Application Note

AN2040

D-Series

Getting started with PROFINET®

V1.00

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Abstract

This Application Note describes a simple example of use to get started with the PROFINET® interface of the Dimetix D-Series laser distance sensors.

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Table of content

1 Document scope

This document covers an Application Note written for the Dimetix D-Series Laser Distance Sensors with PROFINET® interface. The following topics are discussed:

- Safety instructions
- Application Note descriptions

2 Safety instructions

This Application Note is written for qualified system integrators to help doing an application specific sensor configuration.

Before using the D-Series sensor also the safety related information in the D-Series Technical Reference Manuals must be consider.

Looking into the laser beam may be hazardous to the eyes.

- Do not look into the laser beam. Make sure the laser is aimed above or below eye level. (particularly with fixed installations, in machines, etc.).

Take precaution against electrostatic discharge (ESD) when the D-Series laser distance sensors exchangeable cover is open.

- Generally the sensor with removed exchangeable cover is a sensitive device and can be damaged by electrostatic discharge.
- Only handle the device properly grounded and with care.
- No warranty will be granted on improper handling and / or ESD caused problems.

3 Introduction

3.1 Overview

This document describes a simple example of use to get started with the PROFINET® interface of the Dimetix D-Series laser distance sensors. All information and instructions necessary to understand this example of use and to run it on a Siemens SIMATIC S7 PLC are included. The used example project for the Siemens PLC can be downloaded from the Dimetix website (www.dimetix.com).

The following functions are covered by this example:

- Process input / output data
  - Measurement Control – Start / Stop continuous distance measurement
  - Distance Integer / Distance Float – Distance data of the laser sensor
  - Distance Unit – Selected distance unit number for distance data
- Acyclic read / write services
  - Serial Number – Read serial number of laser sensor
  - Distance Unit – Read / Write distance unit number for distance data

Additionally, the following protocol specific features are covered too:

- Configuration of IP address and NameOfStation

For detail information about the laser sensor or the Industrial Ethernet (PROFINET®, EtherCAT®[1] or EtherNet/IP™) interface, please see the corresponding Technical Reference Manual on the Dimetix website (www.dimetix.com). Please note, the used designations in this document refer to the previously mentioned Technical Reference Manuals.

For questions, comments or technical support concerning this document please contact us (service@dimetix.com). Please note, we are able to support you regarding our laser distance sensor but we only have limited support possibilities regarding the PROFINET® networks as well as for the used PLC's.

3.2 Prerequisites – Hardware & Software

The following hardware and software are used to create this example:

- PLC hardware: Siemens SIMATIC S7-1215C
- PLC software: TIA V13/SP1/UPD9 – Ensure the TIA Portal software is installed and running correctly.
- Sensor hardware: Dimetix laser distance sensor with correct assembled PROFINET® interface (for details about assembling the exchangeable cover with PROFINET®, see the Technical Reference Manual of the Industrial Ethernet on the Dimetix website).
- Sensor software: Only the GSDML file of the Dimetix sensor. No additional sensor software.

Remark: The TIA V13 is not the newest version, but there are mostly no notable differences between this and newer versions e.g. TIA V15. Known differences between TIA V13 and TIA V15 are marked in this example.

1 EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

4 Description file (GSDML)

First of all the GSDML file of the laser distance sensor must be added / installed. This can be done over the TIA Portal software menu, Options –› Manage general station description files (GSD). Then select the right GSDML file path for the installation. See figure 1 and 2 for more details.

The latest GSDML file for the Dimetix laser distance sensor with PROFINET® can be downloaded from www.dimetix.com/IndustrialEthernet.

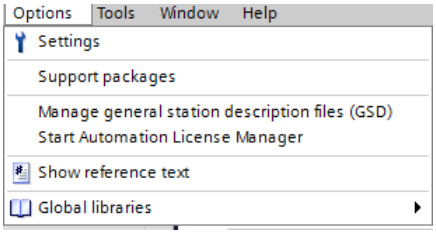

Figure 1: TIA Portal software menu, Options –› Manage general station description files (GSD).

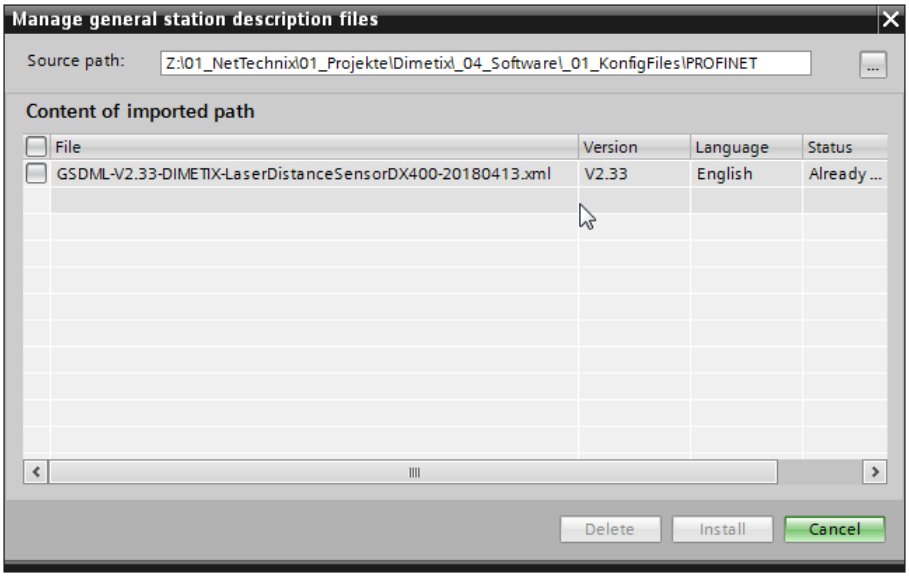

Figure 2: Manage general station description files (GSD).Selection and installation of the GSDML source file.

After this step the Dimetix Laser Distance Sensor will be available in the hardware catalog of the TIA Portal software as a PROFINET® IO device. For details see the next chapter 5.

5 Hardware catalog

The Laser Distance Sensor IO device can now be selected in the hardware catalog (see figure 3) and projected by Drag & Drop in the network view of the TIA Portal software. For details about the network view, see the next chapter 6.

Remark: The device name "Laser Distance Sensor DX400" stands for all Dimetix D-Series Laser Distance Sensor types.

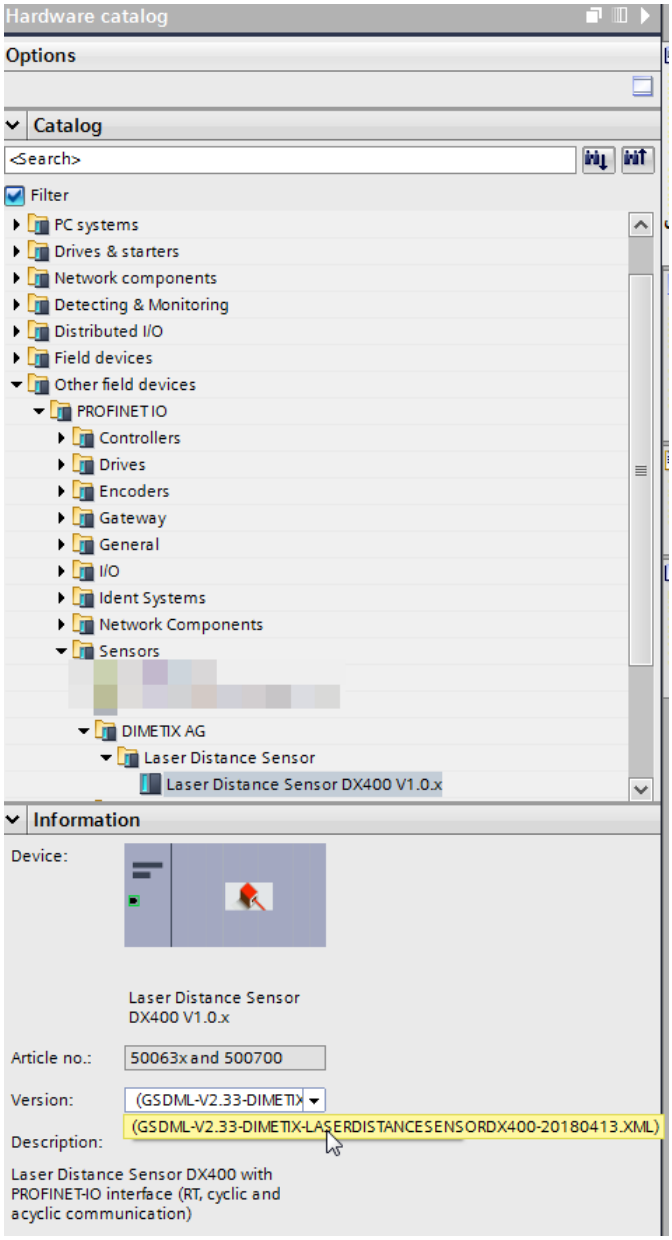

Figure 3: Hardware catalog with selected Dimetix Laser Distance Sensor in the IO device group: Other field devices → PROFINET® IO → Sensor.

