Integration Tutorial HIMA01

HIMA Paul Hildebrandt GmbH HIMax and HART for SIL applications in Chemical Industry

Table of Contents

1 Document Information

1.1 Purpose and Scope

This document provides a step by step description on how to integrate HART devices with the HIMA Paul Hildebrandt GmbH HIMax System. All content of this document is jointly developed, reviewed and approved by HIMA Paul Hildebrandt GmbH 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	2016-05	Initial version

1.3 Related Documents

Please refer to related documents as listed below:

Document	Description
SD01679S/04/EN/01.16	Reference Topology HIMA01
SD01681S/04/EN/01.16	Integration Test Summary HIMA01
SD01682S/04/EN/01.16	List of Tested Devices and Versions HIMA01

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 HIMA HIMax System and HART in general. Please refer to recommended literature as listed in chapter 2.1.

2.1 Recommended Literature

2.1.1 HIMA Paul Hildebrandt GmbH

Document	Description
HI 801 007 E Rev.6.00	System Bus Module Manual
HI 801 009 E Rev.6.00	Processor Module Manual
HI 801 021 E Rev.6.00	Analog Input Manual
HI 801 307 E Rev.5.00	HART Analog Input Manual
HI 801 101 E Rev.6.01	Communication for controllers that are using SILworX
HI 801 089 E Rev.1.00	User Manual HIMax HART Package V1.00 (1016)
HI 801 001 E Rev.6.01	System Manual

2.1.2 Endress+Hauser

Document	Description
BA00065S	FieldCare Project Tutorial

2.1.3 HART Foundation

Document	Description
HCF_SPEC-127	Universal Command Specification, Revision 7.1
HCF_SPEC-151	Common Practice Command Specification, Revision 9.1

2.2 Operable Control System

This document assumes an operable HIMA HIMax System as defined by Reference Topology HIMA01. Please refer to the manuals listed in chapter 2.1.1 for an explanation on how to use hard- and software provided by HIMA Paul Hildebrandt GmbH.

2.3 Operable Asset Management System

This document assumes an operable Endress+Hauser PAM System as defined by Reference Topology HIMA01. 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 HART devices, as defined by Reference Topology HIMA01. Each field device is powered if needed and adequately connected to the HIMA HIMax System. If required, please refer to individual device manuals for further advice.

3 Basic Integration

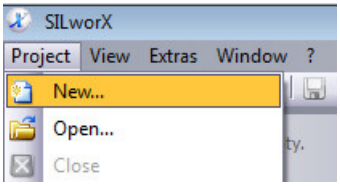
This chapter describes the main workflow for integration of HART devices into the HIMA HIMax System by means of Universal Commands. As a result, the 4-20 mA/HART communication is running. HART process values and status information is available within the control strategy of the system for further processing.

3.1 System Configuration

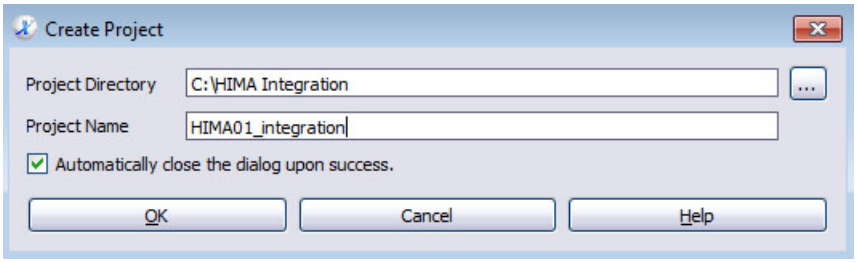
3.1.1 New Project

- Start the software SILworX.

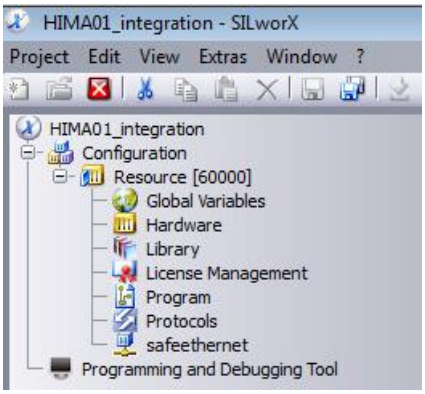
- Create a new project with the menu “Project→ New...”.



- Indicate the Project Directory, the Project Name and click on the button “OK”.

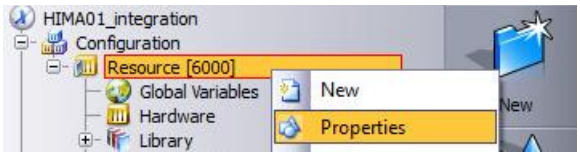


- Created project structure.

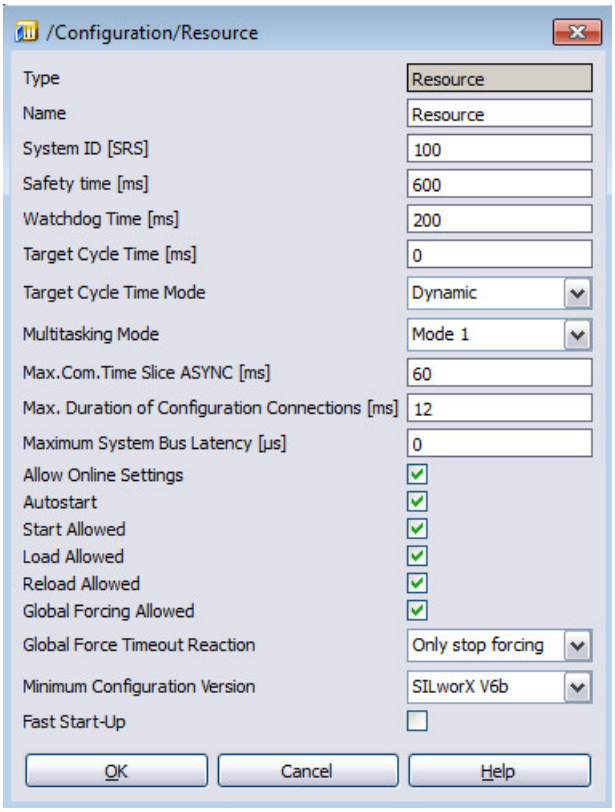


3.1.2 Resource Configuration

- Right-click on the field “Resource” and select the option “Properties”.



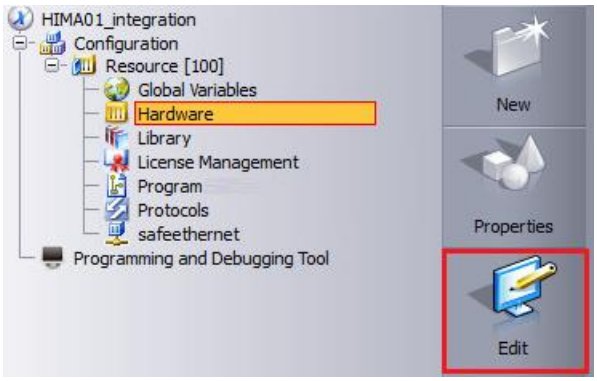
- All parameters of the Resource Properties are project specific. The configured System ID [SRS] is displayed in the project tree. Following configuration has been done for this application.



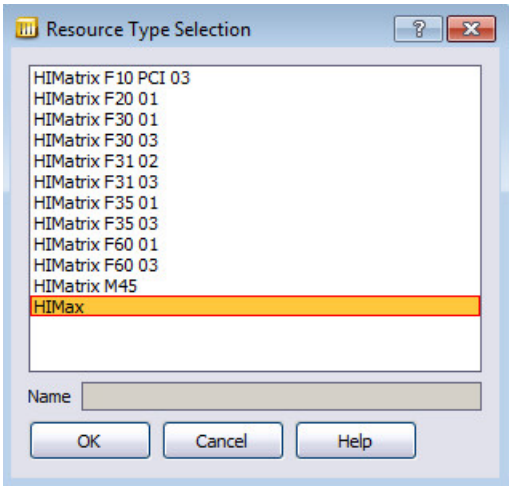
3.1.3 Hardware Configuration

3.1.3.1 Rack Modules

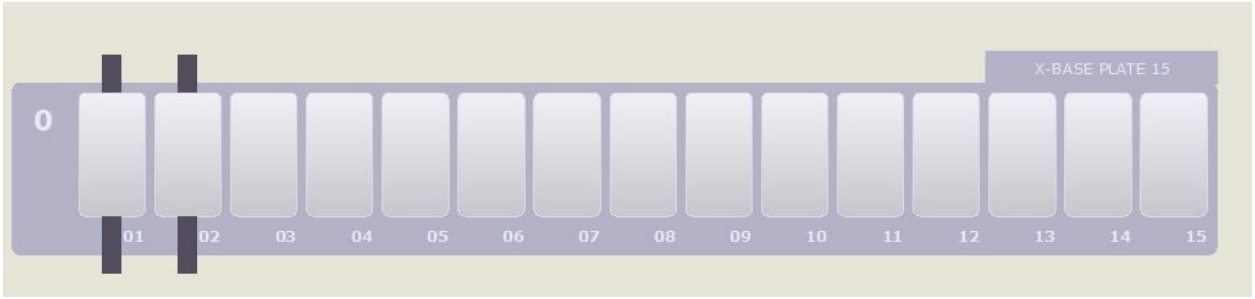
- Select the field “Hardware” and click on the button “Edit”.



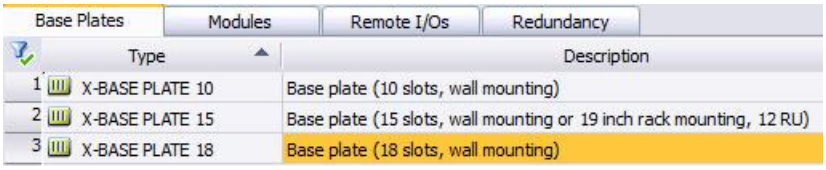
- Select the resource “HIMax” and click on the button “OK”.



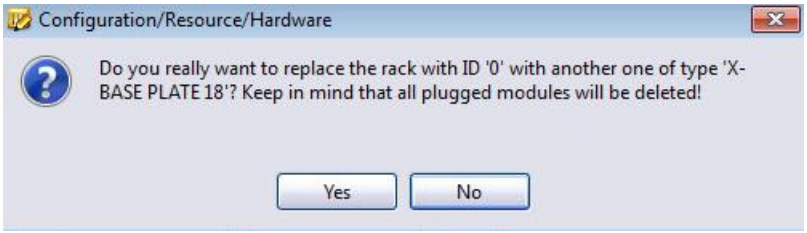
- A Base Plate “X-BASE PLATE 15” is automatically inserted the project. Change it if necessary.



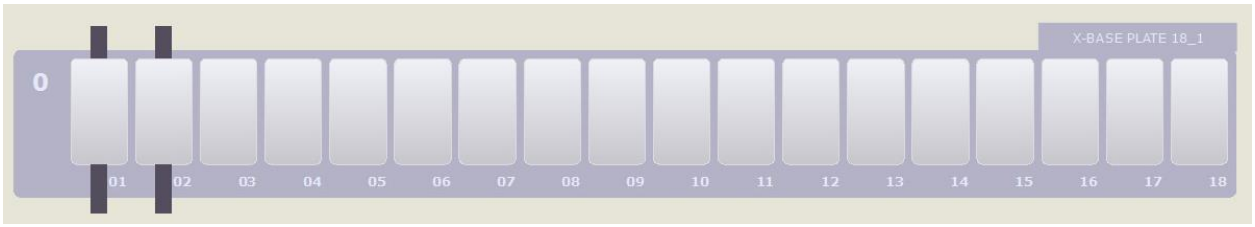
- In this example, a Base Plate “X-BASE PLATE 18” is used.
  Select the Base Plate “X-BASE PLATE 18” and drag it on the existing one.



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

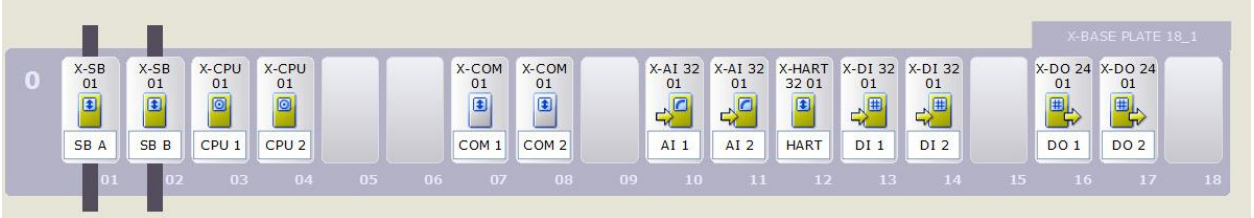


- New Base Plate is displayed.



- Select the tab “Modules”.

- Add all required modules of the HIMax System. Change the name if needed.
  In this example, following modules have been inserted:
  - 2 system bus module (SIL3) “X-SB01”
  - 2 processor modules (SIL3) “X-CPU01”
  - 2 communication modules “X-COM 01”
  - 2 analog input modules (32 channels, SIL3) “X-AI 32 01”, with redundancy configuration
  - 1 HART interface module (32 modems, SIL3) “X-HART 32 01”
  - 2 modules X-DI 32 01
  - 2 modules X-DO 24 01

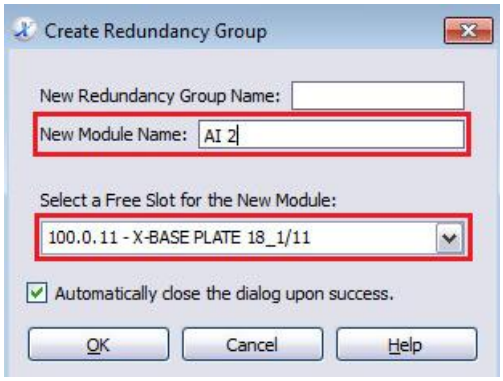


3.1.3.2 Analog Inputs Modules 4-20 mA Redundancy Configuration

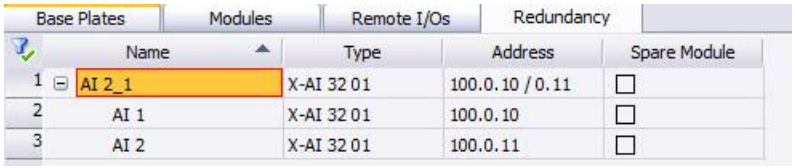
- In this application, the second analog input card on slot 11 is configured as a redundant analog input of slot 10. That means, when a device is connected on a channel of analog input card AI 1, it is connected automatically on the same channel of analog input card AI 2.

- To configure this redundant concept:
  - Right-click on the analog input card on slot 10 and select the menu “Create Redundancy Group.”

  - Indicate the new Module Name and the slot location.
    In this case, the new name is “AI 2” and the slot location is on slot 11.



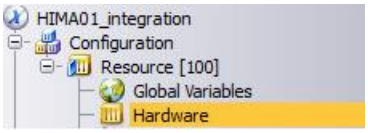
  - The redundancy configuration appears in the Tab “Redundancy”.



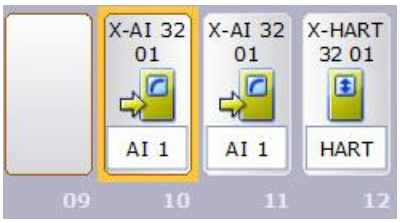
3.1.3.3 Analog Inputs Modules 4-20 mA Power Supply Supervision

This parameter must be configured in order to handle the power supply supervision of HART active/passive devices.

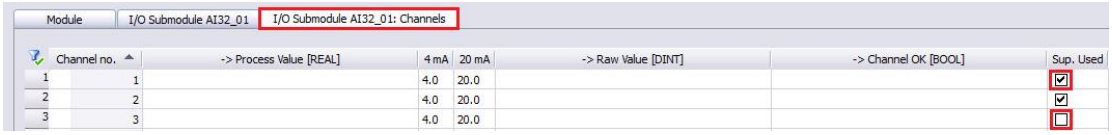
- Open the Hardware configuration view.



- Double-click on the analog input card "X-AI 32 01".



- Select the tab "I/O Submodule AI32_01: Channels" and check the parameter "Sup. Used" for each connected device. When activated, this option is used to supervise the transmitter supplies.

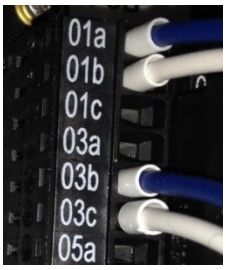


  - If the parameter "Sup. Used" is crosschecked, then the HART device is supplied by the AI32_01 card (Configuration used for a passive device, for example Channel 1 of previous picture).
  - If the parameter "Sup. Used" isn't crosschecked, then the HART device is supplied by an external power supply (Configuration used for an active device, for example Channel 3 of previous picture).

3.1.3.4 HART Device Connection

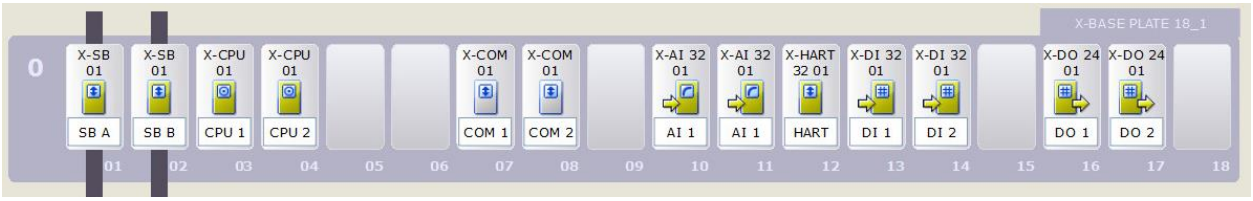
There are 3 available connectors per channel on the connector board, identifiable with the character “a”, “b” and “c”.

- A passive device is connected on “a” (positive terminal) and “b” (negative terminal), for example on Channel 1 of following picture.
- An active device is connected on “b” (positive terminal) and “c” (negative terminal), for example on Channel 3 of following picture.



3.1.4 Network Configuration

In the Hardware configuration defined in part 3.1.3, there are 6 modules which have an IP address (SB A, SB B, CPU 1, CPU 2, COM 1, COM 2). Factory default IP address is 168.168.0.99 for all modules.

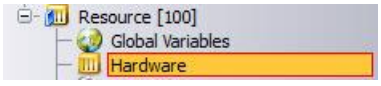


IP addresses need to be configured according to the network configuration of the project.

- In this example, we want to connect the HIMax Station via communication modules COM 1 and COM 2 to our system backbone (10.126.xxx.xxx). All other modules don’t need to be configured in the same IP address range and can use default range (192.168.xxx.xxx).

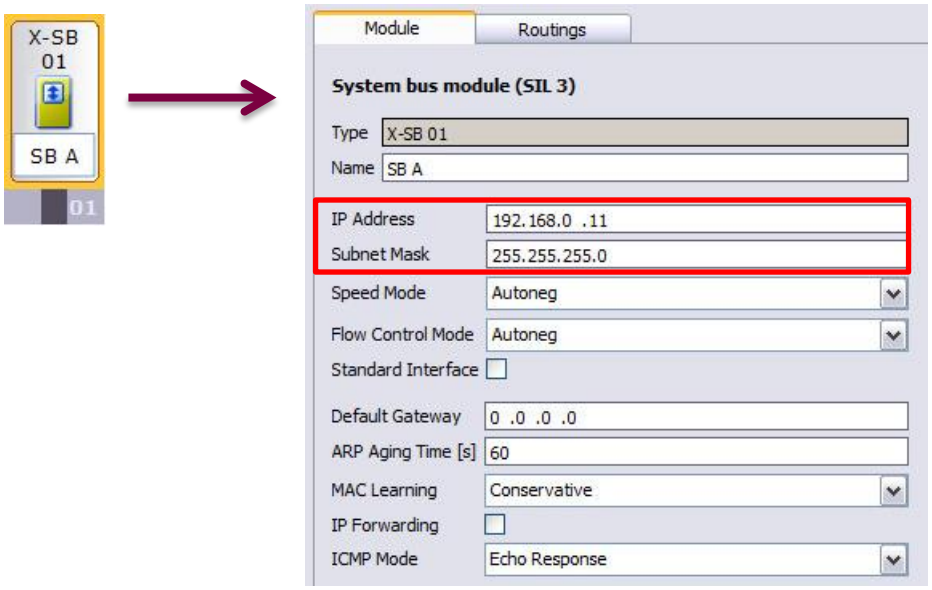
Moduls	Slot	IP address
SB A	1	192.168.0.11
SB B	2	192.168.0.12
CPU 1	3	192.168.0.99
CPU 2	4	192.168.0.100
COM 1	7	10.126.105.52
COM 2	8	10.126.105.53

- Double-click on the field “Hardware” to open the hardware configuration view.

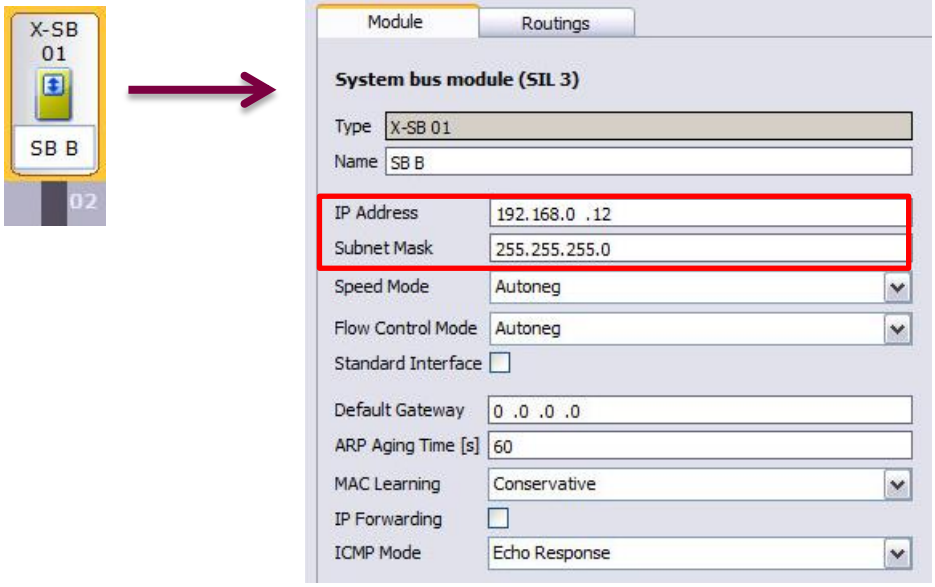


3.1.4.1 Bus Modules IP Address Configuration

- Double-click on the module SB A and set the required IP addresses.
  In this example, IP address is set to 192.168.0.11 and mask address is set to 255.255.255.0.

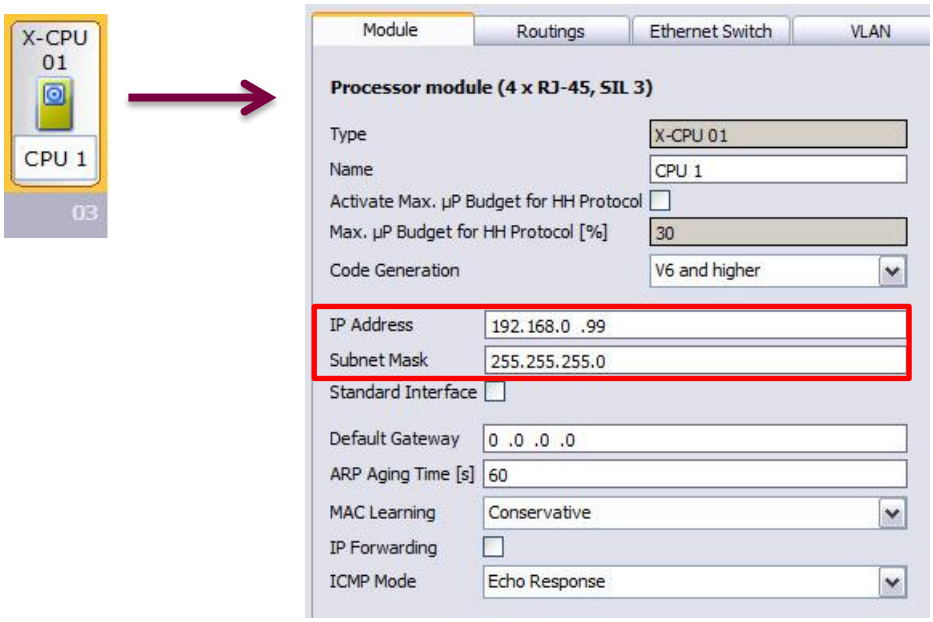


- Double-click on the module SB B and set the required IP addresses.
  In this example, IP address is set to 192.168.0.12 and mask address is set to 255.255.255.0.

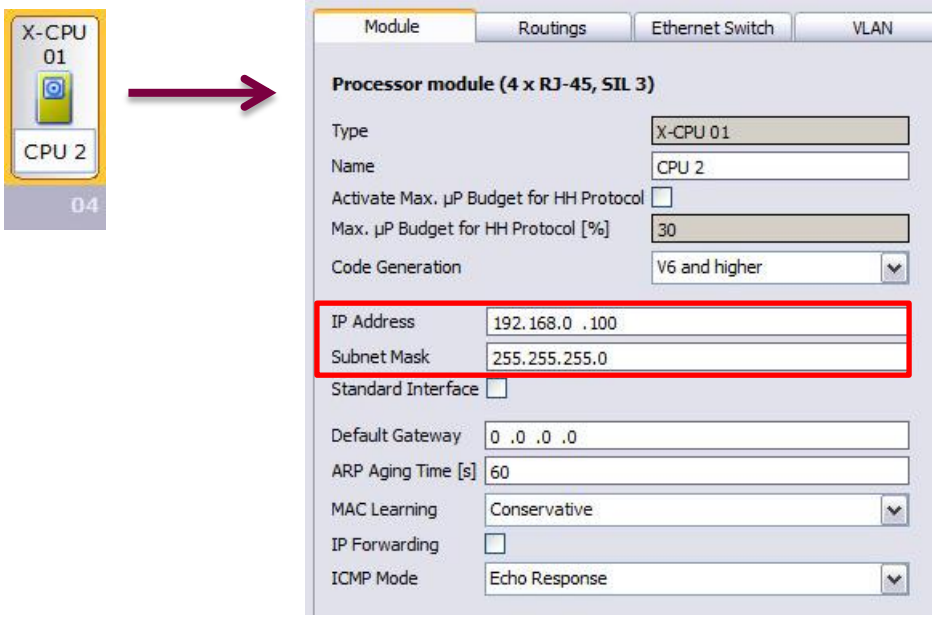


3.1.4.2 CPUs IP Address Configuration

- Double-click on the module COM 1 and set the required IP addresses.
  In this example, IP address is set to 192.168.0.99 and mask address is set to 255.255.255.0.

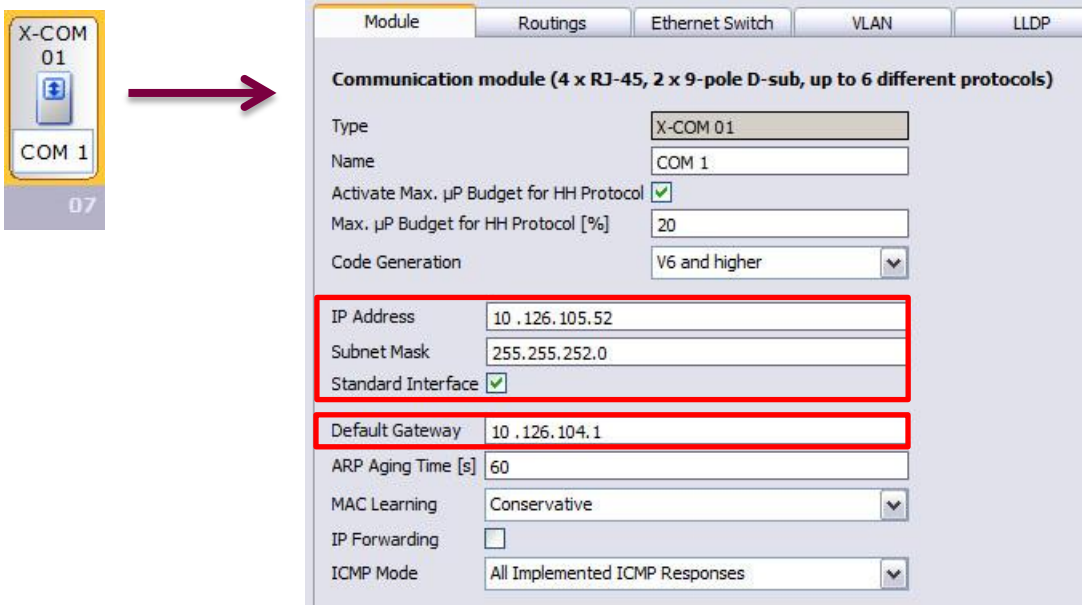


- Double-click on the module COM 2 and set the required IP addresses.
  In this example, IP address is set to 192.168.0.100 and mask address is set to 255.255.255.0.

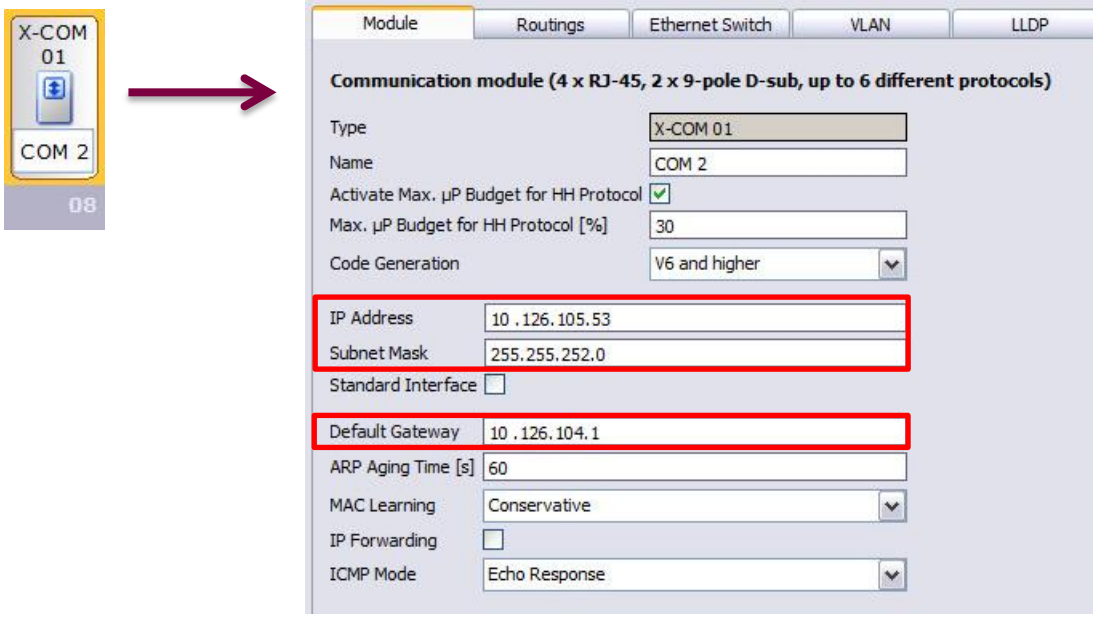


3.1.4.3 Communication Modules IP Address Configuration

- Double-click on the module CPU 1 and set the required IP addresses. Select the option “Standard Interface”.
  In this example, IP address is set to 10.126.105.52, mask address is set to 255.255.252.0 and Gateway address is set to 10.126.104.1.



