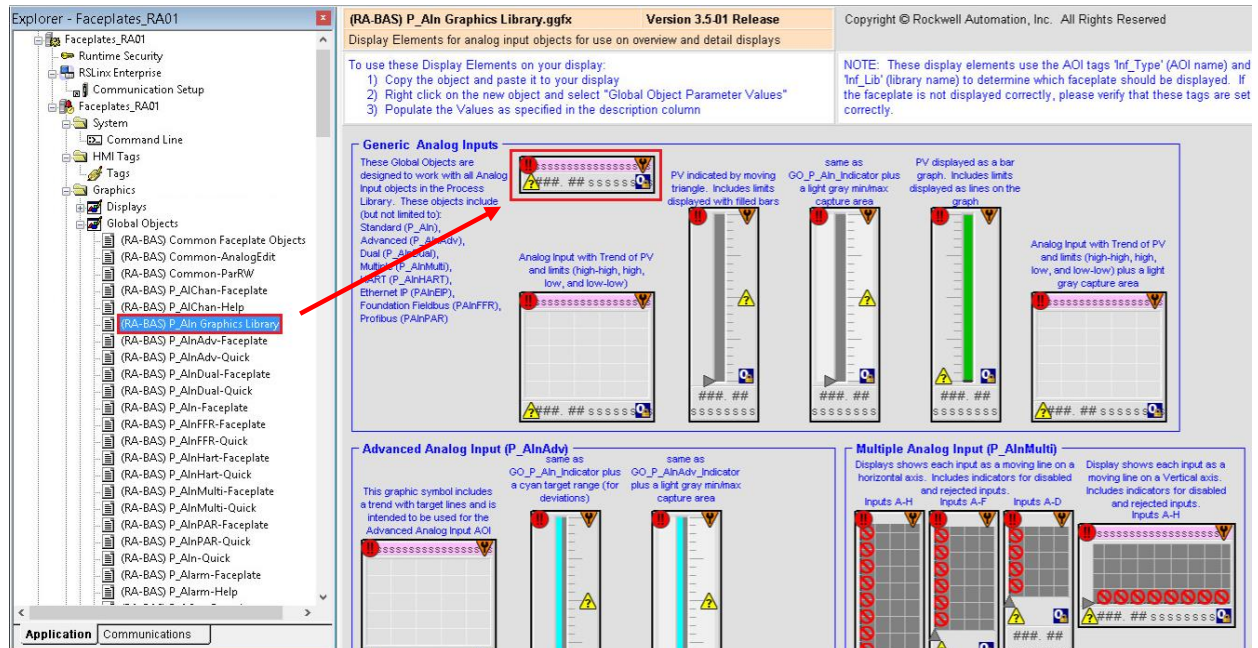
- Select all Images and click on the button "Open":



- This imports the objects in the menu "Images". This step may take few minutes.

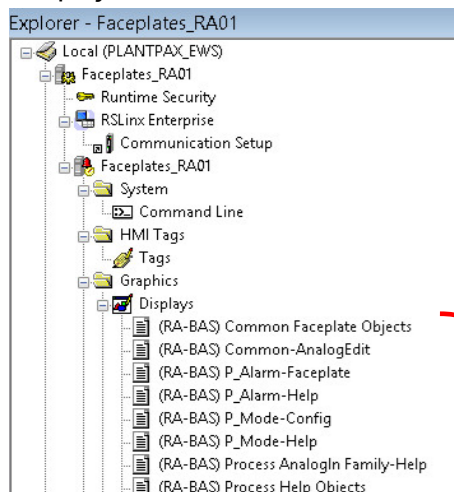
4.2.3 Generic Analog Input Faceplate

- In the menu "Global Objects", 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:



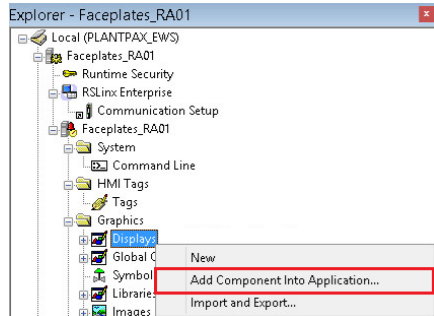
In this example, the "P_Aln" object is selected and copied. Other objects can be used as well.

- Using this analog input faceplate requires importing eight objects as listed below in the menu "Displays":



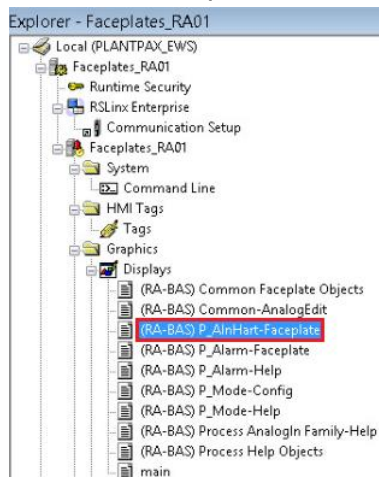
All these objects must be imported from the Process library as well for successful use of the analog input faceplate.

- For importing objects, right-click on the menu "Displays" and select the option "Displays→Add Component Into Application":

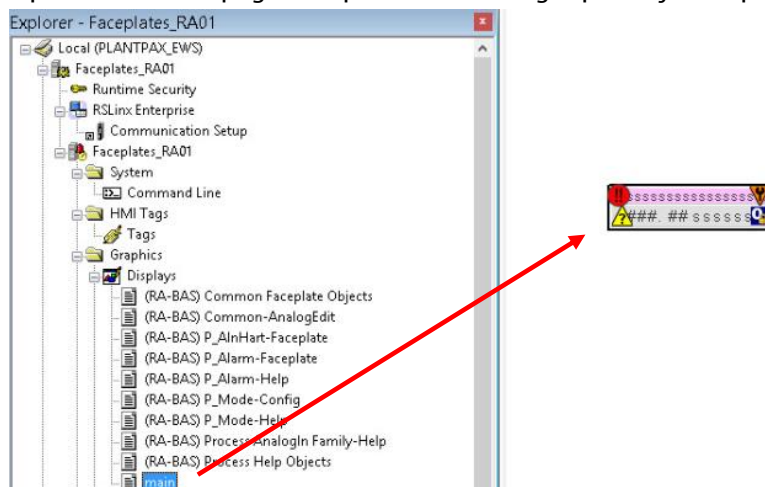


4.2.4 HART Analog Input Faceplate

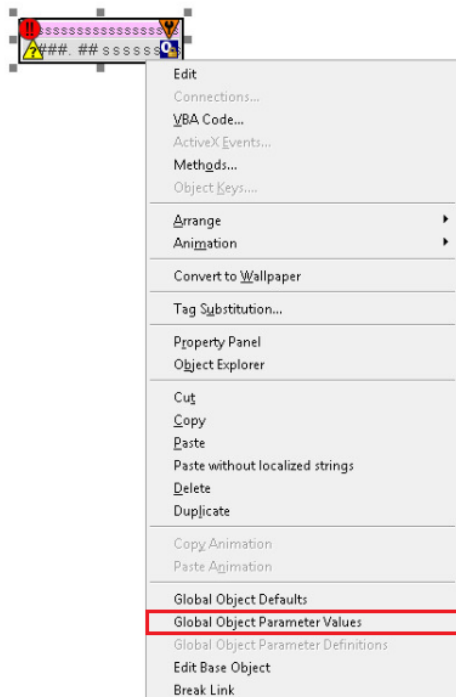
- In the menu, import at first the object "(RA-BAS)P_AlnHart-Faceplate" from the process library:



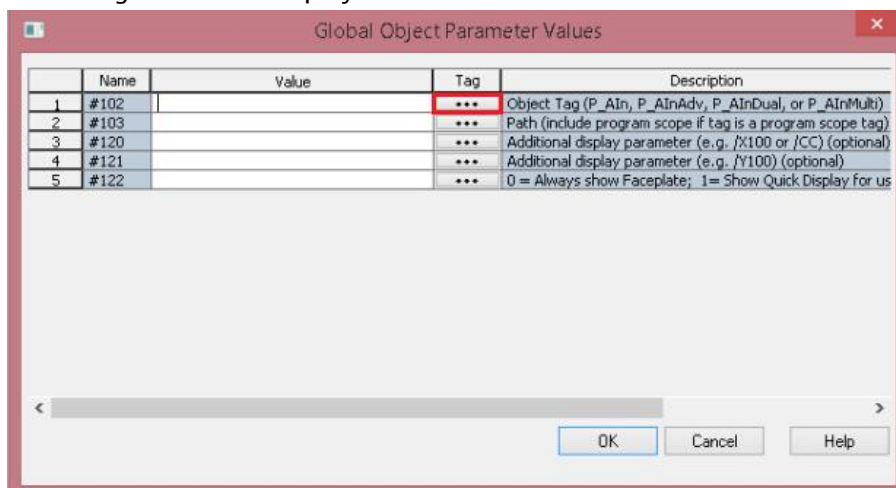
- Open the "main" page and paste the analog input object copied previously in chapter 0:



- The object must now be linked to the data structure created in Studio5000.
Right-click on the analog input object and select the menu "Global Object Parameter Values":

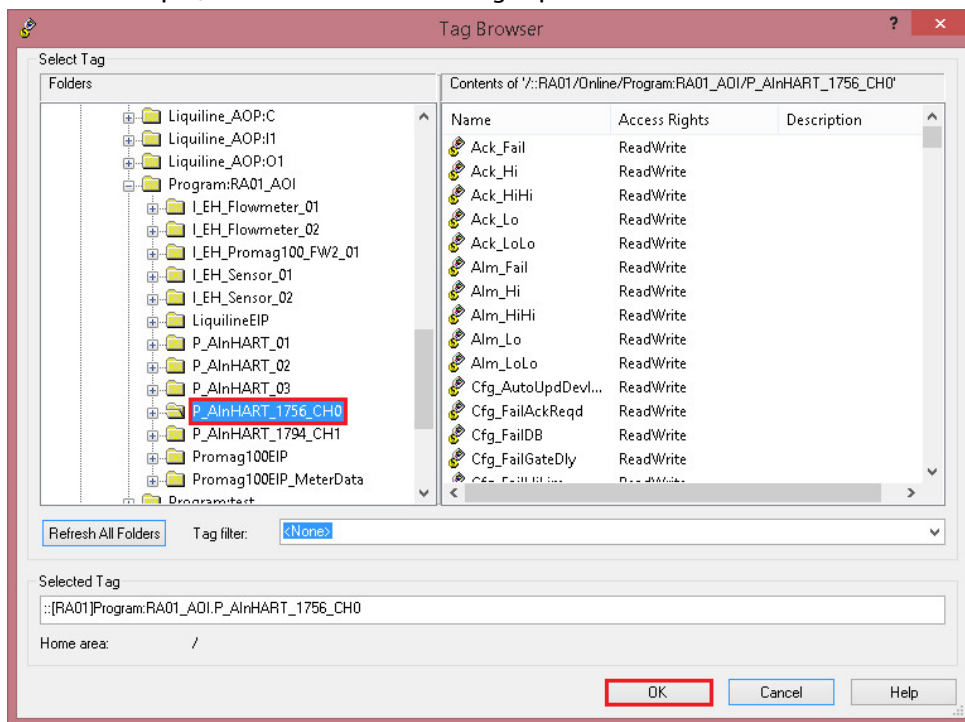


- Following window is displayed:

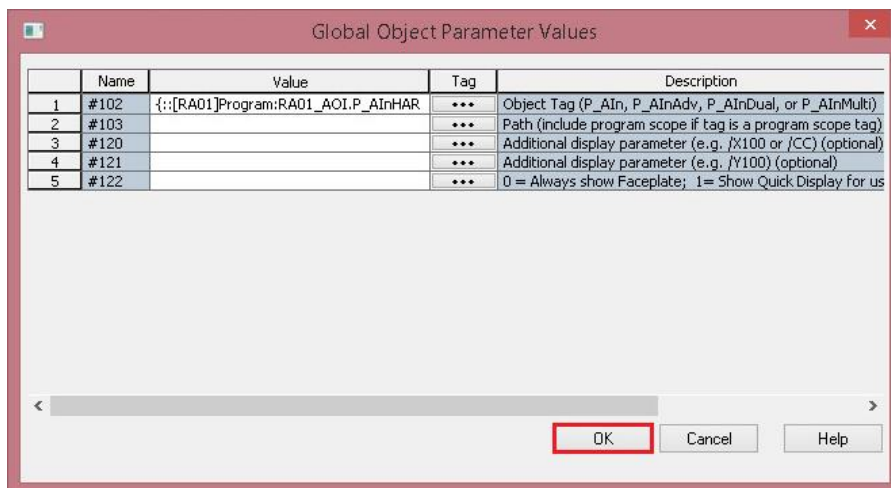


Click on the shortcut button to search the variable to address.

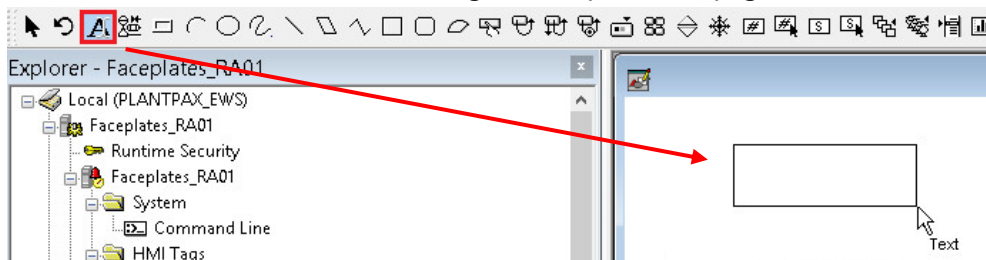
- In this example, channel 0 of the analog input card 1756 is selected:



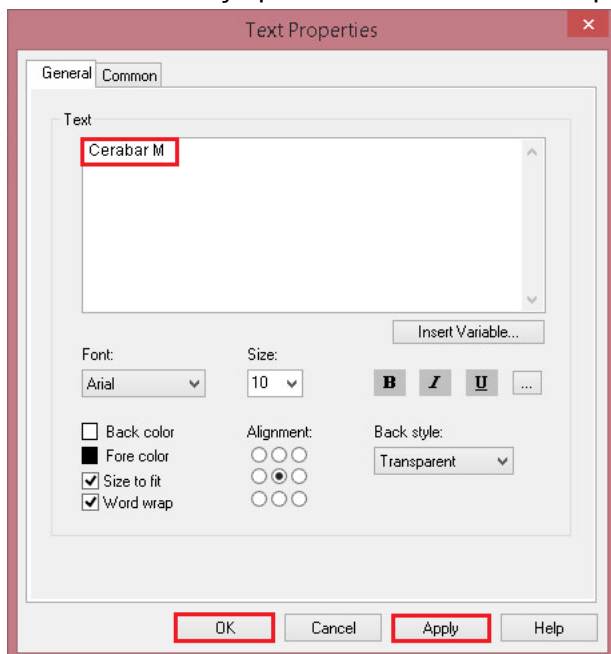
- Click on the button "OK":



- 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:

Cerabar M HART



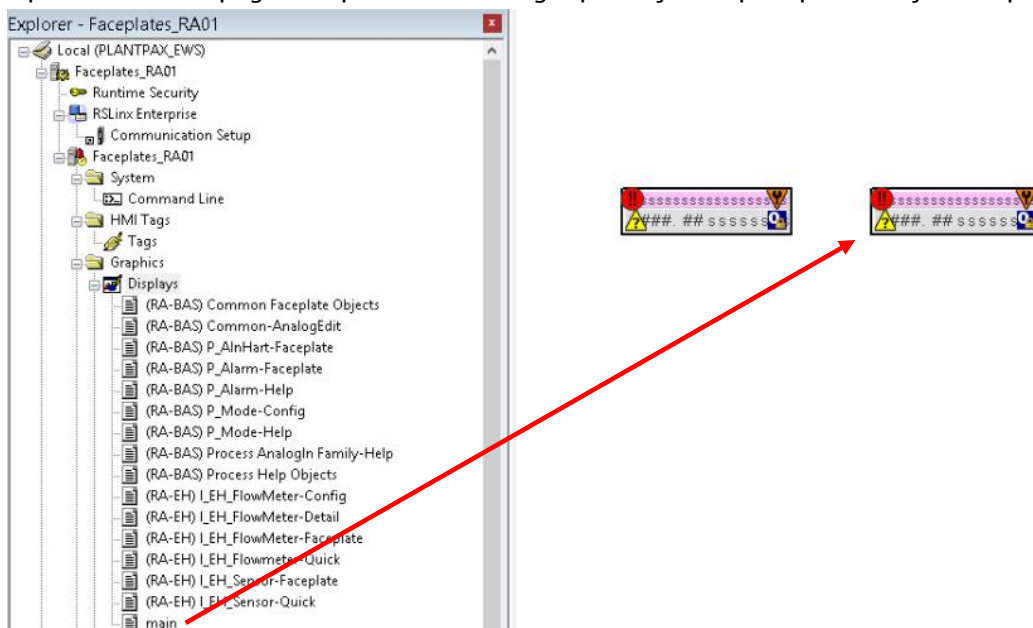
4.2.5 EtherNet/IP Faceplate

EtherNet faceplates are categorized under two groups: "Flowmeter" for the flow devices and "Sensor" for all others.

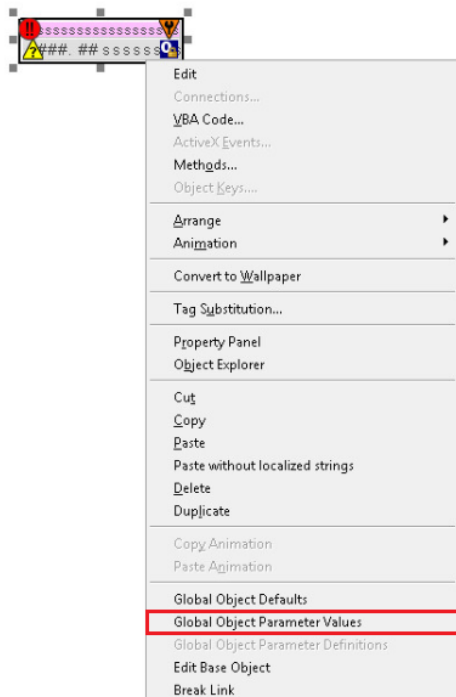
- In the menu "Displays", import the marked objects from the Endress+Hauser process library:



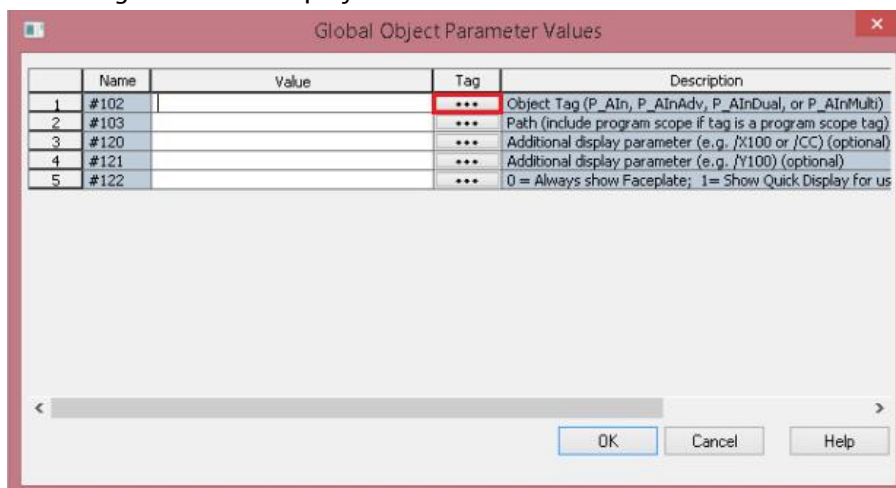
- Open the "main" page and paste the analog input object copied previously in chapter 0:



- The object must now be linked to the data structure created in Studio5000.
Right-click on the analog input object and select the menu "Global Object Parameter Values":

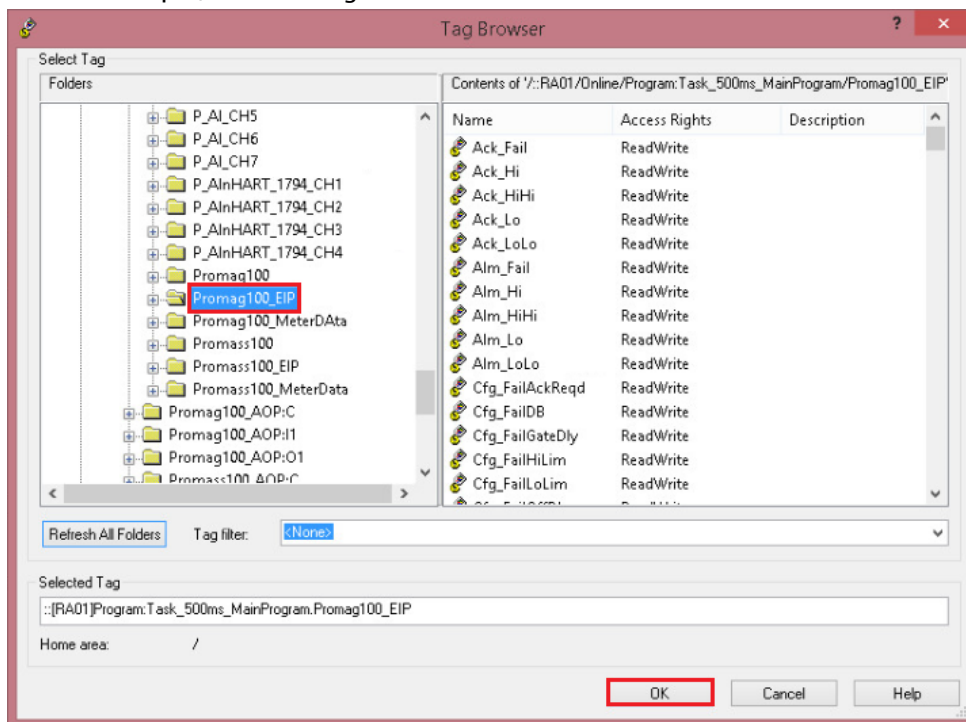


- Following window is displayed:

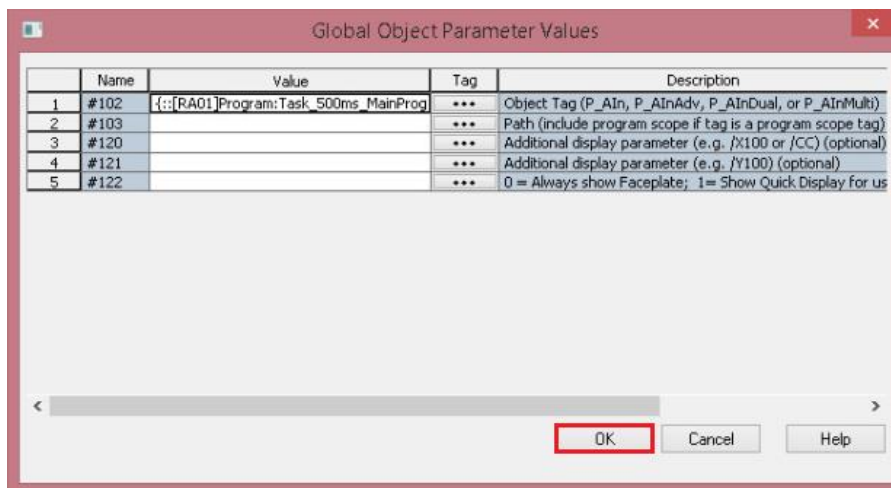


Click on the shortcut button to search the variable to address.