6 Network view

The network view in figure 4 shows the projected devices in this example network (Siemens PLC and Dimetix Laser Distance Sensor).

Generally the network view is used to visualize the projected system consisting of the PLC and all necessary IO devices. The network view works without the exact definition of the connected device port. The PLC and devices do not care about the used port (for devices with more than one port).

Remark: In addition to the network view, it's also possible to use the topology view (with exact definition of the connected device port). For more details about the topology view, see chapter 8.

Figure 4: Network view – Overview of projected PLC and IO devices (without definition of the device port). Network devices: Siemens PLC CPU 1215 and Dimetix Laser Distance Sensor.

7 Device view

The device view in figure 5 shows detail information e.g. module (slot) and sub module (sub slot) numbers and allows additional configurations for the selected Laser Distance (Default NameOfStation: "laserdistancesensor").

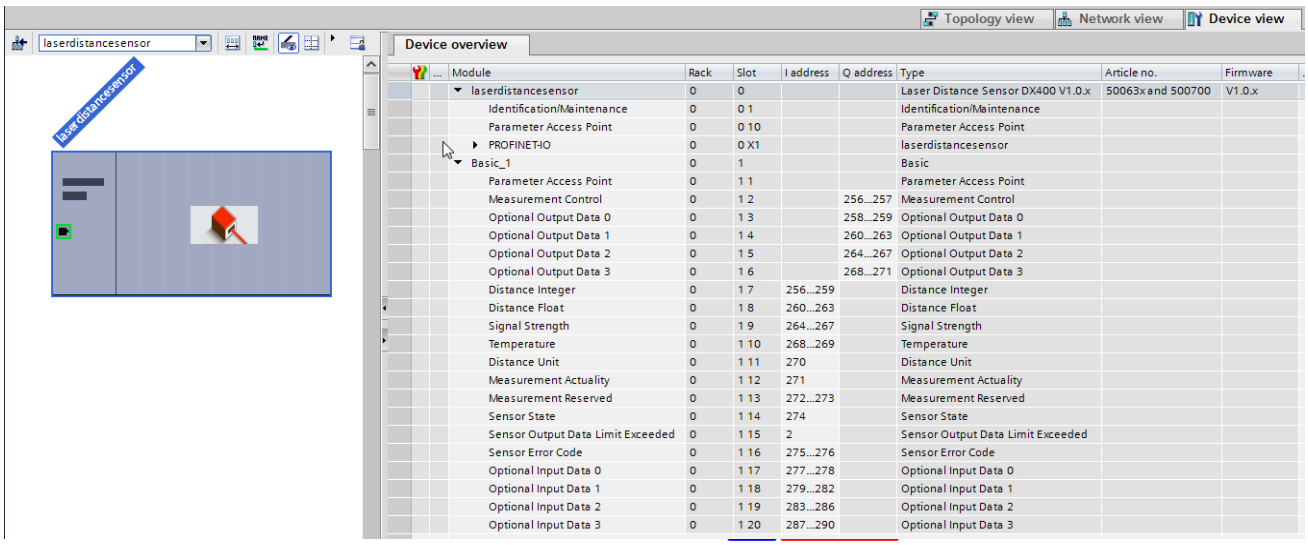

Figure 5: Device view – Overview of the device with modules (slots), sub modules (sub slots) and process data input / output addresses.

7.1 Update time

The configuration of the update time for the selected Laser Distance Sensor is available in the properties windows in the device view (see figure 6 for details). The update time can be chosen between 1 ms (minimum for PROFINET® RT) and 512 ms (maximum). Only supported update times are shown in the drop down list.

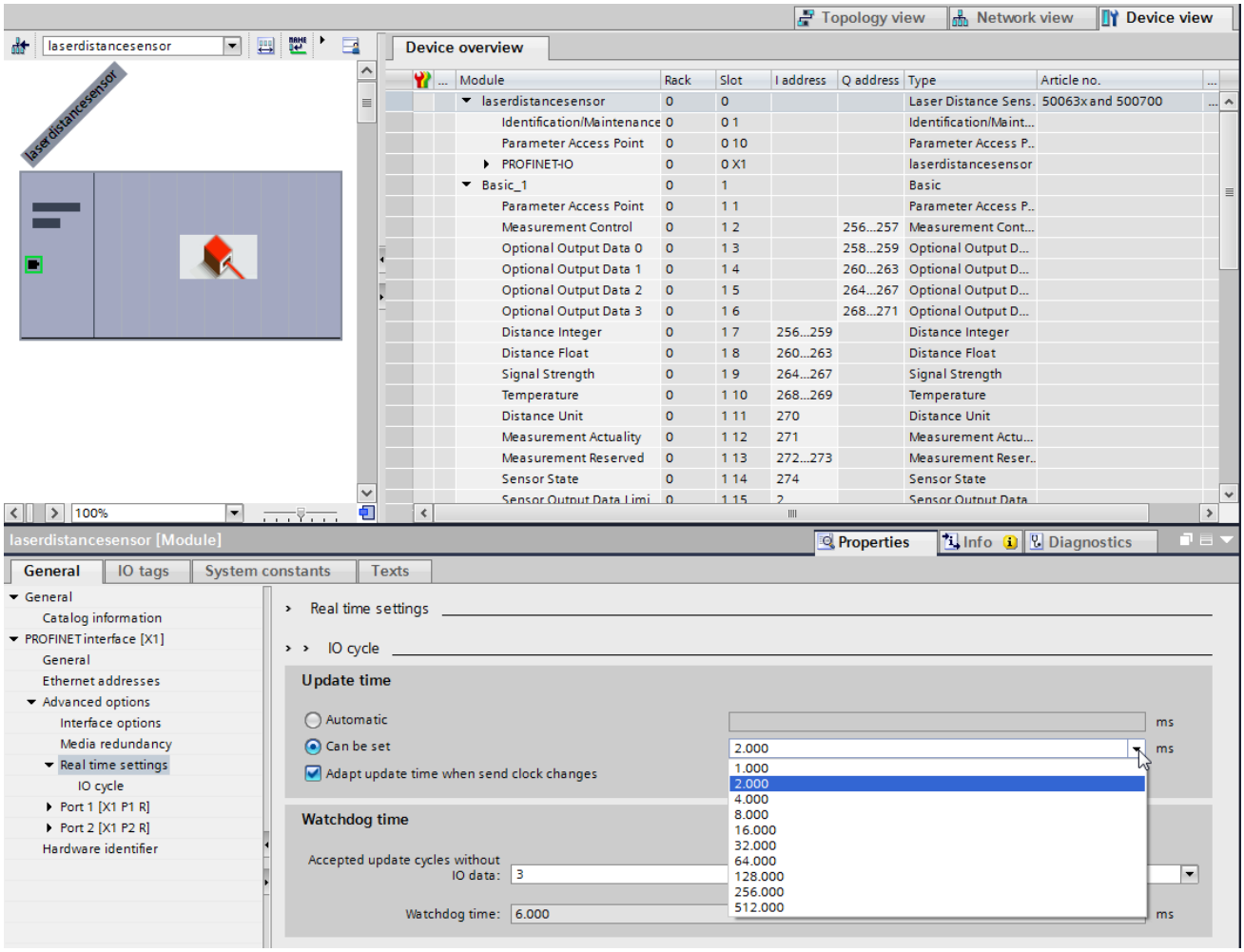

Figure 6: Properties windows in the device view, Real time settings – Configuration of update time in the range of 1...512 ms.

7.2 IP parameter / NameOfStation

The configuration of the IP parameter and the NameOfStation (or PROFINET® device name) are also available in the properties windows in the device view (see figure 7 for details).

Remarks: The NameOfStation of the IO device (configurable and storable) must match the NameOfStation defined in the PLC application otherwise no connection can be established. The name in the PLC application is loaded by default from the GSDML file. The name of the IO device can be assigned and stored permanently by using the DCP protocol (for more details see chapter 12).

The factory default value of the Dimetix laser sensor IO devices is "laserdistancesensor". This information can also be found in the Technical Reference Manual of the Industrial Ethernet.

Every IO device must have a unique NameOfStation value e.g. "laserdistancesensor0", "laserdistancesensor1" and so on.