- Double-click on the module CPU 2 and set the required IP addresses.
  In this example, IP address is set to 10.126.105.53, mask address is set to 255.255.252.0 and Gateway address is set to 10.126.104.1.

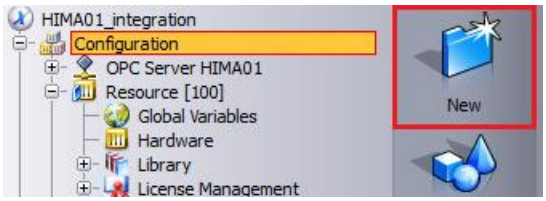


3.1.5 OPC Server Configuration

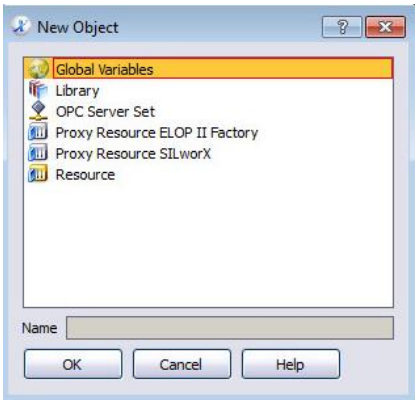
3.1.5.1 Variables Assignment

There exists a global variables list inside the project item resource (“Ressource[100]” in this project). These variables can only be used inside this part. As soon as variables need to be exchanged in a higher level, for example with an OPC Server, then the variables need to be defined in another global list (outside of the configuration resource part).

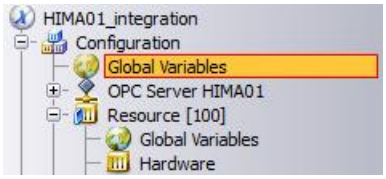
- Select the field “Configuration” and click on the shortcut button “New”.



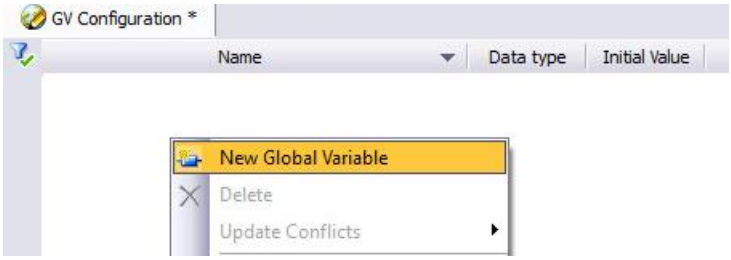
- Select the option “Global Variables” and click on the button “OK”.



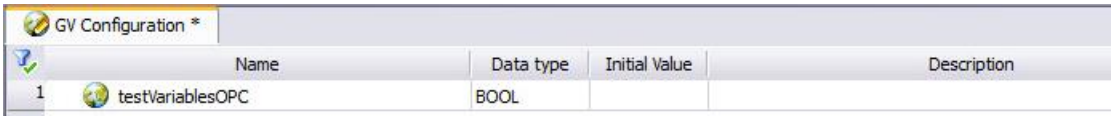
- The new global variables list is inserted in the project in a higher level as this of the resource part “Ressource[100]”.



- Double-click on the new list “Global Variables”.
  To create a new variable, right-click in the field and select the menu “New Global Variable”.

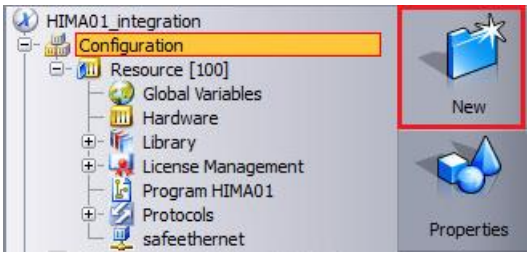


- In this example, the variable “testVariablesOPC” is created.

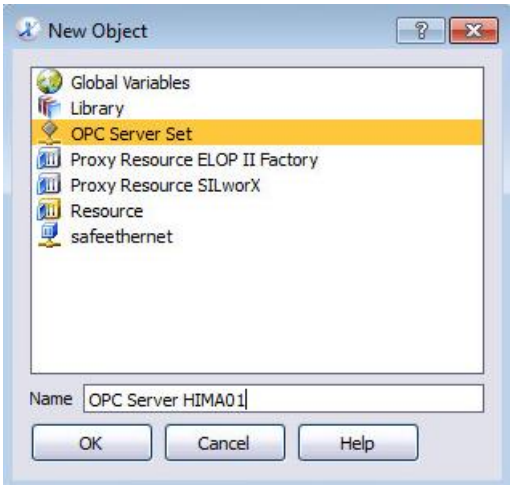


3.1.5.2 OPC Host Configuration

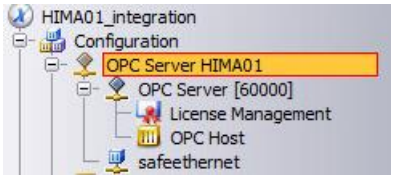
- Select the field “Configuration” and click on the shortcut button “New”.



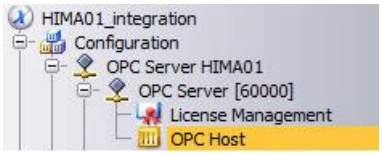
- Select the option “OPC Server Set”, enter a name, for example “OPC Server HIMA01” and click on the button “OK” to validate.



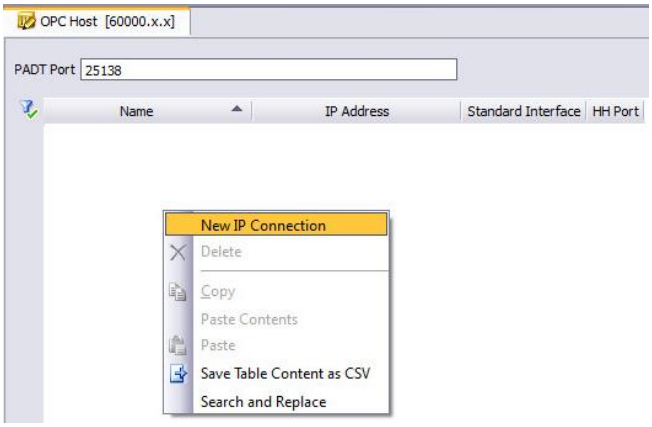
- The new OPC Server package is inserted in the project view.



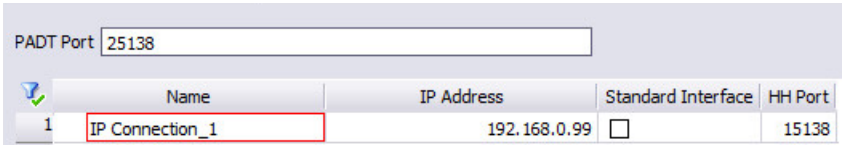
- Double-click on the menu “OPC Host”. This opens the OPC Host page.



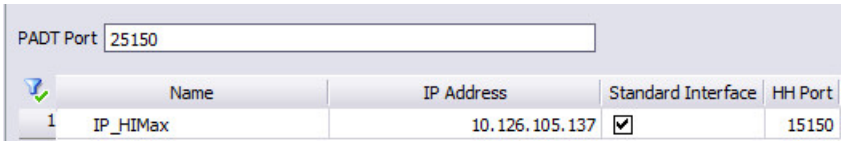
- Right-click in the field and select the menu “New IP Connection”.



- New IP connection is inserted in the page.

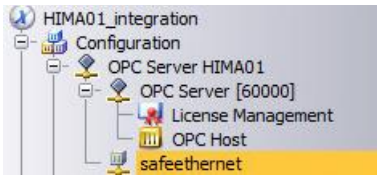


- Update the parameters according to the connected network.

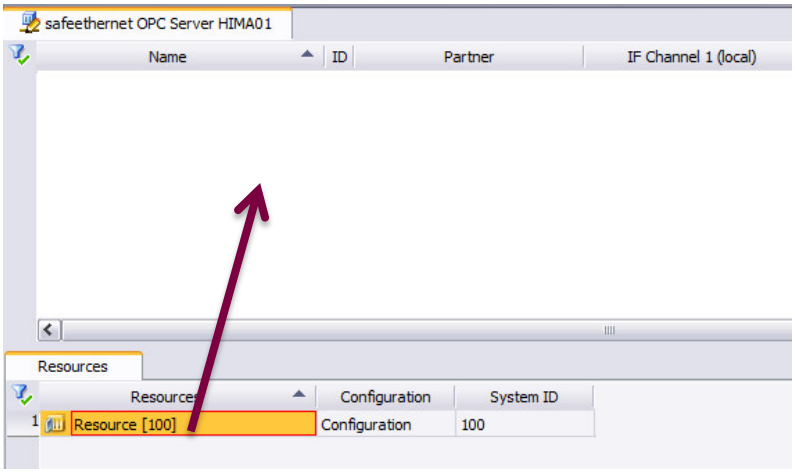


3.1.5.3 Safe Ethernet Configuration

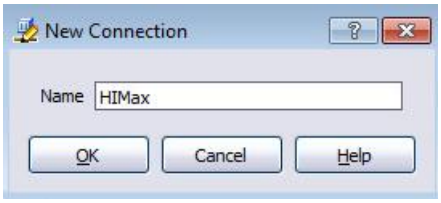
- Double-click on the menu “OPC Host”. This opens the safeethernet OPC server configuration page.



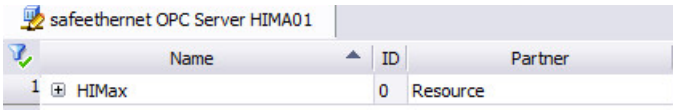
- Select the resource “Resource[100]” and drag it in the safeethernet OPC Server part.



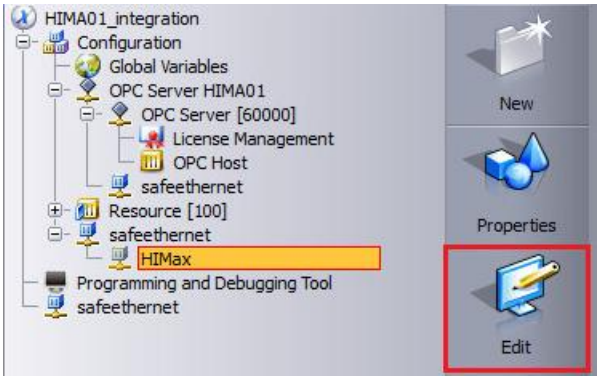
- Following parameter window is automatically opened. Enter a connection name, for example “HIMax” and click on the button “OK” to validate.



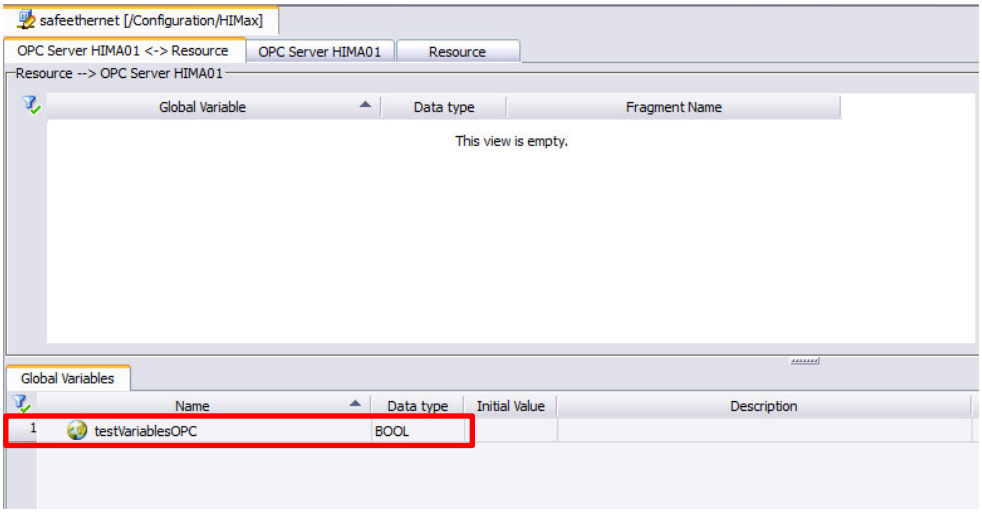
- New connection is successfully created.



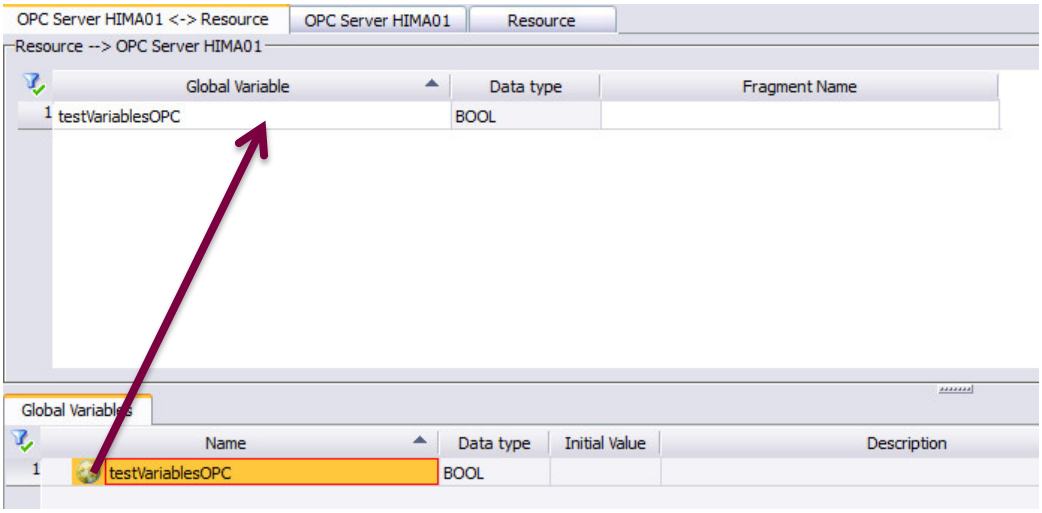
- The new OPC server connection is automatically imported in the project safeethernet part. Select it and click on the shortcut button “Edit”.



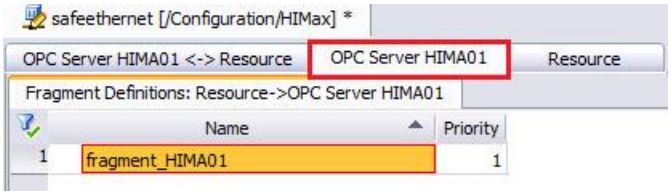
- This opens the following window:
  The created variable “testVariablesOPC” is automatically displayed.



- Drag the variable “testVariablesOPC” in the upper part.

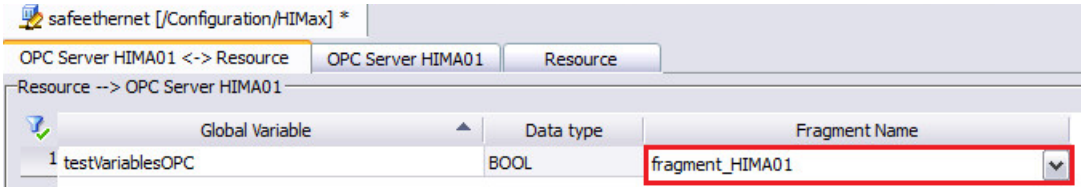


- Select the tab “OPC Server HIMA01” and configure the fragment “fragment_HIMA01” with Priority 1.



➔ Refer to the document “HI 801 101 E Rev.6.01” for further details about fragments and priorities configuration.

- Go back to the tab OPC Server HIMA01 <-> Resource.
  Assign the fragment “fragment_HIMA01” to the variable “testVariablesOPC”.

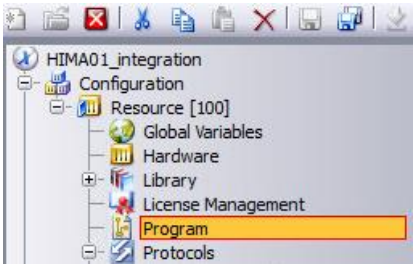


- Save and close the window.

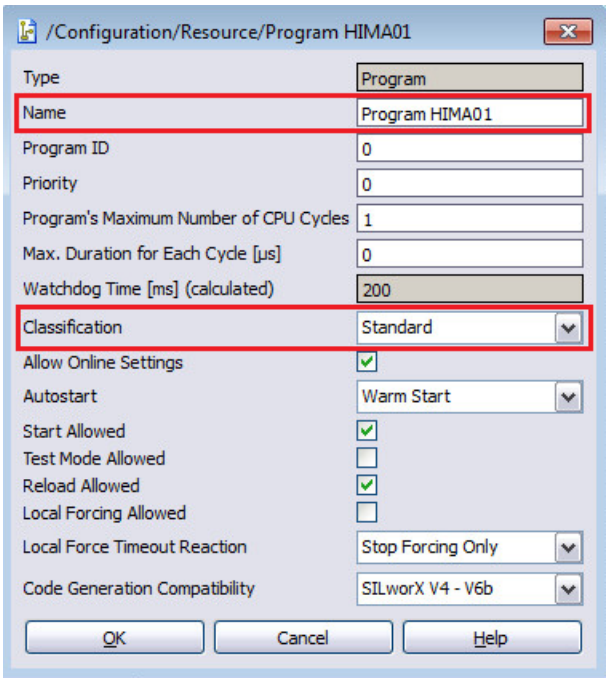
3.2 Mapping of Process Values to Control Strategy

3.2.1 New Program

- Right-click on the menu “Program”.



  - Edit the field “Name” and the classification if needed.
    Other parameters are specific to the application.



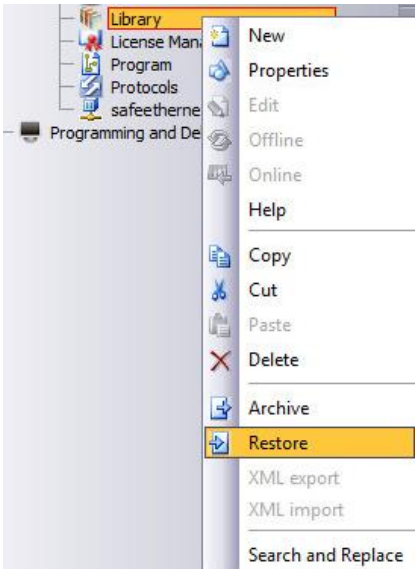
    Click on the button “OK” to validate.

- There is the possibility to add other program pages (Resource(100)→New→ Program).

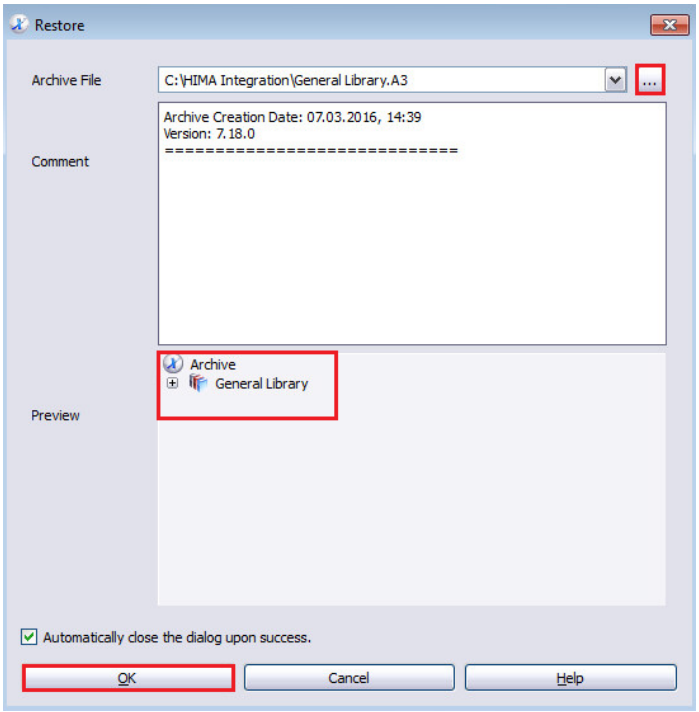
3.2.2 Import of Function Block Libraries

- Three libraries provided by HIMA Paul Hildebrandt GmbH need to be imported in the project:
  - The library “General Library” contains general conversion data type functions.
  - The library “X-HART-Lib V1.0” contains HART function blocks.
  - The library “X-Lib” contains specific SIL function blocks.

- Right-click on the field “Library” and click on the button “Restore”.

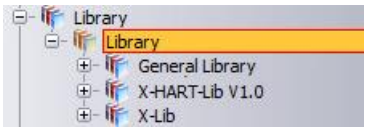


- Browse for the library files and select the HIMA Library “General Library”. The selected library is shown in the “Preview”. Confirm by clicking on the button “OK”.



- Repeat the previous steps to import the libraries “X-Lib” and “X-HART-Lib V1.0”.

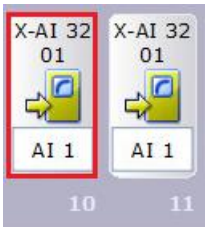
- Imported Libraries are shown in the overview.



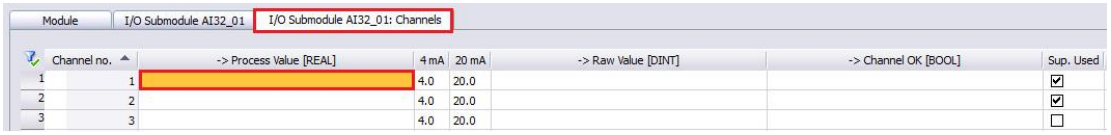
3.2.3 4...20mA Inputs/Outputs

3.2.3.1 SIL 1oo1 Configuration

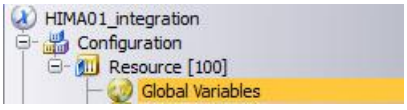
- Double-click on the configured analog input card.



- Select the tab “I/O Submodule AI32_01:Channels”.
  The process value 4..20mA and all channel specific parameters of AI 1 can be assigned at this place.



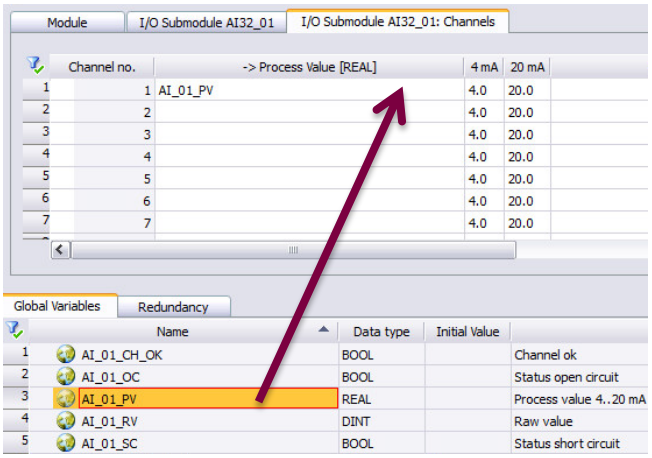
- Double-click on the field “Global variables” in Resource[100].



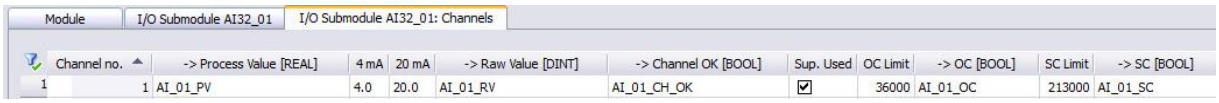
- Create the following global variables and save:

AI_01_PV	REAL		Process value 4..20 mA
AI_01_RV	DINT		Raw value
AI_01_CH_OK	BOOL		Channel ok
AI_01_OC	BOOL		Status open circuit
AI_01_SC	BOOL		Status short circuit

- Assign all created variables to the channel by dragging each variable to the corresponding field.
  The following picture shows the assignment of variable “AI_01_PV” for a process value:



- Result after the assignment of all relevant variables:



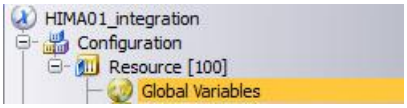
These variables can be used in the control strategy.

3.2.3.2 SIL 1oo2 Configuration

For SIL 1oo2, additional steps have to be configured as follows:

3.2.3.2.1 Redundant device variables

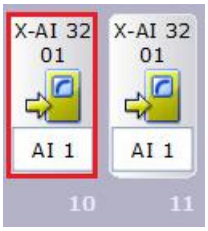
- Double-click on the field “Global variables” in Resource[100].



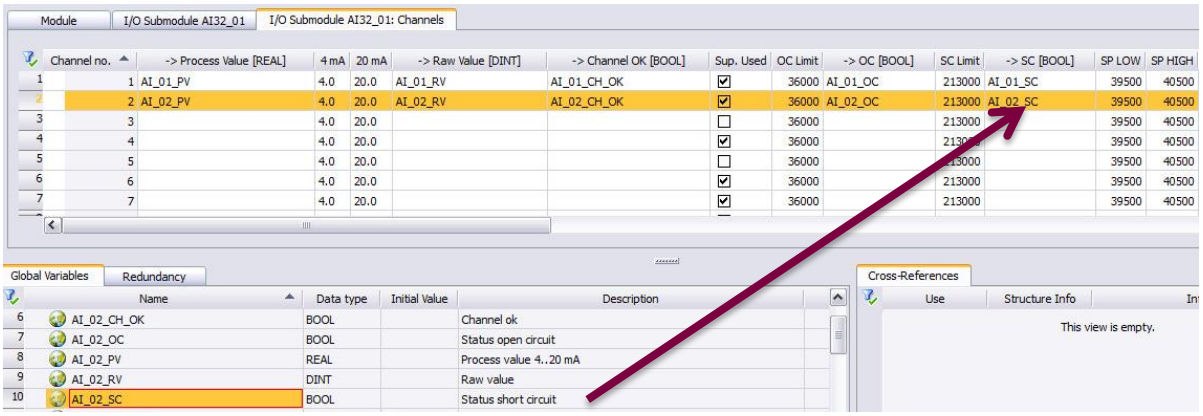
- Create the corresponding variables for the second device and save the modifications.

AI_02_PV	REAL		Process value 4..20 mA
AI_02_RV	DINT		Raw value
AI_02_CH_OK	BOOL		Channel ok
AI_02_OC	BOOL		Status open circuit
AI_02_SC	BOOL		Status short circuit

- Double-click on the configured analog input card and select the tab "I/O Submodule AI32_01:Channels".

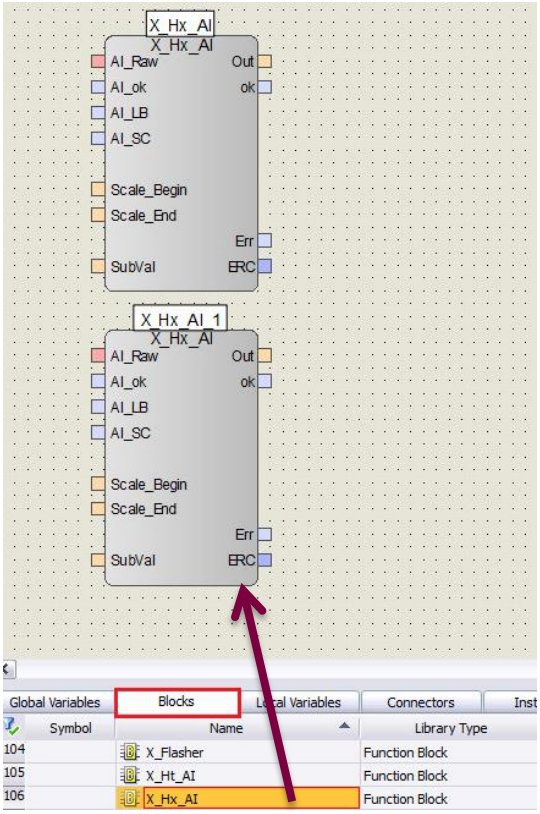


- Assign all created variables to the channel by dragging each variable to the corresponding field:

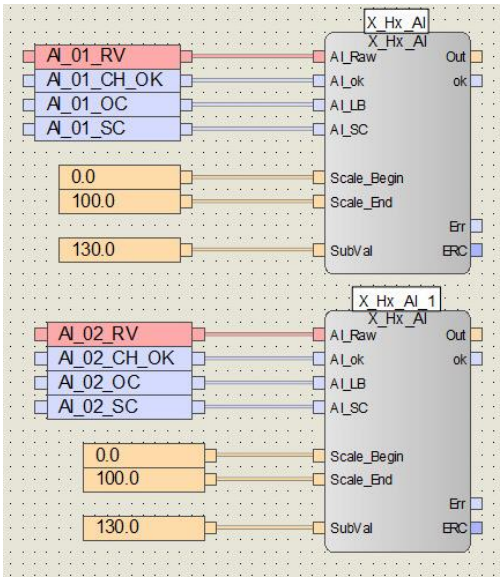


3.2.3.2.2 SIL 1oo2 Logic

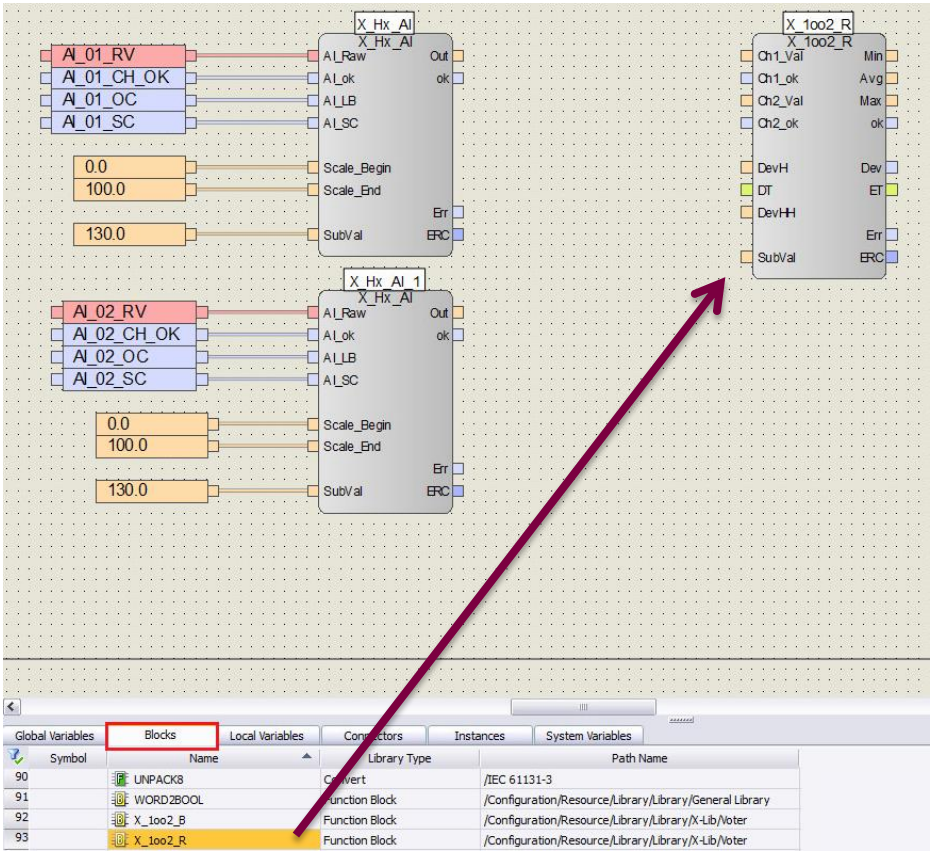
- In the page “Program HIMA01”, select the tab “Blocks” and insert two times the function block “X_Hx_AI” by dragging them in the program page.



- Assign created global variables to the function block as well as the scaling ranges:
  In this example, the scaling ranges are set between 0 and 100. Values are set to 130 in case of error.