- In this example, the Promag100EIP is selected:

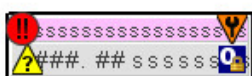


- Click on the button "OK":



- Give a Text, for example "Promag100 EIP" as done for the Cerabar M in chapter 4.2.4:

Cerabar M HART



Promag100 EIP



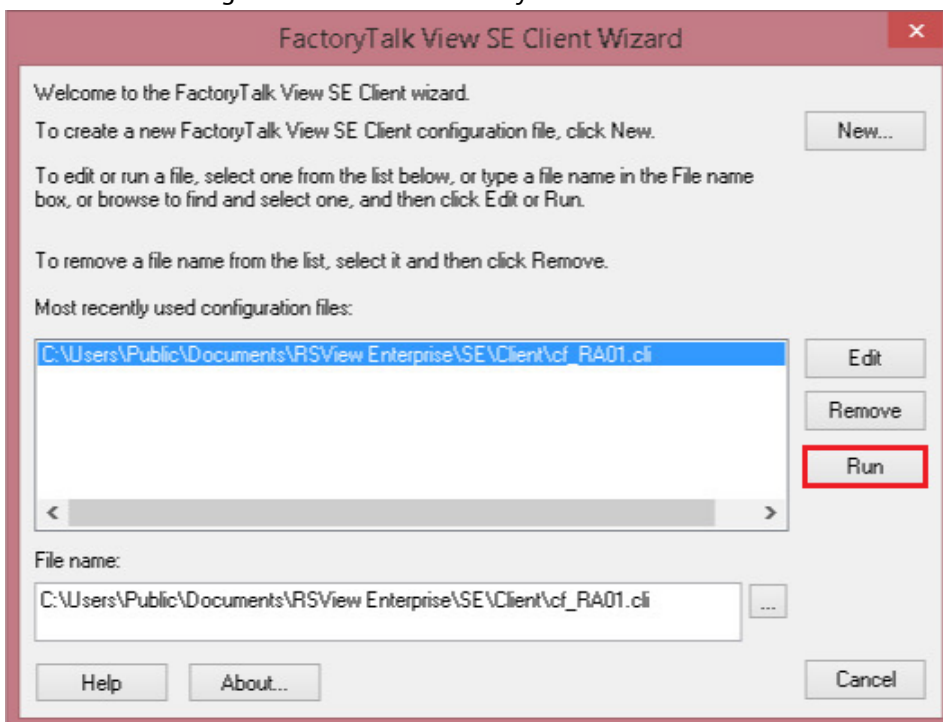
4.2.6 Faceplates Online Connection

4.2.6.1 Factory Talk Start

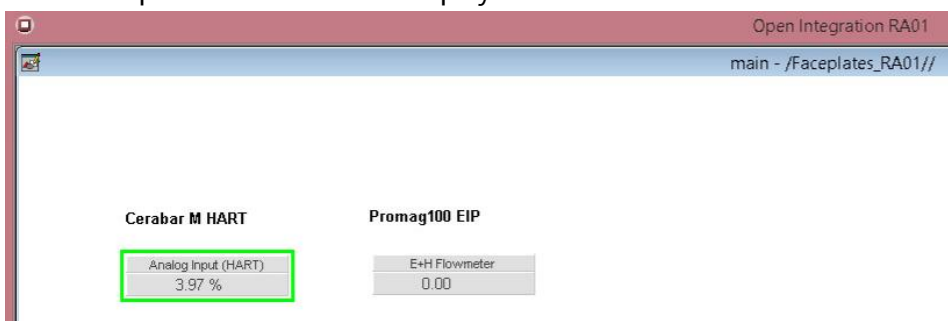
- Save first the changes and click on the shortcut button "Launch SE Client":



- The created configuration is automatically selected. Click on the button "Run":



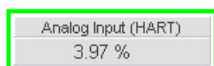
- Online Graphic User Interface is displayed:



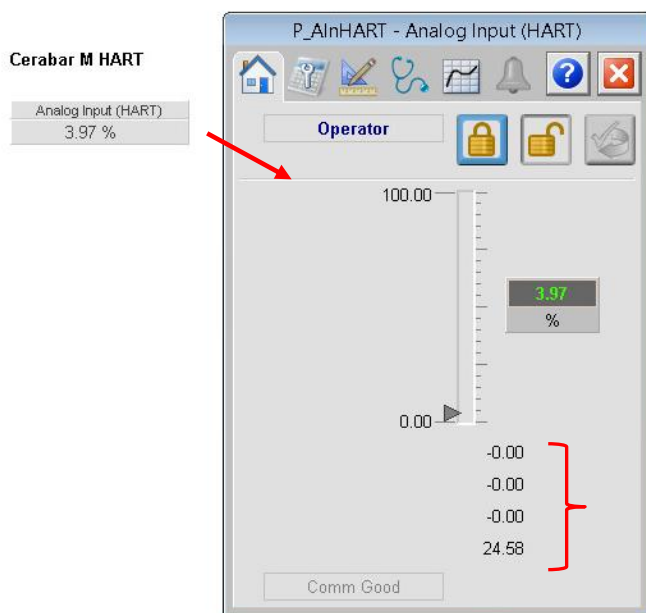
4.2.6.2 HART Analog Input Faceplate

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

Cerabar M HART



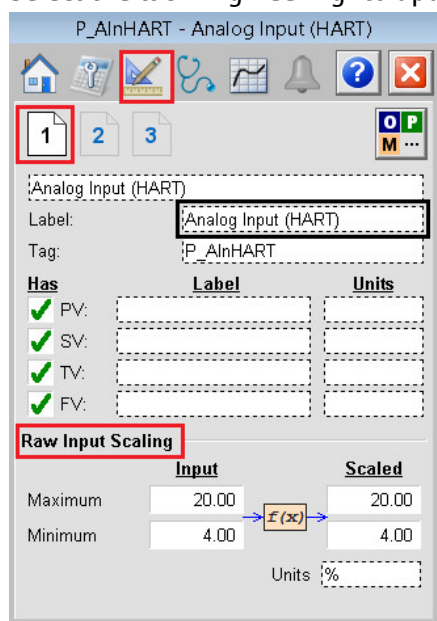
- This opens the faceplate main page:



HART data (PV, SV, TV, QV).

Labels and units must be entered manually

- Select the tab "Engineering" to update labels and check the scaling settings:

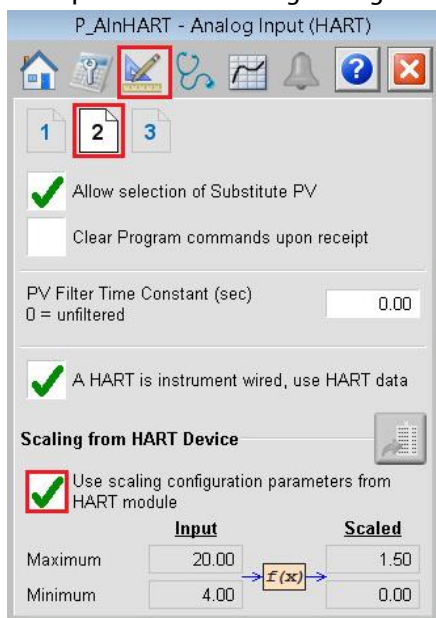


HART data labels and units can be entered in these fields.

Click on "Enter" to save each update

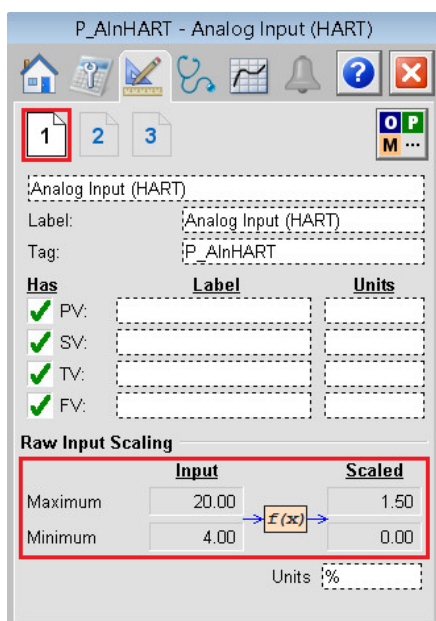
Default PV scaling and unit

- Default device settings can be configured. Click on the tab "2" of the menu "Engineering" and select the option "User scaling configuration parameters from HART module":

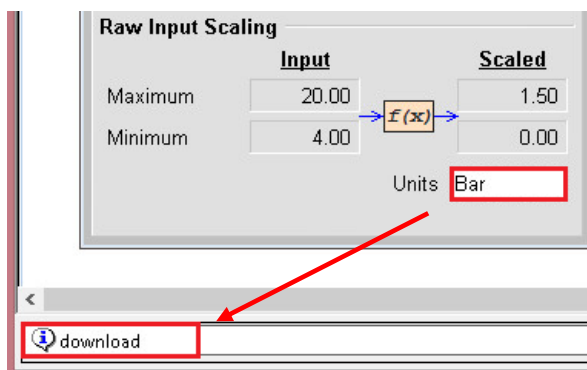


In this example this updates the range from 4.00/20.00 to 0.00/1.50.

- Go back on tab "1" of the menu "Engineering" and check the scaling:

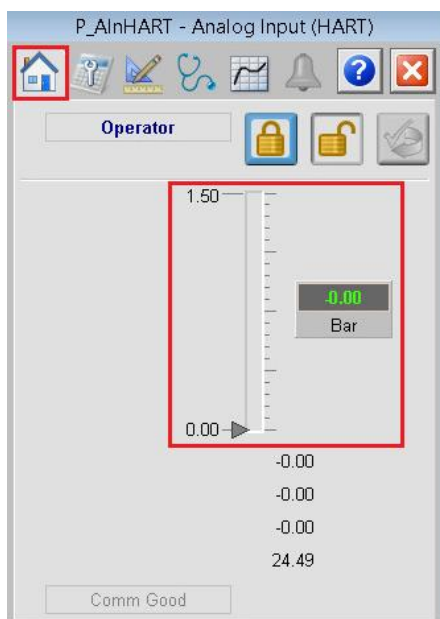


- Unit must be updated manually.
Change the Unit, for example Bar for the Cerabar M device, and click on the keyboard touch "Enter":



Message is displayed when the unit has been downloaded.

- Click on the tab "Home":





Scaling, units and process value have been successfully updated.

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

Remarks

A missing object is notified in the diagnostic window when the application is running:

-  Driver Ethernet re-established a session to 10.126.104.155
-  Driver Ethernet lost communications to 10.126.104.155: connect
-  Component does not exist: (RA-BAS) P_Mode-Help

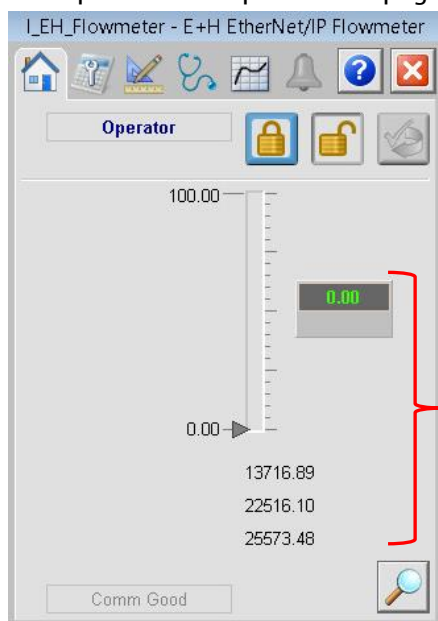
In this example, the object "(RA-BAS)P_Mode-Help" is missing in the menu "Displays".

4.2.6.3 EtherNet/IP Promag100 Faceplate

- Click for example on the "Promag100EIP":

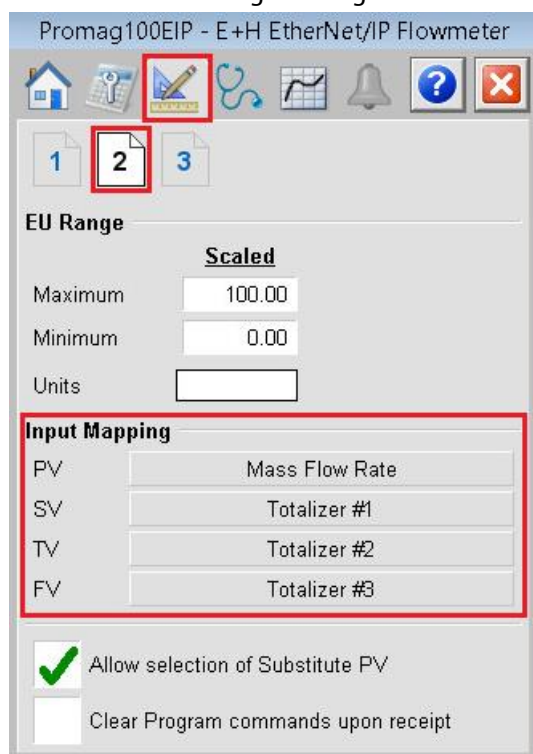


- This opens the faceplate main page:



Displayed values are defined in the faceplate
"Input Mapping".

- Click on the tab "Engineering" and select the tab "2":



Promag100EIP - E+H EtherNet/IP Flowmeter

1 2 3

EU Range

Scaled

Maximum 100.00

Minimum 0.00

Units

Input Mapping

PV	Mass Flow Rate
SV	Totalizer #1
TV	Totalizer #2
FV	Totalizer #3

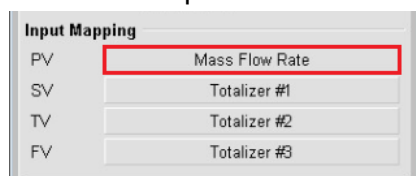
☒ Allow selection of Substitute PV

☐ Clear Program commands upon receipt

This is the mapping displayed on the main page.

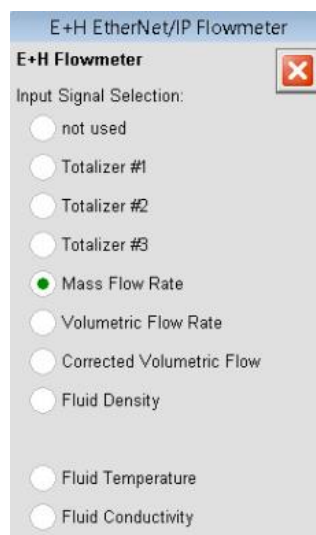
It can be changed by clicking on each button

- Click for example on "Mass Flow Rate" to set another parameter if needed:



Input Mapping

PV	Mass Flow Rate
SV	Totalizer #1
TV	Totalizer #2
FV	Totalizer #3



E+H EtherNet/IP Flowmeter

E+H Flowmeter

Input Signal Selection:

☐ not used

☐ Totalizer #1

☐ Totalizer #2

☐ Totalizer #3

☒ Mass Flow Rate

☐ Volumetric Flow Rate

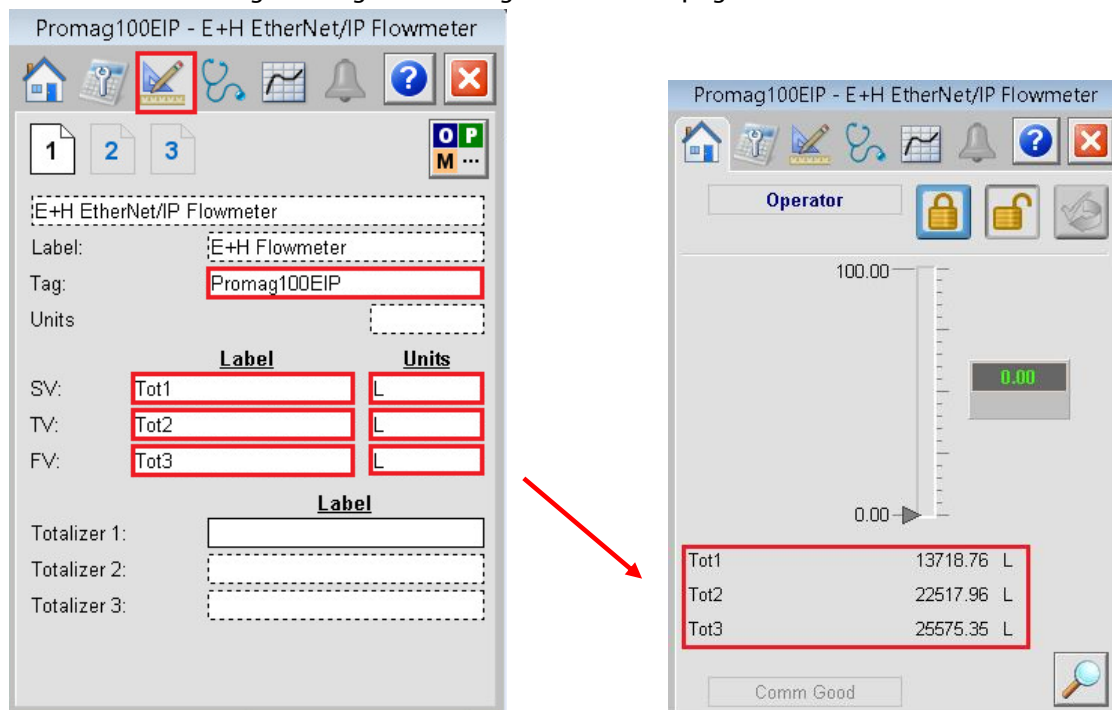
☐ Corrected Volumetric Flow

☐ Fluid Density

☐ Fluid Temperature

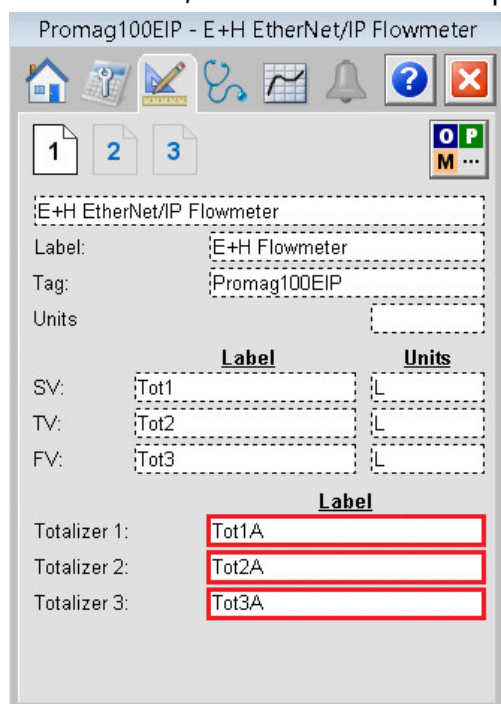
☐ Fluid Conductivity

- Click on the tab "Engineering" and configure the main page totalizer labels:

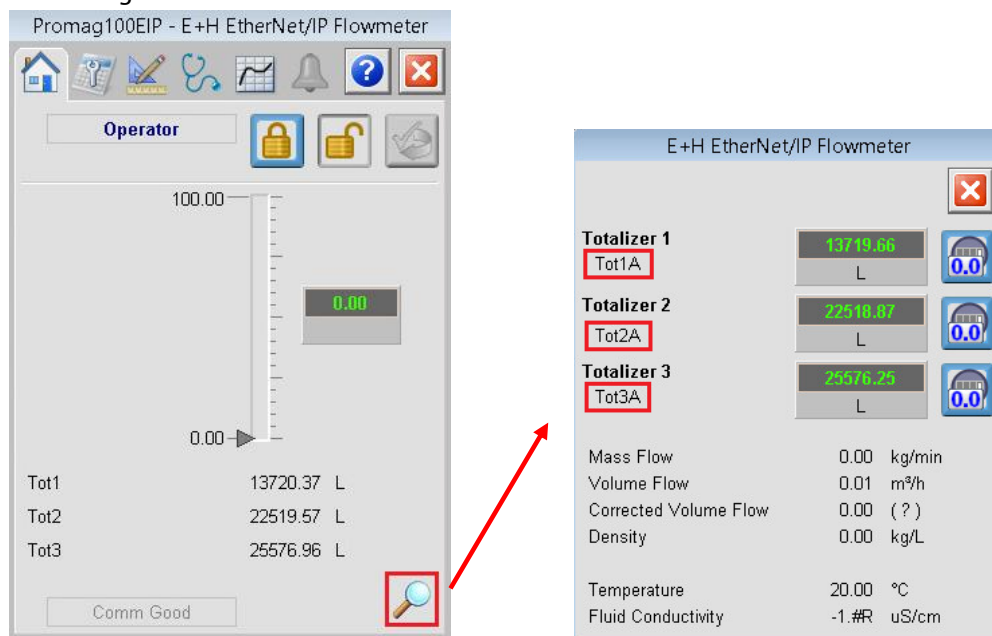


In this mapping, "SV", "TV" and "FV" correspond to "Totalizer1", "Totalizer2" and "Totalizer3".

- Configure the fields "Totalizer 1", "Totalizer 2" and "Totalizer 3" as well, which corresponds to the labels "Tot1A", "Tot1B" and "Tot1C" displayed on the measurement page:



- On the faceplate main page, click on the magnifying glass symbol to display the measurements with assigned labels:



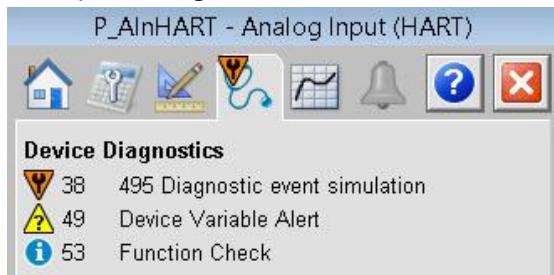
Refer to Rockwell Automation documentation for further details about faceplates handling.

4.2.6.4 Device Diagnostics

- Device diagnostics are available in the HART and EtherNet/IP faceplates in the tab4:

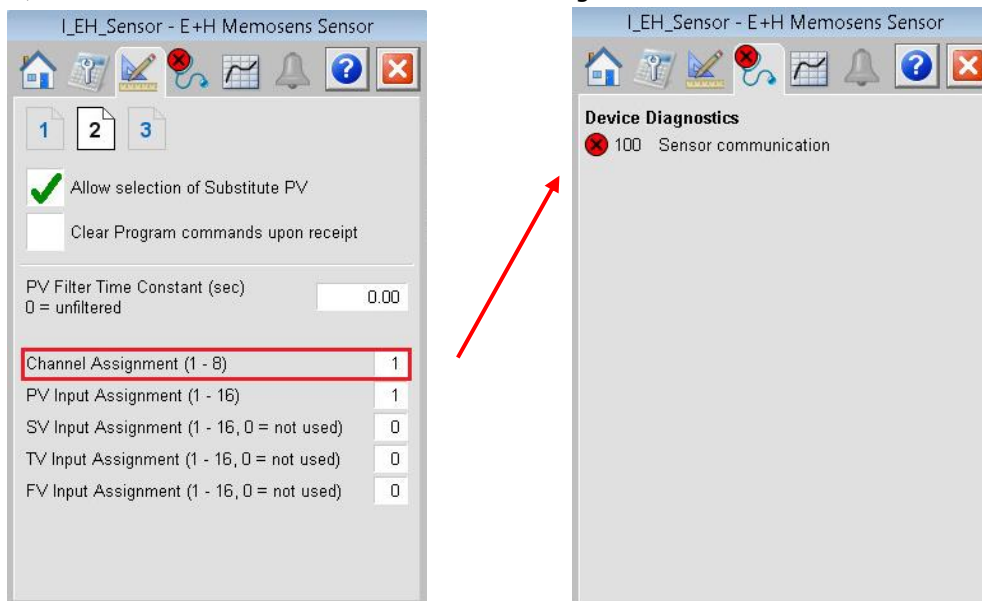


- Example of diagnostics:



Remarks regarding the Liquiline:

- The first time the Liquiline Faceplate is started, the diagnostic parameter "Channel Assignment (1-8)" has the value "0". This value must be configured on the Slot, on which is connected the sensor:



Only one sensor diagnostics can be displayed at the same time. Channel Assignment value "1" means that the sensor is connected on Slot1 and configured for the diagnostics.

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":

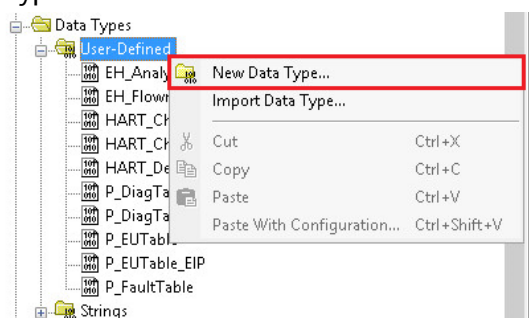
Table 94 - Reply Packet - Request Succeeded

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

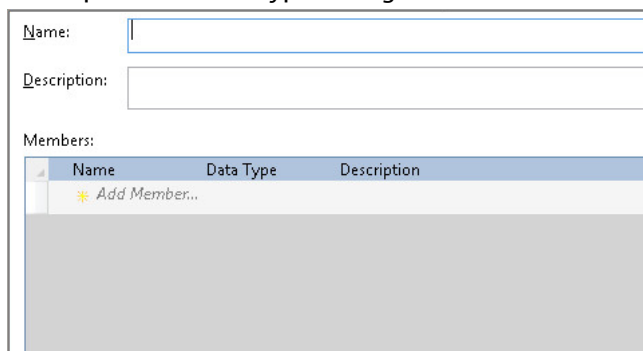
Reply Size = Instance 1...8: 2...28 bytes; Instance 0: 224 bytes. If sent to Instance 0, all channels of the module are included in the response, which results in 28 bytes per channel. This total is due to 27 bytes of response to the HART Read Additional Status plus 1 byte of pad to align the data to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



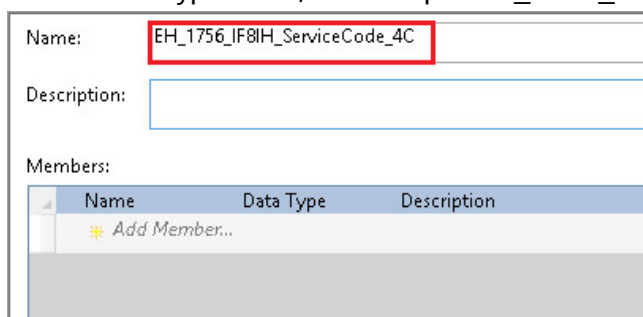
Name:

Description:

Members:

Name	Data Type	Description
* Add Member...		