The IP parameter are usually defined in the PLC project. This means that the PLC / IO controller explicitly assigns them to the IO devices during each connect process. According to the PROFINET® specification the IO device then save automatically the IP of 0.0.0.0 nonvolatile. Thus, the IO device without an established connection (Application relation – AR) always has the IP of 0.0.0.0.

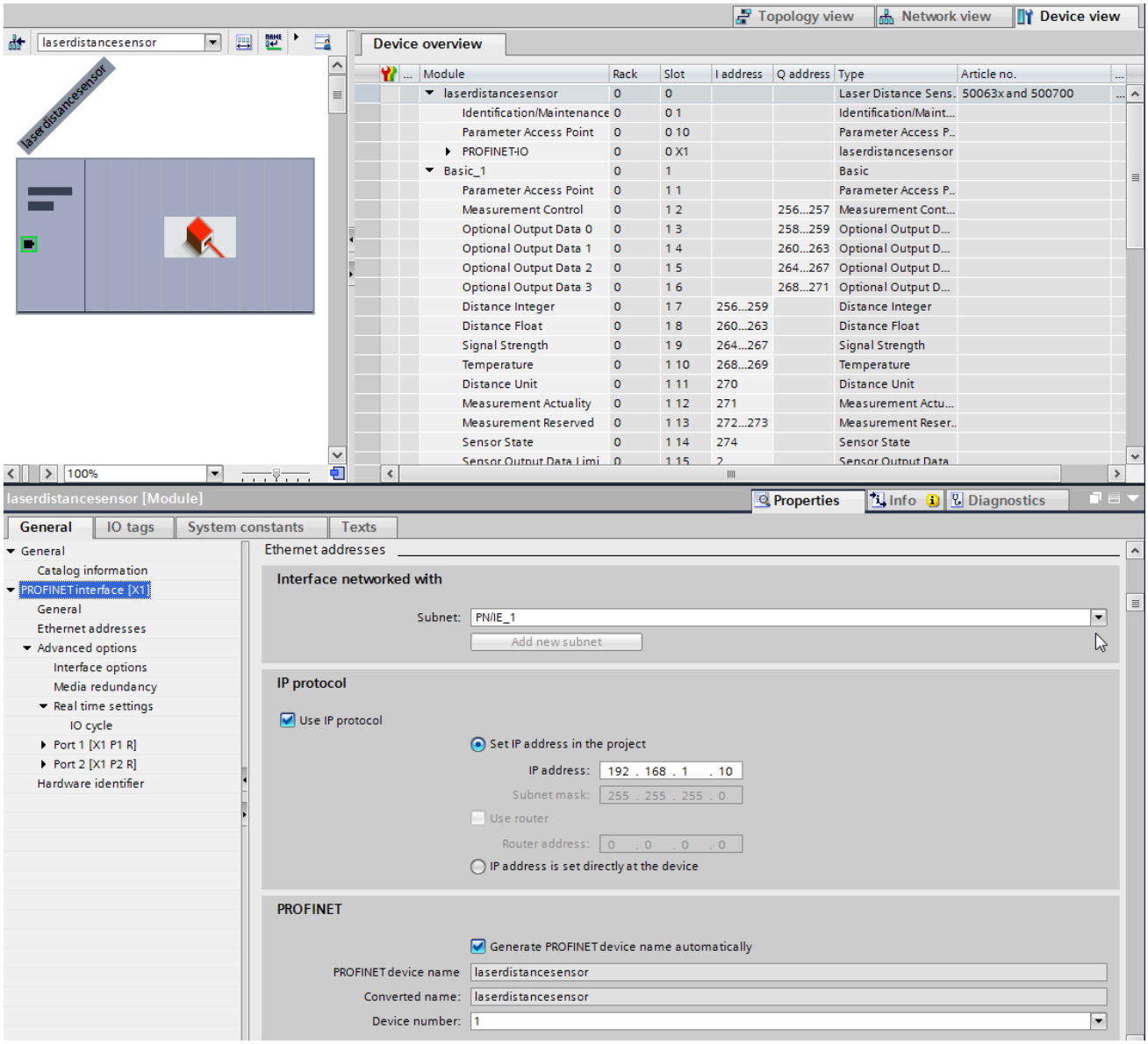

Figure 7: Properties windows in the device view, PROFINET® interface – Configuration of the IP parameter and the NameOfStation / PROFINET® device name.

8 Topology overview

The topology view in figure 8 shows the projected devices in this example network (Siemens PLC and Dimetix Laser Distance Sensor). This view works with exact definitions of the connected device ports. That means that the projected network and the network in hardware must be identical e.g. the physical connected port must correspond to the connected port in the topology view. Otherwise the connection can not be established.

Due to the fact that most people are using the network view, only the network view is used in this example (see chapter 6 for details).

Remark: The topology view with PROFINET® RT can be used for auto assignment of the NameOfStation e.g. in case of a replacement device. For this auto assignment by the PLC / IO controller the NameOfStation of the device must be "" (blank) and the IP parameter "0.0.0.0". For PROFINET® IRT the topology view is mandatory.

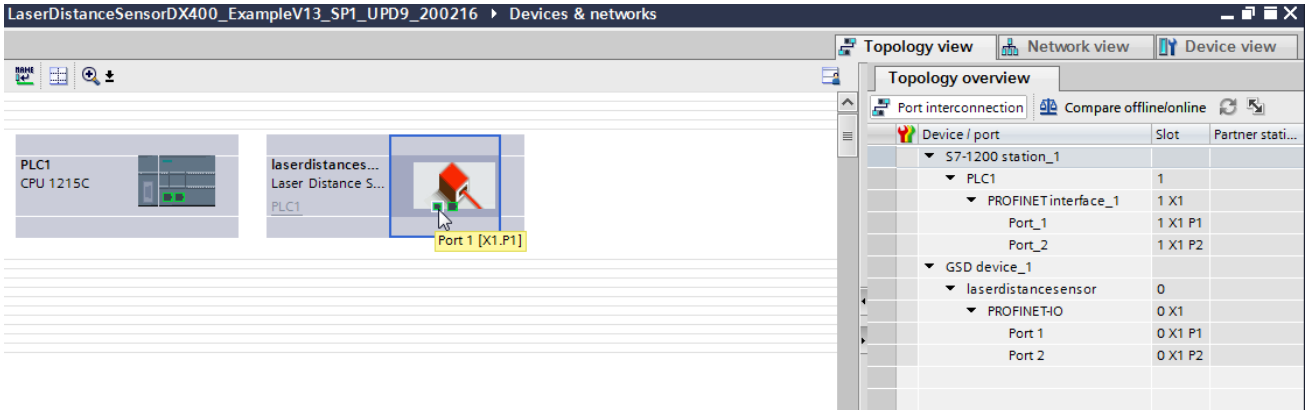

Figure 8: Topology view – Overview of projected PLC and IO devices with exact definition of the used / connected device port. Topology devices: Siemens PLC CPU 1215 and Dimetix Laser Distance Sensor.

9 Hardware identifier

The hardware identifier (HW ID) is used for the acyclic read and write services and therefor must be determined in advance. This ID information can be found in the general properties of the device view. See chapter 9.1 and 9.2 for details how to find the hardware identifier for the sub modules "Identification/Maintenance" and "Parameter Access Point".

9.1 Sub module "Identification/Maintenance"

Figure 9 shows where to find the hardware identifier of the sub module "Identification/Maintenance" in the TIA Portal software V13. See figure 10 when using TIA V15 or newer. For details about the accessible data / parameters in this module see the Technical Reference Manual of the Industrial Ethernet interface.