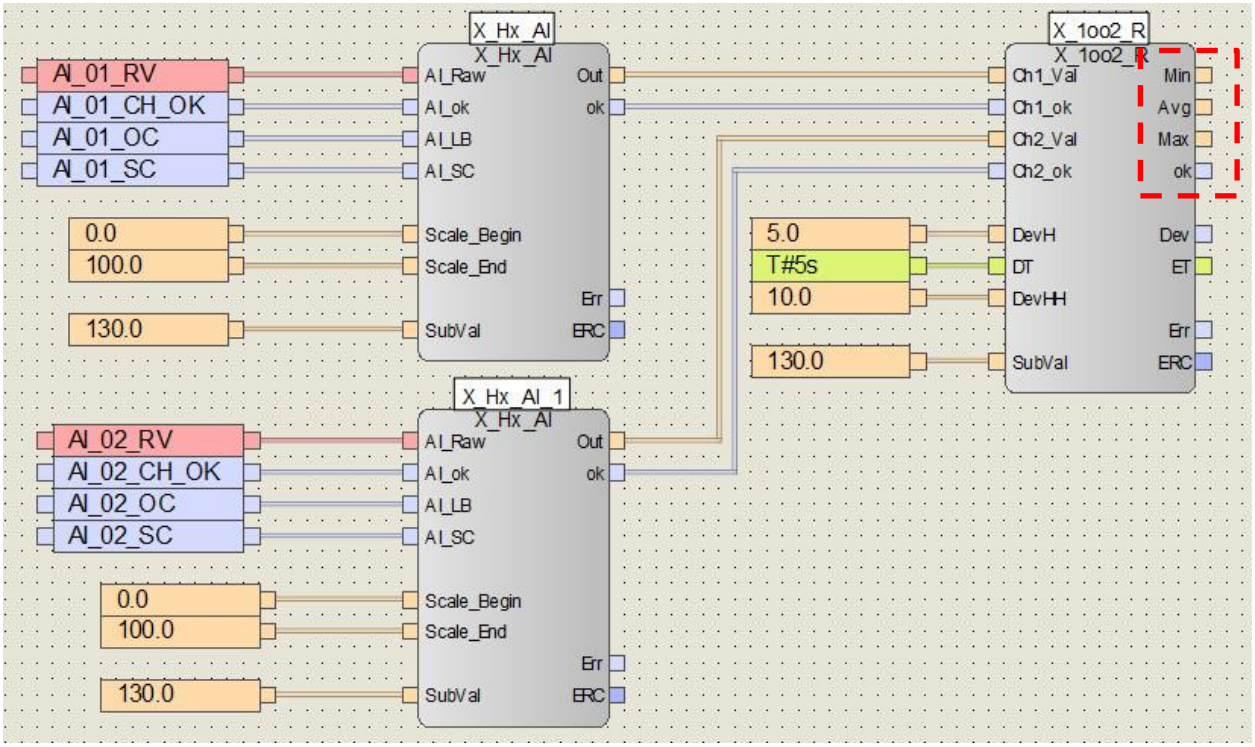


- In the page “Program HIMA01”, select the tab “Blocks” and insert the function block “X_1oo2_R” by dragging it in the program page.



- Connect both function block outputs to the function block "X_1oo2_R" and assign the parameters DevH, DT, DevHH and SuvVal.
  - DevH = Deviation limit alarm. This value, set to 5, is compared to the absolute value of the subtraction between Ch1_Val and Ch2_Val. If greater, an alarm is set.
  - DevHH = Deviation limit fault. This value, set to 10, is compared to the absolute value of the subtraction between Ch1_Val and Ch2_Val. If greater, a fault is set.
  - DT= Delay time for deviation alarm. This value is set to 5s.
  - SubVal = Set Value in case of error, 130 in this example.

"X_1oo2_R" output values



The "X_1oo2_R" outputs values "Min", "Avg", "Max" and "ok" can be used in the control strategy.

3.2.4 HART Interface

3.2.4.1 HART IP ComUserTask

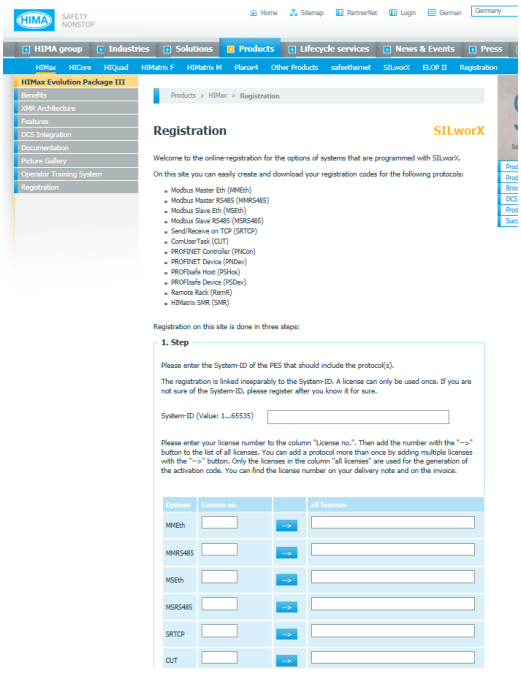
HART Libraries called “HIMax HART Packages” and provided by HIMA Paul Hildebrandt GmbH must be installed in the project. These packages contain HART function blocks and user tasks. There exists different “HIMax HART Packages” depending on the number of HART interfaces (100, 300, 500 and 700).

Please refer to the document “HI 801 089 E User Manual HIMax HART Package V1.00 (1016)” for further information.

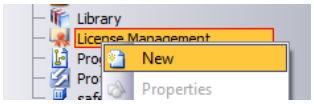
3.2.4.1.1 License Management

The use of ComUserTask requires a license, provided by HIMA Paul Hildebrandt GmbH.

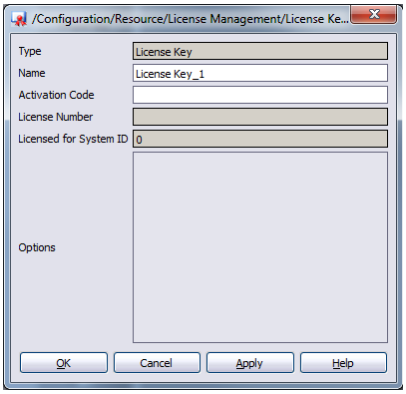
- To obtain the correct license key for your System-ID from the license number received via delivery note, go to the following internet page:
  http://www.hima.com/Products/HIMax/SILworX_registration.php
  By entering your system ID and licenses number you can create your relevant license key for SILworX. Please NOTE down and archive that key!



- In SILworX, right-click on “License Management” and select the menu “New” to create a new license key:



- Go to the new License Key, right click and open “Properties”, following Window will shop up:

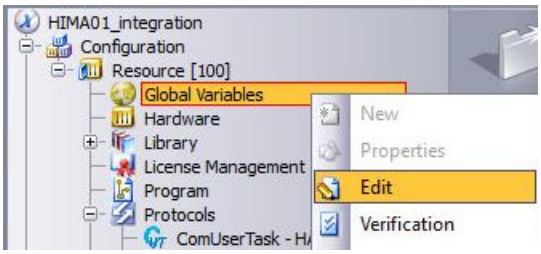


Under “Activation Code”, enter the key, which was created in the internet page.
Obtained licenses will be shown under “Options”. The “Licensed for System ID” number must match the System ID entered for the resource. Changing the “Name” is optional.

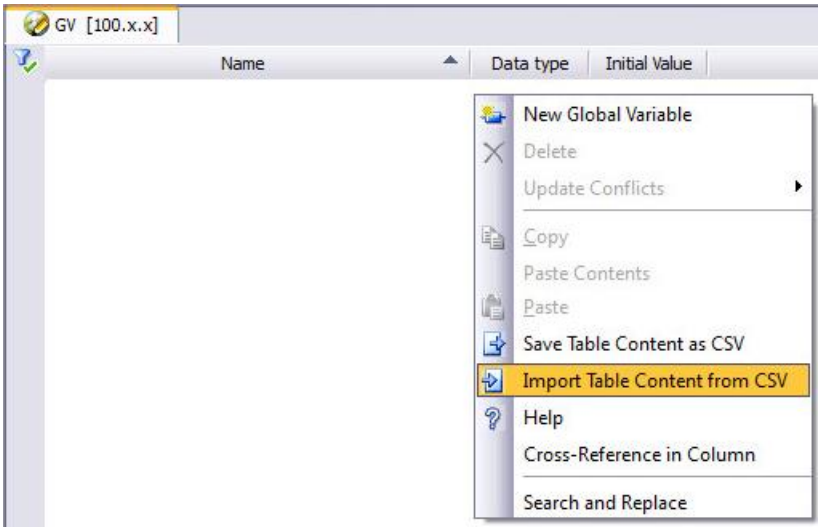
3.2.4.1.2 Import of Global Variables

An existing global variables list is provided by HIMA Paul Hildebrandt GmbH as part of the package “HIMax HART package”. This list provides the corresponding interfaces variables of the ComUserTask.

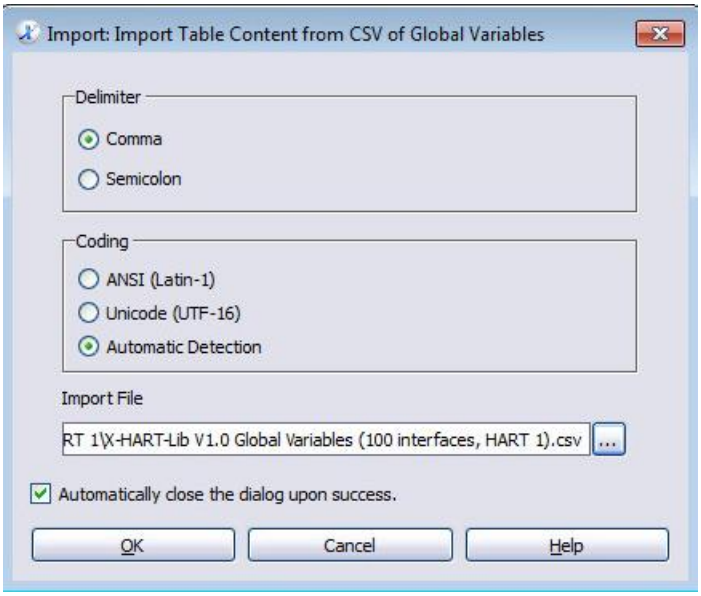
- Right-click on the field “Global Variables” and select the option “Edit”. This opens the global variables window.



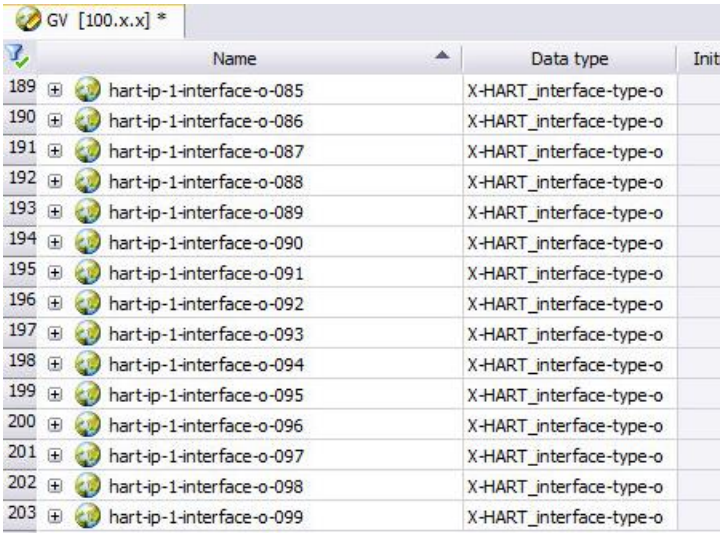
- Right-click in the field and select the option “Import Table Content from *.CSV”.



- Select the *.csv file of the global variables and click on the button “OK”.



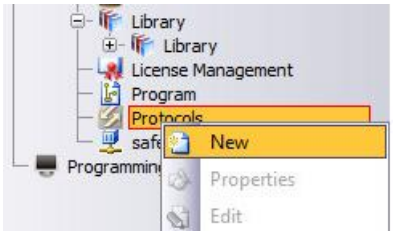
- Variables for 100 Inputs/Outputs Interfaces are successfully imported.



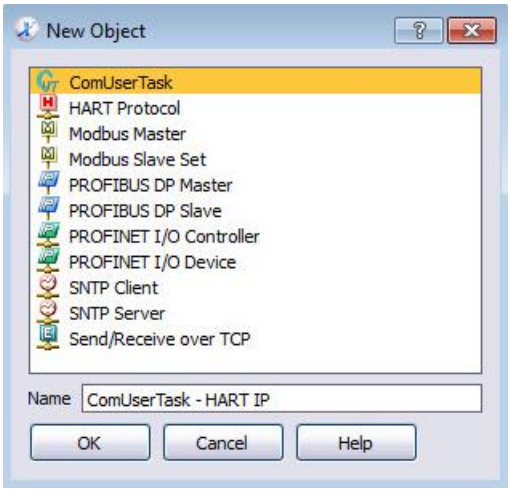
3.2.4.1.3 Inputs/Outputs Configuration

In this example, the package “HIMax HART Package” for 100 Interfaces has been implemented.

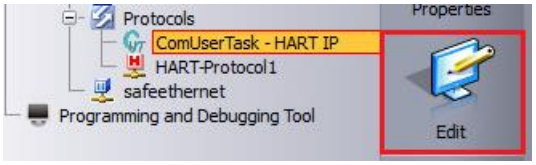
- Right-click on the field “Protocols” and select the menu “New”.



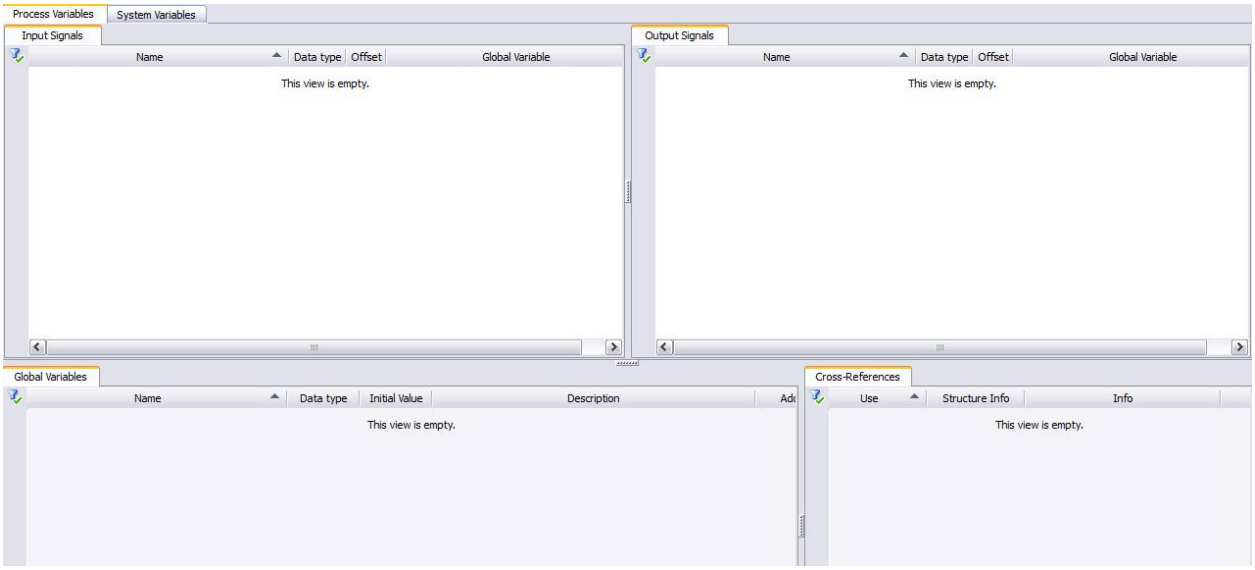
- Select the object “ComUserTask” and enter a name, for example “ComUserTask - HART IP”.



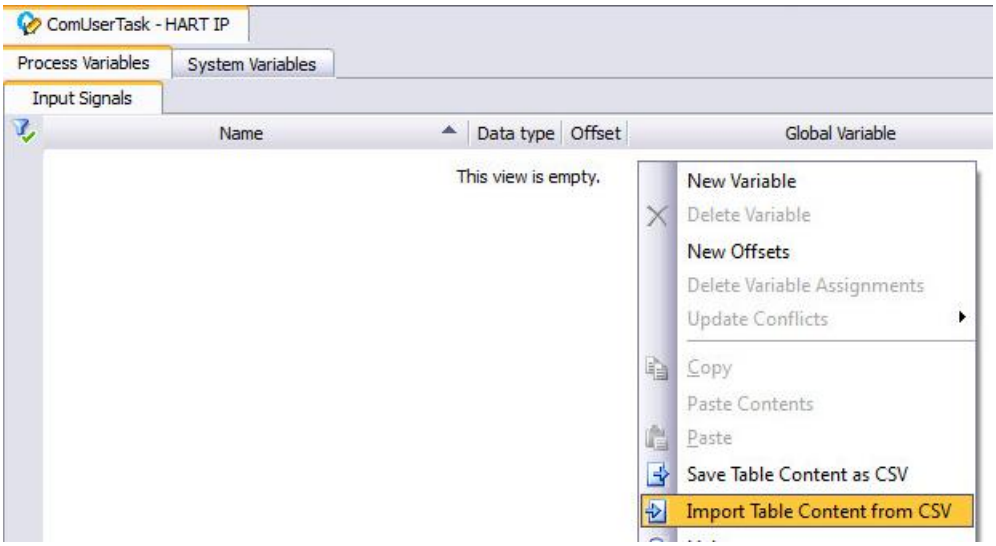
- The new "ComUserTask" is inserted in the Project.
  Select it and click on the shortcut button "Edit".



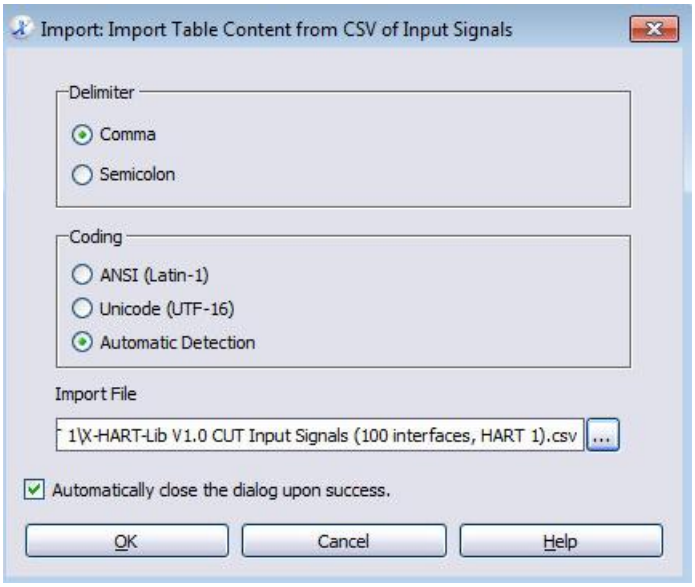
- Following window is displayed.
  Now, variables need to be imported from the corresponding *.CSV file of the "HIMax HART Package".



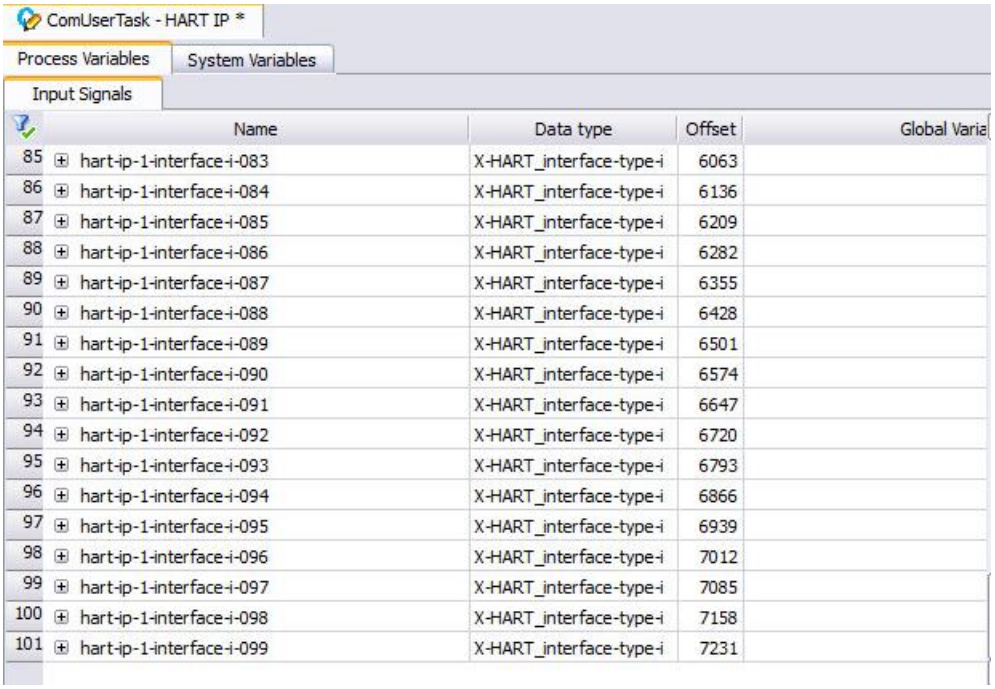
- Right-click in the field of the "Input Signals" and select the option "Import Table Content from *.CSV".



- Select the *.csv file of the Inputs and click on the button "OK".

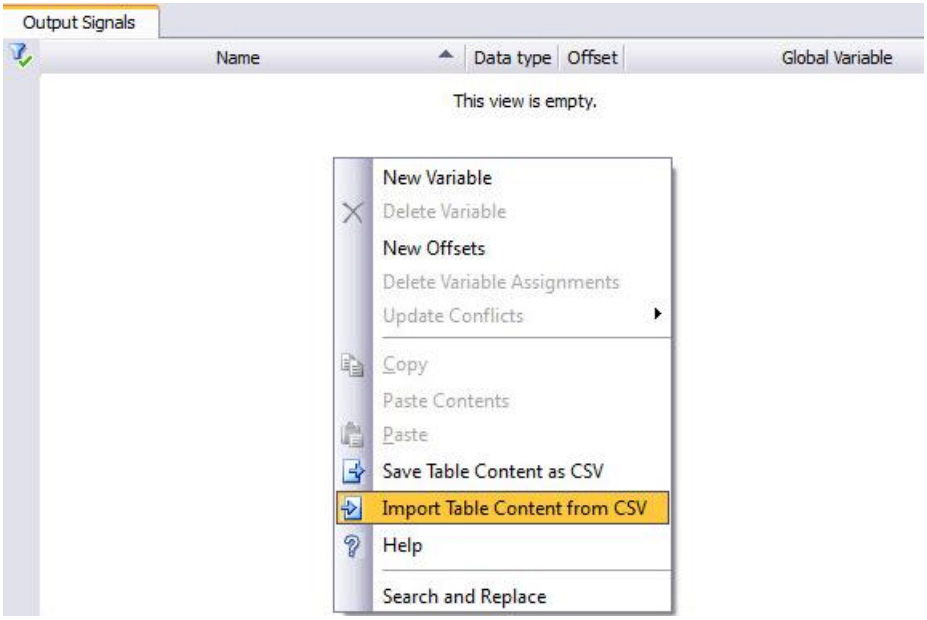


- Variables for 100 Inputs Interfaces are successfully imported.

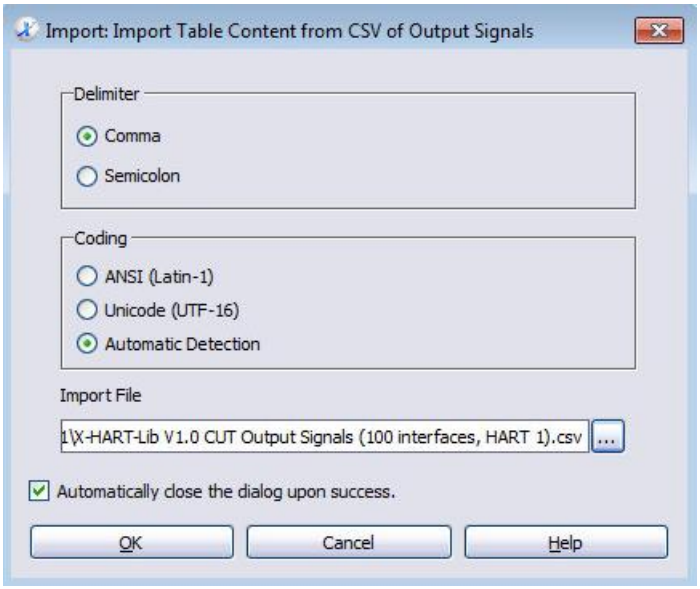


	Name	Data type	Offset	Global Varia
85	hart-ip-1-interface-i-083	X-HART_interface-type-i	6063	
86	hart-ip-1-interface-i-084	X-HART_interface-type-i	6136	
87	hart-ip-1-interface-i-085	X-HART_interface-type-i	6209	
88	hart-ip-1-interface-i-086	X-HART_interface-type-i	6282	
89	hart-ip-1-interface-i-087	X-HART_interface-type-i	6355	
90	hart-ip-1-interface-i-088	X-HART_interface-type-i	6428	
91	hart-ip-1-interface-i-089	X-HART_interface-type-i	6501	
92	hart-ip-1-interface-i-090	X-HART_interface-type-i	6574	
93	hart-ip-1-interface-i-091	X-HART_interface-type-i	6647	
94	hart-ip-1-interface-i-092	X-HART_interface-type-i	6720	
95	hart-ip-1-interface-i-093	X-HART_interface-type-i	6793	
96	hart-ip-1-interface-i-094	X-HART_interface-type-i	6866	
97	hart-ip-1-interface-i-095	X-HART_interface-type-i	6939	
98	hart-ip-1-interface-i-096	X-HART_interface-type-i	7012	
99	hart-ip-1-interface-i-097	X-HART_interface-type-i	7085	
100	hart-ip-1-interface-i-098	X-HART_interface-type-i	7158	
101	hart-ip-1-interface-i-099	X-HART_interface-type-i	7231	

- Right-click in the field of the “Output Signals” and select the option “Import Table Content from *.CSV”.



- Select the *.csv file of the Outputs and click on the button “OK”.

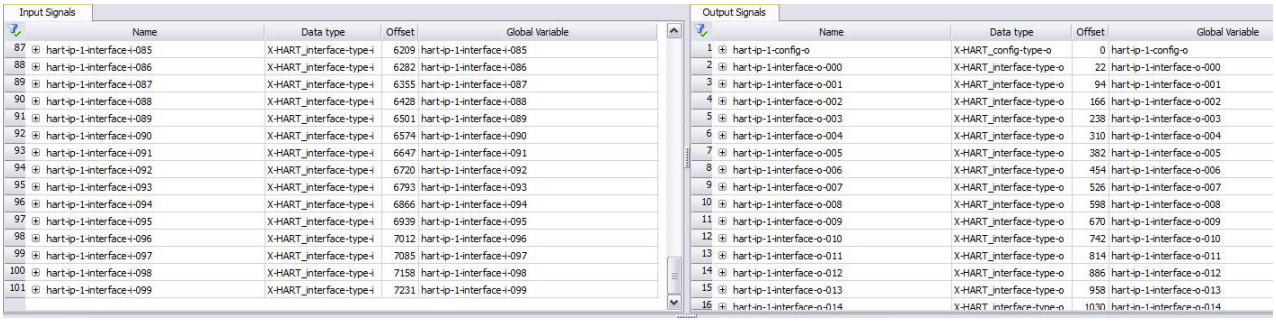


- Variables for 100 Outputs Interfaces are successfully imported.

Output Signals

	Name	Data type	Offset
85	hart-ip-1-interface-o-083	X-HART_interface-type-o	5998
86	hart-ip-1-interface-o-084	X-HART_interface-type-o	6070
87	hart-ip-1-interface-o-085	X-HART_interface-type-o	6142
88	hart-ip-1-interface-o-086	X-HART_interface-type-o	6214
89	hart-ip-1-interface-o-087	X-HART_interface-type-o	6286
90	hart-ip-1-interface-o-088	X-HART_interface-type-o	6358
91	hart-ip-1-interface-o-089	X-HART_interface-type-o	6430
92	hart-ip-1-interface-o-090	X-HART_interface-type-o	6502
93	hart-ip-1-interface-o-091	X-HART_interface-type-o	6574
94	hart-ip-1-interface-o-092	X-HART_interface-type-o	6646
95	hart-ip-1-interface-o-093	X-HART_interface-type-o	6718
96	hart-ip-1-interface-o-094	X-HART_interface-type-o	6790
97	hart-ip-1-interface-o-095	X-HART_interface-type-o	6862
98	hart-ip-1-interface-o-096	X-HART_interface-type-o	6934
99	hart-ip-1-interface-o-097	X-HART_interface-type-o	7006
100	hart-ip-1-interface-o-098	X-HART_interface-type-o	7078
101	hart-ip-1-interface-o-099	X-HART_interface-type-o	7150

- Declared Global variables are automatically assigned to the ComUserTask for the inputs/outputs.



Input Signals

	Name	Data type	Offset	Global Variable
87	hart-ip-1-interface-i-085	X-HART_interface-type-i	6209	hart-ip-1-interface-i-085
88	hart-ip-1-interface-i-086	X-HART_interface-type-i	6282	hart-ip-1-interface-i-086
89	hart-ip-1-interface-i-087	X-HART_interface-type-i	6355	hart-ip-1-interface-i-087
90	hart-ip-1-interface-i-088	X-HART_interface-type-i	6428	hart-ip-1-interface-i-088
91	hart-ip-1-interface-i-089	X-HART_interface-type-i	6501	hart-ip-1-interface-i-089
92	hart-ip-1-interface-i-090	X-HART_interface-type-i	6574	hart-ip-1-interface-i-090
93	hart-ip-1-interface-i-091	X-HART_interface-type-i	6647	hart-ip-1-interface-i-091
94	hart-ip-1-interface-i-092	X-HART_interface-type-i	6720	hart-ip-1-interface-i-092
95	hart-ip-1-interface-i-093	X-HART_interface-type-i	6793	hart-ip-1-interface-i-093
96	hart-ip-1-interface-i-094	X-HART_interface-type-i	6866	hart-ip-1-interface-i-094
97	hart-ip-1-interface-i-095	X-HART_interface-type-i	6939	hart-ip-1-interface-i-095
98	hart-ip-1-interface-i-096	X-HART_interface-type-i	7012	hart-ip-1-interface-i-096
99	hart-ip-1-interface-i-097	X-HART_interface-type-i	7085	hart-ip-1-interface-i-097
100	hart-ip-1-interface-i-098	X-HART_interface-type-i	7158	hart-ip-1-interface-i-098
101	hart-ip-1-interface-i-099	X-HART_interface-type-i	7231	hart-ip-1-interface-i-099

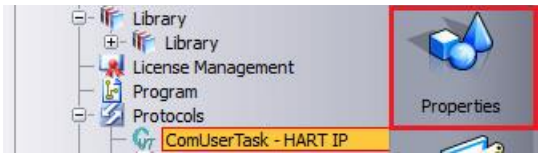
Output Signals

	Name	Data type	Offset	Global Variable
1	hart-ip-1-config-o	X-HART_config-type-o	0	hart-ip-1-config-o
2	hart-ip-1-interface-o-000	X-HART_interface-type-o	22	hart-ip-1-interface-o-000
3	hart-ip-1-interface-o-001	X-HART_interface-type-o	94	hart-ip-1-interface-o-001
4	hart-ip-1-interface-o-002	X-HART_interface-type-o	166	hart-ip-1-interface-o-002
5	hart-ip-1-interface-o-003	X-HART_interface-type-o	238	hart-ip-1-interface-o-003
6	hart-ip-1-interface-o-004	X-HART_interface-type-o	310	hart-ip-1-interface-o-004
7	hart-ip-1-interface-o-005	X-HART_interface-type-o	382	hart-ip-1-interface-o-005
8	hart-ip-1-interface-o-006	X-HART_interface-type-o	454	hart-ip-1-interface-o-006
9	hart-ip-1-interface-o-007	X-HART_interface-type-o	526	hart-ip-1-interface-o-007
10	hart-ip-1-interface-o-008	X-HART_interface-type-o	598	hart-ip-1-interface-o-008
11	hart-ip-1-interface-o-009	X-HART_interface-type-o	670	hart-ip-1-interface-o-009
12	hart-ip-1-interface-o-010	X-HART_interface-type-o	742	hart-ip-1-interface-o-010
13	hart-ip-1-interface-o-011	X-HART_interface-type-o	814	hart-ip-1-interface-o-011
14	hart-ip-1-interface-o-012	X-HART_interface-type-o	886	hart-ip-1-interface-o-012
15	hart-ip-1-interface-o-013	X-HART_interface-type-o	958	hart-ip-1-interface-o-013
16	hart-ip-1-interface-o-014	X-HART_interface-type-o	1030	hart-ip-1-interface-o-014

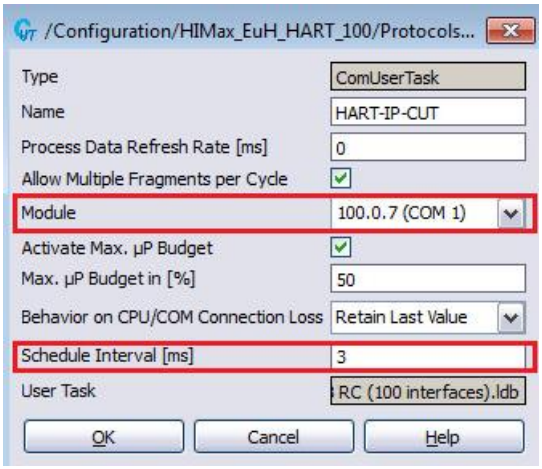
- Save and close the window.

