Application Note

FESTO

CPX-HART module configuration with Portal TIA and PROFINET

How to configure CPX-4AE-4AA-H module using Siemens TIA Portal® with PROFINET.

CPX-4AE-4AA-H

100183

Title ..... CPX-HART module configuration with Portal TIA
Version 1.10
Document no. 100183
Original ..... en
Author ..... Festo

Last saved 24.09.2018

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1 Components/Software used

1.1 Software

Type/Name	Version Software	Date of manufacture
PACTware	4.1	--
TIA Portal	V14 or Later	--
CPX GSDML for PROFINET	REV 30 or Later	--
DTM Driver for CPX-P-HART	1.1 or Later	--
DTM Driver for E+H TMT-182	05.00.03	--
Festo Maintenance Tool	4.21.203 or Later	--
Catalog Update for FMT	1.255 Update 15 or Later	--

Table 1.1: Software used

1.2 Hardware

Type/Name	Version Hardware/Firmware	Date of manufacture
CPX-4AE-4AA-H	All FW/HW Versions	--
CPX-FB33/34/35	Rev 33	--
TMT-182	Rev 1.0	--
S7-1200	Rev	--

Table 1.2: Components used

1.3 Documentation

This documentation intends to deliver supplementary information regarding the following documentations:

- CPX-4AE-4AA-H (8083252):
  http://ademsp00.de.festo.net/net/en-gb_gb/SupportPortal/Files/491948/CPX-4AE-4AA-H_2017-12_8083252g1.pdf

- P.BE-CPX-PNIO-EN (548760):
  http://ademsp00.de.festo.net/net/en-gb_gb/SupportPortal/Files/407977/CPX-FB33_35_41_2014-10d_548760g1.pdf

2 Application Description

This Application Note explains about configuration for module CPX-4AE-4AA-H (8059847) with Siemens TIA Portal® using CPX-FB34 as PROFINET remote I/O.

For exemplary purposes, a Temperature Transmitter from Pepperl+Fuchs Model TMT182® as well as your DTM Driver and PACTware® FDT Application has been used for better understanding about specific behaviors for data format, data exchange and commissioning of a HART network using the module CPX-4AE-4AA-H (8059847).

In this document we will describe good practices and possible different configurations for applications that requires uses from CPX-P HART module and TIA Portal.

3 Product-specific terms and abbreviations

Term/abbreviation	Significance
O	Output
I	Input
CPX terminal (-P)	Modular electrical terminal which is particularly suitable for use in the process industry (intrinsically safe electronics modules available)
HART	Highway Addressable Remote Transducer
HART protocol	Bidirectional, platform-independent data transfer protocol that permits access to the data of intelligent field devices
IEEE Routing	As known as “HART Variables” as well. These are variables that can be transferred inside of the HART protocol through Shift Frequency Key (SFK).
Process image	The process image is part of a controller's system memory. At the start of the cyclical program, the signal states of the input modules are transferred to the process image for the inputs (PII). At the end of the cyclical program, the process image for the outputs (PIO) is transferred to the output modules as a signal status.
Process Variable	Current measured value from a variable used for control and monitoring in a Process. In this document is referred as the variable that its sent thought 4-20 mA channel.
FDT Frame Application	Software that enables a graphical interface to configure, maintain and diagnose intelligent measurement devices. It can displays device parameters and information from an installed DTM driver provided by the device supplier.
DTM Drive	A Device driver which is delivered by device supplier for configuration, maintenance, diagnostics and troubleshooting through FDT application.
PV	Primary Value
SV	Secondary Value
TV	Tertiary Value
QV	Quaternary Value

Table 3.1: Product-specific terms and abbreviations

4 Installation

4.1 Hardware Setup

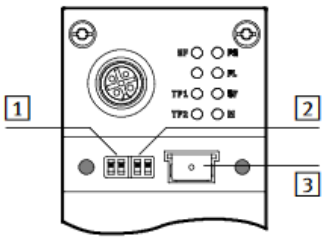
Warning
This application note is entirely based in the following HW configuration as described
Any possible modification into the hardware can be consider as a possible troubleshoot step.

For this Application Note, we have to setup the Hardware as described below:

4.1.1 CPX-FB34

The required configuration for the CPX-FB34 is:

- Remote I/O operating mode : (DIL 1.1 OFF ; DIL 1.2 OFF) ;
- Status bit switched off : (DIL 2.1 OFF; DIL 2.2 OFF)



DIL switch 1		Set bus node operating mode
	DIL 1.1: OFF DIL 1.2: OFF (Factory setting)	**Remote I/O operating mode** All functions of the CPX terminal are controlled directly by the PROFINET-I/O controller or a higher-level PLC. The bus node undertakes the **required** connection to PROFINET.
	DIL 1.1: ON DIL 1.2: OFF	**Operating mode Remote Controller** **Requirement:** A control block CPX-FEC or CPX-CEC is a component of the CPX terminal. The CPX-FEC or CPX-CEC control block integrated into the terminal controls all functions of the CPX terminal, i.e. the control block takes on the I/O control. The bus node takes over the **additional** connection to PROFINET.

DIL switch 2		Set diagnostics mode: (in the remote I/O operating mode)
	DIL 2.1: OFF DIL 2.2: OFF (factory setting)	**I/O diagnostics interface and status bits are switched off or diagnostics mode is set via the hardware configuration of the configuration software**[3] (+ 0 byte I / 0 byte O)
	DIL 2.1: OFF DIL 2.2: ON	**Status bits are switched on** (+ 1 Byte E / 0 Byte A) [1]
	DIL 2.1: ON DIL 2.2: OFF	**I/O diagnostics interface is switched on** (+ 2 bytes I / 2 bytes O) [2]
	DIL 2.1: ON DIL 2.2: ON	Reserved for future extensions

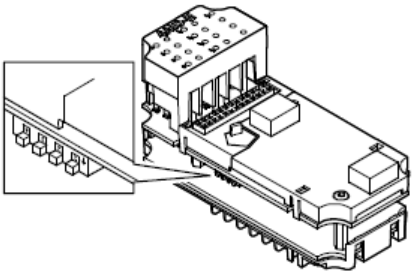
[1] Diagnostics mode status bits occupy 1 byte of address space (8 I bits)
[2] Diagnostics mode I/O diagnostics interface occupies 4 bytes of address space (16 I and 16 O bits)
[3] From Revision 21

Note
This configuration is valid for CPX-FB33 and CPX-FB35 as well.

4.1.2 CPX-4AE-4AA-H

The required configuration for the CPX-FB34 is:

- 2 HART enable Input and 2 HART enable Outputs (2AEAA-H + 4HV);



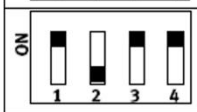
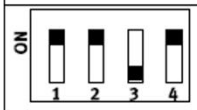
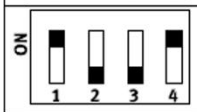
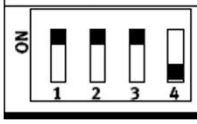
With HART variables				
	4AE-H + 4HV	24 bytes	0 bytes	Channel 0: input Channel 1: input Channel 2: input Channel 3: input
	3AE1AA-H + 4HV	22 bytes	2 bytes	Channel 0: input Channel 1: input Channel 2: input Channel 3: output
	2AE2AA-H + 4HV	20 bytes	4 bytes	Channel 0: input Channel 1: input Channel 2: output Channel 3: output
	1AE3AA-H + 4HV	18 bytes	6 bytes	Channel 0: input Channel 1: output Channel 2: output Channel 3: output
	4AA-H + 4HV	16 bytes	8 bytes	Channel 0: output Channel 1: output Channel 2: output Channel 3: output

Table 4.1: DIL switches variants for HART Module

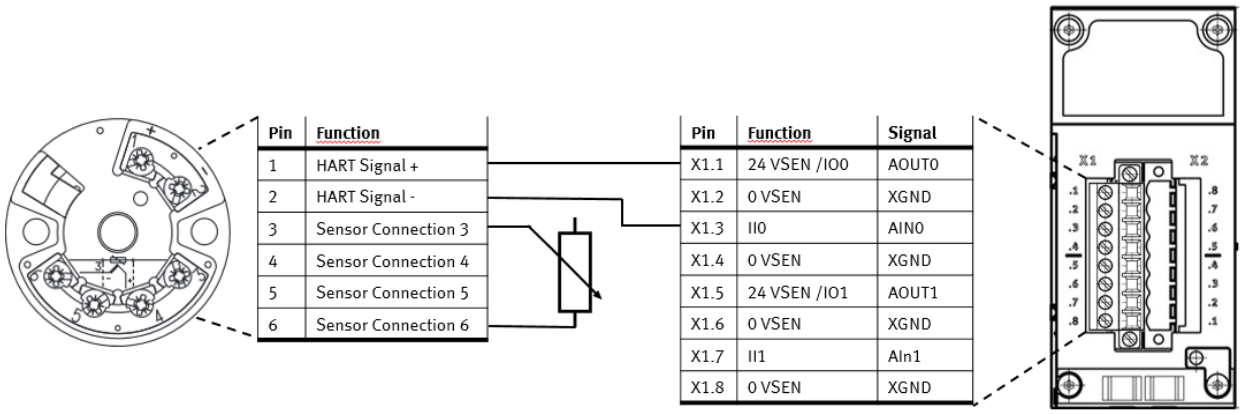
4.1.3 Siemens S7-1200 and TMT-182

This devices do not require any hardware setup for this Application Note.