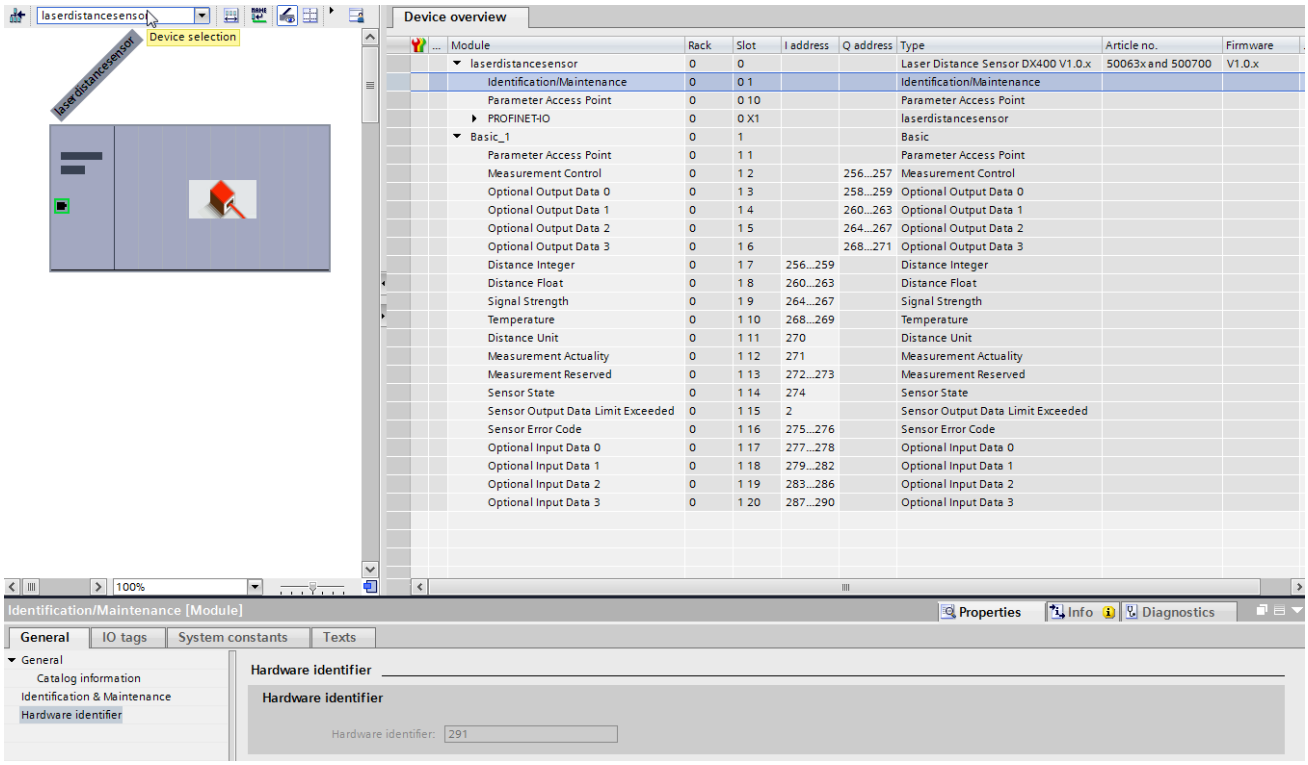

Figure 9: Hardware identifier of sub module "Identification/Maintenance" (HW ID: 291) in the TIA Portal software V13.

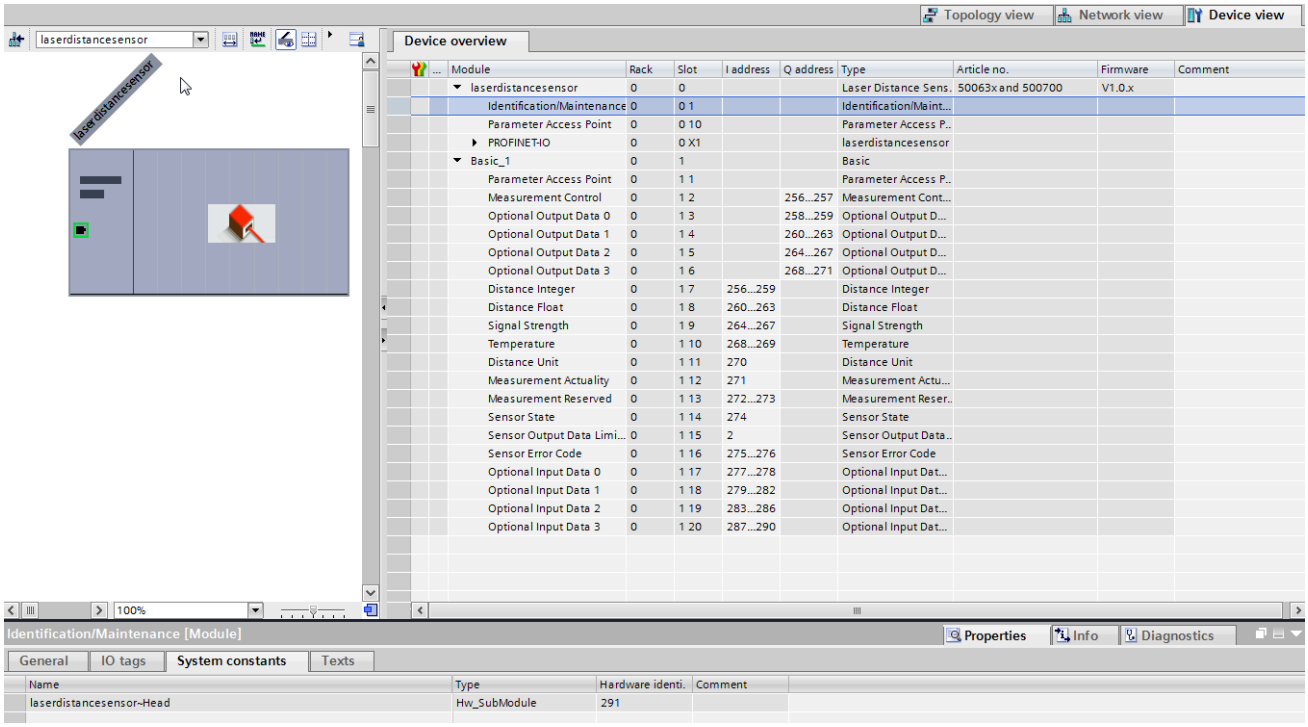

Figure 10: Hardware identifier of sub module "Identification/Maintenance" (HW ID: 291) in the TIA Portal software V15 or newer.

9.2 Sub module „Parameter Access Point"

Figure 11 shows where to find the hardware identifier of the sub module "Parameter Access Point" in the TIA Portal software V13. See figure 12 when using TIA V15 or newer. For details about the accessible data / parameters in this module see the Technical Reference Manual of the Industrial Ethernet interface.

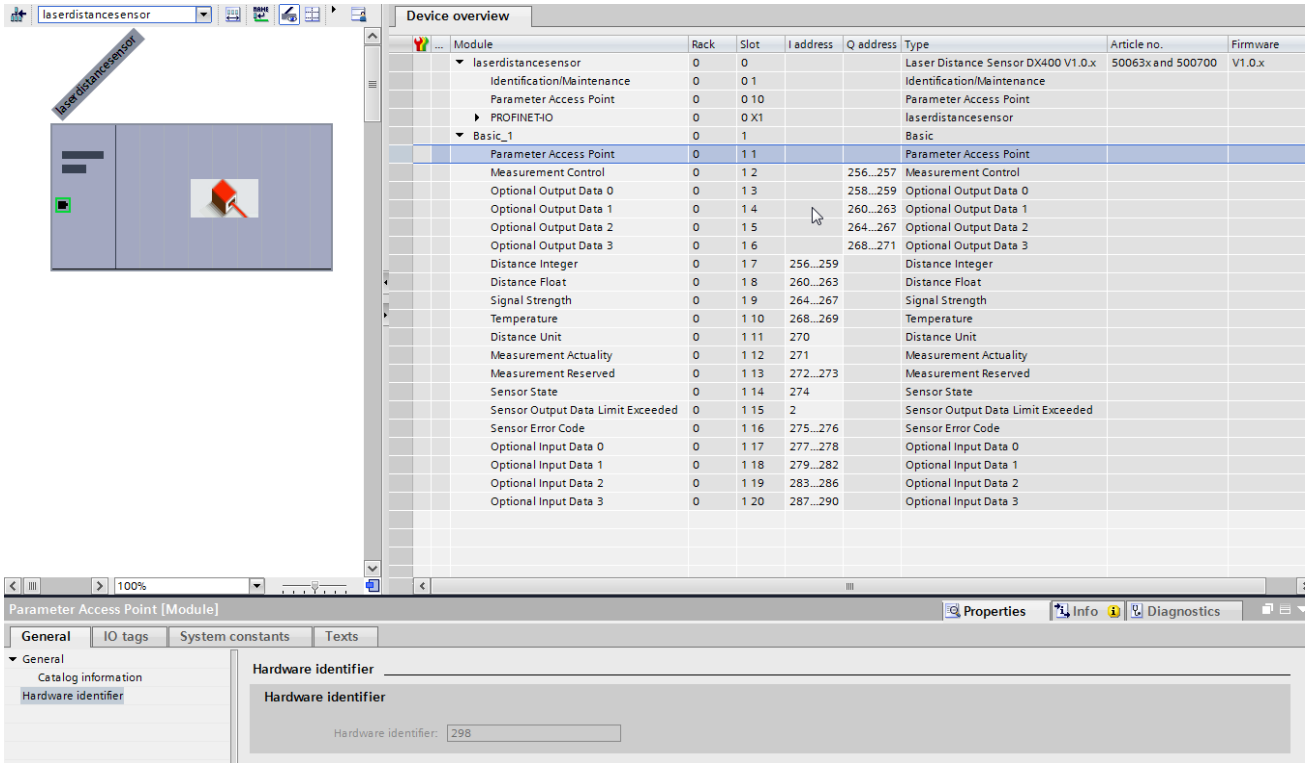

Figure 11: Hardware identifier of sub module "Parameter Access Point" (HW ID: 298) in the TIA Portal software V13.