3.2.4.1.4 Communication Module and User Task Assignment

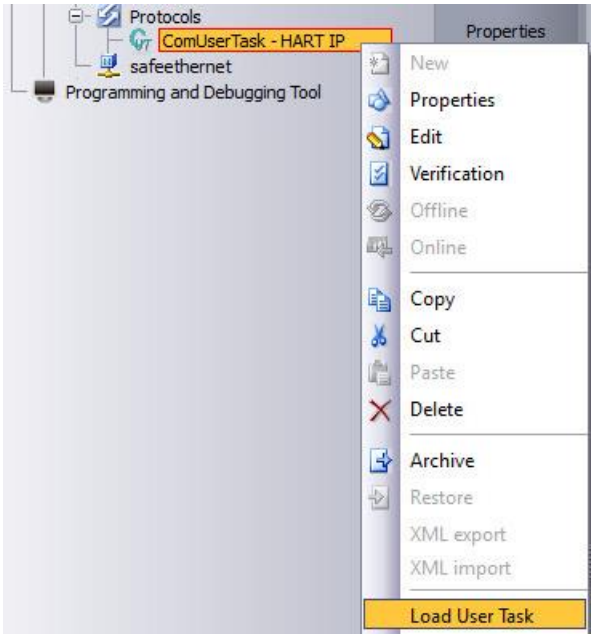
- Select the ComUserTask "ComUserTask – HART IP" and click on the shortcut button "Properties".



- Select the communication Module 100.0.7 (COM 1) and set the parameter "Schedule Interval [ms]" to the value "3ms". Then click on the button "OK".

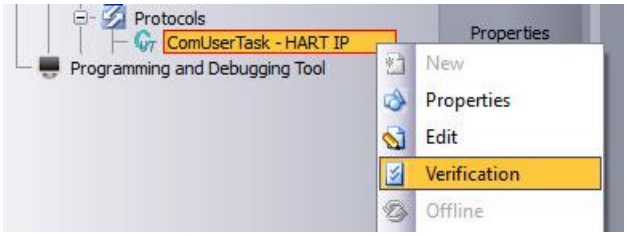


- Right-click on the ComUserTask , then select the menu "Load User Task" and select the User Task of the "HIMax HART Package".

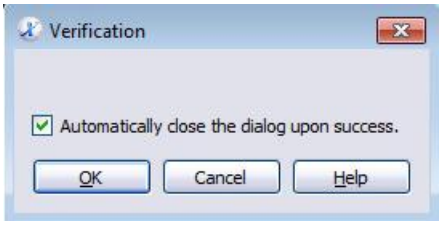


3.2.4.1.5 ComUserTask Verification

- Right-click on the ComUserTask and select the menu “Verification” in order to check the configuration.



- Following window appears. Click on the button “OK” to proceed.

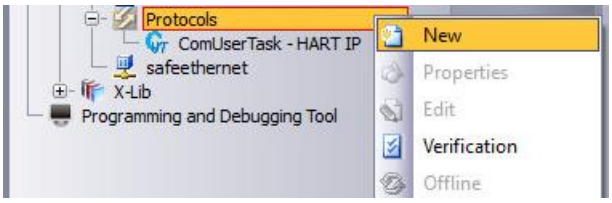


- Verification result is displayed in the logbook window.

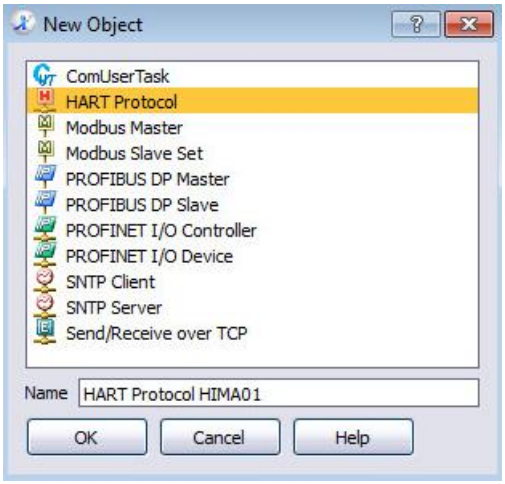
3.2.4.2 HART IP Protocols

3.2.4.2.1 New Protocol

- Right-click on the field “Protocols” and select the menu “New”.

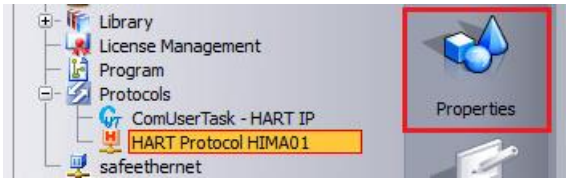


- Select the object “HART Protocol” and enter a name, for example “HART Protocol HIMA01” and click on the button “OK”.

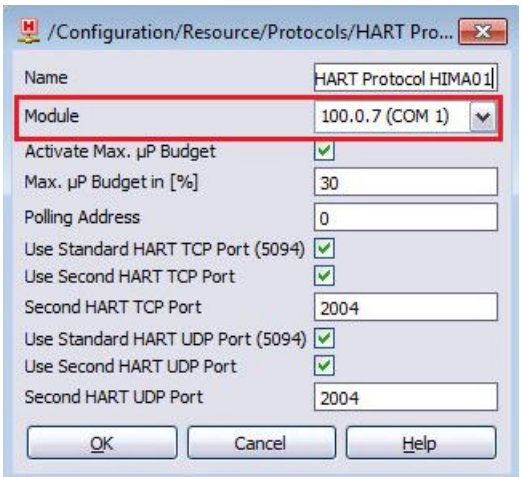


3.2.4.2.2 Communication Module Assignment

- In the project view, select “HART Protocol HIMA01” and select the shortcut button “Properties”.

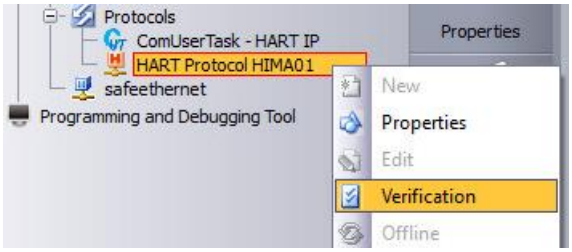


- Select the communication Module 100.0.7 (COM 1) and click on the button “OK”.

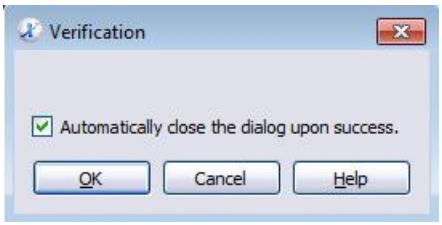


3.2.4.2.3 Protocol Verification

- Right-click on the ComUserTask and select the menu “Verification” in order to check the configuration.



- Following window appears. Click on the button “OK” to proceed.

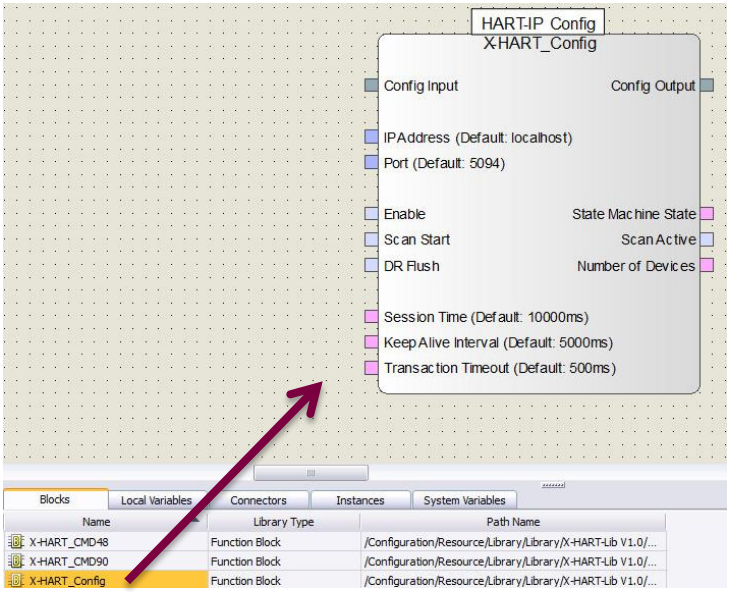


- Verification result is displayed in the logbook window.

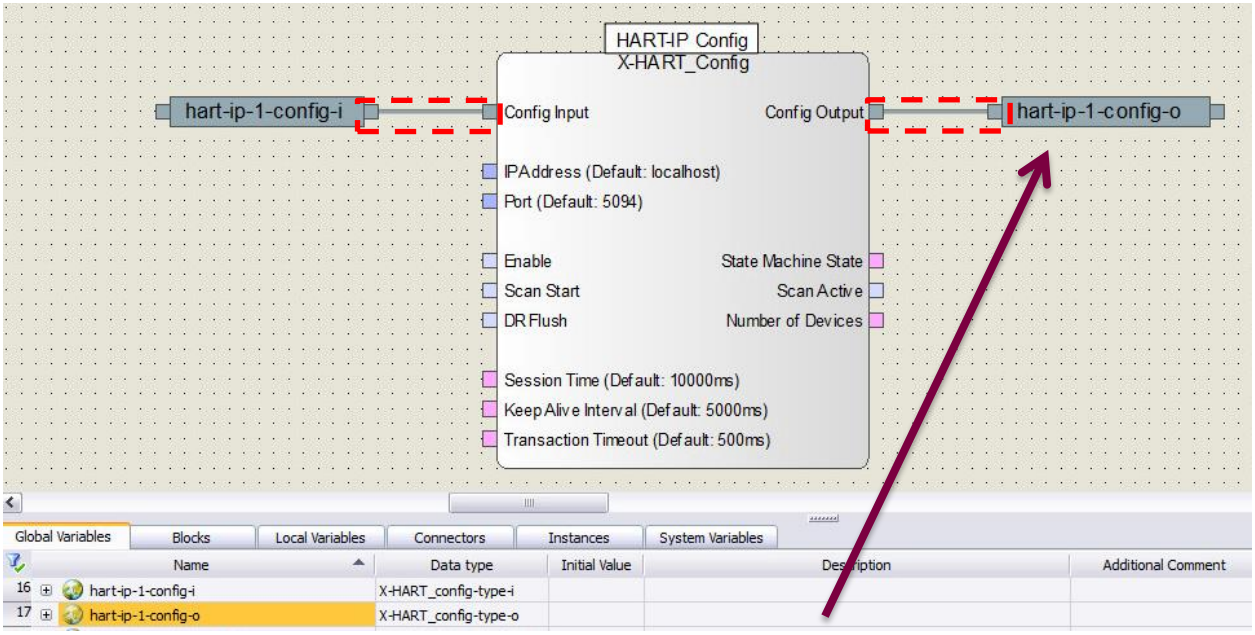
	Date/Time	Severity	
1	24/02/2016 14:19:33.781	Info	Verification started.
2	24/02/2016 14:19:36...	Info	Verification finished. Warnings: 0. Errors: 0.

3.2.4.3 HART IP Master Configuration

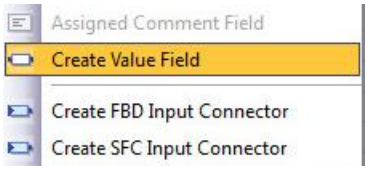
- Open the program page “Program HIMA01” and select the tab “Blocks”. Drag the function block “X-HART_Config” and drop it into the program page:



- Select the tab “Global Variables”, drag and drop the variables “hart-ip-1-config-i” and “hart-ip-1-config-o” into the program page and connect both variables to the function block:



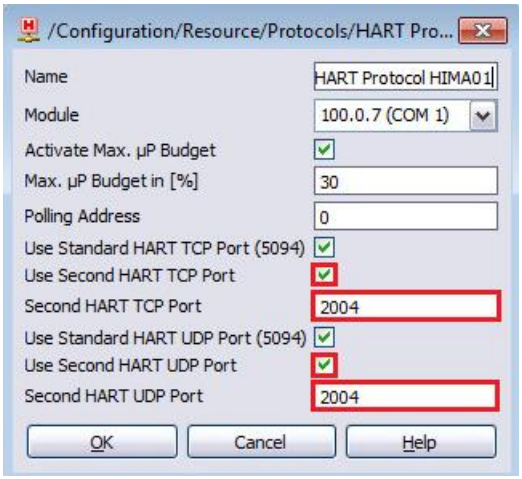
- Right-click in the program page and select the menu “Create Value Field”.



- Paste the “Value Field” in the program.

- Enter the value “2004” for this example and connect the variable to the instance “Port (default:5094)” of the function block.

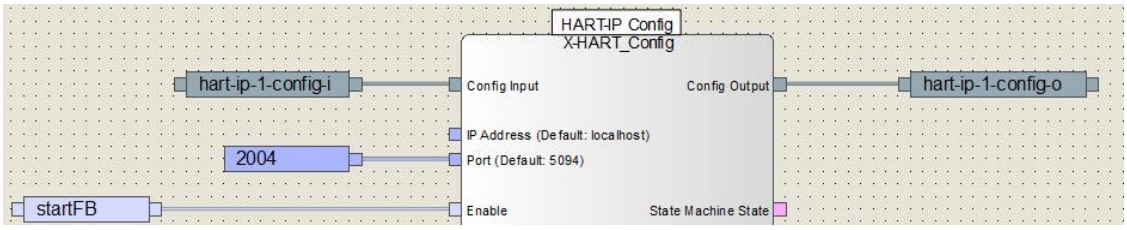
- This port value must be the same as the configured one in the "HART Protocol HIMA01" properties in chapter 3.2.4.2.2:



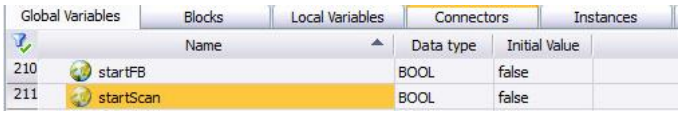
In this example, we use the Second Port because the Standard Port (5094) will be used for the Routed Tool Integration.

- Create a new global variable "startFB" with data type "BOOL" used for enabling the function block "HART-IP Config" in this example.

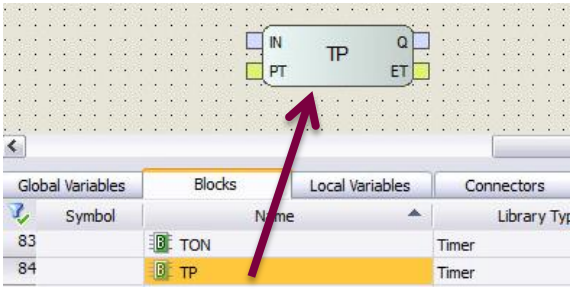
- Drag the variable "startFB" in the program page and connect it to the instance "Enable" of the function block.



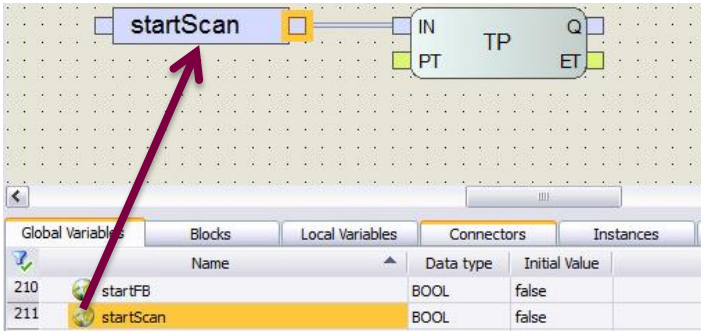
- Create a new global variable "startScan" with "BOOL" data type:



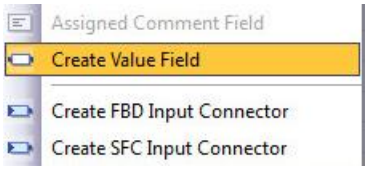
- While going from FALSE to TRUE, the "Scan Start" input starts the new HART device scan process. The TRUE level must be set for at least two HART-IP Master CUT cycles to start the device scan. That's why a timer function block must be inserted. Select the tab "Blocks" function block "TP and drag it closed to the HART-IP config function block:



- Assign the variable "startScan" to the instance "IN" of the function block "TP":



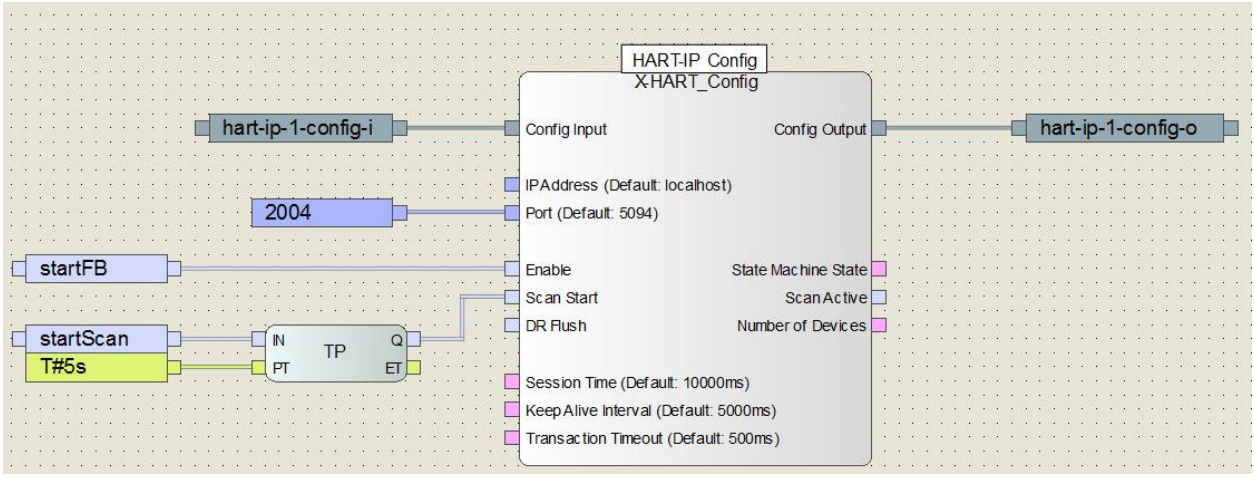
- Right-click in the program page and select the menu "Create Value Field":



Paste the Field value in the program:

Enter the value "T#5s" for this example and connect the variable to the instance "PT" of the function block TP. Connect the function block "TP" output to the HART-IP Config "Scan Start" bit.

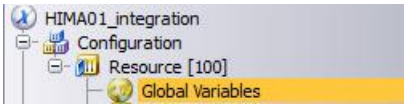
- Now the configured “HART-IP Config” function block should look like this:



3.2.4.4 HART Modem Enabling/Disabling

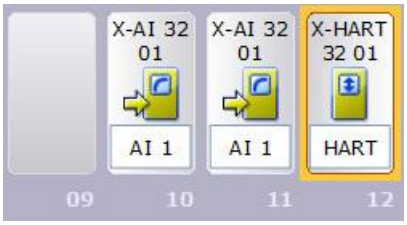
The HIMA HART interface module is not a multiplexer; it has individual HART modems for each channel. A connected HART device can only be scanned and operated, if its corresponding HART channel modem is enabled. This can be managed by assigning a global variable per channel:

- Double-click on the field “Global variables” in Resource[100].

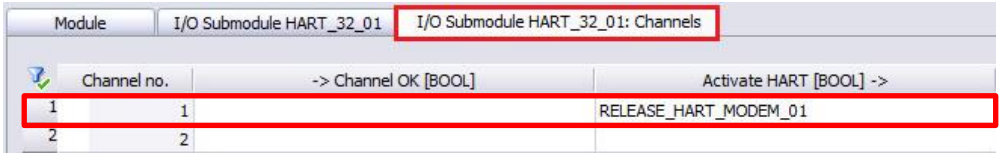


- Create global variables with data type “BOOL” for all used HART channels and initialize them as required (TRUE or FALSE). In our application, we initialize with “TRUE”.

- In the Hardware configuration view, double-click on the HART card “X-HART 32 01”.

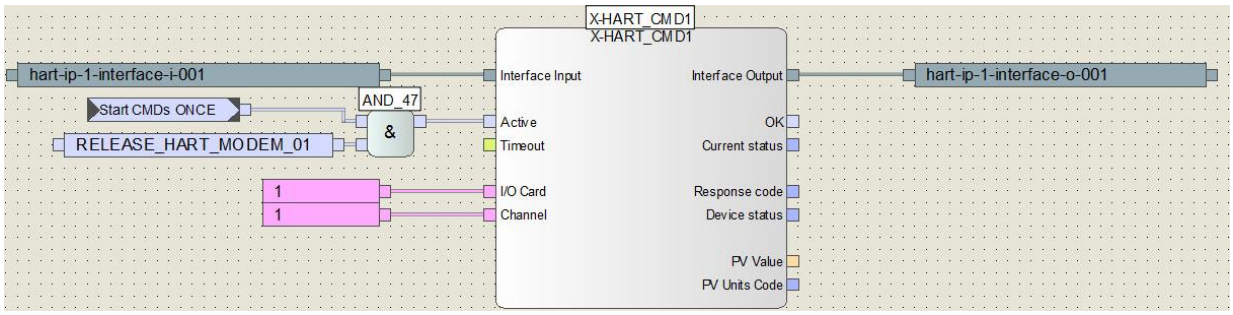


- Select the tab “I/O Submodule HART_32_01: Channels” and assign the created global variables to the corresponding channel. E.g. “RELEASE_HART_MODEM_01” is used here to enable the HART modem for channel 1:



3.2.4.5 Universal HART Command Function Blocks

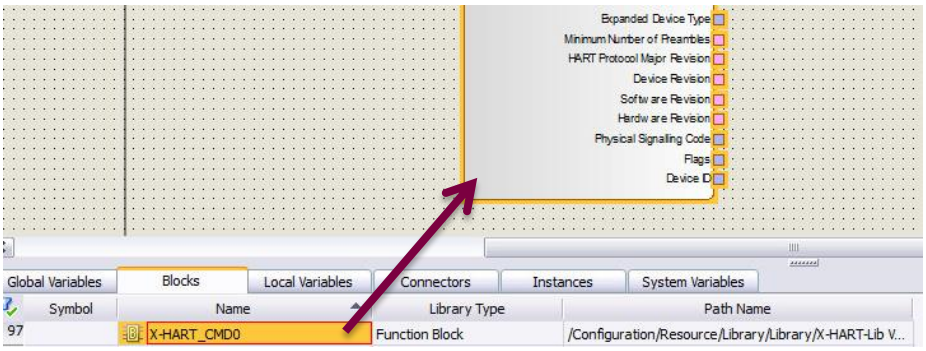
All universal HART Command function blocks are used in a similar manner. Each requires an “Interface Input” and an “Interface Output” signal as well as a BOOL input variable to activate the function block. The assignment to the X-HART module and a specific channel is done by constant parameters connected to “I/O Card” and “Channel” input:



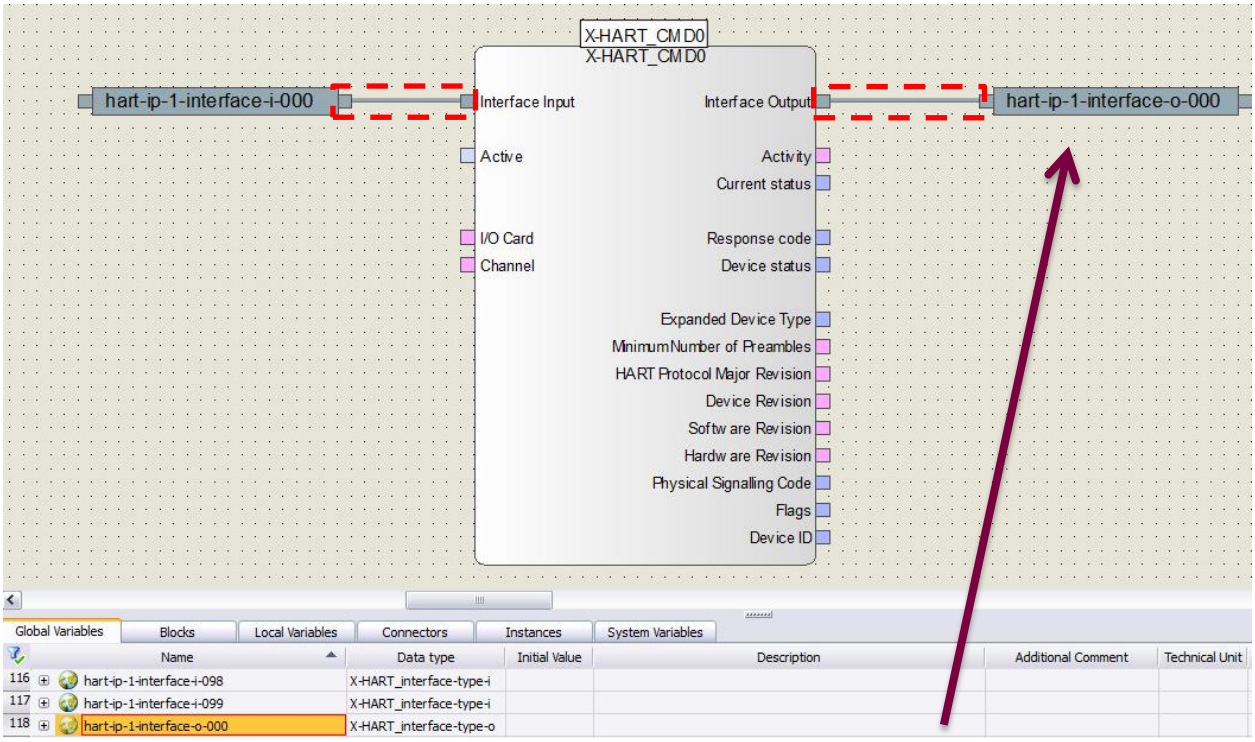
The following chapter shows how to configure these parameters for Command 0. All this is applicable for all other Commands later on.

3.2.4.5.1 HART CMD 0: Read unique identifier

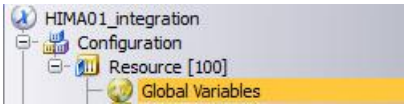
- Open the program page “Program HIMA01” and select the tab “Blocks”. Drag the function block “X-HART_CMD0” and drop it into the program page:



- Select the tab “Global Variables”, drag and drop the variables “hart-ip-1-interface-i-000” and “hart-ip-1-interface-o-000” into the program page. Then connect both variables to the function block:

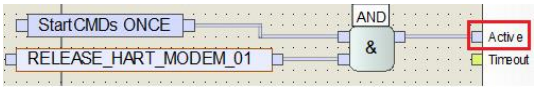


- Double-click on the field “Global variables” in Resource[100].

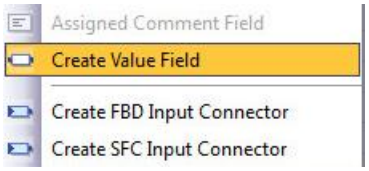


- In our example, we have created another global variable called “StartCMDs ONCE”:

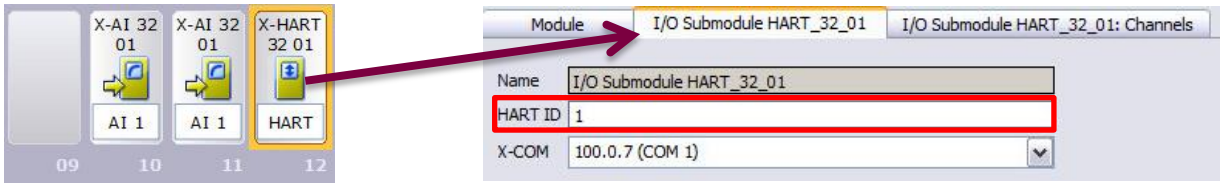
- This start command variable “StartCMDs ONCE” must be set to TRUE and the relevant HART modem must be enabled in order to activate the function block. The “AND” function can be found in the tab “Blocks”:



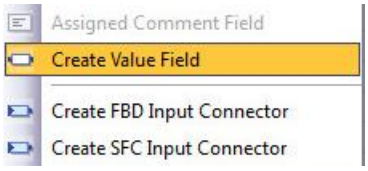
- The “I/O Card” assignment is done by using a value field. Right-click in the program page and select the menu “Create Value Field”:



- Paste the value field in the program and connect it to the "I/O Card" input of the function block. Double-click to edit its value. In our example, the value must be "1". This corresponds to the HART ID number of the X-HART module which can be found in the Hardware configuration view:

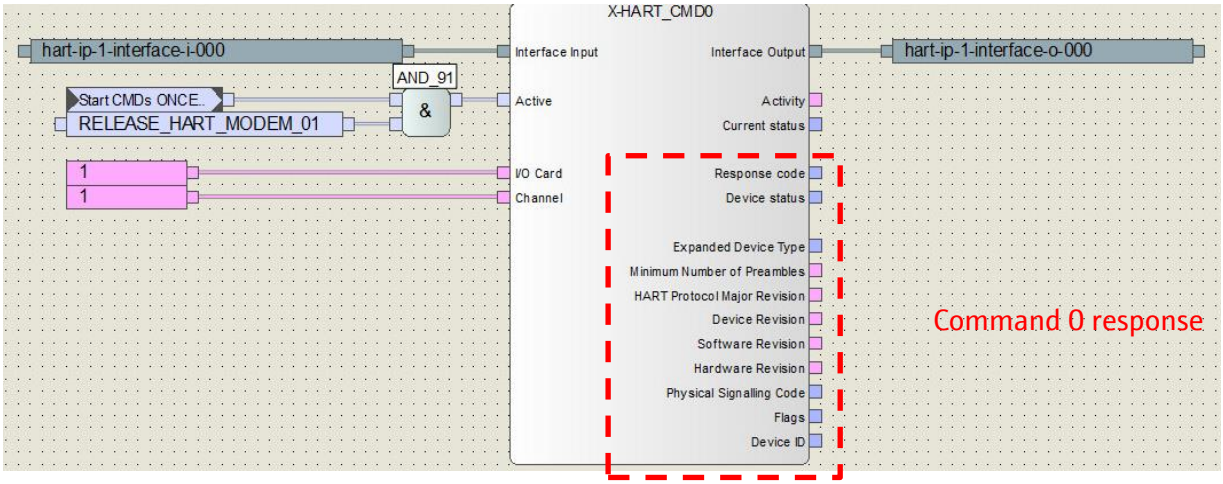


- The "Channel" assignment is done by using another value field. Right-click in the program page and select the menu "Create Value Field":



- Paste the value field in the program and connect it to the "Channel" input of the function block. Double-click to edit its value. In our example, the value is "1". This corresponds to the HART channel on which the field device is connected.