- Enter a data type name, for example "EH_1756_IF8IH_ServiceCode_4C":



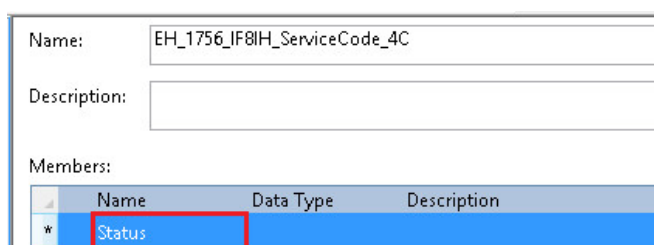
Name:

Description:

Members:

Name	Data Type	Description
* Add Member...		

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



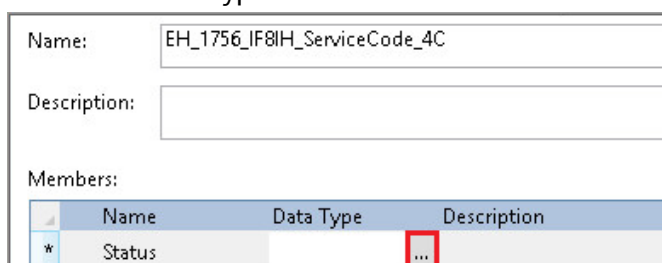
Name:

Description:

Members:

Name	Data Type	Description
* Status		

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



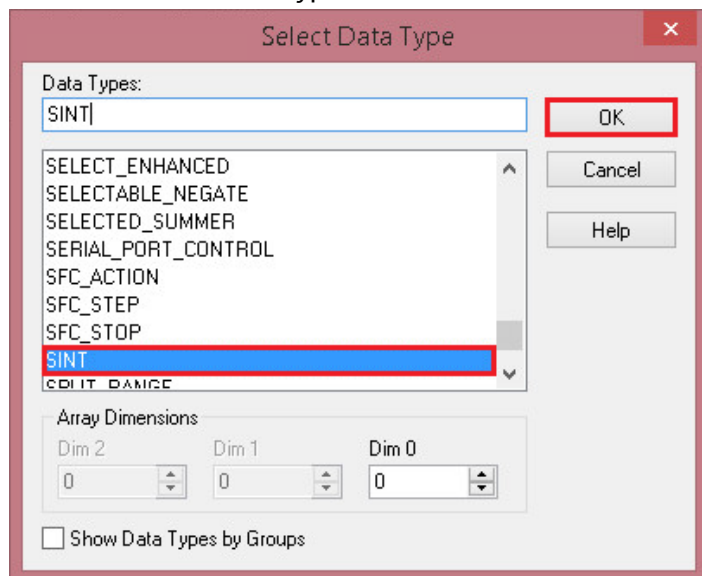
Name:

Description:


Members:

Name	Data Type	Description
* Status		...


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



- "Status" data type is set:

Name:	EH_1756_IF8IH_ServiceCode_4C			
Description:				
Members:				
		Name	Data Type	Description
*		Status	SINT	

- Description may be added as well:

Name:	EH_1756_IF8IH_ServiceCode_4C			
Description:				
Members:				
		Name	Data Type	Description
*		Status	SINT	Command Status

- Repeat the previous steps for all members:

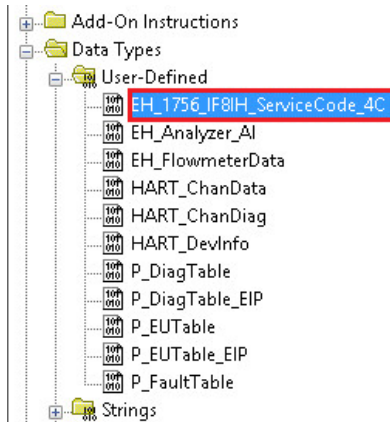
Members:

	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":



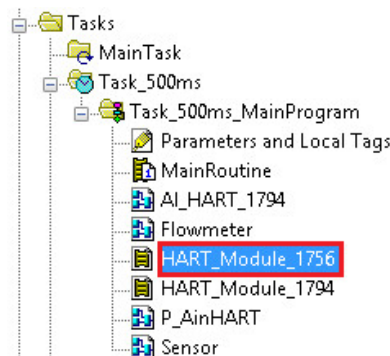
- New data type “EH_1756_IF8IH_ServiceCode_4C” appears in the list:



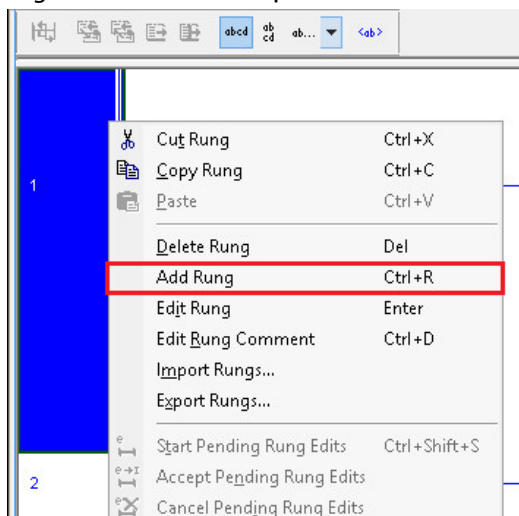
4.3.2.1.2 CIP Message Configuration

The next step consists in configuring the CIP message function block. In this example, this block will be implemented for example in the routine “HART_Module_1756” used for the AOI.

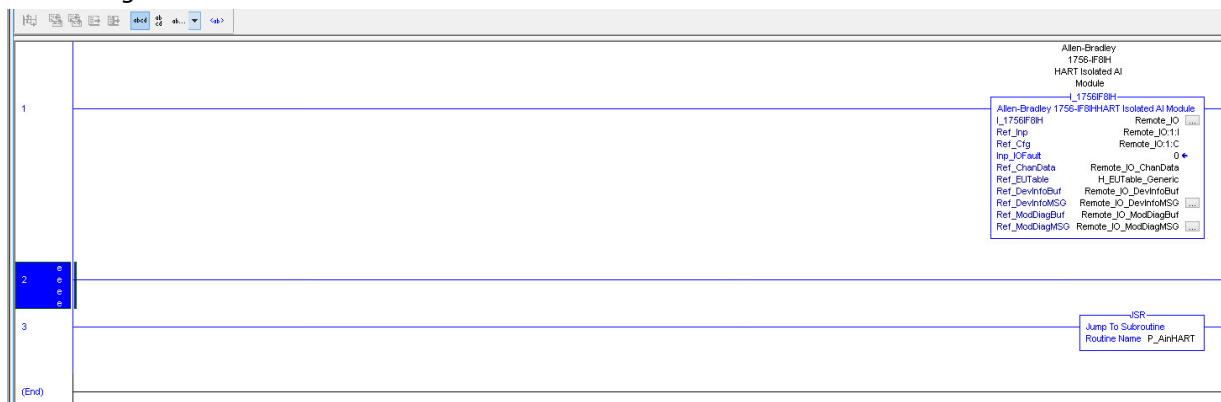
- Double-click on the routine “HART_Module_1756” to open it:



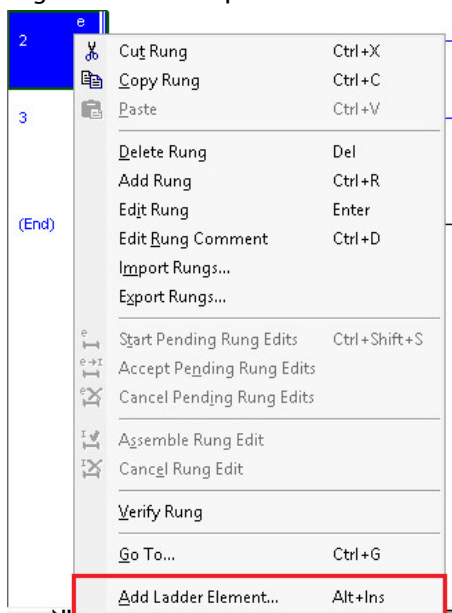
- Right-click on the Step1 and select the menu:



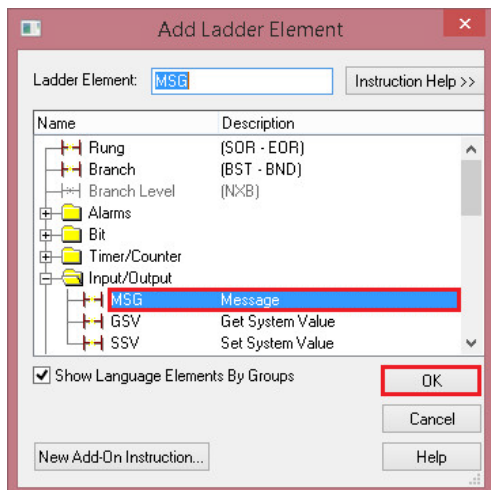
- New Rung is inserted:



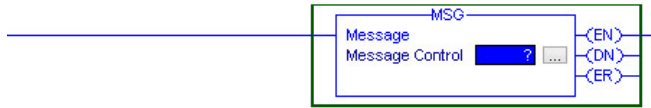
- Right-click on Step2 and select the menu "Add Ladder Element":



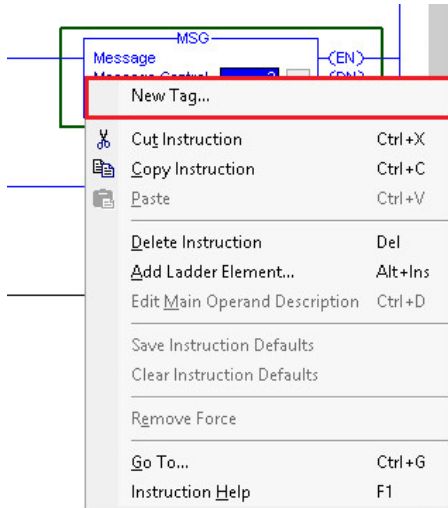
- Select the ladder element "MSG" and click on the button "OK":



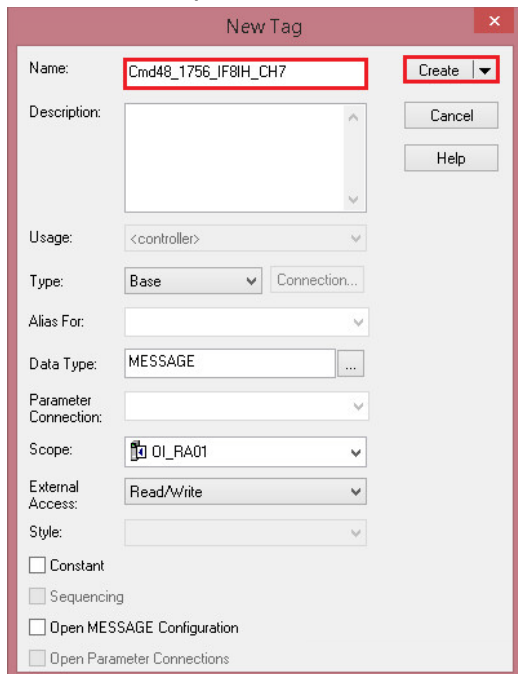
- Ladder element is inserted in the routine:



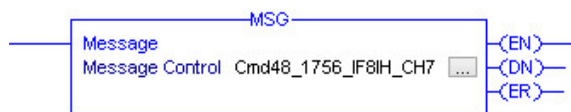
- Right-click on the Message Control field and select the menu "New Tag...":



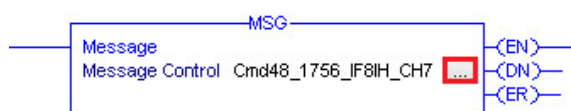
- Enter for example the name "CMD48_1756_IF8IH_CH7" and click on the button "Create":



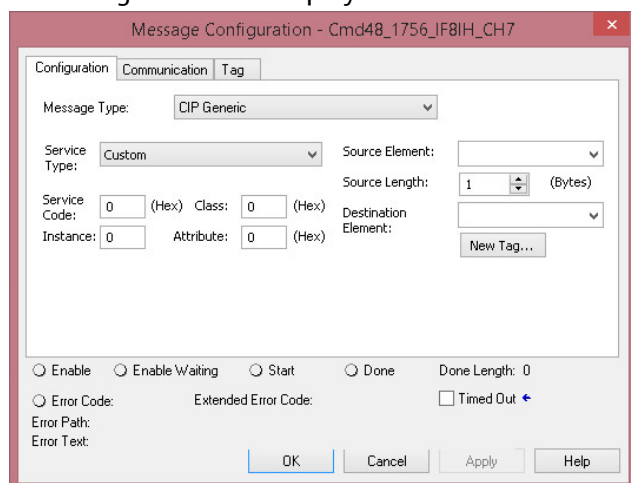
- This sets the Tag name:



- 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”:

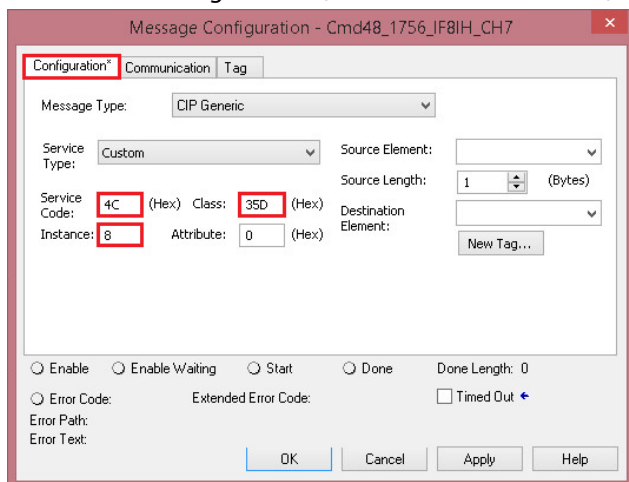
This table shows channel and instance correspondence.

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:



Message Configuration - Cmd48_1756_JF8IH_CH7

Configuration* Communication Tag

Message Type: CIP Generic

Service Type: Custom

Service Code: 4C (Hex) Class: 35D (Hex)

Instance: 8 Attribute: 0

Source Element:

Source Length: 1 (Bytes)

Destination Element:

New Tag...

☐ Enable
 ☐ Enable Waiting
 ☐ Start
 ☐ Done
 Done Length: 0

☐ Error Code:
 Extended Error Code:
 ☐ Timed Out

Error Path:

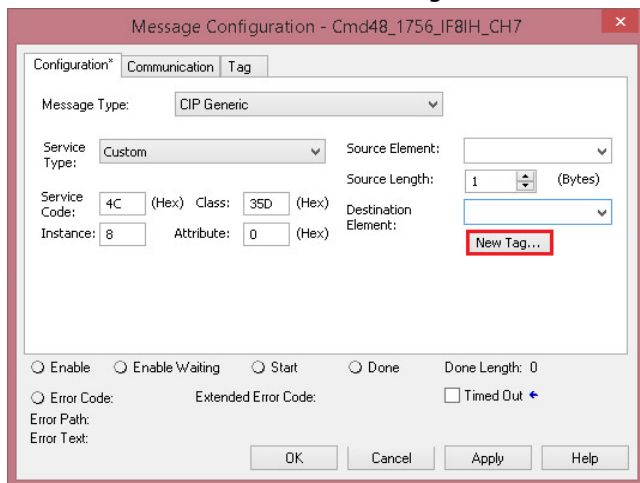
Error Text:

OK Cancel Apply Help

In this example, the aim is to send HART CMD48 on channel7, that means:

- Service Code = 16#4C
- Instance = 8 (this corresponds to channel7)
- Class = 16#35D

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



Message Configuration - Cmd48_1756_JF8IH_CH7

Configuration* Communication Tag

Message Type: CIP Generic

Service Type: Custom

Service Code: 4C (Hex) Class: 35D (Hex)

Instance: 8 Attribute: 0

Source Element:

Source Length: 1 (Bytes)

Destination Element:

New Tag...

☐ Enable
 ☐ Enable Waiting
 ☐ Start
 ☐ Done
 Done Length: 0

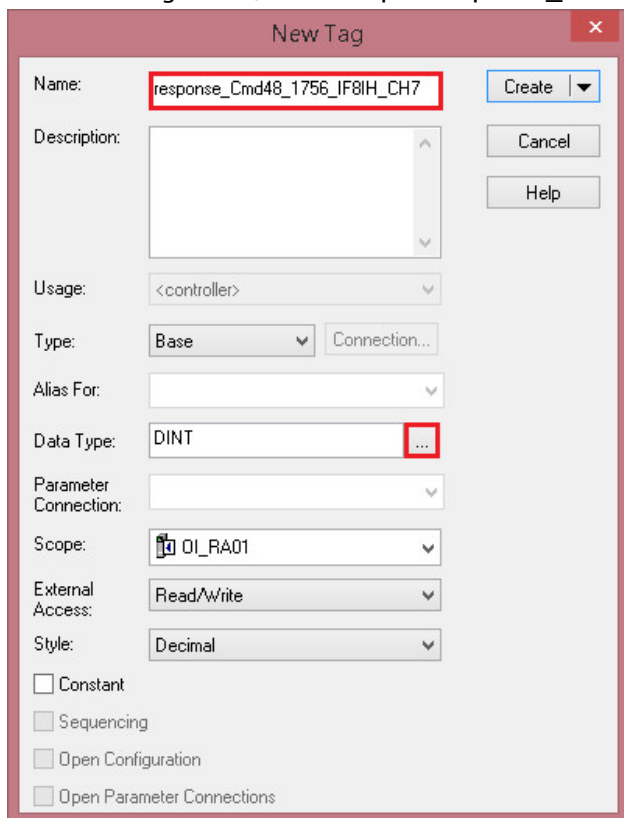
☐ Error Code:
 Extended Error Code:
 ☐ Timed Out

Error Path:

Error Text:

OK Cancel Apply Help

- Enter the Tag name, for example "response_Cmd48_1756_IF8IH_CH7":

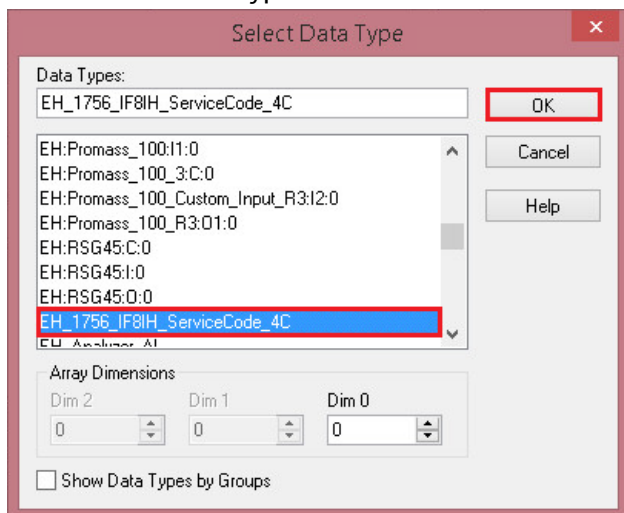


The "New Tag" dialog box is shown with the following fields and values:

- Name:** response_Cmd48_1756_IF8IH_CH7 (highlighted with a red box)
- Description:** (empty text area)
- Usage:** <controller>
- Type:** Base (dropdown menu)
- Alias For:** (empty dropdown menu)
- Data Type:** DINT (dropdown menu, with a red box around the selection button)
- Parameter Connection:** (empty dropdown menu)
- Scope:** OI_RA01 (dropdown menu)
- External Access:** Read/Write (dropdown menu)
- Style:** Decimal (dropdown menu)
- ☐ Constant
- ☐ Sequencing
- ☐ Open Configuration
- ☐ Open Parameter Connections

Buttons on the right: Create (dropdown), Cancel, Help.

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



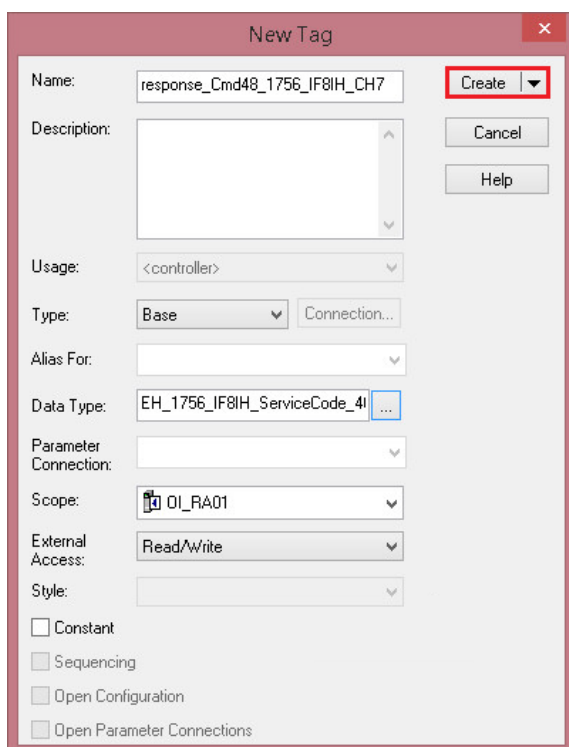
The "Select Data Type" dialog box is shown with the following fields and values:

- Data Types:** EH_1756_IF8IH_ServiceCode_4C (highlighted with a red box)
- Array Dimensions:** Dim 2: 0, Dim 1: 0, Dim 0: 0
- ☐ Show Data Types by Groups

Buttons on the right: OK (highlighted with a red box), Cancel, Help.

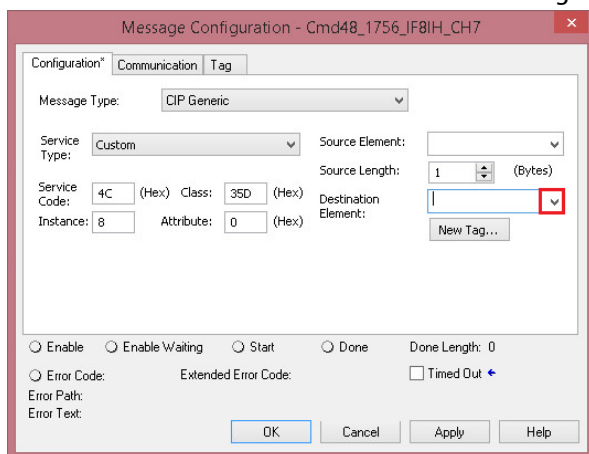
Click on the button "OK".

- Click on the button "Create":



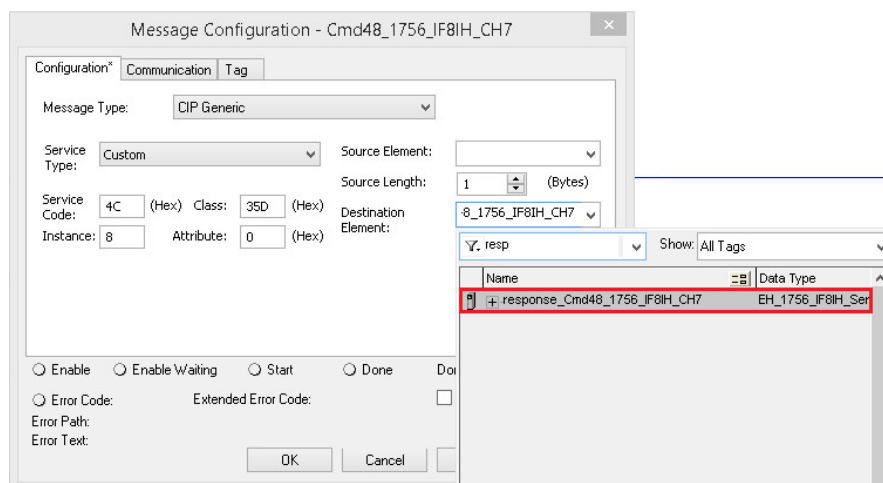
The "New Tag" dialog box is shown. The "Name" field contains "response_Cmd48_1756_IF8IH_CH7". The "Create" button is highlighted with a red box. Other fields include "Description", "Usage" (set to "<controller>"), "Type" (set to "Base"), "Alias For", "Data Type" (set to "EH_1756_IF8IH_ServiceCode_4I"), "Parameter Connection", "Scope" (set to "OI_RA01"), "External Access" (set to "Read/Write"), and "Style". There are also checkboxes for "Constant", "Sequencing", "Open Configuration", and "Open Parameter Connections".