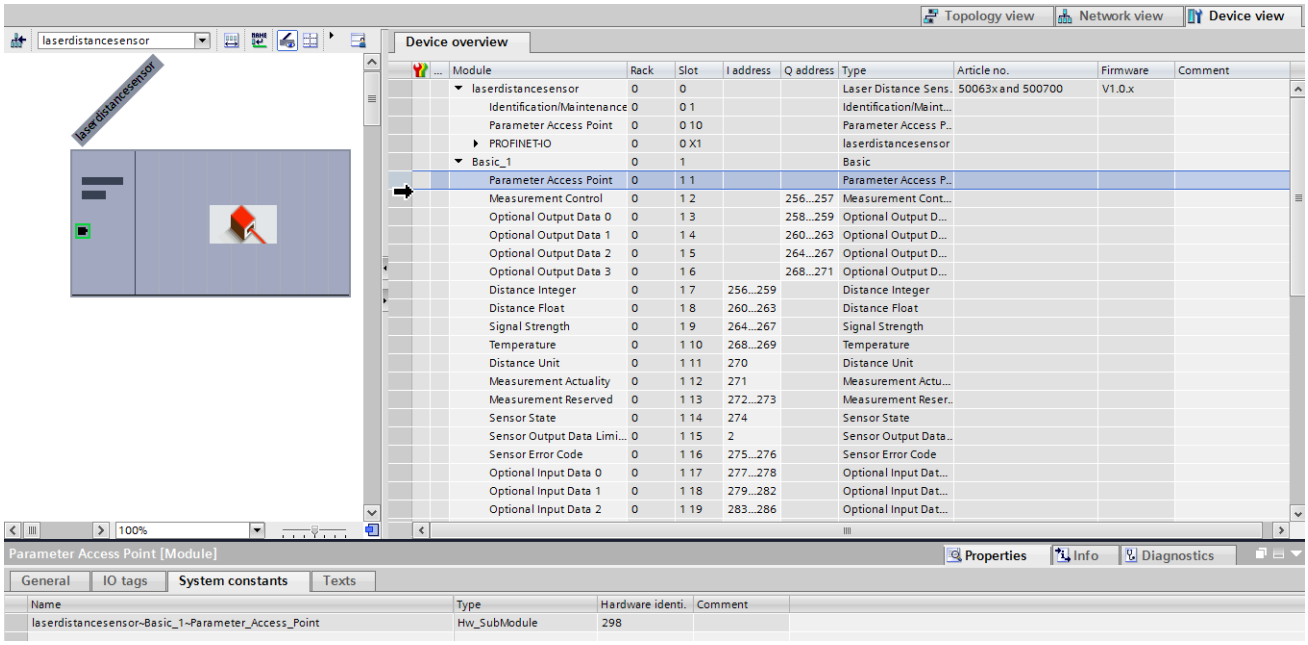

Figure 12: Hardware identifier of sub module "Parameter Access Point" (HW ID: 298) in the TIA Portal software V15 or newer.

10 PLC tags

PLC tags are like variables and used to store data in the TIA Portal software. In this example the process input / output data of the Dimetix Laser Distance Sensor can be easy accessed over the PLC tag list "LaserSensor". In figure 13 the corresponding PLC tag list and all other available PLC tag lists are shown.

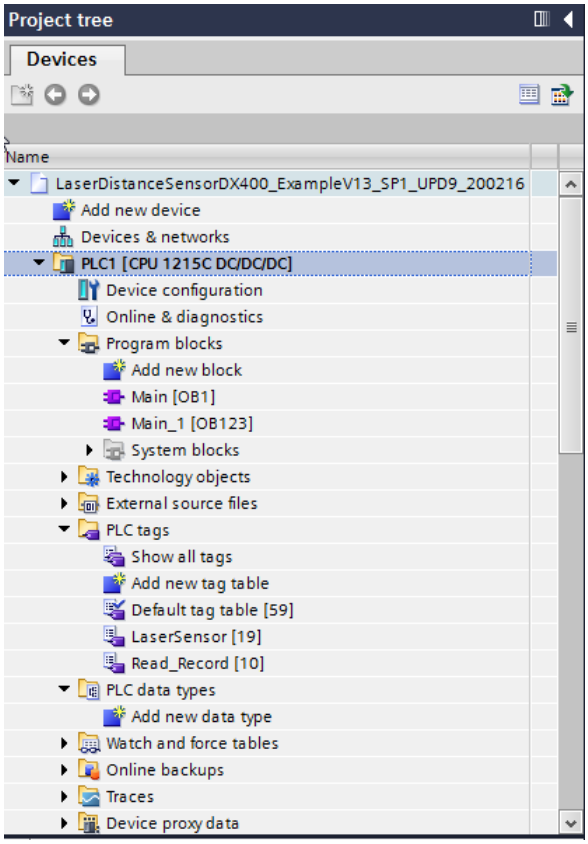

Figure 13: List of available PLC tags in this example.

The relevant PLC tag list "LaserSensor" is shown in figure 14. This list contains general tags (%M's – Flags), process data (%Q's – Outputs, %I's – Inputs) and digital IO's (%I0.x, %Q0.x), which are PLC specific and only used for test purpose.

The process data are mapped directly into the corresponding tags. The addresses of the process input and output data can be found e.g. in the device view (see chapter 7) and other views with the column "I address" and "Q address".

Remark: It's important to note, that due to the consistency issue and also due to different PLC's the data should first be buffered with special functions blocks (e.g. SFC 14/15).

Remark: The addresses of the process data in the PLC tag list consists of the type (Q → Output, I → Input), the size (B → Byte [1 Byte], W → Word [2 Byte], D → Double[4 Byte]) and the start address according the address mapping (see the device view in chapter 7).

LaserSensor

	Name	Data type	Address	Retain	Visibl...	Acces...	Comment
1	Measurement Control	UInt	%QW256	☐	☑	☑	
2	Optional Output Data 0	UInt	%QW258	☐	☑	☑	
3	Optional Output Data 1	UDInt	%QD260	☐	☑	☑	
4	Optional Output Data 2	UDInt	%QD264	☐	☑	☑	
5	Optional Output Data 3	UDInt	%QD268	☐	☑	☑	
6	Distance Float	Real	%ID260	☐	☑	☑	
7	Distance Integer	UDInt	%ID256	☐	☑	☑	
8	Distance Unit	USInt	%IB270	☐	☑	☑	
9	Distance Unit - Read (Ctrl)	Bool	%I0.1	☐	☑	☑	
10	Distance Unit - Write (Ctrl)	Bool	%I0.2	☐	☑	☑	
11	Serial Number - Read (Ctrl)	Bool	%I0.3	☐	☑	☑	
12	Measurement Start/Stop	Bool	%I0.0	☐	☑	☑	
13	Serial Number	UDInt	%MD20	☐	☑	☑	
14	Distance Unit - Read	USInt	%MB24	☐	☑	☑	
15	Distance Unit - Write	USInt	%MB25	☐	☑	☑	
16	Distance Unit - Read (Error)	Bool	%Q0.1	☐	☑	☑	
17	Distance Unit - Write (Error)	Bool	%Q0.2	☐	☑	☑	
18	Serial Number - Read (Error)	Bool	%Q0.3	☐	☑	☑	
19	Reset Acyclic Values	Bool	%I0.4	☐	☑	☑	

Figure 14: PLC tags – PLC tag list "LaserSensor" with tags used in this example.

11 PLC application

11.1 Program block – Main [OB1]

In the project tree the "Main[OB1]" program block can be found (see figure 15 for details). This program block consists of different networks / program segments used for this PROFINET® example.

Remark: Only the program block Main[OB1] is used in this example. The block Main_1[OB123] was only for test purpose.