4.2 Electrical Connection

For this application it was used the following connections between devices:

4.2.1 CPX-4AE-4AA-H and TMT-182 Temperature Transmitter



Note

The TMT-182 is an passive power transmitter

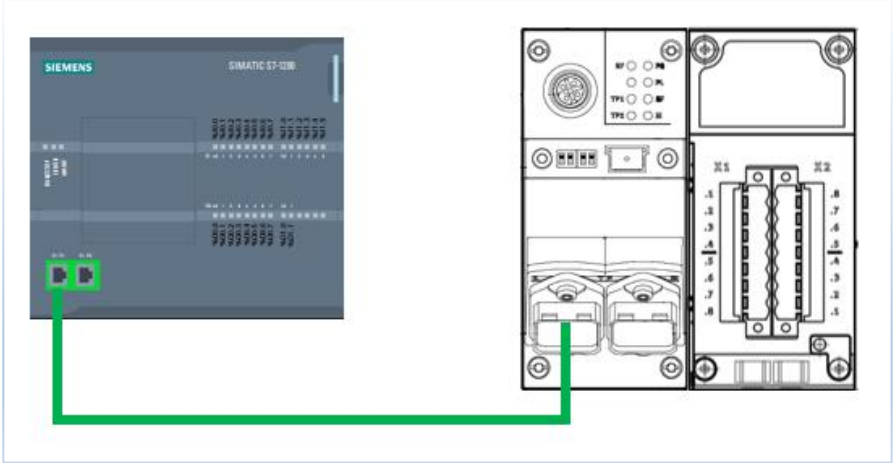
For further information about TMT-182 and possible functions , please, contact the manufacturer.

Information

Further information about how to connect your transmitter into CPX-4AE-4AA-H is explained at:
CPX-4AE-4AA-H Manual ➔ Cap.7.5 (Connection scenarios).

4.2.2 CPX-FB34 and Siemens S7-1200

There are two RJ45 push-pull sockets (AIDA-compliant) on the CPX-M-FB34 for the network connection:



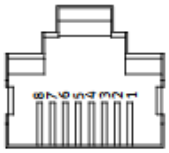
Socket	Pin	Signal	Explanation
RJ45, push-pull 	1	**TD+**	Transmission data (transmit data, TD) +
	2	**TD–**	Transmitted data –
	3	**RD+**	Receive data (receive data, RD) +
	4	n.c.	Not connected
	5	n.c.	Not connected
	6	**RD–**	Received data –
	7	n.c.	Not connected
	8	n.c.	Not connected
	Housing	Shield/FE	Shield/functional earth (FE)

Table 4.2: Pin allocation of the network interfaces of the bus node CPX-M-FB34 (RJ45)

Device	IP Address	PROFINET Name
CPX-FB34 Remote I/O	192.168.0.14	CPX
S7-1200 CPU	192.168.0.1	S71200

Table 4.3: Device Configuration

Information

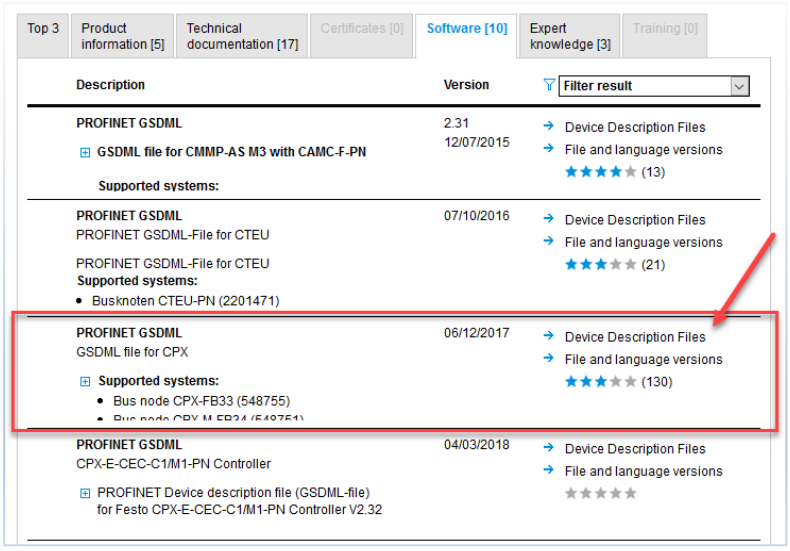
Further information about how to assign name and IP address for CPX is explained at:
CPX-FB34 Manual ➔ Cap.2.6 (Basic hardware configuration).

5 Commissioning

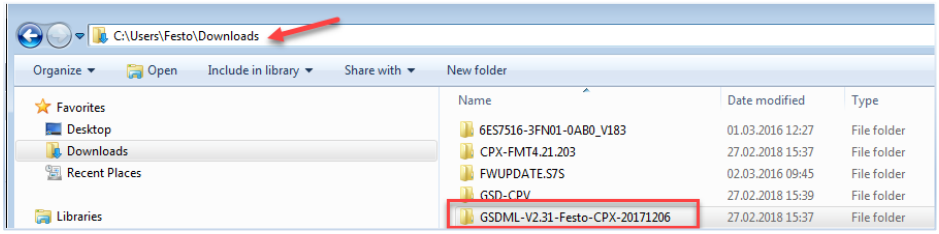
5.1 Hardware configuration into TIA Portal

5.1.1 Download for GSDML file

- Open the browser;
- Open the link below ;
  https://www.festo.com/net/en-gb_gb/SupportPortal/default.aspx?q=GSDML&tab=4&s=t#result
- Download the “PROFINET GSDML file for CPX“ clicking in “Device Description Files”;

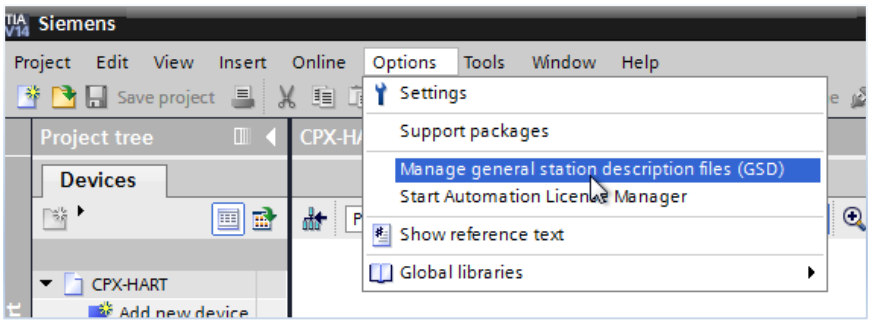


- Once that you downloaded, extract the file in a known place into your computer.

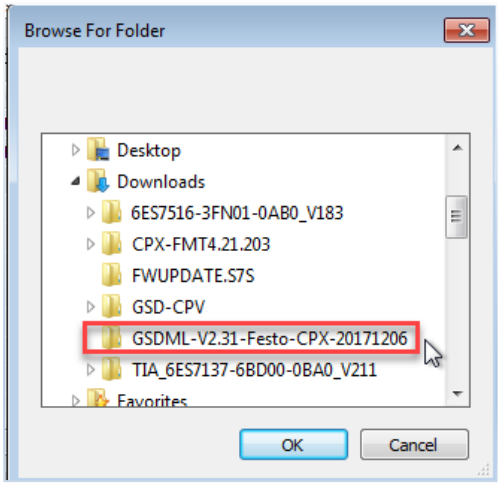


5.1.2 Installation for GSDML file into the TIA Portal

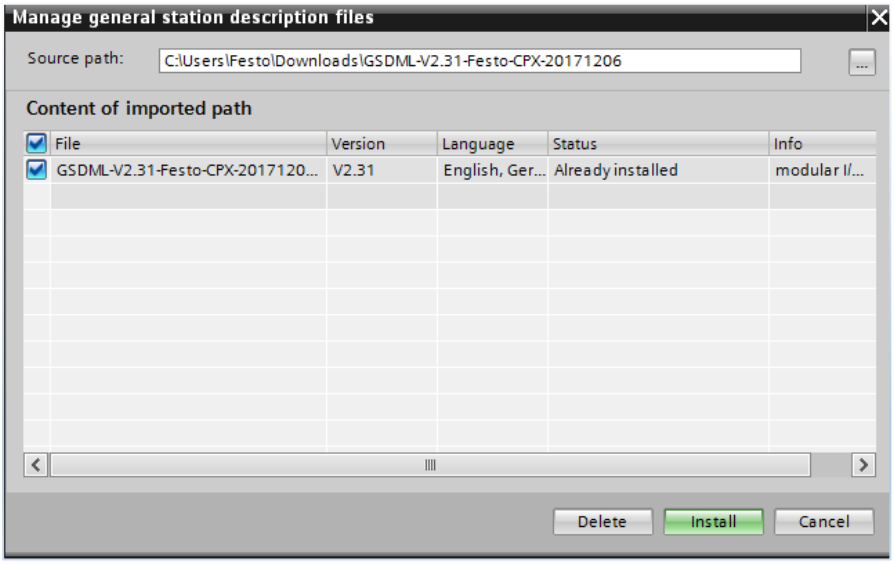
- Create a project in TIA Portal and select your PLC;
- Open the Project Tree and Select “Device Configuration”;
- Go to : Options -› Manage general station description files (GSD);