- Click on the list box to search the created Tag "response_Cmd48_1756_IF8IH_CH7":

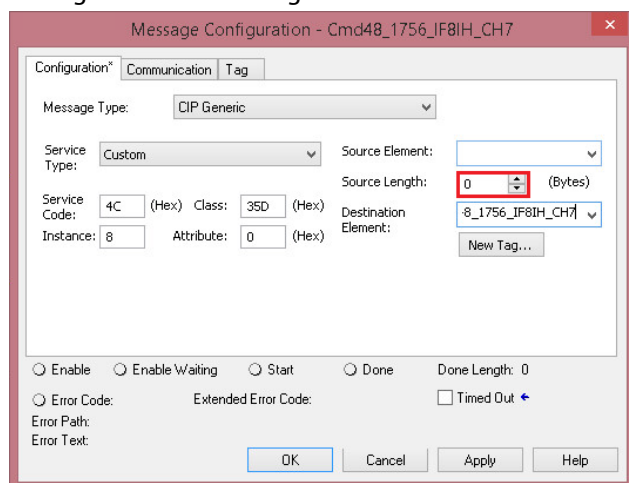


The "Message Configuration - Cmd48_1756_IF8IH_CH7" dialog box is shown. The "Configuration" tab is active. The "Message Type" is set to "CIP Generic". The "Service Type" is set to "Custom". The "Service Code" is set to "4C (Hex)" and the "Class" is set to "35D (Hex)". The "Instance" is set to "8" and the "Attribute" is set to "0 (Hex)". The "Source Element" is set to "1" (Bytes). The "Destination Element" list box is highlighted with a red box. The "New Tag..." button is visible. At the bottom, there are radio buttons for "Enable", "Enable Waiting", "Start", and "Done", and a "Done Length" field set to "0". There are also checkboxes for "Error Code", "Extended Error Code", and "Timed Out".

- Search the Tag "response_Cmd48_1756_IF8IH_CH7" and double-click on it to assign the Destination Element:



- Change the Source length to "0":

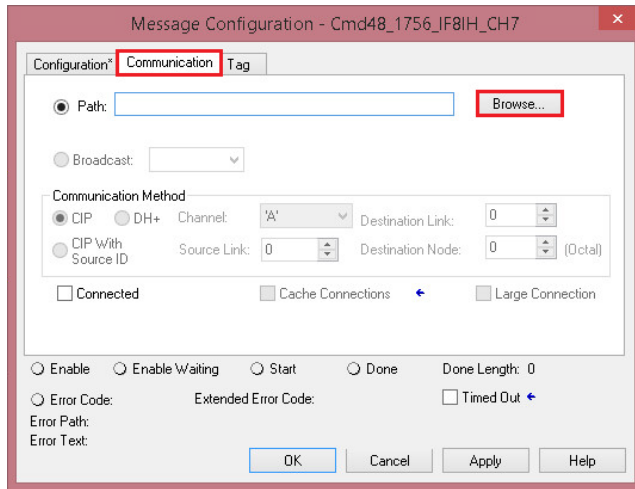


This information (Request size = 0 bytes) is specified in the ControlLogix HART Analog I/O Modules user manual in the chapter "Read Additional Status (Service Code = 16#4C)":

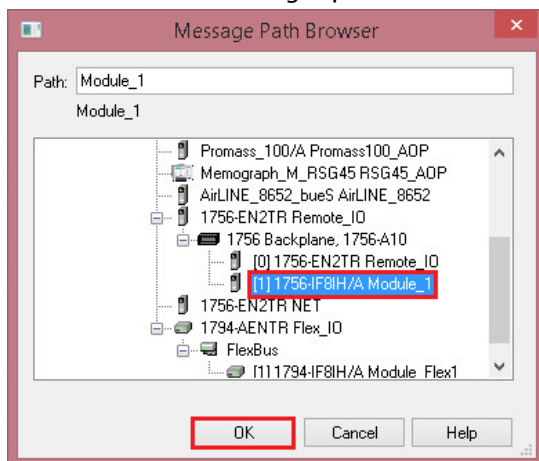
Table 92 - Request Packet

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

- Click on the tab "Communication" and on the button "Browse":

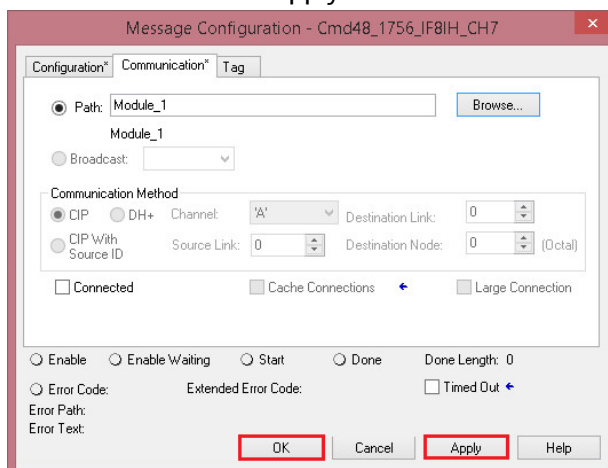


- Select the HART analog input module 1756-IF8IH on which is connected the device:

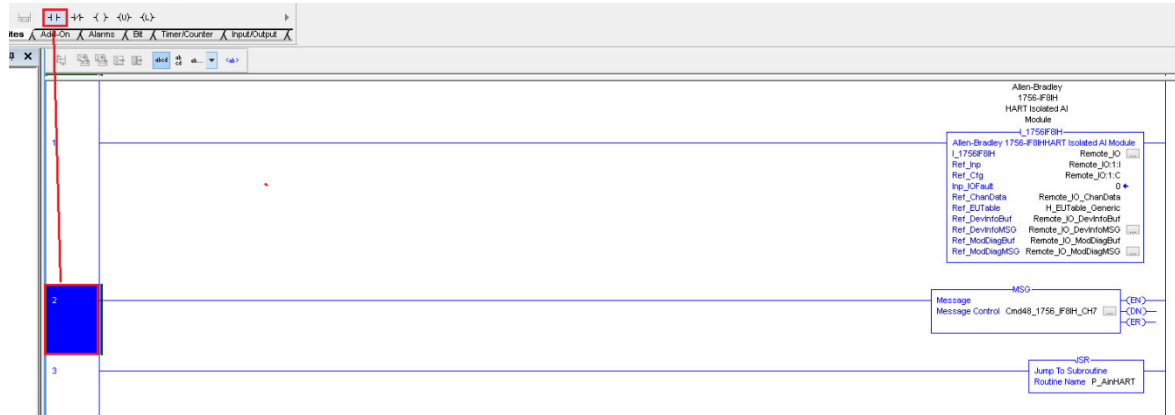


Click on the button "OK".

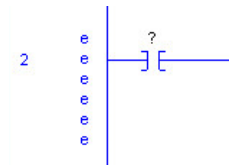
- Click on the buttons "Apply" and "OK":



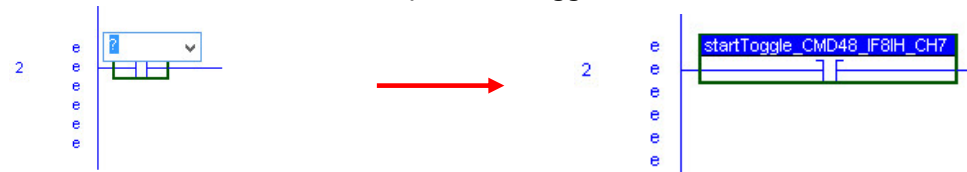
- Click on the Step 2 and add a ladder element "Examine on" to toggle the read of the function:



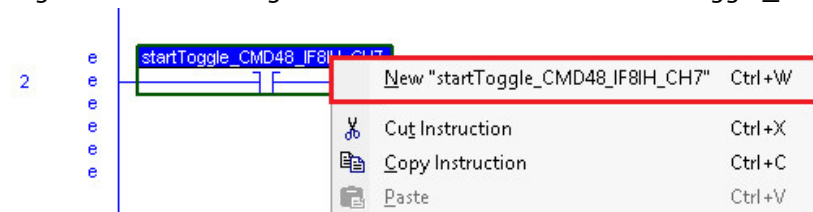
- Inserted ladder element:



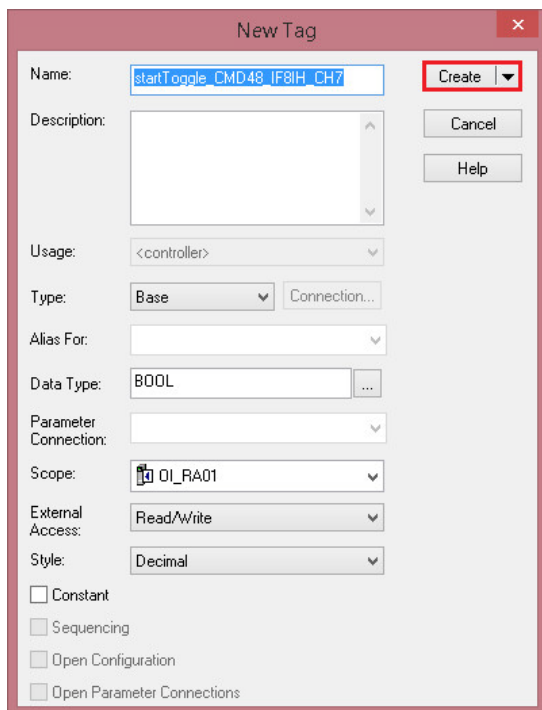
- Enter a variable name, for example "startToggle_CMD48_IF8IH_CH7":



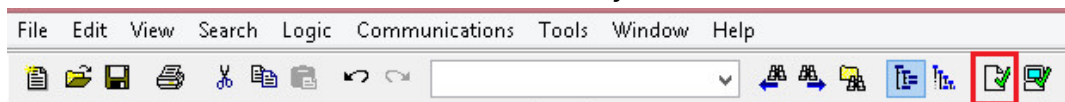
- Right-click on the Tag and select the menu "New startToggle_CMD48_IF8IH_CH7":



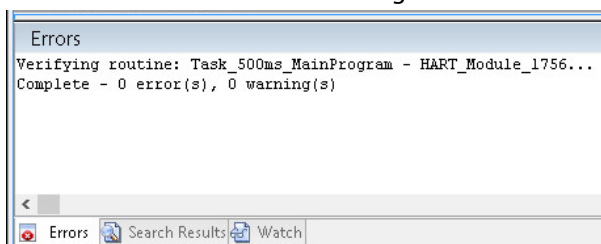
- Click on the button "Create":



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



- Check the result in the Error diagnostic window:



- 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:

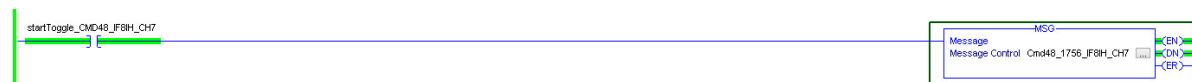


- Select the variable "startToggle_CMD48_IF8IH_CH7" and set the value to "1":

Scope: Show:

Name	Value	Force Mask	Style	Data Type
startToggle_CMD48_IF8IH_CH7	1		Decimal	BOOL


- No errors are detected in the function block:



- Select the variable "response_Cmd48_1756_IF8IH_CH7" to display the read values:

Scope:	OI_RA01	Show:	All Tags	
Name	Value	Force Mask	Style	Data Type
response_Cmd48_1756_IF8IH_CH7	{...}	{...}		EH_1756_IF8IH_ServiceCode_4C
response_Cmd48_1756_IF8IH_CH7.Status	0		Decimal	SINT
response_Cmd48_1756_IF8IH_CH7.Count	25		Decimal	SINT
response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_00	0		Decimal	SINT
response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_01	0		Decimal	SINT
response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_02	0		Decimal	SINT
response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_03	0		Decimal	SINT
response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_04	0		Decimal	SINT
response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_05	0		Decimal	SINT
response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_06	2		Decimal	SINT
response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_07	0		Decimal	SINT
response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_08	0		Decimal	SINT
response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_09	0		Decimal	SINT
response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_10	0		Decimal	SINT
response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_11	0		Decimal	SINT
response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_12	0		Decimal	SINT
response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_13	0		Decimal	SINT
response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_14	0		Decimal	SINT
response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_15	0		Decimal	SINT
response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_16	0		Decimal	SINT
response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_17	0		Decimal	SINT
response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_18	0		Decimal	SINT
response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_19	0		Decimal	SINT
response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_20	0		Decimal	SINT
response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_21	0		Decimal	SINT
response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_22	0		Decimal	SINT
response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_23	0		Decimal	SINT
response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_24	0		Decimal	SINT
response_Cmd48_1756_IF8IH_CH7.Pad	0		Decimal	SINT

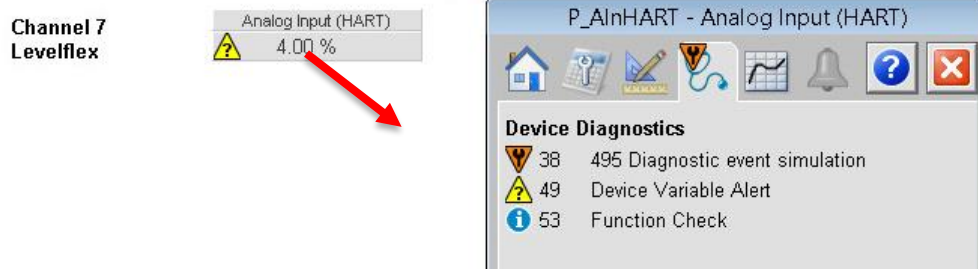
- Read of CMD48 after a Diagnostic Event 801 simulation (from the device):

Scope:  OI_RA01		Show: All Tags		
Name	Value	Force Mask	Style	Data Type
- response_Cmd48_1756_IF8IH_CH7	{...}	{...}		EH_1756_IF8IH_ServiceCode_4C
+ response_Cmd48_1756_IF8IH_CH7.Status	0		Decimal	SINT
+ response_Cmd48_1756_IF8IH_CH7.Count	25		Decimal	SINT
+ response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_00	0		Decimal	SINT
+ response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_01	0		Decimal	SINT
+ response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_02	0		Decimal	SINT
+ response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_03	0		Decimal	SINT
+ response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_04	64		Decimal	SINT
+ response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_05	0		Decimal	SINT
+ response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_06	34		Decimal	SINT
+ response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_07	0		Decimal	SINT
+ response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_08	17		Decimal	SINT
+ response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_09	0		Decimal	SINT
+ response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_10	0		Decimal	SINT
+ response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_11	0		Decimal	SINT
+ response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_12	0		Decimal	SINT
+ response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_13	0		Decimal	SINT
+ response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_14	0		Decimal	SINT
+ response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_15	0		Decimal	SINT
+ response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_16	4		Decimal	SINT
+ response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_17	0		Decimal	SINT
+ response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_18	0		Decimal	SINT
+ response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_19	0		Decimal	SINT
+ response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_20	0		Decimal	SINT
+ response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_21	0		Decimal	SINT
+ response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_22	0		Decimal	SINT
+ response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_23	0		Decimal	SINT
+ response_Cmd48_1756_IF8IH_CH7.Ext_Status_Byte_24	0		Decimal	SINT
+ response_Cmd48_1756_IF8IH_CH7.Pad	0		Decimal	SINT

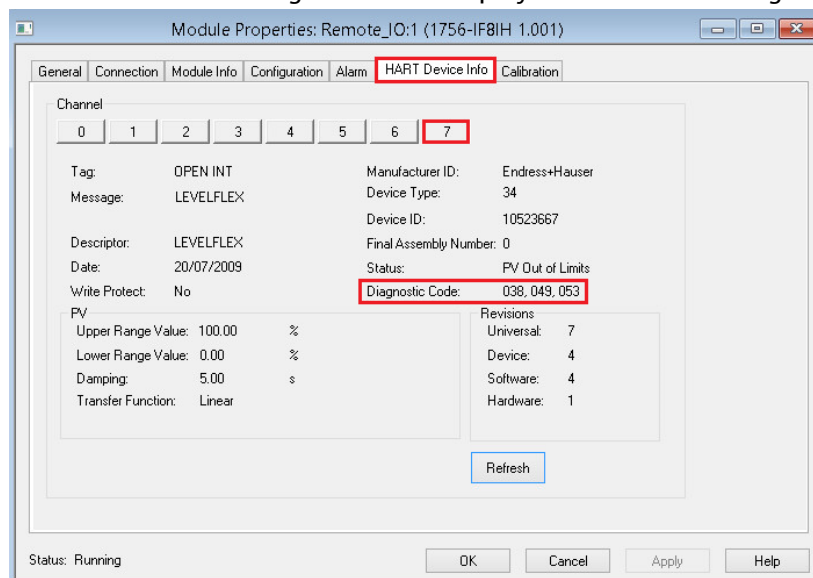
- Refer to the device specification for decoding byte0 to 5 and byte14 to 24 as well as the HART specification for decoding byte6 to 13.
- Decoding for this example:
 - Byte4 = (64)₁₀ = 0x40 → "Diagnostic Event Simulation" (Diagnostic number 495).
 - Byte6 = (34)₁₀ = 0x22 → "Function Check" and "Device 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).

Remarks

- If the device AOI and faceplate are configured, part of these data are displayed in the faceplate in a text format as well:



- These three device diagnostics are displayed in the ControlLogix 1756-IF8IH AOP as well:



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":

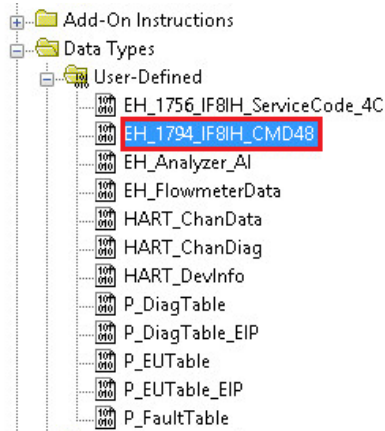
Name:

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:

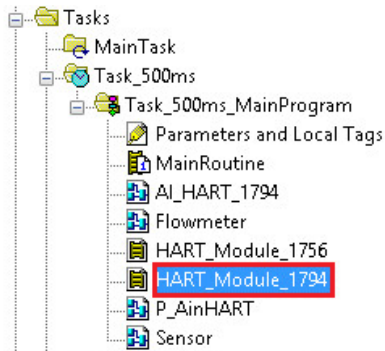


4.3.2.2.2 CIP Message Configuration

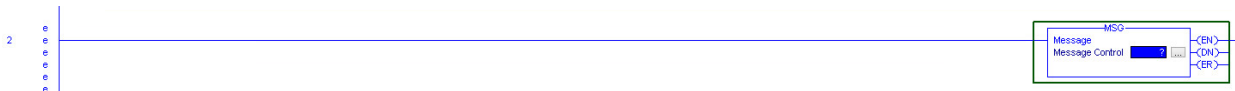
The next step consists in configuring the CIP message function block. In this example, this block will be implemented in the routine “HART_Module_1794” used for the AOI.

For detailed steps, please refer to chapter 4.3.2.1.2.

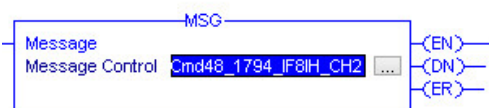
- Double-click on the routine “HART_Module_1794” to open it:



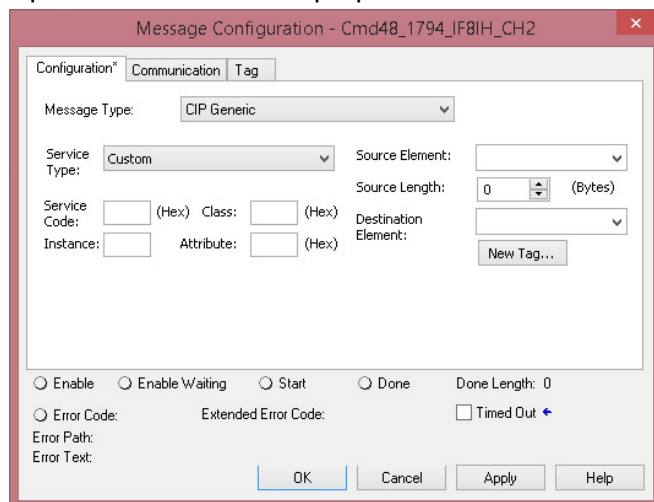
- Insert a new rung as well as the function block “MSG”:



- Create a new Tag for this function block:



- Open the function block properties:



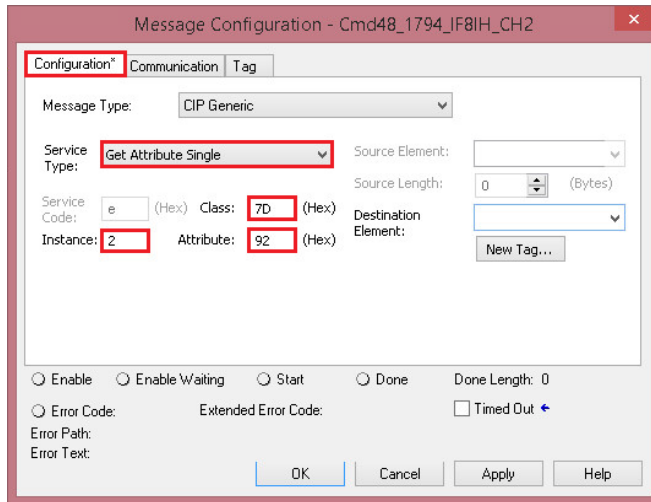
- “Service Type”, “Instance”, “Class” and “Attribute” parameters are defined in the FLEX I/O Isolated Input/Output HART Analog Modules user manual in the chapter “Get Device Information 4 Message”:

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 the tab "Configuration", set the "Service Type", "Instance", "Class" and "Attribute" parameters:



Message Configuration - Cmd48_1794_IF8IH_CH2

Configuration* Communication Tag

Message Type: CIP Generic

Service Type: Get Attribute Single

Source Element:

Source Length: 0 (Bytes)

Service Code: e (Hex) Class: 7D (Hex) Destination Element:

Instance: 2 Attribute: 92 (Hex)

New Tag...

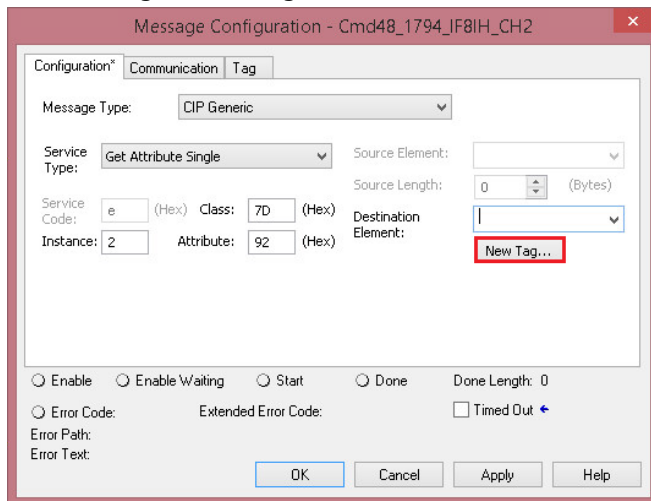
Enable Enable Waiting Start Done Done Length: 0

Error Code: Extended Error Code: Timed Out

Error Path: Error Text:

OK Cancel Apply Help

- Then configure the Tag of Destination Element:



Message Configuration - Cmd48_1794_IF8IH_CH2

Configuration* Communication Tag

Message Type: CIP Generic

Service Type: Get Attribute Single

Source Element:

Source Length: 0 (Bytes)

Service Code: e (Hex) Class: 7D (Hex) Destination Element:

Instance: 2 Attribute: 92 (Hex)

New Tag...

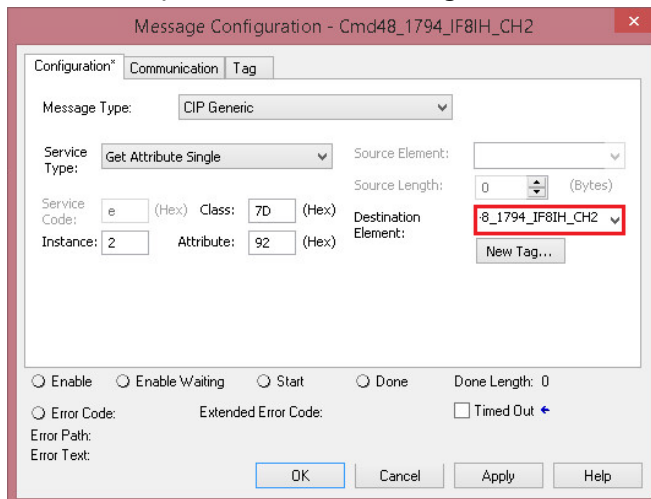
Enable Enable Waiting Start Done Done Length: 0

Error Code: Extended Error Code: Timed Out

Error Path: Error Text:

OK Cancel Apply Help

- In this example, the Destination Tag is "Cmd48_1794_IF8IH_CH2":



Message Configuration - Cmd48_1794_IF8IH_CH2

Configuration* Communication Tag

Message Type: CIP Generic

Service Type: Get Attribute Single

Source Element:

Source Length: 0 (Bytes)

Service Code: e (Hex) Class: 7D (Hex) Destination Element: 8_1794_IF8IH_CH2

Instance: 2 Attribute: 92 (Hex)

New Tag...