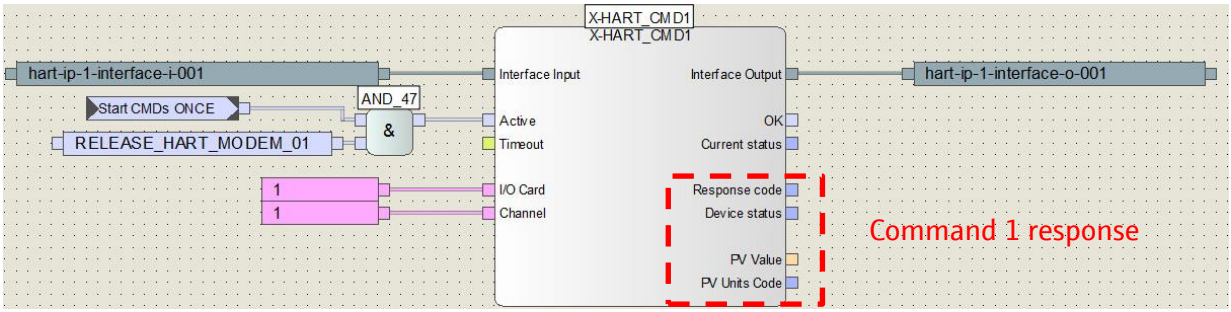
- All necessary input and output variables are now connected. Command 0 response variables are available (marked with red rectangle) and can be assigned for further use:



- Refer to the document "HI 801 089 E User Manual HIMax HART Package V1.00 (1016)" for further information about the HART Commands function blocks. Refer to the document "HCF_SPEC-127" for further information about Universal HART Commands.

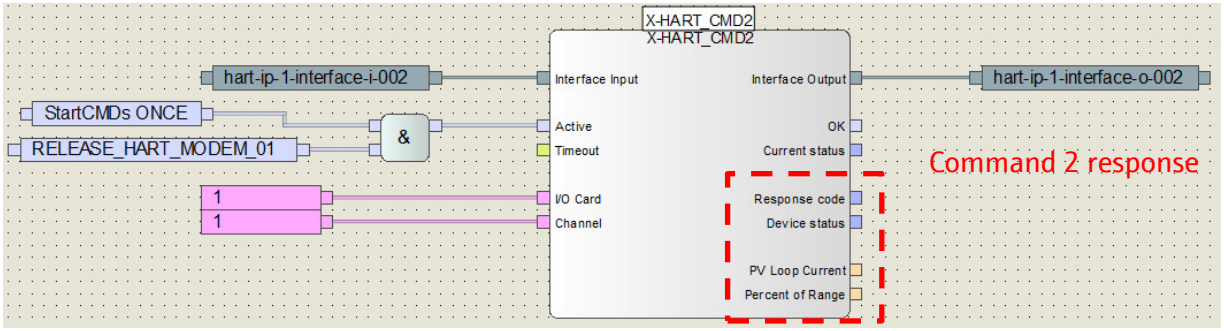
3.2.4.5.2 HART CMD 1: Read primary variable

- Following the steps described in chapter 3.2.4.5.1, Command 1 response variables are available (marked with red rectangle) and can be assigned for further use:



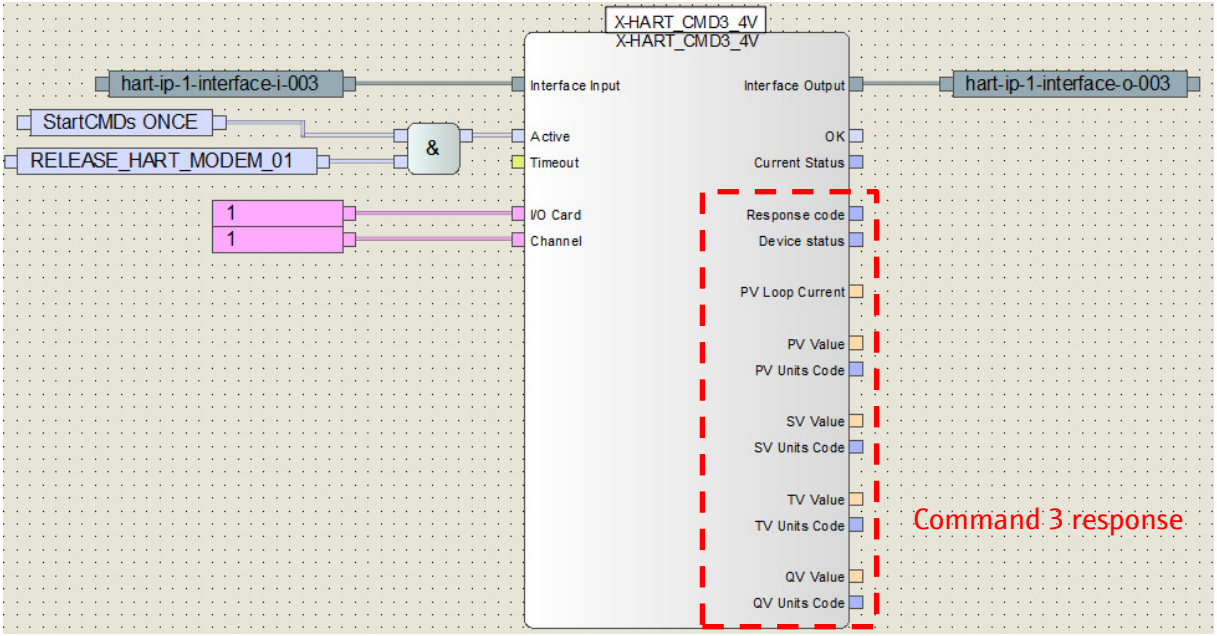
3.2.4.5.3 HART CMD 2: Read loop current and percent of range

- Following the steps described in chapter 3.2.4.5.1, Command 2 response variables are available (marked with red rectangle) and can be assigned for further use:



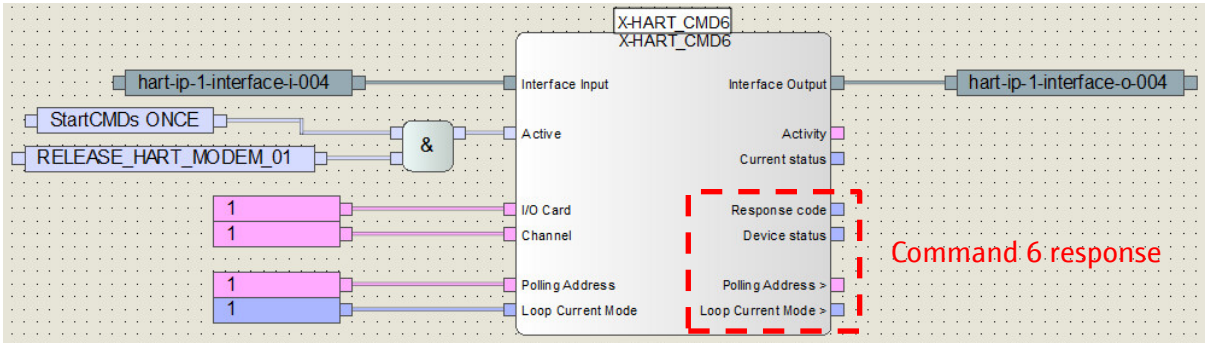
3.2.4.5.4 HART CMD 3: Read dynamic variables and loop current

- Following the steps described in chapter 3.2.4.5.1, Command 3 response variables are available (marked with red rectangle) and can be assigned for further use:



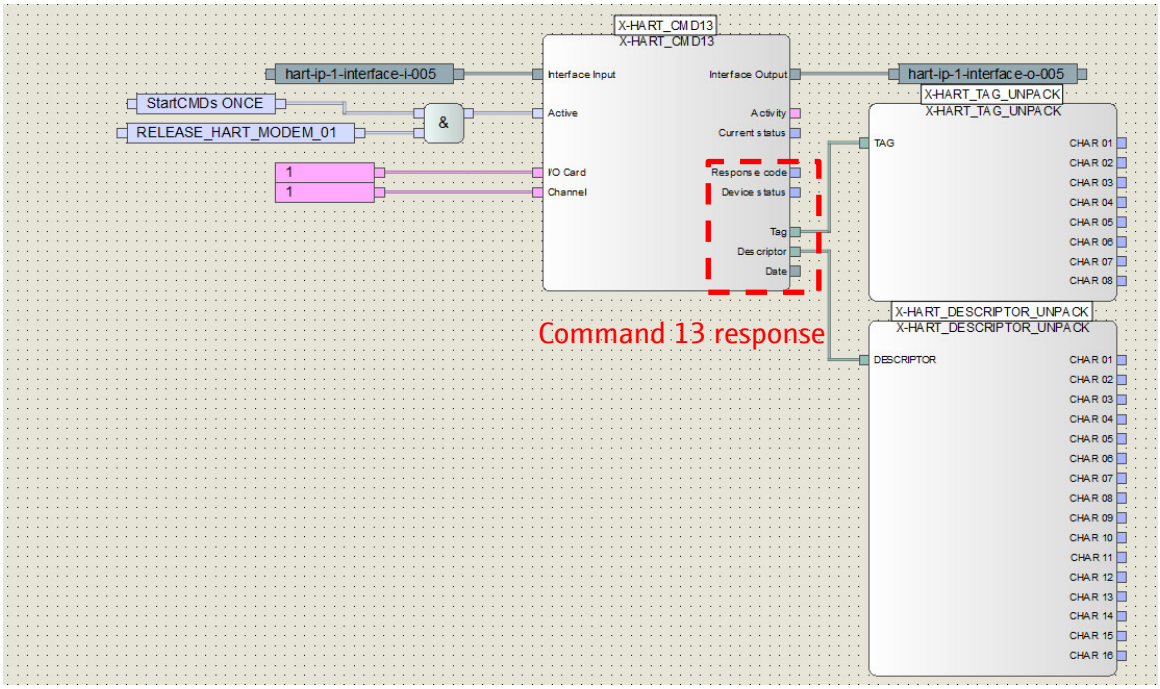
3.2.4.5.5 HART CMD 6: Write polling address

- Following the steps described in chapter 3.2.4.5.1, Command 6 is prepared to write the “Polling Address” and “Loop Current Mode” parameters. Response variables are available (marked with red rectangle) and can be assigned for further use:



3.2.4.5.6 HART CMD 13: Read tag, descriptor and date

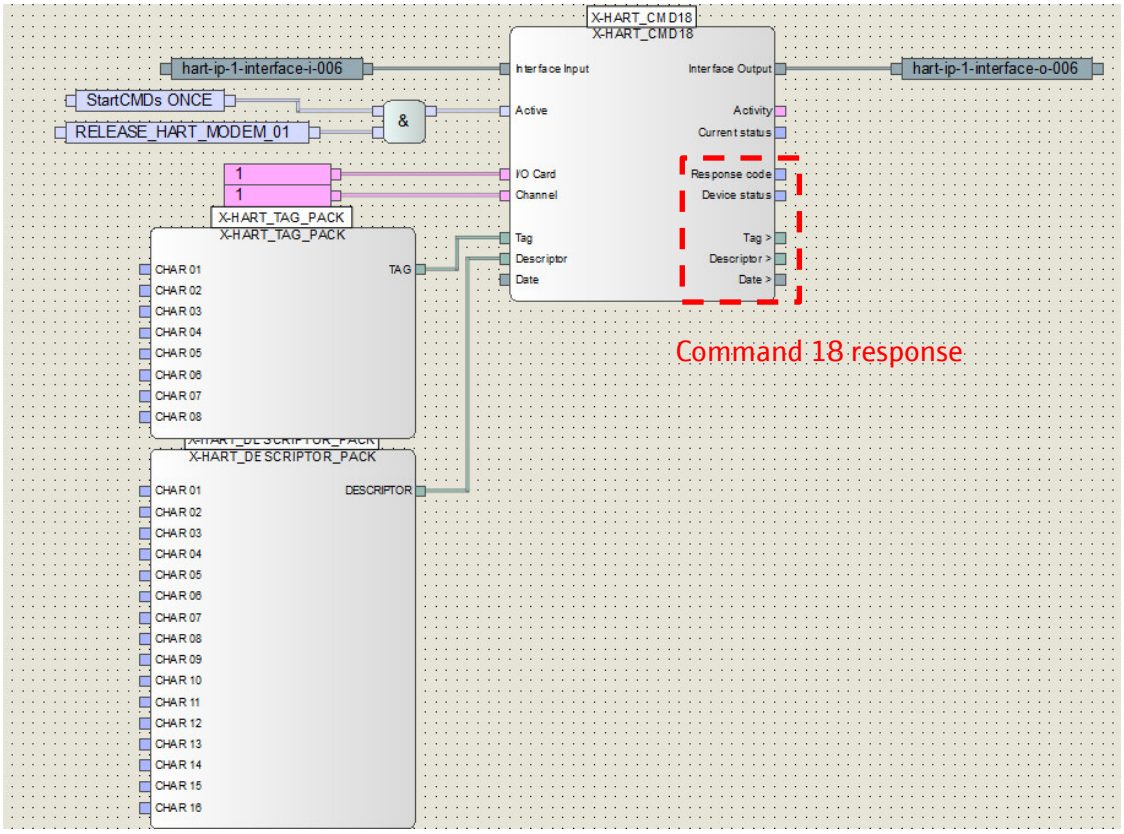
- Following the steps described in chapter 3.2.4.5.1, Command 13 response variables are available (marked with red rectangle) and can be assigned for further use:



- Received Data bytes for “Tag” and “Descriptor” have the Packed ASCII format. Specific function blocks provided by the HIMA Paul Hildebrandt GmbH “X-HART-Lib V1.0” library need to be used to decode the Packed ASCII data bytes for further use. The function blocks “X-HART_TAG_UNPACK” and “X-HART_DESCRIPTOR_UNPACK” can be found in the tab “Blocks”.

3.2.4.5.7 HART CMD 18: Write tag, Descriptor, Date

- Following the steps described in chapter 3.2.4.5.1, Command 18 is prepared to write the “Tag” , “Descriptor” and “Date” parameters. Response variables are available (marked with red rectangle) and can be assigned for further use.

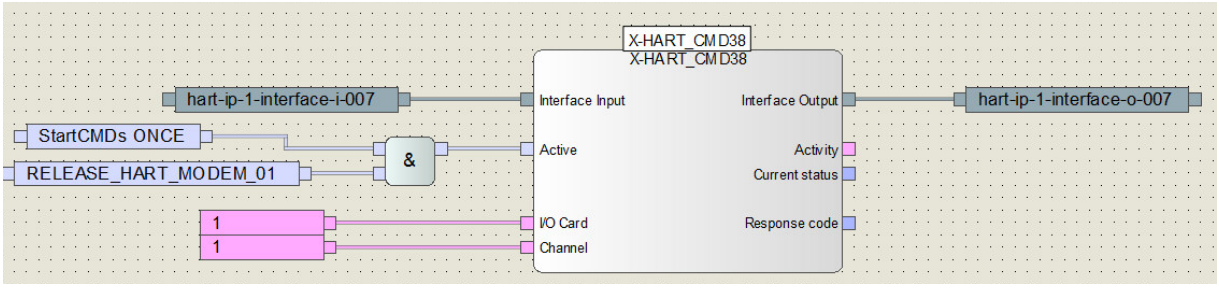


- The parameters “Tag” and “Descriptor” must have the Packed ASCII format. Specific function blocks provided by the HIMA Paul Hildebrandt GmbH “X-HART-Lib V1.0” library need to be used to code the bytes in Packed ASCII format. The function blocks “X-HART_TAG_PACK” and “X-HART_DESCRIPTOR_PACK” can be found in the tab “Blocks”.

- The parameter “Date” must have the HART Date format. Dates are represented by three 8-bit binary unsigned integers representing respectively, the day, month and year minus 1900. Date is transmitted day first followed by the month and year bytes. This allows the representation of any date between 1 January 1900 and 31 December 2155.

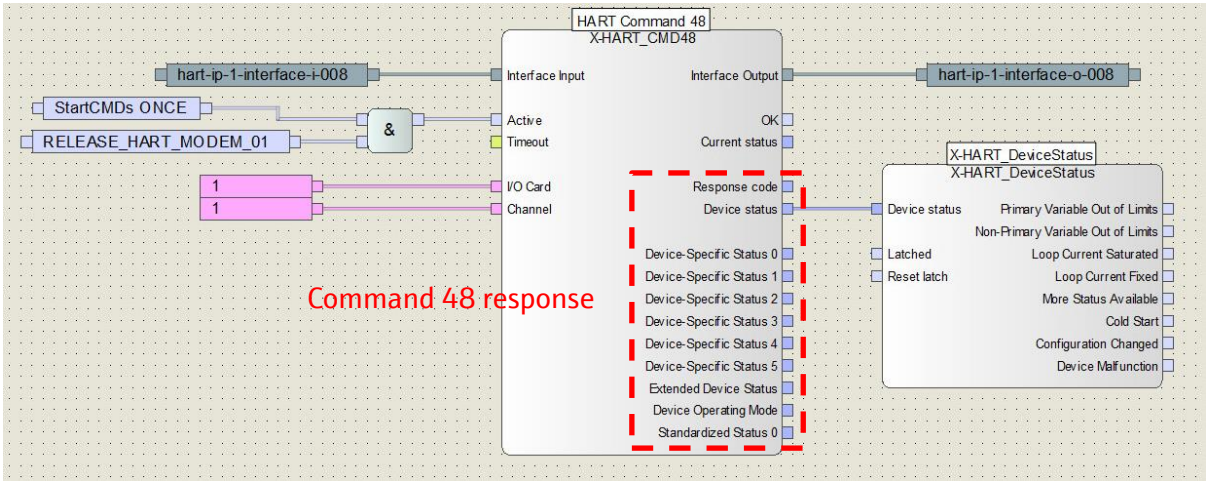
3.2.4.5.8 HART CMD 38: Reset configuration changed flag (from HART 6)

- Following the steps described in chapter 3.2.4.5.1, Command 38 is prepared to force a reset of the configuration change flag. The response code is available and can be assigned for further use:



3.2.4.5.9 HART CMD 48: Read additional device status

- Following the steps described in chapter 3.2.4.5.1, Command 48 response variables are available (marked with red rectangle) and can be assigned for further use.



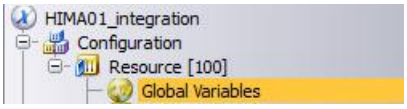
- An additional function block called “X-HART DeviceStatus” is provided by HIMA Paul Hildebrandt GmbH and can be used to extract details from the device status.

3.2.4.6 HART Interface Module Write Protection

The Write Protection control is relevant for SIL applications. During commissioning or maintenance, the Write Protection often will be disabled to allow configuration of HART devices. During operation, the Write Protection often will be enabled to avoid modification of safety relevant device settings.

3.2.4.6.1 Write Protection Variable Assignment

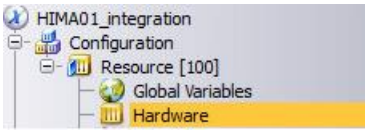
- Double-click on the field “Global variables” in Resource[100].



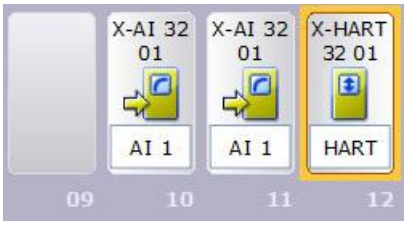
- Create these following variables, which will be used in this example and save the modifications.

Name	Data type	Initial Value	Description
CMD_WriteProtection	BOOL	false	
HART_allowDeviceSpecificCommands	BOOL	FALSE	For allowing device specific commands
HART_allowReadCommands	BOOL	TRUE	For allowing reading commands
HART_allowWriteCommands	BOOL	FALSE	For allowing writing commands

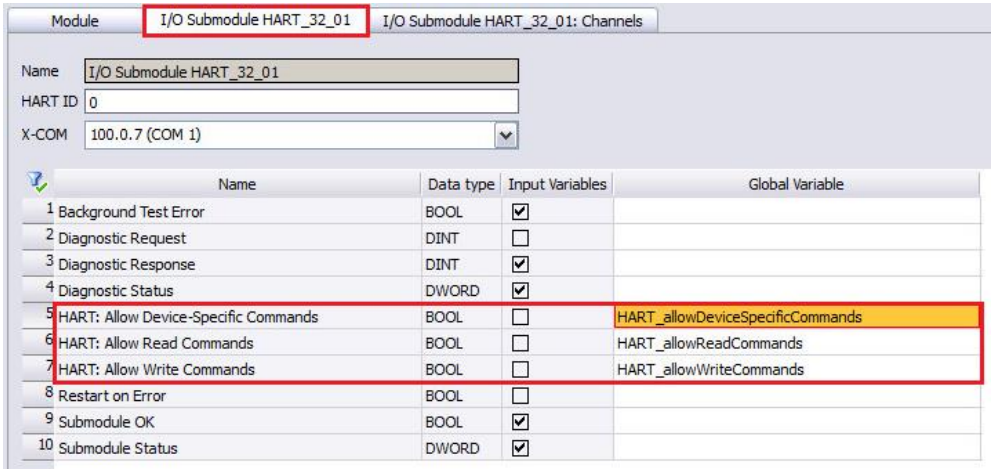
- Open the Hardware configuration view.



- Double-click on the HART card “X-HART 32 01”.



- Select the tab “I/O Submodule HART_32_01” and insert these 3 variables used to control the HART read/write functionality of the card.



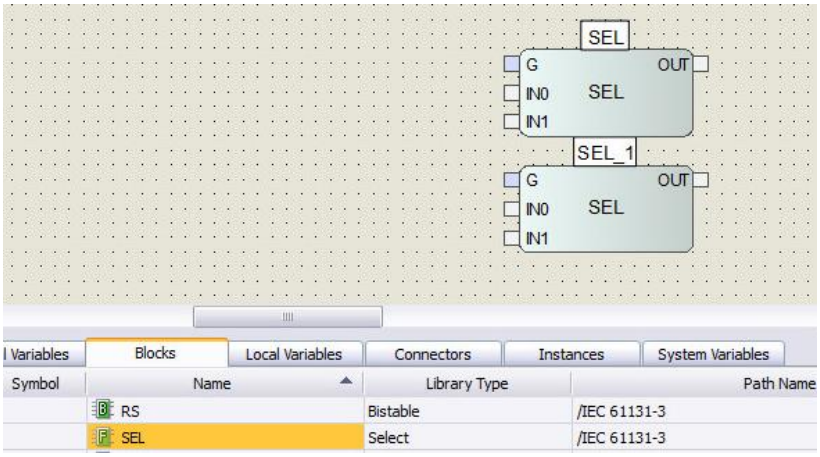
- Close the window.

3.2.4.6.2 Write Protection Control

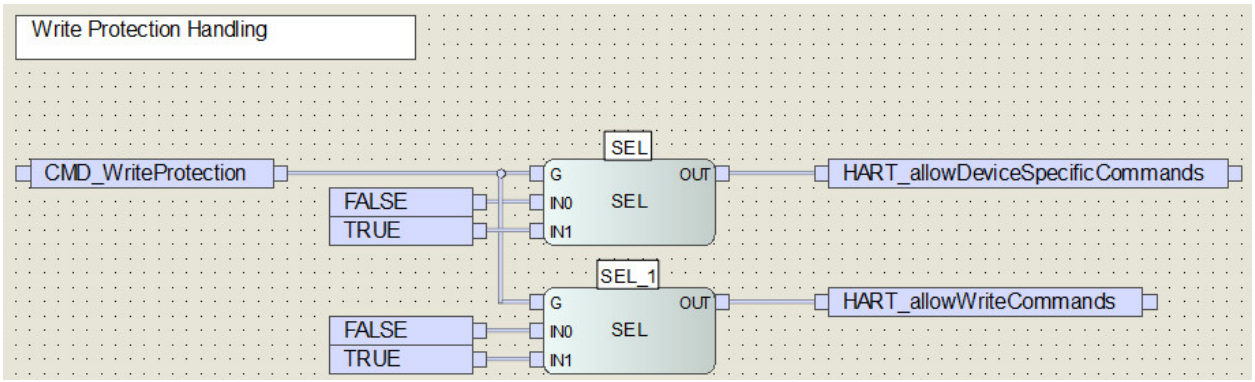
In this example, the target is to control the Write Protection with the bit “CMD_WriteProtection”.

- Open the program “Program HIMA01”.

- Insert two function blocks “SEL”.



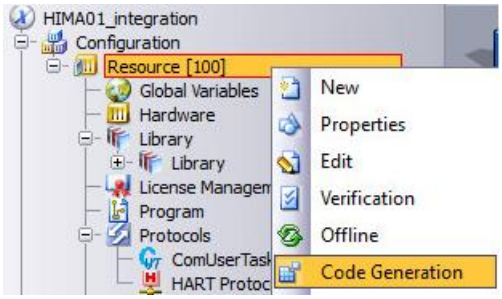
- Assign the corresponding variables as follow.



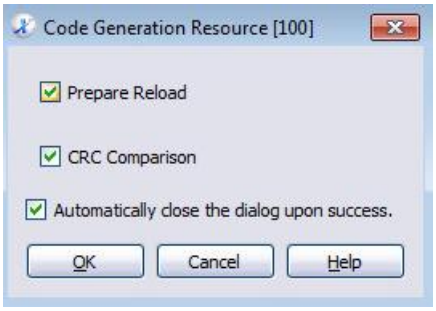
3.3 Commissioning of the Control Project

3.3.1 Program Compilation

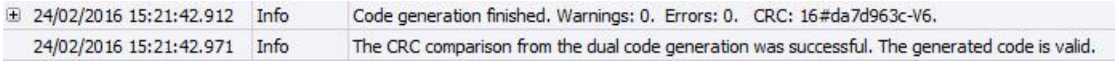
- Right-click on the field “Resource[100]” and select the menu “Code Generation”.



- Following window is displayed. Click on the button “OK” to continue.



- When the compilation is finished, check the status in the logbook window.



3.3.2 Program Download

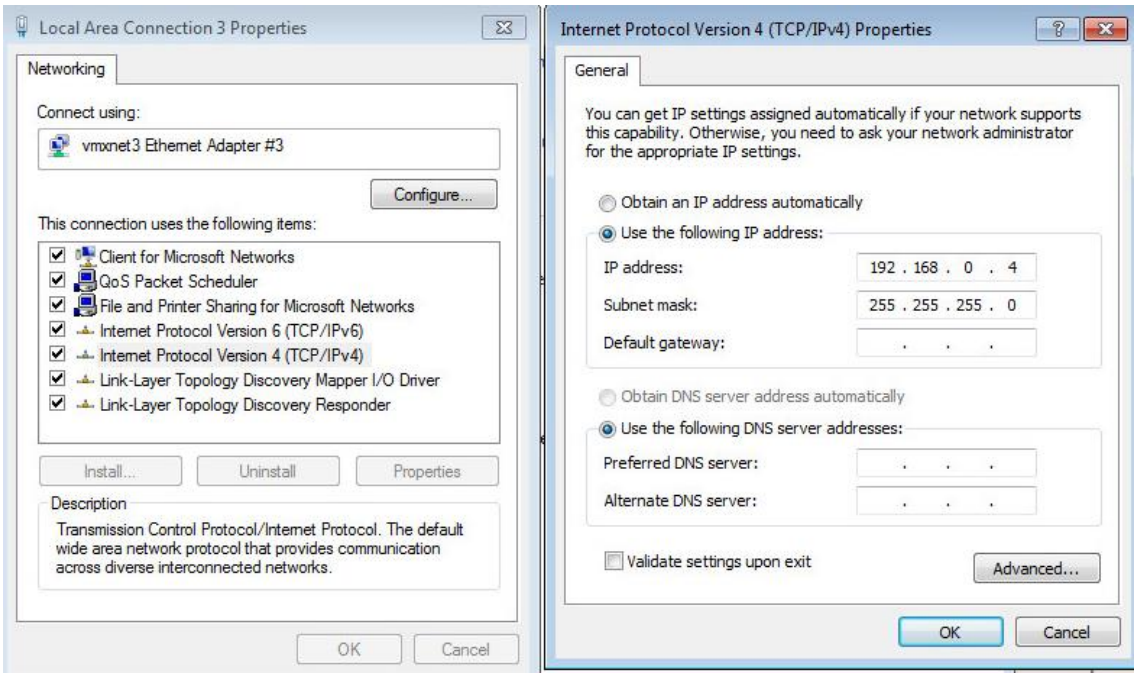
The target is to connect the HIMA HIMax System to the network via the COM1 communication module. However the first download needs to be done locally because of the default IP addresses of the new modules.

3.3.2.1 First Download (in local)

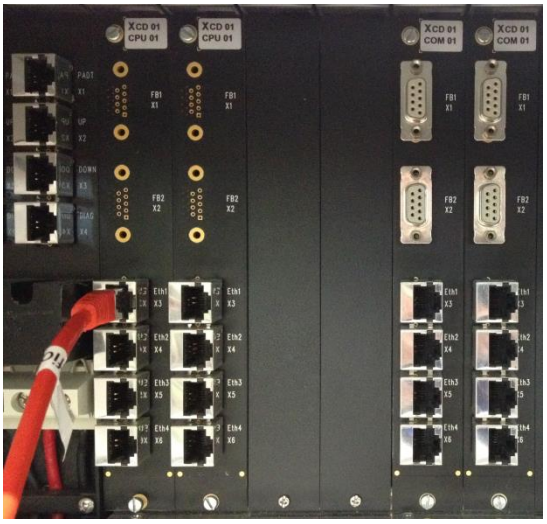
- All new cards have the default IP address 192.168.0.99.
  In part “Network Configuration”, the IP parameters of the modules have been configured in order to connect locally the CPU1 module.

- Both CPUs switches are configured on “RUN”.

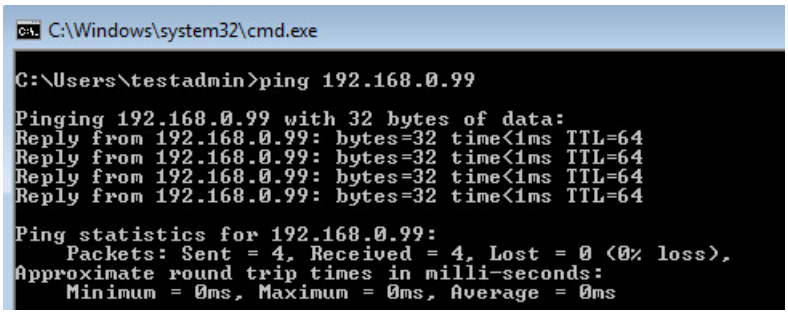
- Network settings of the connected local engineering station.