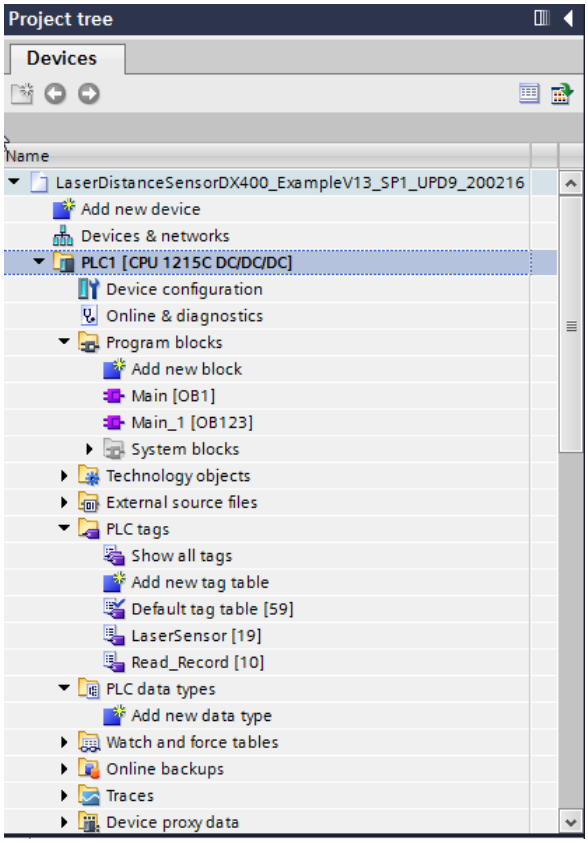

Figure 15: Project tree view – Program block "Main[OB1] with used networks in this example.

11.2 Local tags

Local tags are temporary variable. In this example the local tags in figure 16 are used for the status information of the acyclic read and write record service blocks. For more details about the acyclic read / write record services see chapter 11.4.

Main

	Name	Data type	Default value	Comment
1	Input			
2	Initial_Call	Bool		Initial call of this OB
3	Remanence	Bool		=True, if remanent data are available
4	Temp			
5	Distance Unit - Write(DONE)	Bool		
6	Distance Unit - Write(BUSY)	Bool		
7	Distance Unit - Write(ERROR)	Bool		
8	Distance Unit - Write(STATUS)	DWord		
9	Distance Unit - Read(VALID)	Bool		
10	Distance Unit - Read(BUSY)	Bool		
11	Distance Unit - Read(ERROR)	Bool		
12	Distance Unit - Read(STATUS)	DWord		
13	Distance Unit - Read(LEN)	UInt		
14	Serial Number - Read(VALID)	Bool		
15	Serial Number - Read(BUSY)	Bool		
16	Serial Number - Read(ERROR)	Bool		
17	Serial Number - Read(STATUS)	DWord		
18	Serial Number - Read(LEN)	UInt		

Figure 16: Local tags – List of the temporary used variables in this example.

11.3 Measurement control

The “Measurement Control”, a part of the cyclic process output data, is used to start and stop the distance measurements of the laser distance sensor. In this example the “Measurement Control” can be set to “1” or “0” with the digital input I0.0 and the associated switch of the used PLC hardware. See figure 17 for the corresponding network of this digital input I0.0 together with the “Measurement Control”.

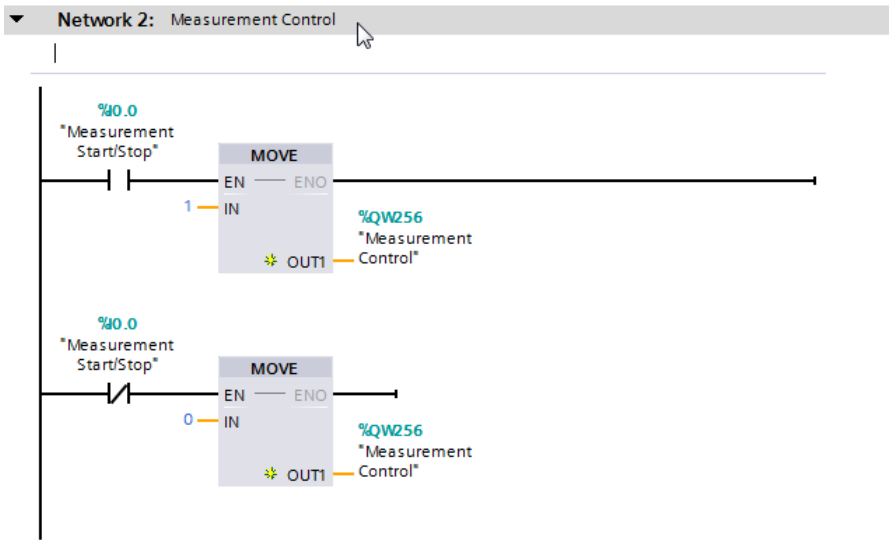

Figure 17: Main[OB1] program block – Network 2: Control of the process data output “Measurement Control” to start / stop distance measurements.

11.4 Acyclic read / write record services

The acyclic read and write record services are used to e.g. read device information and to configure the sensor. In this example the serial number and the distance unit are used to demonstrate the basic principle of reading or writing acyclic parameters. See chapter 11.4.3 to 11.4.6 for the corresponding networks.

11.4.1 Basic information (RDREC & WRREC records)

This record services can be programmed using the RDREC and WRREC blocks. These blocks are available by default and no additions need to be added. Some selected information for the usage of these blocks is shown in the table below. Detailed information can be found in the Siemens documentation.

Block information	Descriptions
ID	Hardware identifier (HW ID) of the corresponding sub module. See chapter 9 for the corresponding hardware identifier information.
INDEX	PROFINET® index of the corresponding parameter. See the Technical Reference Manual of the Industrial Ethernet for the corresponding index information.
MLEN	Data length in number of bytes. This length must exactly match the data length according the parameter list in the Technical Reference Manual of the Industrial Ethernet.
RECORD	Variable / Tag for the read or write value (source for writing / destination for reading).
STATUS	PNIO error code. More details about the error codes can be found in the Siemens / PROFINET® literature.

11.4.2 Parameter initialization

Certain PROFINET® devices supports the device parameter configuration during the “Connect” process. This is before the cyclic data exchange starts operation. The major disadvantage of this possibility is that the values of the device parameters / configurations are stored in the projected application and every change needs to be done in the application. Therefore this feature is not supported by the Dimetix laser distance sensors of the D-Series.

But all device parameters can be simple configured in the running application by using the acyclic read and write record services at the system start or if needed at anytime during operation.

11.4.3 Serial number – Read

The network in figure 18 shows the acyclic read record service RDREC to read the serial number of the IO device. This read service can be triggered with the digital input I0.3 and the associated switch of the used PLC hardware. So that this acyclic service is only done once, the TP[2] (Timer Pulse) block is used in addition.

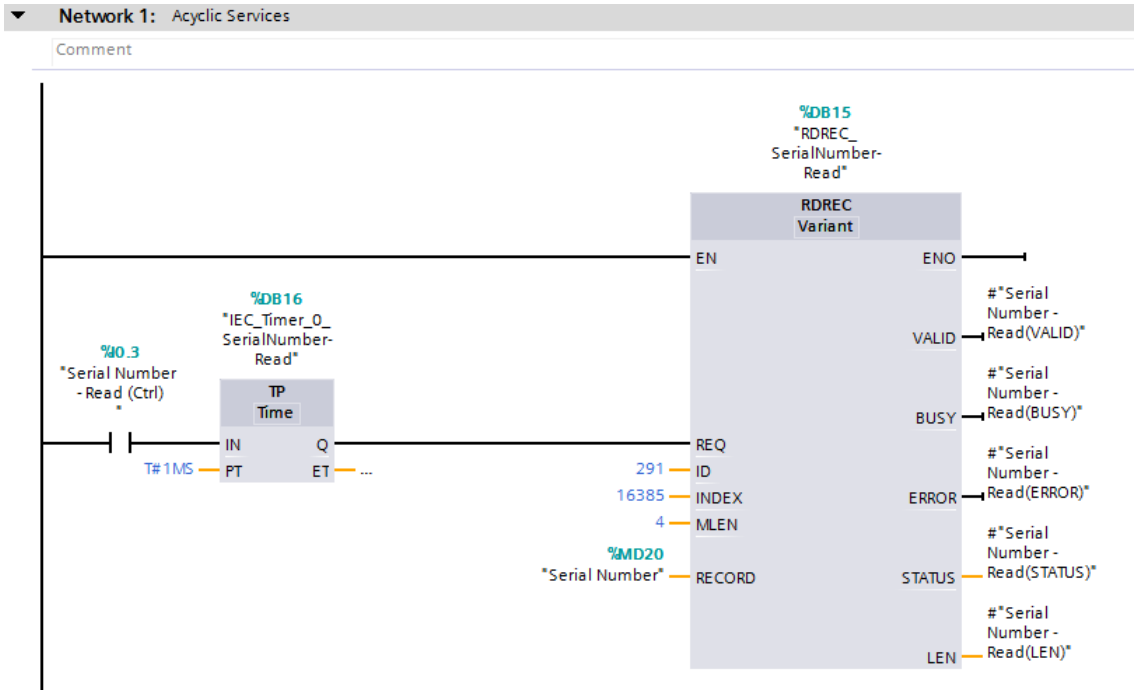

Figure 18: Main[OB1] program block – Network 1: Acyclic service (RDREC) to read "Serial Number" of the device.