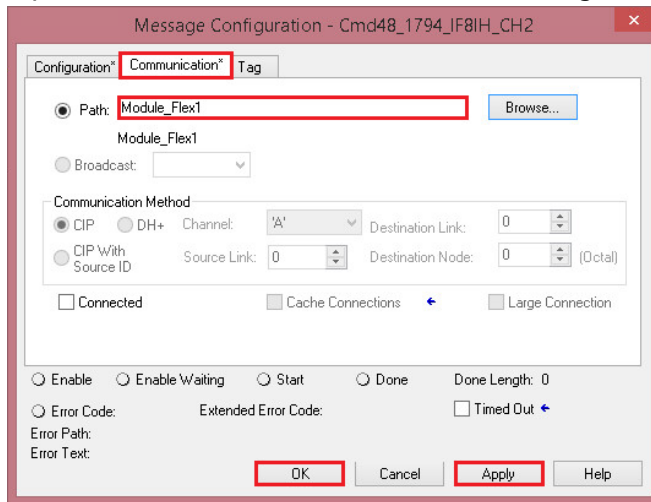
Enable Enable Waiting Start Done Done Length: 0

Error Code: Extended Error Code: Timed Out

Error Path: Error Text:

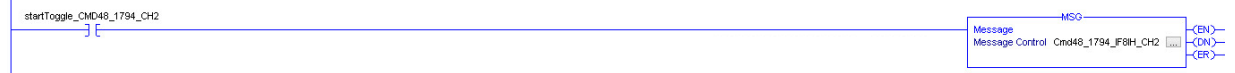
OK Cancel Apply Help

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



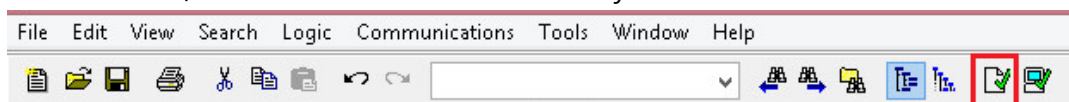
Click on the button "Apply" and "OK".

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

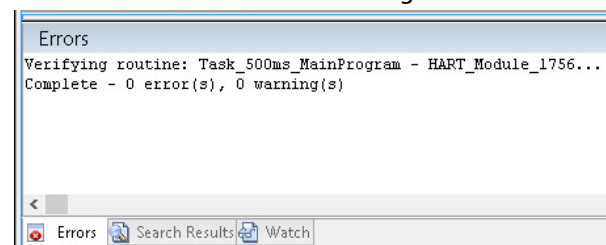


In this example, the Tag of this "Examine on" element is "startToggle_CMD48_1794".

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



- Check the result in the Error diagnostic window:



- 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 "startToggle_CMD48_1794_CH2" and set the value to "1":

Scope: Show: All Tags

	Name	Value	Force Mask	Style	Data Type
*	startToggle_CMD48_1794_CH2	1		Decimal	BOOL

- Select the variable "response_Cmd48_1794_IF8IH_CH2" to display the read values:

Scope: OI_RA01 Show: All Tags

Name	Value	Force Mask	Style	Data Type
response_Cmd48_1794_IF8IH_CH2	{...}	{...}		EH_1794_IF8IH_CMD48
+ response_Cmd48_1794_IF8IH_CH2.Status	0		Decimal	SINT
+ response_Cmd48_1794_IF8IH_CH2.Echo_of_Channel	1		Decimal	SINT
+ response_Cmd48_1794_IF8IH_CH2.pad1	0		Decimal	SINT
+ response_Cmd48_1794_IF8IH_CH2.pad2	0		Decimal	SINT
response_Cmd48_1794_IF8IH_CH2.Loop_Current	19.959131		Float	REAL
+ response_Cmd48_1794_IF8IH_CH2.Count	0		Decimal	DINT
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_00	0		Decimal	SINT
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_01	0		Decimal	SINT
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_02	0		Decimal	SINT
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_03	0		Decimal	SINT
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_04	0		Decimal	SINT
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_05	0		Decimal	SINT
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_06	0		Decimal	SINT
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_07	0		Decimal	SINT
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_08	0		Decimal	SINT
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_09	0		Decimal	SINT
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_10	0		Decimal	SINT
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_11	0		Decimal	SINT
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_12	0		Decimal	SINT
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_13	0		Decimal	SINT
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_14	0		Decimal	SINT
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_15	0		Decimal	SINT
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_16	0		Decimal	SINT
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_17	0		Decimal	SINT
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_18	0		Decimal	SINT
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_19	0		Decimal	SINT
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_20	0		Decimal	SINT
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_21	0		Decimal	SINT
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_22	0		Decimal	SINT
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_23	0		Decimal	SINT
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_24	0		Decimal	SINT
+ response_Cmd48_1794_IF8IH_CH2.pad3	0		Decimal	SINT

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

Scope: <input type="text" value="OI_RA01"/>		Show: <input type="text" value="All Tags"/>			
Name	Value	Force Mask	Style	Data Type	
- response_Cmd48_1794_IF8IH_CH2	{ ... }	{ ... }		EH_1794_IF8IH_CMD48	
+ response_Cmd48_1794_IF8IH_CH2.Status	0		Decimal	SINT	
+ response_Cmd48_1794_IF8IH_CH2.Echo_of_Channel	1		Decimal	SINT	
+ response_Cmd48_1794_IF8IH_CH2.pad1	0		Decimal	SINT	
+ response_Cmd48_1794_IF8IH_CH2.pad2	0		Decimal	SINT	
- response_Cmd48_1794_IF8IH_CH2.Loop_Current	19.958918		Float	REAL	
+ response_Cmd48_1794_IF8IH_CH2.Count	25		Decimal	DINT	
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_00	0		Decimal	SINT	
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_01	0		Decimal	SINT	
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_02	0		Decimal	SINT	
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_03	0		Decimal	SINT	
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_04	64		Decimal	SINT	
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_05	0		Decimal	SINT	
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_06	32		Decimal	SINT	
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_07	0		Decimal	SINT	
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_08	17		Decimal	SINT	
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_09	0		Decimal	SINT	
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_10	0		Decimal	SINT	
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_11	0		Decimal	SINT	
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_12	0		Decimal	SINT	
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_13	0		Decimal	SINT	
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_14	0		Decimal	SINT	
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_15	0		Decimal	SINT	
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_16	4		Decimal	SINT	
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_17	0		Decimal	SINT	
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_18	0		Decimal	SINT	
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_19	0		Decimal	SINT	
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_20	0		Decimal	SINT	
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_21	0		Decimal	SINT	
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_22	0		Decimal	SINT	
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_23	0		Decimal	SINT	
+ response_Cmd48_1794_IF8IH_CH2.Ext_Status_Byte_24	0		Decimal	SINT	
+ response_Cmd48_1794_IF8IH_CH2.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".

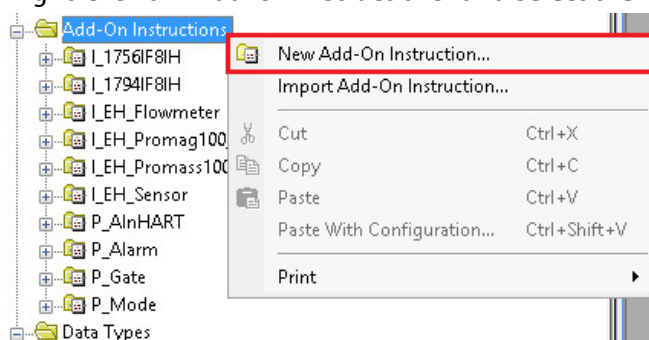
4.3.3.1 CIP Messages Configuration with ControlLogix 1756-IF8IH

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

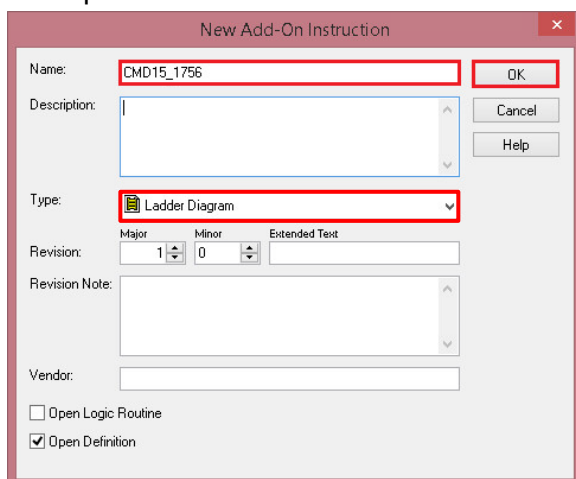
4.3.3.1.1 New Add On Instruction

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...":

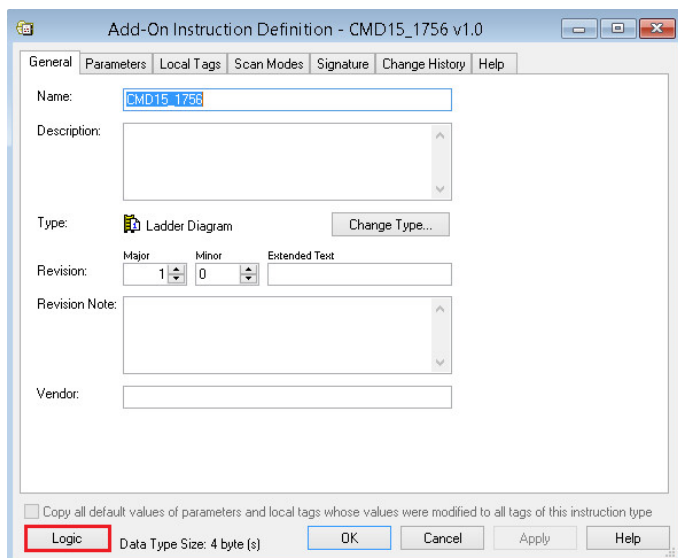


- This opens the window "New Add-On Instruction":



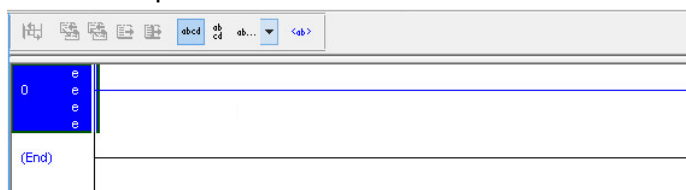
Enter a name and select the programming language. In this example, the AOI name is "CMD15_1756" and the selected programming language is "Ladder Diagram". Then click on the button "OK".

- This creates the window "Add-On Instruction Definition":



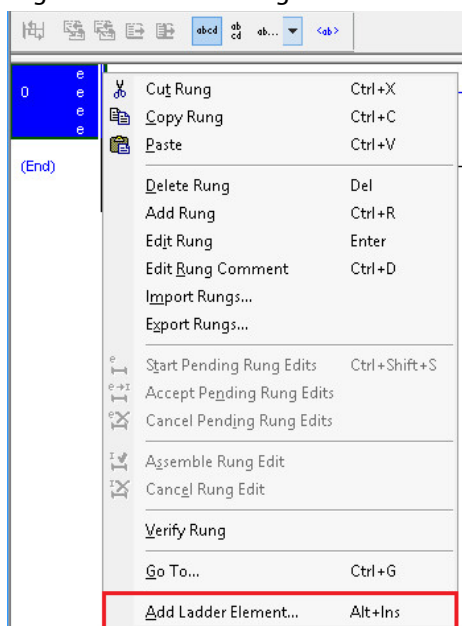
Click on the button "Logic" to access the routine logic window.

- Routine is opened:

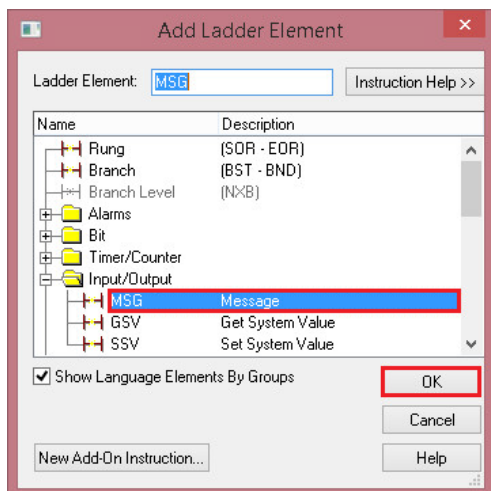


Init and Query Message Function block

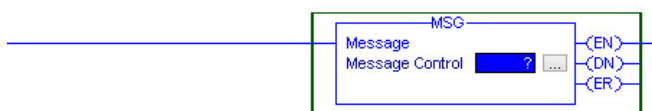
- Right-click on the rung 0 and select the menu "Add Ladder Element":



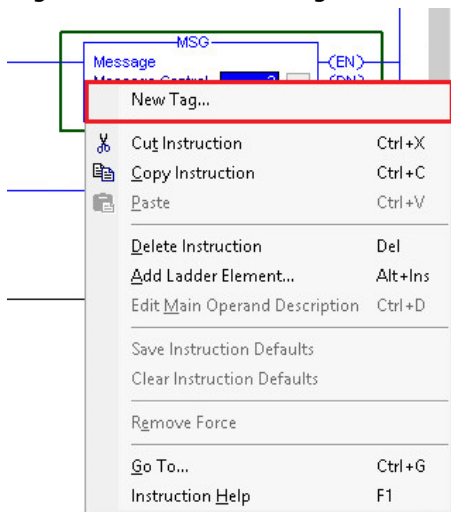
- Select the ladder element “MSG” and click on the button “OK”:



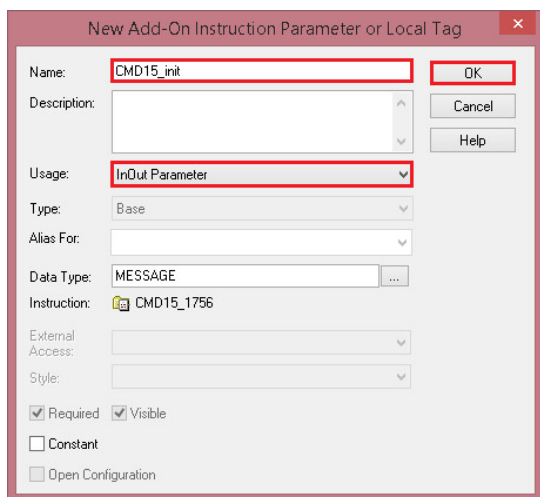
- Ladder element is inserted in the routine:



- 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":



New Add-On Instruction Parameter or Local Tag

Name: **CMD15_init** OK


Description:

Usage: **InOut Parameter** Cancel

Type: Base Help

Alias For:

Data Type: MESSAGE

Instruction:  CMD15_1756

External Access:

Style:

☒ Required ☒ Visible

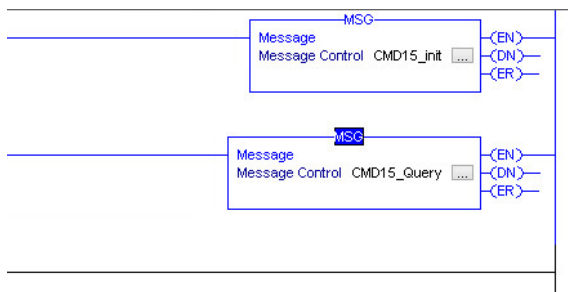
☐ Constant

☐ Open Configuration

MSG function bloc is inserted:



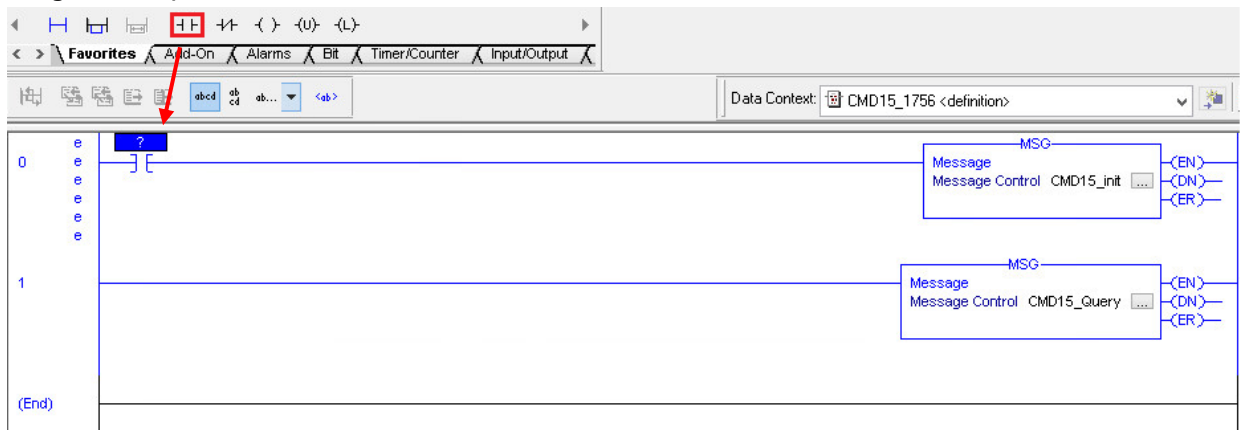
- Repeat the previous steps to add another MSG function block called "CMD15_Query" and defined as a "**InOut Parameter**":



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.

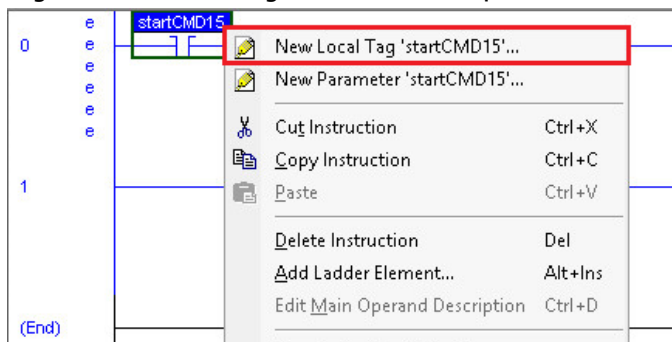
- Drag and drop a "If" ladder element:



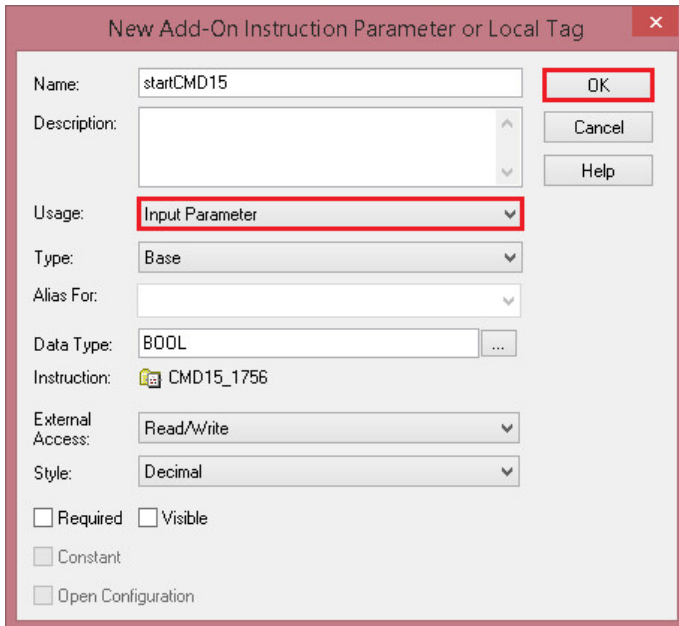
- Enter a Tag, for example "startCMD15":



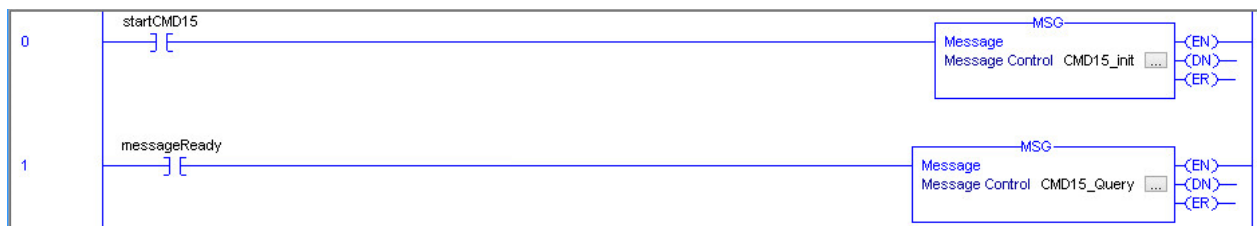
- Right-click on the Tag and select the option "New Local Tag 'startCMD15'":



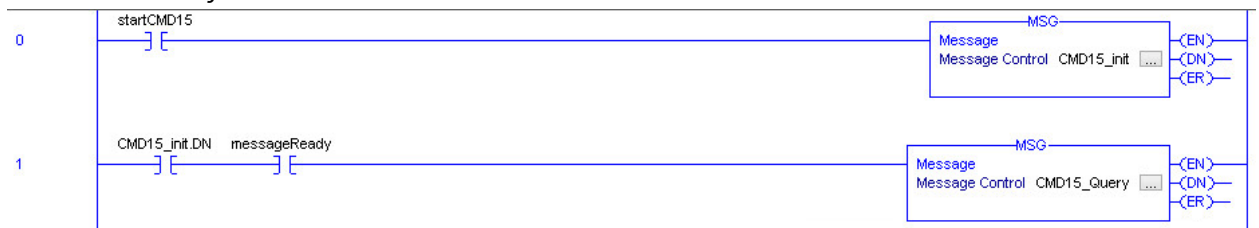
- Select the “Usage” parameter “Input Parameter” and click on the button “OK”:



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

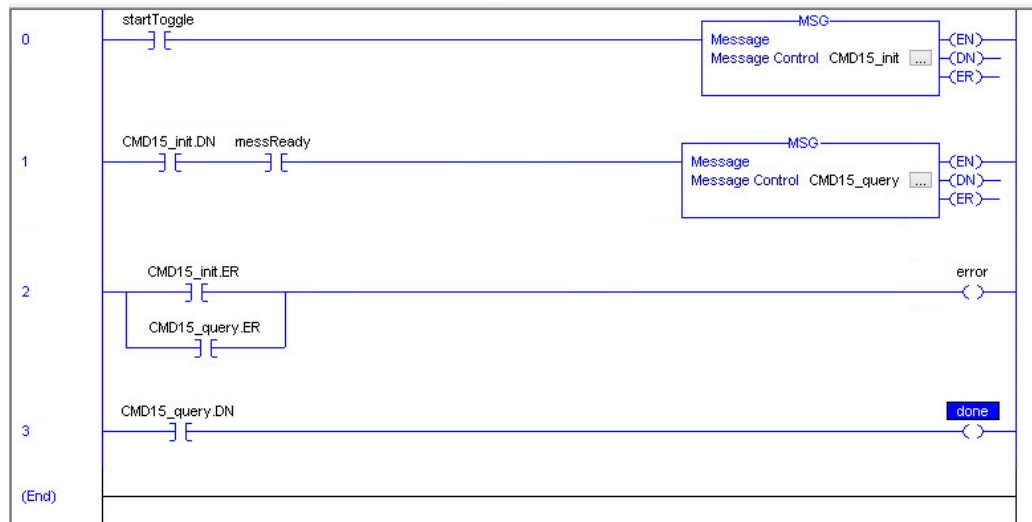


For triggering the second function block, we add in this example a second input, the bit “CMD15_init.DN”. When this bit is set to “TRUE”, this ensures that the CMD15_Init message has been successfully transferred:



Messages Status handling

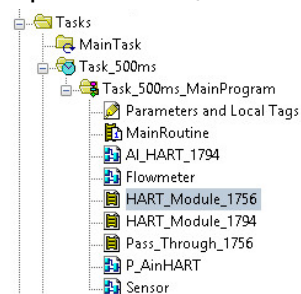
- In this example, the Message function blocks error status is checked as well. If one error occurs, the output Tag "error" (defined as **Output Parameter**) is set to "TRUE" and if there are no errors, the output Tag "done" (defined as **Output Parameter**) is set to "TRUE":



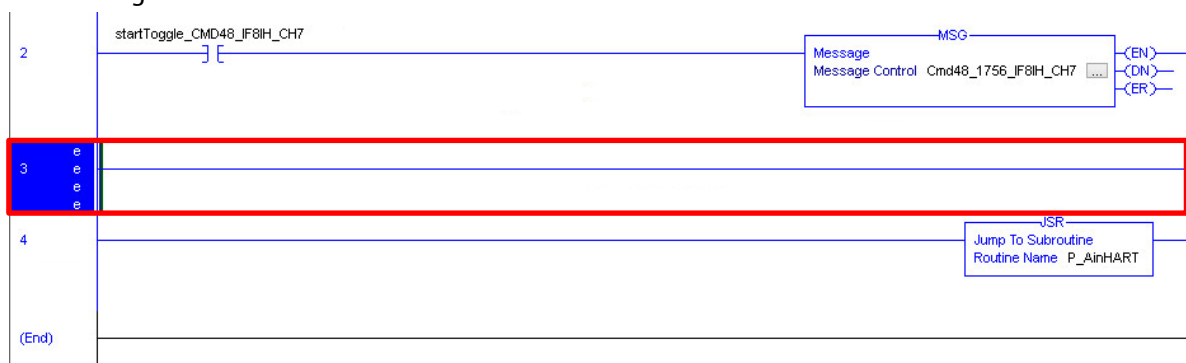
- Save and close the AOI logic "CMD15_1756". The AOI can now be implemented in a routine.