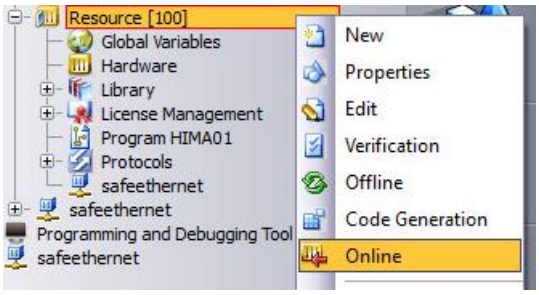
- In this example, the engineering station is connected on the **port ETH1 of the module CPU 1**.



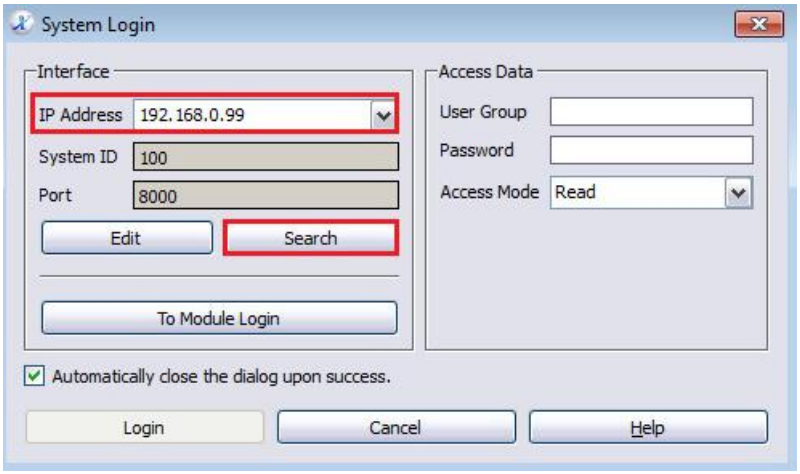
- Open the MS DOS command and try the Ping function with the IP address 192.168.0.99.



- Right-click on “Resource[100]” and select the menu “Online”.

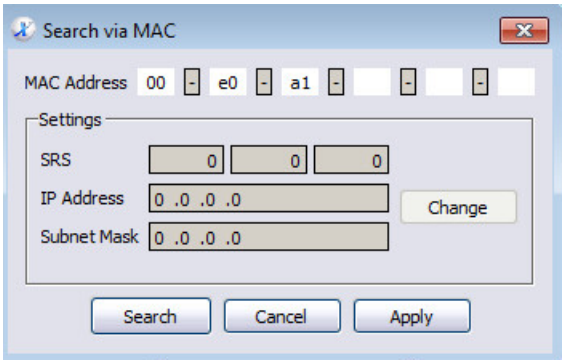


- The window “System Login” is displayed.

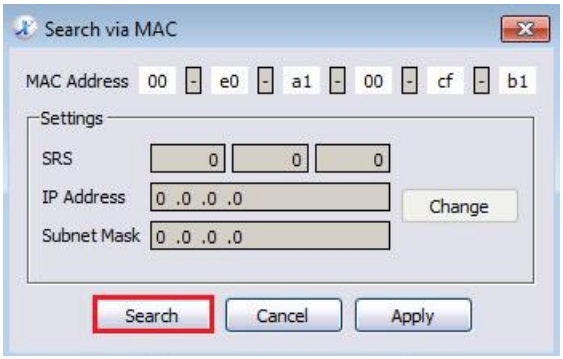


  - Enter the IP address 192.168.0.99.
  - Click on the button search

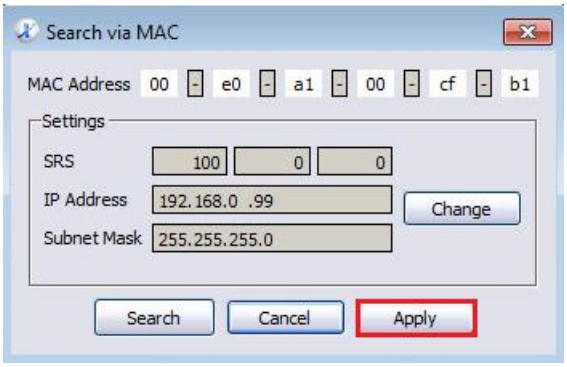
- The window “Search via MAC” is displayed.



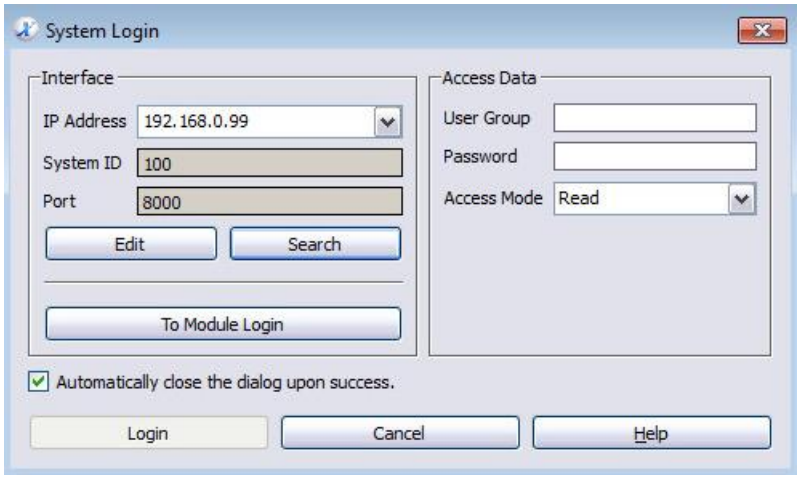
- Enter the MAC address of the CPU 1 module and click on the button “Search”.
  In this example, the MAC address is 00-E0-A1-00-CF-B1.



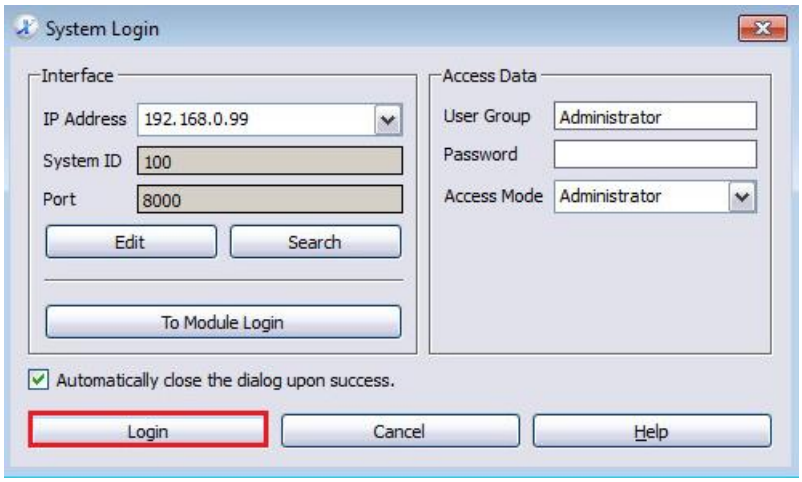
- Check the “Settings” parameters. SRS, IP Address and Subnet Mask must correspond with the configured one in chapter 3.1.2 and 3.1.4.2. If not, click on the button “change” to modify the parameters. Then click on the button “Apply”.



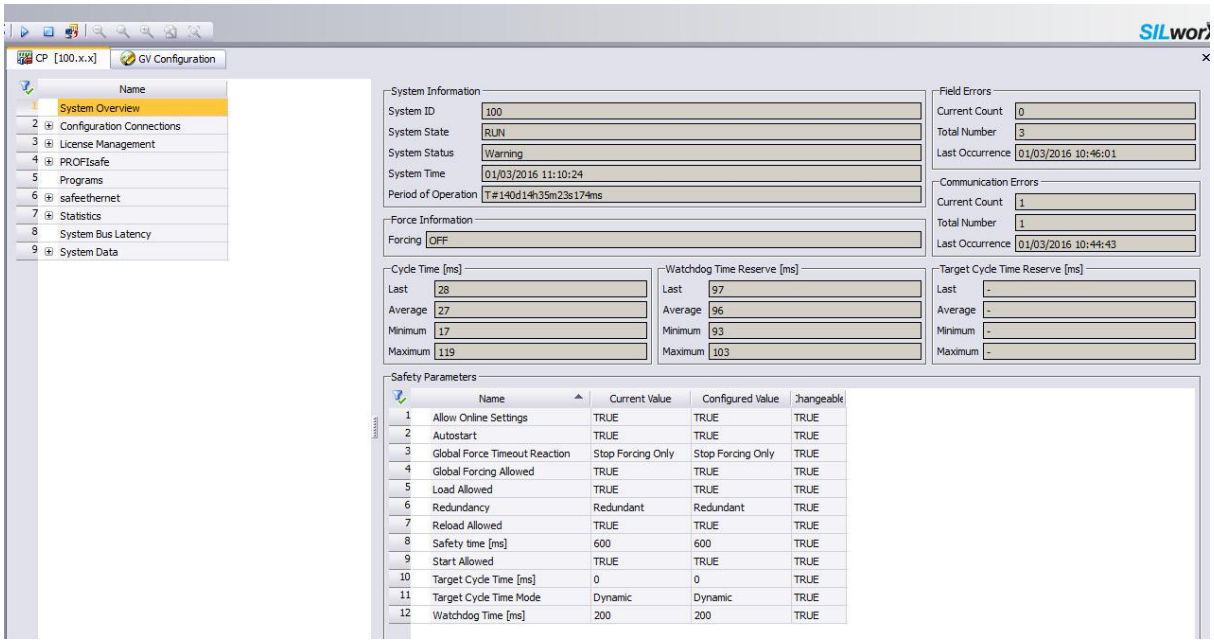
- The window “System Login” is displayed again.



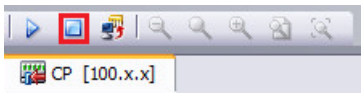
- Connect the Administrator mode (CTRL+A) and click on the button “Login”.



- Following Online parameters page is automatically displayed.

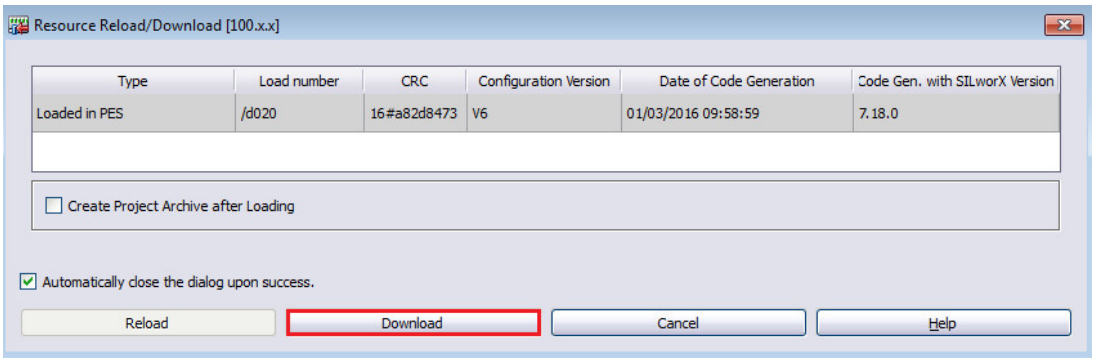


- On the top of this page:
  - Click at first on the button “Stop”.



  - Click on the shortcut button “Reload/Download”.

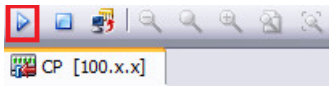
- Then click on the button “Download”.



- Download has been done successfully.

01/03/2016 11:23:16.750	Info	Current configuration will be used for download. CRC: '16#a82d8473'
01/03/2016 11:23:17.387	Info	[192.168.0.99:8000 / 100] Loading the resource configuration started
01/03/2016 11:23:38.490	Info	[192.168.0.99:8000 / 100] Resource configuration successfully loaded.
01/03/2016 11:23:38.490	Info	Resource Reload/Download [100.x.x]: Successful.

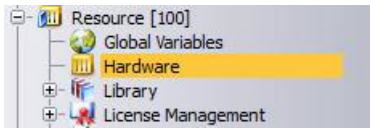
- Click on the button "Resource Cold Start" to run the application.



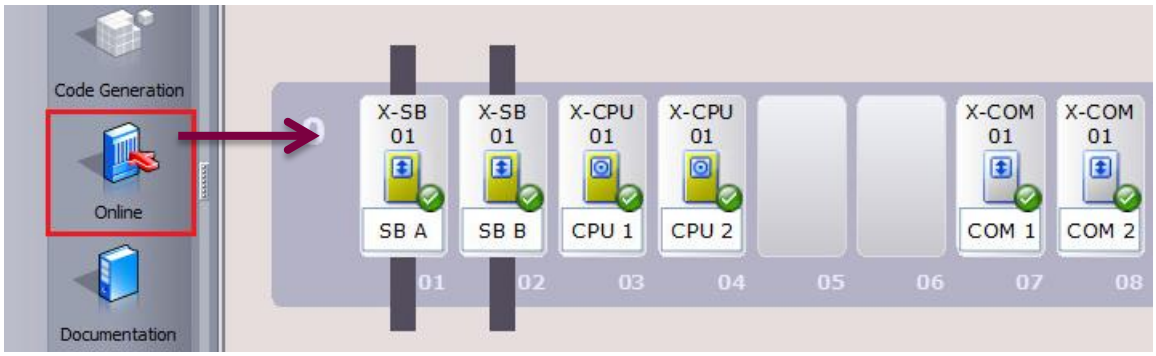
3.3.2.2 IP Addresses Verification

In this part, all configured IP addresses are checked online.

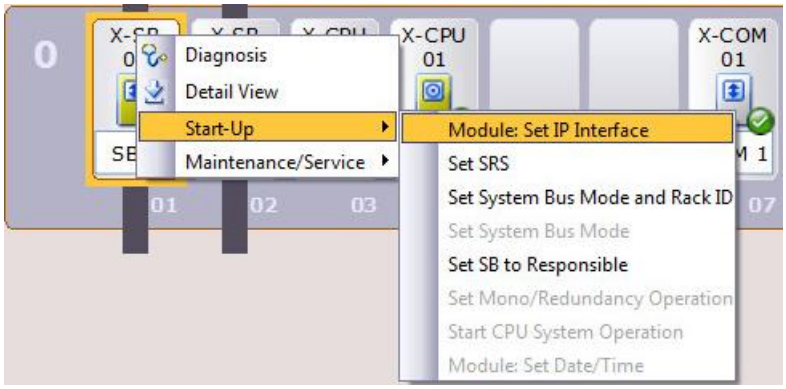
- Double-click on the menu "Hardware".



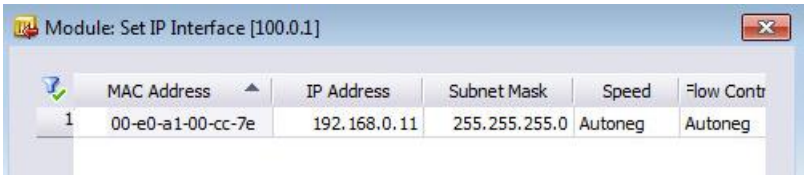
- Enable the Online mode by-clicking on the shortcut button "Online".



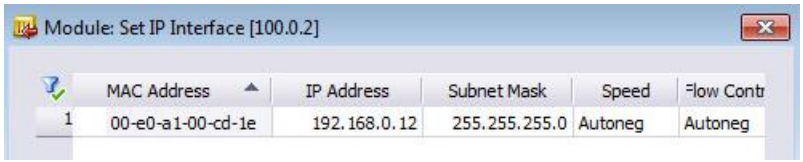
- Right-click on the card "SB A" and select the menu "Start-Up → Module: Set IP Interface".



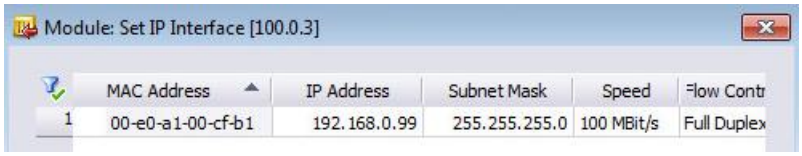
- The window “Set IP Interface” is displayed with configured IP settings of the module “SB A”.



- Repeat the same steps for all configured cards:
  - Module “SB B”



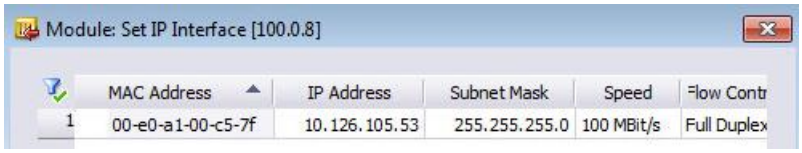
  - Module “CPU 1”



  - Module “CPU 2”

  - Module “COM 1”

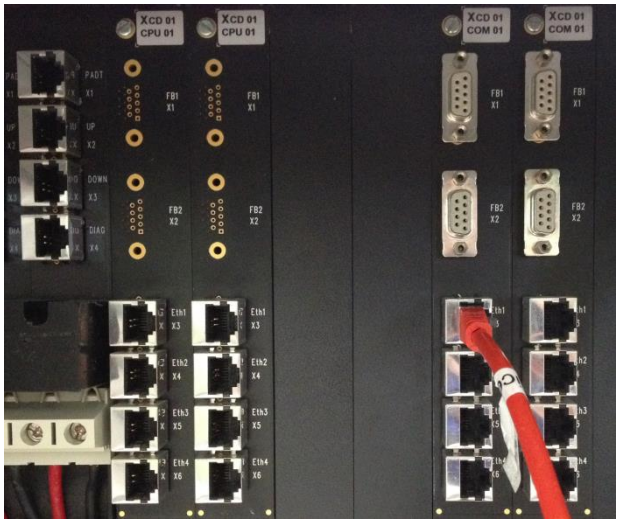
  - Module “COM 2”



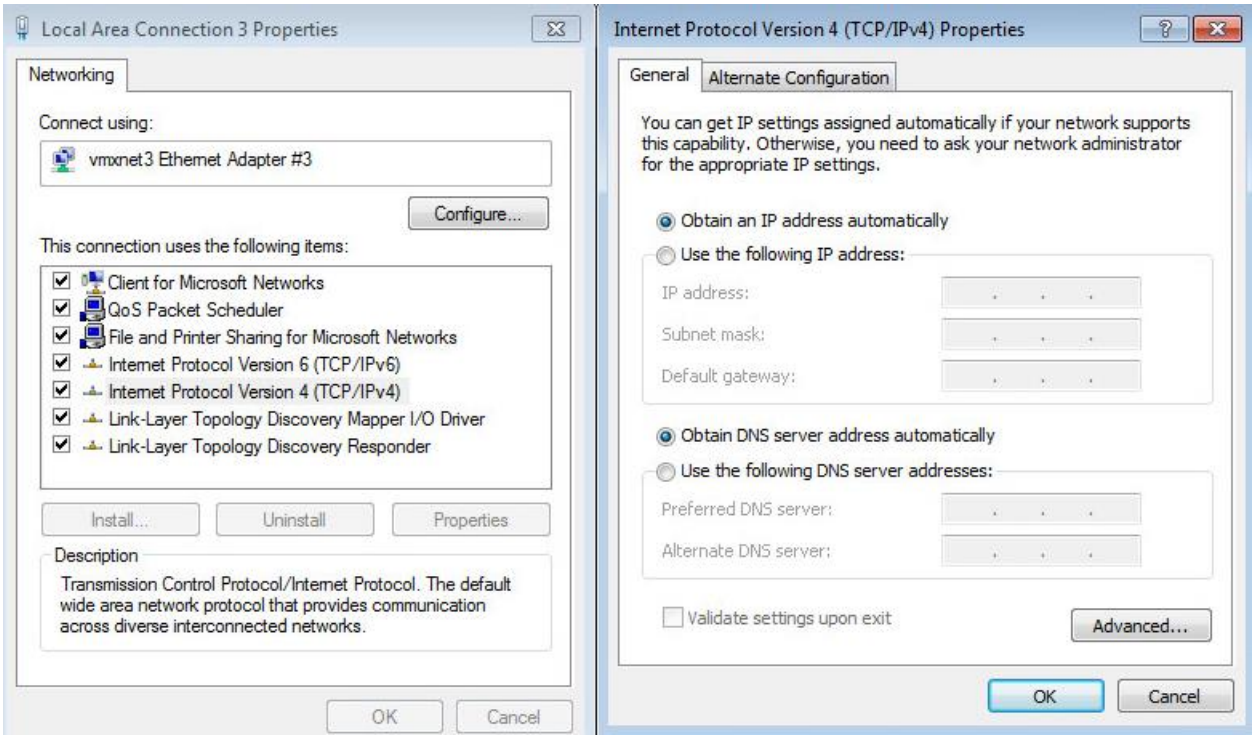
All IP addresses correspond to the configured one in the part “Network Configuration”.

3.3.2.3 Program Download (normal case)

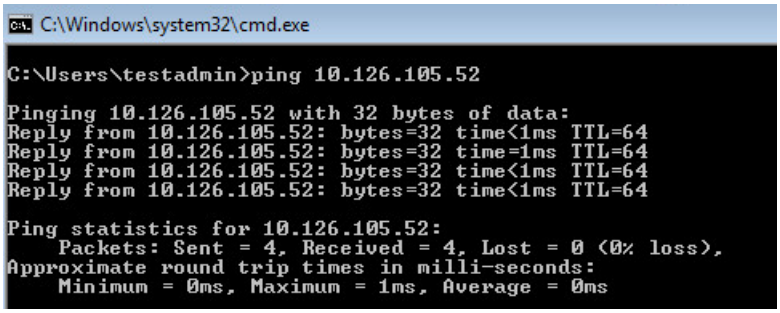
- After the program has been downloaded one time, the local station can be removed and the network can be connected on the **communication module COM 1 port ETH1**.



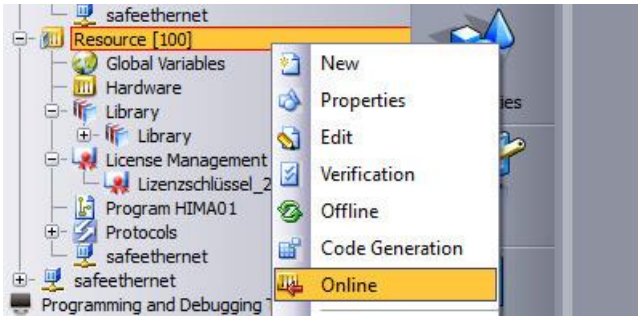
- Network settings of the connected engineering station.



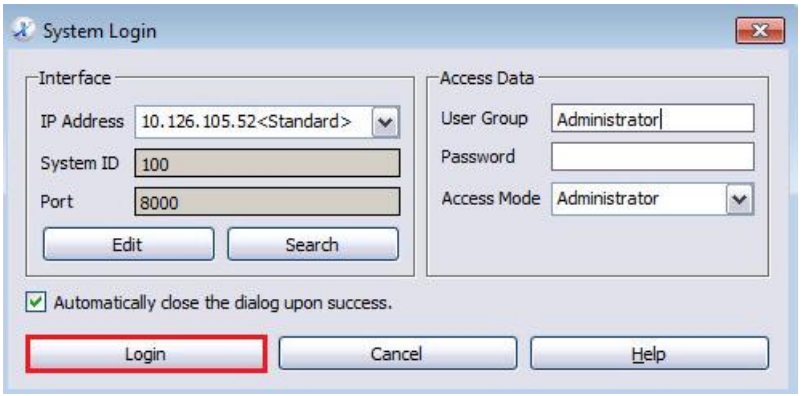
- Open the MS DOS command and try the Ping function with the IP address 10.126.105.52.



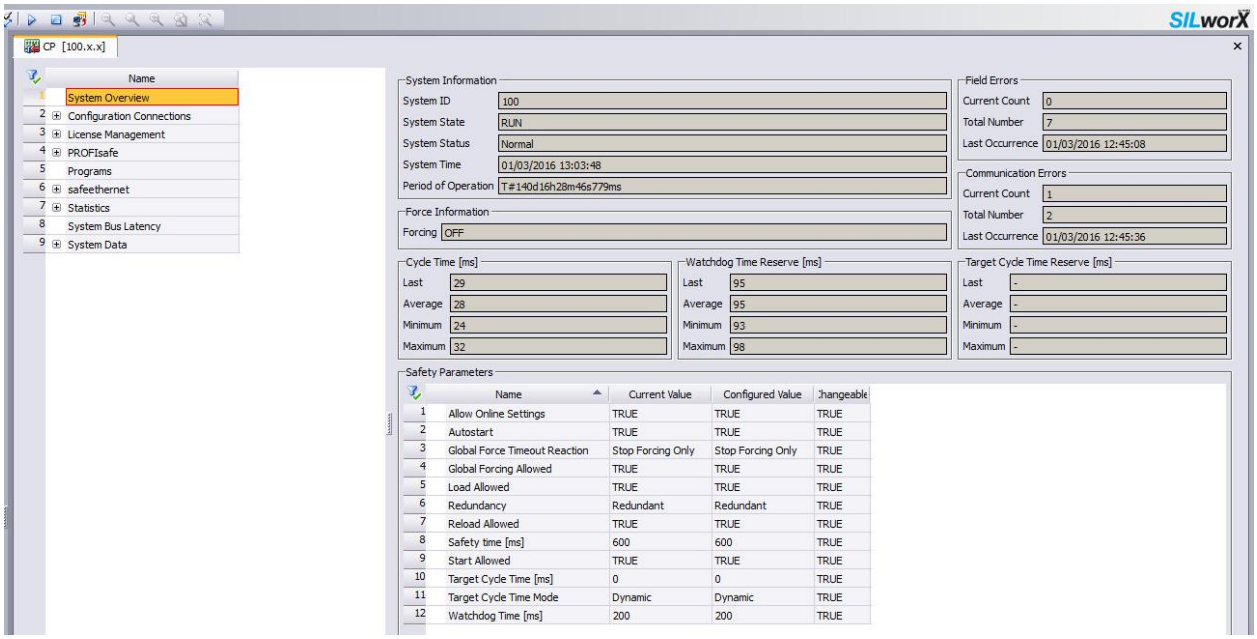
- Right-click on the field “Resource[100]” and select the option “Online”.



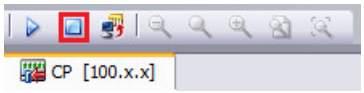
- Select the Interface IP address 10.126.105.52, configure the administrator mode and click on the button “Login”.



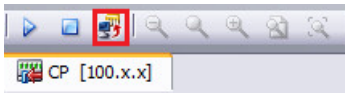
- Following Online parameters page is automatically displayed.



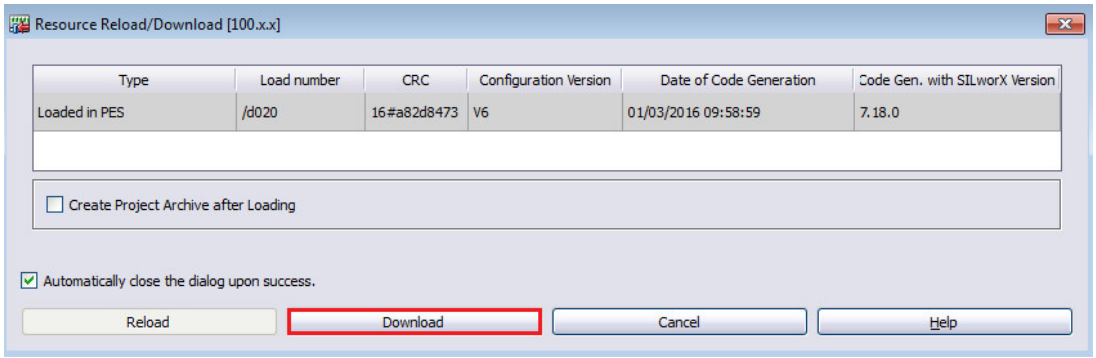
- On the top of this page:
  - Click at first on the button “Stop”.



  - Click on the shortcut button “Reload/Download”.



- Then click on the button “Download”.



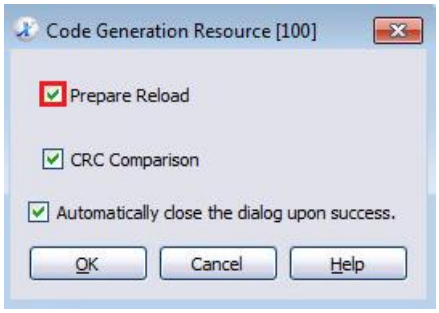
- Download has been done successfully.

01/03/2016 13:13:07.485	Info	[10.126.105.52:8000 / 100] Loading the resource configuration started
01/03/2016 13:13:29.026	Info	[10.126.105.52:8000 / 100] Resource configuration successfully loaded.
01/03/2016 13:13:29.027	Info	Resource Reload/Download [100.x.x]: Successful.

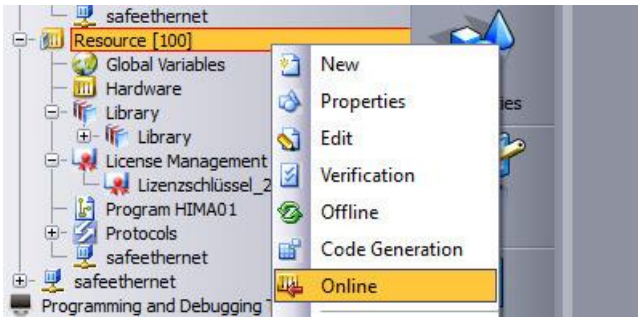
3.3.3 Program Reload

The difference between a program Download and Reload is that the CPU is not stopped during a Reload, when the data transfer is performing.

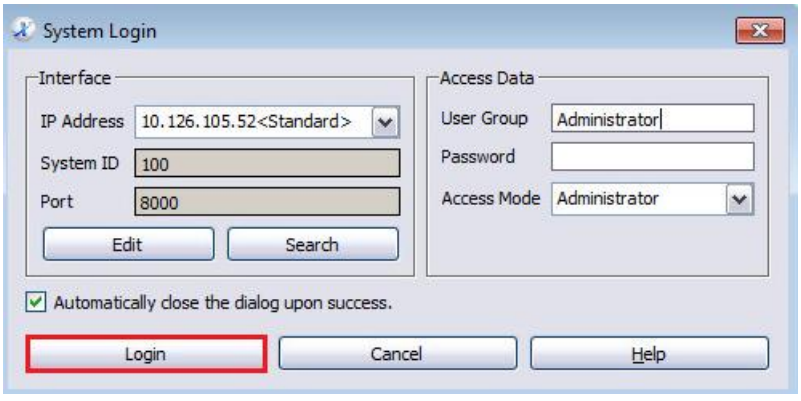
- The option “Prepare Reload” must be selected before compiling the program.



- Right-click on the field “Resource[100]” and select the option “Online”.