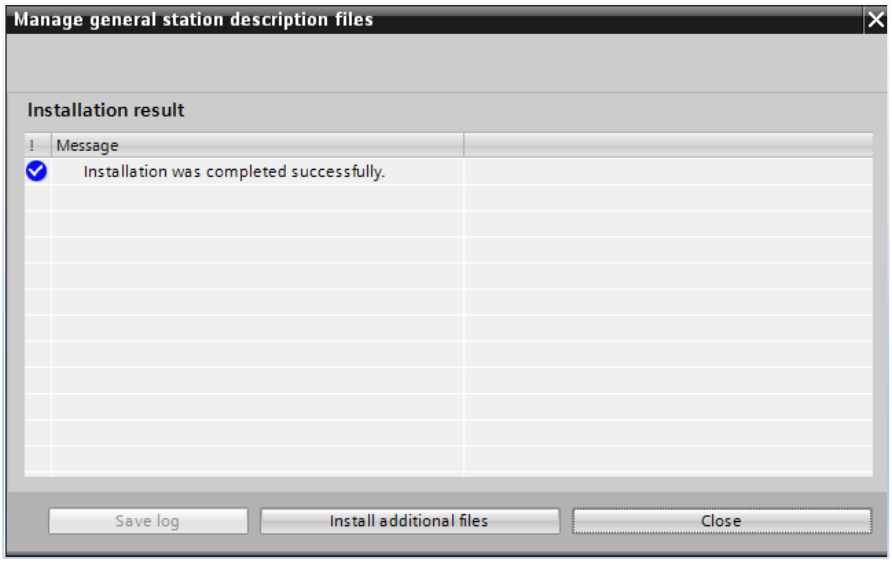
- In source path, select where the extracted files are located;



- Select all Files and clink at “Install”;



- You will get a message when is done.

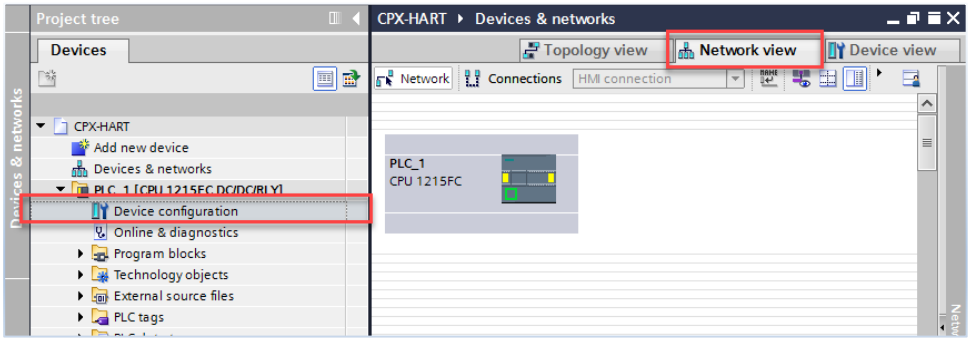


➔ **Note**

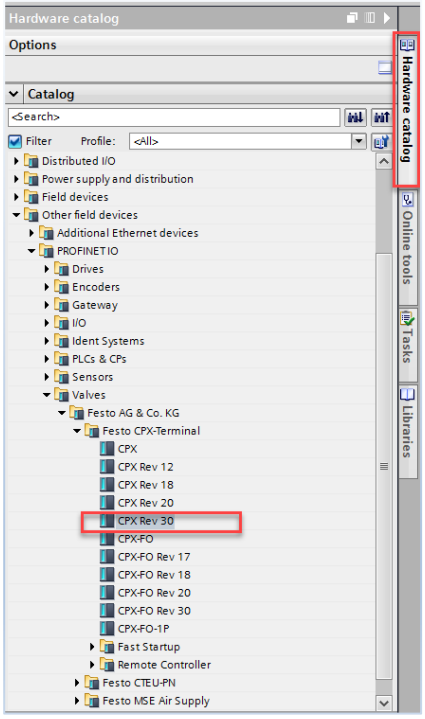
For older GSDML versions is the same procedure.

5.1.3 Inserting the CPX in the TIA Portal Project

- Double Click in “Device configuration”;
- Select “network view” Tab;



- Open the guide “Hardware Catalog”;
- Search inside of PROFINET IO device catalog for :
- Valves -› Festo AG & CO. KG -› Festo CPX Terminal -› CPX REV.30

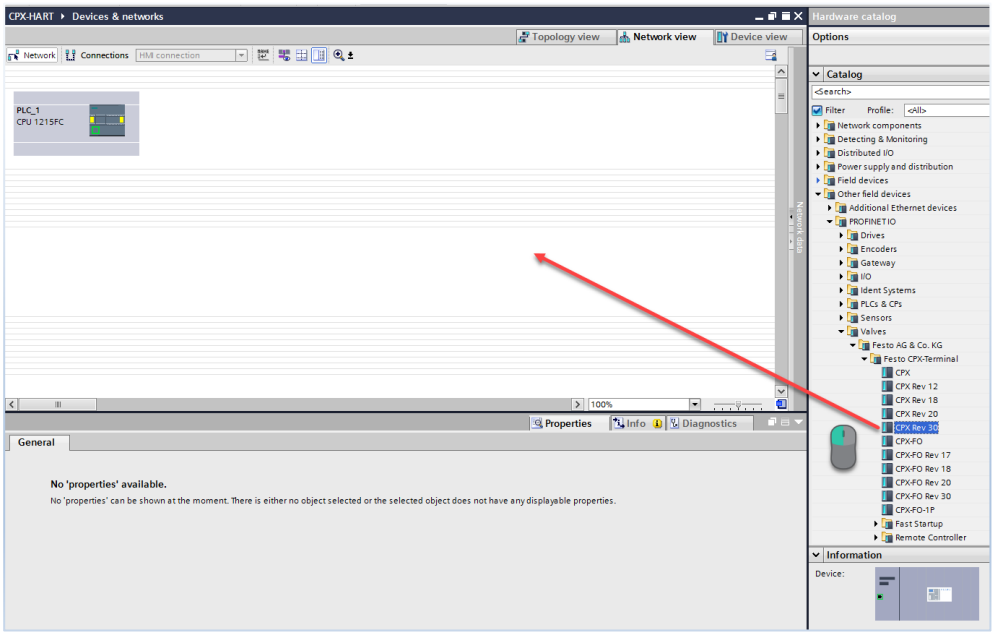


Warning

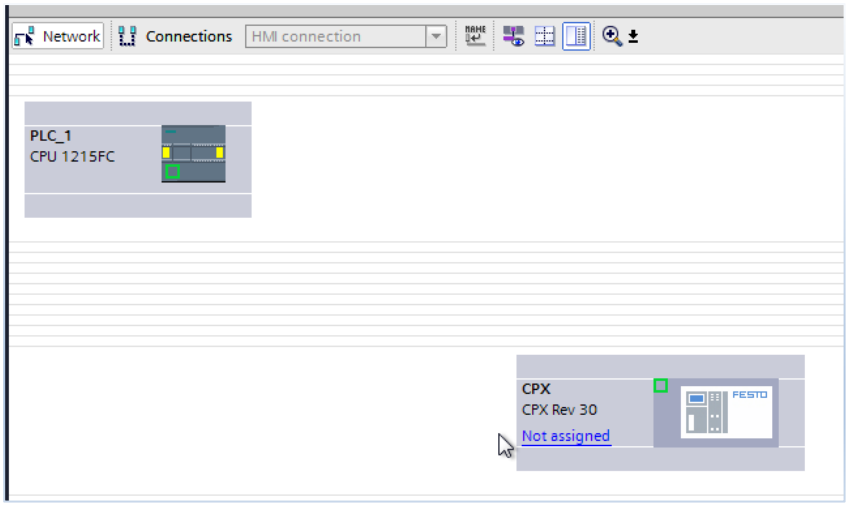
The module CPX-4AE-4AA-H is compatible with CPX GSD REV.30 or later.

Any other older version has no compatibility with the HART Module.