4.3.3.1.2 AOI Tags Assignment

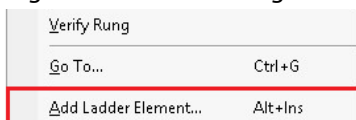
- Open a routine, for example "HART_module_1756":



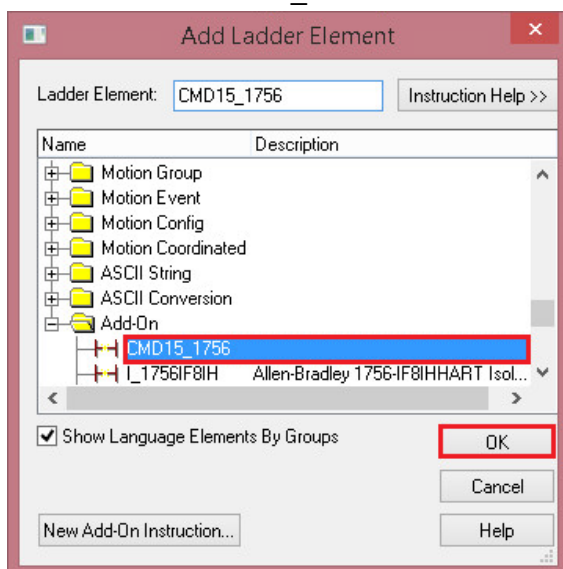
- Add a rung:



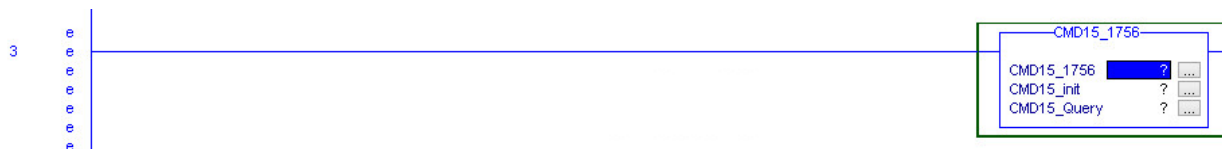
- Right-click on the rung 3 and select the menu "Add Ladder Element":



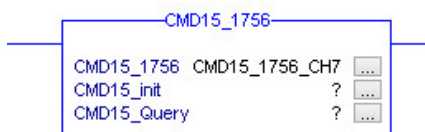
- Insert the AOI "CMD15_1756" and click on the button "OK":



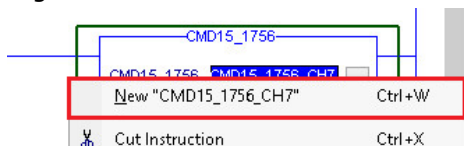
- CMD15 function block is inserted in the routine:



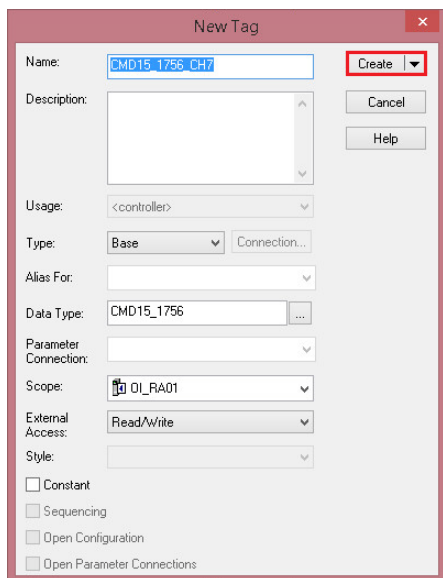
- Enter a Tag for this function block, for example "CMD15_1756_CH7":



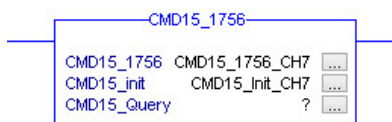
- Right-click on it and select the menu "New "CMD15_1756_CH7"":



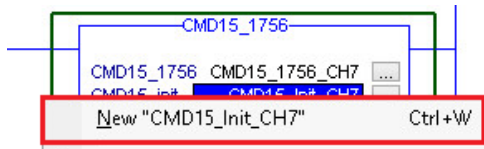
- Click on the button "Create":



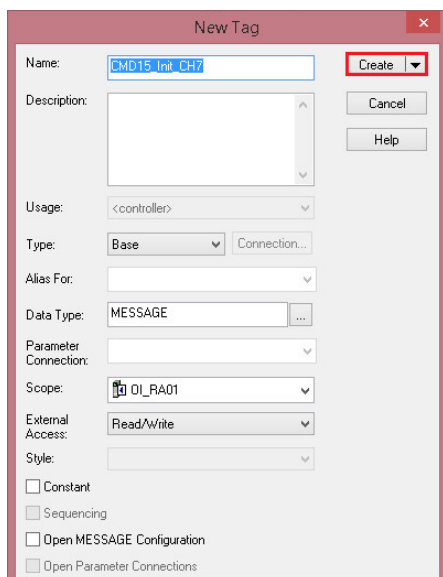
- Enter a Tag for the parameter "CMD15_Init", for example "CMD15_Init_CH7":



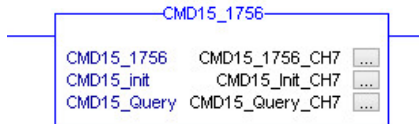
- Right-click on it and select the menu "New "CMD15_Init_CH7"":



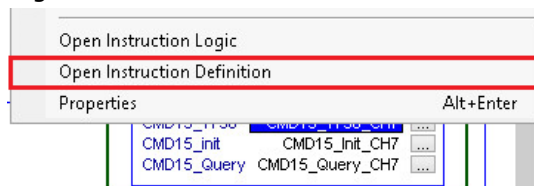
- Click on the button "Create":



- Create as well another "MESSAGE" Tag, "CMD15_Query_CH7" in this example for the function block parameter "CMD15_Query":



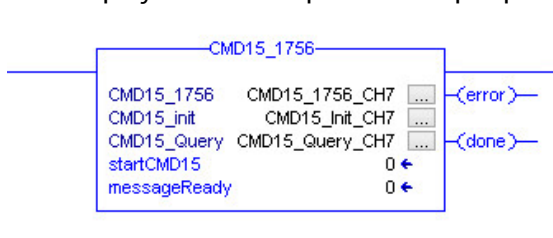
- Right-click on the function block and select the menu "Open Instruction Definition":



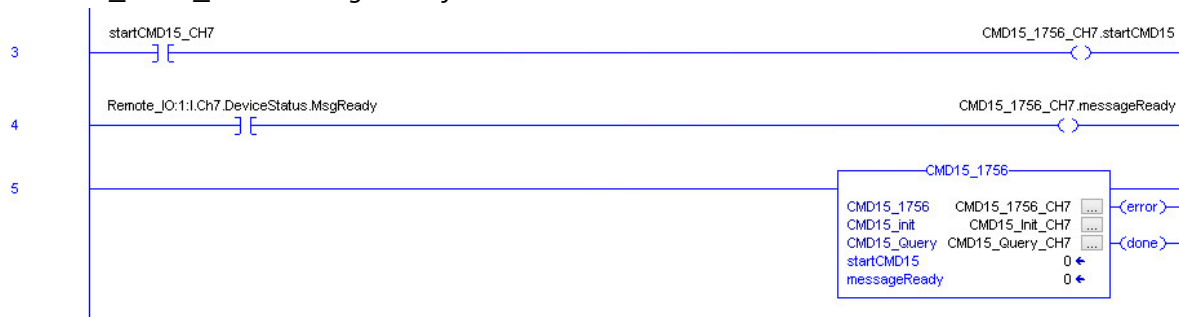
- In the Tab "Parameters", select the input and output variables to display and click on the buttons "Apply" and "OK":

Name	Usage	Data Type	Alias For	Default	Style	Req	Vis	Description	External Access	Constant
EnableIn	Input	BOOL		1	Decimal	<input type="checkbox"/>	<input type="checkbox"/>	Enable Input - Sys...	Read Only	<input type="checkbox"/>
EnableOut	Output	BOOL		0	Decimal	<input type="checkbox"/>	<input type="checkbox"/>	Enable Output - S...	Read Only	<input type="checkbox"/>
CMD15_init	InOut	MESSAGE				<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input type="checkbox"/>
CMD15_Query	InOut	MESSAGE				<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input type="checkbox"/>
startCMD15	Input	BOOL		0	Decimal	<input type="checkbox"/>	<input checked="" type="checkbox"/>		Read/Write	<input type="checkbox"/>
messageReady	Input	BOOL		0	Decimal	<input type="checkbox"/>	<input checked="" type="checkbox"/>		Read/Write	<input type="checkbox"/>
error	Output	BOOL		0	Decimal	<input type="checkbox"/>	<input checked="" type="checkbox"/>		Read Only	<input type="checkbox"/>
done	Output	BOOL		0	Decimal	<input type="checkbox"/>	<input checked="" type="checkbox"/>		Read Only	<input type="checkbox"/>

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



- In two new rungs, initialize the inputs "CMD15_1756_CH7.startCMD15" and "CMD15_1756_CH7.messageReady":



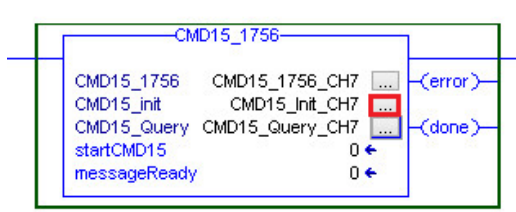
Remark

- The parameter MsgReady is channel specific (Channel7 for this example) and can be found in the ControlLogix 1756-IF8IH DeviceStatus Tags:

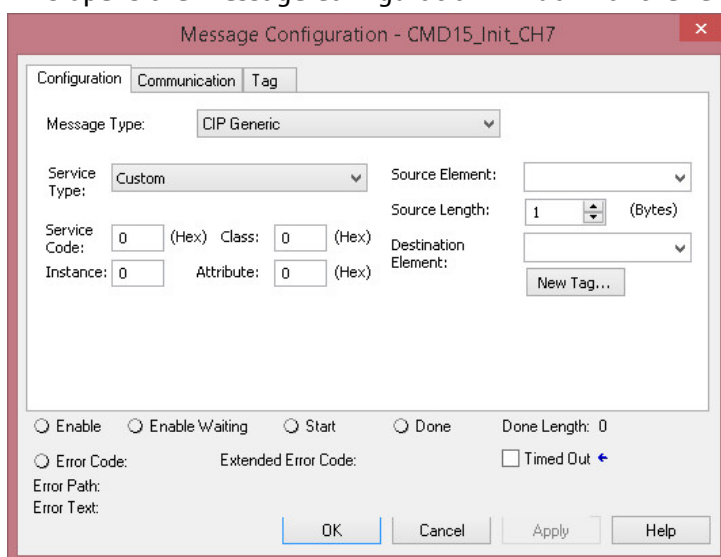
[- Remote_IO:1:I
[- Remote_IO:1:I.Ch7.DeviceStatus
[- Remote_IO:1:I.Ch7.DeviceStatus.HARTInit
[- Remote_IO:1:I.Ch7.DeviceStatus.HARTCommFail
[- Remote_IO:1:I.Ch7.DeviceStatus.MsgReady

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.

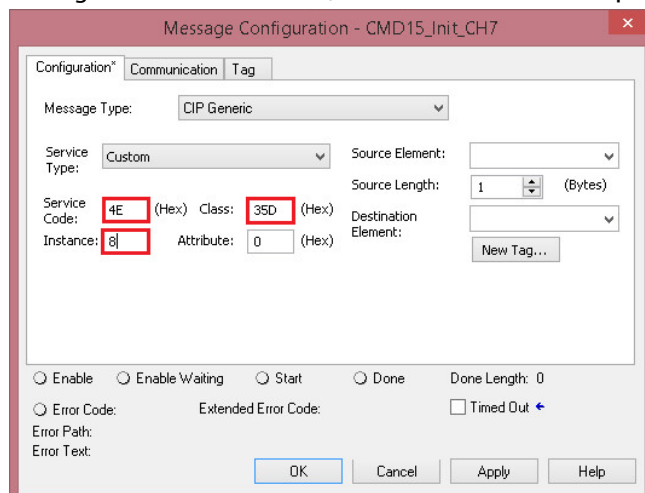
Channel	Instance
0	1
1	2
2	3
3	4
...	...
15	16

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 "8" because the HART command is attended for channel7.

- 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:

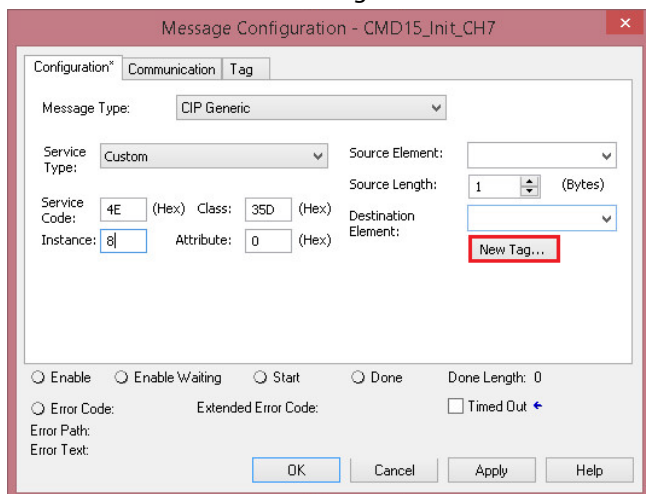
Table 100 - Short Format (Ladder) Reply Packet

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.

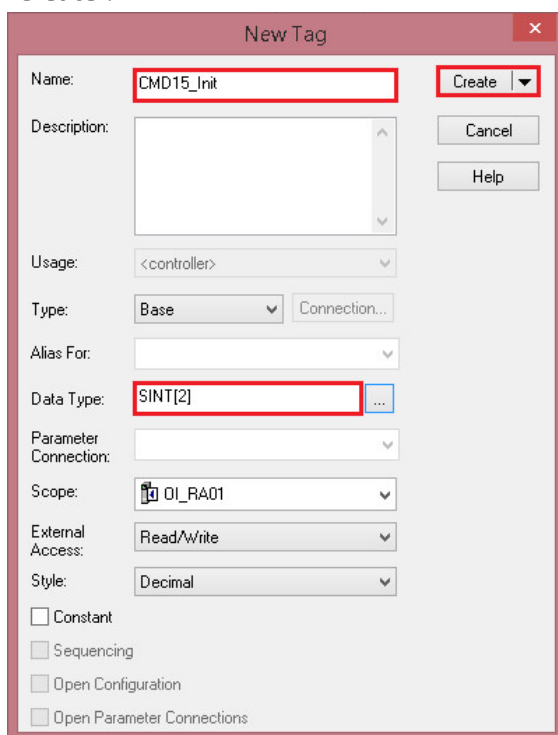
Reply Size = 4 bytes

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

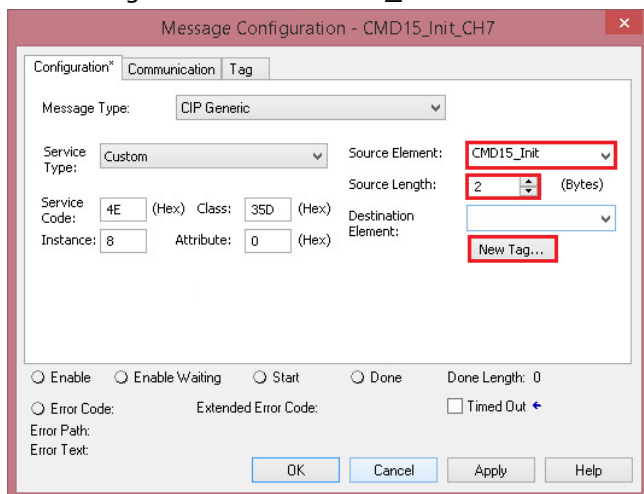
- Click on the button "New Tag..." to create the "Source Element" and "Destination Element" tables:



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

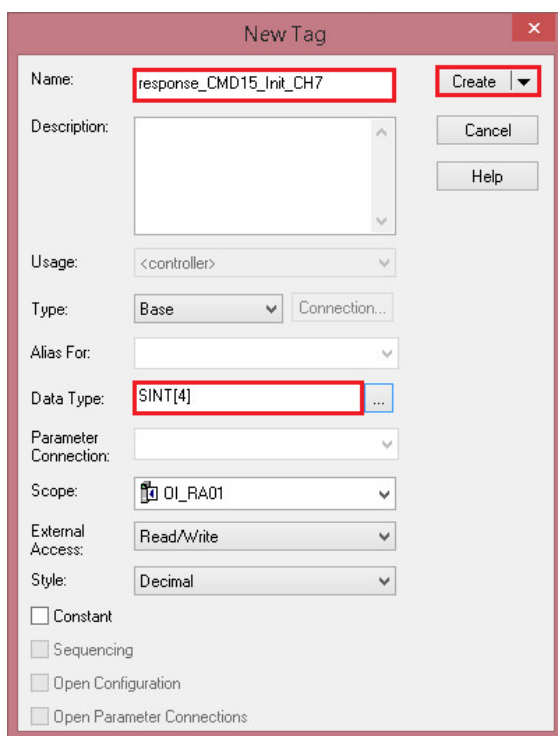


- Then assign the table "CMD15_Init" as well as the Source length which is 2:

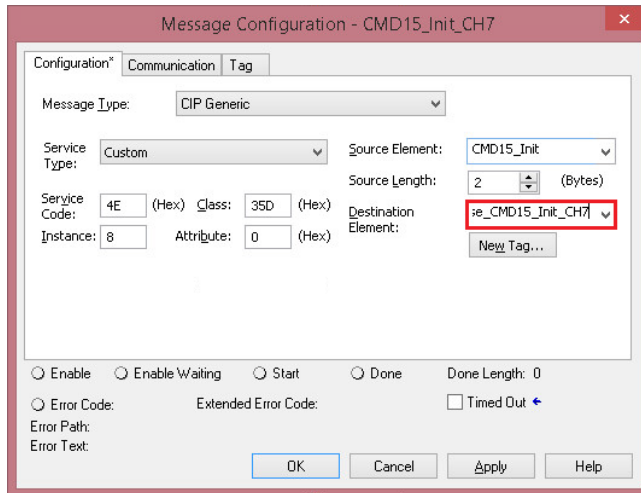


Then click on the button "New Tag...".

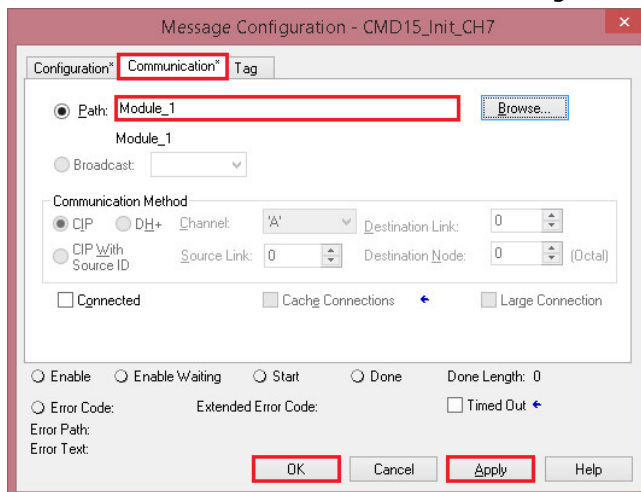
- Enter for example the name "response_CMD15_Init_CH7" with Data Type "SINT[4]" and click on the button "Create":



- Then assign the table "response_CMD15_Init_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.

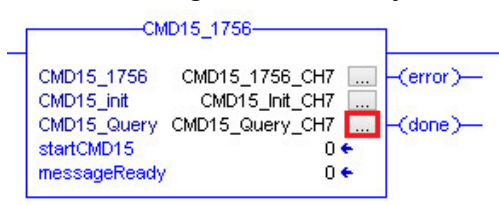
- Open the Controller Tags and initialize the HART Command of the tag "CMD15_Init":

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

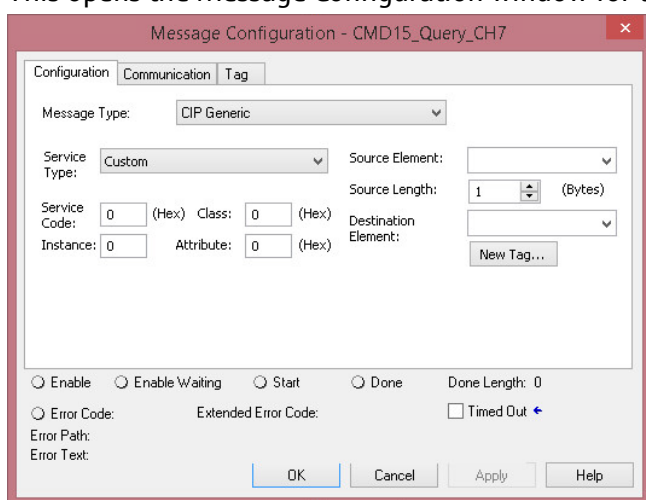
- CMD15_Init[0] = 15 corresponds to the HART Command
- CMD15_Init[1] = 0 corresponds to the HART data length

4.3.3.1.4 AOI Query Message configuration

- Click on the Tag "CMD15_Query_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.

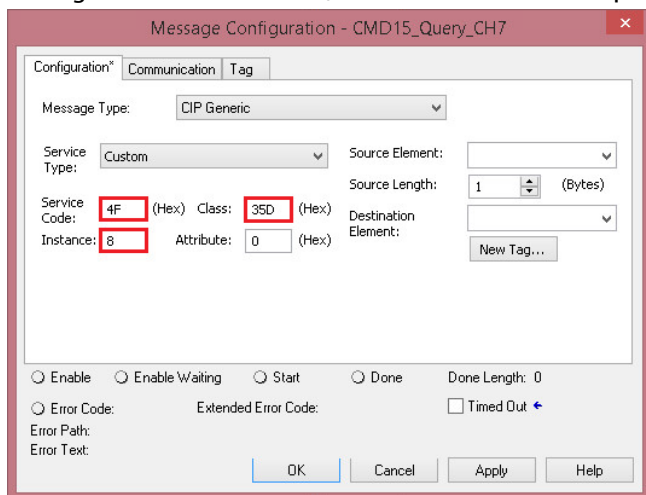
Channel	Instance
0	1
1	2
2	3
3	4
...	...
15	16

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 "8" because the HART command is attended for channel7.

- 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

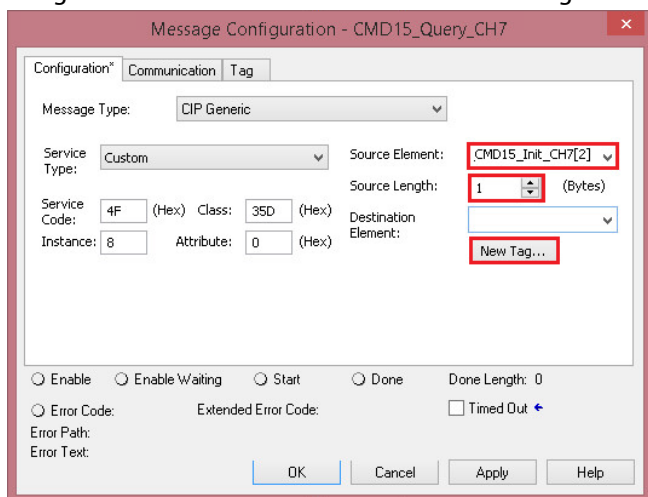
Offset	Offset	Data Type	Definition
0	Status	USINT	Query Status 00 = Success 34 = Running - try again later 35 = Dead (See MsgReady in Input Tag)
1	HART Command	USINT	Echo of HART Command ⁽¹⁾
2	HART CommStatus	USINT	HART Reply Status Byte #1 (response code) ⁽¹⁾
3	HART FieldDeviceStatus	USINT	HART Reply 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 "CMD15_Init_CH7[2]", check that the "Source Length" is 1 and click on the button "New Tag...":



Message Configuration - CMD15_Query_CH7

Configuration Communication Tag

Message Type: CIP Generic

Service Type: Custom

Source Element: CMD15_Init_CH7[2]

Source Length: 1 (Bytes)

Service Code: 4F (Hex) Class: 35D (Hex)

Instance: 8 Attribute: 0 (Hex)

Destination Element:

New Tag...