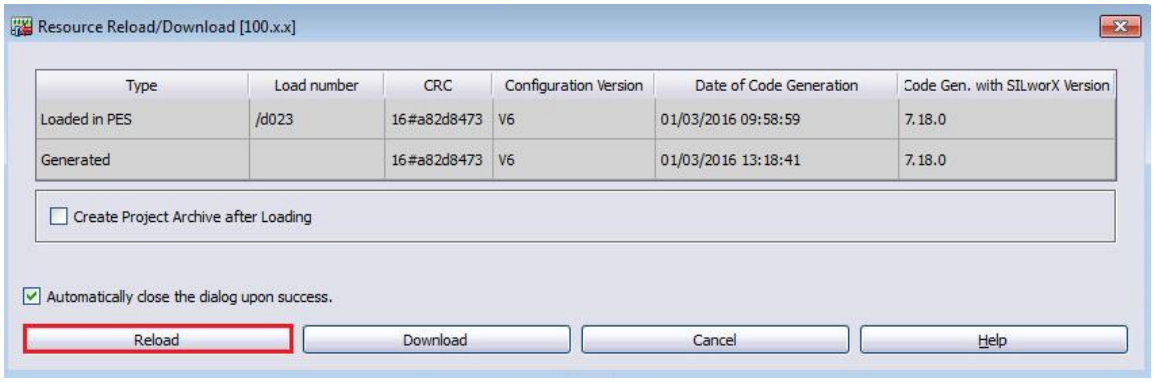


- Select the Interface IP address 10.126.105.52, configure the administrator mode and click on the button “Login”.



- Click on the shortcut button “Reload/Download”.

- Click on the button “Reload”.

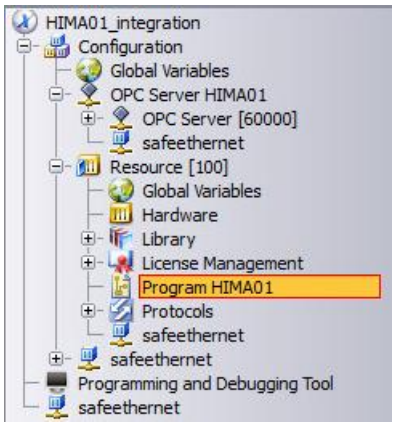


- Reload has been done successfully.

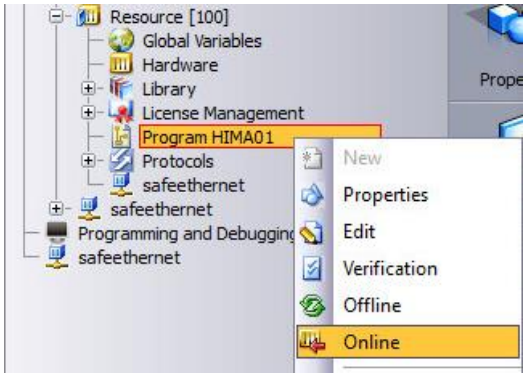
Date/Time	Severity	Message
01/03/2016 13:31:12.552	Info	Reload started.
01/03/2016 13:31:12.776	Info	Current configuration will be used for reload. CRC: '16#a82d8473'
01/03/2016 13:31:13.044	Info	[10.126.105.52:8000 / 100] Loading the resource configuration started
01/03/2016 13:31:36.839	Info	Reload successful.

3.3.4 Monitoring of HART Process Values and Commands

- Double-click on the program “Program HIMA01”. This opens the program page.



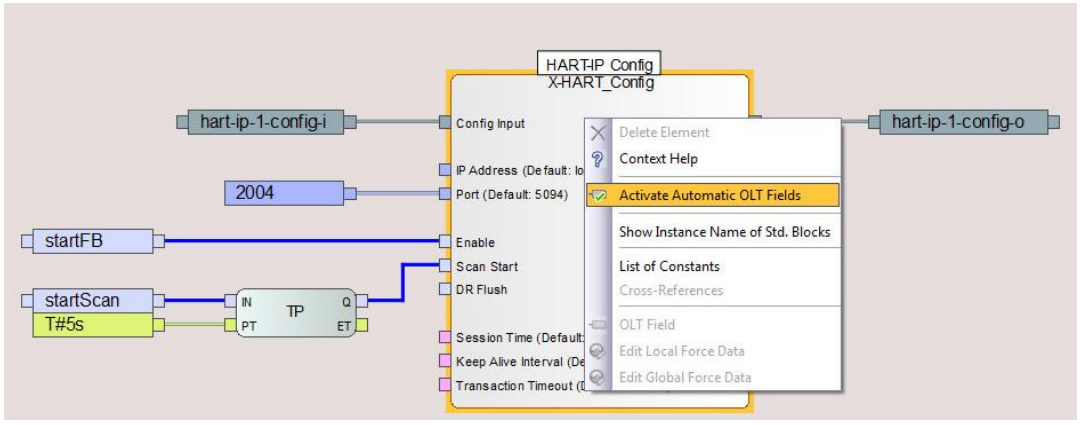
- Right-click on the program “Program HIMA01” and select the menu “Online”.



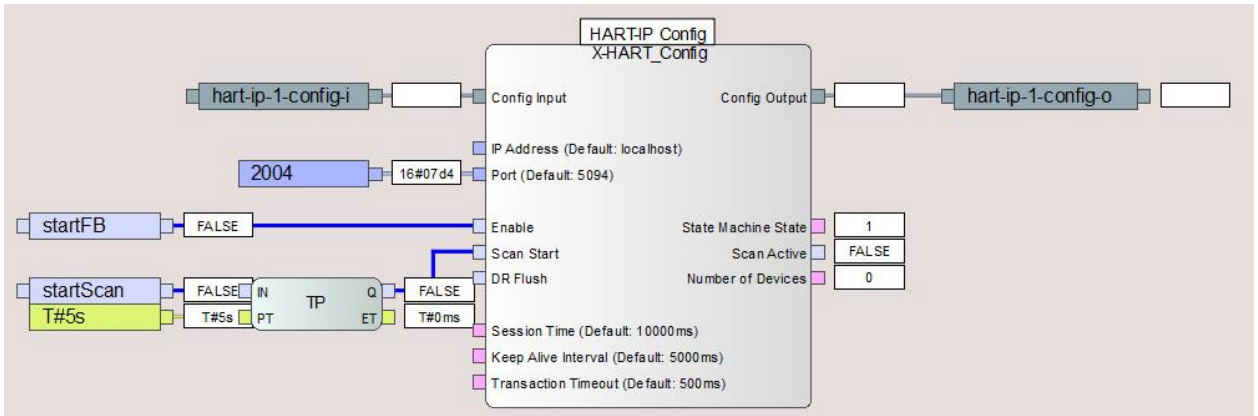
3.3.4.1 HART-IP Config Enabling

This function block needs to be enabled. In this example, two variables must be forced.

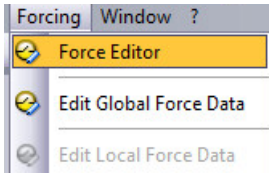
- Right-click on the function block and select the option “Activate automatic OLT Fields”.



- This displays the current values and status for all function blocks of the program.

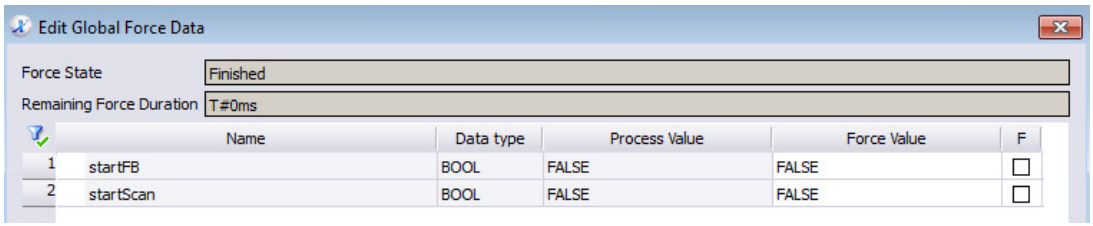


- Select the menu “Forcing →Force Editor” in the main bar menu.

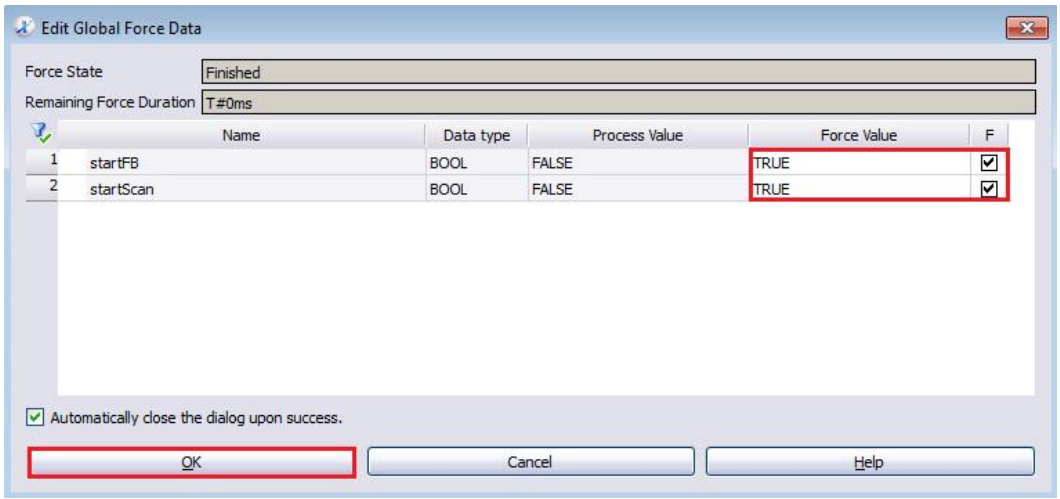


- Look for both variables “StartFB” and “StartScan”.

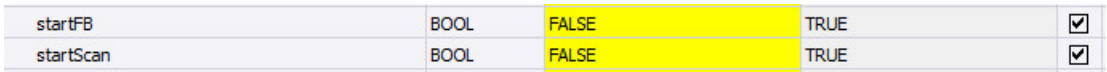
- Select both variables, right-click and select the option “Edit Global Data”.



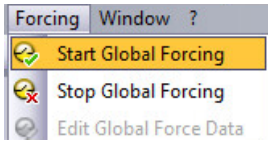
- Force both values to the value “TRUE” and click on the button “OK”.



- This changes the variables status in the Global Variables Editor.

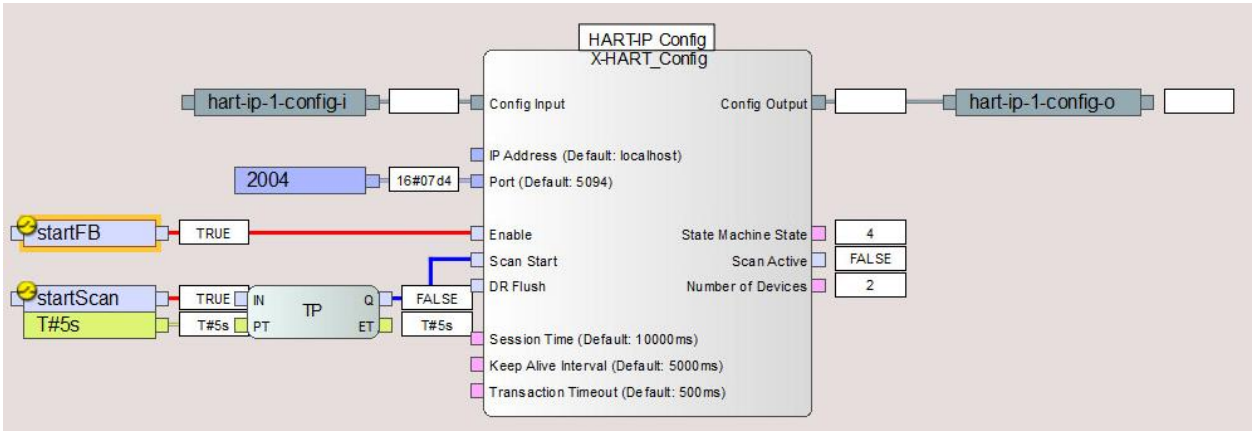


- Select the menu “Forcing → Start Global Forcing” to start the update.



- Clcik on the button “OK” to proceed.

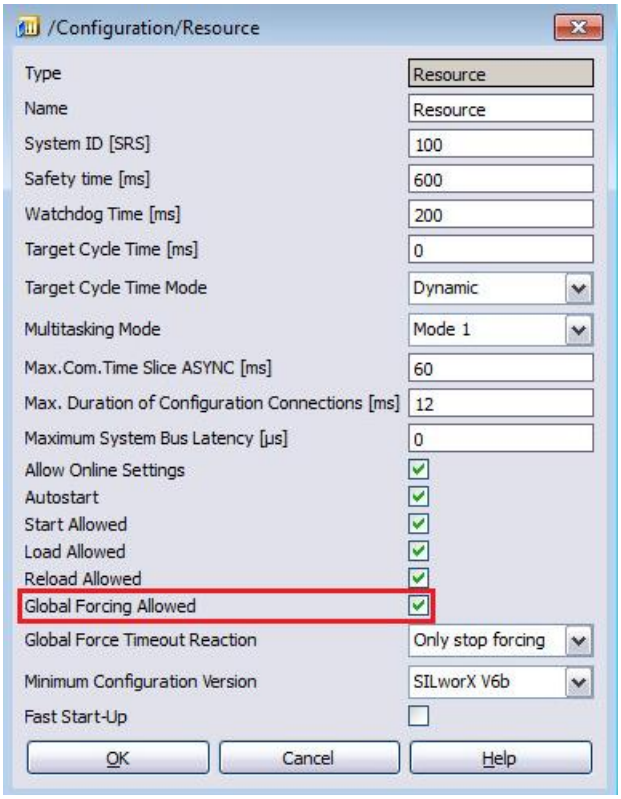
- The function block is now enabled and devices have been scanned.
  The value “State Machine State” is changing between value 3 or 4 in normal mode.



- Refer to the documentation “HI 801 089 E User Manual HIMax HART Package V1.00 (1016)” for further information about the HART IP Config values.

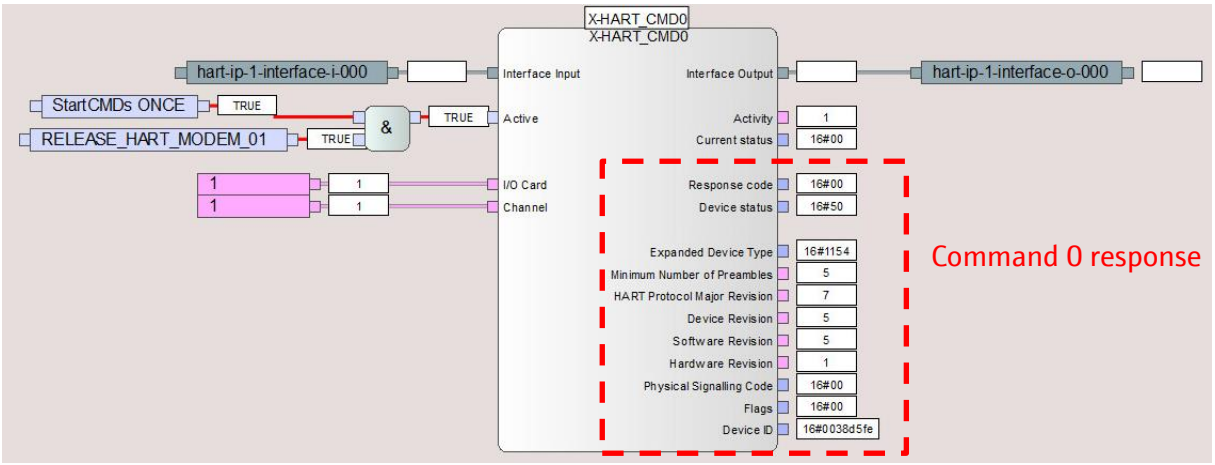
Remark :

- Forcing the global variables is only possible if the option is selected in the Resource. Right-click on the Resource[100], select the option “Properties” and check if the option is selected.



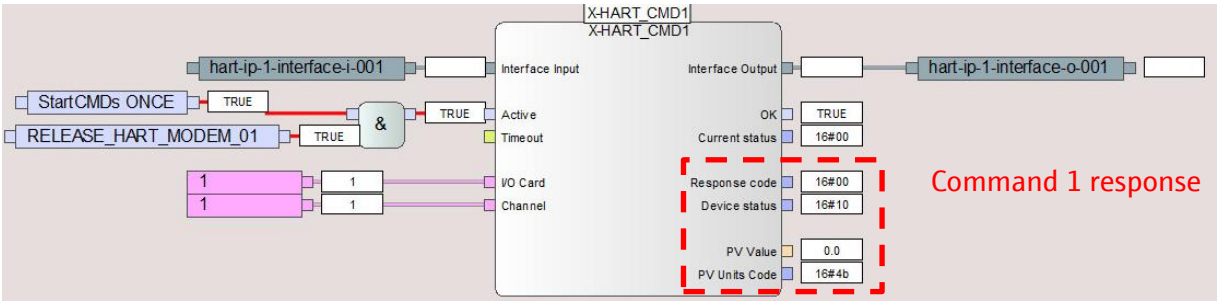
3.3.4.2 Universal HART Command 0 - Read unique identifier

- Function block X-HART_CMD0 in online mode:



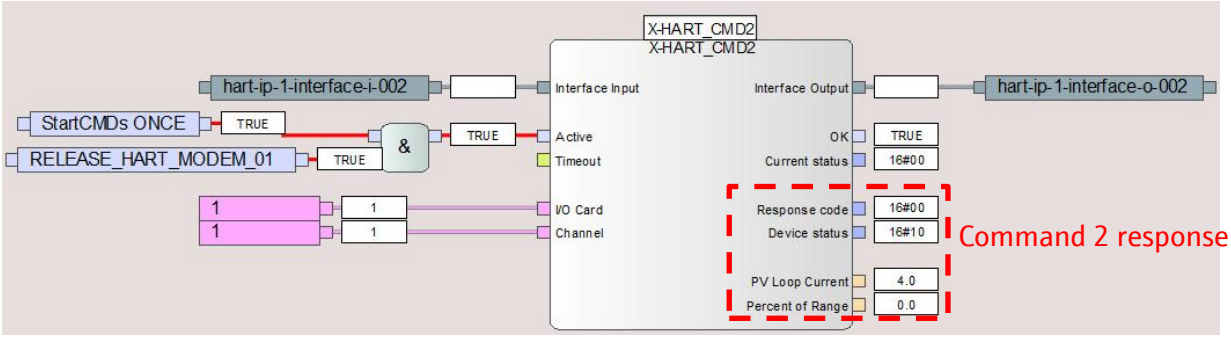
3.3.4.3 Universal HART Command 1 - Read primary variable

- Function block X-HART_CMD1 in online mode:



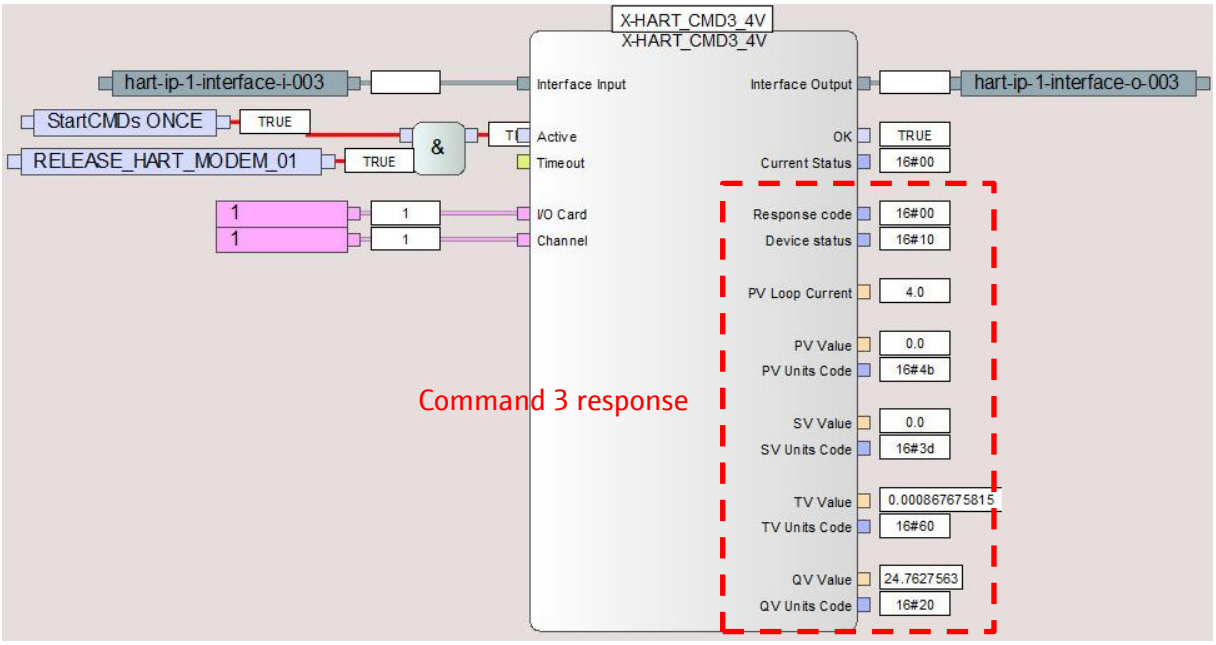
3.3.4.4 Universal HART Command 2 - Read loop current and percent of range

- Function block X-HART_CMD2 in online mode:



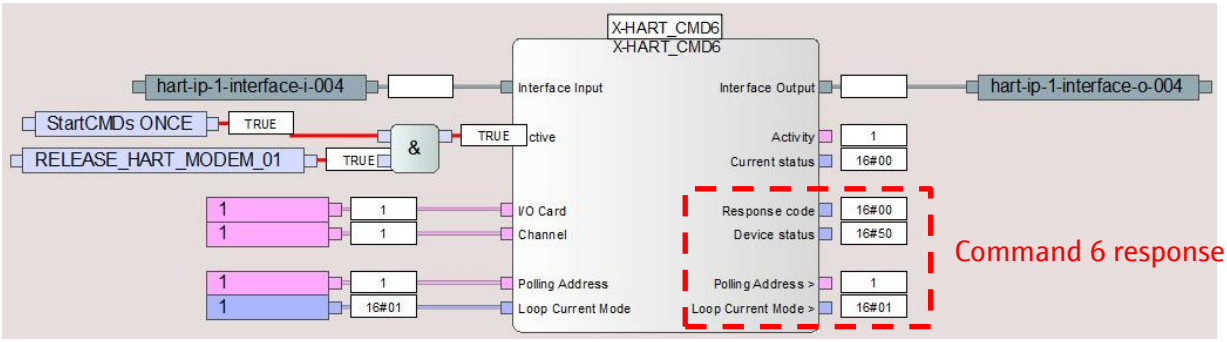
3.3.4.5 Universal HART Command 3 - Read dynamic variables and loop current

- Function block X-HART_CMD3_4V in online mode:



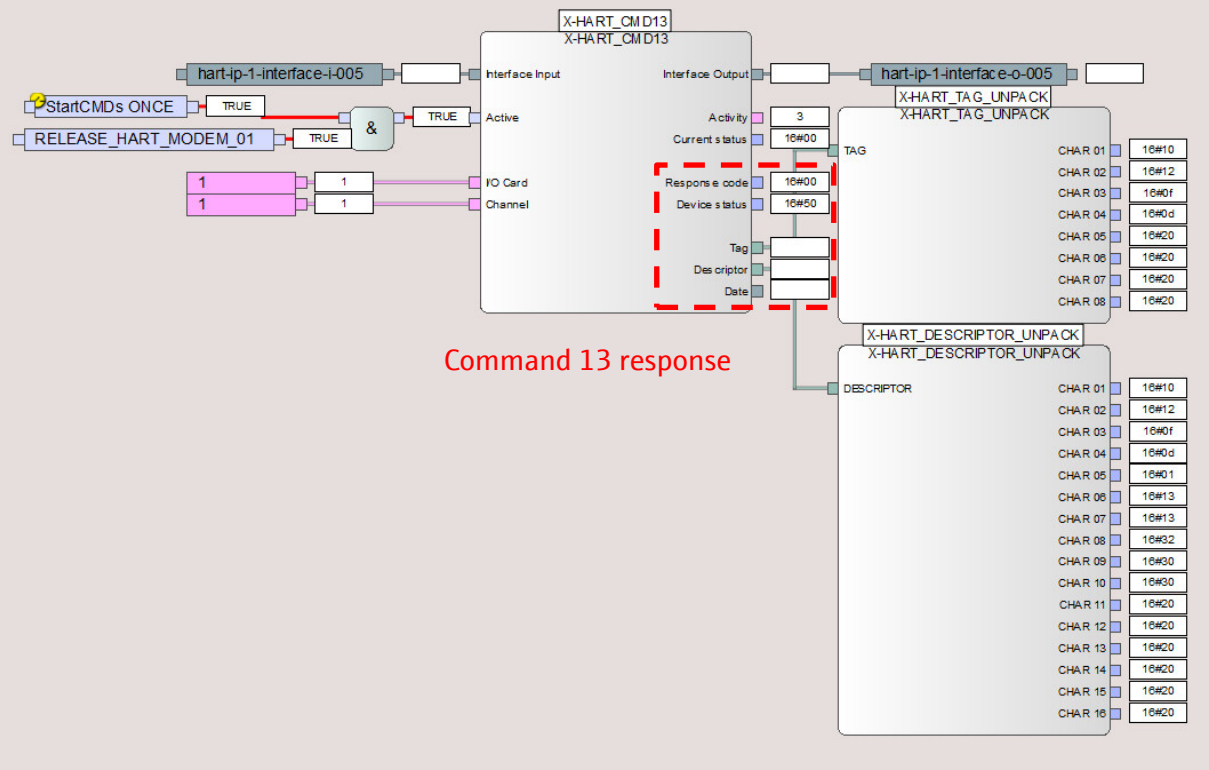
3.3.4.6 Universal HART Command 6 - Write polling address

- Function block X-HART_CMD6 in online mode:



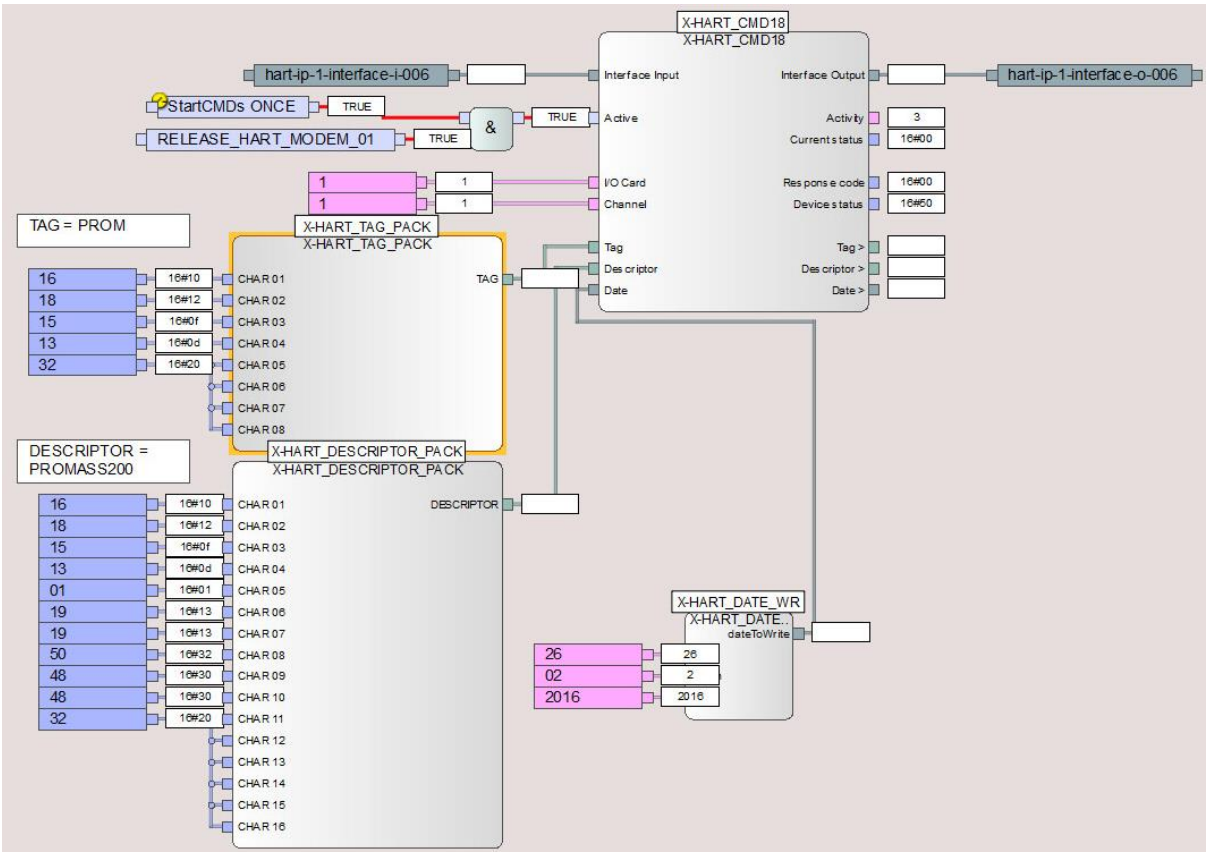
3.3.4.7 Universal HART Command 13- Read tag, descriptor and date

- Function block X-HART_CMD13 in online mode:



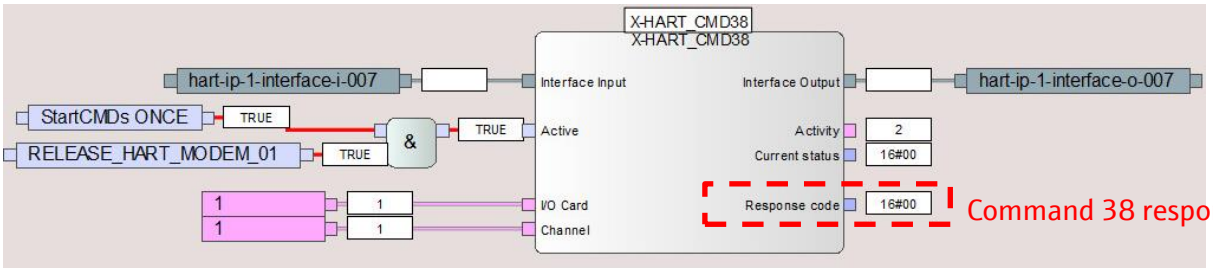
3.3.4.8 Universal HART Command 18- Write tag, Descriptor, Date

- Function block X-HART_CMD18 in online mode:



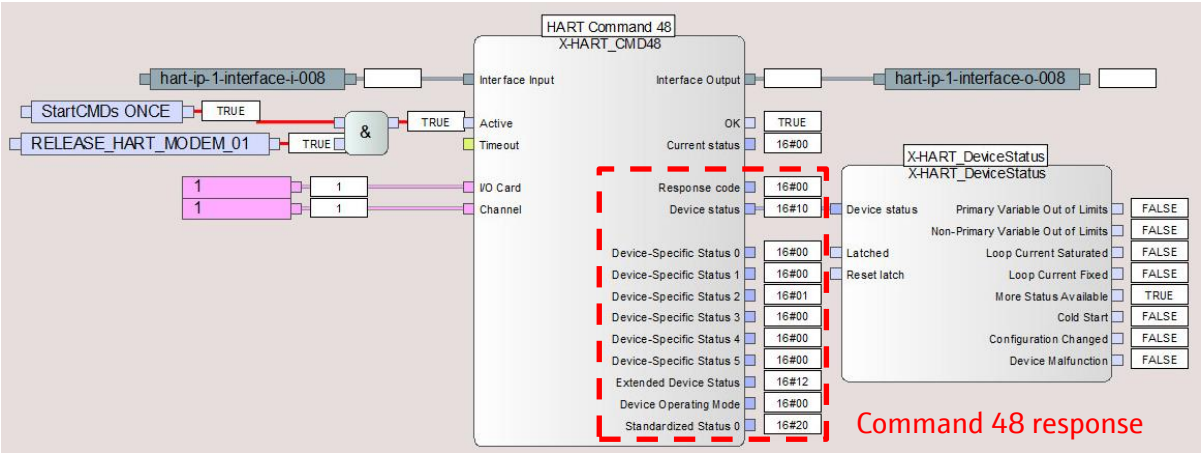
3.3.4.9 Universal HART Command 38- Reset configuration changed flag (from HART 6)

- Function block X-HART_CMD38 in online mode:



3.3.4.10 Universal HART Command 48- Read additional device status

- Function block X-HART_CMD48 in online mode:



4 Routed Tool Integration

This chapter describes the main workflow for integration of HIMA HIMax 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 HART devices via HIMA Paul Hildebrandt GmbH Ethernet backbone for device configuration.