- Drag and drop the terminal “CPX Rev. 30 “ at “network view”:

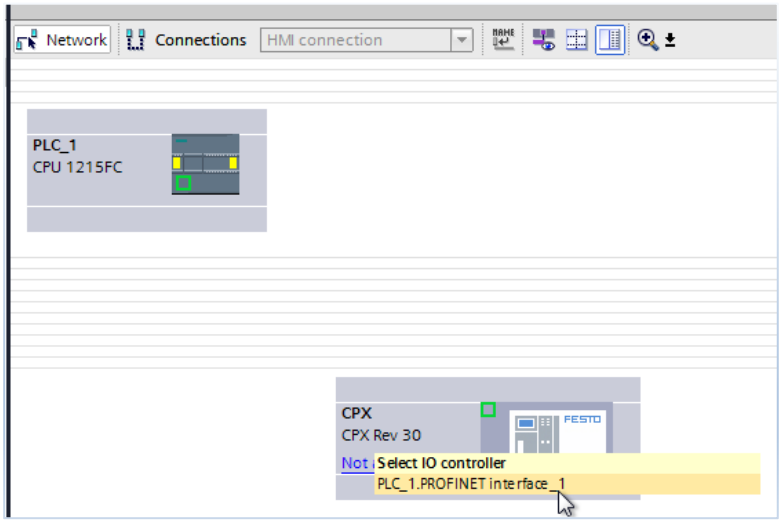


- The terminal should show as below:

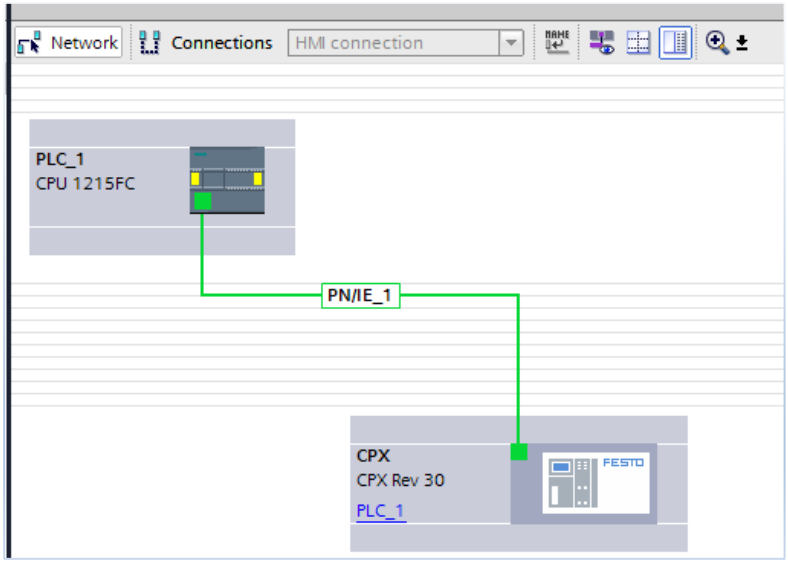


5.1.4 PROFINET network assignment

- Click on “Not assignment” at CPX system:
- Select the Master port (in example: PLC_1.PROFINET interface_1)



- Your CP system will be directly addressed for the available PROFINET network.



Note

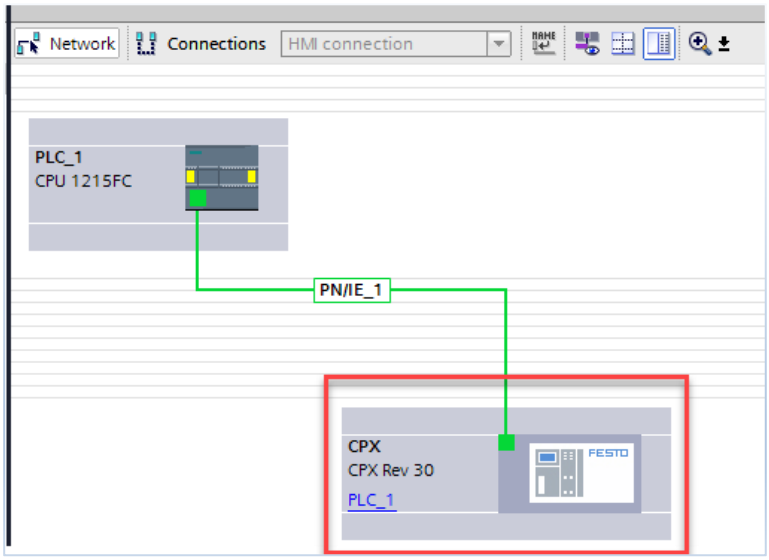
This the PLC1_PROFINET interface_1 is automatically generated by default.

You can choose other subnet using following steps:

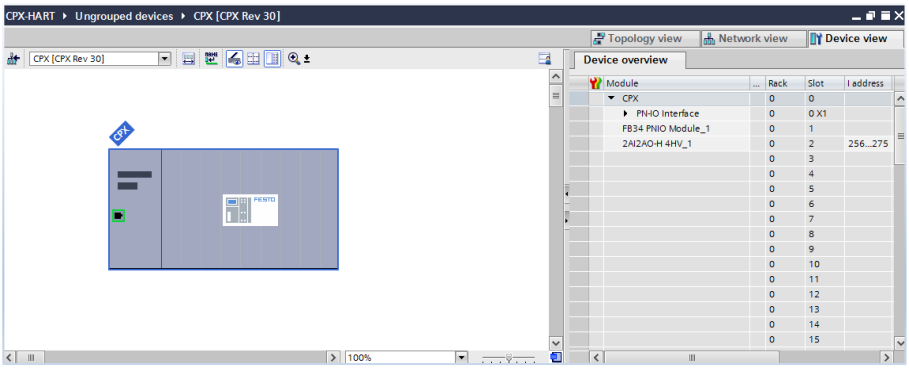
- Click at the PROFINET Master ;
- Go to the tab : Network settings ➔ PROFINET Interface ;
- Add s subnet clicking at section Ethernet Addressing ➔ Add Subnet .

5.1.5 Hardware configuration for CPX into TIA Portal

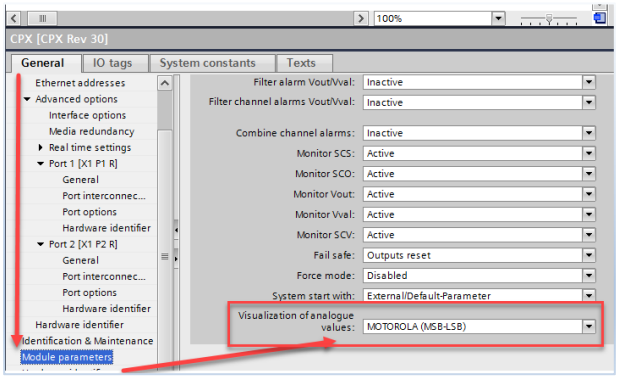
- Double-click in to your CPX System at “Network View”;



- Select your modules dragging from the “Hardware Catalogue” according with your actual configuration for the slave the modules have different configurations based on your DIL switches (See more at ➔ 4.1.2) This application note contains the following configuration:
  - CPX-FB34 PNIO (CPX PROFINET Slave without Status configuration);
  - 2AI2AO-H 4HV (2 Inputs , 2 Outputs + 4 Slots for IEEE Routing);



- Click in CPX Module
- Go to General ➔ Module Parameters;
- Change the “Visualization of analogue variables” to “MOTOROLA (MSB-LSB)”;



➔ **Note**

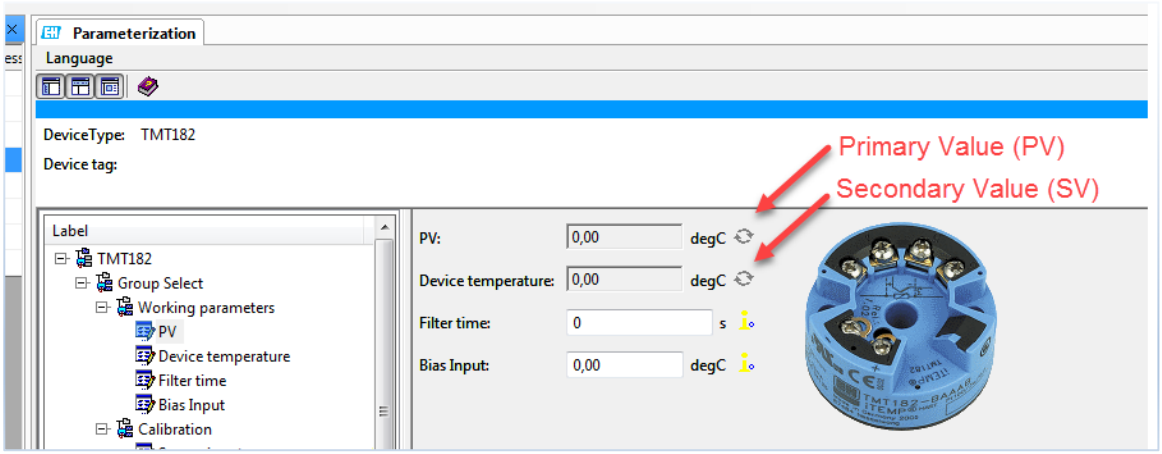
This is an additional step due to addressing behavior between devices.

The CPX uses INTEL addressing and Siemens has MOTOROLA byte order.

For different PROFINET master, this can vary.