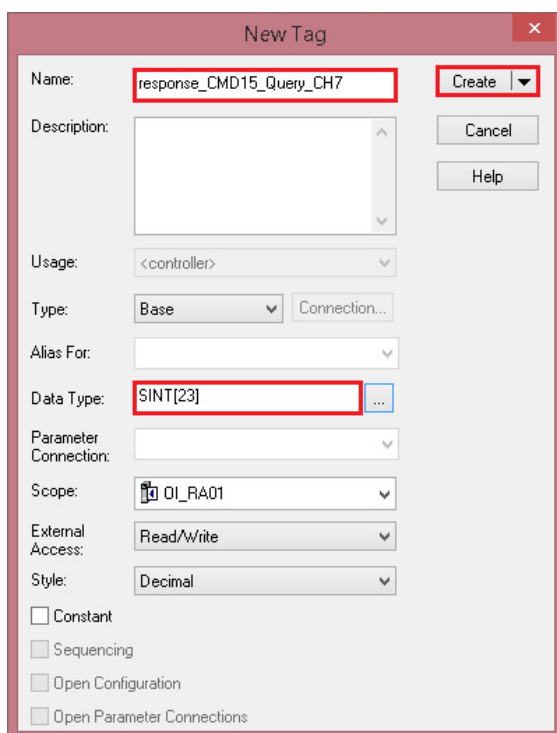
Enable Enable Waiting Start Done Done Length: 0

Error Code: Extended Error Code: Timed Out

Error Path: Error Text:

OK Cancel Apply Help

- Enter for example the name "response_CMD15_Query_CH7" with Data Type "SINT[24]" and click on the button "Create":



New Tag

Name: response_CMD15_Query_CH7

Description:

Usage: <controller>

Type: Base

Alias For:

Data Type: SINT[23]

Parameter Connection:

Scope: 01_RA01

External Access: Read/Write

Style: Decimal

Constant

Sequencing

Open Configuration

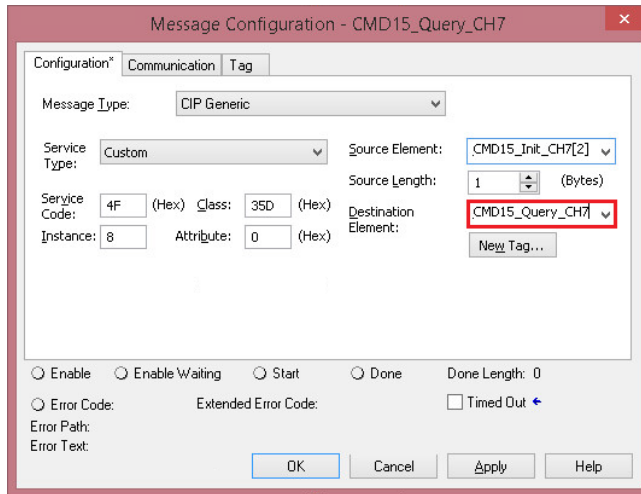
Open Parameter Connections

Create

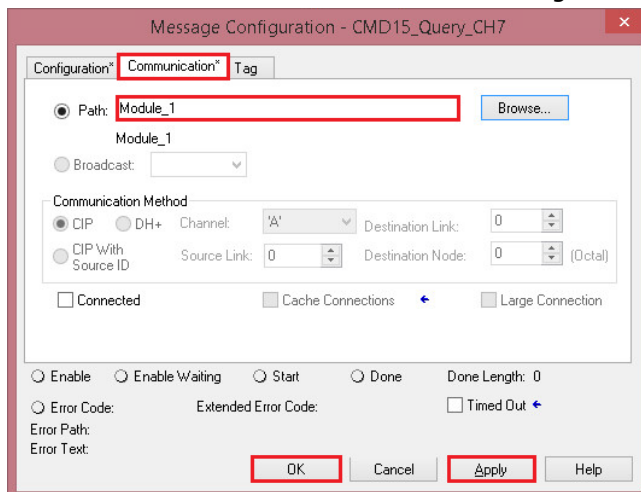
Cancel

Help

- Then assign the table "response_CMD15_Query_CH7":

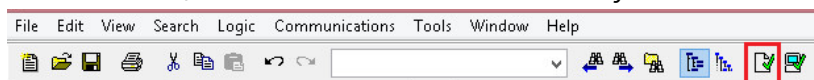


- Select the menu "Communication" and configure the path to the ControlLogix 1756-IF8IH card:

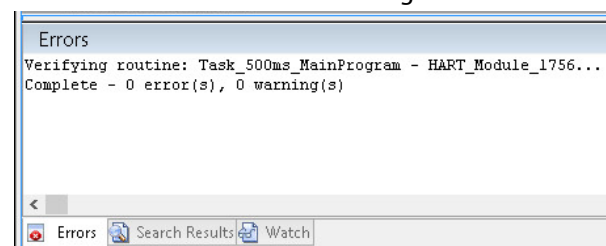


Click on the button "Apply" and "OK" to close the window.

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



- Check the result in the Error diagnostic 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 "startToggle_CMD48_1794_CH2" and set the value to "1":

Controller Tags - OI_RA01(controller)						
Scope:  OI_RA01		Show: All Tags		startCMD15		
Name	Value	Force Mask	Style	Data Type		
* startCMD15_CH7	1		Decimal	BOOL		

Results:

- Response from the Init MSG function block:

Scope:  OI_RA01		Show: All Tags				
Name	Value	Force Mask	Style	Data Type		
- response_CMD15_Init_CH7	{ ... }	{ ... }	Decimal	SINT[4]		
+ response_CMD15_Init_CH7[0]	33		Decimal	SINT		
+ response_CMD15_Init_CH7[1]	15		Decimal	SINT		
+ response_CMD15_Init_CH7[2]	5		Decimal	SINT		
+ response_CMD15_Init_CH7[3]	0		Decimal	SINT		

- Byte0 = 33 → "Command status: Initiated – command started – send query to get reply."
- Byte1 = 15 → "Echo of HART Command number".
- Byte2 = 5 → "Handle Used in Query Operation".

- Response from the Query MSG function block:

Name		Value	Force Mask	Style	Data Type
- response_CMD15_Query_CH7		{ ... }	{ ... }	Decimal	SINT[24]
+ response_CMD15_Query_CH7[0]		0	Status: Success	Decimal	SINT
+ response_CMD15_Query_CH7[1]		16#0f	Echo of HART Command	Hex	SINT
+ response_CMD15_Query_CH7[2]		0	HART CommStatus	Decimal	SINT
+ response_CMD15_Query_CH7[3]		16#11	HART Field Device Status	Hex	SINT
+ response_CMD15_Query_CH7[4]		16#12	Data Size	Hex	SINT
HART CMD15	+ response_CMD15_Query_CH7[5]	0	Unit: %	Decimal	SINT
	+ response_CMD15_Query_CH7[6]	0		Decimal	SINT
	+ response_CMD15_Query_CH7[7]	16#39		Hex	SINT
	+ response_CMD15_Query_CH7[8]	16#42	PV Upper Range: 100	Hex	SINT
	+ response_CMD15_Query_CH7[9]	16#c8		Hex	SINT
	+ response_CMD15_Query_CH7[10]	16#00		Hex	SINT
	+ response_CMD15_Query_CH7[11]	16#00	PV Lower Range: 0	Hex	SINT
	+ response_CMD15_Query_CH7[12]	0		Decimal	SINT
	+ response_CMD15_Query_CH7[13]	0		Decimal	SINT
	+ response_CMD15_Query_CH7[14]	0	PV Damping Value: 5	Decimal	SINT
	+ response_CMD15_Query_CH7[15]	0		Decimal	SINT
	+ response_CMD15_Query_CH7[16]	16#40		Hex	SINT
	+ response_CMD15_Query_CH7[17]	16#a0		Hex	SINT
	+ response_CMD15_Query_CH7[18]	0		Decimal	SINT
	+ response_CMD15_Query_CH7[19]	0		Decimal	SINT
	+ response_CMD15_Query_CH7[20]	0		Decimal	SINT
	+ response_CMD15_Query_CH7[21]	16#fa		Hex	SINT
	+ response_CMD15_Query_CH7[22]	0		Decimal	SINT
	+ response_CMD15_Query_CH7[23]	0		Decimal	SINT

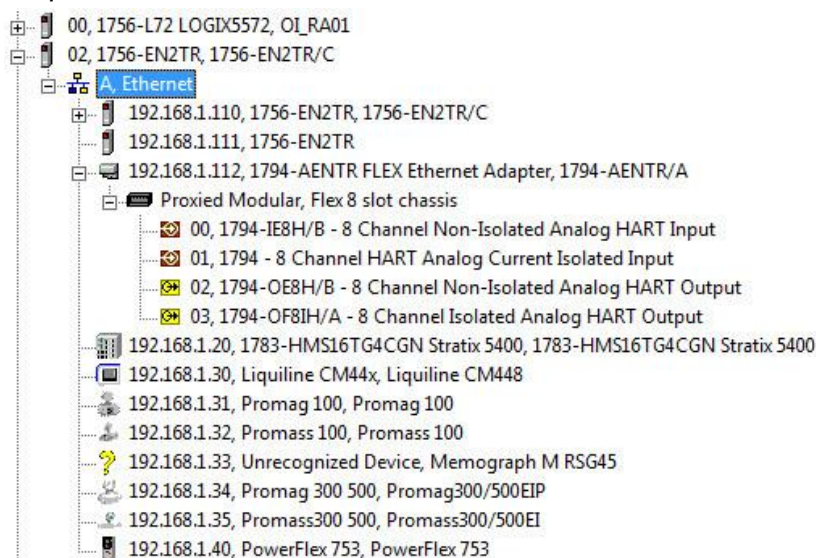
5 Rooted Tool Integration

This chapter describes the main workflow for integration of Rockwell Automation system components to the Endress+Hauser Plant Asset Management (PAM 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.

5.1 RSLinx Tool

Using Rockwell Automation Communication DTMs in FieldCare requires installing the tool RSLinx on the same station in order to configure CommDTM settings.

- Configure the used IP addresses of the Ethernet Adapter and import all EDS files as done in chapter 3.1.4 and 3.1.5:

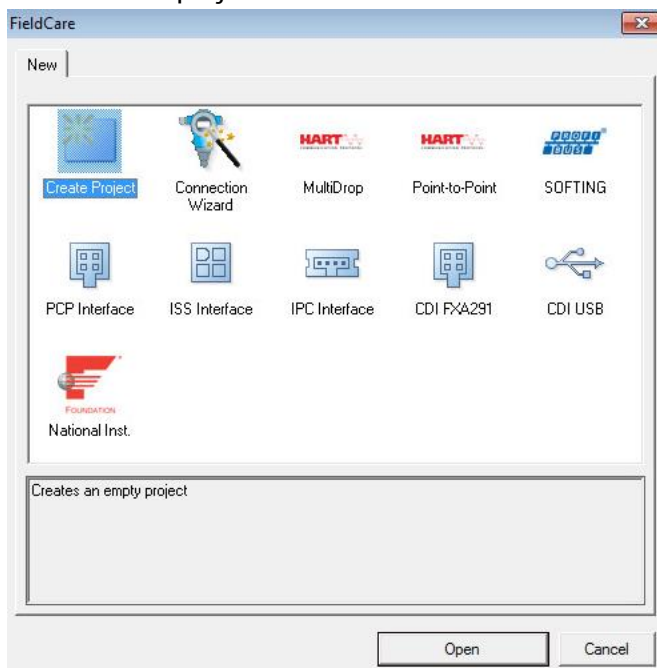


5.2 New FieldCare Project

- Start the application FieldCare:



- Create a new project:

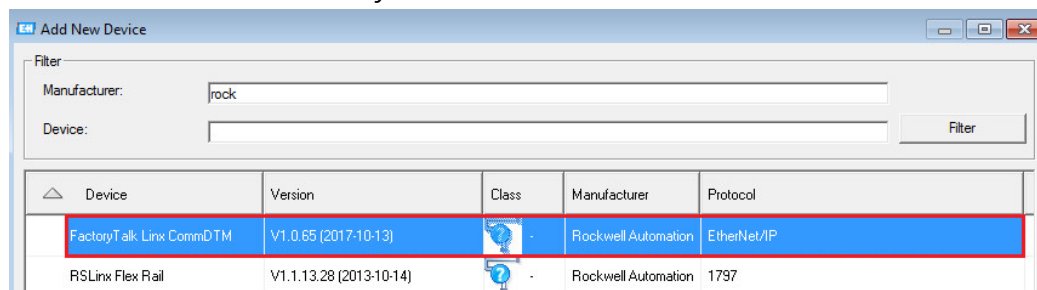


5.3 EtherNet/IP Integration

- Click on the button Add a device:



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



- The CommDTM "FactoryTalk Linx CommDTM" is implemented in the Network view:



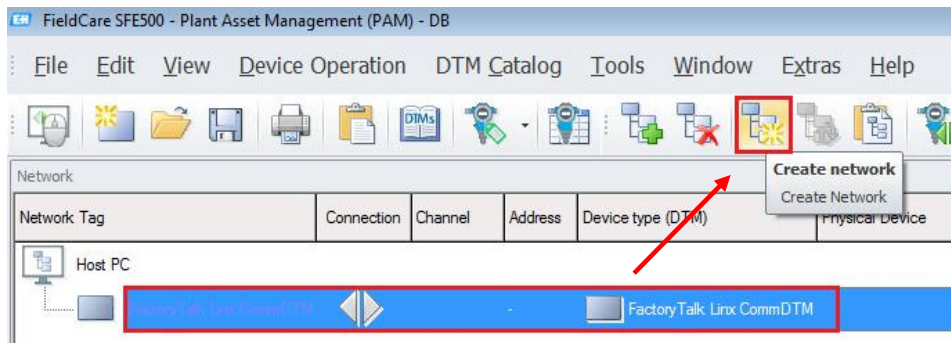
- Double-click on the CommDTM "FactoryTalk Linx CommDTM" and check that there is one RSLinx Edition in user:



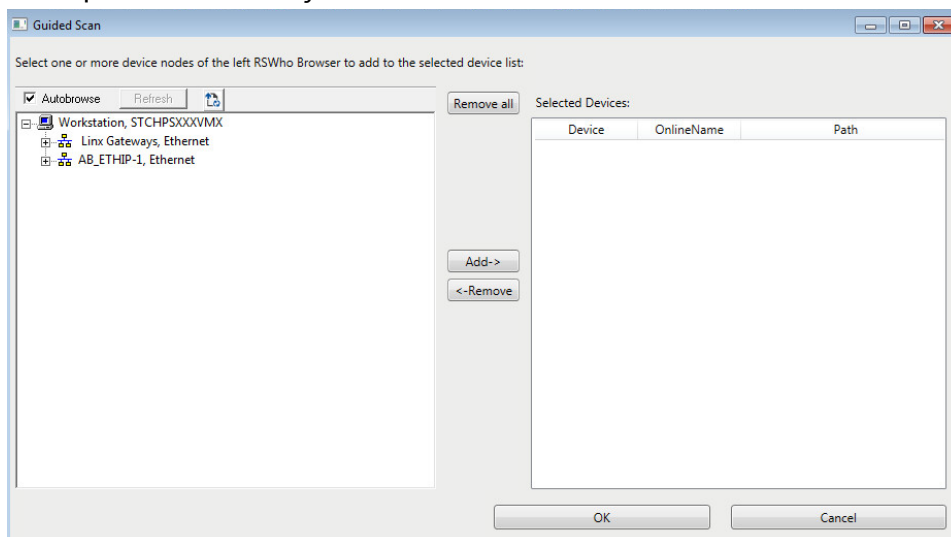
In this example, the "RSLinx Classic" version is installed on the PAM station.

5.3.1 Adding an EtherNet/IP Devices with the Function Create Network

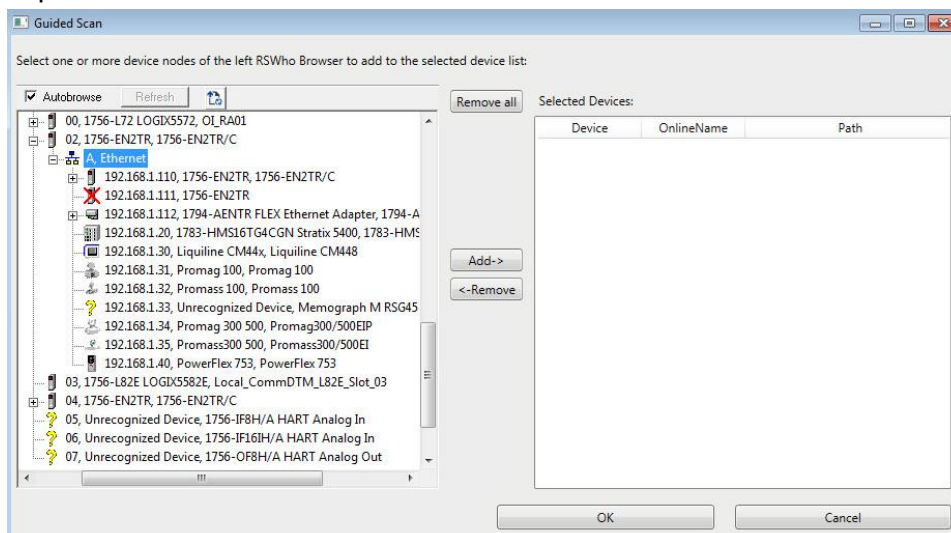
- Select the CommDTM "FactoryTalk Linx CommDTM" and click on the shortcut button "Create Network":



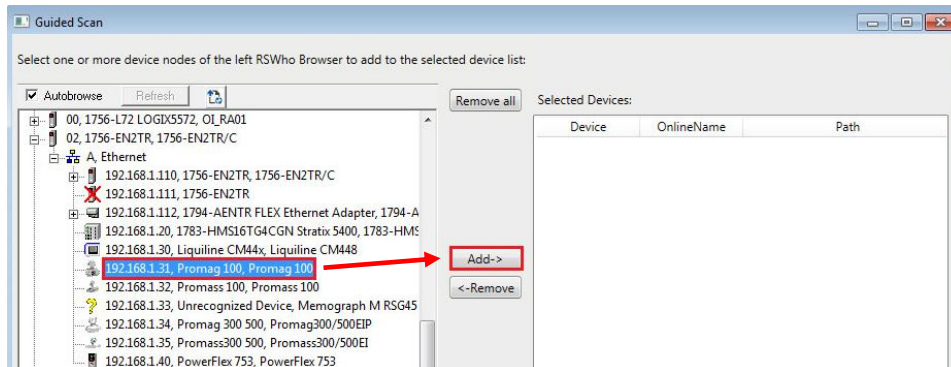
- This opens automatically the window "Guided Scan":



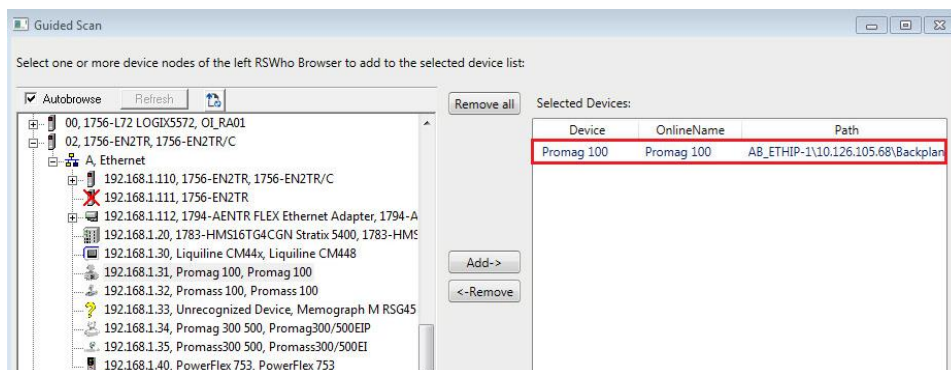
- Expand the menu to the network on which are connected the devices:



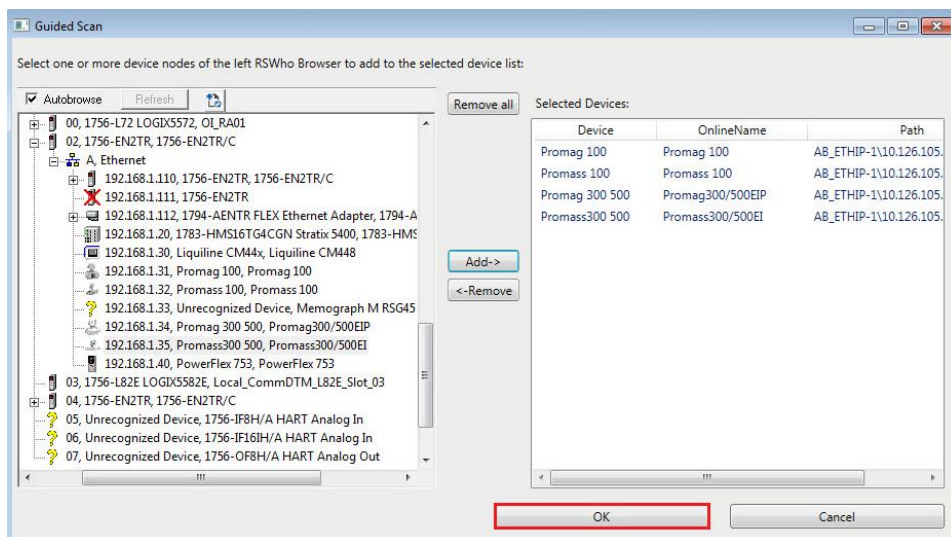
- Select for example the Promag100 and click on the button Add“:



- This adds the selected device into the selected devices list:



- Add all other devices and click on the button “OK“:

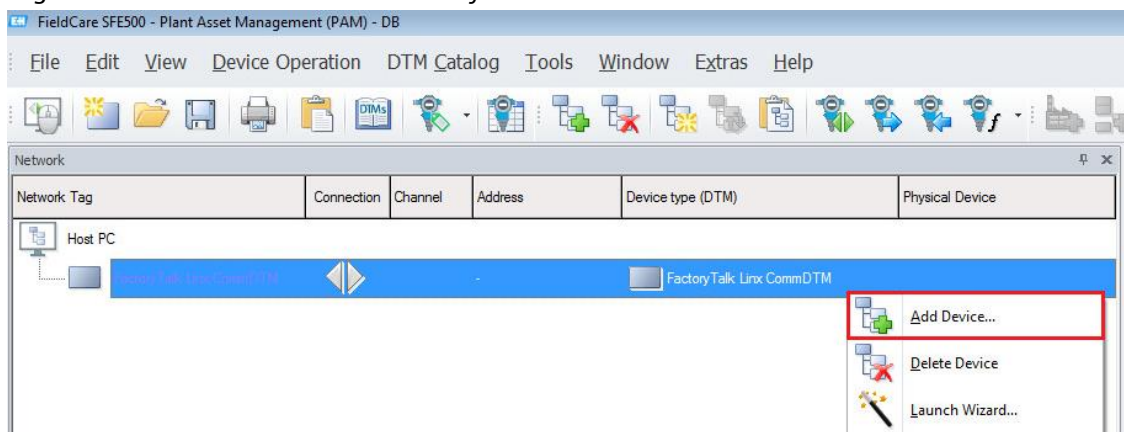


- Inserted devices:

Network				
Network Tag	Co...	Channel	Address	Device type (DTM)
Host PC				
FactoryTalk Linx CommDTM				
Promag 100		Channel	192.168.1.31	Promag 100 / 5x1B / EIP / FW 1.01.zz / Dev.Rev. 2
Promass 100		Channel	192.168.1.32	Promass 100 / 8x1B / EIP / FW 1.02.zz / Dev.Rev. 3
Promag300500EIP		Channel	192.168.1.34	Promag 300 500 / 5x3x 5x5x / EIP / FW 1.00.zz / Dev.Rev. 01
Promass300500EI		Channel	192.168.1.35	Promass 300 500 / 8x3x 8x5x / EIP / FW 1.00.zz / Dev.Rev. 01