11.4.4 Distance unit – Read

The network in figure 19 shows the acyclic read record service RDREC to read the distance unit of the IO device. This read service can be triggered with the digital input I0.1 and the associated switch of the used PLC hardware. So that this acyclic service is only done once, the TP (Timer Pulse) block is used in addition.

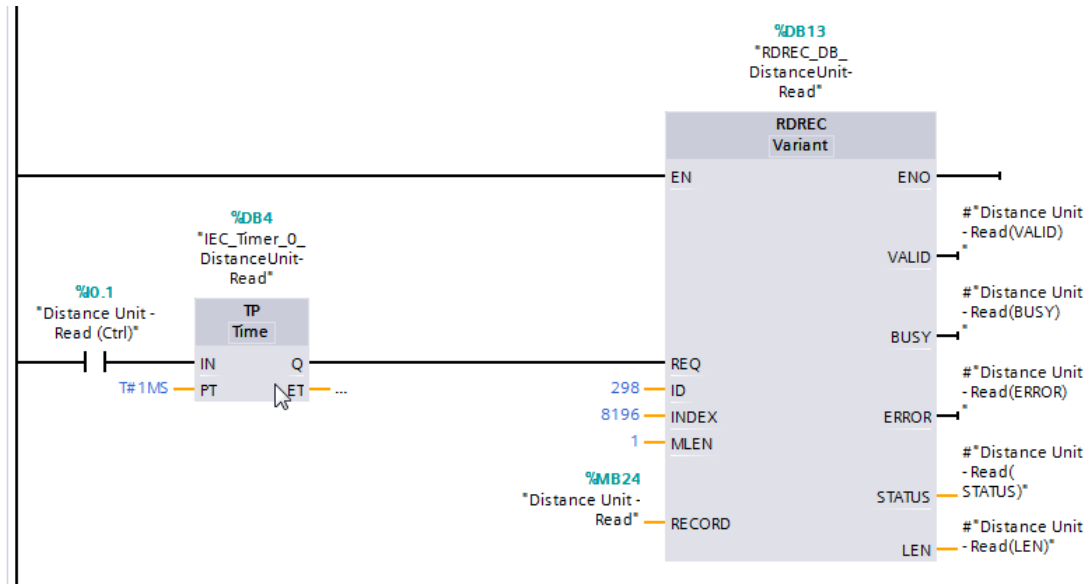

Figure 19: Main[OB1] program block – Network: Acyclic service (RDREC) to read "Distance Unit" of the device.

2 TP (Timer Pulse): Detailed information for the TP block can be found in the Siemens documentation.

11.4.5 Distance unit – Write

The network in figure 20 shows the acyclic write record service WRREC to write the distance unit of the IO device. This write service can be triggered with the digital input I0.2 and the associated switch of the used PLC hardware. So that this acyclic service is only done once, the TP (Timer Pulse) block is used in addition.

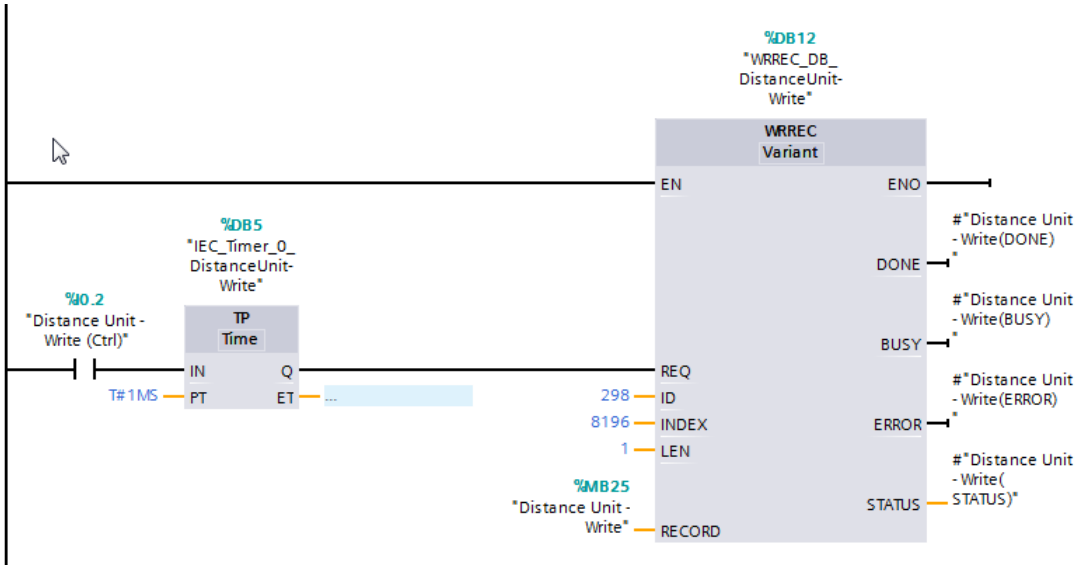

Figure 20: Main[OB1] program block – Network: Acyclic service (WRREC) to write "Distance Unit" of the device.

11.4.6 Error handling

The error outputs of the used acyclic read and write services (RDREC and WRREC blocks) are displayed on the digital outputs Q0.1 to Q0.3 of the used PLC hardware. All of the used outputs are defined in the PLC tag list in chapter 10.

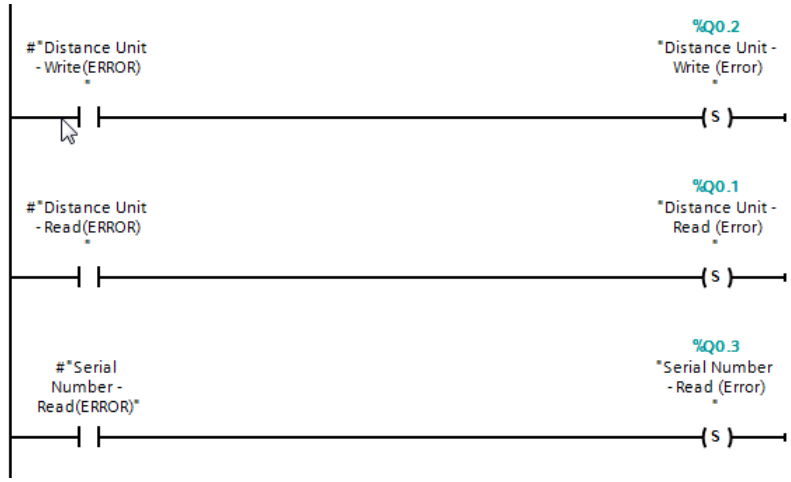

Figure 21: Main[OB1] program block – Network: Error handling of used acyclic read / write services.

11.5 Reset acyclic values

In this example the PLC tags "Distance Unit – Read" and the "Serial Number" (see chapter 10 for the PLC tag list) can be cleared by the digital input I0.4 and the associated switch of the used PLC hardware. See figure 22 for the corresponding network of this digital input I0.4 together with the mentioned PLC tags.

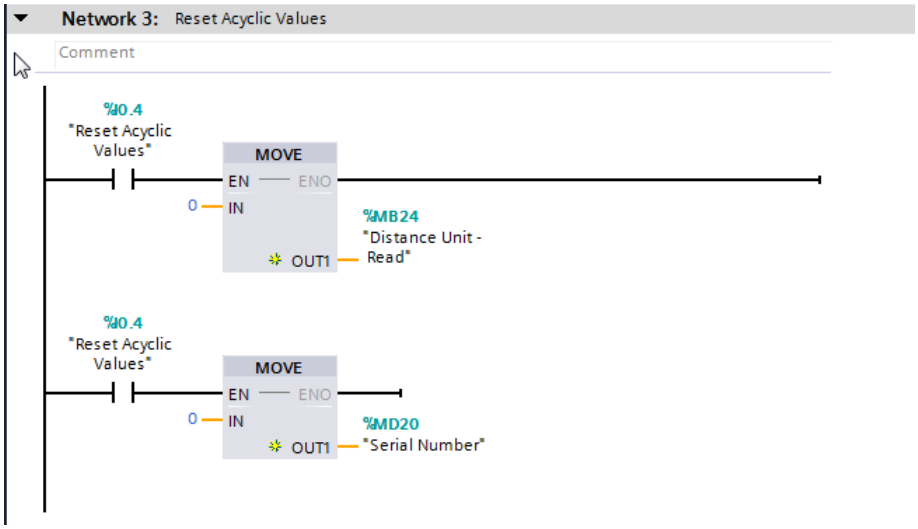

Figure 22: Main[OB1] program block – Network 3: Reset acyclic general tags (flags) in the PLC tag list.