5.2 Accessible Parameters from TMT-182

Accessing the DTM from TMT-182 using PACTware you have the following variables to access through IEEE Routing:



The available values for TMT-182 are:

Variable	Communication Channel	Range	Description
Process Variable	Analog Signal	4-20 mA	Scaled Process Variable from Transmitter
Primary Value (PV)	IEEE Routing	FSK – 1200~2200 Hz	Raw Process Variable from Transmitter
Secondary Value (SV)	IEEE Routing	FSK – 1200~2200 Hz	Device Temperature

Table 5.1: Available variables from TMT-182

The Analog Variables has a fast update rate and must be configured direct in parameters from the TMT-182. Normally in transmitters they are fully scalable or exchangeable for other variables , depending of the complexity of the measured value and the application.

The IEEE Routing variables have a slow update rates due to protocols overhead and can be used for monitoring and diagnosis purposes from the transmitter.

The CPX-4AE-4AA-H allows you to read up to 4 IEEE routing variables (4 bytes each variable : 16 Bytes total).

Information

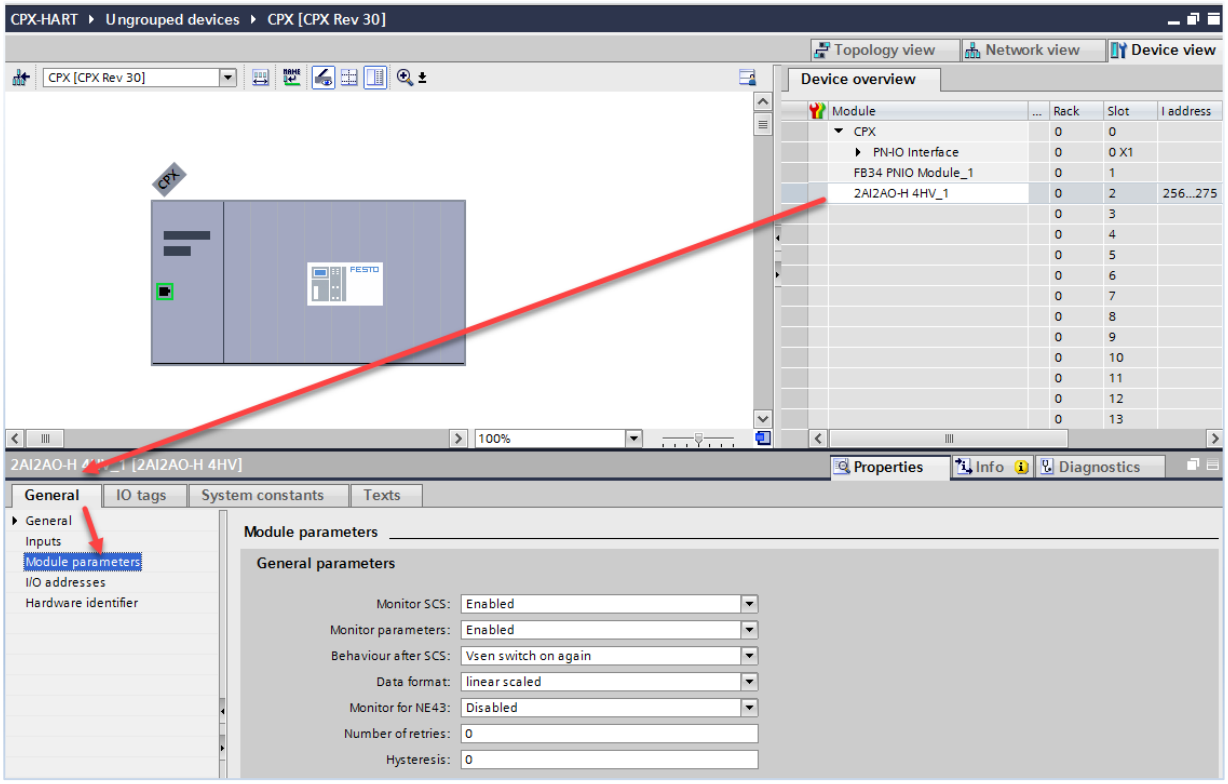
Further information about the parameters and data allocation is explained at:

CPX-4AE-4AA-H Manual ➔ Cap.8 (Commissioning).

5.3 Module Parametrization in “HW configuration”

This configuration allows the PROFINET Master to overwrite configuration via DPV1 during the start-up from the Slave and this activates the HART module for data exchange.

- Click at “2AI2AO-H 4HV”;
- Go to “General -› Module Parameters”



At “Module Parameters” you can configure this application note we are using the following configuration:

Category	Variable	Value	Description
IEEE Routing	Source IEEE Variable 0	PV	Primary Value of the Channel 0 **TMT-182 / Raw Process Variable.**
	Channel IEEE Variable 0	0	
	Source IEEE Variable 1	SV	Secondary Value from the Channel 0 **TMT-182 / Device Temperature.**
	Channel IEEE Variable 1	0	
I-Channel 0	Signal Range	4..20 mA with HART	Activates the channels for 4..20 mA and HART variables.
I-Channel 1	Signal Range	4..20 mA with HART [1)]	
O-Channel 0	Signal Range	4..20 mA with HART [1)]	
O-Channel 1	Signal Range	4..20 mA with HART [1)]	

1) Not mandatory for this application.

Table 5.2: Parameter list for configuration

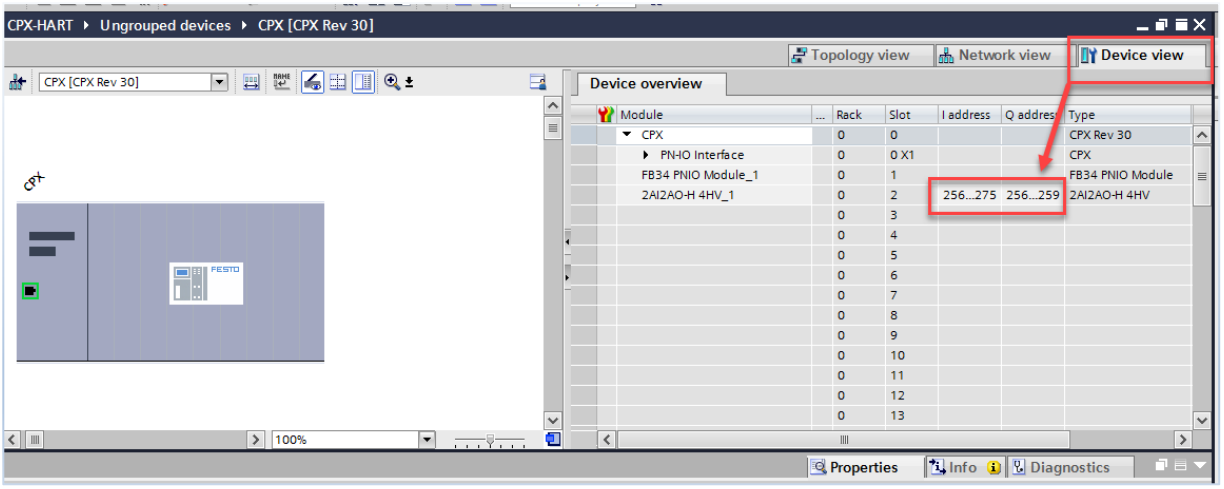
Note

All the variables not mentioned in this part of the document you can assume that they are in default value

6 Operation

6.1 Checking address allocation to CPX-4AE-4AA-H

You can check the address allocation into your CPX using “Device View”.



6.2 Process Image and addressing for TMT-182 with 2AI2AO-H 4HV

The Process image for the CPX-4AE-4AA-H depends of which DIL configuration has been made for the application. This application uses the Processing Image for 2AI2AO-H 4HV as follow:

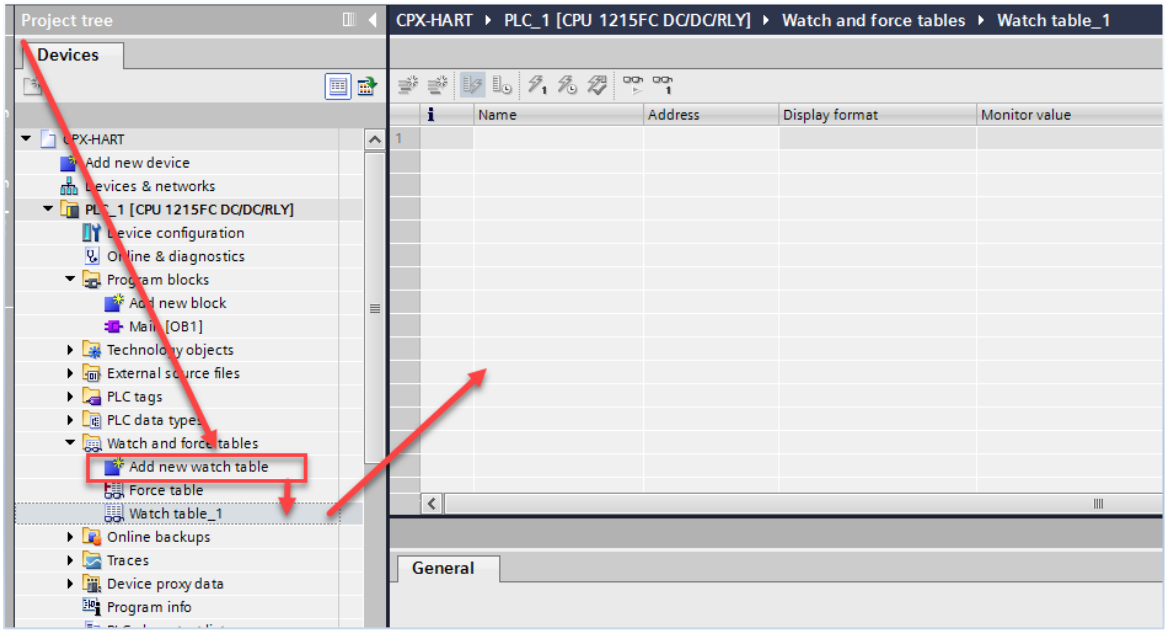
2AI2AO-H 4HV	**Contents of Bytes** [1]																							
	23	**22**	**21**	**20**	**19**	**18**	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Input	-	-	-	-	HV4 n/a %ID272				HV3 n/a %ID268				HV2 **Device Temp. (SV)** %ID264				HV1 **Raw Process Variable (PV)** %ID260				IW CH 1 n/a %IW258		IW CH O **Process Variable** %IW256	
Output	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SW CH 3 n/a7 %QW258		SW CH 2 n/a %QW256	

1) IW CH ”x” = Input Word for Channel “x” (Exchange via Analog Channel)
SW CH ”y” = Output Word for Channel “y” (Exchange via Analog Channel)
HV ”z” = HART Variable “z” (via IEEE Routing)
n/a = not appliable for this Application Note, but still mapped
“-“ = not mapped , used in other types of configuration.

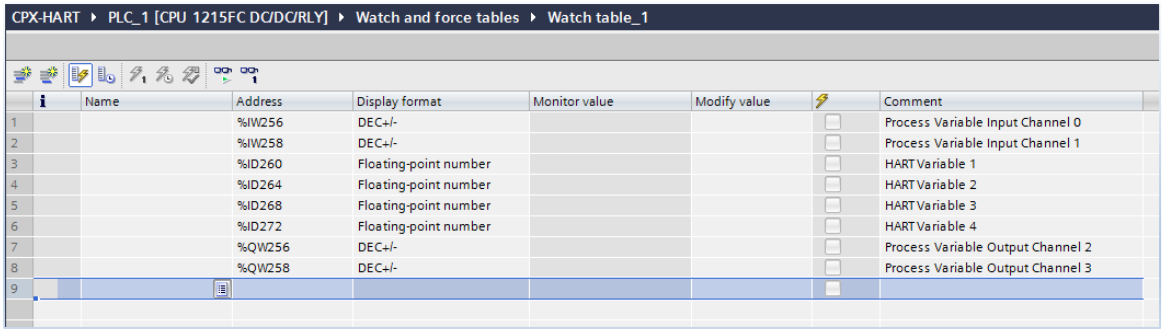
Table 6.1: 2AI2AO-H 4HV variant processing image for CPX-4AE-4AA-H.

6.3 Add variables using TIA Portal “Watch Table”

- Open “Project Tree”;
- Click at “Watch and force tables”;
- Double click at “add new watch table” icon;
- The Table will appears empty;



- Fulfill the table as mentioned at Cap. ➔ 6.2;



	Name	Address	Display format	Monitor value	Modify value	Comment
1		%IW256	DEC+/-			Process Variable Input Channel 0
2		%IW258	DEC+/-			Process Variable Input Channel 1
3		%ID260	Floating-point number			HART Variable 1
4		%ID264	Floating-point number			HART Variable 2
5		%ID268	Floating-point number			HART Variable 3
6		%ID272	Floating-point number			HART Variable 4
7		%QW256	DEC+/-			Process Variable Output Channel 2
8		%QW258	DEC+/-			Process Variable Output Channel 3
9						

- Perform download in your system and make sure to be at RUN MODE;

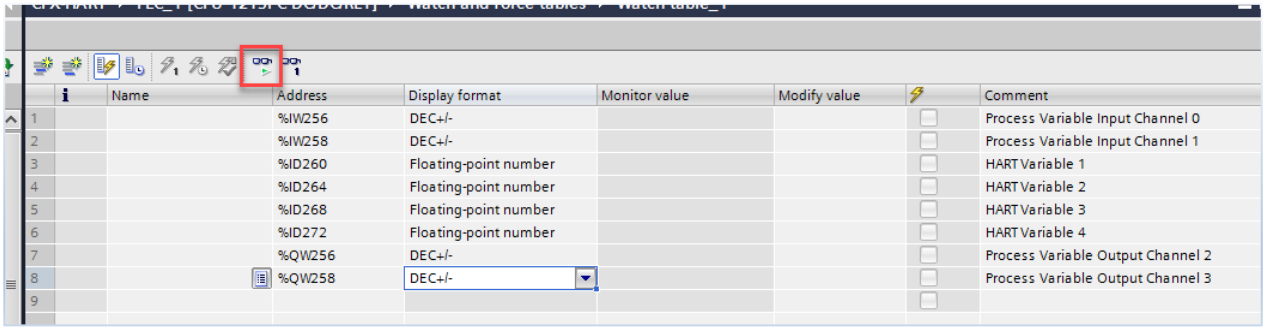
➔ **Note**

This step may vary for different CPU´s from Siemens

Make sure that your system is with the correct downloaded program and at RUN MODE.

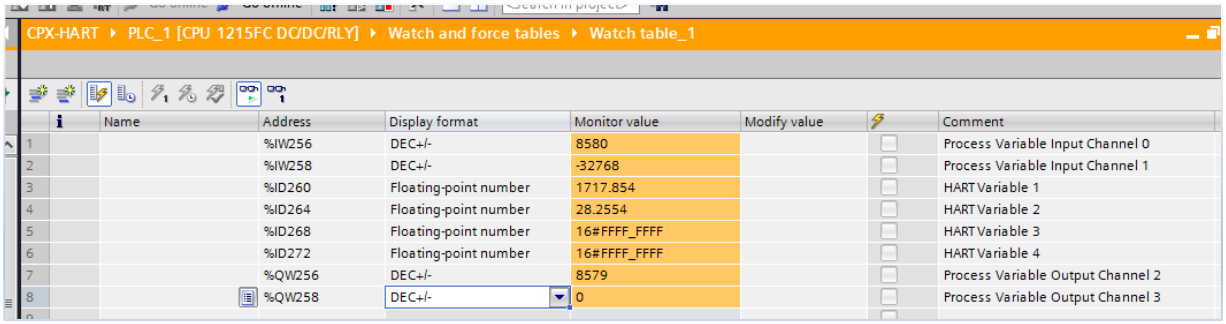
6.4 Online Values and comparison with DTM drive

- When in “Online Mode”, open “Watch Table”;
- Click into “Monitor All” Icon ;



	Name	Address	Display format	Monitor value	Modify value	Comment
1		%IW256	DEC+/-			Process Variable Input Channel 0
2		%IW258	DEC+/-			Process Variable Input Channel 1
3		%ID260	Floating-point number			HART Variable 1
4		%ID264	Floating-point number			HART Variable 2
5		%ID268	Floating-point number			HART Variable 3
6		%ID272	Floating-point number			HART Variable 4
7		%QW256	DEC+/-			Process Variable Output Channel 2
8		%QW258	DEC+/-			Process Variable Output Channel 3
9						

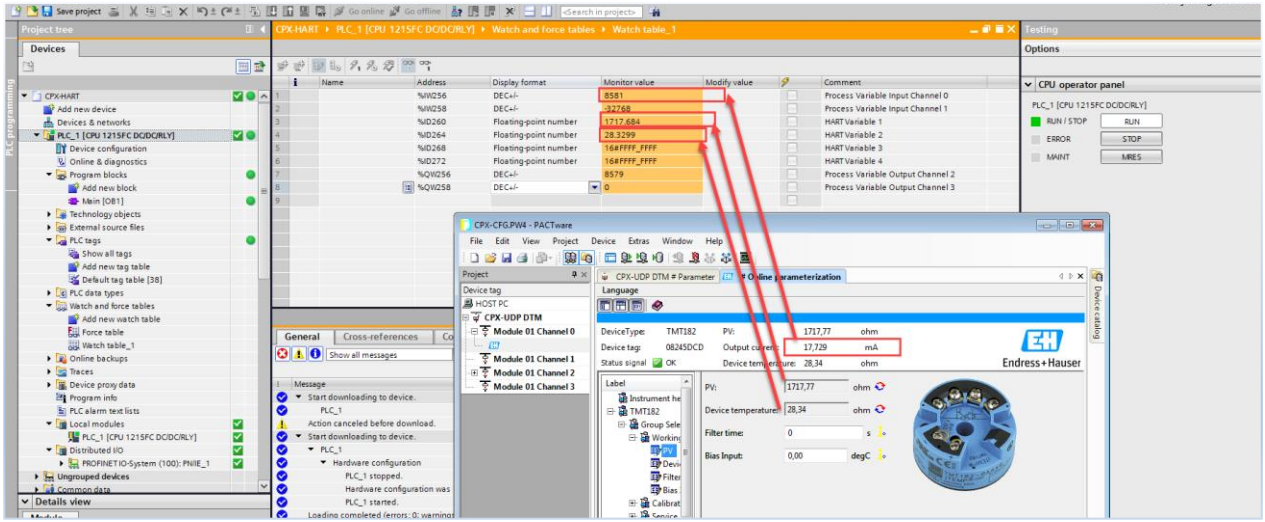
- The Values will appears at “Monitor Value” Column:



	Name	Address	Display format	Monitor value	Modify value	Comment
1		%IW256	DEC+/-	8580		Process Variable Input Channel 0
2		%IW258	DEC+/-	-32768		Process Variable Input Channel 1
3		%ID260	Floating-point number	1717.854		HART Variable 1
4		%ID264	Floating-point number	28.2554		HART Variable 2
5		%ID268	Floating-point number	16#FFFF_FFFF		HART Variable 3
6		%ID272	Floating-point number	16#FFFF_FFFF		HART Variable 4
7		%QW256	DEC+/-	8579		Process Variable Output Channel 2
8		%QW258	DEC+/-	0		Process Variable Output Channel 3

Values outside of the measurement range will be with the value 0xFFFF. Make sure that your variables are being read properly:

- Open your DTM drive and compare the values between TIA Portal.



Note

The values for the Process Value are scaled to 4-20 mA (linear scaled)

You can change the scale simply going into CPX-4AE-4AA-H at “Device View” and modifying the scale as your application request.

Info

Further information about scaling is explained at:

CPX-4AE-4AA-H Manual ➔ Cap.8.5 (Data format and range of the Actual Values)

7 Technical appendix

7.1 Module Parametrization using “DPV1 Direct Message”

Siemens system allows you to write parameters for your CPX using DPV1 parameter channel through SFC blocks and programming. In this section we will explain other possible way to parametrize your application with S7-1200 using DPV1 Direct Message.

You can use different parameters for CPX-4AE-4AA-H and here is some possible application for this parameters:

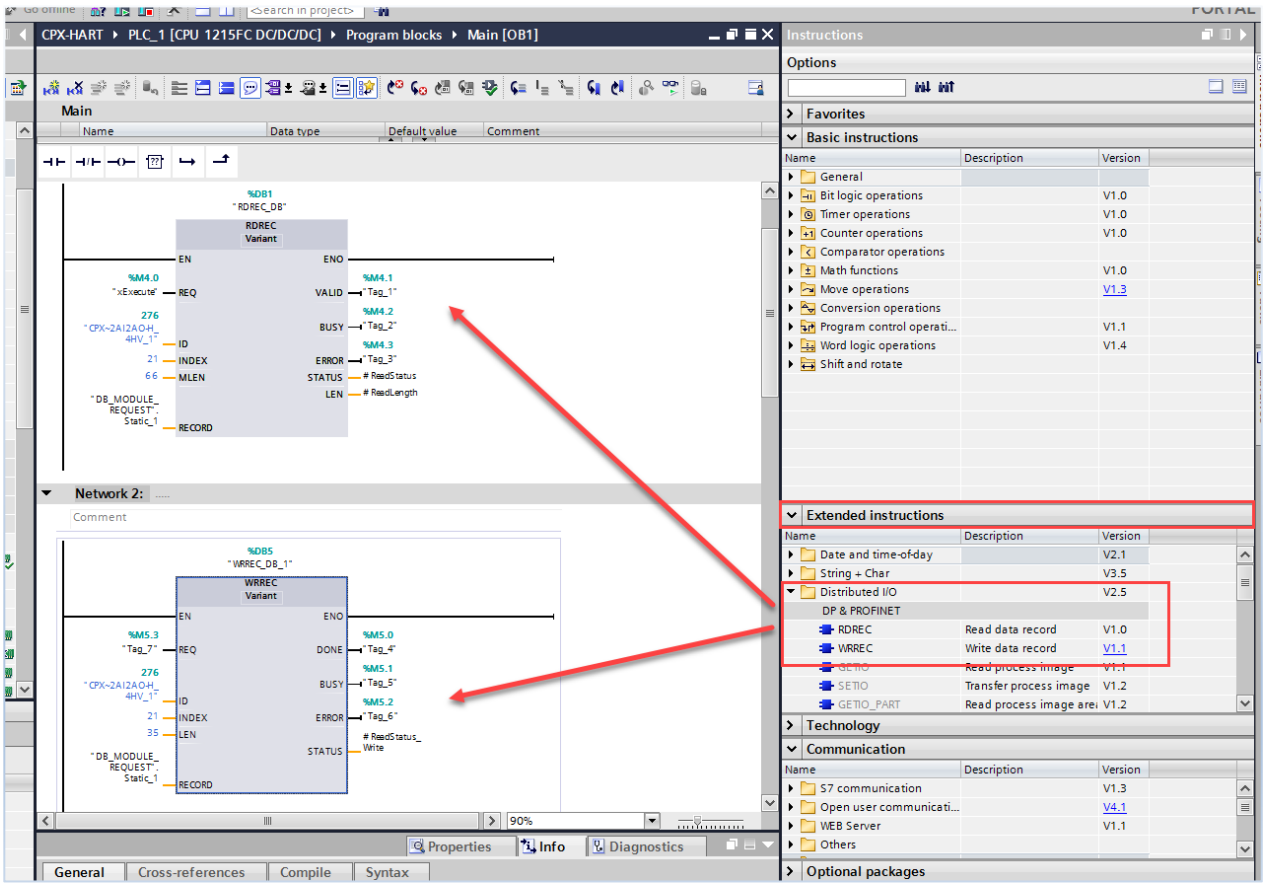
- Change the type of scaling on-fly from the module;
- Change the type of signal (4-20mA, 4-20ma HART; “Disable for maintenance”);
- Change HART variables that you would like to get from your Transmitter (Change SV to TV or QV);
- SCS and Fail-Safe Behavior;

7.1.1 Needed resources from Siemens

For this application you will need the following resources from TIA Portal:

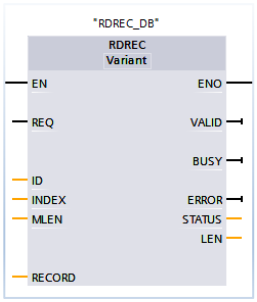
- RDREC – block to Read parameters
- WDREC – block to Read parameters
- DB – Database Creation for Change / Read your Parameters

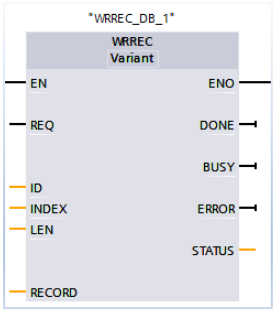
You will find both at the catalogue function at “Extended Instructions”:



7.1.2 RDREC and WDREC parameters

The SFC blocks WRRED and RDREC have common parameters to exchange data as described below:





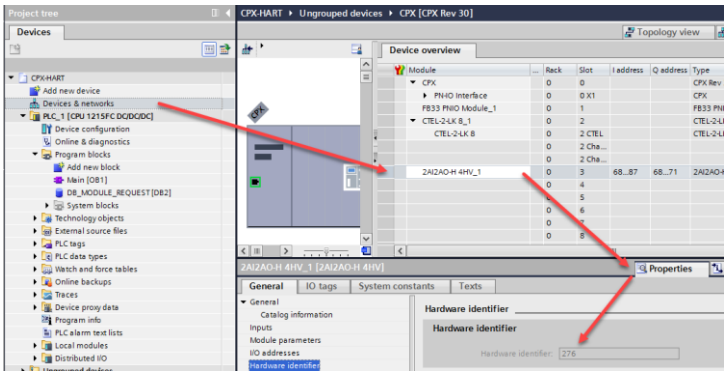
Parameter	Declaration	Value	Description
ID	Input – HW_IO	See HW-ID	Based on HW configuration. You can find this number at: Devices & Networks ➔ Device Overview ➔ Click at the "CPX-System" ➔ Click into your "CPX-Module" ➔ Properties ➔HW Identification: 
INDEX	Input – DINT	21	21 represents "Module Specific Parameters". See Table
MLEN/LEN	Input – UINT	66	Size of read/write parameters you want to get (64 bytes) + 2 Header bytes for identification (=66 bytes). The parameters will be offset as described at table due to the header identification.
RECORD	InOut - VARIANT	DB Block	Variable that will be transfer with the parameters. See ➔cap.7.1.3

Table 7.1: Parameters for RDREC AND WDREC.

Warning

This for different Siemens CPU's you have different type of configurations for the parameter (ID).

Make sure that you are using the right one:

- For S7-1200/S7-1500 - ID PARAMETER
  Hardware identifier of the hardware module (DP/PROFINET IO)
  The number is assigned automatically and is stored in the properties of the module or of the interface in the hardware configuration.