5.3.2 Adding Manually an EtherNet/IP Device

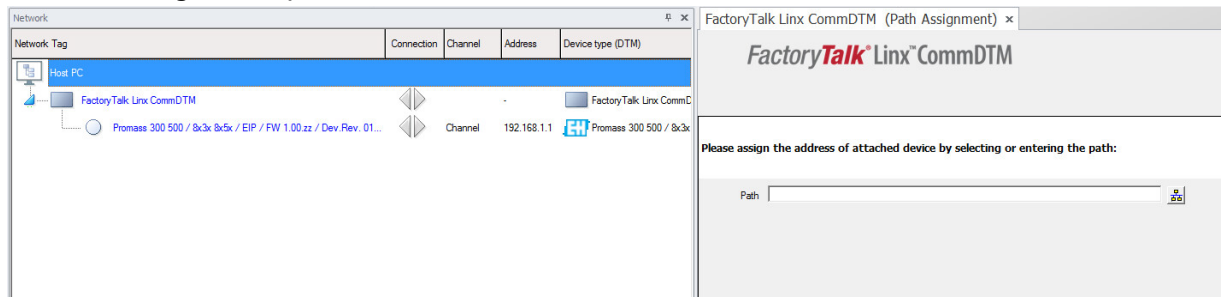
- Right-click on the CommDTM "FactoryTalk Linx CommDTM" and select the menu "Add Device...":



- Select for example the Promass300 500 deviceDTM and click on the button "OK":

Add New Device				
Filter				
Manufacturer:				
Device:				
		Filter		
Device	Version	Class	Manufacturer	Protocol
Flow Verification DTM EtherNet/IP	V1.06.00 (2017-09-28)	flow	Endress+Hauser	EtherNet/IP
Promag 100 / 5x1B / EIP / FW 1.01.zz / Dev.Rev. 2	V1.6.0.174 (2015-05-29)	flow	Endress+Hauser	EtherNet/IP
Promag 300 500 / 5x3x 5x5x / EIP / FW 1.00.zz / Dev.Rev. 01	V1.10.0.59 (2017-12-01)	flow	Endress+Hauser	EtherNet/IP
Promag 400 / 5x4C / EIP / FW 1.01.zz / Dev.Rev. 2	V1.8.0.101 (2016-09-12)	flow	Endress+Hauser	EtherNet/IP
Promass 100 / 8x1B / EIP / FW 1.02.zz / Dev.Rev. 3	V1.6.0.463 (2015-05-29)	flow	Endress+Hauser	EtherNet/IP
Promass 300 500 / 8x3x 8x5x / EIP / FW 1.00.zz / Dev.Rev. 01	V1.10.0.94 (2017-12-01)	flow	Endress+Hauser	EtherNet/IP

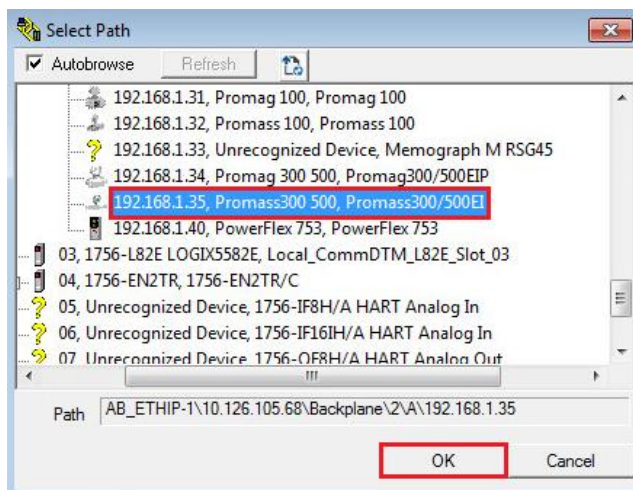
- DeviceDTM is inserted and window "Factory Talk Linx CommDTM" is automatically opened in order to configure the path to the device:



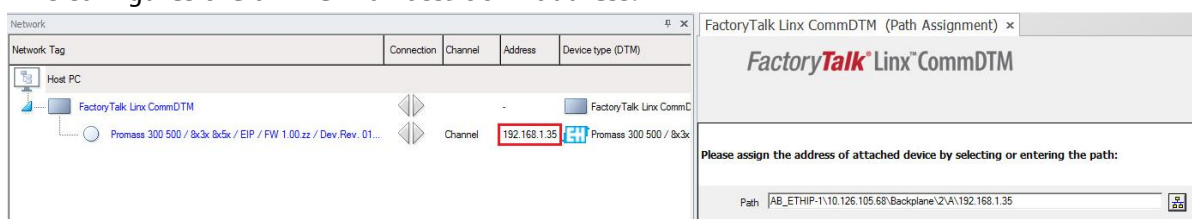
- Click on the shortcut button:



- Select the needed device and click on the button "OK":



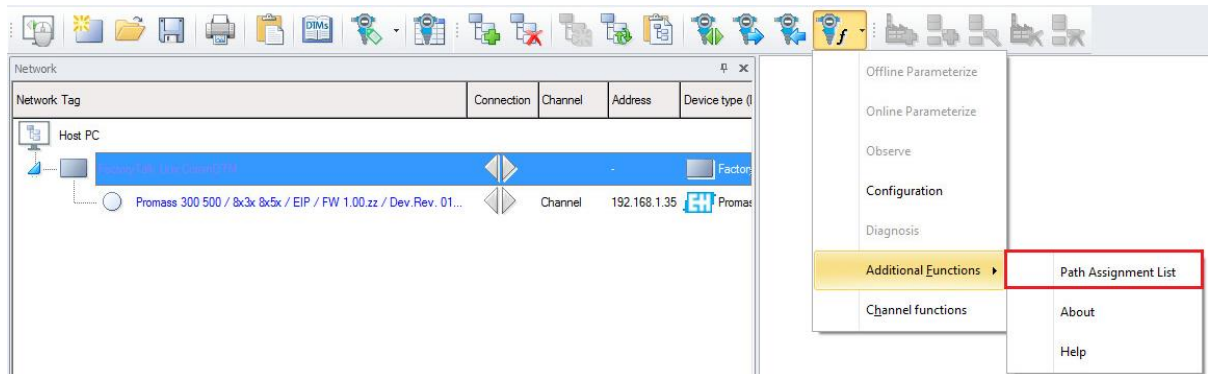
- This configures the offline Promass300 IP address:



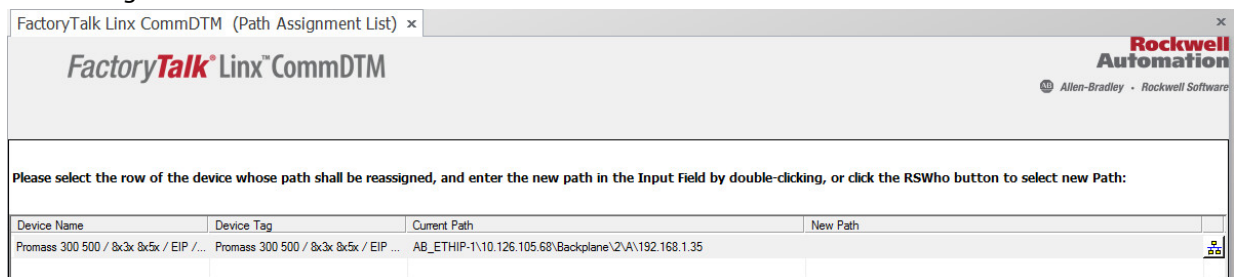
- Close the device path Assignment window.

Remark

- Path can be configured as well by selecting the CommDTM "FactoryTalk Linx CommDTM" and then clicking on the menu "Device Functions→Additional Functions→Path Assignment List"

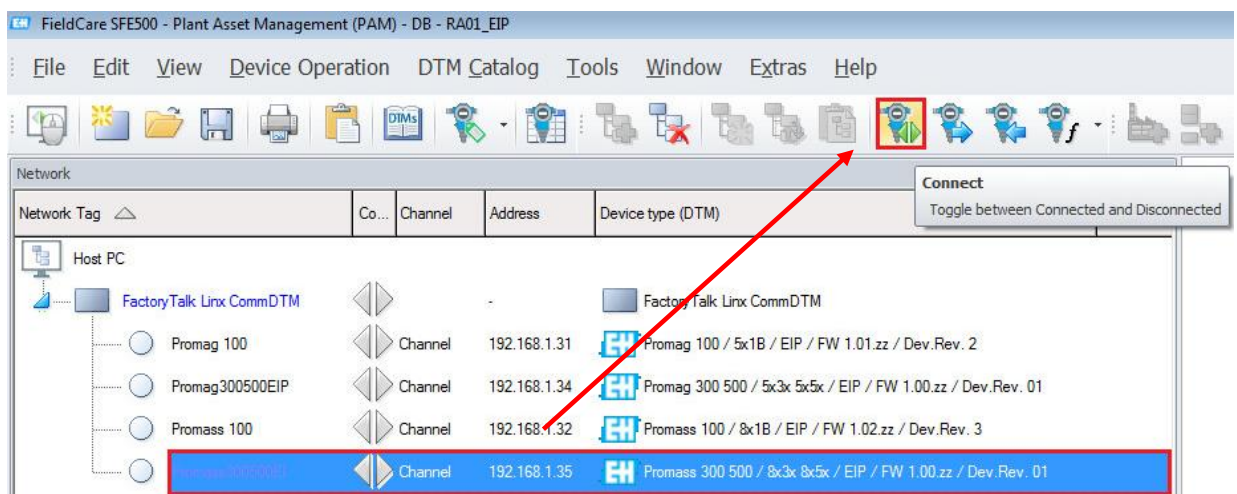


- Path Assignment window:

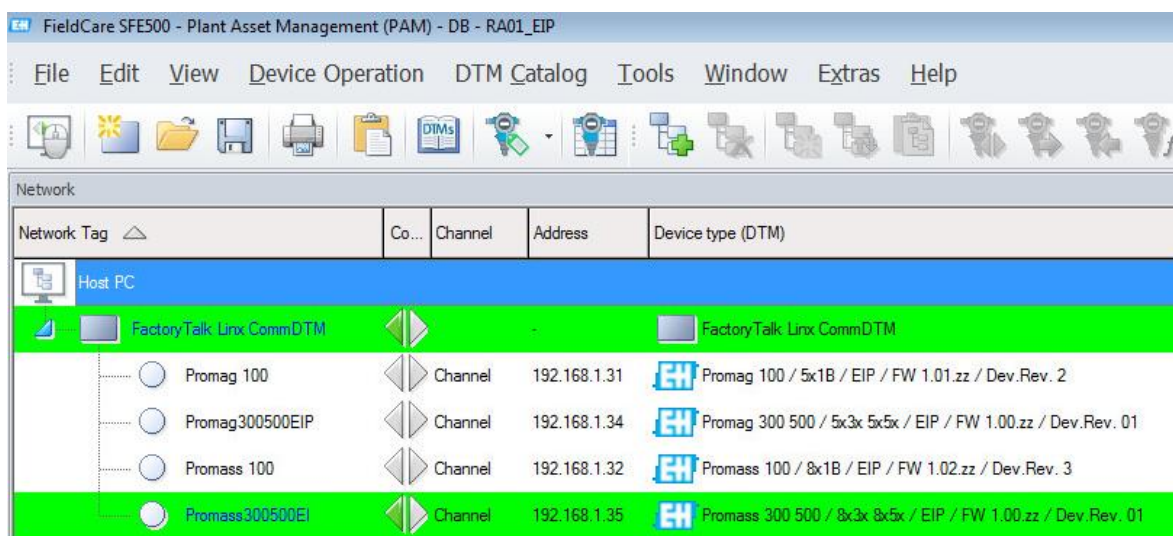


5.3.3 Device Online Connection

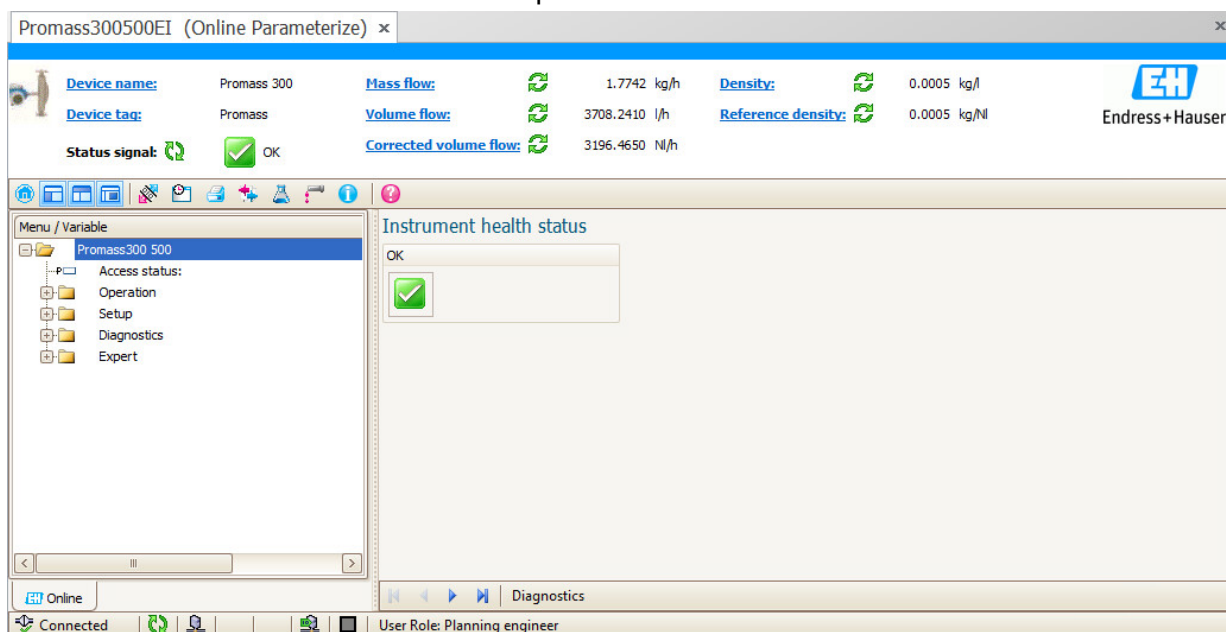
- Select the Promass300 and click on the button:



- Device is connected:



- Double-click on the Promass300 DTM to open the window "Online Parameterize":



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.

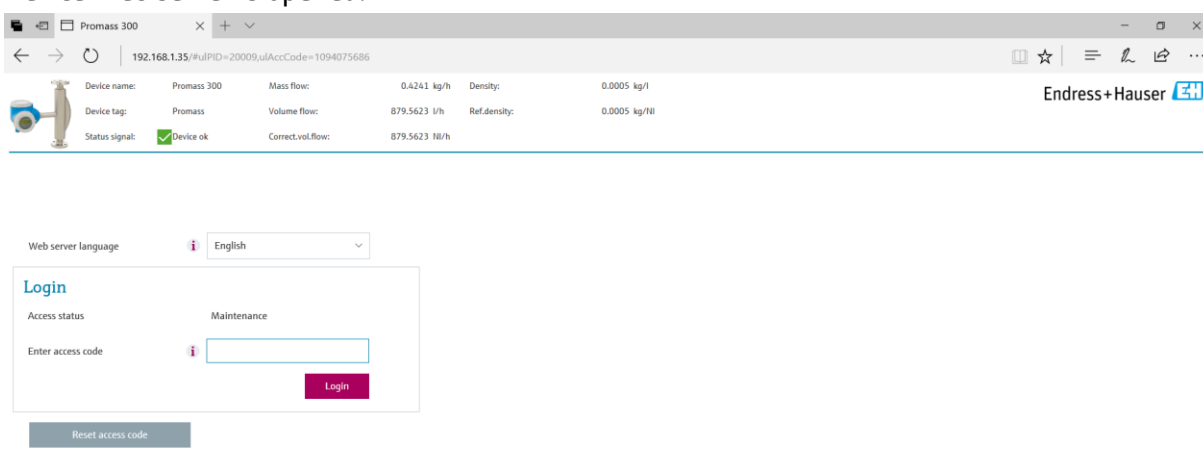
6.2 Connection

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

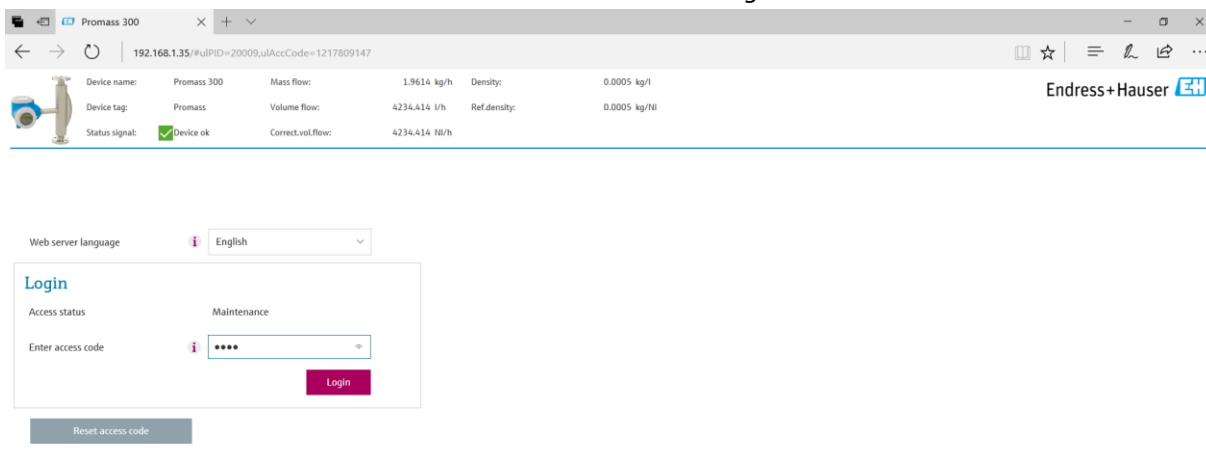


In this example, the IP address 192.168.1.35 corresponds to the Promass300.

- Device Web server is opened:



- Enter the user level code "0000" and click on the button "Login":



Device name: Promass 300 Mass flow: 1.9614 kg/h Density: 0.0005 kg/l
 Device tag: Promass Volume flow: 4234.414 l/h Ref.density: 0.0005 kg/NI
 Status signal: Device ok Correct.vol.flow: 4234.414 NI/h

Web server language: English

Login

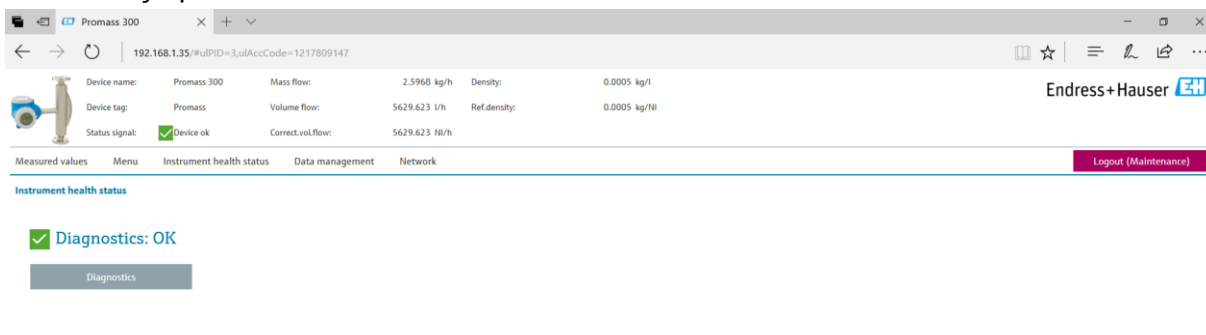
Access status: Maintenance

Enter access code: *****

Login

Reset access code

- This directly opens the Instrument health status window:



Device name: Promass 300 Mass flow: 2.5968 kg/h Density: 0.0005 kg/l
 Device tag: Promass Volume flow: 5629.623 l/h Ref.density: 0.0005 kg/NI
 Status signal: Device ok Correct.vol.flow: 5629.623 NI/h

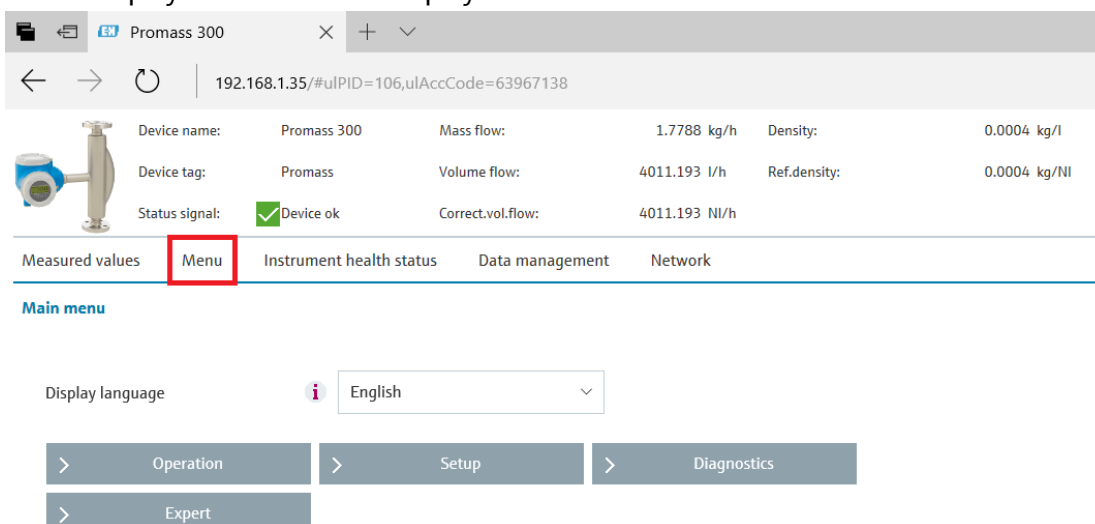
Measured values Menu **Instrument health status** Data management Network

Instrument health status

Diagnostics: OK

Diagnostics

- This interface allows to access to the same device menu structure (Operation, Setup, Diagnostics, as this displayed on the device display or in the deviceDTM:



Device name: Promass 300 Mass flow: 1.7788 kg/h Density: 0.0004 kg/l
 Device tag: Promass Volume flow: 4011.193 l/h Ref.density: 0.0004 kg/NI
 Status signal: Device ok Correct.vol.flow: 4011.193 NI/h

Measured values **Menu** Instrument health status Data management Network

Main menu

Display language: English

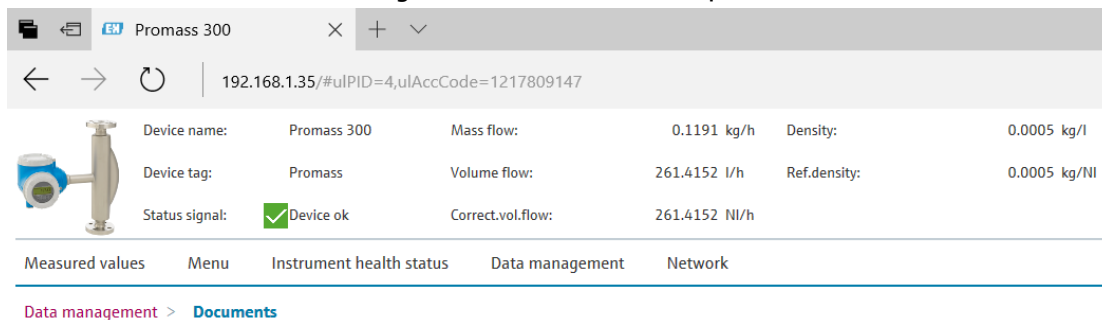
> Operation > Setup > Diagnostics

> Expert

6.3 EDS File Upload

This example displays how to upload the EDS file from the Promass300.

- Click on the button “Data Management→Documents→Upload EDS file from device”:



The screenshot shows the Promass 300 web interface. At the top, there's a browser tab for 'Promass 300' and a URL bar showing '192.168.1.35/#ulPID=4,ulAccCode=1217809147'. Below the URL bar, there's a table of device data:

Device name:	Promass 300	Mass flow:	0.1191 kg/h	Density:	0.0005 kg/l
Device tag:	Promass	Volume flow:	261.4152 l/h	Ref.density:	0.0005 kg/NI
Status signal:	✓ Device ok	Correct.vol.flow:	261.4152 NI/h		

Below the table, there's a navigation bar with links: Measured values, Menu, Instrument health status, Data management, and Network. Under 'Data management', there's a sub-menu 'Documents'.



Three buttons are shown: 'Export backup data set', 'Verification report', and 'Upload EDS file from device'. The 'Upload EDS file from device' button is highlighted with a red border.

- File can be uploaded:



A dialog box titled 'What do you want to do with EDSFileUpload.gz?' is shown. It includes the text 'From: 192.168.1.35' and four buttons: 'Open', 'Save', 'Cancel', and a close button (X).

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