12 NameOfStation

There are various possibilities to configure the NameOfStation (or PROFINET® device name) of a selected IO device. See chapter 12.1 and 12.2 for details when using a DCP tool or the TIA Portal software (PLC).

Remarks: The factory default value of the Dimetix laser sensor IO devices is "laserdistancesensor". This information can also be found in the Technical Reference Manual of the Industrial Ethernet.

12.1 DCP tool

The configuration over the DCP (Discovery and basic Configuration Protocol) can be done with every available DCP tool. E.g. the Ethernet Device Configuration[3] tool from Hilscher. This example is shown in figure 23.

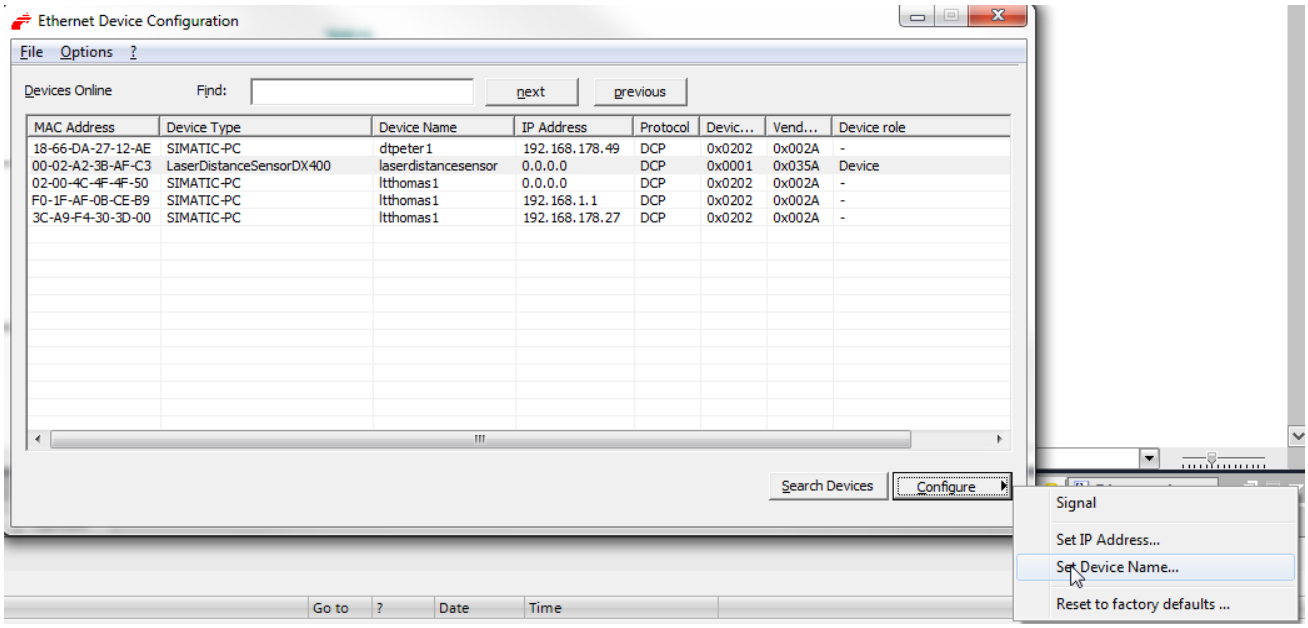

Figure 23: Ethernet Device Configuration (Software tool from Hilscher)– Configuration of the NameOfStation (Device Name)

3 Ethernet Device Configuration: Hilscher software for basi IO device configurations (free of change).

12.2 TIA software (PLC)

The configuration over the TIA Portal software can be done with the function "Assign name" and the configuration field PROFINET® device name. After pressing the button "Assign name" the NameOfStation is set. This example is shown in figure 24.

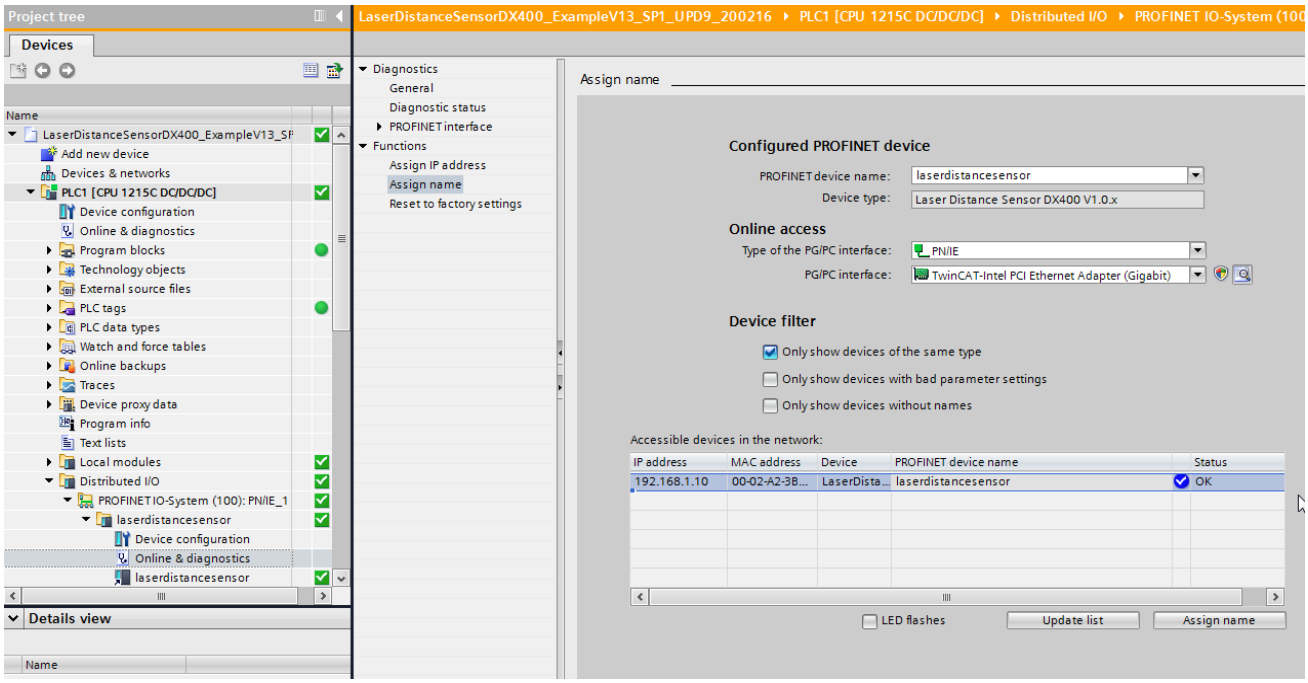

Figure 24: TIA Portal software – Configuration / Assignment of the NameOfStation (PROFINET® device name)

13 DCP blink service

The DCP blink service can be used to identify visually an IO device in a PROFINET® network. As soon as this service is activated (see also the "LED flashes" check box in figure 24), the SF LED (System Failure LED) on the selected IO device starts flashing.

14 Glossary

DAP	Device Access Point
DCP	Discovery and basic Configuration Protocol: A protocol for identifying and configuring devices which is defined within the PROFINET® specification.
GSDML	General Station Description Markup Language. Describes the properties of a IO device in XML format.
IP	Internet Protocol: Belongs to the TCP/IP family of protocols and is defined in RFC791 (see online for more details).
NameOfStation	PROFINET® device name
OB	Organization Block: Used in the TIA program block context.
PLC	Programmable Logic Controller
Process data	Cyclic data communication of the Industrial Ethernet interfaces. Cyclic process data exchange with PROFINET® always with a minimum size of 40 Bytes, even if less data is used.
PROFINET®	PROFINET® is one of the most popular Industrial Ethernet interfaces (see PROFIBUS® and PROFINET® International).
Record	Record services (RDREC / WRREC) used for acyclic read / write data access. Detailed information for the RDREC and WRREC blocks can be found in the Siemens documentation.
TIA	Totally Integrated Automation: Siemens software for controlling PLC hardware.
TP	Timer Pulse: Detailed information for the TP block can be found in the Siemens documentation.

15 Revision history

The release versions and the changes of this technical reference manual are listed below.

Date	Revision	Changes
03.03.2020	V0.01	Initial version of the PROFINET® Application Note.
23.03.2020	V0.02	Internal feedback and revision version.
20.05.2020	V1.00	First release of the PROFINET® Application Note.

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