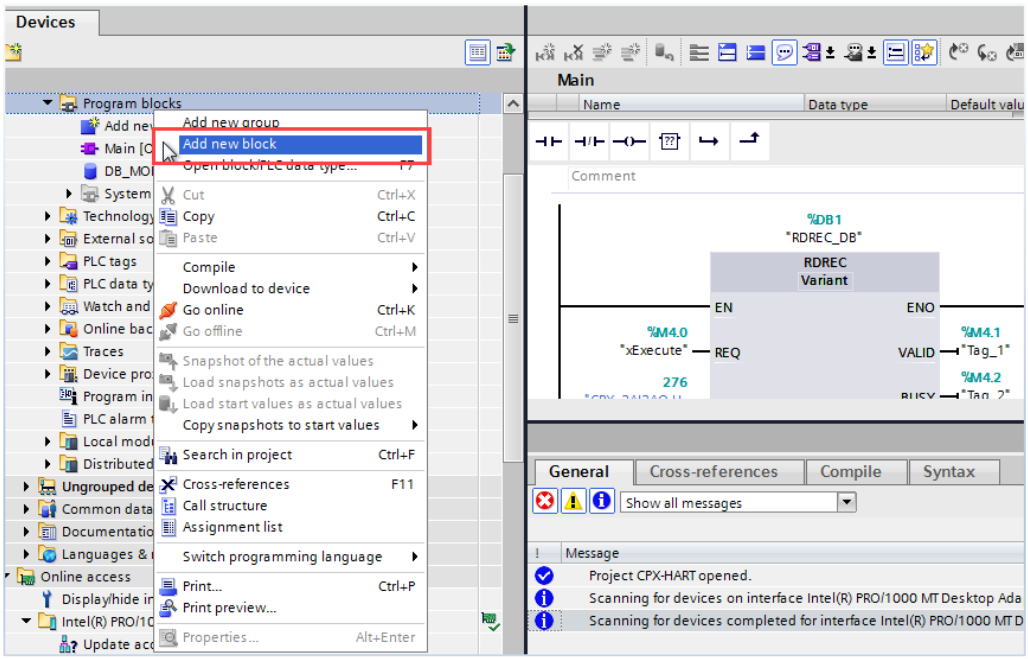
- For S7-300/S7-400
  Logical address of the DP slave/PROFINET IO component (module or sub-module).
  For an output module, bit 15 has to be set (for example, for address 5: ID:=DW#16#8005).
  For (a mixed module, the lower of the two (addresses must be specified).

Info

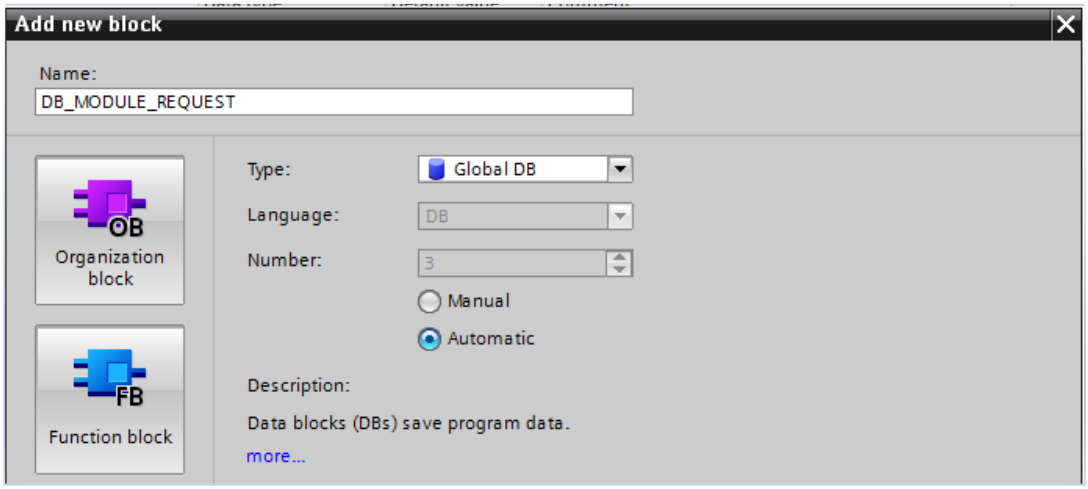
For additional information you can use TIA portal help with keywords ➔ WRRED ; RDREC ; DPV1.

7.1.3 Creating a Database (DB) for exchange variables

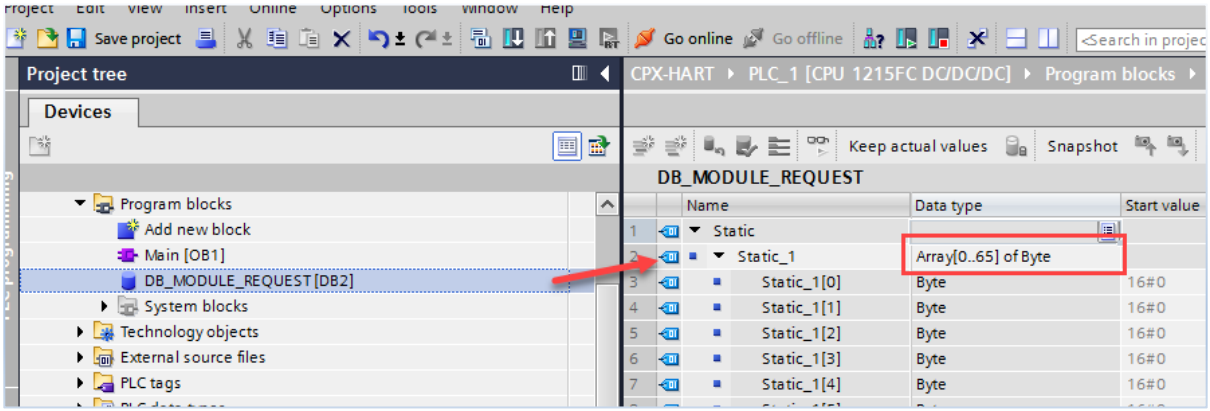
- Right Click at “Program Blocks” in “Project Tree”;



- Select a “Data Block” and Type” Global Block”;



- Create an Variable type “Array [0…xx] of Byte” whereas “xx” need to be at least the quantity of exchangeable parameters + 2 Header Bytes;



Info

Further information about “Device Specific Parameters” for CPX-4AE-4AA-H explained at:
CPX-4AE-4AA-H Manual ➔ Cap.8.4 (Parameterization)

7.1.4 Accessible module parameters

INDEX	Description	System Read	System Write	Module Read	Module Write
16	Data	X		X	
17	Serie			X	
18	Revision			X	
19	Diagnosis	X			
21	Module Parameters			X	X
26	Filter U_{out}/U_{val}		X		X
27	System Monitor U_{out}/U_{val}		X		X
28	Condition Counter			X	X
31	Internal Clock	X	X		

Table 7.2: Accessible INDEX data.

Function Number	Bit	Parameter	DB Variables [1]
4828 + m* 64 + **0**	0	Monitoring of short circuit/overload	Static_1 **[2]**
	1 … 6	Reserved	
	7	Monitoring of parameterization errors	
4829 + m* 64 + **1**	0	Behavior after short circuit/overload	Static_1 **[3]**
	1..7	Reserved	
4830 + m* 64 + **2**	0 … 7	Reserved	Static_1 **[4]**
4831 + m* 64 + **3**	0 … 7	Reserved	Static_1 **[5]**
4832 + m* 64 + **4**	0 … 7	Reserved	Static_1 **[6]**
4833 + m* 64 + **5**	0 … 7	Reserved	Static_1 **[7]**
4834 + m* 64 + **6**	0	Data Format	Static_1 **[8]**
	1 … 3	Reserved	
	4	Monitoring according to NAMUR NE43	
	5 … 6	Reserved	
	7	Reserved	
4835 + m* 64 + **7…10**	0 … 7	Monitoring of channel 0 … 3	Static_1 **[9] … [12]**
4839 + m* 64 + **11…18**	0 … 7	Lower limit value of channel 0 … 3	Static_1 **[13] … [20]**
4847 + m* 64 + **19…26**	0 … 7	Upper limit value of channel 0 … 3	Static_1 **[21] … [28]**
4855 + m* 64 + **27**	0 … 3	Number of HART repetitions	Static_1 **[29]**
	4 … 7	Reserved	
4856 + m* 64 + **28**	0 … 7	Limit monitoring hysteresis of channel 0 … 3	Static_1 **[30]**
4856 + m* 64 + **29**			Static_1 **[31]**
4858 + m* 64 + **30**	0 … 7	Signal range of channel 0 … 3	Static_1 **[32]**
4859 + m* 64 + **31**	0 … 7	Smoothing factor	Static_1 **[33]**
4860 + m* 64 + **32**	0 … 7	IEEE variable 0 … 3	Static_1 **[34]**
4861 + m* 64 + **33**			Static_1 **[35]**

1) First 2 Bytes are Headers

Table 7.3: Database Parameters and Specific Module Parameters for CPX-4AE-4AA-H.