4.1 Pre-Requisites

4.1.1 Enable HART Channel Modems

The HIMA HART interface module is not a multiplexer; it has individual HART modems for each channel. A connected HART device can only be scanned and operated, if its corresponding HART channel modem is enabled. Please refer to chapter 3.2.4.4.

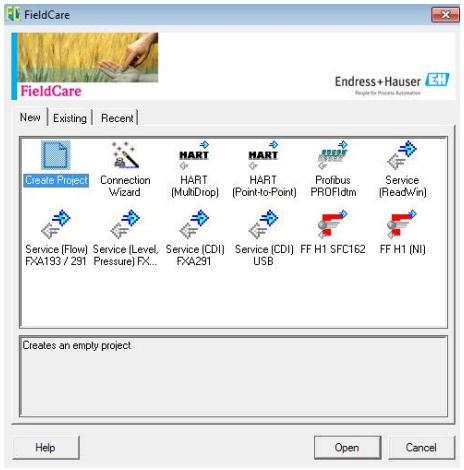
4.1.2 Disable Write Protection for HART Commands

The Write Protection is used by HIMA to secure versus modification of HART device settings during safety relevant operation. If enabled, only the HART universal and common practice read only commands will be forwarded to underlying HART devices. Write Protection must be disabled in order to work successfully with FieldCare. The control of the Write Protection is realized in the HIMA logic. Please refer to chapter 0.

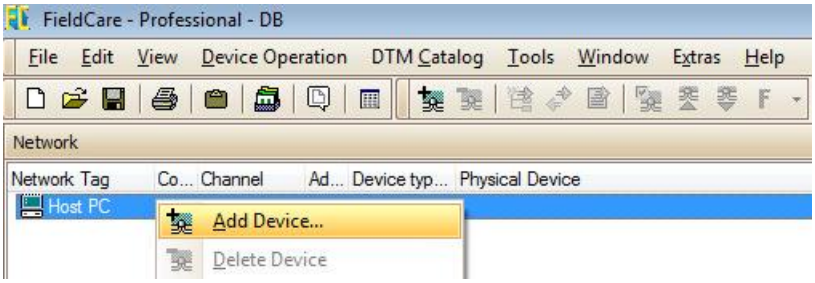
4.2 HIMA CommDTM Configuration

- Start the application FieldCare.

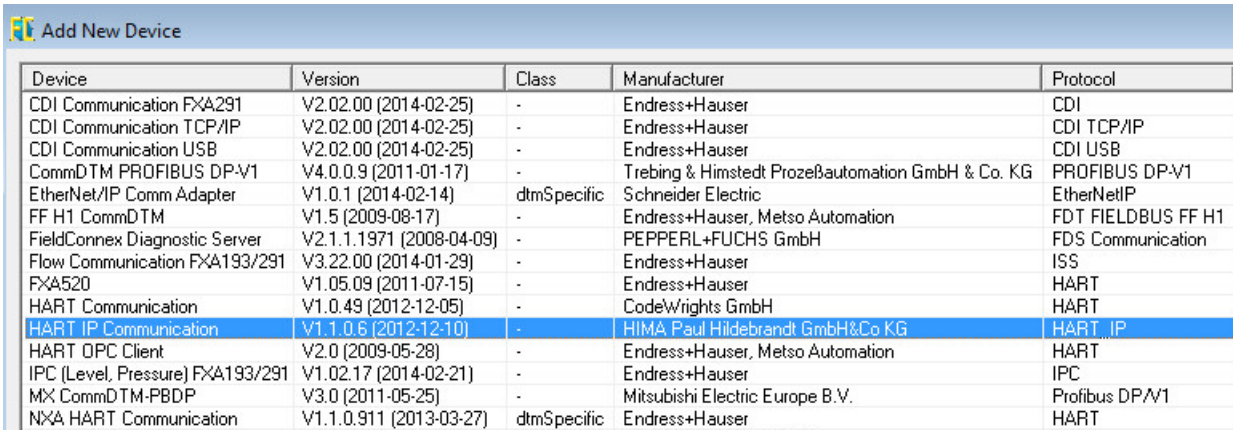
- Create a new project.



- Right-click on the Network Tag “Host PC” and select the menu ”Add Device”.

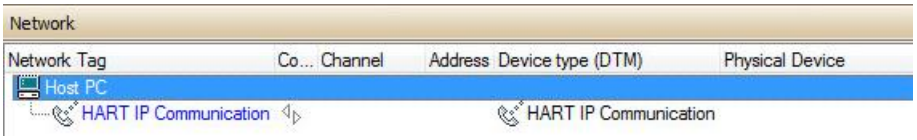


- Select the DTM “HART IP Communication” and click on the button “OK”.

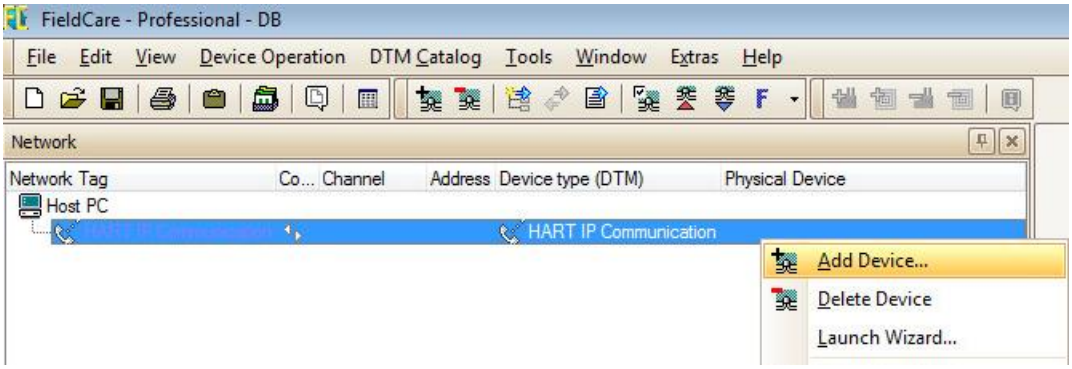


Device	Version	Class	Manufacturer	Protocol
CDI Communication FXA291	V2.02.00 (2014-02-25)	-	Endress+Hauser	CDI
CDI Communication TCP/IP	V2.02.00 (2014-02-25)	-	Endress+Hauser	CDI TCP/IP
CDI Communication USB	V2.02.00 (2014-02-25)	-	Endress+Hauser	CDI USB
CommDTM PROFIBUS DP-V1	V4.0.0.9 (2011-01-17)	-	Trebing & Himstedt Prozeßautomation GmbH & Co. KG	PROFIBUS DP-V1
EtherNet/IP Comm Adapter	V1.0.1 (2014-02-14)	dtmSpecific	Schneider Electric	EtherNetIP
FF H1 CommDTM	V1.5 (2009-08-17)	-	Endress+Hauser, Metso Automation	FDT FIELDBUS FF H1
FieldConnex Diagnostic Server	V2.1.1.1971 (2008-04-09)	-	PEPPERL+FUCHS GmbH	FDS Communication
Flow Communication FXA193/291	V3.22.00 (2014-01-29)	-	Endress+Hauser	ISS
FXA520	V1.05.09 (2011-07-15)	-	Endress+Hauser	HART
HART Communication	V1.0.49 (2012-12-05)	-	CodeWrights GmbH	HART
HART IP Communication	V1.1.0.6 (2012-12-10)	-	HIMA Paul Hildebrandt GmbH&Co KG	HART_IP
HART OPC Client	V2.0 (2009-05-28)	-	Endress+Hauser, Metso Automation	HART
IPC (Level, Pressure) FXA193/291	V1.02.17 (2014-02-21)	-	Endress+Hauser	IPC
MX CommDTM-PBDP	V3.0 (2011-05-25)	-	Mitsubishi Electric Europe B.V.	Profibus DP/V1
NXA HART Communication	V1.1.0.911 (2013-03-27)	dtmSpecific	Endress+Hauser	HART

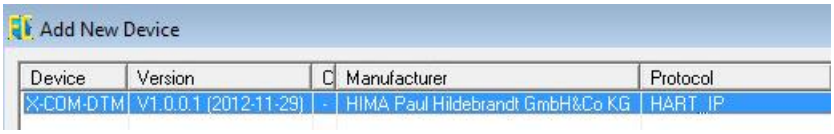
- The new DTM “HART IP Communication” is implemented in the Network view.



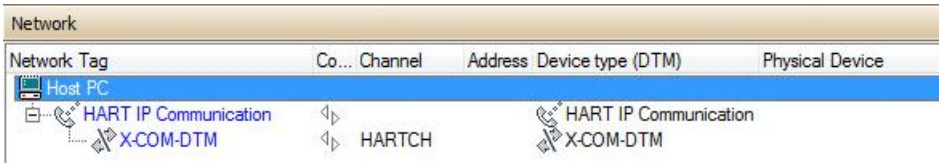
- Right-click on the DTM “HART IP Communication” and select the menu “Add Device”.



- Select the DTM “X-COM-DTM” and click on the button “OK”.

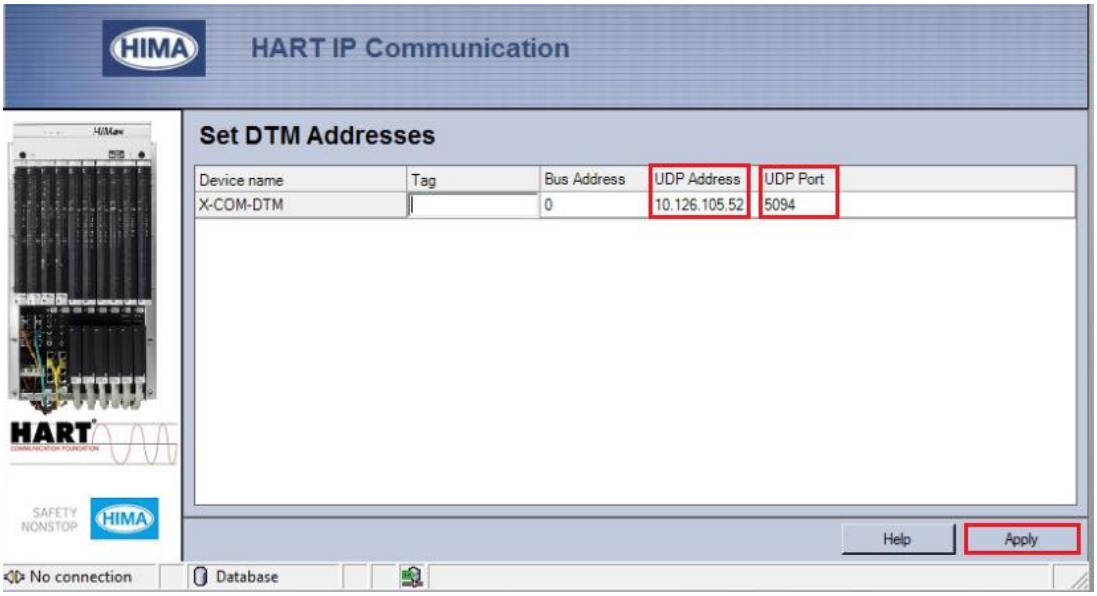


- The new DTM "X-COM-DTM" is implemented in the Network view.



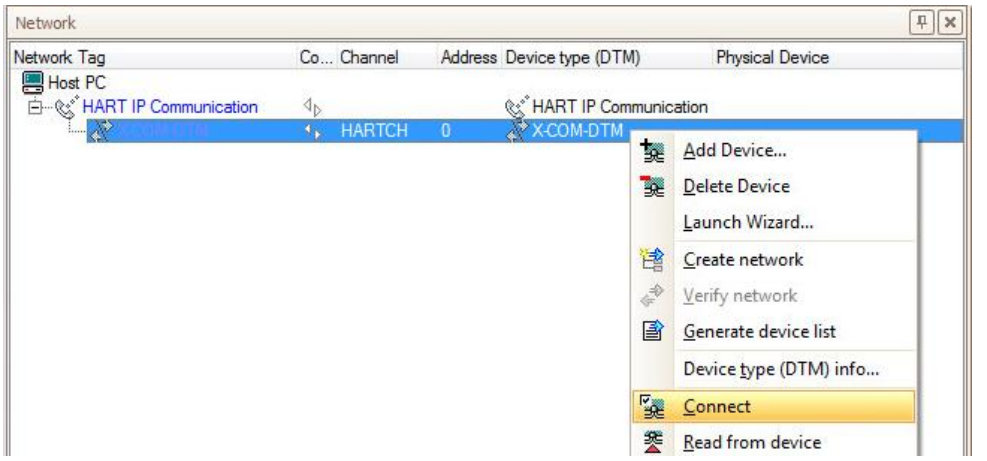
- Select the DTM "HART IP Communication", then click on the shortcut button "Device Functions" and select the menu "Additional Functions→ Set DTM Addresses".

- Following window is displayed.
  Enter the IP address of the HIMax System and indicate the UDP Port according to the network and click on the button "Apply". Close the window.
  In this example, the IP address is 10.126.105.52 and the UDP Port is 5094.

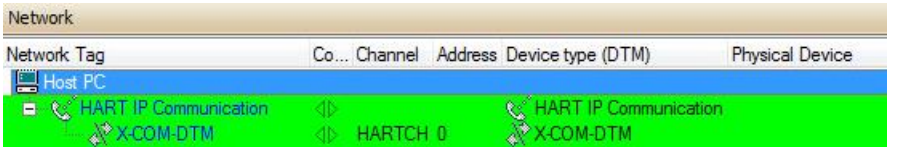


Please note that the UDP Port 5094 is the default port for HART Communication with the HIMA System. Make sure that the same port is not used twice, e.g. in the HIMA HART IP Protocol configuration. Please refer to chapter 3.2.4.3.

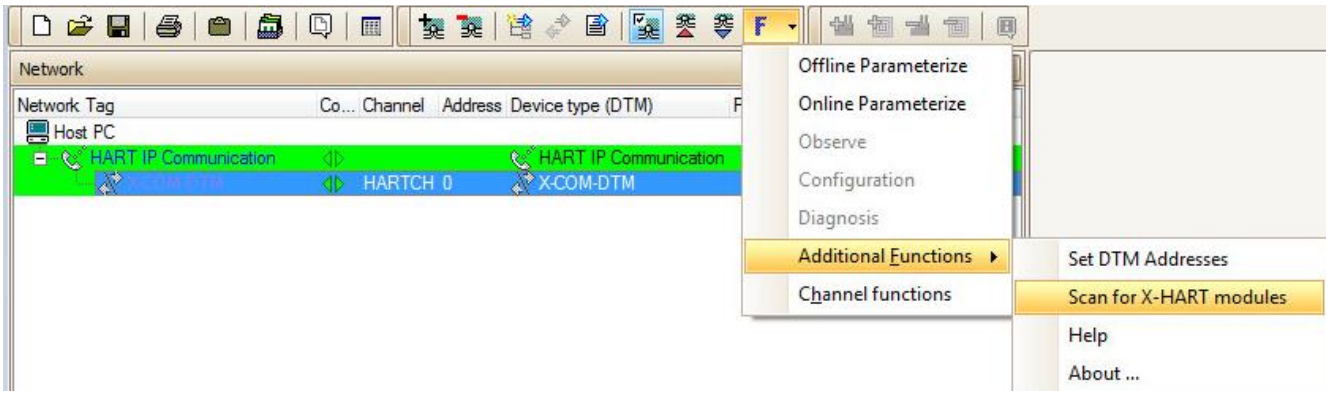
- Right-click on the DTM "X-COM-DTM" and select the option "Connect".



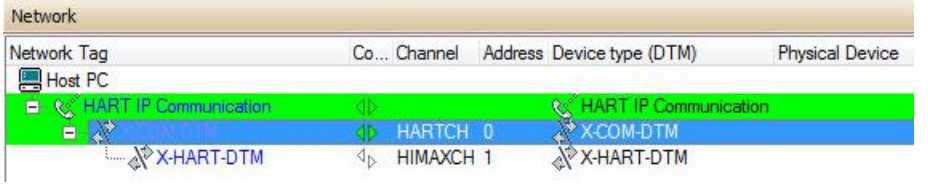
- The connection is done.



- Select the DTM "X-COM-DTM", then click on the shortcut button "Device Functions" and select the menu "Additional Functions→Scan for X-HART modules".

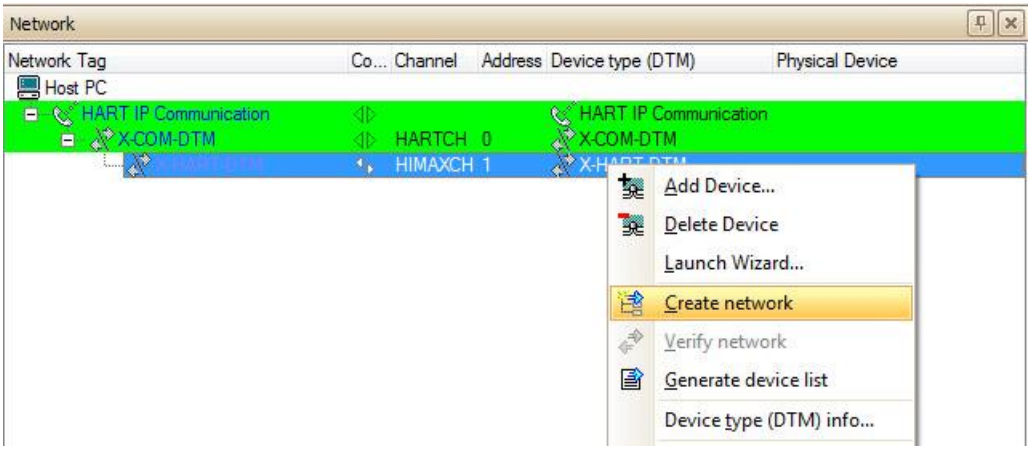


- The found X-HART module is implemented in the network with address 1.

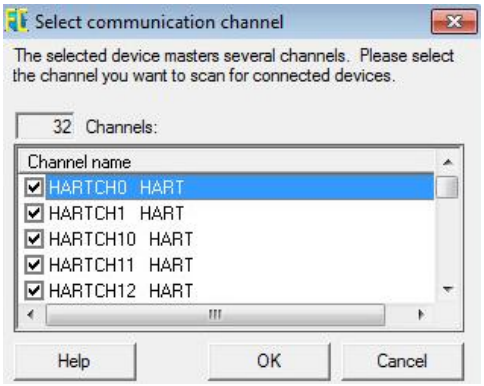


4.3 Scan for HART Devices (Online)

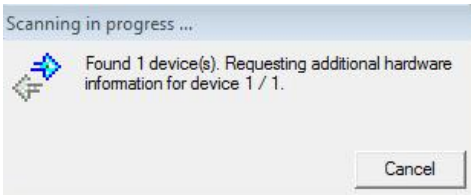
- Right-click on the DTM "X-HART-DTM" and select the menu "Create Network".



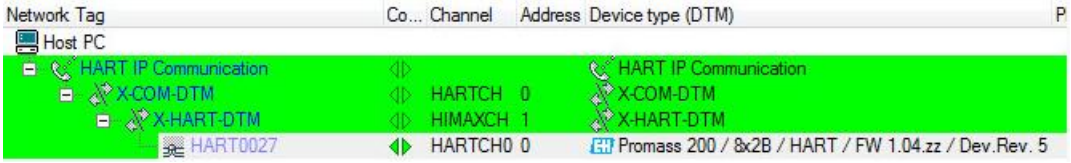
- Select the channels which need to be scanned.
  All channels are default selected.



- One device has been detected in this example.

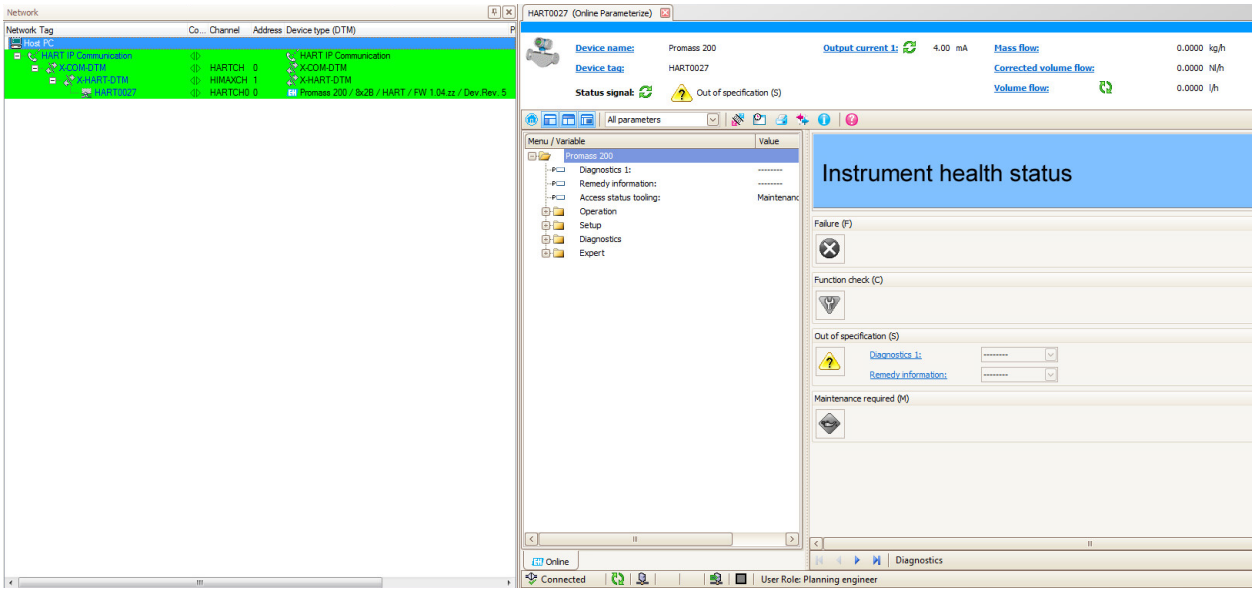


- Found devices are automatically inserted in the project.



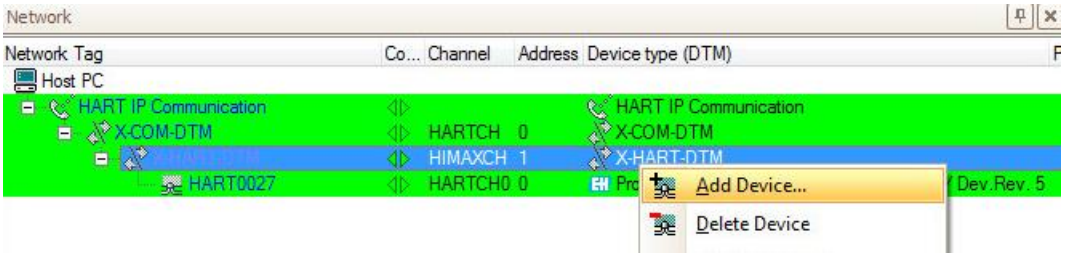
Please note that a device can only be scanned if its corresponding channel modem is enabled. Please refer to chapter 3.2.4.4.

- Double-click on the device DTM to open the "Online Parameterize" window.

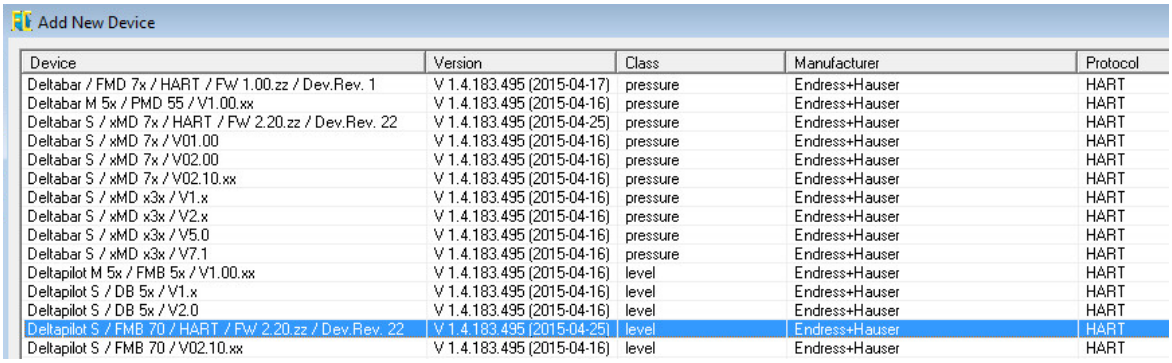


4.4 Configure HART Devices (Offline)

- Right-click on the DTM "X-HART-DTM" and select the menu "Add device".

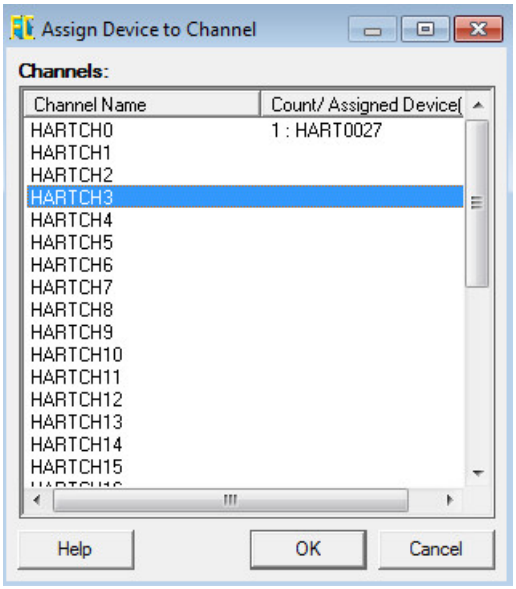


- Select the needed deviceDTM and click on the button "OK".
  In this example, it is the deviceDTM "Deltapilot S".

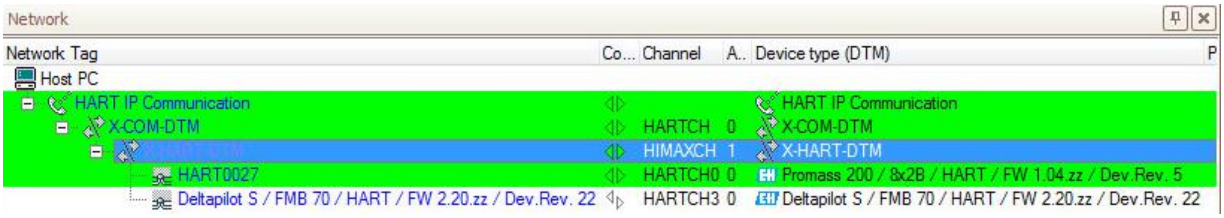


Device	Version	Class	Manufacturer	Protocol
Deltabar / FMD 7x / HART / FW 1.00.zz / Dev.Rev. 1	V 1.4.183.495 (2015-04-17)	pressure	Endress+Hauser	HART
Deltabar M 5x / PMD 55 / V1.00.xx	V 1.4.183.495 (2015-04-16)	pressure	Endress+Hauser	HART
Deltabar S / xMD 7x / HART / FW 2.20.zz / Dev.Rev. 22	V 1.4.183.495 (2015-04-25)	pressure	Endress+Hauser	HART
Deltabar S / xMD 7x / V01.00	V 1.4.183.495 (2015-04-16)	pressure	Endress+Hauser	HART
Deltabar S / xMD 7x / V02.00	V 1.4.183.495 (2015-04-16)	pressure	Endress+Hauser	HART
Deltabar S / xMD 7x / V02.10.xx	V 1.4.183.495 (2015-04-16)	pressure	Endress+Hauser	HART
Deltabar S / xMD x3x / V1.x	V 1.4.183.495 (2015-04-16)	pressure	Endress+Hauser	HART
Deltabar S / xMD x3x / V2.x	V 1.4.183.495 (2015-04-16)	pressure	Endress+Hauser	HART
Deltabar S / xMD x3x / V5.0	V 1.4.183.495 (2015-04-16)	pressure	Endress+Hauser	HART
Deltabar S / xMD x3x / V7.1	V 1.4.183.495 (2015-04-16)	pressure	Endress+Hauser	HART
Deltapilot M 5x / FMB 5x / V1.00.xx	V 1.4.183.495 (2015-04-16)	level	Endress+Hauser	HART
Deltapilot S / DB 5x / V1.x	V 1.4.183.495 (2015-04-16)	level	Endress+Hauser	HART
Deltapilot S / DB 5x / V2.0	V 1.4.183.495 (2015-04-16)	level	Endress+Hauser	HART
Deltapilot S / FMB 70 / HART / FW 2.20.zz / Dev.Rev. 22	V 1.4.183.495 (2015-04-25)	level	Endress+Hauser	HART
Deltapilot S / FMB 70 / V02.10.xx	V 1.4.183.495 (2015-04-16)	level	Endress+Hauser	HART

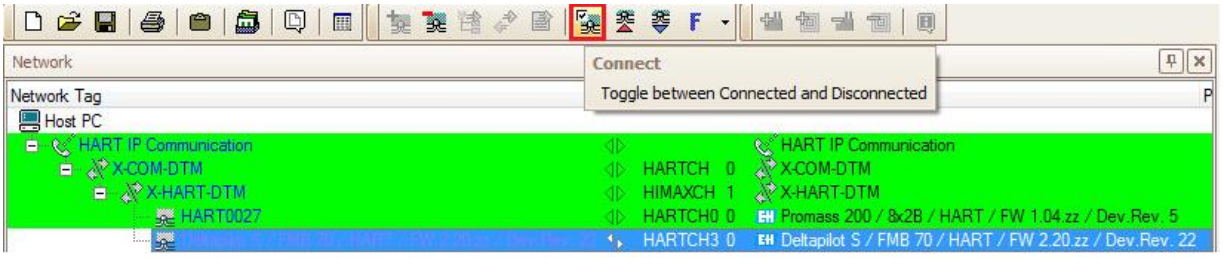
- Select the channel of the HART analog input module on which the device is connected and click on the button “OK”.
  In this example, the Deltapilot S is connected on Channel 4 of the HIMA System.



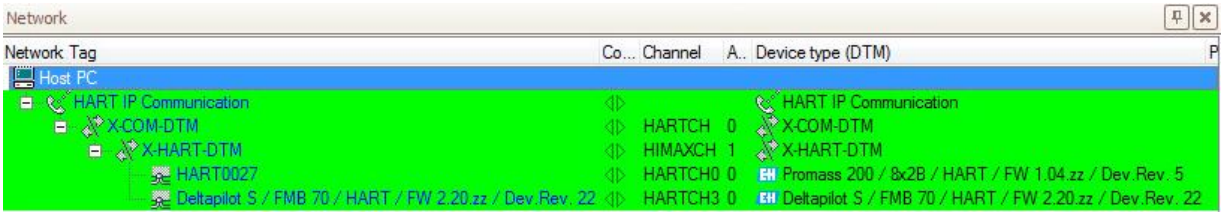
- The device DTM is added in the project.



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



- The Deltapilot S is now connected and can be operated as usual in FieldCare.



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